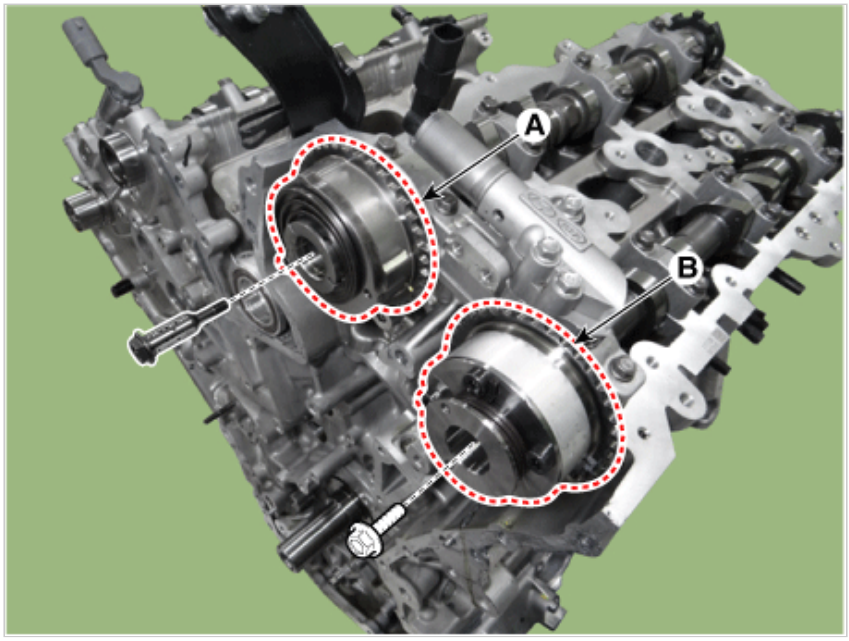
Removal

LH CVVT & Camshaft

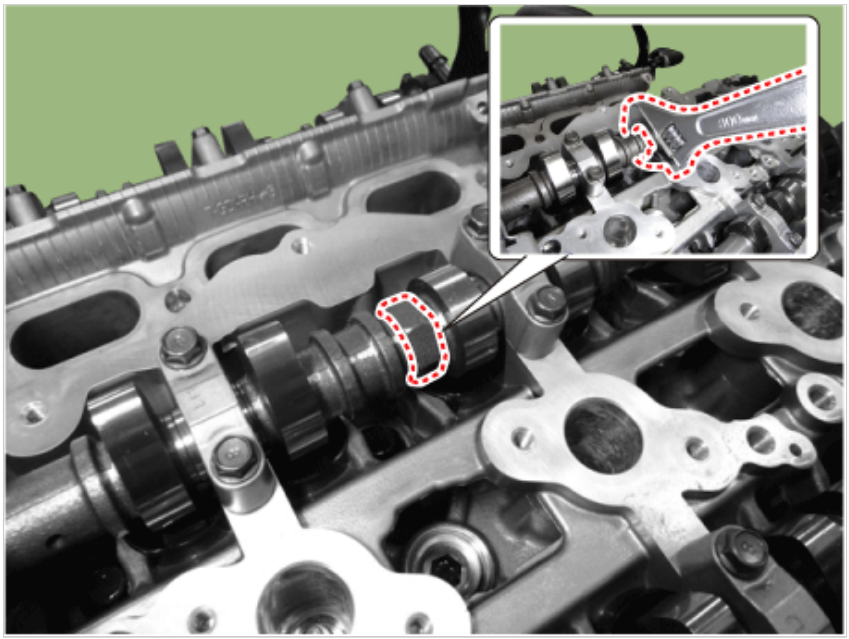
1. Remove the LH/RH Cylinder head cover.
   (Refer to Cylinder Head Assembly - "Cylinder Head Cover")
2. Remove the timing chain cover.
   (Refer to Timing System - "Timing Chain Cover")
3. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
4. Remove the LH intake CVVT assembly (A) and exhaust CVVT assembly (B).



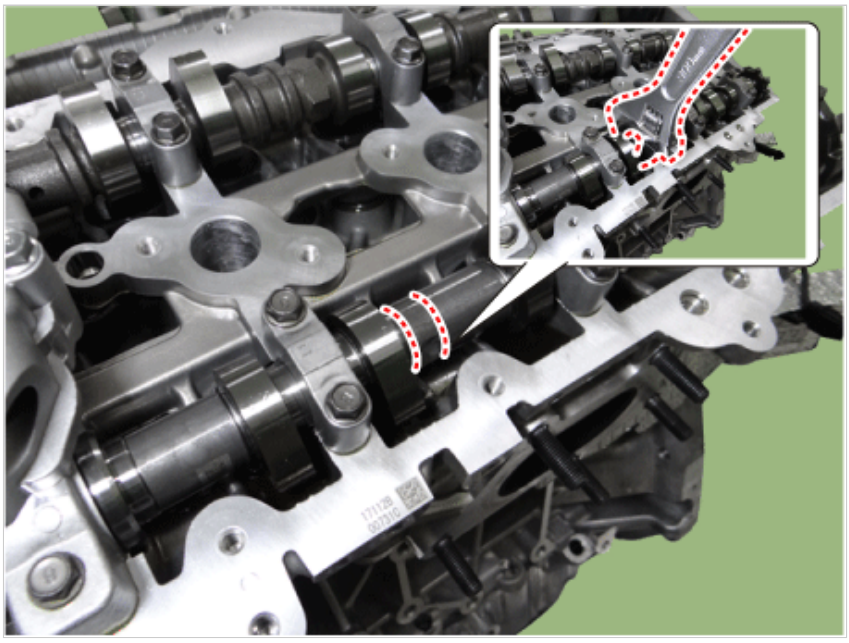
NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When removing the intake OCV & center bolt and exhaust CVVT bolt, place a wrench at position to prevent the camshaft from rotating.

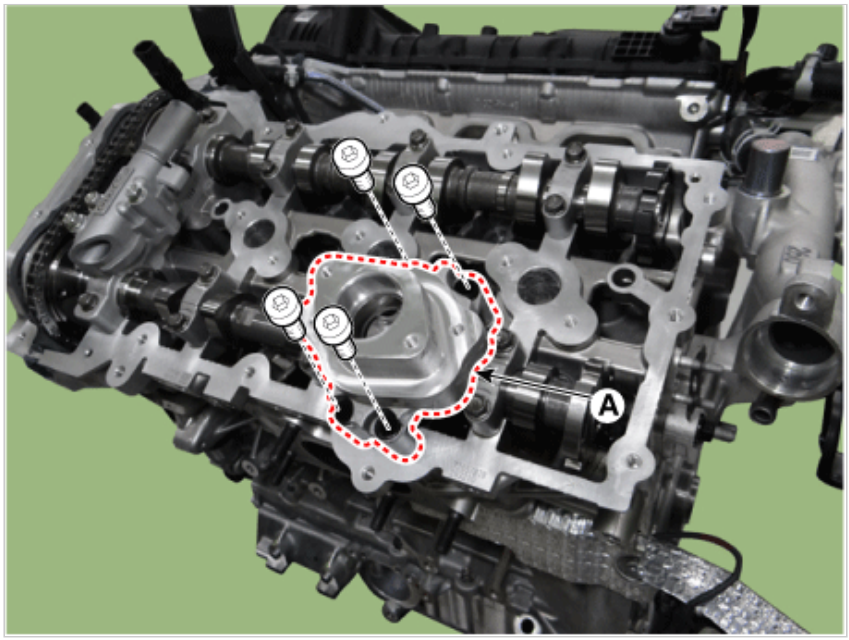
[Intake]



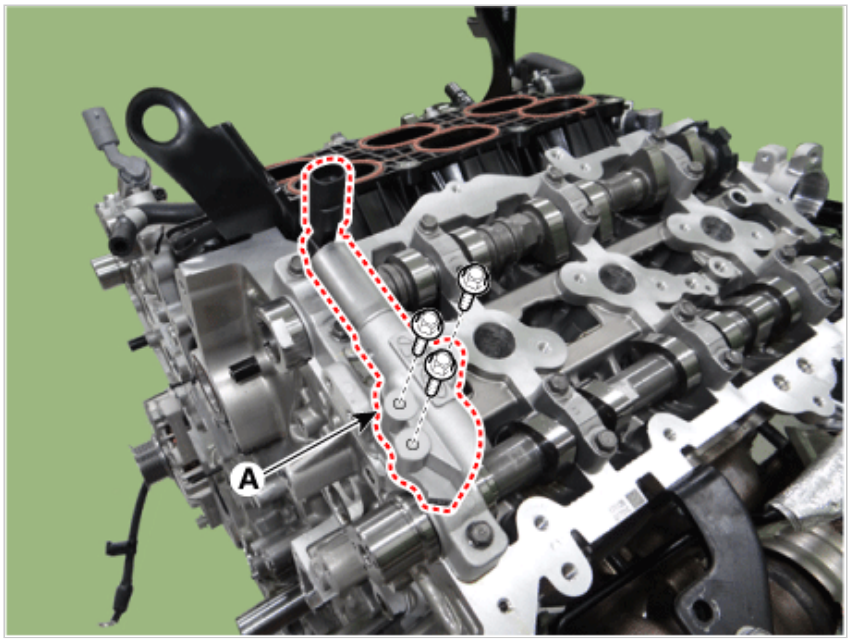
[Exhaust]



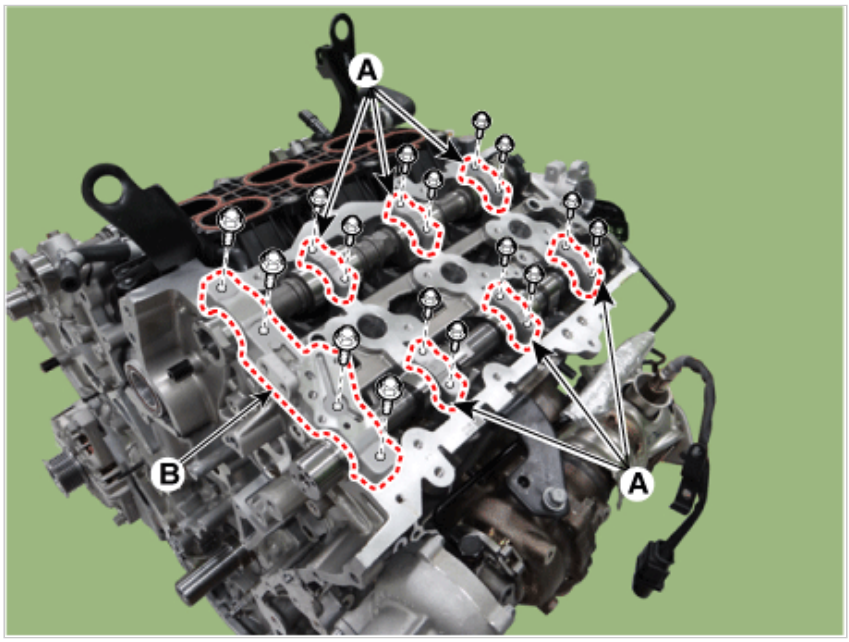
5. Remove the high pressure fuel pump bracket (A).



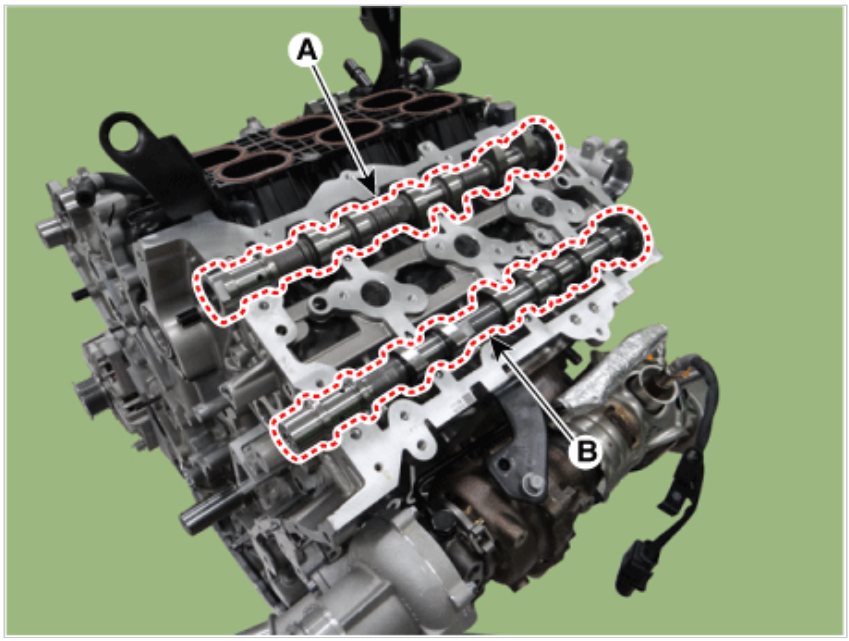
6. Remove the exhaust oil control valve (OCV) (A).



7. Remove the LH camshaft bearing cap (A) and thrust bearing cap (B).

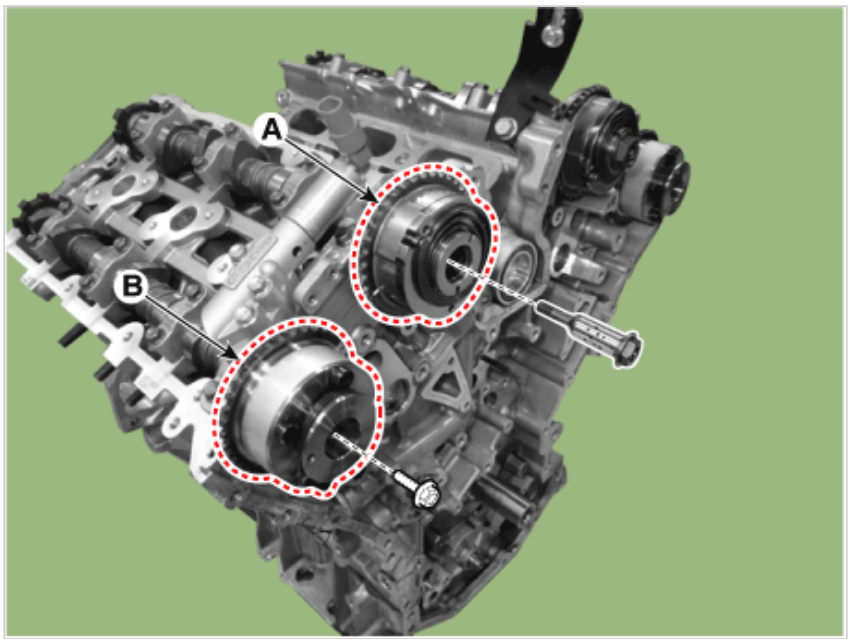


8. Remove the LH intake camshaft (A) and exhaust camshaft (B).



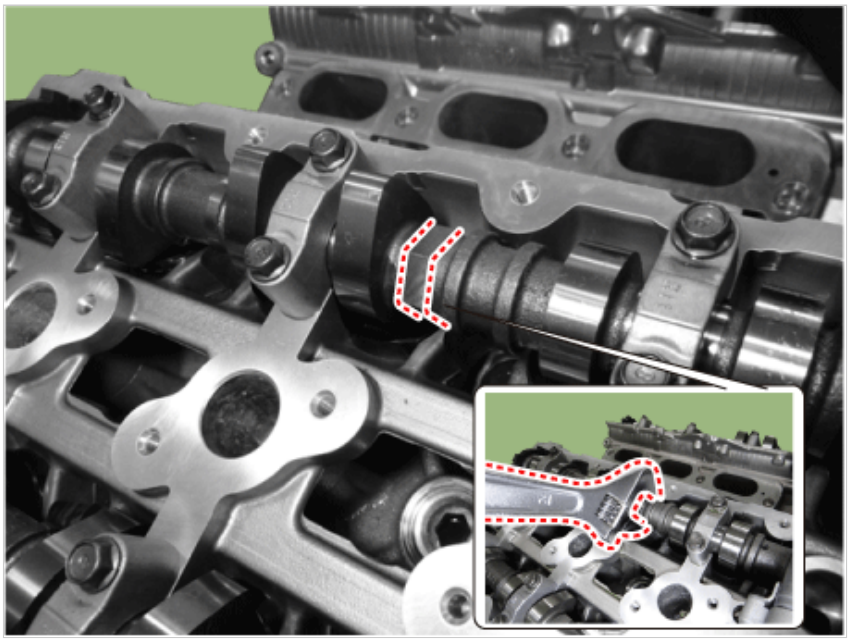
RH CVVT & Camshaft

1. Remove the LH/RH Cylinder head cover.
   (Refer to Cylinder Head Assembly - "Cylinder Head Cover")
2. Remove the timing chain cover.
   (Refer to Timing System - "Timing Chain Cover")
3. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
4. Remove the RH intake CVVT assembly (A) and exhaust CVVT assembly (B).

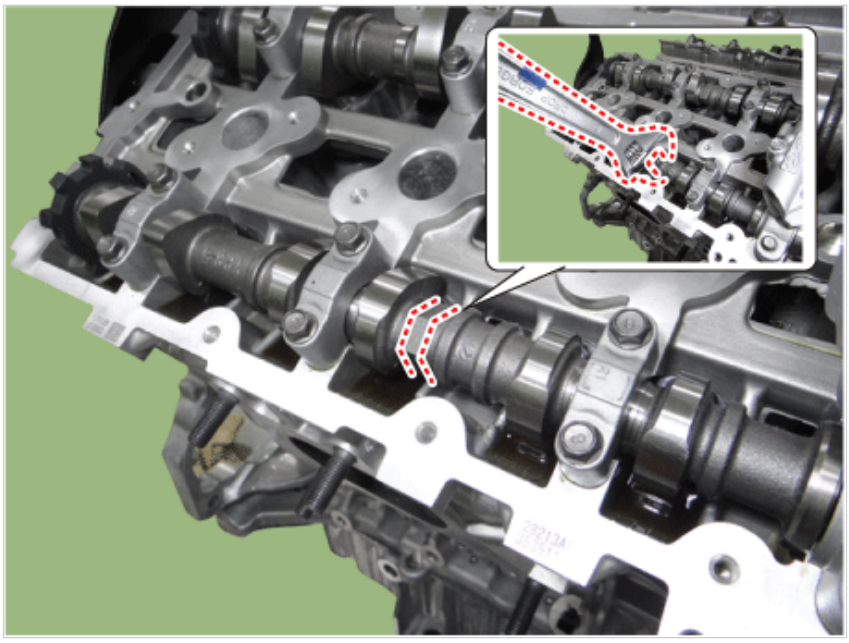


NOTICE

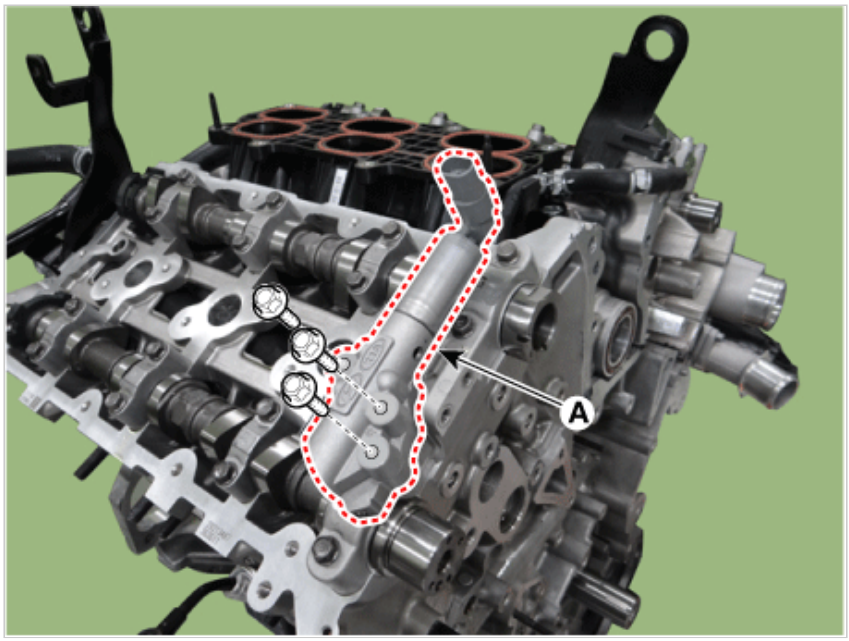
- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When removing the intake OCV & center bolt and exhaust CVVT bolt, place a wrench at position to prevent the camshaft from rotating.
  [Intake]



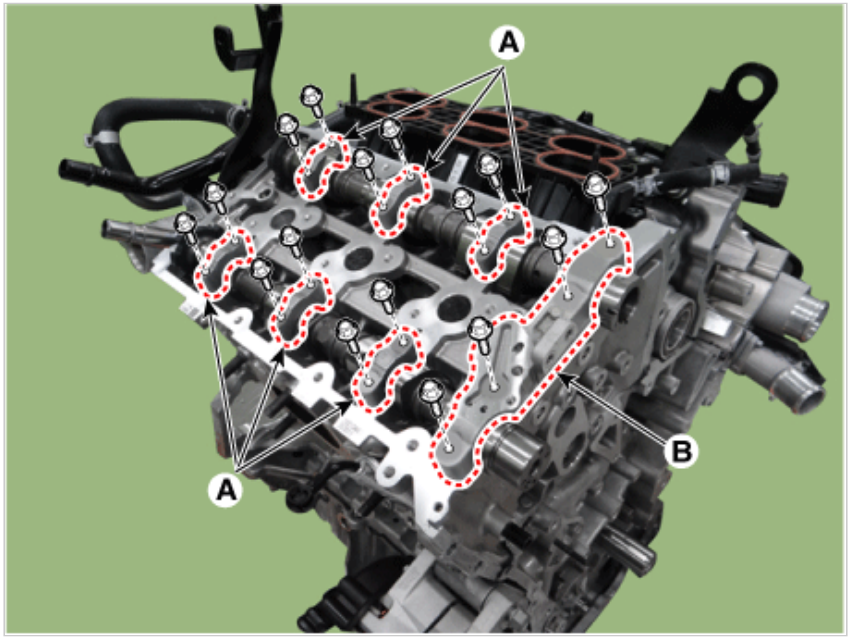
[Exhaust]



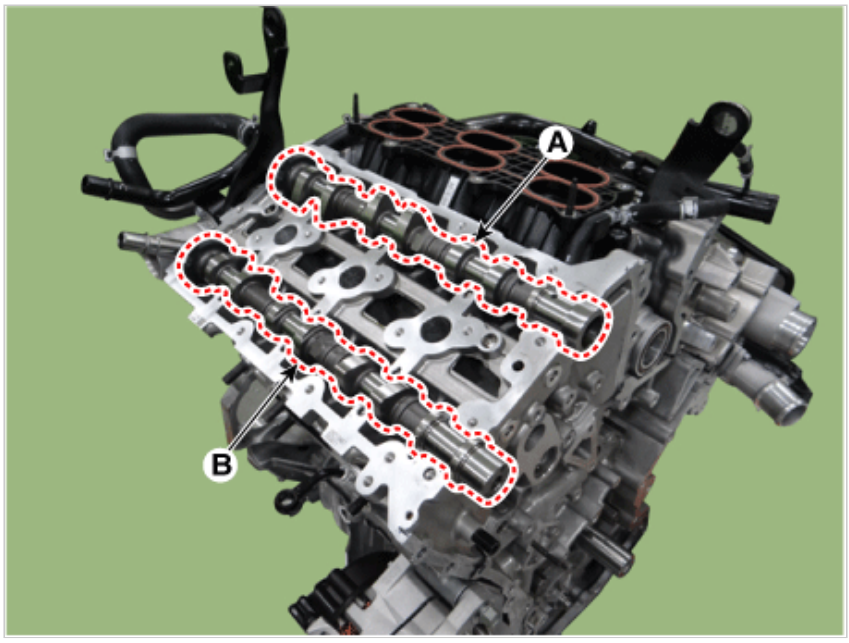
5. Remove the exhaust oil control valve (OCV) (A).



6. Remove the RH camshaft bearing cap (A) and thrust bearing cap (B).



7. Remove the RH intake camshaft (A) and exhaust camshaft (B).

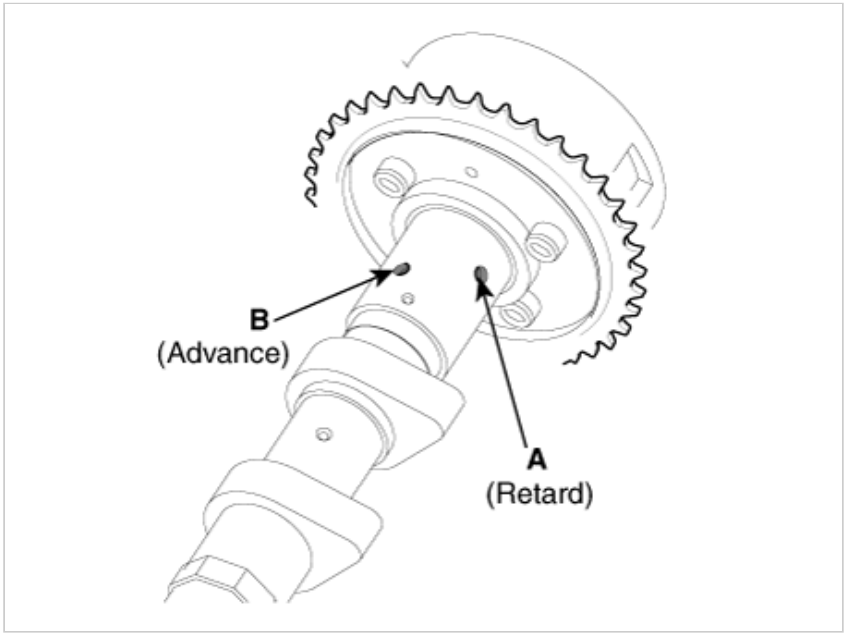


Inspection

Continuous Variable Valve Timing (CVVT) Assembly

1. Inspect the exhaust CVVT for smooth rotation.
   (1) Clamp the camshaft using a vise. Be careful not to damage the cam lobes and journals in the vise.
   (2) Check that the exhaust CVVT is locked by turning it clockwise or counterclockwise. It must not rotate.
   (3) Intake CVVT : Seal one of the two advance holes in the camshaft journal with tape.
   Exhaust CVVT : Seal one of the two retard holes in the camshaft journal with tape.

[Exhaust]

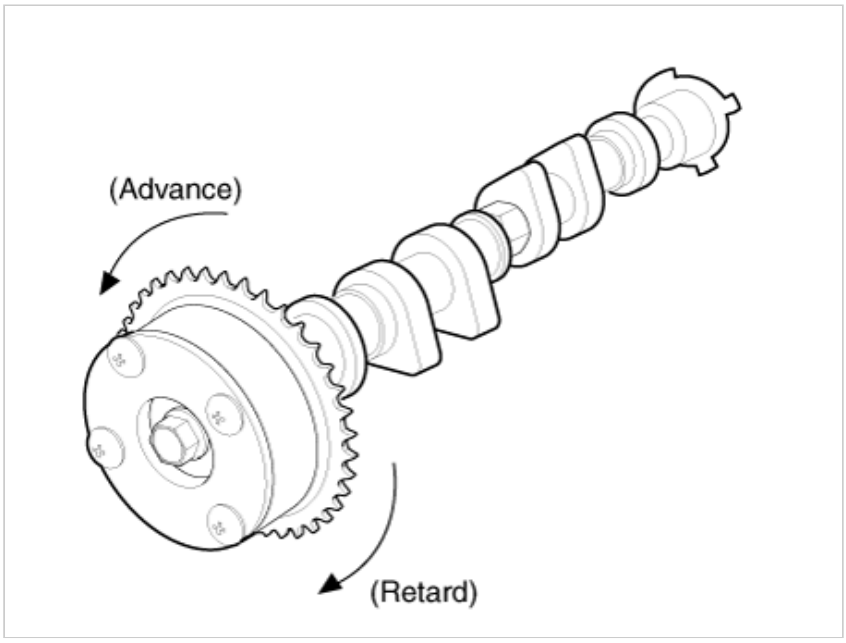


   (4) Exhaust CVVT : Apply approx. 150 kPa (1.5 kgf/cm², 21 psi) of compressed air into the unsealed retard hole to release the lock.

> **Information**
> Cover the oil paths with a piece of cloth when applying compressed air to prevent oil from spraying.

   (5) With compressed air applied, rotate the exhaust CVVT into the retard direction (clockwise) and check that the CVVT turns smoothly.

Exhaust CVVT phasing range
25°± 0°30’ (from the most advanced position to the most retarded position)

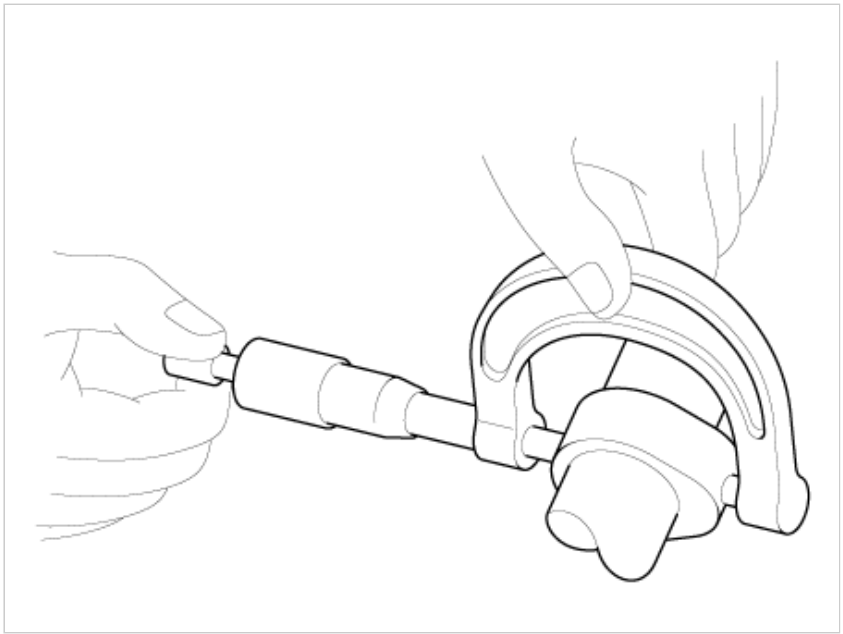


(6) Rotate the exhaust CVVT into the most advanced position (counterclockwise) and then check that the CVVT is locked.

Camshaft

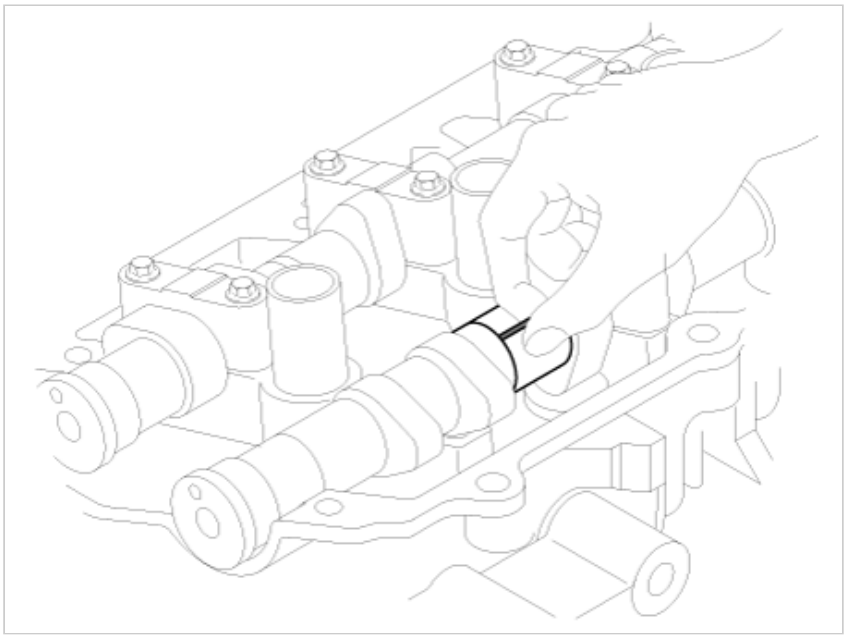
1. Inspect cam lobes.
   Using a micrometer, measure the cam lobe height.

   Cam height
   LH, RH cam height
   Intake :47.20 mm (1.8582 in.)
   Exhaust :45.40 mm (1.7875 in.)



   If the cam lobe height is below specification, replace the camshaft.

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



(4) Install the bearing cap and thrust bearing cap to the specified torque.

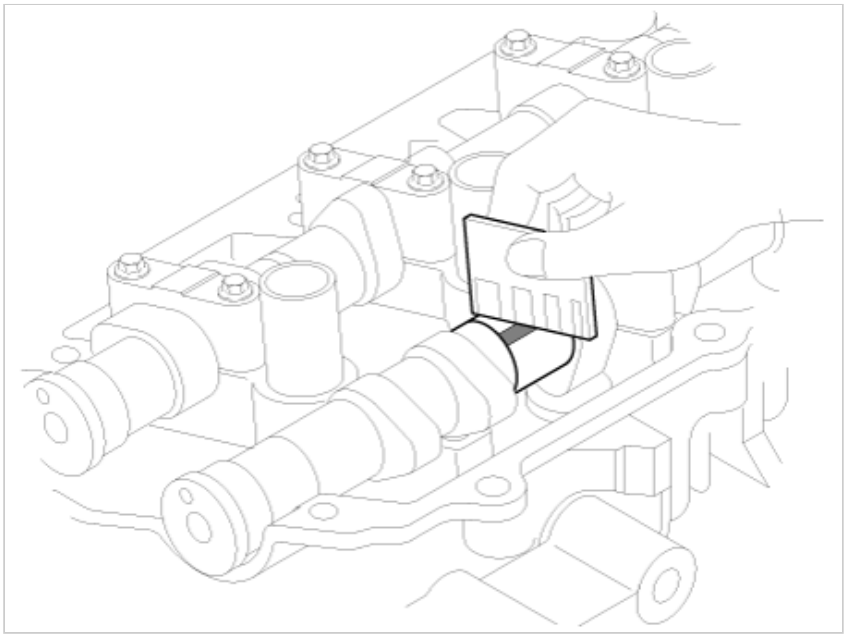
Tightening torque :
1st step : 5.8 N·m (0.6 kgf·m, 4.3 lb·ft)
2nd step : 9.8 - 11.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)

NOTICE
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 : 0.037 - 0.067 mm (0.0015 - 0.0026 in.)
No.2,3,4 journal : 0.030 - 0.058 mm (0.0012 - 0.0023 in.)
Exhaust
No.1 journal : 0.028 - 0.058 mm (0.0011 - 0.0023 in.)
No.2,3,4 journal : 0.030 - 0.058 mm (0.0012 - 0.0023 in.)



- If the oil clearance is greater than specification, replace the camshaft.
- If the oil clearance is still over the specification after replacing the camshaft, replace the bearing caps and cylinder head as an assembly.

(7) Completely remove the plastigage.

(8) Remove the camshafts.

3. Inspect the camshaft end play.

(1) Install the camshafts.

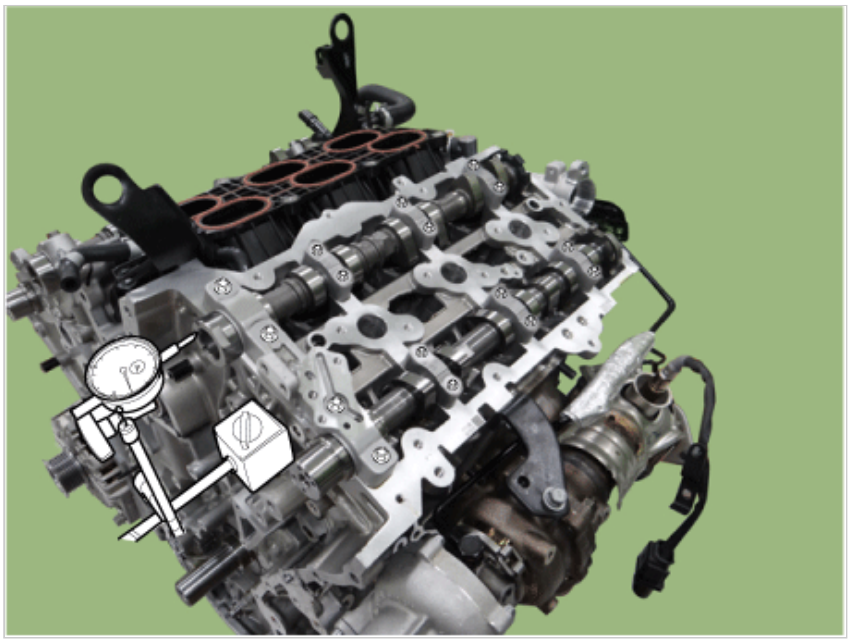
(2) Install the bearing cap and thrust bearing cap to the specified torque.

Tightening torque :
1st step : 5.8 N·m (0.6 kgf·m, 4.31 lb·ft)
2st step : 9.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)

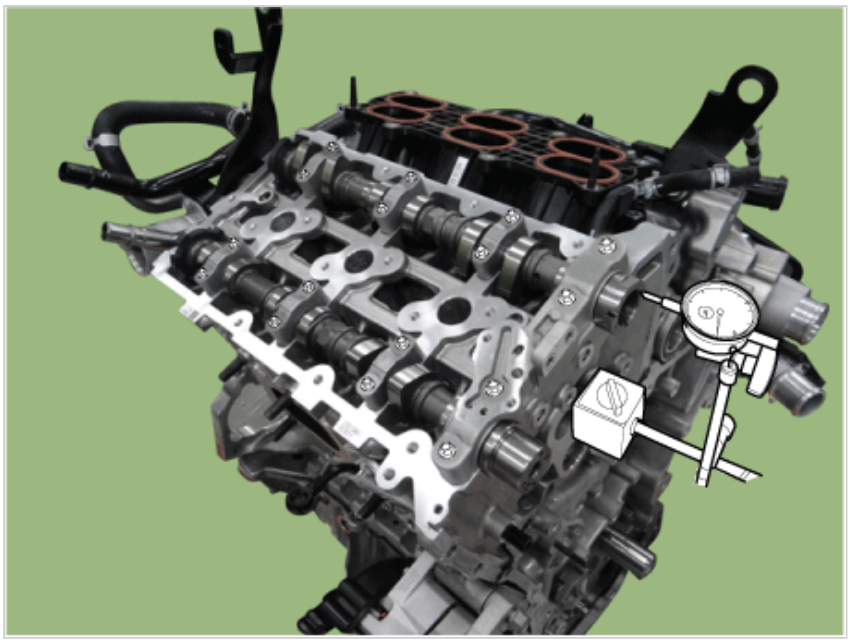
(3) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play
[Standard value] :
Intake : 0.04 - 0.18 mm (0.0016 - 0.0071 in.)
Exhaust : 0.02 - 0.18 mm (0.0008 - 0.0071 in.)

[LH]



[RH]



- If the end play is greater than specification, replace the camshaft.
- If the end play is still over the specification after replacing the camshaft, replace the bearing caps and cylinder head as an assembly.

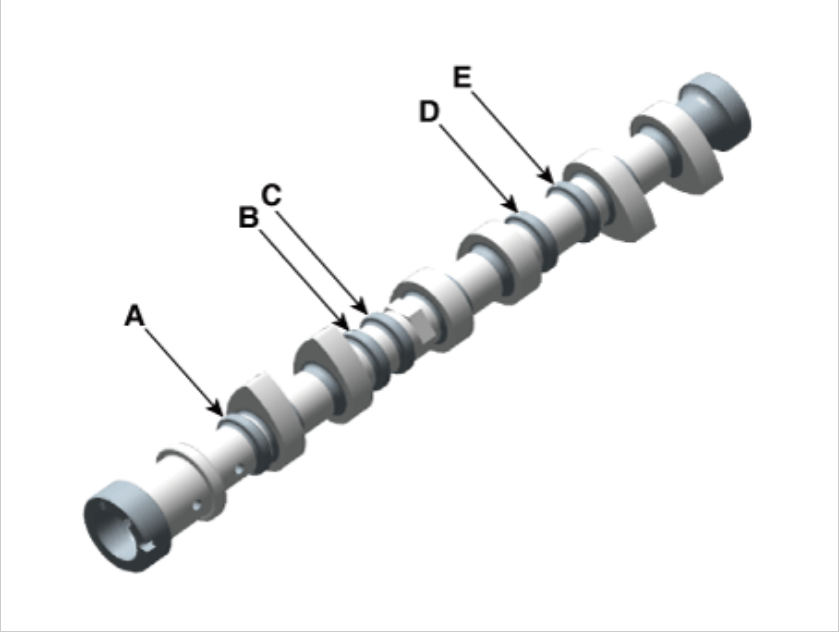
(4) Remove the camshafts.

Installation

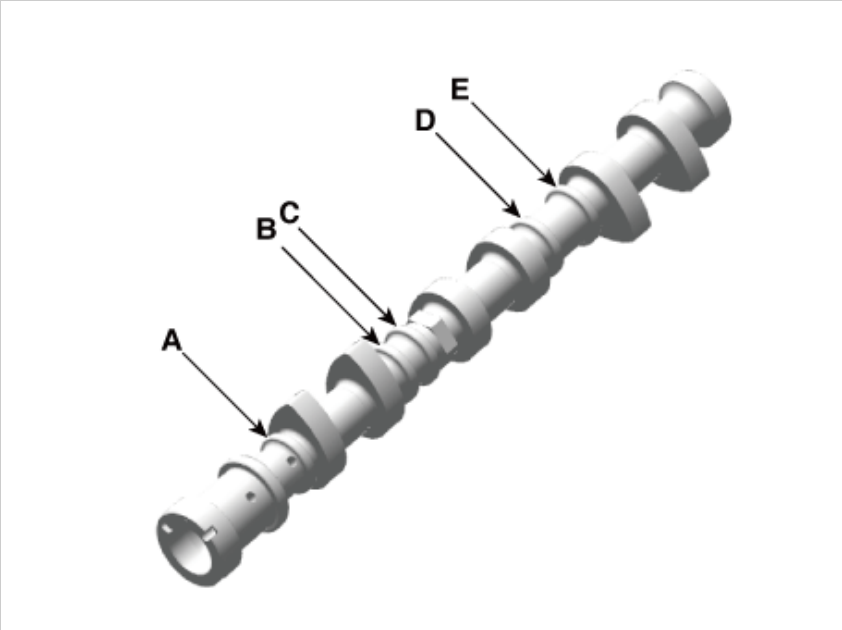
NOTICE

- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

LH intake camshaft



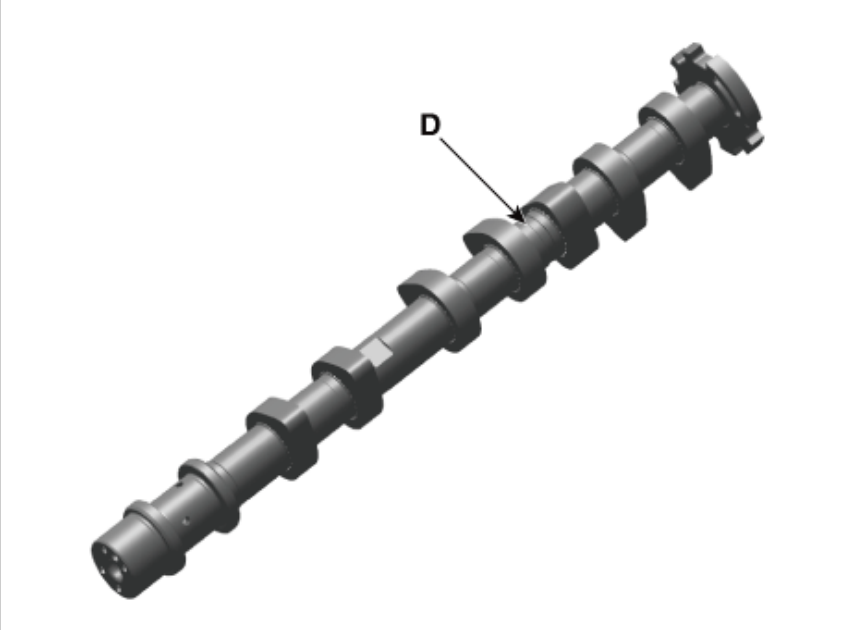
RH intake camshaft



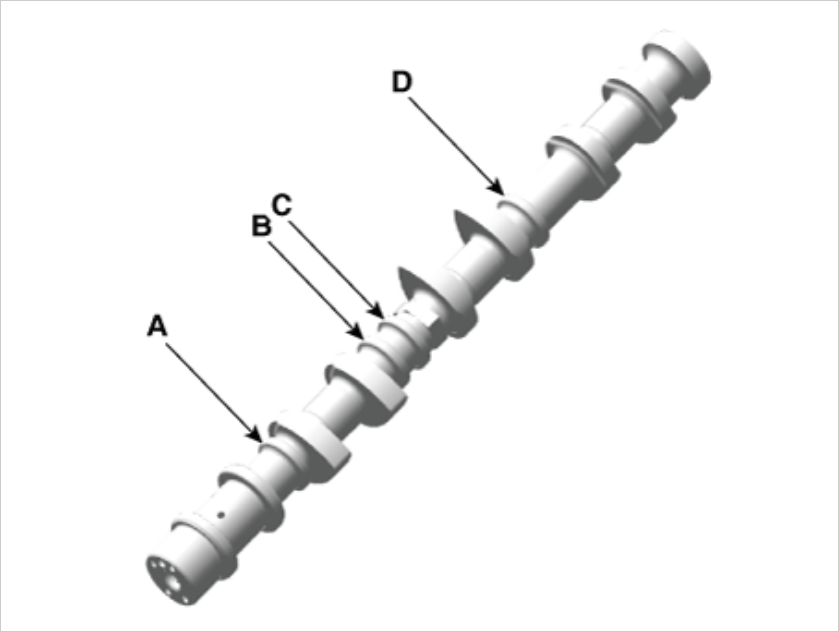
As for camshaft identification (A, B, C, D, E), refer to the table below.

Outer diameter	
LH	**RH**
A : 30 mm (1.1811 in.)	A : 30 mm (1.1811 in.)
B : 30 mm (1.1811 in.)	B : 30 mm (1.1811 in.)
C : 30 mm (1.1811 in.)	C : 30 mm (1.1811 in.)
D : 30 mm (1.1811 in.)	D : 27 mm (1.0630 in.)
E : 27 mm (1.0630 in.)	E : 30 mm (1.1811 in.)

LH exhaust camshaft



RH exhaust camshaft

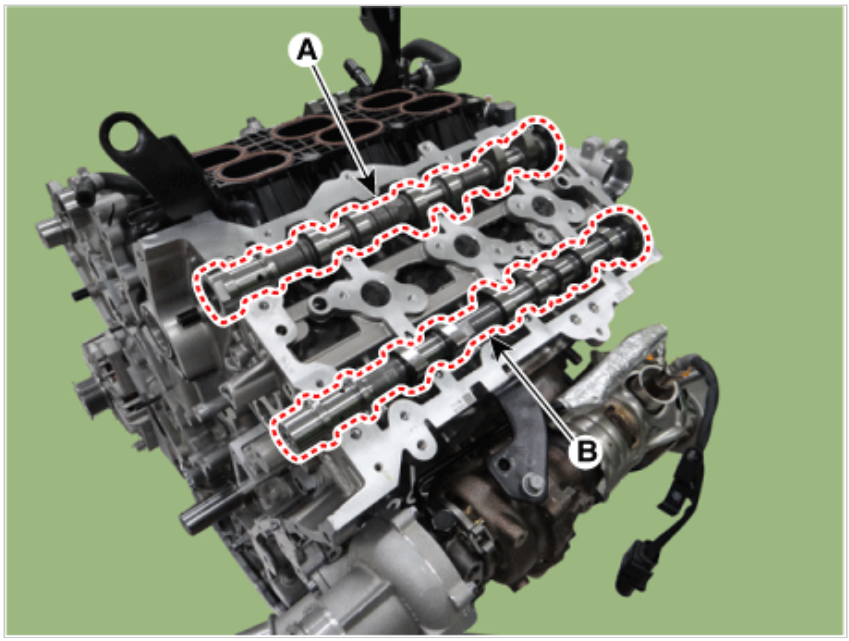


As for camshaft identification (A, B, C, D), refer to the table below.

Outer diameter	
LH	**RH**
A : -	A : 30 mm (1.1811 in.)
B : -	B : 30 mm (1.1811 in.)
C : -	C : 30 mm (1.1811 in.)
D : 24 mm (0.9449 in.)	D : 30 mm (1.1811 in.)

LH CVVT & Camshaft

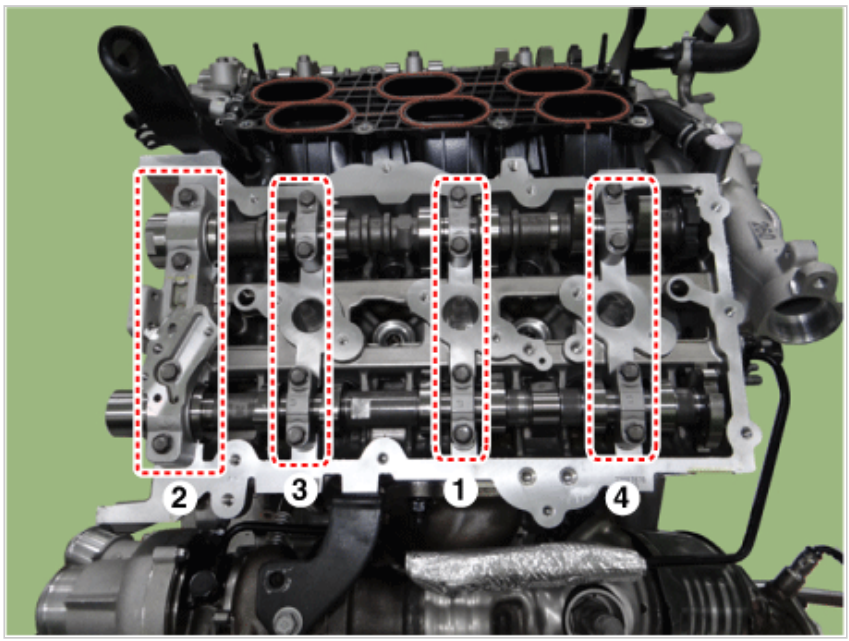
1. Install the LH intake camshaft (A) and exhaust camshaft (B).



2. Install the LH camshaft bearing cap and thrust bearing cap with specified torque.

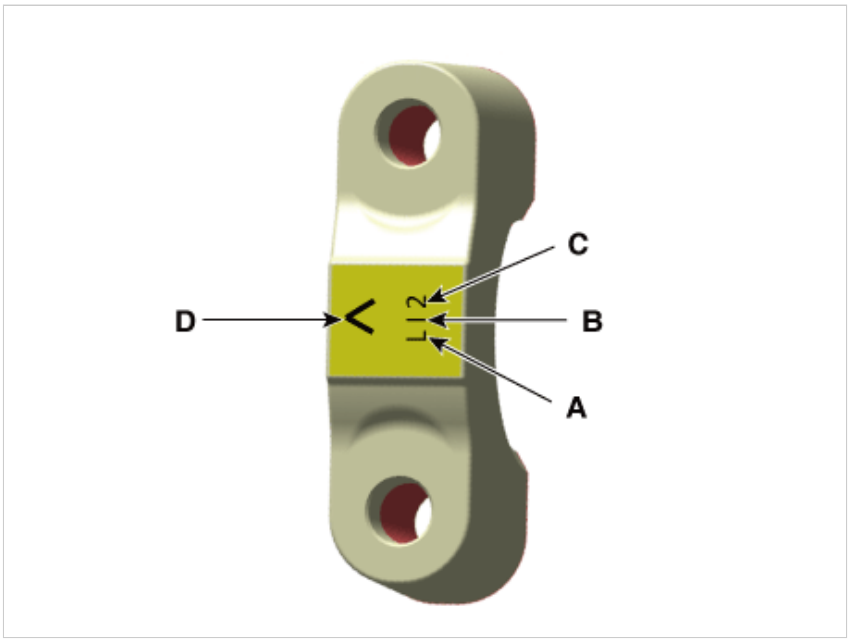
Tightening torque

1st step :
5.8 N·m (0.6 kgf·m, 4.3 lb·ft, 52.1 lb·in)
2nd step :
9.8 - 11.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)



NOTICE

- Be sure to install the thrust bearing cap bolts and the bearing cap bolts in the correct place.
- Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

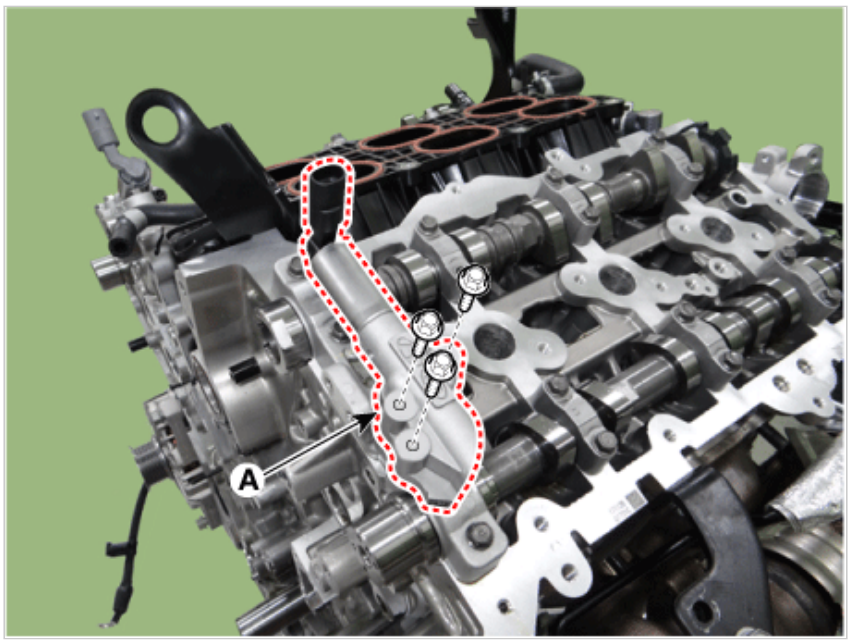


A : L (LH), R (RH)
B : I (Intake), - (Exhaust)
C : Journal number (1,2,3)
D : Front mark

- Rotate the crankshaft until the pistons are located 10mm (0.3937in.) below the top of cylinder block so that it doesn"t come into contact with the valves.

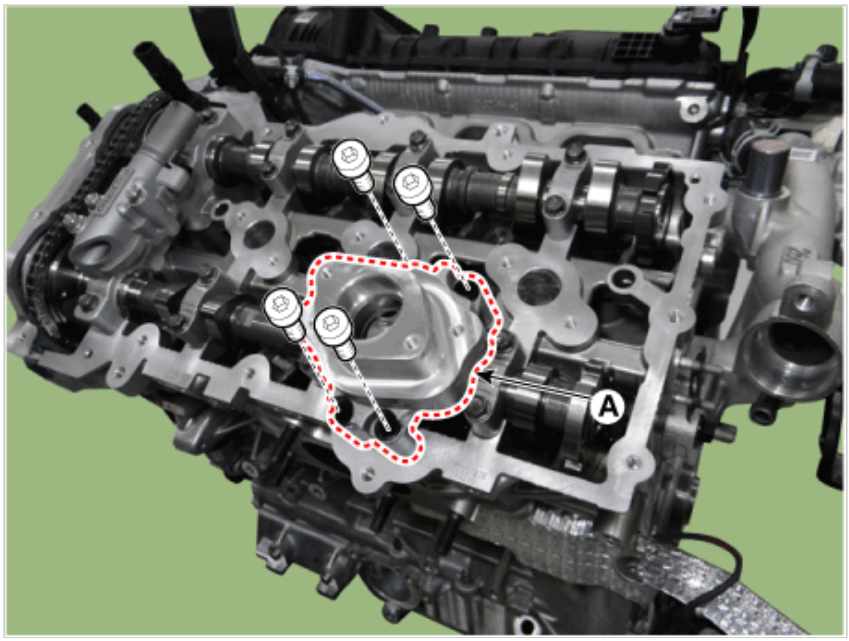
3. Install the exhaust oil control valve (OCV) (A).

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



4. Install the high pressure fuel pump bracket (A).

Tightening torque :
18.6 - 23.5 N·m (1.9 - 2.4 kgf·m, 13.7 - 17.4 lb·ft)



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

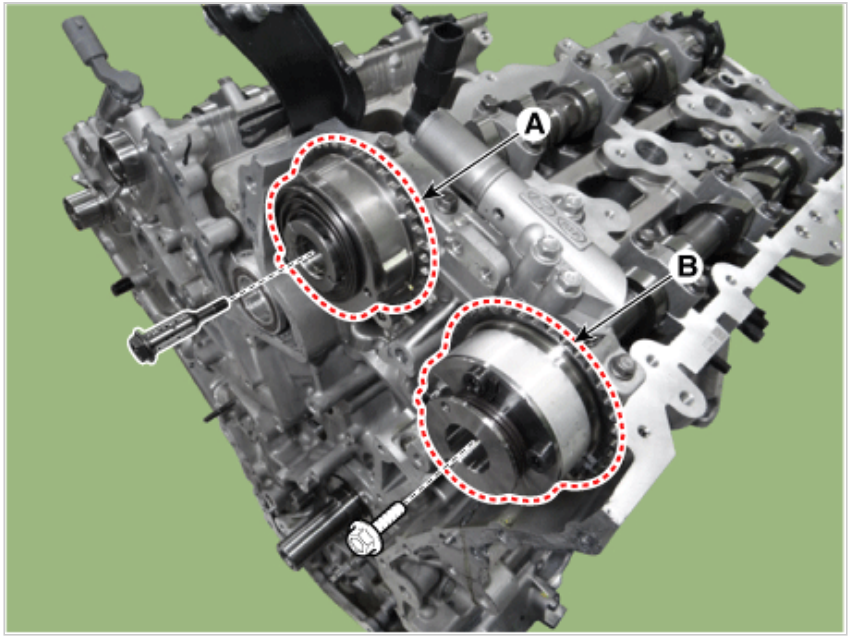
Tightening torque

Intake :

24.5 N·m (2.5 kgf·m, 18.1 lb·ft) + 55 - 61°

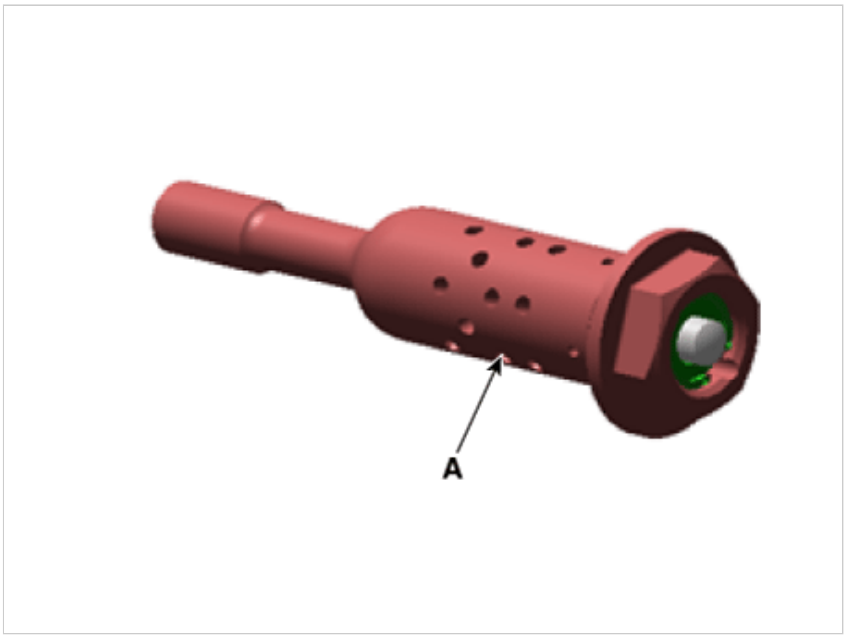
Exhaust :

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



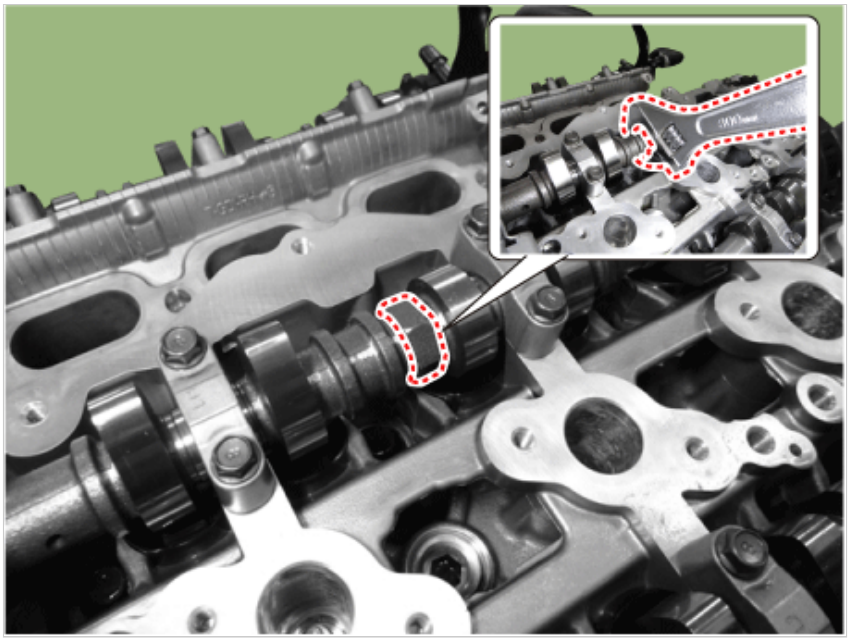
NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When installing intake OCV & center bolt, temporarily install by hand, and then fully install by using a tool.
- When installing intake OCV & center bolt, install to the specified tightening torque.
- Do not use any dropped intake OCV & center bolt.
- When installing intake CVVT, apply engine oil on cross section (A) of OCV.

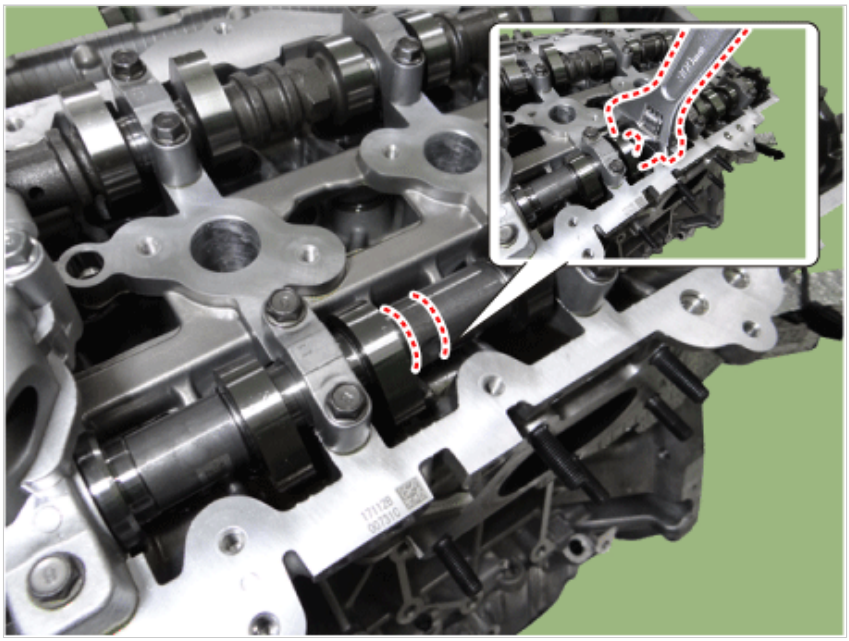


- When installing CVVT assembly bolt, hold section of camshaft with a wrench.

[Intake]



[Exhaust]

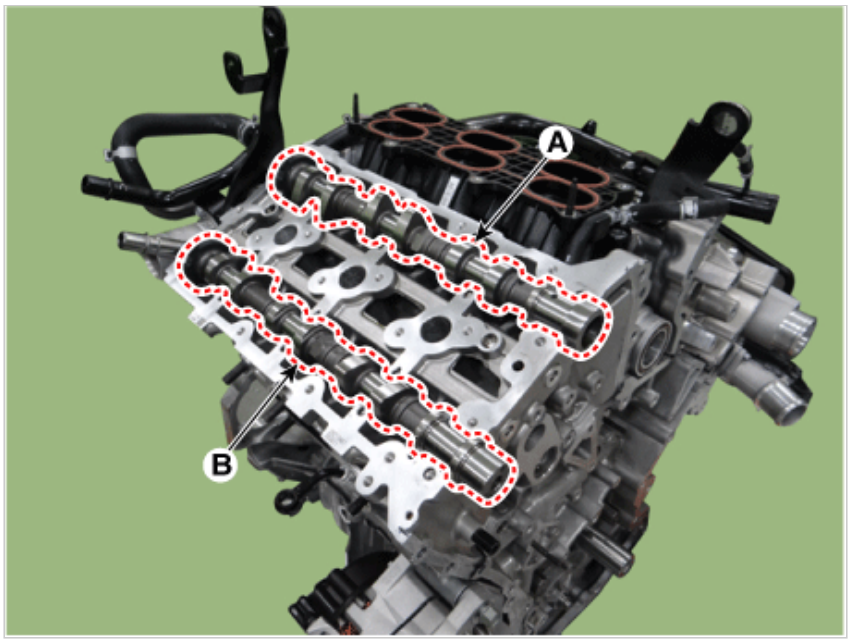


- Be careful not to damage cylinder head and camshaft.
- Install camshaft-inlet to dowel pin of CVVT assembly.
  When doing this, be careful not to install on the oil hole of camshaft-inlet.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when installing the camshaft to the dowel pin of CVVT assembly.

6. Install in the reverse order of removal.

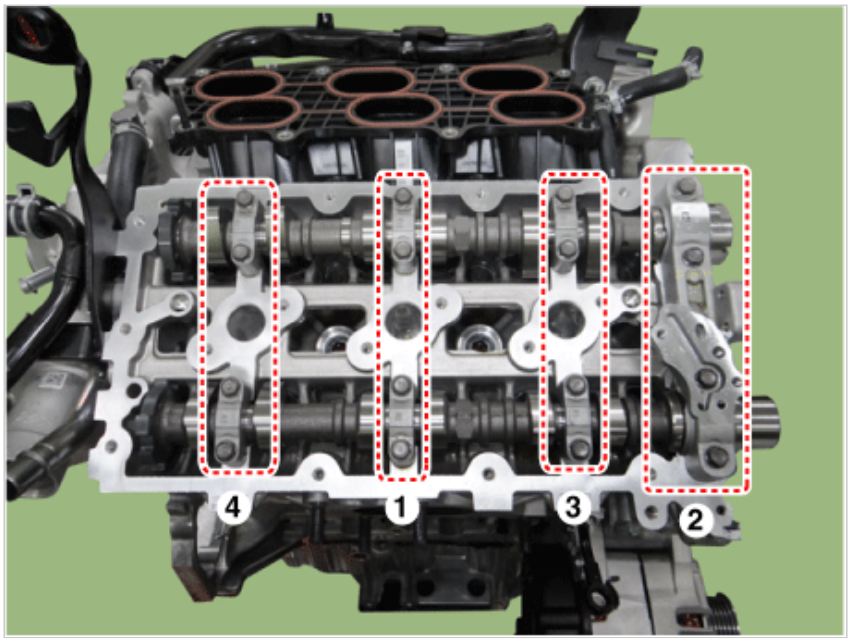
RH CVVT & Camshaft

1. Install the RH intake camshaft (A) and exhaust camshaft (B).



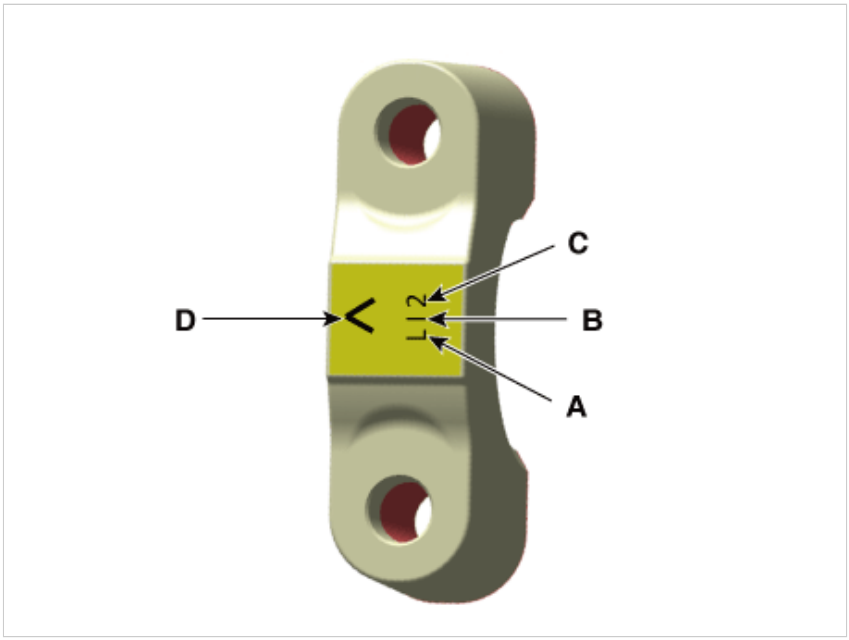
2. Install the RH camshaft bearing cap and thrust bearing cap to the specified torque.

Tightening torque
1st step :
5.8 N·m (0.6 kgf·m, 4.3 lb·ft, 52.1 lb·in)
2nd step :
9.8 - 11.8 N·m (1.0 - 1.2 kgf·m, 7.2 - 8.7 lb·ft)



NOTICE

- Be sure to install the thrust bearing cap bolts and the bearing cap bolts in the correct place.
- Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

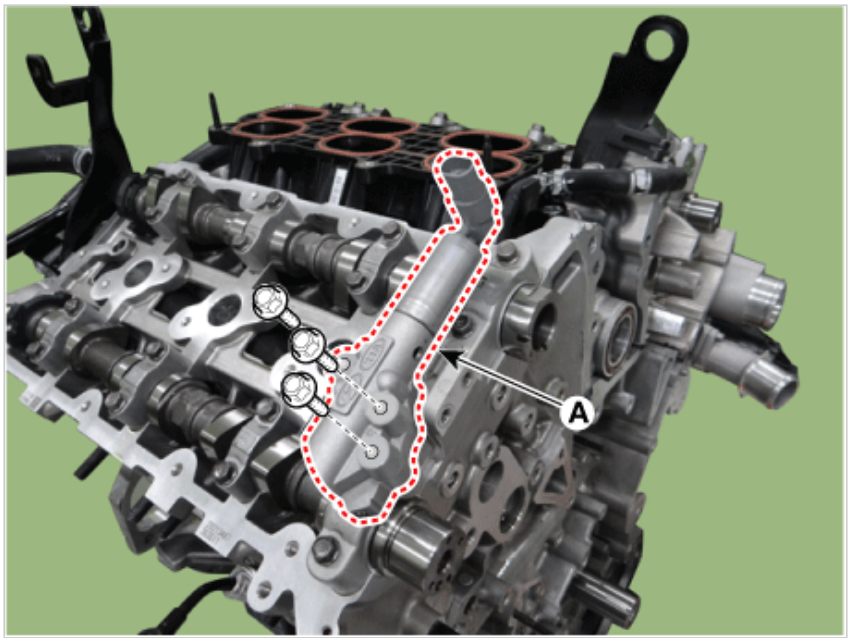


A : L (LH), R (RH)
B : I (Intake), - (Exhaust)
C : Journal number (1,2,3)
D : Front mark

- Rotate the crankshaft until the pistons are located 10mm (0.3937in.) below the top of cylinder block so that it doesn"t come into contact with the valves.

3. Install the exhaust oil control valve (OCV) (A).

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

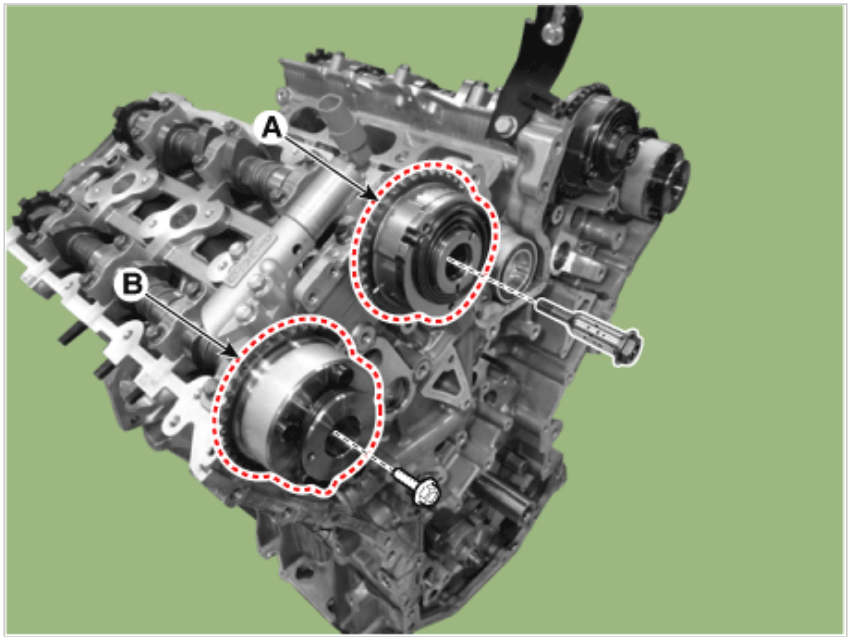


4. Install the RH intake CVVT assembly (A) and exhaust CVVT assembly (B).

Tightening torque

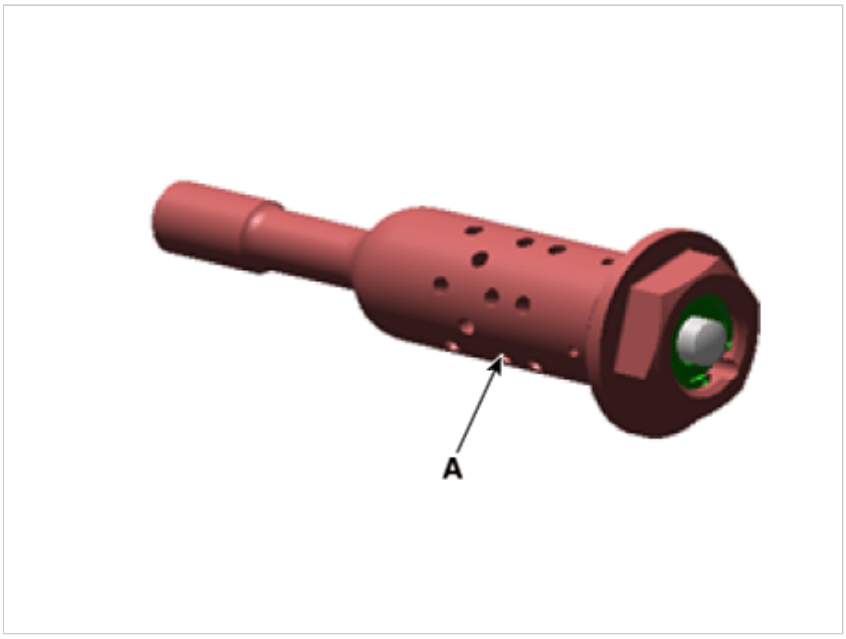
Intake : 24.5 N·m (2.5 kgf·m, 18.1 lb·ft) + 55 - 61°

Exhaust : 64.7 - 76.5 N·m (6.6 - 7.8 kgf·m, 47.7 - 56.4 lb·ft)



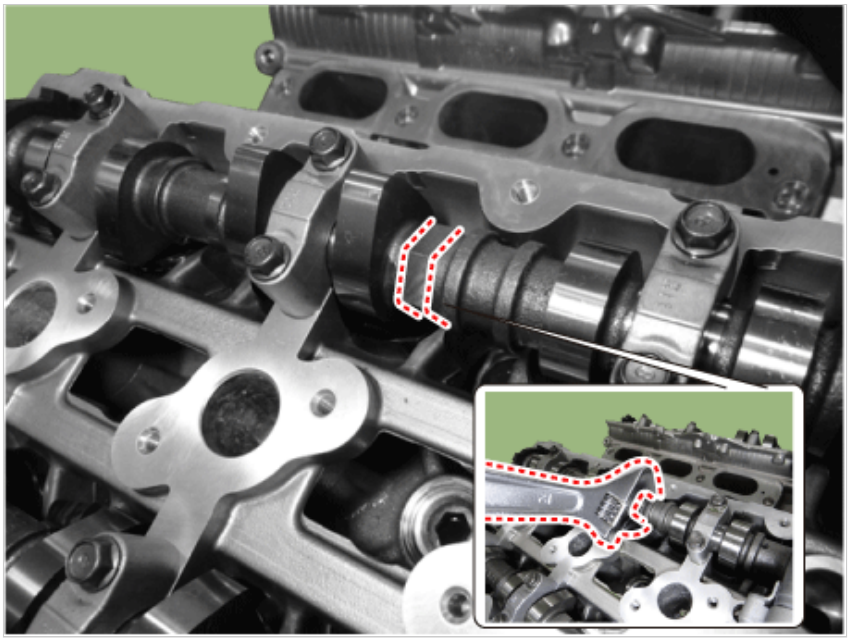
NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When installing intake OCV & center bolt, temporarily install by hand, and then fully install by using a tool.
- When installing intake OCV & center bolt, install to the specified tightening torque.
- Do not use any dropped intake OCV & center bolt.
- When installing intake CVVT, apply engine oil on cross section (A) of OCV.

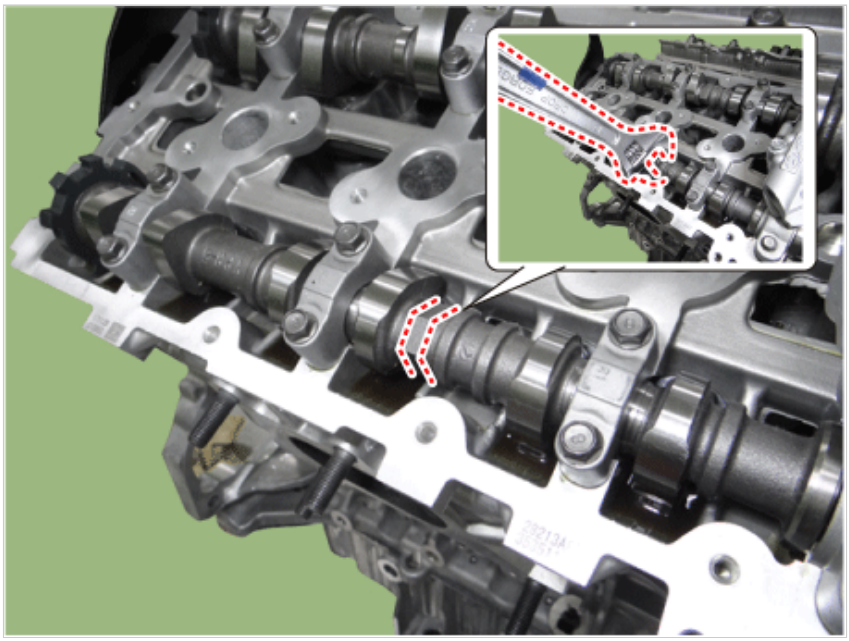


- When installing CVVT assembly bolt, hold section of camshaft with a wrench.

[Intake]



[Exhaust]



- Be careful not to damage cylinder head and camshaft.
- Install camshaft-inlet to dowel pin of CVVT assembly.
  When doing this, be careful not to install on the oil hole of camshaft-inlet.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when installing the camshaft to the dowel pin of CVVT assembly.

5. Install in the reverse order of removal.