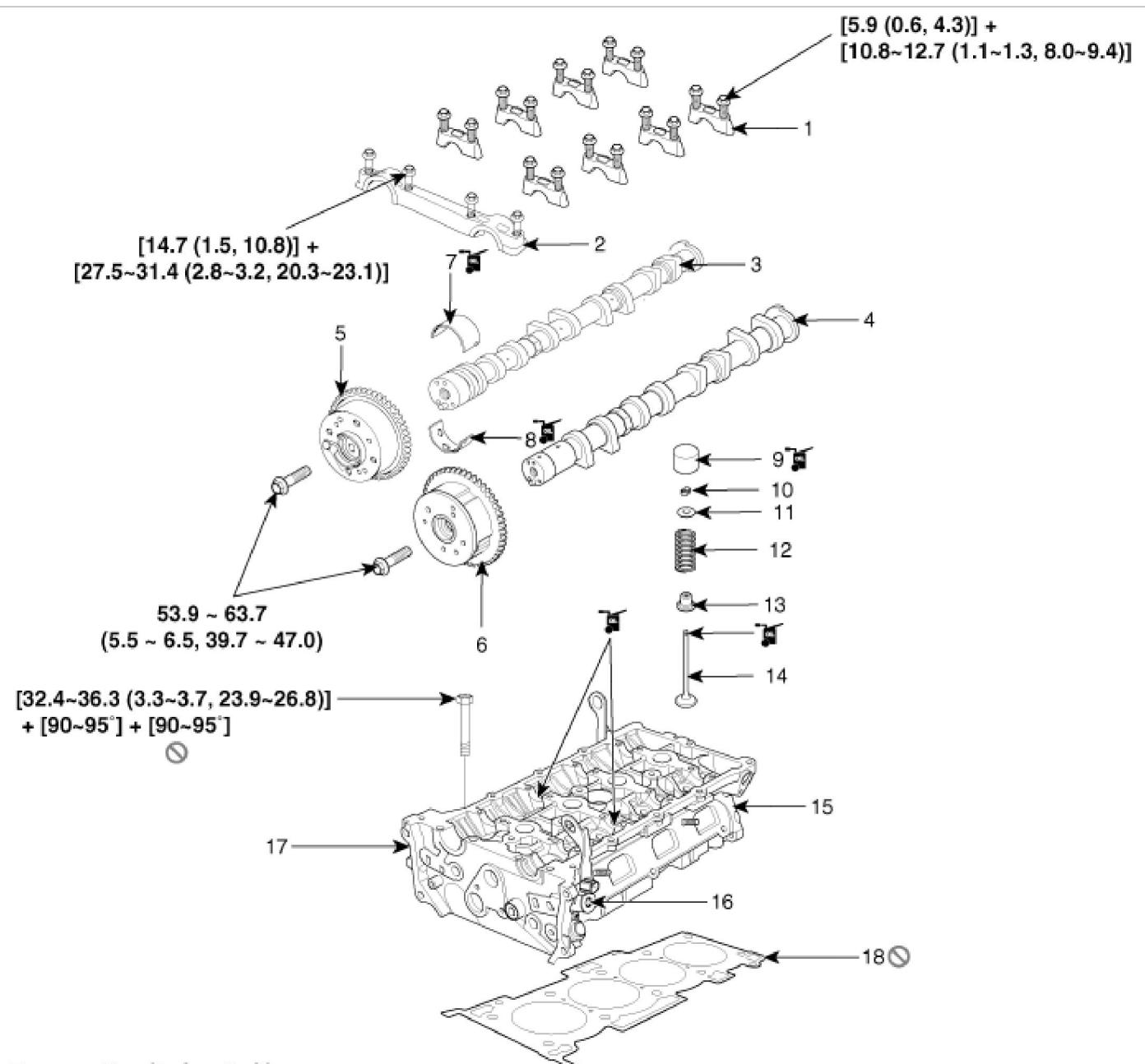


NOTE

- Refill engine with engine oil.
- Clean battery posts and cable terminals and assemble (12 Volt only).
- Inspect for fuel leakage.
- After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuelline pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

Engine Mechanical System > Cylinder Head Assembly > Cylinder Head > Components and Components Location**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 (Mechanical lash adjuster)	15. Cylinder head
4. Intake camshaft	10. Retainer lock	16. Intake OCV (Oil control valve)
5. Exhaust CVVT assembly	11. Retainer	17. Exhaust OCV (Oil control valve)
6. Intake CVVT assembly	12. Valve spring	18. Cylinder head gasket

Engine Mechanical System > Cylinder Head Assembly > Cylinder Head > Repair procedures

Removal

CAUTION

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

NOTE

Mark all wiring and hoses to avoid misconnection.

WARNING

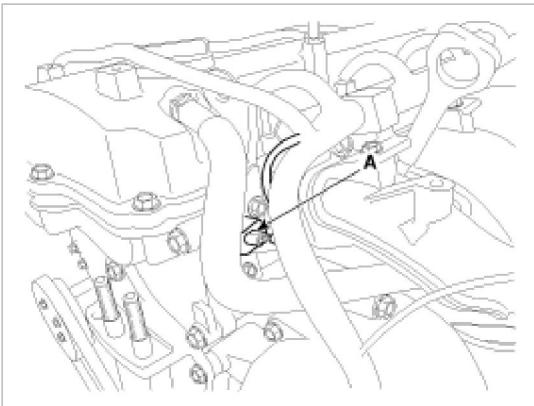
The hybrid system uses DC 270V high voltage. So, be sure to follow safety instructions below. Otherwise, there may be a serious injury or electrocution (Refer to "Safety Precaution").

1. Shut off the High Voltage circuit (Refer to "High Voltage Shutoff Procedure" in this group).
2. Remove the engine cover.
3. Remove the air duct and the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
4. Remove the under covers. (Refer to Engine and transaxle assembly in this group)
5. Remove the RH front wheel. (Refer to SS group - "Wheel")
6. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster. (Refer to Cooling system in this group)

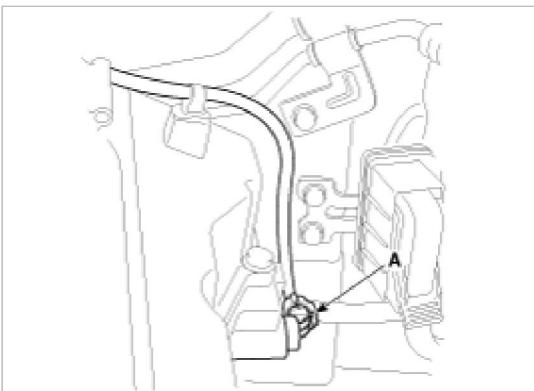
7. Disconnect the radiator upper hose and lower hose. (Refer to Cooling system in this group)

8. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.

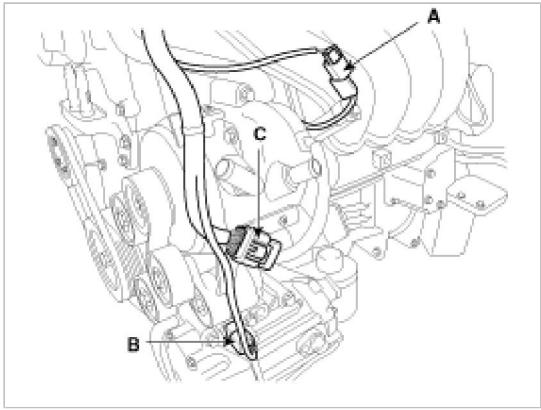
(1) The intake OCV (Oil control valve) connector (A)



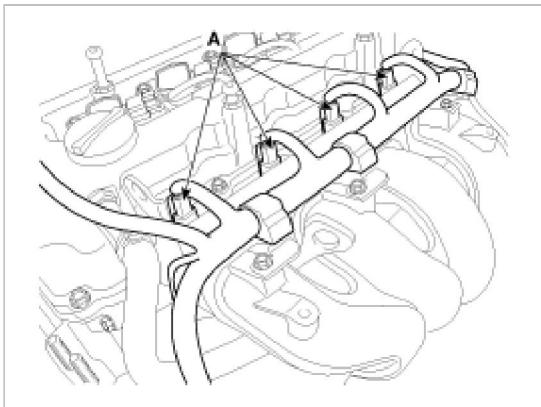
(2) The exhaust OCV (Oil control valve) connector (A)



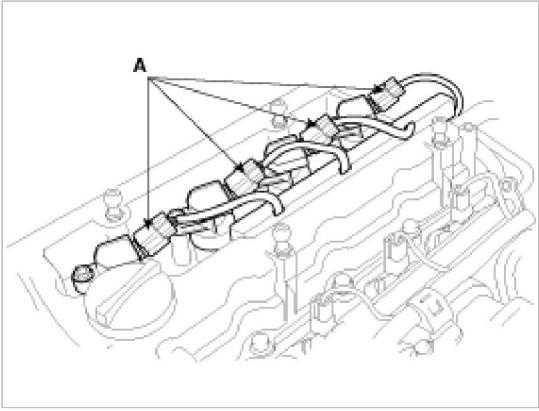
(3) The OPS (Oil pressure switch) connector (A), the A/C compressor switch connector (B) and the HSG (Hybrid searter generator) sensor connector (C)



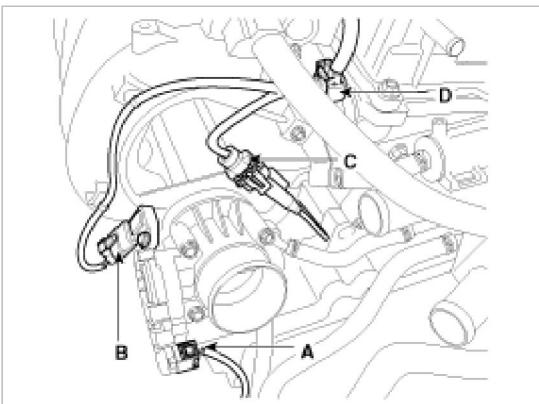
(4) The injector connectors (A)



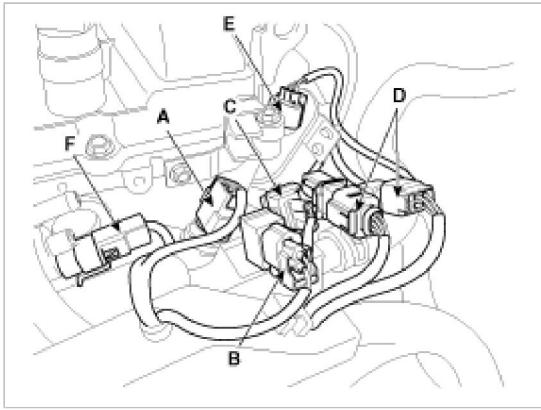
(5) The ignition coil connectors (A)



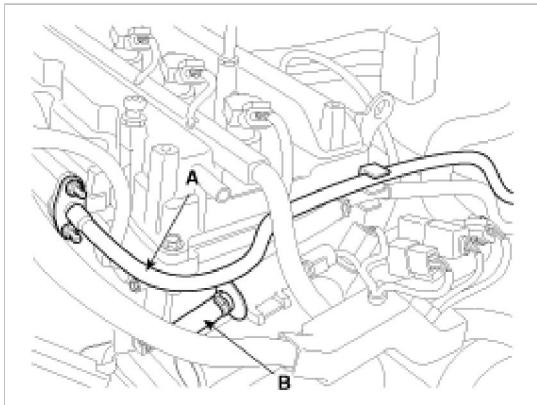
(6) The ETC (Electronic throttle control) connector (A), the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B), the knock sensor connector (C) and the intake CMPS (Camshaft position sensor) connector (D)



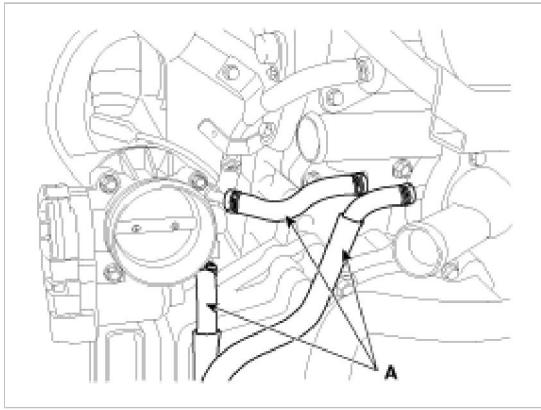
(7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the oxygen sensor connectors (D), the exhaust CMPS (Camshaft position sensor) connector (E) and the PCSV (Purge control solenoid valve) connector (F)



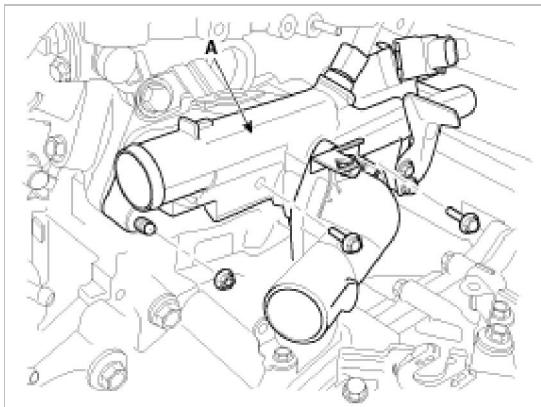
9. Disconnect the heater hoses. (Refer to Engine and transaxle assembly in this group)
10. Disconnect the fuel hose (A) and the PCSV (Purge control solenoid valve) hose (B).



11. Disconnect the water hoses (A).



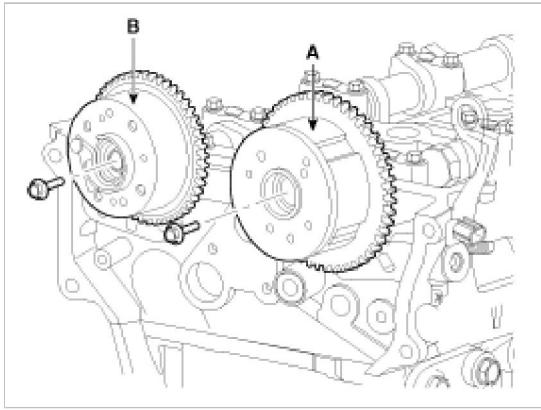
12. Remove the water temperature control assembly (A).



13. Remove the timing chain. (Refer to Timing system in this group)

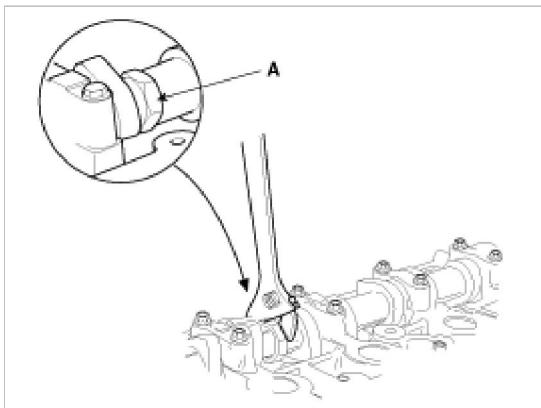
14. Remove the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)

15. Remove the intake CVVT assembly (A) and exhaust CVVT assembly (B).



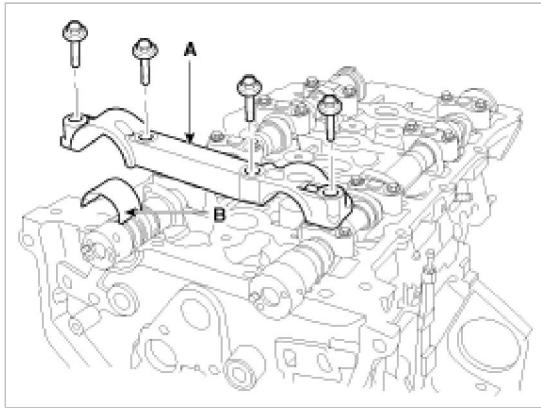
NOTE

When removing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position A.

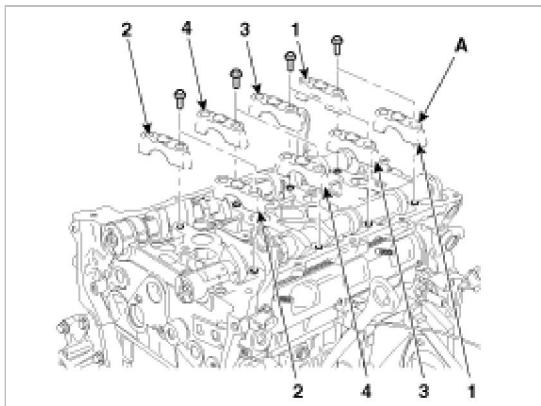


16. Remove the camshaft.

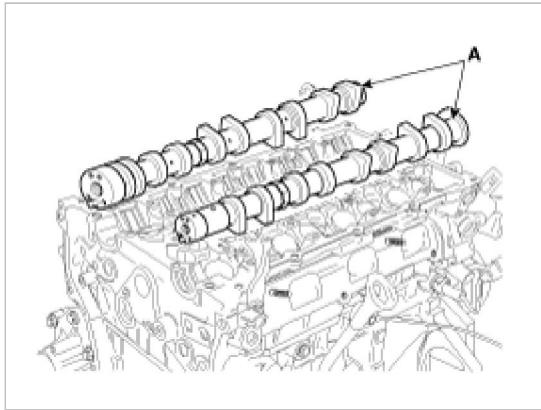
- (1) Remove the front camshaft bearing cap (A) with the upper bearing (B).



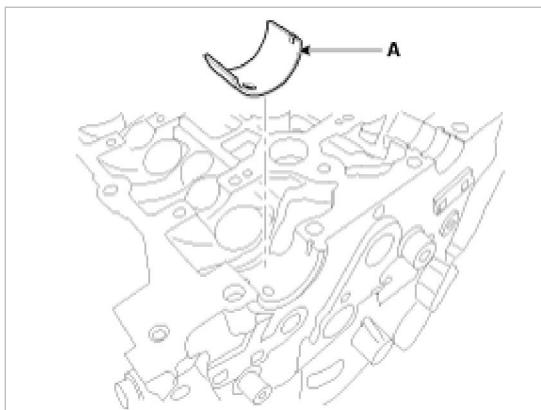
(2) Remove the camshaft bearing cap (A) in the sequence shown.



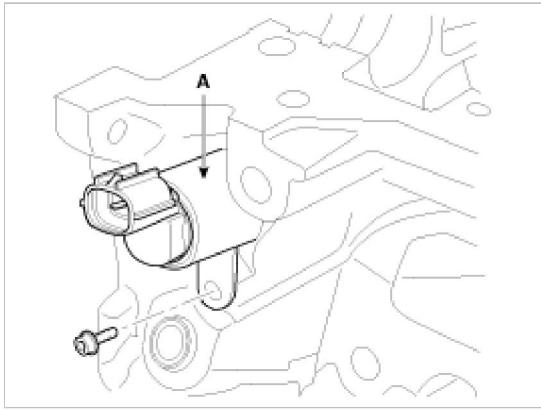
(3) Remove the camshafts (A).



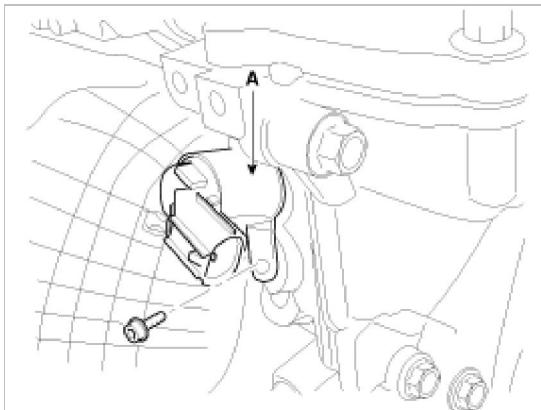
(4) Remove the exhaust camshaft lower bearing (A).



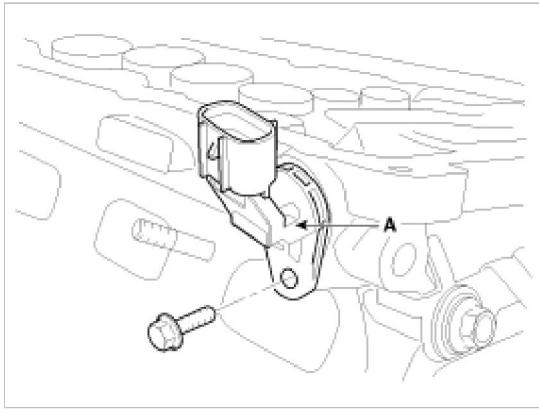
17. Remove the intake OCV (Oil control valve) (A) using a torx wrench.



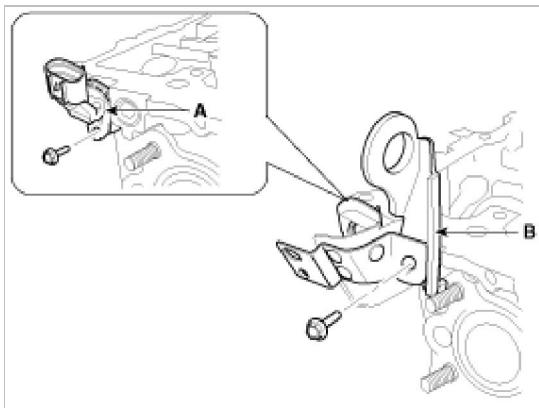
18. Remove the exhaust OCV (Oil control valve) (A) using a torque wrench.



19. Remove the intake CMPS (Camshaft position sensor) (A).

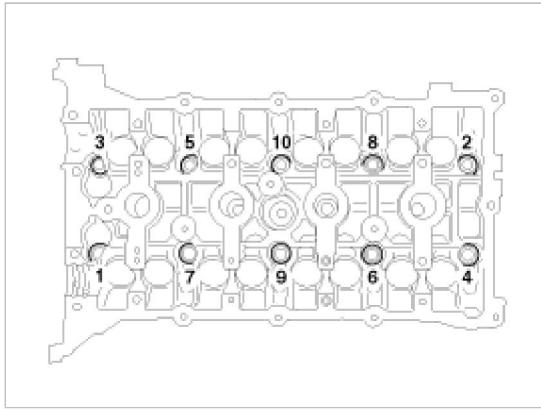


20. Remove the exhaust CMPS (Camshaft position sensor) (A) after removing the engine hanger and cam position sensor cover (B).



21. 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. Remove the 10 cylinder head bolts and plate washers.



CAUTION

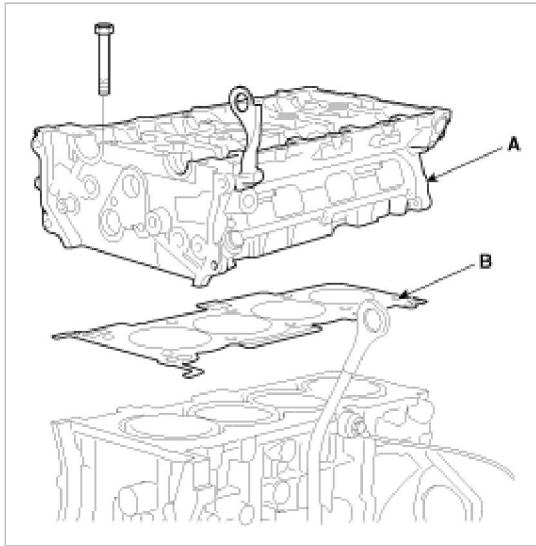
Head warpage or cracking could result from removing bolts in an incorrect order.

(2) Lift the cylinder head (A) 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.

(3) Remove the cylinder head gasket (B).

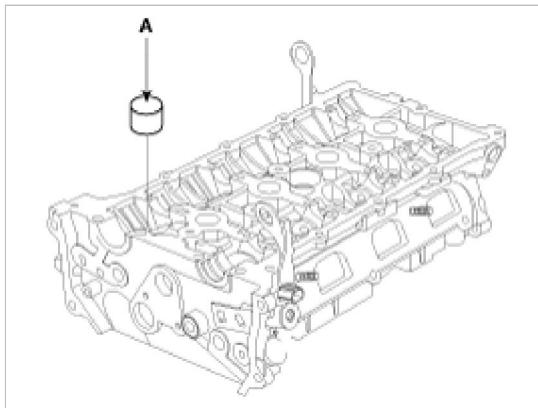


Disassembly

NOTE

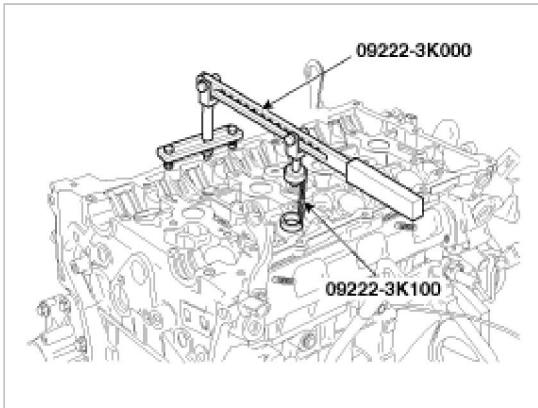
Identify MLA(Mechanical Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove the MLAs (A).



2. Remove the 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 needle-nose pliers, remove the valve stem seal.

NOTE

Do not reuse old valve stem seals.

Inspection

Cylinder Head

1. Inspect for flatness.

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

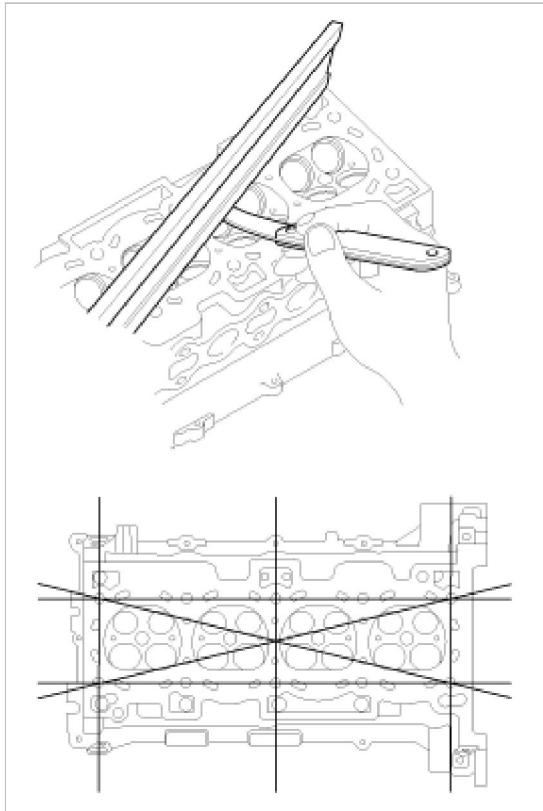
Flatness of cylinder head gasket surface

Standard : Less than 0.05mm (0.0019in.) for total area

Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) X 100mm (3.9370in.)

Flatness of manifold mounting surface (Intake/Exhaust)

Standard : Less than 0.10mm (0.0039in.)



2. Inspect for cracks.

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

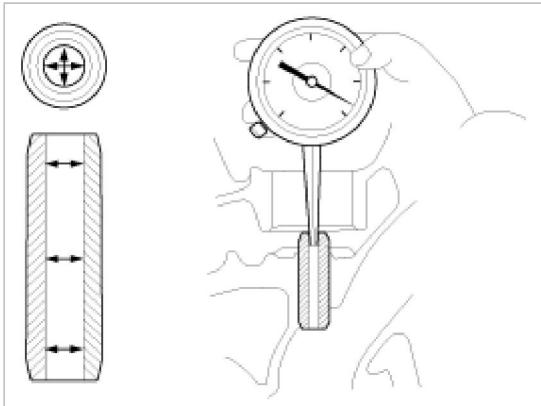
Valve And Valve Spring

1. Inspect valve stems and valve guides.

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

Valve guide inner diameter

Intake / Exhaust : 5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)

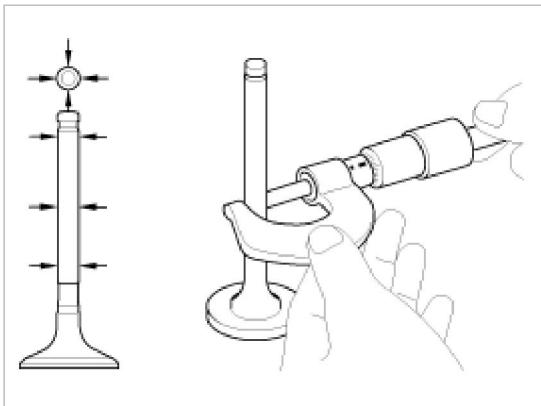


(2) Using a micrometer, measure the diameter of the valve stem.

Valve stem outer diameter

Intake : 5.465 ~ 5.480mm (0.21516 ~ 0.21575in.)

Exhaust : 5.458 ~ 5.470mm (0.214988 ~ 0.21535in.)



(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 (0.00078 ~ 0.00185in.)

Exhaust : 0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)

[Limit]

Intake : 0.070mm (0.00275in.)

Exhaust : 0.090mm (0.00354in.)

If the clearance is greater than maximum, replace the valve or cylinder head.

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.

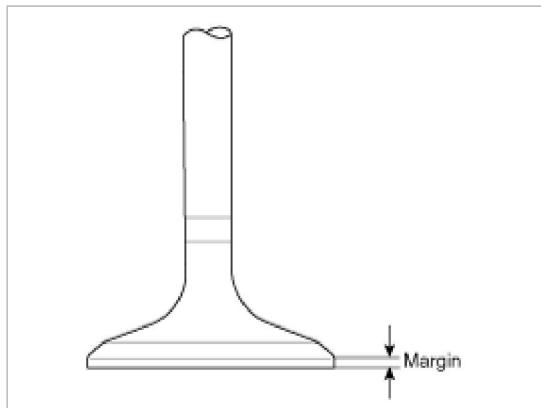
(3) Check the valve head margin thickness.

Valve head thickness (Margin)

[Standard]

Intake : 1.02mm(0.0401in.)

Exhaust : 1.09mm(0.0429in.)



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

(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 : 105.59m(4.1571in.)

(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

(1) Check the valve seat for evidence of overheating and improper contact with the valve face. Replace the cylinder head if necessary.

(2) Check the valve guide for wear. If the valve guide is worn, replace the cylinder head.

4. Inspect the valve springs.

(1) Using a steel square, measure the out-of-square of the valve spring.

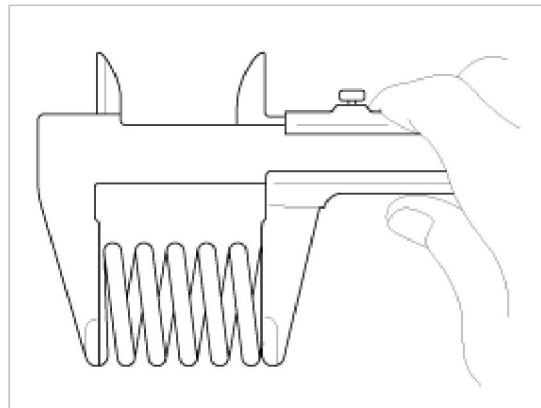
(2) Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 44.45mm (1.7500in.)

Out-of-square : Less than 1.5°



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

MLA (Mechanical Lash Adjuster)

1. Inspect the MLA.

Using a micrometer, measure the MLA outside diameter.

MLA outer diameter :

31.964 ~ 31.980mm (1.2584 ~ 1.2590in.)

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

Tappet bore inner diameter :

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] : 0.020 ~ 0.061mm (0.00078 ~ 0.00240in.)

[Limit] : 0.070mm (0.00275in.)

Camshaft

1. Inspect the cam lobes.

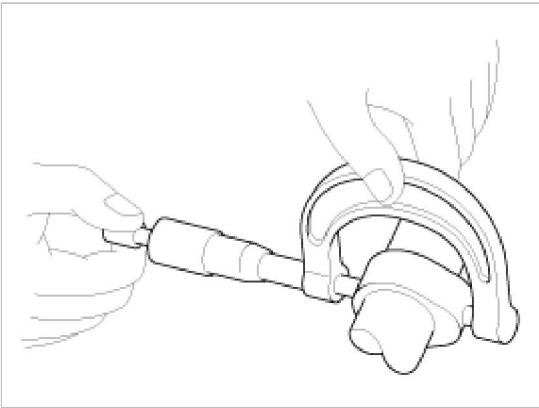
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

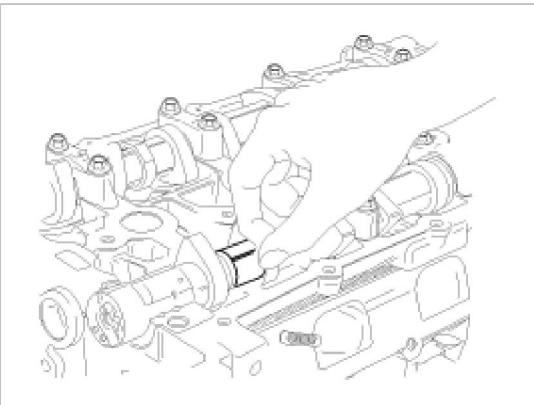
Intake : 43.20 ~ 43.40mm (1.7008 ~ 1.7087in.)

Exhaust : 44.40 ~ 44.60mm (1.7480 ~ 1.7559in.)



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

2. Check the surface of the camshaft journal for wear. If the journal is worn excessively, replace the camshaft.
3. 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.



(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 : 0.022 ~ 0.057mm (0.00087 ~ 0.00224in.)

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

Exhaust:

No.1 : 0 ~ 0.032mm (0 ~ 0.00126in.)

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

[Limit]

Intake:

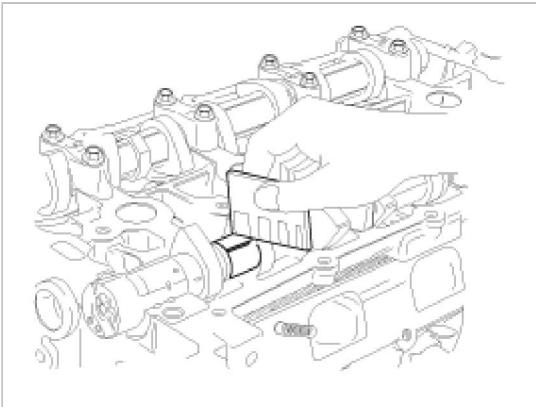
No.1 : 0.090mm (0.00354in.)

No.2, 3, 4, 5 : 0.120mm (0.00472in.)

Exhaust :

No.1 : 0.090mm (0.00354in.)

No.2, 3, 4, 5 : 0.120mm (0.00472in.)



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

(7) Completely remove the plastigage.

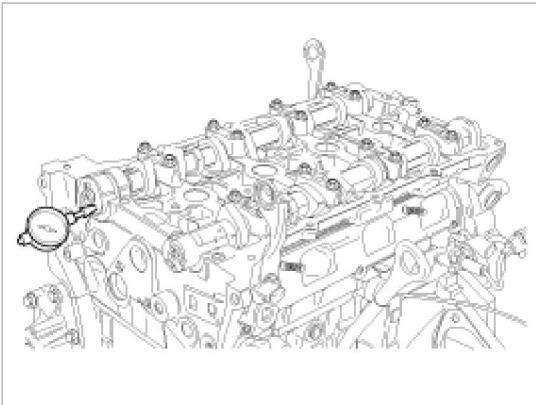
(8) Remove the camshafts.

4. 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 ~ 0.0063in.)
[Limit] : 0.20mm (0.0078in.)



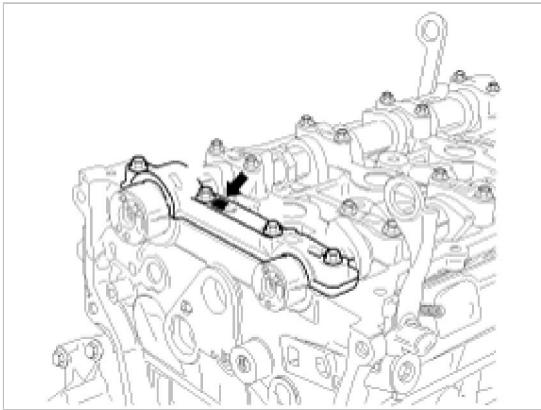
If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- (3) Remove the camshafts.

Exhaust Camshaft Bearing

1. Check the cylinder head bore mark.

Cylinder Head Bore Identification Mark

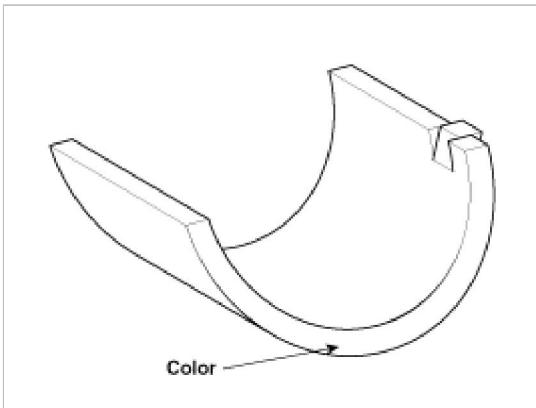


Cylinder Head Specifications

Class	Mark	Exhaust No.1 Inside Diameter Of Cylinder Head Bore
a	A	40.000 ~ 40.008mm (1.57480 ~ 1.5751in.)
b	B	40.008 ~ 40.016mm (1.57511 ~ 1.57543in.)
c	C	40.016 ~ 40.021mm (1.57543 ~ 1.57563in.)

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

Exhaust Camshaft Bearing Identification Mark



Exhaust Camshaft Bearing Specifications

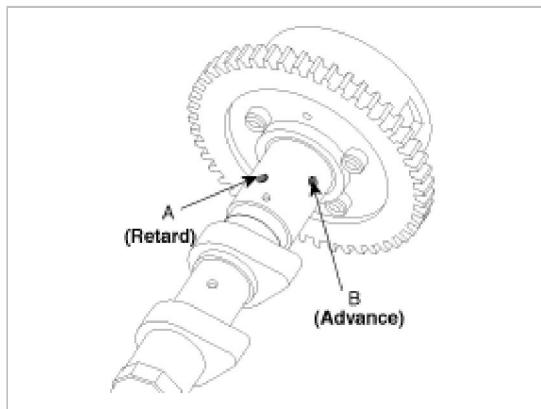
Cylinder Head Bore Class	Bearing Class For Installing (Color)	Thickness Of Bearing
a (A)	C (Green)	1.996~2.000mm (0.07858~0.07874in.)
b (B)	B (None)	2.000~2.004mm (0.07874~0.07890in.)
c (C)	A (Black)	2.004~2.008mm (0.07890~0.07905in.)

Oil clearance : 0 ~ 0.032mm (0 ~ 0.00126in.)

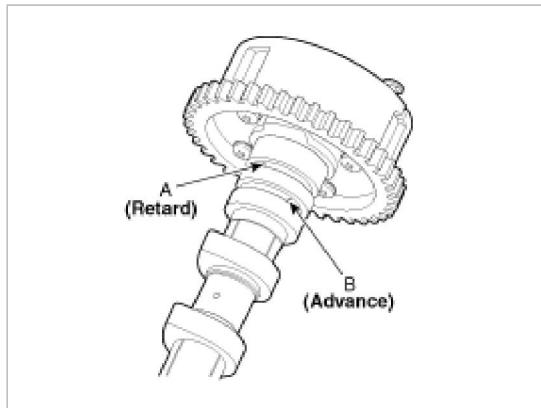
CVVT Assembly

1. Inspect CVVT assembly.
 - (1) Fix the camshaft using a vise.
Be careful not to damage the cam lobe and journal.
 - (2) Check that the CVVT assembly will not turn.
 - (3) Apply vinyl tape to the retard hole like the one indicated by the arrow in the illustration.
Verify that the tape holds and put air through the port of the camshaft.

[Intake]



[Exhaust]



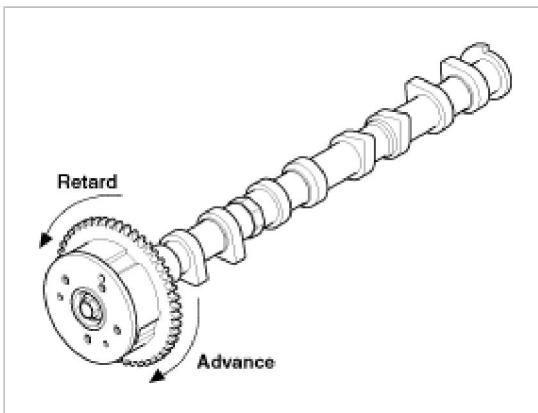
(4) Wind tape around the tip of the air gun and apply air of approx. 150kPa(1.5kgf/cm², 21psi) to the port of the camshaft.
(Perform this in order to release the lock pin.)

NOTE

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

(5) 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.



(6) 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)

(7) Turn the intake CVVT assembly with your hand and lock it at the maximum retard angle position (counter clockwise).

(8) Turn the exhaust CVVT assembly with your hand and lock it at the maximum advance angle position (clockwise).

Reassembly

NOTE

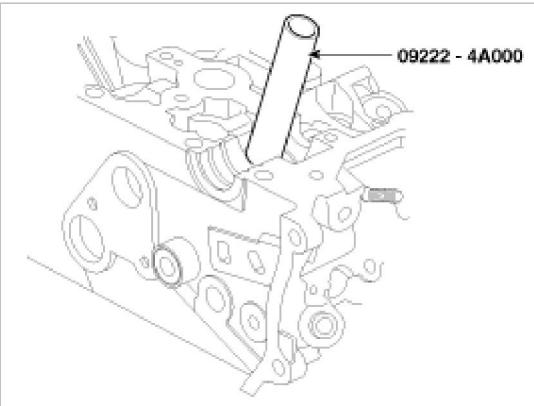
Thoroughly clean all parts to be assembled.
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
Replace oil seals with new ones.

1. Install 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.

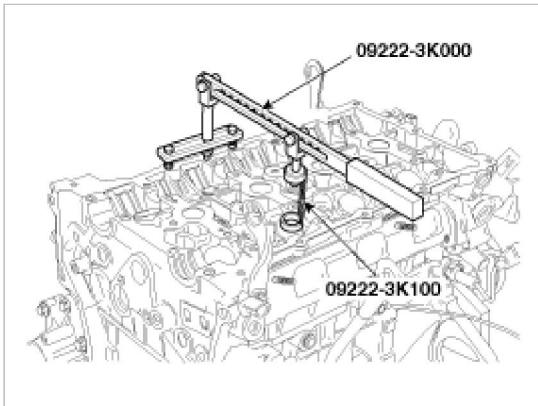


(2) Install the valve, valve spring and spring retainer.

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.



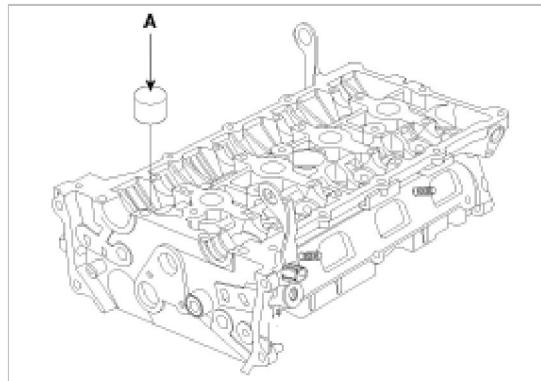
NOTE

Do not press down the valve spring retainer more than 10mm (0.4in.).

(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 after applying engine oil.

Check that the MLA rotates smoothly by hand.

**NOTE**

MLA can be reinstalled in its original position.

However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block.

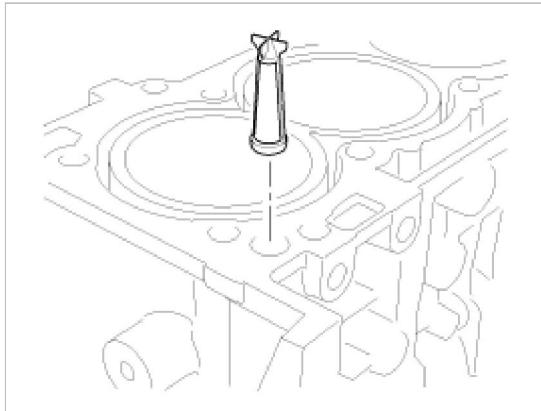
Refer to General information in EM section for Valve Clearance checking and adjustment procedure.

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 (Oil control valve) filter.

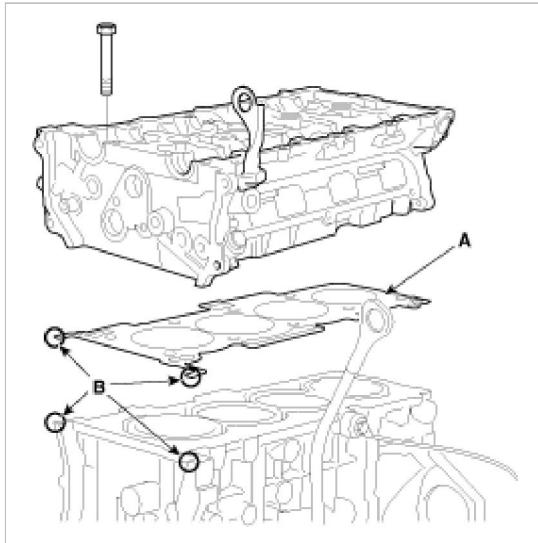
**CAUTION**

Keep the OCV filter clean.

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

NOTE

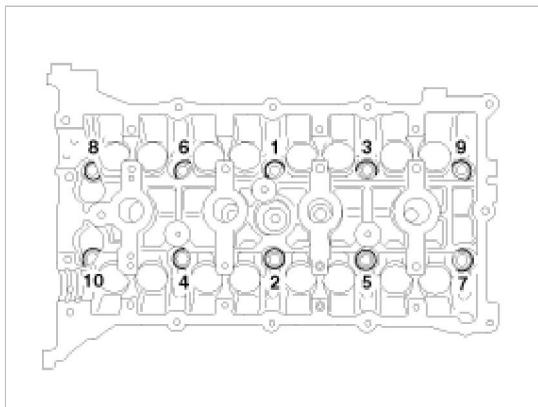
- Be careful of the installation direction.
- Apply liquid gasket (Loctite 5900H or equivalent) on the edge of cylinder head gasket upside and downside. (At the position 'B')
- After applying sealant, assemble the cylinder head in five minutes.



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.
 - (1) Do not apply engine oil on the the cylinder head bolts.
 - (2) Using the SST(09221-4A000), tighten the 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°



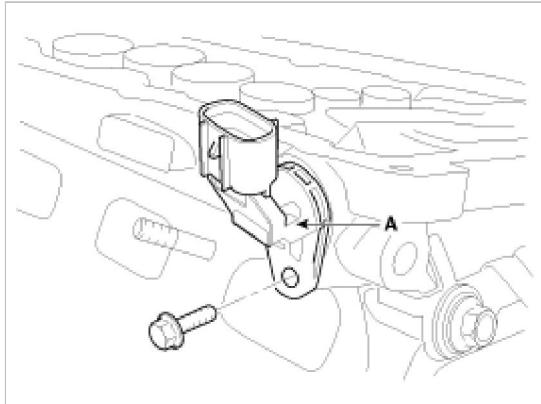
CAUTION

Always use new cylinder head bolt.

5. Install the intake CMPS (Camshaft position sensor) (A).

Tightening torque :

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

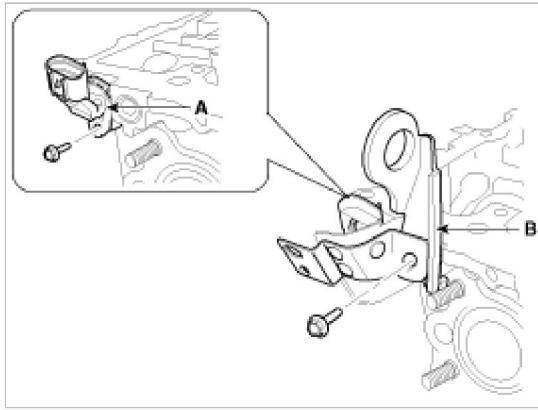


6. Install the exhaust CMPS (Camshaft position sensor) (A) and the engine hanger and cam position sensor cover (B).

Tightening torque :

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

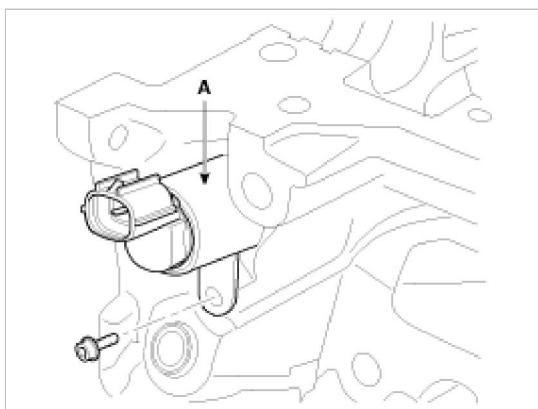
Bolt B : 27.5 ~ 31.4N.m (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)



7. Install the intake OCV (Oil control valve) (A).

Tightening torque :

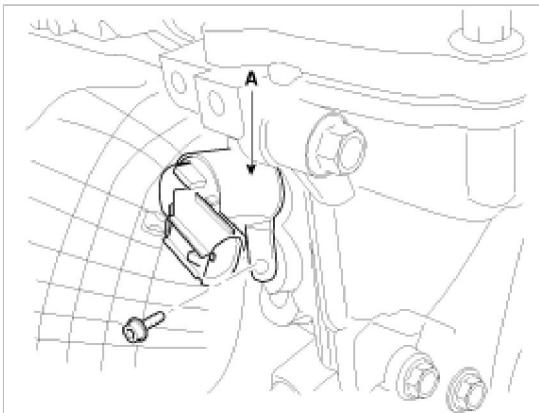
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



8. Install the exhaust OCV (Oil control valve) (A).

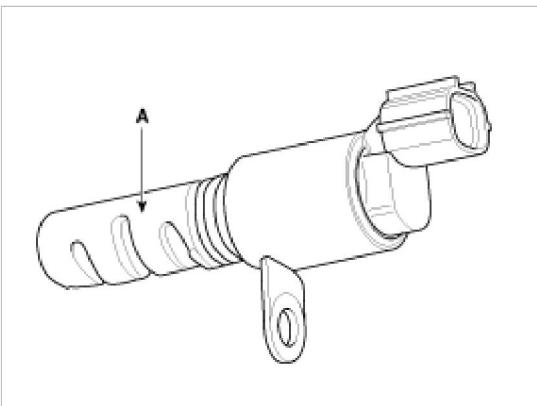
Tightening torque :

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 (A) during servicing.
- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.

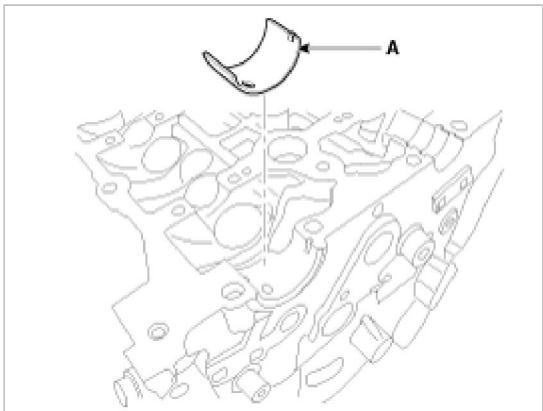


9. Install the camshafts.

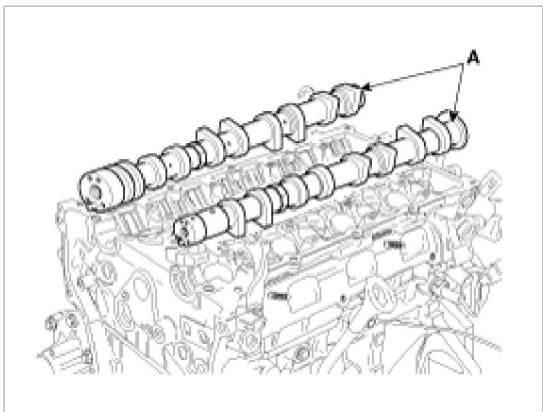
NOTE

Apply a light coat of engine oil on camshaft journals.

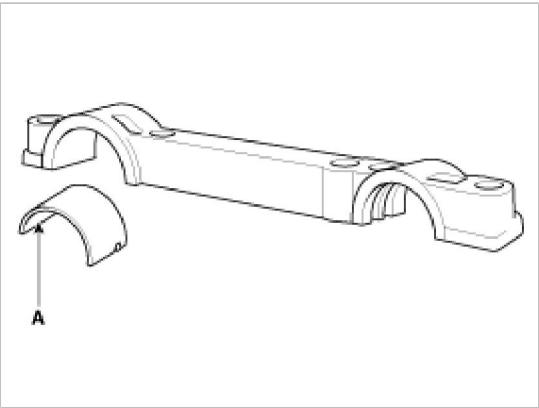
(1) Install the exhaust camshaft lower bearing (A).



(2) Install the camshafts (A).



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



(4) Install camshaft bearing caps (A) in their proper locations.

Tightening order

Group A → Group B → Group C.

Tightening torque :

Step 1

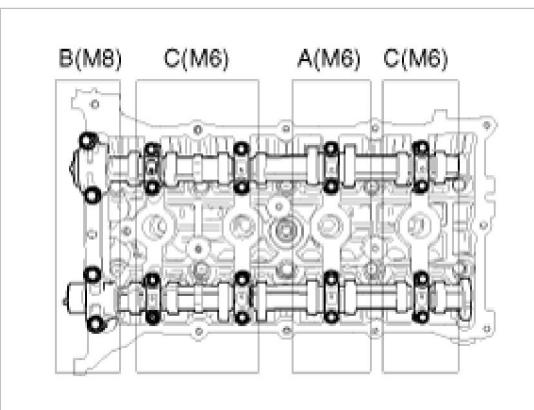
M6 : 5.9N.m (0.6kgf.m, 4.3lb-ft)

M8 : 14.7N.m (1.5kgf.m, 10.8lb-ft)

Step 2

M6 : 10.8 ~ 12.7N.m (1.1 ~ 1.3kgf.m, 8.0 ~ 9.4lb-ft)

M8 : 27.5 ~ 31.4N.m (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)



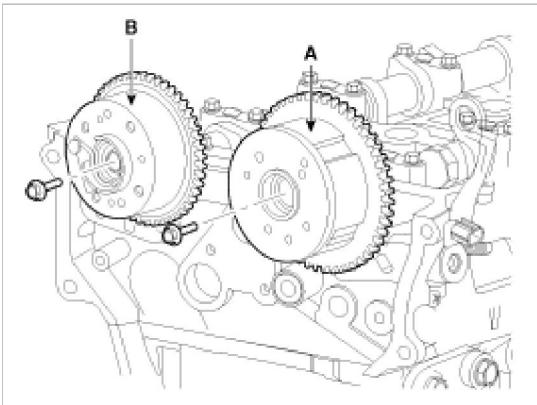
CAUTION

Be careful not to change the position and direction of bearing caps.

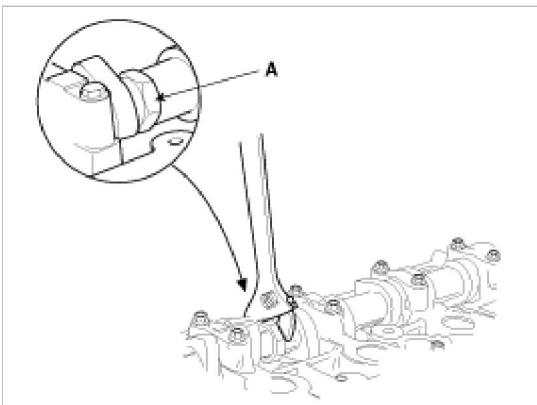
10. Install the intake CVVT assembly (A) and exhaust CVVT assembly (B).

Tightening torque :

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

**NOTE**

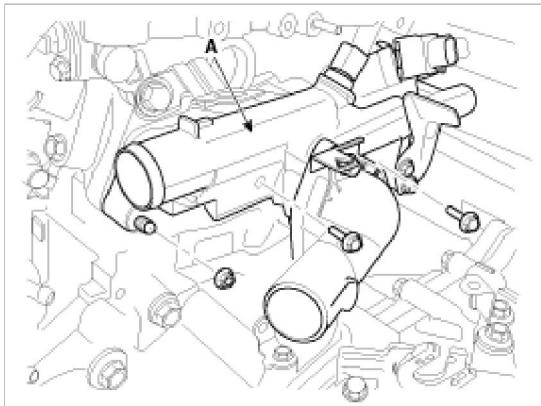
When installing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position A.



11. Install the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
12. Install the timing chain. (Refer to Timing system in this group)
13. Check and adjust the valve clearance. (Refer to General information in this group)
14. Install the water temperature control assembly (A).

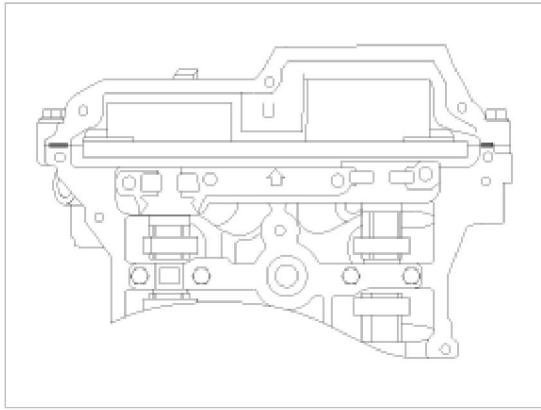
Tightening torque :

Bolts : 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)



15. 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 (Loctite 5900H or equivalent), it should be assembled within 5 minutes.

Bead width : 2.5mm (0.10in.)

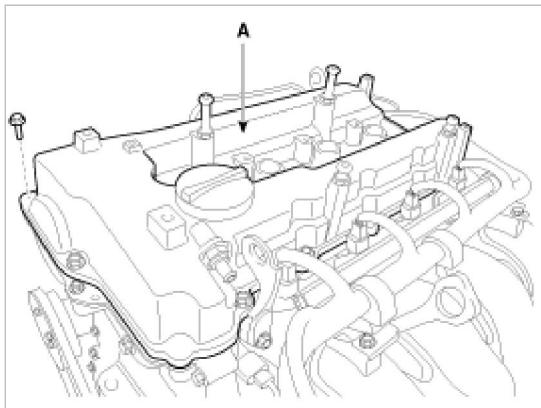


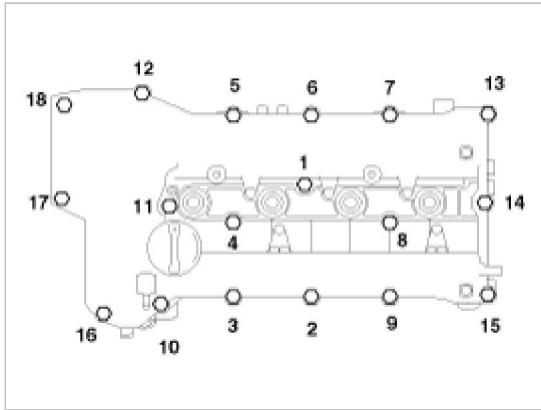
(3) Install the cylinder head cover (A) by tightening the bolts as following method.

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)

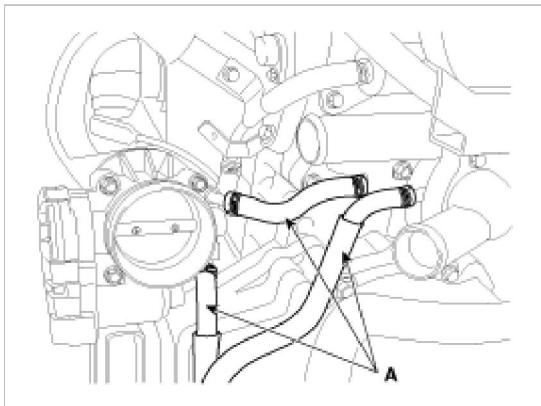




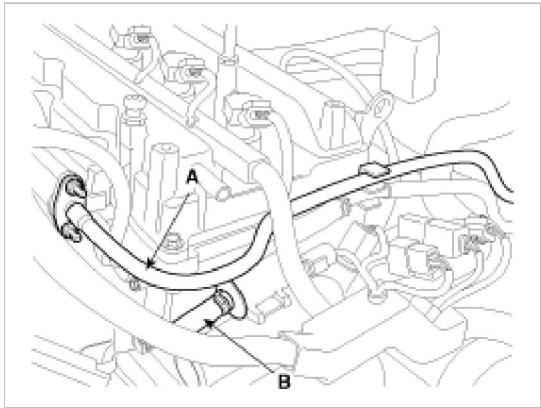
CAUTION

- 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.

16. Connect the water hoses (A). (if equipped)



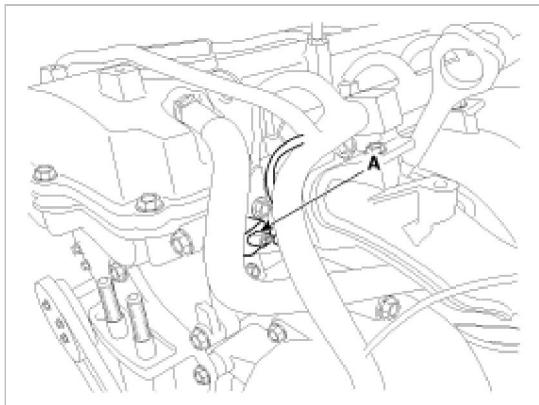
17. Connect the fuel hose (A) and the PCSV (Purge control solenoid valve) hose (B).



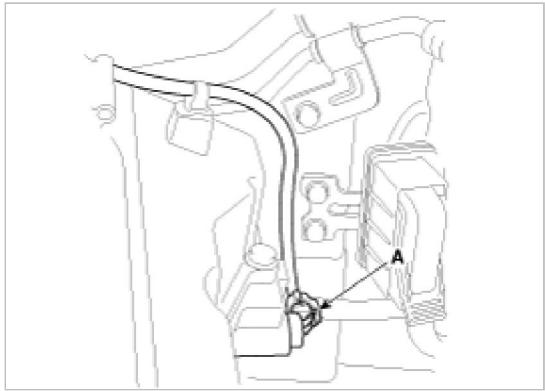
18. Connect the heater hoses. (Refer to Engine and transaxle assembly in this group)

19. Connect the wiring connectors and harness clamps, and install the wiring and protectors to the cylinder head and intake manifold.

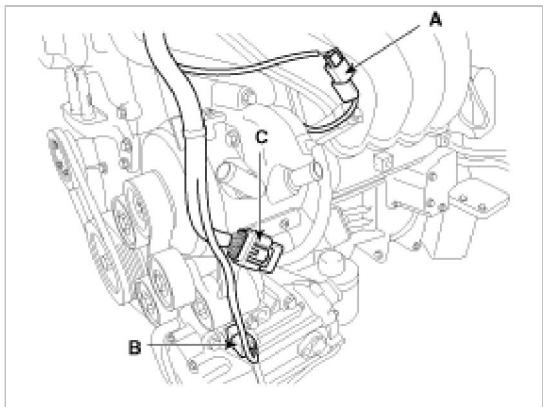
(1) The intake OCV (Oil control valve) connector (A)



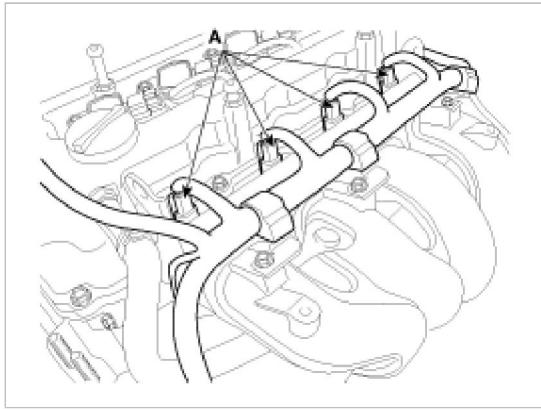
(2) The exhaust OCV (Oil control valve) connector (A)



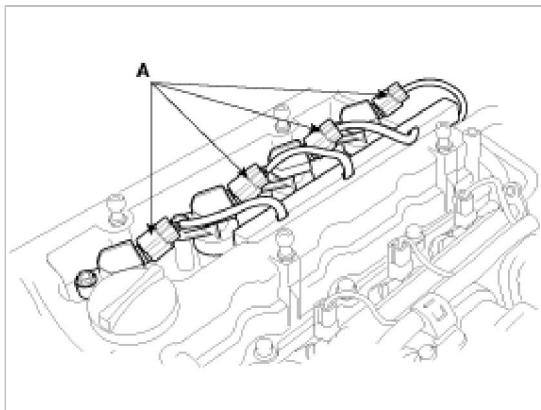
(3) The OPS (Oil pressure switch) connector (A), the A/C compressor switch connector (B) and the HSG (Hybrid searter generator) sensor connector (C)



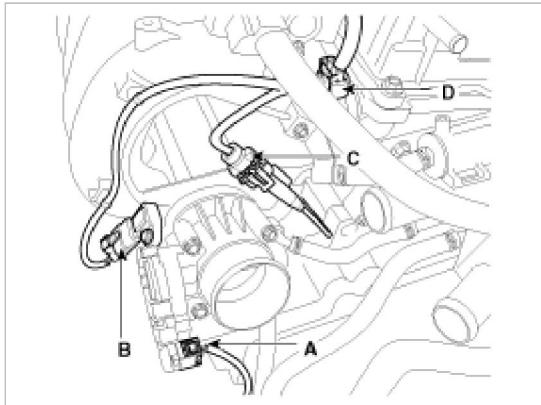
(4) The injector connectors (A)



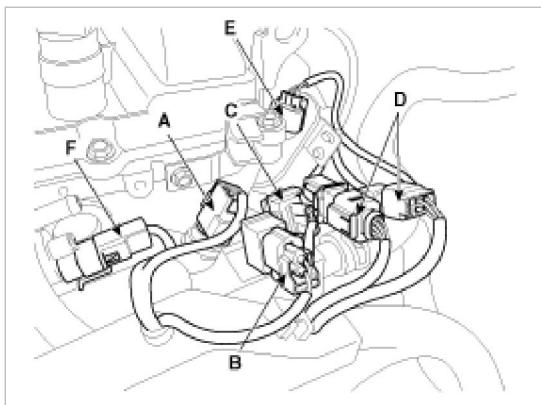
(5) The ignition coil connectors (A)



(6) The ETC (Electronic throttle control) connector (A), the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B), the knock sensor connector (C) and the intake CMPS (Camshaft position sensor) connector (D)



(7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the oxygen sensor connectors (D), the exhaust CMPS (Camshaft position sensor) connector (E) and the PCSV (Purge control solenoid valve) connector (F)



20. Connect the radiator upper hose and lower hose. (Refer to Cooling system in this group)
21. Install the RH front wheel. (Refer to SS group - "Wheel")
22. Install the under covers. (Refer to Engine and transaxle assembly in this group)
23. Install the air duct and the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
24. Install the engine cover.
25. Connect the battery negative terminal in the right side luggage trim. (Refer to Engine and transaxle assembly in this group)
26. Install the safety plug in the trunk. (Refer to Engine and transaxle assembly in this group)