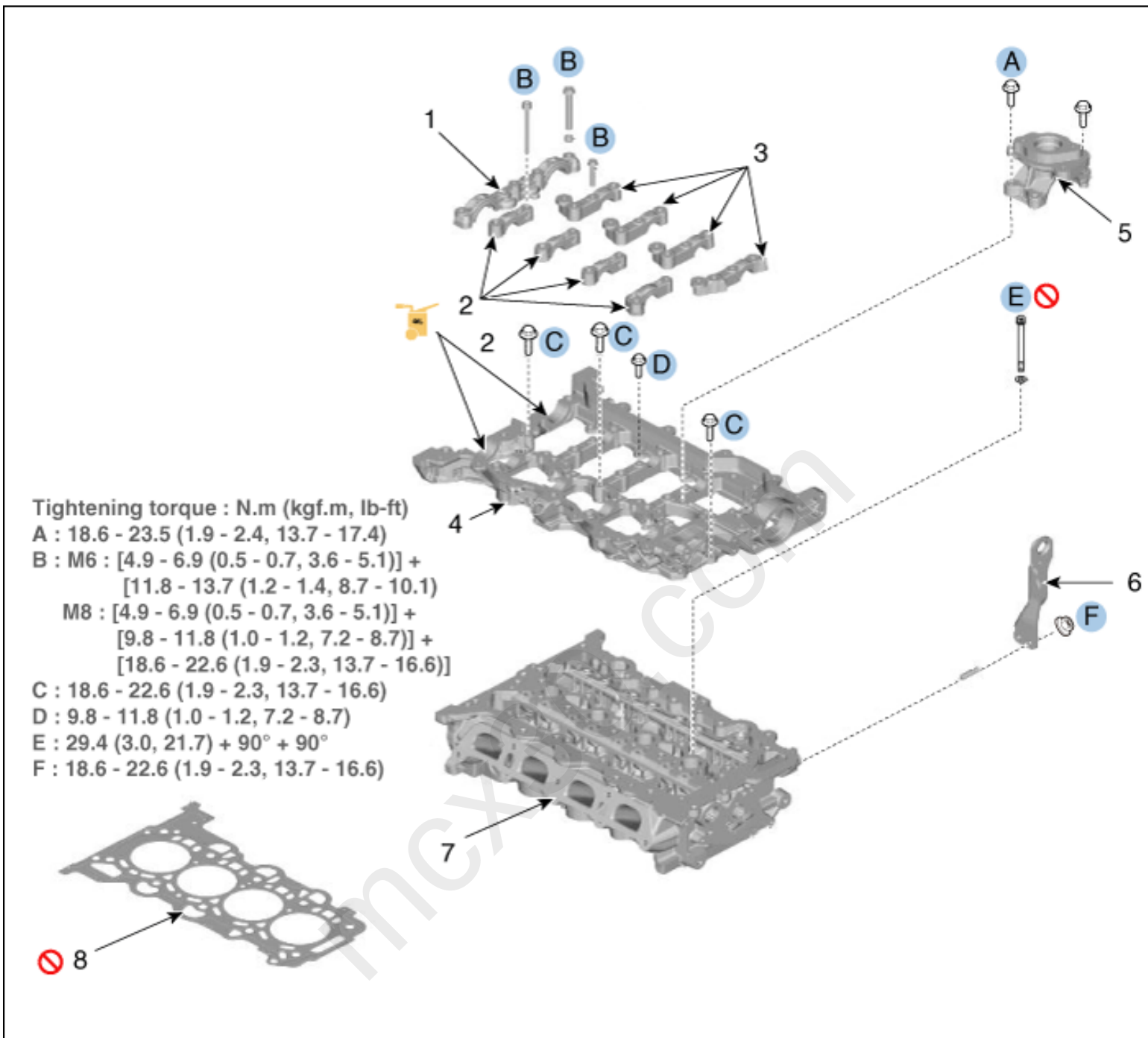
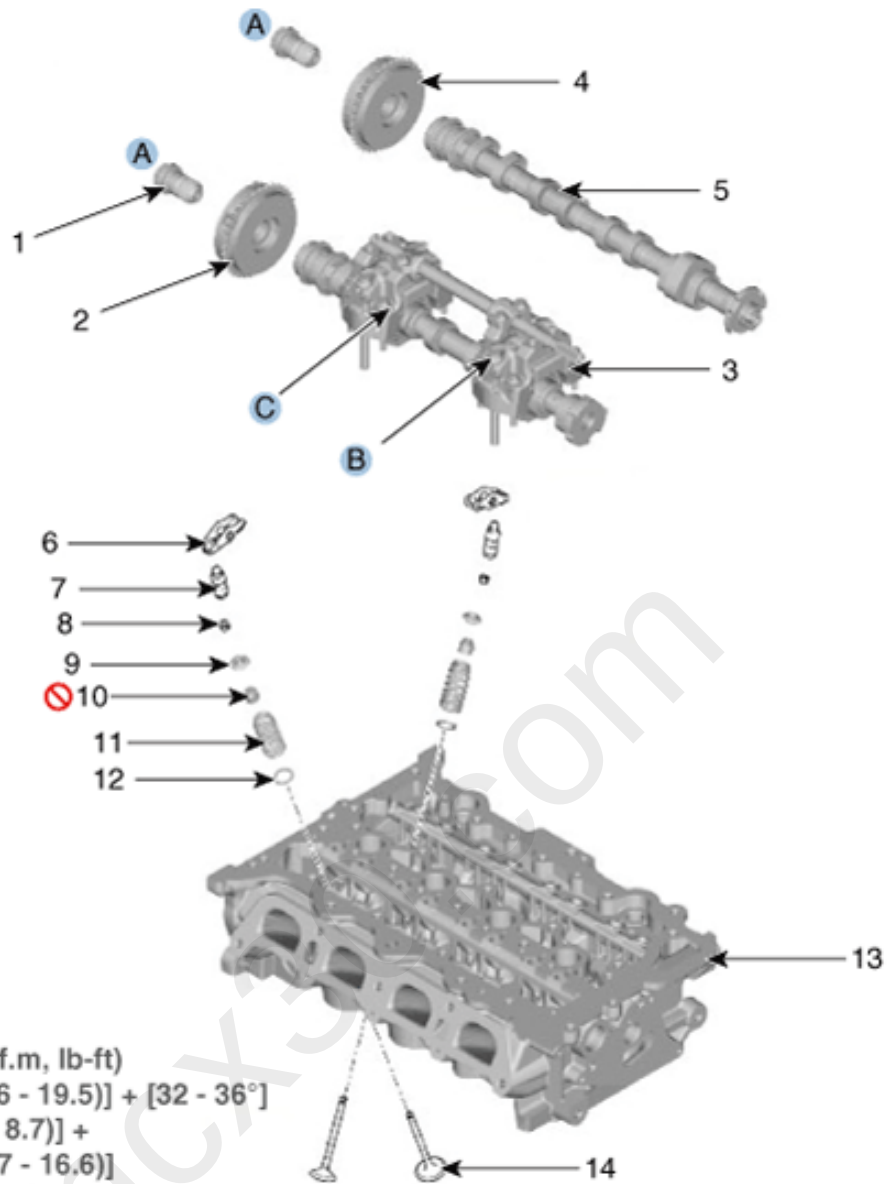




1. Front camshaft bearing cap
2. Intake camshaft bearing cap
3. Exhaust camshaft bearing cap
4. Cam carrier

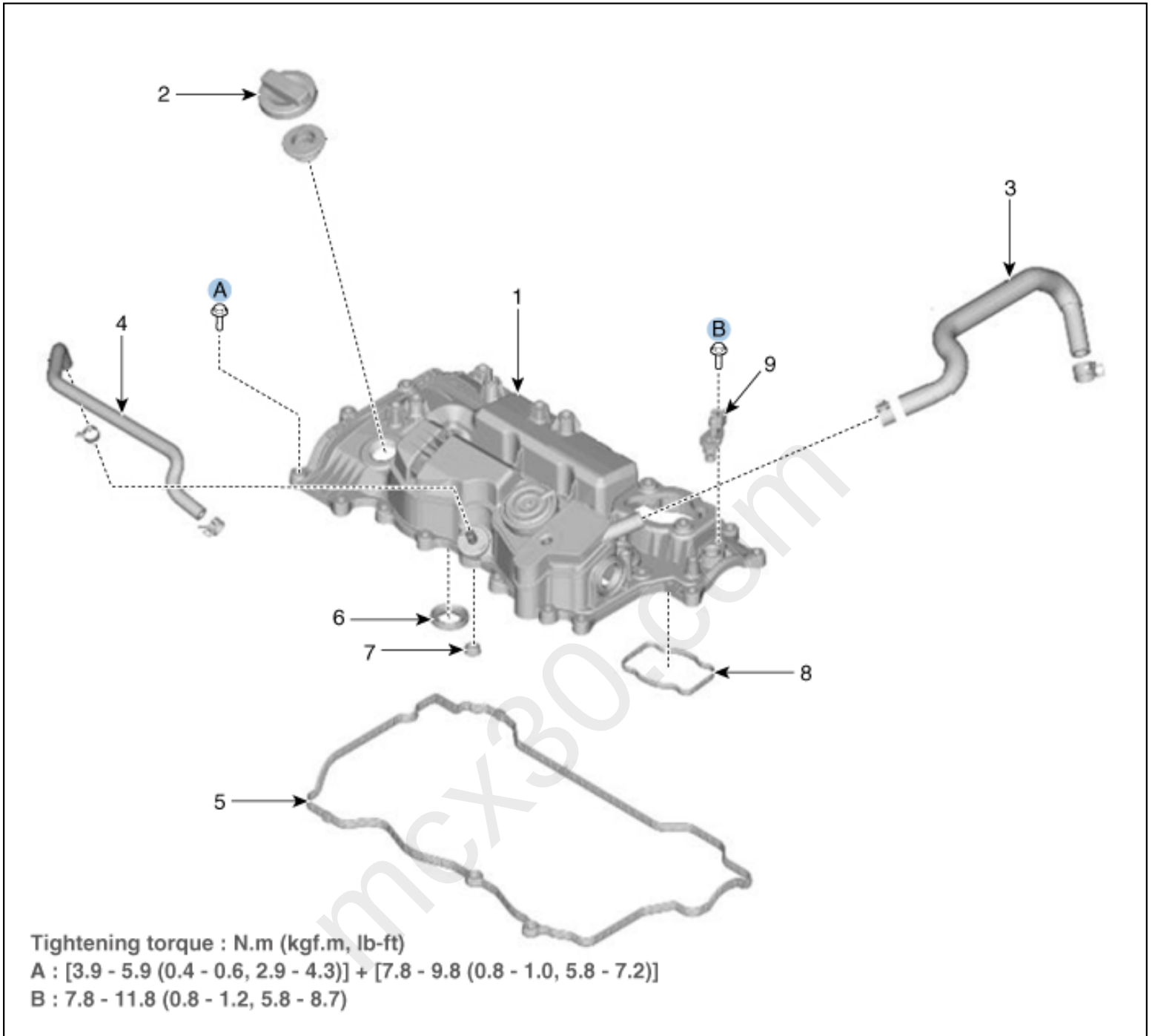
5. Fuel pump adaptor
6. Engine hanger
7. Cylinder head
8. Cylinder head gasket



1. Intake OCV center bolt
2. Intake OCV center bolt
3. CVVD assembly
4. Exhaust CVVT assembly
5. Exhaust camshaft
6. Swing arm
7. Hydraulic lash adjuster (HLA)

8. Retainer lock
9. Retainer
10. Valve stem seal
11. Valve spring
12. Valve spring seat
13. Cylinder head
14. Valve

Components

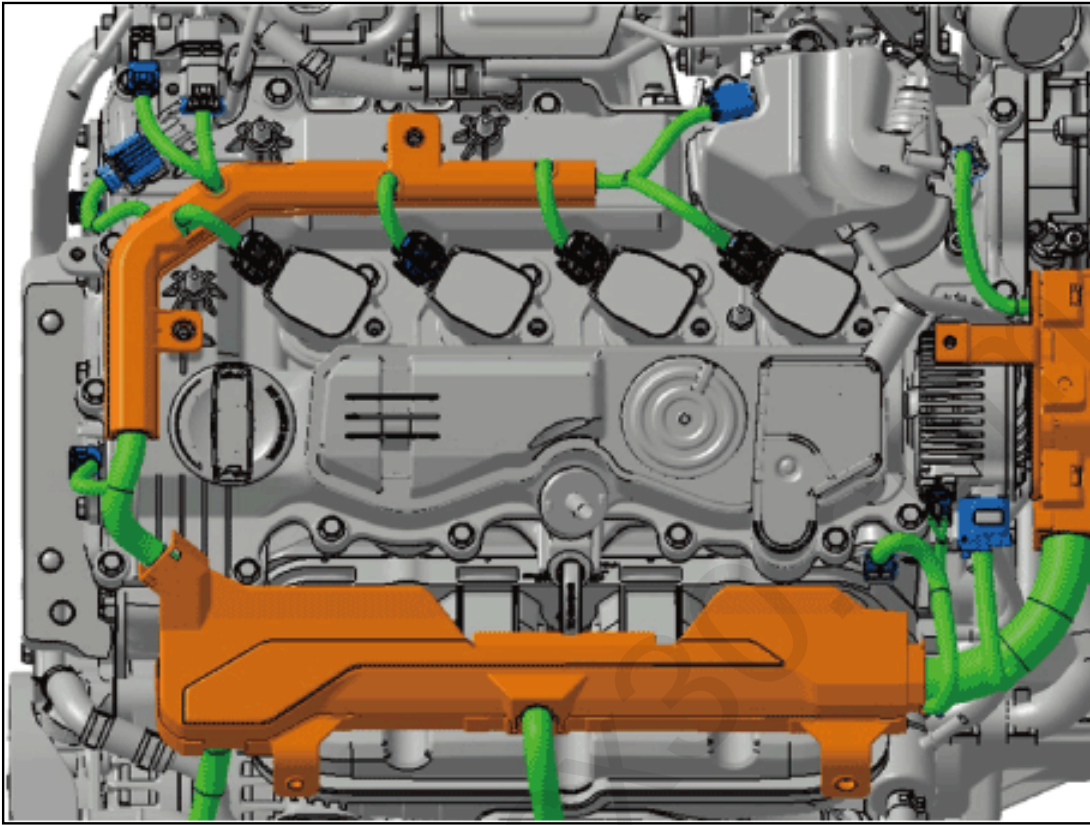


1. Cylinder head cover
2. Engine oil filler cap
3. Breather hose
4. PCV hose
5. Cylinder head cover gasket

6. Oil seal
7. Gasket
8. High pressure fuel pump gasket
9. Cam position sensor

Removal

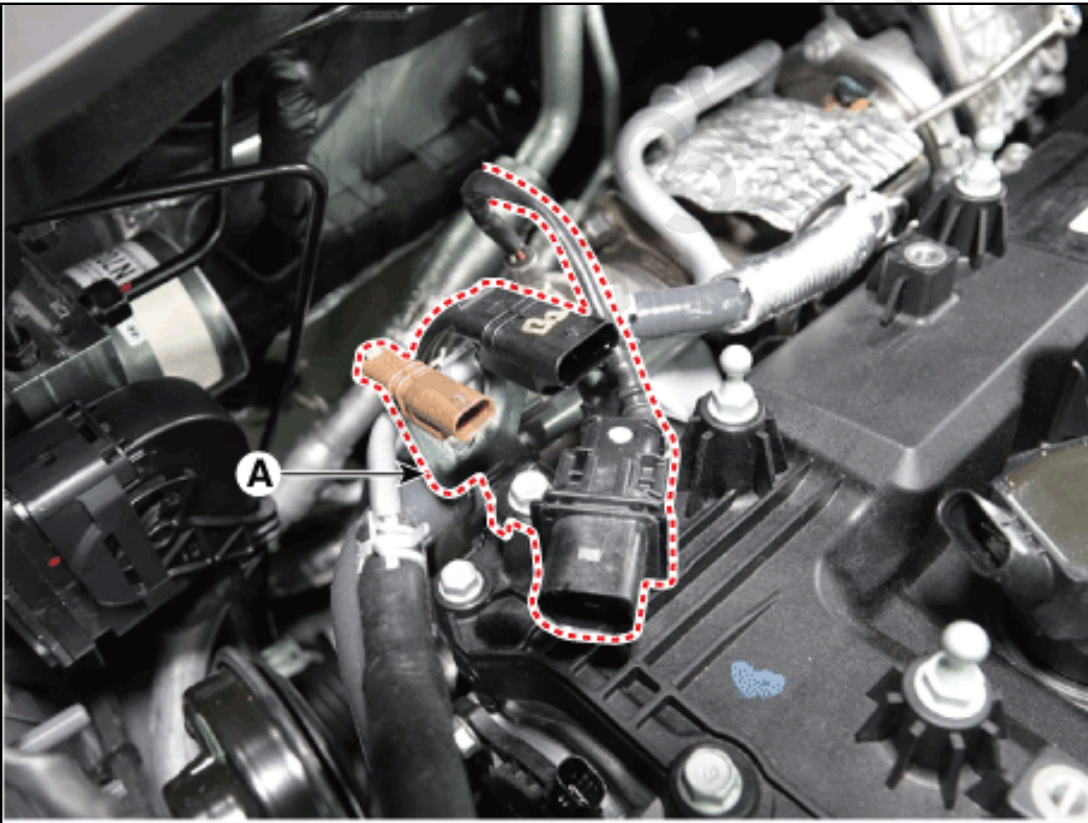
1. Disconnect the battery negative terminal.
2. Remove the engine cover.
(Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the air duct and air cleaner assembly.
(Refer to Intake and Exhaust System - "Air Cleaner")
4. Disconnect the wiring connectors and harness clamps and remove the connector brackets around the cylinder head cover.



5. Disconnect the breather hoses (A).



6. Remove the connector bracket (A) after loosening the mounting bolt.

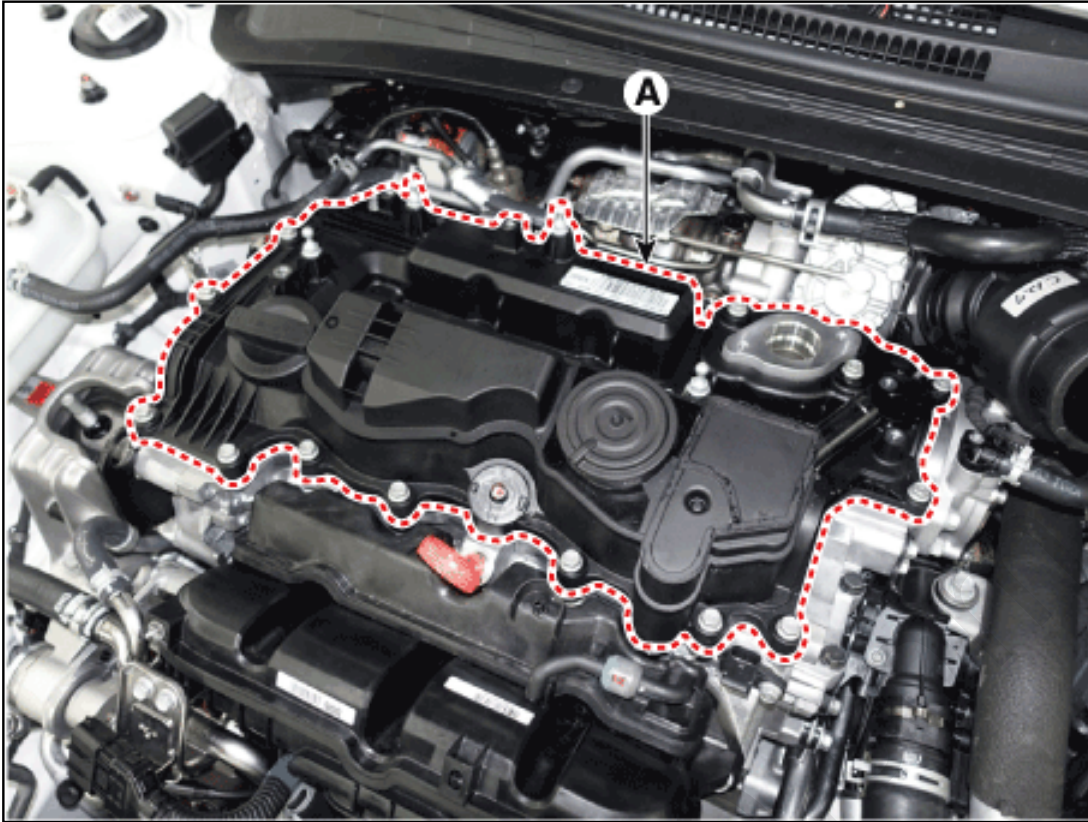


7. Remove the high pressure fuel pump.
(Refer to Engine Control / Fuel System - "High Pressure Fuel Pump")
8. Remove the ignition coil.
(Refer to Engine Electrical System - "Ignition Coil")

9. Remove the CVVD actuator.

(Refer to Engine Control / Fuel System - "CVVD Acuator")

10. Remove the cylinder head cover (A) with gasket.



Installation

1. The hardening sealant located on the upper area between timing chain cover and cam carrier, cylinder head cover should be removed before assembling cylinder head cover.

2. Install the cylinder head cover.

(1) Install the new gasket.

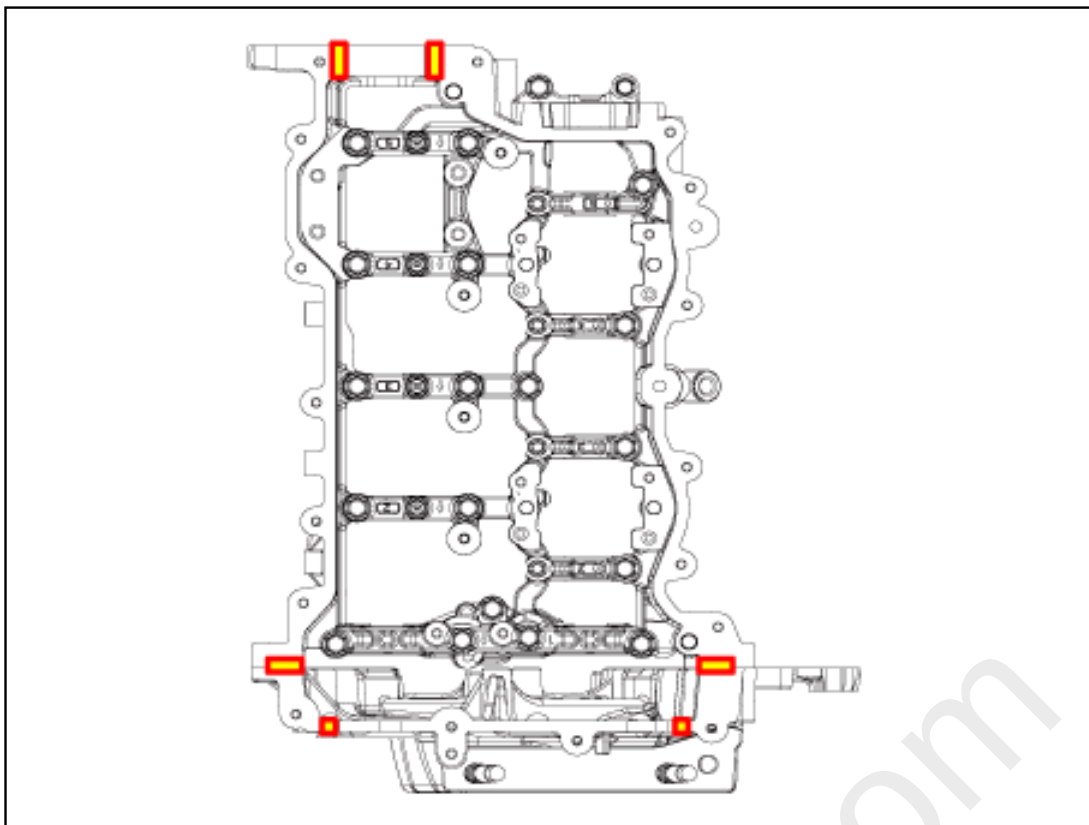


• Always use the new inner and outer cylinder head cover gaskets.

(2) Apply liquid gasket sealant to the marked area of the cam carrier and assemble within 5 minutes of application.

Width : 2.0 - 3.0 mm (0.0787 - 0.1181 in.)

Specification : MS721-40AA or AAO

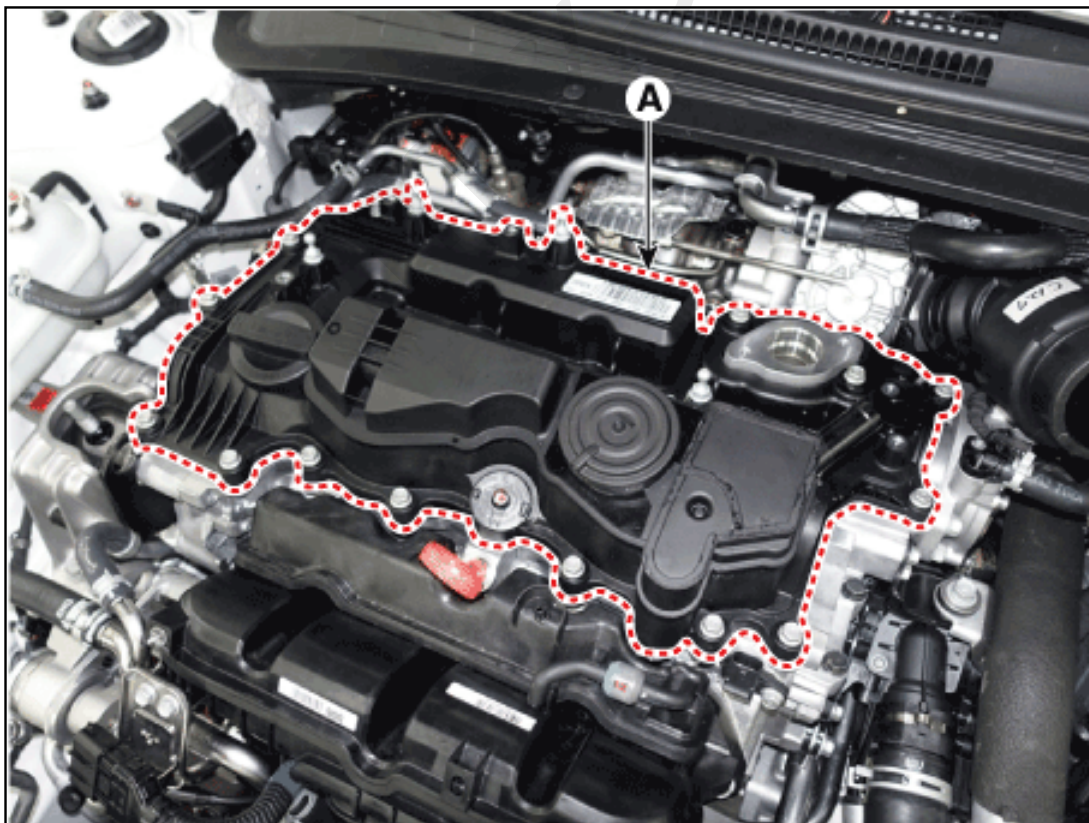


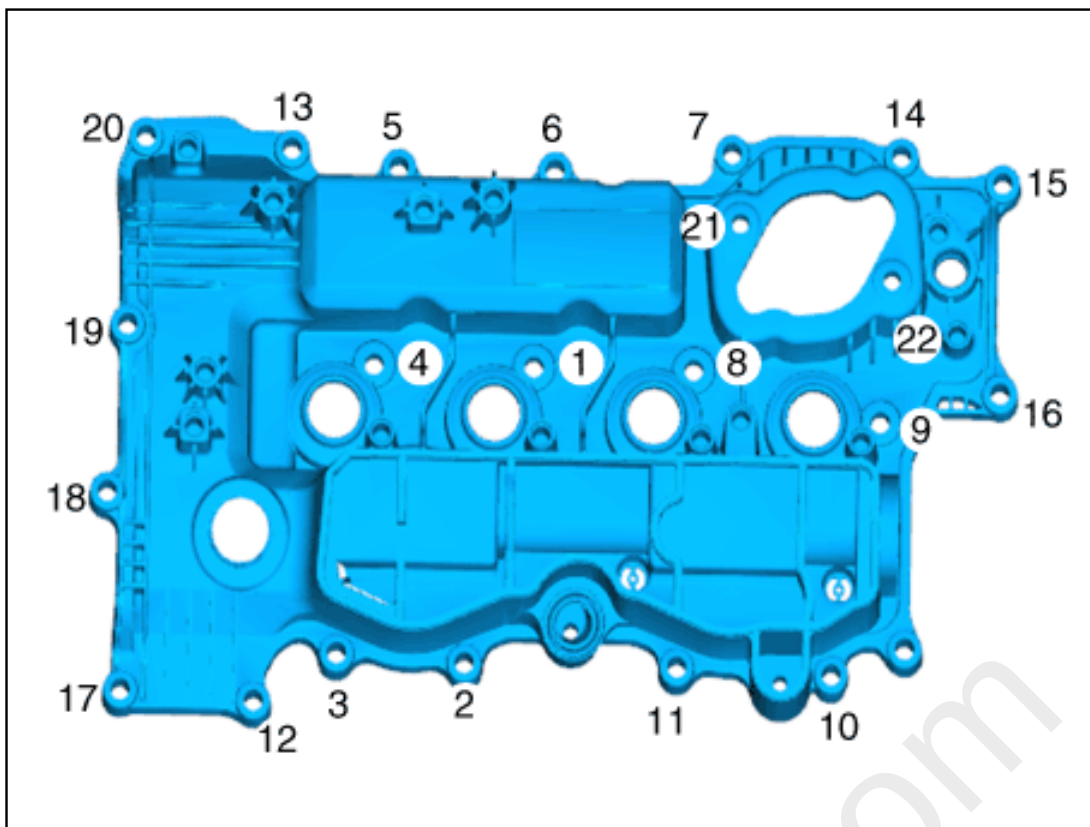
(3) Install the cylinder head cover (A) by tightening the bolts, in several passes, in the sequence as shown.

Tightening torque

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

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





- The firing and/or blow out test should not be performed within 30 minutes of assembling the cylinder head cover.

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

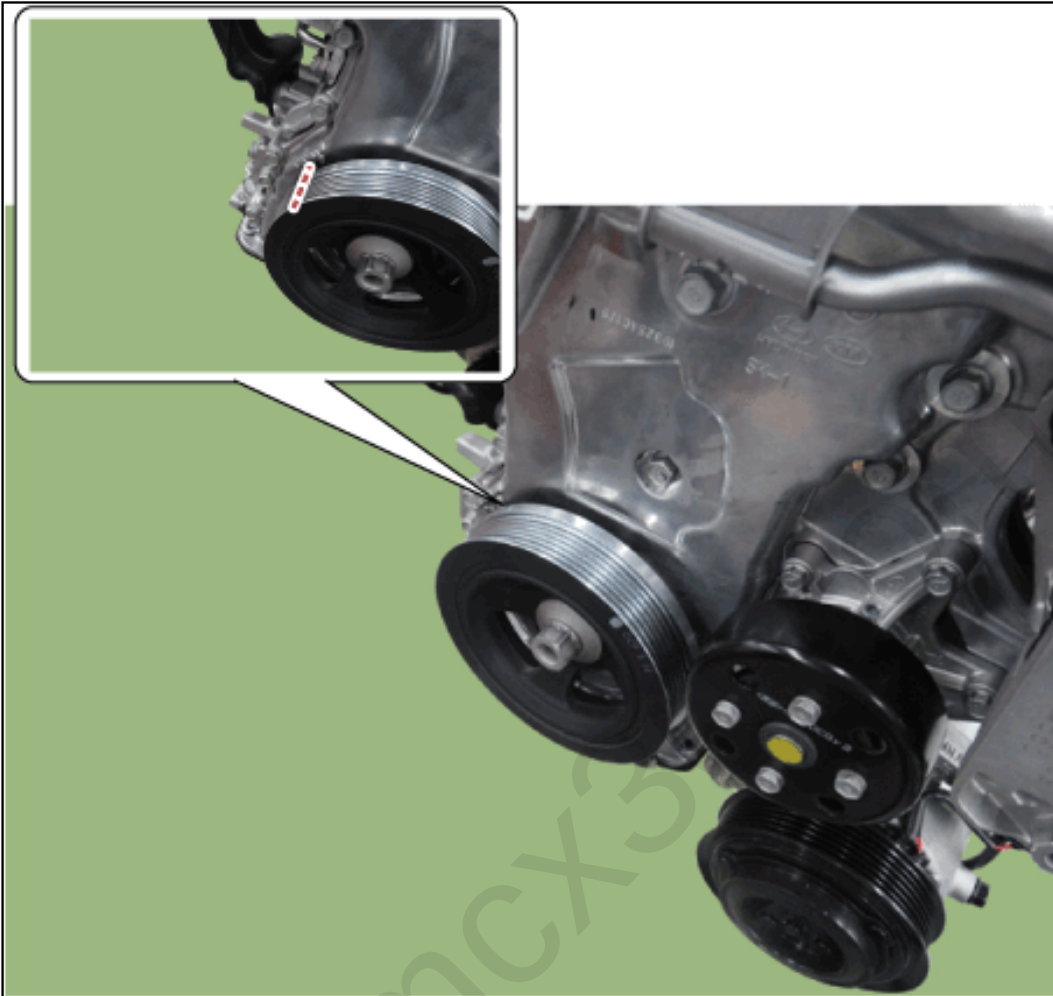
Removal

1. Disconnect the battery negative terminal.
2. Remove the cylinder head cover.

(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

3. Turn the crankshaft damper pulley so that No. 1 piston is at top dead center.

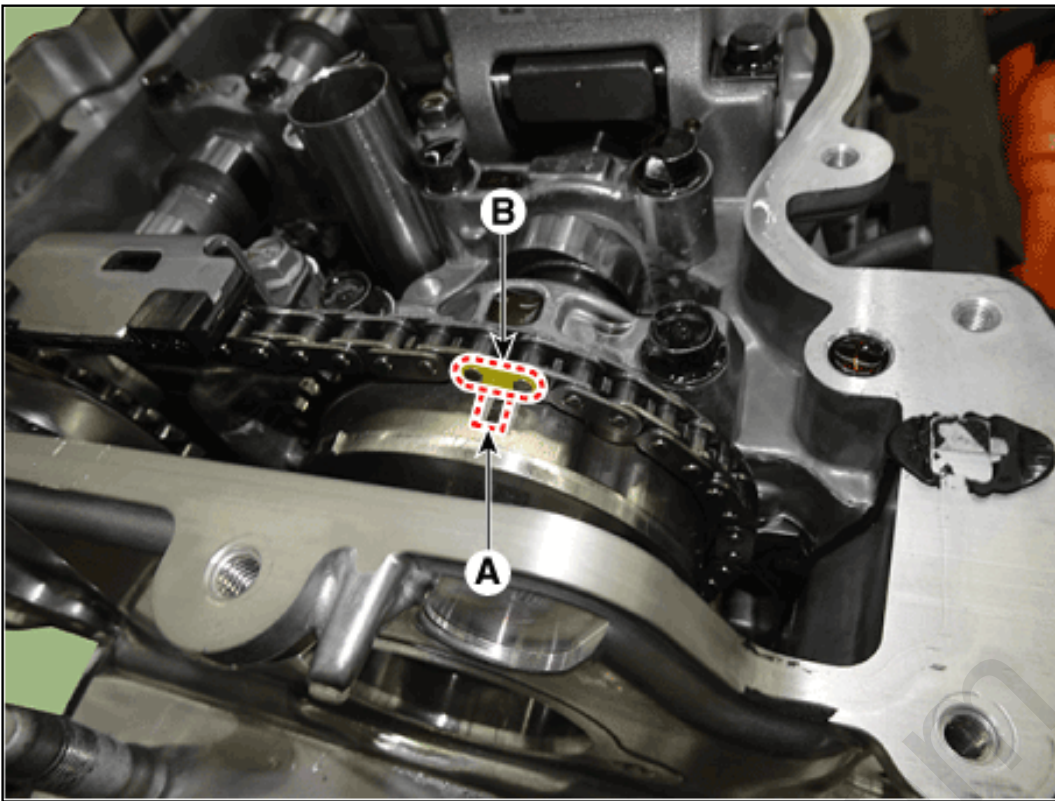
(1) Turn the crankshaft damper pulley and align its groove with the timing mark on the timing chain cover



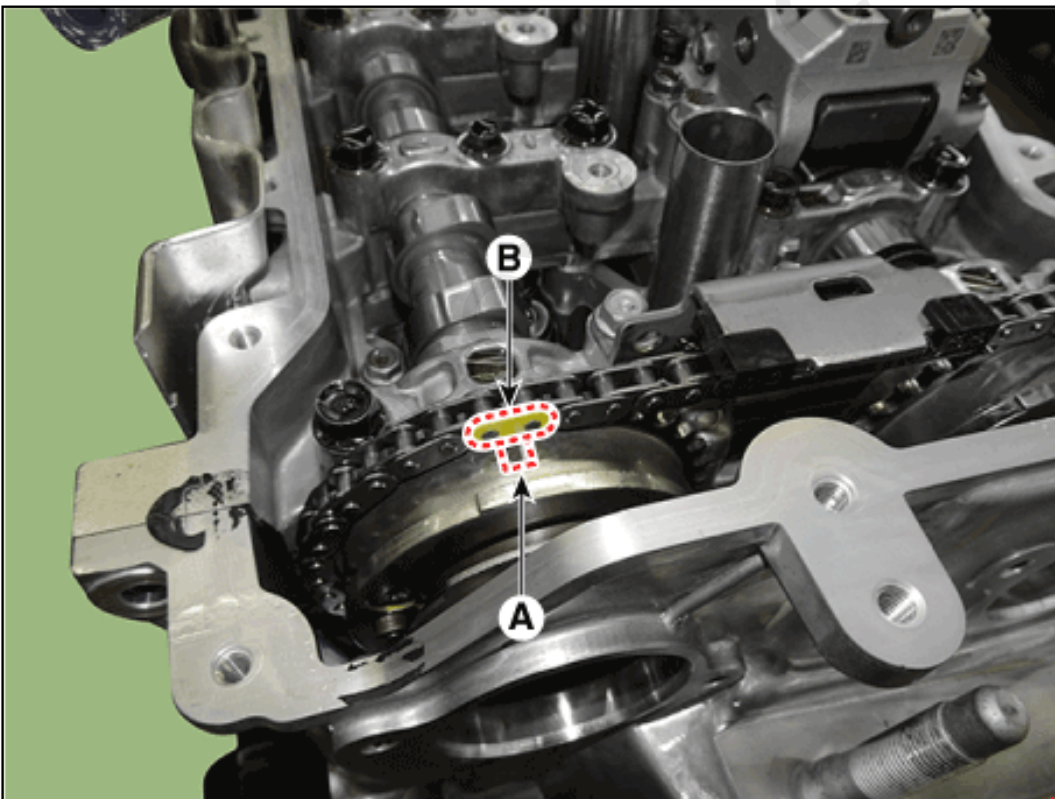
- (2) Check the timing chain, be sure that the timing mark (A) of each sprocket is matched with the timing mark (B) (color link) of the timing chain.

If not, turn the crankshaft damper pulley by one revolution (360°).

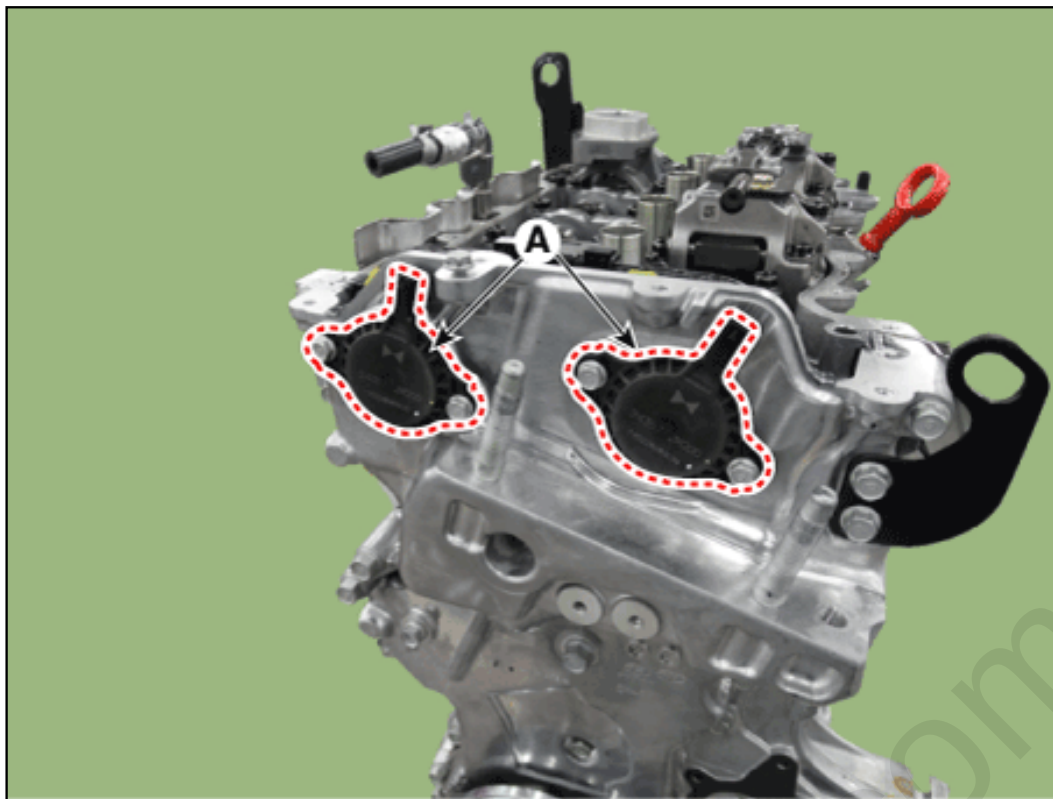
[Intake CVVT]



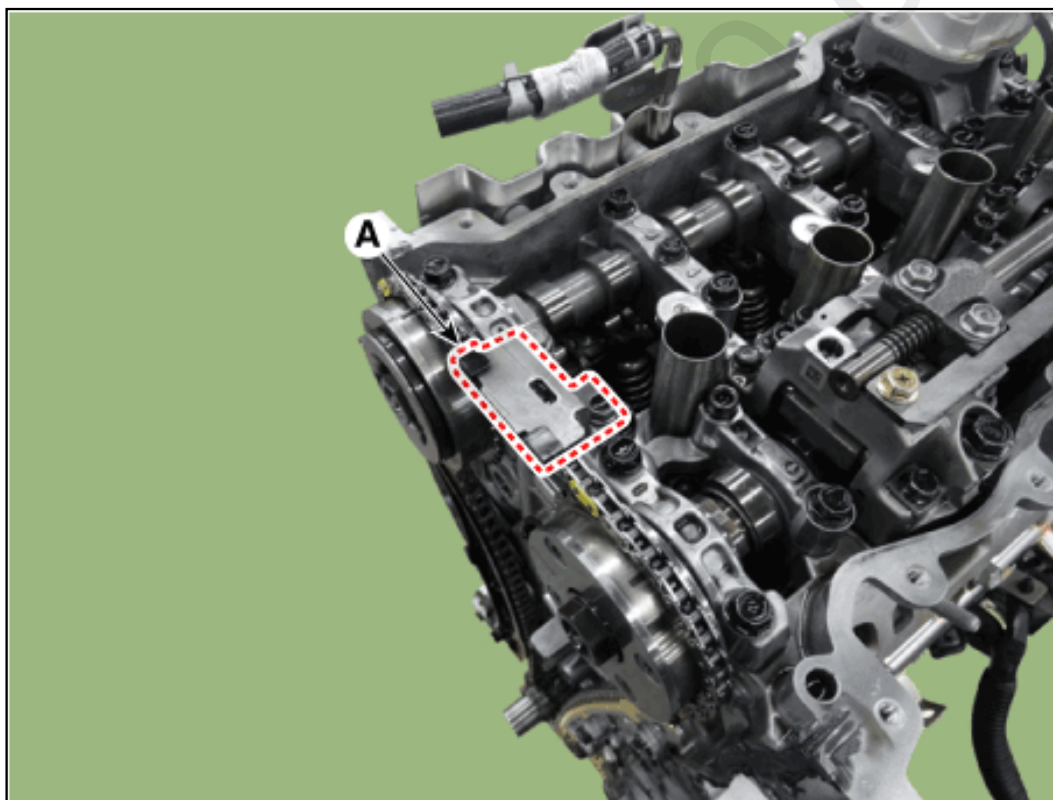
[Exhaust CVVT]



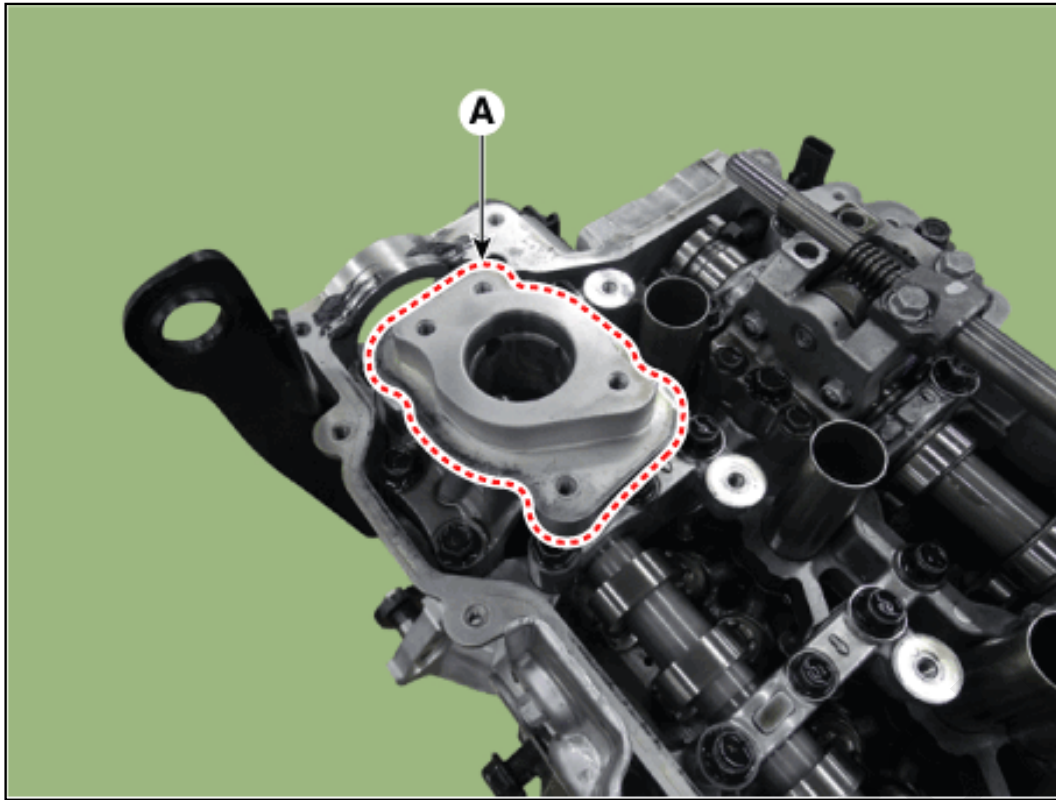
4. Remove the intake and exhaust variable force solenoid (VFS) valves (A).



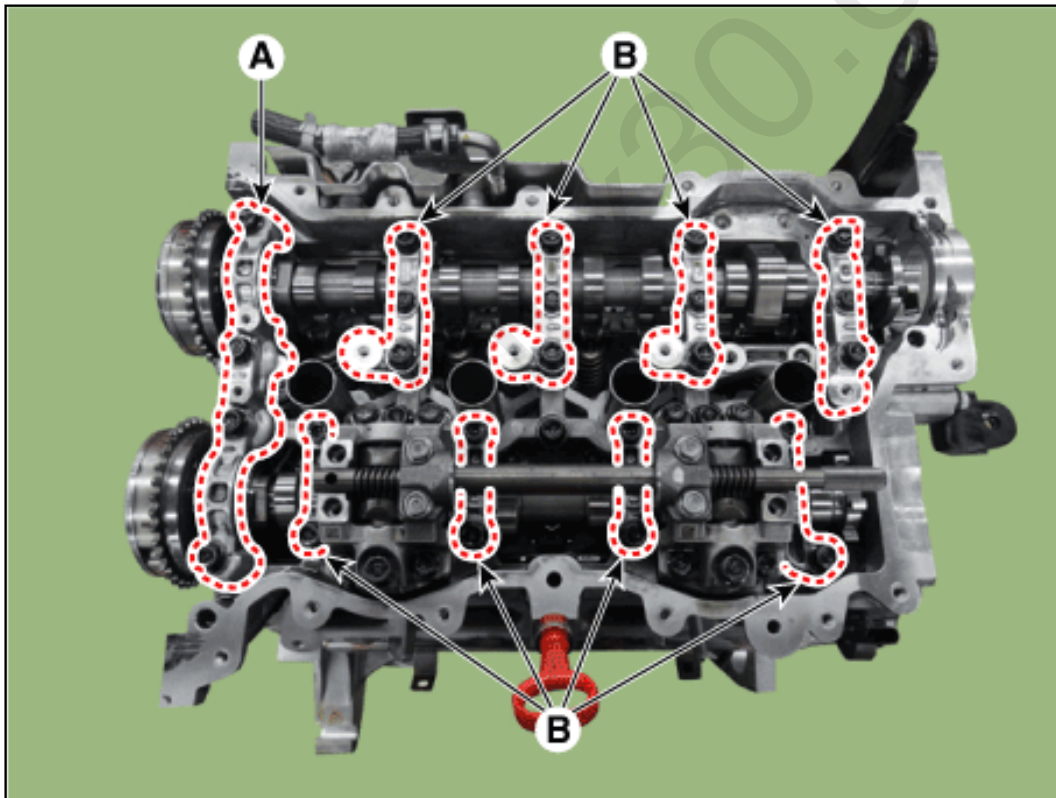
5. Remove the cam to cam guide (A).



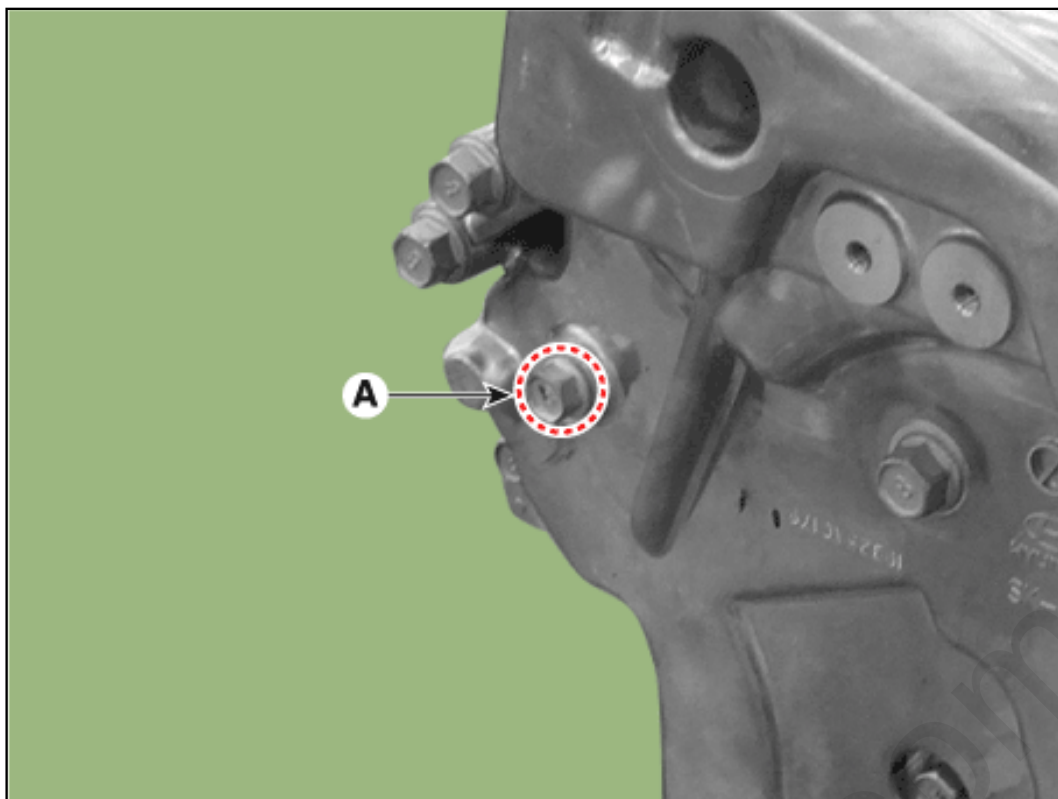
6. Remove the fuel pump bracket (A).



7. Remove the camshaft front bearing cap (A) and camshaft bearing caps (B).



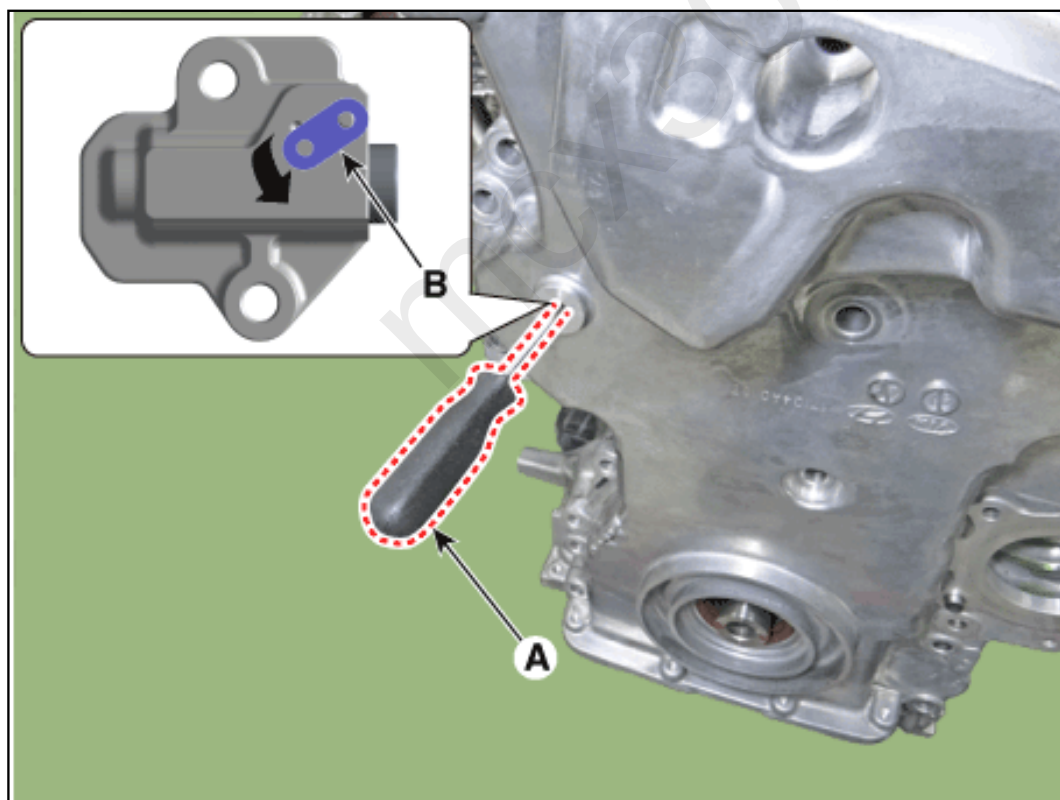
8. Loosen the service hole bolt (A).



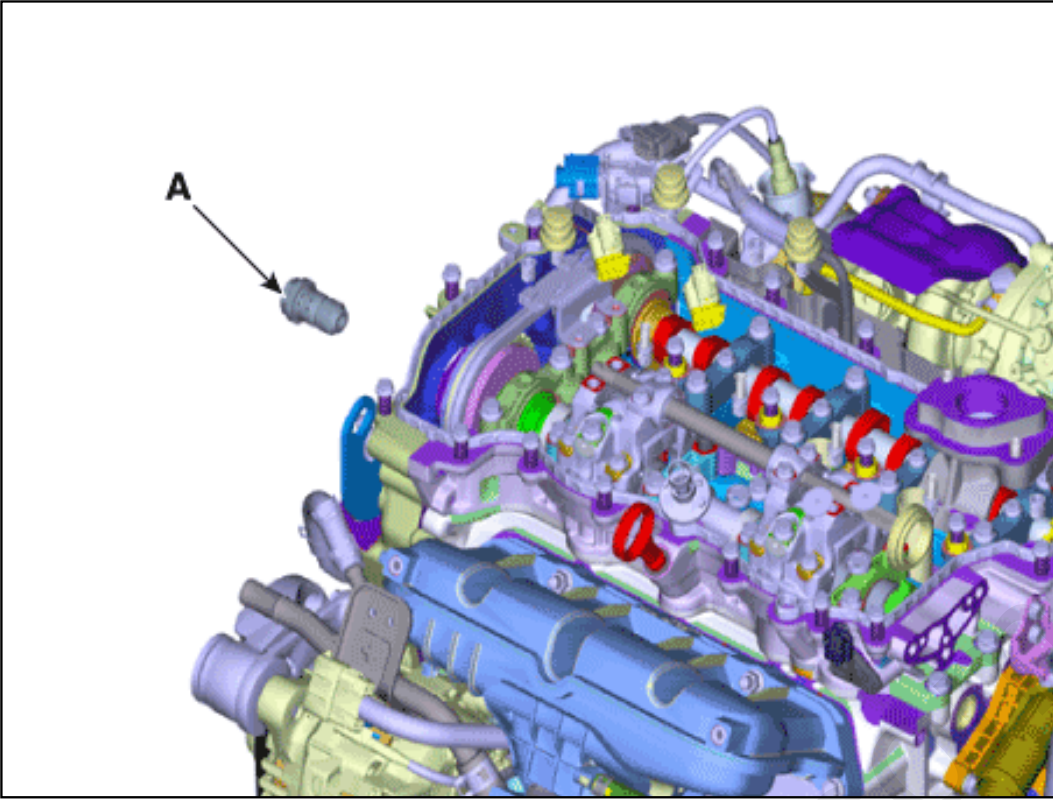
9. Install the jack to the edge of oil pan

10. Lift the engine using the jack to obtain space.

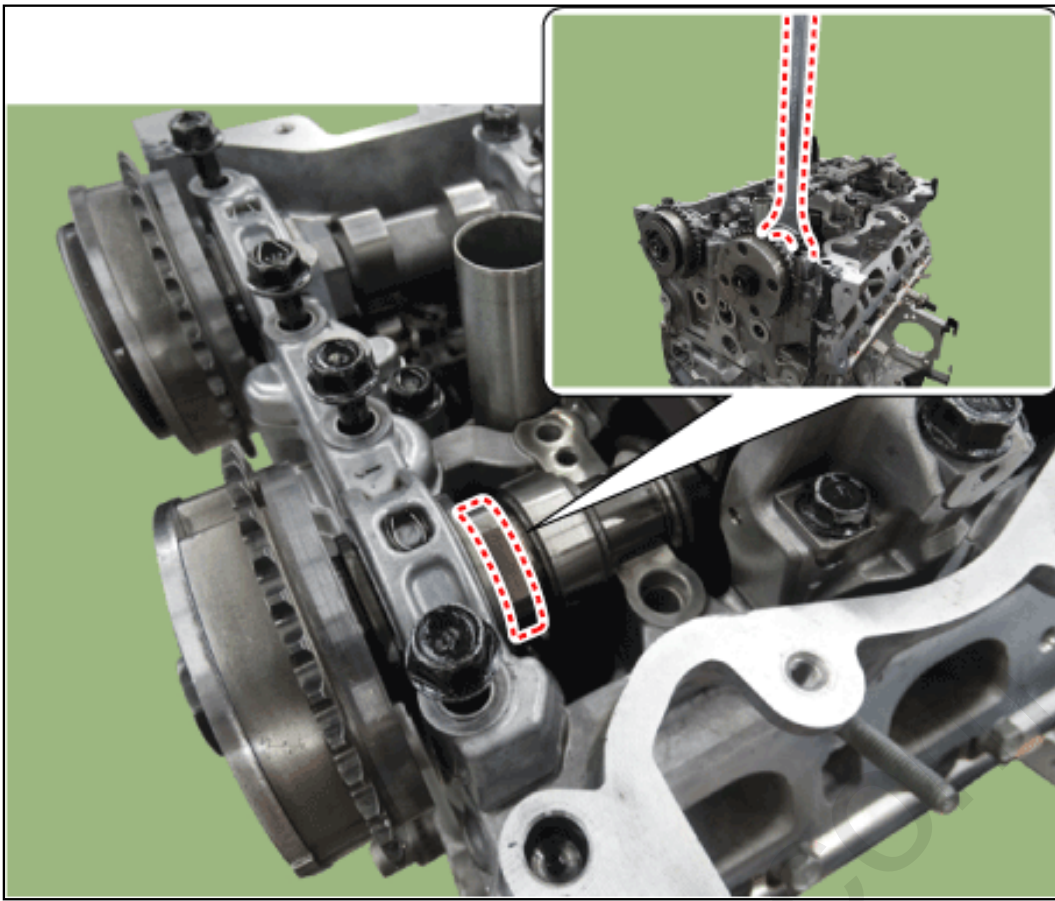
11. Release the lock by putting down ratchet plate (B) of timing chain tensioner with using back of tiny awl (A).



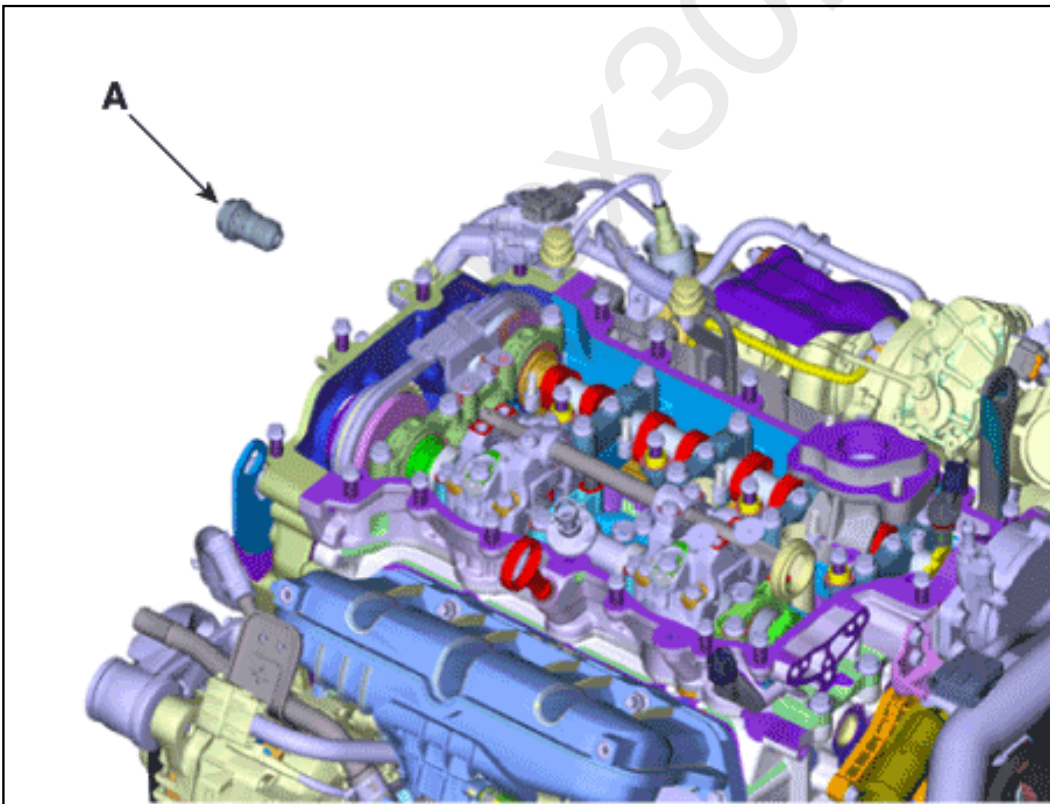
12. Remove the intake oil control valve (OCV) & center bolt (A).



- To prevent impurities from entering intake oil control valve (OCV) & center bolt, wear rubber gloves.
- Intake oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.

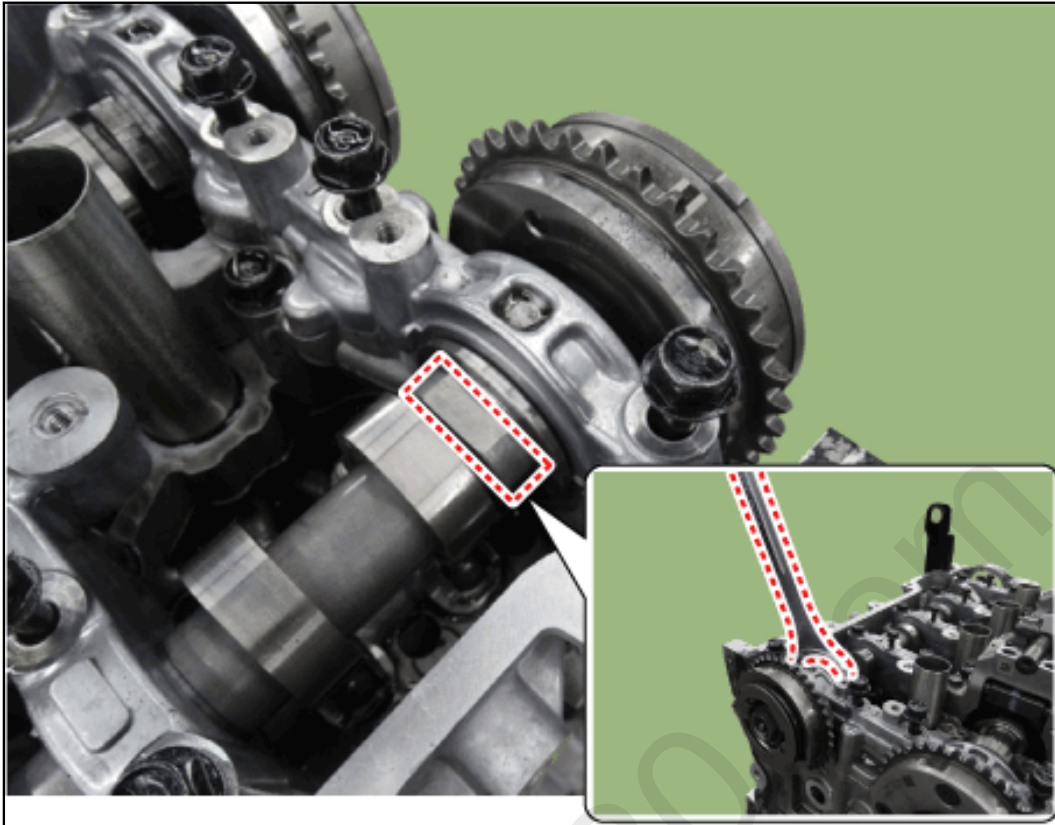


13. Remove the exhaust oil control valve (OCV) and center bolt (A).





- To prevent impurities from entering exhaust oil control valve (OCV) & center bolt, wear rubber gloves.
- When removing the exhaust oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.



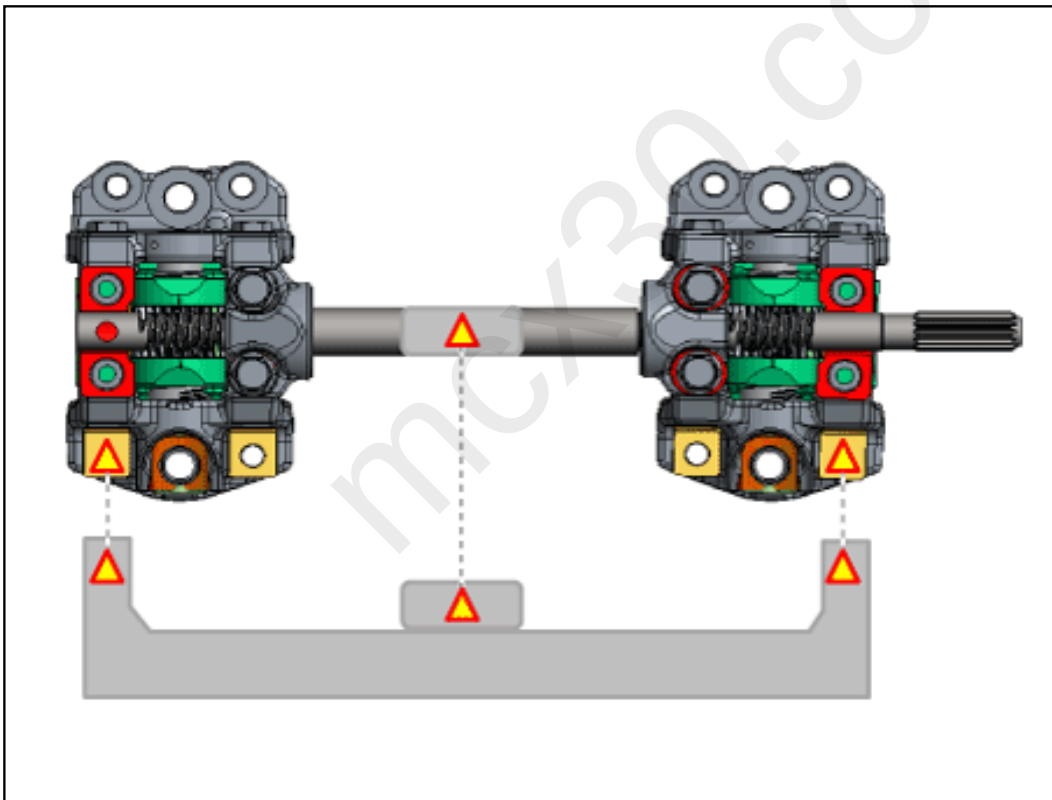
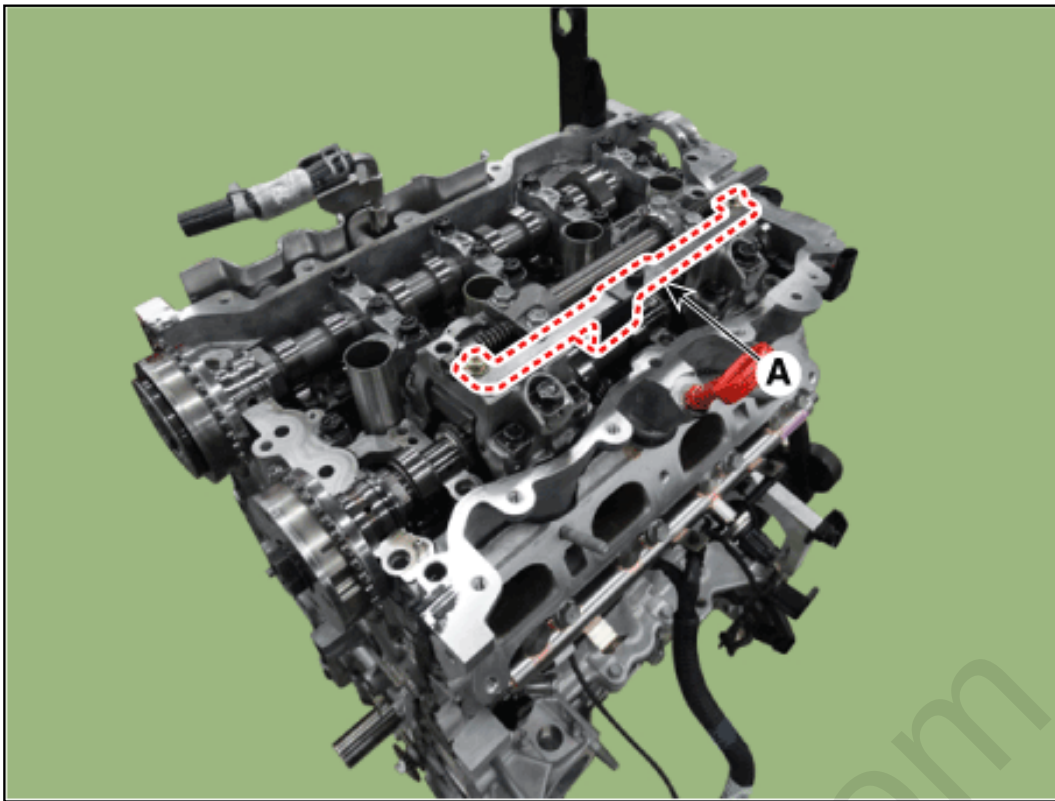
14. Remove the CVVD assembly.



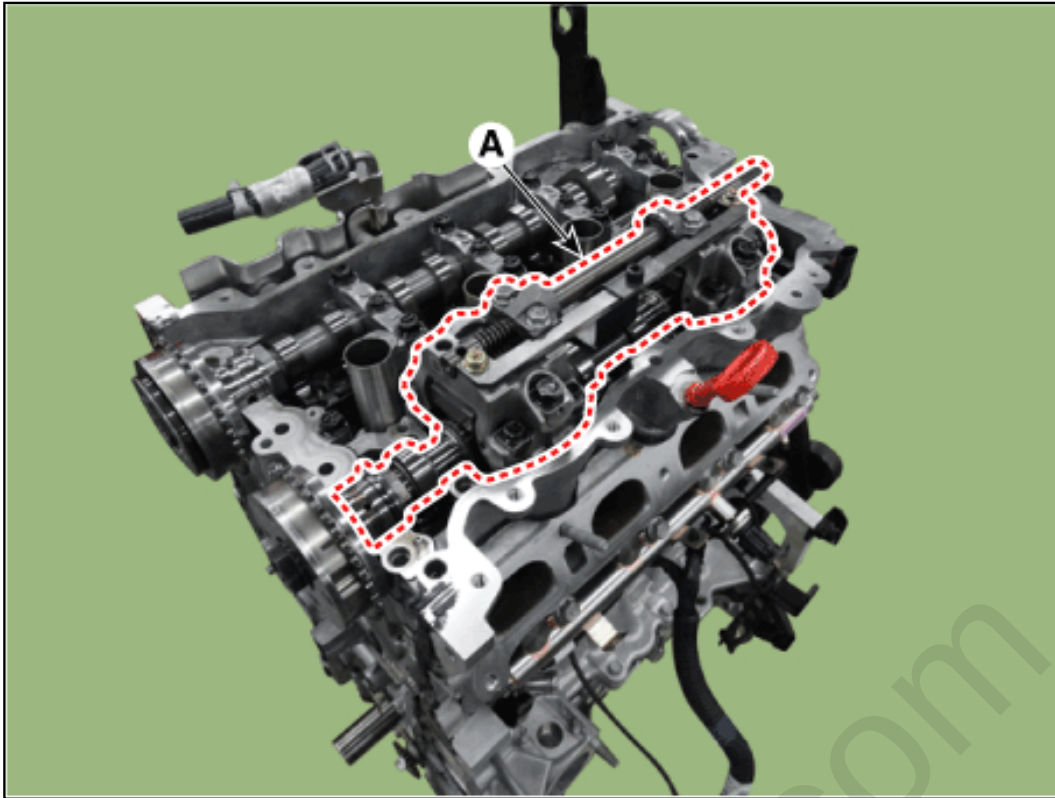
- After removing the CVVD unit, make sure that the parts such as lifter, cam, etc are not separated.
- Ensure that the CVVD components are not damaged.

When Using the CVVD fixture

(1) Install the CVVD fixture (A) over the CVVD assembly.

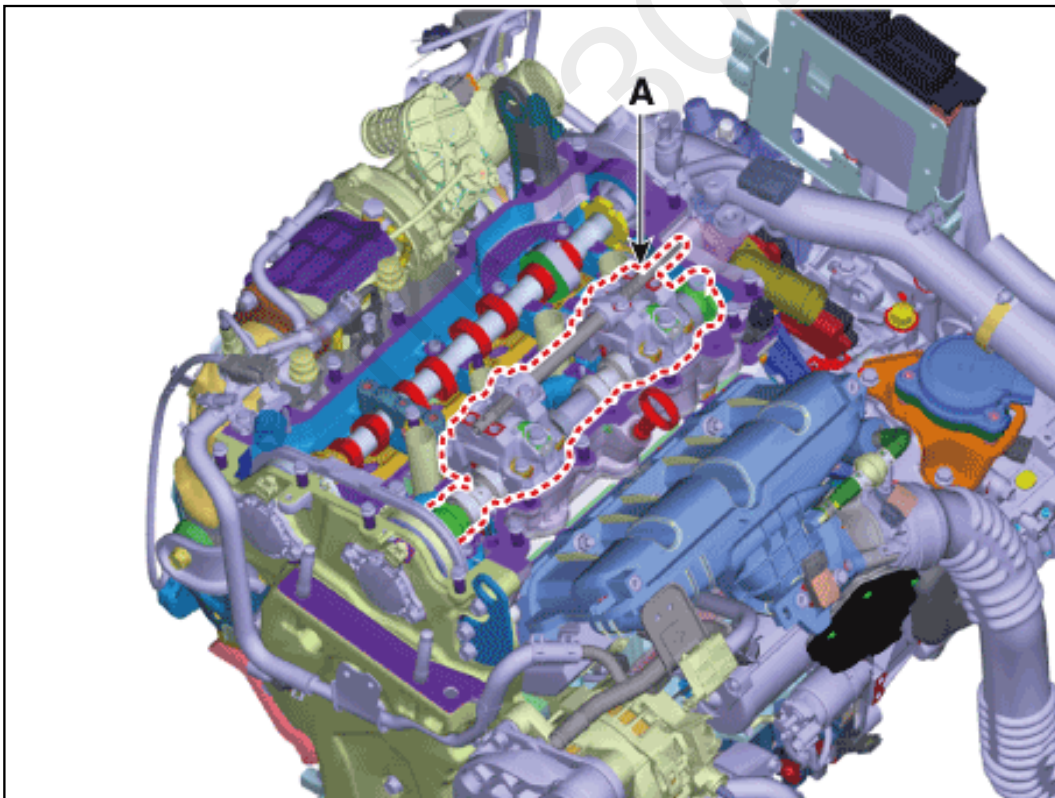


(2) Remove the CVVD assembly.

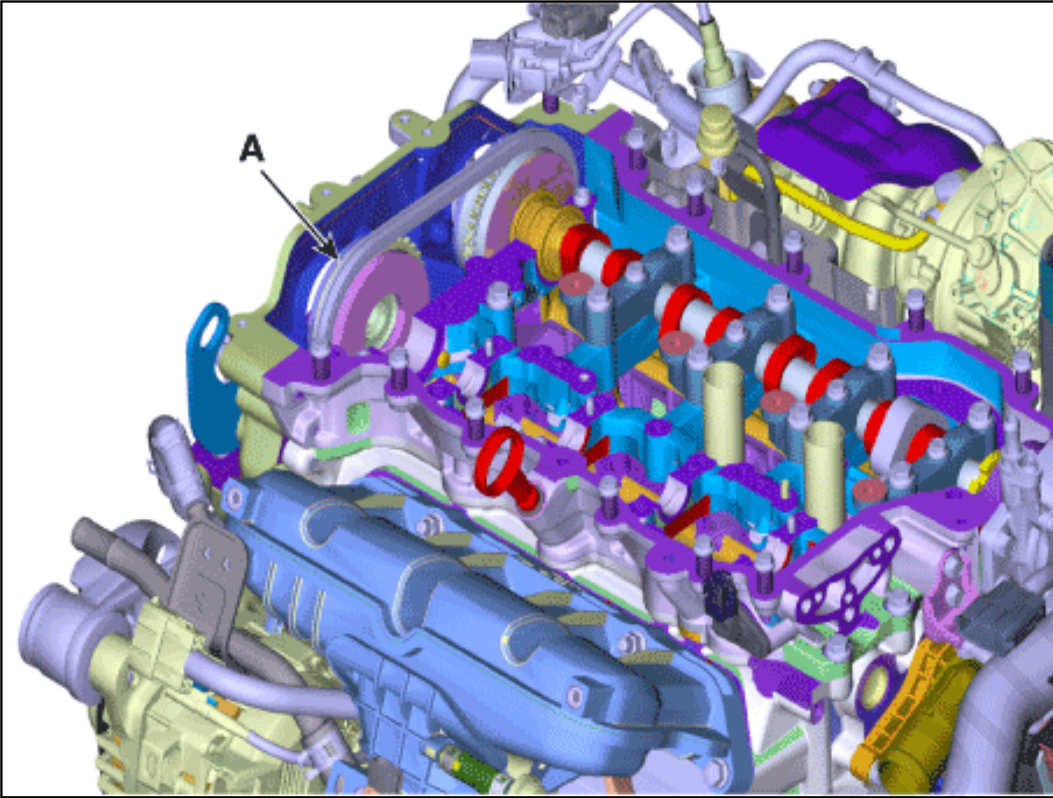


When not using the CVVD fixture

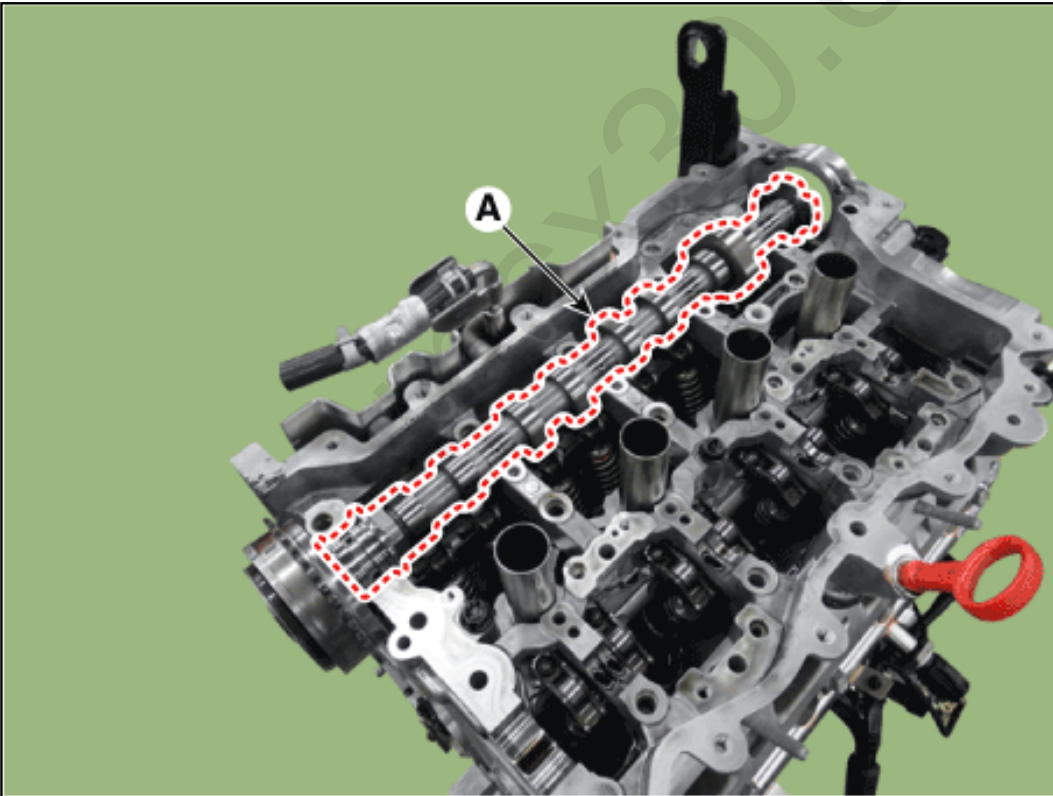
(3) Remove the CVVD assembly.



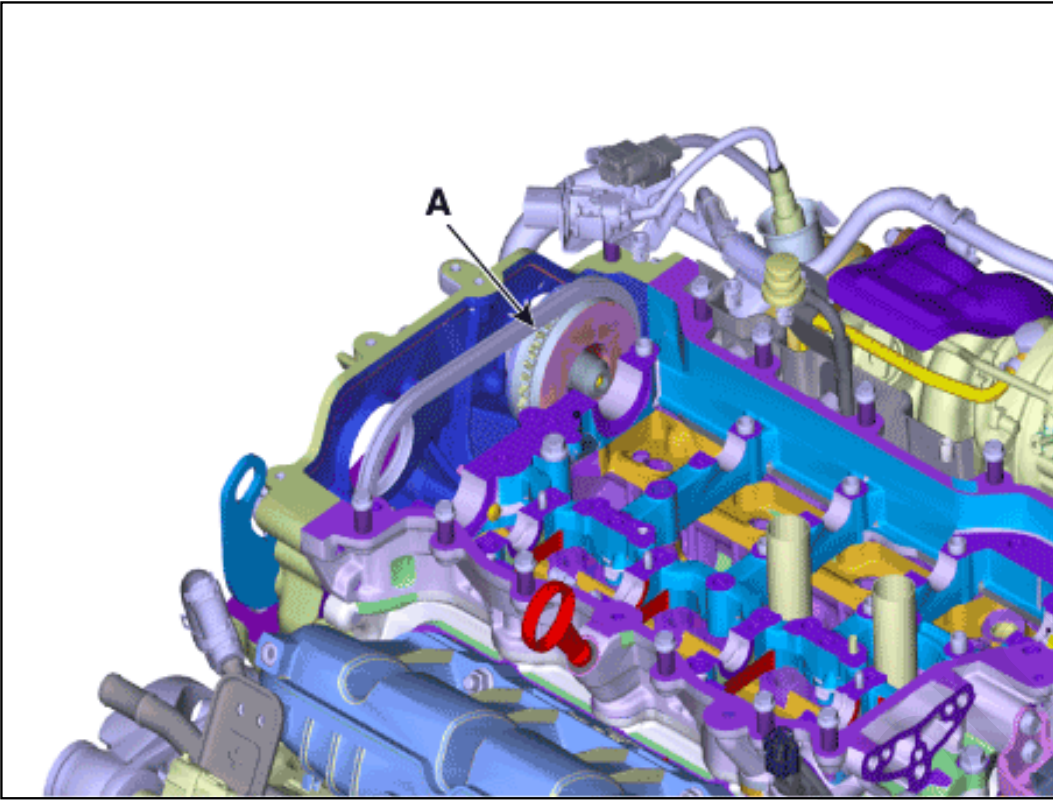
15. Remove the Intake CVVT (A).



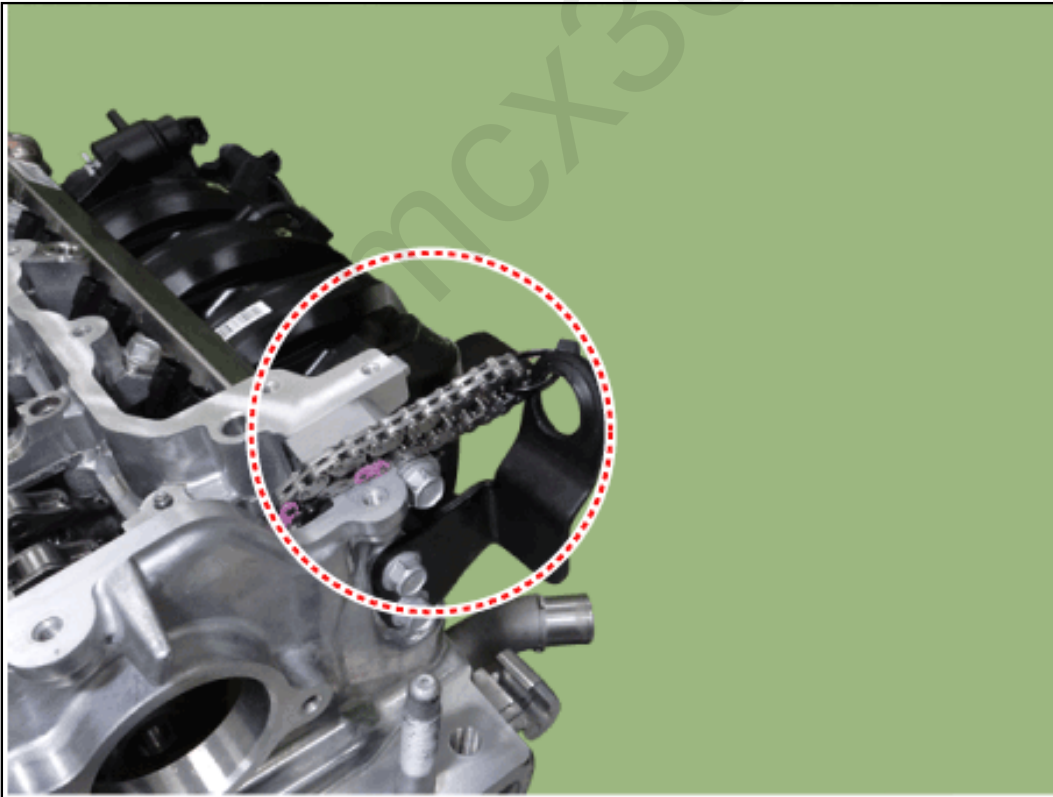
16. Remove the exhaust camshaft (A).



17. Remove the exhaust CVVT (A).



- Fasten the timing chain to the engine hanger with a cable tie or strap not to allow the timing chain to fall down when removing the intake and exhaust CVVT & camshaft.



Inspection

Camshaft

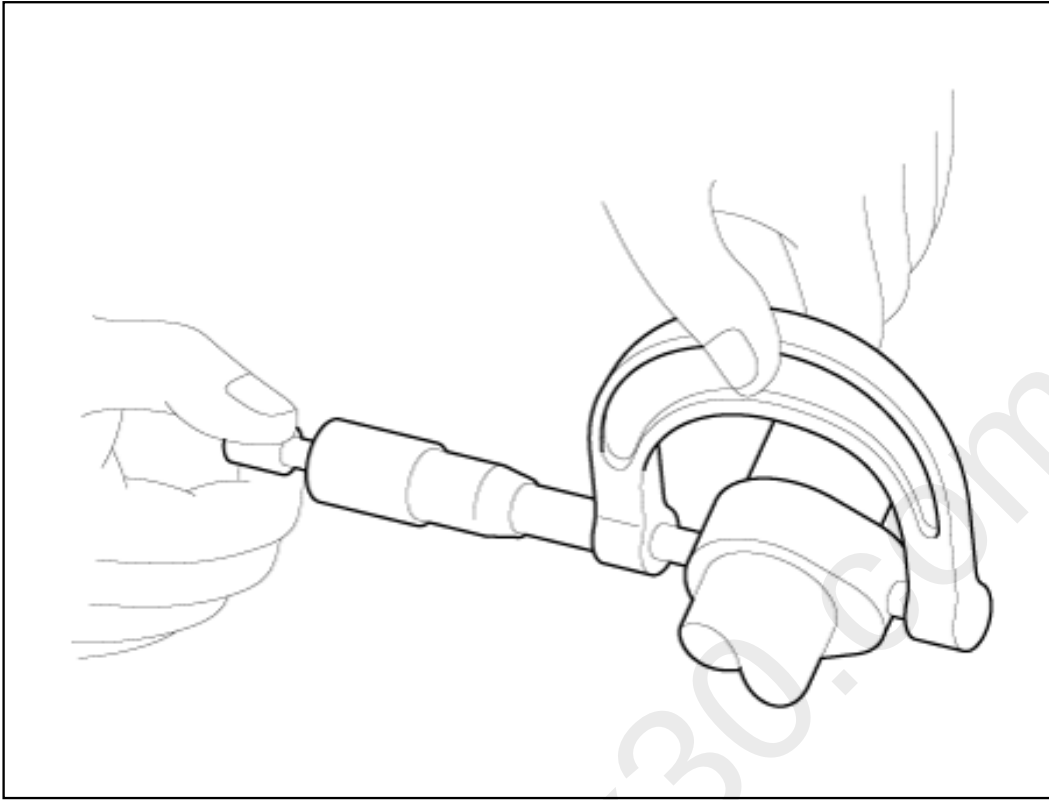
1. Measure the height of the cam.

Check the surface of the cam lob for wear and tear. If necessary, replace the camshaft.

Cam height

Intake : 37.33 mm (1.4697 in.)

Exhaust : 37.44 mm (1.474 in.)

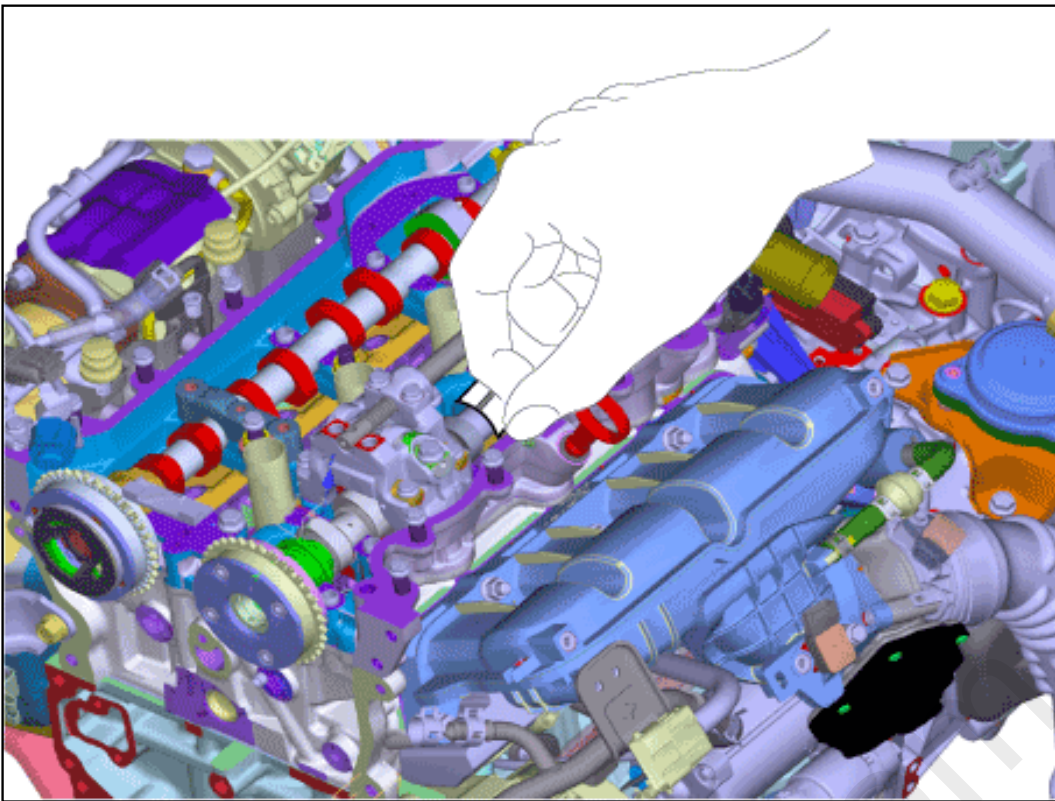


2. Inspect the camshaft journal clearance.

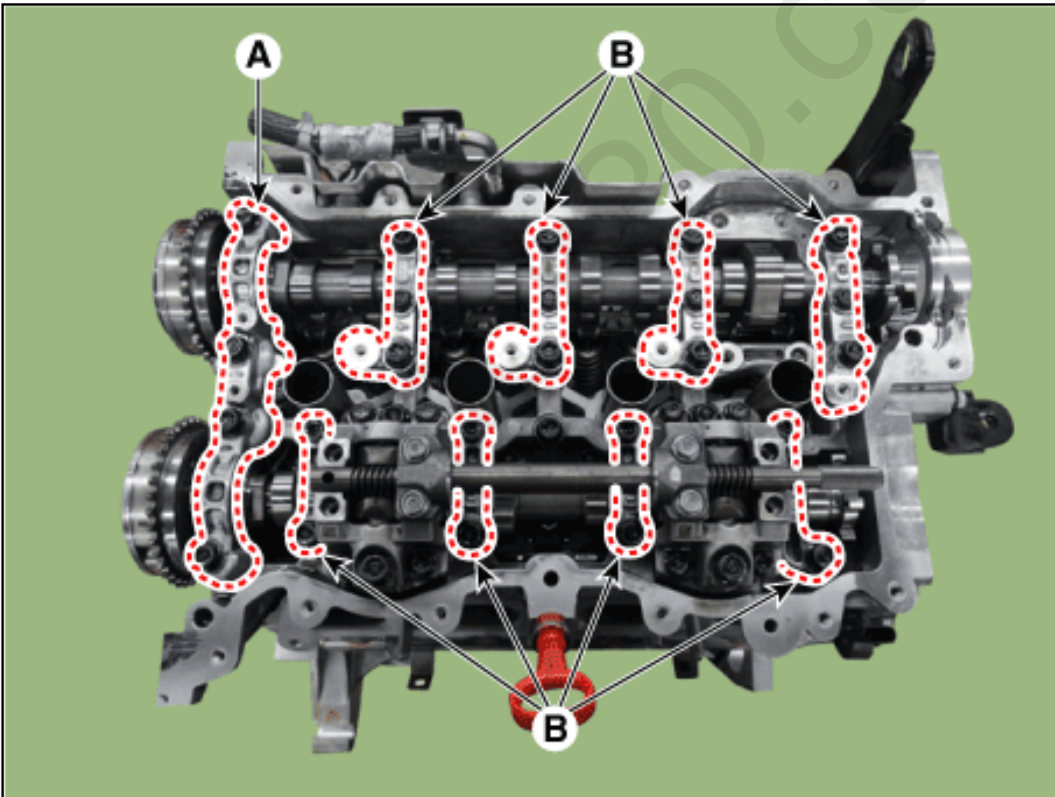
(1) Clean the camshaft journals and bearing caps.

(2) Place the camshafts on the cam carrier.

(3) Lay a strip of plasticgauge across each of the camshaft journals.



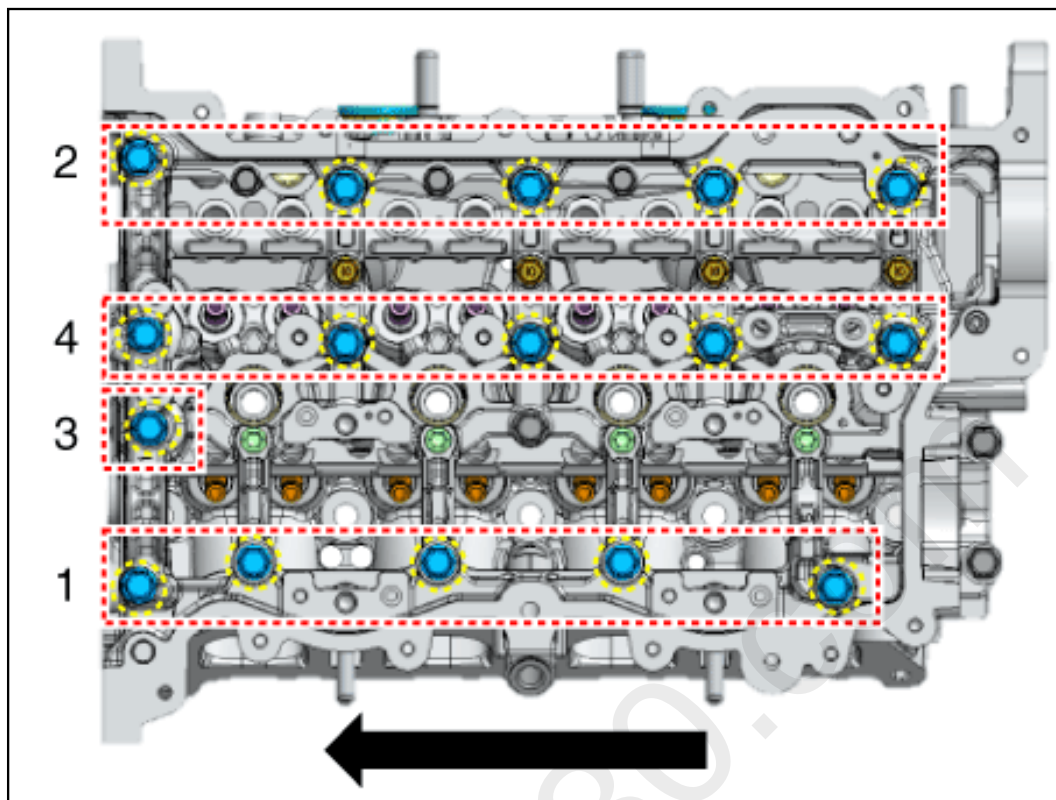
(4) Install the camshaft front bearing cap (A) and camshaft bearing caps (B).



- 1) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

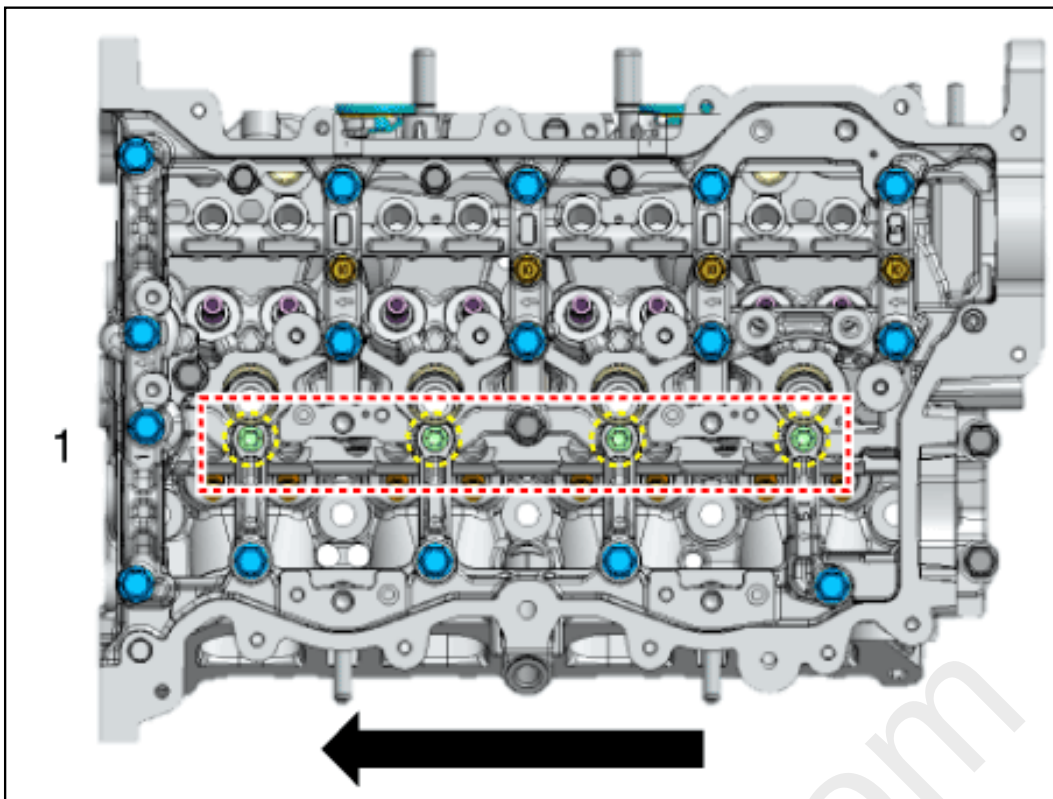
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



- 2) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

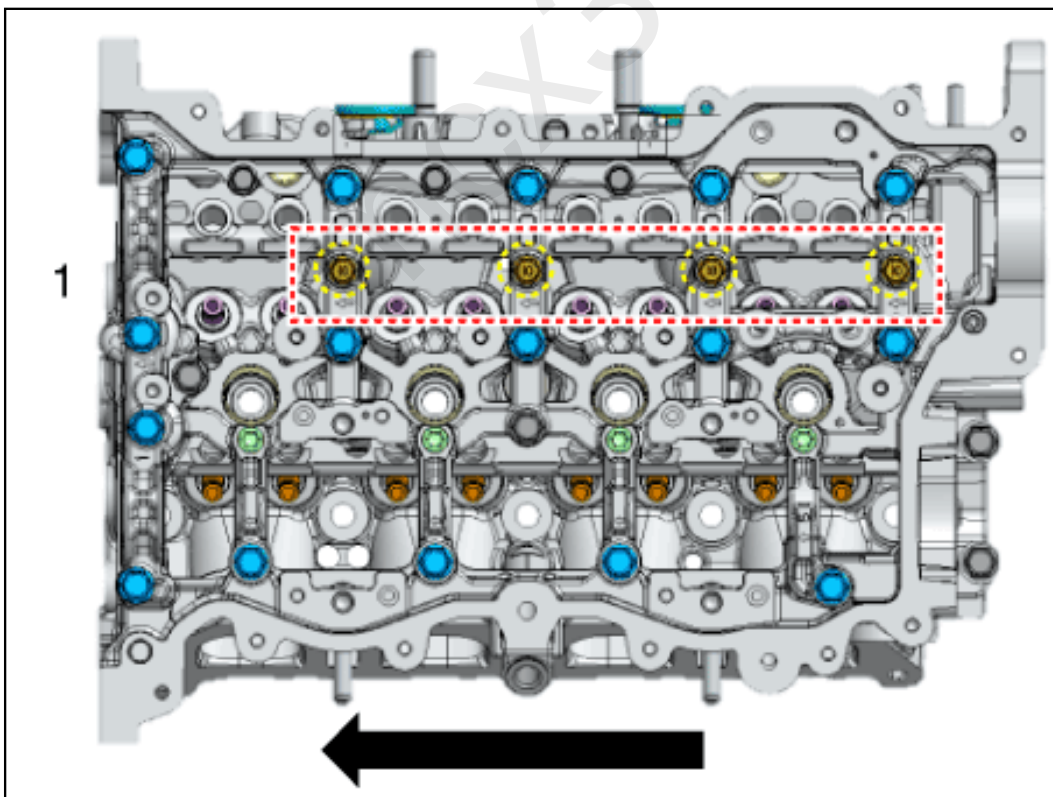
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



3) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

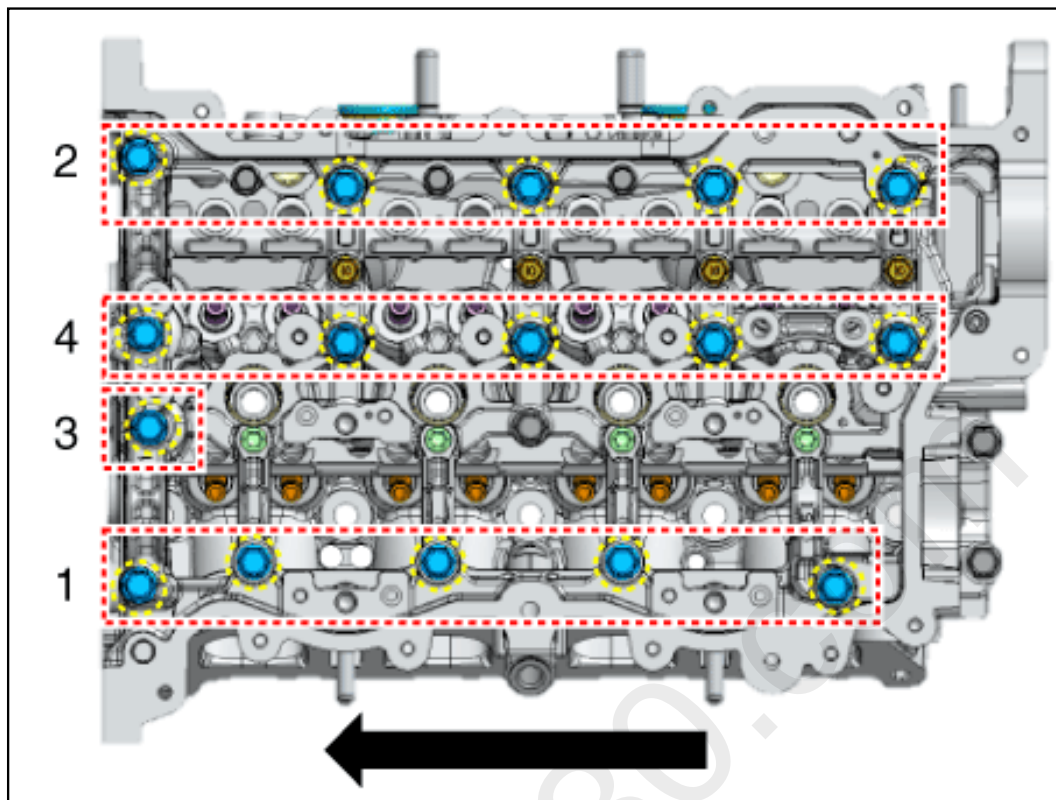
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



- 4) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

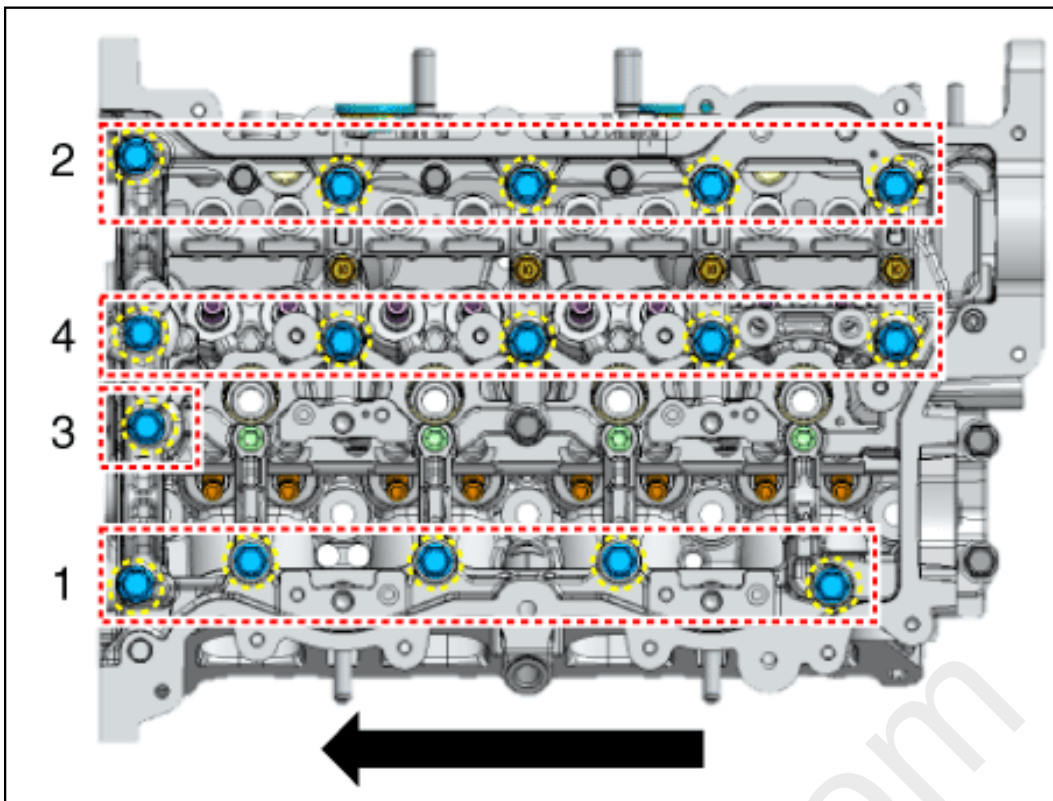
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



- 5) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

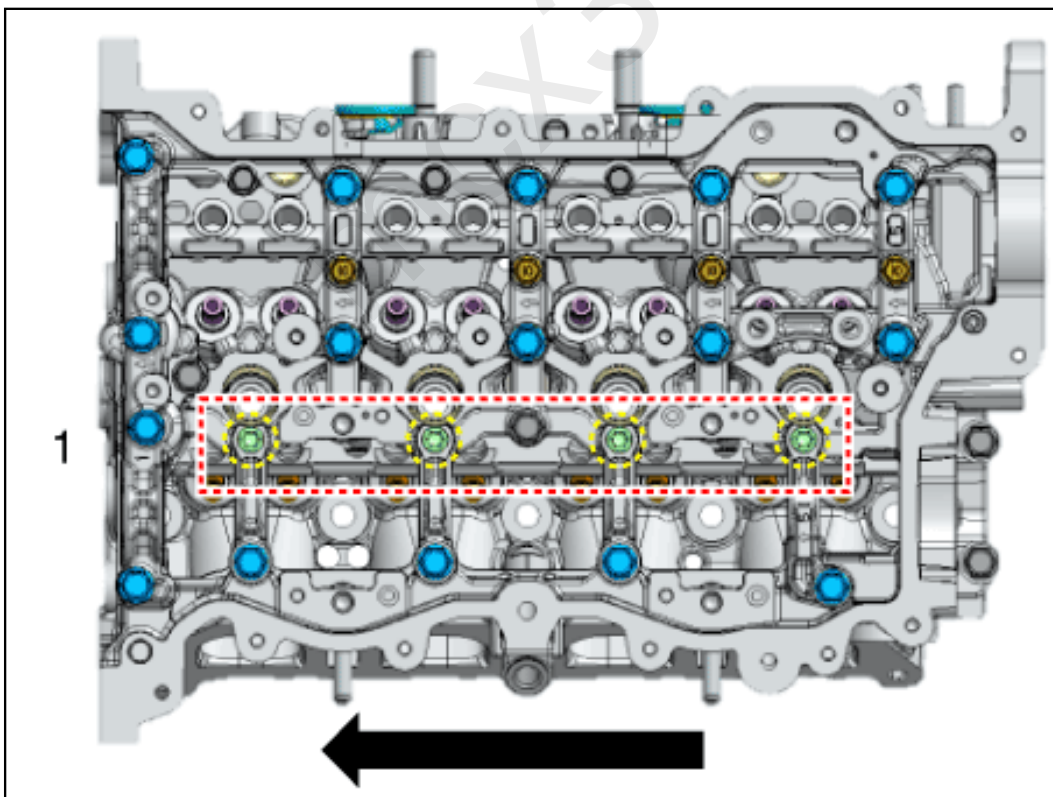
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



6) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

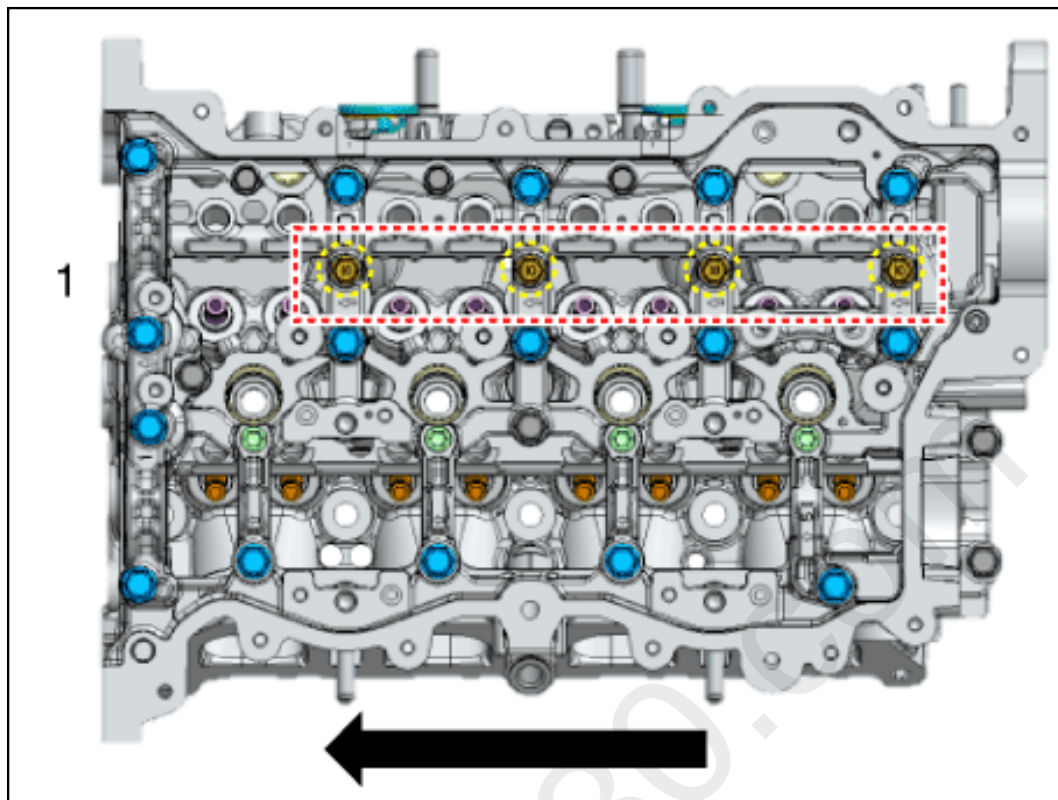
11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)



- 7) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)

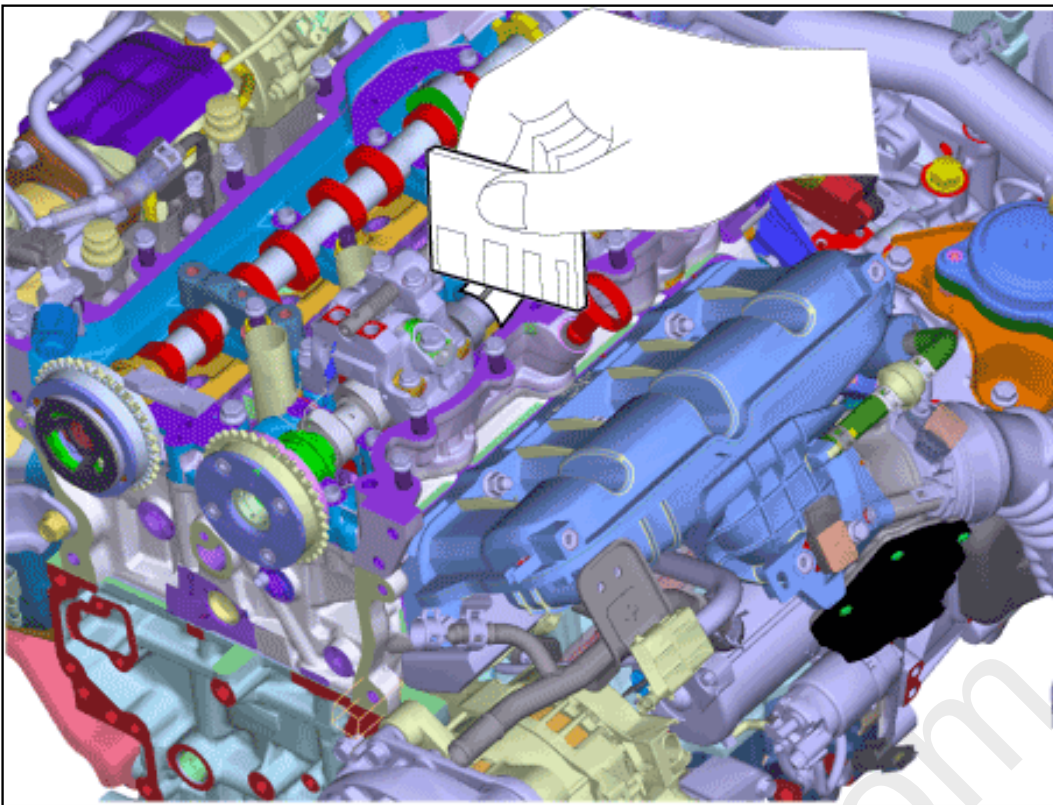


- (5) Remove the camshaft bearing caps.
(6) Measure the plastic gauge at the widest point.
If the oil clearance is greater than the specification, replace the camshaft.
If necessary, replace the bearing caps and cam carrier.

Cam height

No.1 : 0.040 - 0.071 mm (0.0016 - 0.0028 in.)

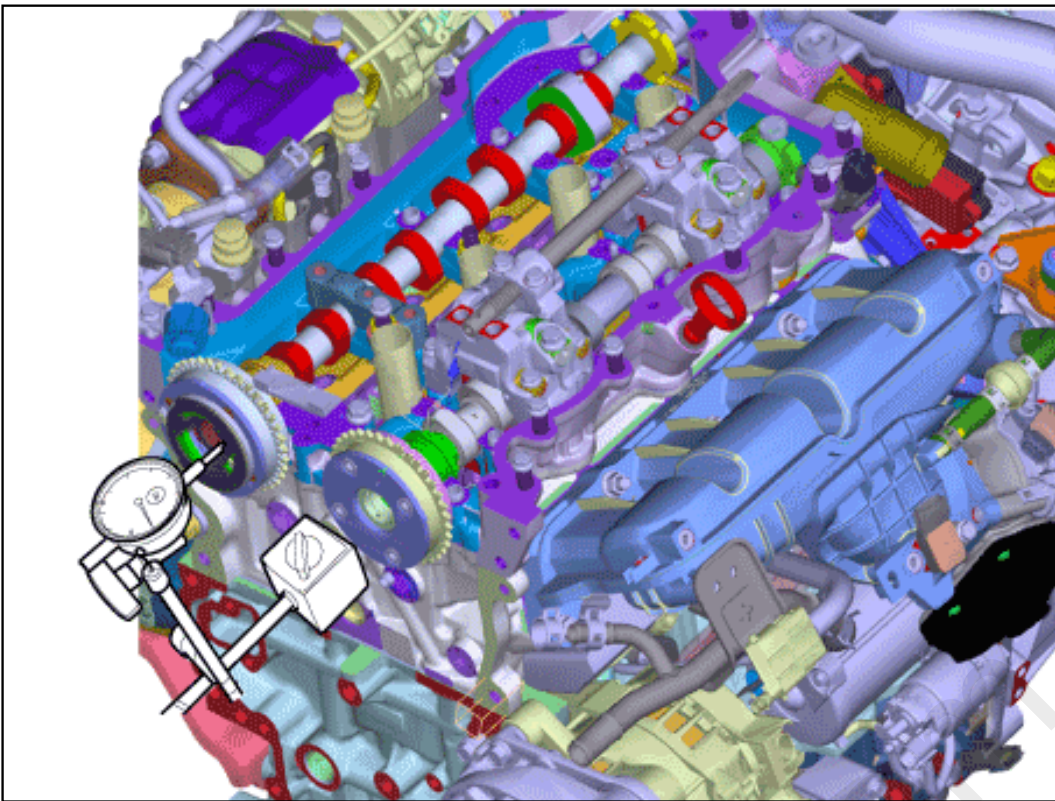
No.2, 3, 4, 5 : 0.035 - 0.065 mm (0.0014 - 0.0026 in.)



- (7) Remove the plastic gauge.
- (8) Remove the camshafts.
- 3. Inspect the camshaft end play.
 - (1) Install the camshafts.
 - (2) Measure the end play while moving the camshaft back and forth using a dial gauge.

Camshaft end play

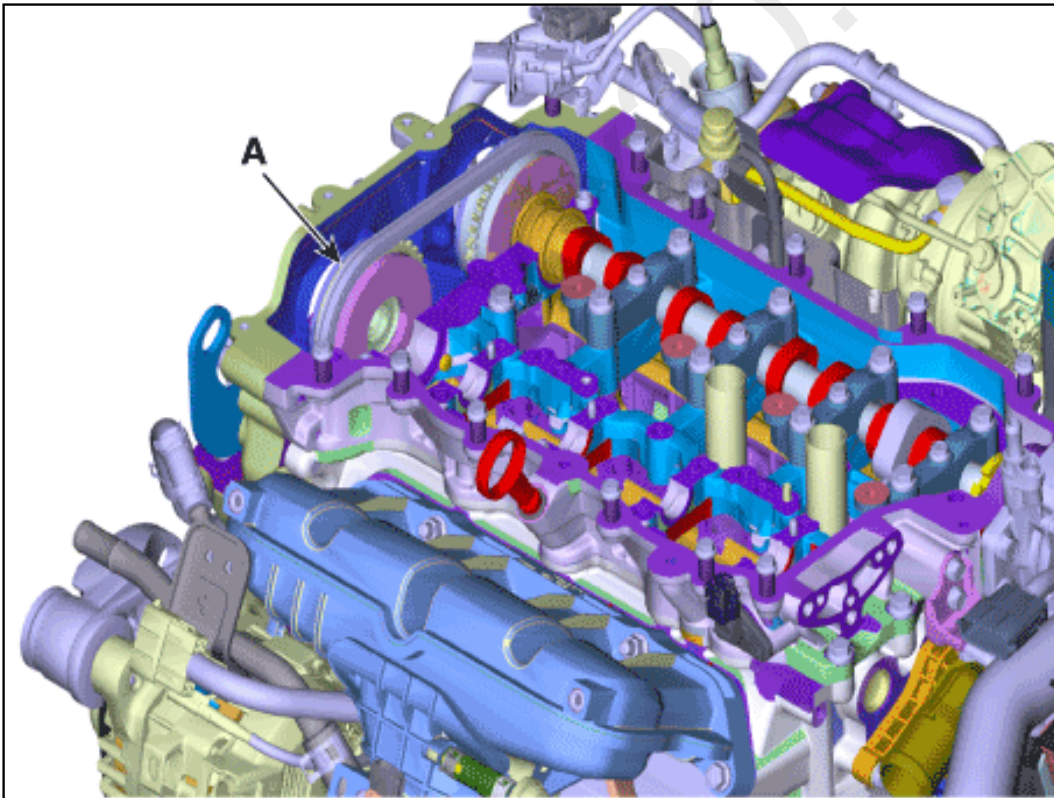
Standard value : 0.10 - 0.19 mm (0.0039 - 0.0075 in.)



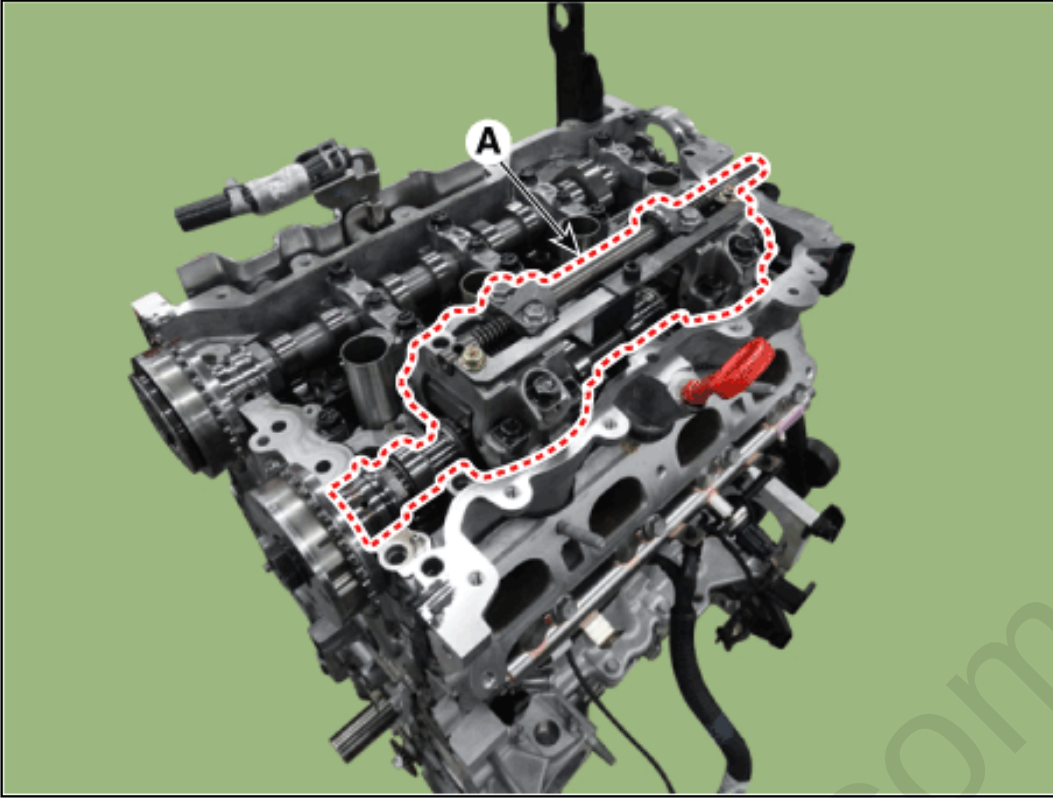
If the end play is greater than the specification, replace the camshaft. If necessary, replace the cylinder head.

Installation

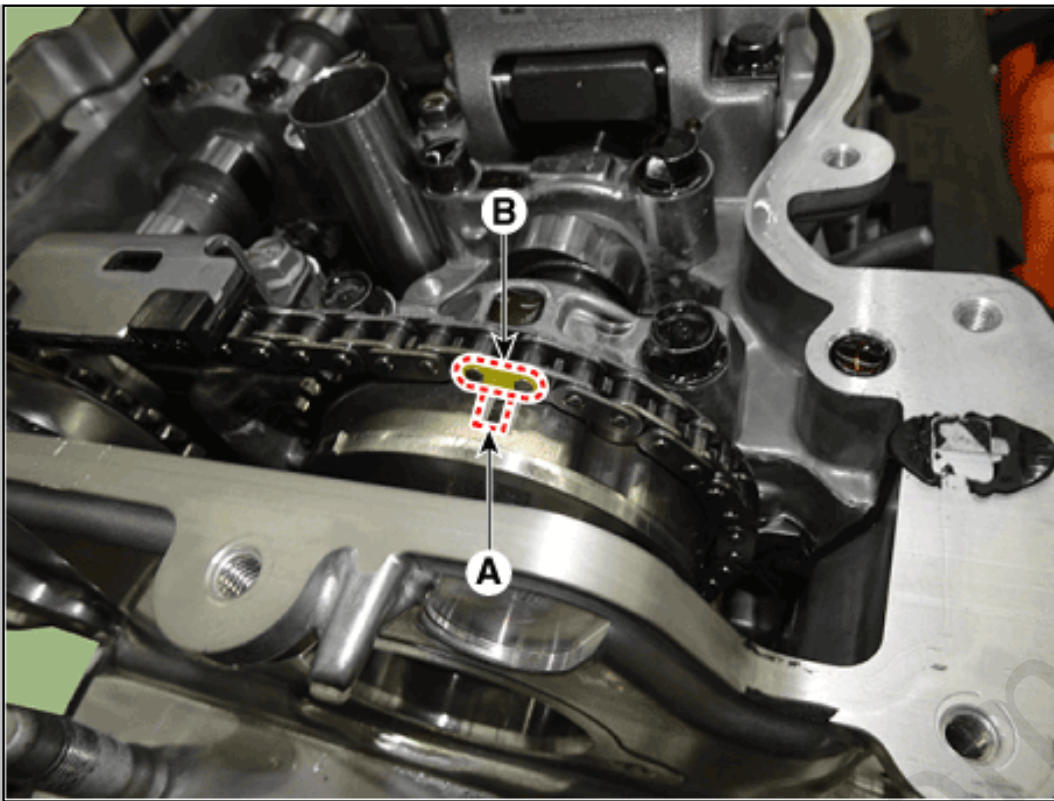
1. Install the intake CVVT (A).



2. Install the CVVD assembly (A).



- After installing the CVVD, check whether the swing arm is separated or is installed correctly.
- When installing the intake camshaft, spray the engine oil to the camshaft journal installing part (A) of the cam carrier.
The amount of application should be enough to flow down both the front and back sides when it is applied to the center.
- For installation, the timing mark (A) of the intake CVVT and the timing chain mark (B) should be matched.



- During the installation, there should be no artificial rotation or movement of the guide bracket and control shaft.
- When removing the CVVD fixing jig, be sure to securely tighten the M6 bolts.
- If CVVD fixing jig is available, be sure to work by using it.

When Using the CVVD fixture

1. When installing the CVVD assembly mounting bolts (M6), tighten sequence shown.

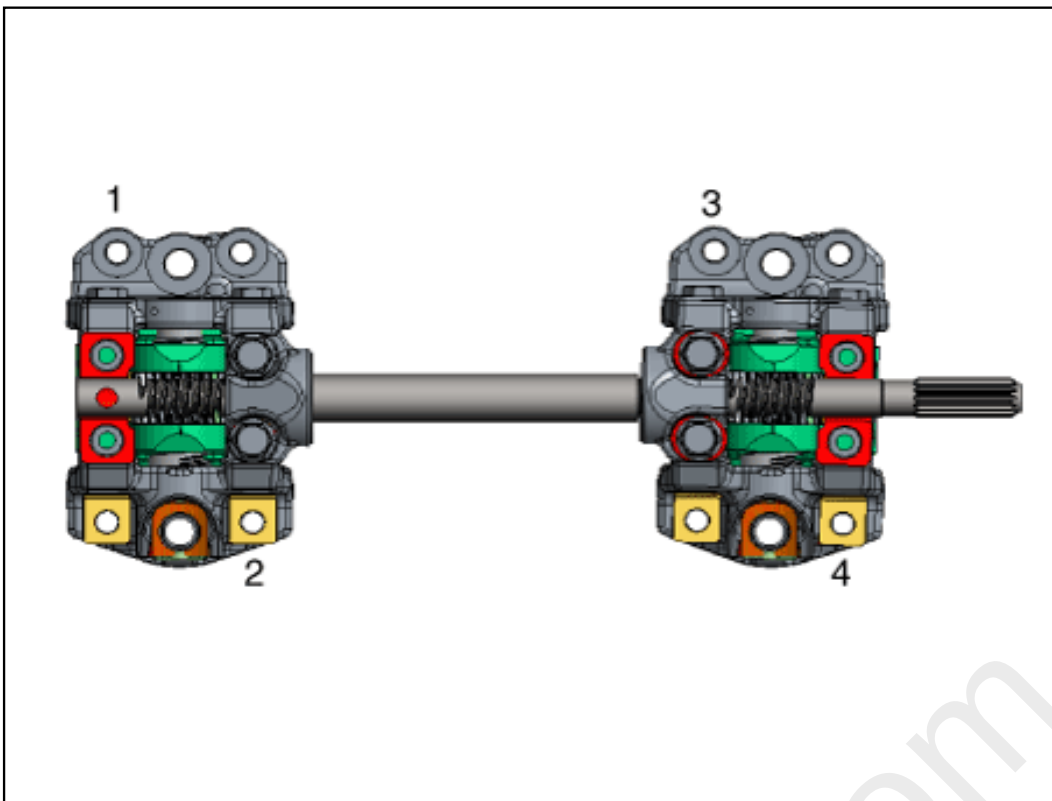
Tightening torque :

1ST

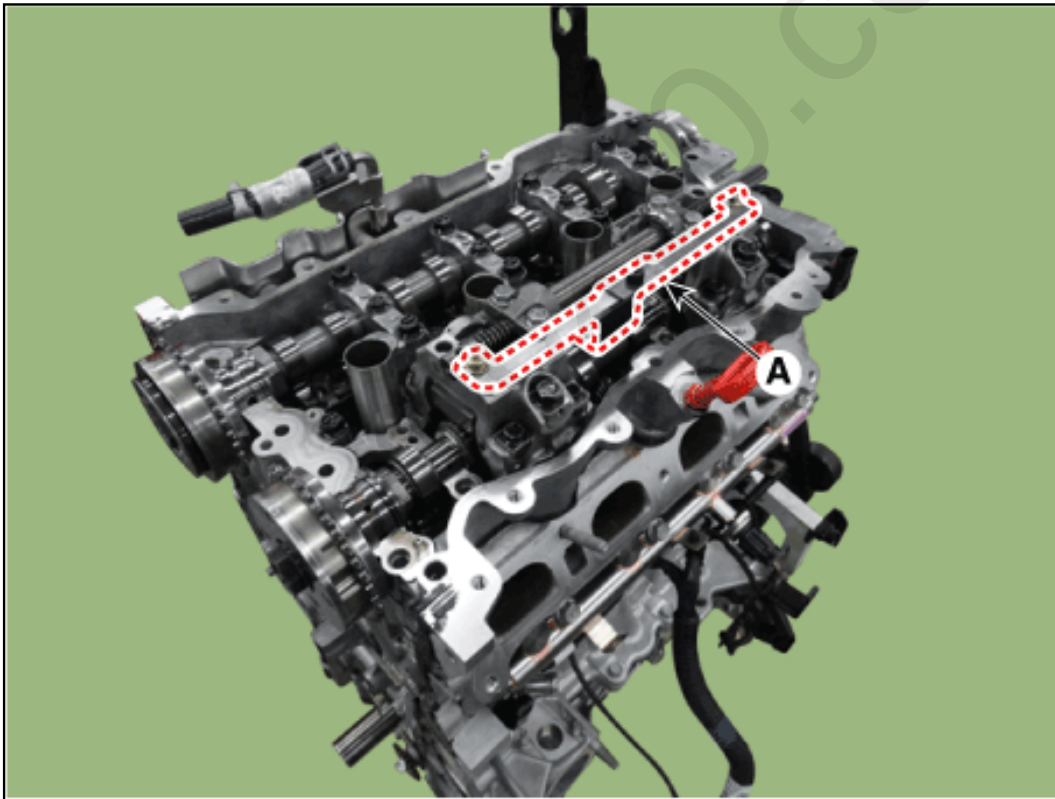
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)

2nd

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



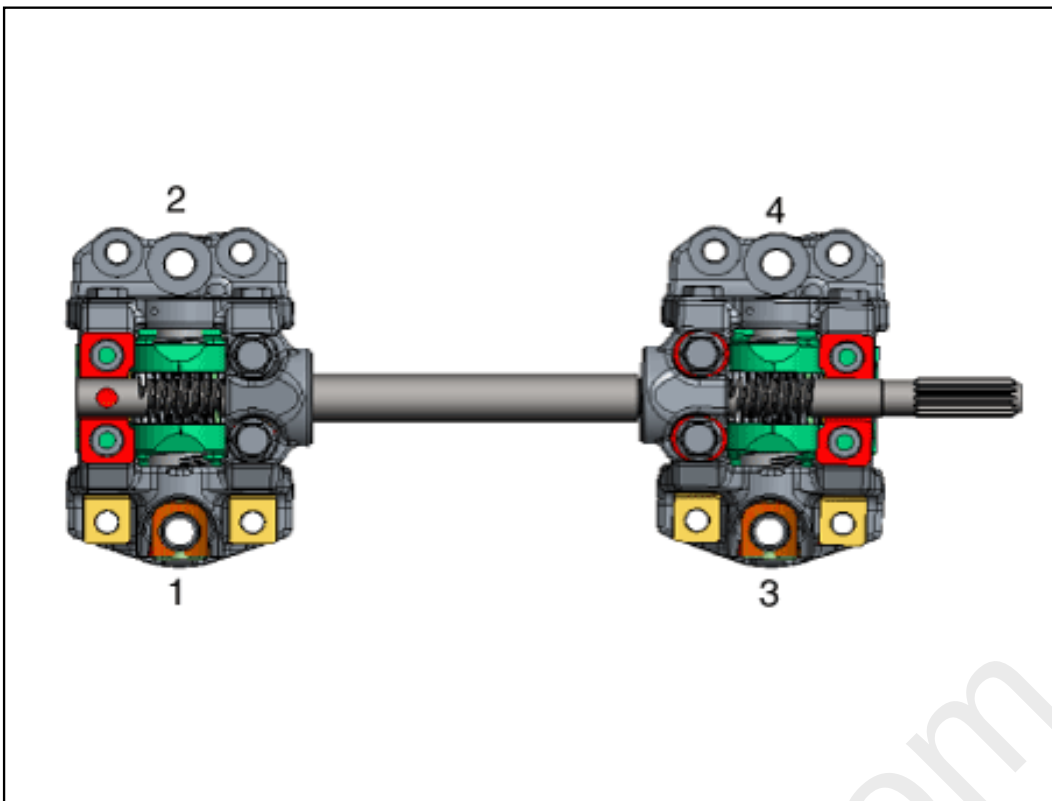
2. Remove the CVVD fixture (A).



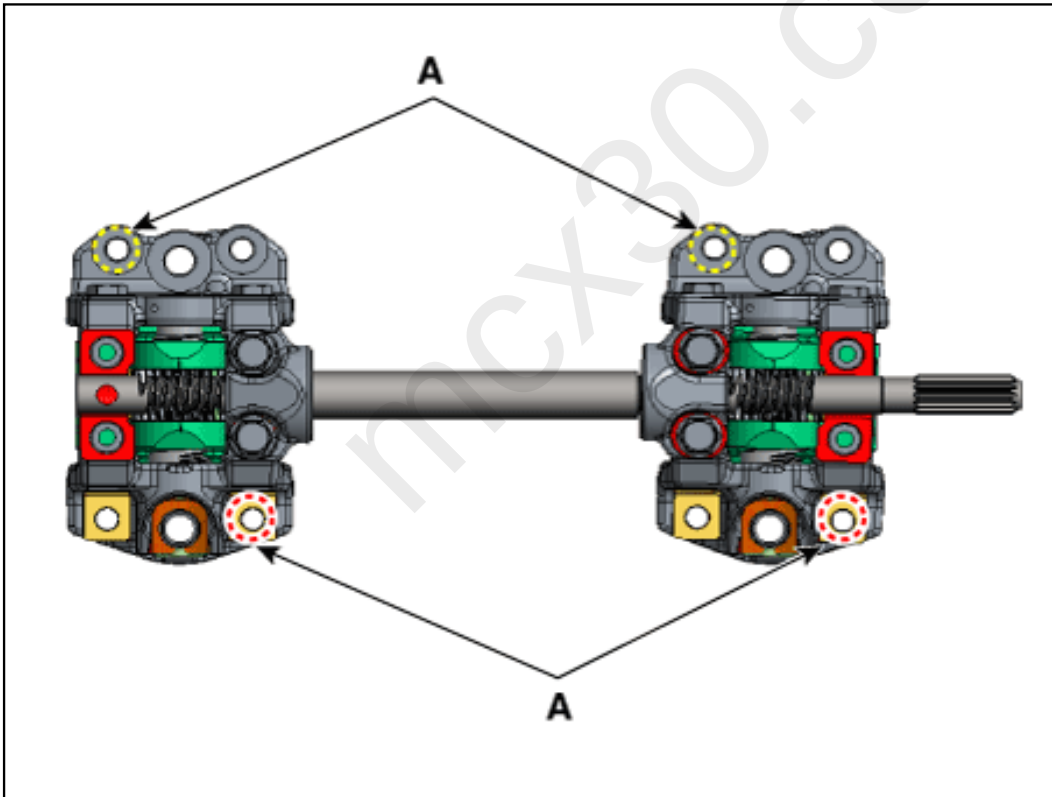
3. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

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



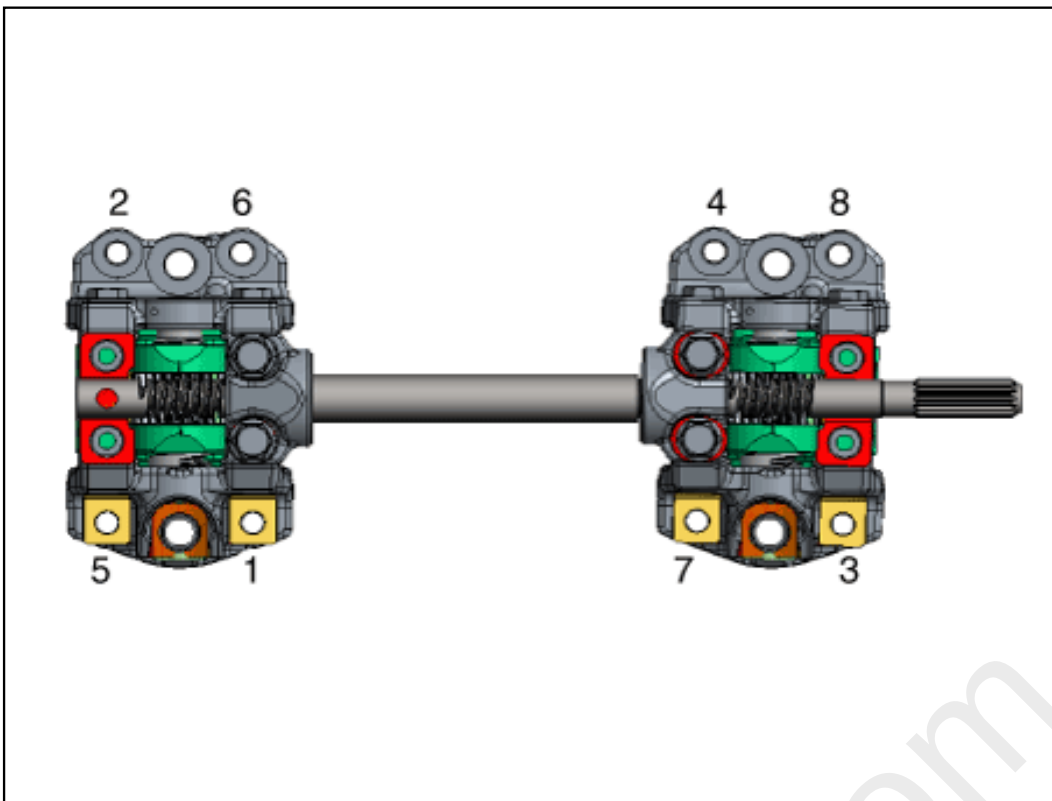
4. Remove the CVVD assembly mounting bolts (M6) (A).



5. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

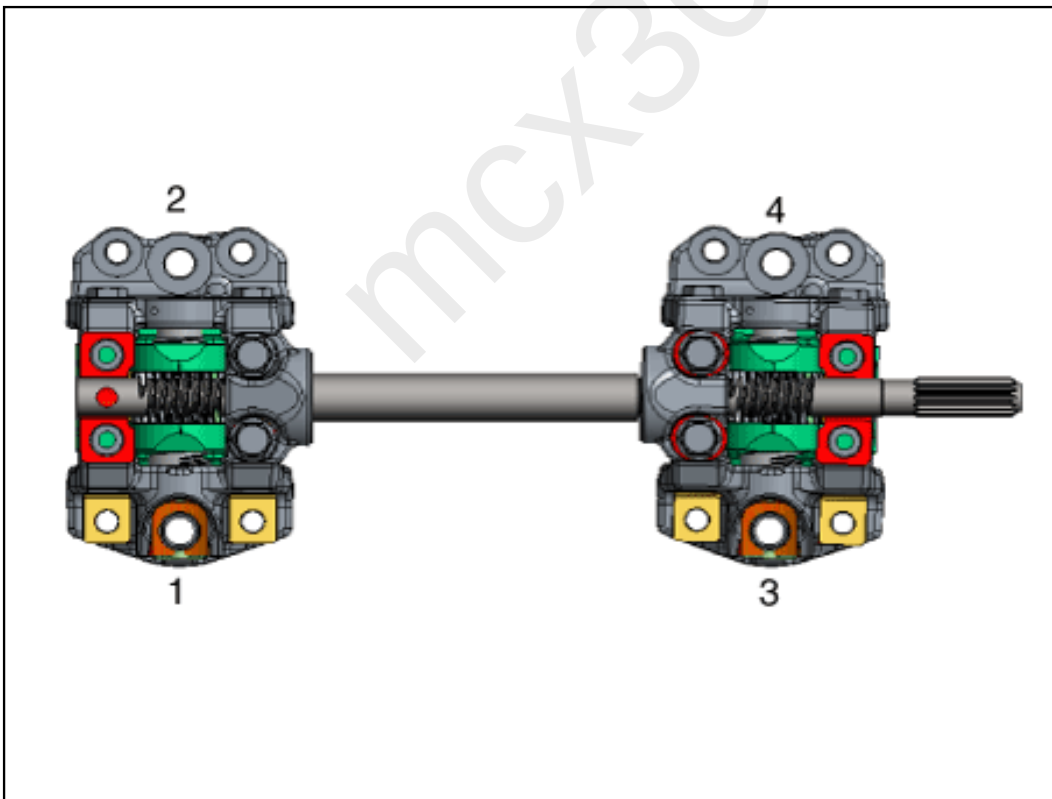
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



6. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

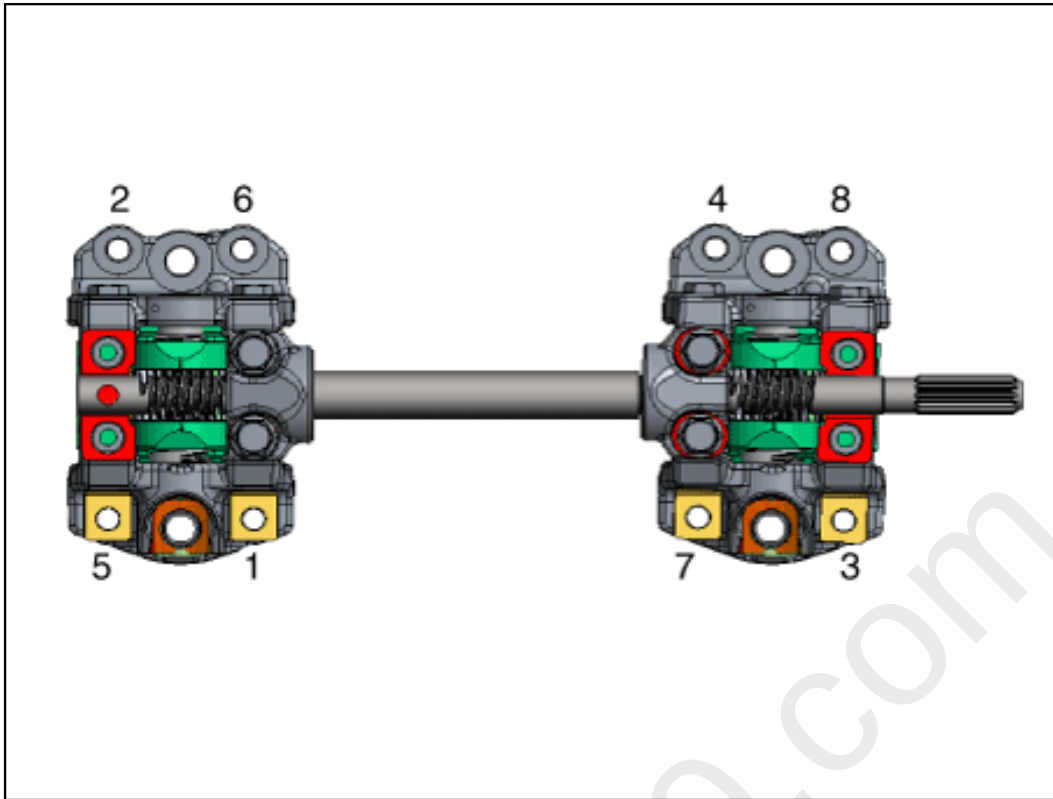
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



7. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

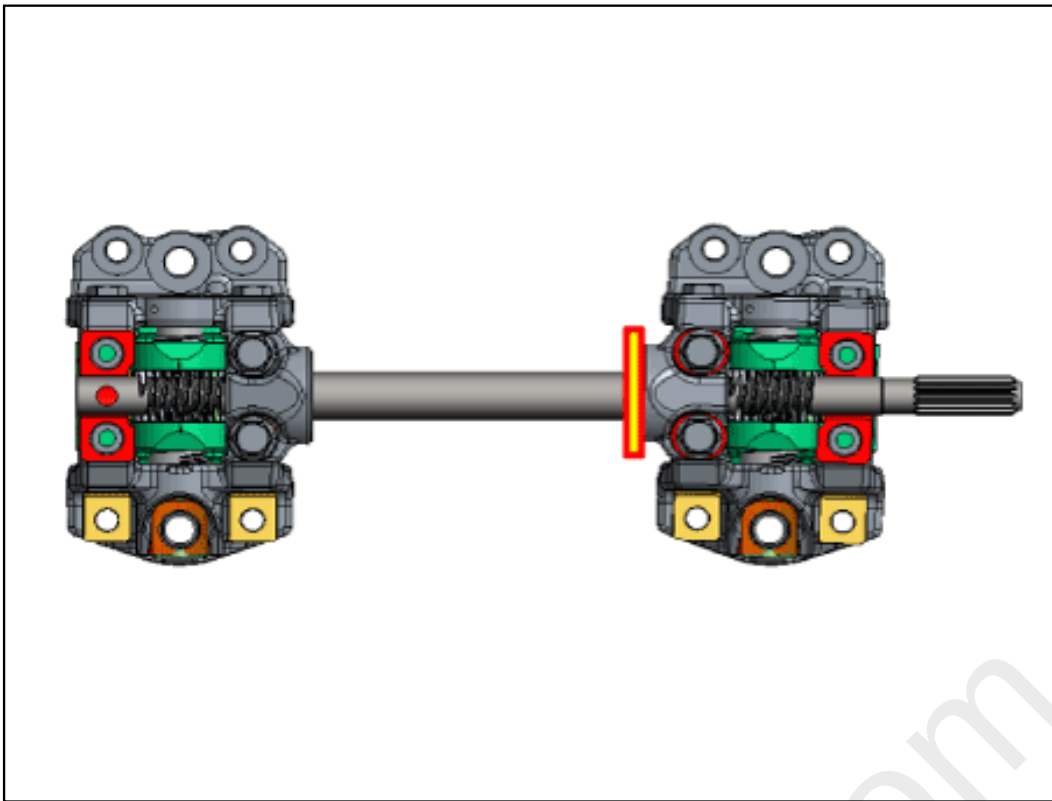
Tightening torque :

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



8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)

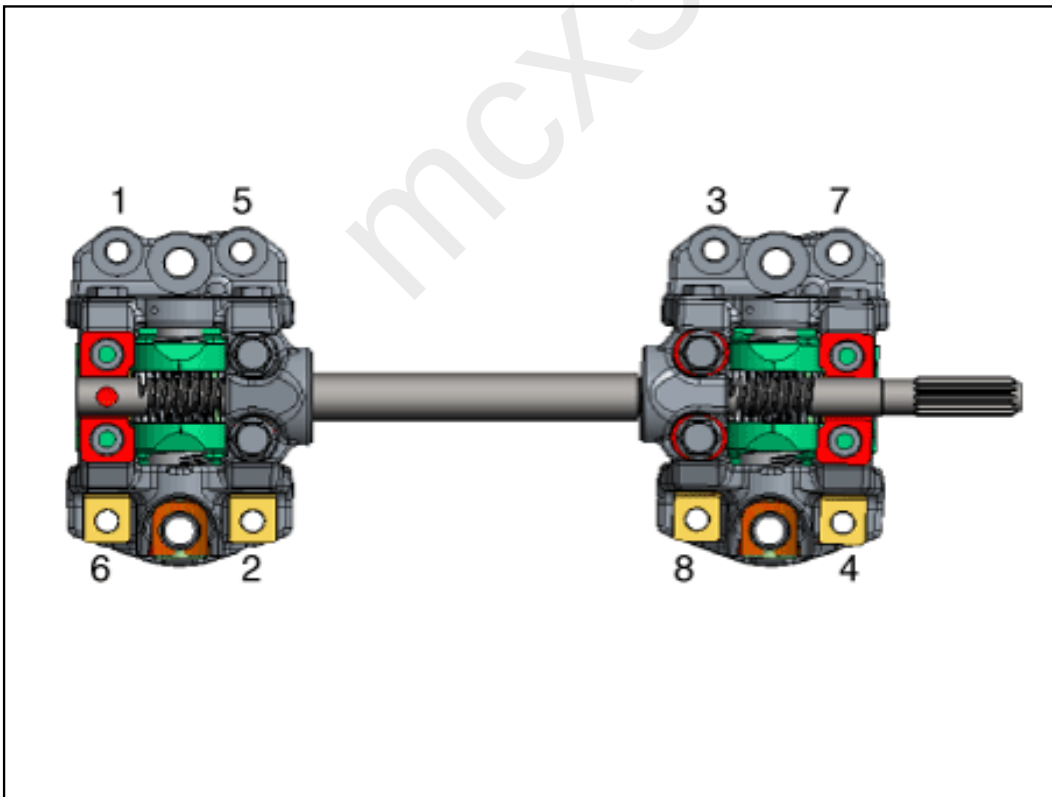


When not using the CVVD fixture

1. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

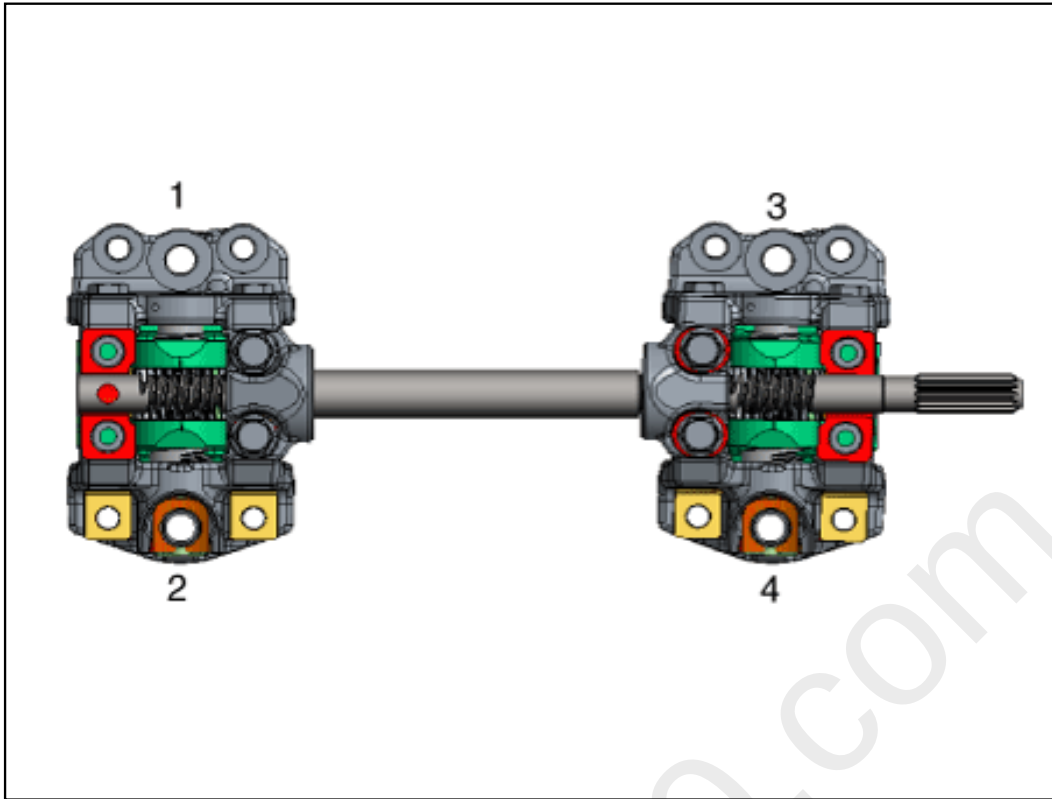
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



2. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

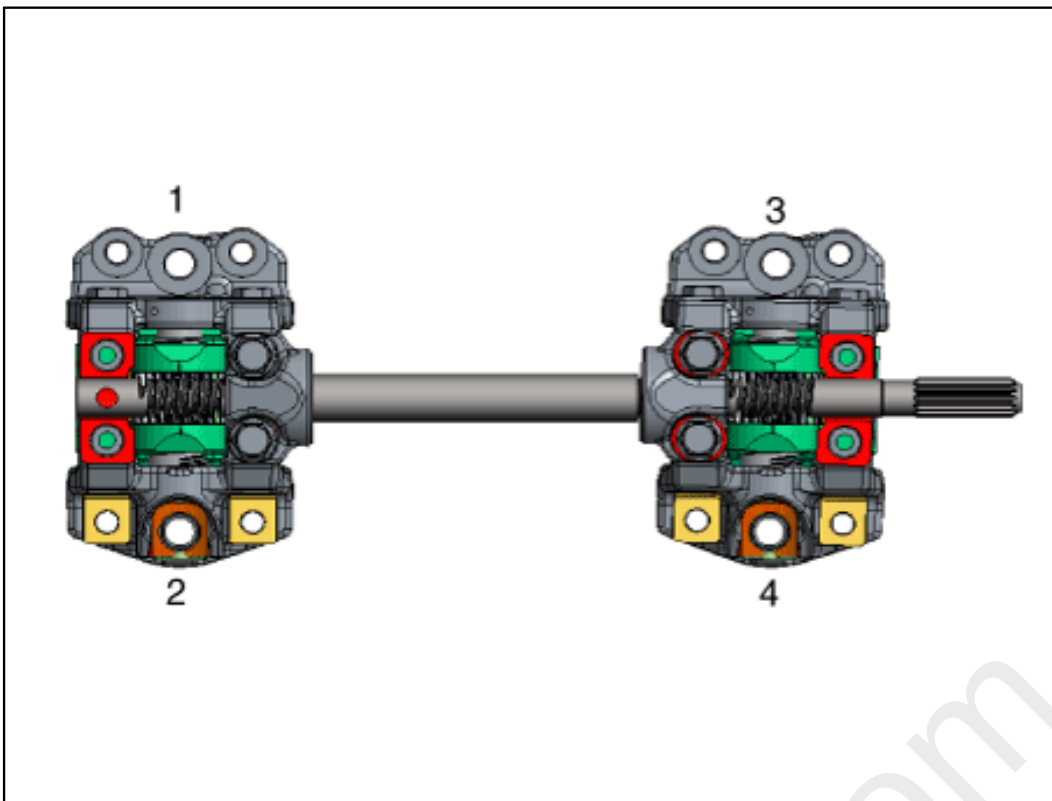
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



3. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

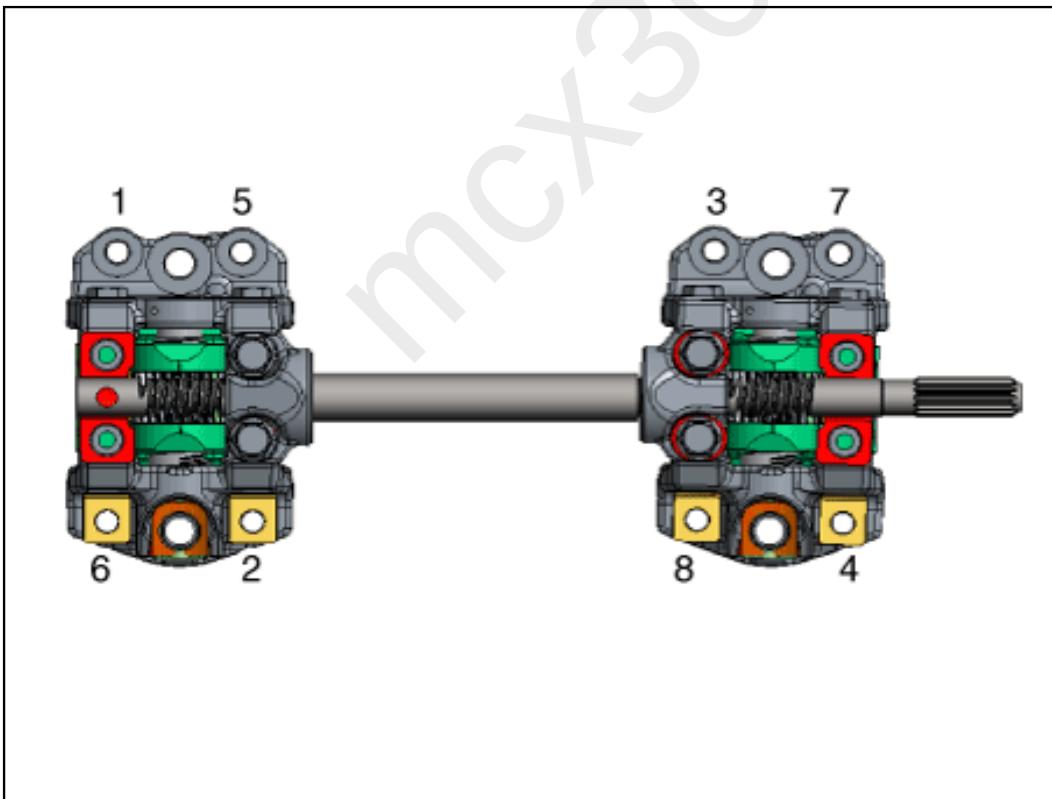
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



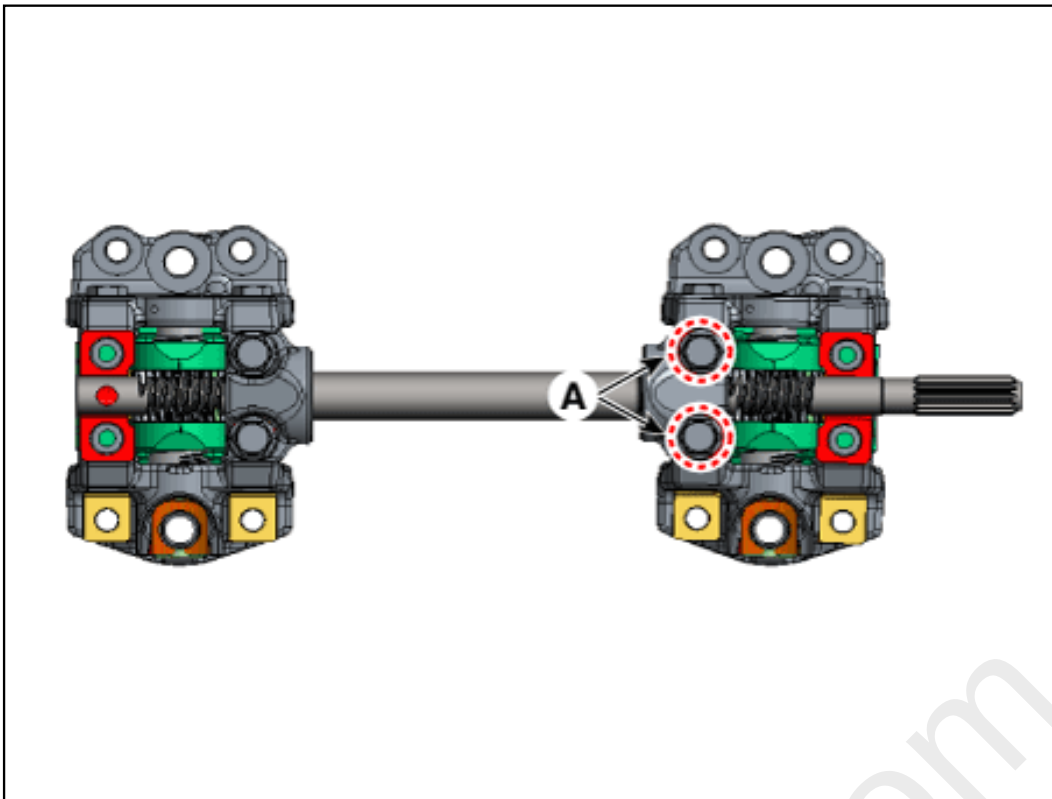
4. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

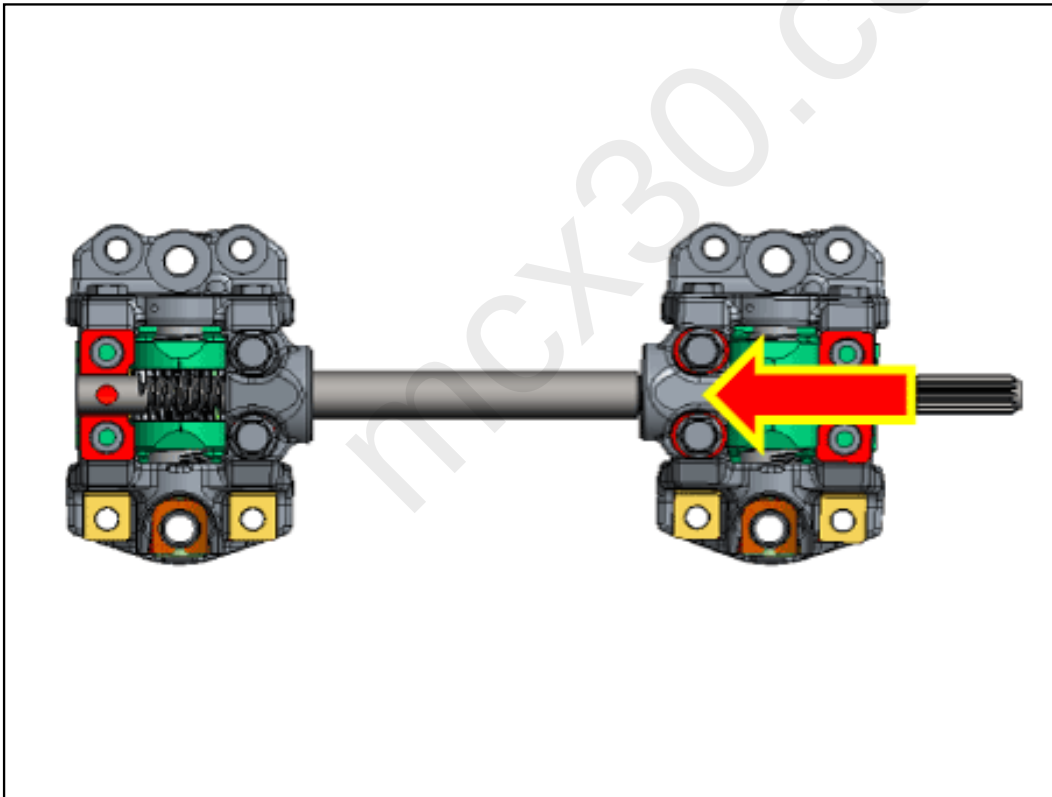
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



5. Release the torque of control shaft bearing cap bolt (A).



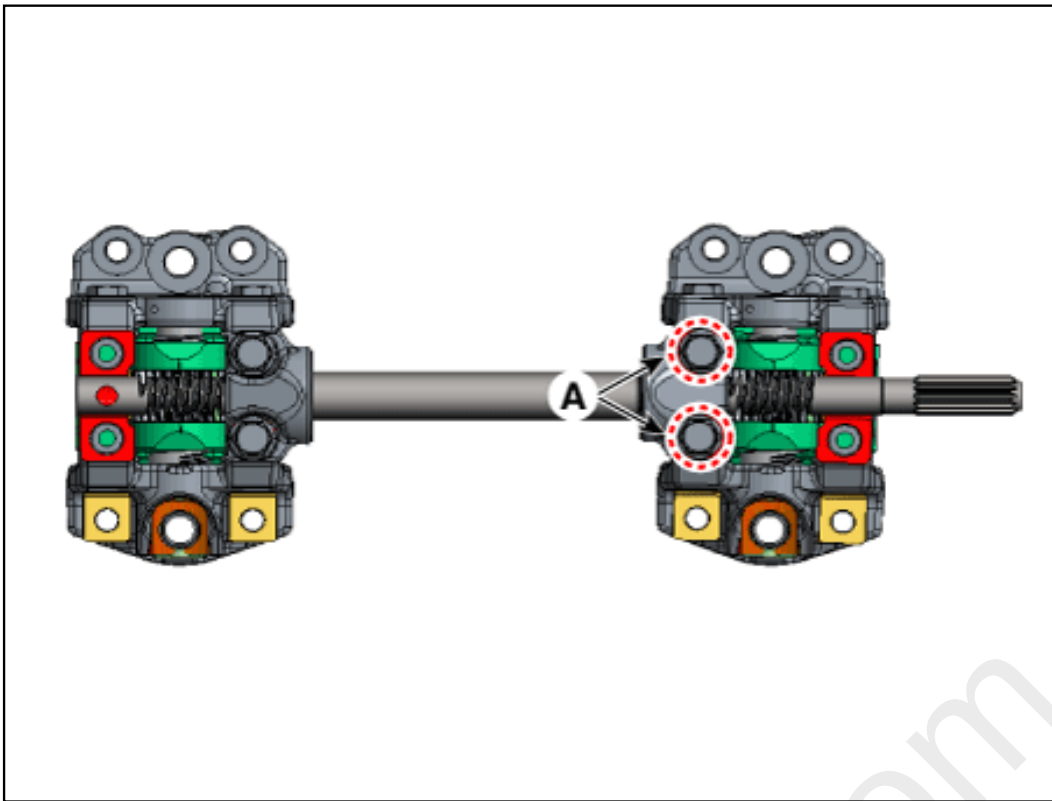
6. Push the control shaft bearing cap as close as possible in the direction of the arrow.



7. Install the control shaft bearing cap mounting bolts (A).

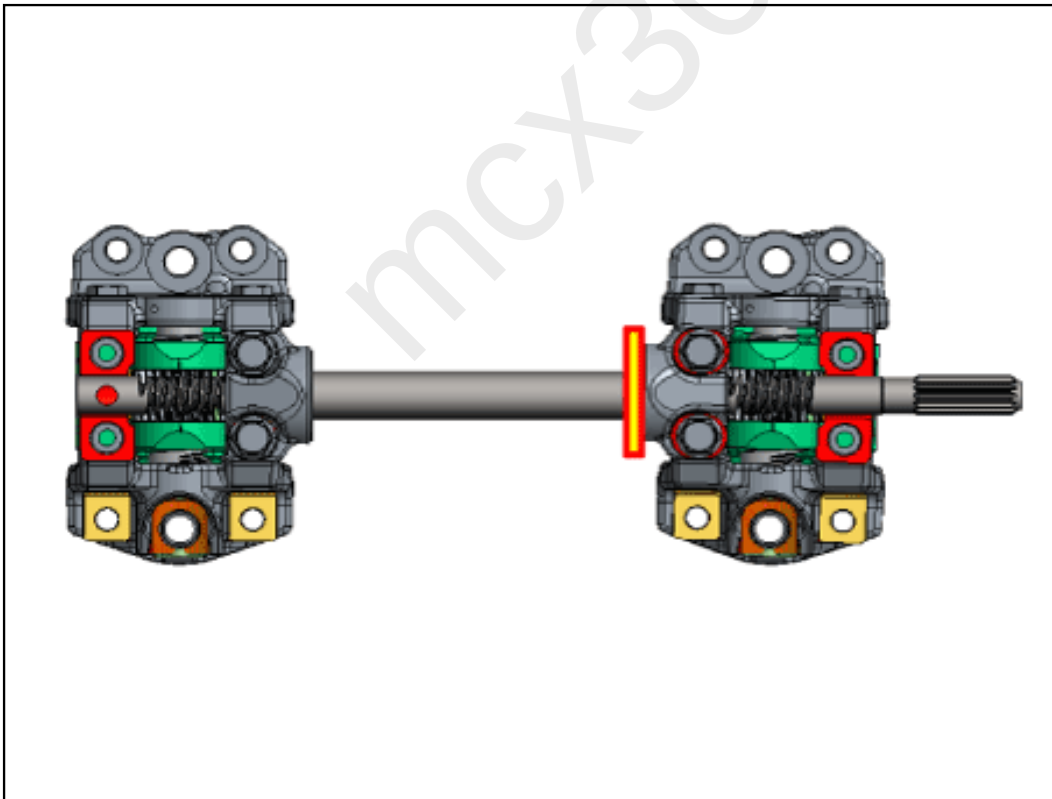
Tightening torque :

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



8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

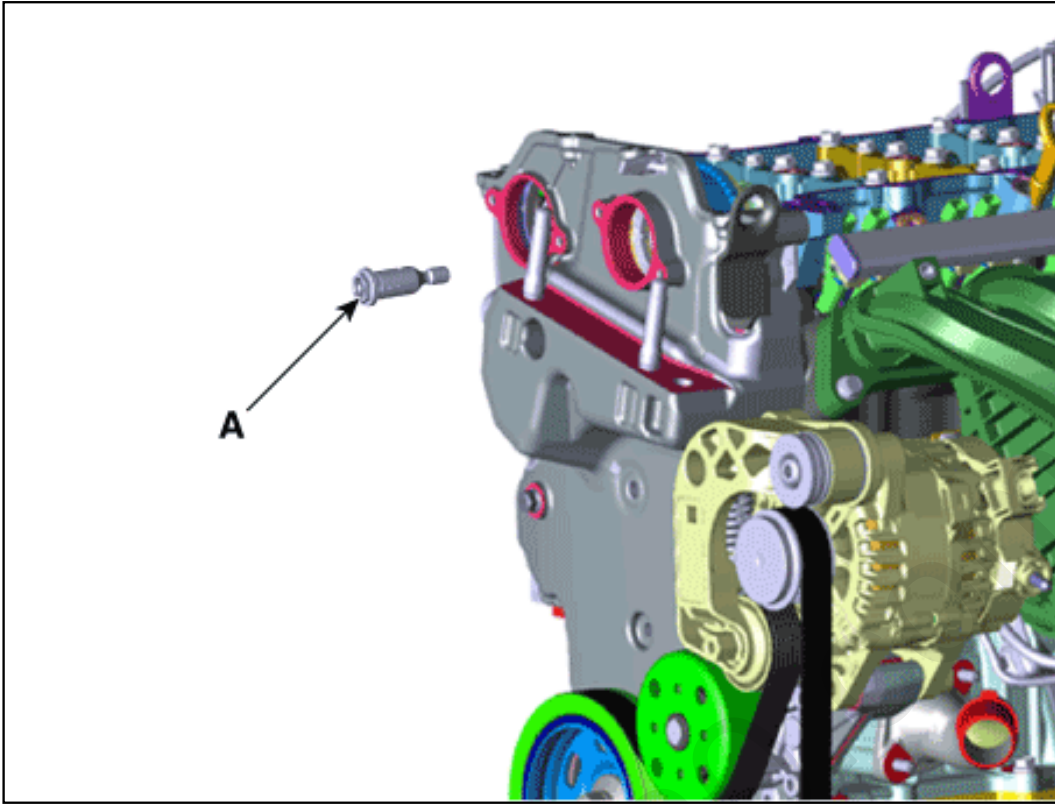
Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)



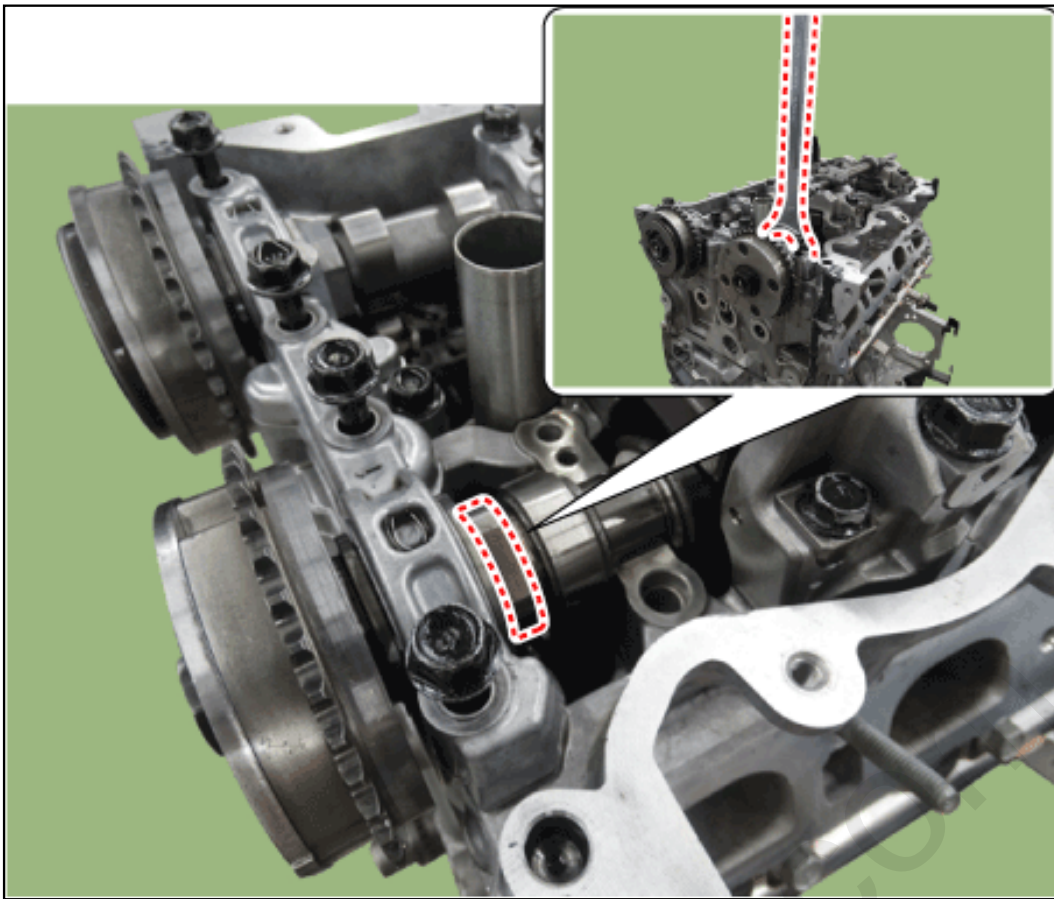
3. Install the intake OCV & center bolt (A).

Tightening torque :

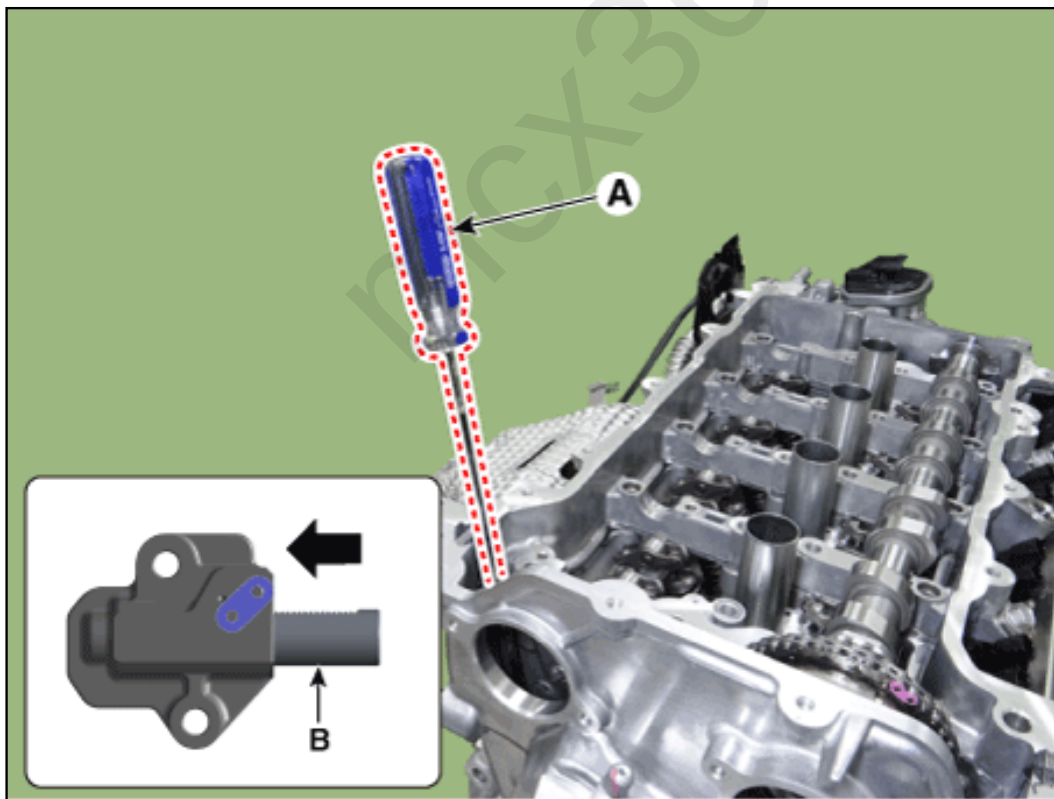
22.6 - 26.5 N.m (2.3 - 2.7 kgf.m, 16.6 - 19.5 lb-ft) + 32 - 36°



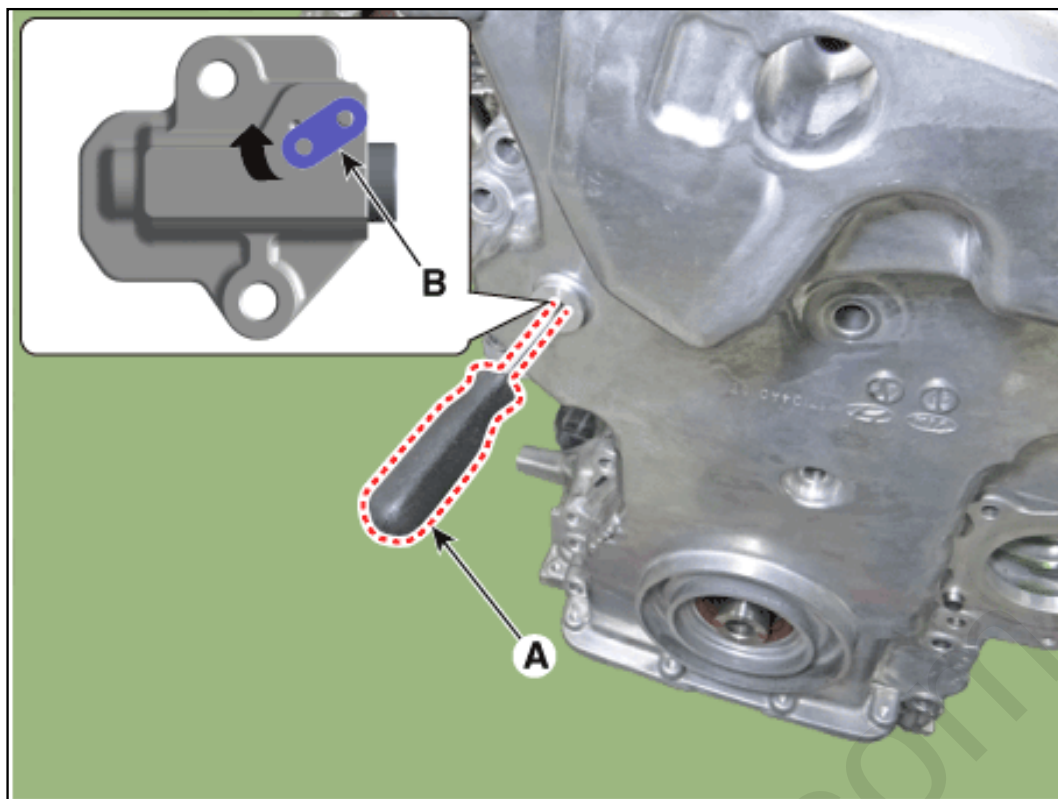
- To prevent impurities from entering intake oil control valve (OCV) & center bolt, wear rubber gloves.
- intake oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.



4. Compress the timing chain tensioner piston.
(1) With a pry bar (A), compress the timing chain tensioner piston (B).

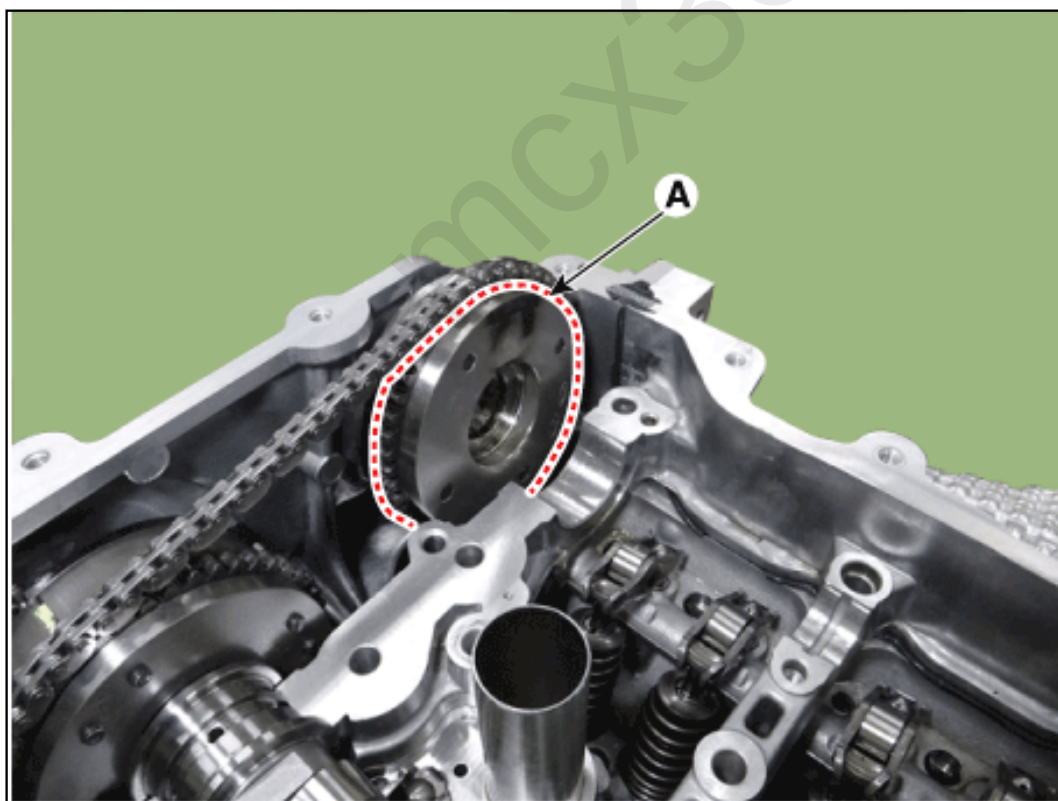


(2) With a thin gimlet (A), raise the ratchet plate (B) of the timing chain tensioner and fix the piston.



•Do not remove the pick (A).

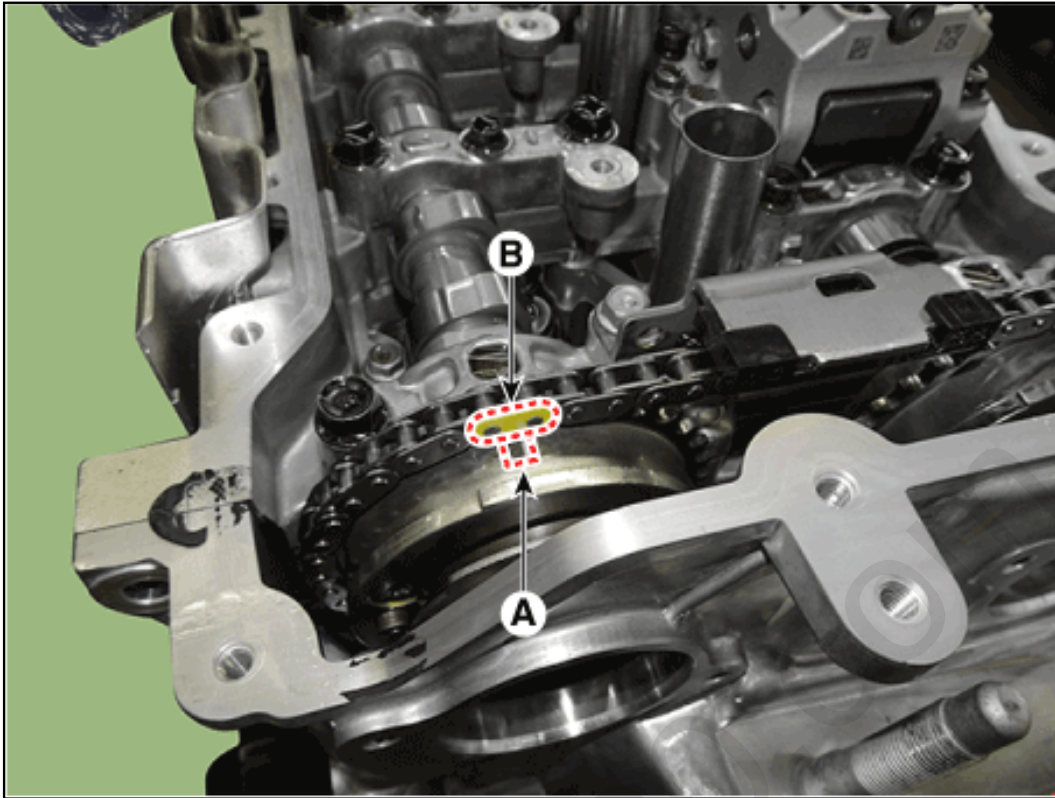
5. Install the exhaust CVVT (A).



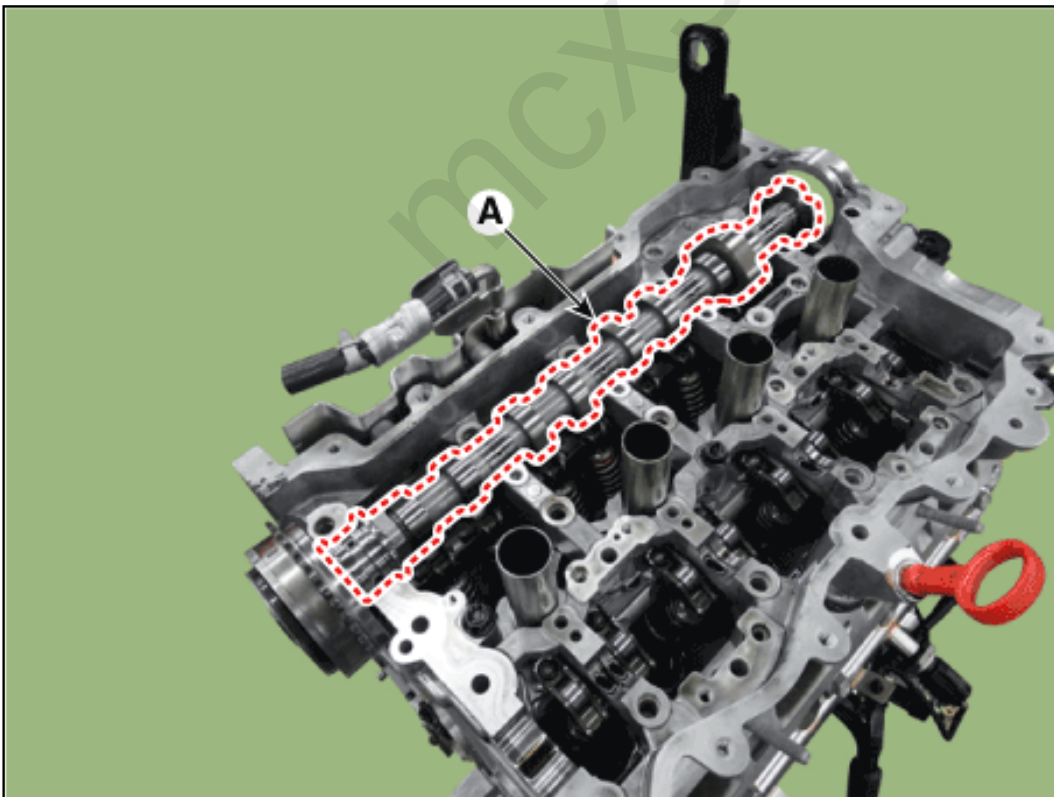


- When installing the timing chain, be sure that the timing mark (A) of each sprocket is matched with the timing mark (B) (color link) of the timing chain.

[Exhaust CVVT Timing Mark]



6. Install the exhaust camshaft (A).



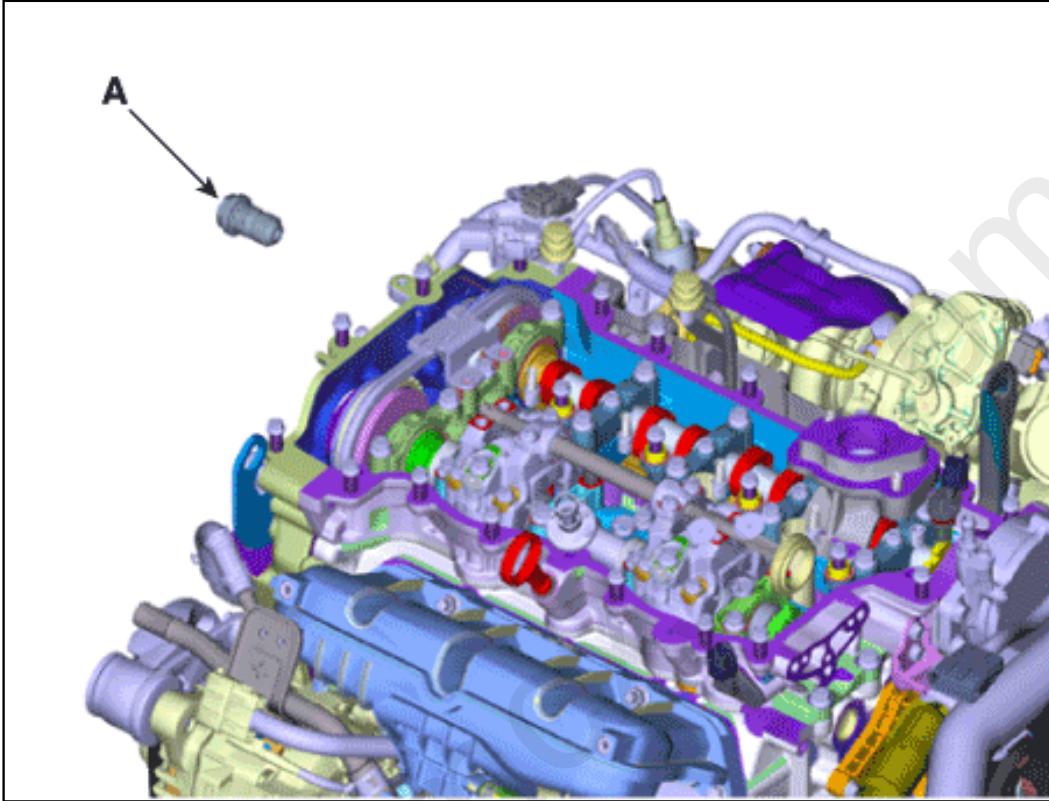


- After installing exhaust camshaft, check whether the swing arm is separated or is installed correctly.
- When installing the exhaust camshaft, spray the engine oil to the camshaft journal installing part of the cam carrier.
The amount of application should be enough to flow down both the front and back sides when it is applied to the center..

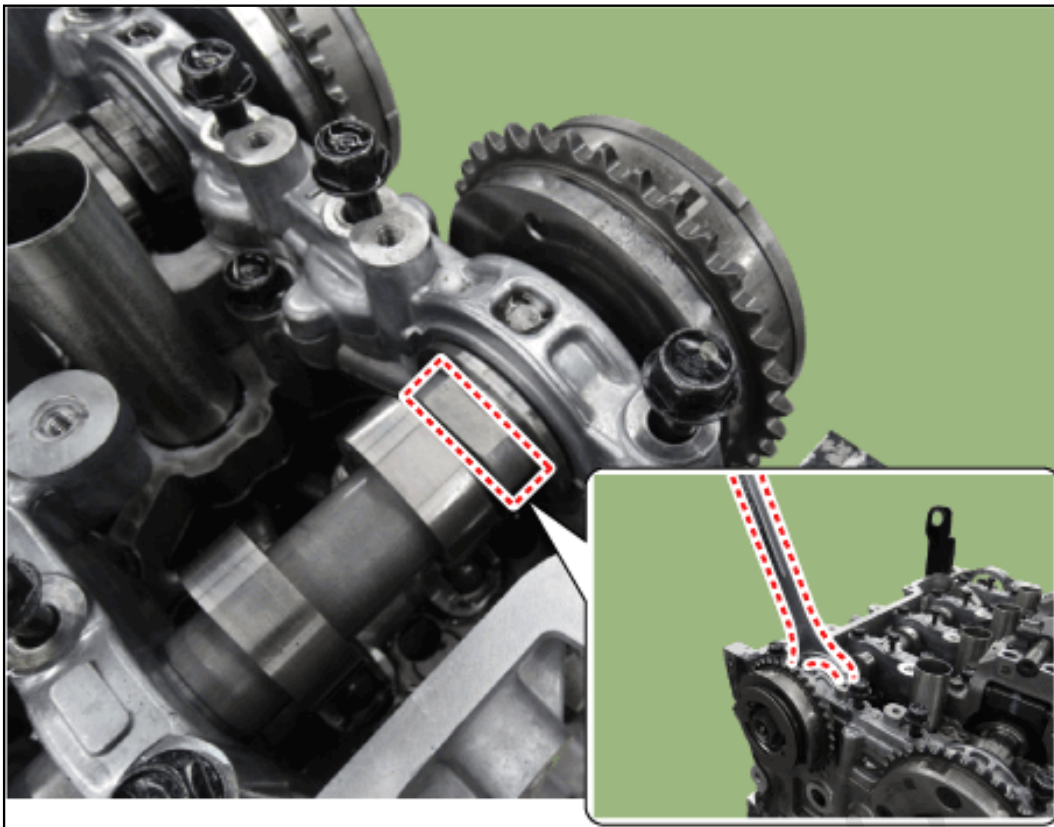
7. Install the exhaust oil control valve (OCV) and center bolt (A).

Tightening torque :

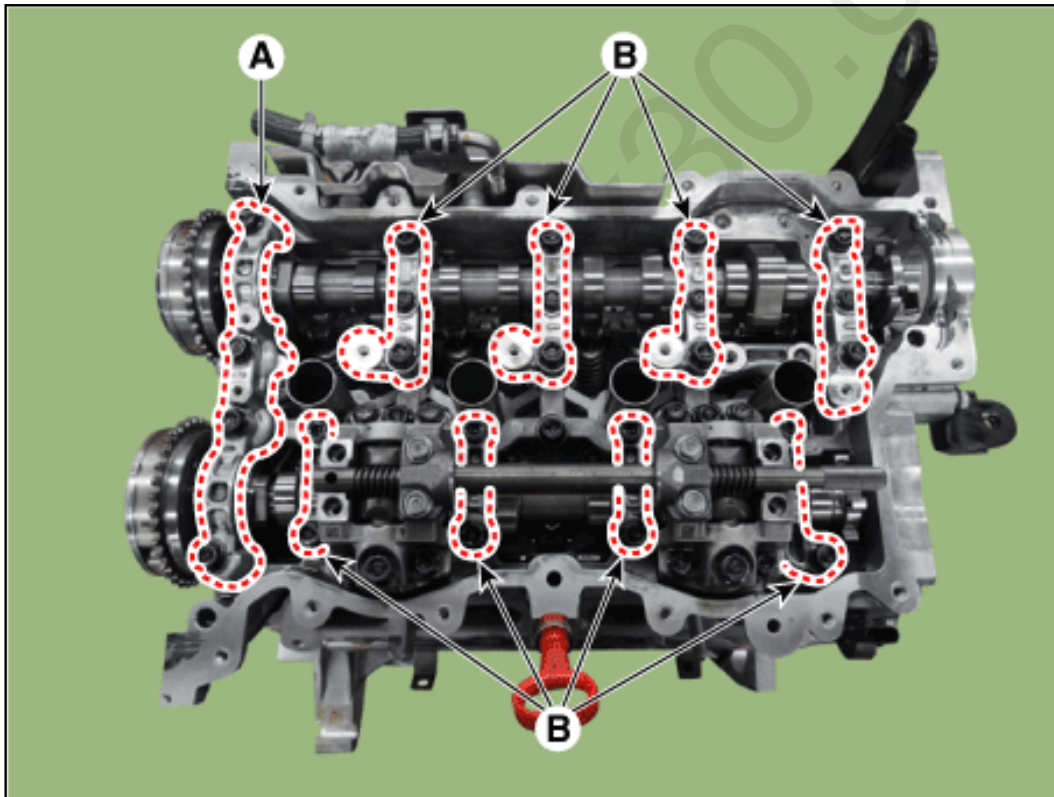
22.6 - 26.5 N.m (2.3 - 2.7 kgf.m, 16.6 - 19.5 lb-ft) + 32 - 36°



- To prevent impurities from entering exhaust oil control valve (OCV) & center bolt, wear rubber gloves.
- When installing the exhaust oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.



8. Install the camshaft front bearing cap (A) and camshaft bearing caps (B).



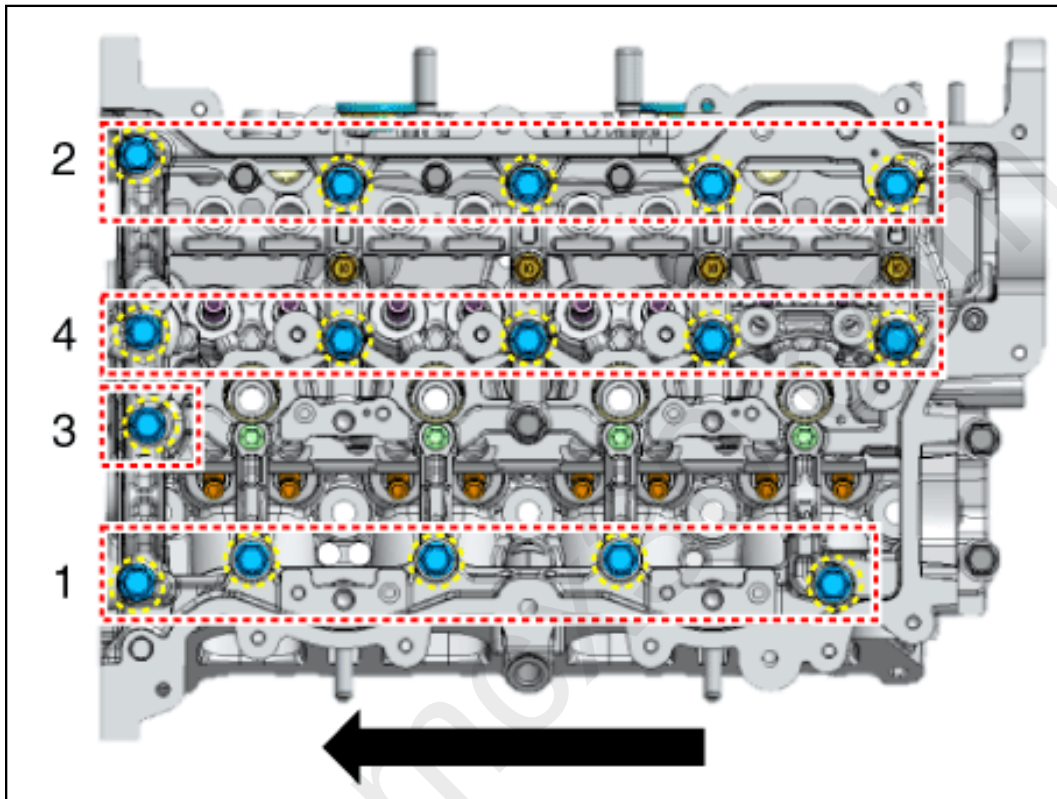


- If there is enough engine oil on the camshaft front bearing cap and camshaft bearing cap installing bolt and bolt hole, tighten to the minimum required tightening torque.
- Apply engine oil the upper part of the intake / exhaust camshaft journal, then install the camshaft front bearing cap and camshaft bearing cap. The amount of application should be enough to flow down both the front and back sides when it is applied to the center.

1) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

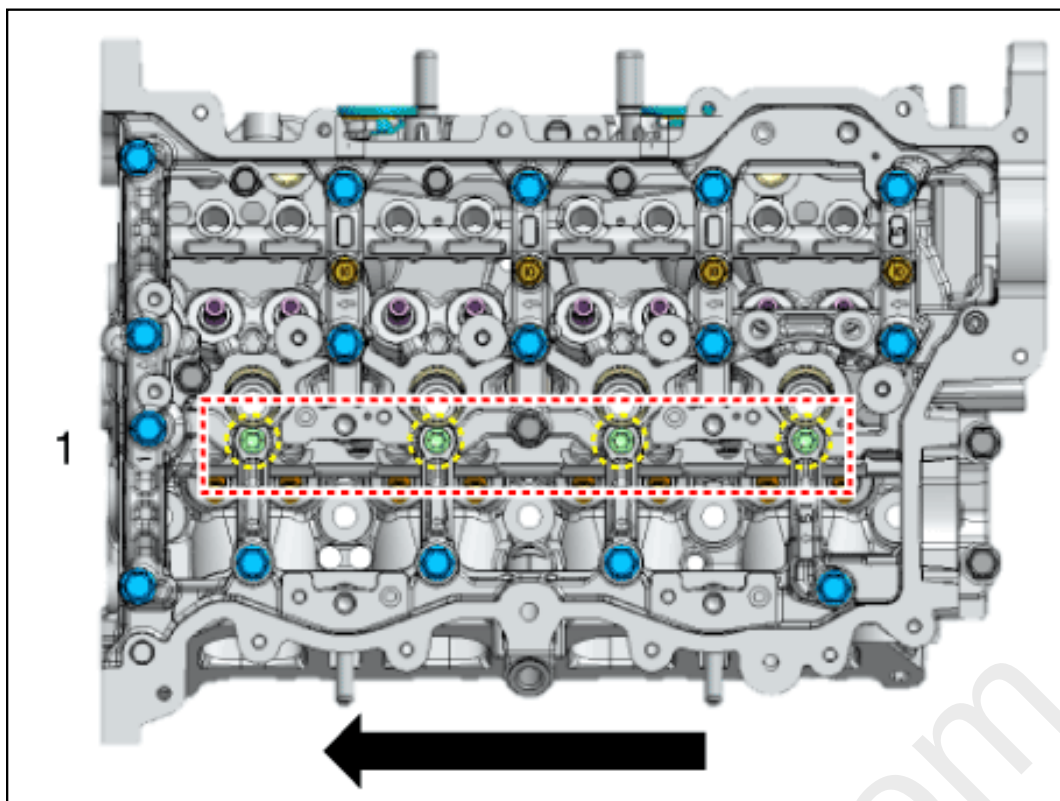
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



2) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

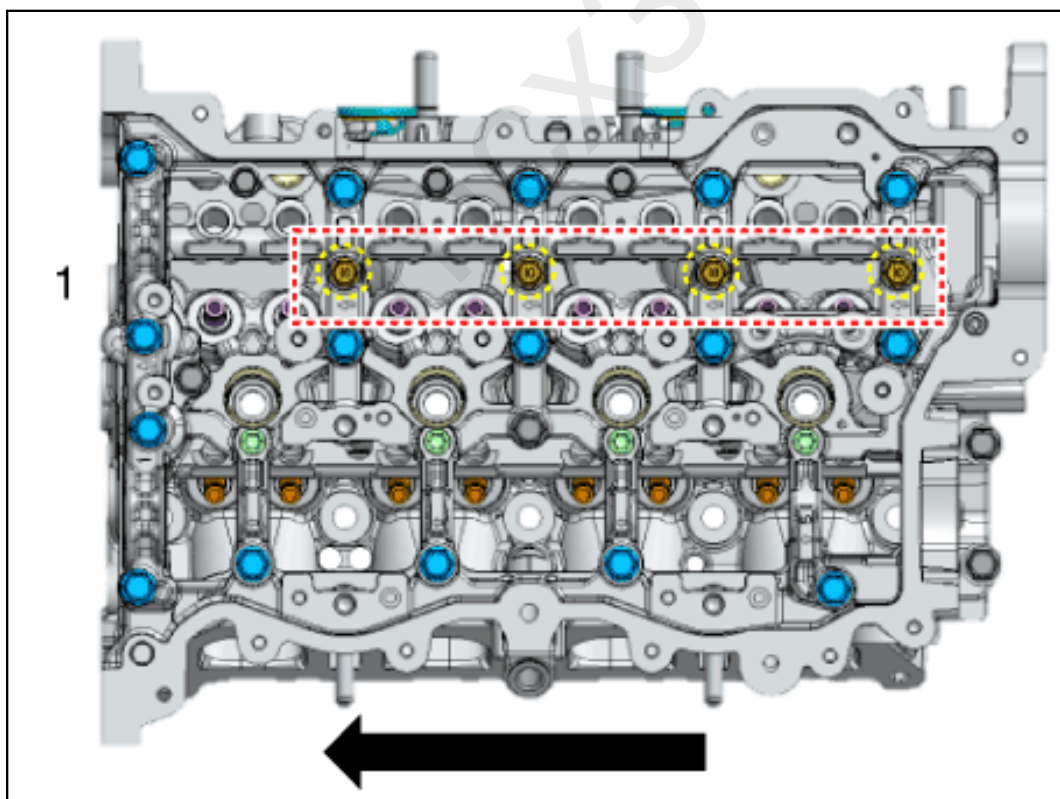
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



3) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

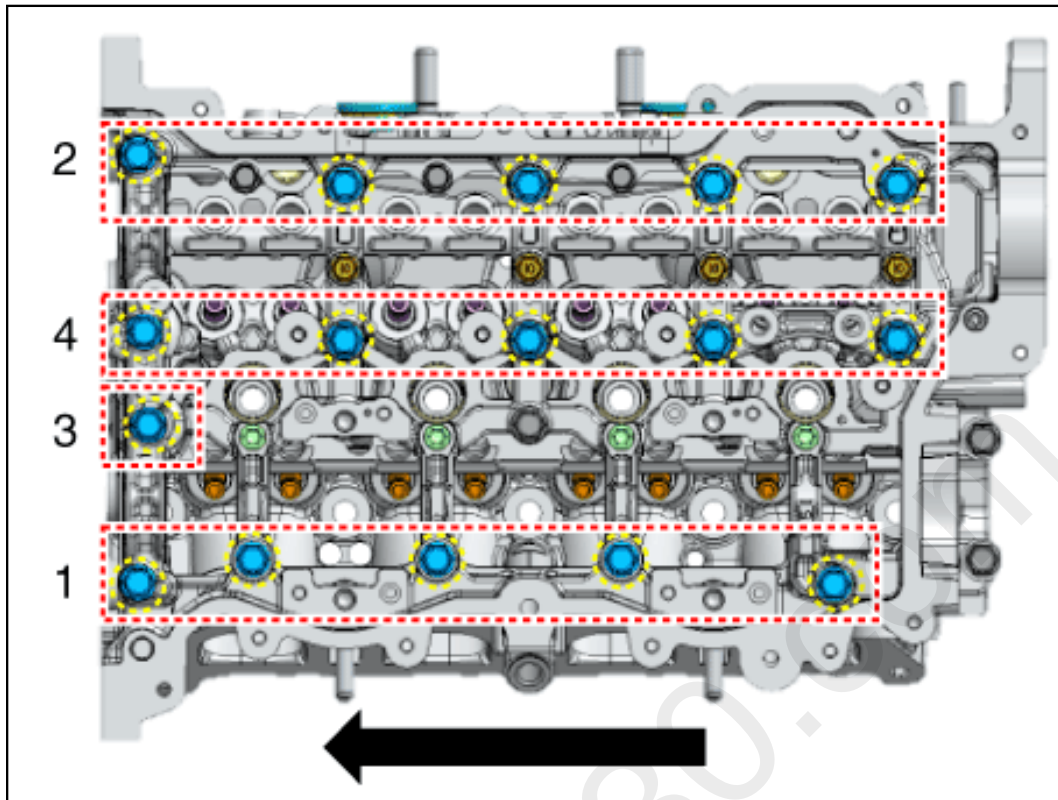
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



- 4) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

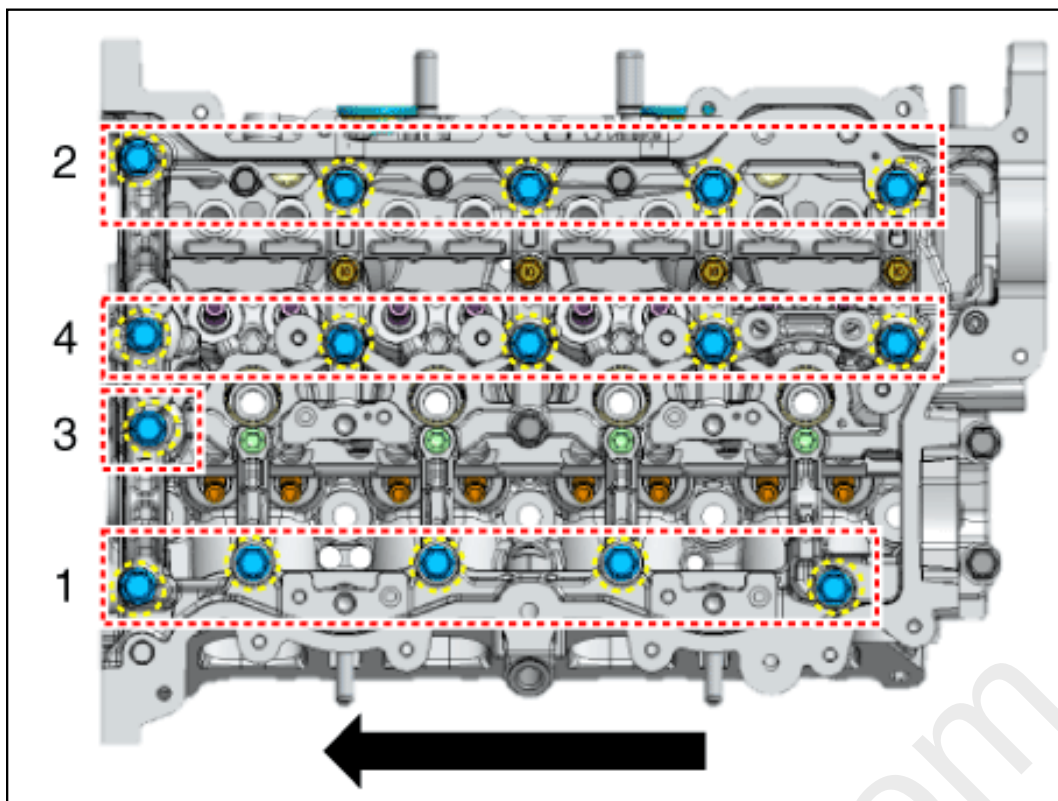
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



- 5) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

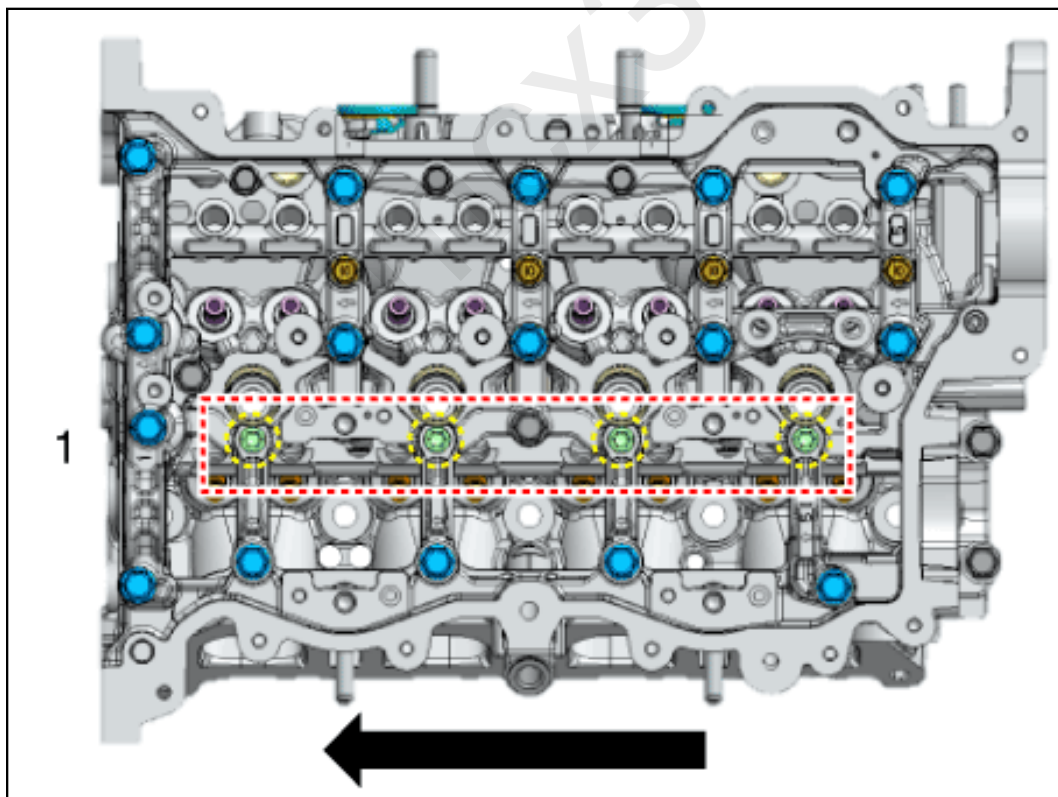
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



6) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

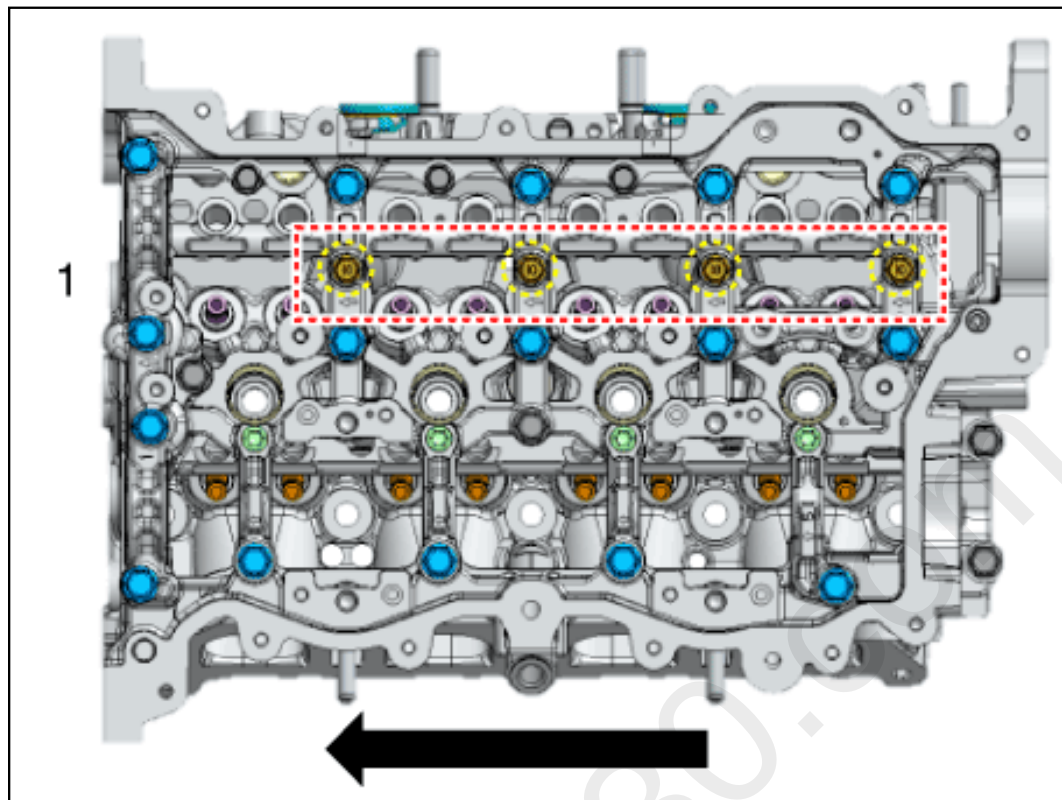
11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)



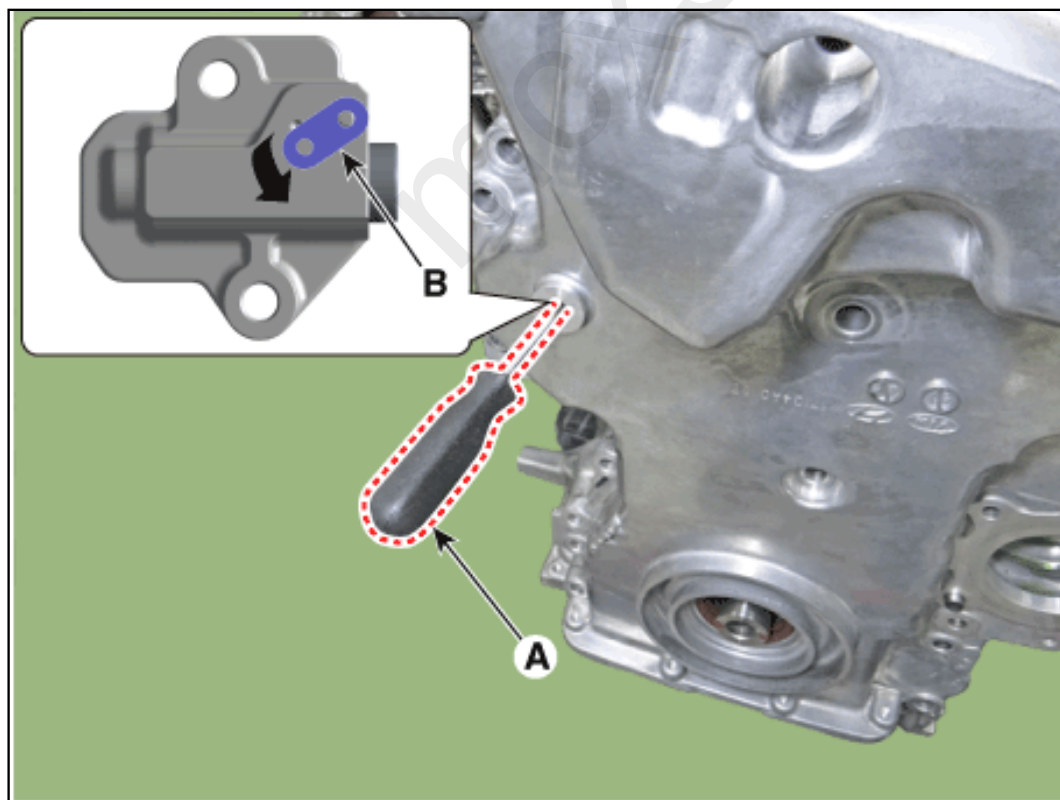
- 7) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)

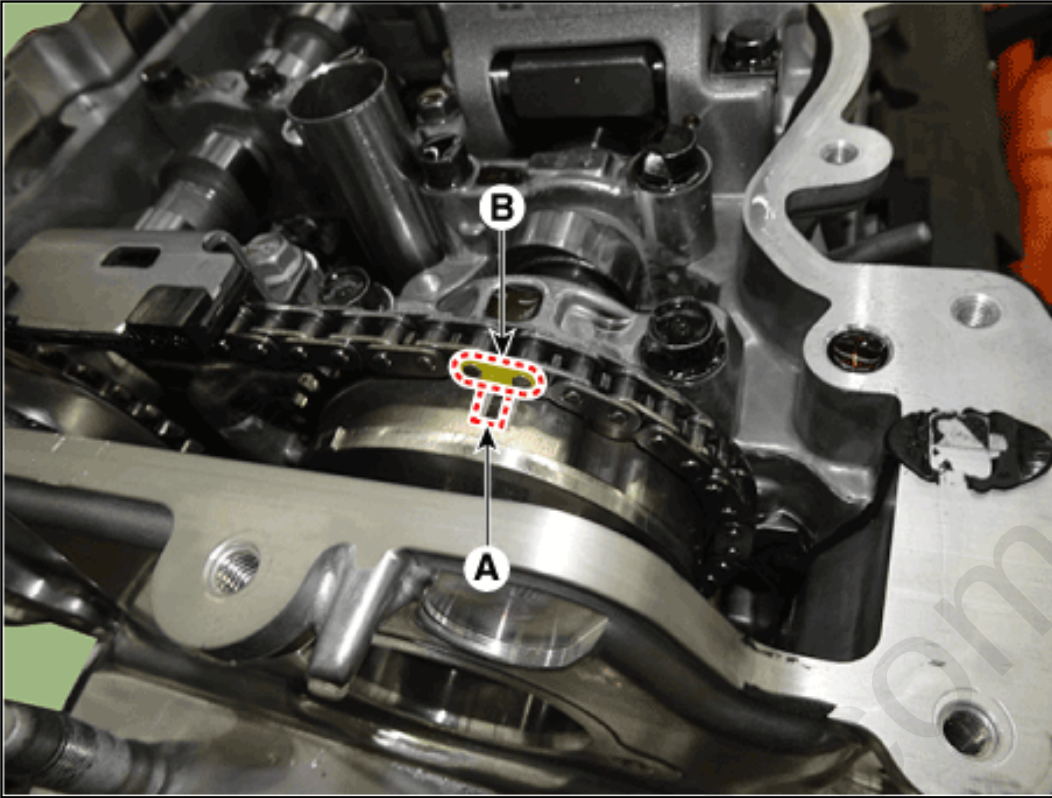


9. Remove the fine gimlets (A) that hold the timing chain tensioner.

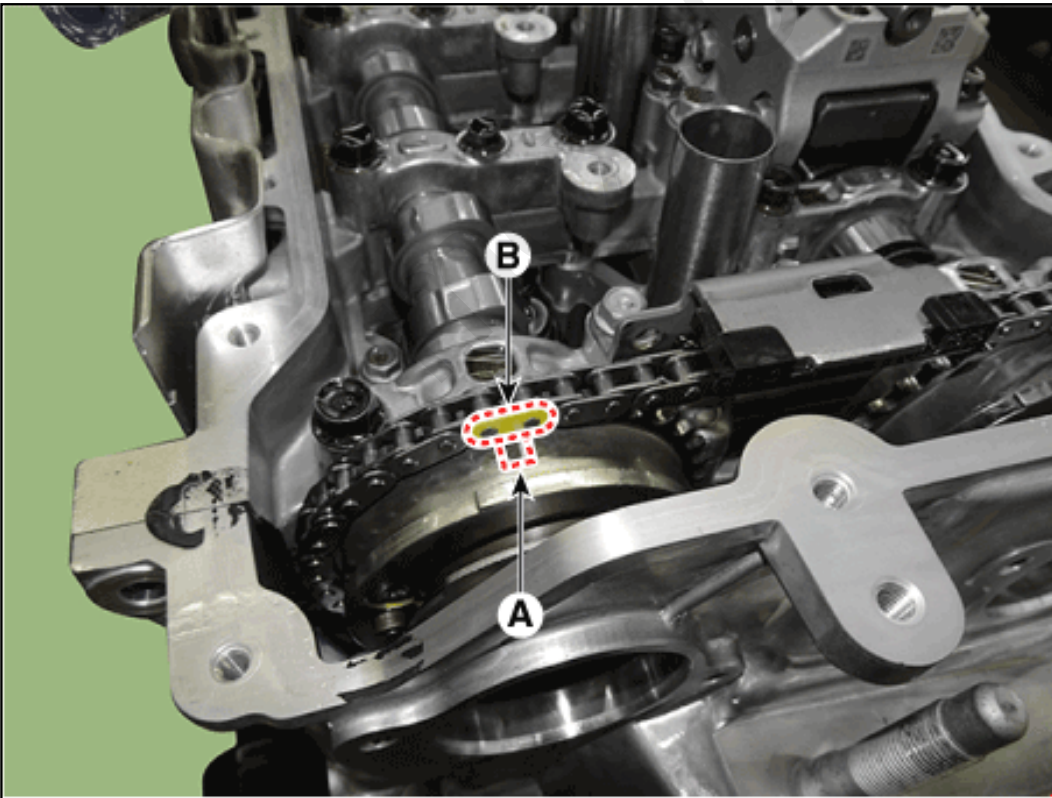


10. When installing the timing chain, be sure that the timing mark (A) of each sprocket is matched with the timing mark (B) (color link) of the timing chain.

[Intake CVVT Timing Mark]



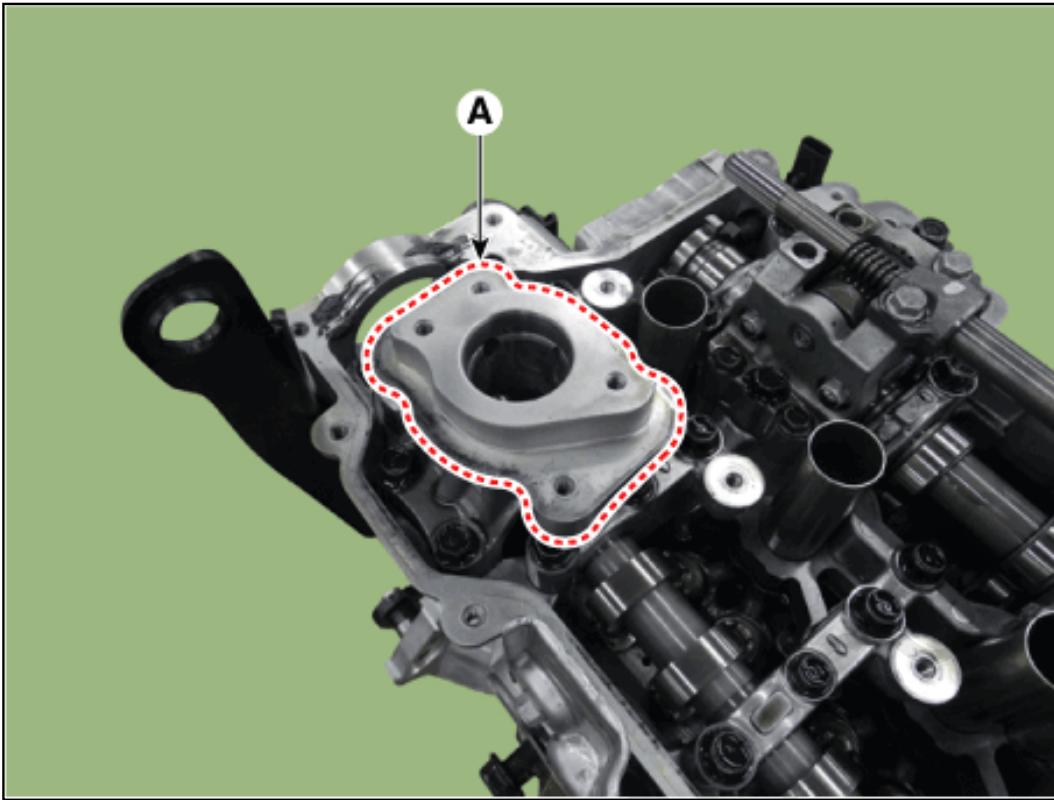
[Exhaust CVVT Timing Mark]



11. Install the fuel pump bracket (A).

Tightening torque :

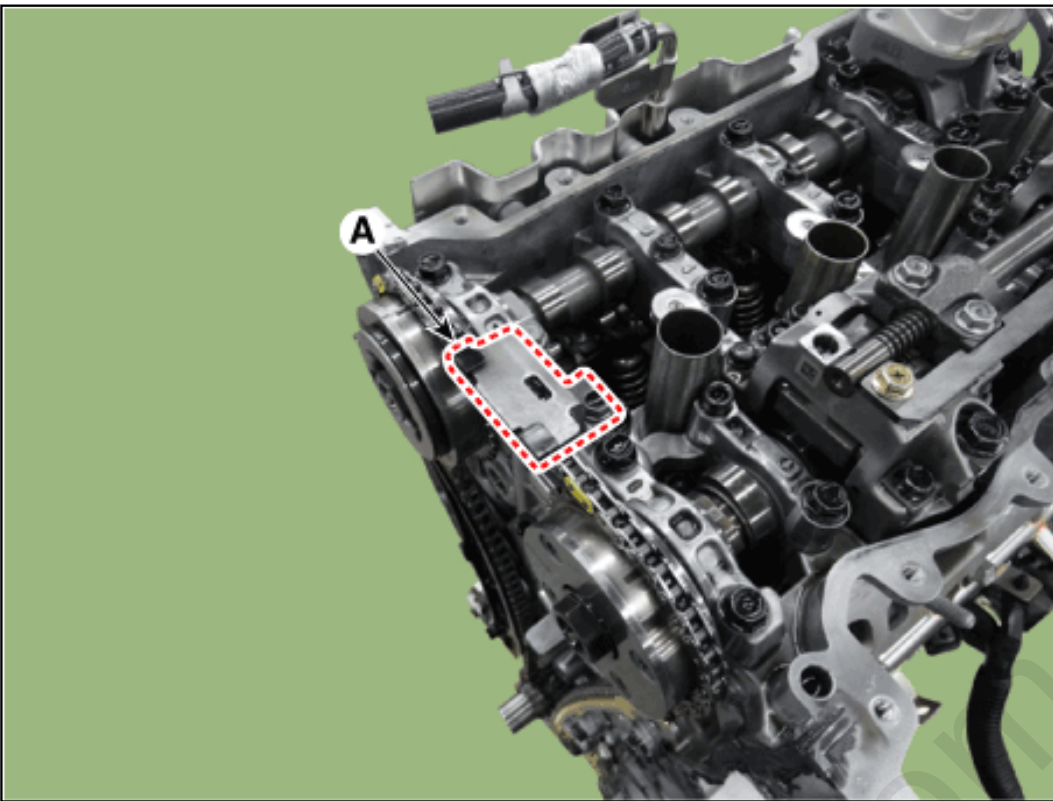
18.6 - 23.5 N.m (1.9 - 2.4 kgf.m, 13.7 - 17.4 lb-ft)



12. Install the cam to cam guide (A).

Tightening torque :

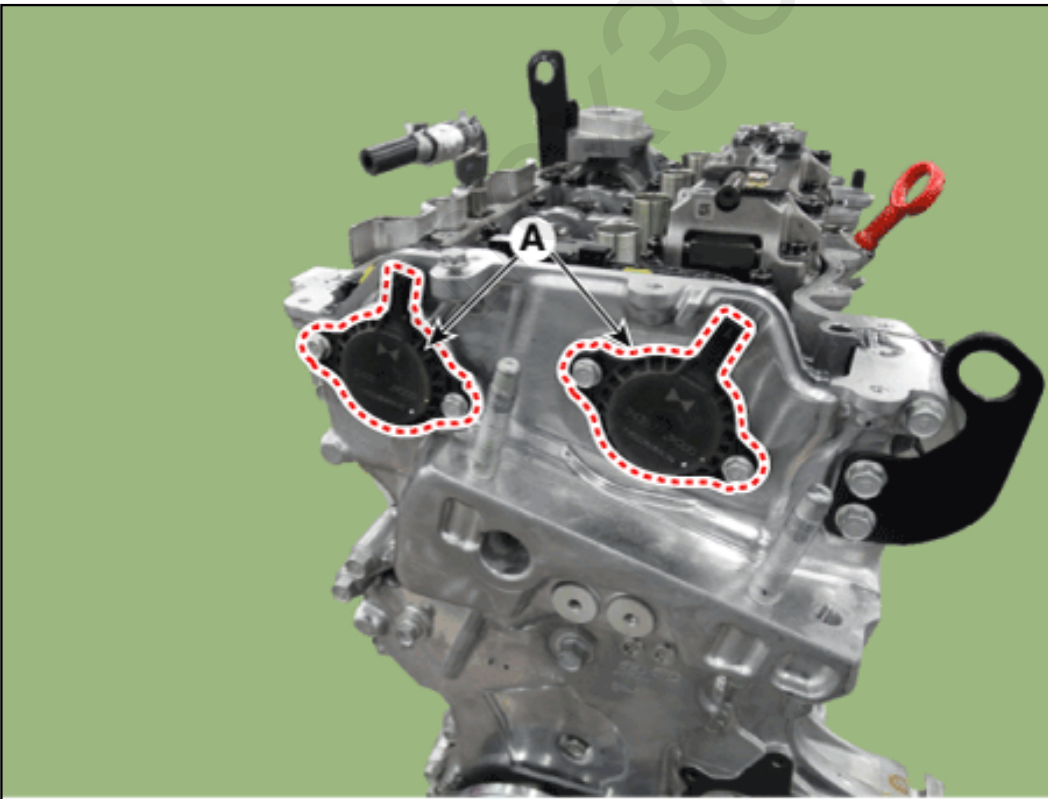
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



13. Install the intake and exhaust variable force solenoid (VFS) valves (A).

Tightening torque :

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



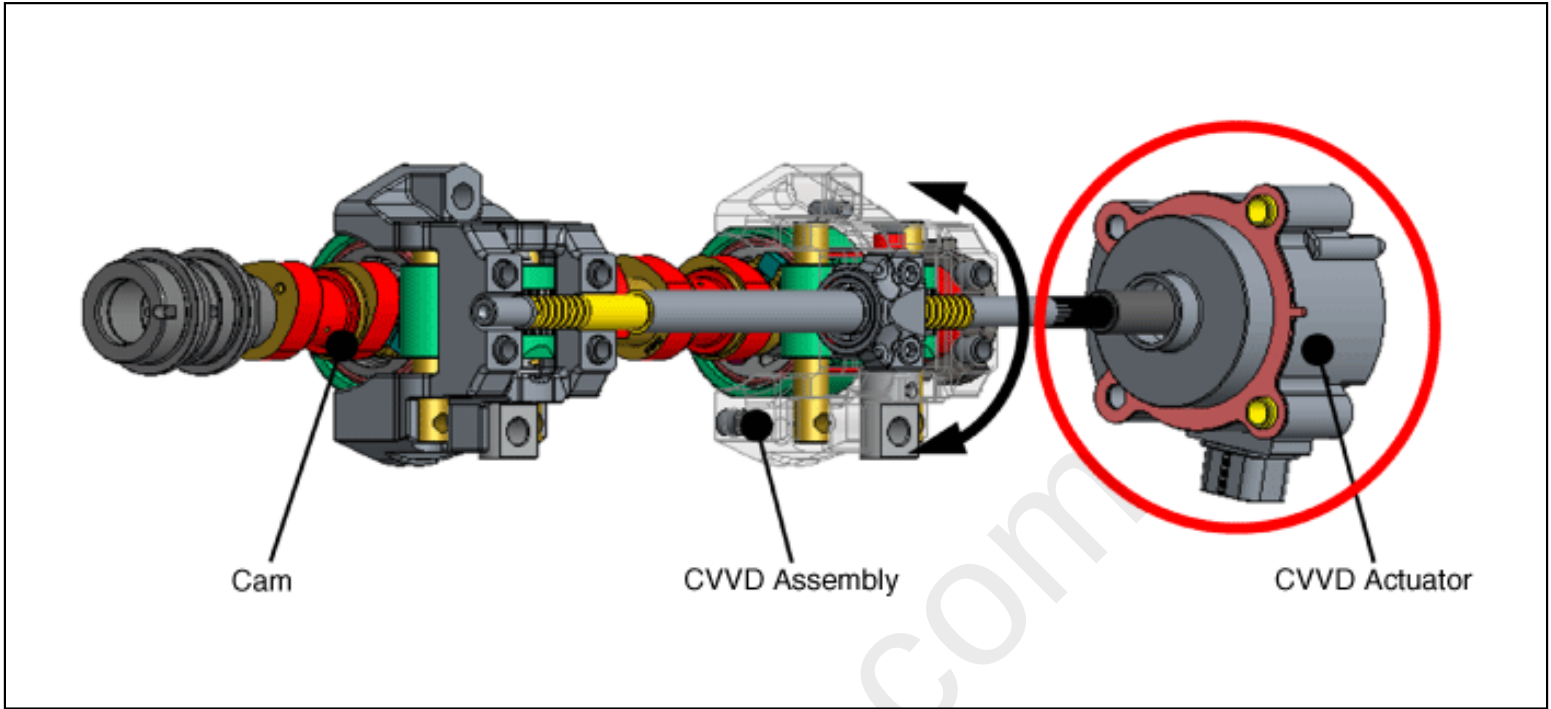
14. Install the cylinder head cover.
(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

Description

CVVD (Continuous Variable Valve Duration) System is a device to control the optimum open and close timing according to the driving mode by changing the valve opening section.

It is composed of cam shaft, CVVD assembly, and CVVD acatuator.

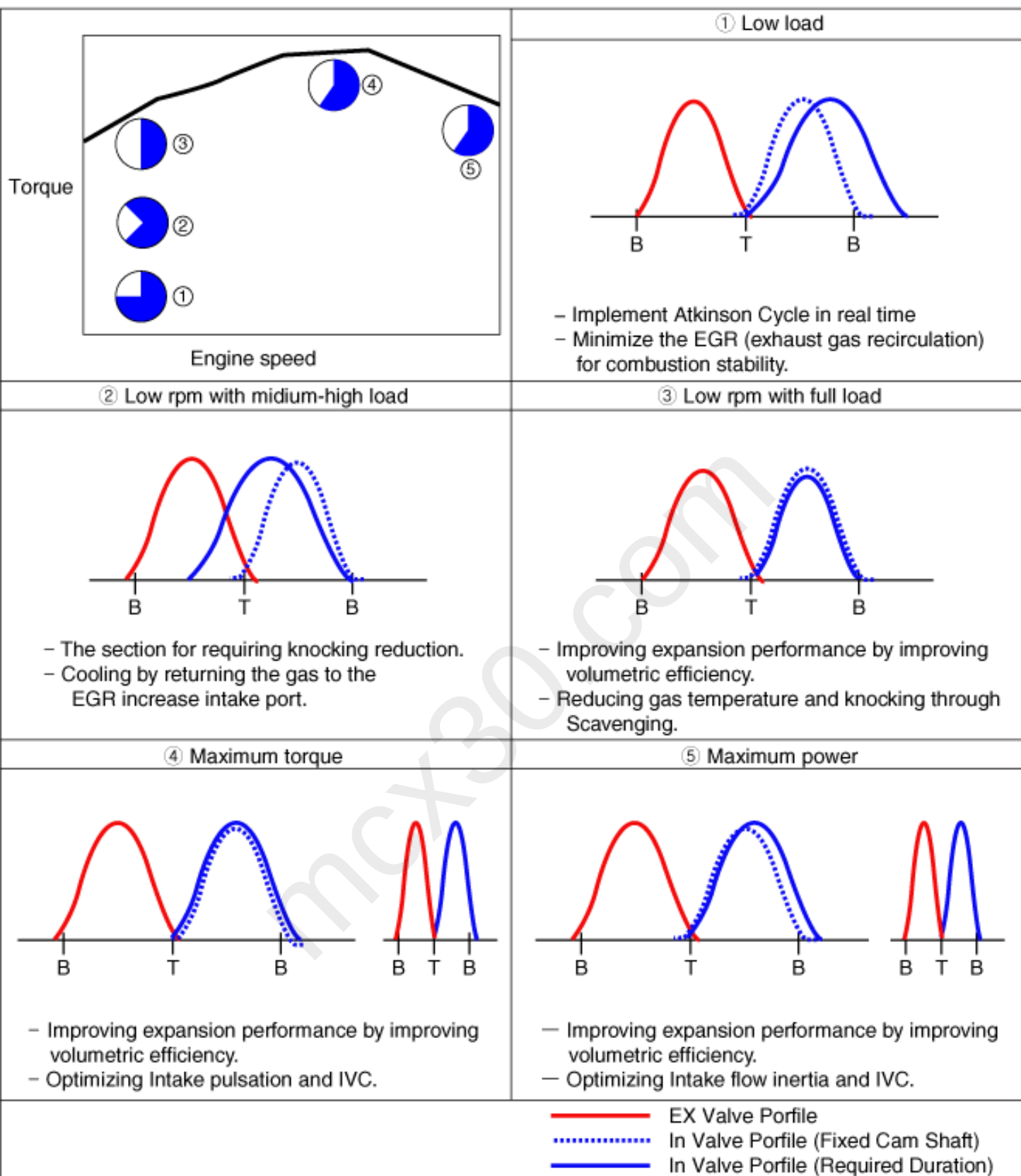
The valve opening time operates in proportion to the rpm of control shaft.



Operation Principle

[CVVD System Operating Mode]

Optimum Valve Timing by Engine Load



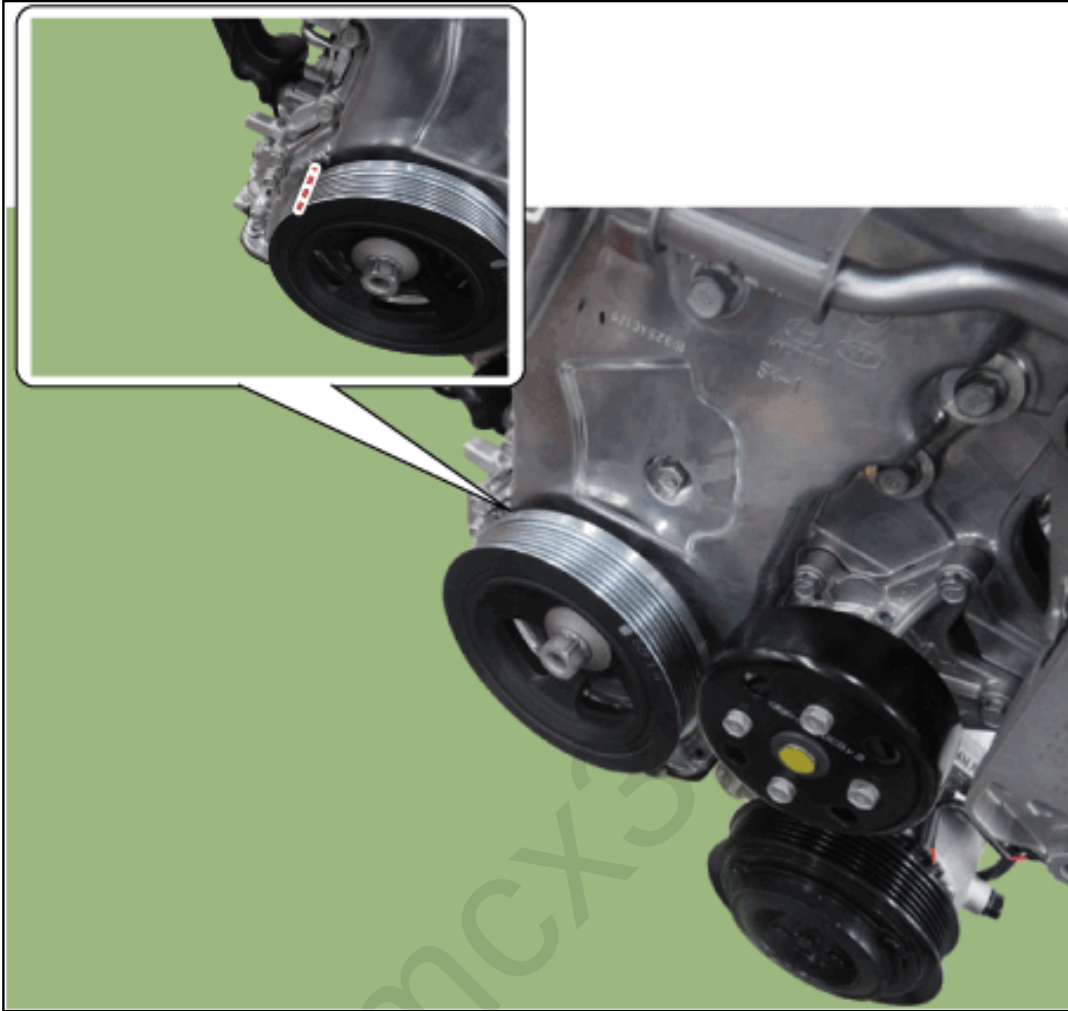
Removal

1. Disconnect the battery negative terminal.
2. Remove the cylinder head cover.

(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

3. Turn the crankshaft damper pulley so that No. 1 piston is at top dead center.

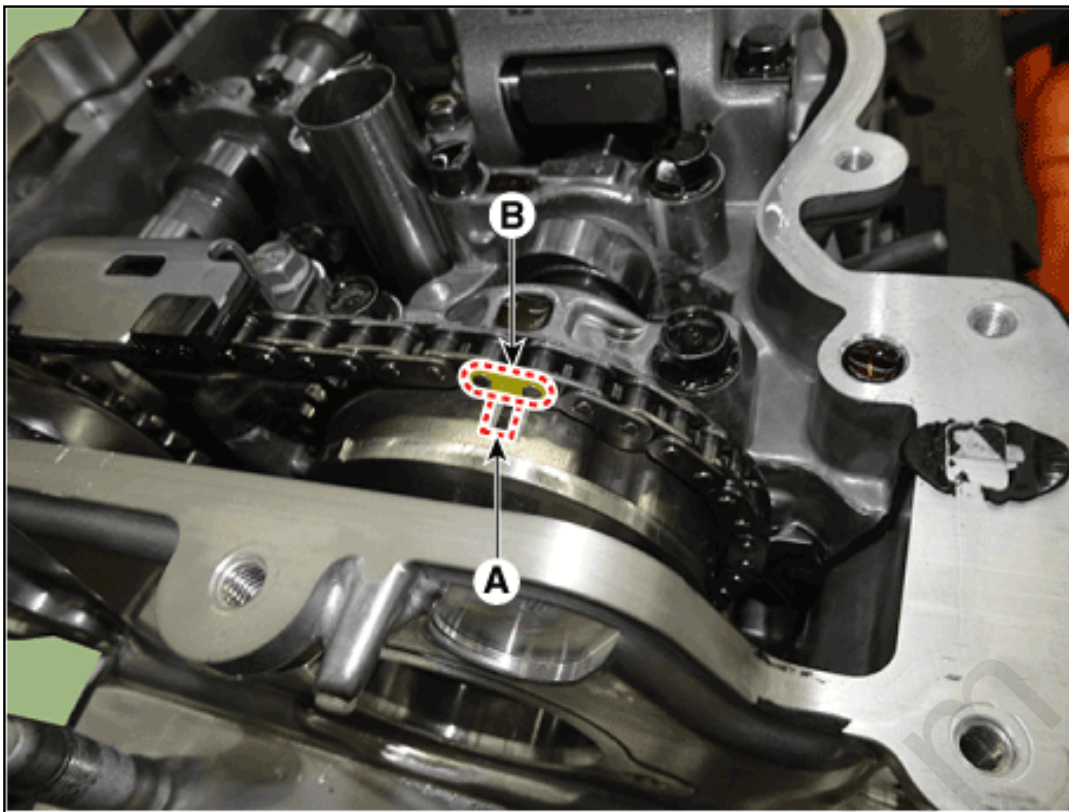
(1) Turn the crankshaft damper pulley and align its groove with the timing mark on the timing chain cover



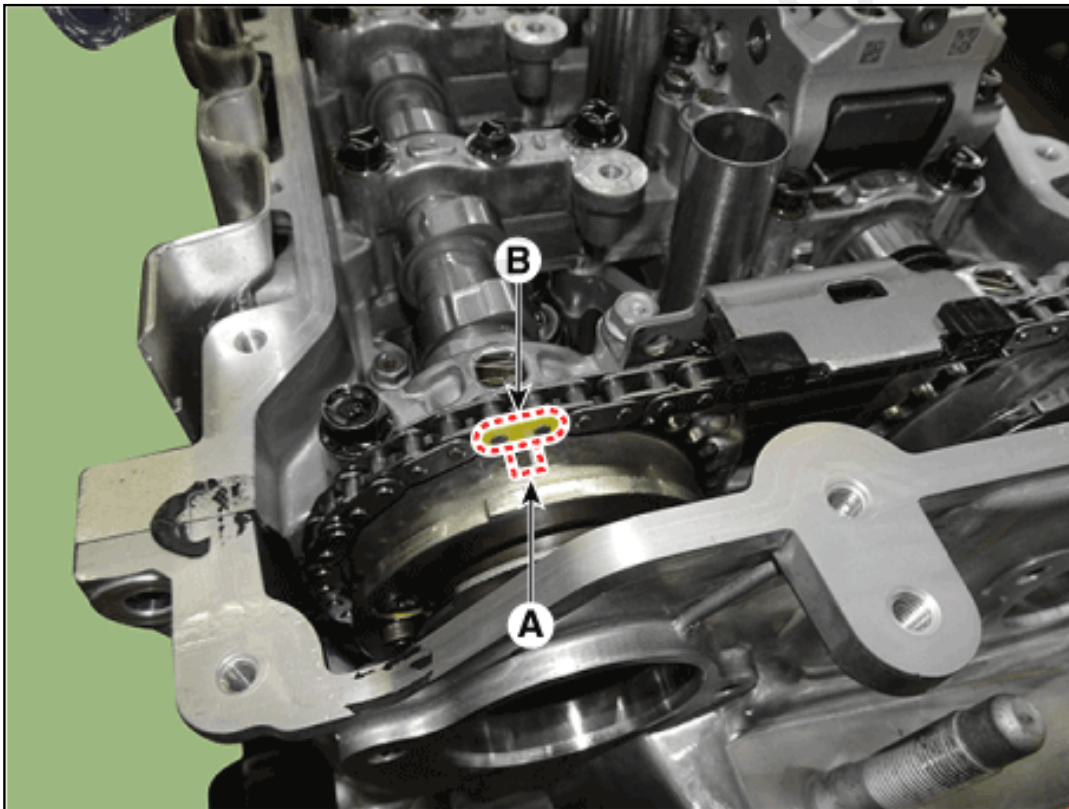
- (2) Check the timing chain, be sure that the timing mark (A) of each sprocket is matched with the timing mark (B) (color link) of the timing chain.

If not, turn the crankshaft damper pulley by one revolution (360°).

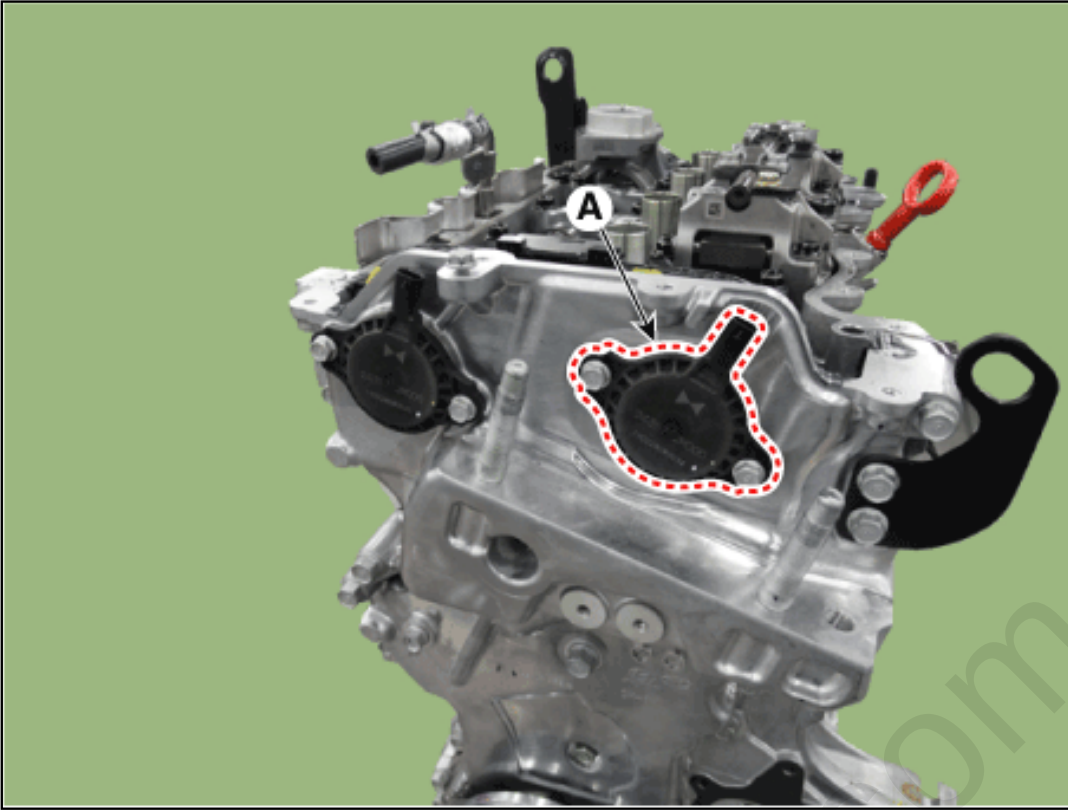
[Intake CVVT]



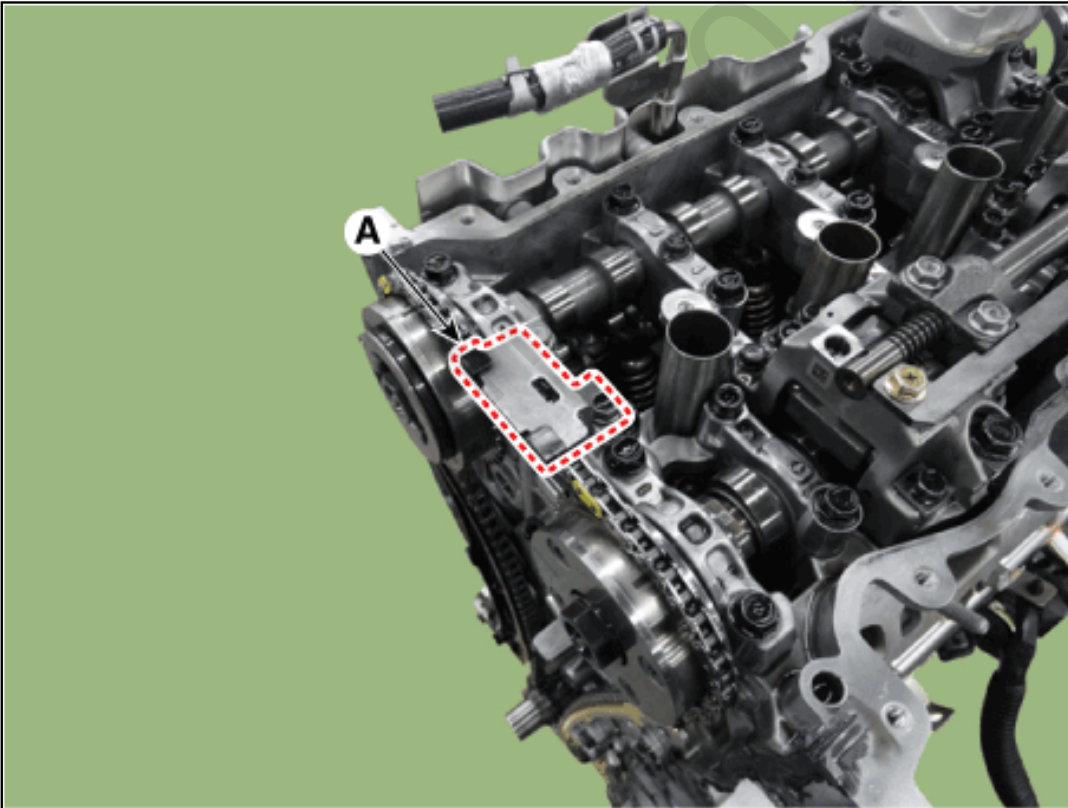
[Exhaust CVVT]



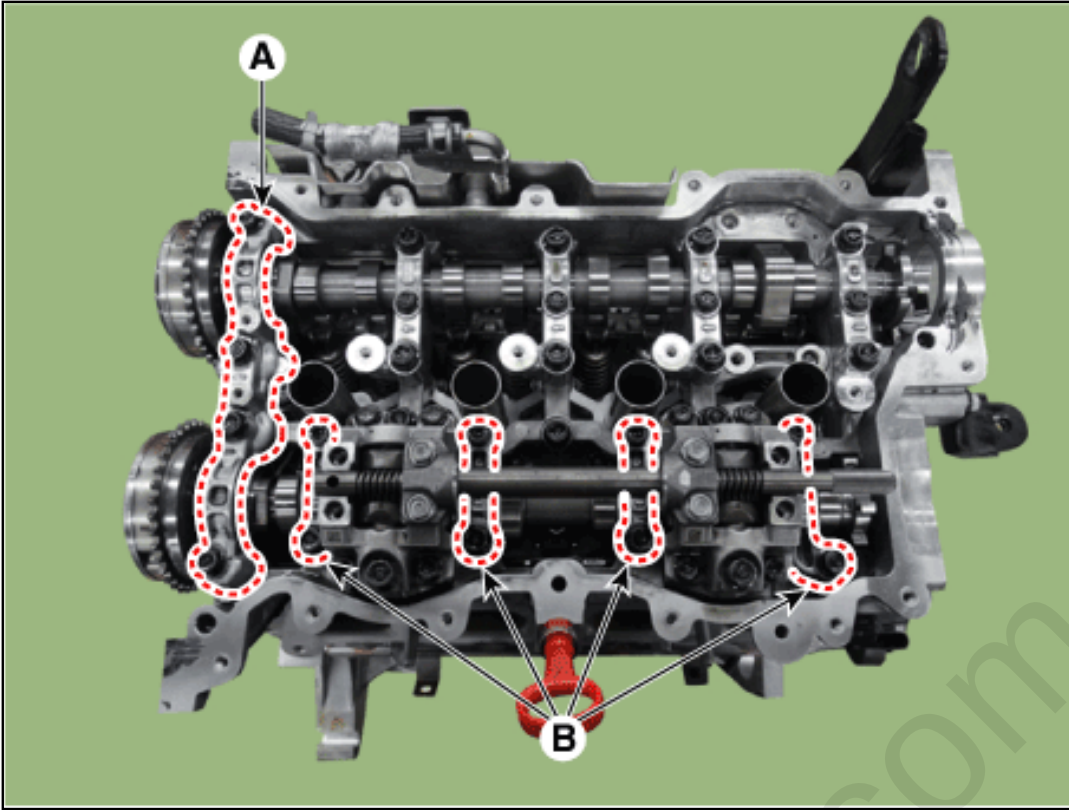
4. Remove the Intake variable force solenoid (VFS) valve (A).



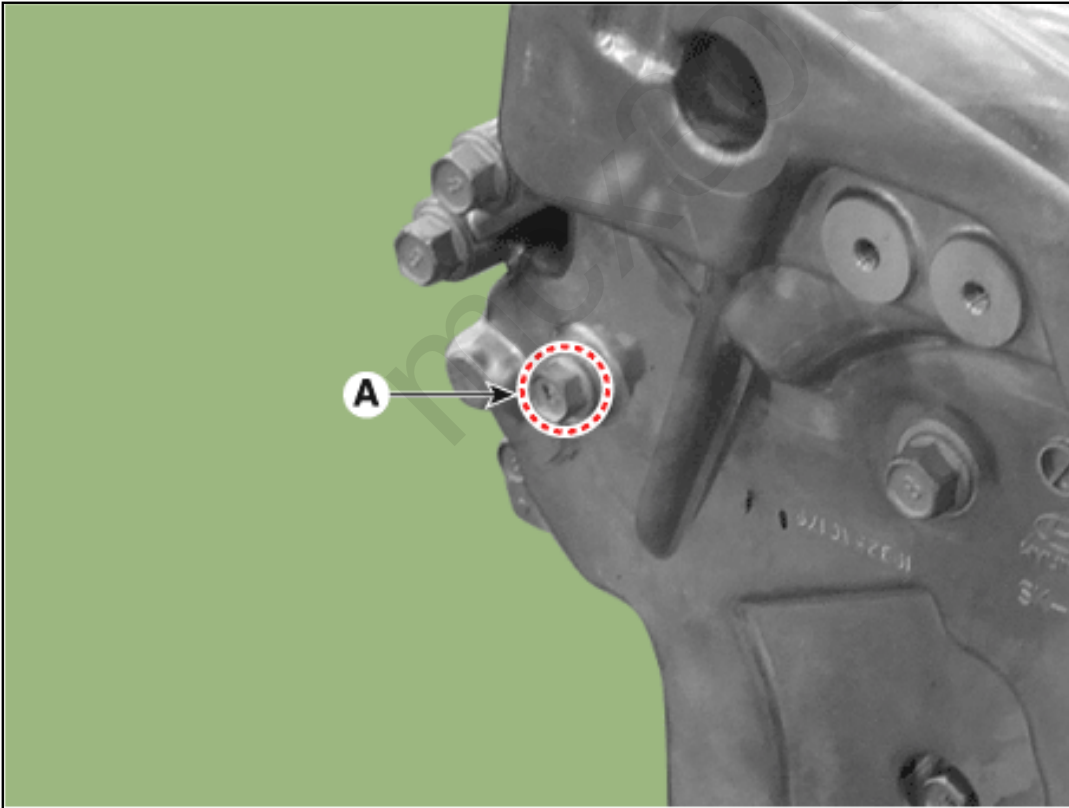
5. Remove the cam to cam guide (A).



6. Remove the front bearing cap (A) and intake camshaft bearing caps (B).

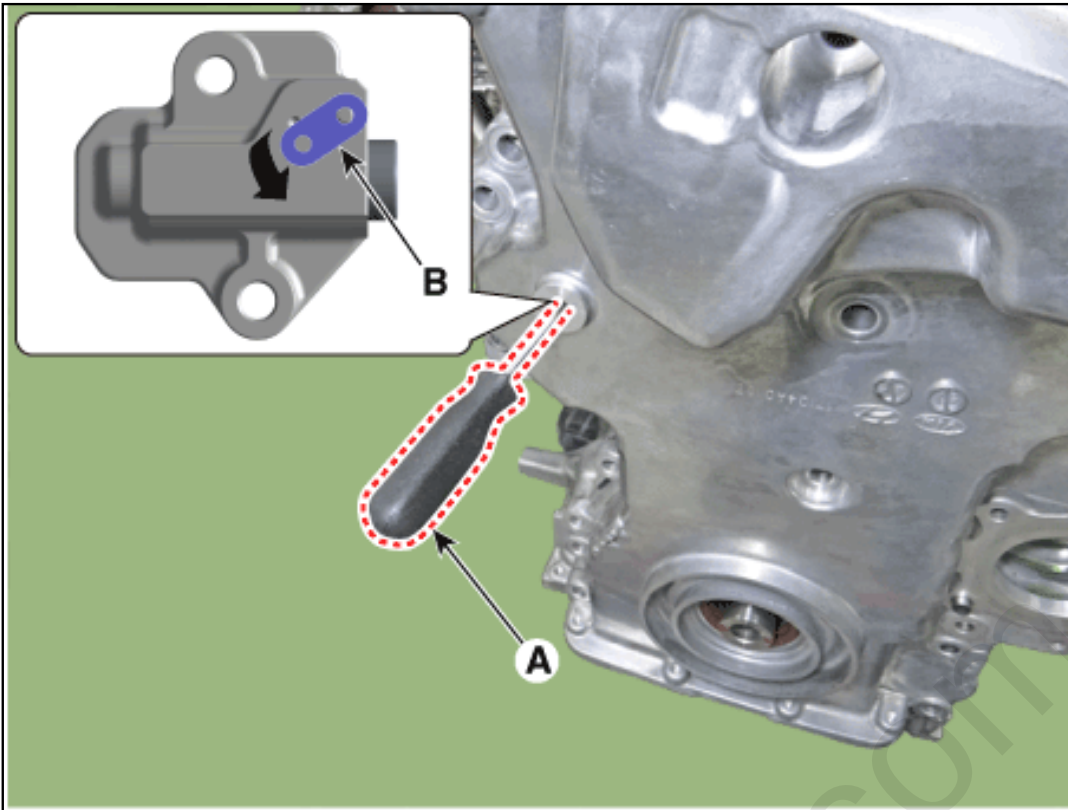


7. Remove the service hole bolt (A).

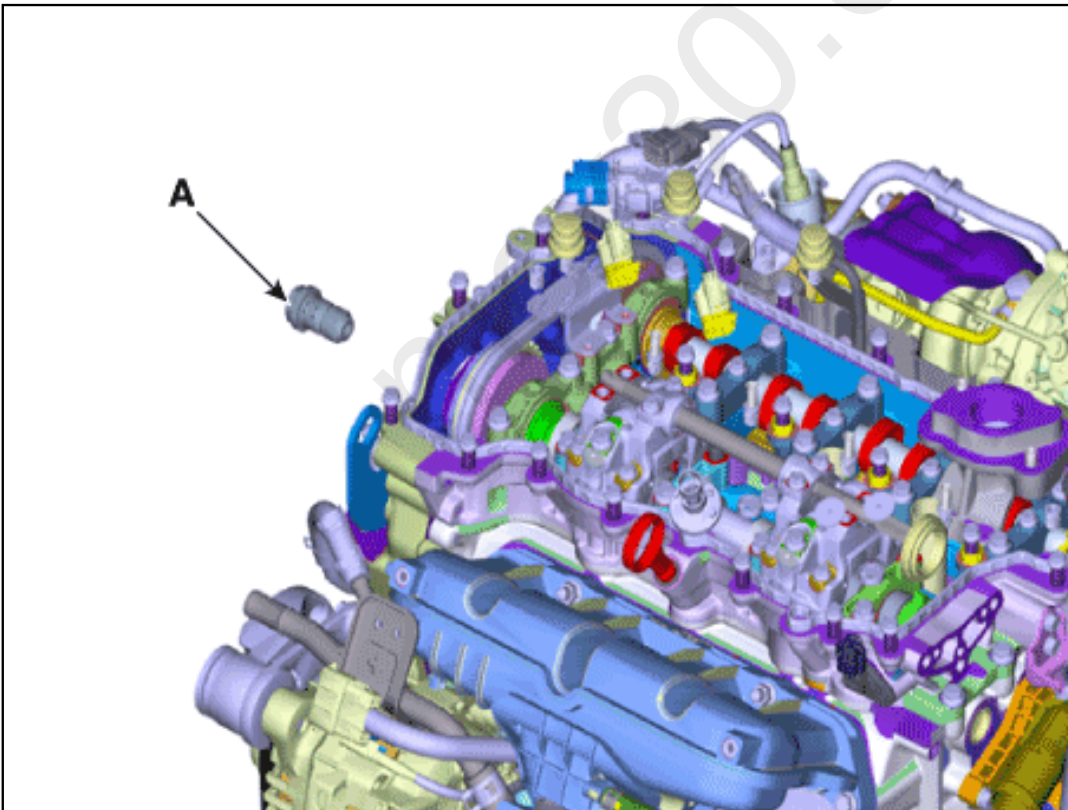


8. Remove the engine mounting support bracket.
(Refer to Engine and Transaxle Assembly - "Engine Mounting")
9. Lift the engine using the jack to obtain space.

10. Release the lock by putting down ratchet plate (B) of timing chain tensioner with using back of tiny awl (A).

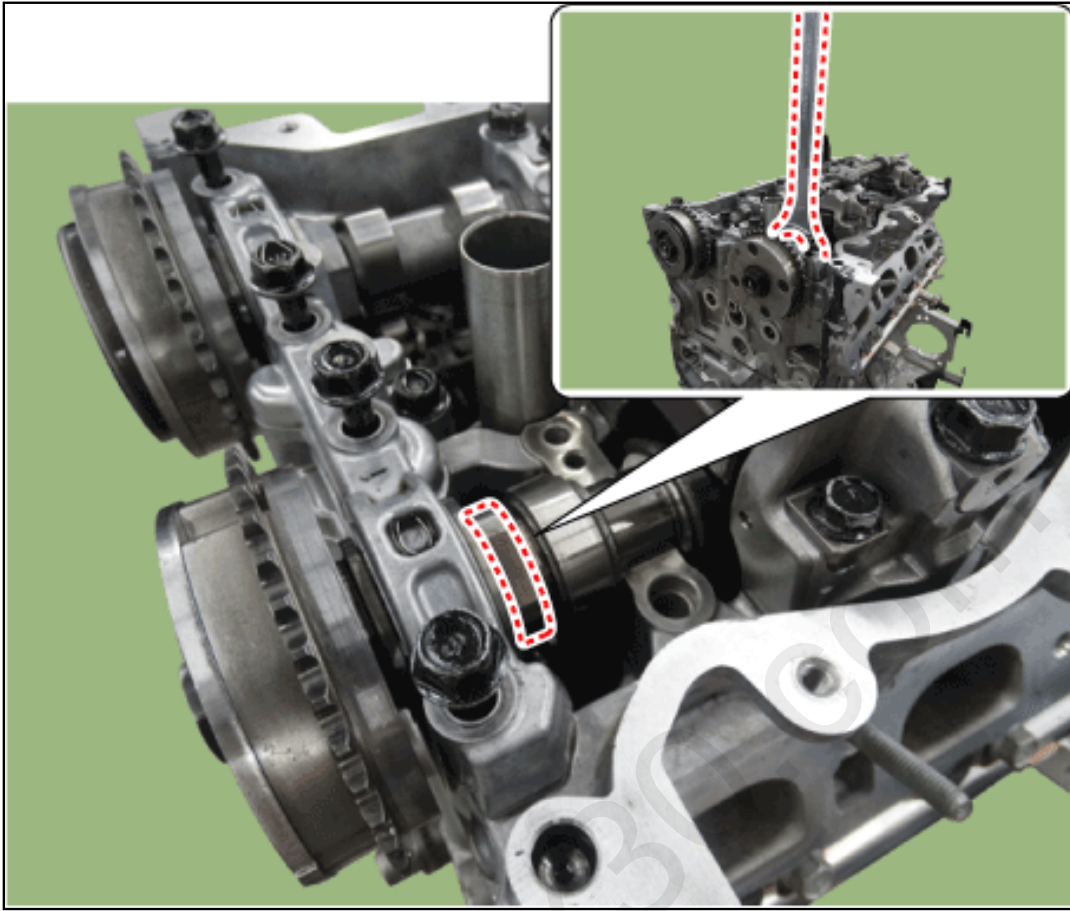


11. Remove the intake oil control valve (OCV) & center bolt (A).





- To prevent impurities from entering intake oil control valve (OCV) & center bolt, wear rubber gloves.
- Intake oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.



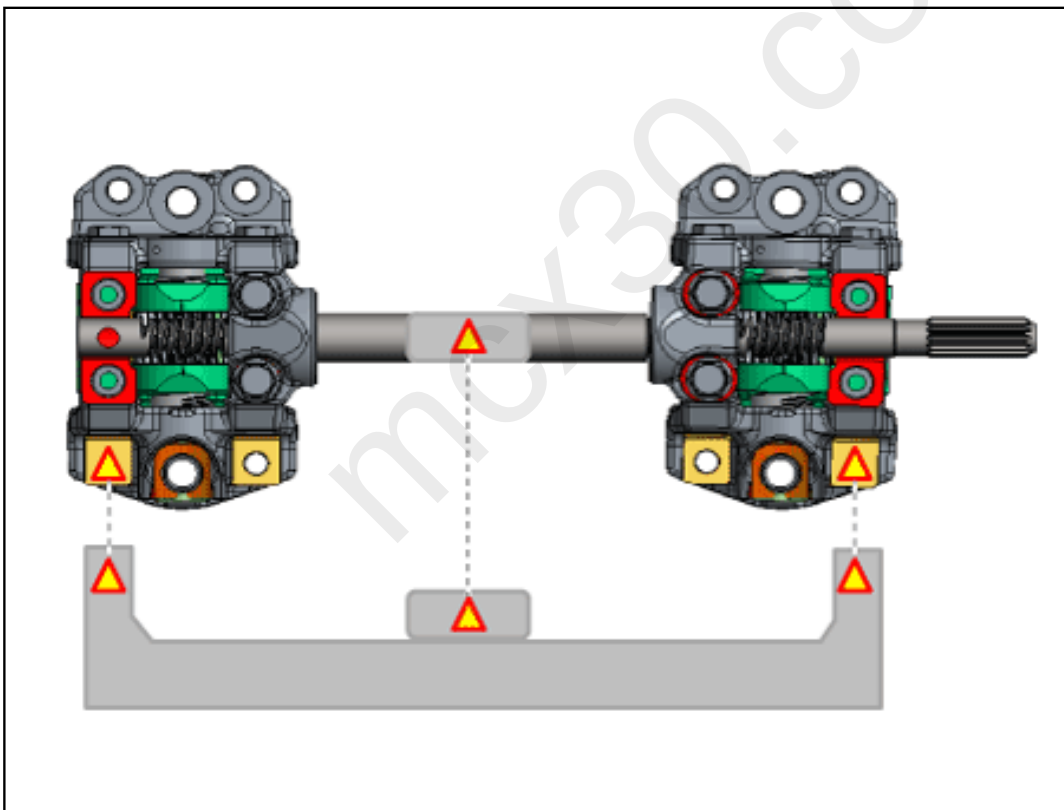
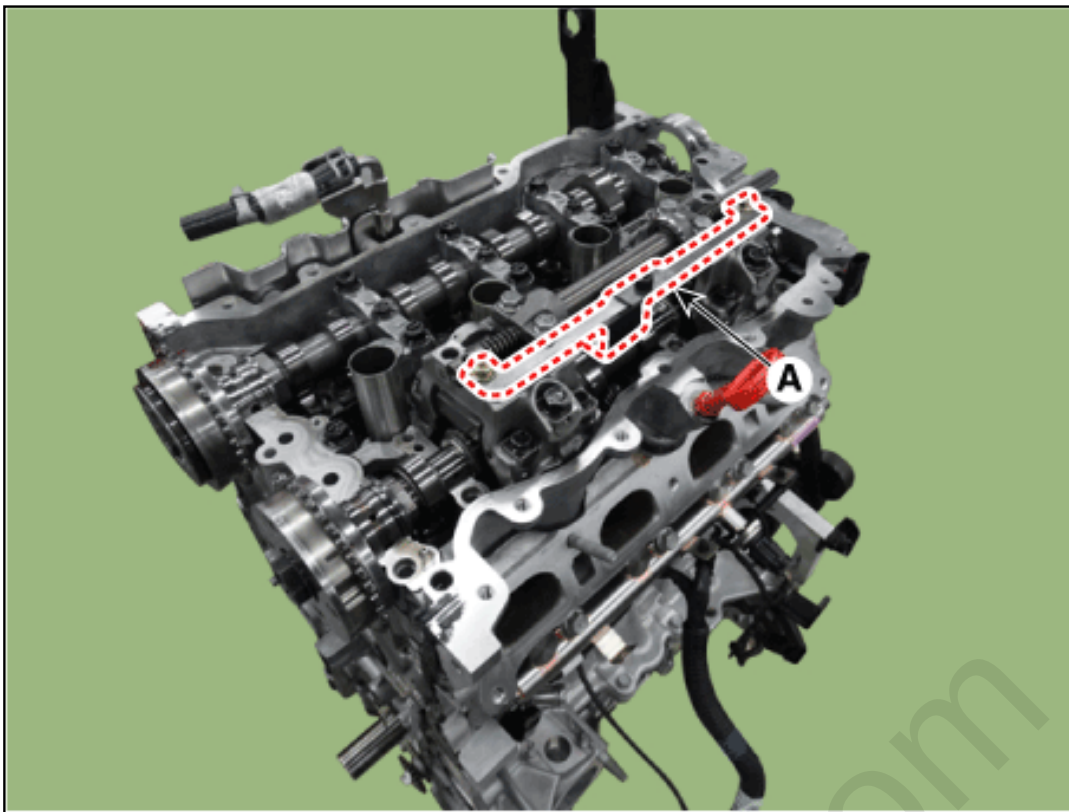
12. Remove the CVVD assembly.



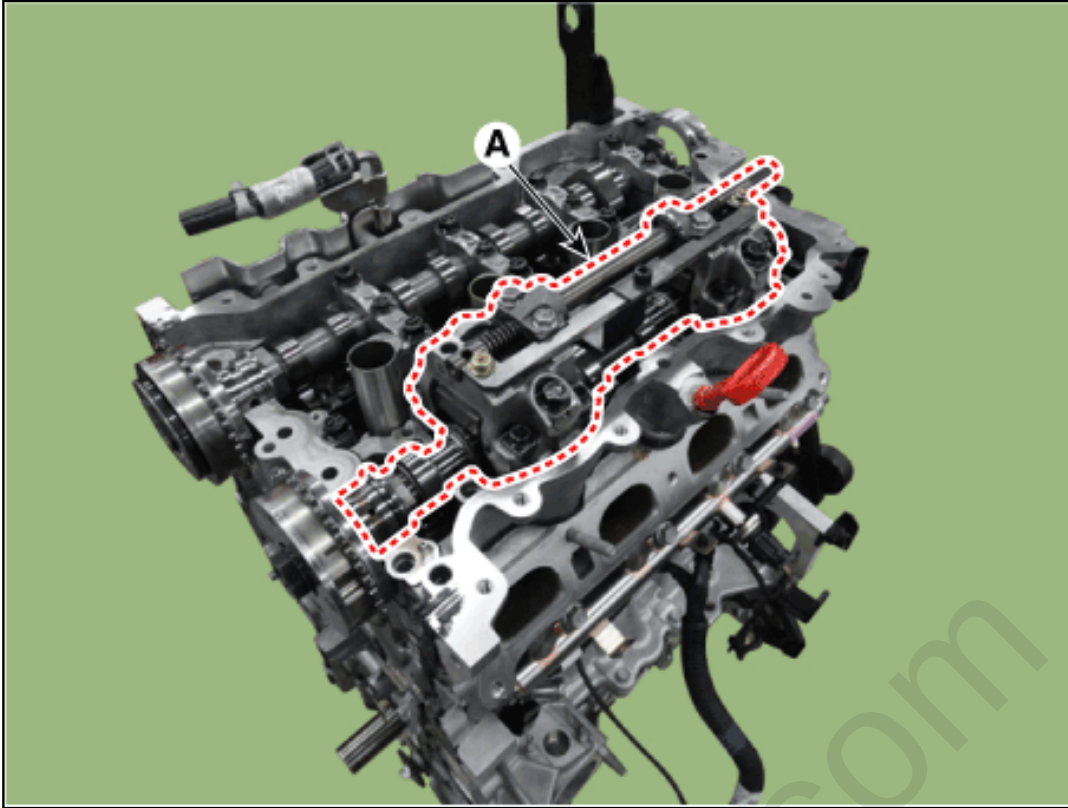
- After removing the CVVD unit, make sure that the parts such as lifter, cam, etc are not separated.
- Ensure that the CVVD components are not damaged.

When Using the CVVD fixture

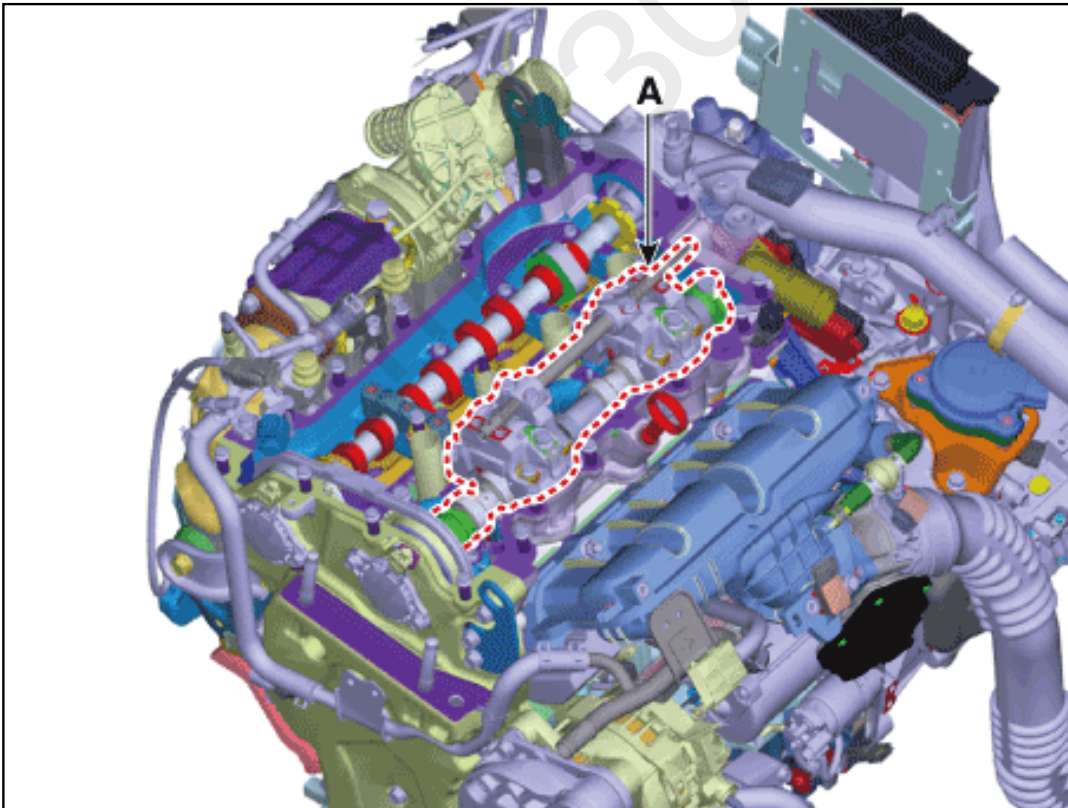
(1) Install the CVVD fixture (A) over the CVVD assembly.



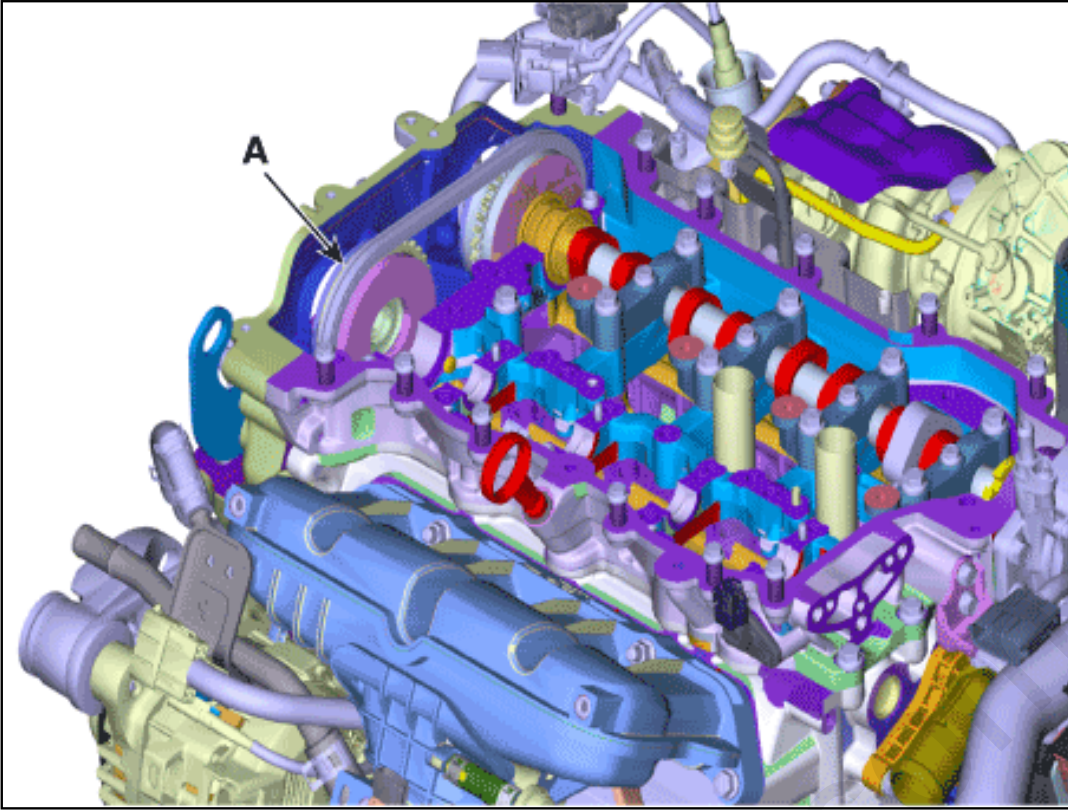
(2) Remove the CVVD assembly.



When not using the CVVD fixture
(3) Remove the CVVD assembly.

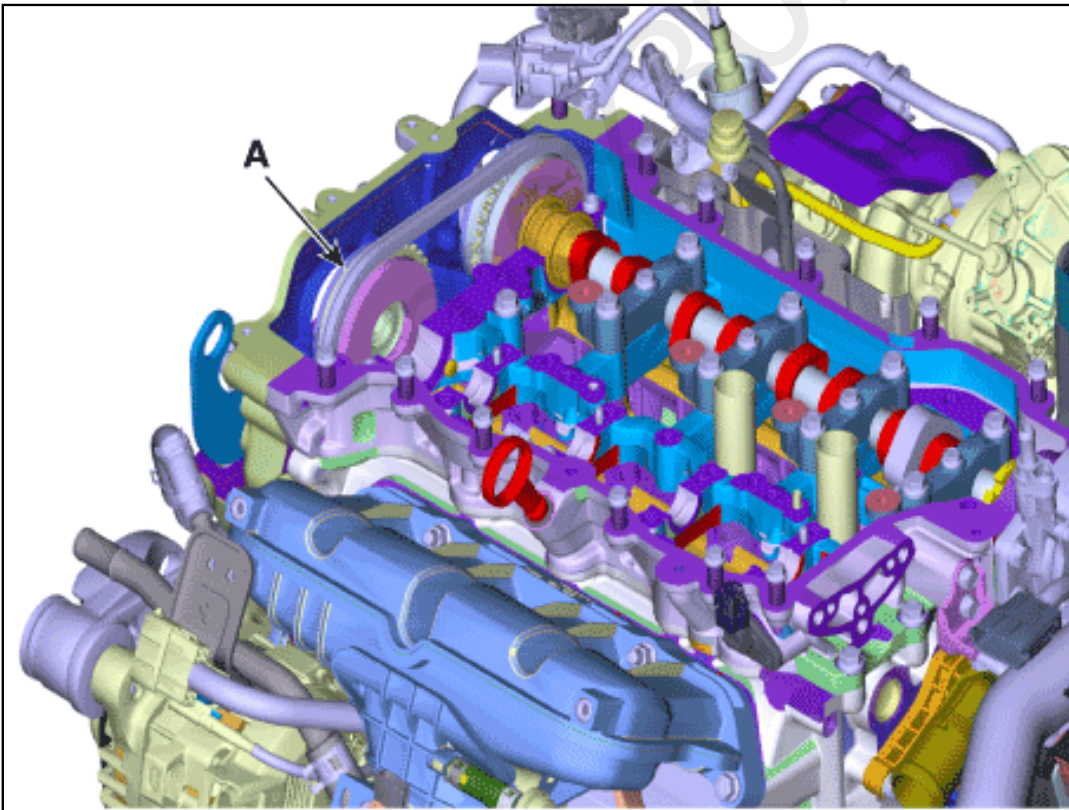


13. Remove the Intake CVVT (A).

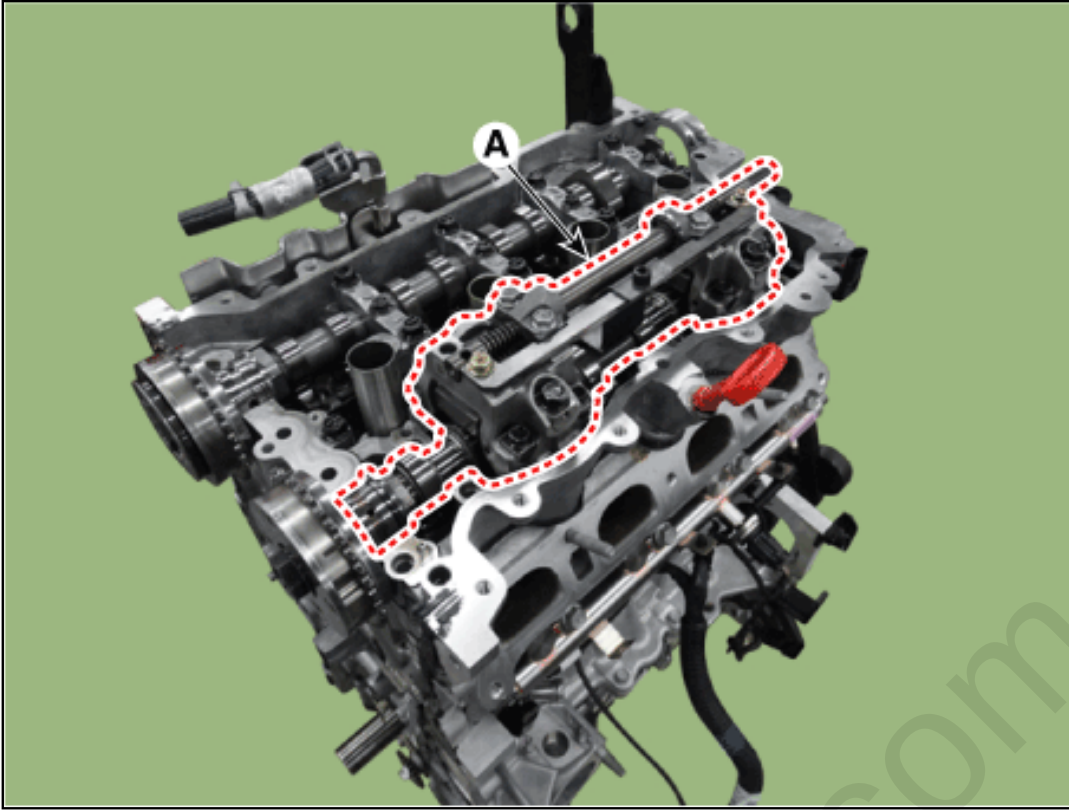


Installation

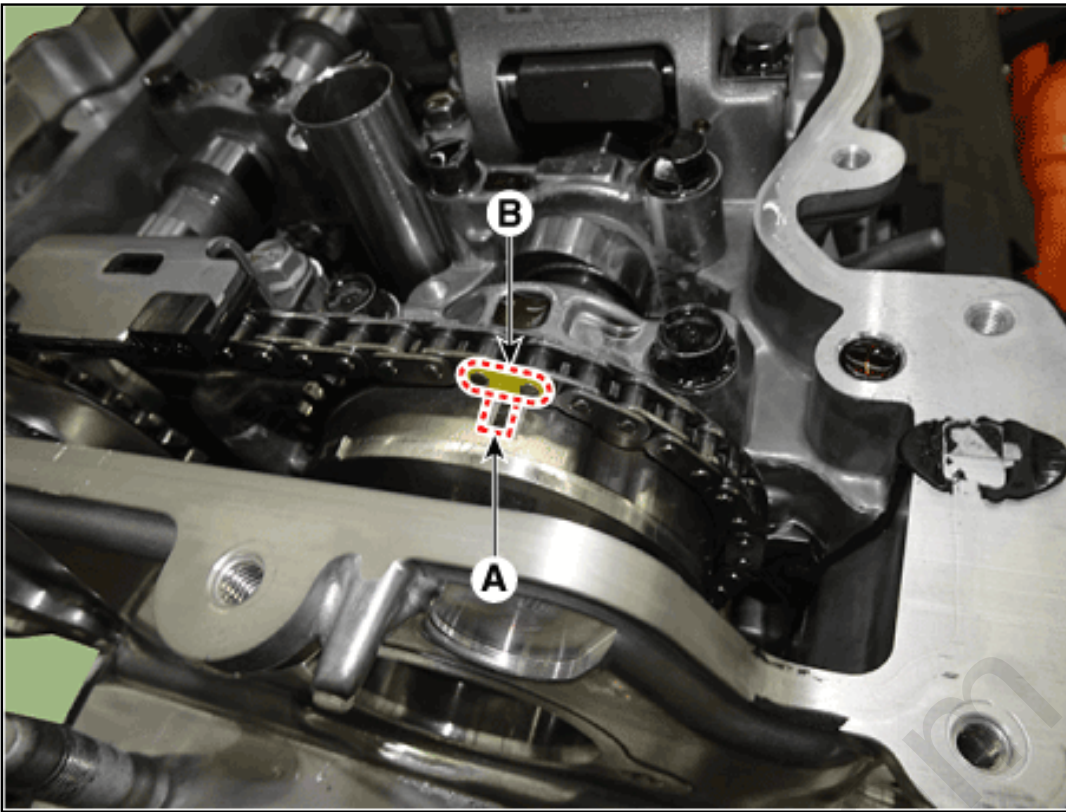
1. Install the Intake CVVT (A).



2. Install the CVVD assembly (A).



- After installing the CVVD, check whether the swing arm is separated or is installed correctly.
- When installing the intake camshaft, spray the engine oil to the camshaft journal installing part (A) of the cam carrier.
The amount of application should be enough to flow down both the front and back sides when it is applied to the center.
- For installation, the timing mark (A) of the intake CVVT and the timing chain mark (B) should be matched.



- During the installation, there should be no artificial rotation or movement of the guide bracket and control shaft.
- When removing the CVVD fixing jig, be sure to securely tighten the M6 bolts.
- If CVVD fixing jig is available, be sure to work by using it.

When Using the CVVD fixture

1. When installing the CVVD assembly mounting bolts (M6), tighten sequence shown.

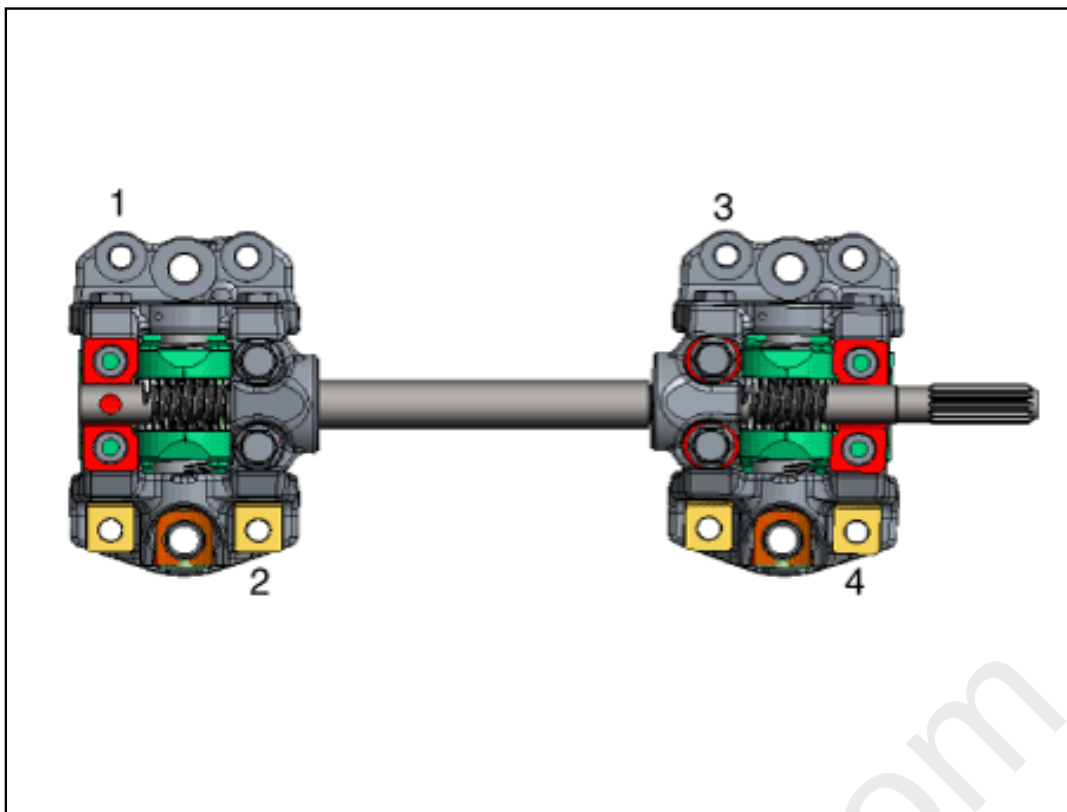
Tightening torque :

1st

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

2nd

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



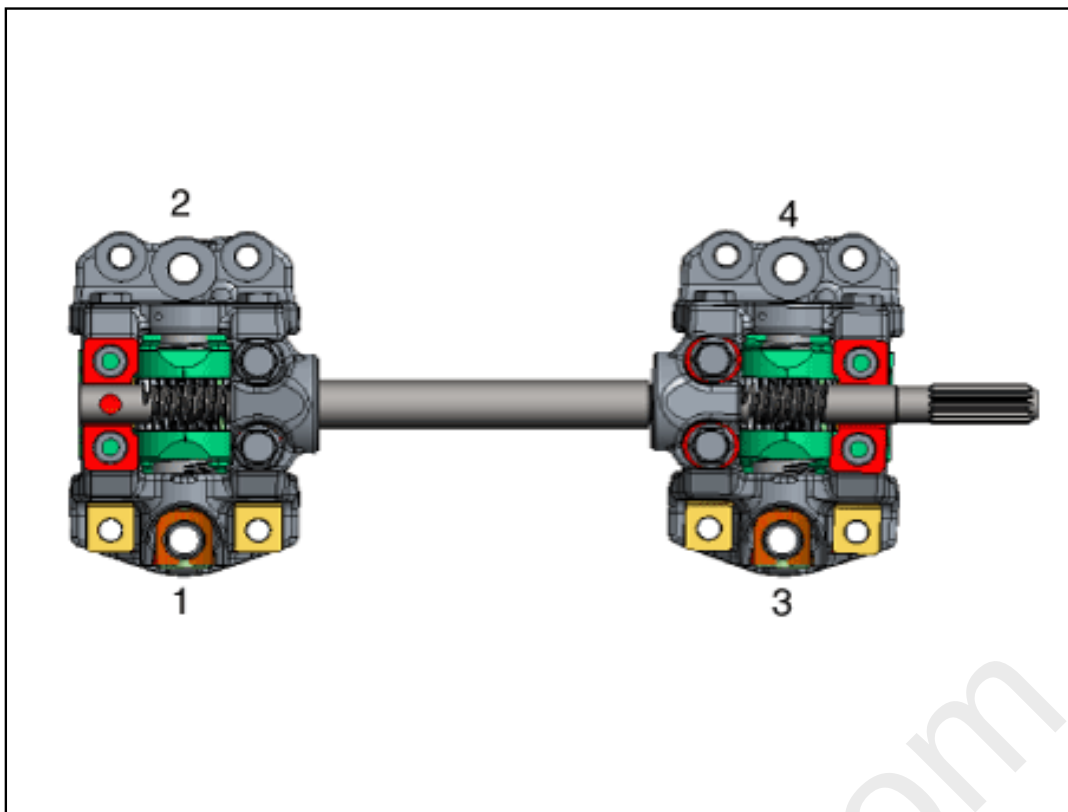
2. Remove the CVVD fixture (A).



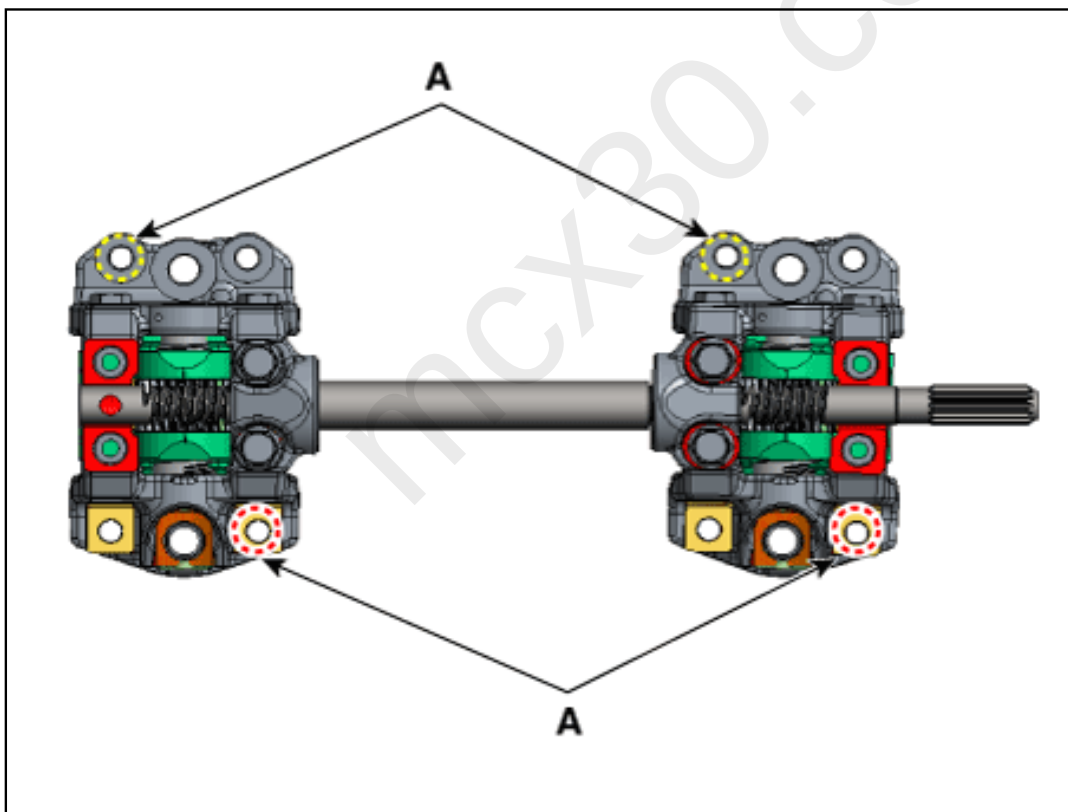
3. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

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



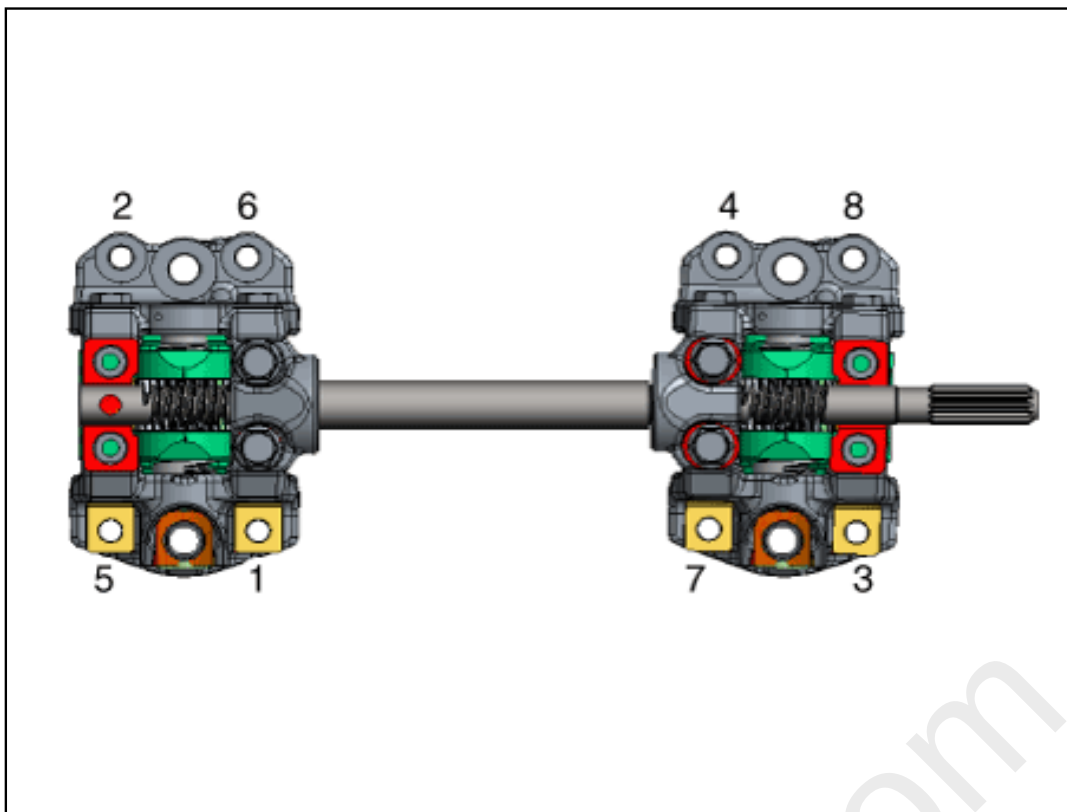
4. Remove the CVVD assembly mounting bolts (M6) (A).



5. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

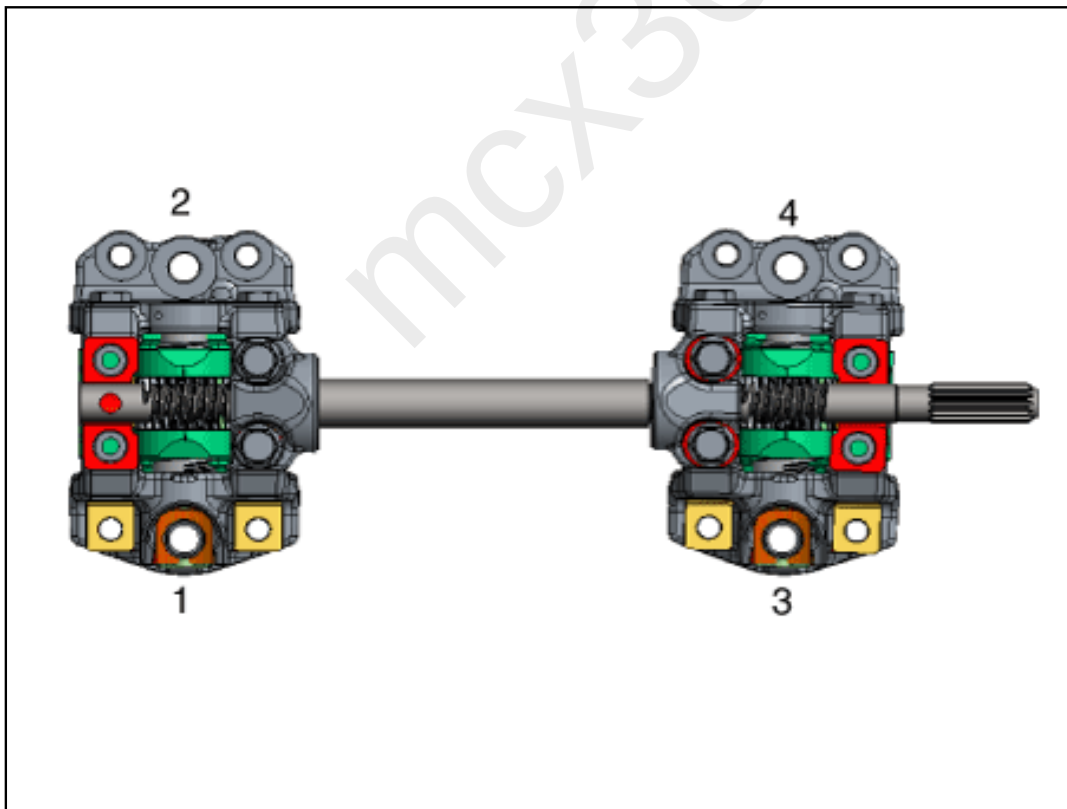
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



6. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

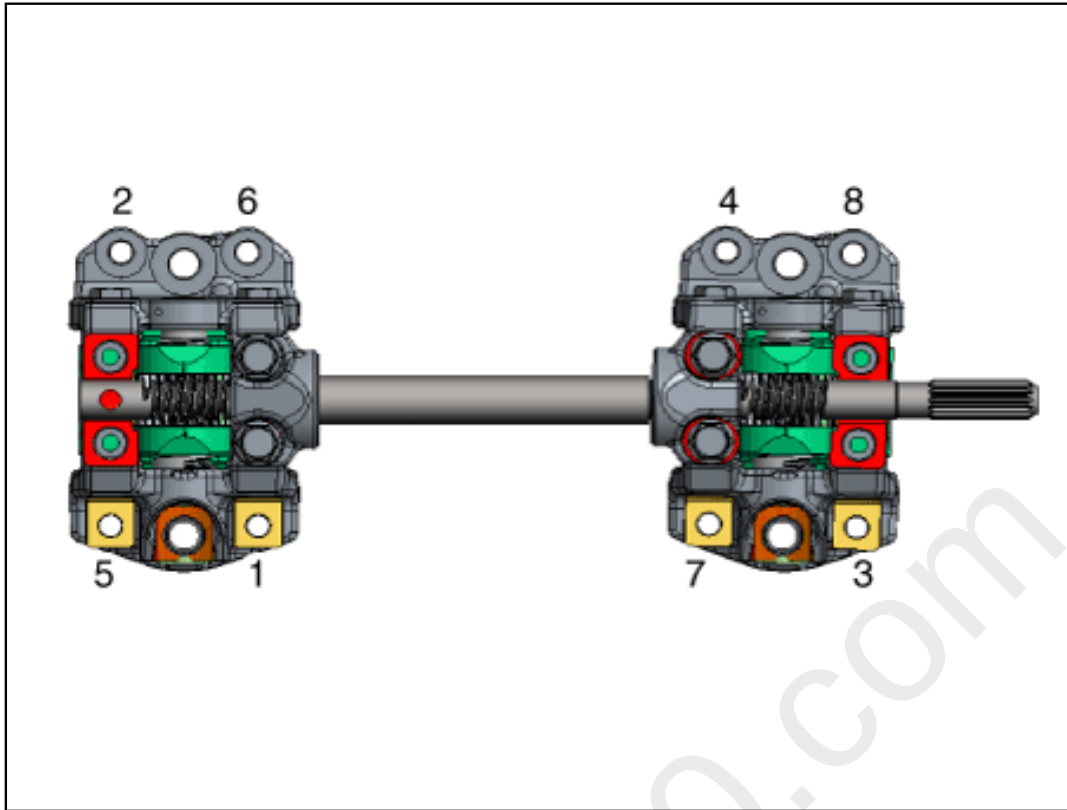
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



7. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

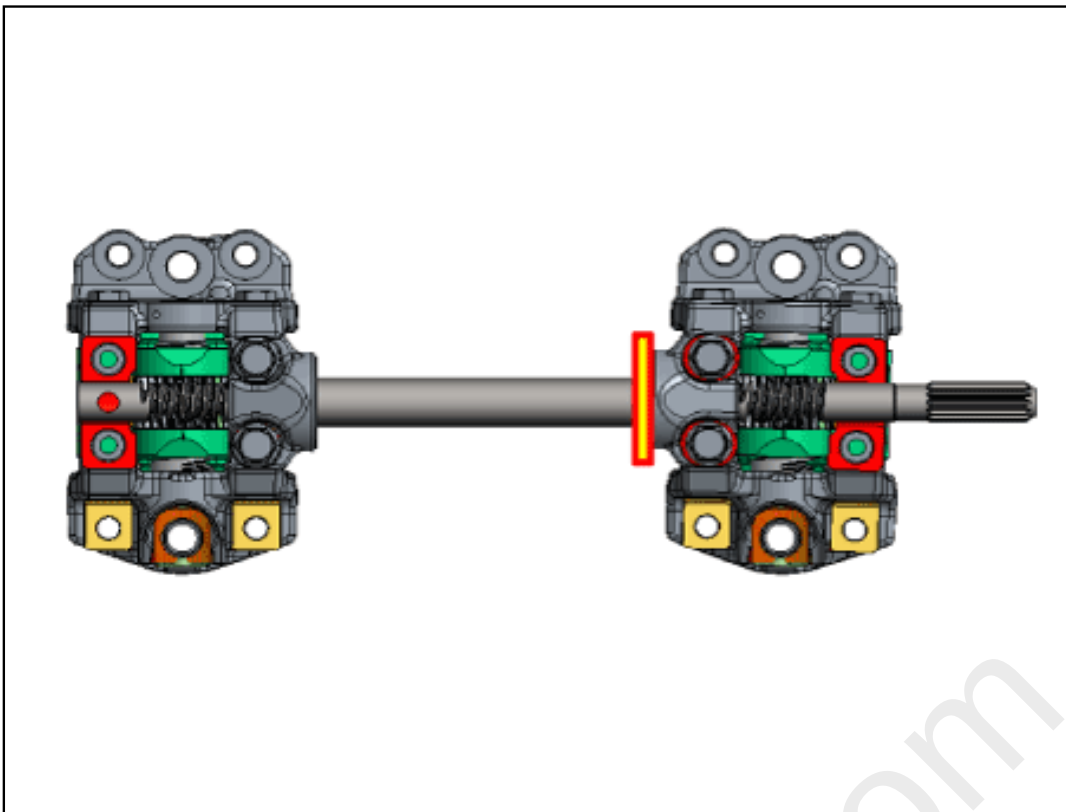
Tightening torque :

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



8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)

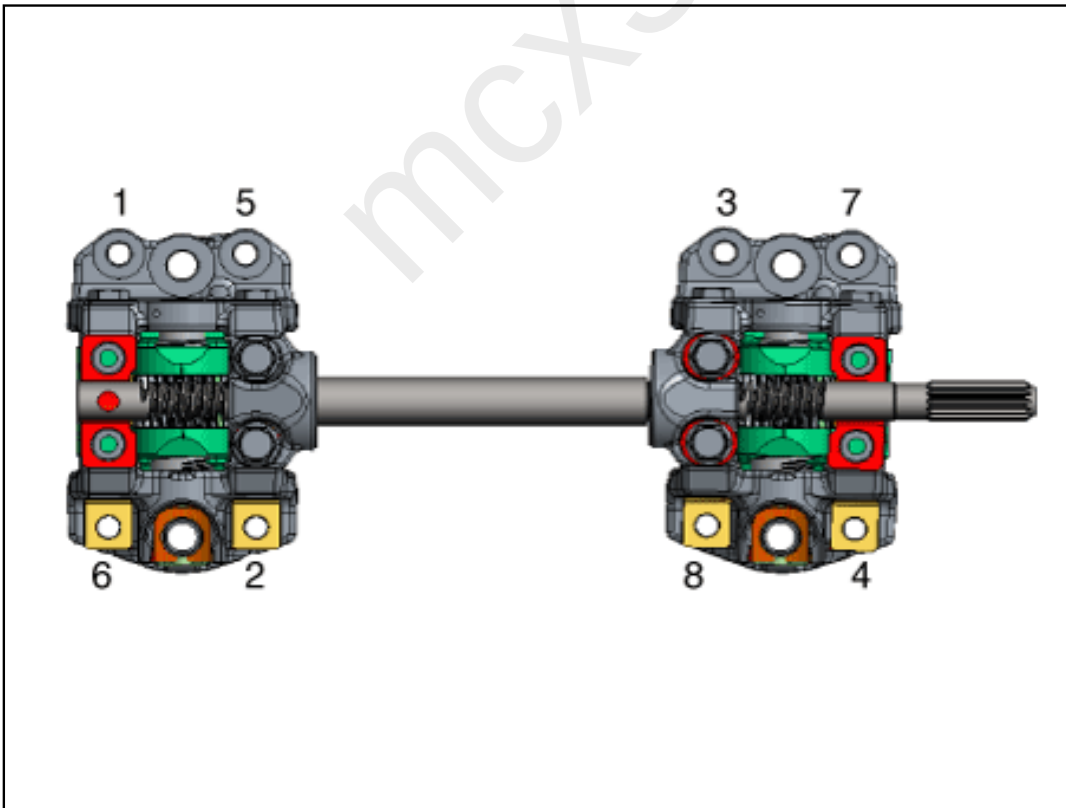


When not using the CVVD fixture

1. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

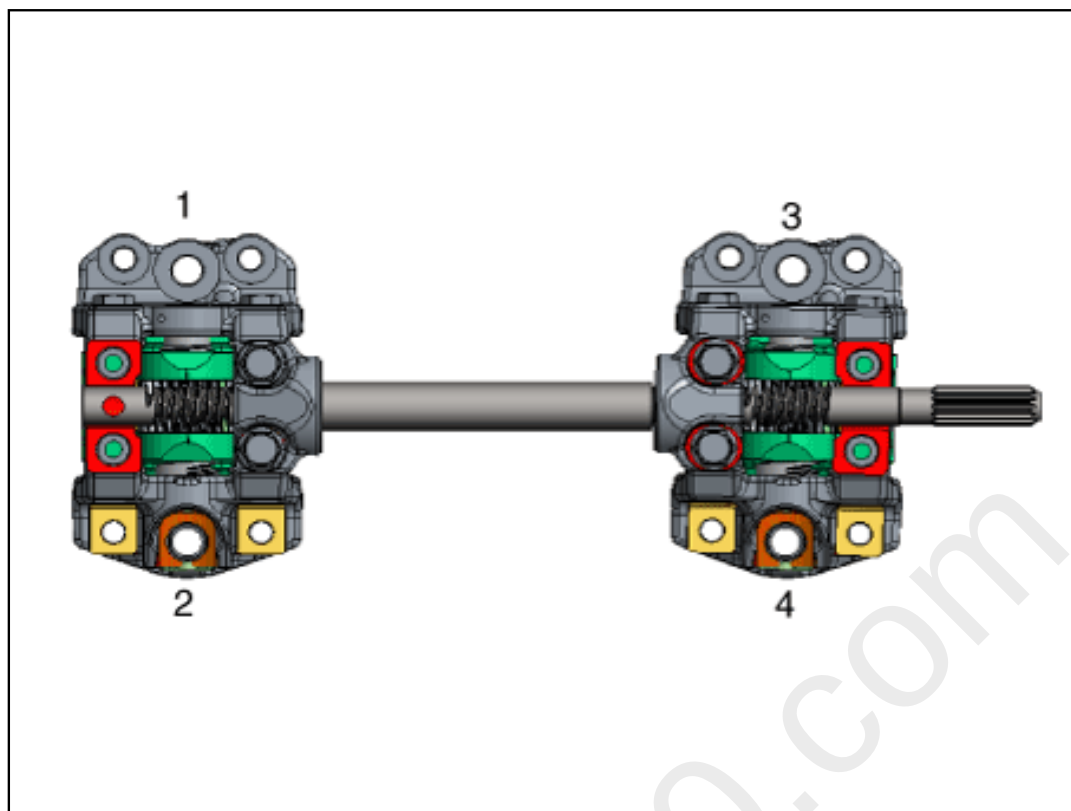
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



2. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

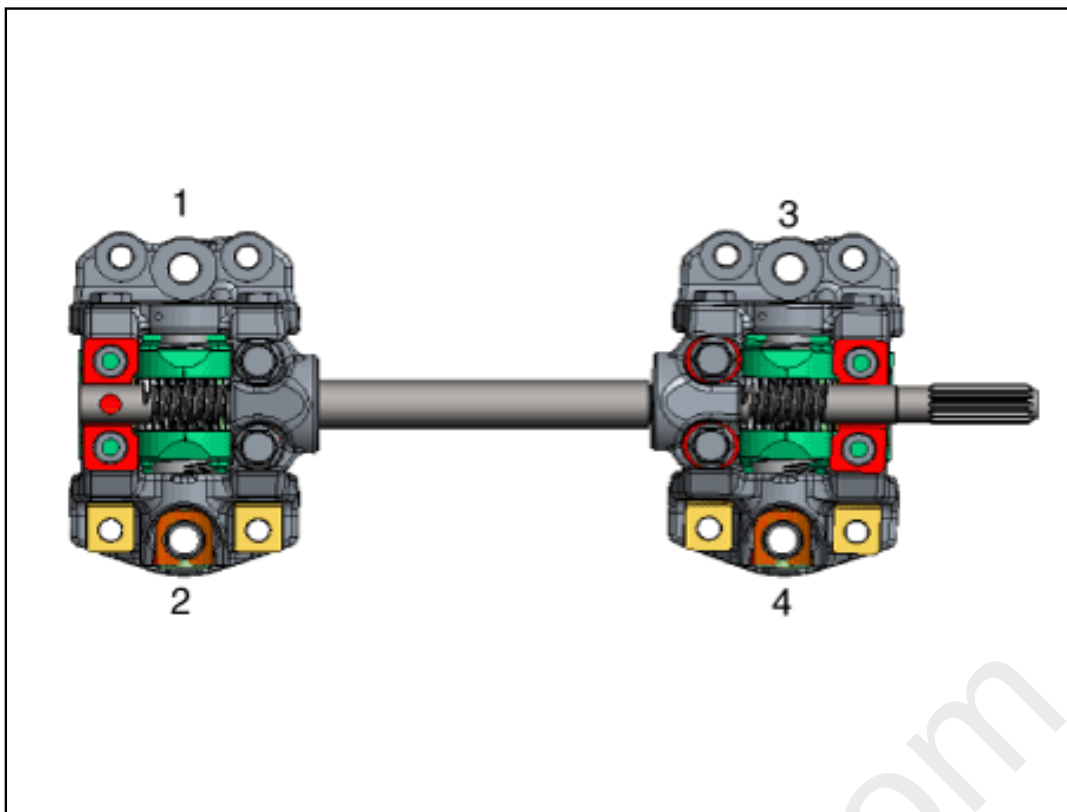
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



3. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

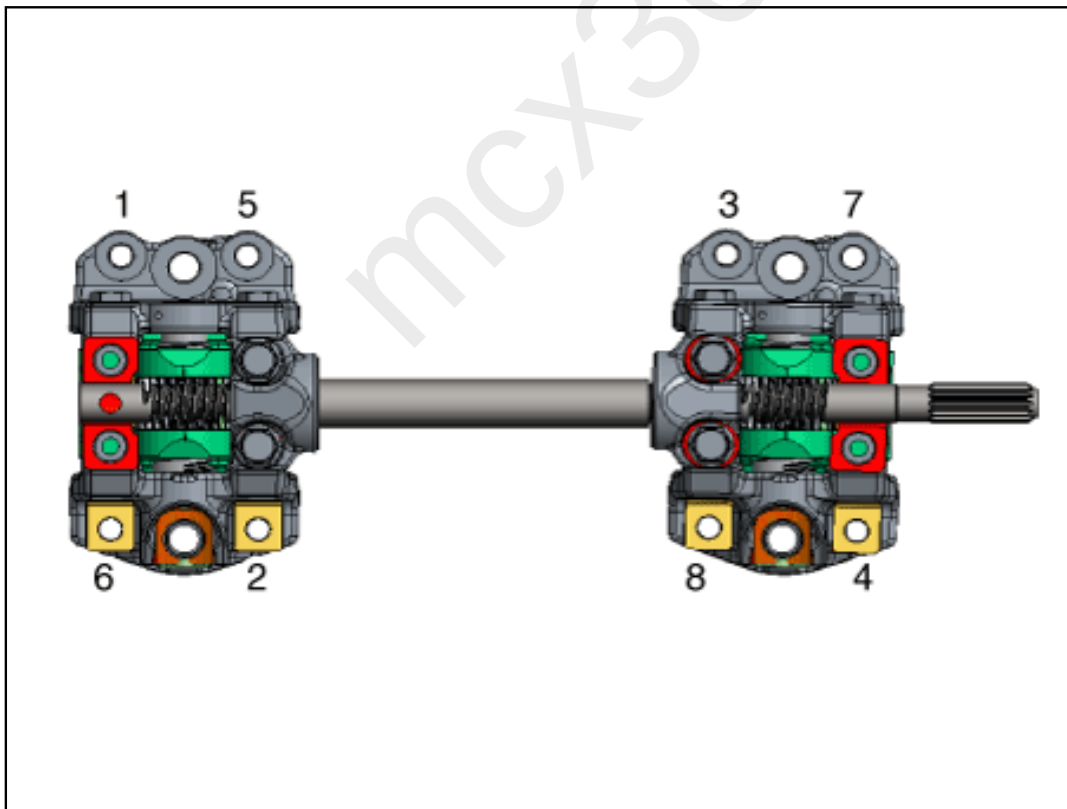
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



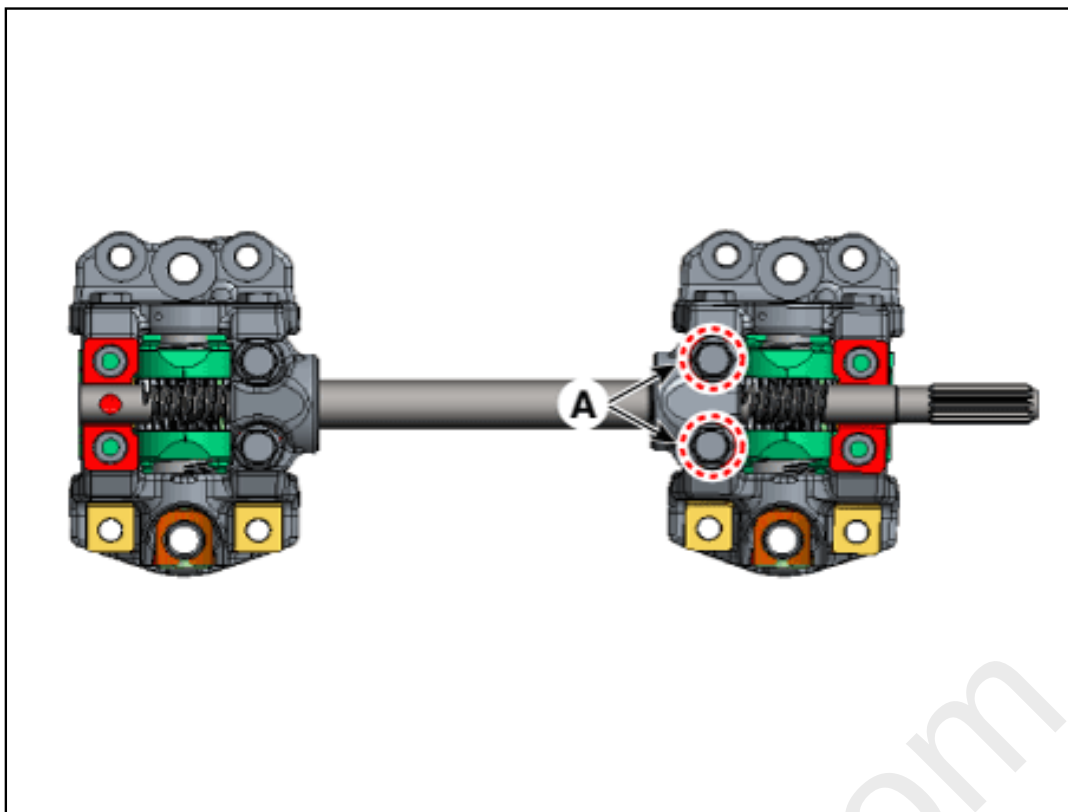
4. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

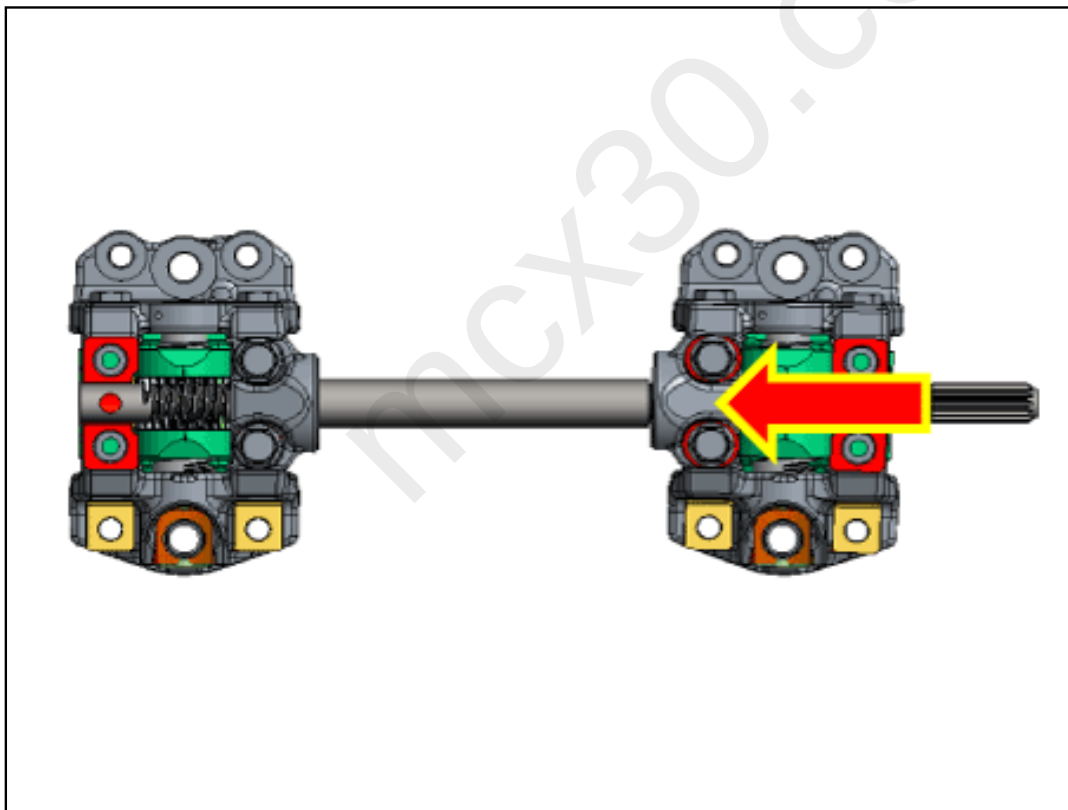
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



5. Release the torque of control shaft bearing cap bolt (A).



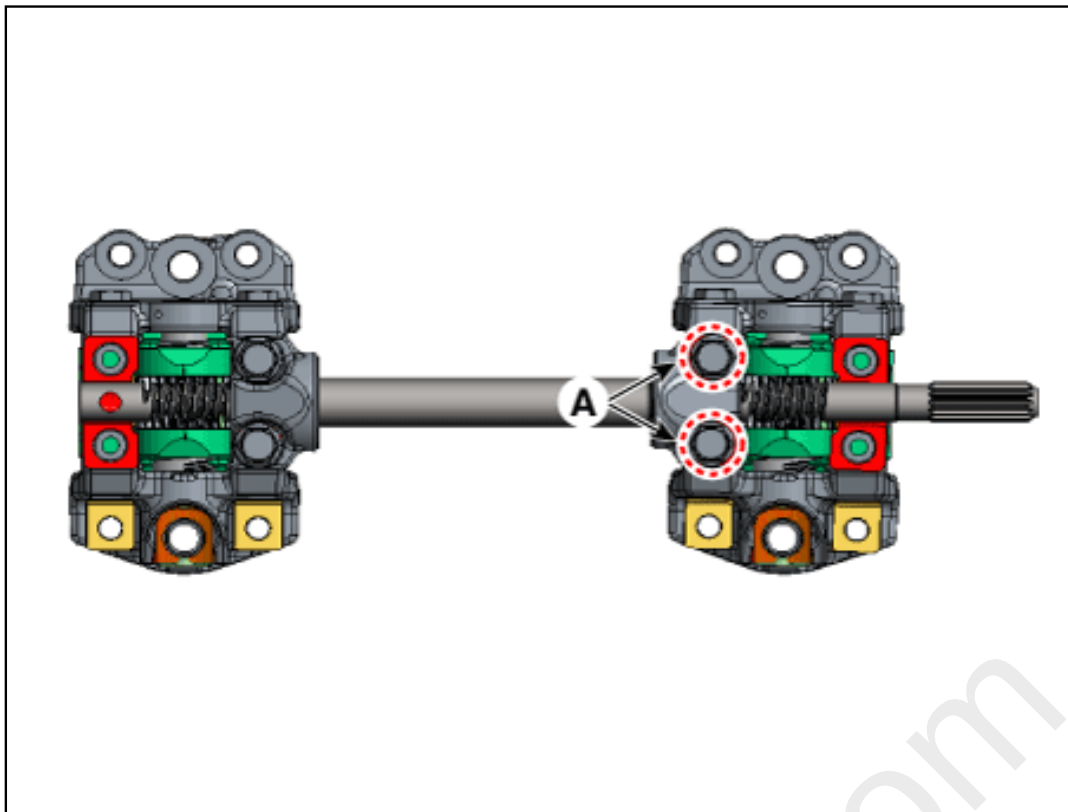
6. Push the control shaft bearing cap as close as possible in the direction of the arrow.



7. Install the control shaft bearing cap mounting bolts (A).

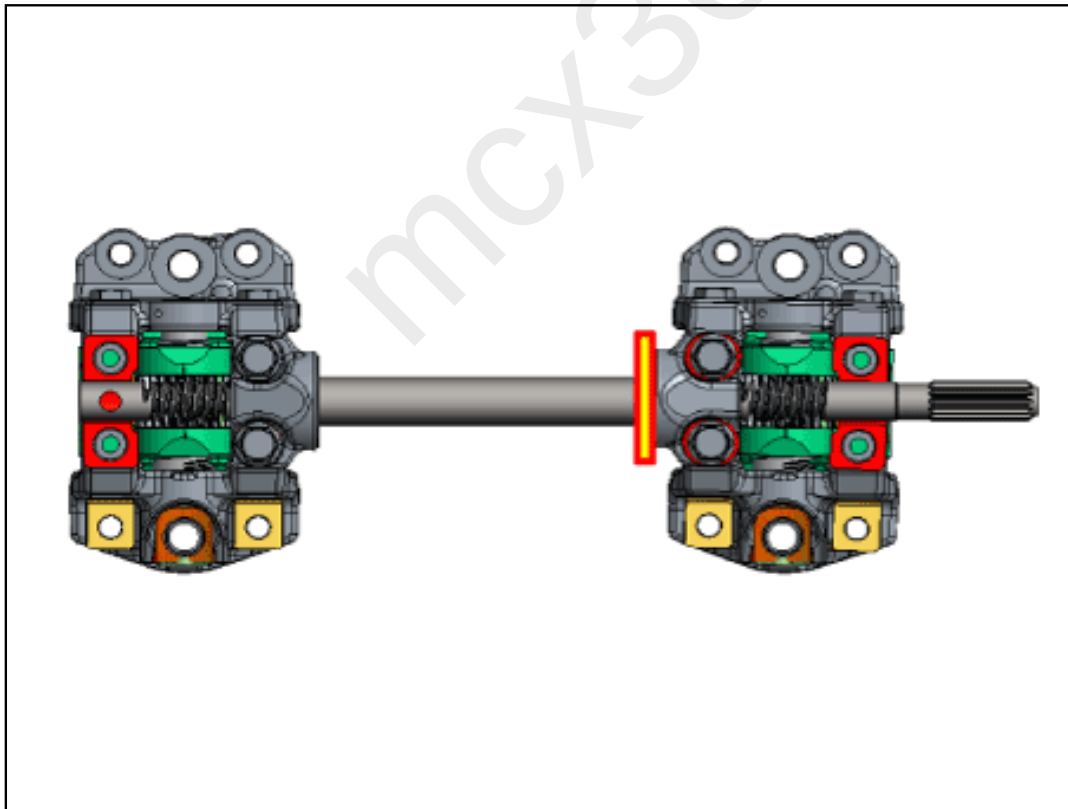
Tightening torque :

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



8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

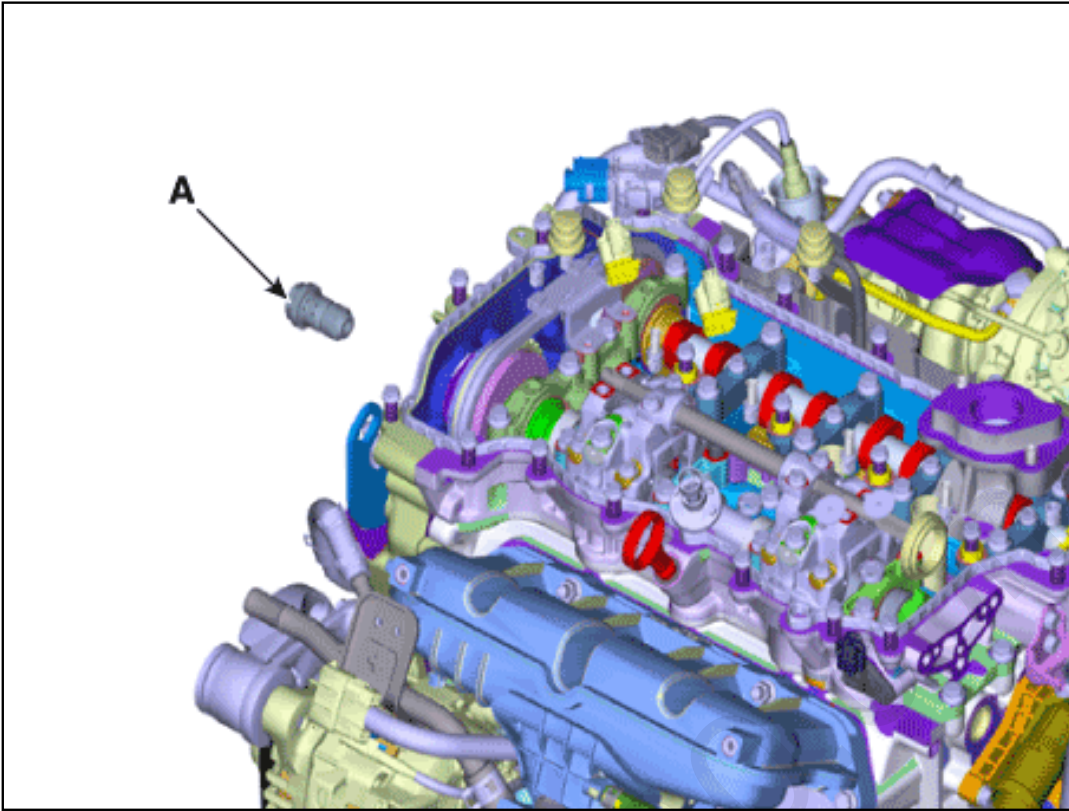
Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)



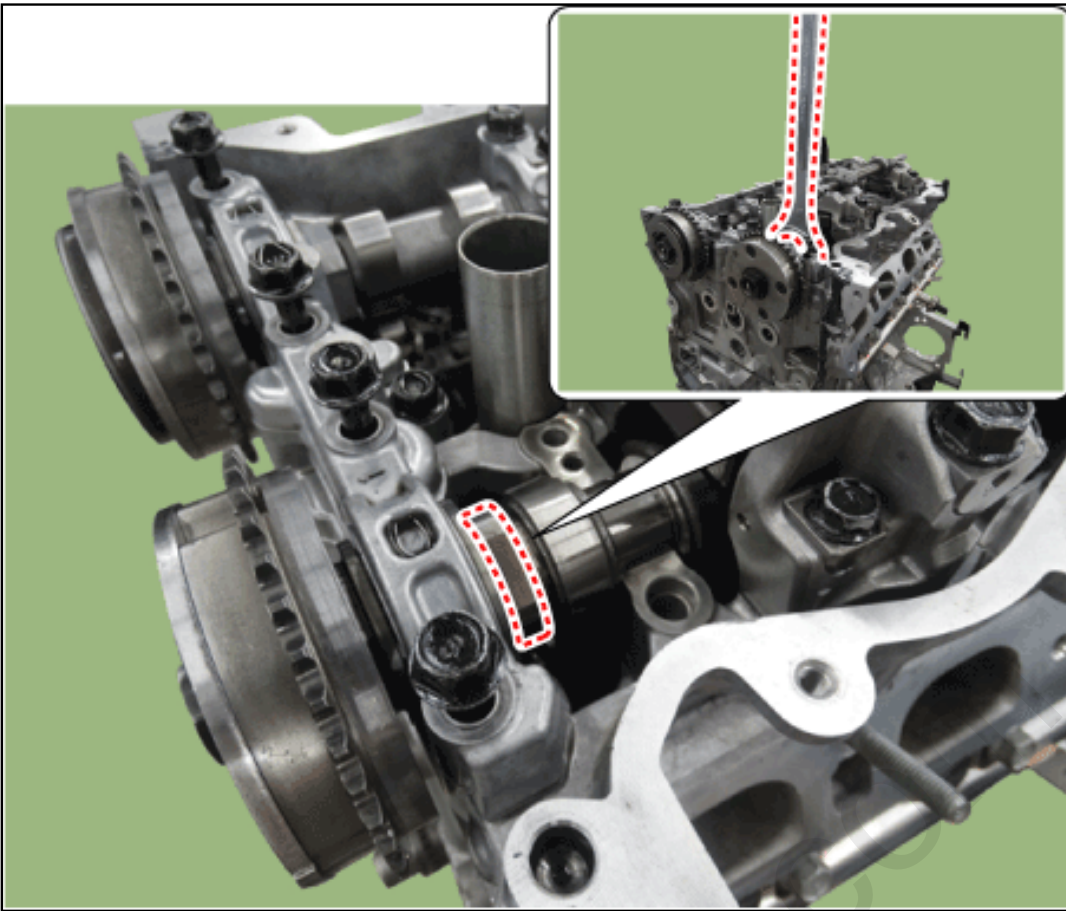
3. Install the intake OCV & center bolt (A).

Tightening torque :

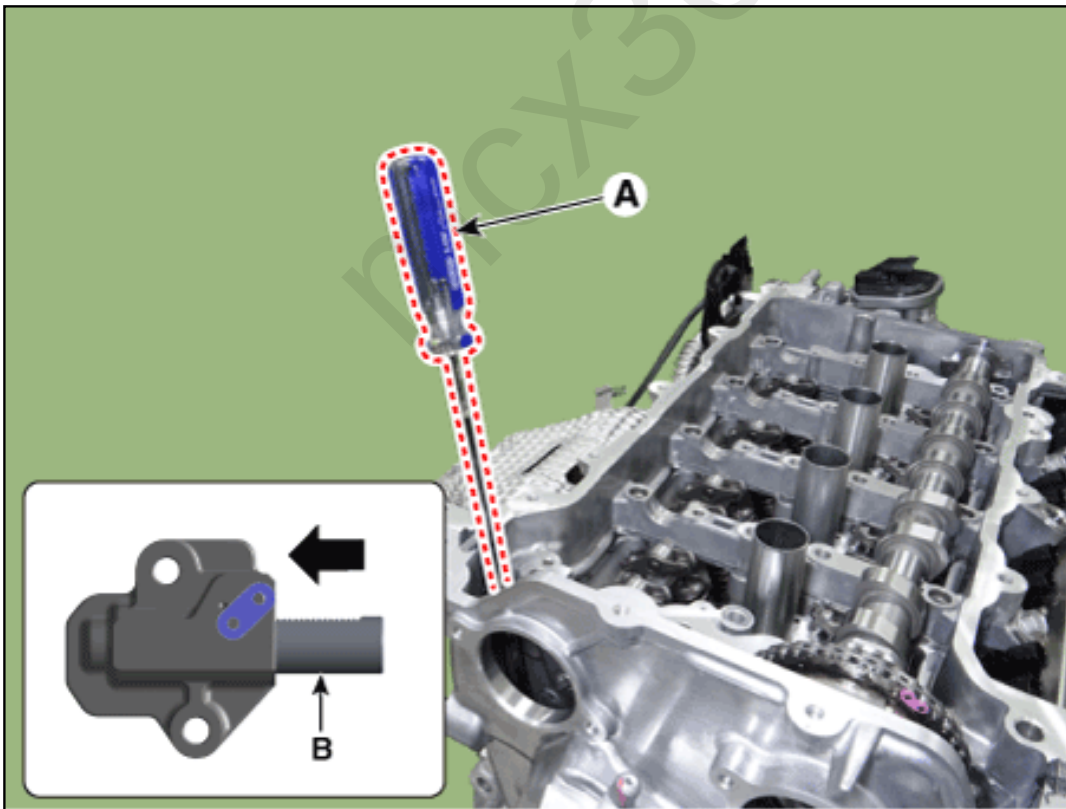
22.6 - 26.5 N.m (2.3 - 2.7 kgf.m, 16.6 - 19.5 lb-ft) + 32 - 36°



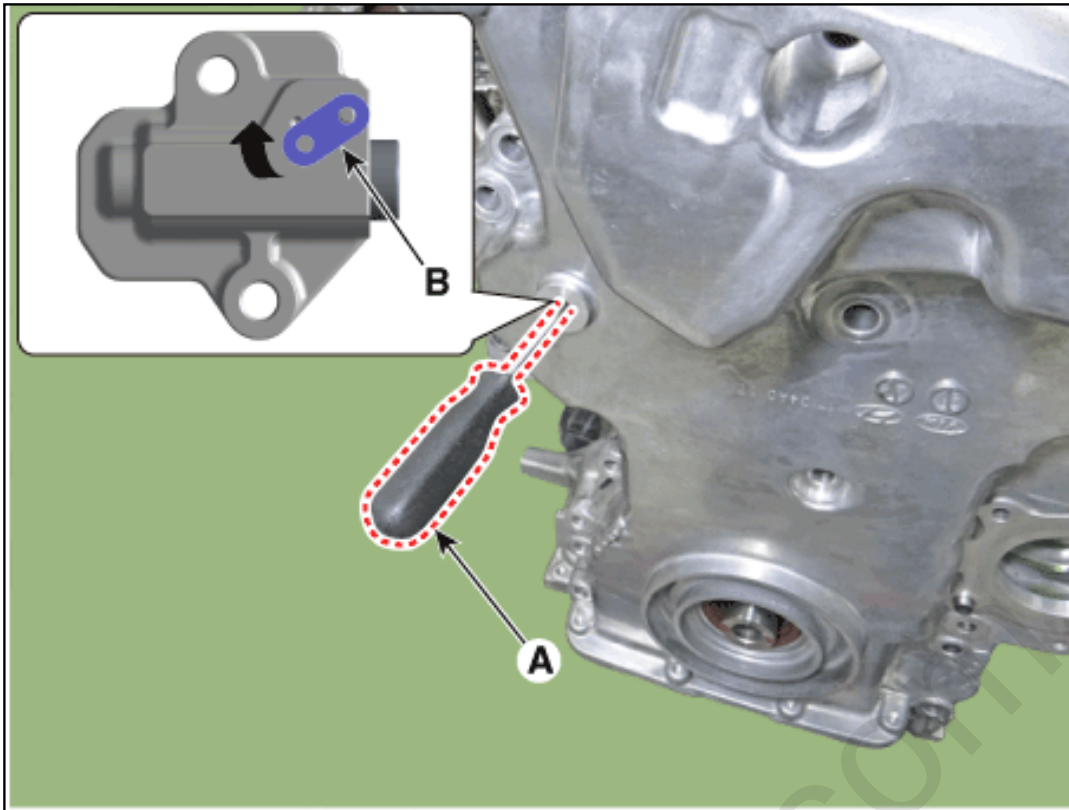
- To prevent impurities from entering intake oil control valve (OCV) & center bolt, wear rubber gloves.
- Intake oil control valve (OCV) and center bolt, hold the hexagonal portion on the camshaft with a wrench to prevent the camshaft from rotating.



4. Compress the timing chain tensioner piston.
(1) With a pry bar (A), compress the timing chain tensioner piston (B).



(2) With a thin gimlet (A), raise the ratchet plate (B) of the timing chain tensioner and fix the piston.



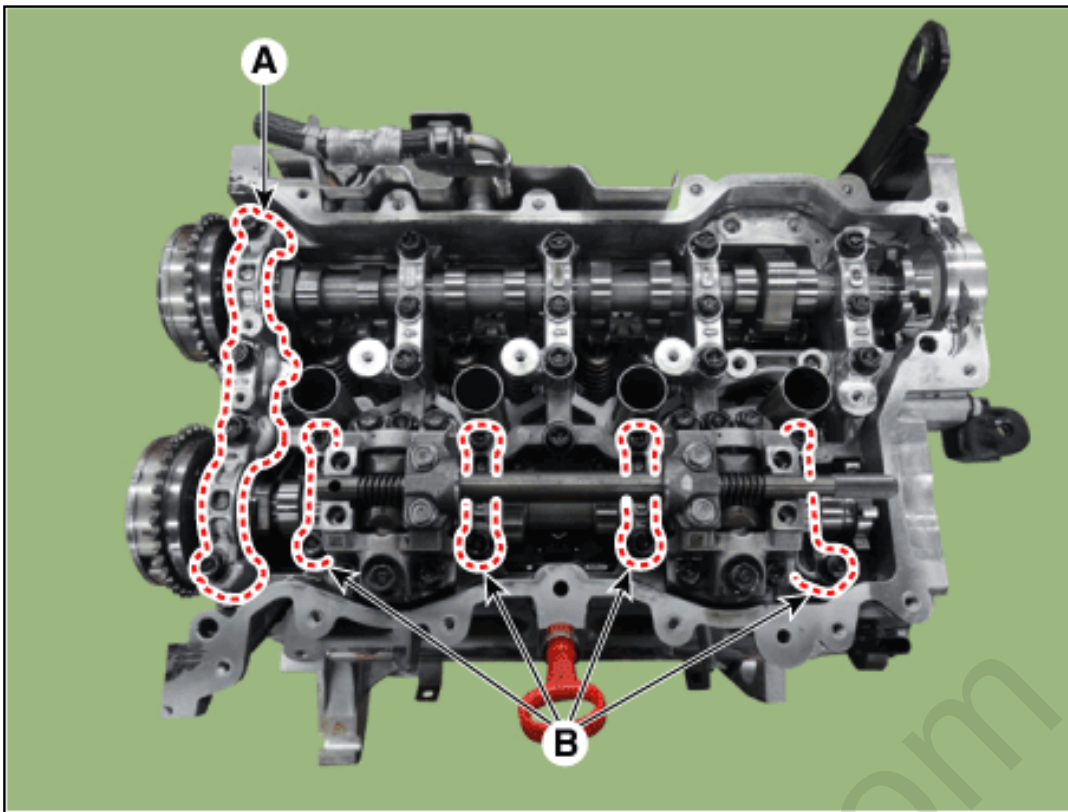
- Do not remove the pick (A).

5. Install the front bearing cap and camshaft bearing cap

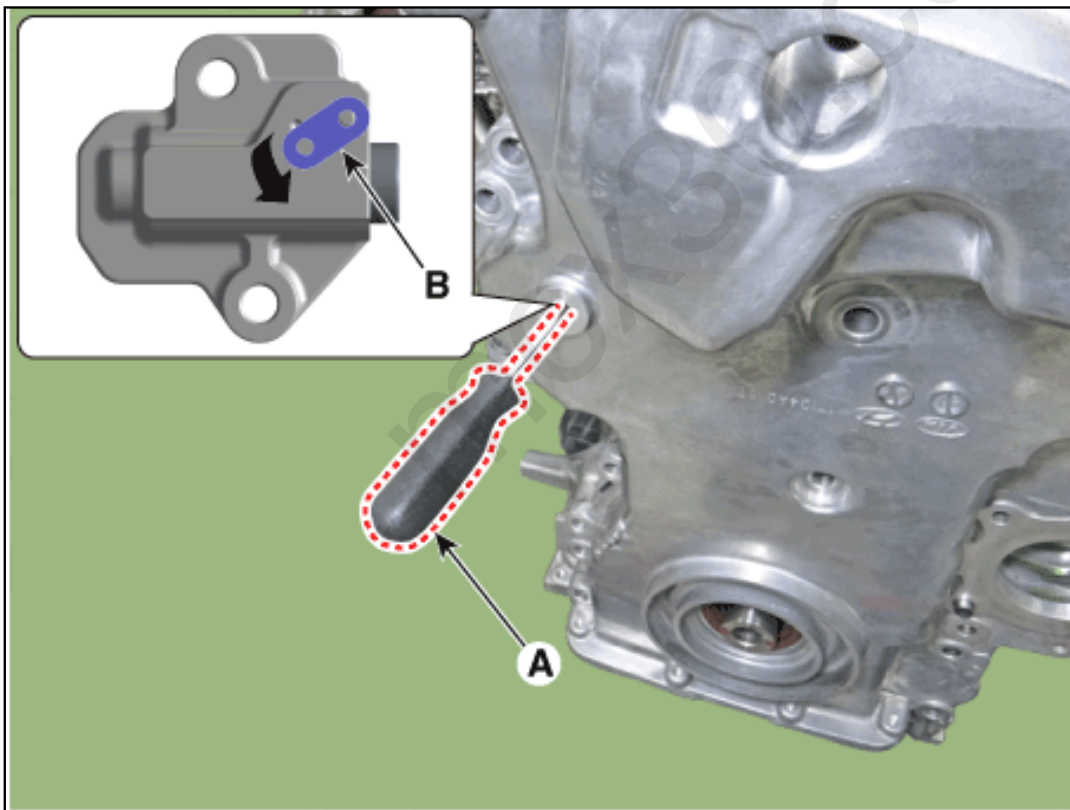


- If there is enough engine oil on the camshaft front bearing cap and camshaft bearing cap installing bolt and bolt hole, tighten to the minimum required tightening torque.
- Apply engine oil the upper part of the intake / exhaust camshaft journal, then install the camshaft front bearing cap and camshaft bearing cap. The amount of application should be enough to flow down both the front and back sides when it is applied to the center.

(1) Install the front bearing cap (A) and intake camshaft bearing cap (B).

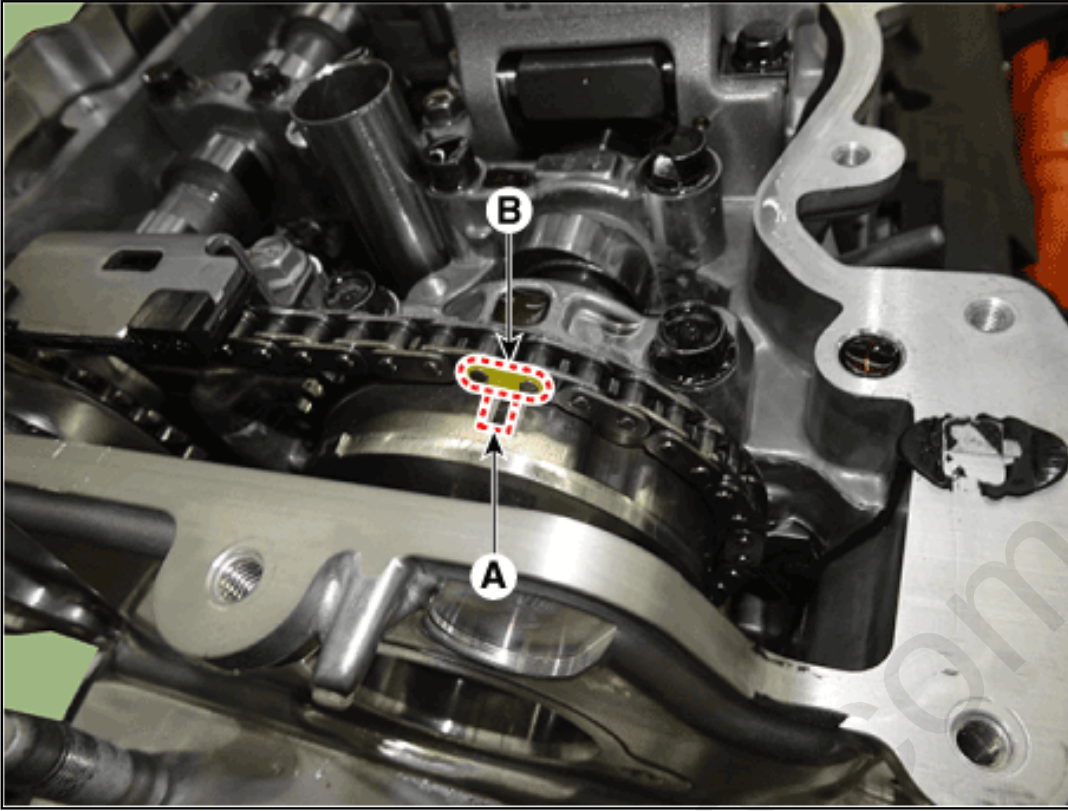


6. Remove the fine gimlets (A) that hold the timing chain tensioner.

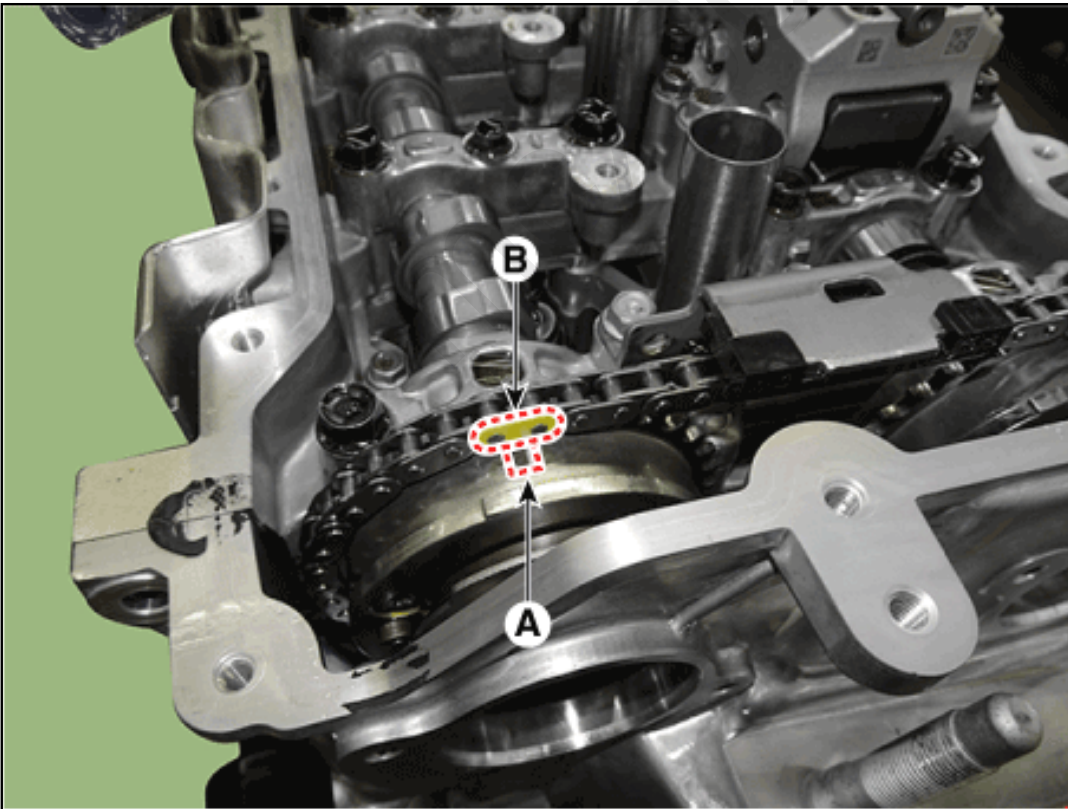


7. When installing the timing chain, be sure that the timing mark (A) of each sprocket is matched with the timing mark (B) (color link) of the timing chain.

[Intake CVVT Timing Mark]



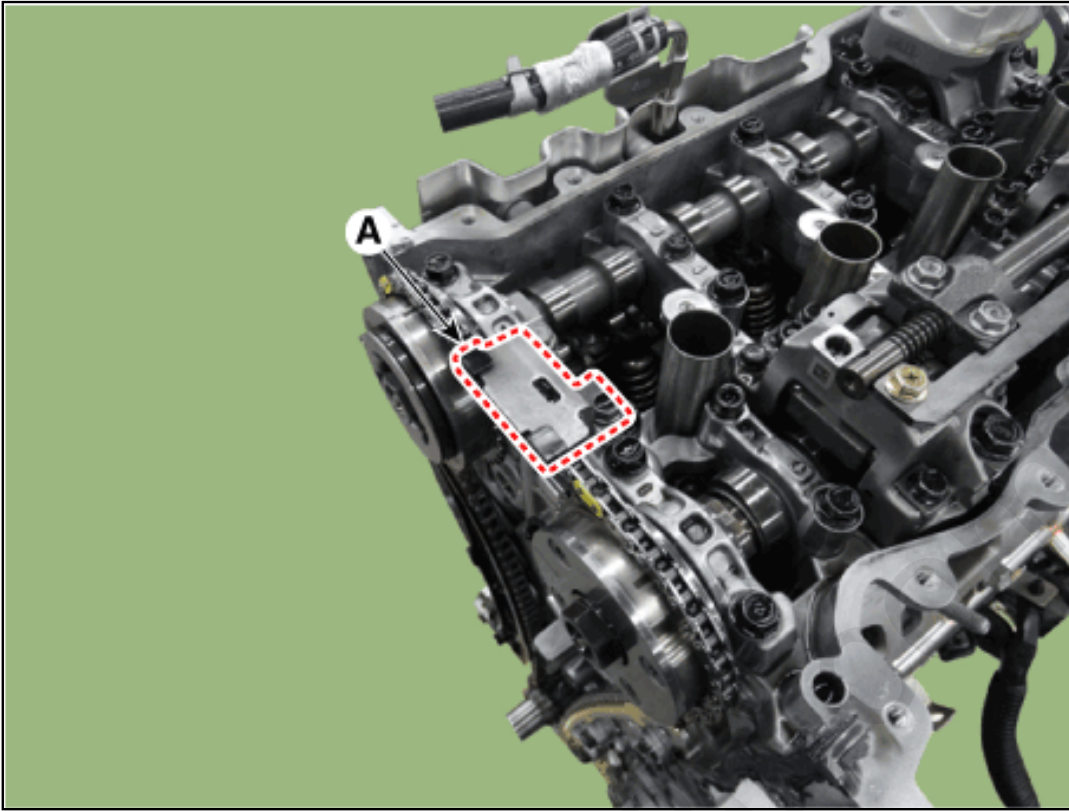
[Exhaust CVVT Timing Mark]



8. Install the cam to cam guide (A).

Tightening torque :

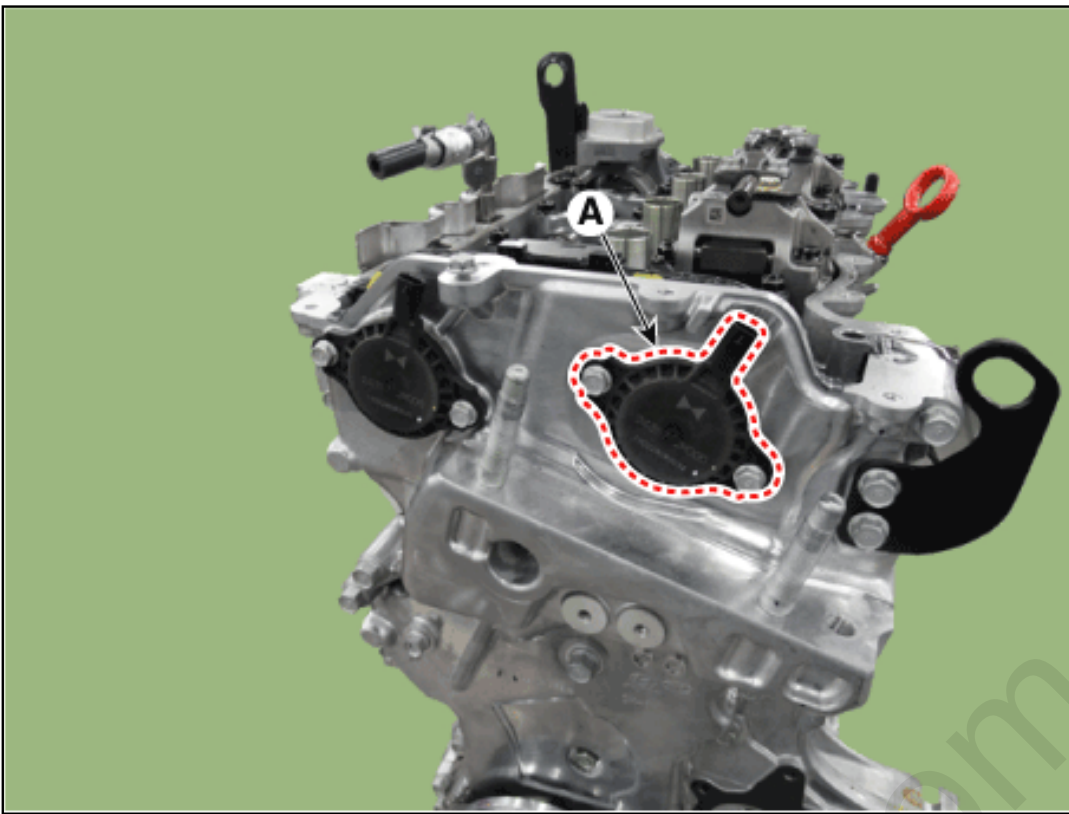
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



9. Install the intake variable force solenoid (VFS) valve (A).

Tightening torque :

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



10. Install the cylinder head cover.
(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

Removal



- Use Fender cover 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.



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

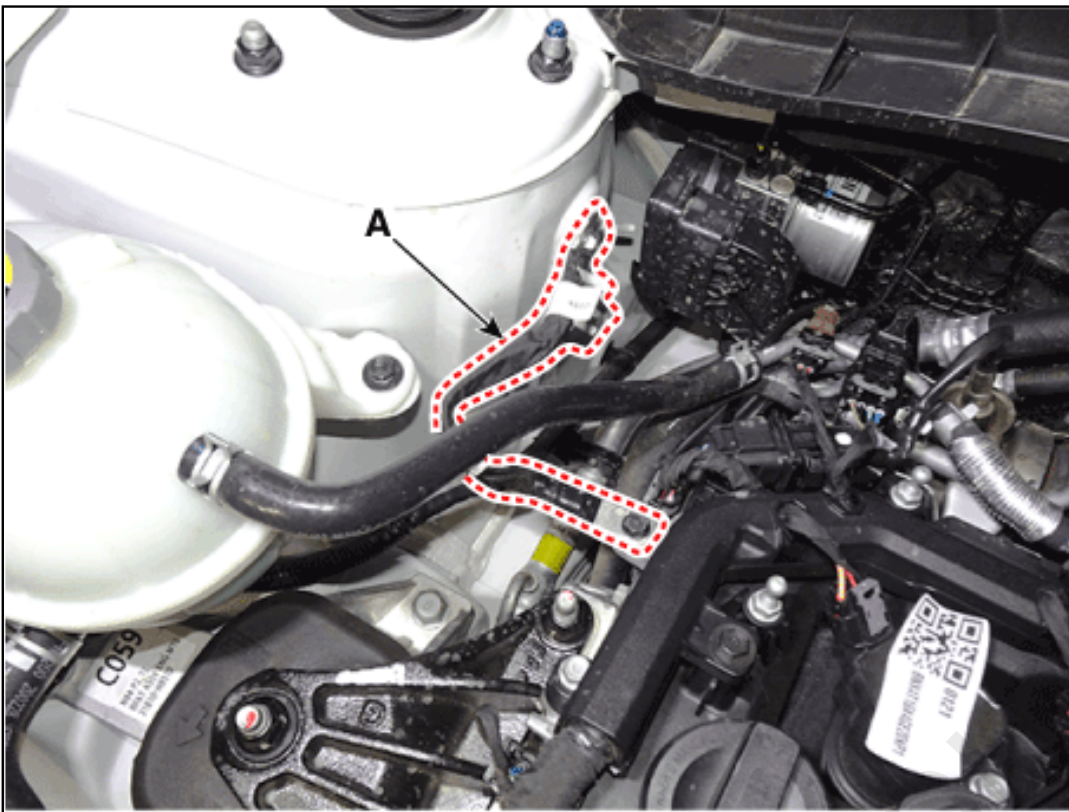
1. Disconnect the negative battery terminal.

Tightening torque :

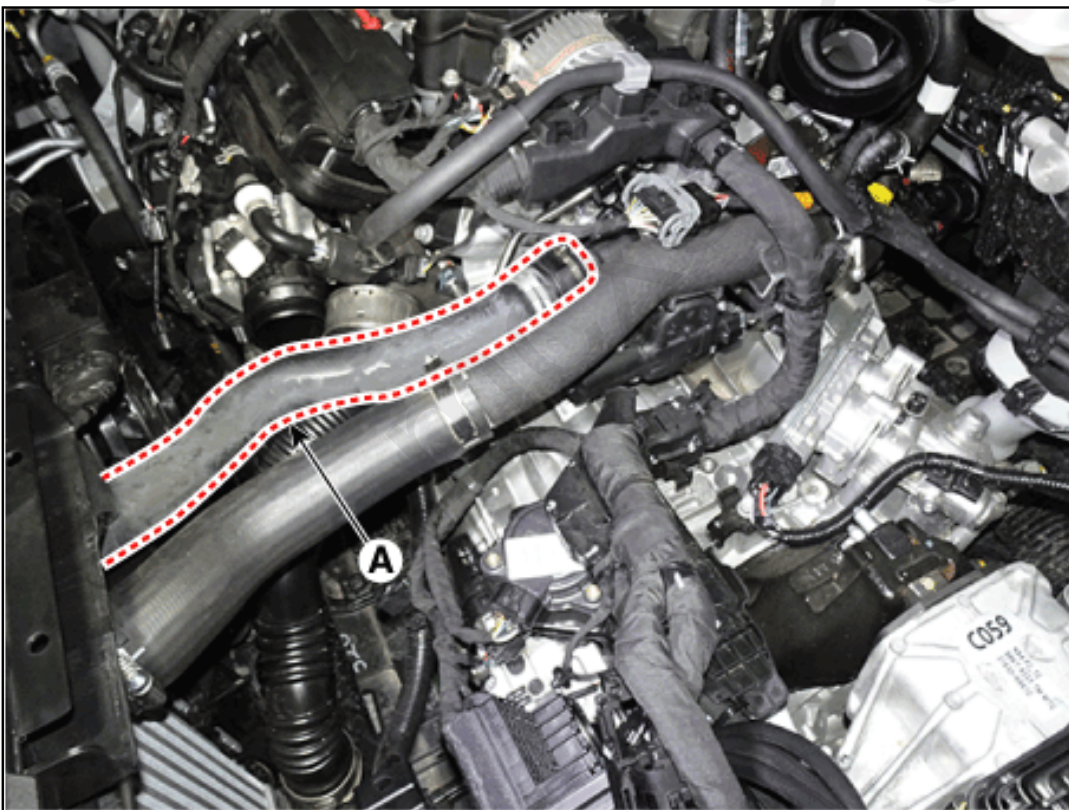
2. Remove the engine cover.
(Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the engine room under cover.
(Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
4. Drain the coolant.
(Refer to Cooling System - "Coolant")
5. Remove the air duct and air cleaner assembly.
(Refer to Intake and Exhaust System - "Air Cleaner")
6. Remove the battery and battery tray.
(Refer to Engine Electrical System - "Battery")
7. Remove the engine ground cable (A).

Tightening torque :

10.8 - 13.7 N.m (1.1 - 1.4 kgf.m, 8.0 - 10.1 lb-ft)



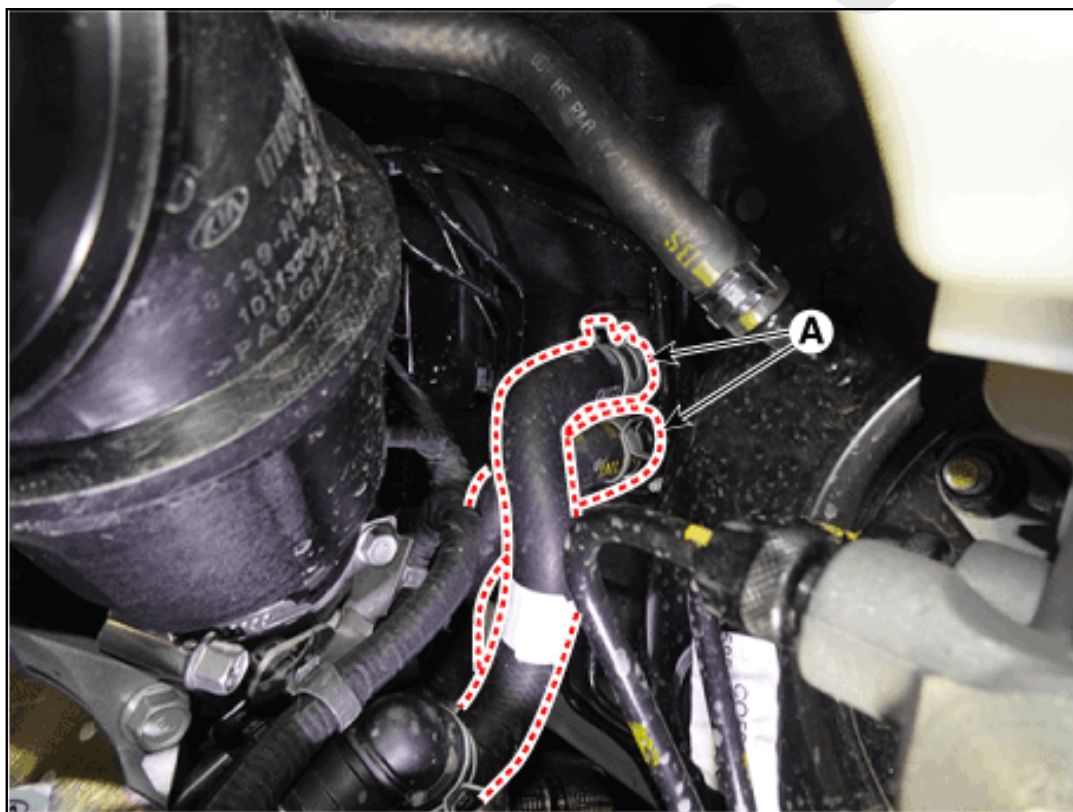
8. Disconnect the radiator upper hose (A).



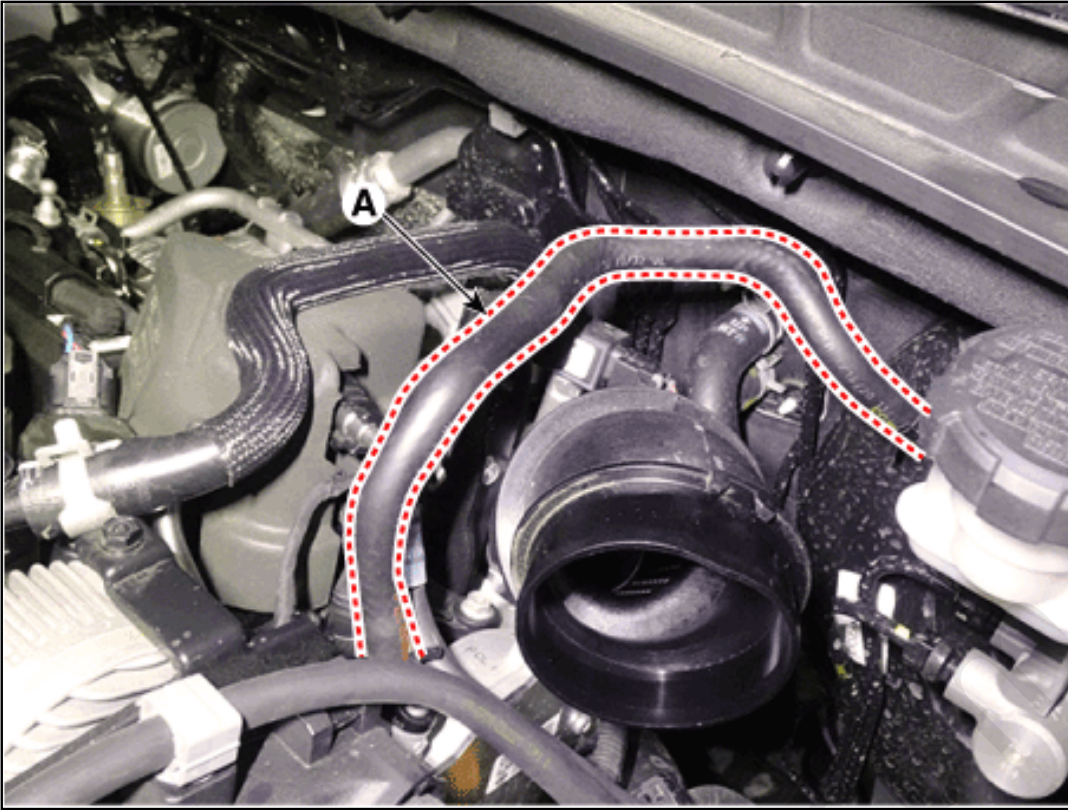
9. Disconnect the coolant reservoir tank coolant hose (A).



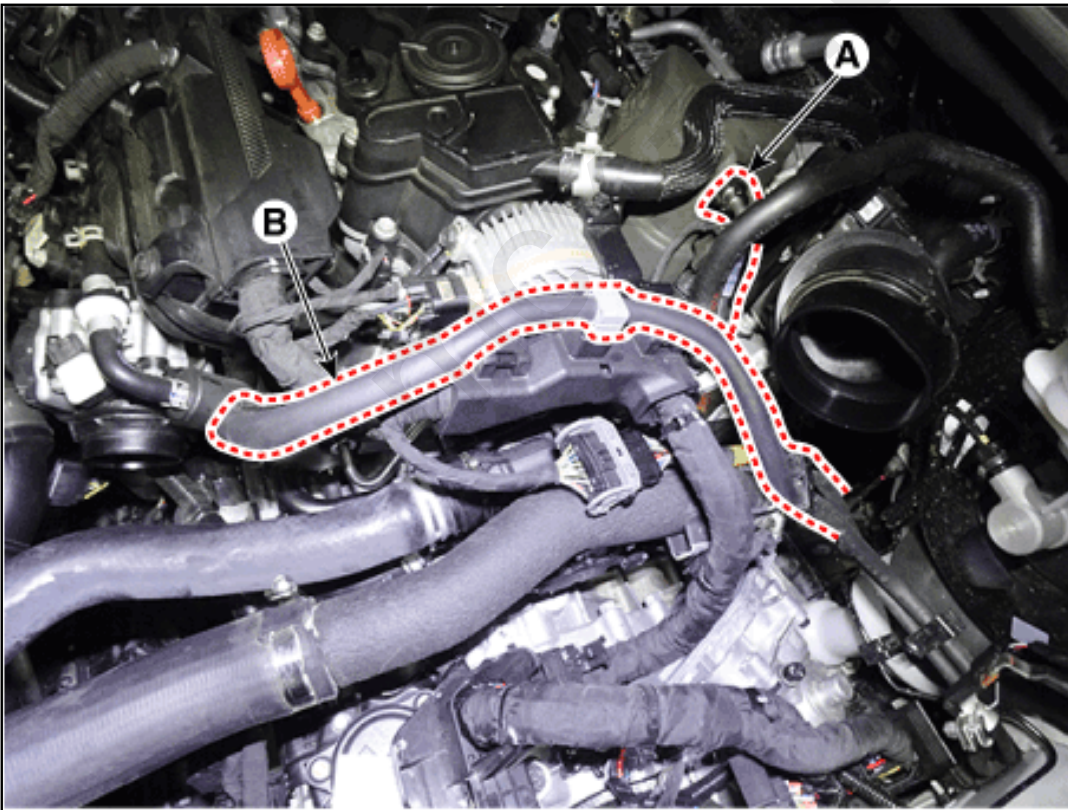
10. Disconnect the heater hoses (A).



11. Disconnect the brake vacuum hose (A).



12. Disconnect the fuel hose (A) and purge control solenoid valve (PCSV) hose (B).



13. Remove the intake manifold.

(Refer to Intake and Exhaust System - "Intake Manifold")

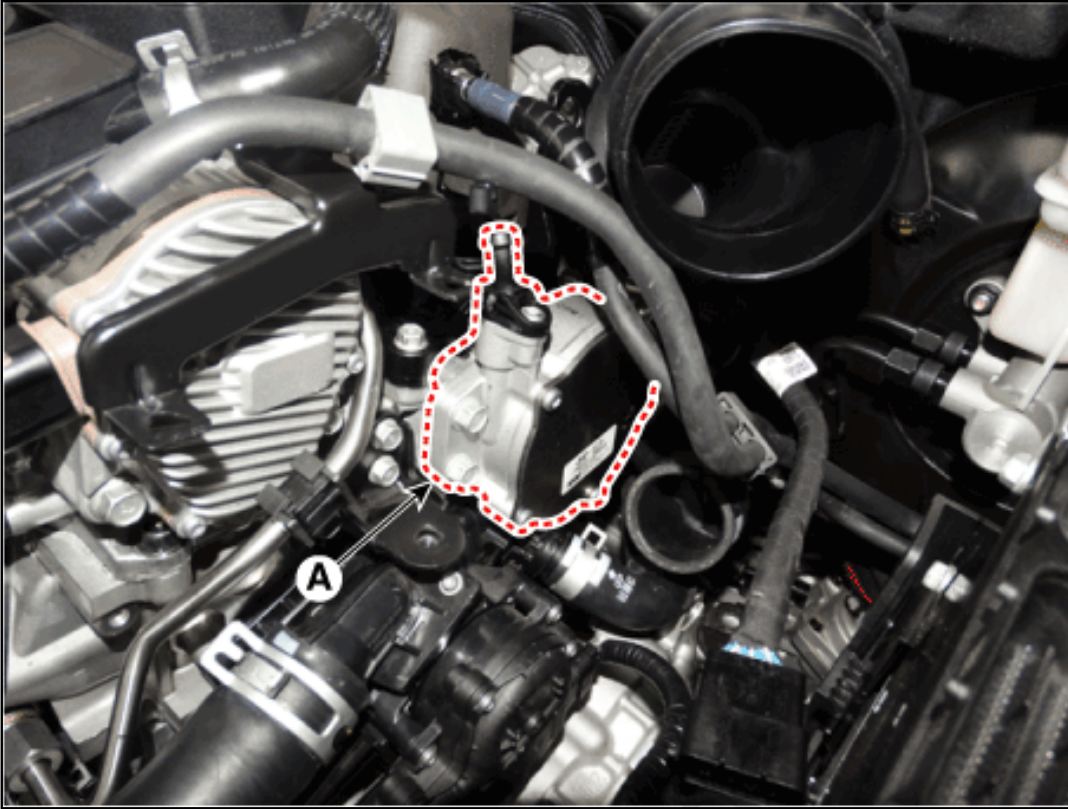
14. Remove the delivery pipe.

(Refer to Engine Control / Fuel System - "Delivery Pipe")

15. Remove the exhaust manifold.

(Refer to Intake and Exhaust System - "Exhaust Manifold")

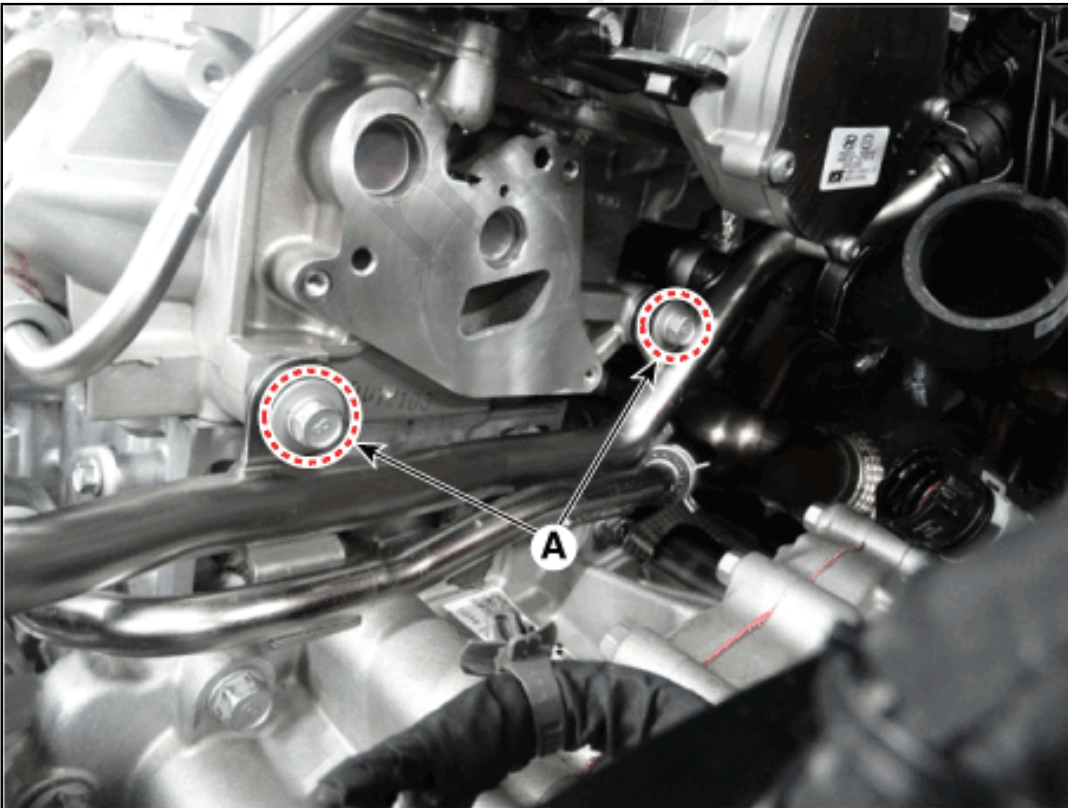
16. Remove the vaccum pump (A).



17. Remove the integrated thermal management module (ITM).

(Refer to Cooling System - "Integrated Thermal Management Module (ITM)")

18. Remove the heater pipe mounting bolts (A).



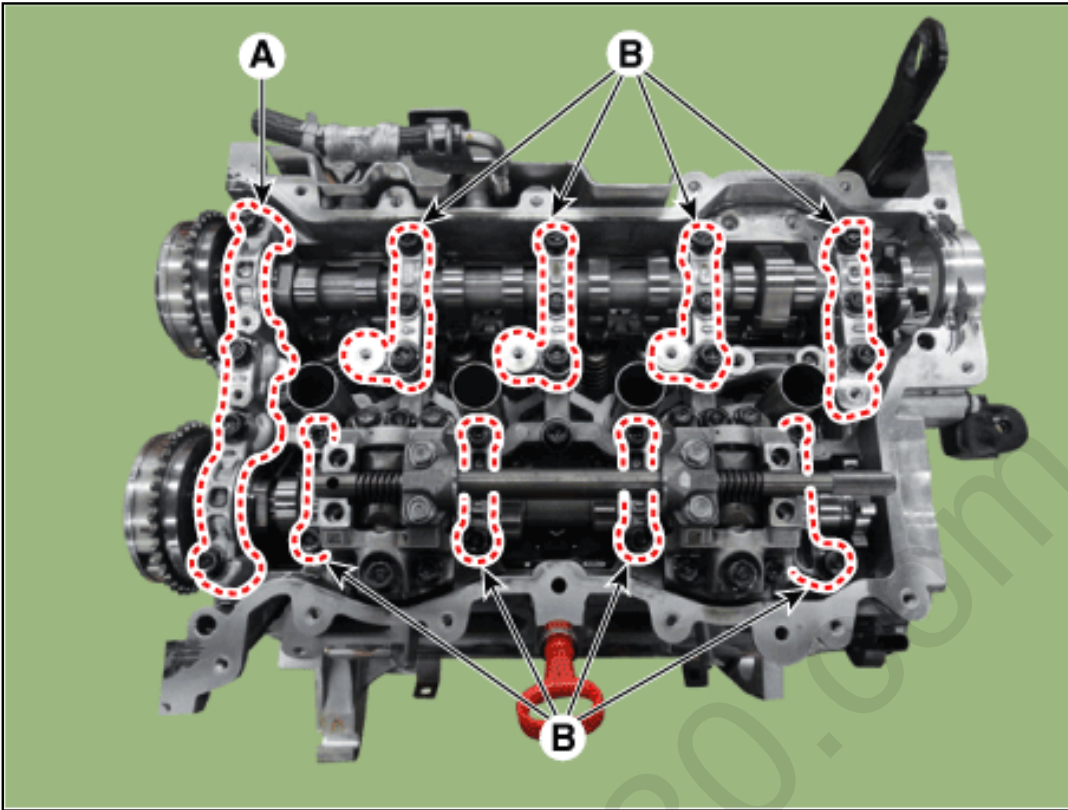
19. Remove the spark plug.

(Refer to Engine Electrical System - "Spark Plug")

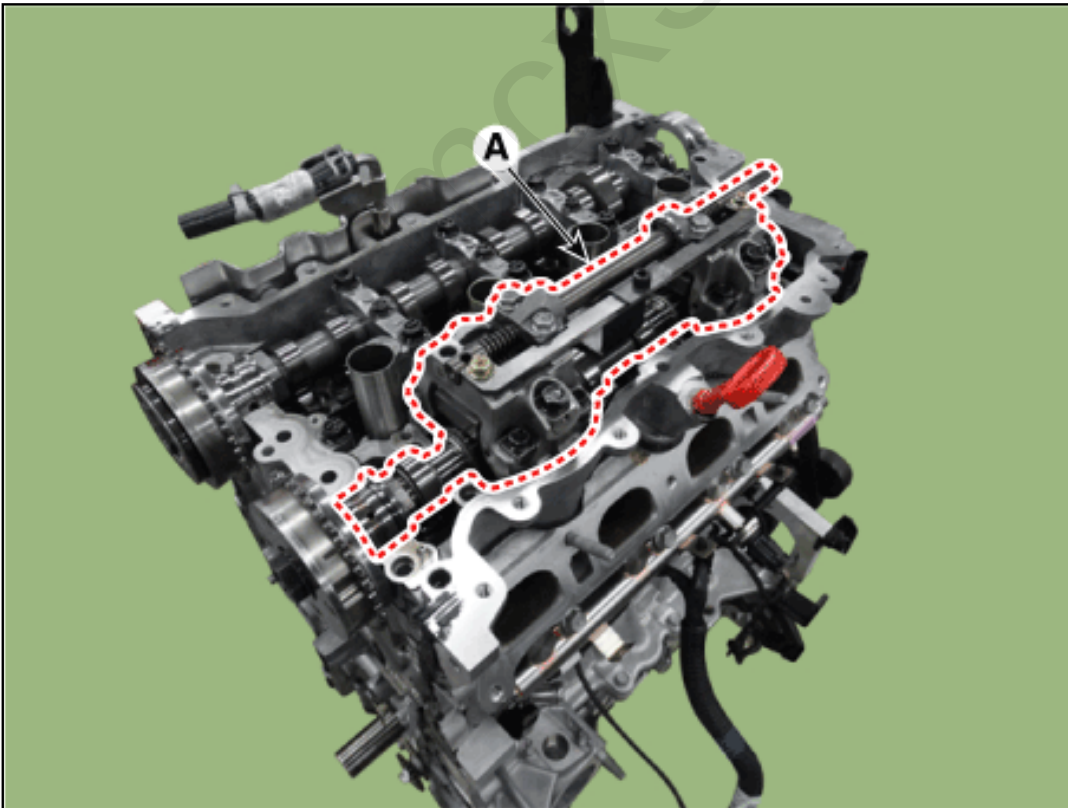
20. Remove the timing chain.

(Refer to Timing System - "Timing Chain")

21. Remove the camshaft front bearing cap (A) and camshaft bearing caps (B).



22. Remove the CVVD assembly (A).

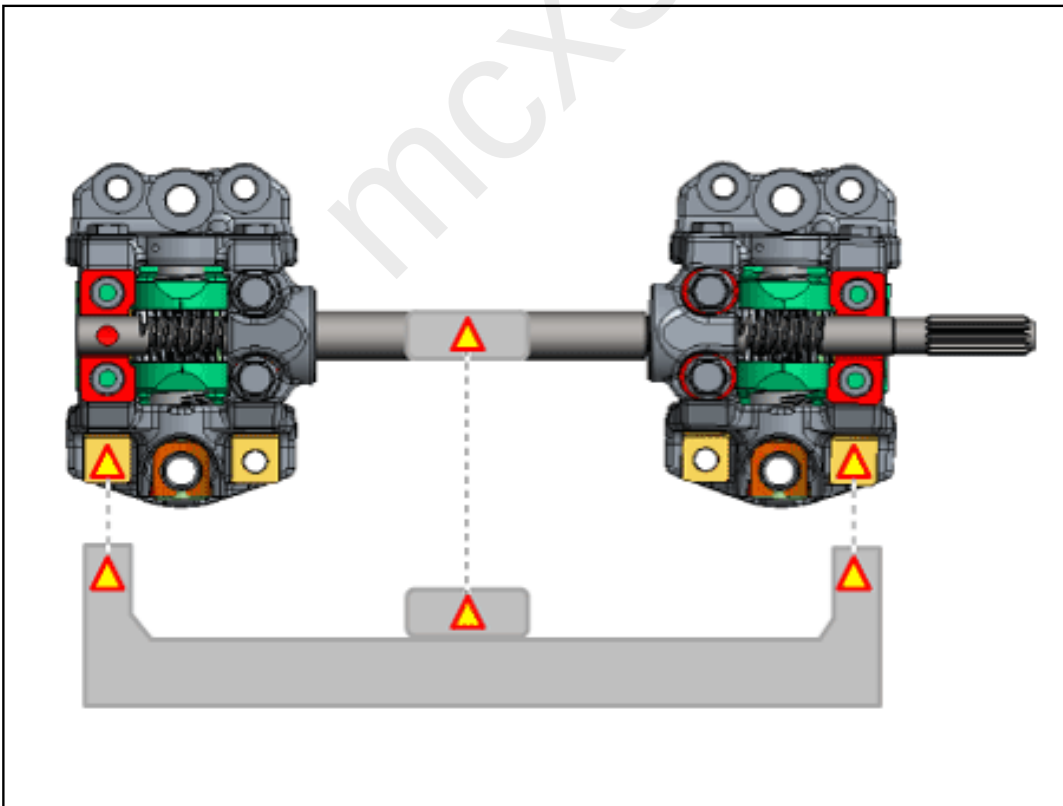




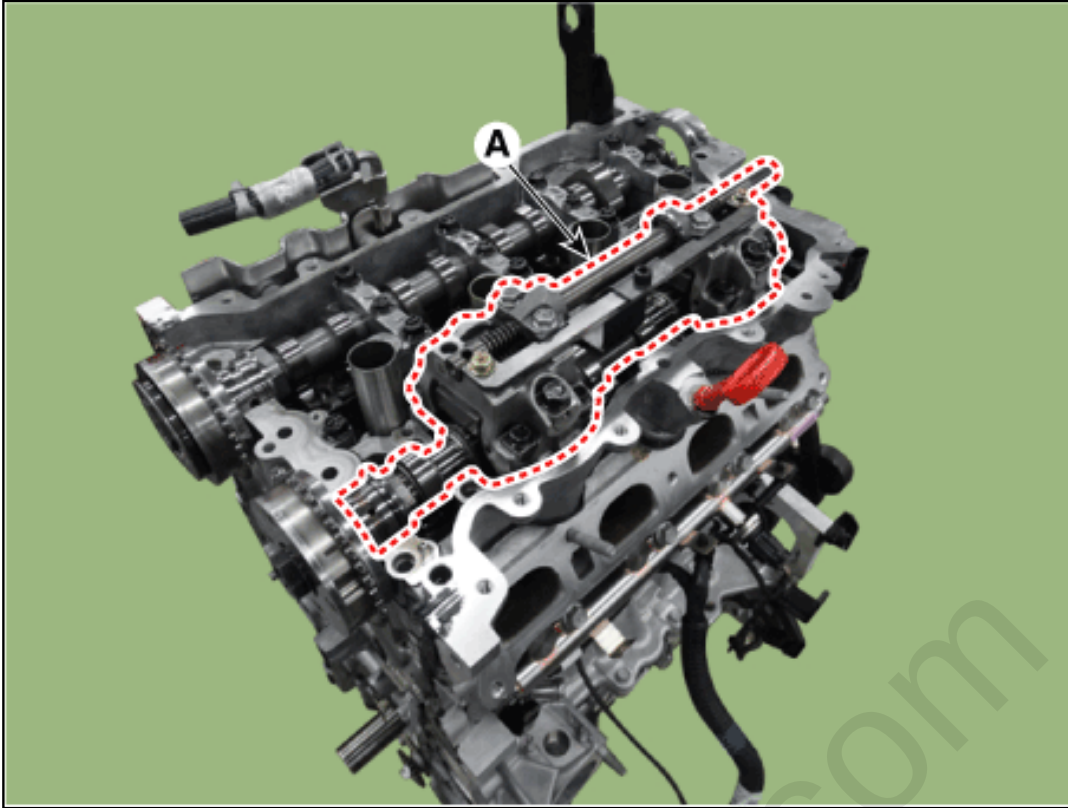
- After removing the CVVD unit, make sure that the parts such as lifter, cam, etc are not separated.
- Ensure that the CVVD components are not damaged.

When Using the CVVD fixture

(1) Install the CVVD fixture (A) over the CVVD assembly.

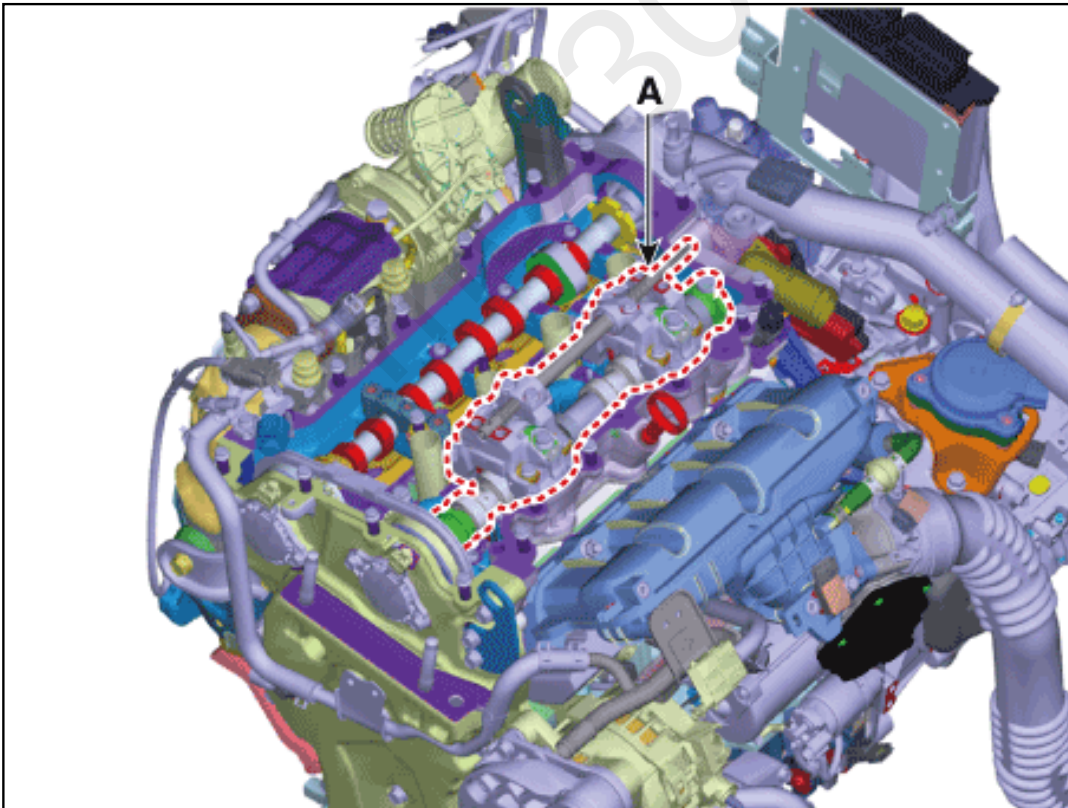


(2) Remove the CVVD assembly (A).

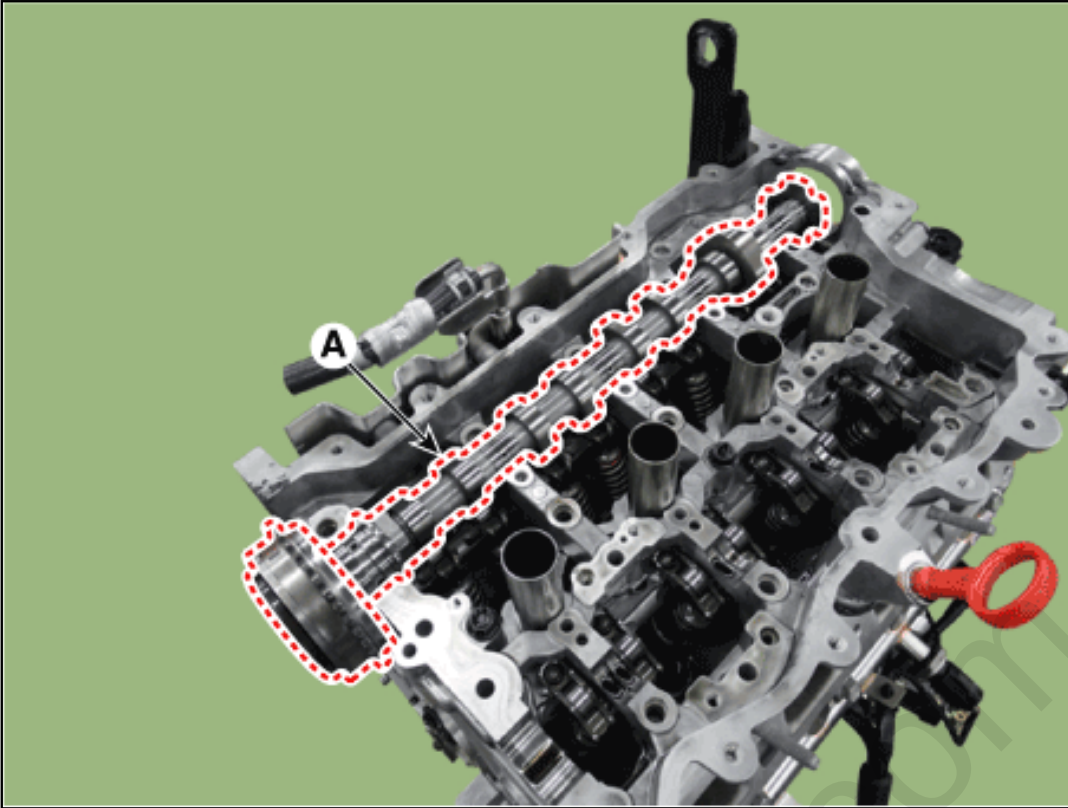


When not using the CVVD fixture

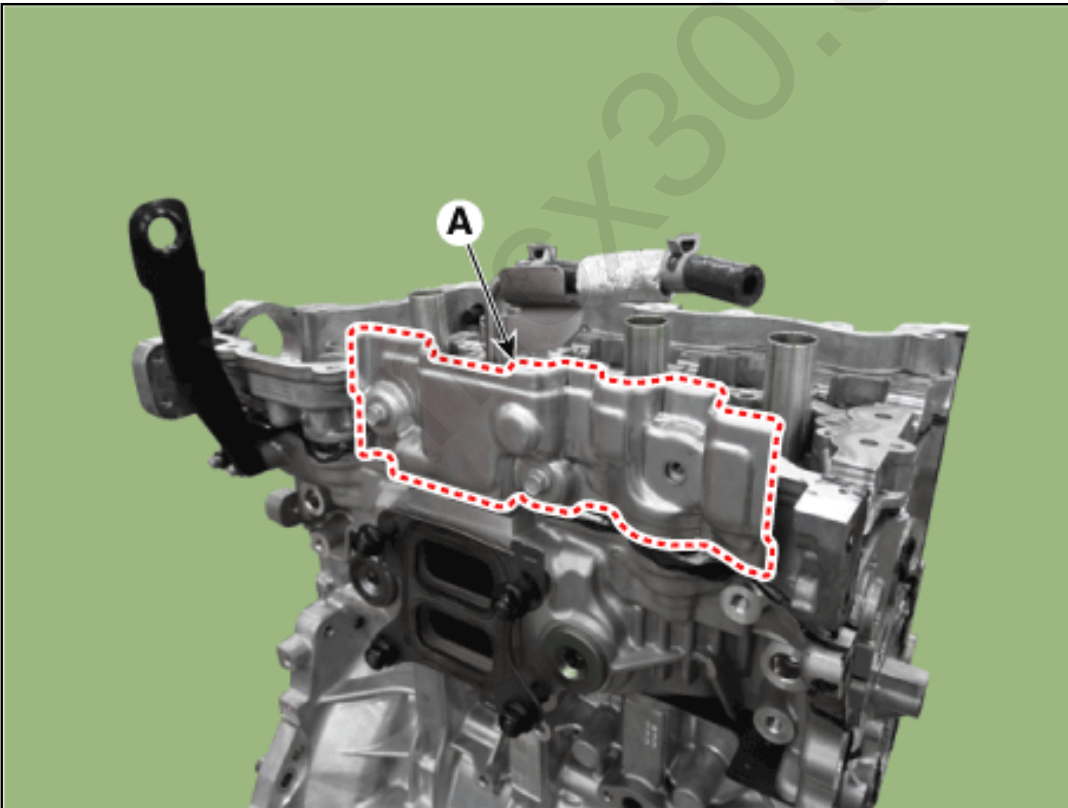
(3) Remove the CVVD assembly (A).



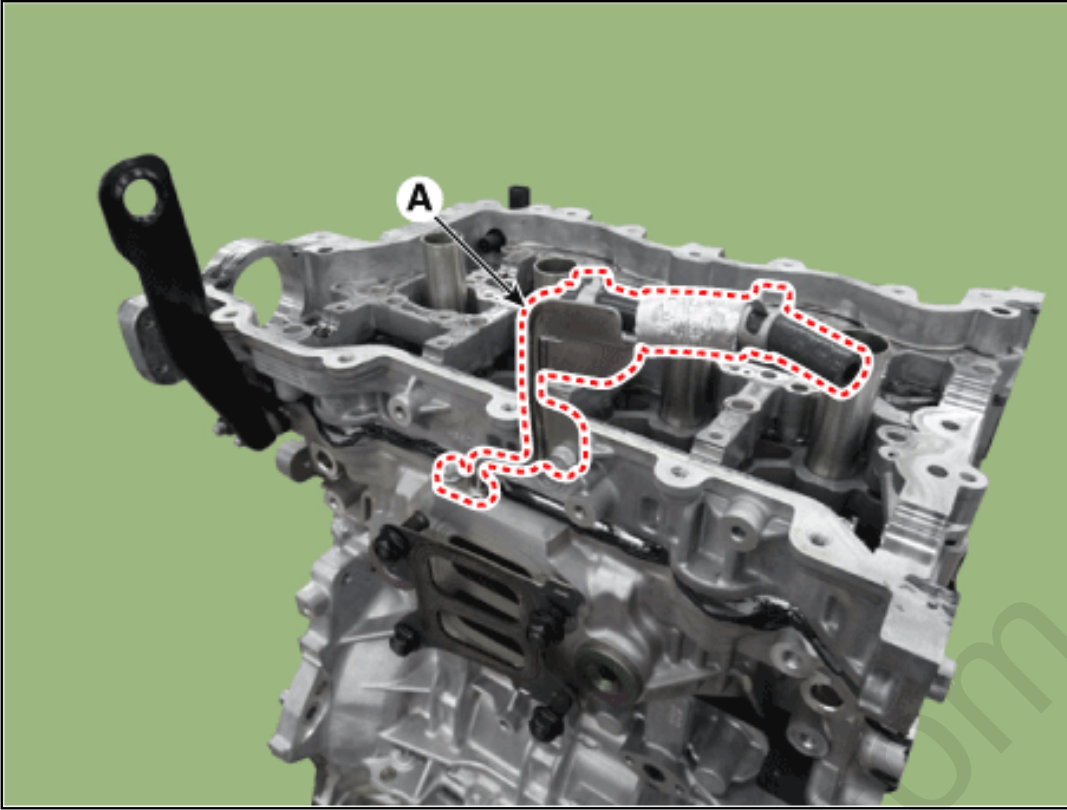
23. Remove the exhaust camshaft & CVVT assembly (A).



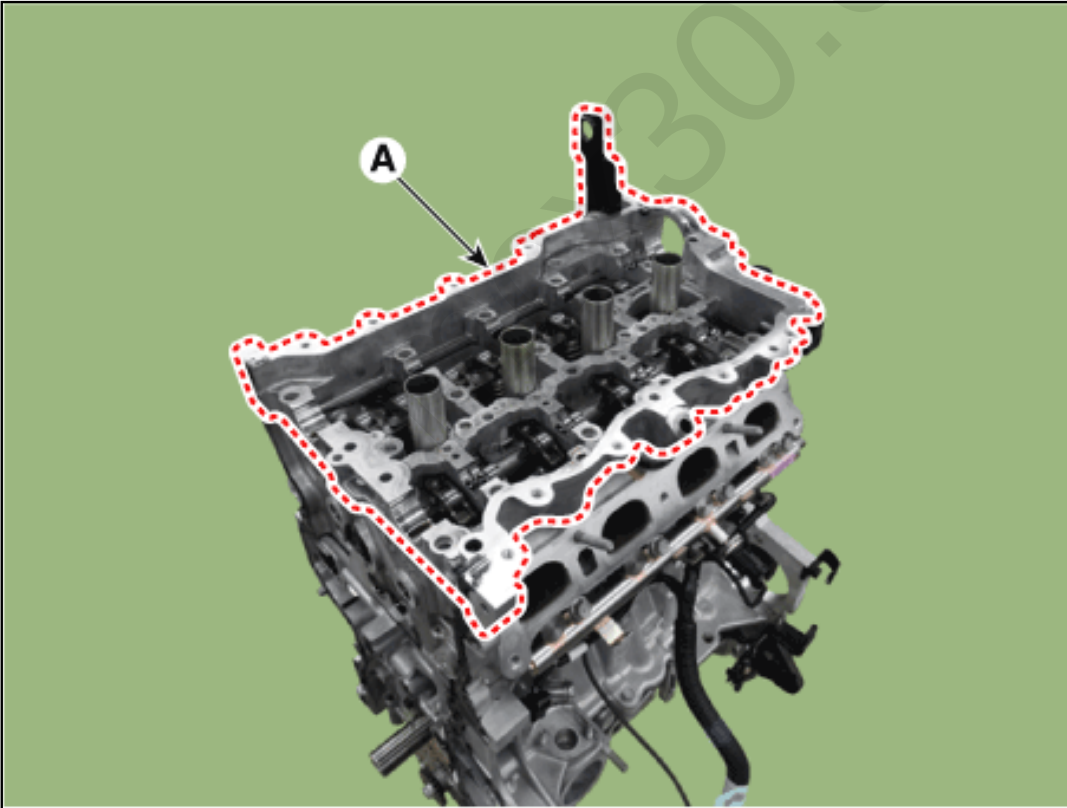
24. Remove the cylinder head heat protector (A).



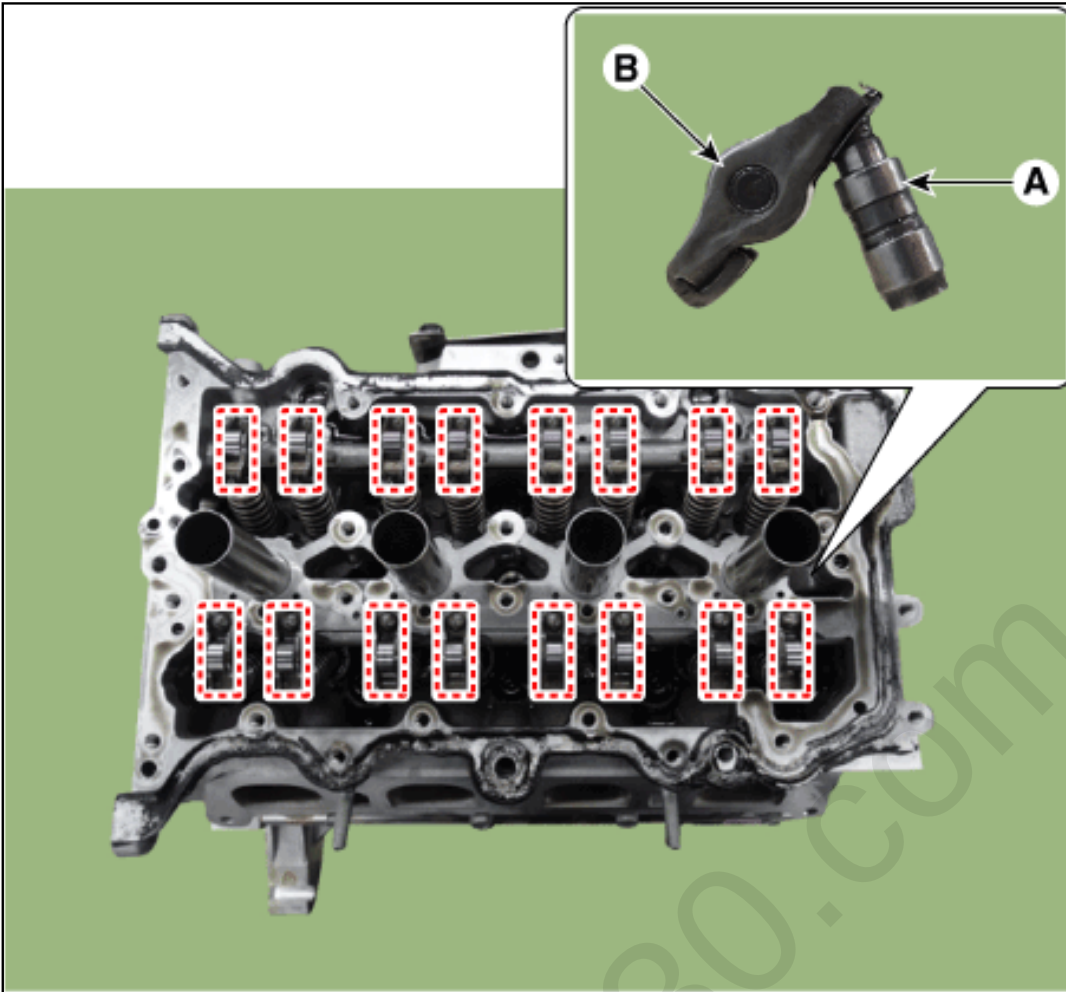
25. Remove the cylinder head degasing water hose and pipe (A).



26. Remove the cam carrier (A).

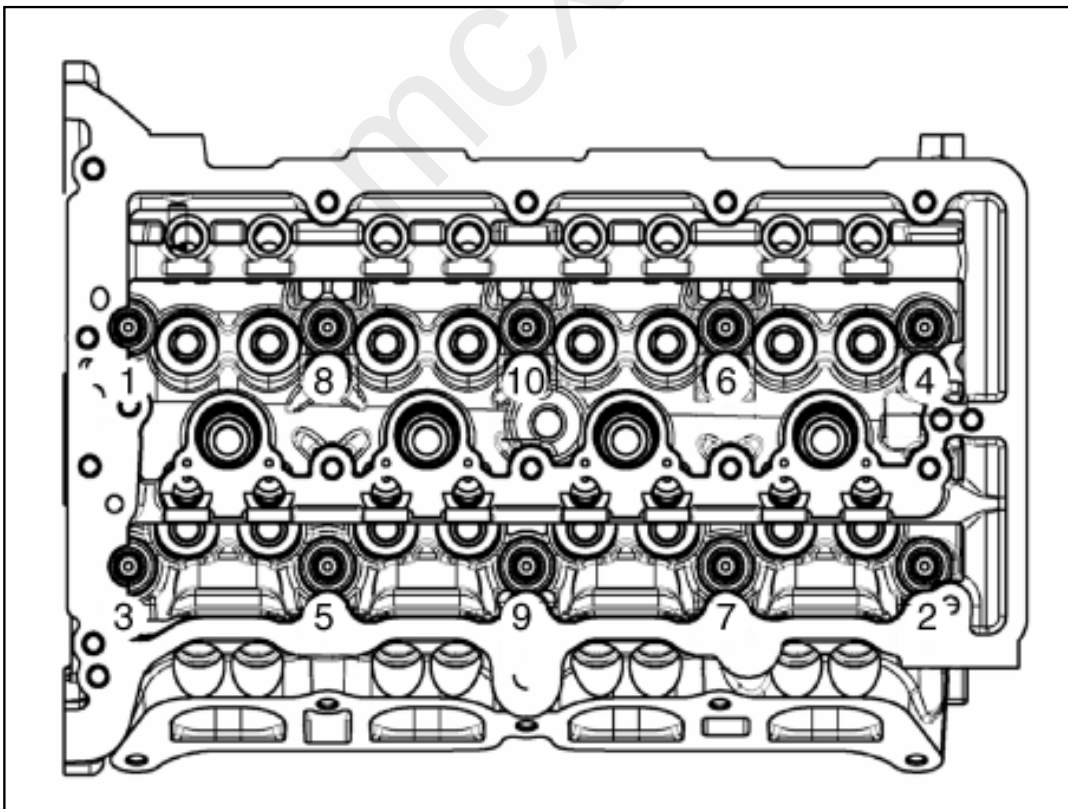


27. Remove the hydraulic lash adjuster (HLA) (A) and swing arm (B).



28. Remove the cylinder head.

(1) Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.

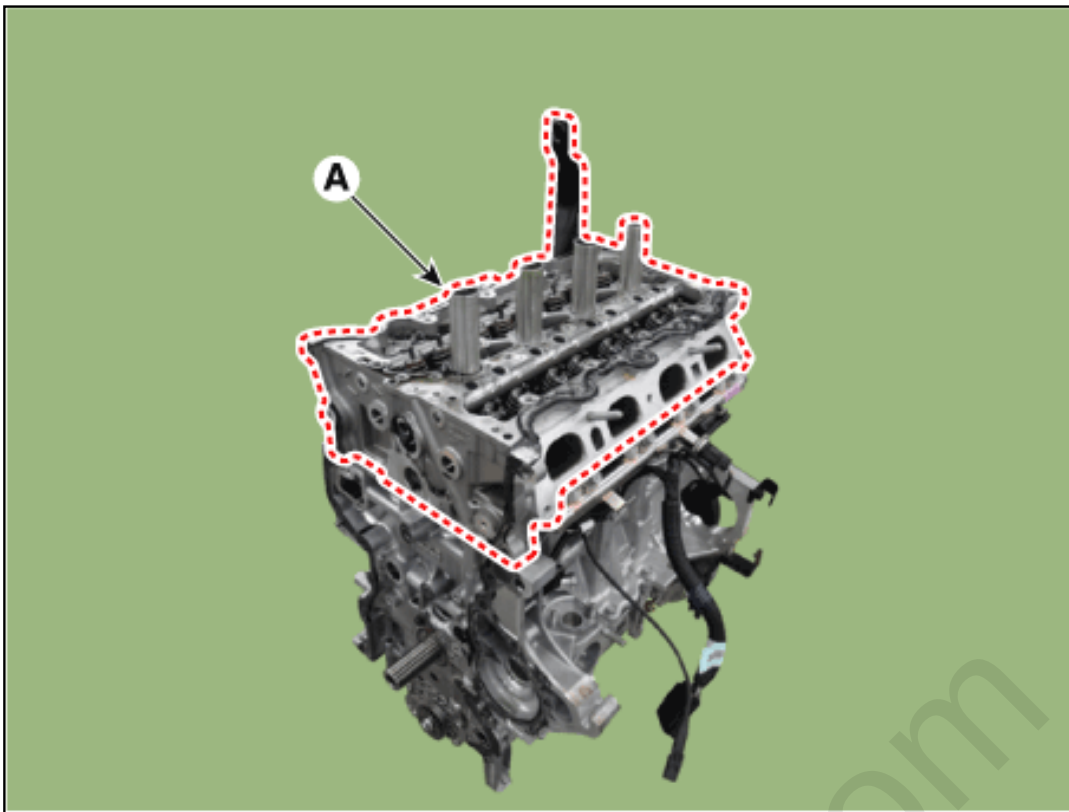


- Removing cylinder head bolts in an incorrect order may result in head warpage or crack.
- Use dodecagonal driver socket that has under 15mm(0.5906 in.) external diameter and longer than 75mm(2.9528 in.) cylinder to not have interference between cylinder head and dodecagonal driver socket when the cylinder head bolt removal.

Removing cylinder head bolts in an incorrect order may result in head warpage or crack.

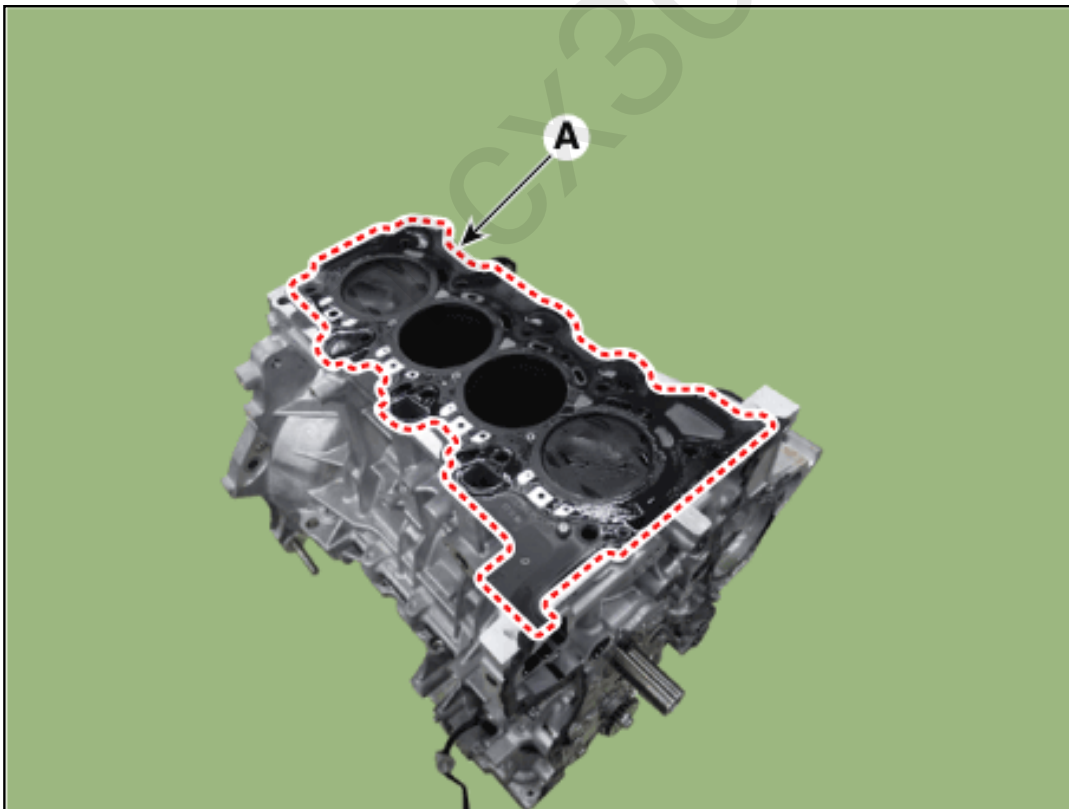


(2) Lift the cylinder head (A) from the cylinder block and put the cylinder head on wooden blocks.



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

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

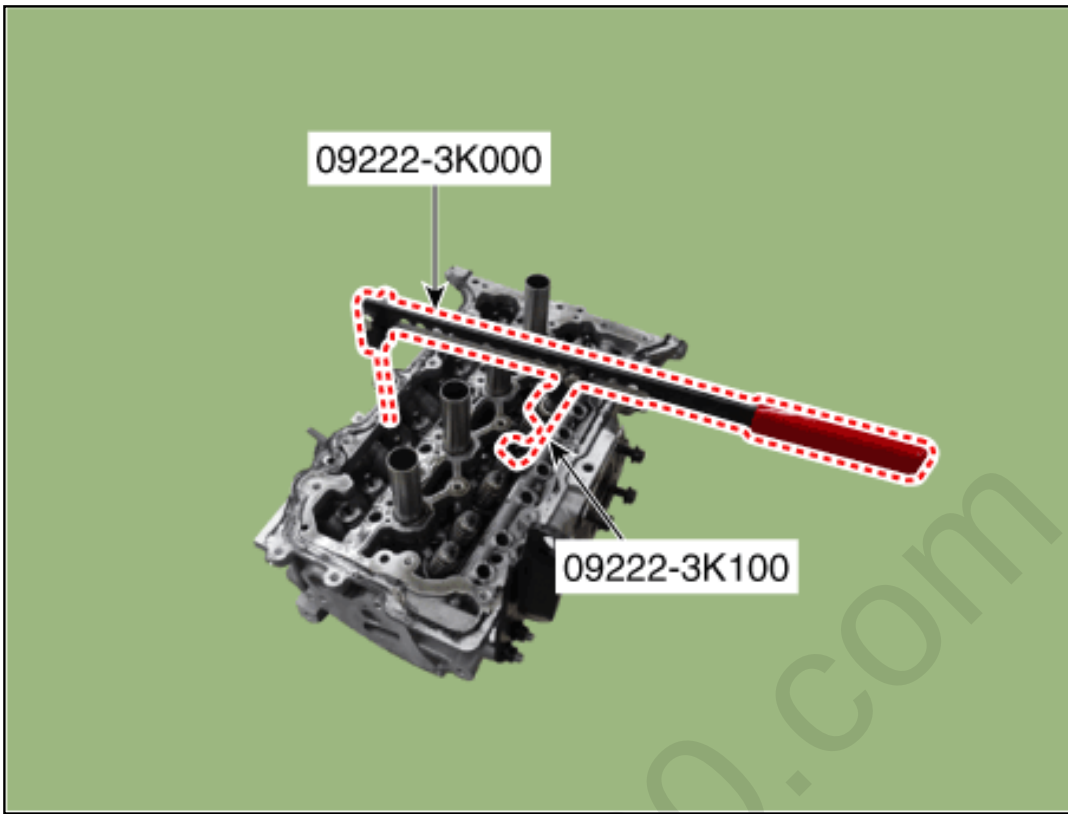


- Do not reuse the cylinder head gasket.

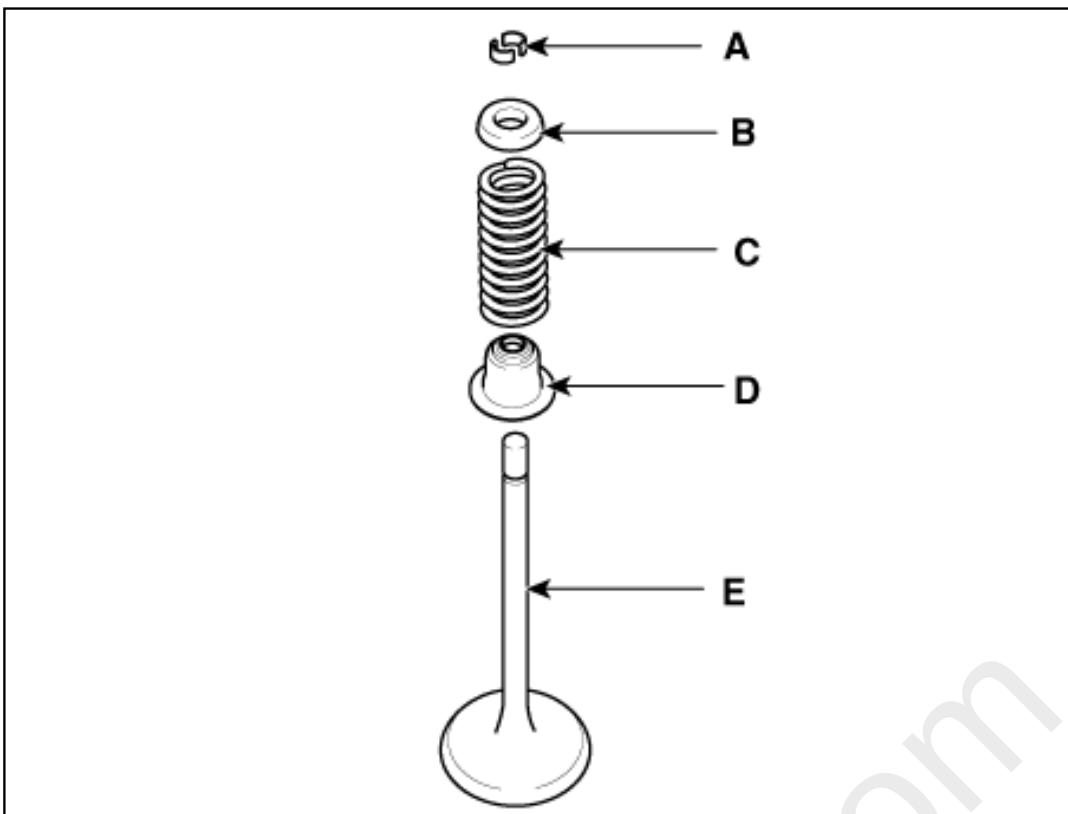
Disassembly

1. Remove the valves.

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



- (2) Remove the retainer lock (A) and retainer (B).
- (3) Remove the valve spring (C).
- (4) Using needle-nose pliers, remove the valve stem seal (D).
- (5) Remove the valve (E).



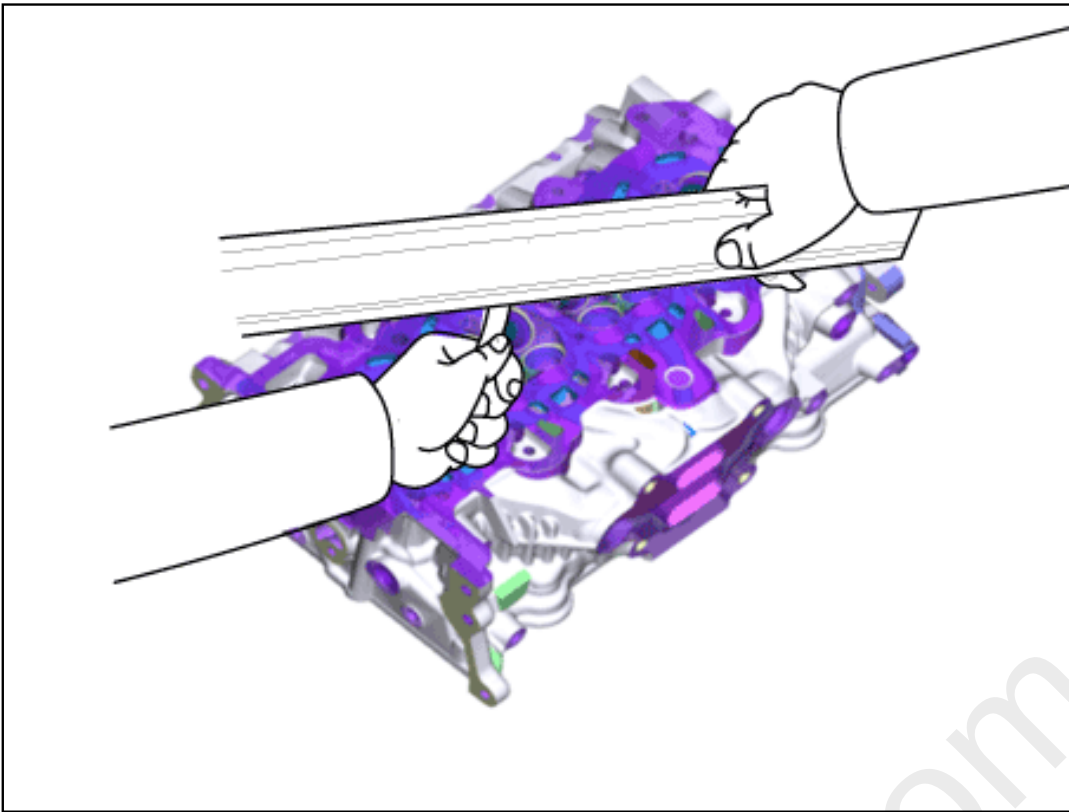
- Always use new valve stem seals.

Inspection

Cylinder Head

1. Inspect for flatness.

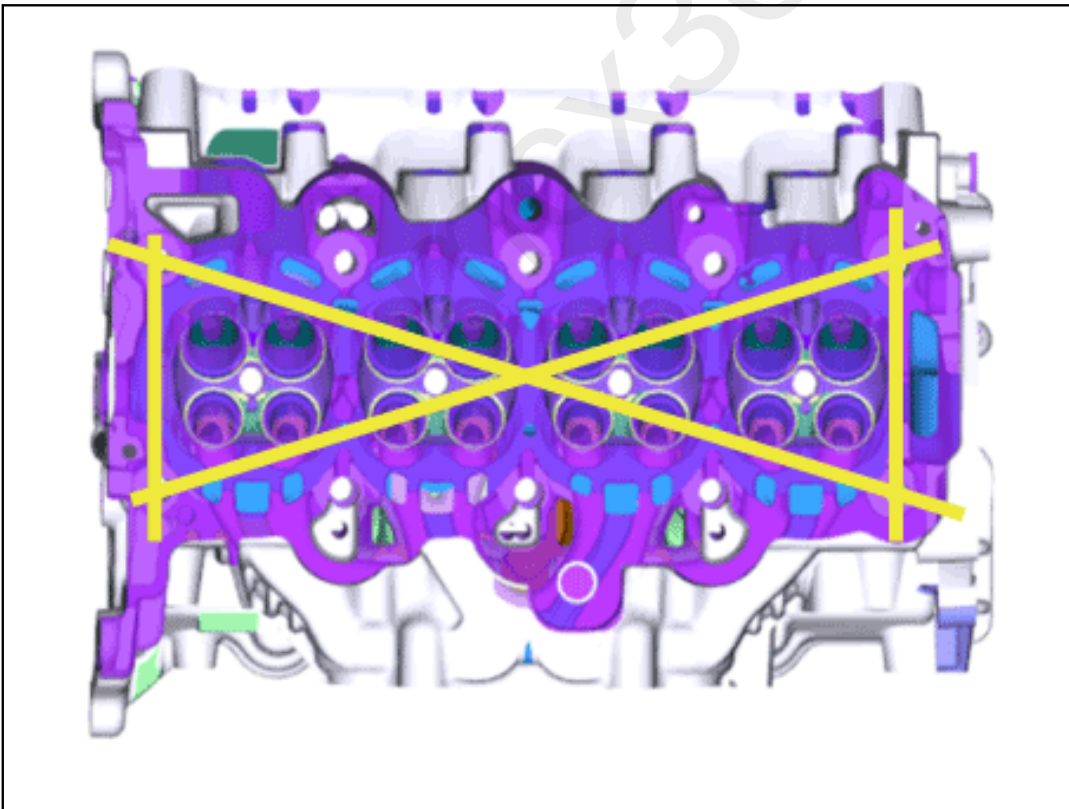
Using a precision straight edge and feeler gauge, measure the contacting surface of the cylinder block and the manifolds for warpage.



Flatness of cylinder head gasket surface:

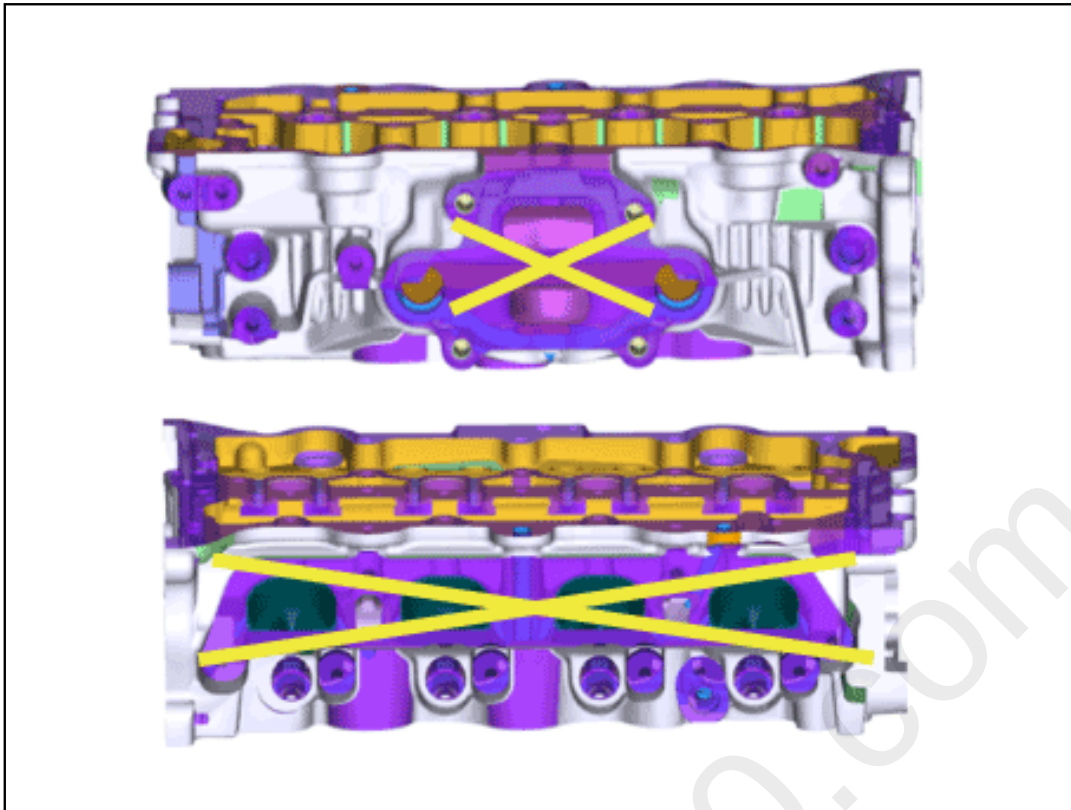
Less than 0.05 mm (0.0020 in.) for total area

Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) X 100 mm (3.9370 in.)



Flatness of manifold mounting surface:

Less than 0.10 mm (0.0039 in.)



2. Inspect for cracks.

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

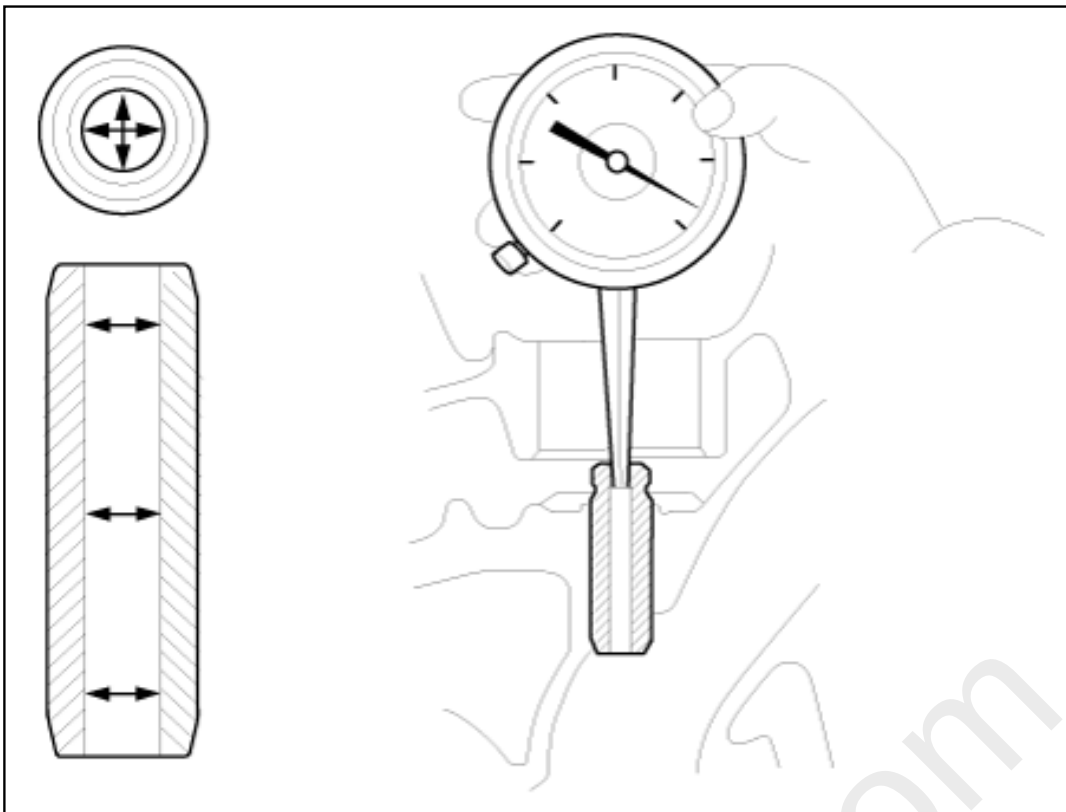
Valve And Valve Spring

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) :

5.505 - 5.517 mm (0.2167 - 0.2172 in.)

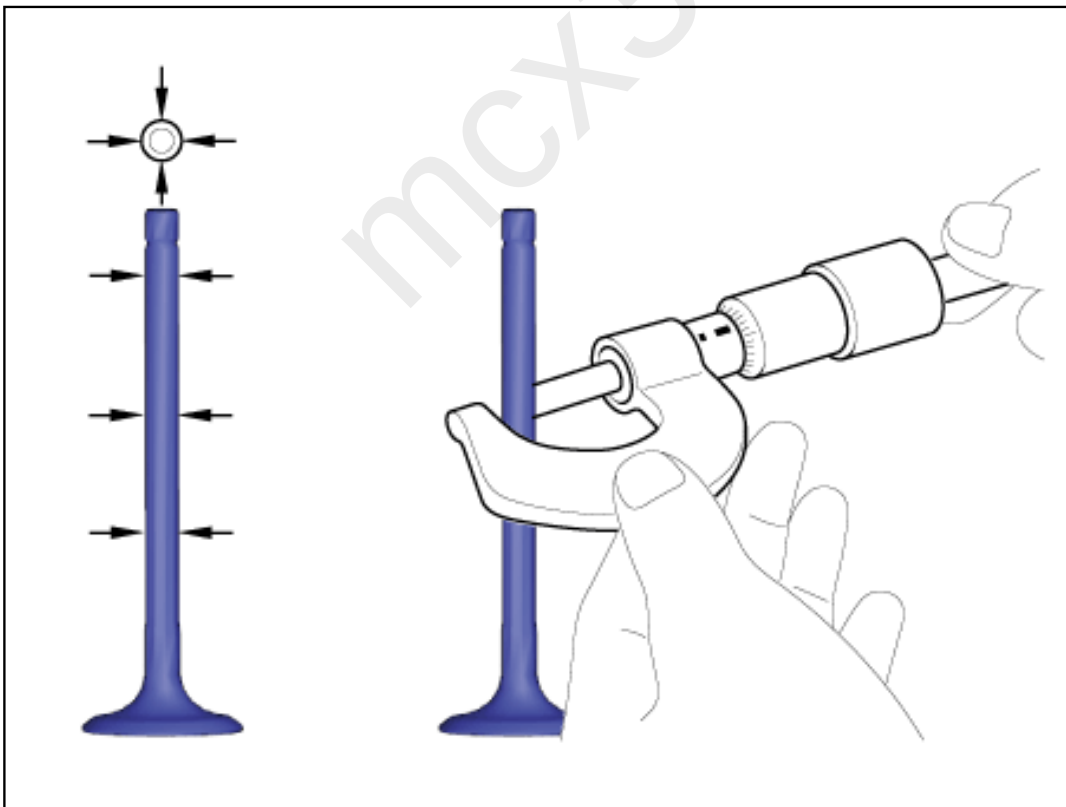


(2) Using a micrometer, measure the outer diameter of valve stem.

Valve stem outer diameter

Intake : 5.465 - 5.480mm (0.2152 - 0.2157in.)

Exhaust : 5.458 - 5.470mm (0.2149 - 0.2154in.)



(3) Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

Valve stem- to-guide clearance

Intake : 0.025 - 0.052 mm (0.0010 - 0.0020 in.)

Exhaust : 0.035 - 0.059 mm (0.0014 - 0.0023 in.)

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

2. Inspect the valves.

(1) Check the valve is ground to the correct valve face angle.

(2) Check that the surface of valve for wear.

If the valve face is worn, replace the valve.

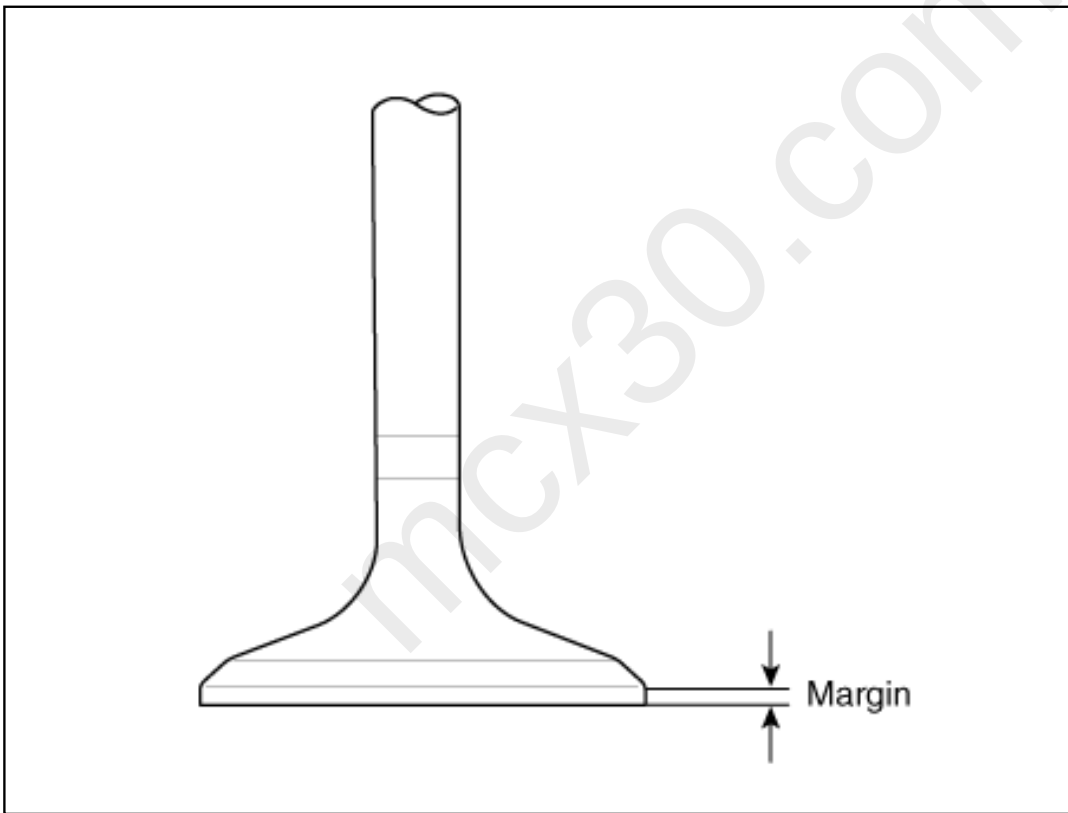
(3) Check the valve head margin thickness.

Valve head thickness (Margin)

Standard

Intake : 0.70 mm (0.0276 in.)

Exhaust : 0.91 mm (0.0358 in.)



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

(4) Check the length of valve.

Intake : 112.84 mm (4.4425 in.)

Exhaust : 122.83 mm (4.8358 in.)

3. Inspect the valve seats.

(1) Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace the cylinder head.

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

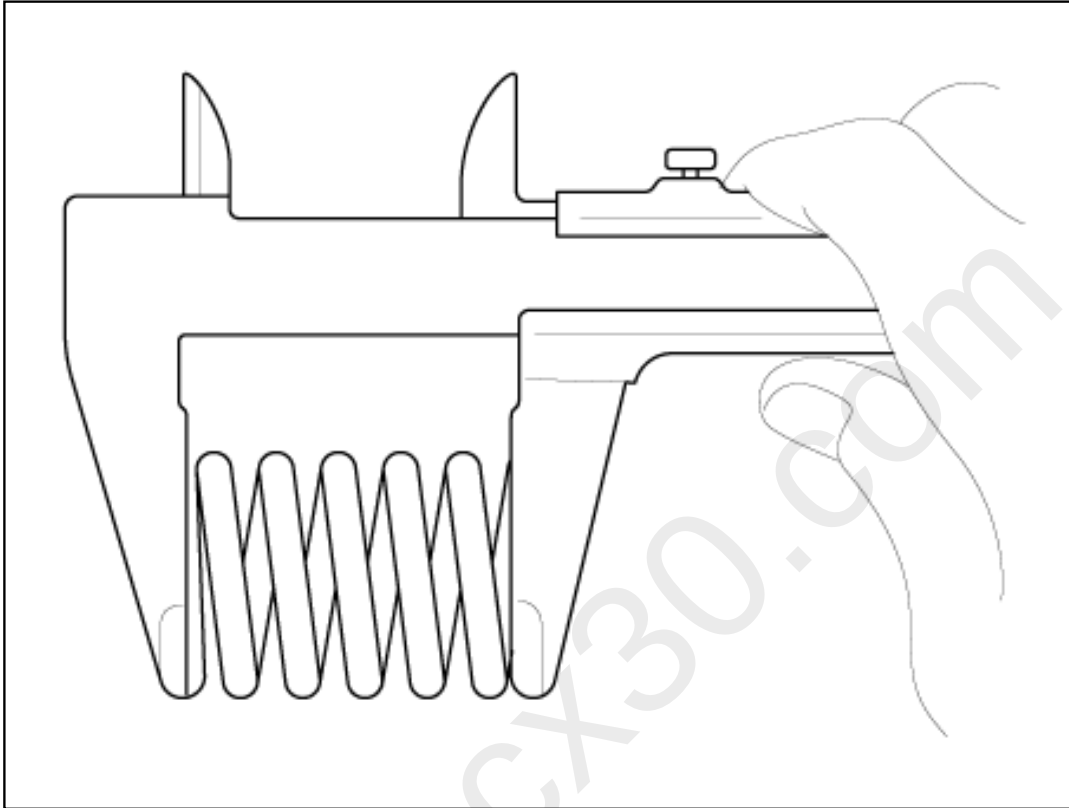
Valve spring

Free height

Intake : 52.55 mm (2.0689 in.)

Exhaust : 50.00 mm (1.9685 in.)

Out of square : Less than 1.5°



Reassembly



- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Always use new valve stem seals.

1. Install the valves.

(1) After applying engine oil to the valve stem seal, install a new valve stem seal using the special tool (09222-2B100).



- Do not reuse old valve stem oil seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.
- Do not reassembly ones in the other's places.



- Intake valve stem seals are different from exhaust ones in type.

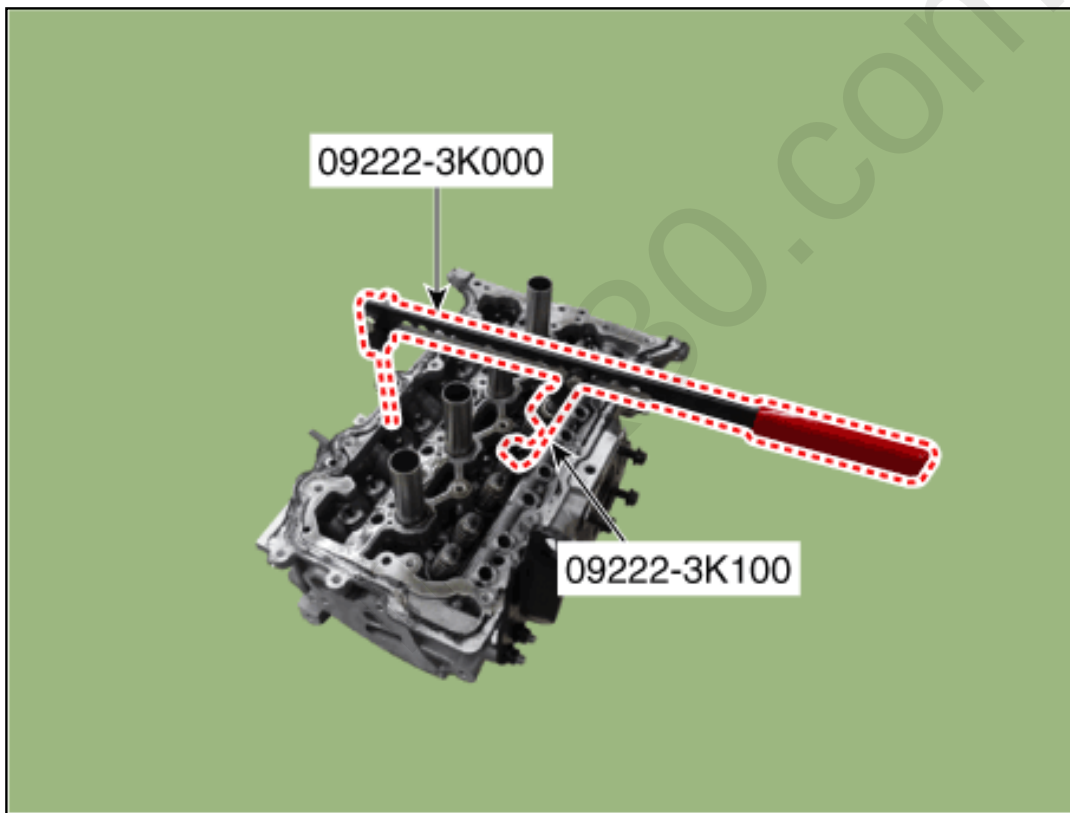
(2) Install the spring seats.

(3) Apply engine oil to the entire outer surface of each valve stem and insert the valve inside the valve guide.

(4) Install the valve spring.

(5) Install the retainer.

(6) Using the SST (09222-3K000, 09222-3K100), compress the valve spring and install the valve spring retainer lock.



Installation



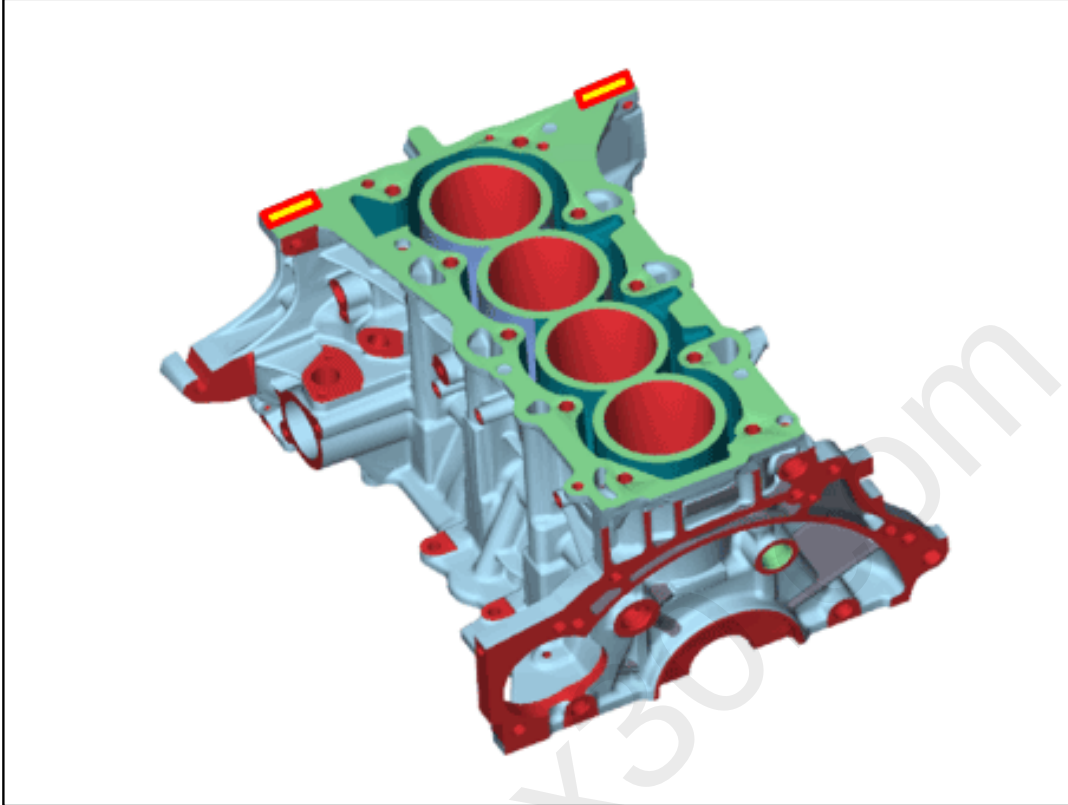
- Thoroughly clean all parts to be assembled.
- Always use a new cylinder head gasket and manifold gasket.
- Always use a new cylinder head bolt and cylinder head bolt washer.
- The cylinder head and exhaust manifold is a metal gasket. Take care not to bend it.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Install the cylinder head.

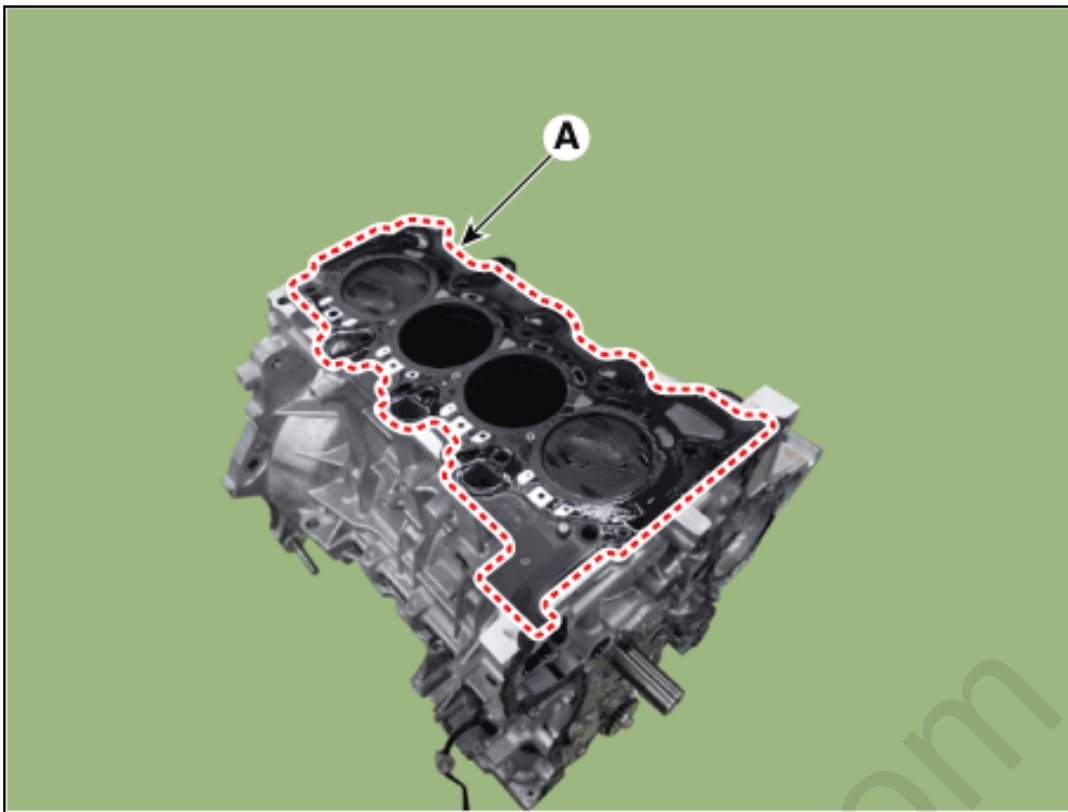
- (1) Remove hardening sealant, oil, dust, moisture and harmful foreign materials from the cylinder block and the cylinder head.
- (2) Apply liquid sealant on the upper surface of the cylinder block.

Width : Ø 2.0 - 3.0 mm (0.0787 - 0.1181 in.)

Specification : MS721-40AA or above.



- (3) Install the cylinder head gasket (A) to the cylinder block.

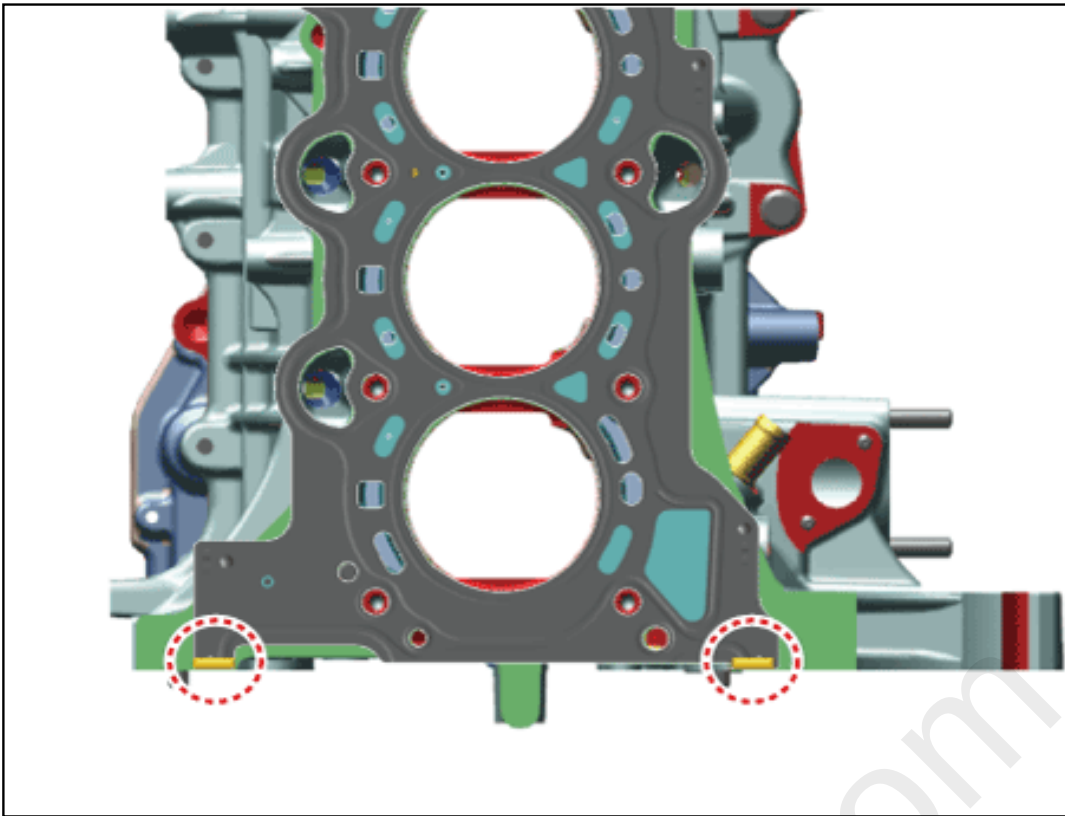


- Be careful not to change the install direction of gasket.

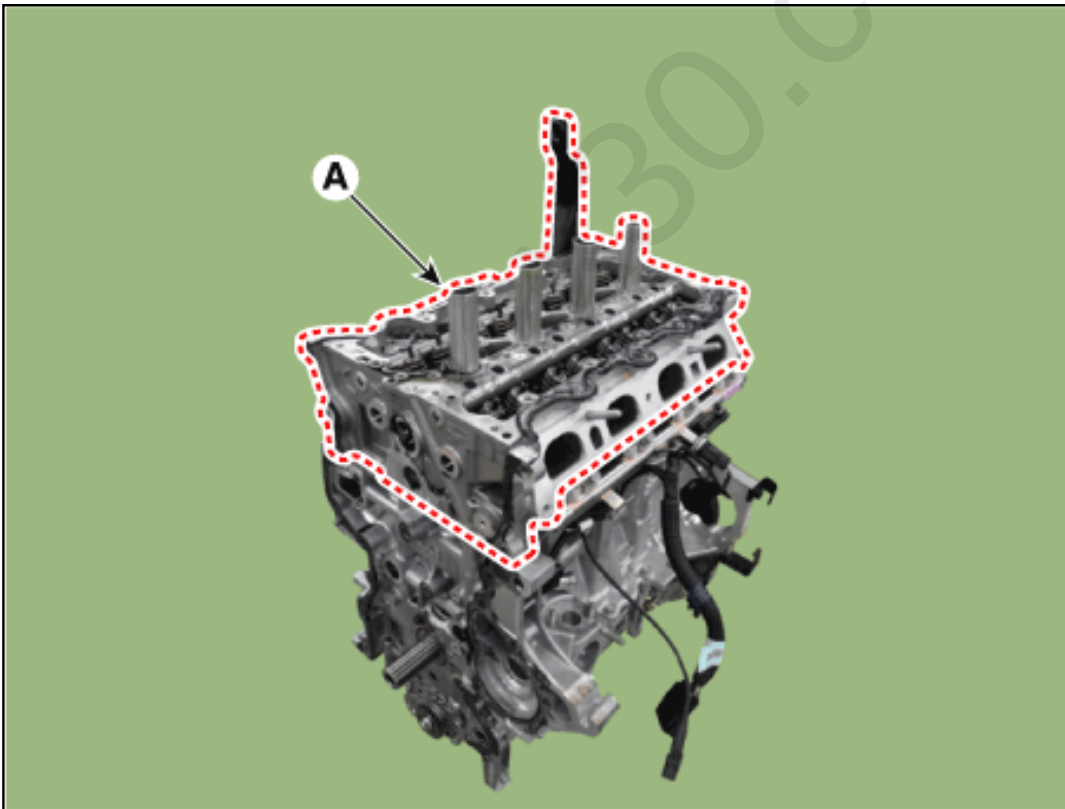
(4) Apply liquid sealant on the upper surface of the cylinder head gasket.

Width : Ø 2.0 - 3.0 mm (0.0787 - 0.1181 in.)

Specification : MS721-40AA or above.



(5) Place the cylinder head (A) carefully not to damage the head gasket.



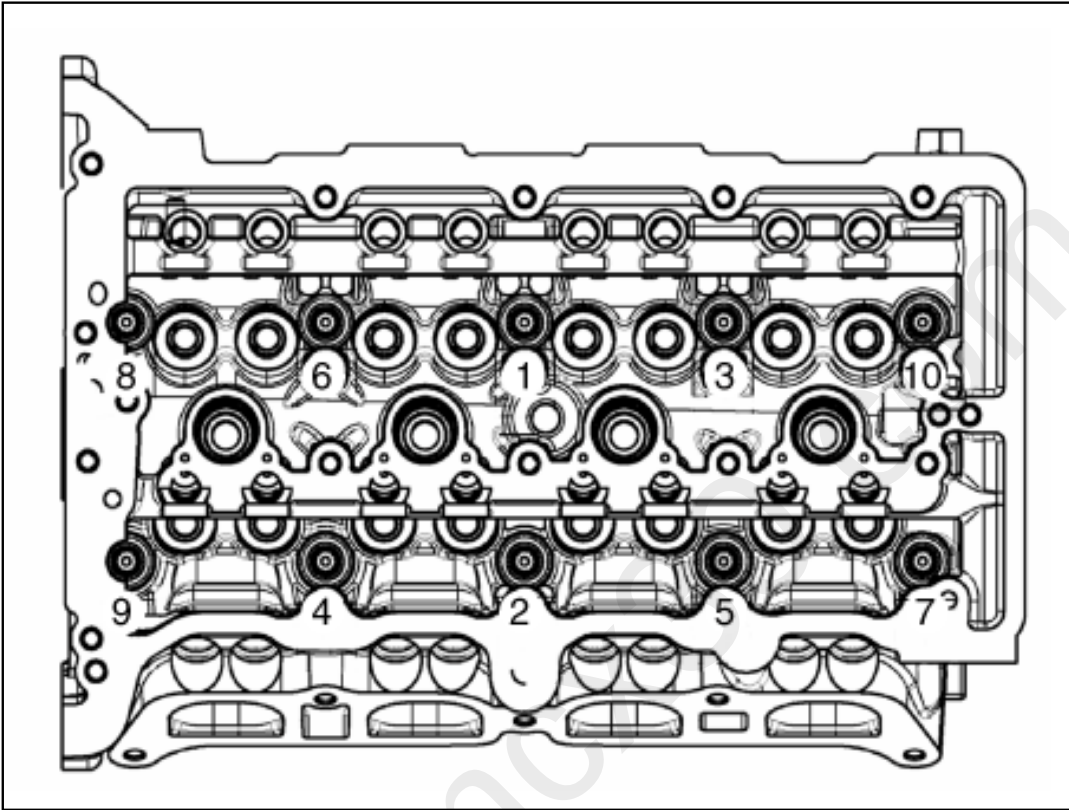
2. Install the new cylinder head bolts.

(1) Do not apply engine oil on the new cylinder head bolts.

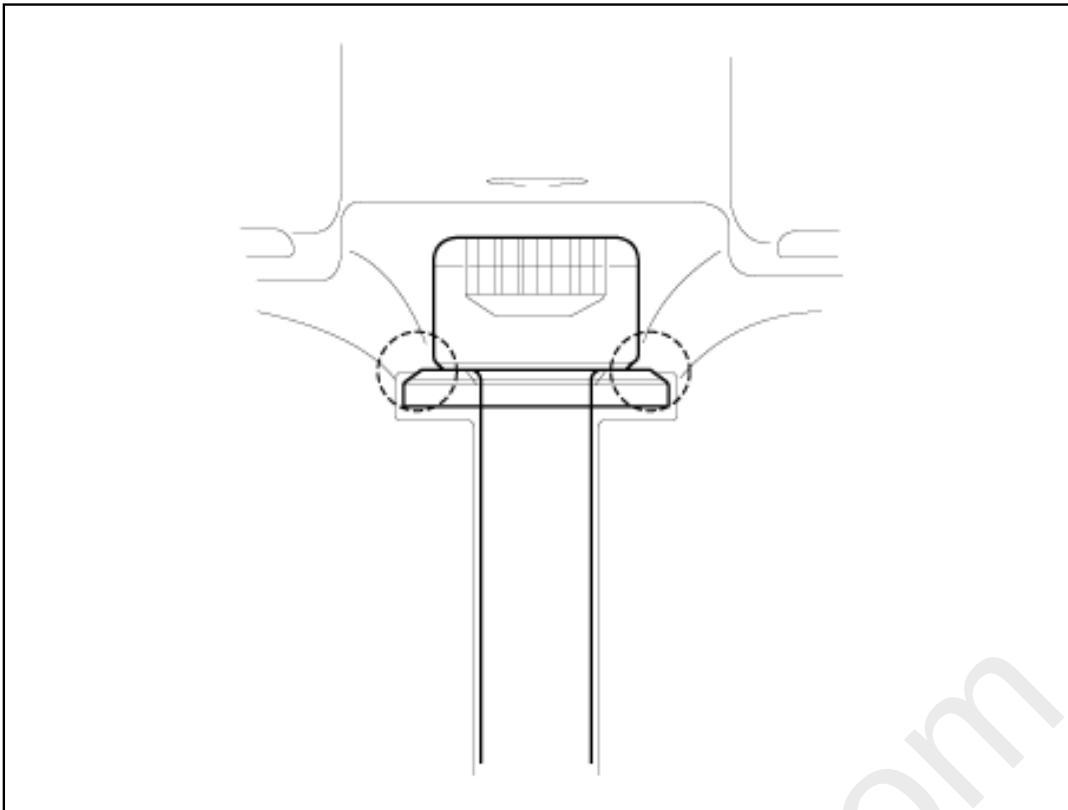
(2) Recheck tightening torque 29.4 N·m (3.0 kgf·m, 21.7 lb·ft) of each cylinder head bolt, after installing a new plain washer and a new cylinder head bolt according to the tightening torque 29.4 N·m (3.0 kgf·m, 21.7 lb·ft) in procedure down below. Continuesly tighten with angle tightening torque(90°) following the procedure in picture below after tightening with angle tightening torque(90°) with no stop following the procedure down below.

Tightening torque :

29.4 N.m (3.0 kgf.m, 21.7 lb-ft) + 90° + 90°



- Always use a new cylinder head bolt and cylinder head bolt washer.
- Assemble the cylinder head gasket and cylinder head within 5 minutes after applying liquid sealant.
- Remove the extruded sealant within 5 minutes after installing cylinder head bolts.
- When installing the cylinder head bolt, make sure where up/down direction of the cylinder head bolt washer part is headed and check if the chamber and round part of the washer is facing the head of the cylinder head bolt.

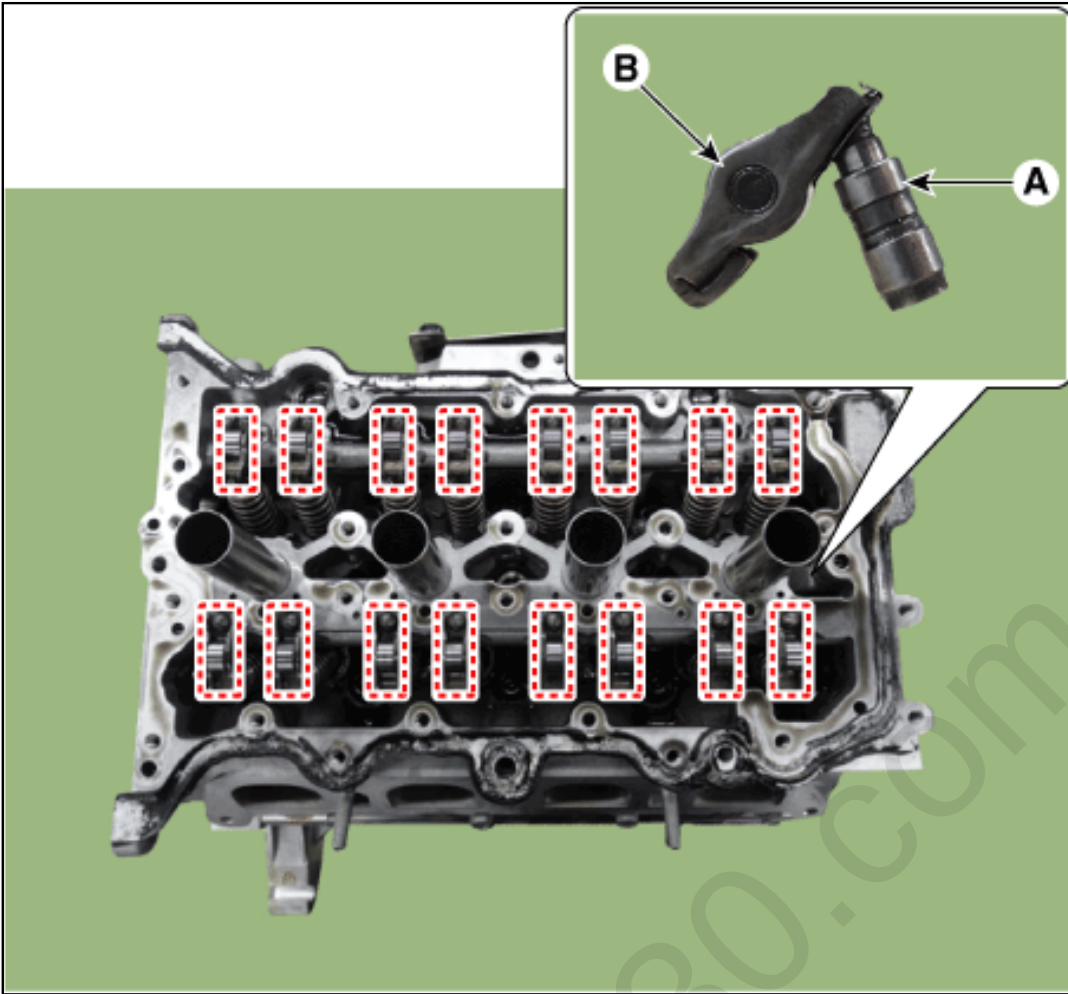


- Use dodecagonal driver socket that has under 15mm(0.5906 in.) external diameter and longer than 75mm (2.9528 in.) cylinder to not have interference between cylinder head and dodecagonal driver socket when the cylinder head bolt installation.



- Camshaft may rotate unstably, if the shape of the attached side of the carrier has altered by running into a cylinder head and the tool to detach a cylinder head bolt.

3. Install the hydraulic lash adjuster (HLA) (A) and swing arm (B).

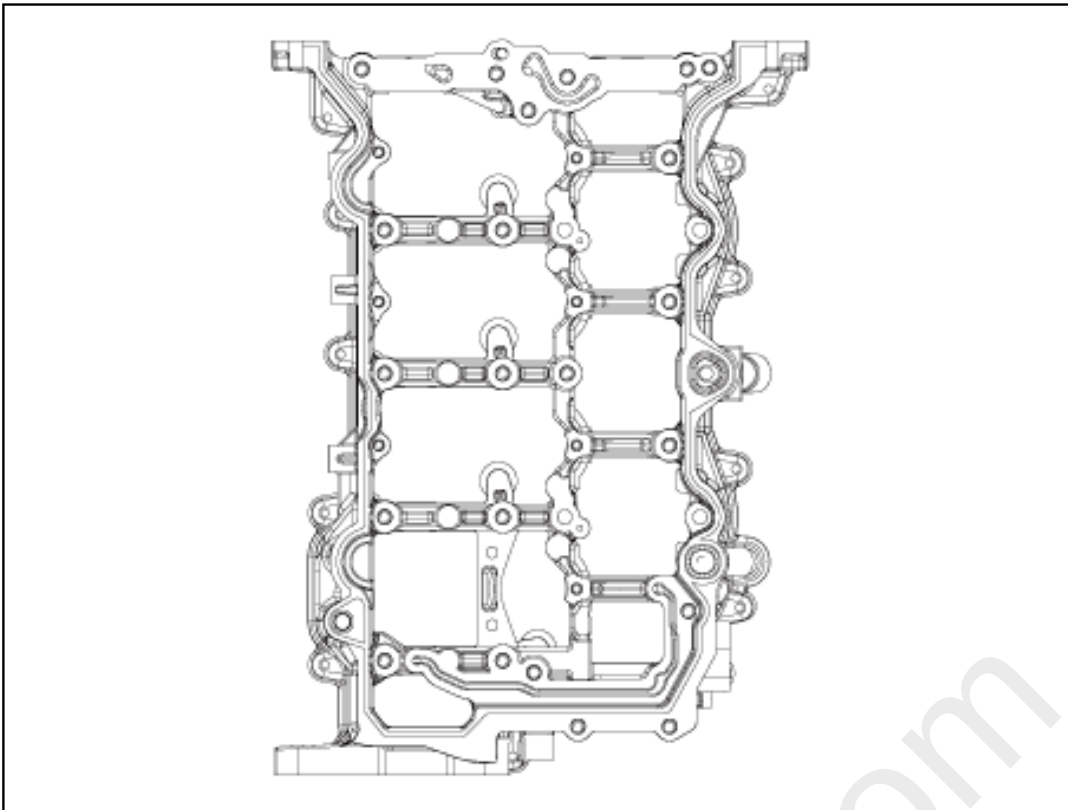


4. Install the cam carrier to the cylinder head.

- (1) Remove hardening sealant, oil, dust, moisture and harmful foreign materials from the bottom surface of the cam carrier and top surface of the cylinder head.
- (2) After applying liquid sealant on the bottom surface of the cam carrier, Continuous bead of sealant should be applied to prevent any path from oil leakage.

Width : Ø 2.5 - 3.5 mm (0.0984 - 0.1378 in.)

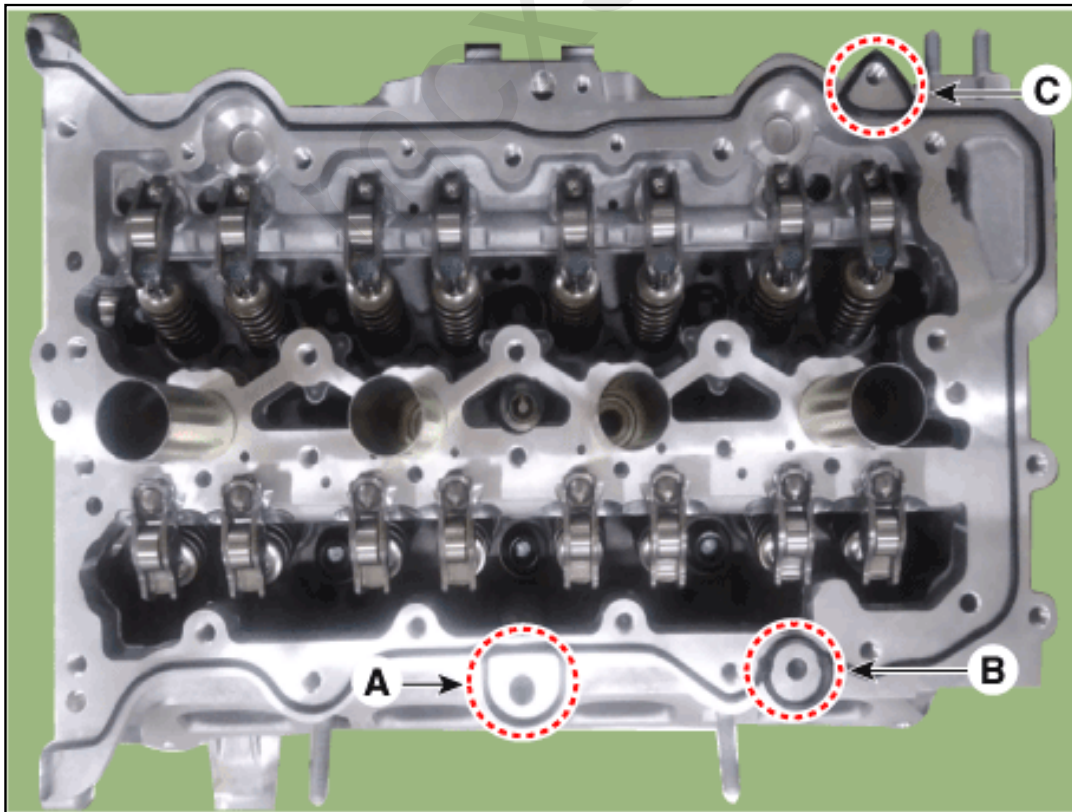
Specification : MS721-40AA or above.



- (3) The dowel pins on the cam carrier and holes on the cylinder head should be used as a reference in order to assemble the cam carrier in exact position.



- When installing the cam carrier to the cylinder head, make sure to prevent the sealant from entering the hole of the oil level gauge (A) and the positive crankcase ventilation (PCV) (B) and high pressure fuel pump bracket mounting hole (C).

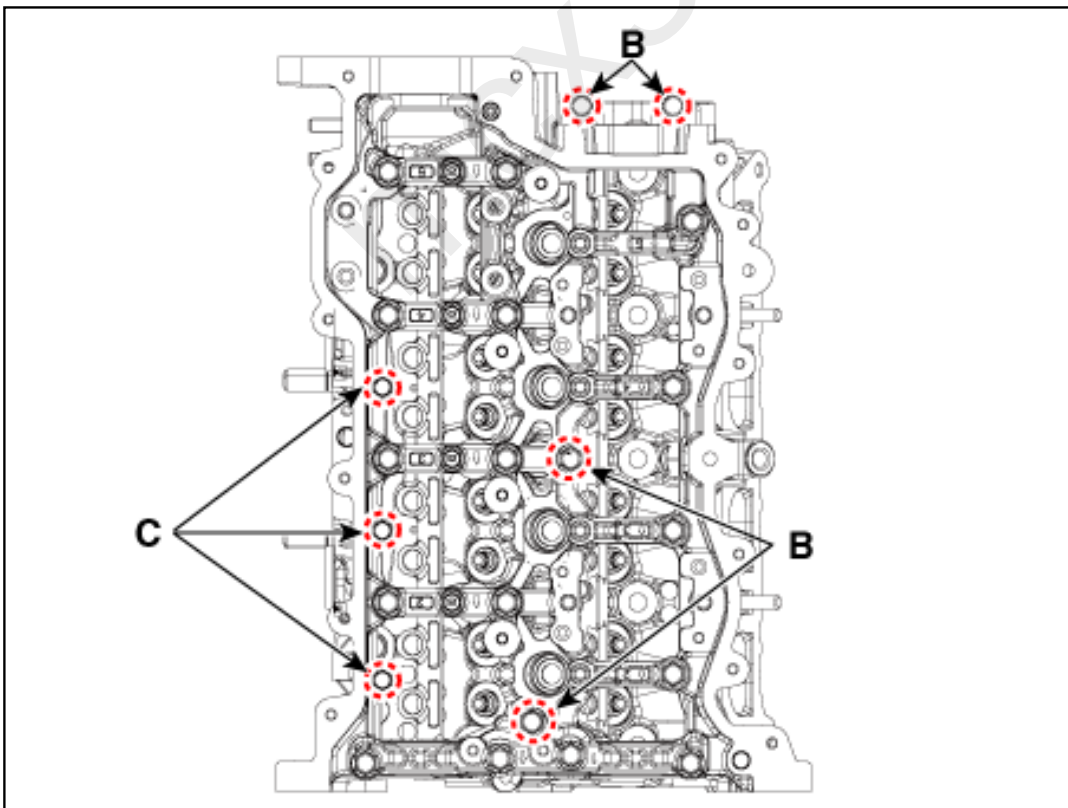
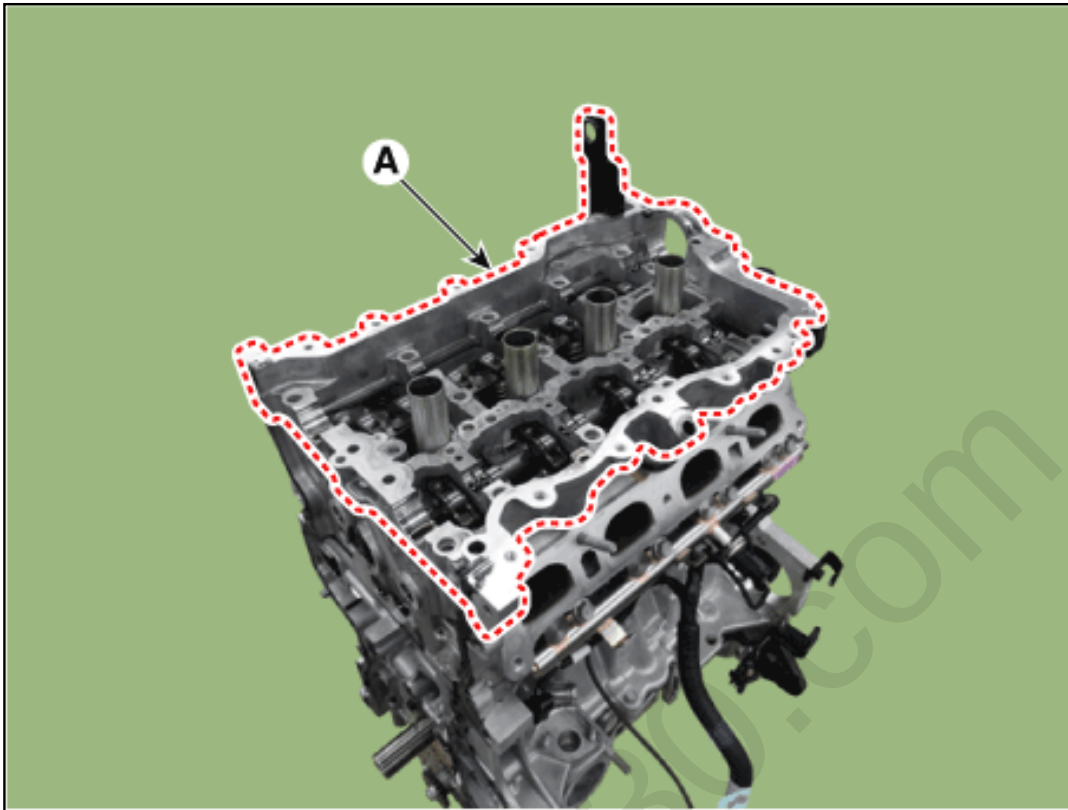


(4) Install the cam carrier (A).

Tightening torque :

Bolts (B): 18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)

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



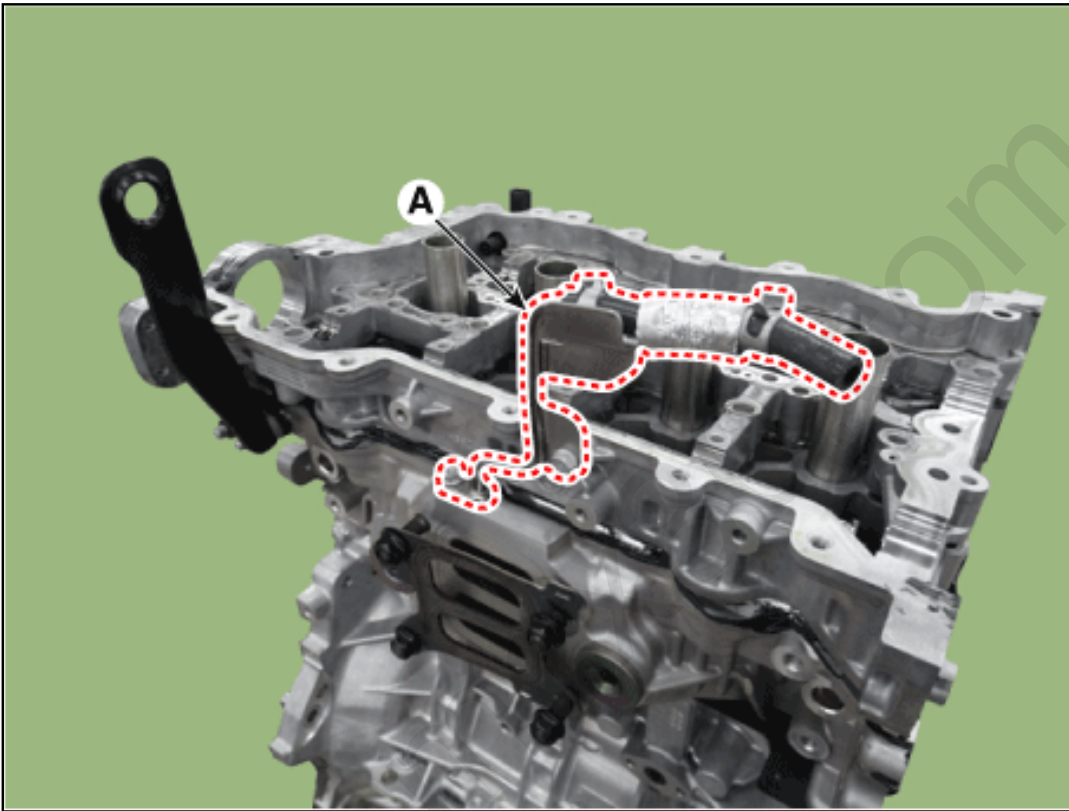


- Assemble the cam carrier within 5 minutes after applying sealant.
- Assemble the camshaft bearing cap within 5 minutes after assembling the cam carrier.
- The engine running or pressure test should not be performed within 30 minutes after assembling the cam carrier.
- After installing the cam carrier to the cylinder head, check whether there are sealants in the hole of the oil level gauge and the positive crankcase ventilation (PCV).

5. Install the cylinder head degasing water hose and pipe (A).

Tightening torque :

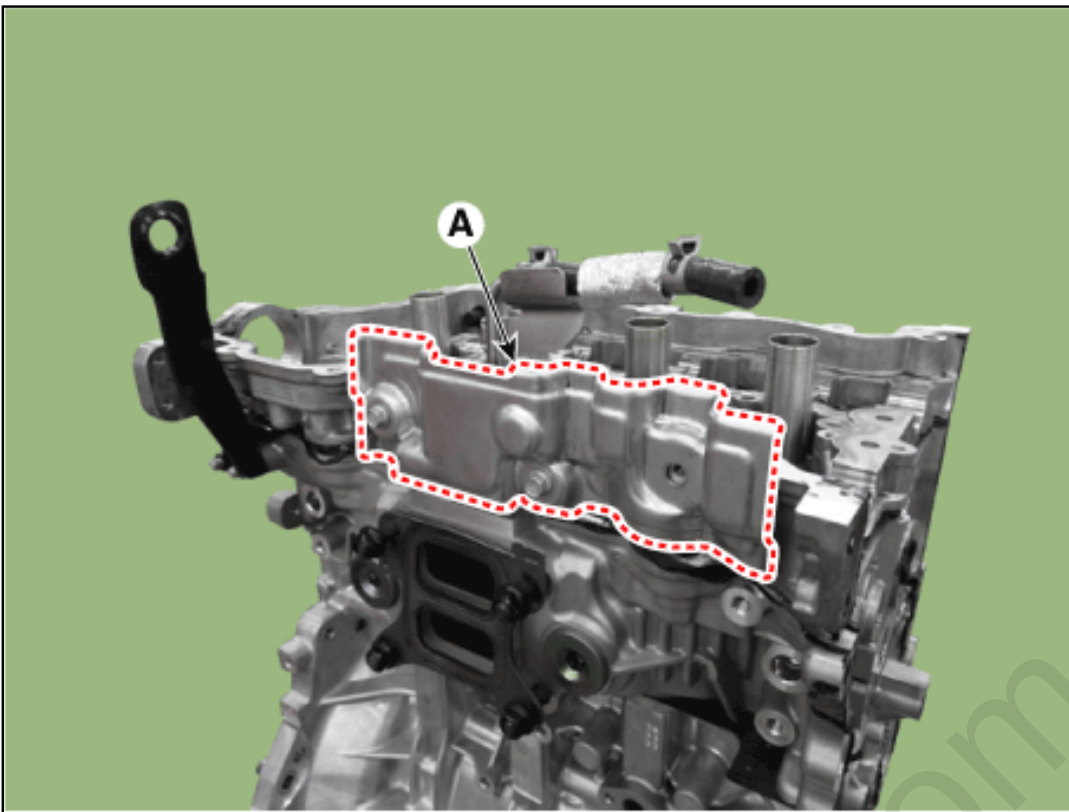
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



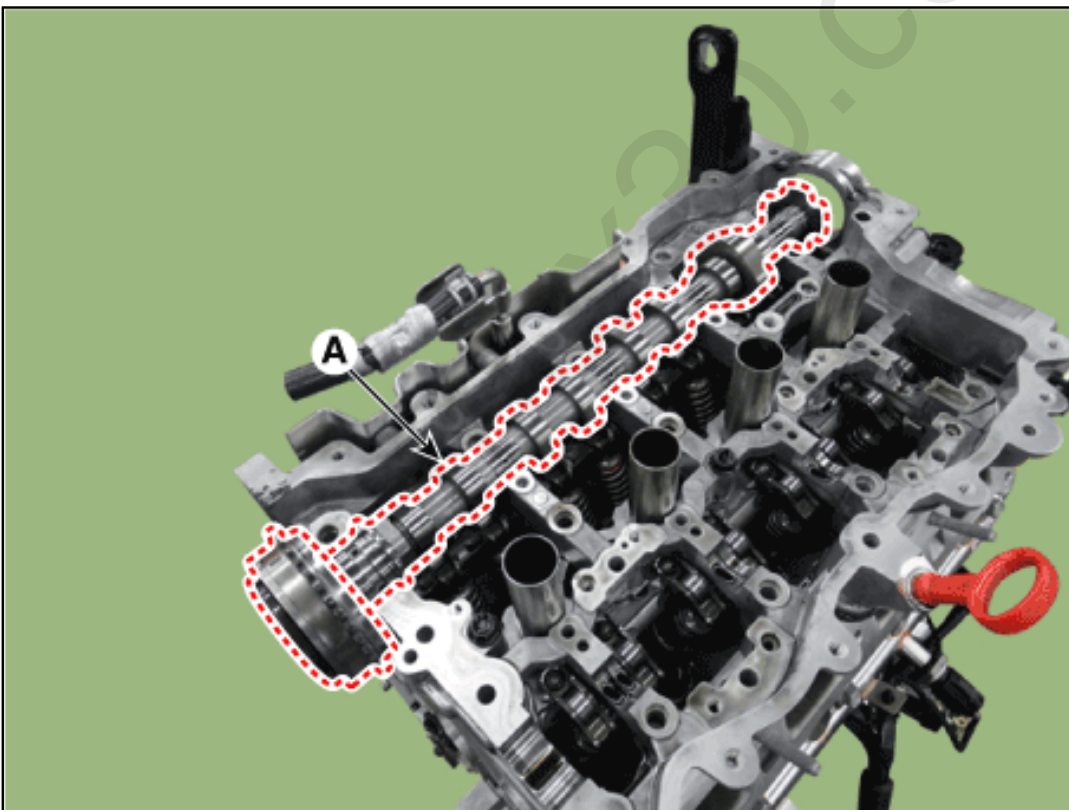
6. Install the cylinder head heat protector (A).

Tightening torque :

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

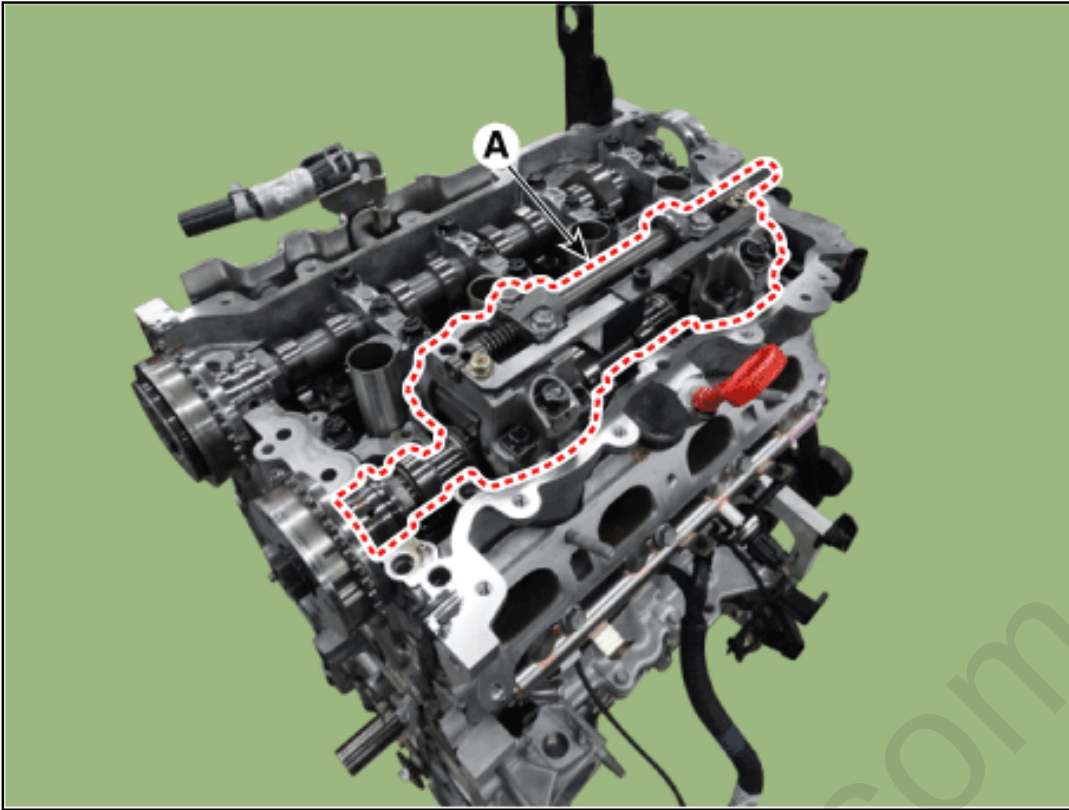


7. Install the exhaust camshaft & CVVT assembly (A).



- After installing exhaust camshaft, check whether the swing arm is separated or is installed correctly.

8. Install the CVVD assembly.



- During the installation, there should be no artificial rotation or movement of the guide bracket and control shaft.
- When removing the CVVD fixing jig, be sure to securely tighten the M6 bolts.
- If CVVD fixing jig is available, be sure to work by using it.

When Using the CVVD fixture

1. When installing the CVVD assembly mounting bolts (M6), tighten sequence shown.

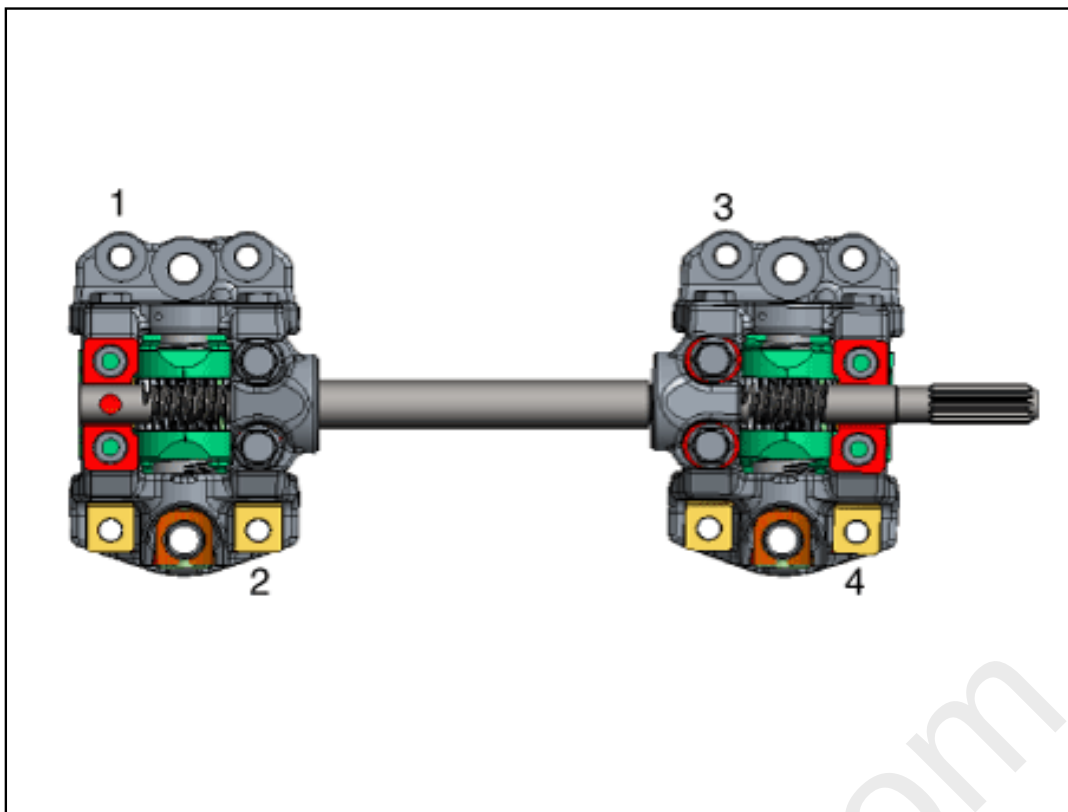
Tightening torque :

1ST

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

2nd

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



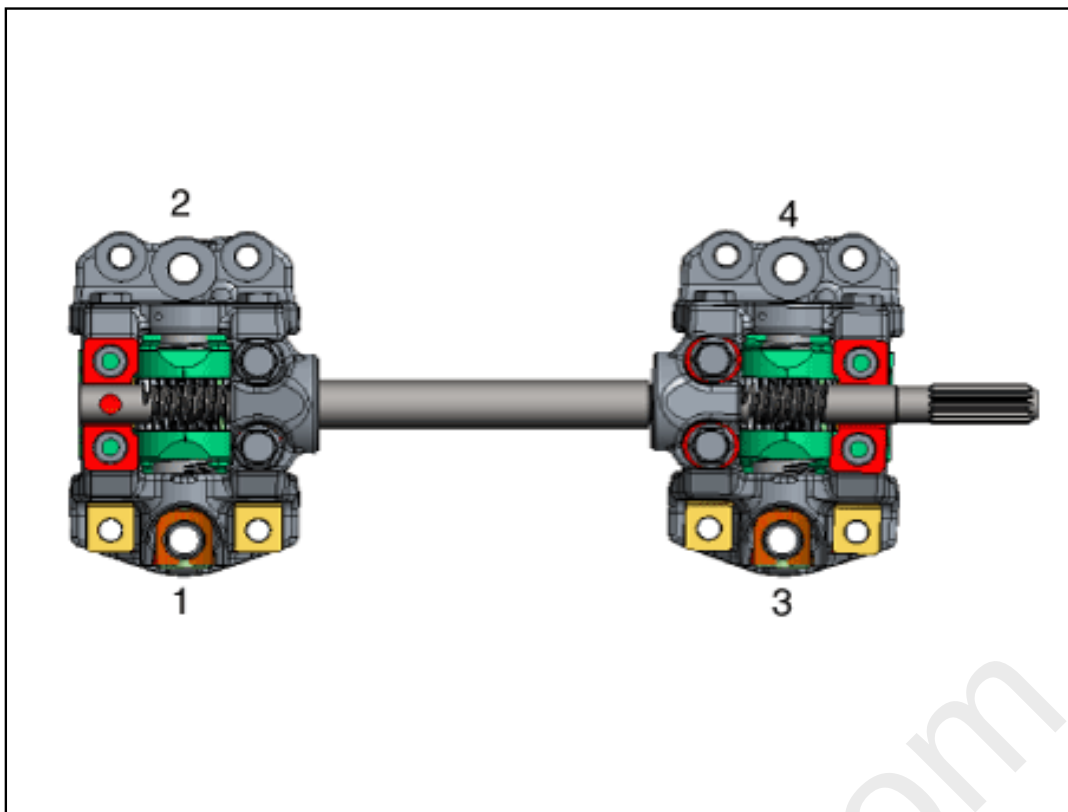
2. Remove the CVVD fixture (A).



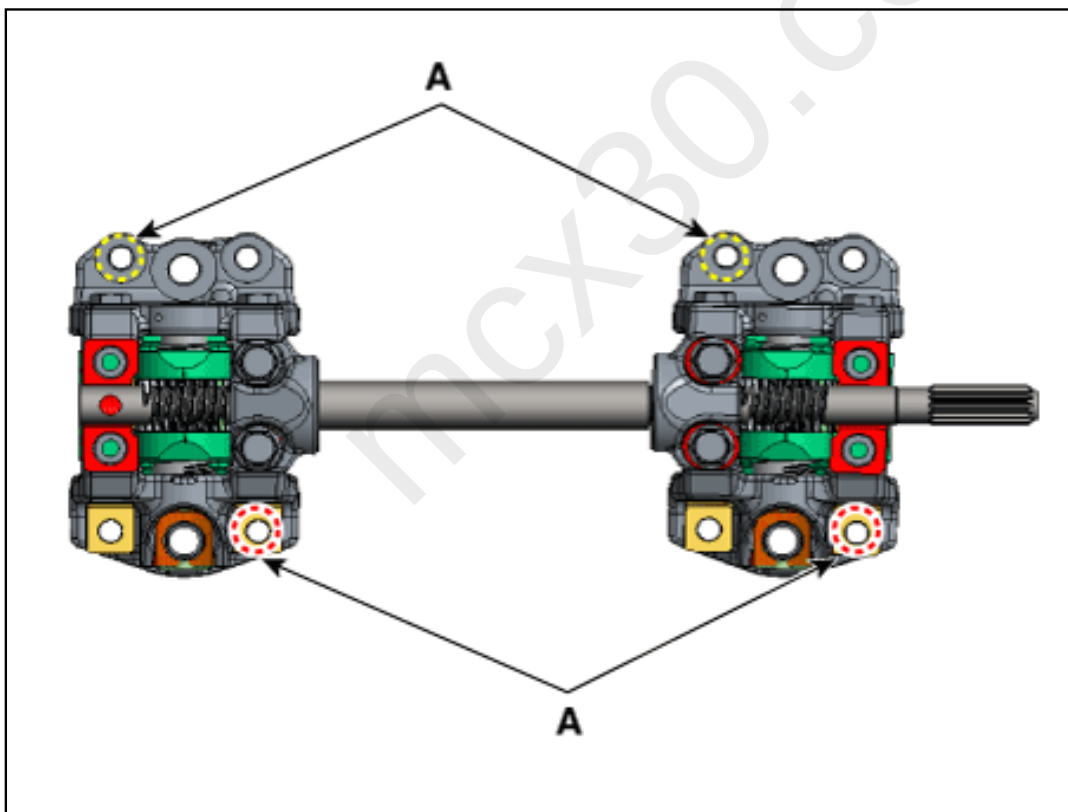
3. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

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



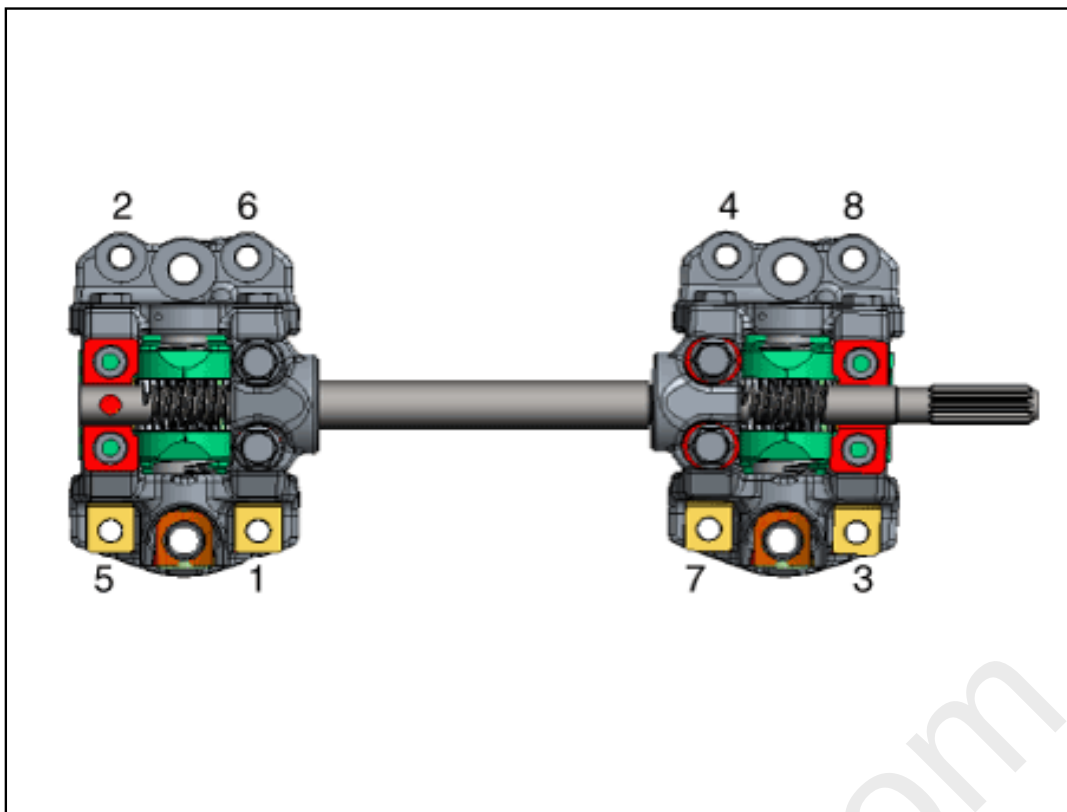
4. Remove the CVVD assembly mounting bolts (M6) (A).



5. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

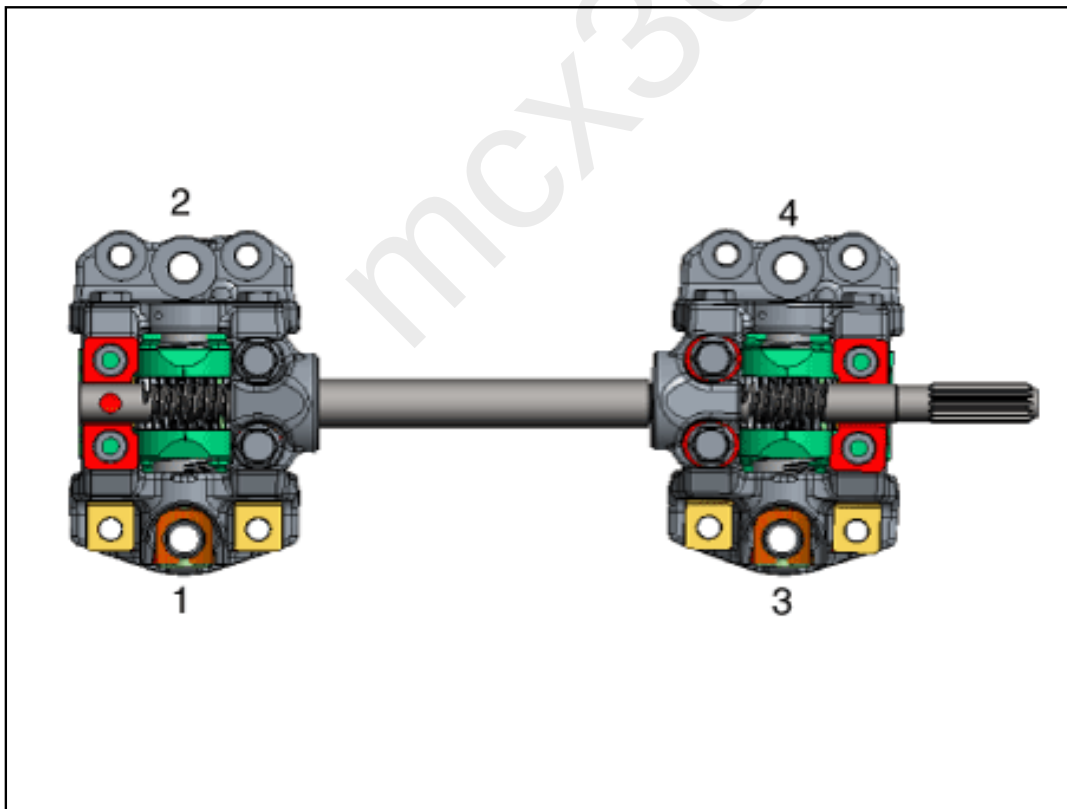
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



6. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

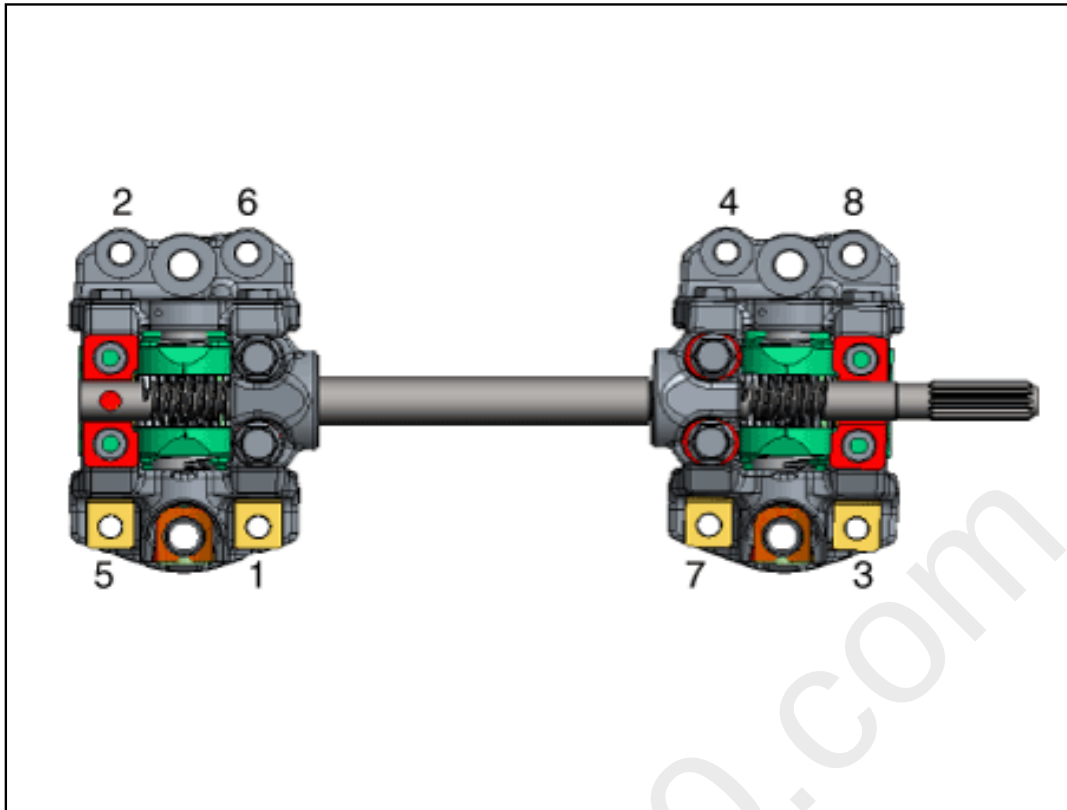
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



7. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

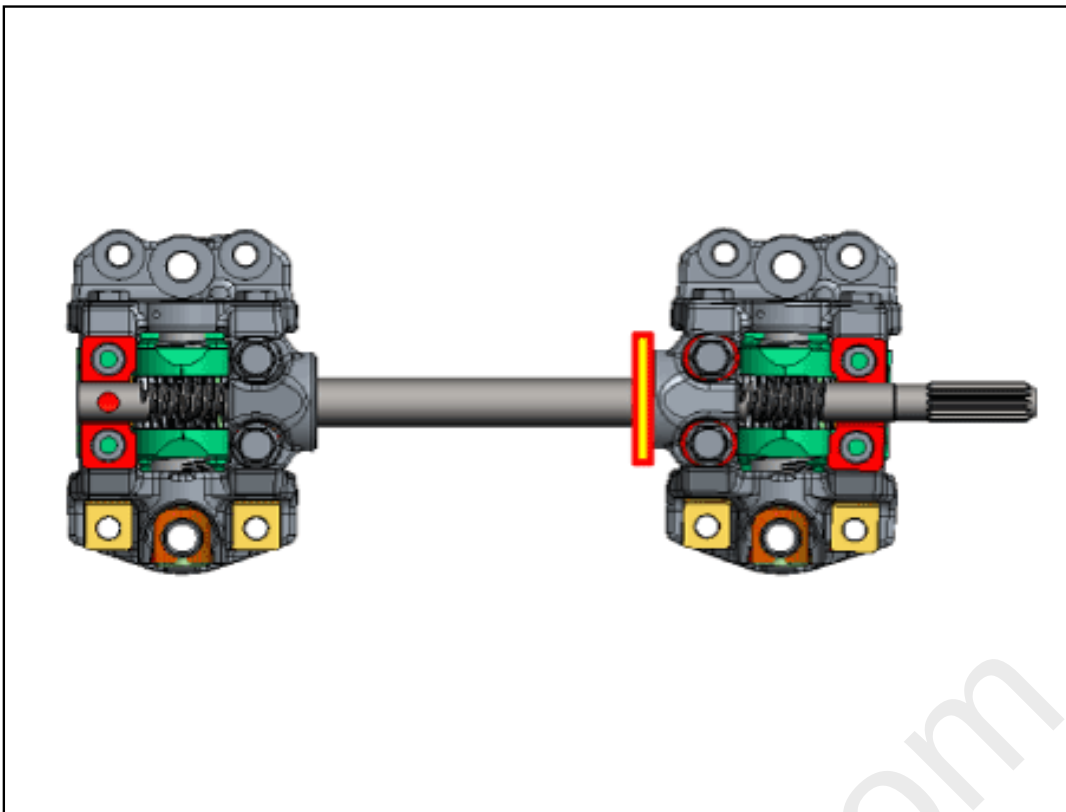
Tightening torque :

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



8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)

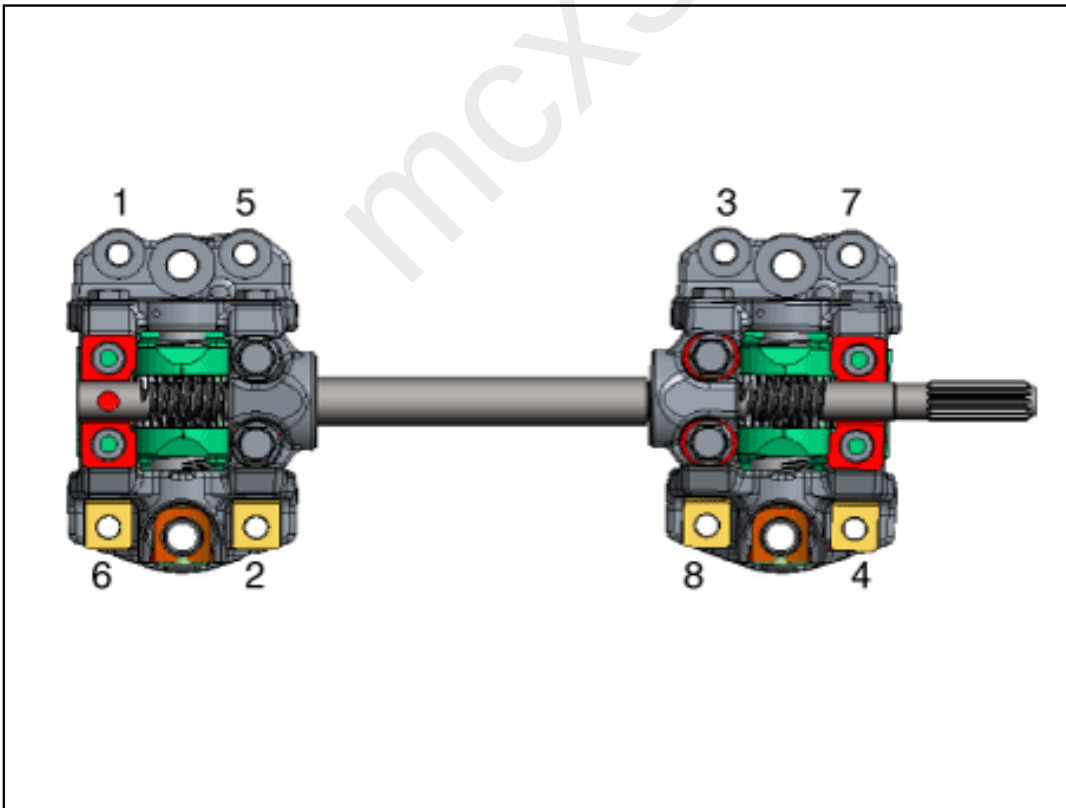


When not using the CVVD fixture

1. Provisionally tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

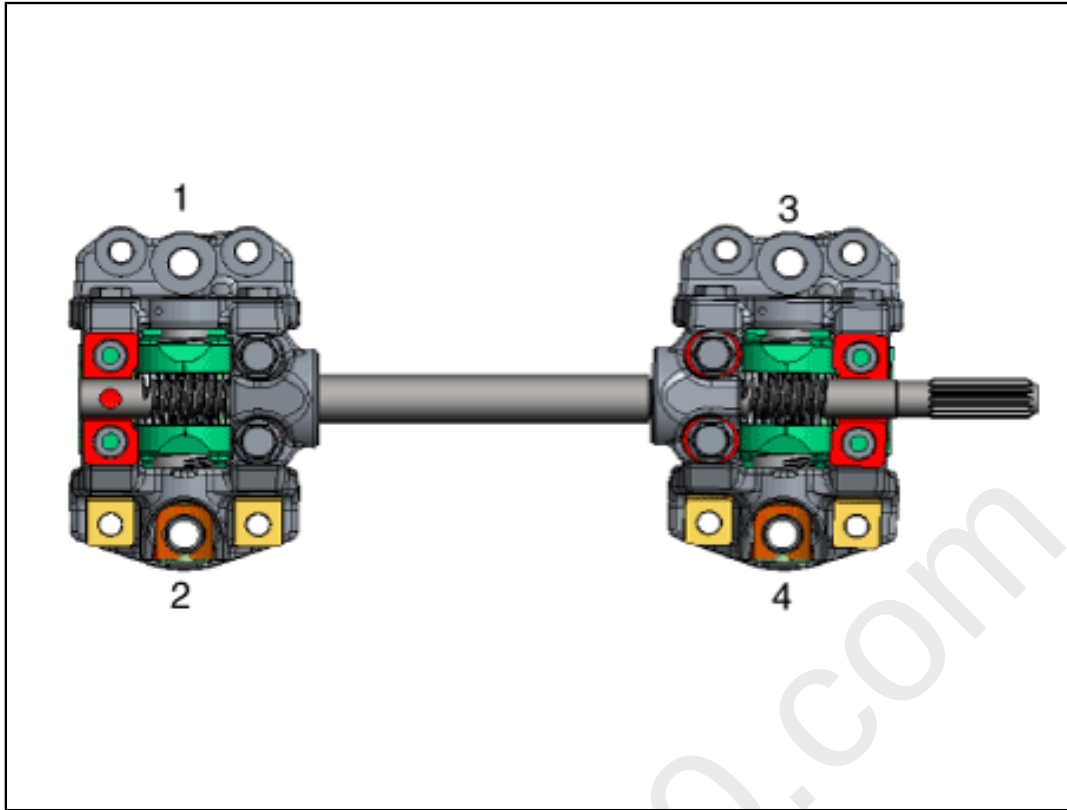
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



2. Provisionally tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

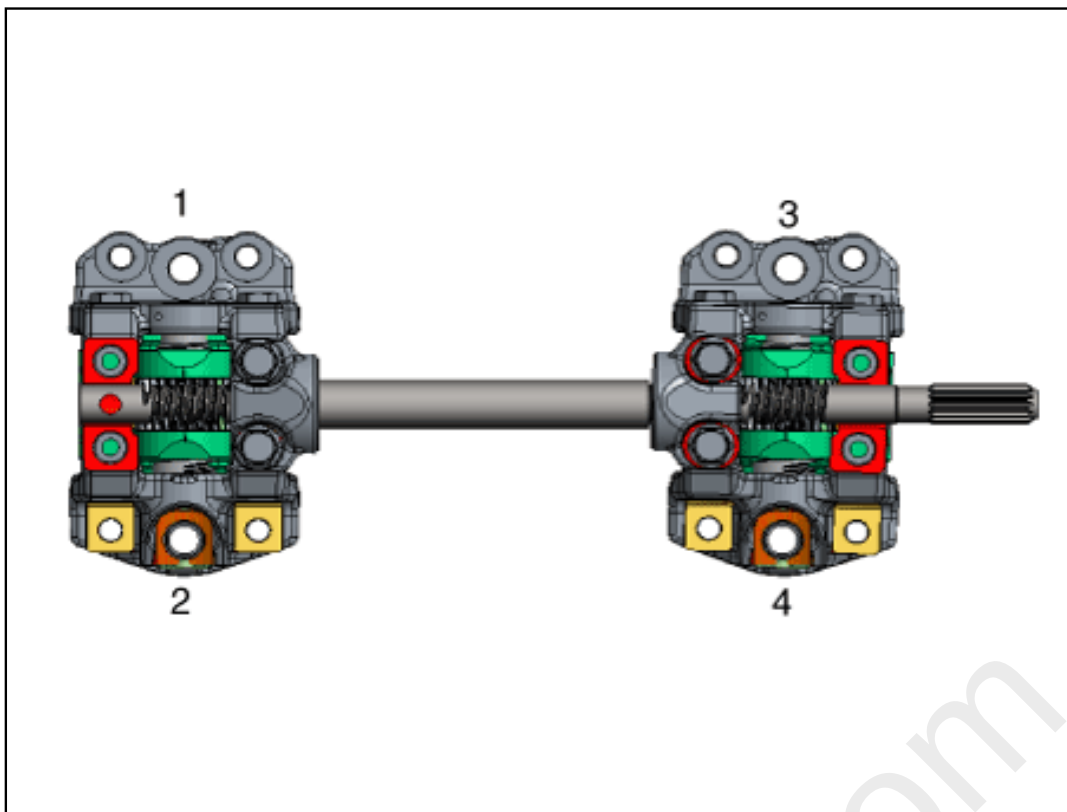
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



3. Tighten the CVVD assembly mounting bolts (M8) in sequence shown below.

Tightening torque :

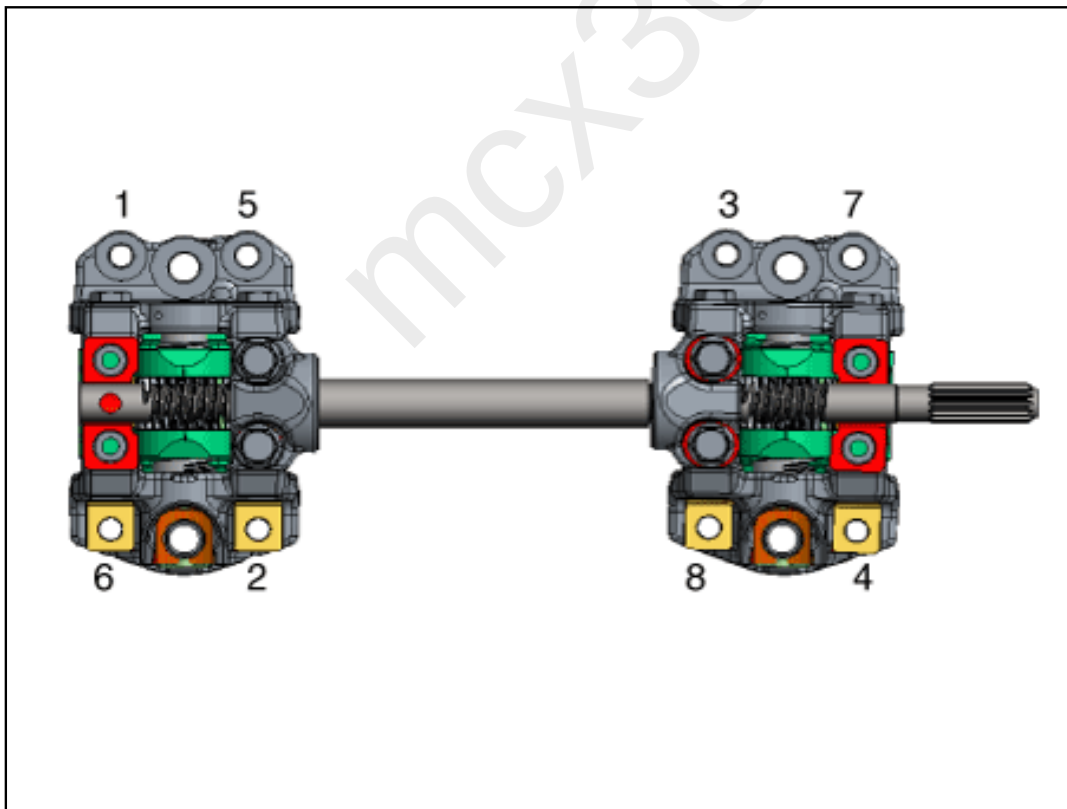
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



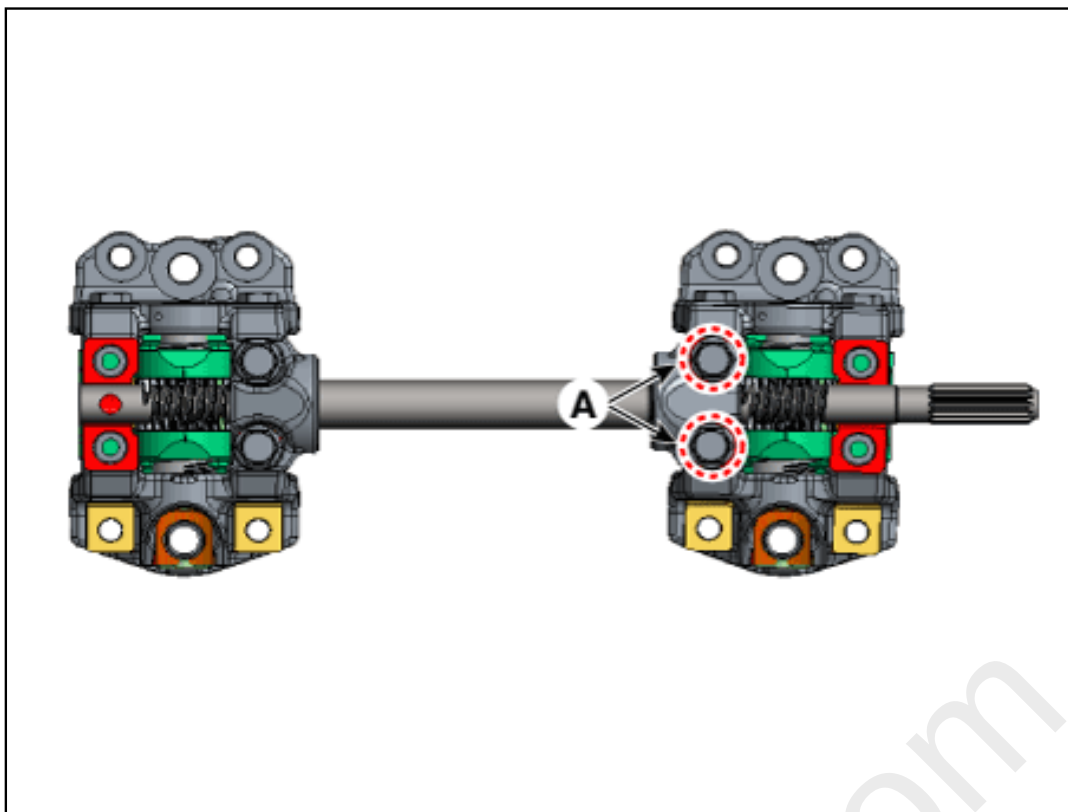
4. Tighten the CVVD assembly mounting bolts (M6) in sequence shown below.

Tightening torque :

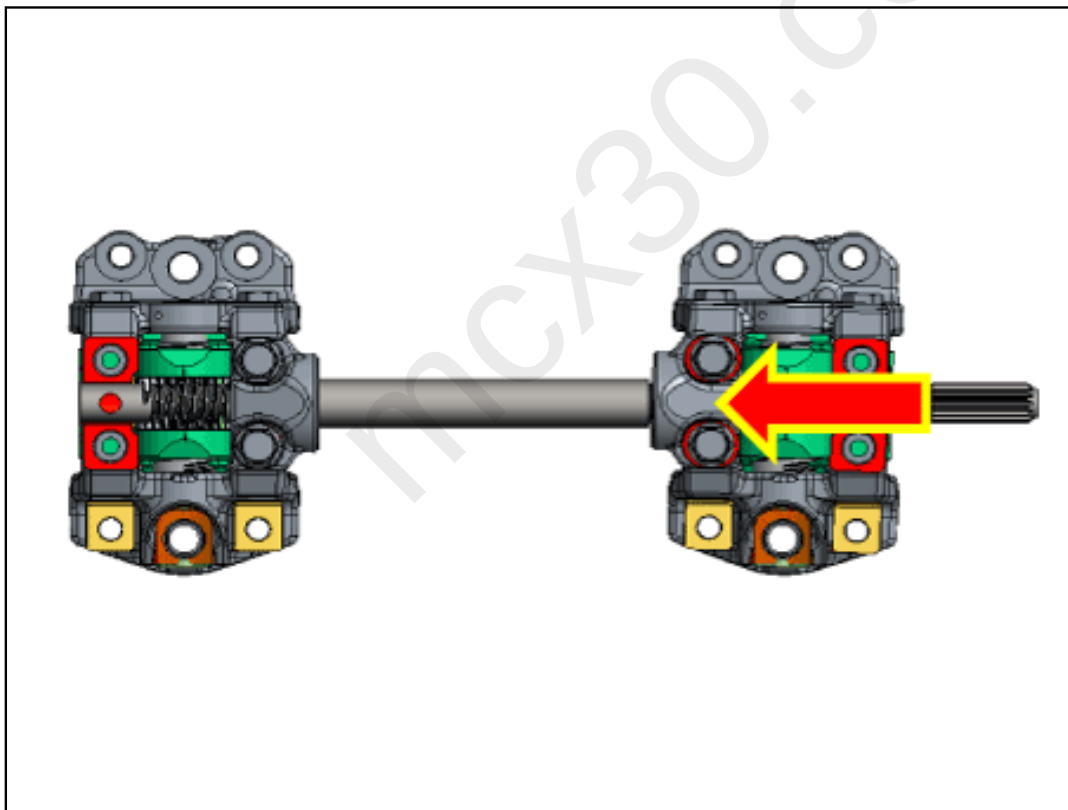
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



5. Release the torque of control shaft bearing cap bolt (A).



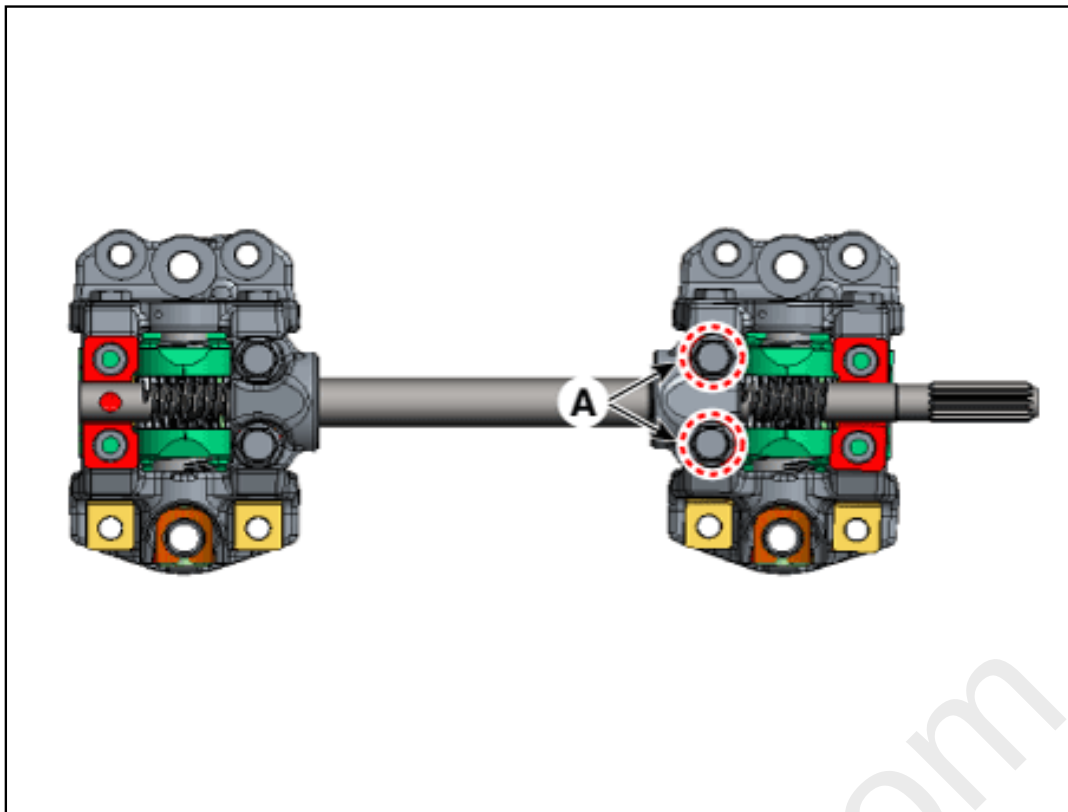
6. Push the control shaft bearing cap as close as possible in the direction of the arrow.



7. Install the control shaft bearing cap mounting bolts (A).

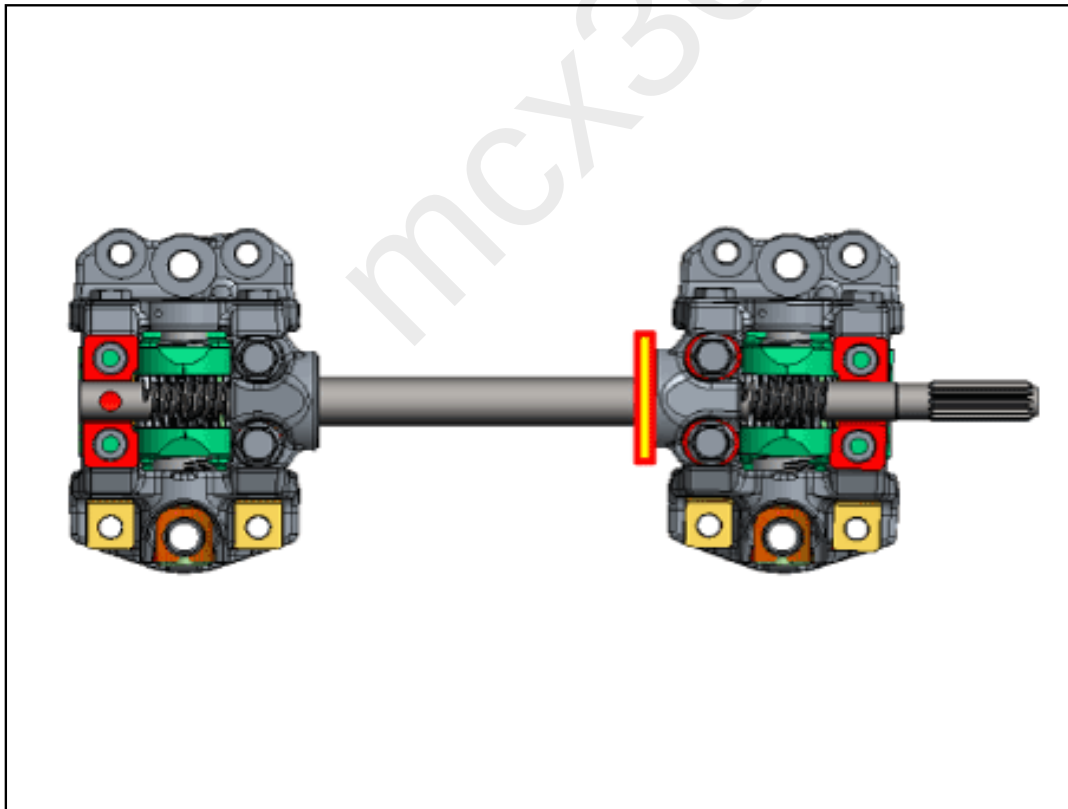
Tightening torque :

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

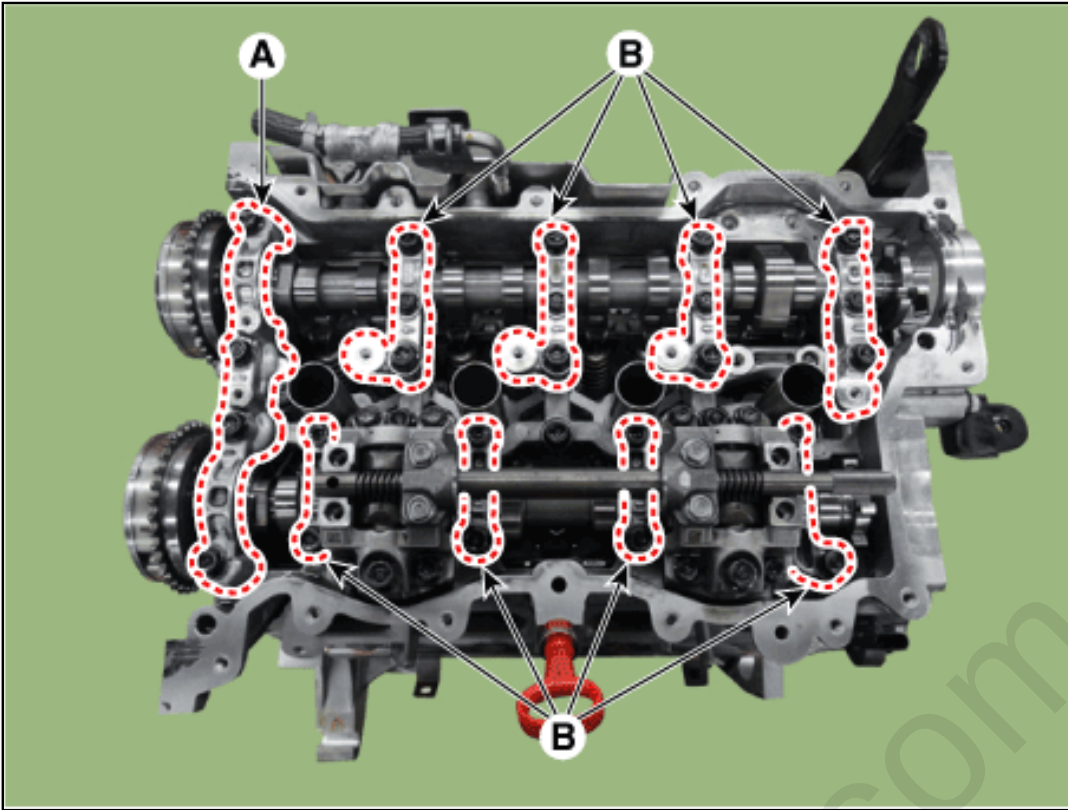


8. Measure the clearance between the control shaft bearing cap and the end of control shaft using a clearance gauge.

Clearance : 0.0 - 0.05 mm (0.0 - 0.002 in.)



9. Install the camshaft front bearing cap (A) and camshaft bearing caps (B).

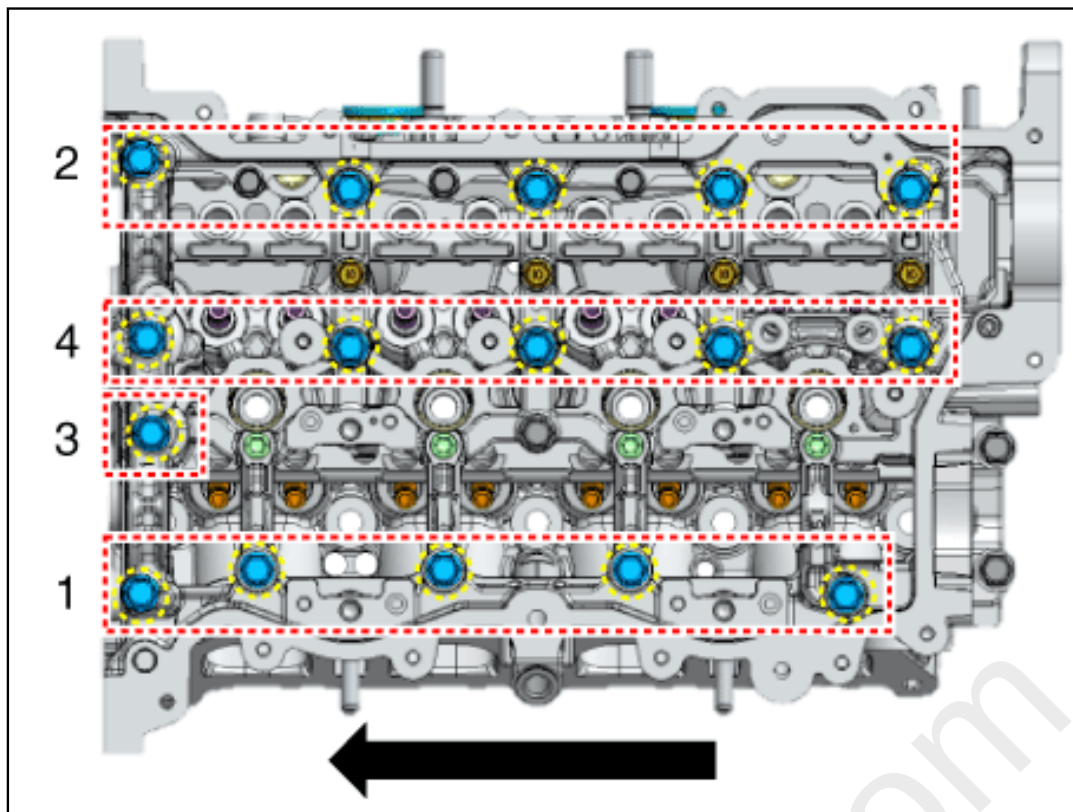


- If there is enough engine oil on the camshaft front bearing cap and camshaft bearing cap installing bolt and bolt hole, tighten to the minimum required tightening torque.
- Apply engine oil the upper part of the intake / exhaust camshaft journal, then install the camshaft front bearing cap and camshaft bearing cap. The amount of application should be enough to flow down both the front and back sides when it is applied to the center.

1) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

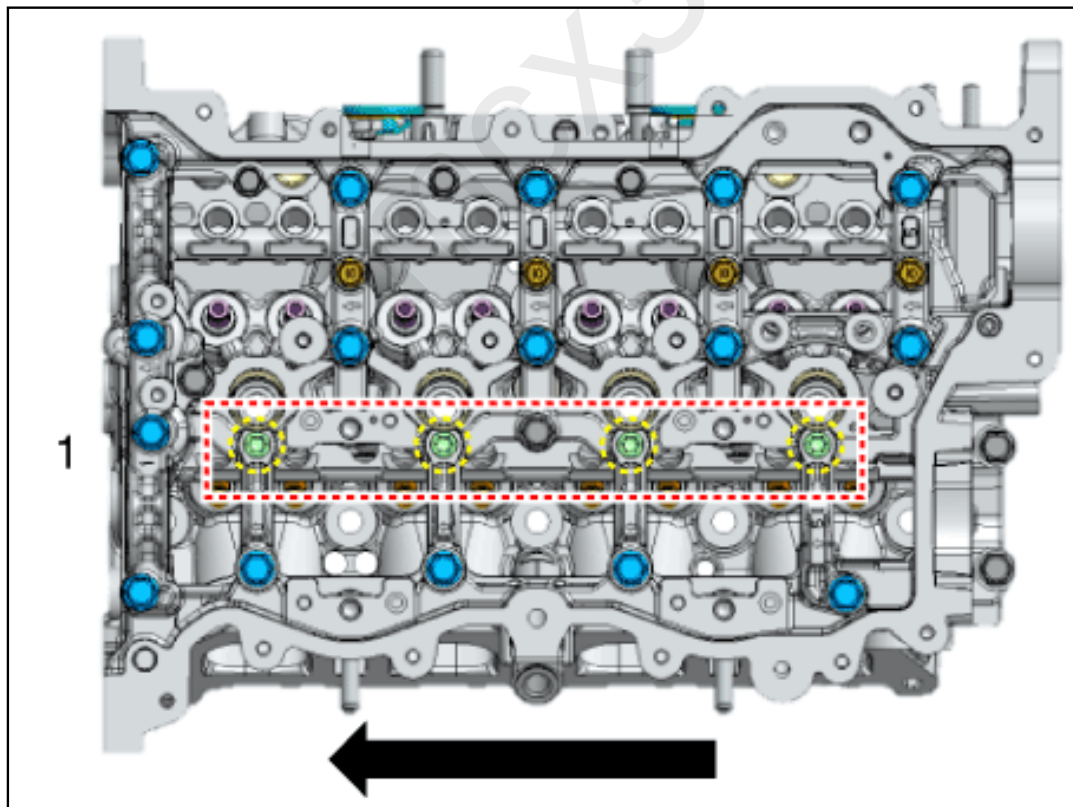
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



2) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

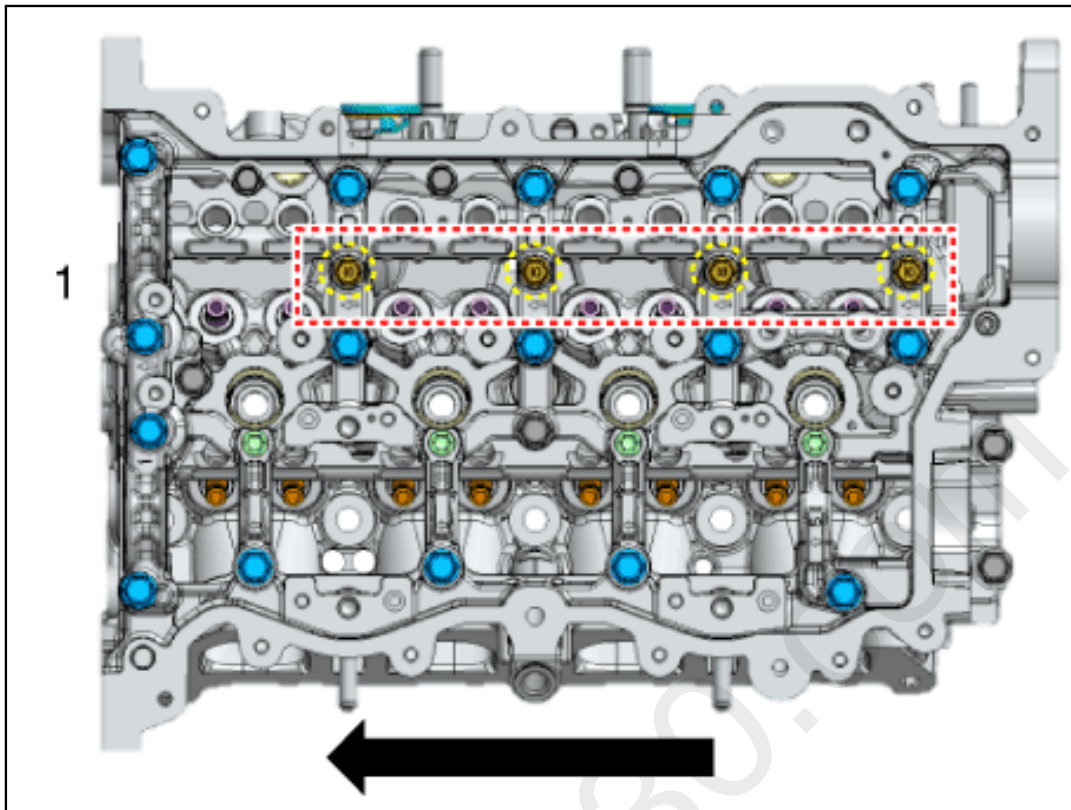
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



- 3) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

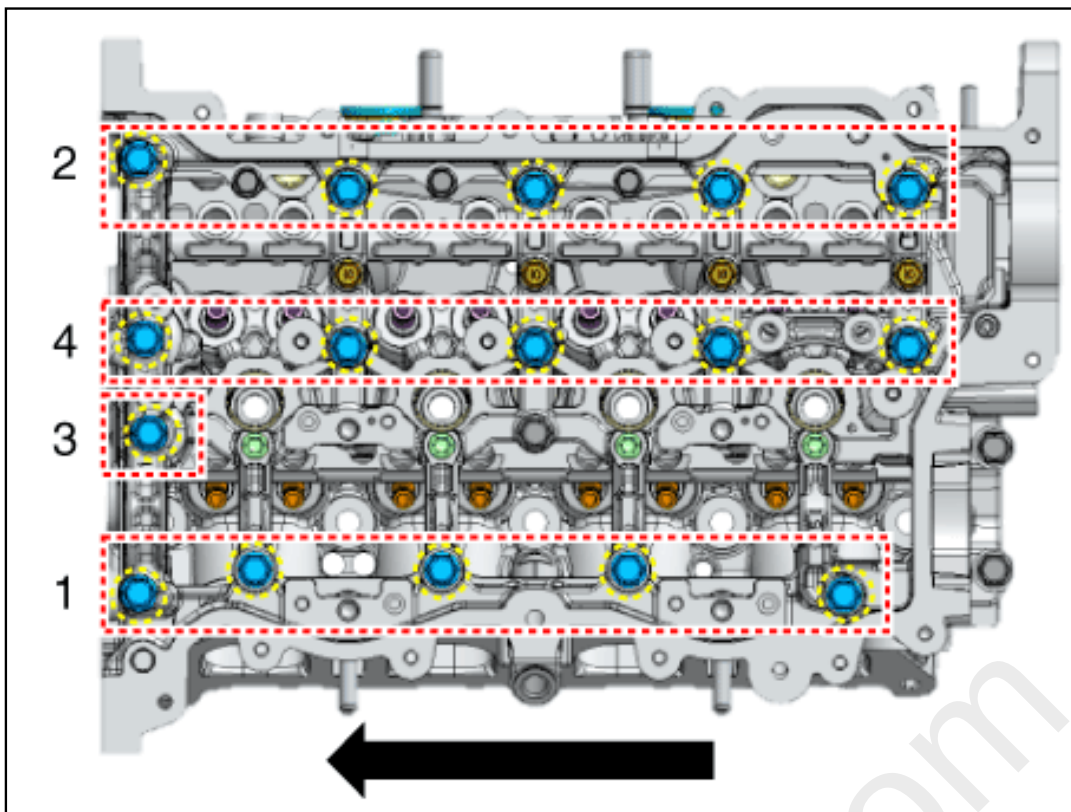
4.9 - 6.9 N.m (0.5 - 0.7 kgf.m, 3.6 - 5.1 lb-ft)



- 4) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

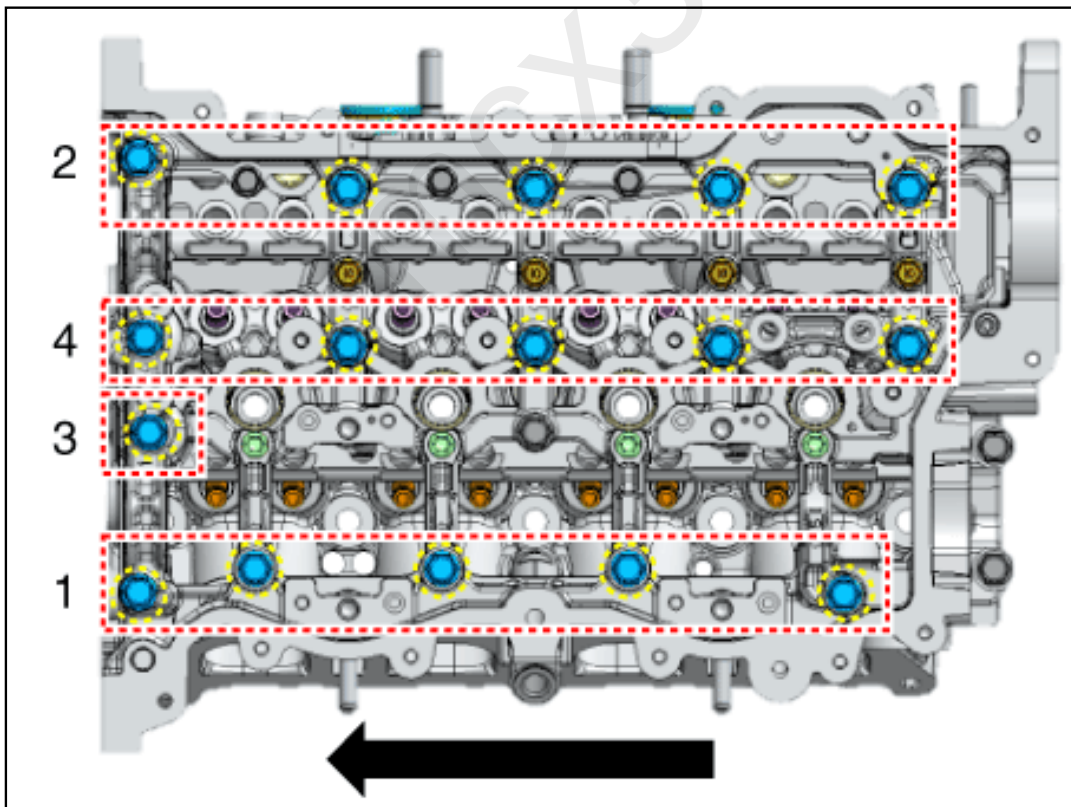
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)



5) Install the camshaft front bearing cap and camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

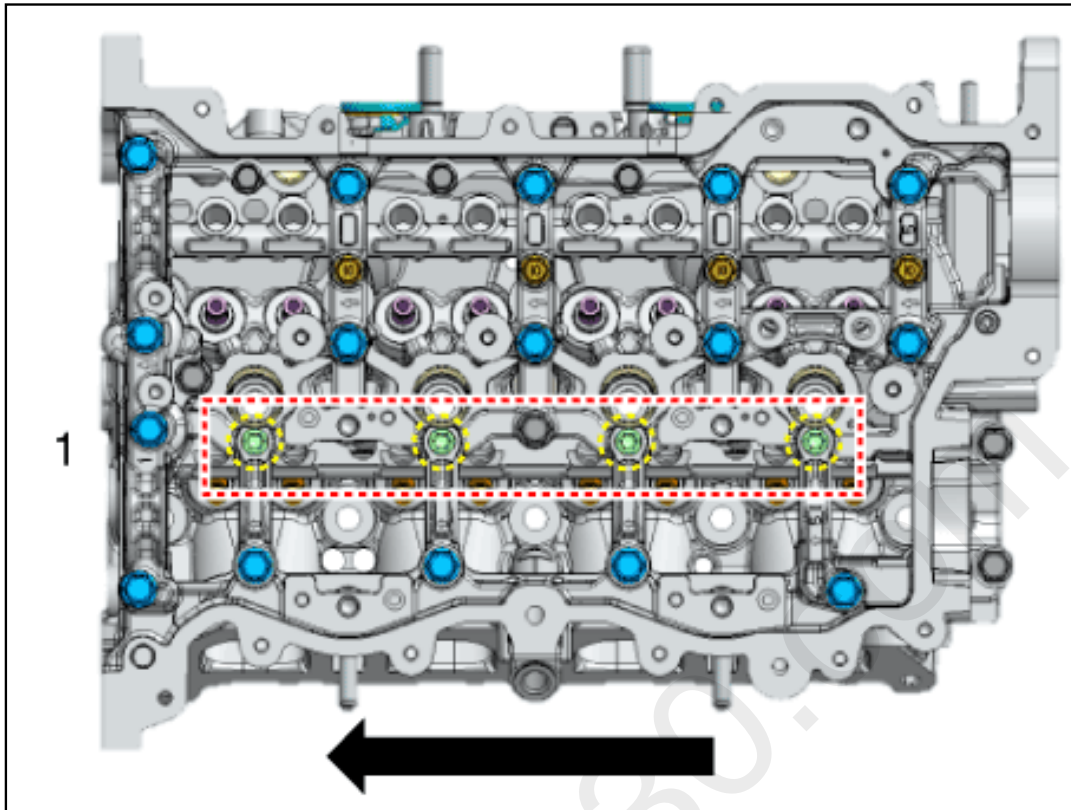
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb-ft)



- 6) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

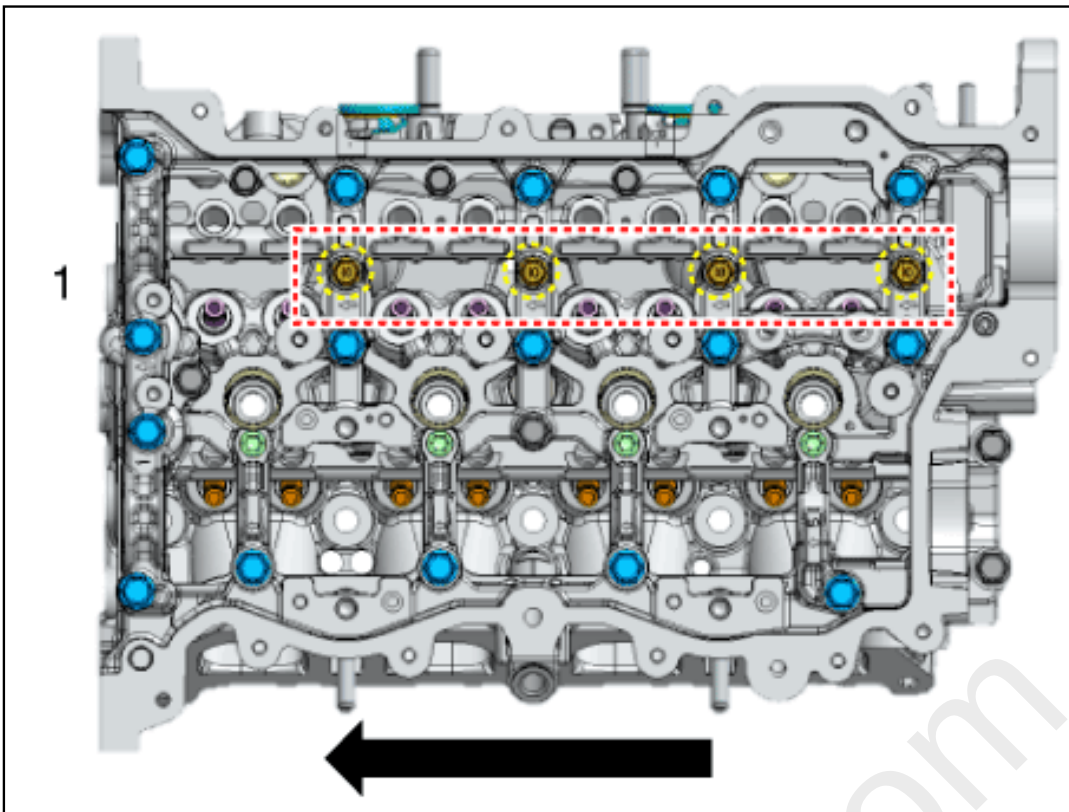
11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)



- 7) Install the camshaft bearing cap installing bolt with direction from back of engine to the front of engine according to the procedure at down below.

Tightening torque :

11.8 - 13.7 N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb-ft)



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

11. Fill with engine coolant.

(Refer to Cooling System - "Coolant")



- The coolant must be injected according to the integrated thermal management module (ITM) coolant filling method.

12. Refill engine with engine oil.

(Refer to Lubrication System - "Engine Oil")