

2009 ENGINE

General Information (Engine Mechanical System) - 2.4L - Magentis & Optima

SPECIFICATIONS

SPECIFICATIONS

GENERAL INFORMATION CHART

Description	Specifications	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinder	4	
Bore	88mm (3.464in.)	
Stroke	97mm (3.819in.)	
Total displacement	2359cc (143.90cu.in.)	
Compression ratio	10.5	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Opens (ATDC/BTDC)	7°/38°	
Closes (ABDC)	67°/22°	
Exhaust		
Opens (BBDC)	44°/4°	
Closes (ATDC)	0°/40°	
Valve		
Valve length		
Intake	113.18mm (4.4559in.)	112.93mm (4.4460in.)
Exhaust	105.84mm (4.1669in.)	105.59mm (4.1570in.)
Stem O.D.		
Intake	5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)	
Exhaust	5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)	
Face angle	45.25° ~ 45.75°	
Margin		
Intake	1.02mm (0.0401in.)	
Exhaust	1.09mm (0.0429in.)	
Valve stem to valve guide clearance		
Intake	0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)	0.07mm (0.00275in.)
Exhaust	0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)	0.09mm (0.00354in.)
Valve guide		
Length		
Intake	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	

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Exhaust	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	
Valve seat		
Width of seat contact		
Intake	1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)	
Exhaust	1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)	
Seat angle	44.75° ~ 45.10°	
Valve spring		
Free length	47.44mm (1.8677in.)	
Load	19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in.)	
Squareness	39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)	
	1.5° MAX.	
Valve clearance		
Cold (20°C[68°F])		
Intake	0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust	0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0078 ~ 0.0157in.)
Cylinder head		
Flatness of gasket surface	Max. 0.05mm (0.0019in.)	
Flatness of manifold mounting surface	Max. 0.10mm (0.0039in.)	
Cylinder block		
Cylinder bore	88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)	
Out-of-round and taper of cylinder bore	Less than 0.05mm (0.0019in.)	
Clearance with piston (To set limits to new parts)	0.015 ~ 0.035mm (0.0005 ~ 0.0013in.)	
Piston		
O.D (To set limits to new parts)	87.975 ~ 88.005mm (3.4635 ~ 3.4647in.)	
Ring groove width		
No. 1	1.235 ~ 1.250mm (0.0486 ~ 0.0492in.)	1.26mm (0.0496in.)
No. 2	1.230 ~ 1.250mm (0.0484 ~ 0.0492in.)	1.26mm (0.0496in.)
Oil ring	ring 2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)	2.05mm (0.0807in.)
Piston ring		
Side clearance		
No. 1	0.05 ~ 0.08mm (0.0019 ~ 0.0031in.)	0.1mm (0.004in.)
No. 2	0.04 ~ 0.08mm (0.0015 ~ 0.0031in.)	0.1mm (0.004in.)
Oil ring	0.06 ~ 0.13mm (0.0023 ~ 0.0051in.)	0.2mm (0.008in.)
End gap		
No. 1	0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)	0.6mm (0.0236in.)

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No. 2			0.30 ~ 0.52mm (0.0118 ~ 0.0204in.)	0.7mm (0.0275in.)
Oil ring side rail			0.20 ~ 0.70mm (0.0078 ~ 0.0275in.)	0.8mm (0.0315in.)
Connecting rod				
Bend			0.05mm (0.0020in.) or less	
Twist			0.1mm (0.004in.) or less	
Connecting rod big end to crankshaft side clearance			0.100 ~ 0.250mm (0.0039 ~ 0.010in.)	0.35mm (0.0138in.)
Connecting rod bearing				
Oil clearance (To seat limits to new parts)			0.025 ~ 0.043mm (0.0009 ~ 0.0016in.)	0.05mm (0.0078in.)
Camshaft				
Cam height	Intake		44.20mm (1.7401in.)	
	Exhaust		45.00mm (1.7716in.)	
Journal O.D	Intake	No. 1	30mm (1.1811in.)	
		No. 2, 3, 4,	5 24mm (0.9449in.)	
	Exhaust	No. 1	36mm (1.4173in.)	
		No. 2, 3, 4, 5	24mm (0.9449in.)	
Bearing oil clearance	Intake	No. 1	0.022 ~ 0.057mm (0.0008 ~ 0.0022in.)	0.09mm (0.0035in.)
		No. 2, 3, 4, 5	0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)	0.12mm (0.0047in.)
	Exhaust	No. 1	0 ~ 0.032mm (0 ~ 0.0012in.)	
		No. 2, 3, 4, 5	0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)	0.12mm (0.0047in.)
End play			0.04 ~ 0.016mm (0.0015 ~ 0.0062in.)	0.20mm (0.0047in.)
Crankshaft				
Pin O.D.			47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)	
Journal O.D.			51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)	
End play			0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)	
Crankshaft bearing				
Oil clearance			0.020 ~ 0.038mm (0.0007 ~ 0.0014in.)	
Cooling method			Water-cooled, pressurized. Forced circulation with water pump	
Radiator				
Type			Pressurized corrugated fin type	
Radiator cap				
Main valve opening pressure			83 ~ 110kpa (12 ~ 16psi, 0.83 ~ 1.1kg/cm ²)	
Vacuum valve opening pressure			-7kpa (-100psi, -0.07kg/cm ²) or less	
Thermostat				
Type			Wax pellet type with jiggle valve	

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Valve opening temperature	82°C (177°F)	
Full-opening temperature	95°C (201°F)	
Coolant pump	Centrifugal type impeller	
Drive belt		
Type	V-ribbed belt	
Engine coolant temperature sensor		
Type	Heat-sensitive thermistor type	
Resistance	2.31 ~ 2.59Kohms at 20°C (68°F)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

Service Standards**STANDARD VALUE REFERENCE**

Standard value	
Antifreeze	Mixture ratio of anti-freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50%

Tightening Torque**ITEM TIGHTENING TORQUE SPECIFICATION**

Item	N.m	kgf.m	lb-ft
Ladder frame bolt (M8 x 55)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Ladder frame bolt (M8 x 103)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Oil pump & Balance shaft module bolt (BSM)	16.7+ 60° + 60°	1.7 + 60° + 60°	12.3 + 60° + 60°
Timing chain cover bolt (M8)	18.6 ~ 22.5	1.9 ~ 2.3	13.7 ~ 16.6
Timing chain cover bolt (M6)	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Oil pan bolt (M6 x 10)	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (M8 x 103)	26.5 ~ 30.4	2.7 ~ 3.1	19.5 ~ 22.4
Engine support bracket bolt (M8 x 30)	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Engine support bracket bolt (M10 x 40)	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Engine support bracket bolt (M12 x 45)	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Camshaft bearing cap bolt (M6)	10.8 ~ 12.7	1.1 ~ 1.3	7.9 ~ 9.4
Camshaft bearing cap bolt			

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(M8)	27.4 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1
Cylinder head bolt	(32.4~36.3) + (90~95°) + (90~95°)	(3.3~3.7) + (90~95°) + (90~95°)	(23.9~26.8) + (90~95°) + (90~95°)
Engine hanger bolt	19.6 ~ 27.5	2.0 ~ 2.8	14.5 ~ 10.3
Cylinder head cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Crankshaft pulley bolt	166.6 ~ 176.4	17.0 ~ 18.0	122.9 ~ 130.1
Connecting rod bearing cap bolt	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Main bearing cap bolt	14.7 + (27.5~31.4) + (120~125°)	1.5 + (2.8~3.2) + (120~125°)	10.8 + (20.3~23.1) + (120~125°)
Flywheel bolt	117.6 ~ 127.4	12.0 ~ 13.0	86.8 ~ 93.9
Drive plate bolt	117.6 ~ 127.4	12.0 ~ 13.0	86.8 ~ 93.9
Timing chain tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
OCV bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
CVVT bolt	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
BSM chain tensioner arm bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
BSM chain guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
BSM chain tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
A/C compressor bracket bolt	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
P/S pump bracket bolt	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Tensioner & idler bracket bolt	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Water temp. control bolt	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Water temp. control nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water inlet pipe nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil level gauge assembly bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Ignition coil bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Intake manifold bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold stay bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold heat protector bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Exhaust manifold nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Exhaust manifold stay bolt (M8)	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Exhaust manifold stay bolt (M10)	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Muffler bolt	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Engine cover mounting	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7

bracket bolt			
Crankshaft position sensor bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Oxygen sensor	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Knock sensor	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Camshaft position sensor	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Oil pressure switch	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6

REPAIR PROCEDURES

COMPRESSION

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

1. Warm up and stop engine.

Allow the engine to warm up to normal operating temperature.

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

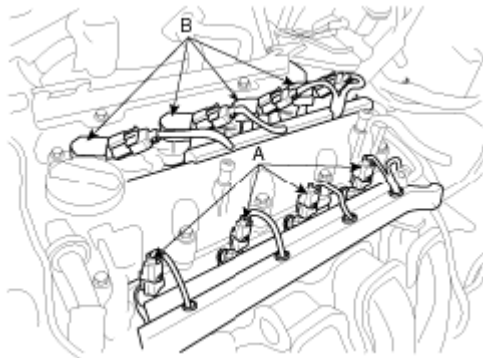


Fig. 1: Identifying Injector Connectors And Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove ignition coils(A).

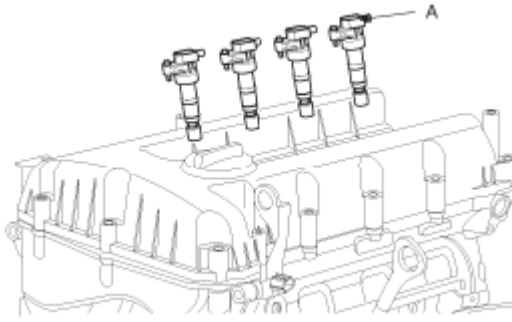


Fig. 2: Identifying Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove spark plugs.

Using a 16mm plug wrench, remove the 4 spark plugs.

5. Check cylinder compression pressure.
 - A. Insert a compression gauge into the spark plug hole.

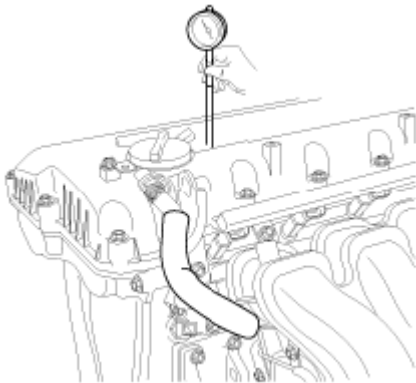


Fig. 3: Checking Cylinder Compression Pressure
Courtesy of KIA MOTORS AMERICA, INC.

- B. Fully open the throttle.
 - C. While cranking the engine, measure the compression pressure.

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

- D. Repeat steps (a) through (c) for each cylinder.

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

Compression pressure :

1,283kPa (13.0kgf/cm² , 185psi)

Minimum pressure :

1,135kPa (11.5kgf/cm² , 164psi)

Difference between each cylinder :

100kPa (1.0kgf/cm² , 15psi) or less

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

Valve Clearance Inspection And Adjustment

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

1. Remove the engine cover(A).

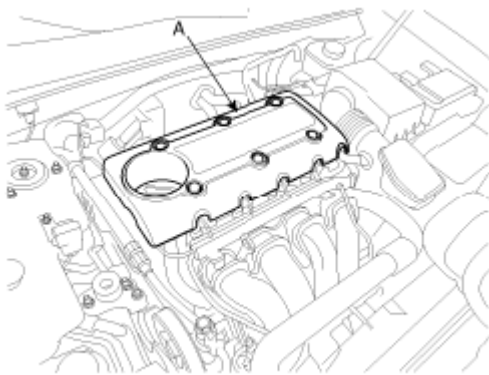


Fig. 4: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the cylinder head cover.
 - A. Disconnect the ignition coil connectors(A) and remove the ignition coils.

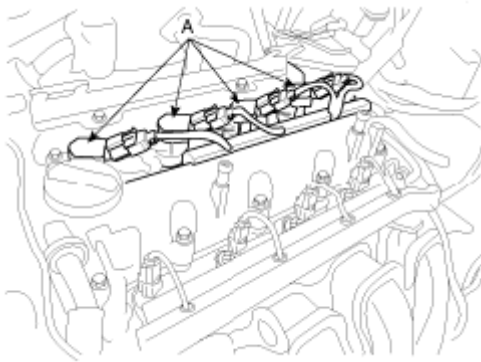


Fig. 5: Identifying Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

- B. Disconnect the P.C.V hose(A).

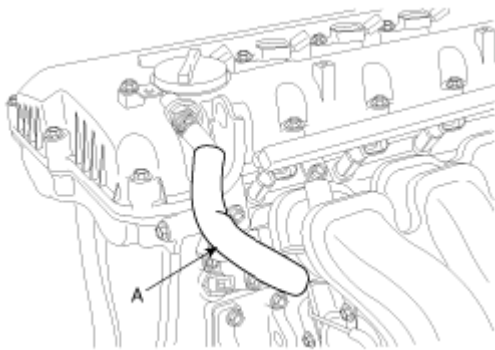


Fig. 6: Identifying P.C.V Hose
Courtesy of KIA MOTORS AMERICA, INC.

- C. Disconnect the breather hose (A).

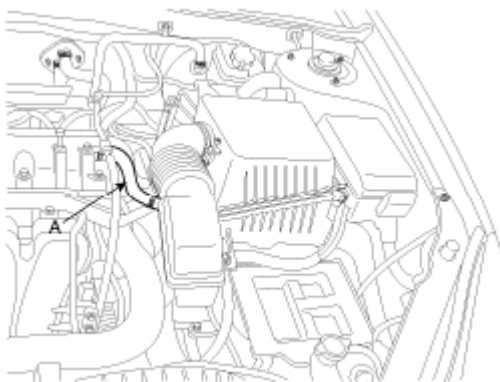


Fig. 7: Identifying Breather Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

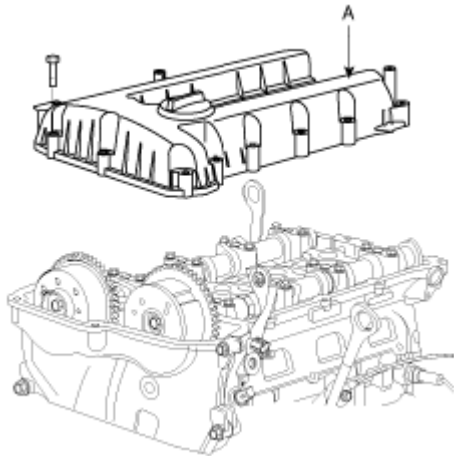


Fig. 8: Identifying Cylinder Head Cover Bolts And Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

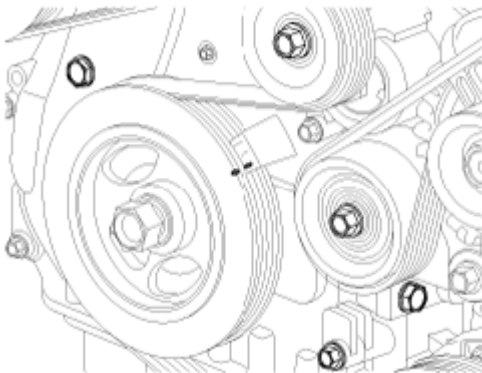


Fig. 9: Identifying Timing Mark "T" Of Lower Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

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

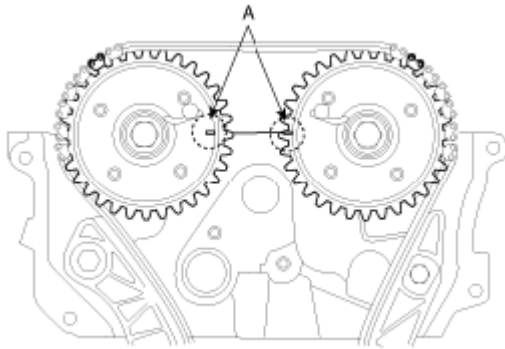


Fig. 10: Identifying Mark Of Camshaft Timing Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect the valve clearance.

- A. Check only the valve indicated as shown. [No. 1 cylinder : TDC/Compression] measure the valve clearance.

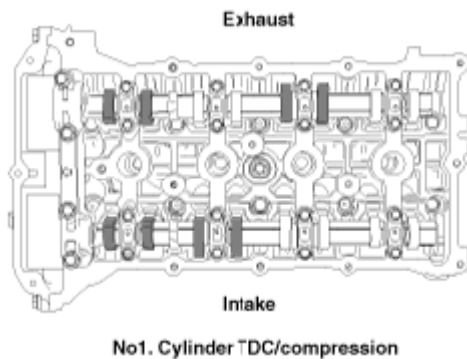


Fig. 11: Identifying No. 1 Cylinder TDC/Compression
Courtesy of KIA MOTORS AMERICA, INC.

Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.

Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting tappet.

Valve clearance

Specification

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

Limit

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

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

- B. Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.
- C. Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance.

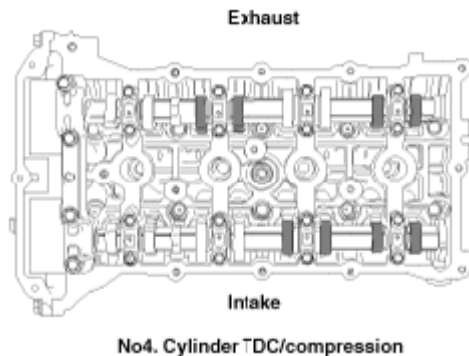


Fig. 12: Identifying No. 4 Cylinder TDC/Compression
Courtesy of KIA MOTORS AMERICA, INC.

5. Adjust the intake and exhaust valve clearance.
 - A. Set the No. 1 cylinder to the TDC/compression.
 - B. Marks on the timing chain and camshaft timing sprockets.
 - C. Remove the service hole bolt(A) of the timing chain cover.

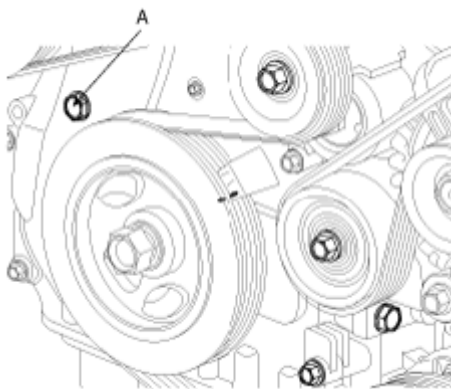


Fig. 13: Identifying Service Hole Bolt
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: The bolt must not be reused once it has been assembled.

- D. Insert the SST(A) (09242-2G000) in the service hole of the timing chain cover and release the ratchet.

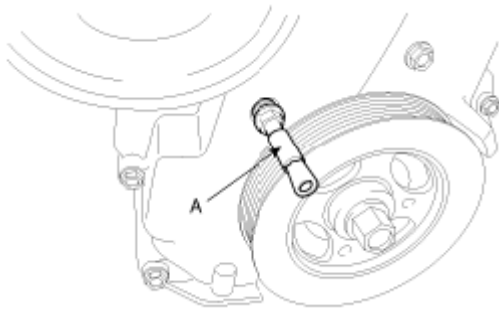


Fig. 14: Inserting SST(A) (09242-2G000) In Service Hole Of Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

- E. Remove the front camshaft bearing cap(A).

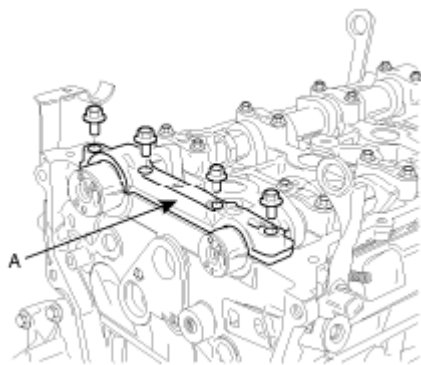


Fig. 15: Identifying Front Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

- F. Remove the exhaust camshaft bearing cap and exhaust camshaft.
G. Remove the intake camshaft bearing cap and intake camshaft.

CAUTION: When disconnect the timing chain from the camshaft timing sprocket, holding the timing chain.

- H. Tie a timing chain with a string.

CAUTION: Be careful not to drop anything inside timing chain cover.

- I. Measure the thickness of the removed tappet using a micrometer.

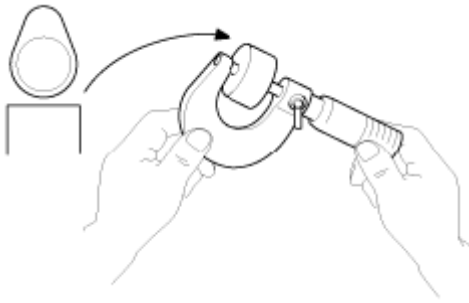


Fig. 16: Measuring Tappet Thickness
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve clearance (Engine coolant temperature : 20°C)

T : Thickness of removed tappet

A : Measured valve clearance

N : Thickness of new tappet

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

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

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

NOTE: Shims are available in 47 size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.690mm (0.1452in.)

- L. Place a new tappet on the cylinder head.
- M. Hold the timing chain, and place the intake camshaft and timing sprocket assembly.
- N. Align the matchmarks on the timing chain and camshaft timing sprocket.
- O. Install the intake and exhaust camshaft.
- P. Install the front bearing cap.
- Q. Install the service hole bolt.

Tightening torque :

11.8 ~ 14.7N.m (1.2 ~ 1.5kgf.m, 8.7 ~ 10.8lb-ft)

- R. Turn the crankshaft two turns in the operating direction(clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks(A).

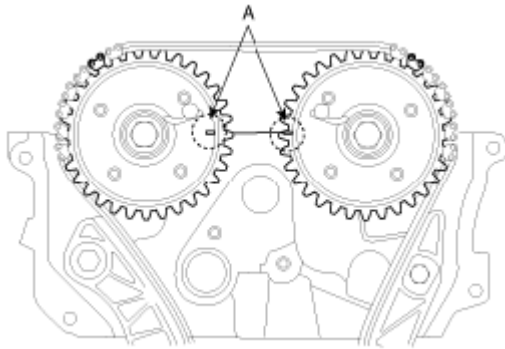


Fig. 17: Identifying Camshaft Sprocket Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

S. Recheck the valve clearance.

Valve clearance (Engine coolant temperature : 20°C)

[Specification]

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

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

TROUBLESHOOTING

TROUBLESHOOTING

TROUBLESHOOTING CHART

Sympton	Suspect area	Remedy (See page)
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings	Replace the crankshaft and bearings as required.
	Loose or improperly engine flywheel	Repair or replace the flywheel as required.
	Worn piston rings (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	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.
	Faulty cylinder head gasket and/or	

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2009 ENGINE General Information (Engine Mechanical System) - 2.4L - Magentis & Optima

Engine misfire with coolant consumption	cranking or other damage to the cylinder head and engine block cooling system. Coolant consumption may or may not cause the engine to overheat.	- 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. Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	Repair or replace as required. - 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 Worn crankshaft thrust bearing.	- Drain the oil. - Install the correct viscosity oil. - Inspect the thrust bearing and crankshaft. - Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	- Inspect the camshaft lobes. - Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required
	Low oil pressure	Repair or required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	- Inspect the oil pan. - Inspect the oil pump screen. - Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	- Inspect the oil pump screen. - Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston, piston pin and cylinder bore.

2009 Kia Magentis LX

2009 ENGINE General Information (Engine Mechanical System) - 2.4L - Magentis & Optima

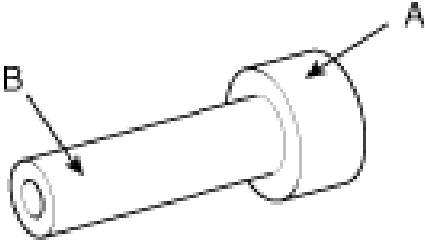
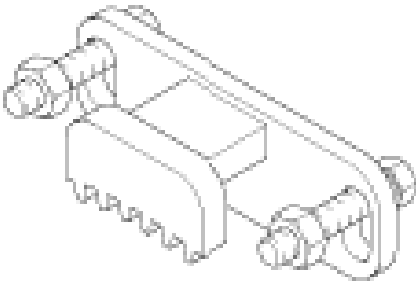
Lower engine noise, regardless of engine speed		• Repair as required.
	Excessive piston pin-to-piston clearance	• Inspect the piston, piston pin and the connecting rod. • Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft pin journals.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required : • The connecting rod bearings. • The connecting rods. • The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
	Hydraulically locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	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.

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

SPECIAL SERVICE TOOLS

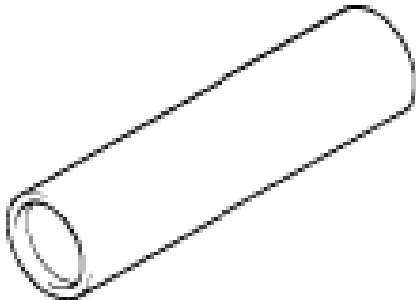
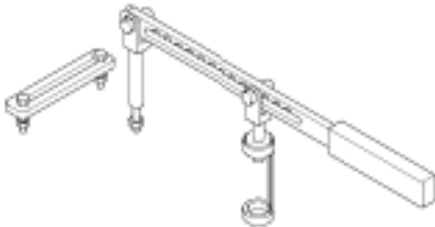
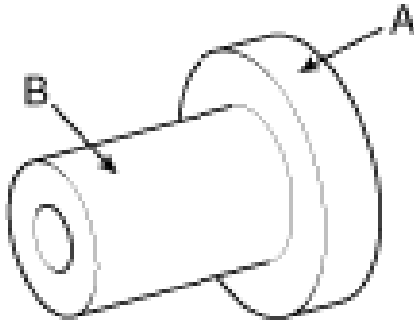
SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS REFERENCE

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-3K000) (09231-H1100)		Installation of the front oil seal A. 09214-3K000 B. 09231-H1100
Flywheel stopper (09231-3K000)		Removal and installation of the flywheel and crankshaft pulley.

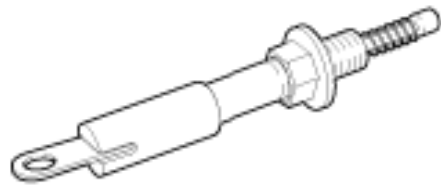
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Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method
Valve stem oil seal installer (09222-4A000)		Installation of the valve stem oil seal
Valve spring compressor & holder (09222-3K000) (09222-3K100)		Removal and installation of the intake or exhaust valve 09222-3K100 (holder)
Crankshaft rear oil seal installer (09214-3K100) (09231-H1100)		Installation of the crankshaft rear oil seal A. 09214-3K100 B. 09231-H1100
Timing chain tensioner ratchet holder (09240-2G000)		Timing chain tension release

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2009 ENGINE General Information (Engine Mechanical System) - 2.4L - Magentis & Optima



2009 ENGINE

Cylinder Block - 2.4L - Magentis & Optima

COMPONENTS AND COMPONENTS LOCATION

COMPONENTS

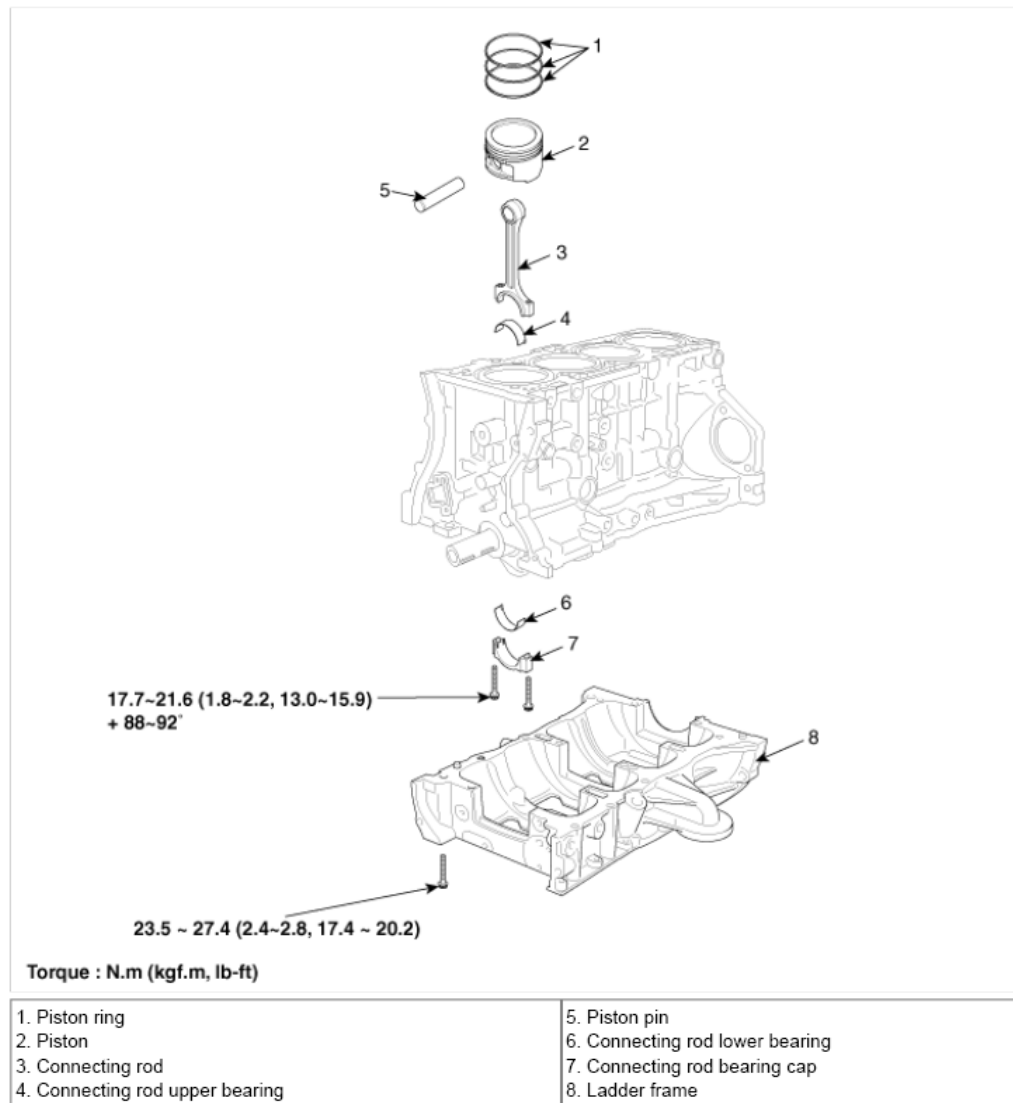


Fig. 1: Identifying Cylinder Block Components With Torque Specifications (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

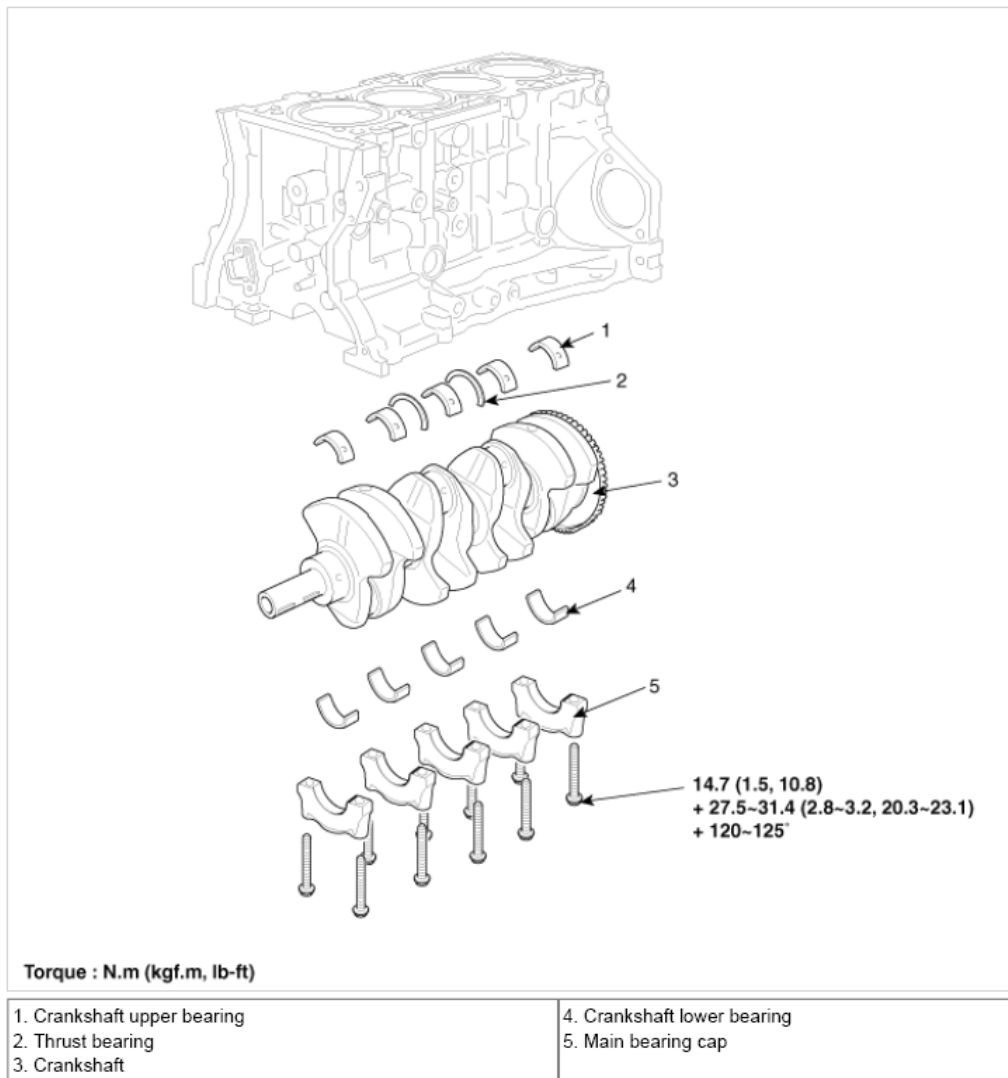


Fig. 2: Identifying Cylinder Block Components With Torque Specifications (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

DISASSEMBLY

1. M/T : remove flywheel.
2. A/T : remove drive plate.
3. Install engine to engine stand for disassembly.
4. Remove timing chain. (Refer to **TIMING SYSTEM - 2.4L** in this group)
5. Remove cylinder head. (Refer to **CYLINDER BLOCK** in this group)
6. Remove A/C compressor(A) from engine.

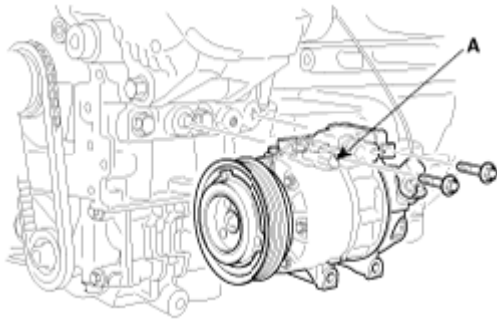


Fig. 3: Identifying A/C Compressor
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove alternator(A) from engine.

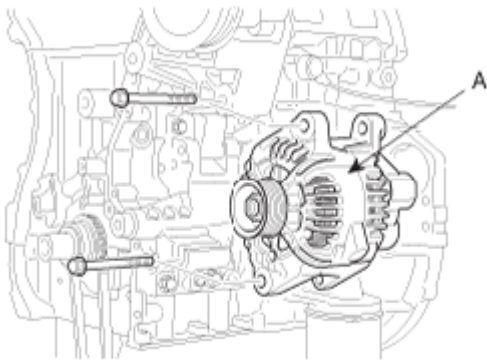


Fig. 4: Identifying Alternator From Engine
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove power steering pump and bracket.

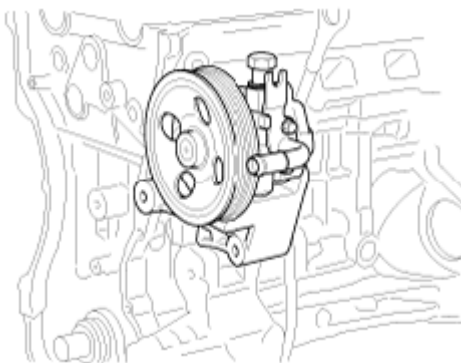


Fig. 5: Identifying Power Steering Pump And Bracket
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove tensioner assembly integrated bracket(A).

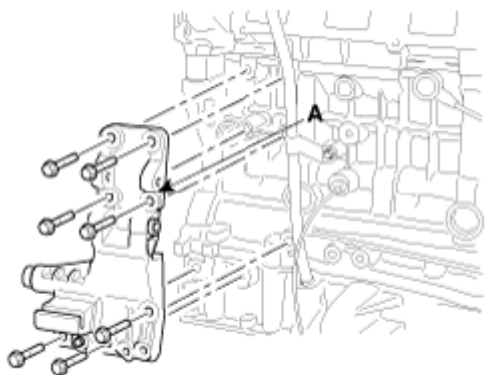


Fig. 6: Identifying Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove oil level gauge assembly(A).

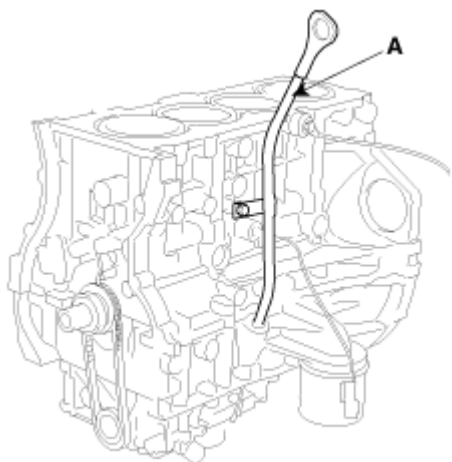


Fig. 7: Identifying Oil Level Gauge Assembly
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove knock sensor(A).

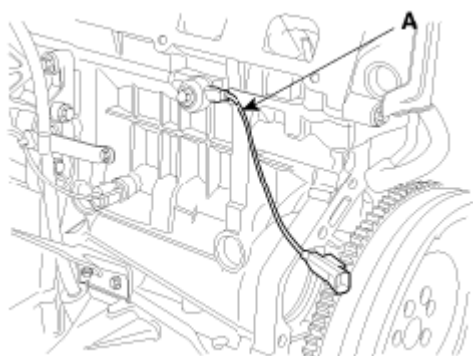


Fig. 8: Identifying Knock Sensor

Courtesy of KIA MOTORS AMERICA, INC.

12. Remove oil pressure sensor(A).

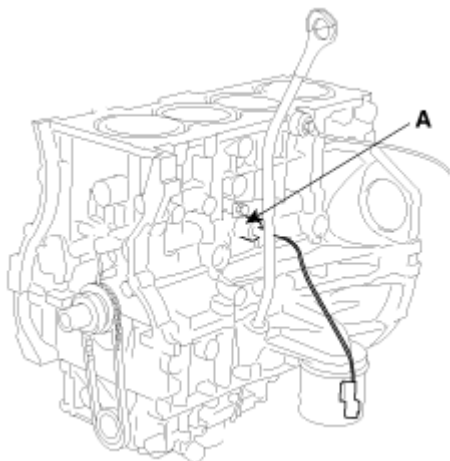


Fig. 9: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove CKP sensor(A).

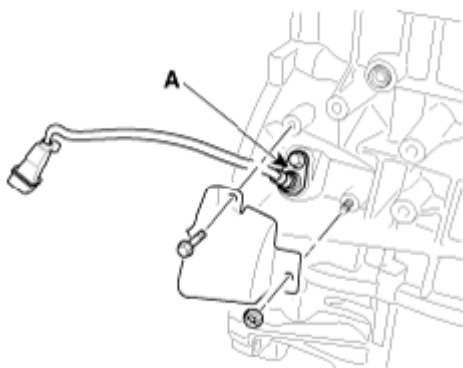


Fig. 10: Identifying CKP Sensor
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove water pump.
15. Remove balance shaft module.
16. Remove ladder frame(A).

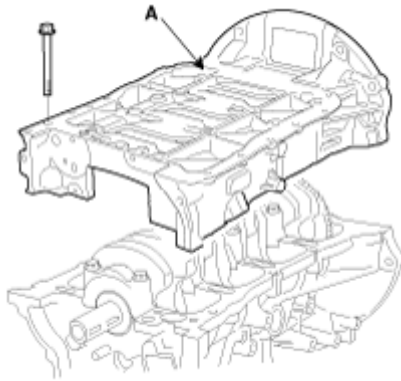


Fig. 11: Identifying Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

17. Check the connecting rod end play.
18. Remove the connecting rod caps and check oil clearance.
19. 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.

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

NOTE:

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

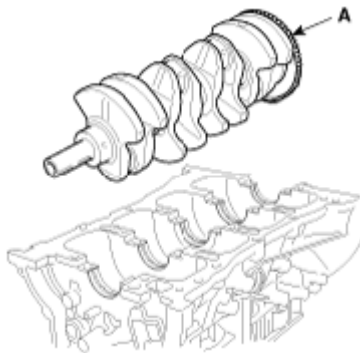


Fig. 12: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

23. 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 the piston and pin as a set.

24. 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.

25. Disconnect connecting rod from piston.

INSPECTION

Connecting Rod And Crankshaft

1. Check the connecting rod end play.

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

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

Maximum end play: 0.35mm (0.0138in.)

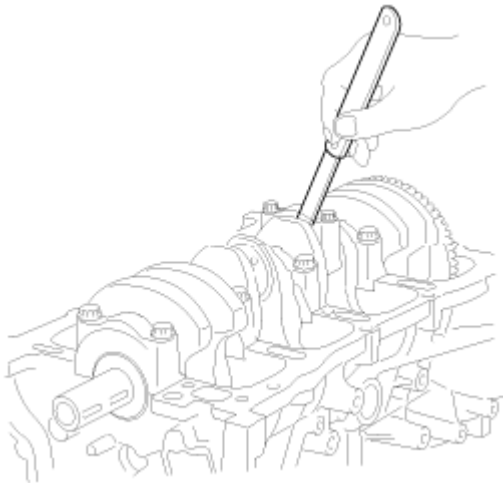


Fig. 13: Checking Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

- A. If out-of-tolerance, install a new connecting rod.
 - B. If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.

1. Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
2. Remove 2 connecting rod cap bolts.
3. Remove the connecting rod cap and bearing half.
4. Clean the crank pin and bearing.
5. Place plastigage across the crank pin.
6. Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

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

NOTE: **Do not turn the crankshaft.**

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

Standard oil clearance

0.028 ~ 0.046mm(0.0011 ~ 0.0018in.)

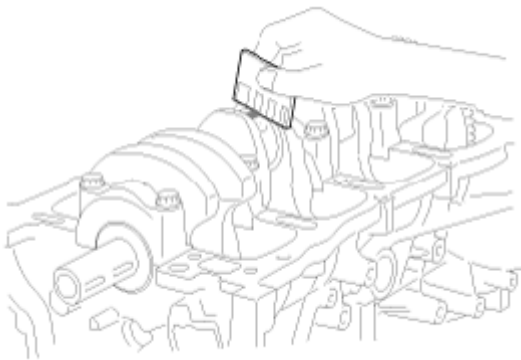


Fig. 14: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

Connecting Rod Mark Location



Fig. 15: Identifying Connecting Rod Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod

CONNECTING ROD INSIDE DIAMETER CHART

Class	Mark	Inside Diameter
a	A	51.000 ~ 51.006mm (2.0079 ~ 2.0081in.)
b	B	51.006 ~ 51.012mm (2.0081 ~ 2.0083in.)
c	C	51.012 ~ 51.018mm (2.0083 ~ 2.0085in.)

Crankshaft Pin Mark Location Discrimination Of Crankshaft



Fig. 16: Identifying Crankshaft Pin Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft

CRANKSHAFT OUTSIDE DIAMETER CHART

Class	Mark	Outside Diameter Of Pin
I	1	47.966 ~ 47.972mm (1.8884 ~ 1.8886in.)
II	2	47.960 ~ 47.966mm (1.8881 ~ 1.8884in.)
III	3	47.954 ~ 47.960mm (1.8879 ~ 1.8881in.)

Place Of Identification Mark (Connecting Rod Bearing) Discrimination Of Connecting Rod Bearing

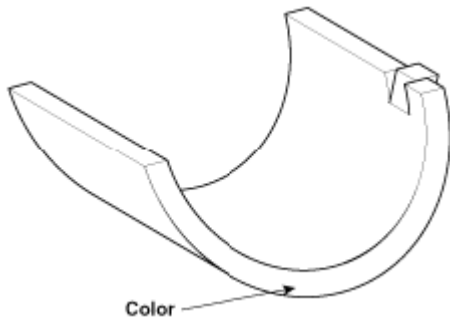


Fig. 17: Identifying Connecting Rod Bearing Color Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod Bearing

BEARING THICKNESS CHART

Class	Mark	Thickness Of Bearing
AA	BLUE	1.514 ~ 1.517mm (0.0596 ~ 0.0597in.)
A	BLACK	1.511 ~ 1.514mm (0.0595 ~ 0.0596in.)
B	NONE	1.508 ~ 1.511mm (0.0594 ~ 0.0595in.)
C	GREEN	1.505 ~ 1.508mm (0.0593 ~ 0.0594in.)
D	YELLOW	1.502 ~ 1.505mm (0.0591 ~ 0.0593in.)

(11) Selection

CONNECTING ROD IDENTIFICATION MARK CHART

Crankshaft Identification Mark	Connecting Rod Identification Mark	Assembling Classification Of Bearing
I (1)	a (A)	D (YELLOW)
	b (B)	C (GREEN)
	c (C)	B (NONE)
II (2)	a (A)	C (GREEN)
	b (B)	B (NONE)
	c (C)	A (BLACK)
	a (A)	B (NONE)

III (3)	b (B)	A (BLACK)
	c (C)	AA (BLUE)

3. Check the crankshaft bearing oil clearance.

1. To check main bearing-to-journal oil clearance, remove the main 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

14.7Nm (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.020 ~ 0.038mm (0.0008 ~ 0.0015in.)

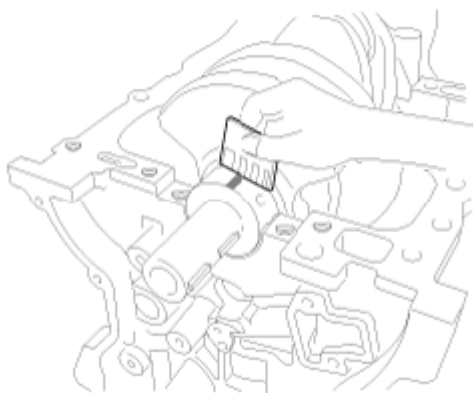


Fig. 18: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

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 :

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

Allowable twist of connecting rod :

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

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.

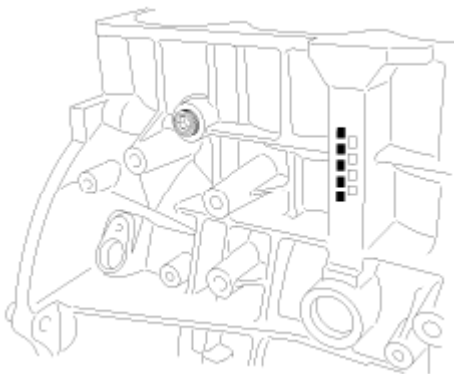


Fig. 19: Identifying Crankshaft Bore Mark Location

Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block

CYLINDER BLOCK INSIDE DIAMETER

Class	Mark	Inside Diameter
a	A	56.000 ~ 56.006mm (2.2047 ~ 2.2049in.)
b	B	56.006 ~ 56.012mm (2.2049 ~ 2.2052in.)
c	C	56.012 ~ 56.018mm (2.2052 ~ 2.2054in.)

Crankshaft Journal Mark Location Discrimination Of Crankshaft



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

Discrimination Of Crankshaft

CRANKSHAFT OUTSIDE DIAMETER CHART

Class	Mark	Outside Diameter Of Journal
I	1	51.954 ~ 51.960mm (2.0454 ~ 2.0456in.)
II	2	51.948 ~ 51.954mm (2.0452 ~ 2.0454.)
III	3	51.942 ~ 51.948mm (2.0449 ~ 2.0452in.)

Place Of Identification Mark (Crankshaft Bearing) Discrimination Of Crankshaft Bearing

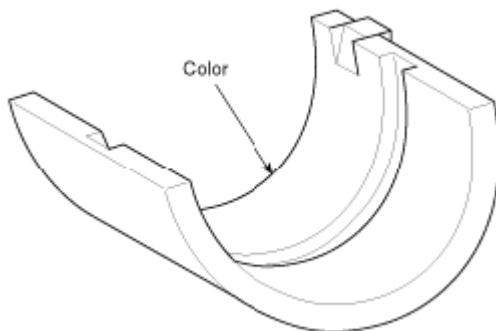


Fig. 21: Identifying Crankshaft Bearing Color
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing

BEARING THICKNESS

Class	Mark	Thickness Of Bearing
AA	Blue	2.026 ~ 2.029mm (0.0797 ~ 0.0798in.)
A	Black	2.023 ~ 2.026mm (0.0796 ~ 0.0797in.)
B	None	2.020 ~ 2.023mm (0.0795 ~ 0.0796in.)
C	Green	2.017 ~ 2.020mm (0.0794 ~ 0.795in.)
D	Yellow	2.014 ~ 2.017mm (0.0793 ~ 0.0794in.)

Selection

CRANKSHAFT BORE IDENTIFICATION MARK CHART

Crankshaft Identification Mark	Crankshaft Bore Identification Mark	Assembling Classification Of Bearing
I (1)	a (A)	D (Yellow)
	b (B)	C (Green)
	c (C)	B (None)
II (2)	a (A)	C (Green)
	b (B)	B (None)
	c (C)	A (Black)
III (3)	a (A)	B (None)
	b (B)	A (Black)
	c (C)	AA (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

0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)

Limit : 0.30mm (0.0118in.)

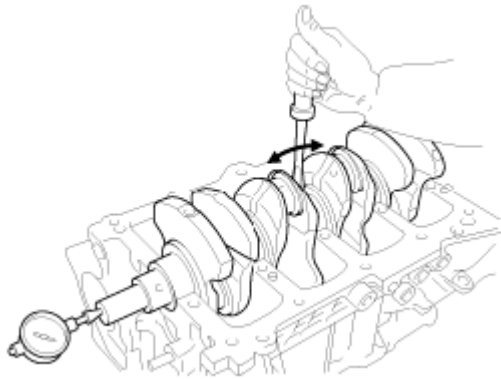


Fig. 22: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

1.925 ~ 1.965mm(0.0758 ~ 0.07736in.)

5. Inspect main journals and crank pins

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

Main journal diameter: 51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)

Crank pin diameter: 47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)

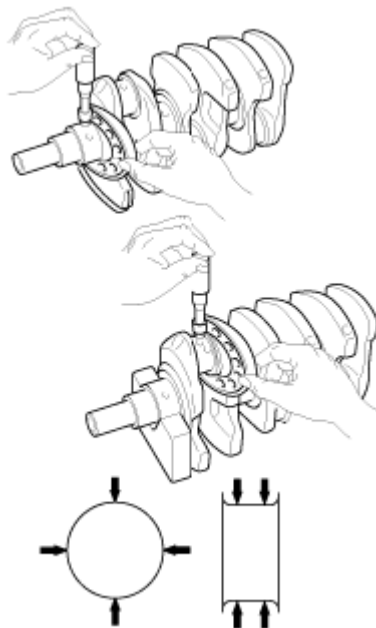


Fig. 23: Inspecting Main Journals And Crank Pins
Courtesy of KIA MOTORS AMERICA, INC.

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 0.05mm(0.0020 in.)

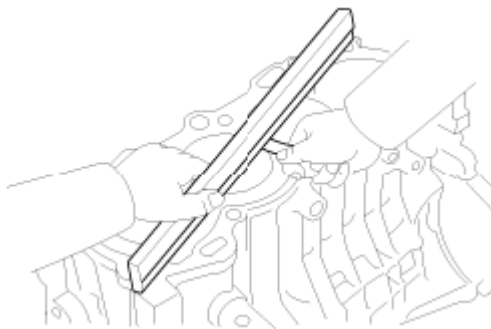


Fig. 24: Checking Cylinder Block Surface
Courtesy of KIA MOTORS AMERICA, INC.

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

88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)

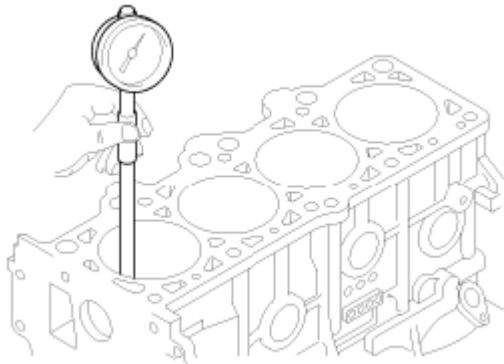


Fig. 25: Measuring Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Measure position(from the bottom of the cylinder block)
: 110.7mm(4.3582in.)/160mm(6.2992in.)/210mm(8.2677in.)

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

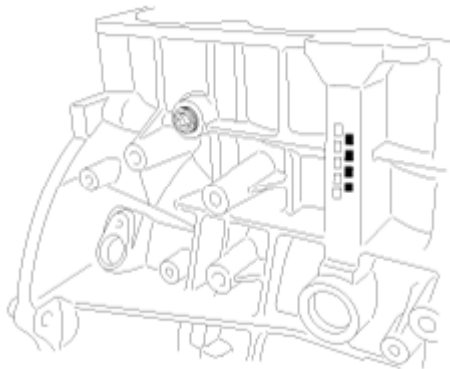


Fig. 26: Checking Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

Cylinder Bore Inner Diameter

CYLINDER BORE INNER DIAMETER CHART

Size Code	2.4
A	88.00 ~ 88.01mm (3.4645~ 3.4649in.)
B	88.01 ~ 88.02mm (3.4649~ 3.4653in.)
C	88.02 ~ 88.03mm (3.4653~ 3.4657in.)

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

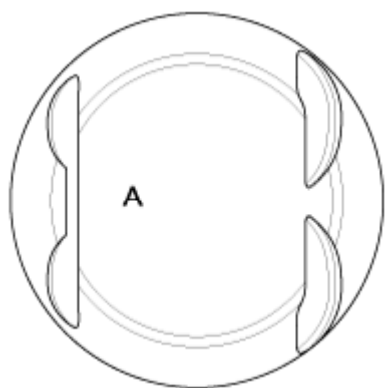


Fig. 27: Checking Piston Size Code On Piston Top Face
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Stamp the grade mark of basic diameter with rubber stamp.

Piston Outer Diameter

PISTON OUTER DIAMETER CHART

Size Code	2.4
A	87.975 ~ 87.985mm (3.4635~ 3.4639in.)
B	87.985 ~ 87.995mm (3.4639~ 3.4643in.)
C	87.995 ~ 88.005mm (3.4643~ 3.4647in.)

8. Select the piston related to cylinder bore class.

Clearance: 0.015 ~ 0.035mm (0.00059 ~ 0.00137in.)

Piston And Rings

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

NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 14 mm (0.55 in.) from the top land of the piston.

Standard diameter

87.975 ~ 88.005mm (3.4635 ~ 3.4647in.)

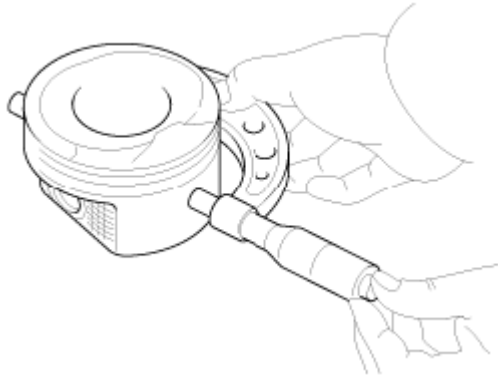


Fig. 28: Measuring Piston Outer Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.015 ~ 0.035mm(0.00059 ~ 0.00137in.)

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 : 0.05 ~ 0.08mm (0.0019 ~ 0.0031in.)

No. 2 : 0.04 ~ 0.08mm (0.0015 ~ 0.0031in.)

Oil ring : 0.06 ~ 0.15mm (0.0023 ~ 0.0059in.)

Limit

No. 1 : 0.1mm (0.004in.)

No. 2 : 0.1mm (0.004in.)

Oil ring : 0.2mm (0.008in.)

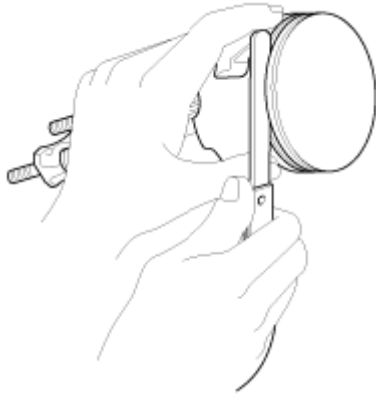


Fig. 29: Measuring Piston Ring Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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 rebored.

Piston ring end gap

Standard

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

No. 2 : 0.37 ~ 0.52m (0.0145 ~ 0.0204in.)

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

Limit

No. 1 : 0.6mm (0.0236in.)

No. 2 : 0.7mm (0.0275in.)

Oil ring : 0.8mm (0.0315in.)

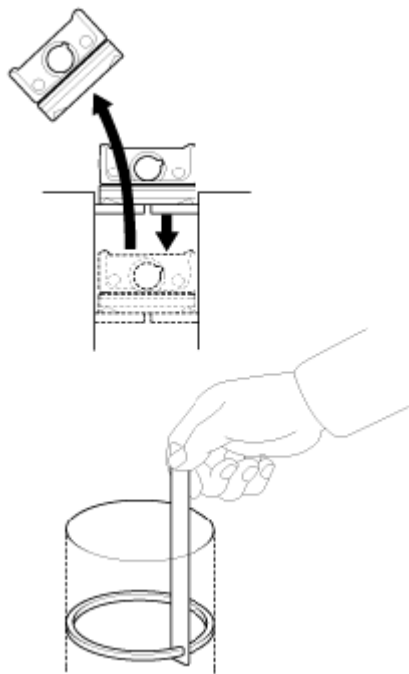


Fig. 30: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the diameter of the piston pin.

Piston pin diameter

21.001 ~ 21.006mm (0.8268 ~ 0.8270in.)

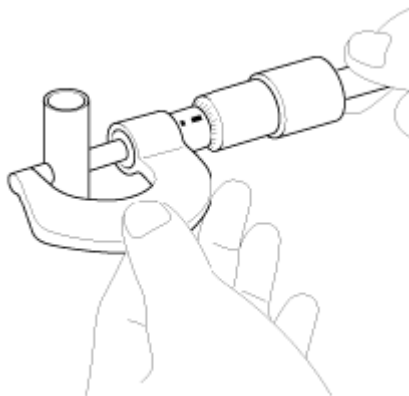


Fig. 31: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.01 ~ 0.02mm (0.0004 ~ 0.0008in.)

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

Piston pin-to-connecting rod interference

0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)

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.

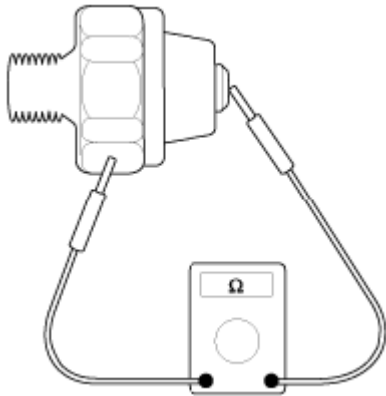


Fig. 32: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

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

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

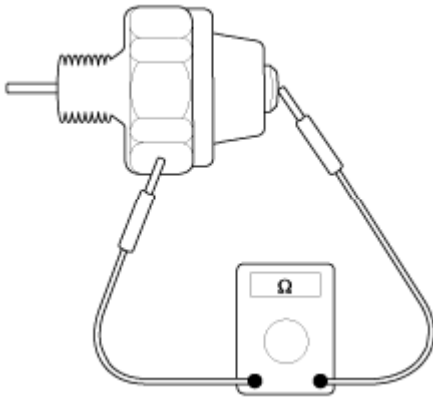


Fig. 33: Checking Continuity Between Terminal And Body
Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

NOTE:

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

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

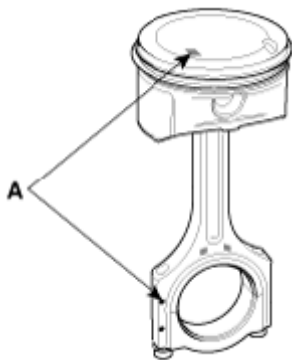


Fig. 34: Identifying Piston Front Mark And Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

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.

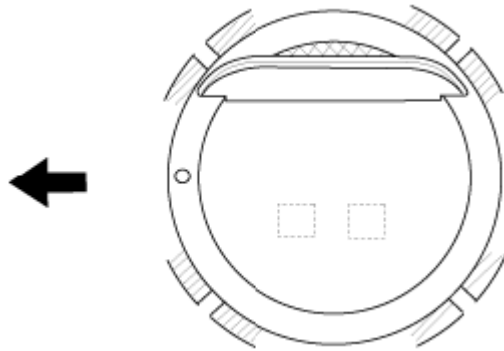


Fig. 35: Identifying Piston Rings

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).

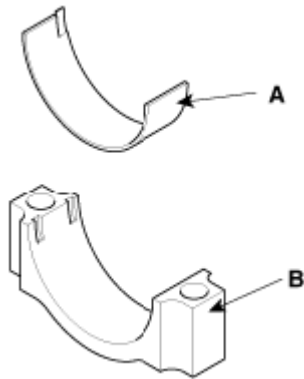


Fig. 36: Identifying Bearings And Connecting Rod Cap

Courtesy of KIA MOTORS AMERICA, INC.

4. Install main bearings.

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

1. Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).

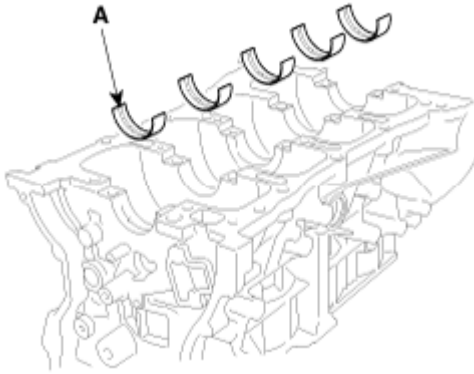


Fig. 37: Identifying Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 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.

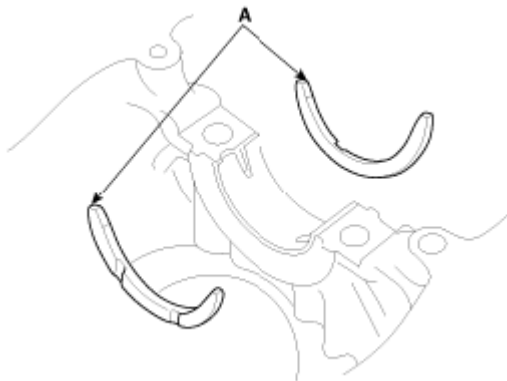


Fig. 38: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

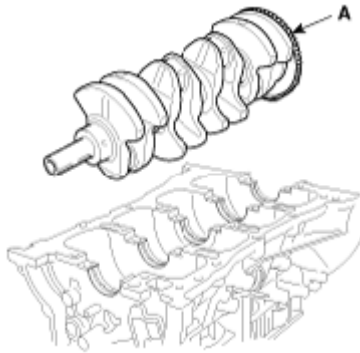


Fig. 39: Identifying Crankshaft On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

14.7Nm (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°

NOTE:

- The main bearing cap bolts are tightened in 2 progressive steps.
- If any of the bearing cap bolts is broken or deformed, replace it.

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 10 bearing cap bolts(A), in several passes, in the sequence shown.

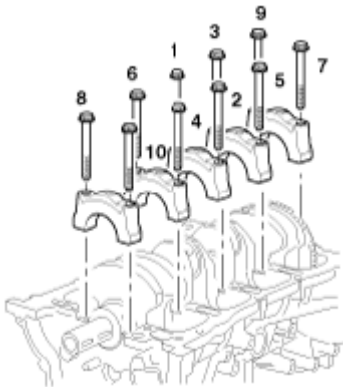


Fig. 40: Identifying Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Retighten the bearing cap bolts by 120° in the numerical order shown.
4. 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. Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
2. 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.
3. Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
4. Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

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

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

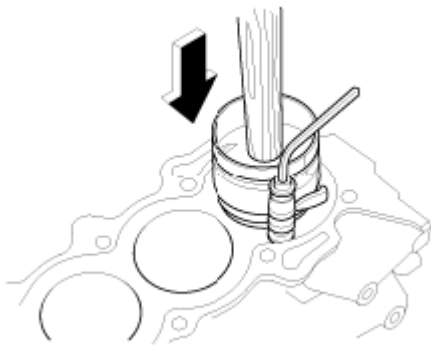


Fig. 41: Expanding Ring Using Ring Compressor
Courtesy of KIA MOTORS AMERICA, INC.

11. Apply liquid gasket to the mating surface of cylinder block and ladder frame.

NOTE:

- Be assembling ladder frame, the liquid sealant Loctite 5900 should be applied ladder frame.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

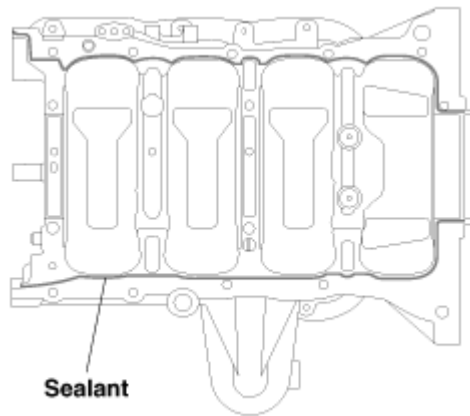


Fig. 42: Applying Liquid Gasket To Mating Surface Of Cylinder Block And Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

12. Install ladder frame(A) with 10 bolts in several passes in sequence shown.

Tightening torque

Step 1 : 7.8 ~ 8.8N.m (0.8 ~ 0.9kgf.m, 5.8 ~ 6.5lb-ft)

Step 2 : 15.7 ~ 18.6N.m (1.6 ~ 1.9kgf.m, 11.6 ~ 13.7lb-ft)

Step 3 : 23.5 ~ 27.5N.m (2.4 ~ 2.8kgf.m, 17.4 ~ 20.3lb-ft)

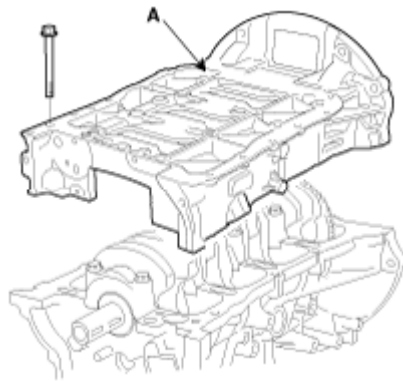


Fig. 43: Identifying Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

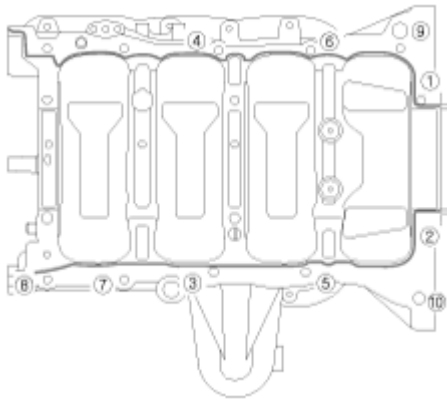


Fig. 44: Identifying Ladder Frame Bolts Tighten Sequence
Courtesy of KIA MOTORS AMERICA, INC.

13. Install rear oil seal.
 1. Apply engine oil to a new oil seal lip.
 2. Using SST(09231-H1100, 09214-3K100) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
14. Install balance shaft module.
15. Install water pump.
16. Install CKP sensor(A) and sensor cover.

Tightening torque

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

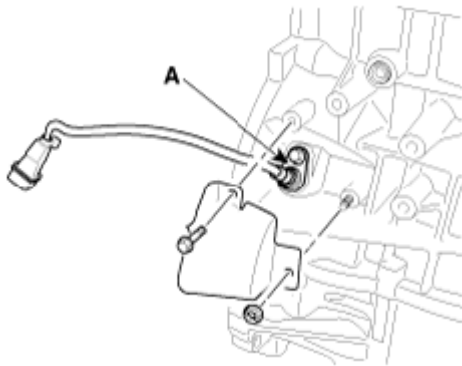


Fig. 45: Identifying CKP Sensor And Sensor Cover
Courtesy of KIA MOTORS AMERICA, INC.

17. Install oil pressure sensor.
 1. Apply adhesive to 2 or 3 threads.

Adhesive : MS 721-39(B) or equivalent.

2. Install the oil pressure sensor (A).

Tightening torque

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

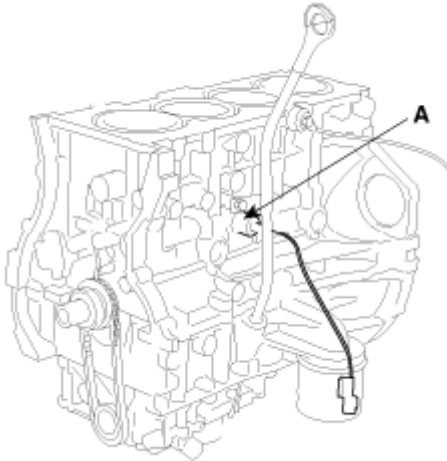


Fig. 46: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

18. Install knock sensor(A).

Tightening torque

16.7 ~ 25.5N.m (1.7 ~ 2.6kgf.m, 12.3 ~ 18.8lb-ft)

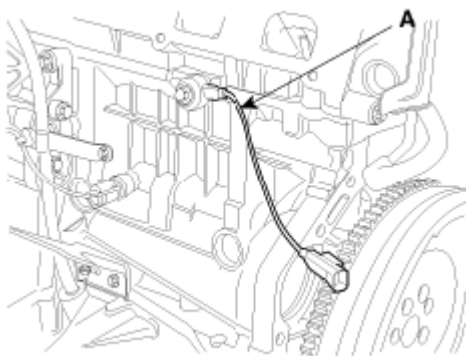


Fig. 47: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

19. Install oil level gauge assembly.
 1. Install a new O-ring on the oil level gauge.
 2. Apply engine oil on the O-ring.
 3. Install the oil level gauge assembly(A) with the bolt.

Tightening torque

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

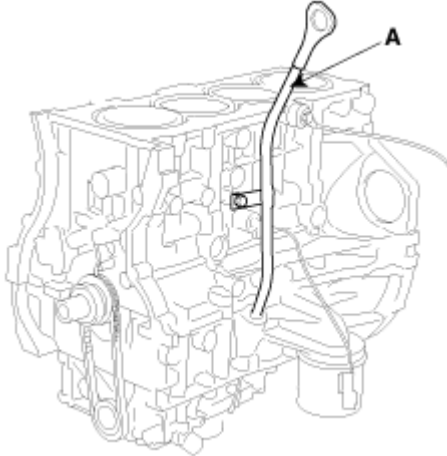


Fig. 48: Identifying Oil Level Gauge Assembly
Courtesy of KIA MOTORS AMERICA, INC.

20. Install tensioner assembly integrated bracket(A).

Tightening torque

39.2 ~ 44.1N.m (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lb-ft)

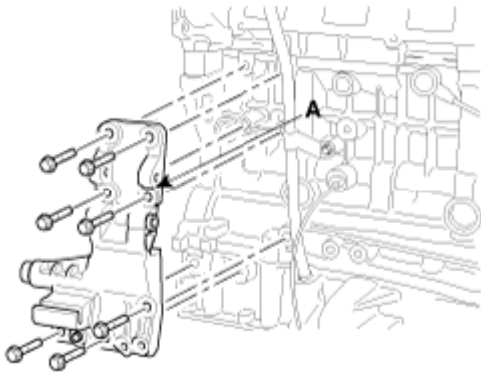


Fig. 49: Identifying Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

21. Install the power steering pump bracket and power steering pump.
22. Install the alternator.
23. Install the A/C compressor.
24. Install the cylinder head.
25. Install the timing chain.

26. Install the oil pan.

1. Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

NOTE: Check that the mating surfaces are clean and dry before applying liquid gasket.

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

Use liquid gasket LOCTITE5900H or equivalent(MS721-40A).

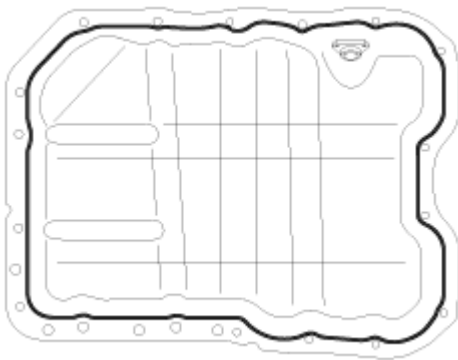


Fig. 50: Applying Liquid Gasket Centered Between Edges Of Mating Surface
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

3. Install the oil pan(A).

Uniformly tighten the bolts in several passes.

Tightening torque

M8(B):26.5 ~ 30.4N.m (2.7 ~ 3.1kgf.m, 19.5 ~ 22.4lb-ft)

M6(C):9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

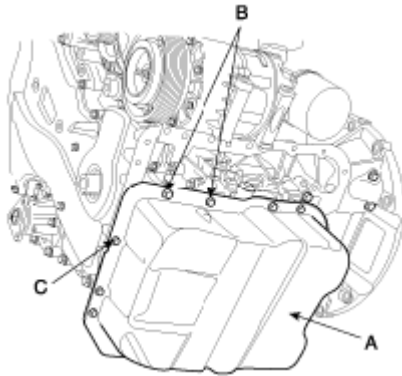


Fig. 51: Identifying Oil Pan

Courtesy of KIA MOTORS AMERICA, INC.

27. Remove engine stand.
28. A/T : Install drive plate(A).

Tightening torque

117.7 ~ 127.5N.m (12 ~ 13kgf.m, 86.8 ~ 94.0lb-ft)

M/T : Install flywheel(B).

Tightening torque

117.7 ~ 127.5N.m (12 ~ 13kgf.m, 86.8 ~ 94.0lb-ft)

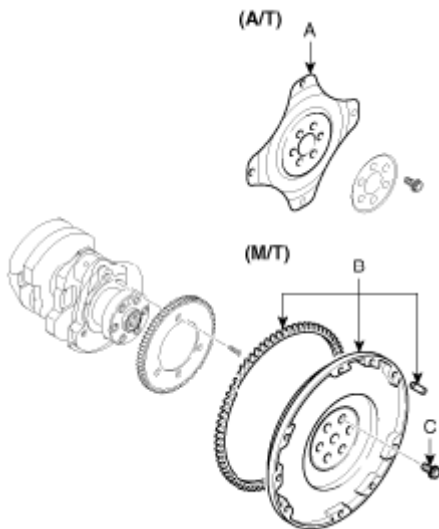


Fig. 52: Identifying Drive Plate

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Always use new flywheel(drive plate) bolts(C).
- Apply sealant to the screw part(8mm from the end of the bolt) when using new flywheel bolts.

Sealant : Three bond 2403, Loctite 200 or 204

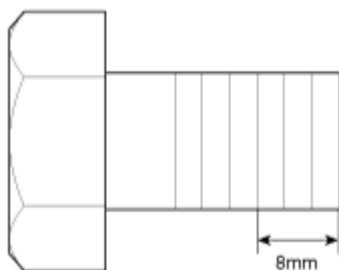


Fig. 53: Identifying Flywheel Bolt (Drive Plate)
Courtesy of KIA MOTORS AMERICA, INC.

- Install and uniformly tighten the 7 bolts, in several passes.

2009 ENGINE

Cylinder Head Assembly (2.4L)- Magentis & Optima

CYLINDER HEAD

COMPONENTS AND COMPONENTS LOCATION

Components

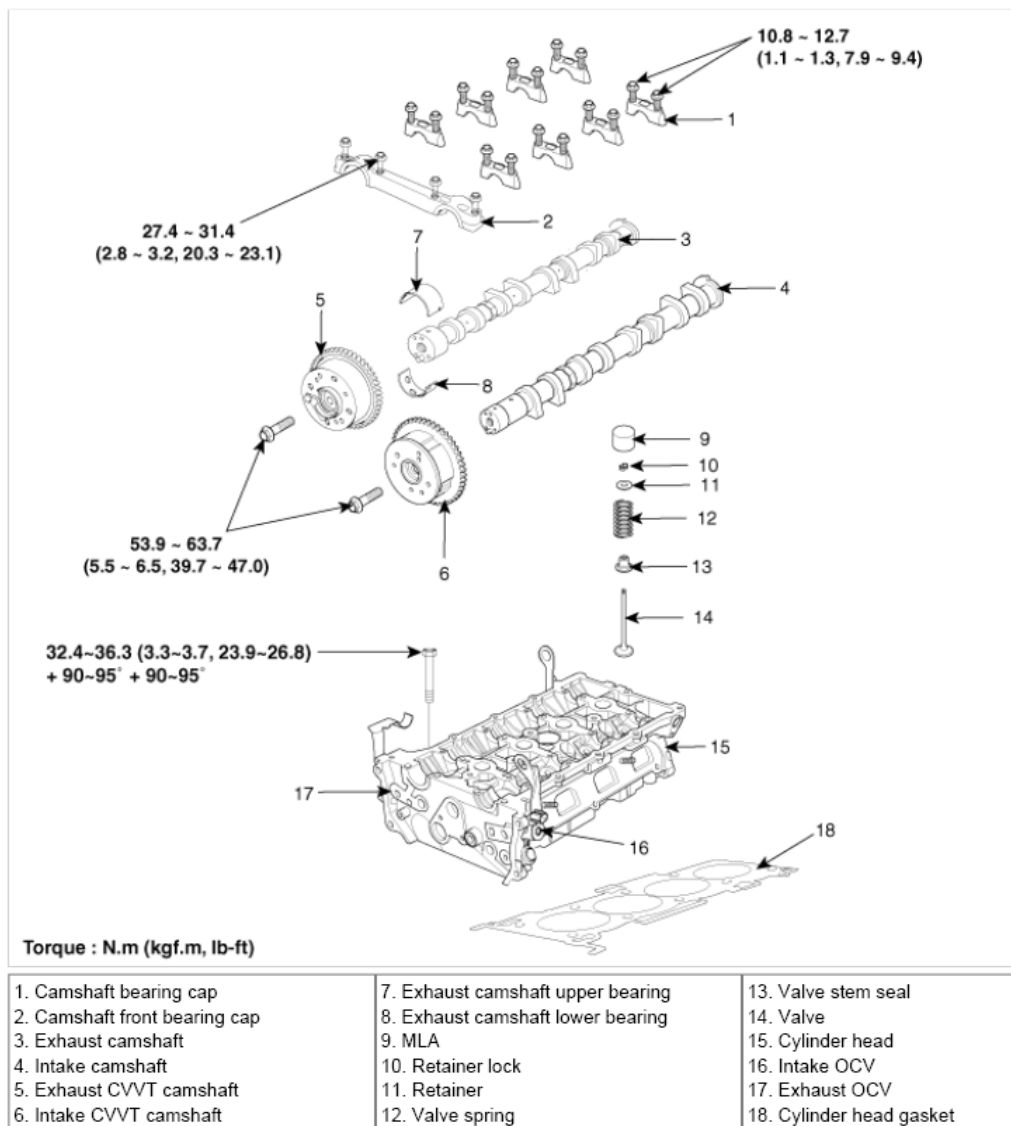


Fig. 1: Identifying Cylinder Head Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

Removal

Engine removal is not required for this procedure.

CAUTION:

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

NOTE:

Mark all wiring and hoses to avoid misconnection.

1. Disconnect the battery terminals and remove the battery.
2. Remove the engine cover (A).

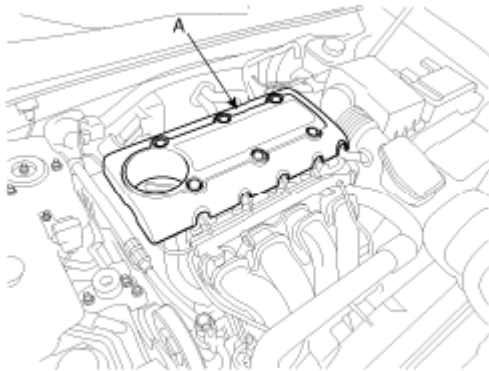


Fig. 2: Identifying Engine Cover

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the air duct (A).

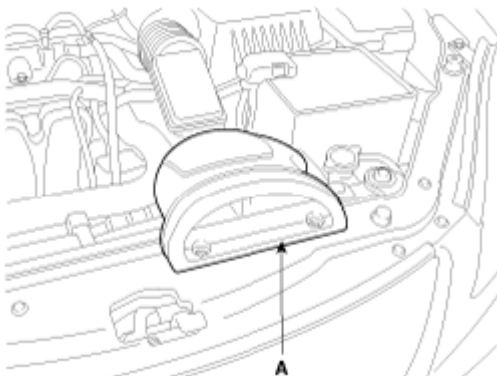
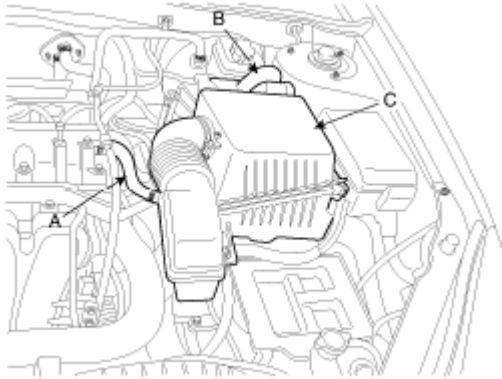


Fig. 3: Identifying Air Duct

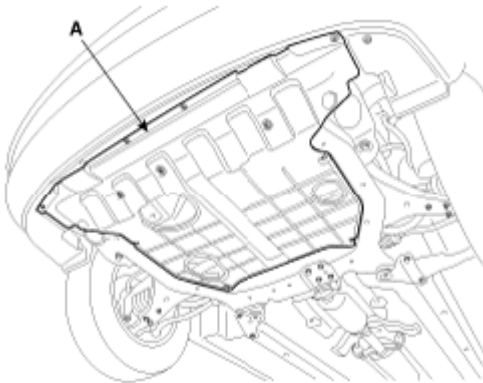
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the breather hose (A), ECM connector (B) and remove the air cleaner assembly (C).

**Fig. 4: Identifying Breather Hose, ECM Connector And Air Cleaner Assembly**

Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the under cover (A).

**Fig. 5: Identifying Under Cover**

Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the drain plug and drain the engine coolant.
7. Remove the radiator upper hose (A) and lower hose (B).

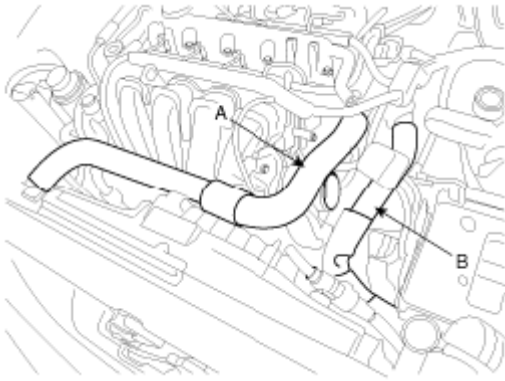


Fig. 6: Identifying Radiator Upper Hose And Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the heater hoses (A).



Fig. 7: Identifying Heater Hoses
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect the VIS connector (A), OPS connector (B), knock sensor connector (C) and A/C switch connector (D).

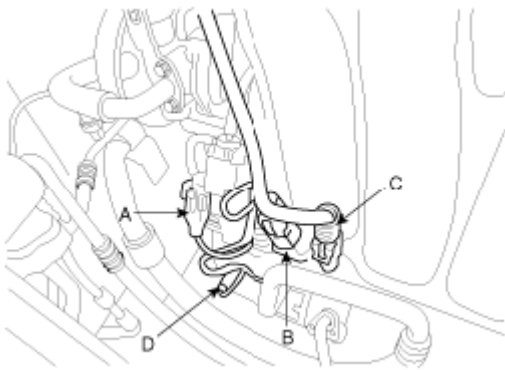


Fig. 8: Identifying VIS Connector, OPS Connector, Knock Sensor Connector And A/C Switch Connector

Courtesy of KIA MOTORS AMERICA, INC.

10. Disconnect the intake OCV connector (A).



Fig. 9: Identifying Intake OCV Connector
Courtesy of KIA MOTORS AMERICA, INC.

11. Disconnect the injector connectors (A) and ignition coil connectors (B).

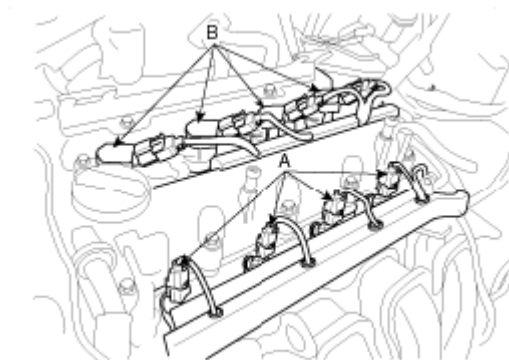


Fig. 10: Identifying Injector Connectors And Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

12. Disconnect the ETC connector (A) and MAP sensor connector (B).

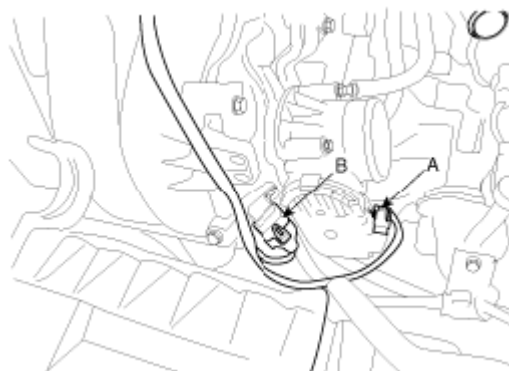


Fig. 11: Identifying ETC Connector And MAP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

13. Disconnect the CMP sensor connector (A), fuel hose (B), brake booster vacuum hose (C) and PCSV hose (D).

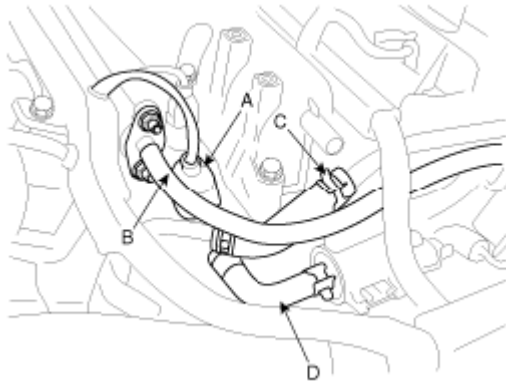


Fig. 12: Identifying CMP Sensor Connector, Fuel Hose, Brake Booster Vacuum Hose And PCSV Hose
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the PCSV connector (A), ECT connector (B), condenser connector (C), CKP sensor connector (D), CMP sensor connector (E) and brake booster vacuum hose (F).

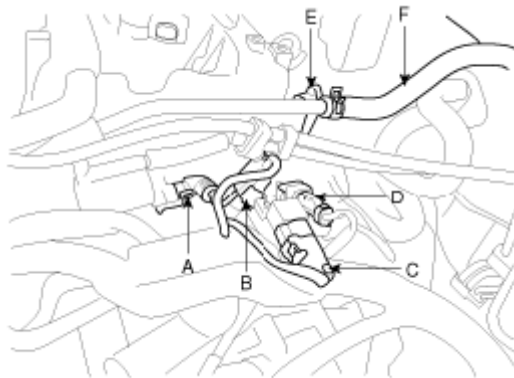


Fig. 13: Identifying PCSV Connector, ECT Connector, Condenser Connector, CKP Sensor Connector And CMP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the water temp control assembly (A).

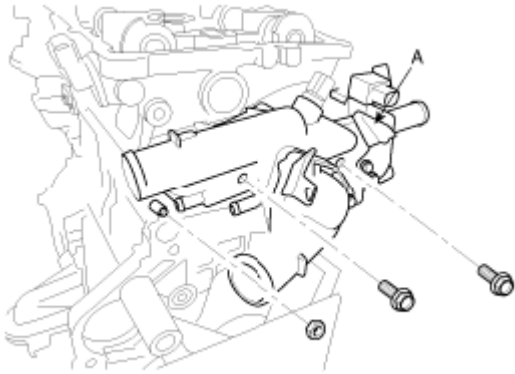


Fig. 14: Identifying Water Temp Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

16. Remove the timing chain. (Refer to **TIMING SYSTEM - 2.4L** in this group)
17. Remove the intake & exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM - 2.4L** in this group)
18. Remove the intake & exhaust CVVT assembly.

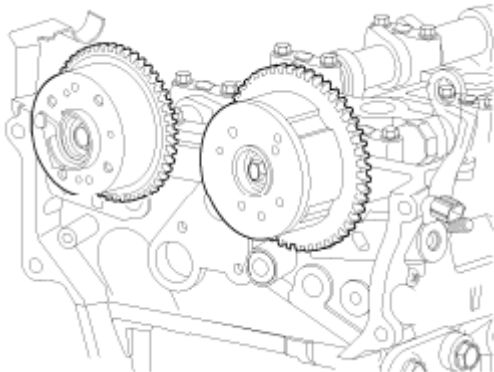


Fig. 15: Identifying Intake And Exhaust CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove the cam shaft.
 - A. Remove the front cam shaft bearing cap (A).

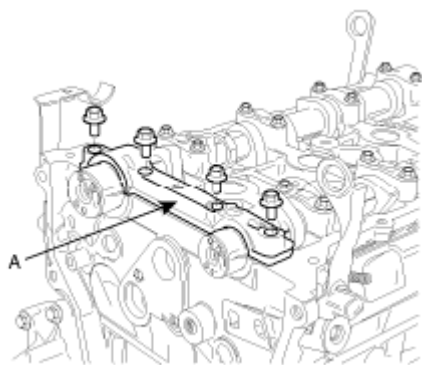


Fig. 16: Identifying Front Cam Shaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

- B. Remove the exhaust cam shaft upper bearing (A).

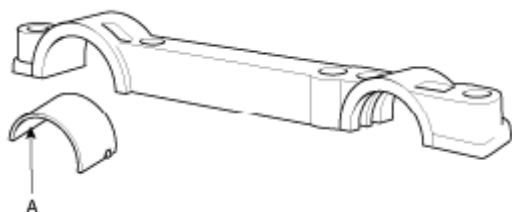


Fig. 17: Identifying Exhaust Cam Shaft Upper Bearing
Courtesy of KIA MOTORS AMERICA, INC.

- C. Remove camshaft bearing cap (A), in the sequence shown.

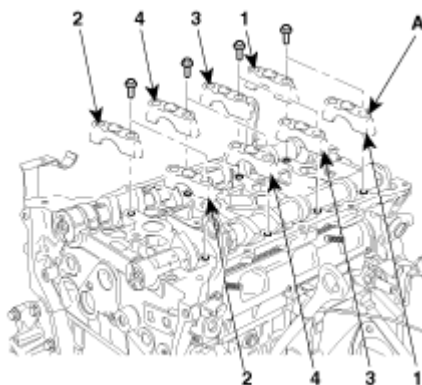


Fig. 18: Identifying Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

- D. Remove the cam shaft (A).

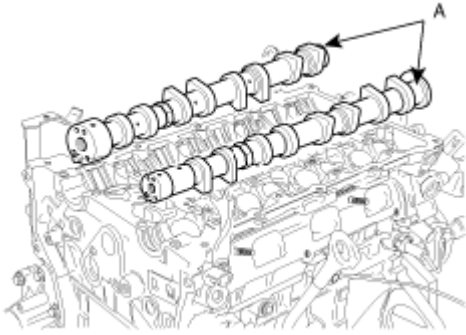


Fig. 19: Identifying Cam Shaft
Courtesy of KIA MOTORS AMERICA, INC.

- E. Remove the exhaust cam shaft lower bearing (A).

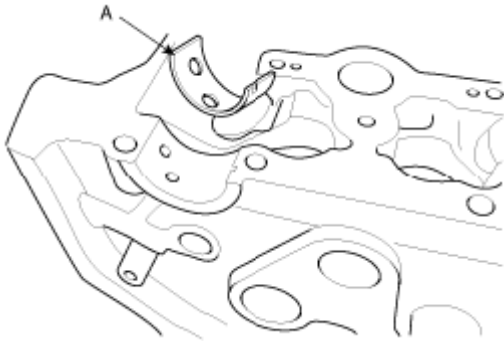


Fig. 20: Identifying Exhaust Cam Shaft Lower Bearing
Courtesy of KIA MOTORS AMERICA, INC.

20. Remove the intake OCV (A).

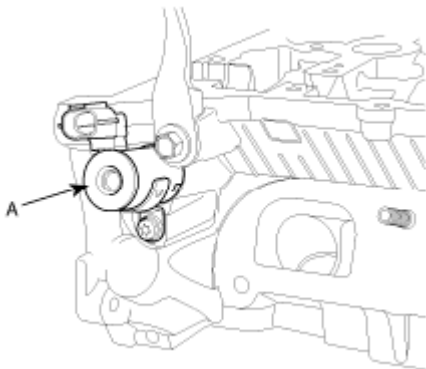


Fig. 21: Identifying Intake OCV
Courtesy of KIA MOTORS AMERICA, INC.

21. Remove the exhaust OCV.
22. Remove the cylinder head bolts, then remove the cylinder head.

- A. Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown.

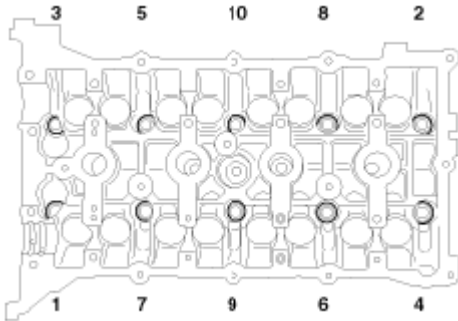


Fig. 22: Identifying Cylinder Head Bolts Remove Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

- B. 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.

23. Remove the cylinder head gasket.

Disassembly

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

1. Remove MLAs(A).

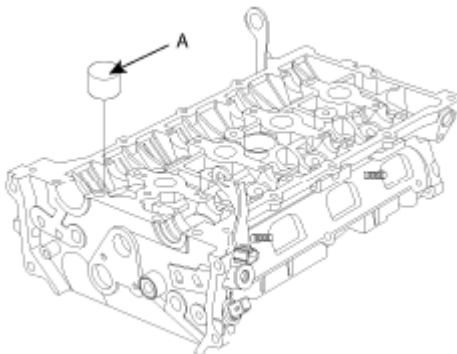


Fig. 23: Identifying MLAs

Courtesy of KIA MOTORS AMERICA, INC.

2. Remove valves.
 1. Using SST(09222-3K000, 09222-3K100), compress the valve spring and remove retainer lock.

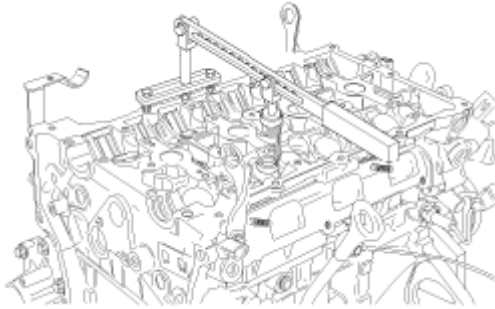


Fig. 24: Compressing Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Using needle-nose pliers, remove the valve stem seal.

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05 mm (0.002in.)

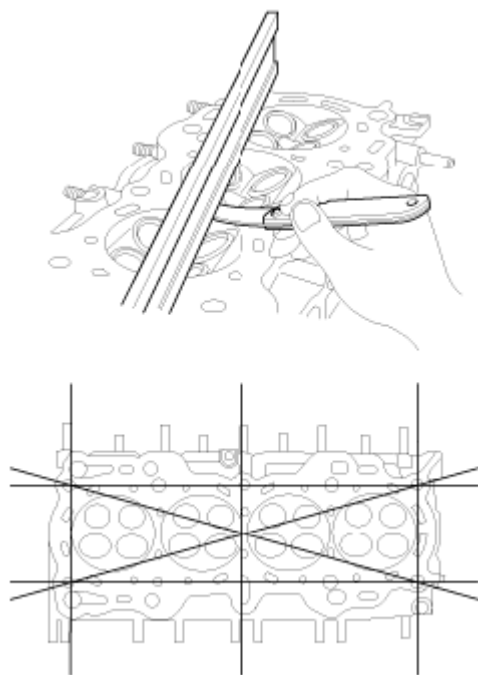


Fig. 25: Inspecting Cylinder Head Surface
Courtesy of KIA MOTORS AMERICA, INC.

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 guid I.D.

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

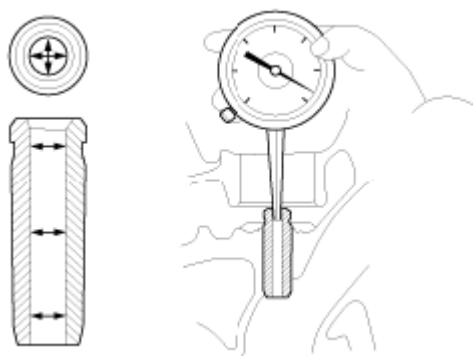


Fig. 26: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem O.D.

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

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

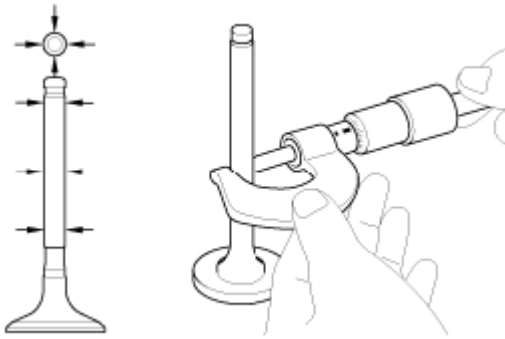


Fig. 27: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem-to-guide clearance

[Standard]

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

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

[Limit]

Intake : 0.07mm (0.0027in.)

Exhaust : 0.09mm (0.0035in.)

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

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 : 1.02mm (0.0401in.)

Exhaust : 1.09mm (0.0429in.)

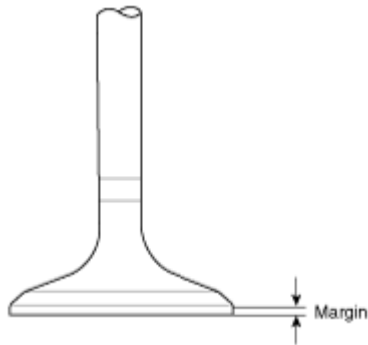


Fig. 28: Identifying Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Valve length

[Standard]

Intake : 113.18mm (4.456in.)

Exhaust : 105.84mm (4.167in.)

[Limit]

Intake : 112.93mm (4.446in.)

Exhaust : 105.59mm (4.157in.)

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.

Replace the seat if necessary.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.

Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

4. Inspect valve springs.

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

Valve spring

[Standard]

Free height : 47.44mm (1.8677in.)

Out-of-square : 1.5°

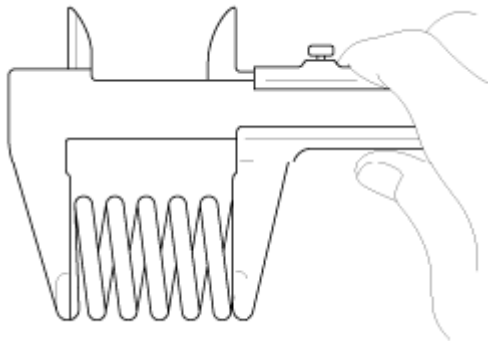


Fig. 29: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

If the free length is not as specified, replace the valve spring.

MLA

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust : 31.964 ~ 31.980mm(1.2584 ~ 1.2590in.)

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

Tappet bore I.D.

Intake/Exhaust : 32.000 ~ 32.025mm(1.2598 ~ 1.2608in.)

3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

MLA to tappet bore clearance

[Standard]

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

[Limit]

Intake/Exhaust : 0.07mm(0.0027in.)

Camshaft

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake : 44.10 ~ 44.30mm (1.7362 ~ 1.7440in.)

Exhaust : 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)

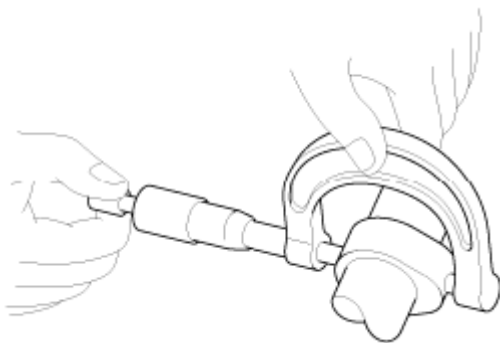


Fig. 30: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

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

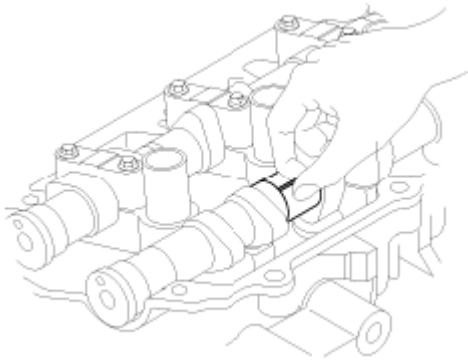


Fig. 31: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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 : 0.022 ~ 0.057mm (0.0008 ~ 0.0022in.)

No. 2, 3, 4, 5, journal : 0.045 ~ 0.082mm (0.0018 ~ 0.0032in.)

Exhaust

No. 1 journal : 0 ~ 0.032mm (0 ~ 0.0012in.)

No. 2, 3, 4, 5, journal : 0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)

[Limit] :

Intake

No. 1 journal : 0.09mm (0.0035in.)

No. 2, 3, 4, 5 journal : 0.12mm (0.0047in.)

Exhaust : 0.12mm (0.0047in.)

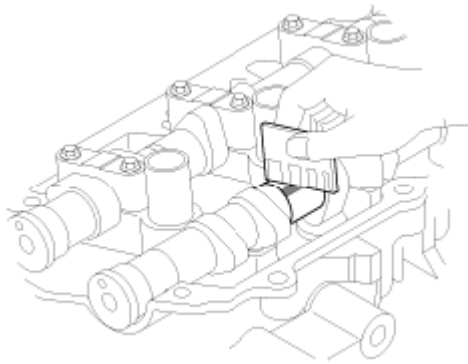


Fig. 32: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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] : 0.04 ~ 0.16mm(0.0015 ~ 0.0062in.)

[Limit] : 0.24mm (0.0094in.)

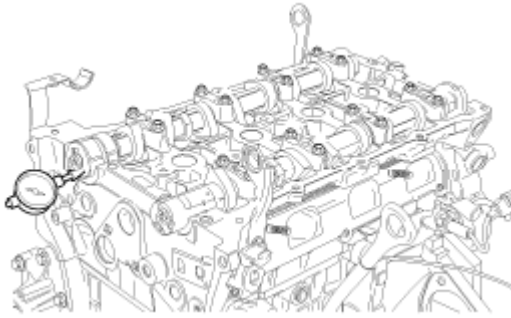


Fig. 33: Measuring Camshaft End Play
 Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

Exhaust Cam Shaft Bearing

1. Check the cylinder head bore mark.

Location Of Cylinder Head Bore Mark

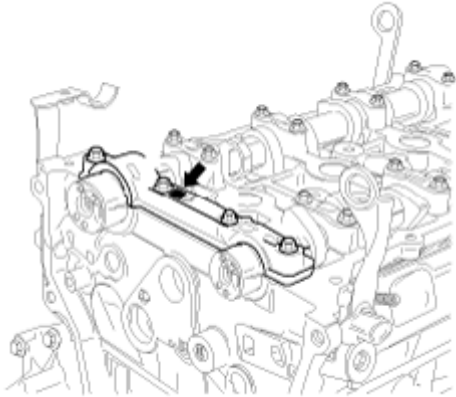


Fig. 34: Locating Cylinder Head Bore Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Head

CYLINDER HEAD BORE MARKS CHART

Class	Mark	Exhaust No. 1 Inside Diameter Of Cylinder Head Bore
a	A	40.000 ~ 40.008 mm (1.5748 ~ 1.5751 in.)
b	B	40.008 ~ 40.016 mm (1.5751 ~ 1.5754 in.)
c	C	40.016 ~ 40.024 mm (1.5754 ~ 1.5757 in.)

2. Select class of camshaft bearing same as class of cylinder head as shown on the table below.

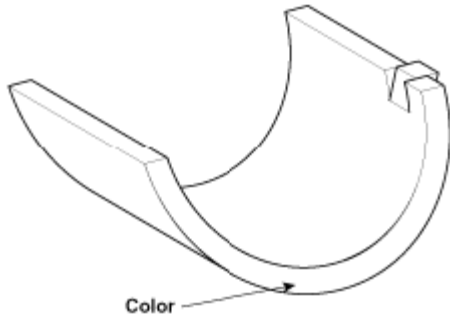
Place Of Exhaust Cam Shaft Bearing Identification Mark

Fig. 35: Identifying Exhaust Cam Shaft Bearing Identification Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Exhaust Camshaft Bearing**BEARING THICKNESS CHART**

Bore Class	Bearing Class For Installing (Color)	Thickness Of Bearing
a (A)	C (Green)	1.996~2.000mm (0.0785~0.0787in.)
b (B)	B (None color)	2.000~2.004mm (0.0787~0.0788in.)
c (C)	A (Black)	2.004~2.008mm (0.0788~0.0790in.)

Oil clearance: 0 ~ 0.032mm (0 ~ 0.0012in.)

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.

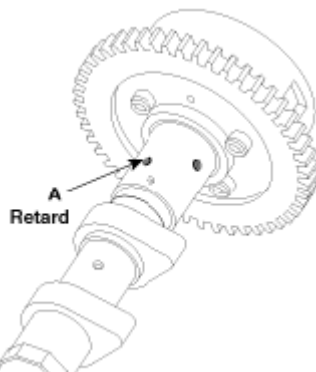


Fig. 36: Identifying CVVT Assembly
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.

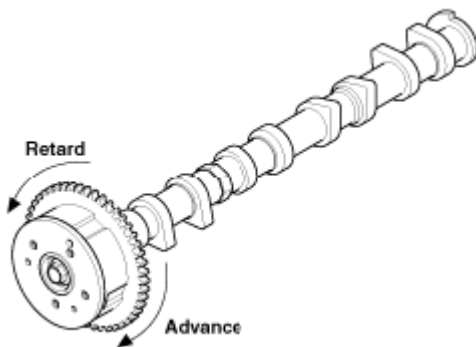


Fig. 37: Identifying CVVT Assembly Marked Direction
Courtesy of KIA MOTORS AMERICA, INC.

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

Standard:

Movable smoothly in the range about

22.5° (Intake)/20.0° (Exhaust)

6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (counter 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(09222-4A000), 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.

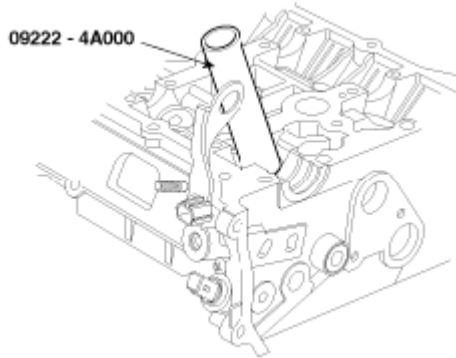


Fig. 38: Pushing Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

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

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

3. Using the SST(09222-3K000, 09222-3K100), 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.

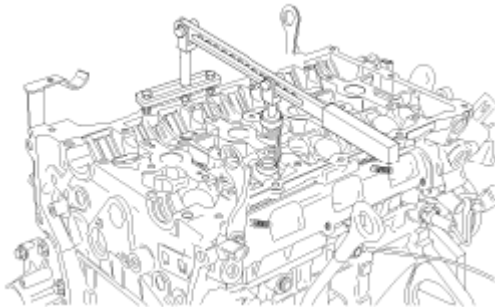
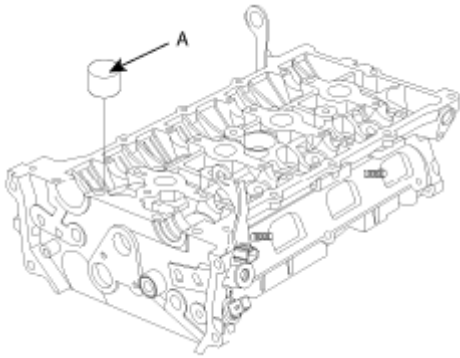


Fig. 39: Installing Retainer Locks
Courtesy of KIA MOTORS AMERICA, INC.

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.

**Fig. 40: Identifying MLAs**

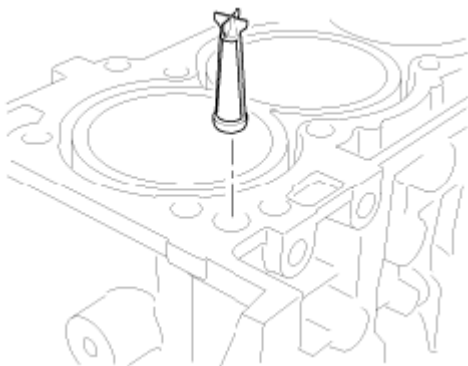
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

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 OCV filter.

**Fig. 41: Identifying OCV Filter**

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Keep clean the OCV filter.

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

NOTE:

- Be careful of the installation direction.
- Apply liquid gasket (Loctite 5900H) on the mark (B).
- After applying sealant, assemble the cylinder head in five minutes.

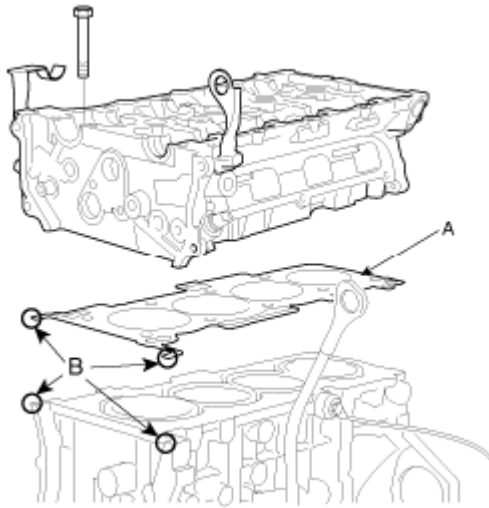


Fig. 42: Identifying Cylinder Head Gasket On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
4. Install cylinder head bolts.
 - A. Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
 - B. Using triple square hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque :

32.4~36.3Nm (3.3~3.7kgf.m, 23.9~26.8lb-ft) + (90~95°) + (90~95°)

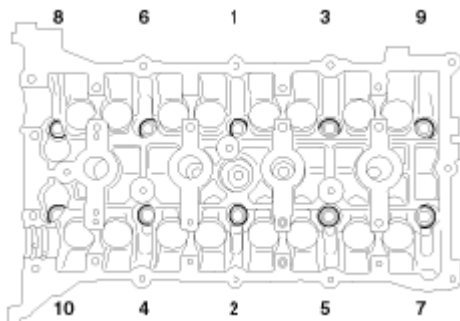


Fig. 43: Identifying Cylinder Head Bolts Tighten Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Always use new cylinder head bolt.

5. Install the OCV(A).

Tightening torque :

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

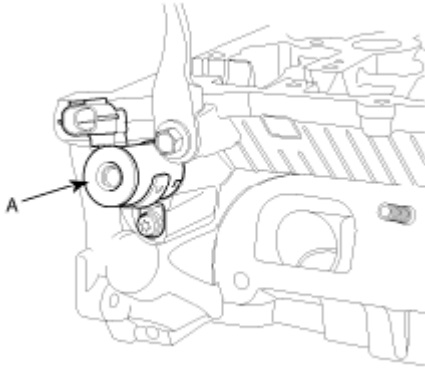


Fig. 44: Identifying OCV
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

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

6. Install the camshafts.

NOTE: Apply a light coat of engine oil on camshaft journals.

- A. Install the exhaust camshaft lower bearing (A).

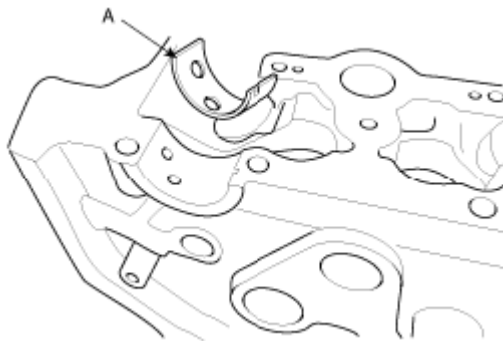


Fig. 45: Identifying Exhaust Camshaft Lower Bearing
Courtesy of KIA MOTORS AMERICA, INC.

- B. Install the camshafts (A).

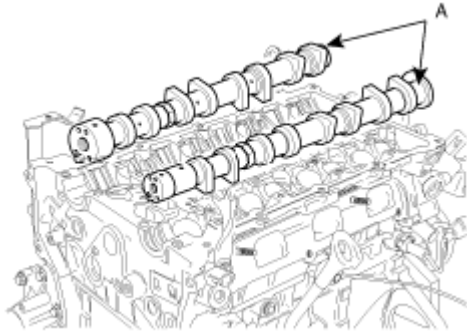


Fig. 46: Identifying Camshafts
Courtesy of KIA MOTORS AMERICA, INC.

- C. Install the exhaust camshaft upper bearing (A).

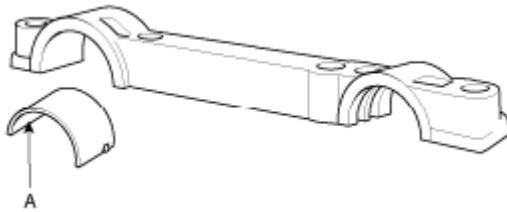


Fig. 47: Identifying Exhaust Camshaft Upper Bearing
Courtesy of KIA MOTORS AMERICA, INC.

- D. Install camshaft bearing caps in their proper locations.

Tightening order.

Group A --> Group B --> Group C.

Tightening torque

Step 1

M6 : 5.9N.m(0.6kgf.m, 4.3lb-ft)

M8 : 14.7N.m(1.5kgf.m, 10.8lb-ft)

Step 2

M6 : 10.8 ~ 12.7N.m(1.1 ~ 1.3kgf.m, 7.9 ~ 9.4lb-ft)

M8 : 27.5 ~ 31.4N.m(2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)

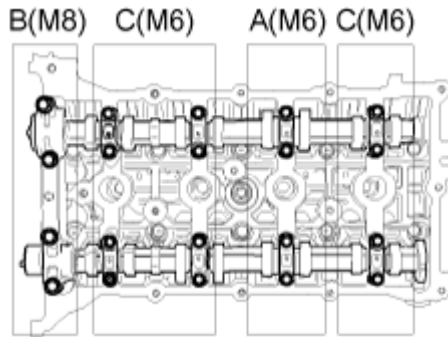


Fig. 48: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the water temp control assembly (A).

Tightening torque :

Bolt : 14.7 ~ 19.6N.m(1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)

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

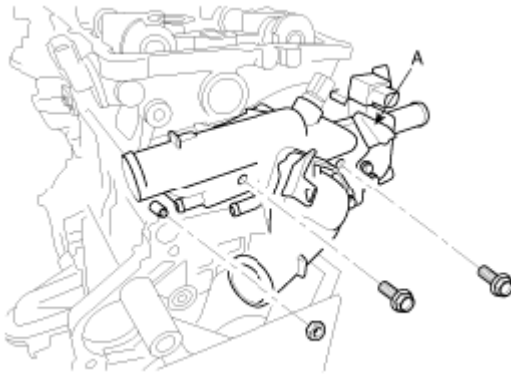


Fig. 49: Identifying Water Temp Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.
- Always use a new O-ring.

8. Install the timing chain.
9. Check and adjust valve clearance.
10. Install the cylinder head cover.

- A. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- B. After applying sealant, it should be assembled within 5 minutes.

Bead width: 2.5mm(0.1in.)

Sealant: LOCTITE 5900H

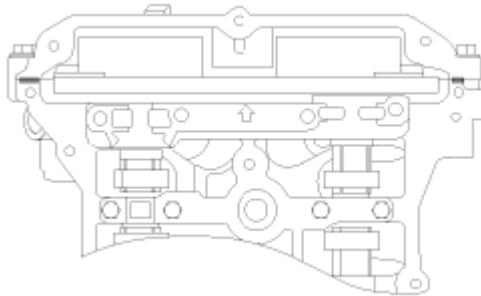


Fig. 50: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque :

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

Step 2 : 7.8 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

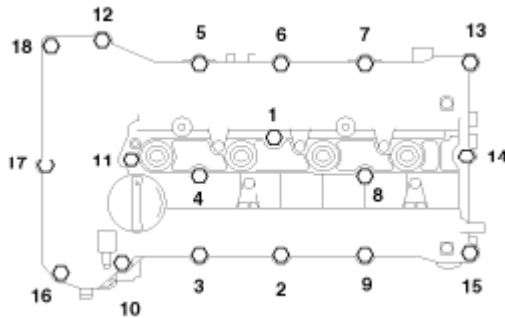


Fig. 51: Identifying Cylinder Head Core Bolts Tighten Sequence
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not reuse cylinder head cover gasket.

11. Install the intake & exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM - 2.4L** in this group)
12. Connect the PCSV connector (A), ECT connector (B), condenser connector (C), CKP sensor connector (D), CMP sensor connector (E) and brake booster vacuum hose (F).

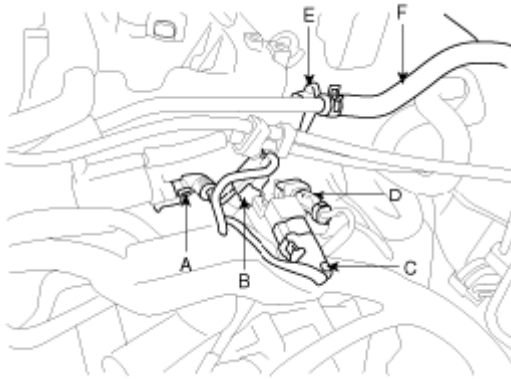


Fig. 52: Identifying PCSV Connector, ECT Connector, Condenser Connector, CKP Sensor Connector And CMP Sensor Connector
 Courtesy of KIA MOTORS AMERICA, INC.

13. Connect the brake booster vacuum hose (D), PCSV hose (C) fuel hose (B) and CMP sensor connector (A).

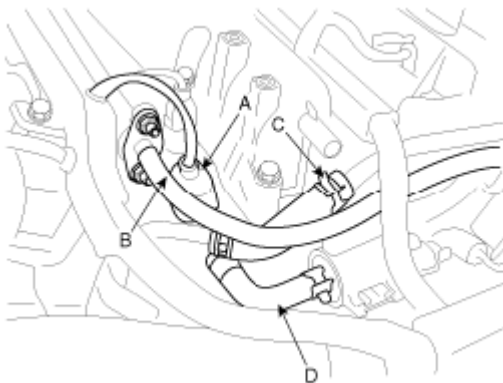


Fig. 53: Identifying Brake Booster Vacuum Hose, PCSV Hose, Fuel Hose And CMP Sensor Connector
 Courtesy of KIA MOTORS AMERICA, INC.

14. Connect the ETC connector (A) and MAP sensor connector (B).



Fig. 54: Identifying ETC Connector And MAP Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

15. Connect the injector connectors (A) and ignition coil connectors (B).

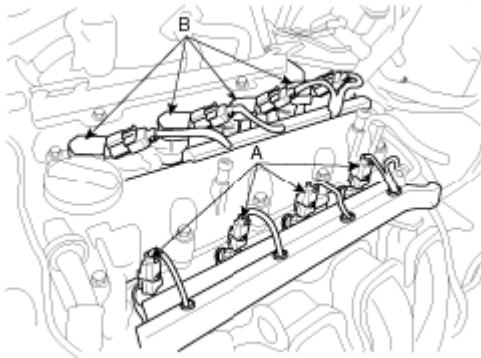


Fig. 55: Identifying Injector Connectors And Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

16. Connect the OCV connector (A).



Fig. 56: Identifying OCV Connector
Courtesy of KIA MOTORS AMERICA, INC.

17. Connect the VIS connector (A), OPS connector (B), knock sensor connector (C) and A/C switch

connector (D).

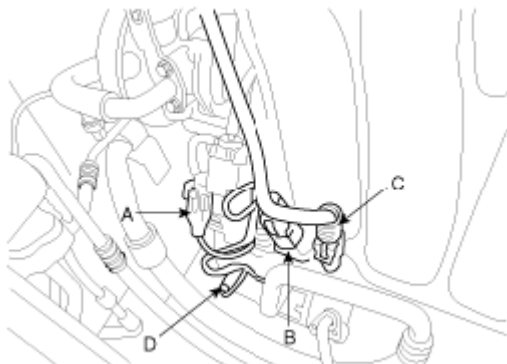


Fig. 57: Identifying VIS Connector, OPS Connector, Knock Sensor Connector And A/C Switch Connector

Courtesy of KIA MOTORS AMERICA, INC.

18. Install the heater hoses (A).



Fig. 58: Identifying Heater Hoses

Courtesy of KIA MOTORS AMERICA, INC.