

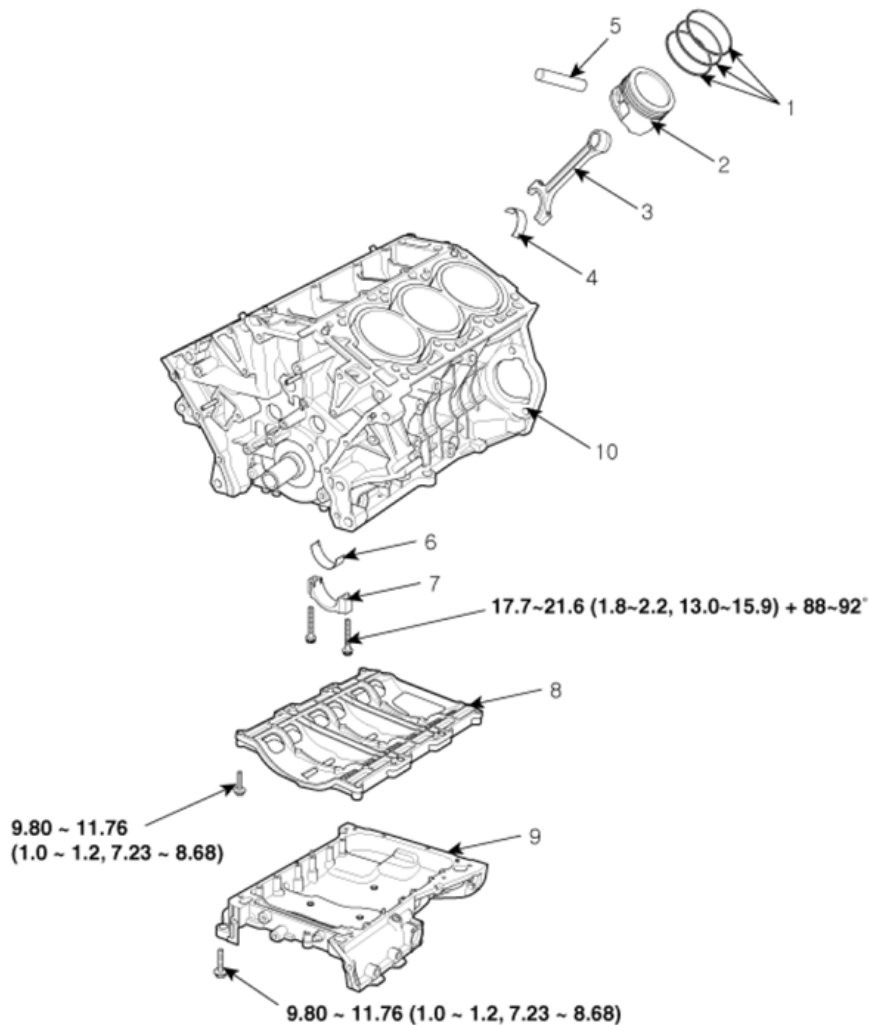
2010 ENGINE

Cylinder Block - Sedona

COMPONENTS AND COMPONENTS LOCATION

ENGINE MECHANICAL SYSTEM

COMPONENTS

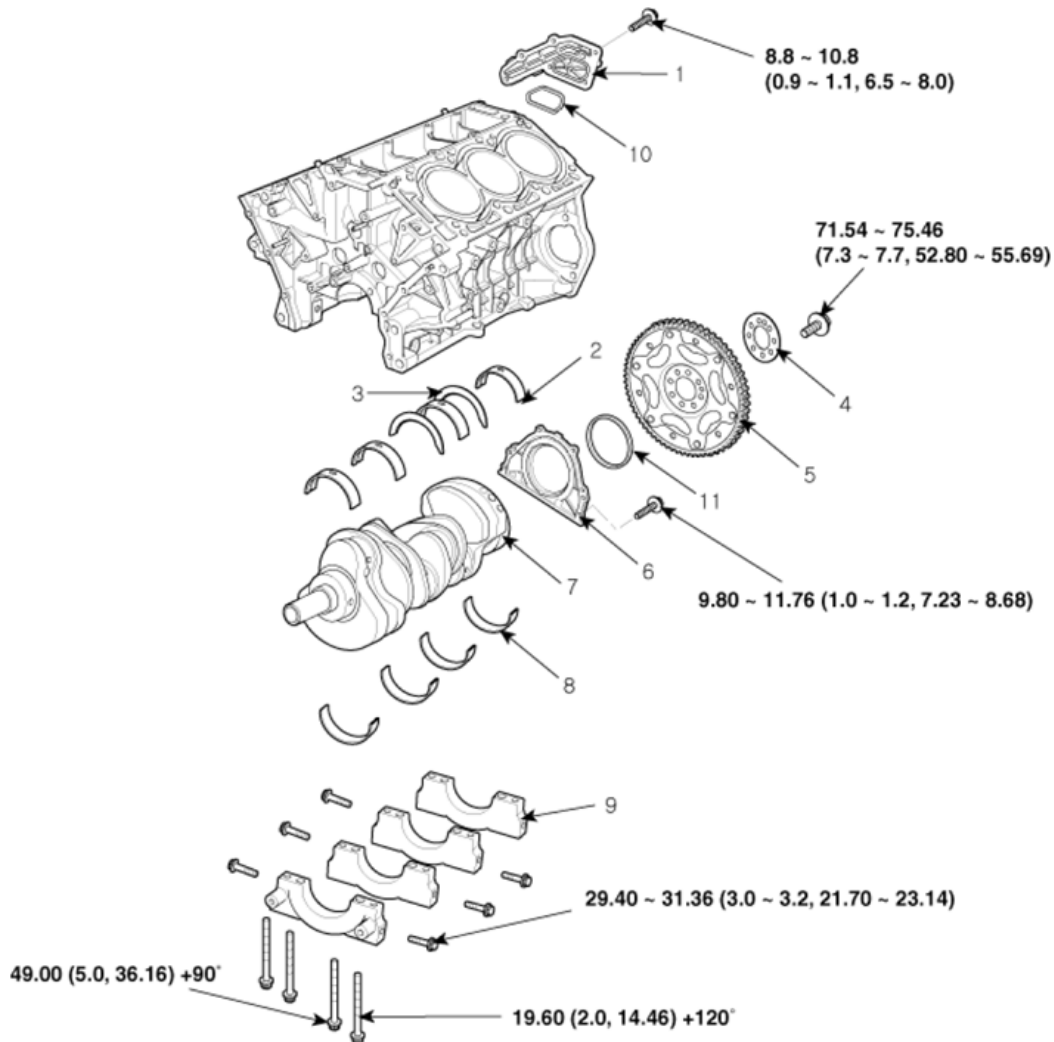


TORQUE : N.m (kgf.m, lb-ft)

- | | |
|---------------------------------|---------------------------------|
| 1. Piston ring | 6. Connecting rod lower bearing |
| 2. Piston | 7. Connecting rod bearing cap |
| 3. Connecting rod | 8. Baffle plate |
| 4. Connecting rod upper bearing | 9. Upper oil pan |
| 5. Piston pin | 10. Cylinder block |

Fig. 1: Identifying Cylinder Block Components

Courtesy of KIA MOTORS AMERICA, INC.



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

- | | |
|-----------------------------|-----------------------------|
| 1. Oil drain cover | 6. Rear oil seal case |
| 2. Crankshaft upper bearing | 7. Crankshaft |
| 3. Thrust bearing | 8. Crankshaft lower bearing |
| 4. Plate adapter | 9. Main bearing cap |
| 5. Drive plate | 10. Oil drain cover gasket |
| | 11. Rear oil seal |

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

REPAIR PROCEDURES

REMOVAL

CAUTION: • Use fender covers to avoid damaging painted surfaces.

- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor (A) from engine.

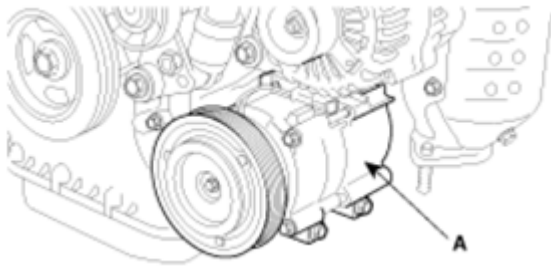


Fig. 3: Identifying A/C Compressor
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove generator (A) from engine.

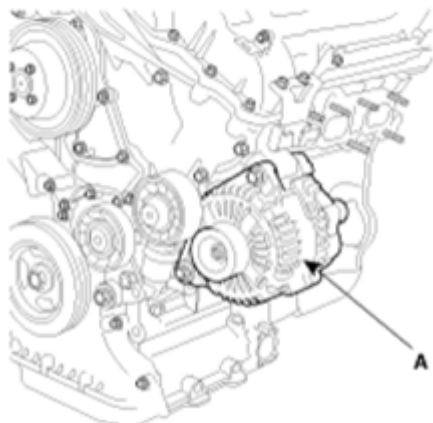
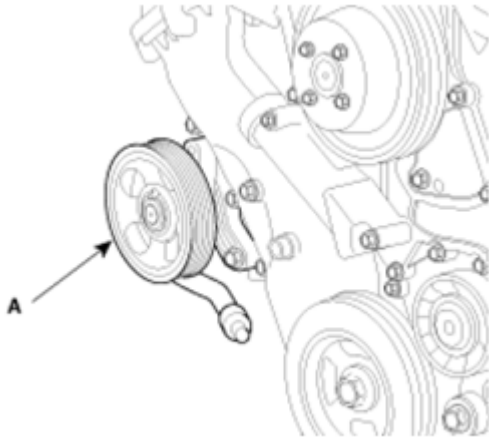
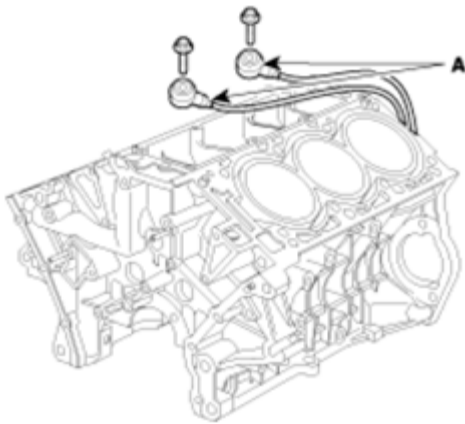


Fig. 4: Identifying Generator**Courtesy of KIA MOTORS AMERICA, INC.**

10. Remove power steering pump (A) from engine.

**Fig. 5: Identifying Power Steering Pump****Courtesy of KIA MOTORS AMERICA, INC.****DISASSEMBLY**

1. Remove drive plate.
2. Remove knock sensor (A).

**Fig. 6: Identifying Knock Sensor****Courtesy of KIA MOTORS AMERICA, INC.**

3. Remove upper oil pan (A).



Fig. 7: Identifying Upper Oil Pan

Courtesy of KIA MOTORS AMERICA, INC.

4. Remove baffle plate (A).

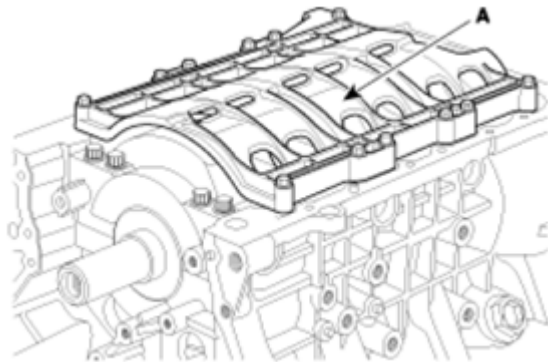


Fig. 8: Identifying Baffle Plate

Courtesy of KIA MOTORS AMERICA, INC.

5. Remove rear oil seal case (A).

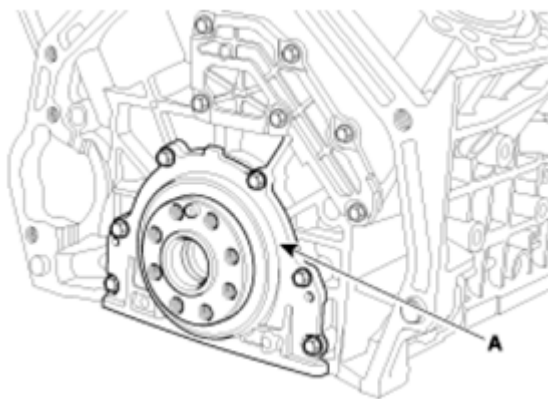


Fig. 9: Identifying Rear Oil Seal Case

Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil drain cover (A).

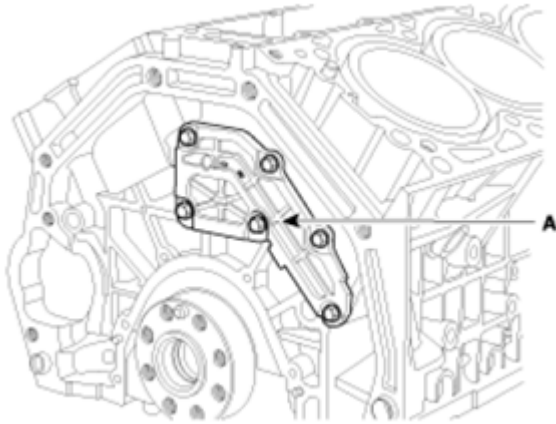


Fig. 10: Identifying Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

7. Check the connecting rod end play.
8. Check the connecting rod cap oil clearance.
9. 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.**

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

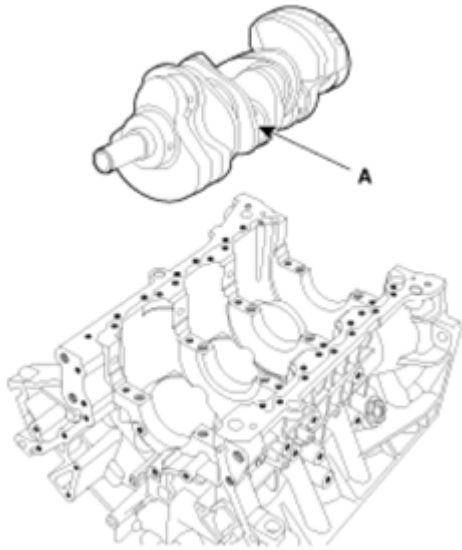


Fig. 11: Identifying Crankshaft

Courtesy of KIA MOTORS AMERICA, INC.

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

13. 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 piston and piston pin as a set.

14. 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.

15. Disconnect connecting rod from piston.

Using a press, remove the piston pin from piston.

(Press-in load : 800 ~ 1400kg (1764 ~ 3086lb))

INSPECTION

CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.

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

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

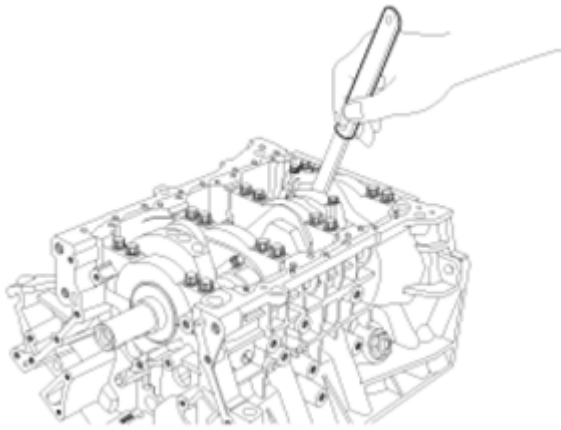


Fig. 12: Measuring End Play

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.038 ~ 0.056mm (0.0015 ~ 0.0022in.)

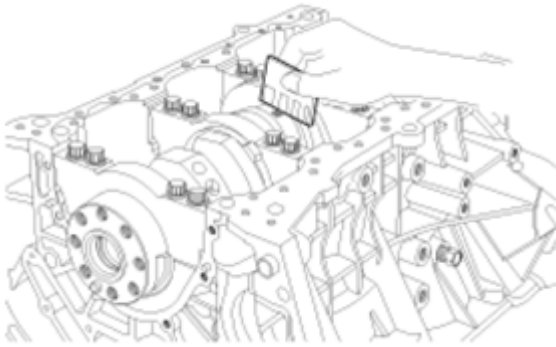


Fig. 13: Measuring Plastigage

Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

CONNECTING ROD MARK LOCATION



Fig. 14: Identifying Connecting Rod Mark
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD

CONNECTING ROD SPECIFICATION

CLASS	MARK	INSIDE DIAMETER
0	a	58.000 ~ 58.006mm (2.2834 ~ 2.2837in.)
1	b	58.006 ~ 58.012mm (2.2837 ~ 2.2839in.)
2	c	58.012 ~ 58.018mm (2.2839 ~ 2.2842in.)

CRANKSHAFT PIN MARK LOCATION

DISCRIMINATION OF CRANKSHAFT

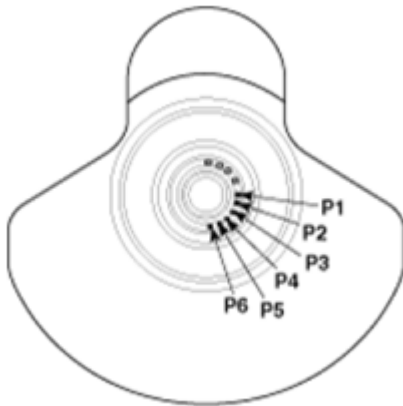


Fig. 15: Identifying Crankshaft Pin Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT DISCRIMINATION

CLASS	MARK	OUTSIDE DIAMETER OF PIN
I	1 or A	54.966 ~ 54.972mm (2.1640 ~ 2.1642in.)
II	2 or B	54.960 ~ 54.966mm (2.1638 ~ 2.1640in.)
III	3 or C	54.954 ~ 54.960mm (2.1635 ~ 2.1638in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)

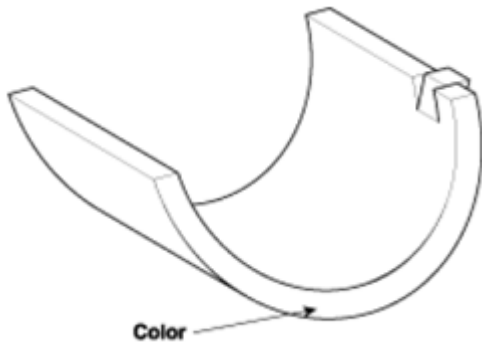


Fig. 16: Identifying Connecting Rod Bearing Mark
 Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CONNECTING ROD BEARING

CONNECTING ROD BEARING DISCRIMINATION

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	1.514 ~ 1.517mm (0.0596 ~ 0.0597in.)
D	BLACK	1.511 ~ 1.514mm (0.0595 ~ 0.0596in.)
C	BROWN	1.508 ~ 1.511mm (0.0594 ~ 0.0595in.)
B	GREEN	1.505 ~ 1.508mm (0.0593 ~ 0.0594in.)
A	YELLOW	1.502 ~ 1.505mm (0.0591 ~ 0.0593in.)

(11) Selection

CONNECTING ROD IDENTIFICATION MARK SPECIFICATION

		CONNECTING ROD IDENTIFICATION MARK		
		0 (a)	1 (b)	2 (c)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

3. Check the crankshaft bearing oil clearance.

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

49.00Nm (5.0 kgf.m, 36.16lb-ft) + 90°

19.60 Nm (2.0 kgf.m, 14.46lb-ft)+ 120°

29.40 ~ 31.36Nm (3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14lb-ft)

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.022 ~ 0.040mm (0.0009 ~ 0.0016in.)

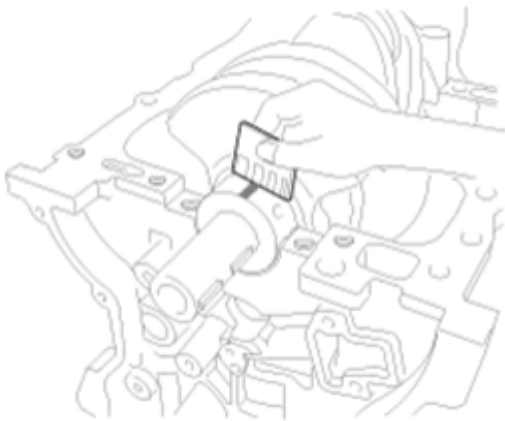


Fig. 17: Measuring Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the size of each of the 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.

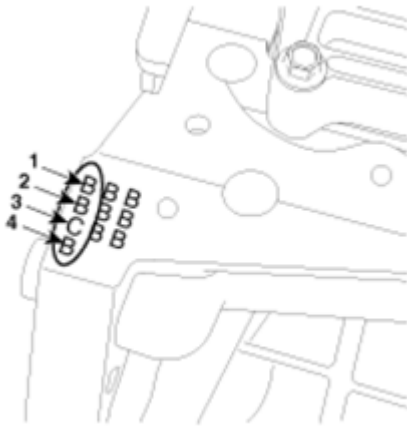


Fig. 18: Identifying Crankshaft Bore Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CYLINDER BLOCK

CYLINDER BLOCK DISCRIMINATION

CLASS	MARK	INSIDE DIAMETER
a	A	73.500 ~ 73.506mm (2.8937 ~ 2.8939in.)
b	B	73.506 ~ 73.512mm (2.8939 ~ 2.8942in.)
c	C	73.512 ~ 73.518mm (2.8942 ~ 2.8944in.)

CRANKSHAFT JOURNAL MARK LOCATION

DISCRIMINATION OF CRANKSHAFT

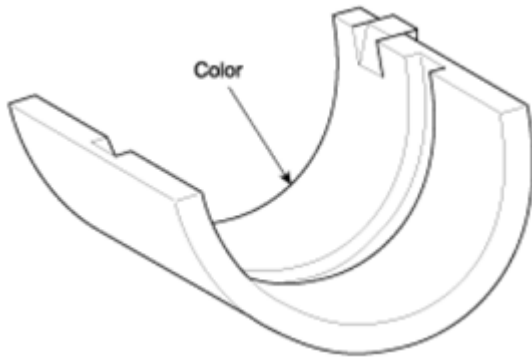


Fig. 19: Identifying Crankshaft Journal Mark Location

Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT**CRANKSHAFT DISCRIMINATION**

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	1 or A	68.954 ~ 68.960mm (2.7147 ~ 2.7150in.)
II	2 or B	68.948 ~ 68.954mm (2.7145 ~ 2.7147in.)
III	3 or C	68.942 ~ 68.948mm (2.7142 ~ 2.7145in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)**Fig. 20: Identifying Crankshaft Bearing Mark**

Courtesy of KIA MOTORS AMERICA, INC.

DISCRIMINATION OF CRANKSHAFT BEARING**CRANKSHAFT BEARING DISCRIMINATION**

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	2.277 ~ 2.280mm (0.0896 ~ 0.0897in.)
D	BLACK	2.274 ~ 2.277mm (0.0895 ~ 0.0896in.)
C	BROWN	2.271 ~ 2.274mm (0.0894 ~ 0.0895in.)
B	GREEN	2.268 ~ 2.271mm (0.0893 ~ 0.0894in.)
A	YELLOW	2.265 ~ 2.268mm (0.0892 ~ 0.0893in.)

SELECTION**CRANKSHAFT BORE IDENTIFICATION MARK**

		CRANKSHAFT BORE IDENTIFICATION MARK		
		a (A)	b (B)	c (C)
	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)

CRANKSHAFT IDENTIFICATION MARK	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (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

0.10 ~ 0.28mm (0.0039 ~ 0.0110in.)

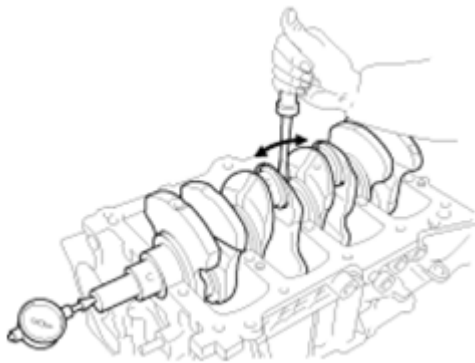


Fig. 21: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

2.41 ~ 2.45mm (0.0949 ~ 0.0964in.)

5. Inspect main journals and crank pins

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

Main journal diameter : 68.942 ~ 68.960mm (2.7142 ~ 2.7149in.)

Crank pin diameter : 54.954 ~ 54.972mm (2.1635 ~ 2.1642in.)

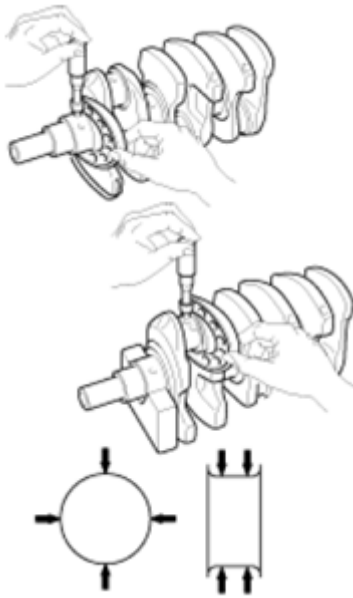


Fig. 22: Measuring Diameter Of Main Journal And Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

CONNECTING RODS

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

Allowable bend of connecting rod:

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

Allowable twist of connecting rod:

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

CYLINDER BLOCK

1. Remove gasket material.

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

2. Clean cylinder block

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

3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard : Less than 0.05mm (0.0020 in.), Less than 0.02mm (0.0008in.)/150 x 150

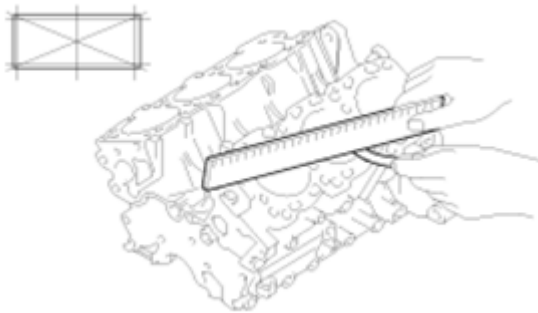


Fig. 23: Inspecting Surface Of Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

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

Standard diameter

96.00 ~ 96.03mm (3.7795 ~ 3.7807in.)

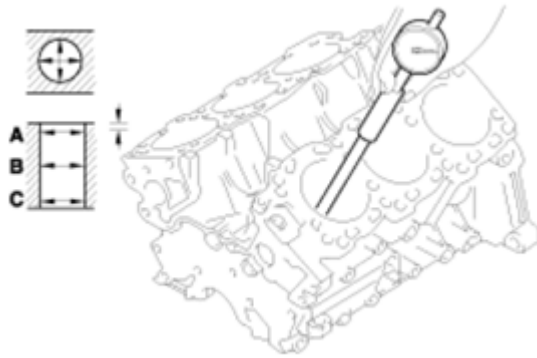


Fig. 24: Inspecting Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

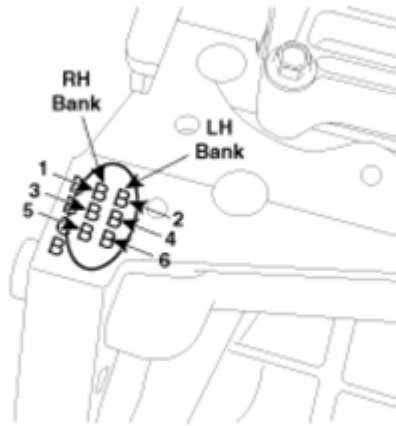


Fig. 25: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

CYLINDER BORE INNER DIAMETER

Class	Size code	Cylinder bore inner diameter
A	A	96.00~96.01mm (3.7795 ~ 3.7799in.)
B	B	96.01~96.02mm (3.7799 ~ 3.7803in.)
C	C	96.02~96.03mm (3.7803 ~ 3.7807in.)

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

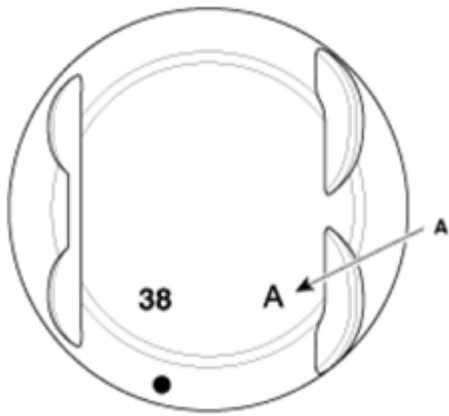


Fig. 26: Identifying Piston Size Code On Piston
 Courtesy of KIA MOTORS AMERICA, INC.

PISTON OUTER DIAMETER

Class	Size code	Piston outer diameter
A	A	95.96~95.97mm (3.7779 ~ 3.7783in.)
B	B	95.97~95.98mm (3.7783 ~ 3.7787in.)
C	C	95.98~95.99mm (3.7787 ~ 3.7791in.)

8. Select the piston related to cylinder bore class.

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

PISTON AND RINGS

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

NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 14 mm (0.5512 in.) from the bottom of the piston.

Standard diameter

95.96 ~ 95.99mm (3.7779~ 3.7791in.)

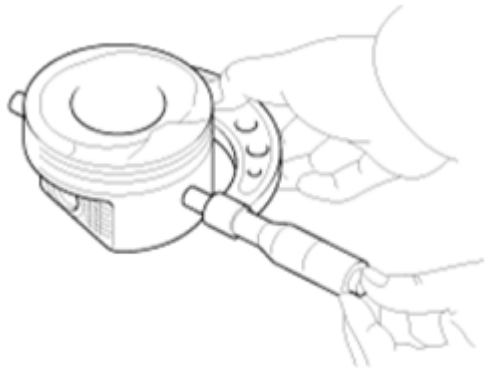


Fig. 27: Measuring Of Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.03 ~ 0.05mm (0.0012 ~ 0.0020in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

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

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

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

Limit

No. 1 : 0.1mm (0.004in.)

No. 2 : 0.1mm (0.004in.)

Oil ring : 0.2mm (0.008in.)



Fig. 28: Measuring Clearance Between Piston Ring And Wall
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. See **CYLINDER BLOCK**. If the bore is over the service limit, the cylinder block must be replaced. (Refer to **CYLINDER BLOCK**)

Piston ring end gap

Standard

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

No. 2 : 0.32 ~ 0.47m (0.0126 ~ 0.0185in.)

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

Limit

No. 1 : 0.6mm (0.0236in.)

No. 2 : 0.7mm (0.0275in.)

Oil ring : 0.8mm (0.0315in.)

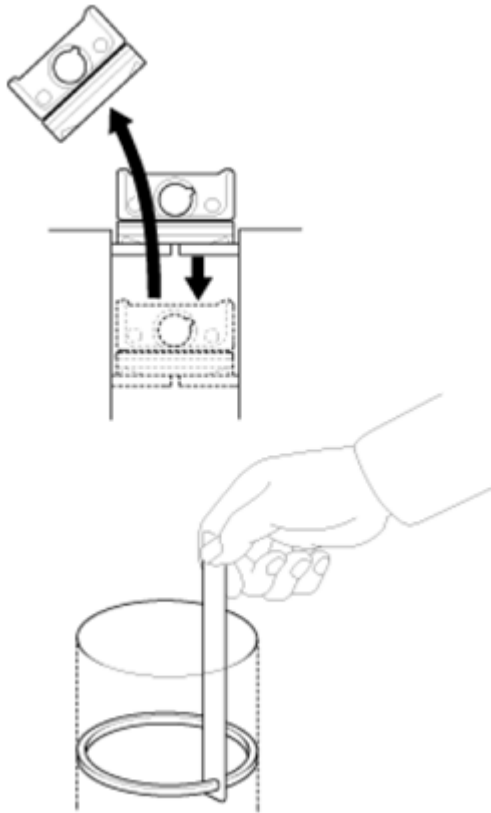


Fig. 29: Checking Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.002 ~ 23.006mm (0.9056 ~ 0.9057in.)

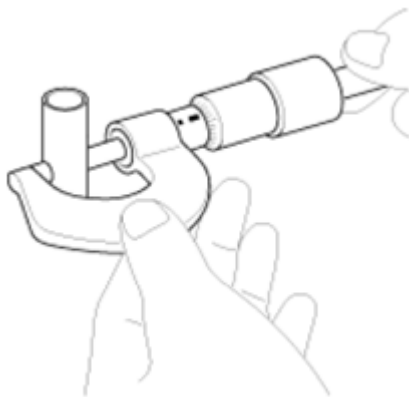


Fig. 30: Measuring Diameter Of Piston Pin

Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.009 ~ 0.017mm (0.0004 ~ 0.0007in.)

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

Piston pin-to-connecting rod interference

-0.032 ~ -0.017mm (-0.0012 ~ -0.0007in.)

REASSEMBLY

NOTE:

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

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

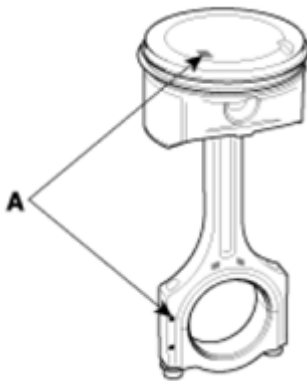


Fig. 31: Checking Difference Between Piston Pin Diameter And Connecting Rod Small End Diameter

Courtesy of KIA MOTORS AMERICA, INC.

2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

3. Position the piston rings so that the ring ends are as shown.

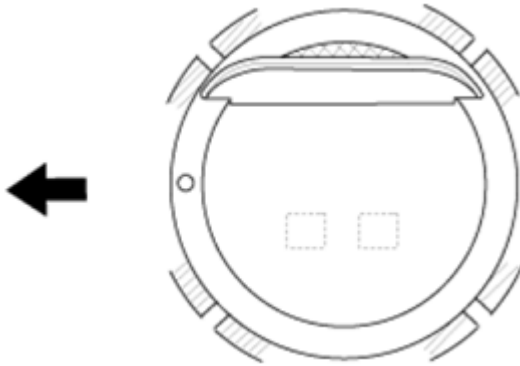


Fig. 32: Identifying Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

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

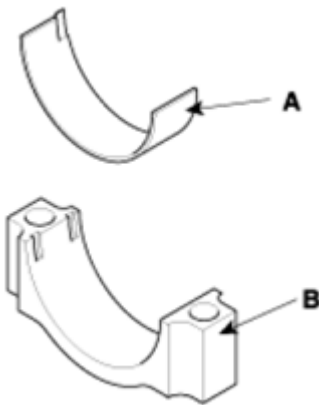


Fig. 33: Identifying Bearings
Courtesy of KIA MOTORS AMERICA, INC.

4. Install main bearings.

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

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

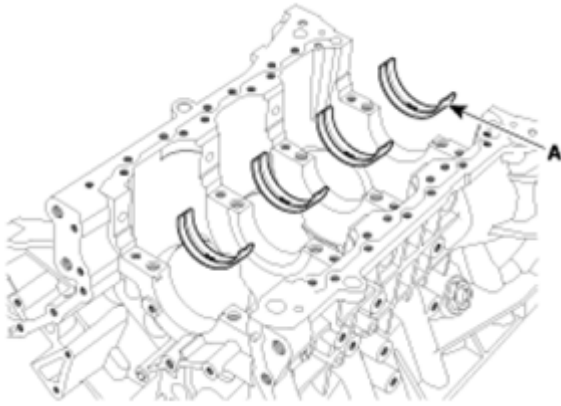


Fig. 34: Identifying Lower Bearings
Courtesy of KIA MOTORS AMERICA, INC.

5. Install thrust bearings.

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



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

6. Place crankshaft on the cylinder block.

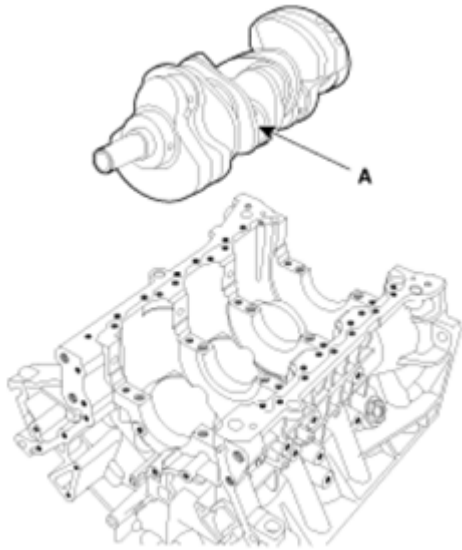


Fig. 36: Identifying Crankshaft

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

Main bearing cap bolt

49.00Nm (5.0 kgf.m, 36.16lb-ft) + 90° (1 ~ 8)

19.60 Nm (2.0 kgf.m, 14.46lb-ft)+ 120° (9 ~ 16)

29.40 ~ 31.36Nm (3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14lb-ft) (17 ~ 22)

NOTE:

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

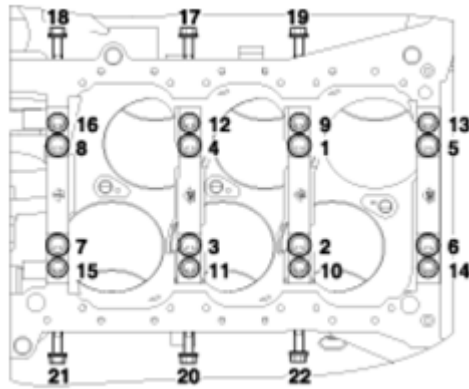


Fig. 37: Identifying Main Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

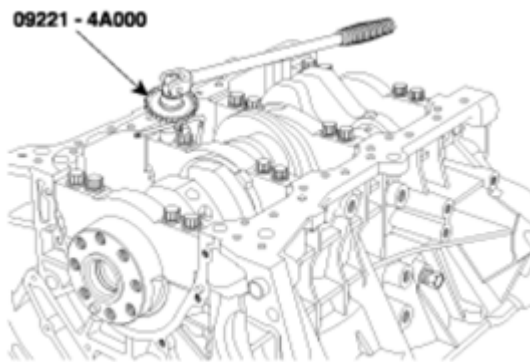


Fig. 38: Installing Main Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

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

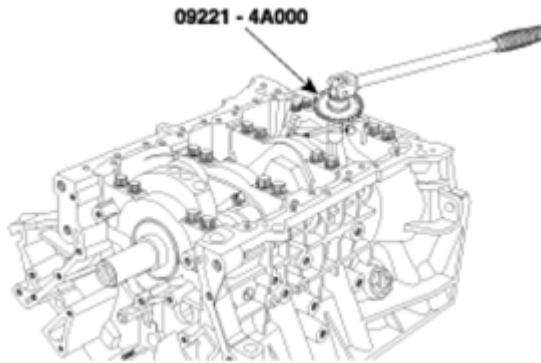


Fig. 39: Installing Connecting Rod Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

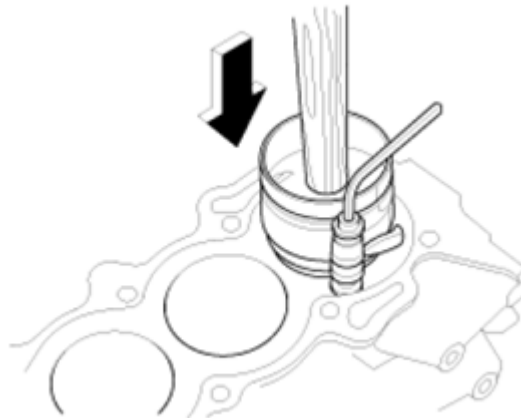


Fig. 40: Installing Piston
Courtesy of KIA MOTORS AMERICA, INC.

11. Check the connecting rod end play.
12. Install oil drain cover.

Tightening torque

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

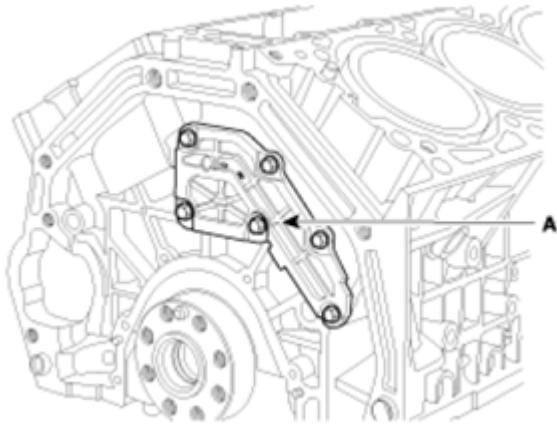


Fig. 41: Identifying Oil Drain Cover

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling oil drain cover, the liquid sealant TB1217H should be applied oil drain cover.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

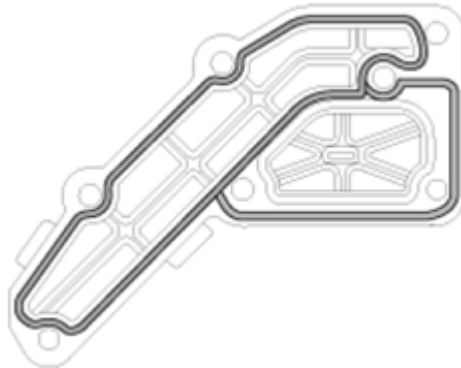


Fig. 42: Identifying Sealant Apply Area

Courtesy of KIA MOTORS AMERICA, INC.

13. Install rear oil seal case.

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lb-ft)

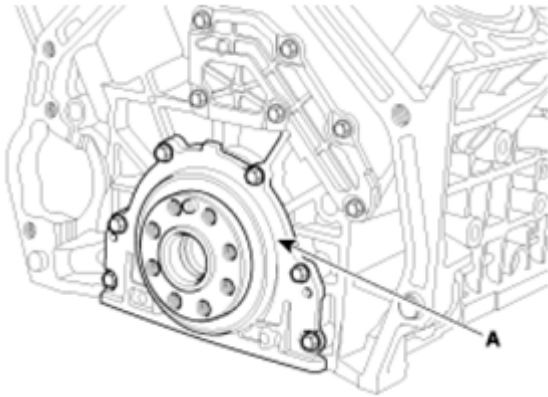


Fig. 43: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

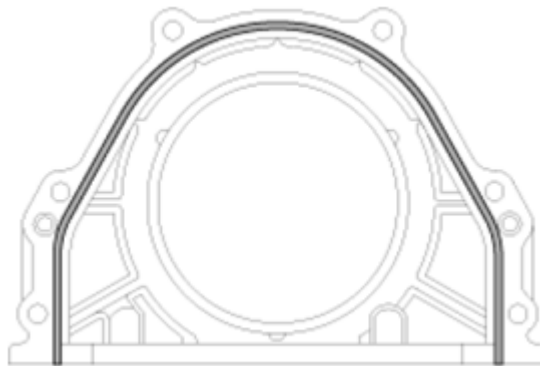


Fig. 44: Identifying Sealant Apply Area
Courtesy of KIA MOTORS AMERICA, INC.

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

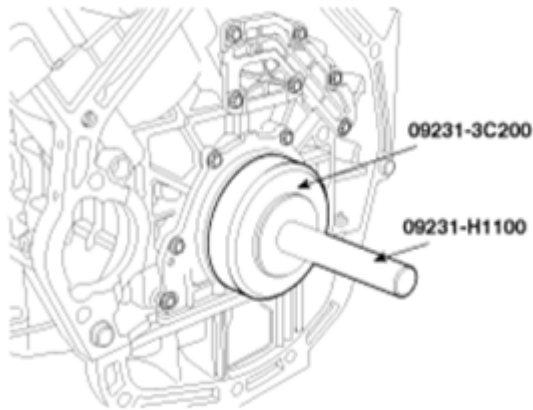


Fig. 45: Identifying Rear Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

15. Install baffle plate.

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

Tightening torque

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



Fig. 46: Identifying Baffle Plate Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

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

Bead width : 2.5mm (0.1in.)

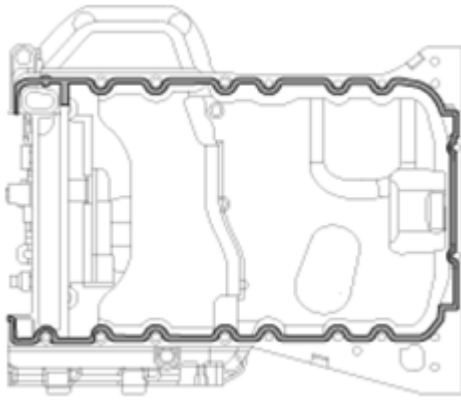


Fig. 47: Identifying Upper Oil Pan Liquid Sealant Apply Area
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

C. Install upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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

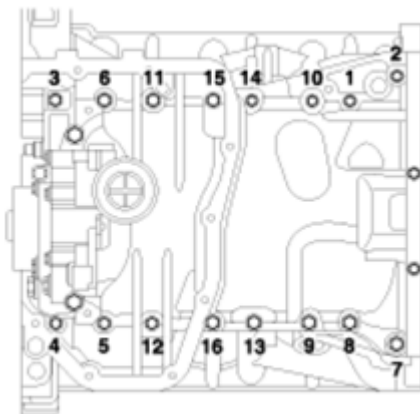


Fig. 48: Identifying Upper Oil Pan Bolts Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

17. Install knock sensor.

Tightening torque

15.68 ~ 23.52Nm (1.6 ~ 2.4kgf.m, 11.57 ~ 17.36lb-ft)

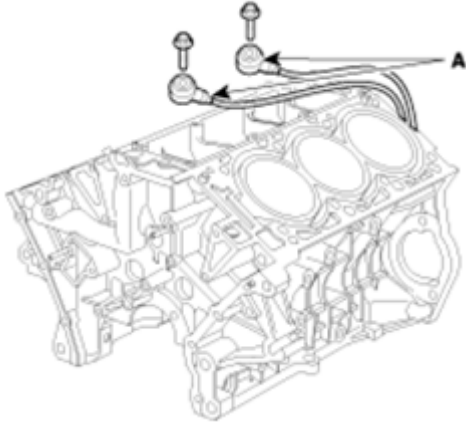


Fig. 49: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

18. Install drive plate.

Tightening torque

71.54 ~ 75.46Nm (7.3 ~ 7.7kgf.m, 52.80 ~ 55.69lb-ft)

INSTALLATION

1. Install power steering pump.
2. Install generator.
3. Install air conditioner compressor
4. Install oil filter assembly.
5. Install oil pump.
6. Install cylinder head.
7. Install water temperature control assembly.
8. Install timing chain.
9. Install intake manifold.
10. Install exhaust manifold.

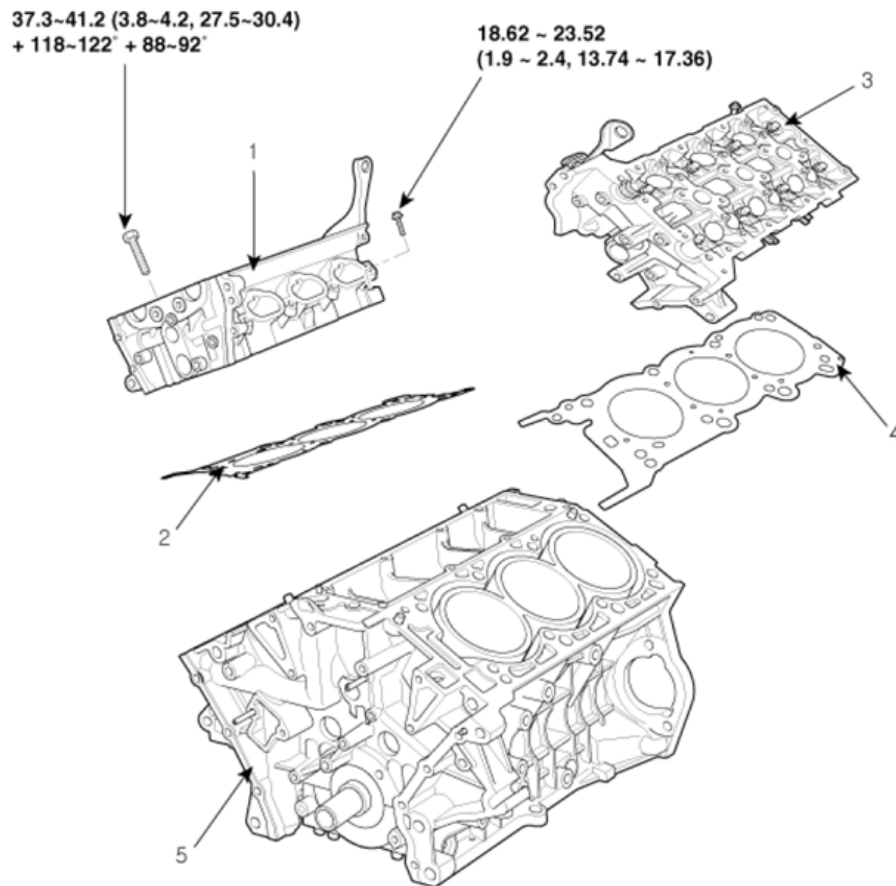
2010 ENGINE

Cylinder Head Assembly - Sedona

COMPONENTS AND COMPONENTS LOCATION

ENGINE MECHANICAL SYSTEM

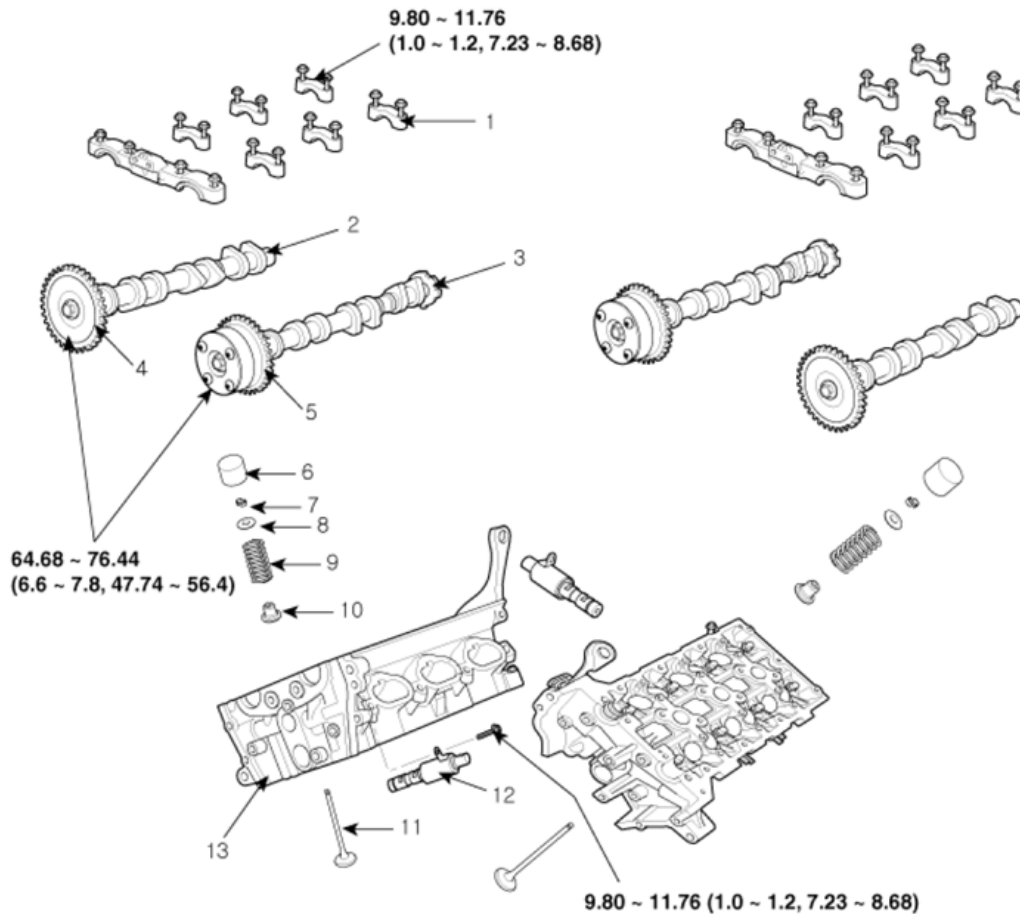
COMPONENTS



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

- | | |
|----------------------------|----------------------------|
| 1. RH cylinder head | 4. LH cylinder head gasket |
| 2. RH cylinder head gasket | 5. Cylinder block |
| 3. LH cylinder head | |

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



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

- | | | |
|------------------------------|---------------------|-------------------|
| 1. Camshaft bearing cap | 6. MLA | 11. Valve |
| 2. Exhaust camshaft | 7. Retainer lock | 12. OCV |
| 3. Intake camshaft | 8. Retainer | 13. Cylinder head |
| 4. Exhaust camshaft sprocket | 9. Valve spring | |
| 5. CVVT assembly | 10. Valve stem seal | |

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

REPAIR PROCEDURES

REMOVAL

CAUTION:

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal operating temperature before

removing it.

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT)

Engine removal is required for this procedure.

1. Remove exhaust manifold. (Refer to EXHAUST MANIFOLD)
2. Remove intake manifold.(Refer to INTAKE MANIFOLD)
3. Remove timing chain. (Refer to TIMING CHAIN)
4. Remove water temperature control assembly. (Refer to WATER TEMPERATURE CONTROL ASSEMBLY)
5. Remove camshaft bearing cap (A).

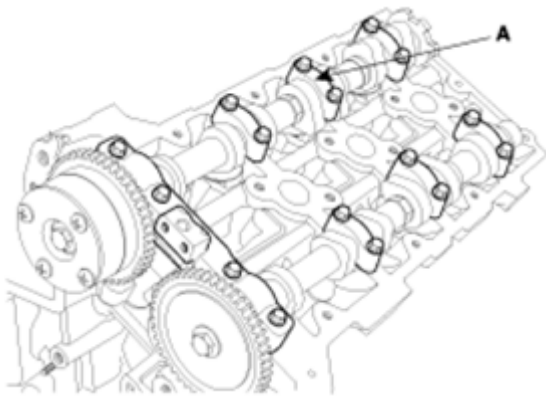


Fig. 3: Identifying Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove camshaft assembly (A).

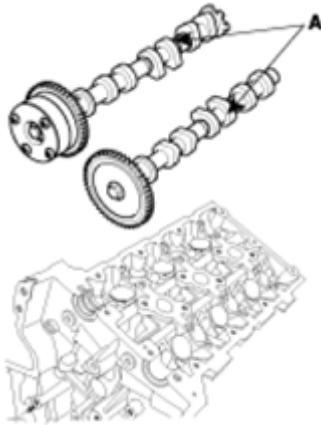


Fig. 4: Identifying Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove cylinder head bolts, then remove cylinder head.
 1. Uniformly loosen and remove the 16 cylinder head bolts, in several passes, in the sequence shown. Remove the 16 cylinder head bolts and plate washers.

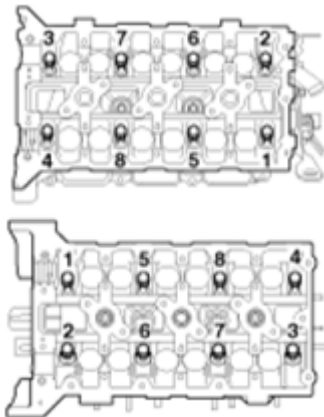


Fig. 5: Identifying Cylinder Head Bolt Loosen Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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.

DISASSEMBLY

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

1. Remove MLAs (A).

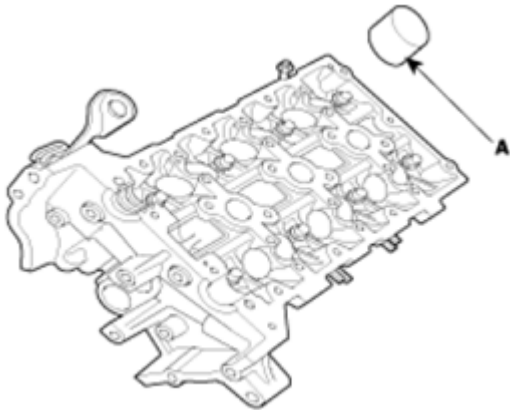


Fig. 6: Identifying MLA

Courtesy of KIA MOTORS AMERICA, INC.

2. Remove valves.
 1. Using SST (09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.

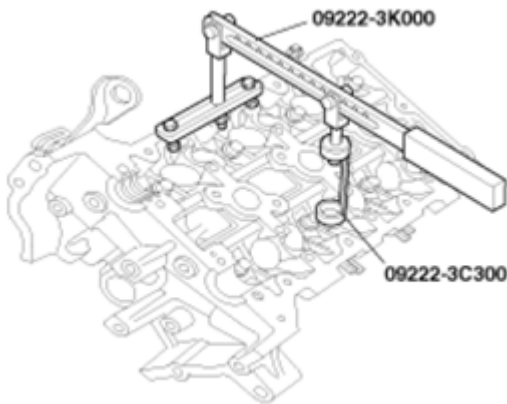


Fig. 7: Compressing Valve Spring

Courtesy of KIA MOTORS AMERICA, INC.

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

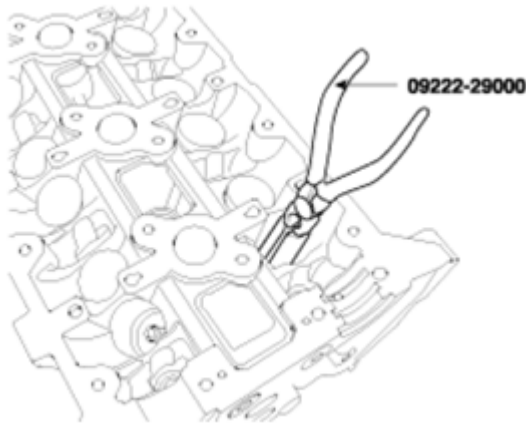


Fig. 8: Removing Valve Stem Seal
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: **Do not reuse old valve stem seals.**

3. Remove OCV (A).

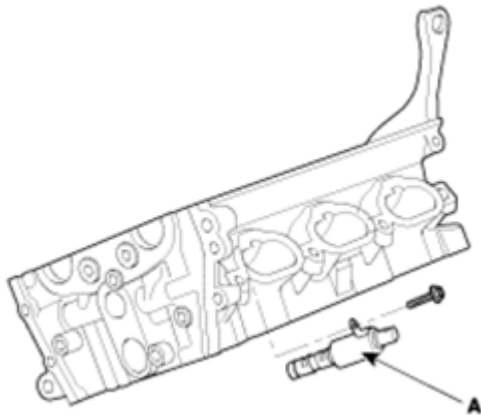


Fig. 9: Identifying OCV
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05mm (0.002in.)[Less than 0.02mm (0.0008in.)/150x150]

Flatness of manifold gasket surface

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

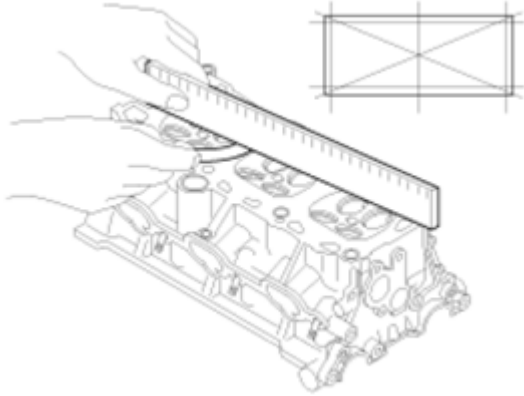


Fig. 10: Inspecting For Flatness

Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

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

Valve guide I.D.

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

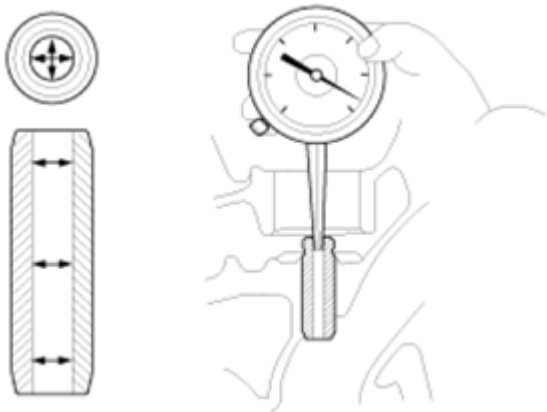


Fig. 11: Measuring Inside Diameter Of Valve Guide

Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem O.D.

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

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

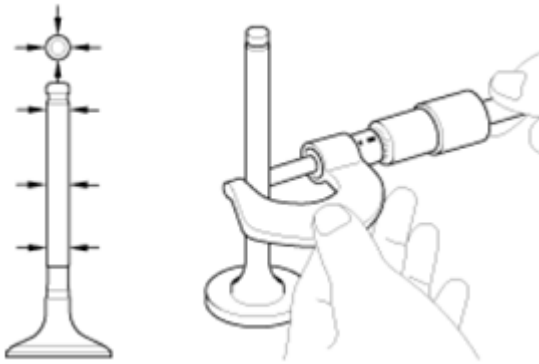


Fig. 12: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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

Valve stem-to-guide clearance

[Standard]

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

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

[Limit]

Intake : 0.07mm (0.0027in.)

Exhaust : 0.09mm (0.0035in.)

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

If the valve face is worn, replace the valve.

3. Check the valve head margin thickness.

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

Margin

[Standard]

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

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

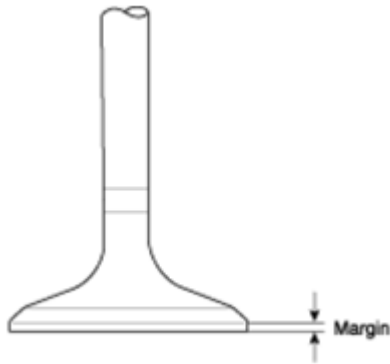


Fig. 13: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

Length

Intake : 105.27mm (4.1445in)

Exhaust : 105.50mm (4.1535in)

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

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

3. Inspect valve seats

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

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

4. Inspect valve springs.

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

Valve spring

[Standard]

Free height : 43.86mm (1.7267in.)

Out-of-square : 1.5°

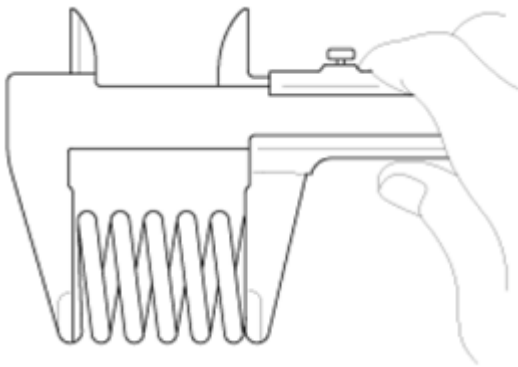


Fig. 14: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

MLA

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust : 34.964 ~ 34.980mm (1.3765 ~ 1.3771in.)

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

Tappet bore I.D.

Intake/Exhaust : 35.000 ~ 35.025mm (1.3779 ~ 1.3789in.)

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

MLA to tappet bore clearance

[Standard]

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

[Limit]

Intake/Exhaust : 0.07mm (0.0027in.)

CAMSHAFT

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake : 46.8mm (1.8425in.)

Exhaust : 45.8mm (1.8031in.)



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

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

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

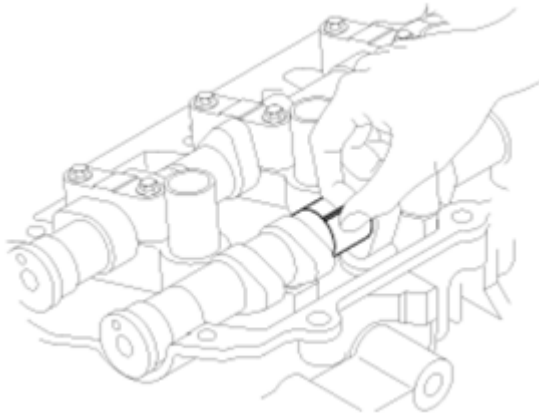


Fig. 16: Laying Strip Of Plastigage Across Of Camshaft Journal
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps. (Refer to **INSTALLATION**)

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

[Standard value]

Intake

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

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

Exhaust

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

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

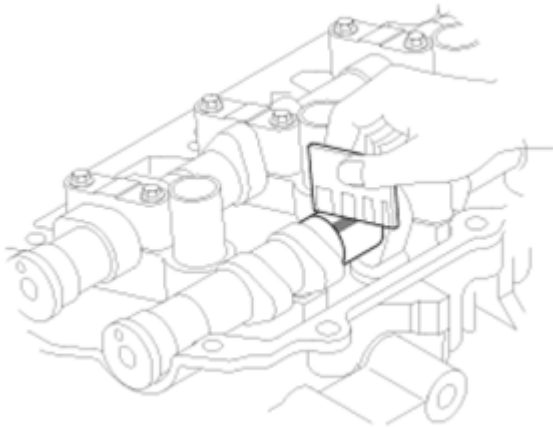


Fig. 17: Measuring Plastigage

Courtesy of KIA MOTORS AMERICA, INC.

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

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

Camshaft end play

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

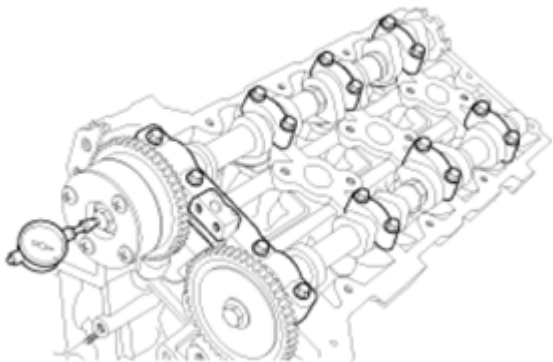


Fig. 18: Measuring End Play

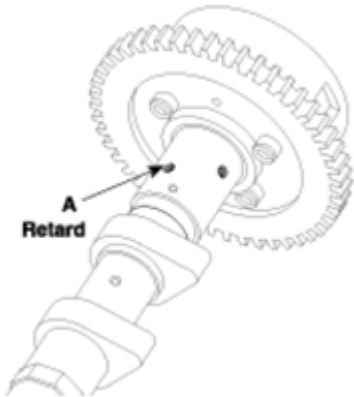
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

CVVT ASSEMBLY

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

**Fig. 19: Identifying Mark**

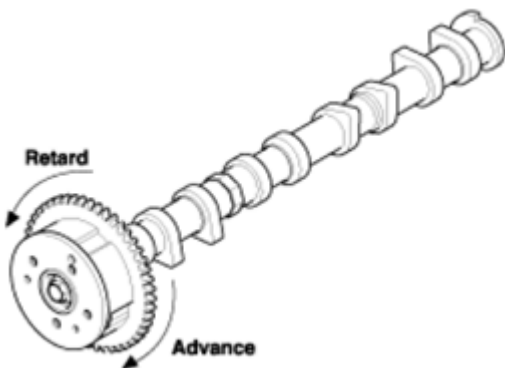
Courtesy of KIA MOTORS AMERICA, INC.

3. Wind tape around the tip of the air gun and apply air of approx. 150kpa (1.5kgf/cm², 21psi) to the port of the camshaft. (Perform this order to release the lock pin for the maximum delay angle locking.)

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

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

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, If excessive air leaks from the port, the lock pin may not be fully released.

**Fig. 20: Turning CVVT Assembly**

Courtesy of KIA MOTORS AMERICA, INC.

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

Standard: Movable smoothly in the range about 22.5°

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

REASSEMBLY

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

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

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

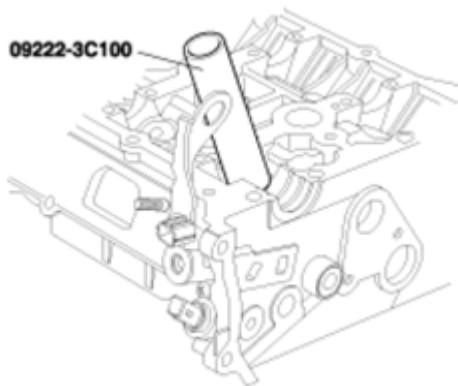


Fig. 21: Pushing Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

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

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

3. Using the SST (09222 - 3K000, 09222-3C300), 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.

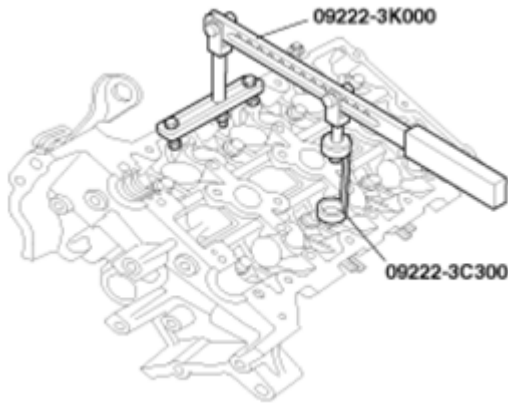


Fig. 22: Compressing Spring
Courtesy of KIA MOTORS AMERICA, INC.

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

Check that the MLA rotates smoothly by hand.

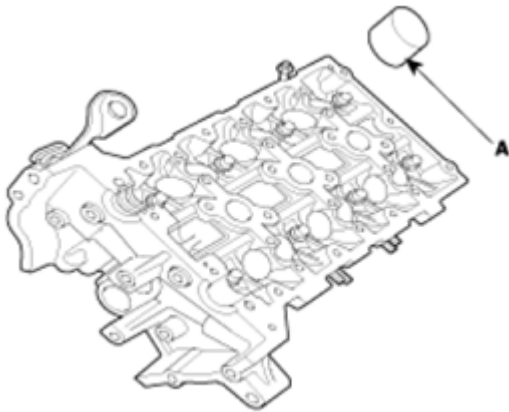


Fig. 23: Identifying MLA
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

3. Install OCV (A).

Tightening torque

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

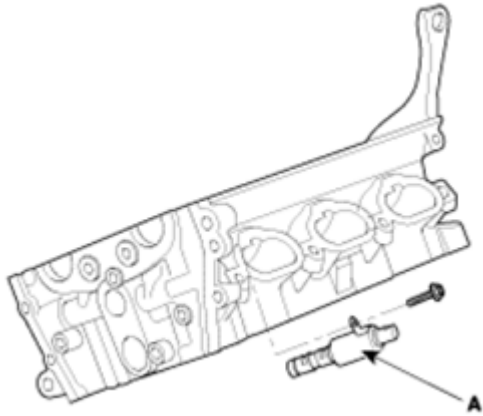


Fig. 24: Identifying OCV

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

CAUTION:

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

INSTALLATION

NOTE:

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

1. Install the cylinder head.

- A. The sealant locations on cylinder head and cylinder block must be free from contamination.
- B. Apply sealant on cylinder block top face before assembling cylinder head gaskets.

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

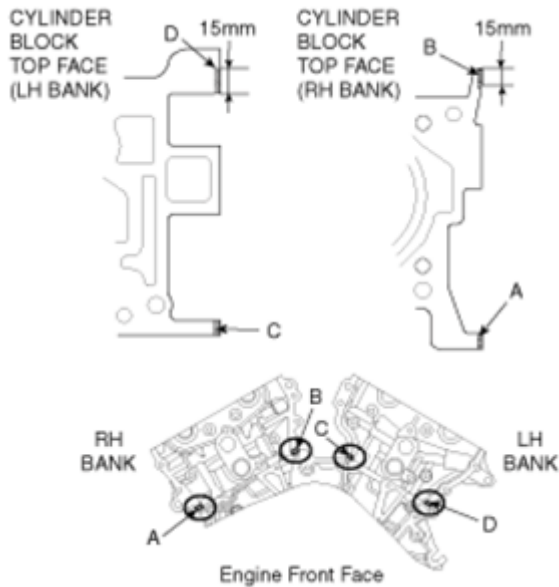


Fig. 25: Identifying Sealant Location
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to Fig. 26 to apply the sealant.

Bead width : 2.0~3.0 mm

Sealant locations : 1.0~1.5mm from block surface

Recommended sealant : Liquid sealant TB1217H

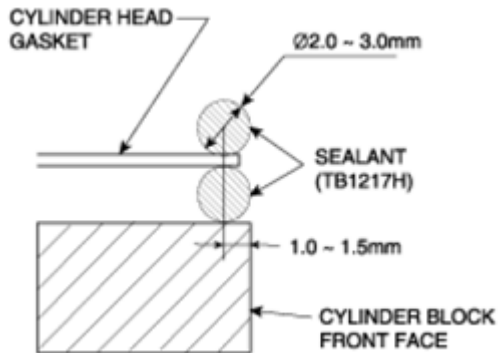


Fig. 26: Identifying Sealant Apply Area
Courtesy of KIA MOTORS AMERICA, INC.

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

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

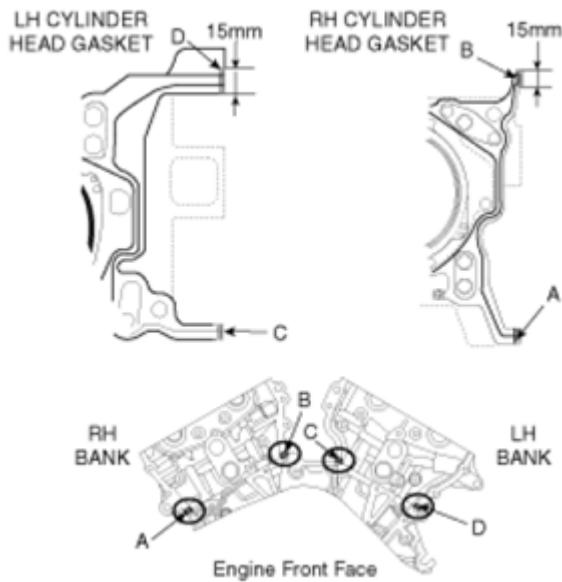


Fig. 27: Identifying Sealant On Cylinder Head Gaskets
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

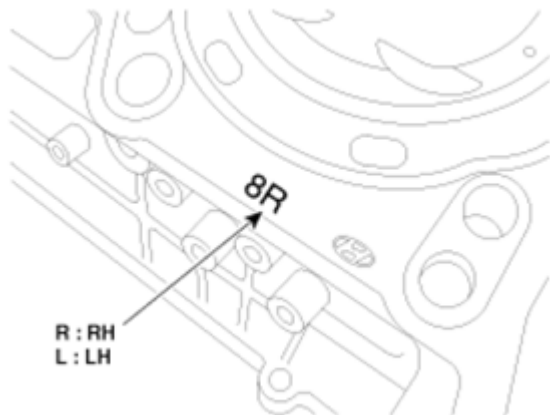


Fig. 28: Identifying Mark
Courtesy of KIA MOTORS AMERICA, INC.

D. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

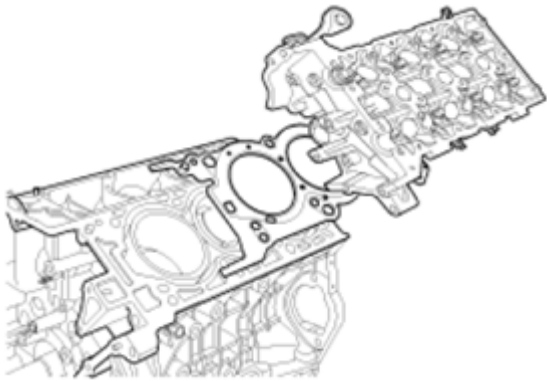


Fig. 29: Identifying Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

Bolt (A) : 18.62~23.52Nm (1.9~2.4kgf.m, 13.74~17.36lb-ft)

NOTE: Always use new cylinder head bolt.

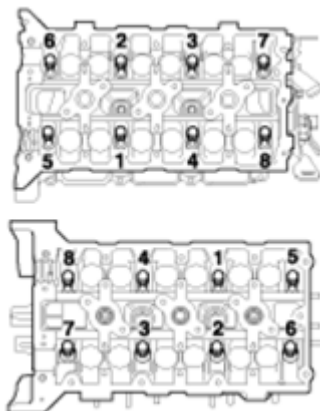


Fig. 30: Identifying Cylinder Head Bolts Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

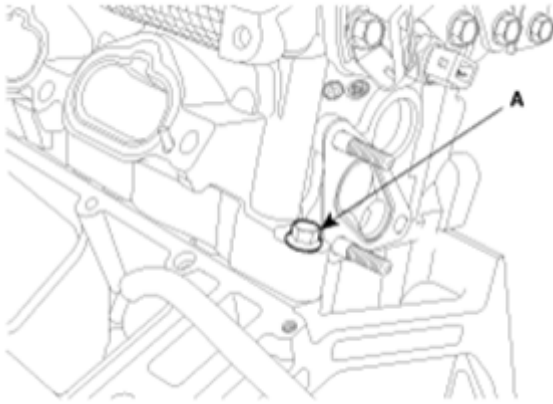


Fig. 31: Identifying Bolt

Courtesy of KIA MOTORS AMERICA, INC.

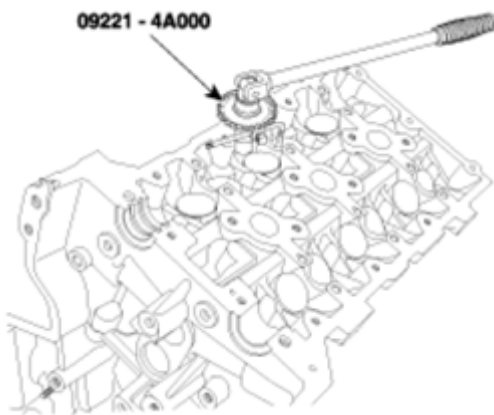


Fig. 32: Installing Cylinder Head Bolts

Courtesy of KIA MOTORS AMERICA, INC.

4. Install the CVVT and camshaft sprocket.

Tightening torque

64.68 ~ 76.44Nm (6.6 ~ 7.8 kgf.m, 47.74 ~ 56.4lb-ft)

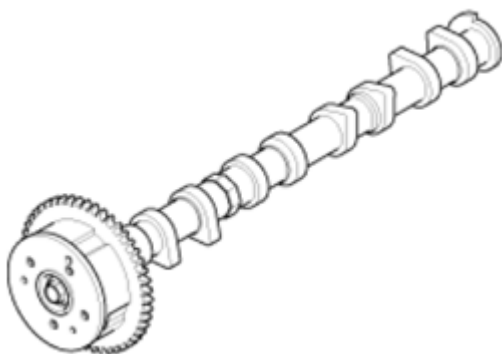


Fig. 33: Identifying CVVT And Camshaft Sprocket

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

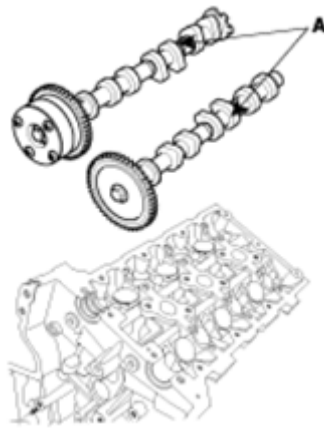
Ensure that the camshaft oil inlet is not obstructed.

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

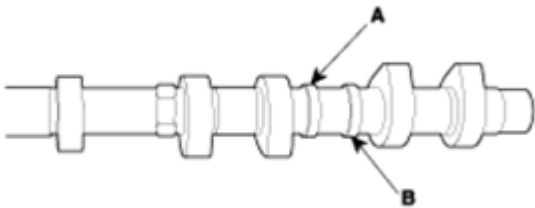
5. Install camshafts (A).

NOTE:

- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Ensure that the camshaft components are installed in the correct locations.

**Fig. 34: Identifying Camshafts**

Courtesy of KIA MOTORS AMERICA, INC.

Intake camshaft**Fig. 35: Identifying Intake Camshaft**

Courtesy of KIA MOTORS AMERICA, INC.

INTAKE CAMSHAFT SPECIFICATION

LH	RH
A: 30mm (1.1811in.) B: 27mm (1.0630in.)	A: 27mm (1.0630in.) B: 30mm (1.1811in.)

Exhaust camshaft

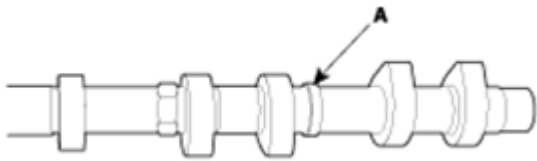


Fig. 36: Identifying Exhaust Camshaft

Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST CAMSHAFT SPECIFICATION

LH	RH
A: 27mm (1.0630in.)	A: 30mm (1.1811in.)

6. Install camshaft bearing caps.

Assemble camshaft bearing caps as the order below.

Tightening torque

5.9Nm (0.6kgf.m, 4.3lb-ft) - 1st step

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft) - 2nd step

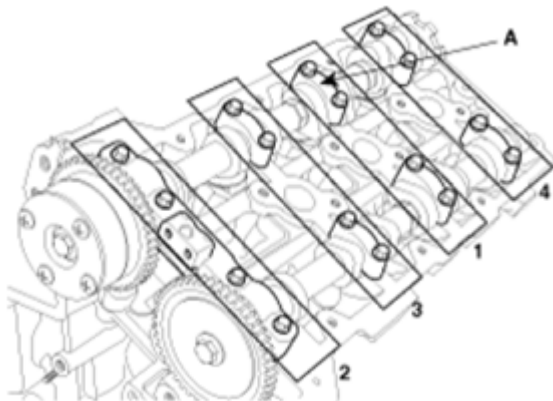


Fig. 37: Identifying Camshaft Bearing Caps

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Ensure that the cam bearing caps are installed in the correct location and direction.

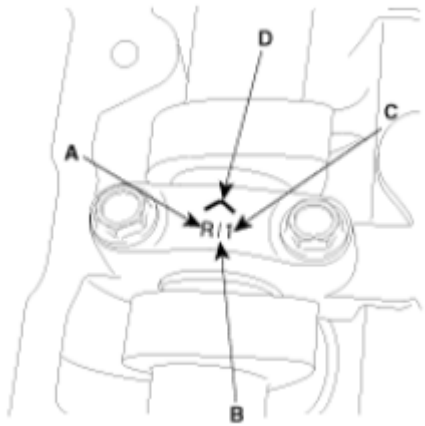


Fig. 38: Identifying Mark On Cam Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

- A. L (LH), R (RH)
- B. I (Intake), None (Exhaust)
- C. Journal number
- D. Front mark

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

7. Install water temperature control assembly. (Refer to WATER TEMPERATURE CONTROL ASSEMBLY)
8. Install timing chain (Refer to INSTALLATION)
9. Check and adjust valve clearance. (Refer to VALVE CLEARANCE INSPECTION AND ADJUSTMENT)
10. Install the exhaust manifold. (Refer to EXHAUST MANIFOLD)
11. Install the intake manifold. (Refer to INTAKE MANIFOLD)

2010 ENGINE

General Information - Engine Mechanical System - Sedona

GENERAL INFORMATION

ENGINE MECHANICAL SYSTEM

SPECIFICATION

SPECIFICATION

Description		Specifications	Limit
General			
Type		V-type, DOHC	
Number of cylinders		6	
Bore		96mm (3.7795in.)	
Stroke		87.0mm (3.4252in.)	
Total displacement		3.778cc (230.55cu.in.)	
Compression ratio		10.4	
Firing order		1-2-3-4-5-6	
Valve timing			
Intake	Opens (ATDC)	10°	
	Closes (ABDC)	62°	
Exhaust	Opens (BBDC)	42°	
	Closes (ATDC)	6°	
Cylinder head			
Flatness of gasket surface		Less than 0.05mm (0.0019in.) [Less than 0.02mm (0.0008in.)/150x150]	
Flatness of manifold mounting	Intake	Less than 0.1mm (0.0039in.) [Less than 0.03mm (0.001in.)/110x110]	
	Exhaust	Less than 0.1mm (0.0039in.) [Less than 0.03mm (0.001in.)/110x110]	
Camshaft			
Cam height	LH Camshaft	Intake	46.8mm (1.8425in.)
		Exhaust	45.8mm (1.8031in.)
	RH Camshaft	Intake	46.8mm (1.8425in.)
		Exhaust	45.8mm (1.8031in.)
Journal outer	LH, RH	Intake	No. 1: 27.964 ~ 27.980mm (1.1009 ~ 1.1016in.) No. 2,3,4: 23.954 ~ 23.970mm (0.9430 ~ 0.9437in.)

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diameter	camshaft	Exhaust	No. 1: 27.964 ~ 27.980mm (1.1009 ~ 1.1016in.) No. 2,3,4: 23.954 ~ 23.970mm (0.9430 ~ 0.9437in.)	
Bearing oil clearance	LH, RH camshaft	Intake	No. 1: 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.) No. 2,3,4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in.)	
		Exhaust	No. 1: 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.) No. 2,3,4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in.)	
End play			0.02 ~ 0.18mm (0.0008 ~ 0.0071in.)	
Valve				
Valve length	Intake		105.27mm (4.1445in.)	
	Exhaust		105.50mm (4.1535in.)	
Stem outer diameter	Intake		5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)	
	Exhaust		5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)	
Face angle			45.25° ~ 45.75°	
Thickness of valve head (margin)	Intake		1.56 ~ 1.86mm (0.06142 ~ 0.07323in.)	
	Exhaust		1.73 ~ 2.03mm (0.06811 ~ 0.07992in.)	
Valve stem to valve guide clearance	Intake		0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)	0.07mm (0.00275in.)
	Exhaust		0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)	0.09mm (0.00354in.)
Valve guide				
Inner diameter	Intake		5.500 ~ 5.512mm (0.2165 ~ 0.2170in.)	
	Exhaust		5.500 ~ 5.512mm (0.2165 ~ 0.2170in.)	
Length	Intake		41.8 ~ 42.2mm (1.6457 ~ 1.6614in.)	
	Exhaust		41.8 ~ 42.2mm (1.6457 ~ 1.6614in.)	
Valve seat				
Width of seat contact	Intake		1.15 ~ 1.45mm (0.05118 ~ 0.05709in.)	
	Exhaust		1.35 ~ 1.65mm (0.05315 ~ 0.06496in.)	

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Seat angle	Intake	44.75° ~ 45.20°	
	Exhaust	44.75° ~ 45.20°	
Valve spring			
Free length		43.86mm (1.7267in.)	
Load		19.3±0.8kg/34.0mm (42.7±1.8 lb/1.3386in.)	
		42.3±1.3kg/24.2mm (93.3±2.9 lb/0.9527in.)	
Out of squareness		Less than 1.5°	
MLA			
MLA outer diameter	Intake	34.964 ~ 34.980mm (1.3765 ~ 1.3772in.)	
	Exhaust	34.964 ~ 34.980mm (1.3765 ~ 1.3772in.)	
Cylinder head tappet bore inner diameter	Intake	35.000 ~ 35.025mm (1.3779 ~ 1.3789in.)	
	Exhaust	35.000 ~ 35.025mm (1.3779 ~ 1.3789in.)	
MLA to tappet bore clearance	Intake	0.020 ~ 0.061mm (0.0008 ~ 0.0024in.)	0.07mm (0.0027in.)
	Exhaust	0.020 ~ 0.061mm (0.0008 ~ 0.0024in.)	0.07mm (0.0027in.)
Valve clearance			
Intake		0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust		0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0078 ~ 0.0157in.)
Cylinder block			
Cylinder bore		96.00 ~ 96.03mm (3.7795 ~ 3.7807in.)	
Flatness of gasket surface		Less than 0.05mm (0.0019in.) [Less than 0.02mm (0.0008in.)/150x150]	
Piston			
Piston outer diameter		95.96 ~ 95.99mm (3.7779 ~ 3.7791in.)	
Piston to cylinder clearance		0.03 ~ 0.05mm (0.0012 ~ 0.0020in.)	
Ring groove width	No. 1 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in.)	1.26mm (0.0496in.)
	No. 2 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in.)	1.26mm (0.0496in.)
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)	2.05mm (0.0807in.)

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Piston ring

Side clearance	No. 1 ring	0.03 ~ 0.07mm (0.0012 ~ 0.0027in.)	0.1mm (0.004in.)
	No. 2 ring	0.03 ~ 0.07mm (0.0012 ~ 0.0027in.)	0.1mm (0.004in.)
	Oil ring	0.06 ~ 0.15mm (0.0024 ~ 0.0059in.)	0.2mm (0.008in.)
End gap	No. 1 ring	0.17 ~ 0.32mm (0.0067 ~ 0.0126in.)	0.6mm (0.0236in.)
	No. 2 ring	0.32 ~ 0.47mm (0.0126 ~ 0.0185in.)	0.7mm (0.0275in.)
	Oil ring	0.20 ~ 0.70mm (0.0078 ~ 0.0275in.)	0.8mm (0.0315in.)

Piston pin

Piston pin outer diameter	23.001 ~ 23.006mm (0.9055 ~ 0.9057in.)	
Piston pin hole inner diameter	23.016 ~ 23.021mm (0.9061 ~ 0.9063in.)	
Piston pin hole clearance	0.01 ~ 0.02mm (0.0039 ~ 0.0078in.)	
Connecting rod small end inner diameter	22.974 ~ 22.985mm (0.9045 ~ 0.9049in.)	
Connecting rod small end hole clearance	-0.032 ~ -0.016mm (-0.0012 ~ 0.0006in.)	

Connecting rod

Connecting rod big end inner diameter	58.000 ~ 58.018mm (2.2834 ~ 2.2842in.)	
Connecting rod bearing oil clearance	0.038 ~ 0.056mm (0.0015 ~ 0.0022in.)	
Side clearance	0.1 ~ 0.25mm (0.0039 ~ 0.0098in.)	

Crankshaft

Main journal outer diameter	68.942 ~ 68.960mm (2.7142 ~ 2.7149in.)	
Pin journal outer diameter	54.954 ~ 54.972mm (2.1635 ~ 2.1642in.)	
Main bearing oil clearance	0.022 ~ 0.040mm (0.0008 ~ 0.0016in.)	
End play	0.10 ~ 0.28mm (0.0039 ~ 0.0110in.)	

Oil pump

Relief valve opening pressure	450 ~ 550kPa (4.59 ~ 5.61kgf/cm ² , 65.28 ~ 79.79psi)	
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Engine oil

Oil quantity	Total	6.0 L (6.34 US qt, 5.27 imp qt)	When replacing a short engine or a block assembly
	Oil pan	5.5 L (5.81 US qt, 4.83 imp qt)	
	Drain and refill	5.2 L (5.49 US qt, 4.57 imp qt)	Including oil filter
Oil grade	Recommendation	5W-20/GF4 & SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	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 1000rpm)		130kPa (1.32kg/cm ² , 18.77psi) or above	Oil temperature in oil pan : 110±2°C (230± 36° F)

Cooling system

Cooling method		Forced circulation with electrical fan	
Coolant quantity		8.6L (9.09U.S.qts, 7.57imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82±2°C (179.6±35.6°F)	
	Fully opened temperature	95°C (203°F)	
	Full lift	10mm (0.3937in.)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm ² , 13.51 ~ 17.78psi)	
	Vacuum valve opening pressure	0.98 ~ 4.90 kpa (0.01 ~ 0.05kg/cm ² , 0.14 ~ 0.71 psi)	

Water temperature sensor

Type		Thermistor type	
Resistance	20°C (68°F)	2.31 ~ 2.59Kohms	
	80°C (176°F)	0.3222 Kohms	

TIGHTENING TORQUES

TIGHTENING TORQUES SPECIFICATION

Item	Quantity	Nm	kgf.m	lb-ft
Crankshaft pulley bolt	1	284.2 ~ 303.8	29.0 ~ 31.0	209.76 ~ 224.22
Timing chain cover bolt B	17	18.62 ~ 21.56	1.9 ~ 2.2	13.74 ~ 15.91
Timing chain cover bolt C	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt D	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63

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Timing chain cover bolt E	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63
Timing chain cover bolt F	2	24.50 ~ 26.46	2.5 ~ 2.7	18.08 ~ 19.53
Timing chain cover bolt G	4	21.56 ~ 23.52	2.2 ~ 2.4	15.91 ~ 17.36
Timing chain cover bolt H	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt I	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt J	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cam to cam guide bolt	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner nut	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain guide bolt	4	19.60 ~ 24.50	2.0 ~ 2.5	14.17 ~ 18.08
Oil pump chain cover bolt	3	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain tensioner bolt	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain guide bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain sprocket bolt	1	18.62 ~ 21.56	1.9 ~ 2.2	13.74 ~ 15.91
Lower oil pan bolt	13	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Drive belt auto tensioner bolt (M12)	1	96.04 ~ 99.96	9.8 ~ 10.2	70.88 ~ 73.78
Drive belt auto tensioner bolt (M8)	1	17.64 ~ 21.56	1.8 ~ 2.2	13.02 ~ 15.91
Drive belt idler bolt	1	53.90 ~ 57.82	5.5 ~ 5.9	39.78 ~ 42.67
OCV (oil control valve) bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cylinder head bolt	16	(37.3~41.2) + (118~122°) + (88~92°)	(3.8~4.2) + (118~122°) + (88~92°)	(27.5~30.4) + (118~122°) + (88~92°)
Cylinder head bolt	1	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
CVVT & exhaust cam sprocket bolt	4	64.68 ~ 76.44	6.6 ~ 7.8	47.74 ~ 56.42
Camshaft bearing cap bolt	32	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cylinder head cover bolt	38	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Connecting rod bearing bolt	12	(17.7~21.6) + (88~92°)	(1.8~2.2) + (88~92°)	(13.0~15.9) + (88~92°)
Main bearing cap inner bolt (M11)	8	49.00 + 90°	5.0 + 90°	36.16 + 90°
Main bearing cap outer bolt (M8)	8	19.60 + 120°	2.0 + 120°	14.46 + 120°
Main bearing cap side bolt (M8)	6	29.40 ~ 31.36	3.0 ~ 3.2	21.70 ~ 23.14
Oil drain cover bolt	6	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68

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Rear oil seal case bolt	6	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Baffle plate bolt	12	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Upper oil pan bolt	16	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Knock sensor bolt	2	15.68 ~ 23.52	1.6 ~ 2.4	11.57 ~ 17.36
Drive plate bolt cap	8	71.54 ~ 75.46	7.3 ~ 7.7	52.80 ~ 55.69
Oil filter cap		24.50	2.5	18.08
Oil drain bolt cap	1	34.30 ~ 44.10	3.5 ~ 4.5	25.31 ~ 32.55
Oil pump bolt	3	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Oil filter body bolt	10	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil filter body cover bolt	11	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water vent hose bolt (Timing chain cover bolt L)	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump bolt (Timing chain cover bolt K)	1	21.56 ~ 26.46	2.2 ~ 2.7	15.91 ~ 19.53
Water pump bolt	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump pulley bolt	4	7.84 ~ 9.80	0.8 ~ 1.0	5.78 ~ 7.23
Water temp. control nut	4	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Water temp. control bolt	2	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Water inlet pipe bolt	3	16.66 ~ 19.60	1.7 ~ 2.0	12.30 ~ 14.47
Air vent pipe bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Intake manifold bolt	6	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Intake manifold nut	2	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Surge tank bolt (M8 x 25)	3	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Surge tank bolt (M6 x 106)	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank nut	1	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Breather pipe bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank bracket bolt rear (M10 x 18)	2	27.44 ~ 31.36	2.8 ~ 3.2	20.25 ~ 23.14
Surge tank bracket bolt front (M8 x 16)	2	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
ETC bracket bolt	2	15.68 ~ 25.48	1.6 ~ 2.6	11.57 ~ 18.80
Exhaust manifold nut	16	39.20 ~ 44.10	4.0 ~ 4.5	28.93 ~ 32.55
Heat proctor bolt	8	3.9 ~ 5.9	0.4 ~ 0.6	2.89 ~ 4.34
Front muffler	2	39.20 ~ 58.80	4.0 ~ 6.0	28.93 ~ 43.40

COMPRESSION

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

1. Warm up and stop engine.

Allow the engine to warm up to normal operating temperature.

2. Remove the surge tank.
3. Remove the ignition coil connectors (A) and ignition coils (B).

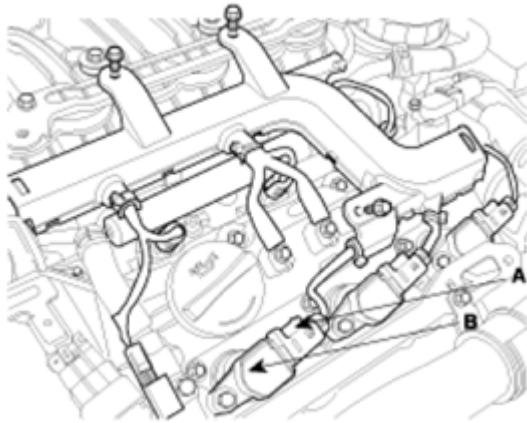


Fig. 1: Identifying Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the spark plugs.

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

5. Check cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole.
 2. Fully open the throttle.
 3. After 7 times of cranking the engine, measure the compression pressure.

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

Repeat steps 1) through 3) for each cylinder.

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

Compression pressure:

1,225kPa (12.5kgf/cm² , 177psi) - 200 ~ 250rpm

Minimum pressure:

1,078kPa (11.0kgf/cm² , 156psi)

4. 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.
 - A. If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
 - B. If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
6. Reinstall the spark plugs.
7. Install the ignition coil and ignition coil connectors.
8. Install the surge tank.

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

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

1. Remove the engine cover.
2. Remove air cleaner assembly.
3. Remove the surge tank.
4. Remove the cylinder head cover.
 1. Disconnect the ignition coil connector and remove the ignition coil.
 2. Disconnect the breather pipe assembly (A) from the cylinder head cover.

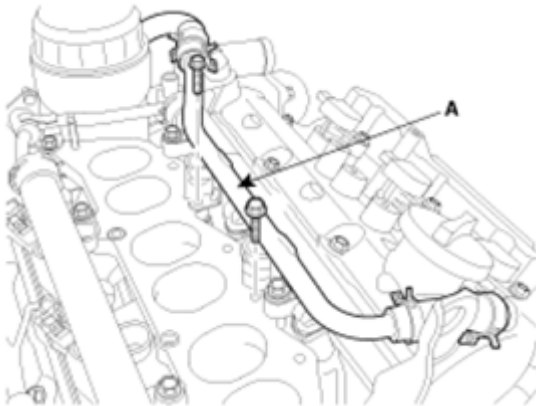


Fig. 2: Identifying Breather Pipe Assembly
Courtesy of KIA MOTORS AMERICA, INC.

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

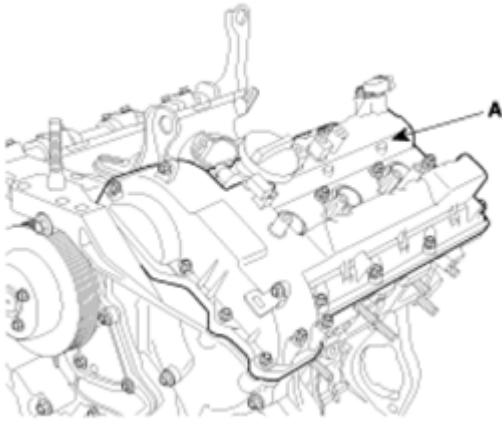


Fig. 3: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

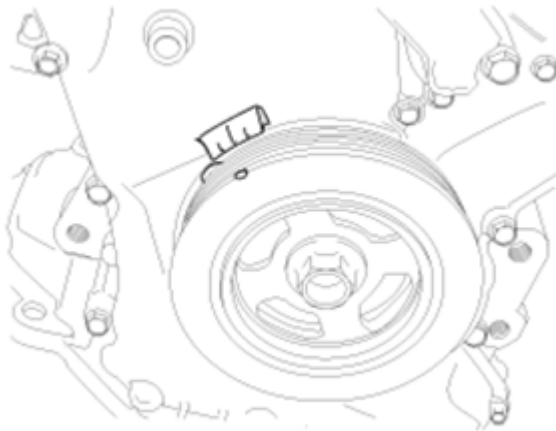


Fig. 4: Identifying Groove Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

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

NOTE: Do not rotate engine counterclockwise

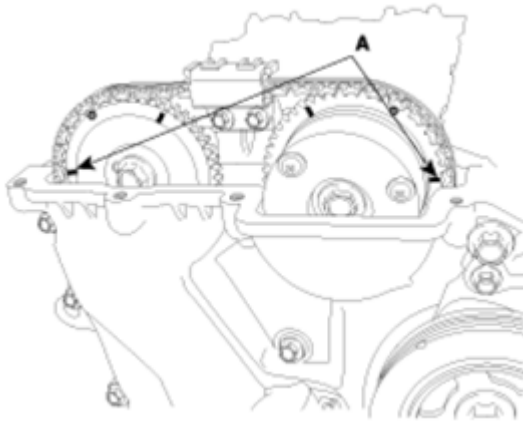


Fig. 5: Identifying Mark On Camshaft
Courtesy of KIA MOTORS AMERICA, INC.

6. Inspect the valve clearance.

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

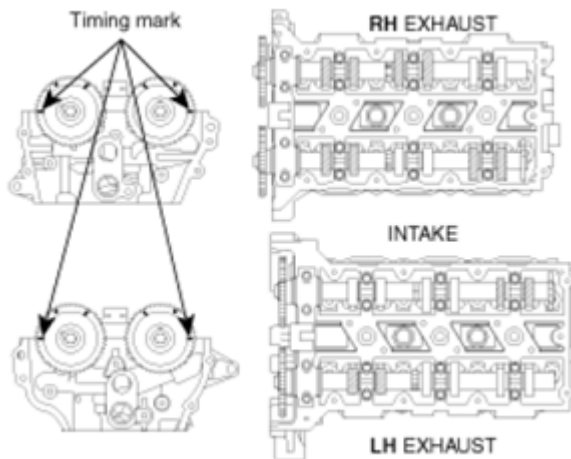


Fig. 6: Identifying Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

Measurement method.

A.

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

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

NOTE: Do not rotate engine counterclockwise

3. Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance. (Refer to procedure step 1))

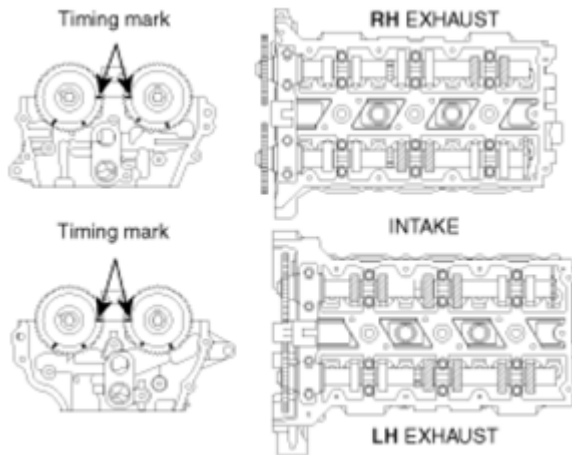


Fig. 7: Identifying Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

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

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

3. Remove the camshaft bearing caps (A).

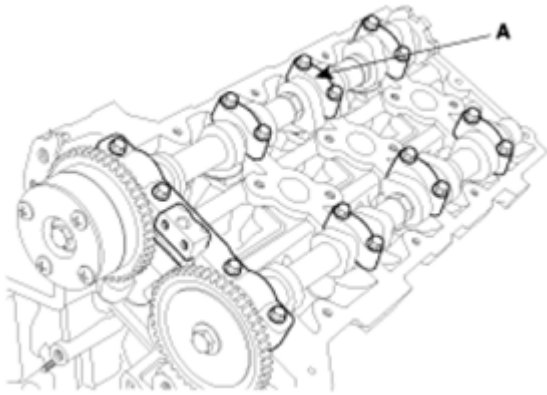


Fig. 8: Identifying Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the camshaft assembly (A).

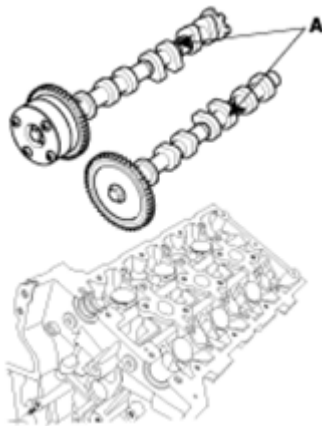


Fig. 9: Identifying Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove MLAs.
6. Measure the thickness of the removed tappet using a micrometer.

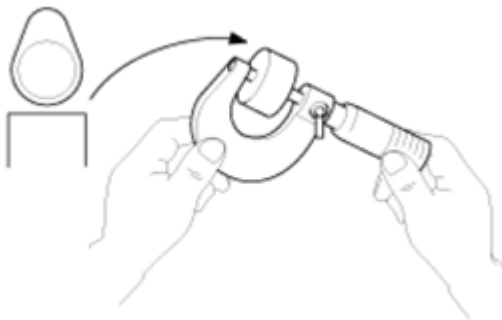


Fig. 10: Measuring Thickness Of Tappet

Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

9. Place a new tappet on the cylinder head.

NOTE: Applying engine oil at the selected tappet on the periphery and top surface.

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

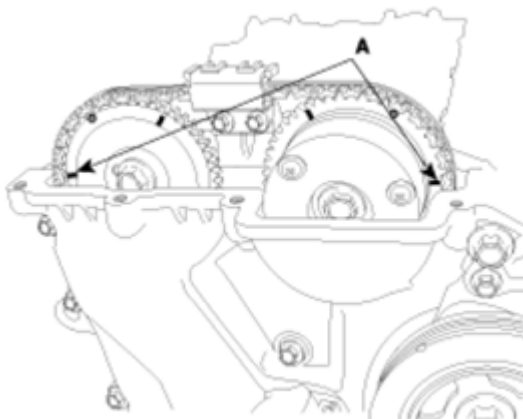


Fig. 11: Identifying Timing Mark On Camshaft Sprocket
 Courtesy of KIA MOTORS AMERICA, INC.

14. Recheck the valve clearance.

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

[Specification]

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

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

TROUBLESHOOTING

TROUBLESHOOTING

TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improperly installed engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption.	- Malfunctioning cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. - Coolant consumption may or may not cause the engine to overheat.	- Inspect the cylinder head and engine block for damage to the coolant passages and/or a malfunctioning head gasket. - Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	- Inspect the cylinder for a loss of compression. - Repair or replace as required.
	Incorrect oil viscosity.	Drain the oil.

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Engine noise on startup, but only lasting a few seconds.		• Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	• Inspect the camshaft lobes. • Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
Lower engine noise, regardless of engine speed.	Worn drive belt, idler, tensioner and bearing.	Replace as required.
	Low oil pressure.	Repair or required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	• Inspect the oil pan. • Inspect the oil pump screen. • Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	• Inspect the oil pump screen. • Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	• Inspect the piston, piston pin and cylinder bore. • Repair as required.
	Excessive piston pin-to-piston clearance.	• Inspect the piston, piston pin and the connecting rod. • Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft pin journals.

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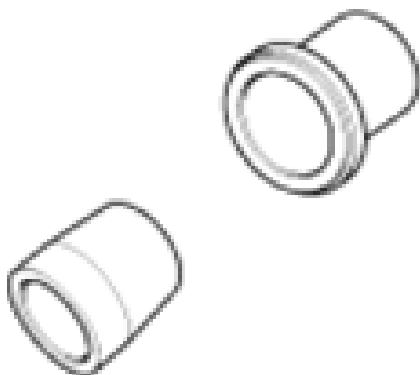
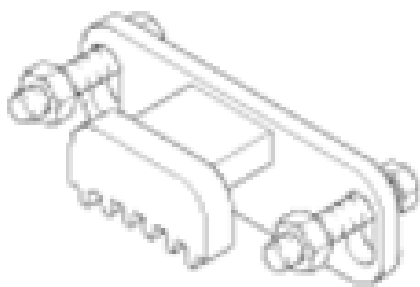
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required: • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
Engine will not crank crankshaft will not rotate.	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.

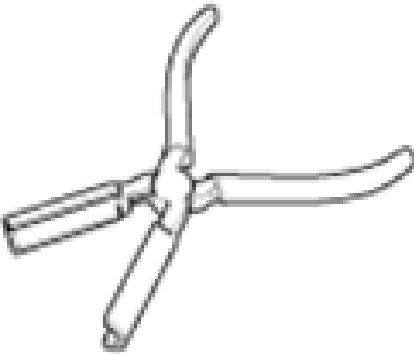
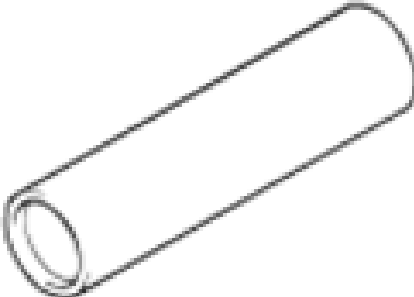
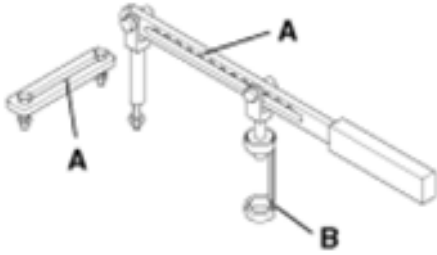
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	1. Inspect crankshaft. 2. Repair as required.

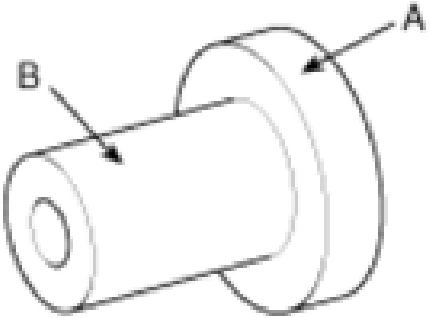
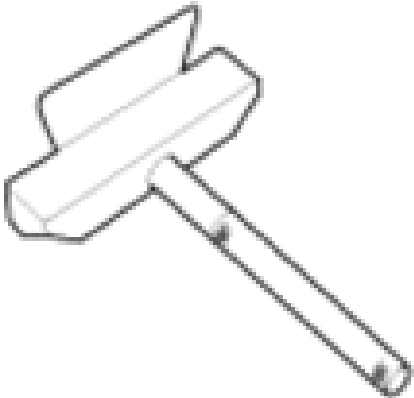
SPECIAL SERVICE TOOLS

SPECIAL TOOLS

SPECIAL TOOLS DESCRIPTION

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-3C100)		Installation of the front oil seal
Flywheel stopper (09231-3C300)		Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method

		
Valve stem seal remover (09222-29000)		Remover of the valve stem seal
Valve stem seal remover (09222-3C100)		Installation of the valve stem seal
Valve spring compressor & holder (09222-3K000) (09222-3C300)		Removal and installation of the intake or exhaust valve A. 09222-3K000 B. 09222-3C300 (holder)

Crankshaft rear oil seal installer (09231-3C200) (09231-H1100)		Installation of the crankshaft rear oil seal A. 09231-3C200 B. 09231-H1100
Oil pan remover (09215-3C000)		Removal of oil pan
Oil filter wrench (09263-3C100)		Removal and installation of the oil filter housing cover