

2012 ENGINE**Engine Cylinder Head Assembly - Elantra****CAMSHAFT****REPAIR PROCEDURES****Removal**

Timing chain cover removal is not required for this procedure.

CAUTION:

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

1. Remove the cylinder head cover. (Refer to **TIMING SYSTEM**)
2. Set No. 1 cylinder to TDC (Top dead center) on compression stroke.
 1. Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover.

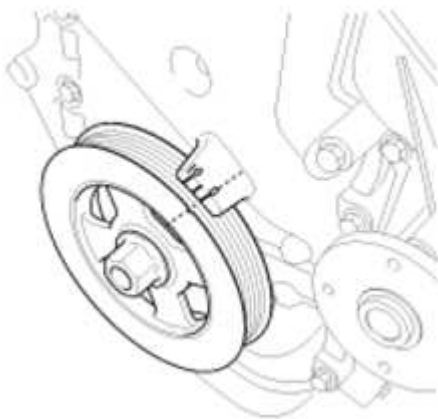


Fig. 1: Timing Mark

Courtesy of HYUNDAI MOTOR CO.

2. Check that the TDC marks of the intake and exhaust CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft by one revolution (360°) more.
3. Mark the timing chains corresponding to the timing marks of the CVVT sprockets.

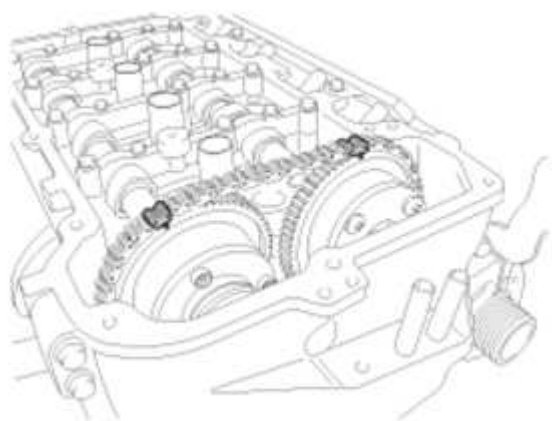


Fig. 2: Timing Marks Of CVVT Sprockets
Courtesy of HYUNDAI MOTOR CO.

3. Remove the crankshaft damper pulley.

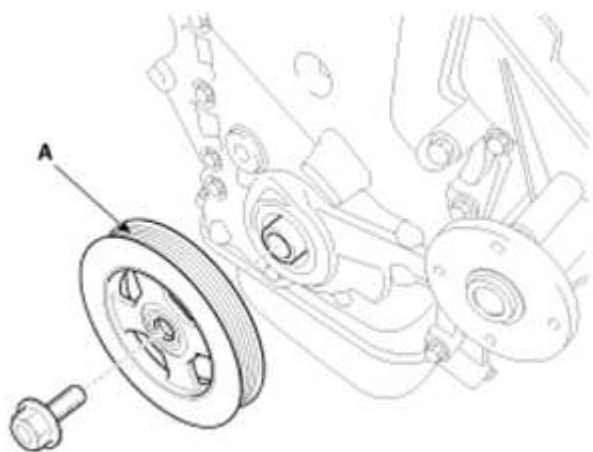


Fig. 3: Crankshaft Damper Pulley
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE: There are two methods to hold the ring gear when removing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.

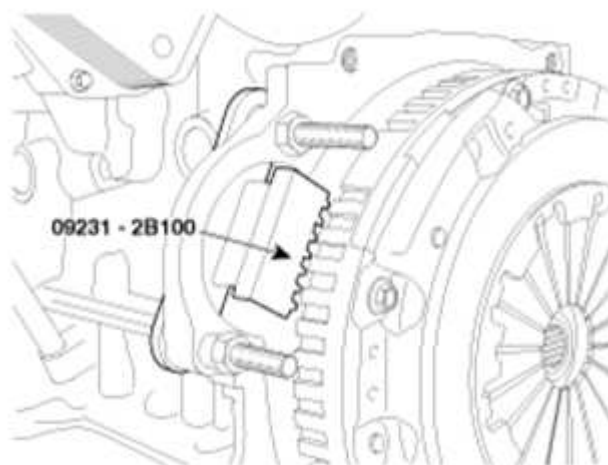


Fig. 4: SST (09231-2B100)
Courtesy of HYUNDAI MOTOR CO.

- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.
1. Remove the air guard (A).

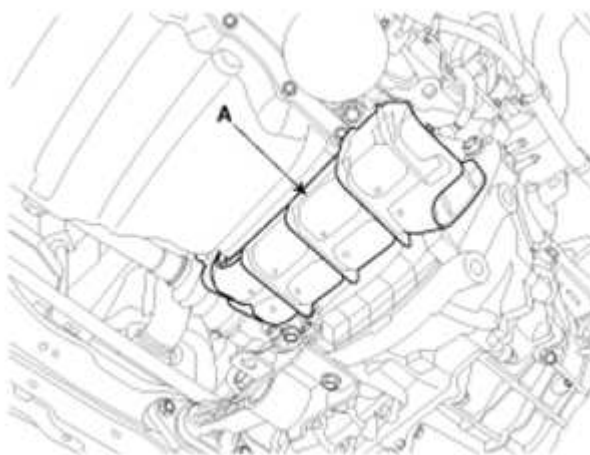


Fig. 5: Air Guard
Courtesy of HYUNDAI MOTOR CO.

2. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.

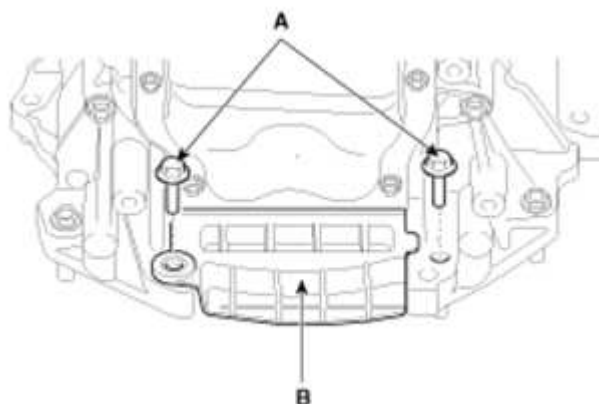


Fig. 6: Transaxle Mounting Bolts
Courtesy of HYUNDAI MOTOR CO.

3. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.
- Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.

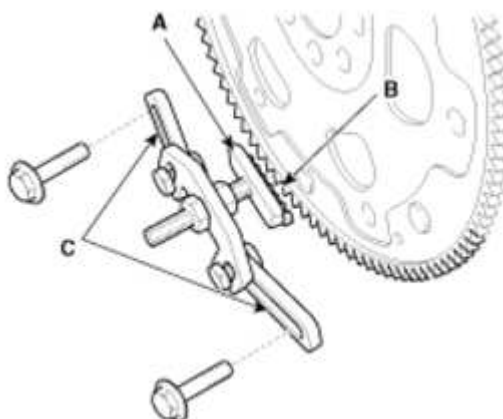


Fig. 7: Adjusting Length Of Holder
Courtesy of HYUNDAI MOTOR CO.

- Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.

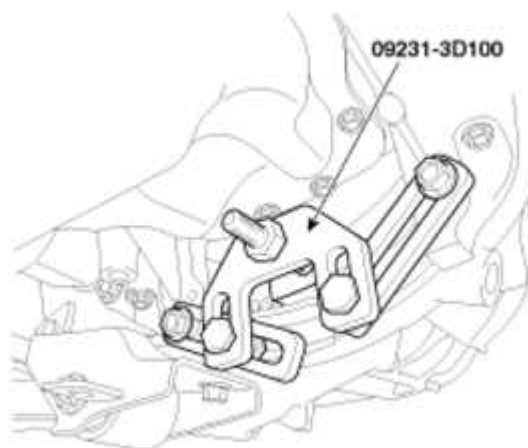


Fig. 8: Installing SST
Courtesy of HYUNDAI MOTOR CO.

4. Remove the service plug bolt (A) with the gasket (B).

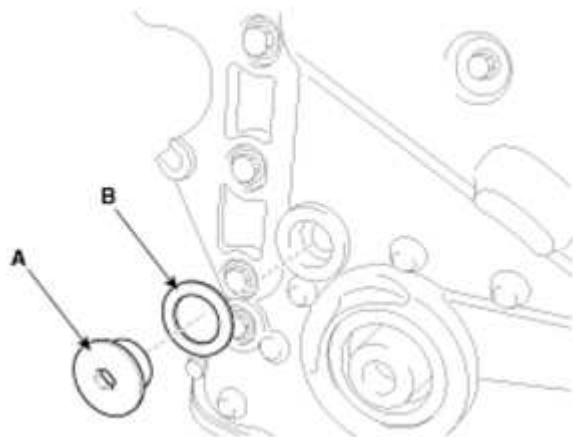


Fig. 9: Service Plug Bolt
Courtesy of HYUNDAI MOTOR CO.

5. Remove the tensioner arm bolt (A).



Fig. 10: Tensioner Arm Bolt
Courtesy of HYUNDAI MOTOR CO.

6. Push down the tensioner arm (A).

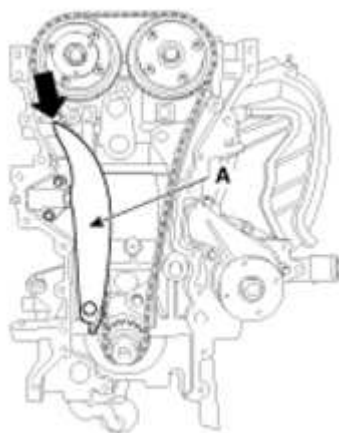


Fig. 11: Tensioner Arm
Courtesy of HYUNDAI MOTOR CO.

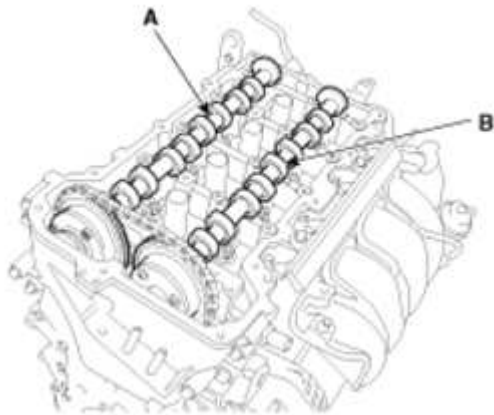
7. Remove the camshaft bearing caps.



Fig. 12: Camshaft Bearing Caps

Courtesy of HYUNDAI MOTOR CO.

8. Remove the exhaust camshaft (A) first, then intake camshaft (B).

**Fig. 13: Exhaust Camshaft**

Courtesy of HYUNDAI MOTOR CO.

9. Remove the tensioner arm (A).

**Fig. 14: Tensioner Arm**

Courtesy of HYUNDAI MOTOR CO.

NOTE: To hold the timing chain, tie it with strap.

Installation

1. Compress the piston of the tensioner using a handy bar (A) and then insert a stopper pin (B) into the hole on the tensioner to hold the compressed piston.

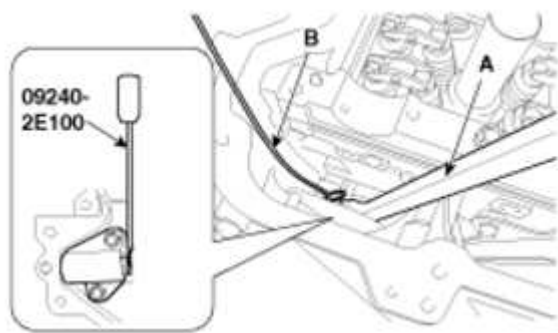


Fig. 15: Compressing Piston

Courtesy of HYUNDAI MOTOR CO.

2. Place the intake camshaft (A) and then insert the tensioner arm (B) along the timing chain.

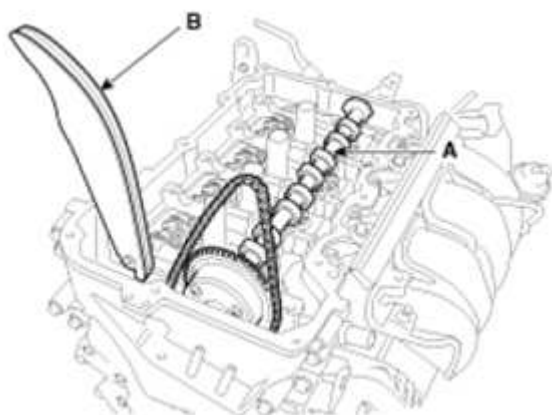


Fig. 16: Intake Camshaft

Courtesy of HYUNDAI MOTOR CO.

3. Place the exhaust camshaft (A).

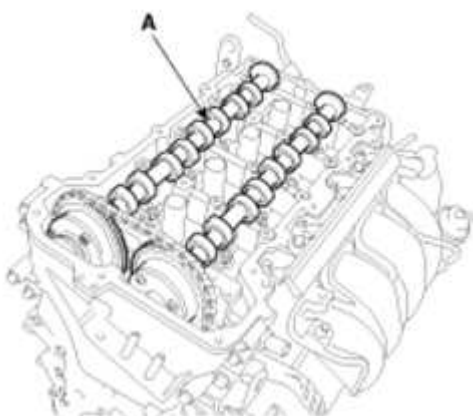


Fig. 17: Exhaust Camshaft

Courtesy of HYUNDAI MOTOR CO.

NOTE: The timing marks of each CVVT sprocket should be matched with timing marks (painted link) of timing chain when installing the timing chain.

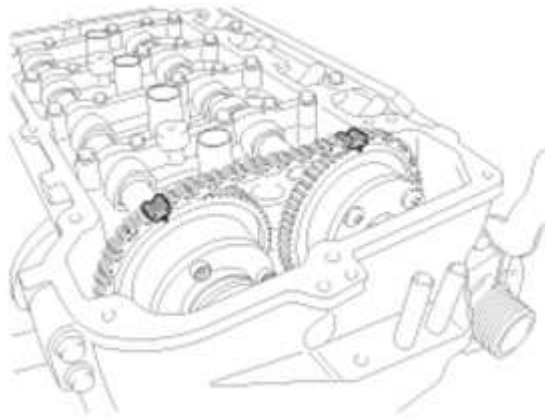


Fig. 18: Timing Marks Of CVVT Sprocket
Courtesy of HYUNDAI MOTOR CO.

4. Install the camshaft bearing caps.



Fig. 19: Camshaft Bearing Caps
Courtesy of HYUNDAI MOTOR CO.

Tighten the bolts, in several passes, in the sequence as shown in the illustration below.

Tightening torque

M6 bolts:

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

M8 bolts:

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

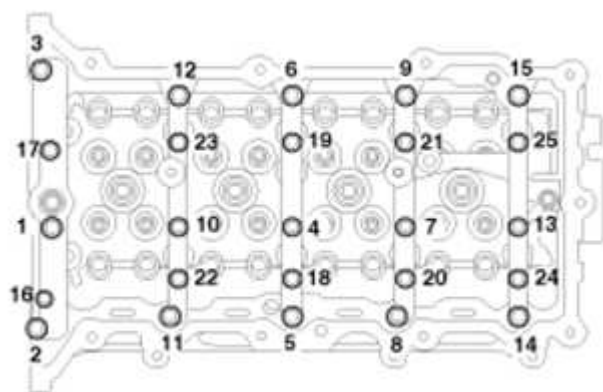


Fig. 20: Camshaft Bearing Caps Bolts Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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

5. Using a suitable tool, move the tensioner arm to align the tensioner bolt hole with the service hole.

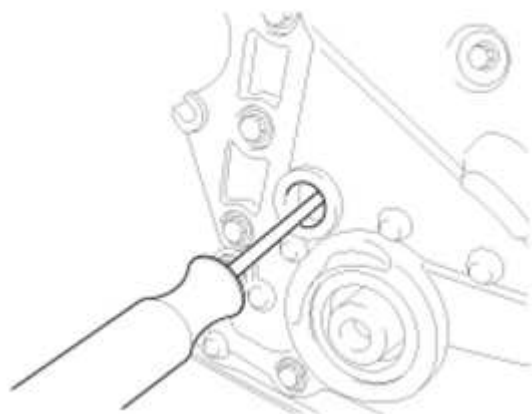


Fig. 21: Moving Tensioner Arm
Courtesy of HYUNDAI MOTOR CO.

6. Install the tensioner arm bolt (A).

Tightening torque:

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



Fig. 22: Tensioner Arm Bolt

Courtesy of HYUNDAI MOTOR CO.

7. Remove the stopper pin from the tensioner.
8. Turn the crankshaft two turns in the operating direction (clockwise), and then check that the TDC marks of the CVVT sprockets are in straight line on the cylinder head surface.

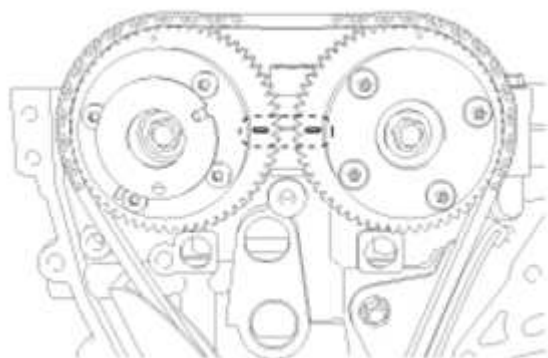


Fig. 23: Stopper Pin

Courtesy of HYUNDAI MOTOR CO.

9. Install a service plug bolt (A) with a gasket.

Tightening torque:

29.4 ~ 39.2 N.m (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)

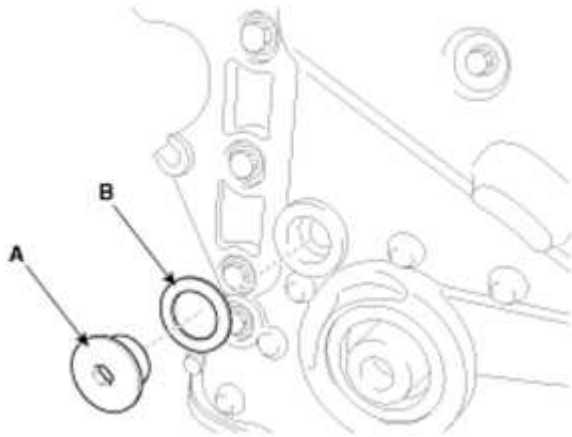


Fig. 24: Service Plug Bolt

Courtesy of HYUNDAI MOTOR CO.

CAUTION: Do not reuse the service plug bolt and gasket.

10. Install the crankshaft damper pulley (A).

Tightening torque:

196.1 ~ 205.9 N.m (20.0 ~ 21.0 kgf.m, 144.7 ~ 151.9 lb-ft)

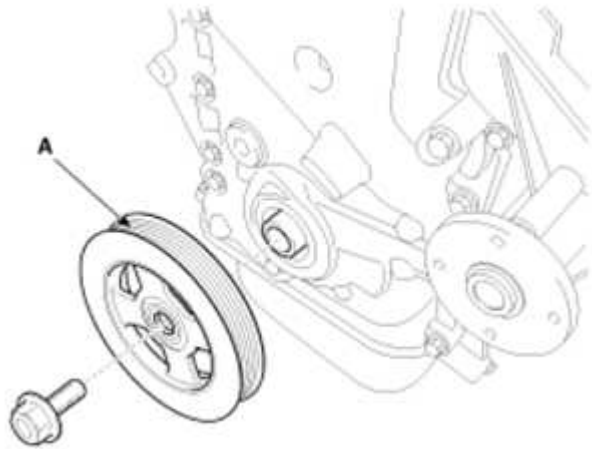


Fig. 25: Crankshaft Damper Pulley

Courtesy of HYUNDAI MOTOR CO.

CAUTION: Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE: There are two methods to hold the ring gear when installing the crankshaft

damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.

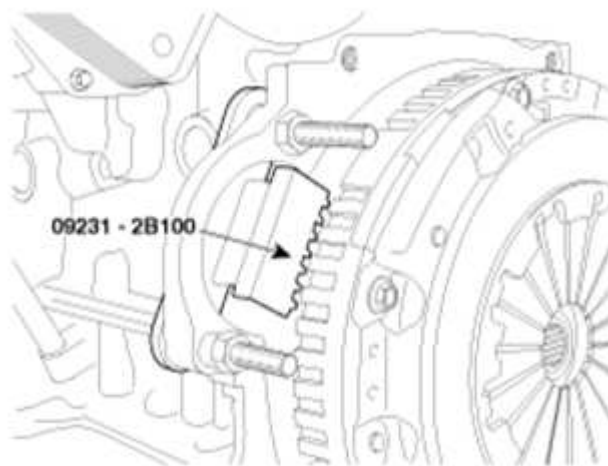


Fig. 26: Installing SST (09231-2B100)
Courtesy of HYUNDAI MOTOR CO.

- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.
1. Remove the air guard (A).

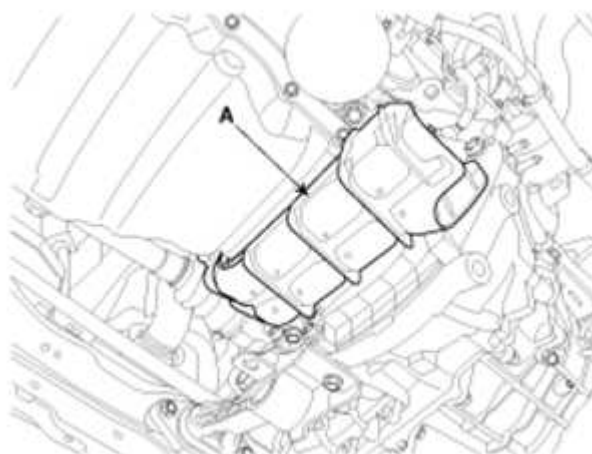


Fig. 27: Air Guard
Courtesy of HYUNDAI MOTOR CO.

2. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.

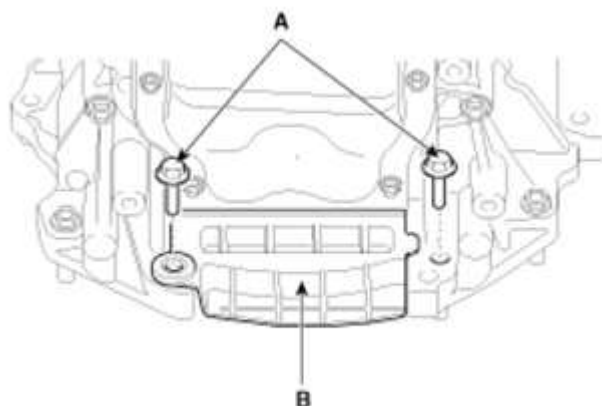


Fig. 28: Transaxle Mounting Bolts
Courtesy of HYUNDAI MOTOR CO.

3. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.
- Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.

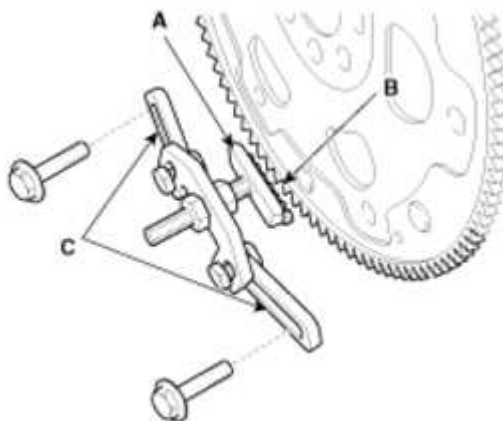


Fig. 29: Adjusting Length Of Holder
Courtesy of HYUNDAI MOTOR CO.

- Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.

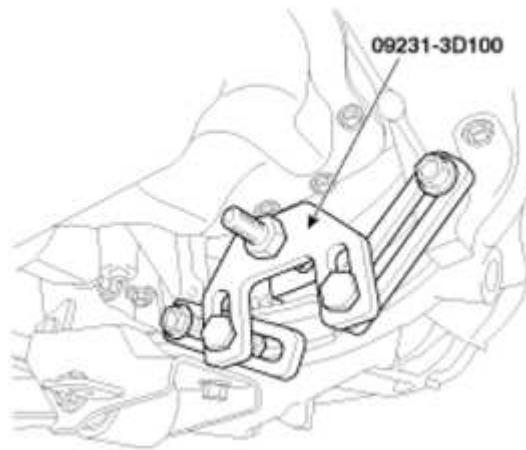


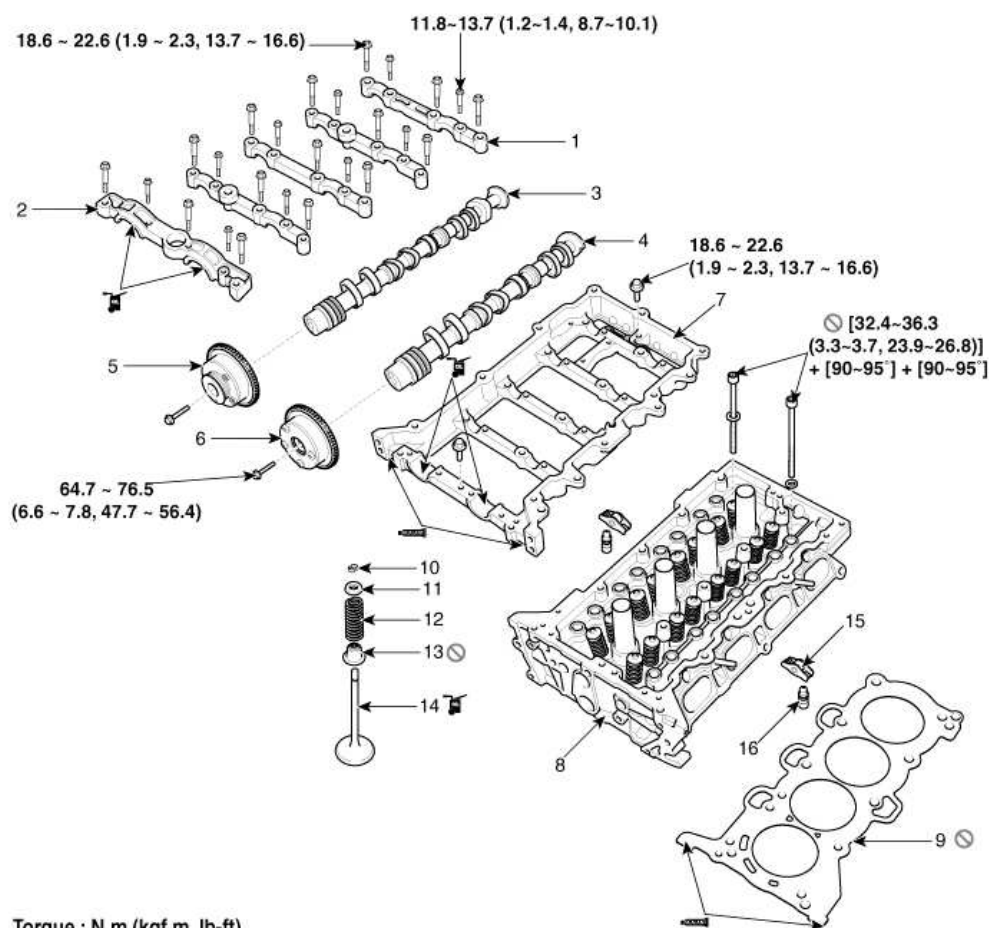
Fig. 30: Installing SST
Courtesy of HYUNDAI MOTOR CO.

11. Install the cylinder head cover. (Refer to **TIMING SYSTEM**)

CYLINDER HEAD

COMPONENTS AND COMPONENTS LOCATION

Components



1. Camshaft bearing cap	7. Cam carrier	13. Valve stem seal
2. Camshaft front bearing cap	8. Cylinder head	14. Valve
3. Exhaust camshaft	9. Cylinder head gasket	15. Swing arm
4. Intake camshaft	10. Retainer lock	16. HLA (Hydraulic lash adjuster)
5. Exhaust CVVT assembly	11. Retainer	
6. Intake CVVT assembly	12. Valve spring	

Fig. 31: Cylinder Head Components With Torque Specifications
 Courtesy of HYUNDAI MOTOR CO.

REPAIR PROCEDURES

Removal

Engine removal is not required for this procedure.

CAUTION:

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or

damage the contact surface of the gasket.

- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

1. Disconnect the battery negative terminal. (Refer to ENGINE AND TRANSAXLE ASSEMBLY)
2. Remove the RH front wheel. (Refer to "WHEEL ")
3. Remove the RH under cover. (Refer to ENGINE AND TRANSAXLE ASSEMBLY)
4. Remove the engine cover. (Refer to ENGINE AND TRANSAXLE ASSEMBLY)
5. Remove the air duct and the air cleaner assembly. (Refer to INTAKE AND EXHAUST SYSTEM)
6. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster. (Refer to COOLING SYSTEM)
7. Disconnect the radiator upper hose and lower hose. (Refer to COOLING SYSTEM)
8. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the cylinder head and the intake manifold.
 1. The intake OCV (Oil control valve) connector (A)

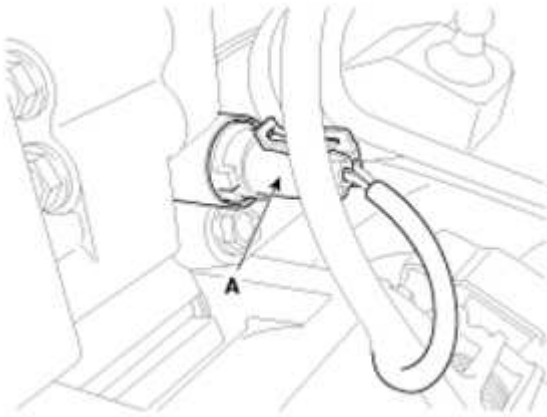


Fig. 32: Intake OCV Connector
Courtesy of HYUNDAI MOTOR CO.

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

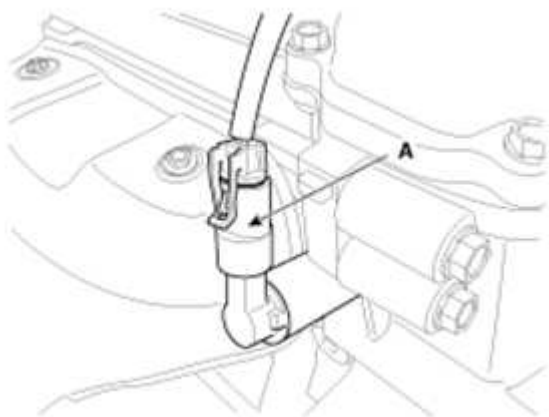


Fig. 33: Exhaust OCV Connector
Courtesy of HYUNDAI MOTOR CO.

3. The alternator connector (A)

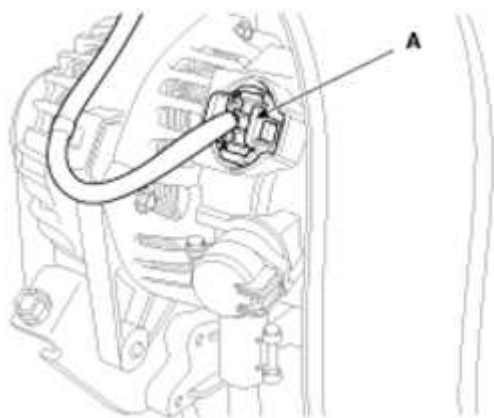


Fig. 34: Alternator Connector
Courtesy of HYUNDAI MOTOR CO.

4. The ignition coil connectors (A)

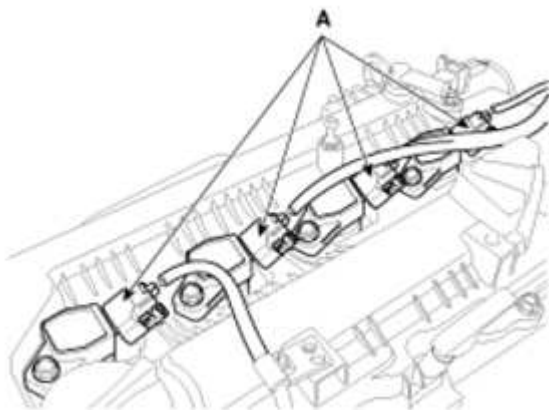
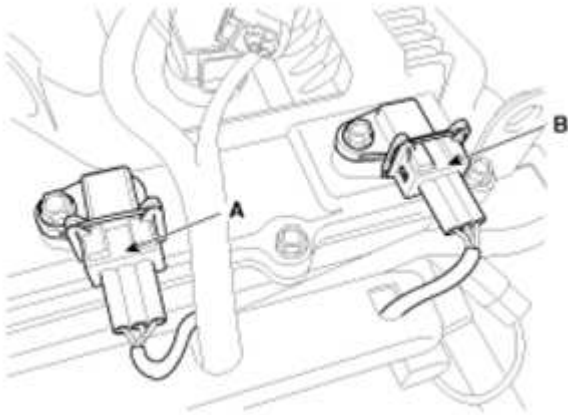


Fig. 35: Ignition Coil Connectors

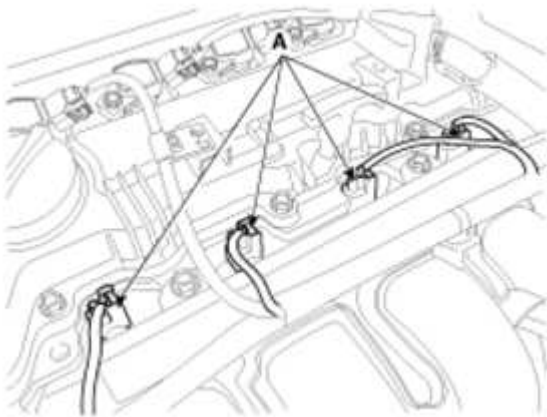
Courtesy of HYUNDAI MOTOR CO.

5. The intake CMPS (Camshaft position sensor) connector (A)
6. The exhaust CMPS (Camshaft position sensor) connector (B)

**Fig. 36: CMPS Connector**

Courtesy of HYUNDAI MOTOR CO.

7. The injector connectors (A)

**Fig. 37: Injector Connectors**

Courtesy of HYUNDAI MOTOR CO.

8. The front and/or rear HO2S (Heated oxygen sensor connectors) (A)

[ULEV]

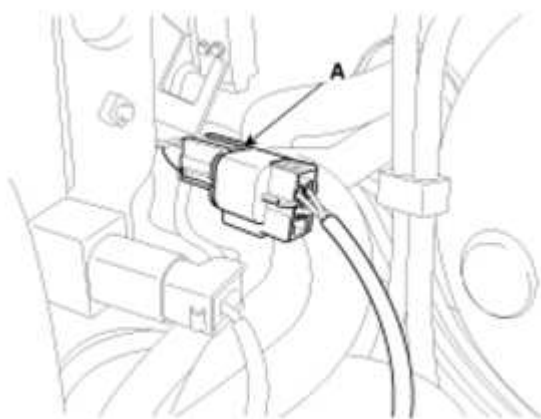


Fig. 38: Heated Oxygen Sensor Connectors (ULEV)
Courtesy of HYUNDAI MOTOR CO.

[SULEV]

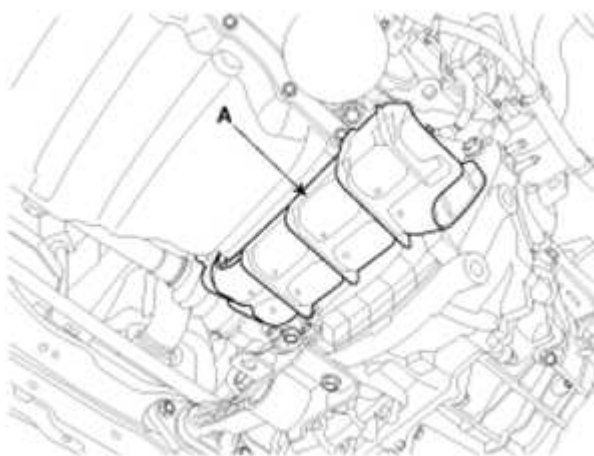


Fig. 39: Heated Oxygen Sensor Connectors (SULEV)
Courtesy of HYUNDAI MOTOR CO.

9. The condenser connector (A)

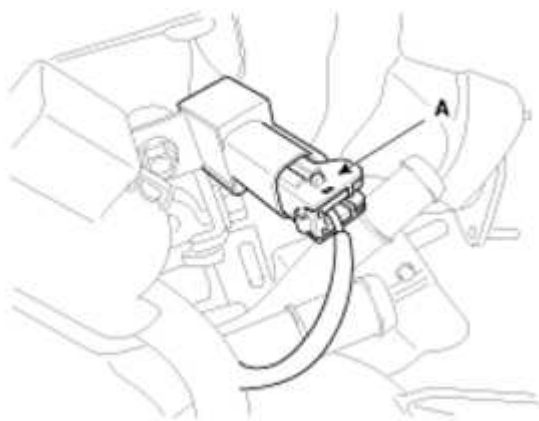


Fig. 40: Condenser Connector
Courtesy of HYUNDAI MOTOR CO.

10. The PCSV (Purge control solenoid valve) connector (A)

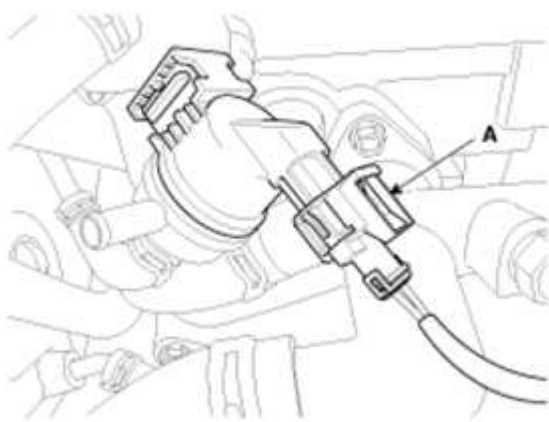


Fig. 41: Purge Control Solenoid Valve Connector
Courtesy of HYUNDAI MOTOR CO.

11. The ECTS (Engine coolant temperature sensor) connector (A)

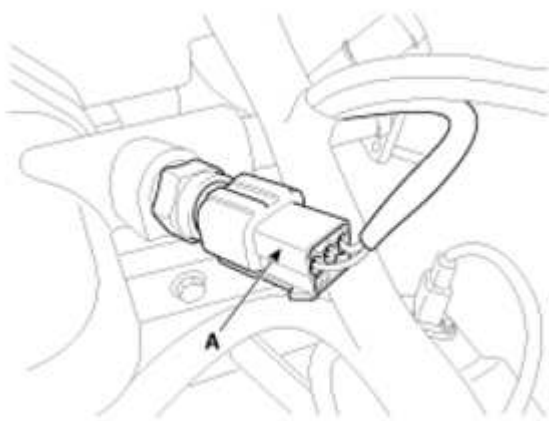


Fig. 42: Engine Coolant Temperature Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

12. The VIS (Variable Intake System) connector (A)

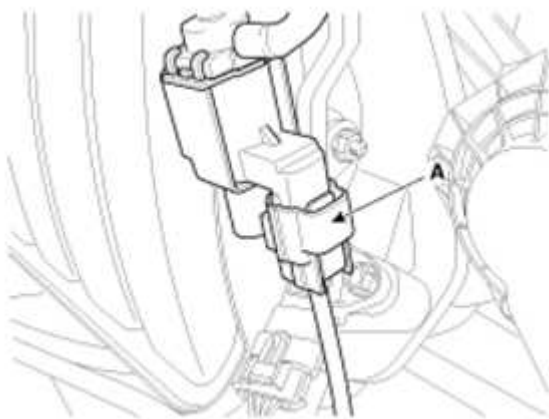


Fig. 43: Variable Intake System Connector
Courtesy of HYUNDAI MOTOR CO.

13. The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



Fig. 44: Intake Air Temperature Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

14. The ETC (Electronic throttle control) connector (A)

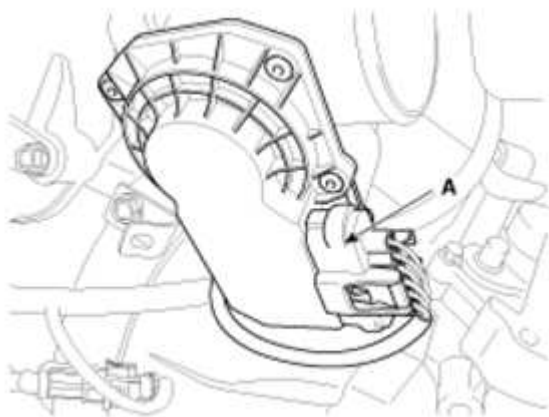


Fig. 45: Electronic Throttle Control Connector
 Courtesy of HYUNDAI MOTOR CO.

15. The VCMA (Variable charge motion actuator) connector (A)

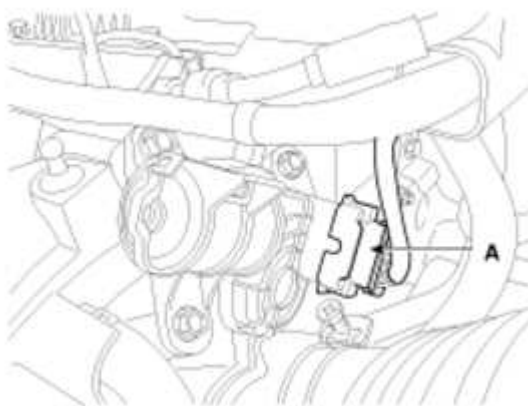


Fig. 46: Variable Charge Motion Actuator Connector
 Courtesy of HYUNDAI MOTOR CO.

9. Disconnect the brake booster vacuum hose (A) and the heater hoses (B).

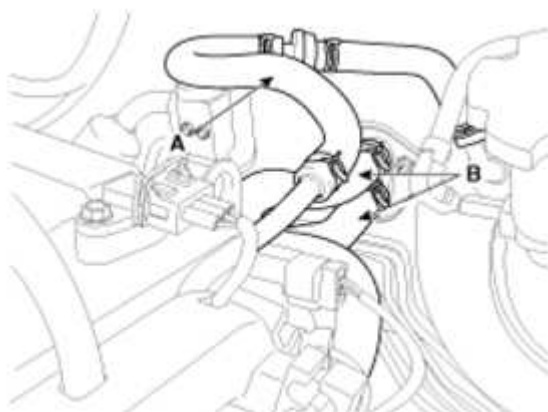


Fig. 47: Brake Booster Vacuum Hose
Courtesy of HYUNDAI MOTOR CO.

10. Disconnect the fuel hose (A) and PCSV (Purge control solenoid valve) hose (B).

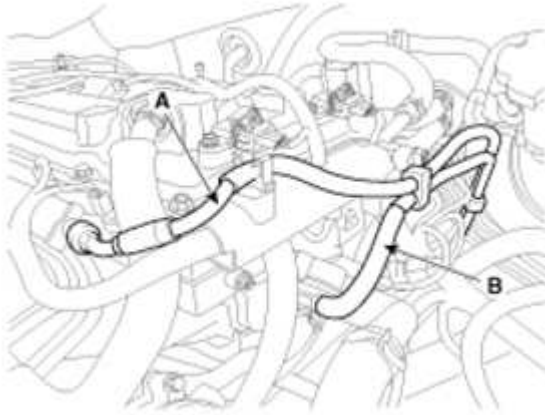


Fig. 48: Fuel Hose
Courtesy of HYUNDAI MOTOR CO.

11. Remove the injector & rail assembly (A). (Refer to "INJECTOR ")

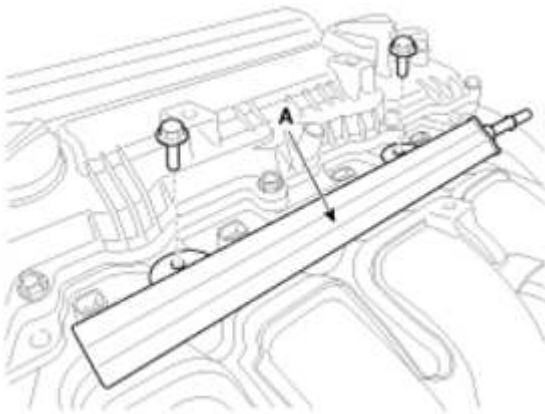


Fig. 49: Rail Assembly
Courtesy of HYUNDAI MOTOR CO.

12. Remove the intake and exhaust manifold. (Refer to INTAKE AND EXHAUST SYSTEM)
13. Remove the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover. (Refer to TIMING SYSTEM)
14. Remove the vacuum pipe (A).



Fig. 50: Vacuum Pipe

Courtesy of HYUNDAI MOTOR CO.

15. Remove the condenser (A).

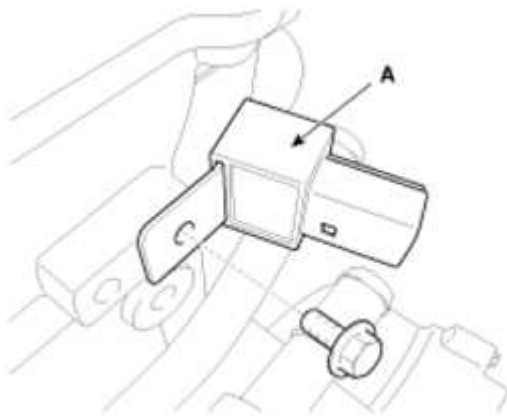


Fig. 51: Condenser

Courtesy of HYUNDAI MOTOR CO.

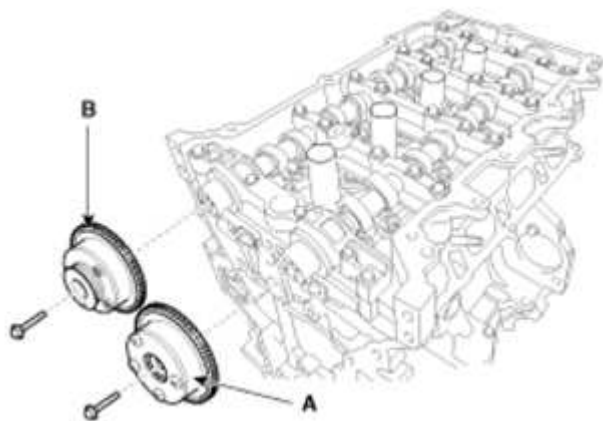
16. Remove the PCSV bracket (A).



Fig. 52: PCSV Bracket

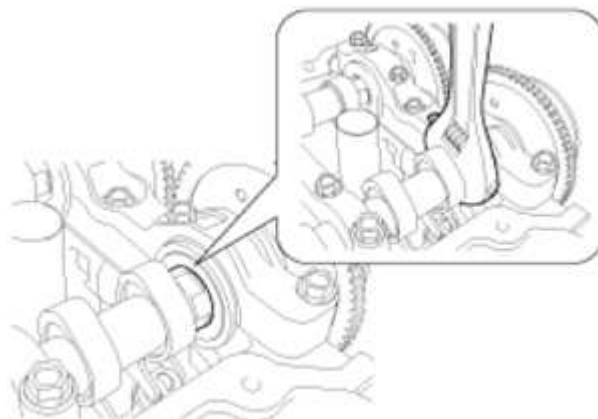
Courtesy of HYUNDAI MOTOR CO.

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

**Fig. 53: Intake CVVT Assembly**

Courtesy of HYUNDAI MOTOR CO.

NOTE: When removing the CVVT assembly bolt, hold the camshaft with a wrench to prevent the camshaft from rotating.

**Fig. 54: Holding Camshaft**

Courtesy of HYUNDAI MOTOR CO.

18. Remove the camshaft.
1. Remove the camshaft bearing cap (A) by loosening the bolts in the sequence as shown in the illustration below.

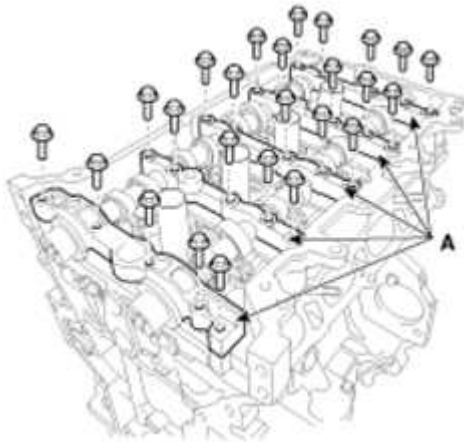


Fig. 55: Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

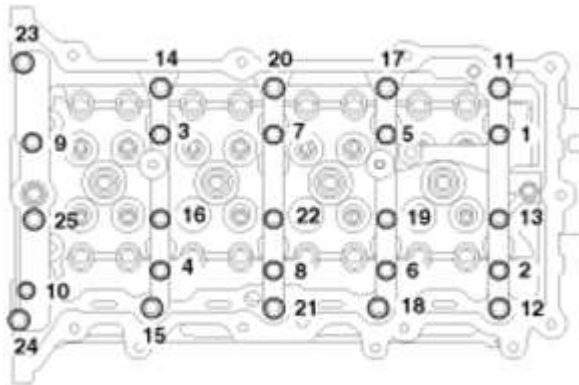


Fig. 56: Camshaft Bearing Cap Bolt Loosening Sequence
Courtesy of HYUNDAI MOTOR CO.

2. Remove the camshafts (A).

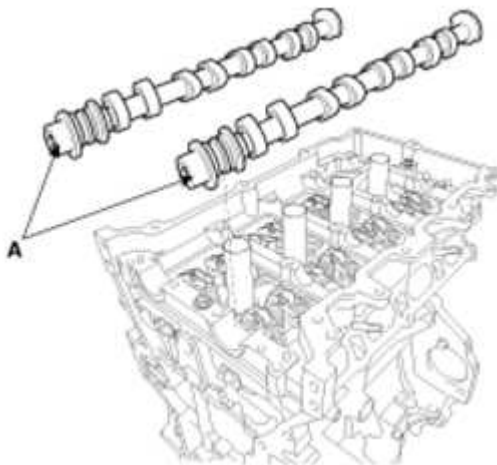
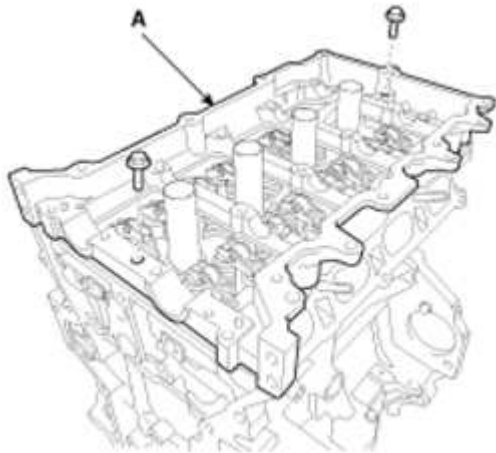


Fig. 57: Camshafts

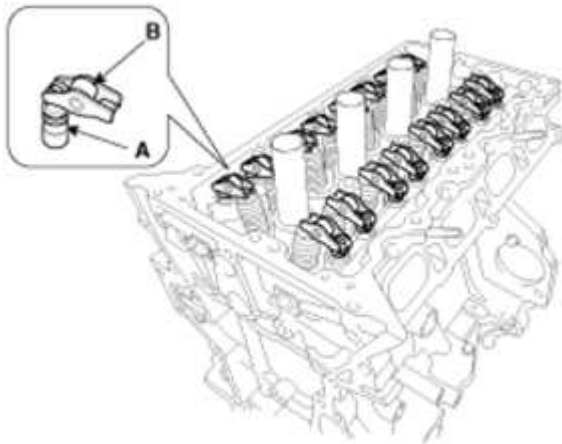
Courtesy of HYUNDAI MOTOR CO.

19. Remove the cam carrier (A).

**Fig. 58: Cam Carrier**

Courtesy of HYUNDAI MOTOR CO.

20. Remove the HLA (Hydraulic lash adjuster) (A) and the swing arm (B).

**Fig. 59: Hydraulic Lash Adjuster**

Courtesy of HYUNDAI MOTOR CO.

NOTE: The HLA and swing arm should be kept together as pairs during storage after removal and reinstallation.

21. Disconnect the bypass hose (A).
22. Unfasten the heater pipe mounting bolts (B).

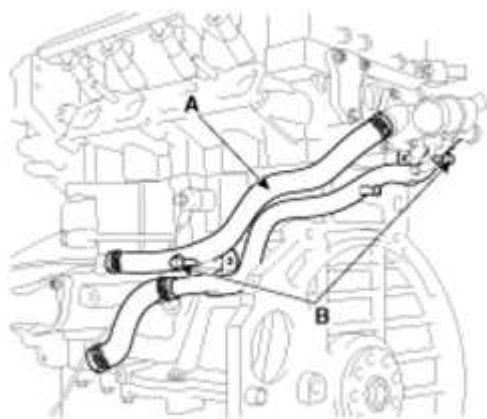


Fig. 60: Bypass Hose

Courtesy of HYUNDAI MOTOR CO.

23. Remove the water temperature control assembly.

(Refer to **COOLING SYSTEM**)

24. Remove the oil control adapter (A) with the gasket (B).

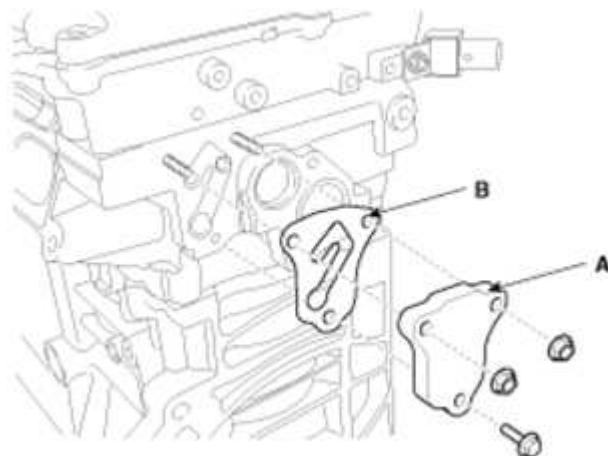


Fig. 61: Oil Control Adapter

Courtesy of HYUNDAI MOTOR CO.

25. Remove the intake OCV (Oil control valve) (A).

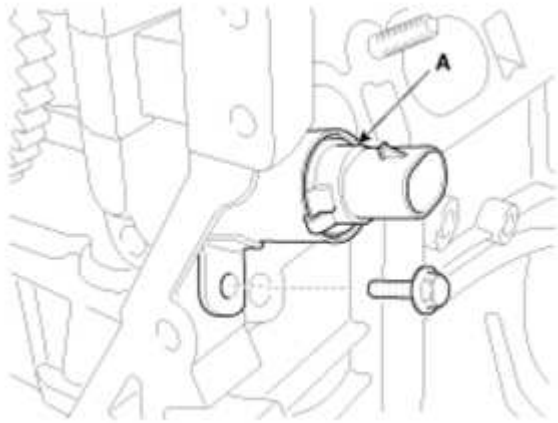


Fig. 62: Oil Control Valve
Courtesy of HYUNDAI MOTOR CO.

26. Remove the exhaust OCV (Oil control valve) (A).

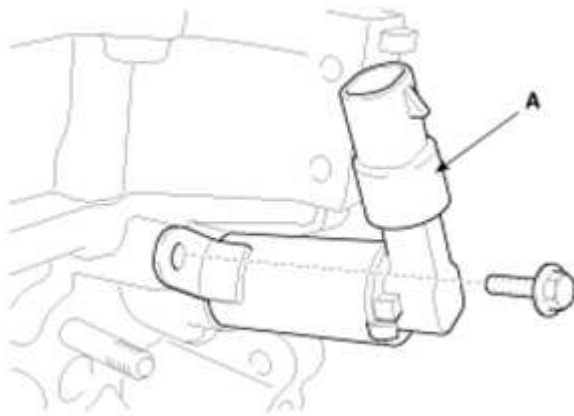


Fig. 63: Exhaust OCV
Courtesy of HYUNDAI MOTOR CO.

27. Remove the rear engine hanger (A).

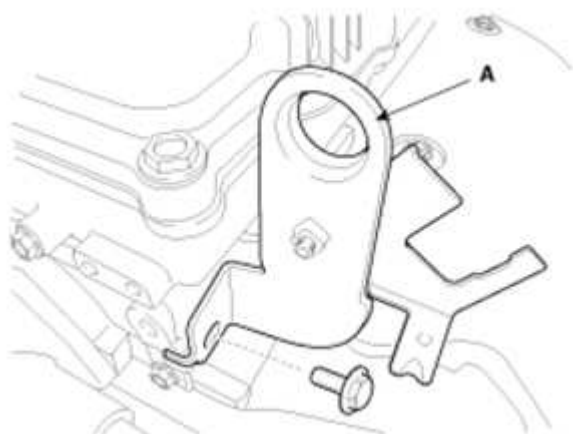


Fig. 64: Rear Engine Hanger
 Courtesy of HYUNDAI MOTOR CO.

28. Remove the spark plugs (A). (Refer to "IGNITION SYSTEM ")

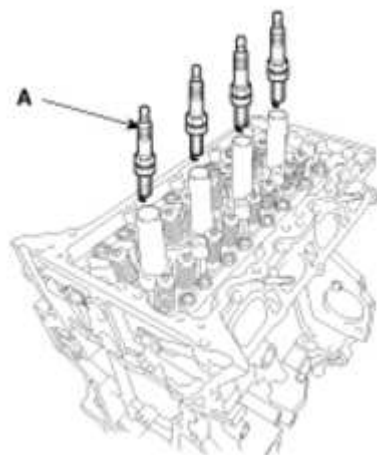


Fig. 65: Spark Plugs
 Courtesy of HYUNDAI MOTOR CO.

29. Remove the cylinder head.
 1. Using bit socket (12PT), uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence as shown in the illustration below.

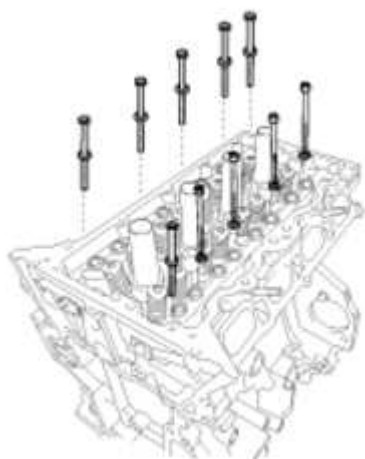


Fig. 66: Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.

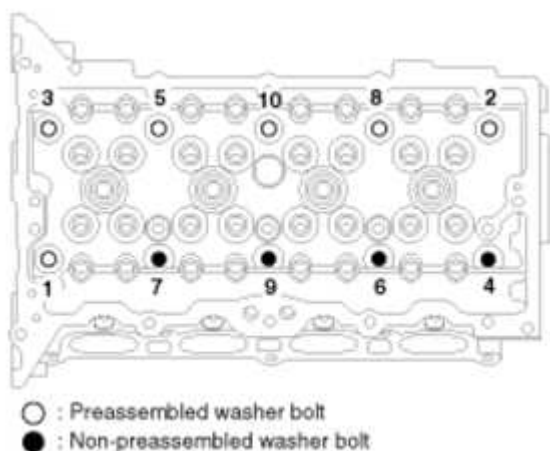


Fig. 67: Cylinder Head Bolts Loosening Sequence
Courtesy of HYUNDAI MOTOR CO.

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

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

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

3. Remove the cylinder head gasket (B).

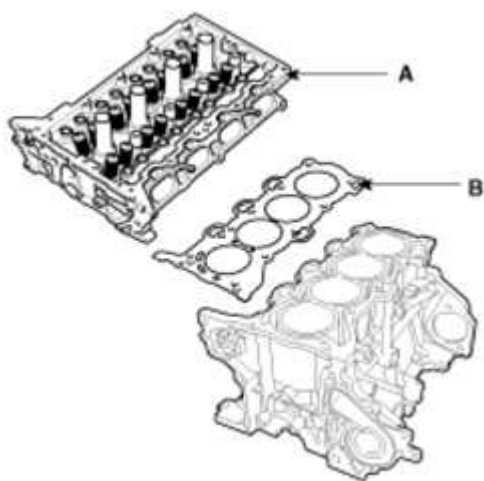


Fig. 68: Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

Disassembly

NOTE: Identify, valves and valve springs as they are removed so that each item can be reinstalled in its original position.

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

NOTE: When installing the SST, insert the front support (A) directly into the bolt hole on the cylinder head.

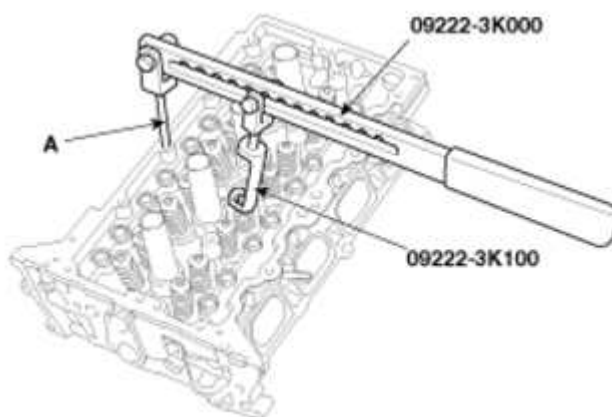


Fig. 69: Front Support
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Do not press valve retainer more than 12 mm (0.47 in.).

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

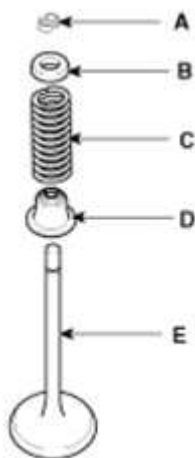


Fig. 70: Spring Retainer, Valve Spring And Valve
Courtesy of HYUNDAI MOTOR CO.

NOTE: Do not reuse the valve stem seals.

Inspection

Cylinder Head

1. Inspect for flatness.



Fig. 71: Inspecting For Flatness

Courtesy of HYUNDAI MOTOR CO.

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.)

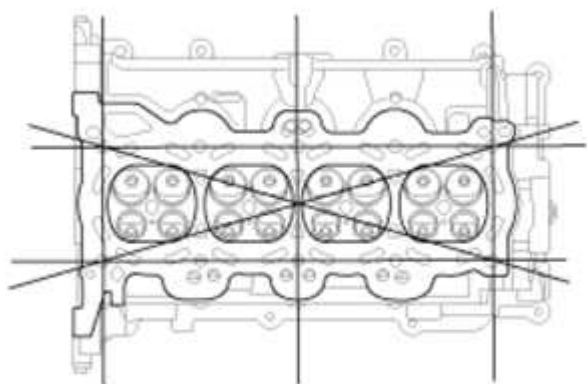


Fig. 72: Measuring Contacting Surface Of Cylinder Block And Manifolds For Warpage
Courtesy of HYUNDAI MOTOR CO.

Flatness of manifold mounting surface:

Less than 0.10 mm (0.0039 in.)

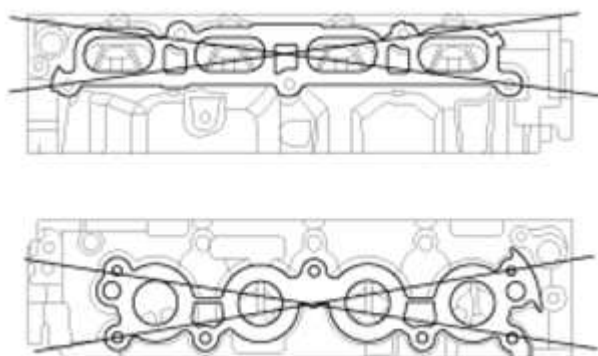


Fig. 73: Checking Flatness Of Manifold Mounting Surface
Courtesy of HYUNDAI MOTOR CO.

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: 5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)

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

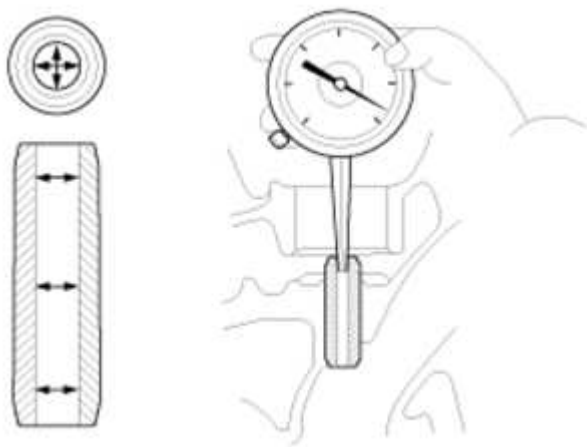


Fig. 74: Measuring Inside Diameter Of Valve Guide
Courtesy of HYUNDAI MOTOR CO.

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

Valve stem outer diameter

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

Exhaust: 5.458 ~ 5.470 mm (0.21488 ~ 0.21535 in.)

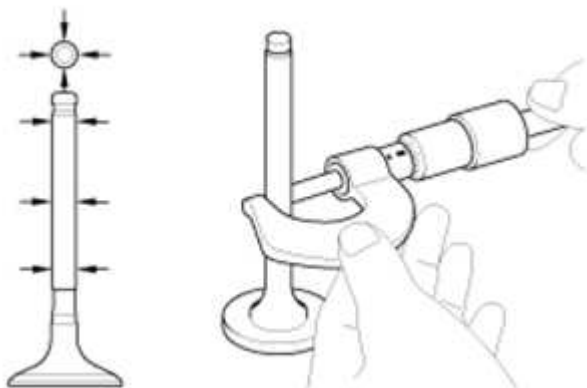


Fig. 75: Measuring Diameter Of Valve Stem
Courtesy of HYUNDAI MOTOR CO.

3. Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

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

Valve stem-to-guide clearance

[Standard]

Intake: 0.020 ~ 0.047 mm (0.00079 ~ 0.00185 in.)

Exhaust: 0.030 ~ 0.054 mm (0.00118 ~ 0.00213 in.)

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

If the valve face is worn, replace the valve.

3. Check the valve head margin thickness.

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

Margin

[Standard]

Intake: 1.30 mm (0.0512 in.)

Exhaust: 1.26 mm (0.0496 in.)

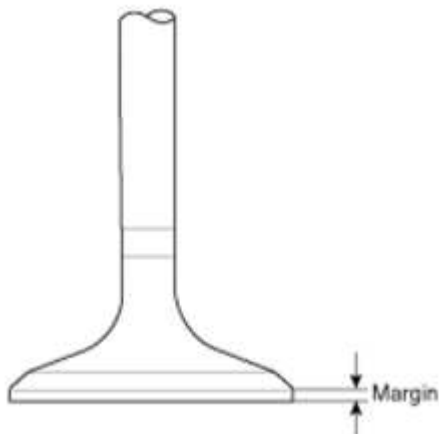


Fig. 76: Checking Valve Head Margin Thickness
Courtesy of HYUNDAI MOTOR CO.

4. Check the valve length.

Valve length

[Standard]

Intake: 102.22 mm (4.0244 in.)

Exhaust: 104.04 mm (4.0961 in.)

[Limit]

Intake: 101.97 mm (4.0146 in.)

Exhaust: 103.79 mm (4.0862 in.)

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

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

3. Inspect the valve seats and the valve guides.

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.

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

Valve spring

[Standard]

Free height: 45.93 mm (1.8083 in.)

Out-of-square: Less than 1.5°

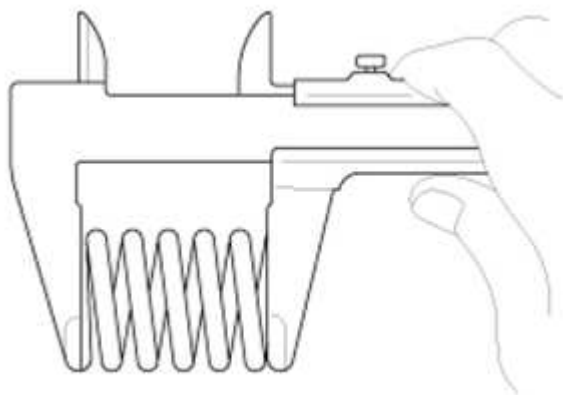


Fig. 77: Measuring Out-Of-Square Of Valve Spring
Courtesy of HYUNDAI MOTOR CO.

Camshaft

1. Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

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

Cam height

Intake: 39.0 mm (1.5354 in.)

Exhaust: 38.7 mm (1.5236 in.)



Fig. 78: Measuring Cam Lobe Height
Courtesy of HYUNDAI MOTOR CO.

2. Check the surface of the camshaft journal for wear.

If the journal is worn excessively, replace the camshaft.

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

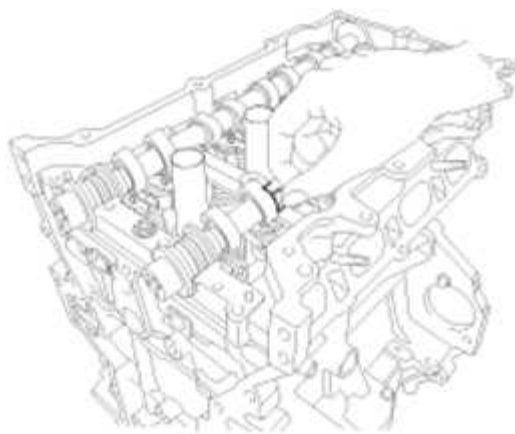


Fig. 79: Inspecting Camshaft Journal Clearance
Courtesy of HYUNDAI MOTOR CO.

4. Install the bearing caps and tighten the bolts with specified torque.

Tightening torque

M6 bolts:

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

M8 bolts:

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

CAUTION: Do not turn the camshaft.

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

If the oil clearance is greater than specification, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

Bearing oil clearance

Standard:

0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)

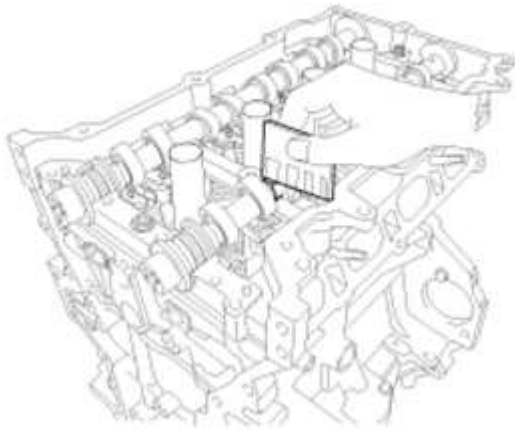


Fig. 80: Measuring Plastigage
Courtesy of HYUNDAI MOTOR CO.

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

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

If necessary, replace the bearing caps and cylinder head as a set

Camshaft end play

Standard:

0.10 ~ 0.19mm (0.0039 ~ 0.0075 in.)

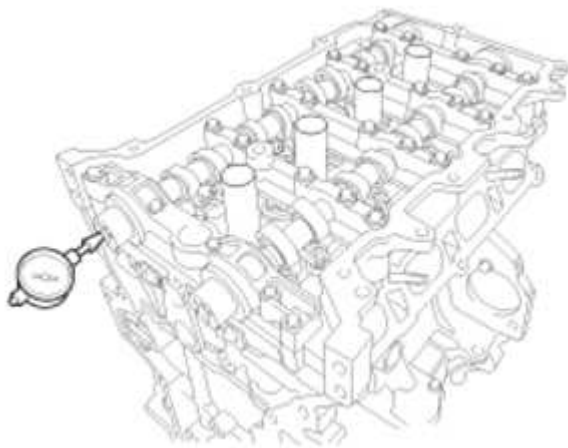


Fig. 81: Measuring End Play

Courtesy of HYUNDAI MOTOR CO.

3. Remove the camshafts.

CVVT (Continuous Variable Valve Timing) Assembly

1. Inspect CVVT assembly.

1. Fix the camshaft using a vise.

Be careful not to damage the cam lobe and journal.

2. Check that the CVVT assembly will not turn.
3. Apply vinyl tape to the retard hole like the one indicated by the arrow in the illustration.

Verify that the tape holds and put air through the port of the camshaft.

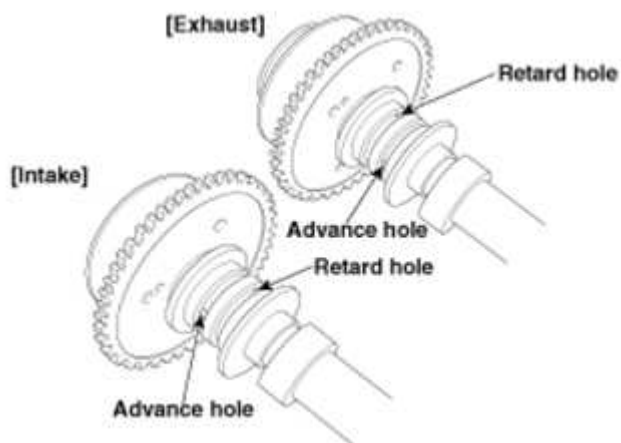


Fig. 82: Inspecting CVVT Assembly
Courtesy of HYUNDAI MOTOR CO.

4. Wind tape around the tip of the air gun and apply air of approx. 150 kPa (1.5 kgf/cm², 21 psi) to the port of the camshaft.

Perform this in order to release the lock pin for the maximum delay angle locking.

NOTE: **Wrap around it with a shop rag and the likes to prevent oil from splashing.**

5. With air applied, as in step (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

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

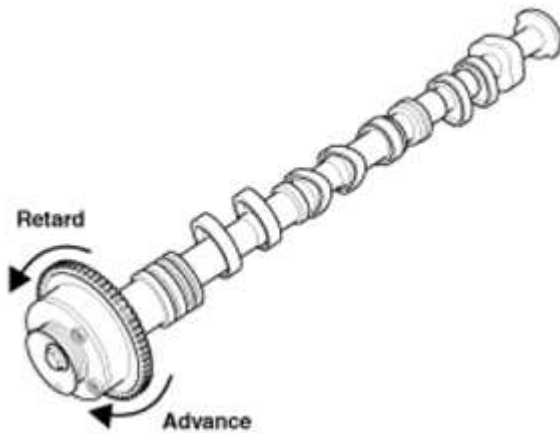


Fig. 83: Turning CVVT Assembly
Courtesy of HYUNDAI MOTOR CO.

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

Standard:

Should move smoothly in a range from about

25.0° (Intake)/20.0° (Exhaust)

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

HLA (Hydraulic Lash Adjuster)

With the HLA filled with engine oil, hold A and press B by hand.

If B moves, replace the HLA.

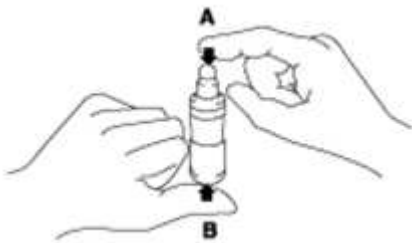


Fig. 84: Inspecting Hydraulic Lash Adjuster
Courtesy of HYUNDAI MOTOR CO.

PROBLEM SYMPTOMS

Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48 hours	Oil leakage of the high pressure chamber on the HLA, allowing air to get in	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear, refer to step 7 below.
3. Continuous noise when the engine is first started after rebuilding cylinder head	Insufficient oil in cylinder head oil gallery	
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band	<ul style="list-style-type: none"> Oil leakage of the high-pressure chamber in the HLA, allowing air to get in Insufficient oil in the HLA 	
5. Continuous noise when the engine is running after changing the HLA		CAUTION: Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.
6. Continuous noise during idle after high engine speed	Engine oil level too high or too low	<ul style="list-style-type: none"> Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed	Check oil supply system.
	Deteriorated oil	Check oil quality. If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes	Low oil pressure	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.

Reassembly

NOTE:

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

1. Install the valves.

1. Using the SST (09222-2E000), push in a new stem seal (A).

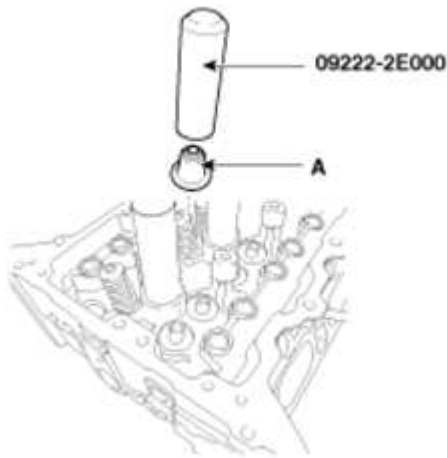


Fig. 85: Installing Stem Seal
Courtesy of HYUNDAI MOTOR CO.

NOTE:

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

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

NOTE:

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

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

Before releasing the valve spring compressor, ensure that the retainer locks are correctly in place after pushing down and releasing the compressor handle 2 ~ 3 times.

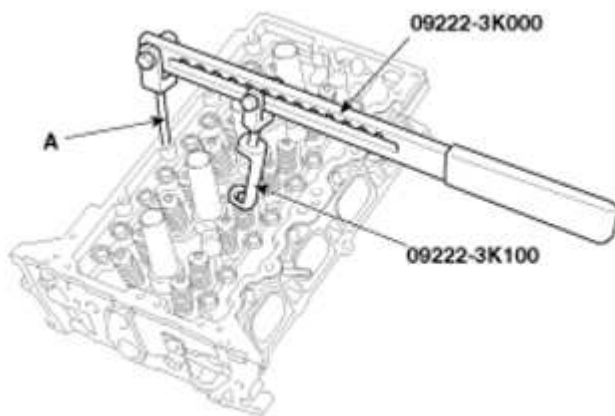


Fig. 86: Compressing Spring Using SST (09222-3K000, 09222-3K100)
Courtesy of HYUNDAI MOTOR CO.

NOTE: When installing the SST, insert the front support (A) directly into the bolt hole on the cylinder head.

CAUTION: Do not press valve retainer more than 12 mm (0.47 in.).

Installation

- NOTE:**
- Thoroughly clean all parts to be assembled.
 - Always use new cylinder head and manifold gaskets.
 - Always use new cylinder head bolts.
 - The cylinder head gasket is a metal gasket. Take care not to bend it.
 - Rotate the crankshaft to set the No. 1 piston at TDC (Top dead center) on compression stroke.

1. Install the cylinder head gasket (B) on the cylinder block.
 1. Remove hardening sealant, oil, dust, moisture and harmful foreign materials from the cylinder block and the cylinder head.
 2. Apply liquid gasket on the edge of the cylinder block.
 3. Install the cylinder head gasket with the dowel pins of the cylinder block.
 4. Apply liquid gasket on the edge of the cylinder head gasket.

NOTE: Apply liquid gasket on the edge of the cylinder block and cylinder head gasket.

Sealant: Threebond 1217H or equivalent

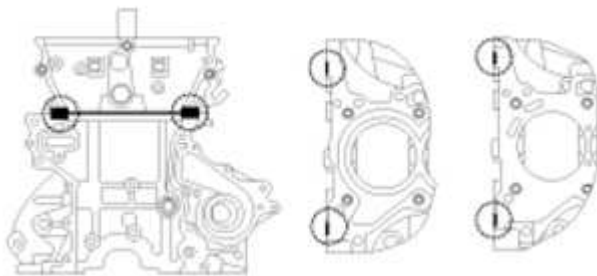


Fig. 87: Applying Liquid Gasket On Edge Of Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Assemble the cylinder head gasket and the cylinder head within 5 minutes after applying sealant.

2. Place the cylinder head (A) carefully to protect damage to the head gasket during installation.

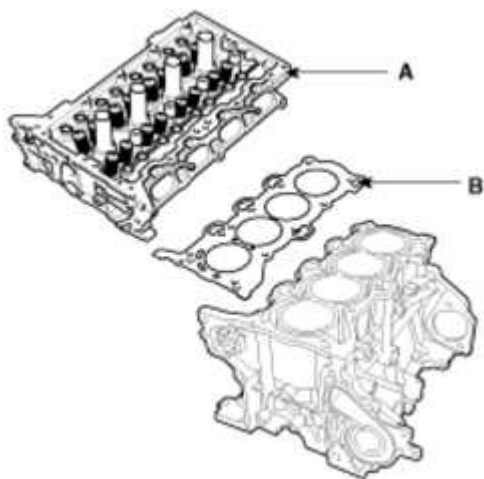


Fig. 88: Placing Cylinder Head On Head Gasket
Courtesy of HYUNDAI MOTOR CO.

3. Install the cylinder head bolts with washers.

Using SST (09221-4A000), install and tighten the 10 cylinder head bolts, in several passes, in the sequence as shown in the illustration.

Tightening torque

1st step:

32.4 ~ 36.3 N.m (3.3 ~ 3.7 kgf.m, 23.9 ~ 26.8 lb-ft)

2nd step: 90~95°

3rd step: 90~95°

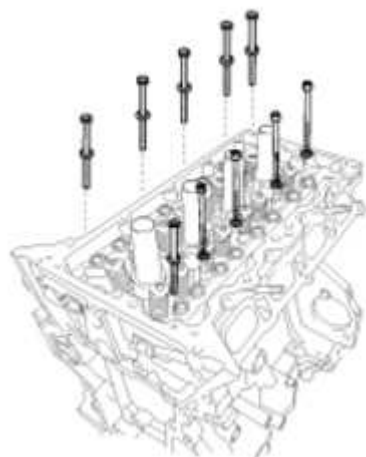


Fig. 89: Installing Cylinder Head Bolts With Washers

Courtesy of HYUNDAI MOTOR CO.

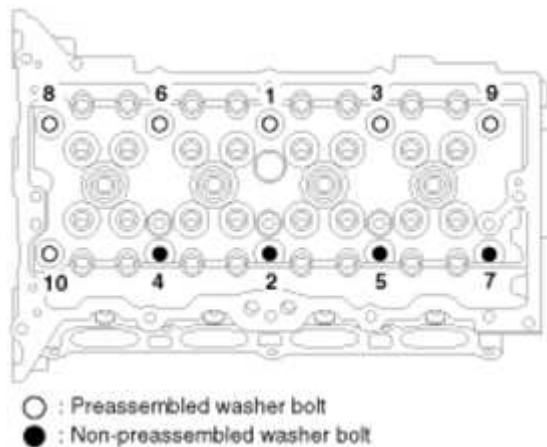


Fig. 90: Cylinder Head Bolts Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

- Do not reuse the cylinder head bolts.
- Do not apply engine oil on the bolt threads to achieve correct torque.
- Remove the extruded sealant within 5 minutes after installing cylinder head bolts.
- The engine running or pressure test should not be performed within 30 minutes after installing cylinder head bolts.
- Be careful not to change the installing position of the preassembled washer bolts and non-preassembled washer bolts.
- When installing the washer of the non-preassembled washer bolts, the round and chamfer of washers should be faced up.

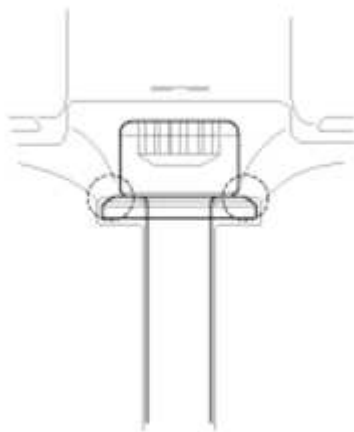


Fig. 91: Installing Washer Of Non-Preassembled Washer Bolts

Courtesy of HYUNDAI MOTOR CO.

4. Install the spark plugs (A). (Refer to "**IGNITION SYSTEM** ")

Tightening torque:

14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.1 lb-ft)

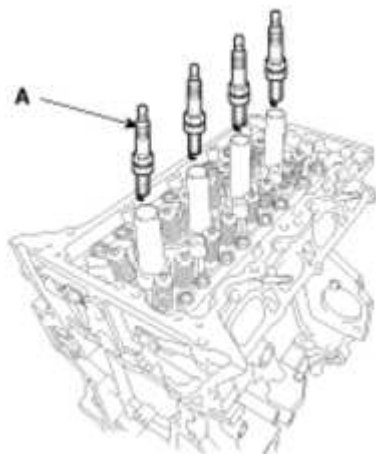


Fig. 92: Installing Spark Plugs

Courtesy of HYUNDAI MOTOR CO.

5. Install the rear engine hanger (A).

Tightening torque:

34.3 ~ 39.2 N.m (3.5 ~ 4.0 kgf.m, 25.3 ~ 28.9 lb-ft)

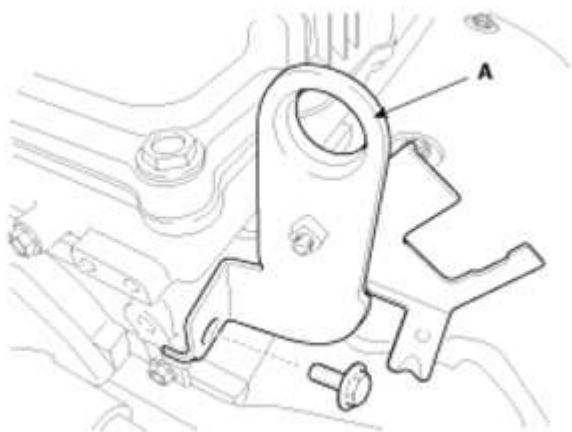


Fig. 93: Installing Rear Engine Hanger

Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque:

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

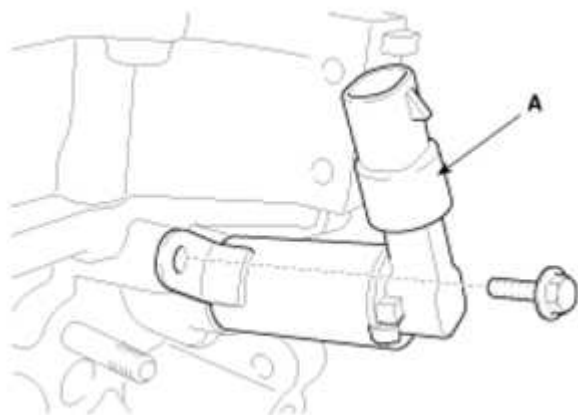


Fig. 94: Exhaust Oil Control Valve
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque:

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

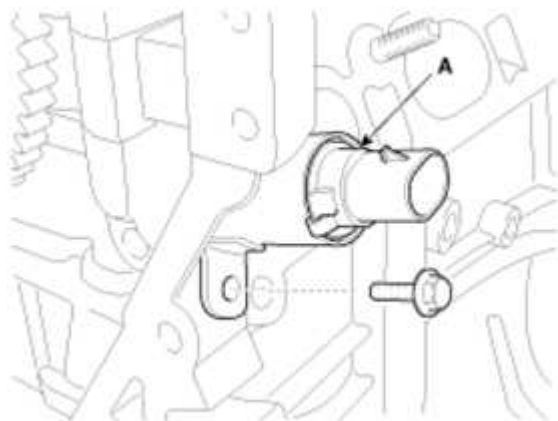


Fig. 95: Intake Oil Control Valve
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

- Do not reuse the OCV when dropped.
- Keep the OCV filter clean.
- Do not hold the OCV sleeve (A) during servicing.

- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.

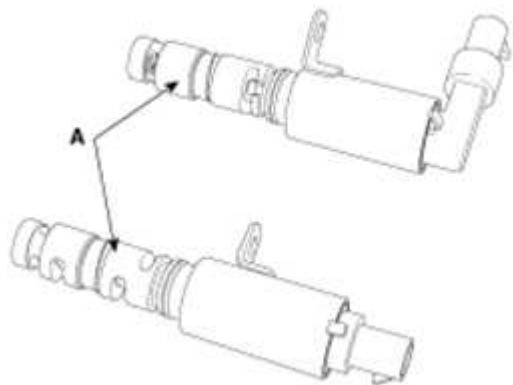


Fig. 96: OCV Sleeve
Courtesy of HYUNDAI MOTOR CO.

8. Install the oil control adapter (A) with a new gasket (B).

Tightening torque:

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

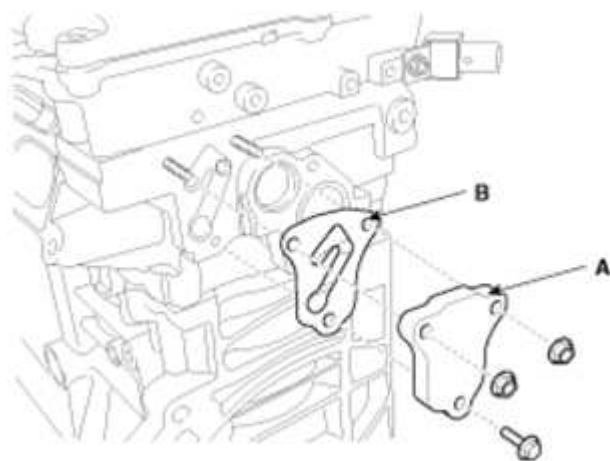


Fig. 97: Installing Oil Control Adapter With New Gasket
Courtesy of HYUNDAI MOTOR CO.

9. Install the water temperature control assembly.

(Refer to **COOLING SYSTEM**)

10. Fasten the heater pipe mounting bolts (B).

Tightening torque:

19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)

CAUTION: Do not reuse the seal bolts.

11. Connect the bypass hose (A).

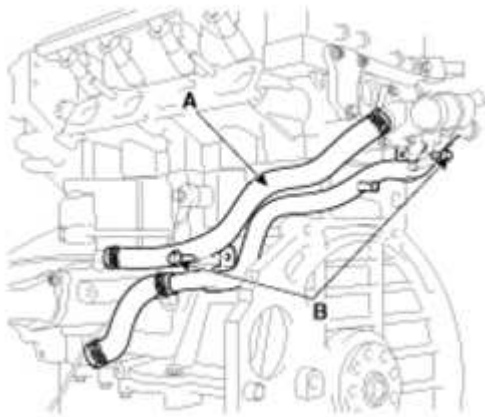


Fig. 98: Bypass Hose

Courtesy of HYUNDAI MOTOR CO.

12. Install the HLA (Hydraulic lash adjuster) (A) and the swing arm (B).

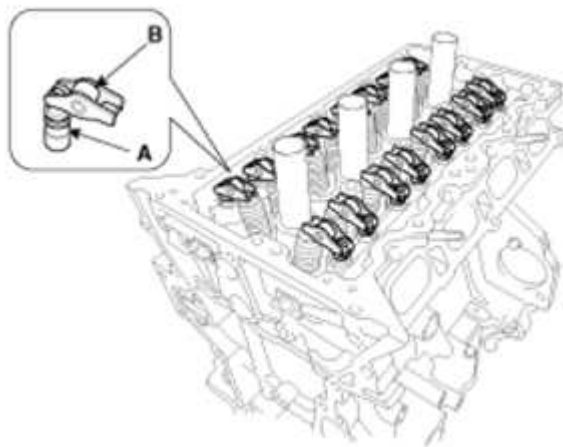


Fig. 99: Hydraulic Lash Adjuster

Courtesy of HYUNDAI MOTOR CO.

1. When installing HLA, it should be held upright so that engine oil in HLA may not spill and assured that dust does not adhere to HLA.
2. HLA should be inserted carefully to the cylinder head not to spill engine oil.

CAUTION: In case of spilling, air bleed should be done in accordance with the air bleed procedure. Stroke HLA in diesel oil 4 ~ 5 times by pushing its cap while pushing the ball down slightly with a hard steel wire. (Take care not to severely push a hard steel wire down since ball is several grams.)

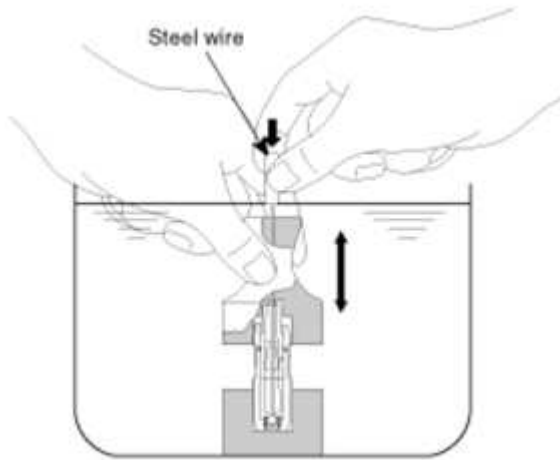


Fig. 100: Checking HLA
Courtesy of HYUNDAI MOTOR CO.

13. Install the cam carrier.
 1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. The sealant locations on the cam carrier and the cylinder head must be free of harmful foreign materials, oil, dust and moisture. Spray cleaner on the surface and wipe with a clean duster.
 3. After applying liquid sealant on the bottom surface of the cam carrier, assemble the cam carrier. Continuous bead of sealant should be applied to prevent any path from oil leakage.

Bead width: 2.5 ~ 3.5 mm (0.10 ~ 0.14 in.)

Sealant: Threebond 1217H or equivalent

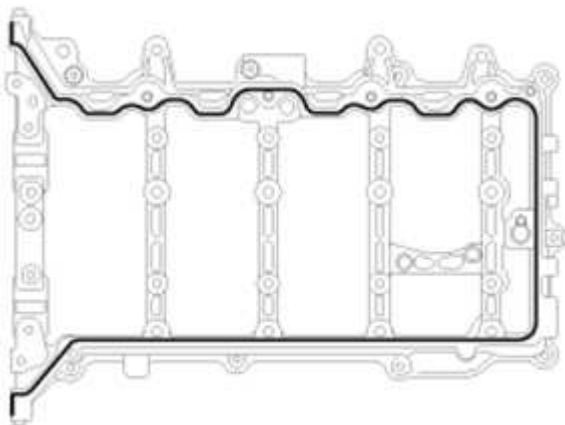


Fig. 101: Liquid Sealant Apply Area
Courtesy of HYUNDAI MOTOR CO.

4. Place the cam carrier (A) on the cylinder head. 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.
5. Fasten the cam carrier bolts.

Tightening torque:

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

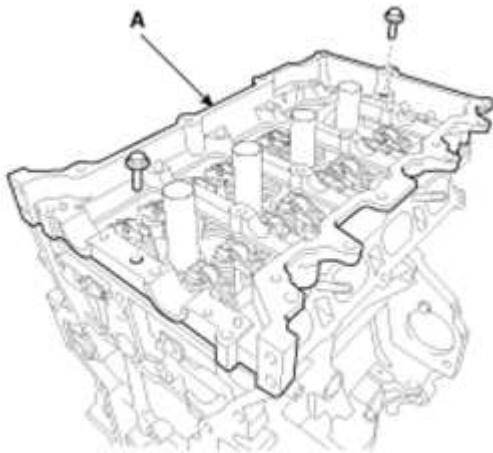


Fig. 102: Placing Cam Carrier On Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

- 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.

14. Install the camshafts.

1. Place the intake and exhaust camshafts (A) on the cam carrier.

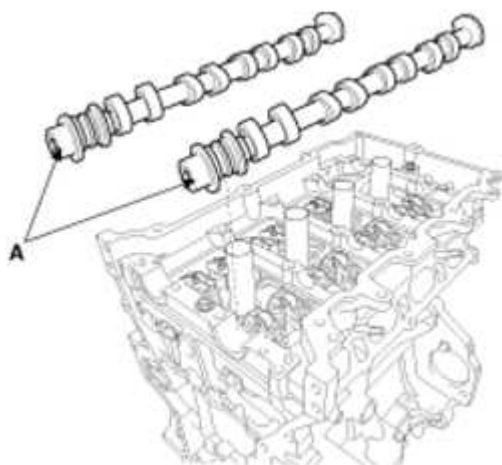


Fig. 103: Intake And Exhaust Camshafts
Courtesy of HYUNDAI MOTOR CO.

2. Install the camshaft bearing cap (A).

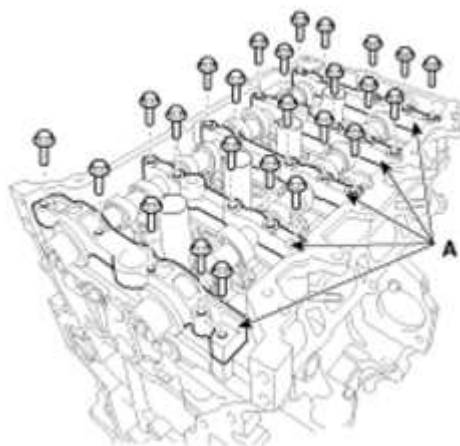


Fig. 104: Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

Tighten the bolts, in several passes, in the sequence as shown in the illustration.

Tightening torque

M6 bolts:

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

M8 bolts:

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

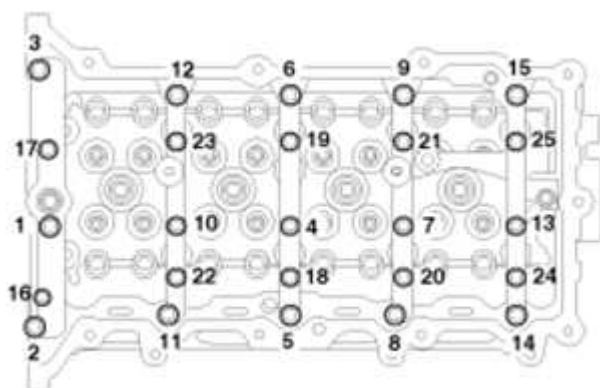


Fig. 105: Camshaft Bearing Cap Bolts Tightening Sequence
 Courtesy of HYUNDAI MOTOR CO.

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

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

Tightening torque:

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

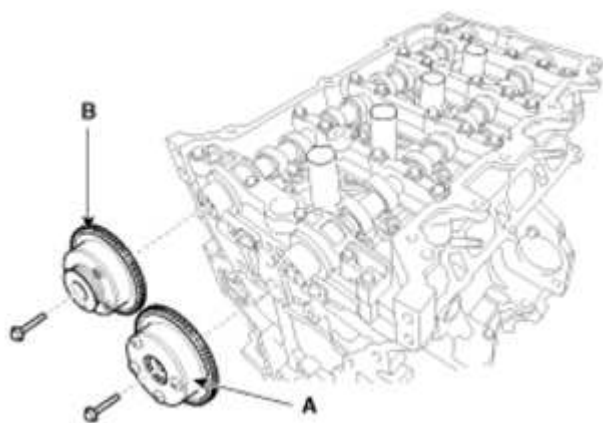


Fig. 106: Intake CVVT Assembly
 Courtesy of HYUNDAI MOTOR CO.

NOTE: When removing the CVVT assembly bolt, hold the camshaft with a wrench to prevent the camshaft from rotating.

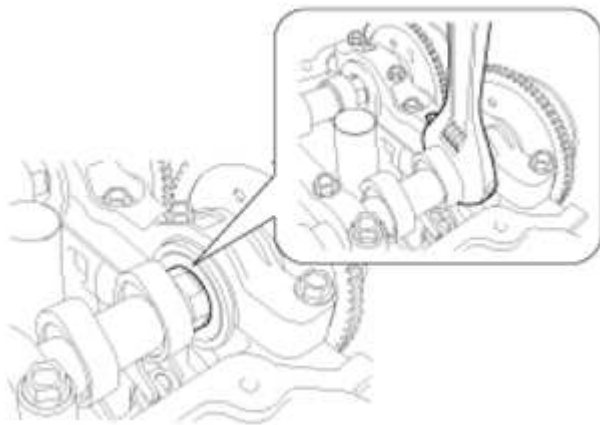


Fig. 107: Holding Camshaft
 Courtesy of HYUNDAI MOTOR CO.

16. Install the PCSV bracket (A).

Tightening torque:

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



Fig. 108: PCSV Bracket
 Courtesy of HYUNDAI MOTOR CO.

17. Install the condenser (A).

Tightening torque:

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

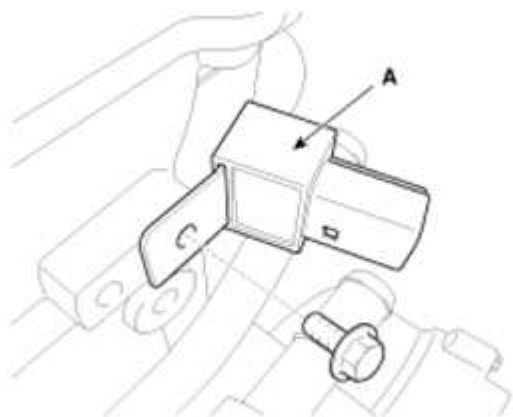


Fig. 109: Condenser

Courtesy of HYUNDAI MOTOR CO.

18. Install the vacuum pipe (A).

Tightening torque:

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

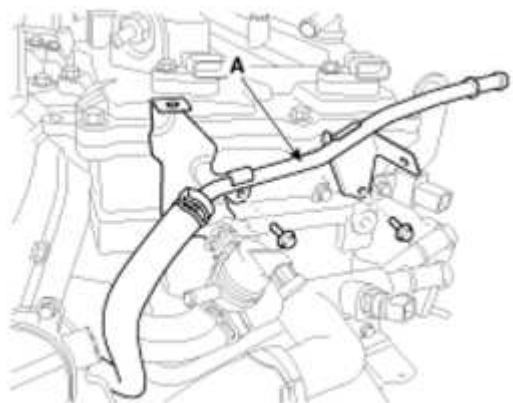


Fig. 110: Vacuum Pipe

Courtesy of HYUNDAI MOTOR CO.

19. Install the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover. (Refer to **TIMING SYSTEM**)
20. Install the intake and exhaust manifold.

(Refer to **INTAKE AND EXHAUST SYSTEM**)

21. Install the injector & rail assembly (A). (Refer to "**INJECTOR** ")

Tightening torque:

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

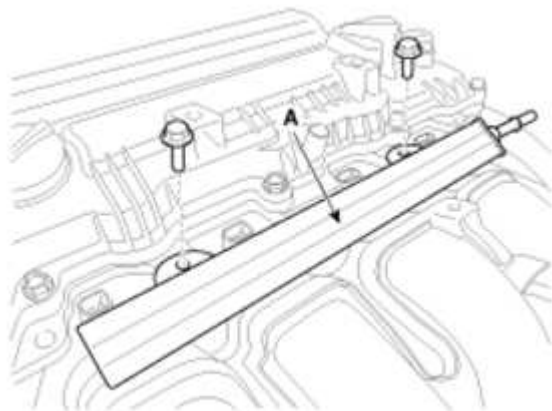


Fig. 111: Injector & Rail Assembly
Courtesy of HYUNDAI MOTOR CO.

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

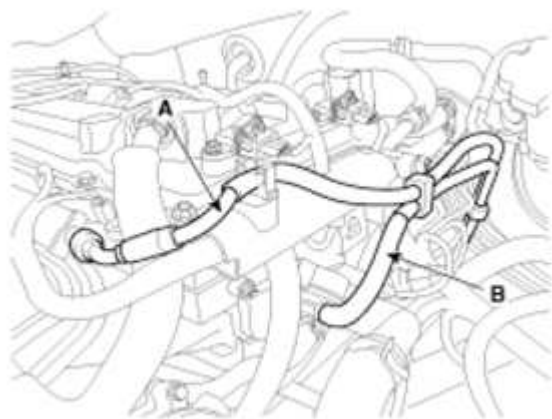


Fig. 112: Fuel Hose
Courtesy of HYUNDAI MOTOR CO.

23. Connect the brake booster vacuum hose (A) and the heater hoses (B).

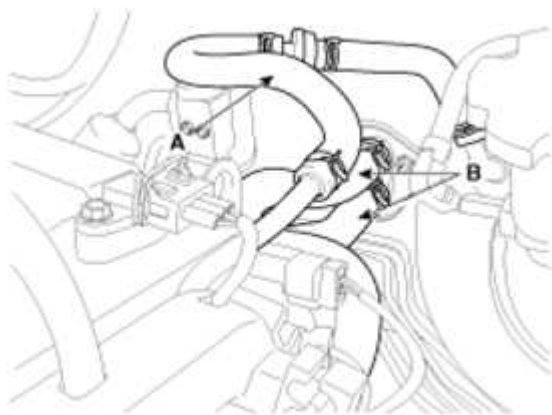


Fig. 113: Brake Booster Vacuum Hose
Courtesy of HYUNDAI MOTOR CO.

NOTE: When installing the heater hoses, install as shown in the illustrations.



Fig. 114: Heater Hoses
Courtesy of HYUNDAI MOTOR CO.

24. Install the wiring and protectors on the cylinder head and the intake manifold and then connect the wiring connectors and harness clamps.
 1. The intake OCV (Oil control valve) connector (A)

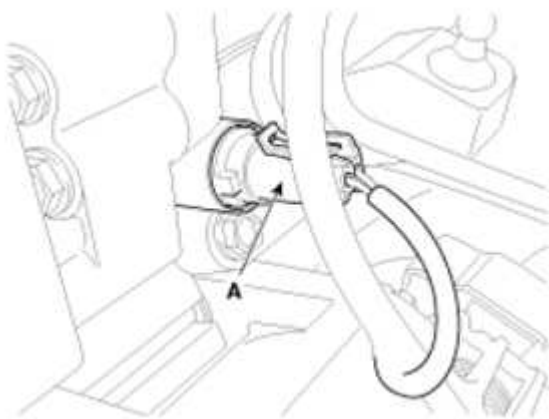


Fig. 115: Intake OCV Connector
Courtesy of HYUNDAI MOTOR CO.

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

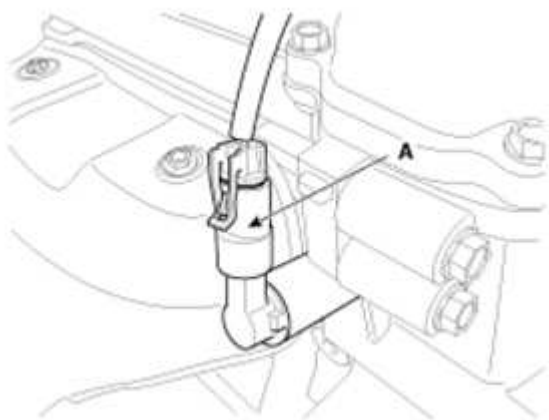


Fig. 116: Exhaust OCV Connector
Courtesy of HYUNDAI MOTOR CO.

3. The alternator connector (A)

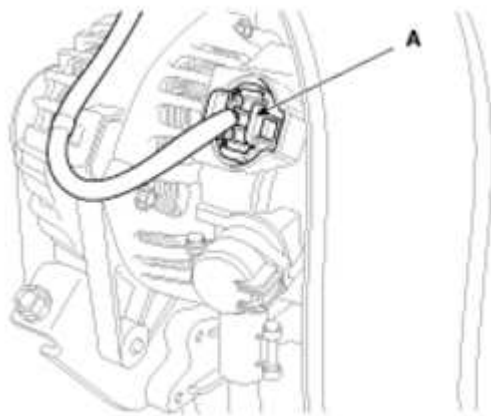


Fig. 117: Alternator Connector
Courtesy of HYUNDAI MOTOR CO.

4. The ignition coil connectors (A)

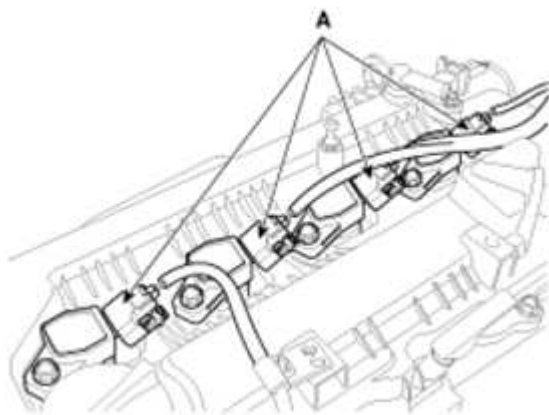


Fig. 118: Ignition Coil Connectors
Courtesy of HYUNDAI MOTOR CO.

5. The intake CMPS (Camshaft position sensor) connector (A)
6. The exhaust CMPS (Camshaft position sensor) connector (B)

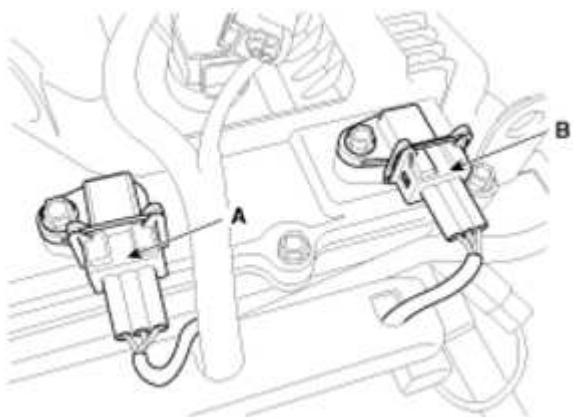


Fig. 119: CMPS Connectors
Courtesy of HYUNDAI MOTOR CO.

7. The injector connectors (A)

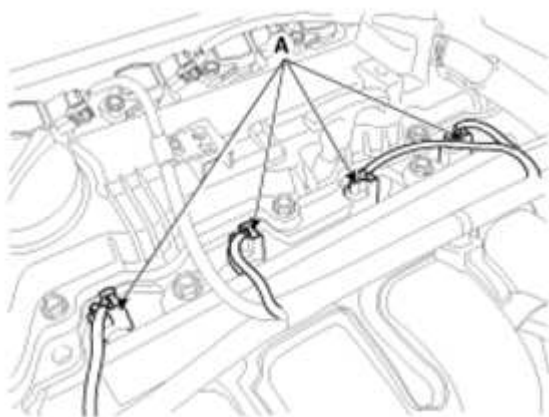


Fig. 120: Injector Connectors
Courtesy of HYUNDAI MOTOR CO.

8. The front and/or rear HO2S (Heated oxygen sensor connectors (A))

[ULEV]

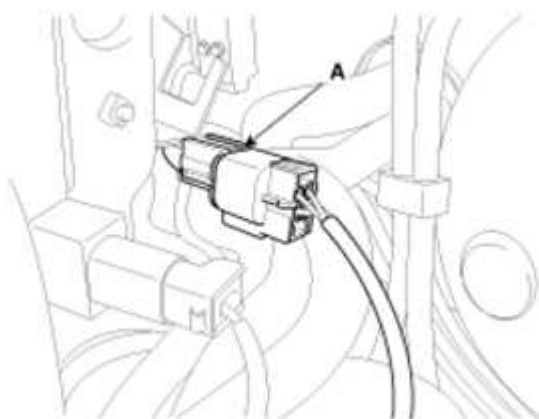


Fig. 121: Heated Oxygen Sensor Connectors (ULEV)
Courtesy of HYUNDAI MOTOR CO.

[SULEV]

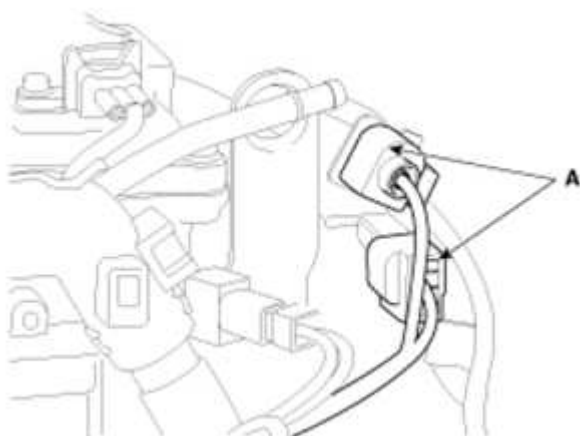


Fig. 122: Heated Oxygen Sensor Connectors (SULEV)
Courtesy of HYUNDAI MOTOR CO.

9. The condenser connector (A)

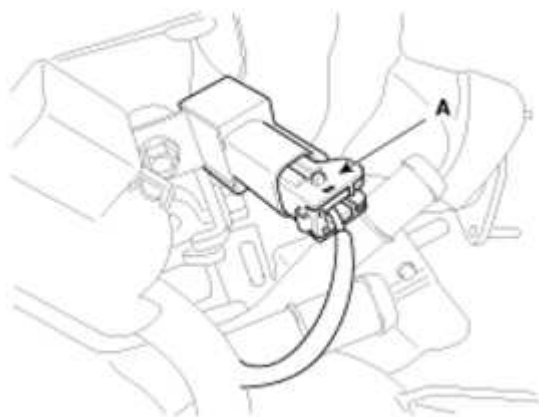


Fig. 123: Condenser Connector
Courtesy of HYUNDAI MOTOR CO.

10. The PCSV (Purge control solenoid valve) connector (A)

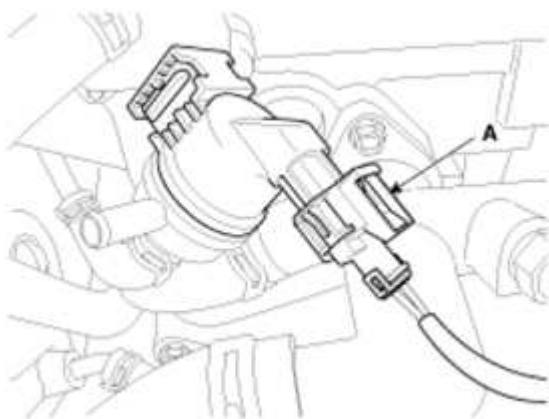


Fig. 124: Purge Control Solenoid Valve Connector
Courtesy of HYUNDAI MOTOR CO.

11. The ECTS (Engine coolant temperature sensor) connector (A)

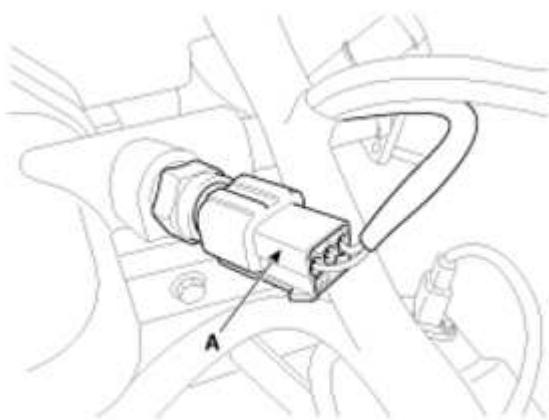


Fig. 125: Engine Coolant Temperature Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

12. The VIS (Variable Intake System) connector (A)

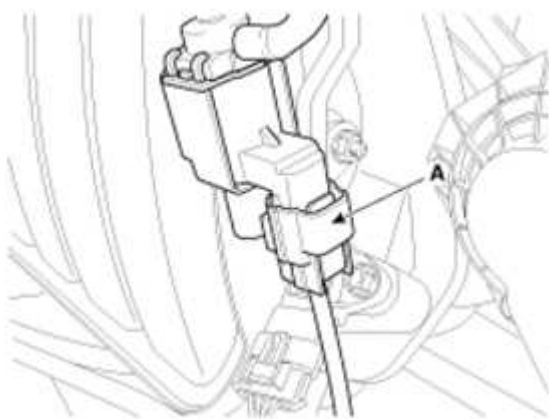


Fig. 126: Variable Intake System Connector
Courtesy of HYUNDAI MOTOR CO.

13. The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)

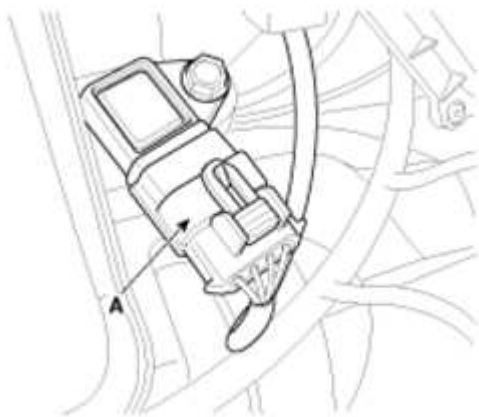


Fig. 127: MAPS Connector
Courtesy of HYUNDAI MOTOR CO.

14. The ETC (Electronic throttle control) connector (A)

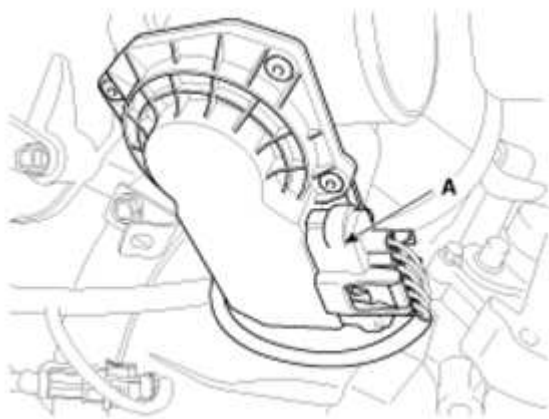


Fig. 128: Electronic Throttle Control Connector
Courtesy of HYUNDAI MOTOR CO.

15. The VCMA (Variable charge motion actuator) connector (A)

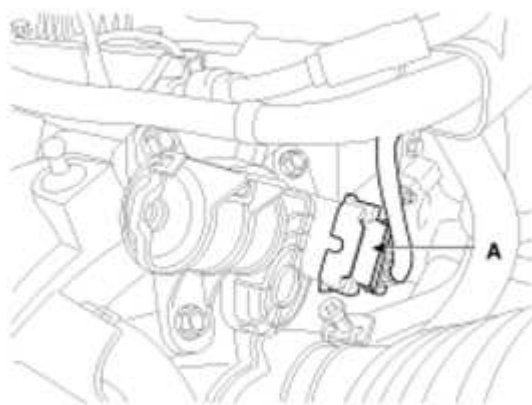


Fig. 129: VCMA Connector

Courtesy of HYUNDAI MOTOR CO.

25. Connect the radiator upper hose and lower hose. (Refer to **COOLING SYSTEM**)
26. Install the air duct and the air cleaner assembly. (Refer to **INTAKE AND EXHAUST SYSTEM**)
27. Install the engine cover. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY**)
28. Install the RH under cover. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY**)
29. Install the RH front wheel. (Refer to **"WHEEL "**)
30. Connect the battery negative terminal. (Refer to **ENGINE AND TRANSAXLE ASSEMBLY**)
31. Add all the necessary fluids and check for leaks.

Connect GDS. Check for codes, note, and clear. Recheck.

NOTE:

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