

2012 Kia Forte LX

2012-2013 ENGINE Engine Mechanical System - General Information - Forte/Forte Koup

2012-2013 ENGINE**Engine Mechanical System - General Information - Forte/Forte Koup****SPECIFICATIONS****ENGINE MECHANICAL SYSTEM SPECIFICATIONS**

Description	Specifications		Limit
	2.0	2.4	
General			
Type	In-line, Double Overhead Camshaft		
Number of cylinder	4		
Bore	86mm (3.385in)	88mm (3.464in)	
Stroke	86mm (3.385in)	97mm (3.819in)	
Total displacement	1998cc (121.92cu.in)	2359cc (143.90cu.in)	
Compression ratio	10.5		
Firing order	1-3-4-2		
Valve timing			
Intake valve			
Opens (ATDC/BTDC)	ATDC 7° ~ BTDC 38°		
Closes (ABDC)	ABDC 63° ~ 18°	ABDC 67° ~ 22°	
Exhaust			
Opens (BBDC)	BBDC 38°	BBDC 44° ~ 4°	
Closes (ATDC)	ATDC 6°	ATDC 0° ~ 40°	
Valve			
Valve length			
Intake	113.18mm (4.4559in.)		112.93mm (4.4460in)
Exhaust	105.84mm (4.1669in.)		105.59mm (4.1570in)
Stem O.D.			
Intake	5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)		
Exhaust	5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)		
Face angle	45.25° ~ 45.75°		
Margin			
Intake	1.02mm (0.0401in.)		
Exhaust	1.09mm (0.0429in.)		
Valve stem to valve guide clearance			
Intake	0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)		0.07mm (0.00275in.)

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Exhaust	0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)		0.09mm (0.00354in.)
Valve guide			
Length			
Intake	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)		
Exhaust	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)		
Valve guide I.D	5.500 ~ 5.512mm (0.2165 ~ 0.2170in.)		
Valve seat			
Width of seat contact			
Intake	1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)		
Exhaust	1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)		
Seat angle	44.75° ~ 45.10°		
Valve spring			
Free length	47.44mm (1.8677in.)		
Load	19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in)		
	39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)		
Squareness	1.5° MAX.		
Valve clearance			
Cold (20°C (68°F))			
Intake	0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)		
Exhaust	0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)		
Cylinder head			
Flatness of gasket surface	Max. 0.05mm (0.0019in.)		
Flatness of manifold mounting surface	Max. 0.10mm (0.0039in.)		
Cylinder block			
Cylinder bore	86.00 ~ 86.03mm (3.3858 ~ 3.3870in.)	88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)	
Out-of-round and taper of cylinder bore	Less than 0.05mm (0.0019in.)		
Clearance with piston (To set limits to new parts)	0.015 ~ 0.035mm (0.0005 ~ 0.0013in.)		
Piston			
O.D (To set limits to new parts)	85.975 ~ 86.0050mm	87.975 ~ 88.005mm	

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			(3.3848 ~ 3.3860in.)	(3.4635 ~ 3.4647in.)	
Ring groove width					
No. 1			1.235 ~ 1.250mm (0.0486 ~ 0.0492in.)		1.26mm (0.0496in.)
No. 2			1.230 ~ 1.250mm (0.0484 ~ 0.0492in.)		1.26mm (0.0496in.)
Oil ring			2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)		2.05mm (0.0807in.)
Piston ring					
Side clearance					
No. 1			0.05 ~ 0.08mm (0.0019 ~ 0.0031in.)		0.1mm (0.004in.)
No. 2			0.04 ~ 0.08mm (0.0015 ~ 0.0031in.)		0.1mm (0.004in.)
Oil ring			0.06 ~ 0.15mm (0.0023 ~ 0.0059in.)		0.2mm (0.008in.)
End gap					
No. 1			0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)		0.6mm (0.0236in.)
No. 2			0.37 ~ 0.52mm (0.0145 ~ 0.0204in.)		0.7mm (0.0275in.)
Oil ring side rail			0.20 ~ 0.70mm (0.0078 ~ 0.0275in.)		0.8mm (0.0315in.)
Connecting rod					
Bend			0.05mm (0.0020in.) or less		
Twist			0.1mm (0.004in.) or less		
Connecting rod big end to crankshaft side clearance			0.100 ~ 0.250mm (0.0039 ~ 0.010in.)		0.35mm (0.0138in.)
Connecting rod bearing					
Oil clearance (To seat limits to new parts)			0.027 ~ 0.045mm (0.0010 ~ 0.0017in.)		0.05mm (0.0078in.)
Camshaft					
Cam height	Intake		43.8mm (1.7244in.)	44.2mm (1.7401in.)	
	Exhaust		45.00mm (1.7716in.)	45.0mm (1.7716in.)	
Journal O.D	Intake	No. 1	30mm (1.1811in.)		
		No. 2, 3, 4, 5	24mm (0.9449in.)		
	Exhaust	No. 1	40mm (1.5748in.)	36mm (1.4173in.)	
		No. 2, 3, 4, 5	24mm (0.9449in.)		
Bearing oil	Intake	No. 1	0.022 ~ 0.057mm (0.0008 ~		0.09mm

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clearance			0.0022in.)		(0.0035in.)
		No. 2, 3, 4, 5	0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)		0.12mm (0.0047in.)
	Exhaust	No. 1	0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)	0 ~0.032mm (0 ~ 0.0012in.)	0.12mm (0.0047in.)
		No. 2, 3, 4, 5	0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)		
End play			0.04 ~ 0.16mm (0.0015 ~ 0.0062in.)		0.18mm (0.0071in.)
Crankshaft					
Pin O.D.			47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)		
Journal O.D.			51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)		
End play			0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)		
Crankshaft bearing					
Oil clearance			0.020 ~ 0.038mm (0.0007 ~ 0.0014in.)		0.1mm (0.0039in.)
Radiator					
Type			Pressurized corrugated fin type		
Cooling method			Water-cooled, pressurized. Forced circulation with water pump		
Radiator cap					
Main valve opening pressure			83 ~ 110kpa (12 ~ 16 psi, 0.83 ~ 1.1kg/cm ²)		
Vacuum valve opening pressure			-7kpa (-100 psi, -0.07kg/cm ²) or less		
Thermostat					
Type			Wax pellet type with jiggle valve		
Valve opening temperature			82°C (177°F)		
Full-opening temperature			95°C (201°F)		
Coolant pump			Centrifugal type impeller		
Engine oil					
Oil quantity	Total	4.7L (4.97US qt, 4.13lmp qt)	5.4L (5.71US qt, 4.75lmp qt)	When replacing a short engine or a block assembly	
	Oil pan	3.8L (4.01US qt, 3.34lmp qt)	4.2L (4.44US qt, 3.69lmp qt)		
	Drain and refill	4.1L (4.33US qt, 3.61lmp qt)	4.5L (4.76US qt, 3.96lmp qt)	Including oil filter	
Oil grade	Recommendation	5W-20/GF4 & SM			If not available,

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			refer to the recommended API or ILSAC classification and SAE viscosity number.
	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 <u>LUBRICATION SYSTEM</u> .
Oil pressure (at 1000 RPM)		108kPa (1.1kg/cm ² , 15.6 psi) or above	147kPa (1.5kg/cm ² , 21.3 psi) or above
			Oil temperature in oil pan : 110±2°C (230± 36°F)

TIGHTENING TORQUES

ENGINE MECHANICAL SYSTEM BOLTS TIGHTENING TORQUES SPECIFICATIONS

Item	N.m	kgf.m	lb-ft
Ladder frame bolt (M8 x 55)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Ladder frame bolt (M8 x 103)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Oil pump bolt (M8x179)	23.5 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2
Oil pump bolt (M9x181.5)	27.5 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1
Timing chain cover bolt (M8)	18.6 ~ 22.5	1.9 ~ 2.3	13.7 ~ 16.6
Timing chain cover bolt (M6)	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Oil pan bolt (M6 x 10)	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (M8 x 103)	26.5 ~ 30.4	2.7 ~ 3.1	19.5 ~ 22.4
Engine support bracket bolt (M8 x 30)	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Engine support bracket bolt (M10 x 40)	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Engine support bracket bolt (M10 x 45)	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Camshaft bearing cap bolt (M6)	10.8 ~ 12.7	1.1 ~ 1.3	7.9 ~ 9.4
Camshaft bearing cap bolt (M8)	27.4 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1

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Cylinder head bolt	$(32.4 \sim 36.3) + (90 \sim 95^\circ) + (90 \sim 95^\circ)$	$(3.3 \sim 3.7) + (90 \sim 95^\circ) + (90 \sim 95^\circ)$	$(23.9 \sim 26.8) + (90 \sim 95^\circ) + (90 \sim 95^\circ)$
Engine hanger bolt	27.5 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1
Cylinder head cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Crankshaft pulley bolt	166.6 ~ 176.4	17.0 ~ 18.0	122.9 ~ 130.1
Connecting rod bearing cap bolt	$(17.7 \sim 21.6) + (88 \sim 92^\circ)$	$(1.8 \sim 2.2) + (88 \sim 92^\circ)$	$(13.0 \sim 15.9) + (88 \sim 92^\circ)$
Main bearing cap bolt	$14.7 + (27.5 \sim 31.4) + (120 \sim 125^\circ)$	$1.5 + (2.8 \sim 3.2) + (120 \sim 125^\circ)$	$10.8 + (20.3 \sim 23.1) + (120 \sim 125^\circ)$
Flywheel bolt	117.6 ~ 127.4	12.0 ~ 13.0	86.8 ~ 93.9
Drive plate bolt	117.6 ~ 127.4	12.0 ~ 13.0	86.8 ~ 93.9
Timing chain tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
OCV bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
CVVT bolt	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Exhaust camshaft sprocket bolt	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Oil pump (BSM) chain tensioner arm bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump (BSM) chain guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump (BSM) chain tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
A/C compressor bracket bolt	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
P/S pump bracket bolt	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Tensioner assy integrated bracket bolt	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Water temperature control assembly nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Balance shaft module bolt (M8x179)-4 bolt type	$14.7 \sim 18.6 + 58 \sim 62^\circ + 58 \sim 62^\circ$	$1.5 \sim 1.9 + 58 \sim 62^\circ + 58 \sim 62^\circ$	$10.8 \sim 13.7 + 58 \sim 62^\circ + 58 \sim 62^\circ$
Balance shaft module bolt (M8x181.5)-4 bolt type	$22.6 \sim 26.5 + 103 \sim 107^\circ$	$2.3 \sim 2.7 + 103 \sim 107^\circ$	$16.6 \sim 19.5 + 103 \sim 107^\circ$
Balance shaft module bolt (M9x95)-6 bolt type	$22.6 \sim 26.5 + 43 \sim 47^\circ$	$2.3 \sim 2.7 + 43 \sim 47^\circ$	$16.6 \sim 19.5 + 43 \sim 47^\circ$
Balance shaft module bolt (M9x181.5)-6 bolt type	$22.6 \sim 26.5 + 88 \sim 92^\circ$	$2.3 \sim 2.7 + 88 \sim 92^\circ$	$16.6 \sim 19.5 + 88 \sim 92^\circ$
Water temperature control assembly bolt	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5

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Water inlet pipe nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil level gauge assembly bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Ignition coil bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Intake manifold bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold stay bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold heat protector bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Exhaust manifold nut	49.0 ~ 53.9	5.0 ~ 5.5	36.2 ~ 39.7
Exhaust manifold stay bolt (M8)	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Exhaust manifold stay bolt (M10)	51.9 ~ 57.8	5.3 ~ 5.9	38.3 ~ 42.6
Muffler bolt	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Engine cover mounting bracket bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Crankshaft position sensor bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Oxygen sensor	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.1
Knock sensor	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Camshaft position sensor	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Oil pressure switch	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6

REPAIR PROCEDURES

COMPRESSION PRESSURE INSPECTION

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. Disconnect the injector connectors and ignition coil connectors.
3. Remove ignition coils.
4. Remove spark plugs.

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

5. Check cylinder compression pressure.

- A. Insert a compression gauge into the spark plug hole.

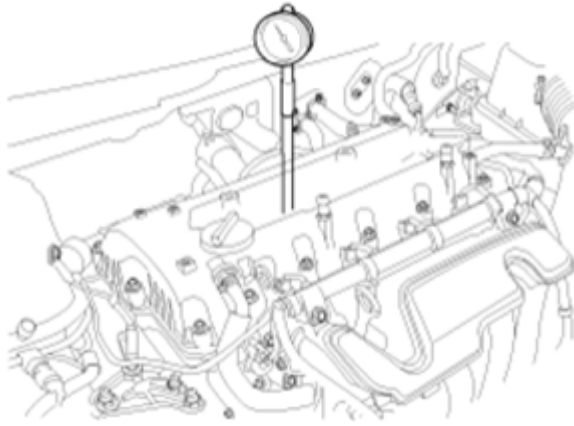


Fig. 1: Checking Cylinder Compression Pressure
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

Compression pressure:

1, 283kPa (13.0kgf/cm² , 185 psi)

Minimum pressure:

1, 135kPa (11.5kgf/cm² , 164 psi)

Difference between each cylinder:

100kPa (1.0kgf/cm² , 15 psi) or less

- E. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for cylinders with low compression.
- If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.

- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
- 6. Reinstall spark plugs.
- 7. Install ignition coils.
- 8. Connect the injector connectors and ignition coil connectors.

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

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

1. Remove the cylinder head cover (A). Refer to **TIMING SYSTEM** .
2. Set No. 1 cylinder to TDC/compression.
 - A. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

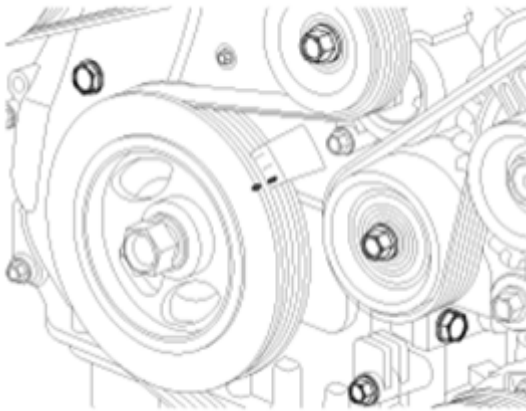


Fig. 2: Timing Mark Of Lower Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

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

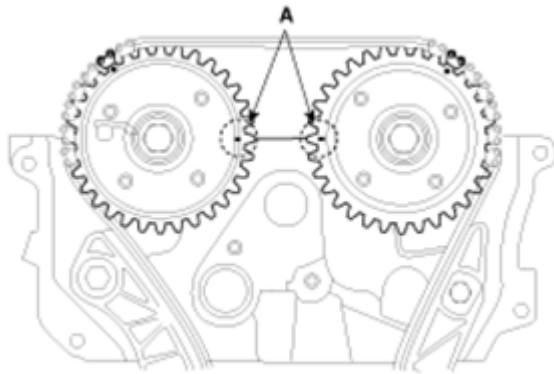


Fig. 3: Identifying Mark Of Camshaft Timing Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

3. Inspect the valve clearance.

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

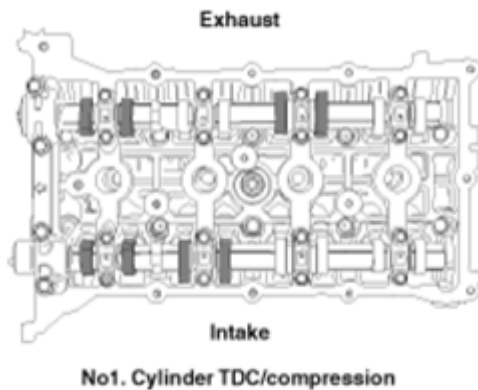


Fig. 4: Identifying Intake & Exhaust Valves (No. 1 Cylinder At TDC)
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve clearance

Specification

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

Limit

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

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

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

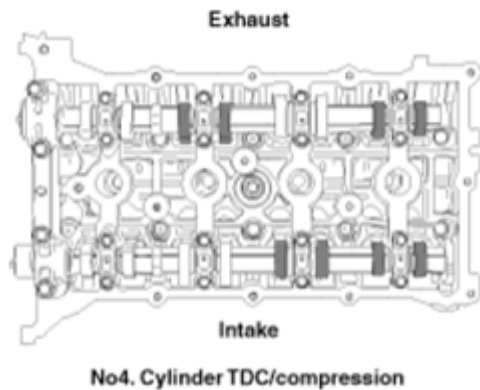


Fig. 5: Identifying Intake & Exhaust Valves (No. 4 Cylinder At TDC)
 Courtesy of KIA MOTORS AMERICA, INC.

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

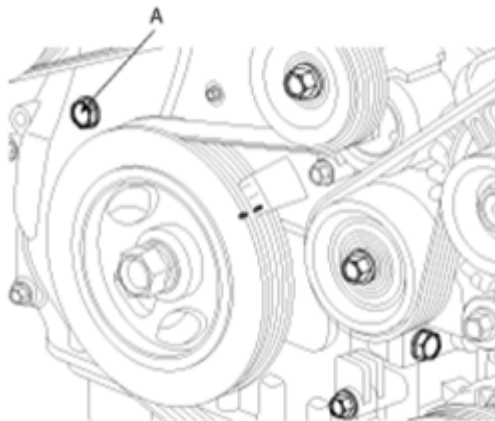


Fig. 6: Identifying Service Hole Bolt Of Timing Chain Cover
 Courtesy of KIA MOTORS AMERICA, INC.

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

- D. Insert the SST (A) (09240-2G000) in the service hole of the timing chain cover and release the ratchet.

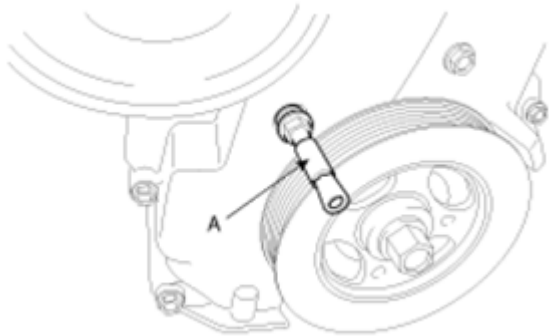


Fig. 7: Identifying SST
Courtesy of KIA MOTORS AMERICA, INC.

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

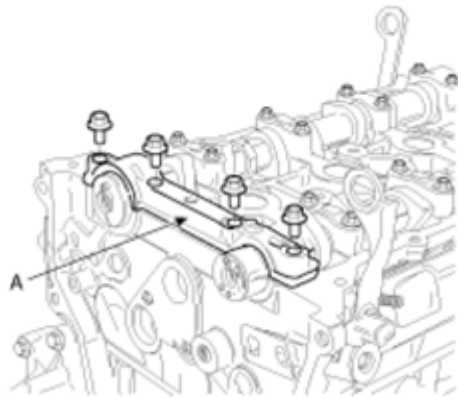


Fig. 8: Front Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

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

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

- H. Tie down timing chain so that it doesn't move.

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

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

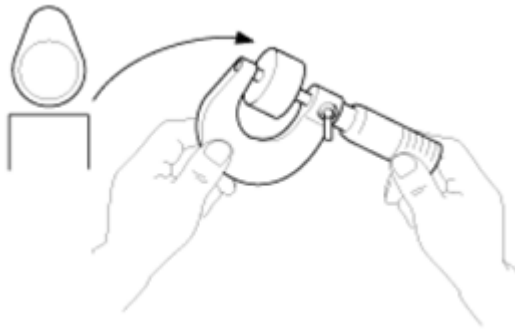


Fig. 9: Measuring Thickness Of Tappet
 Courtesy of KIA MOTORS AMERICA, INC.

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

Valve clearance (Engine coolant temperature : 20°C)

T : Thickness of removed tappet

A : Measured valve clearance

N : Thickness of new tappet

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

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

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

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

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

Tightening torque:

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

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

and camshaft sprocket timing marks (A).

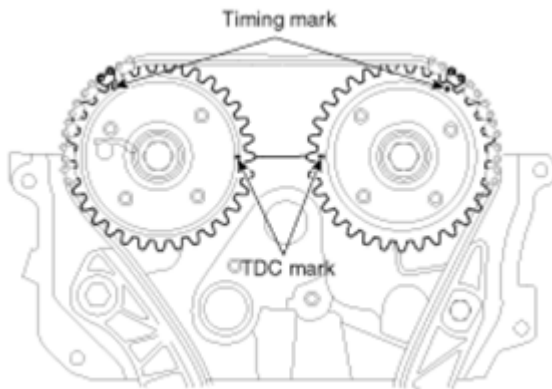


Fig. 10: Identifying Camshaft Sprocket Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

S. Recheck the valve clearance.

Valve clearance (Engine coolant temperature : 20°C)

Specification

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

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

TROUBLESHOOTING

ENGINE MECHANICAL SYSTEM TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings Loose or improperly engine flywheel	Replace the crankshaft and bearings as required. 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 build up 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.

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Engine misfire with coolant consumption	<ul style="list-style-type: none"> Faulty cylinder head gasket or other damage to the cylinder head and engine block cooling system. Coolant consumption may or may not cause the engine to overheat. 	<ul style="list-style-type: none"> Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul style="list-style-type: none"> Inspect the cylinder for a loss of compression. Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity	<ul style="list-style-type: none"> Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	<ul style="list-style-type: none"> Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul style="list-style-type: none"> Inspect the camshaft lobes. Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair or replace 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 or replace as required.
	Worn drive belt, idler, tensioner and bearing.	Replace 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.	<ul style="list-style-type: none"> Inspect the oil pan. Inspect the oil pump screen.

2012 Kia Forte LX

2012-2013 ENGINE Engine Mechanical System - General Information - Forte/Forte Koup

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

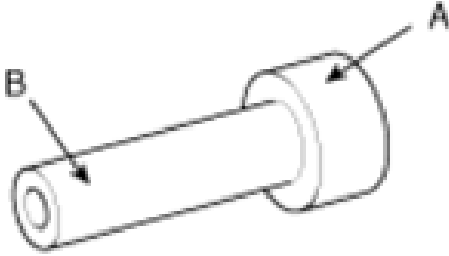
2012 Kia Forte LX

2012-2013 ENGINE Engine Mechanical System - General Information - Forte/Forte Koup

		<ul style="list-style-type: none"> • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
Engine will not crank, crankshaft will not rotate	Hydraulically locked cylinder <ul style="list-style-type: none"> • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder 	<ol style="list-style-type: none"> 1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	<ol style="list-style-type: none"> 1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder <ul style="list-style-type: none"> • Broken valve • Piston material • Foreign material 	<ol style="list-style-type: none"> 1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	<ol style="list-style-type: none"> 1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	<ol style="list-style-type: none"> 1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft	<ol style="list-style-type: none"> 1. Inspect crankshaft. 2. Repair as required.

SPECIAL SERVICE TOOLS

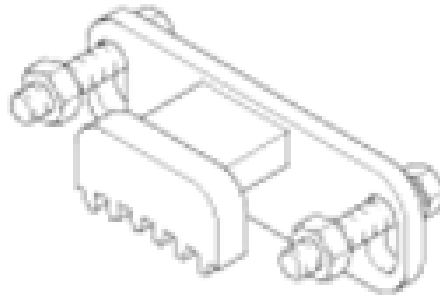
SPECIAL SERVICE TOOLS DESCRIPTION CHART

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-3K000) (09231-H1100)		Installation of the front oil seal A. 09214-3K000 B. 09231-H1100

2012 Kia Forte LX

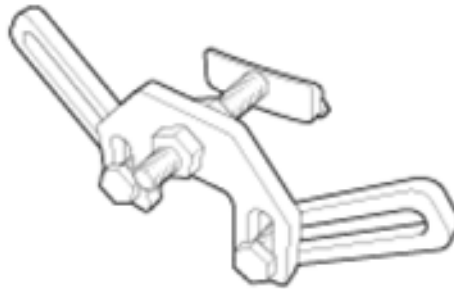
2012-2013 ENGINE Engine Mechanical System - General Information - Forte/Forte Koup

Ring gear stopper
(09231-3K000)



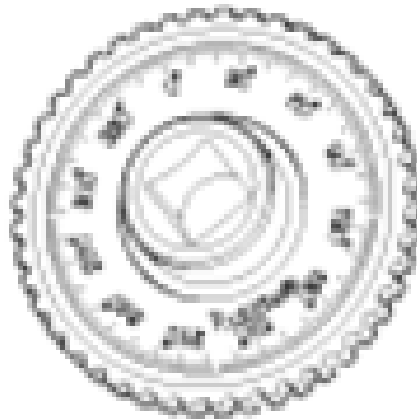
Removal and installation of
crankshaft pulley bolt.

Ring gear stopper
(09231-3D100)



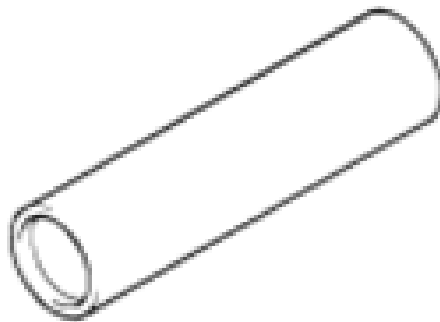
Removal and installation of
crankshaft pulley bolt.

Torque angle adapter
(09221-4A000)



Installation of bolts & nuts
needing an angular method of
adjustment.

Valve stem oil seal installer
(09222-4A000)



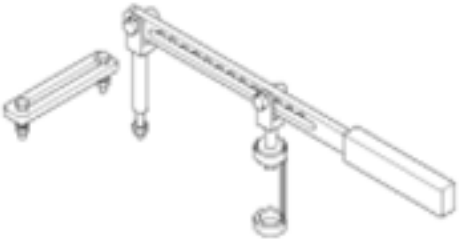
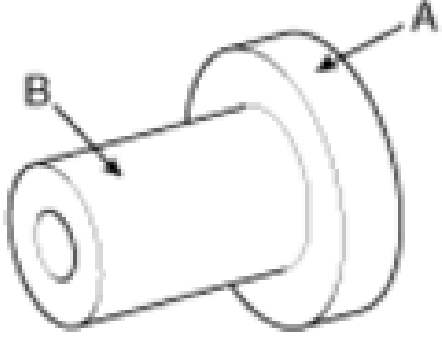
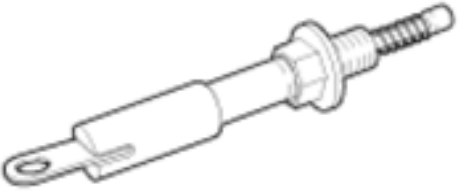
Installation of the valve stem oil
seal

Valve spring compressor &
holder
(09222-3K000)

Removal and installation of the
intake or exhaust valve
09222-3K100 (holder)

2012 Kia Forte LX

2012-2013 ENGINE Engine Mechanical System - General Information - Forte/Forte Koup

(09222-3K100)		
Crankshaft rear oil seal installer (09214-3K100) (09231-H1100)		Installation of the crankshaft rear oil seal A. 09214-3K100 B. 09231-H1100
Timing chain tensioner ratchet holder (09240-2G000)		Timing chain tension release In vehicle inspection and adjustment of valve clearance.

2012-2013 ENGINE

Cylinder Block - Forte/Forte Koup

CYLINDER BLOCK

COMPONENTS AND COMPONENTS LOCATION

Components

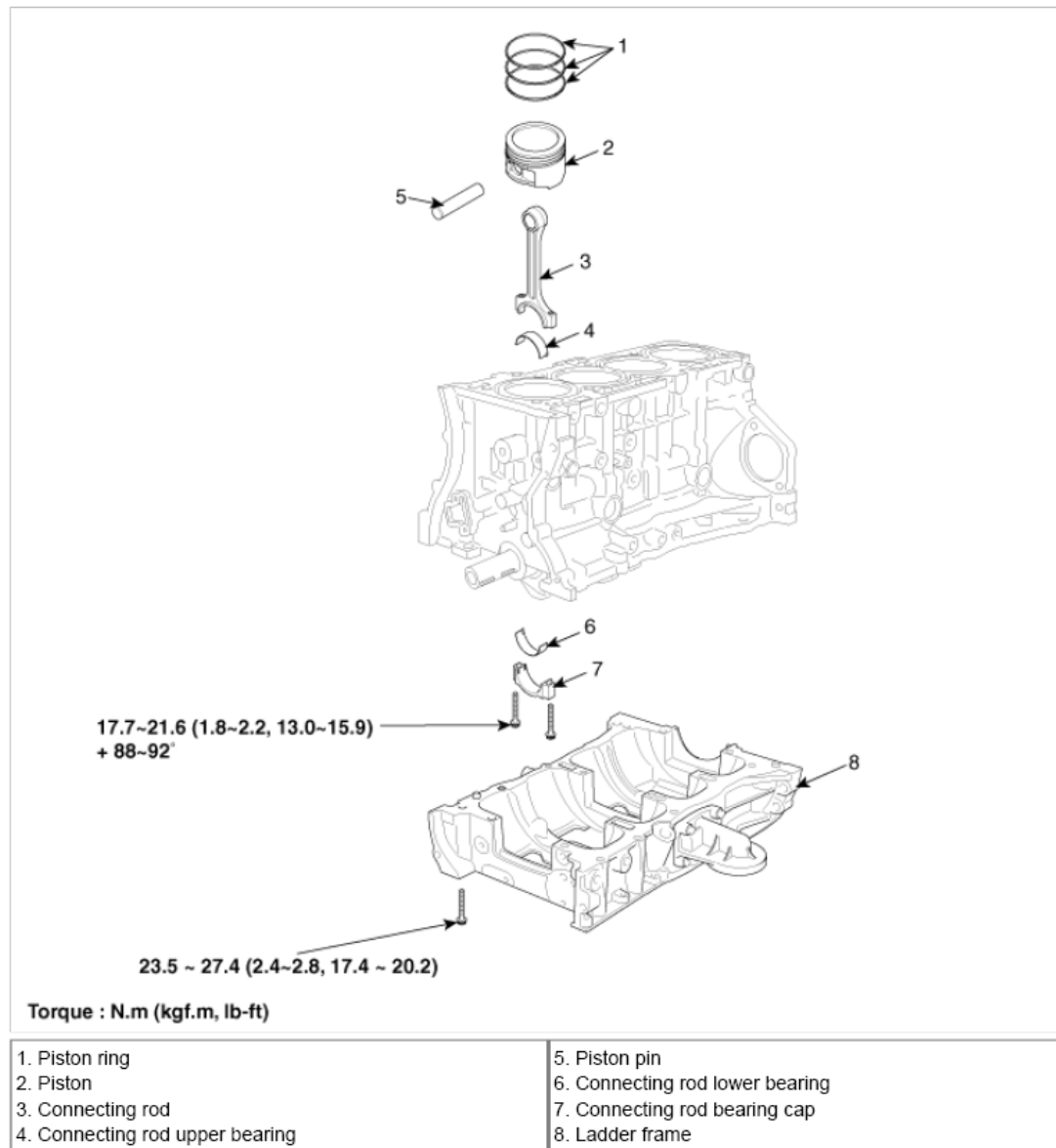
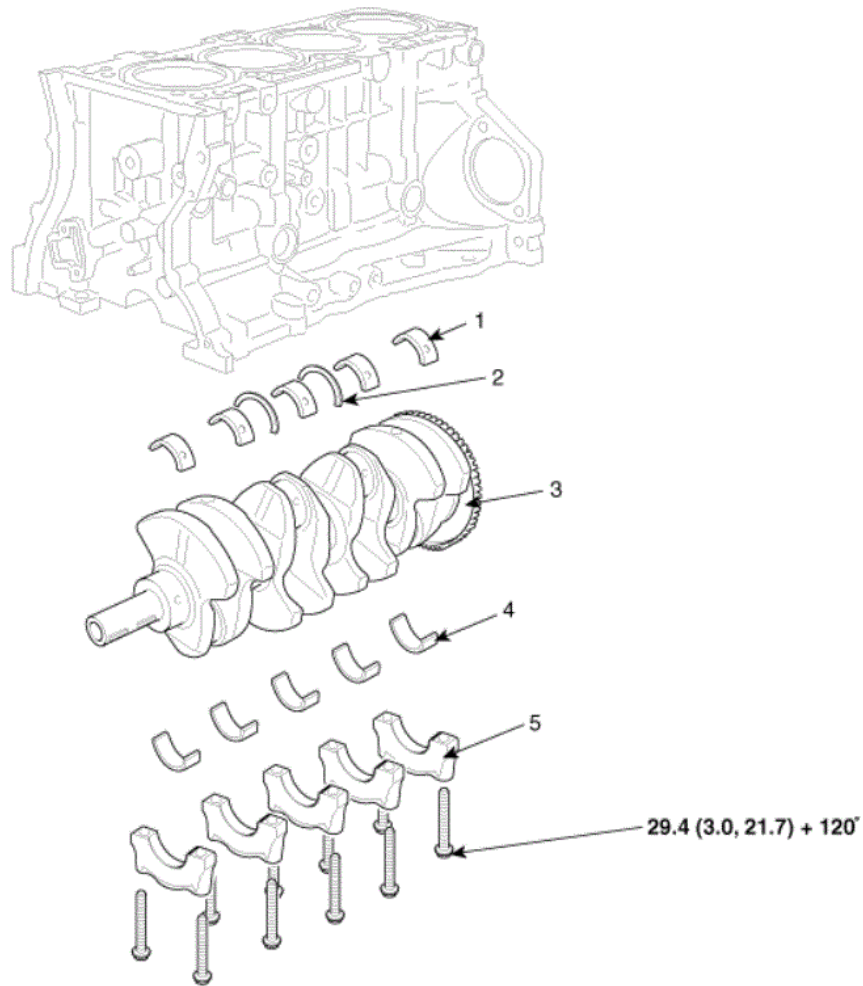


Fig. 1: Exploded View Of Cylinder Block With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



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

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

1. Crankshaft upper bearing
2. Thrust bearing
3. Crankshaft
4. Crankshaft lower bearing
5. Main bearing cap

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 misconception.
- 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. Install 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 cylinder head assembly. Refer to **CYLINDER HEAD** .
6. Remove the drive plate (AT only) or flywheel (MT only).
7. Remove the oil pump. Refer to **LUBRICATION SYSTEM** .
8. Remove the A/C compressor. Refer to **COMPRESSOR** .
9. Remove the alternator (A).

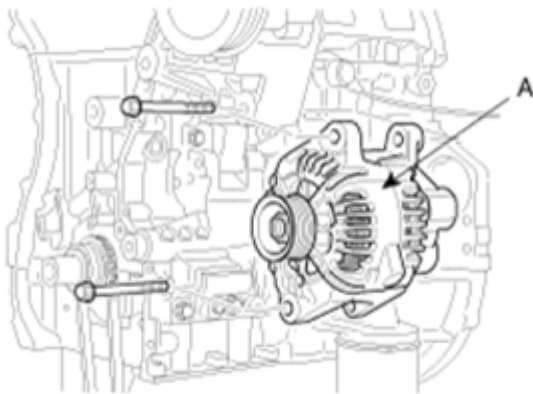


Fig. 3: Alternator

Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the power steering pump and the bracket. Refer to **POWER STEERING OIL PUMP** .

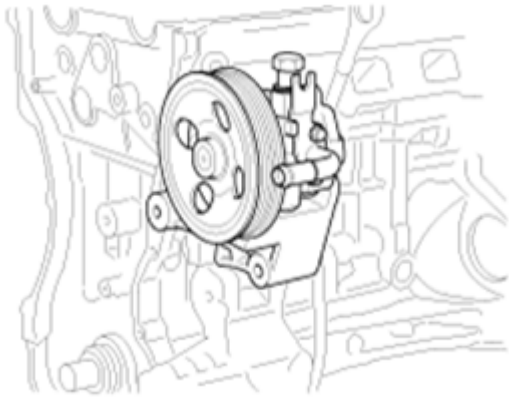


Fig. 4: Power Steering Pump & Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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

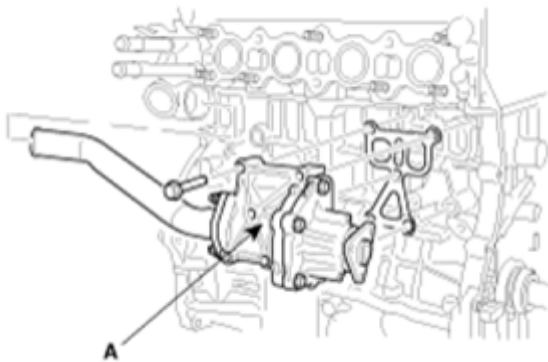


Fig. 5: Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the tensioner assembly integrated bracket (A).

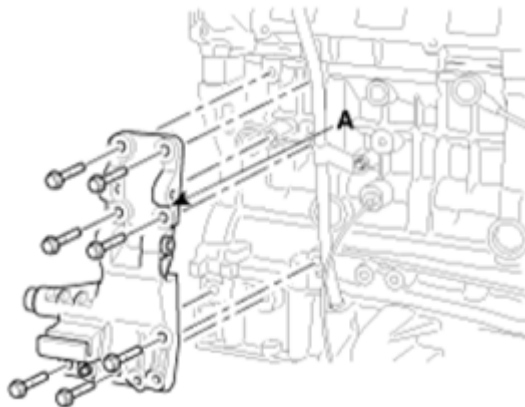


Fig. 6: Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the oil level gauge (A).

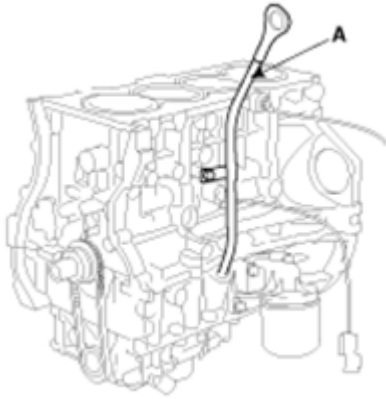


Fig. 7: Oil Level Gauge
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the knock sensor (A).

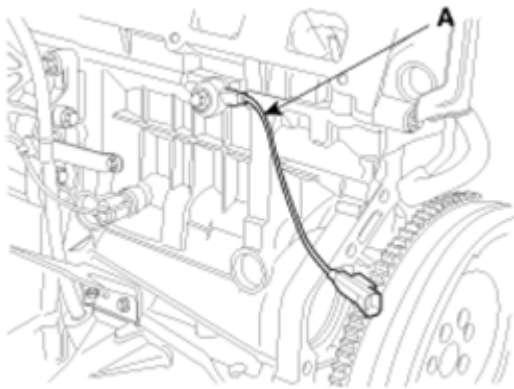


Fig. 8: Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the oil pressure sensor (A).

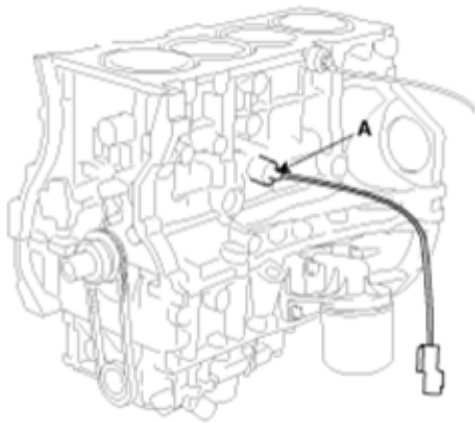


Fig. 9: Oil Pressure Sensor

Courtesy of KIA MOTORS AMERICA, INC.

16. Remove the CKP sensor (A).

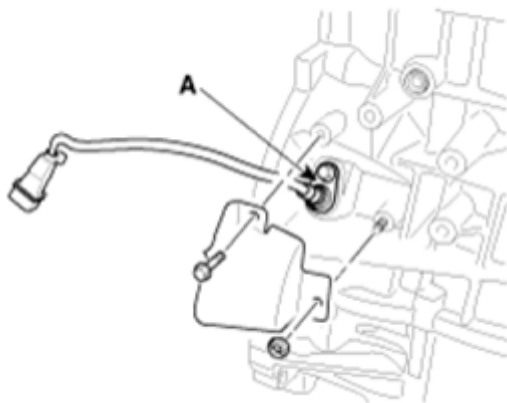


Fig. 10: CKP Sensor

Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the ladder frame (A).

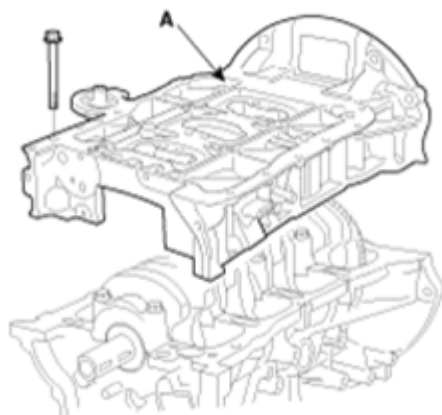


Fig. 11: Ladder Frame

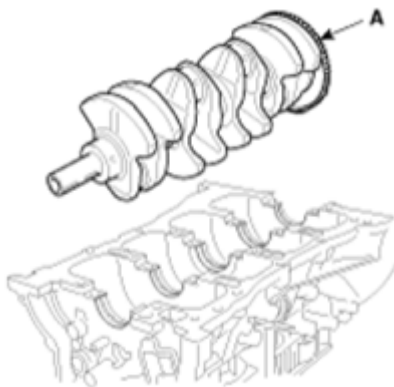
Courtesy of KIA MOTORS AMERICA, INC.

18. Check the connecting rod end play.
19. Remove the connecting rod caps and check oil clearance.
20. 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.**

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

NOTE:**Arrange the main bearings and thrust bearings in the correct order.****Fig. 12: Crankshaft**

Courtesy of KIA MOTORS AMERICA, INC.

24. 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.

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

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

26. 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~ 0.25 mm (0.004 ~ 0.010 in.)

Maximum end play : 0.35 mm (0.0138 in.)

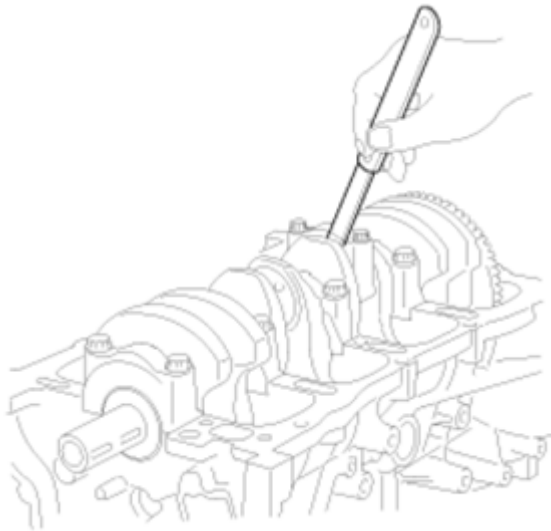


Fig. 13: Measuring Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

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

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

Standard oil clearance

0.027 ~ 0.045 mm (0.0010 ~ 0.0017 in.)

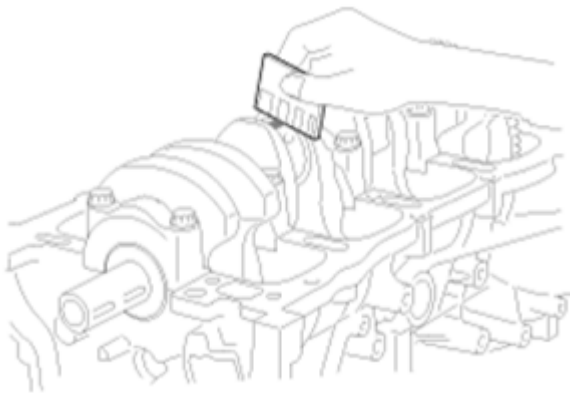


Fig. 14: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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 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

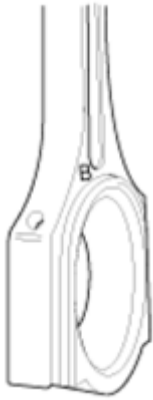


Fig. 15: Connecting Rod Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod

DISCRIMINATION OF CONNECTING ROD

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

Crankshaft Pin Mark Location Discrimination Of Crankshaft

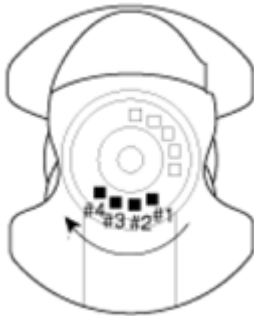


Fig. 16: Crankshaft Pin Mark Location Discrimination Of Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Conform to read stamping order as shown arrow direction from #1.

Discrimination Of Crankshaft

DISCRIMINATION OF CRANKSHAFT

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

III	3	47.954 ~ 47.960 mm (1.8879 ~ 1.8881 in.)
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Place Of Identification Mark (Connecting Rod Bearing) Discrimination Of Connecting Rod Bearing

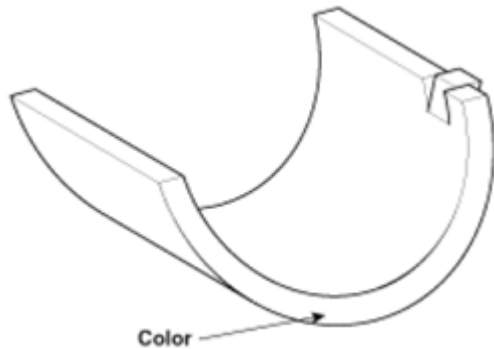


Fig. 17: Identification Mark Of Connecting Rod Bearing
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod Bearing

DISCRIMINATION OF CONNECTING ROD BEARING

Class	Mark	Thickness Of Bearing
AA	Blue	1.517 ~ 1.520 mm (0.0597 ~ 0.0598 in.)
A	Black	1.514 ~ 1.517 mm (0.0596 ~ 0.0597 in.)
B	None	1.511 ~ 1.514 mm (0.0595 ~ 0.0596 in.)
C	Green	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in.)
D	Yellow	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in.)

11. Selection

CRANKSHAFT IDENTIFICATION MARK REFERENCE CHART

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

3. Check the crankshaft bearing oil clearance.

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

Tightening torque

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

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

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

Standard oil clearance

0.020 ~ 0.038 mm (0.0008 ~ 0.0015 in.)

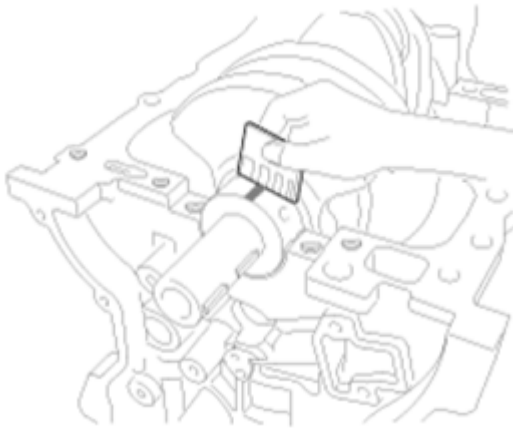


Fig. 18: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

Connecting Rods

1. When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
3. Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

Allowable bend of connecting rod:

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

Allowable twist of connecting rod:

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

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores.

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

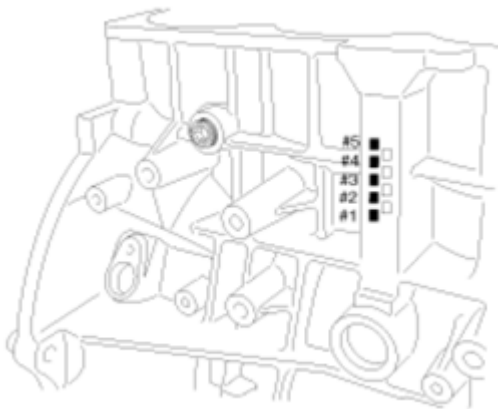


Fig. 19: Crankshaft Bore Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block**DISCRIMINATION OF CYLINDER BLOCK**

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

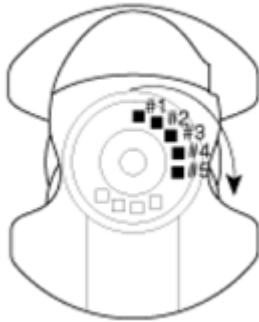
Crankshaft Journal Mark Location Discrimination Of Crankshaft

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

NOTE: Conform to read stamping order as shown arrow direction from #1.

Discrimination Of Crankshaft**DISCRIMINATION OF CRANKSHAFT**

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

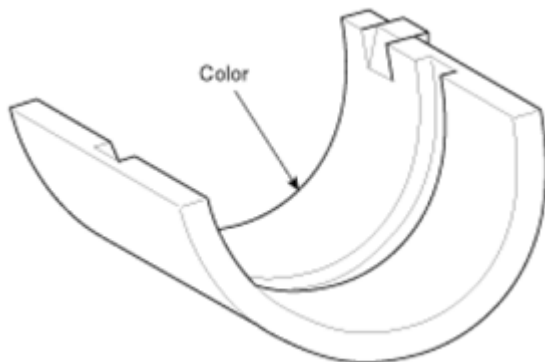
Place Of Identification Mark (Crankshaft Bearing) Discrimination Of Crankshaft Bearing

Fig. 21: Identification Mark Of Crankshaft Bearing
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing

DISCRIMINATION OF CRANKSHAFT BEARING

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

Selection

CRANKSHAFT IDENTIFICATION MARK REFERENCE CHART

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

4. Check crankshaft end play.

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

Standard end play

0.07 ~ 0.25 mm (0.0027 ~ 0.0098 in.)

Limit : 0.30 mm (0.0118 in.)

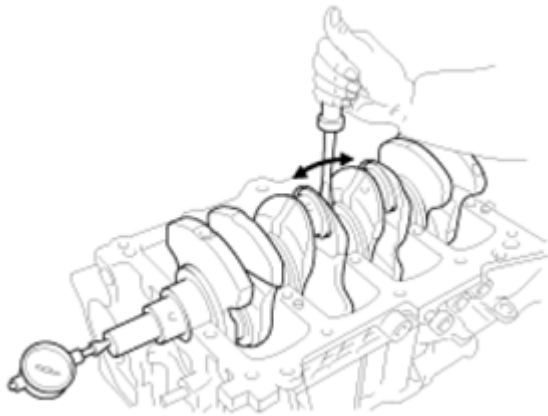


Fig. 22: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

1.925 ~ 1.965 mm (0.0758 ~ 0.07736 in.)

5. Inspect main journals and crank pins

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

Main journal diameter:

51.942 ~ 51.960 mm (2.0449 ~ 2.0456 in.)

Crank pin diameter:

47.954 ~ 47.972 mm (1.8879 ~ 1.8886 in.)

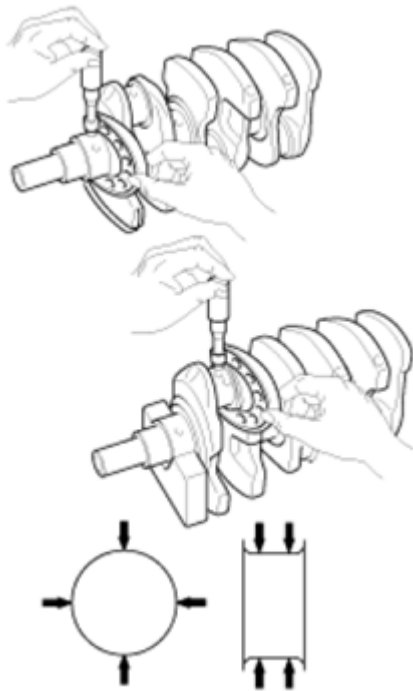


Fig. 23: Measuring Diameter Of Main Journals & Crank Pins
 Courtesy of KIA MOTORS AMERICA, INC.

Cylinder Block

1. Remove gasket material.

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

2. Clean cylinder block

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

3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard : Less than 0.05 mm (0.0020 in.)

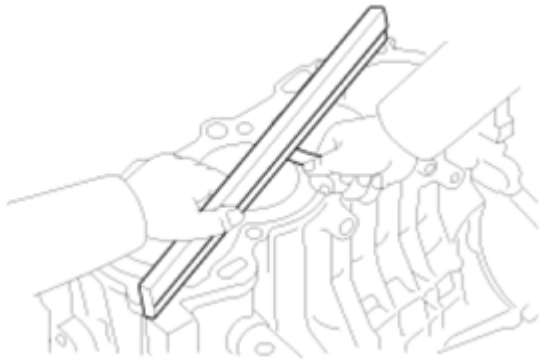


Fig. 24: Measuring Cylinder Block Flatness
Courtesy of KIA MOTORS AMERICA, INC.

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

2.0 : 86.00 ~ 86.03 mm (3.3858 ~ 3.3870 in.)

2.4 : 88.00 ~ 88.03 mm (3.4645 ~ 3.4657 in.)

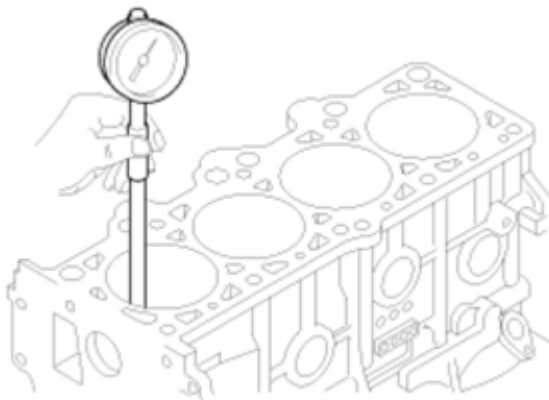


Fig. 25: Measuring Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Measure position (from the bottom of the cylinder block)

: 110.7 mm (4.3582 in.)/160 mm (6.2992 in.)/210 mm (8.2677 in.)

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

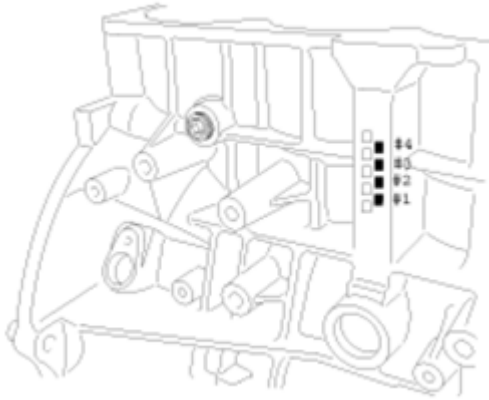


Fig. 26: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

Cylinder Bore Inner Diameter

CYLINDER BORE INNER DIAMETER SPECIFICATIONS

Size Code	Cylinder Bore Inner Diameter	
	2.0	2.4
A	86.00 ~ 86.01 mm (3.3858 ~ 3.3862 in.)	88.00 ~ 88.01 mm (3.4645 ~ 3.4649 in.)
B	86.01 ~ 86.02 mm (3.3862 ~ 3.3866 in.)	88.01 ~ 88.02 mm (3.4649 ~ 3.4653 in.)
C	86.02 ~ 86.03 mm (3.3866 ~ 3.3870 in.)	88.02 ~ 88.03 mm (3.4653 ~ 3.4657 in.)

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

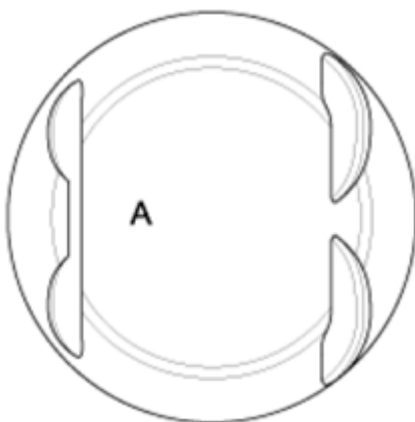


Fig. 27: Identifying Piston Size Code On Piston Top Face
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston Outer Diameter

PISTON OUTER DIAMETER SPECIFICATIONS

Size Code	Piston Outer Diameter	
	2.0	2.4
A	85.975 ~ 85.985 mm (3.3848 ~ 3.385 2 in.)	87.975 ~ 87.985 mm (3.4635 ~ 3.4639 in.)
B	85.985 ~ 85.995 mm (3.3852 ~ 3.3856 in.)	87.985 ~ 87.995 mm (3.4639 ~ 3.4643 in.)
C	85.995 ~ 86.005 mm (3.3856 ~ 3.3860 in.)	87.995 ~ 88.005 mm (3.4643 ~ 3.4647 in.)

8. Select the piston related to cylinder bore class.

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

Piston And Rings

1. Clean piston
 1. Using a gasket scraper, remove the carbon from the piston top.
 2. Using a groove cleaning tool 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 34.5 mm (1.35 in.) from the top land of the piston.

Standard diameter

2.0 : 85.975 ~ 86.005 mm (3.3848 ~ 3.3860 in.)

2.4 : 87.975 ~ 88.005 mm (3.4635 ~ 3.4647 in.)

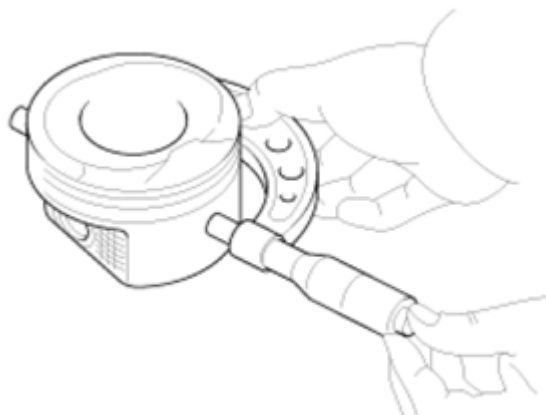


Fig. 28: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.015 ~ 0.035 mm (0.00059 ~ 0.00137 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 : 0.05 ~ 0.08 mm (0.0019 ~ 0.0031 in.)

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

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

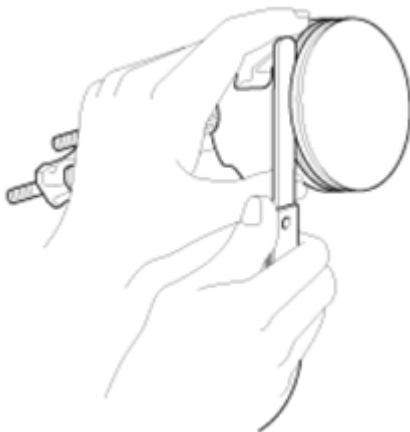


Fig. 29: Measuring Piston Ring Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Inspect piston ring end gap.

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

Piston ring end gap

Standard

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

No. 2 : 0.37 ~ 0.52 mm (0.0145 ~ 0.0204 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.)

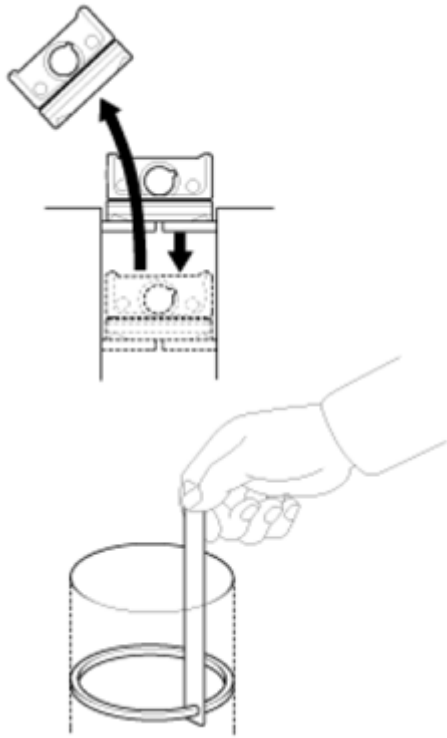


Fig. 30: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the diameter of the piston pin.

Piston pin diameter

21.001 ~ 21.006 mm (0.8268 ~ 0.8270 in.)

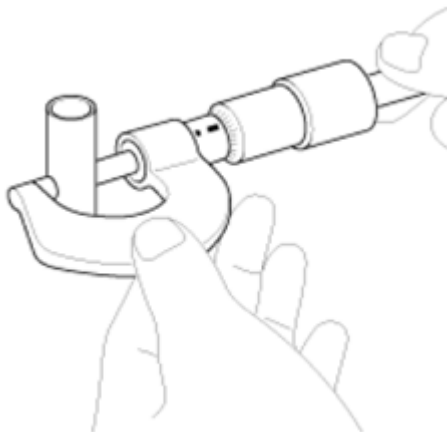


Fig. 31: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.013 ~ 0.023 mm (0.0005 ~ 0.0009 in.)

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

Piston pin-to-connecting rod interference

0.016 ~ 0.032 mm (0.00063 ~ 0.00126 in.)

Oil Pressure Switch

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

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

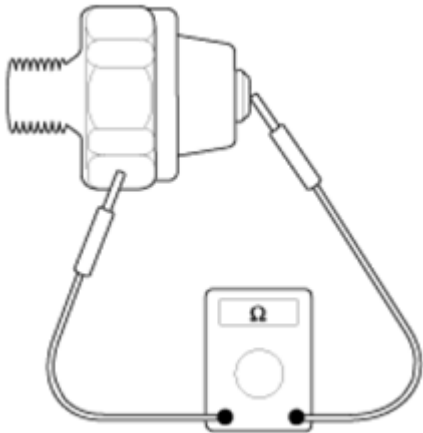


Fig. 32: Checking Continuity Between Oil Pressure Switch Terminal & Body
 Courtesy of KIA MOTORS AMERICA, INC.

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 50 kPa (7 psi) is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

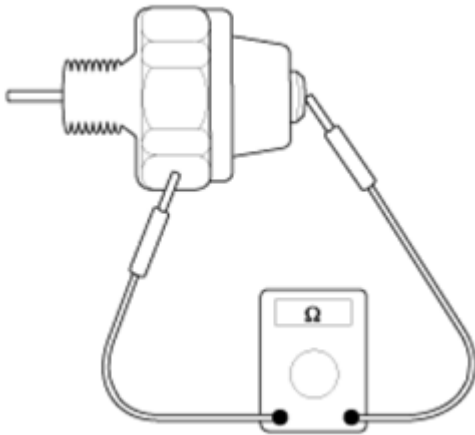


Fig. 33: Checking Continuity Between Oil Pressure Switch Terminal & Body (Fine Wire Pushed)
Courtesy of KIA MOTORS AMERICA, INC.

Reassembly

NOTE:

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

1. Assemble the piston and connecting rod.

1. Before pressing the piston pin, apply a coat of lubricant oil to the piston pin outer and connecting rod.

CAUTION:

- Take care that piston pin is not to be damaged during pressing process.
- When replace the piston pin, check the piston pin outer diameter and connecting rod small end inner diameter as below.

Piston pin outer DIA.:

21.001 ~ 21.006 mm (0.8268 ~ 0.8270 in)

Connecting rod small end inner DIA.:

20.974 ~ 20.985 mm (0.8257 ~ 0.8261 in)

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

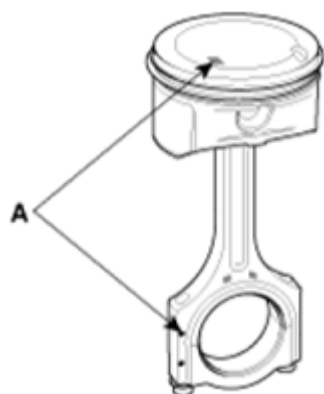


Fig. 34: Identifying Piston & Connecting Rod Front Marks
Courtesy of KIA MOTORS AMERICA, INC.

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.

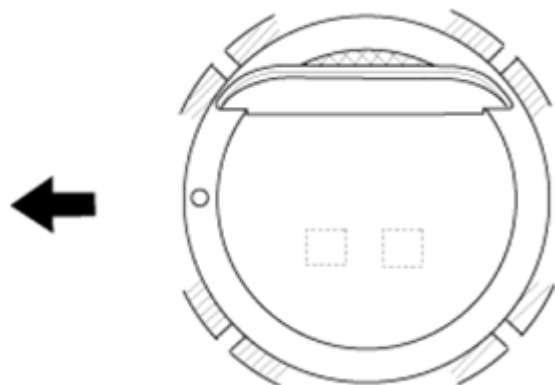


Fig. 35: Identifying Piston Ring Ends
Courtesy of KIA MOTORS AMERICA, INC.

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).

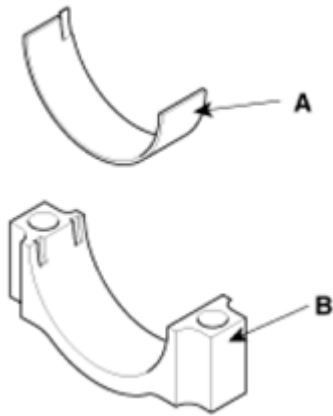


Fig. 36: Bearing & Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the main bearings.

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

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

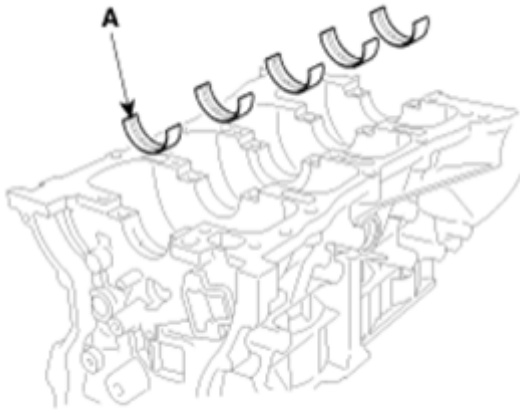


Fig. 37: Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

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

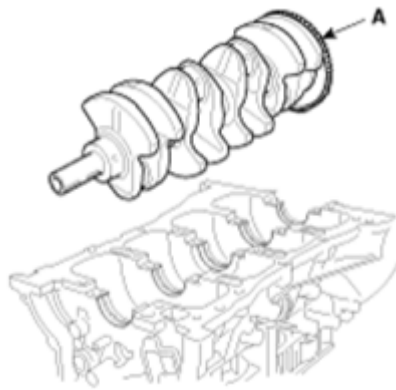


Fig. 39: Crankshaft

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

NOTE:

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

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown. (with specified torque 29.4 N.m (3.0kgf.m, 21.7 lb-ft))

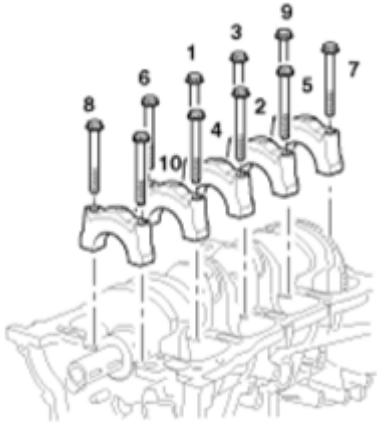


Fig. 40: Bearing Cap Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

3. Retighten the bearing cap bolts by 120° in the numerical order shown.
4. Check that the crankshaft turns smoothly.
9. Check crankshaft end play.
10. Install piston and connecting rod assemblies.

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

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

Tightening torque

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

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

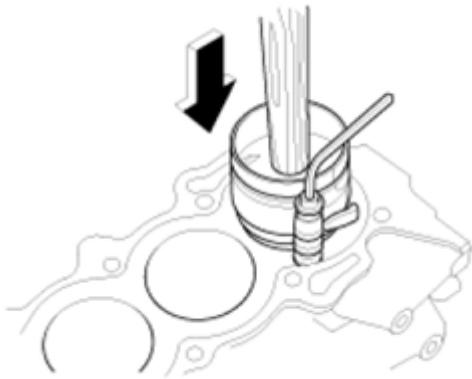


Fig. 41: Installing Piston

Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

- When assembling ladder frame, the liquid sealant Loctite 5900H or THREEBOND 1217H should be applied ladder frame.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

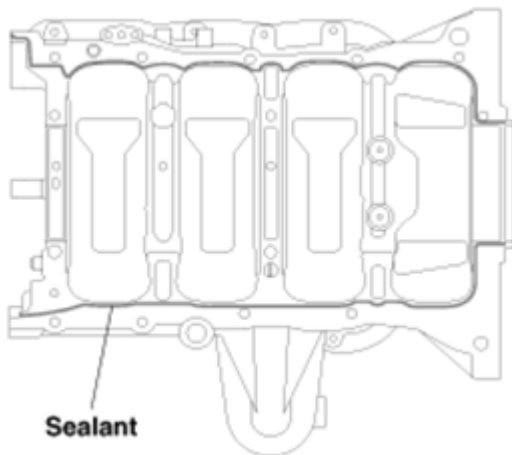


Fig. 42: Identifying Sealant Application Areas

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

Step 1 :

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

Step 2 :

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

Step 3 :

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

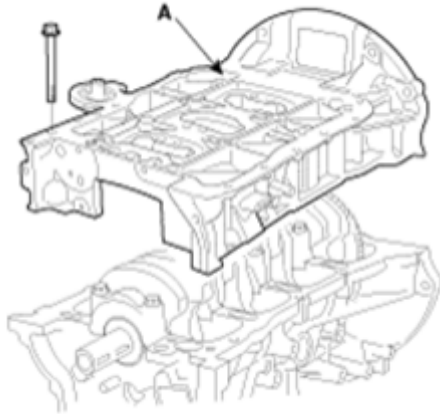


Fig. 43: Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

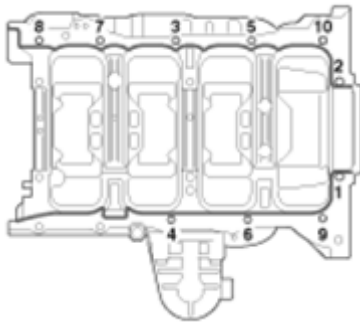
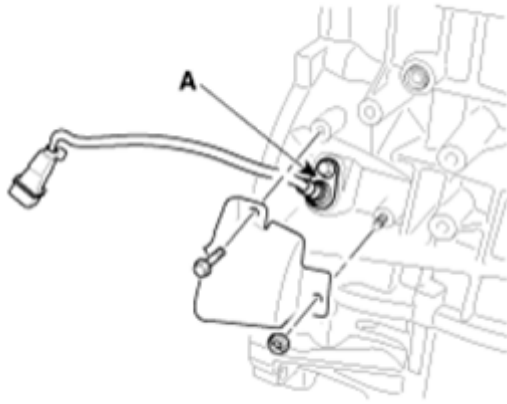


Fig. 44: Ladder Frame Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

**Fig. 45: CKP Sensor**

Courtesy of KIA MOTORS AMERICA, INC.

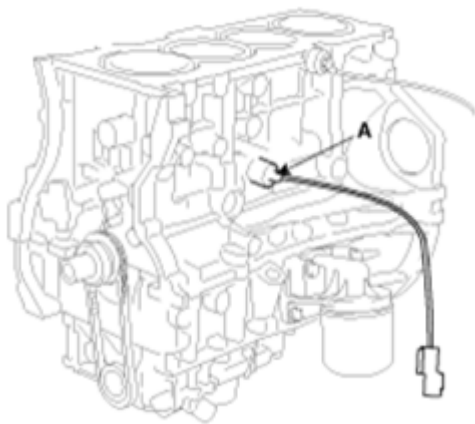
15. Install oil pressure sensor.
 1. Apply adhesive to 2 or 3 threads.

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

2. Install the oil pressure sensor (A).

Tightening torque

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

**Fig. 46: Oil Pressure Sensor**

Courtesy of KIA MOTORS AMERICA, INC.

16. Install knock sensor (A).

Tightening torque

18.6 ~ 23.5 N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 13.4 lb-ft)

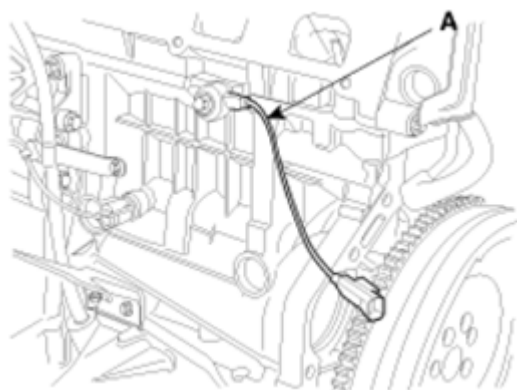


Fig. 47: Knock Sensor

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

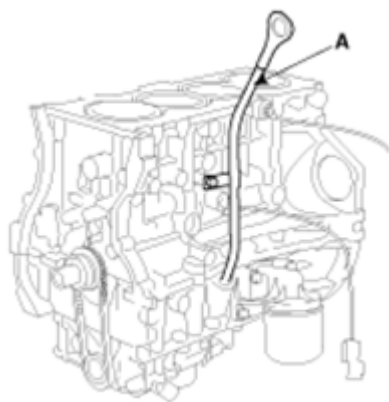


Fig. 48: Oil Level Gauge Assembly

Courtesy of KIA MOTORS AMERICA, INC.

18. Install tensioner assembly integrated bracket (A).

Tightening torque

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

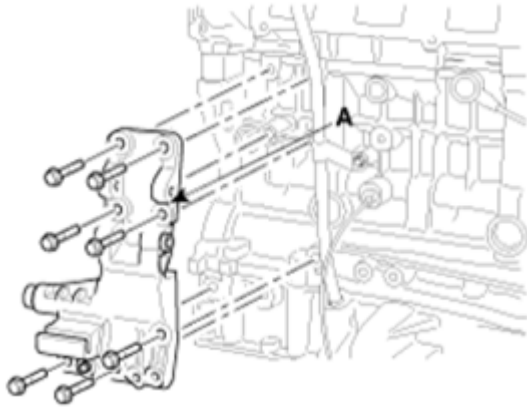


Fig. 49: Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the water pump (A) with a new water pump gasket.

Tightening torque:

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

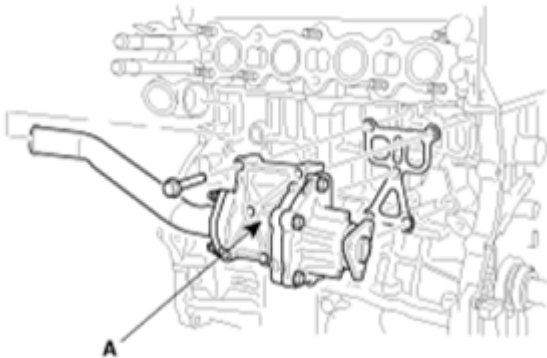


Fig. 50: Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

20. Install the power steering pump and the bracket. Refer to **POWER STEERING OIL PUMP** .

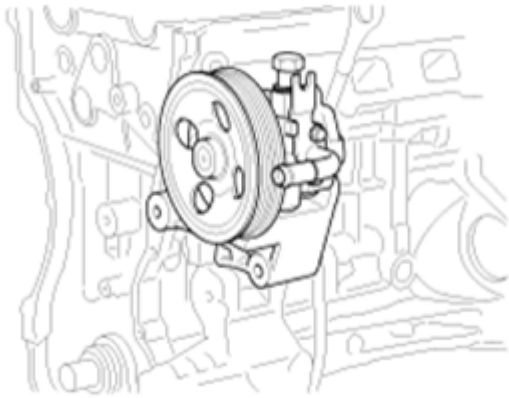


Fig. 51: Power Steering Pump & Bracket
Courtesy of KIA MOTORS AMERICA, INC.

21. Install the alternator (A).

Tightening torque:

49.0 ~ 63.7 N.m (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0 lb-ft)

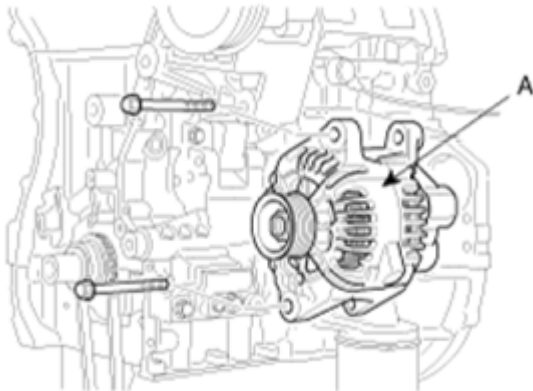


Fig. 52: Alternator
Courtesy of KIA MOTORS AMERICA, INC.

22. Install the oil pump. Refer to LUBRICATION SYSTEM .
23. Install the cylinder head assembly. Refer to INSTALLATION .
24. Install the timing chain. Refer to INSTALLATION .
25. Install the oil pan.
 1. Using a razor blade and gasket scraper, remove all the old gasket 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 LOCTITE 5900H or THREEBOND 1217H equivalent (MS721-40).

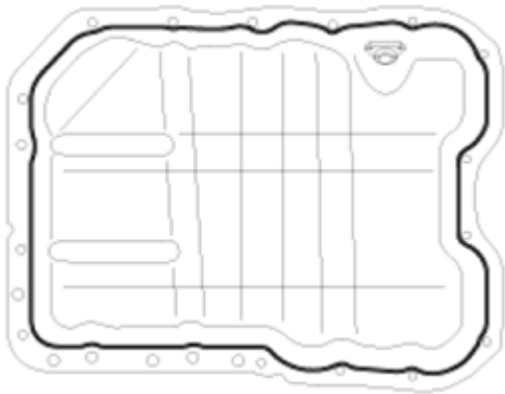


Fig. 53: Identifying Liquid Gasket Application Area
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

3. Install the oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque:

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

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

26. Install the A/C compressor. Refer to **INSTALLATION** .

27. Install the intake manifold and exhaust manifold.

Refer to **INTAKE AND EXHAUST SYSTEM** .

28. Install the drive plate (AT only) or flywheel (MT only).

Tightening torque:

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

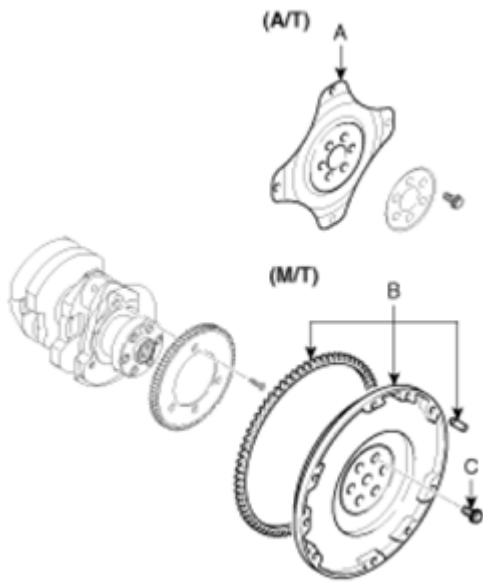


Fig. 54: Identifying Drive Plate (AT Only) Or Flywheel (MT Only)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

Sealant: Three bond 2403, Loctite 200 or 204

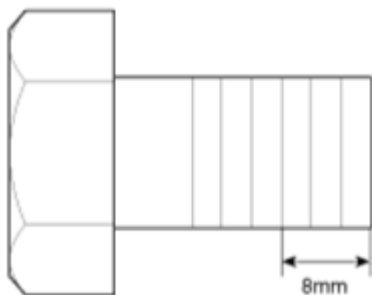


Fig. 55: Identifying Sealant Applying Area Of Bolt
Courtesy of KIA MOTORS AMERICA, INC.

- Install and uniformly tighten the 7 bolts, in several passes.
29. Install the engine assembly on the vehicle.

Refer to **INSTALLATION** .

Add all fluids to their normal operating levels.

2012-2013 ENGINE**Cylinder Head Assembly - Forte/Forte Koup****CVVT & CAMSHAFT****COMPONENTS AND COMPONENT LOCATIONS**

Refer to **Fig. 25**.

DESCRIPTION AND OPERATION**Description**

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load. By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of:

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.

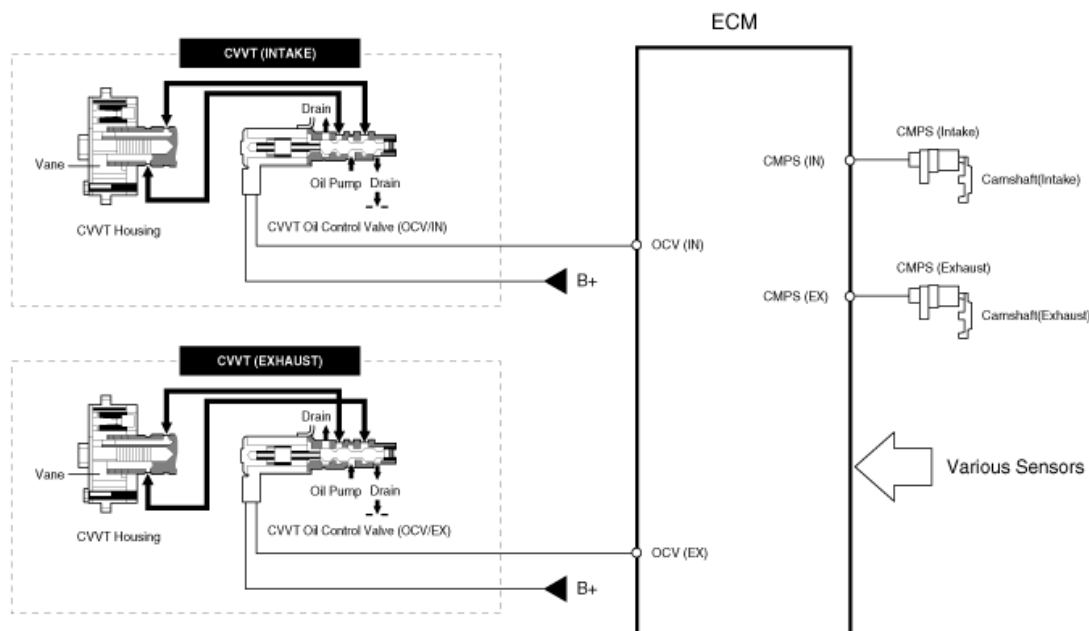


Fig. 1: CVVT Oil Control Valve System Diagram
Courtesy of KIA MOTORS AMERICA, INC.

Operation Principle

The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the advance or retard chamber in accordance with the CVVT oil control valve control.

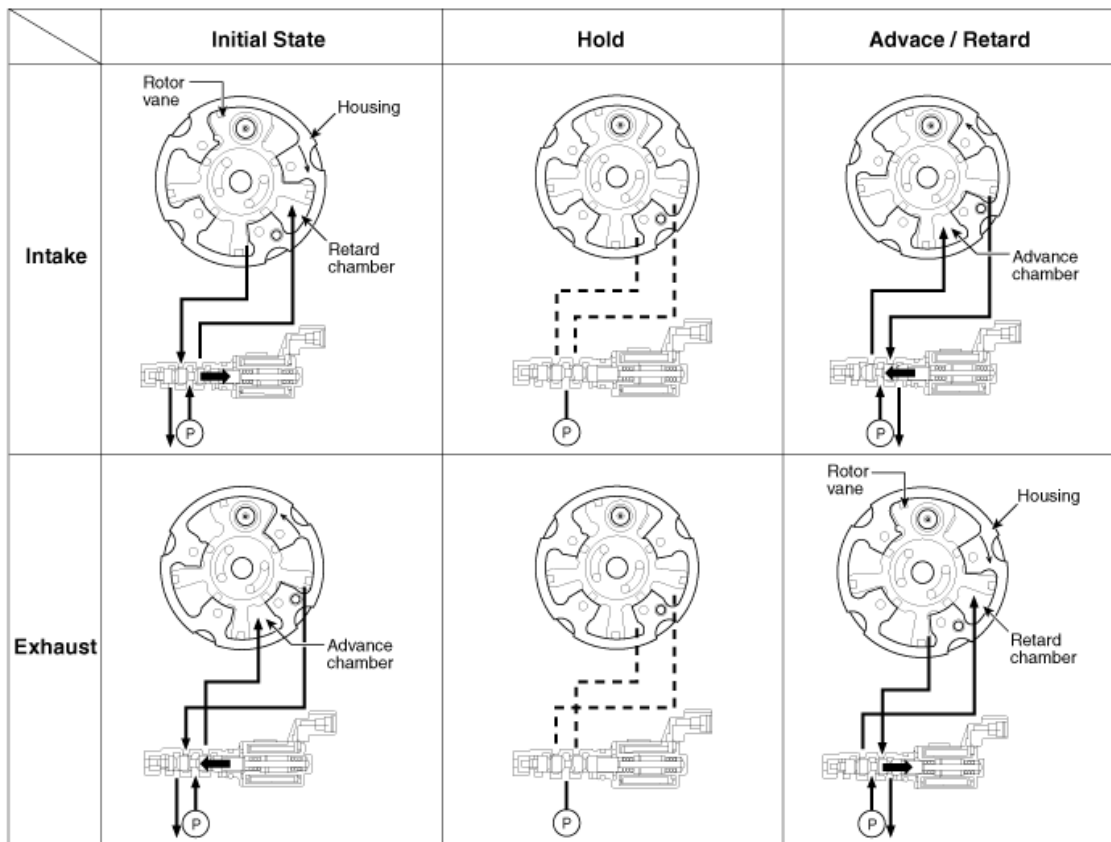


Fig. 2: CVVT Oil Control Valve Advance/Retard Diagram
Courtesy of KIA MOTORS AMERICA, INC.

CVVT System Mode

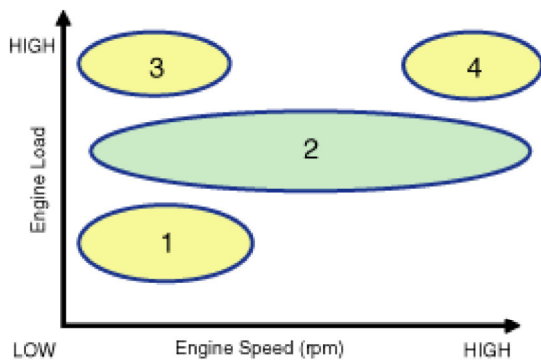


Fig. 3: CVVT System Mode Chart
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: The Graphs in the illustrations below refer to the conditions in the chart below.

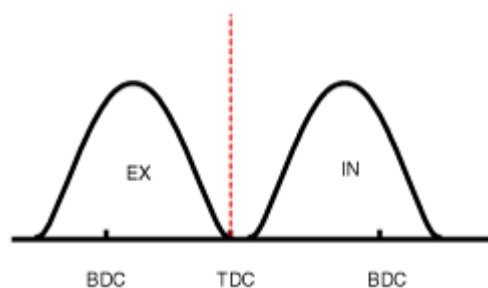


Fig. 4: (1) Low Speed / Low Load
Courtesy of KIA MOTORS AMERICA, INC.

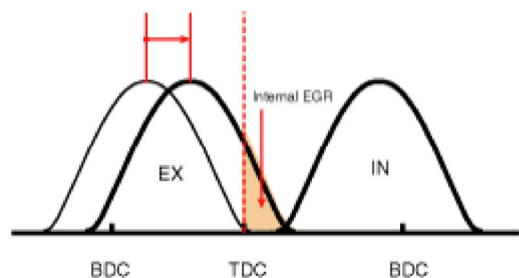


Fig. 5: (2) Part Load
Courtesy of KIA MOTORS AMERICA, INC.

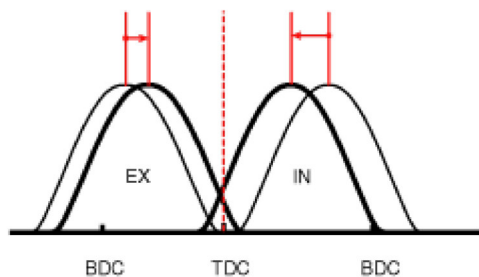


Fig. 6: (3) Low Speed / High Load
Courtesy of KIA MOTORS AMERICA, INC.

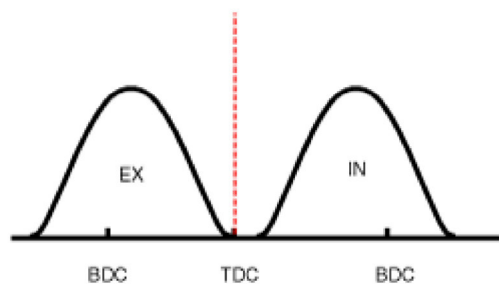


Fig. 7: (4) High Speed / High Load
Courtesy of KIA MOTORS AMERICA, INC.

DRIVING CONDITION & VALVE TIMING EFFECT TABLE

2012 Kia Forte LX

2012-2013 ENGINE Cylinder Head Assembly - Forte/Forte Koup

Driving Condition	Exhaust Valve		Intake Valve	
	Valve Timing	Effect	Valve Timing	Effect
(1) Low Speed /Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap * Improvement of combustion stability
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss
(3) Low Speed /High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Improvement of volumetric efficiency)
(4) High Speed /High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency

REPAIR PROCEDURES

NOTE: For valve clearance inspection and adjustment procedure, refer to **VALVE CLEARANCE INSPECTION AND ADJUSTMENT** .

Removal

1. Remove the cylinder head cover. Refer to **REMOVAL** .
2. Set No. 1 cylinder to TDC/compression.
 - a. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

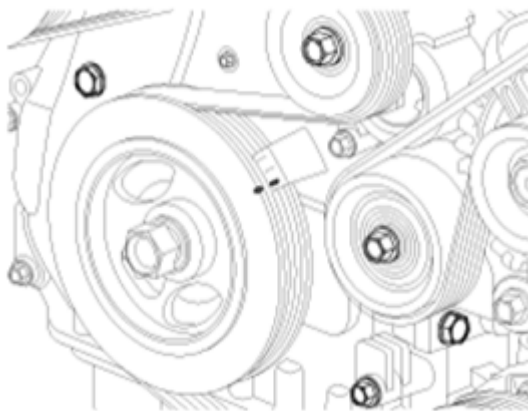


Fig. 8: Identifying Mark On Pulley
Courtesy of KIA MOTORS AMERICA, INC.

- b. Check that the mark (A) of the CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft one revolution (360°)

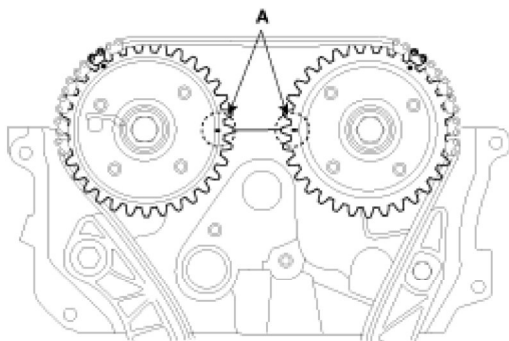


Fig. 9: Timing Marks On Sprockets

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the service hole bolt (A) of the timing chain cover. Refer to **Fig. 8**

CAUTION: Ensure that debris does not enter into the engine through the open bolt hole.

4. Pull and turn the loop (A) on the SST 09240-2G000 to allow the spring loaded shaft (B) to be pulled (locked) against the spring. Add a small amount of light lubricant to the threads of the tool and then thread it into the hole in the timing cover until you can feel it hit the tensioner. Then thread the tool back out about one turn.

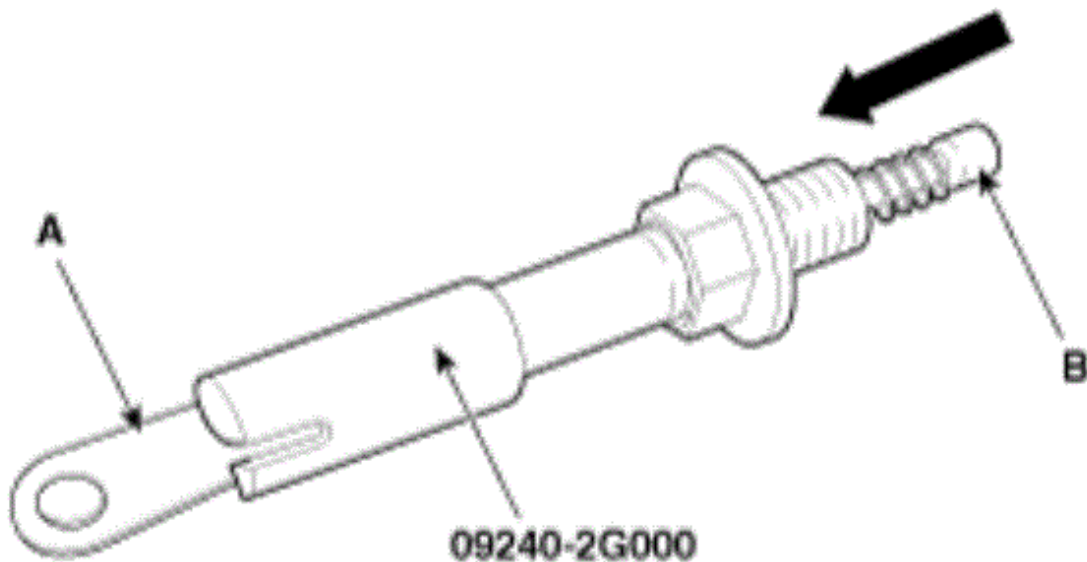


Fig. 10: SST 09240-2G000 Loop & Shaft
Courtesy of KIA MOTORS AMERICA, INC.

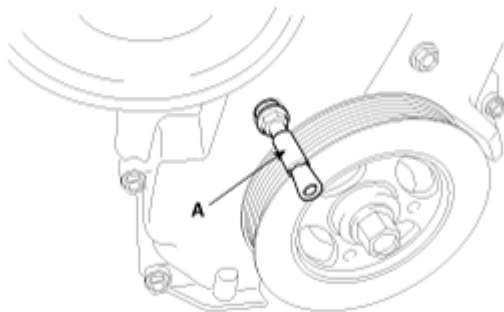


Fig. 11: SST In Service Hole Of The Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

5. Turn the loop to unlock the tool.

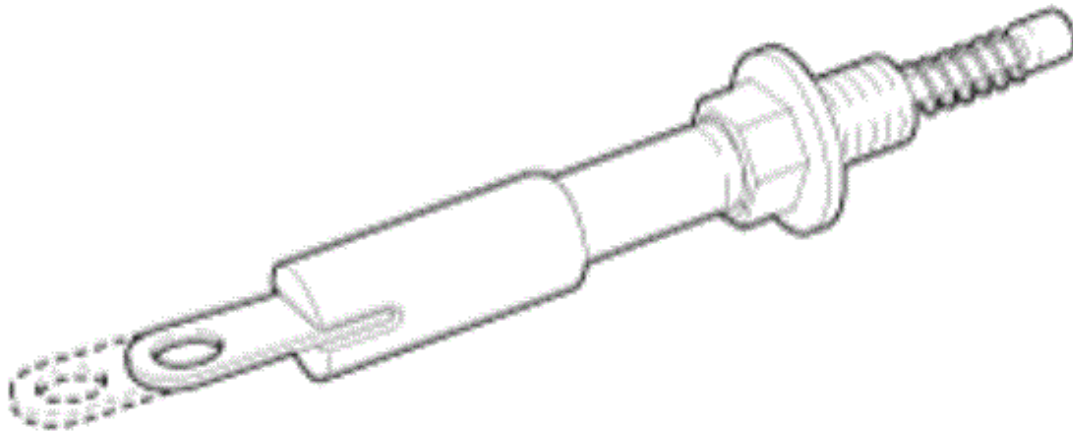


Fig. 12: SST 09240-2G000

Courtesy of KIA MOTORS AMERICA, INC.

6. Slowly turn the tool counterclockwise. Depending on where the pin on the tool is located, a few clicks may be heard as the pin moves over the pawl and shaft. As you turn, you should be able to feel the spring loaded pawl being lifted. Once lifting the pawl, tighten the lock nut (A) and lift the chain and cam gear onto the cam.

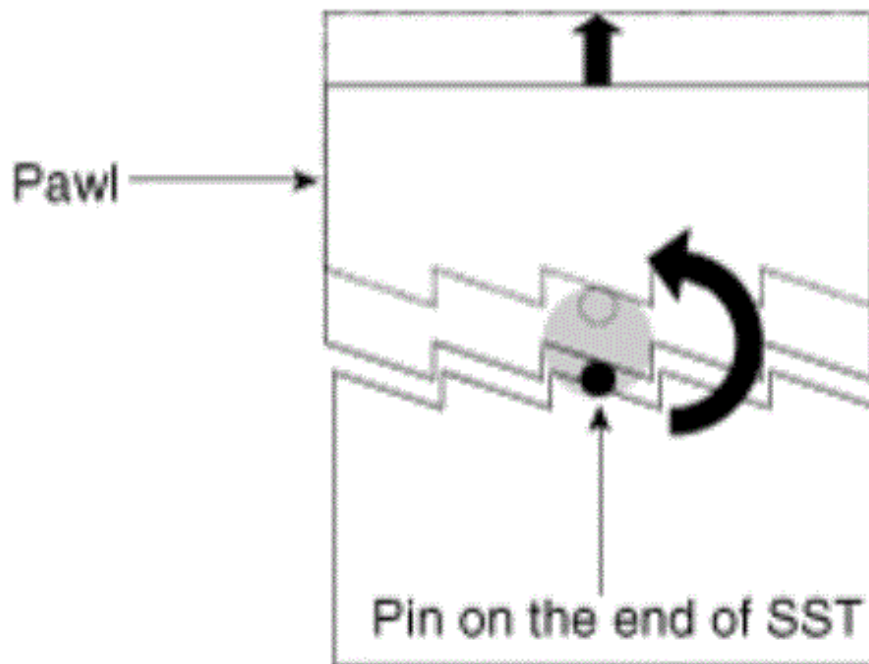


Fig. 13: Releasing Tensioner

Courtesy of KIA MOTORS AMERICA, INC.

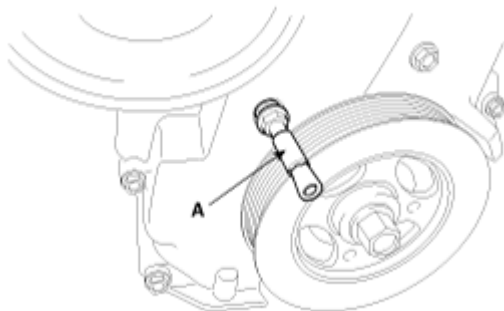


Fig. 14: SST In Service Hole Of The Timing Chain Cover

Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the camshaft.
 1. Remove the front camshaft bearing cap (A) with the upper bearing (B).

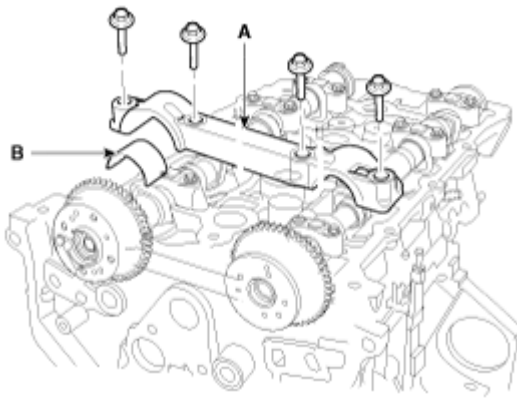


Fig. 15: Front Camshaft Bearing Cap & Upper Bearing
 Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the camshaft bearing cap (A) in the sequence shown in illustration.

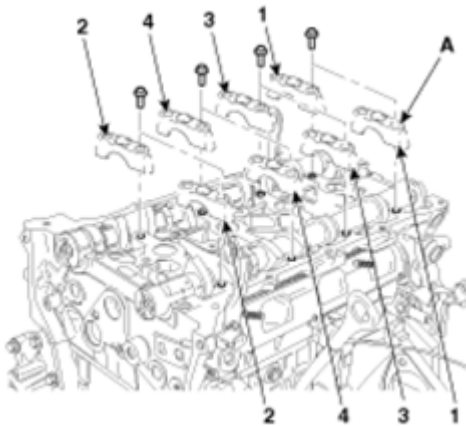


Fig. 16: Camshaft Bearing Cap Loosening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the camshafts (A).

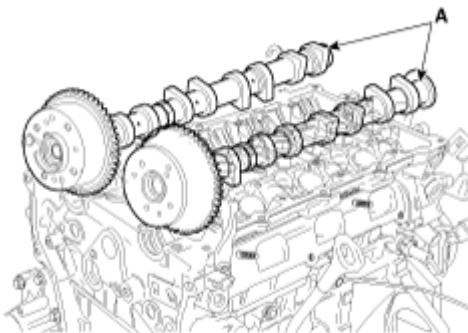


Fig. 17: Camshafts
 Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the intake CVVT assembly (A) and exhaust CVVT assembly (B) from camshaft (C).

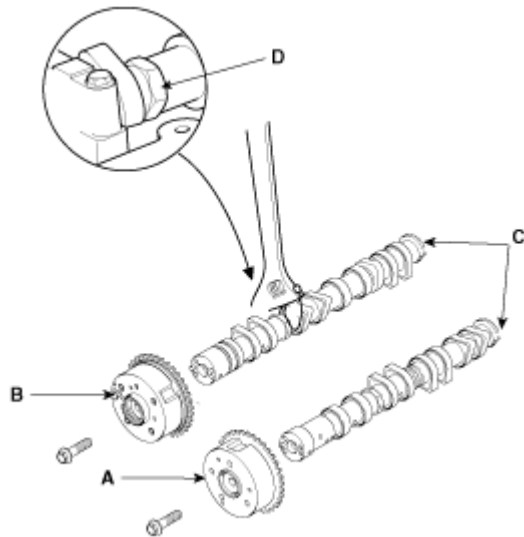


Fig. 18: CVVT Assemblies, Camshafts & Wrench Position
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When removing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position D, shown in illustration.

Installation

1. Install the intake CVVT assembly (A), exhaust CVVT assembly (B) and camshaft (C).

Tightening torque:

53.9 ~ 63.7 N.m (5.5 ~ 6.5 kgf.m, 39.7 ~ 47.0 lb-ft)

Refer to **Fig. 18**

NOTE: When installing the CVVT assembly bolt, fix the camshaft by wrench at position D.

2. Install the camshafts.

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

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

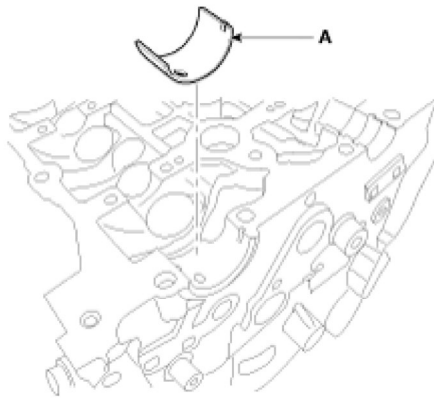


Fig. 19: Exhaust Camshaft Lower Bearing
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the camshafts (A).

Refer to **Fig. 17**

3. Install the timing chain. Check that the mark (A) of the CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration.

Refer to **Fig. 9**

4. Install the exhaust camshaft upper bearing (A) to the front bearing cap.

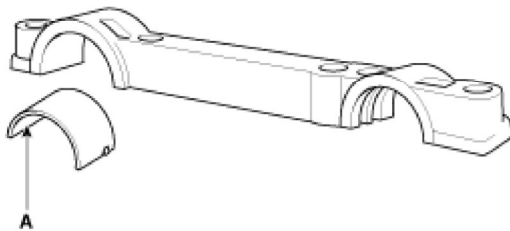


Fig. 20: Exhaust Camshaft Upper Bearing
Courtesy of KIA MOTORS AMERICA, INC.

3. Install camshaft bearing caps (A) in their proper locations. Tightening order: Group A, then Group B, then Group C. Refer to **Fig. 21**

Tightening torque:

Step 1

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

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

Step 2

- M6 : 10.8 ~ 12.7 N.m (1.1 ~ 1.3 kgf.m, 8.0 ~ 9.4 lb-ft)
- M8 : 27.5 ~ 31.4 N.m (2.8 ~ 3.2 kgf.m, 20.3 ~ 23.1 lb-ft)

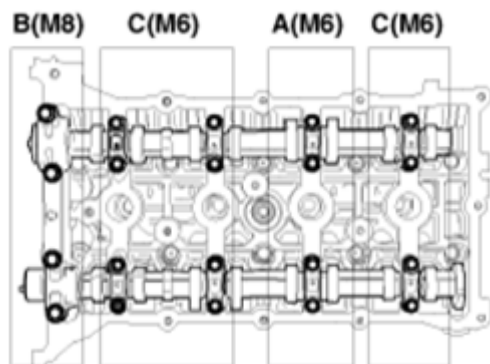


Fig. 21: Camshaft Bearing Caps Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the SST (A) (09240-2G000).

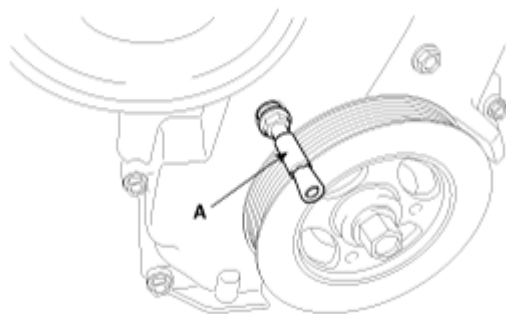


Fig. 22: Identifying SST
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the service hole bolt of the timing chain cover.

Tightening torque:

11.7 ~ 14.7 N.m (1.2 ~ 1.5 kgf.m, 8.6 ~ 10.8 lb-ft)

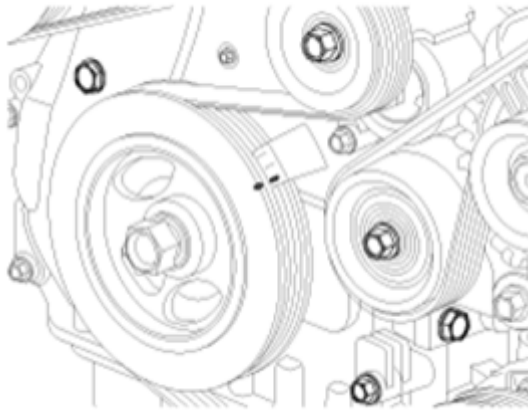


Fig. 23: Identifying Mark On Pulley
Courtesy of KIA MOTORS AMERICA, INC.

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

6. Install the cylinder head cover. Refer to **INSTALLATION** .

CYLINDER HEAD

COMPONENTS AND COMPONENTS LOCATION

Components

2.0 ULEV -Single CVVT

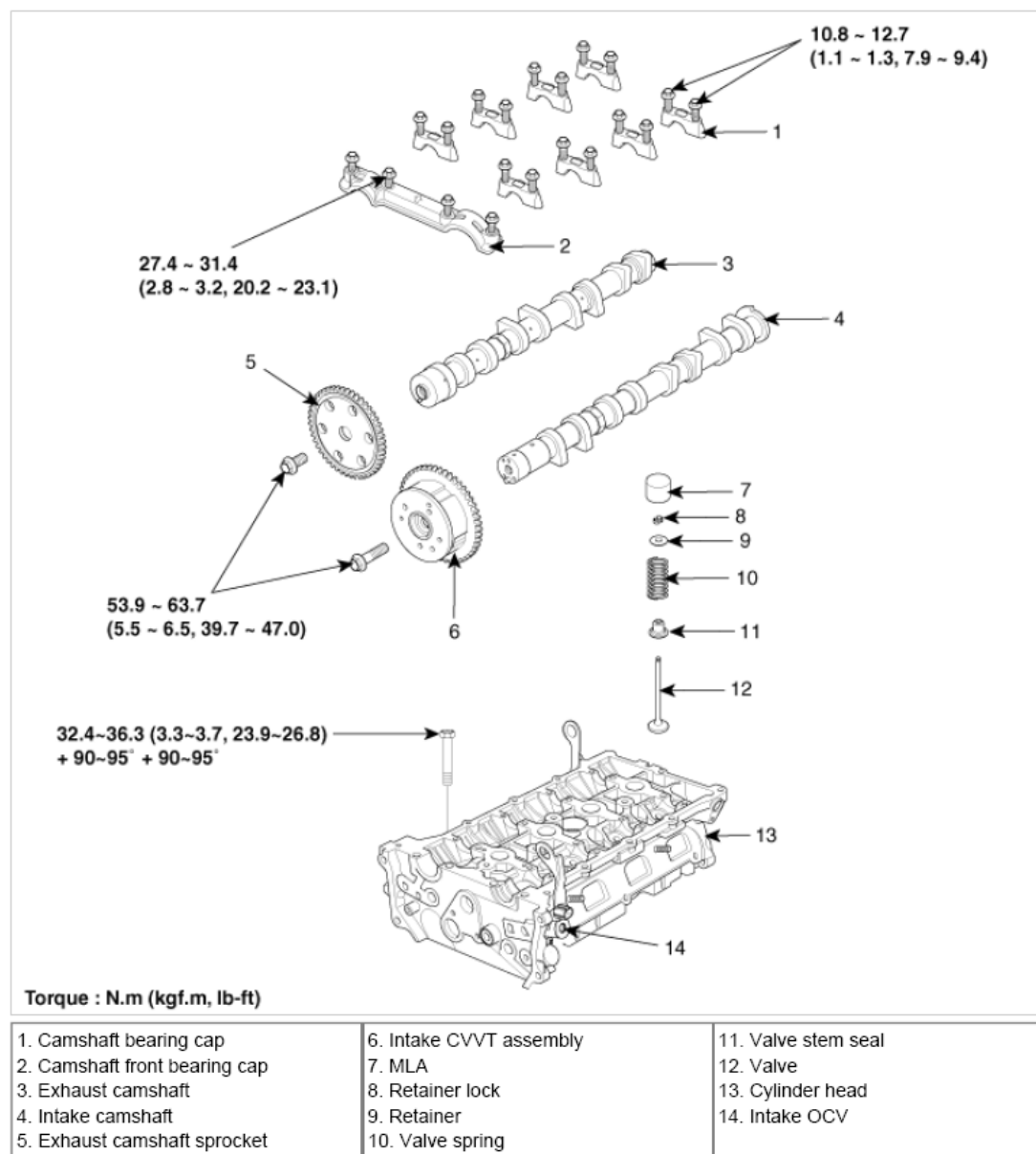


Fig. 24: Exploded View Of Cylinder Head With Torque Specifications (2.0 ULEV- Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

Dual CVVT

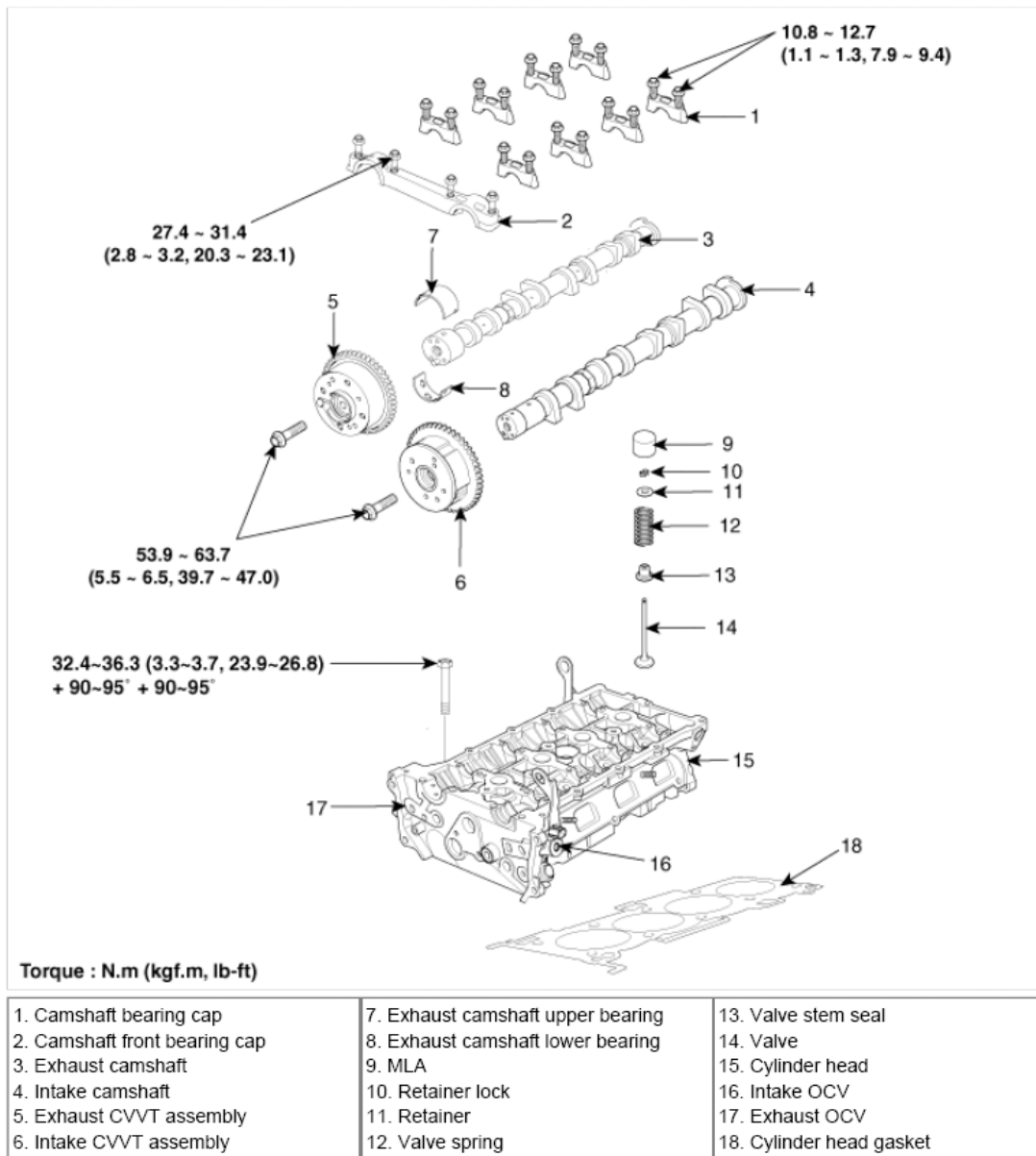


Fig. 25: Exploded View Of Cylinder Head With Torque Specifications (Dual CVVT)
 Courtesy of KIA MOTORS AMERICA, INC.

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 misconception.

1. Disconnect the battery terminals (A).
2. Remove the engine cover (B).
3. Disconnect the ECM connector (C).
4. Disconnect the breather hose and then, remove the air duct (D) and air cleaner assembly (E).

Tightening torque:

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

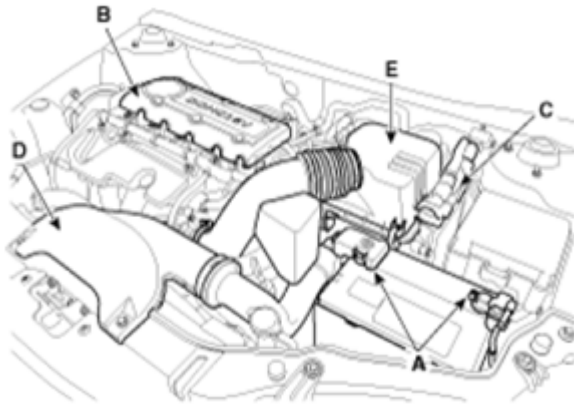
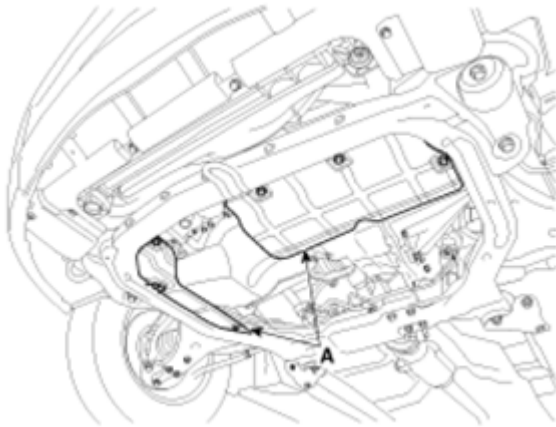


Fig. 26: Air Cleaner Assembly, Battery Terminals, Engine Cover, ECM Connector & Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the under covers (A).

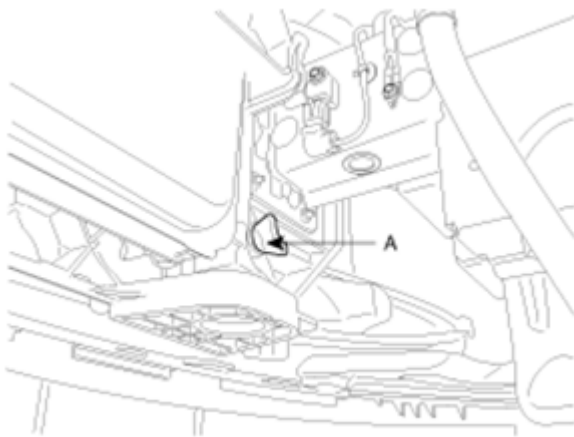
Tightening torque:

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

**Fig. 27: Under Covers**

Courtesy of KIA MOTORS AMERICA, INC.

6. Loosen the drain plug (A), and then drain the engine coolant.

**Fig. 28: Drain Plug**

Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the radiator upper hose (A) and lower hose (B).
8. Remove the heater hoses (C).
9. Disconnect the brake booster vacuum hose (D).

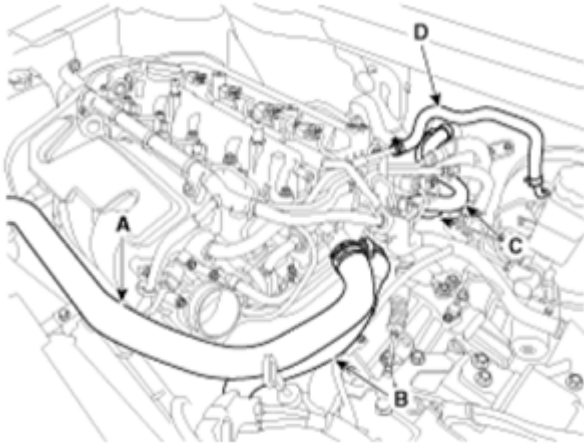


Fig. 29: Radiator Upper/Lower Hose, Heater & Brake Booster Vacuum Hoses
 Courtesy of KIA MOTORS AMERICA, INC.

10. Disconnect the wiring connectors and harness clamps from the engine.
 1. Disconnect the ETC connector (A) and knock sensor connector (B).
 2. Disconnect the PCSV connector (C).
 3. Disconnect the ECT connector (D).
 4. Disconnect the condenser connector (E).
 5. Disconnect the CKP sensor connector (F).
 6. Disconnect the oxygen sensor connector (G).

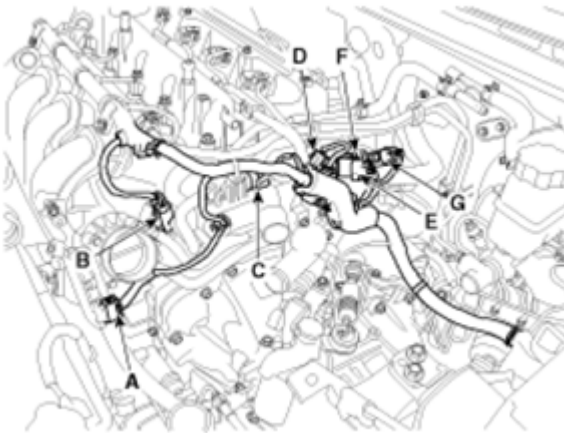


Fig. 30: ETC, PCSV, ECT, Condenser, CKP Sensor & Oxygen Sensor Connectors
 Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the VCM connector (A) and MAP sensor connector (B). (SULEV type only)

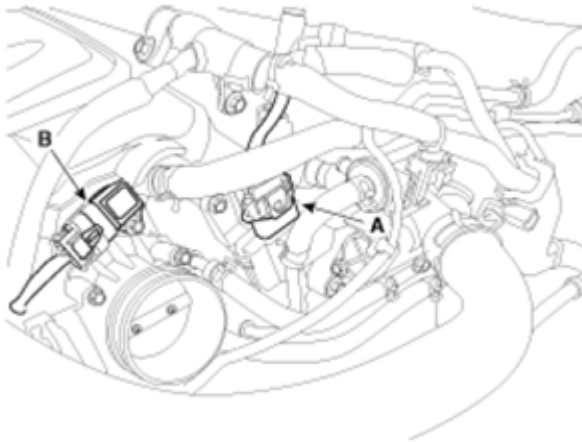


Fig. 31: VCM & MAP Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the power steering fluid pressure switch connector (A).
9. Disconnect the MAP sensor connector (B).
10. Disconnect the OPS connector (C).
11. Disconnect the alternator connector (D) and 'B' terminal cable from the alternator.
12. Disconnect the A/C switch connector from the compressor.
13. Disconnect the VIS connector.

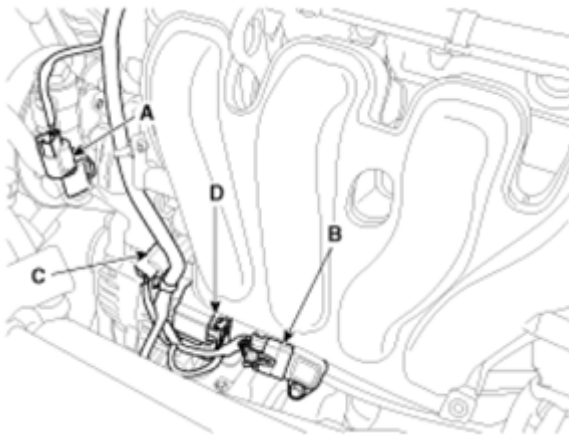


Fig. 32: Power Steering Fluid Pressure Switch, MAP Sensor, OPS & Alternator Connectors
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the intake OCV connector (A).



Fig. 33: Intake OCV Connector
 Courtesy of KIA MOTORS AMERICA, INC.

15. Disconnect the CMP sensor connector (A) and fuel hose (B).

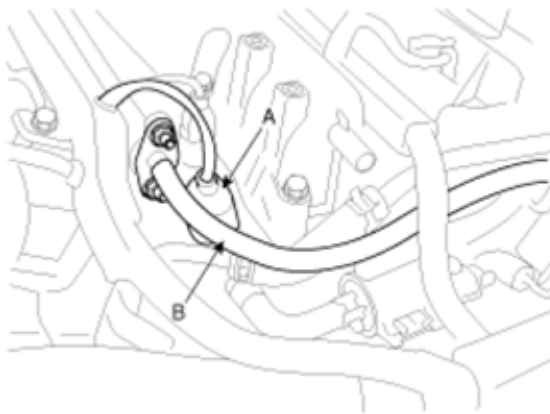


Fig. 34: CMP Sensor Connector & Fuel Hose
 Courtesy of KIA MOTORS AMERICA, INC.

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

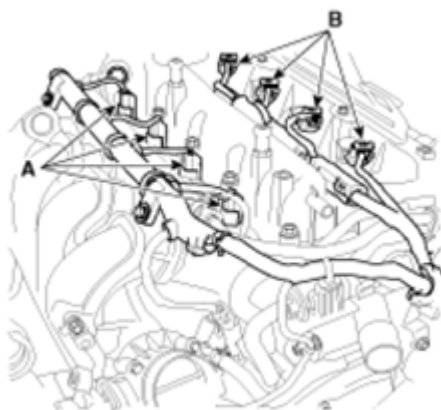


Fig. 35: Injector & Ignition Coil Connectors

Courtesy of KIA MOTORS AMERICA, INC.

11. Remove timing chain. Refer to **TIMING SYSTEM** .
12. Remove the intake and exhaust manifold. Refer to **INTAKE AND EXHAUST SYSTEM** .
13. Remove the water temperature control assembly (A).

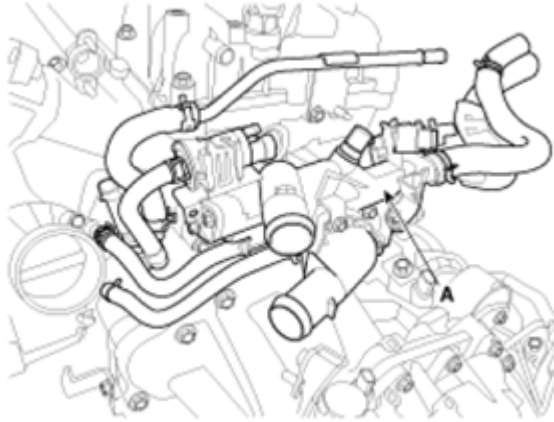


Fig. 36: Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the intake CVVT assembly (A) and exhaust CVVT sprocket or camshaft sprocket (B).

Single CVVT

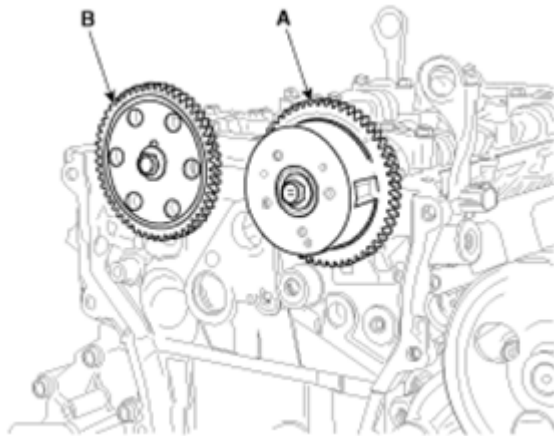


Fig. 37: Intake CVVT Assembly & Exhaust Sprocket (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

Dual CVVT

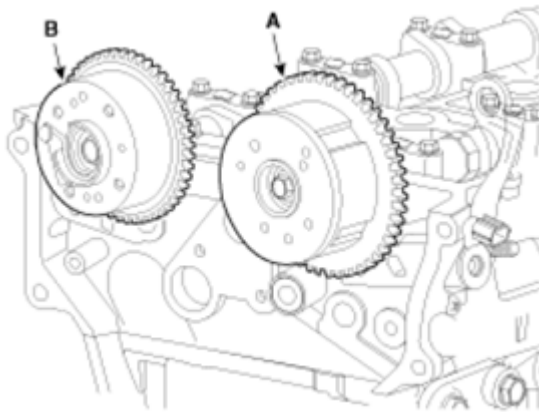


Fig. 38: Intake & Exhaust CVVT Assemblies (Dual CVVT)

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When removing the sprocket bolt or CVVT assembly bolt, fix the camshaft by wrench at position A.

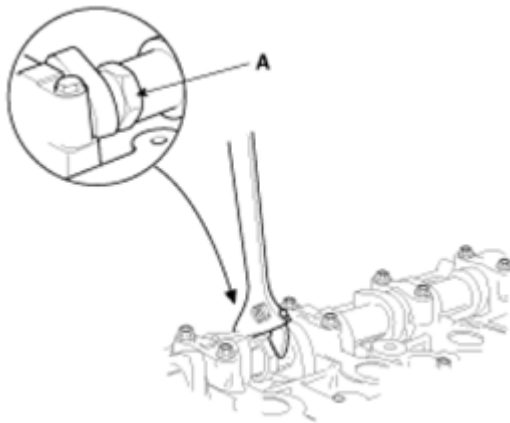


Fig. 39: Removing Sprocket Bolt Or CVVT Assembly Bolt

Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the camshaft.
 1. Remove the front camshaft bearing cap (A).

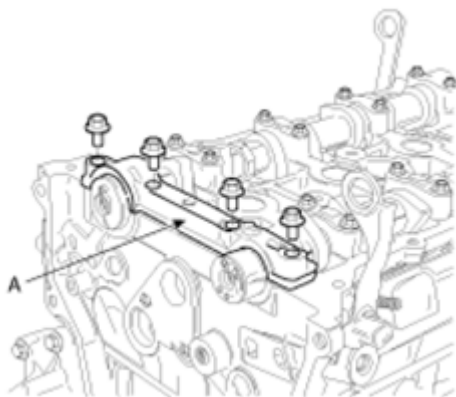


Fig. 40: Front Camshaft Bearing Cap
 Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the exhaust camshaft upper bearing (A). (Dual CVVT only)

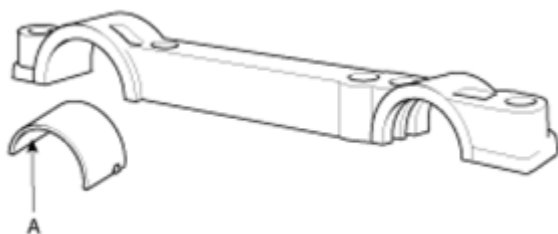


Fig. 41: Exhaust Camshaft Upper Bearing (Dual CVVT Only)
 Courtesy of KIA MOTORS AMERICA, INC.

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

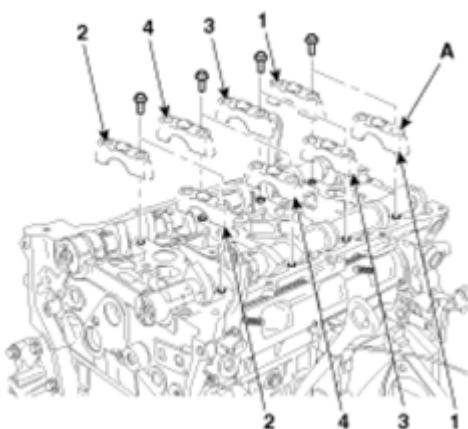
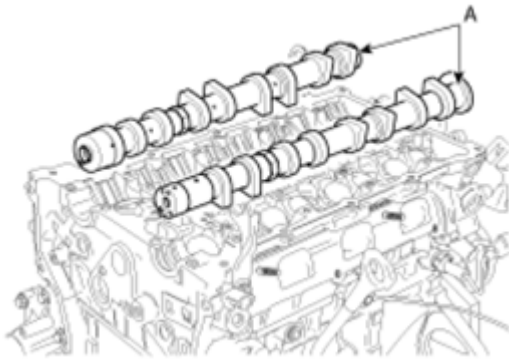


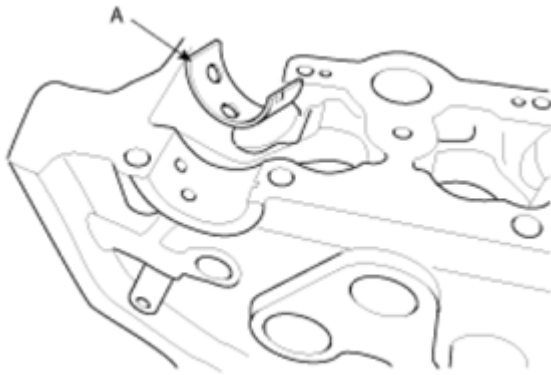
Fig. 42: Camshaft Bearing Cap Loosening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the camshafts (A).

**Fig. 43: Camshafts**

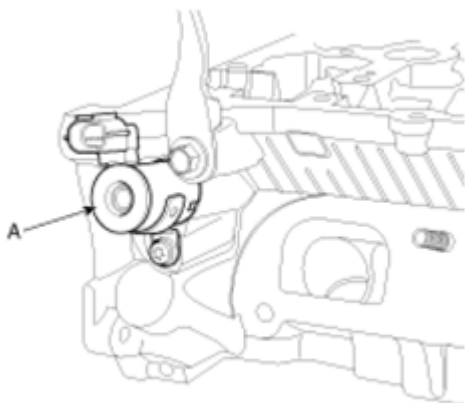
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the exhaust lower bearing (A). (Dual CVVT only)

**Fig. 44: Exhaust Lower Bearing (Dual CVVT Only)**

Courtesy of KIA MOTORS AMERICA, INC.

16. Use a Torx wrench, remove the intake OCV (A).

**Fig. 45: Intake OCV**

Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the exhaust OCV (A). (Dual CVVT only)
18. Remove the cylinder head bolts, then remove the cylinder head.
 1. Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.

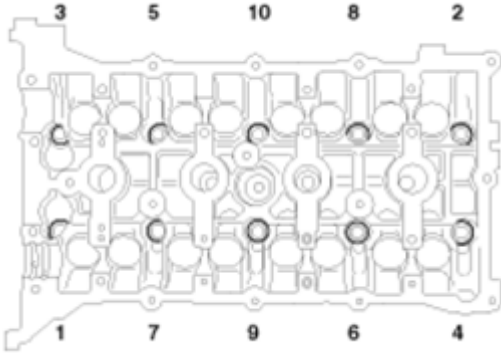


Fig. 46: Cylinder Head Bolts Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

19. Remove the cylinder head gasket.

Disassembly

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

1. Remove the MLAs (A).

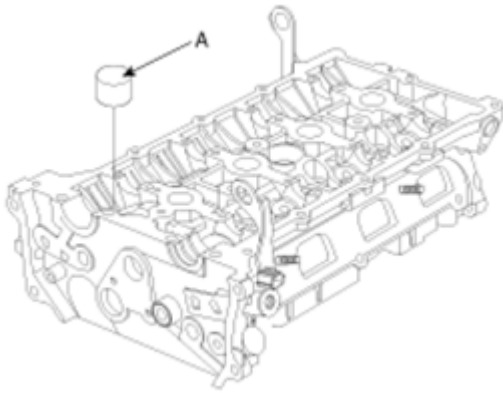


Fig. 47: Identifying MLAs (Mechanical Lash Adjuster)
Courtesy of KIA MOTORS AMERICA, INC.

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

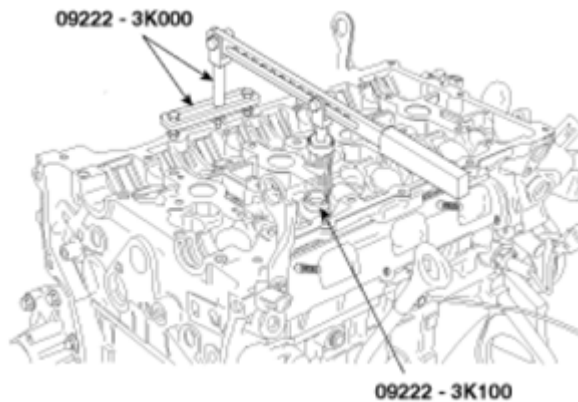


Fig. 48: Compressing Valve Spring Using SST
Courtesy of KIA MOTORS AMERICA, INC.

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

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05 mm (0.002 in.) (0.02 mm (0.0008 in.)/100x100)

Flatness of manifold mounting surface

Standard : Less than 0.1 mm (0.0039 in.)

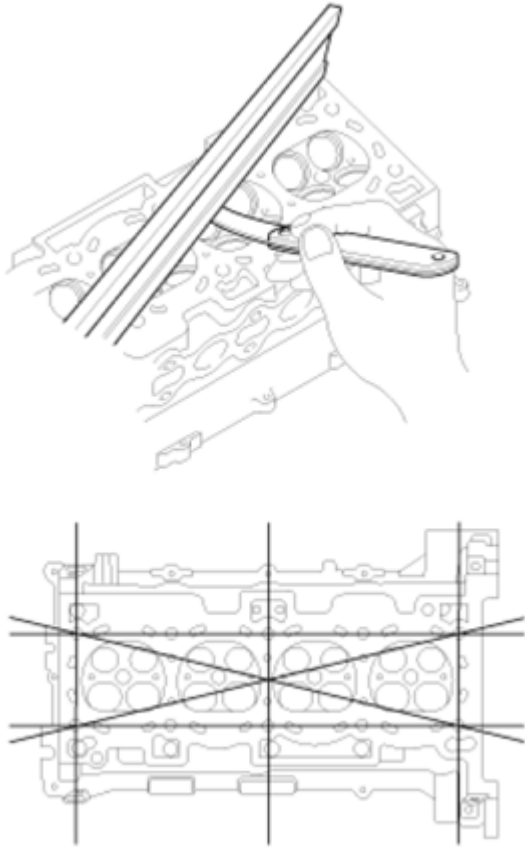


Fig. 49: Measuring Surface Contacting Cylinder Block & Manifolds For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

Valve And Valve Spring

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

Valve guide I.D.

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

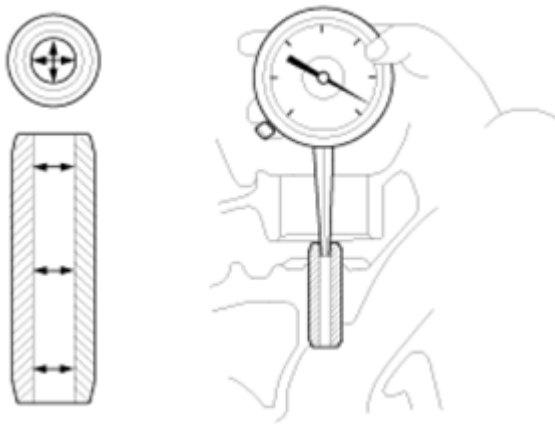


Fig. 50: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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.)

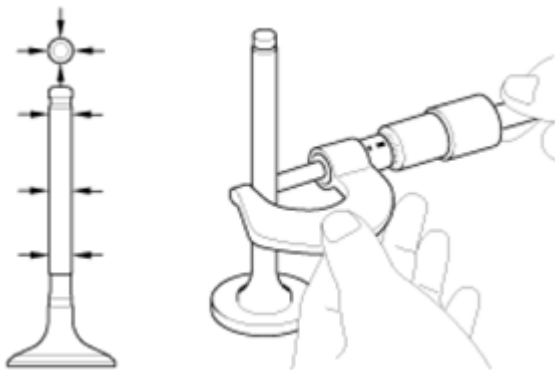


Fig. 51: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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 : 0.0 9 mm (0.0035 in.)

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

2. Inspect the 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 : 1.02 mm (0.0401 in.)

Exhaust : 1.09 mm (0.0429 in.)

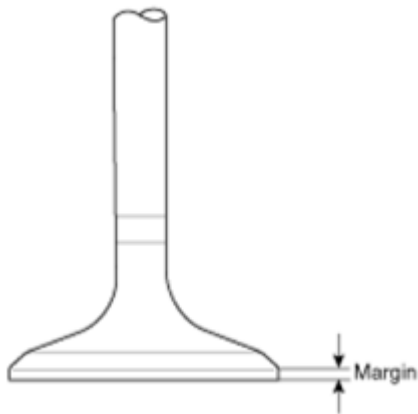


Fig. 52: Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Valve length

Standard

Intake : 113.18 mm (4.4559 in.)

Exhaust : 105.84 mm (4.1669 in.)

Limit

Intake : 112.93 mm (4.4461 in.)

Exhaust : 105.74 mm (4.1630 in.)

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

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

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

Valve spring**Standard**

Free height : 47.44 mm (1.8677 in.)

Out-of-square : 1.5°

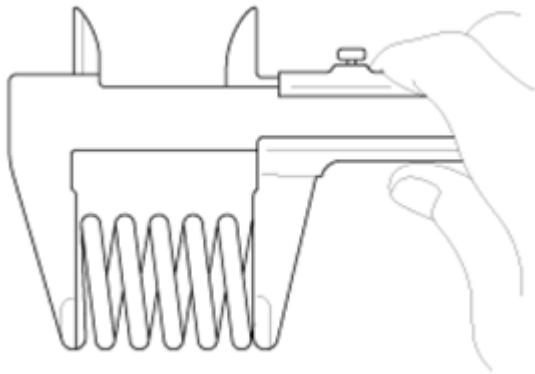


Fig. 53: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

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

MLA

1. Inspect the MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust :

31.964 ~ 31.980 mm (1.2584 ~ 1.2590 in.)

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

Tappet bore I.D.

Intake/Exhaust :

32.000 ~ 32.025 mm (1.2598 ~ 1.2608 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 the cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

Standard value

Intake :

Single CVVT : 43.70 ~ 43.90 mm (1.7204 ~ 1.7283 in.)

Dual CVVT : 44.10 ~ 44.30 mm (1.7362 ~ 1.7440 in.)

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

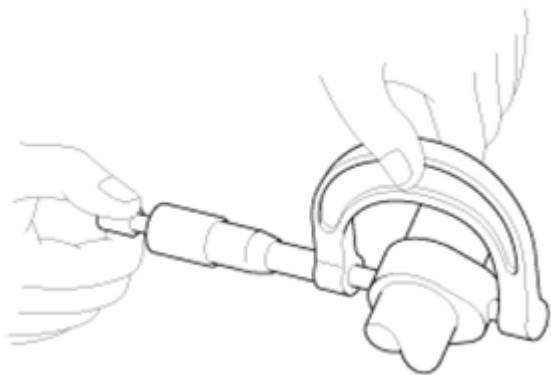


Fig. 54: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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 journal.

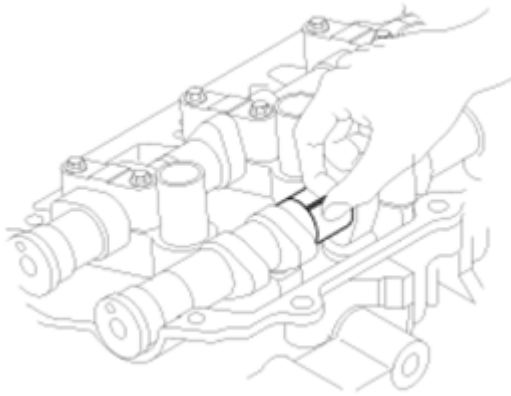


Fig. 55: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps.

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

Standard value

Intake :

No. 1 journal : 0.022 ~ 0.057 mm (0.00087 ~ 0.00224 in)

No. 2, 3, 4, 5 : 0.045 ~ 0.082 mm (0.00177 ~ 0.00323 in)

Exhaust:

Single CVVT

No. 1, 2, 3, 4, 5 : 0.045 ~ 0.082 mm (0.00177 ~ 0.00323 in)

Dual CVVT

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

No. 2, 3, 4, 5 : 0.045 ~ 0.082 mm (0.00177 ~ 0.00323 in)

Limit

Intake:

No. 1 journal : 0.09 mm (0.0035 in)

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

Exhaust :

No. 1, 2, 3, 4, 5 : 0.12 mm (0.0047 in)

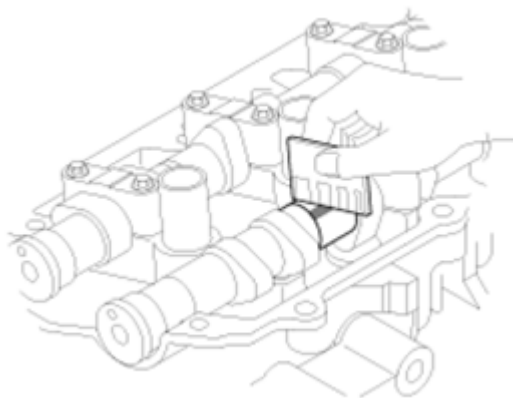


Fig. 56: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

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

Camshaft end play

Standard value : 0.04 ~ 0.16 mm (0.0016 ~ 0.0062 in.)

Limit : 0.18 mm (0.0071 in.)

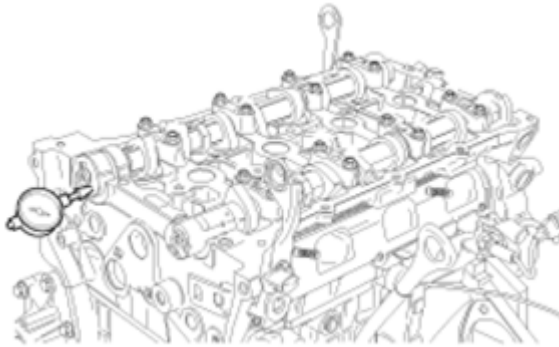


Fig. 57: Measuring Camshaft End Play
 Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

Exhaust Cam Shaft Bearing

1. Check the cylinder head bore mark.

Location Of Cylinder Head Bore Mark

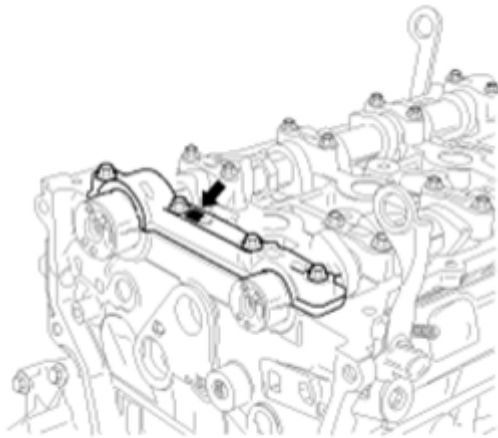


Fig. 58: Identifying Cylinder Head Bore Identification Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Head

DISCRIMINATION OF CYLINDER HEAD

Class	Mark	Exhaust No. 1 Inside Diameter Of Cylinder Head Bore
a	A	40.000 ~ 40.008 mm (1.5748 ~ 1.5751 in.)

2012 Kia Forte LX**2012-2013 ENGINE Cylinder Head Assembly - Forte/Forte Koup**

b	B	40.008 ~ 4.016 mm (1.5751 ~ 1.5754 in.)
c	C	40.016 ~ 40.024 mm (1.5754 ~ 1.5757 in.)

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

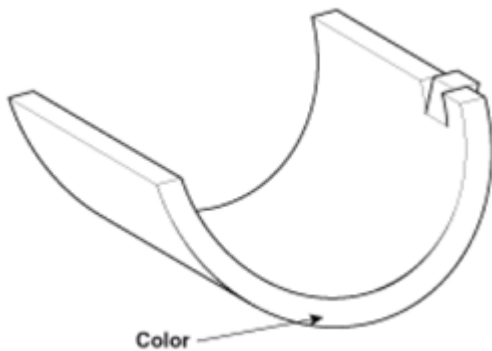
Place Of Exhaust Cam Shaft Bearing Identification Mark

Fig. 59: Identifying Exhaust Camshaft Bearing Identification Mark
 Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Exhaust Camshaft Bearing**DISCRIMINATION OF EXHAUST CAMSHAFT BEARING**

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

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

CVVT Assembly**Single CVVT**

1. Inspect CVVT assembly.
 1. Check that the CVVT assembly will not turn.
 2. Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.

Verify the hole to tape and the hole to put air in.

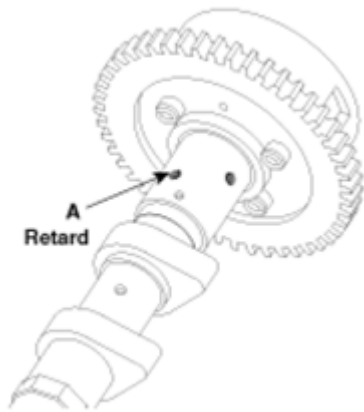


Fig. 60: Identifying Retard Hole Of CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

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

(Perform this in order to release the lock pin.)

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

4. With air applied, as in step (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

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

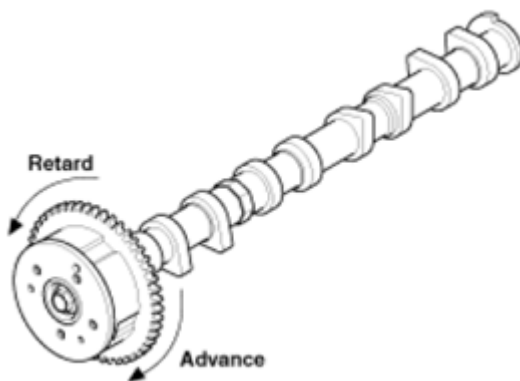


Fig. 61: Turning CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

5. Turn the CVVT assembly back and forth and check the movable range and that there is no disturbance.

Standard:

Should move smoothly in a range from about

22.5° (Intake)/20.0° (Exhaust)

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

Dual CVVT

1. Inspect CVVT assembly.
 1. Check that the CVVT assembly will not turn.
 2. Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.

Verify the hole to tape and the hole to put air in.

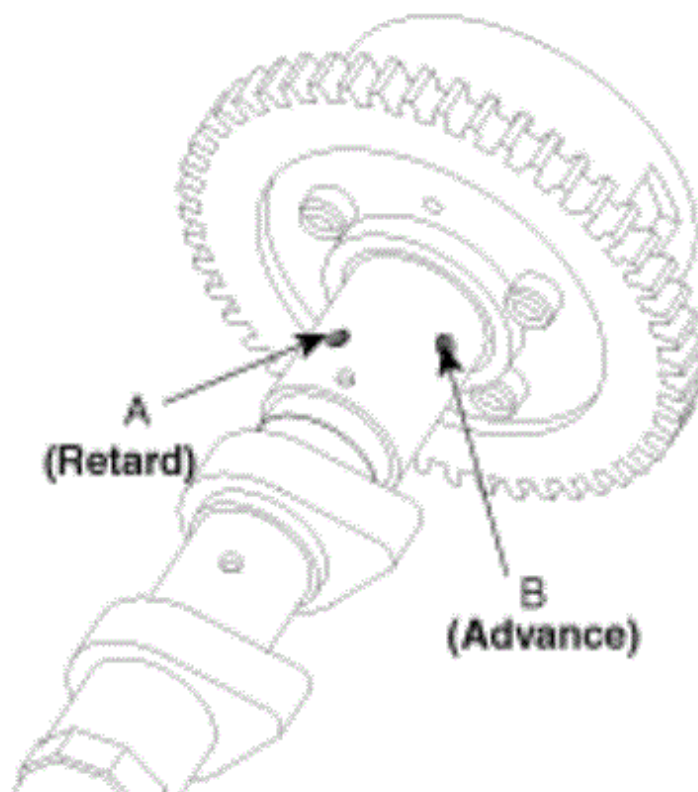
Intake

Fig. 62: Identifying Retard Hole Of CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

Exhaust

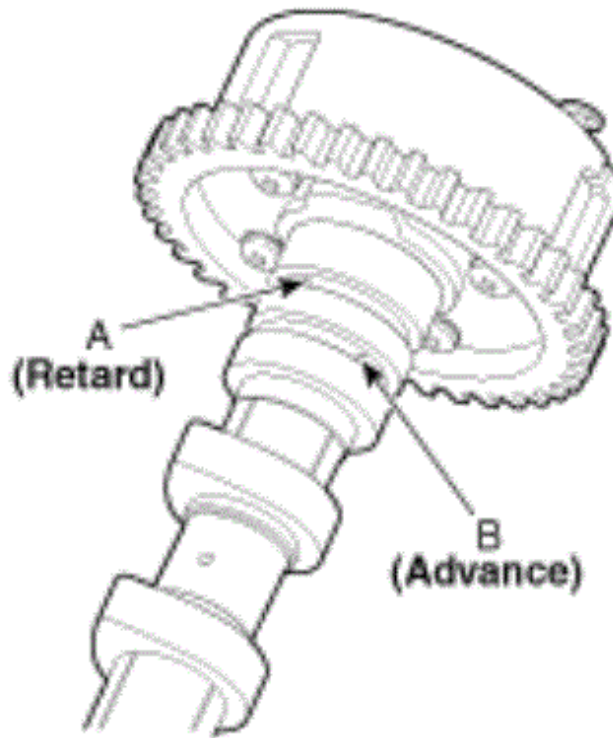


Fig. 63: Identifying Retard Hole Of CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

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

(Perform this in order to release the lock pin.)

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

4. With air applied, as in step (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

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

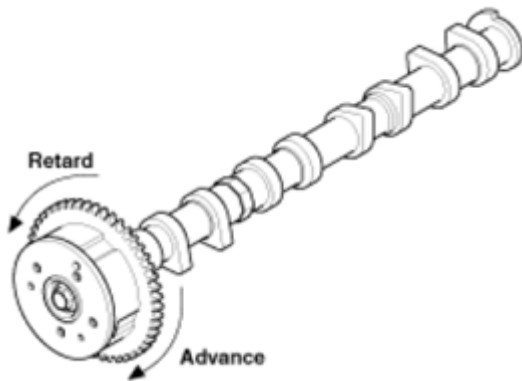


Fig. 64: Turning CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

5. Turn the CVVT assembly back and forth and check the movable range and that there is no disturbance.

Standard:

Should move smoothly in a range from about

22.5° (Intake)/20.0° (Exhaust)

6. Turn the CVVT assembly with your hand and lock it at the maximum retard angle position (counter clockwise).
7. Turn the exhaust CVVT assembly with your hand and lock it at the maximum advance angle position (clockwise).

Reassembly

NOTE: Thoroughly clean all parts to be assembled.

Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.

Replace oil seals with new ones.

1. Install valves.
 1. Using SST(09222-4A000), push in a new oil seal.

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

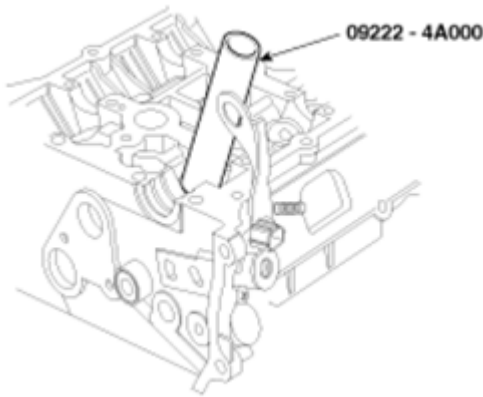


Fig. 65: Pushing Oil Seal

Courtesy of KIA MOTORS AMERICA, INC.

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

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

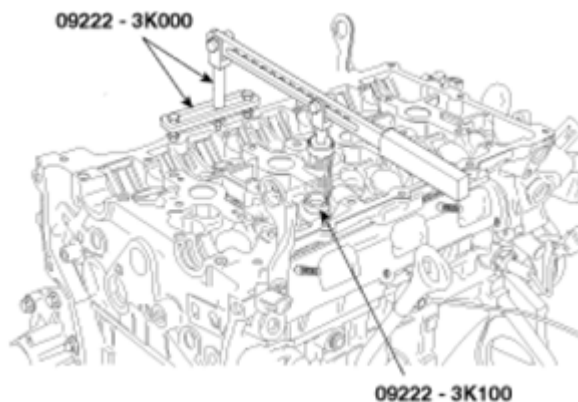


Fig. 66: Compressing Spring Using SST

Courtesy of KIA MOTORS AMERICA, INC.

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

Check that the MLA rotates smoothly by hand.

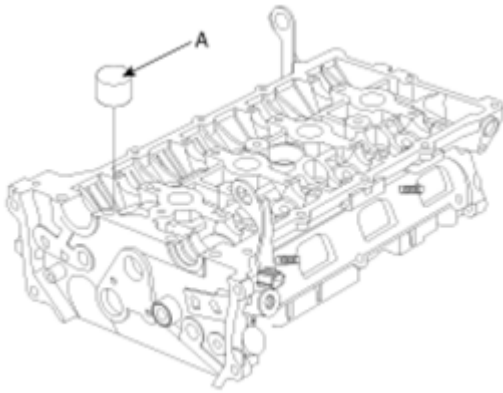


Fig. 67: Identifying MLAs (Mechanical Lash Adjuster)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

Installation

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

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

- NOTE:**
- Be careful of the installation direction.
 - Apply liquid gasket (Loctite 5900H) on the edge of cylinder head gasket upside and downside. (At the position 'B')
 - After applying sealant, assemble the cylinder head in five minutes.

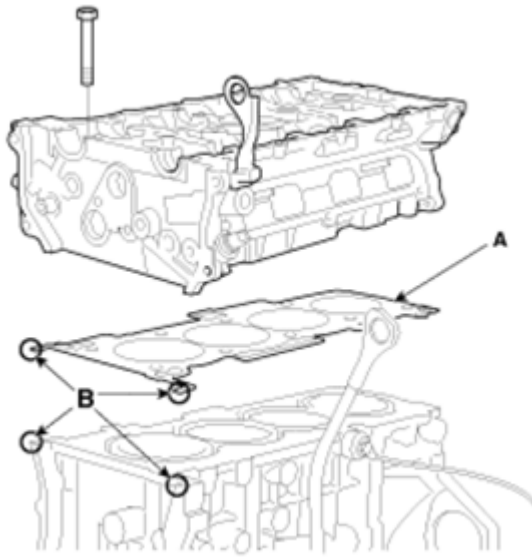


Fig. 68: Identifying Cylinder Head Gasket
Courtesy of KIA MOTORS AMERICA, INC.

2. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
 - A. Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
 - B. Using the SST(09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque:

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

CAUTION: Always use new cylinder head bolt.

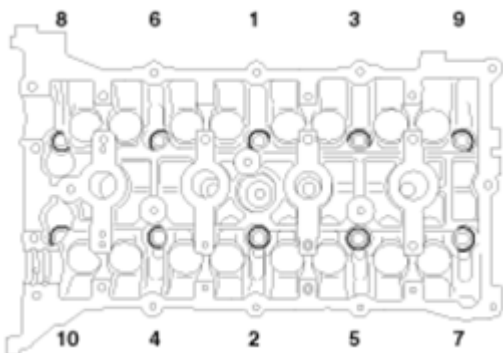


Fig. 69: Cylinder Head Gasket Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the intake OCV (A).

Tightening torque:

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

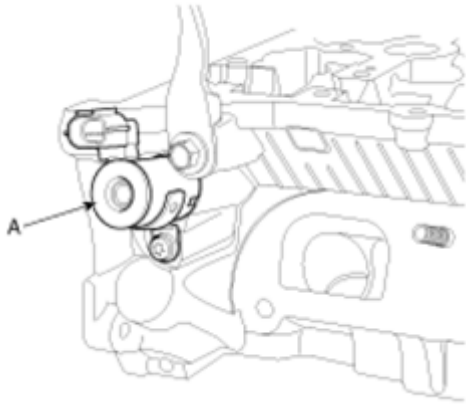


Fig. 70: Intake OCV (Oil Control Valve)
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the exhaust OCV (A). (Dual CVVT only)

Tightening torque:

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



Fig. 71: Exhaust OCV (Oil Control Valve)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Do not reuse the OCV when dropped.
- Keep the OCV filter clean.
- Do not hold the OCV sleeve (A) during servicing.

- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.

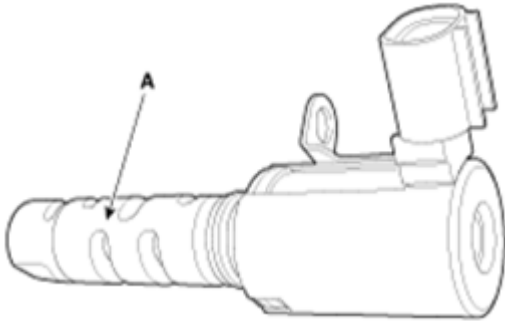


Fig. 72: OCV Sleeve

Courtesy of KIA MOTORS AMERICA, INC.

6. Install the camshafts.

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

1. Install the exhaust camshaft lower bearing (A). (Dual CVVT only)

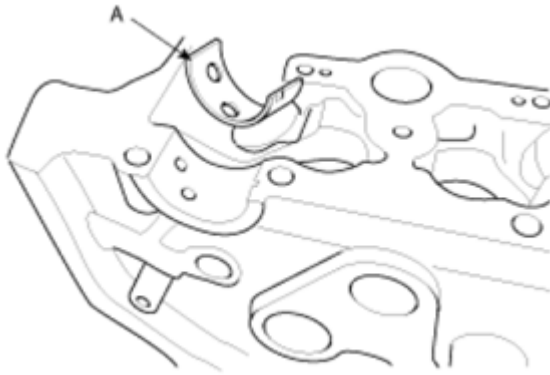
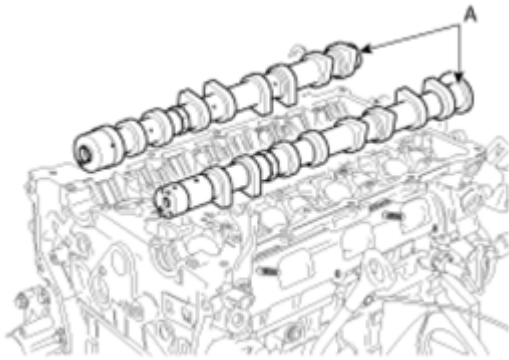


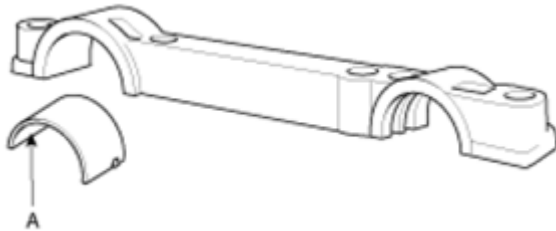
Fig. 73: Exhaust Camshaft Lower Bearing

Courtesy of KIA MOTORS AMERICA, INC.

2. Install the camshafts (A).

**Fig. 74: Camshafts****Courtesy of KIA MOTORS AMERICA, INC.**

3. Install the exhaust camshaft upper bearing (A) to the front bearing cap (A). (Dual CVVT only)

**Fig. 75: Exhaust Camshaft Upper Bearing****Courtesy of KIA MOTORS AMERICA, INC.**

7. Install camshaft bearing caps in their proper locations.

Tightening order.

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

Tightening torque:

M6 : 10.8 ~ 12.7 N.m (1.1 ~ 1.3kgf.m, 7.9 ~ 9.3 lb-ft)

M8 : 27.4 ~ 31.4 N.m (2.8 ~ 3.2kgf.m, 20.2 ~ 23.1 lb-ft)

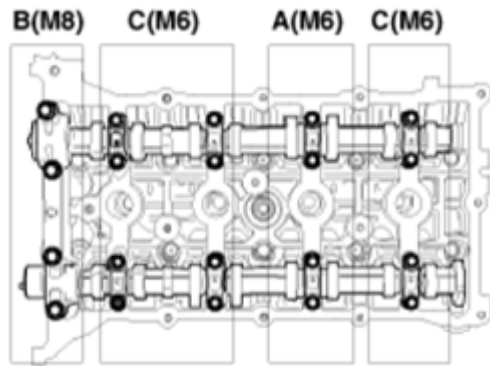


Fig. 76: Camshaft Bearing Caps Tightening Sequence

Courtesy of KIA MOTORS AMERICA, INC.

8. Install the intake CVVT assembly (A) and exhaust CVVT sprocket or camshaft sprocket (B).

Tightening torque :

53.9 ~ 63.7 N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0 lb-ft)

Single CVVT

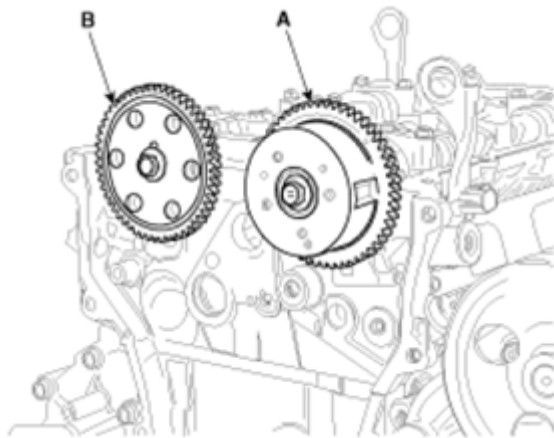


Fig. 77: Intake CVVT Assembly & Exhaust Sprocket (Single CVVT)

Courtesy of KIA MOTORS AMERICA, INC.

Dual CVVT

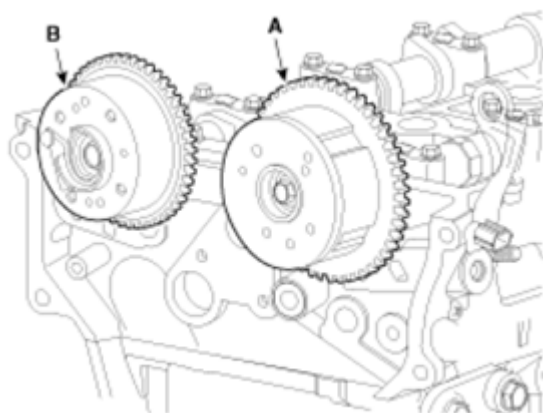


Fig. 78: Intake & Exhaust CVVT Assemblies (Dual CVVT)

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When installing the sprocket bolt or CVVT assembly bolt, fix the camshaft by wrench at position A.

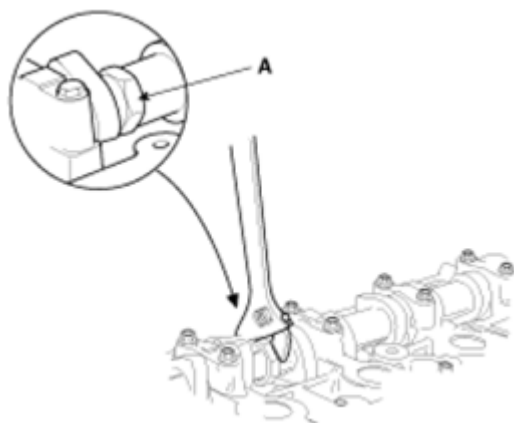


Fig. 79: Identifying Wrench Position

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque:

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

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

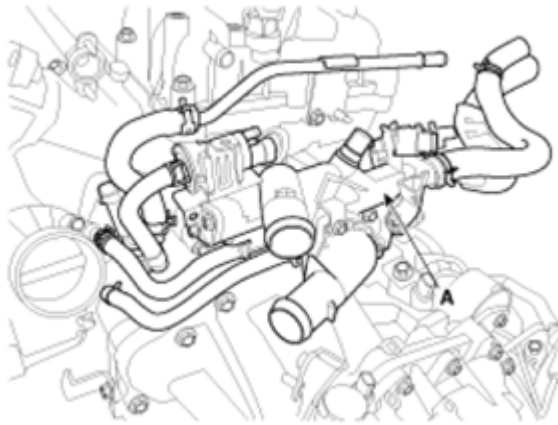


Fig. 80: Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.
- Insert after wetting O-ring or inner surface of thermostat housing.
- Always use a new O-ring.

10. Install the timing chain. Refer to **TIMING SYSTEM** .
11. Install the intake and exhaust manifold. Refer to **INTAKE AND EXHAUST SYSTEM** .
12. Check and adjust the valve clearance. Refer to **GENERAL INFORMATION** .
13. Install cylinder head cover.
 1. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
 2. After applying sealant, it should be assembled within 5 minutes.

Bead width : 2.5 mm (0.1 in.)

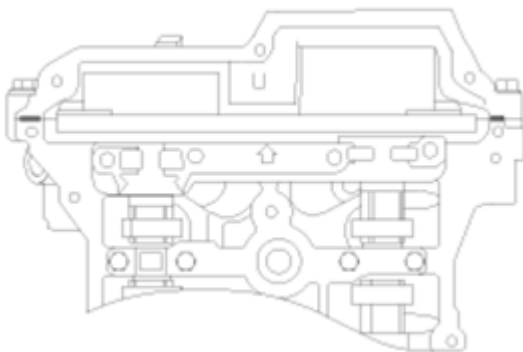


Fig. 81: Identifying Sealant Applying Areas Of Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the cylinder head cover bolts as following method.

Tightening torque:

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

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

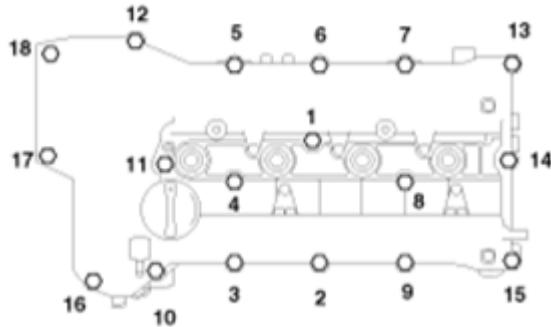


Fig. 82: Cylinder Head Cover Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Do not reuse cylinder head cover gasket.
- The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

14. Install the other parts in the reverse order of removal.

NOTE:

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper assemble them, 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, and 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. 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.**