

2012 Kia Sedona EX

2012 ENGINE Engine Mechanical System - General Information - Sedona

2012 ENGINE**Engine Mechanical System - General Information - Sedona****SPECIFICATIONS****ITEM SPECIFICATION**

Description		Specifications	Limit
General			
Type		V-type, DOHC	
Number of cylinders		6	
Bore		92mm (3.6220in.)	
Stroke		87.0mm (3.4252in.)	
Total displacement		3, 470cc (211.75cu.in.)	
Compression ratio		10.6	
Firing order		1-2-3-4-5-6	
Valve timing			
Intake	Opens (ATDC)	10°	
	Closes (ABDC)	74°	
Exhaust	Opens (BBDC)	52°	
	Closes (ATDC)	0°	
Cylinder head			
Flatness of gasket surface		Less than 0.05mm (0.0019in.) (Less than 0.02mm (0.0008in.) / 150x150)	
Flatness of manifold mounting	Intake	Less than 0.1mm (0.0039in.) (Less than 0.03mm (0.001in.) / 110x110)	
	Exhaust	Less than 0.1mm (0.0039in.) (Less than 0.03mm (0.001in.) / 110x110)	
Camshaft			
Cam height	LH Camshaft	Intake	47.2mm (1.8582in.)
		Exhaust	45.8mm (1.8031in.)
	RH Camshaft	Intake	47.2mm (1.8582in.)
		Exhaust	45.8mm (1.8031in.)
Journal outer diameter	LH, RH camshaft	Intake	No. 1: 27.964 ~ 27.978mm (1.1009 ~ 1.1015in.) No. 2, 3, 4: 23.954 ~ 23.970mm (0.9430 ~ 0.9437in.)
		Exhaust	No. 1: 27.964 ~ 27.978mm (1.1009 ~ 1.1015in.) No. 2, 3, 4: 23.954 ~ 23.970mm

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			(0.9430 ~ 0.9437in.)	
Bearing oil clearance	LH, RH camshaft	Intake	No. 1: 0.027 ~ 0.057mm (0.0011 ~ 0.0022in.) No. 2, 3, 4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in.)	
		Exhaust	No. 1: 0.027 ~ 0.057mm (0.0011 ~ 0.0022in.) No. 2, 3, 4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in.)	
End play			0.02 ~ 0.18mm (0.0008 ~ 0.0071in.)	
Valve				
Valve length	Intake		105.27mm (4.1445in.)	
	Exhaust		105.50mm (4.1535in.)	
Stem outer diameter	Intake		5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)	
	Exhaust		5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)	
Face angle			45.25° ~ 45.75°	
Thickness of valve head (margin)	Intake		1.56 ~ 1.86mm (0.06142 ~ 0.07323in.)	
	Exhaust		1.73 ~ 2.03mm (0.06811 ~ 0.07992in.)	
Valve stem to valve guide clearance	Intake		0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)	0.07mm (0.00275in.)
	Exhaust		0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)	0.09mm (0.00354in.)
Valve guide				
Inner diameter	Intake		5.500 ~ 5.512mm (0.2165 ~ 0.2170in.)	
	Exhaust		5.500 ~ 5.512mm (0.2165 ~ 0.2170in.)	
Length	Intake		41.8 ~ 42.2mm (1.6457 ~ 1.6614in.)	
	Exhaust		41.8 ~ 42.2mm (1.6457 ~ 1.6614in.)	
Valve seat				
Width of seat contact	Intake		1.15 ~ 1.45mm (0.05118 ~ 0.05709in.)	
	Exhaust		1.35 ~ 1.65mm (0.05315 ~ 0.06496in.)	
Seat angle	Intake		44.75° ~ 45.20°	
	Exhaust		44.75° ~ 45.20°	
Valve spring				

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Free length		45.5mm (1.7913in.)	
Load		19.3 ± 0.8kg/34.0mm (42.7 ± 1.8 lb/1.3386in.)	
		42.3 ± 1.3kg/23.8mm (93.3 ± 2.9 lb/0.9370in.)	
Out of squareness		Less than 1.5°	
MLA			
MLA outer diameter	Intake	34.964 ~ 34.980mm (1.3765 ~ 1.3772in.)	
	Exhaust	34.964 ~ 34.980mm (1.3765 ~ 1.3772in.)	
Cylinder head tappet bore inner diameter	Intake	35.000 ~ 35.025mm (1.3779 ~ 1.3789in.)	
	Exhaust	35.000 ~ 35.025mm (1.3779 ~ 1.3789in.)	
MLA to tappet bore clearance	Intake	0.020 ~ 0.061mm (0.0008 ~ 0.0024in.)	0.07mm (0.0027in.)
	Exhaust	0.020 ~ 0.061mm (0.0008 ~ 0.0024in.)	0.07mm (0.0027in.)
Valve clearance (At 20°C (68°F))			
Intake		0.17 ~ 0.23 mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust		0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0078 ~ 0.0157in.)
Cylinder block			
Cylinder bore		92.00 ~ 92.03mm (3.6220 ~ 3.6232in.)	
Flatness of gasket surface		Less than 0.05mm (0.0019in.) (Less than 0.02mm (0.0008in.) / 150x150)	
Piston			
Piston outer diameter		91.96 ~ 91.99mm (3.6204 ~ 3.6216in.)	
Piston to cylinder clearance		0.03 ~ 0.05mm (0.0012 ~ 0.0020in.)	
Ring groove width	No. 1 ring groove	1.23 ~ 1.25mm (0.0484 ~ 0.0492in.)	
	No. 2 ring groove	1.23 ~ 1.25mm (0.0484 ~ 0.0492in.)	
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)	
Piston ring			

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Side clearance	No. 1 ring	0.04 ~ 0.08mm (0.0015 ~ 0.0031in.)	0.1mm (0.004in.)
	No. 2 ring	0.04 ~ 0.08mm (0.0015 ~ 0.0031in.)	0.1mm (0.004in.)
	Oil ring	0.06 ~ 0.15mm (0.0024 ~ 0.0059in.)	0.2mm (0.008in.)
End gap	No. 1 ring	0.17 ~ 0.32mm (0.0067 ~ 0.0126in.)	0.6mm (0.0236in.)
	No. 2 ring	0.37 ~ 0.52mm (0.0145 ~ 0.0204in.)	0.7mm (0.0275in.)
	Oil ring	0.20 ~ 0.50mm (0.0078 ~ 0.0196in.)	0.8mm (0.0315in.)
Piston pin			
Piston pin outer diameter		21.097 ~ 22.000mm (0.8305 ~ 0.8661in.)	
Piston pin hole inner diameter		22.004 ~ 22.010mm (0.8662 ~ 0.8665in.)	
Piston pin hole clearance		0.004 ~ 0.013mm (0.00015 ~ 0.00051in.)	
Connecting rod small end inner diameter		22.005 ~ 22.016mm (0.8663 ~ 0.8667in.)	
Connecting rod small end hole clearance		0.005 ~ 0.019mm (0.00019 ~ 0.00074in.)	
Connecting rod			
Connecting rod big end inner diameter		58.000 ~ 58.018mm (2.2834 ~ 2.2842in.)	
Connecting rod bearing oil clearance		0.038 ~ 0.056mm (0.0014 ~ 0.0022in.)	
Side clearance		0.1 ~ 0.25mm (0.0039 ~ 0.0098in.)	
Crankshaft			
Main journal outer diameter		68.942 ~ 68.960mm (2.7142 ~ 2.7149in.)	
Pin journal outer diameter		54.954 ~ 54.972mm (2.1635 ~ 2.1642in.)	
Main bearing oil clearance		0.022 ~ 0.040mm (0.0008 ~ 0.0016in.)	
End play		0.10 ~ 0.28mm (0.0039 ~ 0.0110in.)	
Oil pump			
Regulating pressure		400 ~ 450kPa (4.08 ~ 4.59kgf/cm ² , 58.01 ~ 65.27 psi)	
Engine oil			
	Total	6.0 L (6.34 US qt, 5.28 Imp.qt)	

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Oil quantity	Oil pan	5.5 L (5.81 US qt, 4.84 Imp.qt)	
	Drain and refill	5.2 L (5.49 US qt, 4.58 Imp.qt)	Including oil filter
Oil grade	Recommendation	5W-20 / GF4 & SM	If not available, refer to LUBRICATION SYSTEM . .
	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 LUBRICATION SYSTEM .
Oil pressure (at 1000 RPM)		130 kPa (1.32kgf/cm ² , 18.77 psi) (at 1000 RPM, 110°C (230°F))	Oil temperature (oil pan): 110 ± 2°C (230 ± 35.6° F)
Cooling system			
Cooling method		Forced circulation with water pump	
Coolant quantity		8.3 L (8.8 US.qts, 7.3 Imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82 ± 2°C (179.6 ± 3.6°F)	
	Fully opened temperature	95°C (203°F)	
	Full lift	10mm (0.3937in.) MIN	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58 kPa (0.95 ~ 1.25kg/cm ² , 13.51 ~ 17.78 psi)	
	Vacuum valve opening pressure	0 ~ 6.86 kPa (0 ~ 0.07kg/cm ² , 0 ~ 0.99 psi)	
Water temperature sensor			
Type		Thermistor type	
Resistance	20°C (68°F)	2.31 ~ 2.59Kohms	
	80°C (176°F)	0.3222 Kohms	

TIGHTENING TORQUES

TIGHTENING TORQUE SPECIFICATIONS

Item	Quantity	Nm	kgf.m	lb-ft
Crankshaft pulley bolt	1	284.4 ~ 304.0	29.0 ~ 31.0	209.8 ~ 224.2
Timing chain cover bolt B	17	18.6 ~ 21.6	1.9 ~ 2.2	13.7 ~ 15.9
Timing chain cover bolt C	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

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Timing chain cover bolt D	2	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
Timing chain cover bolt F	2	24.5 ~ 26.5	2.5 ~ 2.7	18.1 ~ 19.5
Timing chain cover bolt G	4	21.6 ~ 23.5	2.2 ~ 2.4	15.9 ~ 17.4
Timing chain cover bolt H	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt I	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt J	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt K	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt L	1	21.6 ~ 26.5	2.2 ~ 2.7	15.9 ~ 19.5
Timing chain auto tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain auto tensioner nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain auto tensioner arm bolt	2	18.6 ~ 21.6	1.9 ~ 2.2	13.7 ~ 15.9
Timing chain guide bolt	4	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Oil pump chain cover bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump chain tensioner bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump chain guide bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump chain sprocket bolt	1	18.6 ~ 21.6	1.9 ~ 2.2	13.7 ~ 15.9
Lower oil pan bolt	13	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Drive belt auto tensioner bolt (M12)	1	81.4 ~ 85.3	8.3 ~ 8.7	60.0 ~ 62.9
Drive belt auto tensioner bolt (M8)	1	17.7 ~ 21.6	1.8 ~ 2.2	13.0 ~ 15.9
Drive belt idler bolt	1	53.9 ~ 55.9	5.5 ~ 5.7	39.8 ~ 41.2
OCV (oil control valve) bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head bolt	16	(37.3~41.2) + (118~122°) + (88~92°)	(3.8~4.2) + (118~122°) + (88~92°)	(27.5~30.4) + (118~122°) + (88~92°)
Cylinder head bolt	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
CVVT bolt	4	64.7 ~ 76.5	6.6 ~ 7.8	47.7 ~ 56.4
Camshaft bearing cap bolt	32	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head cover bolt	38	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Connecting rod bolt	12	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Main bearing cap inner bolt (M11)	8	49.0 + 90°	5.0 + 90°	36.2 + 90°
Main bearing cap outer bolt (M8)	8	19.6 + 120°	2.0 + 120°	14.5 + 120°
Main bearing cap side bolt (M8)	8	29.4 ~ 31.4	3.0 ~ 3.2	21.7 ~ 23.1
Oil drain cover bolt	6	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil jet bolt	3	27.5 ~ 31.3	2.8 ~ 3.2	20.2 ~ 23.1
Rear oil seal case bolt	6	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Baffle plate bolt	6	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan bolt	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

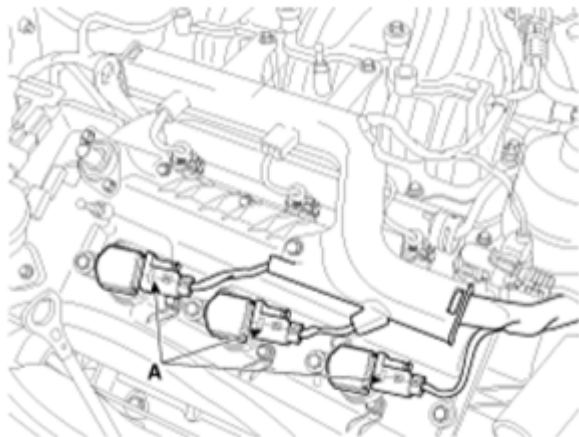
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Knock sensor bolt	2	15.7 ~ 23.5	1.6 ~ 2.4	11.6 ~ 17.4
Drive plate bolt	8	71.54 ~ 75.46	7.3 ~ 7.7	52.80 ~ 55.69
Oil filter cap		35.0	3.57	25.8
Oil drain bolt	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil pump bolt	3	20.6 ~ 22.6	2.1 ~ 2.3	15.2 ~ 16.6
Oil filter body bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil cover bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt (Timing chain cover bolt L)	1	21.6 ~ 26.5	2.2 ~ 2.7	15.9 ~ 19.5
Water pump bolt (Timing chain cover bolt K)	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt (Timing chain cover bolt G)	4	21.6 ~ 23.5	2.2 ~ 2.4	15.9 ~ 17.4
Water pump pulley bolt	4	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Water temp. control nut	4	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water temp. control bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water inlet pipe bolt	3	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Intake manifold bolt	6	26.5 ~ 31.4	2.7 ~ 3.2	19.5 ~ 23.1
Intake manifold nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Surge tank bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Surge tank bolt (M6 x 112.6)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Surge tank nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Surge tank stay bolt (M10 x 1.25)	2	27.5 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1
Exhaust manifold nut	16	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.6
Exhaust manifold stay bolt	4	24.5 ~ 35.3	2.5 ~ 3.6	18.1 ~ 26.0
Heat protector bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Front muffler nut	4	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler nut	4	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Main muffler nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Air cleaner assembly bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake air hose clamp bolt	1	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6

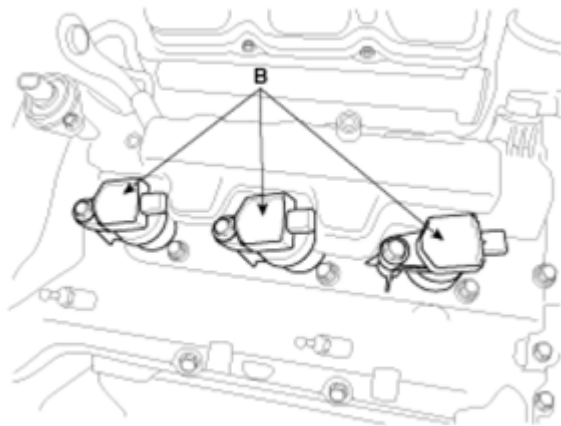
REPAIR PROCEDURES**COMPRESSION PRESSURE INSPECTION**

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

1. Warm up engine until the normal operating temperature (80~95°C (176-203°F)).
2. Remove the surge tank. Refer to **INTAKE AND EXHAUST SYSTEM**.
3. Remove the ignition coil connectors (A) and ignition coils (B).

**Fig. 1: Ignition Coil Connectors**

Courtesy of KIA MOTORS AMERICA, INC.

**Fig. 2: Ignition Coils**

Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the spark plugs.

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

5. Check cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole.
 2. Fully open the throttle.
 3. Crank the engine over 7 times to measure compression pressure.

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

4. Repeat step 1 though 3 for each cylinder.

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

Compression pressure:

1, 029 kPa (10.5kgf/cm² , 149 psi) (250~400 RPM)

Minimum pressure:

882 kPa (9.0kgf/cm² , 128 psi)

Difference between each cylinder:

98 kPa (1.0kg/cm² , 14 psi) or less

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

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

NOTE: Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C (68°F)) and cylinder head is installed on the cylinder block.

1. Remove the engine cover.
2. Remove the engine side cover.
3. Remove air cleaner assembly.
4. Remove the surge tank. Refer to **INTAKE AND EXHAUST SYSTEM** .
5. Remove the cylinder head cover. Refer to **TIMING SYSTEM** .
6. Set No. 1 cylinder to TDC/compression.
 1. Turn the crankshaft pulley clockwise and align its groove with the timing mark "T" of the lower timing chain cover.

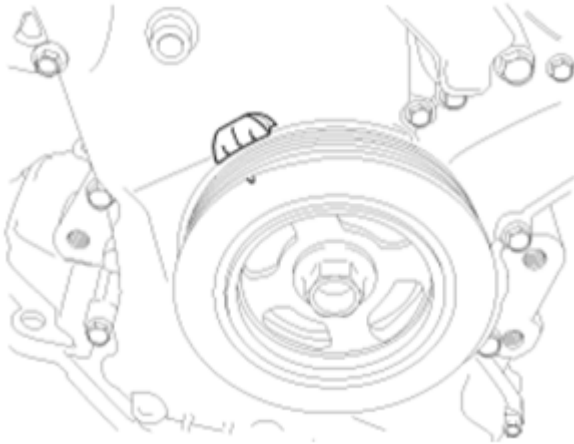


Fig. 3: Crankshaft Pulley Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

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

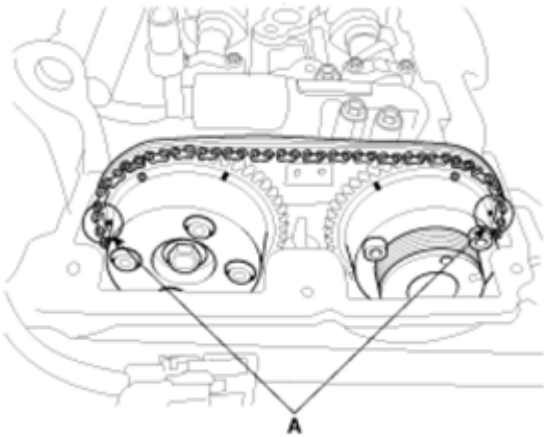


Fig. 4: Identifying Mark Of Camshaft Timing Sprocket (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

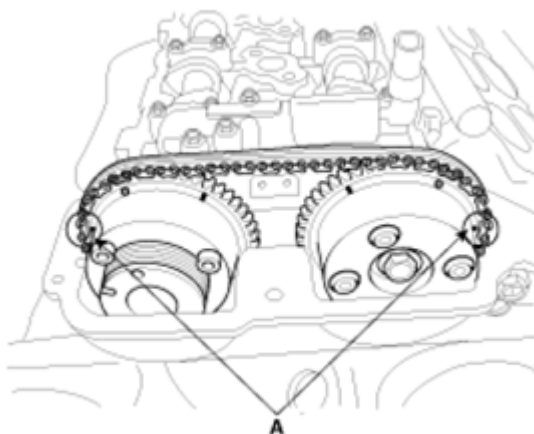


Fig. 5: Identifying Mark Of Camshaft Timing Sprocket (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not rotate engine counterclockwise.

7. Inspect the valve clearance.

1. With No. 1 cylinder at TDC inspect clearances only on the valves shown in diagram below.

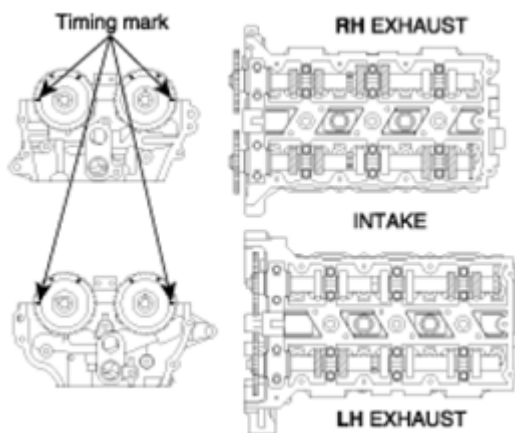


Fig. 6: Identifying Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

Measurement method.

- A. Using a thickness gauge, measure the clearance between the tappet 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 tappet.

Valve clearance

Specification

Engine coolant temperature : 20°C (68°F)

Limit

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

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

2. Turn the crankshaft pulley clockwise one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.
3. With No. 4 cylinder at TDC inspect clearances only the valves shown in diagram below. Refer to procedure step 1.

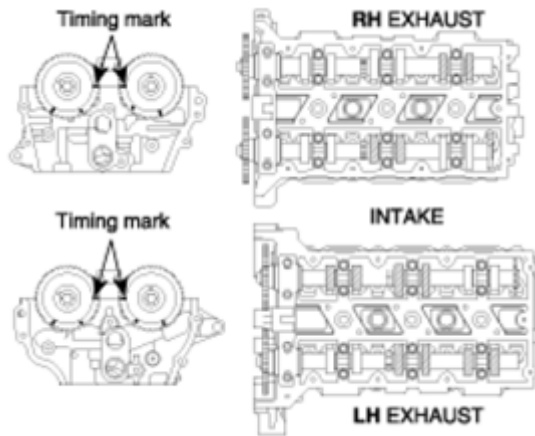


Fig. 7: Identifying Timing Marks

Courtesy of KIA MOTORS AMERICA, INC.

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

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

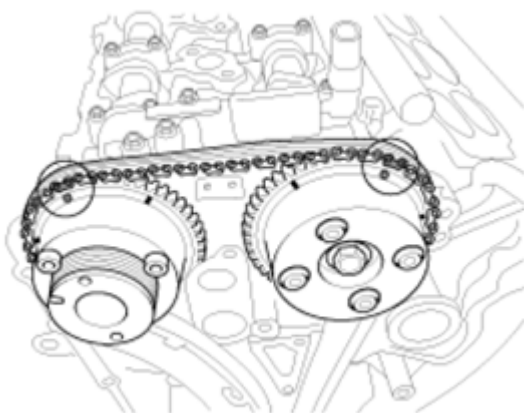


Fig. 8: Identifying Mark On Chain (1 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.



Fig. 9: Identifying Mark On Chain (2 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.



Fig. 10: Identifying Mark On Chain (3 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.

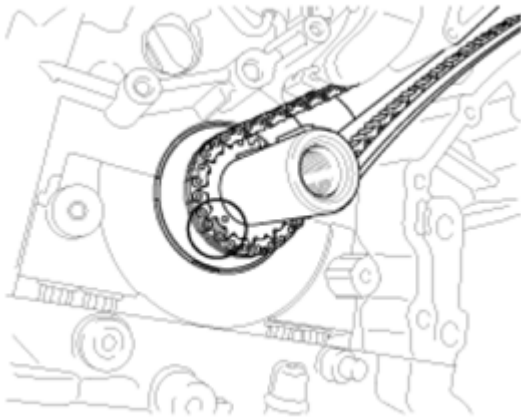


Fig. 11: Identifying Mark On Chain (4 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the LH/RH exhaust camshaft OCV (A).

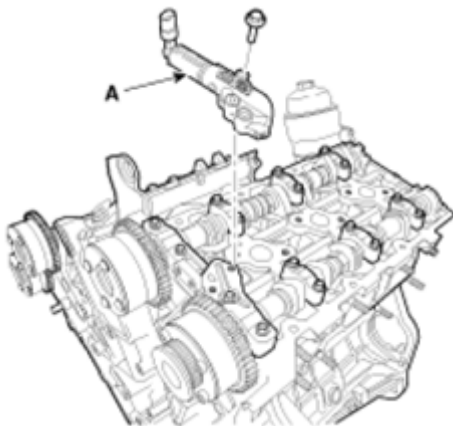


Fig. 12: Identifying Exhaust Camshaft OCV (1 Of 2)
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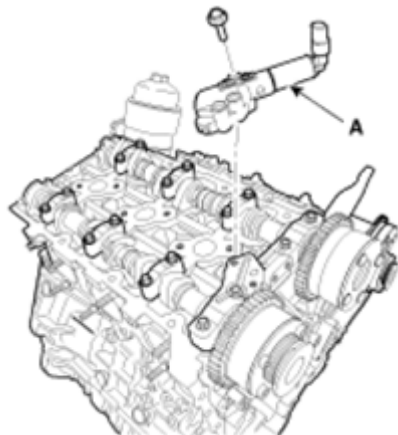


Fig. 13: Identifying Exhaust Camshaft OCV (2 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the LH/RH camshaft bearing cap (A) and thrust bearing cap (B).

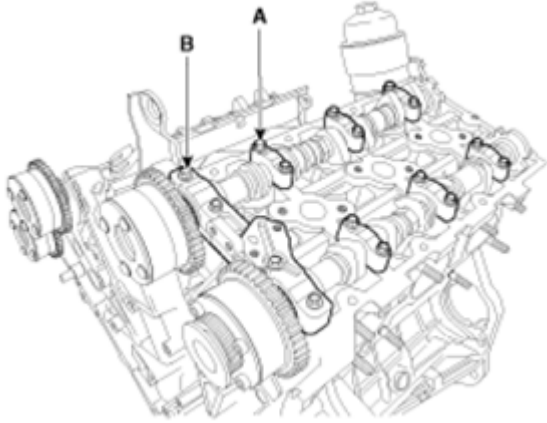


Fig. 14: Identifying Camshaft & Thrust Bearing Cap (1 Of 2)
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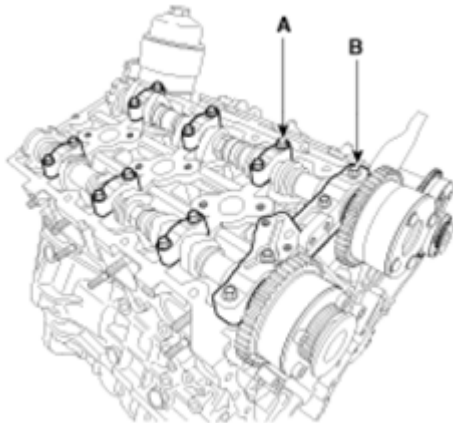


Fig. 15: Identifying Camshaft & Thrust Bearing Cap (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the LH/RH camshaft assembly (A).

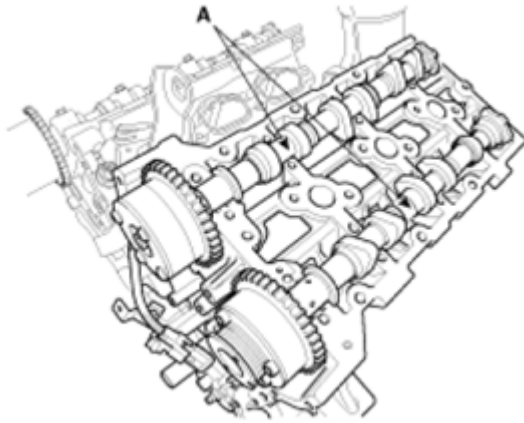


Fig. 16: Identifying Camshaft Assembly (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

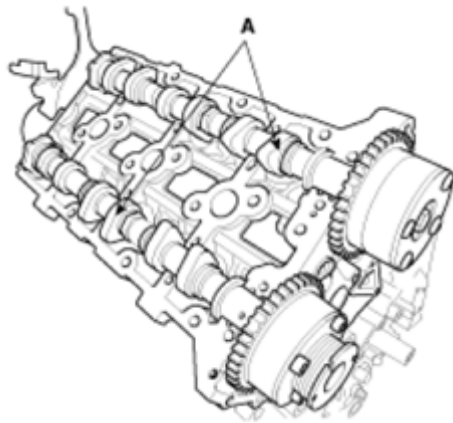


Fig. 17: Identifying Camshaft Assembly (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the tappets.
7. Measure the thickness of the removed tappet using a micrometer.

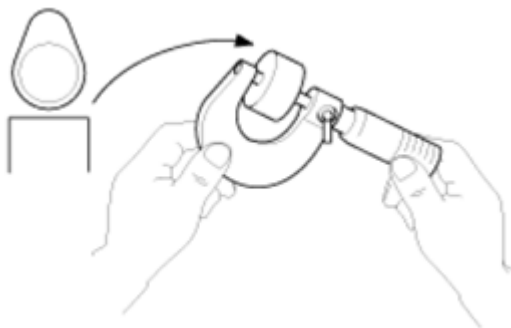


Fig. 18: Measuring Tappet Thickness
Courtesy of KIA MOTORS AMERICA, INC.

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

T : Thickness of removed tappet

A : Measured valve clearance

N : Thickness of new tappet

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

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

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

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

10. Place a new tappet on the cylinder head.

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

11. Install the intake and exhaust camshaft.
12. Install the bearing caps. Refer to **REASSEMBLY** .
13. Install the timing chain. Refer to **INSTALLATION** .
14. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks (A).

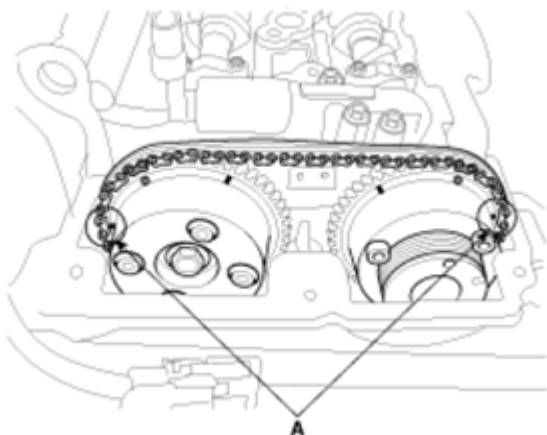


Fig. 19: Identifying Sprocket Timing Mark (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

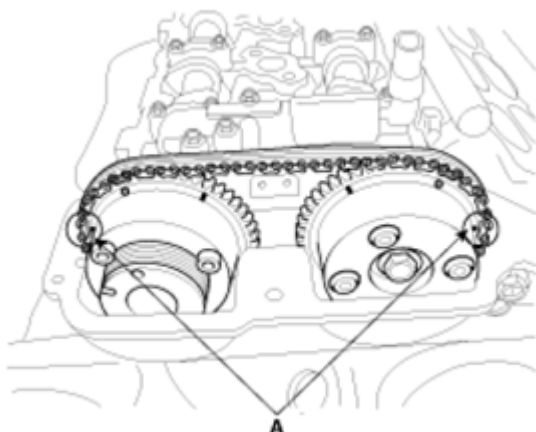


Fig. 20: Identifying Sprocket Timing Mark (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

15. Recheck the valve clearance.

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

(Specification)

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

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

TROUBLESHOOTING

PROBLEM SYMPTOMS

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings.	Replace the crankshaft and bearings as required.
	Loose or damaged engine drive plate.	Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
Engine misfire with abnormal valve train noise.	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
Engine misfire with coolant	Worn camshaft lobes.	Replace the camshaft and valve lifters.
	• Faulty cylinder head gasket	• Inspect the cylinder head

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2012 ENGINE Engine Mechanical System - General Information - Sedona

consumption.	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.	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.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	• Inspect the oil pan. • Inspect the oil pump screen. • Repair or replace as

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

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		journals. • The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	1. Inspect crankshaft. 2. Repair as required.

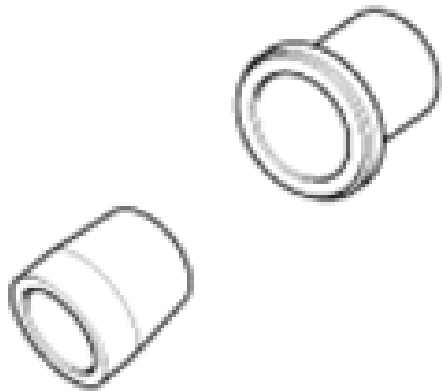
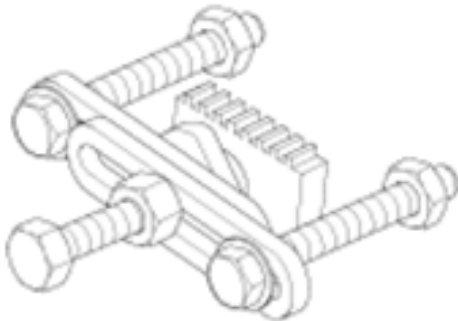
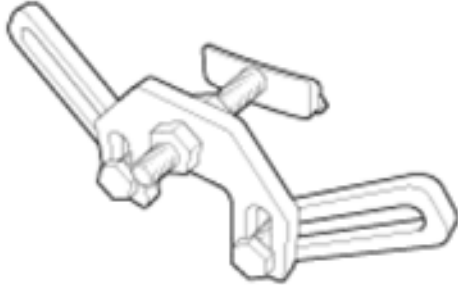
SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOL DESCRIPTION

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

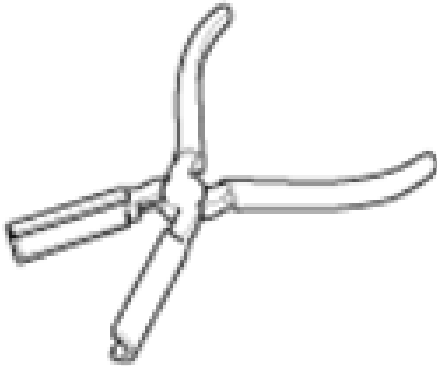
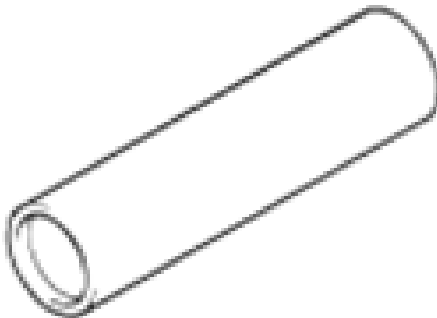
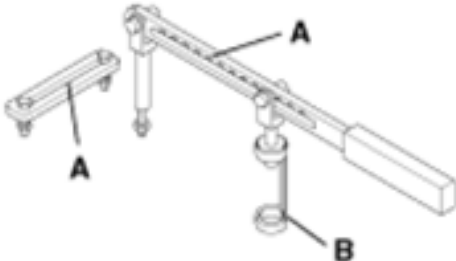
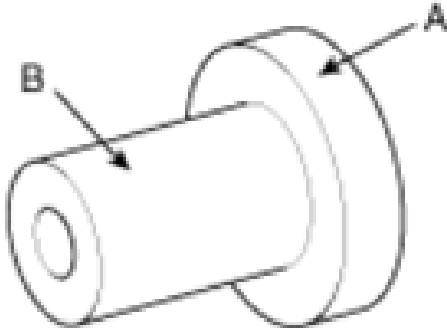
2012 Kia Sedona EX

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Ring gear stopper (09231-2B100)		Removal and installation of crankshaft pulley bolt
Ring gear stopper (09231-3D100)		Removal and installation of crankshaft pulley bolt.
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method
Valve stem seal remover		Removal of the valve stem seal

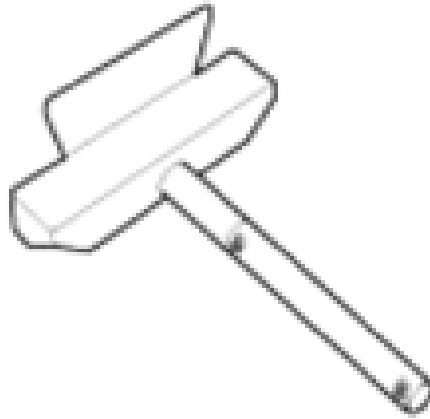
2012 Kia Sedona EX

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(09222-29000)		
Valve stem seal installer (09222-3C100)		Installation of the valve stem seal
Valve spring compressor & holder (09222-3K000) (09222-3K100)		Removal and installation of the intake or exhaust valves A. 09222-3K000 B. 09222-3K100 (holder)
Crankshaft rear oil seal installer (09231-3C200) (09231-H1100)		Installation of the crankshaft rear oil seal A. 09231-3C200 B. 09231-H1100
Oil pan remover (09215-3C000)		Removal of oil pan

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2012 ENGINE Engine Mechanical System - General Information - Sedona



2012 ENGINE

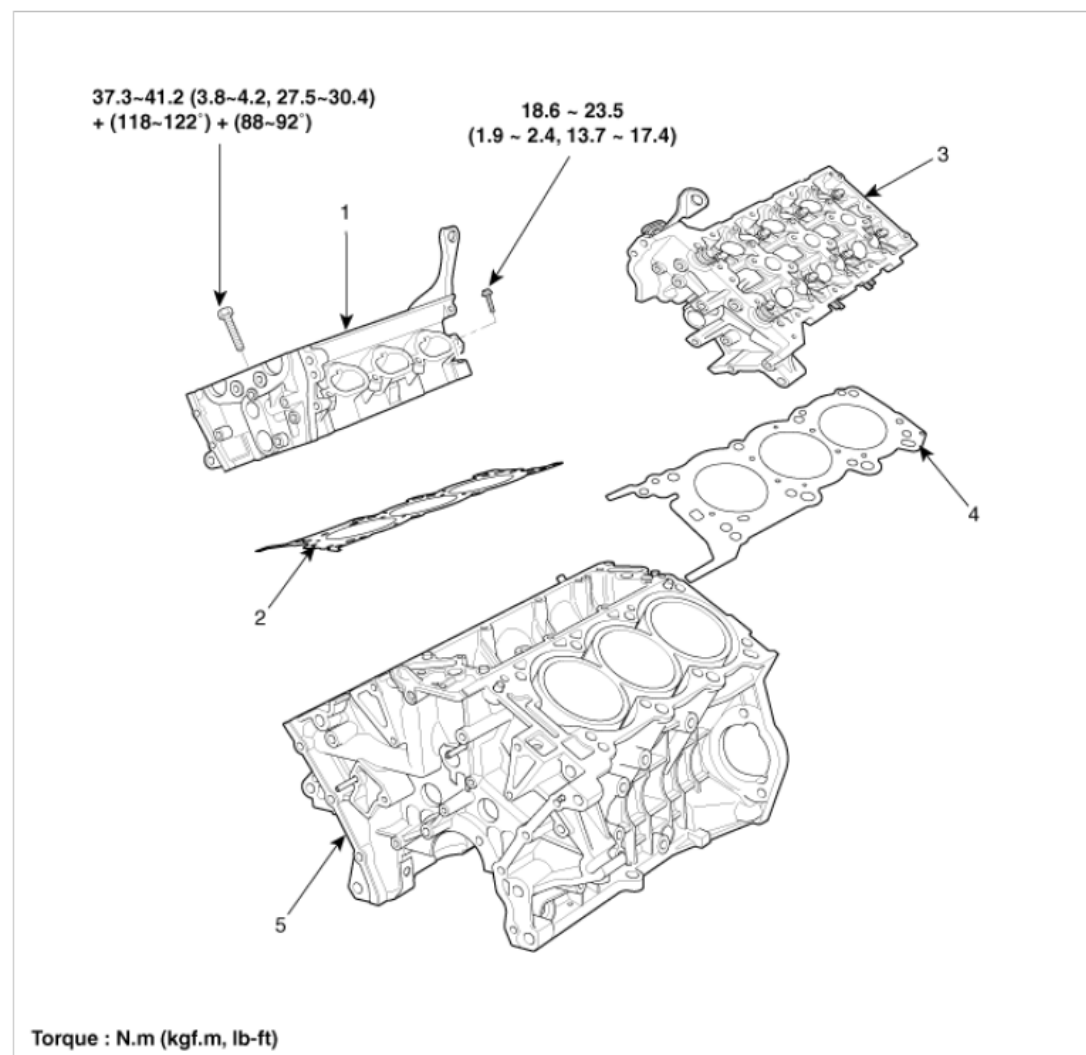
Cylinder Head Assembly - Sedona

CYLINDER HEAD

NOTE: For valve clearance inspection and adjustment procedure, refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT in ENGINE MECHANICAL SYSTEM - GENERAL INFORMATION article.

COMPONENTS AND COMPONENTS LOCATION

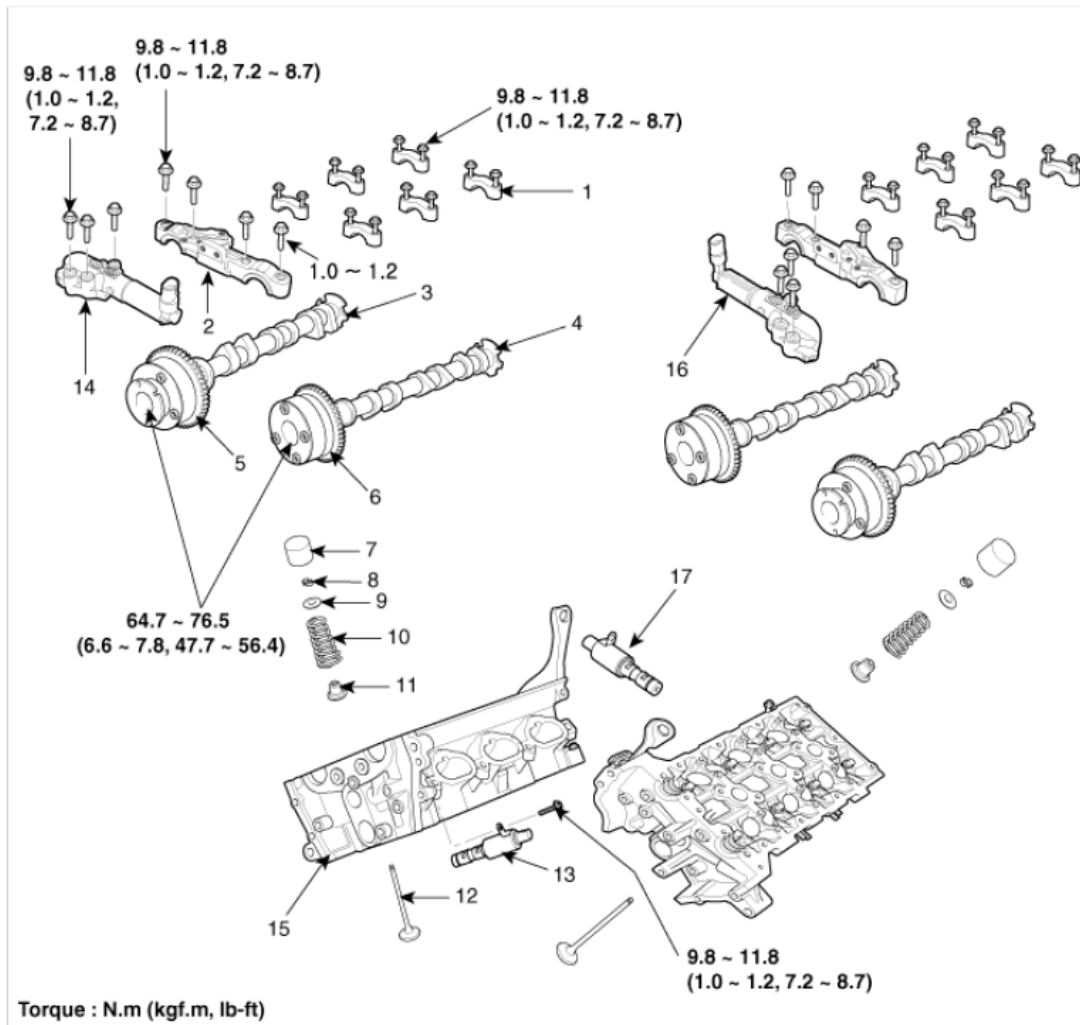
Components



- 1. RH Cylinder head
- 2. RH Cylinder head gasket
- 3. LH Cylinder head

- 4. LH Cylinder head gasket
- 5. Cylinder block

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



1. Camshaft bearing cap	7. Mechanical lash adjuster (MLA)	13. RH Exhaust camshaft OCV
2. Camshaft thrust bearing cap	8. Retainer lock	14. RH Intake camshaft OCV
3. Exhaust camshaft	9. Retainer	15. Cylinder head
4. Intake camshaft	10. Valve spring	16. LH Exhaust camshaft OCV
5. Exhaust CVVT assembly	11. Valve stem seal	17. LH Intake camshaft OCV
6. Intake CVVT assembly	12. Valve	

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

REPAIR PROCEDURES

NOTE: For valve clearance inspection and adjustment procedure, refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT in ENGINE MECHANICAL SYSTEM - GENERAL INFORMATION article.

Removal

CAUTION:

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C (68°F)) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

1. Remove the intake manifold and exhaust manifolds. Refer to INTAKE AND EXHAUST SYSTEM.
2. Remove the timing chain. Refer to TIMING SYSTEM.
3. Remove the water temperature control assembly. Refer to COOLING SYSTEM.
4. Remove the LH/RH exhaust camshaft OCV (A).

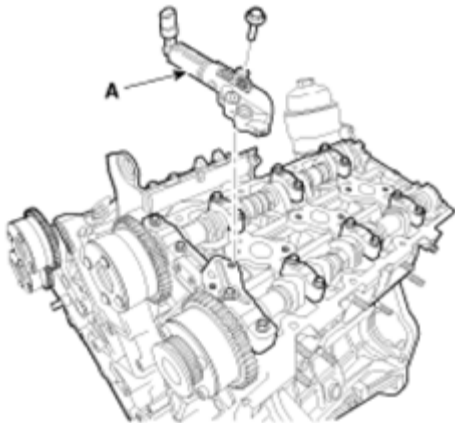


Fig. 3: Identifying Exhaust Camshaft OCV (1 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

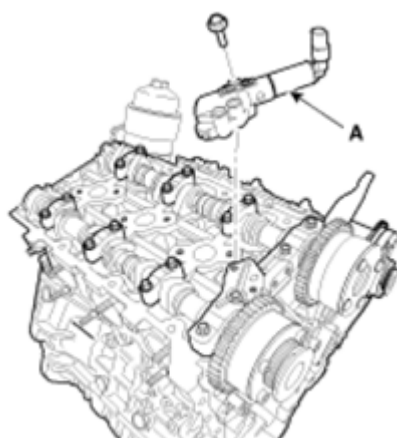


Fig. 4: Identifying Exhaust Camshaft OCV (2 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the LH/RH camshaft bearing cap (A) and thrust bearing cap (B).

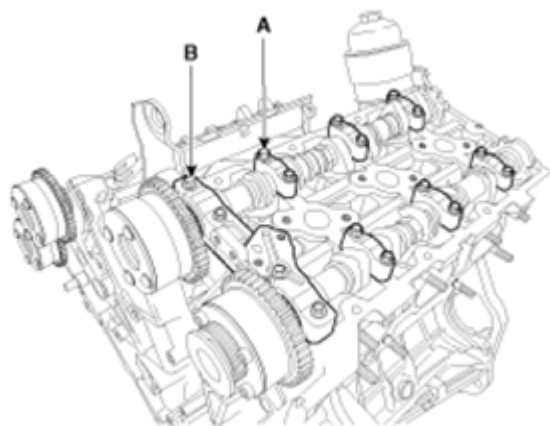


Fig. 5: Identifying Camshaft Bearing Cap & Thrust Bearing Cap (1 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

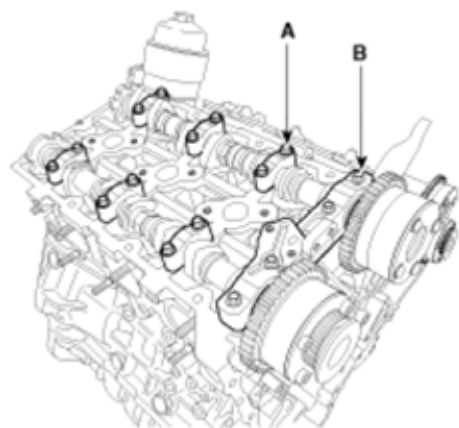


Fig. 6: Identifying Camshaft Bearing Cap & Thrust Bearing Cap (2 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the LH/RH camshaft assembly (A).

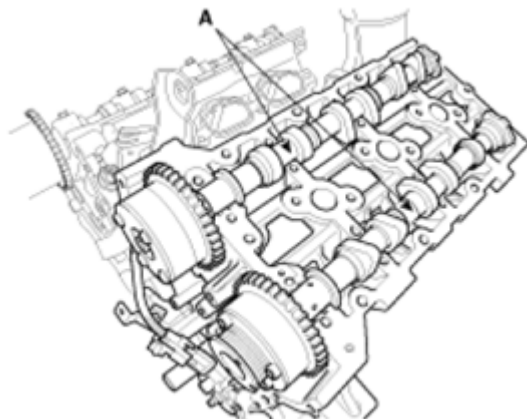


Fig. 7: Identifying Camshaft Assembly (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

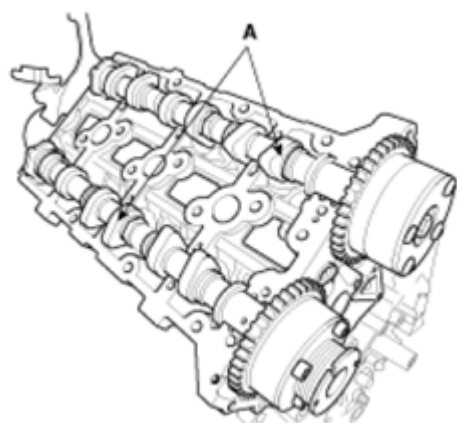


Fig. 8: Identifying Camshaft Assembly (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the LH/RH cylinder heads.
 1. Remove the RH cylinder head rear bolt (A).

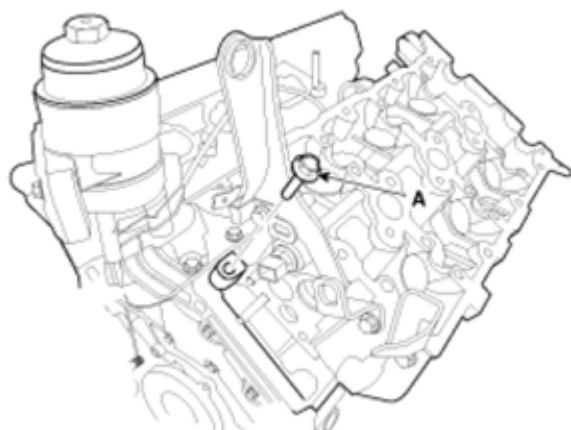


Fig. 9: Cylinder Head Rear Bolt
 Courtesy of KIA MOTORS AMERICA, INC.

2. Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.

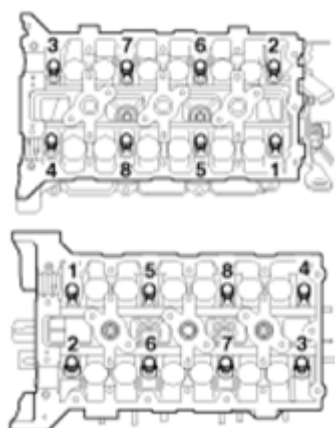


Fig. 10: Cylinder Head Bolt Loosening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

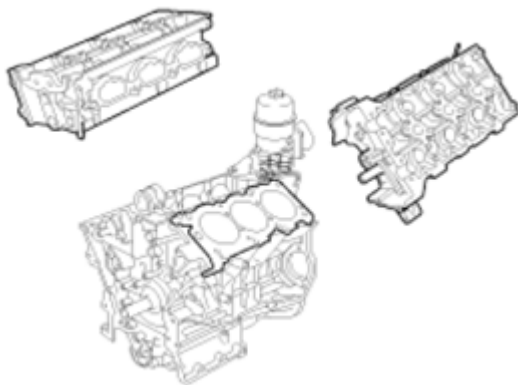


Fig. 11: Cylinder Heads

Courtesy of KIA MOTORS AMERICA, INC.

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

4. Remove the cylinder head gaskets.

Disassembly

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

1. Remove the MLAs (A).

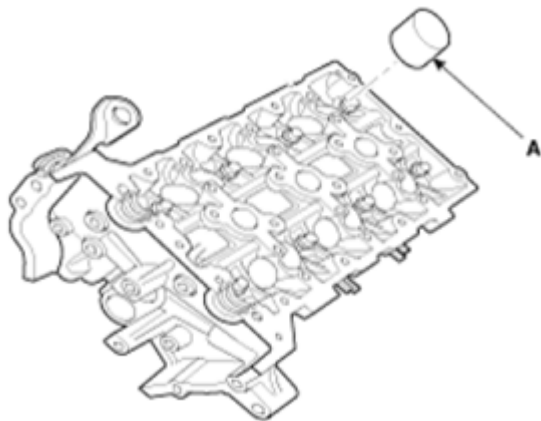


Fig. 12: Identifying MLAs

Courtesy of KIA MOTORS AMERICA, INC.

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

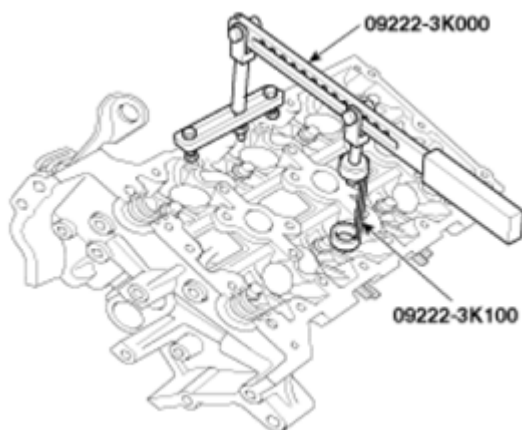


Fig. 13: Compressing Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Using the SST (09222-29000), remove the valve stem seal.

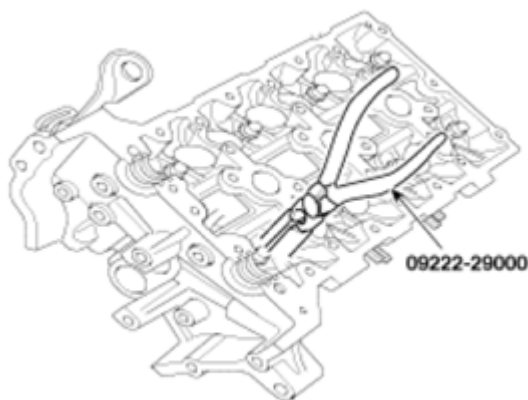


Fig. 14: Removing Valve Stem Seal
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not reuse old valve stem seals.

3. Remove the intake camshaft OCV (A).

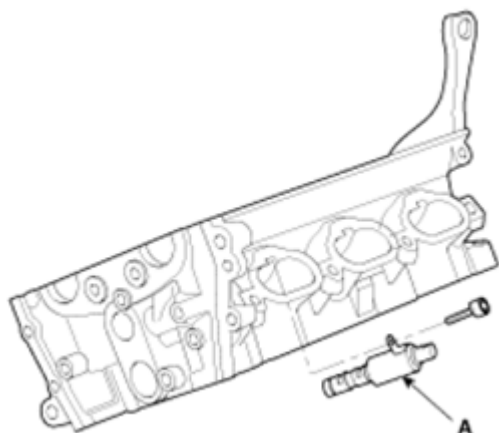


Fig. 15: Identifying Intake Camshaft OCV
Courtesy of KIA MOTORS AMERICA, INC.

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05 mm (0.002 in.)

(Less than 0.02 mm (0.0008 in.)/150x150)

Flatness of manifold gasket surface

Standard : Less than 0.03 mm (0.001 in)/110x110

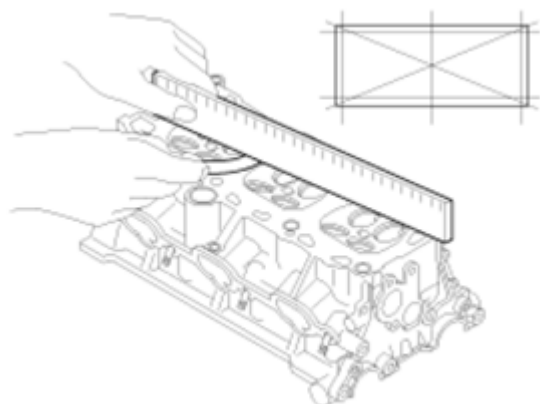


Fig. 16: Inspecting Cylinder Head Flatness
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

Valve And Valve Spring

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

Valve guide I.D.

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

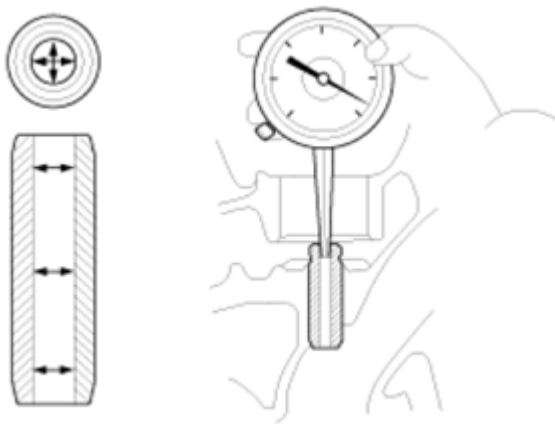


Fig. 17: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem O.D.

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

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

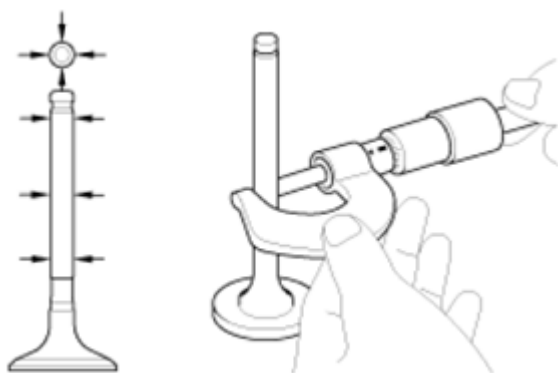


Fig. 18: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem-to-guide clearance

(Standard)

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

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

(Limit)

Intake : 0.07 mm (0.0027 in.)

Exhaust : 0.09 mm (0.0035 in.)

2. Inspect valves.
 1. Check the valve is ground to the correct valve face angle.
 2. Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.

3. Check the valve head margin thickness.

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

Margin

(Standard)

Intake : 1.56 ~ 1.86 mm (0.06142 ~ 0.07323 in.)

Exhaust : 1.73 ~ 2.03 mm (0.06811 ~ 0.07992 in.)

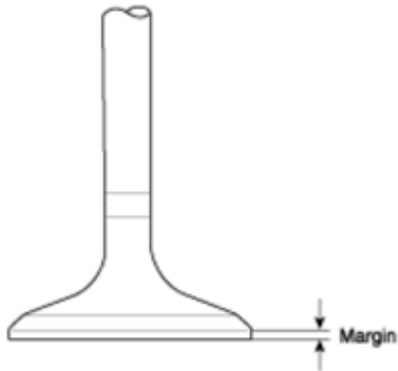


Fig. 19: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Length

Intake : 105.27 mm (4.1445 in)

Exhaust : 105.50 mm (4.1535 in)

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

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

3. Inspect valve seats

Check the valve seat for evidence of overheating and improper contact with the valve face.

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head.

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

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

Valve spring

(Standard)

Free height : 45.5 mm (1.7913 in.)

Out-of-square : 1.5°

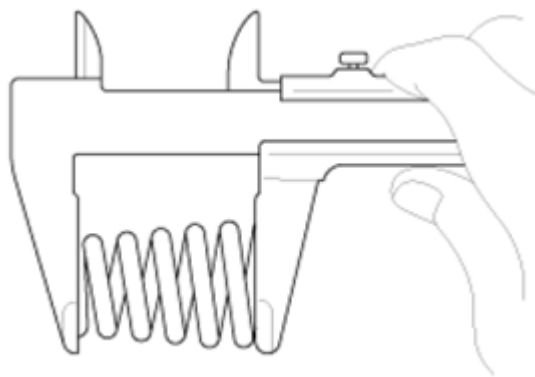


Fig. 20: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

MLA

1. Inspect MLAs.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust :

34.964 ~ 34.980 mm (1.3765 ~ 1.3771 in.)

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

Tappet bore I.D.

Intake/Exhaust :

35.000 ~ 35.025 mm (1.3779 ~ 1.3789 in.)

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

MLA to tappet bore clearance

(Standard)

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

(Limit)

Intake/Exhaust : 0.07 mm (0.0027 in.)

Camshaft

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

(Standard value)

Intake : 47.2 mm (1.8582 in.)

Exhaust : 45.8 mm (1.8031 in.)



Fig. 21: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

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

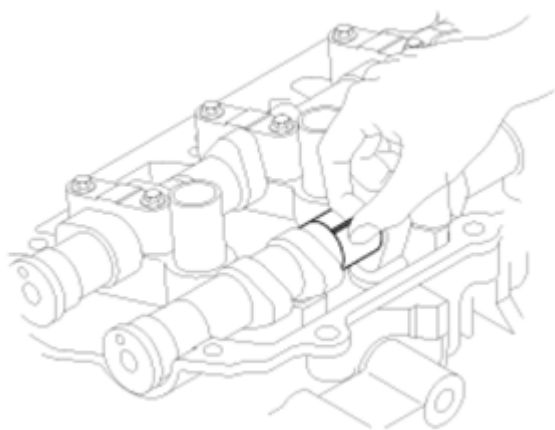


Fig. 22: Strip Of Plastigage Across Camshaft Journals
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing cap (A) and thrust bearing cap (B) with specified torque. Refer to **Fig. 23** and **Fig. 24**.

Tightening torque:

1st step : 5.8 N.m (0.6kgf.m, 4.3 lb-ft)

2nd step : 9.8 ~ 11.8 N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7 lb-ft)

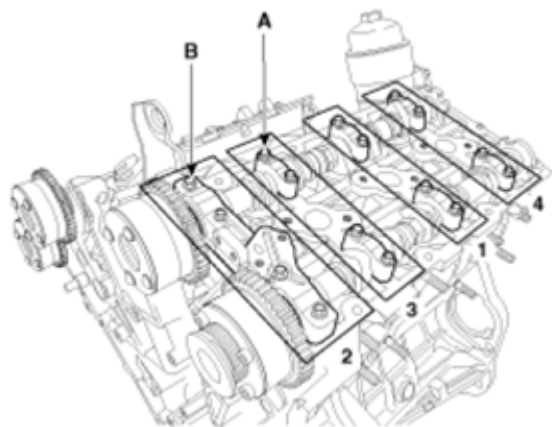


Fig. 23: Identifying Bearing Cap & Thrust Bearing Cap (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

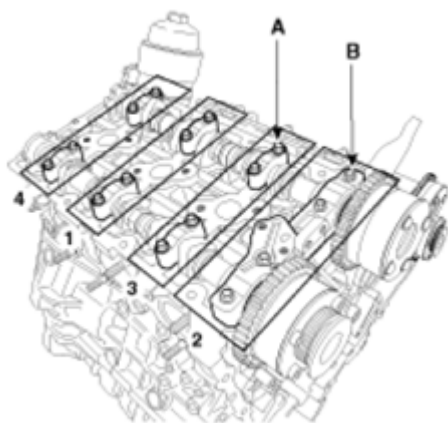


Fig. 24: Identifying Bearing Cap & Thrust Bearing Cap (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

(Standard value)

Intake

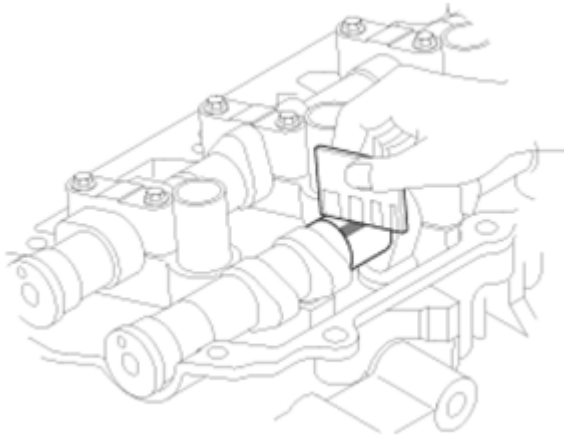
No. 1 journal : 0.020 ~ 0.057 mm (0.0008 ~ 0.0022 in.)

No. 2, 3, 4 journal : 0.030 ~ 0.067 mm (0.0012 ~ 0.0026 in.)

Exhaust

No. 1 journal : 0.027 ~ 0.057 mm (0.0010 ~ 0.0022 in.)

No. 2, 3, 4 journal : 0.030 ~ 0.067 mm (0.0012 ~ 0.0026 in.)

**Fig. 25: Measuring Plastigage**

Courtesy of KIA MOTORS AMERICA, INC.

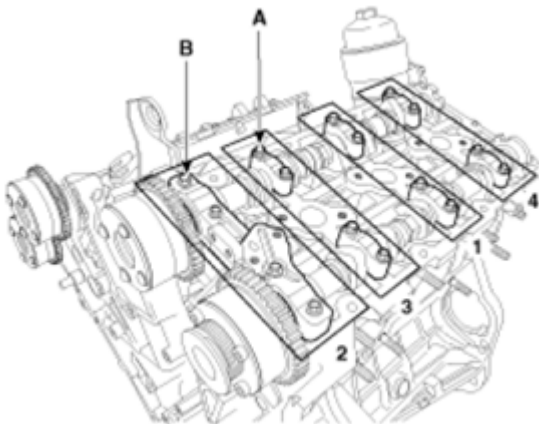
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

7. Completely remove the plastigage.
8. Remove the camshafts.
3. Inspect the camshaft end play.
 1. Install the camshafts.
 2. Install the bearing cap (A) and thrust bearing cap (B) with specified torque.

Tightening torque:

1st step : 5.8 N.m (0.6kgf.m, 4.31 lb-ft)

2nd step : 9.8 N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7 lb-ft)

**Fig. 26: Identifying Bearing Cap & Thrust Bearing Cap (1 Of 2)**

Courtesy of KIA MOTORS AMERICA, INC.

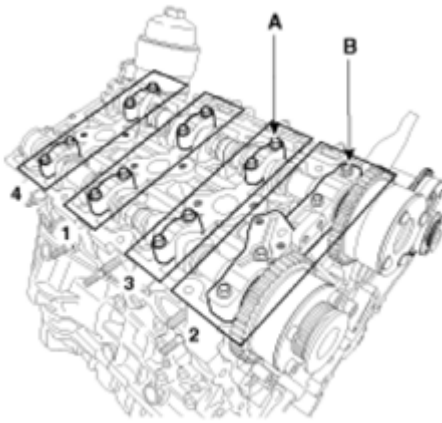


Fig. 27: Identifying Bearing Cap & Thrust Bearing Cap (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

3. Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

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

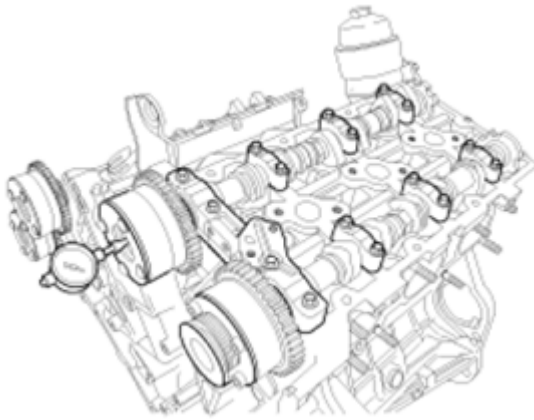


Fig. 28: Measuring End Play (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

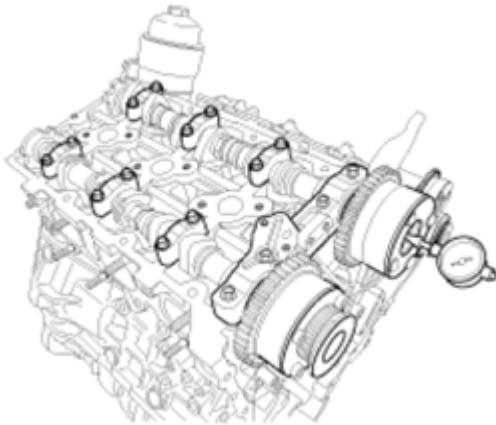


Fig. 29: Measuring End Play (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

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

4. Remove the camshafts.

Continuously Variable Valve Timing (CVVT) Assembly

1. Inspect the CVVT for smooth rotation.
 1. Clamp the camshaft using a vise. Be careful not to damage the cam lobes and journals in the vise .
 2. Check that the CVVT is locked by turning it clockwise or counterclockwise. It must not rotate.
 3. Intake CVVT : Seal one of the two advance holes in the camshaft journal with tape.

Exhaust CVVT : Seal one of the two retard holes in the camshaft journal with tape.

Intake CVVT

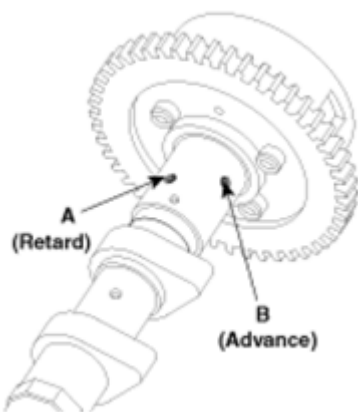


Fig. 30: Identifying Retard & Advance Port (Intake)
Courtesy of KIA MOTORS AMERICA, INC.

Exhaust CVVT

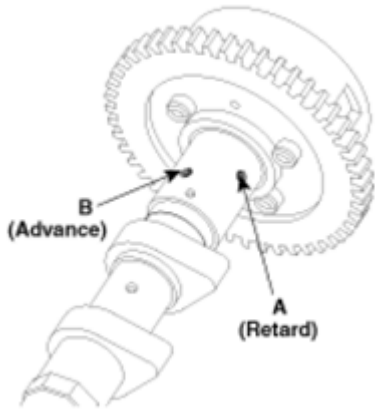


Fig. 31: Identifying Retard & Advance Port (Exhaust)

Courtesy of KIA MOTORS AMERICA, INC.

4. Intake CVVT : Apply Approx. 150 kPa (1.5 kgf/cm² , 21 psi) of compressed air into the unsealed advance hole to release the lock.

Exhaust CVVT : Apply Approx. 150 kPa (1.5 kgf/cm² , 21 psi) of compressed air into the unsealed advance hole to release the lock.

CAUTION: Cover the oil paths with a piece of cloth when applying compressed air to prevent oil from spraying.

5. Intake CVVT : With compressed air applied, rotate the CVVT into the advance direction (counterclockwise) within its phasing range and check that the CVVT turns smoothly.

Exhaust CVVT : With compressed air applied, rotate the CVVT into the retard direction (clockwise) and check that the CVVT turns smoothly.

CVVT Phasing Range

Intake : 25°±0°30' (from the most retarded position to the most advanced position).

Exhaust : 25°±0°30' (from the most advanced position to the most retarded position).

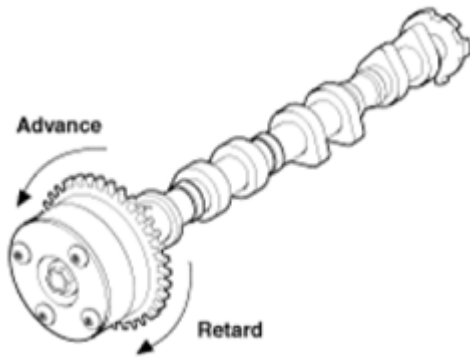


Fig. 32: Turning CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

6. Intake CVVT : Rotate the CVVT into the most retarded position (clockwise) and then check that the CVVT is locked.

Exhaust CVVT : Rotate the CVVT into the most advanced position (counterclockwise) and then check that the CVVT is locked.

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 the valves.
 1. Using the SST (09222-3C100), push in a new oil seal.

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

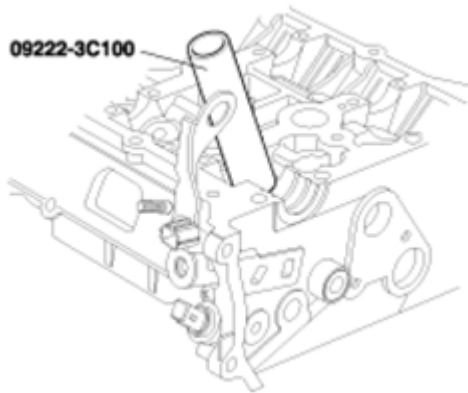


Fig. 33: Installing Oil Seal

Courtesy of KIA MOTORS AMERICA, INC.

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

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

3. Using the SST (09222 - 3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

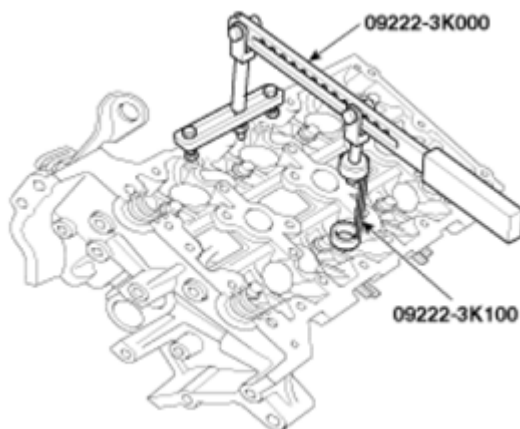


Fig. 34: Compressing Spring

Courtesy of KIA MOTORS AMERICA, INC.

4. Lightly tap the end of each valve stem two or three times with a soft hammer or the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.
2. Install the MLAs.

Check that the MLA rotates smoothly by hand.

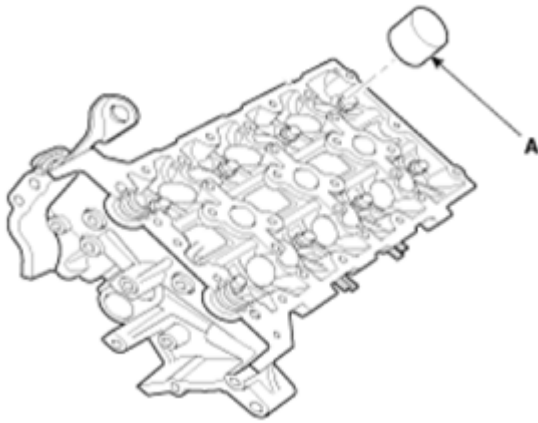


Fig. 35: Identifying MLAs

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position. However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block. Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT for Valve Clearance checking and adjustment procedure.

3. Install the OCV (A).

Tightening torque

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

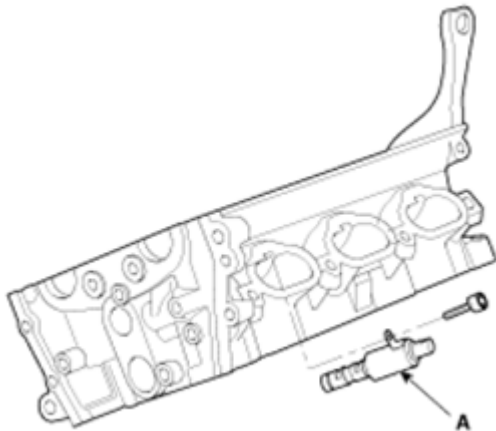


Fig. 36: Identifying Intake OCV

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Install OCV with gray colored connector into RH bank.
- Install OCV with black colored connector into LH bank.

CAUTION:

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

Installation

NOTE:

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

1. Install the cylinder head.

- The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
- Apply sealant on cylinder block top face before assembling cylinder head gaskets.

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

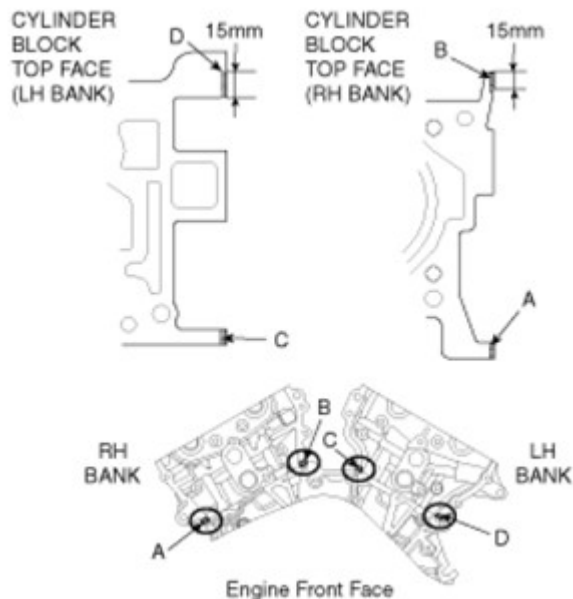


Fig. 37: Sealant Application Area On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

Refer to below illustration to apply the sealant.

Bead width:

2.0~3.0 mm (0.078 ~ 0.118 in.)

Sealant locations:

1.0~1.5 mm (0.039 ~ 0.059 in.) from block surface

Recommended sealant : Liquid sealant TB1217H

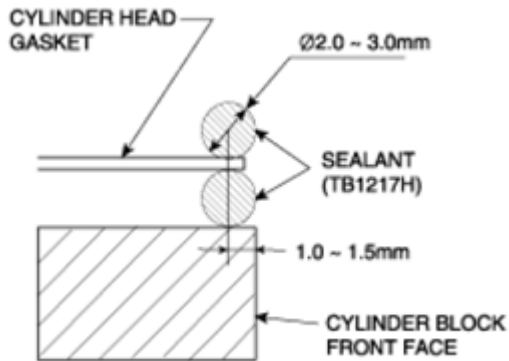


Fig. 38: Applying Sealant On Block Surface
Courtesy of KIA MOTORS AMERICA, INC.

- C. Apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block.

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

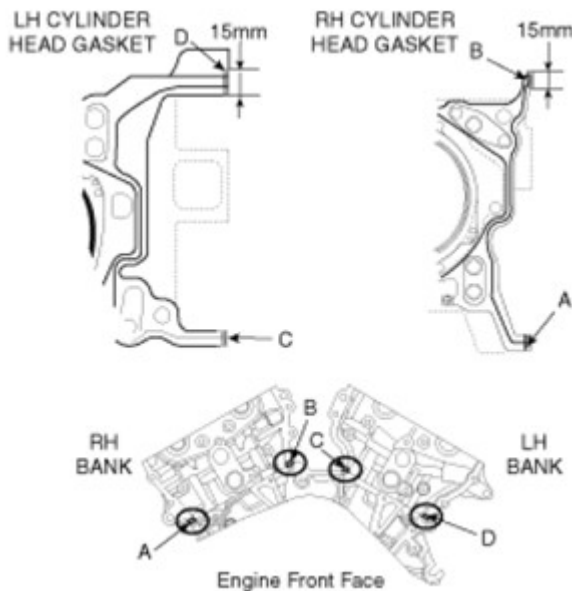


Fig. 39: Sealant Application Area On Cylinder Head Gasket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

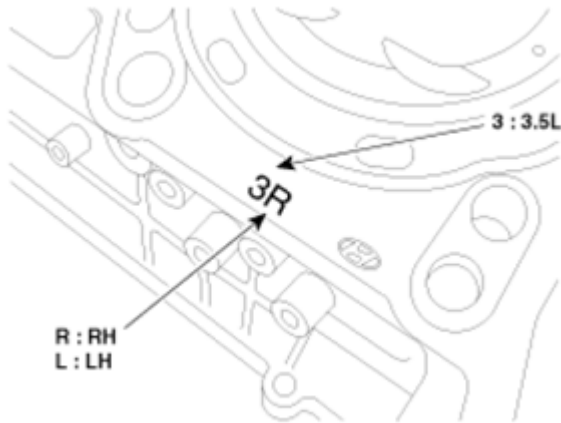


Fig. 40: Identifying Mark On Block
Courtesy of KIA MOTORS AMERICA, INC.

D. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

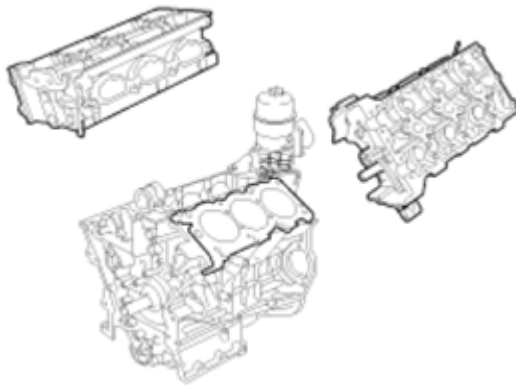


Fig. 41: Cylinder Heads
Courtesy of KIA MOTORS AMERICA, INC.

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

CAUTION: Always use new cylinder head bolts.

Tightening torque

Head bolt: 37.3~41.2 N.m (3.8~4.2kgf.m, 27.5~30.4 lb-ft) + (118~122°) + (88~92°)

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

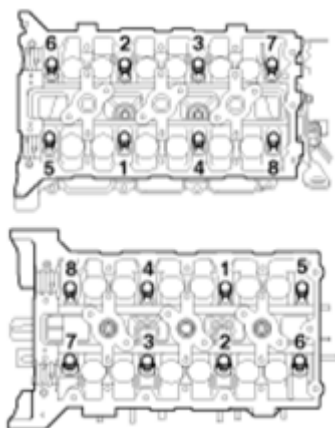


Fig. 42: Cylinder Head Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



Fig. 43: Cylinder Head Bolt
Courtesy of KIA MOTORS AMERICA, INC.

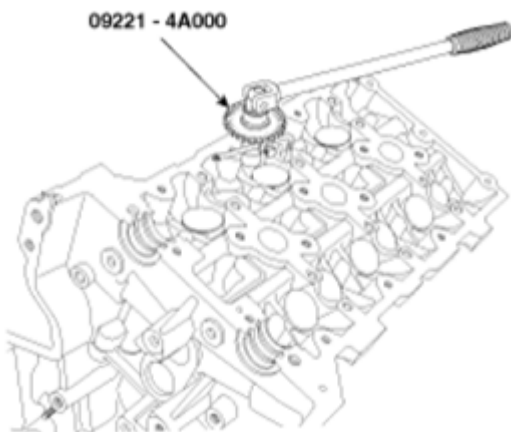


Fig. 44: Tightening Cylinder Head Bolt
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the CVVT assembly.

Tightening torque:

64.7 ~ 76.5 N.m (6.6 ~ 7.8kgf.m, 47.7 ~ 56.4 lb-ft)

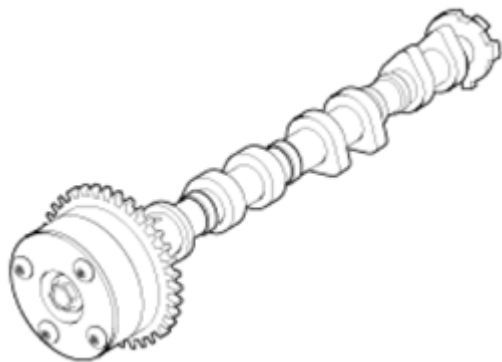


Fig. 45: CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

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

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

- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when camshaft is installed to dowel pin of CVVT assembly.

4. Install the LH/RH camshaft assembly (A).

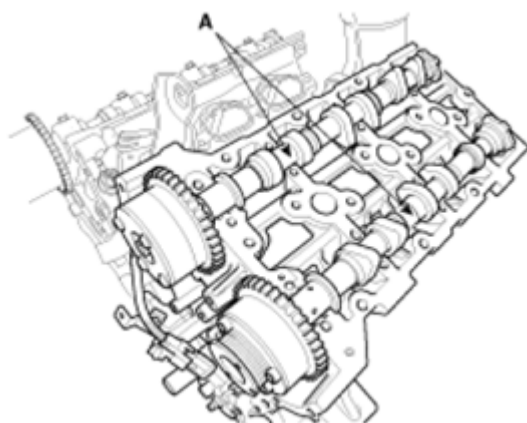


Fig. 46: Camshaft Assembly (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

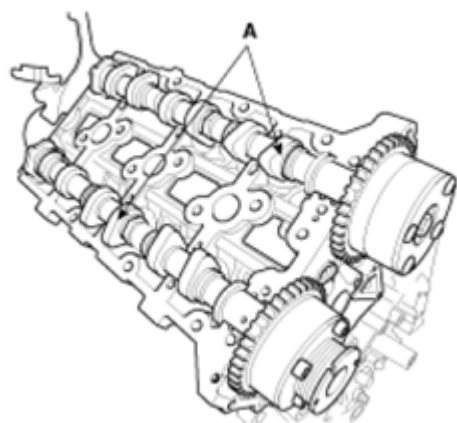
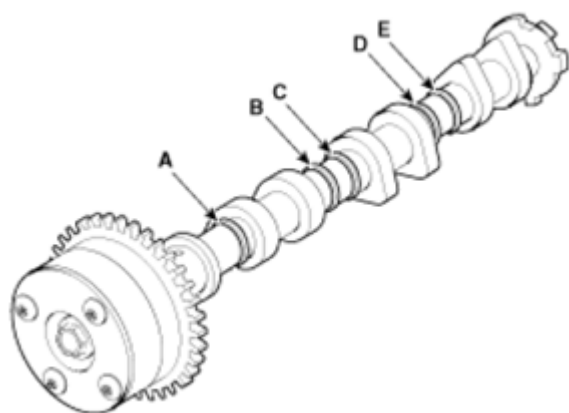


Fig. 47: Camshaft Assembly (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

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

Intake Camshaft

**Fig. 48: Intake Camshaft**

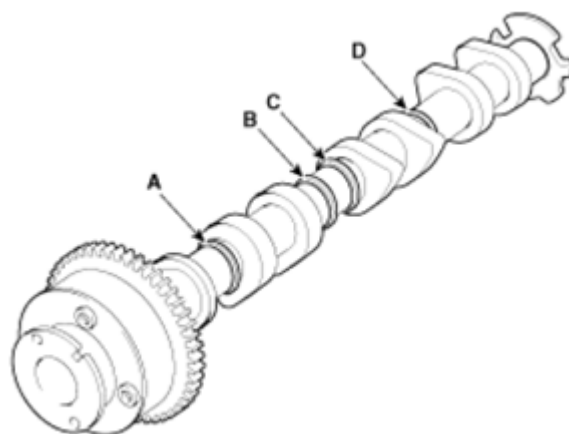
Courtesy of KIA MOTORS AMERICA, INC.

As for camshaft identification, refer to the table below.

OUTER DIAMETER SPECIFICATION

Displacement	Outer diameter	
	LH	RH
Intake camshaft	A : 27 mm (1.0630 in.)	A : 27 mm (1.0630 in.)
	B : 27 mm (1.0630 in.)	B : 27 mm (1.0630 in.)
	C : 30 mm (1.1811 in.)	C : 30 mm (1.1811 in.)
	D : 30 mm (1.1811 in.)	D : 27 mm (1.0630 in.)
	E : 27 mm (1.0630 in.)	E : 30 mm (1.1811 in.)

Exhaust Camshaft

**Fig. 49: Exhaust Camshaft**

Courtesy of KIA MOTORS AMERICA, INC.

As for camshaft identification, refer to the table below.

OUTER DIAMETER SPECIFICATION

Displacement	Outer diameter	
	LH	RH
Exhaust camshaft	A : 27 mm (1.0630 in.)	A : 27 mm (1.0630 in.)
	B : 27 mm (1.0630 in.)	B : 27 mm (1.0630 in.)
	C : 30 mm (1.1811 in.)	C : 30 mm (1.1811 in.)
	D : 27 mm (1.0630 in.)	D : 30 mm (1.1811 in.)

- Install the LH/RH camshaft bearing cap (A) and thrust bearing cap (B).

Tightening torque

1st step : 5.8 N.m (0.6kgf.m, 4.3 lb-ft)

2nd step : 9.8 ~ 11.8 N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7 lb-ft)

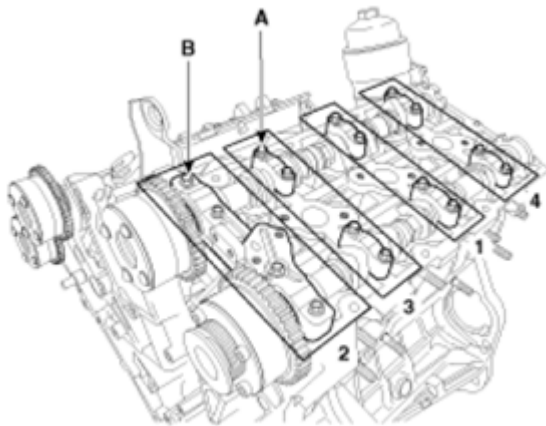


Fig. 50: Camshaft Bearing Cap & Thrust Bearing Cap (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

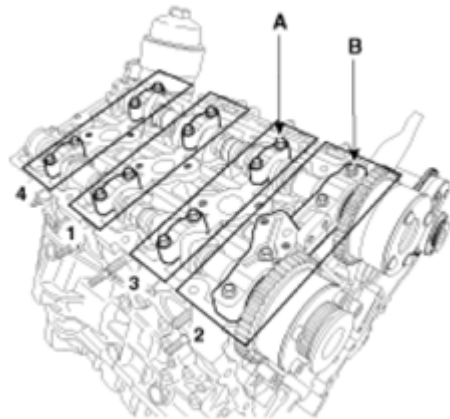


Fig. 51: Camshaft Bearing Cap & Thrust Bearing Cap (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Be sure to install the thrust bearing cap bolts and the bearing cap bolts in the correct place.

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

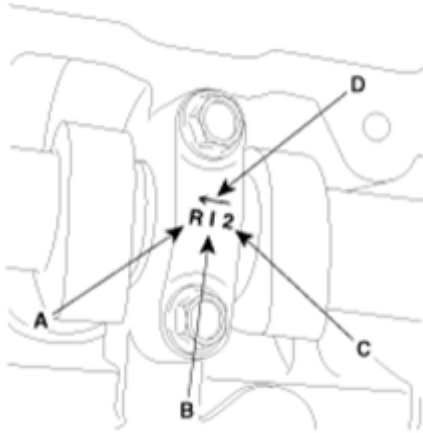


Fig. 52: Identifying Mark On Cap
Courtesy of KIA MOTORS AMERICA, INC.

- A. L (LH), R (RH)
- B. I (Intake), E (Exhaust)
- C. Journal number
- D. Front mark

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

6. Install the LH/RH exhaust camshaft OCV (A).

Tightening torque:

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

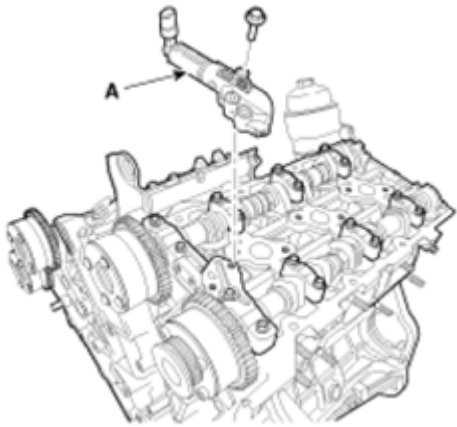


Fig. 53: Identifying Exhaust Camshaft OCV (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

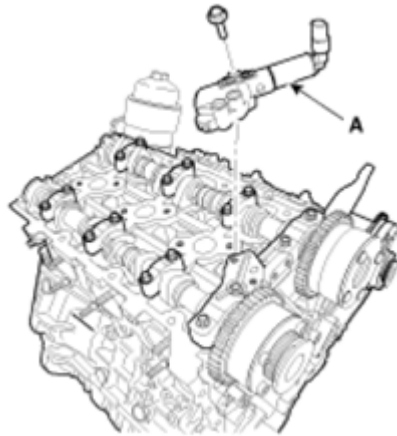


Fig. 54: Identifying Exhaust Camshaft OCV (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the water temperature control assembly. Refer to **COOLING SYSTEM** .
8. Install the timing chain. Refer to **INSTALLATION** .
9. Install the intake manifold and exhaust manifolds. Refer to **INTAKE AND EXHAUST SYSTEM** .

NOTE:

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.
 - After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
 - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel lines.

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

2012 ENGINE

Cylinder Block - Sedona

COMPONENTS AND COMPONENTS LOCATION

COMPONENTS

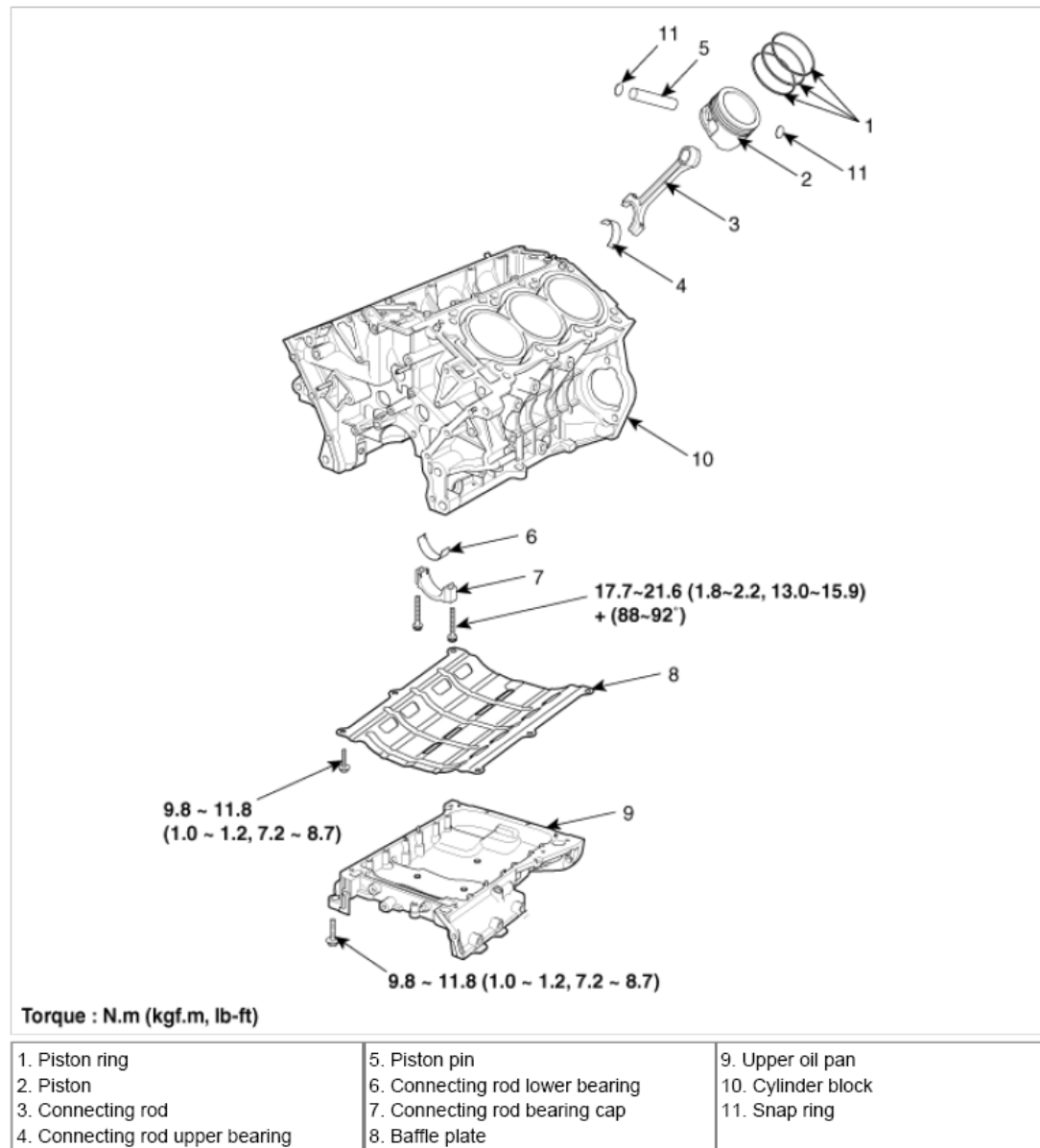


Fig. 1: Identifying Cylinder Block Components With Torque Specifications (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

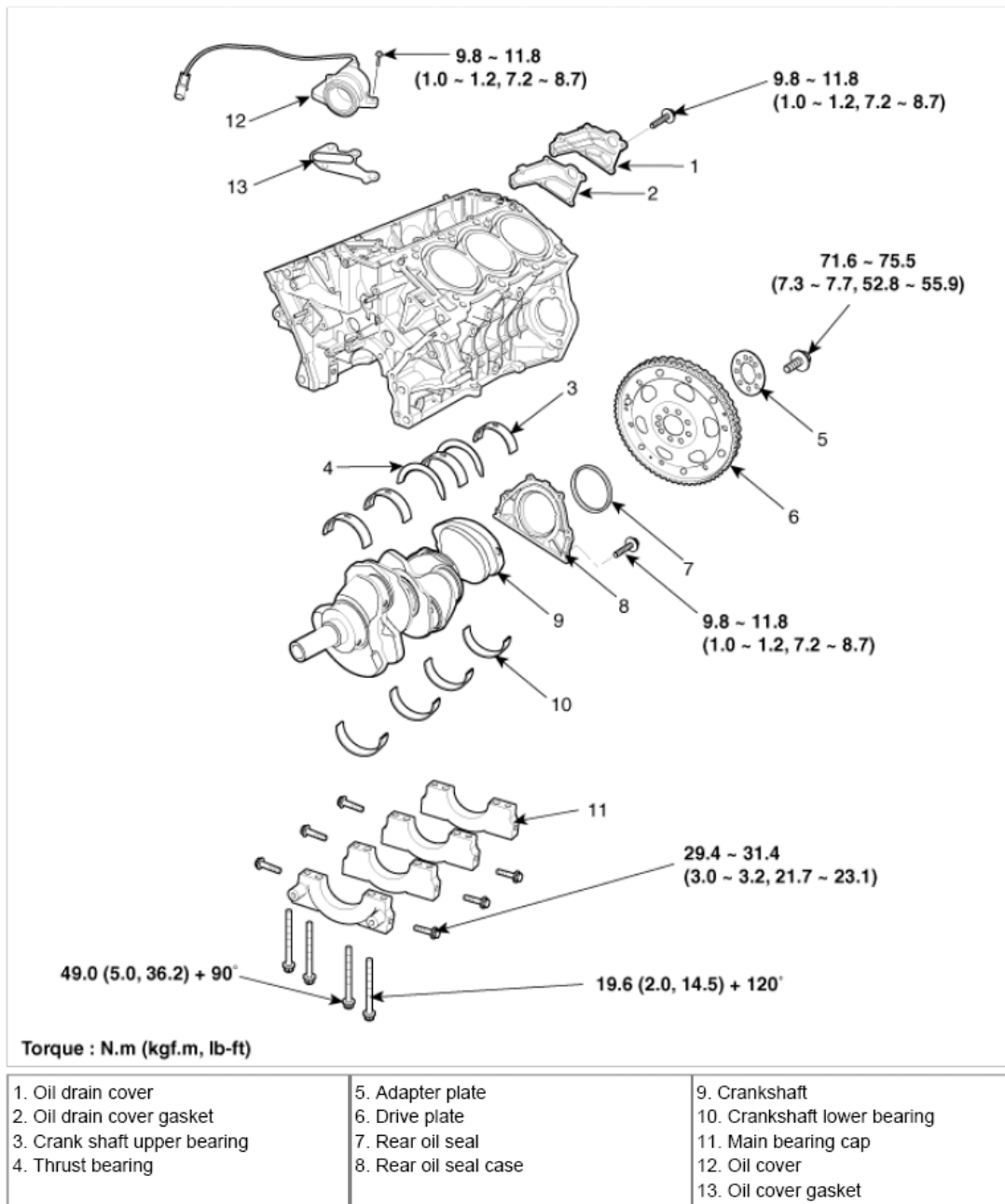


Fig. 2: Identifying Cylinder Block Components With Torque Specification (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

DISASSEMBLY

CAUTION:

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing chain before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- Engine removal is required for this procedure.

1. Remove the engine assembly from the vehicle. Refer to ENGINE AND TRANSAXLE ASSEMBLY .
2. Attach the engine to engine stand for disassembly.
3. Remove the intake manifold and exhaust manifold. Refer to INTAKE AND EXHAUST SYSTEM .
4. Remove the timing chain. Refer to TIMING SYSTEM .
5. Remove the water temperature control assembly. Refer to WATER TEMPERATURE CONTROL ASSEMBLY .
6. Remove the cylinder head. Refer to CYLINDER HEAD .
7. Remove the oil pump. Refer to LUBRICATION SYSTEM .
8. Remove the oil filter assembly. Refer to LUBRICATION SYSTEM .
9. Remove the drive plate (A) and adapter plate (B).

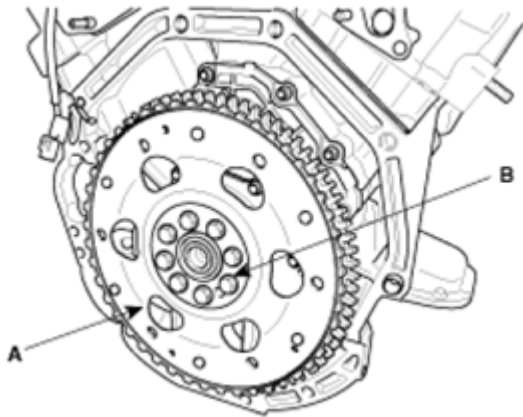


Fig. 3: Drive Plate & Adapter Plate
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the oil cover (A) and gasket (B).

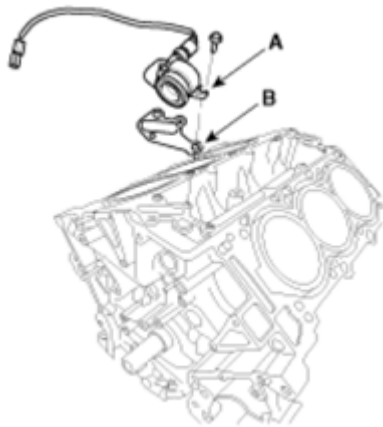


Fig. 4: Oil Cover & Gasket

Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the knock sensor (A).

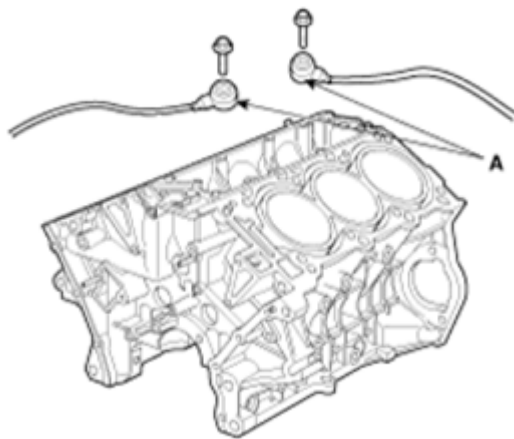
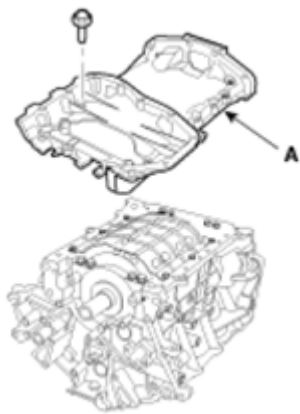


Fig. 5: Knock Sensor

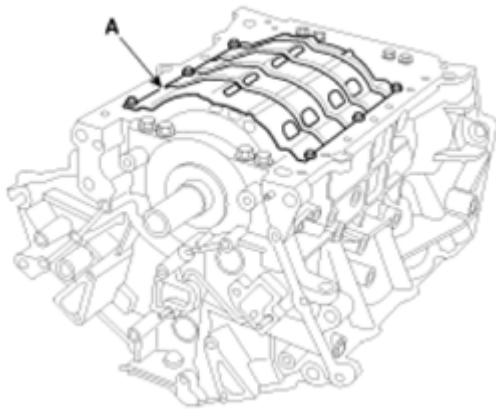
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the upper oil pan (A).

**Fig. 6: Upper Oil Pan**

Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the baffle plate (A).

**Fig. 7: Baffle Plate**

Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the rear oil seal case (A).

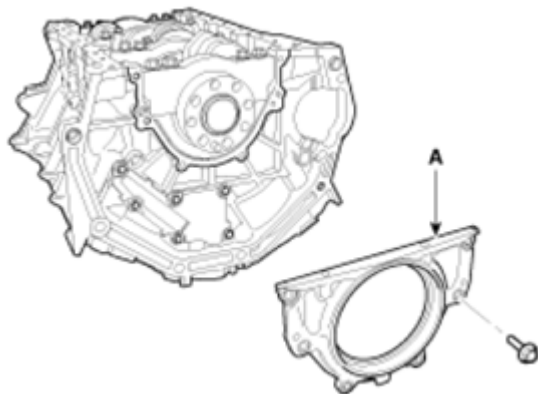
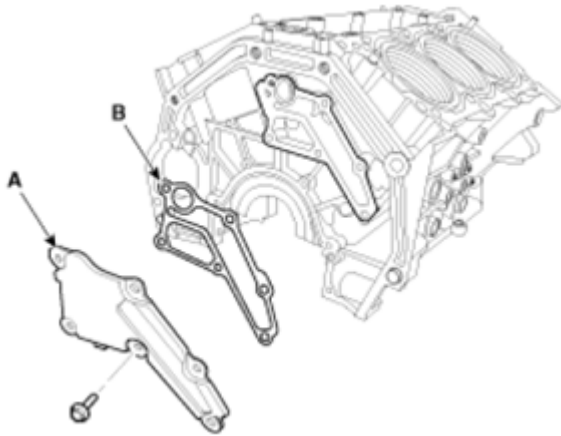


Fig. 8: Rear Oil Seal Case**Courtesy of KIA MOTORS AMERICA, INC.**

15. Remove the oil drain cover (A) and gasket (B).

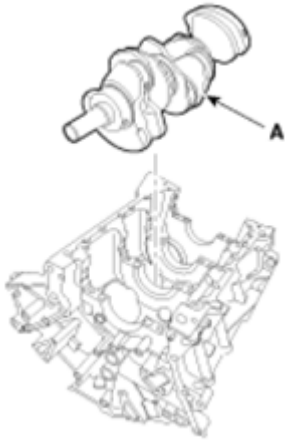
**Fig. 9: Oil Drain Cover & Gasket****Courtesy of KIA MOTORS AMERICA, INC.**

16. Check the connecting rod end play.
17. Check the connecting rod cap oil clearance.
18. Remove the piston and connecting rod assemblies.
 1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE:

- **Keep the bearings, connecting rod and cap together.**
- **Arrange the piston and connecting rod assemblies in the correct order.**

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

**Fig. 10: Crankshaft**

Courtesy of KIA MOTORS AMERICA, INC.

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

22. Remove the oil jets (A).

**Fig. 11: Oil Jets**

Courtesy of KIA MOTORS AMERICA, INC.

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

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

24. Disconnect the connecting rod from the piston.

Remove the snap ring at both ends of piston pin. And push the piston pin to separate and connecting rod.

INSPECTION

Connecting Rod And Crankshaft

1. Check the connecting rod end play.

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

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

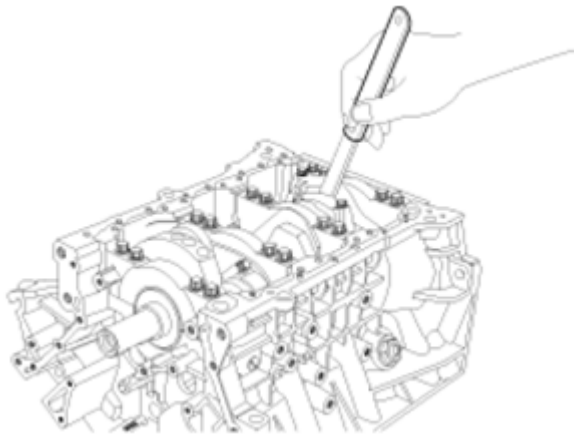


Fig. 12: Measuring End Play

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

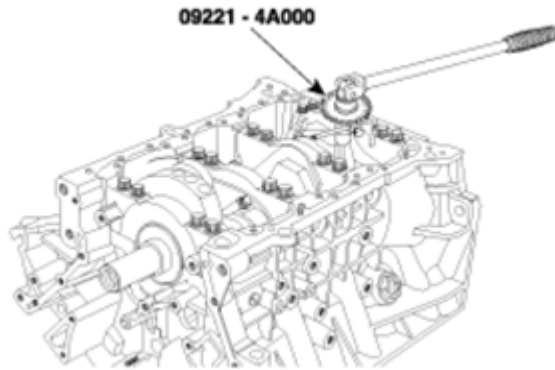


Fig. 13: Installing Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.038 ~ 0.056 mm (0.0015 ~ 0.0022 in.)

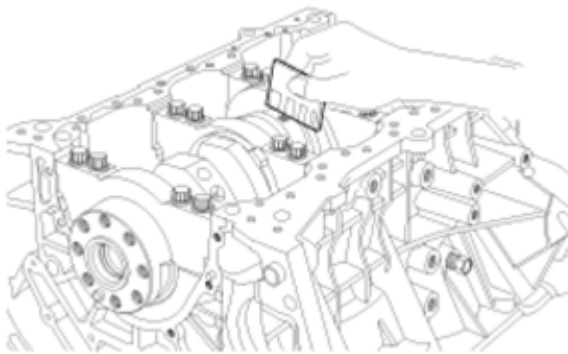


Fig. 14: Measuring Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

Connecting Rod Mark Location

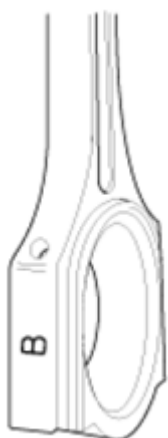


Fig. 15: Identifying Connecting Rod Mark
Courtesy of KIA MOTORS AMERICA, INC.

Identification Of Connecting Rod

CONNECTING ROD IDENTIFICATION

Class	Mark	Inside Diameter
0	a	58.000 ~ 58.006 mm (2.2834 ~ 2.2837 in.)
1	b	58.006 ~ 58.012 mm (2.2837 ~ 2.2839 in.)
2	c	58.012 ~ 58.018 mm (2.2839 ~ 2.2842 in.)

Crankshaft Pin Mark Location

Identification Of Crankshaft

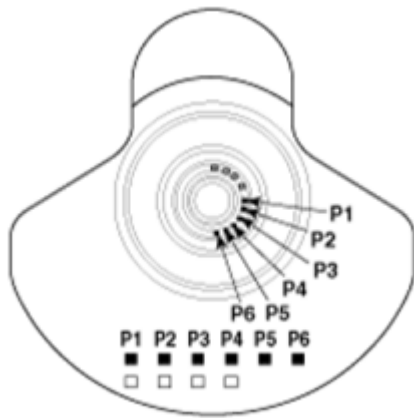


Fig. 16: Identifying Crankshaft Pin Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft

CRANKSHAFT DISCRIMINATION

Class	Mark	Outside Diameter Of Pin
I	1 or A	54.966 ~ 54.972 mm (2.1640 ~ 2.1642 in.)
II	2 or B	54.960 ~ 54.966 mm (2.1638 ~ 2.1640 in.)
III	3 or C	54.954 ~ 54.960 mm (2.1635 ~ 2.1638 in.)

Place Of Identification Mark (Connecting Rod Bearing)

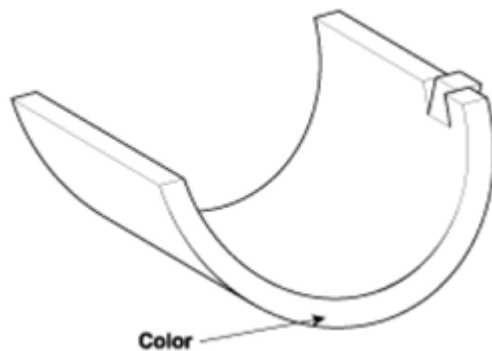


Fig. 17: Identifying Connecting Rod Bearing Mark
Courtesy of KIA MOTORS AMERICA, INC.

Identification Of Connecting Rod Bearing

CONNECTING ROD BEARING IDENTIFICATION

Class	Mark	Thickness Of Bearing
E	Blue	1.514 ~ 1.517 mm (0.0596 ~ 0.0597 in.)
D	Black	1.511 ~ 1.514 mm (0.0595 ~ 0.0596 in.)
C	Brown	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in.)

B	Green	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in.)
A	Yellow	1.502 ~ 1.505 mm (0.0591 ~ 0.0593 in.)

11. Selection

CONNECTING ROD IDENTIFICATION MARK SPECIFICATION

		Connecting Rod Identification Mark		
		0 (a)	1 (b)	2 (c)
Crankshaft Identification Mark	1 or A	A (Yellow)	B (Green)	C (Brown)
	2 or B	B (Green)	C (Brown)	D (Black)
	3 or C	C (Brown)	D (Black)	E (Blue)

3. Check the connecting rod.

- When reinstalling, check the cylinder numbers on the connecting rods and the caps. When installing a new connecting rod, the notches for bearing fixing on the connecting rods and caps should face the same direction.
- If one or both edge of the connecting rod thrust surface is damaged, replace the rod. If the inner surface of the rod is damaged or rough, also replace it.
- Using a connecting rod aligner, measure the bent or torsion of the rod. If the measurement is near the specification, adjust the rod with a press. If the rod is bent or twisted excessively, replace it.

Allowable bend of connecting rod

0.05 mm/100 mm (0.0020 in./3.9370 in.)

Allowable twist of connecting rod

0.1 mm/100 mm (0.0039 in./3.9370 in.)

NOTE: When assembling the rod without a bearing, there should be no difference.

4. Check the crankshaft bearing oil clearance.

- To check main bearing-to-journal oil clearance, remove the main bearing caps and bearing halves.
- Clean each main journal and bearing half with a clean shop towel.
- Place one strip of plastigage across each main journal.
- Reinstall the bearings and caps, then torque the bolts.

Tightening torque

49.0 Nm (5.0 kgf.m, 36.2 lb-ft) + 90°

19.6 Nm (2.0 kgf.m, 14.5 lb-ft) + 120°

29.4 ~ 31.4 Nm (3.0 ~ 3.2 kgf.m, 21.7 ~ 23.1 lb-ft)

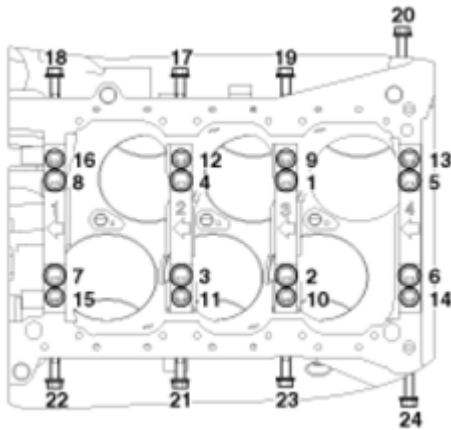


Fig. 18: Crankshaft Bearing Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.022 ~ 0.040 mm (0.0009 ~ 0.0016 in.)

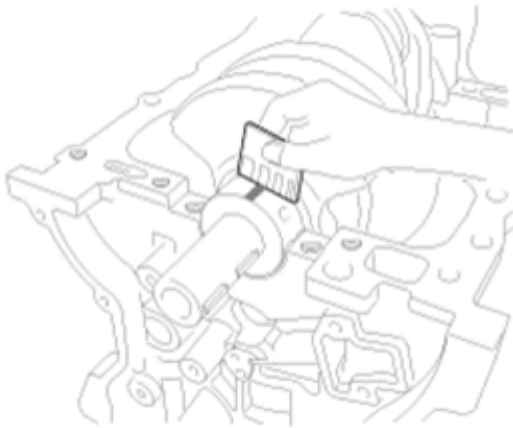


Fig. 19: Measuring Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

clearance.

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

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

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

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the size of each of the 4 main journal bores.

Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

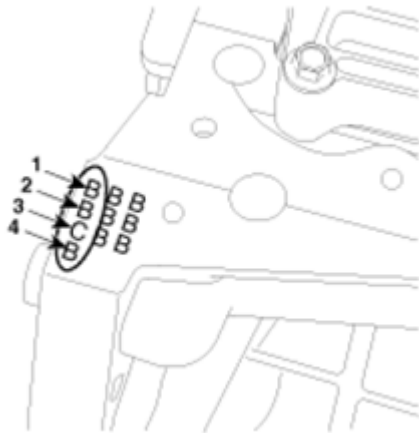


Fig. 20: Identifying Crankshaft Bore Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block

CYLINDER BLOCK DISCRIMINATION

Class	Mark	Inside Diameter
a	A	73.500 ~ 73.506 mm (2.8937 ~ 2.8939 in.)
b	B	73.506 ~ 73.512 mm (2.8939 ~ 2.8942 in.)
c	C	73.512 ~ 73.518 mm (2.8942 ~ 2.8944 in.)

Crankshaft Journal Mark Location

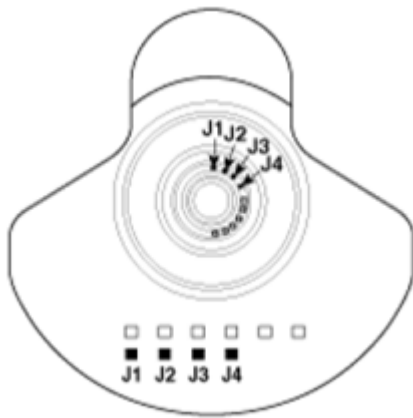
Discrimination Of Crankshaft

Fig. 21: Identifying Crankshaft Journal Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft**CRANKSHAFT DISCRIMINATION**

Class	Mark	Outside Diameter Of Journal
I	1 or A	68.954 ~ 68.960 mm (2.7147 ~ 2.7150 in.)
II	2 or B	68.948 ~ 68.954 mm (2.7145 ~ 2.7147 in.)
III	3 or C	68.942 ~ 68.948 mm (2.7142 ~ 2.7145 in.)

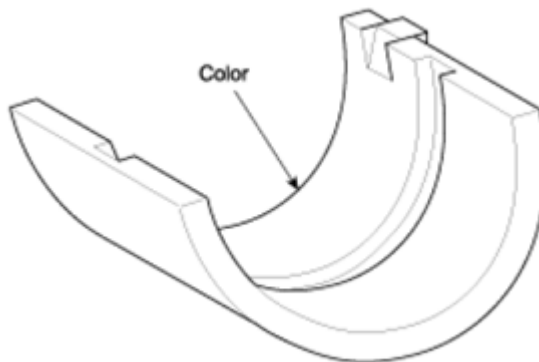
Place Of Identification Mark (Crankshaft Bearing)

Fig. 22: Identifying Crankshaft Bearing Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing**CRANKSHAFT BEARING DISCRIMINATION**

Class	Mark	Thickness Of Bearing

E	Blue	2.277 ~ 2.280 mm (0.0896 ~ 0.0897 in.)
D	Black	2.274 ~ 2.277 mm (0.0895 ~ 0.0896 in.)
C	Brown	2.271 ~ 2.274 mm (0.0894 ~ 0.0895 in.)
B	Green	2.268 ~ 2.271 mm (0.0893 ~ 0.0894 in.)
A	Yellow	2.265 ~ 2.268 mm (0.0892 ~ 0.0893 in.)

Selection

CRANKSHAFT BORE IDENTIFICATION MARK

		Crankshaft Bore Identification Mark		
		a (A)	b (B)	c (C)
Crankshaft Identification Mark	1 or A	A (Yellow)	B (Green)	C (Brown)
	2 or B	B (Green)	C (Brown)	D (Black)
	3 or C	C (Brown)	D (Black)	E (Blue)

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

0.10 ~ 0.28 mm (0.0039 ~ 0.0110 in.)

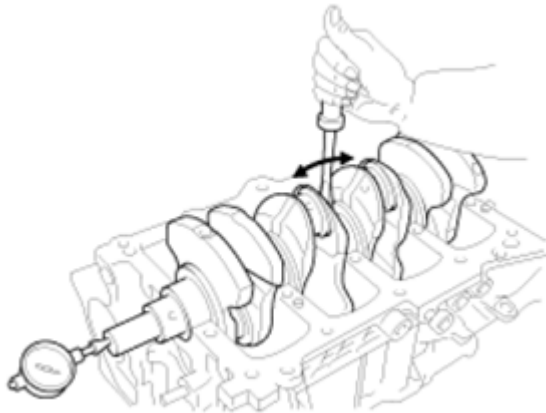


Fig. 23: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

2.41 ~ 2.45 mm (0.0949 ~ 0.0964 in.)

6. Inspect main journals and crank pins

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

Main journal diameter:

68.942 ~ 68.960 mm (2.7142 ~ 2.7149 in.)

Crank pin diameter:

54.954 ~ 54.972 mm (2.1635 ~ 2.1642 in.)

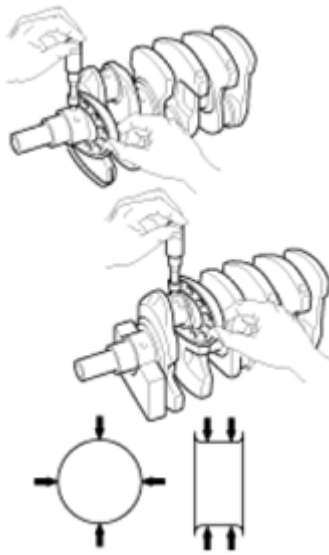


Fig. 24: Measuring Diameter Of Main Journal & Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BLOCK

1. Remove the gasket material.

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

2. Clean the cylinder block

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

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

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

Flatness of cylinder block gasket surface

Standard : Less than 0.05 mm (0.0020 in.),

Less than 0.02 mm (0.0008 in.) / 150 x 150

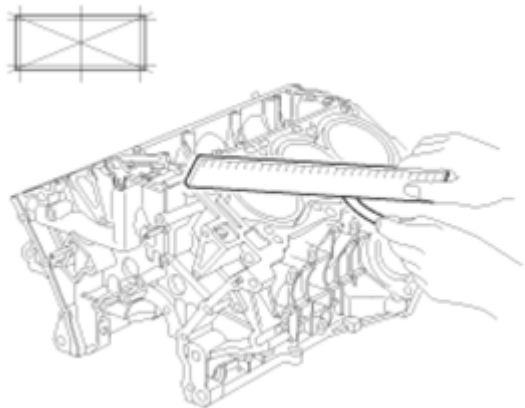


Fig. 25: Inspecting Surface Of Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

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

92.00 ~ 92.03 mm (3.6220 ~ 3.6232 in.)

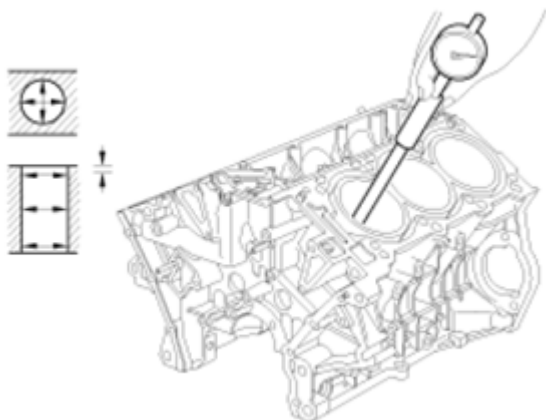


Fig. 26: Inspecting Cylinder Bore Diameter
 Courtesy of KIA MOTORS AMERICA, INC.

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

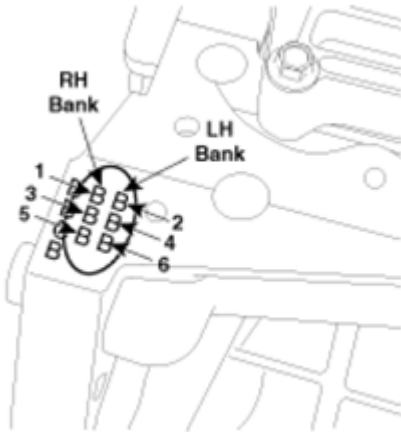


Fig. 27: Identifying Cylinder Bore Size Code On Cylinder Block
 Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE INNER DIAMETER

Class	Size code	Cylinder bore inner diameter
A	A	92.00 ~ 92.01 mm (3.6220 ~ 3.6224 in.)
B	B	92.01 ~ 92.02 mm (3.6224 ~ 3.6228 in.)
C	C	92.02 ~ 92.03 mm (3.6228 ~ 3.6232 in.)

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

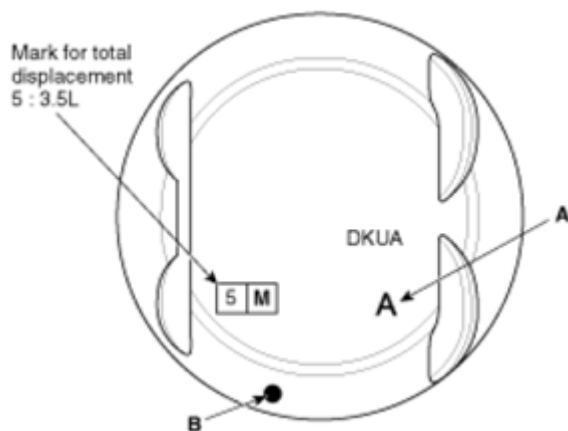


Fig. 28: Identifying Piston Size Code On Piston
 Courtesy of KIA MOTORS AMERICA, INC.

PISTON OUTER DIAMETER

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Class	Size code	Piston outer diameter
A	A	91.96 ~ 91.97 mm (3.6204 ~ 3.6208 in.)
B	B	91.97 ~ 91.98 mm (3.6208 ~ 3.6212 in.)
C	C	91.98 ~ 91.99 mm (3.6212 ~ 3.6216 in.)

- Select the piston related to cylinder bore class.

Clearance : 0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)

BORING CYLINDER

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

PISTON SIZE SPECIFICATION

Identification Mark	Size
0.1	0.1 mm (0.004 in)
0.25	0.25 mm (0.010 in)

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

- Measure the outside diameter of the piston to be used.
- According to the measured O.D (Outer Diameter), calculate the new bore size.

New bore size = piston O.D + 0.03 to 0.05 mm (0.0012 to 0.0020 in) (clearance between piston and cylinder) - 0.01 mm (0.0004 in) (honing margin.)

- 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.

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

Standard : 0.03 ~ 0.05 mm (0.0012 ~ 0.0020 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

- Clean piston
 - Using a gasket scraper, remove the carbon from the piston top.

2. Using a groove cleaning tool, clean the piston ring grooves.
3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 12 mm (0.4724 in.) from the bottom of the piston.

Standard diameter

91.96 ~ 91.99 mm (3.6204 ~ 3.6216 in.)

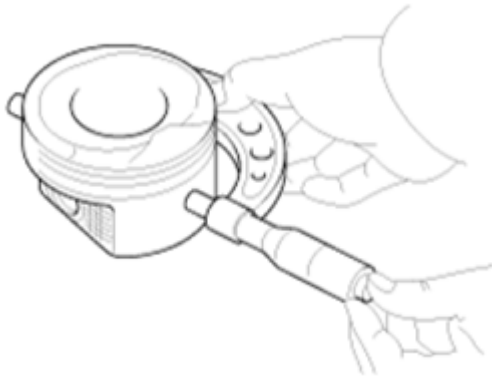


Fig. 29: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

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

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

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

Limit

No. 1 : 0.1 mm (0.004 in.)

No. 2 : 0.1 mm (0.004 in.)

Oil ring : 0.2 mm (0.008 in.)



Fig. 30: Measuring Piston Ring Side Clearance

Courtesy of KIA MOTORS AMERICA, INC.

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

5. **Inspect piston ring end gap.**

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

Piston ring end gap**Standard**

No. 1 : 0.17 ~ 0.32 mm (0.0067 ~ 0.0126 in.)

No. 2 : 0.37 ~ 0.52 mm (0.0145 ~ 0.0205 in.)

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

Limit

No. 1 : 0.6 mm (0.0236 in.)

No. 2 : 0.7 mm (0.0275 in.)

Oil ring : 0.8 mm (0.0315 in.)

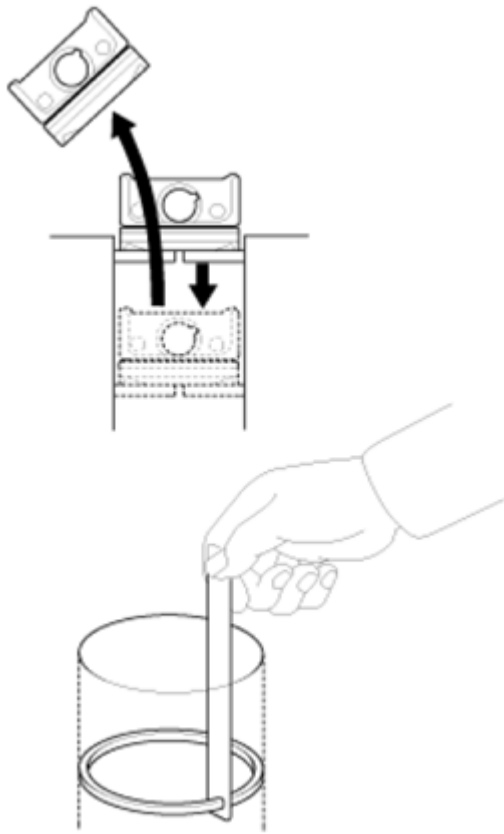


Fig. 31: Checking Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

21.097 ~ 22.000 mm (0.8305 ~ 0.8661 in.)

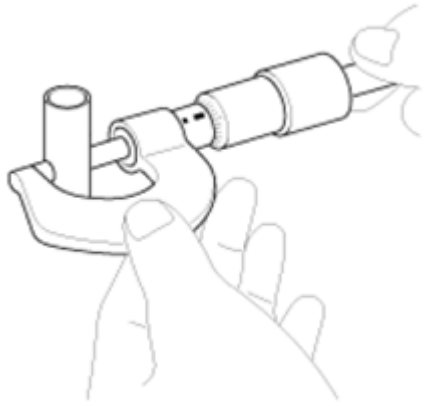


Fig. 32: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.004 ~ 0.013 mm (0.00015 ~ 0.00051 in.)

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

Piston pin-to-connecting rod interference

0.005 ~ 0.019 mm (0.00019 ~ 0.00074 in.)

REASSEMBLY

NOTE:

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

1. Assemble the piston and the connecting rod.
 1. Install piston pin with snap ring 2 ea. and check the snap ring assembly thoroughly.
 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.

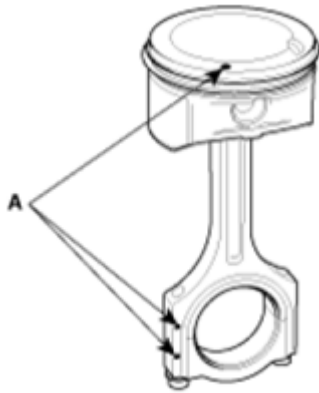


Fig. 33: Identifying Piston & Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

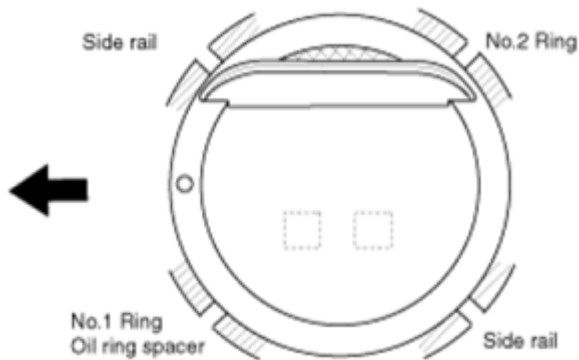


Fig. 34: Identifying Piston Rings Spacing
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the 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).

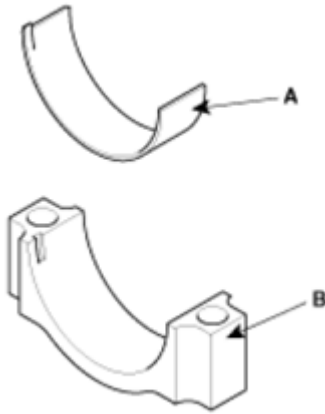


Fig. 35: Connecting Rod Cap & Bearing
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: When reassembling the connecting rods and the caps, ensure the front marks on them and the number of cylinder.

4. Install the oil jets (A).

Tightening torque

27.5 ~ 31.3 N.m (2.8 ~ 3.2 kgf.m, 20.2 ~ 23.1 lb-ft)



Fig. 36: Oil Jets
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the main bearings.

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

1. Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings (A).

**Fig. 37: Upper Bearings**

Courtesy of KIA MOTORS AMERICA, INC.

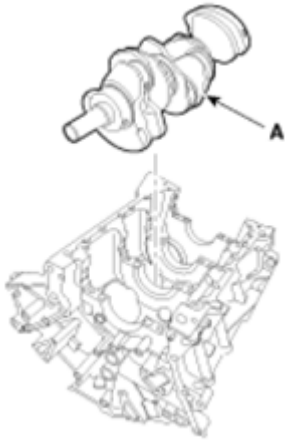
2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.
6. Install the thrust bearings.

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

**Fig. 38: Thrust Bearings**

Courtesy of KIA MOTORS AMERICA, INC.

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

**Fig. 39: Crankshaft**

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

Main bearing cap bolt

49.0 N.m (5.0 kgf.m, 36.2 lb-ft) + 90° (1 ~ 8)

19.6 N.m (2.0 kgf.m, 14.5 lb-ft) + 120° (9 ~ 16)

29.4 ~ 31.4 N.m (3.0 ~ 3.2 kgf.m, 21.7 ~ 23.1 lb-ft) (17 ~ 24)

NOTE:

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

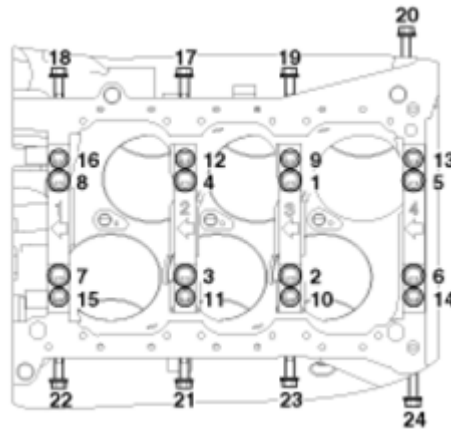


Fig. 40: Main Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

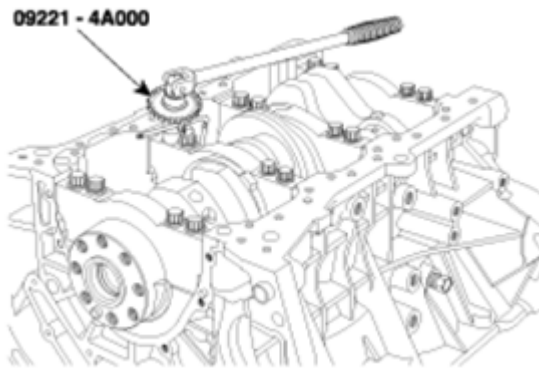


Fig. 41: Installing Main Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

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

1. Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
2. Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
3. Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

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

NOTE:

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

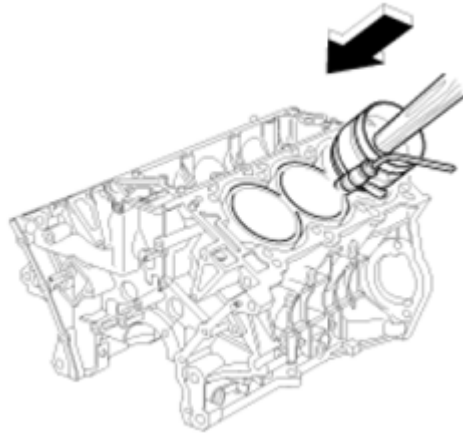


Fig. 42: Installing Piston

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

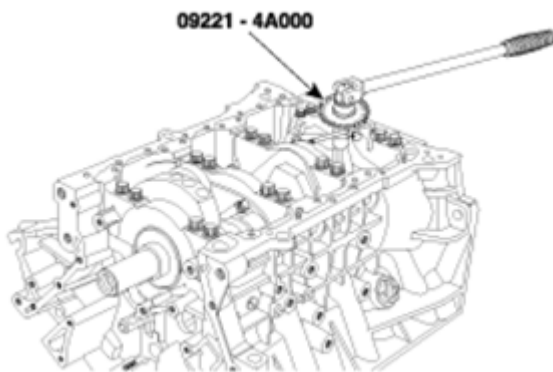


Fig. 43: Tightening Connecting Rod Bearing Cap Bolt

Courtesy of KIA MOTORS AMERICA, INC.

12. Check the connecting rod end play.
13. Install the oil drain cover (A) with a new gasket (B).

Tightening torque

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

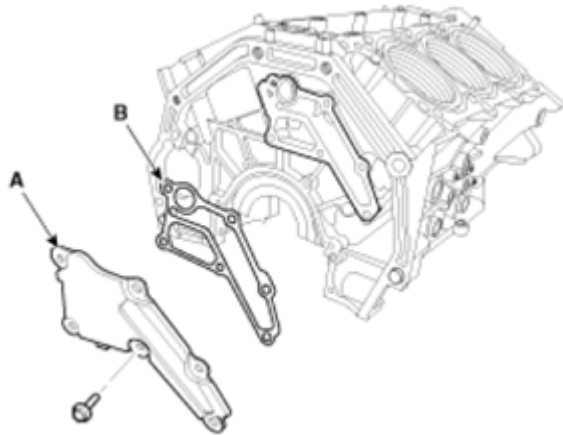


Fig. 44: Oil Drain Cover & Gasket
Courtesy of KIA MOTORS AMERICA, INC.

14. Install the rear oil seal case (A).

Tightening torque

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

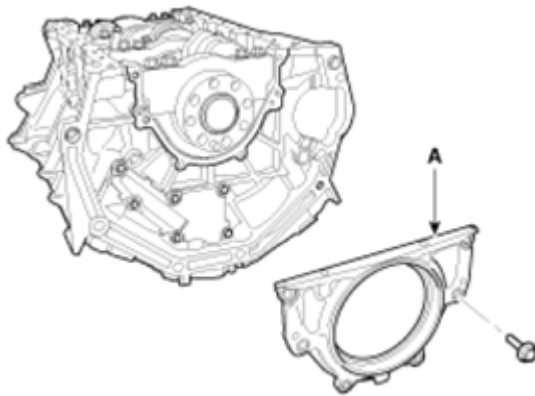


Fig. 45: Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

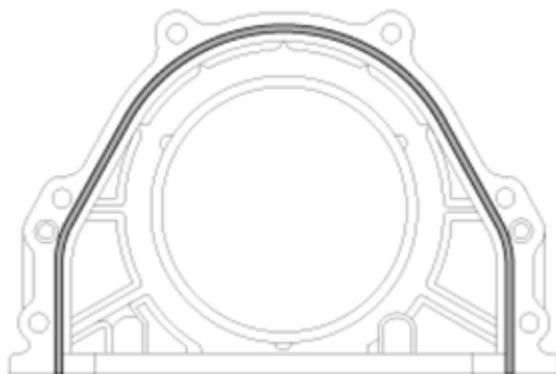


Fig. 46: Identifying Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

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

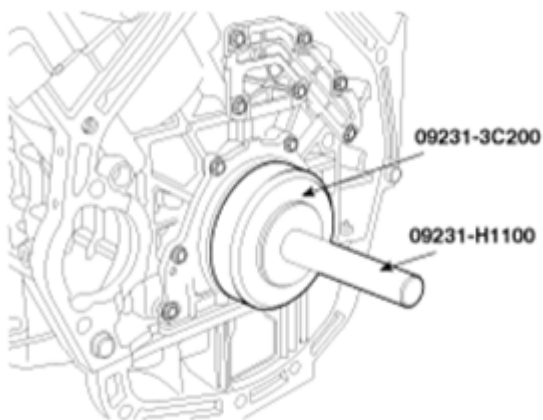


Fig. 47: Installing Rear Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

16. Install the baffle plate.

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

Tightening torque

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

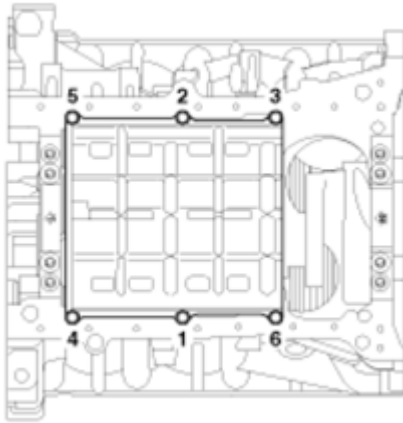


Fig. 48: Baffle Plate Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

17. Install the upper oil pan.
 - A. Using a gasket scraper, remove all the old gasket material from the gasket surfaces.
 - B. Before assembling the oil pan, the liquid sealant TB1217H should be applied on upper oil pan.

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

Bead width : 2.5 mm (0.1 in.)

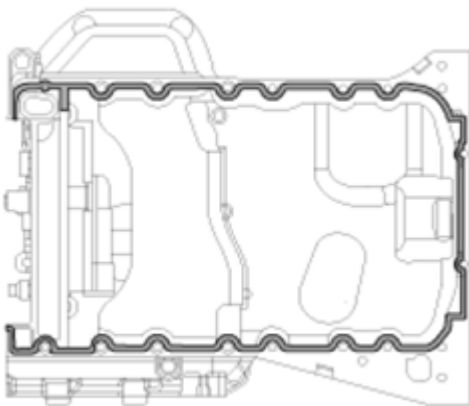


Fig. 49: Identifying Upper Oil Pan Liquid Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

threads of the bolt holes.

- C. Install the upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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



Fig. 50: Upper Oil Pan Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

18. Install the oil cover (A) and gasket (B).

Tightening torque

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

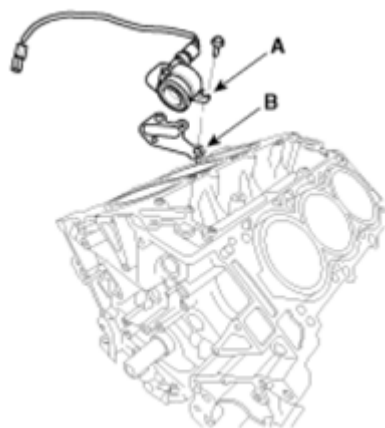


Fig. 51: Oil Cover & Gasket
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the knock sensor (A).

Tightening torque

15.7 ~ 23.5 N.m (1.6 ~ 2.4 kgf.m, 11.6 ~ 17.3 lb-ft)

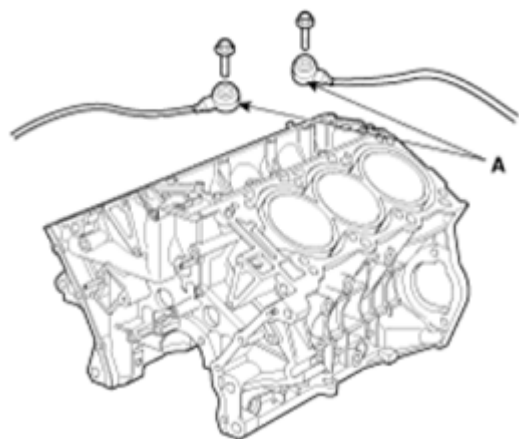


Fig. 52: Knock Sensor

Courtesy of KIA MOTORS AMERICA, INC.

20. Install the drive plate (A) and adapter plate (B).

Tightening torque:

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

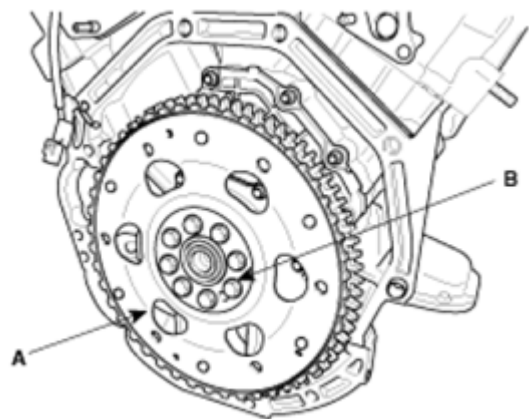


Fig. 53: Drive Plate & Adapter Plate

Courtesy of KIA MOTORS AMERICA, INC.

21. Install the oil filter assembly. Refer to **OIL FILTER ASSEMBLY** .
22. Install the oil pump. Refer to **OIL PUMP** .
23. Install the cylinder head. Refer to **INSTALLATION** .

24. Install the water temperature control assembly. Refer to **WATER TEMPERATURE CONTROL ASSEMBLY** .
25. Install the timing chain. Refer to **INSTALLATION** .
26. Install the intake manifold and exhaust manifold. Refer to **INTAKE AND EXHAUST SYSTEM** .
27. Install the engine assembly to the vehicle. Refer to **ENGINE AND TRANSAXLE ASSEMBLY** .