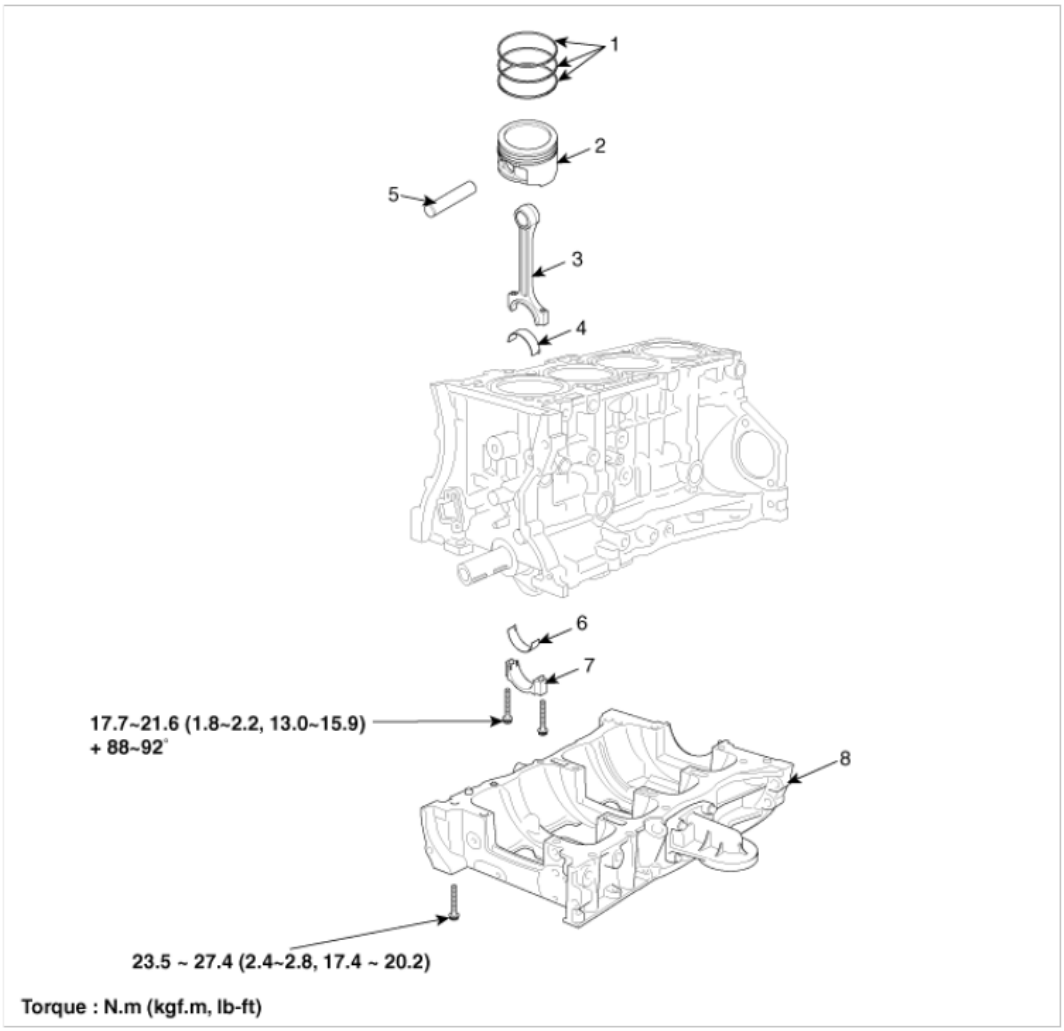
2010 ENGINE

Cylinder Block - Forte/Forte Koup

CYLINDER BLOCK

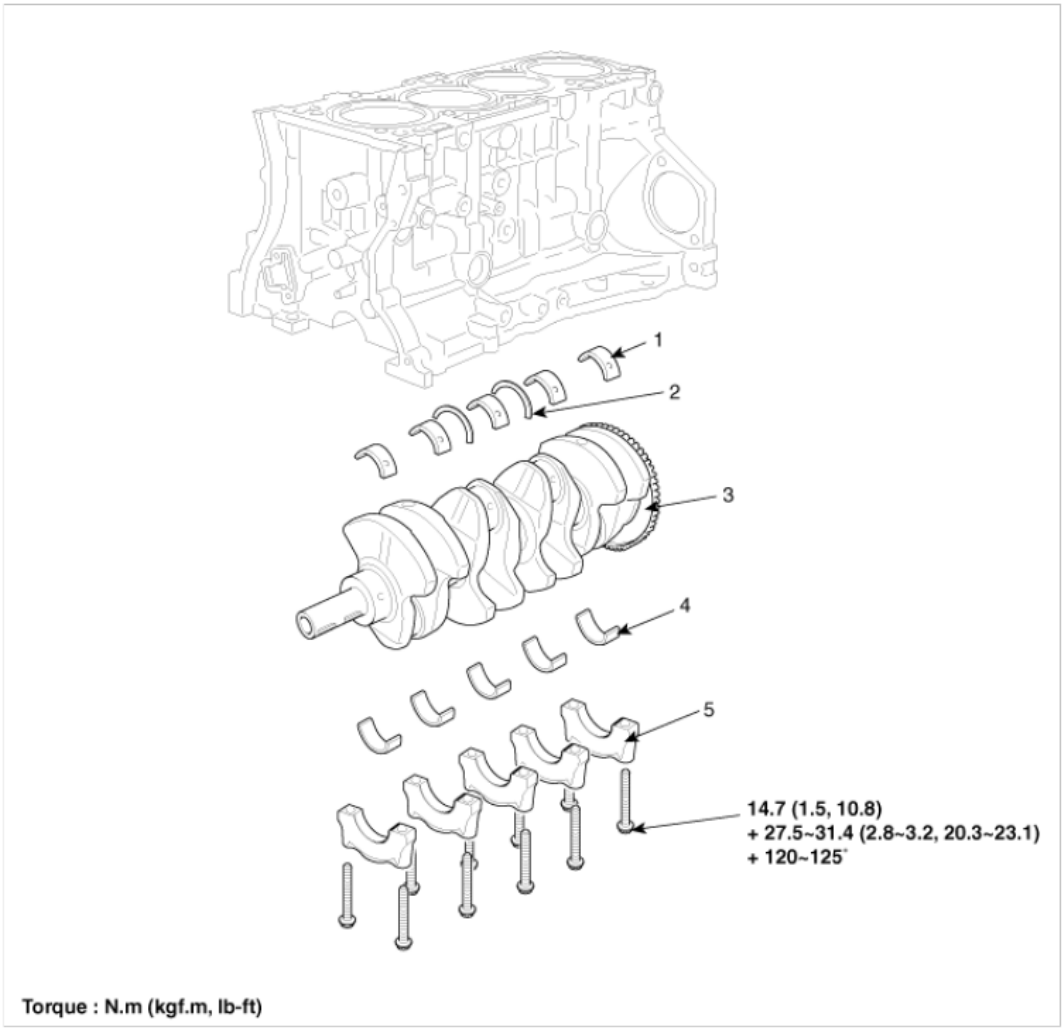
COMPONENTS AND COMPONENT LOCATIONS

Components



1. Piston ring	5. Piston pin
2. Piston	6. Connecting rod lower bearing
3. Connecting rod	7. Connecting rod bearing cap
4. Connecting rod upper bearing	8. Ladder frame

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



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

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.**
- **Turn the crankshaft pulley so that the No. 1 piston is at top dead center.**
- **Engine removal is required for this procedure.**

1. Remove the engine assembly from the vehicle. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY**)
2. Install the engine to engine stand for disassembly.
3. Remove the intake manifold and exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM**)
4. Remove the timing chain. (Refer to **TIMING SYSTEM**)
5. Remove the cylinder head assembly. (Refer to **CYLINDER HEAD**)
6. Remove the drive plate (AT only) or fly wheel (MT only).
7. Remove the oil pump. (Refer to **LUBRICATION SYSTEM**)
8. Remove the A/C compressor. (Refer to **COMPRESSOR**)
9. Remove the alternator (A).

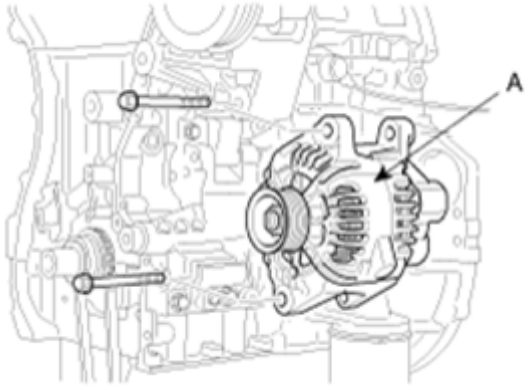


Fig. 3: Identifying Alternator
Courtesy of KIA MOTORS AMERICA, INC.

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

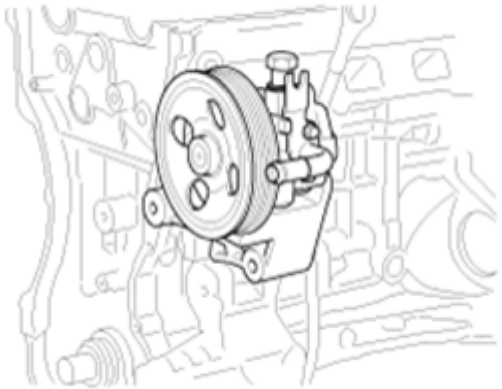


Fig. 4: Identifying Power Steering Pump & Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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

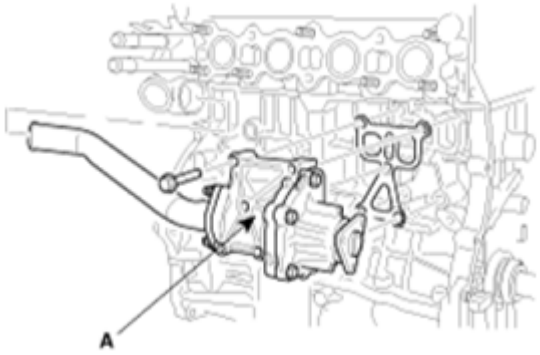


Fig. 5: Identifying Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

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

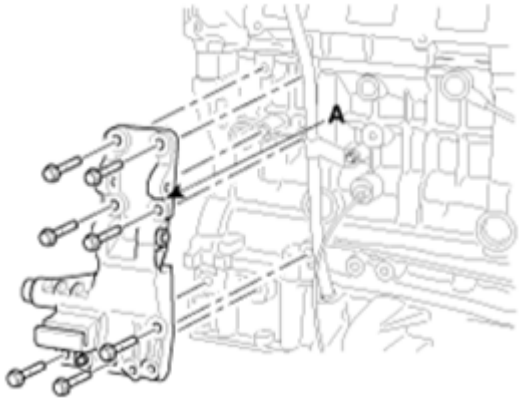


Fig. 6: Identifying Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the oil level gauge (A).

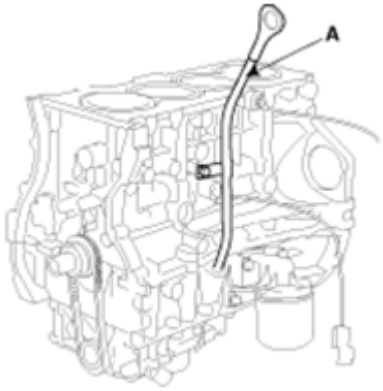


Fig. 7: Identifying Oil Level Gauge
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the knock sensor (A).

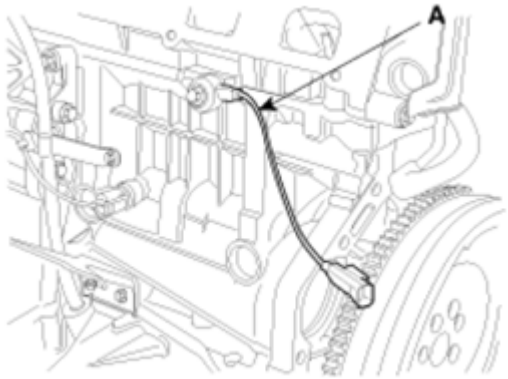


Fig. 8: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

15. Remove the oil pressure sensor (A).

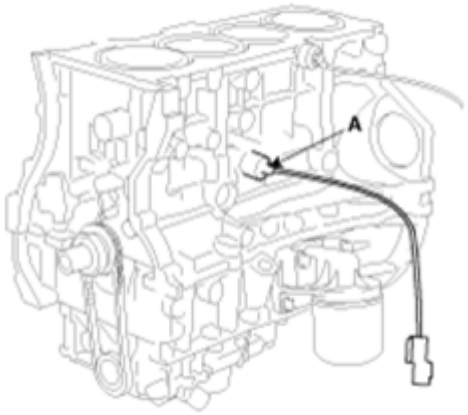


Fig. 9: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

16. Remove the CKP sensor (A).

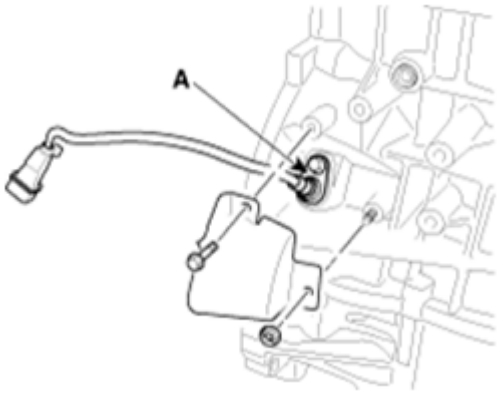


Fig. 10: Identifying CKP Sensor
Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the ladder frame (A).

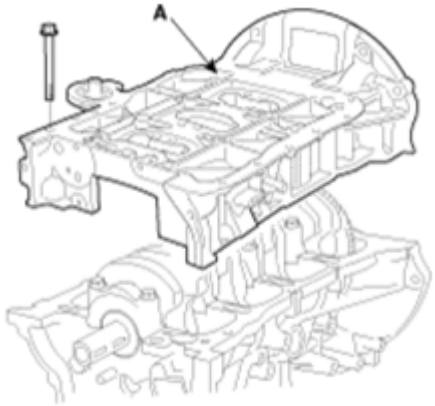


Fig. 11: Identifying Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

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

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

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

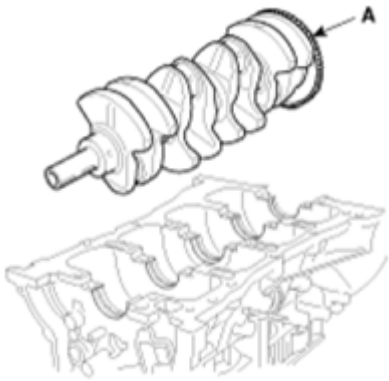


Fig. 12: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

24. Check fit between piston and piston pin.

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

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

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

26. Disconnect connecting rod from piston.

Inspection

Connecting Rod And Crankshaft

1. Check the connecting rod end play.

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

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

   Maximum end play: 0.35mm (0.0138in.)

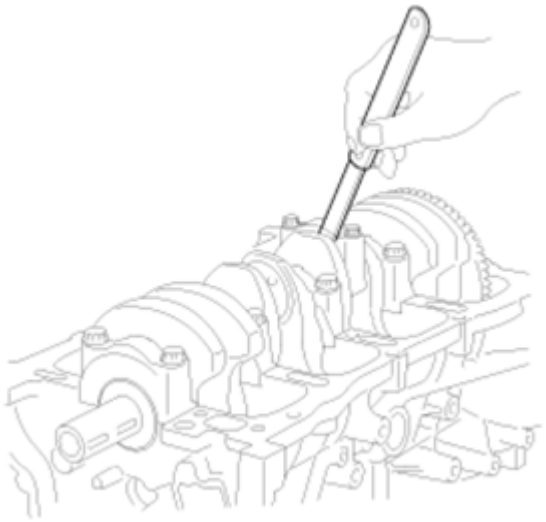


Fig. 13: Measuring Connecting Rod End Play
Courtesy of KIA MOTORS AMERICA, INC.

A. If out-of-tolerance, install a new connecting rod.
B. If still out-of-tolerance, replace the crankshaft.

2. Check the connecting road bearing oil clearance.
   1. Check that the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
   2. Remove 2 connecting rod cap bolts.
   3. Remove the connecting rod cap and bearing half.
   4. Clean the crank pin and bearing.
   5. Place plastigage across the crank pin.
   6. Reinstall the bearing half and cap, and torque the bolts.

      Tightening torque

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

      NOTE: Do not turn the crankshaft.

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

      Standard oil clearance

      0.027 ~ 0.045mm (0.0010 ~ 0.0017in.)

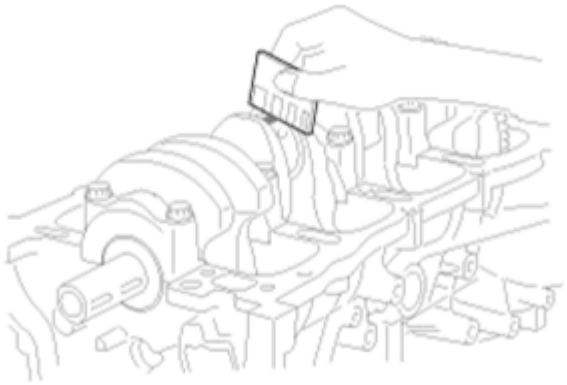


Fig. 14: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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 **CONNECTING ROD BEARING DISCRIMINATION**), and recheck the clearance.

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

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

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

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

Connecting Rod Mark Location

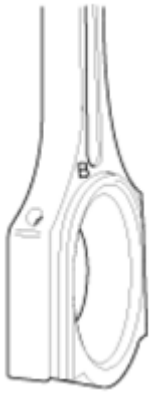


Fig. 15: Identifying Connecting Rod Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod

CONNECTING ROD DISCRIMINATION

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

Crankshaft Pin Mark Location Discrimination Of Crankshaft

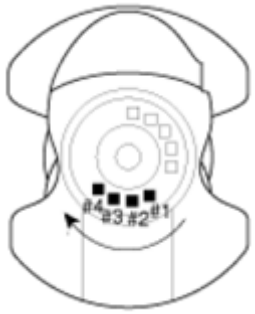


Fig. 16: Identifying Crankshaft Pin Mark
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Conform to read stamping order as shown by arrow direction from #1 in Fig. 16.

Discrimination Of Crankshaft

CRANKSHAFT DISCRIMINATION

Class	Mark	Outside Diameter Of Pin
I	1	47.966 ~ 47.972mm (1.8884 ~ 1.8886in.)
II	2	47.960 ~ 47.966mm (1.8881 ~ 1.8884in.)
III	3	47.954 ~ 47.960mm (1.8879 ~ 1.8881in.)

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

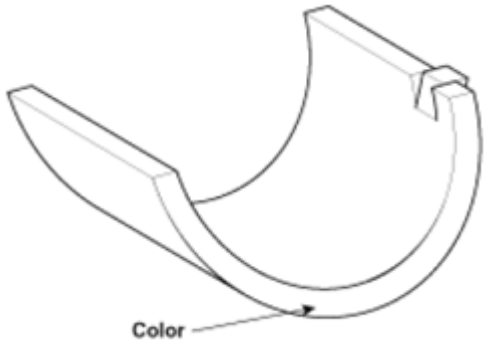


Fig. 17: Identifying Connecting Rod Bearing Color
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Connecting Rod Bearing

CONNECTING ROD BEARING DISCRIMINATION

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

11. Selection

CRANKSHAFT AND CONNECTING ROD IDENTIFICATION MARK REFERENCE

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

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

Tightening torque

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

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.020 ~ 0.038mm (0.0008 ~ 0.0015in.)

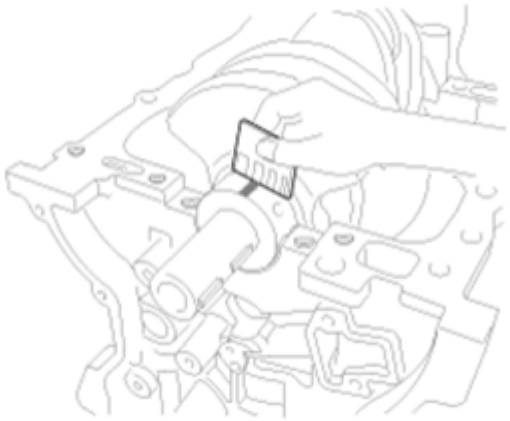


Fig. 18: Measuring Widest Part Of Plastigage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

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

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

Connecting Rods

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

Allowable bend of connecting rod:

0.05mm/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

Crankshaft bore mark location

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

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

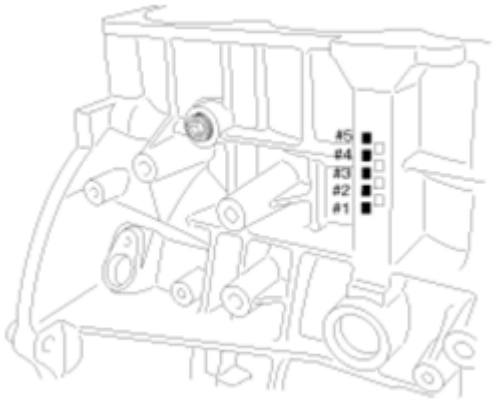


Fig. 19: Identifying Crankshaft Bore Marks
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Block

CYLINDER BLOCK DISCRIMINATION

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

c	C	56.012 ~ 56.018mm (2.2052 ~ 2.2054in.)

Crankshaft Journal Mark Location Discrimination Of Crankshaft

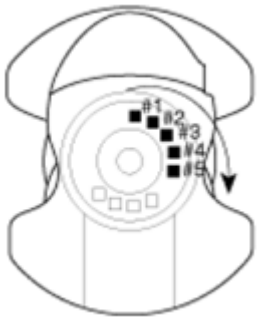


Fig. 20: Identifying Crankshaft Journal Mark
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Conform to read stamping order as shown by arrow direction from #1 in Fig. 20.

Discrimination Of Crankshaft

CRANKSHAFT DISCRIMINATION

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

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

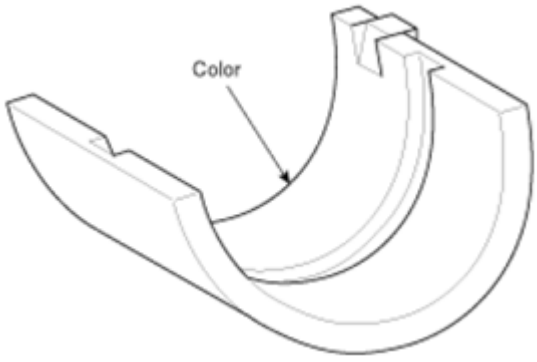


Fig. 21: Identifying Crankshaft Bearing Color
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Crankshaft Bearing

CRANKSHAFT BEARING DISCRIMINATION

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

Selection

CRANKSHAFT AND CRANKSHAFT BORE IDENTIFICATION MARK REFERENCE

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

4. Check crankshaft end play.

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

   Standard end play

   0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)

   Limit : 0.30mm (0.0118in.)

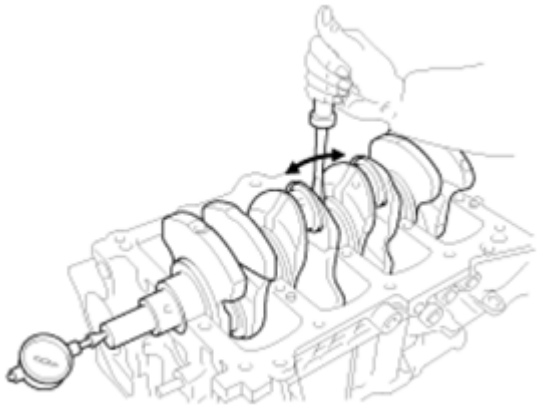


Fig. 22: Checking Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

Thrust bearing thickness

1.925 ~ 1.965mm (0.0758 ~ 0.07736in.)

5. Inspect main journals and crank pins

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

   Main journal diameter:

   51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)

   Crank pin diameter:

   47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)

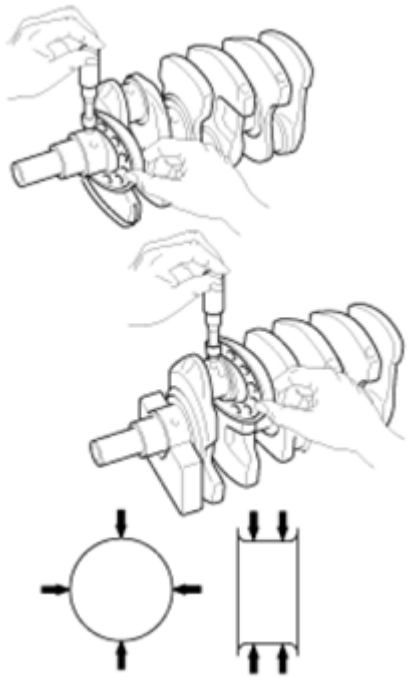


Fig. 23: Measuring Diameter Of Each Main Journal & Crank Pin
Courtesy of KIA MOTORS AMERICA, INC.

Cylinder Block

1. Remove gasket material.

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

2. Clean cylinder block

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

3. Inspect top surface of cylinder block for flatness.

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

   Flatness of cylinder block gasket surface

   Standard : Less than 0.05mm (0.0020 in.)

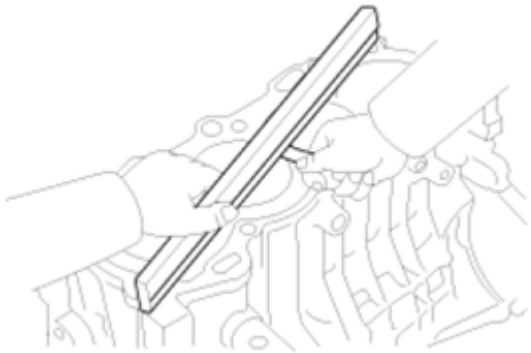


Fig. 24: Measuring Surface Contacting Cylinder Head Gasket For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

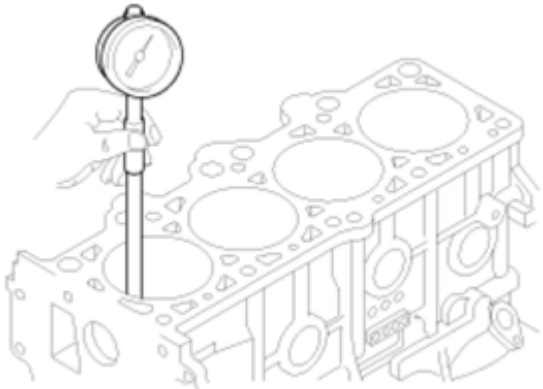


Fig. 25: Measuring Cylinder Bore Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

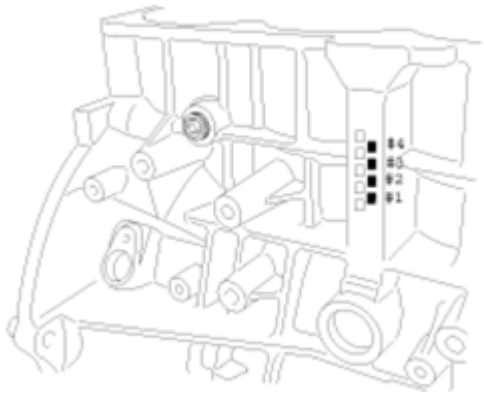


Fig. 26: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of KIA MOTORS AMERICA, INC.

Cylinder Bore Inner Diameter

CYLINDER BORE INNER DIAMETER SPECIFICATION

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

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

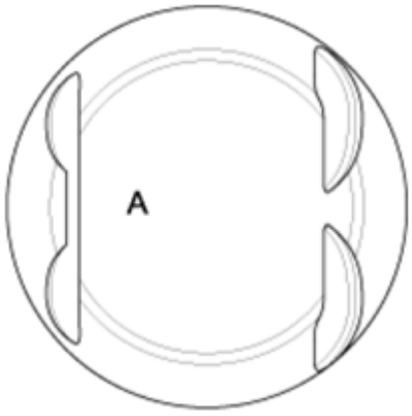


Fig. 27: Identifying Piston Size Code
Courtesy of KIA MOTORS AMERICA, INC.

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

Piston Outer Diameter

PISTON OUTER DIAMETER SPECIFICATION

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

8. Select the piston related to cylinder bore class.

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

Piston And Rings

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

NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 34.5mm (1.35in.) from the top land of the piston.

Standard diameter

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

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

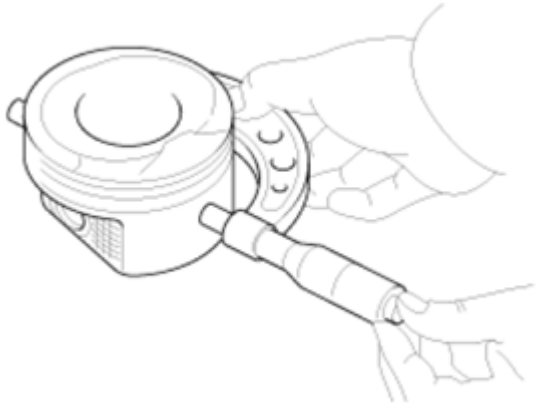


Fig. 28: Measuring Piston Outside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

   Piston-to-cylinder clearance

   0.015 ~ 0.035mm (0.00059 ~ 0.00137in.)

4. Inspect the piston ring side clearance.

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

   Piston ring side clearance

   Standard

   No. 1 : 0.05 ~ 0.08mm (0.0019 ~ 0.0031in.)

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

   Oil ring : 0.06 ~ 0.15mm (0.0023 ~ 0.0059in.)

   Limit

   No. 1 : 0.1mm (0.004in.)

   No. 2 : 0.1mm (0.004in.)

   Oil ring : 0.2mm (0.008in.)

Fig. 29: Measuring Clearance Between New 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 rebored.

   Piston ring end gap

   Standard

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

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

   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.)

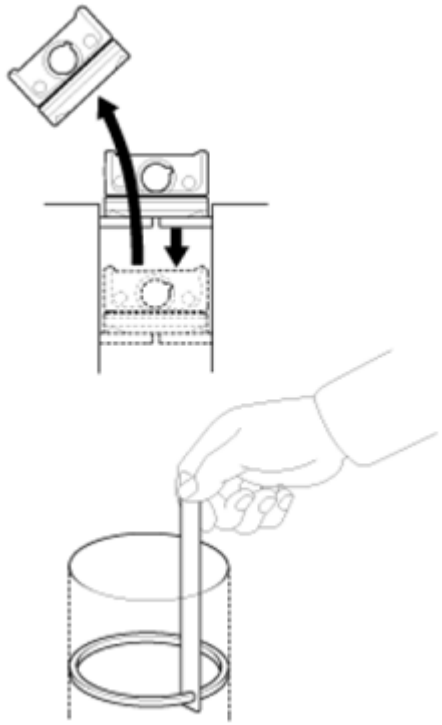


Fig. 30: Measuring Piston Ring End Gap
Courtesy of KIA MOTORS AMERICA, INC.

Piston Pins

1. Measure the diameter of the piston pin.

   Piston pin diameter

   21.001 ~ 21.006mm (0.8268 ~ 0.8270in.)

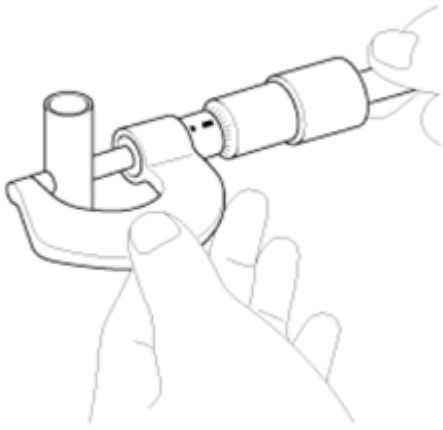


Fig. 31: Measuring Diameter Of Piston Pin
Courtesy of KIA MOTORS AMERICA, INC.

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

   Piston pin-to-piston clearance

   0.013 ~ 0.023mm (0.0005 ~ 0.0009in.)

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

   Piston pin-to-connecting rod interference

   0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)

Oil Pressure Switch

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

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

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.

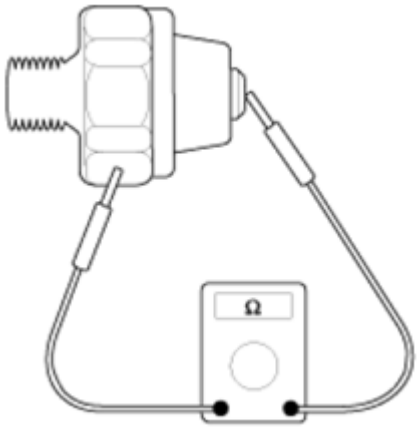


Fig. 32: Checking Continuity Between Oil Pressure Switch Terminal & Body (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

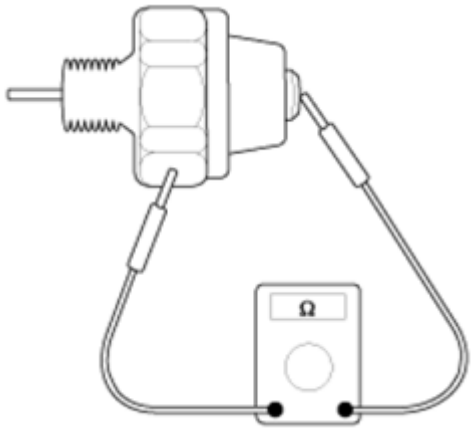


Fig. 33: Checking Continuity Between Oil Pressure Switch Terminal & Body (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

3. If there is no continuity when a 50kpa (7psi) is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

Reassembly

NOTE:

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

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

CAUTION:

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

Piston pin outer DIA.:

21.001 ~ 21.006mm (0.8268 ~ 0.8270in)

Connecting rod small end inner DIA.:

20.974 ~ 20.985mm (0.8257 ~ 0.8261in)

    2. Use a hydraulic press for installation.

3. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.

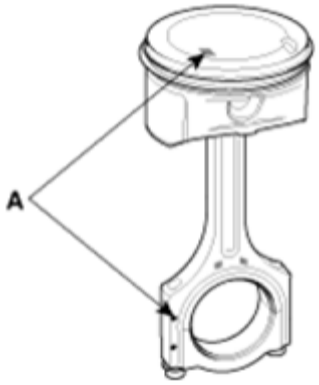


Fig. 34: Identifying Piston Front Mark & Connecting Rod Front Mark
Courtesy of KIA MOTORS AMERICA, INC.

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. 35**.

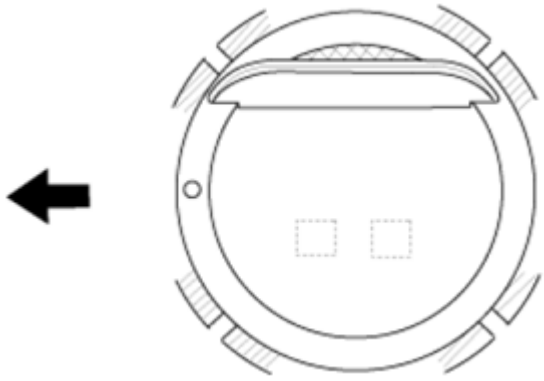


Fig. 35: Installing Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

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).

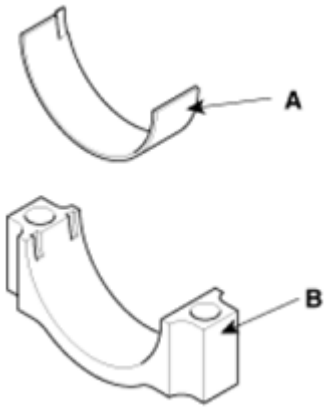


Fig. 36: Identifying Bearings & Connecting Rod Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the main bearings.

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

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

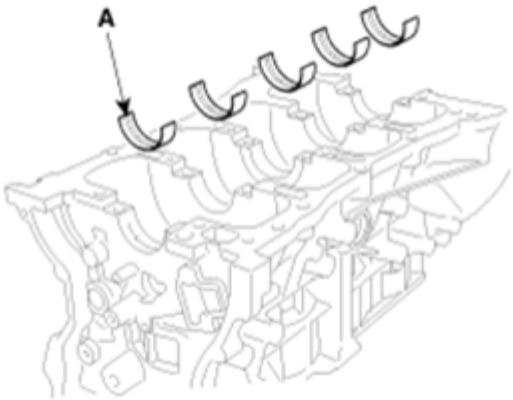


Fig. 37: Installing Main Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

5. Install the thrust bearings.

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

Fig. 38: Identifying Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

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

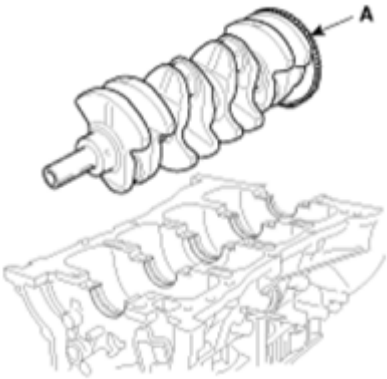


Fig. 39: Identifying Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

NOTE:

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

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown in **Fig. 40**. (with specified torque 29.4N.m (3.0kgf.m, 21.7lb-ft))

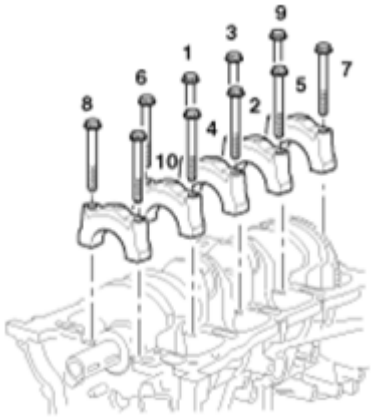


Fig. 40: Installing Torque Sequence Of Main Bearing Cap Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Retighten the bearing cap bolts by 120° in the numerical order shown in **Fig. 40**.
4. Check that the crankshaft turns smoothly.

9. Check crankshaft end play.
10. Install piston and connecting rod assemblies.

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

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

Tightening torque

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

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

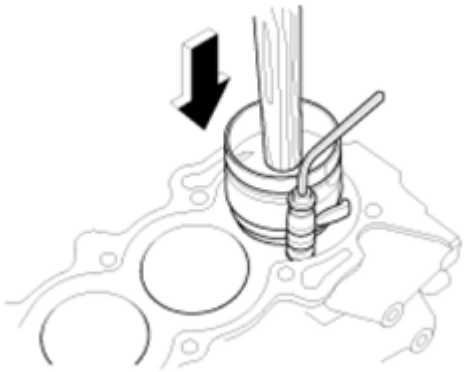


Fig. 41: Installing Piston & Connecting Rod
Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

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

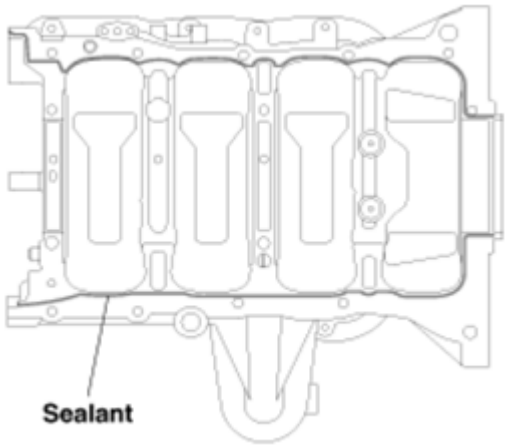


Fig. 42: Identifying Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

12. Install ladder frame (A) with 10 bolts in several passes in sequence shown in **Fig. 44**.

Tightening torque

Step 1:

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

Step 2:

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

Step 3:

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

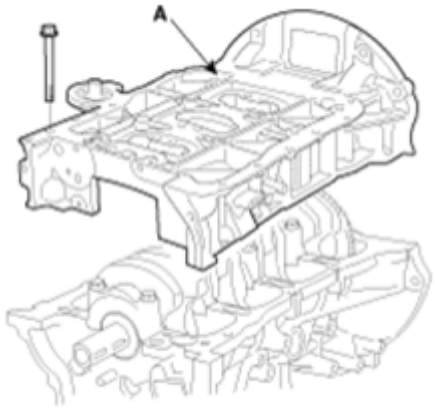


Fig. 43: Identifying Ladder Frame
Courtesy of KIA MOTORS AMERICA, INC.

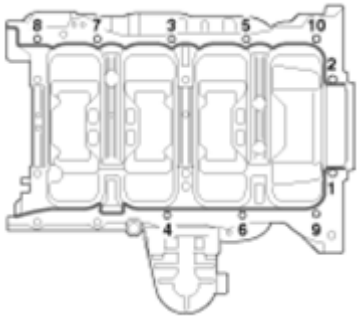


Fig. 44: Identifying Torque Sequence Of Ladder Frame Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

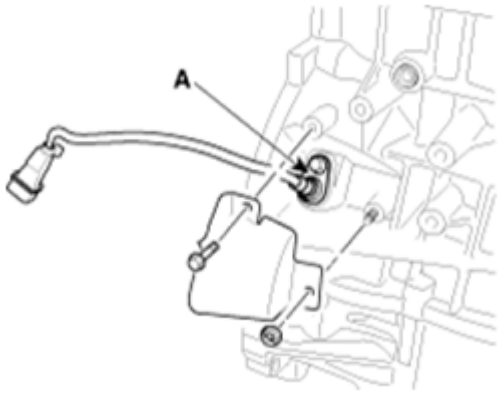


Fig. 45: Identifying CKP Sensor
Courtesy of KIA MOTORS AMERICA, INC.

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

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

    2. Install the oil pressure sensor (A).

       Tightening torque

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

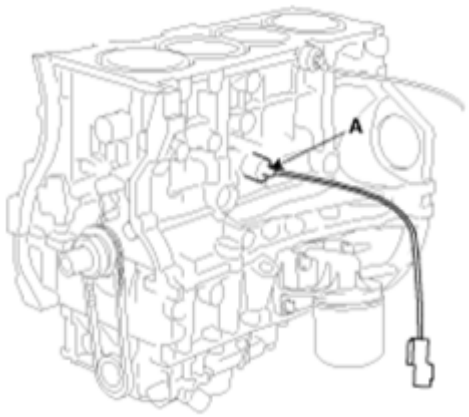


Fig. 46: Identifying Oil Pressure Sensor
Courtesy of KIA MOTORS AMERICA, INC.

16. Install knock sensor (A).

    Tightening torque

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

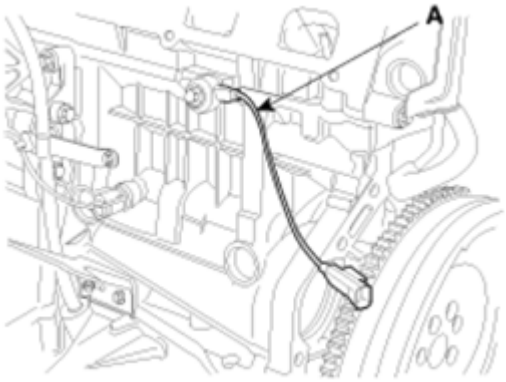


Fig. 47: Identifying Knock Sensor
Courtesy of KIA MOTORS AMERICA, INC.

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

    Tightening torque

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

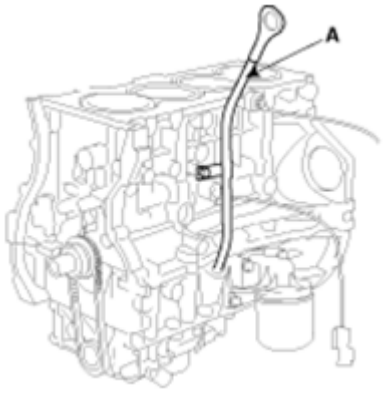


Fig. 48: Identifying Oil Level Gauge Assembly
Courtesy of KIA MOTORS AMERICA, INC.

18. Install tensioner assembly integrated bracket (A).

    Tightening torque

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

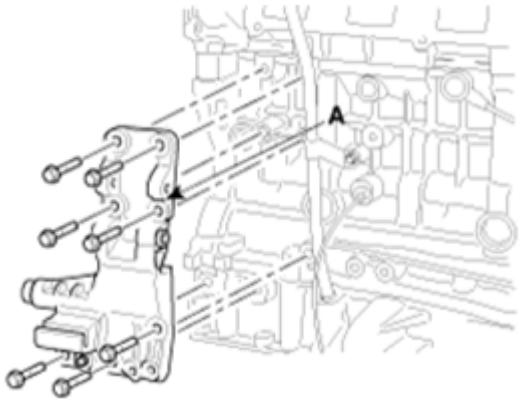


Fig. 49: Identifying Tensioner Assembly Integrated Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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

    Tightening torque:

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

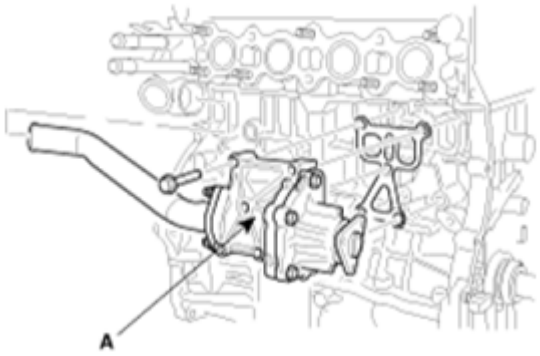


Fig. 50: Identifying Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

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

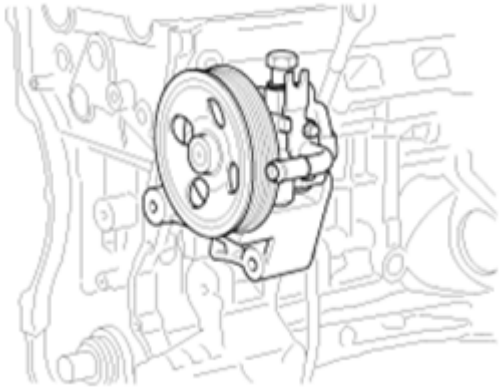


Fig. 51: Identifying Power Steering Pump
Courtesy of KIA MOTORS AMERICA, INC.

21. Install the alternator (A).

    Tightening torque:

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

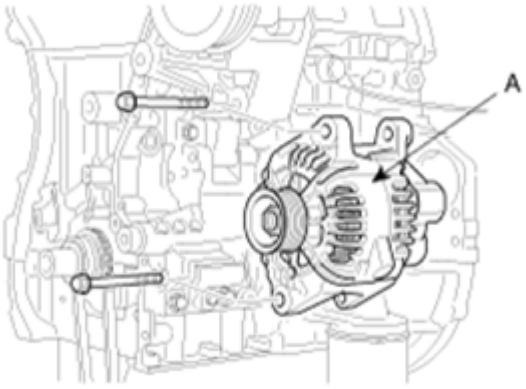


Fig. 52: Identifying Alternator
Courtesy of KIA MOTORS AMERICA, INC.

22. Install the oil pump. (Refer to **LUBRICATION SYSTEM**)
23. Install the cylinder head assembly. (Refer to **CYLINDER HEAD**)
24. Install the timing chain. (Refer to **TIMING SYSTEM**)
25. Install the oil pan.
    1. Using a razor blade and gasket scraper, remove all the old gasket material from the gasket surfaces.

       NOTE: Check that the mating surfaces are clean and dry before applying liquid gasket.

    2. Apply liquid gasket as an even bead, centered between the edges of the mating surface. Use liquid

gasket LOCTITE 5900H or THREEBOND 1217H equivalent (MS721-40).

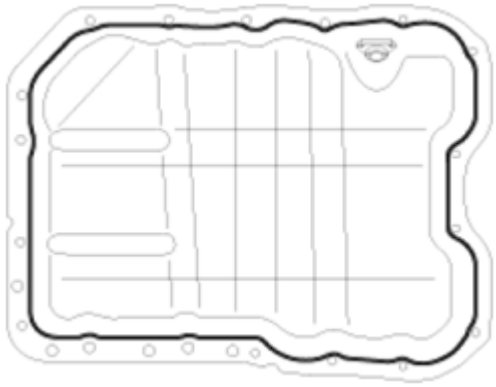


Fig. 53: Identifying Liquid Gasket Application Area
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

3. Install the oil pan.

   Uniformly tighten the bolts in several passes.

   Tightening torque:

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

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

26. Install the A/C compressor. (Refer to **COMPRESSOR**)
27. Install the intake manifold and exhaust manifold. (Refer to **INTAKE AND EXHAUST SYSTEM**)
28. Install the drive plate (AT only) or fly wheel (MT only).

    Tightening torque:

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

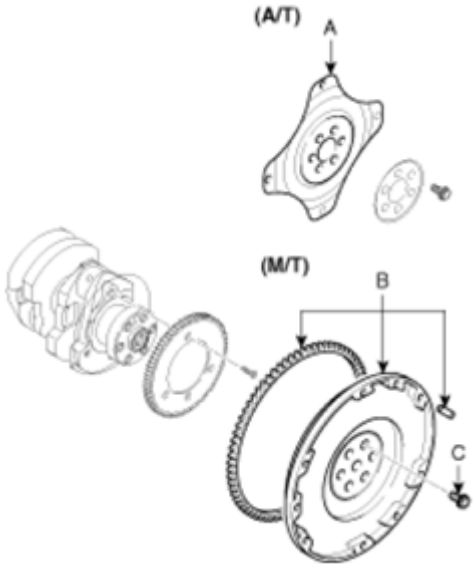


Fig. 54: Identifying Drive Plate (AT Only) & Fly Wheel (MT Only)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

  Sealant: Three bond 2403, Loctite 200 or 204

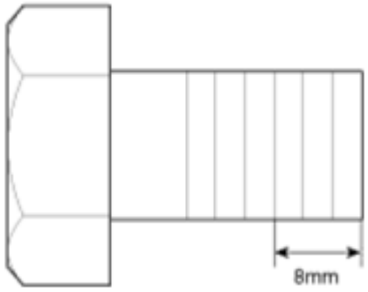


Fig. 55: Identifying Sealant Application Area At End Of Bolt
Courtesy of KIA MOTORS AMERICA, INC.

- **Install and uniformly tighten the 7 bolts, in several passes.**

29. Install the engine assembly on the vehicle.

    (Refer to **ENGINE AND TRANSAXLE ASSEMBLY**). Add all fluids to their normal operating levels.

2010 ENGINE

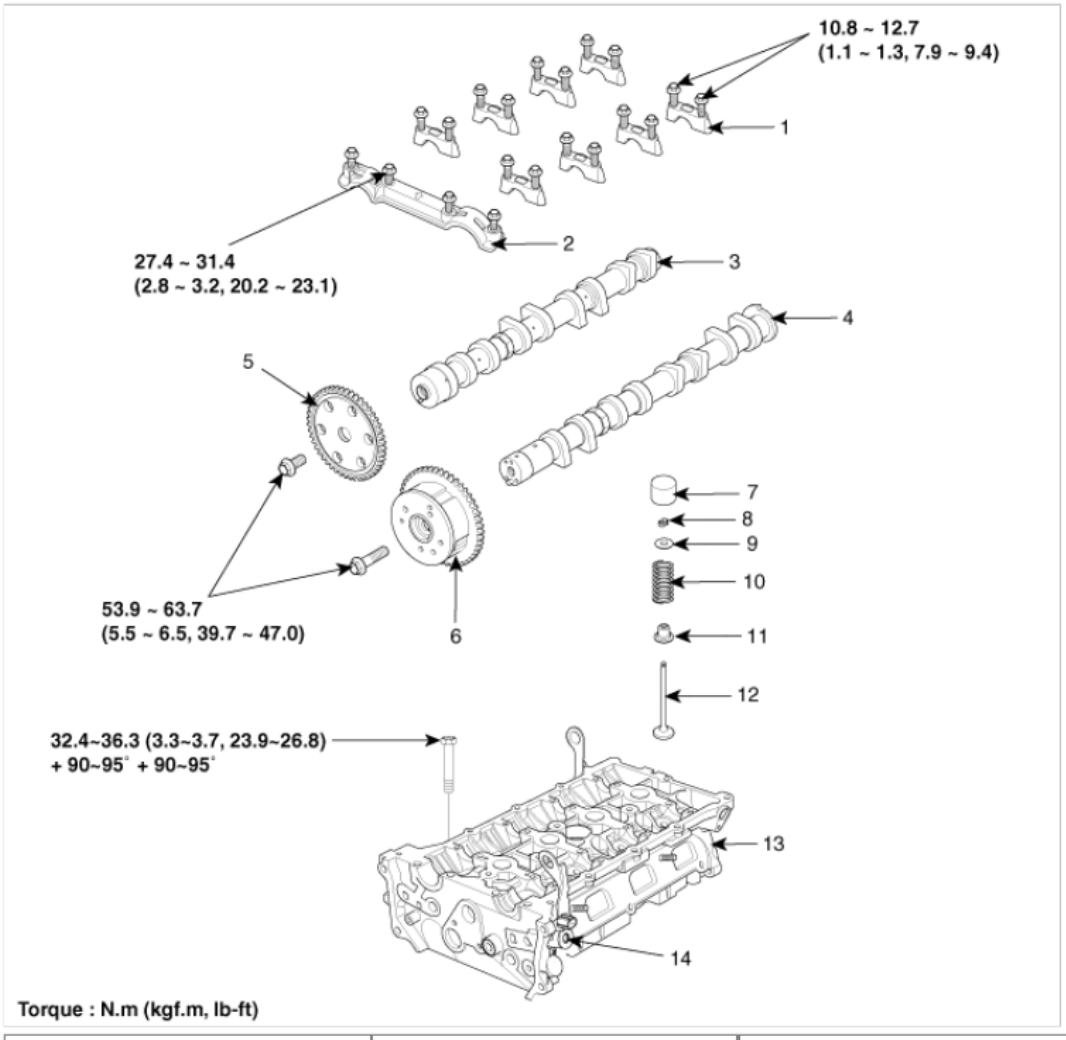
Cylinder Head Assembly - Forte/Forte Koup

CYLINDER HEAD

COMPONENTS AND COMPONENT LOCATIONS

Components

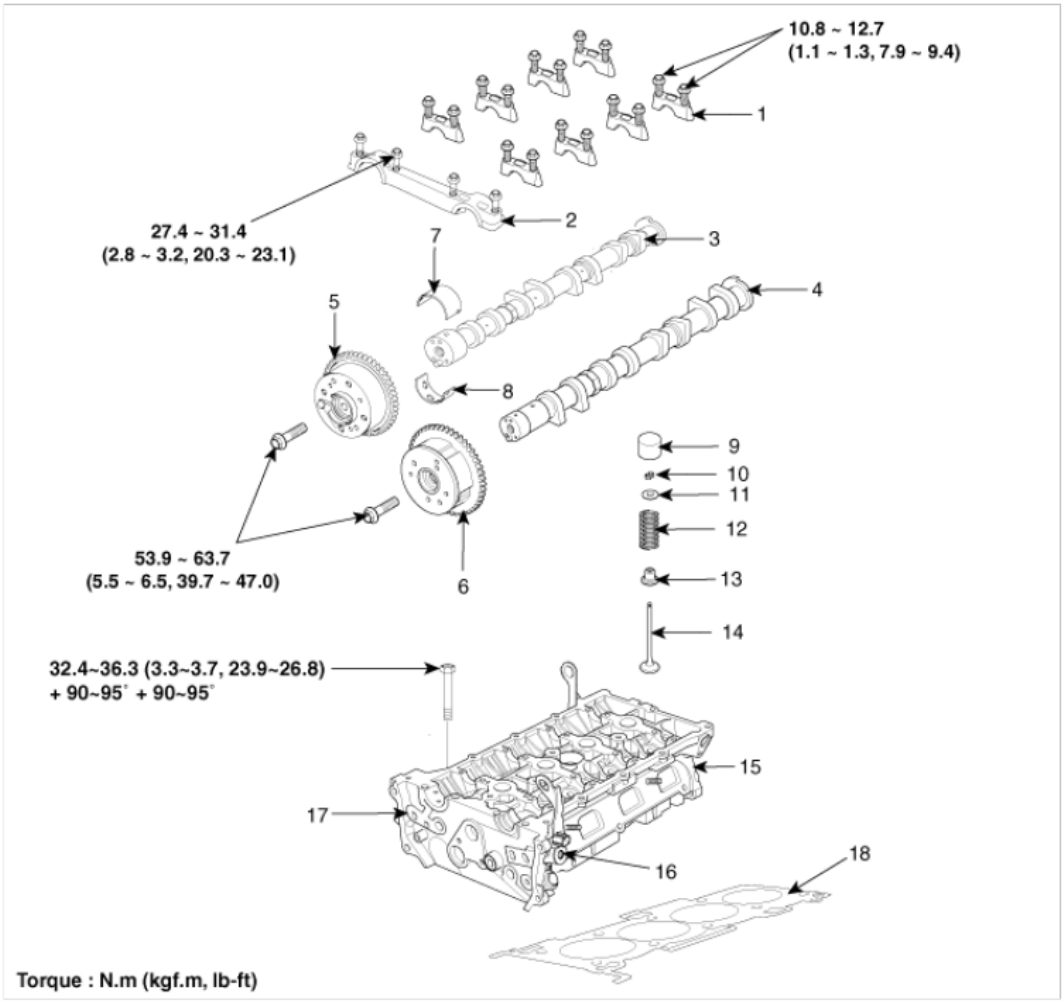
[2.0 ULEV - Single CVVT]



1. Camshaft bearing cap	6. Intake CVVT assembly	11. Valve stem seal
2. Camshaft front bearing cap	7. MLA	12. Valve
3. Exhaust camshaft	8. Retainer lock	13. Cylinder head
4. Intake camshaft	9. Retainer	14. Intake OCV
5. Exhaust camshaft sprocket	10. Valve spring	

Fig. 1: Locating Cylinder Head Components (2.0 ULEV - Single CVVT) With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]



1. Camshaft bearing cap	7. Exhaust camshaft upper bearing	13. Valve stem seal
2. Camshaft front bearing cap	8. Exhaust camshaft lower bearing	14. Valve
3. Exhaust camshaft	9. MLA	15. Cylinder head
4. Intake camshaft	10. Retainer lock	16. Intake OCV
5. Exhaust CVVT assembly	11. Retainer	17. Exhaust OCV
6. Intake CVVT assembly	12. Valve spring	18. Cylinder head gasket

Fig. 2: Locating Cylinder Head Components (Dual CVVT) With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

Removal

Engine removal is not required for this procedure.

CAUTION:

- **Use fender covers to avoid damaging painted surfaces.**
- **To avoid damaging the cylinder head, wait until the engine coolant**

temperature drops below normal temperature before removing it.

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

NOTE: Mark all wiring and hoses to avoid misconnection.

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

   Tightening torque:

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

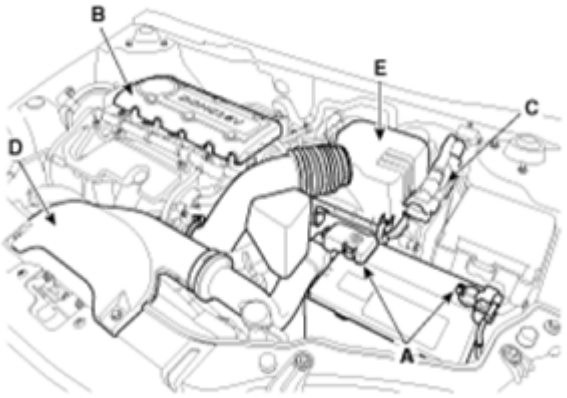


Fig. 3: Identifying Battery Terminals, Engine Cover, ECM Connector, Air Duct, & Air Cleaner Assembly
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove the under covers (A).

   Tightening torque:

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

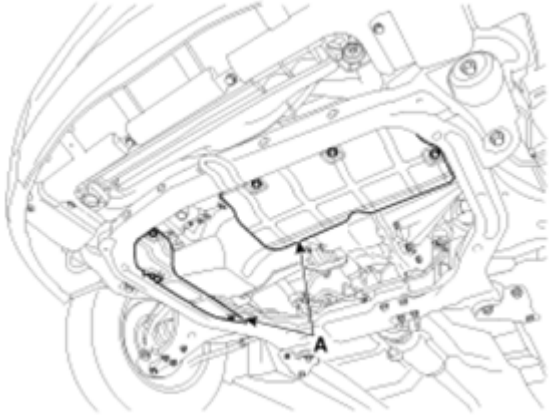


Fig. 4: Identifying Under Covers
Courtesy of KIA MOTORS AMERICA, INC.

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

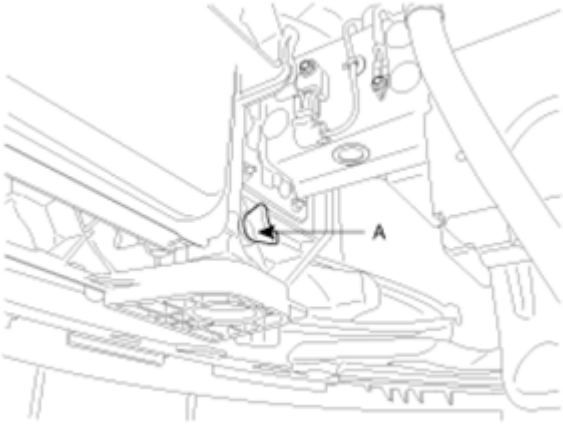


Fig. 5: Identifying Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

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

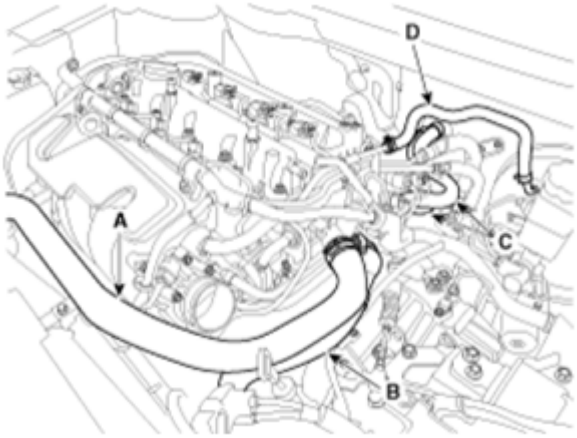


Fig. 6: Identifying Radiator Upper/Lower Hoses, Heater Hoses, & Brake Booster Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

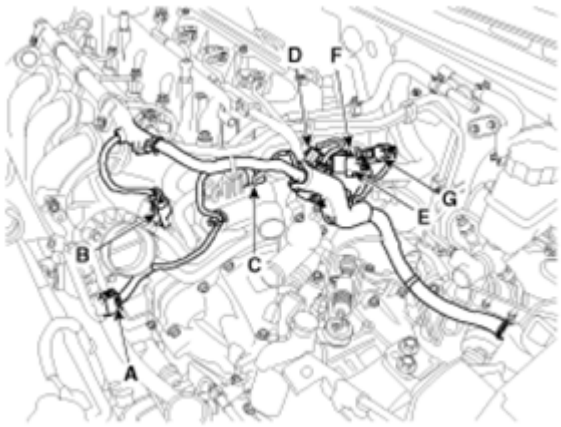


Fig. 7: Identifying Connectors (1 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

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

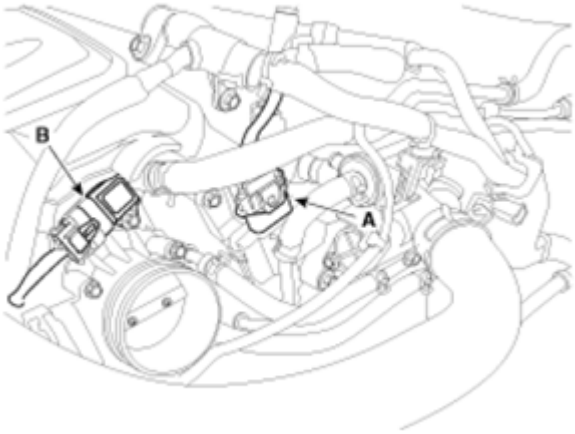


Fig. 8: Identifying Connectors (2 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

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

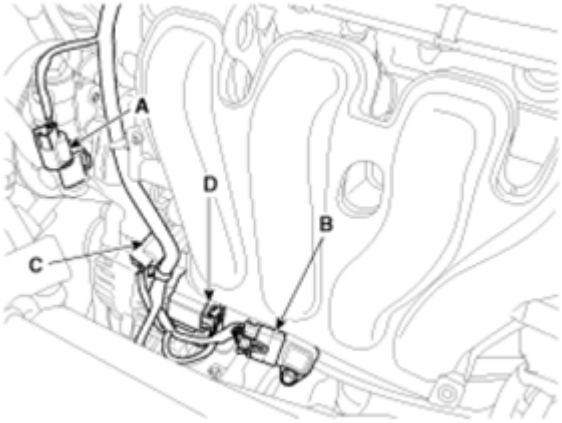


Fig. 9: Identifying Connectors (3 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

14. Disconnect the intake OCV connector (A).

Fig. 10: Identifying Intake OCV Connector
Courtesy of KIA MOTORS AMERICA, INC.

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

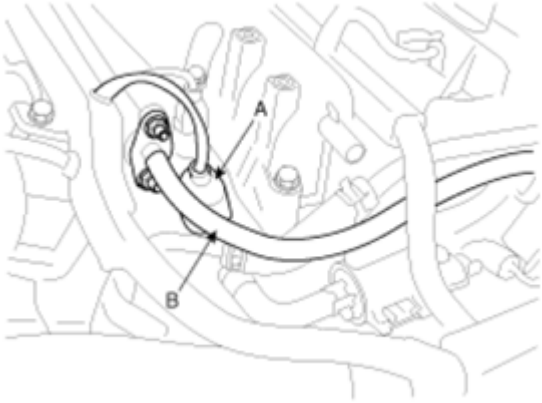


Fig. 11: Identifying CMP Sensor Connector & Fuel Hose
Courtesy of KIA MOTORS AMERICA, INC.

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

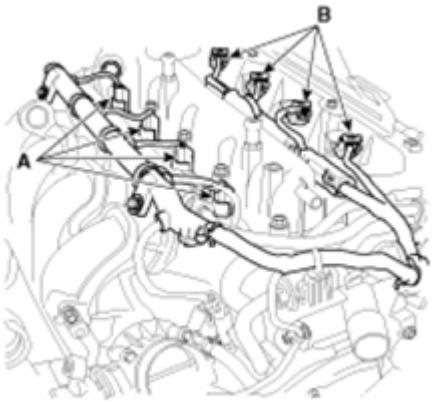


Fig. 12: Identifying Injector Connectors & Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

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

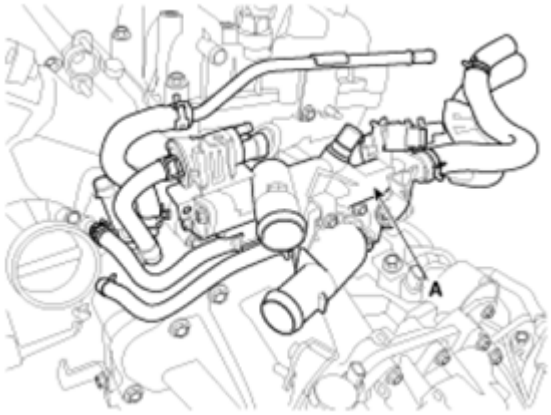


Fig. 13: Identifying Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

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

[Single CVVT]

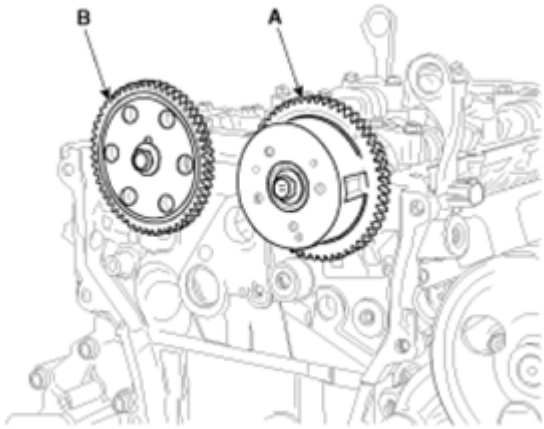


Fig. 14: Identifying Intake CVVT Assembly & Exhaust CVVT Sprocket - (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

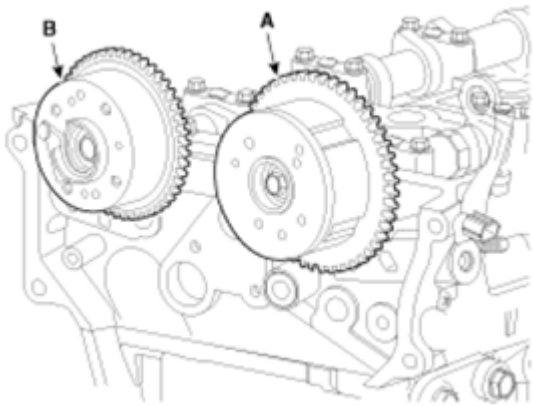


Fig. 15: Identifying Intake CVVT Assembly & Exhaust CVVT Sprocket - (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When removing the sprocket bolt or CVVT assembly bolt, fix the camshaft by wrench at position "A" shown in Fig. 16.

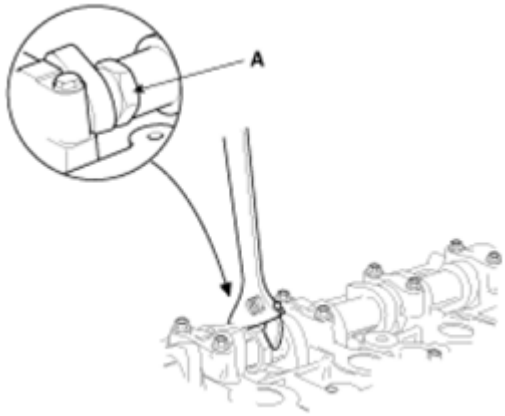


Fig. 16: Removing Sprocket Bolt
Courtesy of KIA MOTORS AMERICA, INC.

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

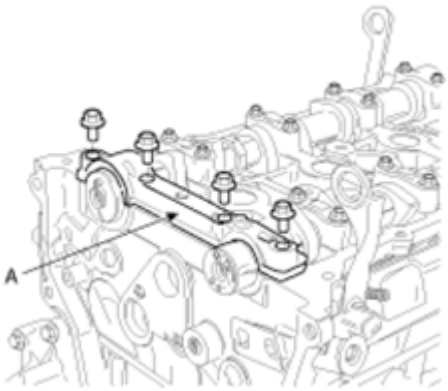


Fig. 17: Identifying Front Camshaft Bearing Cap
Courtesy of KIA MOTORS AMERICA, INC.

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

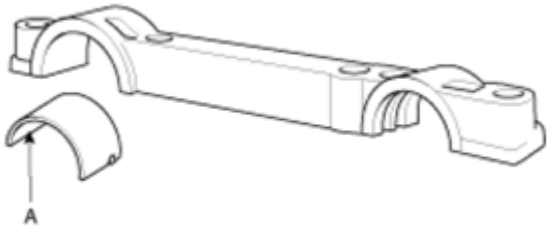


Fig. 18: Identifying Exhaust Camshaft Upper Bearing
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the camshaft bearing cap (A), in the sequence shown in **Fig. 19**.

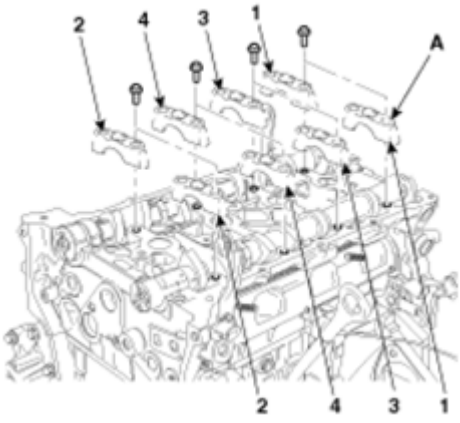


Fig. 19: Identifying Camshaft Bearing Cap Removal Sequence
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the camshafts (A).

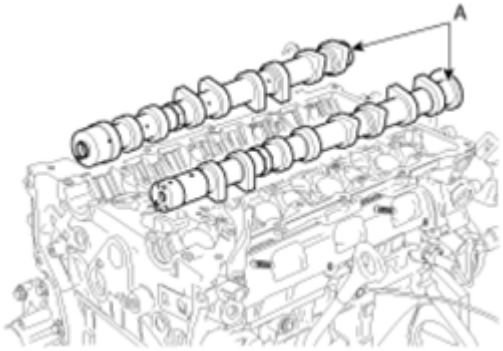


Fig. 20: Identifying Camshafts
Courtesy of KIA MOTORS AMERICA, INC.

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

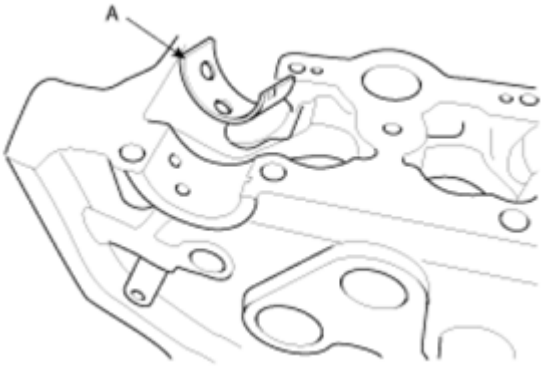


Fig. 21: Identifying Exhaust Lower Bearing
Courtesy of KIA MOTORS AMERICA, INC.

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

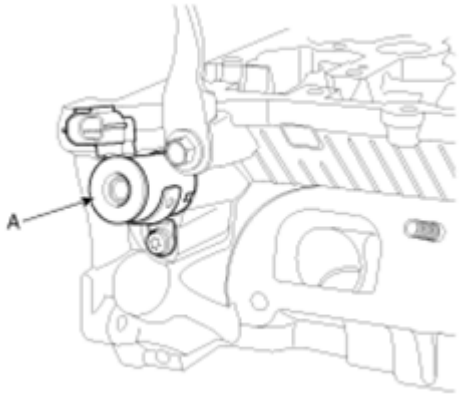


Fig. 22: Identifying Intake OCV
Courtesy of KIA MOTORS AMERICA, INC.

17. Remove the exhaust OCV (A). (Dual CVVT only)
18. Remove the cylinder head bolts, then remove the cylinder head.
    1. Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown in **Fig. 23**. Remove the 10 cylinder head bolts and plate washers.

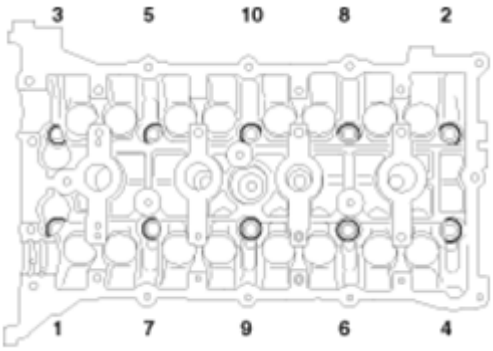


Fig. 23: Identifying Cylinder Head Bolts Removal Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

19. Remove the cylinder head gasket.

Disassembly

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

1. Remove the MLAs (A).

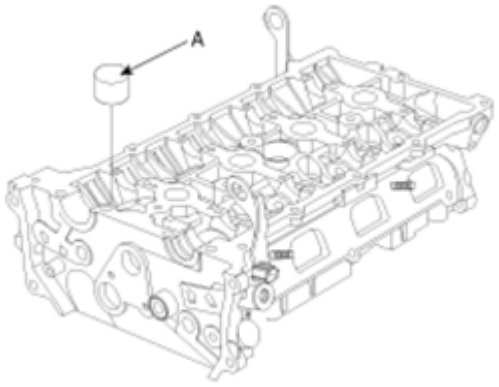


Fig. 24: Identifying Mechanical Lash Adjuster
Courtesy of KIA MOTORS AMERICA, INC.

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

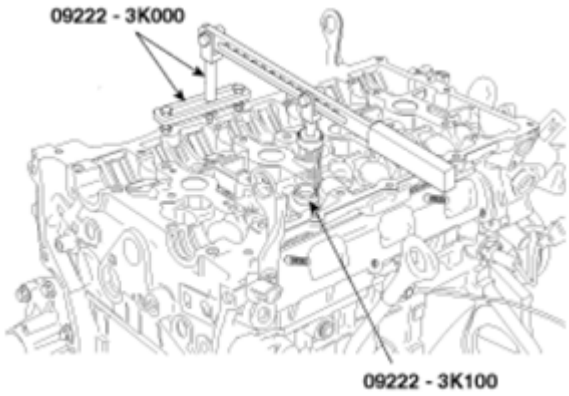


Fig. 25: Compressing Valve Springs Using SST
Courtesy of KIA MOTORS AMERICA, INC.

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

Inspection

Cylinder Head

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

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

Flatness of manifold mounting surface

Standard : Less than 0.1mm (0.0039in.)

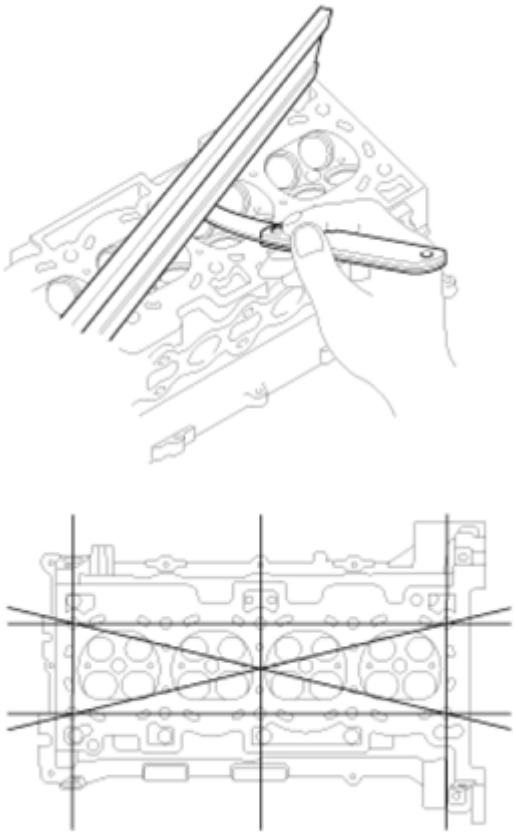


Fig. 26: Measuring Surface Contacting Cylinder Block & Manifolds For Warpage
Courtesy of KIA MOTORS AMERICA, INC.

2. Inspect for cracks.

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

Valve And Valve Spring

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

      Valve guide I.D.

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

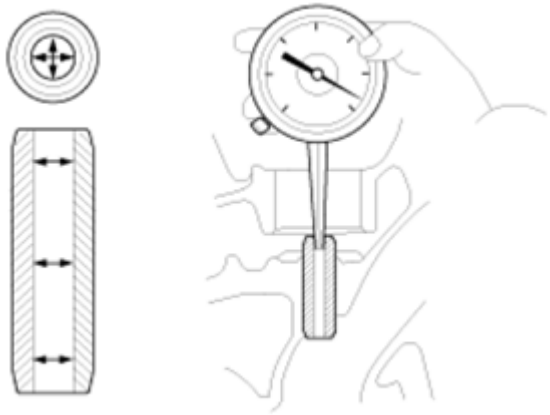


Fig. 27: Measuring Inside Diameter Of Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

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.)

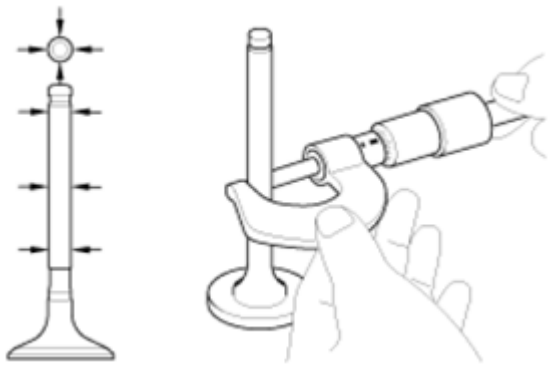


Fig. 28: Measuring Diameter Of Valve Stem
Courtesy of KIA MOTORS AMERICA, INC.

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.)

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

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

       If the valve face is worn, replace the valve.

    3. Check the valve head margin thickness.

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

       Margin

       [Standard]

       Intake : 1.02mm (0.0401in.)

       Exhaust : 1.09mm (0.0429in.)

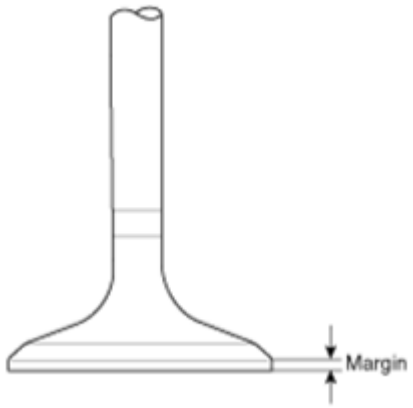


Fig. 29: Checking Valve Head Margin Thickness
Courtesy of KIA MOTORS AMERICA, INC.

    4. Check the valve length.

       Valve length

[Standard]

Intake : 113.18mm (4.4559in.)

Exhaust : 105.84mm (4.1669in.)

[Limit]

Intake : 112.93mm (4.4461in.)

Exhaust : 105.74mm (4.1630in.)

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

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

3. Inspect the valve seats

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

   Replace the seat if necessary.

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

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

      Valve spring

      [Standard]

      Free height : 47.44mm (1.8677in.)

      Out-of-square : 1.5°

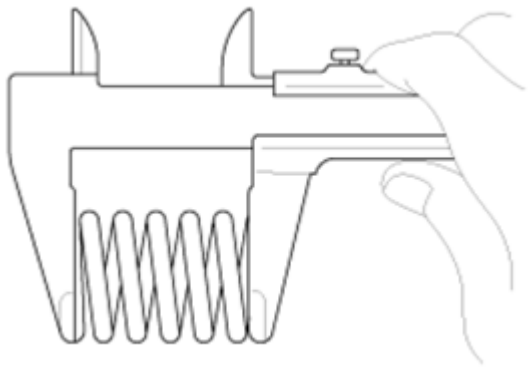


Fig. 30: Measuring Free Length Of Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

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

MLA

1. Inspect the MLA.

   Using a micrometer, measure the MLA outside diameter.

   MLA O.D.

   Intake/Exhaust:

   31.964 ~ 31.980mm (1.2584 ~ 1.2590in.)

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

   Tappet bore I.D.

   Intake/Exhaust:

   32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)

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 the cam lobes.

   Using a micrometer, measure the cam lobe height.

   Cam height

   [Standard value]

   Intake:

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

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

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

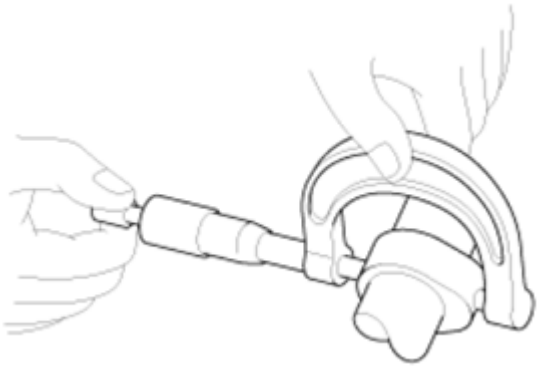


Fig. 31: Measuring Cam Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

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

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

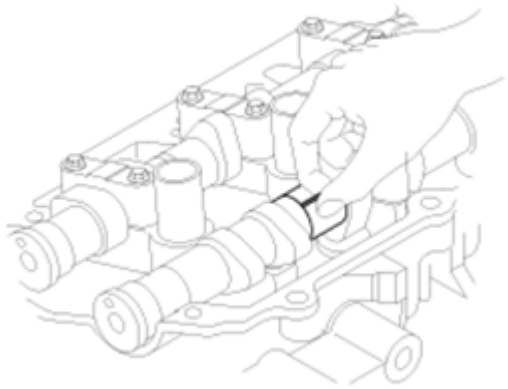


Fig. 32: Inspecting Camshaft Journal Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the bearing caps.

CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

[Standard value]

Intake:

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

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

Exhaust:

Single CVVT

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

Dual CVVT

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

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

[Limit]

Intake:

No. 1 journal : 0.09mm (0.0035in)

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

Exhaust:

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

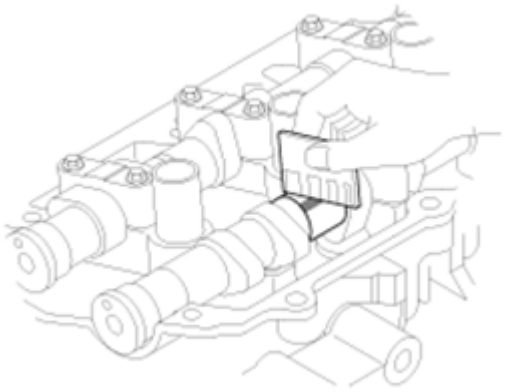


Fig. 33: Measuring Plastigage At Widest Point
Courtesy of KIA MOTORS AMERICA, INC.

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

7. Completely remove the plastigage.
8. Remove the camshafts.

3. Inspect the camshaft end play.
    1. Install the camshafts.
    2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

    Camshaft end play

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

    [Limit] : 0.18mm (0.0071in.)

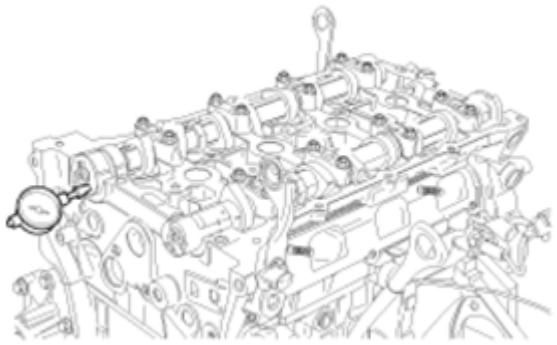


Fig. 34: Inspecting Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

3. Remove the camshafts.

Exhaust Cam Shaft Bearing

1. Check the cylinder head bore mark.

Location Of Cylinder Head Bore Mark

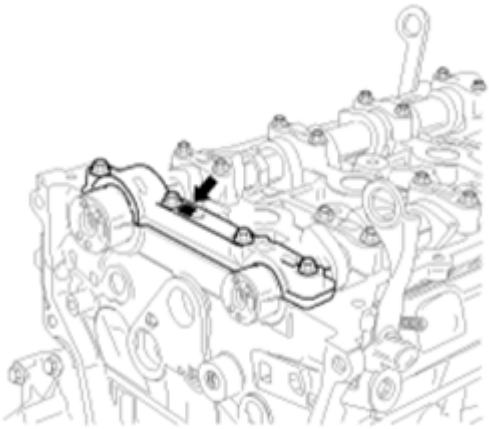


Fig. 35: Locating Cylinder Head Bore Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Cylinder Head

CYLINDER HEAD BORE MARKS

Class	Mark	Exhaust No. 1 Inside Diameter Of Cylinder Head Bore
a	A	40.000 ~ 40.008 mm (1.5748 ~ 1.5751 in.)
b	B	40.008 ~ 4.016 mm (1.5751 ~ 1.5754 in.)
c	C	40.016 ~ 40.024 mm (1.5754 ~ 1.5757 in.)

2. Select class of camshaft bearing same as class of cylinder head as shown in the following table.

Place Of Exhaust Cam Shaft Bearing Identification Mark

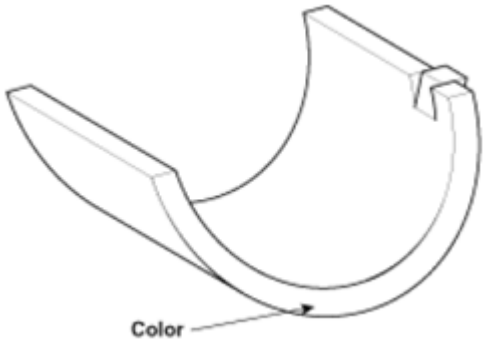


Fig. 36: Identifying Exhaust Cam Shaft Bearing Identification Mark
Courtesy of KIA MOTORS AMERICA, INC.

Discrimination Of Exhaust Camshaft Bearing

EXHAUST CAMSHAFT BEARING IDENTIFICATION AND SPECIFICATION

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

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

CVVT Assembly

1. Inspect CVVT assembly.
    1. Check that the CVVT assembly will not turn.
    2. Apply vinyl tape to the retard hole except the one indicated by the arrow in **Fig. 37**.

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

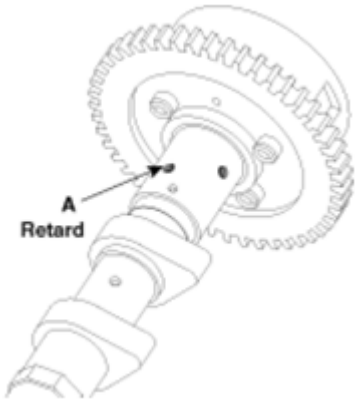


Fig. 37: Identifying Retard Hole
Courtesy of KIA MOTORS AMERICA, INC.

3. Wind tape around the tip of the air gun and apply air of approx. 150kpa (1.5kgf/cm^2 , 21psi) to the port of the camshaft. (Perform this in order to release the lock pin.)

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

4. With air applied, as in step (3), turn the CVVT assembly to the advance angle side (as shown in **Fig. 38**) with your hand.

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

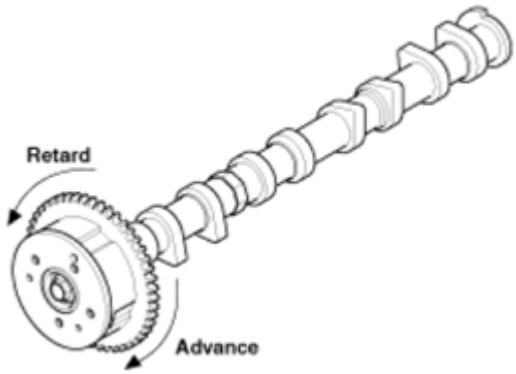


Fig. 38: Identifying CVVT Advance & Retard Rotation Directions
Courtesy of KIA MOTORS AMERICA, INC.

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

   Standard:

Should move smoothly in a range from about

22.5° (Intake) / 20.0° (Exhaust)

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

Reassembly

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

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

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

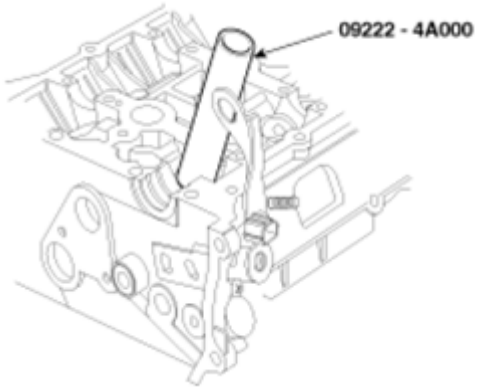


Fig. 39: Pushing In Oil Seal Using SST
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

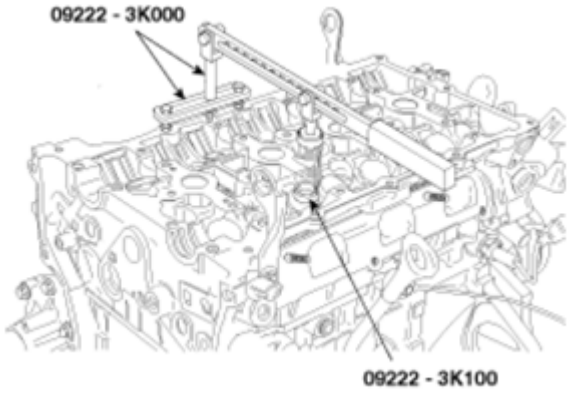


Fig. 40: Compressing Valve Springs Using SST
Courtesy of KIA MOTORS AMERICA, INC.

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

2. Install the MLAs.

Check that the MLA rotates smoothly by hand.

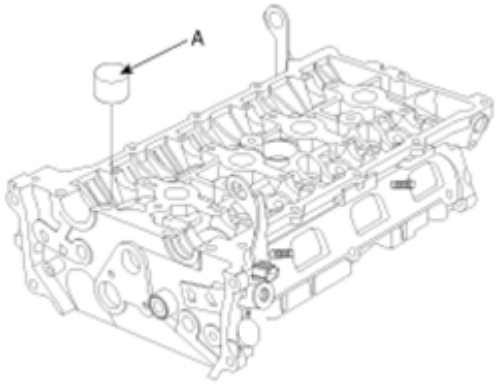


Fig. 41: Identifying MLA
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: MLA can be reinstalled in its original position.

Installation

NOTE:

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

1. Install the OCV filter.

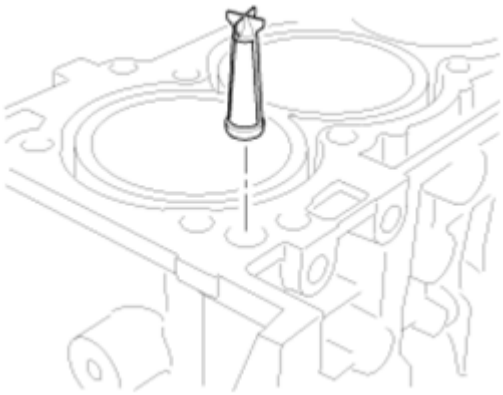


Fig. 42: Identifying OCV Filter
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Keep the OCV filter clean.

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

NOTE:

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

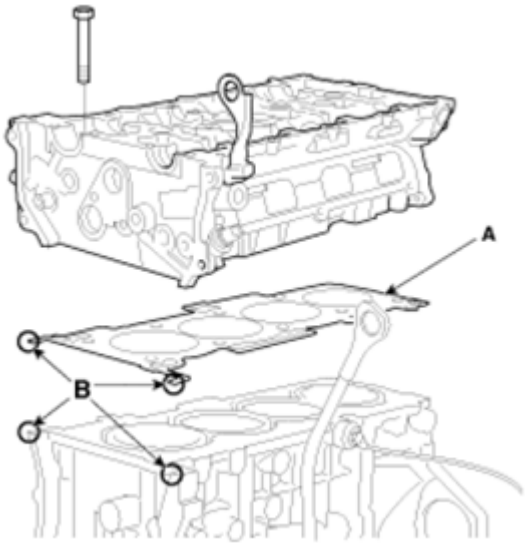


Fig. 43: Identifying Cylinder Head Gasket & Liquid Gasket Application Areas
Courtesy of KIA MOTORS AMERICA, INC.

3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
4. Install cylinder head bolts.
   A. Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.
   B. Using the SST (09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown in **Fig. 44**.

      Tightening torque:

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

      CAUTION: Always use new cylinder head bolt.

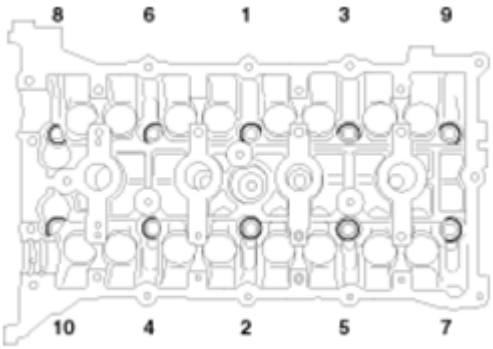


Fig. 44: Identifying Cylinder Head Bolts Torque Sequence
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the intake OCV (A).

   Tightening torque:

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

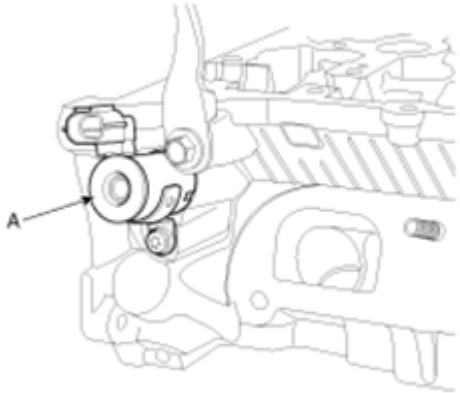


Fig. 45: Identifying Intake OCV

Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque:

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

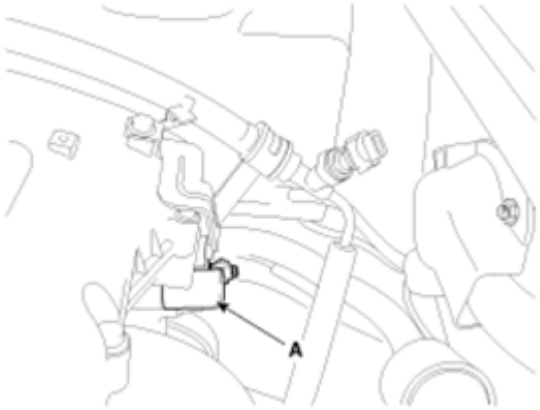


Fig. 46: Identifying Exhaust OCV
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:
- **Do not reuse the OCV when dropped.**
- **Keep the OCV filter clean.**
- **Do not hold the OCV sleeve (A) during servicing.**
- **When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.**

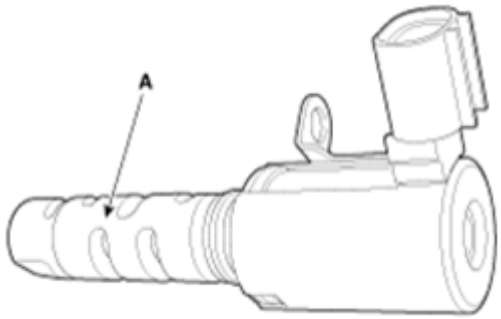


Fig. 47: Identifying OCV Sleeve
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the camshafts.

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

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

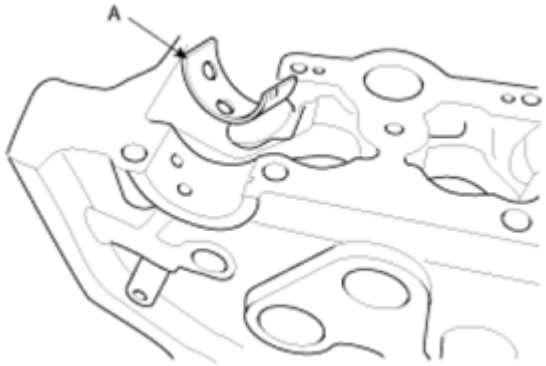


Fig. 48: Identifying Exhaust Camshaft Lower Bearing
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the camshafts (A).

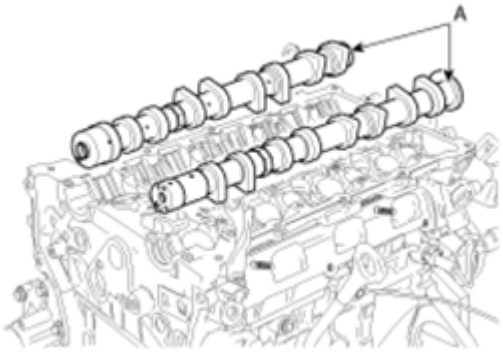


Fig. 49: Identifying Camshafts
Courtesy of KIA MOTORS AMERICA, INC.

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

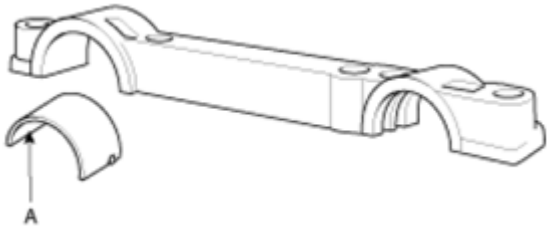


Fig. 50: Identifying Exhaust Camshaft Upper Bearing
Courtesy of KIA MOTORS AMERICA, INC.

8. Install camshaft bearing caps in their proper locations.

   Tightening order.

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

Tightening torque:

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

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

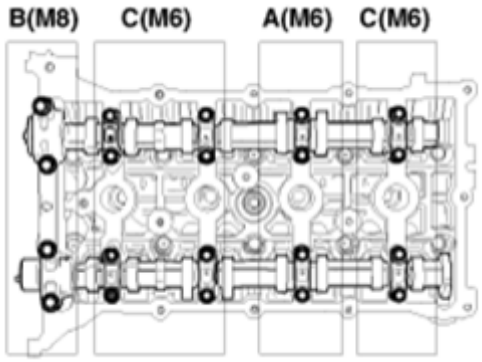


Fig. 51: Identifying Proper Locations For Installing Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

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

[Single CVVT]

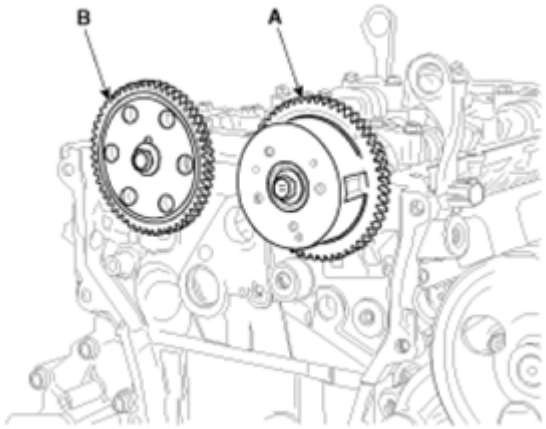


Fig. 52: Identifying Intake CVVT Assembly & Exhaust CVVT Sprocket (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

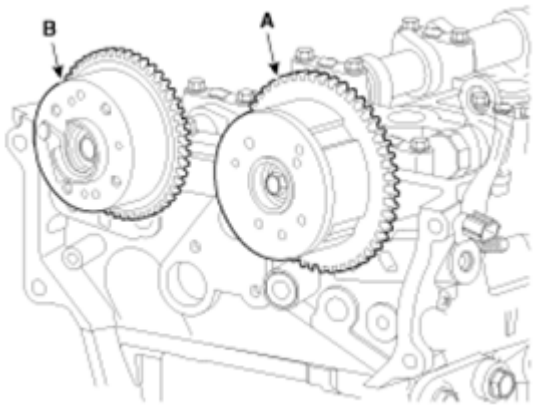


Fig. 53: Identifying Intake CVVT Assembly & Exhaust CVVT Sprocket (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: When installing the sprocket bolt or CVVT assembly bolt, fix the camshaft by wrench at position "A" as shown in Fig. 54.

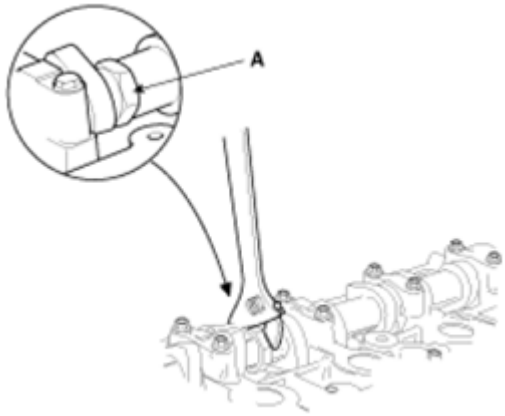


Fig. 54: Installing Sprocket Bolt
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque:

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

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

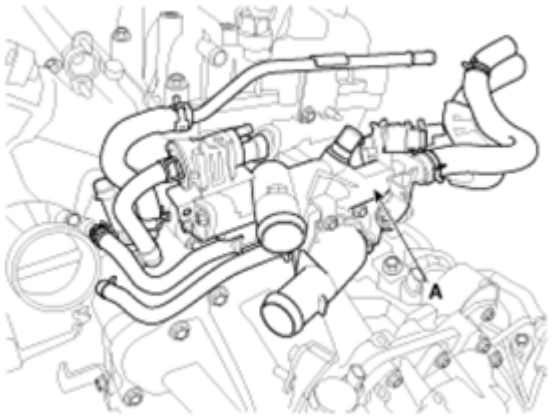


Fig. 55: Identifying Water Temperature Control Assembly
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

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

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

       Bead width: 2.5mm (0.1in.)

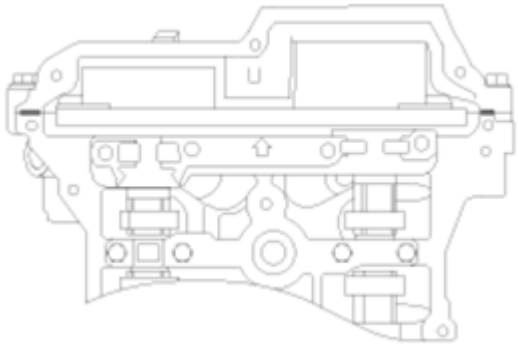


Fig. 56: Identifying Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the cylinder head cover bolts by following method:

   Tightening torque:

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

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

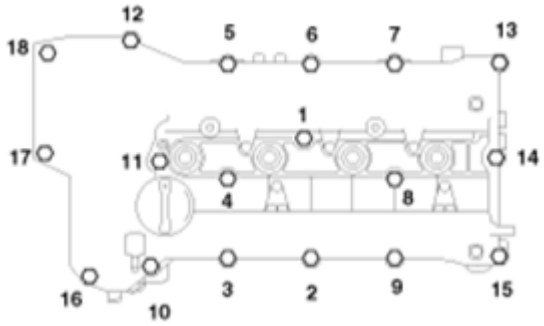


Fig. 57: Identifying Cylinder Head Cover Bolts Torque Sequence
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

- **Put radiator cap on tightly, then run the engine again and check for leaks.**

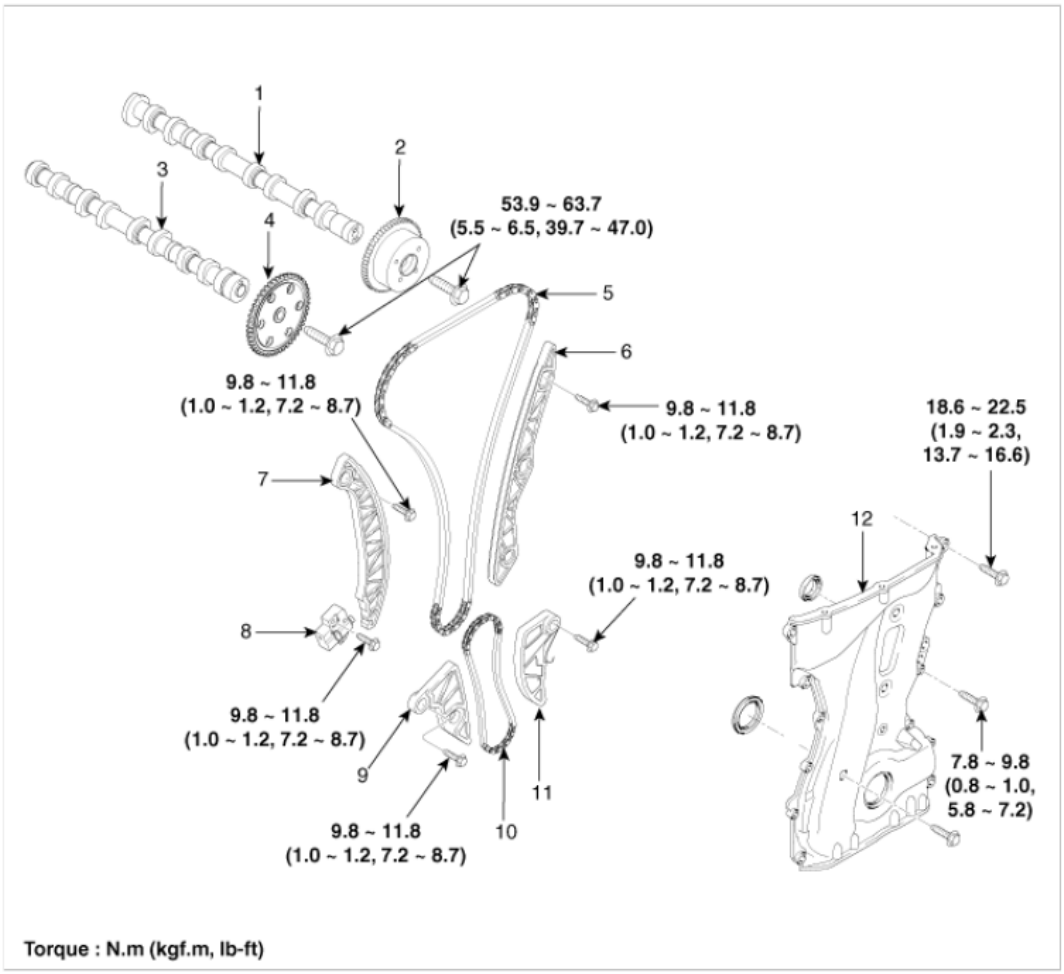
2010 ENGINE

Timing System - Forte/Forte Koup

TIMING CHAIN

COMPONENTS

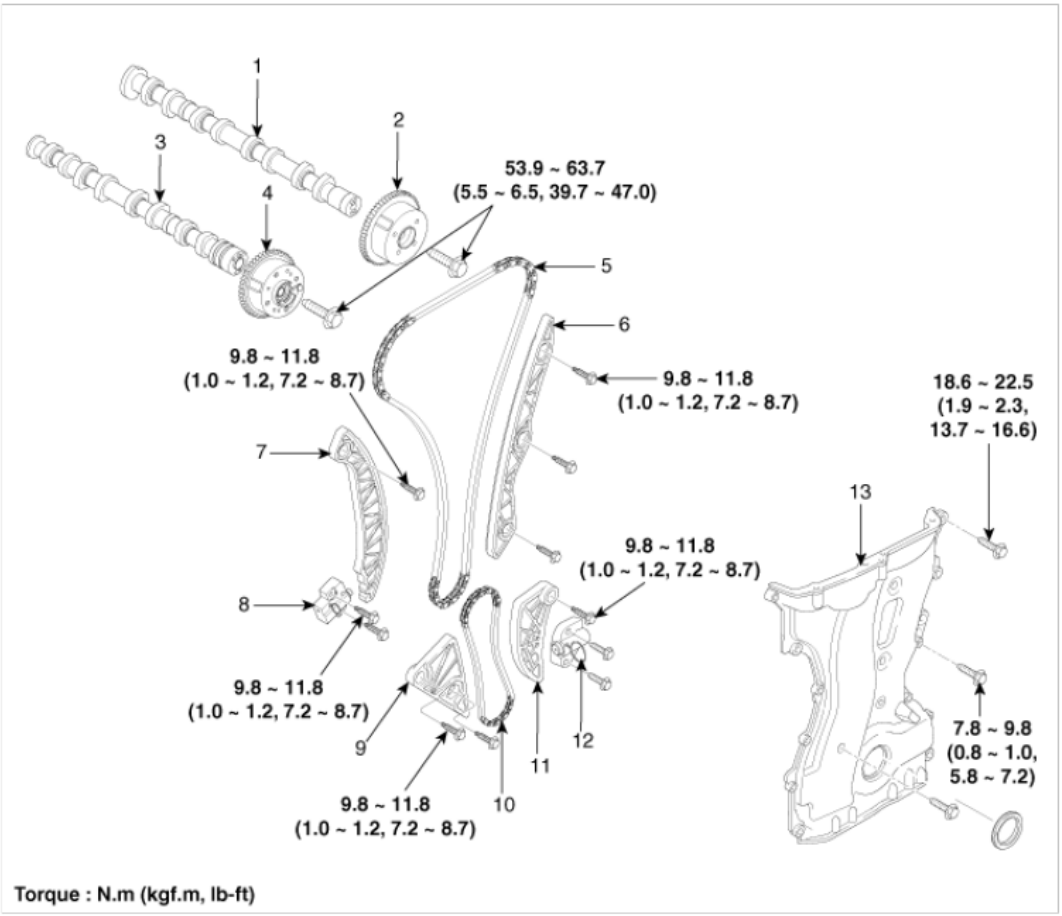
[2.0 ULEV - Single CVVT]



1. Intake camshaft	5. Timing chain	9. Oil pump chain guide
2. Intake CVVT assembly	6. Timing chain tensioner arm	10. Oil pump chain
3. Exhaust camshaft	7. Timing chain tensioner guide	11. Oil pump chain tensioner arm
4. Exhaust camshaft sprocket	8. Timing chain tensioner	12. Timing chain cover

Fig. 1: Identifying Timing Chain Components With Torque Specifications (2.0 ULEV - Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]



1. Intake camshaft	6. Timing chain guide	10. Balance shaft chain
2. Intake CVVT assembly	7. Timing chain tensioner arm	11. Balance shaft chain tensioner arm
3. Exhaust camshaft	8. Timing chain tensioner	12. Balance shaft chain tensioner
4. Exhaust CVVT assembly	9. Balance shaft chain guide	13. Timing chain cover
5. Timing chain		

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

REMOVAL

1. Disconnect the battery negative cable (A) .
2. Remove the engine cover (B) .

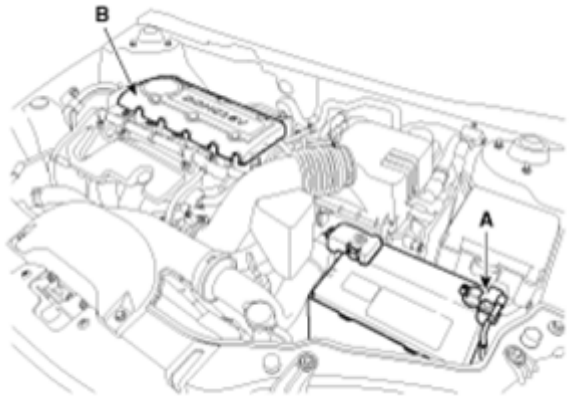


Fig. 3: Identifying Engine Cover & Battery Negative Cable
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove RH front wheel.
4. Remove RH side cover.
5. Set No. 1 cylinder to TDC/compression.

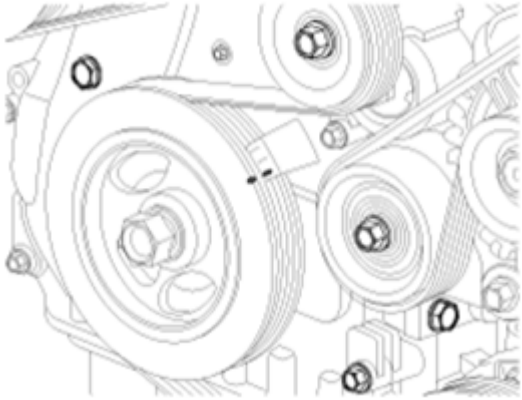


Fig. 4: Identifying Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

6. Drain the engine oil, and then set a jack to the oil pan.

NOTE: Place wooden block between the jack and engine oil pan.

7. Disconnect the ground line and then remove the engine mounting bracket (A) .

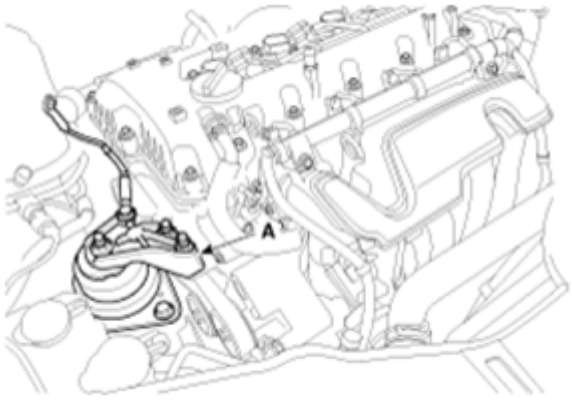


Fig. 5: Identifying Engine Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove the drive belt (A) .

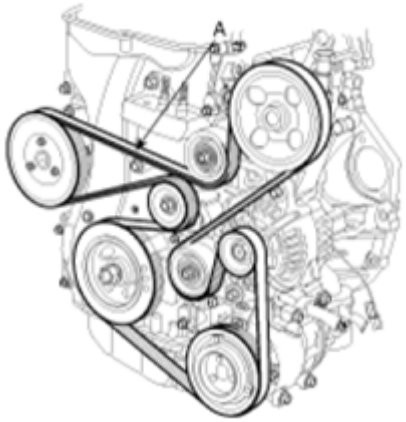


Fig. 6: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove the idler (A) and drive belt tensioner (B) .

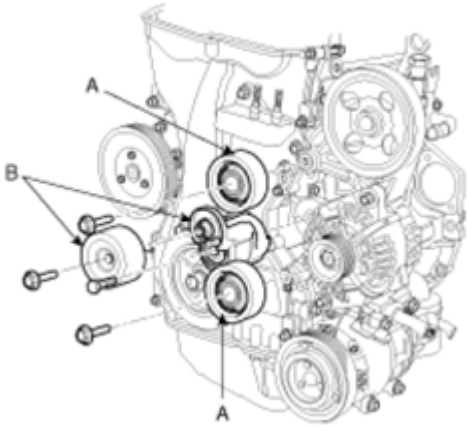


Fig. 7: Identifying Idler & Drive Belt Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Tensioner pulley bolt is left - handed screw.

10. Remove the water pump pulley (A) , crankshaft pulley (B) and engine support bracket (C) .

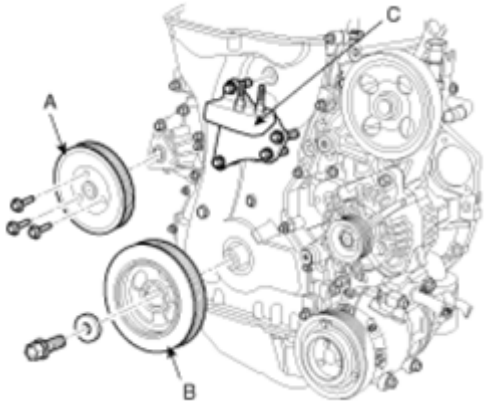


Fig. 8: Identifying Water Pump Pulley, Crankshaft Pulley, & Engine Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Use the SST (flywheel stopper, 09231-3K000) to remove the crankshaft pulley bolt, after remove the starter.

11. Disconnect the ignition coil connectors (A) and remove the ignition coils.

Fig. 9: Identifying Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove the cylinder head cover (A) .

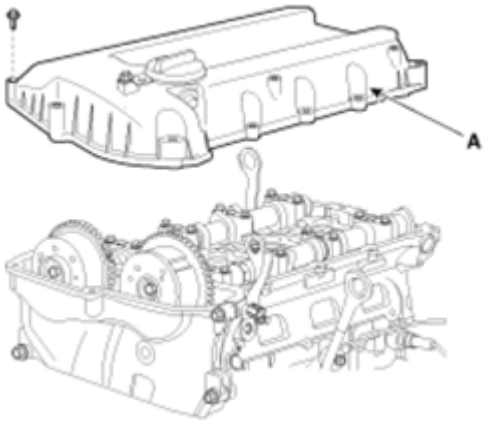


Fig. 10: Identifying Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

13. Remove the compressor lower bolts.

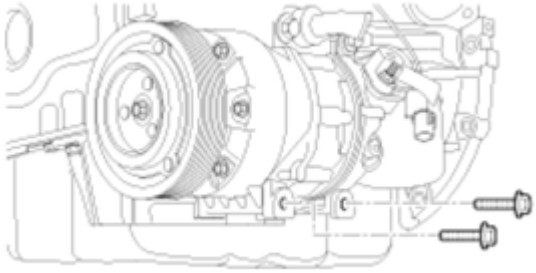


Fig. 11: Identifying Compressor Lower Bolts
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove the compressor bracket.
15. Remove the oil pan.

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

16. Remove the timing chain cover (A) by gently prying the portions between the cylinder head and cylinder block.

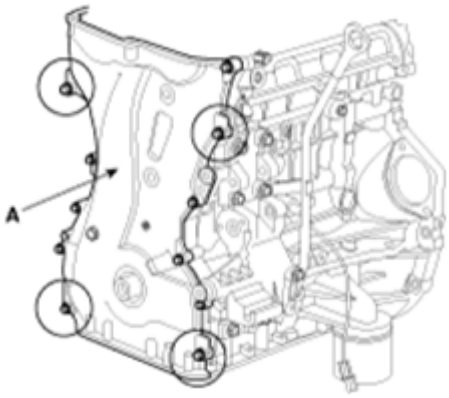


Fig. 12: Identifying Timing Chain Cover
Courtesy of KIA MOTORS AMERICA, INC.

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

17. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.

NOTE: Before removing the timing chain, mark the 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.

18. Install a set pin after compressing the timing chain tensioner.

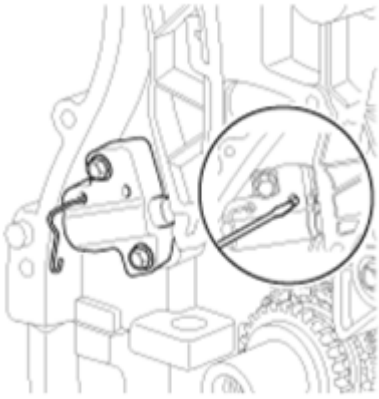


Fig. 13: Installing Set Pin
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove the timing chain tensioner (A) and timing chain tensioner arm (B) .

[Single CVVT]

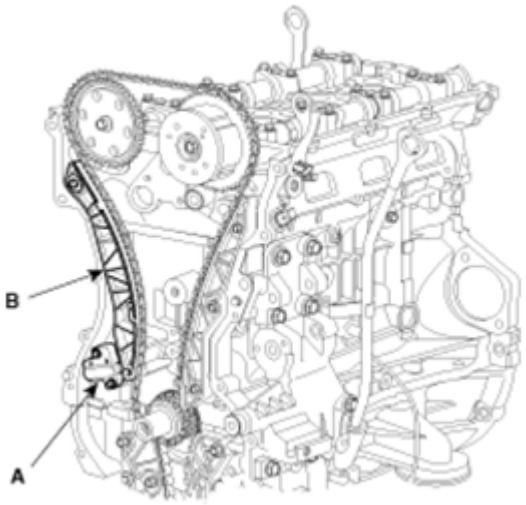


Fig. 14: Identifying Timing Chain Tensioner & Tensioner Arm (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

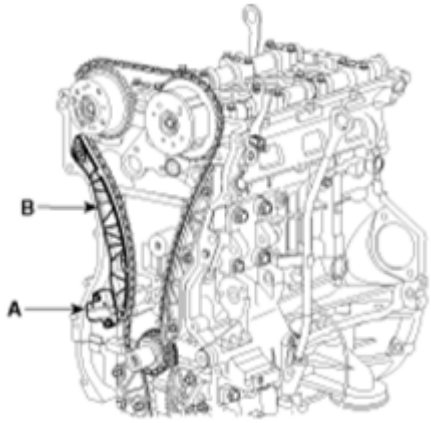


Fig. 15: Identifying Timing Chain Tensioner & Tensioner Arm (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

20. Remove the timing chain.
21. Remove the timing chain guide (A) .

[Single CVVT]

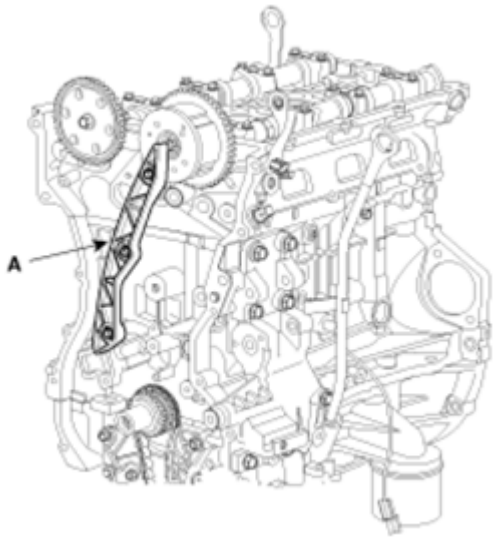


Fig. 16: Identifying Timing Chain Guide (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

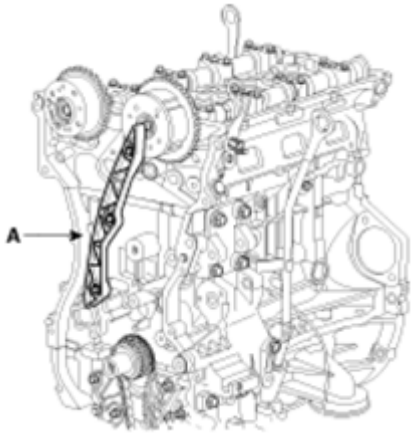


Fig. 17: Identifying Timing Chain Guide (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

22. Remove the timing chain oil jet (A) .
23. Remove the crankshaft chain sprocket (B) .

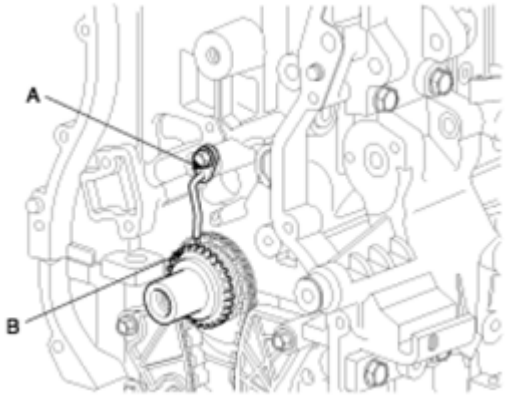


Fig. 18: Identifying Timing Chain Oil Jet & Crankshaft Chain Sprocket
Courtesy of KIA MOTORS AMERICA, INC.

24. Remove the oil pump chain.

    (Refer to **LUBRICATION SYSTEM**)

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.

Drive belt, Idler, Pulley

1. Check the idler for excessive oil leakage, abnormal rotation or vibration. Replace if necessary.
2. Check belt for maintenance and abnormal wear of V-ribbed part. Replace if necessary.
3. Check the pulleys for vibration in rotation, oil or dust deposit of V-ribbed part. Replace if necessary.

INSTALLATION

1. Install the oil pump chain.

   (Refer to **LUBRICATION SYSTEM**)

2. Install the crankshaft sprocket (B) .
3. Install the timing chain oil jet (A) .

   Tightening torque:

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

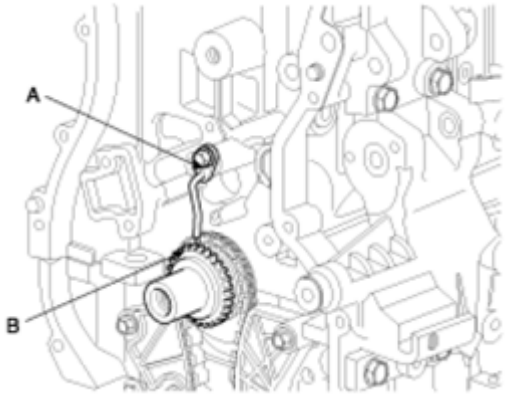


Fig. 19: Identifying Crankshaft Sprocket & Timing Chain Oil Jet
Courtesy of KIA MOTORS AMERICA, INC.

4. Set crankshaft that the key of crankshaft should be aligned with the mating surface of main bearing cap. Put the intake, exhaust camshaft assembly that the TDC mark of intake CVVT sprocket and exhaust camshaft sprocket should be aligned with the top surface of cylinder head. As a result of this, place the piston on No. 1 cylinder at the top dead center on compression stroke.
5. Install the timing chain guide (A) .

   Tightening torque:

   9.8 ~ 11.6N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

   [Single CVVT]

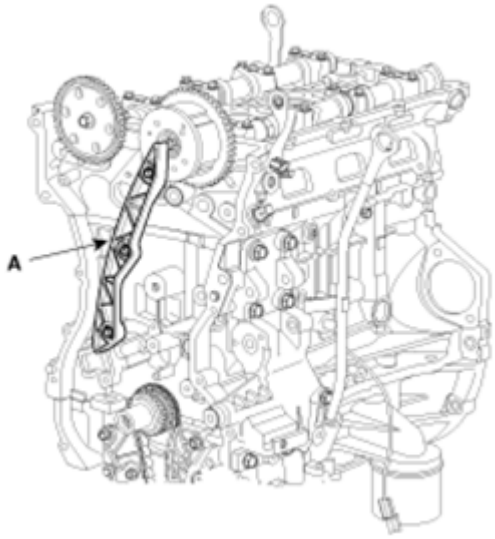


Fig. 20: Identifying Timing Chain Guide (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

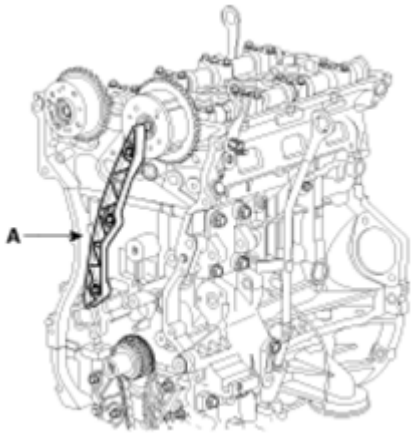


Fig. 21: Identifying Timing Chain Guide (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the timing chain.

   To install the timing chain with no slack between each shaft (cam, crank), use the following procedure:

   Crankshaft sprocket (A) --> Timing chain guide (B) --> Intake CVVT sprocket (C) --> Exhaust CVVT sprocket or camshaft sprocket (D) .

   [Single CVVT]

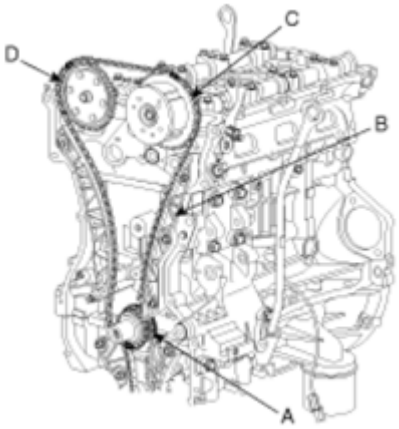


Fig. 22: Installing Timing Chain (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

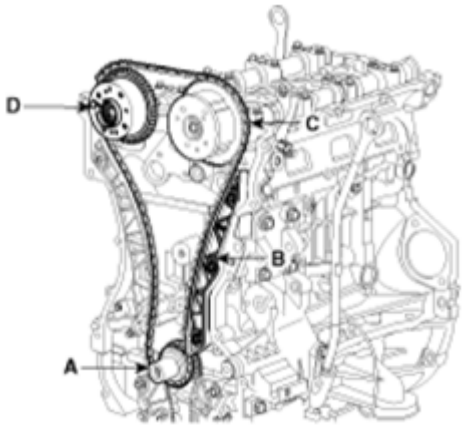


Fig. 23: Installing Timing Chain (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: The timing mark of each sprocket should be matched with timing mark (color link) of timing chain at installing timing chain.

[Single CVVT]

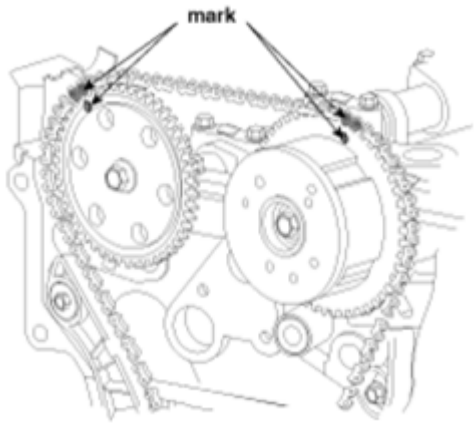


Fig. 24: Identifying Timing Marks (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

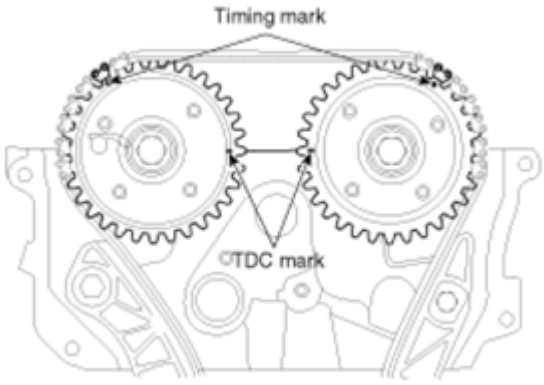


Fig. 25: Identifying Timing Marks (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

7. Install timing chain tensioner arm (B) .

   Tightening torque:

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

8. Install timing chain auto tensioner (A) and remove set pin.

   Tightening torque:

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

   [Single CVVT]

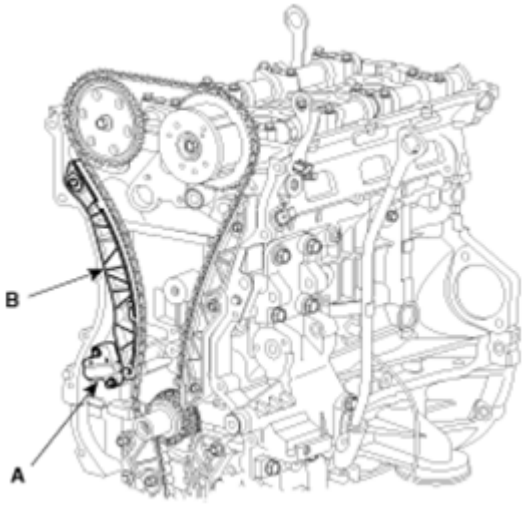


Fig. 26: Identifying Timing Chain Auto Tensioner & Tensioner Arm (Single CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

[Dual CVVT]

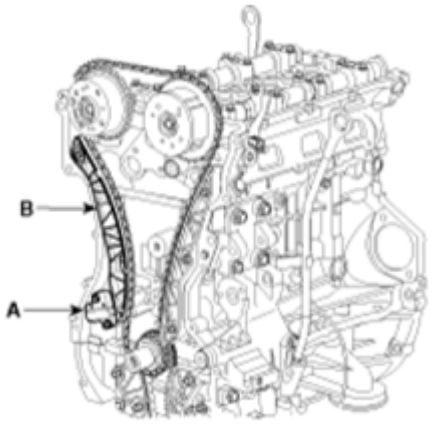


Fig. 27: Identifying Timing Chain Auto Tensioner & Tensioner Arm (Dual CVVT)
Courtesy of KIA MOTORS AMERICA, INC.

9. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front) , confirm the timing mark.
10. Install timing chain cover.
    1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
    2. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and ladder frame) must be free of engine oil and ETC.
    3. Before assembling the timing chain cover, the liquid sealant Loctite 5900H or THREEBOND 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.)

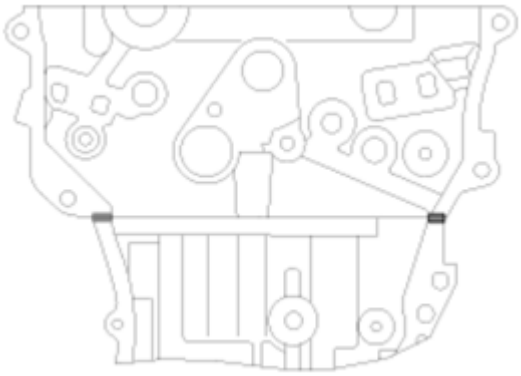


Fig. 28: Identifying Liquid Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

    4. After applying liquid sealant Loctite 5900H on timing chain cover.

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

Sealant should be applied without discontinuity.

Bead width : 2.5mm (0.1in.)

Fig. 29: Identifying Liquid Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

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 to be in exact position.

   Tightening torque:

   M6: 7.84 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

   M8: 18.6 ~ 22.5N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)

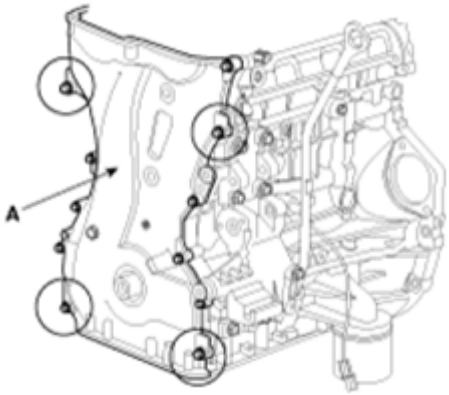


Fig. 30: Identifying Cylinder Block Dowel Pins
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.

11. Install 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 Loctite 5900H should be applied on oil pan.

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

       Sealant : Loctite 5900H or equivalent

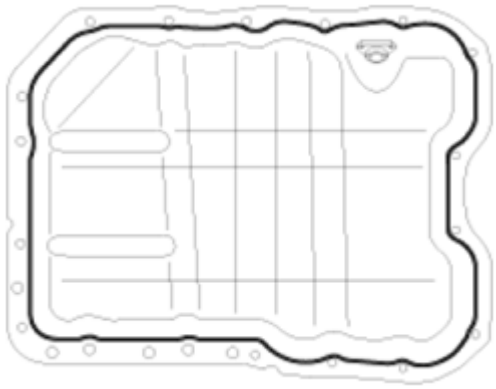


Fig. 31: Identifying Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION:
- **When applying sealant gasket, sealant must not be protruded into the inside of oil pan.**
- **To prevent leakage of oil, apply sealant gasket on the inner threads of the bolt holes.**

    3. Install oil pan.

       Uniformly tighten the bolts in several passes.

       Tightening torque

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

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

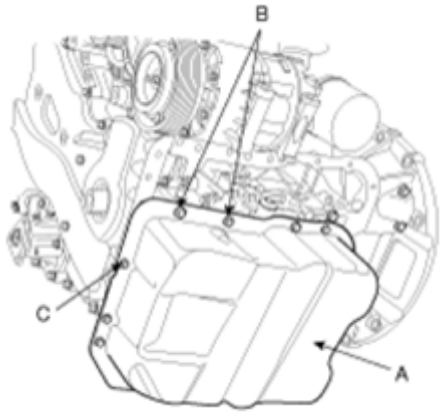


Fig. 32: Installing Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: After assembly, wait at least 30 minutes before filling the engine with oil.

12. Install the air compressor bracket.

    Tightening torque:

    19.6 ~ 23.5N.m (2.0 ~ 2.4kgf.m, 13.7 ~ 14.5lb-ft)

13. Install the compressor lower bolts.

    Tightening torque:

    19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 13.7 ~ 18.1lb-ft)

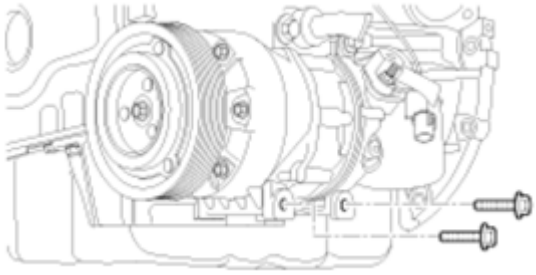


Fig. 33: Identifying Compressor Lower Bolts
Courtesy of KIA MOTORS AMERICA, INC.

14. Install cylinder head cover.
    1. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
    2. After applying sealant, it should be assembled within 5 minutes.

Bead width : 2.5mm (0.1in.)

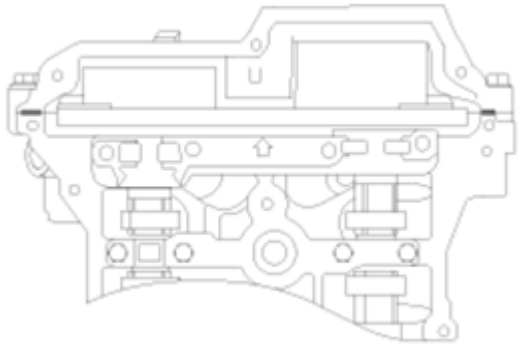


Fig. 34: Identifying Sealant Application Area
Courtesy of KIA MOTORS AMERICA, INC.

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

Tightening torque

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

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

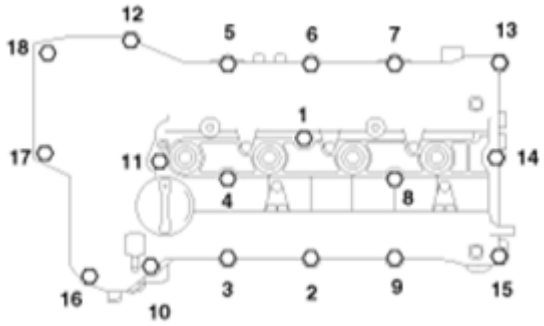


Fig. 35: Identifying Tightening Sequence Of Cylinder Head Cover Bolts
Courtesy of KIA MOTORS AMERICA, INC.

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

15. Install the ignition coils and connect the ignition coil connectors (A) .

Fig. 36: Identifying Ignition Coil Connectors
Courtesy of KIA MOTORS AMERICA, INC.

16. Install the engine support bracket (C) .

    Tightening torque:

    M10 : 39.2 ~ 44.1N.m (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lb-ft)

    M8 : 19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)

17. Install the crankshaft pulley (B) .

    Tightening torque:

    166.6 ~ 176.4N.m (17.0 ~ 18.0kgf.m, 122.9 ~ 130.1lb-ft)

    NOTE: Use the SST (flywheel stopper, 09231-3K000) to install the crankshaft pulley bolt, after remove the starter.

18. Install the water pump pulley (A) .

    Tightening torque:

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

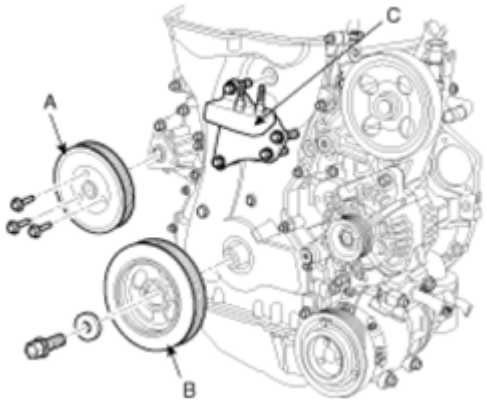


Fig. 37: Installing Engine Support Bracket, Crankshaft Pulley, & Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

19. Install the drive belt tensioner and tensioner pulley (B).

    Tightening torque:

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

    NOTE: Tensioner pulley bolt is left-handed screw.

20. Install idler pulley (A) .

    Tightening torque:

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

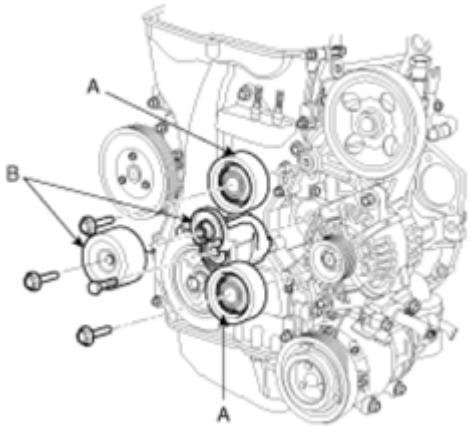


Fig. 38: Installing Drive Belt Tensioner, Tensioner Pulley, & Idler Pulley
Courtesy of KIA MOTORS AMERICA, INC.

21. Install the drive belt (A) .

Crankshaft pulley --> A/C pulley --> Alternator pulley --> Idler pulley --> P/S pump pulley --> Idler pulley --> Water pump pulley --> Tensioner pulley.

Rotate auto tensioner arm in the counter - clockwise moving auto tensioner pulley bolt with wrench. After putting belt on auto tensioner pulley, release the auto tensioner pulley slowly.

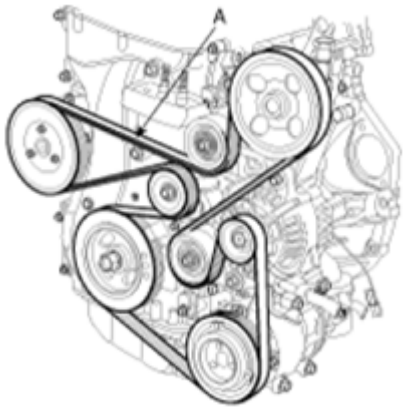


Fig. 39: Identifying Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

22. Install the engine mounting bracket (A) and then connect the ground cable.

    Tightening torque:

    63.7 ~ 83.4N.m (6.5 ~ 8.5kgf.m, 47.0 ~ 61.5lb-ft)

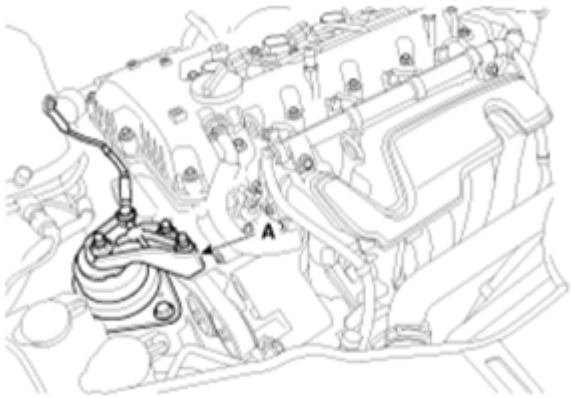


Fig. 40: Identifying Engine Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

23. Remove the RH side cover.

    Tightening torque:

    8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 7.9lb-ft)

24. Install the RH front wheel.

    Tightening torque:

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

25. Install the engine cover (B) .
26. Connect the battery negative cable (A) .

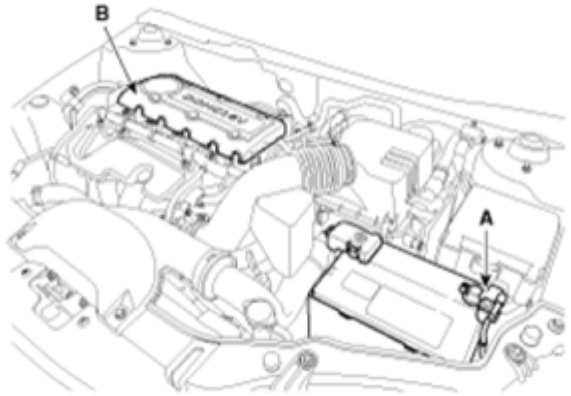


Fig. 41: Identifying Engine Cover & Battery Negative Cable
Courtesy of KIA MOTORS AMERICA, INC.

2010 ENGINE

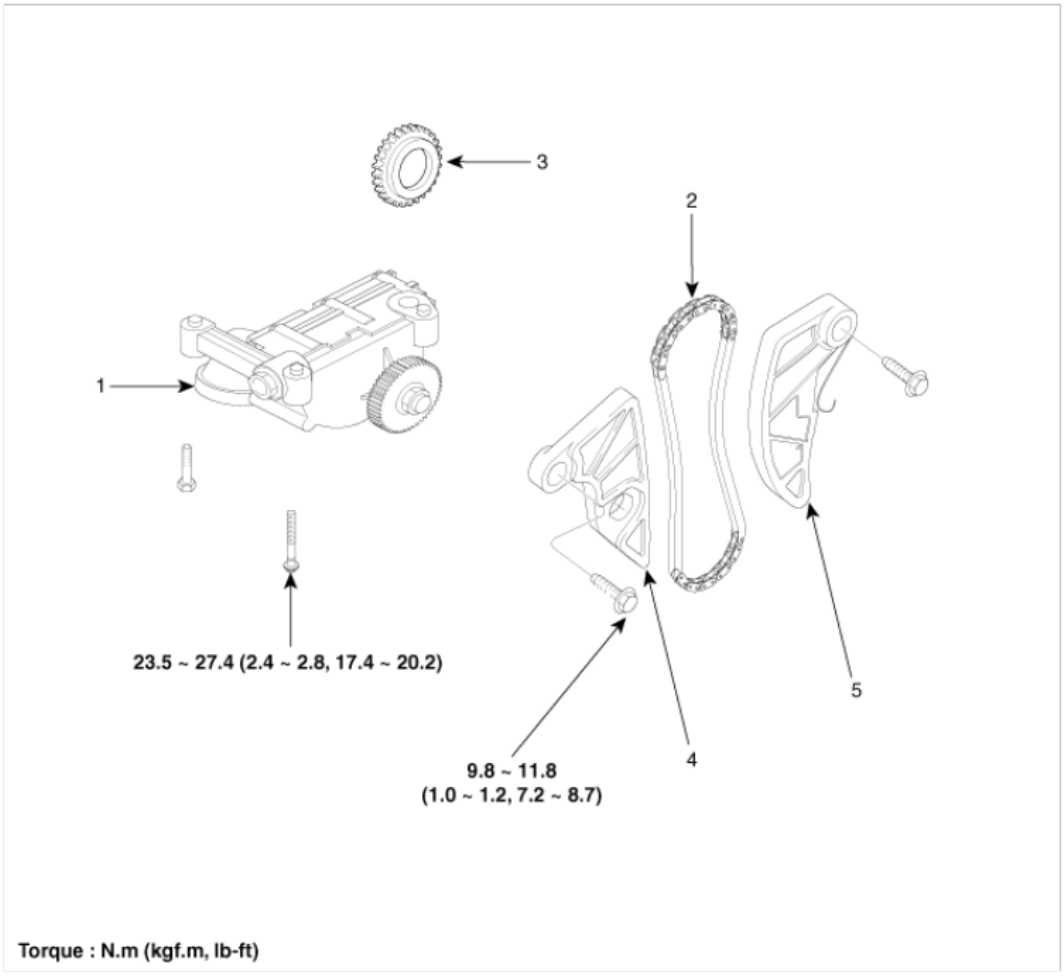
Lubrication System - Forte/Forte Koup

OIL PUMP

COMPONENTS AND COMPONENTS LOCATION

Components

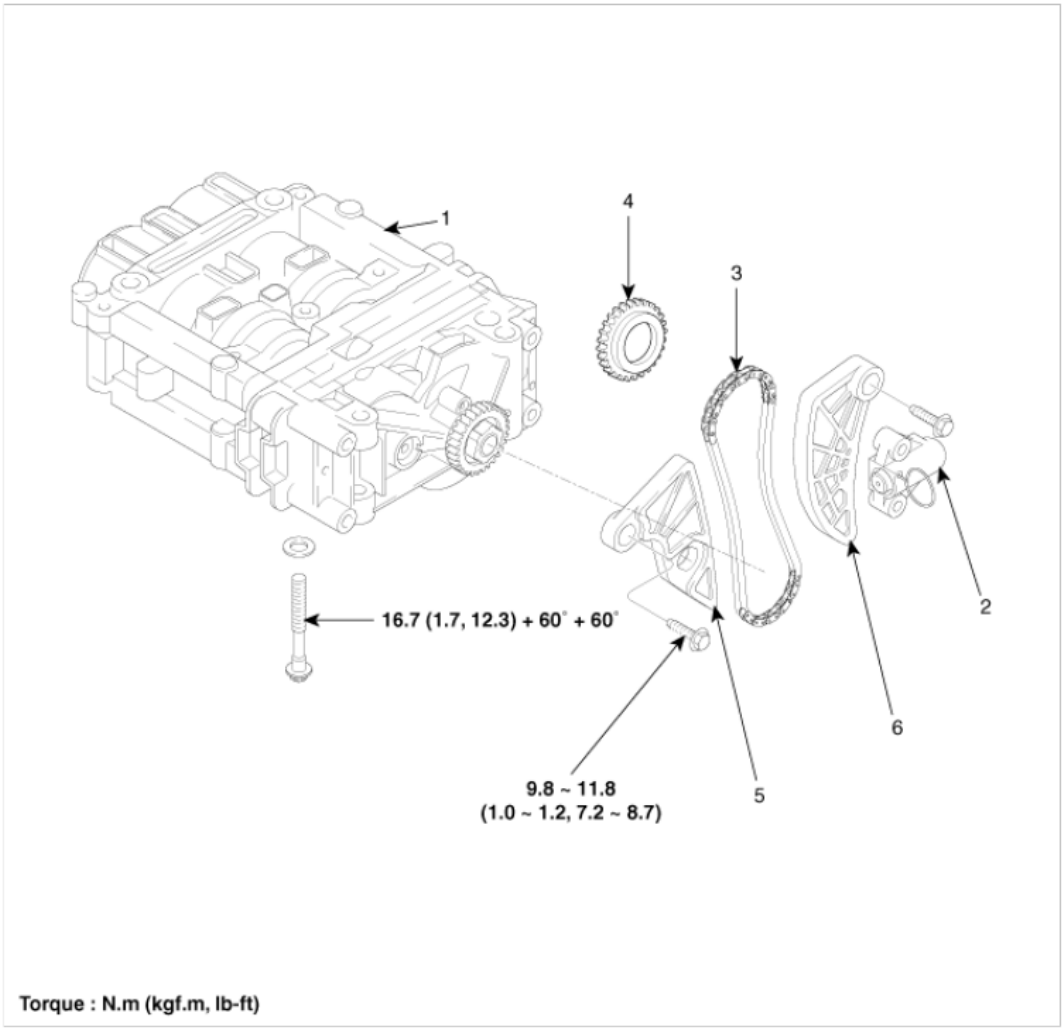
[Oil Pump Type]



1. Oil pump 2. Oil pump chain 3. Oil pump sprocket	4. Oil pump chain guide 5. Oil pump chain tensioner arm

Fig. 1: Locating Oil Pump Components With Torque Specifications (Oil Pump Type)
Courtesy of KIA MOTORS AMERICA, INC.

[BSM Type]



1. Balance shaft & oil pump assembly	4. Balance shaft chain sprocket
2. Balance shaft chain tensioner	5. Balance shaft chain guide
3. Balance shaft chain	6. Balance shaft chain tensioner arm

Fig. 2: Locating Oil Pump Components With Torque Specifications (BSM Type)
Courtesy of KIA MOTORS AMERICA, INC.

REPAIR PROCEDURES

Removal

[2.0 Non-BSM]

1. Remove the timing chain. (Refer to **TIMING SYSTEM**)
2. Remove the oil pump mechanical tensioner (B).
3. Remove the oil pump chain guide (D).

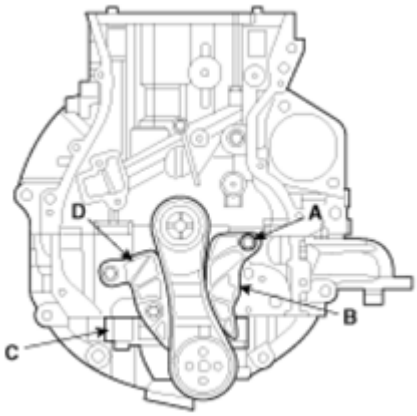


Fig. 3: Identifying Oil Pump Mechanical Tensioner & Oil Pump Chain Guide (2.0 Non-BSM)
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the oil pump (A) and oil pump chain.

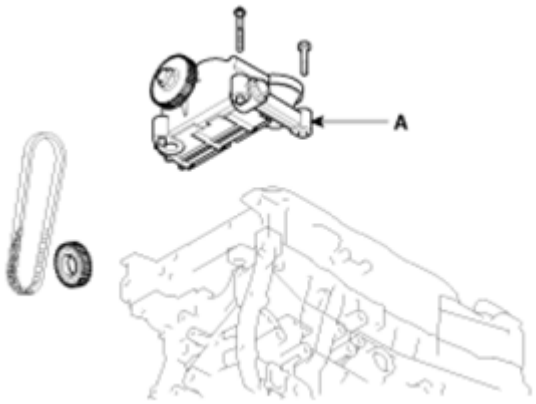


Fig. 4: Identifying Oil Pump (2.0 Non-BSM)
Courtesy of KIA MOTORS AMERICA, INC.

[2.4 BSM]

1. Remove the timing chain.

   (Refer to **TIMING SYSTEM**)

   NOTE:

2. Install a set pin after compressing the balance shaft chain tensioner.
3. Remove the balance shaft chain hydraulic tensioner (A).
4. Remove the balance shaft chain tensioner arm (B).
5. Remove the balance shaft chain guide (C).

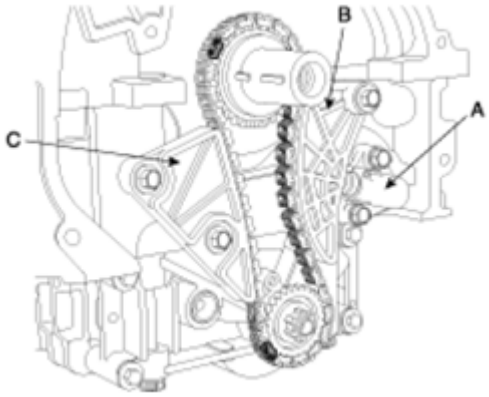


Fig. 5: Identifying Balance Shaft Chain Hydraulic Tensioner, Arm, & Chain Guide (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove the oil pump & balance shaft module (A) and balance shaft chain (B).

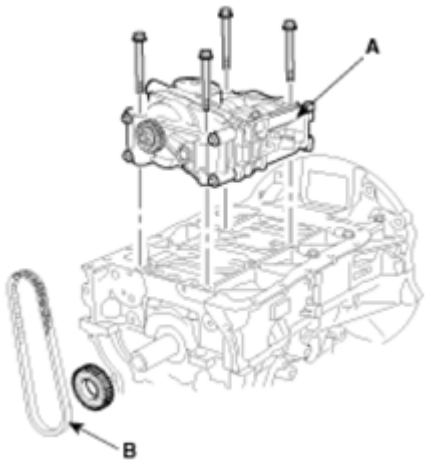


Fig. 6: Identifying Oil Pump/Balance Shaft Module & Balance Shaft Chain (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Do not disassemble the oil pump & balance shaft module.

Installation

[2.0 Non-BSM]

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.
2. Assemble the crankshaft sprocket on the crankshaft as the front mark on the crankshaft sprocket to be outward.
3. Tighten the oil pump tensioner bolt (A) after placing the tensioner spring on the dowel pin located in ladder frame, and then insert stopper pin to fix the tensioner (B).

Tightening torque:

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

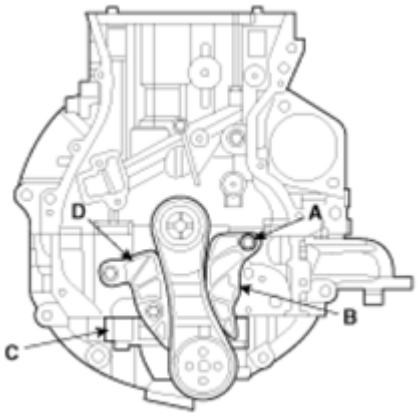


Fig. 7: Identifying Oil Pump Tensioner & Bolt (2.0 Non-BSM)
Courtesy of KIA MOTORS AMERICA, INC.

4. Assemble the oil pump chain on the crankshaft sprocket.
5. Assemble the oil pump assembly (C) on the ladder frame as placing oil pump sprocket in to oil pump.

Tightening torque:

23.5 ~ 27.4N.m (2.4 ~ 2.8kgf.m, 17.4 ~ 20.2lb-ft)

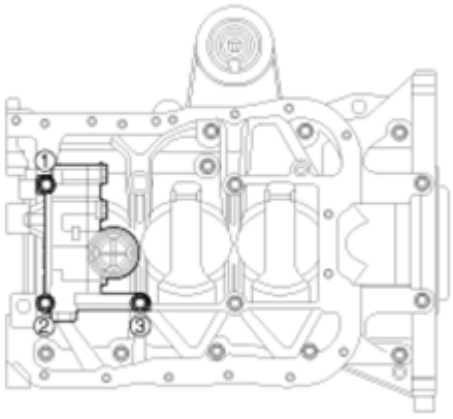


Fig. 8: Identifying Bolts (2.0 Non-BSM)
Courtesy of KIA MOTORS AMERICA, INC.

6. Install the oil pump chain guide (D) then remove the stopper pin.

Tightening torque:

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

[2.4 BSM]

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.
2. Confirm the balance shaft module timing mark.

   Timing marks to be visually aligned with centers of adjacent cast timing notches.

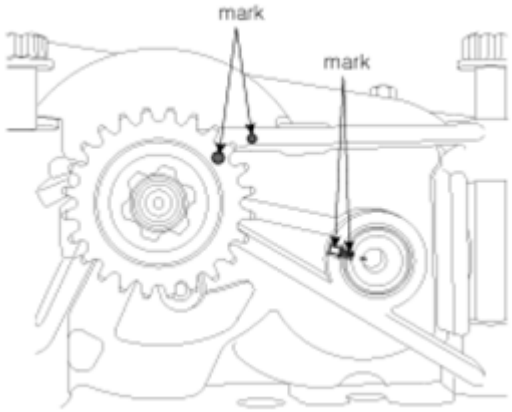


Fig. 9: Locating Timing Marks (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

3. Install balance shaft module that the timing mark of balance shaft module sprocket should be matched with the timing mark (color link) of balance shaft chain.

   Tightening torque:

   16.7N.m (1.7kgf.m, 12.3lb-ft) + 60° + 60°

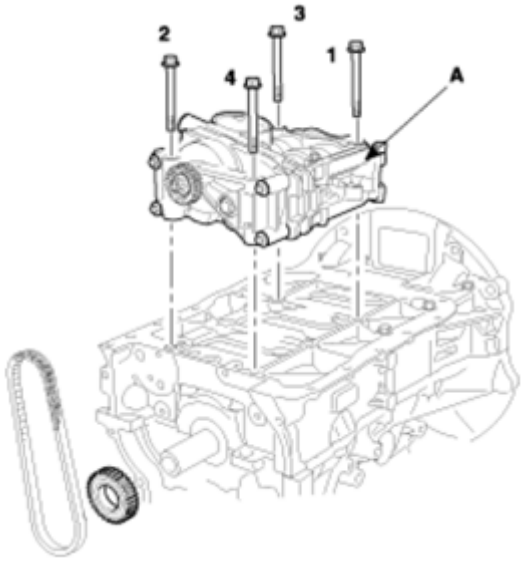


Fig. 10: Identifying Bolts (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

Bolting order

A. Assemble the bolts in order number as shown in **Fig. 11** with seating torque 25.5 N.m (2.6kgf.m, 18.8 lb-ft).
B. Unfasten the bolts as reverse bolting order. (4-3-2-1)
C. Assemble the bolts as specified bolting order in same increments as shown in **Fig. 11**.

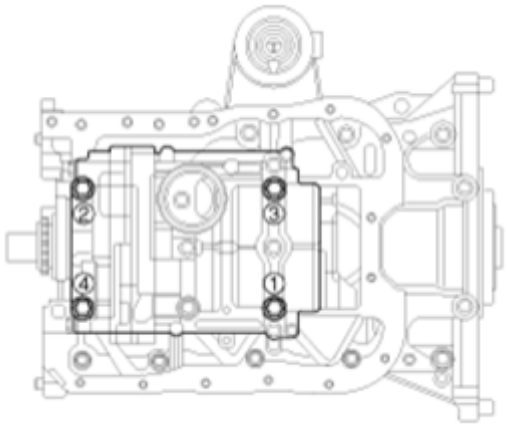


Fig. 11: Identifying Tightening Sequence Of Bolts (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the balance shaft chain guide (C).

   Tightening torque:

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

5. Install the balance shaft chain tensioner arm (B).

   Tightening torque:

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

6. Install the balance shaft chain hydraulic tensioner (A) then remove the stopper pin.

   Tightening torque:

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

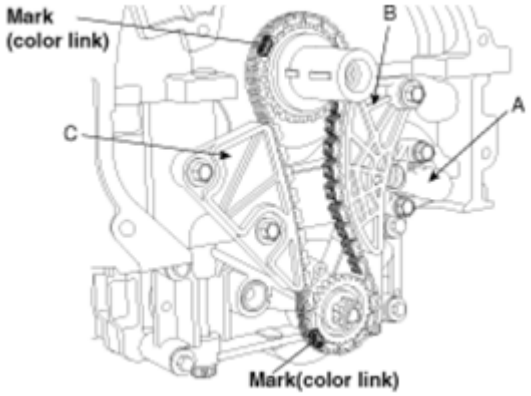


Fig. 12: Identifying Balance Shaft Chain Hydraulic Tensioner, Arm, & Chain Guide (2.4 BSM)
Courtesy of KIA MOTORS AMERICA, INC.

7. Confirm the timing marks.
8. Install the timing chain.

   (Refer to **TIMING SYSTEM**)

ENGINE OIL

REPAIR PROCEDURES

Oil And Filter Replacement

CAUTION:

- **Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation, and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.**
- **In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.**

1. Park the car on level ground.

   Start the engine and let it warm up.

2. Drain engine oil.
   1. Remove the oil filler cap.
   2. After lifting the car, remove the oil drain plug (A) and drain oil into a container.

3. Replace the oil filter (B).
    1. Remove the oil filter.
    2. Check and clean the oil filter installation surface.
    3. Check the part number of the new oil filter is as same as old one.
    4. Apply clean engine oil to the gasket of a new oil filter.
    5. Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
    6. Tighten it with the torque below.

    Tightening torque:

    11.8 ~ 15.7N.m (1.2 ~ 1.6kgf.m, 8.7 ~ 11.6lb-ft)

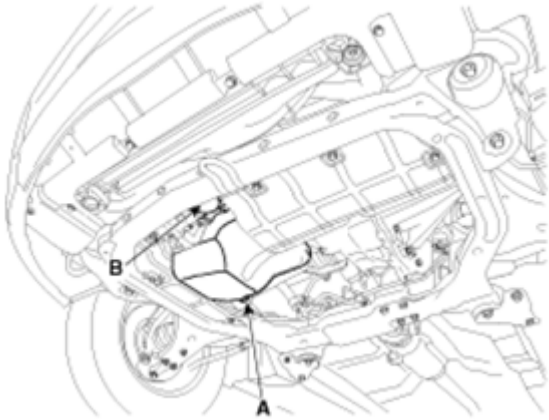


Fig. 13: Identifying Oil Filter & Oil Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the oil drain plug with a new gasket.

    Tightening torque:

    34.3 ~ 44.1N.m (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)

5. Fill with new engine oil, after removing the engine oil level gauge.

    Capacity:

    Total:

    2.0 : 4.7 L (4.97 US qt, 4.13 lmp qt)

    2.4 : 5.4 L (5.71 US qt, 4.75 lmp qt)

    Oil pan:

2.0 : 3.8 L (4.01 US qt, 3.34 lmp qt)

2.4 : 4.2 L (4.44 US qt, 3.69 lmp qt)

Drain and refill including oil filter:

2.0 : 4.1 L (4.33 US qt, 3.61 lmp qt)

2.4 : 4.5 L (4.76 US qt, 3.96 lmp qt)

6. Install the oil filler cap.
7. Start engine and check for oil leaks and check the oil gauge or light for an indication of oil pressure.
8. Recheck the engine oil level.

Inspection

1. Check the engine oil quality.

   Check the oil deterioration, entry of water, discoloring of thinning. If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

   After engine warm up stop the engine wait 5 minutes then check the oil level. Oil level should be between the "L" and "F" marks on the dipstick. If low check for leakage and add oil up to the "F" mark.

NOTE: Do not fill with engine oil above the "F" mark.

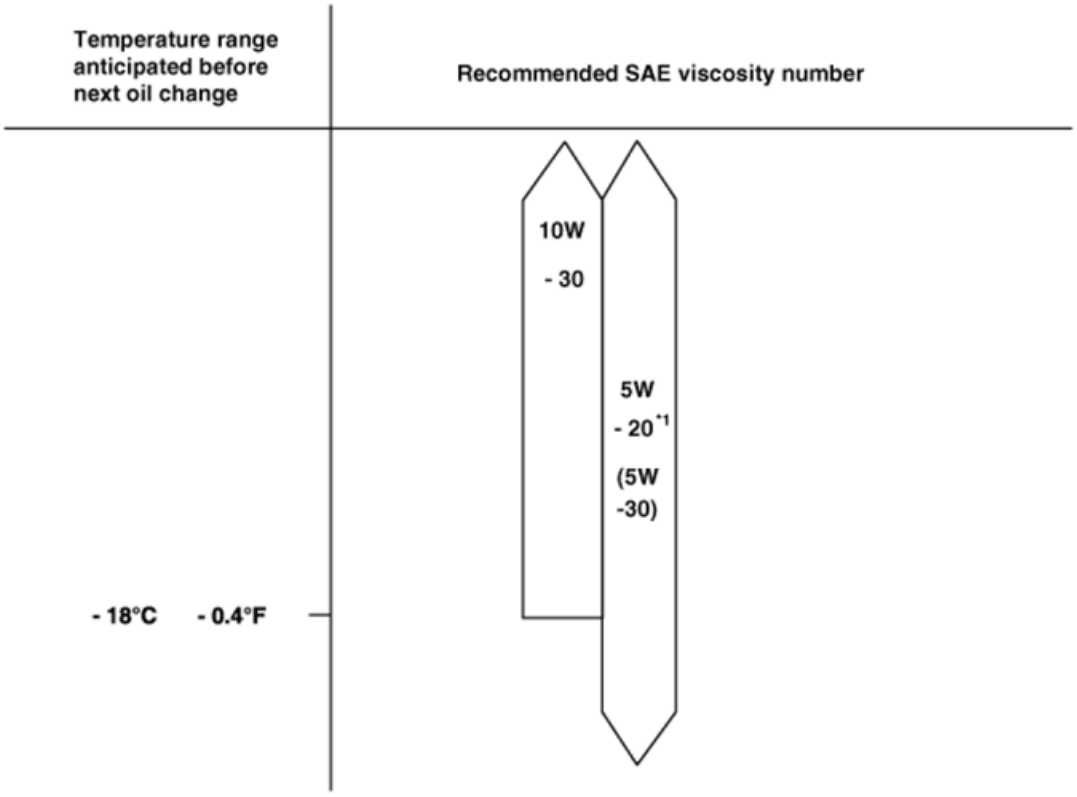
Selection Of Engine Oil

Recommendation : 5W-20/GF4&SM (If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.)

API classification : SL, SM or above

ILSAC classification : GF3, GF4 or above

SAE viscosity grade : Refer to the recommended SAE viscosity number .



*1 If 5W-20 / GF4 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.

Fig. 14: Recommended SAE Viscosity Number Chart
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: For best performance and maximum protection of all types of operation, select only those lubricants which:

1. **Satisfy the requirement of the API or ILSAC classification.**
2. **Have proper SAE grade number for expected ambient temperature range.**
3. **Lubricants that do not have both an SAE grade number and API or ILSAC service classification on the container should not be used.**

