

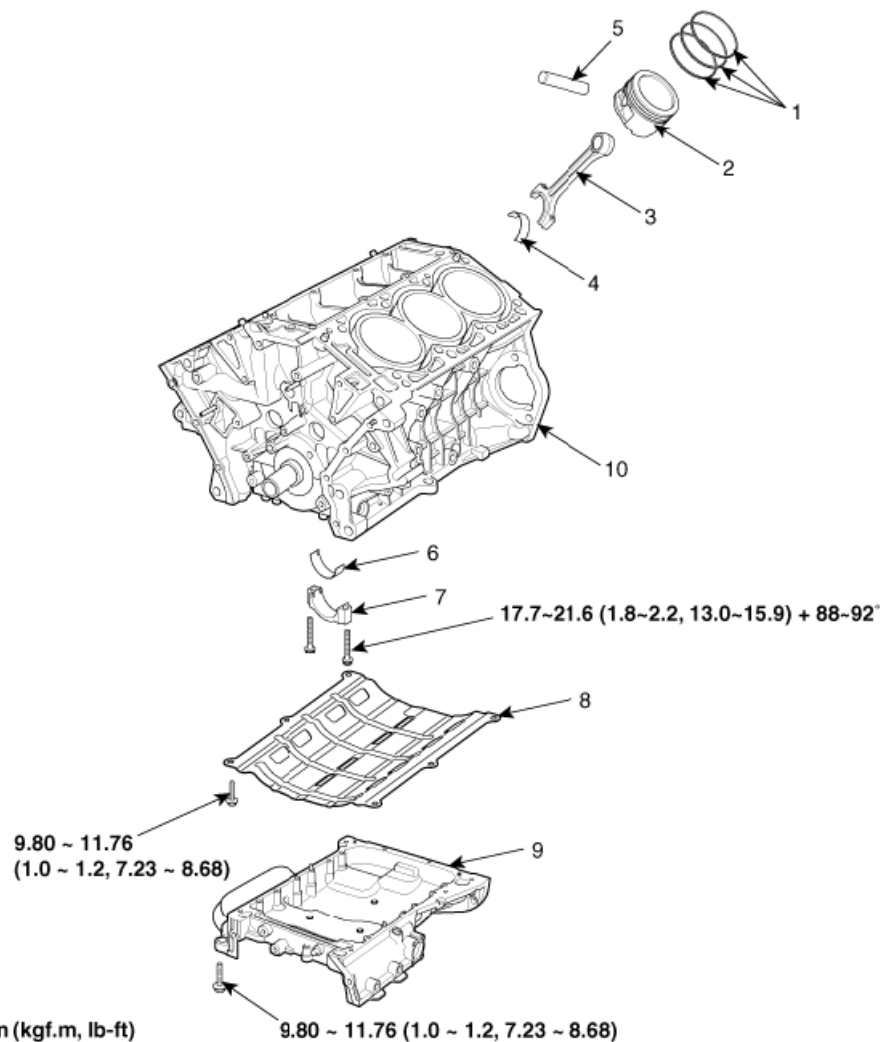
2009-10 ENGINE

Cylinder Block - 3.8L - Borrego + 2010 Canadian

CYLINDER BLOCK

COMPONENTS AND COMPONENT LOCATIONS

Components



1. Piston ring

2. Piston

3. Connecting rod

4. Connecting rod upper bearing

5. Piston pin

6. Connecting rod lower bearing

7. Connecting rod bearing cap

8. Baffle plate

9. Upper oil pan

10. Cylinder block

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

2009 Kia Borrego EX

2009-10 ENGINE Cylinder Block - 3.8L - Borrego + 2010 Canadian

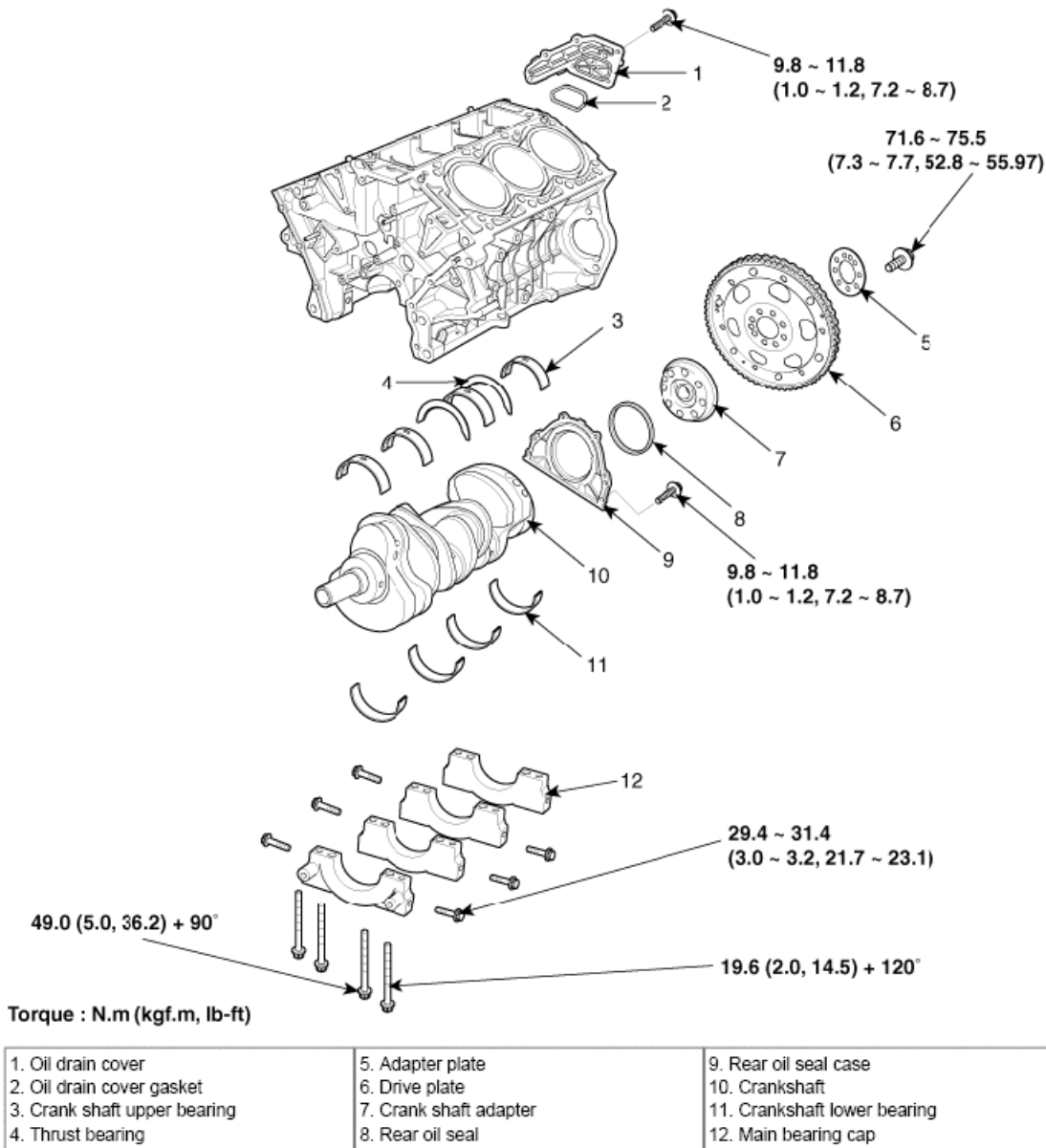


Fig. 2: Identifying Cylinder Block Components With Torque Specifications (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

Disassembly

CAUTION:

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

NOTE:

- Mark all wiring and hoses to avoid misconnection.

- **Inspect the timing 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 the engine assembly from the vehicle. (Refer to **ENGINE AND TRANSMISSION ASSEMBLY**)
2. Install the engine to engine stand for disassembly.
3. Remove the intake manifold and exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM - 3.8L**)
4. Remove the timing chain. (Refer to **TIMING SYSTEM - 3.8L**)
5. Remove the water temperature control assembly. (Refer to **COOLING SYSTEM - 3.8L**)
6. Remove the cylinder head. (Refer to **CYLINDER HEAD**)
7. Remove the oil pump. (Refer to **LUBRICATION SYSTEM - 3.8L**)
8. Remove the oil filter assembly. (Refer to **LUBRICATION SYSTEM - 3.8L**)
9. Remove the drive plate (A) and adapter plate (B).

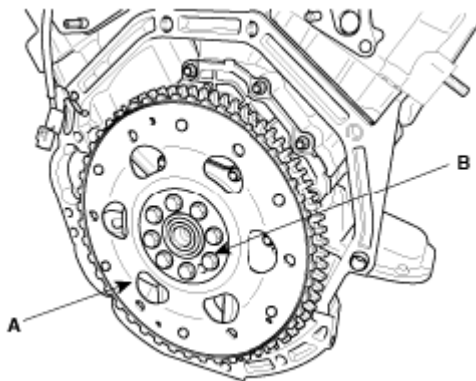


Fig. 3: Identifying Drive Plate & Adapter Plate
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the crankshaft adapter (A).

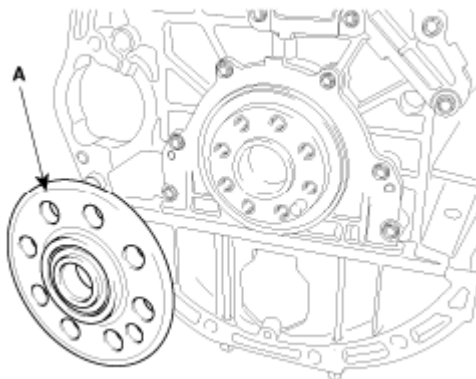


Fig. 4: Identifying Crankshaft Adapter
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the knock sensor (A).

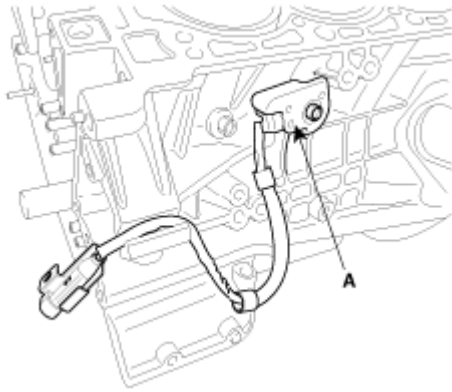


Fig. 5: Identifying Knock Sensor (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

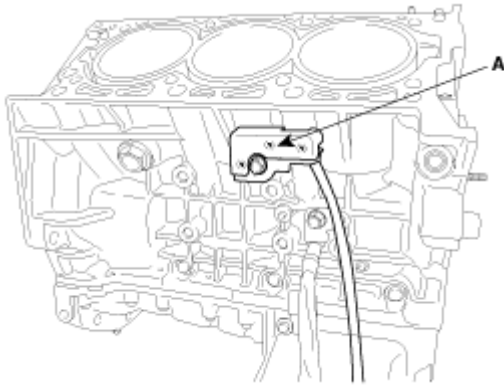


Fig. 6: Identifying Knock Sensor (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the upper oil pan (A).

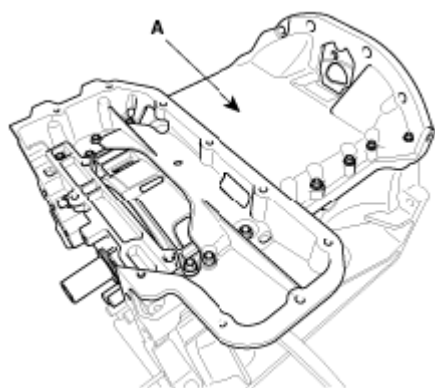


Fig. 7: Identifying Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the baffle plate (A).

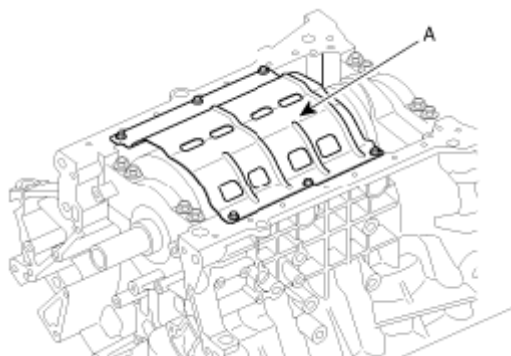


Fig. 8: Identifying Baffle Plate
Courtesy of KIA MOTORS AMERICA, INC.

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

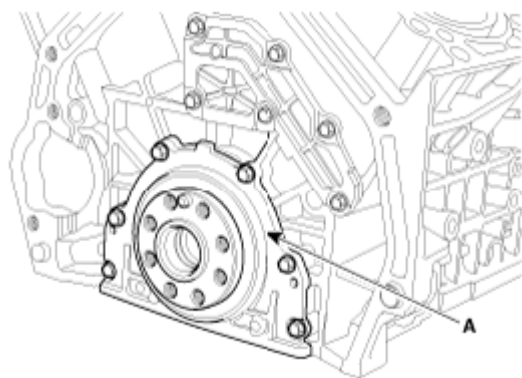
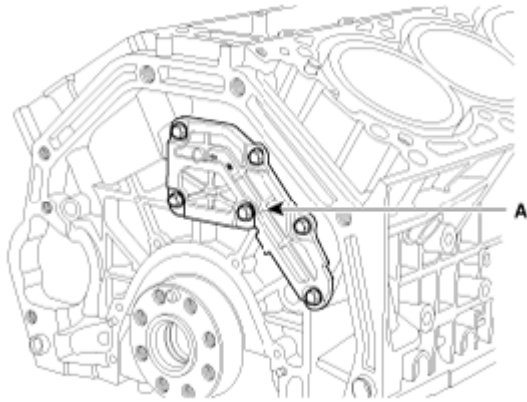


Fig. 9: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the oil drain cover (A).

**Fig. 10: Identifying Oil Drain Cover**

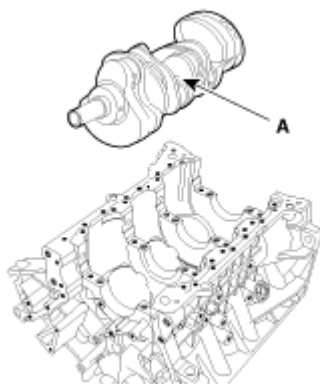
Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

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

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

**Fig. 11: Identifying Crankshaft**

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

22. 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.

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

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

24. Disconnect connecting rod from piston. Using a press, remove the piston pin from the 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.)

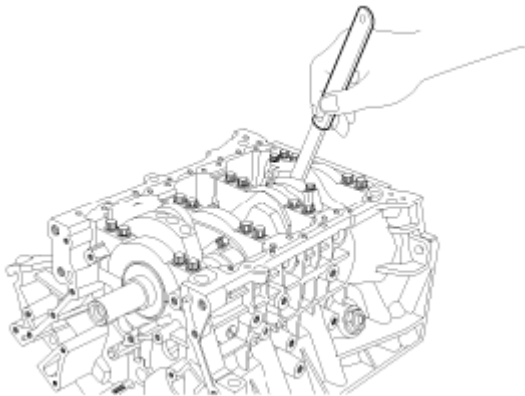


Fig. 12: Measuring Connecting Rod End Play Using Feeler Gauge
Courtesy of KIA MOTORS AMERICA, INC.

- 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°

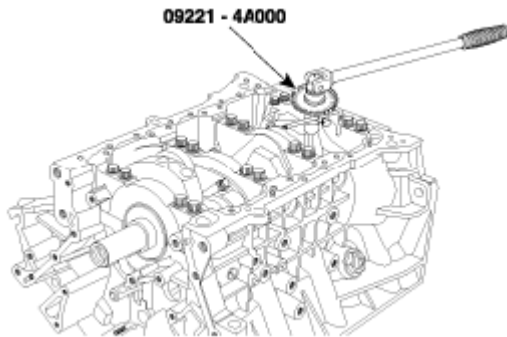


Fig. 13: Removing Connecting Rod Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.038 ~ 0.056mm (0.0015 ~ 0.0022in.)

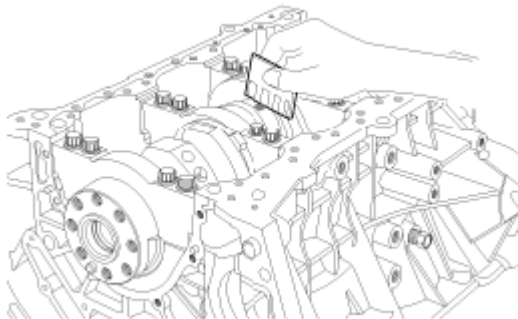


Fig. 14: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

Identification Of Connecting Rod

IDENTIFICATION OF CONNECTING ROD

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

Identification Of Crankshaft

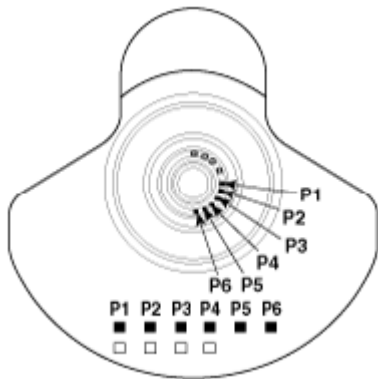


Fig. 16: Locating Crankshaft Pin Marks
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft

DISCRIMINATION OF CRANKSHAFT

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)

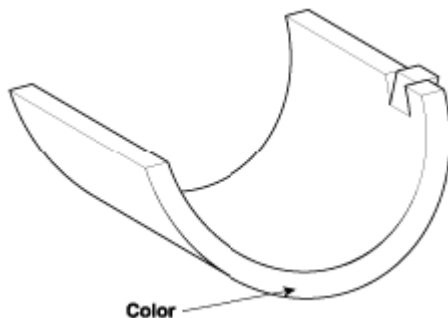


Fig. 17: Locating Connecting Rod Bearing Identification Mark
Courtesy of KIA MOTORS AMERICA, INC.

Identification Of Connecting Rod Bearing

IDENTIFICATION OF CONNECTING ROD BEARING

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 SELECTION

		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

49.0Nm (5.0 kgf.m, 36.2lb-ft) + 90°

19.6Nm (2.0 kgf.m, 14.5lb-ft)+ 120°

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

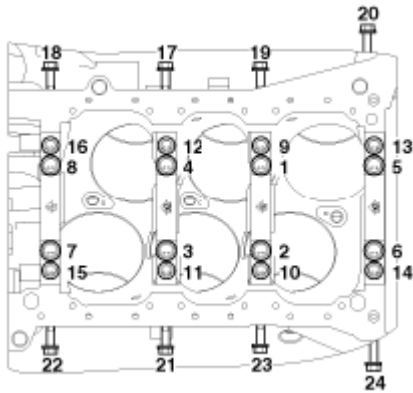


Fig. 18: Identifying Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.022 ~ 0.040mm (0.0009 ~ 0.0016in.)

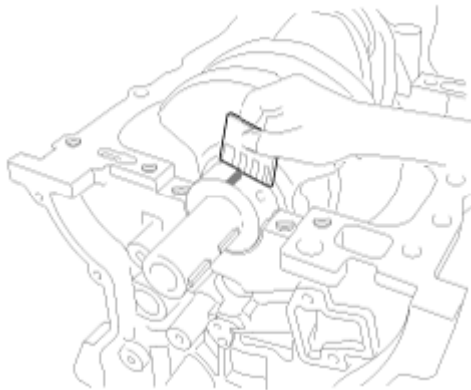


Fig. 19: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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.

Crankshaft bore mark location

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

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

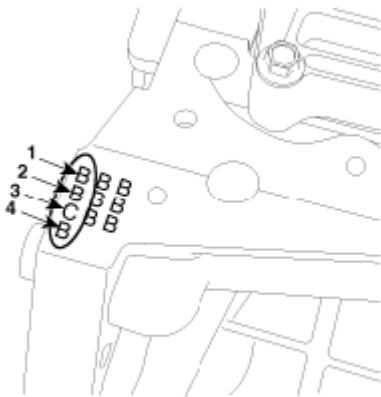


Fig. 20: Locating Crankshaft Bore Marks
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block

DISCRIMINATION OF CYLINDER BLOCK

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

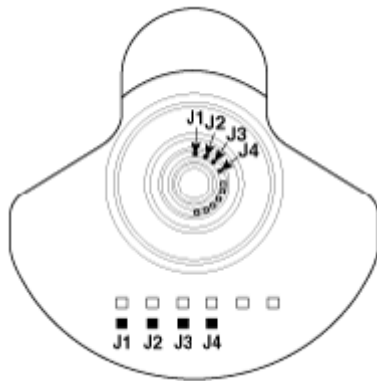


Fig. 21: Locating Crankshaft Journal Marks
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft

DISCRIMINATION OF CRANKSHAFT

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)

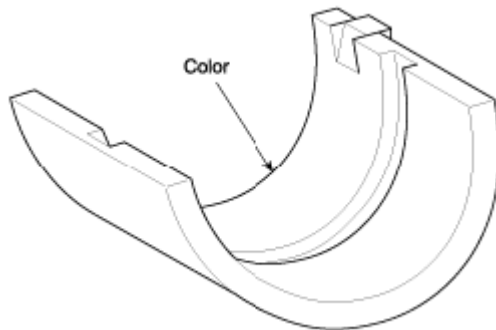


Fig. 22: Locating Crankshaft Bearing Identification Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing

DISCRIMINATION OF CRANKSHAFT BEARING

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 MARKS

		Crankshaft Bore Identification Mark		
		a (A)	b (B)	c (C)
Crankshaft Identification Mark	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

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.)

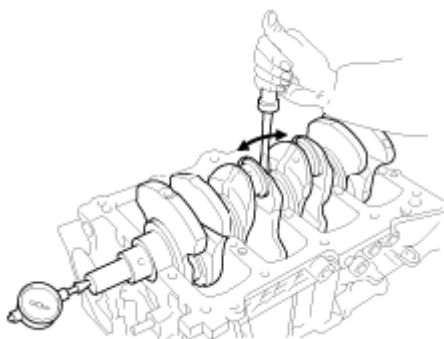


Fig. 23: Measuring Thrust Clearance Using Dial Indicator While Prying Crankshaft Back & Forth
Courtesy of KIA MOTORS AMERICA, INC.

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.)

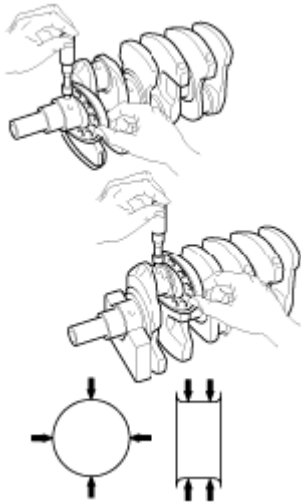


Fig. 24: Measuring Diameter Of Main Journal & Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

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 the gasket material.

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

2. Clean the cylinder block

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

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

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

Flatness of cylinder block gasket surface

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

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

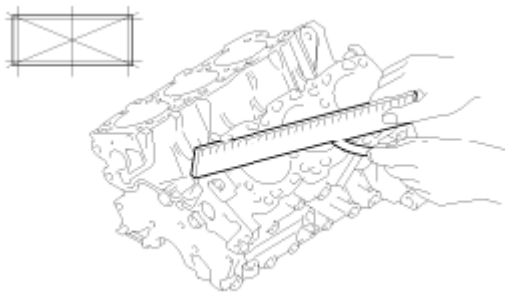


Fig. 25: Measuring Surface Contacting Cylinder Head Gasket For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

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.)

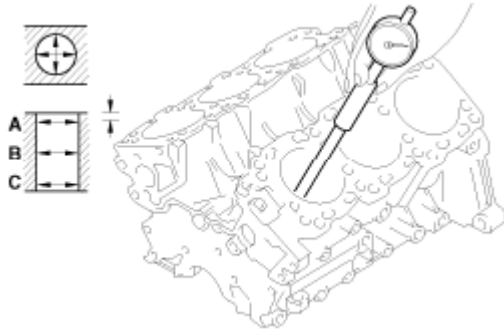


Fig. 26: Measuring Cylinder Bore Diameter At Position In Thrust & Axial Directions
Courtesy of KIA MOTORS AMERICA, INC.

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

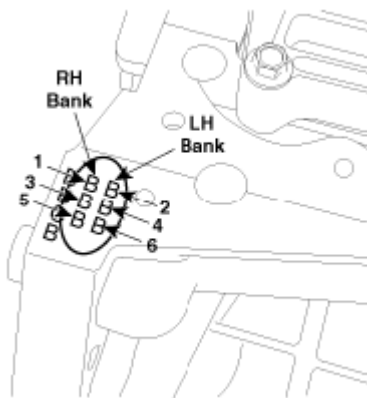


Fig. 27: Checking Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

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 (A) and the front mark (B) on the piston top face.

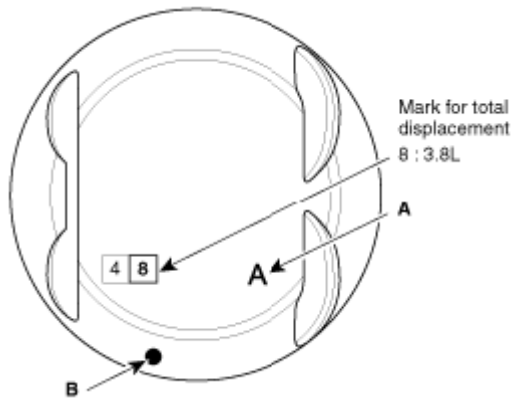


Fig. 28: Checking Piston Size Code & Front Mark On Piston Top Face
Courtesy of KIA MOTORS AMERICA, INC.

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, 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.)

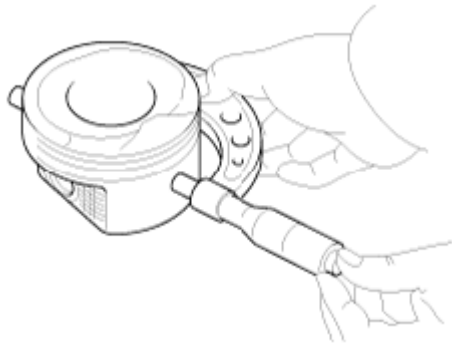


Fig. 29: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston-to-cylinder clearance

0.03 ~ 0.05mm (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. 30: Measuring Clearance Between Piston Ring & Wall Of Ring Groove
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Inspect piston ring end gap.

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

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.)

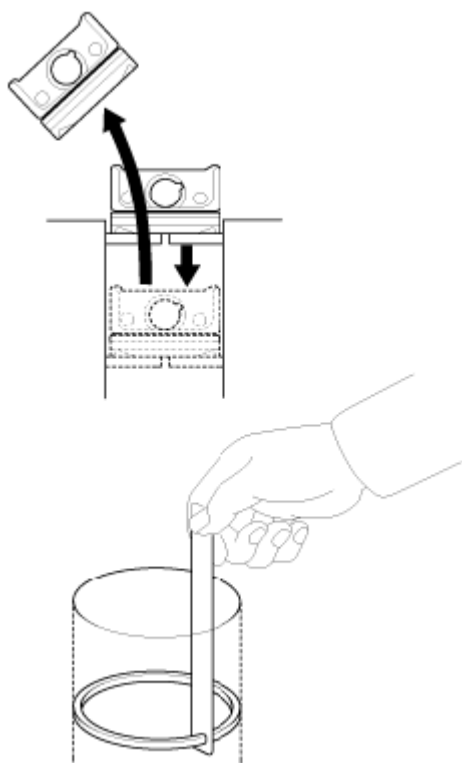


Fig. 31: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001 ~ 23.006mm (0.9056 ~ 0.9057in.)

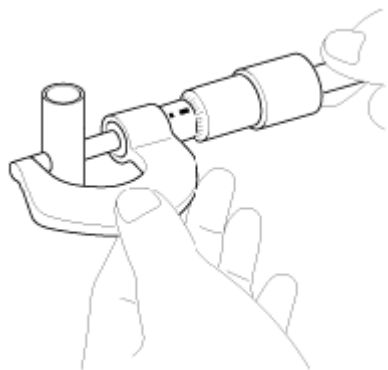


Fig. 32: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston pin-to-piston clearance

0.01 ~ 0.02mm (0.0004 ~ 0.0008in.)

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

Piston pin-to-connecting rod interference

-0.032 ~ -0.016mm (-0.0012 ~ -0.0007in.)

Reassembly

NOTE:

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

1. Assemble the piston and the connecting rod.
 1. 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.

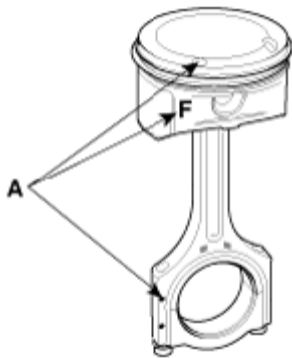


Fig. 33: Identifying Piston Front Mark & Connecting Rod Front Mark
 Courtesy of KIA MOTORS AMERICA, INC.

2. Install the piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown in **Fig. 34**.

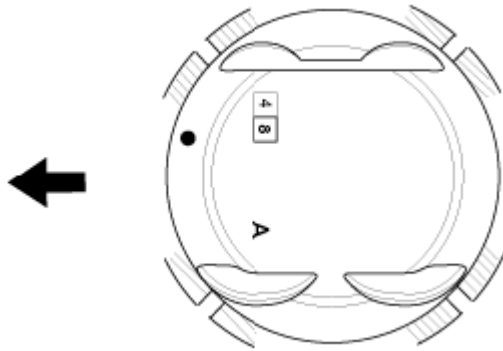


Fig. 34: Positioning Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

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

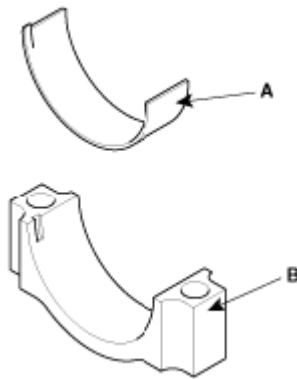


Fig. 35: Identifying Bearing & Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

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 4 upper bearings (A).

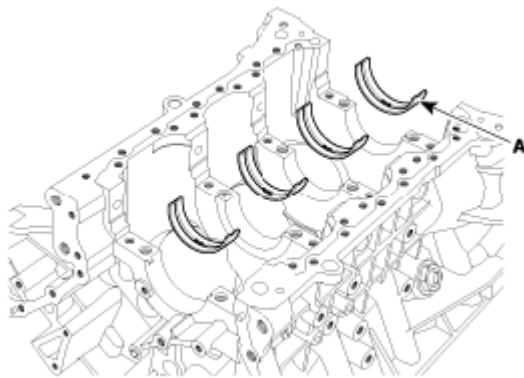


Fig. 36: Identifying Upper Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

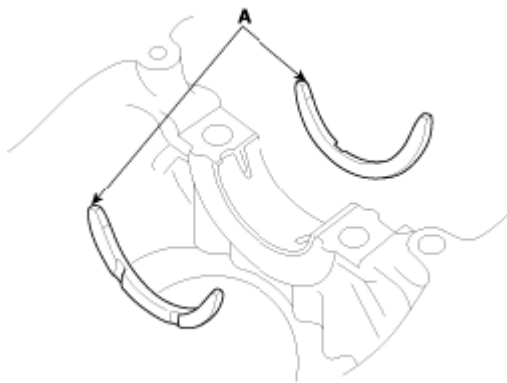


Fig. 37: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

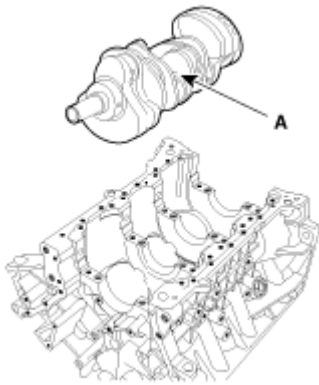


Fig. 38: Identifying Crankshaft

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

Main bearing cap bolt

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

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

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

NOTE:

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

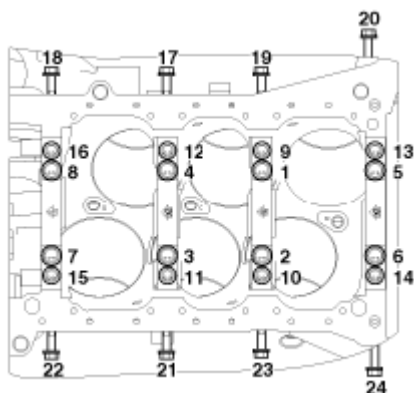


Fig. 39: Identifying Torque Sequence Of Main Bearing Cap Bolts

Courtesy of KIA MOTORS AMERICA, INC.

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

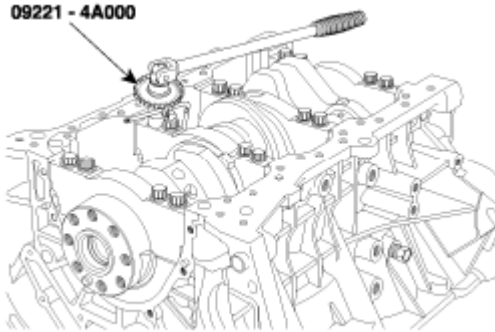


Fig. 40: Installing Main Bearing Cap Bolts Using SST
 Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

Tightening torque

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

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

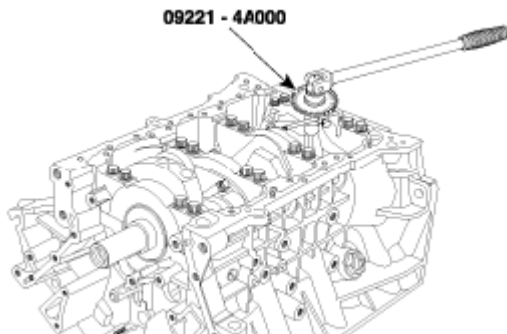
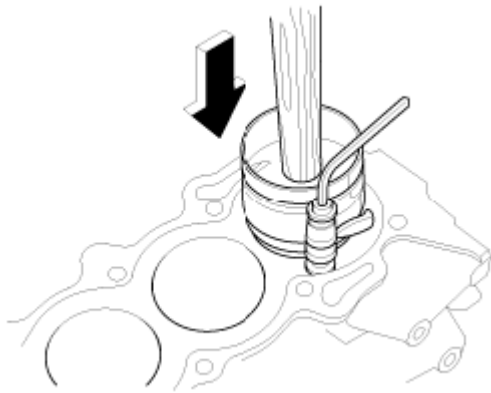


Fig. 41: Installing Connecting Rod Bearing Cap Bolts Using SST

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

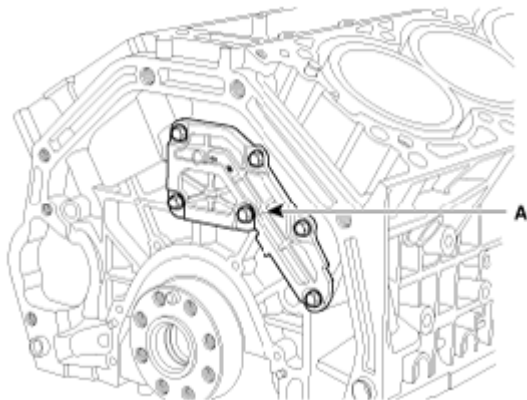
**Fig. 42: Maintaining Downward Force On Ring Compressor**

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

**Fig. 43: Identifying Oil Drain Cover**

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the sealing face before assembling two parts.

- Remove harmful foreign materials on the sealing face before applying sealant
- Before assembling oil drain cover, the liquid sealant TB1217H should be applied to the 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.

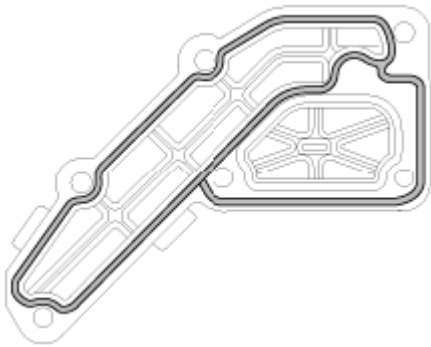


Fig. 44: Applying Sealant To Oil Drain Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

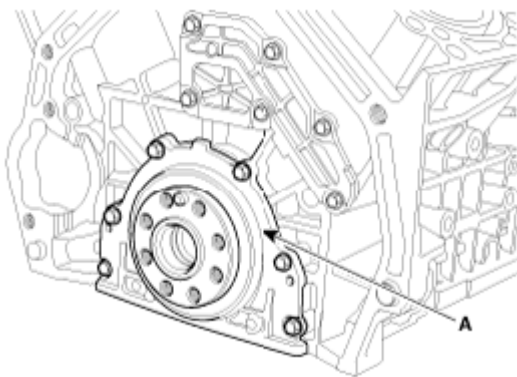


Fig. 45: Identifying Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant

- Before assembling rear oil seal case, the liquid sealant TB1217H should be applied to the rear oil seal case.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

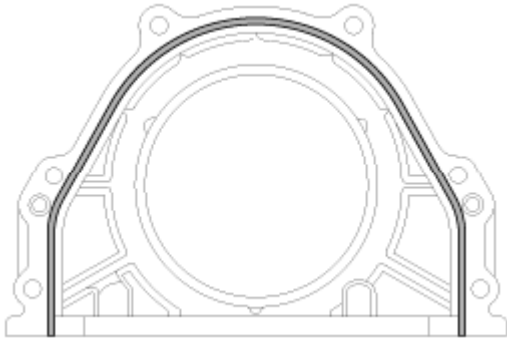


Fig. 46: Applying Sealant To Rear Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

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

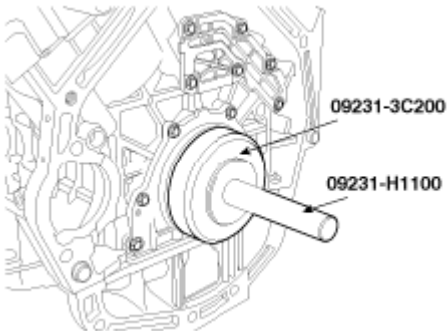


Fig. 47: Installing Rear Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

15. Install the baffle plate.

Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown in **Fig. 48**.

Tightening torque

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

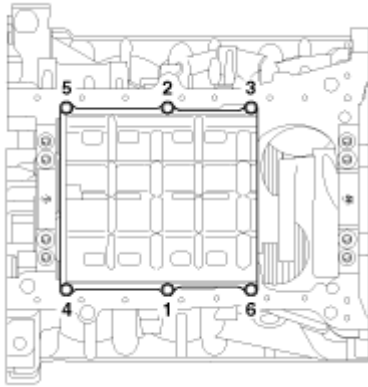


Fig. 48: Identifying Tightening Sequence Of Baffle Plate Bolts
Courtesy of KIA MOTORS AMERICA, INC.

16. Install the 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.)

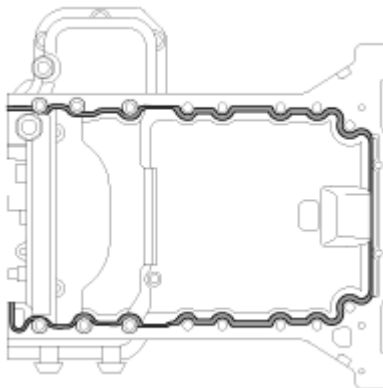


Fig. 49: Applying Sealant To Upper Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

- C. Install the upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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

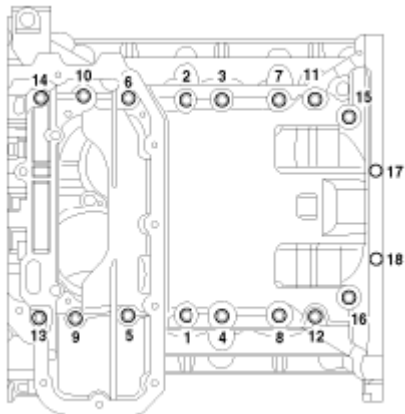


Fig. 50: Identifying Tightening Sequence Of Upper Oil Pan Bolts
Courtesy of KIA MOTORS AMERICA, INC.

17. Install the knock sensor (A).

Tightening torque

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

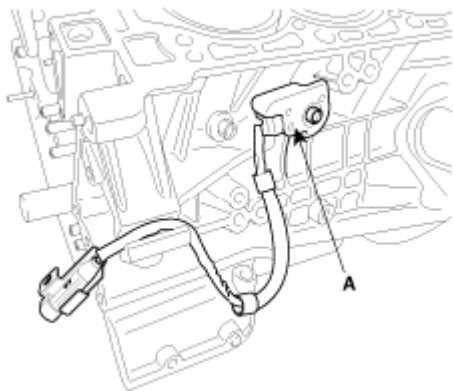


Fig. 51: Identifying Knock Sensor (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

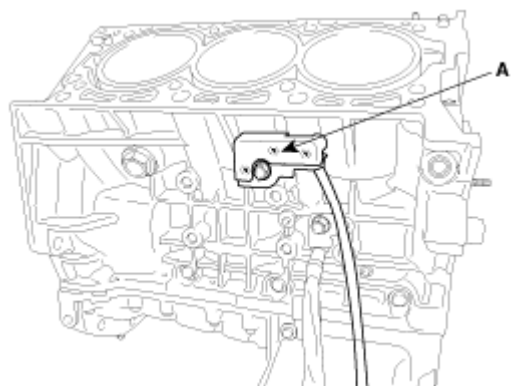


Fig. 52: Identifying Knock Sensor (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

18. Install the crankshaft adapter (A).

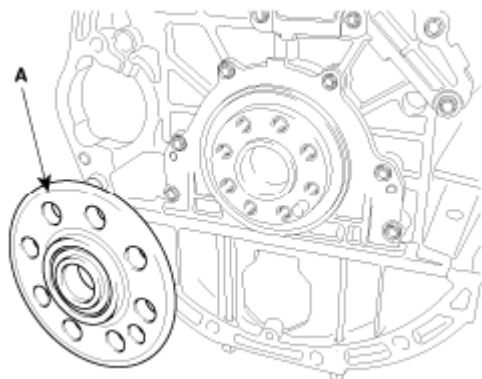


Fig. 53: Identifying Crankshaft Adapter
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque :

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

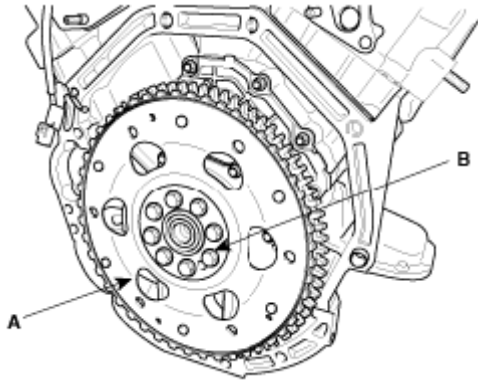


Fig. 54: Identifying Drive Plate & Adapter Plate
Courtesy of KIA MOTORS AMERICA, INC.

20. Install the oil filter assembly. (Refer to **LUBRICATION SYSTEM - 3.8L**)
21. Install the oil pump. (Refer to **LUBRICATION SYSTEM - 3.8L**)
22. Install the cylinder head. (Refer to **CYLINDER HEAD** in this group)
23. Install the water temperature control assembly. (Refer to **COOLING SYSTEM - 3.8L**)
24. Install the timing chain. (Refer to **TIMING SYSTEM - 3.8L**)
25. Install the intake manifold and exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM - 3.8L**)
26. Install the engine assembly to the vehicle. (Refer to **ENGINE AND TRANSMISSION ASSEMBLY**)

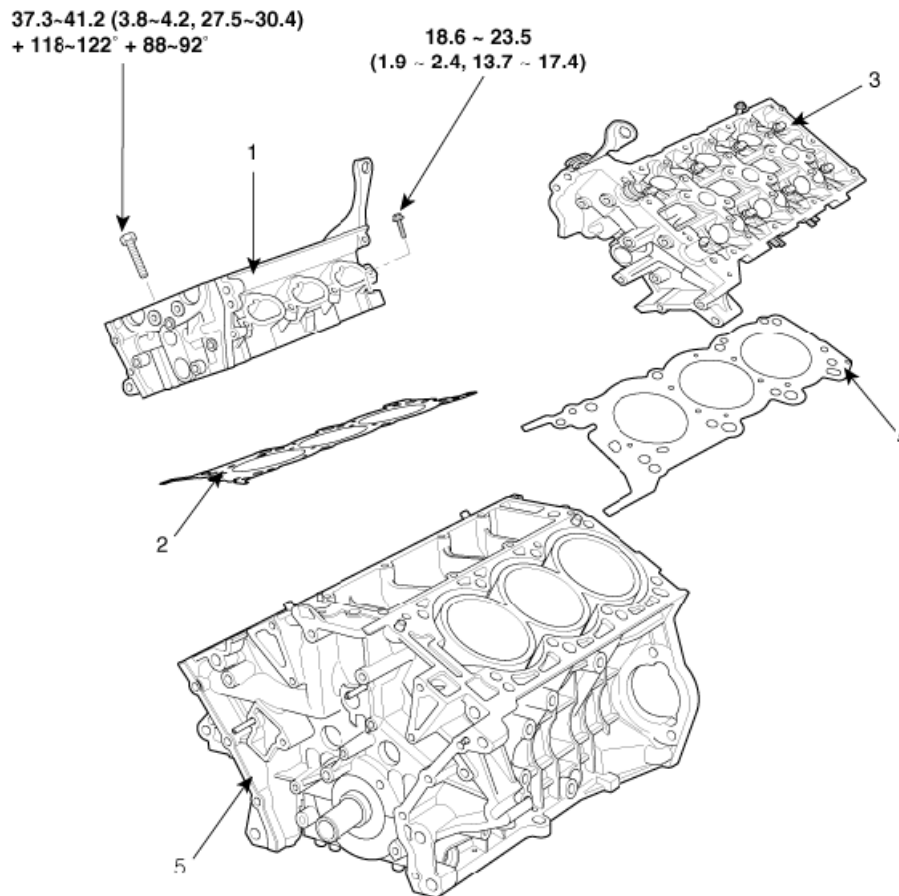
2009-10 ENGINE

Cylinder Head Assembly - 3.8L - Borrego + 2010 Canadian

CYLINDER HEAD

COMPONENTS AND COMPONENT LOCATIONS

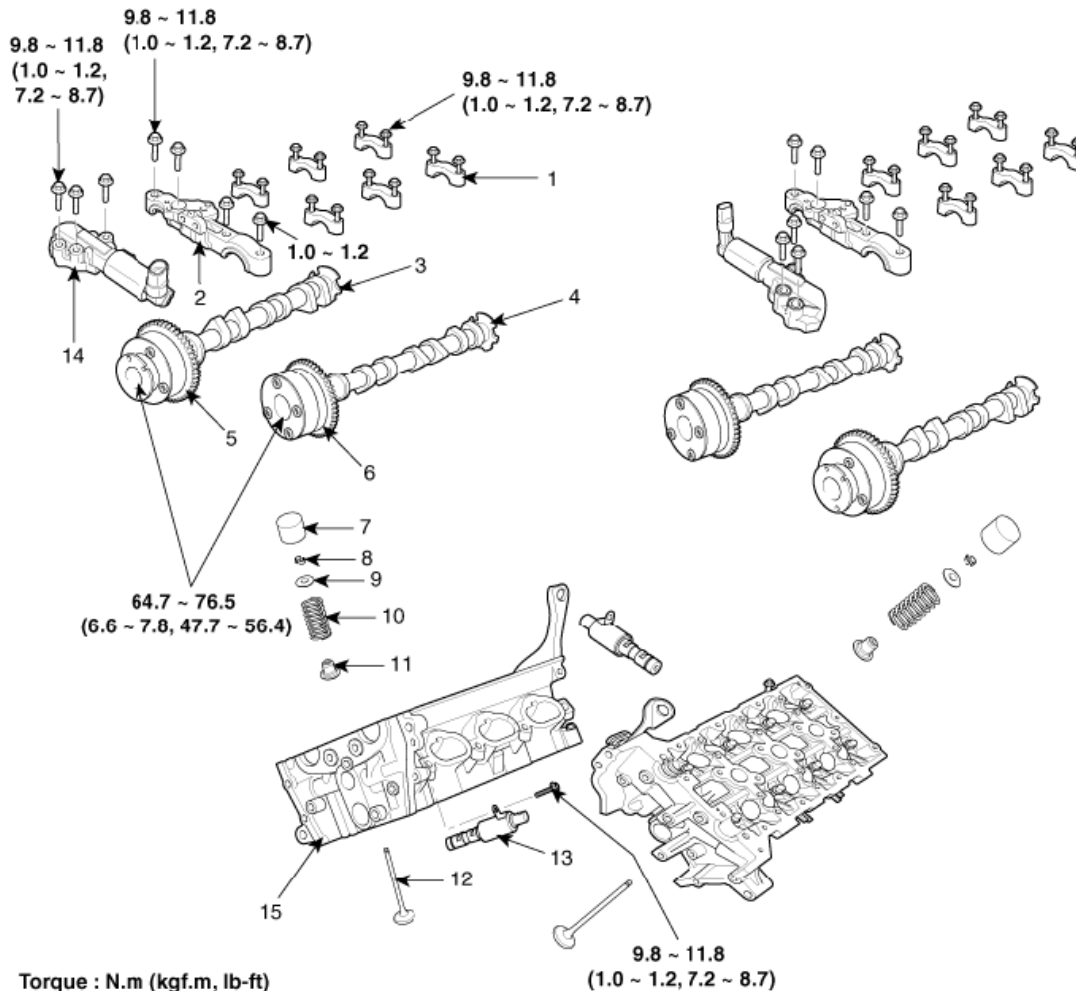
Components



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 Components With Torque Specifications (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.



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

Fig. 2: Identifying Cylinder Head Assembly Components 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 temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.

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

NOTE:

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

1. Remove the timing chain. (Refer to **TIMING SYSTEM - 3.8L**)
2. Remove the mounting bolts (B, C) and then remove the water temperature control assembly (A).

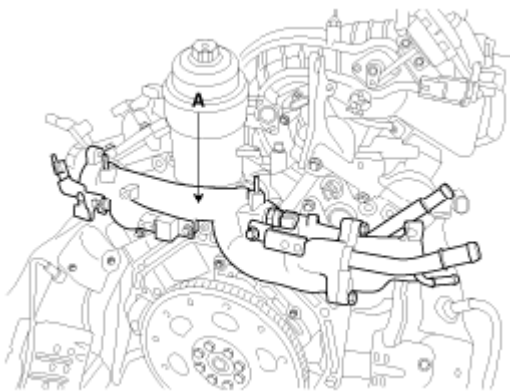


Fig. 3: Identifying Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

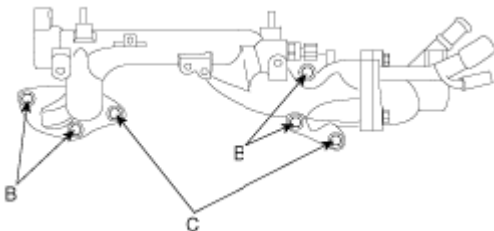


Fig. 4: Identifying Mounting Bolts For Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the water vent hose (A) and then remove the intake manifold (B).

CAUTION:

- Be sure to drain the engine coolant before removing the intake manifold.
- If any coolant drained from the cylinder head vent hole has entered the intake port; this can potentially lead to engine trouble.

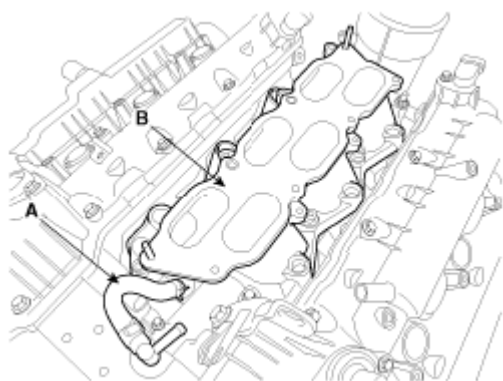


Fig. 5: Identifying Water Vent Hose & Intake Manifold
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the LH/RH exhaust manifold heat protector (A).

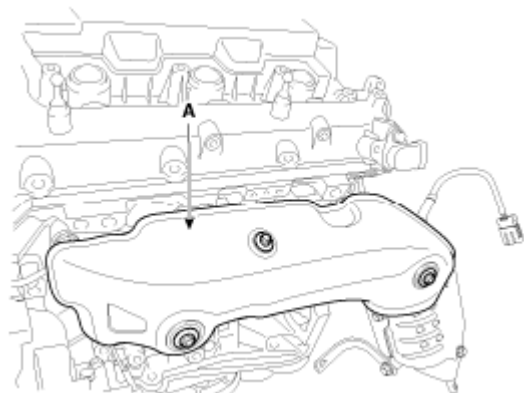


Fig. 6: Identifying LH Exhaust Manifold Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

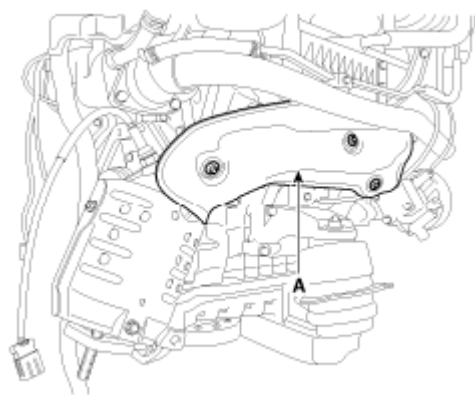


Fig. 7: Identifying RH Exhaust Manifold Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

5. Loosen the LH/RH exhaust manifold stay bolt (A).

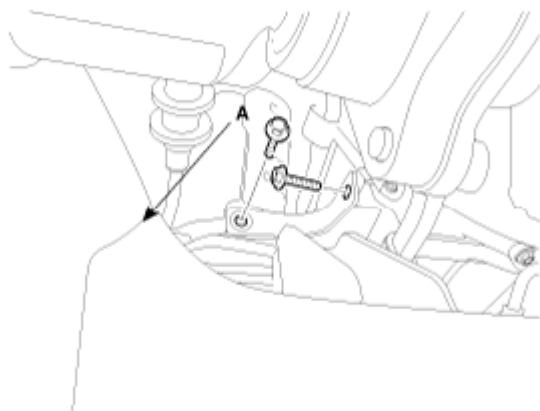


Fig. 8: Identifying LH Exhaust Manifold Stay Bolt
Courtesy of KIA MOTORS AMERICA, INC.

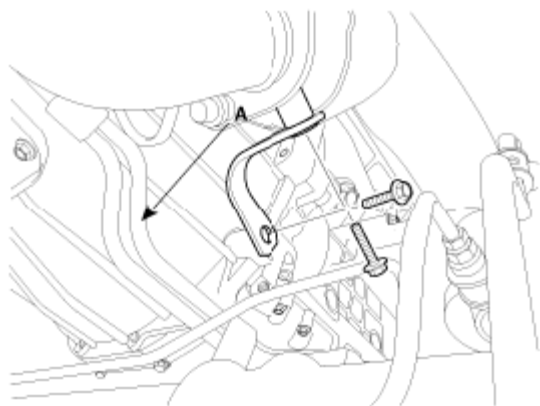


Fig. 9: Identifying RH Exhaust Manifold Stay Bolt
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the LH/RH exhaust manifold (A).

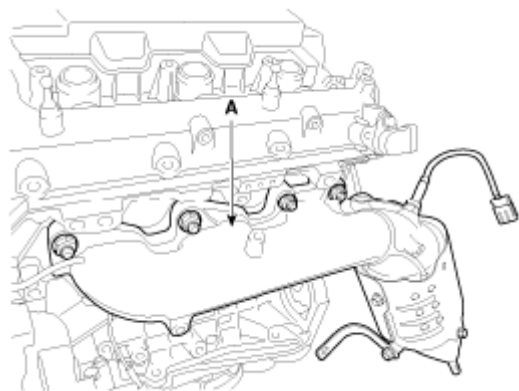


Fig. 10: Identifying LH Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

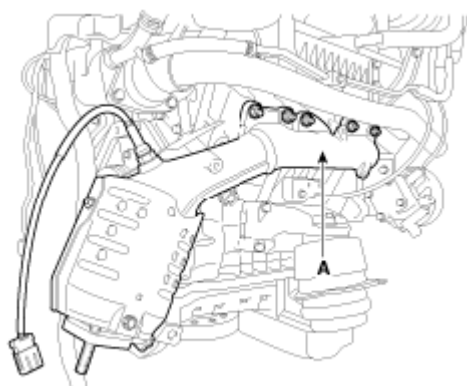


Fig. 11: Identifying RH Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

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

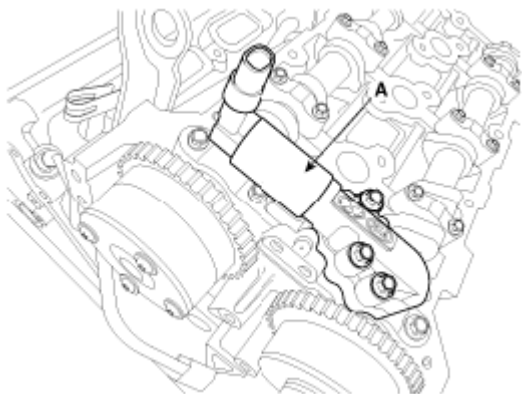


Fig. 12: Identifying LH Exhaust Camshaft OCV
Courtesy of KIA MOTORS AMERICA, INC.

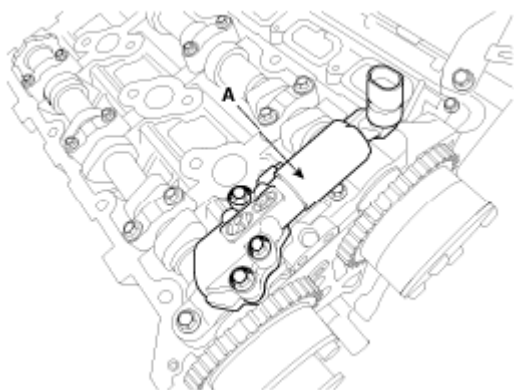


Fig. 13: Identifying RH Exhaust Camshaft OCV
Courtesy of KIA MOTORS AMERICA, INC.

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

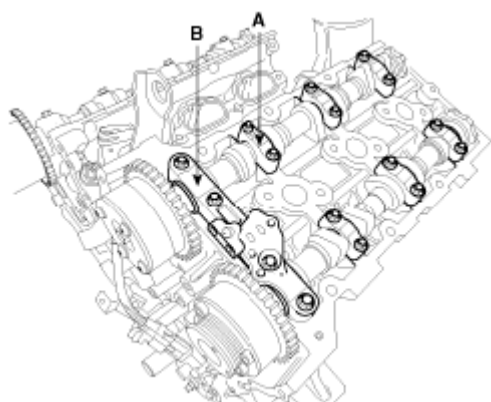


Fig. 14: Identifying LH Camshaft Bearing Cap & Thrust Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

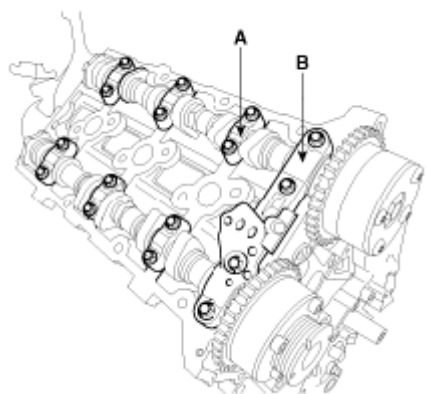


Fig. 15: Identifying RH Camshaft Bearing Cap & Thrust Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

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

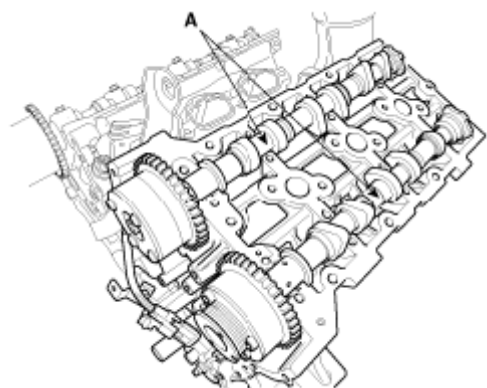


Fig. 16: Identifying LH Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

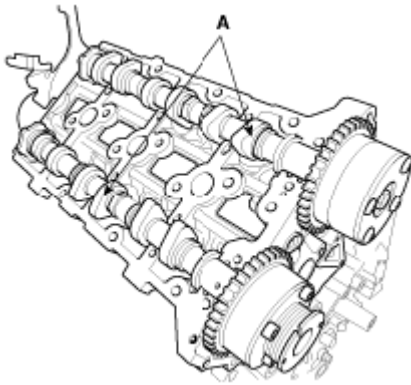


Fig. 17: Identifying RH Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the cylinder head.
 1. Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.

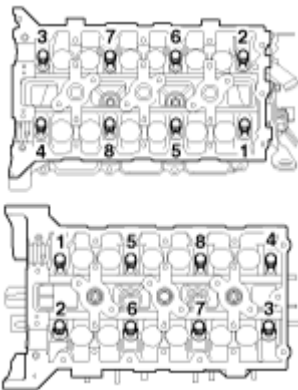


Fig. 18: Identifying Removal Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Lift the cylinder head from the dowels on the cylinder block and 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 the MLAs (A).

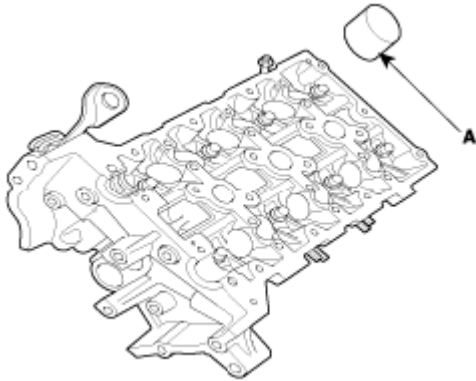


Fig. 19: Identifying MLA

Courtesy of KIA MOTORS AMERICA, INC.

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

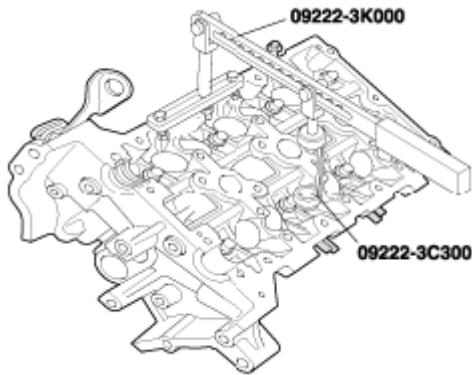


Fig. 20: Compressing Valve Spring & Removing Retainer Lock

Courtesy of KIA MOTORS AMERICA, INC.

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

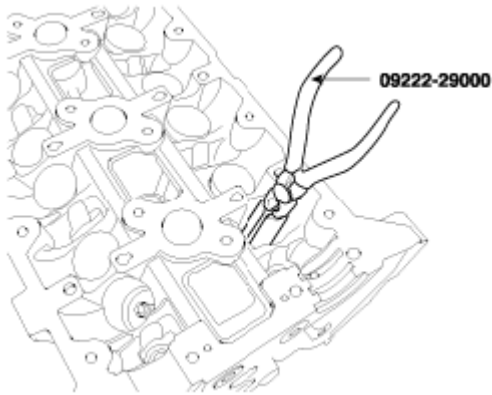


Fig. 21: Removing Valve Stem Seal
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the OCV (A).

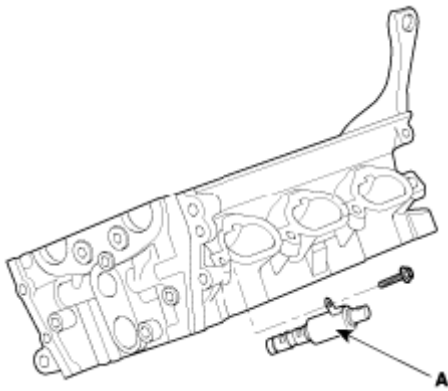


Fig. 22: Removing OCV
Courtesy of KIA MOTORS AMERICA, INC.

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard : Less than 0.05mm (0.002in.)

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

Flatness of manifold gasket surface

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

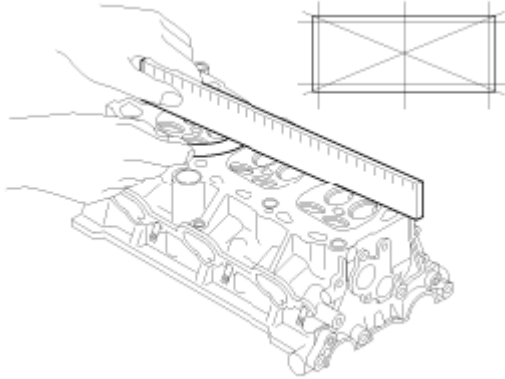


Fig. 23: Inspecting Cylinder Head For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

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.)

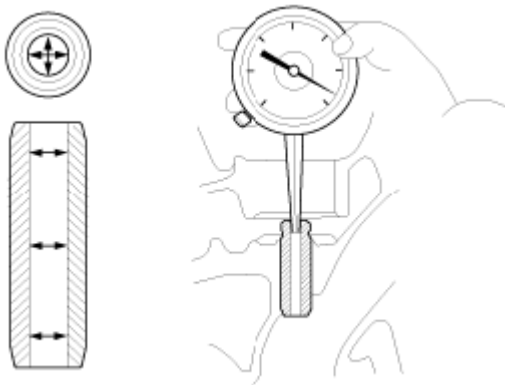


Fig. 24: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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.)

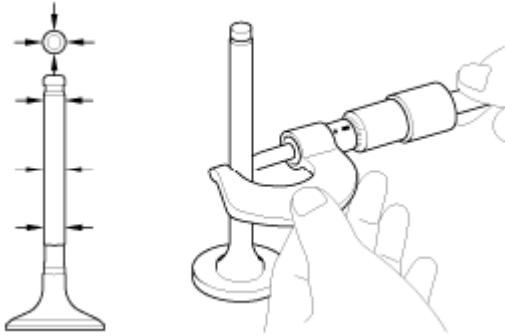


Fig. 25: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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.)

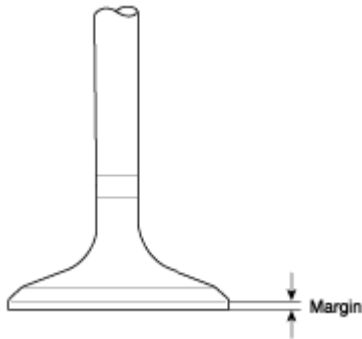


Fig. 26: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

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 vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 43.86mm (1.7267in.)

Out-of-square : 1.5°

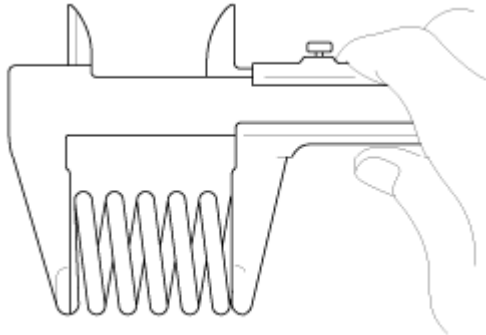


Fig. 27: Measuring Out-Of-Square & Free Height Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

MLA

1. Inspect MLAs.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust :

34.964 ~ 34.980mm (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.)

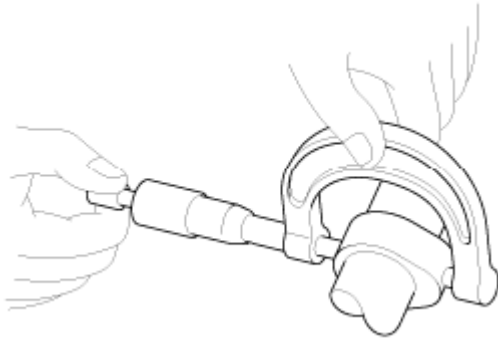


Fig. 28: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

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

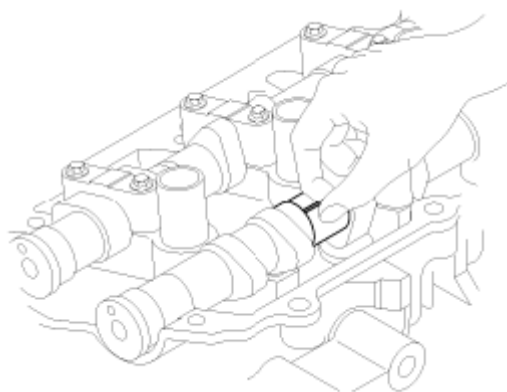


Fig. 29: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing cap (A) and thrust bearing cap (B) with specified torque.

Tightening torque :

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

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

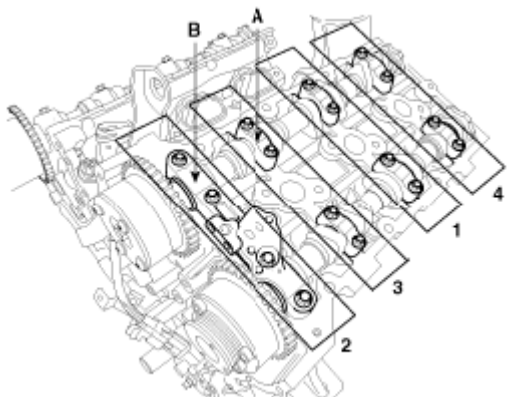


Fig. 30: Identifying Bearing Cap & Thrust Bearing Cap (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

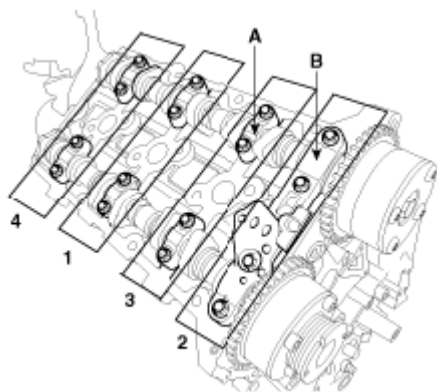


Fig. 31: Identifying Bearing Cap & Thrust Bearing Cap (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

[Standard value]

Intake

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

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

Exhaust

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

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

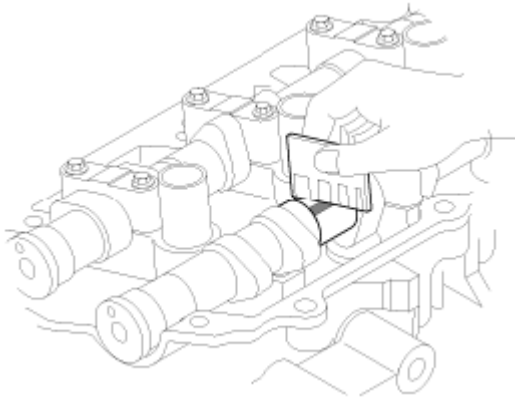


Fig. 32: Measuring Bearing Oil Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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

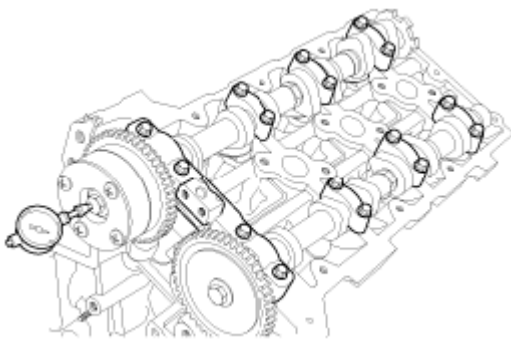


Fig. 33: Measuring Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

CVVT Assembly

1. Inspect the 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 **Fig. 34**.

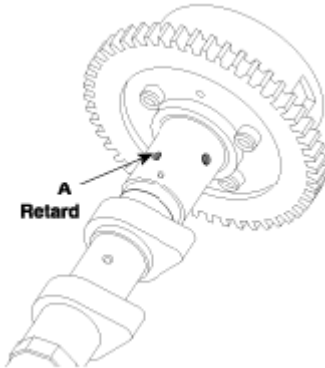


Fig. 34: Applying Vinyl Tape To Retard Hole Except For One Indicated By Arrow
 Courtesy of KIA MOTORS AMERICA, INC.

3. Wrap 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 in 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 Step 3, turn the CVVT assembly to the advance angle side (the arrow marked direction in **Fig. 35**) with your hand.

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand.

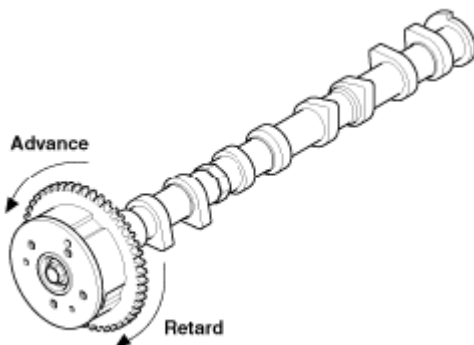


Fig. 35: Turning CVVT Assembly To Advance Angle Side
 Courtesy of KIA MOTORS AMERICA, INC.

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 interference.

Standard: Movable smoothly in the range about 30°

6. Turn the CVVT assembly with your hand and lock it at the maximum delay 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 the valves.
 1. Using the SST (09222-3C100), push in a new oil seal.

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

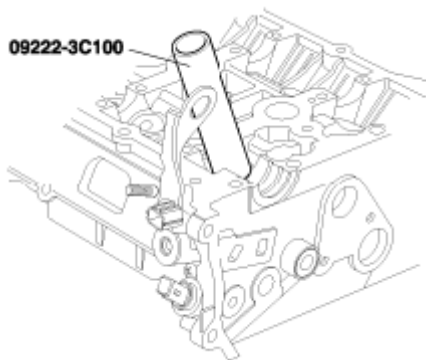
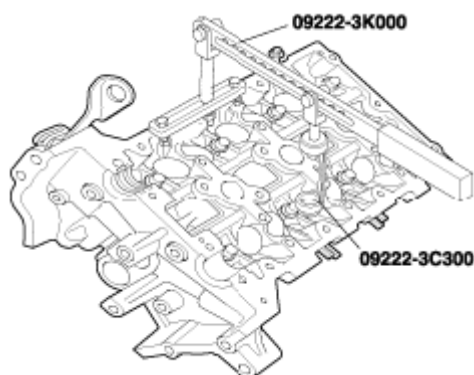


Fig. 36: Installing New Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

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.

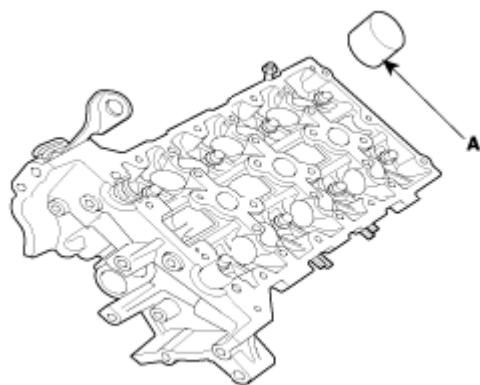
3. Using the SST (09222 - 3K000, 09222-3C300), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

**Fig. 37: Installing Retainer Locks**

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. 38: Identifying MLA**

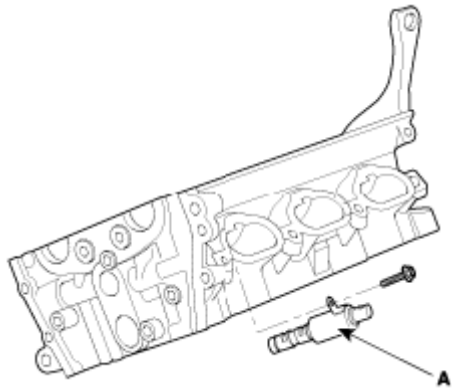
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

3. Install the OCV (A).

Tightening torque

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

**Fig. 39: Identifying OCV**

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

CAUTION:

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

Installation**NOTE:**

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

1. Install the cylinder head.

- A. The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
- 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.

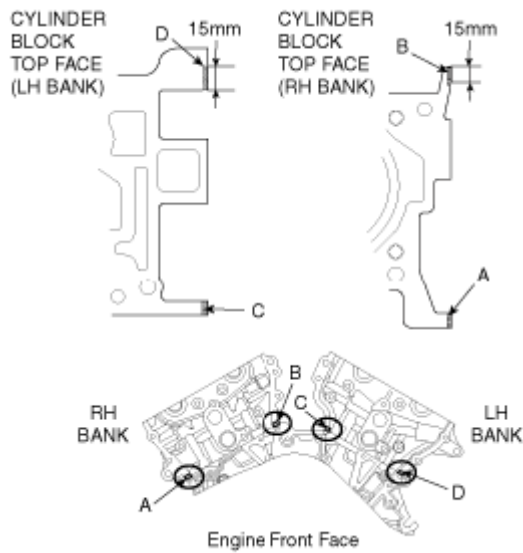


Fig. 40: Applying Sealant On Cylinder Block Top Face
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Refer to **Fig. 41** to apply the sealant.

Bead width :

2.0~3.0 mm (0.078 ~ 0.118 in.)

Sealant locations :

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

Recommended sealant : Liquid sealant TB1217H

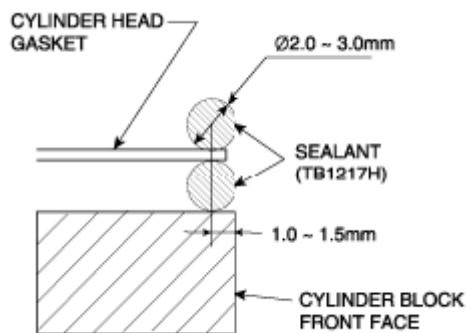


Fig. 41: Applying Sealant On Cylinder Block Front Face
Courtesy of KIA MOTORS AMERICA, INC.

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.

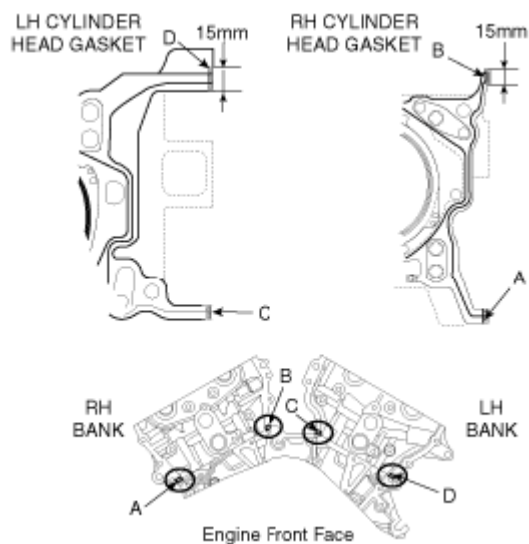


Fig. 42: Applying Sealant On Cylinder Head Gaskets
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Be careful of the installation direction.

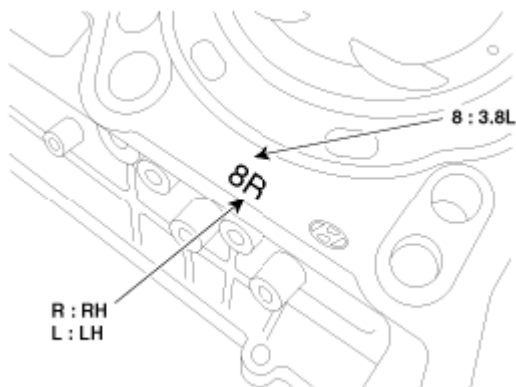


Fig. 43: Assembling Cylinder Head Gaskets On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

D. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.

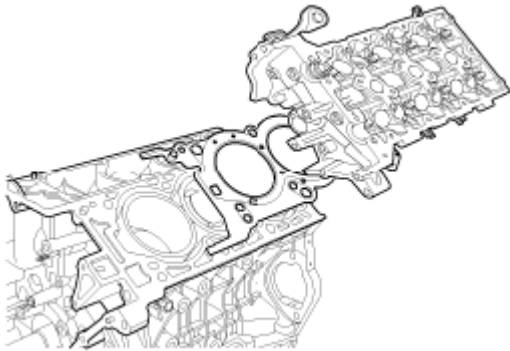


Fig. 44: Identifying Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

2. Install cylinder head bolts.
 1. Do not apply engine oil on the threads and under the heads of the cylinder head bolts.
 2. Using SST (09221-4A000), install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown in **Fig. 45**.

Tightening torque

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

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

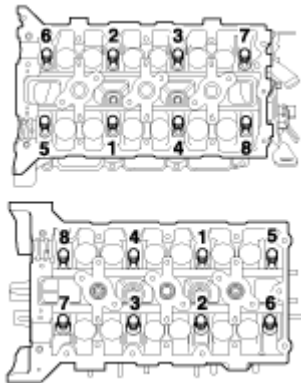


Fig. 45: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

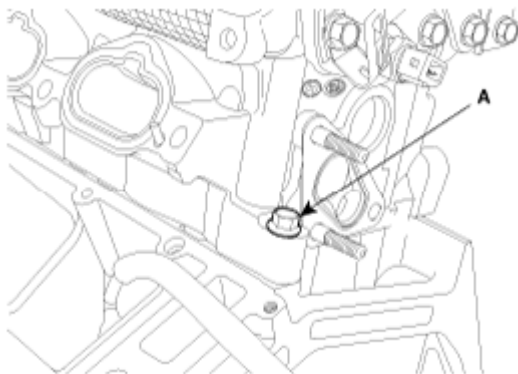


Fig. 46: Identifying Bolt
Courtesy of KIA MOTORS AMERICA, INC.

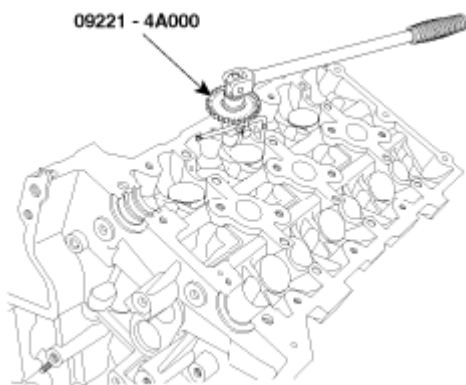


Fig. 47: Tightening Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the CVVT assembly.

Tightening torque :

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

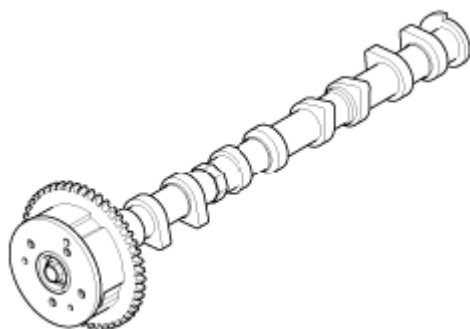


Fig. 48: Identifying CVVT Assembly
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

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

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

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

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

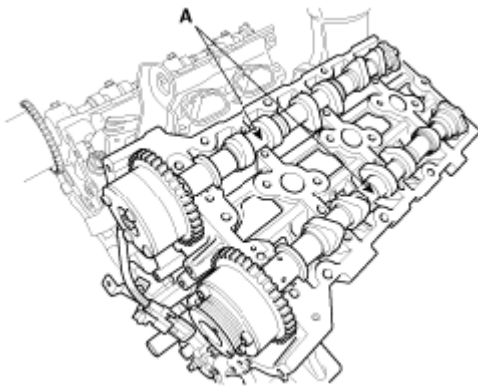


Fig. 49: Identifying LH Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

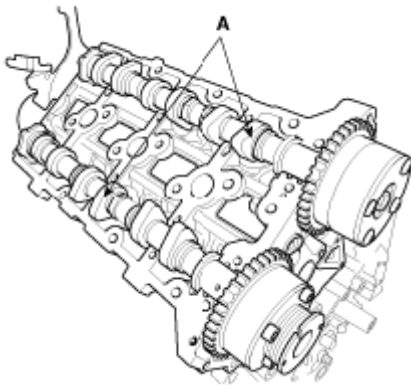


Fig. 50: Identifying RH Camshaft Assembly
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

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

assembling.

Intake Camshaft

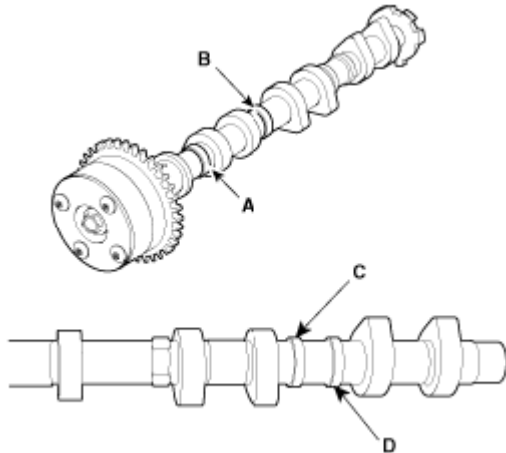


Fig. 51: Identifying Intake Camshaft Out Diameter
Courtesy of KIA MOTORS AMERICA, INC.

As for camshaft identification, refer to INTAKE CAMSHAFT OUTER DIAMETER CHART.

INTAKE CAMSHAFT OUTER DIAMETER CHART

Displacement	Outer diameter	
	LH	RH
3.8L Intake camshaft	A : 27mm (1.0630in.)	A : 27mm (1.0630in.)
	B : 30mm (1.1811in.)	B : 30mm (1.1811in.)
	C : 30mm (1.1811in.)	C : 27mm (1.0630in.)
	D : 27mm (1.0630in.)	D : 30mm (1.1811in.)

Exhaust Camshaft

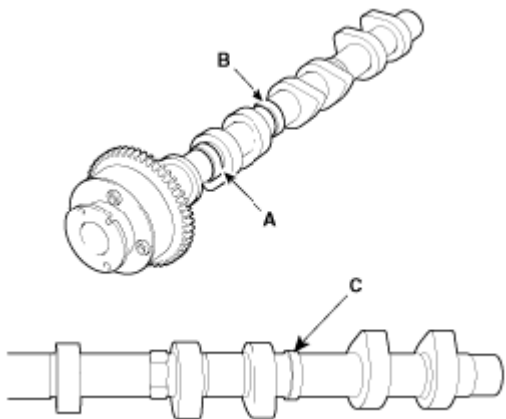


Fig. 52: Identifying Exhaust Camshaft Outer Diameter

Courtesy of KIA MOTORS AMERICA, INC.

As for camshaft identification, refer to **EXHAUST CAMSHAFT OUTER DIAMETER CHART**.

EXHAUST CAMSHAFT OUTER DIAMETER CHART

Displacement	Outer diameter	
	LH	RH
3.8L Exhaust camshaft	A : 27mm (1.0630in.)	A : 27mm (1.0630in.)
	B : 30mm (1.1811in.)	B : 30mm (1.1811in.)
	C : 27mm (1.0630in.)	C : 30mm (1.1811in.)

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

Tightening torque

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

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

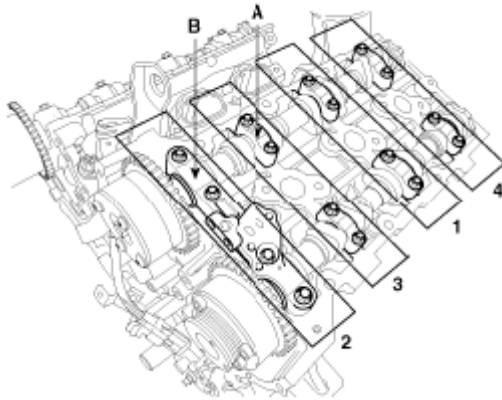


Fig. 53: Identifying LH Camshaft Bearing Cap & Thrust Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

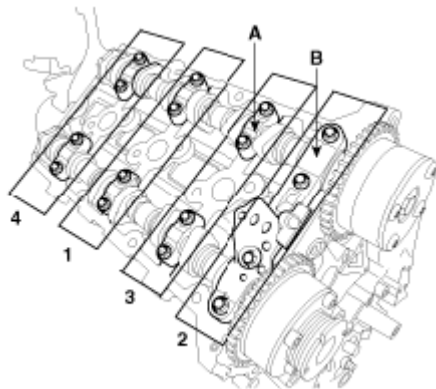


Fig. 54: Identifying RH Camshaft Bearing Cap & Thrust Bearing Cap

Courtesy of KIA MOTORS AMERICA, INC.

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

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

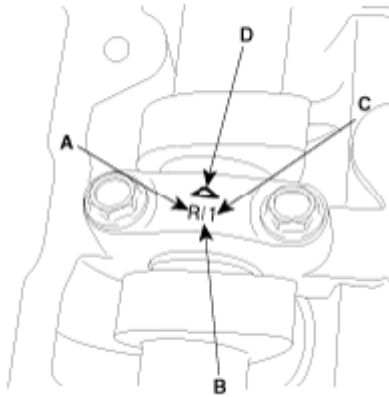


Fig. 55: Installing LH/RH Camshaft Bearing Cap & Thrust Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

- 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.

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

Tightening torque :

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

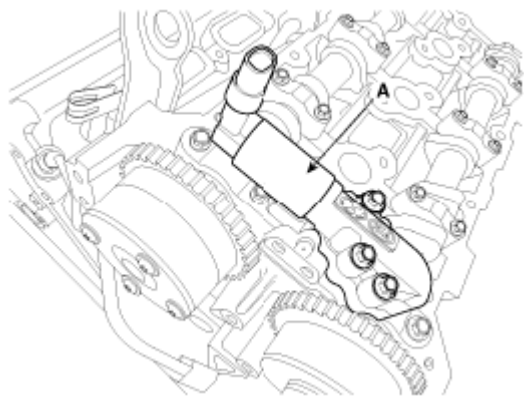


Fig. 56: Identifying LH Exhaust Camshaft OCV
Courtesy of KIA MOTORS AMERICA, INC.

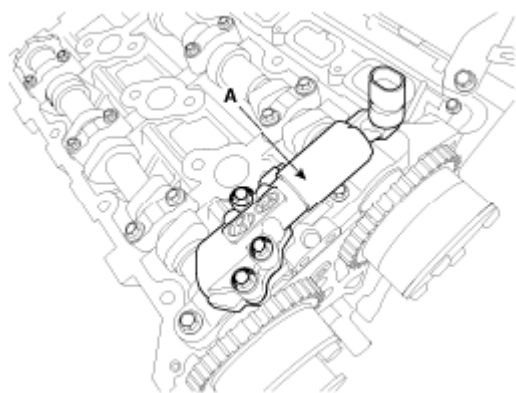


Fig. 57: Identifying RH Exhaust Camshaft OCV
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the LH/RH exhaust manifold (A) with a new gasket.

Tightening torque :

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

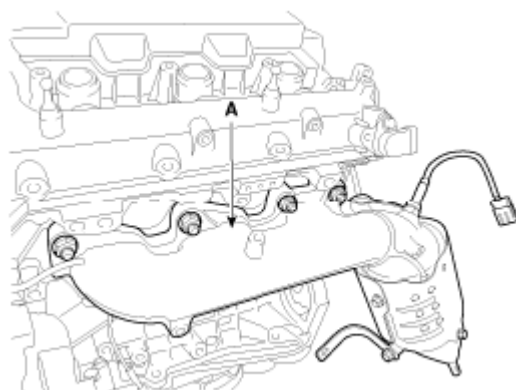


Fig. 58: Identifying LH Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

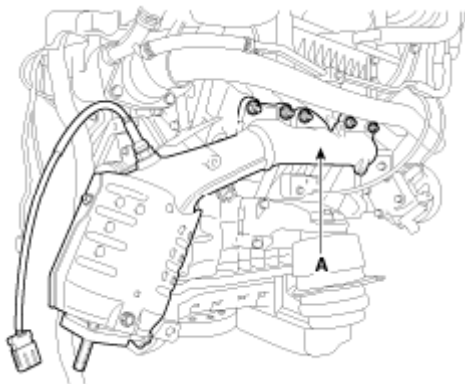


Fig. 59: Identifying RH Exhaust Manifold
Courtesy of KIA MOTORS AMERICA, INC.

8. Install the LH/RH exhaust manifold heat protector (A).

Tightening torque :

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

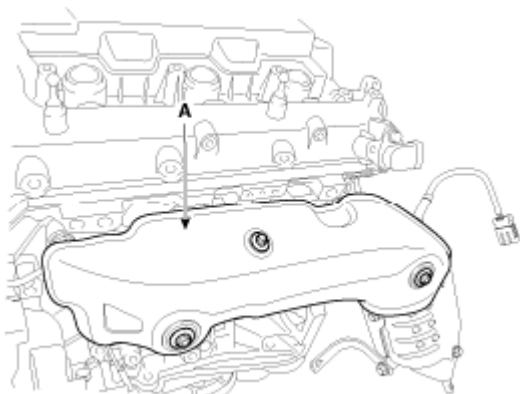


Fig. 60: Identifying LH Exhaust Manifold Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

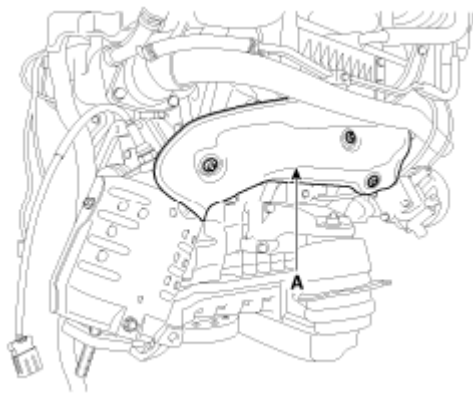


Fig. 61: Identifying RH Exhaust Manifold Heat Protector
Courtesy of KIA MOTORS AMERICA, INC.

9. Install the LH/RH exhaust manifold stay bolt (A).

Tightening torque :

34.3 ~ 41.2N.m (3.5 ~ 4.2kgf.m, 25.3 ~ 30.4lb-ft)

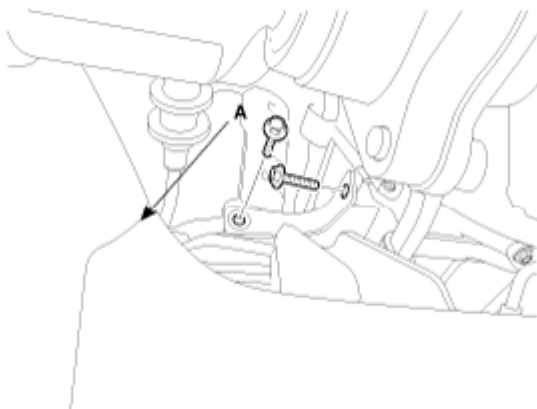


Fig. 62: Identifying LH Exhaust Manifold Stay Bolt
Courtesy of KIA MOTORS AMERICA, INC.

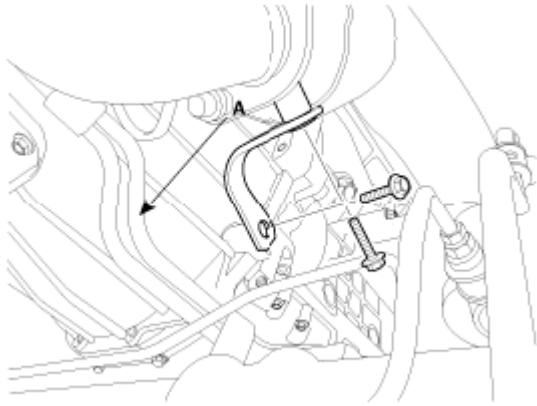


Fig. 63: Identifying RH Exhaust Manifold Stay Bolt
 Courtesy of KIA MOTORS AMERICA, INC.

10. Install the intake manifold (B) with a new gasket, and connect the water vent hose (A).

CAUTION:

- Be sure to drain the engine coolant before removing the intake manifold.
- If any coolant drained from the cylinder head vent hole has entered the intake port; this can potentially lead to engine trouble.

Tightening torque

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

Step 2:

Nut-18.62 ~ 23.52N.m (1.9~2.4kgf.m, 13.74~17.36lb-ft)

Bolt -26.5 ~ 31.4 N.m (2.7 ~ 3.2 kgf.m, 19.5 ~ 23.1lb-ft)

Step 3: Repeat 2nd step twice or more.

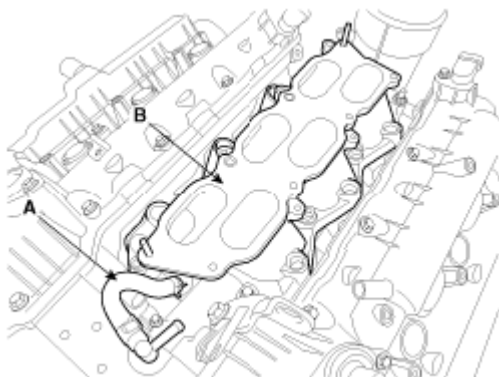


Fig. 64: Identifying Water Vent Hose & Intake Manifold

Courtesy of KIA MOTORS AMERICA, INC.

a - h : 1st step order

1 ~ 8 : 2nd step order

NOTE: Confirm the manifold gasket identification mark (LH, RH) and be careful of the installation direction.

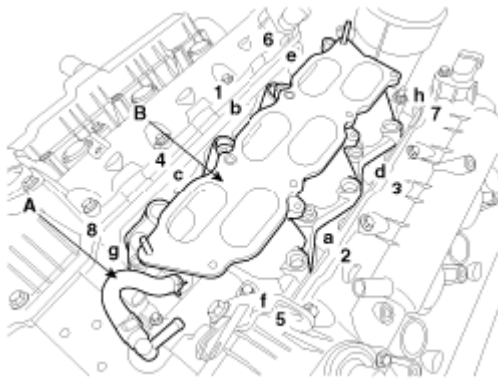


Fig. 65: Identifying 1st Step Order & 2nd Step Order

Courtesy of KIA MOTORS AMERICA, INC.

11. Install the water temperature control assembly (A) with a new gasket.

Tightening torque :

19.6 ~ 23.5Nm (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft)

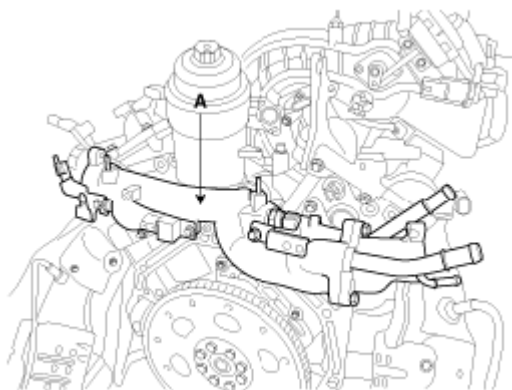


Fig. 66: Identifying Water Temperature Control Assembly

Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: When tightening the bolts (C), use a ground bolt.

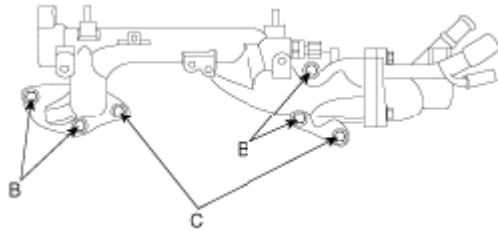


Fig. 67: Identifying Water Temperature Control Assembly Mounting Bolts
 Courtesy of KIA MOTORS AMERICA, INC.

12. Install the timing chain. (Refer to **TIMING SYSTEM - 3.8L**)

NOTE:

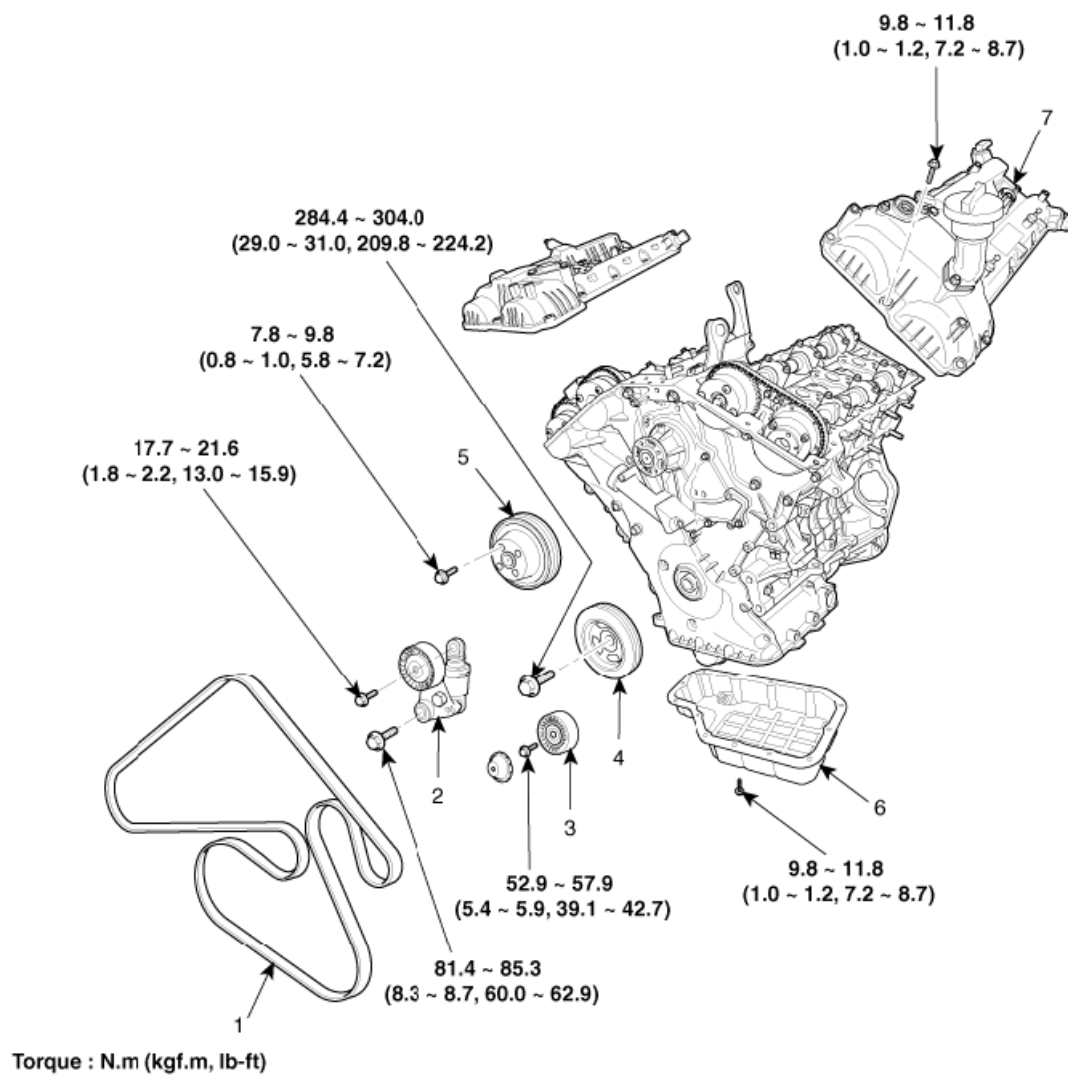
- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.
 - After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
 - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel lines.
- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.
 - Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
 - Turn Off the engine. 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.

2009-10 ENGINE

Timing System - 3.8L - Borrego + 2010 Canadian

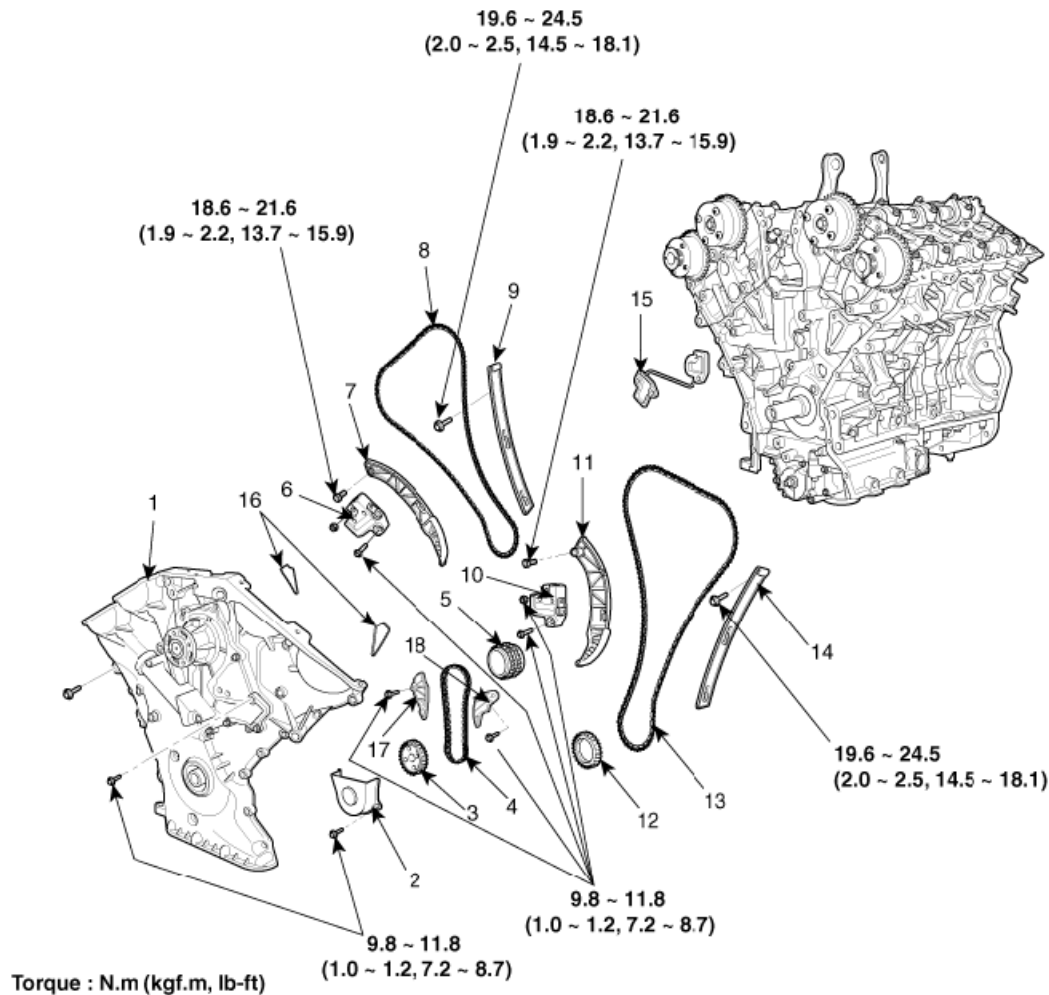
TIMING CHAIN

COMPONENTS



- | | |
|-------------------------|------------------------|
| 1. Drive belt | 5. Water pump pulley |
| 2. Drive belt tensioner | 6. Oil pan |
| 3. Idler | 7. Cylinder head cover |
| 4. Crank shaft pulley | |

Fig. 1: Identifying Timing Chain & Related Components With Torque Specifications (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.



1. Timing chain cover	7. Timing chain tensioner arm	13. Timing chain
2. Oil pump chain cover	8. Timing chain	14. Timing chain guide
3. Oil pump sprocket	9. Timing chain guide	15. Tensioner adapter
4. Oil pump chain	10. Timing chain auto tensioner	16. Gasket
5. Crankshaft sprocket	11. Timing chain tensioner arm	17. Oil pump chain guide
6. Timing chain auto tensioner	12. Crankshaft sprocket	18. Oil pump tensioner assembly

Fig. 2: Identifying Timing Chain & Related Components With Torque Specifications (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

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.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Disconnect the negative cable (A) from the battery.

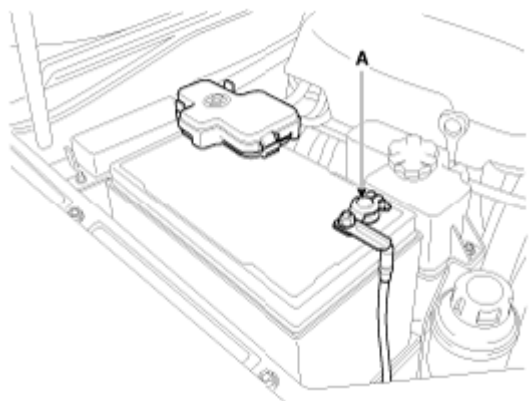


Fig. 3: Disconnecting Negative Cable On Battery
Courtesy of KIA MOTORS AMERICA, INC.

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

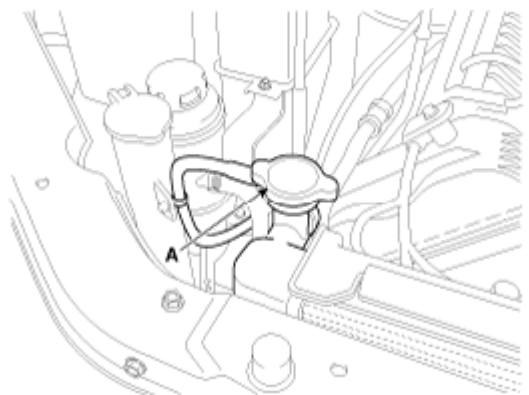


Fig. 4: Identifying Radiator Cap
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the engine cover (A).

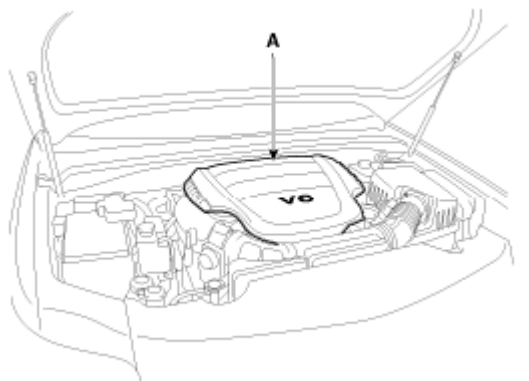
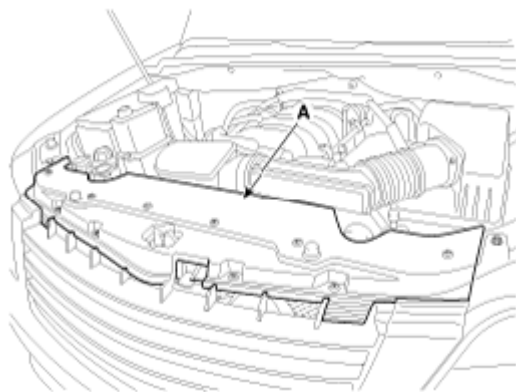


Fig. 5: Identifying Engine Cover

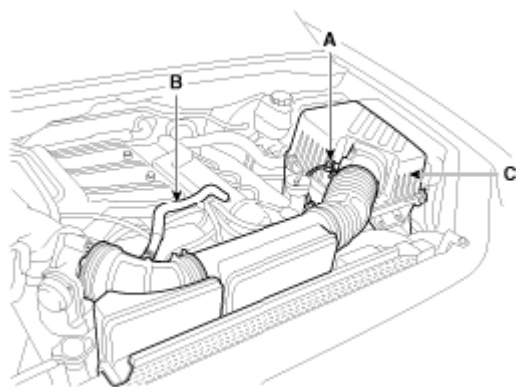
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the radiator grill upper guard (A).

**Fig. 6: Identifying Radiator Grill Upper Guard**

Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the AFS connector (A) and breather hose (B) and then remove the air cleaner assembly (C).

**Fig. 7: Identifying AFS Connector, Breather Hose, & Air Cleaner Assembly**

Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the radiator upper hose (A) and lower hose (B).

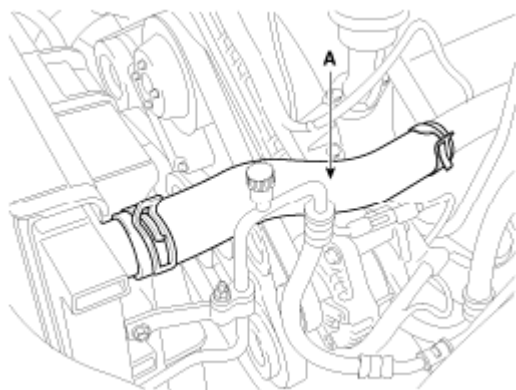


Fig. 8: Identifying Radiator Upper Hose
Courtesy of KIA MOTORS AMERICA, INC.

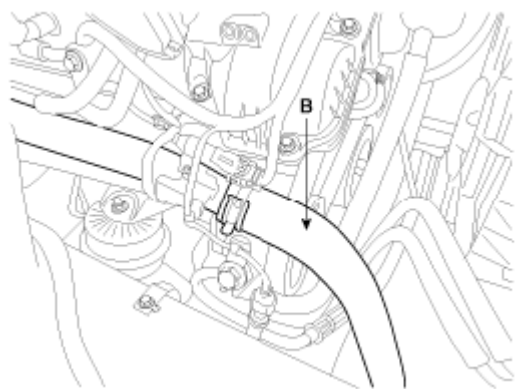


Fig. 9: Identifying Radiator Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the purge control solenoid valve (PCSV) hose (A) and the brake booster vacuum hose (B).

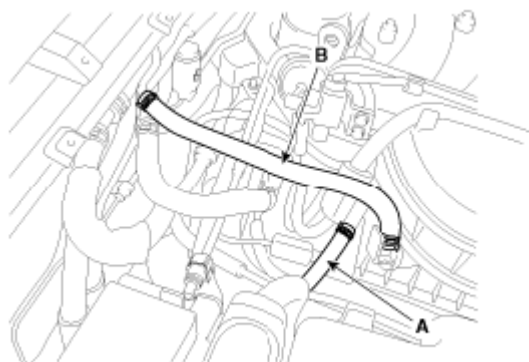


Fig. 10: Identifying Purge Control Solenoid Valve Hose & Brake Booster Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the fan connector (A) and remove the cooling fan assembly (B).

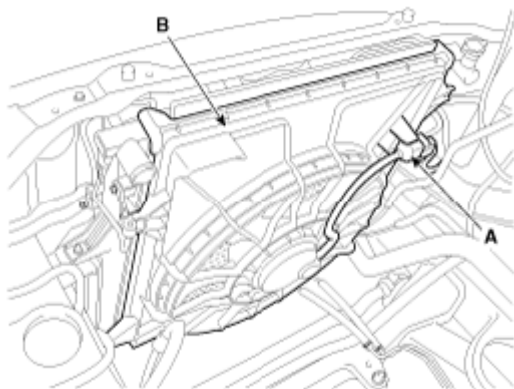


Fig. 11: Identifying Fan Connector & Cooling Fan Assembly
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect the engine wiring connectors.
 1. Disconnect the power steering oil pressure switch connector (A) and RH knock sensor connector (B).

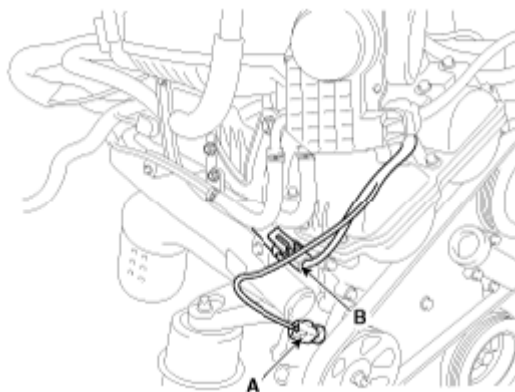


Fig. 12: Identifying Connectors For Power Steering Oil Pressure Switch & RH Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

2. Disconnect the MAP sensor connector (A), ETC connector (B), RH exhaust OCV connector (C), RH injector connector (D) and RH ignition coil connector (E).

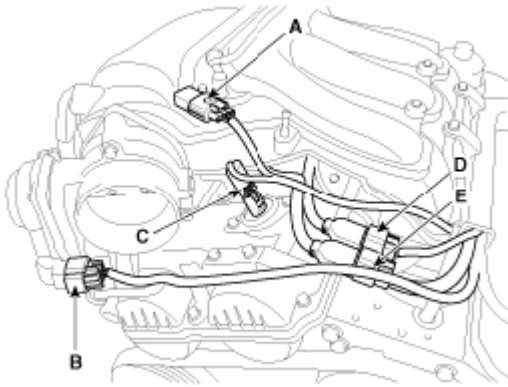


Fig. 13: Identifying Connectors For MAP Sensor, ECT, RH Exhaust OCV, RH Injector, & RH Ignition Coil
Courtesy of KIA MOTORS AMERICA, INC.

3. Disconnect the LH knock sensor connector (A), LH/RH intake OCV connector (B) and LH exhaust OCV connector (C).

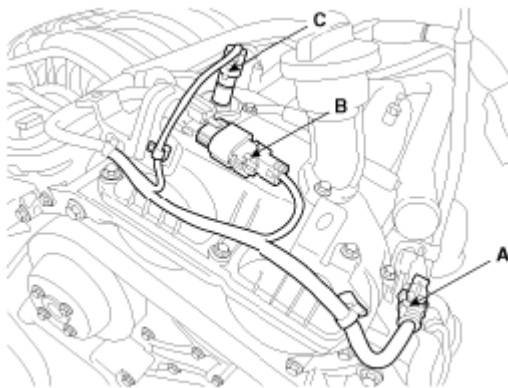


Fig. 14: Identifying Connectors For LH Knock Sensor, LH/RH Intake OCV, & LH Exhaust OCV
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect the LH injector connector (A) and LH ignition coil connector (B).

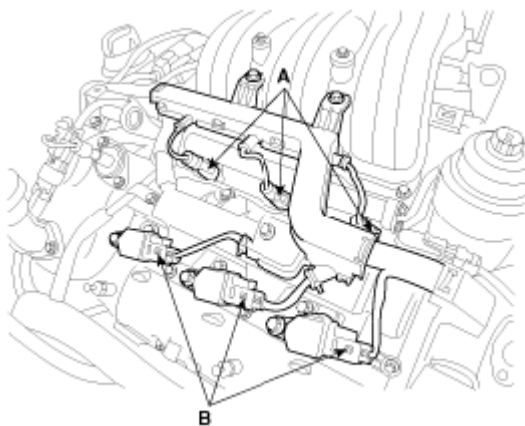


Fig. 15: Identifying Connectors For LH Injector & LH Ignition Coil
Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the oil pressure switch connector (A), LH exhaust camshaft CMP sensor connector (B) and LH oxygen sensor connector (C).

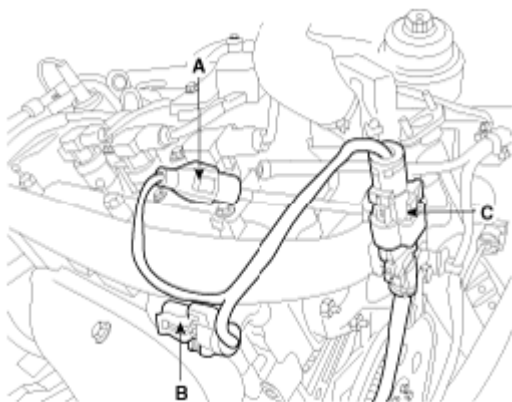


Fig. 16: Identifying Connectors For Oil Pressure Switch, LH Exhaust Camshaft CMP Sensor, & LH Oxygen Sensor
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the LH intake camshaft CMP sensor connector (A), RH intake camshaft CMP sensor connector (B) and condenser connector (C).

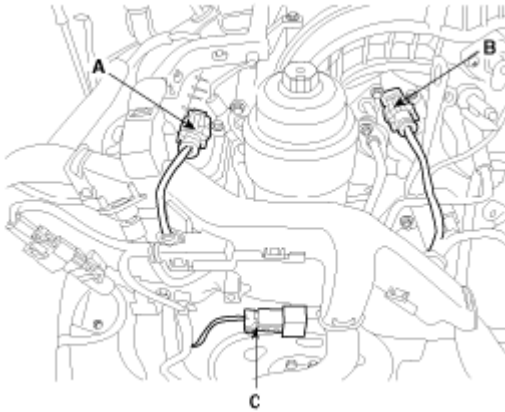


Fig. 17: Identifying Connectors For LH Intake Camshaft CMP Sensor, RH Intake Camshaft CMP Sensor, & Condenser

Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the VIS solenoid valve connector (A), PCSV connector (B), RH oxygen sensor connector (C) and the RH exhaust camshaft CMP sensor connector (D).

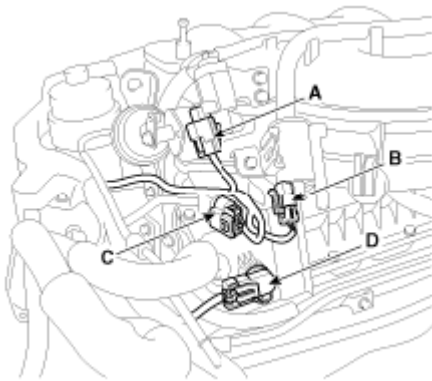


Fig. 18: Identifying Connectors For VIS Solenoid Valve, PCSV, RH Oxygen Sensor, & RH Exhaust Camshaft CMP Sensor

Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the water temperature sensor connector (A) and oil temperature sensor connector (B).

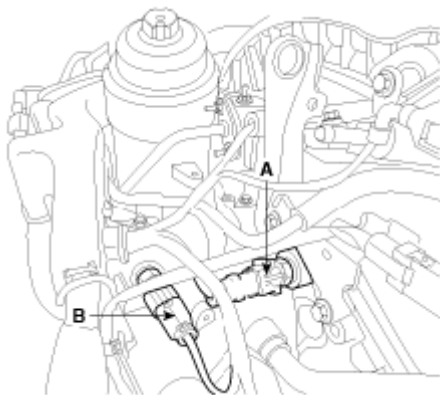


Fig. 19: Identifying Connectors For Water Temperature Sensor & Oil Temperature Sensor
Courtesy of KIA MOTORS AMERICA, INC.

10. Disconnect the throttle body coolant hoses (A), breather hose (B) and loosen the surge tank stay bolts (C).

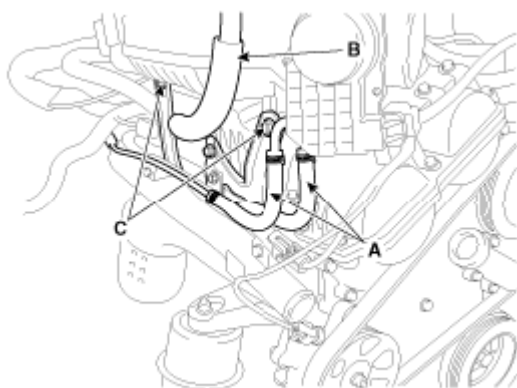


Fig. 20: Identifying Throttle Body Coolant Hoses, Breather Hose, & Surge Tank Stay Bolts
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the surge tank (A).

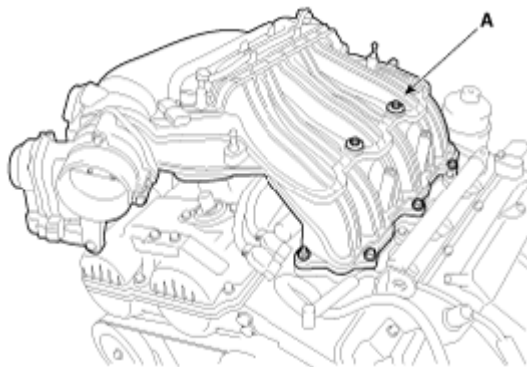


Fig. 21: Identifying Surge Tank
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the coolant pipe (A).

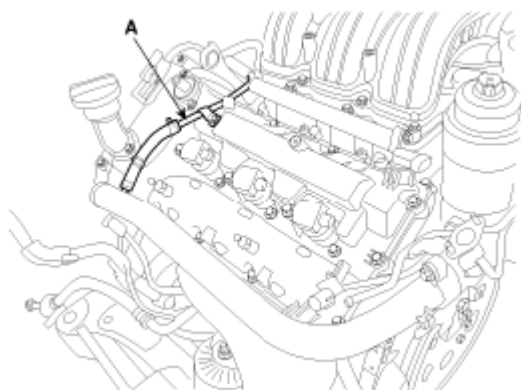


Fig. 22: Identifying Coolant Pipe
Courtesy of KIA MOTORS AMERICA, INC.

13. Disconnect the RH ignition coil connector (A) and the injector connector (B).

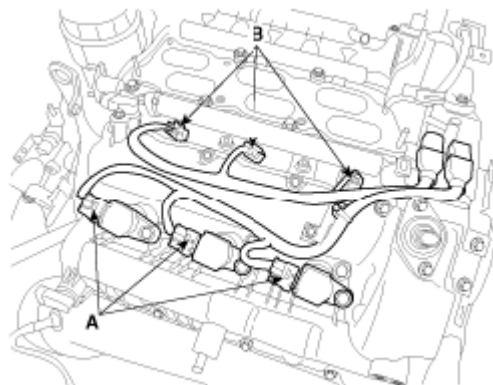


Fig. 23: Identifying RH Ignition Coil Connector & Injector Connector
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the LH/RH ignition coils (A).

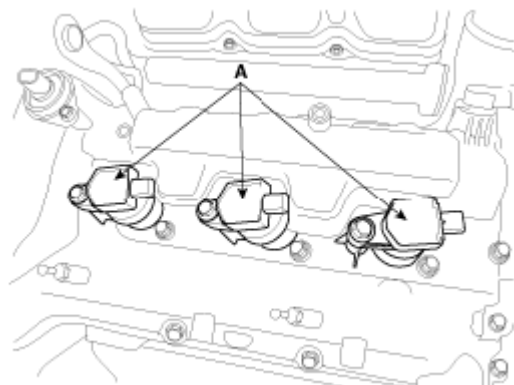


Fig. 24: Identifying LH/RH Ignition Coils (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

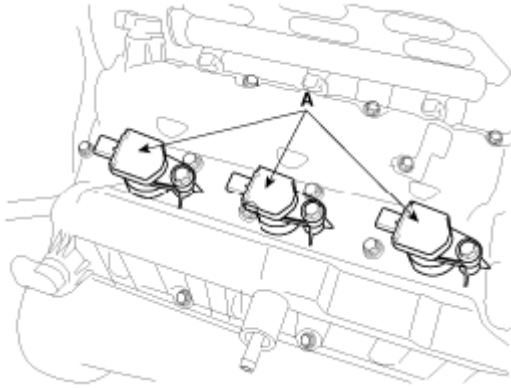


Fig. 25: Identifying LH/RH Ignition Coils (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the LH/RH cylinder head cover (A).

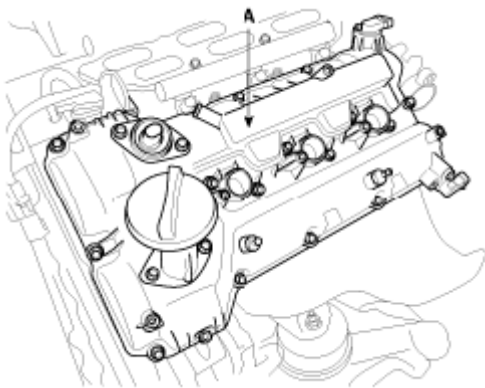


Fig. 26: Identifying LH/RH Cylinder Head Cover (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

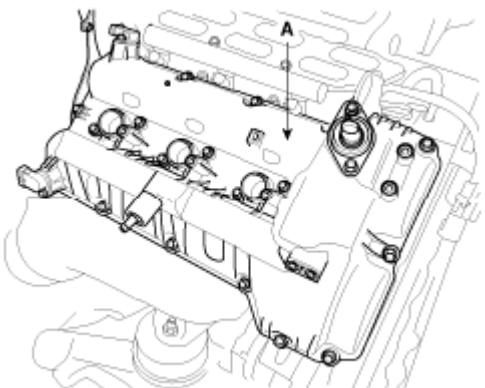


Fig. 27: Identifying LH/RH Cylinder Head Cover (2 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

16. Remove the drive belt (A).

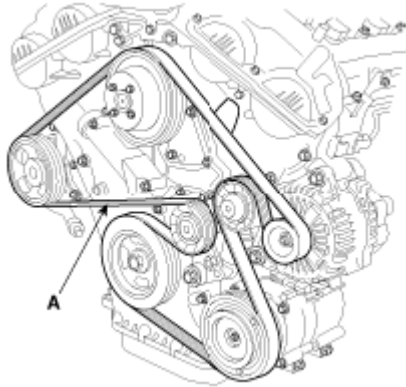


Fig. 28: Identifying Drive Belt

Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the drive belt idler (A).

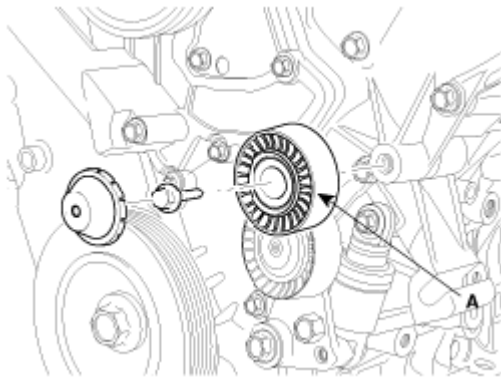


Fig. 29: Identifying Drive Belt Idler

Courtesy of KIA MOTORS AMERICA, INC.

18. Remove the drive belt auto tensioner (A).

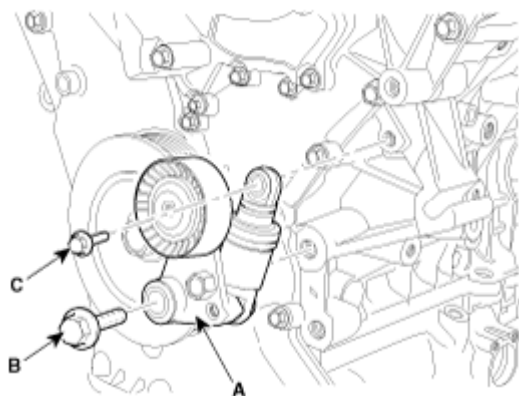


Fig. 30: Identifying Drive Belt Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove the water pump pulley (A).

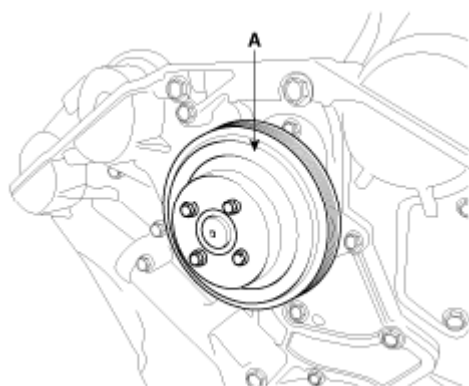


Fig. 31: Identifying Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

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

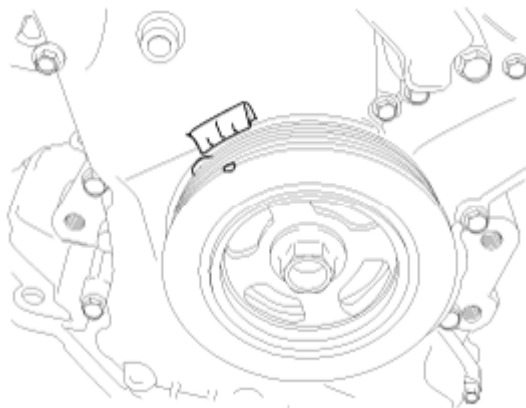


Fig. 32: Aligning Groove Of Crankshaft Pulley With Timing Mark "T" Of Lower Timing Chain Cover

Courtesy of KIA MOTORS AMERICA, INC.

2. Check that the mark (A) of the camshaft timing sprockets are lined up on the cylinder head surface as shown in **Fig. 33** and **Fig. 34**. If not, turn the crankshaft clockwise one revolution (360°).

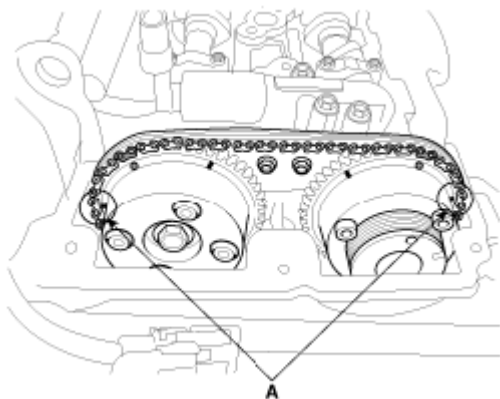


Fig. 33: Identifying Mark Of Camshaft Timing Sprockets (1 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

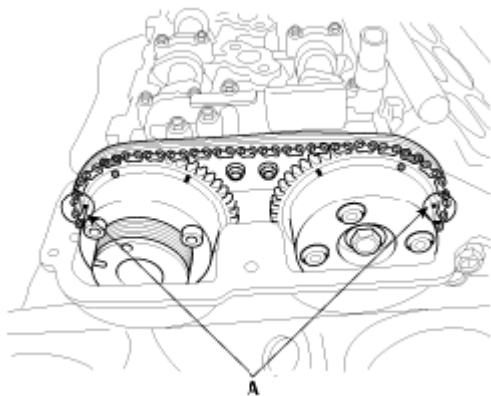


Fig. 34: Identifying Mark Of Camshaft Timing Sprockets (2 Of 2)

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not rotate engine counterclockwise.

21. Remove the lower oil pan (A).

Insert the blade of SST (09215-3C000) between the upper oil pan and lower oil pan. Cut off applied sealer and remove the lower oil pan.

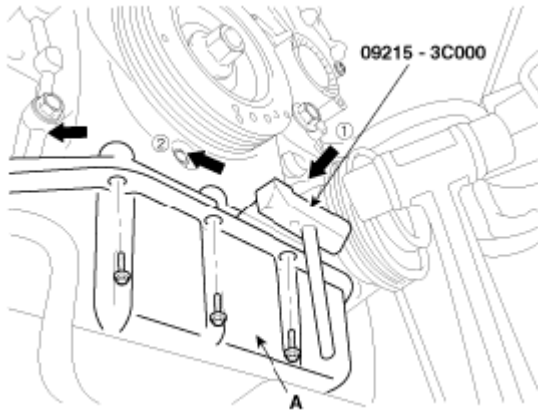


Fig. 35: Removing Lower Oil Pan

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of arrow.
- After tapping the SST with a plastic hammer along the direction of arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It be result in damage of the SST.
- Be careful not to damage the contact surfaces of Upper oil pan and lower oil pan.

22. Remove the crankshaft pulley (A).

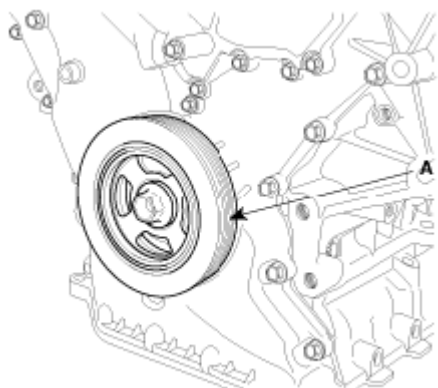


Fig. 36: Identifying Crankshaft Pulley

Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Use the SST (09231-2J200, 09231-2J210) to remove the crankshaft pulley bolt.

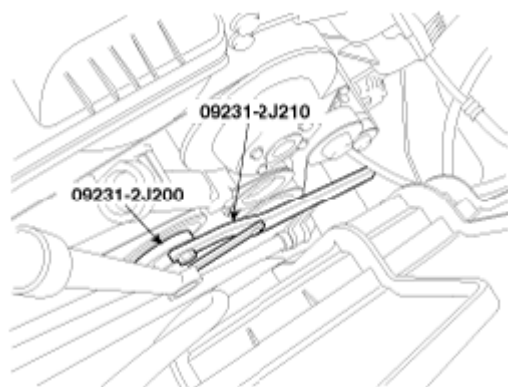


Fig. 37: Removing Crankshaft Pulley Bolt

Courtesy of KIA MOTORS AMERICA, INC.

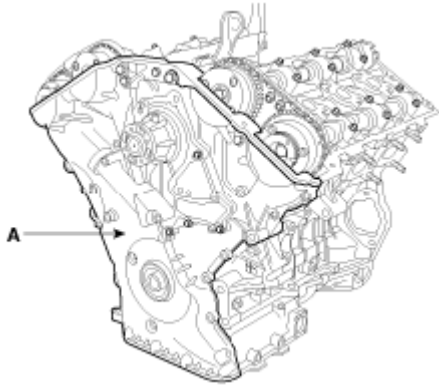
23. Remove the water vent hose (A) from the timing chain cover.



Fig. 38: Identifying Water Vent Hose

Courtesy of KIA MOTORS AMERICA, INC.

24. Remove the timing chain cover (A).

**Fig. 39: Identifying Timing Chain Cover**

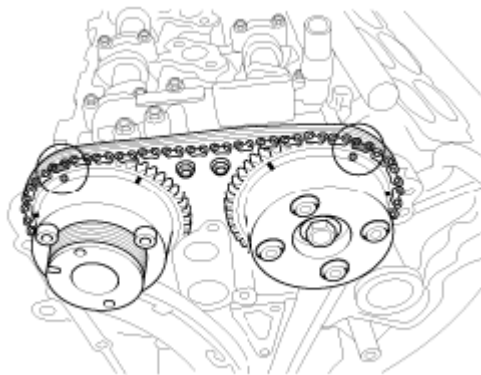
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

NOTE:

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

**Fig. 40: Identifying Marks On Sprockets & RH/LH Timing Chain (1 Of 4)**

Courtesy of KIA MOTORS AMERICA, INC.



Fig. 41: Identifying Marks On Sprockets & RH/LH Timing Chain (2 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.

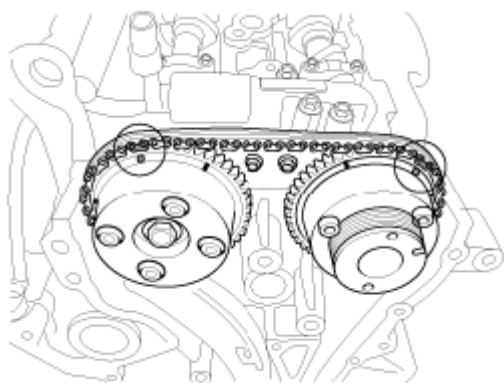


Fig. 42: Identifying Marks On Sprockets & RH/LH Timing Chain (3 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.

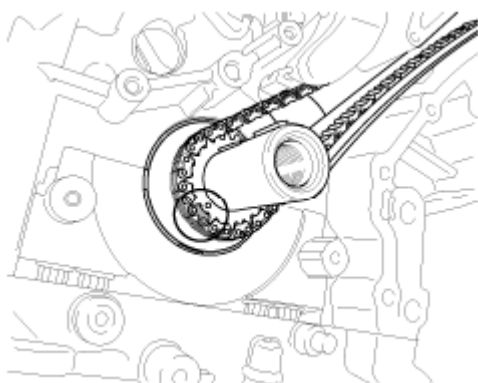


Fig. 43: Identifying Marks On Sprockets & RH/LH Timing Chain (4 Of 4)
Courtesy of KIA MOTORS AMERICA, INC.

25. Remove the oil pump chain cover (A).

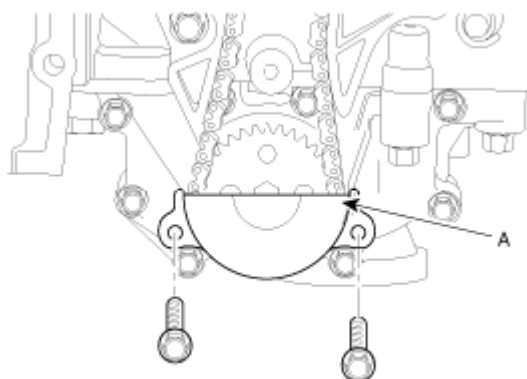


Fig. 44: Identifying Oil Pump Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

26. Remove the oil pump chain tensioner assembly (A).

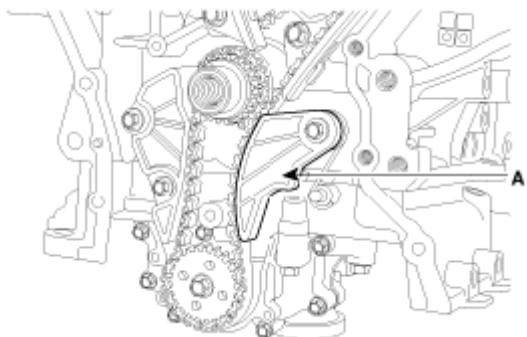


Fig. 45: Identifying Oil Pump Chain Tensioner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

27. Remove the oil pump chain guide (A).

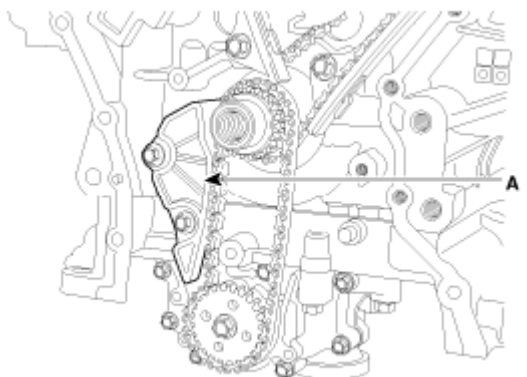


Fig. 46: Identifying Oil Pump Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

28. Install a set pin after compressing the RH timing chain tensioner.

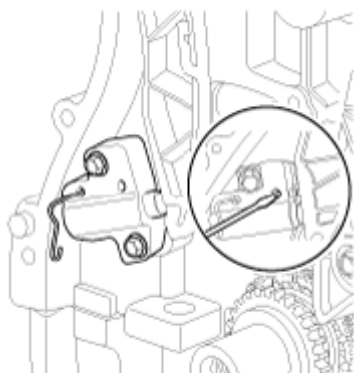


Fig. 47: Installing Set Pin After Compressing RH Timing Chain Tensioner
 Courtesy of KIA MOTORS AMERICA, INC.

29. Remove the RH timing chain auto tensioner (A) and the RH timing chain tensioner arm (B).

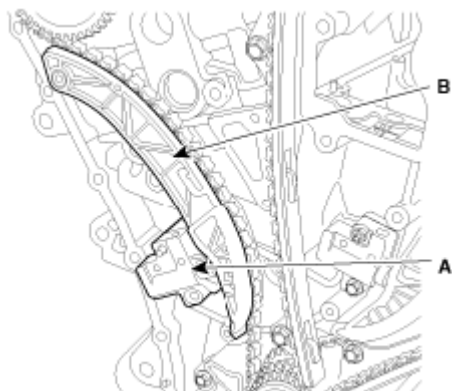


Fig. 48: Identifying RH Timing Chain Auto Tensioner & RH Timing Chain Tensioner Arm
 Courtesy of KIA MOTORS AMERICA, INC.

30. Remove the RH timing chain guide (A) and RH timing chain (B).

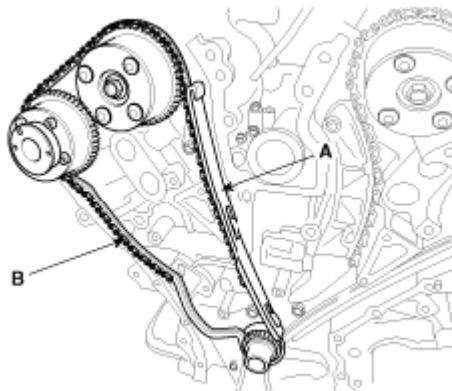


Fig. 49: Identifying RH Timing Chain Guide & RH Timing Chain
 Courtesy of KIA MOTORS AMERICA, INC.

31. Remove the oil pump chain sprocket (A) and oil pump chain (B).

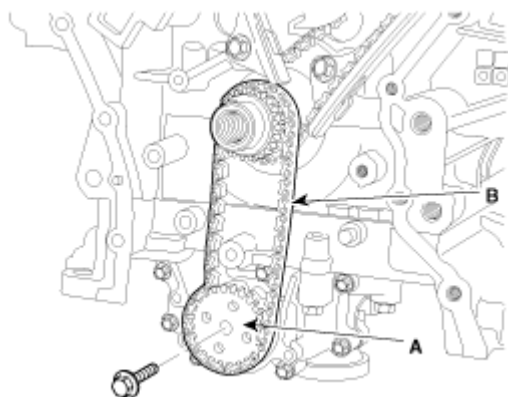


Fig. 50: Identifying Oil Pump Chain Sprocket & Oil Pump Chain
Courtesy of KIA MOTORS AMERICA, INC.

32. Remove the crankshaft sprocket (A) (O/P & RH camshaft drive).

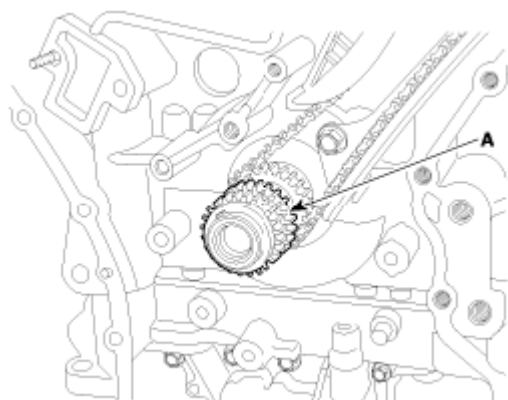


Fig. 51: Identifying Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

33. Install a set pin after compressing the LH timing chain tensioner.

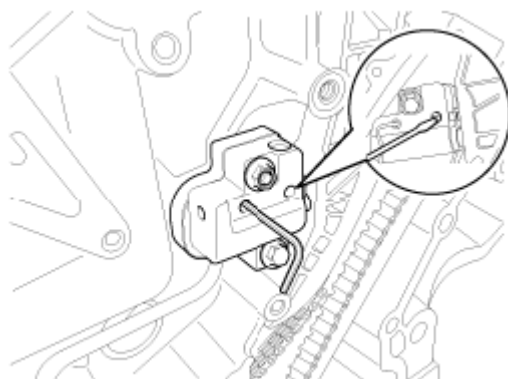


Fig. 52: Installing Set Pin After Compressing LH Timing Chain Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

34. Remove the LH timing chain auto tensioner (A) and LH timing chain tensioner arm (B).

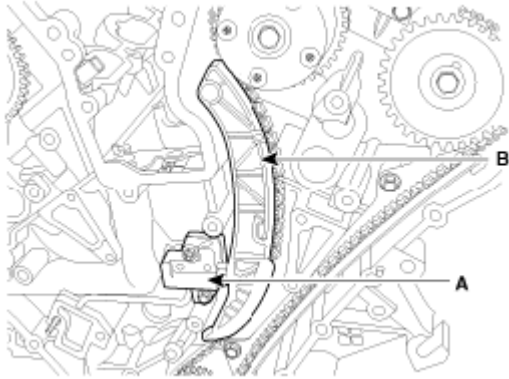


Fig. 53: Identifying LH Timing Chain Auto Tensioner & LH Timing Chain Tensioner Arm
Courtesy of KIA MOTORS AMERICA, INC.

35. Remove the LH timing chain guide (A) and LH timing chain (B).

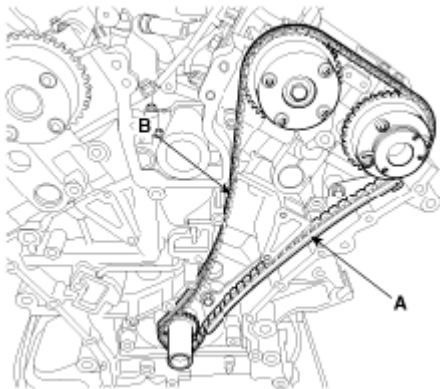


Fig. 54: Identifying LH Timing Chain Guide & LH Timing Chain
Courtesy of KIA MOTORS AMERICA, INC.

36. Remove the crankshaft sprocket (A). (LH camshaft drive).

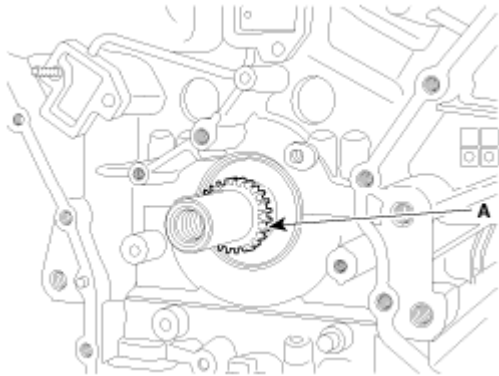


Fig. 55: Identifying Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

37. Remove the tensioner adapter assembly (A).

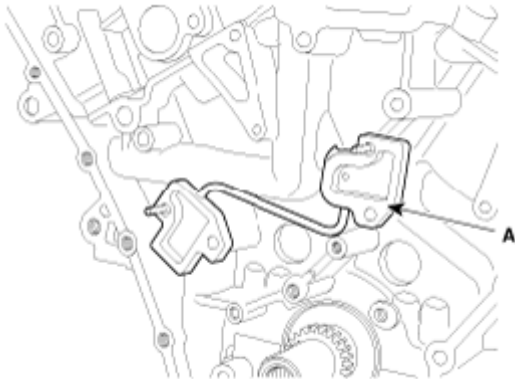


Fig. 56: Identifying Tensioner Adapter Assembly
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

INSTALLATION

1. The key (A) of crankshaft should be aligned with the timing mark (B) of timing chain cover. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.

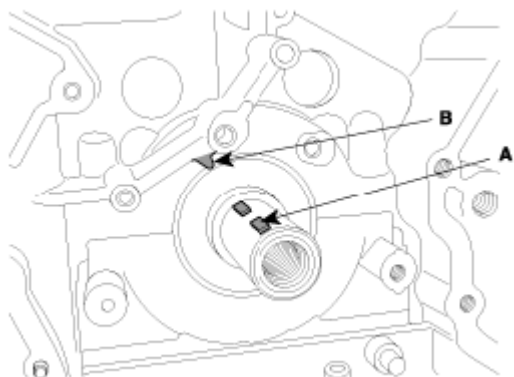


Fig. 57: Aligning Key Of Crankshaft With Timing Mark Of Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the tensioner adapter assembly (A).

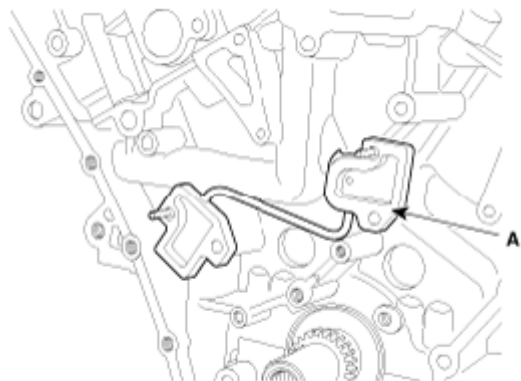


Fig. 58: Identifying Tensioner Adapter Assembly
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the crankshaft sprocket (A). (LH camshaft drive).

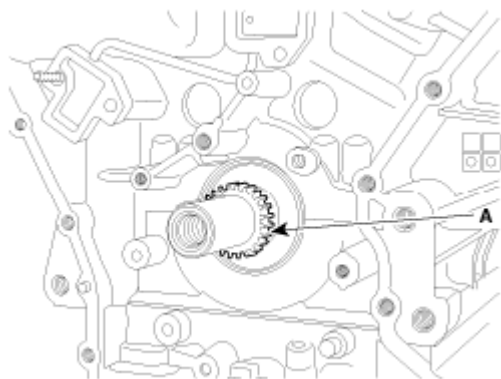


Fig. 59: Identifying Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the LH timing chain (B) and the LH timing chain guide (A).

Tightening torque:

19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)

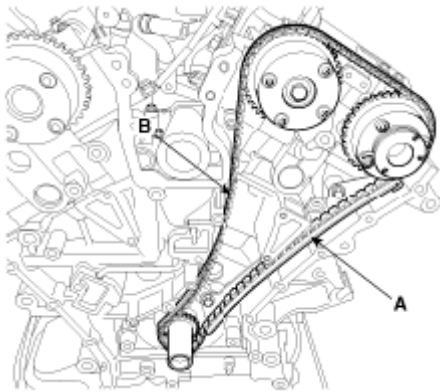


Fig. 60: Identifying LH Timing Chain & LH Timing Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: To install the timing chain with no slack between each shaft (cam, crank), perform the following procedure.
Crankshaft sprocket --> Timing chain guide --> Exhaust camshaft sprocket --> Intake camshaft sprocket.
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at during installation.

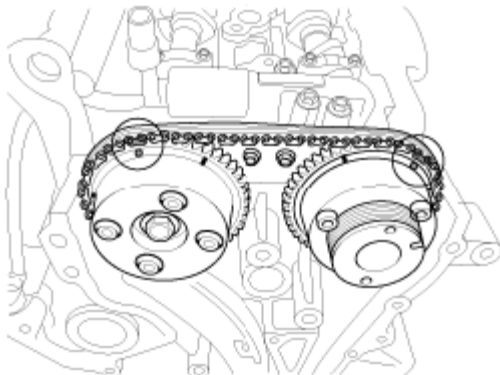


Fig. 61: Identifying Timing Mark Of Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

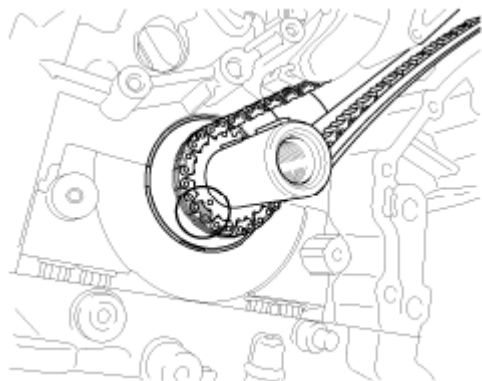


Fig. 62: Identifying Timing Mark Of Timing Chain
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the LH timing chain tensioner arm (B) and the LH timing auto tensioner (A).

Tightening torque

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

B : 18.6 ~ 21.6N.m (1.9 ~ 2.2kgf.m, 13.7 ~ 15.9lb-ft)

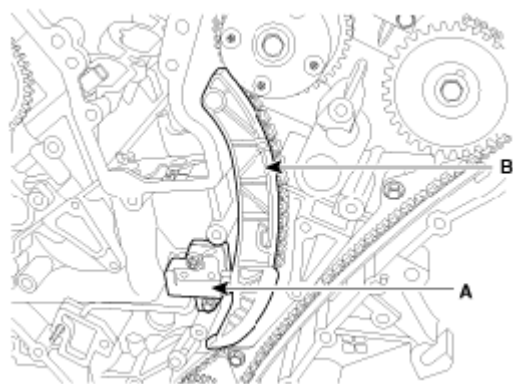


Fig. 63: Identifying LH Timing Chain Tensioner Arm & LH Timing Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the crankshaft sprocket (A) (O/P & RH camshaft drive).

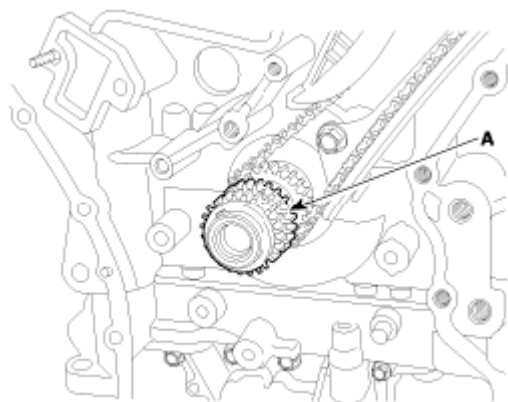


Fig. 64: Identifying Crankshaft Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the oil pump chain sprocket (A) and oil pump chain (B).

Tightening torque:

18.6 ~ 21.6N.m (1.9 ~ 2.2kgf.m, 13.7 ~ 15.9lb-ft)

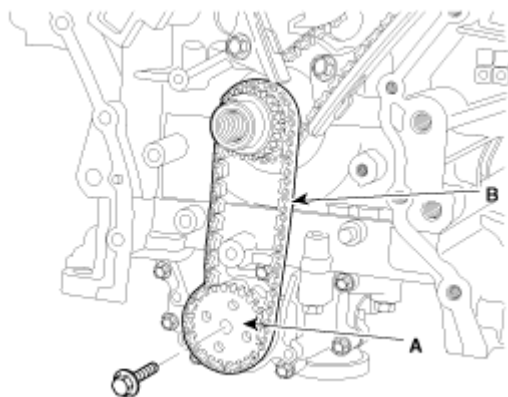


Fig. 65: Identifying Oil Pump Chain Sprocket & Oil Pump Chain
Courtesy of KIA MOTORS AMERICA, INC.

8. Install the RH timing chain (B) and the RH timing chain guide (A).

Tightening torque:

A : 19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)

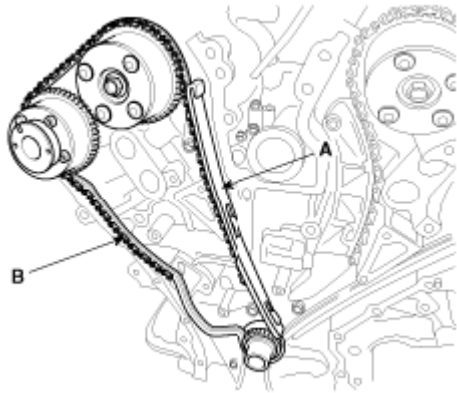


Fig. 66: Identifying RH Timing Chain & RH Timing Chain Guide

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: To install the timing chain with no slack between each shaft (cam, crank), perform the following procedure.
Crankshaft sprocket --> Timing chain guide --> Intake camshaft sprocket --> Exhaust camshaft sprocket.
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at during installation.

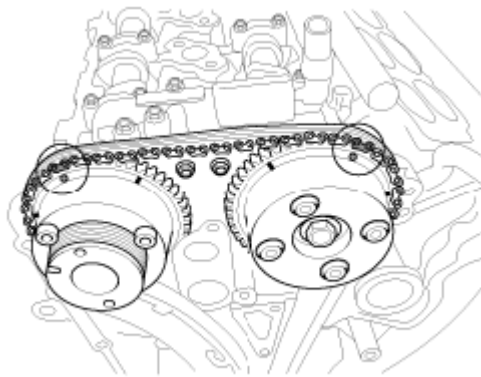


Fig. 67: Identifying Timing Mark Of Sprockets

Courtesy of KIA MOTORS AMERICA, INC.



Fig. 68: Identifying Timing Mark Of Timing Chain
Courtesy of KIA MOTORS AMERICA, INC.

9. Install the RH timing chain tensioner arm (B) and the RH timing auto tensioner (A).

Tightening torque

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

B : 18.6 ~ 21.6N.m (1.9 ~ 2.2kgf.m, 13.7 ~ 15.9lb-ft)

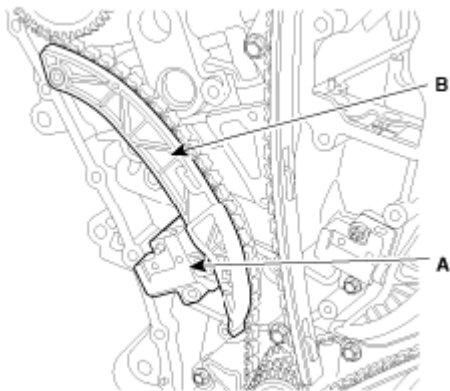


Fig. 69: Identifying RH Timing Chain Tensioner Arm & RH Timing Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the oil pump chain guide (A).

Tightening torque:

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

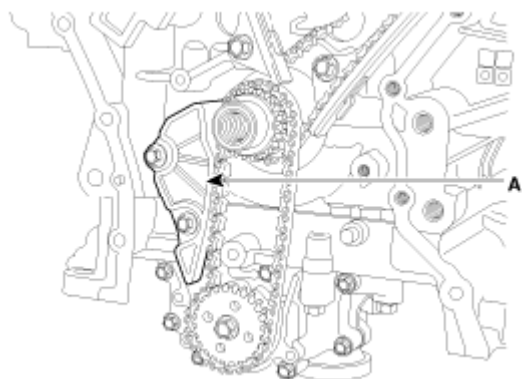


Fig. 70: Identifying Oil Pump Chain Guide
Courtesy of KIA MOTORS AMERICA, INC.

11. Install the oil pump chain tensioner assembly (A).

Tightening torque:

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

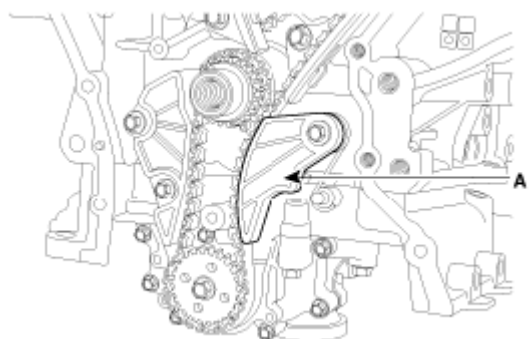


Fig. 71: Identifying Oil Pump Chain Tensioner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

12. Pull out the pins of hydraulic tensioner (LH & RH).

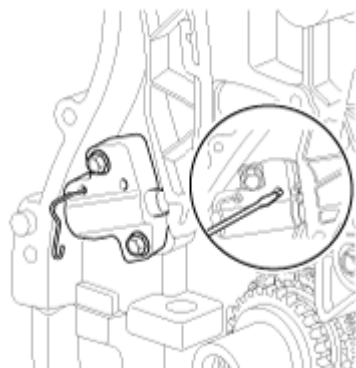


Fig. 72: Identifying Pins Of LH/RH Hydraulic Tensioners (1 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

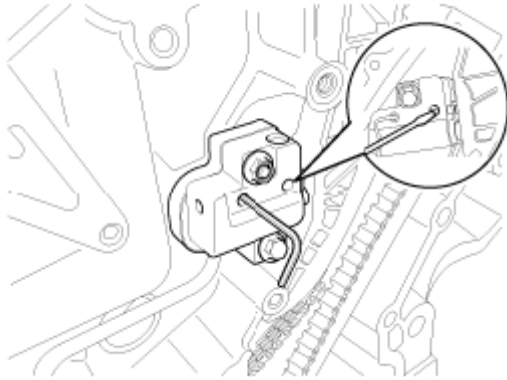


Fig. 73: Identifying Pins Of LH/RH Hydraulic Tensioners (2 Of 2)
 Courtesy of KIA MOTORS AMERICA, INC.

13. Install the oil pump chain cover (A).

Tightening torque:

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

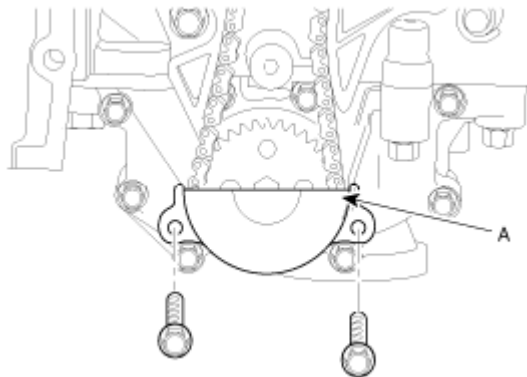


Fig. 74: Identifying Oil Pump Chain Cover
 Courtesy of KIA MOTORS AMERICA, INC.

14. After rotating the crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.

NOTE: Always turn the crankshaft clockwise.
 Turning the crankshaft counter clockwise before building up oil pressure in the hydraulic timing chain tensioner may result in the chain disengaging from the sprocket teeth.

15. Install the timing chain cover.

1. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and lower oil pan) must be free of engine oil and etc.
2. Before assembling the timing chain cover, the liquid sealant TB 1217H should be applied on the gap between cylinder head and cylinder block.

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

Bead width : 2.5mm (0.1in.)

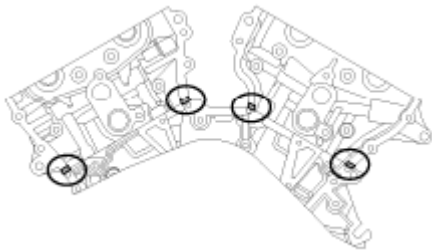


Fig. 75: Identifying Locations For Sealant Application
Courtesy of KIA MOTORS AMERICA, INC.

3. After applying liquid sealant TB1217H on timing chain cover. The part must be assembled within 5 minutes after sealant was applied.

Sealant should be applied in a continuous bead in each of the areas indicated below.

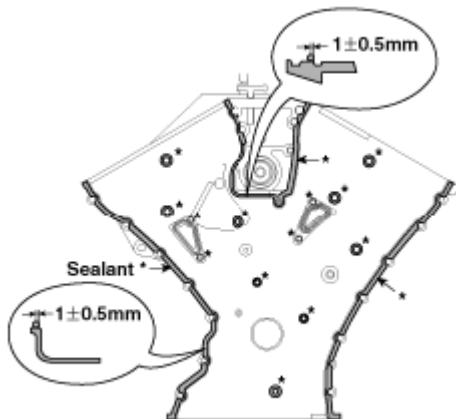


Fig. 76: Applying Liquid Sealant On Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the new gasket (A) to the timing chain cover.

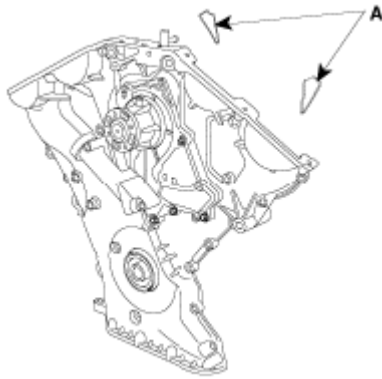


Fig. 77: Installing New Gasket To Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

5. The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover correctly.

Tightening torque

B (17) :

18.62 ~ 21.56N.m (1.9 ~ 2.2kgf.m, 13.74 ~ 15.91lb-ft)

C (4) :

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

D (2) :

58.80 ~ 68.80N.m (6.0 ~ 7.0kgf.m, 43.40 ~ 50.63lb-ft)

F (2) :

24.50 ~ 26.46N.m (2.5 ~ 2.7kgf.m, 18.08 ~ 19.53lb-ft)

G (4) :

21.56 ~ 23.52N.m (2.2 ~ 2.4kgf.m, 15.91 ~ 17.36lb-ft)

H (1) :

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

I (1) :

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

J (1) :

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

K (4) :

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

L (1):

21.56 ~ 26.46N.m (2.2 ~ 2.7kgf.m, 15.91 ~ 19.53lb-ft)

- New bolt

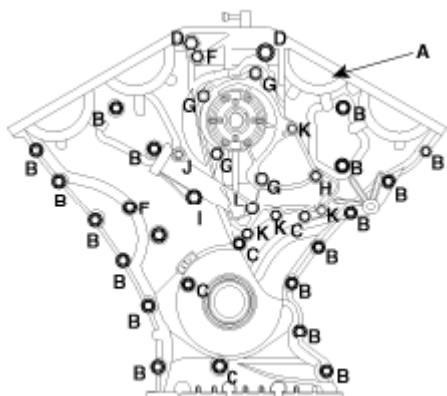


Fig. 78: Identifying Timing Cover Bolts
Courtesy of KIA MOTORS AMERICA, INC.

6. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.
16. Install the water vent hose (A) to the timing chain cover.



Fig. 79: Identifying Water Vent Hose

Courtesy of KIA MOTORS AMERICA, INC.

17. Using SST (09231-3C100), install timing chain cover oil seal.

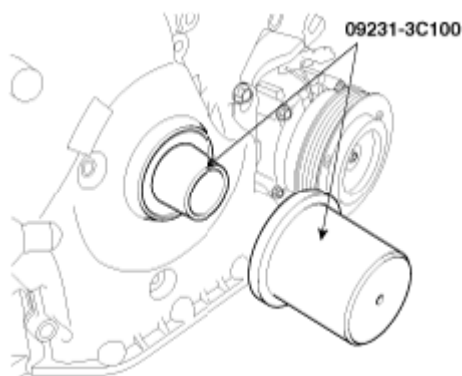


Fig. 80: Installing Timing Chain Cover Oil Seal

Courtesy of KIA MOTORS AMERICA, INC.

18. Install the lower oil pan (A).
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB 1217H should be applied on oil pan. The part must be assembled within 5 minutes after the sealant was applied.

Bead width : 2.5mm (0.1in.)

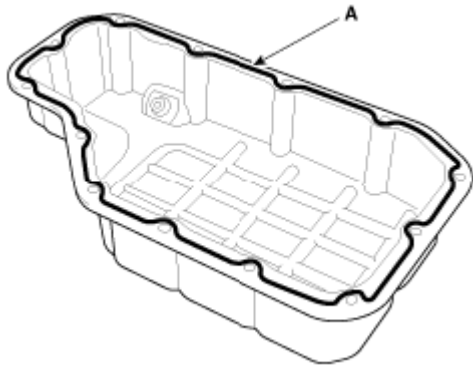


Fig. 81: Identifying Lower Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:

- Clean the sealing face 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.

3. Install the oil pan (A).
4. Uniformly tighten the bolts in several passes.

Tightening torque:

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

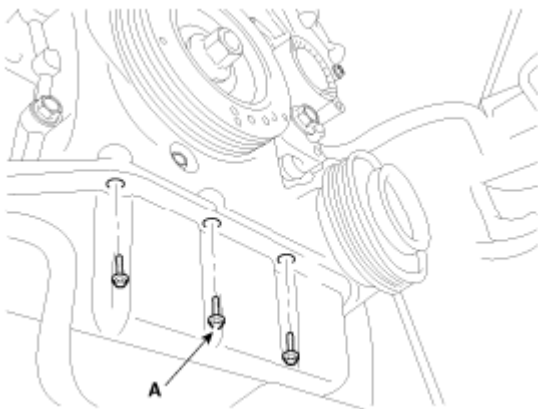


Fig. 82: Identifying Oil Pan Bolts
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the crankshaft pulley (A).

Tightening torque:

284.4 ~ 304.0N.m (29.0~31.0kgf.m, 209.8~224.2lb-ft)

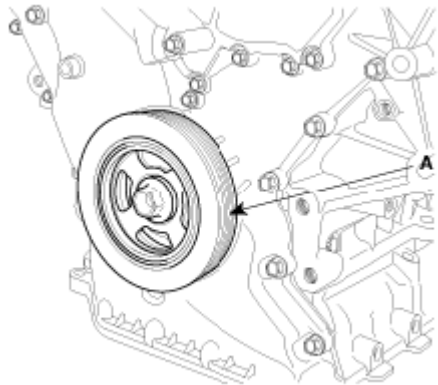


Fig. 83: Identifying Crankshaft Pulley
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- Use the SST (09231-2J200, 09231-2J210) to install the crankshaft pulley bolt.

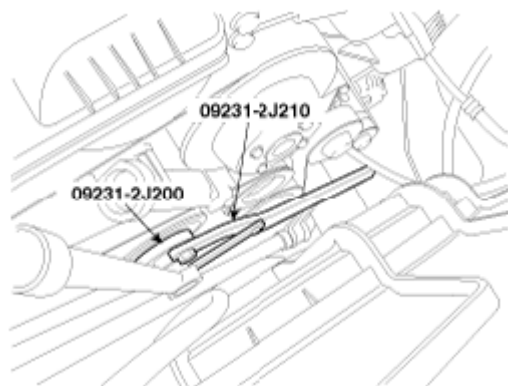


Fig. 84: Installing Crankshaft Pulley Bolt
Courtesy of KIA MOTORS AMERICA, INC.

20. Install the water pump pulley (A).

Tightening torque:

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

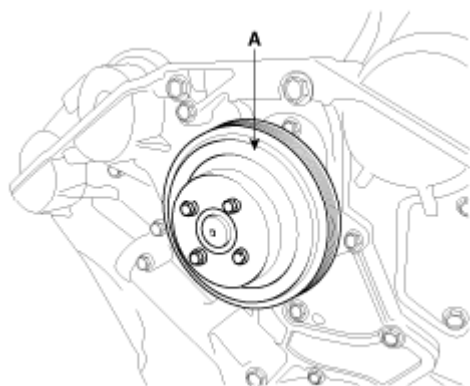


Fig. 85: Identifying Water Pump Pulley
 Courtesy of KIA MOTORS AMERICA, INC.

21. Install the drive belt auto tensioner (A).

Tightening torque

Bolt (B) :

81.4 ~ 85.3N.m (8.3 ~ 8.7kgf.m, 60.0 ~ 62.9lb-ft)

Bolt (C) :

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

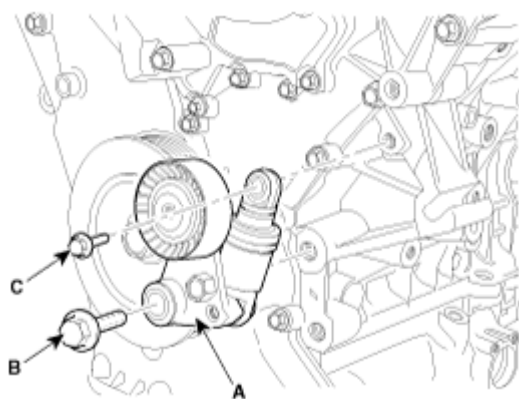


Fig. 86: Identifying Drive Belt Auto Tensioner
 Courtesy of KIA MOTORS AMERICA, INC.

22. Install the drive belt idler (A).

Tightening torque:

52.9 ~ 57.9N.m (5.4 ~ 5.9kgf.m, 39.1 ~ 42.7lb-ft)

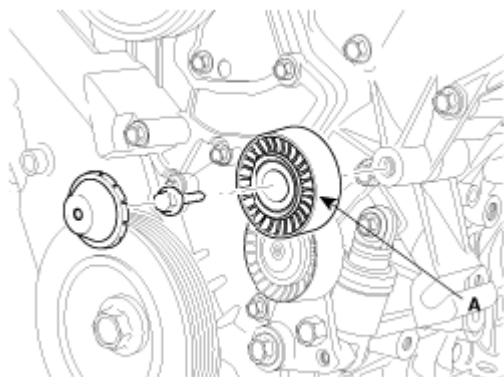


Fig. 87: Identifying Drive Belt Idler
Courtesy of KIA MOTORS AMERICA, INC.

23. Install the drive belt (A).

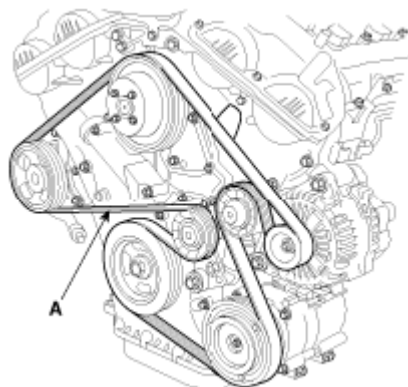


Fig. 88: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

24. Install the LH/RH 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 (TB1217H), it should be assembled within 5 minutes.

Bead width : 2.5mm (0.1in.)

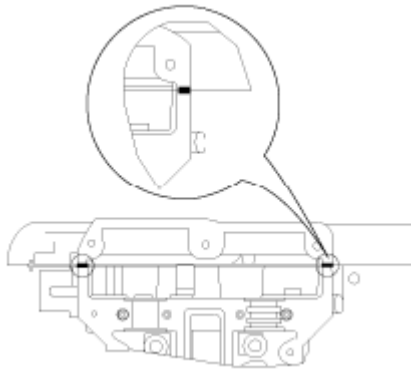


Fig. 89: Identifying Sealant Location On Upper Area Between Timing Chain Cover & Cylinder Head
 Courtesy of KIA MOTORS AMERICA, INC.

3. The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.
4. Install the cylinder head cover bolts as shown in **Fig. 90**.

Tightening torque:

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

CAUTION: Do not reuse cylinder head cover gasket.

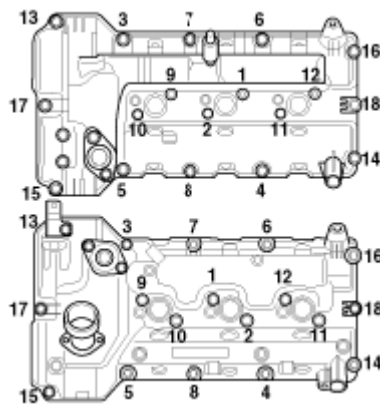


Fig. 90: Identifying Tightening Sequence Of Cylinder Head Cover Bolts
 Courtesy of KIA MOTORS AMERICA, INC.

25. Install the LH/RH ignition coils (A).

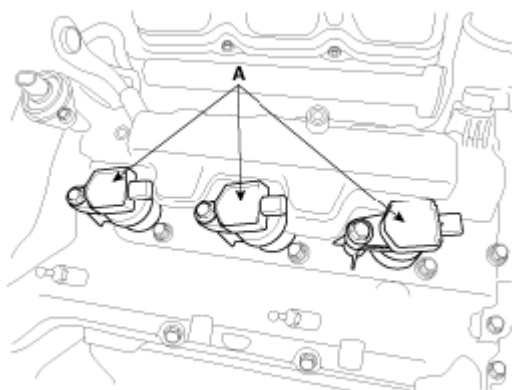


Fig. 91: Identifying LH Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

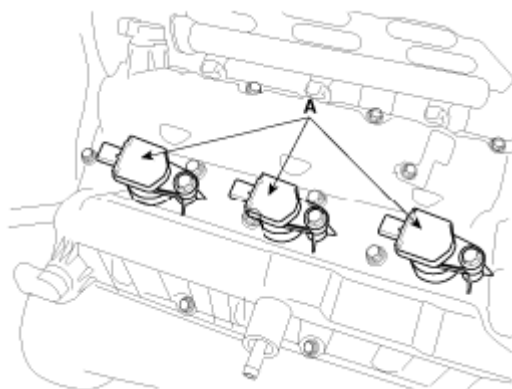


Fig. 92: Identifying RH Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

26. Connect the RH ignition coil connector (A) and the injector connector (B).

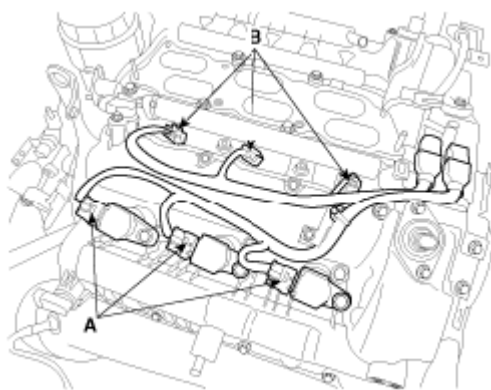


Fig. 93: Identifying RH Ignition Coil Connector & Injector Connector
Courtesy of KIA MOTORS AMERICA, INC.

27. Install the coolant pipe (A).

Tightening torque:

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

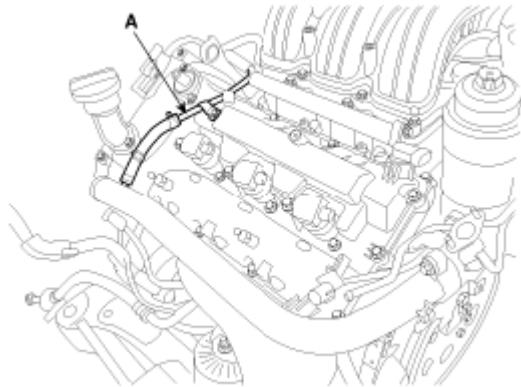


Fig. 94: Identifying Coolant Pipe
Courtesy of KIA MOTORS AMERICA, INC.

28. Install the surge tank (A).

Tightening torque:

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

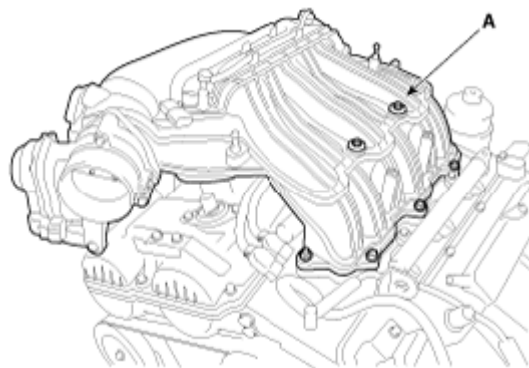


Fig. 95: Identifying Surge Tank
Courtesy of KIA MOTORS AMERICA, INC.

29. Connect the throttle body coolant hoses (A), breather hose (B) and tighten the surge tank stay bolts (C).

Tightening torque:

27.5 ~ 31.4N.m (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)

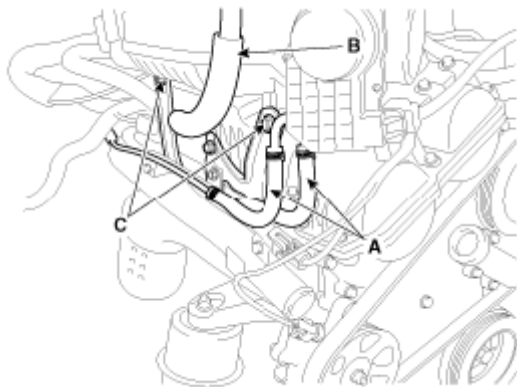


Fig. 96: Identifying Throttle Body Coolant Hoses, Breather Hose, & Surge Tank Stay Bolts
Courtesy of KIA MOTORS AMERICA, INC.

30. Connect the engine wiring connectors.

1. Connect the water temperature sensor connector (A) and oil temperature sensor connector (B).

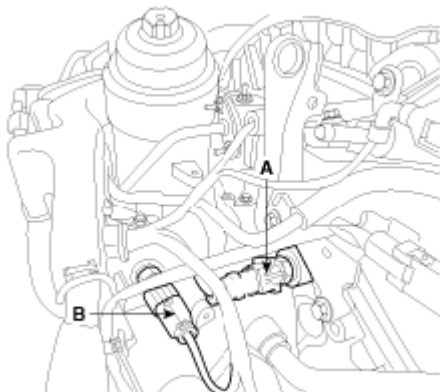


Fig. 97: Identifying Connectors For Water Temperature Sensor & Oil Temperature Sensor
Courtesy of KIA MOTORS AMERICA, INC.

2. Connect the VIS solenoid valve connector (A), PCSV connector (B), RH oxygen sensor connector (C) and the RH exhaust camshaft CMP sensor connector (D).

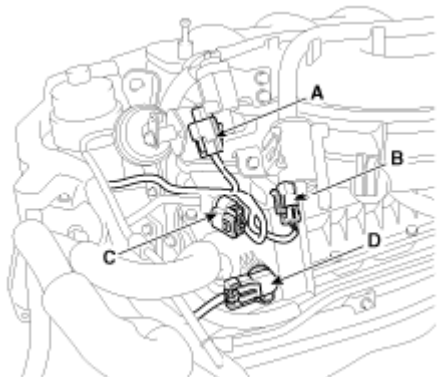


Fig. 98: Identifying Connectors For VIS Solenoid Valve, PCSV, RH Oxygen Sensor, & RH Exhaust Camshaft CMP Sensor
Courtesy of KIA MOTORS AMERICA, INC.

3. Connect the LH intake camshaft CMP sensor connector (A), RH intake camshaft CMP sensor connector (B) and condenser connector (C).

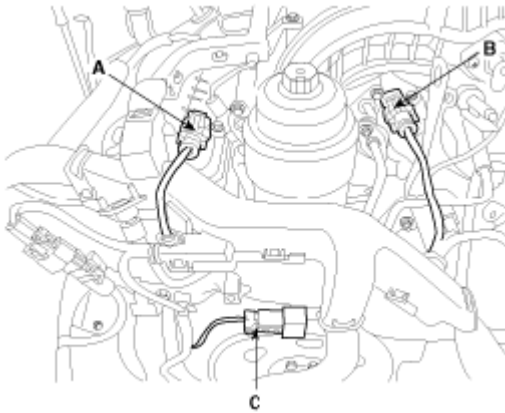


Fig. 99: Identifying Connectors For LH Intake Camshaft CMP Sensor, RH Intake Camshaft CMP Sensor, & Condenser
Courtesy of KIA MOTORS AMERICA, INC.

4. Connect the oil pressure switch connector (A), LH exhaust camshaft CMP sensor connector (B) and LH oxygen sensor connector (C).

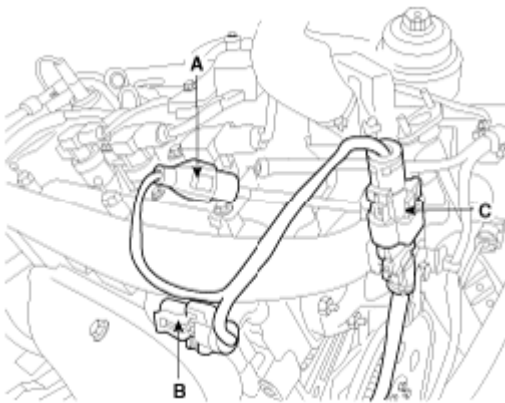


Fig. 100: Identifying Connectors For Oil Pressure Switch, LH Exhaust Camshaft CMP Sensor, & LH Oxygen Sensor
Courtesy of KIA MOTORS AMERICA, INC.

5. Connect the LH injector connector (A) and LH ignition coil connector (B).

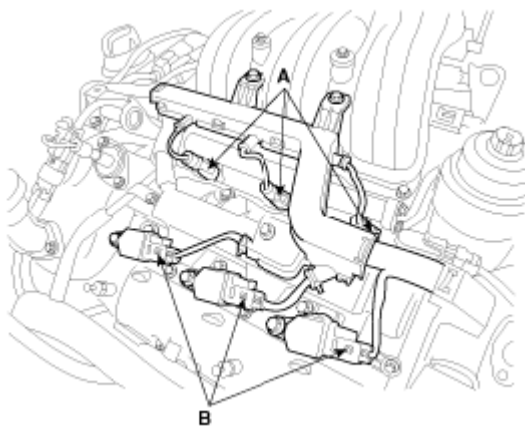


Fig. 101: Identifying Connectors For LH Injector & LH Ignition Coil
Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the LH knock sensor connector (A), LH/RH intake OCV connector (B) and LH exhaust OCV connector (C).

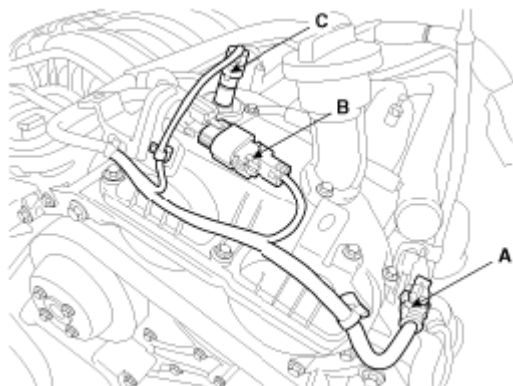


Fig. 102: Identifying Connectors For LH Knock Sensor, LH/RH Intake OCV, & LH Exhaust OCV
Courtesy of KIA MOTORS AMERICA, INC.

7. Connect the MAP sensor connector (A), ETC connector (B), RH exhaust OCV connector (C), RH injector connector (D) and RH ignition coil connector (E).

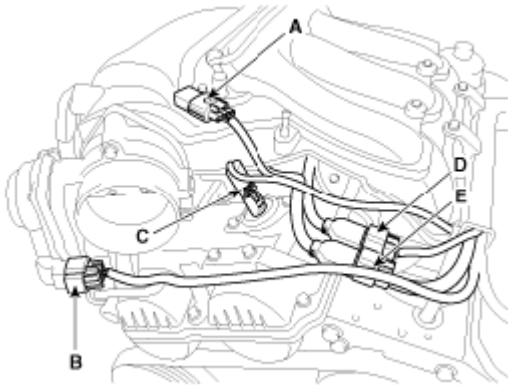


Fig. 103: Identifying Connectors For MAP Sensor, ETC, RH Exhaust OCV, RH Injector, & RH Ignition Coil
Courtesy of KIA MOTORS AMERICA, INC.

8. Connect the power steering oil pressure switch connector (A) and RH knock sensor connector (B).

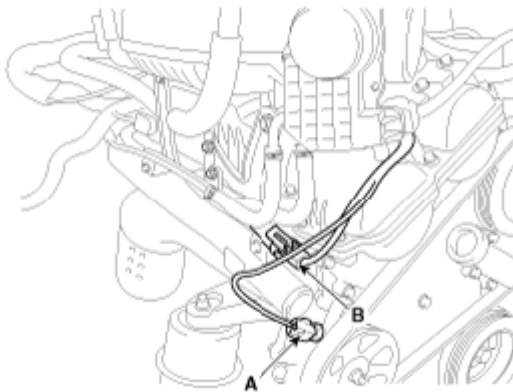


Fig. 104: Identifying Connectors For Power Steering Oil Pressure Switch & RH Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

31. Install the cooling fan assembly (B) and connect the fan connector (A).

Tightening torque :

8.8 ~ 13.7N.m (0.9 ~ 1.4kgf.m, 6.5 ~ 10.1lb-ft)

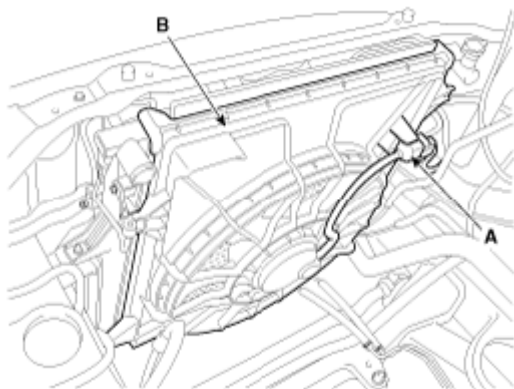


Fig. 105: Identifying Cooling Fan Assembly & Fan Connector
Courtesy of KIA MOTORS AMERICA, INC.

32. Connect the purge control solenoid valve (PCSV) hose (A) and the brake booster vacuum hose (B).

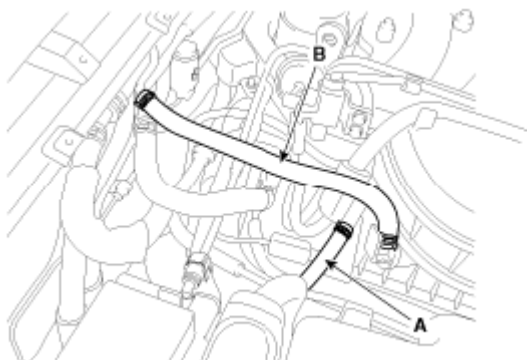


Fig. 106: Identifying Purge Control Solenoid Valve Hose & Brake Booster Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

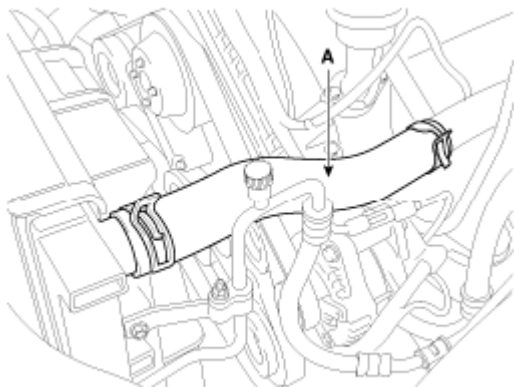


Fig. 107: Identifying Radiator Upper Hose
Courtesy of KIA MOTORS AMERICA, INC.

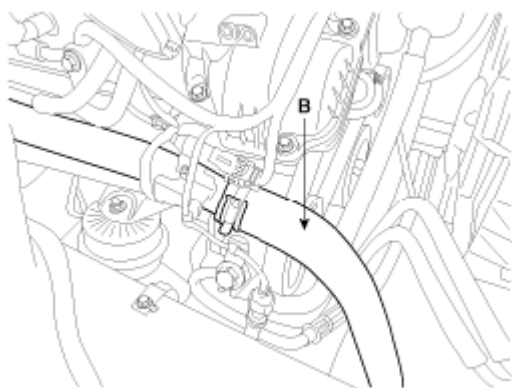


Fig. 108: Identifying Radiator Lower Hose
Courtesy of KIA MOTORS AMERICA, INC.

34. Install the air cleaner assembly (C), and connect the AFS connector (A), breather hose (B).

Tightening torque:

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

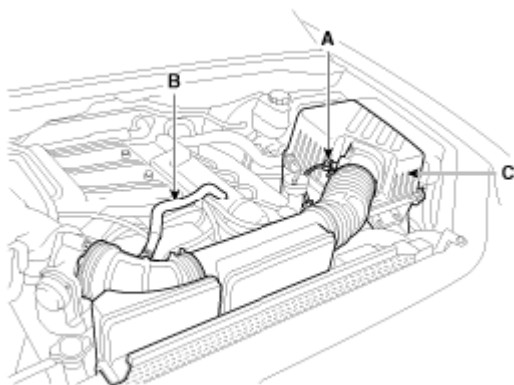


Fig. 109: Identifying Air Cleaner Assembly, AFS Connector, & Breather Hose
Courtesy of KIA MOTORS AMERICA, INC.

35. Install the radiator grill upper guard (A).

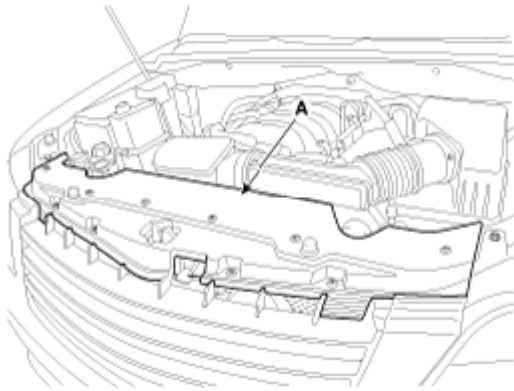


Fig. 110: Identifying Radiator Grill Upper Guard
Courtesy of KIA MOTORS AMERICA, INC.

36. Install the engine cover (A).

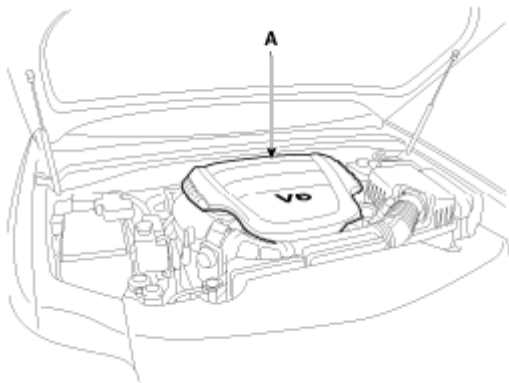


Fig. 111: Identifying Engine Cover
Courtesy of KIA MOTORS AMERICA, INC.

37. Connect the battery negative cable (A).

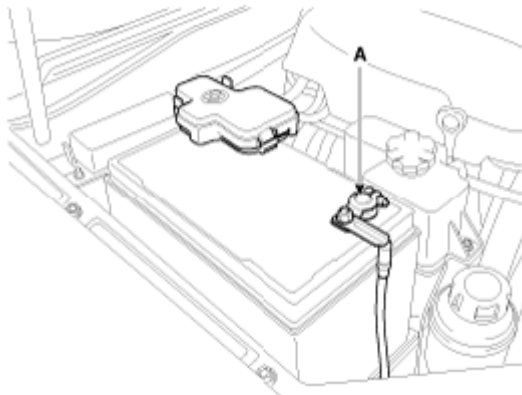


Fig. 112: Connecting Battery Negative Cable
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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