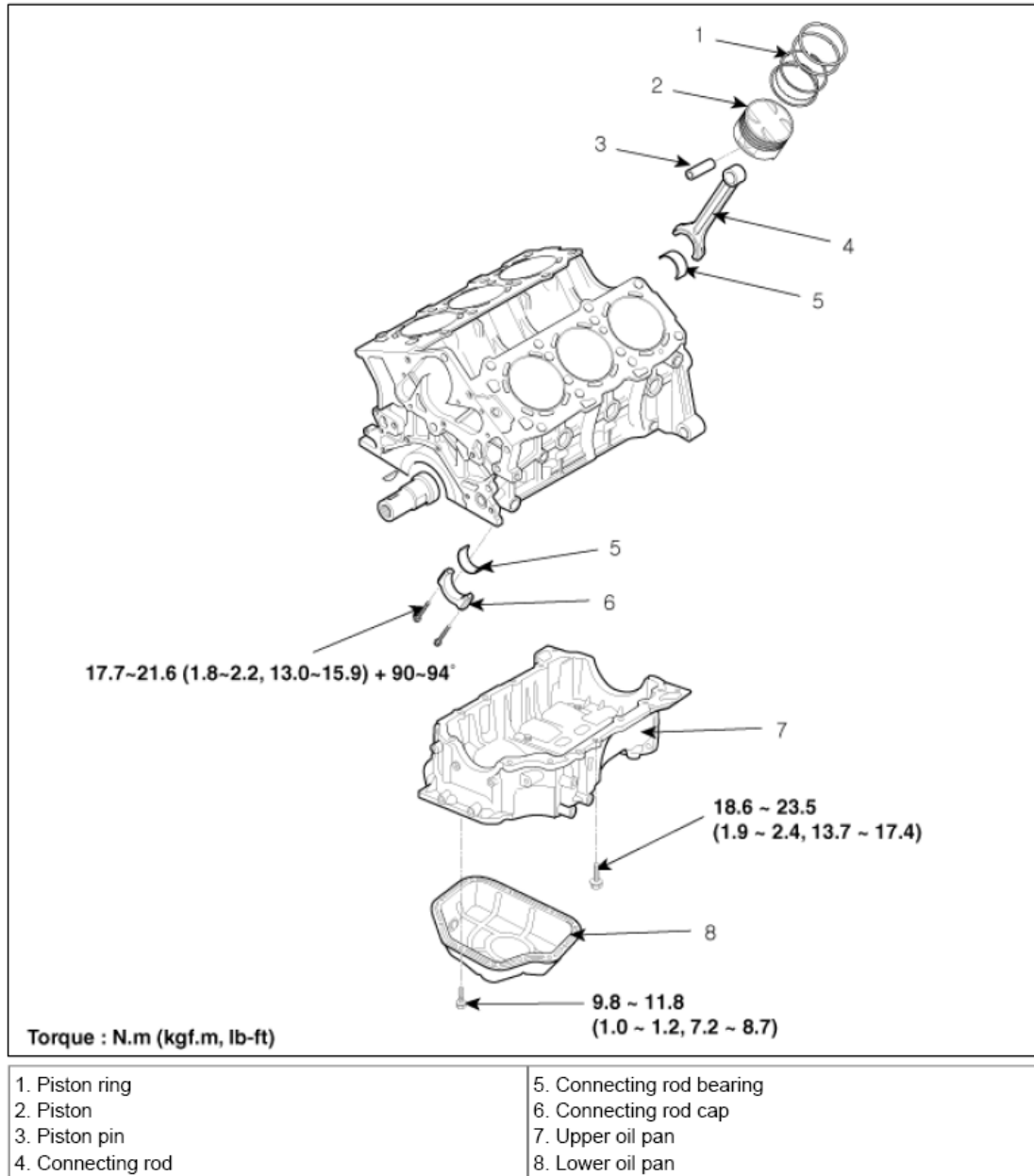


## 2009 ENGINE

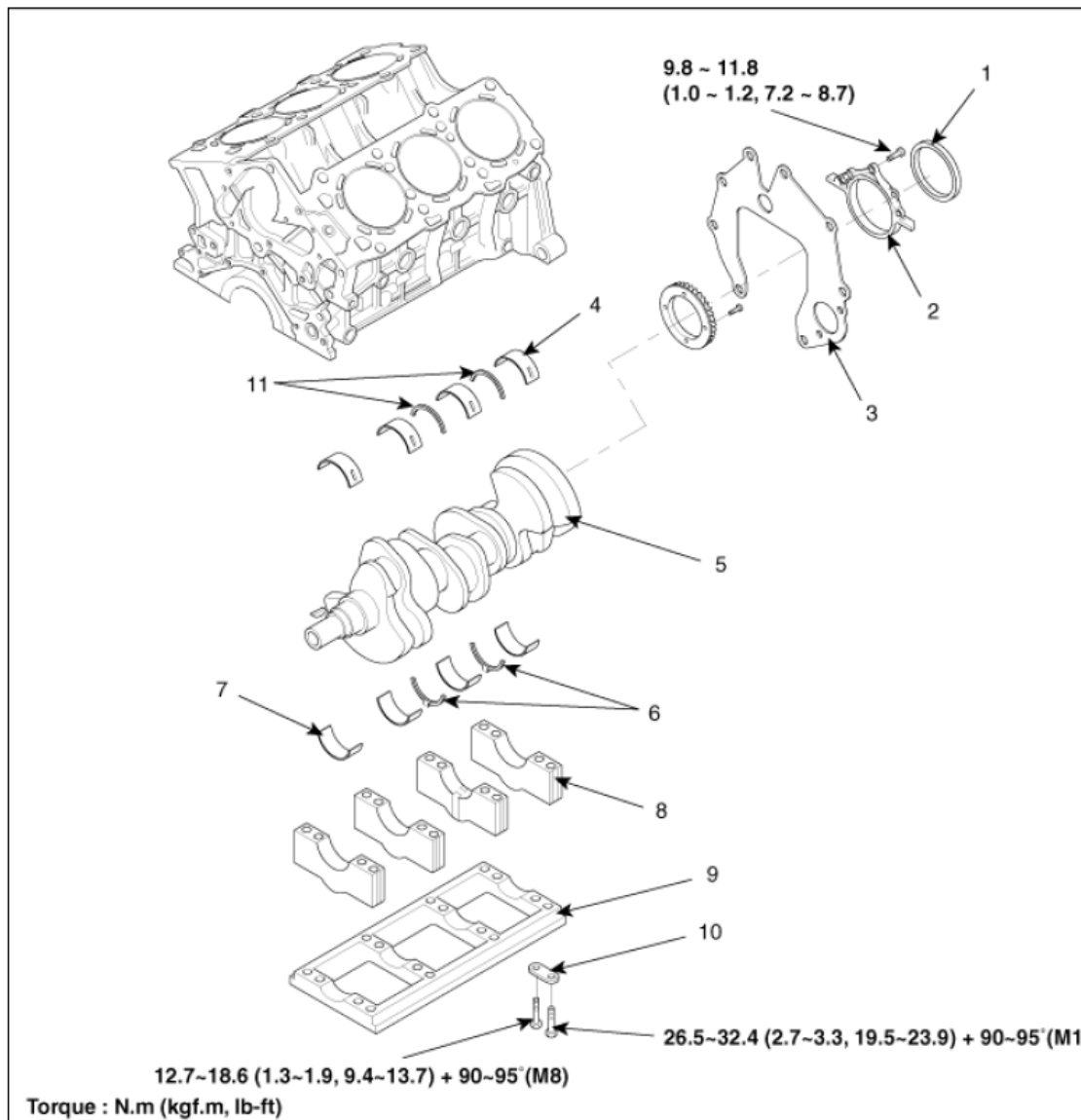
### Cylinder Block - 2.7L - Magnetis & Optima

## COMPONENTS AND COMPONENTS LOCATION

### COMPONENTS



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



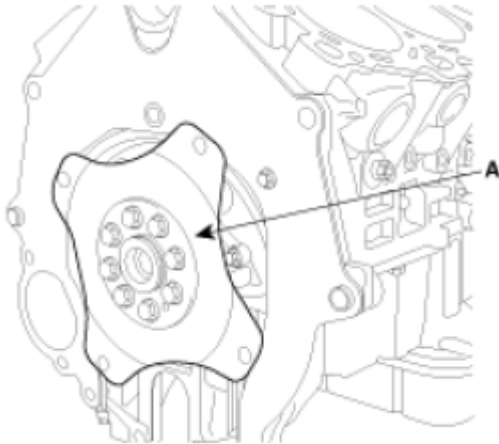
- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Rear oil seal            | 7. Crankshaft lower bearing |
| 2. Rear oil seal case       | 8. Main bearing cap         |
| 3. Rear plate               | 9. Bearing cap bridge       |
| 4. Crankshaft upper bearing | 10. Bearing cap bolt washer |
| 5. Crankshaft               | 11. Upper thrust bearing    |
| 6. Lower thrust bearing     |                             |

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

## REPAIR PROCEDURES

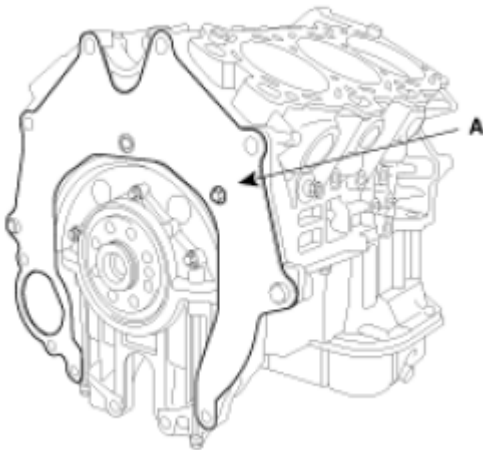
### REMOVAL

1. Remove the drive plate (A).

**Fig. 3: Identifying Drive Plate**

Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the rear plate (A).

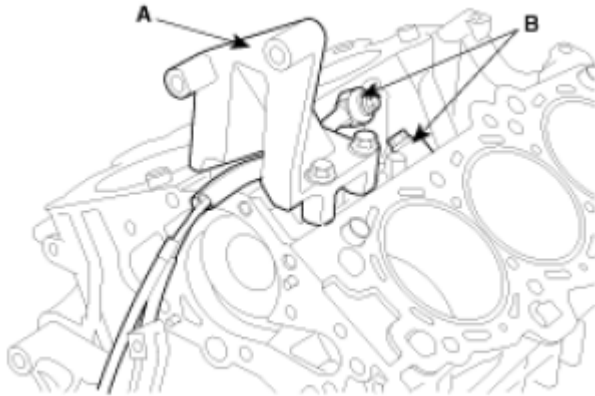
**Fig. 4: Identifying Rear Plate**

Courtesy of KIA MOTORS AMERICA, INC.

3. Remove timing belt.
4. Remove intake manifold.
5. Remove exhaust manifold.
6. Remove generator from engine.(Refer to **CHARGING SYSTEM** ).
7. Remove power steering pump from engine.(Refer to **HYDRAULIC POWER STEERING SYSTEM** ).
8. Remove cylinder head.
9. Remove A/C compressor from engine.(Refer to **AIR CONDITIONING SYSTEM** ).
10. Remove water pump assembly.

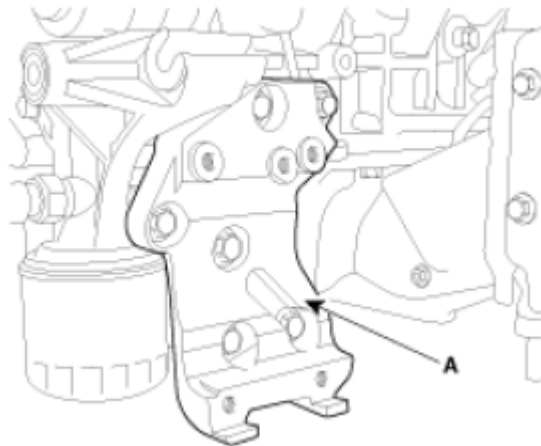
## **DISASSEMBLY**

1. Remove the power steering pump bracket (A) and the knock sensor (B).



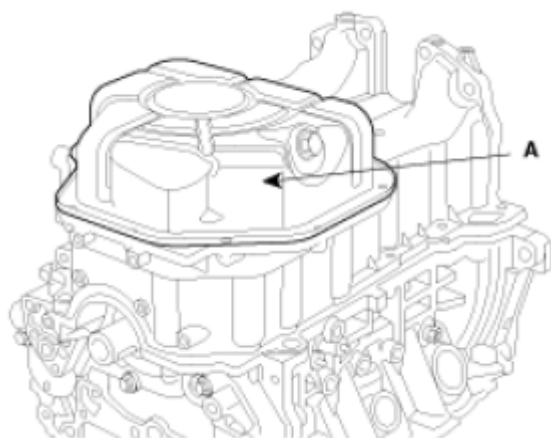
**Fig. 5: Identifying Power Steering Pump Bracket And Knock Sensor**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the air conditioning compressor bracket (A).



**Fig. 6: Identifying Air Conditioning Compressor Bracket**  
Courtesy of KIA MOTORS AMERICA, INC.

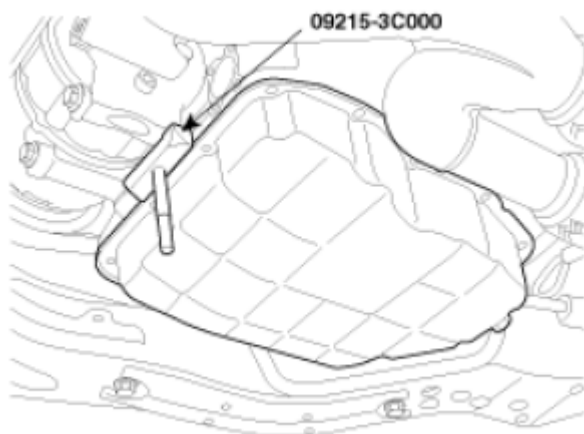
3. Remove the lower oil pan (A).



**Fig. 7: Identifying Lower Oil Pan**

Courtesy of KIA MOTORS AMERICA, INC.

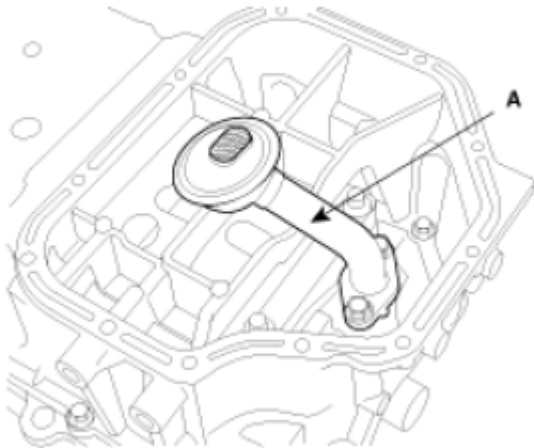
**CAUTION:** When removing the oil pan, use the SST (09215-3C000) not to damage the contacting surface of the oil pan.



**Fig. 8: Contacting Surface Of Oil Pan**

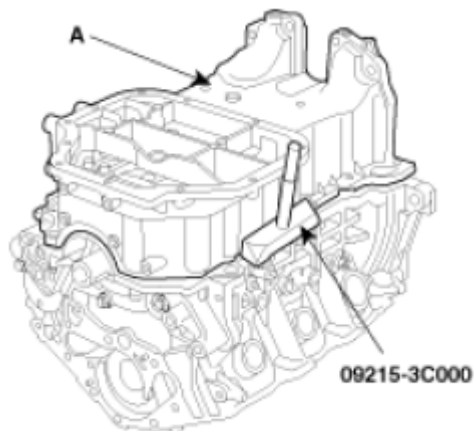
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the oil screen (A).

**Fig. 9: Identifying Oil Screen**

Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the upper oil pan (A).

**Fig. 10: Identifying Upper Oil Pan**

Courtesy of KIA MOTORS AMERICA, INC.

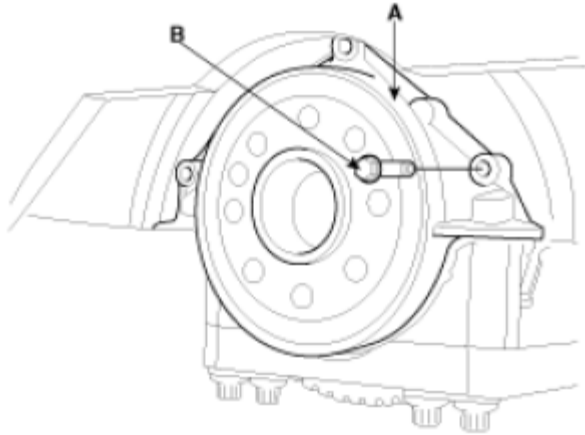
**CAUTION:** When removing the oil pan, use the SST (09215-3C000) not to damage the contacting surface of the oil pan.

6. Check the connecting rod side clearance.
7. Check the connecting rod bearing oil clearance.
8. Remove the piston and connecting rod assemblies.

**NOTE:**

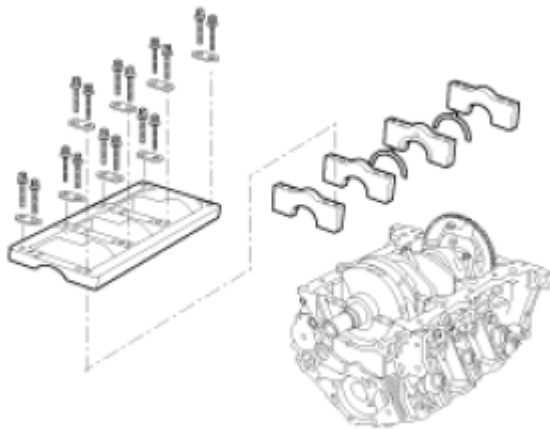
- Keep the bearings the connecting rods and the caps together.
- Arrange the piston and connecting rod assemblies in the correct order.

9. Remove the oil pump case.
10. Remove the oil seal case (A).



**Fig. 11: Identifying Oil Seal Case**  
Courtesy of KIA MOTORS AMERICA, INC.

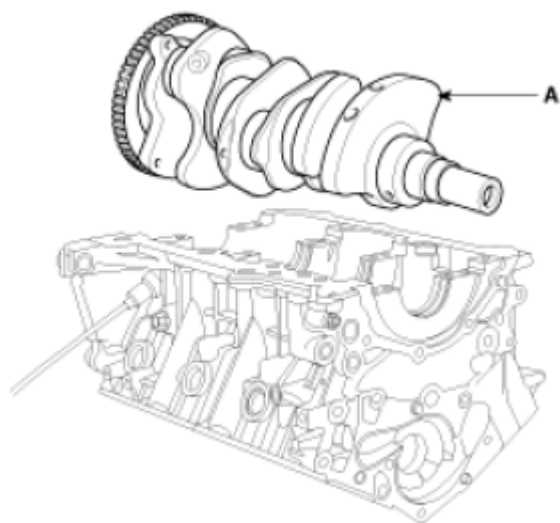
11. Check the crankshaft end play.
12. Remove the crankshaft bearing cap and check oil clearance.



**Fig. 12: Identifying Crankshaft End Play**  
Courtesy of KIA MOTORS AMERICA, INC.

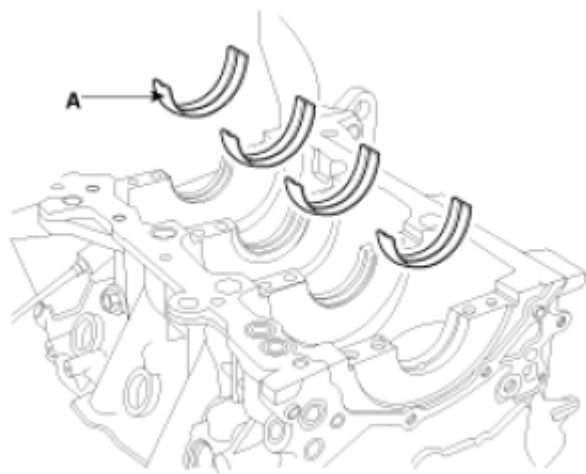
**NOTE:**        **Arrange the bearings and the bearing caps in order.**

13. Lift the crankshaft (A) out of the block, being careful not to damage journals.



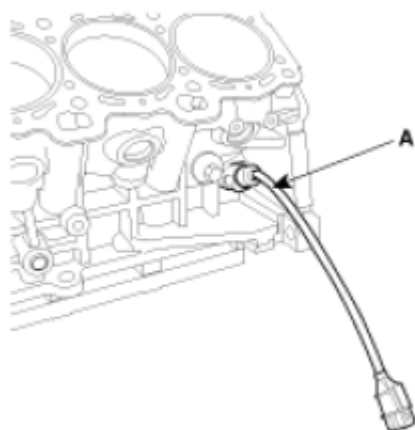
**Fig. 13: Identifying Crankshaft Of Block**  
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove and arrange the main bearings and thrust bearings in the correct order.



**Fig. 14: Identifying Main Bearings And Thrust Bearings**  
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the CKP sensor (A).



**Fig. 15: Identifying CKP Sensor**

Courtesy of KIA MOTORS AMERICA, INC.

16. Check the free play between a piston and a piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and the piston pin as a set.

17. Remove the piston rings.

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

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

18. Disconnect the connecting rod from the piston.

Using a press, remove the piston pin from the piston.

(Press-in load: 2451.7 ~ 12258.3N (250 ~ 1250kg, 551.2 ~ 2755.81lb))

## INSPECTION

### Connecting Rod And Crankshaft

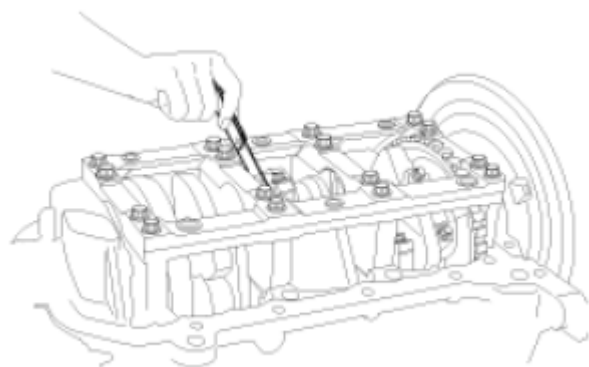
1. Check the connecting rod side clearance.

Using a feeler gauge, measure the side clearance while moving the connecting rod back and forth.

### Specification

Standard: 0.1~ 0.25mm (0.0039 ~ 0.0098in.)

Limit: 0.4mm (0.0157in.)



**Fig. 16: Checking Connecting Rod Side Clearance**  
Courtesy of KIA MOTORS AMERICA, INC.

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

#### **Tightening torque**

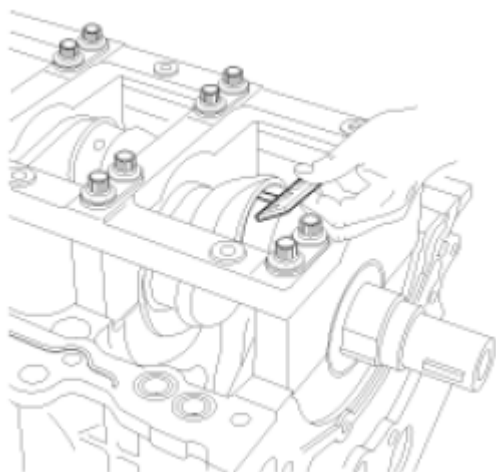
17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 90~94°

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

7. Remove the connecting rod cap again.
8. Measure the plastigage at its widest point.

#### **Standard oil clearance**

0.018 ~ 0.036mm (0.0007 ~ 0.0014in.)



**Fig. 17: Measuring Plastigage At Its 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. 18: Identifying Connecting Rod Mark Location**  
Courtesy of KIA MOTORS AMERICA, INC.

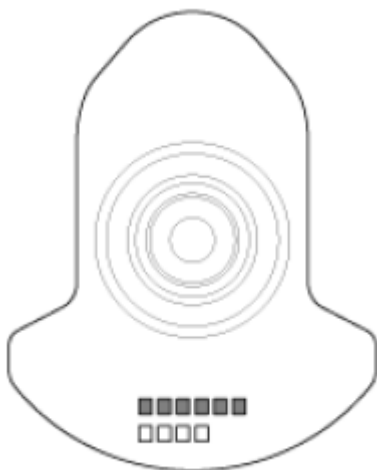
#### Discrimination Of Connecting Rod

##### CONNECTING ROD MARK SPECIFICATION

| Class | Mark | Inside Diameter                           |
|-------|------|-------------------------------------------|
| 0     | a    | 51.000 ~ 51.006mm<br>(2.0079 ~ 2.0081in.) |
| 1     | b    | 51.006 ~ 51.012mm<br>(2.0081 ~ 2.0083in.) |
| 2     | c    | 51.012 ~ 51.018mm<br>(2.0083 ~ 2.0086in.) |

#### Crankshaft Pin Mark Location

#### Discrimination Of Crankshaft



**Fig. 19: Identifying Crankshaft Pin Mark Location**

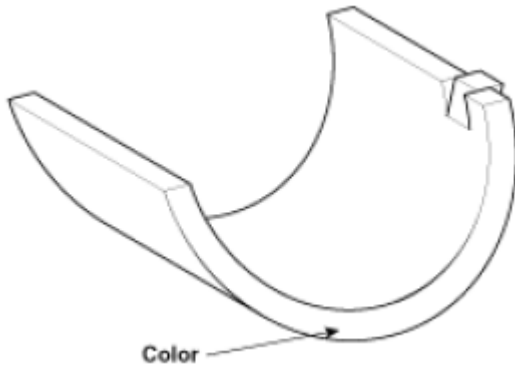
Courtesy of KIA MOTORS AMERICA, INC.

### Discrimination Of Crankshaft

#### CRANKSHAFT PIN MARK CHART

| Class | Mark   | Outside Diameter Of Pin                   |
|-------|--------|-------------------------------------------|
| I     | 1 or A | 47.994 ~ 48.000mm<br>(1.8895 ~ 1.8898in.) |
| II    | 2 or B | 47.988 ~ 47.994mm<br>(1.8893 ~ 1.8895in.) |
| III   | 3 or C | 47.982 ~ 47.988mm<br>(1.8891 ~ 1.8893in.) |

### Place Of Identification Mark (Connecting Rod Bearing)



**Fig. 20: Identifying Connecting Rod Bearing Identification Mark**  
Courtesy of KIA MOTORS AMERICA, INC.

### Discrimination Of Connecting Rod Bearing

#### BEARING THICKNESS CHART

| Class | Mark   | Thickness Of Bearing                     |
|-------|--------|------------------------------------------|
| A     | Blue   | 1.5000 ~ 1.503mm<br>(0.0591 ~ 0.0592in.) |
| B     | Black  | 1.497 ~ 1.500mm<br>(0.0589 ~ 0.0591in.)  |
| C     | -      | 1.494 ~ 1.497mm<br>(0.0588 ~ 0.0589in.)  |
| D     | Green  | 1.491 ~ 1.494mm<br>(0.0587 ~ 0.0588in.)  |
| E     | Yellow | 1.488 ~ 1.491mm<br>(0.0586 ~ 0.0587in.)  |

11. Select the proper connecting rod bearing from the table below.

**CONNECTING ROD IDENTIFICATION MARK CHART**

|                                |         | Connecting Rod Identification Mark |           |           |
|--------------------------------|---------|------------------------------------|-----------|-----------|
|                                |         | 0 (A)                              | 1 (B)     | 2 (C)     |
| Crankshaft Identification Mark | I (A)   | E (Yellow)                         | D (Green) | C (-)     |
|                                | II (B)  | D (Green)                          | C (-)     | B (Black) |
|                                | III (C) | C (-)                              | B (Black) | A (Blue)  |

## 3. Check the connecting rod.

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

**Bending** : 0.05mm/100mm (0.0020in./3.9370in.)

**Torsion** : 0.1mm/100mm (0.0039in./3.9370in.)

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

## 4. 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**

M8: 12.7~18.6Nm (1.3~1.9kgf.m, 9.4~13.7lb-ft) + 90~95°

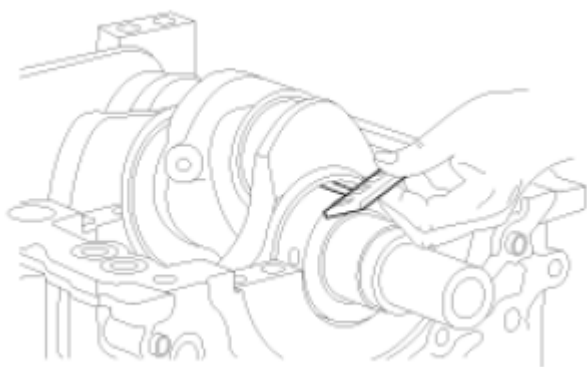
M10: 26.5~32.4Nm (2.7~3.3kgf.m, 19.5~23.9lb-ft) + 90~95°

**NOTE:**        **Tighten the bolts in order.**

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

**Standard oil clearance**

0.004~ 0.022mm (0.0002 ~ 0.0009in.)



**Fig. 21: 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.

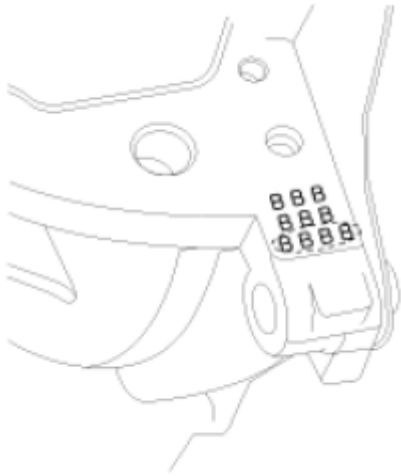
**CAUTION: If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.**

#### **Crankshaft bore mark location**

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

No. 1 journal stamping mark starts from the front of the engine.

Use the size marks which are stamped on the block and the crankshaft for the journal bore inner diameter and the journal outer diameter to choose the correct bearings.



**Fig. 22: Identifying Crankshaft Bore Mark Location**  
Courtesy of KIA MOTORS AMERICA, INC.

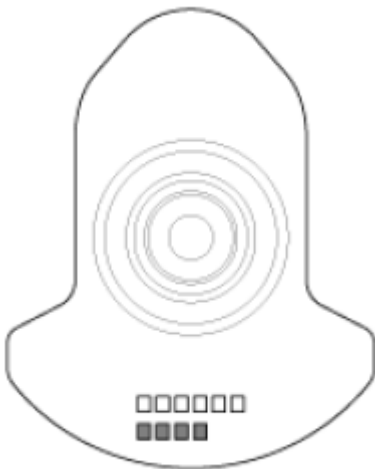
### Discrimination Of Cylinder Block

#### CYLINDER BLOCK SPECIFICATION

| Class | Mark | Inside Diameter                           |
|-------|------|-------------------------------------------|
| a     | A    | 66.000 ~ 66.006mm<br>(2.5984 ~ 2.5987in.) |
| b     | B    | 66.006 ~ 66.012mm<br>(2.5987 ~ 2.5989in.) |
| c     | C    | 66.012 ~ 66.018mm<br>(2.5989 ~ 2.5991in.) |

### Crankshaft Journal Mark Location

#### Discrimination Of Crankshaft



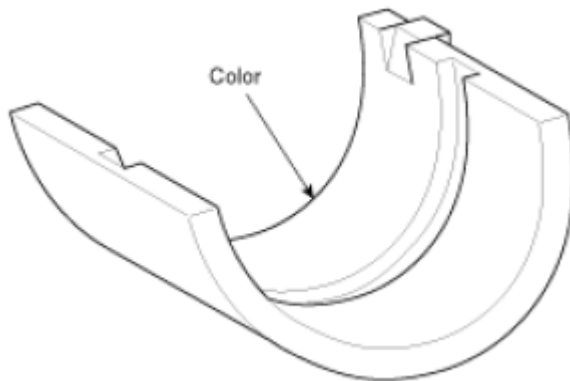
**Fig. 23: Crankshaft Journal Mark Location**  
Courtesy of KIA MOTORS AMERICA, INC.

### Discrimination Of Crankshaft

#### CRANKSHAFT SPECIFICATION

| Class | Mark | Outside Diameter Of Journal               |
|-------|------|-------------------------------------------|
| I     | A    | 61.994 ~ 62.000mm<br>(2.4407 ~ 2.4409in.) |
| II    | B    | 61.988 ~ 61.994mm<br>(2.4405 ~ 2.4407in.) |
| III   | C    | 61.982 ~ 61.988mm<br>(2.4402 ~ 2.4405in.) |

### Place Of Identification Mark (Crankshaft Bearing)



**Fig. 24: Identifying Crankshaft Bearing Identification Mark**  
Courtesy of KIA MOTORS AMERICA, INC.

### Discrimination Of Crankshaft Bearing

#### BEARING THICKNESS CHART

| Class | Mark   | Thickness Of Bearing                    |
|-------|--------|-----------------------------------------|
| A     | Blue   | 2.007 ~ 2.010mm<br>(0.0790 ~ 0.0791in.) |
| B     | Black  | 2.004 ~ 2.007mm<br>(0.0789 ~ 0.0790in.) |
| C     | -      | 2.001 ~ 2.004mm<br>(0.0788 ~ 0.0789in.) |
| D     | Green  | 1.998 ~ 2.001mm<br>(0.0787 ~ 0.0788in.) |
| E     | Yellow | 1.995 ~ 1.998mm<br>(0.0785 ~ 0.0787in.) |

## Selection Table

## CRANKSHAFT BORE IDENTIFICATION MARK CHART

|                                |         | Crankshaft Bore Identification Mark |           |           |
|--------------------------------|---------|-------------------------------------|-----------|-----------|
|                                |         | a (A)                               | b (B)     | c (C)     |
| Crankshaft Identification Mark | I (A)   | E (Yellow)                          | D (Green) | C (-)     |
|                                | II (B)  | D (Green)                           | C (-)     | B (Black) |
|                                | III (C) | C (-)                               | B (Black) | A (Blue)  |

## 5. Check crankshaft end play.

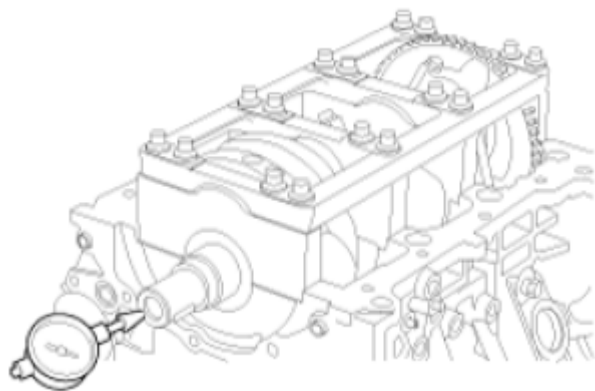
Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

**Standard end play**

0.07 ~ 0.25mm (0.0028 ~ 0.0098in.)

**[Limit]**

0.3mm (0.0118in.)



**Fig. 25: Checking Crankshaft End Play**  
Courtesy of KIA MOTORS AMERICA, INC.

If the end play is greater than the maximum, replace the center bearing.

**Thrust bearing thickness**

1.925 ~ 1.965mm (0.0758 ~ 0.0774in.)

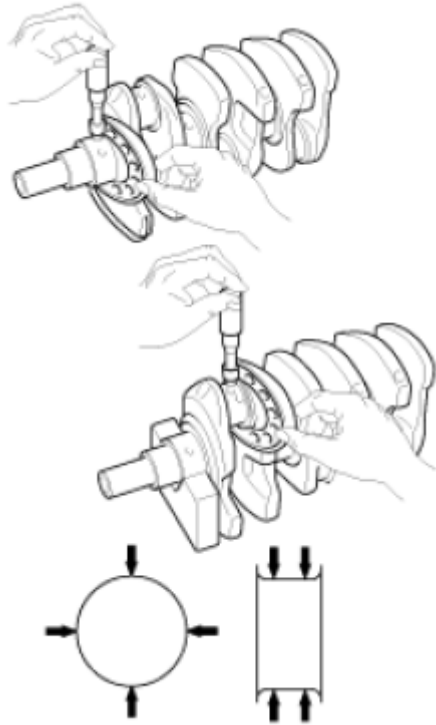
6. Inspect the main journals and the pin journals of the crankshaft.
7. Using a micrometer, measure the outer diameter of each main journal and pin journal.

**Main journal diameter:**

61.982~ 62.000mm (2.4402 ~ 2.4409in.)

**Crank pin diameter:**

47.982 ~ 48.000mm (1.8891 ~ 1.8898in.)



**Fig. 26: Measuring Outer Diameter Of Main Journal And Pin Journal**  
 Courtesy of KIA MOTORS AMERICA, INC.

**CYLINDER BLOCK**

1. Remove gasket materials.

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

2. Clean cylinder block

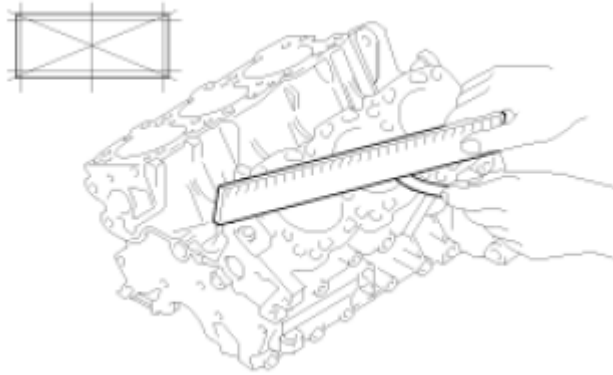
Using a soft brush and solvent, thoroughly clean the cylinder block.

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

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

Flatness of cylinder block gasket surface

Standard: 0.03mm (0.0012in.) or less



**Fig. 27: Inspecting Top Surface Of Cylinder Block For Flatness**  
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

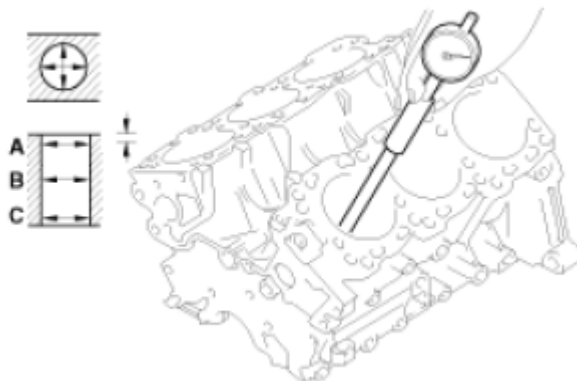
If deep scratches are present, replace the cylinder block or process the piston to be oversized.

5. Inspect the cylinder bore diameter

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

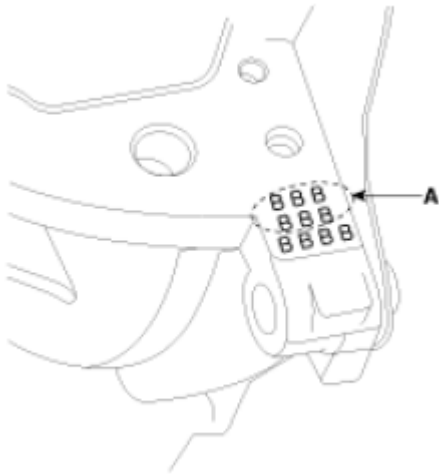
**Standard diameter**

86.70 ~ 86.73mm (3.4134 ~ 3.4146in.)



**Fig. 28: Measuring Cylinder Bore Diameter At Position In Thrust And Axial Directions**  
Courtesy of KIA MOTORS AMERICA, INC.

6. Check the cylinder bore size code (A) on the cylinder block.

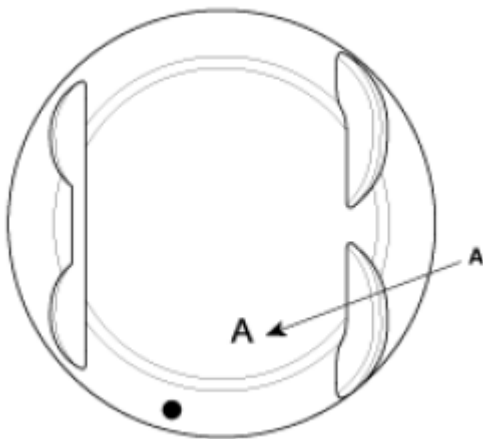


**Fig. 29: Locating Cylinder Bore Size Code On Cylinder Block**  
Courtesy of KIA MOTORS AMERICA, INC.

**CYLINDER BORE INNER DIAMETER CHART**

| Class | Size code | Cylinder bore inner diameter            |
|-------|-----------|-----------------------------------------|
| A     | A         | 86.70 ~ 86.71mm<br>(3.4134 ~ 3.4138in.) |
| B     | B         | 86.71 ~ 86.72mm<br>(3.4138 ~ 3.4142in.) |
| C     | C         | 86.72 ~ 86.73mm<br>(3.4142 ~ 3.4146in.) |

7. Check the piston size code (A) on the piston top face.



**Fig. 30: Identifying Piston Size Code On Piston Top Face**  
Courtesy of KIA MOTORS AMERICA, INC.

**PISTON OUTER DIAMETER CHART**

| Class | Size code | Piston outer diameter                   |
|-------|-----------|-----------------------------------------|
| A     | A         | 86.67 ~ 86.68mm<br>(3.4122 ~ 3.4126in.) |
| B     | B         | 86.68 ~ 86.69mm<br>(3.4126 ~ 3.4130in.) |
| C     | C         | 86.69 ~ 86.70mm<br>(3.4130 ~ 3.4134in.) |

8. Select the proper piston related to the cylinder bore class.

**Clearance** : 0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)

**CYLINDER BORING**

1. The over size piston is chosen on the maximum inner diameter of the cylinder.

**NOTE:** The piston size mark is on the top surface of the piston.

2. Measure the outer diameter of the piston which is installed before.
3. Calculate the new bore size with the measurement in the step 2.

New bore size = measured outer diameter of piston + 0.02 ~ 0.04mm (0.0008~0.0016in.)[clearance] - 0.01mm (0.0004in.)[for honing]

4. Bore the cylinder to the calculated size.

**CAUTION:** Bore the cylinders in firing order to prevent the cylinders from be twisted by high temperature.

5. Stop boring and start honing for the proper clearance.
6. Measure the clearance between a piston and a cylinder.

**Specification**

0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)

**NOTE:** Bore all the cylinders with the same over size.

**PISTON AND RINGS**

1. Clean pistons.
  1. Using a gasket scraper, remove the carbon from the piston top.
  2. Using a groove cleaning tool or a broken ring, clean the piston ring grooves.

3. Using solvent and a brush, thoroughly clean the piston.

**CAUTION: 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**

86.67 ~ 87.00 (3.4122 ~ 3.4252in.)



**Fig. 31: Measuring Piston Outside Diameter From Bottom Of Piston**  
Courtesy of KIA MOTORS AMERICA, INC.

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

**Piston-to-cylinder clearance**

0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)

4. Inspect the piston ring side clearance.

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

**Piston ring side clearance**

Standard

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

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. 32: Measuring Clearance Between Piston Ring And Ring Groove**  
Courtesy of KIA MOTORS AMERICA, INC.

If the clearance is greater than the 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. If the bore is over the service limit, the cylinder block must be replaced or bored

**Piston ring end gap**

Standard

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

No. 2: 0.30 ~ 0.45m (0.0118 ~ 0.0177in.)

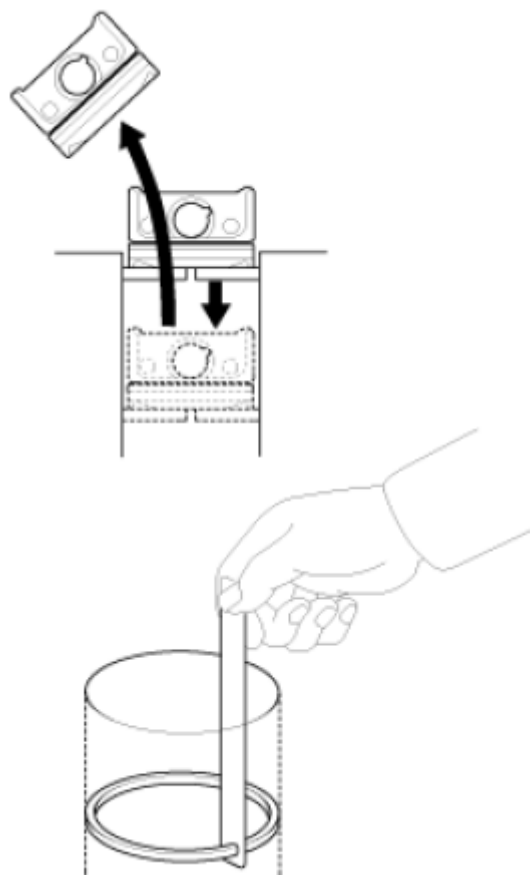
Oil ring: 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)

Limit

No. 1: 0.6mm (0.0236in.)

No. 2: 0.7mm (0.0275in.)

Oil ring: 0.8mm (0.0315in.)



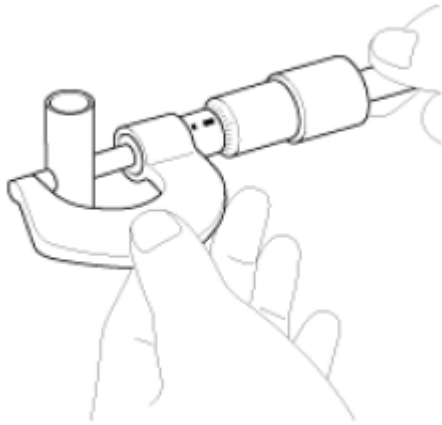
**Fig. 33: Measuring Gap Using Feeler Gauge**  
Courtesy of KIA MOTORS AMERICA, INC.

## PISTON PINS

1. Measure the outer diameter of the piston pin.

### Piston pin outer diameter

21.001 ~ 21.007mm (0.8268 ~ 0.8270in.)



**Fig. 34: Measuring Outer Diameter Of Piston Pin**  
Courtesy of KIA MOTORS AMERICA, INC.

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

**Piston pin-to-piston clearance**

0.011 ~ 0.018mm (0.0004 ~ 0.0007in.)

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

**Piston pin-to-connecting rod interference**

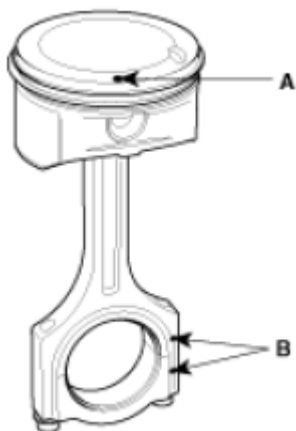
-0.033 ~ -0.016mm (-0.0013 ~ -0.0006in.)

**REASSEMBLY**

**NOTE:**

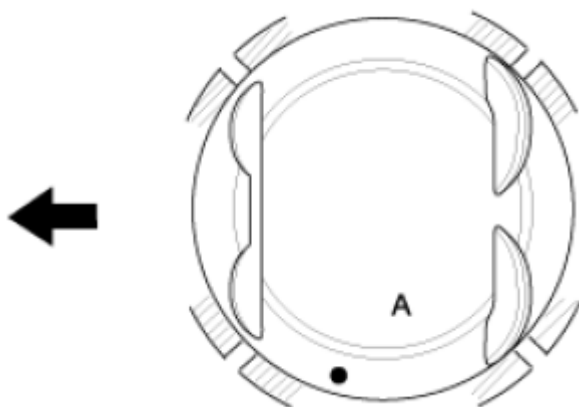
- Thoroughly clean all parts before reassembling.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

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



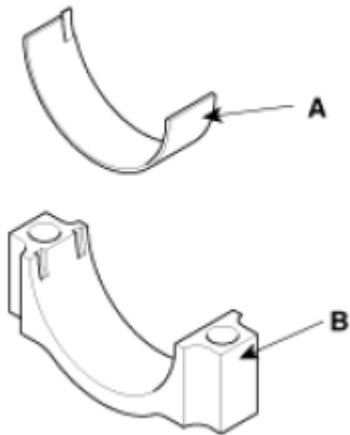
**Fig. 35: Identifying Piston Front Mark And Connecting Rod Front Mark**  
Courtesy of KIA MOTORS AMERICA, INC.

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



**Fig. 36: Positioning Piston Rings**  
Courtesy of KIA MOTORS AMERICA, INC.

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



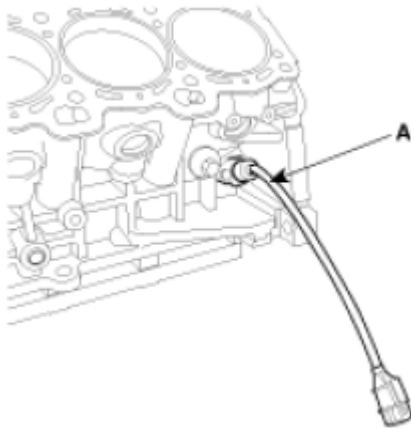
**Fig. 37: Identifying Bearings And Connecting Rod Cap**  
Courtesy of KIA MOTORS AMERICA, INC.

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

4. Install the CKP sensor (A).

**Tightening torque:**

6.9 ~ 9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)

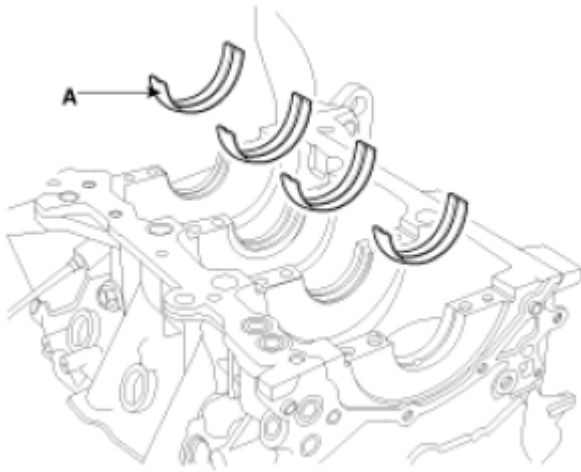


**Fig. 38: Identifying CKP Sensor**  
Courtesy of KIA MOTORS AMERICA, INC.

5. Install main bearings.

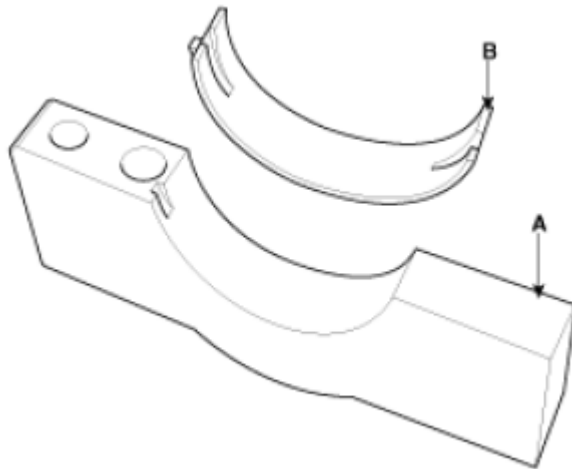
**NOTE:** Upper bearings have the oil grooves of the oil holes; Lower bearings do not.

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



**Fig. 39: Identifying Upper Bearings**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Aligning the bearing claw with the claw groove of the main bearing cap, push in the 4 lower bearings (B) on the bearing caps (A).



**Fig. 40: Identifying Lower Bearings And Bearing Caps**  
Courtesy of KIA MOTORS AMERICA, INC.

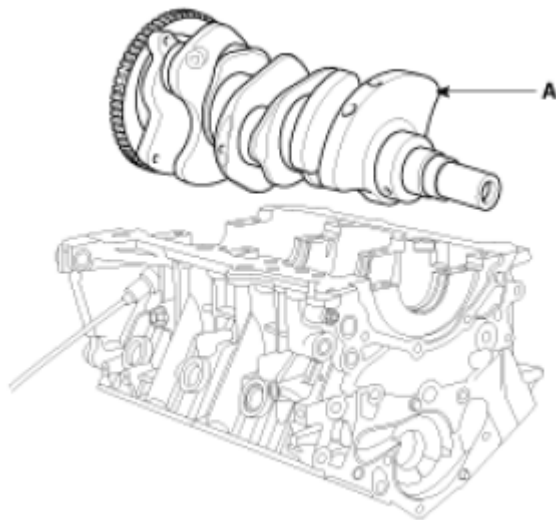
6. Install thrust bearings.

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



**Fig. 41: Identifying Thrust Bearings**  
Courtesy of KIA MOTORS AMERICA, INC.

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



**Fig. 42: Identifying Crankshaft On Cylinder Block**  
Courtesy of KIA MOTORS AMERICA, INC.

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

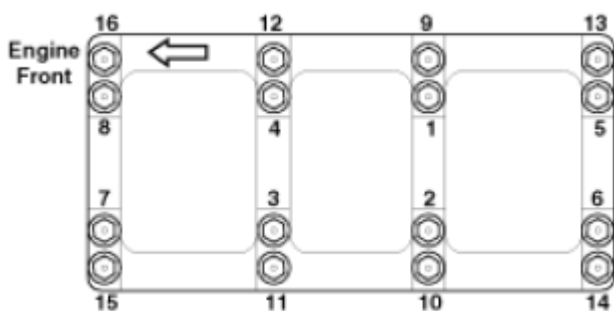
**Tightening torque**

M8: 12.7~18.6Nm (1.3~1.9kgf.m, 9.4~13.7lb-ft) + 90~95°

M10: 26.5~32.4Nm (2.7~3.3kgf.m, 19.5~23.9lb-ft) + 90~95°

**NOTE:**

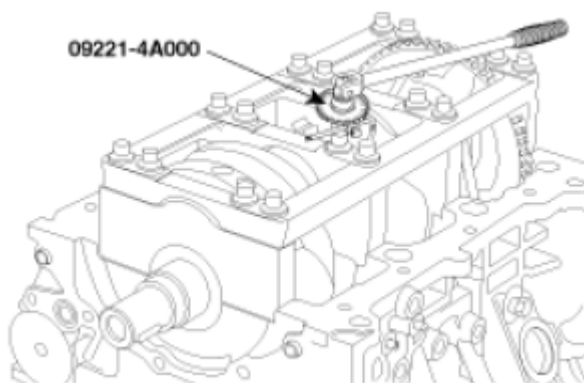
- Use new main bearing cap bolt with engine oil applied.
- If any of the bearing cap bolts are broken or deformed, replace it.
- Washers have their direction (Up/Down)
- Assemble the bearing cap bridge on which its arrow mark faces the engine front.
- Before tightening, make the bearing caps be seated on the block firmly.



**Fig. 43: Identifying Main Bearing Cap Bolt Tighten Sequence**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:**

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



**Fig. 44: Installing Main Bearing Cap Bolts**  
Courtesy of KIA MOTORS AMERICA, INC.

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

**NOTE:**

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

- **When installing the piston, ensure that the coat on the cylinder wall is not damaged or scratched.**

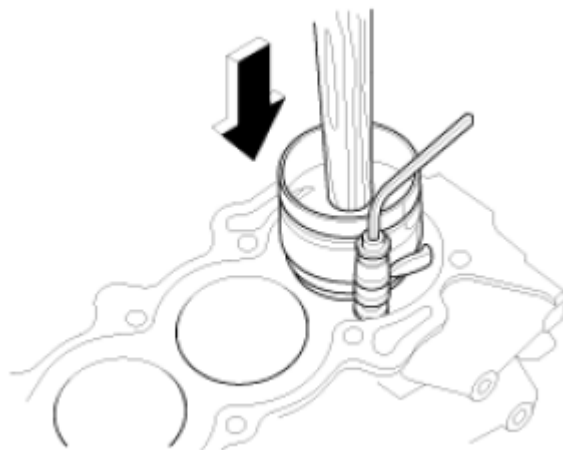
1. Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
2. Stop inserting the piston when the ring inserted in the cylinder and check the alignment of the journal and the connecting rod.
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) + 90~94°

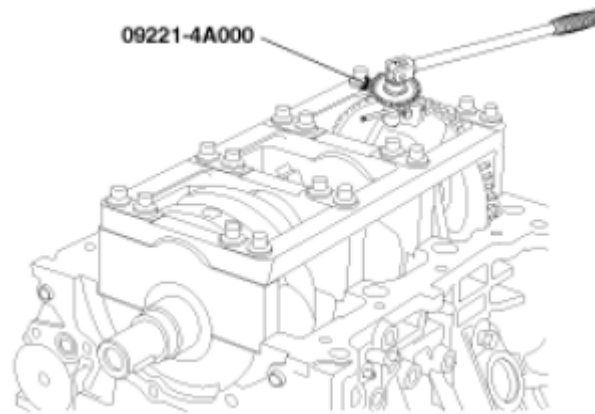
**NOTE:**

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



**Fig. 45: Installing Main Bearing Cap Bolts**  
Courtesy of KIA MOTORS AMERICA, INC.

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

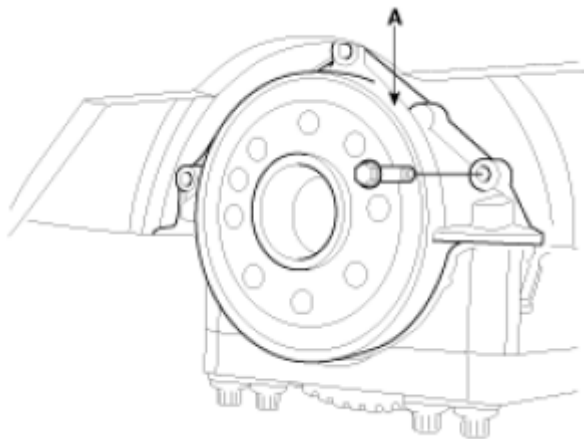


**Fig. 46: Installing Connecting Rod Bearing Cap Bolts**  
Courtesy of KIA MOTORS AMERICA, INC.

12. Install the rear oil seal case.

**Tightening torque**

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



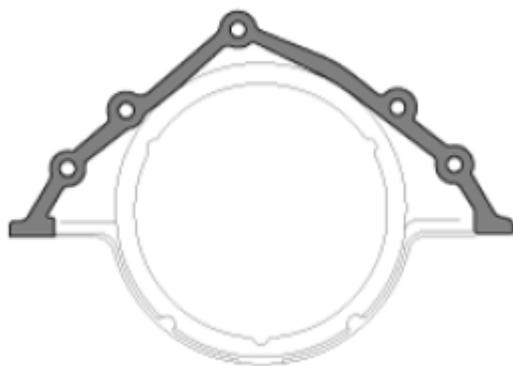
**Fig. 47: Identifying Rear Oil Seal Case**  
Courtesy of KIA MOTORS AMERICA, INC.

1. Make clean the sealing face before assembling two parts.

**NOTE:**

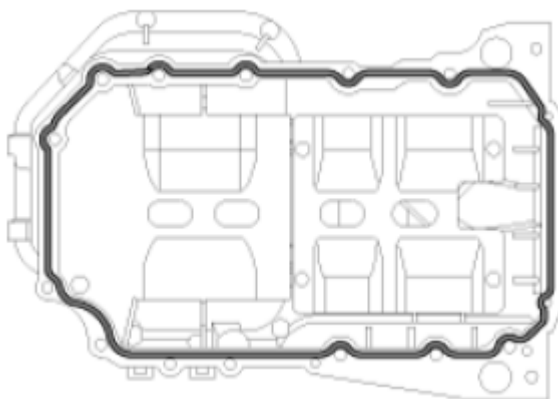
- Remove harmful foreign materials on the sealing face before applying sealant
- Apply sealant to the inner threads of the bolt holes.

2. 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.



**Fig. 48: Identifying Rear Oil Seal Case**  
Courtesy of KIA MOTORS AMERICA, INC.

13. Using SST (09231-33000), install rear oil seal after applying engine oil on the rip of the oil seal.
14. Install the oil pump case.
15. Install upper oil pan.
  1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
  2. 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.



**Fig. 49: Identifying Upper Oil Pan Gasket Area**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:**

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

3. Install upper oil pan.

Uniformly tighten the bolts in several passes.

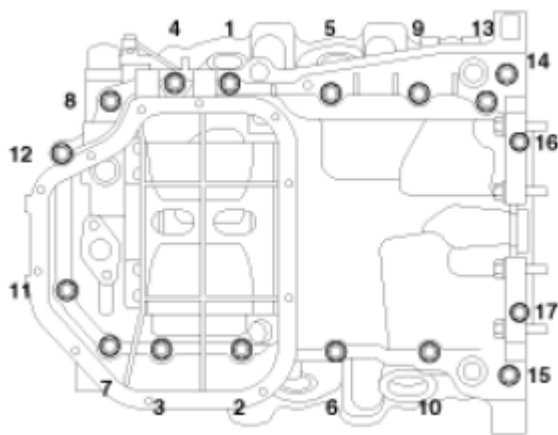
### Tightening torque

Bolts 1~15:

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

Bolts 16, 17:

4.9 ~ 6.9Nm (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft)



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

16. Install the oil screen (A).

### Tightening torque

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



**Fig. 51: Installing Oil Screen**

Courtesy of KIA MOTORS AMERICA, INC.

## 17. Install the lower oil pan.

1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on lower oil pan.

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

**NOTE:**

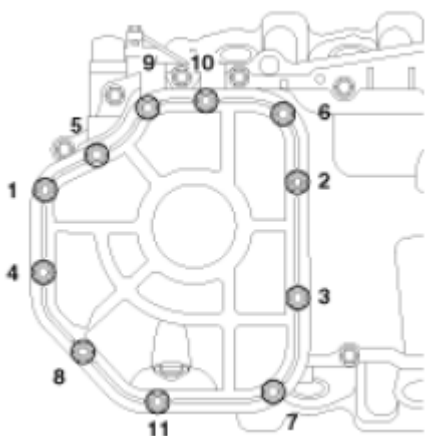
- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt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

## 3. Install lower oil pan.

Uniformly tighten the bolts in several passes.

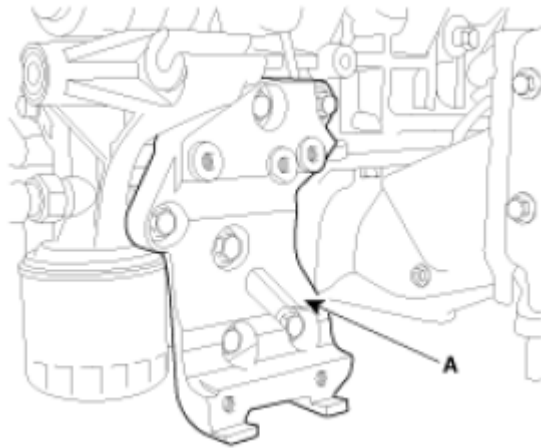
**Tightening torque**

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

**Fig. 52: Identifying Lower Oil Pan Bolts Tighten Sequence**

Courtesy of KIA MOTORS AMERICA, INC.

18. Install the air conditioning compressor bracket (A). (Refer to AIR CONDITIONING SYSTEM )

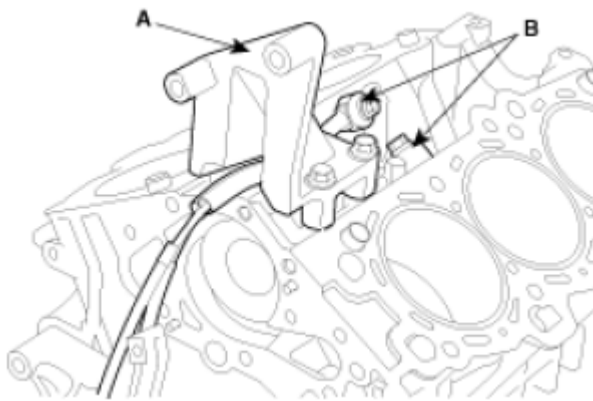


**Fig. 53: Identifying Air Conditioning Compressor Bracket**  
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the power steering pump bracket (A) and the knock sensor (B).

**Tightening torque**

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



**Fig. 54: Identifying Power Steering Pump Bracket And Knock Sensor**  
Courtesy of KIA MOTORS AMERICA, INC.

**CAUTION:**

- On Bank 1, the black knock sensor connector should be installed and on Bank 2, the gray one should.

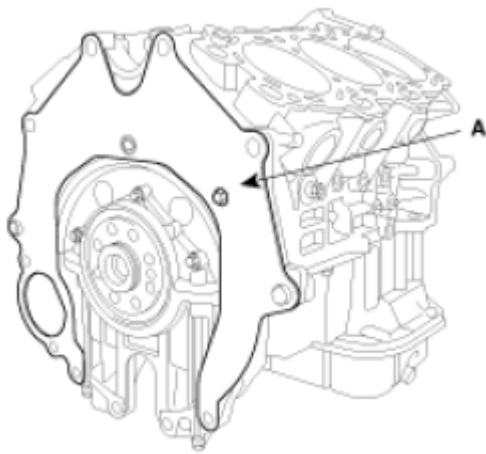
**INSTALLATION**

1. Install the water pump.
2. Install the air conditioning compressor.(Refer to **AIR CONDITIONING SYSTEM** ).
3. Install the cylinder head.

4. Install the power steering pump.(Refer to **HYDRAULIC POWER STEERING SYSTEM** ).
5. Install the generator.
6. Install the intake manifold.
7. Install the exhaust manifold.
8. Install the timing belt.
9. Install the rear plate (A).

**Tightening torque**

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



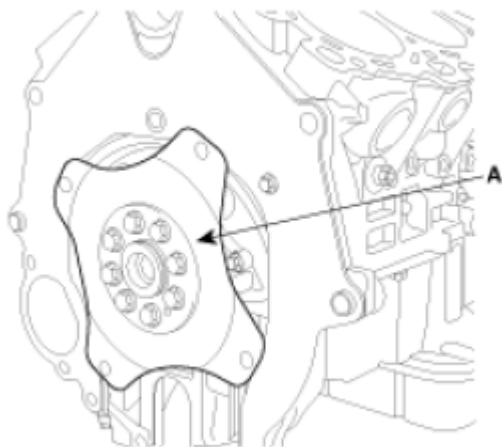
**Fig. 55: Identifying Rear Plate**

Courtesy of KIA MOTORS AMERICA, INC.

10. Install the drive plate (A).

**Tightening torque**

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



**Fig. 56: Identifying Drive Plate**

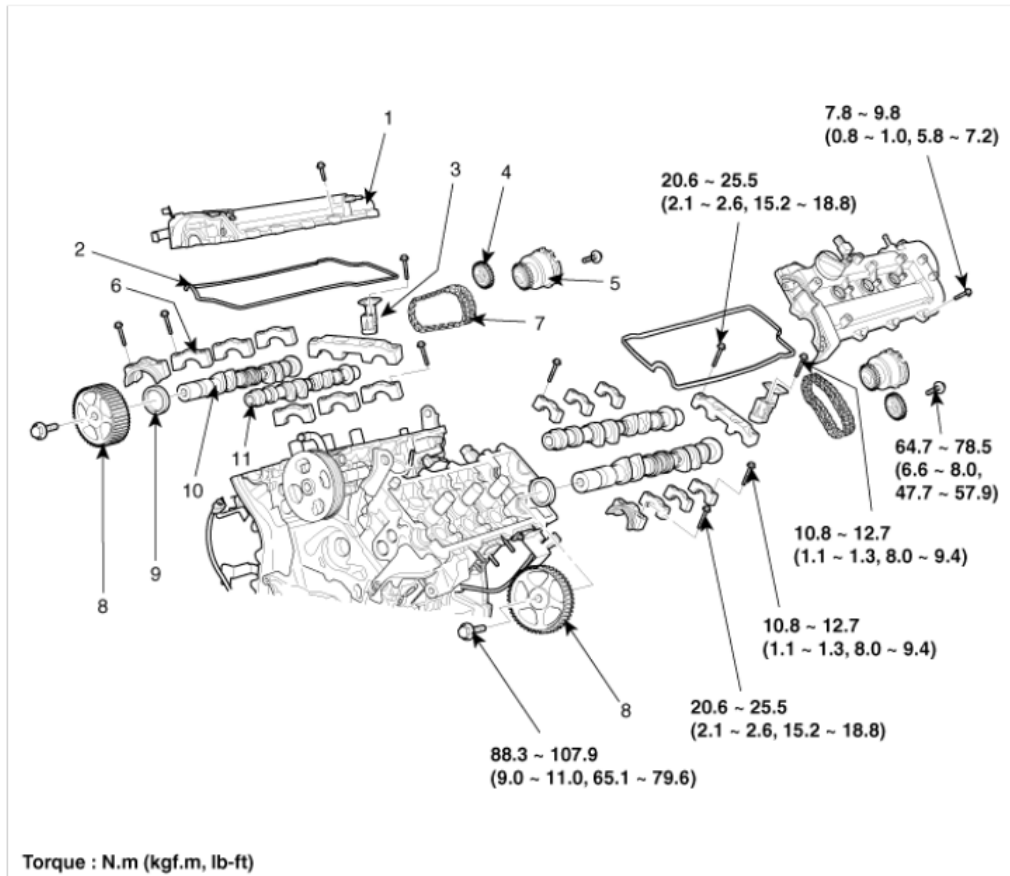
Courtesy of KIA MOTORS AMERICA, INC.

## 2009 ENGINE

### Cylinder Head Assembly - 2.7L - Magentis & Optima

## COMPONENTS AND COMPONENT LOCATION

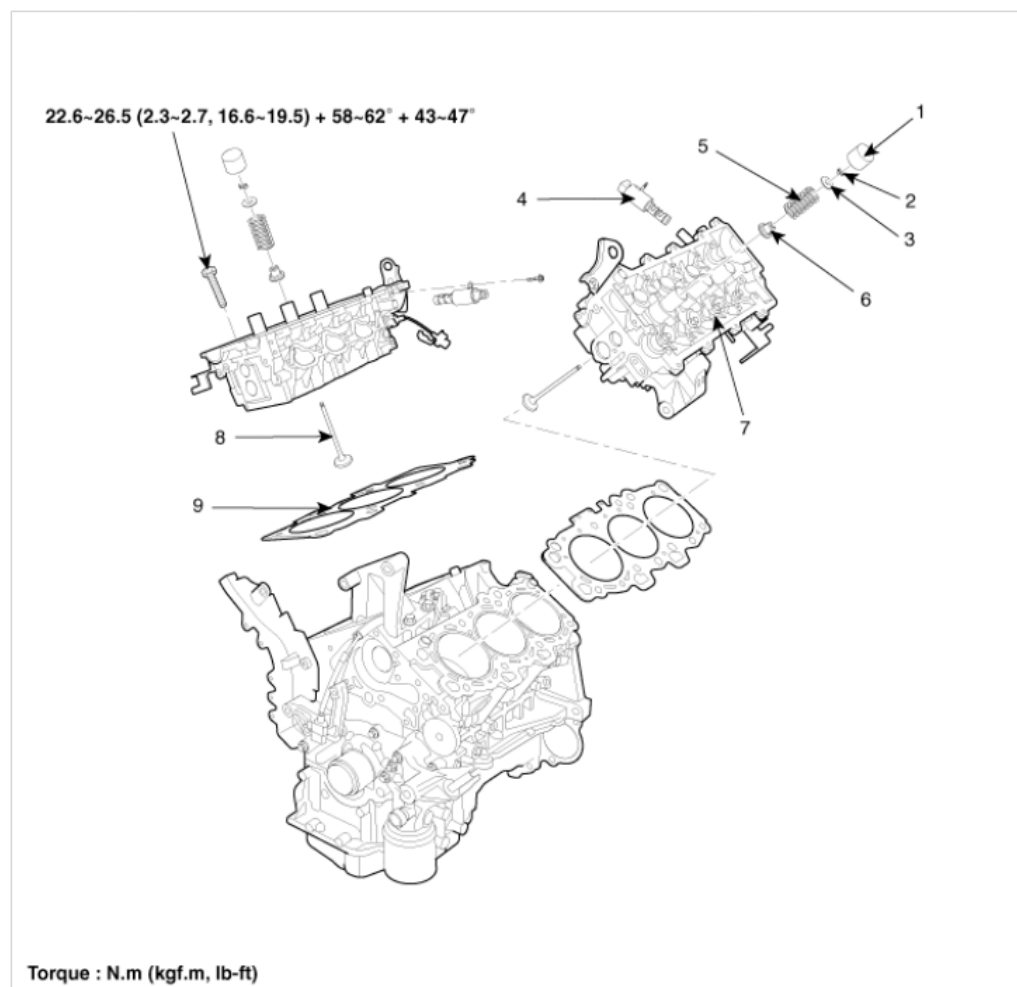
### COMPONENTS



1. Cylinder head cover
2. Cylinder head cover gasket
3. Timing chain auto tensioner
4. Exhaust camshaft chain sprocket
5. CVVT assembly
6. Camshaft bearing cap

7. Timing chain
8. Exhaust camshaft sprocket
9. Camshaft oil seal
10. Exhaust camshaft
11. Intake camshaft

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



1. MLA(Mechanical Lash Adjuster)
2. Retainer lock
3. Retainer
4. OCV(Oil Control Valve)
5. Valve spring

6. Valve stem seal
7. Cylinder head
8. Valve
9. Cylinder head gasket

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

## REPAIR PROCEDURES

### REMOVAL

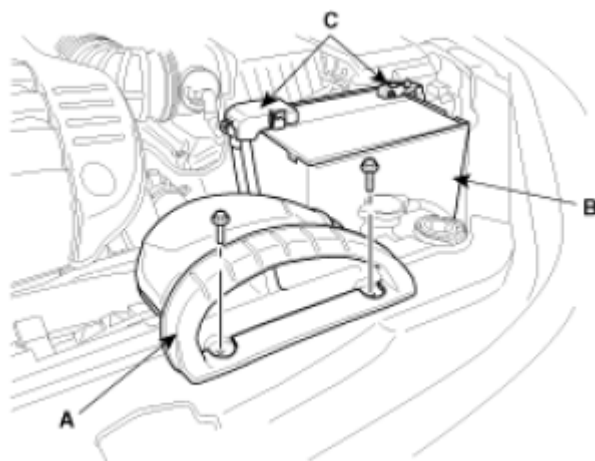
#### CAUTION:

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

**NOTE:**

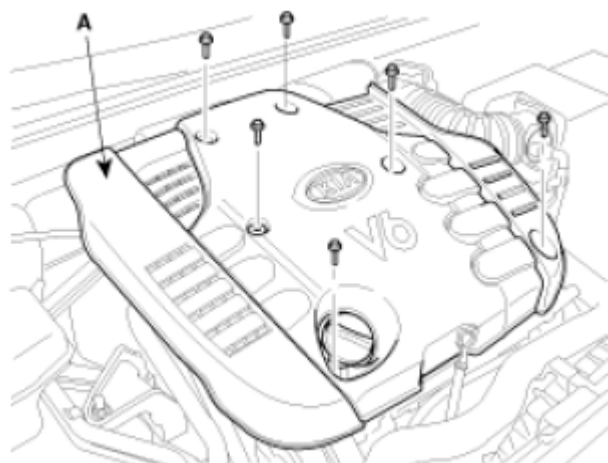
- Mark all wiring and hoses to avoid mis-connection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Remove the air duct (A) and the battery (B) after disconnecting the terminals (C) from the battery.



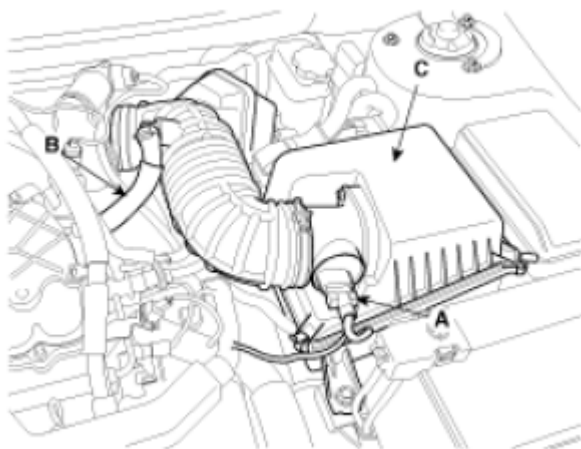
**Fig. 3: Identifying Air Duct And Battery**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove the engine cover (A).

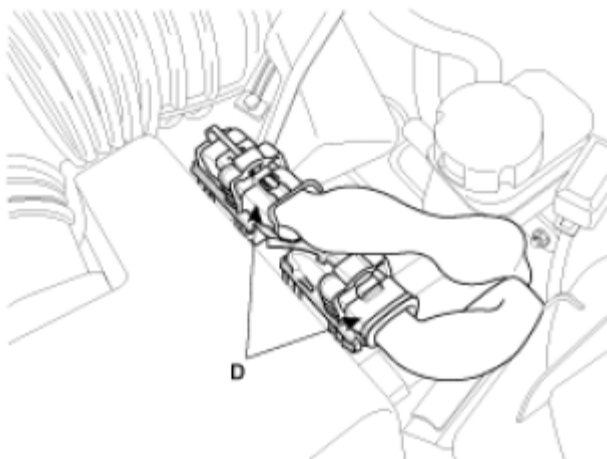


**Fig. 4: Identifying Engine Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the intake air hose and air cleaner assembly.
  1. Disconnect the MAF connector (A).
  2. Disconnect the breather hose (B) from air cleaner hose.
  3. Remove the intake air hose and air cleaner assembly (C).
  4. Disconnect the PCM connectors (D).

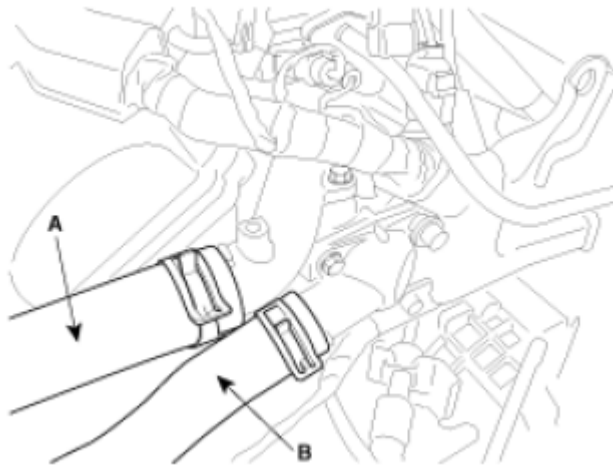


**Fig. 5: Identifying MAF Connector, Breather Hose And Air Cleaner Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.



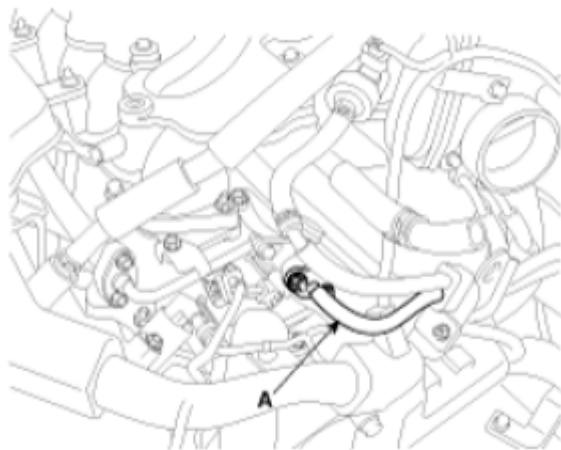
**Fig. 6: Identifying PCM Connectors**  
Courtesy of KIA MOTORS AMERICA, INC.

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



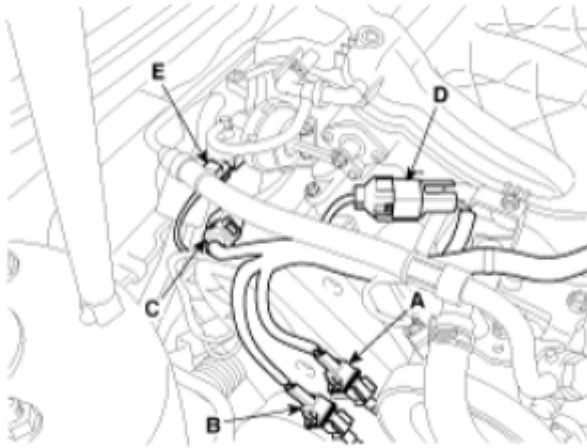
**Fig. 7: Identifying Upper Radiator Hose And Lower Radiator Hose**  
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the fuel inlet hose (A) from the delivery pipe.



**Fig. 8: Identifying Fuel Inlet Hose From Delivery Pipe**  
Courtesy of KIA MOTORS AMERICA, INC.

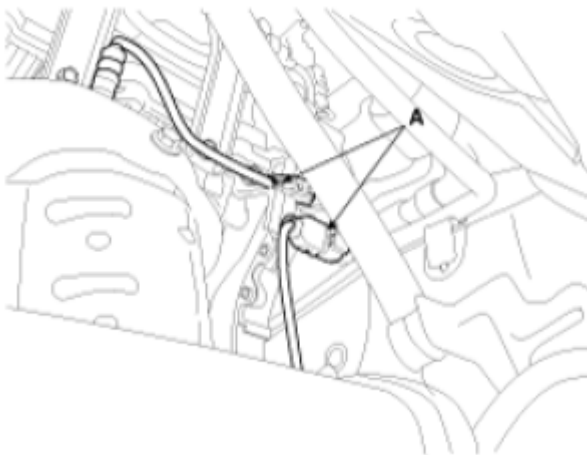
6. Disconnect the engine wiring harness connectors.
  1. Disconnect the No. 1/No. 2 knock sensor connectors (A, B), injector connector (C), the ignition coil harness (D) and the No. 1 VIS (Variable Induction System) connector (E).



**Fig. 9: Identifying No. 1/No. 2 Knock Sensor Connectors, Injector Connector And Ignition Coil Harness**

Courtesy of KIA MOTORS AMERICA, INC.

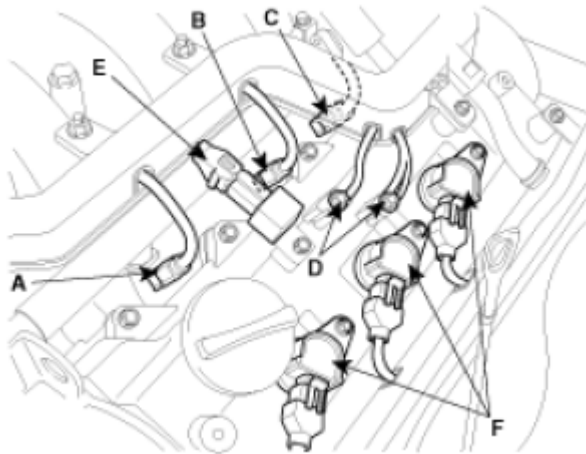
2. Disconnect the bank 1 front/rear O2 sensor connectors (A).



**Fig. 10: Identifying Bank 1 Front/Rear O2 Sensor Connectors**

Courtesy of KIA MOTORS AMERICA, INC.

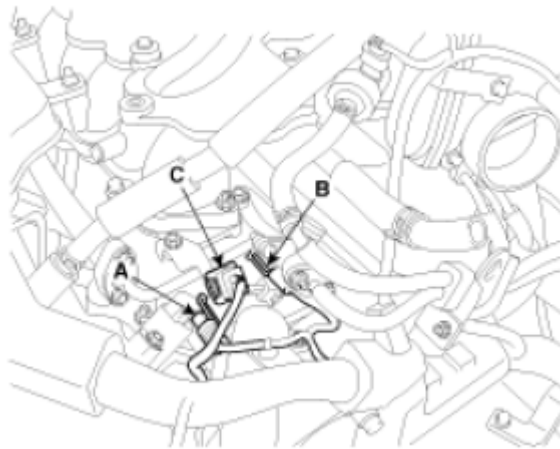
3. Disconnect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).



**Fig. 11: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors**

Courtesy of KIA MOTORS AMERICA, INC.

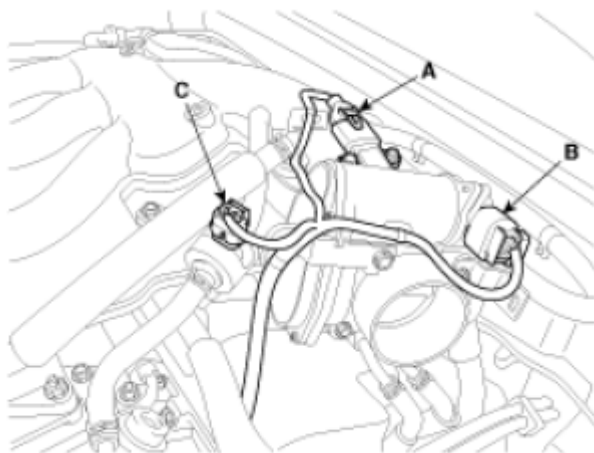
4. Disconnect the No. 1/No. 2 OCV (Oil Control Valve) connectors (A, B), and the OTS (Oil Temperature Sensor) connector (C).



**Fig. 12: Identifying No. 1/No. 2 OCV Connectors And OTS Connector**

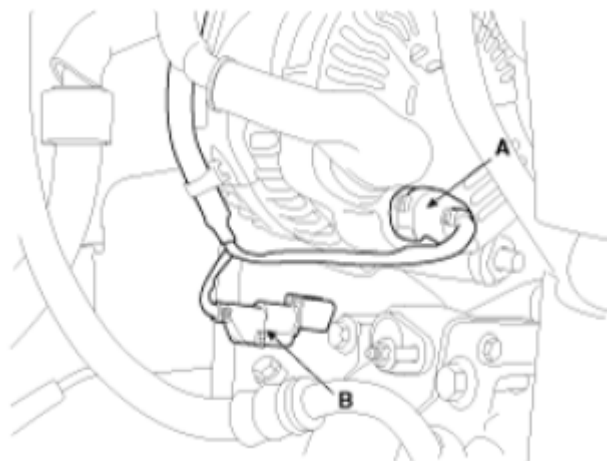
Courtesy of KIA MOTORS AMERICA, INC.

5. Disconnect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).



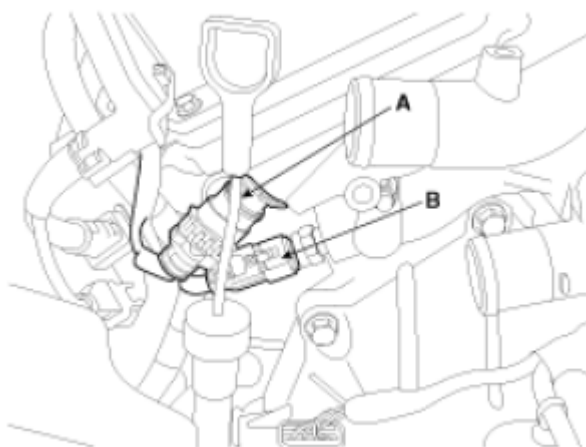
**Fig. 13: Identifying MAPS Connector, ETC Connector And PCSV Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

6. Disconnect the generator connector (A) and the air conditioning compressor connector (B).



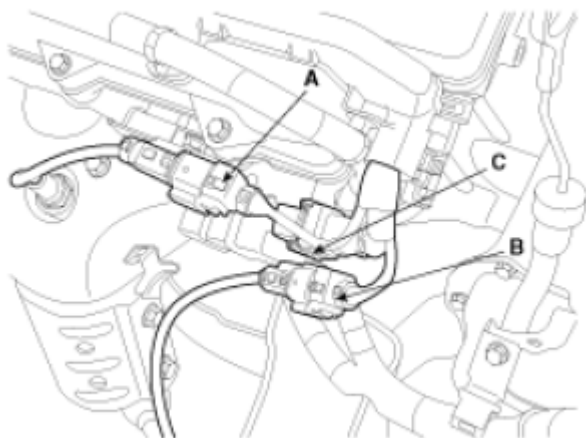
**Fig. 14: Identifying Generator Connector And Air Conditioning Compressor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the bank 2 CMP sensor connector (A) and the ECT (Engine Coolant Temperature) sensor connector (B).



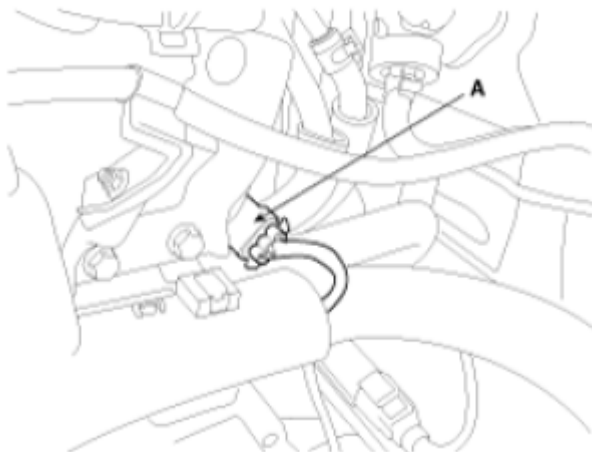
**Fig. 15: Identifying Bank 2 CMP Sensor Connector And ECT Sensor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



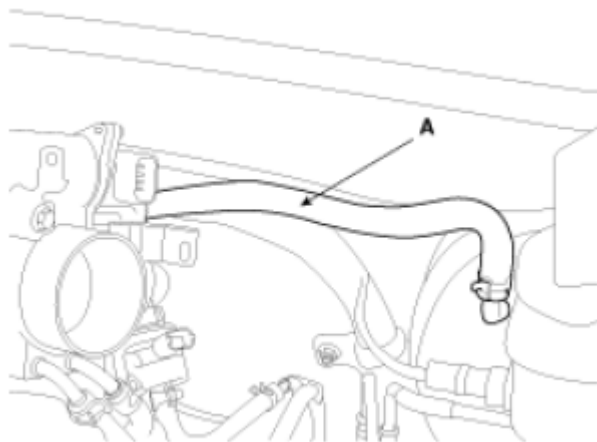
**Fig. 16: Identifying Bank 2 Front/Rear O2 Sensor Connectors And CKP Sensor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect the bank 1 CMP sensor connector (A).



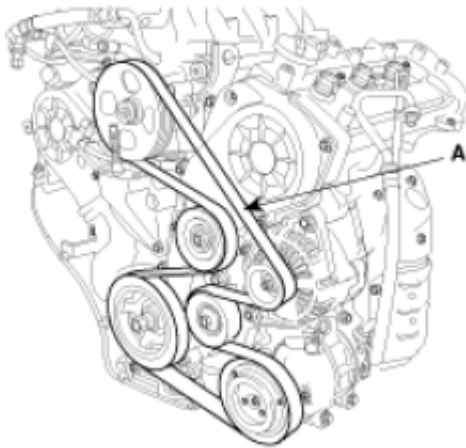
**Fig. 17: Identifying Bank 1 CMP Sensor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

7. Disconnect the brake vacuum hose (A).



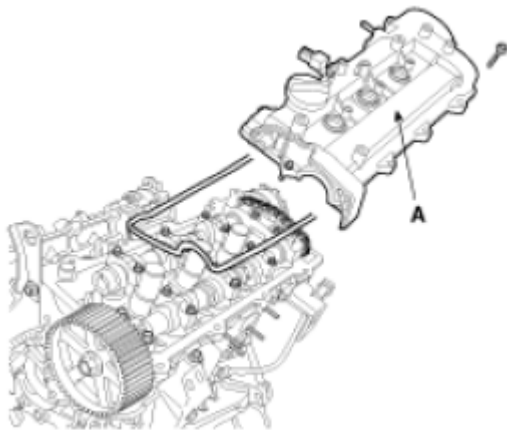
**Fig. 18: Identifying Brake Vacuum Hose**  
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the heater hoses.
9. Remove the drive belt (A).

**Fig. 19: Identifying Drive Belt**

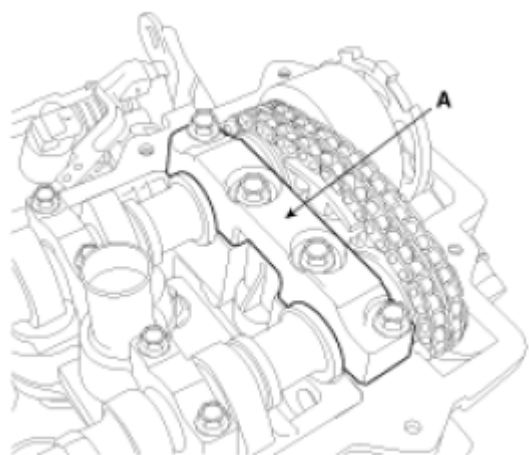
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove the power steering pump. Refer to **POWER STEERING OIL PUMP** .
11. Remove the exhaust manifold assembly. Refer to **INTAKE AND EXHAUST SYSTEM-2.7L** .
12. Remove the intake manifold assembly. Refer to **INTAKE AND EXHAUST SYSTEM-2.7L** .
13. Remove the timing belt. Refer to **TIMING SYSTEM** .
14. Remove the ignition coils.
15. Remove the water temp. control assembly.
16. Remove the cylinder head cover (A).

**Fig. 20: Identifying Cylinder Head Cover**

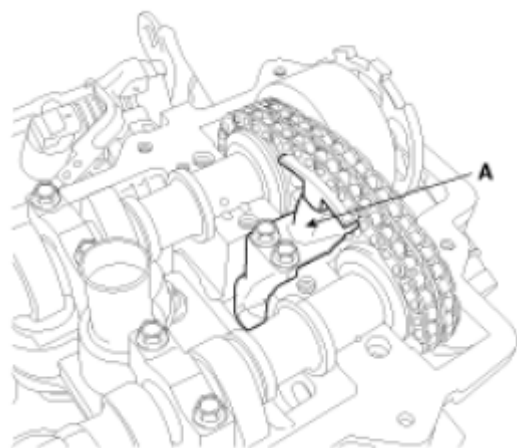
Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the camshaft bearing cap (A).



**Fig. 21: Identifying Camshaft Bearing Cap**  
Courtesy of KIA MOTORS AMERICA, INC.

18. Remove the timing chain tensioner (A).



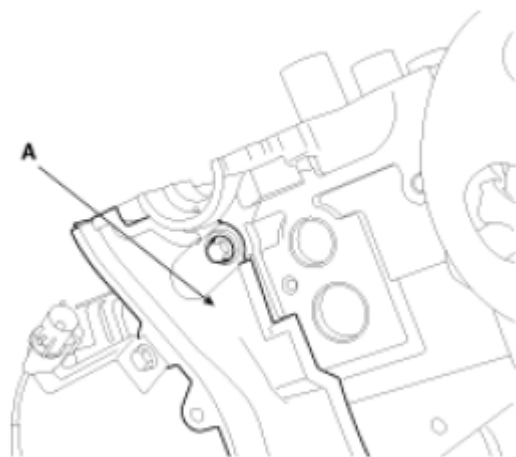
**Fig. 22: Identifying Timing Chain Tensioner**  
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove the camshaft.
20. Remove the bank 2 timing belt rear cover (A).



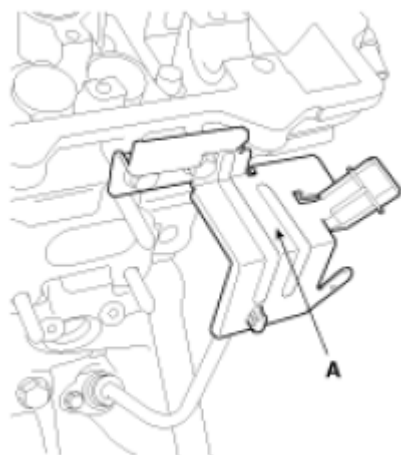
**Fig. 23: Identifying Bank 2 Timing Belt Rear Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

21. Remove the bank 1 timing belt rear cover (A).



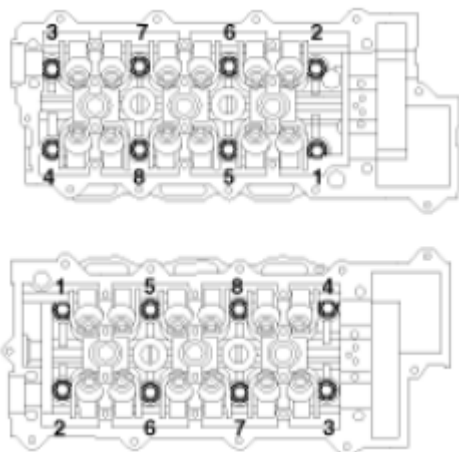
**Fig. 24: Identifying Bank 1 Timing Belt Rear Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

22. Remove the CKP sensor connector bracket (A).



**Fig. 25: Identifying CKP Sensor Connector Bracket**  
 Courtesy of KIA MOTORS AMERICA, INC.

23. Remove the cylinder head assembly.
  1. Remove the bolts in 2-3 steps as following orders.



**Fig. 26: Identifying Cylinder Head Assembly And Bolts In Sequence**  
 Courtesy of KIA MOTORS AMERICA, INC.

**CAUTION:** If the bolts are not removed as the order, the deformation of the head assembly can be occurred.

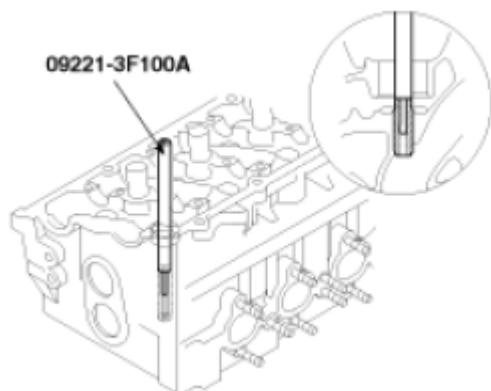
2. Put the cylinder head assembly on a wooden block after removal from the cylinder block.

**CAUTION:** Ensure that the surface between the cylinder head and the block is not damaged.

## REPLACEMENT

### Valve Guide

1. Using the SST (09221-3F100A), remove the valve guide from the downside of the cylinder head assembly.



**Fig. 27: Inserting Valve Guide From Downside Of Cylinder Head Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Reprocess the valve guide hole for the oversized valve guide newly installed.
3. Using the SST (09221-3F100A/B), insert the valve guide in the upside of the cylinder head assembly. Be aware of the difference in length between the intake and the exhaust valve guides.

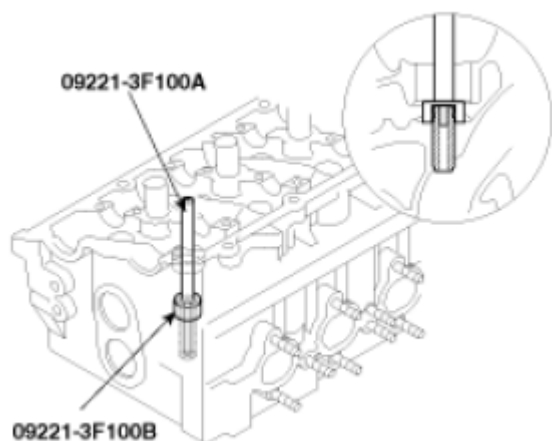
### Specification

Intake valve guide:

45.8-46.2 mm (1.8031-1.8189 in.)

Exhaust valve guide:

46.8-47.2 mm (1.8425-1.8583 in.)



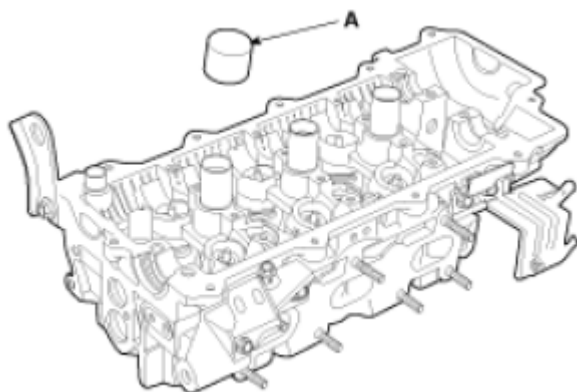
**Fig. 28: Inserting Valve Guide In Upside Of Cylinder Head Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

4. After installing the valve guides, insert new valves and check the clearance between the valve stems and the valve guides.
5. After replacing the valve guides, check if they are properly installed with the valve seats. Reprocess valve seats if necessary.

## DISASSEMBLY

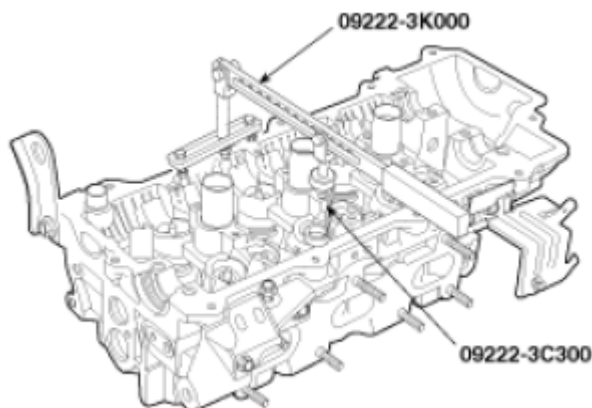
**NOTE:** Identify MLA (Mechanical Lash Adjuster), valves and valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove MLA (Mechanical Lash Adjusters) (A).



**Fig. 29: Identifying MLA (Mechanical Lash Adjuster)**  
Courtesy of KIA MOTORS AMERICA, INC.

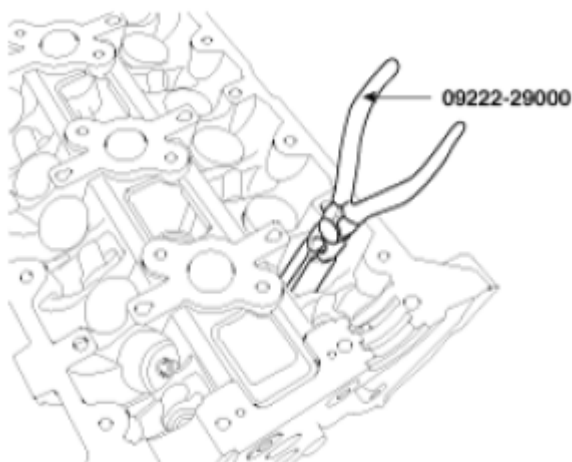
2. Remove valves.
  1. Using SST (09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.



**Fig. 30: Compressing Valve Spring And Retainer Lock**

**Courtesy of KIA MOTORS AMERICA, INC.**

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

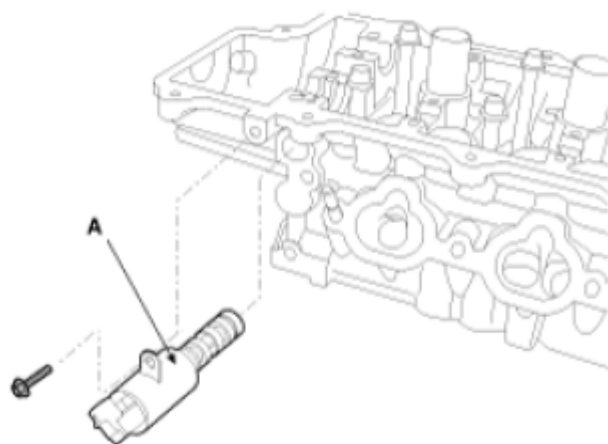


**Fig. 31: Removing Valve Stem Seal**

**Courtesy of KIA MOTORS AMERICA, INC.**

**NOTE: Do not reuse the removed valve stem seals.**

3. Remove OCV (Oil Control Valve) (A).



**Fig. 32: Identifying OCV (Oil Control Valve)**

**Courtesy of KIA MOTORS AMERICA, INC.**

## **INSPECTION**

**Cylinder Head**

1. Inspect for flatness.

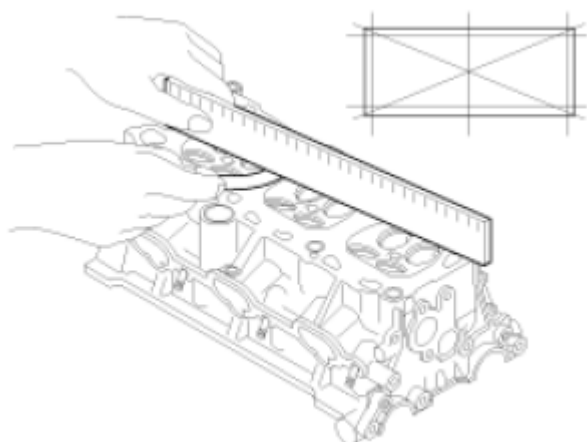
Using a precision straight edge and feeler gauge, measure the surface contacting cylinder block and the manifolds for warpage.

**Flatness of cylinder head gasket surface**

Standard: 0.03 mm (0.0012 in.) or less

**Flatness of manifold gasket surface**

Standard: 0.15 mm (0.0059 in.) or less



**Fig. 33: Measuring Surface Contacting Cylinder Block And Manifolds For Warpage**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

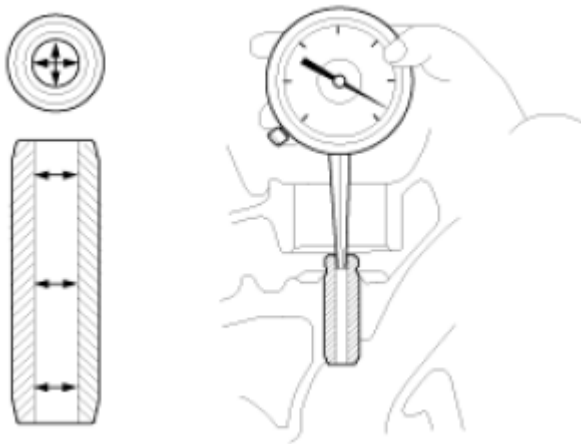
**Valve And Valve Spring**

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

**Valve guide inside diameter**

Intake/Exhaust:

6.000-6.015 mm (2.2362-2.2368 in.)



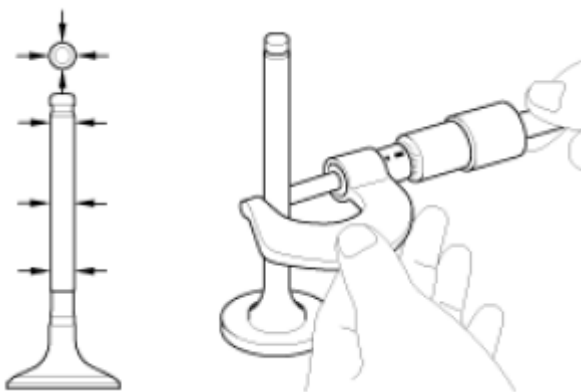
**Fig. 34: Measuring Inside Diameter Of Valve Guide**  
Courtesy of KIA MOTORS AMERICA, INC.

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

**Valve stem outer diameter**

Intake: 5.965-5.980 mm (0.2348-0.2354 in.)

Exhaust: 5.950-5.965 mm (0.2343-0.2348 in.)



**Fig. 35: Measuring Outer Diameter Of Valve Stem**  
Courtesy of KIA MOTORS AMERICA, INC.

3. Calculate the clearance between the valve guides and the stems by difference between the valve stem measured diameter and the valve guide measured inside diameter.

**Valve stem-to-guide clearance**

[Standard]

Intake: 0.020-0.050 mm (0.0008-0.0020 in.)

Exhaust: 0.035-0.065 mm (0.0014-0.0026 in.)

[Limit]

Intake: 0.10 mm (0.0039 in.) or less

Exhaust: 0.13 mm (0.0051 in.) or less

2. Inspect valves.

1. Check the valve face angle.
2. Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.

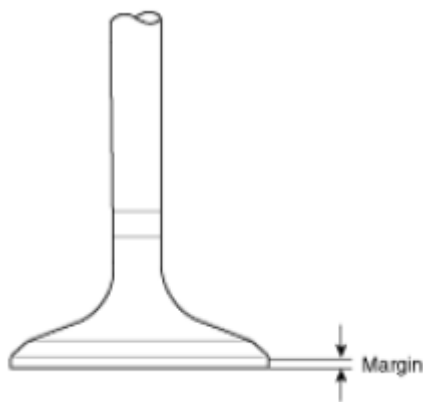
3. Check the valve head margin thickness.

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

**Specification**

Intake: 1.0 mm (0.0394 in.)

Exhaust: 1.3 mm (0.0512 in.)



**Fig. 36: Checking Valve Head Margin Thickness**  
Courtesy of KIA MOTORS AMERICA, INC.

4. Check the valve length.

**Length**

Intake: 110.1 mm (4.3346 in.)

Exhaust: 111.1 mm (4.3740 in.)

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

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

3. Inspect valve seats

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

If the valve seat is worn, replace cylinder head.

2. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace the valve guide first.
  3. 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.

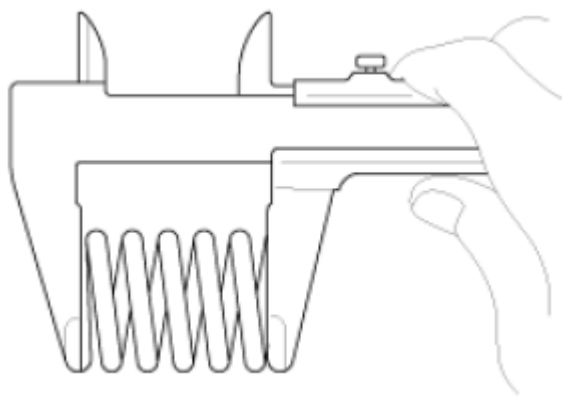
1. Using a steel square, measure the out-of-square of the valve spring.
  2. Using vernier calipers, measure the free length of the valve spring.

### **Valve spring**

[Standard]

Free height: 46.8 mm (1.8425 in.)

Out-of-square: 1.5° or less



**Fig. 37: Measuring Free Length Of Valve Spring**  
Courtesy of KIA MOTORS AMERICA, INC.

### **MLA (Mechanical Lash Adjuster)**

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

**MLA O.D.**

Intake/Exhaust:

29.964-29.980 mm (1.1797-1.1803 in.)

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

**Tappet bore I.D.**

Intake/Exhaust:

30.000-30.025 mm (1.1811-1.1821 in.)

3. Calculate the clearance by subtracting MLA outside diameter measurement from tappet bore inside diameter measurement.

**MLA to tappet bore clearance**

[Standard]

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

[Limit]

Intake/Exhaust: 0.07 mm (0.0027 in.) or less

**Camshaft**

1. Inspect cam lobes.

Using a micrometer, measure the cam lobe height.

**Cam height**

[Standard value]

Intake: 44.5 mm (1.7520 in.)

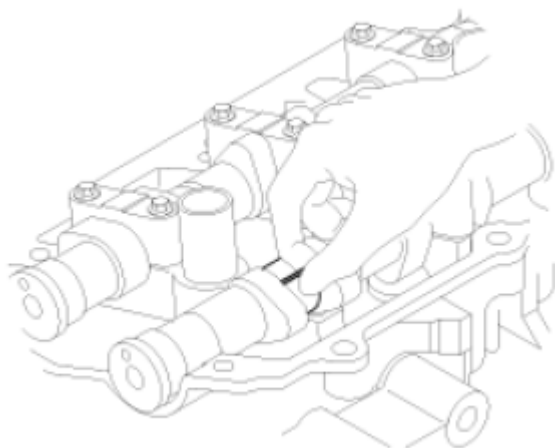
Exhaust: 44.5 mm (1.7520 in.)



**Fig. 38: Measuring Cam Lobe Height**  
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Check the cam lobe surface for wear or damage. If necessary, replace it.
3. Inspect camshaft journal clearance.
  1. Clean the bearing caps and camshaft journals.
  2. Place the camshafts on the cylinder head.
  3. Lay a strip of plastigage across each of the camshaft journals.



**Fig. 39: Inspecting Camshaft Journal Clearance**  
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps with the tightening torque.

**CAUTION: Do not turn the camshaft.**

5. Remove the bearing caps.

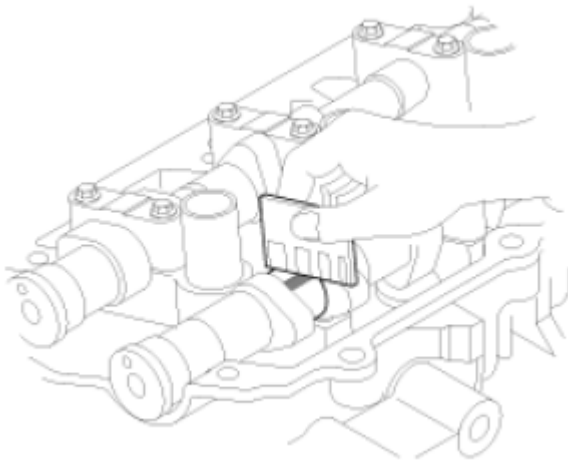
6. Measure the plastigage at its widest point.

**Bearing oil clearance**

[Standard value]

Intake: 0.020-0.057 mm (0.0008-0.0022 in.)

Exhaust: 0.020-0.057 mm (0.0008-0.0022 in.)



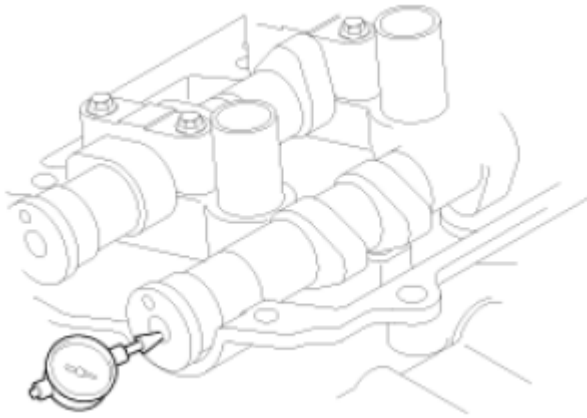
**Fig. 40: Measuring Plastigage At Widest Point**  
Courtesy of KIA MOTORS AMERICA, INC.

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

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

**Camshaft end play**

[Standard value]: 0.1-0.2 mm (0.0039-0.0079 in.)



**Fig. 41: Measuring Camshaft End Play Back And Forth**  
Courtesy of KIA MOTORS AMERICA, INC.

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

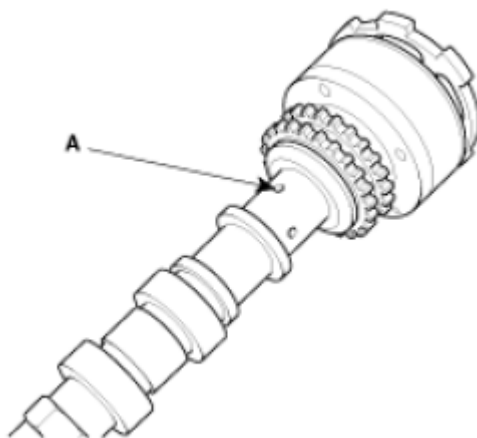
3. Remove the camshafts.

#### **CVVT Assembly**

1. Inspect CVVT assembly.
  1. Fix the CVVT assembly with a vice. Ensure that the cam lobe and journal is not damaged.
  2. Check that the CVVT assembly will not turn.

It should not be turned.

3. Apply vinyl tape to the retard hole except the one (A) indicated by the arrow in the illustration.



**Fig. 42: Identifying CVVT Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

4. Wind tape around the tip of the air gun and apply air of approx. 150 kPa (1.5 kgf/cm<sup>2</sup> , 21 psi) 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.

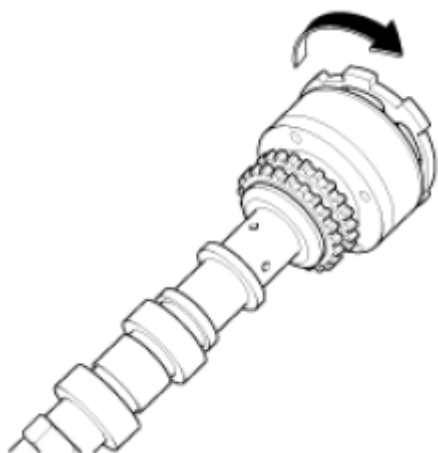
5. After the lock pin released, the CVVT assembly can turned in advanced direction.

If the air applied is leaked much, the lock pin can not be released.

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

**Standard:** Movable smoothly in the range about 30°

7. Turn the CVVT assembly with your hand in retard direction and lock it at the maximum delay angle position.



**Fig. 43: Turning CVVT Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

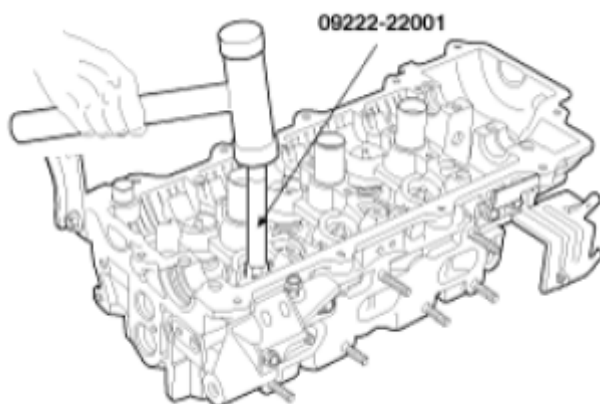
## REASSEMBLY

**NOTE:**

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

1. Install valves.

1. Using SST (09222-22001), push in a new valve stem seal with applying engine oil.



**Fig. 44: Pushing Valve Stem Seal**

Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:**

- Do not reuse old valve stem seals.

Incorrect installation of the seal could result in oil leakage past the valve guides.

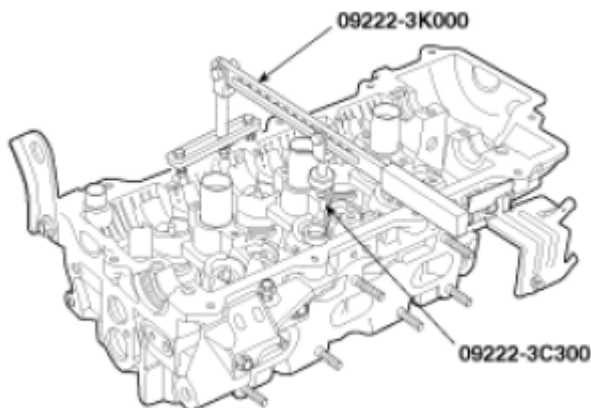
- Reassemble the valve stem seals

2. After applying engine oil on the outer surface of each valve stem, insert the valve in the valve guide. Install the valve, valve spring and spring retainer.

**NOTE:**

When installing valve springs, the side coated with enamel should face toward the valve spring retainer.

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

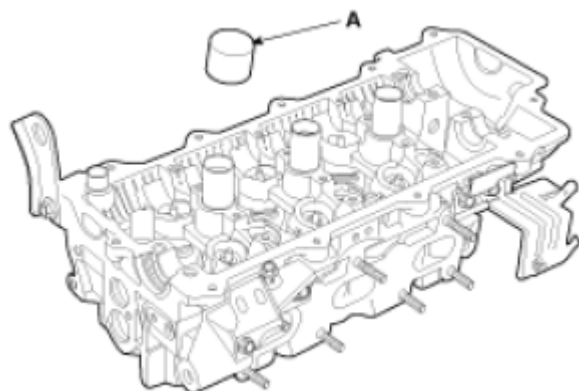


**Fig. 45: Compressing Springs And Retainer Locks**

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 MLAs with engine oil applied on its surface.

Check that the MLA rotates smoothly by hand.



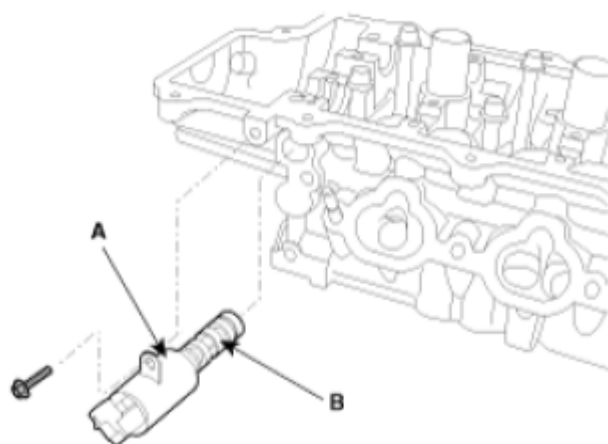
**Fig. 46: Identifying MLAs With Engine Oil On Surface**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:** MLA should be reinstalled in its original position.

3. Install OCV (Oil Control Valve) (A).

**Tightening torque**

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



**Fig. 47: Identifying OCV (Oil Control Valve)**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:** • To install OCV with gray colored connector into RH bank.

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

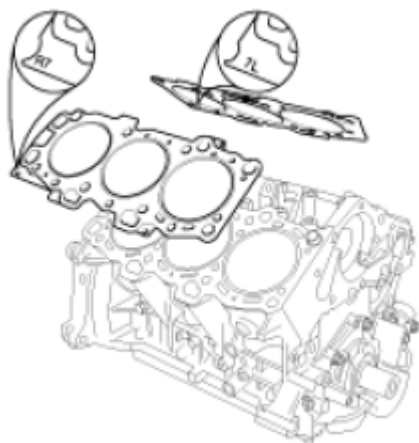
**CAUTION:**

- Do not reuse the OCV when dropped.
- Keep clean the OCV.
- 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.
- If there is dust on the filter (B) of the OCV, clean it all.

**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 to set the No. 1 cylinder piston at TDC.

1. After putting the cylinder head gasket on the cylinder block, install the cylinder head.



**Fig. 48: Identifying Cylinder Head Gasket On Cylinder Block**  
Courtesy of KIA MOTORS AMERICA, INC.

**CAUTION:** Ensure the LH/RH classification of the cylinder head gasket when installing.

2. Tighten the cylinder head bolts with the plain washers in several steps as following order.

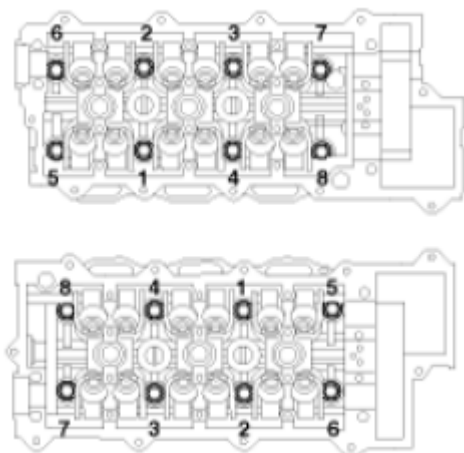
**NOTE:**

- In assembling washers, the marked surface should face upward.
- In installing the cylinder head bolts, apply engine oil on the thread of the bolts and the surface of the washers.

**CAUTION:** Always use new cylinder head bolts.

### Tightening torque

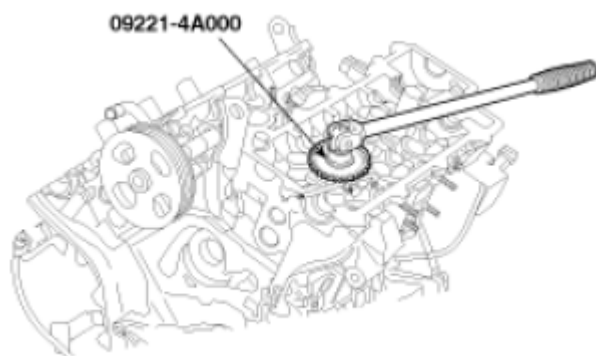
22.6-26.5 N.m (2.3-2.7 kgf.m, 16.6-19.5 lb-ft) + 58-62° + 43-47°



**Fig. 49: Identifying Cylinder Head Bolts In Sequence**

Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:** Using the SST (09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



**Fig. 50: Tightening Bolts**

Courtesy of KIA MOTORS AMERICA, INC.

3. Install the CVVT assembly and camshaft chain sprocket with the dowel pin in the CVVT installed to the intake camshaft. Ensure that the pin will not be installed in the hole for oil feeding.

### Tightening torque

66.7-78.5 N.m (6.8-8.0 kgf.m, 49.2-57.9 lb-ft)

**NOTE:** After tightening the CVVT bolts, rotate the CVVT assembly housing counterclockwise by hand to seat the lock pin in the CVVT assembly in good position.

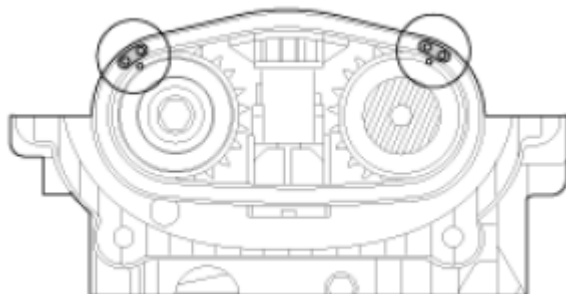
**CAUTION:** Fix the hexagonal part of the camshaft in a vice when tightening the CVVT bolts. Do not fix the CVVT housing or sprocket in a vice.

4. Install the camshaft in the cylinder head assembly.
  1. Align the timing marks of the intake and exhaust camshaft chain sprockets and the timing chain.

**CAUTION:** Both timing marks should face upward for reassembly.

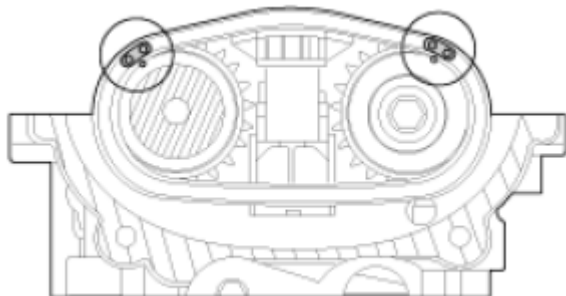
2. Install the intake and exhaust camshafts on the cylinder head with the timing marks aligned.

**LH camshaft chain timing mark**



**Fig. 51: Identifying LH Camshaft Chain Timing Mark**  
Courtesy of KIA MOTORS AMERICA, INC.

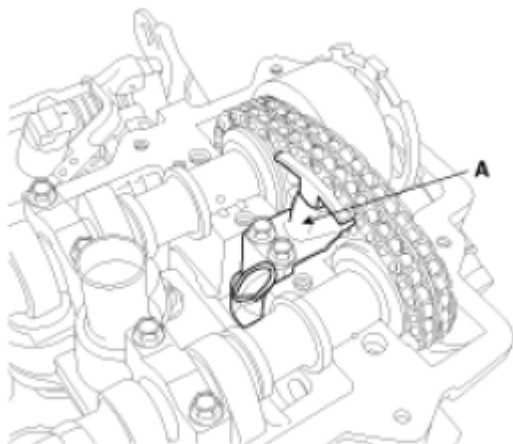
**RH camshaft chain timing mark**



**Fig. 52: Identifying RH Camshaft Chain Timing Mark**  
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the timing chain tensioner.

1. Insert the set pin by pressing the timing chain tensioner.
2. Install the chain tensioner (A) in the cylinder head assembly.
3. Remove the set pin from the tensioner after installing.



**Fig. 53: Identifying Chain Tensioner In Cylinder Head Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the camshaft bearing caps.

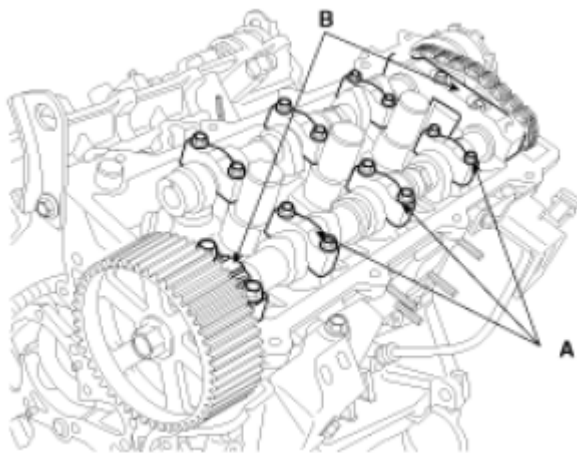
#### **Tightening torque**

Bearing cap bolt (A: 6x38):

10.8-12.7 N.m (1.1-1.3 kgf.m, 8.0-9.4 lb-ft)

Bearing cap bolt (B: 8x38):

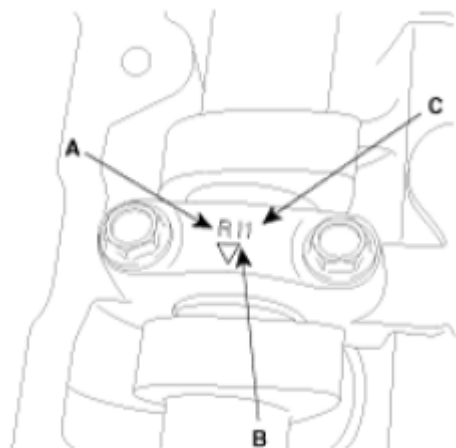
20.6-22.5 N.m (2.1-2.6 kgf.m, 15.2-18.8 lb-ft)



**Fig. 54: Identifying Camshaft Bearing Caps**

Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:** When installing the bearing caps, check the marks on them as shown below and install them in its proper position.



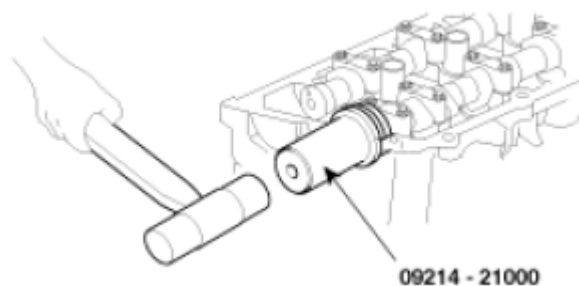
**Fig. 55: Identifying Bearing Caps Marks On Proper Position**

Courtesy of KIA MOTORS AMERICA, INC.

- A. (LH/RH HEAD): L (LH), R (RH)
- B. (Intake/Exhaust): I (Intake), E (Exhaust)
- C. (Cap no.): 1,2,3

**CAUTION:** When installing the bearing caps, turn the crankshaft to place a piston in the middle of the block because interference between valves and pistons can occur.

7. Using the SST (09214-21000), install the camshaft oil seal.



**Fig. 56: Identifying Camshaft Oil Seal**

Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:**

- Before installing, apply engine oil.
- The camshaft cap surface should adhere to the cylinder head

**assembly.**

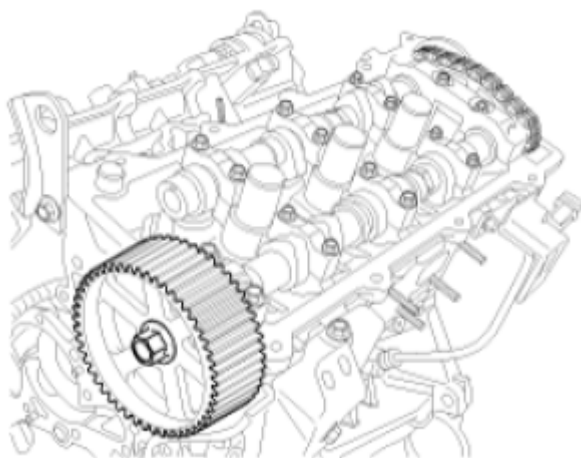
- **Do not press an eccentric load.**

8. Install the camshaft sprocket.

1. Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt.

**Tightening torque**

88.3-107.9 N.m (9.0-11.0 kgf.m, 65.1-79.6 lb-ft)

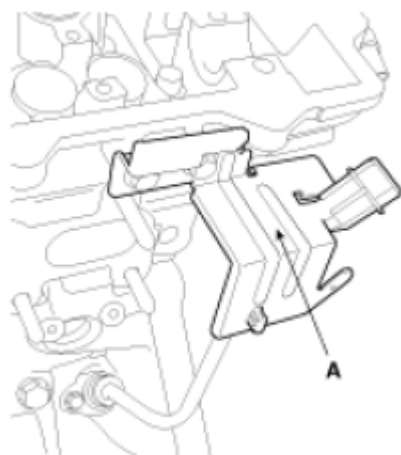


**Fig. 57: Identifying Camshaft Sprocket**  
Courtesy of KIA MOTORS AMERICA, INC.

2. In case that the camshaft is replaced with new one, inspect the valve clearances and then install appropriate MLA tappet. Refer to **VALVE CLEARANCE INSPECTION AND ADJUSTMENT** .

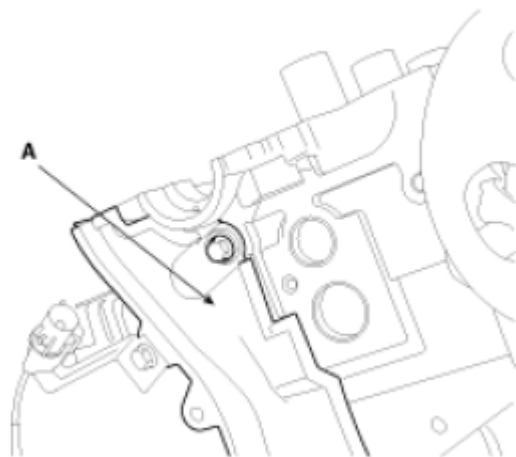
**CAUTION:** To prevent the valve from interfering with the piston, rotate the crankshaft sprocket at 3 pitches counterclockwise from the No. 1 cylinder piston at TDC position before inspecting the valve clearances.

9. Install the CKP sensor connector bracket (A).



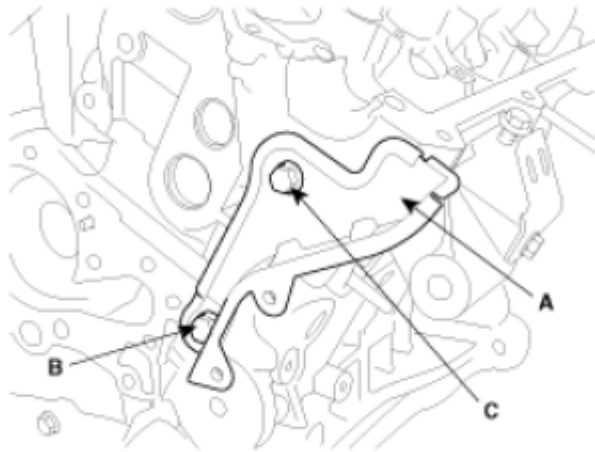
**Fig. 58: Identifying CKP Sensor Connector Bracket**  
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the bank 1 timing belt rear cover (A).



**Fig. 59: Identifying Bank 1 Timing Belt Rear Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

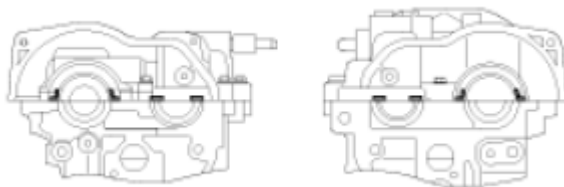
11. Install the bank 2 timing belt rear cover (A).



**Fig. 60: Identifying Bank 2 Timing Belt Rear Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:** The length of the bolt B is longer than that of the bolt C.

12. Install the cylinder head cover.
  1. Remove oil, dust or sealant on the upper surface of the cylinder before assembling cylinder head cover.
  2. Assemble the cylinder head cover in five minutes after applying liquid gasket (LOCTITE 5900) on the camshaft cap and packing part.

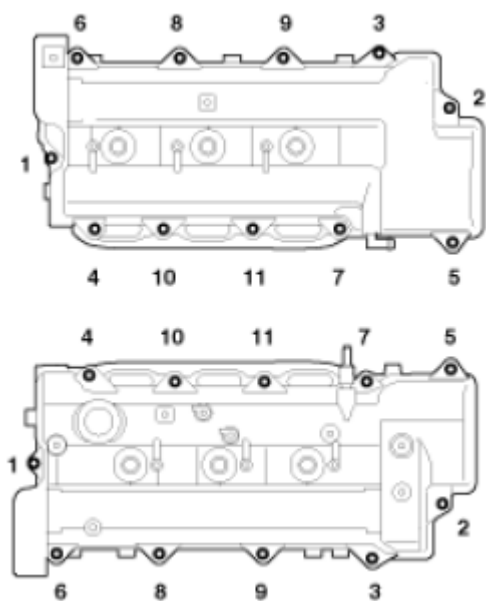


**Fig. 61: Identifying Liquid Gasket On Camshaft Cap And Packing Part**  
Courtesy of KIA MOTORS AMERICA, INC.

3. Tighten the cylinder head cover bolts as following order (A).

**Tightening torque**

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



**Fig. 62: Identifying Cylinder Head Cover Bolts In Tightening Sequence**  
Courtesy of KIA MOTORS AMERICA, INC.

**NOTE:**

- Do not start engine for thirty minutes after assembling the cylinder head cover.
- Do not reuse the cylinder head cover gasket.

13. Install the timing belt.

1. Align the timing marks of the LH/RH camshaft sprockets.

**CAUTION:** To prevent the valve from interfering with the piston, rotate the crankshaft sprocket at 3 pitches counterclockwise from the No. 1 cylinder piston at TDC position before aligning the timing marks of the camshaft sprockets.

2. After aligning the timing marks of the camshaft sprockets, rotate the crankshaft sprocket at 3 pitches clockwise then align the timing mark of the crankshaft sprocket to set the crankshaft to the No. 1 cylinder piston at TDC position.
3. Install the timing belt. Refer to **TIMING SYSTEM**.

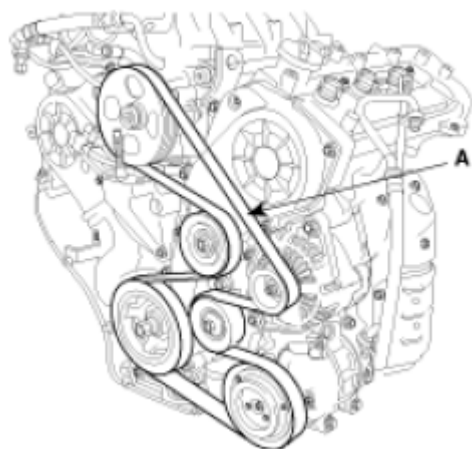
14. Install the water temp. control assembly.

15. Install the intake manifold assembly.

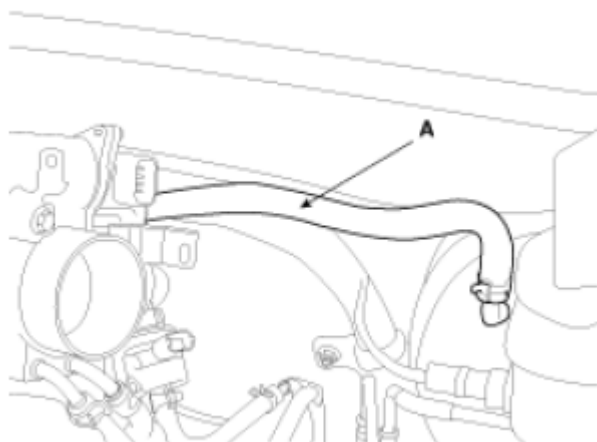
16. Install the exhaust manifold assembly.

17. Install the power steering pump. Refer to **POWER STEERING OIL PUMP**.

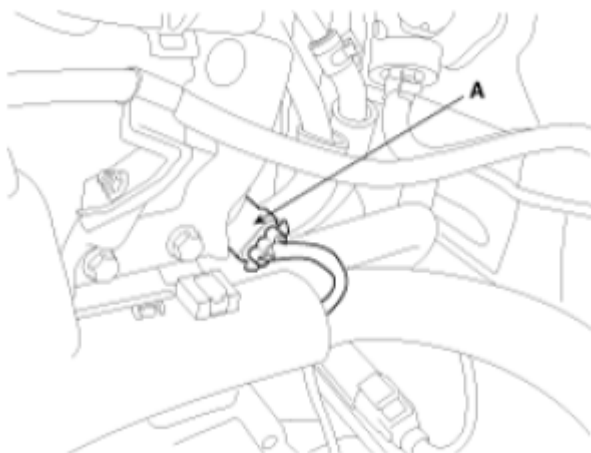
18. Install the drive belt (A).

**Fig. 63: Identifying Drive Belt****Courtesy of KIA MOTORS AMERICA, INC.**

19. Install the heater hose.
20. Connect the brake vacuum hose (A).

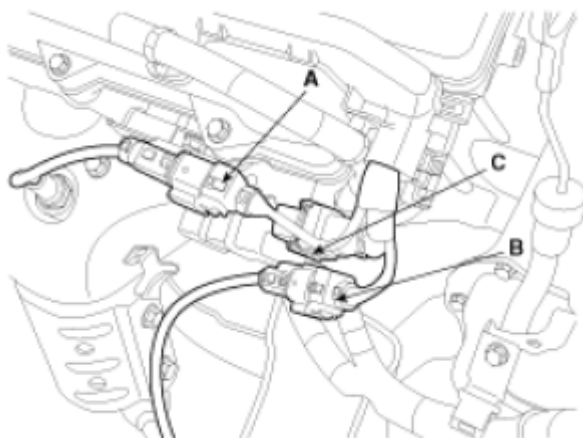
**Fig. 64: Identifying Brake Vacuum Hose****Courtesy of KIA MOTORS AMERICA, INC.**

21. Connect the engine wiring harness connectors.
  1. Connect the bank 1 CMP sensor connector (A).



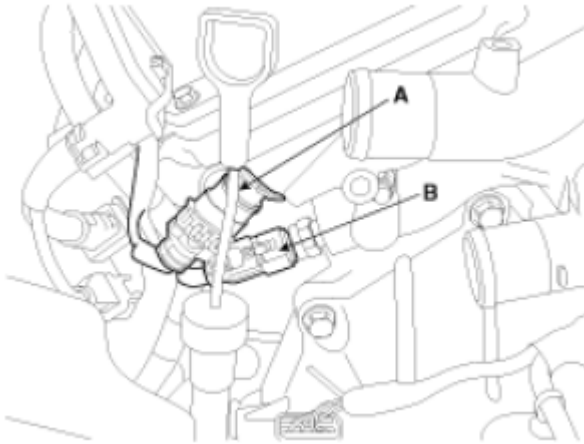
**Fig. 65: Identifying Bank 1 CMP Sensor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Connect the bank 2 front/rear O2 sensor connectors (A, B) and the CKP sensor connector (C).



**Fig. 66: Identifying Bank 2 Front/Rear O2 Sensor Connectors And CKP Sensor Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

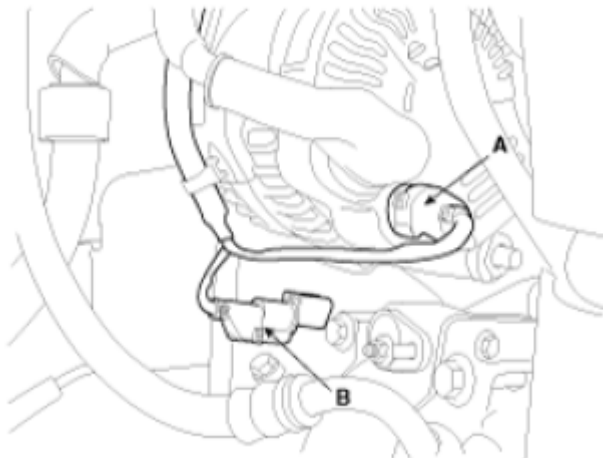
3. Connect the bank 2 CMP sensor connector (A) and the WTS (Water Temperature Sensor) connector (B).



**Fig. 67: Identifying Bank 2 CMP Sensor Connector And WTS (Water Temperature Sensor) Connector**

Courtesy of KIA MOTORS AMERICA, INC.

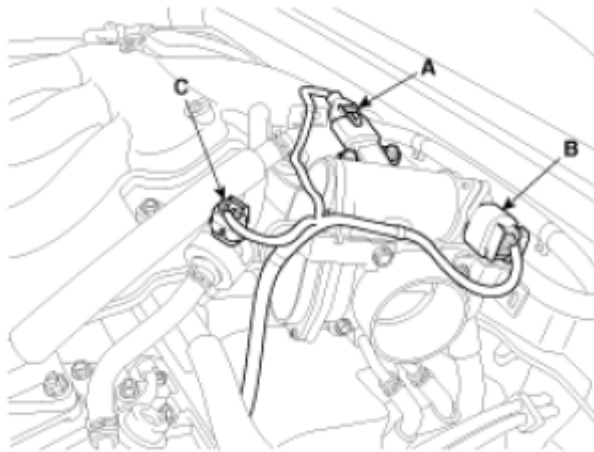
4. Connect the generator connector (A) and the air conditioning compressor connector (B).



**Fig. 68: Identifying Generator Connector And Air Conditioning Compressor Connector**

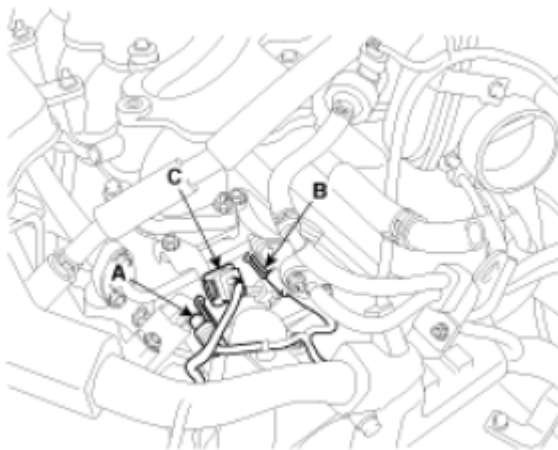
Courtesy of KIA MOTORS AMERICA, INC.

5. Connect the MAPS (Manifold Absolute Pressure Sensor) connector (A), the ETC (Electronic Throttle Control) connector (B) and the PCSV (Purge Control Solenoid Valve) connector (C).



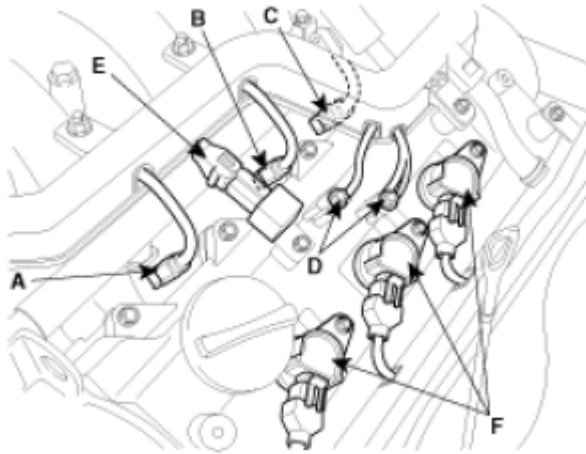
**Fig. 69: Identifying MAPS Connector, ETC Connector And PCSV Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

6. Connect the No. 1/No. 2 OCV (Oil Control Valve) connectors (A, B) and the OTS (Oil Temperature Sensor) connector (C).



**Fig. 70: Identifying No. 1/No. 2 OCV Connectors And OTS Connector**  
Courtesy of KIA MOTORS AMERICA, INC.

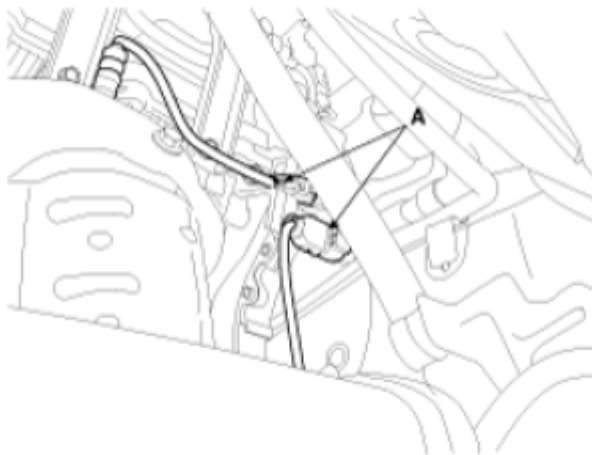
7. Connect the injection connectors (A, B, C), the ground lines (D), the condenser connector (E) and the Ignition coil connectors (F).



**Fig. 71: Identifying Injection Connectors, Ground Lines, Condenser Connector And Ignition Coil Connectors**

Courtesy of KIA MOTORS AMERICA, INC.

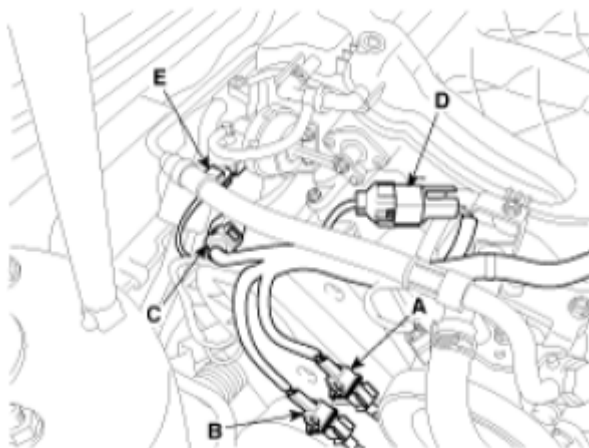
8. Connect the bank 1 front/rear O2 sensor connectors (A).



**Fig. 72: Identifying Bank 1 Front/Rear O2 Sensor Connectors**

Courtesy of KIA MOTORS AMERICA, INC.

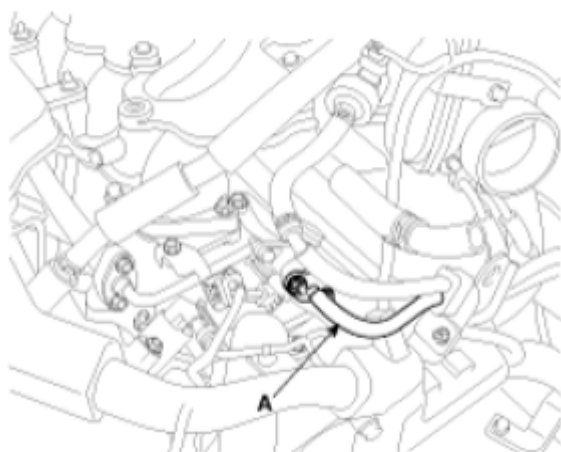
9. Connect the No. 1/No. 2 knock sensor connectors (A, B), the injector connector (C), the ignition coil harness (D) and the No. 1 VIS (Variable Induction System) connector (E).



**Fig. 73: Identifying No. 1/No. 2 Knock Sensor Connectors, Injector Connector And Ignition Coil Harness**

Courtesy of KIA MOTORS AMERICA, INC.

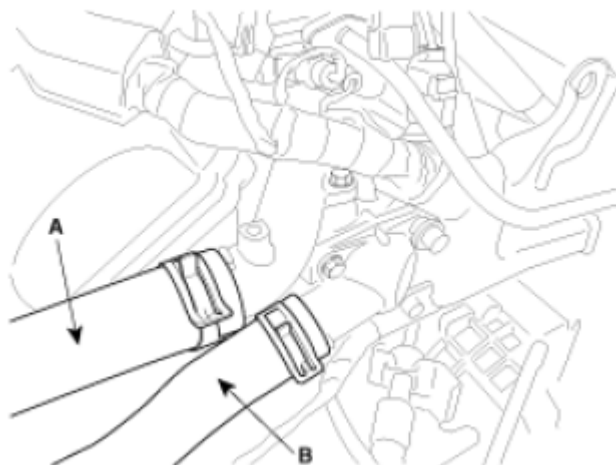
22. Install the fuel inlet hose (A) to the delivery pipe.



**Fig. 74: Identifying Fuel Inlet Hose To Delivery Pipe**

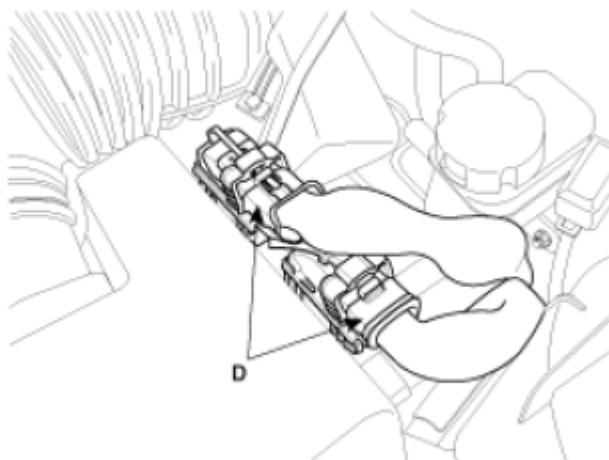
Courtesy of KIA MOTORS AMERICA, INC.

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



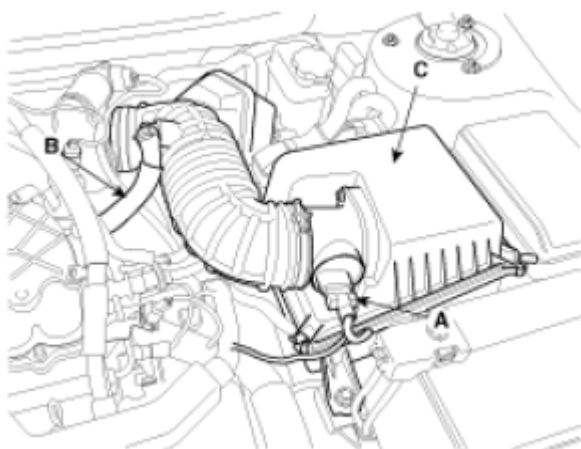
**Fig. 75: Identifying Upper Radiator Hose And Lower Radiator Hose**  
Courtesy of KIA MOTORS AMERICA, INC.

24. Install the intake air hose and air cleaner assembly.
  1. Connect the PCM connectors (D).



**Fig. 76: Identifying PCM Connectors**  
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the intake air hose and air cleaner assembly (C).
  3. Connect the breather hose (B) from air cleaner hose.
  4. Connect the MAF connector (A).

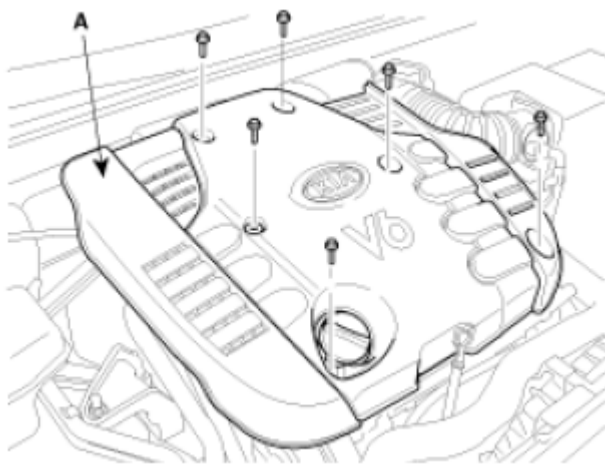


**Fig. 77: Identifying MAF Connector, Breather Hose And Air Cleaner Assembly**  
Courtesy of KIA MOTORS AMERICA, INC.

25. Install the engine cover (A).

**Tightening torque**

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



**Fig. 78: Identifying Engine Cover**  
Courtesy of KIA MOTORS AMERICA, INC.

26. Refill engine coolant.