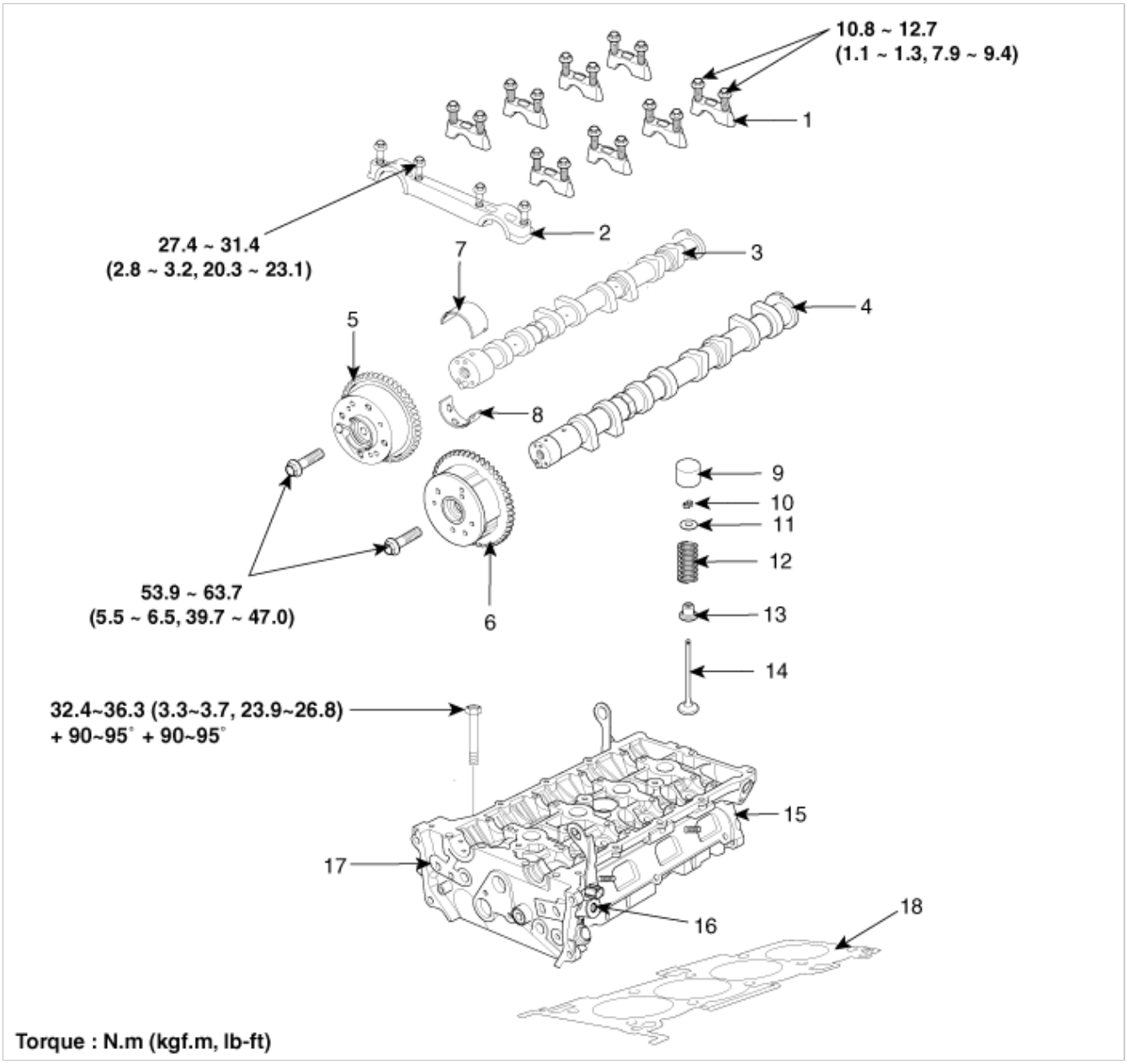
Components



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

Removal

Engine removal is not required for this procedure.

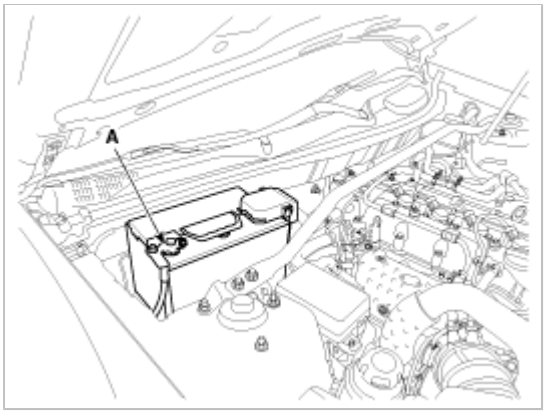
CAUTION

- 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.

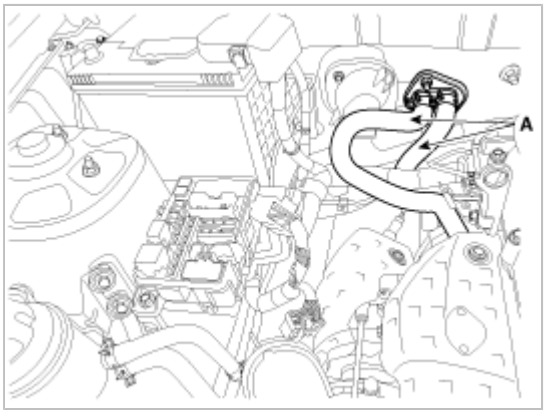
NOTE

Mark all wiring and hoses to avoid misconnection.

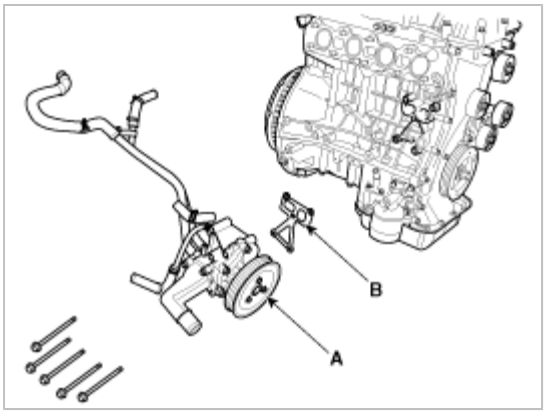
1. Disconnect the negative (-) battery terminal (A).



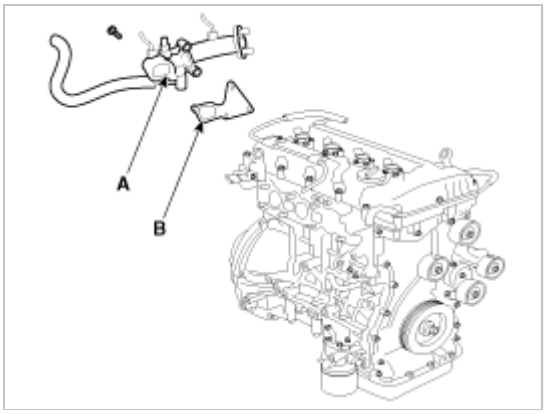
2. Remove the heater hoses (A).



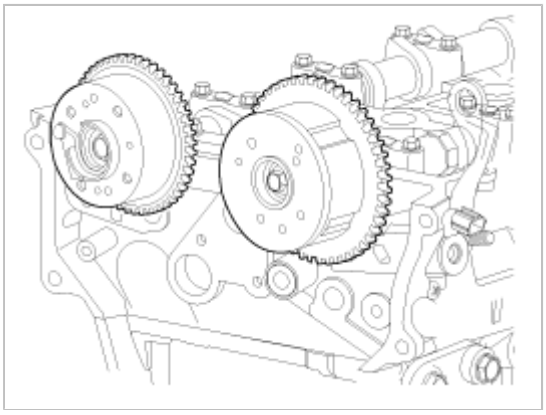
3. Remove the intake & exhaust manifold. (Refer to Intake and exhaust system in this group)
4. Remove the water pump (A) and gasket (B).



5. Remove the water temperature control assembly (A) and gasket (B).

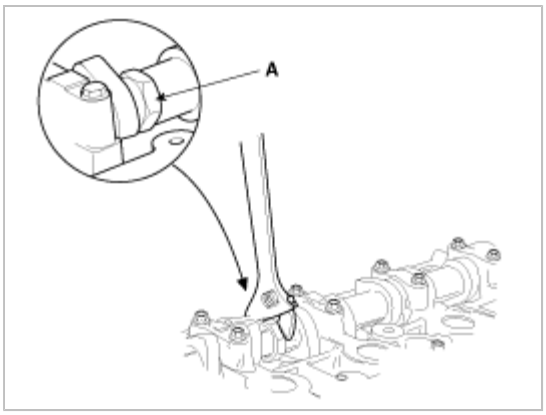


6. Remove the intake & exhaust CVVT assembly. (Refer to Timing system in this group)
7. Remove the intake & exhaust CVVT assembly.

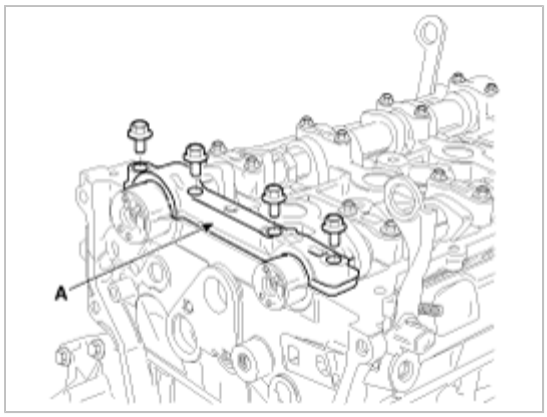


NOTE

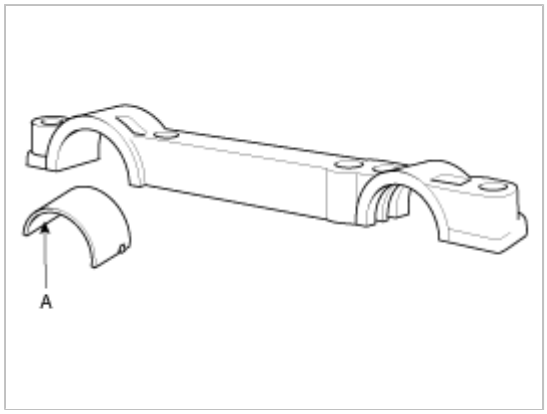
Fix the cam shaft (A) with a wrench when removing the CVVT assembly.



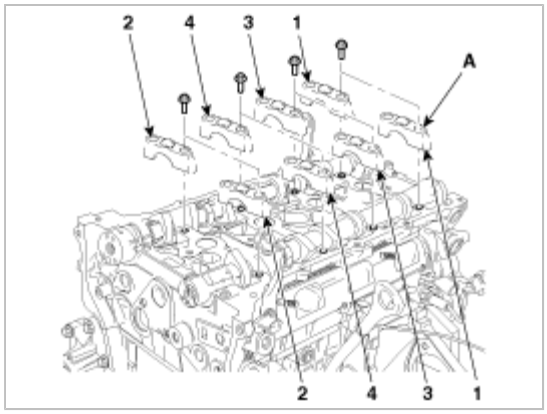
8. Remove the cam shaft.
   A. Remove the front cam shaft bearing cap (A).



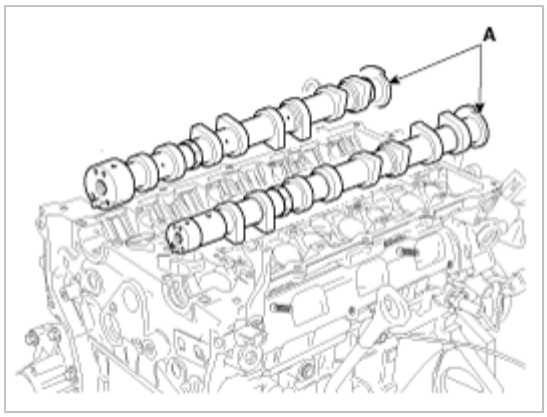
   B. Remove the exhaust cam shaft upper bearing (A).



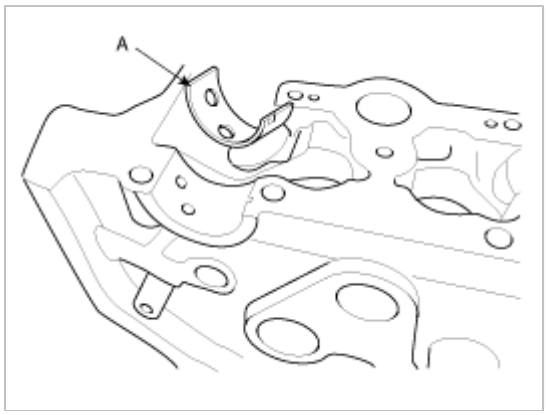
   C. Remove camshaft bearing cap (A), in the sequence shown.



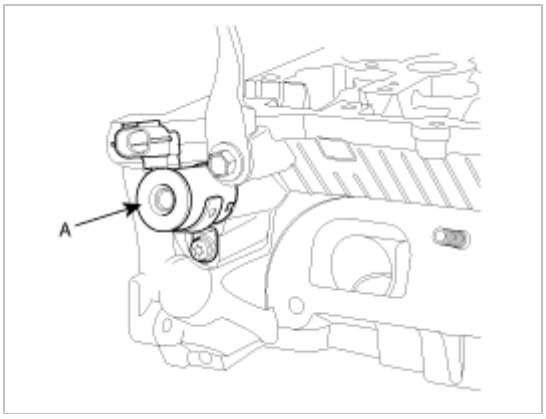
   D. Remove the cam shaft (A).



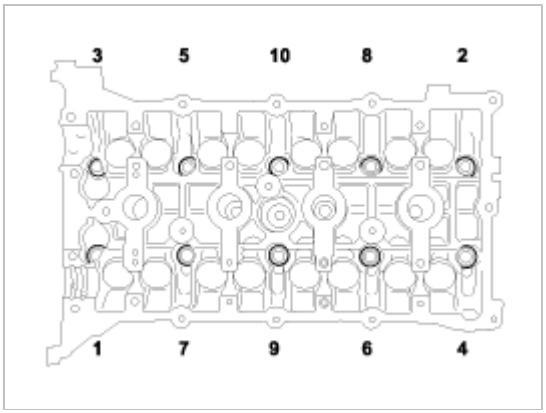
E. Remove the exhaust cam shaft lower bearing (A).



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



10. Remove the exhaust OCV.
11. Remove the cylinder head bolts, then remove the cylinder head.
    A. Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown.



CAUTION

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

B. 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.

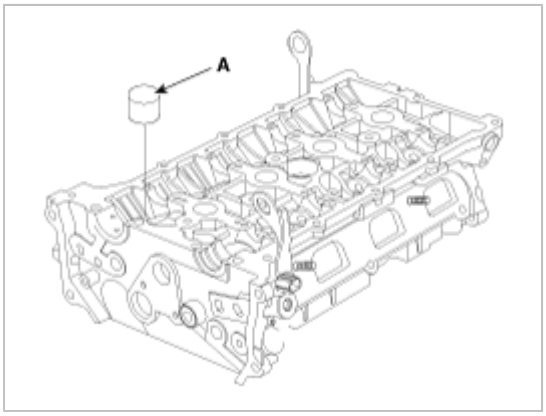
12. Remove the cylinder head gasket.

Disassembly

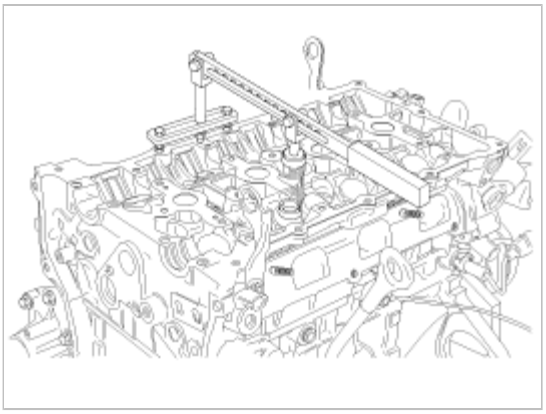
NOTE

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 MLAs(A).



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

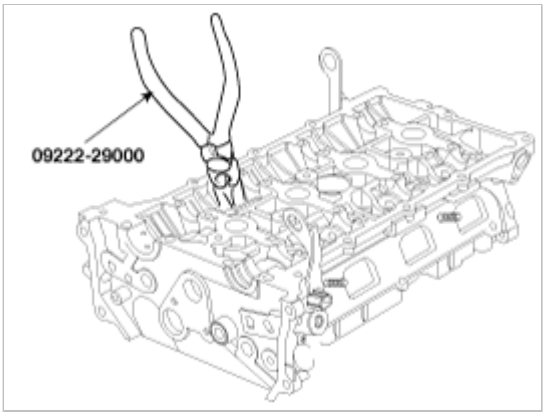


(2) Remove the spring retainer.

(3) Remove the valve spring.

(4) Remove the valve.

(5) Using valve stem seal remover (09222-29000), remove the valve stem seal.

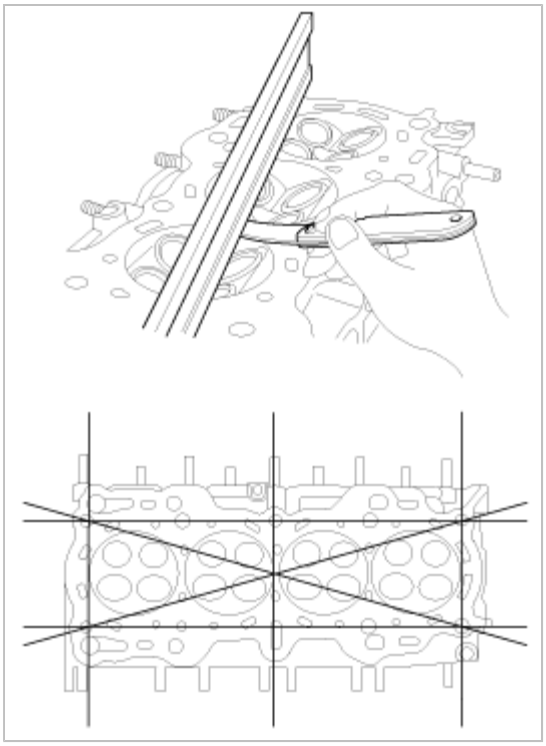


Inspection

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.)

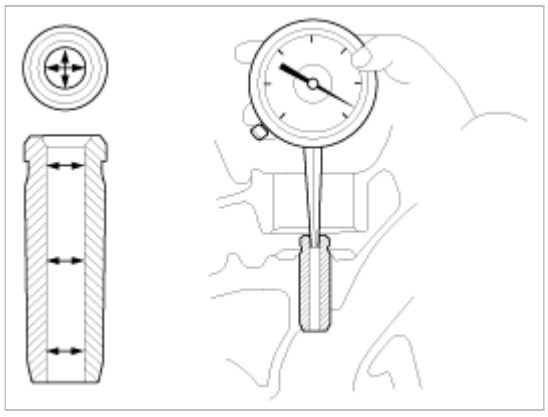


2. Inspect for cracks.
   Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

Valve And Valve Spring

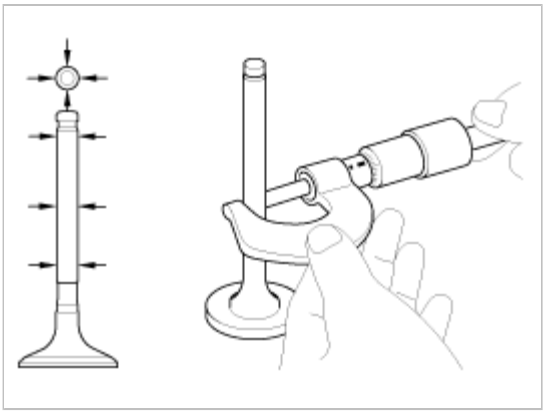
1. Inspect valve stems and valve guides.
   (1) Using a caliper gauge, measure the inside diameter of the valve guide.

Valve guid I.D.
Intake / Exhaust : 5.500 ~ 5.512mm (0.216 ~ 0.217in.)



   (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.)



(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.)

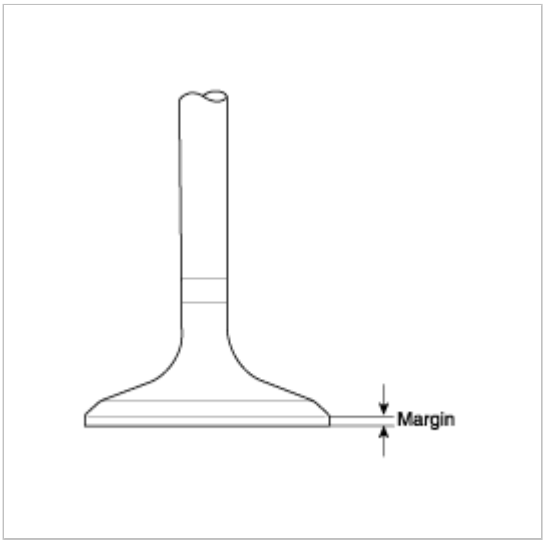
If the clearance is greater than maximum, replace the valve and valve guide.

2. Inspect 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.)



(4) Check the valve length.

Valve length
[Standard]
Intake : 113.18mm (4.456in.)
Exhaust : 105.84mm (4.167in.)
[Limit]
Intake : 112.93mm (4.446in.)
Exhaust : 105.59mm (4.157in.)

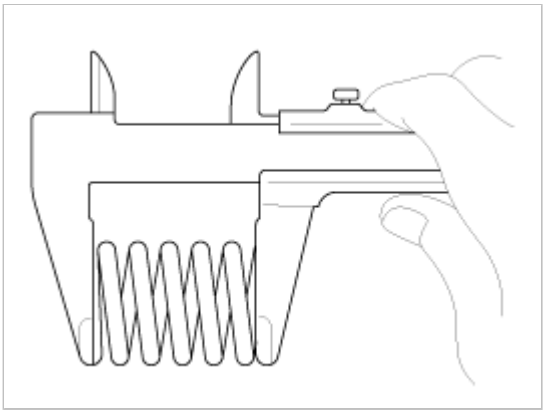
(5) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, replace the valve.

3. Inspect valve seats
Check the valve seat for evidence of overheating and improper contact with the valve face.
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 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°



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

MLA

1. Inspect 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.)

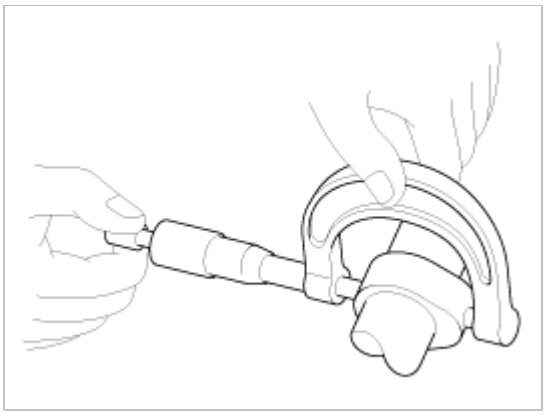
3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

MLA to tappet bore clearance
[Standard]
Intake/Exhaust : 0.020 ~ 0.061mm(0.0008 ~ 0.0024in.)
[Limit]
Intake/Exhaust : 0.07mm(0.0027in.)

Camshaft

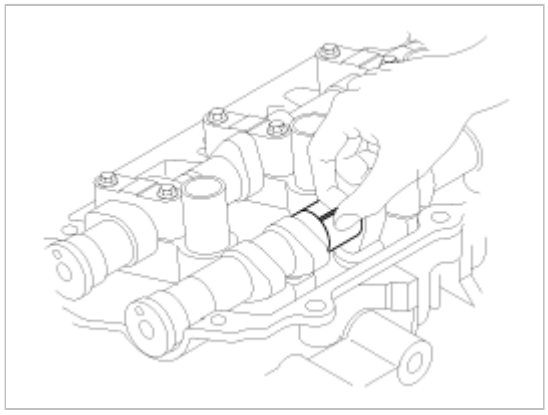
1. Inspect cam lobes.
   Using a micrometer, measure the cam lobe height.

Cam height
[Standard value]
Intake : 43.70 ~ 43.90mm (1.7204 ~ 1.7283in.)
Exhaust : 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)



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

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



   (4) Install the bearing caps.

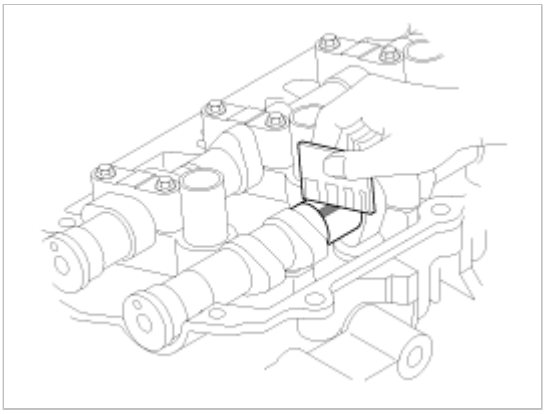
CAUTION

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 (0.0008 ~ 0.0022in.)
No.2,3,4,5, journal : 0.045 ~ 0.082mm (0.0018 ~ 0.0032in.)
Exhaust
No.1 journal : 0 ~ 0.032mm (0 ~ 0.0012in.)
No.2,3,4,5, journal : 0.045 ~ 0.082mm (0.0017 ~ 0.0032in.)
[Limit] :
Intake
No.1 journal : 0.09mm (0.0035in.)
No.2,3,4,5 journal : 0.12mm (0.0047in.)
Exhaust : 0.12mm (0.0047in.)



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

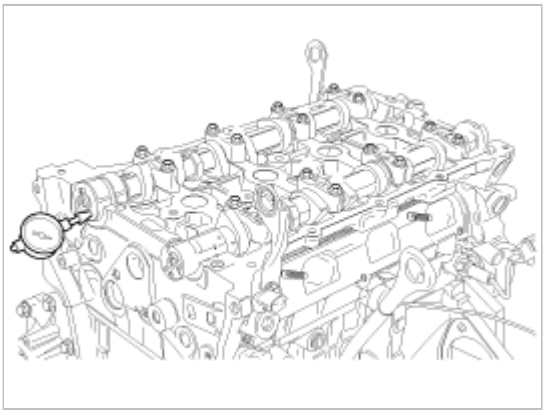
(7) Completely remove the plastigage.

(8) Remove the camshafts.

3. Inspect camshaft end play.
(1) Install the camshafts.

(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(0.0015 ~ 0.0062in.)
[Limit] : 0.20mm (0.0078in.)



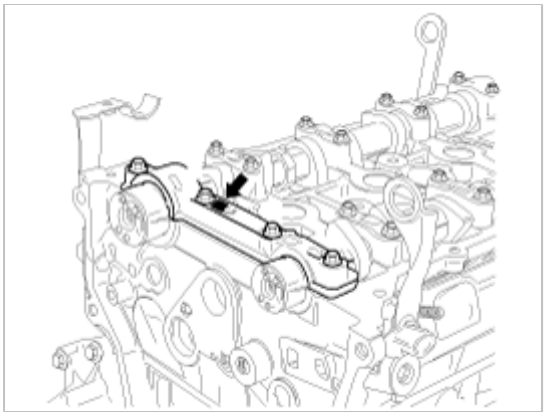
If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

(3) Remove the camshafts.

Exhaust Cam Shaft Bearing

1. Check the cylinder head bore mark.

Location Of Cylinder Head Bore Mark

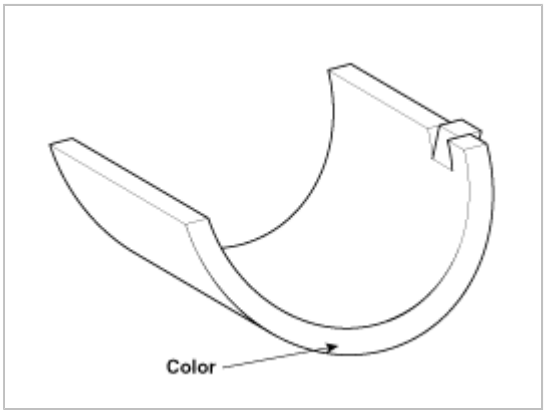


Discrimination Of Cylinder Head

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

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

Place Of Exhaust Cam Shaft Bearing Identification Mark



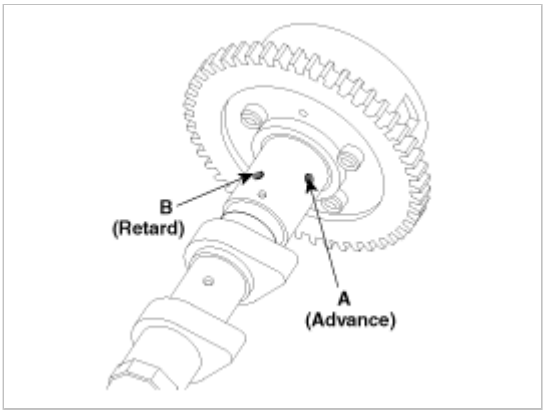
Discrimination Of Exhaust Camshaft Bearing

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

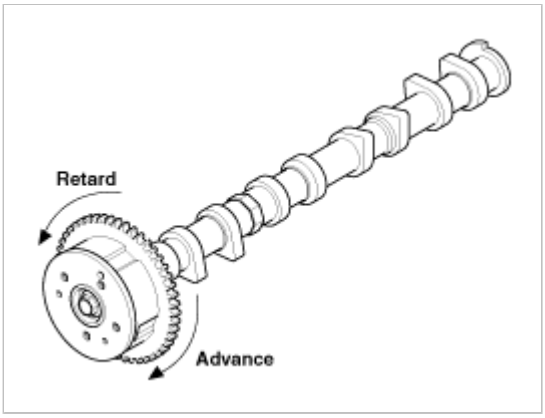
1. Inspect CVVT assembly.
   (1) Check that the CVVT assembly will not turn.
   (2) Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.
   Verify the hold to tape and the hole to put air in.



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

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

   (4) With air applied, as in step(3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.
   Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.



   (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

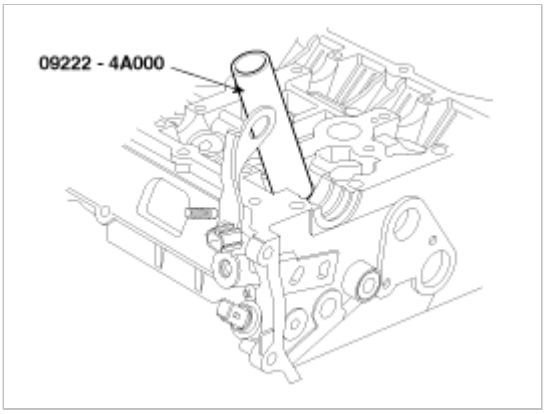
NOTE

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.

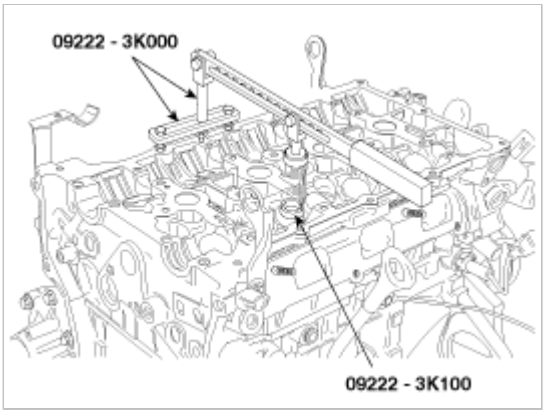
   

   (2) Install the valve, valve spring and spring retainer.

   NOTE

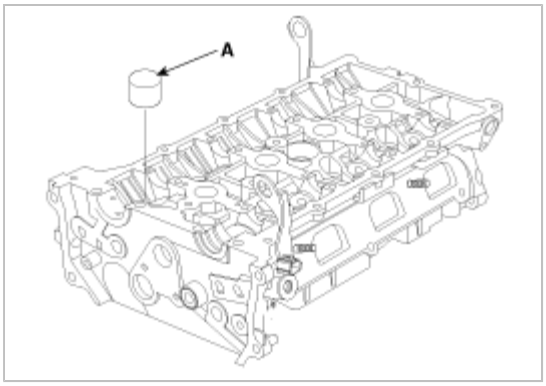
   Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

   (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.

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

2. Install MLAs.
   Check that the MLA rotates smoothly by hand.



NOTE

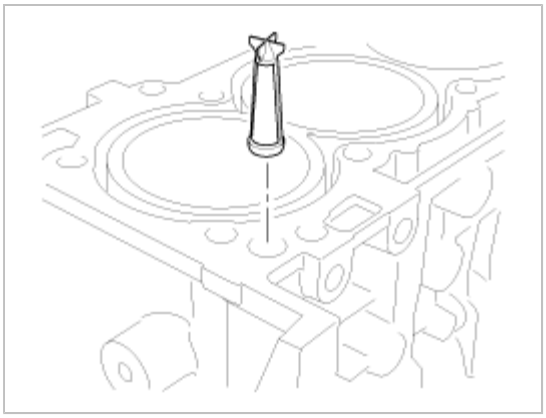
MLA can be reinstalled in its original position.

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 OCV filter.



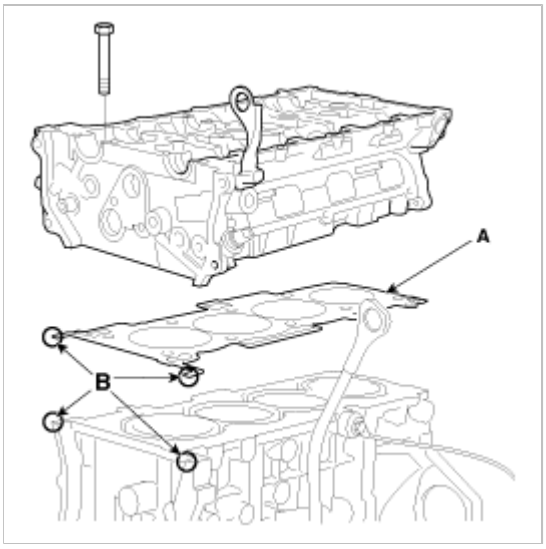
CAUTION

Keep the OCV filter clean.

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

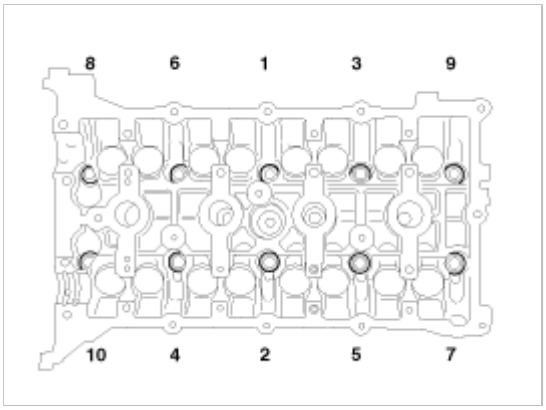
NOTE

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



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 hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

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

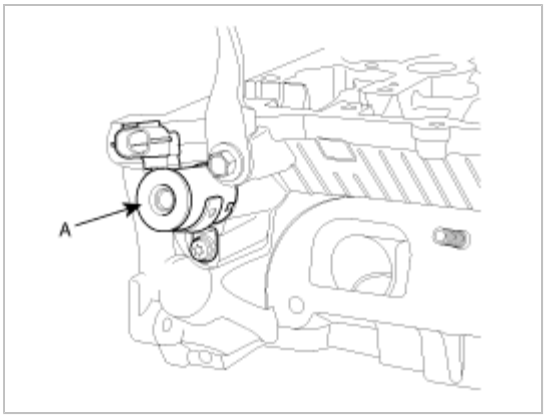


NOTE

Always use new cylinder head bolt.

5. Install the OCV(A).

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



CAUTION

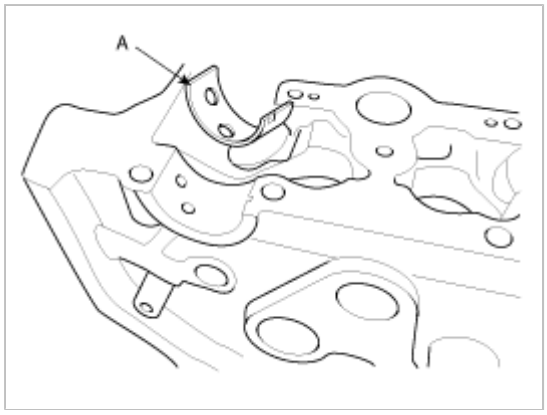
- Do not reuse the OCV when dropped.
- Keep the OCV filter clean.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.

6. Install the camshafts.

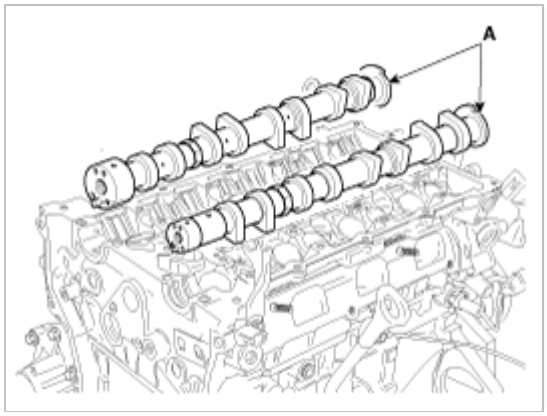
NOTE

Apply a light coat of engine oil on camshaft journals.

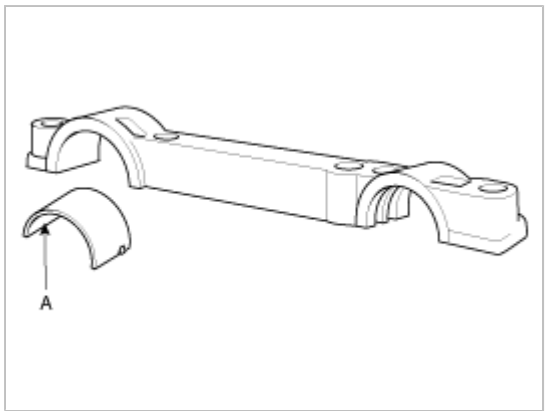
A. Install the exhaust camshaft lower bearing (A).



B. Install the camshafts (A).

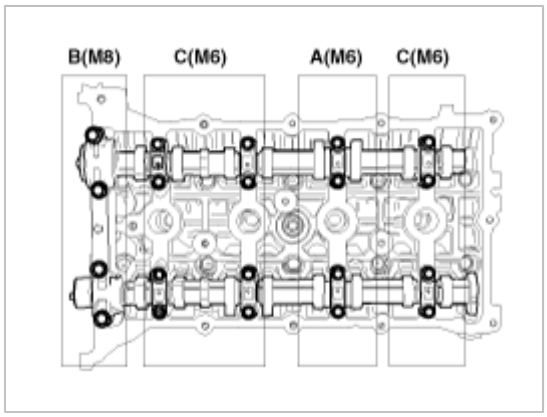


C. Install the exhaust camshaft upper bearing (A).



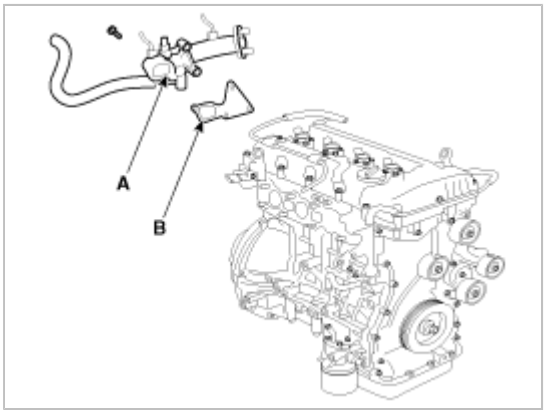
D. Install camshaft bearing caps in their proper locations.
Tightening order.
Group A → Group B → Group C.

Tightening torque
Step 1
M6 : 5.9N.m(0.6kgf.m, 4.3lb-ft)
M8 : 14.7N.m(1.5kgf.m, 10.8lb-ft)
Step 2
M6 : 10.8 ~ 12.7N.m(1.1 ~ 1.3kgf.m, 7.9 ~ 9.4lb-ft)
M8 : 27.5 ~ 31.4N.m(2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)



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

Tightening torque :
Bolts : 14.7 ~ 19.6N.m (1.5 ~ 2.0kgf.m, 10.8 ~ 14.4lb-ft)
Nut : 18.6 ~ 23.5N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)

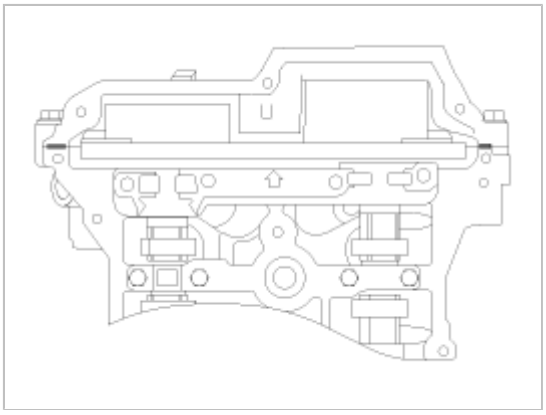


CAUTION

- Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.
- Always use a new O-ring.

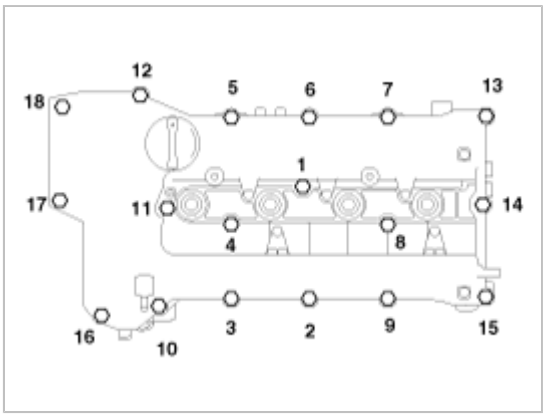
8. Install the timing chain.
9. Check and adjust valve clearance.
10. Install the cylinder head cover.
    A. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
    B. After applying sealant, it should be assembled within 5 minutes.

Bead width : 2.5mm(0.1in.)
Sealant : LOCTITE 5900H



    C. The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.
    D. Install the cylinder head cover bolts as following method.

Tightening torque :
Step 1 : 3.9 ~ 5.9N.m(0.4 ~ 0.6kgf.m, 2.9 ~ 4.3lb-ft)
Step 2 : 7.8 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

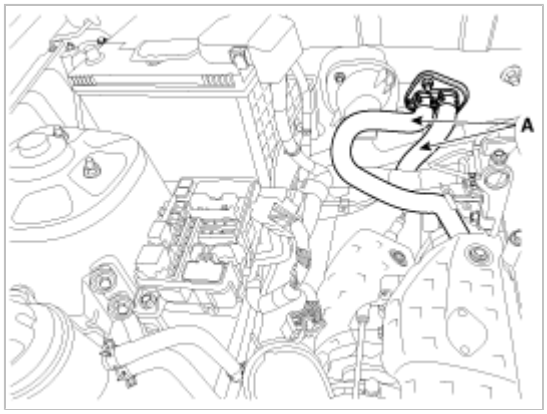


CAUTION

Do not reuse cylinder head cover gasket.

11. Install the intake & exhaust manifold. (Refer to Intake and exhaust system in this group)

12. Install the heater hoses (A).



13. Connect the negative (-) battery terminal (A).