2010 ENGINE

General Information (Engine Mechanical System) - 2.0L - Soul

SPECIFICATIONS

GENERAL SPECIFICATIONS

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Description		Specifications	Limit
General			
Type		In-line, Double Overhead Camshaft	
Number of cylinder		4	
Bore		82mm (3.228in)	
Stroke		93.5mm (3.681in)	
Total displacement		1975cc (120.52cu.in)	
Compression ratio		10.1 : 1	
Firing order		1 - 3 - 4 - 2	
Valve timing			
Intake valve	Opens (ATDC)	ATDC 11° ~ BTDC 29°	
	Closes (ABDC)	ABDC 59° ~ ABDC 19°	
Exhaust	Opens (BBDC)	42°	
	Closes (ATDC)	6°	
Valve			
Valve length	Intake	114.34mm (4.5016in)	
	Exhaust	116.8mm (4.598in)	
Stem outer diameter	Intake	5.965 ~ 5.98mm (0.2348 ~ 0.2354in)	
	Exhaust	5.950 ~ 5.965mm (0.2343 ~ 0.2348in)	
Face angle		45° ~ 45°30'	
Thickness of valve head (Margin)			
Intake		1.6±0.15mm (0.0630±0.0059in)	0.8mm (0.031in)
Exhaust		1.8±0.15mm (0.0709±0.0059in)	1.0mm (0.039in)
Valve stem to valve guide clearance			
Intake		0.02 ~ 0.05mm (0.0008 ~ 0.0019in)	0.10mm (0.0039in)
Exhaust		0.035 ~ 0.065mm (0.0014 ~ 0.0026in)	0.13mm(0.0051in)
Valve guide			

Installed dimension outer diameter	Intake	45.8~46.2mm (1.8031~1.8189in)	
	Exhaust	52.8~53.2mm (2.0787~2.0945in)	
Service oversize		0.05, 0.25, 0.50mm (0.002, 0.010, 0.020in) oversize	
Valve seat			
Width of seat contact	Intake	1.1 ~ 1.5mm (0.043 ~ 0.059in)	
	Exhaust	1.3 ~ 1.7mm (0.051 ~ 0.066in)	
Oversize		0.3, 0.6mm (0.012, 0.024in) oversize	
Valve spring			
Free length		48.86mm (1.9236in)	
Load		18.8k±0.9kg/39.0mm (41.4±2.0lb/1.5354in) 41.0±1.5kg/30.5mm (90.4±3.3lb/1.2008in)	
Squareness		1.5° or less	
Valve clearance			
Cold (20°C[68°F])	Intake	0.20mm (0.0079in)	0.17~0.23mm (0.0067~0.0091in)
	Exhaust	0.28mm (0.0110in)	0.25~0.31mm (0.0098~0.0122in)
Hot (80°C[176°F]) : only for reference	Intake	0.29mm (0.0114in)	
	Exhaust	0.34mm (0.0134in)	
Cylinder head			
Flatness of gasket surface		Max. 0.03mm (0.0012in)	0.06mm(0.0024in)
Flatness of manifold mounting surface		Max. 0.15mm (0.0059in)	0.03mm(0.0012in)
Oversize rework dimensions of valve seat hole			
Intake	0.3mm (0.012in) O.S.	33.300 ~ 33.325mm (1.3110 ~ 1.3120in)	
	0.6mm (0.024in) O.S.	33.600 ~ 33.625mm (1.3228 ~ 1.3238in)	
Exhaust	0.3mm (0.012in) O.S.	28.800 ~ 28.821mm (1.1338 ~ 1.1346in)	
	0.6mm (0.024in) O.S.	29.100 ~ 29.121mm (1.1456 ~ 1.1465in)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)			
0.05mm (0.002in) O.S.		11.05 ~ 11.068mm (0.435 ~ 0.4357in)	
0.25mm (0.010in) O.S.		11.25 ~ 11.268mm (0.443 ~ 0.4436in)	

0.50mm (0.020in) O.S.		11.50 ~ 11.518mm (0.453 ~ 0.4535in)	
Cylinder block			
Cylinder bore		82.00 ~ 82.03mm (3.2283 ~ 3.2295in)	
Out-of-round and taper of cylinder bore		Less than 0.01mm (0.0004in)	
Clearance with piston (To set limits to new parts)		0.02 ~ 0.04mm (0.0008 ~ 0.0016in)	
Piston			
Outer diameter (To set limits to new parts)		81.97 ~ 82.00mm (3.2271 ~ 3.2283in)	
Service oversize		0.25, 0.50mm (0.010, 0.020in) oversize	
Piston ring			
Side clearance	No. 1	0.04 ~ 0.08mm (0.0015 ~ 0.0031in)	0.1mm (0.004in)
	No. 2	0.03 ~ 0.07mm (0.0012 ~ 0.0027in)	
End gap	No. 1	0.20 ~ 0.35mm (0.0079 ~ 0.0138in)	1mm (0.039in)
	No. 2	0.37 ~ 0.52mm (0.0146 ~ 0.0205in)	1mm (0.039in)
Oil ring side rail		0.20 ~ 0.60mm (0.0078 ~ 0.0236in)	1mm (0.039in)
Service oversize		0.25, 0.50mm (0.010, 0.020in.) oversize	
Piston pin			
Outer diameter		20.001 ~ 20.006mm (0.7874 ~ 0.7876in)	
Hole inner diameter		20.016 ~ 20.021mm (0.7880 ~ 0.7882in)	
Hole clearance		0.010 ~ 0.020mm (0.0004 ~ 0.0008in)	
Connecting rod small end inner diameter		19.974 ~ 19.985mm (0.7864 ~ 0.7868in)	
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)	0.4mm(0.0157in)
Connecting rod bearing			
Oil clearance (To seat limits to new parts)		0.024 ~ 0.042mm (0.0009 ~ 0.0017in)	

Undersize		0.25mm (0.01in)	
Camshaft			
Cam height	Intake	44.618mm (1.7566in)	44.518mm(1.7527in)
	Exhaust	44.518mm (1.7527in)	44.418mm (1.7487in)
Journal outer diameter		28mm (1.1023in)	
Bearing oil clearance		0.027 ~ 0.061mm (0.0011 ~ 0.0024in)	0.1mm(0.0039in)
End play		0.1 ~ 0.2mm (0.0040 ~ 0.0079in)	
Crankshaft			
Pin outer diameter		44.946 ~ 44.966mm (1.7695 ~ 1.7703in)	
Journal outer diameter		56.942 ~ 56.962mm (2.2418 ~ 2.2426in)	
Bend		0.03mm (0.0012in) or less	
Out-of-round, taper of journal and pin		0.01mm (0.0004in) or less	0.030mm (0.0012in)
End play		0.06 ~ 0.260mm (0.0023 ~ 0.010in)	
Undersize rework dimension of pin	0.25mm (0.010in)	44.725 ~ 44.740mm (1.7608 ~ 1.7614in)	
Undersize rework dimension of journal	0.25mm (0.010in)	56.727 ~ 56.742mm (2.2333 ~ 2.2339in)	
Crankshaft bearing			
Oil clearance		0.028 ~ 0.046mm (0.0011 ~ 0.0018in)	
Flywheel			
Runout		0.1mm (0.0039in)	0.13mm(0.0051in)
Cooling method		Water-cooled, pressurized. Forced circulation with electrical fan	
Coolant			
Quantity		7.2liter (7.6U.S qts, 6.3lmp.qts)	
Radiator			
Type		Pressurized corrugated fin type	
Radiator cap			
Main valve opening pressure		93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm^2 , 13.51 ~ 17.78psi)	
Vacuum valve opening pressure		MAX. 6.86 kpa (0.07kg/cm^2 , 1.00 psi)	
Thermostat			

Type		Wax pellet type with jiggle valve	
Valve opening temperature		82°C (177°F)	
Valve closing temperature		77°C (170.6°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) 0.3222kohms at 80° C (176°F)	
Oil pump			
Clearance between outer circumference and front case.		0.120 ~ 0.185mm (0.0049 ~ 0.0073in)	
Front case tip clearance		0.025 ~ 0.069mm (0.0009 ~ 0.0027in)	
Side clearance			
Inner gear		0.04 ~ 0.085mm (0.0016 ~ 0.0033in)	
Outer gear		0.04 ~ 0.09mm (0.0016 ~ 0.0035in)	
Engine oil			
Oil quantity	Total	4.1L (4.33US qt, 3.60lmp.qt)	When replacing a short engine or block assembly
	Oil pan	3.7L (3.91US qt, 3.26lmp.qt)	
	Drain and refill	4.0L (4.23US qt, 3.52lmp.qt)	Including oil filter
Oil grade	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.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to **SELECTION OF ENGINE OIL** .
Oil pressure (at 800rpm)		100kPa (1.0kg/cm^2 , 14.5psi)	Oil temperature in oil pan : 90 ~ 100°C (194 ~

		212°F)
Relief spring		
Free height	43.8mm (1.725in.)	
Load	3.7kg at 40.1mm (3.15lb/1.578in)	
Air cleaner		
Type	Dry type	
Element	Un-woven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

SERVICE STANDARDS

SERVICE STANDARDS SPECIFICATIONS

Standard value	
Antifreeze	Mixture ratio of anti-freeze in coolant
Ethylene glycol base for aluminum	50%

TIGHTENING TORQUES

TIGHTENING TORQUE SPECIFICATIONS

Item	Nm	kgf.m	lb-ft
Cylinder Block			
Front engine support bracket bolt	34.3 ~ 49.0	3.5 ~ 5.0	25.3 ~ 36.2
Rear engine support bracket bolt	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Engine support bracket stay plate bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Main Moving			
Connecting rod cap nut	49.0 ~ 52.0	5.0 ~ 5.3	36.2 ~ 38.3
Crankshaft main bearing cap bolt	27.5~31.4 + (60°~64°)	2.8~3.2 + (60°~64°)	20.3~23.1 + (60°~64°)
Fly wheel M/T bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Drive plate A/T bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Cooling system			
Water pump pulley bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Water pump bolts (8X20)	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Water pump bolts (8X35)	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Coolant temperature sensor	19.6 ~ 39.2	2.0 ~ 4.0	14.5 ~ 28.9
Coolant inlet fitting nuts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5

Water pump to alternator brace bolt	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Alternator brace to cylinder block bolt	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Thermostat housing bolts and nuts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Lubrication system			
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pan bolts	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug (Aluminum)	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Oil pan drain plug (Steel)	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolts	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil pressure switch	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Intake and Exhaust system			
Air cleaner body mounting bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake manifold to cylinder head nuts	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold stay to cylinder block bolts	17.7 ~ 24.5	1.8 ~ 2.5	13.0 ~ 18.1
Throttle body to surge tank bolts and nuts	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold to cylinder head nuts	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Exhaust manifold cover to exhaust manifold bolts	16.7 ~ 21.6	1.7 ~ 2.2	12.3 ~ 15.9
Oxygen sensor to exhaust manifold	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Front muffler to exhaust manifold nuts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front muffler to catalytic converter nuts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Catalytic converter to center muffler nuts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler to main muffler nuts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Cylinder head			
Cylinder head bolts (M10)	22.6~26.5+(60°~65°)+(60°~65°)	2.3~2.7 + (60°~65°)+(60°~65°)	16.6~19.5+(60°~65°)+(60°~65°)
Cylinder head bolts (M12)	27.5~31.4+(60°~65°) +(60°~65°)	2.8~3.2 + (60°~65°)+(60°~65°)	20.3~33.1+(60°~65°)+(60°~65°)
Cylinder head cover bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap	13.7 ~ 14.7	1.4 ~ 1.5	10.1 ~ 10.8

bolts			
Oil control valve bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
OCV filter	40.2 ~ 50.0	4.1 ~ 5.1	29.7 ~ 36.9
CVVT unit to exhaust camshaft bolt	64.7 ~ 76.5	6.6 ~ 7.8	47.7 ~ 56.4
Timing chain auto tensioner bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Timing Belt			
Crankshaft pulley bolt	156.9 ~ 166.7	16.0 ~ 17.0	115.7 ~ 123.0
Camshaft sprocket bolt	98.1 ~ 117.7	10.0 ~ 12.0	72.3 ~ 86.8
Timing belt auto tensioner bolt	22.6 ~ 28.4	2.3 ~ 2.9	16.6 ~ 21.0
Timing belt cover bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Front case bolts	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing belt idler bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8

REPAIR PROCEDURES

INSPECTION

Compression Pressure

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

1. Warm up and stop engine.

   Allow the engine to warm up to normal operating temperature.

2. Remove ignition wires.

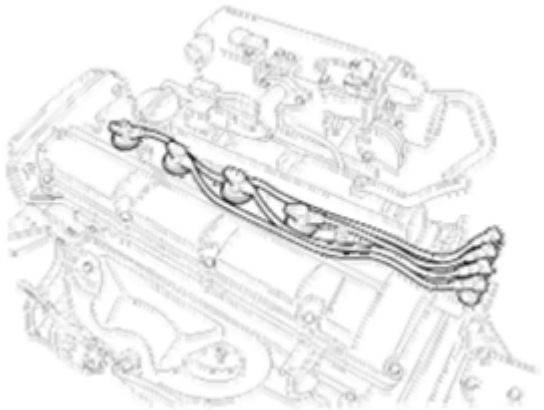


Fig. 1: Identifying Ignition Wires

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove spark plugs.

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

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

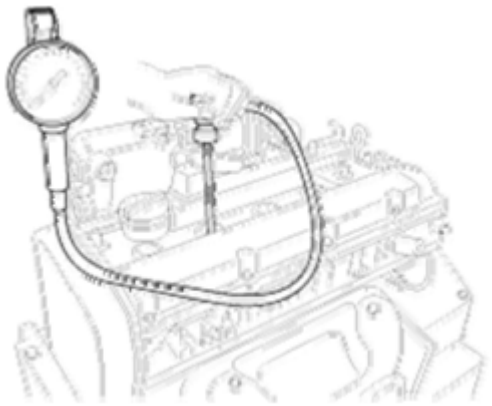


Fig. 2: Checking Cylinder Compression Pressure
Courtesy of KIA MOTORS AMERICA, INC.

   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 250 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: 1421.96kPa (14.5kgf/cm^2 , 206.24psi)

Minimum pressure: 1274.86kPa (13.0kgf/cm^2 , 184.90psi)

Difference between each cylinder: 98.07kPa (1.0kgf/cm^2 , 14.22psi) 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.

5. Reinstall spark plugs.
6. Install ignition coils.

Timing Belt Tension Adjustment

1. Remove RH front wheel.
2. Remove the 4 bolts and timing belt upper cover (A).

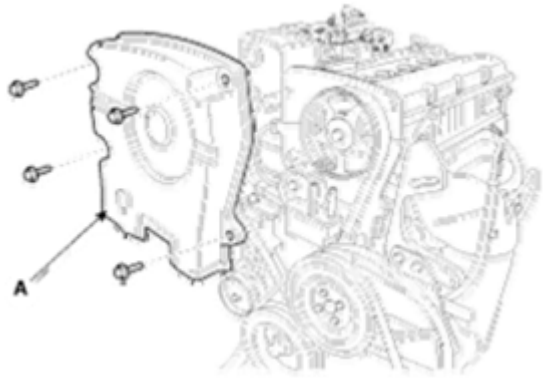


Fig. 3: Identifying Timing Belt Upper Cover & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Loosen the tensioner bolt.

NOTE: When checking the timing belt tension or installing the timing belt tensioner, the engine oil temperature must be between 15°C (59°F) and 25° C (77°F)

4. Using a hex wrench, turn the adjuster counterclockwise to make the indicator of the arm (A) located at the center of the base notch.

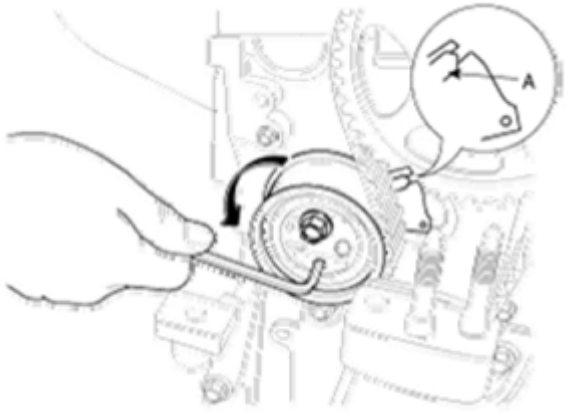


Fig. 4: Turning Adjuster Counterclockwise Using Hex Wrench
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not rotate the adjuster clockwise.
It will result in functional problem with the auto tensioner.

5. Hold the indicator in place while tightening tensioner bolt.

   Tightening torque

   Tensioner bolt:

   22.6 ~ 28.4Nm (2.3 ~ 2.9kgf.m, 16.6 ~ 21.0lb-ft)

6. Turn the crankshaft two revolutions in the operating direction (clockwise) and check that the indicator is in the center of base.
7. If the indicator is not located at the center of base, loosen the bolt and repeat the above procedure.
8. Install the timing belt upper cover (A).

   Tightening torque: 7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

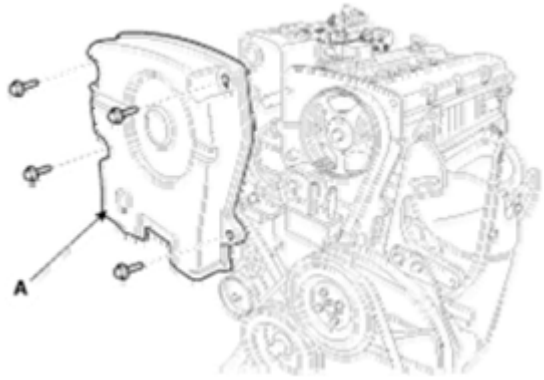


Fig. 5: Installing Timing Belt Upper Cover
Courtesy of KIA MOTORS AMERICA, INC.

9. Install RH front wheel.

Valve Clearance Inspection And Adjustment

MLA (Mechanical Lash Adjuster)

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

1. Remove the engine cover.

2. Remove the upper timing belt cover (A).

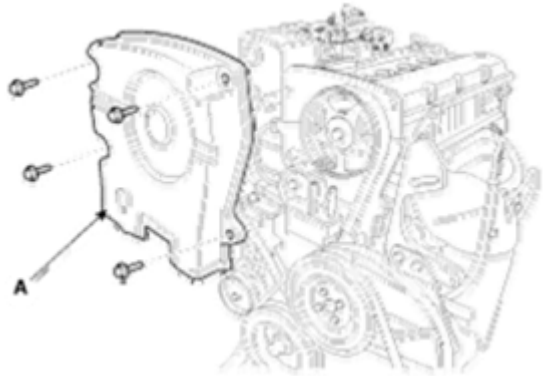


Fig. 6: Identifying Upper Timing Belt Cover
Courtesy of KIA MOTORS AMERICA, INC.

   A. Loosen the upper timing cover bolts and then remove the cover.
3. Remove the cylinder head cover.
   1. Disconnect the spark plug cables and do not pull on the spark plug boot by force.

      NOTE: Pulling on or bending the cables may damage the inside conductor.

   2. Disconnect the PCV hose (A) and the breather hose (B) from the cylinder head cover.
   3. Disconnect the accelerator cable (C) and the auto-cruise cable (D) from the cylinder head cover.

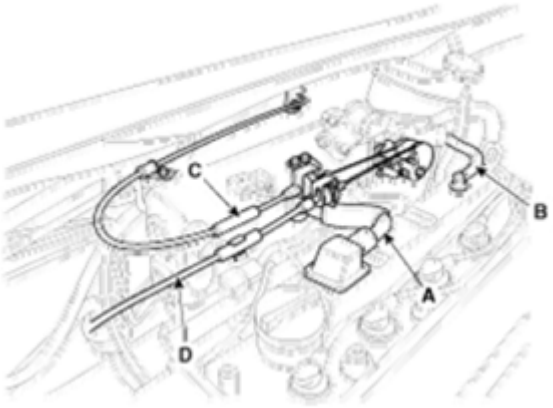


Fig. 7: Identifying Accelerator Cable, Auto-Cruise Cable, PCV Hose, & Breather Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

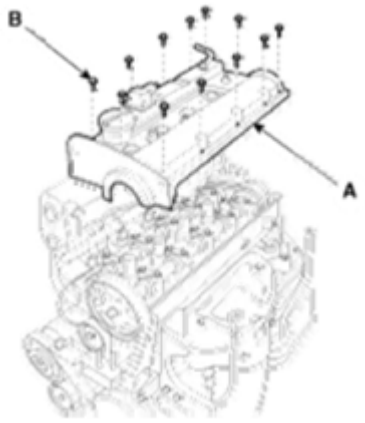


Fig. 8: Identifying Cylinder Head Cover & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

Fig. 9: Aligning Crankshaft Pulley Groove With Timing Mark T Of Lower Timing Belt Cover
Courtesy of KIA MOTORS AMERICA, INC.

    2. Check that the hole of the camshaft timing pulley (A) is aligned with the timing mark of the bearing cap.

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

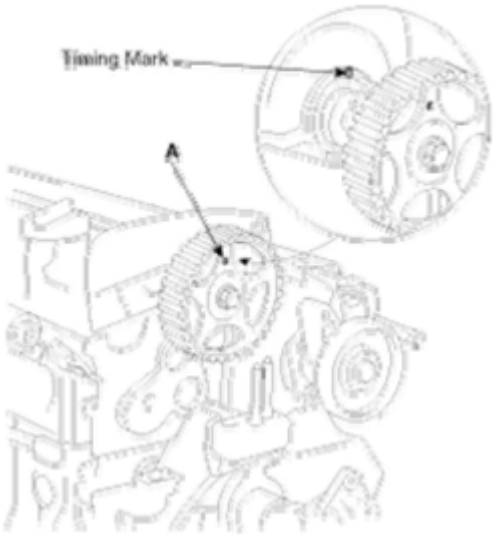


Fig. 10: Checking Alignment Of Camshaft Timing Pulley Hole & Timing Mark Of Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

5. Inspect the valve clearance
    1. Check only the valve indicated [No. 1 cylinder: TDC/Compression] and measure the valve clearance.

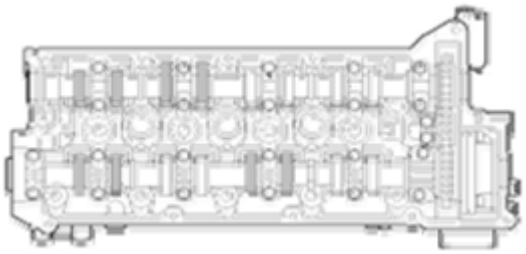


Fig. 11: Inspecting Valve Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve clearance

Specification

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

Intake: 0.20mm (0.0079in.)

Exhaust: 0.28mm (0.0110in.)

Engine coolant temperature: 80°C [176°F]

Intake: 0.29mm (0.0114in.)

Exhaust: 0.34mm (0.0134in.)

Limit

Intake: 0.17 ~ 0.23mm (0.0067 ~ 0.091in.)

Exhaust: 0.25 ~ 0.31mm (0.0098 ~ 0.0122in.)

2. Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing belt cover.
3. Check only valves indicated [NO. 4 cylinder: TDC/compression]. Measure the valve clearance. [See procedure in step 6]

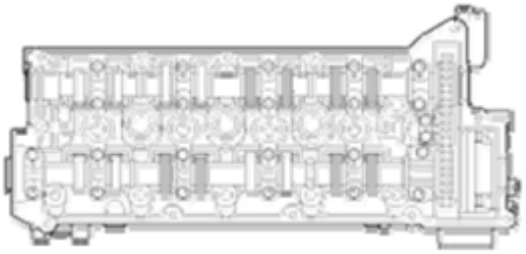


Fig. 12: Aligning Crankshaft Pulley Groove With Timing Mark T Of Lower Timing Belt Cover
Courtesy of KIA MOTORS AMERICA, INC.

6. Adjust the intake and exhaust valve clearance.
   1. Turn the crankshaft so that the cam lobe of the camshaft on the adjusting valve is upward.
   2. Using the SST (09220 - 2D000), press down the valve lifter and place the stopper between the camshaft and valve lifter and remove the special tool.

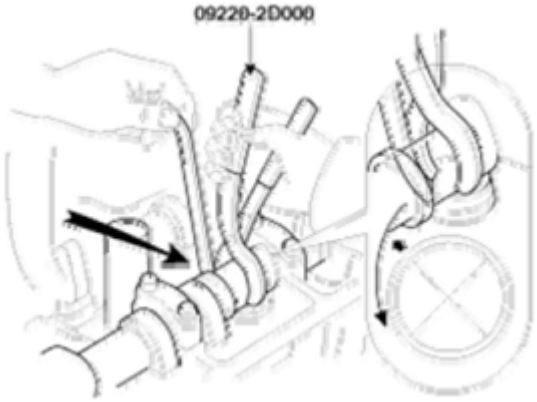


Fig. 13: Adjusting Intake & Exhaust Valve Clearance
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the adjusting shim with a small screw driver (A) and magnet (B).

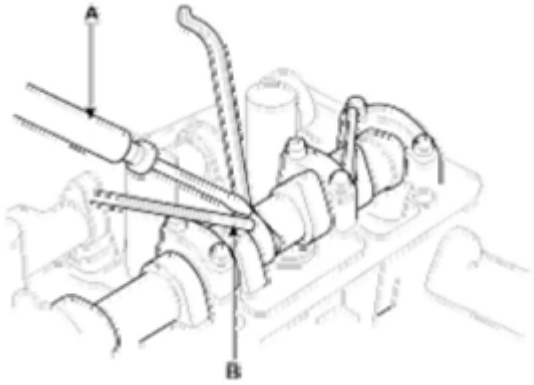


Fig. 14: Adjusting Shim With Screw Driver & Magnet
Courtesy of KIA MOTORS AMERICA, INC.

4. Measure the thickness of the removed shim using a micrometer.

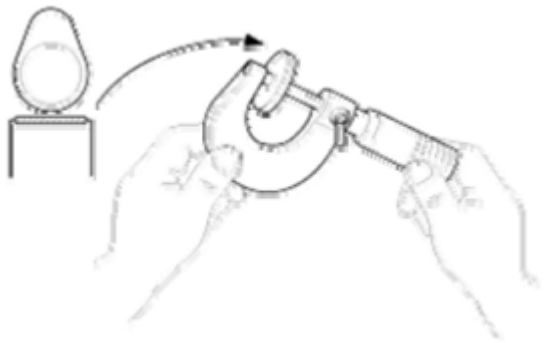


Fig. 15: Measuring Thickness Of Shim Using A Micrometer
Courtesy of KIA MOTORS AMERICA, INC.

5. Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

   Valve clearance (Engine coolant temperature: 20°C)

   T: Thickness of removed shim

   A: Measured valve clearance

   N: Thickness of new shim

   Intake: N = T + [A - 0.20mm (0.0079in.)]

Exhaust: N = T + [A-0.28mm (0.0110in.)]

6. Select a new shim with a thickness as close as possible to the calculated value. [Refer to the Adjusting Shim Selection Charts for Intake/Exhaust in **Fig. 16** and **Fig. 17**]

NOTE: Shims are available in 20size increments of 0.04mm (0.0016in.) from 2.00mm (0.079in.) to 2.76mm (0.1087in.)

7. Place a new adjusting shim on the valve lifter.
8. Using the SST (09220 - 2D000), press down the valve lifter and remove the stopper.
9. Recheck the valve clearance.

Valve clearance (Engine coolant temperature: 20°C)

[Specification]

Intake: 0.20mm (0.0079in.)

Exhaust: 0.28mm (0.0110in.)

[Limit] (After adjusting valve clearance)

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

Exhaust: 0.25 ~ 0.31mm (0.0098 ~ 0.0122in.)

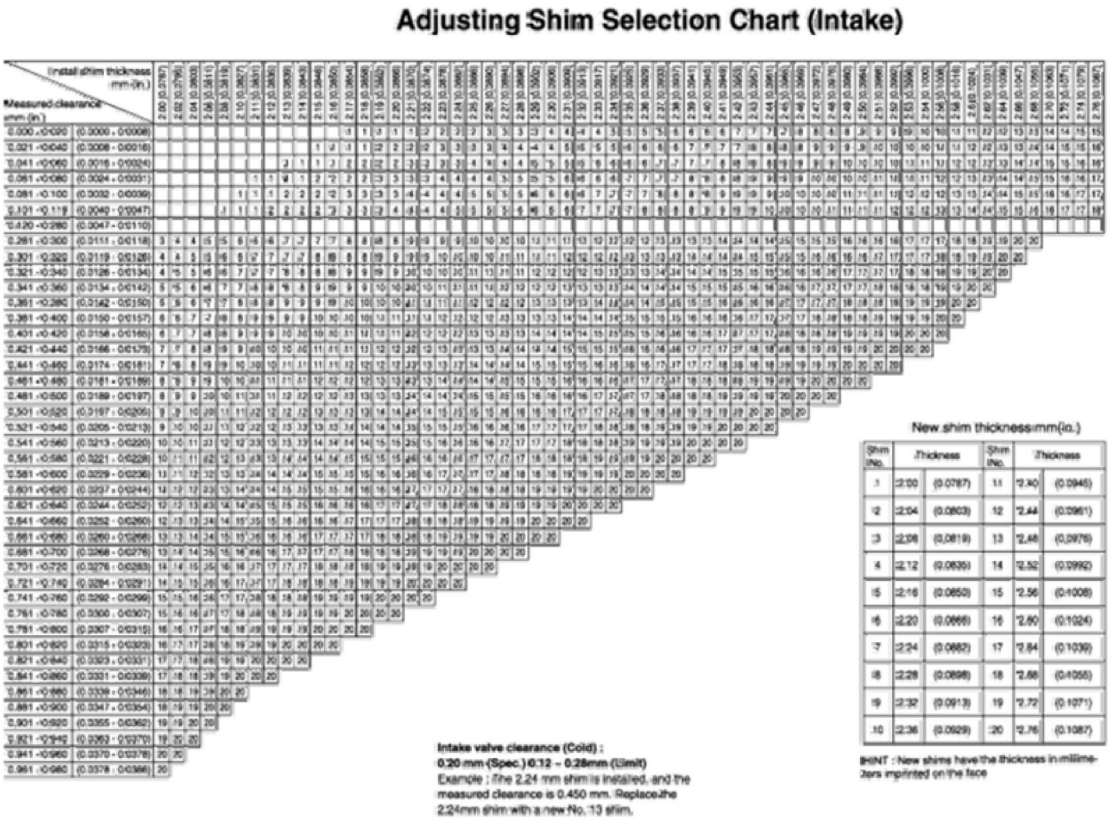


Fig. 16: Adjusting Shim Selection Chart (Intake)
Courtesy of KIA MOTORS AMERICA, INC.

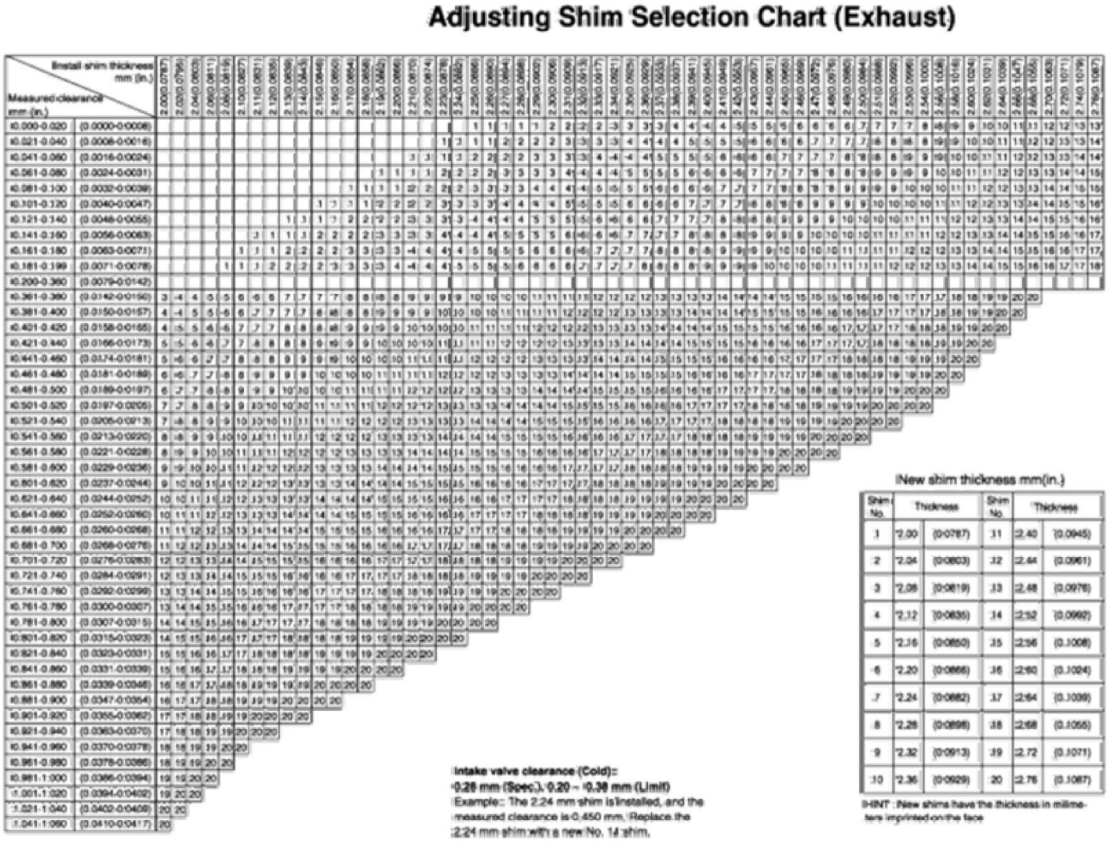


Fig. 17: Adjusting Shim Selection Chart (Exhaust)
Courtesy of KIA MOTORS AMERICA, INC.

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
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required
	Excessive worn or mis-aligned timing chain	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.

Engine misfire with coolant consumption	• Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. • Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	• Inspect the cylinder for a loss of compression. • Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity	• Drain the oil. • Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	• Inspect the camshaft lobes. • Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
Lower engine noise, regardless of engine speed	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. • Repair as required.
	Excessive piston pin-to-clearance	• Inspect the piston, piston pin and the connecting rod. • Repair or replace as required.
	Excessive connecting rod bearing rod 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 bearing. • 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

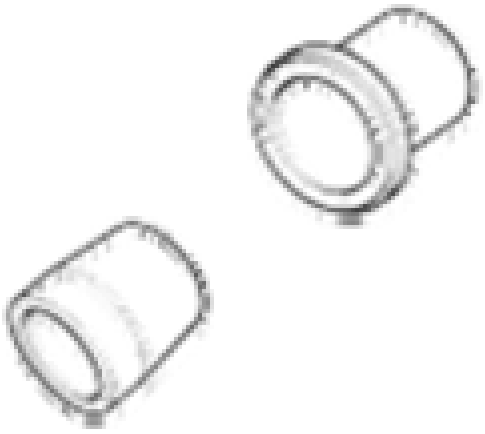
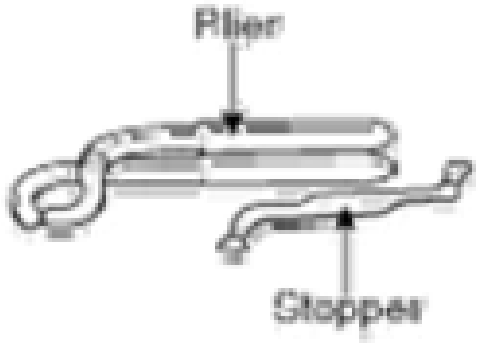
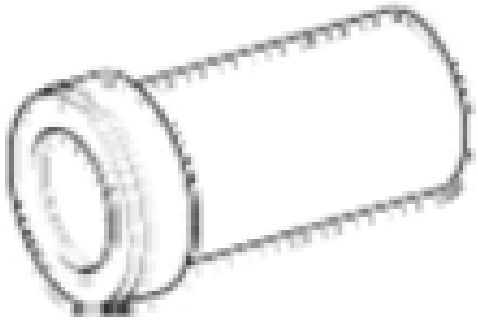
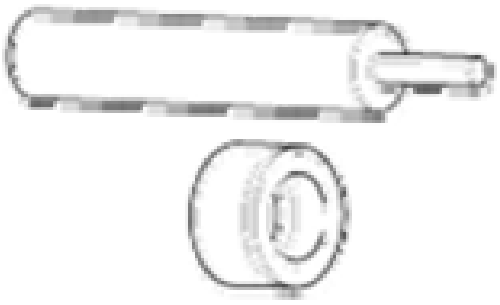
Engine will not crank-crankshaft will not rotate	Hydro-locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine black or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing belt and/or timing belt and/or timing belt gears.	1. Inspect timing belt and gears. 2. Repair as required.
	Material 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.

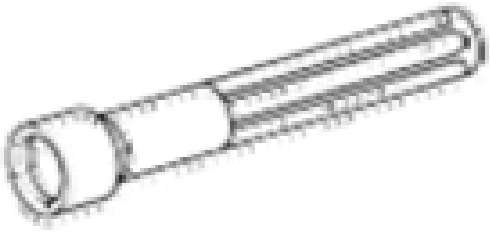
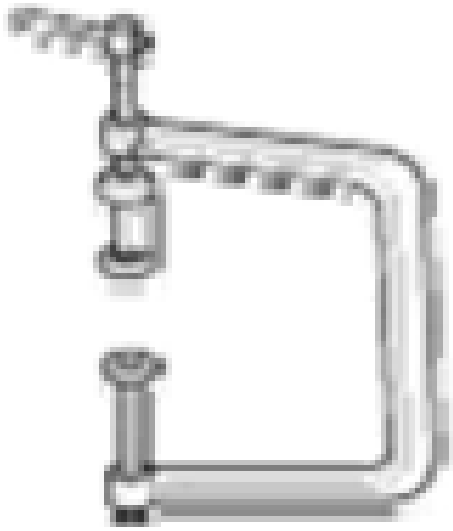
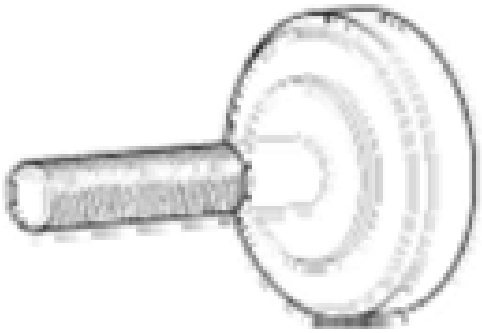
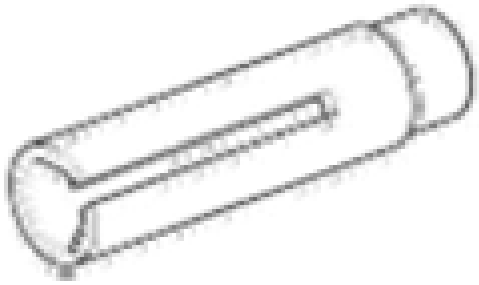
SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS CHART

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-23100)		Installation of the front oil seal

		
Valve clearance adjust tool set (09220-2D000)		Removal and installation of the tappet shim
Camshaft oil seal installer (09221-21000)		Installation of the camshaft oil seal
Valve guide installer (09221-3F100 A/B)		Removal and installation of the valve guide

Valve stem oil seal installer (09222-22001)		Installation of the valve stem oil seal
Valve spring compressor & adaptor (09222-28000, 09222-28100)		Removal and installation of the intake or exhaust valve
Crankshaft rear oil seal installer (09231-23200, 09231-H1100)		Installation of the crankshaft rear oil seal
Oxygen sensor socket (09392-2H100)		Removal and installation of the oxygen sensor

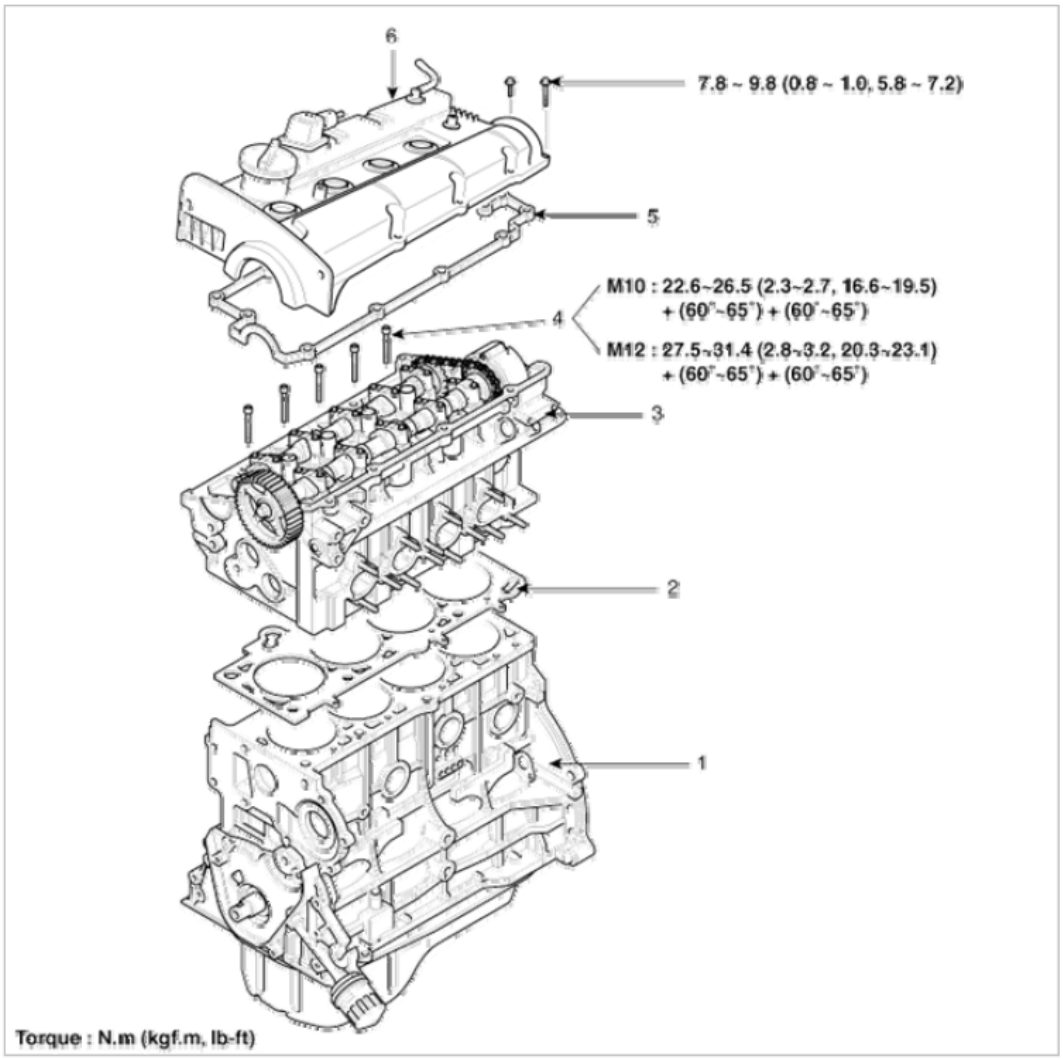
Oil pan remover (09215-3C000)		Removal of the oil pan

2010 ENGINE

Cylinder Head Assembly (Engine Mechanical System) - 2.0L - Soul

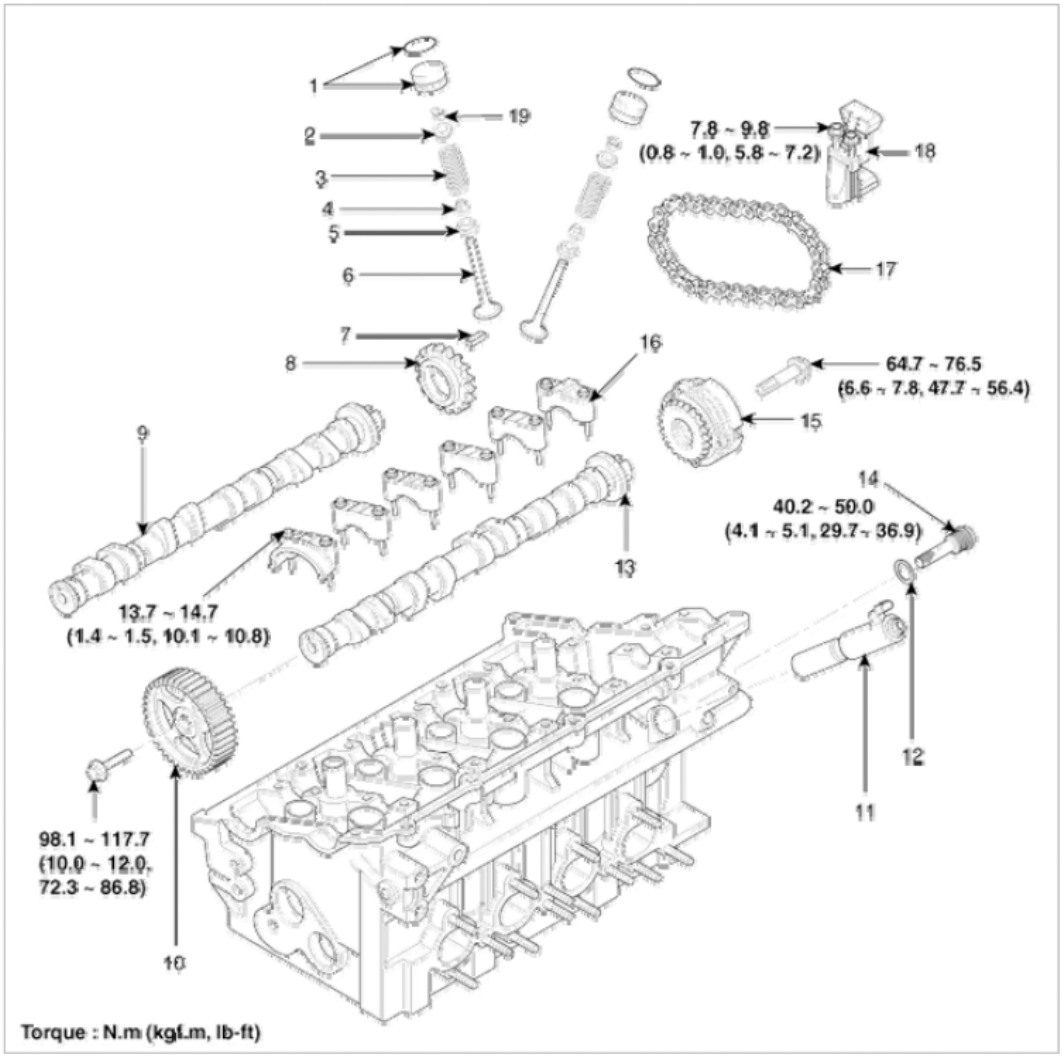
COMPONENTS AND COMPONENTS LOCATION

COMPONENTS



1. Cylinder block	4. Cylinder head bolt
2. Cylinder head gasket	5. Gasket
3. Cylinder head	6. Cylinder head cover

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



1. Mechanical lash adjuster(MLA)	8. Chain sprocket	15. CVVT assembly
2. Retainer	9. Intake camshaft	16. Camshaft bearing cap
3. Valve spring	10. Camshaft sprocket	17. Timing chain
4. Stem seal	11. Oil control valve(OCV)	18. Auto Tensioner
5. Spring seat	12. Washer	19. Retainer lock
6. Valve	13. Exhaust camshaft	
7. Key	14. OCV filter	

Fig. 2: Identifying Cylinder Head Assembly 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 covers to avoid damaging painted surfaces.**
- **To avoid damaging the cylinder head, wait until the engine coolant**

temperature drops below normal temperature before removing it.

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

NOTE:

- **Mark all wiring and hoses to avoid mis-connection.**
- **Inspect the timing belt before removing the cylinder head.**
- **Turn the crankshaft pulley so that the No. 1 piston is at top dead center.**

1. Disconnect the battery terminals (A).

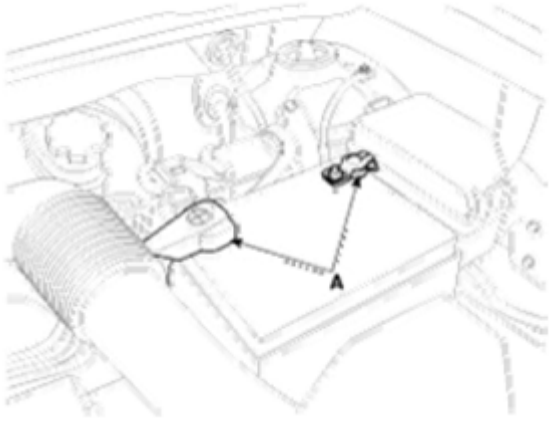


Fig. 3: Identifying Battery Terminals
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the air intake hose and air cleaner assembly.
    1. Disconnect the breather hose (A).
    2. Remove the intake air hose and the air cleaner assembly (B).

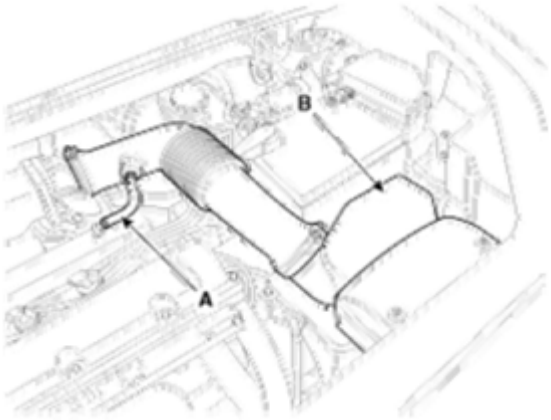


Fig. 4: Identifying Breather Hose & Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Loosen the radiator drain plug (A) and drain engine coolant. Remove the radiator cap to speed draining.

Fig. 5: Identifying Radiator Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the upper radiator hose (A) and lower radiator hose (B).

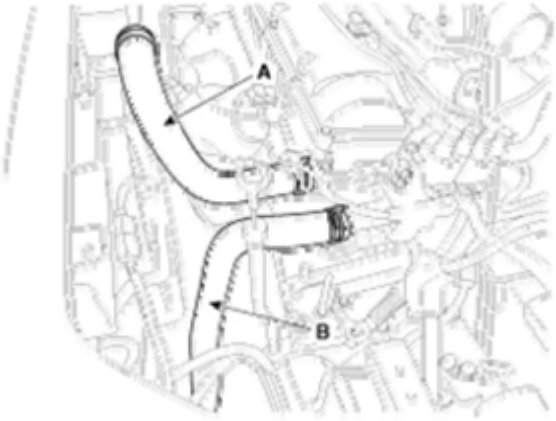


Fig. 6: Identifying Upper Radiator Hose & Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the engine wiring harness connectors, clamps and hoses.
    1. Disconnect the A/C compressor switch connector (A).
    2. Disconnect the knock sensor connector (B).
    3. Disconnect the TDC sensor connector (C).
    4. Disconnect the fuel injector (No. 1) connector (D).
    5. Disconnect the fuel injector (No. 2, 3, 4) connector (E).
    6. Disconnect the MAP sensor connector (F).

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

7. Disconnect the engine ground line (A).

Fig. 8: Identifying Engine Ground Line
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the PCSV connector (A).
9. Disconnect the TPS connector (B).
10. Disconnect the ISCA connector (C).

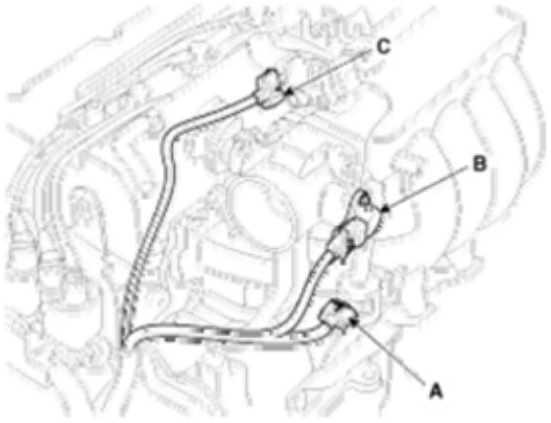


Fig. 9: Identifying Connectors (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

11. Disconnect the front heated oxygen sensor connector (A).
12. Disconnect the rear heated oxygen sensor connector (B).
13. Disconnect the oil pressure switch connector (C).
14. Disconnect the OPS connector (D).
15. Disconnect the CKPS connector (E).
16. Disconnect the OTS connector (F).
17. Disconnect the ECTS connector (D).
18. Disconnect the ignition coil connector (E).
19. Disconnect the inhibitor switch connector (F).

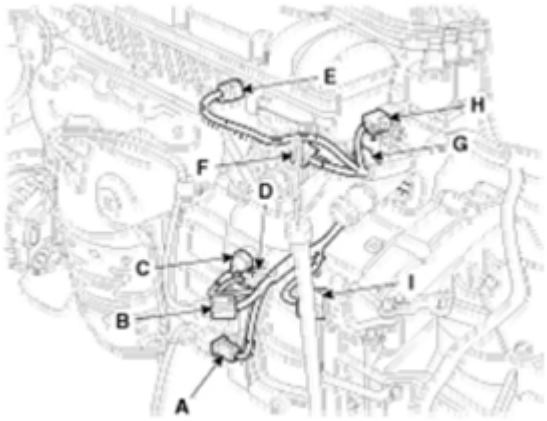


Fig. 10: Identifying Connectors (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

20. Disconnect the brake booster vacuum hose (A).
21. Disconnect the heater hoses (B).
22. Disconnect the fuel inlet hose (C).

23. Disconnect the PCSV hose (D).

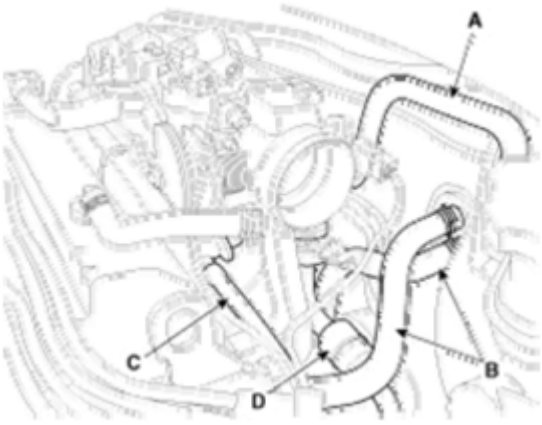


Fig. 11: Identifying Hoses
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the cylinder head cover.
    1. Disconnect the spark plug cables and do not pull on the spark plug by force.

        NOTE: Pulling on or bending the cables may damage the conductor inside.

    2. Disconnect the positive crankcase ventilation (PCV) hose (A).
    3. Disconnect the accelerator cable (B) and the auto-cruise cable (C) from the cylinder head cover.

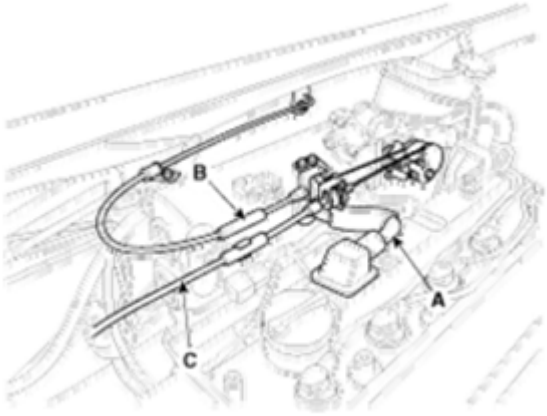


Fig. 12: Identifying PCV Hose, Accelerator Cable, & Auto-Cruise Cable
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the timing belt. (Refer to **TIMING SYSTEM (ENGINE MECHANICAL SYSTEM) - 2.0L**)
8. Remove the exhaust manifold and intake manifold. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 2.0L**)
9. Remove camshaft sprocket.

1. Hold the hexagonal head wrench (A) portion of the camshaft with a wrench (B), and remove the bolt and camshaft sprocket (C).

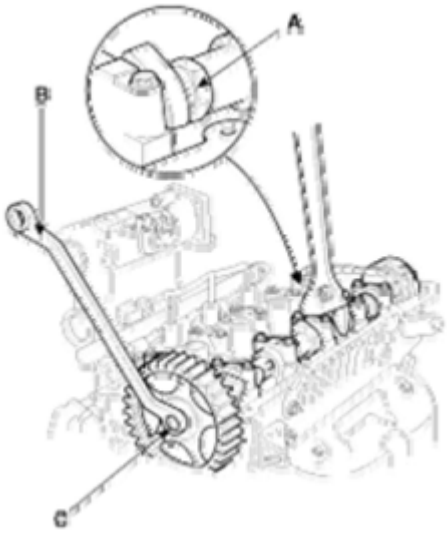


Fig. 13: Removing Camshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Be careful not to damage the cylinder head and valve lifter with the wrench.

10. Remove the timing chain auto tensioner (A) after installing the auto tensioner stopper pin (B).

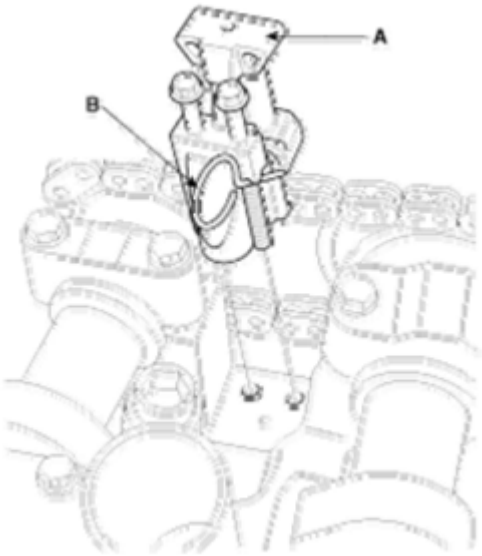


Fig. 14: Identifying Timing Chain Auto Tensioner & Auto Tensioner Stopper Pin
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the camshaft bearing caps (A) and camshafts (B).

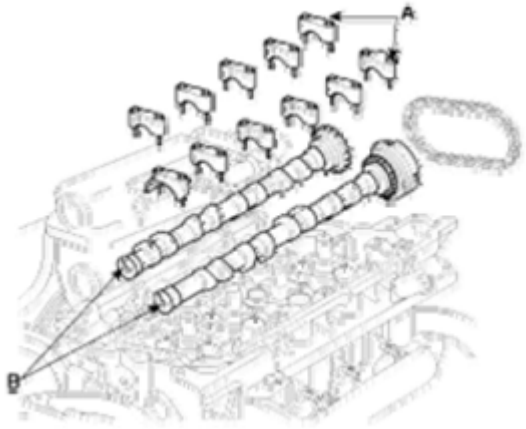


Fig. 15: Identifying Camshafts & Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the OCV (oil control valve) (A).

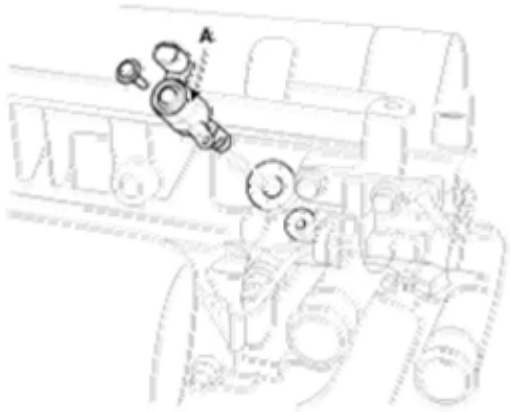


Fig. 16: Identifying Oil Control Valve
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the OCV (oil control valve) filter (A).

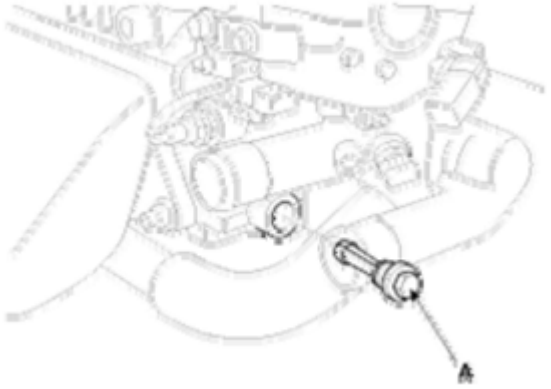


Fig. 17: Identifying OCV Filter
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the water pipe (A) and water hose (B).

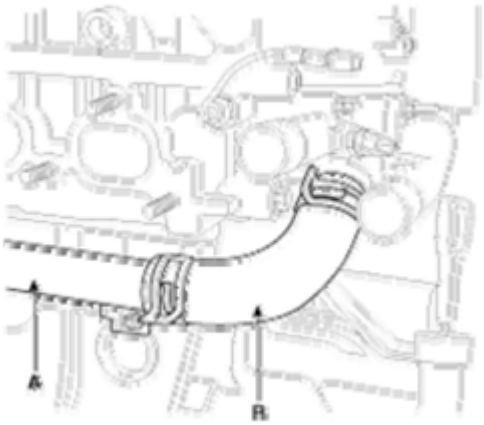


Fig. 18: Identifying Water Pipe & Water Hose
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the cylinder head bolts, then remove the cylinder head.

1. Using 8mm and 10mm hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown in **Fig. 19**. Remove the 10 cylinder head bolts and plate washers.

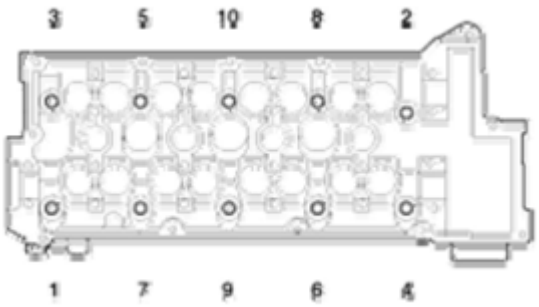


Fig. 19: Identifying Removal Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Lift the cylinder head from the dowels on the cylinder block and replace 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.

REPLACEMENT

Valve Guide

1. Using the SST (09221-3F100A), withdraw the old valve guide toward the bottom of cylinder head.

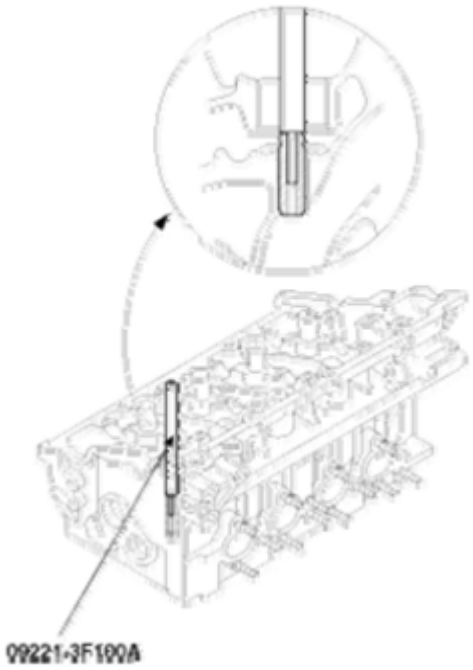


Fig. 20: Replacing Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.
3. Using the SST (09221-3F100A/B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

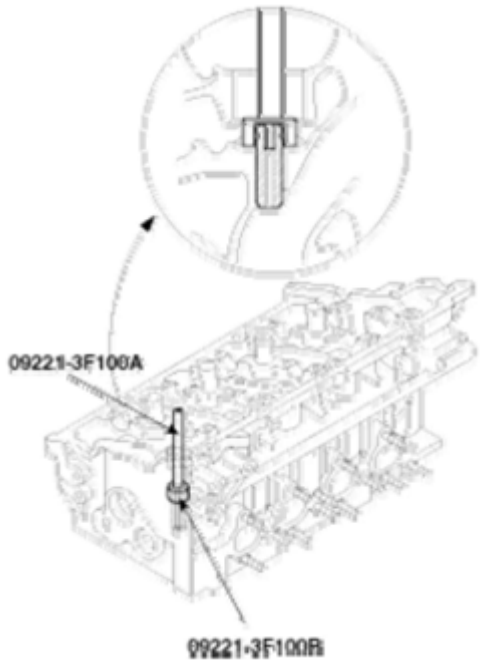


Fig. 21: Press-Fitting Valve Guide Using SST
Courtesy of KIA MOTORS AMERICA, INC.

VALVE GUIDE HOLE SIZE CHART

Over size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05 (0.002)	5	11.05 ~ 11.068 (0.4350 ~ 0.4357)
0.25 (0.010)	25	11.25 ~ 11.268 (0.4429 ~ 0.4436)
0.50 (0.020)	50	11.50 ~ 11.518 (0.4528 ~ 0.4535)

Valve guide length

Intake : 46mm (1.8in.)

Exhaust : 54.5mm (2.15in.)

NOTE: Before the valve guide is press-fitted using the SST (09221-3F100A/B), remove the valve spring seat to install the valve guide correctly.

4. After the valve guide is press-fitted, insert a new valve and check for proper stem-to-guide clearance.
5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

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).

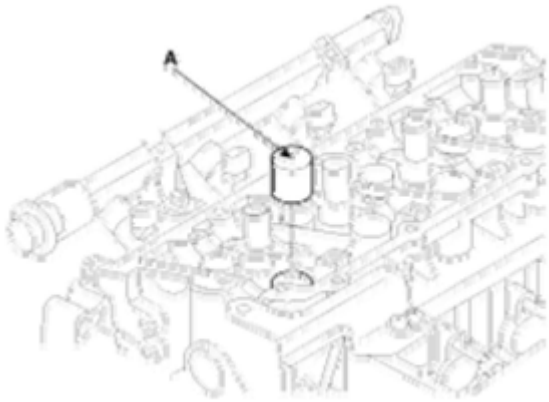


Fig. 22: Identifying MLA
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove valves.
    1. Using SST (09222-28000, 09222-28100), compress the valve spring and remove retainer lock.

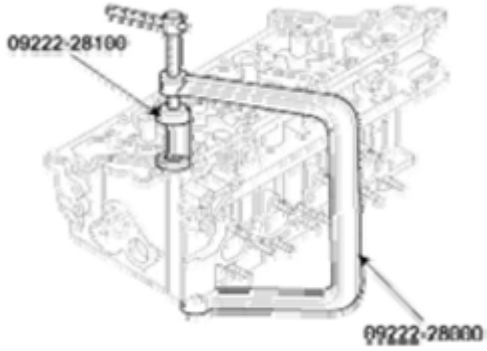


Fig. 23: Compressing Valve Spring & Removing Retainer Lock Using SST
Courtesy of KIA MOTORS AMERICA, INC.

    2. Remove the spring retainer.
    3. Remove the valve spring.
    4. Remove the valve.
    5. Remove the oil seal using needle-nose pliers.
    6. Using a magnetic finger, remove the spring seat.

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 0.03mm (0.0012 in)

Limit : 0.06 mm (0.0024 in)

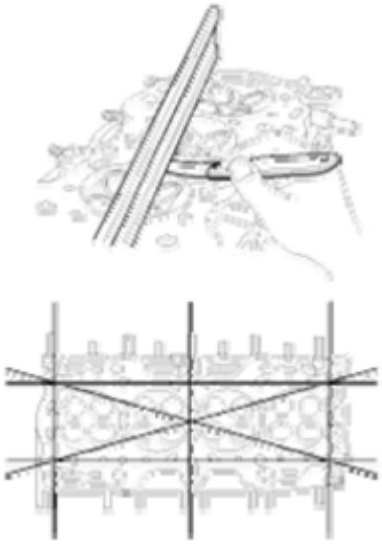


Fig. 24: Checking Flatness Of Contacting Surfaces Of Cylinder Block & Manifolds
Courtesy of KIA MOTORS AMERICA, INC.

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

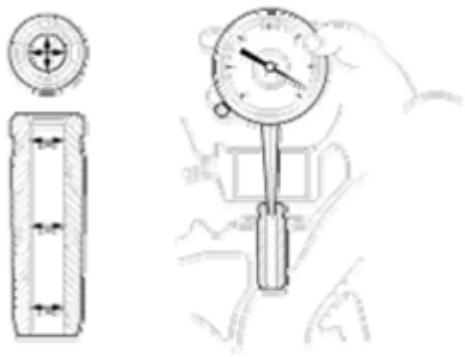


Fig. 25: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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

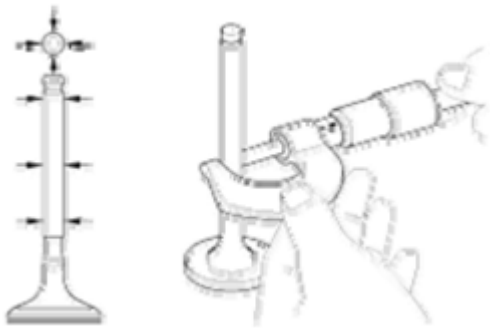


Fig. 26: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem-to-guide clearance

[Standard]

Intake : 0.02 ~ 0.05mm (0.0008 ~ 0.0020in)

Exhaust : 0.035 ~ 0.065mm (0.0014 ~ 0.0026in)

[Limit]

Intake : 0.1mm (0.0040in)

Exhaust : 0.13mm (0.0051in)

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

2. Inspect valves.
    1. Check that the valve is ground to the correct valve face angle.
    2. Check 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 : 1.6 mm (0.0630 in)

       Exhaust : 1.8 mm (0.0709 in)

       [Limit]

       Intake : 1.45 mm (0.0571 in)

       Exhaust : 1.65 mm (0.0650 in)

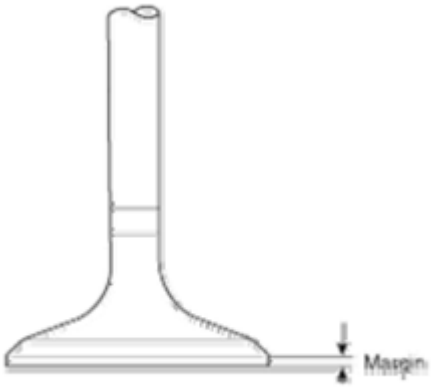


Fig. 27: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

    4. 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 : 48.86mm (1.9236 in)

Load:

18.8±0.9kg/39.0mm (41.4±2.0lb/1.5354in)

41.0±1.5kg/30.5mm (90.4±3.3lb/1.2008in)

Out-of-square : 1.5°

[Limit]

Out-of-square : 3°

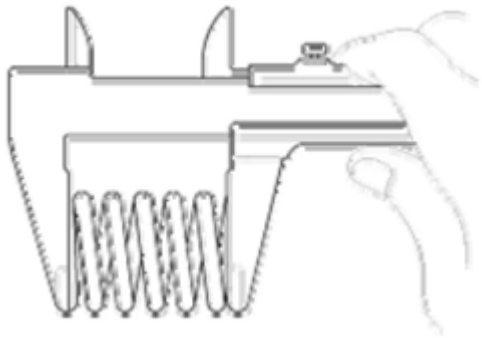


Fig. 28: Measuring Free Length & Out-Of-Square Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

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

Camshaft

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake : 44.518~44.718mm (1.7527~1.7605in)

Exhaust : 44.418~44.618mm (1.7487~1.7566in)

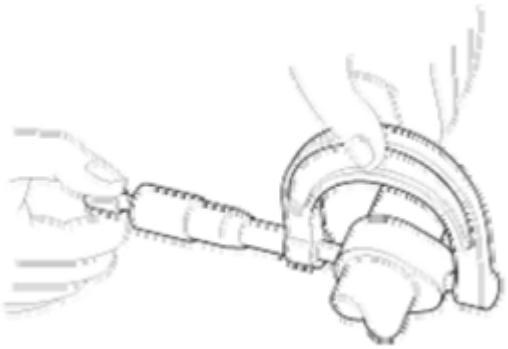


Fig. 29: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

If the cam lobe height is less than minimum, 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. 30: 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] : 0.02 ~ 0.061mm (0.0008 ~ 0.0024in)

[Limit] : 0.1mm (0.0039in)

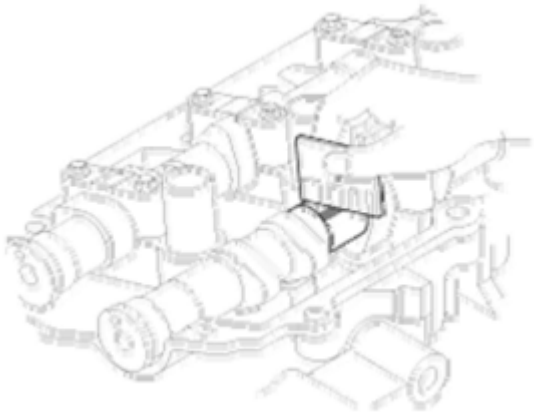


Fig. 31: Measuring Plastigage At Its Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

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] : 0.1 ~ 0.15mm (0.0039 ~ 0.0059in)

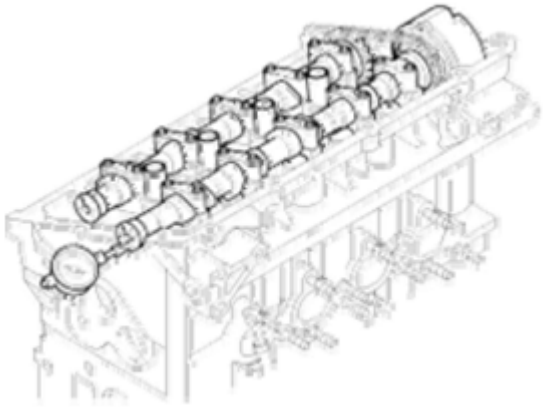


Fig. 32: Measuring Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

CVVT Assembly

1. Inspect CVVT assembly.
    1. Check that the CVVT assembly will not turn.
    2. Apply vinyl tape to all the parts except the one indicated by the arrow in **Fig. 33**.

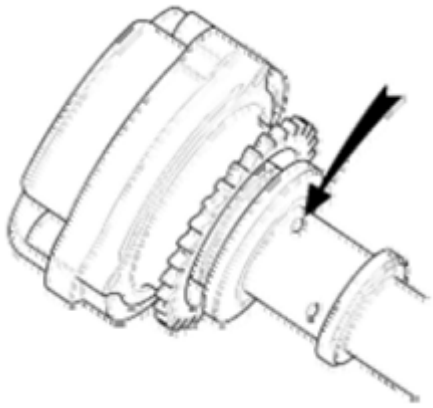


Fig. 33: Identifying No-Tape Area
Courtesy of KIA MOTORS AMERICA, INC.

3. Wind tape around the tip of the air gun and apply air of approx. 100kpa (1kgf/cm^2 , 14psi) 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 up with a shop rag.

4. Under the condition of (3), turn the CVVT assembly to the advance angle side (the arrow marked direction shown in **Fig. 33**) by 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.

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: Moves smoothly in the range about 20°

6. Turn the CVVT assembly with your hand 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 surfaces.

Replace oil seals with new ones.

1. Install valves.
   1. Install the spring seats.
   2. Using SST (09222-22001), 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.

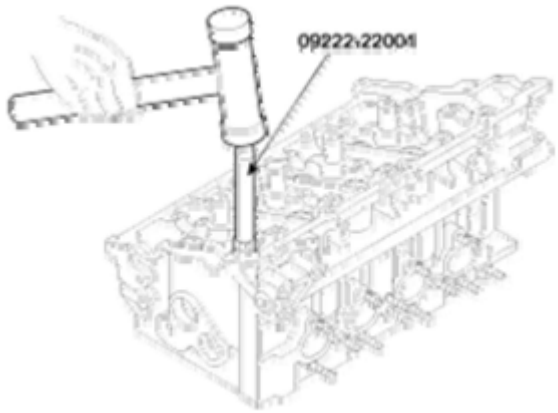


Fig. 34: Pushing In New Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

3. 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.

4. Using the SST (09222-28000, 09222-28100), 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.

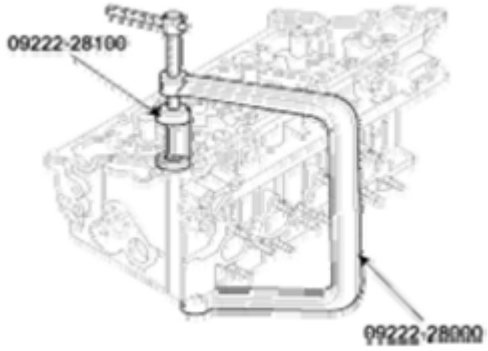


Fig. 35: Compressing Valve Spring & Installing Retainer Locks Using SST
Courtesy of KIA MOTORS AMERICA, INC.

5. 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.

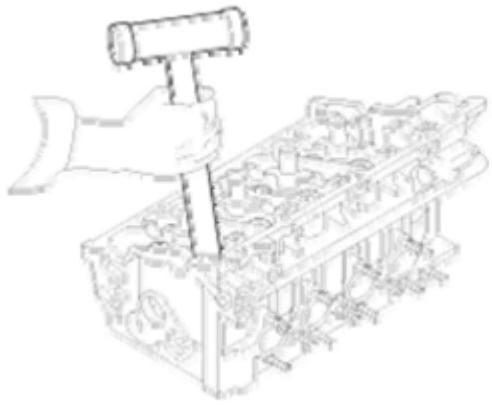


Fig. 36: Tapping Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

2. Install MLAs.

Check that the MLA rotates smoothly by hand.

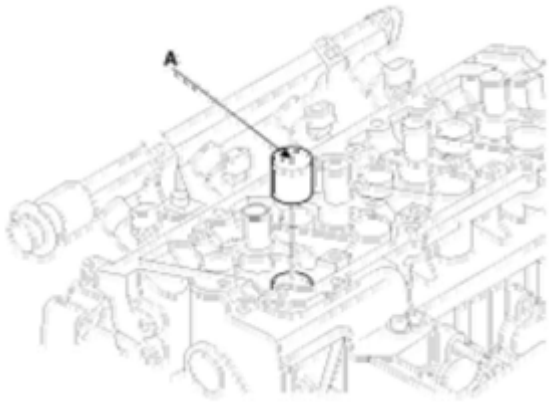


Fig. 37: Identifying MLA
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

NOTE:

- **Thoroughly clean all parts to be assembled.**
- **Always use a new head and manifold gasket.**
- **The cylinder head gasket is a metal gasket. Take care not to bend it.**
- **Rotate the crankshaft, set the No. 1 piston at TDC.**

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

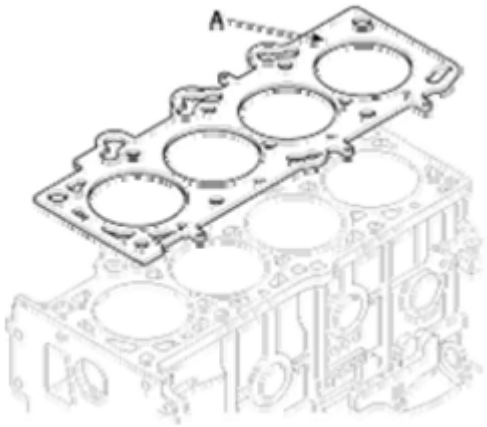


Fig. 38: Installing Cylinder Head Gasket On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

2. Place the cylinder head gently in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
    1. Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.

2. Using 8mm and 10mm hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown in **Fig. 39**.

   Tightening torque

   M10:

   22.6~26.5Nm (2.3~2.7kgf.m, 16.6~19.5lb-ft) + (60° ~ 65°) + (60° ~ 65°)

   M12:

   27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + (60° ~ 65°) + (60° ~ 65°)

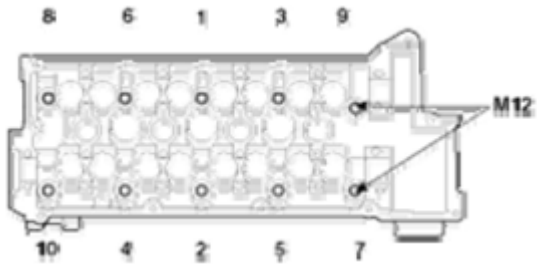


Fig. 39: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

4. Install OCV filter (A).

   Tightening torque

   40.2 ~ 50.0Nm (4.1 ~ 5.1kgf.m, 29.7 ~ 36.9lb-ft)

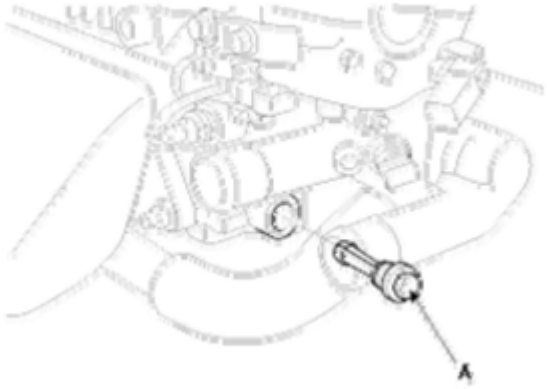


Fig. 40: Identifying OCV Filter
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Always use a new OCV filter gasket.
Keep the OCV filter clean.

5. Install OCV (A).

Tightening torque

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

CAUTION:

- **Do not reuse the OCV when dropped.**
- **Keep clean the OCV.**
- **Do not hold the OCV sleeve (B) during servicing.**
- **When the OCV is installed on the engine, do not rotate the engine while holding the OCV yoke.**

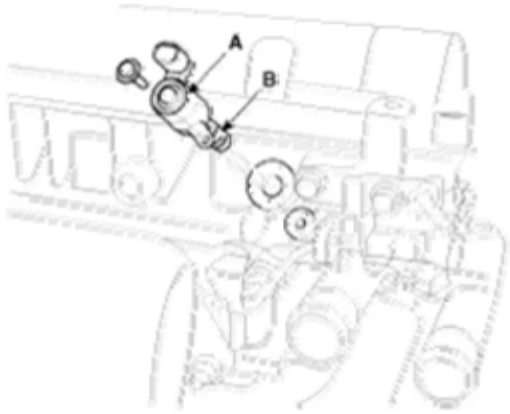


Fig. 41: Identifying OCV & OCV Sleeve
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the camshafts.
   1. Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown in **Fig. 42**.

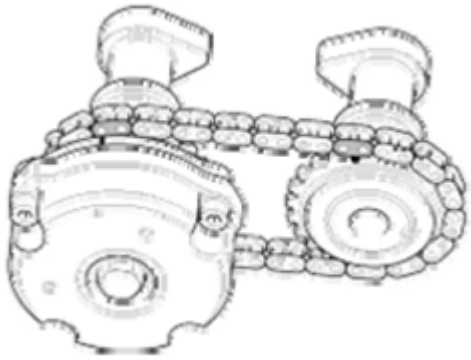


Fig. 42: Aligning Camshaft Timing Chain With Intake Timing Chain Sprocket & Exhaust Timing Chain Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the camshafts (A) and bearing caps (B).

   Tightening torque

   13.7 ~ 14.7Nm (1.4 ~ 1.5kgf.m, 10.1 ~ 10.8lb-ft)

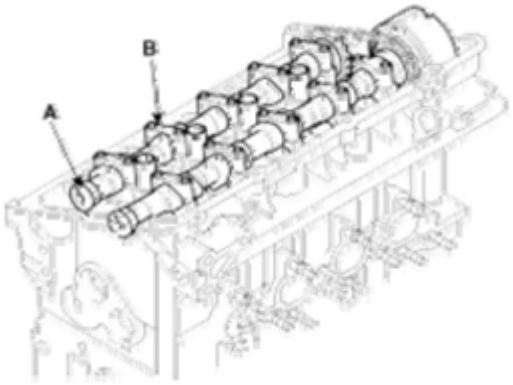


Fig. 43: Identifying Camshafts & Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the timing chain auto tensioner (A).

   Tightening torque

   7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

4. Remove the auto tensioner stopper pin (B).

Fig. 44: Identifying Timing Chain Auto Tensioner & Auto Tensioner Stopper Pin
Courtesy of KIA MOTORS AMERICA, INC.

7. Check and adjust valve clearance.
8. Using the SST (09221-21000), install the camshaft bearing oil seal.

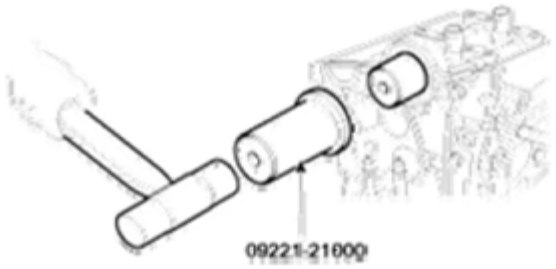


Fig. 45: Installing Camshaft Bearing Oil Seal Using SST
Courtesy of KIA MOTORS AMERICA, INC.

9. Install the camshaft sprocket and tighten the bolt to the specified torque.
    1. Temporarily install the camshaft sprocket bolt.
    2. Hold the hexagonal head wrench (A) portion of the camshaft with a wrench (B), and tighten the camshaft sprocket (C) bolt.

    Tightening torque

    Camshaft sprocket bolt:

    98.1 ~ 117.7Nm (10.0 ~ 12.0kgf.m, 72.3 ~ 86.8lb-ft)

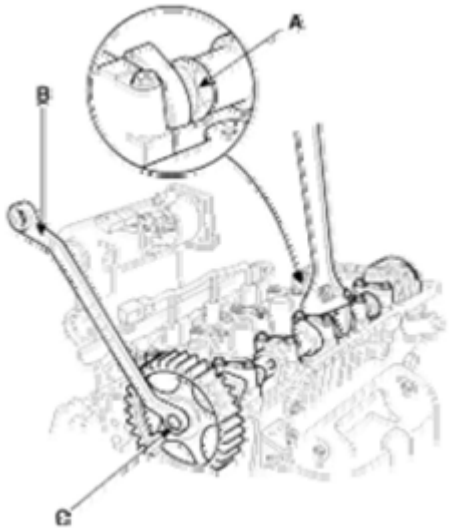


Fig. 46: Tightening Camshaft Sprocket Bolt
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the timing belt. (Refer to **TIMING SYSTEM (ENGINE MECHANICAL SYSTEM) - 2.0L**)
11. Install the cylinder head cover.

1. Install the cylinder head cover gasket (A) in the groove of the cylinder head cover (B).

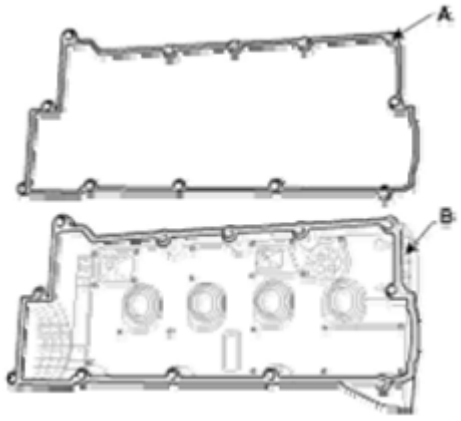


Fig. 47: Installing Cylinder Head Cover Gasket In Groove Of Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- **Before installing the head cover gasket, thoroughly clean the head cover gasket and the groove.**
- **When installing, make sure the head cover gasket is seated securely in the corners of the recesses with no gap.**

2. Apply liquid gasket to the head cover gasket at the corners of the recess.

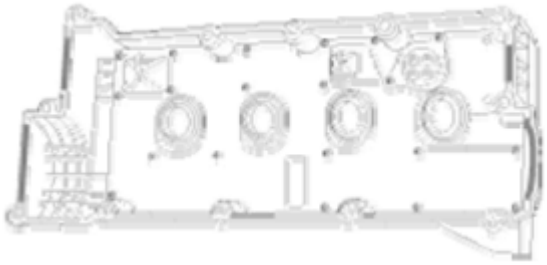


Fig. 48: Identifying Liquid Gasket Application Area On Head Cover Gasket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- **Use liquid gasket, Loctite No. 5999.**
- **Check that the mating surfaces are clean and dry before applying liquid gasket**
- **After assembly, wait at least 30 minutes before filling the engine with oil.**

3. Install the cylinder head cover (A) with the 12 bolts (B). Uniformly tighten the bolts in several passes.

Tightening torque

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

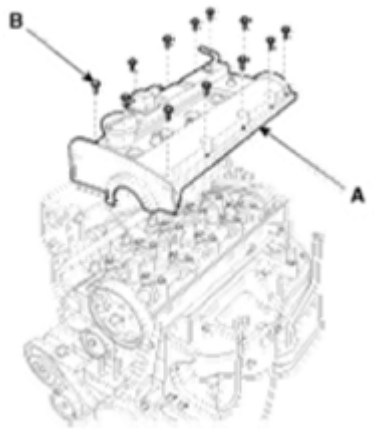


Fig. 49: Identifying Cylinder Head Cover & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

4. Connect the accelerator cable (B) and the auto-cruise cable (C) from the cylinder head cover.
5. Connect the positive crankcase ventilation (PCV) hose (A).

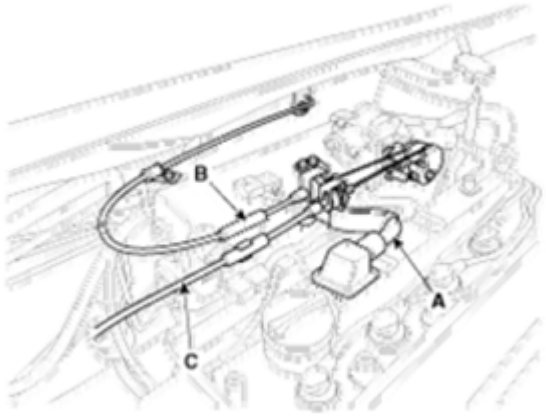


Fig. 50: Identifying PCV Hose, Accelerator Cable, & Auto-Cruise Cable
Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the spark plug cables.

NOTE: Pulling on or bending the cables may damage the inside conductor.

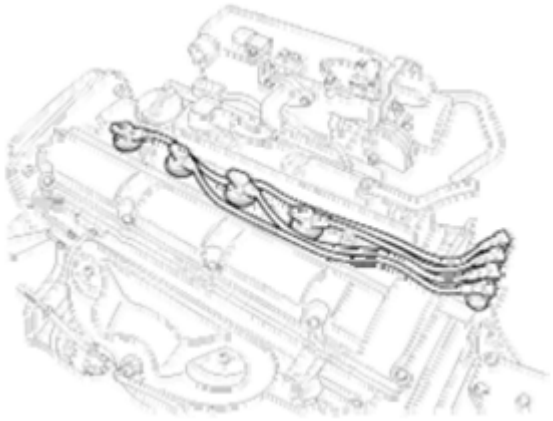


Fig. 51: Identifying Spark Plug Cables
Courtesy of KIA MOTORS AMERICA, INC.

12. Install the intake manifold and exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM (ENGINE MECHANICAL SYSTEM) - 2.0L**)
13. Connect the engine wiring harness connectors, clamps and hoses.
    1. Connect the brake booster vacuum hose (A).
    2. Connect the heater hoses (B).
    3. Connect the fuel inlet hose (C).
    4. Connect the PCSV hose (D).

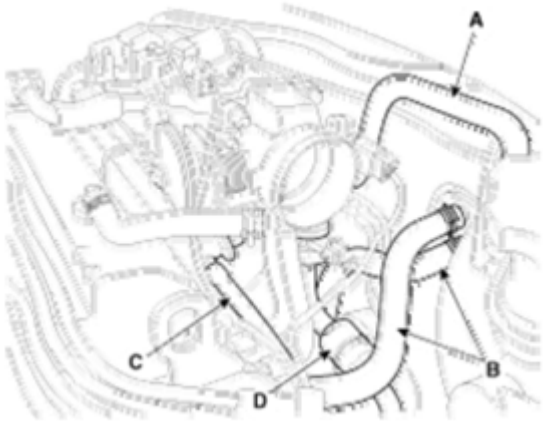


Fig. 52: Identifying Hoses
Courtesy of KIA MOTORS AMERICA, INC.

    5. Connect the front heated oxygen sensor connector (A).
    6. Connect the rear heated oxygen sensor connector (B).
    7. Connect the oil pressure switch connector (C).
    8. Connect the CKPS connector (D).
    9. Connect the OCV connector (E).

10. Connect the OTS connector (F).
11. Connect the ECTS connector (D).
12. Connect the ignition coil connector (E).
13. Connect the inhibitor switch connector (F).

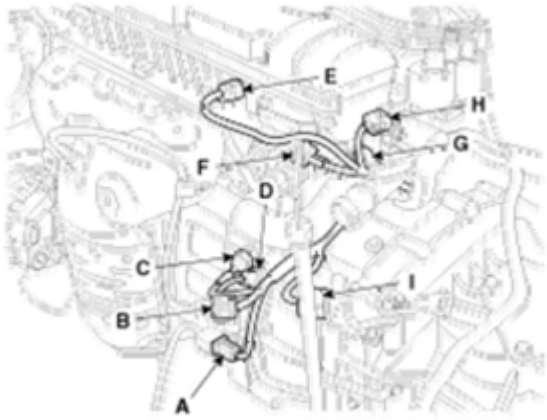


Fig. 53: Identifying Connectors (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

14. Connect the PCSV connector (A).
15. Connect the TPS connector (B).
16. Connect the ISCA connector (C).

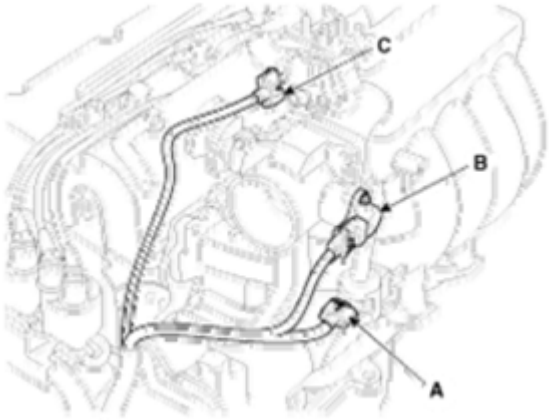


Fig. 54: Identifying Connectors (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

17. Connect the engine ground line (A).

Tightening torque:

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

Fig. 55: Identifying Engine Ground Line
Courtesy of KIA MOTORS AMERICA, INC.

18. Connect the A/C compressor switch connector (A).
19. Connect the knock sensor connector (B).
20. Connect the TDC sensor connector (C).
21. Connect the fuel injector (No. 1) connector (D).
22. Connect the fuel injector (No. 2,3,4) connector (E).
23. Connect the MAP sensor connector (F).

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

14. Install the upper radiator hose (A) and lower radiator hose (B).

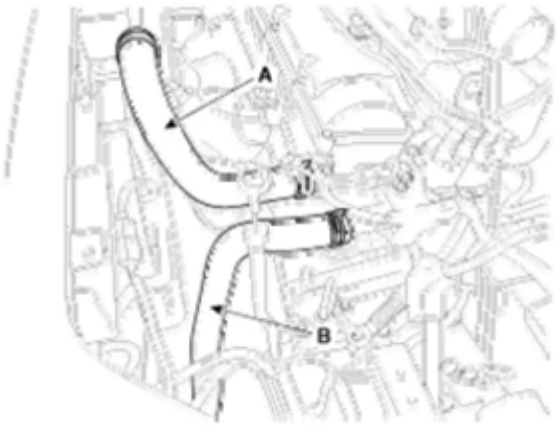


Fig. 57: Identifying Upper Radiator Hose & Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

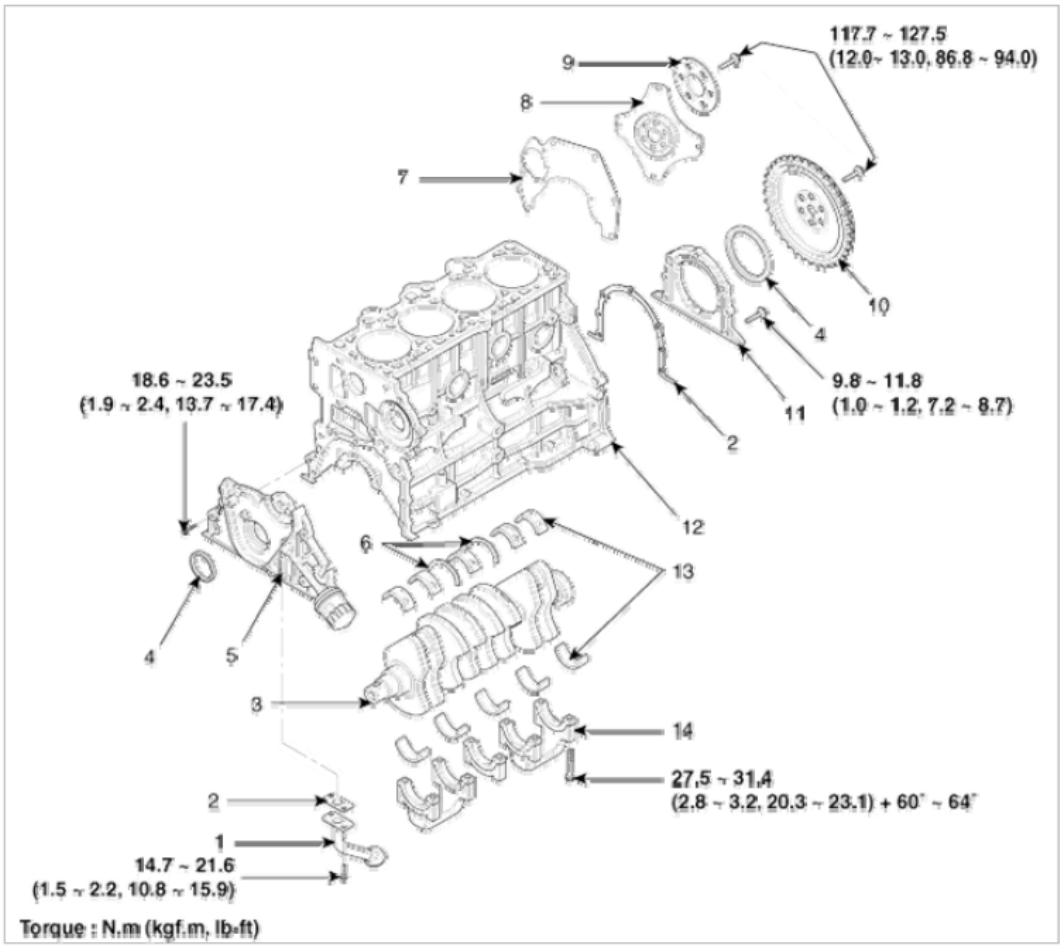
15. Install the air intake hose and air cleaner assembly.
16. Connect the battery terminals.
17. Fill with engine coolant.
18. Start the engine and check for leaks.
19. Recheck engine coolant level and oil level.

2010 ENGINE

Cylinder Block - 2.0L - Soul

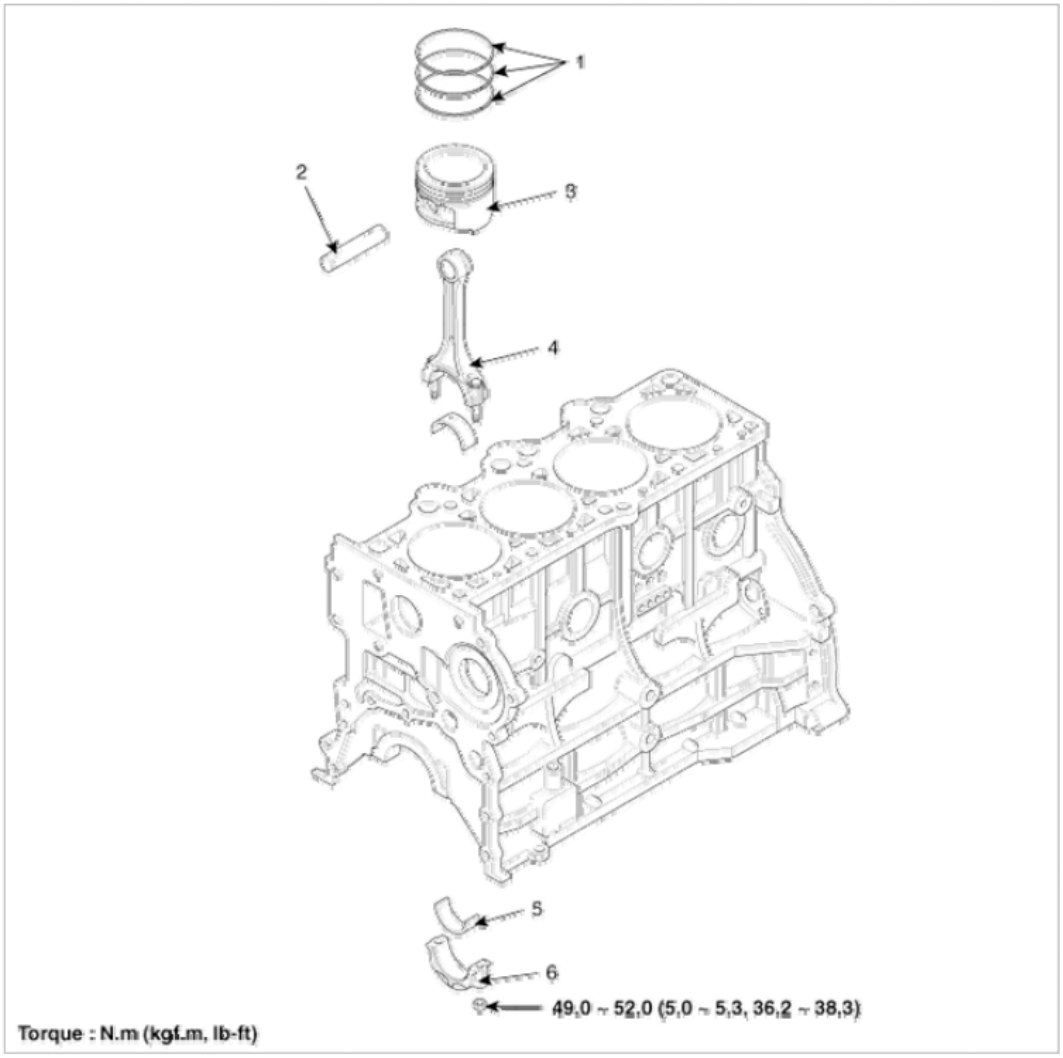
COMPONENTS AND COMPONENT LOCATIONS

COMPONENTS



1. Oil screen	6. Thrust bearing	11. Rear oil seal case
2. Gasket	7. Rear plate	12. Cylinder block
3. Crankshaft	8. Drive plate	13. Main bearing
4. Oil seal	9. Adapter plate	14. Main bearing cap
5. Front case	10. Flywheel	

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



1. Piston ring 2. Piston pin 3. Piston	4. Connecting rod 5. Connecting rod bearing 6. Connecting rod bearing cap

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 belt. (Refer to **TIMING SYSTEM - 2.0L**)
5. Remove cylinder head. (Refer to **CYLINDER HEAD ASSEMBLY - 2.0L**)
6. Remove oil level gauge assembly (A).

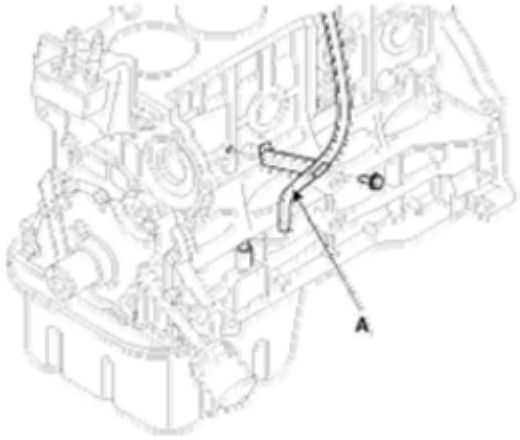


Fig. 3: Identifying Oil Level Gauge Assembly
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove knock sensor.
8. Remove oil pressure sensor (A).

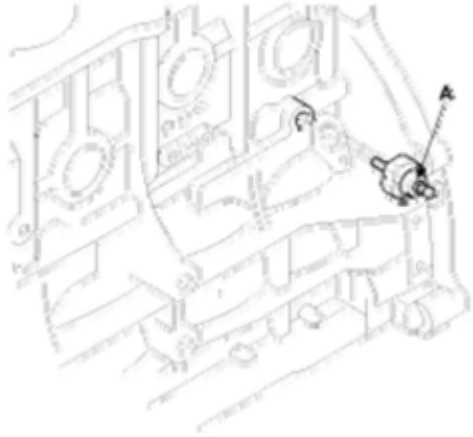


Fig. 4: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove water pump.
10. Remove oil pan.
11. Remove oil screen.

Remove the 2 bolts (C), oil screen (A) and gasket (B).

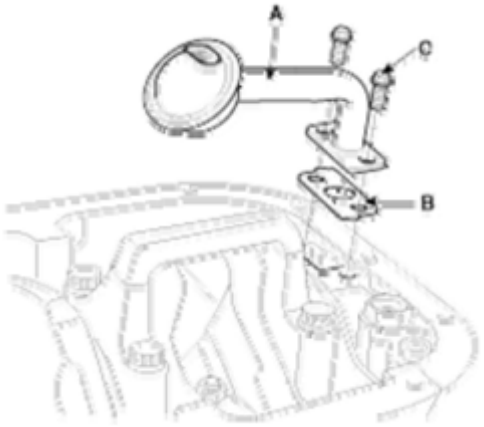


Fig. 5: Identifying Oil Screen, Gasket, & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

15. Remove front case.
16. Remove rear oil seal case.

    Remove the 5 bolts (B) and rear oil seal case (A).

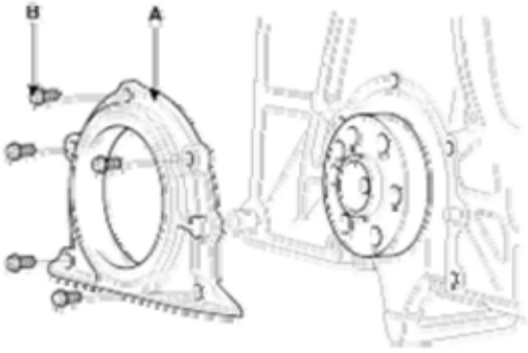


Fig. 6: Identifying Rear Oil Seal Case & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

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

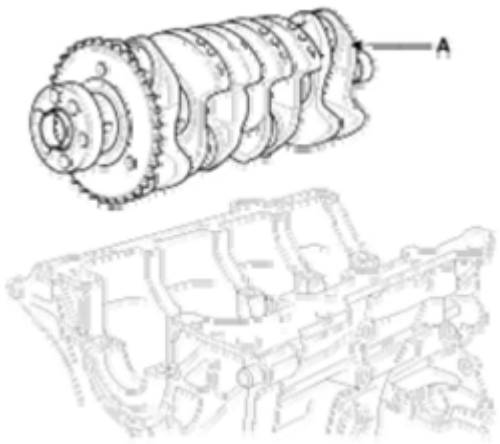


Fig. 7: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

20. 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.

21. Remove 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.

22. 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: 0.4mm (0.016in)

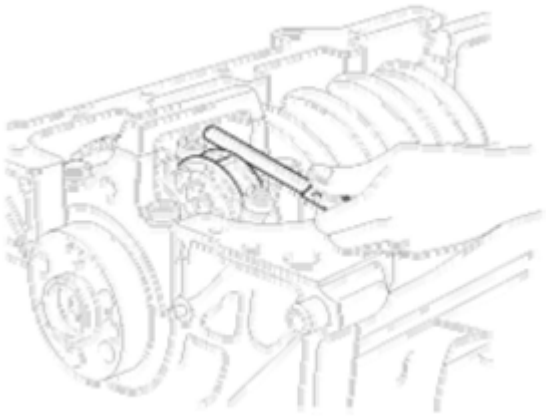


Fig. 8: Checking Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

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 the 2 connecting rod cap nuts.
   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 nuts.

      Tightening torque

      49.0 ~ 52.0 Nm (5.0 ~ 5.3kgf.m, 36.2 ~ 38.3lb-ft)

      NOTE: Do not turn the crankshaft.

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

      Standard oil clearance

      0.024 ~ 0.042mm (0.0009 ~ 0.0017in)

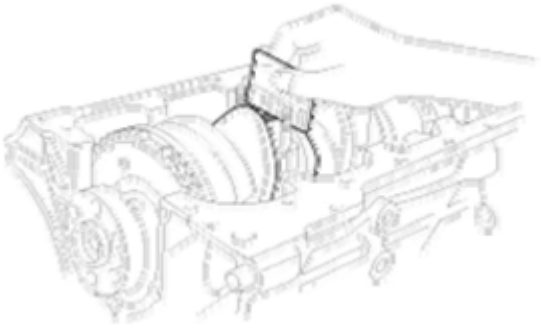


Fig. 9: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

9. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in **CONNECTING ROD SELECTION**), 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

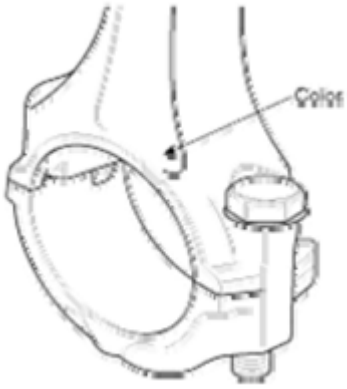


Fig. 10: Locating Connecting Rod Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod

CONNECTING ROD DISCRIMINATION

Class	Mark	Inside Diameter
A	White	48.00 ~ 48.006mm (1.8896 ~ 1.8899in.)
B	None	48.006 ~ 48.012mm (1.8899 ~ 1.8902in.)
C	Yellow	48.012 ~ 48.018mm (1.8902 ~ 1.8904in.)

Crankshaft Pin Mark Location

Fig. 11: Locating Crankshaft Pin Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

Discrimination Of Crankshaft

CRANKSHAFT DISCRIMINATION

Class	Mark	Outside Diameter Of Pan
I	Yellow	44.960 ~ 44.966mm (1.7700 ~ 1.7703in.)
II	None	44.954 ~ 44.960mm (1.7698 ~ 1.7700in.)

III	White	44.948 ~ 44.954mm (1.7696 ~ 1.7698in.)

Place Of Identification Mark (Connecting Rod Bearing)

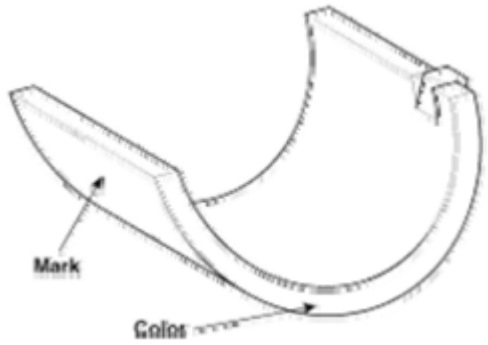


Fig. 13: Locating Connecting Rod Bearing Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod Bearing

CONNECTING ROD BEARING DISCRIMINATION

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 of connecting rod.

CONNECTING ROD SELECTION

Crankshaft Identification Mark	Connecting Rod Identification Mark	Assembling Classification Of Bearing
I (Yellow)	A (White)	D (Yellow)
	B (None)	C (Green)
	C (Yellow)	B (None)
II (None)	A (White)	C (Green)
	B (None)	B (None)
	C (Yellow)	A (Black)

III (White)	A (White)	B (None)
	B (None)	A (Black)
	C (Yellow)	AA (Blue)

3. Check the connecting rod.
    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

4. 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 tower.
    3. Place one strip of plastigage across each main journal.
    4. Reinstall the bearings and caps, then torque the bolts.

        Tightening torque:

        27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.11lb-ft) + 60° ~ 64°

        NOTE: Do not turn the crankshaft.

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

        Standard oil clearance:

        0.028 ~ 0.046mm (0.0011 ~ 0.0018in)

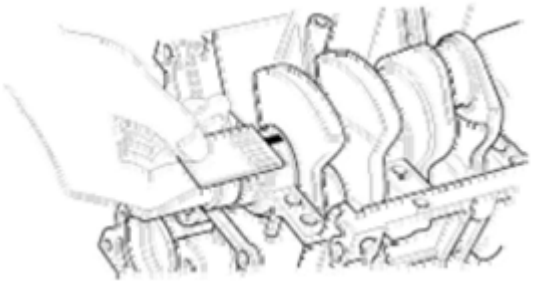


Fig. 14: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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 **CYLINDER BLOCK SELECTION**), and recheck the clearance.

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

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

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

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

Crankshaft Bore Mark Location

Letters have been stamped on the end of 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. 15: Locating Crankshaft Bore Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block

CYLINDER BLOCK DISCRIMINATION

Class	Mark	Inside Diameter
a	A	59.000 ~ 59.006mm (2.3228 ~ 2.3230in.)
b	B	59.006 ~ 59.012mm (2.3230 ~ 2.3233in.)
c	C	59.012 ~ 59.018mm (2.3233 ~ 2.3235in.)

Crankshaft Journal Mark Location

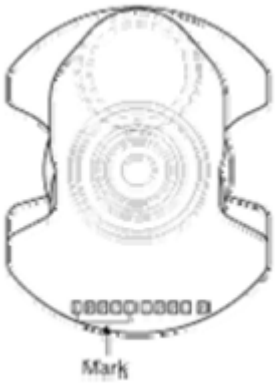


Fig. 16: Locating Crankshaft Journal Mark
Courtesy of KIA MOTORS AMERICA, INC.

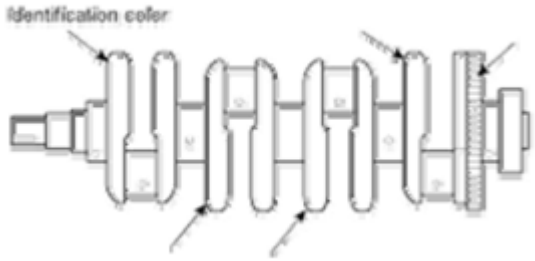


Fig. 17: Locating Crankshaft Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft

CRANKSHAFT DISCRIMINATION

Class	Mark	Outside Diameter Of Journal
I	Yellow	54.956 ~ 54.962mm (2.1636 ~ 2.1638in.)
II	None	54.950 ~ 54.956mm (2.1633 ~ 2.1636in.)
III	White	54.944 ~ 54.950mm (2.1631 ~ 2.1633in.)

Place Of Identification Mark (Crankshaft Bearing)

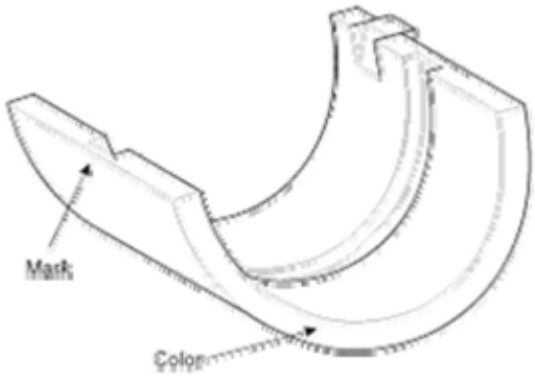


Fig. 18: Identifying Identification Mark Of Crankshaft Bearing
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing

CRANKSHAFT BEARING DISCRIMINATION

Class	Mark	Thickness Of Bearing
AA	Blue	2.014 ~ 2.017mm (0.0793 ~ 0.0794in.)
A	Black	2.011 ~ 2.014mm (0.0791 ~

		0.0793in.)
B	None	2.008 ~ 2.011mm (0.0790 ~ 0.0791in.)
C	Green	2.005 ~ 2.008mm (0.0789 ~ 0.790in.)
D	Yellow	2.002 ~ 2.005mm (0.0788 ~ 0.0789in.)

Selection

CRANKSHAFT BEARING SELECTION

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

5. 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:

   0.06 ~ 0.26mm (0.0023 ~ 0.010in)

   Limit: 0.30mm (0.0118in)

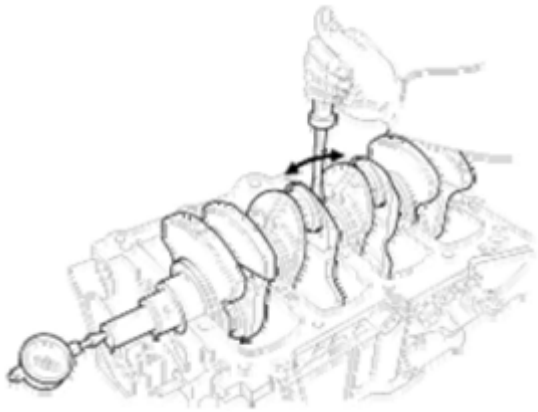


Fig. 19: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness:

2.44 ~ 2.47mm (0.096 ~ 0.097in)

6. Inspect main journals and crank pins

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

   Main journal diameter:

   56.942 ~ 56.962mm (2.2418~2.2426in)

   Crank pin diameter:

   44.946 ~ 44.966mm (1.7695 ~ 1.7703in)

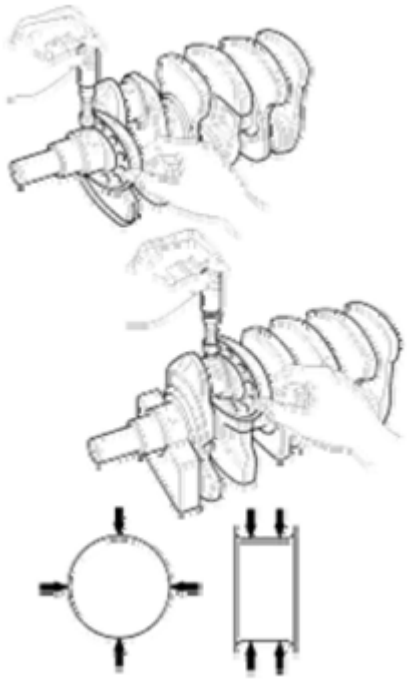


Fig. 20: Measuring Diameter Of Each Main Journal & Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

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 0.03mm (0.0012 in)

   Limit: 0.05 mm (0.0020 in)

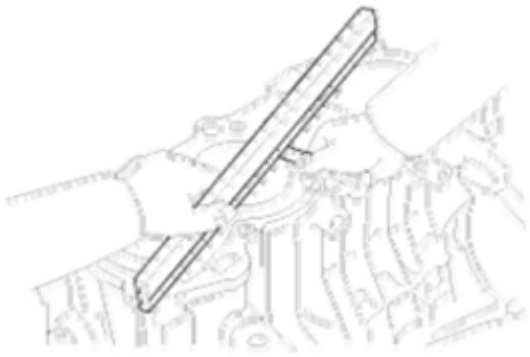


Fig. 21: Inspecting Top Surface Of Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect cylinder bore diameter

   Visually check the cylinder for vertical scratches.

   If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

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

   Standard diameter:

   82.00 ~ 82.03mm (3.2283 ~ 3.2295in)

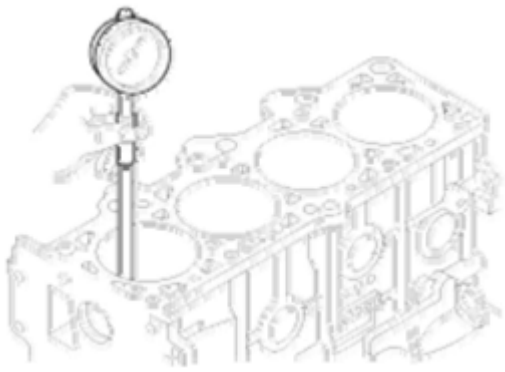


Fig. 22: Inspecting Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

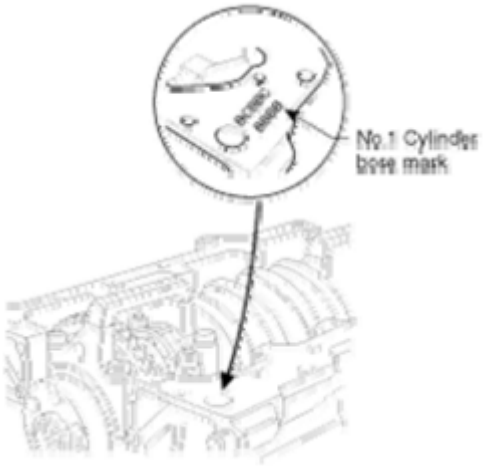


Fig. 23: Checking Cylinder Bore Size Code On Cylinder Block Bottom Face
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE SIZE CODE CHART

Class	Cylinder Bore Inner Diameter	Size code
A	82.00 ~ 82.01mm (3.228~ 3.2287in)	A
B	82.01 ~ 82.02mm (3.2287~ 3.2291in)	B
C	82.02 ~ 82.03mm (3.2291~ 3.2295in.)	C

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

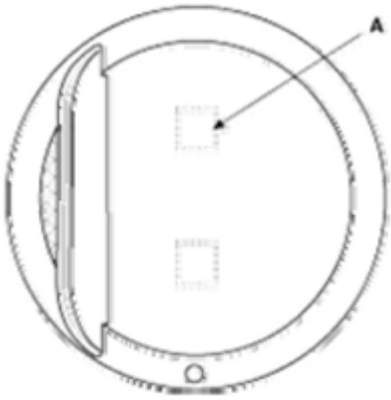


Fig. 24: Checking Piston Size Code On Piston Top Face
Courtesy of KIA MOTORS AMERICA, INC.

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

PISTON SIZE CODE CHART

Class	Piston Outer Diameter	Size Code
A	81.97 ~ 81.98mm (3.2271 ~ 3.2275in)	A
B	81.98 ~ 81.99mm (3.2275 ~ 3.2279in)	B
C	81.99 ~ 82.00mm (3.2279 ~ 3.2283in)	C

8. Select the piston related to cylinder bore class.

   Clearance

   0.02 ~ 0.04mm (0.00078 ~ 0.00157in.)

Boring Cylinder

1. Oversize pistons should be selected according to the largest bore cylinder.

   PISTON SELECTION CHART

Identification Mark	Size
0.25	0.25mm (0.010in)
0.50	0.50mm (0.020in)

NOTE: The size of piston is stamped on top of the piston.

2. Measure the outside diameter of the piston to be used.
3. According to the measured O.D., calculate the new bore size.

   New bore size = Piston O.D. + 0.02 to 0.04 mm

   (0.0008 to 0.0016 in.) (clearance between piston and cylinder) - 0.01 mm (0.0004 in.) (honing margin.)

4. Bore each of the cylinders to the calculated size.

CAUTION: To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.

5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

   Standard: 0.02-0.04 mm (0.0008-0.0016 in.)

NOTE: When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize.

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 47 mm (1.85 in.) from the top land of the piston.

    Standard diameter

    81.97 ~ 82.00mm (3.2272 ~ 3.2283in)

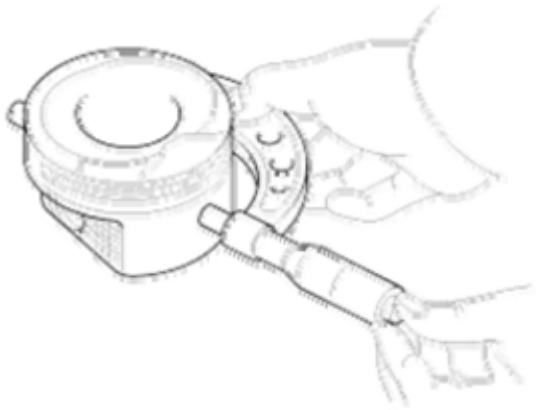


Fig. 25: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

    Piston-to-cylinder clearance

    0.02 ~ 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 the ring groove.

    Piston ring side clearance

    No. 1: 0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in)

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

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

Limit

No. 1: 0.1mm (0.004in)

No. 2: 0.1mm (0.004in)

Oil ring: 0.2 mm (0.0079 in)

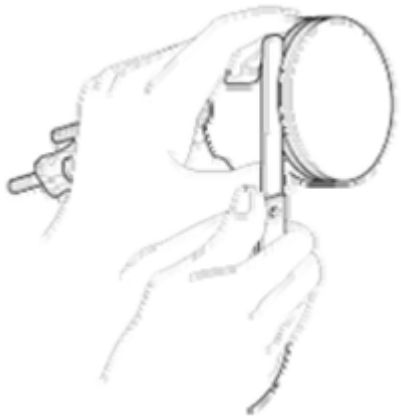


Fig. 26: Measuring Clearance Between Piston Ring & Wall Of Ring Groove
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Inspect 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: 0.20 ~ 0.35mm (0.0079 ~ 0.0138 in)

   No. 2: 0.37 ~ 0.52mm (0.0146 ~ 0.0205 in)

   Oil ring: 0.20 ~ 0.60 mm (0.0079 ~ 0.0236 in)

   Limit

No. 1, 2, oil ring: 1.0mm (0.039in)

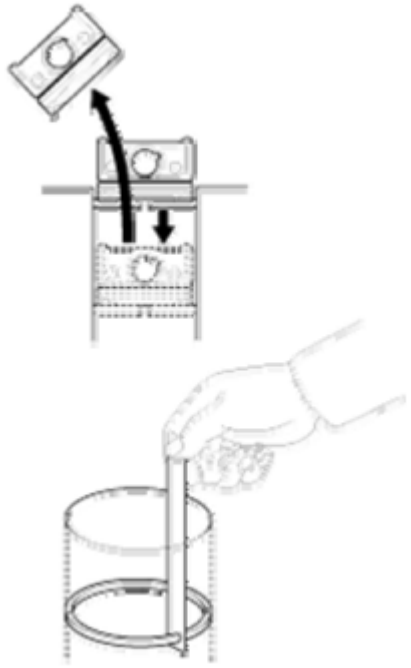


Fig. 27: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the diameter of the piston pin.

   Piston pin diameter

   20.001 ~ 20.006mm (0.7874 ~ 0.7876in)

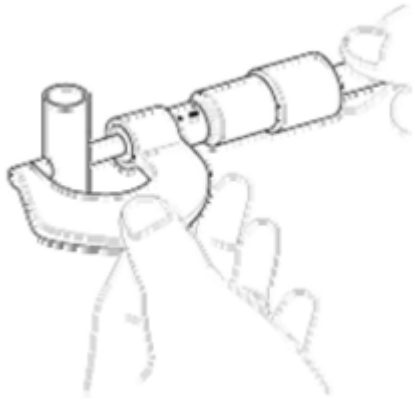


Fig. 28: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

   -0.032 ~ -0.016mm (-0.0013 ~ -0.00006in)

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.

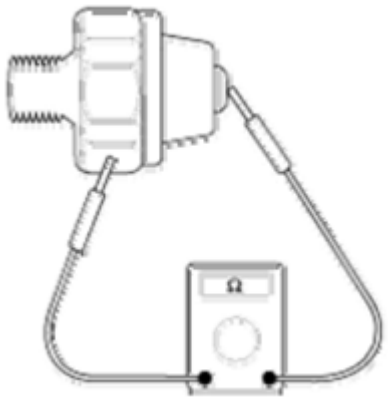


Fig. 29: Checking Continuity Between Oil Pressure Switch Terminal & Body
Courtesy of KIA MOTORS AMERICA, INC.

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.
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.

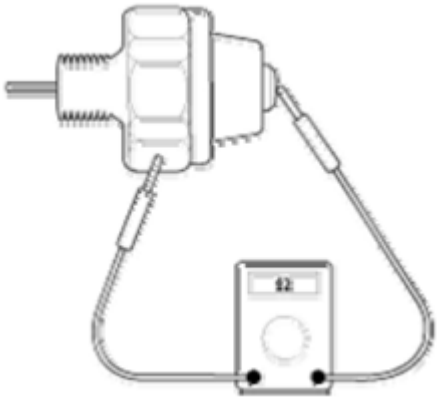


Fig. 30: Checking Continuity Between Oil Pressure Switch Terminal & Body
Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

NOTE:

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

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

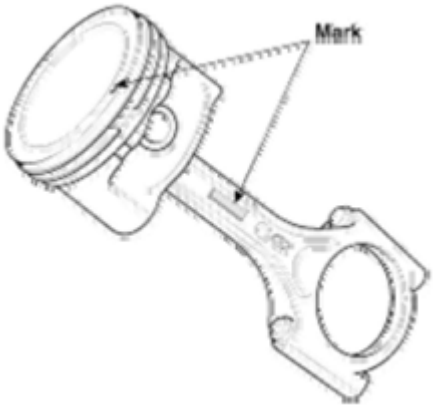


Fig. 31: Identifying Front Marks Of Piston & Connecting Rod
Courtesy of KIA MOTORS AMERICA, INC.

2. Install 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. 32**.

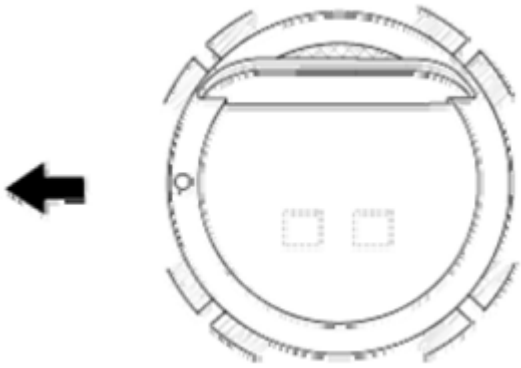


Fig. 32: Installing Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

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).

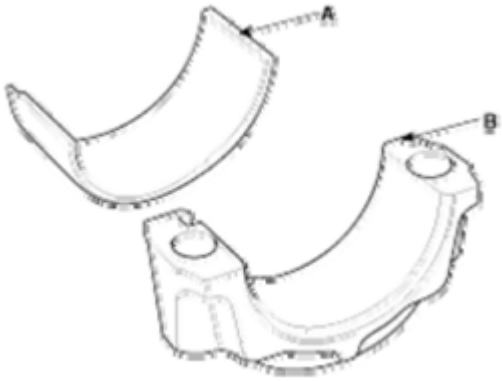


Fig. 33: Identifying Bearing & Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Install main bearings.

NOTE: Upper 1, 2,4,5 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).

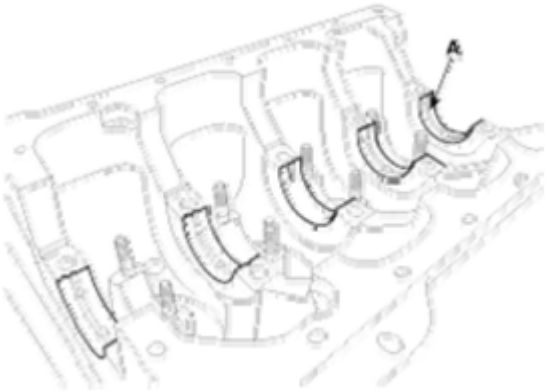


Fig. 34: Pushing In Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Install thrust bearings.

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

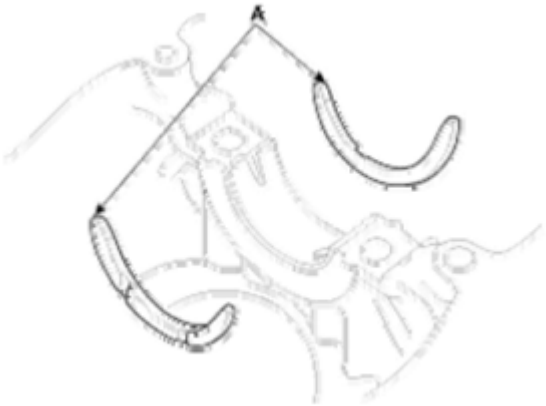


Fig. 35: Installing Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

- **The main bearing cap bolts are tightened in 2 progressive steps.**
- **Always use new main bearing cap bolts.**

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 in **Fig. 36**.

   Tightening torque

   27.5 ~ 31.4Nm (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft) + 60 ~ 64°

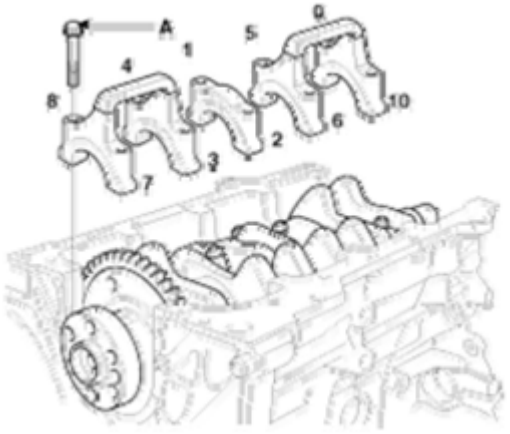


Fig. 36: Identifying Tightening Sequence Of Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. 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 nuts: 49.0 ~ 52.0Nm (5.0 ~ 5.3kgf.m, 36.2 ~ 38.3lb-ft)

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

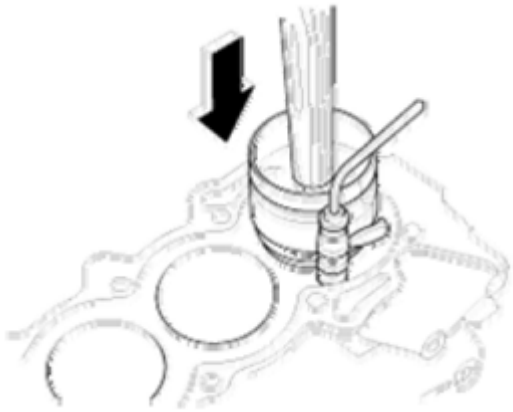


Fig. 37: Installing Piston & Connecting Rod Assemblies
Courtesy of KIA MOTORS AMERICA, INC.

11. Install a new gasket and rear oil seal case (A) with 5 bolts (B).

    Tightening torque

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

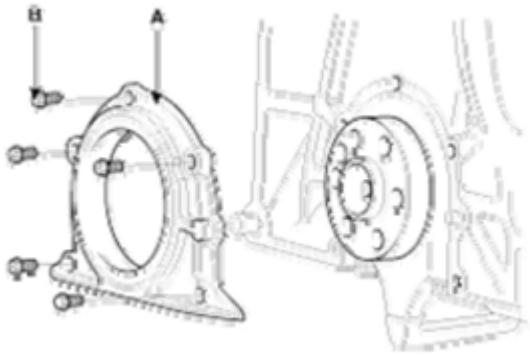


Fig. 38: Identifying Rear Oil Seal Case & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Check that the mating surfaces are clean and dry.

12. Install rear oil seal.
    1. Apply engine oil to a new oil seal lip.
    2. Using SST (09231-23200, 09231-H1100) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

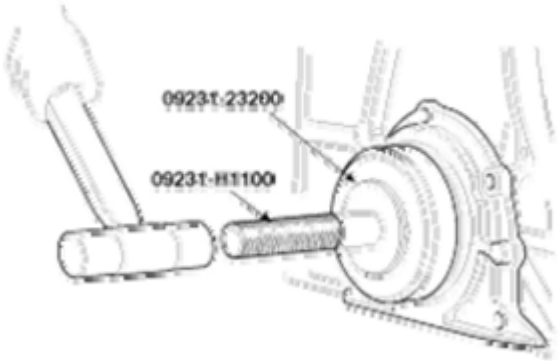


Fig. 39: Installing Oil Seal Using SST & Hammer
Courtesy of KIA MOTORS AMERICA, INC.

13. Install front case.
14. Install oil screen.

    Install a new gasket (A) and oil screen (B) with 2 bolts (C).

    Tightening torque

    14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)

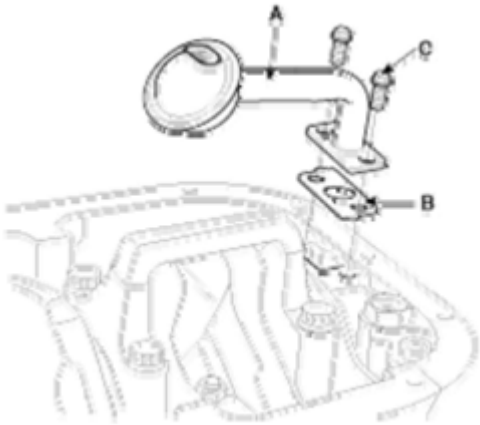


Fig. 40: Identifying Gasket, Oil Screen, & Bolts
Courtesy of KIA MOTORS AMERICA, INC.

15. Install 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 'TB 1217H' or equivalent.

   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 with the 19 bolts.

   Uniformly tighten the bolts in several passes.

   Tightening torque

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

16. Install water pump. (Refer to **COOLING SYSTEM - 2.0L**)
17. Install oil pressure sensor.
    1. Apply adhesive to 2 or 3 threads.

       Adhesive: Three bond 2310/2350 or equivalent.

    2. Install the oil pressure sensor (A).

    Tightening torque

    14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)

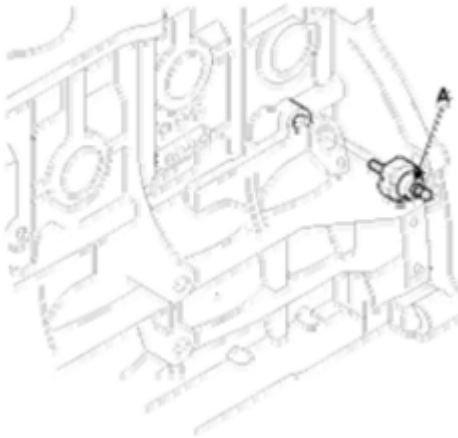


Fig. 41: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

18. Install knock sensor.

    Tightening torque

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

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

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

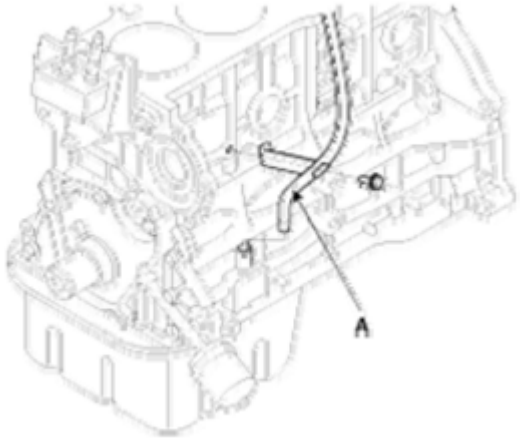


Fig. 42: Identifying Oil Level Gauge Assembly
Courtesy of KIA MOTORS AMERICA, INC.

20. Install cylinder head. (Refer to **CYLINDER HEAD ASSEMBLY - 2.0L**)
21. Install timing belt. (Refer to **TIMING SYSTEM - 2.0L**)
22. Remove engine stand.
23. A/T: Install drive plate (A) with adapter plate (B).

    Tightening torque

    117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)

Fig. 43: Identifying Drive Plate & Adapter Plate
Courtesy of KIA MOTORS AMERICA, INC.

24. M/T: Install flywheel.

Tightening torque

117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)

