

2010 ENGINE

General Information (Engine Mechanical System) - 1.6L - Soul

SPECIFICATIONS

GENERAL SPECIFICATIONS

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Description		Specifications	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		77mm (3.0315in)	
Stroke		85.44mm (3.3638in)	
Total displacement		1,591 cc (97.09 cu.in.)	
Compression ratio		10.5 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Opens	ATDC 10 & deg;/BTDC 40 & deg;	
	Closes	ABDC 63 & deg;/ABDC 13 & deg;	
Exhaust valve	Opens	BBDC 40 & deg;	
	Closes	ATDC 3 & deg;	
Cylinder head			
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Camshaft			
Cam height	Intake	43.85mm (1.726in)	
	Exhaust	42.85mm (1.687in)	
Journal outer diameter (Intake, Exhaust)		22.964 ~ 22.980mm (0.9041 ~ 0.9047in)	
Camshaft cap oil clearance		0.027 ~ 0.058mm (0.0011 ~ 0.0023in)	0.1mm (0.0039in)
End play		0.10 ~ 0.20mm (0.0039 ~ 0.0079in)	
Valve			
Valve length	Intake	93.15mm (3.6673in)	
	Exhaust	92.6mm (3.6457in)	
Stem outer diameter	Intake	5.465 ~ 5.480mm (0.2152 ~ 0.2157in)	
	Exhaust	5.458 ~ 5.470mm (0.2149	

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		~ 0.2154in)	
Face angle		45.25 & deg; ~ 45.75 & deg;	
Thickness of valve head (margin)	Intake	1.1mm (0.0433in)	0.8mm (0.0315in)
	Exhaust	1.26mm (0.0496in)	1.0mm (0.0394in)
Valve stem to valve guide clearance	Intake	0.020 ~ 0.047mm (0.0008 ~ 0.0019in)	0.10mm (0.0039in)
	Exhaust	0.030 ~ 0.054mm (0.0012 ~ 0.0021in)	0.15mm (0.0059in)
Valve guide			
Length	Intake	40.3 ~ 40.7mm (1.5866 ~ 1.6024in)	
	Exhaust	40.3 ~ 40.7mm (1.5866 ~ 1.6024in)	
Valve spring			
Free length		44.0mm (1.7323in)	
Out of squareness		Less than 1.5 & deg;	
Cylinder block			
Cylinder bore		77.00 ~ 77.03mm (3.0315 ~ 3.0327in)	
Flatness of gasket surface		Less than 0.05mm (0.0020in)/Less than 0.02mm (0.0008in) 100mmx100mm	
Piston			
Piston outer diameter		76.97 ~ 77.00mm (3.0303 ~ 3.0315in)	
Piston to cylinder clearance		0.020 ~ 0.040mm (0.0008 ~ 0.0016in)	
Ring groove width	No. 1 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in)	1.26mm (0.0496in)
	No. 2 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in)	1.26mm (0.0496in)
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in)	2.05mm (0.0807in)
Piston ring			
Side clearance	No. 1 ring	0.03 ~ 0.07mm (0.0012 ~ 0.0028in)	0.1 mm (0.0039in)
	No. 2 ring	0.03 ~ 0.07mm (0.0012 ~ 0.0028in)	0.1 mm (0.0039in)
	Oil ring	0.06 ~ 0.15mm (0.0024 ~ 0.0059in)	0.2 mm (0.0079in)
End gap	No. 1 ring	0.14 ~ 0.28mm (0.0055 ~ 0.0110in)	0.30mm (0.0118in)

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	No. 2 ring	0.30 ~ 0.45mm (0.0118 ~ 0.0177in)	0.50mm (0.0197in)
	Oil ring	0.20 ~ 0.70mm (0.0079 ~ 0.0276in)	0.80mm (0.0315in)
Piston pin			
Piston pin outer diameter		18.001 ~ 18.006mm (0.7087 ~ 0.7089in)	
Piston pin hole inner diameter		18.016 ~ 18.021mm (0.7093 ~ 0.7095in)	
Piston pin hole clearance		0.010 ~ 0.020mm (0.0004 ~ 0.0008in)	
Connecting rod small end hole inner diameter		17.974 ~ 17.985mm (0.7076 ~ 0.7081in)	
Piston pin press-in load		500~1,500 kg (1,102 ~ 3,306 lb)	
Connecting rod			
Connecting rod big end inner diameter		45.000 ~ 45.018mm (1.7717 ~ 1.7724in)	
Connecting rod bearing oil clearance		0.018 ~ 0.036mm (0.0007 ~ 0.0014in)	0.060mm (0.0024in)
Side clearance		0.10 ~ 0.25mm (0.0039 ~ 0.0098in)	0.35m (0.0138in)
Crankshaft			
Main bearing oil clearance	No. 1, 2, 3, 4, 5	0.006 ~ 0.024mm (0.0002 ~ 0.0009in)	0.05mm (0.0020in)
End play		0.05 ~ 0.25mm (0.0020 ~ 0.0098in)	0.3mm (0.0118in)
Engine oil			
Oil quantity	Total	3.7L (3.91US qt, 3.26Imp qt)	When replacing a short engine or a block assembly
	Oil pan	3.0L (3.17US qt, 2.64Imp qt)	
	Drain and refill	3.3L (3.49US qt, 2.90Imp qt)	Including oil filter
Oil quality	Recommendation	5W-20/GF4 & SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number (Refer to SELECTION OF ENGINE OIL).
	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.

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	SAE viscosity grade	Recommended SAE viscosity number	Refer to <u>SELECTION OF ENGINE OIL</u>
Oil pressure (at 1000rpm)		100kPa (1.0kg/cm ² , 14.5psi) or above	Oil temperature in oil pan : 110±2°C (230± 36° F)
Cooling system			
Cooling method		Forced circulation with water pump	
Coolant quantity		6.5L (6.86US qt., 5.71Imp qt.)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82 ± 1.5°C (179.6 ± 2.7° F)	
	Full opening temperature	95°C (203°F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25kgf/cm ² , 13.51 ~ 17.78psi)	
	Vacuum valve opening pressure	MAX. 6.86 kpa (0.07kgf/cm ² , 1.00 psi)	
Water temperature sensor			
Type		Thermistor type	
Resistance	20°C (68°F)	2.45±0.14 kohms	
	80°C (176°F)	0.3222 kohms	

TIGHTENING TORQUES

TIGHTENING TORQUE SPECIFICATIONS

Item	Quantity	N.m	kgf.m	lb-ft
Cylinder block				
Engine support bracket bolts (engine side)	4	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Ladder frame bolts	13	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Connecting rod cap bolt	8	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Crankshaft main bearing cap bolt	10	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Flywheel bolts (M/T)	6	71.6 ~ 75.5	7.3 ~ 7.7	52.8 ~ 55.7
Drive plate bolts (A/T)	6	71.6 ~ 75.5	7.3 ~ 7.7	52.8 ~ 55.7
Timing chain system				
Timing chain and oil	10	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

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pump assembly cover bolt (M6x20)				
Timing chain and oil pump assembly cover bolt (M6x38)	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain and oil pump assembly cover bolt (M8x22)	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Idler pulley assembly bolt	1	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Timing chain tensioner arm bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Crankshaft pulley bolt	1	127.5 ~ 137.3	13.0 ~ 14.0	94.0 ~ 101.3
Timing chain tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head				
Engine cover bolt	4	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Cylinder head cover bolt	16	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap bolt (M6)	16	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Camshaft bearing cap bolt (M8)	4	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cylinder head bolt	10	(17.7~21.6) + (90~95°) + (100~105°)	(1.8~2.2) + (90~95°) + (100~105°)	(13.0~15.9) + (90~95°) + (100~105°)
Cooling system				
Water pump pulley bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	5	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water temperature control assembly mounting bolts	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water inlet fitting	nut	2 18.6 ~	23.5 1.9~ 2.4	13.7 ~ 17.4
Heater pipe mounting bolts/Nuts (M6)	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Heater pipe mounting bolt (M8)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Engine coolant temperature sensor	1	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9

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(ECTS)				
Lubrication system				
Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pan bolt	11	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolt	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pressure switch	1	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil level gauge assembly mounting bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intake and exhaust system				
Intake manifold and cylinder head mounting nut	5	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold and cylinder head mounting nut	9	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Oxygen sensor mounting	2	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold heat cover	6	16.7 ~ 21.6	1.7 ~ 2.2	12.3 ~ 15.9
Exhaust manifold and cylinder block, ladder frame mounting bolts	4	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Air cleaner lower cover mounting	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Exhaust manifold and catalytic convertor mounting nut	2	43.1 ~ 45.1	4.4 ~ 4.6	31.8 ~ 33.3
Center muffler and main muffler mounting nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Exhaust manifold stay mounting bolts	3	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

REPAIR PROCEDURES

COMPRESSION PRESSURE INSPECTION

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

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position.
2. Remove the engine center cover.
3. Remove the ignition coils (A).

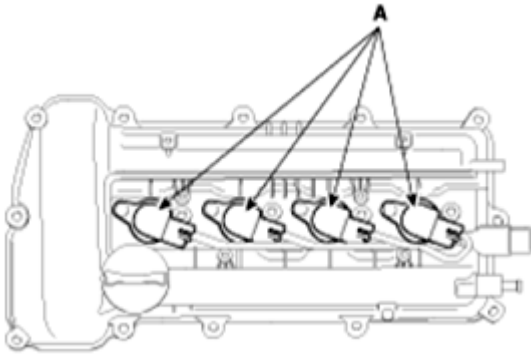


Fig. 1: Identifying Ignition Coils

Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the spark plugs.

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

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

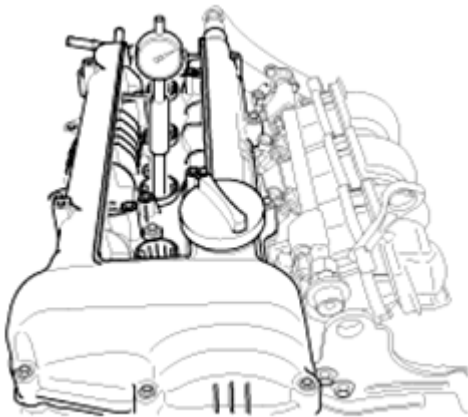


Fig. 2: Checking Cylinder Compression Pressure

Courtesy of KIA MOTORS AMERICA, INC.

2. Set the throttle plate in the wide-open position.
3. While cranking the engine, measure the compression pressure.

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

4. Repeat steps 1 through 3 for each cylinder.

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

Compression pressure

Standard: 1225.83kPa (12.5kg/cm² , 177.79psi) (200~250 RPM)

Minimum: 1078.73kPa (11.0kg/cm² , 156.46psi)

Difference between each cylinder:

98kPa (1.0kg/cm² , 14psi) or less

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

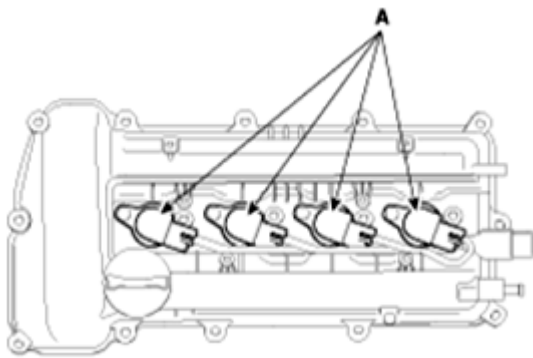


Fig. 3: Identifying Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

8. Install the engine center cover.

Tightening torque:

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

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 center cover.
2. Remove the cylinder head cover.
 1. Disconnect the ignition coils (A).

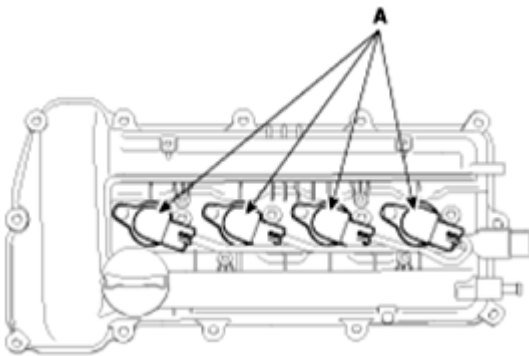


Fig. 4: Identifying Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect the PCV hose (A).

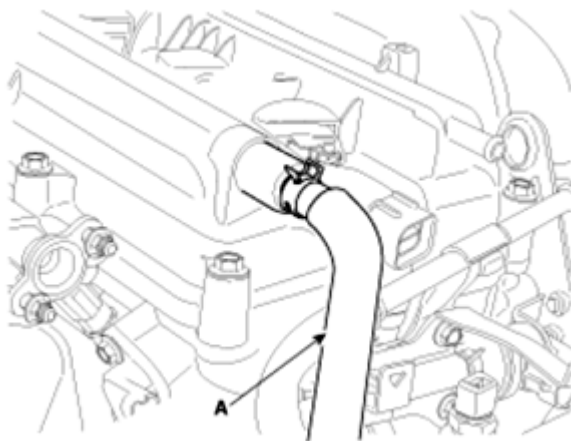


Fig. 5: Identifying PCV Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

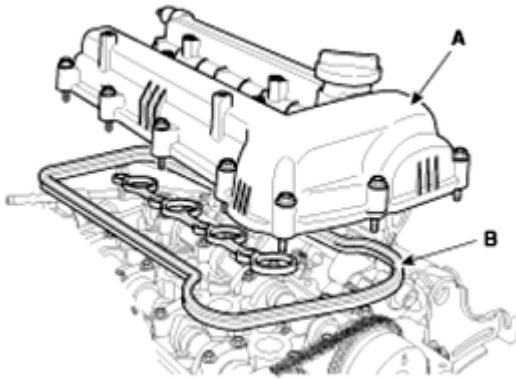


Fig. 6: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not reuse the disassembled gasket.

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

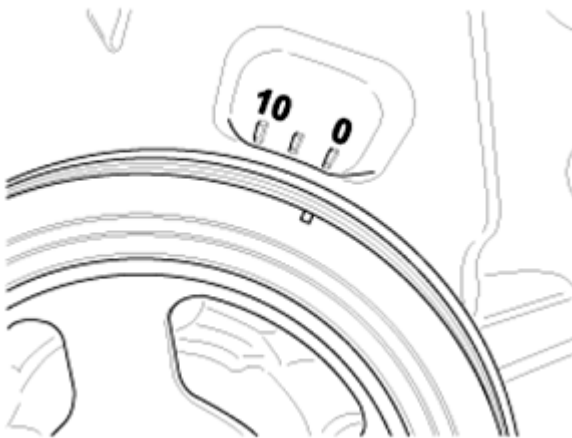


Fig. 7: Aligning Crankshaft Pulley Groove With Timing Mark Of Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the marks of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in **Fig. 8**. If not, turn the crankshaft one revolution (360°).

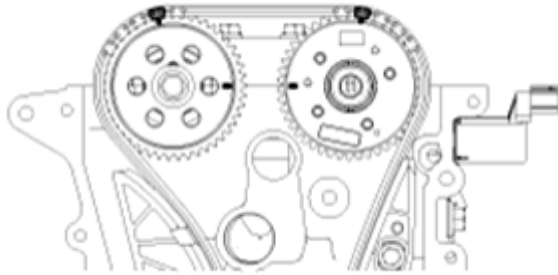


Fig. 8: Checking That Marks Of Camshaft Timing Sprockets Are In Straight Line On Cylinder Head Surface

Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect the valve clearance.

1. Check only the intake valves of the 1st and 2nd cylinders and exhaust valves of the 1st and 3rd cylinders for their clearance.
 - A. Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.

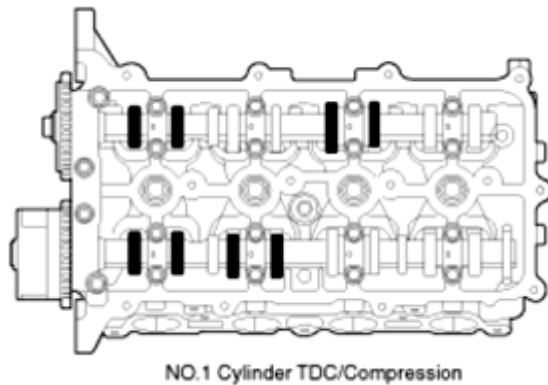


Fig. 9: Inspecting Valve Clearance

Courtesy of KIA MOTORS AMERICA, INC.

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

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

Limit

Intake: 0.17 ~ 0.23mm (0.0067 ~ 0.0091in.)

Exhaust: 0.22 ~ 0.28mm (0.0087 ~ 0.0110in.)

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

3. Check the clearance of the intake valves of the 3rd and 4th cylinders, and check the clearance of the exhaust valves of the 2nd and 4th cylinders.

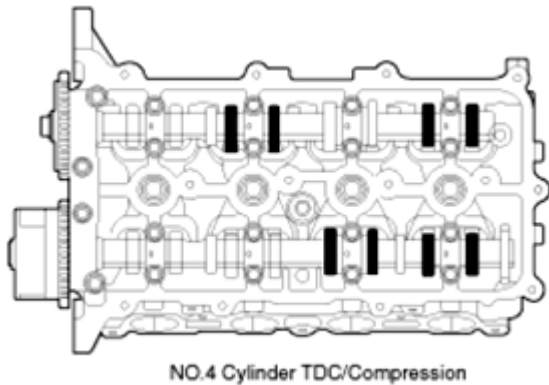


Fig. 10: Checking Clearance Of Intake Valves Of 3rd & 4th Cylinders & Exhaust Valves 2nd & 4th Cylinders

Courtesy of KIA MOTORS AMERICA, INC.

5. Adjust the intake and exhaust valve clearance.
 1. Set the No. 1 cylinder to the TDC/compression position.
 2. Put paint marks on the timing chain links (2 places) that meet with the timing marks of the intake, exhaust camshaft sprockets.
 3. Remove the exhaust camshaft sprocket bolt.
 4. Remove the service hole bolt of the timing chain cover.

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

5. Insert a thin rod in the service hole of the timing chain cover and release the ratchet.
6. Remove the exhaust camshaft sprocket.
7. Remove the camshaft bearing caps (A) with the order below.

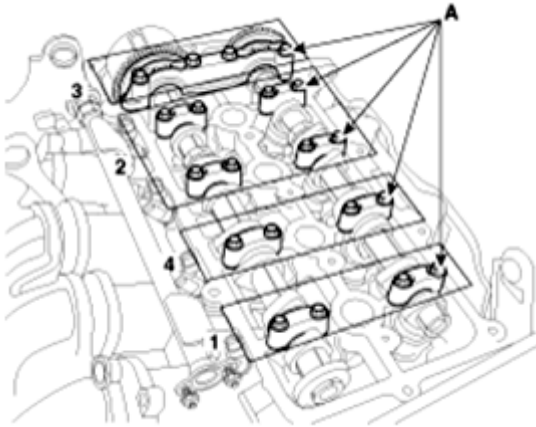


Fig. 11: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the exhaust camshaft.
9. Remove the intake camshaft and CVVT module.

CAUTION: When disconnecting the timing chain from the camshaft timing sprocket, hold the timing chain.

10. Tie a timing chain with a string.

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

11. Measure the thickness of the removed tappet using a micrometer.

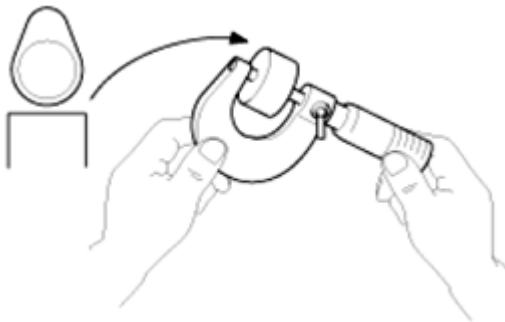


Fig. 12: Measuring Thickness Of Removed Tappet Using Micrometer
Courtesy of KIA MOTORS AMERICA, INC.

12. 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: $N = T + [A - 0.25\text{mm} (0.0098\text{in.})]$

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

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

14. Place a new tappet on the cylinder head.
15. Hold the timing chain, and place the intake camshaft and CVVT module assembly.
16. Align the matchmarks on the timing chain and camshaft timing sprocket.
17. Install the exhaust camshaft.
18. Install the exhaust camshaft sprocket.

Tightening torque:

63.7 ~ 73.5N.m (6.5 ~ 7.5kgf.m, 47.0 ~ 54.2lb-ft)

19. Install the camshaft bearing caps in the order shown in **Fig. 13**.

Tightening torque:

M6 bolts:

11.8 ~ 13.7N.m (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft)

M8 bolts:

18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)

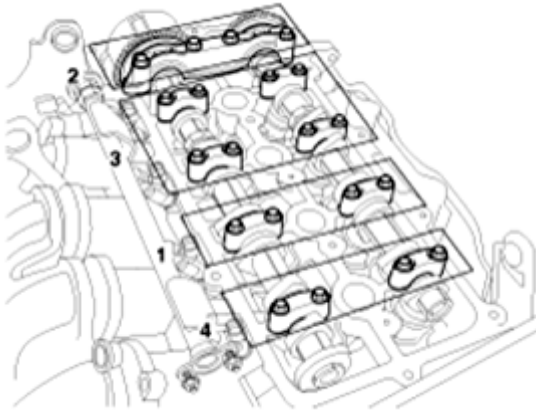


Fig. 13: Identifying Installation Sequence Of Camshaft Bearing Caps
 Courtesy of KIA MOTORS AMERICA, INC.

20. Install the service hole bolt.

Tightening torque:

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

21. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks.
22. Recheck the valve clearance.

Valve clearance (Engine coolant temperature: 20°C)

[Specification]

Intake: 0.17 ~ 0.23mm (0.0067 ~ 0.0091in.)

Exhaust: 0.22 ~ 0.28mm (0.0087 ~ 0.0110in.)

TROUBLESHOOTING

TROUBLESHOOTING

TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed 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.

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Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and MLA.
Engine misfire with coolant consumption.	- Faulty cylinder head gasket and/or cracking 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, valve guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	Inspect the cylinder for a loss of compression. Repair or replace as required.
Engine noise on startup, but only lasting a few seconds.	Incorrect oil viscosity.	Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes. Replace the camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.)	Inspect the valves and valve guides, then repair as required.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil	Inspect the oil pan.

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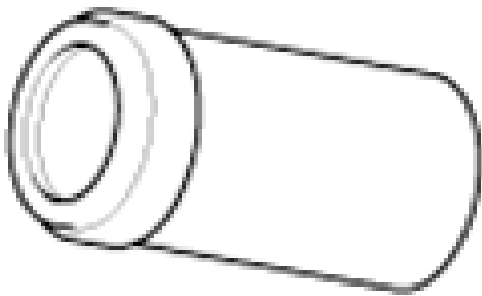
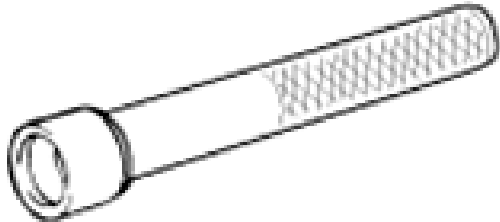
	pump screen.	Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore. Repair as required.
	Excessive piston pin-to-bore 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. • The crankshaft journal.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals.
	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 journals. • The cylinder block crankshaft bearing bore.
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder.	Remove spark plugs and check for fluid.

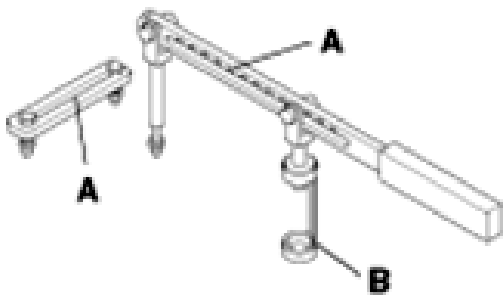
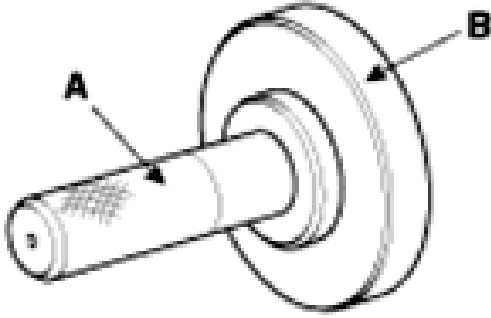
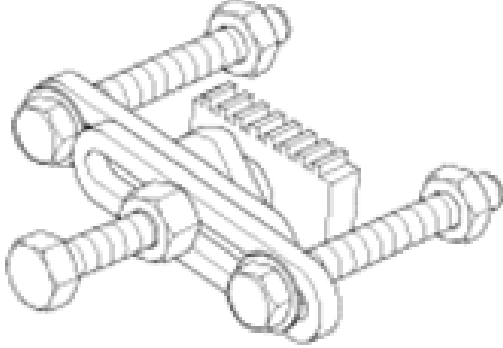
• Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
Foreign material in cylinder. • Broken valve. • Piston material. • Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.
Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
Broken crankshaft.	Inspect crankshaft. Repair or replace as required.

SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS CHART

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09455-21200)		Installation of the front oil seal
Valve stem oil seal installer (09222-2B100)		Installation of the valve stem oil seal
Valve spring compressor and		Removal and installation of

holder A : (09222-3K000) B : (09222-3K100)		the intake or exhaust valve
Crankshaft rear oil seal installer A : (09231-H1100) B : (09231-2B200)		Installation of the crankshaft rear oil seal
Ring gear stopper (09231-2B100)		Installation of crankshaft pulley bolt
Engine coolant temperature sensor socket wrench (09221-25100)		Removal and installation of engine coolant sensor
Oil pan remover (09215-3C000)		Removal of oil pan

2010 Kia Soul

2010 ENGINE General Information (Engine Mechanical System) - 1.6L - Soul



Torque angle adapter
(09221-4A000)



Installation of bolts & nuts
needing an angular method

2010 ENGINE

Cylinder Head Assembly (Engine Mechanical System) - 1.6L - Soul

CYLINDER HEAD

COMPONENTS AND COMPONENT LOCATIONS

Components

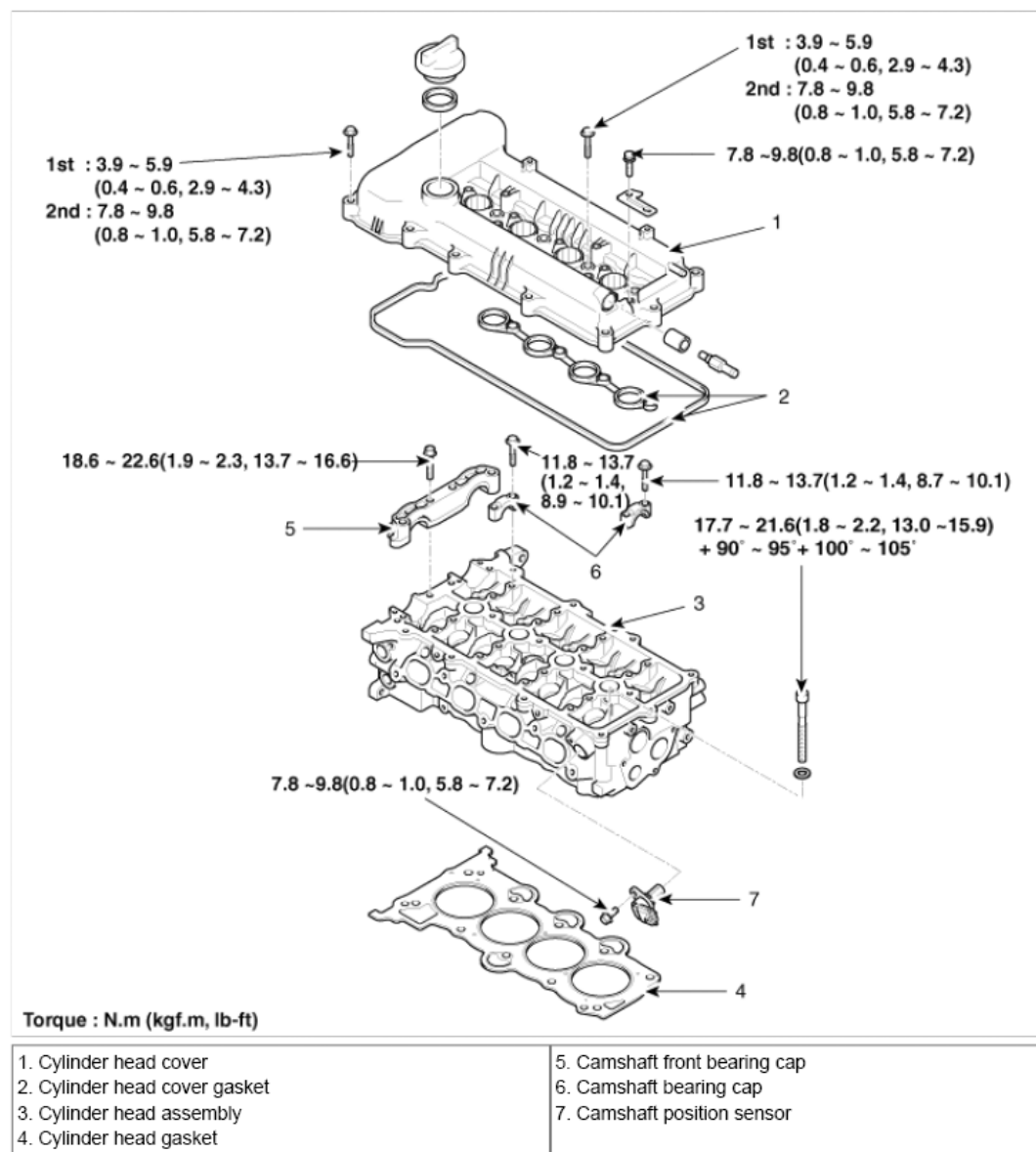
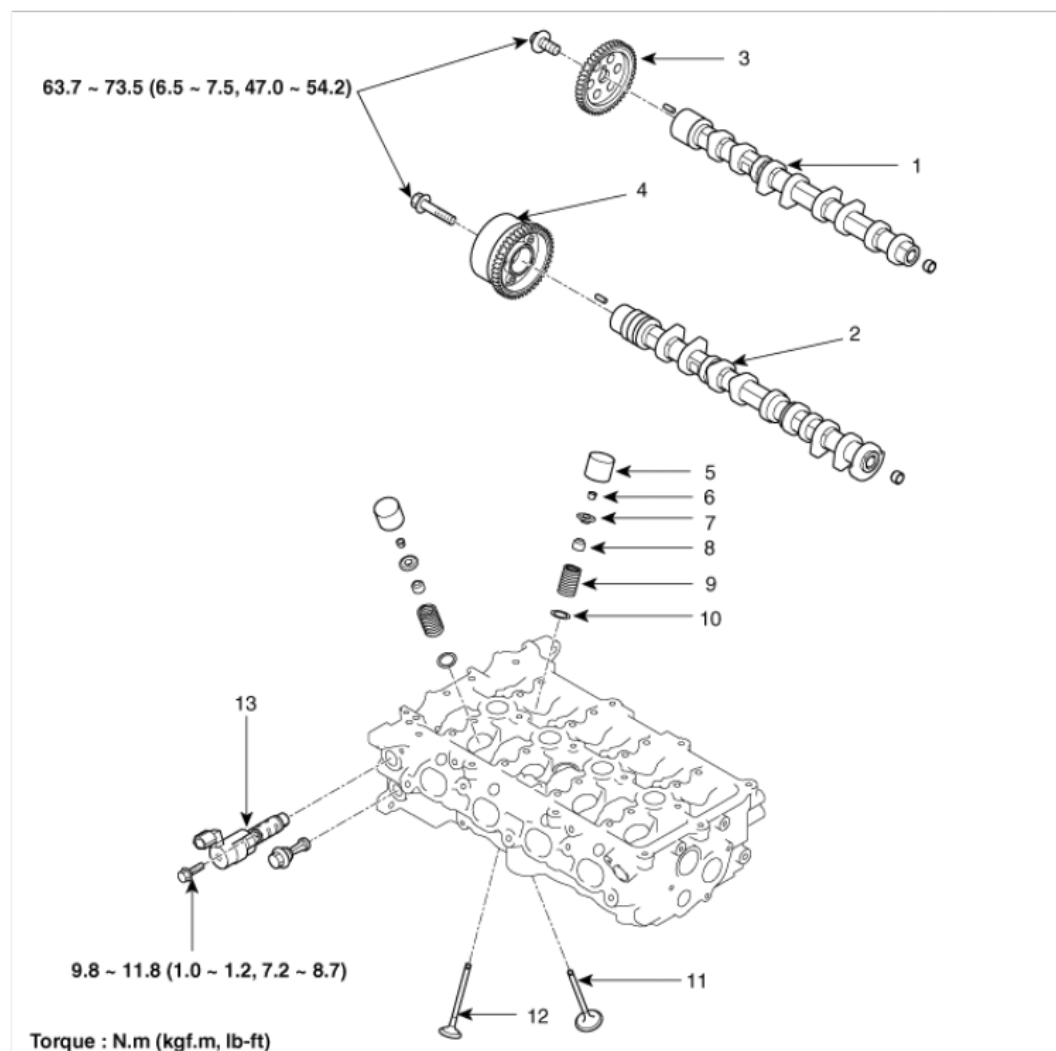


Fig. 1: Identifying Cylinder Head Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



- | | |
|-----------------------------------|-----------------------------|
| 1. Exhaust camshaft | 8. Valve stem seal |
| 2. Intake camshaft | 9. Valve spring |
| 3. Exhaust camshaft sprocket | 10. Valve spring seat |
| 4. CVVT assembly | 11. Intake valve |
| 5. Mechanical Lash Adjuster (MLA) | 12. Exhaust valve |
| 6. Retainer lock | 13. Oil Control Valve (OCV) |
| 7. Retainer | |

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

REPAIR PROCEDURES

Removal

Engine removal is not required for this procedure.

CAUTION:

- Use Fender cover to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant

temperature drops below normal temperature before removing it.

- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

1. Remove the timing chain.

(Refer to **TIMING SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)

2. Remove the camshaft bearing caps (A) with the order below.

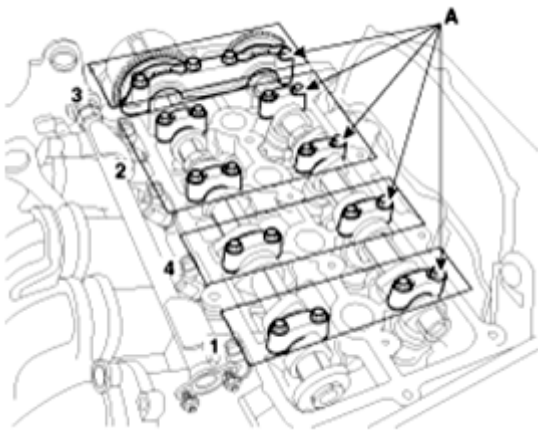


Fig. 3: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the injector connectors (A) and the harness bracket (B).

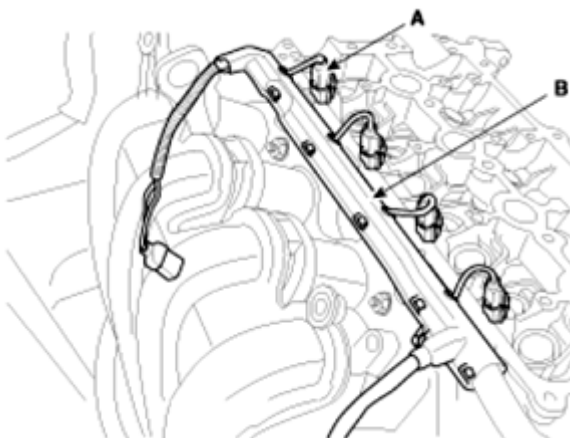


Fig. 4: Identifying Injector Connectors & Harness Bracket
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the delivery pipe (A).

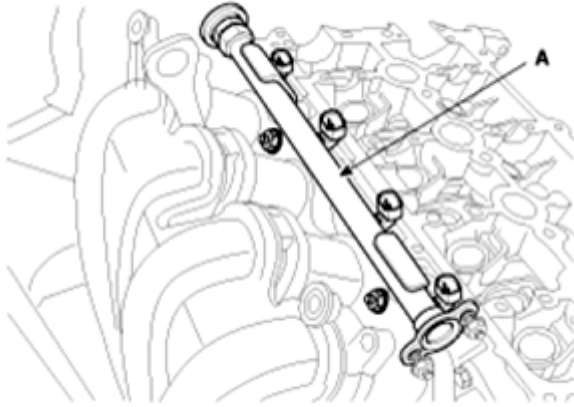


Fig. 5: Identifying Delivery Pipe
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the exhaust manifold assembly. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)
6. Remove the intake manifold module assembly. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)
7. Disconnect the camshaft position sensor (CMP) connector (A) and remove the purge control solenoid valve (PCSV) bracket (B) and the module hanger bracket (C).

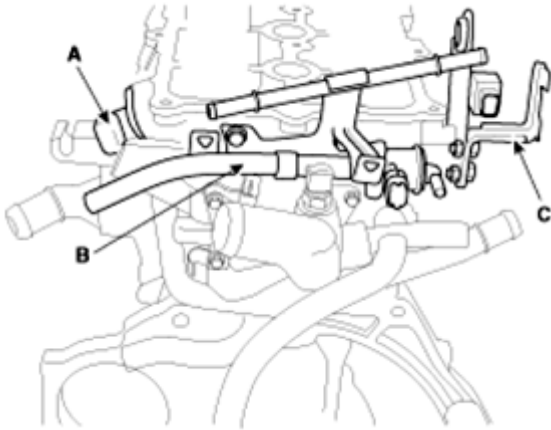


Fig. 6: Identifying CMP Sensor Connector, PCSV Bracket, & Module Hanger Bracket
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the water temperature control assembly and the oil control valve (OCV).
9. Remove the cylinder head bolts, then remove the cylinder head.
 1. Uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown

in **Fig. 7**.

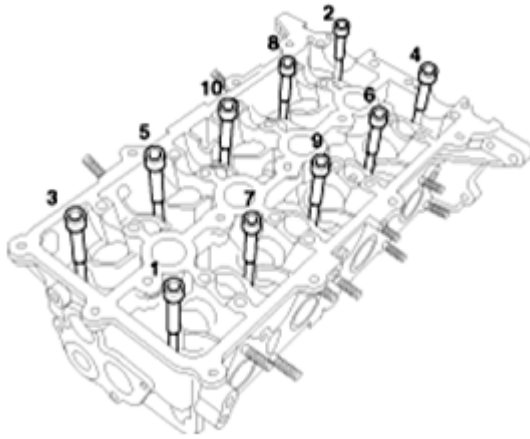


Fig. 7: Identifying Removal Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Lift the cylinder head from the cylinder block and put the cylinder head on wooden blocks.

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

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 the MLAs

CAUTION: When removing MLAs, mark all the MLAs for their rearrangement.

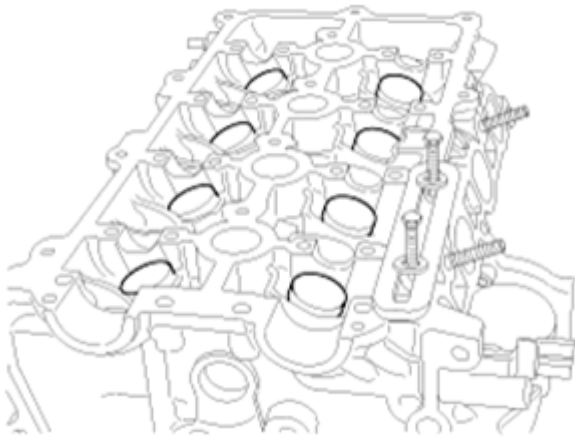


Fig. 8: Removing Mechanical Lash Adjusters
Courtesy of KIA MOTORS AMERICA, INC.

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

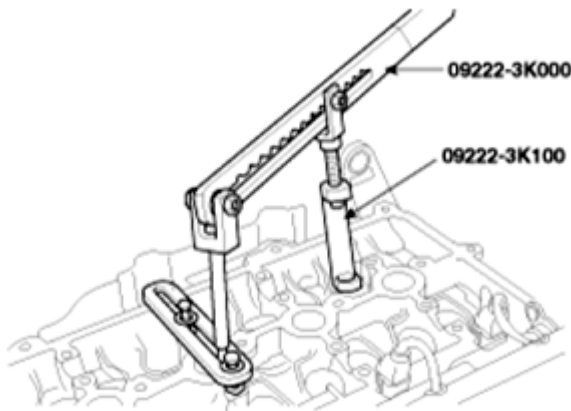


Fig. 9: Compressing Valve Spring & Removing Retainer Lock Using SST
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Remove the valve stem seal.
6. Using a magnetic finger, remove the spring seat.

CAUTION: Do not reuse the valve stem seals.

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05mm (0.0020in)

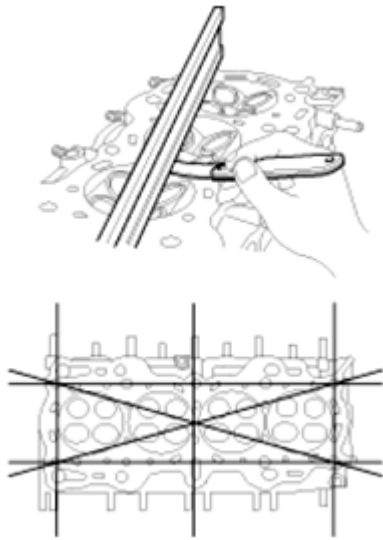


Fig. 10: Checking Flatness Of Contacting Surfaces Of Cylinder Block & Manifolds
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

Valve And Valve Spring

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

Valve guide inner diameter:

5.500 ~ 5.512mm (0.2165 ~ 0.2170in)

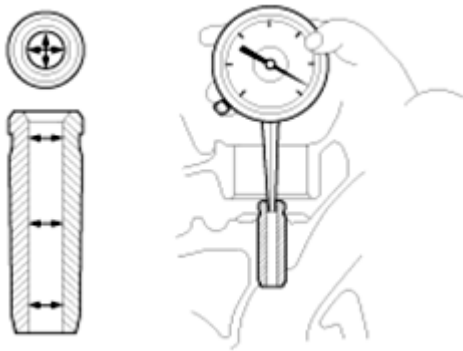


Fig. 11: Measuring Inner Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem outer diameter

Intake : 5.465 ~ 5.480mm (0.2152 ~ 0.2157in)

Exhaust : 5.458 ~ 5.470mm (0.2149 ~ 0.2154in)

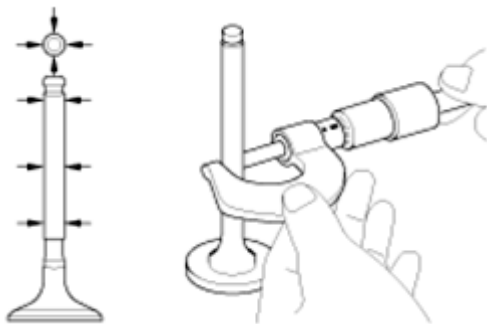


Fig. 12: Measuring Outer Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

3. Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

Valve stem-to-guide clearance

Intake : 0.020 ~ 0.047mm (0.0008 ~ 0.0019in)

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

If the clearance is greater than specification, replace the valve or the cylinder head.

2. Inspect the valves.

1. Check the valve is ground to the correct valve face angle.
2. Check that the surface of 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 : 1.1mm (0.0433in)

Exhaust : 1.26mm (0.0496in)

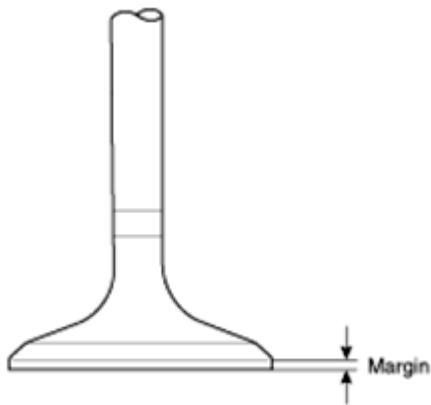


Fig. 13: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the length of valve.

Valve length

Standard

Intake : 93.15mm (3.6673 in)

Exhaust : 92.60mm (3.6457 in)

5. Check the surface of valve stem tip for wear.

If the valve stem tip is worn, replace the valve.

3. Inspect the valve seats.
 1. Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace the cylinder head.
 2. Check the valve guide for wear. If the valve guide is worn, replace the cylinder head.
4. Inspect the valve springs.
 1. Using a steel square, measure the out-of-square of valve spring.
 2. Using a vernier calipers, measure the free length of valve spring.

Valve spring**Standard**

Free height : 44mm (1.7323in)

Out of square : Less than 1.5°

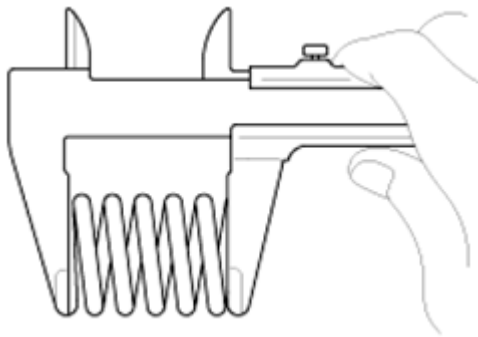


Fig. 14: Measuring Free Length & Out-Of-Square Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

Camshaft

1. Inspect the cam height.

Using a micrometer, measure the cam height.

Cam height

Intake : 43.85mm (1.7264in)

Exhaust : 42.85mm (1.6870in)

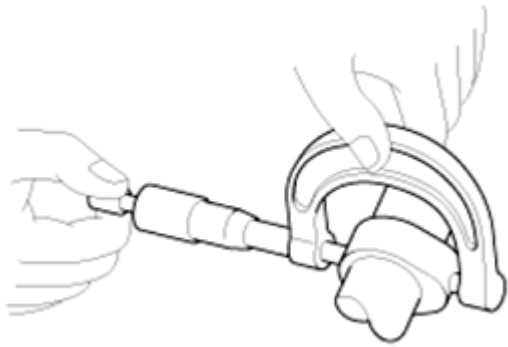


Fig. 15: Measuring Cam Height Using Micrometer
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Inspect the 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.

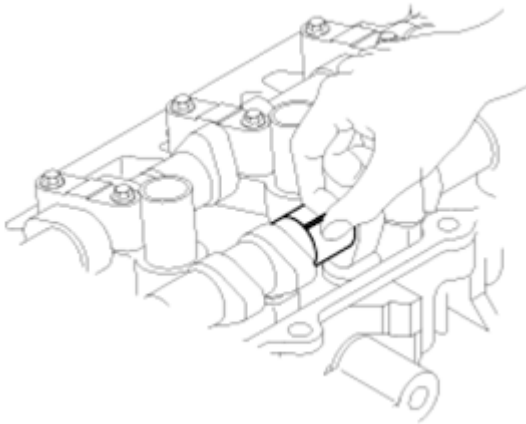


Fig. 16: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps and tighten the bolts with specified torque.

Tightening torque:

M6 bolts:

11.8 ~ 13.7Nm (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft)

M8 bolts:

18.6 ~ 22.6Nm (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6lb-ft)

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

Standard : 0.027 ~ 0.058mm (0.0011 ~ 0.0023in)

Limit : 0.1mm (0.0039in)

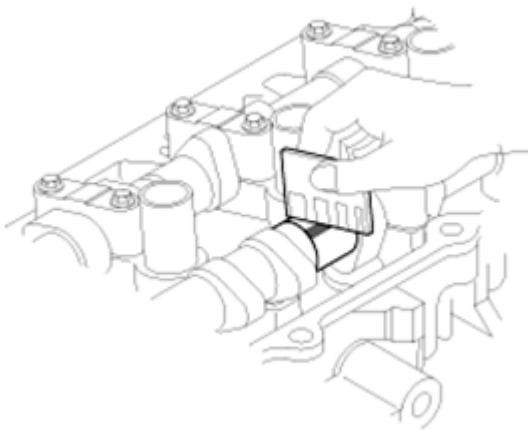


Fig. 17: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

If the oil clearance is greater than specified, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3. Inspect the 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 : 0.1 ~ 0.2mm (0.0039 ~ 0.0079in)

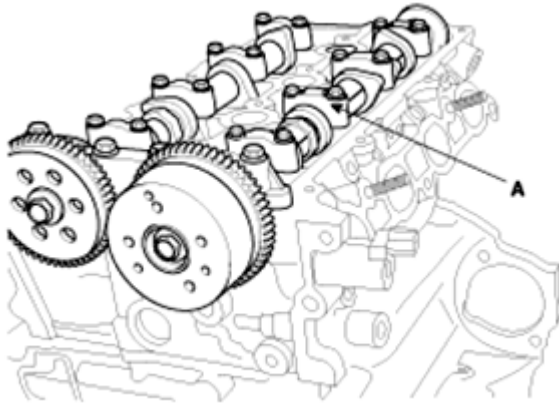


Fig. 18: Inspecting Camshaft End Play
 Courtesy of KIA MOTORS AMERICA, INC.

If the end play is greater than specified, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3. Remove the camshafts.

Continuous Variable Valve Timing (CVVT) Assembly

1. Inspect the Continuous variable valve timing (CVVT) assembly.
 1. Fix the Continuous variable valve timing (CVVT) with its camshaft in a vice.
 2. Check that the CVVT assembly will not turn. If it is not turned, it is in normal condition.
 3. Apply vinyl tape to all the parts except the one hole.
 4. Using an air gun, apply the pressure, 147.10kpa (1.5kg/cm² , 21.33psi) in the hole. This makes the lock pin in maximum retarded state released.

NOTE:

- **Wrap around it with a shop rag and the likes, because the oil splashes.**
 - **After releasing the pin, you can turn the CVVT assembly for advance by hand.**
 - **If there may be much air leakage, the pin can not be released.**
5. Under the condition of 3), turn the CVVT assembly to the advance angle side with your hand.
 - A. Depending on the air pressure, the CVVT assembly will turn to the advance side.
 - B. 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.
 6. Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no disturbance.

Standard: Movable smoothly in the range about 25°

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

Reassembly

NOTE:

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

1. Install the valves.

1. Install the spring seats.
2. Using the SST (09222 - 2B100), push in a new oil seal.

NOTE:

Do not reuse old valve stem oil seals.
Incorrect installation of the seal could result in oil leakage past the valve guides.

CAUTION: Intake valve stem seals are different from exhaust ones in type.
Do not reassembly ones in the other's places.

3. Install the valve, valve spring and spring retainer, after applying engine oil at the end of each valve.

NOTE:

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

2. 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.

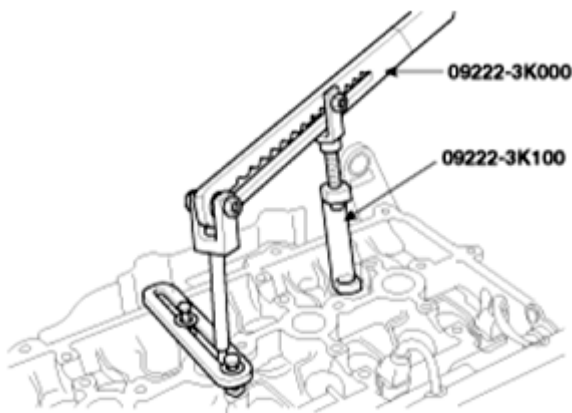


Fig. 19: Compressing Valve Spring & Installing Retainer Locks Using SST

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: When installing the SST, use torque of 1.2kgf.m or less.

3. 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.

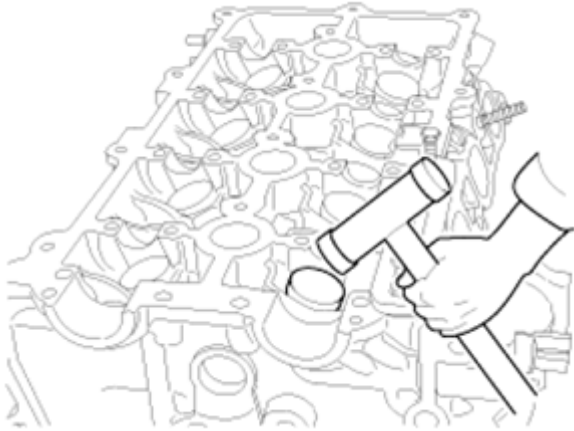


Fig. 20: Tapping Valve Stem

Courtesy of KIA MOTORS AMERICA, INC.

4. Install the MLAs (Mechanical lash adjusters).

Check that the MLA rotates smoothly by hand.

NOTE: All the MLAs should be installed in its original position.

Installation

NOTE:

- Thoroughly clean all parts to be assembled.
- Always use a new cylinder head and manifold gasket.
- Always use a new cylinder head bolt.
- 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 assembly.
 1. Before installing, remove the hardened sealant from the cylinder block and cylinder head surface.
 2. Before installing the cylinder head gasket, apply sealant on the upper surface of the cylinder block and reassemble the gasket within five minutes.

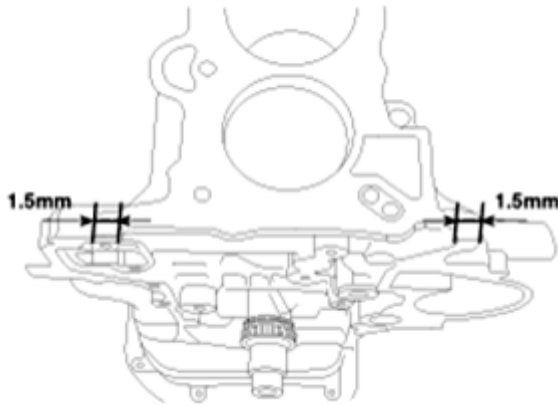


Fig. 21: Installing Cylinder Head Assembly
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to **Fig. 22** for applying sealant.

Width: 2.0 ~ 3.0mm (0.0787~0.1181in.)

Position: 1.0 ~ 1.5mm (0.0394~0.0591in.)

Specification: TB 1217H or LOCTITE 5900H

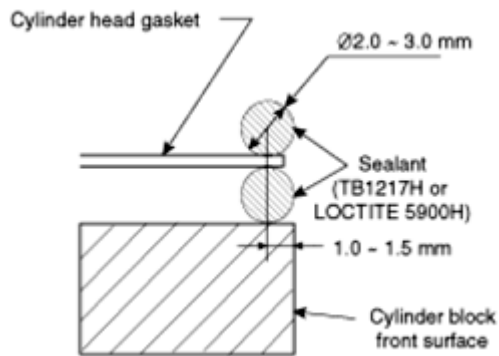


Fig. 22: Identifying Sealant Application Area On Cylinder Block Surface
Courtesy of KIA MOTORS AMERICA, INC.

3. After installing the cylinder head gasket on the cylinder block, apply sealant on the upper surface of the cylinder head gasket and reassemble in five minutes.
2. Place the cylinder head carefully not to damage the gasket.
3. Install the cylinder head bolts with washers.
 1. Tighten the 10 cylinder head bolts, in several passes, in the sequence shown in **Fig. 23**.

Tightening torque:

1st step - 17.7~21.6 N.m (1.8 ~ 2.2 kgf.m, 13.0~15.9 lb-ft)

2nd step - 90°~95°

3rd step - 100°~105°



Fig. 23: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Always use new cylinder head bolts.

4. Install the oil control valve (OCV) (A).

Tightening torque:

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

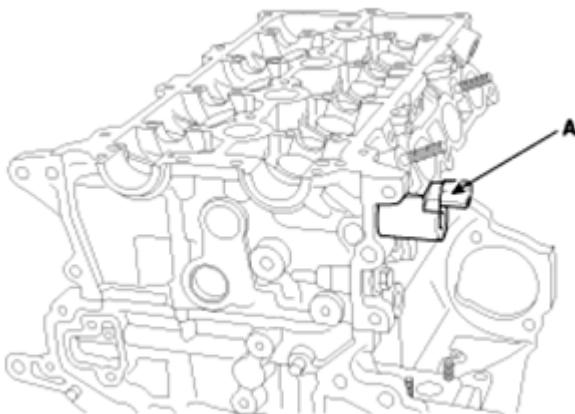


Fig. 24: Identifying Oil Control Valve
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the water temperature control assembly (A).

Tightening torque:

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

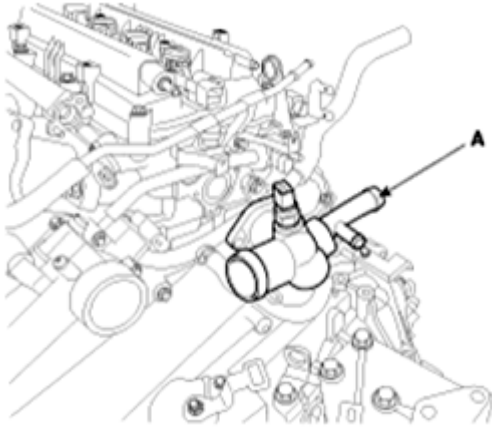


Fig. 25: Identifying Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the camshaft position sensor (CMP) connector (A) and install the purge control solenoid valve (PCSV) bracket (B) and the module hanger bracket (C).

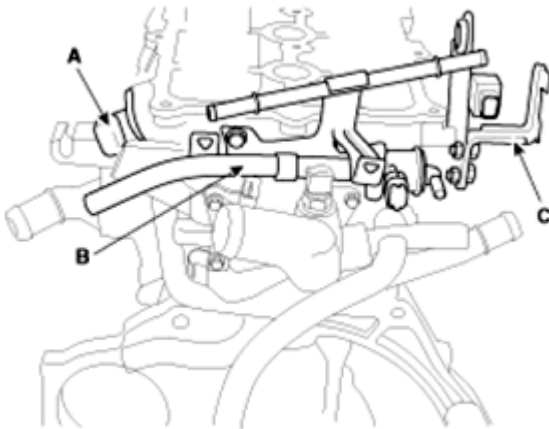


Fig. 26: Identifying CMP Sensor Connector, PCSV Bracket, & Module Hanger Bracket
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the intake manifold module assembly. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)
8. Install the exhaust manifold assembly. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)
9. Install the delivery pipe assembly (A).

Tightening torque:

19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.4 ~ 18.0lb-ft)

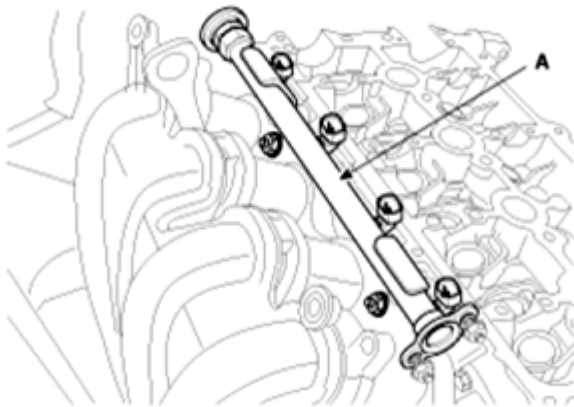


Fig. 27: Identifying Delivery Pipe Assembly
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the injector connector (A) and harness bracket (B).

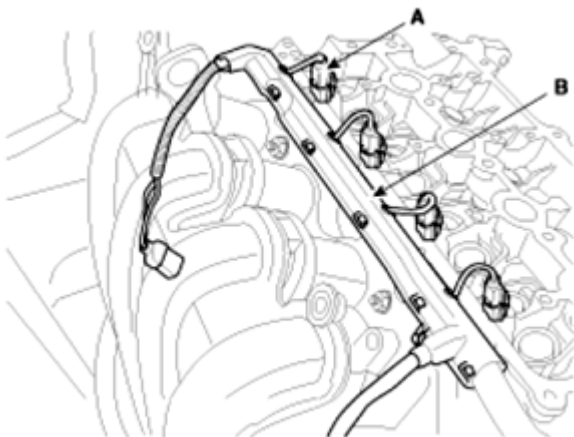


Fig. 28: Identifying Injector Connector & Harness Bracket
Courtesy of KIA MOTORS AMERICA, INC.

11. Install the camshafts.
 1. Before installing, apply engine oil on journals.

CAUTION: Do not make oil flow down to the front side of the cylinder head.

2. After installing, check the valve clearance.
12. Install the camshaft bearing caps with the order shown in **Fig. 29**.

Tightening torque:

M6 bolts - 11.8 ~ 13.7N.m (1.2 ~ 1.4kgf.m, 8.7 ~ 10.1lb-ft)

M8 bolts - 18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)

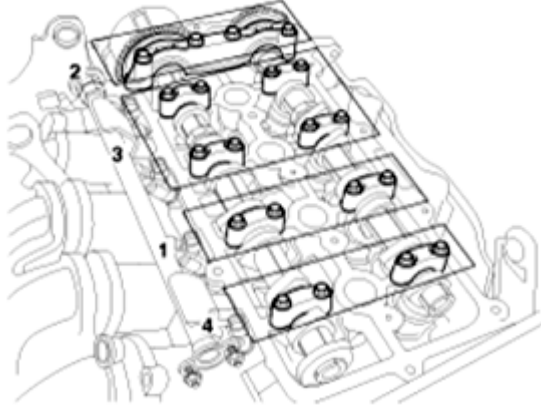


Fig. 29: Identifying Installation Sequence Of Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

13. Install the intake and exhaust manifold.

(Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)

14. Install the timing chain.

(Refer to **TIMING SYSTEM (ENGINE MECHANICAL SYSTEM) - 1.6L**)

2010 ENGINE

Cylinder Block - 1.6L - Soul

CYLINDER BLOCK

COMPONENTS AND COMPONENT LOCATIONS

Components

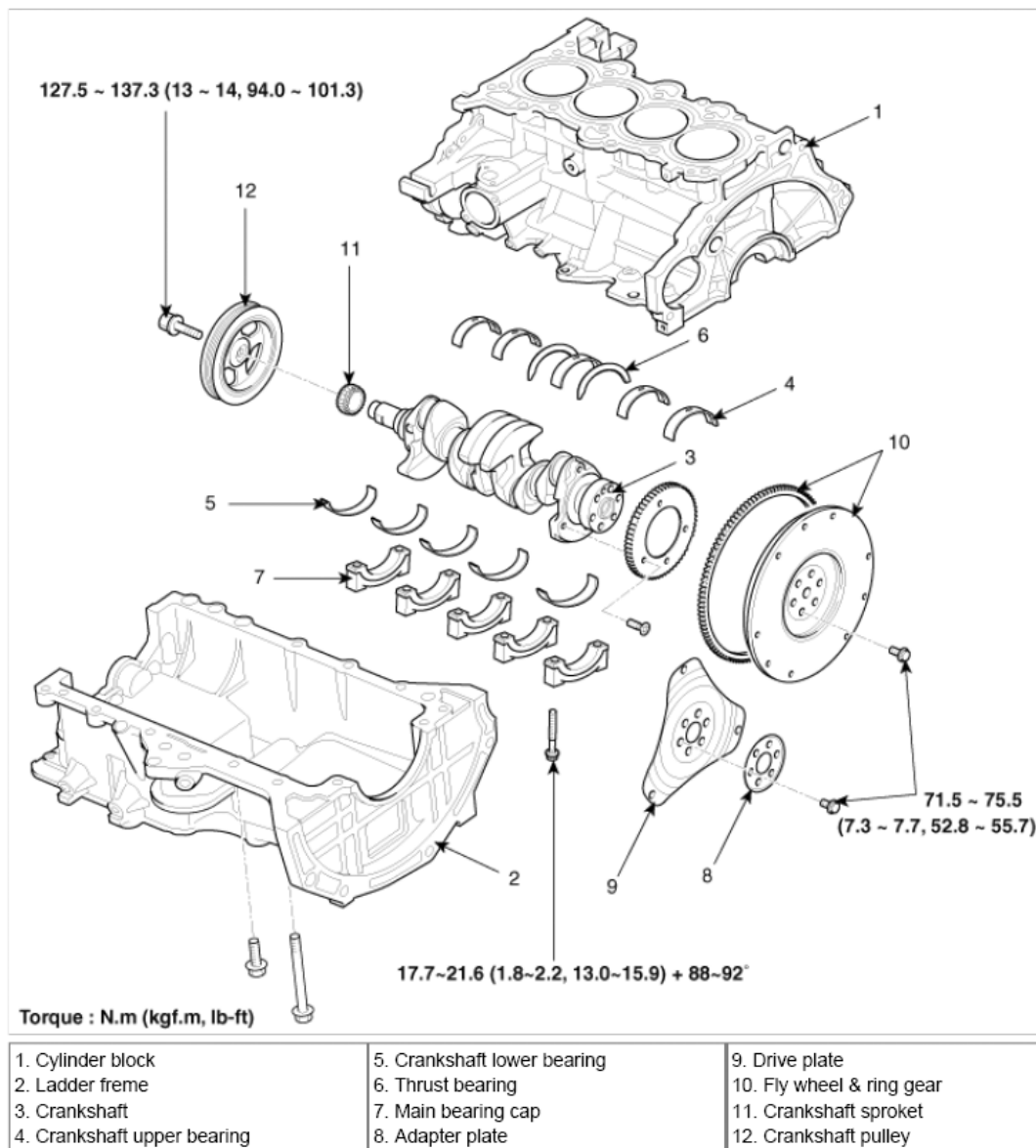


Fig. 1: Identifying Cylinder Block Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

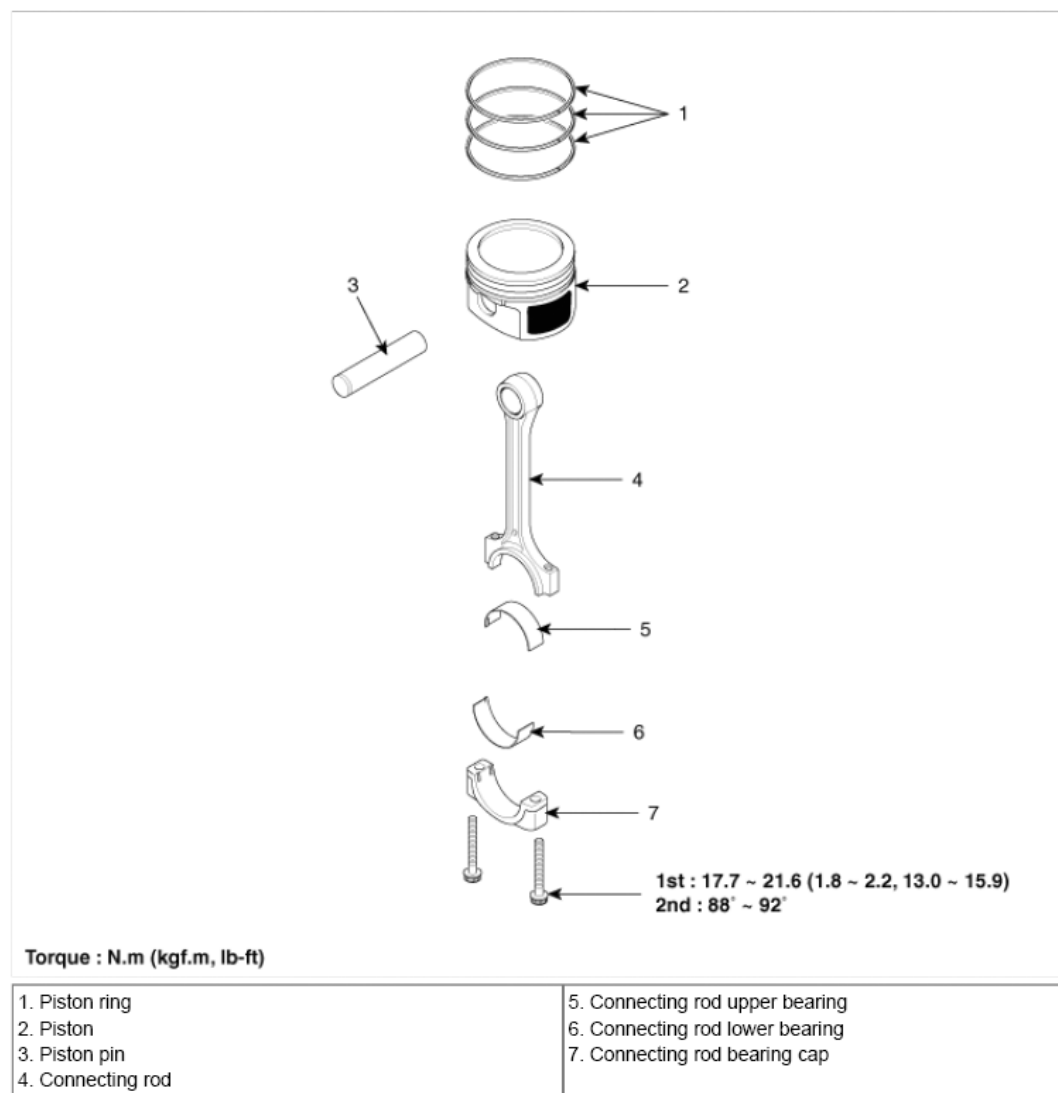


Fig. 2: Identifying Cylinder Block Components With Torque Specifications (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

Disassembly

Engine removal is required for this procedure. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY - 1.6L**)

1. M/T: Remove the fly wheel.
2. A/T: Remove the drive plate.
3. Install the engine to engine stand for disassembly.
4. Remove the timing chain. (Refer to **TIMING SYSTEM - 1.6L**))
5. Remove the cylinder head. (Refer to **CYLINDER HEAD ASSEMBLY - 1.6L**)
6. Remove the oil level gauge tube.

7. Remove the knock sensor (A) and the oil filter (B).

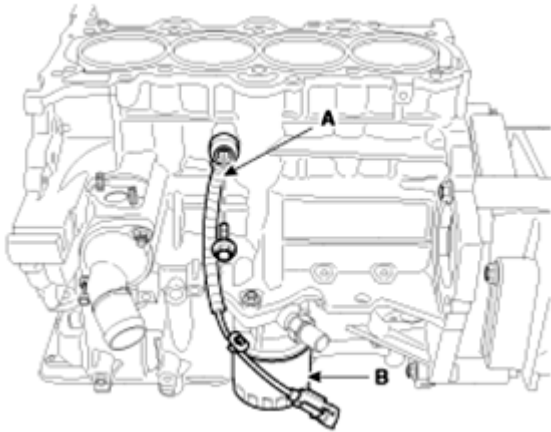


Fig. 3: Identifying Knock Sensor & Oil Filter
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the oil pressure switch (A).

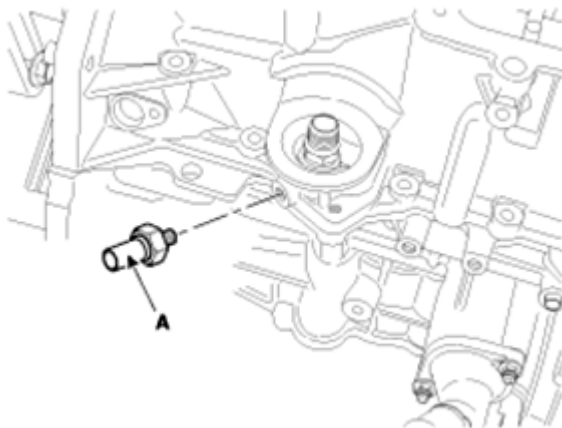


Fig. 4: Identifying Oil Pressure Switch
Courtesy of KIA MOTORS AMERICA, INC.

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

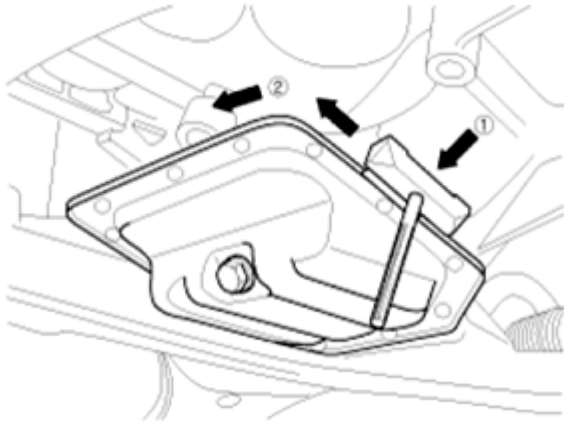


Fig. 5: Removing Oil Pan Using SST
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of arrow as shown in Fig. 5.
- After tapping the SST with a plastic hammer along the direction of arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It may result in damage to the SST.

10. Remove the oil screen (A).

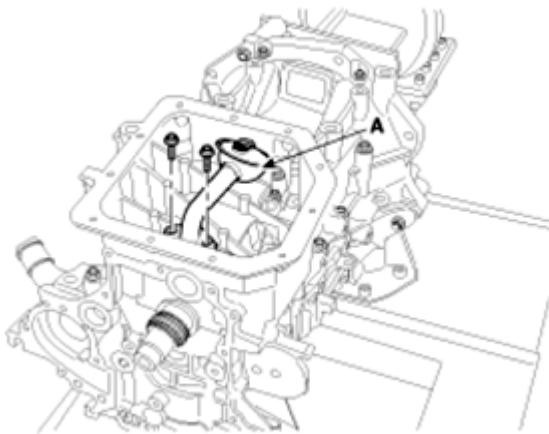
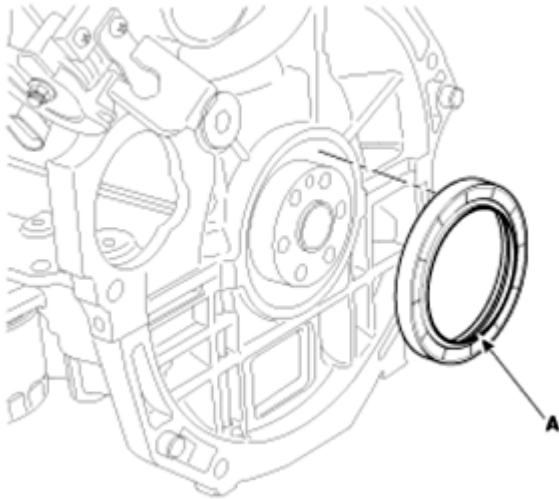


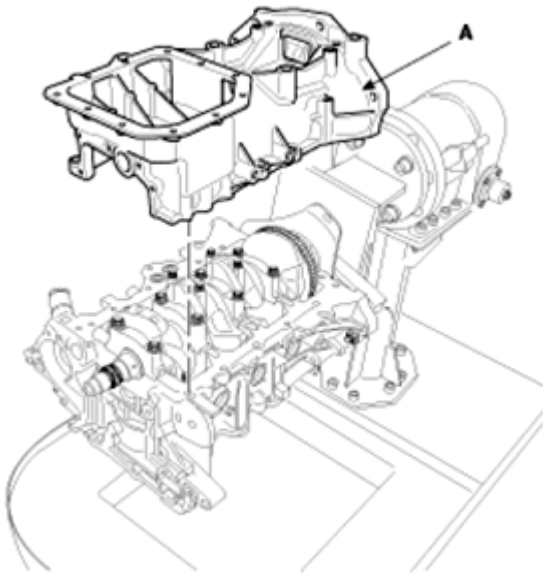
Fig. 6: Identifying Oil Screen
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the rear oil seal (A).

**Fig. 7: Identifying Rear Oil Seal**

Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the ladder frame (A).

**Fig. 8: Identifying Ladder Frame**

Courtesy of KIA MOTORS AMERICA, INC.

13. Check the connecting rod end play.
14. Remove the connecting rod caps and check oil clearance.
15. Remove the 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.

16. Remove the crankshaft bearing cap and check oil clearance.
17. Check the crankshaft end play.
18. 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.

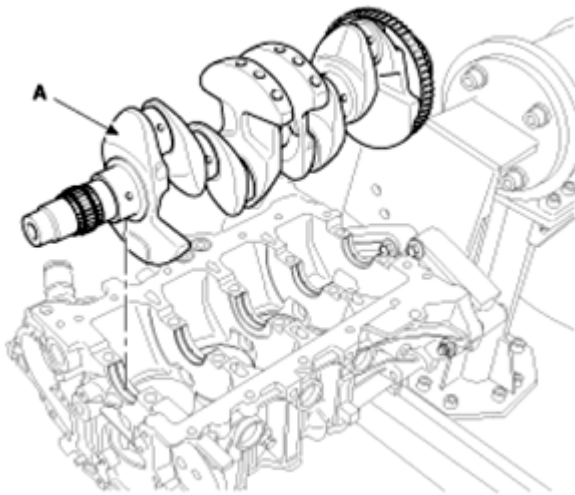


Fig. 9: Identifying Crankshaft

Courtesy of KIA MOTORS AMERICA, INC.

19. 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.
20. Remove the piston rings.
 1. Using a piston ring expander, remove the 2 compression rings.
 2. Remove the 2 side rails and oil ring by hand.

NOTE:

Arrange the piston rings in the correct order only.

21. Remove the connecting rod from the piston.

Using a press, remove the piston pin from piston.

(Press-in load: 500 ~ 1,500kg (1,102 ~ 3,306lb))

Inspection**Connecting Rod And Crankshaft**

1. Check the connecting rod end play.

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

End play

Standard: 0.1 ~ 0.25mm (0.0039 ~ 0.0098in)

Maximum: 0.35mm (0.0138in)

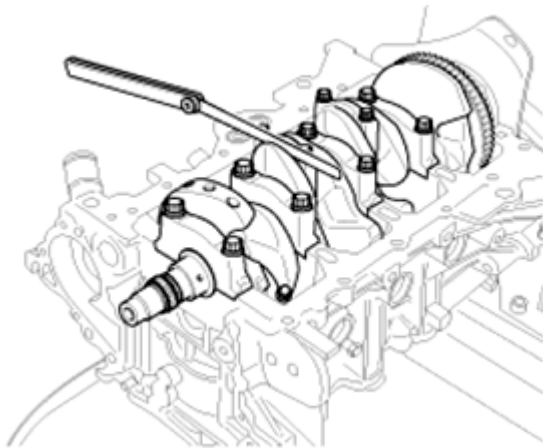


Fig. 10: Checking Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

- 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 match marks on the connecting rod and cap are aligned to ensure correct reassembly.
 2. Remove the 2 connecting rod cap bolts.
 3. Remove the connecting rod cap and lower bearing.
 4. Clean the crankshaft pin journal and bearing.
 5. Place a plastigage across the crankshaft pin journal.
 6. Reinstall the lower bearing and cap, and tighten the bolts. Do not reuse the bolts.

Tightening torque:

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

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.032 ~ 0.052mm (0.0013 ~ 0.0020in)

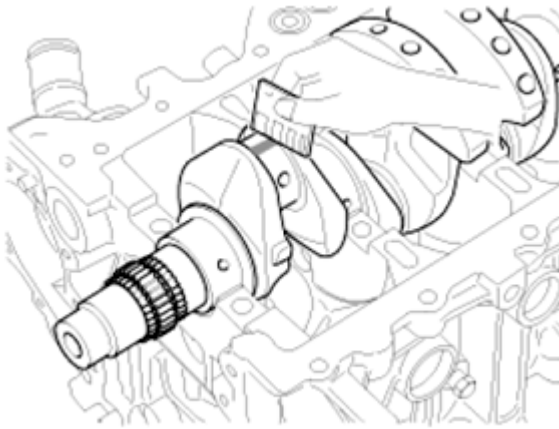


Fig. 11: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

9. If the measurement from the plastigage is too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark.

Recheck the oil 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.

Recheck the oil clearance.

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

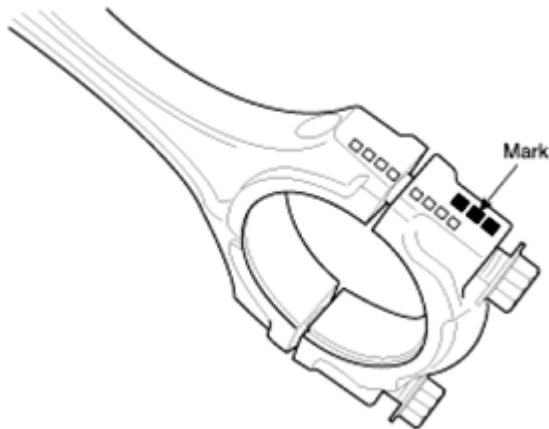


Fig. 12: Locating Connecting Rod Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod

CONNECTING ROD BIG-END DISCRIMINATION

Mark	Connecting rod big-end inner diameter
A, 0	45.000 ~ 45.006mm (1.7717 ~ 1.7719in)
B, 00	45.006 ~ 45.012mm (1.7719 ~ 1.7721in)
C, 000	45.012 ~ 45.018mm (1.7721 ~ 1.7724in)

Crankshaft Pin Diameter Mark Location

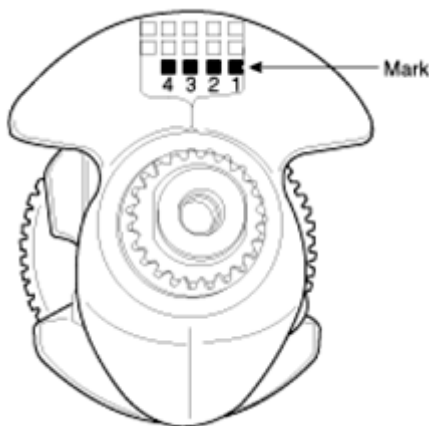


Fig. 13: Locating Crankshaft Pin Diameter Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Pin Diameter

CRANKSHAFT PIN DISCRIMINATION

Mark	Crankshaft pin outer diameter

1	41.972 ~ 41.966mm (1.6524 ~ 1.6522in)
2	41.966 ~ 41.960mm (1.6522 ~ 1.6520in)
3	41.960 ~ 41.954mm (1.6520 ~ 1.6517in)

Connecting Rod Bearing Color Location

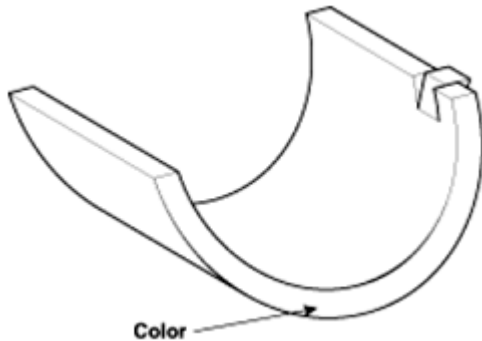


Fig. 14: Locating Connecting Rod Bearing Color
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod Bearing

CONNECTING ROD BEARING DISCRIMINATION

Mark	Color	Connecting rod bearing thickness
A	Blue	1.514 ~ 1.517mm (0.0596 ~ 0.0597in)
B	Black	1.511 ~ 1.514mm (0.0595 ~ 0.0596in)
C	None	1.508 ~ 1.511mm (0.0594 ~ 0.0595in)
D	Green	1.505 ~ 1.508mm (0.0593 ~ 0.0594in)
E	Red	1.502 ~ 1.505mm (0.0591 ~ 0.0593in)

11. Select the bearing by using selection table.

Connecting Rod Bearing Selection Table

CONNECTING ROD BEARING SELECTION

		Connecting rod mark		
		A, 0	B, 00	C, 000
Crank shaft pin journal mark	1	E (Red)	D (Green)	C (None)
	2	D (Green)	C (None)	B (Black)

	3	C (None)	B (Black)	A (Blue)
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3. Check the 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 (0.0020in/3.94in) or less

Allowable twist of connecting rod:

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

NOTE: When the connecting rods are installed without bearings, there should be no difference in side surface.

4. Check the crankshaft bearing oil clearance.

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

Tightening torque:

1st - 17.7 ~ 21.6N.m (1.8 ~ 2.2kgf.m, 13.0 ~ 15.9lb-ft)

2nd - 88° ~ 92°

NOTE: Do not turn the crankshaft.

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

Standard oil clearance:

No. 1, 2, 3, 4, 5: 0.021 ~ 0.042mm (0.0008 ~ 0.0017in)

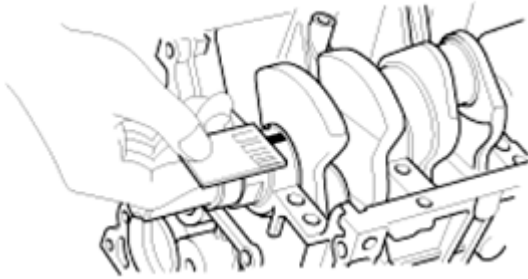


Fig. 15: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

6. If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearing with the same color mark. (Refer to **CRANKSHAFT MAIN BEARING SELECTION**).

Recheck the oil clearance.

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

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to **CRANKSHAFT MAIN BEARING SELECTION**).

Recheck the oil clearance.

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.

Cylinder block crankshaft journal bore mark location

Letters have been stamped on the side surface of the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or letters stamped on the crank (marks for main journal size), to choose the correct bearings.

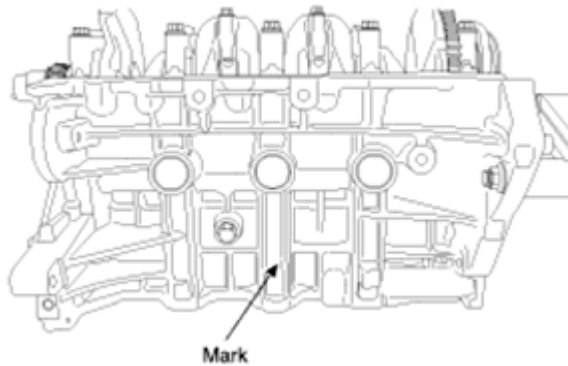


Fig. 16: Locating Cylinder Block Crankshaft Journal Bore Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block Crankshaft Journal Bore

CYLINDER BLOCK CRANKSHAFT JOURNAL BORE DISCRIMINATION

Mark	Cylinder block crankshaft journal bore inner diameter
A	52.000 ~ 52.006mm (2.0472 ~ 2.0475in)
B	52.006 ~ 52.012mm (2.0475 ~ 2.0477in)
C	52.012 ~ 52.018mm (2.0477 ~ 2.0479in)

Crankshaft Main Journal Mark Location

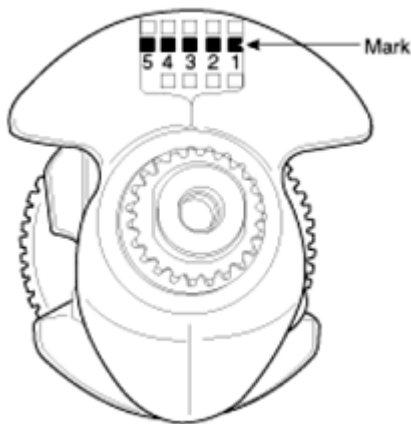


Fig. 17: Locating Crankshaft Main Journal Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Main Journal

CRANKSHAFT MAIN JOURNAL DISCRIMINATION

Mark	Crankshaft main journal outer diameter
1	47.960 ~ 47.954mm (1.8882 ~ 1.8879in)

2	47.954 ~ 47.948mm (1.8879 ~ 1.8877in)
3	47.948 ~ 47.942mm (1.8877 ~ 1.8875in)

Crankshaft Main Bearing Color Location

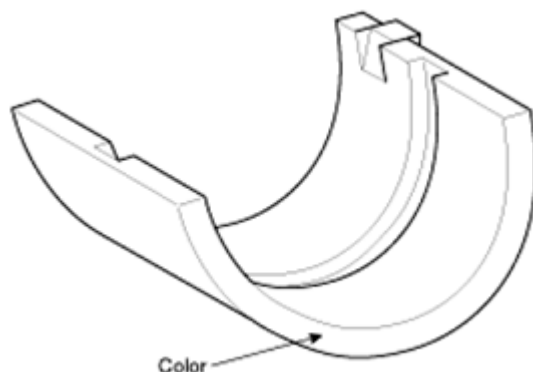


Fig. 18: Locating Crankshaft Main Bearing Color
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Main Bearing

CRANKSHAFT MAIN BEARING DISCRIMINATION

Mark	Color	Crankshaft main bearing thickness
No. 1, 2, 3, 4, 5	Blue	2.026 ~ 2.029mm (0.0798 ~ 0.0799in)
A		
B	Black	2.023 ~ 2.026mm (0.0796 ~ 0.0798in)
C	None	2.020 ~ 2.023mm (0.0795 ~ 0.0796in)
D	Green	2.017 ~ 2.020mm (0.0794 ~ 0.0795in)
E	Red	2.014 ~ 2.017mm (0.0793 ~ 0.0794in)

8. Select the bearing by using selection table.

Crankshaft Main Bearing Selection Table

CRANKSHAFT MAIN BEARING SELECTION

		Cylinder block crankshaft journal bore mark		
		A	B	C
Crank shaft main	1	E (Red)	D (Green)	C (None)
	2	D (Green)	C (None)	B (Black)

journal mark	3	C (None)	B (Black)	A (Blue)
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5. Check the crankshaft end play.

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

End play

Standard: 0.05 ~ 0.25mm (0.0020 ~ 0.0098in)

Limit: 0.30mm (0.0118in)

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

Cylinder Block

1. Remove the gasket material.

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

2. Clean the cylinder block

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

3. Inspect the top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard:

Less than 0.05mm (0.0020in)

Less than 0.02mm (0.0008in) - 100mm x 100mm

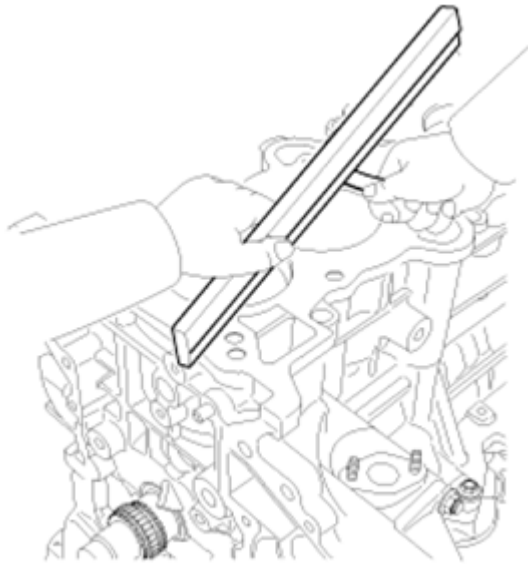


Fig. 19: Inspecting Top Surface Of Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect the cylinder bore.

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

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

Standard diameter:

77.00 ~ 77.03mm (3.0315 ~ 3.0327in)

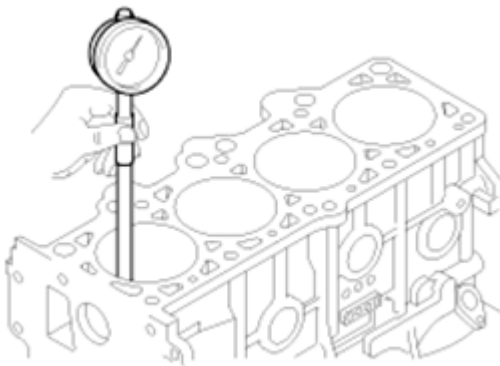


Fig. 20: Inspecting Cylinder Bore Diameter

Courtesy of KIA MOTORS AMERICA, INC.

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

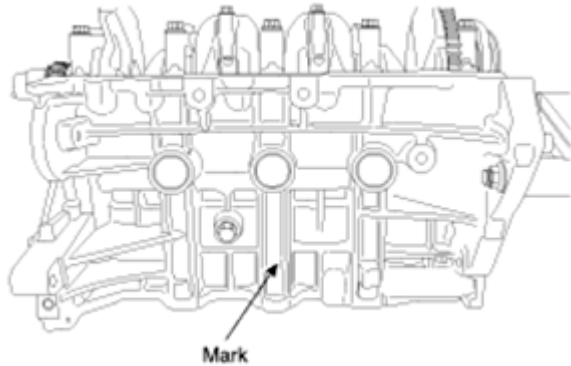


Fig. 21: Locating Cylinder Bore Size Code On Cylinder Block Side Surface

Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Bore Size

CYLINDER BORE DISCRIMINATION

Mark	Cylinder bore inner diameter
A	77.00 ~ 77.01mm (3.0315 ~ 3.0319in)
B	77.01 ~ 77.02mm (3.0319 ~ 3.0323in)
C	77.02 ~ 77.03mm (3.0323 ~ 3.0327in)

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

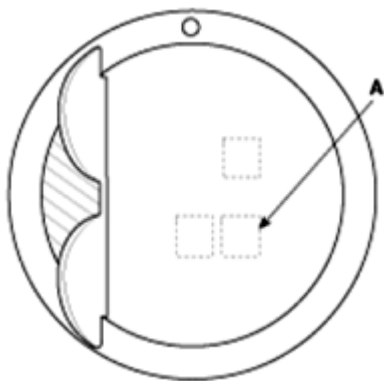


Fig. 22: Locating Piston Size Mark On Piston Top Face

Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Piston Outer Diameter

PISTON DISCRIMINATION

Mark	Piston outer diameter
------	-----------------------

A	76.97 ~ 76.98mm (3.0303 ~ 3.0307in)
B	76.98 ~ 76.99mm (3.0307 ~ 3.0311in)
C	76.99 ~ 77.00mm (3.0311 ~ 3.0315in)

8. Select the piston related to cylinder bore class.

Piston-to-cylinder clearance:

0.02 ~ 0.04mm (0.0008 ~ 0.0016in)

Piston And Piston Rings

1. Clean the 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 33.9mm (1.5697in) from top land of the piston.

Standard diameter:

76.97 ~ 77.00mm (3.0303 ~ 3.0315in)

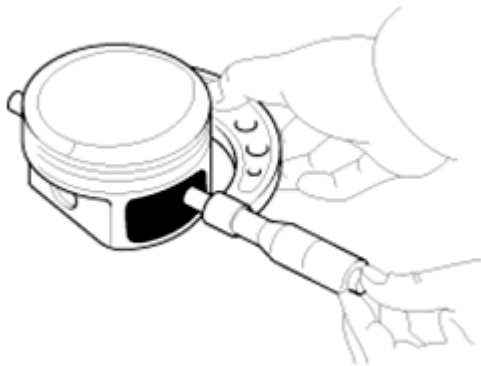


Fig. 23: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance:

0.02 ~ 0.04mm (0.0008 ~ 0.0016in)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance:

No. 1 ring: 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)

No. 2 ring: 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)

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

Limit

No. 1 ring: 0.1mm (0.0039in)

No. 2 ring: 0.1mm (0.0039in)

Oil ring: 0.2mm (0.0079in)



Fig. 24: Measuring Clearance Between Piston Ring & Wall Of Ring Groove
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Inspect the 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 rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored.

Piston ring end gap:

Standard

No. 1 ring: 0.14 ~ 0.28mm (0.0079 ~ 0.0138in)

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

Oil ring: 0.20 ~ 0.70mm (0.0079 ~ 0.0276in)

Limit

No. 1 ring: 0.3mm (0.0118in)

No. 2 ring: 0.5mm (0.0197in)

Oil ring: 0.8mm (0.0315in)

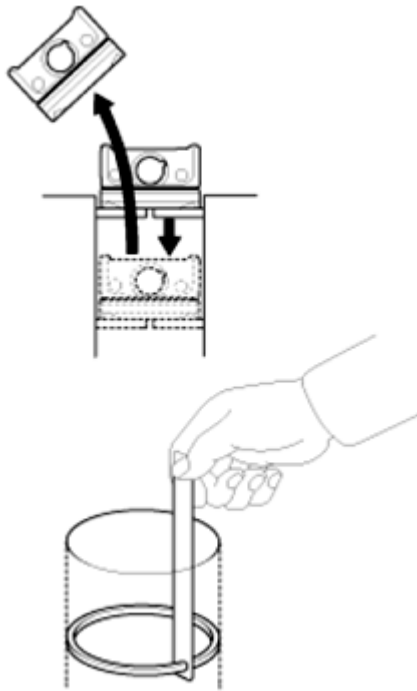


Fig. 25: Inspecting Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the outer diameter of piston pin

Piston pin diameter:

18.001 ~ 18.006mm (0.7087 ~ 0.7089in)

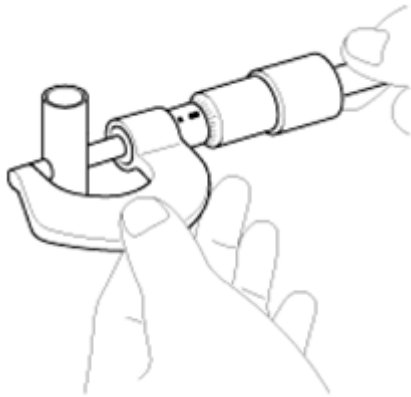


Fig. 26: Measuring Outer Diameter Of Piston Pin
 Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance:

0.010 ~ 0.020mm (0.0004 ~ 0.0008in)

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

Piston pin-to-connecting rod interference:

-0.032 ~ -0.016mm (-0.0013 ~ -0.0006in)

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.

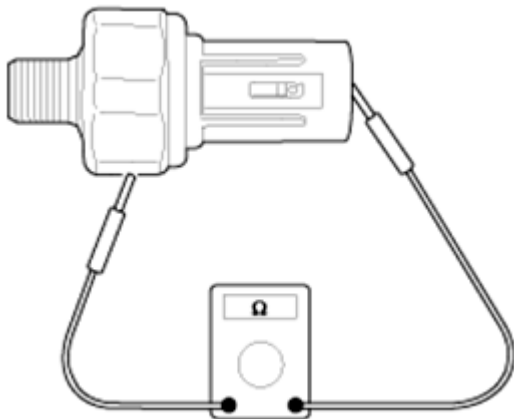


Fig. 27: Checking Oil Pressure Switch Continuity Between Terminal & Body
 Courtesy of KIA MOTORS AMERICA, INC.

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.

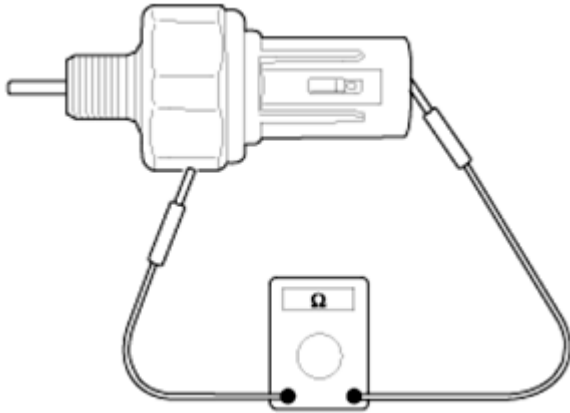


Fig. 28: Checking Oil Pressure Switch Continuity Between Terminal & Body
 Courtesy of KIA MOTORS AMERICA, INC.

3. If there is no continuity when a 49.0kpa (0.5kg/cm² , 7.1psi) is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

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

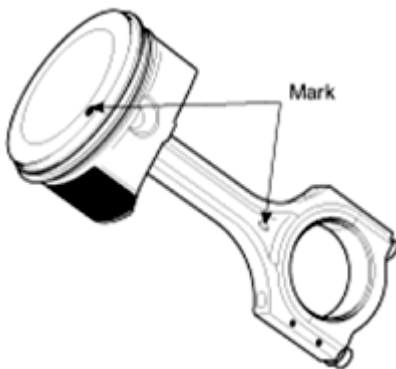


Fig. 29: Identifying Front Marks Of Piston & Connecting Rod

Courtesy of KIA MOTORS AMERICA, INC.

2. Install the piston rings.
 1. Install the oil ring expander and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown in **Fig. 30**.

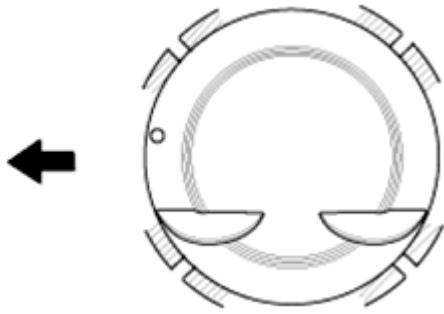


Fig. 30: Installing Piston Rings

Courtesy of KIA MOTORS AMERICA, INC.

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

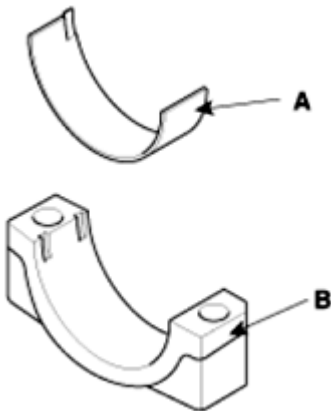


Fig. 31: Identifying Bearing & Connecting Rod Cap

Courtesy of KIA MOTORS AMERICA, INC.

4. Install the crankshaft 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 five upper bearings (A).

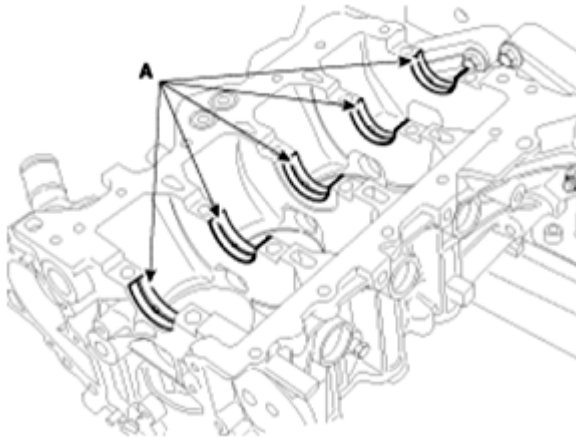


Fig. 32: Pushing In Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

Install the thrust bearing (A) on the No. 3 journal position of the cylinder block with the oil grooves facing outward.

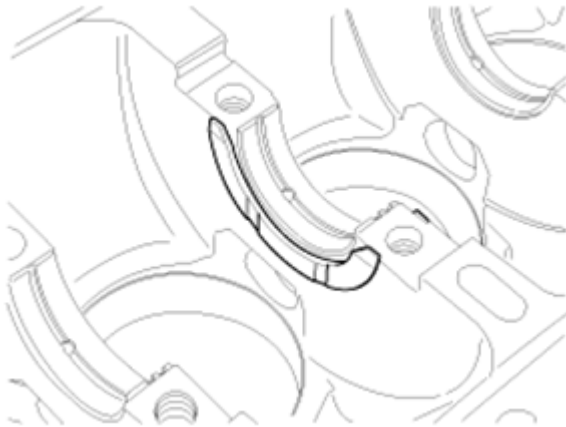


Fig. 33: Identifying Thrust Bearing
Courtesy of KIA MOTORS AMERICA, INC.

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

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, in several passes, in the sequence shown in **Fig. 34**.

Tightening torque:

1st - 17.7 ~ 21.6N.m (1.8 ~ 2.2kgf.m, 13.0 ~ 15.9lb-ft)

2nd - 88° ~ 92°

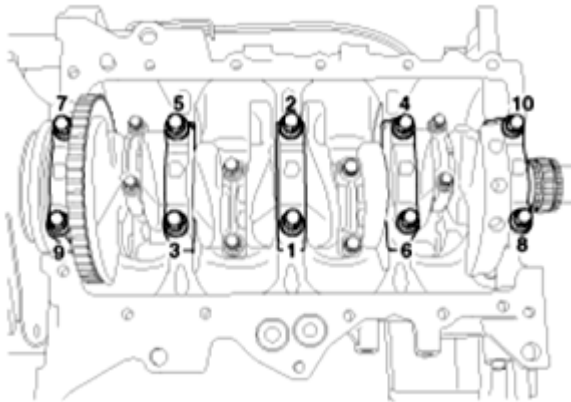


Fig. 34: Identifying Tightening Sequence Of Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not reuse the main bearing cap bolts.

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

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

1. Install the ring compressor, check that the rings are 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-crank journal alignment before pushing the piston into place.
3. Install the rod caps with bearings, and tighten the bolts. (Do not reuse the bolts).

Tightening torque:

1st - 17.7 ~ 21.8N.m (1.8 ~ 2.2kgf.m, 13.0 ~ 15.9lb-ft)

2nd - 88° ~ 92°

11. Apply the sealant on the ladder frame.

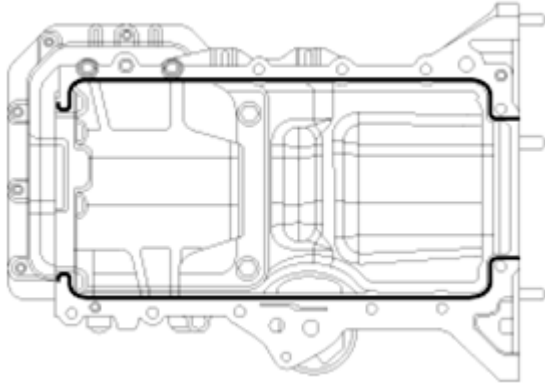


Fig. 35: Applying Sealant On Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Apply the sealant, THREE-BOND 1217H or LOCTITE 5900H on the ladder frame rail portion and install it with in five minutes.

If when sealant is applied to cylinder block bottom position, sealant position to be same with position that is applied to ladder frame rail position.

- Apply sealant along the inner line of the bolt holes.

12. Install the ladder frame (A).

Tightening torque:

18.6 ~ 24.2N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)

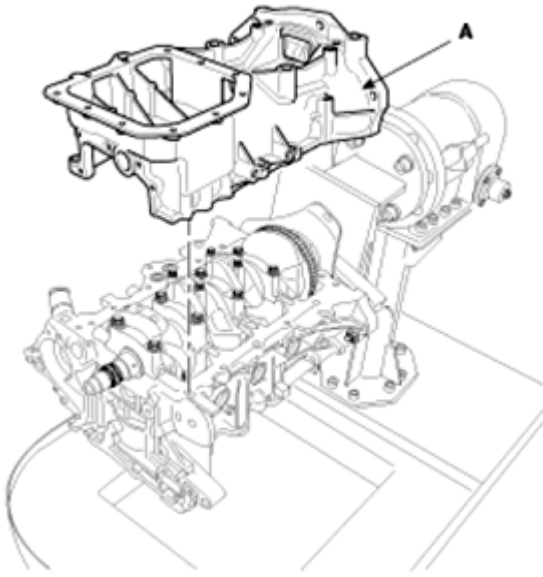


Fig. 36: Identifying Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

13. Install the rear oil seal.
 1. Apply engine oil to a new oil seal lip.
 2. Using the SST (09231-H1100, 09231-2B200) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

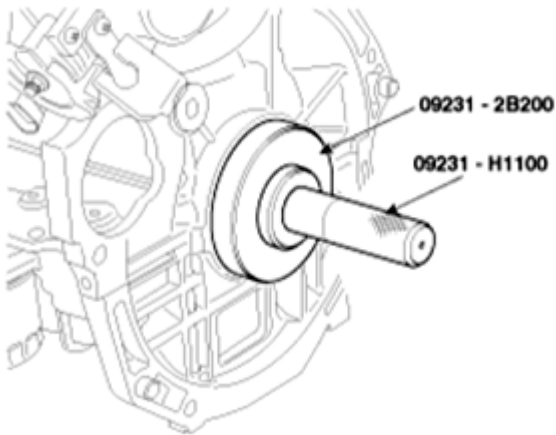


Fig. 37: Installing Rear Oil Seal Using SST & Hammer
Courtesy of KIA MOTORS AMERICA, INC.

14. Install the oil screen.

Install a new gasket and oil screen with 2 bolts.

Tightening torque:

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

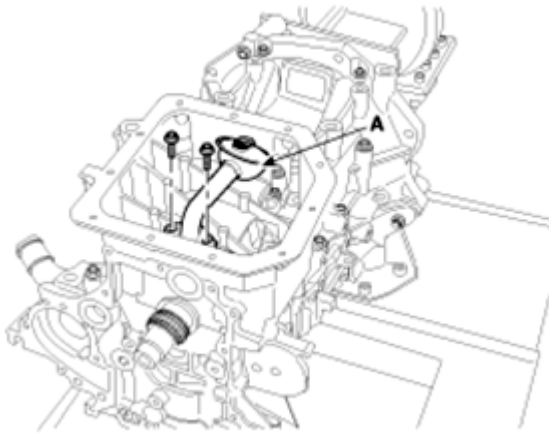


Fig. 38: Installing Oil Screen

Courtesy of KIA MOTORS AMERICA, INC.

15. 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 with the width of $\phi 3\text{mm}$, starting 1mm-away position from the inner rounding of the oil pan rail.

Liquid gasket : TB 1217H or LOCTITE 5900H

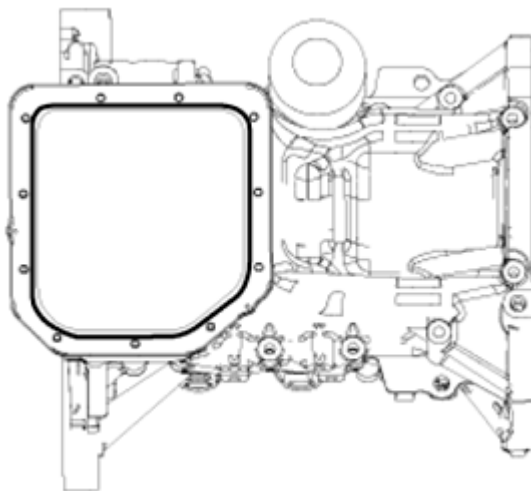


Fig. 39: Installing Oil Pan

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) with the bolts.

Uniformly tighten the bolts in several passes.

Tightening torque:

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

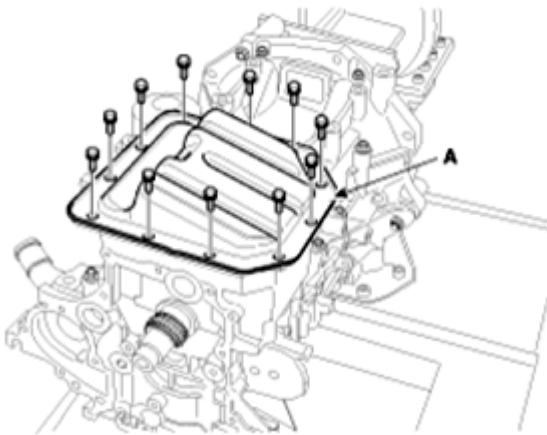


Fig. 40: Identifying Oil Pan & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

16. Install the oil pressure switch.
 1. Apply adhesive to 2 or 3 threads.
 2. Install the oil pressure switch (A).

Tightening torque:

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

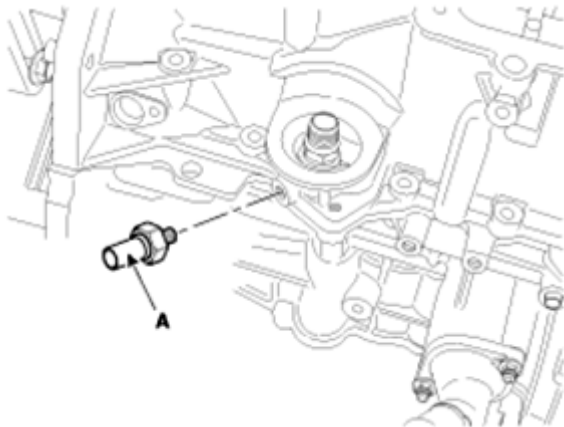


Fig. 41: Identifying Oil Pressure Switch
 Courtesy of KIA MOTORS AMERICA, INC.

17. Install the knock sensor (A) and the oil filter (B).

Tightening torque:

16.7 ~ 26.5N.m (1.7 ~ 2.7kgf.m, 12.3 ~ 19.5lb-ft)

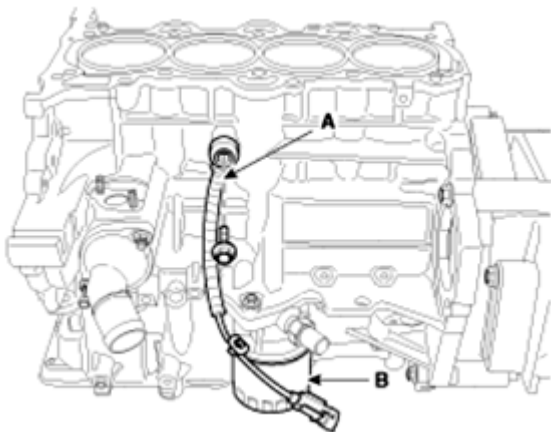


Fig. 42: Identifying Knock Sensor & Oil Filter
 Courtesy of KIA MOTORS AMERICA, INC.

18. Install the oil level gauge tube.
 1. Install a new O-ring on the oil level gauge tube.
 2. Apply engine oil on the O-ring.
 3. Install the oil level gauge tube with the bolt.

Tightening torque:

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

19. Install the cylinder head. (Refer to **CYLINDER HEAD ASSEMBLY - 1.6L**)
20. Install the timing chain. (Refer to **TIMING SYSTEM - 1.6L**)
21. Remove the engine stand.
22. A/T: install the drive plate.

Tightening torque:

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

23. M/T: install the fly wheel.

Tightening torque:

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

24. Install the engine. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY - 1.6L**)