ENGINE ASSEMBLY

**1118-01/1121-01/1130-01/1130-12/1130-13/1130-18/
1130-33/1211-01/1211-26/1221-01/1221-21/1311-01/
1339-01/1350-01/1990-00/**

GENERAL INFORMATION

1. SPECIFICATIONS..... 3
2. TIGHTENING TORQUE..... 4
3. PRECAUTIONS..... 7

OVERVIEW AND OPERATING PROCESS

1. APPEARANCE..... 9

CONFIGURATION AND FUNCTIONS

1350-01 BELT SYSTEM..... 11
1990-00 ENGINE MOUNTING ASSEMBLY..... 14
1221-01 CYLINDER HEAD COVER..... 16
1339-01 TIMING GEAR CASE COVER..... 18
1311-01 CHAIN DRIVE SYSTEM..... 20
1221-21 CAMSHAFT ASSEMBLY..... 26
1211-01 CYLINDER HEAD ASSEMBLY..... 31
1211-26 VALVE SYSTEM..... 35
1121-01 CYLINDER BLOCK ASSEMBLY... 37
1130-01 CRANKSHAFT..... 43
1130-33 PISTON ASSEMBLY..... 45
1130-18 DRIVE PLATE..... 48
1130-13 FLYWHEEL..... 49

REMOVAL AND INSTALLATION

0000-00 CHECK AND INSPECTION..... 50
1350-01 BELT SYSTEM..... 60
1130-12 CRANKSHAFT PULLEY..... 64
1990-00 ENGINE MOUNTING ASSEMBLY..... 67
1221-01 CYLINDER HEAD COVER..... 73
1339-01 TIMING GEAR CASE COVER..... 77
1311-01 ENGINE TIMING CHAIN..... 84
1221-21 CAMSHAFT ASSEMBLY..... 97
1211-01 CYLINDER HEAD ASSEMBLY..... 107
1130-18 DRIVE PLATE(FOR A VEHICLE WITH A/T)..... 126
1130-13 FLYWHEEL(FOR A VEHICLE WITH M/T)..... 129
1118-01 ENGINE ASSEMBLY..... 132
1118-01 ENGINE ASSEMBLY OVERHAUL..... 142

ENGINE ASSEMBLY

1118-01

GENERAL INFORMATION

1. SPECIFICATIONS

Category	Items		Specified value	Remarks
Cylinder head	Cylinder head height		132 ± 0.1 mm	
	Cylinder head weight		11.5 kg	
	Bottom (combustion chamber surface) flatness	All	0.075 mm	
		Range	0.05 mm (100 x 100 mm)	
	Spark plug installation angle		8° to intake side	
	Head gasket thickness		0.55 mm	
Camshaft	Camshaft axial end play	Intake side	0.08 to 0.18 mm	
		Exhaust side		
Connecting rod	End play		0.100 to 0.300 mm	
Cylinder block assembly	Weight		21.5 kg	-
	Bore		Ø76 mm	
	Stroke		Ø88 mm	
	Bore pitch		85 mm	
	Bed plate height		63.5 mm	
	Cylinder block + Bed plate height		274.36 mm (210.86 mm to 63.5 mm)	
Crankshaft	Crankshaft axial end play		0.100 to 0.266 mm	
Piston ring	End gap	No. 1 compression ring	0.15 to 0.30 mm	
		No. 2 compression ring	0.30 to 0.50 mm	
		No. 3 oil ring	0.20 to 0.70 mm	

Modification basis	
Application basis	
Affected VIN	

2. TIGHTENING TORQUE

Components	Tool dimensions	Bolt quantity	Specified torque (Nm)	Remarks
Belt tensioner	17 mm	1	61 ± 2.0 Nm	-
Crankshaft pulley	27 mm	1	220 Nm 90°	
Engine ground cable	10 mm	2	10 ± 1.0 Nm	
Alternator	15 mm	1	61 ± 6.1 Nm	
	17 mm	1		
A/C compressor	13 mm	4	25 ± 2.5 Nm	
Water pump pulley	10 mm	3	10 ± 1.0 Nm	
Water pump	5 mm hexagon wrench	5	10 ± 1.0 Nm	
Exhaust manifold heat protector	10 mm	4	10 ± 1.0 Nm	
Exhaust manifold	12 mm	7	40 ± 5.0 Nm	Non-reusable
	13 mm	3	25 ± 2.5 Nm	-
TOC coolant return pipe (vehicle with A/T)	10 mm	2	10 ± 1.0 Nm	
Coolant return pipe (vehicle with M/T)	10 mm	3	10 ± 1.0 Nm	
TOC coolant supply pipe (vehicle with A/T)	10 mm	2	10 ± 1.0 Nm	
Cylinder head outlet port	10 mm	2	10 ± 1.0 Nm	
Cylinder block outlet port	5 mm hexagon wrench	2	10 ± 1.0 Nm	
Oil filter module	13 mm	1	25 ± 2.5 Nm	Bolt length: 60 mm
		1		Bolt length: 105 mm
		3		Bolt length: 40 mm
Thermostat	5 mm hexagon wrench	2	10 ± 1.0 Nm	-
Electronic throttle body	10 mm	4	10 ± 1.0 Nm	
Fuel rail	13 mm	2	25 ± 2.5 Nm	
Intake manifold	13 mm	3 bolts 1 nut	25 ± 2.5 Nm	

Modification basis	
Application basis	
Affected VIN	

Components	Tool dimensions	Bolt Quantity	Specified torque (Nm)	Remarks
Knock sensor	13 mm	1	20 ± 5.0 Nm	-
OCV	8 mm	2	8 ± 1.0 Nm	
Cam position sensor	10 mm	2	10 ± 1.0 Nm	
Ignition coil	10 mm	4	10 ± 1.0 Nm	
Spark plug	16 mm	4	20 ± 2.5 Nm	
Cylinder head cover	10 mm	16	10 ± 1.0 Nm	
Cylinder head	E16	10	30 ± 3.0 Nm 90° X 2 times	Non-reusable
Camshaft sprocket	M14 (12-point bit socket)	2	110 ± 10 Nm	
Camshaft front bearing cap	10 mm	4	10 ± 1.0 Nm	
Camshaft bearing cap	10 mm	16	10 ± 1.0 Nm	
Oil pan	10 mm	2	10 ± 1.0 Nm	Bolt length: 115 mm
		2	10 ± 1.0 Nm	Bolt length: 105 mm
		16	10 ± 1.0 Nm	Bolt length: 25 mm
	13 mm	2	25 ± 2.5 Nm	Bolt length: 80 mm
Timing gear case cover	15 mm	4	58 ± 5.8 Nm	Bolt length: 80 mm
		1	58 ± 5.8 Nm	Bolt length: 50 mm
	13 mm	1	25 ± 2.5 Nm	Bolt length: 45 mm
		9	25 ± 2.5 Nm	Bolt length: 30 mm
Timing chain tensioner	5 mm hexagon wrench	2	10 ± 1.0 Nm	-
Tensioner rail	T40	1	25 ± 2.5 Nm	
Guide rail	T40	3	25 ± 2.5 Nm	
Sliding upper rail	5 mm hexagon wrench	2	10 ± 1.0 Nm	
Baffle plate	10 mm	6	10 ± 1.0 Nm	
Oil pump chain tensioner	T40	1	25 ± 2.5 Nm	
VOP extension wiring	5 mm hexagon wrench	1	10 ± 1.0 Nm	

Components	Tool dimensions	Bolt Quantity	Specified torque (Nm)	Remarks
Oil pump	6 mm hexagon	4	25 ± 2.5 Nm	-
Connecting rod cap	12 point socket 8 mm	8	20 ± 5.0 Nm 80° + 10°	
Crankshaft position sensor	5 mm hexagon wrench	1	5 ± 1.0 Nm	
Drive plate	T55	8	45 ± 5.0 Nm 45° ± 5°	Non-reusable
Crankshaft rear seal	10 mm	7	10 ± 1.0 Nm	-
Bed plate	E10	10	25 ± 5.0 Nm	Non-reusable
Main journal	12 point socket 13 mm	10	55 ± 5.0 Nm 100° ± 5°	
Starting motor	14 mm	2	45 ± 5.0 Nm	-
Oil filter	Oil filter installation/ removal cup	-	12 to 16 Nm	
Cylinder block coolant screw plug	19 mm	1	30 Nm	
Flywheel	T55	8	45 ± 5.0 Nm 90° ± 5°	Non-reusable

Modification basis	
Application basis	
Affected VIN	

3. PRECAUTIONS

1) When Lifting the Vehicle

- Pay close attention to the safety precautions when lifting the vehicle on a jack lift as the vehicle might slip off the jack lift.
- When working with a 4-column vehicle lift, use the center of the vehicle as a support point and chock the wheels to prevent the vehicle from rolling.
- When work with a 2-column vehicle lift, use the jack point as a support point.
- Take care not to spill the battery electrolyte and wear protective clothing when handling the battery.

2) When Working on the Exhaust System

- Wear protective gloves when removing the exhaust pipe.
- Make sure that the exhaust pipe has sufficiently cooled down before working on the exhaust pipe, because the temperature of the exhaust pipe is very hot right after the engine has been stopped.

3) When Working on the Fuel System

- Disconnect the negative battery terminal and prepare the service plug grip before working on the fuel system.
- Do not smoke and avoid flames nearby when working on the fuel system.
- Keep gasoline away from the parts made of rubber or leather.
- Be sure to avoid sputtering of the fuel when removing the pipe between the high-pressure side fuel pump and the fuel injector.
- Never remove any part of the fuel system before releasing the pressure in the fuel system.
- Even after the fuel pressure has been released, wrap a cloth or equivalent around the mountings to reduce the potential risk of fuel sputtering to a worker or engine compartment.
- Let the engine is cooled down sufficiently before proceeding to the next procedure since the fuel pressure on the high-pressure side will not drop until the engine is cooled down.

4) When Working on the Cooling System

- Do not remove the radiator reservoir cap while the engine or radiator is hot since high-pressure hot coolant or steam may cause severe burn.

5) When Working on the Lubrication System

- Repeated contact with the engine oil for an extended period of time may cause skin irritation.
- Take special care when changing the engine oil to minimize possible skin contact with the used engine oil because hazardous materials that may cause skin cancer are contained in the used engine oil.
- Always wear the oil-resistant protective clothing and gloves when handling the engine oil, and completely remove the used engine oil from the skin with a lot of water or waterless hand cleaner. Never use gasoline, dilute solution or solvent to wash your skin.
- Discard the used oil and used oil filter only in the designated area to protect environment.

6) When Tightening Bolts

Angle tighten the components of engine in a so-called final tightening operation. The tightening procedure is as follows:

① Clean the contact surface and threads before tightening bolts and nuts.
② When angle tightening without a torque wrench tighten the bolt to the specified angle, marking its position. (paint mark to assist the work)

NOTE

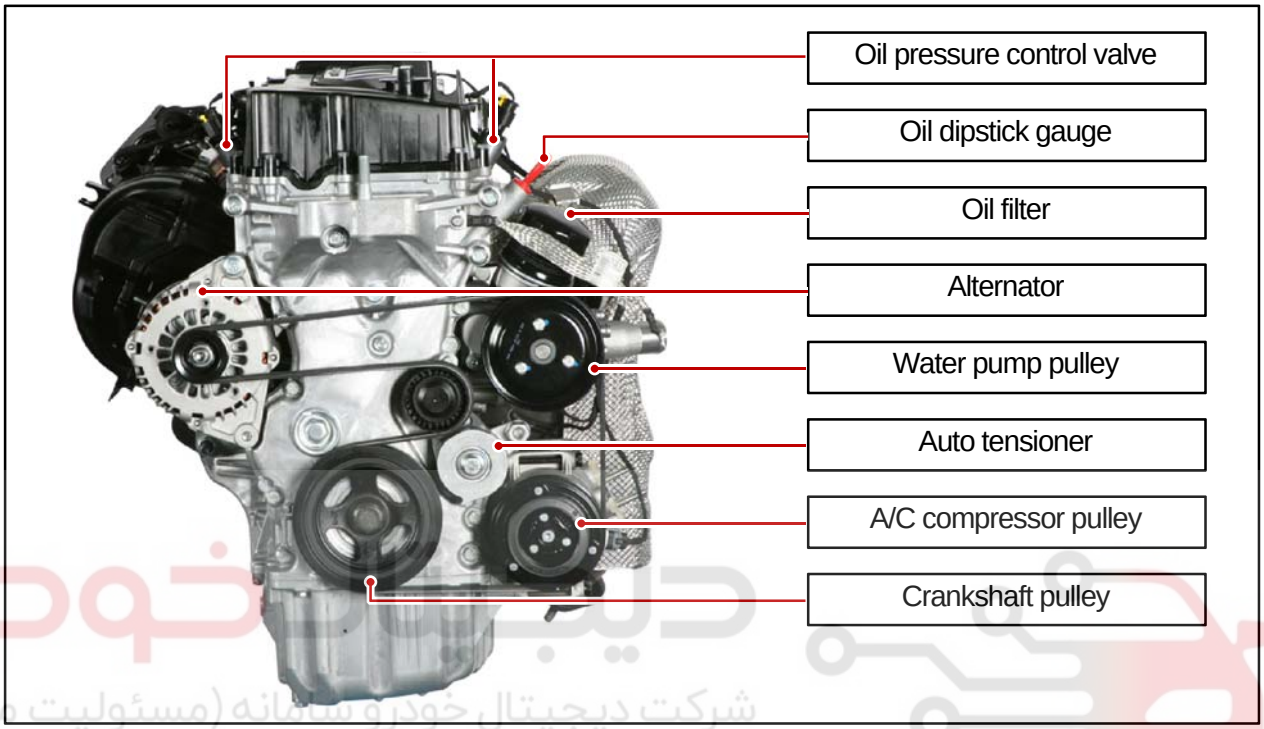
The location and left/right position of components are based on the direction when viewed from the rear side.
The cylinder block is made of aluminum and can be deformed and broken easily when excessive force is applied. Therefore, always observe the specified torque when tightening the cylinder block to prevent its thread from being damaged.
Do not over-tighten a self tapping screw bolt as it creates threads itself.
Never reuse the used bolt if it is a angle-tightened one.
(However, a bolt with specified reuse number with the specified torque is reusable.)

Modification basis	
Application basis	
Affected VIN	

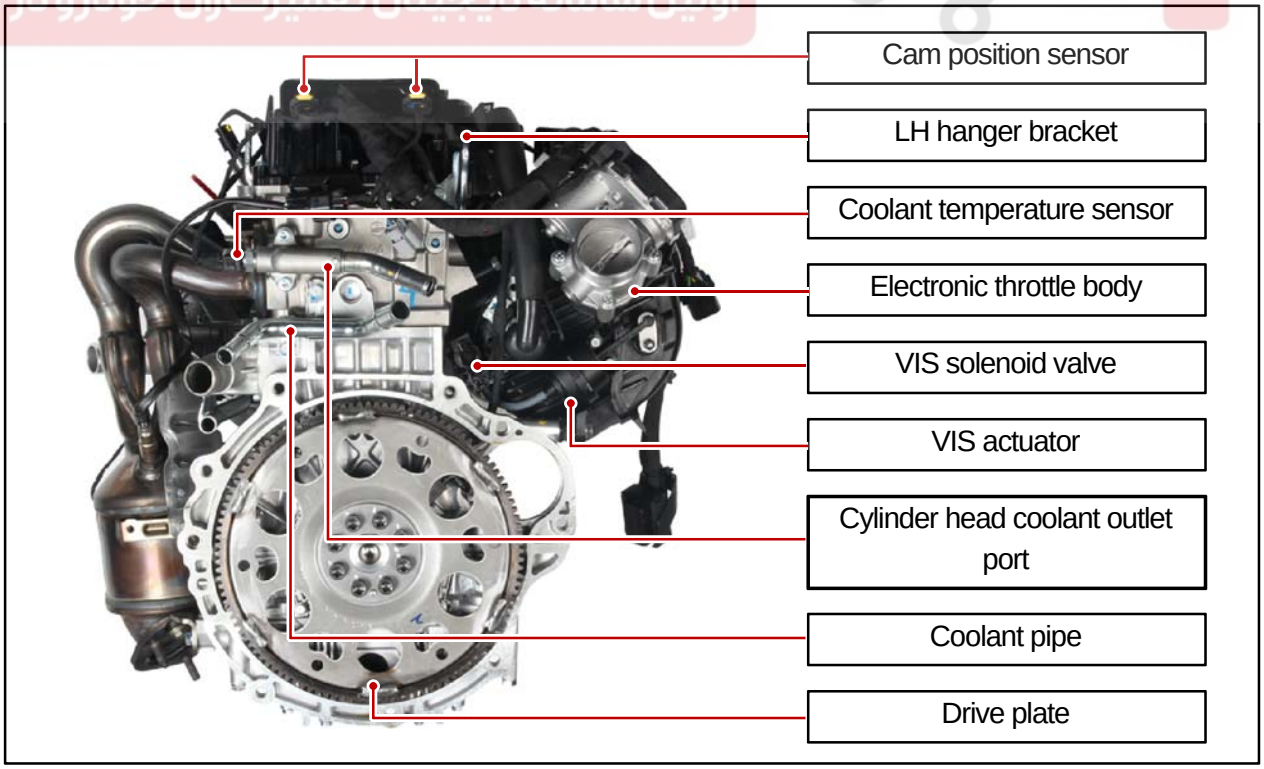
OVERVIEW AND OPERATING PROCESS

1. APPEARANCE

▶ **Front view**

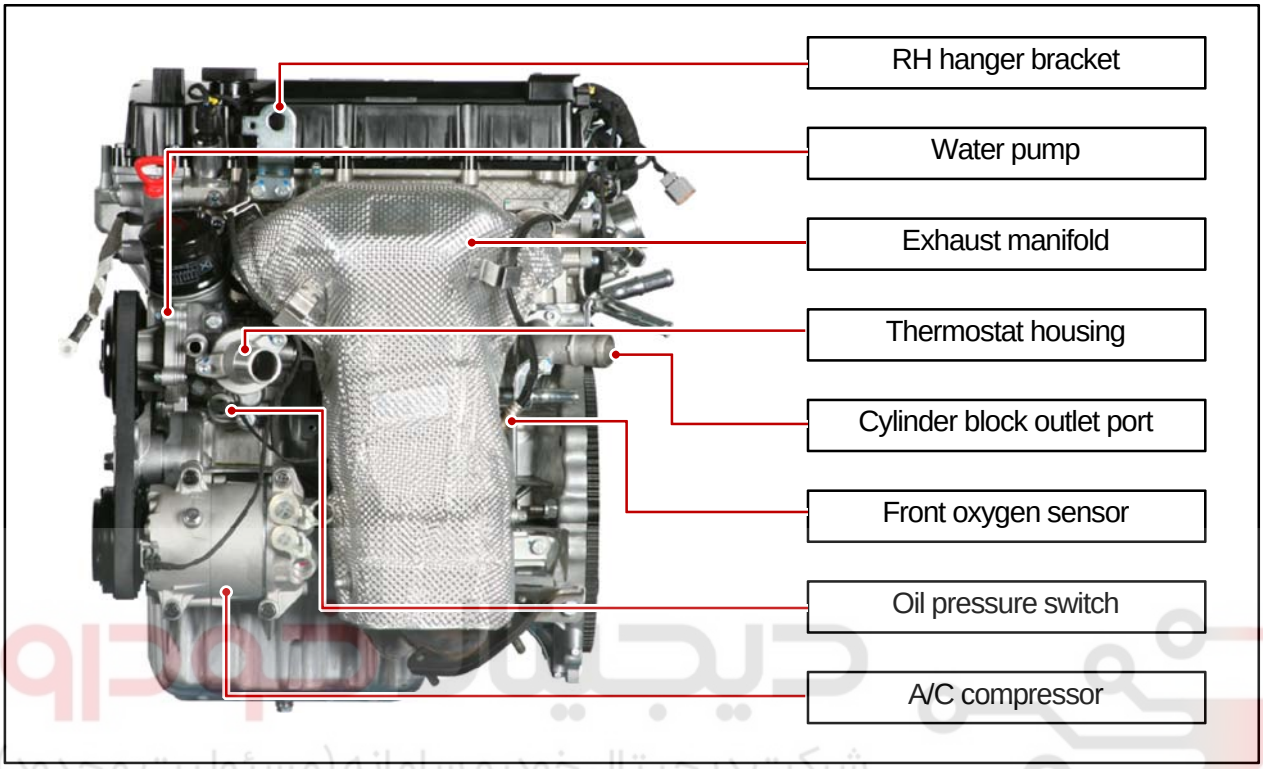


▶ **Rear view**

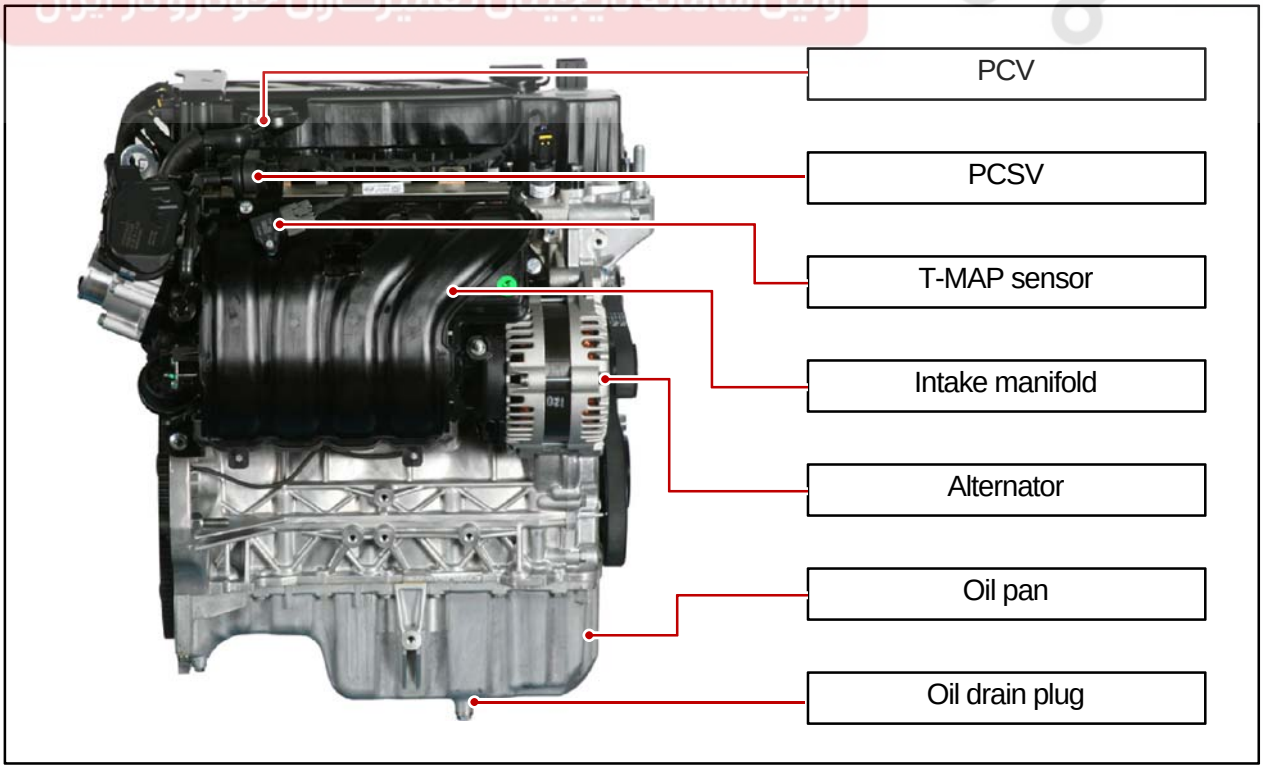


Modification basis	
Application basis	
Affected VIN	

▶ **Left view**



▶ **Right view**



Modification basis	
Application basis	
Affected VIN	

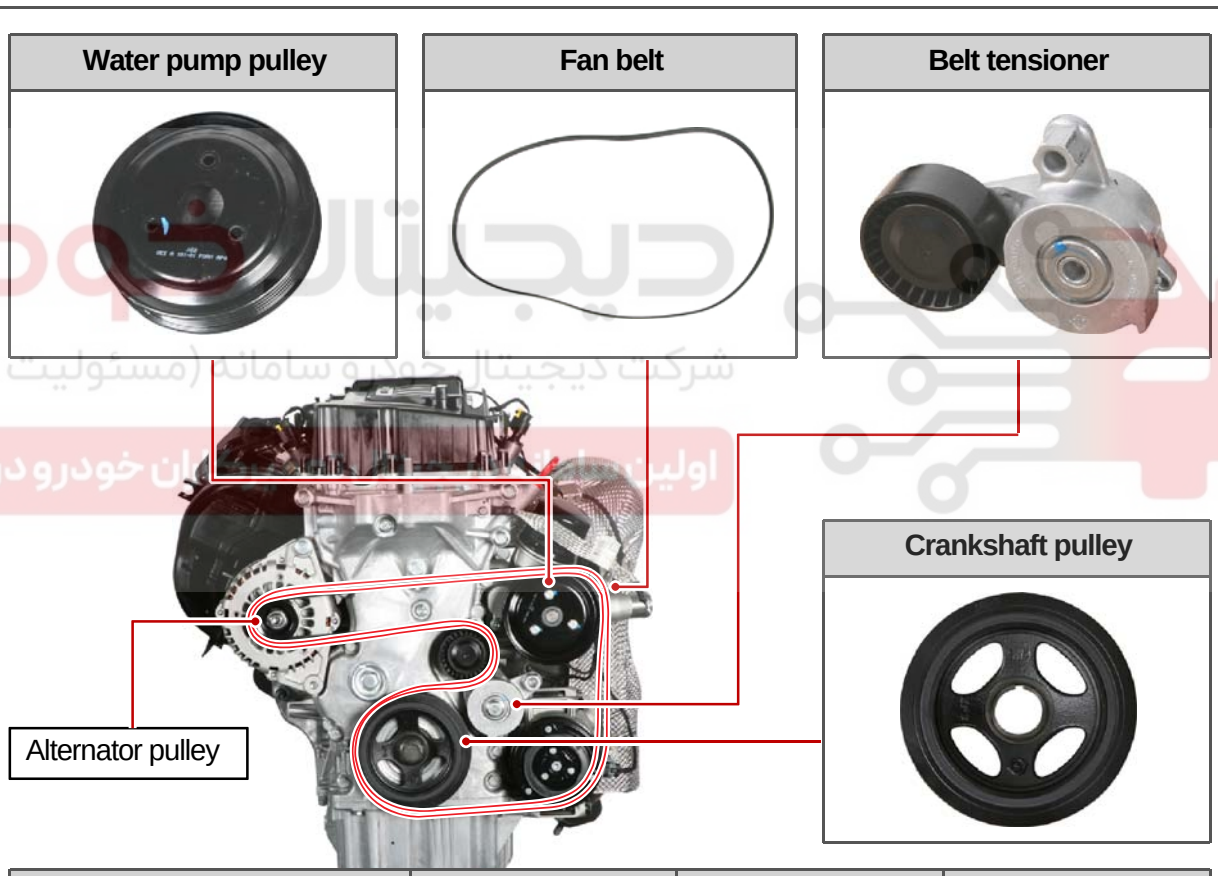
CONFIGURATION AND FUNCTIONS

S.G.N. 1350-01 BELT SYSTEM

1) Overview

The 5PK belt with 5 grooves works with the mechanical type belt tensioner which has a tension regulating spring to ensure the reliability and durability of the system by regulating the tension automatically. And the slip and vibration of belt and each pulley are minimized resulting in reduced friction losses and improved belt operating noise reduction. This is because the tension of the belt is lower than that of the conventional engine. This also leads to improved fuel economy.

2) Mounting Location and Components

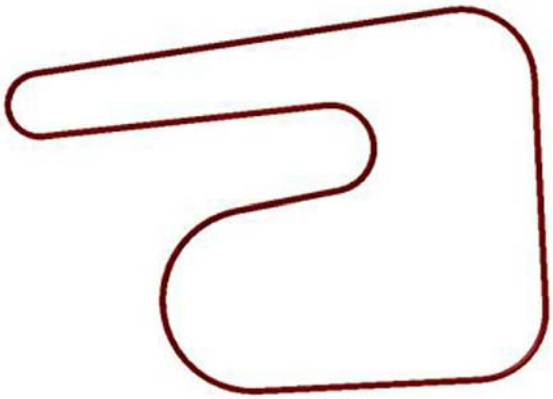


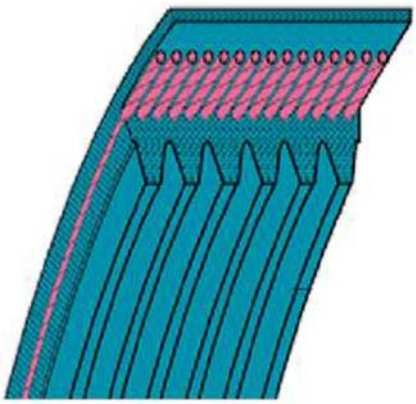
	Size (Ø)	Gear ratio	Remarks
Crankshaft pulley	145	1.00	-
Alternator pulley	50	2.90	
Water pump pulley	116	1.25	
A/C compressor pulley	110	1.32	
Tensioner pulley	70	2.08	

Modification basis	
Application basis	
Affected VIN	

▶ Fan belt

The fan belt used in this system is a 5PK poly-groove belt which reduces belt slip and minimizes friction and noise. The fan belt have a long service life and can be back-bent because its bending stress is low.

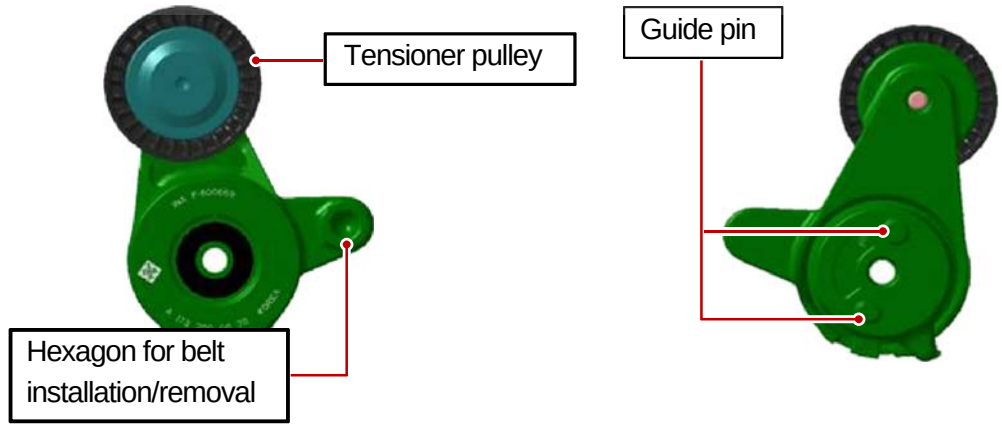




Bolt length: 1,596 mm

▶ Belt tensioner

Belt tensioner minimizes belt slip and vibrations to help the system stay stable and the belt prolong the service life by maintaining a steady belt tension. The two guide pins of the belt tensioner allow easy removal and installation. The hole for the retaining pin is to secure the belt tensioner when installing the belt.



Modification basis	
Application basis	
Affected VIN	

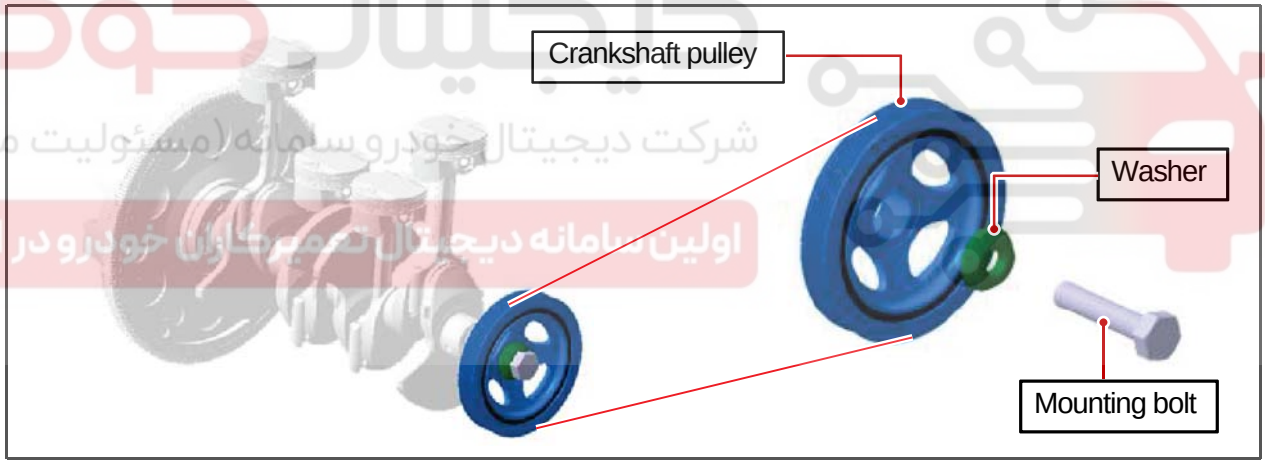
▶ Alternator pulley

Overrunning alternator pulley isolates the alternator from the irregularities in revolutions of the engine crankshaft and offers the following:

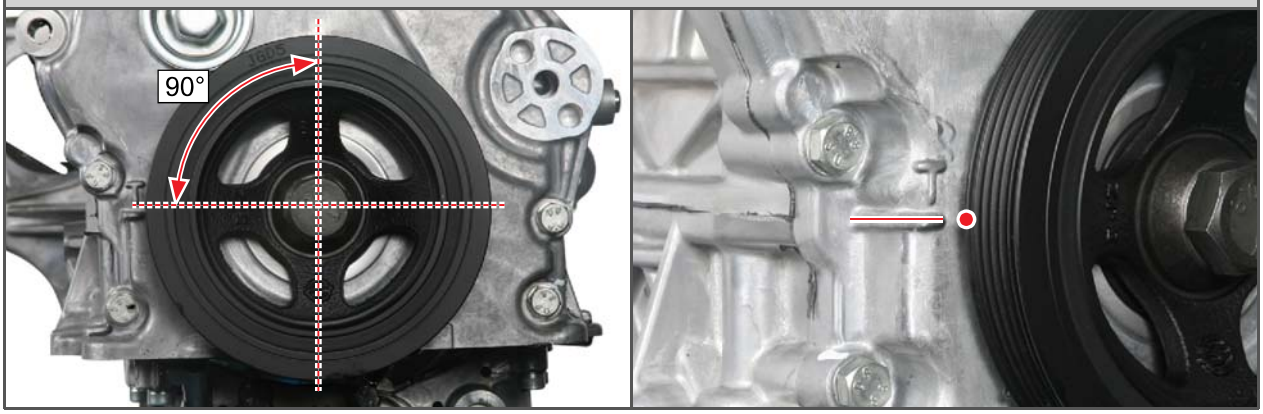
- Vibration reduction
- Reduced belt drive load
- Calming belt tensioner
- Prolonged service life of belt
- Noise reduction in belt drive
- Increased alternator speed at idling, Belt slip and noise reduction in alternator drive wheel during gear shifting

▶ Crankshaft pulley

The pulley reduces belt vibrations by absorbing vibrations and torsional moment due to angular velocity changes to maximize the overall reliability and durability of the system. The mark on the crankshaft pulley is used to align the engine timing.



Engine timing mark alignment (No. 1 cylinder TDC)



reference Align the mark on the crankshaft pulley with the mark on the timing gear case cover.

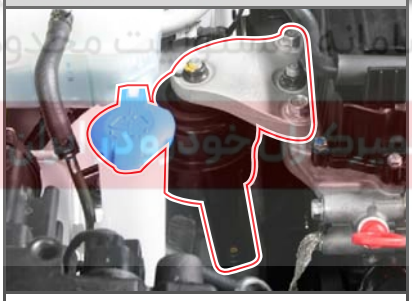
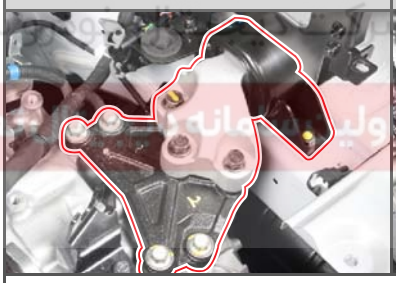
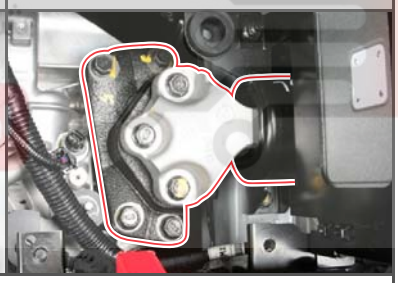
S.G.N. 1990-00

ENGINE MOUNTING ASSEMBLY

1) Overview

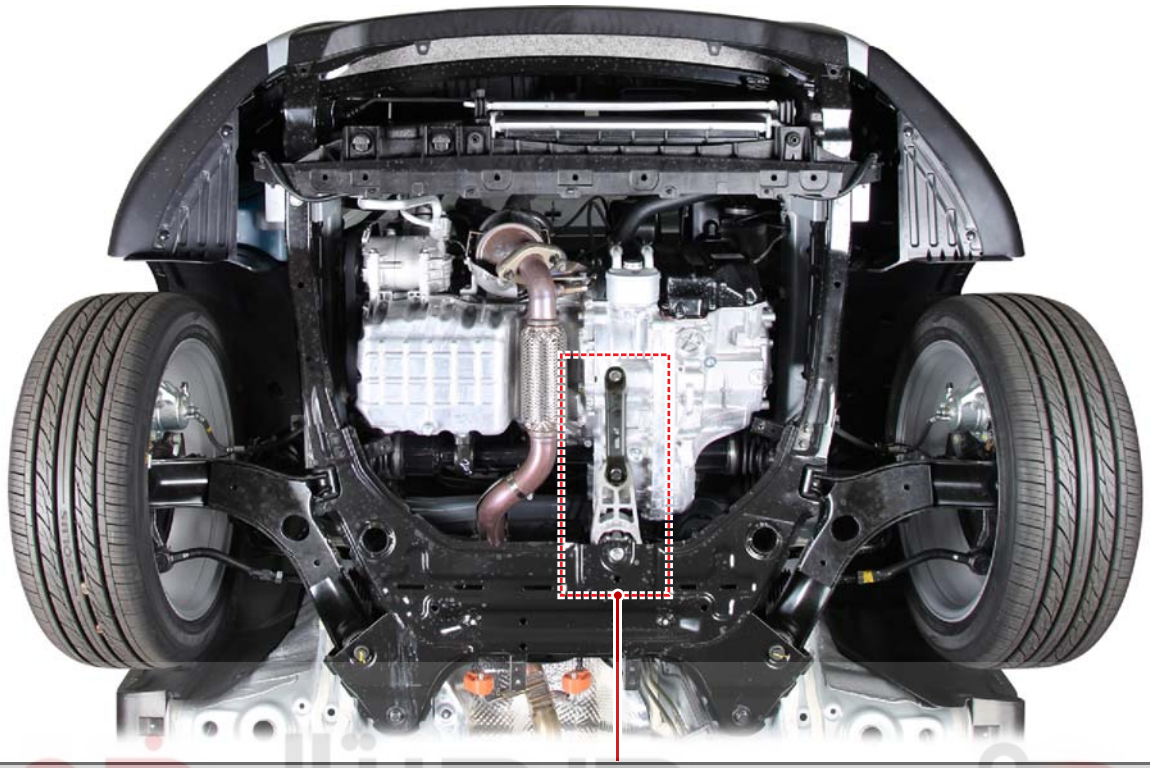
Three-mounting system which supports the engine at three points is used for the engine mounting. This system supports the engine and transmission simultaneously and absorbs the vibrations from the engine.

2) Mounting Location and Components

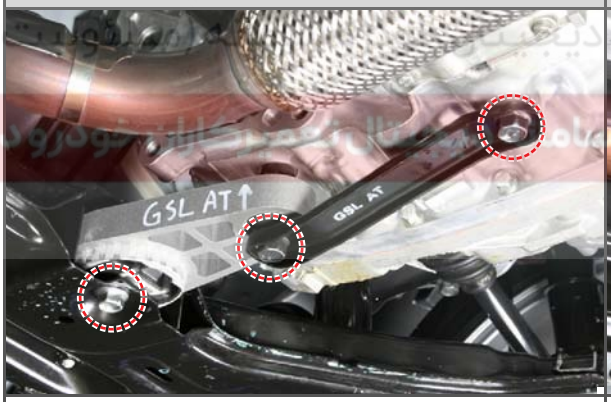
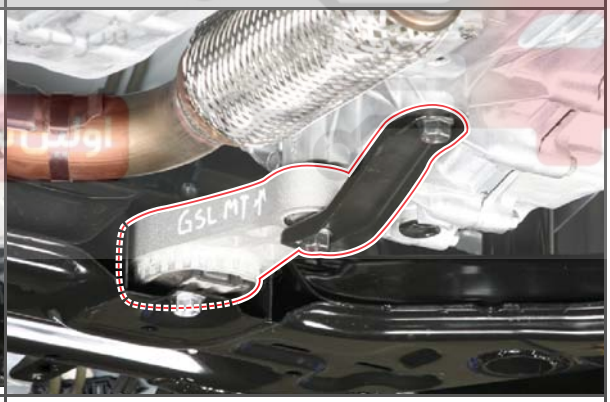
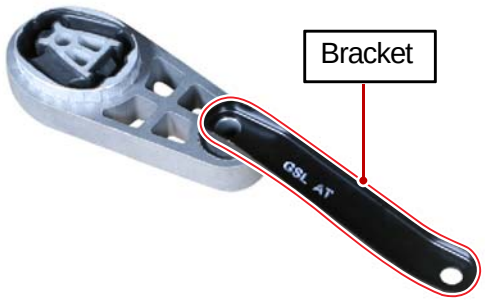
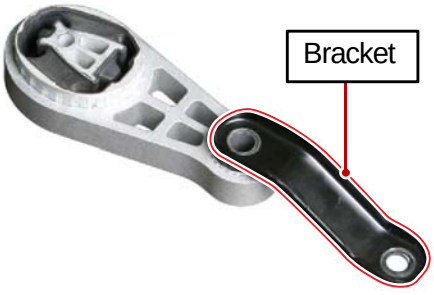
RH engine mounting assembly	LH engine mounting assembly	
	For a vehicle with A/T	For a vehicle with M/T
		
This assembly is a bush-type rubber mounting which consists of insulator and bracket. This is installed to the body with the timing gear case cover.	This is a cone style hydro mounting which consists of insulator and bracket. This is installed to the body with the transmission. The appearance of the LH engine mounting bracket for a vehicle with A/T is different from that of the bracket for a vehicle with M/T.	

RH engine mounting insulator	RH engine mounting bracket	LH engine mounting insulator
		

Modification basis	
Application basis	
Affected VIN	



Rear engine mounting assembly

For a vehicle with A/T	For a vehicle with M/T
	
	

This assembly is a bush type and installed to the transmission with the subframe. A bracket is fitted to the rear engine mounting insulator.

S.G.N. 1221-01

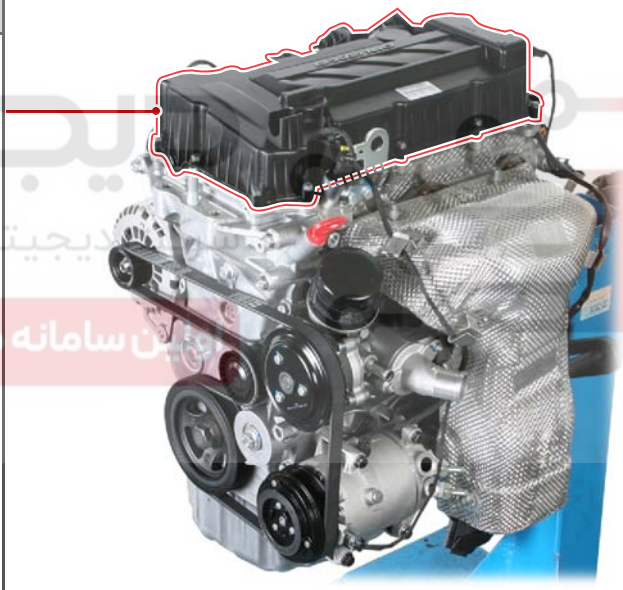
CYLINDER HEAD COVER

1) Overview

The cylinder head cover is made of high strength plastic, and because of this, the cover is lightweight. The cylinder head cover optimizes the oil consumption with the highly efficient oil separator (impact fleece system) mounted inside the cover.
The blowby gases are drawn into the separator inlet port of the cylinder head cover and separated by the integrated bulkhead (impact wall). Then the gas is separated a second time by the oil separator (impact fleece system). The oil flows to the cylinder head and the gas is drawn into the intake manifold through the pressure control valve (PCV), which is opened/closed by the pressure difference between the intake side and the inside of the crank case, and burned in the combustion chamber.

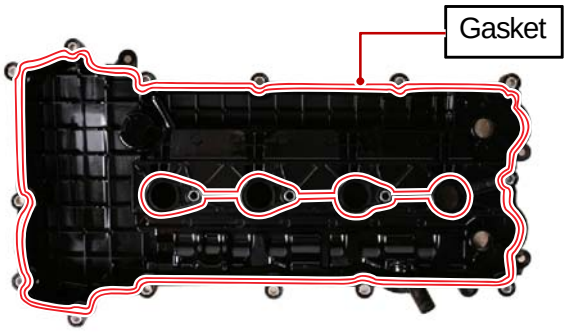
2) Mounting Location and Components

Cylinder head cover



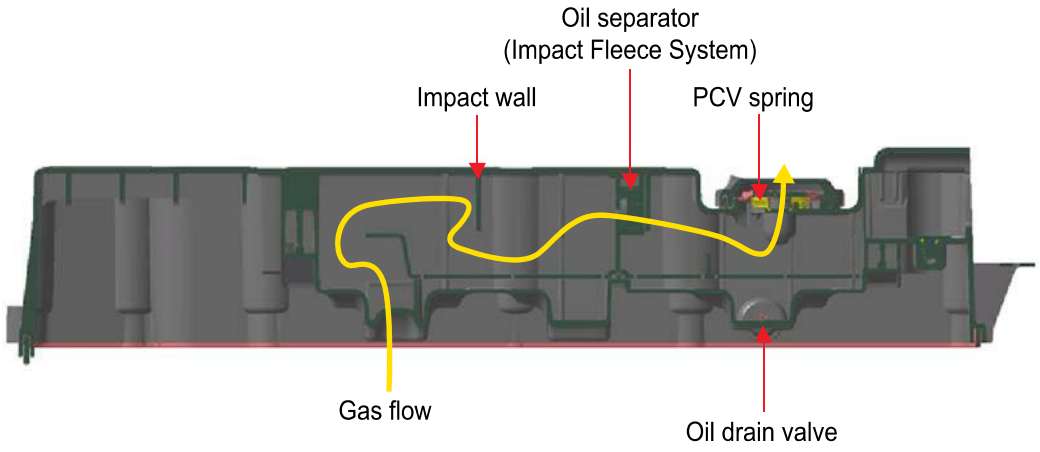
Front view

Rear view



Modification basis	
Application basis	
Affected VIN	

Blowby gas flow



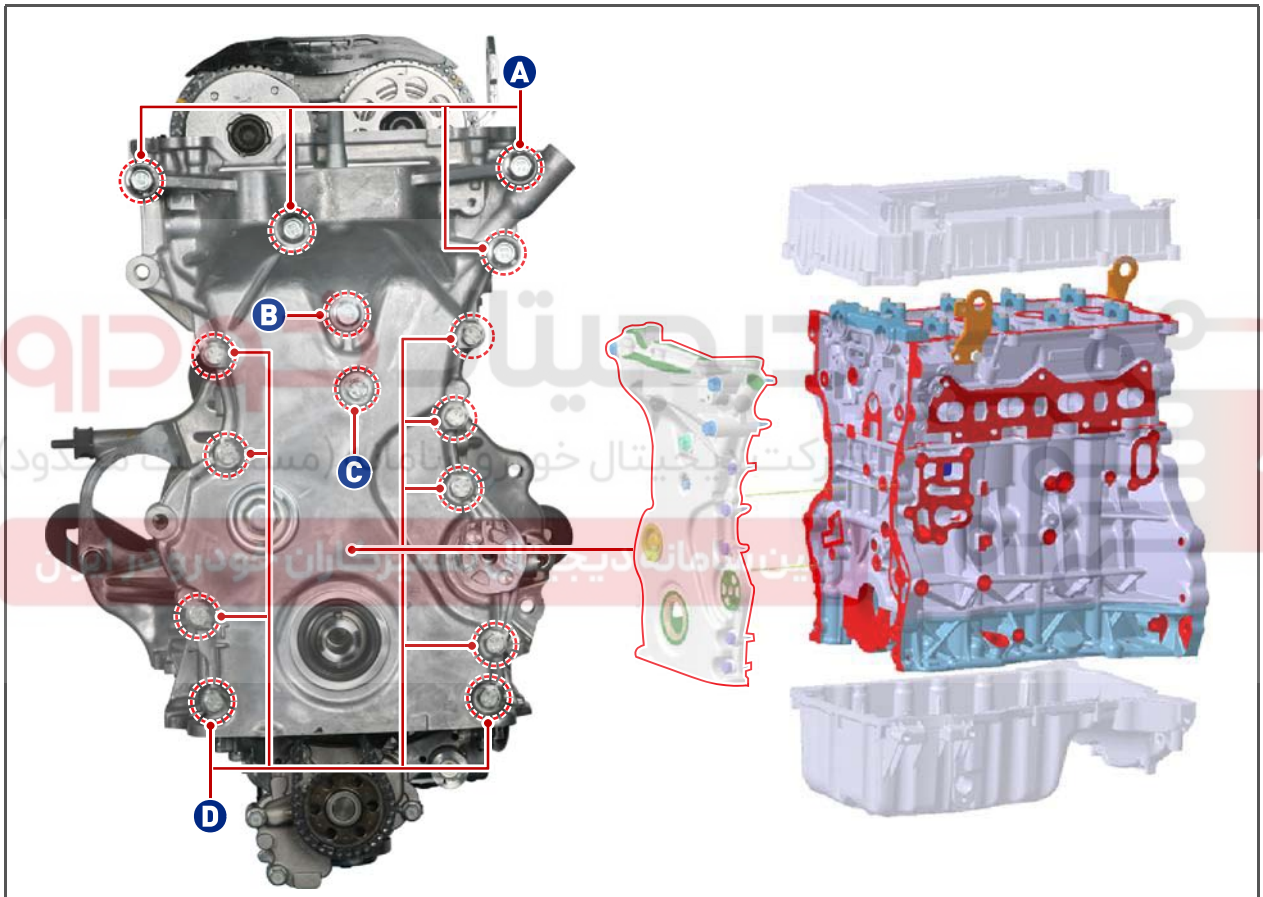
S.G.N. 1339-01

TIMING GEAR CASE COVER

1) Overview

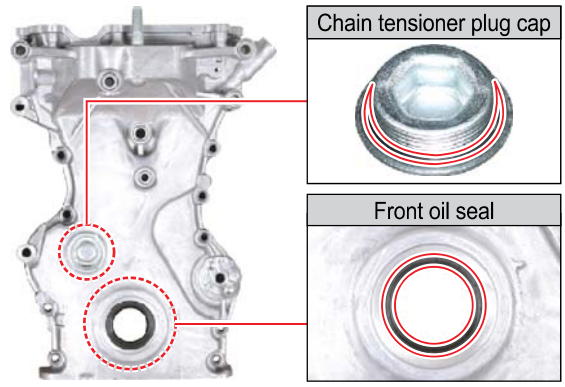
The timing gear case cover serves to secure the base for driving the belt system and integrates engine mounting, timing cover, chain tensioner service hole, and engine oil dipstick gauge. The main function of the timing gear case cover is to protect the chain drive system. The secondary function of the cover is to block the noise from the chain.

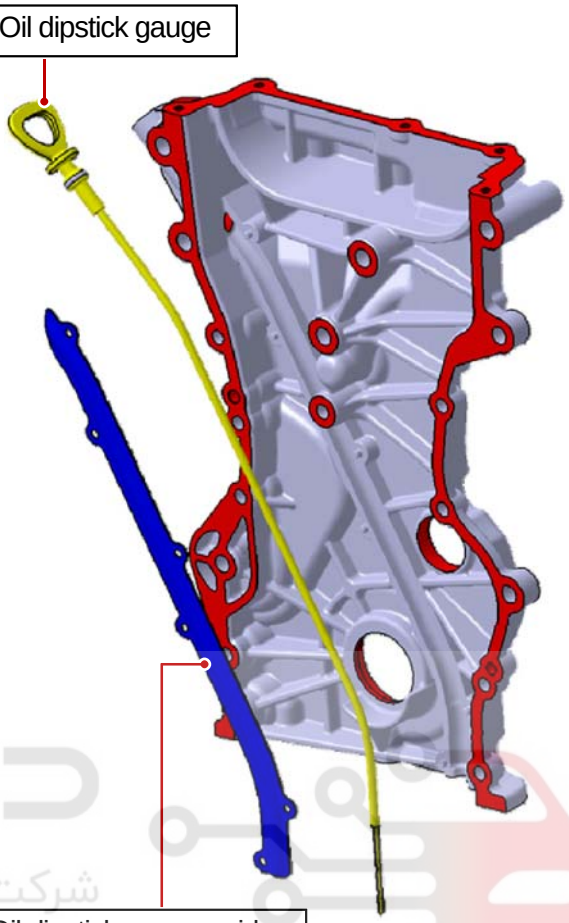
2) Mounting Location and Components



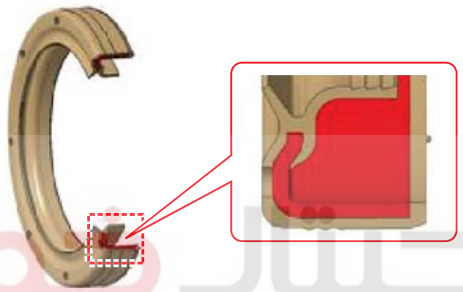
No.	Tool dimensions (mm)	Bolt length (mm)	Quantity
A	15	80	4
B		50	1
C	13	45	1
D		30	9

Modification basis	
Application basis	
Affected VIN	

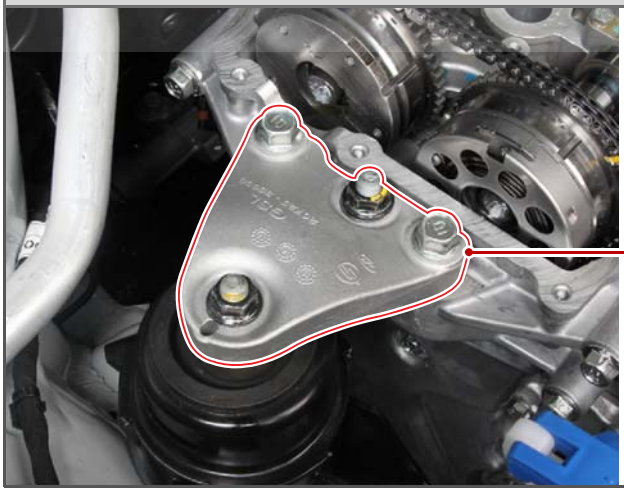




Sectional view of oil seal



RH engine mounting bracket installed



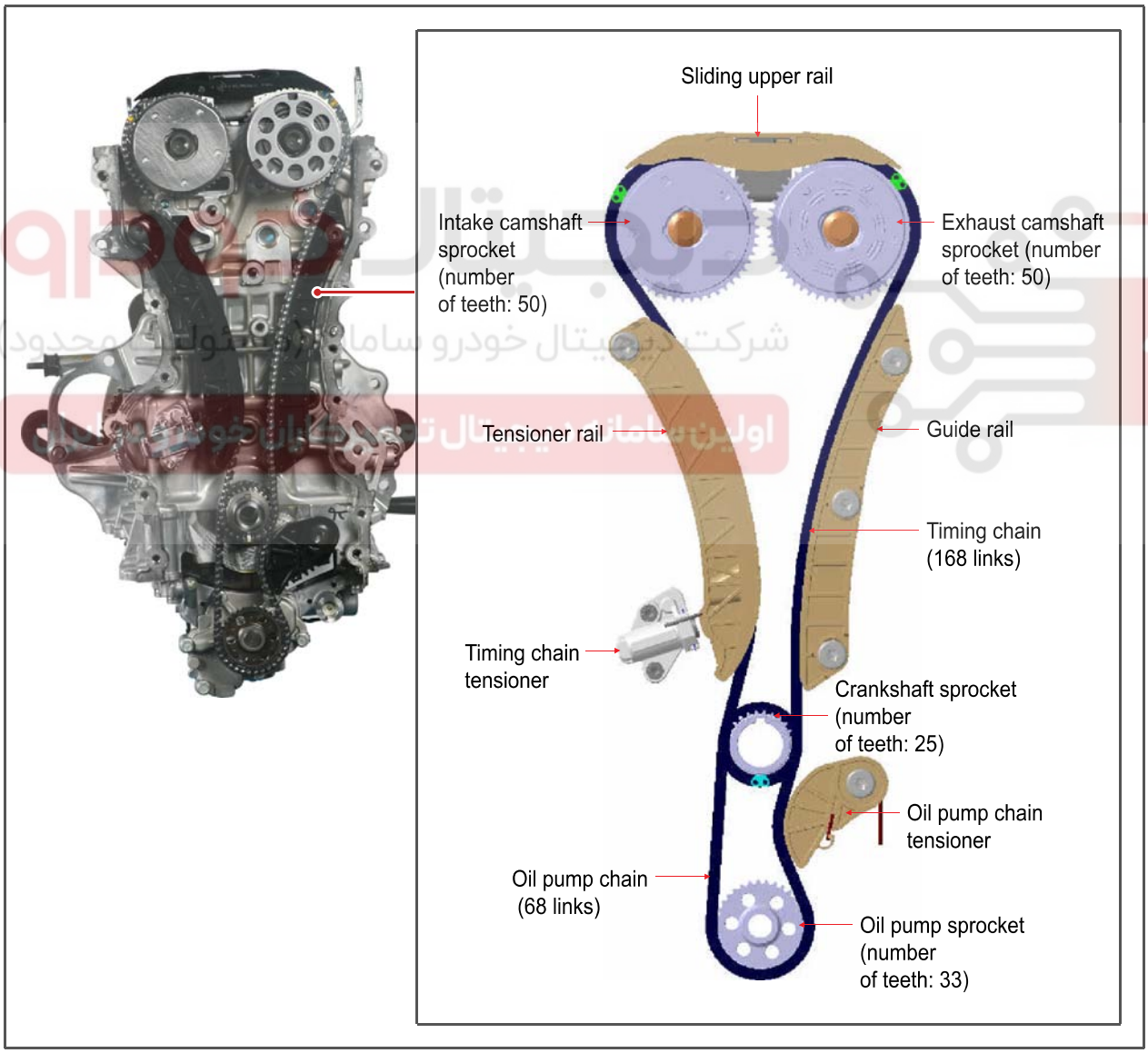
S.G.N. 1311-01

CHAIN DRIVE SYSTEM

1) Overview

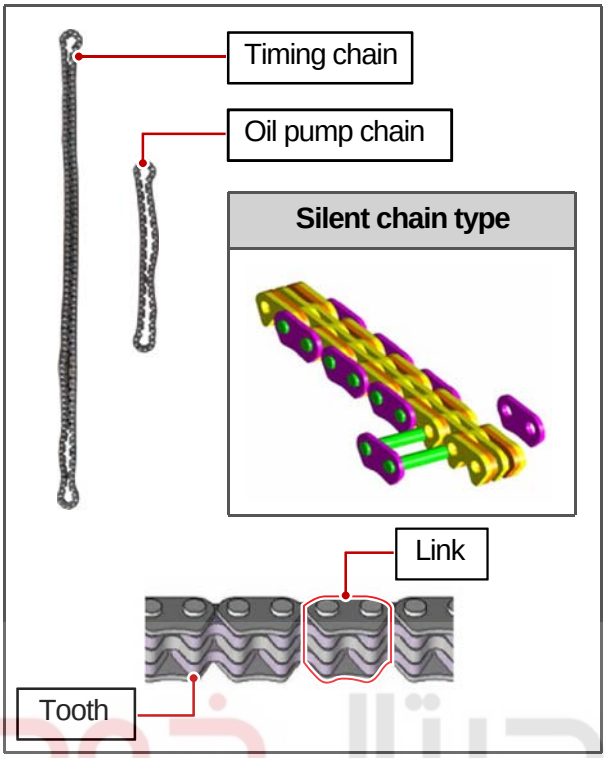
The chain drive system uses the single stage chain drive system to minimize the chain load and to provide dynamic operation with the simplified chain layout.
The type of timing chain is a type of silent chain which reduces the vibrations and noise generated from the chain when the teeth of the chain meshes with the sprocket, unlike the conventional bush- or roller-type chain. The timing chain is equipped with hydraulic tensioner to actively reduce the pressure pulsation of the chain.

2) Mounting Location and Components



Modification basis	
Application basis	
Affected VIN	

▶ Chain assembly

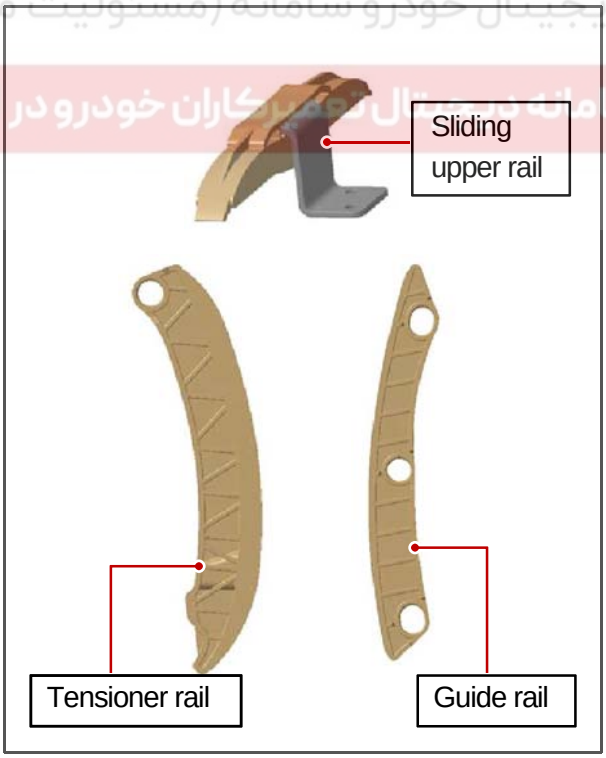


The chain assembly includes engine timing chain and oil pump chain and the chains consist of pins and links. The chains mesh with each sprocket and run in the ratio of 1:2. The 1st, 35th, and 51st outer links of the engine timing chain are marked white, yellow, and yellow, respectively. The link marked white should be meshed with the crank sprocket and the links marked yellow should be meshed with the exhaust and intake cam sprockets in sequence for the initial timing set. Both chains are a type of silent chain which promotes noise reduction.

NOTE

- **Timing chain:** Silent chain type (168 links)
- **Oil pump chain:** Silent chain type (68 links)

▶ Rail assembly



The rail assembly serves as a guide for the chain when the drive system operates to minimize the wear and vibrations due to the pressure pulsation of the chain. It prevents the chain from jumping and maintains a constant tension on the chain. The tensioner rail of the rail assembly has reinforcing side ribs that boost stiffness and resistance against wear to endure high load on the rail. The sliding upper rail is equipped with a steel carrier for easy assembling. The guide rail has 3 holes for mounting. All holes except the one in the center are in a square shape to compensate for the thermal expansion of the engine.

Modification basis	
Application basis	
Affected VIN	

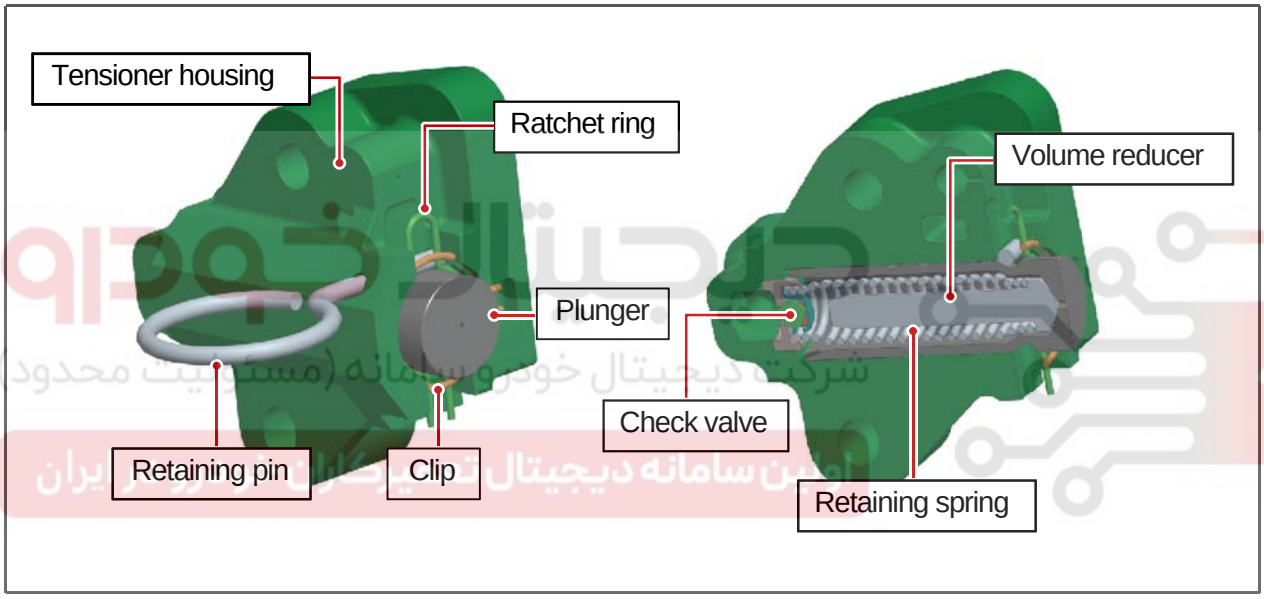
▶ Timing chain tensioner

The timing chain tensioner in minimizes the vibrations from the crankshaft and the pressure pulsation of the chain due to the camshaft drive torque by using hydraulic pressure and spring tension when the engine is running. It also maintains a constant chain tension to prevent the chain from jumping under high load. The ratchet mechanism used in the timing chain tensioner prevents the chain from jumping even when the engine runs unusually, the chain is extended excessively, or the engine starts while the oil is drained.

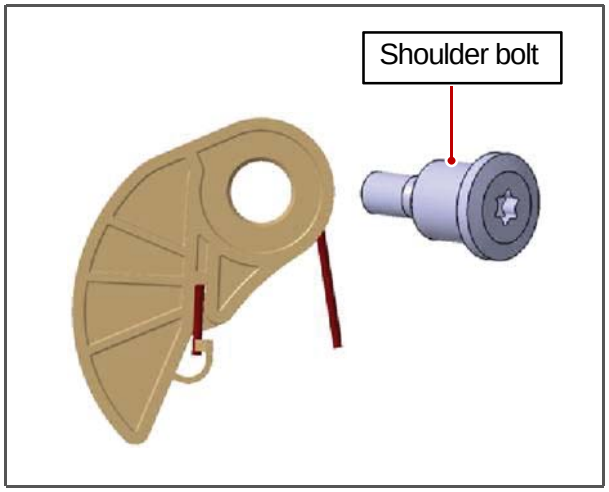
NOTE

Ratchet mechanism

This mechanism prevents the unstable chain jumping and noise when the vehicle is started after a long period of parking.



▶ Oil pump chain tensioner

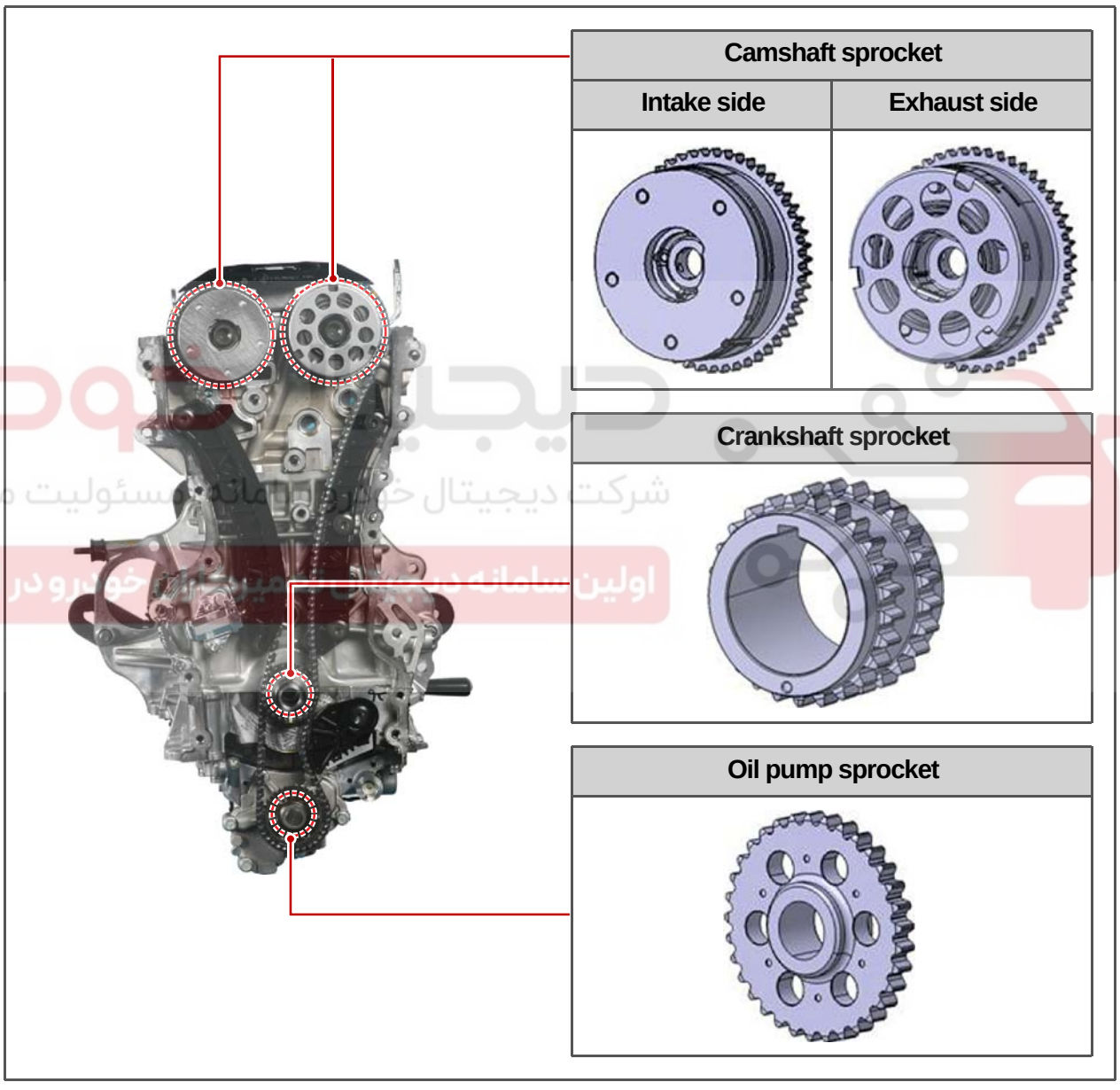


The oil pump chain tensioner is a mechanical tensioner which uses the spring tension to keep the tightness of the oil pump chain.

Modification basis	
Application basis	
Affected VIN	

▶ Sprocket assembly

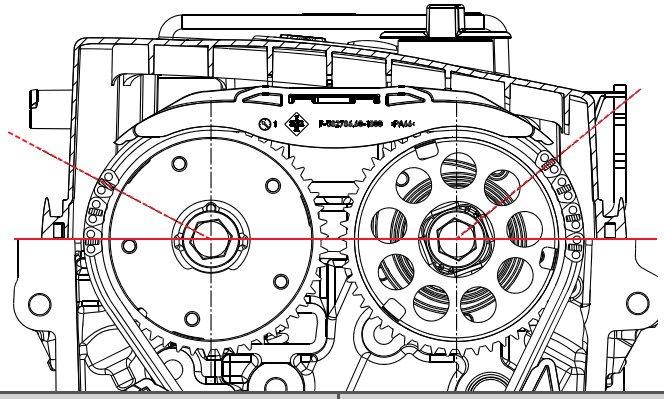
The number of the teeth on the crankshaft and camshaft sprockets are 25 and 50 respectively for the crankshaft to camshaft gear ratio of 2:1, which is one of the most important role of the chain drive system. The camshaft sprockets are secured by the center bolts and the crankshaft sprocket is secured by the crankshaft pulley center bolt with the crankshaft and crankshaft pulley. The oil pump sprocket is pressed in the oil pump shaft and assembled with the oil pump. The crankshaft and camshaft sprockets except the oil pump sprocket have marks to align the engine timing.

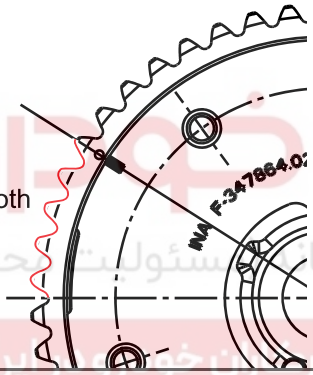
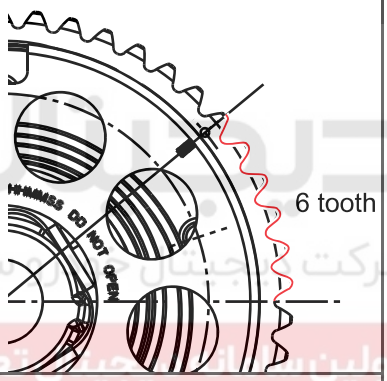


Modification basis	
Application basis	
Affected VIN	

▶ Marks to align the timing

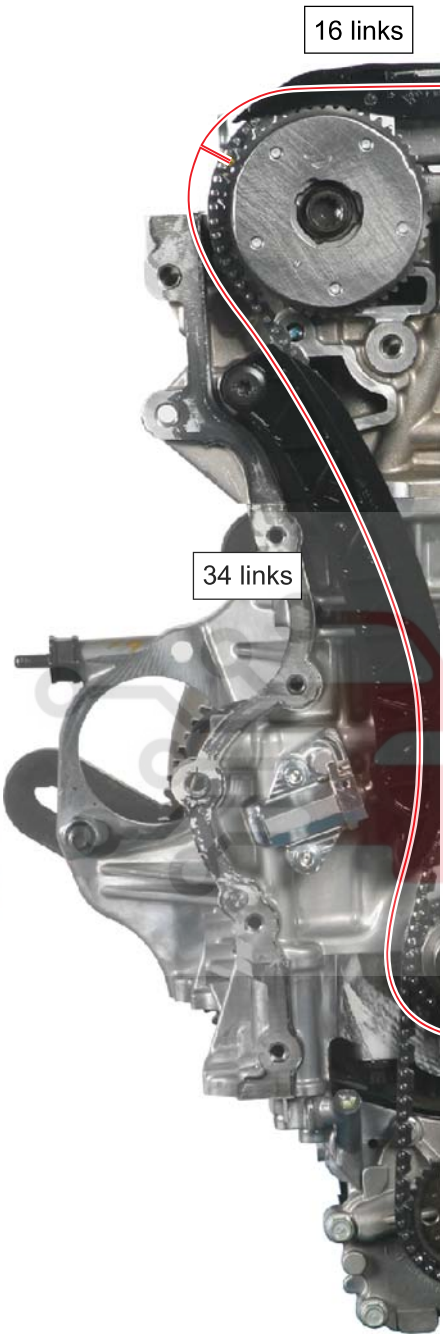
Intake & exhaust camshaft sprocket marks



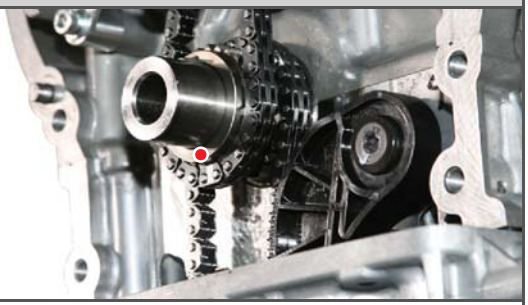
Intake camshaft sprocket mark	Exhaust camshaft sprocket mark
	
5 tooth	6 tooth

Number of chain links from the top surface of the cylinder head:
Intake side: 5 teeth/ Exhaust side: 6 teeth

Number of chain links



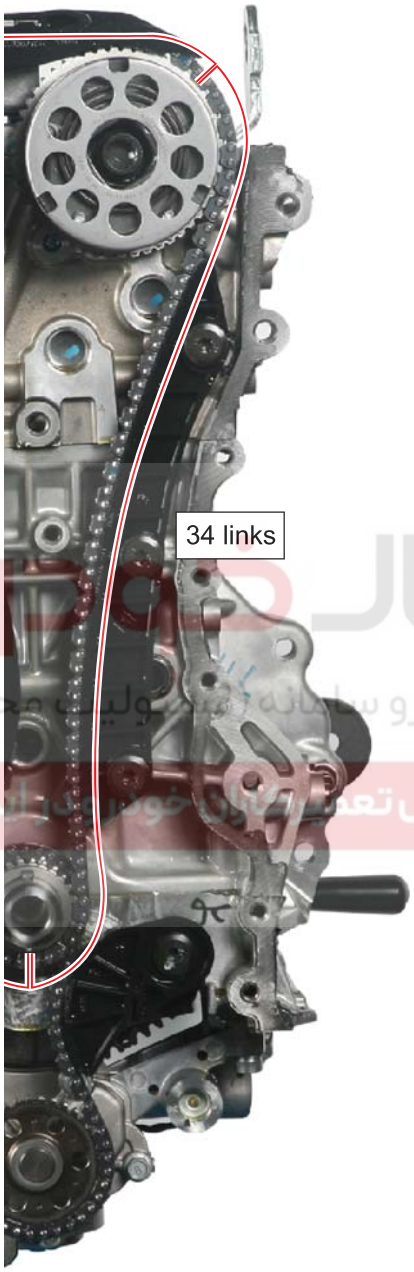
Crankshaft sprocket mark



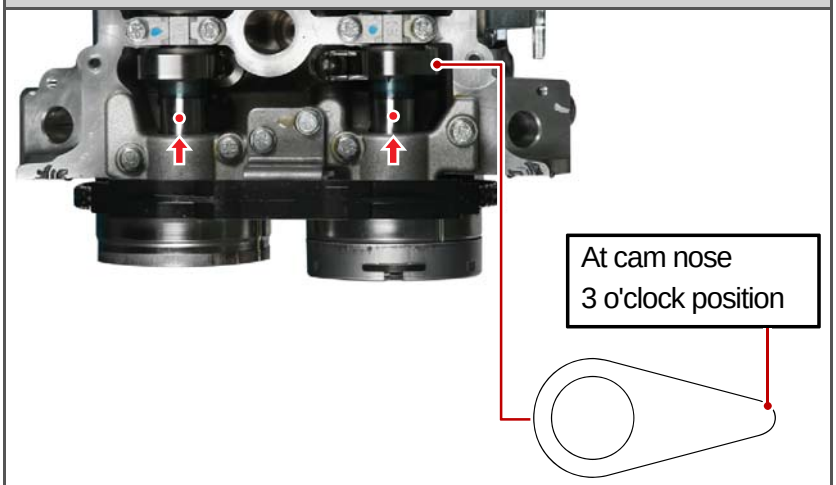
At 6 o'clock position

Modification basis	
Application basis	
Affected VIN	

for each timing mark

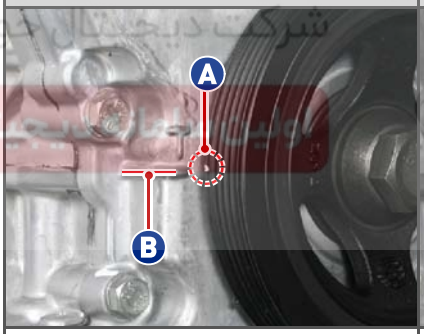
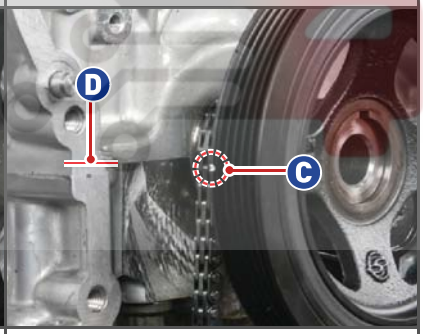


Intake & exhaust camshaft marks



Align the arrow on the camshaft front bearing cap with the mark on the camshaft.

Align timing using crankshaft pulley

With timing gear case	Without timing gear case
	
Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.	Align the mark (C) on the crankshaft pulley with the mating surface (D) of the cylinder block and the bed plate.

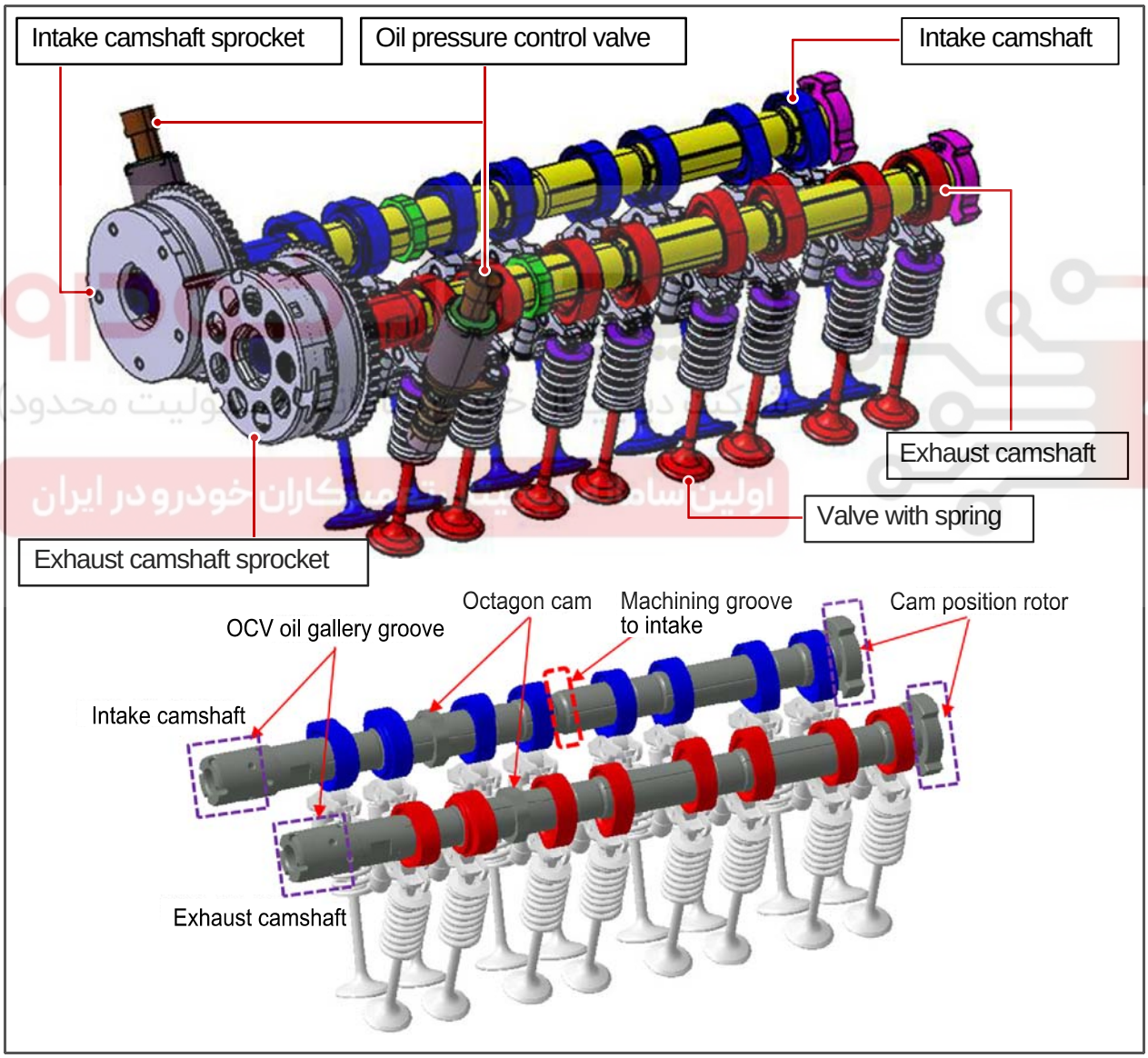
S.G.N. 1221-21

CAMSHAFT ASSEMBLY

1) Overview

The camshaft consists of cams, octagon-shaped cam, oil control valve (OCV) oil passage, and cam position rotor that are mounted to a hollow shaft. The intake and exhaust camshaft sprockets are equipped with continuous variable valve timing (CVVT) system which is operated by the OCV oil passage control. The exhaust camshaft sprocket has a return spring because it rotates in the opposite direction of the engine rotation, unlike the intake camshaft sprocket.

2) Mounting Location and Components

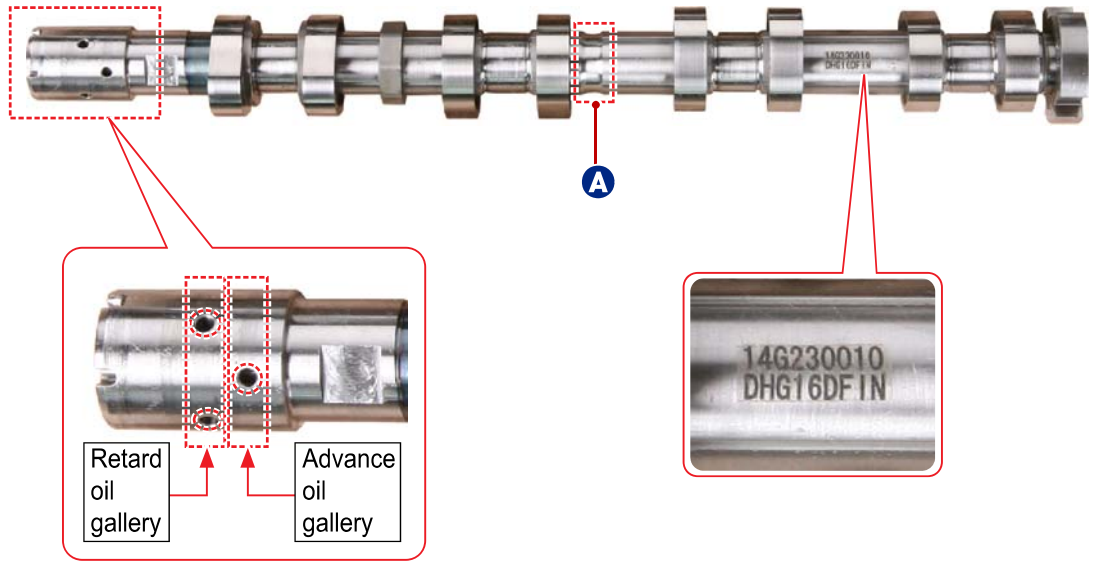


NOTE

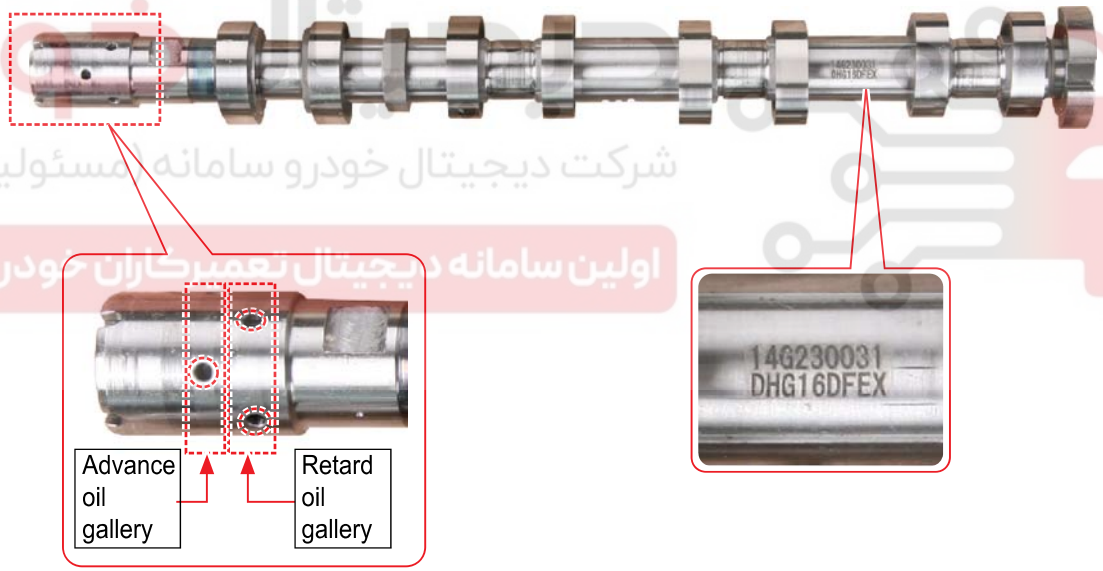
Refer to "ENGINE CONTROL" section for the operating process of the CVVT system.

Modification basis	
Application basis	
Affected VIN	

Intake camshaft



Exhaust camshaft



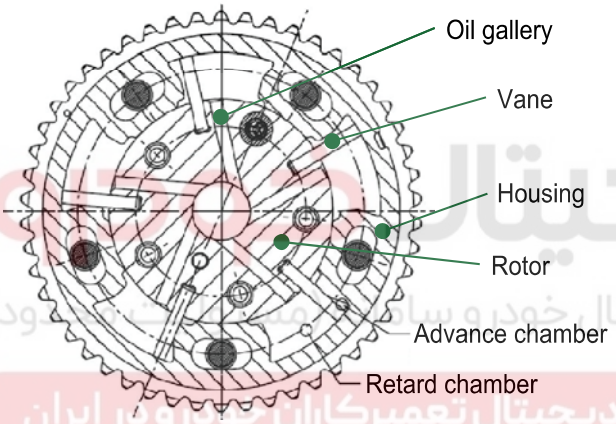
NOTE

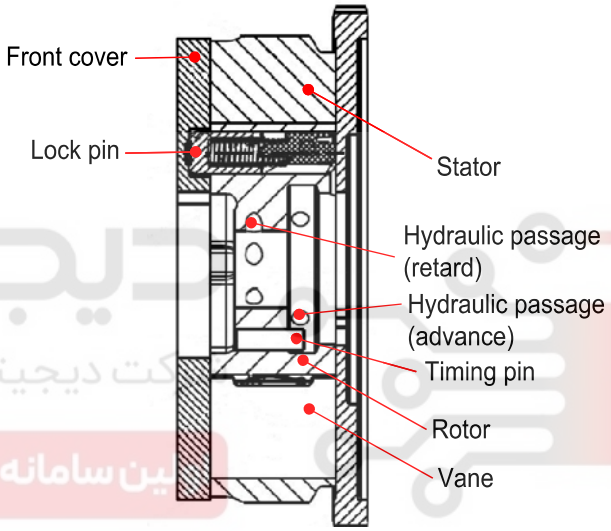
The intake and exhaust camshafts are identified by the texts stamped on each camshaft (intake side: IN, exhaust side: EX) and the recessed area (A) on the intake camshaft.

Intake camshaft sprocket

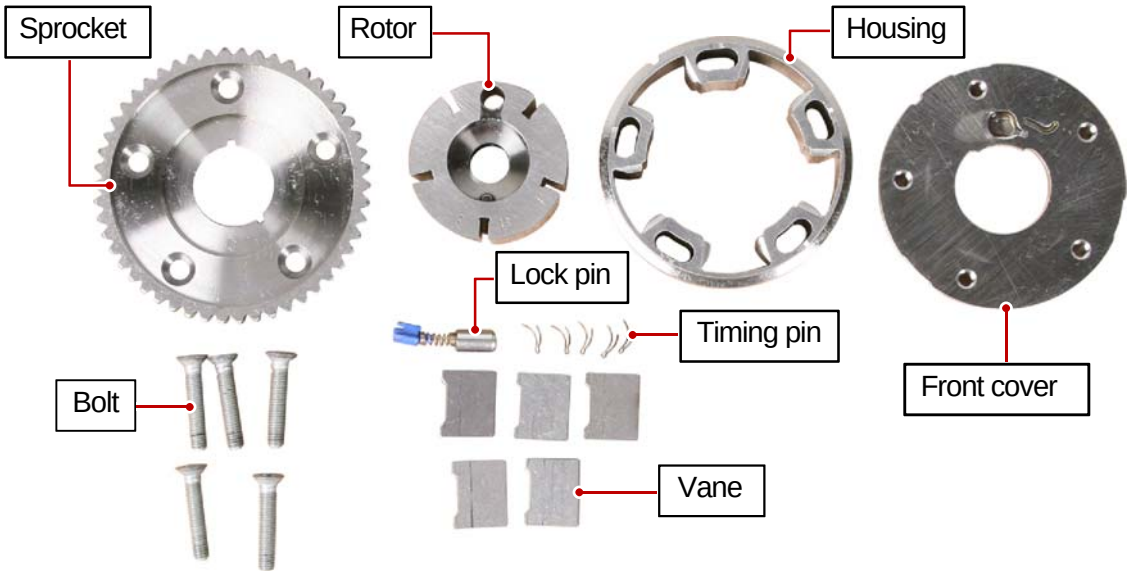
Front view	Rear view
	

Sectional view





Exploded view



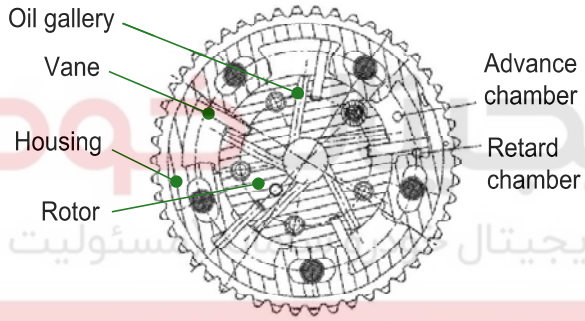
Modification basis	
Application basis	
Affected VIN	

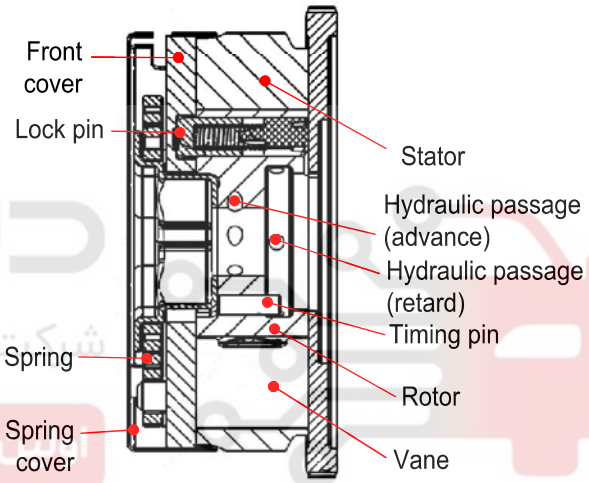
Exhaust camshaft sprocket

Front view

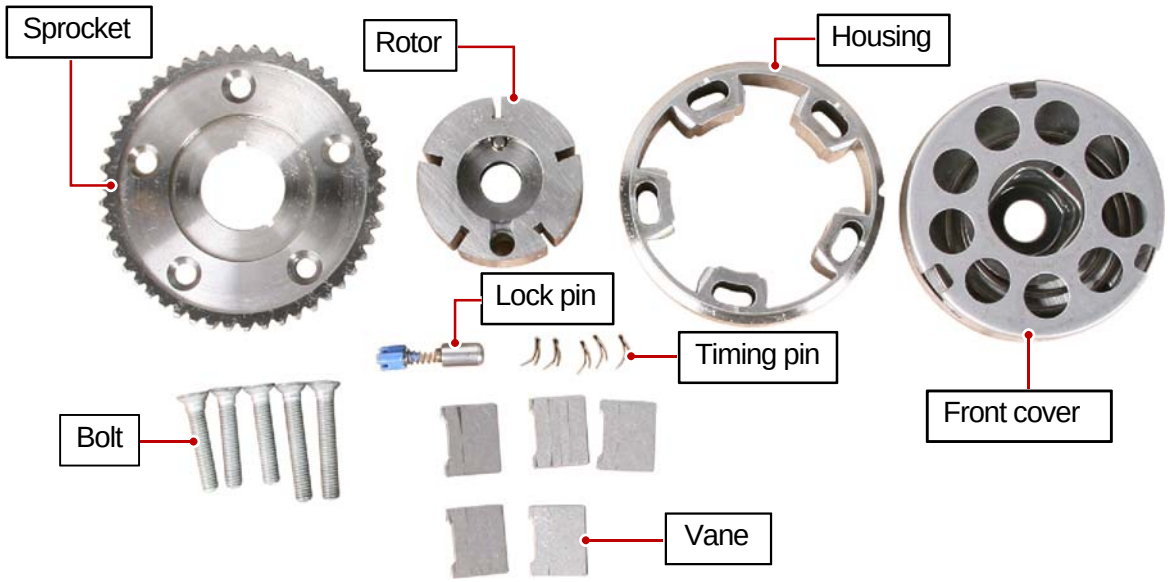
Rear view

Sectional view

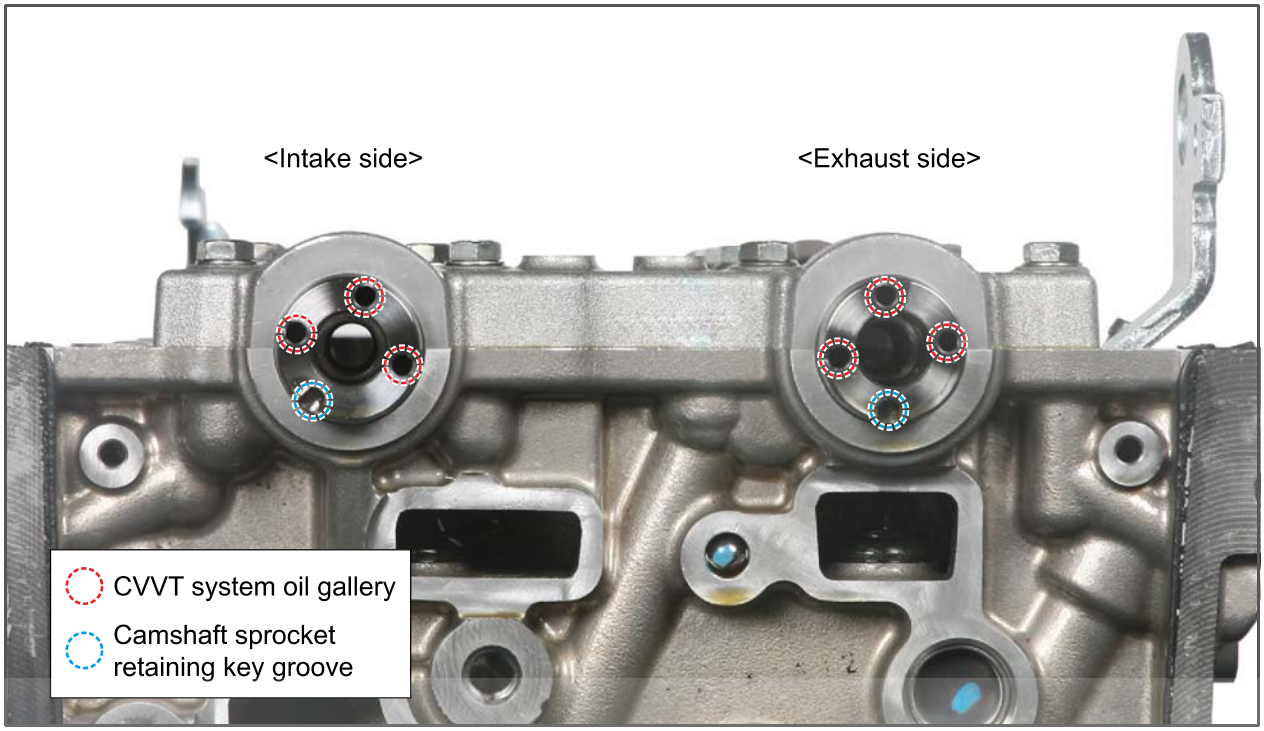




Exploded view



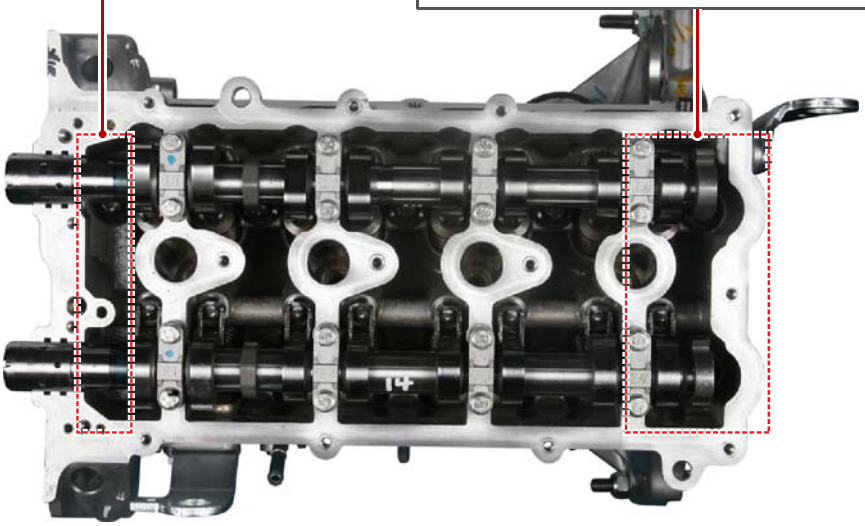
Modification basis	
Application basis	
Affected VIN	



Intake & exhaust camshaft marks

Align the arrow on the camshaft bearing cap with the mark on the camshaft.

Cam position sensor air gap



Modification basis	
Application basis	
Affected VIN	

S.G.N. 1211-01

CYLINDER HEAD ASSEMBLY

1) Overview

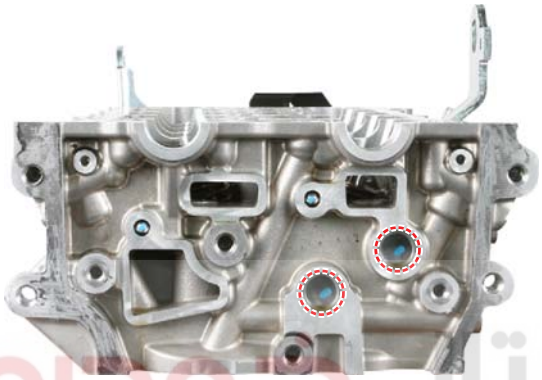
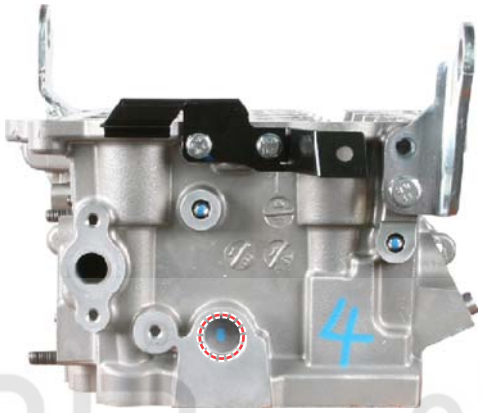
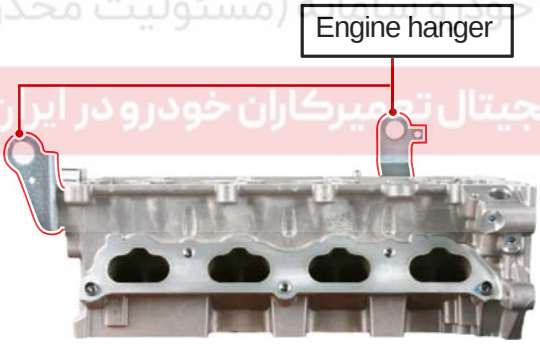
Several parts including dual CVVT, OCV, intake manifold, exhaust manifold, valve assembly are attached to the cylinder head assembly. The dual CVVT system is driven by the silent chain. The intake and exhaust valves are obliquely mounted to optimize the combustion chamber geometry and achieve compact construction of the cylinders. The cylinder oil passage is drilled and sealed with ball bearing. The camshaft bearing cap is molded separately and mounted to the cylinder head.

2) Mounting Location and Components

Modification basis	
Application basis	
Affected VIN	

▶ Cylinder head

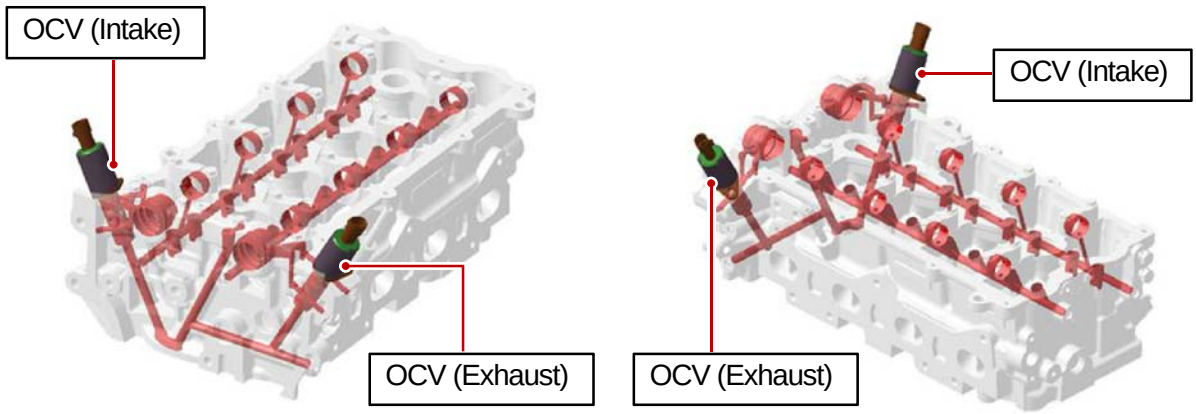
The cylinder head is located on top of the cylinder block to form the combustion chamber and includes intake and exhaust ports. It also houses the valve system and provides oil galleries through which oil flows for lubrication and smooth operation of the valve system and water jackets used to dissipate heat from the combustion chamber.

Front view	Rear view
Coolant expansion plug 	Coolant expansion plug 
Left view	**Right view**
	

Material	AC4CH-T6
Casting	Gravity casting
Height	132 mm
Weight	Approx. 11.5 kg
Spark plug angle	8° to intake side

Modification basis	
Application basis	
Affected VIN	

Cylinder head oil gallery

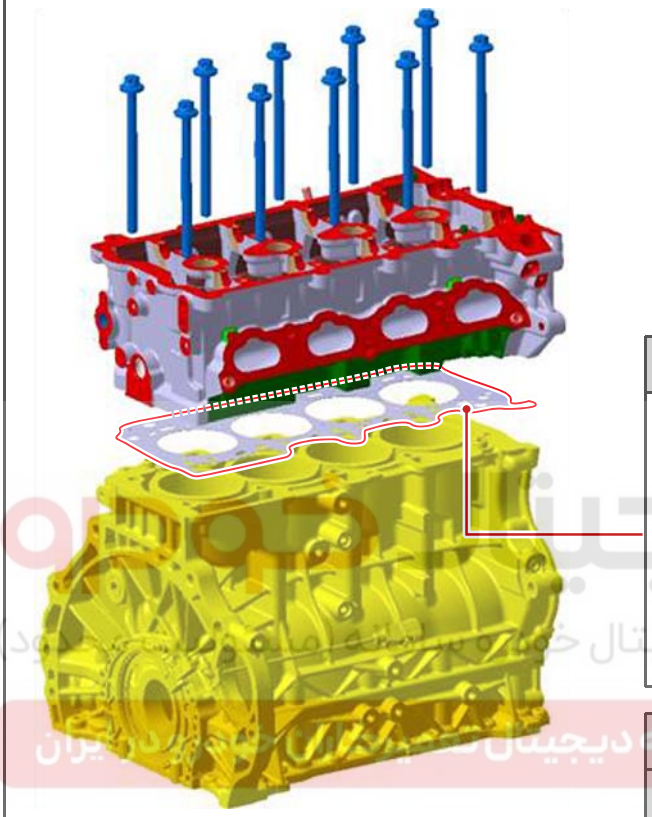


Cylinder head water jacket

Modification basis	
Application basis	
Affected VIN	

▶ Cylinder head gasket

The cylinder head gasket is a multi-layer steel (MLS) gasket with welding stopper. This gasket is installed between the cylinder block and cylinder head and provides fuel vapor-tight seal for the combustion chamber and fluid-tight seal for the space between the cylinder block and cylinder head in which the engine oil and coolant flow through.



Cylinder head gasket

Type	2.5-layer MLS gasket
Thickness	0.55 mm

Modification basis	
Application basis	
Affected VIN	

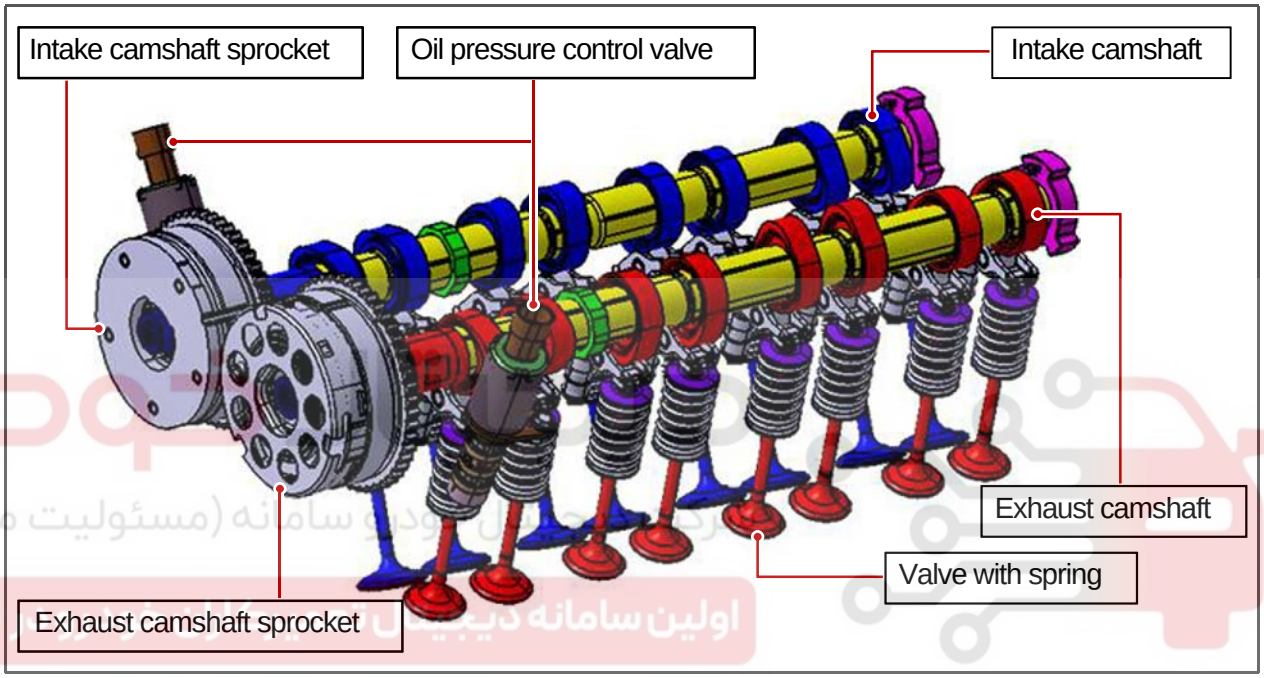
S.G.N. 1211-26

VALVE SYSTEM

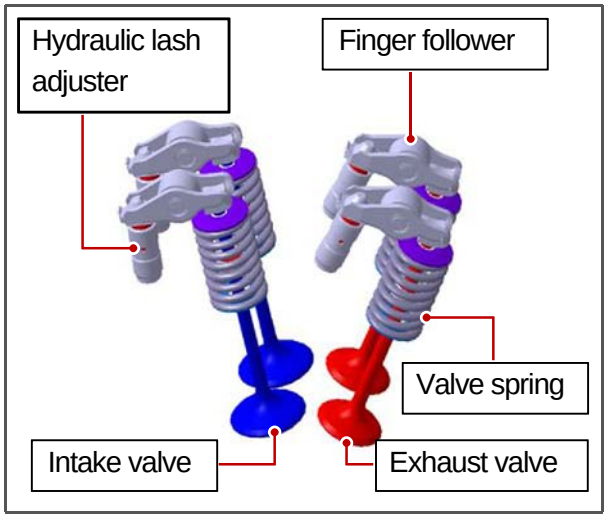
1) Overview

The valve system uses the hydraulic valve clearance adjuster (roller finger follower & hydraulic adjuster) to reduce the friction losses and noise generated between camshaft and hydraulic valve clearance adjuster. It also helps to improve the fuel economy.

2) Mounting Location and Components

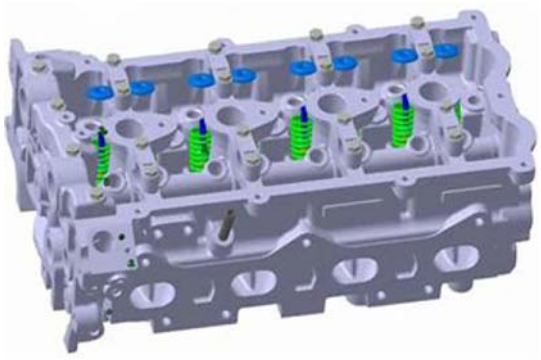
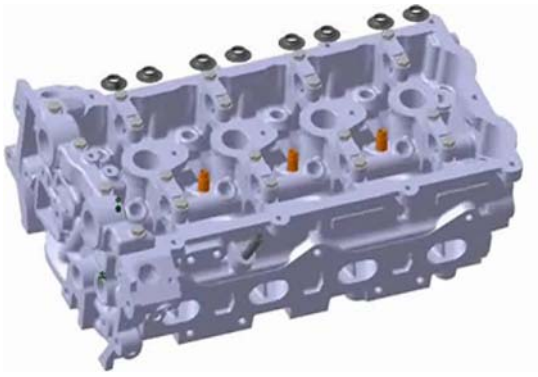
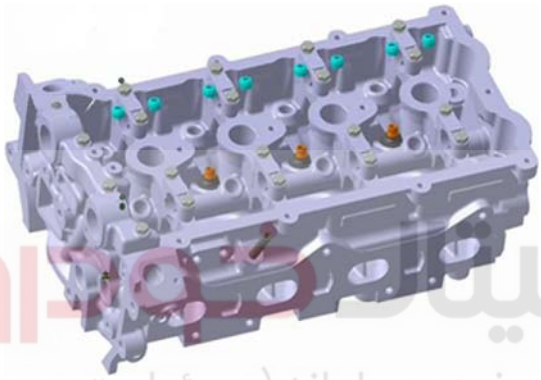
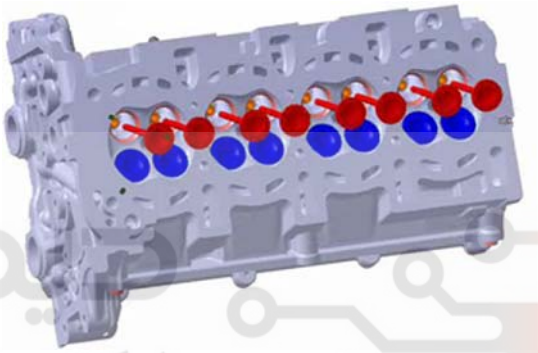


▶ **Valve with spring**



a. Intake & exhaust valves

- The valve clearance is adjusted automatically according to the hydraulic pressure (Maintenance Free) - Hydraulic lash
- The valve noise is reduced with the optimized clearance adjustment
- The friction losses are reduced by using the roller finger follower.
- The valves are obliquely mounted to optimize the combustion chamber geometry.
- The amount of movement is decreased by the compact design (Improved valve following and decreased friction force when rotating at high speed).

Intake & exhaust valves configurations	
	
Upper retainers and valves spring: 16 off, Each	Lower retainers: 16 off
	
Valve stem seals: 16 off	Intake & exhaust valves: 8 off, Each

Modification basis	
Application basis	
Affected VIN	

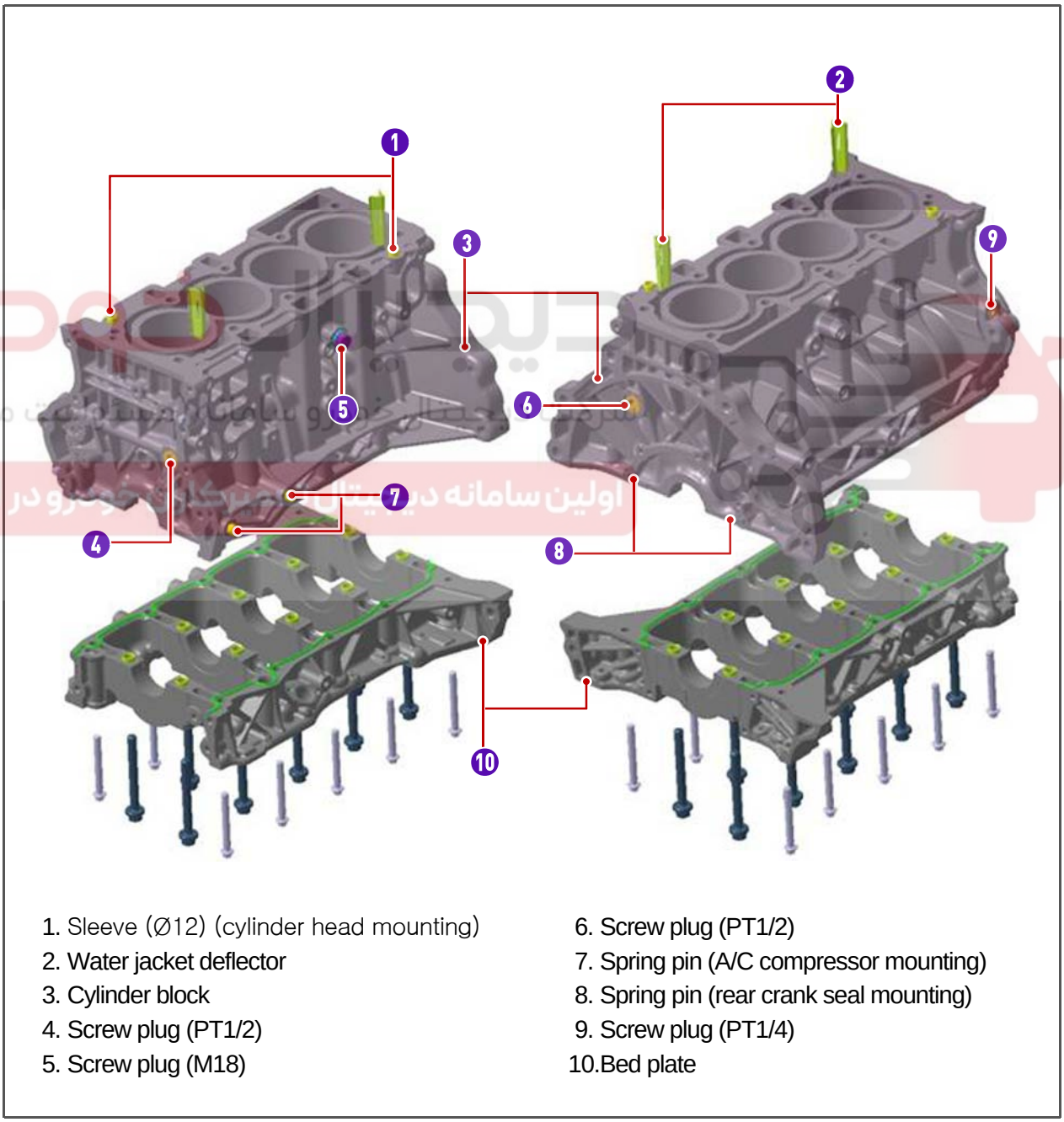
S.G.N. 1121-01

CYLINDER BLOCK ASSEMBLY

1) Overview

The cylinder block is made of aluminum using the high-pressure casting, so it is 35% lighter than the cast iron cylinder block. The bed plate installed to the cylinder block increases rigidity and improves NVH(Noise, Vibration, and Harshness). The cast cylinder liner with high rigidity and durability is inserted in the cylinder block.

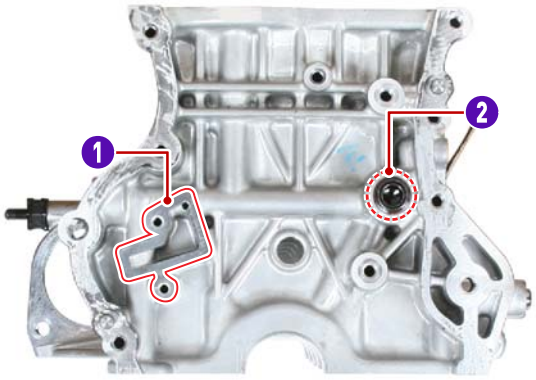
2) Mounting Location and Components



1. Sleeve (Ø12) (cylinder head mounting)
2. Water jacket deflector
3. Cylinder block
4. Screw plug (PT1/2)
5. Screw plug (M18)
6. Screw plug (PT1/2)
7. Spring pin (A/C compressor mounting)
8. Spring pin (rear crank seal mounting)
9. Screw plug (PT1/4)
10. Bed plate

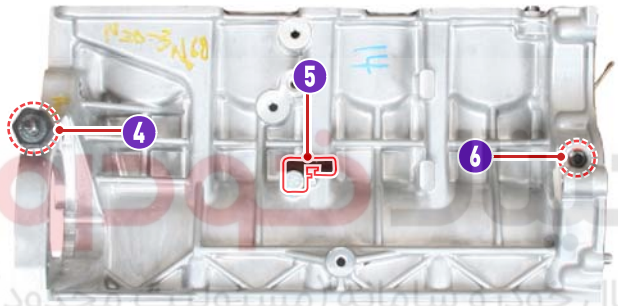
Cylinder block

Front view

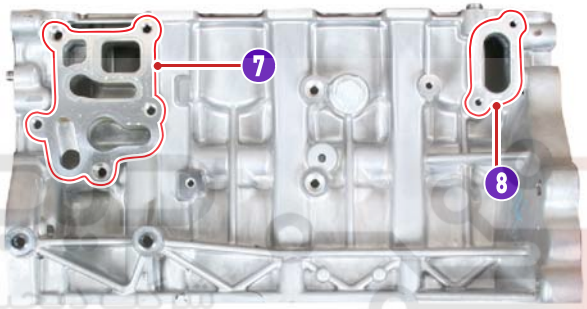


Rear view

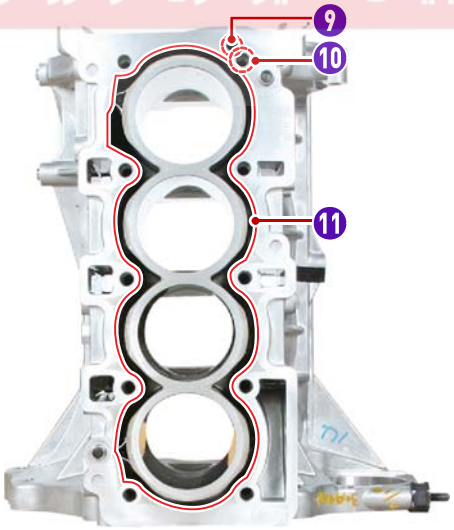
Left view



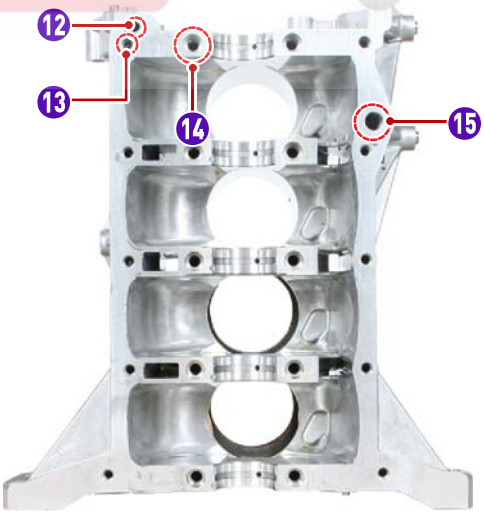
Right view



Top view

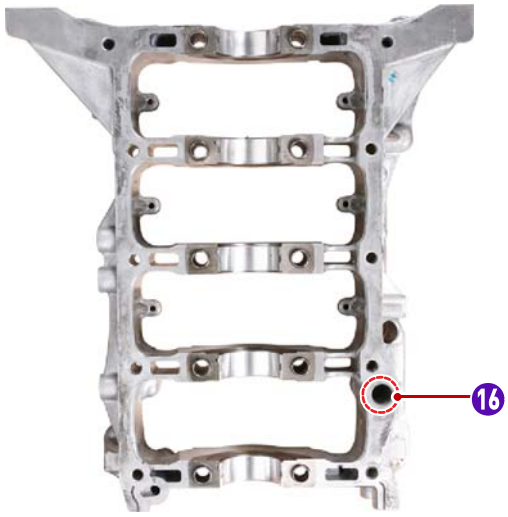


Bottom view



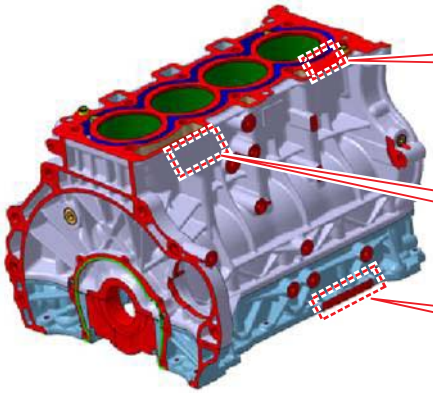
Modification basis	
Application basis	
Affected VIN	

Bed plate

Top view	Bottom view
	

1. Timing chain tensioner mounting
2. Screw plug (PT1/2)
3. Screw plug (PT1/2)
4. Intake manifold damper mounting
5. Crank position sensor connector retaining bracket
6. Screw plug (PT1/4)
7. Oil filter module mounting
8. Cylinder block outlet port mounting
9. Oil passage to cylinder head
10. Cylinder head bolt hole
11. Coolant passage
12. Oil return passage
13. Bed plate bolt hole
14. Main journal bolt hole
15. Cylinder block main oil passage
16. Oil passage from oil pump to bed plate

Information stamped on cylinder block



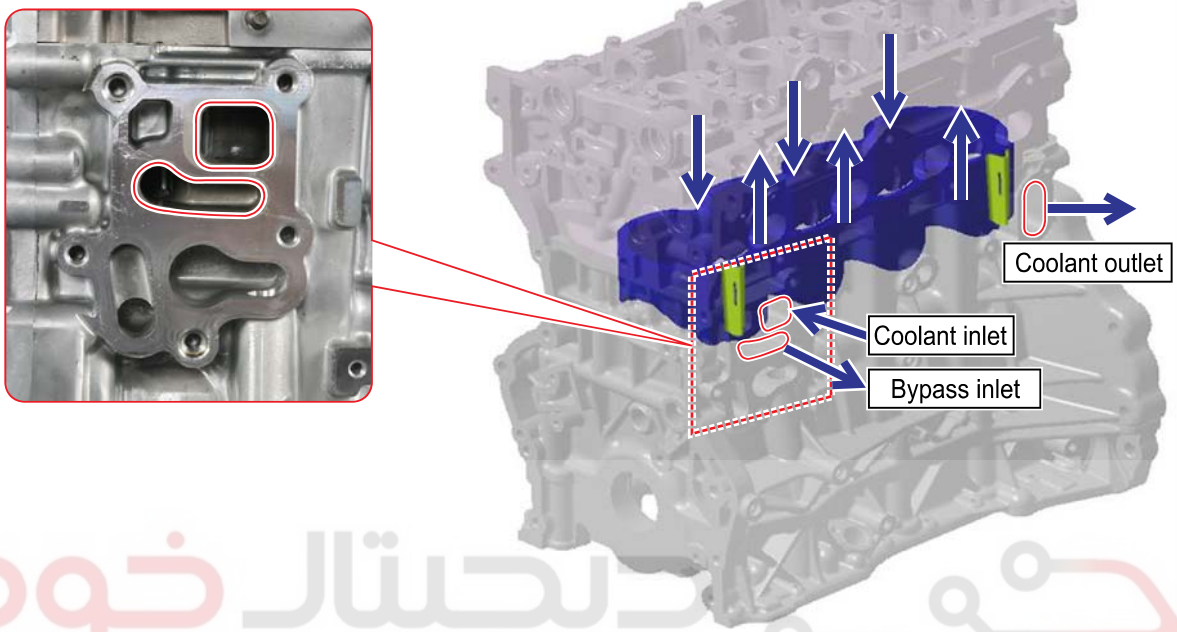
Engine numbering mark

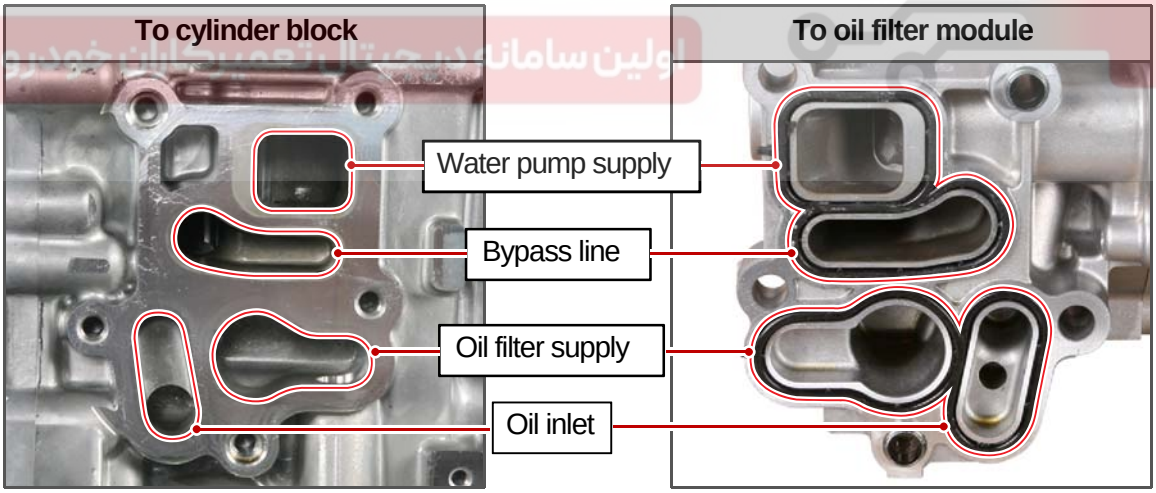
173 910 0 0 999 999

- 173 910: Engine model feature :
  173 : 4-cylinder (Gasoline)
  673 : 4-cylinder (Diesel)
- 910: Engine version
  910 : G16DF
  923 : D16DTF
- 0: Steering type
  1. 0 : Commonly used for LHD and RHD
  2. 1 : LHD
  3. 2 : RHD
- 0: Transmission :
  0(Manual transmission)
  2(Automatic transmission)
- 999 999: Production sequence number :
  determined by engine model, version, steering type and transmission type

Modification basis	
Application basis	
Affected VIN	

Coolant flow in cylinder block assembly

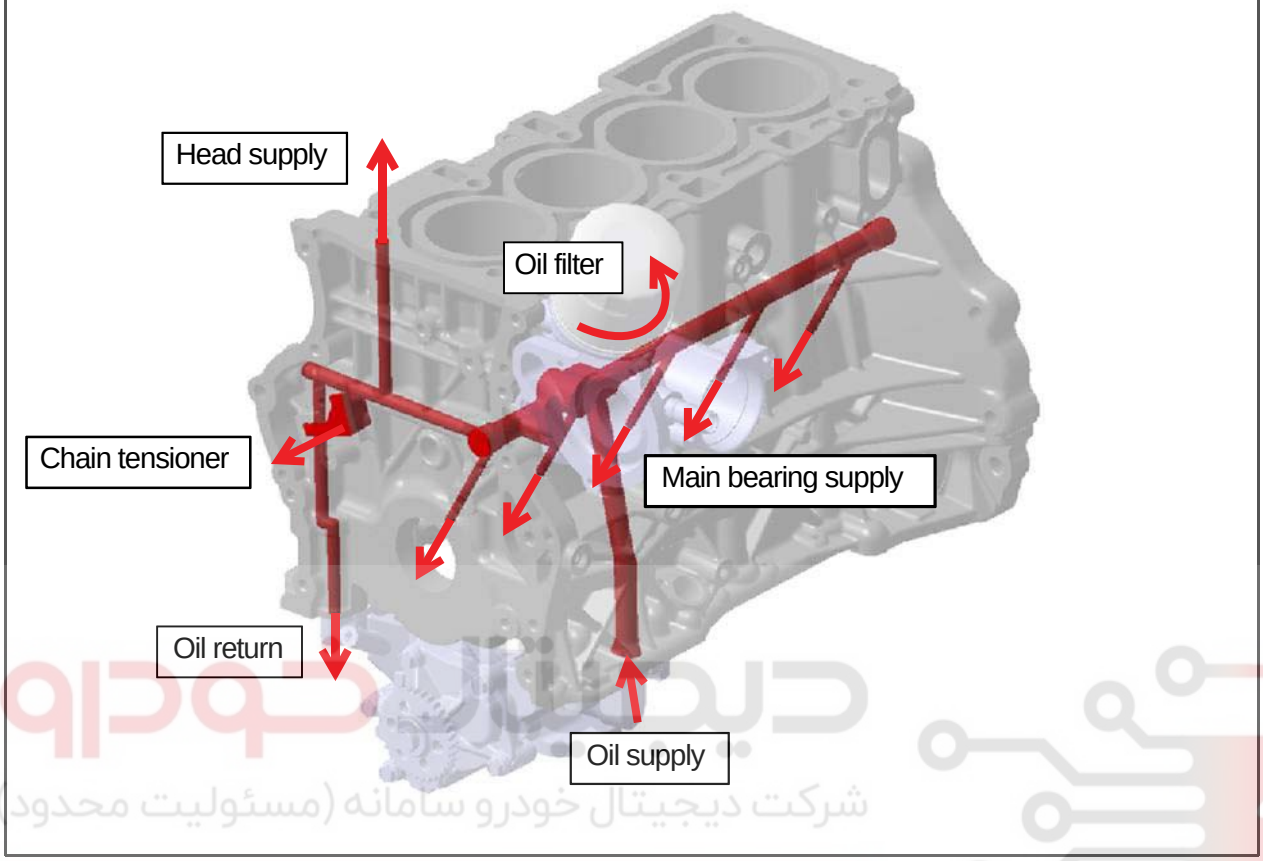




NOTE

- Oil filter supply: Cylinder block to oil filter, Before filtering
- Oil inlet: Oil filter to cylinder block, After filtering

Oil flow in cylinder block assembly



Modification basis	
Application basis	
Affected VIN	

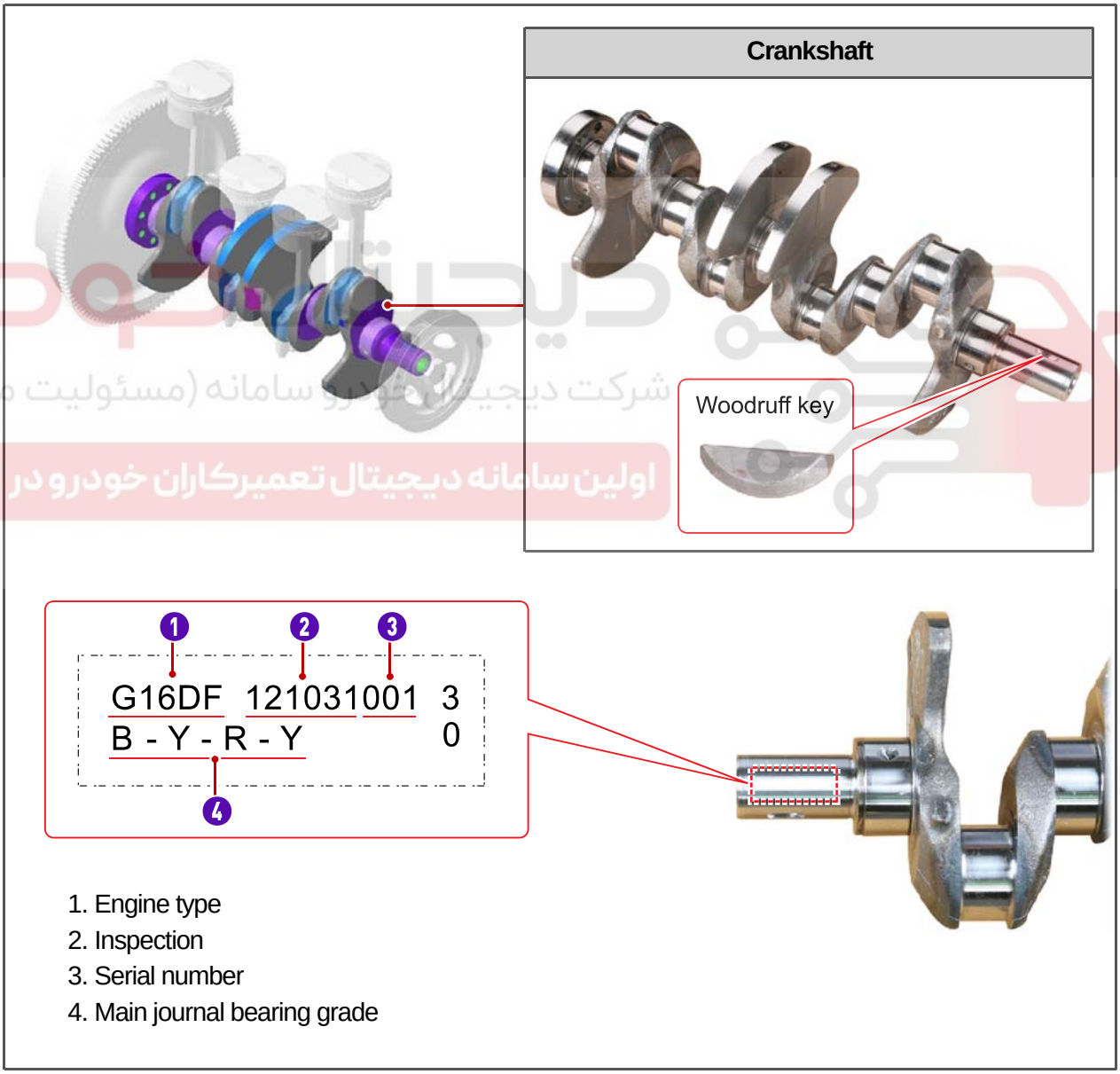
S.G.N. 1130-01

CRANKSHAFT

1) Overview

The crank train has the offset crankshaft which enables a construction that the cylinder bore center line is offset from the crankshaft center line (8 mm). The offset crankshaft reduces piston lateral force applied to the cylinder wall when the pistons move up and down. This reduced lateral force leads to the reduced friction and vibration in the engine. In the long run, this results in improved performance and durability of the engine.

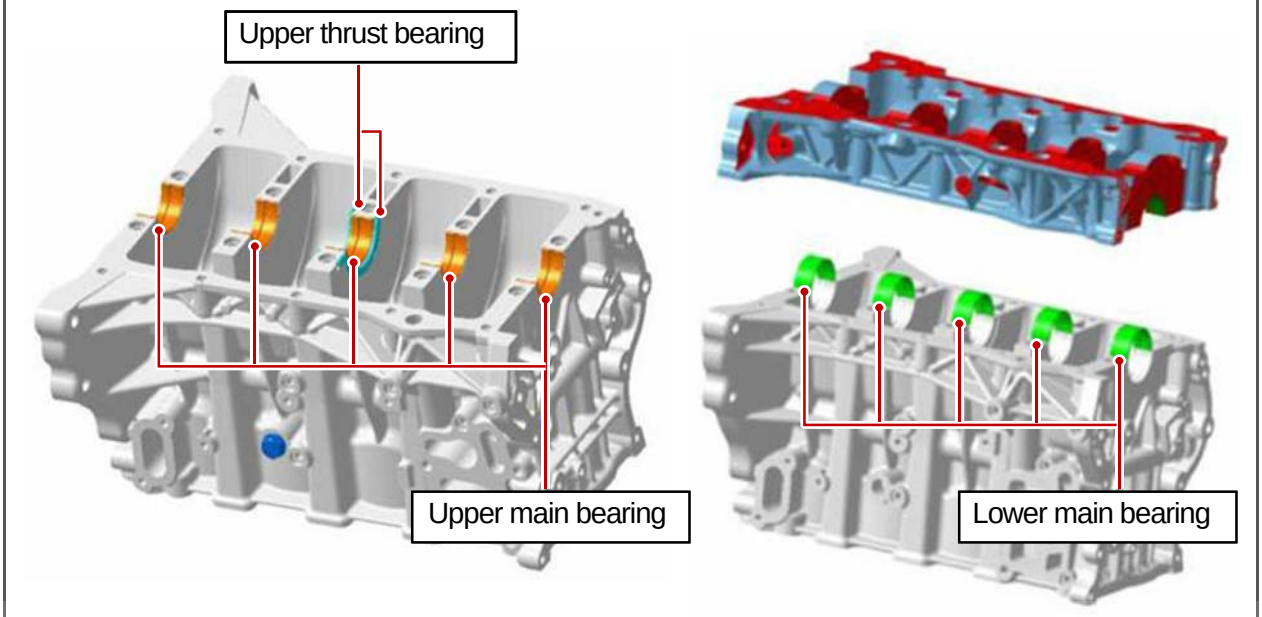
2) Mounting Location and Components

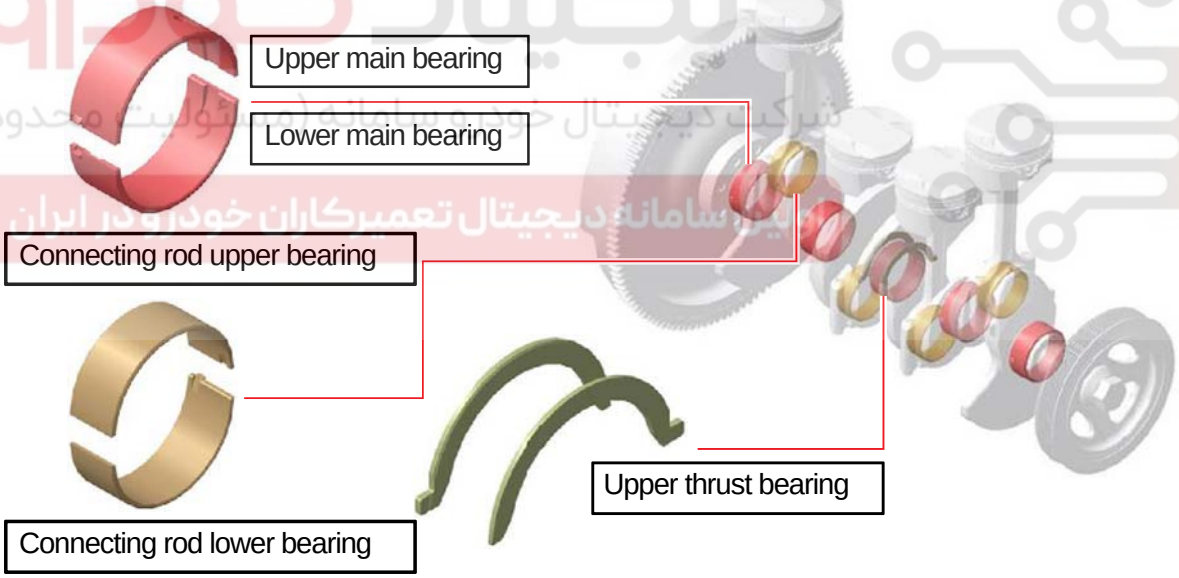


1. Engine type
2. Inspection
3. Serial number
4. Main journal bearing grade

Modification basis	
Application basis	
Affected VIN	

Crankshaft bearing





Modification basis	
Application basis	
Affected VIN	

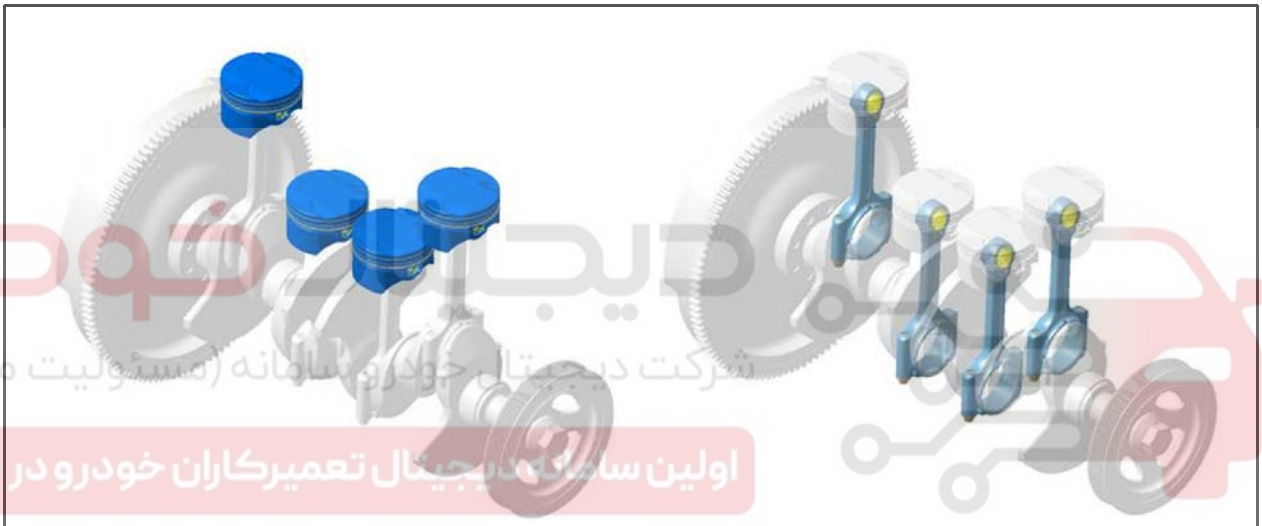
S.G.N. 1130-33

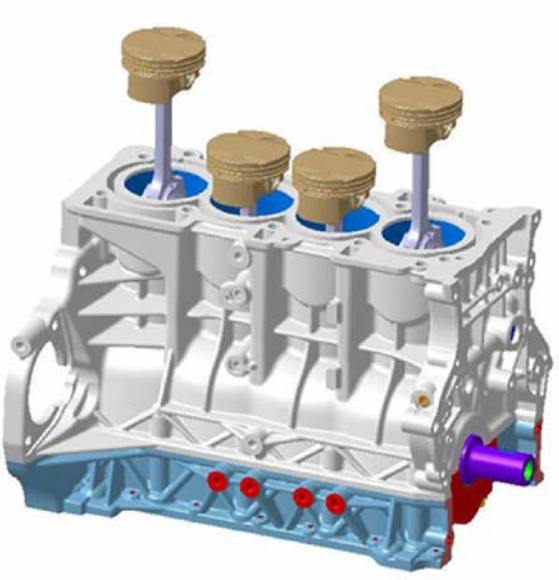
PISTON ASSEMBLY

1) Overview

The piston assembly mainly consists of piston, top ring, second ring, oil ring, piston pin, snap ring, and connecting rod. This assembly transfers the expansion energy generated by combustion in the engine to the crankshaft through the connecting rod. The reciprocating power is converted into rotary power in this process. Therefore, the reciprocal movement of the piston is converted to the rotary movement of the crankshaft through the connecting rod. The big end is engaged to the connecting rod bearing and the crank pin journal, while the small end is connected to the piston pin.

2) Mounting Location and Components

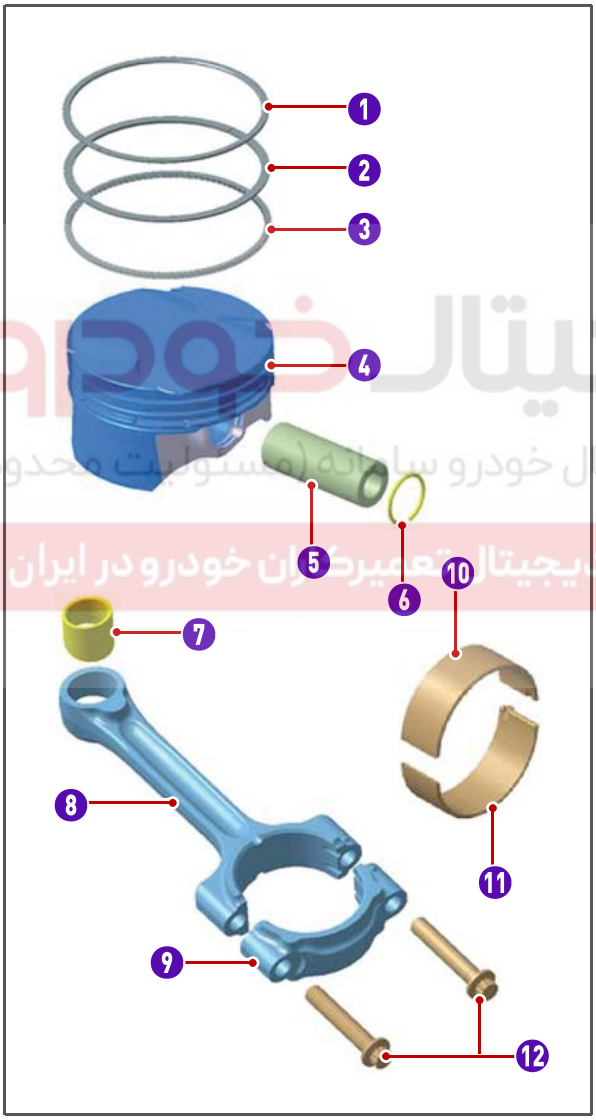




Piston assembly


Modification basis	
Application basis	
Affected VIN	

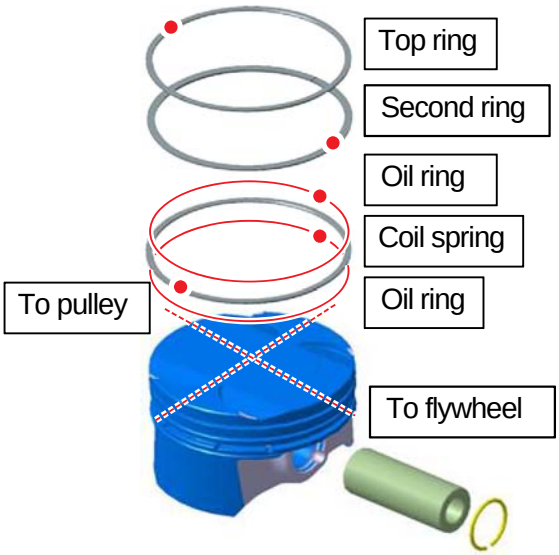
Piston assembly components

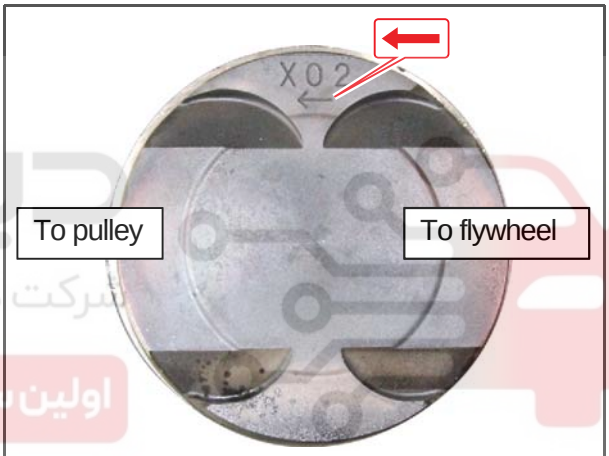


No.	Component
1	Top ring
2	Second ring
3	Oil ring
4	Piston
5	Piston pin
6	Snap ring
7	Piston pin bush
8	Connecting rod
9	Connecting rod cap
10	Connecting rod upper bearing
11	Connecting rod lower bearing
12	Bolt

Modification basis	
Application basis	
Affected VIN	

Installation direction and piston ring





The piston is installed to the cylinder block with the arrow on top toward the pulley.

- The opening of the top ring is at 180° from the opening of the second ring.
- The opening of the oil ring is at 90° from the opening of the second ring.
- The opening of the coil spring is at 180° from the opening of the oil ring.

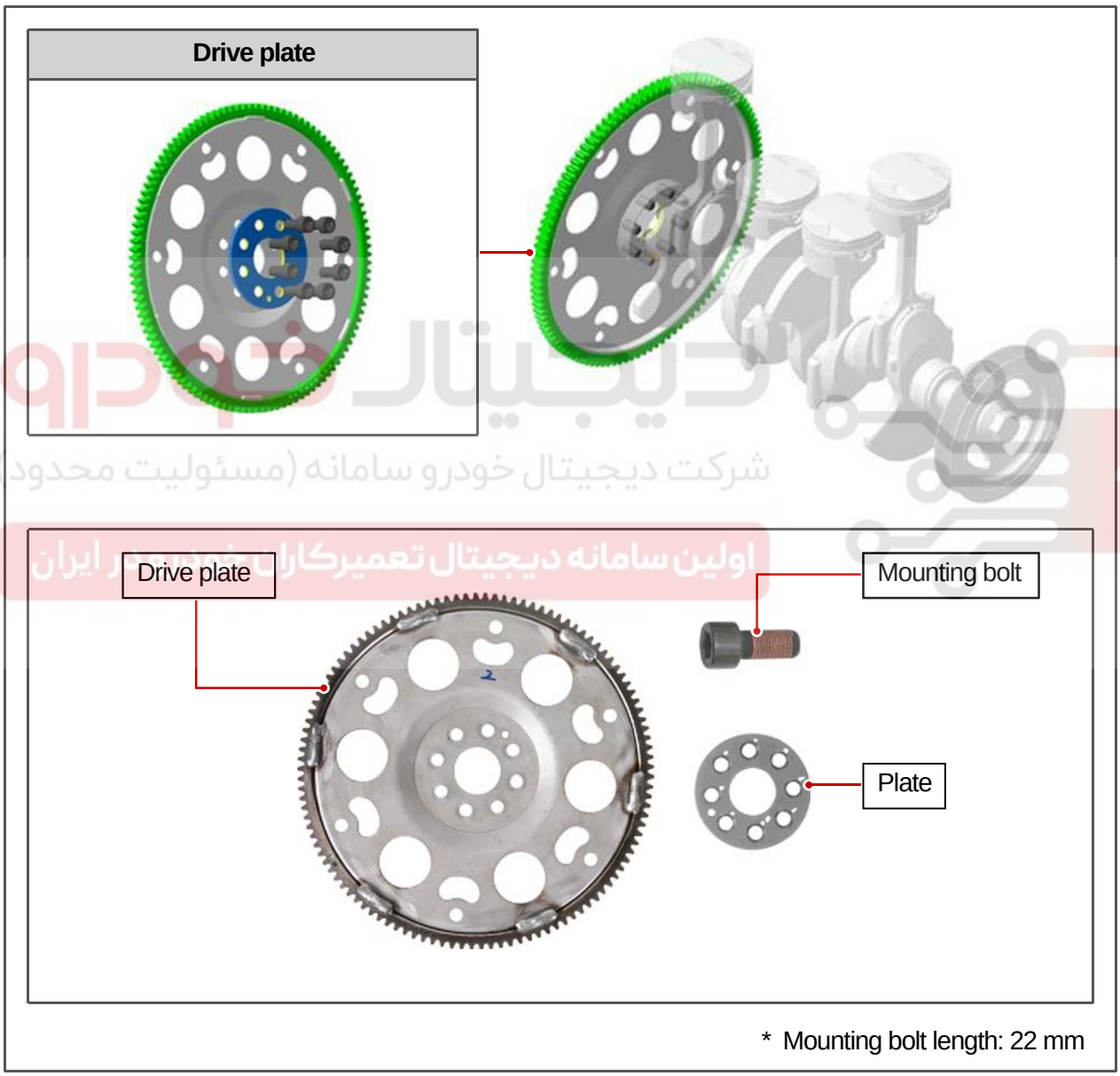
S.G.N. 1130-18

DRIVE PLATE

1) Overview

The drive plate drives the drive train system with the power received from the starter motor when the engine is started. This plate is installed to the crankshaft and connected to the torque converter of A/T transmission to transfer the engine torque to the drive system.

2) Mounting Location and Components



* Mounting bolt length: 22 mm

Modification basis	
Application basis	
Affected VIN	

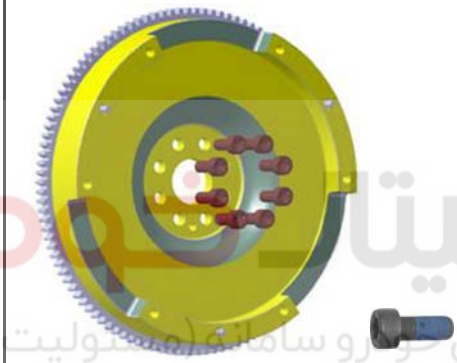
S.G.N. 1130-13

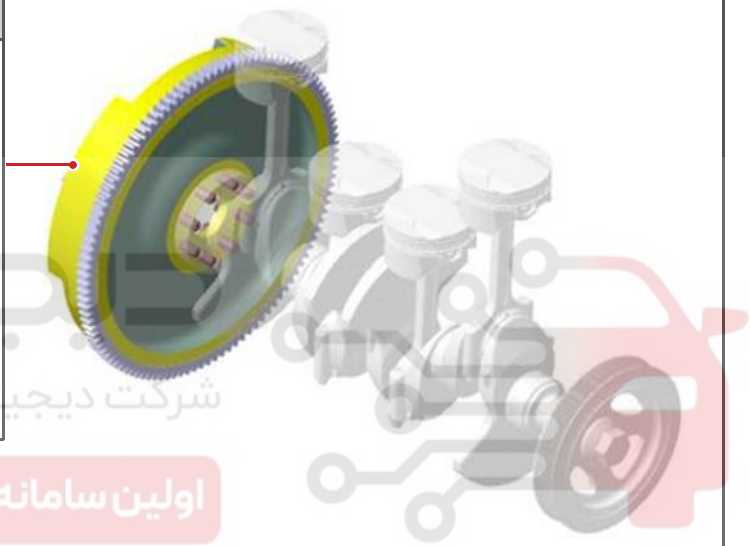
FLYWHEEL

1) Overview

The flywheel is a single mass flywheel (SMF) It is installed to the crankshaft and connected to the clutch disc. The flywheel transfers the torque from the engine to the drive system. Before transferring the torque to the drive system, the flywheel reduces the fluctuation of rotation speed and torque generated from combustion in the engine. Thus, the rattling noise of the transmission and the vibration of the vehicle can be greatly reduced.

2) Mounting Location and Components

Flywheel




* Mounting bolt length: 26 mm

Front view	Rear view
	

NOTE

The SMF reduces the crankshaft revolution irregularities.

REMOVAL AND INSTALLATION

S.G.N. 0000-00 CHECK AND INSPECTION

1) Cylinder

(1) Cylinder compression pressure

▶ **Reference value**

Compression ratio		10.5 : 1
Check condition		At normal engine operating temperature (80°C)
Compression pressure	**Normal**	10 bar to 16 bar
	Optimal fuel pressure	6 bar to 10 bar
Permitted deviation in pressure between cylinders		1.5 bar or less

The aim of measuring the compression pressure is to ensure the maximum performance for the engine by checking the operation of the internal components of the engine, such as piston, piston ring, intake and exhaust valves, head gasket.

CAUTION
- Take extra care not to injure yourself or others by putting away the wirings for measuring and other tools from the rotating parts of the engine before operating the starter motor.
- Make sure nobody is in front of the vehicle and be sure to perform measurement on a level surface.
- Remove the deposits in the cylinder before measuring the compression pressure.
- Apply the parking brake when cranking the engine.

▶ **Measuring procedure**

- Warm up the engine to the normal operating temperature (80°C).
- Remove the fuel pump fuse to shut off the fuel injection.
- Remove the air cleaner duct and 4 ignition plugs.

1. Insert a sheet of diagram sheet in the compression pressure tester and fit the tester in a ignition plug hole.

Modification basis	
Application basis	
Affected VIN	

2

2. Crank the engine for about 10 seconds.

3

3. Repeat the procedure above for the remaining cylinders to measure the compression pressure.

4. If the measured compression pressure value is incorrect, perform the cylinder pressure leak test.

(2) Cylinder pressure leak test

▶ **Permitted leak pressure**

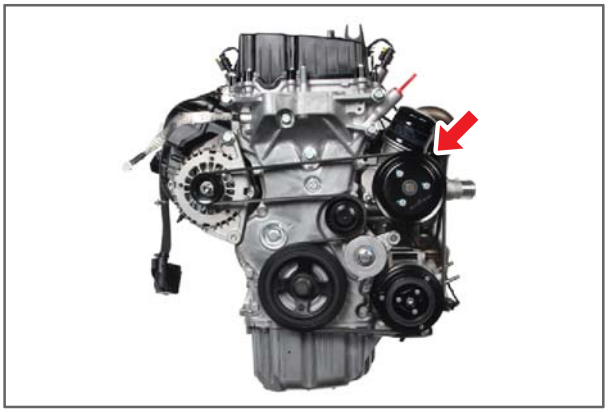
Check condition: At normal engine operating temperature (80°C)	Specified value
Across the engine	Up to 25%
At valve and cylinder head gasket	Up to 10%
At piston ring	Up to 20%

If the measured compression pressure value is out of the specified range, check the cylinder for pressure leaks with a cylinder pressure leak tester. If the measured value exceeds the specified value, then there is leakage in the cylinder.

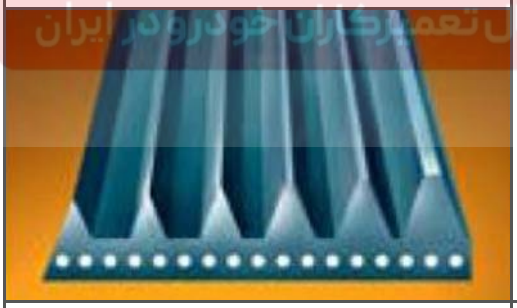
CAUTION

- Check the rest of the cylinders for pressure leaks in the order of the fuel injection sequence.
- Wet tester prohibited: Do not test by filling the combustion chamber with engine oil.

2) V-belt



Mark a start point on the belt and check the belt for possible damage by rotating the crankshaft pulley.

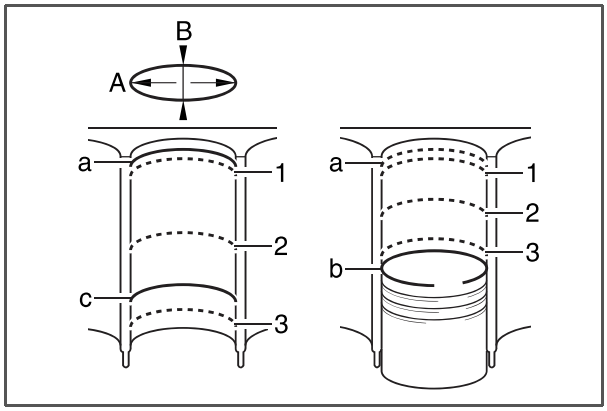
Symptom	Cause	Action
Damage to the side of belt or hardened belt 	- Incorrect tension of belt - Incorrect installation of belt	- Install belt correctly after adjusting belt tension - Replace belt
One-sided wear of belt 	- Drive system pulley is out of alignment - Excessive belt vibration - Hard movement due to faulty pulley or idler	- Re-align drive system pulley and idler pulley, and replace faulty pulley - Check belt tension and replace belt if necessary
Belt noise 	- Low tension of belt - Expected service life of belt already exceeded	- Replace belt

Modification basis	
Application basis	
Affected VIN	

3) Cylinder Block

▶ **Measuring cylinder block bore**

1. Wipe out the cylinder bore.
2. Measure the bore size in axial direction and thrust direction on 3 points (1, 2, 3) with a bore gauge.

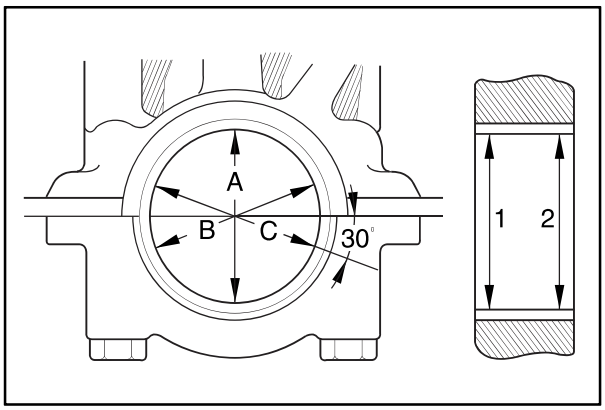


Measuring points 1, 2, 3
A. Axial direction
B. Thrust direction
a. Piston position at TDC
b. Piston position at BTDC
c. Oil ring position centered between TDC and BTDC

Modification basis	
Application basis	
Affected VIN	

4) Crankshaft

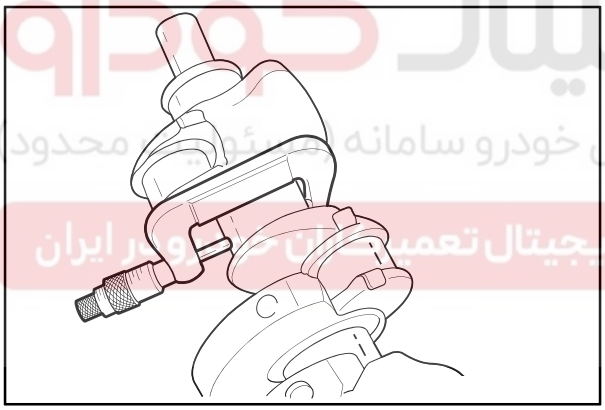
▶ Crankshaft bearing bore



Measure the bore of the crankshaft bearing with a bore gauge.

CAUTION
- Measure the values at 2 positions (1, 2). Measure the values at the positions A, B and C as shown in the figure.
- If the average value of B and C is lower than the value of A, then it can be used as actual average value. If the average value of B and C is higher than the value of A, then the value of A can be used as actual average value.

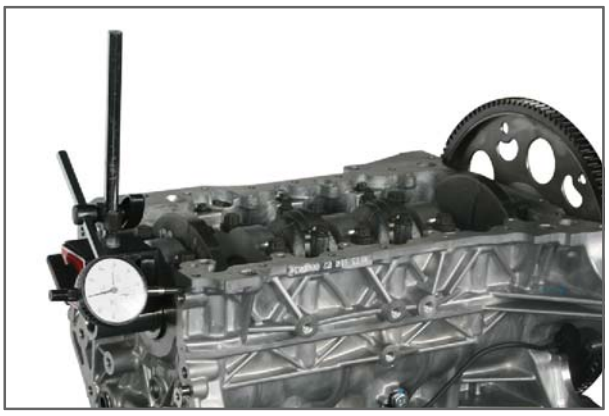
▶ Crankshaft journal



Measure the diameter of the crankshaft bearing journal with a micro meter.

CAUTION
- Measure the values at 3 positions (A, B, C) and calculate the average value.
- If the average values of the bearing bore and journal diameter are not within the specified range, replace the bearing shell.

▶ Crankshaft end play



Location

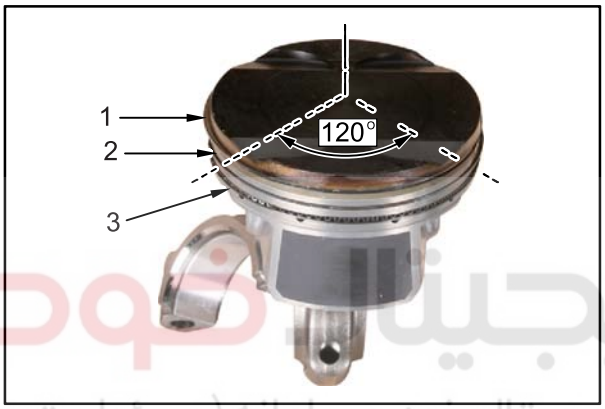
Crankshaft: Magnetic base
Dial gauge: Front of cylinder block

Specified value (mm)	0.100 to 0.266

Modification basis	
Application basis	
Affected VIN	

5) Piston and Connecting Rod

Install the compression ring and oil ring to the piston using a special tool.



The opening section of the piston oil ring should be positioned at 120° from that of the compression ring.

CAUTION

- Install the no.1 and no. 2 compression rings with the marks facing upwards.
- Thickness of no. 1 piston ring is higher than that of no. 2 piston ring.
- Put the oil ring with the opening section positioned on the other side of the base opening.
- The oil ring has no direction.
- Make sure that the openings of the piston are not overlapped.

Modification basis	
Application basis	
Affected VIN	

▶ Measuring clearance of oil ring and compression ring

1. Check the piston ring for damage, wear and crack. Replace a damaged ring with a new one.
2. When replacing the piston, the piston ring should be replaced together.
3. Measure the clearance between the piston ring and ring groove.

No. 1 compression ring	0.15 to 0.30 mm
No. 2 compression ring	0.30 to 0.50 mm
No. 3 oil ring	0.20 to 0.70 mm

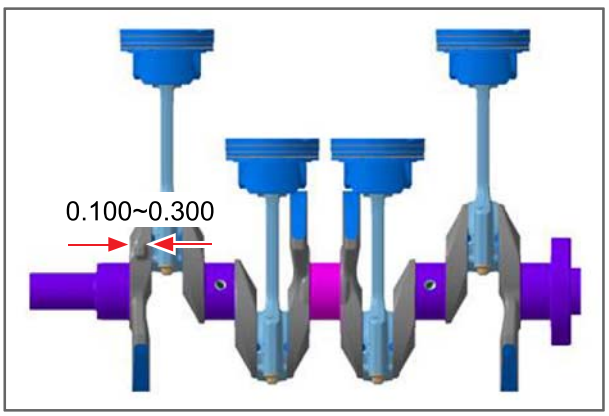
* Piston ring free gap
No. 1 compression ring: 7.5 mm
No. 2 compression ring: 7.5 mm
No. 3 compression ring: 1.0 to 4.0 mm

▶ Connecting rod end play

Location

Crankshaft: Magnetic base
Dial gauge: Front of cylinder block

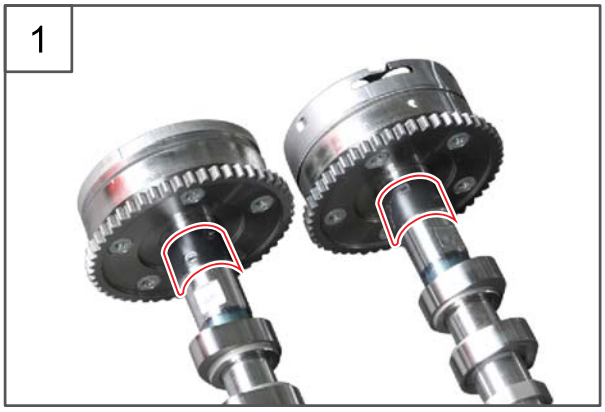
Specified value (mm)	0.100 to 0.300



Modification basis	
Application basis	
Affected VIN	

▶ Continuous variable valve timing (CVVT) system

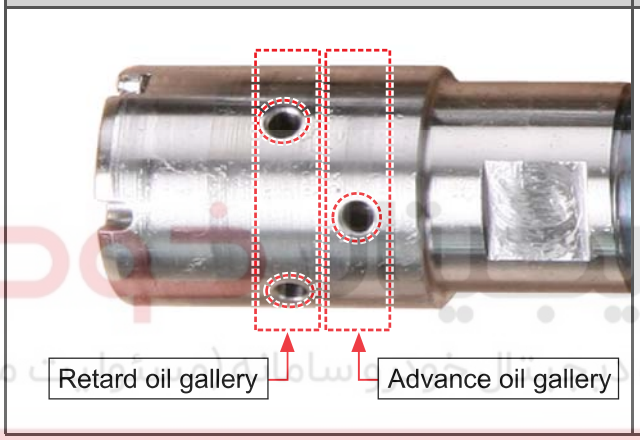
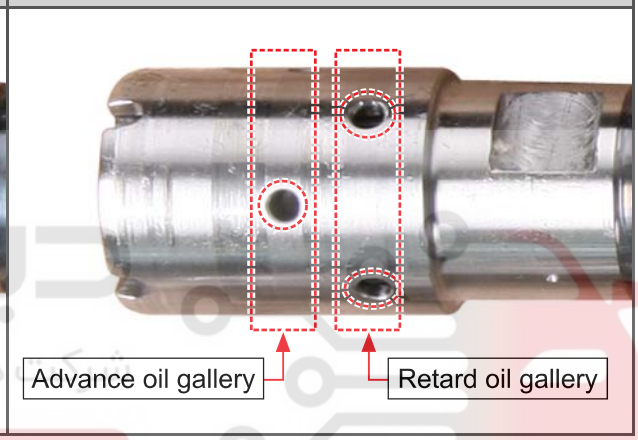
1



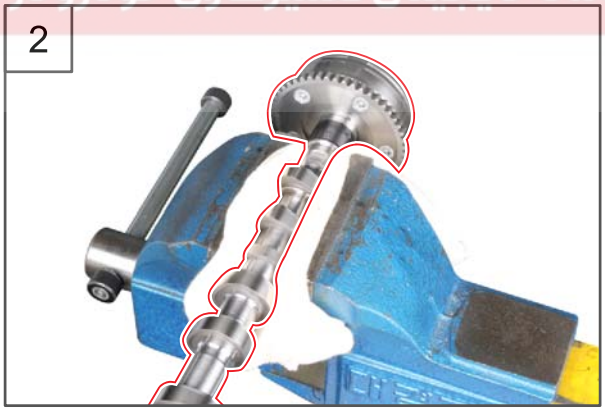
1. Cover all advance and retard holes of the camshaft with vinyl tape or similar except one hole for each type.

NOTE

Cover all advance and retard holes of the camshaft with vinyl tape or similar and punch through the tape in one advance hole and one retard hole.

Intake camshaft	Exhaust camshaft
	

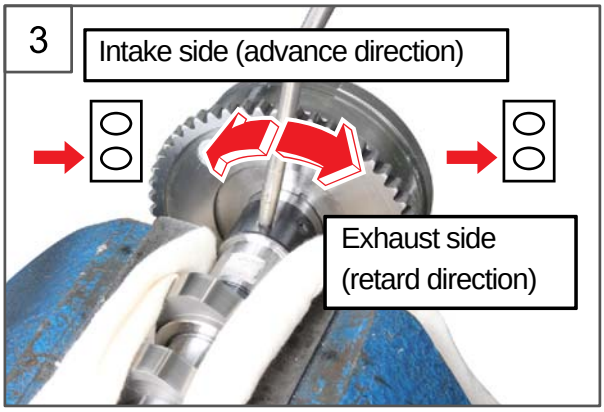
2



2. Clamp the intake/exhaust camshaft in a vice and apply compression pressure to the manually punched advance and retard holes with an air gun to check if the lock pin is released. (Lock pin release pressure: 0.5 bar)

CAUTION

When clamping the camshaft in a vice, cover it e.g. with a rag to protect the cam lobe and journal from being damaged.



3. Check the operation of the CVVT of the intake/exhaust camshaft.

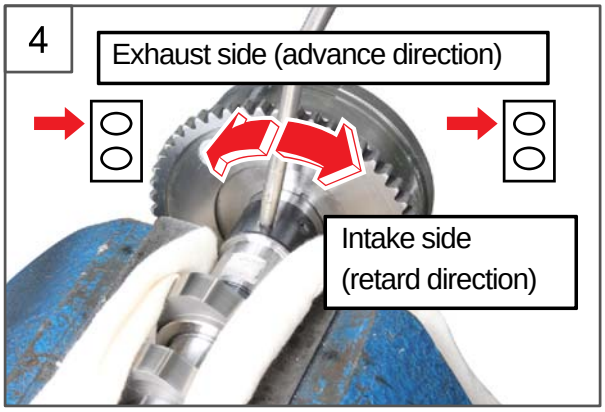
- **Intake side:** Supply compressed air into the advance hole to check if the sprocket rotates in advance direction (counterclockwise).
- **Exhaust side:** Supply compressed air into the retard hole to check if the sprocket rotates in retard direction (clockwise). (For the exhaust side, you need to rotate the sprocket by hand after supplying compressed air and the sprocket returns to its original position after the applied compression pressure is released because of the force of the return spring)

NOTE

CVVT travel range

- Intake side: 25.75° ± 1.0° (from maximum retard position to maximum advance position)
- Exhaust side: 25.75° ± 1.0° (from maximum advance position to maximum retard position)

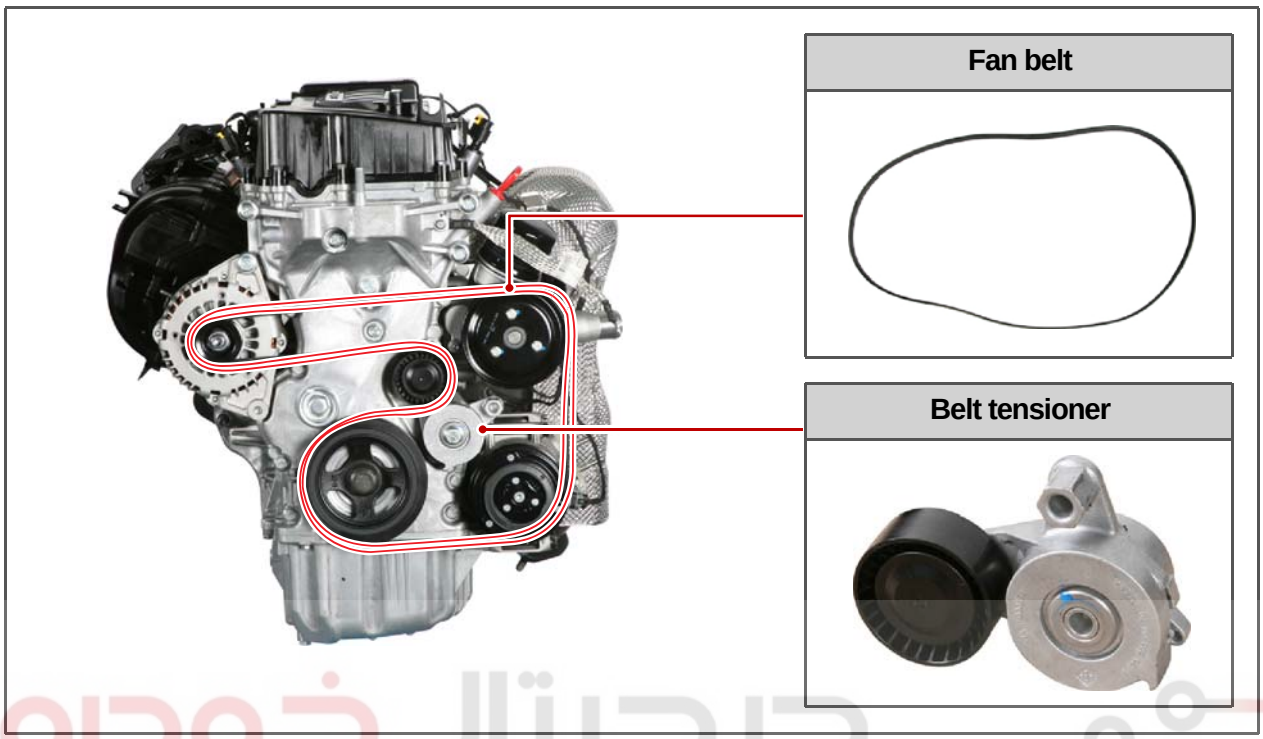
Modification basis	
Application basis	
Affected VIN	

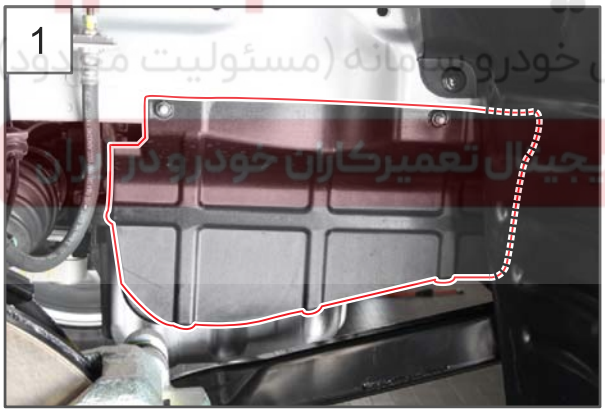


4. Apply compression pressure to the manually punched advance and retard holes of the intake/exhaust camshafts with an air gun to check if the sprocket rotates and lock pin is locked in place.

- **Intake side:** Supply compressed air into the retard hole to check if the sprocket rotates in retard direction (clockwise) and the lock pin is locked in place at the maximum retard position.
- **Exhaust side:** Release the compressed air at the retard position in the step above to check if the sprocket returns to the original position (advance position) and the CVVT system is locked in place by the lock pin. Apply compressed air into the advance hole to check for leak tightness and lock status of the lock pin.
  (For the exhaust side, you need to rotate the sprocket by hand after supplying compressed air because of the force of the return spring)

S.G.N.
1350-01 BELT SYSTEM



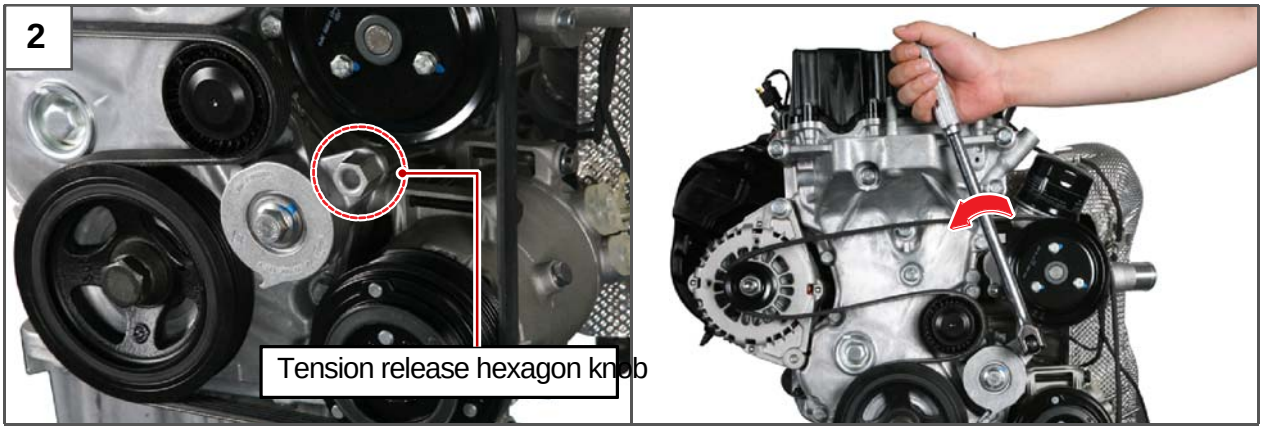


1. Remove the RH side cover.

Modification basis	
Application basis	
Affected VIN	

2. Turn the belt tensioner release hexagon knob (19 mm) counterclockwise using a special tool to relieve the tension.

2



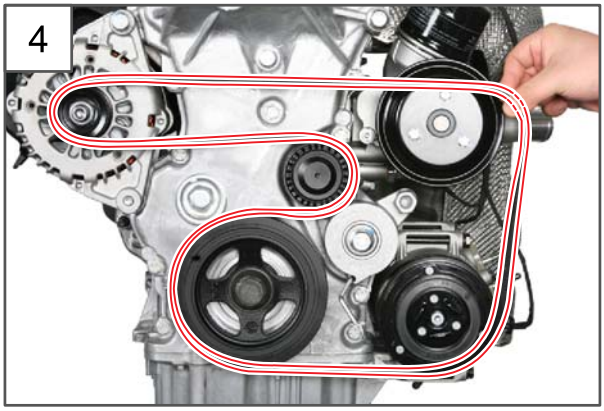
CAUTION

Do not apply excessive force to the fully compressed belt tensioner when releasing the tension. Failure to do so may lead to deformation of the belt tensioner.

3. After releasing the tension of the belt tensioner, secure the belt tensioner by fitting a retaining pin (B, approx. Ø4.5) into the retaining pin hole (A) as shown in the picture.

3

4



4. Remove the fan belt and then retaining pin for the belt tensioner.

5

6

5. Loosen the mounting bolt (17 mm) for the belt tensioner.

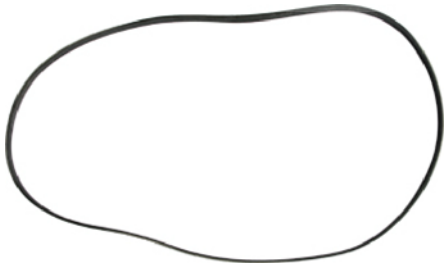
Tightening torque 61 ± 2.0 Nm

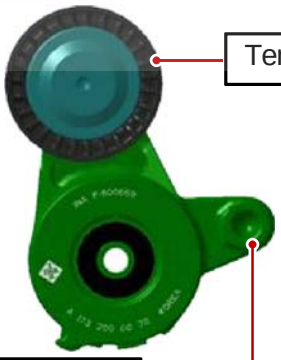
6. Remove the belt tensioner with the mounting bolt fitted.

NOTE

The mounting bolt for the belt tensioner cannot be removed before removing the belt tensioner, because it interferes with the vehicle body.

7. Install in the reverse order of removal.





Modification basis	
Application basis	
Affected VIN	

Installation of belt

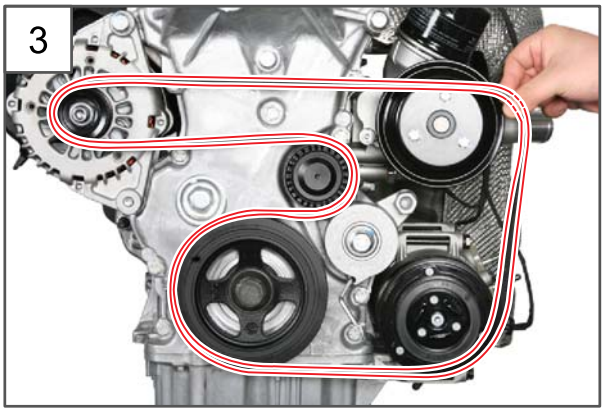
1. Install the belt tensioner by making sure the guide pins on the rear face of the belt tensioner are seated on the guide pin holes on the timing gear case cover.

1

2. After releasing the tension of the belt tensioner, secure the belt tensioner by fitting a retaining pin (B, approx. Ø4.5) into the retaining pin hole (A) as shown in the picture.

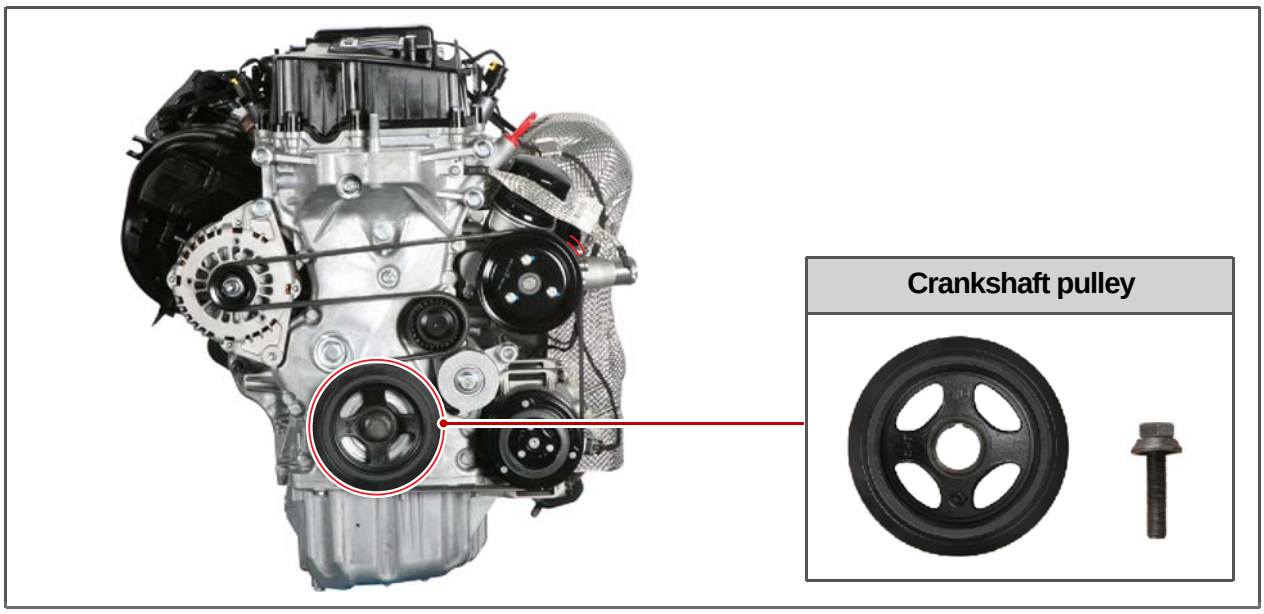
2

3



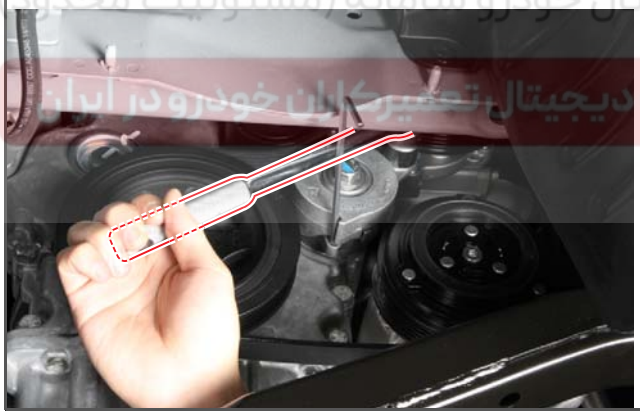
3. Fit the fan belt and remove the retaining pin for the belt tensioner.

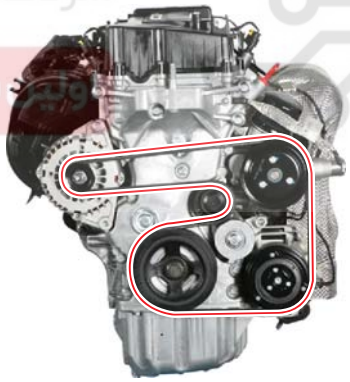
S.G.N.
1130-12 CRANKSHAFT PULLEY



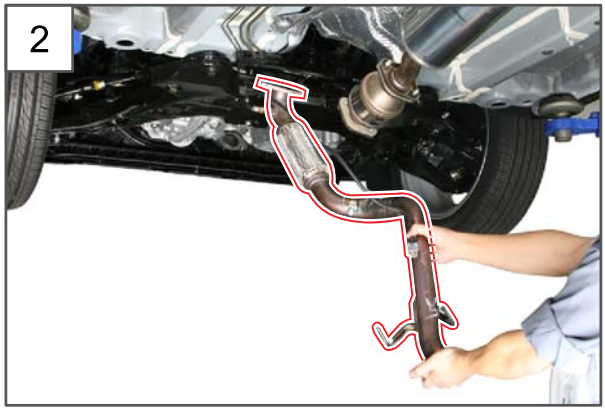
1. Remove the fan belt from the vehicle.

NOTE
Refer to "BELT SYSTEM" under this subsection.





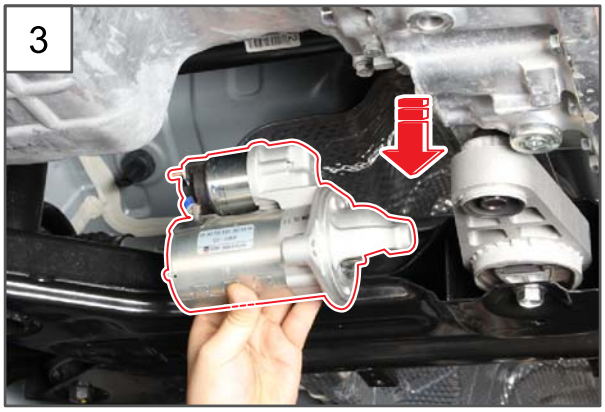
2



2. Remove the front exhaust pipe before removing the starter motor to install a special tool for retaining the flywheel.

NOTE
Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

Modification basis	
Application basis	
Affected VIN	



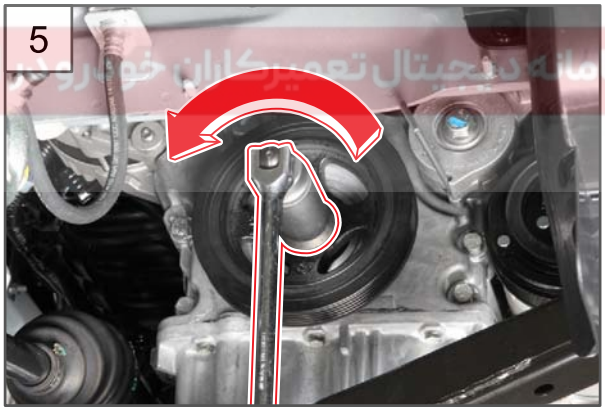
3. Remove the starter motor.

NOTE

Refer to "starter motor" under "REMOVAL AND INSTALLATION" subsection of "STARTING SYSTEM" section in "G16DF ENGINE" chapter.

4. Fit a special tool to the starter motor mounting to hold the flywheel.

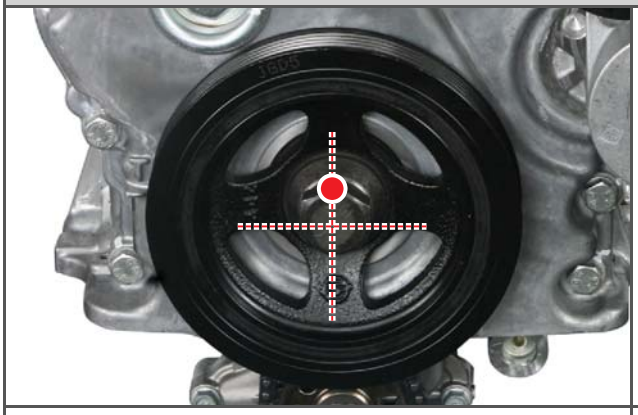
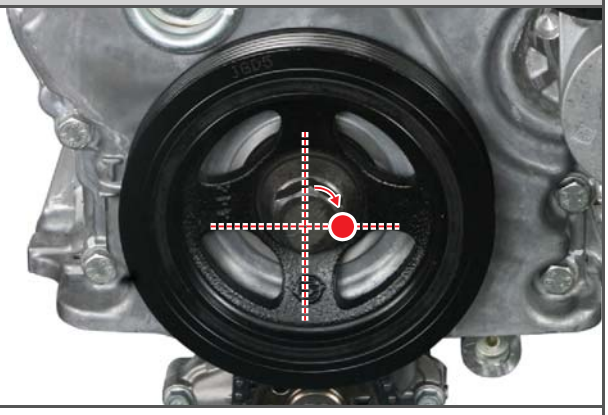
Flywheel fixture

5. Remove the center bolt (27 mm) securing the crankshaft pulley.

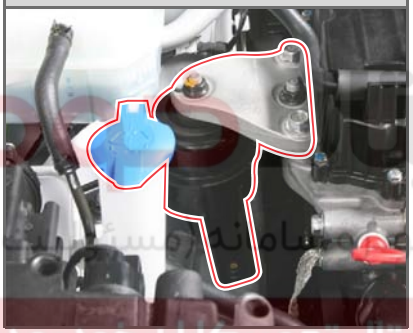
Sequence	Tightening torque
1	220 Nm
2	90°

6. Remove the crankshaft pulley.
7. Install in the reverse order of removal.

Angle tightening crankshaft pulley mounting bolt	
	
Paint mark on each bolt after the 1st torque tightening (220 Nm).	Angle tighten the bolts further (90°) in sequence at the time of 2nd tightening.

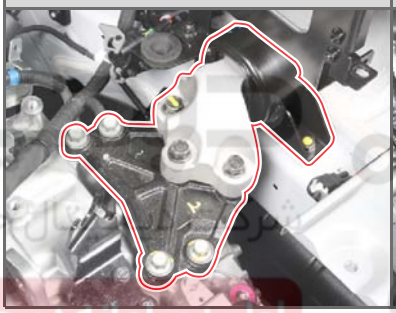
S.G.N.
1990-00 ENGINE MOUNTING ASSEMBLY

RH engine mounting assembly

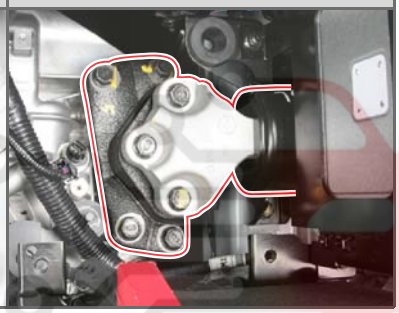


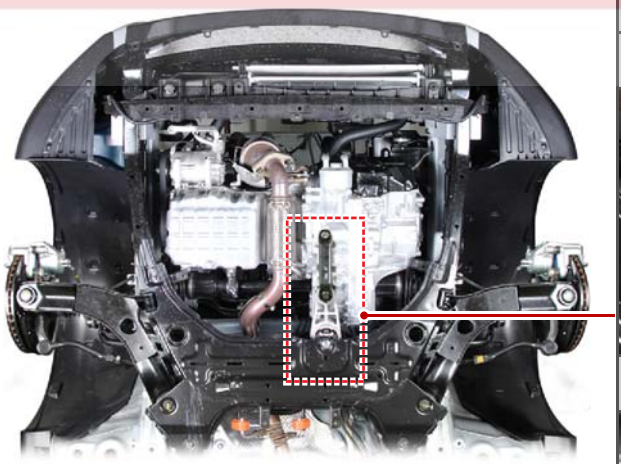
LH engine mounting assembly

For a vehicle with A/T



For a vehicle with M/T

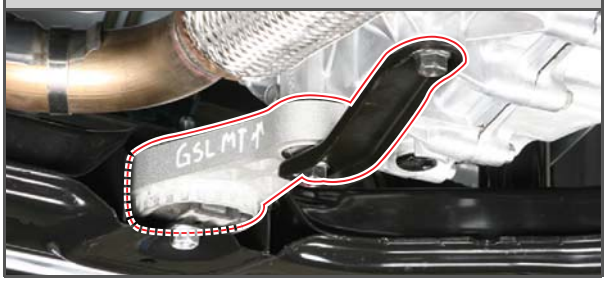




Rear engine mounting assembly

For a vehicle with A/T

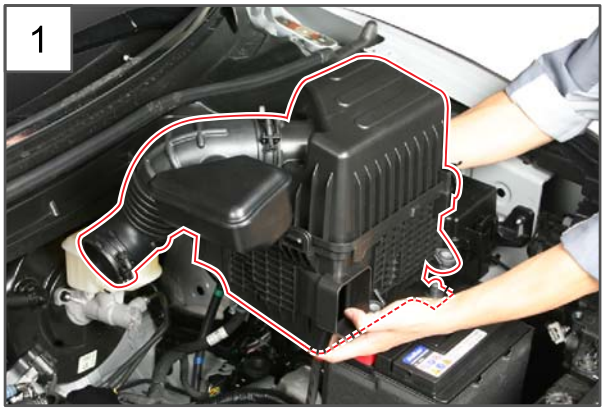
For a vehicle with M/T



Modification basis	
Application basis	
Affected VIN	

1) LH Engine Mounting Insulator

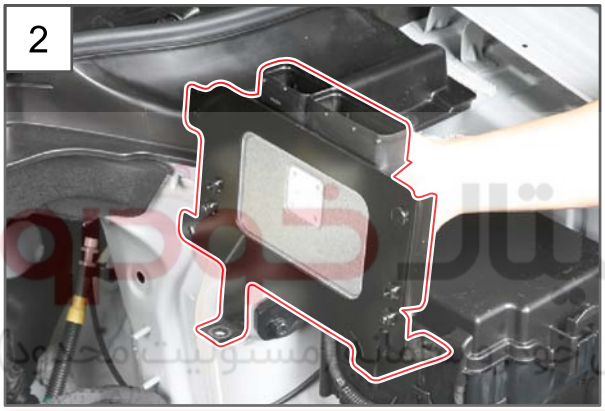
Preceding work - Remove the rear undercover.



1. Remove the air cleaner assembly from the engine compartment.

NOTE

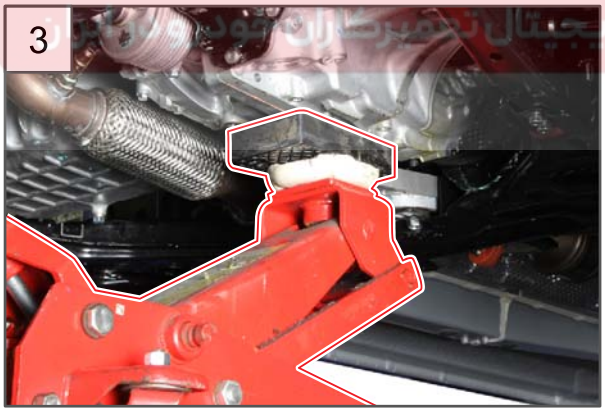
Refer to "AIR CLEANER ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "INTAKE SYSTEM" section in "G16DF ENGINE" chapter.



2. Remove the ECU with bracket.

NOTE

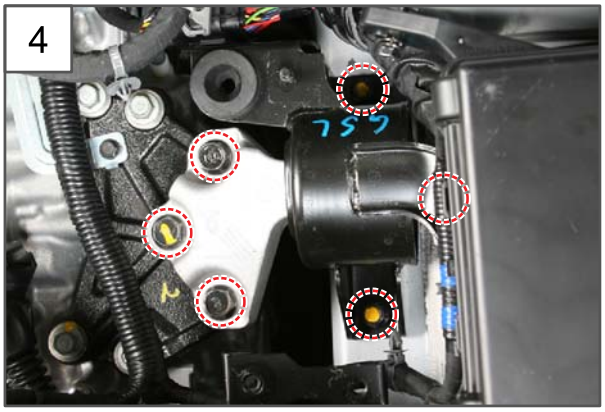
Refer to "ECU" under "REMOVAL AND INSTALLATION" subsection of "ENGINE CONTROL" section in "G16DF ENGINE" chapter.



3. Position the floor jack under the transmission.

Modification basis	
Application basis	
Affected VIN	

4



4. Remove the 3 mounting bolts (A, 17 mm) and 3 mounting nuts (B, 17 mm) for the LH engine mounting insulator.

Tightening torque 68.6 to 88.2 Nm

5

5. Remove the LH engine mounting insulator.

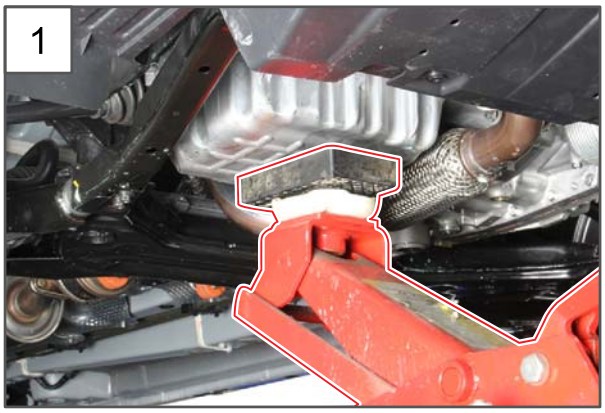
6

6. Install in the reverse order of removal.

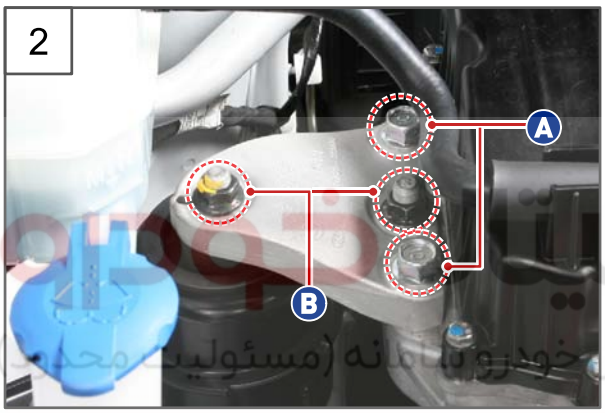
Modification basis	
Application basis	
Affected VIN	

2) RH Engine Mounting Insulator

Preceding work - Remove the rear undercover.



1. Position the floor jack under the engine oil pan.



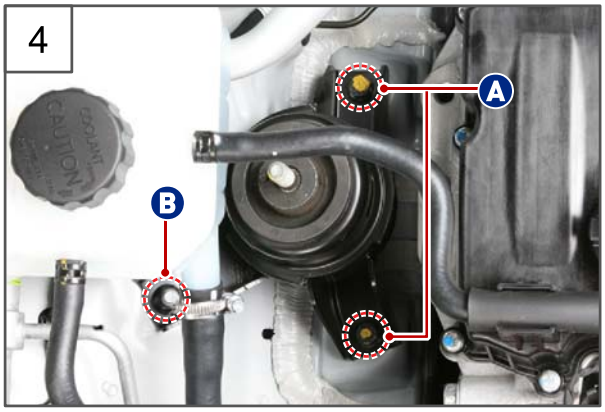
2. Remove the 2 mounting bolts (A, 17 mm) and 2 mounting nuts (B, 17 mm) for the RH engine mounting bracket.

Tightening torque 68.6 to 88.2 Nm

3. Remove the RH engine mounting bracket.

Modification basis	
Application basis	
Affected VIN	

4



4. Remove the 2 mounting bolts (A, 14 mm) and the mounting nut (B, 14 mm) for the RH engine mounting insulator.

Tightening torque 45 ± 5 Nm

5

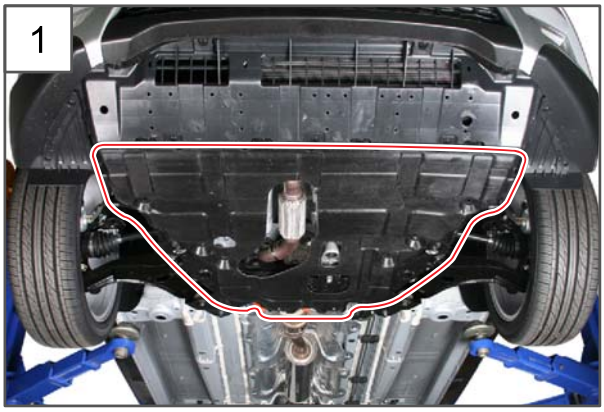
5. Remove the RH engine mounting insulator.

6. Install in the reverse order of removal.

RH engine mounting bracket	RH engine mounting insulator
	

Modification basis	
Application basis	
Affected VIN	

3) Rear Engine Mounting Insulator

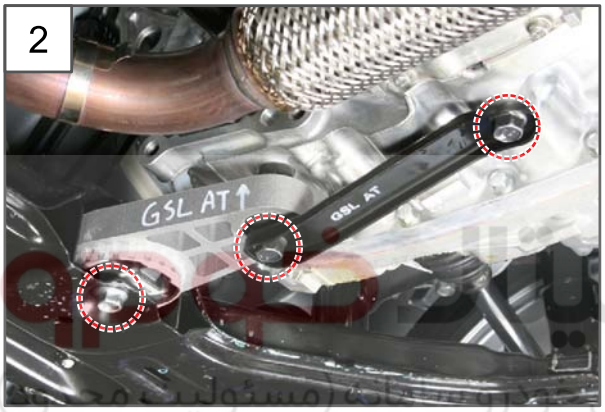


1. Remove the rear under cover under the vehicle.

Tightening torque 13.8 to 17.6 Nm

CAUTION

Tighten the mounting bolt to the specified torque. Excessive tightening torque can cause damage to the rear under cover.

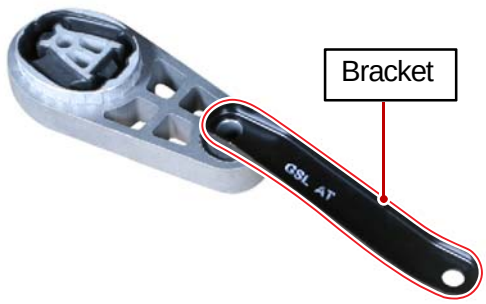
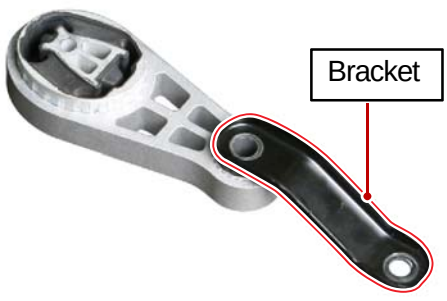


2. Unscrew the 3 mounting bolts (17 mm) for the rear engine mounting insulator.

Tightening torque 68.6 to 88.2 Nm

3. Remove the rear engine mounting insulator.

4. Install in the reverse order of removal.

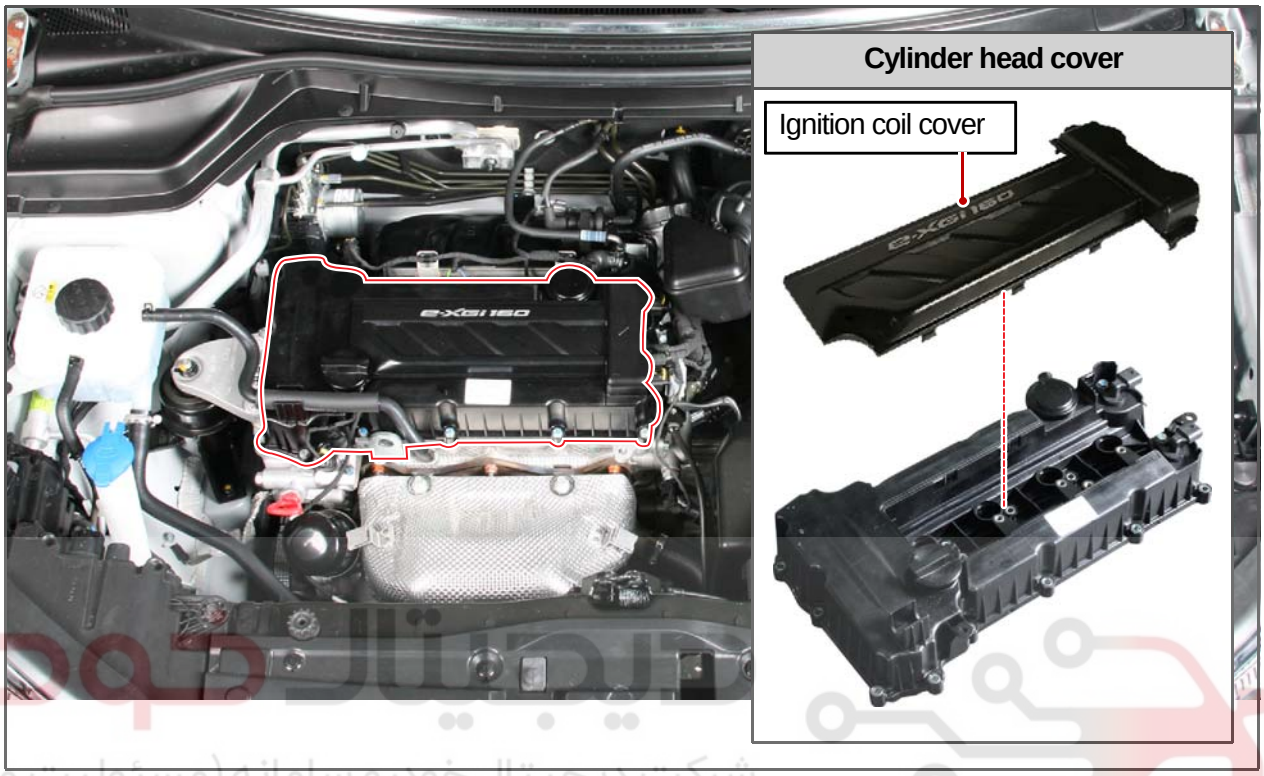
For a vehicle with A/T	For a vehicle with M/T
	

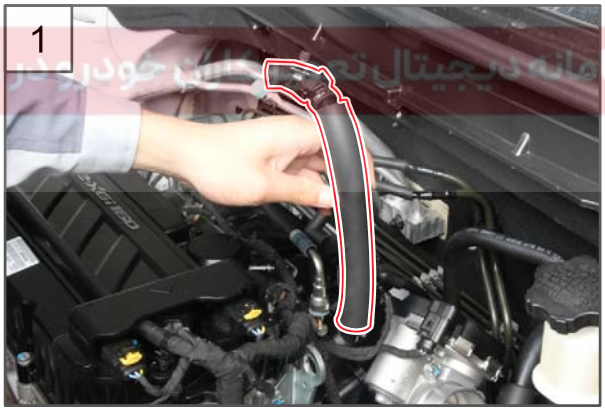
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1221-01

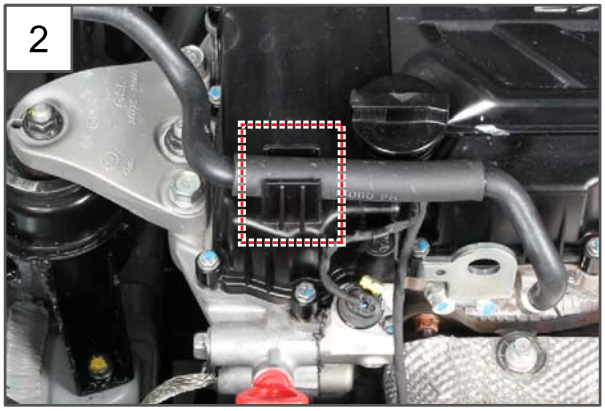
CYLINDER HEAD COVER

Preceding work - Disconnect the negative cable from the battery.





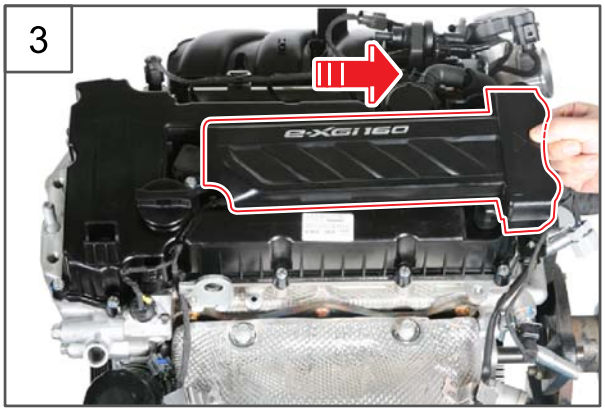
1. Disconnect the blowby hose from the cylinder head cover.



2. Detach the engine de-aeration hose from the mounting on the cylinder head cover.

Modification basis	
Application basis	
Affected VIN	

3

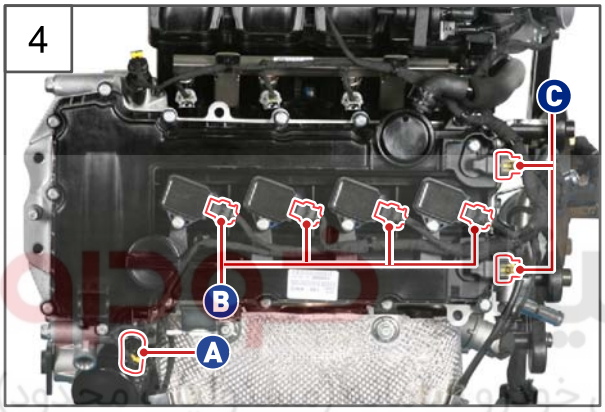


3. Slide and remove the ignition coil cover in the direction of the arrow as shown in the picture.

NOTE

Install the ignition coil cover in vertical direction.

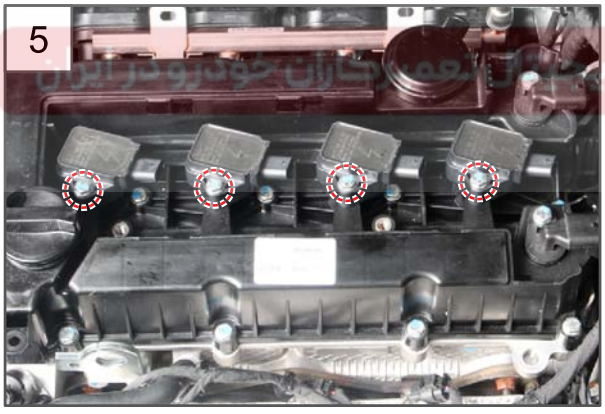
4



4. Disconnect the connectors of the engine main wiring and disengage the wiring clamps.

A. Exhaust OCV connector
B. Ignition coil Connector
C. Intake/exhaust cam position sensor connector

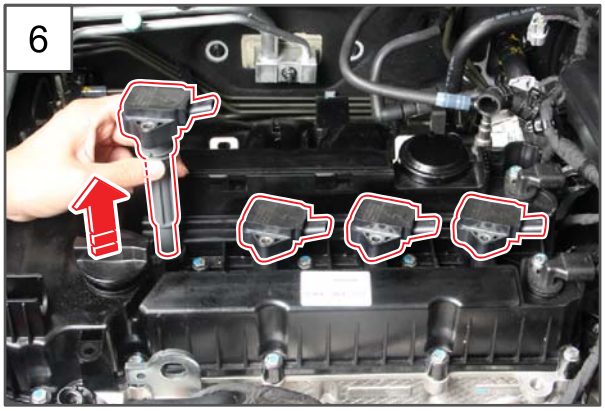
5



5. Unscrew the 4 mounting bolts (10 mm) for the ignition coil.

Tightening torque 10 ± 1.0 Nm

6



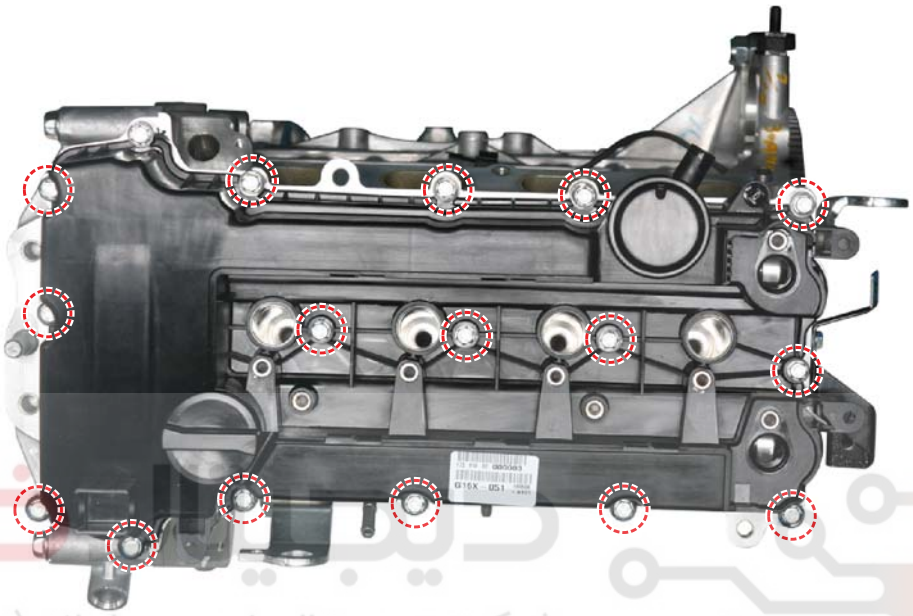
6. Remove the 4 ignition coils in sequence.

Modification basis	
Application basis	
Affected VIN	

7. Remove the 16 mounting bolts (10 mm) for the cylinder head cover.

Tightening torque 10 ± 1.0 Nm

7

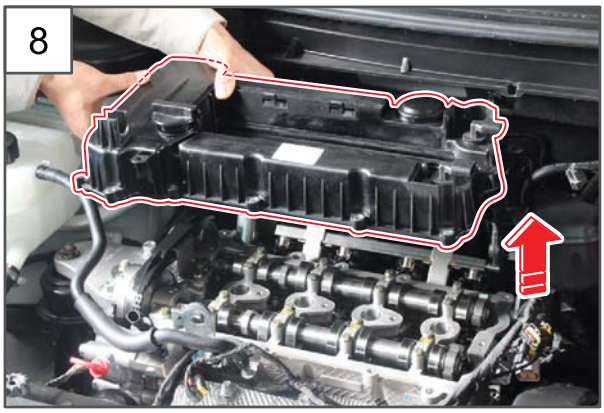


CAUTION

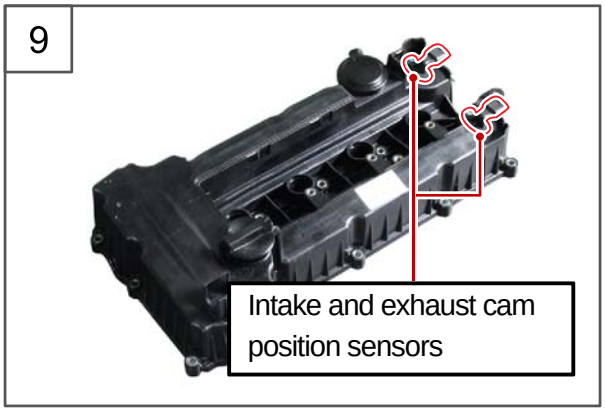
Loosen and remove the mounting bolts in several steps to prevent damage to the cylinder head cover.

- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

8



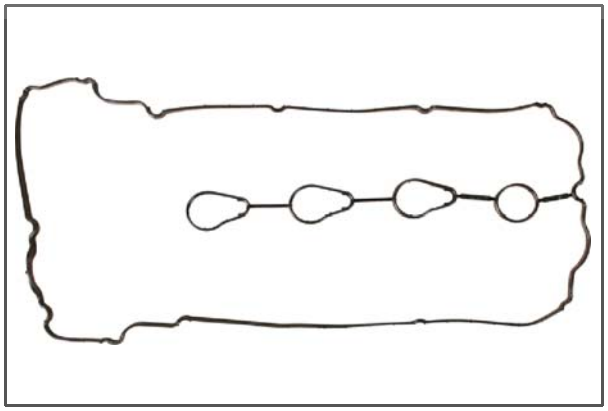
8. Remove the cylinder head cover.



9. Remove the intake and exhaust cam position sensors from the cylinder head cover which has been removed.

10.Install in the reverse order of removal.

Front view	Rear view
	



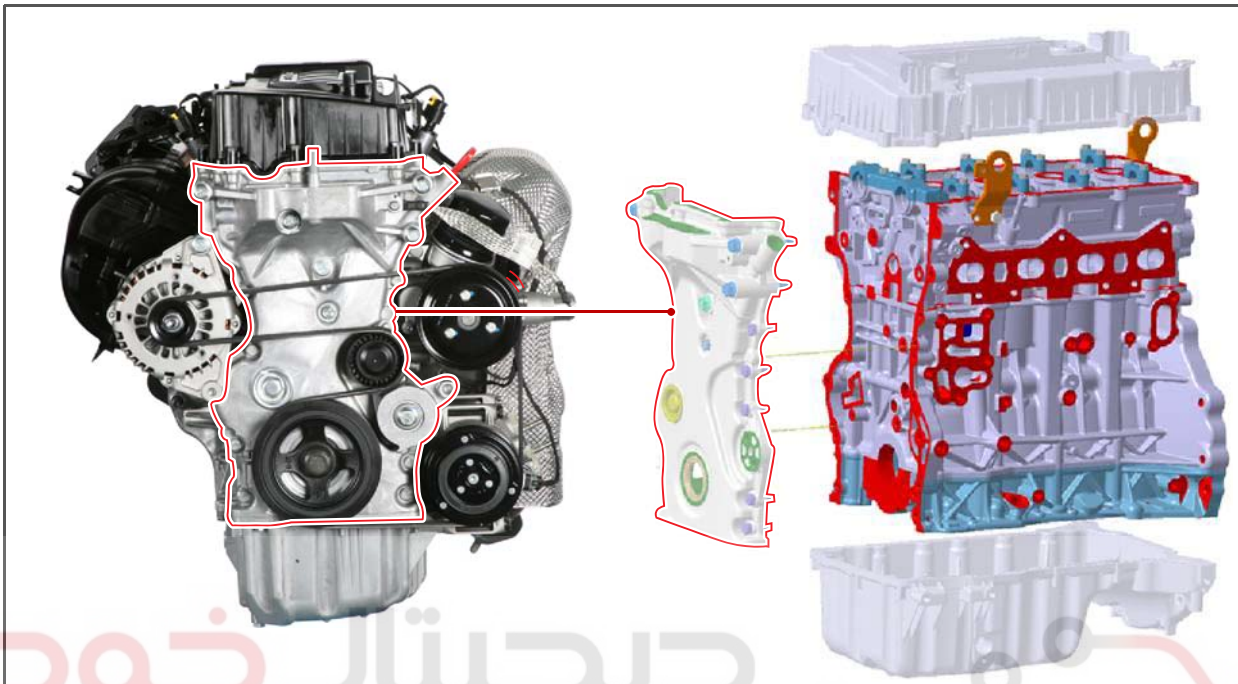
NOTE

Replace the cylinder head cover gasket with a new one when installing.

S.G.N. 1339-01

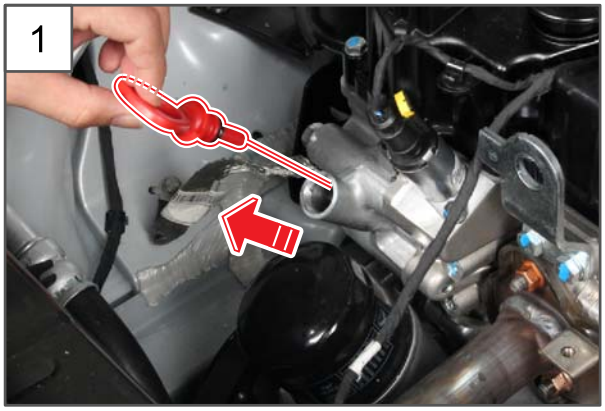
TIMING GEAR CASE COVER

Preceding work - Disconnect the negative cable from the battery.



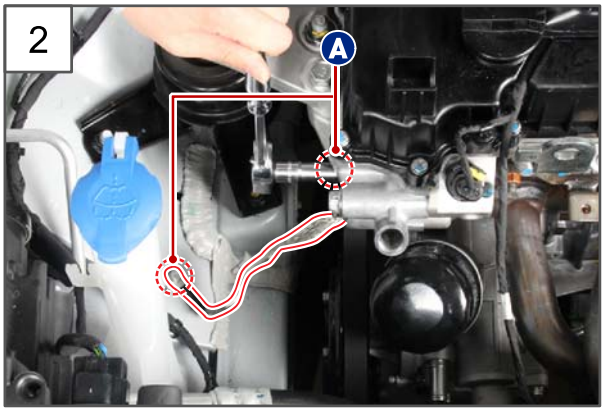
Timing gear case cover

1



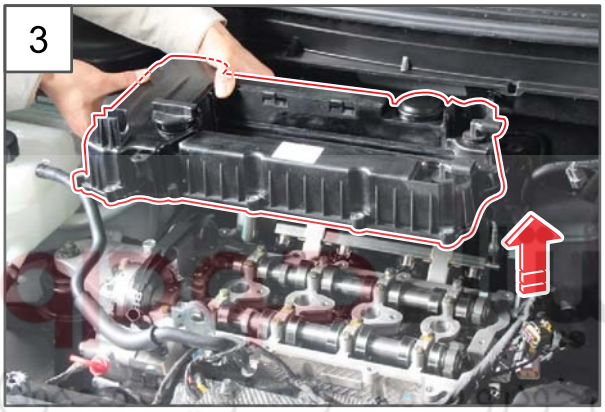
1. Remove the oil dipstick gauge.

Modification basis	
Application basis	
Affected VIN	



2. Unscrew the 2 mounting bolts (A, 10 mm) to remove the engine ground cable.

Tightening torque 10 ± 1.0 Nm



3. Remove the cylinder head cover.

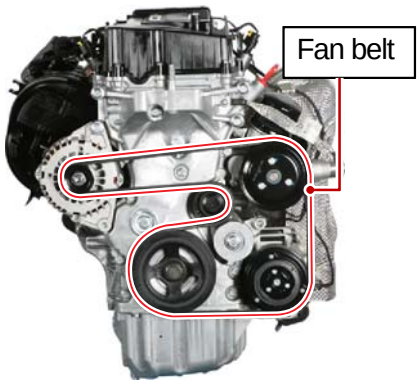
NOTE

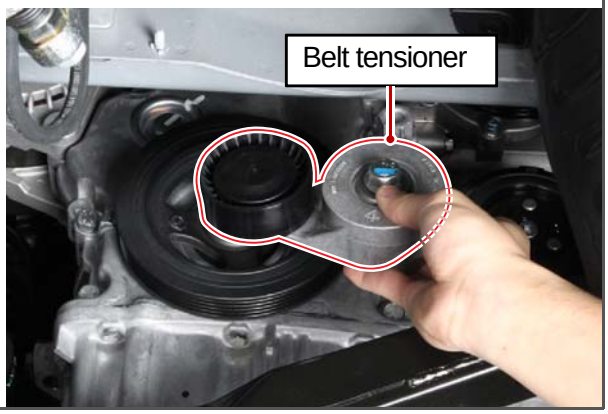
Refer to "CYLINDER HEAD COVER" under this subsection.

4. Remove the fan belt and belt tensioner from the vehicle.

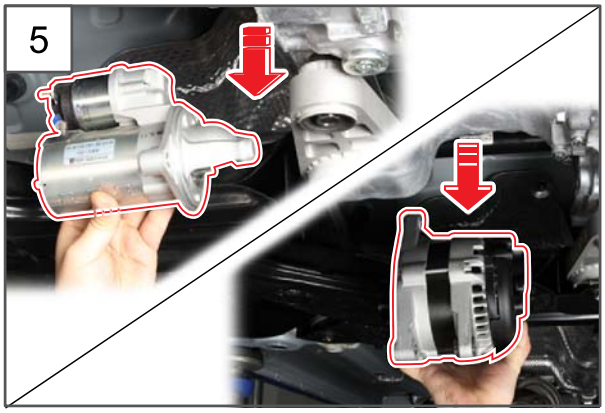
NOTE

Refer to "BELT SYSTEM" under this subsection.





Modification basis	
Application basis	
Affected VIN	



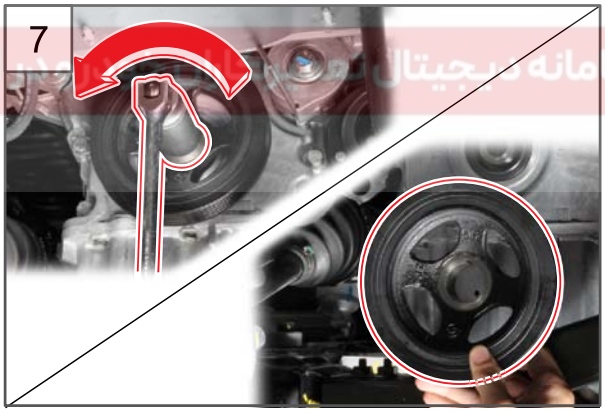
5. Remove the starter motor and alternator.

NOTE

- Refer to "starter motor" under "REMOVAL AND INSTALLATION" subsection of "STARTING SYSTEM" section in "G16DF ENGINE" chapter.
- Refer to "ALTERNATOR" under "REMOVAL AND INSTALLATION" subsection of "CHARGING SYSTEM" section in "G16DF ENGINE" chapter.

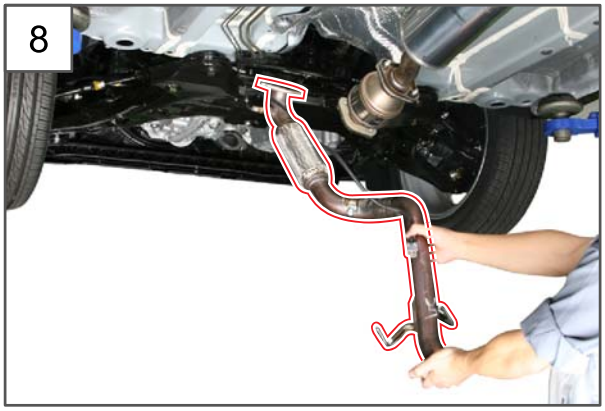
6. Fit a special tool to the starter motor mounting to hold the flywheel.

Flywheel fixture

7. Unscrew the mounting bolt (27 mm) to remove the crankshaft pulley.

Sequence	Tightening torque
1	220 Nm
2	90°



8. Remove the front exhaust pipe under the vehicle.

NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

9

9. Remove the oil pan.

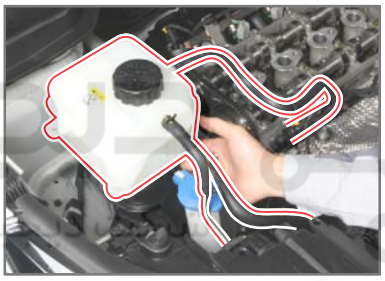
NOTE

Refer to "OIL PAN" under "REMOVAL AND INSTALLATION" subsection of "LUBRICATION SYSTEM" section in "G16DF ENGINE" chapter.

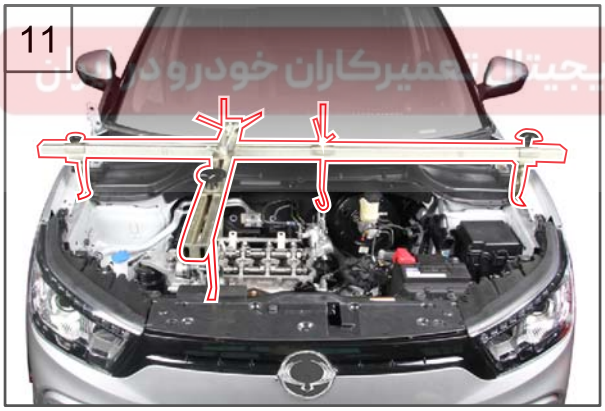
10

10. Unscrew the 2 mounting bolts (10 mm) to free the coolant reservoir tank.

Tightening torque 10 ± 1.0 Nm



11

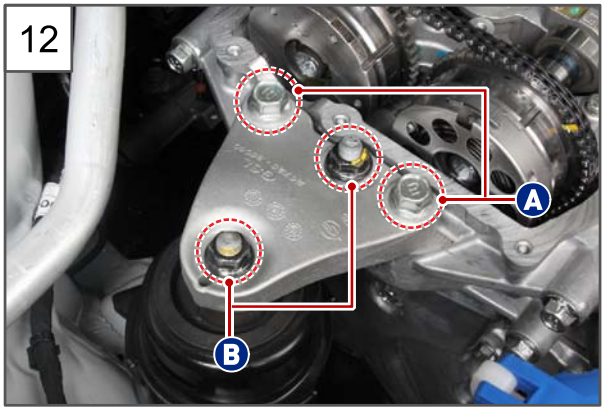


11. Install the engine support hanger.

NOTE

Refer to "INSTALLING THE ENGINE SUPPORT HANGER" under "SPECIAL SERVICE TOOLS" subsection of "ENGINE GENERAL" section in "G16DF ENGINE" chapter.

12



12. Remove the 2 mounting bolts (A, 17 mm) and 2 mounting nuts (B, 17 mm) for the RH engine mounting bracket.

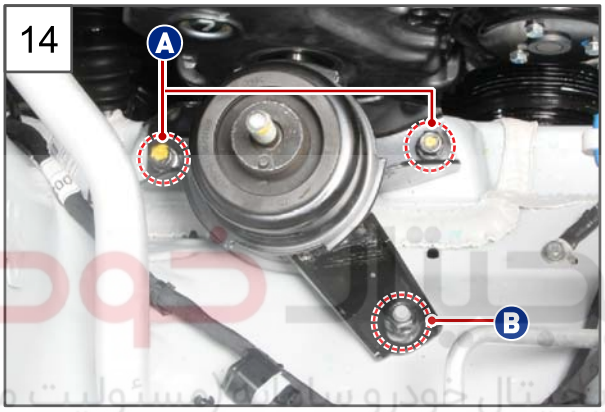
Tightening torque 68.6 to 88.2 Nm

Modification basis	
Application basis	
Affected VIN	

13

13.Remove the RH engine mounting bracket.

14



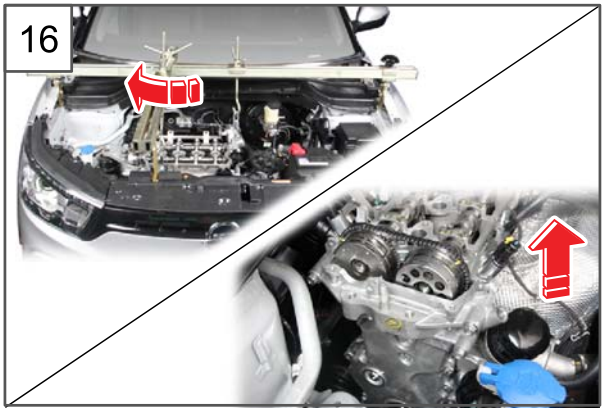
14.Remove the 2 mounting bolts (A, 14 mm) and the mounting nut (B, 14 mm) for the RH engine mounting insulator.

Tightening torque 45 ± 5 Nm

15

15.Remove the RH engine mounting insulator.

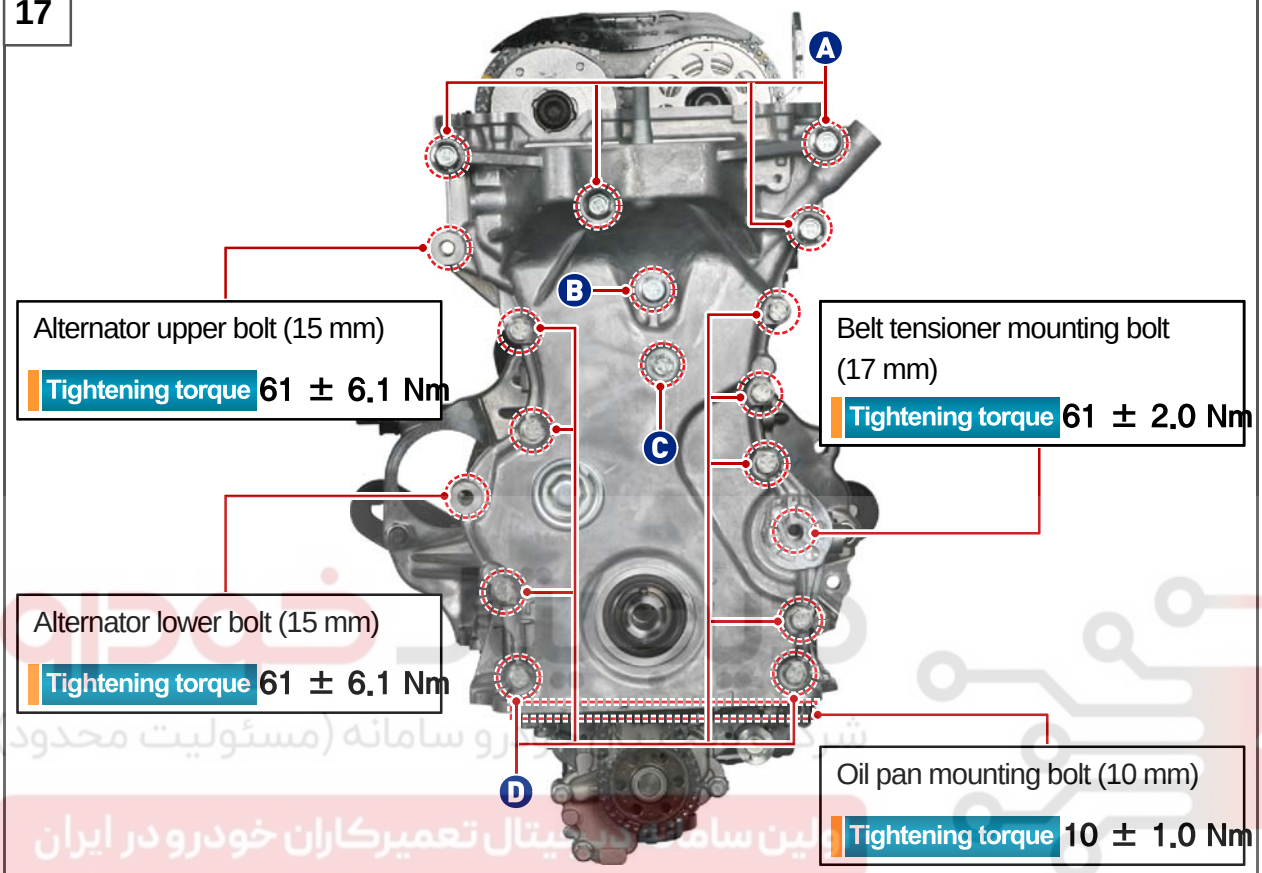
16



16.Lift up the engine using the engine support hanger to make room for accessing the timing gear case cover.

17.Unscrew the mounting bolts (A), (B), (C), and (D) for the timing gear case cover.

17

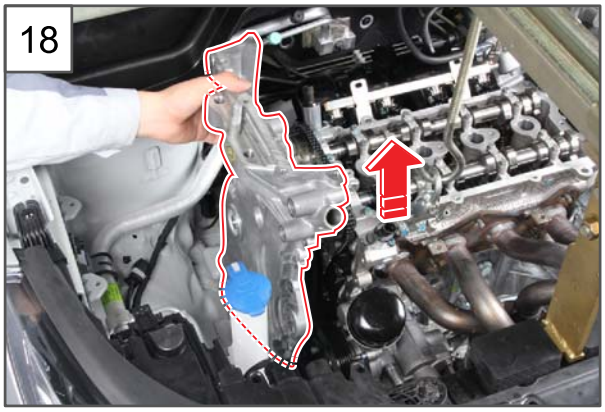


No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	15	80	4	58 ± 5.8 Nm
B		50	1	
C	13	45	1	25 ± 2.5 Nm
D		30	9	

CAUTION

To protect the timing gear case from damage, remove the bolts in sequence as follows:
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

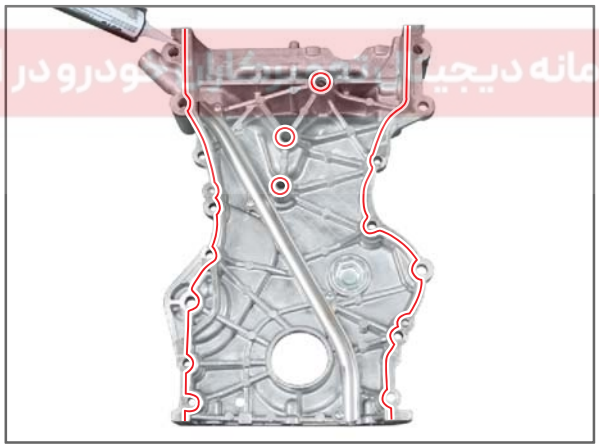
18



18.Remove the timing gear case cover.

19

19.Install in the reverse order of removal.



NOTE

Apply sealant to the rear side of the timing gear case cover (Sealant part number: 661 989 56 A0).

CAUTION

Apply sealant to the 3 holes in the center.

S.G.N. 1311-01

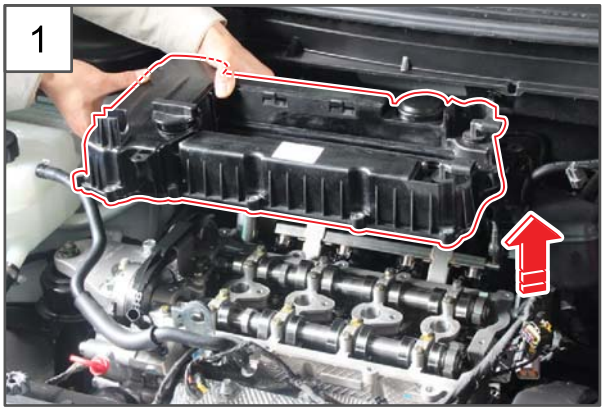
ENGINE TIMING CHAIN

Preceding work - Disconnect the negative cable from the battery.

Rail assembly

Timing chain	Timing chain tensioner
	

1) Removal



1. Remove the cylinder head cover.

NOTE

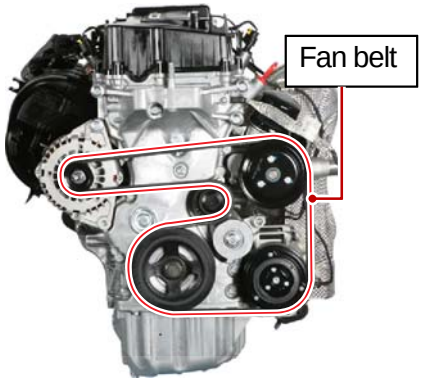
Refer to "CYLINDER HEAD COVER" under this subsection.

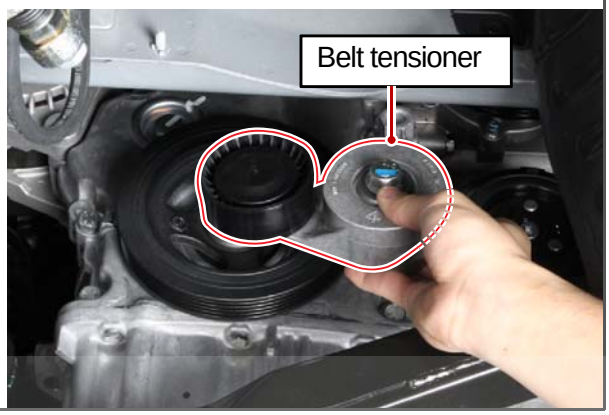
Modification basis	
Application basis	
Affected VIN	

2. Remove the fan belt and belt tensioner from the vehicle.

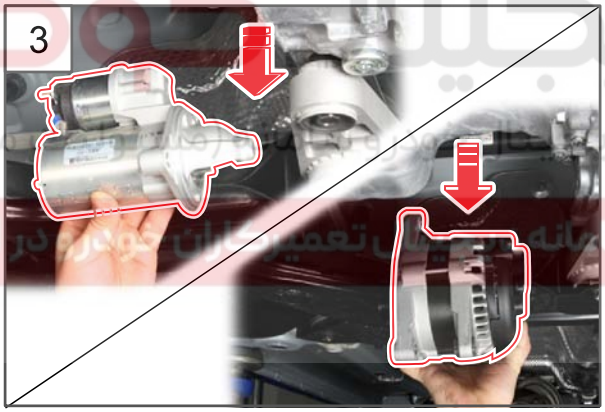
NOTE

Refer to "BELT SYSTEM" under this subsection.





3



3. Remove the starter motor and alternator.

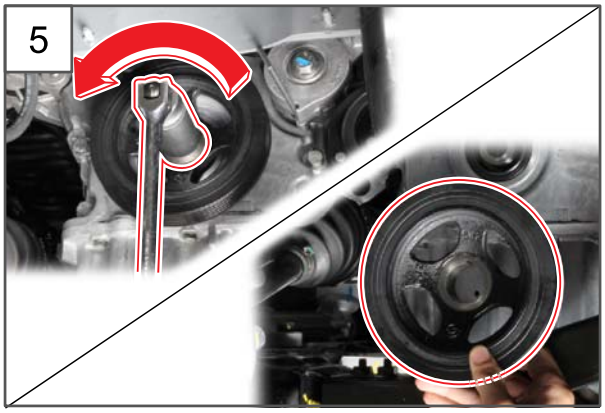
NOTE

- Refer to "starter motor" under "REMOVAL AND INSTALLATION" subsection of "STARTING SYSTEM" section in "G16DF ENGINE" chapter.
- Refer to "ALTERNATOR" under "REMOVAL AND INSTALLATION" subsection of "CHARGING SYSTEM" section in "G16DF ENGINE" chapter.

4

4. Fit a special tool to the starter motor mounting to hold the flywheel.

Flywheel fixture

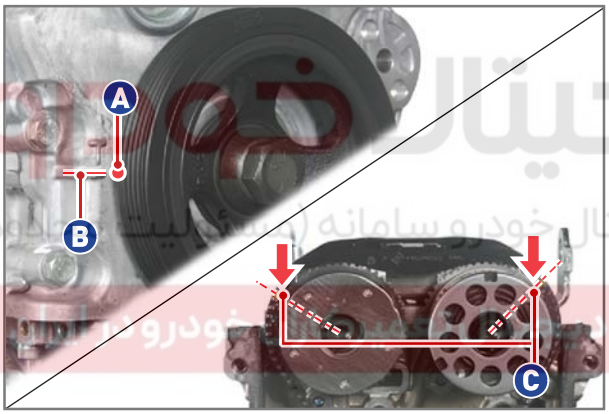



5. Unscrew the mounting bolt (27 mm) to remove the crankshaft pulley.

Sequence	Tightening torque
1	220 Nm
2	90°

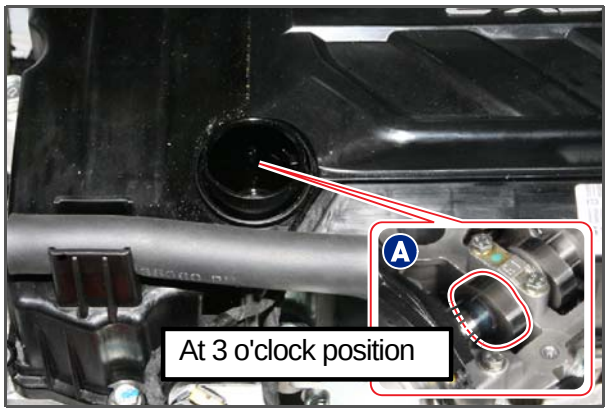
Engine timing check

▶ **Without cylinder head cover**



- Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.
- Intake & exhaust camshaft sprocket marks (C)

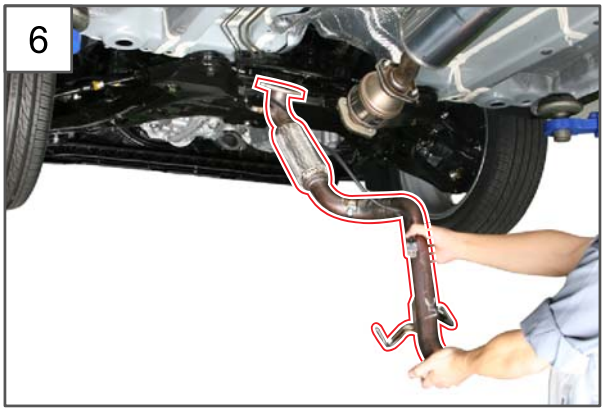
▶ **With cylinder head cover**



Open the oil filler cap and check the cam nose position (A) of the intake camshaft.

Modification basis	
Application basis	
Affected VIN	

6



6. Remove the front exhaust pipe under the vehicle.

NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

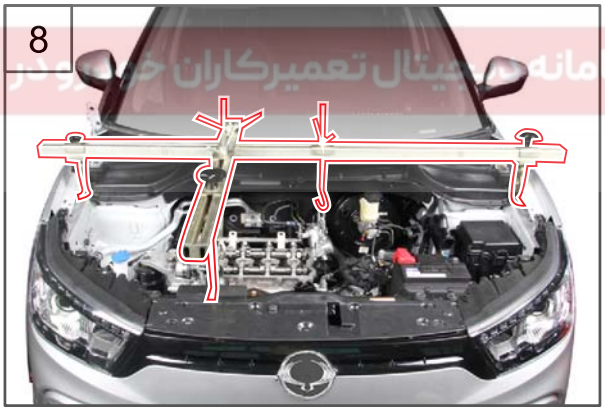
7

7. Remove the oil pan.

NOTE

Refer to "OIL PAN" under "REMOVAL AND INSTALLATION" subsection of "LUBRICATION SYSTEM" section in "G16DF ENGINE" chapter.

8

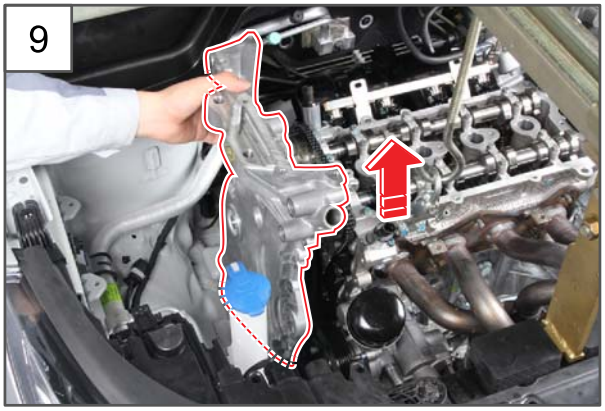


8. Install the engine support hanger.

NOTE

Refer to "INSTALLING THE ENGINE SUPPORT HANGER" under "SPECIAL SERVICE TOOLS" subsection of "ENGINE GENERAL" section in "G16DF ENGINE" chapter.

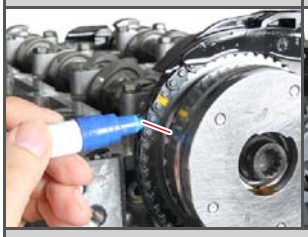
9



9. Remove the timing gear case cover.

NOTE

Refer to "TIMING GEAR CASE COVER" under this subsection.

Intake camshaft sprocket	Exhaust camshaft sprocket
	
Crankshaft sprocket	
	

10. Make a mark on each sprocket at the position where the timing change is aligned with the timing mark.

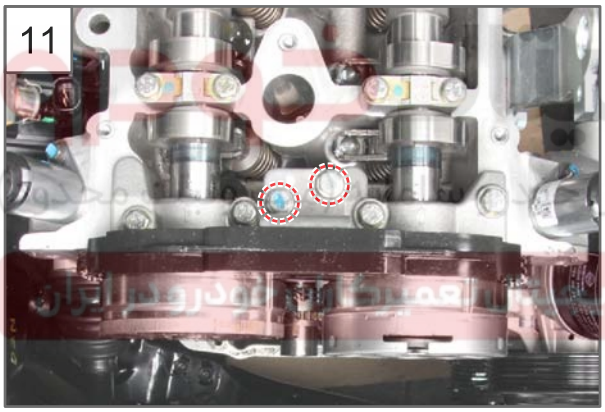
CAUTION

Mark by choosing one of the following:

a. Make a timing mark with color other than yellow or white which was used before to identify easily.

b. Make a timing mark with the same color which was used before.

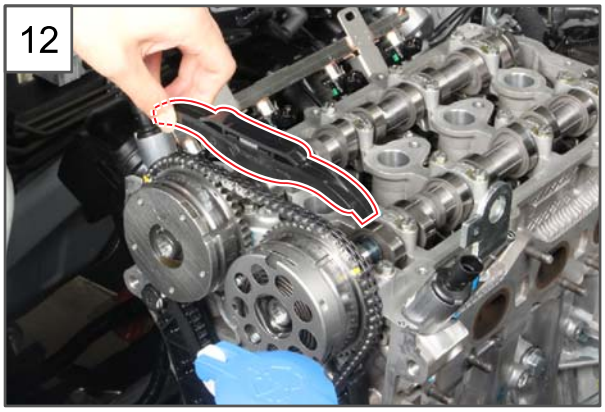
11



11. Unscrew the 2 mounting bolts (10 mm) for the sliding upper rail.

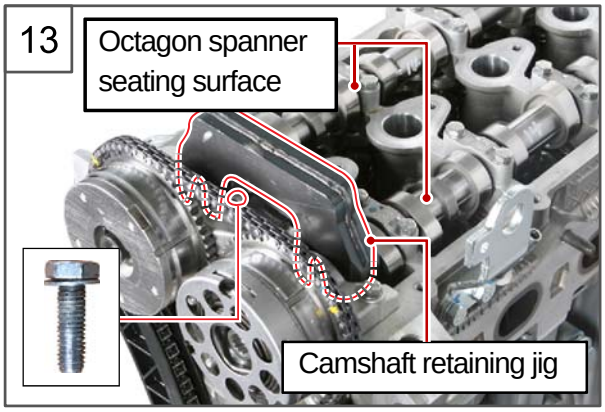
Tightening torque 10 ± 1.0 Nm

12



12. Remove the sliding upper rail.

Modification basis	
Application basis	
Affected VIN	



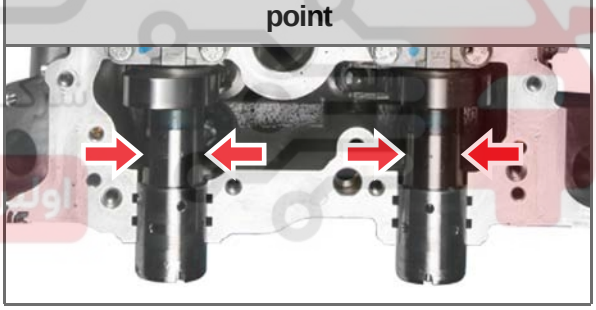
13. Fit a camshaft retaining jig to the intake and exhaust camshafts and screw in a mounting bolt (10 mm).

NOTE

- Fit the camshaft retaining jig when the engine timing is positioned at OT.
- The camshaft retaining jig holds the intake and exhaust camshafts together and prevents rotation by cam lift. This makes the installation of timing chain easier. This jig also can be sued to remove and tighten the mounting bolts for the camshaft sprockets.

Intake & exhaust camshaft marks

Camshaft retaining jig mounting point

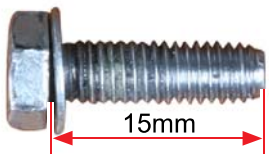


NOTE

Fit the camshaft retaining jig with an about 15 mm long bolt.

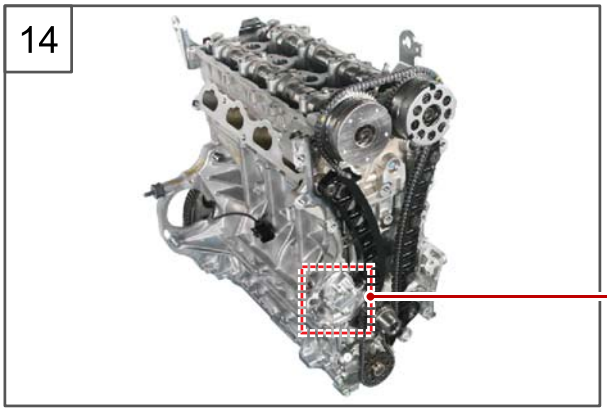
Camshaft retaining jig

Camshaft retaining jig bolt

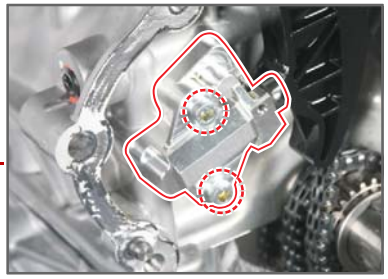


Modification basis	
Application basis	
Affected VIN	

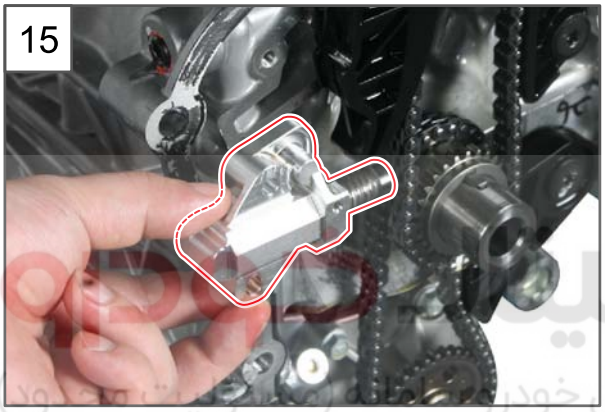
14



14.Unscrew the 2 hexagon mounting bolts (5 mm) for the chain tensioner.



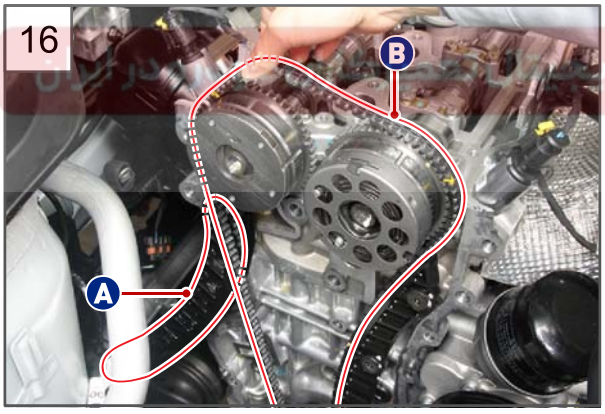
15



15.Remove the chain tensioner.

Timing chain tensioner

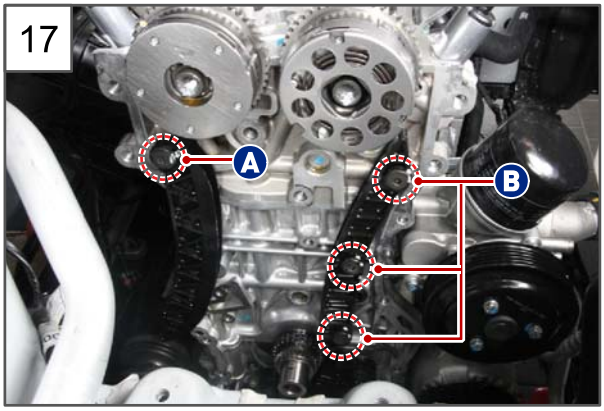

16



16.Move away the tensioner rail (A) to remove the timing chain (B) as shown in the picture.

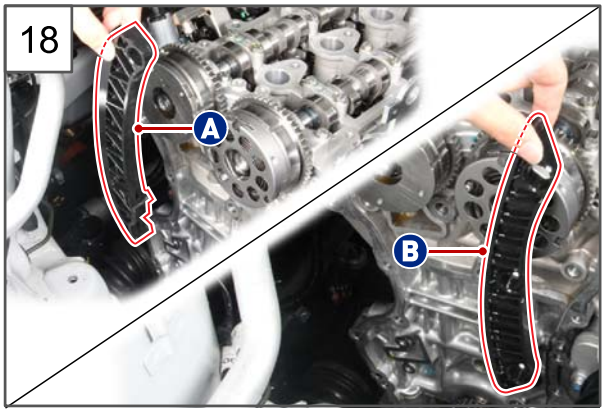
Timing chain


17



17.Unscrew the mounting bolt (A, T40) for the tensioner rail and the 3 mounting bolts (B, T40) for the guide rail.

Modification basis	
Application basis	
Affected VIN	

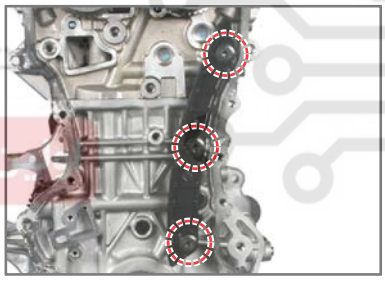


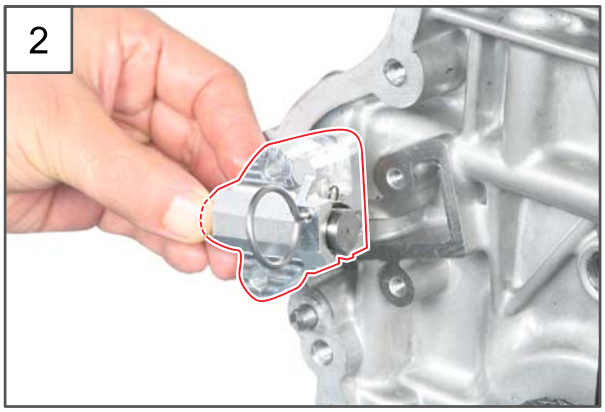
18.Remove the tensioner rail (A) and the guide rail (B).

2) Installation

1. Install the guide rail and torque tighten the 3 mounting bolts (T40) to the specified torque.

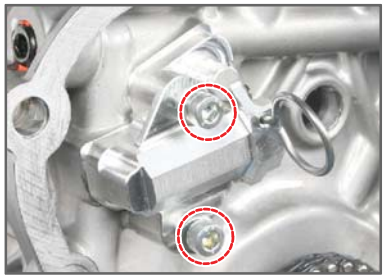
Tightening torque 25 ± 2.5 Nm



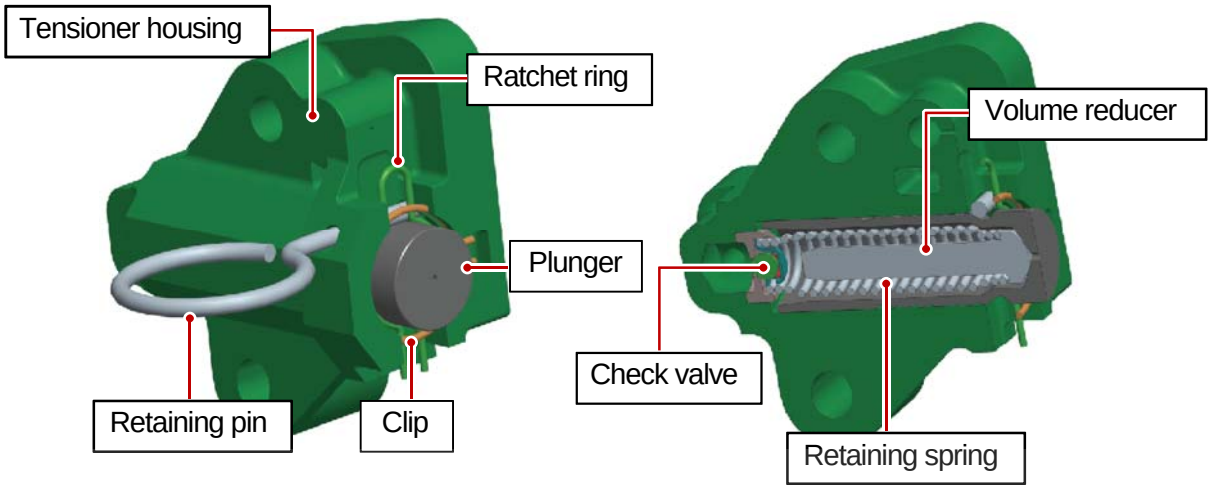


2. Install the chain tensioner (refer to "Resetting chain tensioner") and torque tighten the 2 hexagon mounting bolts (5 mm) to the specified torque.

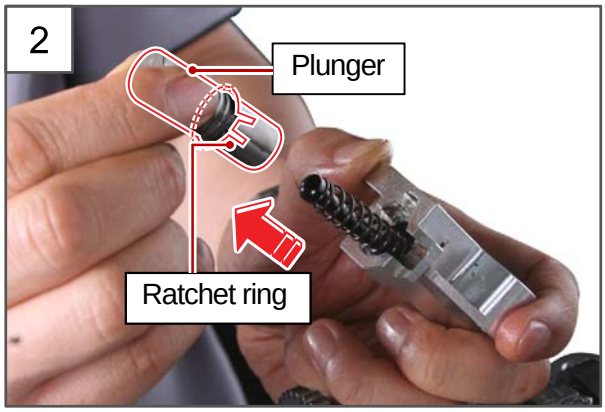
Tightening torque 10 ± 1.0 Nm



Resetting chain tensioner (Compressing plunger)



1. Remove the clip from the chain tensioner.



2. Remove the plunger and ratchet ring.

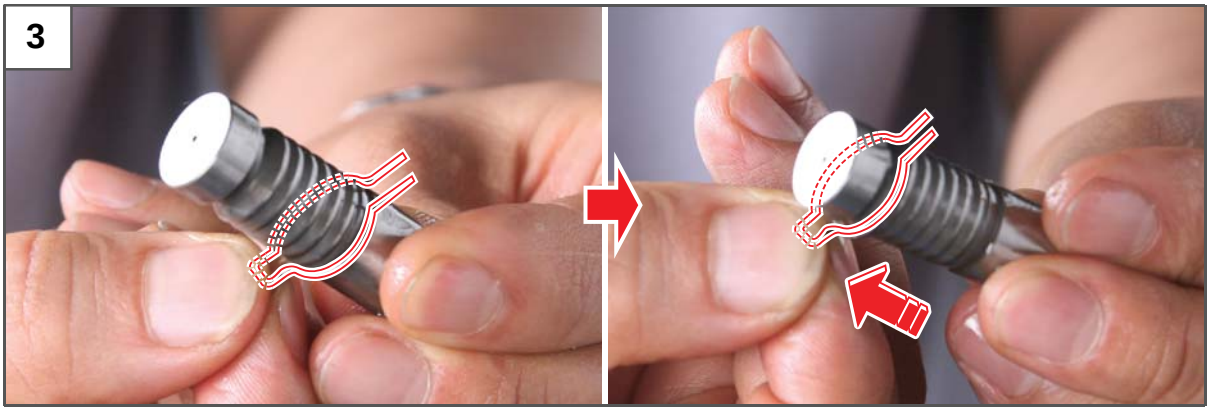
CAUTION

When resetting the chain tensioner, keep the inside of tensioner clean.

Modification basis	
Application basis	
Affected VIN	

3. Expend the ratchet ring on the plunger to move it to the top groove as shown in the picture.

3



4. Insert the plunger in the tensioner housing and fully press it into position by hand.

4

5. Insert the tensioner retaining pin into the retaining pin hole on the tensioner housing.

NOTE

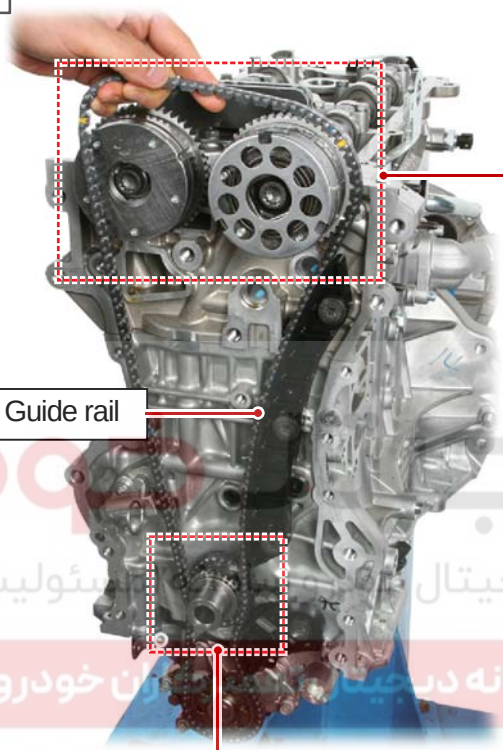
Make sure that the tensioner retaining pin is inserted so that it is positioned inside the ratchet ring.

6. Fit the clip on the chain tensioner.

Modification basis	
Application basis	
Affected VIN	

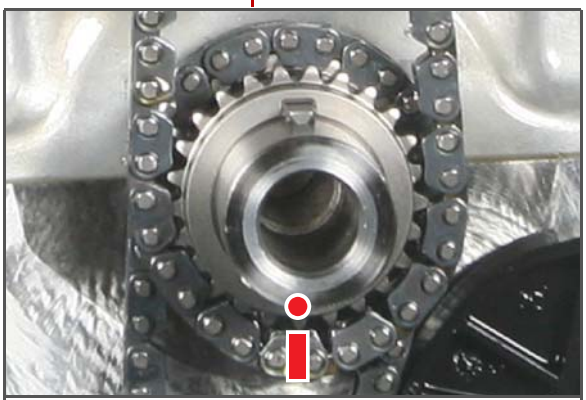
3. Fit the timing chain in the following order: (a) aligning the mark on the chain with the mark on the crankshaft sprocket; (b) letting the chain rest against the guide rail; and (c) aligning the marks with the mark on the exhaust camshaft sprocket and then the mark on intake camshaft sprocket. This procedure must be done with the camshaft retaining jig installed.

3



Align the mark on the timing chain with the mark on the exhaust camshaft sprocket.

Align the mark on the timing chain with the mark on the intake camshaft sprocket.

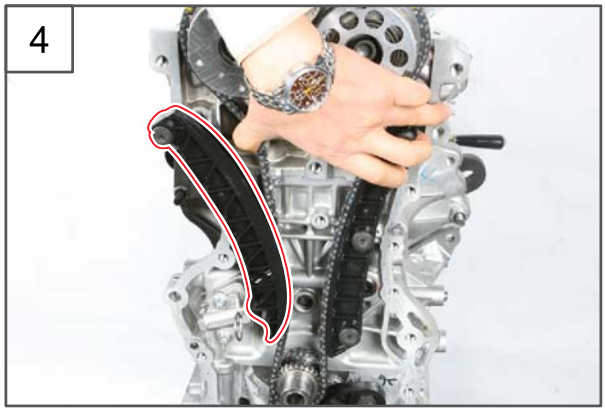


Align the mark on the crankshaft sprocket with the mark on the timing chain.

CAUTION

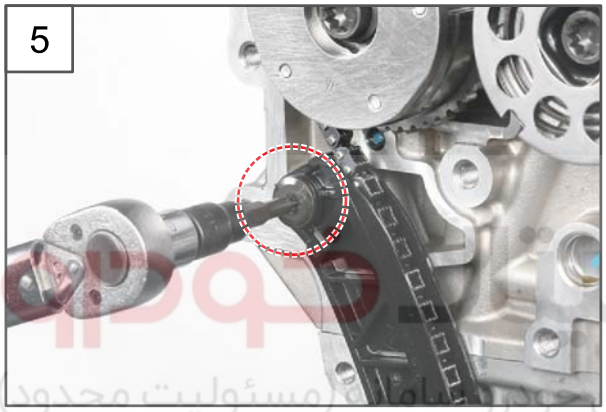
Make sure that the chain on the crankshaft sprocket is not displaced.

4



4. Install the tensioner rail by pulling the timing chain with one hand.

5

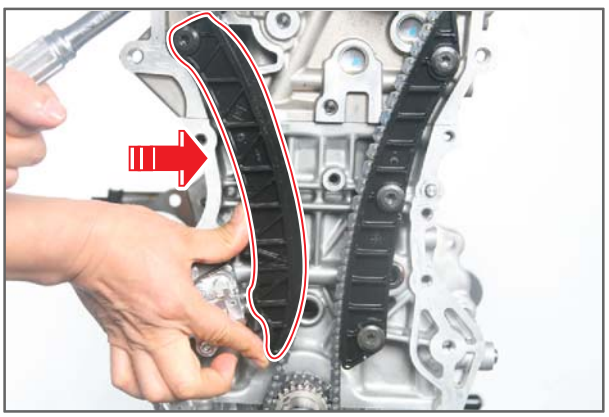


5. Torque tighten the mounting bolt (T40) for the tensioner rail to the specified torque.

Tightening torque 25 ± 2.5 Nm

6

6. Remove the chain tensioner retaining pin and push the tensioner rail.



CAUTION

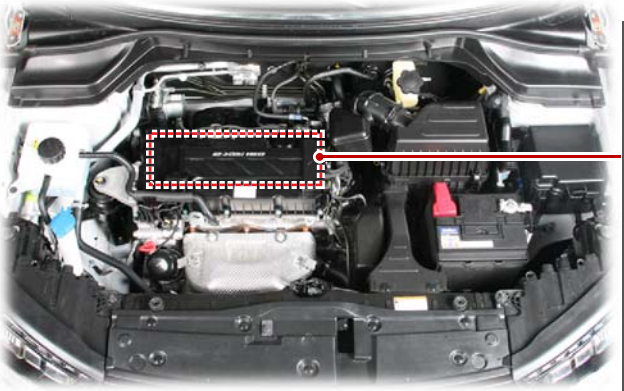
If the oil in the chain tensioner is not enough, the plunger return will not work smoothly. Therefore, push the tensioner rail in the direction of the arrow shown in the picture so that the plunger is protruded sufficiently.

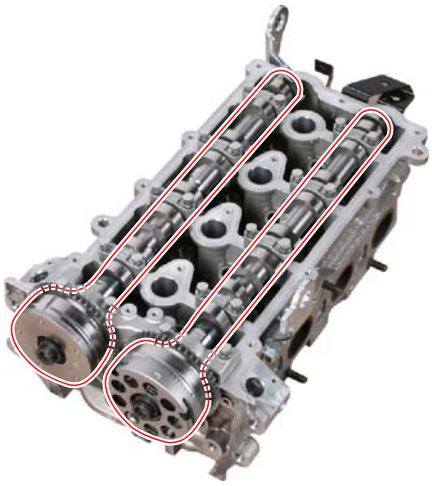
7. Check the engine timing mark after installation.
   (refer to "Marks to align the timing" under "CHAIN DRIVE SYSTEM" subsection of "CONFIGURATION AND FUNCTIONS" section in this chapter.)
8. Install in the reverse of removal.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1221-21 CAMSHAFT ASSEMBLY

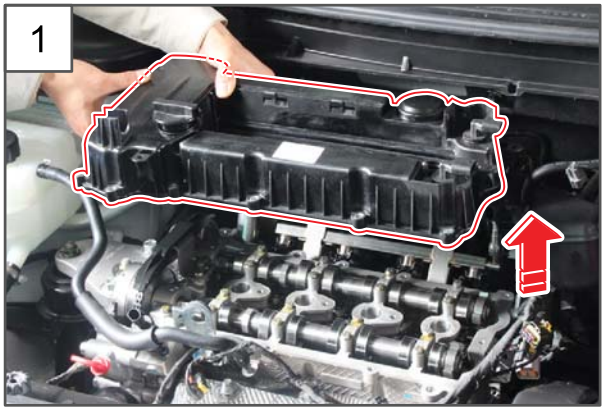
Preceding work - Disconnect the negative cable from the battery.





Camshaft assembly

1



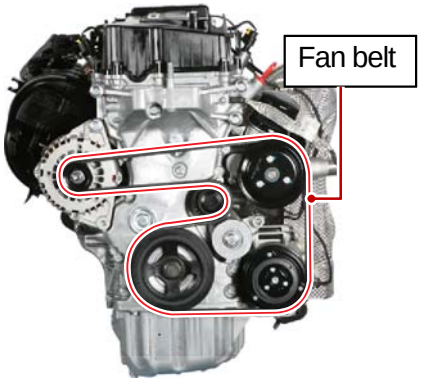
1. Remove the cylinder head cover.

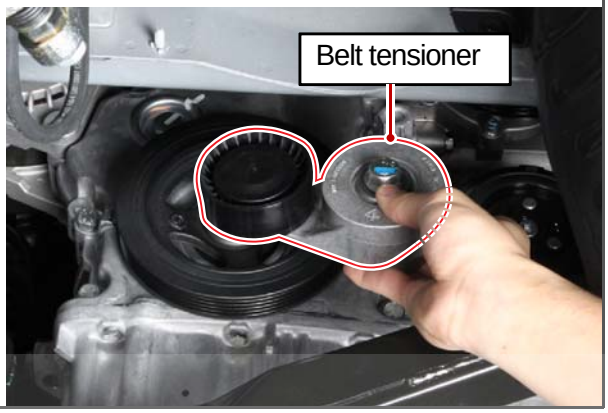
NOTE

Refer to "CYLINDER HEAD COVER" under this subsection.

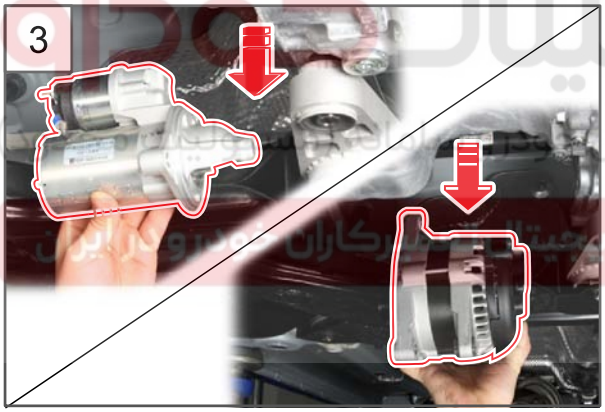
2. Remove the fan belt and belt tensioner from the vehicle.

NOTE
Refer to "BELT SYSTEM" under this subsection.





3



3. Remove the starter motor and alternator.

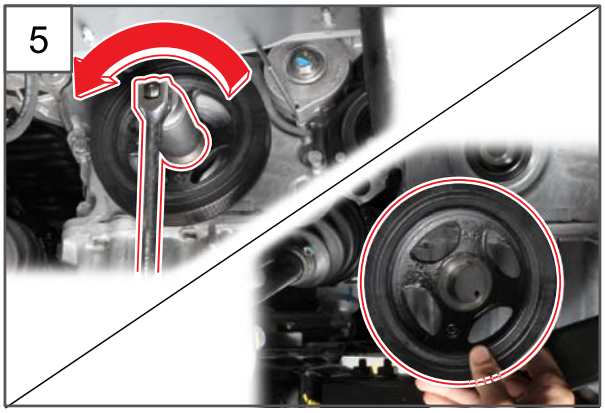
NOTE
- Refer to "starter motor" under "REMOVAL AND INSTALLATION" subsection of "STARTING SYSTEM" section in "G16DF ENGINE" chapter.
- Refer to "ALTERNATOR" under "REMOVAL AND INSTALLATION" subsection of "CHARGING SYSTEM" section in "G16DF ENGINE" chapter.

4

4. Fit a special tool to the starter motor mounting to hold the flywheel.

Flywheel fixture


Modification basis	
Application basis	
Affected VIN	

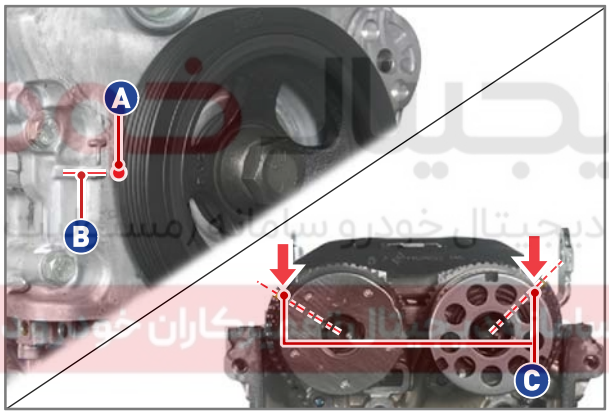


5. Unscrew the mounting bolt (27 mm) to remove the crankshaft pulley.

Sequence	Tightening torque
1	220 Nm
2	90°

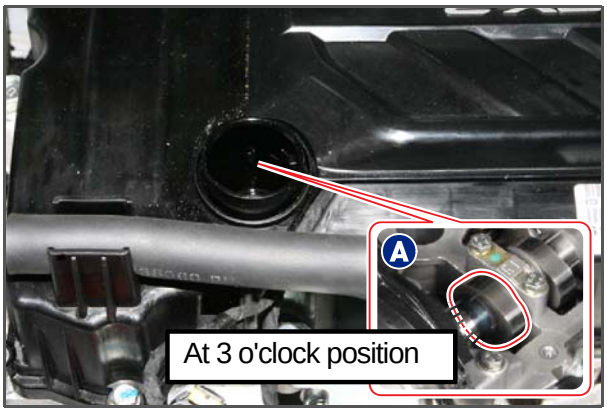
Engine timing check

▶ Without cylinder head cover



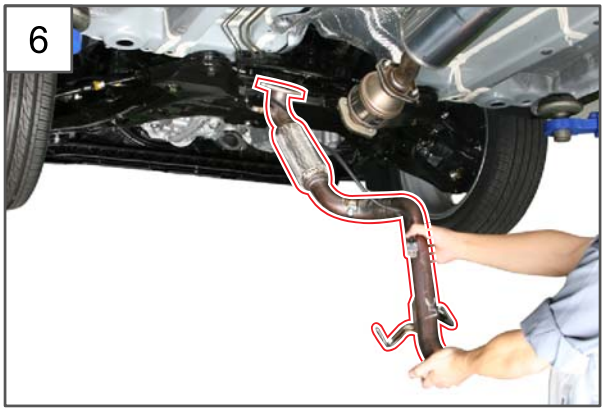
- Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.
- Intake & exhaust camshaft sprocket marks (C)

▶ With cylinder head cover



Open the oil filler cap and check the cam nose position (A) of the intake camshaft.

6



6. Remove the front exhaust pipe under the vehicle.

NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

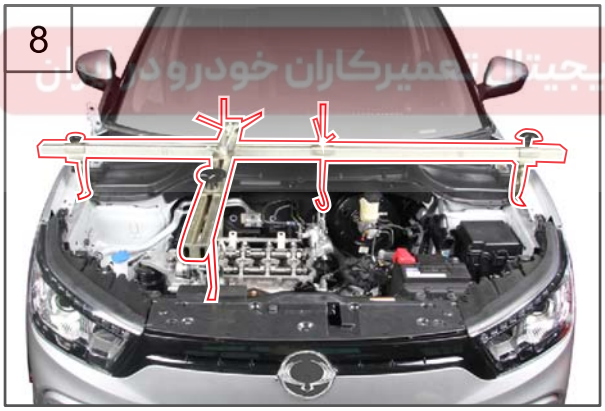
7

7. Remove the oil pan.

NOTE

Refer to "OIL PAN" under "REMOVAL AND INSTALLATION" subsection of "LUBRICATION SYSTEM" section in "G16DF ENGINE" chapter.

8

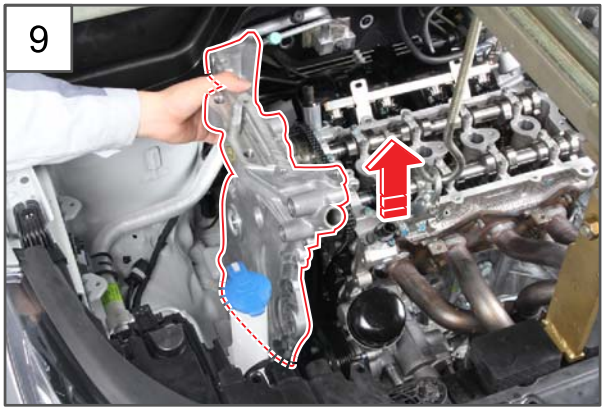


8. Install the engine support hanger.

NOTE

Refer to "INSTALLING THE ENGINE SUPPORT HANGER" under "SPECIAL SERVICE TOOLS" subsection of "ENGINE GENERAL" section in "G16DF ENGINE" chapter.

9

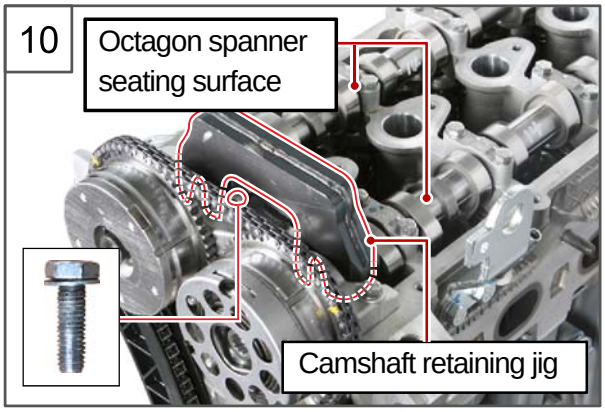


9. Remove the timing gear case cover.

NOTE

Refer to "TIMING GEAR CASE COVER" under this subsection.

Modification basis	
Application basis	
Affected VIN	

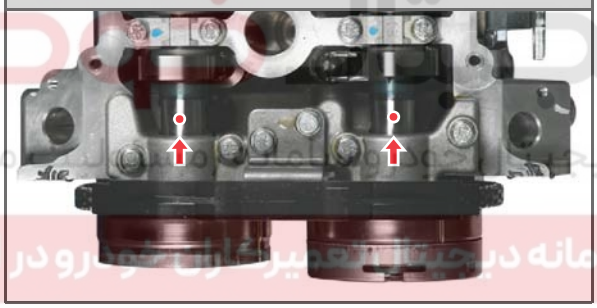


10. Fit a camshaft retaining jig to the intake and exhaust camshafts and screw in a mounting bolt (10 mm).

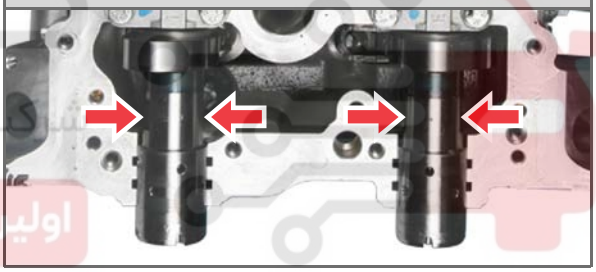
NOTE

- Fit the camshaft retaining jig when the engine timing is positioned at OT.
- The camshaft retaining jig holds the intake and exhaust camshafts together and prevents rotation by cam lift. This makes the installation of timing chain easier. This jig also can be sued to remove and tighten the mounting bolts for the camshaft sprockets.

Intake & exhaust camshaft marks



Camshaft retaining jig mounting point

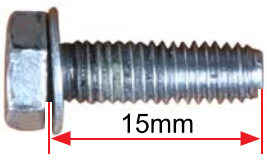


NOTE

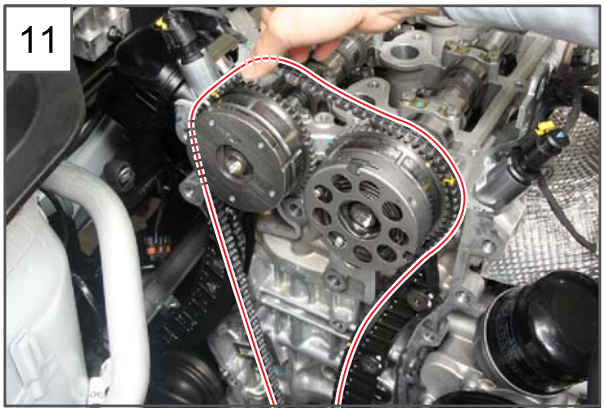
Fit the camshaft retaining jig with an about 15 mm long bolt.

Camshaft retaining jig

Camshaft retaining jig bolt



11



11.Remove the timing chain.

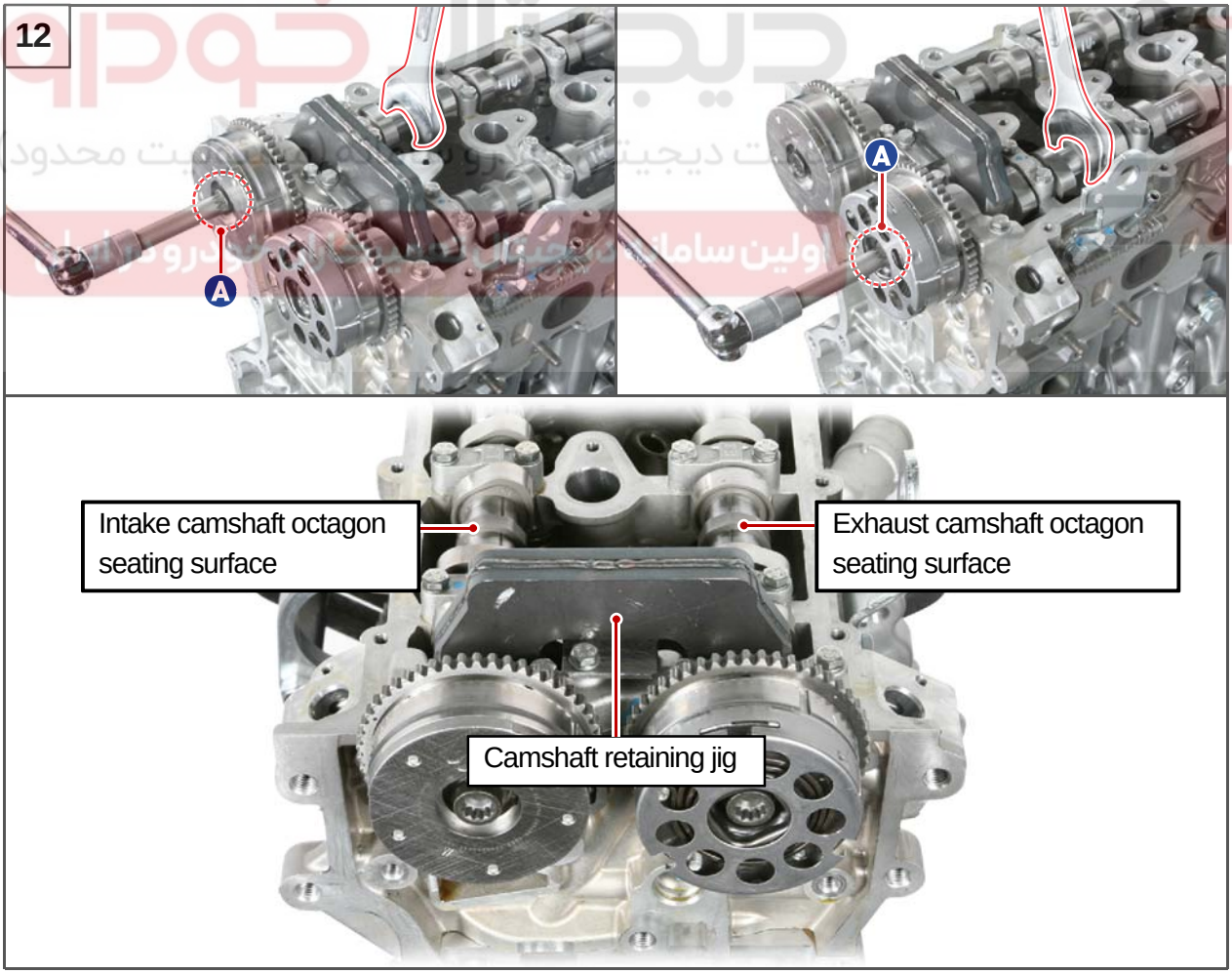
NOTE

Refer to "ENGINE TIMING CHAIN" under this subsection.

12.Fit 30 mm spanners on the octagon seating surfaces of the intake and exhaust camshafts and then unscrew the 2 sprocket mounting bolts (A, M14). This procedure must be done with the camshaft retaining jig installed.

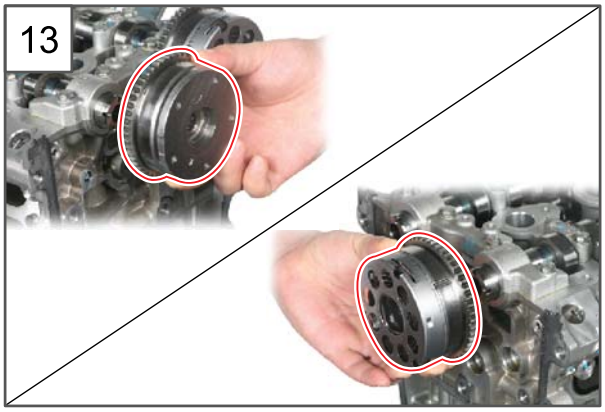
Tightening torque 110 ± 10 Nm

12

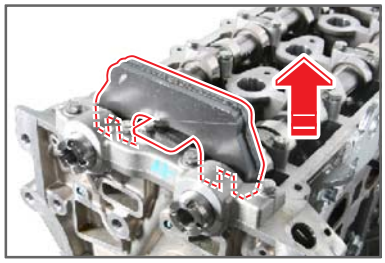


Modification basis	
Application basis	
Affected VIN	

13

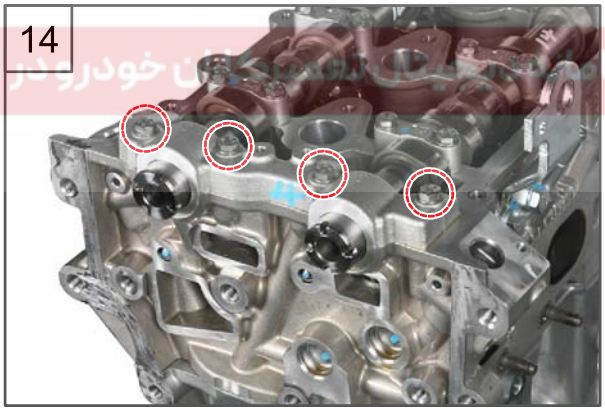


13.Remove the intake and exhaust camshaft sprockets and then the camshaft retaining jig.



Intake side	Exhaust side
	

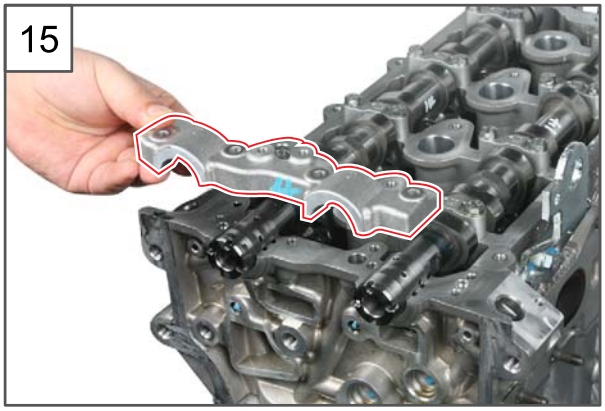
14



14.Unscrew the 4 mounting bolts (10 mm) for the camshaft front bearing cap.

Tightening torque 10 ± 1.0 Nm

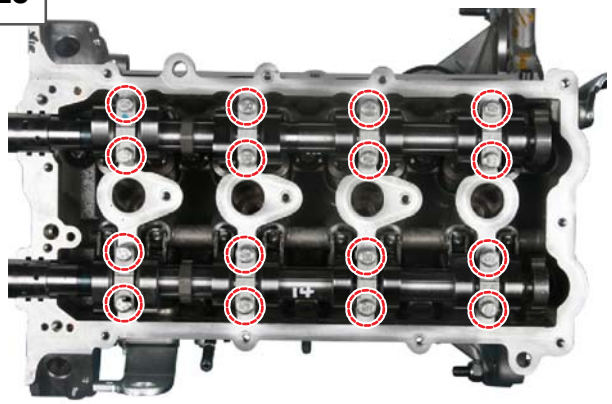
15



15.Remove the camshaft front bearing cap.

16.Unscrew the 16 mounting bolts (10 mm) for the camshaft bearing caps.

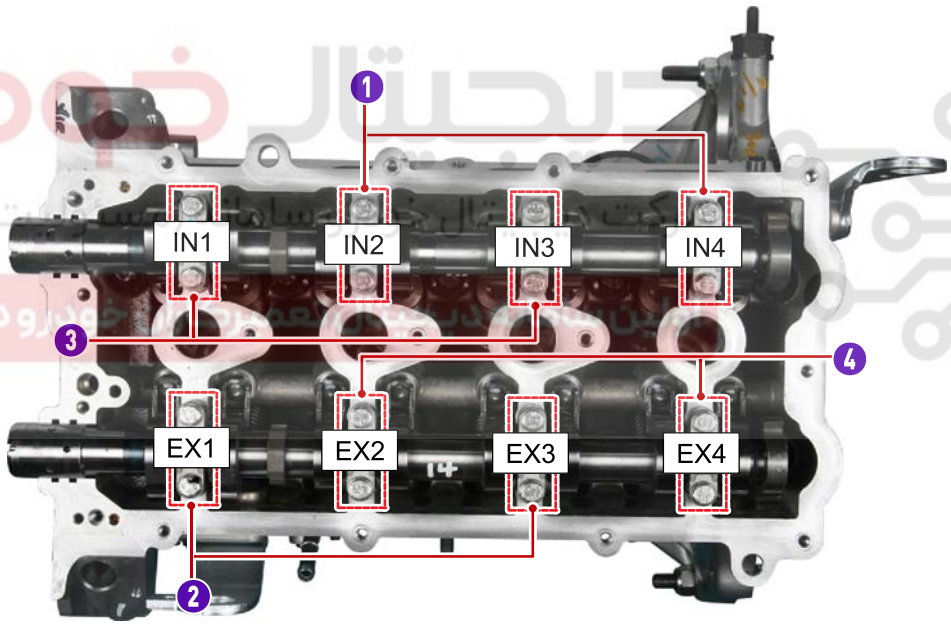
16



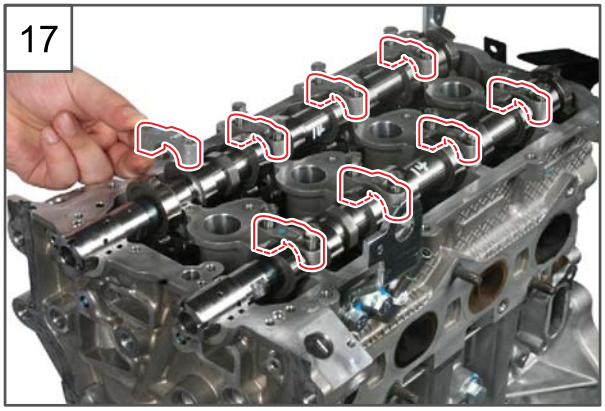
NOTE

Unscrew the camshaft cap mounting bolts slowly in two or more stages according to the specific sequence stated below. Screw in the bolts in the reverse of unscrewing.
(1) Intake cams: IN2, IN4
(2) Exhaust cams: EX1, EX3
(3) Intake cams: IN1, IN3
(4) Exhaust cams: EX2, EX4

Tightening torque 10 ± 1.0 Nm

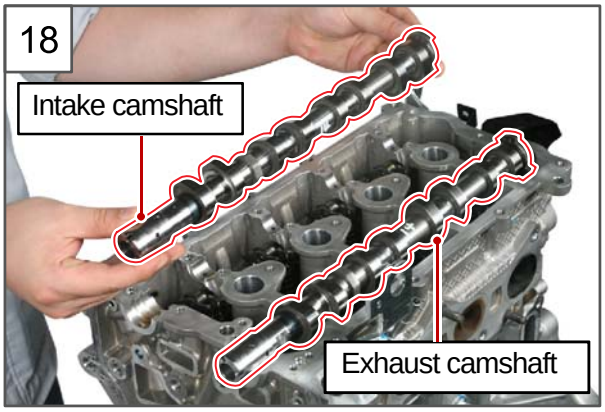


17



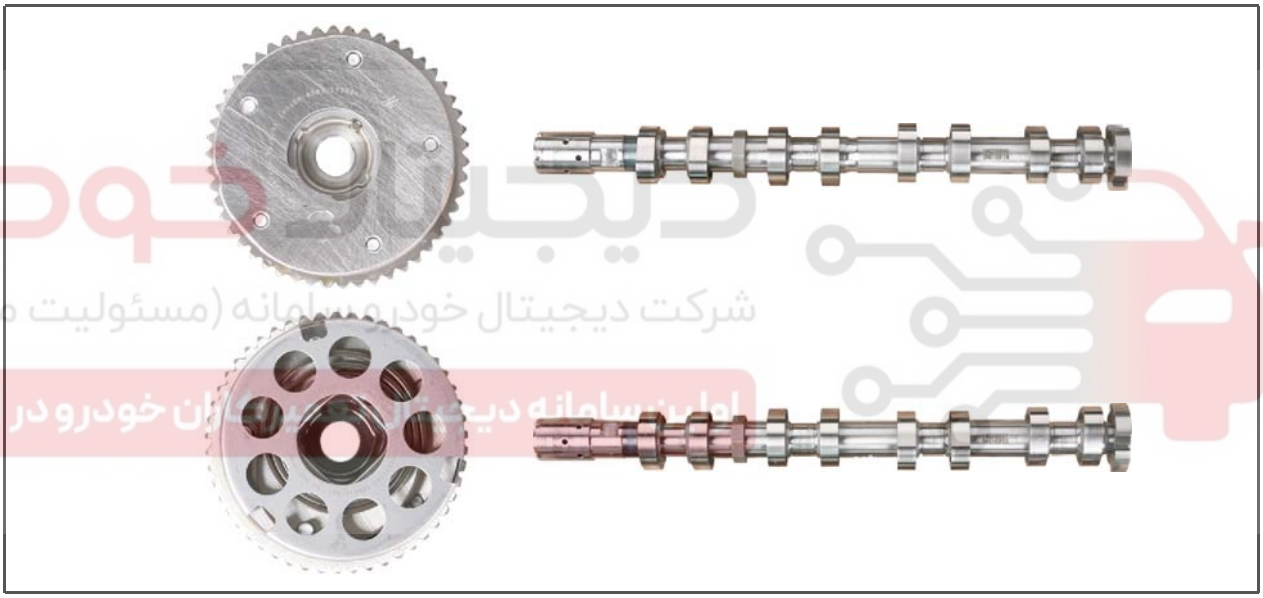
17.Remove the 8 camshaft bearing caps.

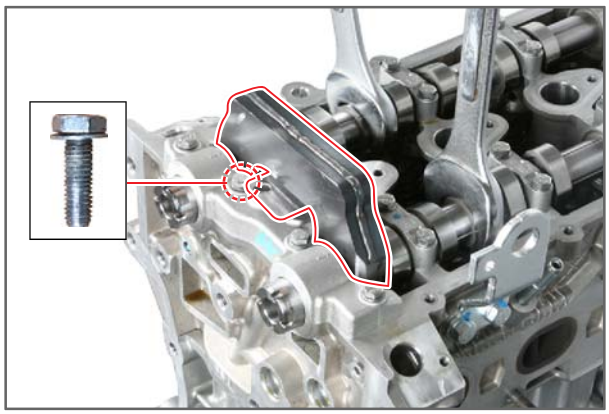
Modification basis	
Application basis	
Affected VIN	



18.Remove the intake and exhaust camshafts.

18.Install in the reverse order of removal.





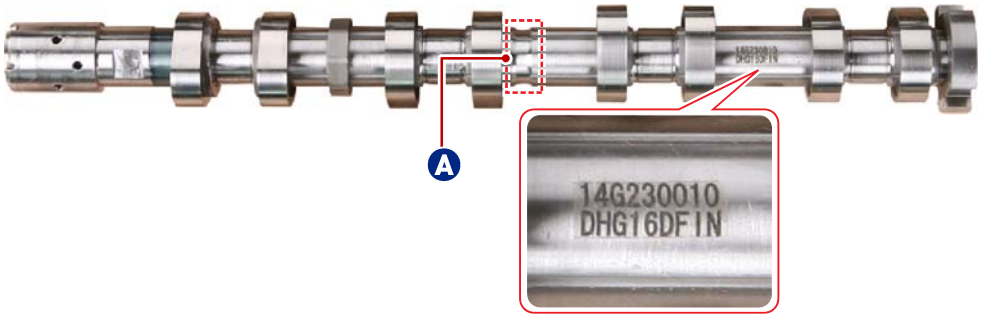
NOTE

When installing the camshaft sprocket, secure the intake and exhaust camshafts so that the marks on these camshafts face 12 o'clock position by fitting 30 mm octagon spanners on the octagon seating surfaces, and then install the camshaft retaining jig.

NOTE

The intake and exhaust camshafts are identified by the texts stamped on each camshaft (intake side: IN, exhaust side: EX) and the recessed area (A) on the intake camshaft.

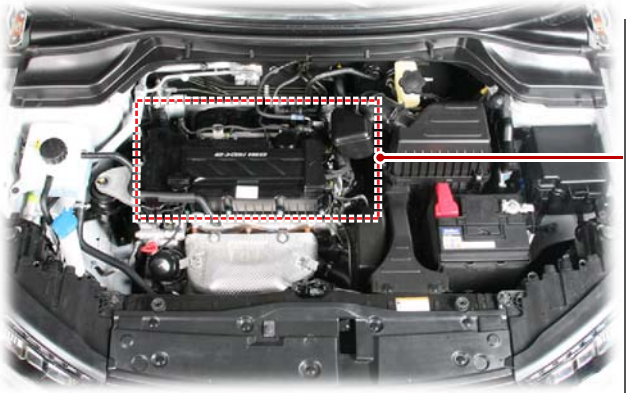
Intake camshaft

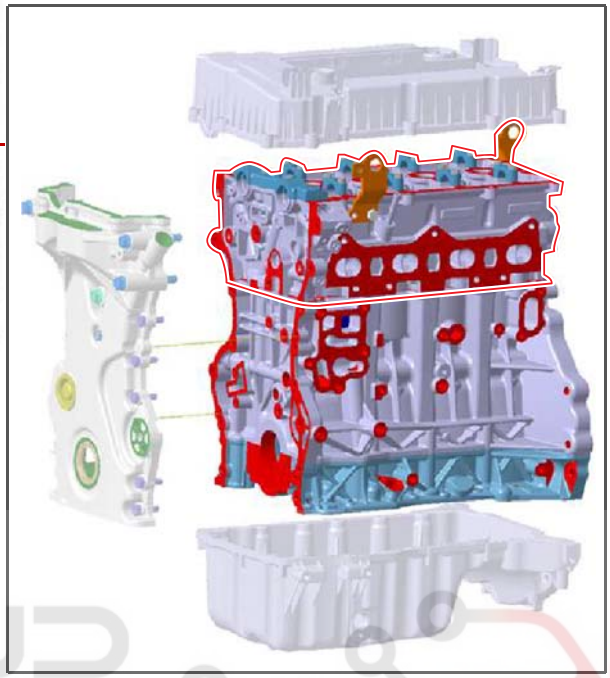


Exhaust camshaft

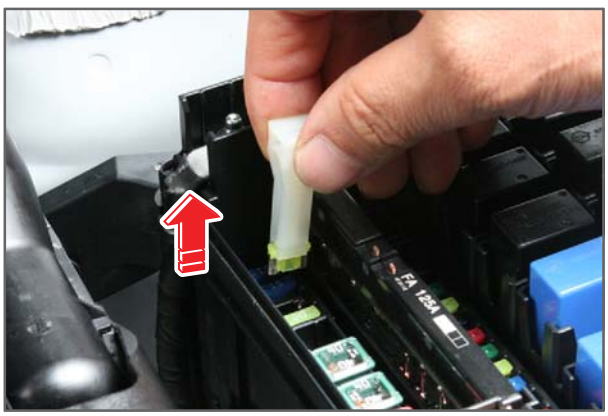
S.G.N.
1211-01 CYLINDER HEAD ASSEMBLY

Preceding work - Disconnect the negative cable from the battery.





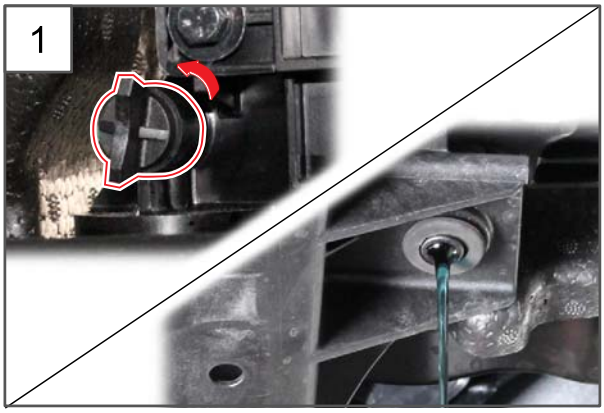
Cylinder head assembly



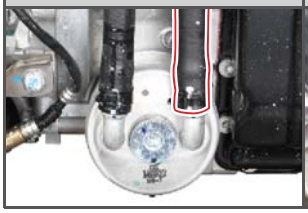
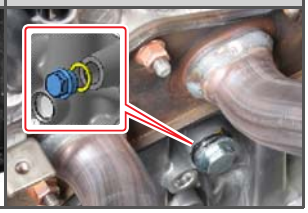
NOTE

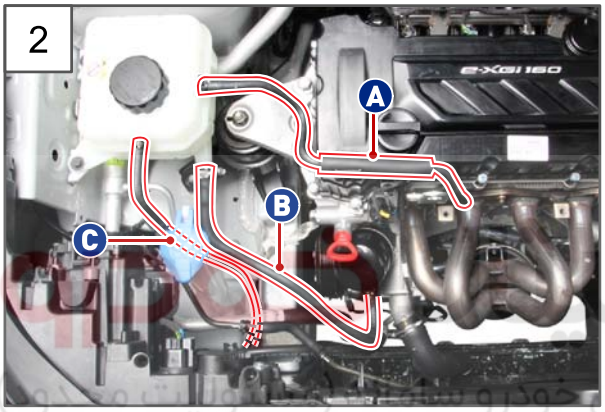
To remove the cylinder head assembly, the fuel supply tube should be disconnected. Therefore, remove the fuel pump fuse from the engine compartment fuse box and rotate the engine to drain the fuel lines.

Modification basis	
Application basis	
Affected VIN	



1. Drain the coolant. Refer to "COOLANT DRAIN AND FILL UP" under "REMOVAL AND INSTALLATION" subsection of "COOLING SYSTEM" section in "G16DF ENGINE" chapter.

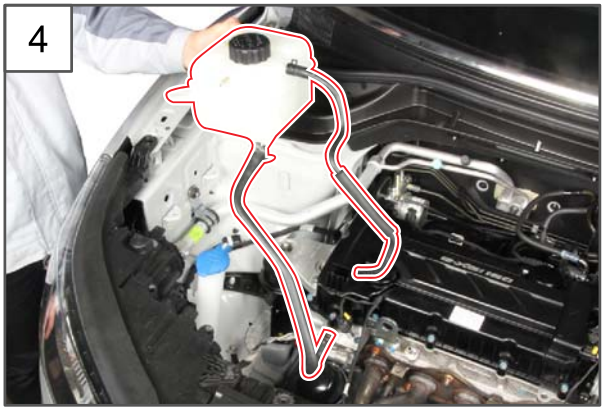
For a vehicle with A/T	For a vehicle with M/T
	



2. Remove the de-aeration hose (A) and make up hose (B) from the engine side, and radiator e-aeration hose (C) from the coolant reservoir tank.

3. Unscrew the 2 mounting bolts (10 mm) for the coolant reservoir tank.

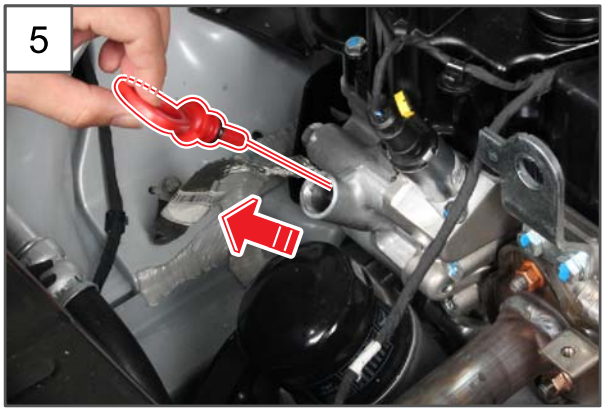
Tightening torque 10 ± 1.0 Nm



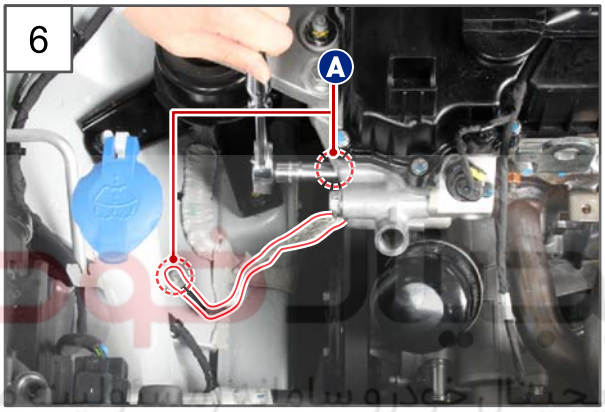
4. Remove the coolant reservoir tank by sliding the mounting upward in the direction of the arrow shown in the picture.

Coolant reservoir tank mounting


Modification basis	
Application basis	
Affected VIN	



5. Remove the oil dipstick gauge.



6. Unscrew the 2 mounting bolts (A, 10 mm) to remove the engine ground cable.

Tightening torque 10 ± 1.0 Nm

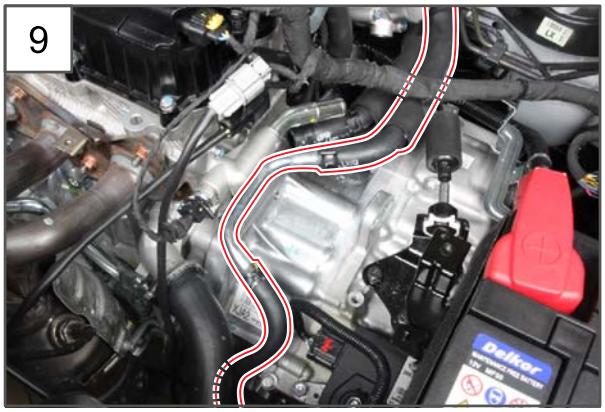
7. Remove the air cleaner assembly from the engine compartment.

NOTE

Refer to "AIR CLEANER ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "INTAKE SYSTEM" section in "G16DF ENGINE" chapter.

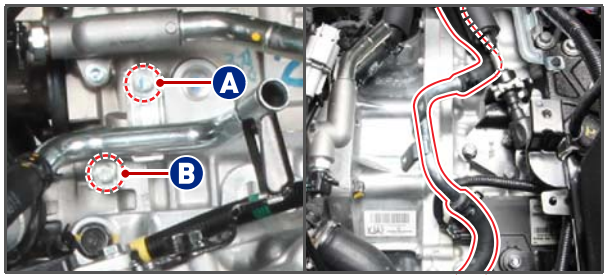
8. Disconnect the heater upper hose from the cylinder head outlet port.

9

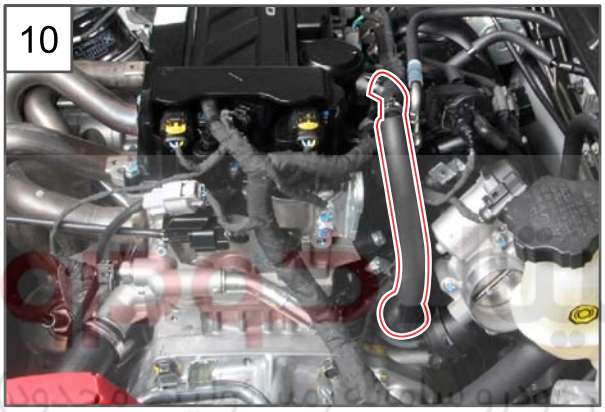


9. Unscrew the mounting bolt (A, 10 mm) for the cylinder head and the mounting bolt (B, 10 mm) for the cylinder block to remove the TOC coolant supply pipe.

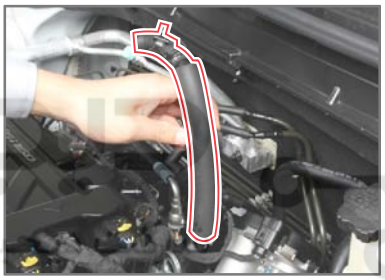
Tightening torque 10 ± 1.0 Nm



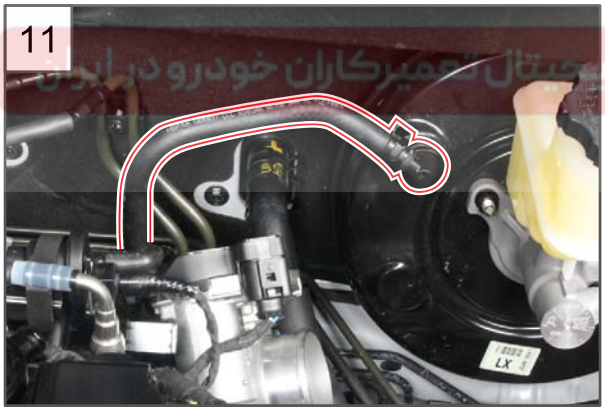
10



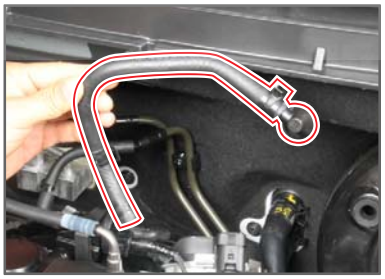
10. Disconnect the blowby hose.



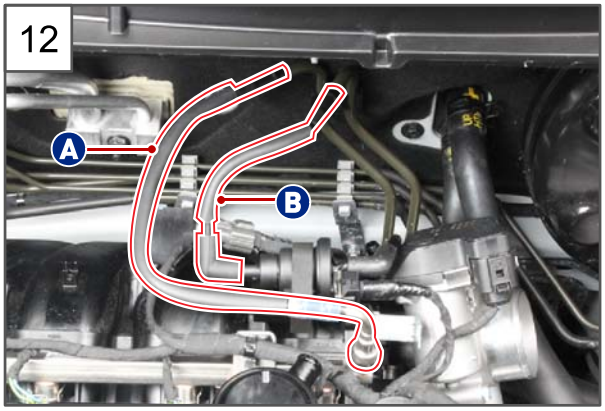
11



11. Disconnect the brake vacuum hose.



12



12. Remove the fuel supply tube (A) and PCSV hose (B).

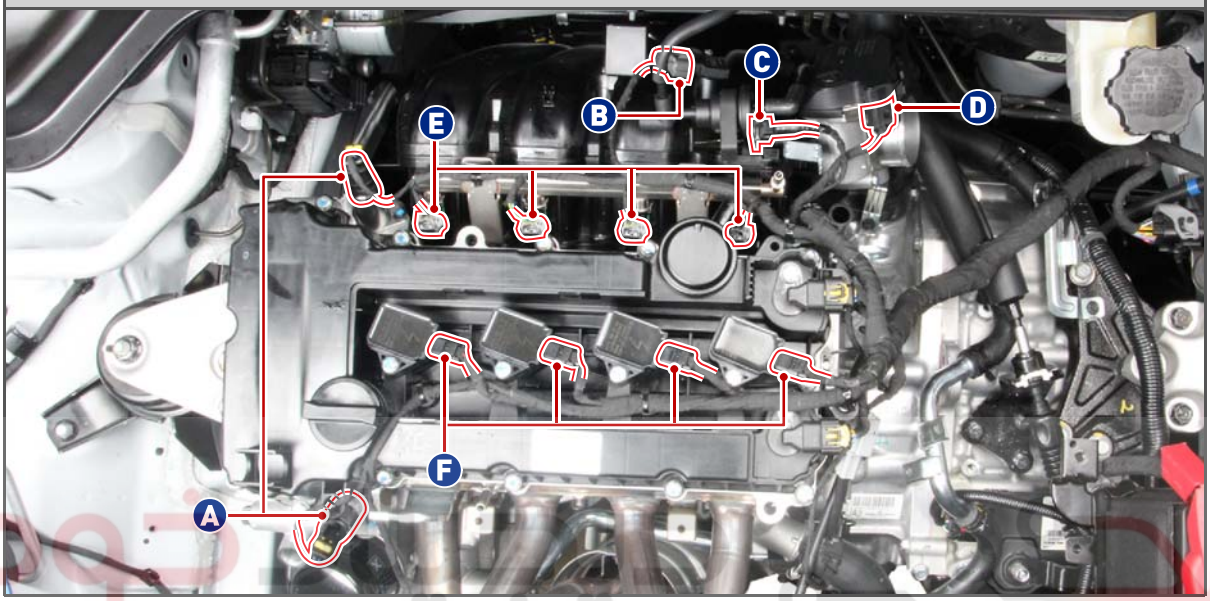
CAUTION

Be careful not to fold the fuel supply tube and PCSV hose to prevent damage to the lines.

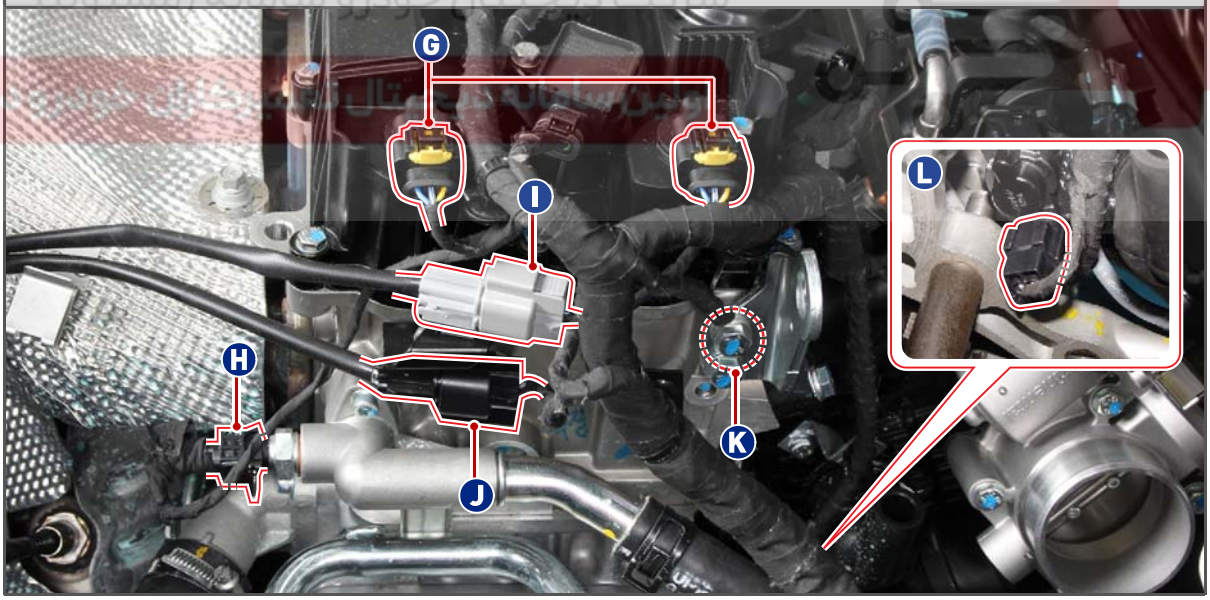
Modification basis	
Application basis	
Affected VIN	

13.Remove the ignition coil cover. And disconnect the connectors of the engine main wiring and disengage t wiring clamps.

Cylinder head cover side



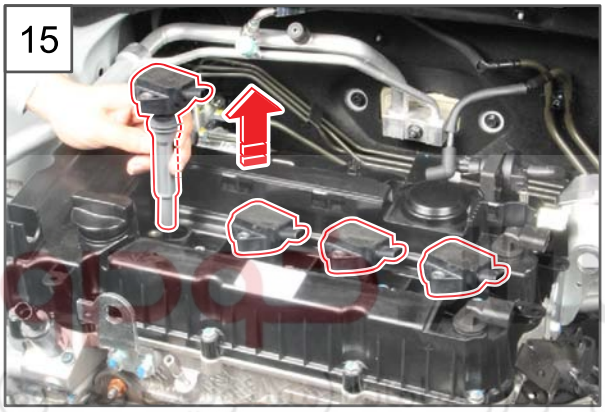
Rear side of engine



A. Intake/exhaust OCV connectors
B. T-MAP sensor
C. PCSV connector
D. Electronic throttle body connector
E. Injector connector
F. Ignition coil Connector
G. Intake/exhaust cam position sensor connector
H. Coolant temperature sensor connector
I. Rear oxygen sensor connector
J. Front oxygen sensor connector
K. Ground mounting bolt (13 mm)
L. VIS solenoid valve connector

14.Remove the 4 ignition plugs in sequence.

Tightening torque 10 ± 1.0 Nm



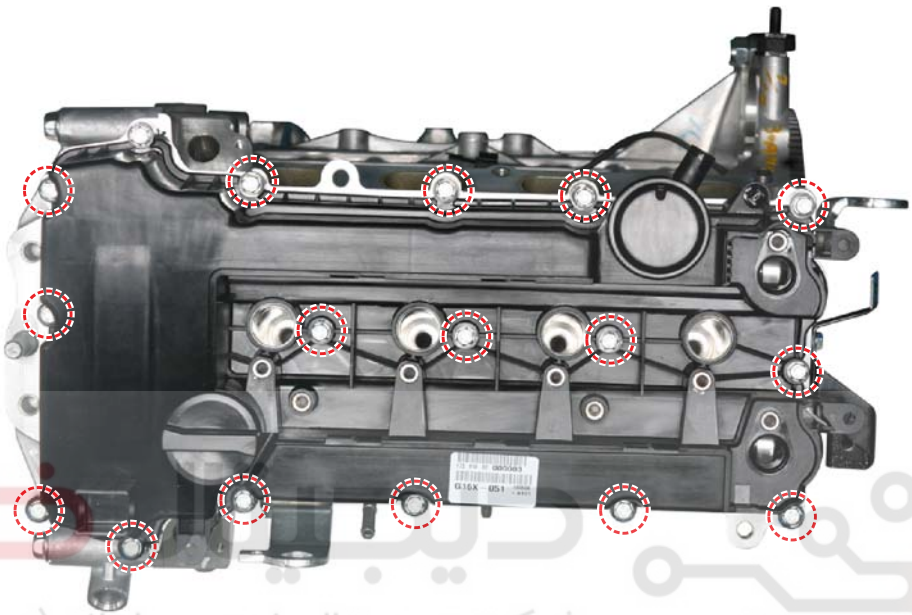
15.Remove the 4 ignition coils in sequence.

Modification basis	
Application basis	
Affected VIN	

16.Remove the 16 mounting bolts (10 mm) for the cylinder head cover.

Tightening torque 10 ± 1.0 Nm

16



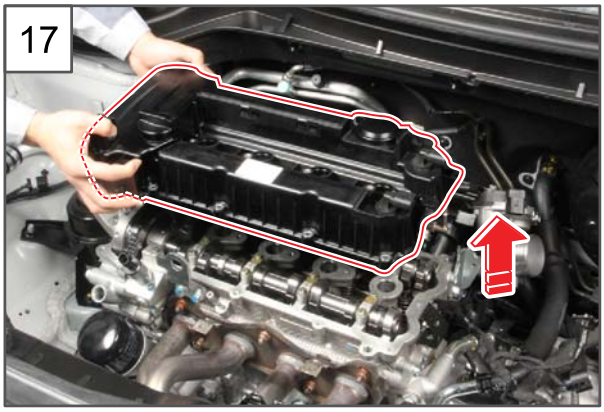
CAUTION

Loosen and remove the mounting bolts in several steps to prevent damage to the cylinder head cover.

- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

Modification basis	
Application basis	
Affected VIN	

17



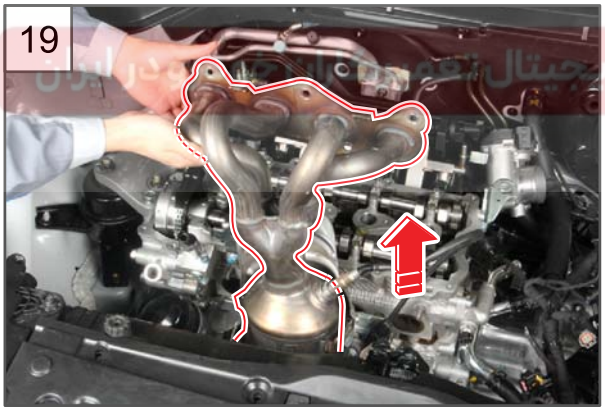
17.Remove the cylinder head cover.

18

18.Unscrew the mounting bolt (13 mm) on the bottom of the intake manifold.

Tightening torque 25 ± 2.5 Nm

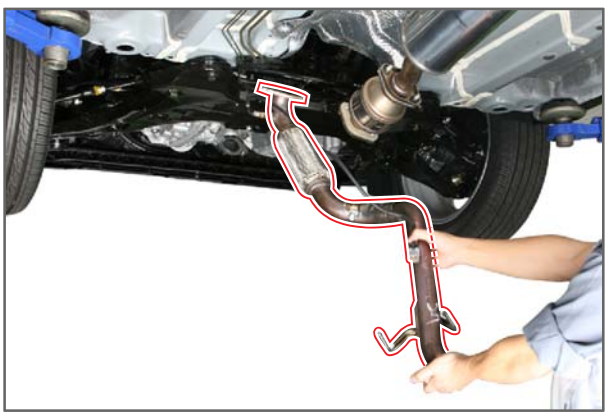
19



19.Remove the exhaust manifold assembly and exhaust pipe.

NOTE

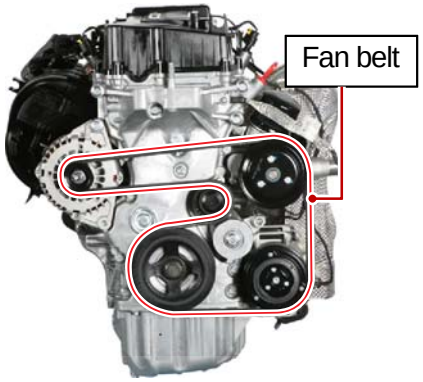
Refer to "EXHAUST MANIFOLD ASSEMBLY" and "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

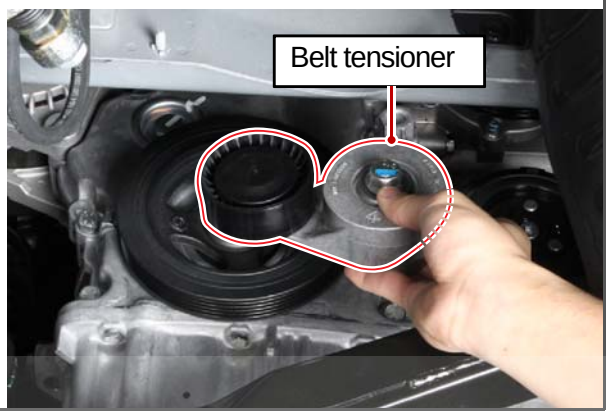


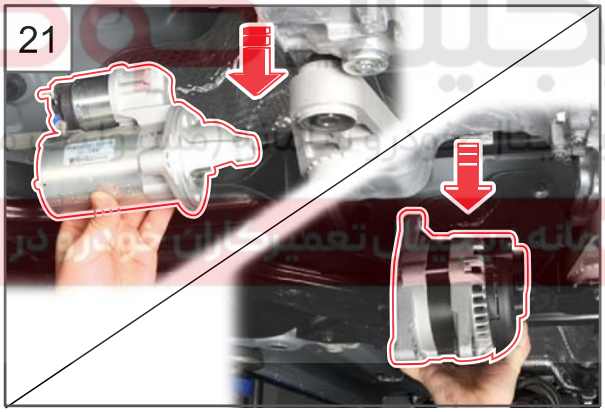
Modification basis	
Application basis	
Affected VIN	

20.Remove the fan belt and belt tensioner from the vehicle.

NOTE
Refer to "BELT SYSTEM" under this subsection.





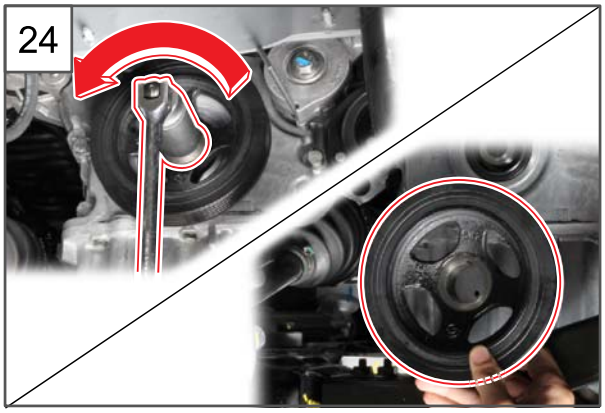


21.Remove the starter motor and alternator.

NOTE
Refer to "starter motor" under "REMOVAL AND INSTALLATION" subsection of "STARTING SYSTEM" section in "G16DF ENGINE" chapter.

22.Fit a special tool to the starter motor mounting to hold the flywheel.

Flywheel fixture

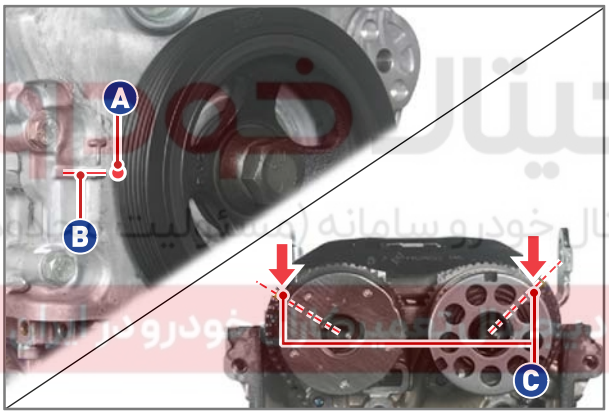



24.Unscrew the mounting bolt (27 mm) to remove the crankshaft pulley.

Sequence	Tightening torque
1	220 Nm
2	90°

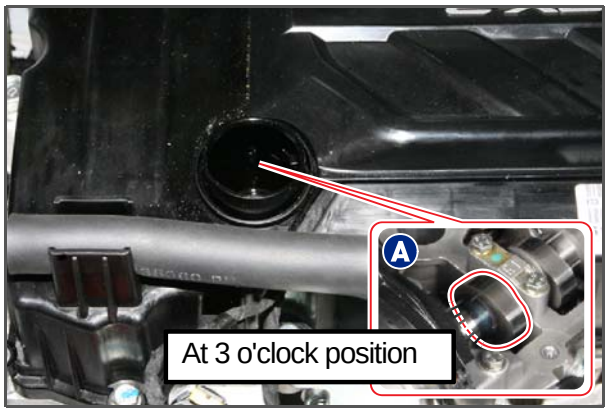
Engine timing check

▶ Without cylinder head cover



- Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.
- Intake & exhaust camshaft sprocket marks (C)

▶ With cylinder head cover



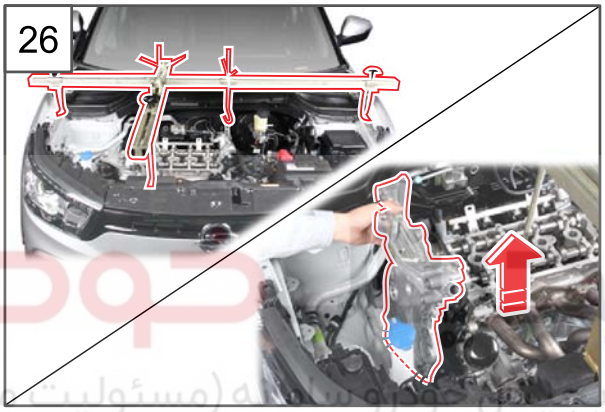
Open the oil filler cap and check the cam nose position (A) of the intake camshaft.

Modification basis	
Application basis	
Affected VIN	

25

25.Remove the oil pan under the vehicle.

26

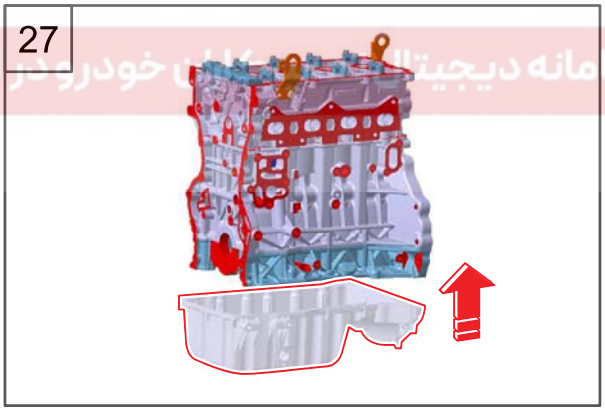


26.Install the engine support hanger and remove the timing gear case cover.

NOTE

Refer to "TIMING GEAR CASE COVER" under this subsection.

27

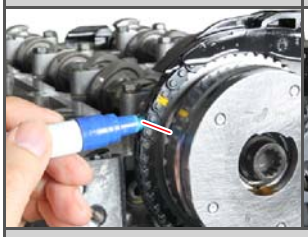


27.Temporarily install the oil pan to place the floor jack under the oil pan.

NOTE

Remove the engine support hanger after installing the floor jack.

Modification basis	
Application basis	
Affected VIN	

Intake camshaft sprocket	Exhaust camshaft sprocket
	

Crankshaft sprocket

28.Make a mark on each sprocket at the position where the timing change is aligned with the timing mark.

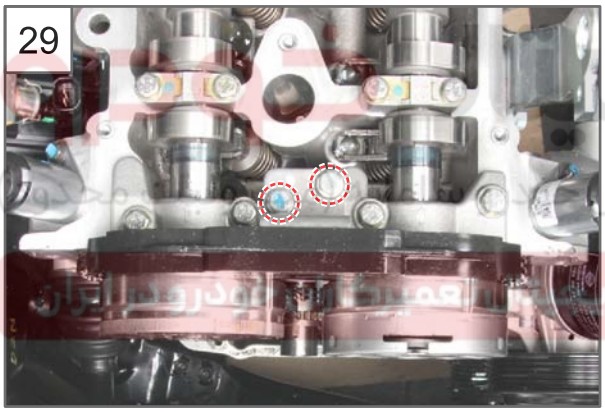
CAUTION

Mark by choosing one of the following:

a. Make a timing mark with color other than yellow or white which was used before to identify easily.

b. Make a timing mark with the same color which was used before.

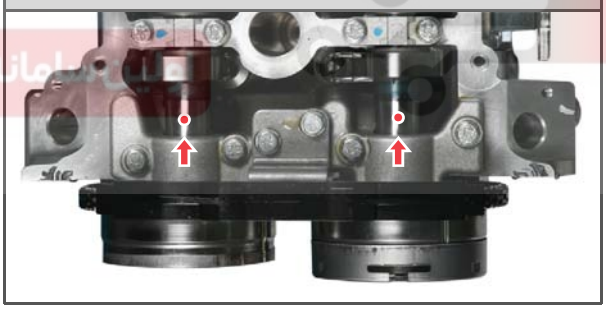
29



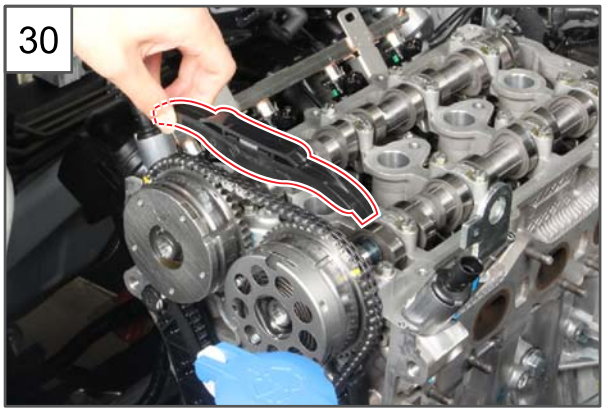
29.Unscrew the 2 mounting bolts (10 mm) for the sliding upper rail.

Tightening torque 10 ± 1.0 Nm

Intake & exhaust camshaft marks

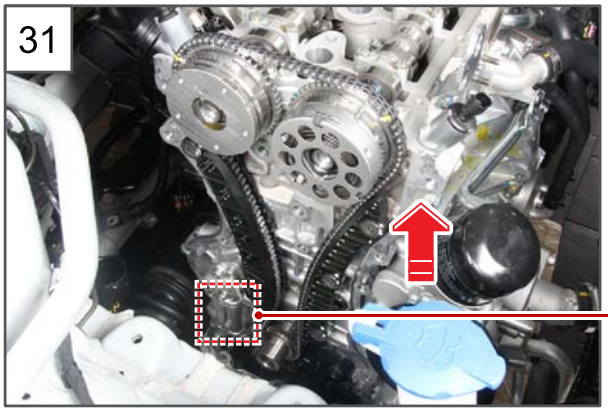


30



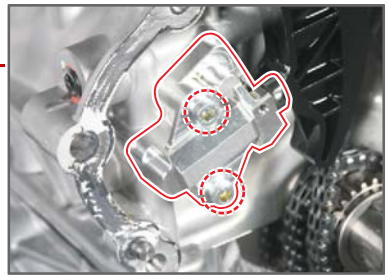
30.Remove the sliding upper rail.

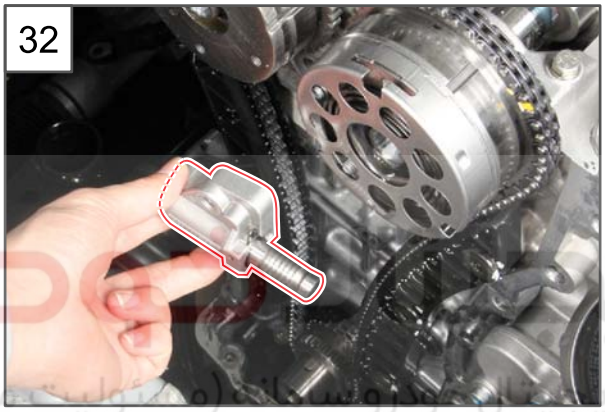
Modification basis	
Application basis	
Affected VIN	



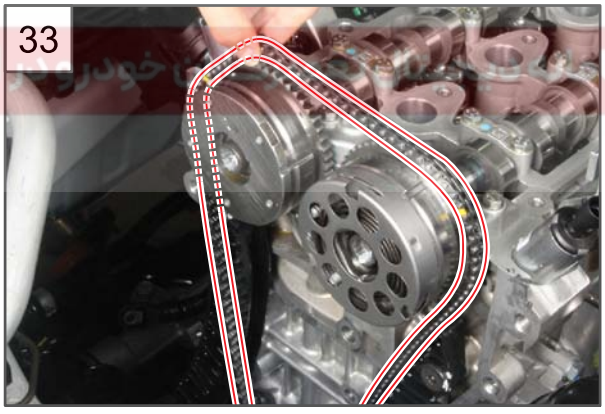
31.Lift up the engine as high as possible using a floor jack and remove the 2 hexagon mounting bolts (5 mm) for the chain tensioner.

Tightening torque 10 ± 1.0 Nm



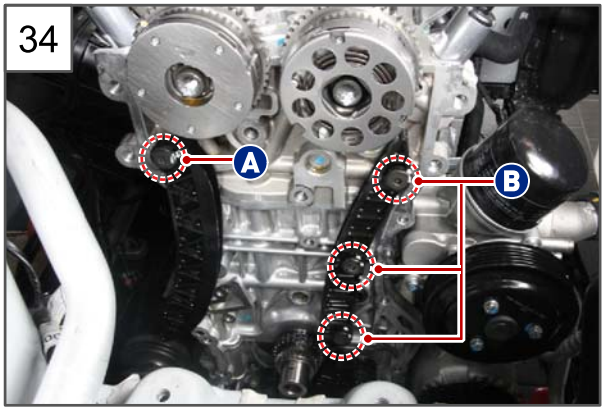


32.Remove the chain tensioner.

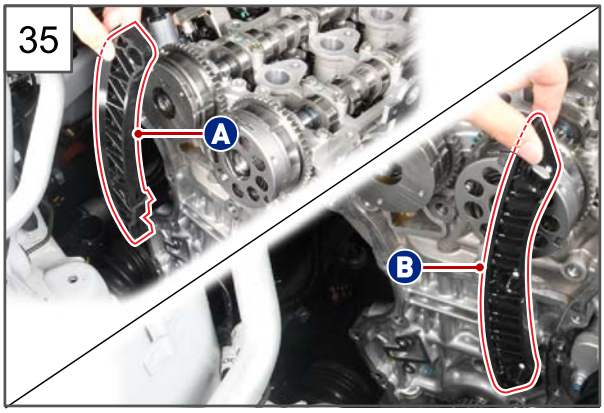


33.Remove the engine timing chain. (When installing the timing chain, refer to "ENGINE TIMING CHAIN" under this subsection)

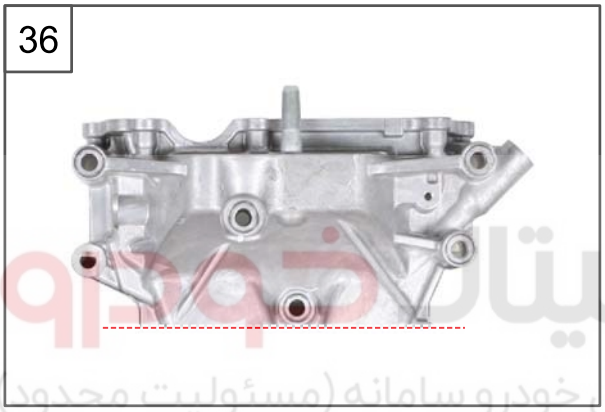
Timing chain

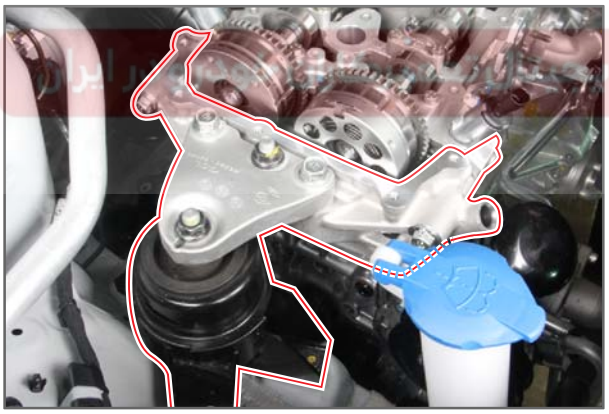


34.Unscrew the mounting bolt (A, T40) for the tensioner rail and the 3 mounting bolts (B, T40) for the guide rail.



35.Remove the tensioner rail (A) and the guide rail (B).



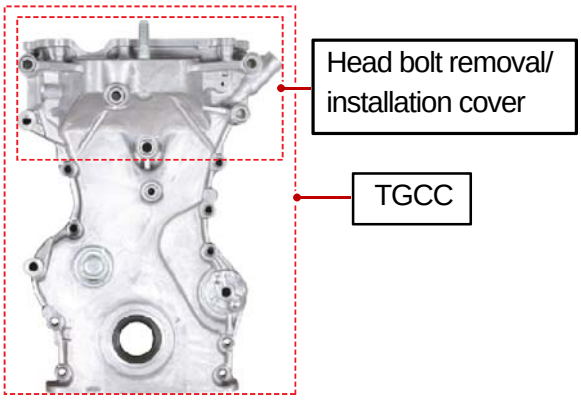


36.Install a head bolt removal/installation tool on the engine as shown in the picture.

- Remove the engine mounting bracket after loosening the camshaft and head bolt one revolution.
- Remove the head bolt completely and remove the head bolt removal/installation tool and the cylinder head.

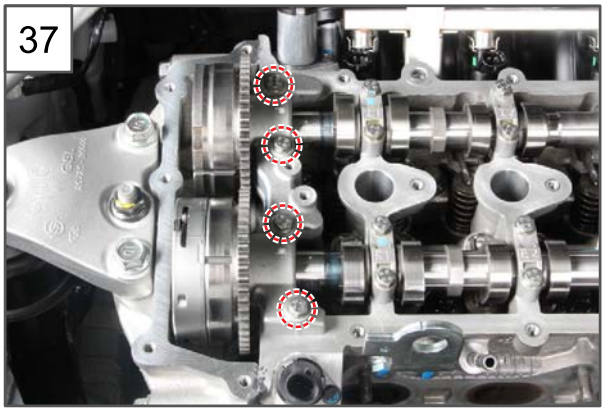
Tip for service

The engine will not be properly secured if the RH engine mounting insulator is remove. Therefore, using a cover for cylinder head removal/installation is required to facilitate removal/installation of cylinder head bolt and camshaft center bolt.



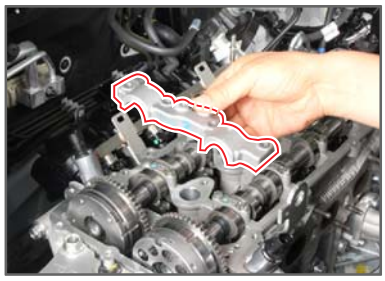
Modification basis	
Application basis	
Affected VIN	

37



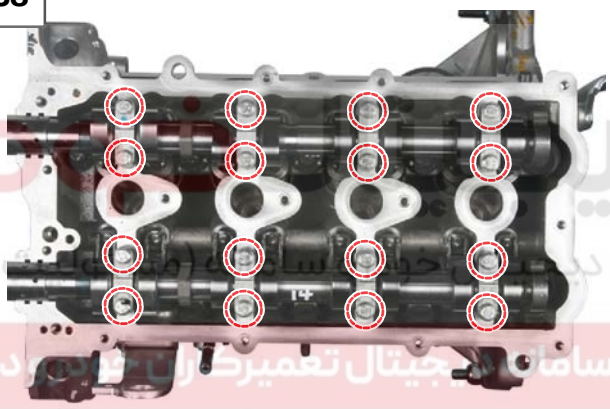
37.Remove the 4 mounting bolts (10 mm) to remove the camshaft front bearing cap.

Tightening torque 10 ± 1.0 Nm



38.Unscrew the 16 mounting bolts (10 mm) for the camshaft bearing caps.

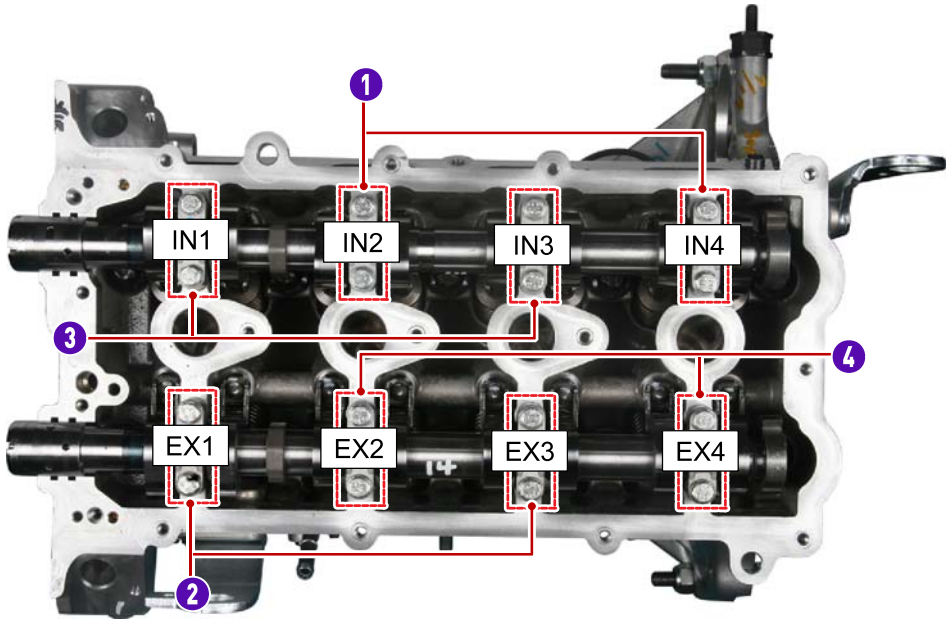
38

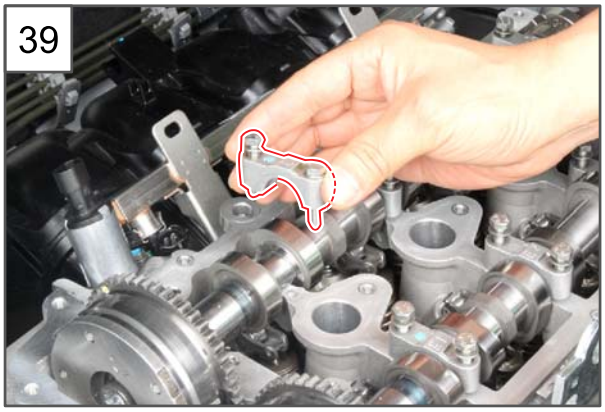


NOTE

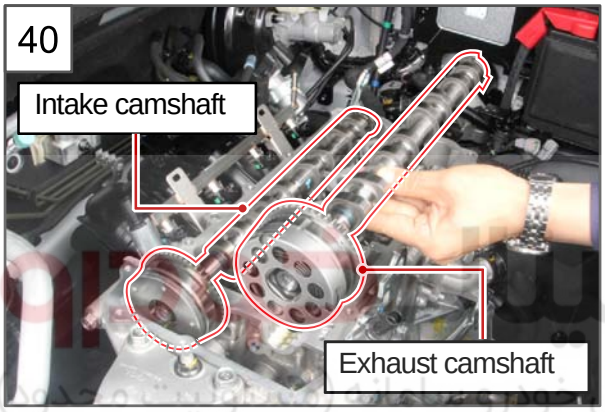
Unscrew the camshaft cap mounting bolts slowly in two or more stages according to the specific sequence stated below. Screw in the bolts in the reverse of unscrewing.
(1) Intake cams: IN2, IN4
(2) Exhaust cams: EX1, EX3
(3) Intake cams: IN1, IN3
(4) Exhaust cams: EX2, EX4

Tightening torque 10 ± 1.0 Nm





39.Remove the 8 camshaft bearing caps.

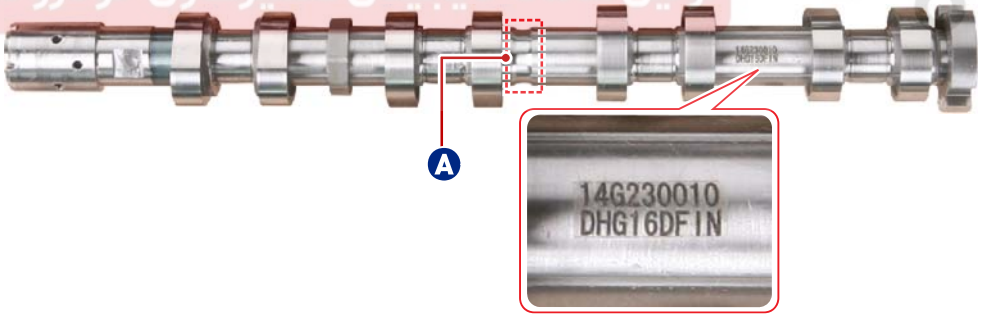


40.Remove the intake and exhaust camshafts.

NOTE

The intake and exhaust camshafts are identified by the texts stamped on each camshaft (intake side: IN, exhaust side: EX) and the recessed area (A) on the intake camshaft.

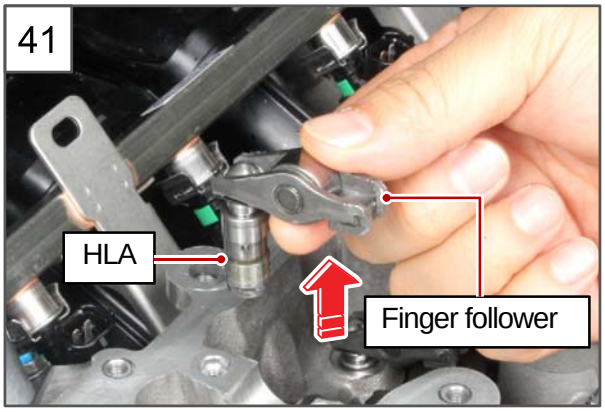
Intake camshaft



Exhaust camshaft

Modification basis	
Application basis	
Affected VIN	

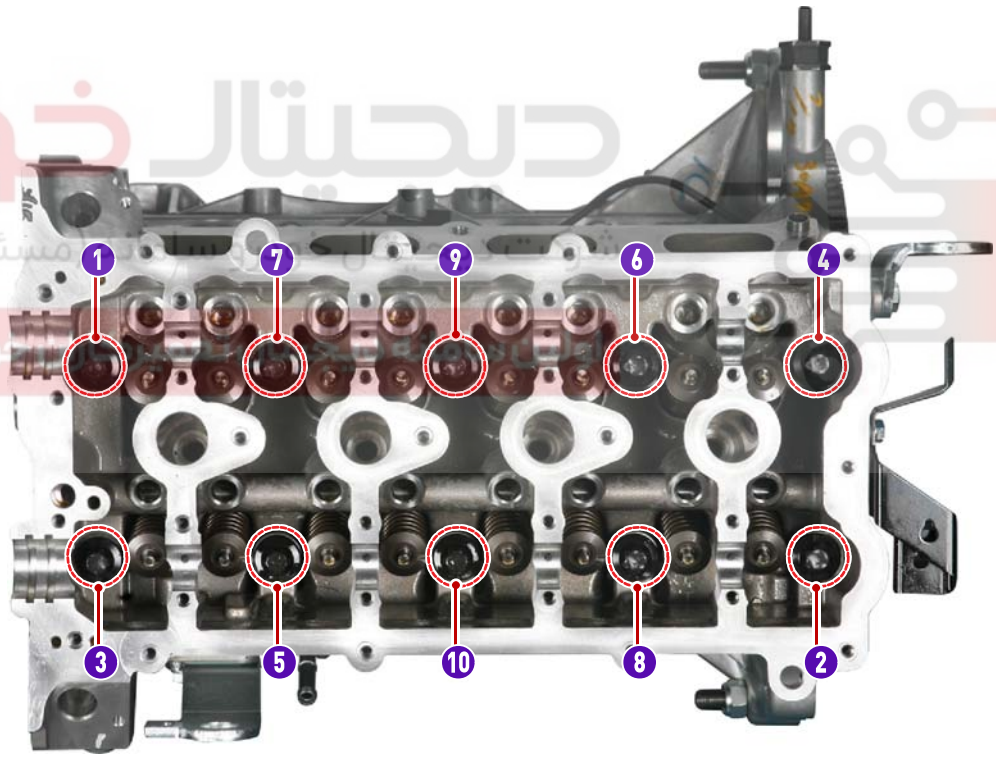
41



41.Remove the 8 HLAs with finger follower.

42.Loosen the 10 mounting bolts (E16) for the cylinder head one revolution (enough only to release the tension of head bolt).

42



Sequence	Tightening torque
1	30 ± 3.0 Nm
2	90° X 2 times

CAUTION

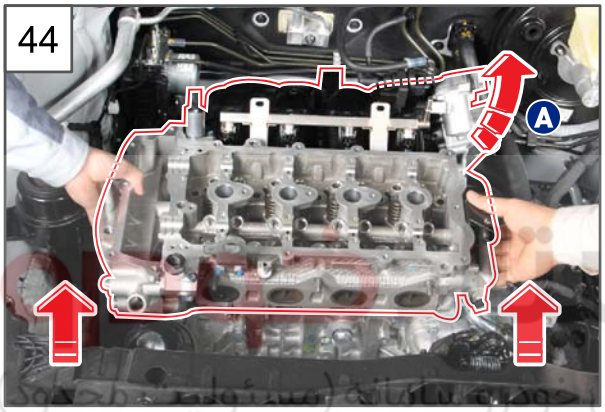
To protect the cylinder head from damage, remove the bolts in sequence as follows:

- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

43

43.Remove the timing gear case cover with the bracket from the temporarily installed RH engine mounting insulator.

44



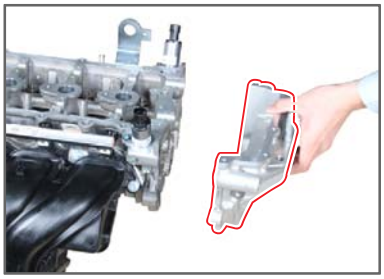
44.Remove the cylinder head assembly from the vehicle.

CAUTION

Remove the cylinder head assembly by moving it in the direction of the arrow shown in the picture to avoid interference of the intake manifold damper mounting.

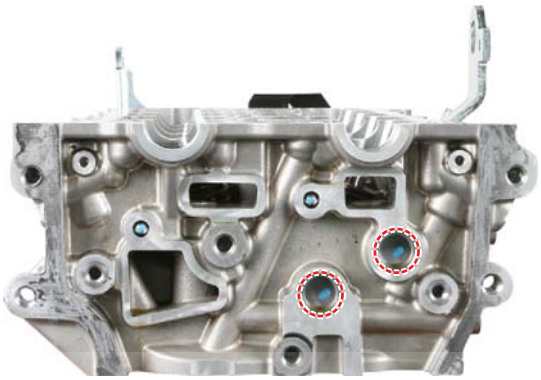
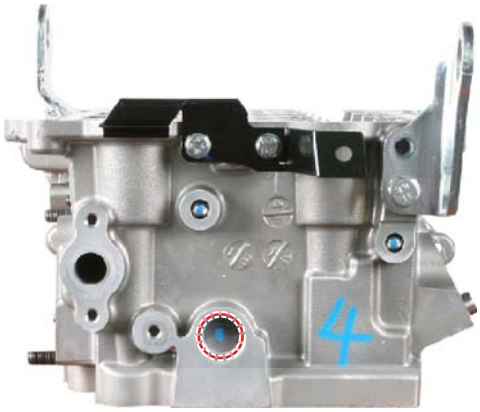
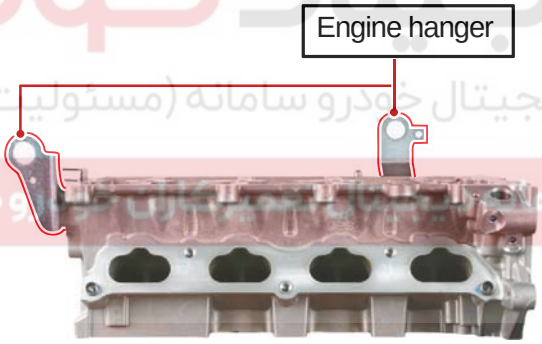
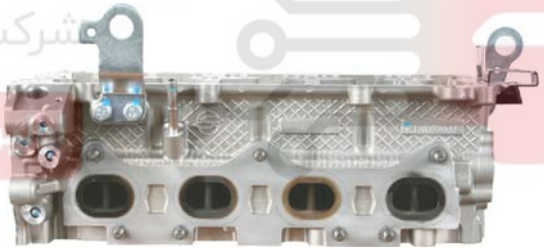
45

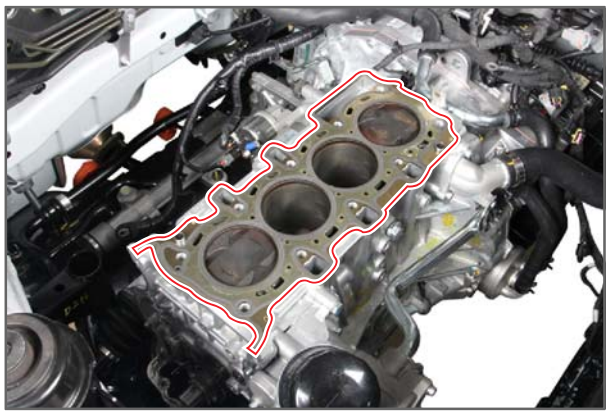
45.Remove the components including intake manifold and head bolt removal/installation tool from the cylinder head assembly.



Modification basis	
Application basis	
Affected VIN	

46.Install in the reverse order of removal.

Front view	Rear view
Coolant expansion plug 	Coolant expansion plug 
Left view	**Right view**
	



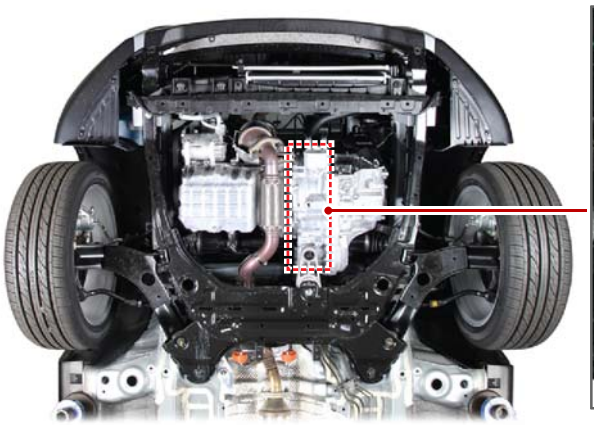
NOTE

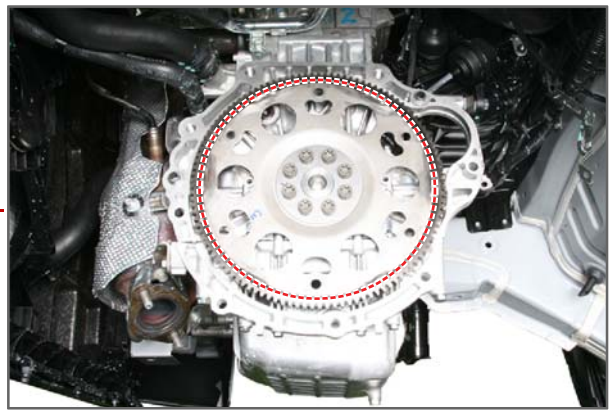
Replace the cylinder head gasket with a new one when installing.

S.G.N. 1130-18

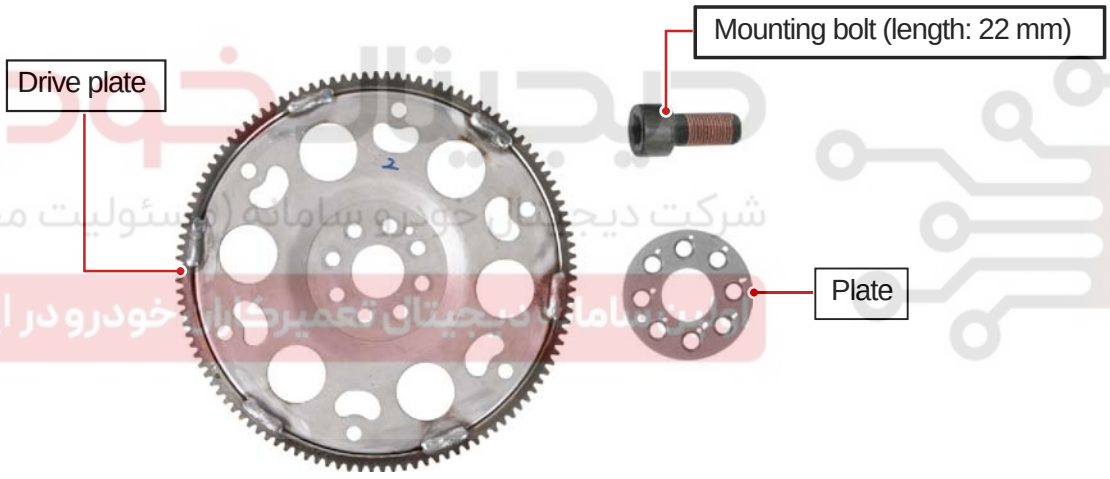
DRIVE PLATE (FOR A VEHICLE WITH A/T)

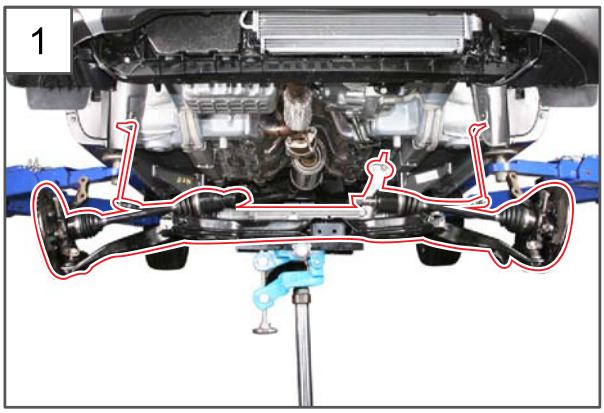
Preceding work - Disconnect the negative cable from the battery.





Drive plate





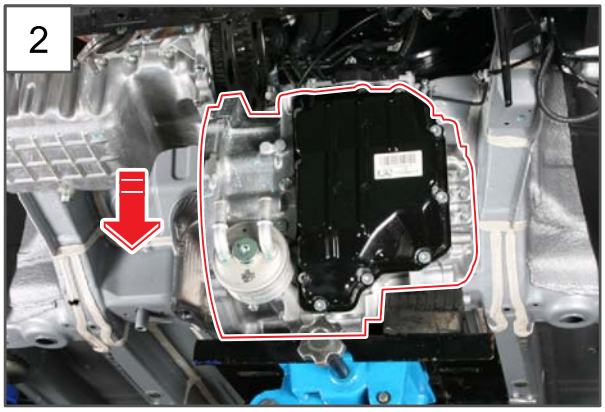
1. Remove the subframe module from the vehicle.

NOTE

Refer to "FRONT SUBFRAME MODULE" under "REMOVAL AND INSTALLATION" subsection of "SUBFRAME ASSEMBLY" section in "CHASSIS" chapter.

Modification basis	
Application basis	
Affected VIN	

2

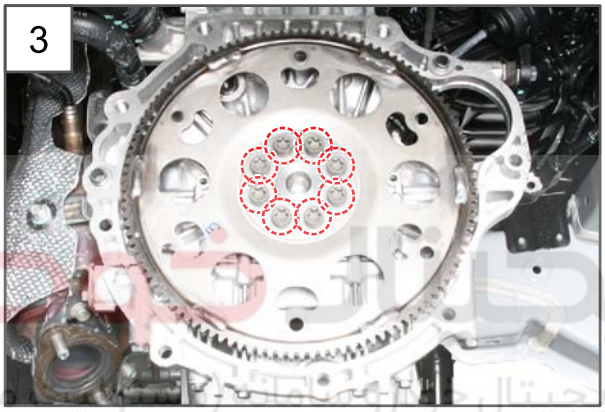


2. Remove the A/T assembly.

NOTE

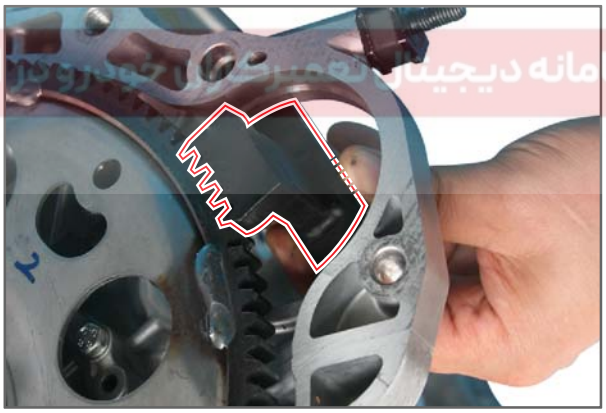
Refer to "A/T ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "6 A/T" section in "CHASSIS" chapter.

3



3. Remove the 8 mounting bolts (T55) for the drive plate.

Sequence	Tightening torque
1	45 ± 5.0 Nm
2	45° ± 5°



NOTE

Remove the mounting bolts after securing the drive plate with the flywheel fixture.

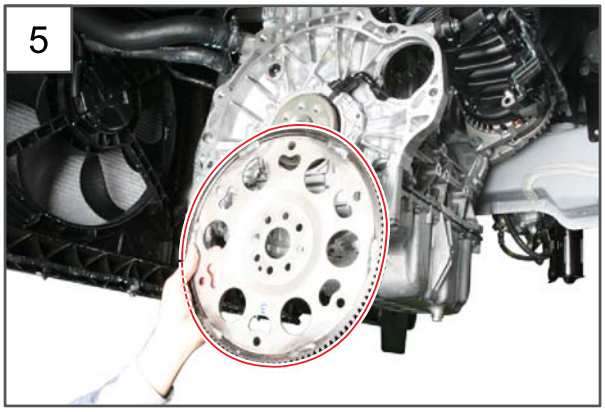
Flywheel fixture


4

4. Remove the plate.

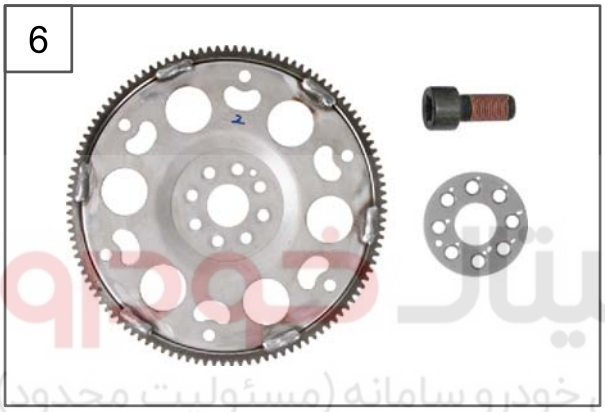
Modification basis	
Application basis	
Affected VIN	

5



5. Remove the drive plate.

6



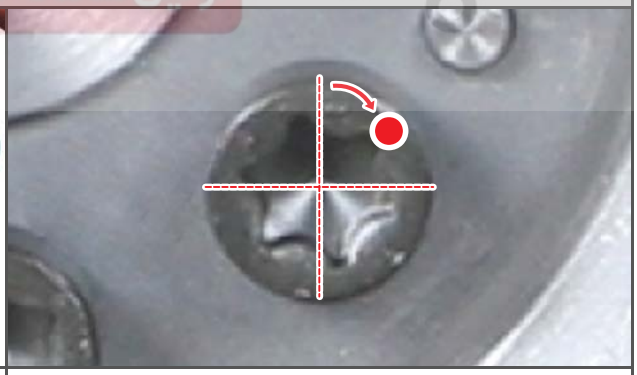
6. Install in the reverse order of removal.

CAUTION

The mounting bolt used for a vehicle with M/T is different from the bolt used for a vehicle with A/T.
(A/T: red lock tight, M/T: blue lock tight)

Angle tightening mounting bolt

Paint mark on each bolt after the 1st torque tightening (45 ± 5.0 Nm).



Angle tighten the bolts further in sequence at the time of 2nd tightening. (45° ± 5°)

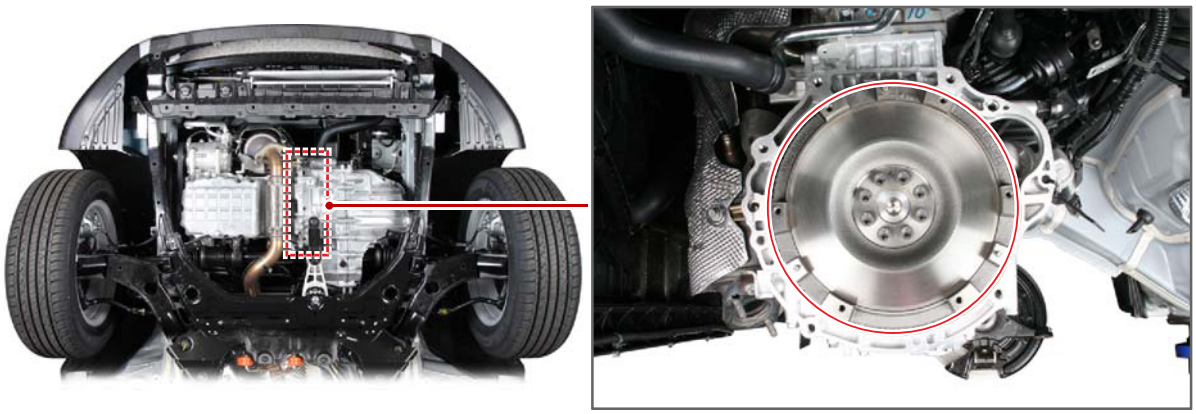
NOTE

- Tighten the mounting bolts in several stages diagonally.
- Check the status and angle of the tightened bolt after the 2nd tightening.

Modification basis	
Application basis	
Affected VIN	

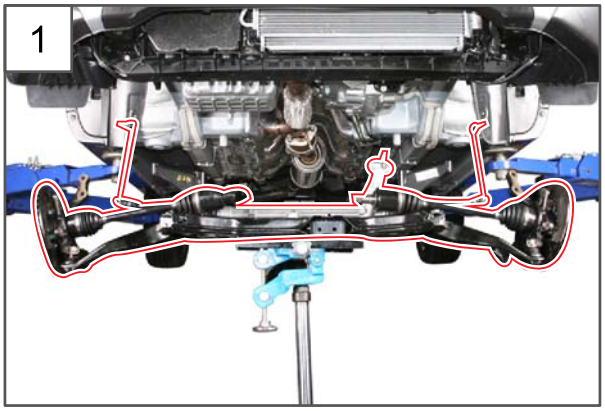
S.G.N. 1130-13 FLYWHEEL (FOR A VEHICLE WITH M/T)

Preceding work - Disconnect the negative cable from the battery.



Flywheel	
Front view	Rear view
	

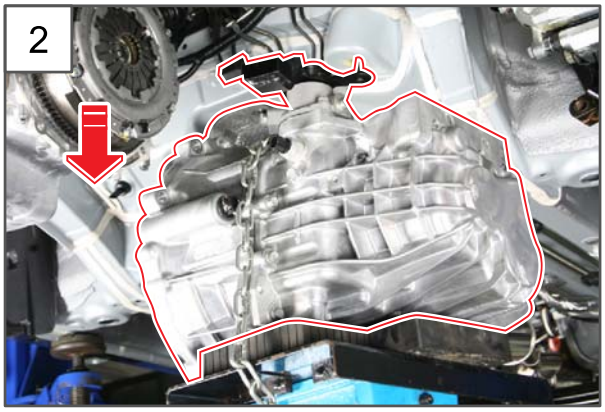
* Mounting bolt length: 26 mm



1. Remove the subframe module from the vehicle.

NOTE
Refer to "FRONT SUBFRAME MODULE" under "REMOVAL AND INSTALLATION" subsection of "SUBFRAME ASSEMBLY" section in "CHASSIS" chapter.

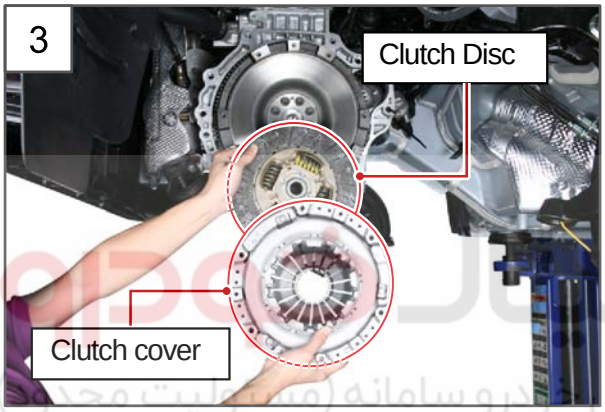
Modification basis	
Application basis	
Affected VIN	



2. Remove the M/T assembly.

NOTE

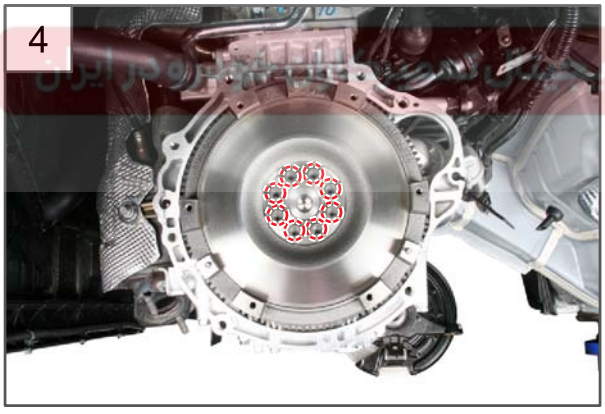
Refer to "M/T ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "6 M/T" section in "CHASSIS" chapter.



3. Remove the clutch cover and clutch disk.

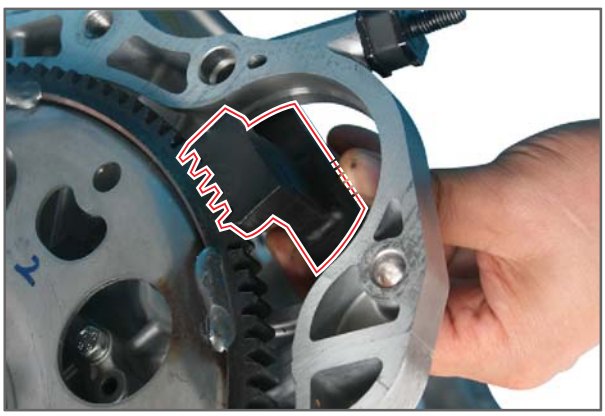
NOTE

Refer to "CLUTCH DISK AND COVER ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "CLUTCH" section in "CHASSIS" chapter.



4. Remove the 8 mounting bolts (T55) for the flywheel.

Sequence	Tightening torque
1	45 ± 5.0 Nm
2	90° ± 5°

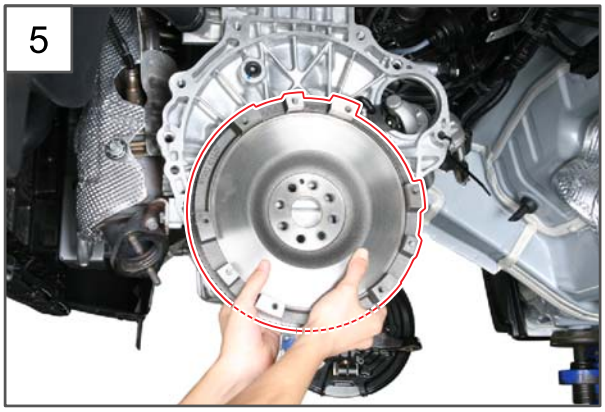


NOTE

Remove the mounting bolts after securing the flywheel with the flywheel fixture.

Flywheel fixture


Modification basis	
Application basis	
Affected VIN	



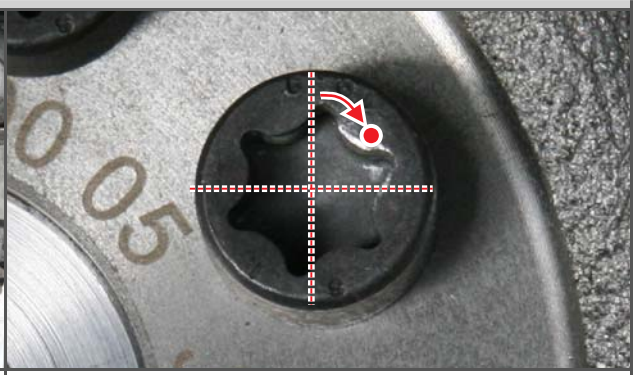
5. Remove the flywheel.

CAUTION

The mounting bolt used for a vehicle with M/T is different from the bolt used for a vehicle with A/T.
(A/T: red lock tight, M/T: blue lock tight)

6. Install in the reverse order of removal.

Front view	Rear view
	

Angle tightening mounting bolt	
	
Paint mark on each bolt after the 1st torque tightening (45 ± 5.0 Nm).	Angle tighten the bolts further (90° ± 5°) in sequence at the time of 2nd tightening.

NOTE

- Tighten the mounting bolts in several stages diagonally.
- Check the status and angle of the tightened bolt after the 2nd tightening.

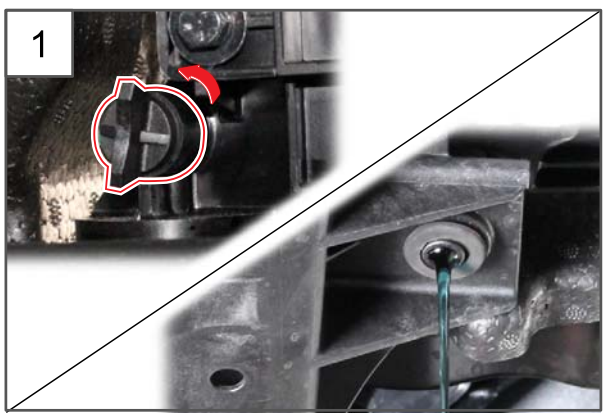
S.G.N. 1118-01

ENGINE ASSEMBLY

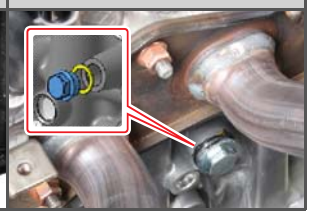
Preceding work - Collect the A/C refrigerant using the equipment for the A/C refrigerant.

NOTE

To remove the engine assembly, the fuel supply tube should be disconnected. Therefore, remove the fuel pump fuse from the engine compartment fuse box and rotate the engine to drain the fuel lines.

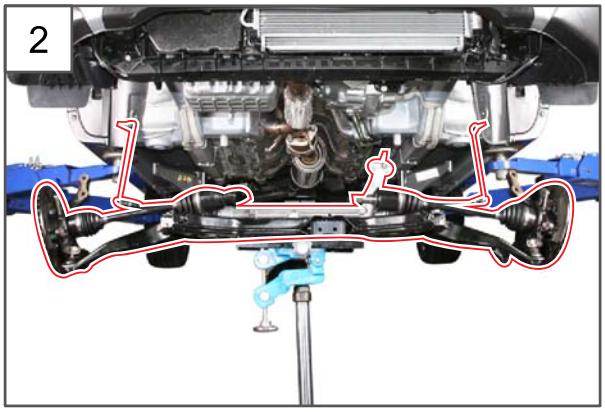


1. Drain the coolant. Refer to "COOLANT DRAIN AND FILL UP" under "REMOVAL AND INSTALLATION" subsection of "COOLING SYSTEM" section in "G16DF ENGINE" chapter.

For a vehicle with A/T	For a vehicle with M/T
	

Modification basis	
Application basis	
Affected VIN	

2

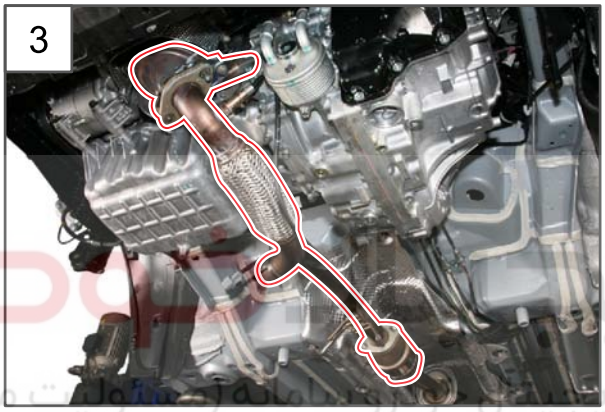


2. Remove the subframe module from the vehicle.

NOTE

Refer to "FRONT SUBFRAME MODULE" under "REMOVAL AND INSTALLATION" subsection of "SUBFRAME ASSEMBLY" section in "CHASSIS" chapter.

3

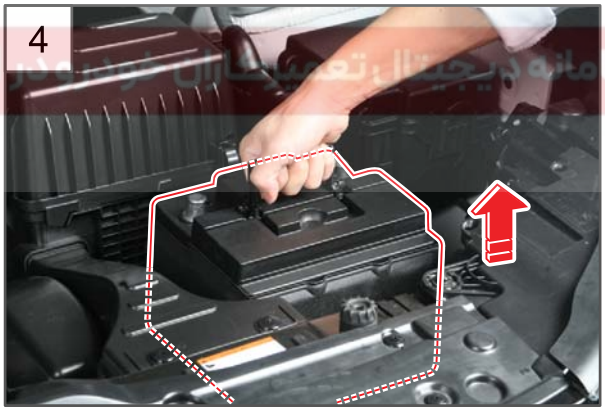


3. Remove the front exhaust pipe under the vehicle.

NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

4



4. Remove the battery from the vehicle.

5

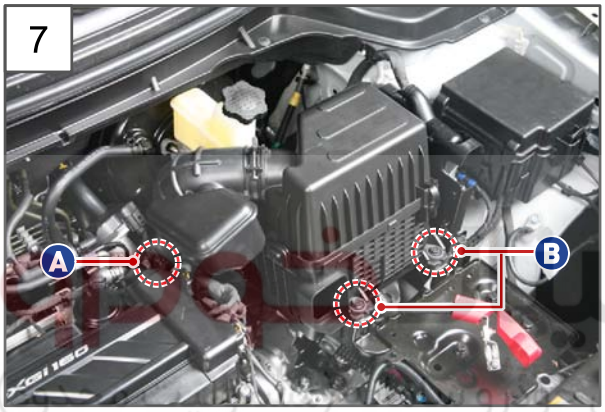
5. Remove the 2 screw rivets securing the snorkel assembly.

Modification basis	
Application basis	
Affected VIN	

6

6. Remove the snorkel assembly.

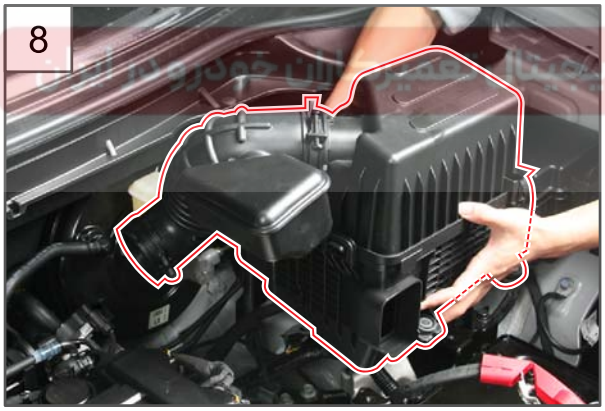
7



7. Remove the spring clamp (A, 10 mm) for the air cleaner hose and 2 mounting bolts (B, 12 mm) for the air cleaner housing.

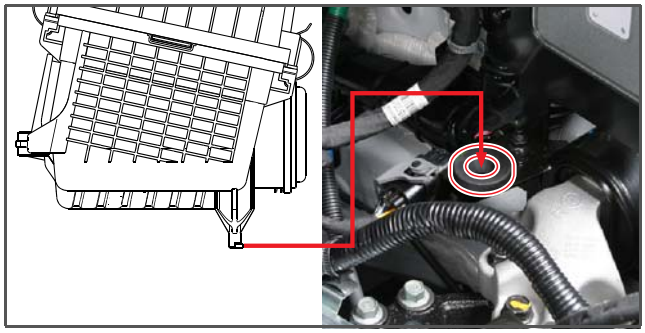
Tightening torque **(A) 6 to 7 Nm**
(B) 25 ± 2.5 Nm

8



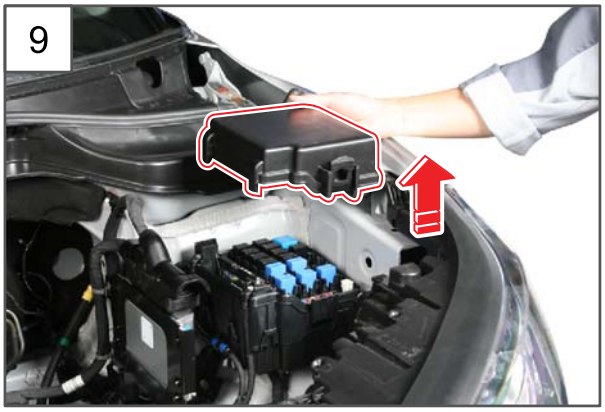
8. Remove the air cleaner housing with the air cleaner hose.

CAUTION



When installing the air cleaner housing, make sure that the retaining key at the bottom of the housing is seated correctly on the recessed area of the engine compartment.

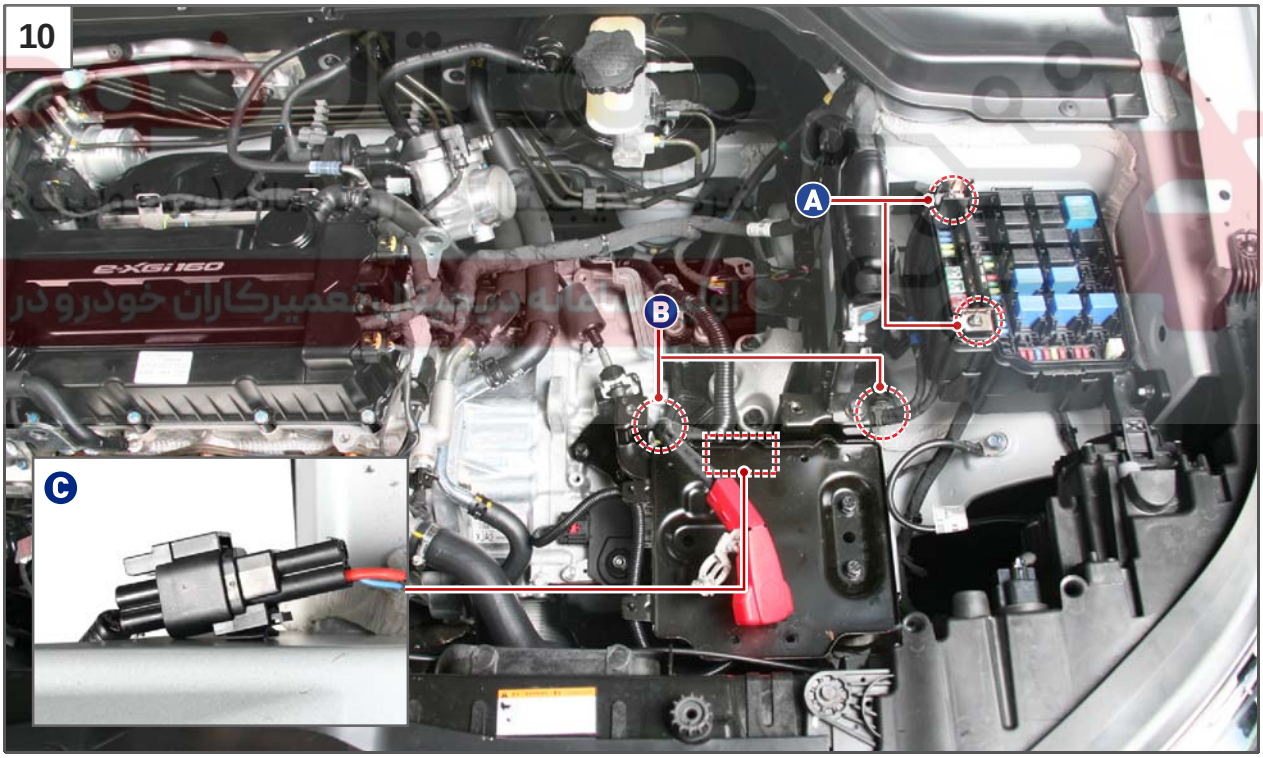
Modification basis	
Application basis	
Affected VIN	



9. Remove the fuse box in the engine compartment.

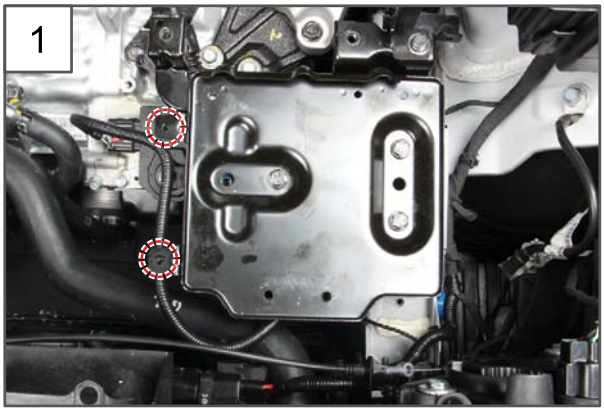
10. Remove the 2 mounting nuts (10 mm) for the underhood fuse box (+) terminal and the 2 wiring clamps (B) to disconnect the battery positive cable connector (C).

Tightening torque 10 ± 1.0 Nm



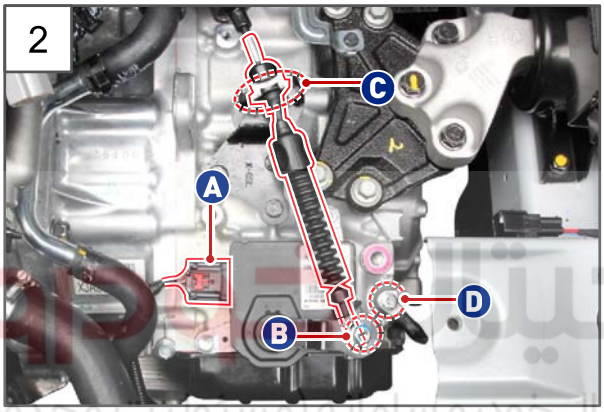
Working on transmission side for a vehicle with A/T

1



1. Detach the 2 wiring clamps (A) from the battery tray.

2



2. Disconnect various connections including connectors, ground cables, gear selector lever cables from the A/T.
   A. Disconnect the TCU connector.
   B. Unscrew the mounting bolt (12 mm) securing the shift cable on the manual lever side.
   C. Remove the mounting clip for the shift cable from the bracket.
   D. Remove the mounting bolt (D, 10 mm) for the transmission ground cable.

Tightening torque **(B) 14 to 18 Nm**
(C) 13.7 to 19.6 Nm

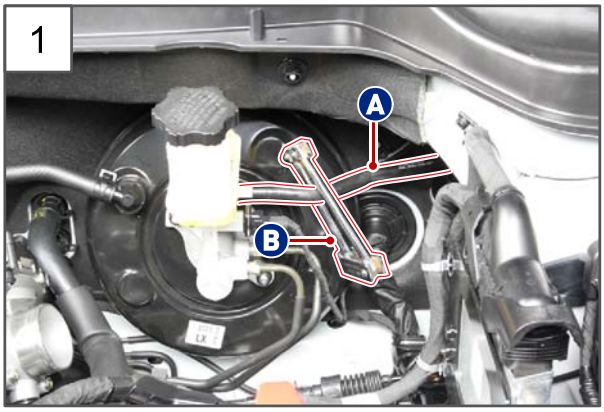
3

3. Disconnect the A/T breather hose on the ECU side.

Modification basis	
Application basis	
Affected VIN	

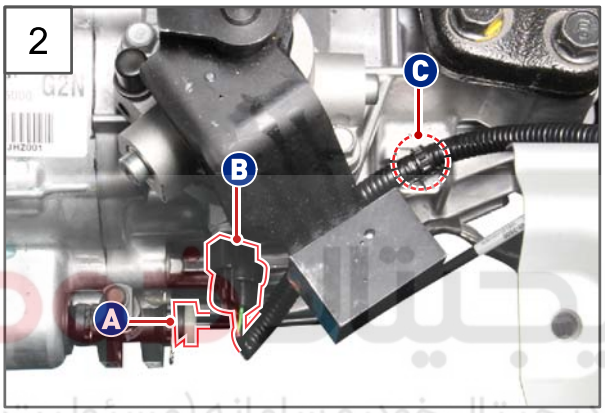
Working on transmission side for a vehicle with M/T

1



1. Fit a special tool (B) on the clutch oil feed hose (A) to cut off the oil supply.

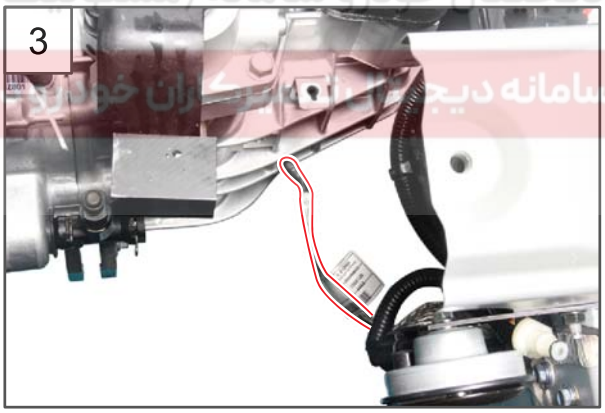
2



2. Remove the air breather hose (A), neutral switch connector (B), and transmission cable wiring clamp (C) from the M/T.

Air breather hose retaining pin

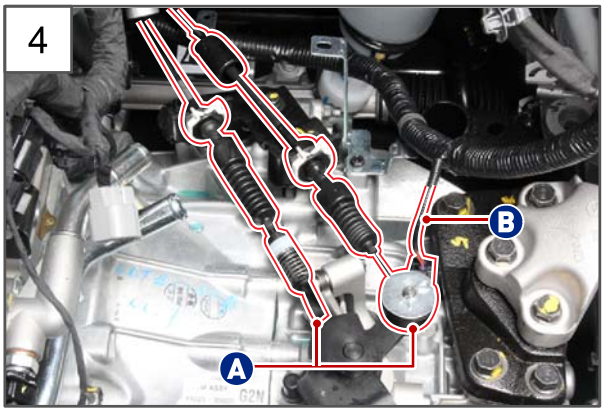
3



3. Unscrew the mounting bolt (10 mm) to remove the transmission ground cable.

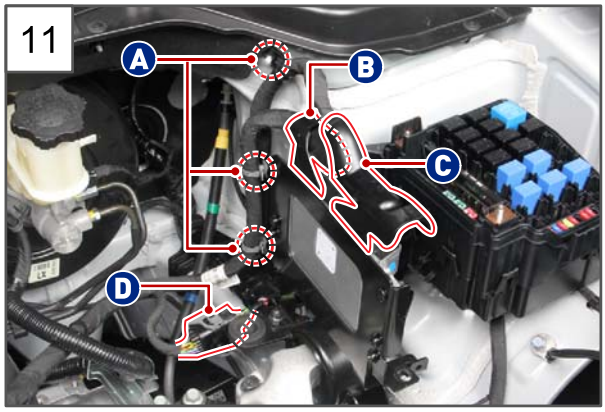
Tightening torque 14 to 18 Nm

4

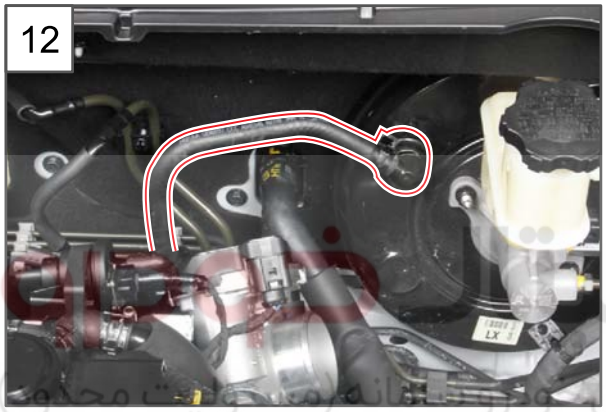


4. Remove the gear selector lever cable (A) and reverse switch (B).

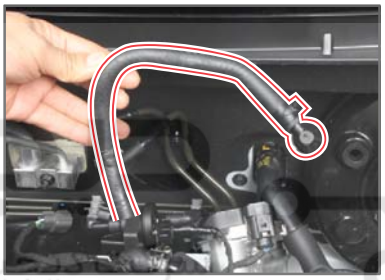
Modification basis	
Application basis	
Affected VIN	

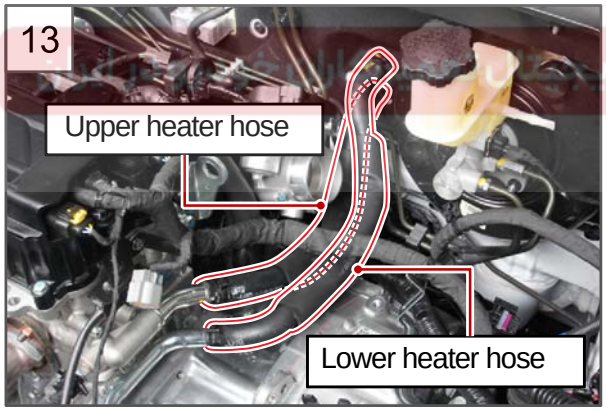


11.Disengage the 3 ECU wiring clamps (A) and disconnect the ECU connectors (B), (C) and C101 connector (D).

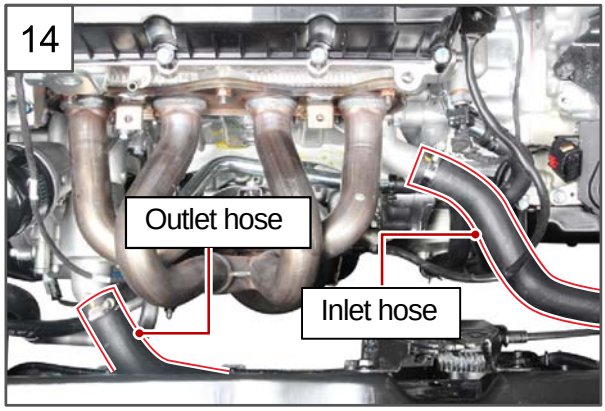


12.Disconnect the brake vacuum hose.





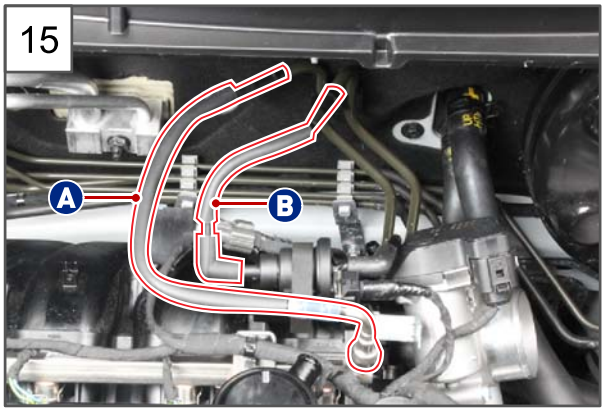
13.Remove the upper and lower heater hoses.



14.Remove the 2 spring clamps (7 mm) and disconnect the radiator inlet/outlet hoses from the engine.

Modification basis	
Application basis	
Affected VIN	

15

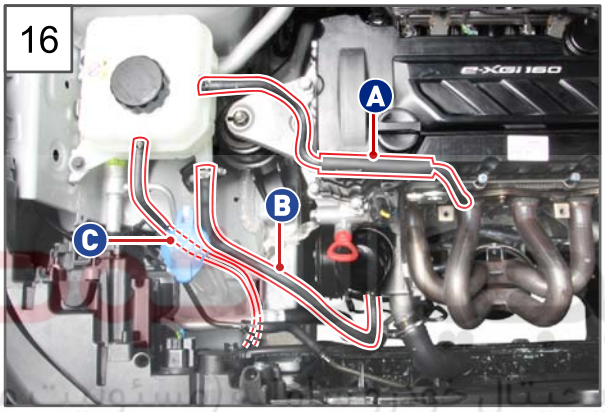


15.Remove the fuel supply tube (A) and PCSV tube (B).

CAUTION

Be careful not to fold the fuel supply tube and PCSV hose to prevent damage to the lines.

16



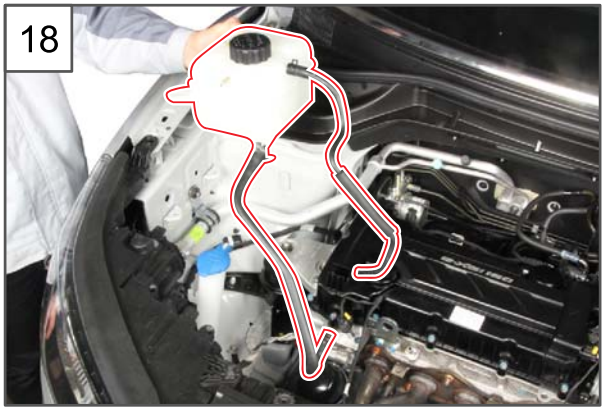
16.Remove the de-aeration hose (A) and make up hose (B) from the engine side, and radiator e-aeration hose (C) from the coolant reservoir tank.

17

17.Unscrew the 2 mounting bolts (10 mm) for the coolant reservoir tank.

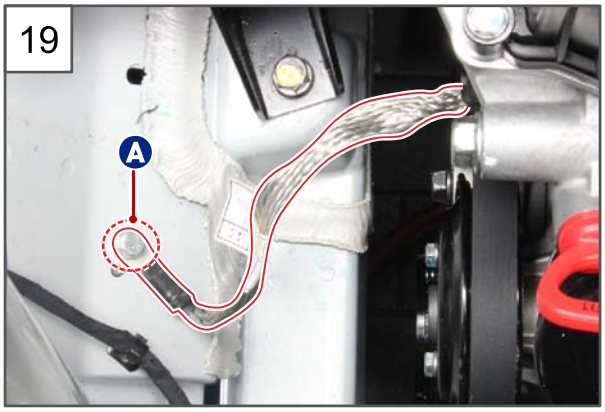
Tightening torque 10 ± 1.0 Nm

18



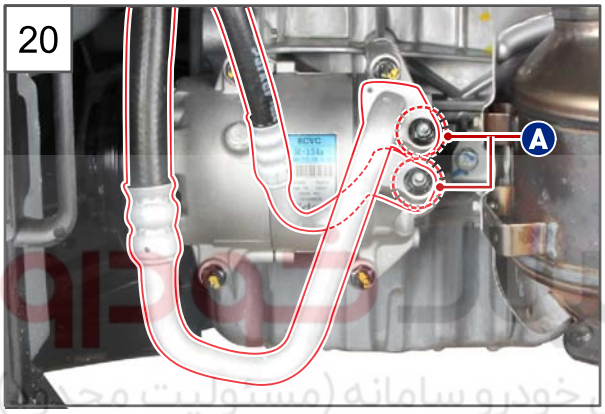
18.Remove the coolant reservoir tank by sliding the mounting upward in the direction of the arrow shown in the picture.

Coolant reservoir tank mounting

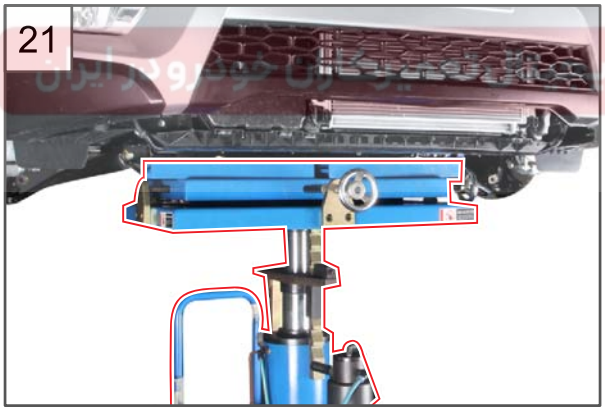


19. Unscrew the mounting bolt (A, 10 mm) to remove the engine ground cable from the vehicle.

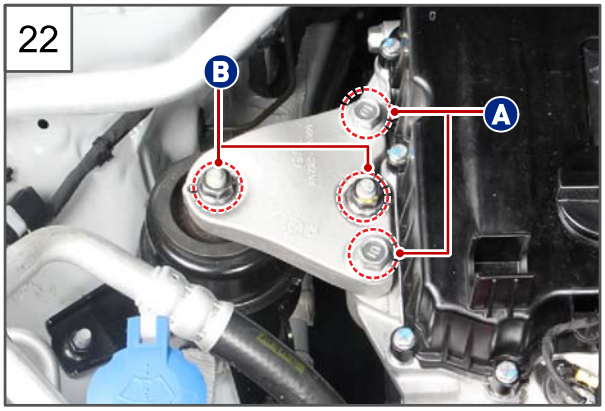
Tightening torque 10 ± 1.0 Nm



20. Unscrew the 2 mounting bolts (A, 12 mm) to disconnect the discharge and suction hoses from the A/C compressor.



21. Place the engine/transmission jack securely under the engine assembly and transmission.

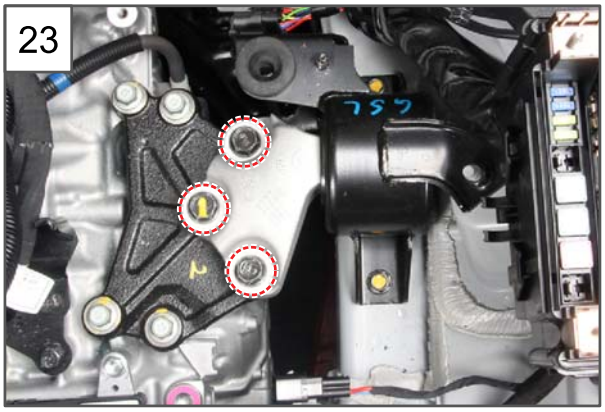


22. Unscrew the 2 mounting bolts (A, 17 mm) and 2 mounting nuts (B, 17 mm) to remove the RH engine mounting bracket.

Tightening torque 68.6 to 88.2 Nm

Modification basis	
Application basis	
Affected VIN	

23



23.Unscrew the 3 mounting bolts (17 mm) for the LH engine mounting insulator.

Tightening torque 68.6 to 88.2 Nm

24

24.Raise the lift while being careful of interferences. Remove the engine assembly with transmission.

25.Remove the components and connections including transmission and positive cable from the engine assembly.

26.Install in the reverse order of removal.

For a vehicle with A/T	For a vehicle with M/T
	

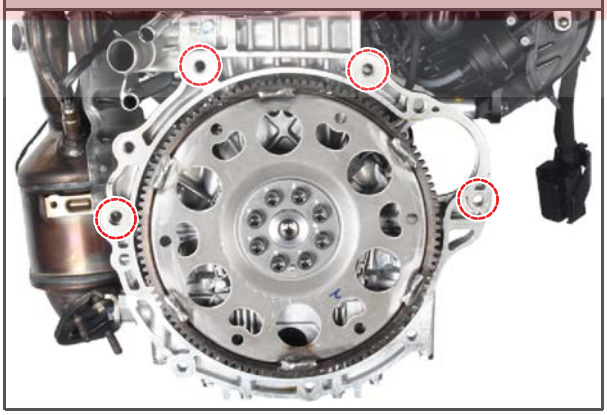
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1118-01

ENGINE ASSEMBLY OVERHAUL

Preceding work
- Remove the engine assembly from the vehicle.(refer to "ENGLINE ASSEMBLY" under this subsection)
- Install the engine assembly to the engine stand.

Engine stand mounting points

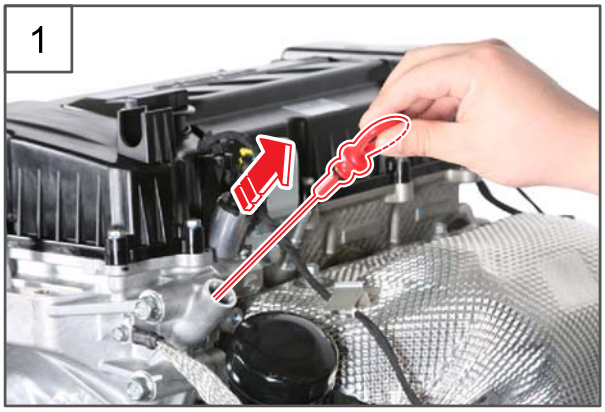


CAUTION

When overhauling the engine, fit the engine assembly to the engine stand at the mounting points shown in the picture to remove the bed plate and cylinder block.

Modification basis	
Application basis	
Affected VIN	

1) Dismantling Engine Assembly



1. Remove the oil dipstick gauge.

2. Unscrew the mounting bolt (10 mm) for the engine ground cable.

Tightening torque 10 ± 1.0 Nm

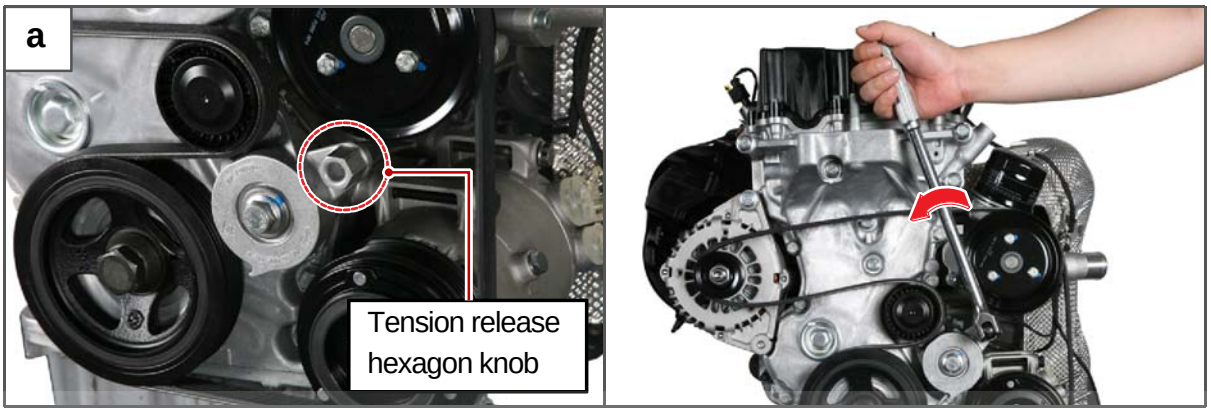
3. Disconnect the engine ground cable.

Modification basis	
Application basis	
Affected VIN	

4. Remove the fan belt and belt tensioner as follows:

a. Turn the belt tensioner release hexagon knob (19 mm) counterclockwise using a special tool to relieve the tension.

a



CAUTION

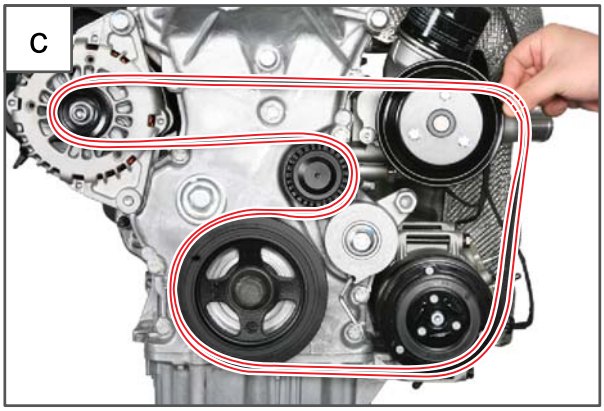
Do not apply excessive force to the fully compressed belt tensioner when releasing the tension. Failure to do so may lead to deformation of the belt tensioner.

b. After releasing the tension of the belt tensioner, secure the belt tensioner by fitting a retaining pin (B, approx. Ø4.5) into the retaining pin hole (A) as shown in the picture.

b

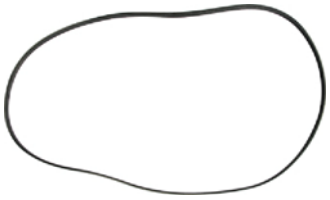
Modification basis	
Application basis	
Affected VIN	

c

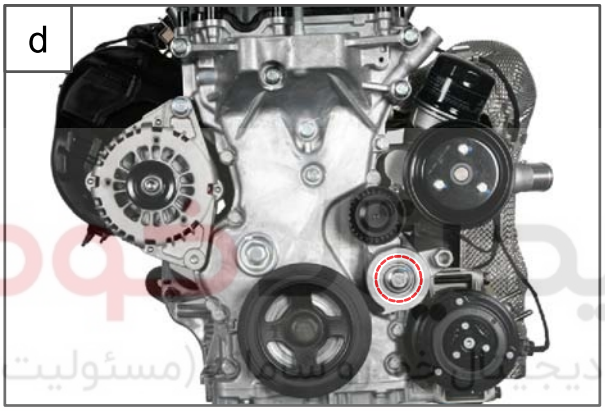


c. Remove the fan belt and then retaining pin for the belt tensioner.

Fan Belt

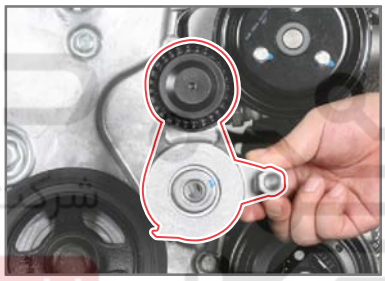


d

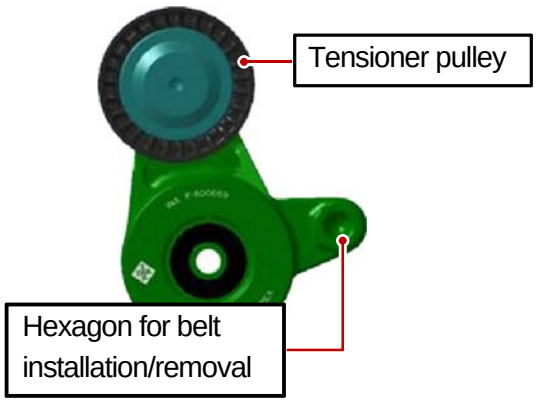
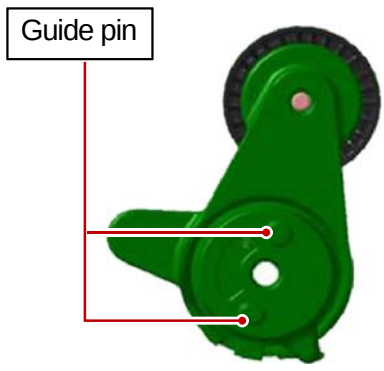


d. Unscrew the mounting bolt (17 mm) and remove the belt tensioner.

Tightening torque 61 ± 2.0 Nm



Belt tensioner

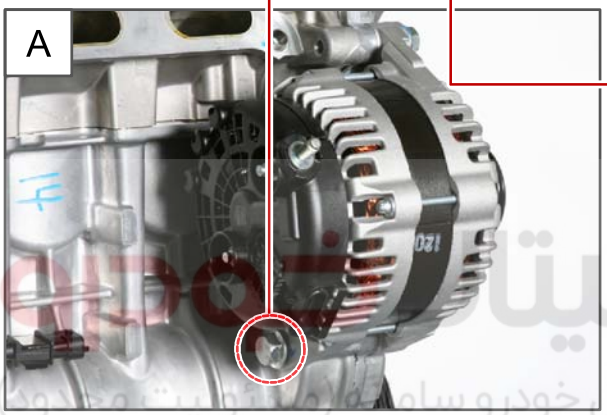
Front view	Rear view
	

5

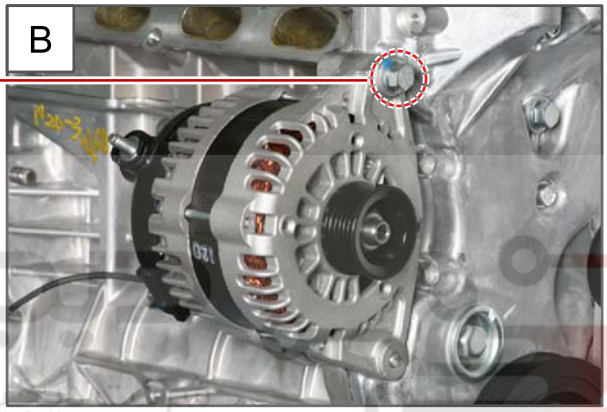
5. Unscrew the mounting bolt (A)(17 mm) and mounting bolt (B)(15 mm) for the alternator.

Tightening torque 61 ± 6.1 Nm

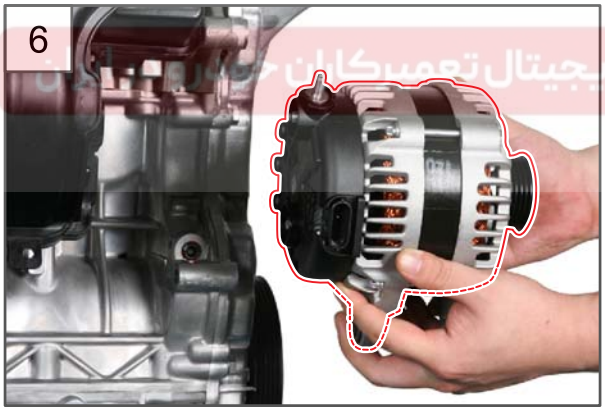
A



B

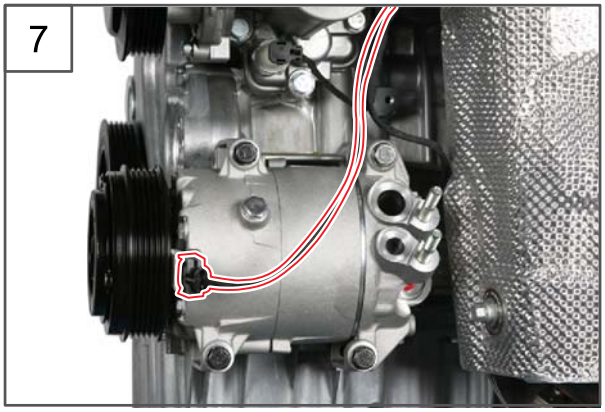


6



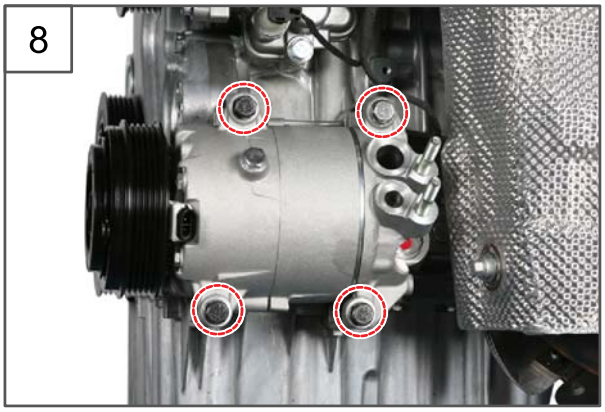
6. Remove the alternator.

7



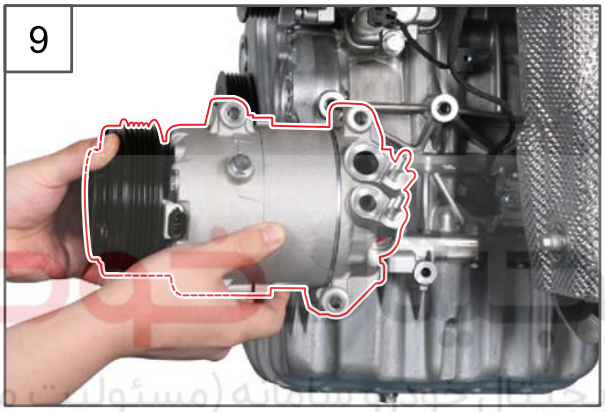
7. Disconnect the A/C compressor connector.

Modification basis	
Application basis	
Affected VIN	

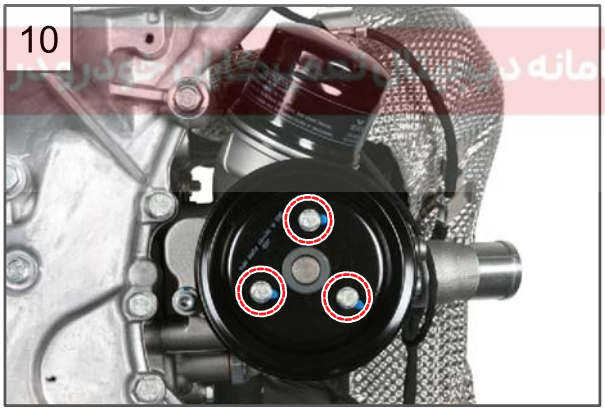


8. Unscrew the 4 mounting bolts (13 mm) for the A/C compressor.

Tightening torque 25 ± 2.5 Nm



9. Remove the A/C compressor.



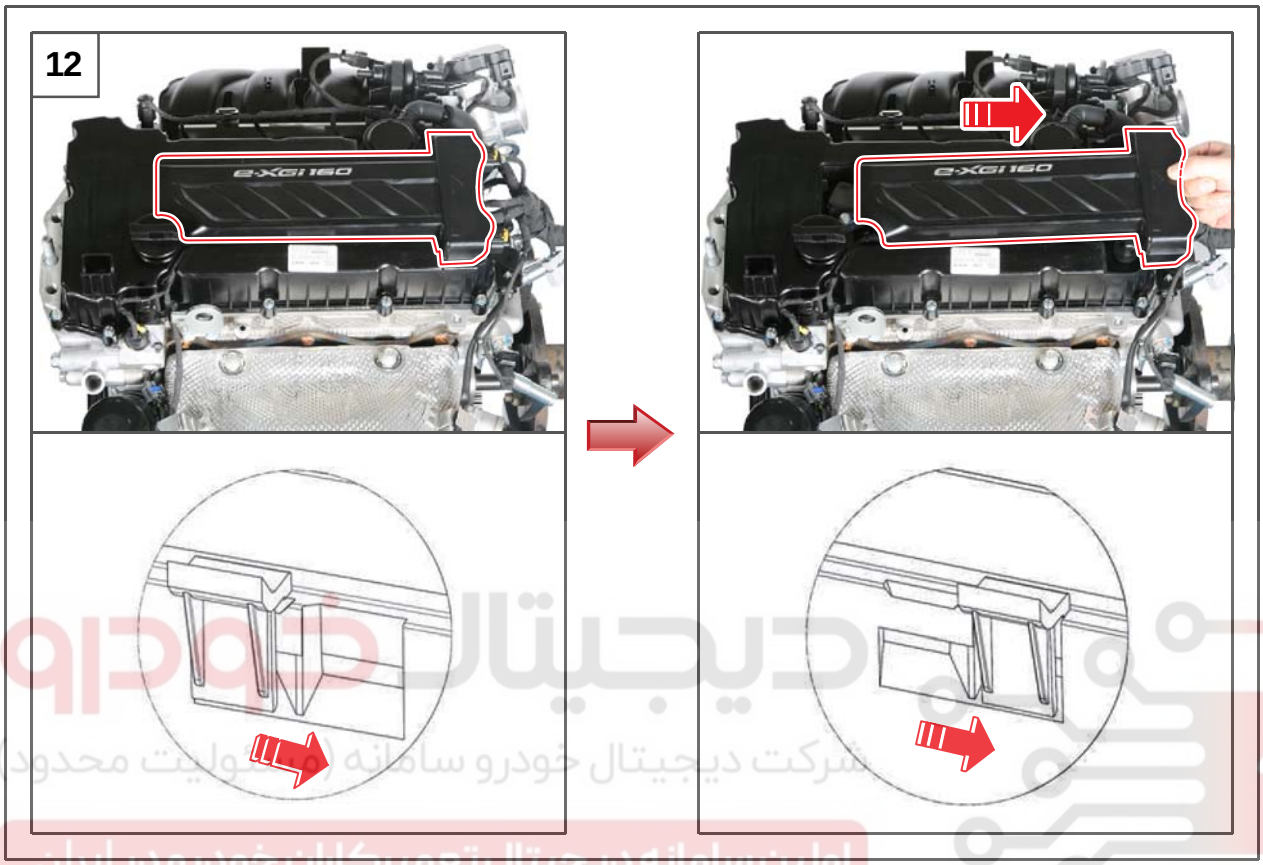
10. Unscrew the 3 mounting bolts (10 mm) for the water pump pulley.

Tightening torque 10 ± 1.0 Nm

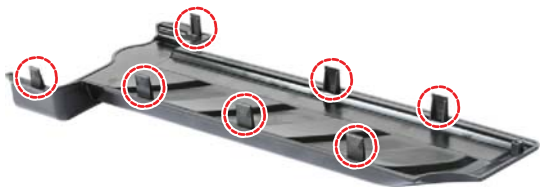
11. Remove the water pump pulley.

Modification basis	
Application basis	
Affected VIN	

12.Slide and remove the ignition coil cover in the direction of the arrow as shown in the picture.



Ignition coil cover mountings - 7 points



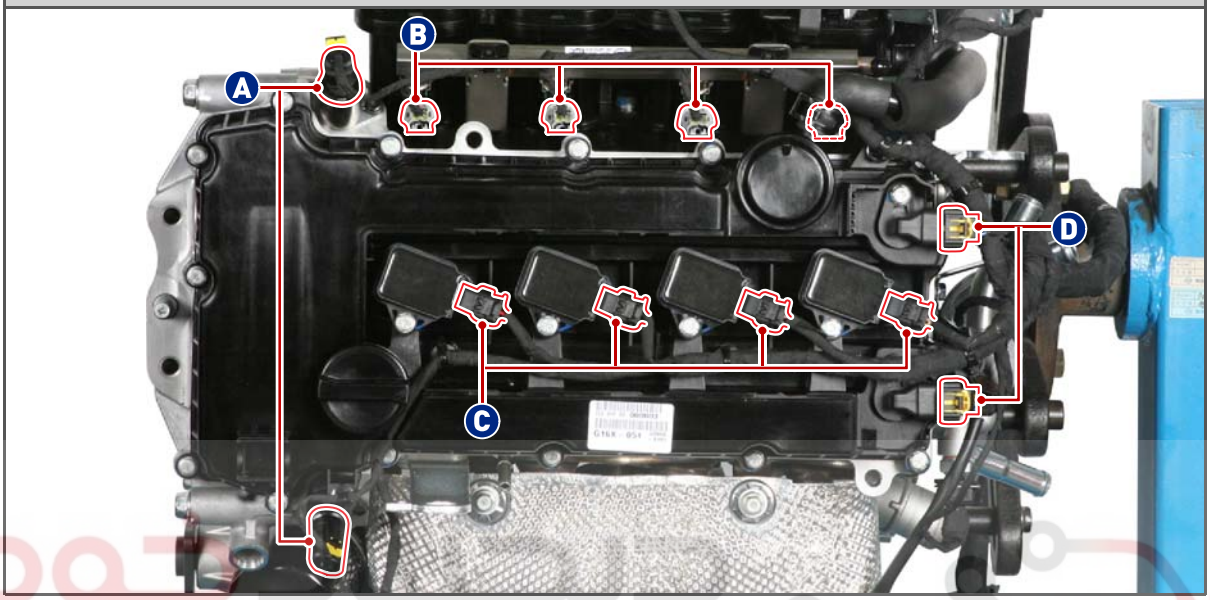
NOTE

Install the ignition coil cover in vertical direction.

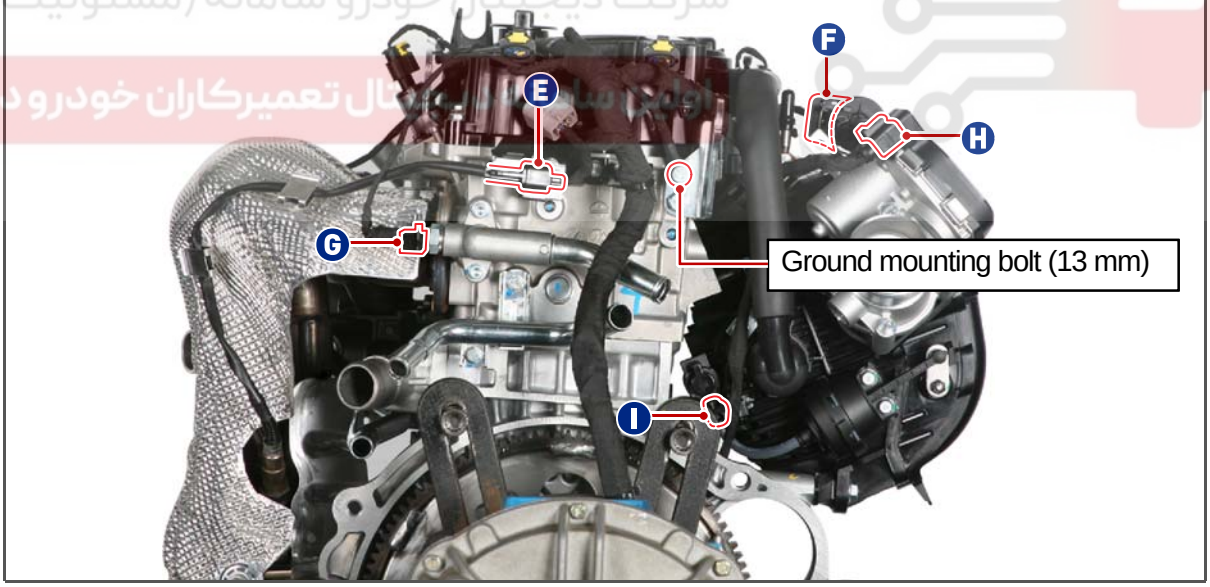
Modification basis	
Application basis	
Affected VIN	

13.Disconnect the connectors as follows to remove the engine main wiring:

Cylinder head cover side

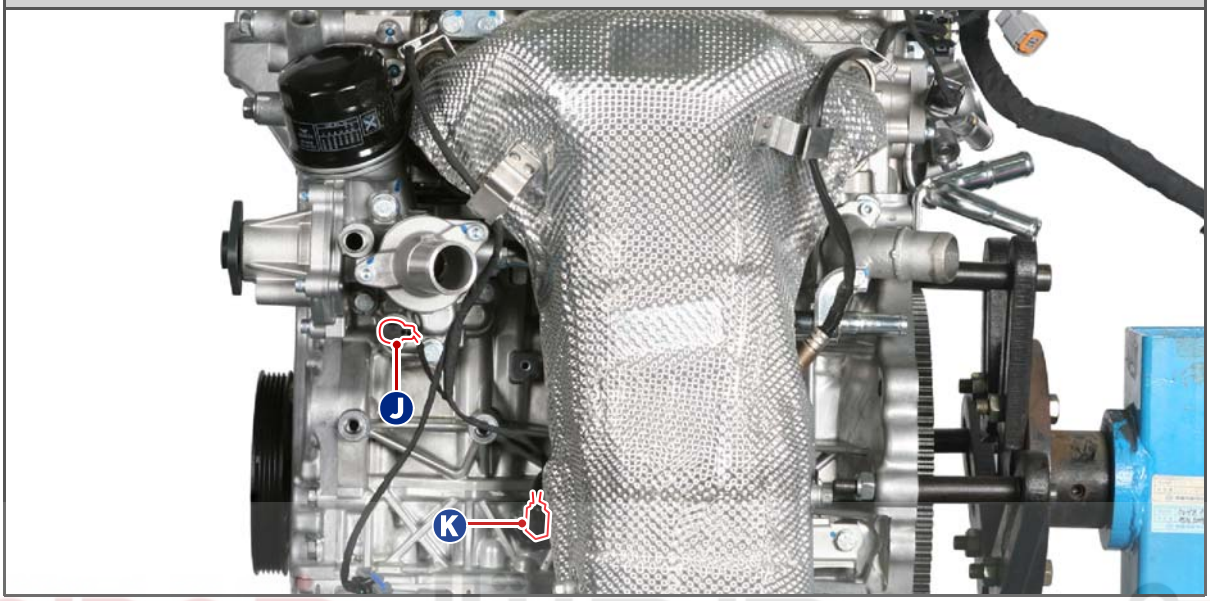


Rear side of engine

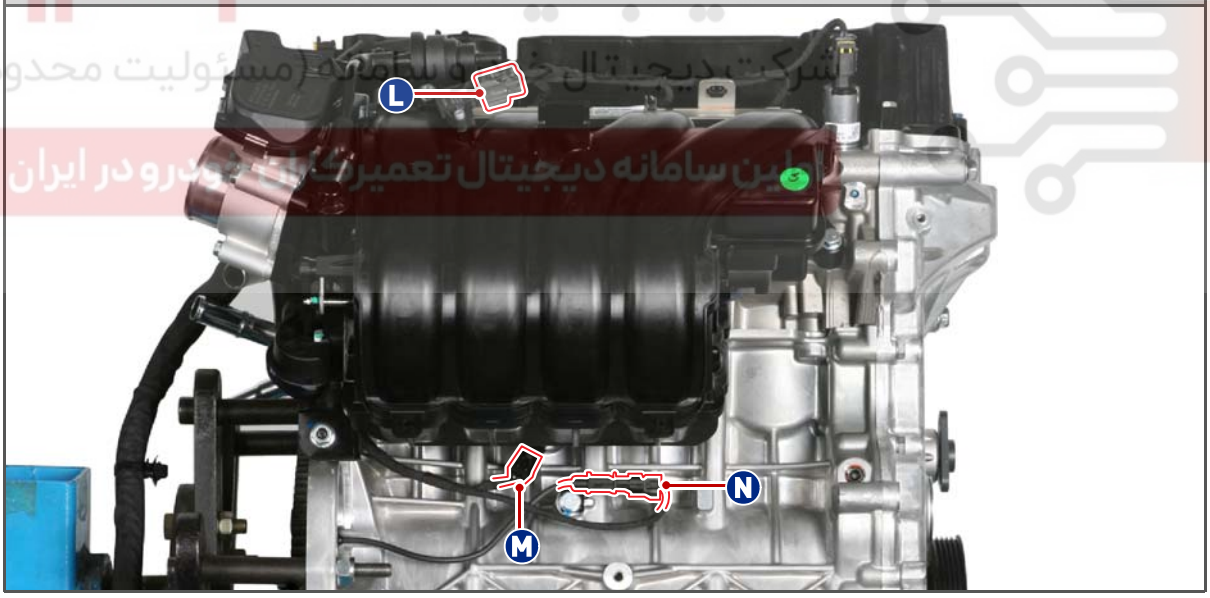


A. Intake/exhaust OCV connectors
B. Injector connector
C. Ignition coil Connector
D. Intake/exhaust cam position sensor connector
E. Front oxygen sensor connector
F. PCV connector
G. Coolant temperature sensor connector
H. Electronic throttle body connector
I. VIS solenoid valve connector

Exhaust side



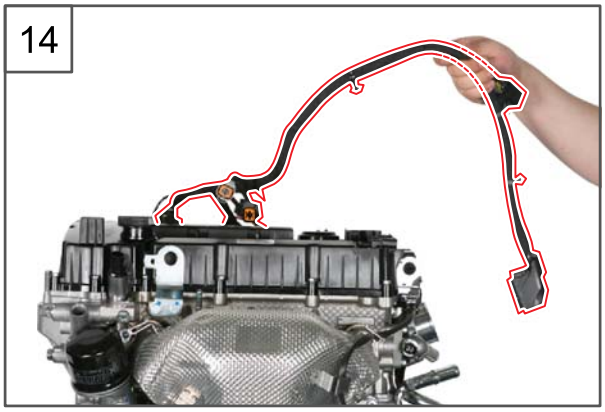
Intake side



J. Oil pressure switch connector
K. VOP solenoid valve connector
L. T-MAP sensor connector
M. Knock sensor connector
N. Crankshaft position sensor connector

Modification basis	
Application basis	
Affected VIN	

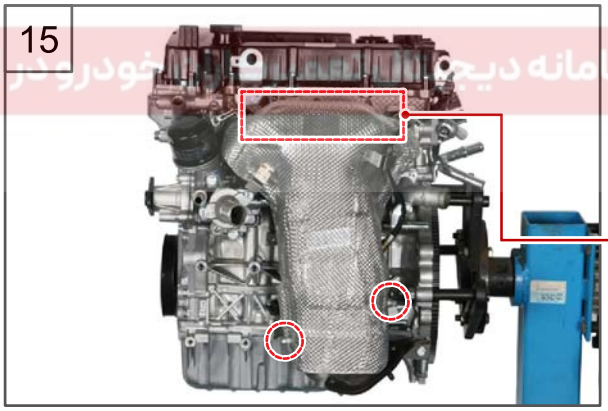
14



14.Remove the engine main wiring.

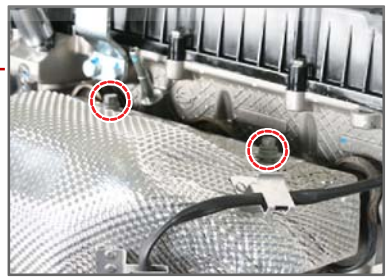
Engine main wiring

15

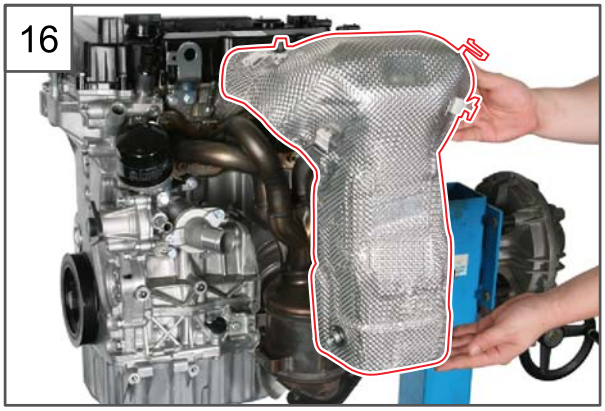


15.Unscrew the 4 mounting bolts (10 mm) for the exhaust manifold heat protector.

Tightening torque 10 ± 1.0 Nm



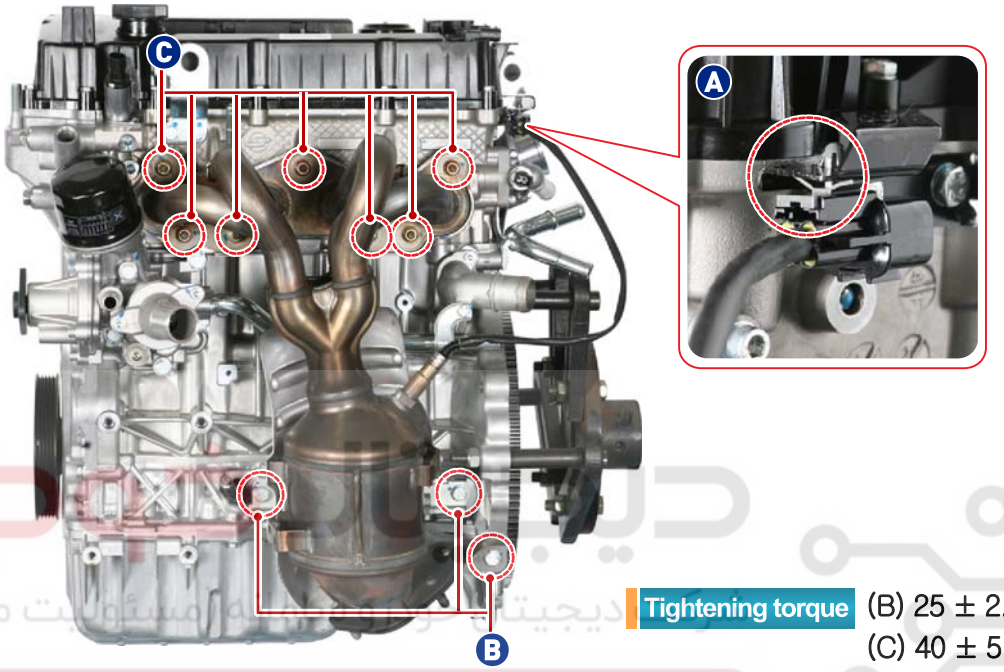
16



16.Remove the exhaust manifold heat protector.

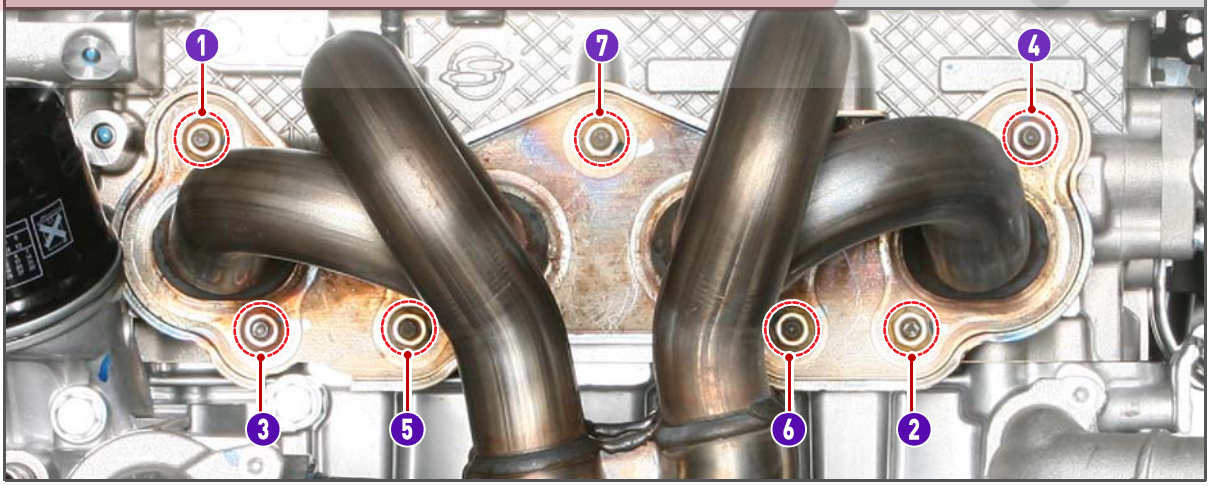
17.Remove the retaining key (A) for the front oxygen sensor connector and unscrew the 3 mounting bolts (B, 13 mm) for the exhaust manifold bracket and 7 mounting nuts (C, 12 mm) for the exhaust manifold in the sequence specified below.
(Remove the mounting bolts from A to B to C)

17



Tightening torque (B) 25 ± 2.5 Nm
(C) 40 ± 5.0 Nm

Removal sequence for mounting nuts

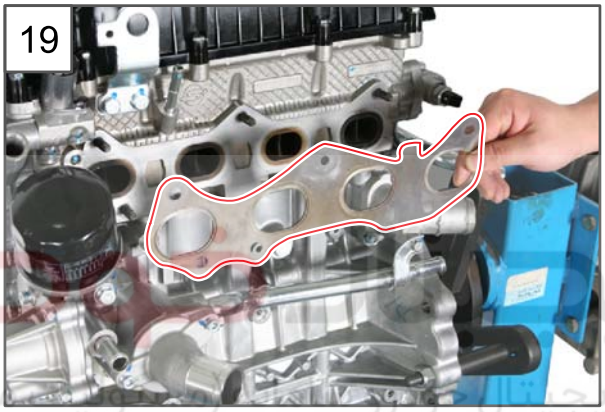


CAUTION

- Unscrew the mounting nuts slowly in two or more stages to prevent distortion of the exhaust manifold and cylinder head.
- Replace the mounting nuts with new ones when installing the exhaust manifold.

Modification basis	
Application basis	
Affected VIN	

18.Remove the exhaust manifold assembly.



19.Remove the exhaust manifold gasket.

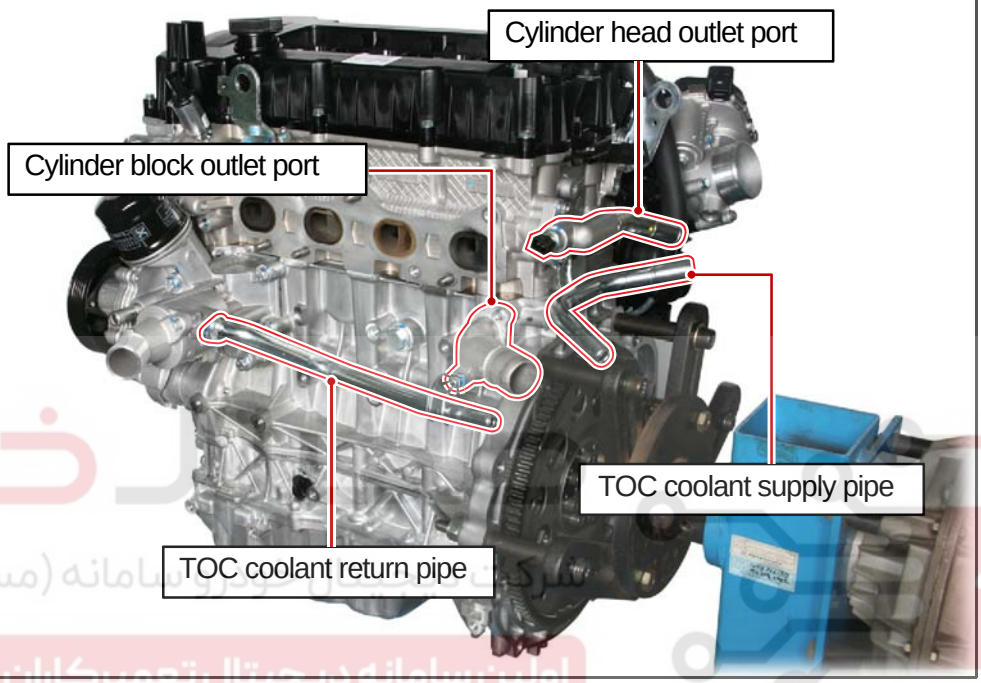
Exhaust manifold assembly and gasket

Modification basis	
Application basis	
Affected VIN	

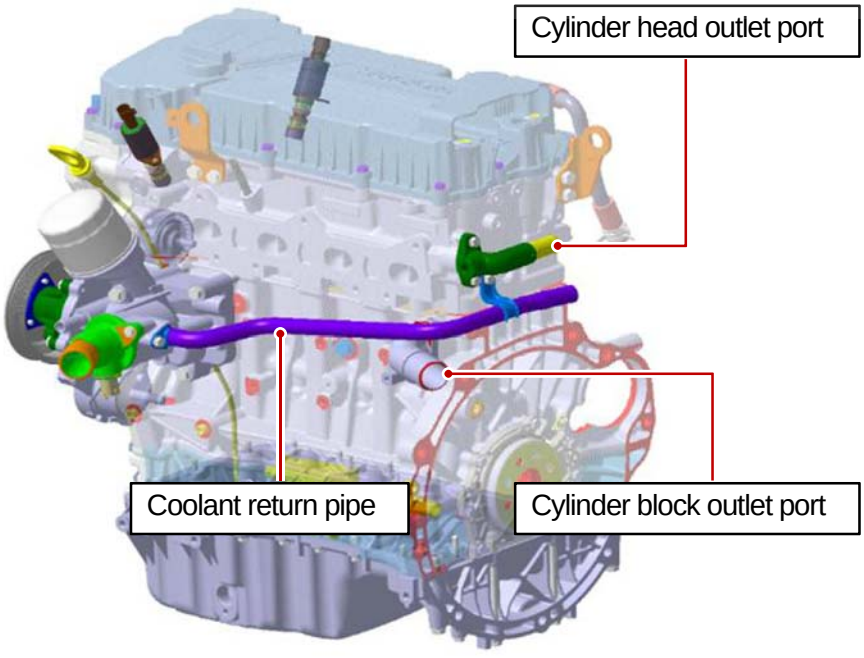
NOTE

This procedure is based on the vehicle with A/T. Keep in mind that the appearance of the coolant pipe may be different from the one described in this manual.

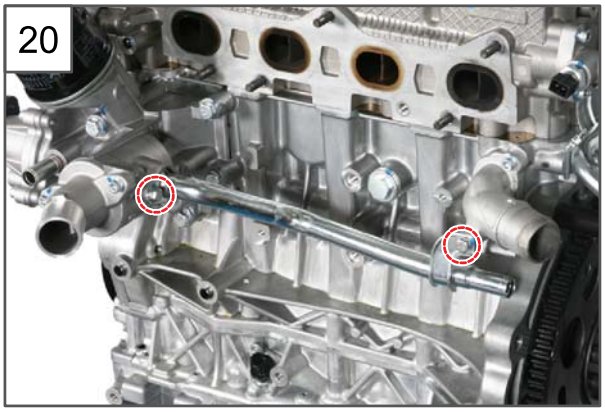
For a vehicle with A/T



For a vehicle with M/T

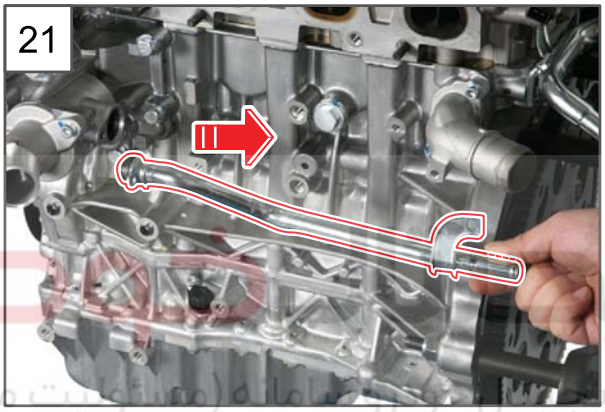


Modification basis	
Application basis	
Affected VIN	



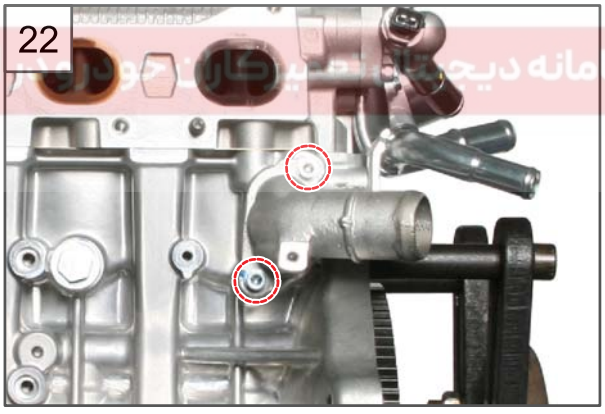
20.Unscrew the 2 mounting bolts (10 mm) for the TOC coolant return pipe.

Tightening torque 10 ± 1.0 Nm



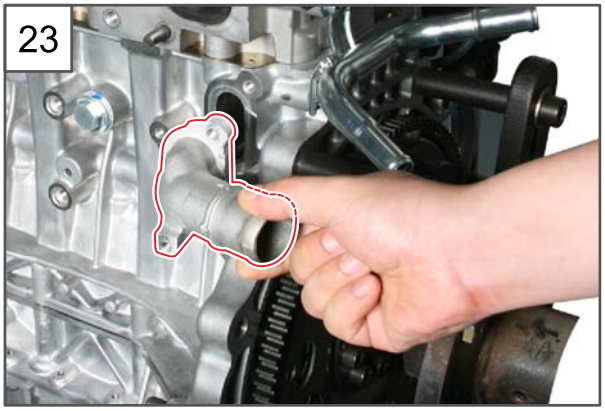
21.Remove the TOC coolant return pipe in the direction of the arrow shown in the picture.

TOC coolant return pipe



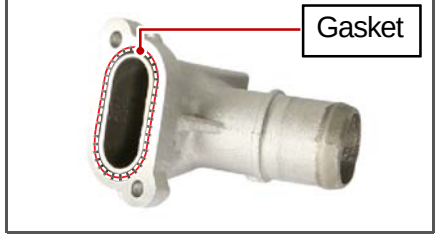
22.Unscrew the 2 hexagon mounting bolts (5 mm) for the cylinder block outlet port.

Tightening torque 10 ± 1.0 Nm

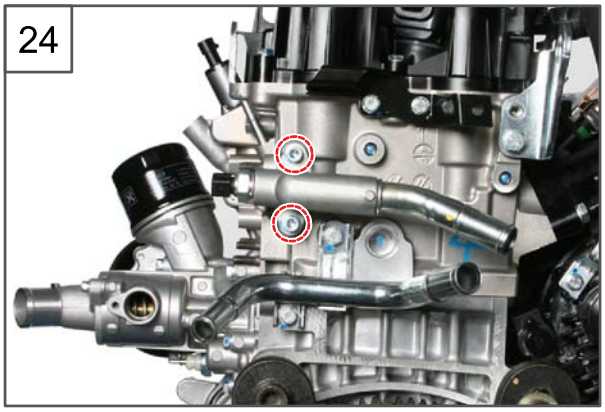


23.Remove the cylinder block outlet port.

Cylinder block outlet port

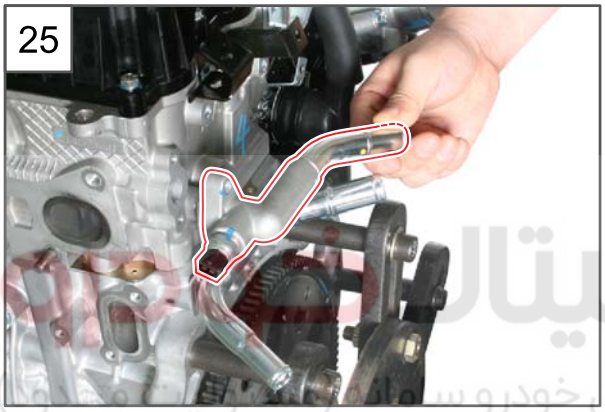


Modification basis	
Application basis	
Affected VIN	



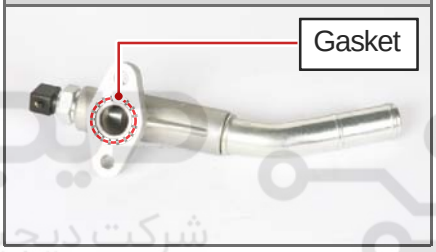
24.Unscrew the 2 hexagon mounting bolts (5 mm) for the cylinder head outlet port.

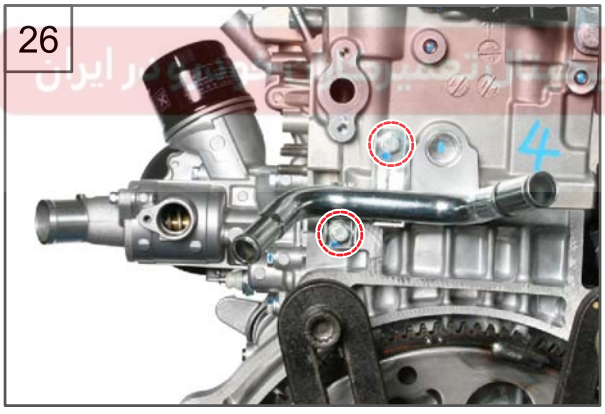
Tightening torque 10 ± 1.0 Nm



25.Remove the cylinder head outlet port.

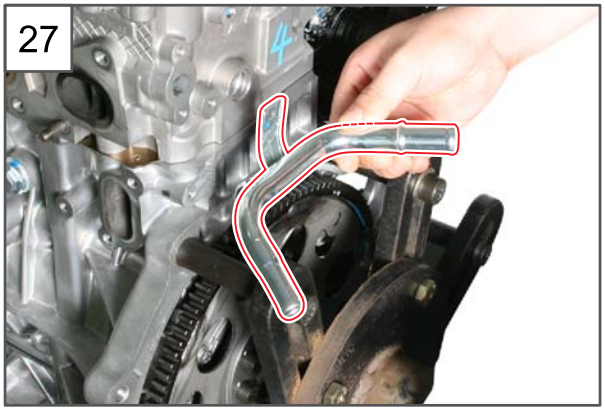
Cylinder head outlet port





26.Unscrew the 2 mounting bolts (10 mm) for the TOC coolant supply pipe.

Tightening torque 10 ± 1.0 Nm

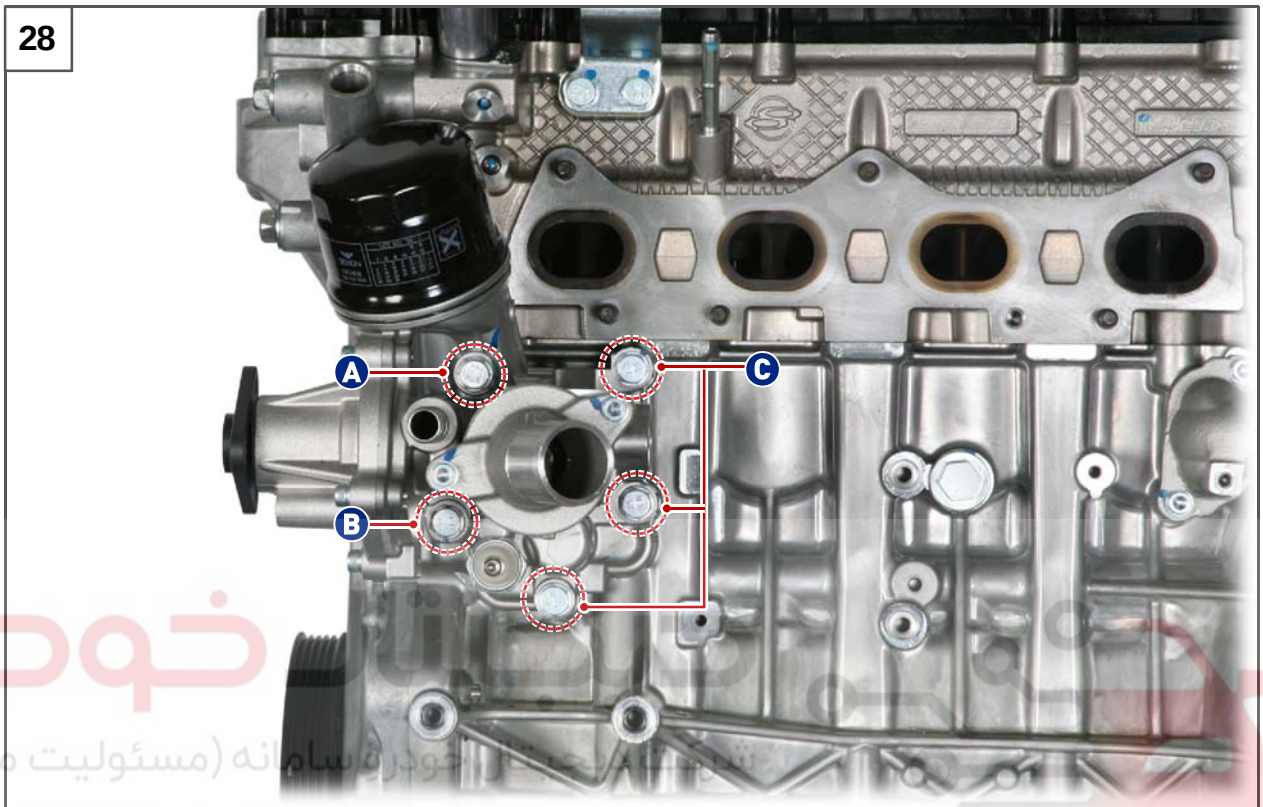


27.Remove the TOC coolant supply pipe.

Modification basis	
Application basis	
Affected VIN	

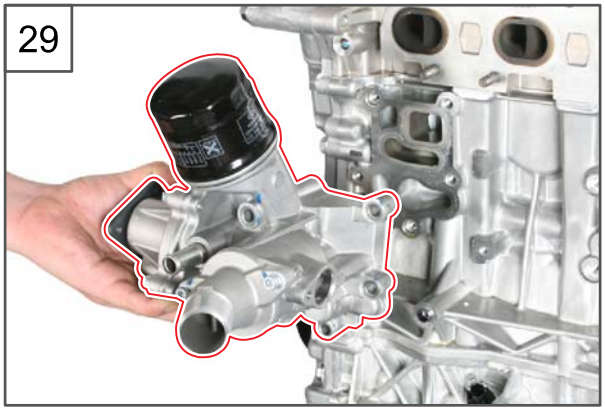
28.Unscrew the 5 mounting bolts (13 mm) for the oil filter module.

28



No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	13	60	1	25 ± 2.5 Nm
B		105	1	
C		40	3	

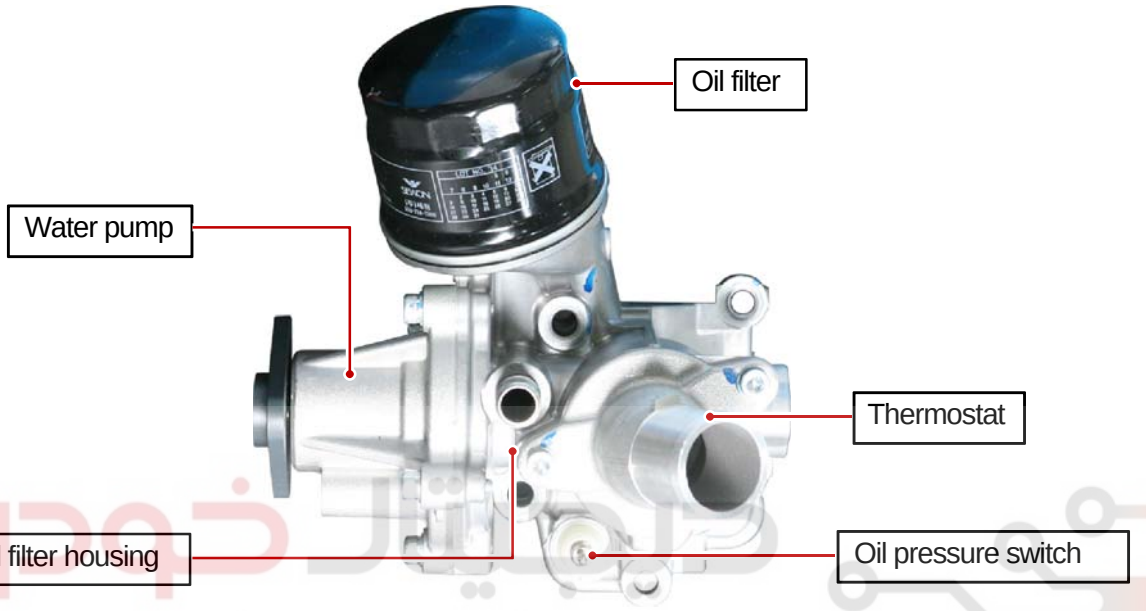
29

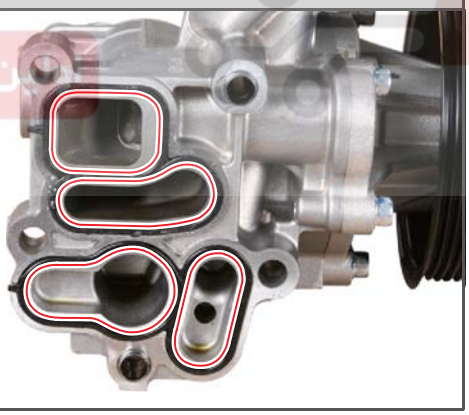


29.Remove the oil filter module.

NOTE

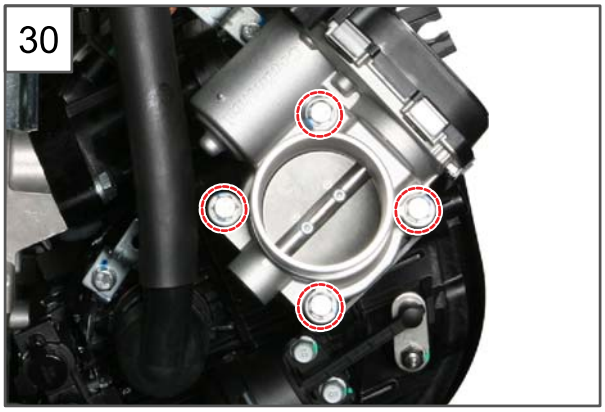
Disassemble the oil filter module and check each component.



Exploded view	Oil filter module gasket
	

Modification basis	
Application basis	
Affected VIN	

30

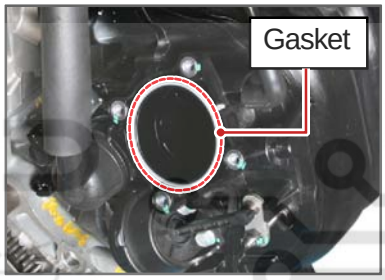


30. Unscrew the 4 mounting bolts (10 mm) for the electronic throttle body from the intake manifold.

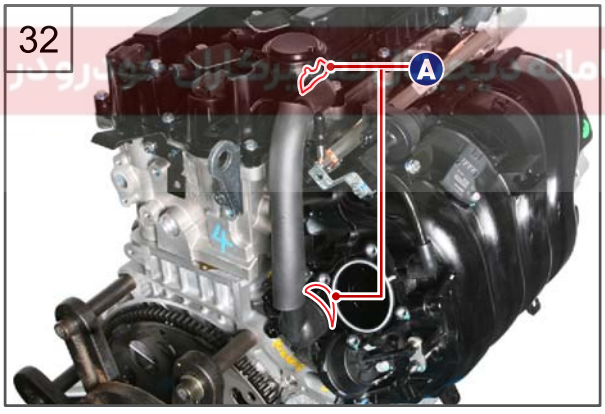
Tightening torque 10 ± 1.0 Nm

31

31. Remove the electronic throttle body and gasket.

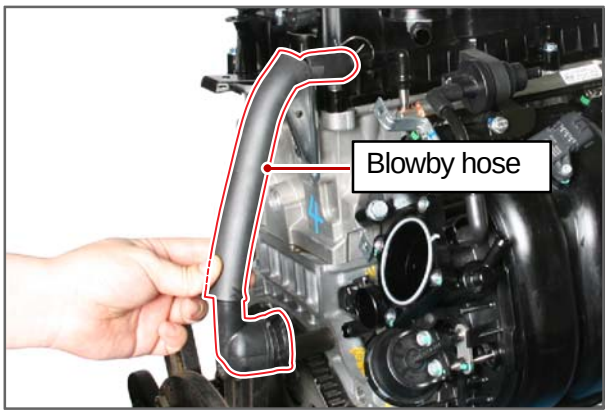


32



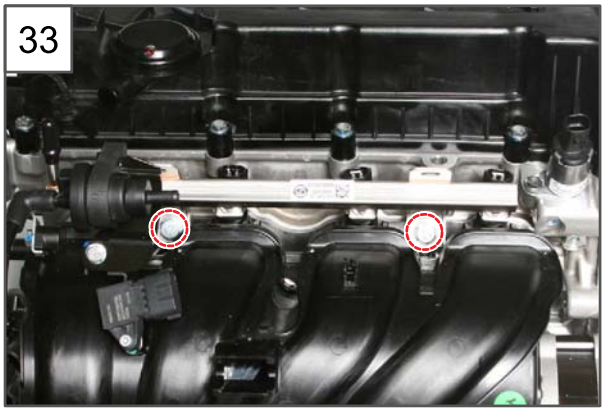
32. Loosen the 2 clamps (A) to remove the blowby hose.

Exploded view - blowby hose



Modification basis	
Application basis	
Affected VIN	

33

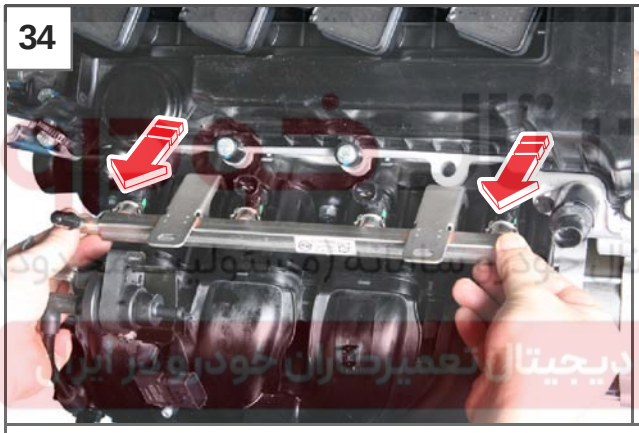


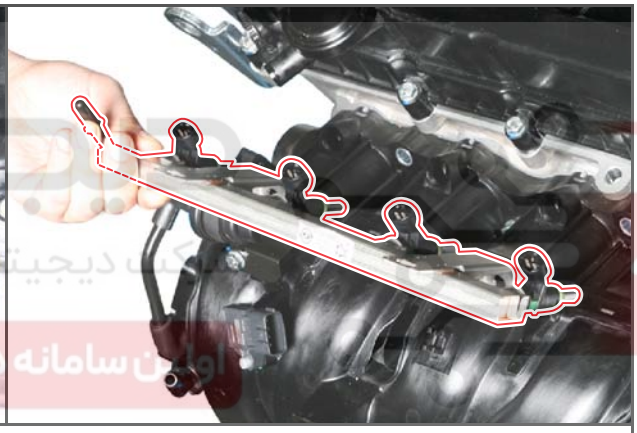
33.Unscrew the 2 mounting bolts (13 mm) securing the fuel rail assembly on the top of the intake manifold.

Tightening torque 25 ± 2.5 Nm

34.Remove the fuel rail assembly from the intake manifold by grasping and pulling it with both hands as shown in the picture.

34

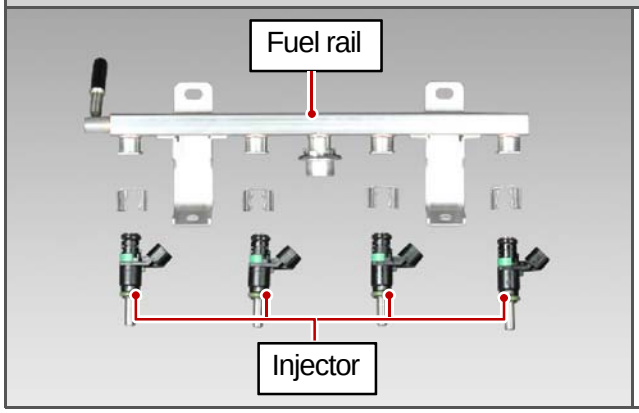


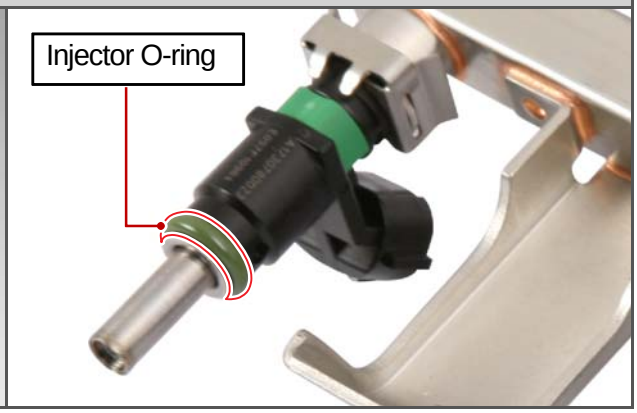


CAUTION

Make sure to use both hands to pull it out as the fuel rail and injector can break.

Fuel rail and injector





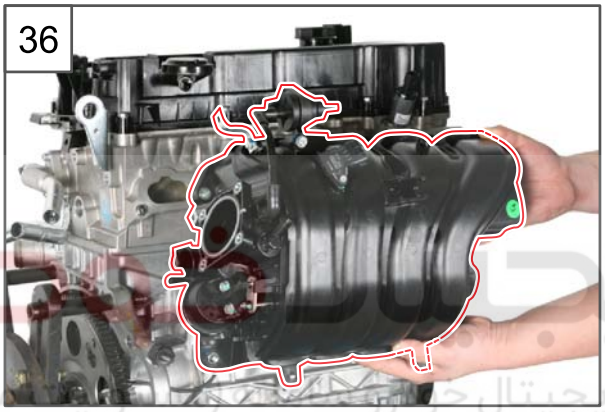
Modification basis	
Application basis	
Affected VIN	

35

35.Unscrew the 4 mounting bolts/nuts (13 mm) for the intake manifold from the outside to the inside in sequence.

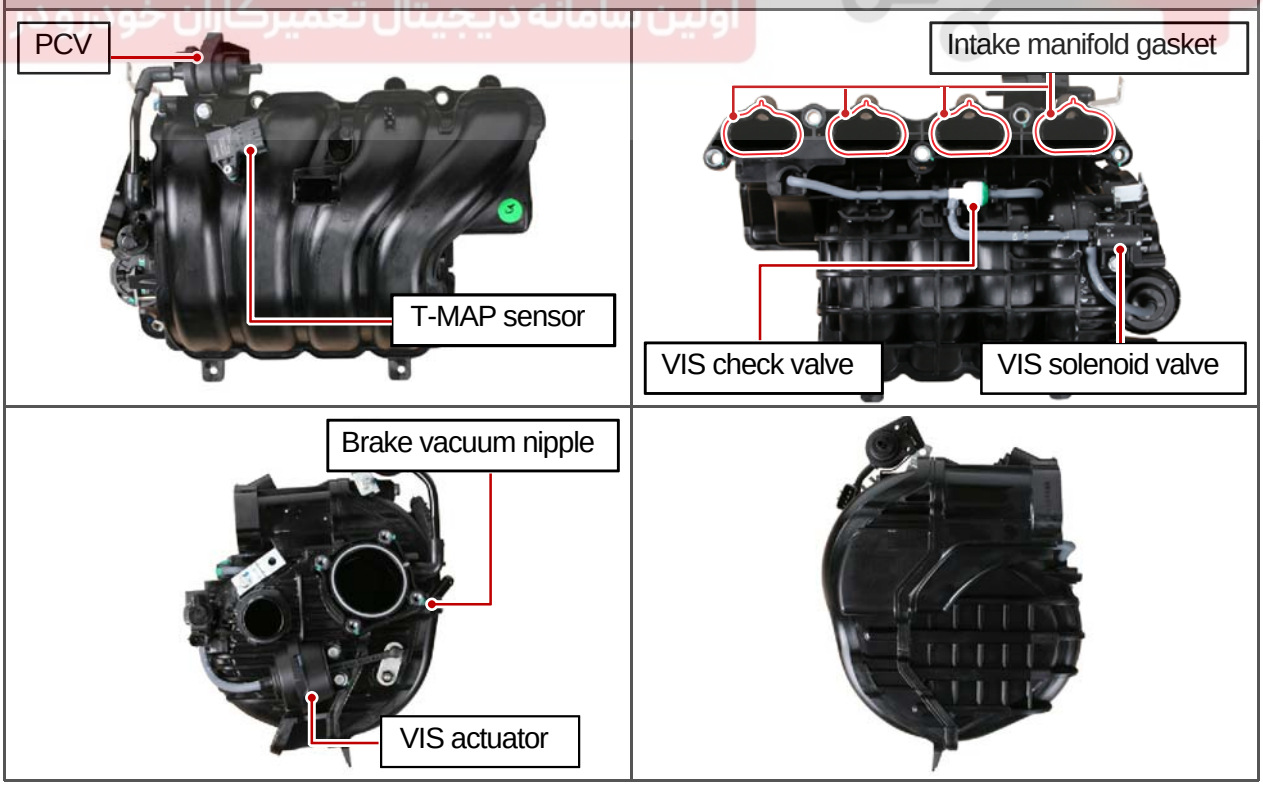
Tightening torque 25 ± 2.5 Nm

36



36.Remove the intake manifold assembly.

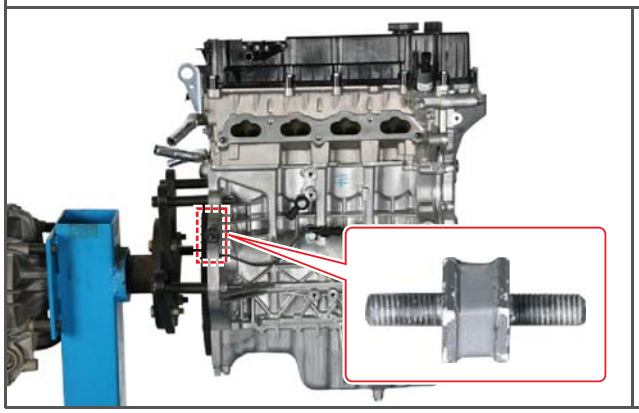
Intake manifold assembly

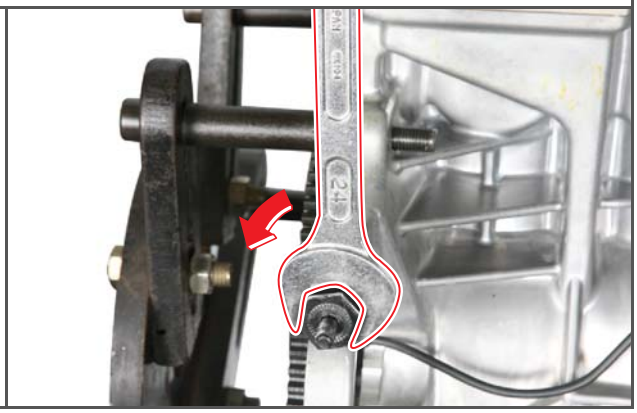


Modification basis	
Application basis	
Affected VIN	

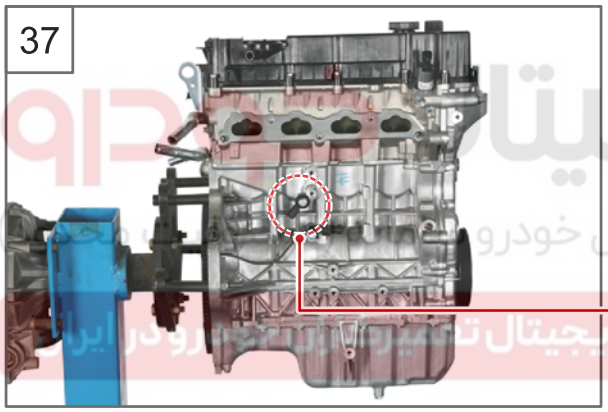
Removing intake manifold damper mounting

Remove the intake manifold damper mounting by rotating it counterclockwise using a 24 mm spanner.



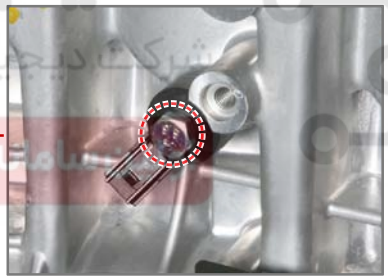


37



37.Unscrew the mounting bolt (13 mm) for the knock sensor.

Tightening torque 25 ± 2.5 Nm

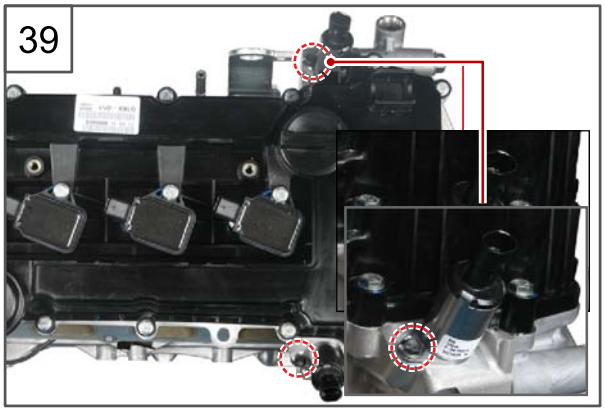


38

38.Remove the knock sensor.

Modification basis	
Application basis	
Affected VIN	

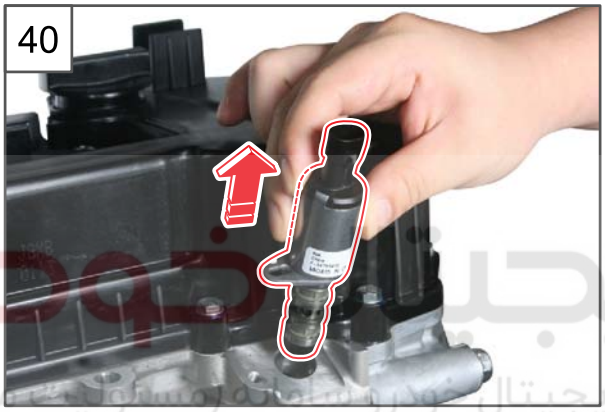
39



39.Unscrew the 2 mounting bolts (8 mm) for the intake/exhaust OCVs.

Tightening torque 8 ± 1.0 Nm

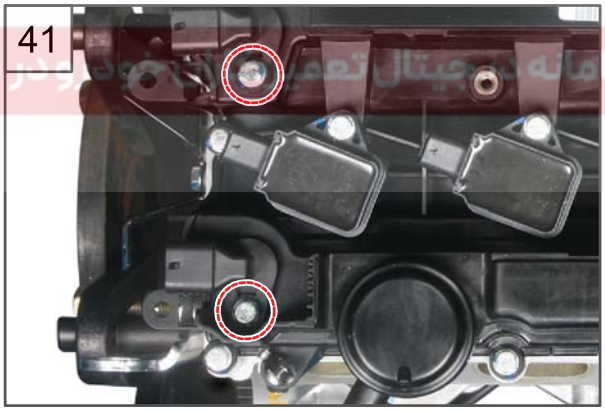
40



40.Remove the intake and exhaust OCVs.

OCV

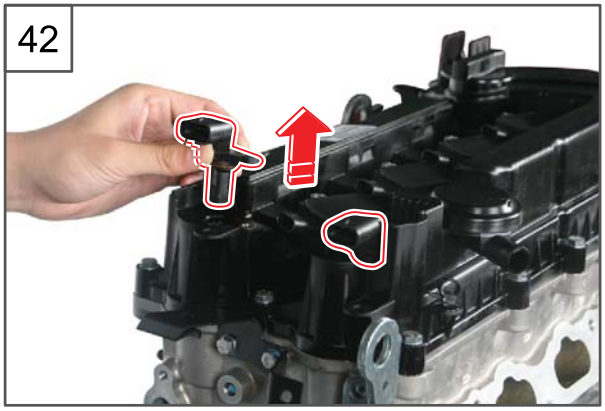
41



41.Unscrew the 2 mounting bolts (10 mm) for the intake/exhaust cam position sensors.

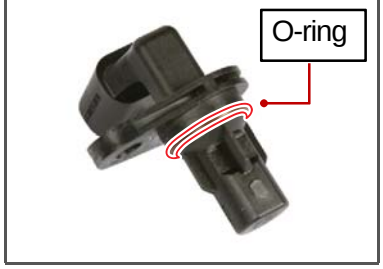
Tightening torque 10 ± 1.0 Nm

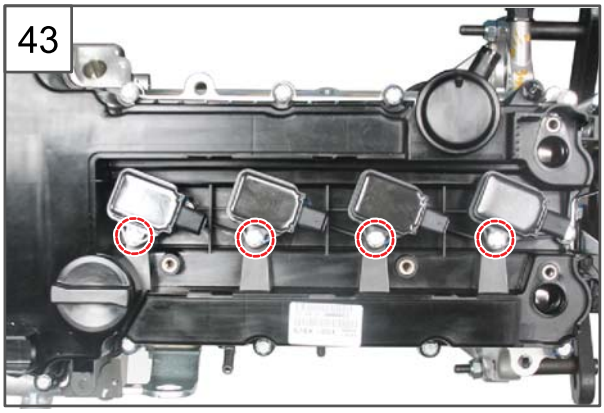
42



42.Remove the intake and exhaust cam position sensors.

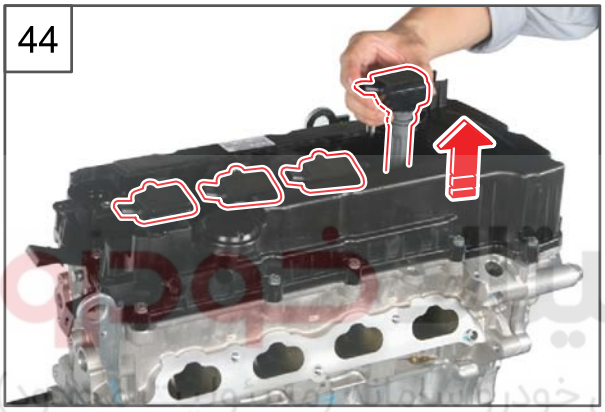
Cam position sensor



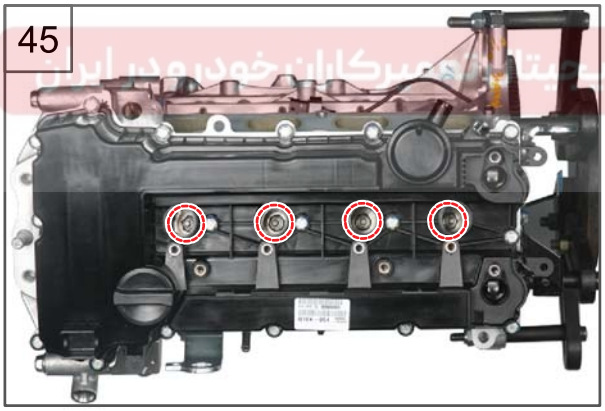


43.Unscrew the 4 mounting bolts (10 mm) for the ignition coil.

Tightening torque 10 ± 1.0 Nm



44.Remove the 4 ignition coils in sequence.

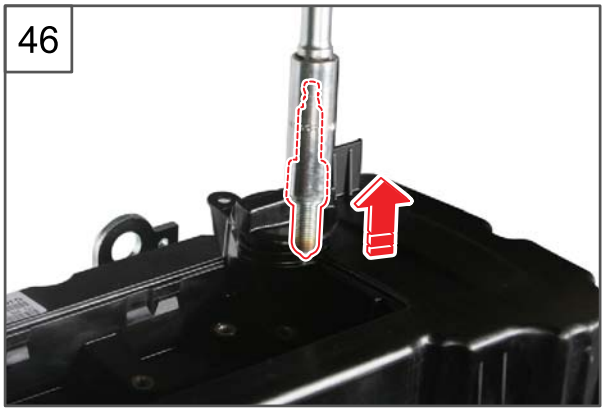


45.Unscrew the 4 ignition plugs (16 mm) in sequence.

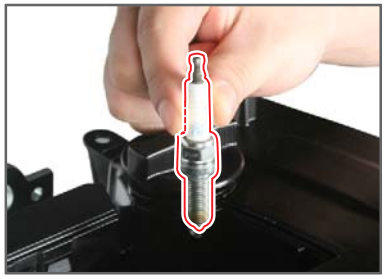
Tightening torque 20 ± 2.5 Nm

Modification basis	
Application basis	
Affected VIN	

46



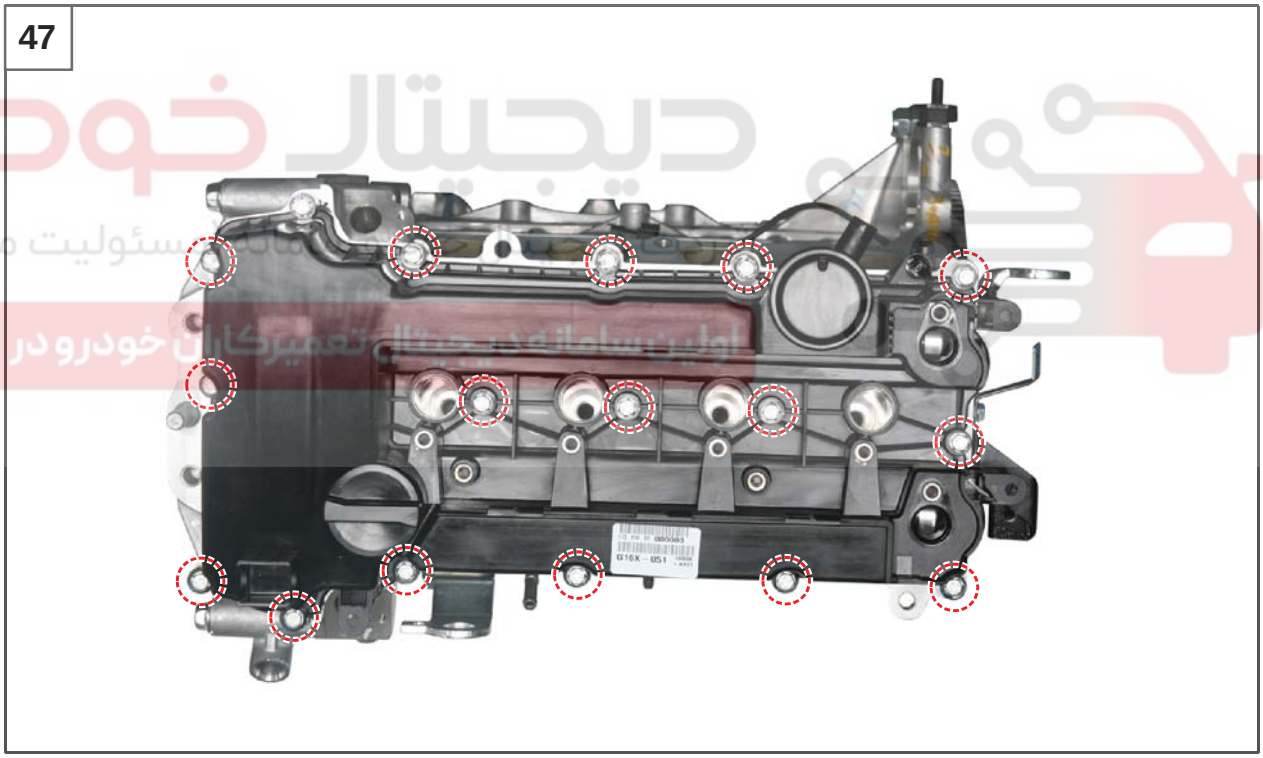
46.Remove the 4 ignition plugs in sequence.



47.Remove the 16 mounting bolts (10 mm) for the cylinder head cover.

Tightening torque 10 ± 1.0 Nm

47

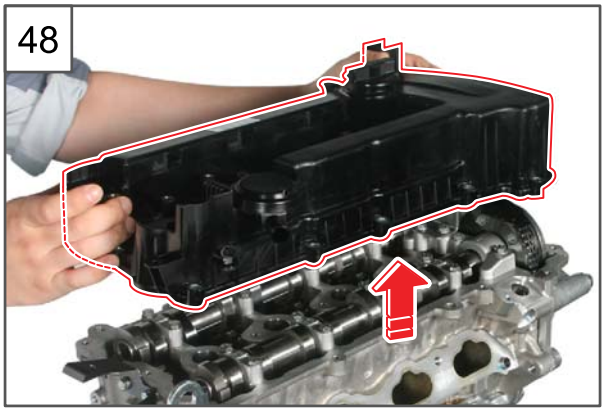


CAUTION

Loosen and remove the mounting bolts in several steps to prevent damage to the cylinder head cover.

- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

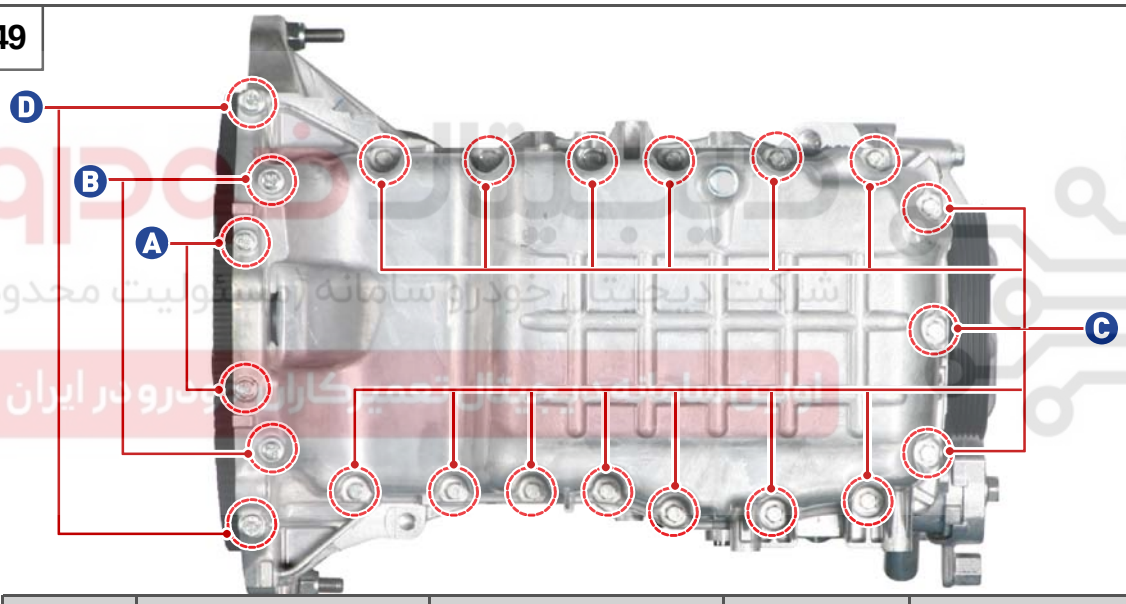
48



48.Remove the cylinder head cover.

49.Unscrew the mounting bolts (A), (B), (C), and (D) for the oil pan from the underside of the engine assembly.

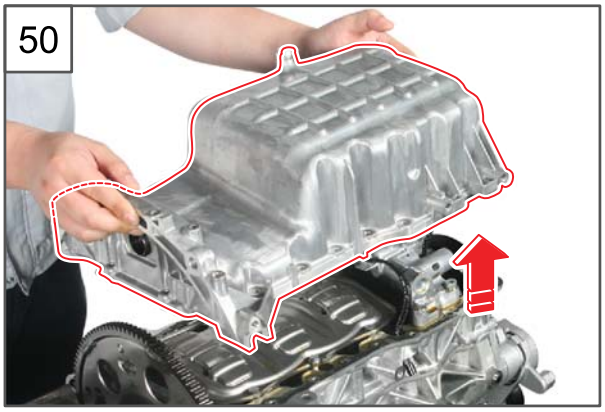
49



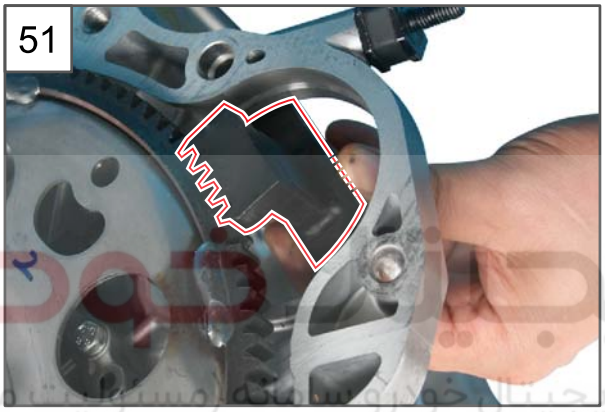
No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	10	115	2	10 ± 1.0 Nm
B		105	2	
C		25	16	
D	13	80	2	25 ± 2.5 Nm

CAUTION

To protect the oil pan from damage, remove the bolts in sequence as follows:
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally



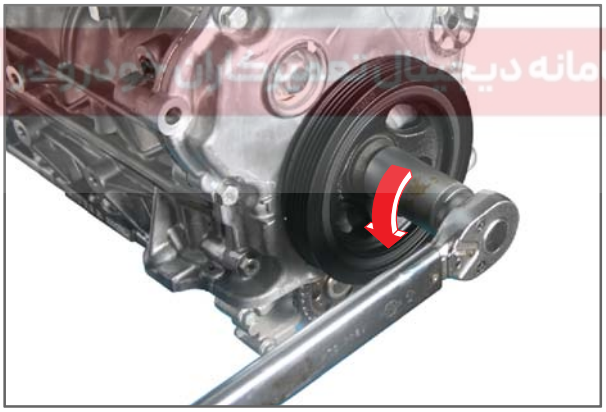
50.Remove the oil pan.



51.Secure the drive plate using the flywheel fixture and unscrew the mounting bolt (27 mm) for the crankshaft pulley.

Flywheel fixture


Sequence	Tightening torque
1	220 Nm
2	90°

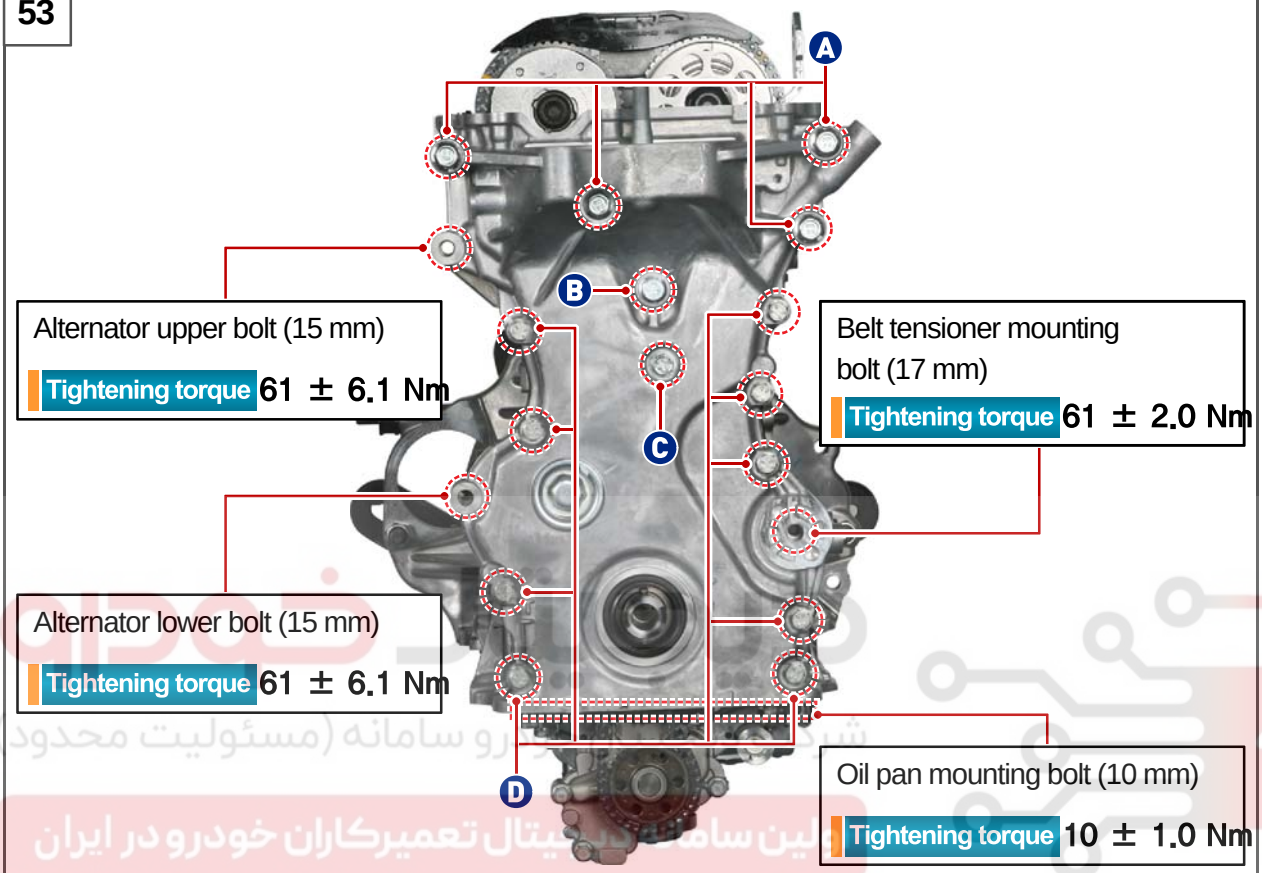


52.Remove the crankshaft pulley.

Crankshaft pulley and mounting bolt


53.Unscrew the mounting bolts (A), (B), (C), and (D) for the timing gear case cover.

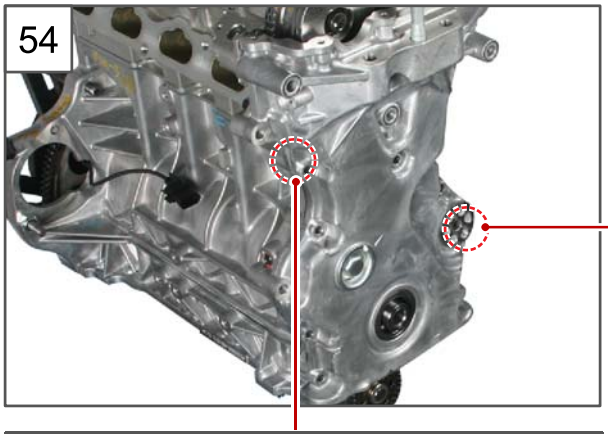
53



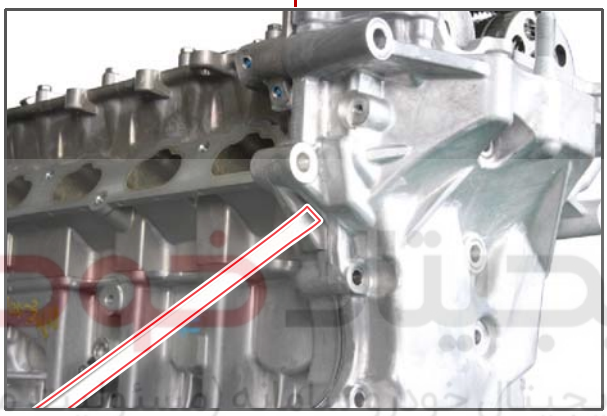
No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	15	80	4	58 ± 5.8 Nm
B		50	1	
C	13	45	1	25 ± 2.5 Nm
D		30	9	

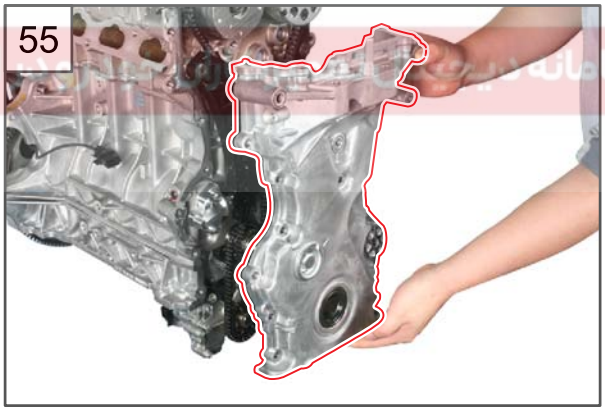
CAUTION

To protect the timing gear case from damage, remove the bolts in sequence as follows:
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

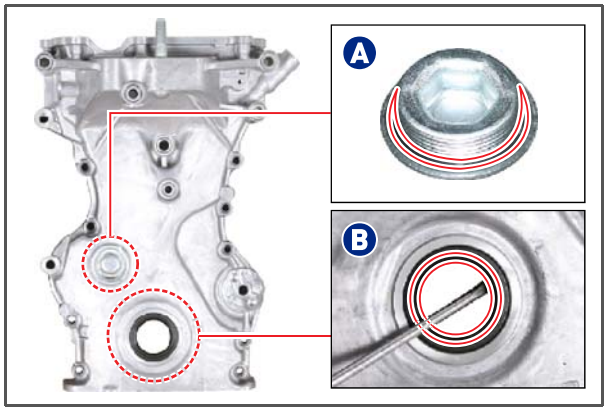


54.Pry off the timing gear case using a screwdriver or equivalent to remove it as shown in the picture.





55.Remove the timing gear case.

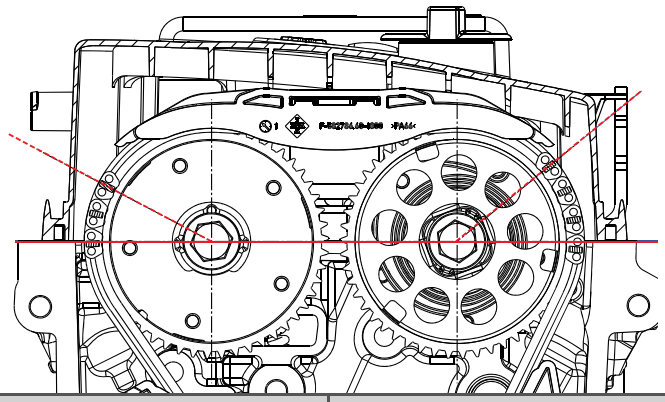


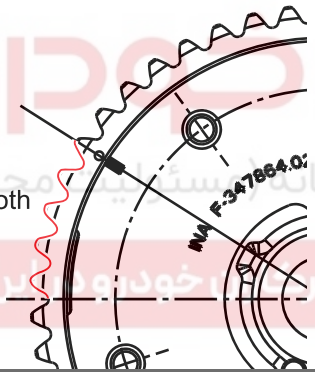
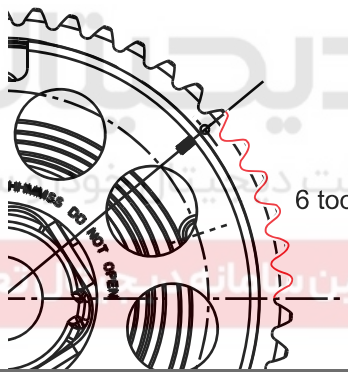
NOTE

(A) Chain tensioner plug cap and O-ring
(B) Front oil seal

56.Check the engine timing mark.

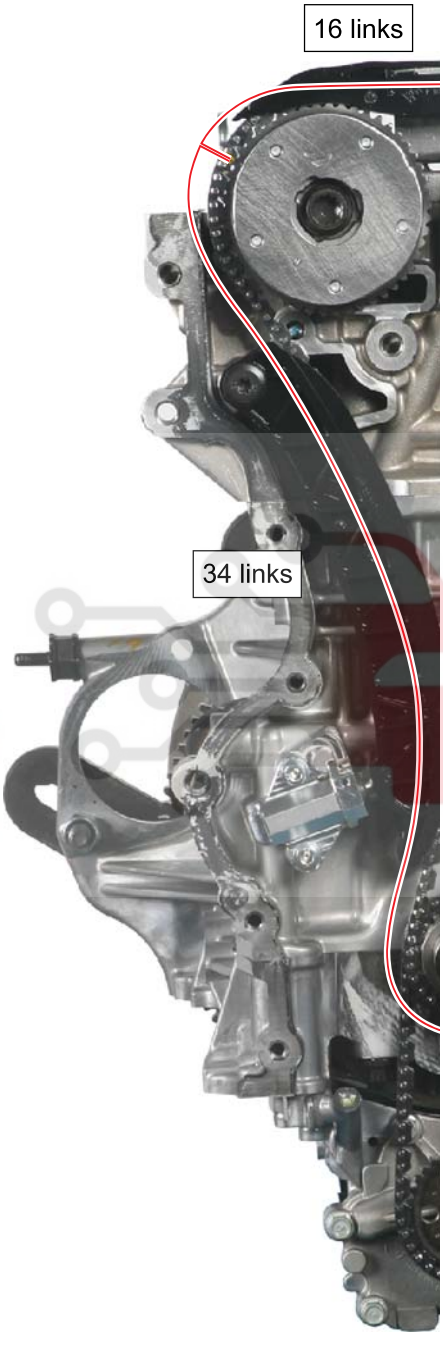
Intake & exhaust camshaft sprocket marks



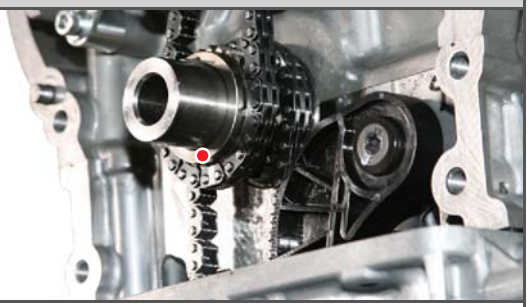
Intake camshaft sprocket mark	Exhaust camshaft sprocket mark
	
5 tooth	6 tooth

Number of chain links from the top surface of the cylinder head:
Intake side: 5 teeth/ Exhaust side: 6 teeth

Number of chain links

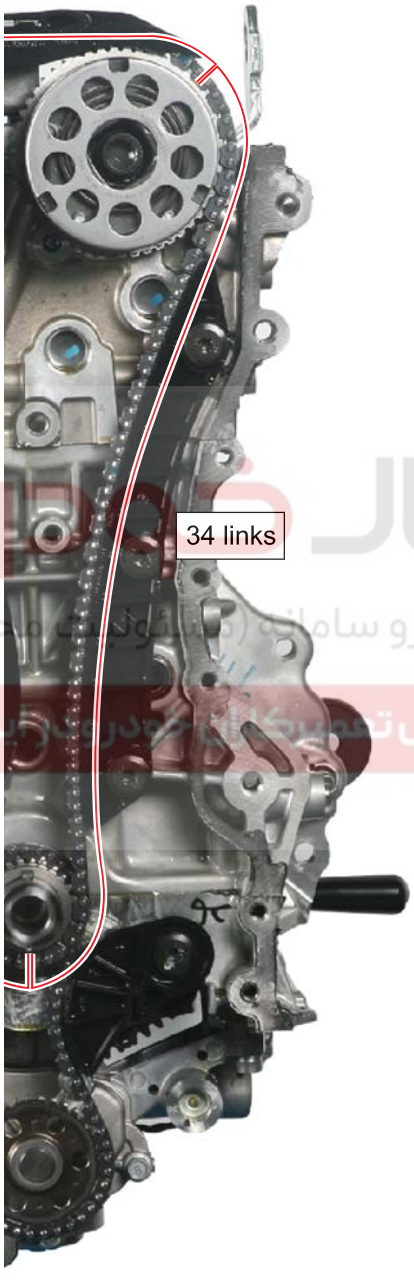


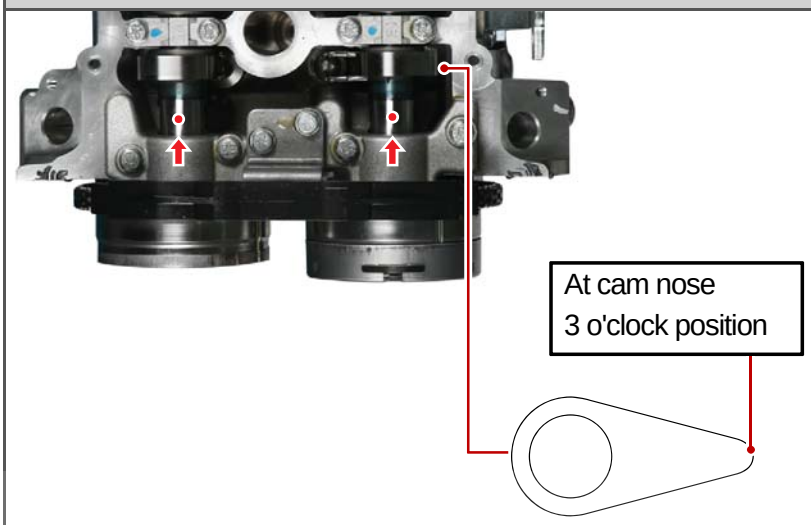
Crankshaft sprocket mark

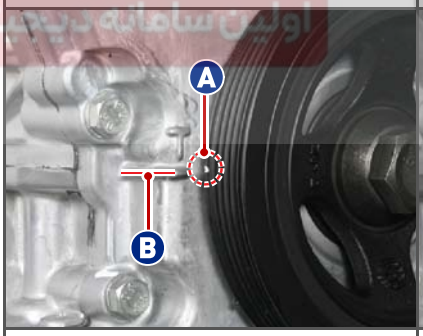
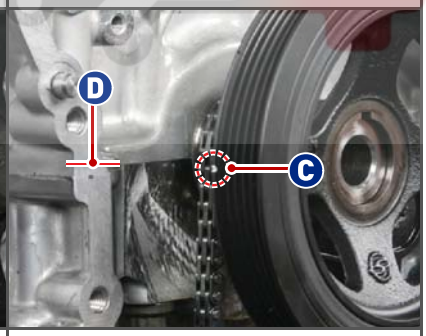


At 6 o'clock position

Modification basis	
Application basis	
Affected VIN	

for each timing mark


Intake & exhaust camshaft marks

Align the arrow on the camshaft front bearing cap with the mark on the camshaft.

Align timing using crankshaft pulley	
With timing gear case	**Without timing gear case**
	
Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.	Align the mark (C) on the crankshaft pulley with the mating surface (D) of the cylinder block and the bed plate.

Modification basis	
Application basis	
Affected VIN	

57.Make a mark on each sprocket at the position where the timing change is aligned with the timing mark.

57

Intake camshaft sprocket	Exhaust camshaft sprocket

Crankshaft sprocket

CAUTION

Mark by choosing one of the following:

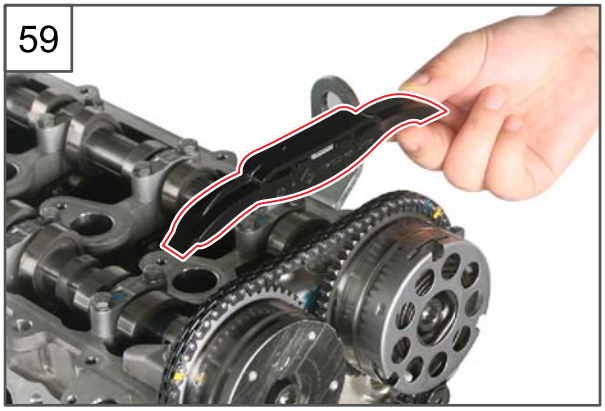
a. Make a timing mark with color other than yellow or white which was used before to identify easily.
Make a timing mark with the same
b. color which was used before.

58

58.Unscrew the 2 mounting bolts (10 mm) for the sliding upper rail.

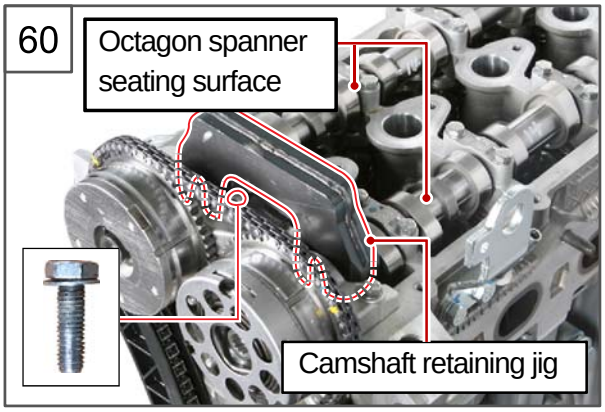
Tightening torque 10 ± 1.0 Nm

59



59.Remove the sliding upper rail.

Modification basis	
Application basis	
Affected VIN	

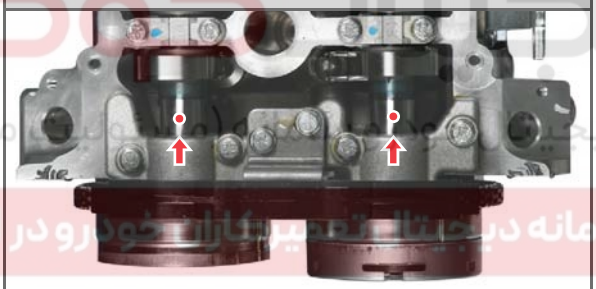


60. Fit a camshaft retaining jig to the intake and exhaust camshafts and screw in a mounting bolt (10 mm).

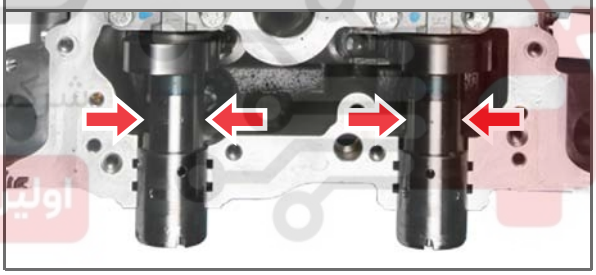
NOTE

- Fit the camshaft retaining jig when the engine timing is positioned at OT.
- The camshaft retaining jig holds the intake and exhaust camshafts together and prevents rotation by cam lift. This makes the installation of timing chain easier. This jig also can be sued to remove and tighten the mounting bolts for the camshaft sprockets.

Intake & exhaust camshaft marks



Camshaft retaining jig mounting point

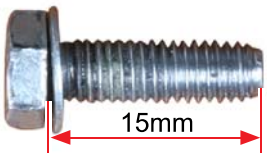


NOTE

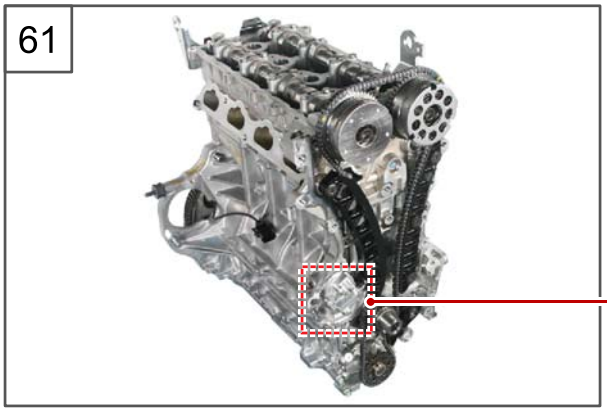
Fit the camshaft retaining jig with an about 15 mm long bolt.

Camshaft retaining jig

Camshaft retaining jig bolt

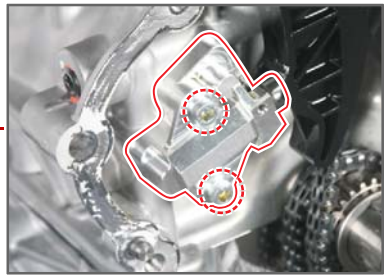


61

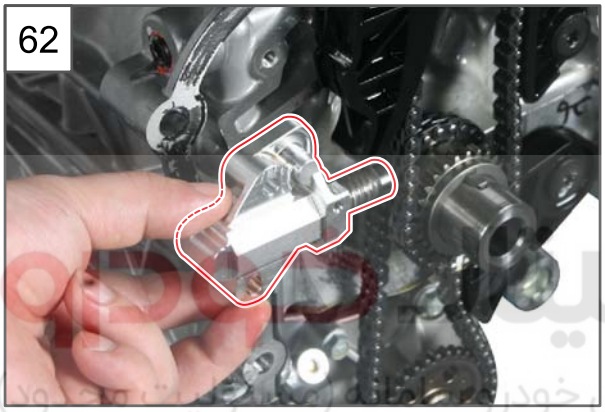


61.Unscrew the 2 hexagon mounting bolts (5 mm) for the chain tensioner.

Tightening torque 10 ± 1.0 Nm

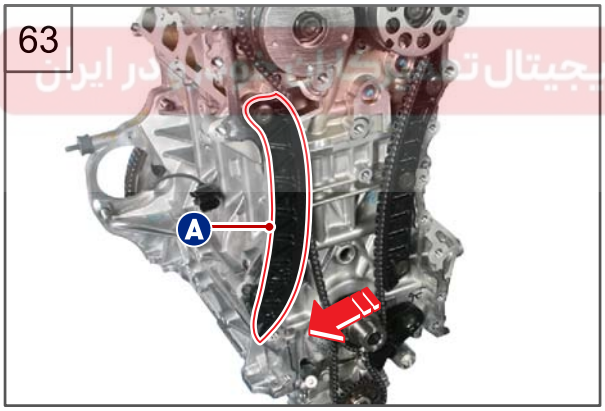


62

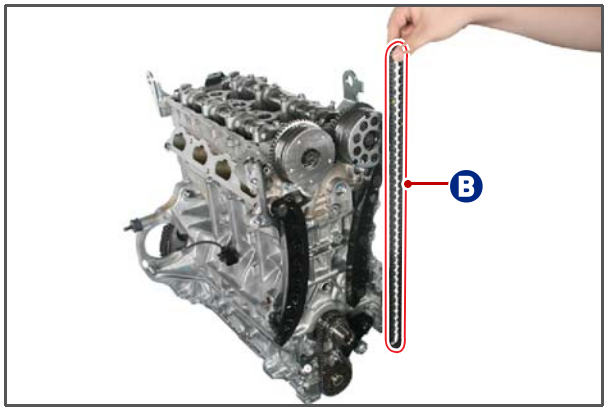


62.Remove the chain tensioner.

63

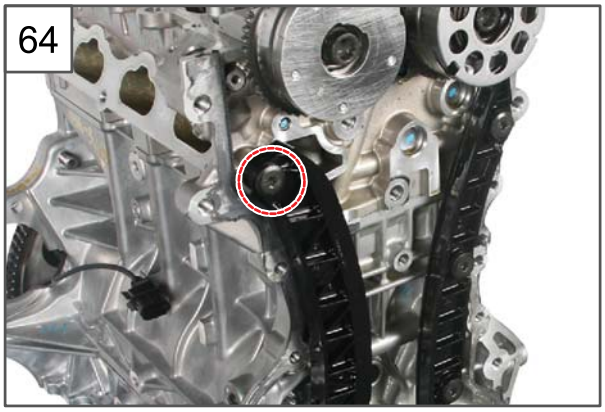


63.Move away the tensioner rail (A) to remove the timing chain (B) as shown in the picture.



Modification basis	
Application basis	
Affected VIN	

64



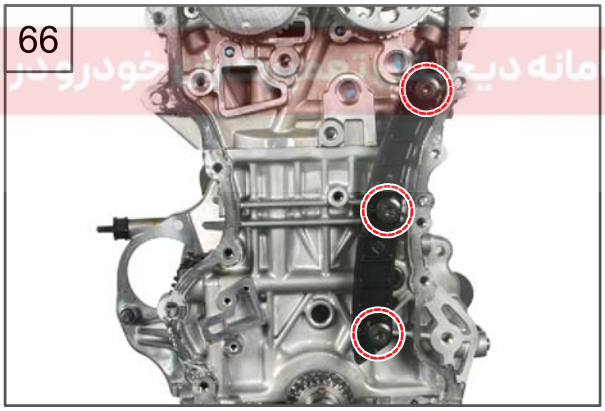
64.Unscrew the mounting bolt (T40) for tensioner rail.

Tightening torque 25 ± 2.5 Nm

65

65.Remove the tensioner rail.

66



66.Unscrew the 3 mounting bolts (T40) for guide rail.

Tightening torque 25 ± 2.5 Nm

67

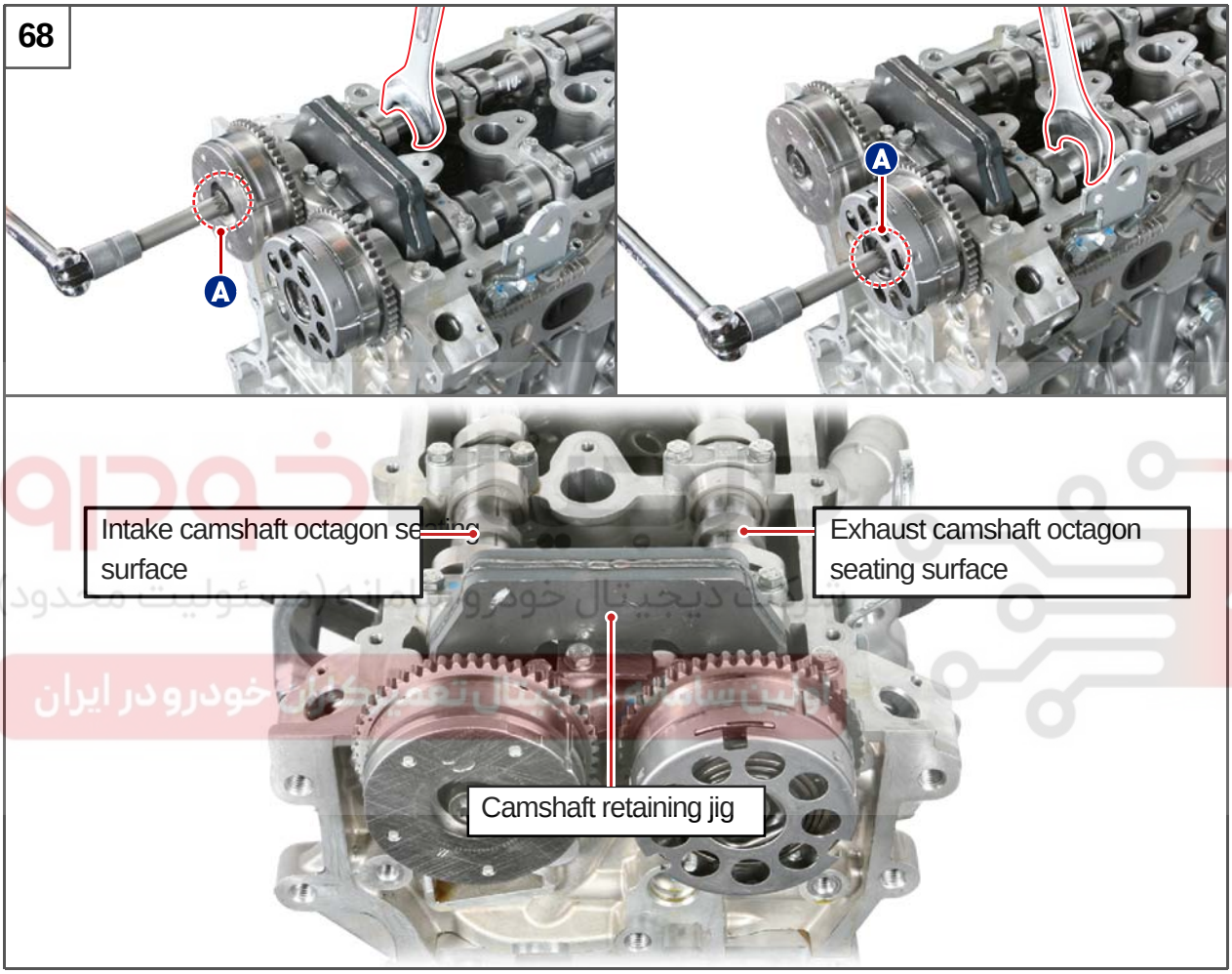
67.Remove the guide rail.

Modification basis	
Application basis	
Affected VIN	

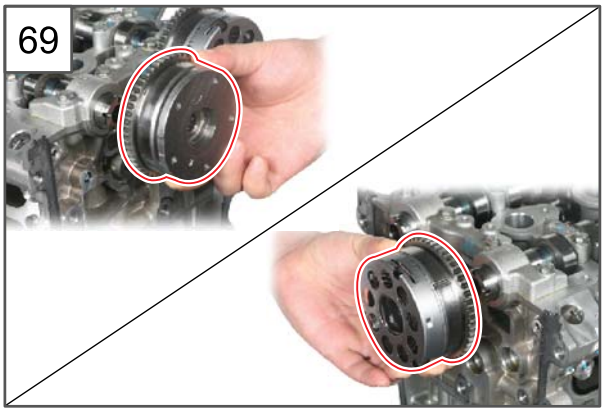
68.Fit 30 mm spanners on the octagon seating surfaces of the intake and exhaust camshafts and then unscrew the 2 sprocket mounting bolts (A, M14). This procedure must be done with the camshaft retaining jig installed.

Tightening torque 110 ± 10 Nm

68



69

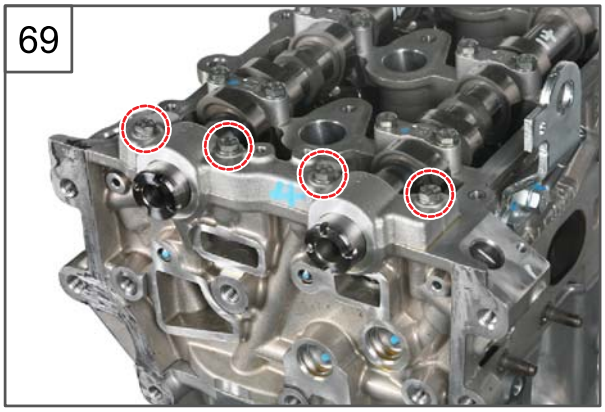


69.Remove the intake and exhaust camshaft sprockets and then the camshaft retaining jig.

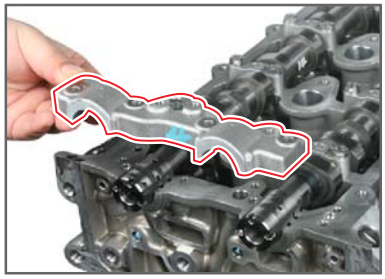
Intake side	Exhaust side
	

Modification basis	
Application basis	
Affected VIN	

69

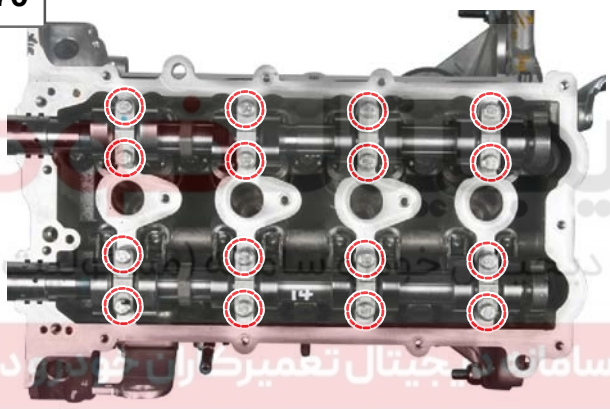


69.Remove the 4 mounting bolts (10 mm) to remove the camshaft front bearing cap.



70.Unscrew the 16 mounting bolts (10 mm) for the camshaft bearing caps.

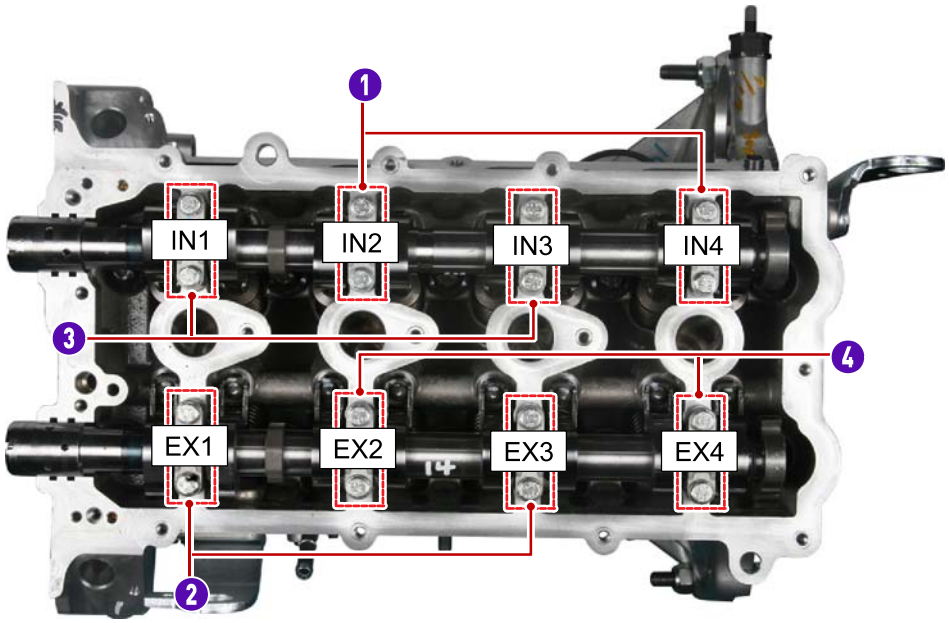
70

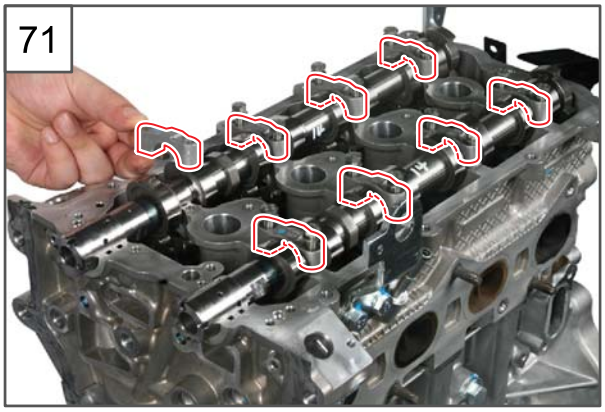


NOTE

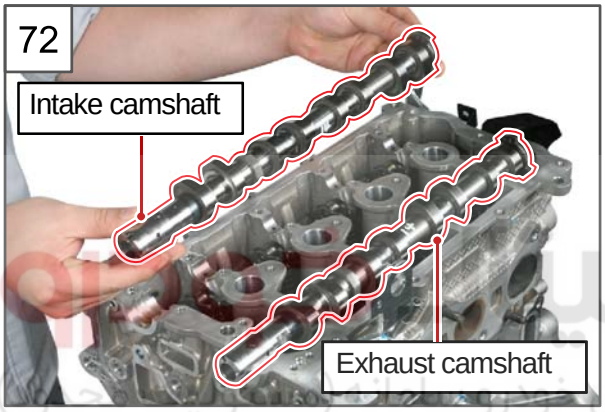
Unscrew the camshaft cap mounting bolts slowly in two or more stages according to the specific sequence stated below.
(1) Intake cams: IN2, IN4
(2) Exhaust cams: EX1, EX3
(3) Intake cams: IN1, IN3
(4) Exhaust cams: EX2, EX4

Tightening torque 10 ± 1.0 Nm

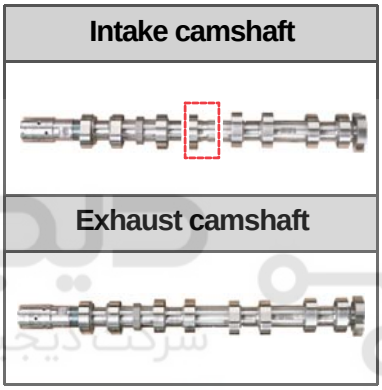




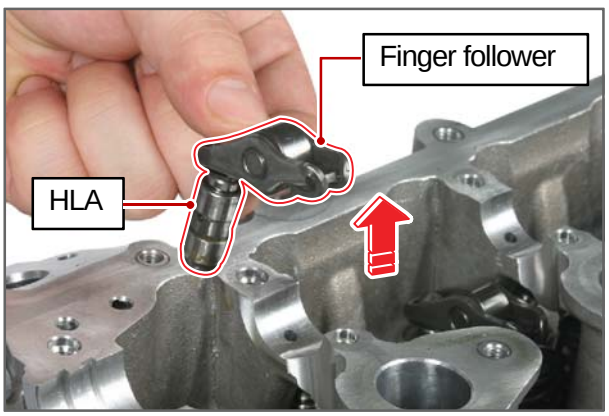
71.Remove the 8 camshaft bearing caps.



72.Remove the intake and exhaust camshafts.



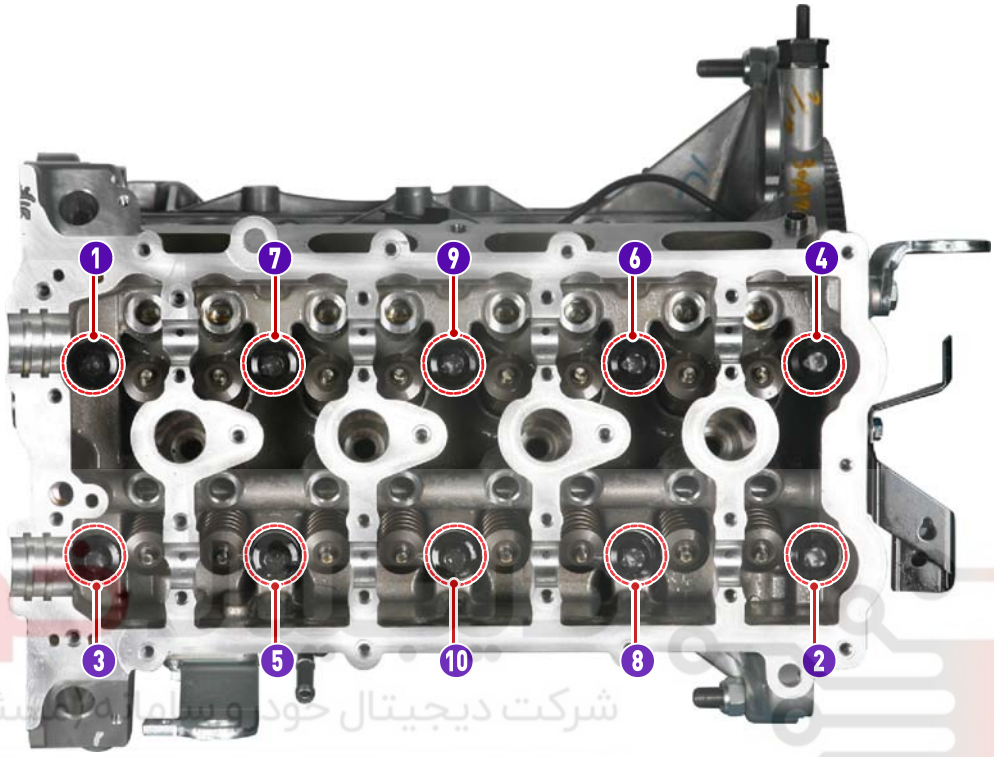
73.Remove the 8 HLAs with finger follower.



Modification basis	
Application basis	
Affected VIN	

74.Remove the 10 mounting bolts (E16 mm) for the cylinder head.

74



Sequence	Tightening torque
1	30 ± 3.0 Nm
2	90° X 2 times

CAUTION

To protect the cylinder head from damage, remove the bolts in sequence as follows:

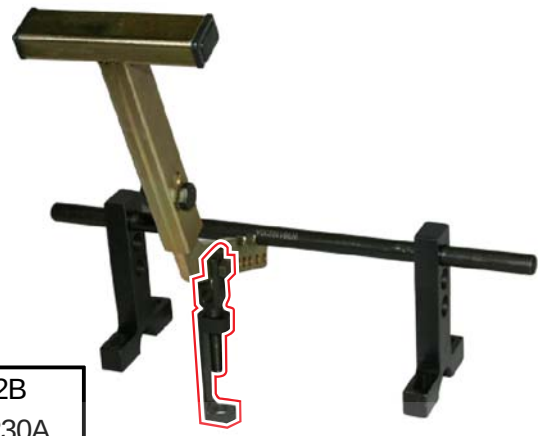
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

75

75.Remove the cylinder head.

Intake & exhaust valves

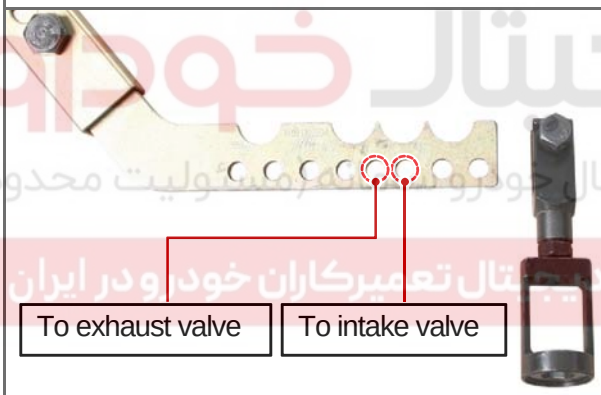
Valve spring complete



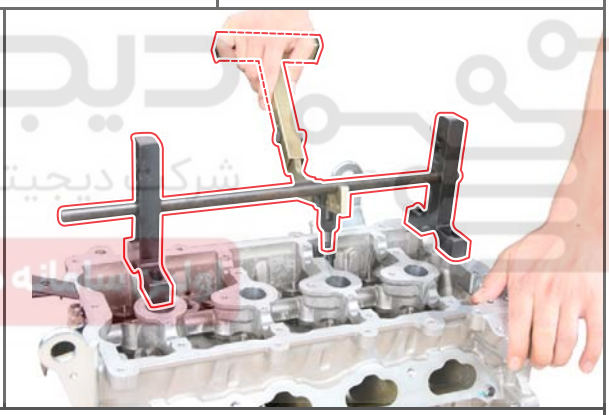
Y9922 082B
W9911 0230A

Y9922 082B

W99110230A



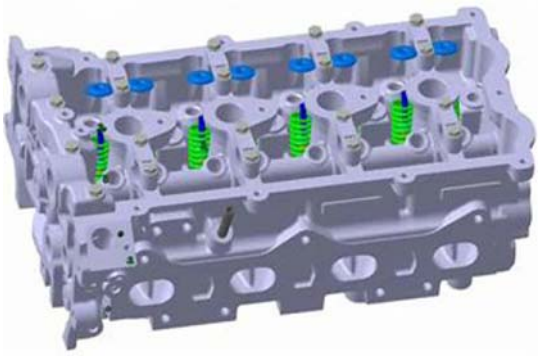
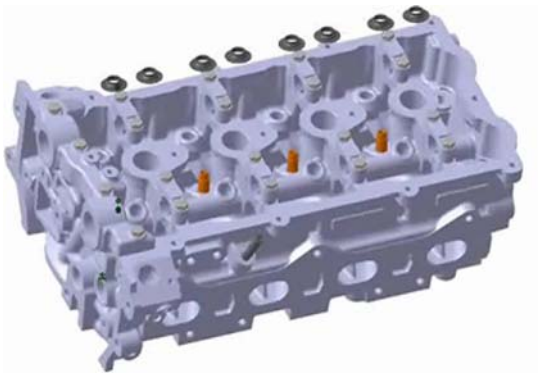
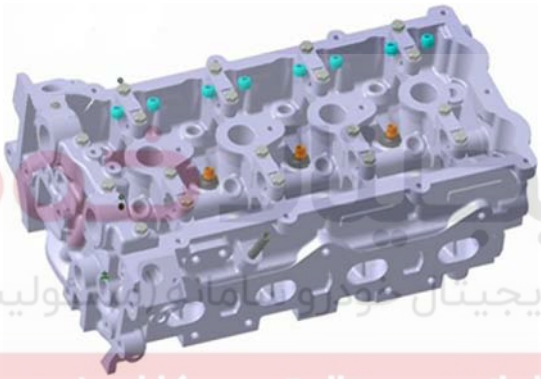
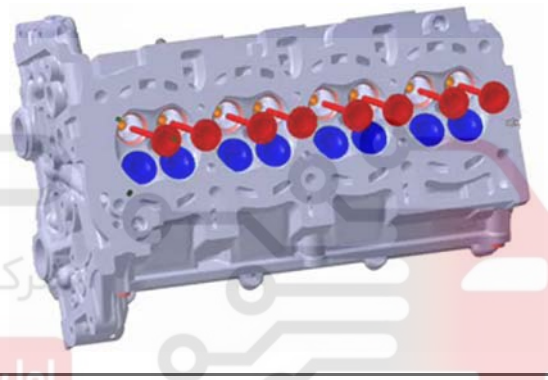
To exhaust valve
To intake valve



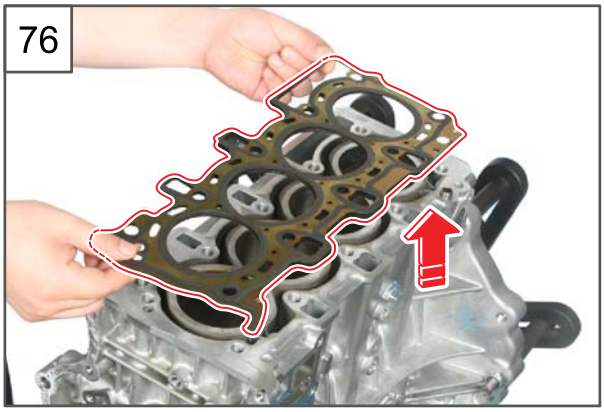
Used to remove and install the valve spring by compressing it.

Valve stem seal remover	Valve stem seal installer
 Y99 22 018	 Y9922008
Used to protect the rubber valve guide from damage when removing/installing it.	Used to install the valve stem seal

Modification basis	
Application basis	
Affected VIN	

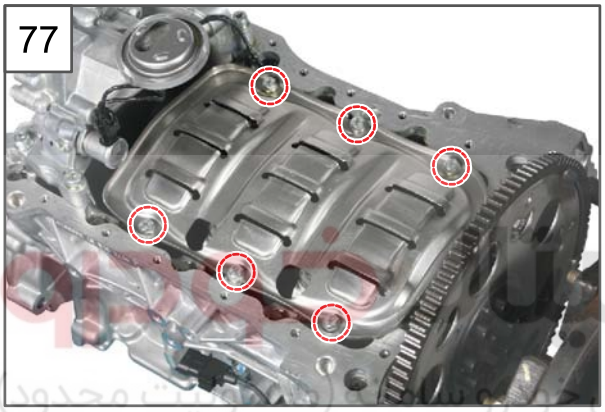
Intake & exhaust valves configurations	
	
Upper retainers and valves spring: 16 off, Each	Lower retainers: 16 off
	
Valve stem seals: 16 off	Intake & exhaust valves: 8 off, Each

76



76.Remove the cylinder head gasket.

77

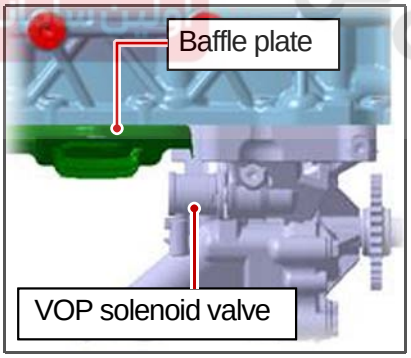


77.Unscrew the 6 mounting bolts (10 mm) for the baffle plate from the underside of the engine.

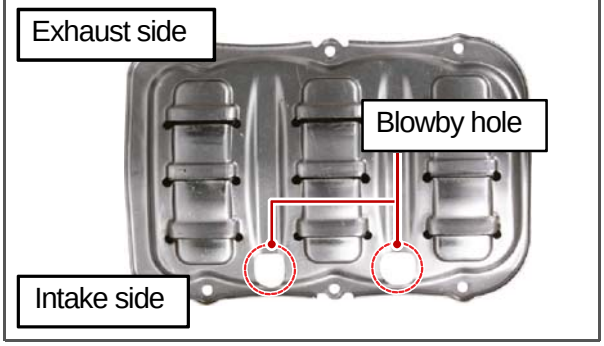
Tightening torque 10 ± 1.0 Nm

78

78.Remove the baffle plate.



Baffle plate



CAUTION

Make sure that the baffle plate does not interfere with the VOP solenoid valve when removing the baffle plate.

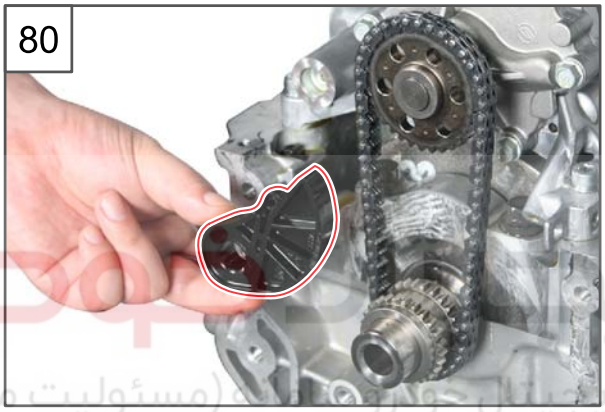
Modification basis	
Application basis	
Affected VIN	

79

79.Unscrew the mounting bolt (T40) for the oil pump chain tensioner.

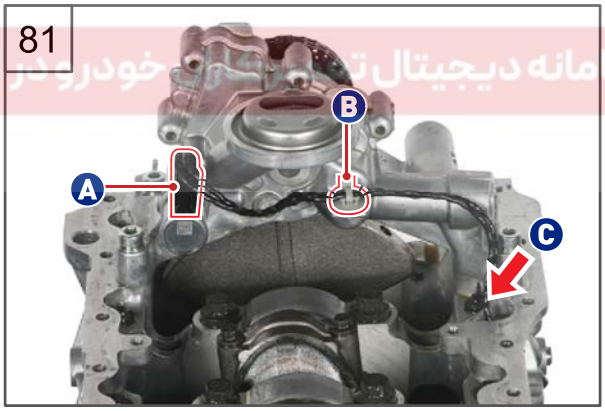
Tightening torque 25 ± 2.5 Nm

80



80.Remove the oil pump chain tensioner.

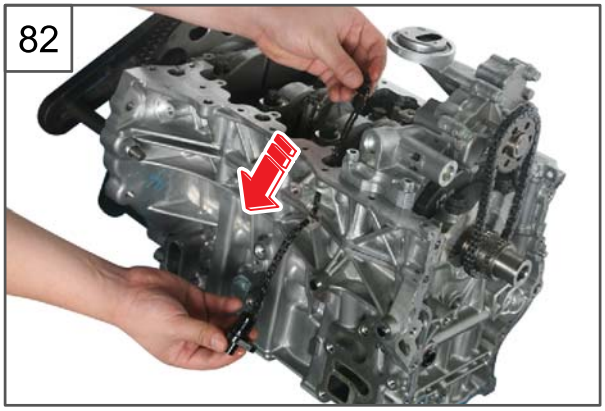
81



81.Remove the VOP solenoid valve connector (A) and wining retaining key (B) from the rear side of the oil pump and unscrew the hexagon mounting bolt (C, 5 mm) from the bed plate.

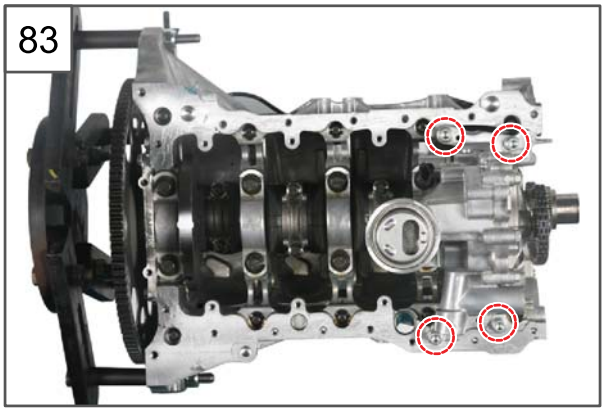
Tightening torque 10 ± 1.0 Nm

82



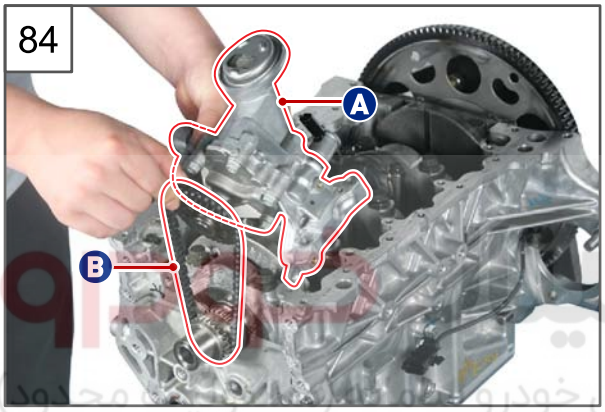
82.Remove the VOP extension wiring through the hole of the bed plate.

Modification basis	
Application basis	
Affected VIN	



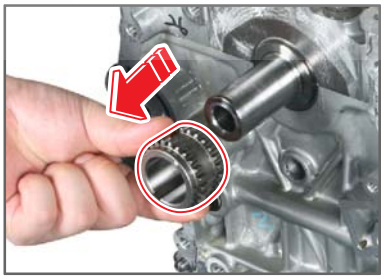
83.Unscrew the 4 hexagon mounting bolts (6 mm) for the oil pump.

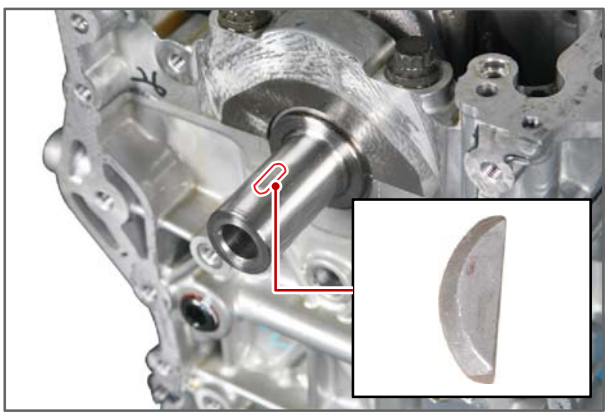
Tightening torque 25 ± 2.5 Nm



84.Remove the oil pump (A) and oil pump chain (B) as shown in the picture.

85.Remove the crankshaft sprocket.





CAUTION

Make sure not to lose the half-moon shaped key when removing the crankshaft sprocket.

Modification basis	
Application basis	
Affected VIN	

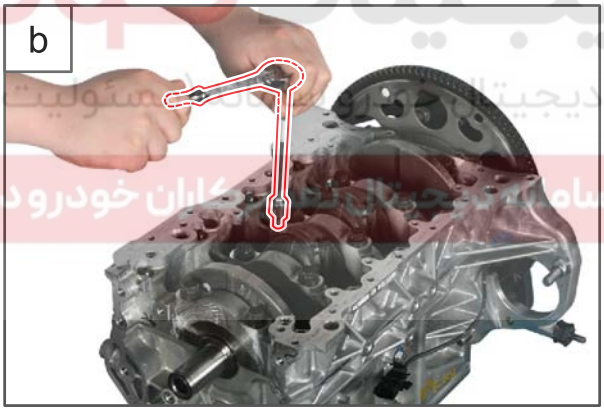
86.Make a mark on each sprocket at the position where the timing change is aligned with the timing mark.

a

a.
No. 1 and 4 cylinders first, and then No. 2 and 3 cylinders.

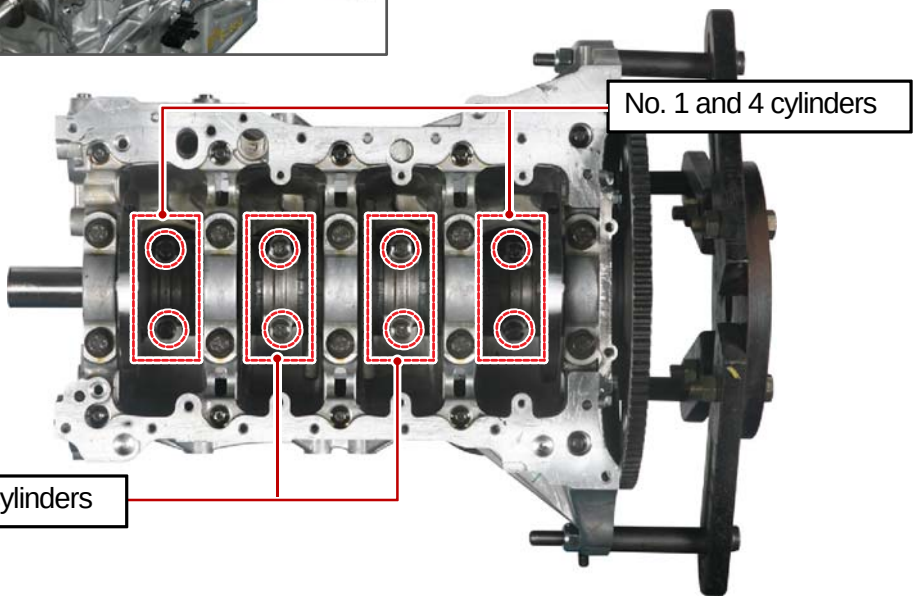
CAUTION
Remove the carbon on the top of each cylinder block combustion chamber to facilitate the removal of piston assembly.

b



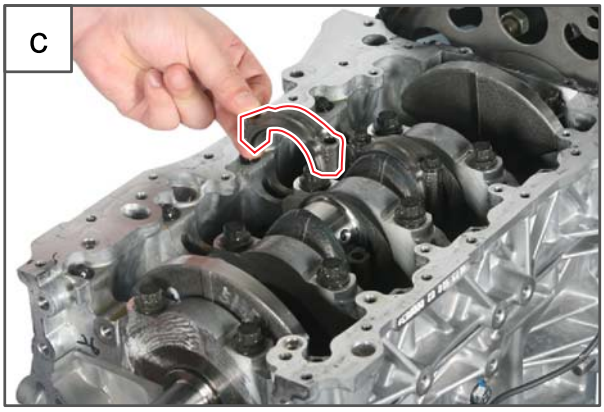
b. Remove the 8 mounting bolts (8 mm, 12-point) for the connecting rod cap.

Sequence	Tightening torque
1	
2	



Modification basis	
Application basis	
Affected VIN	

c



c. Remove the connecting rod cap for each cylinder.

d

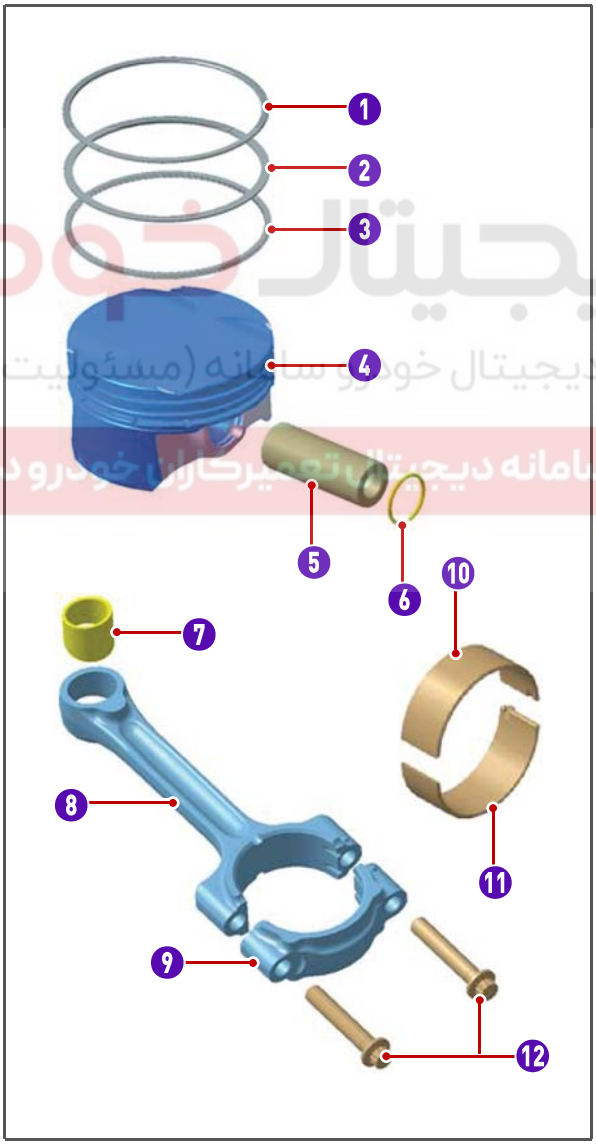
d. Remove the piston assembly for each cylinder.

CAUTION

Make paint marks on the removed piston assembly and connecting rod caps as shown in the picture not to mix up.

Modification basis	
Application basis	
Affected VIN	

Piston assembly components



- Remove the piston pin after separating the snap ring from the removed piston.
- Separate the piston and connecting rod.
- Remove the piston ring from the piston and put them together.

CAUTION

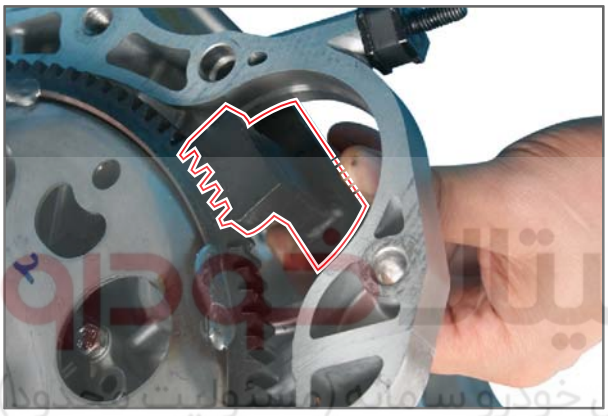
Replace the piston ring, bearing and snap ring with new ones.

No.	Component
1	Top ring
2	Second ring
3	Oil ring
4	Piston
5	Piston pin
6	Snap ring
7	Piston pin bush
8	Connecting rod
9	Connecting rod cap
10	Connecting rod upper bearing
11	Connecting rod lower bearing
12	Bolt

87

87.Unscrew the 8 mounting bolts (T55) for the drive plate (for a vehicle with A/T) or the flywheel (for a vehicle with M/T).

Sequence	Tightening torque
1	
2	



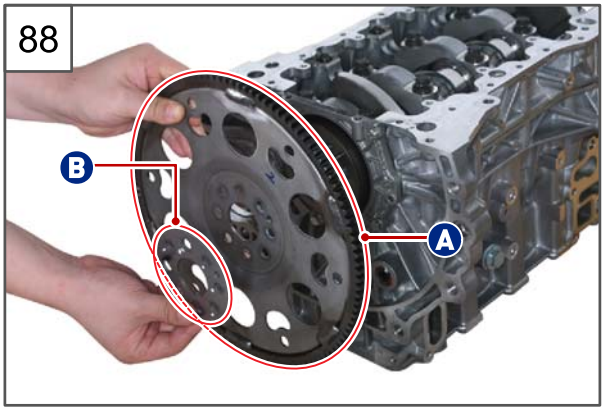
NOTE

Remove the mounting bolts after securing the drive plate with the flywheel fixture.

Flywheel fixture


Drive plate and plate	Flywheel
	

88



88.Remove the drive plate (A) and plate (B). (remove the flywheel for a vehicle with M/T)

Modification basis	
Application basis	
Affected VIN	

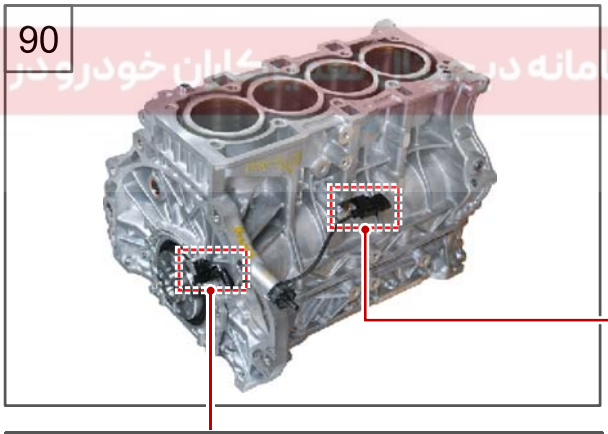
89

89.Remove the trigger ring.

CAUTION

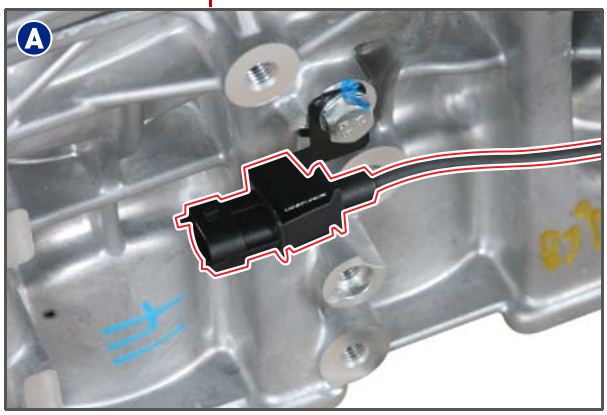
Do not work with a trigger ring near a magnetic tool or equipment, as the triggering can lose magnetic properties easily by an external magnetic field or scratches on the surface.

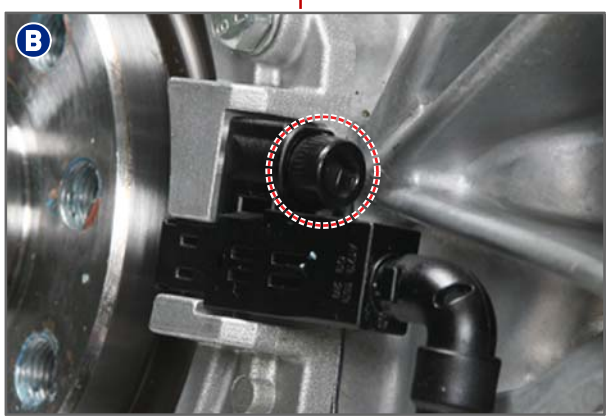
90

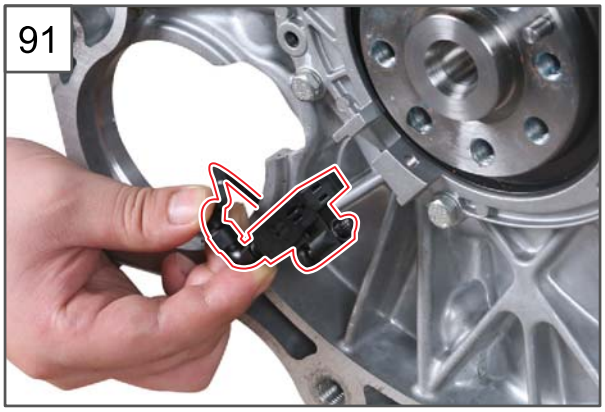


90.Remove the crankshaft position sensor connector from the retaining bracket (A) and unscrew the hexagon mounting bolt (B, 5 mm).

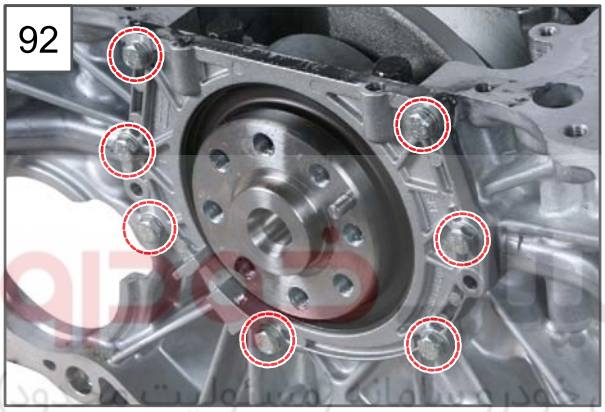
Tightening torque 5 ± 1.0 Nm





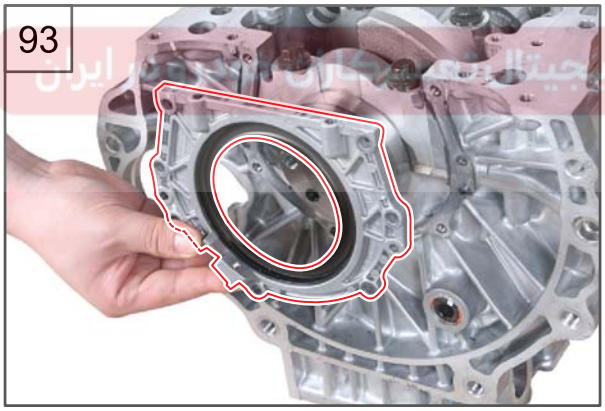


91.Remove the crank position sensor.

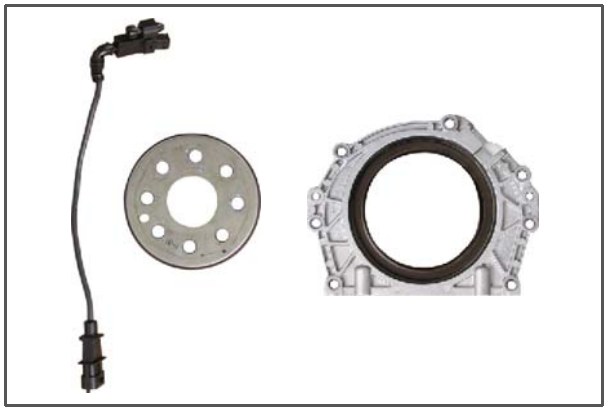


92.Unscrew the 7 mounting bolts (10 mm) for the crankshaft rear seal.

Tightening torque 10 ± 1.0 Nm



93.Remove the crankshaft rear seal.



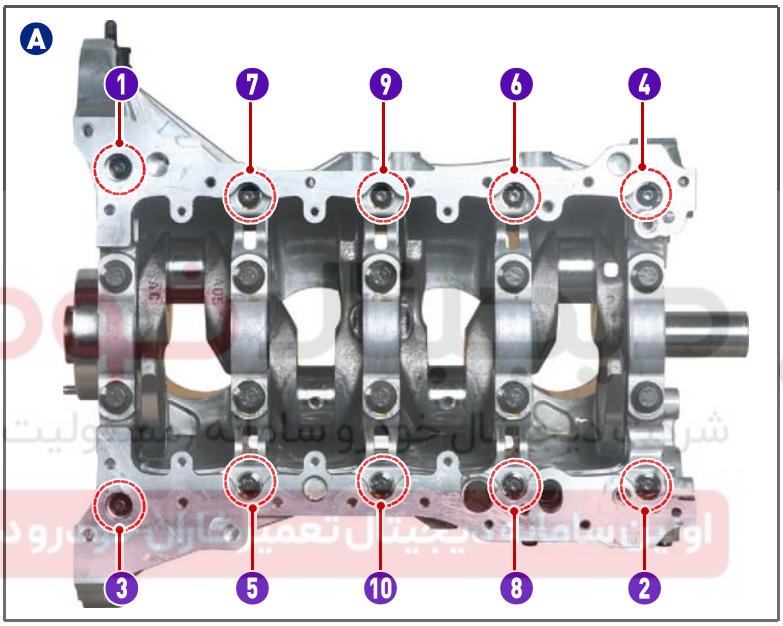
Modification basis	
Application basis	
Affected VIN	

94.Unscrew the 10 mounting bolts (A, E10) for the bed plate and the 10 mounting bolts (B, 12-point 13 mm) for the main journal.

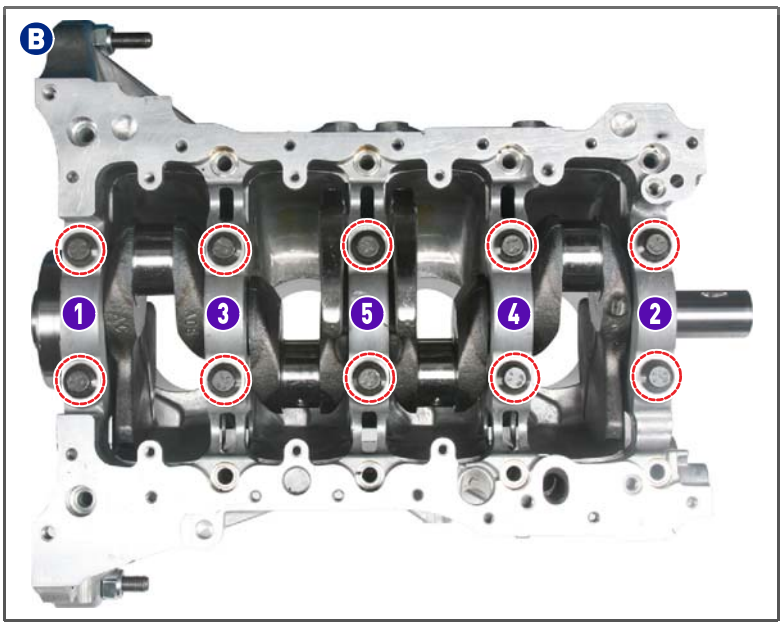
CAUTION

Unscrew the bolts in the sequence shown below (from A to B) to protect the bed plate from damage.

- Mounting bolts (A): from the outside to the inside, diagonally
- Mounting bolts (B): from the outer main journal to the inner main journal

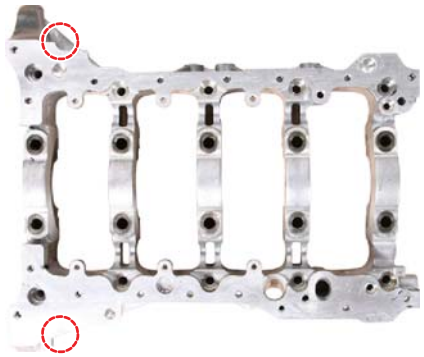


Tightening torque 25 ± 5.0 Nm

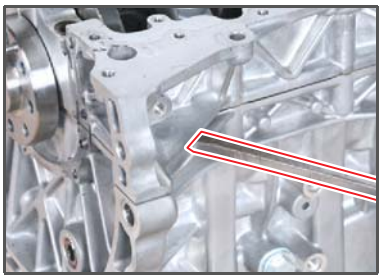


Sequence	Tightening torque
1	
2	

95



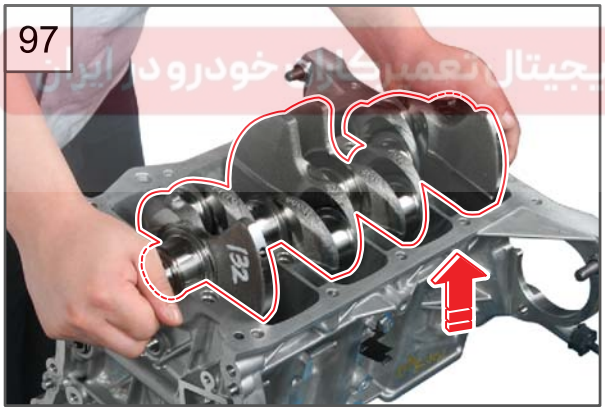
95.Pry off the bed plate using a screwdriver or equivalent to remove it as shown in the picture.



96

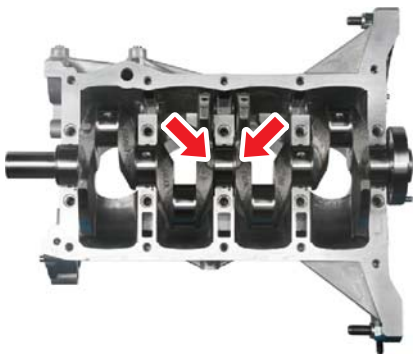
96.Remove the bed plate.

97

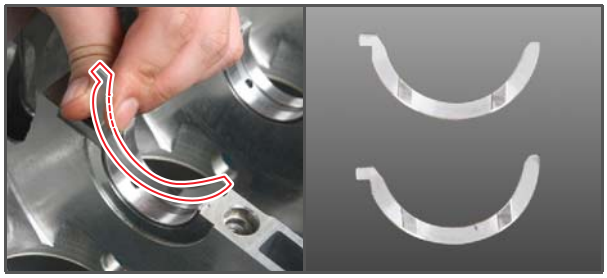


97.Remove the crankshaft.

98



98.Remove the 2 upper thrust bearings from the No. 3 main journal.

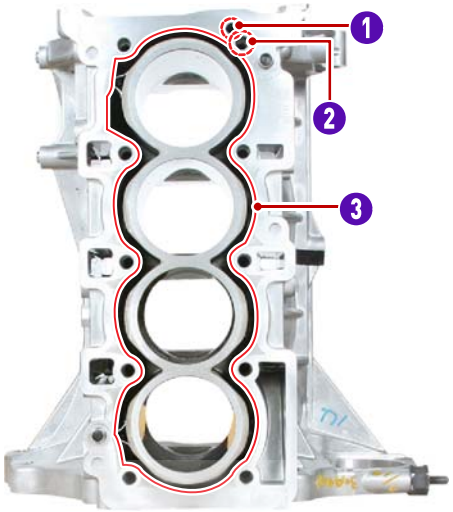
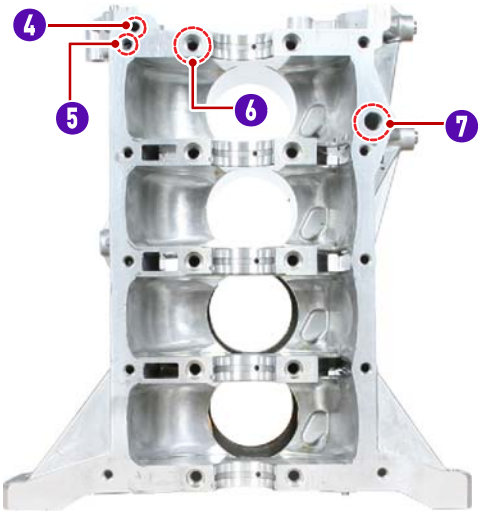


Modification basis	
Application basis	
Affected VIN	

Memo

2) Assembling Engine Assembly

1. Clean the cylinder block and belt plate holes using compressed air

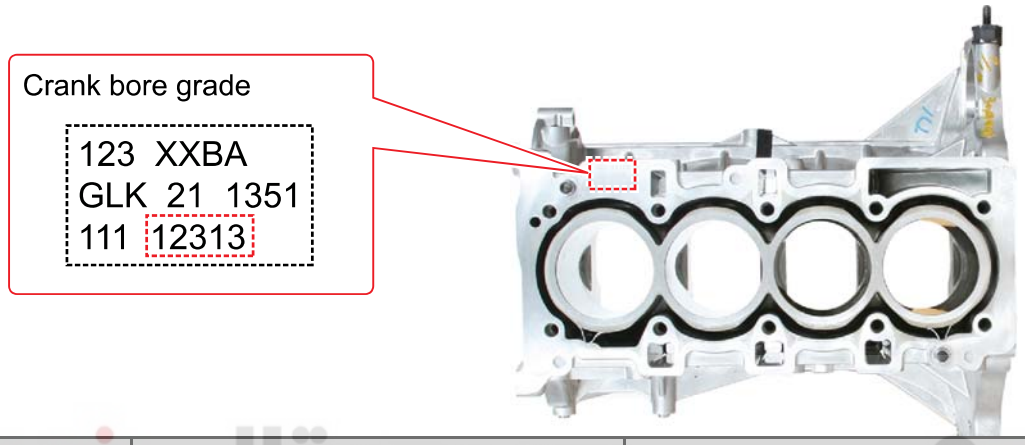
Top view of cylinder block	Bottom view of cylinder block
	
Top view of bed plate	**Bottom view of bed plate**
	

1. Oil passage to cylinder head
2. Cylinder head bolt hole
3. Coolant passage
4. Oil return passage
5. Bed plate bolt hole
6. Main journal bolt hole
7. Cylinder block main oil passage
8. Oil passage from oil pump to bed plate

Selecting crankshaft main bearing

For upper bearing

Choose by checking the mark on the cylinder block (crank bore grade). (from left to right, in marked

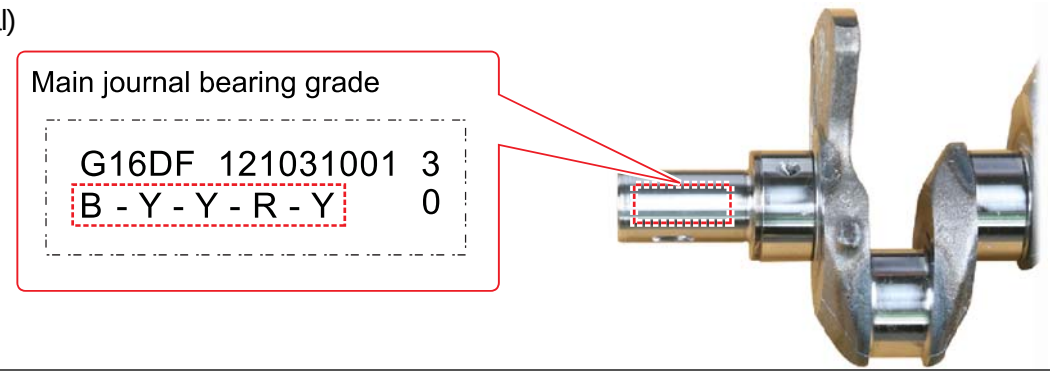


Grade	Color	
1	Blue	50.000 to 50.005
2	Yellow	50.005 to 50.010
3	Red	50.010 to 50.015

For lower bearing

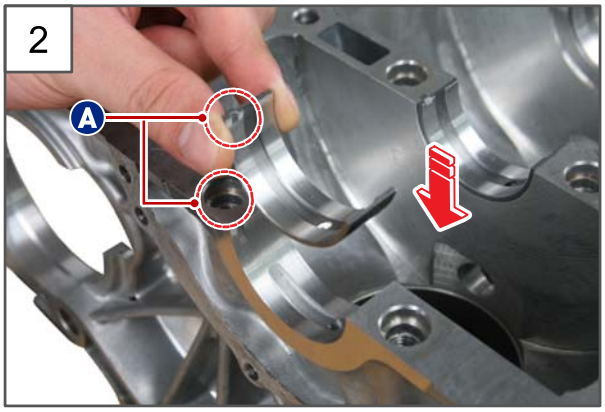
Choose by checking the mark on the crankshaft (main journal bearing grade). (from left to right, in

journal)



Grade	Color	
B	Blue	45.995 to 46.000
Y	Yellow	45.990 to 45.995
R	Red	45.985 to 45.990

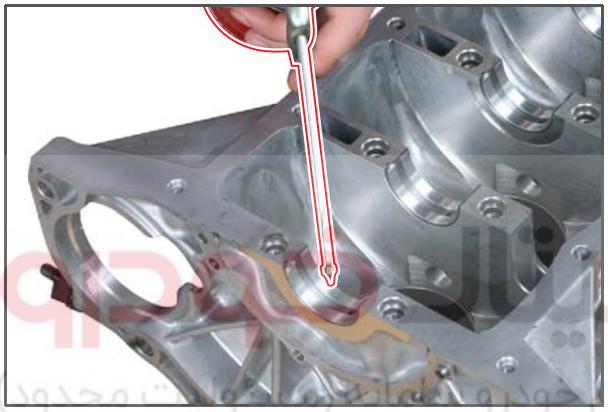
2



2. Install the 5 crankshaft upper main bearings to the cylinder block.

CAUTION

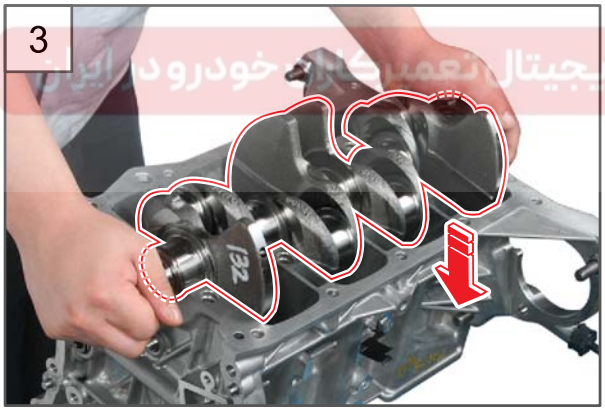
Check the color of new main bearing and match it with the key groove (A) of the cylinder block.



NOTE

Apply the engine oil to the bearing shell.

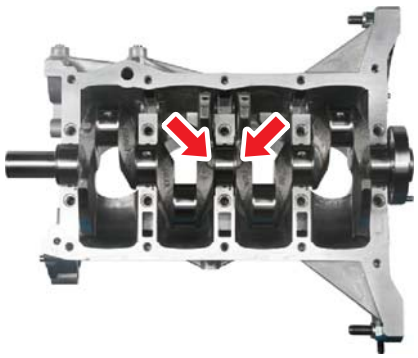
3



3. Fit the crankshaft to the cylinder block.

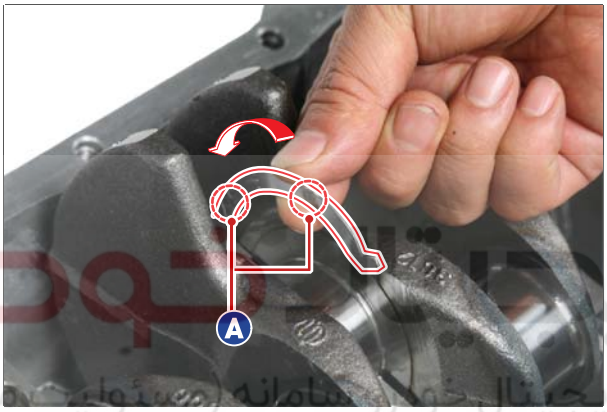
Modification basis	
Application basis	
Affected VIN	

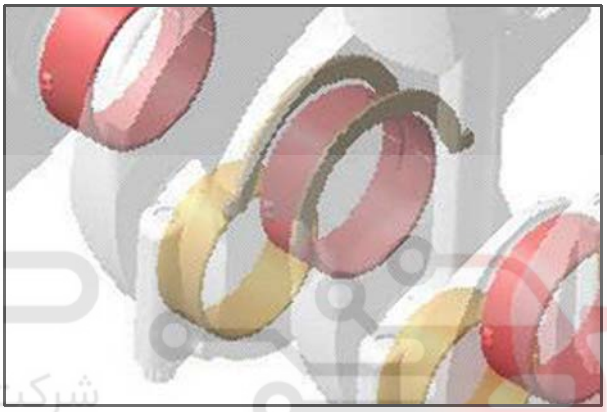
4



4. Install the 2 upper thrust bearings to the No. 3 main journal.
   - Install the thrust bearing so that its oil groove (A) faces outward.

CAUTION
- Remove the foreign materials on the thrust bearing.
- Insert the bearings after applying the engine oil.

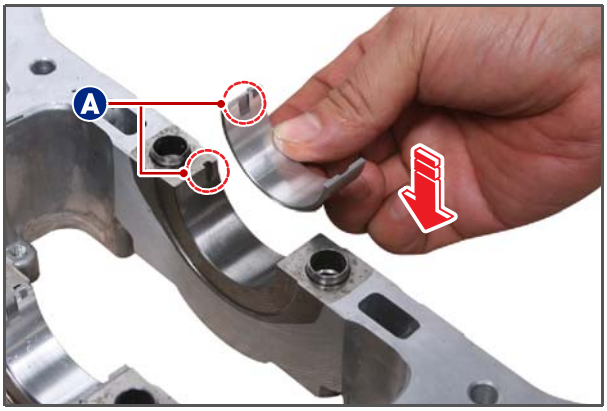


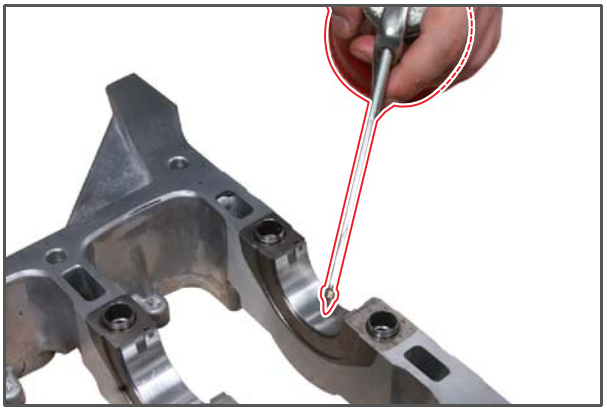


5

5. Install the 5 crankshaft lower main bearings to the bed plate.
   - Check the color of new main bearing and match it with the key groove (A) of the bed plate.

NOTE
Apply the engine oil to the bearing shell.

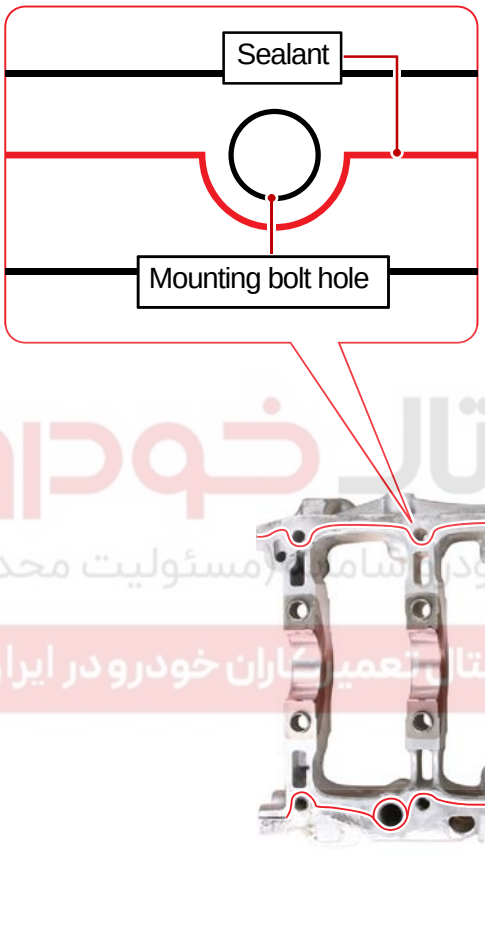




6. Apply sealant to the bed plate.

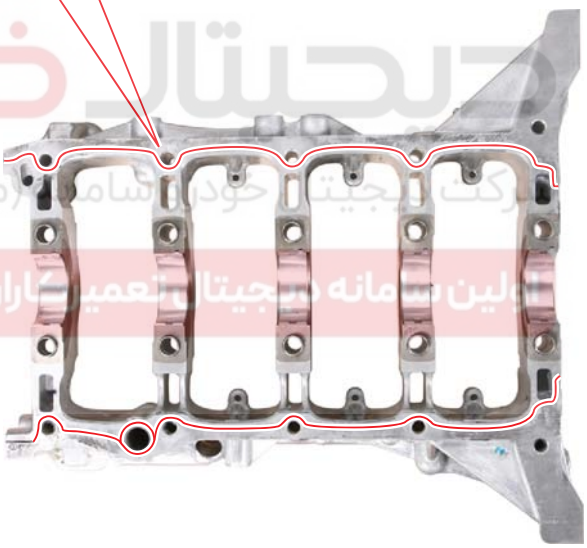
NOTE

Sealant part No.: 661 989 56 A0



CAUTION

- Apply sealant the inner side of the mounting bolt hole of the bed plate as shown in the picture. Failure to do so can lead to engine oil leaks.
-



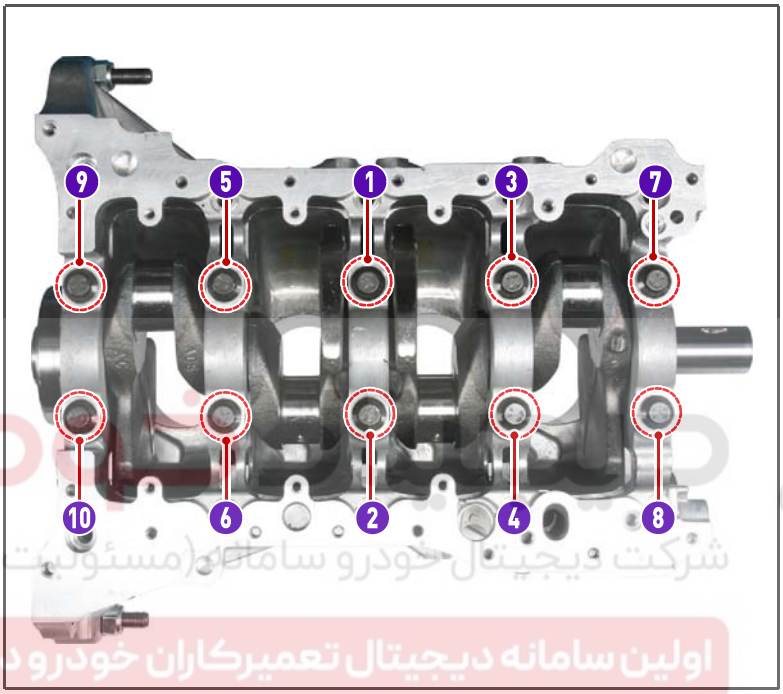
7. Fit the bed plate to the cylinder block.

Modification basis	
Application basis	
Affected VIN	

8. Screw in the 10 main journal mounting bolts.

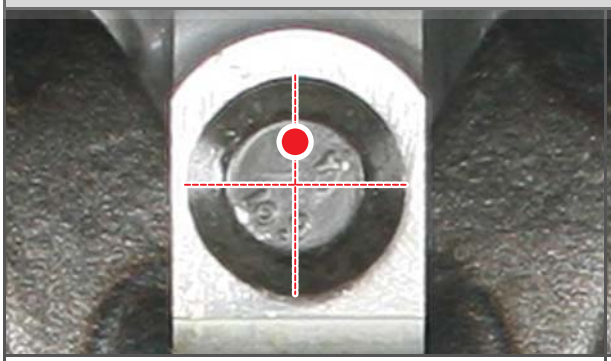
CAUTION

- The main journal mounting bolt is non-reusable part. Replace them with new ones.
- Tighten from the inner main journal mounting bolts to the outer mounting bolts.

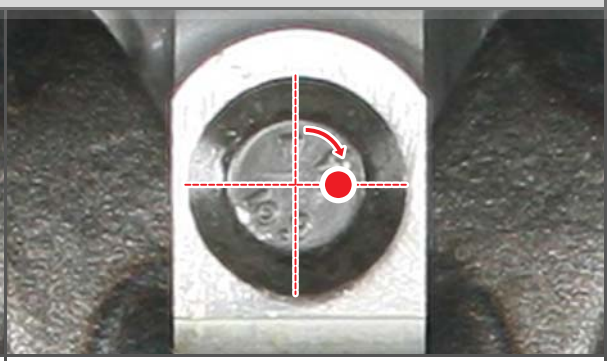


Sequence	Tightening torque
1	
2	

Angle tightening min journal mounting bolt



Paint mark on each bolt after the 1st torque



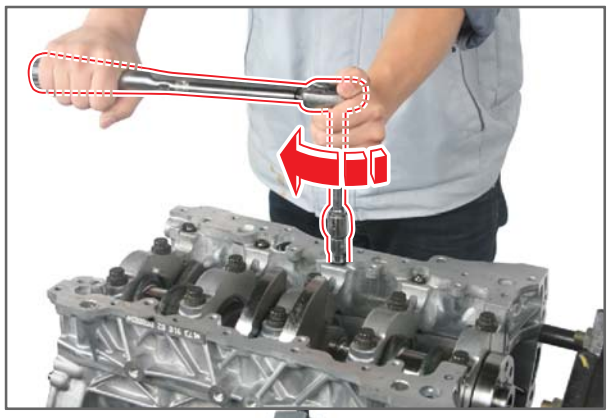
the sequence shown in the picture at the time of 2nd tightening.

NOTE

Check the status and angle of the tightened bolt after the 2nd tightening.

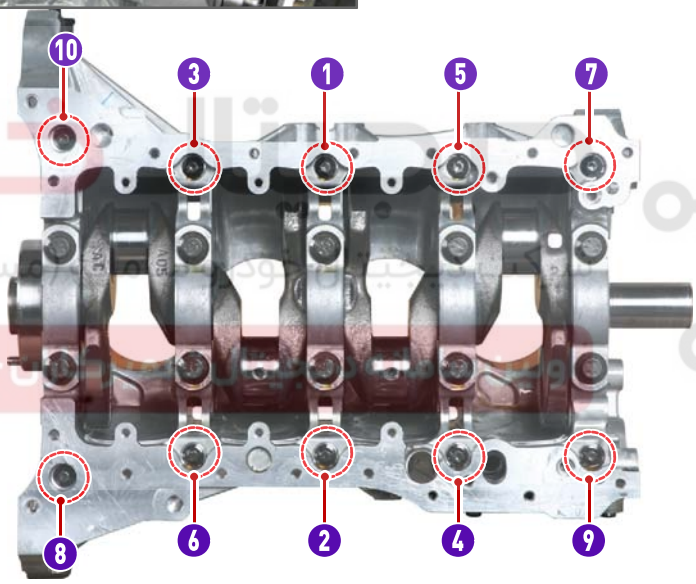
9. Torque tighten the 10 mounting bolts (E10) for the bed plate to the specified torque.

Tightening torque 25 ± 5.0 Nm



CAUTION

- The bed plate mounting bolt is non-reusable part. Replace them with new ones.
- Tighten from the inner mounting bolts to the outer bolts.



Location
Crankshaft: Magnetic base
Dial gauge: Front of cylinder block

NOTE

Check the main journal end play of the crankshaft after installing the bed plate.

Specified value (mm)	0.100 to 0.266

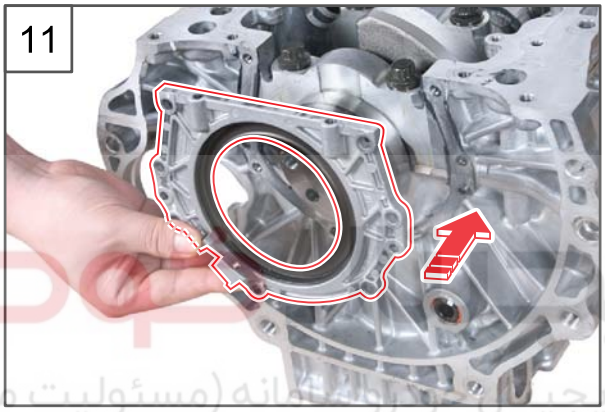
10

10.Apply sealant to the crankshaft rear seal.

NOTE

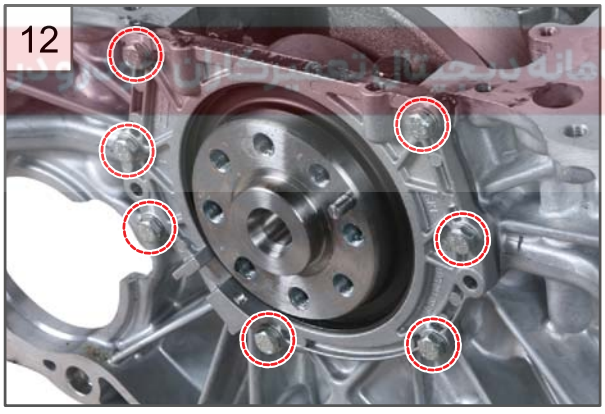
- Sealant part No.: 661 989 56 A0
- Apply a light coat of fresh engine oil to the inner surface of the crankshaft rear oil seal.

11



11.Fit the crankshaft rear oil seal to the cylinder block. Take care not to damage the inner surface of the seal.

12



12.Torque tighten the 7 mounting bolts (10 mm) for the crankshaft rear seal to the specified torque.

Tightening torque 10 ± 1.0 Nm

CAUTION

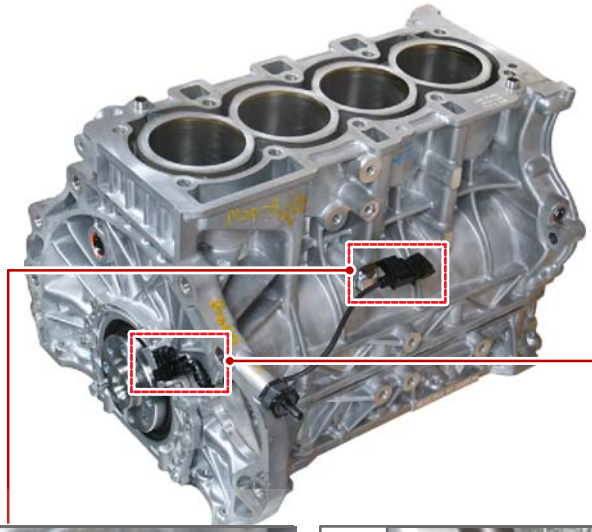
Tighten the mounting bolt after checking the difference in height between the crankshaft rear oil seal and the cylinder block.

Height difference specification	0.2 mm or lower

Modification basis	
Application basis	
Affected VIN	

13.Install the crankshaft position sensor.

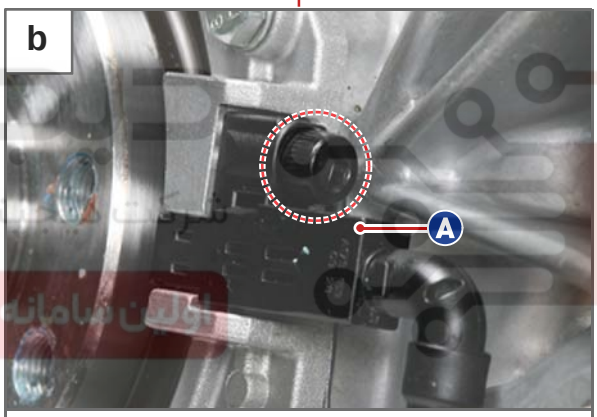
13



a

Fit the crankshaft position sensor connector to the retaining bracket.

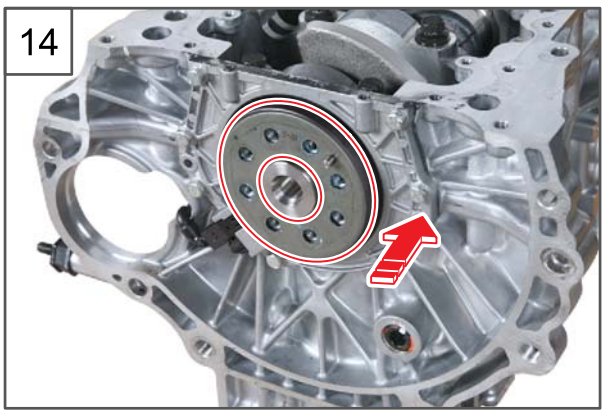
b



Install the crankshaft position sensor to the crankshaft rear seal and torque tighten the hexagon mounting bolt (A, 5 mm) to the specified torque.

Tightening torque 5 ± 1.0 Nm

14



14.Install the trigger ring.

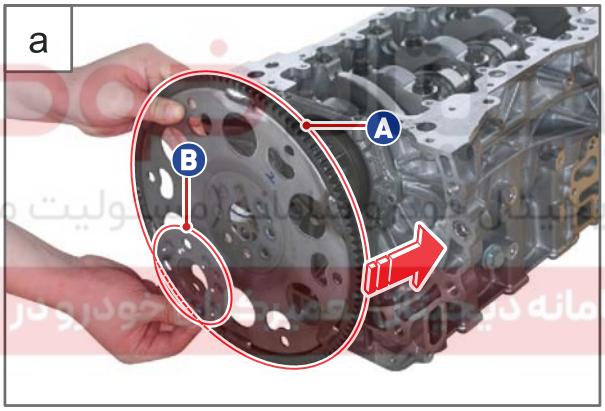
CAUTION

Do not work with a trigger ring near a magnetic tool or equipment, as the triggering can lose magnetic properties easily by an external magnetic field or scratches on the surface.

15. Install the drive plate (for a vehicle with A/T) or the flywheel (for a vehicle with M/T). Keep in mind that this procedure is based on the vehicle with A/T.

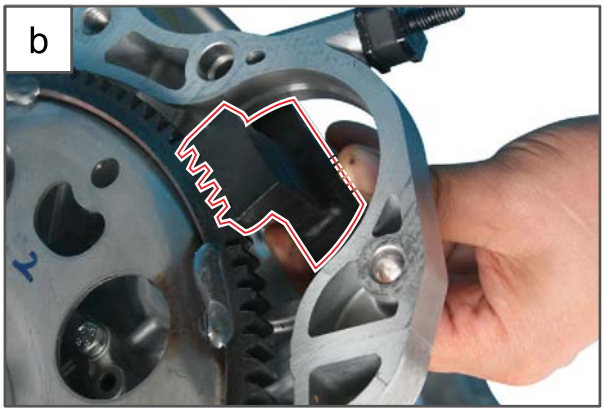
Drive plate and plate	Flywheel
	

a



a. Install the drive plate (A) and plate (B). (install the flywheel for a vehicle with M/T)

b



b. Secure the drive plate with the flywheel fixture.

Flywheel fixture


C

c. Torque tighten the 8 mounting bolts (T55) for the drive plate (for a vehicle with A/T) or the flywheel (for a vehicle with M/T) to the specified torque.

Sequence	Tightening torque
1	
2	

CAUTION

Tighten the mounting bolts in several stages diagonally.

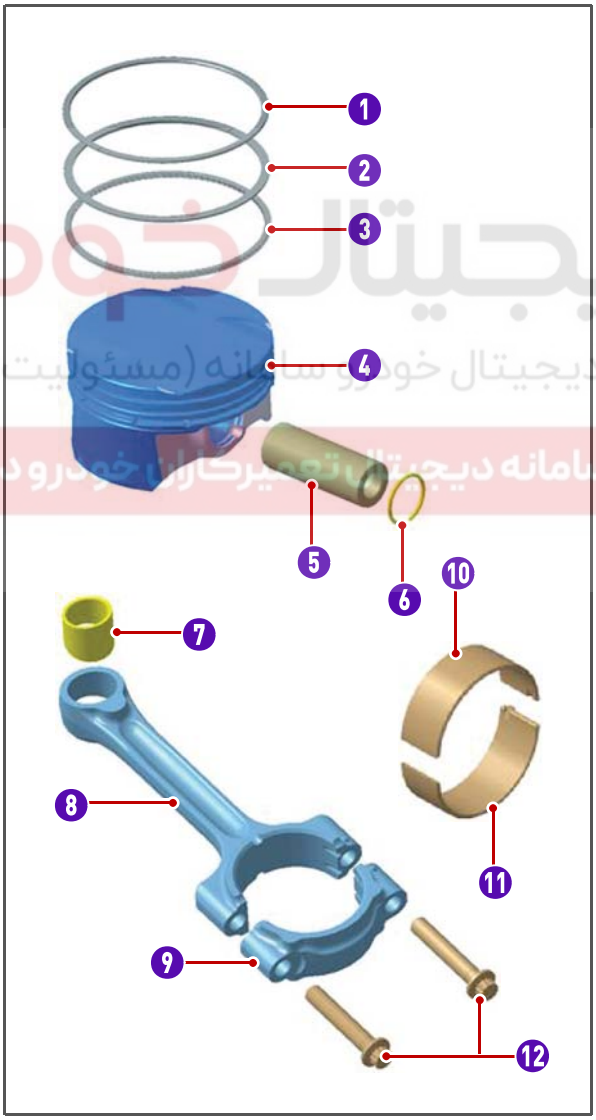
Angle tightening mounting bolt	
	
Paint mark on each bolt after the 1st torque	Angle tighten the bolts further in sequence at the

NOTE

Check the status and angle of the tightened bolt after the 2nd tightening.

16.Assemble the piston assembly.

16



No.	Component
1	Top ring
2	Second ring
3	Oil ring
4	Piston
5	Piston pin
6	Snap ring
7	Piston pin bush
8	Connecting rod
9	Connecting rod cap
10	Connecting rod upper bearing
11	Connecting rod lower bearing
12	Bolt

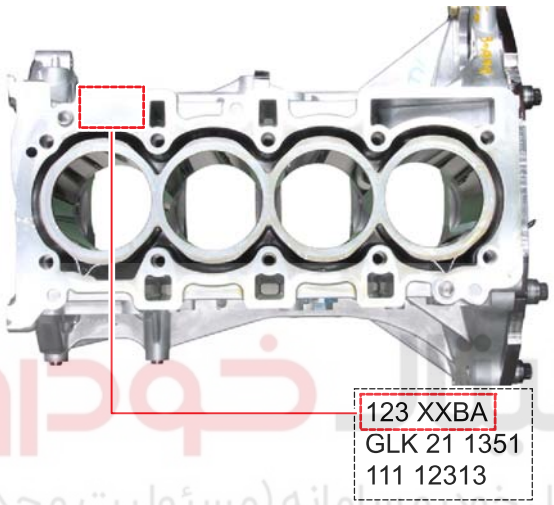
CAUTION

- Replace the piston ring, bearing and snap ring with new ones.
- Apply engine oil before inserting the piston pin.

Notice when assembling piston assembly

Selecting piston oversize

Select the piston which the mark on its top matches with the mark on the cylinder block (cylinder bore diameter).

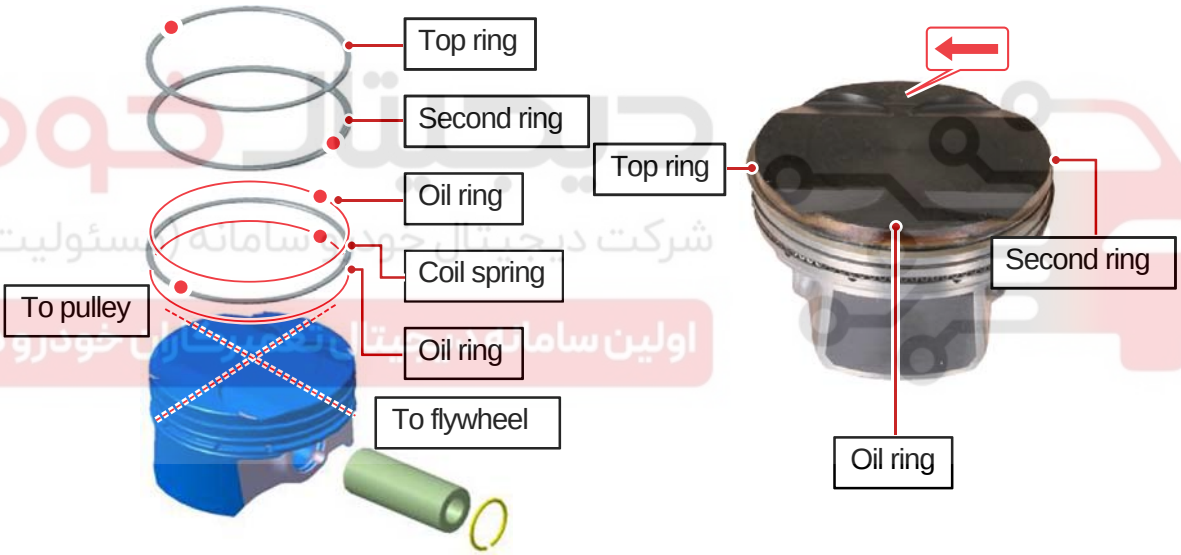
Mark on cylinder block	Mark on top of piston
	

Part number	Mark
A 173 037 01 01	A
A 173 037 02 01	X
A 173 037 03 01	B
A 173 037 04 01	+5
A 173 037 05 01	+10

Piston size / Cylinder bore dimension					Cylinder bore (Ø76.000/ + 0.018)					
					A		X		B	
					± 0.003		± 0.003		± 0.003	
					76.000	76.006	76.006	76.012	76.012	76.018
Piston (Ø75.976 ± 0.009)	A	± 0.003	75.967	75.973	0.027	0.039				
	X	± 0.004	75.972	75.980			0.026	0.040		
	B	± 0.003	75.979	75.985					0.027	0.039

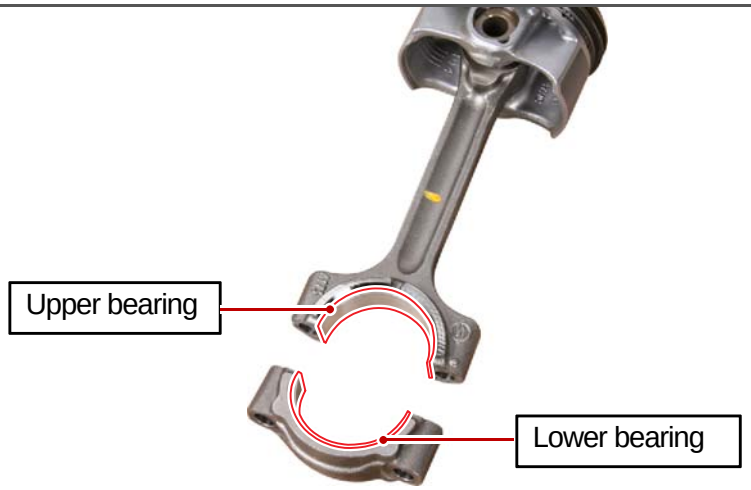
Piston ring installation and opening position

- Install the compression ring and oil ring to the piston using a special tool.



-
-
-

Selecting connecting rod bearing



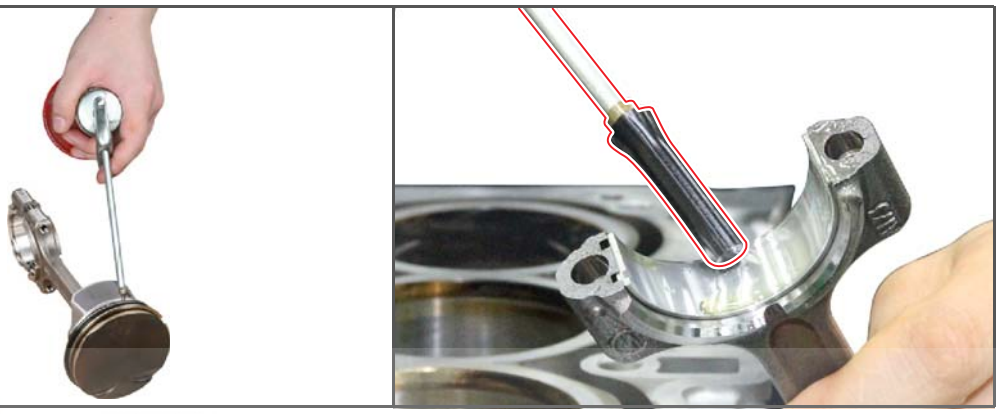
		Upper bearing	Lower bearing
Connecting rod bearing thickness		1.488 to 1.496	
Crankshaft pin journal bore			
Cone rod big end inner diameter			
Bearing clearance	Accumulated tolerance	0.008 to 0.051	
	Expansion when assembling	0.013 to 0.016	
	Total	0.021 to 0.067	

Modification basis	
Application basis	
Affected VIN	

17. Install the piston assembly to the engine and torque tighten the connecting rod cap mounting bolts for each cylinder to the specified torque.

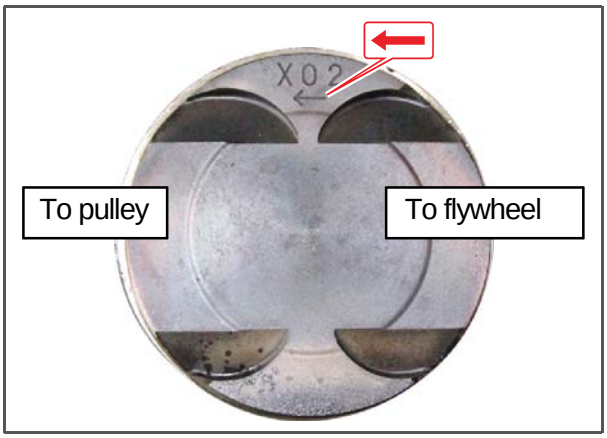
a. Apply engine oil to the piston surface, piston ring, and connecting rod upper bearing before installing.

a



CAUTION

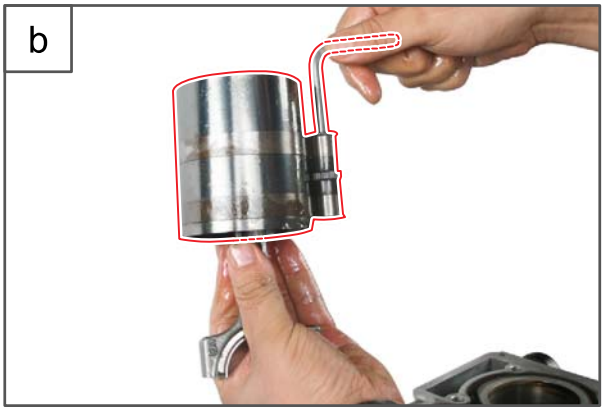
Check the paint marks on the piston assembly and connecting rod caps as shown in the picture. Do not mix up.



CAUTION

When installing the piston assembly to the engine, check the arrow on top of the piston.

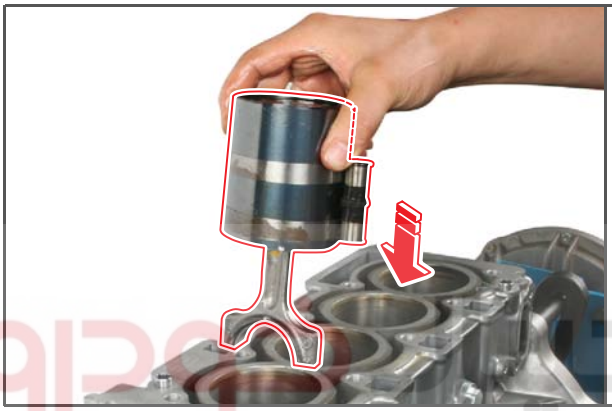
b

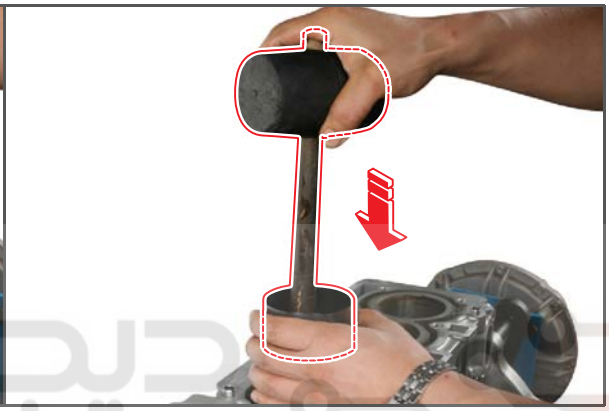


b. Install the 4 piston assembly using a piston compression tool.

NOTE

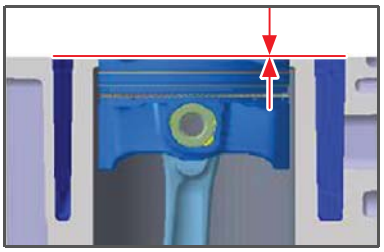
the No. 1 and 4 cylinders first, and then No. 2 and 3 cylinders.



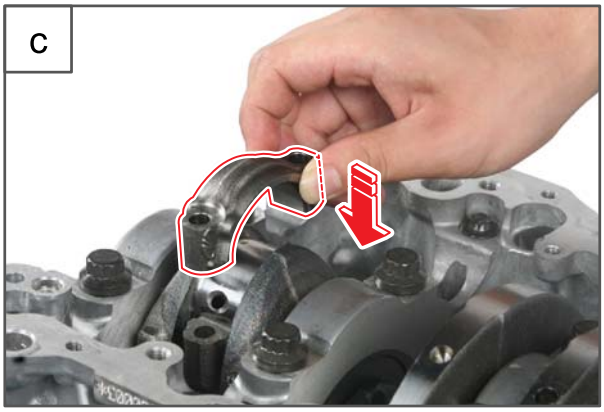


NOTE

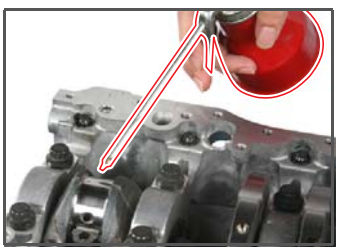
The top surface of the piston is about 0.338 mm lower than the surface of cylinder block because of crankshaft offset.



c

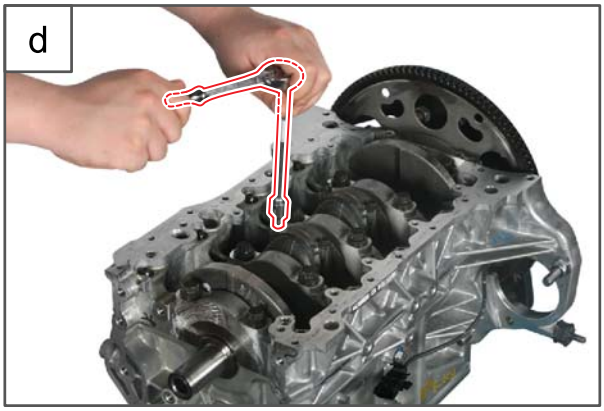


c. Install the connecting rod cap for each cylinder.



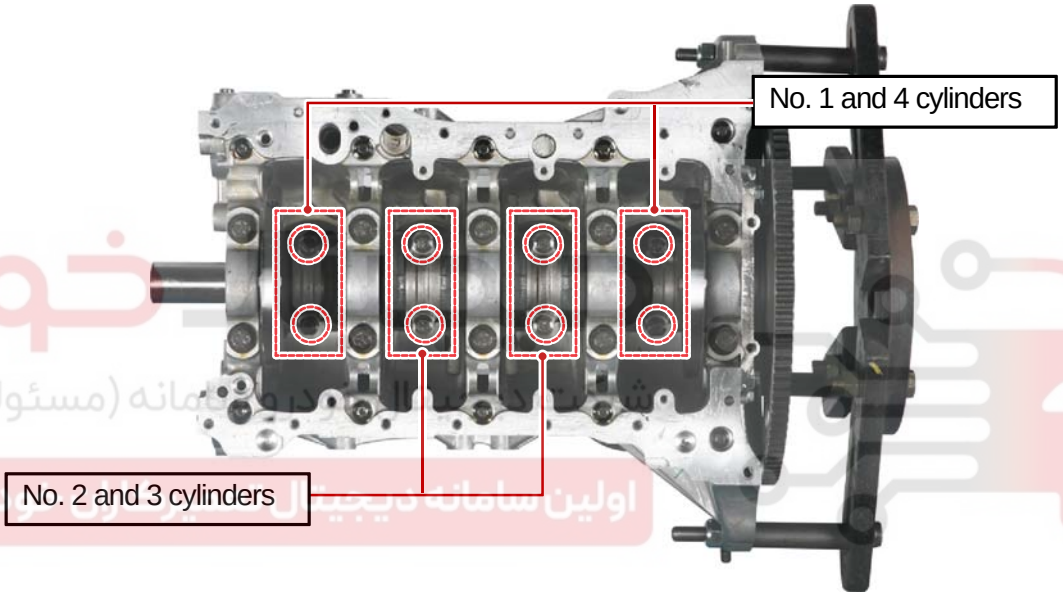
Apply engine oil to the crankshaft before installing.

Modification basis	
Application basis	
Affected VIN	

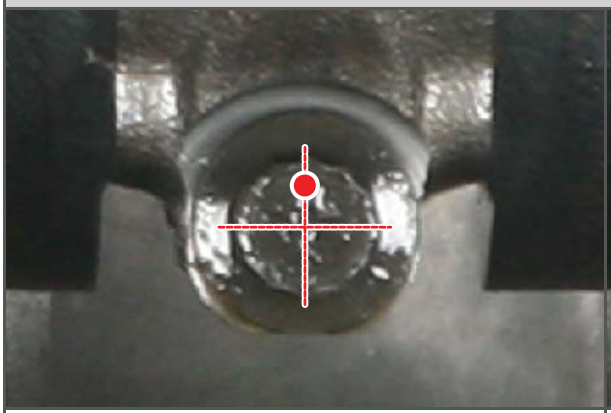


d. Torque tighten the 8 mounting bolts (8 mm, 12-point) for the connecting rod cap to the specified torque.

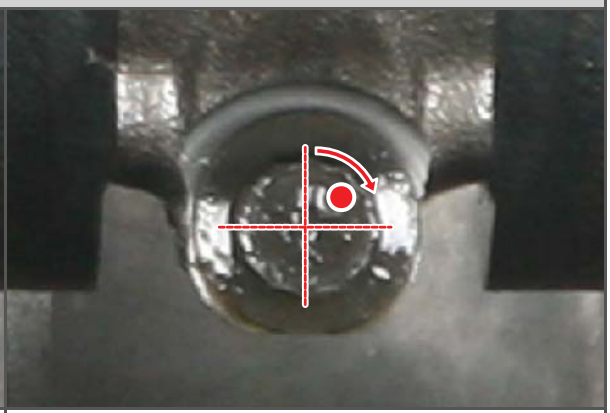
Sequence	Tightening torque
1	
2	



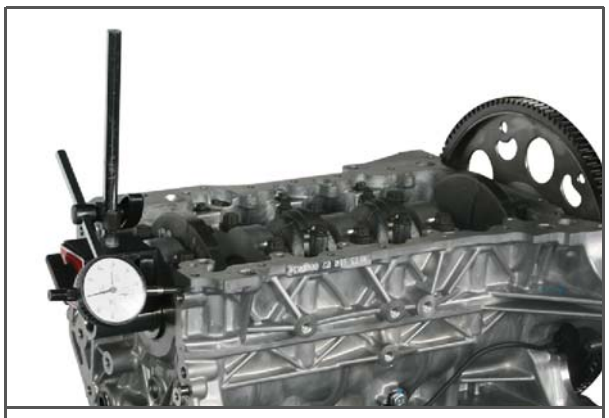
Angle tightening connecting rod cap mounting bolt



Paint mark on each bolt after the 1st torque



sequence at the time of 2nd tightening.

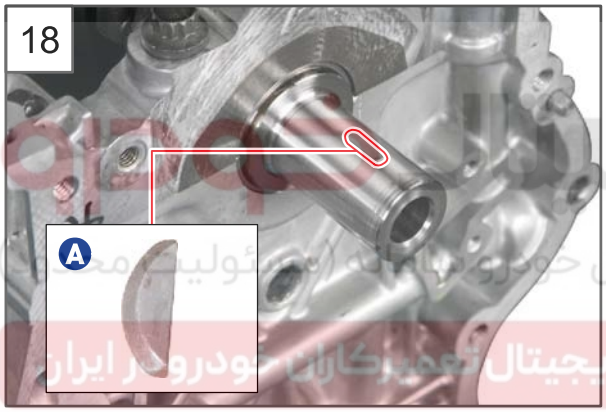


Location
Crankshaft: Magnetic base
Dial gauge: Front of cylinder block

NOTE

Check the pin journal end play of the crankshaft after installing the piston assembly.

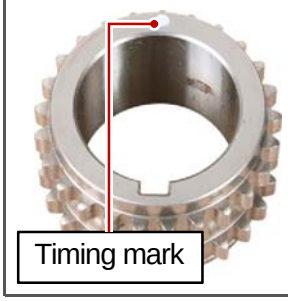
Specified value (mm)	0.100 to 0.300



18.Install the half-moon shaped key (A) and the crankshaft sprocket (B).

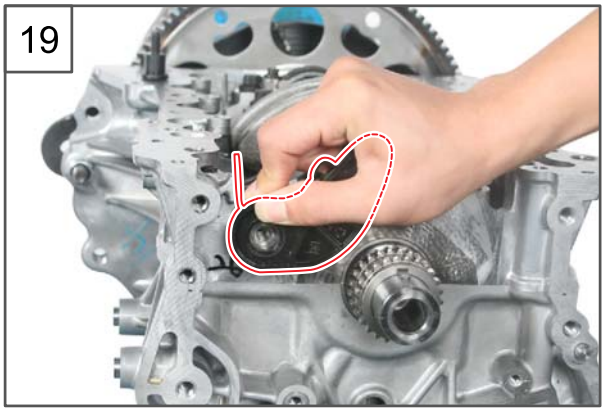
CAUTION

Install the crankshaft sprocket so that the timing mark on the crankshaft sprocket faces outward.

Front view	Rear view
 Timing mark	

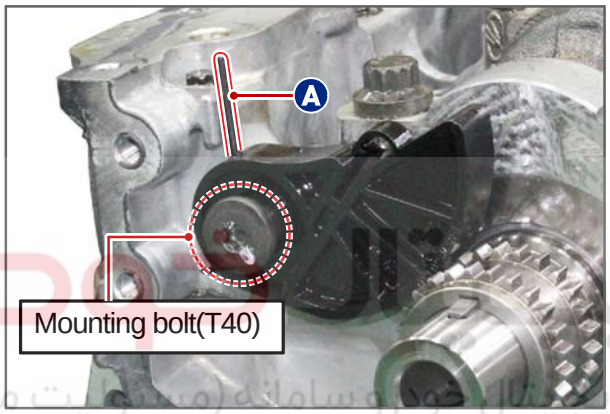
Modification basis	
Application basis	
Affected VIN	

19



19. Install the oil pump chain tensioner and torque tighten the mounting bolt (T40) to the specified torque.

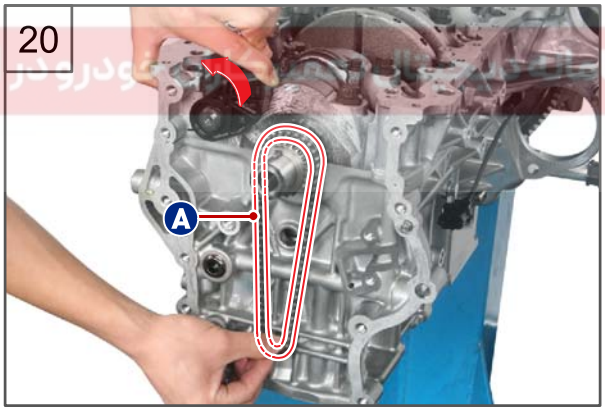
Tightening torque 25 ± 2.5 Nm



CAUTION

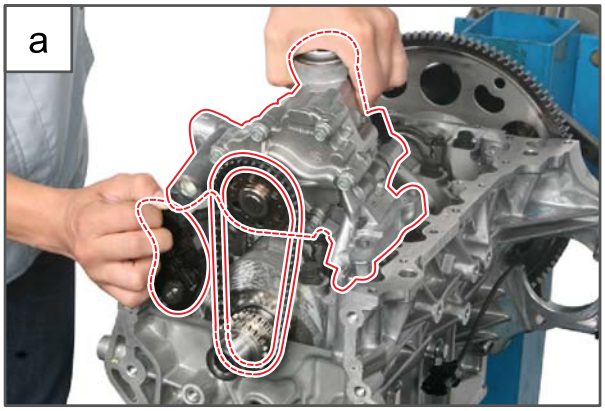
Make sure that the tension spring of the oil pump chain tensioner (A) is seated on the cylinder block securely as shown in the picture.
Install the chain tensioner first to facilitate the assembly.

20



20. Install the oil pump to the crankshaft sprocket after pulling the oil pump chain tensioner (A) in the direction of the arrow to make a room for working.

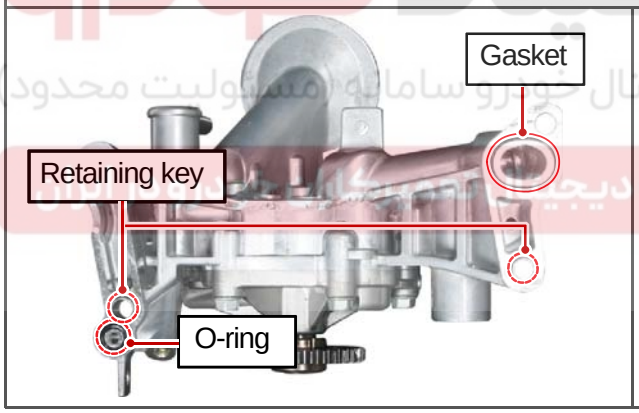
21.Install the oil pump to the engine and torque tighten the mounting bolt to the specified torque.

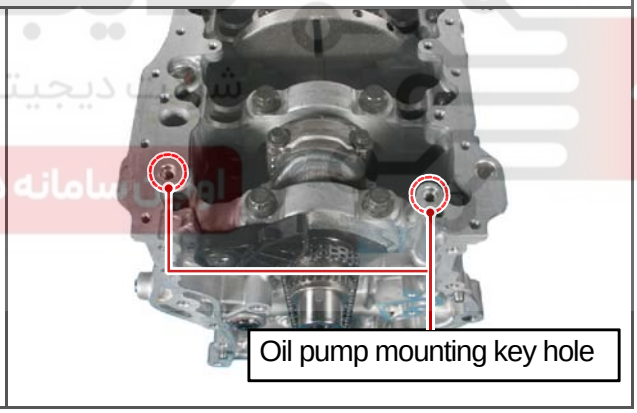


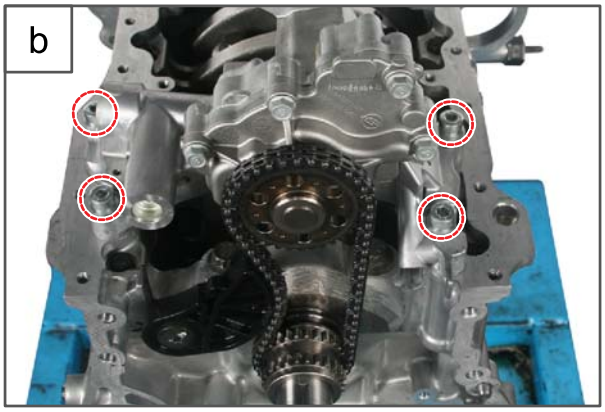
a. When installing the oil pump, make sure that the oil pump chain is seat on the oil pump sprocket as shown in the picture.

CAUTION

- Always replace the O-ring and gasket located on the rear side of the oil pump with new ones.
- Make sure that the retaining key on the rear side of the oil pump is fitted correctly to the retaining key hole on the surface of the cylinder block.



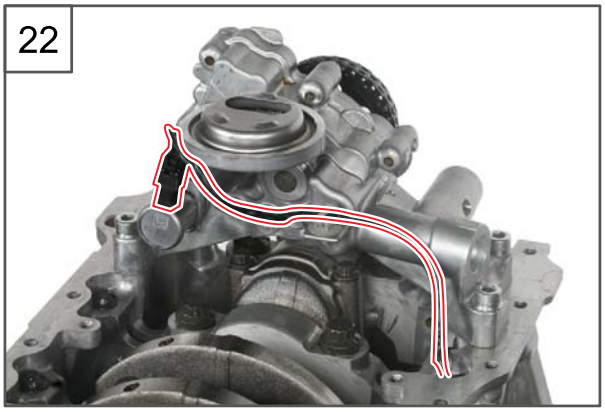




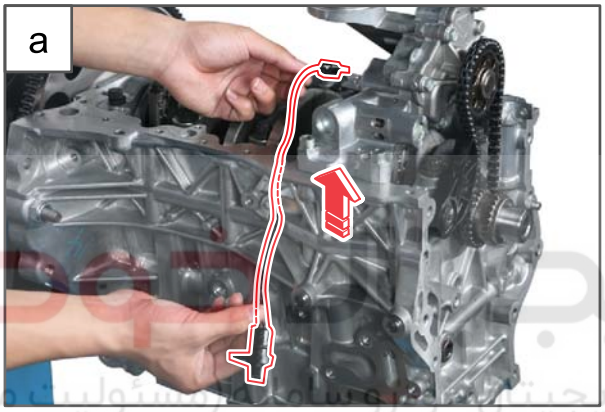
b. Torque tighten the 4 hexagon mounting bolts (6 mm) for the oil pump to the specified torque.

Tightening torque 25 ± 2.5 Nm

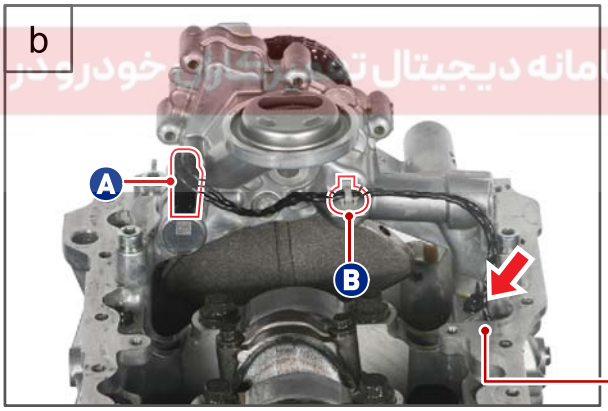
Modification basis	
Application basis	
Affected VIN	



22. Install the VOP extension wiring to the oil pump.

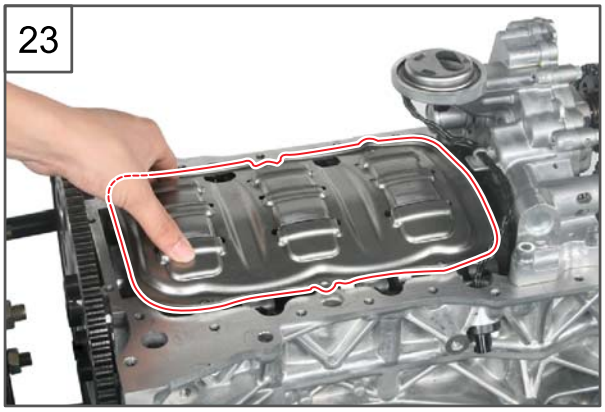


a. Insert the VOP extension wiring through the hole of the bed plate.



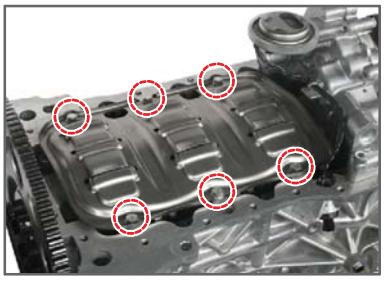
b. Install the VOP solenoid valve connector (A) and wining retaining key (B) on the rear side of the oil pump and torque tighten the hexagon mounting bolt (C, 5 mm) on the bed plate to the specified torque.

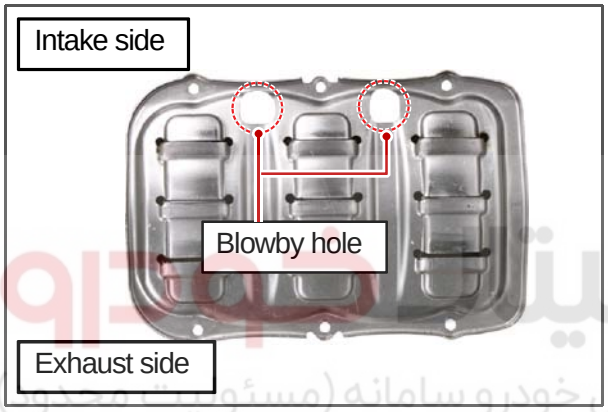
Tightening torque 10 ± 1.0 Nm



23.Install the baffle plate and torque tighten the 6 mounting bolts (10 mm) to the specified torque.

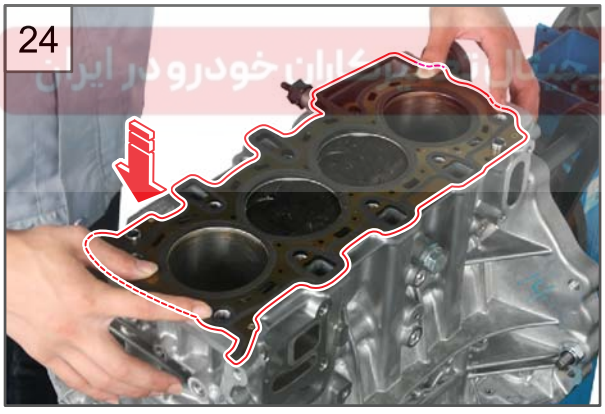
Tightening torque 10 ± 1.0 Nm





CAUTION

Make sure that the blowby holes of the baffle plate face the intake side.



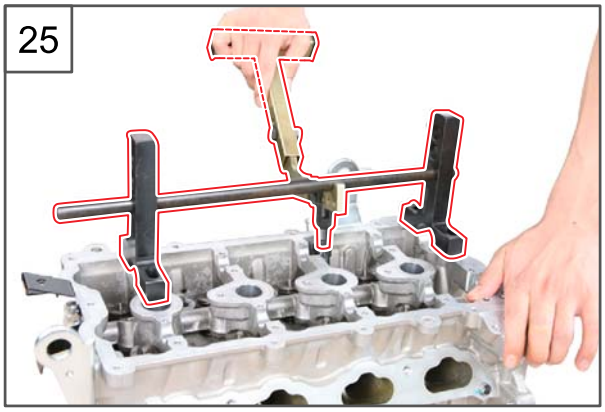
24.Install the cylinder head gasket on the top surface of the cylinder block.

Replace the cylinder head gasket with a new one.

CAUTION

Remove the foreign materials and the gasket residual on the top surface of the cylinder block and cylinder head before installing the cylinder head gasket.

25

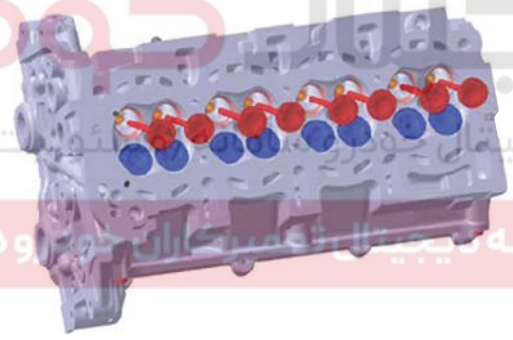


25.Install the intake and exhaust valves to the cylinder head with a special tool.

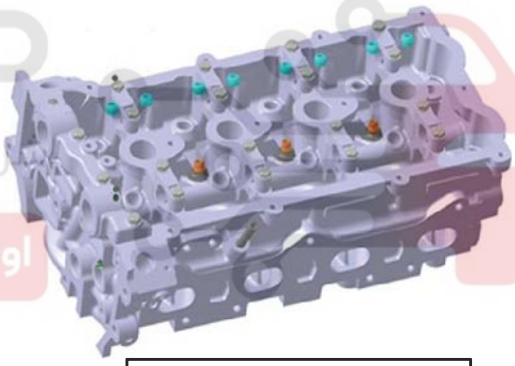
Tool for installing/removing intake & exhaust valves

Y9922 082B
W9911 0230A

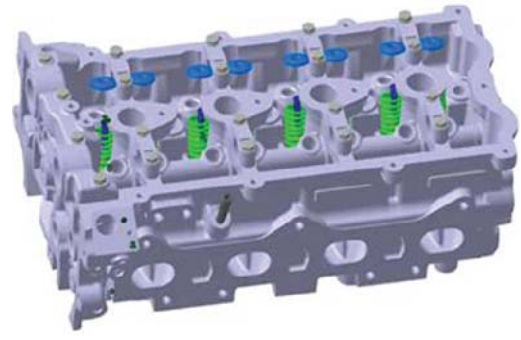
Intake & exhaust valves installation sequence



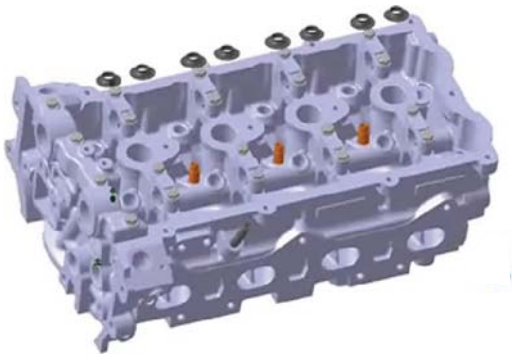
Intake & exhaust valves: 8 off, Each



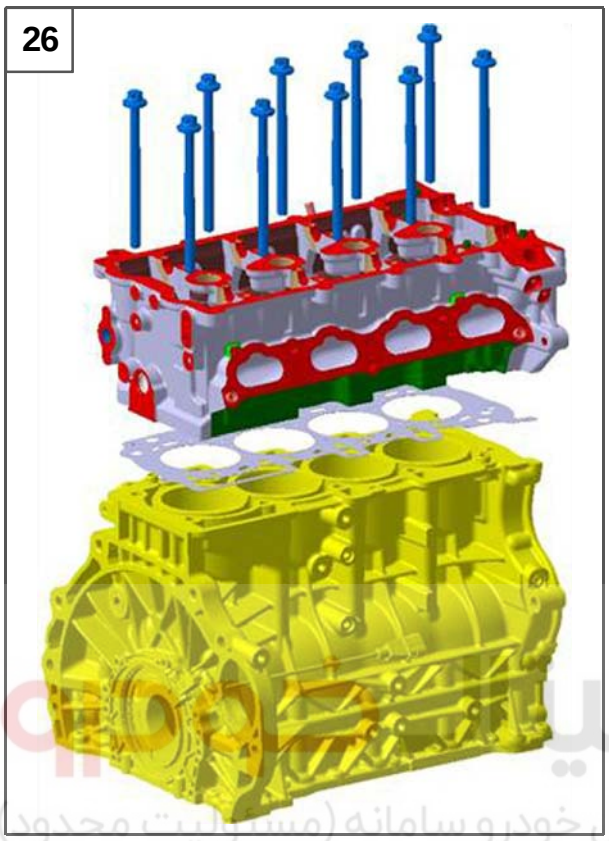
Valve stem seals: 16 off



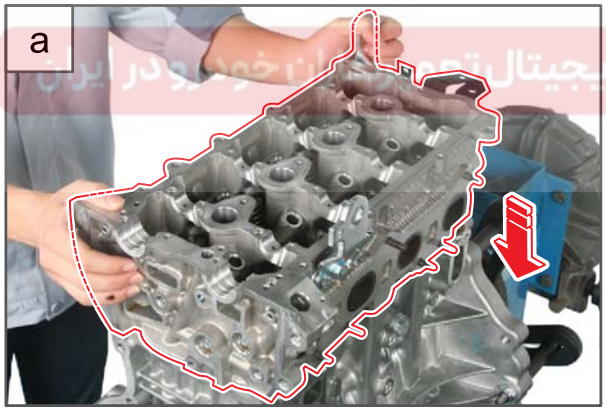
Upper retainers and valves spring: 16 off, Each



Lower retainers: 16 off



26.Install the cylinder head and torque tighten the mounting bolts to the specified torque.

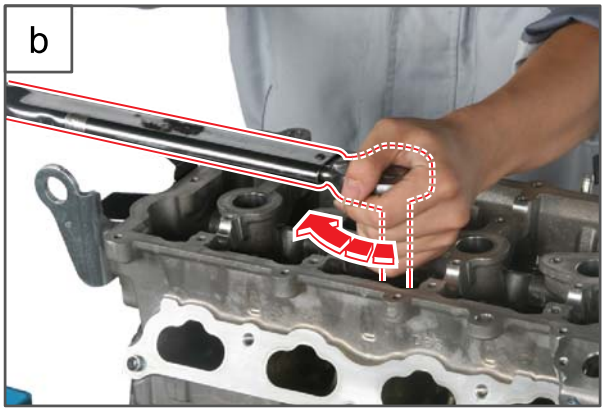


a. Install the cylinder head to the cylinder block.

CAUTION

Make sure that the No. 1 and No. 4 pistons face TDC before installing the cylinder head.

Modification basis	
Application basis	
Affected VIN	

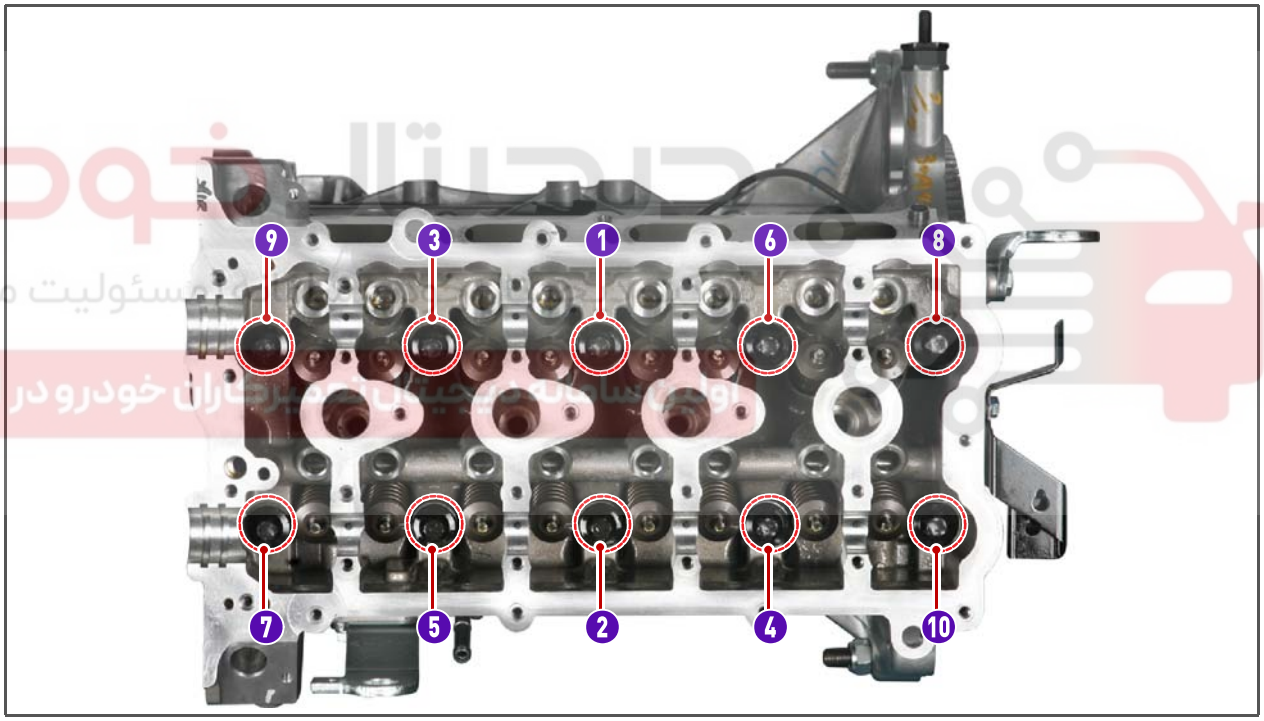


b. Torque tighten the 10 mounting bolts (E16) for the cylinder head to the specified torque.

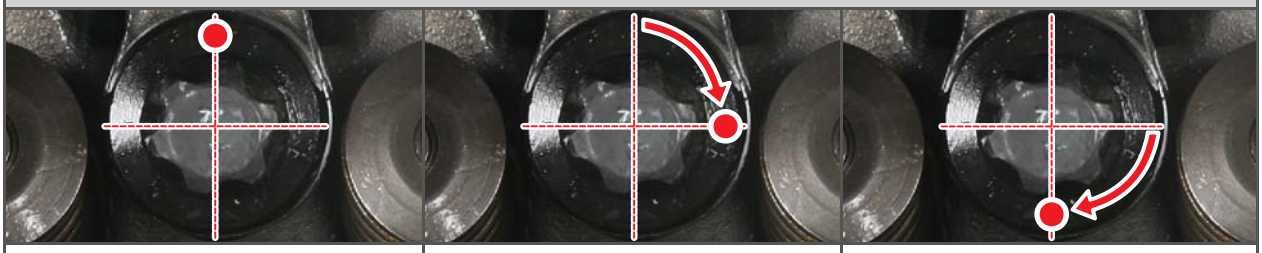
Sequence	Tightening torque
1	
2	

CAUTION

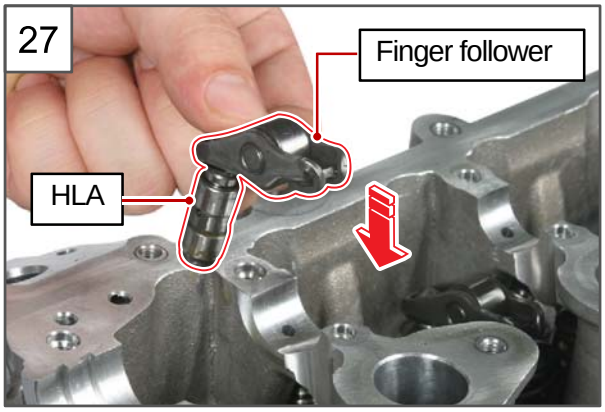
Tighten the cylinder head mounting bolts from the ones in the center to the outer ones diagonally.



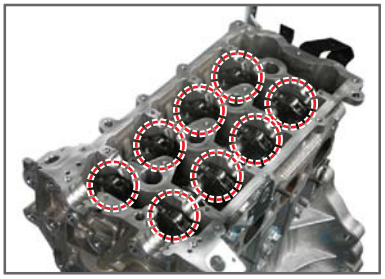
Tightening process for cylinder head bolts

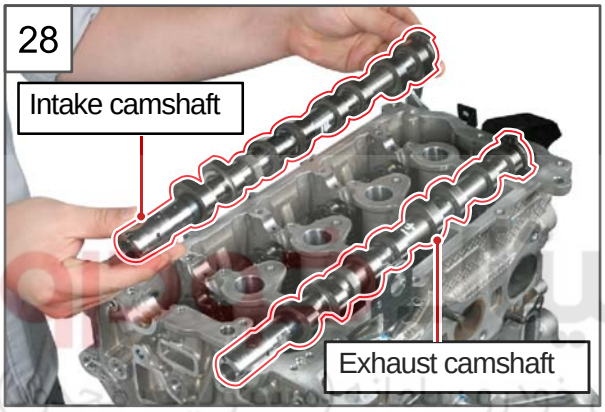


Paint mark on each bolt after the Nm).		



27.Install the 8 HLAs with finger follower to the cylinder head.



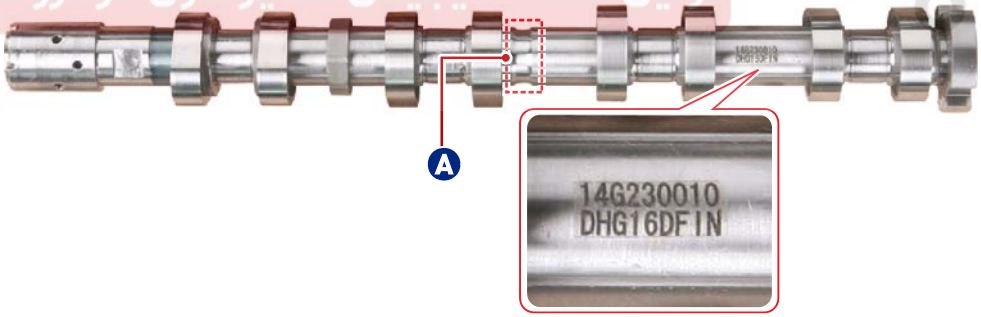


28.Install the intake and exhaust camshafts.

CAUTION

The intake and exhaust camshafts are identified by the texts stamped on each camshaft (intake side: IN, exhaust side: EX) and the recessed area (A) on the intake camshaft.

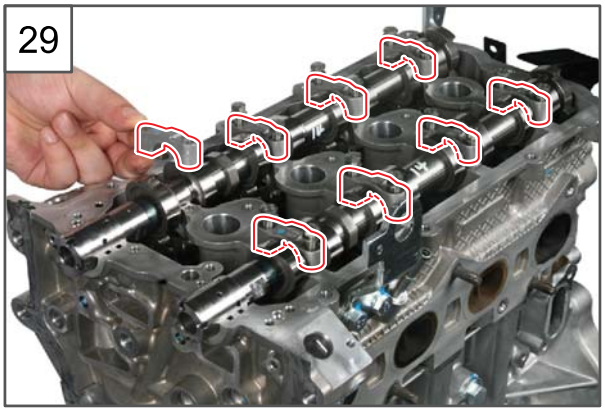
Intake camshaft



Exhaust camshaft

Modification basis	
Application basis	
Affected VIN	

29



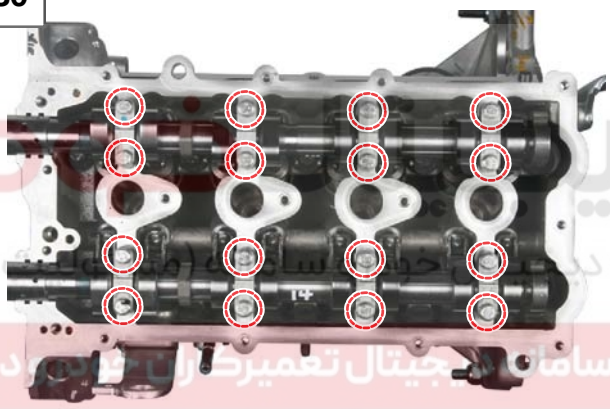
29.Install the 8 camshaft bearing caps.

NOTE

Apply oil to the camshaft before installing the camshaft bearing caps.

30.Torque tighten the 16 mounting bolts (10 mm) for the camshaft bearing caps.

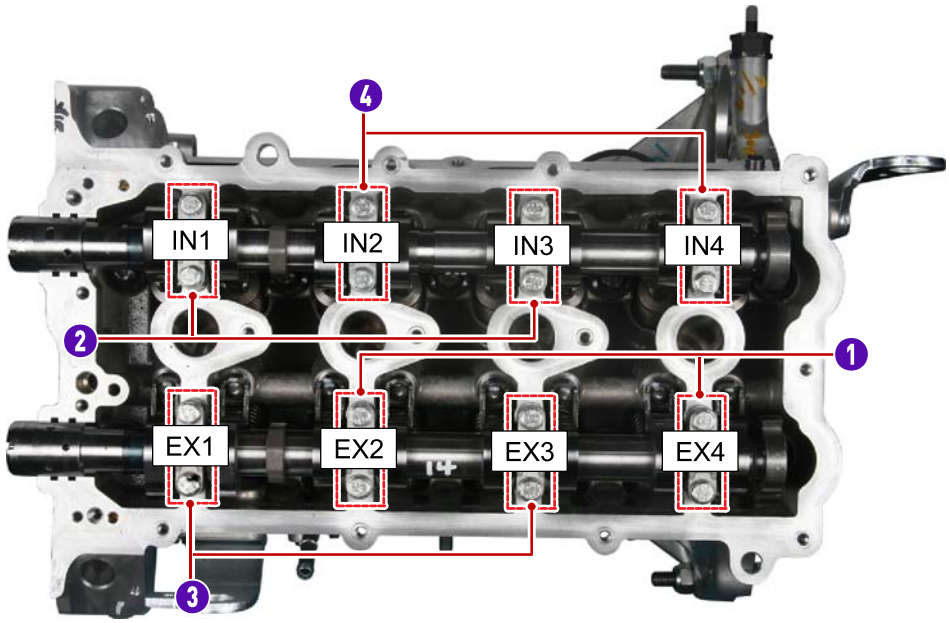
30

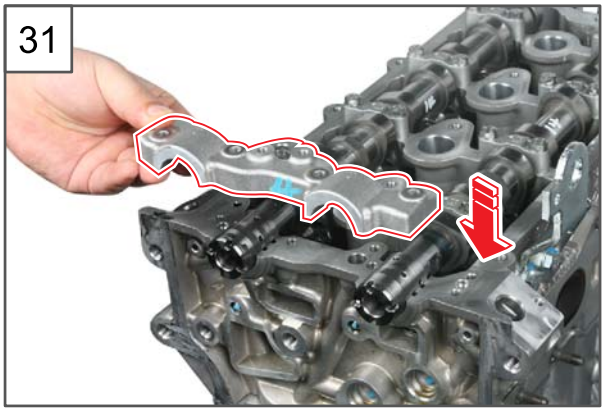


NOTE

Tighten the camshaft cap mounting bolts slowly in two or more stages according to the specific sequence stated below.
(1) Exhaust cams: EX2, EX4
(2) Intake cams: IN1, IN3
(3) Exhaust cams: EX1, EX3
(4) Intake cams: IN2, IN4

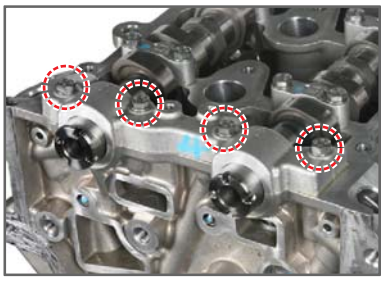
Tightening torque 10 ± 1.0 Nm

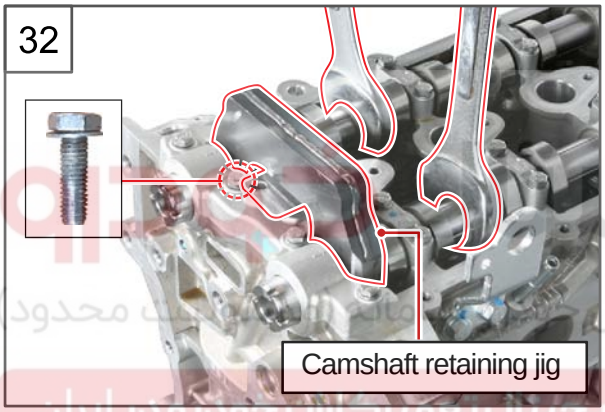




31.Install the camshaft front bearing cap and torque tighten the 4 mounting bolts (10 mm) to the specified torque.

Tightening torque 10 ± 1.0 N





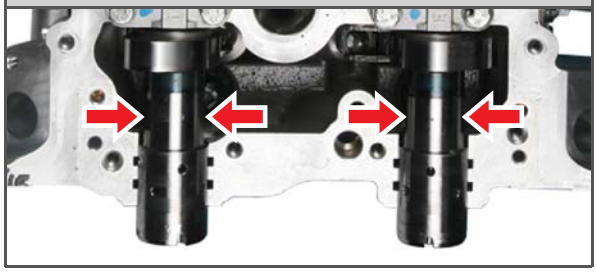
32.Secure the intake and exhaust camshafts so that the marks on these camshafts face 12 o'clock position by fitting 30 mm octagon spanners on the octagon seating surfaces. Install a camshaft retaining jig and then screw in a mounting bolt (10 mm).

NOTE

- Fit the camshaft retaining jig when the engine timing is positioned at OT.
- The camshaft retaining jig holds the intake and exhaust camshafts together and prevents rotation by cam lift. This makes the installation of timing chain easier. This jig also can be sued to remove and tighten the mounting bolts for the camshaft sprockets.

Intake & exhaust camshaft marks

Camshaft retaining jig mounting point



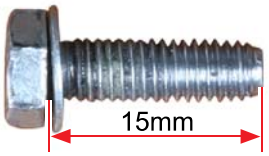
Modification basis	
Application basis	
Affected VIN	

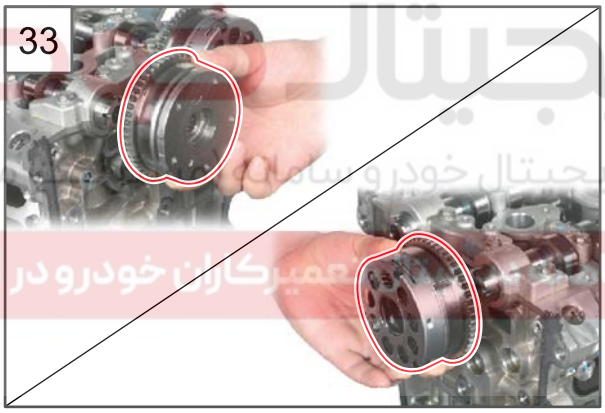
NOTE

Fit the camshaft retaining jig with an about 15 mm long bolt.

Camshaft retaining jig

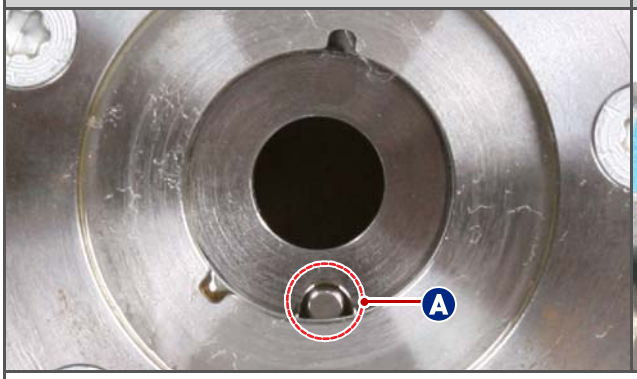
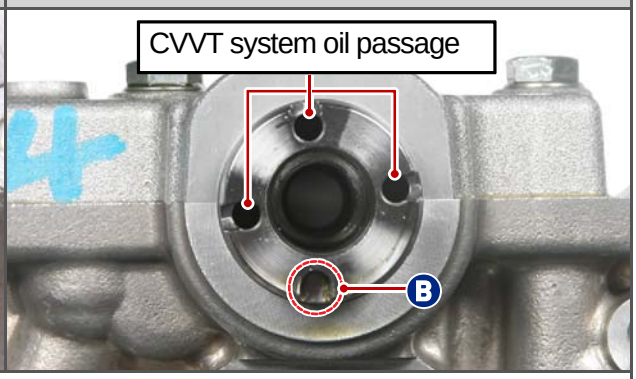
Camshaft retaining jig bolt





33. Install the intake and exhaust camshaft sprockets to the camshaft. Make sure that the retaining key of each camshaft sprocket is seated correctly on the retaining key hole of the camshaft.

Notes on camshaft sprocket installation

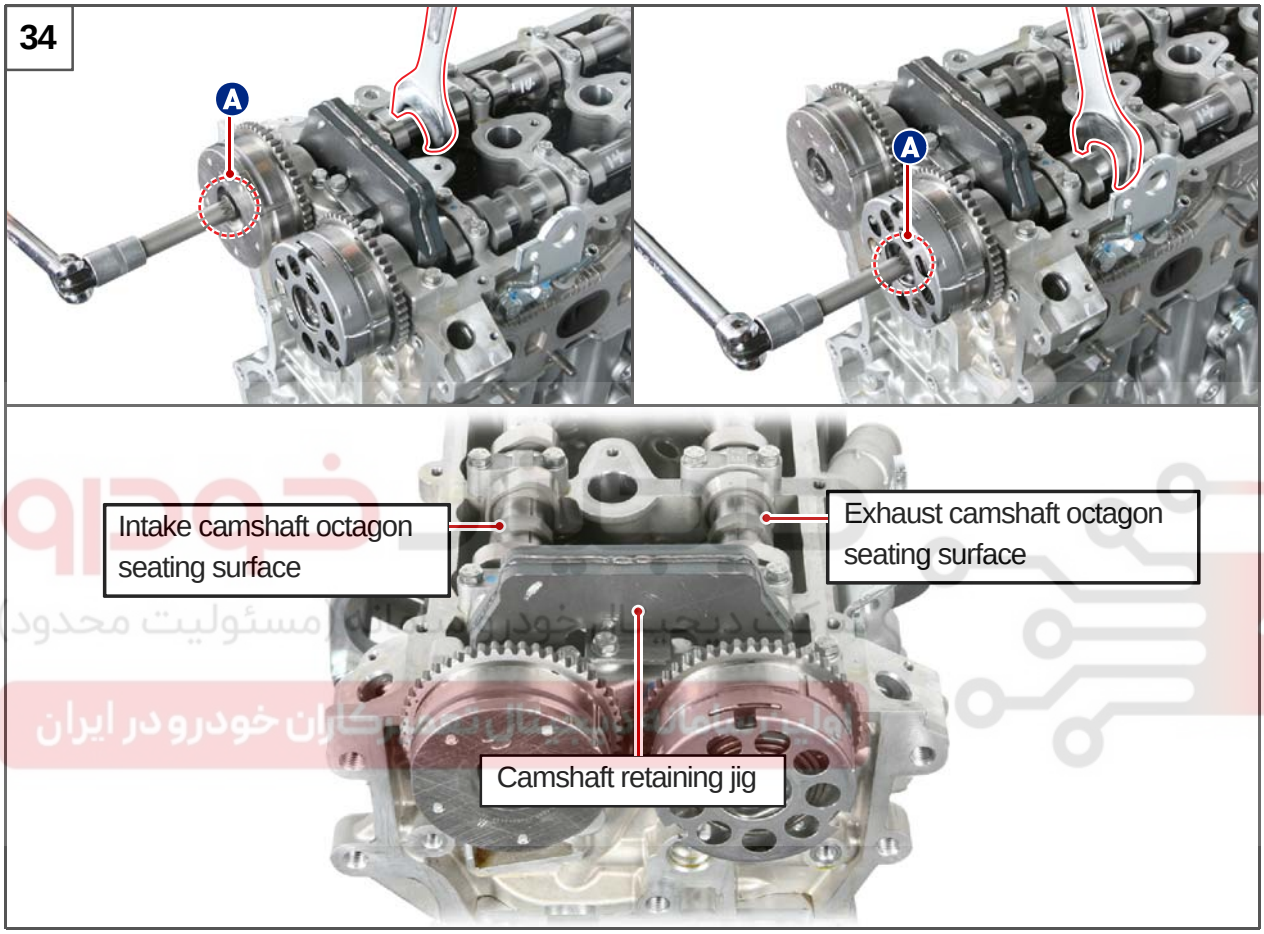
Camshaft sprocket	Camshaft
	

The retaining key (A) on the rear side of the camshaft sprocket should be correctly seated on the retaining key hole (B) of the camshaft. It must not be mistaken for oil passage of the CVVT system.

Modification basis	
Application basis	
Affected VIN	

34.Fit 30 mm spanners on the octagon seating surfaces of the intake and exhaust camshafts and then torque tighten the 2 sprocket mounting bolts (A, M14) to the specified torque. This procedure must be done with the camshaft retaining jig installed.

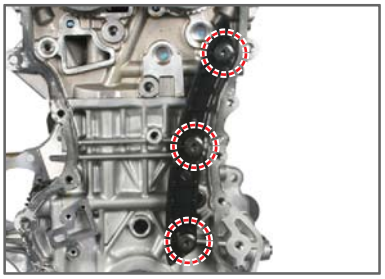
Tightening torque 110 ± 10 Nm



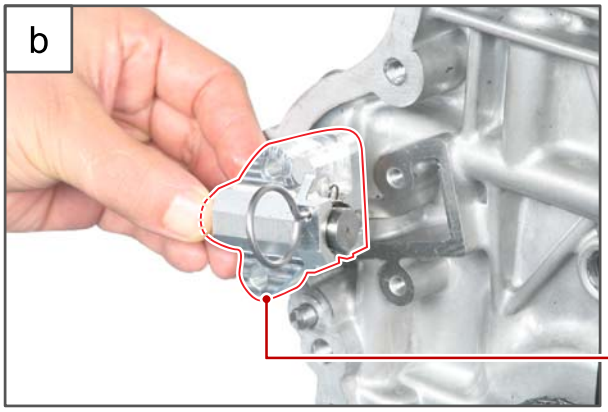
35.Install the chain drive system.

a. Install the guide rail and torque tighten the 3 mounting bolts (T40) to the specified torque.

Tightening torque 25 ± 2.5 Nm

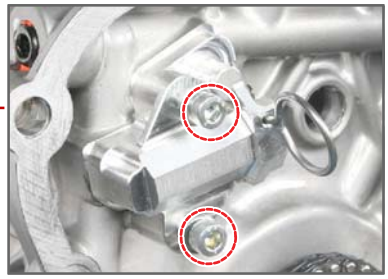


Modification basis	
Application basis	
Affected VIN	

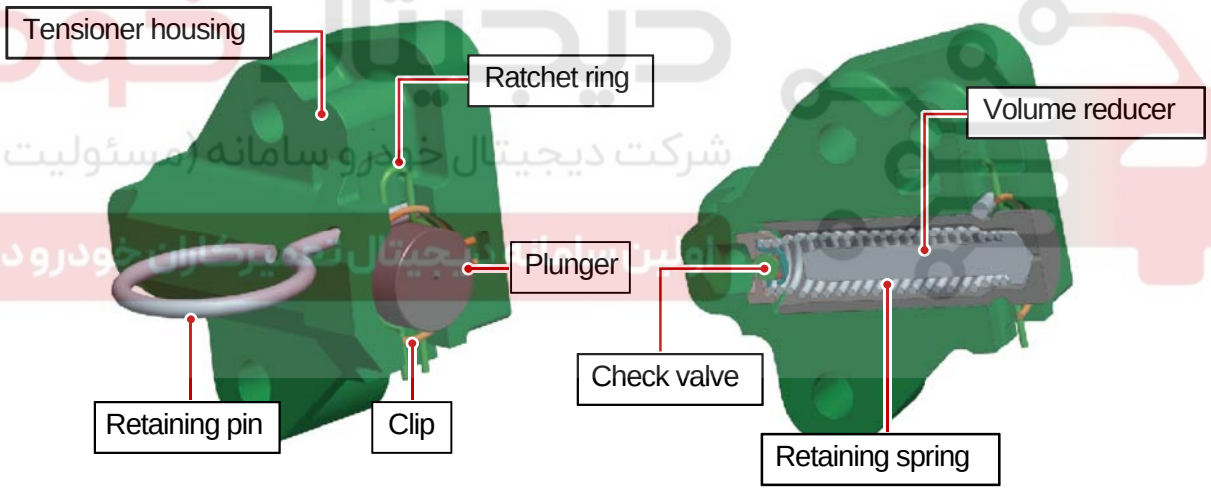


b. Install the chain tensioner (refer to "Resetting chain tensioner") and torque tighten the 2 hexagon mounting bolts (5 mm) to the specified torque.

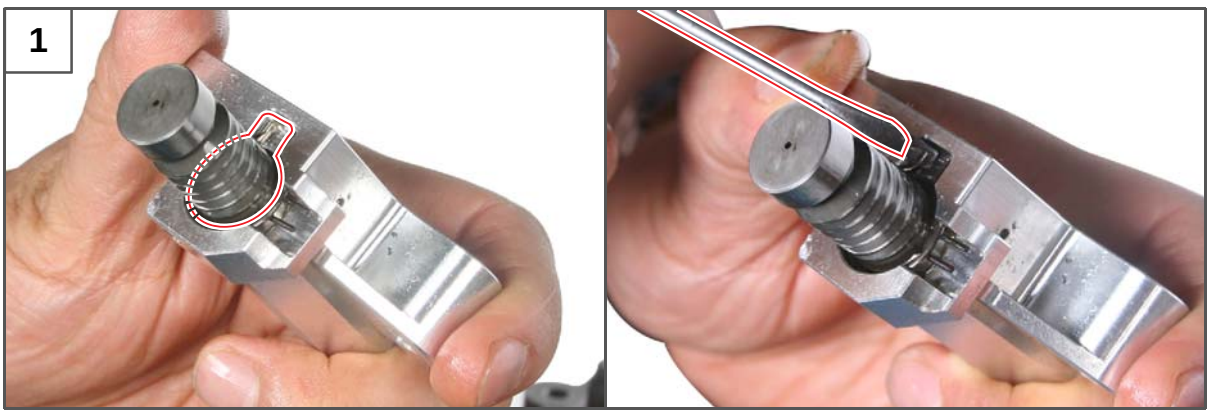
Tightening torque 10 ± 1.0 Nm

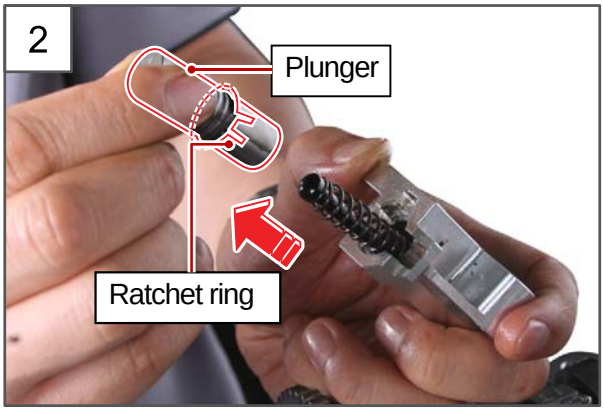


Resetting chain tensioner (Compressing plunger)



1. Remove the clip from the chain tensioner.



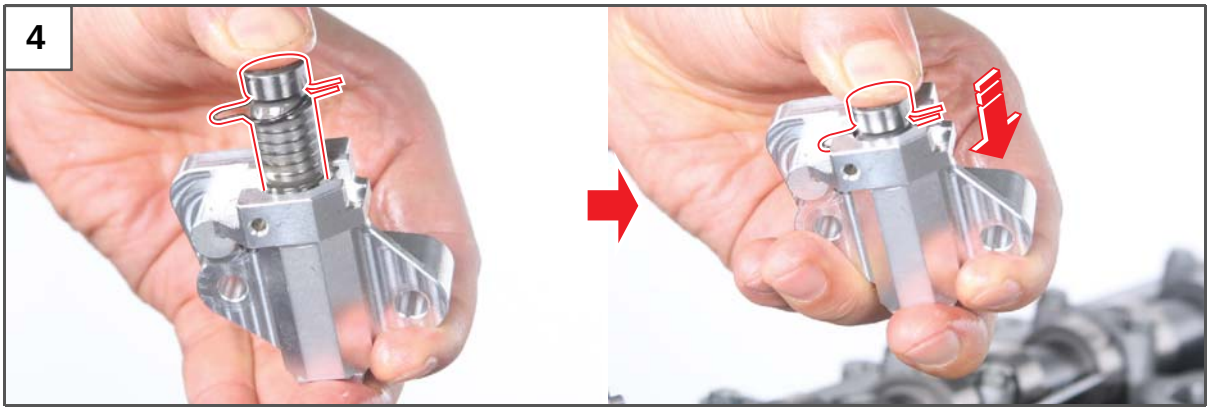


2. Remove the plunger and ratchet ring.

CAUTION
When resetting the chain tensioner, keep the inside of tensioner clean.

3. Expend the ratchet ring on the plunger to move it to the top groove as shown in the picture.

4. Insert the plunger in the tensioner housing and fully press it into position by hand.



Modification basis	
Application basis	
Affected VIN	

5. Insert the tensioner retaining pin into the retaining pin hole on the tensioner housing.

NOTE

Make sure that the tensioner retaining pin is inserted so that it is positioned inside the ratchet ring.

6. Fit the clip on the chain tensioner.

c. Fit the timing chain in the following order: (a) aligning the mark on the chain with the mark on the crankshaft sprocket; (b) letting the chain rest against the guide rail; and (c) aligning the marks with the mark on the exhaust camshaft sprocket and then the mark on intake camshaft sprocket. This procedure must be done with the camshaft retaining jig installed.

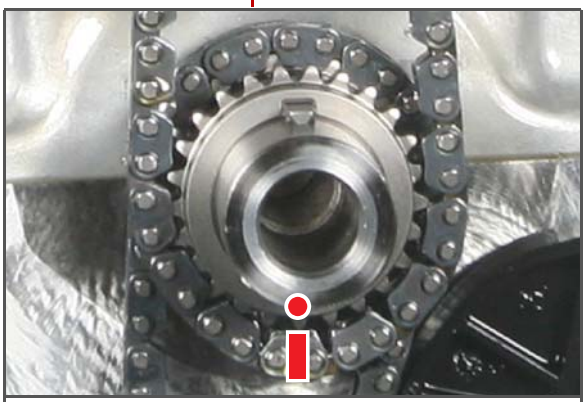
C

Align the mark on the timing chain with the mark on the exhaust camshaft sprocket.

Align the mark on the timing chain with the mark on the intake camshaft sprocket.

CAUTION

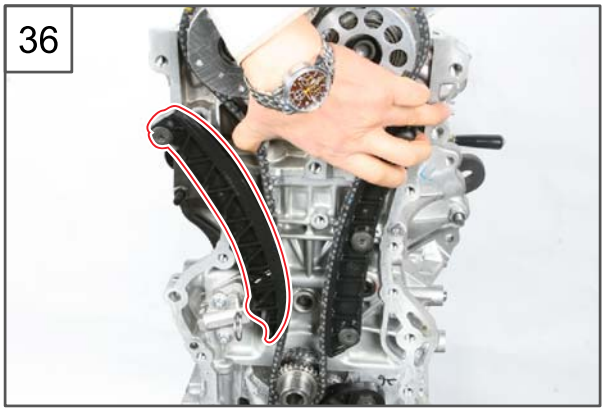
Make sure that the chain on the crankshaft sprocket is not displaced.



Align the mark on the crankshaft sprocket with the mark on the timing chain.

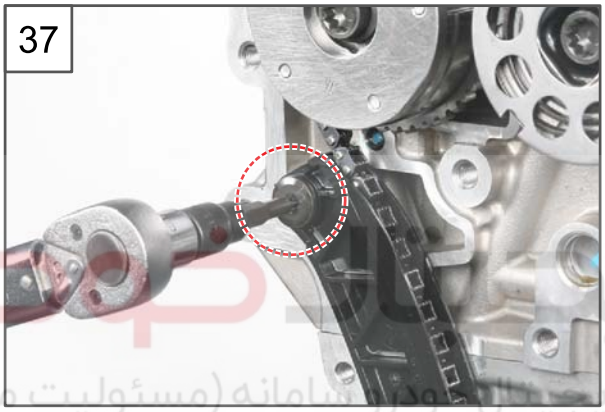
Modification basis	
Application basis	
Affected VIN	

36



36.Install the tensioner rail by pulling the timing chain with one hand.

37

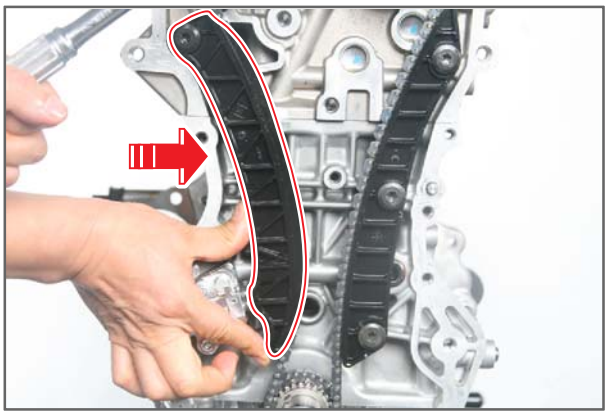


37.Torque tighten the mounting bolt (T40) for the tensioner rail to the specified torque.

Tightening torque 25 ± 2.5 Nm

38

38.Remove the chain tensioner retaining pin and push the tensioner rail.

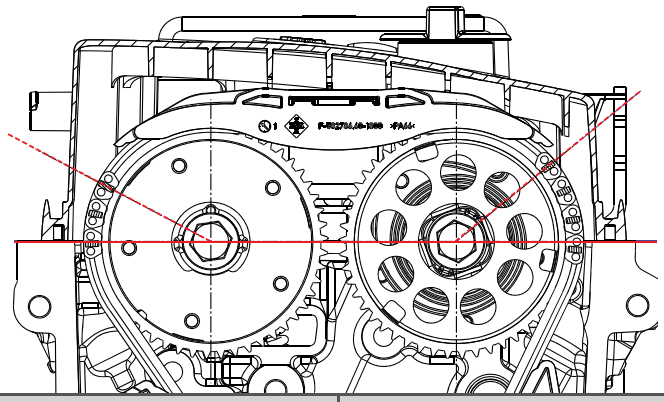


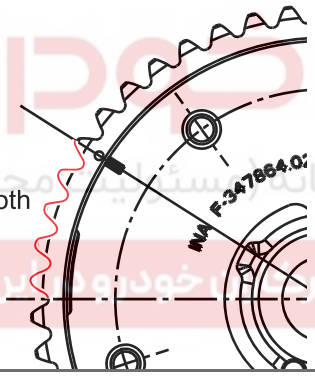
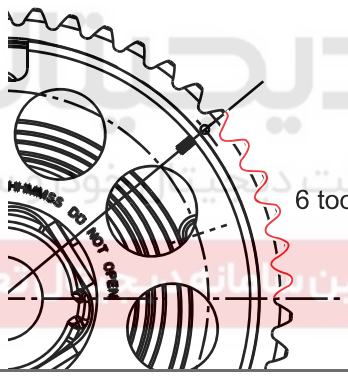
CAUTION

If the oil in the chain tensioner is not enough, the plunger return will not work smoothly. Therefore, push the tensioner rail in the direction of the arrow shown in the picture so that the plunger is protruded sufficiently.

i. Check the engine timing mark.

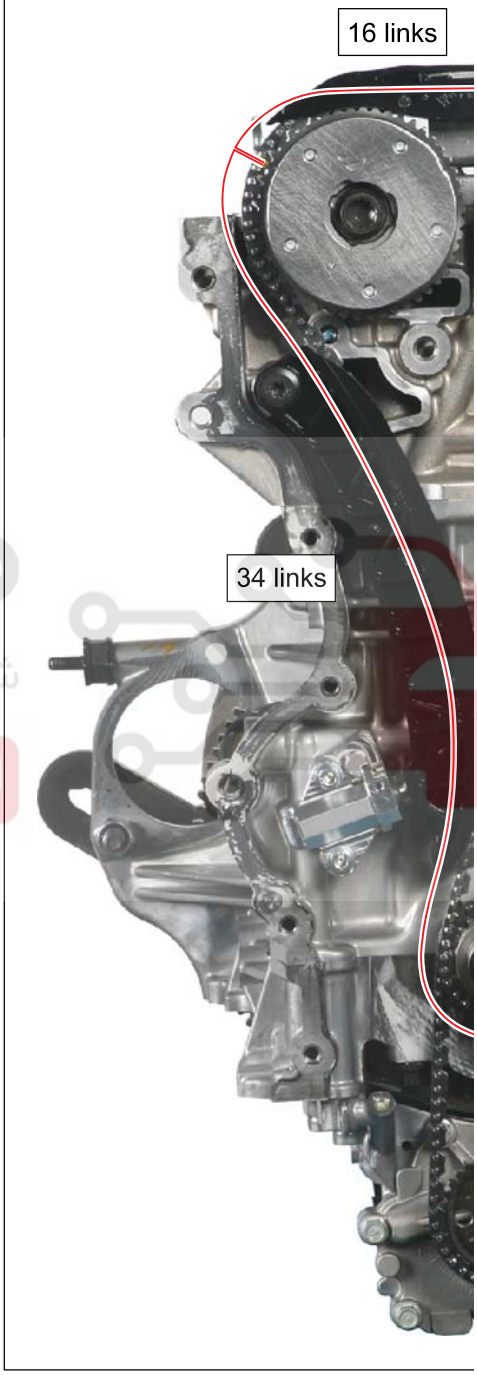
Intake & exhaust camshaft sprocket marks



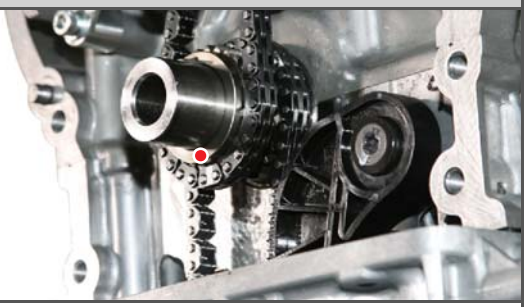
Intake camshaft sprocket mark	Exhaust camshaft sprocket mark
	

Number of chain links from the top surface of the cylinder head:
Intake side: 5 teeth/ Exhaust side: 6 teeth

Number of chain links



Crankshaft sprocket mark

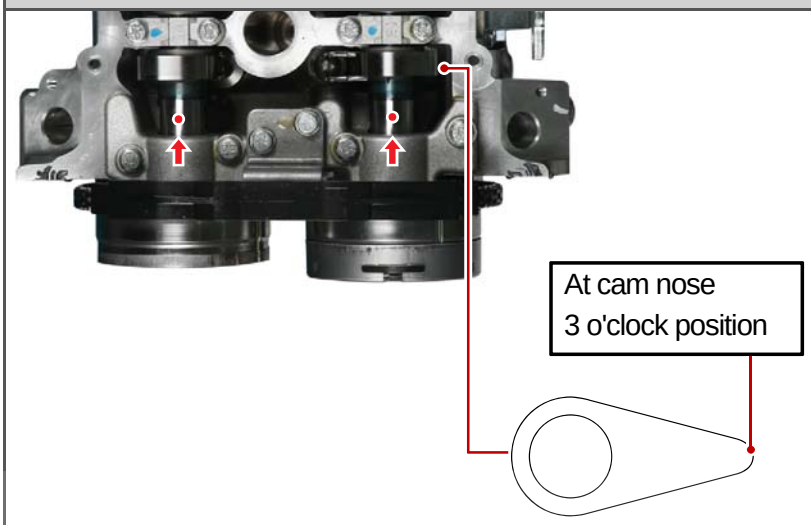


At 6 o'clock position

Modification basis	
Application basis	
Affected VIN	

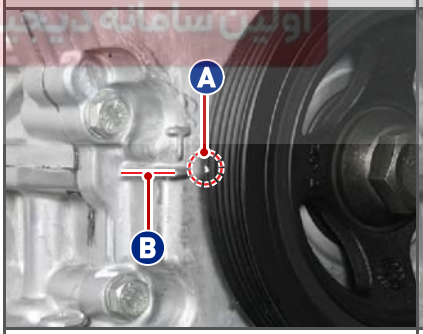
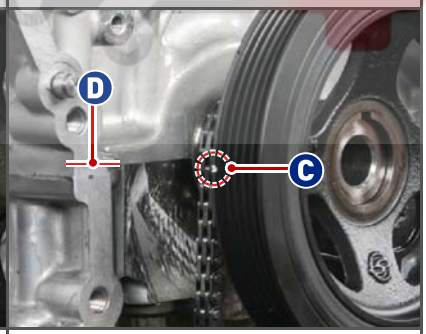
for each timing mark

Intake & exhaust camshaft marks



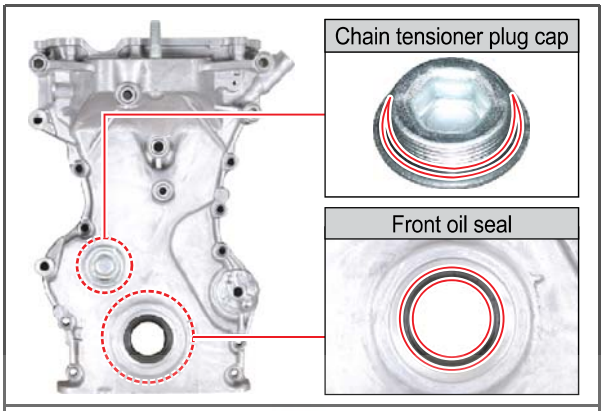
Align the arrow on the camshaft front bearing cap with the mark on the camshaft.

Align timing using crankshaft pulley

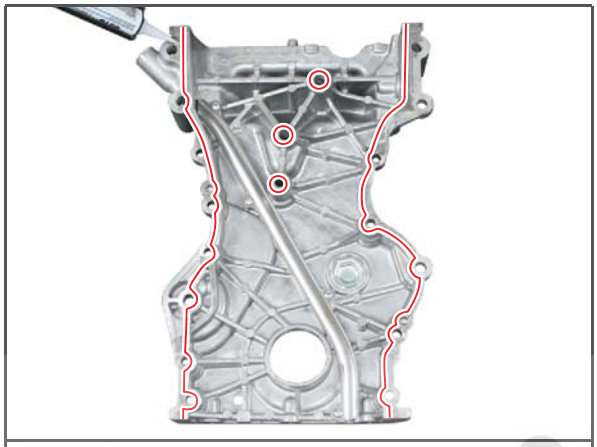
With timing gear case	Without timing gear case
	
Align the mark (A) on the crankshaft pulley with the mark (B) on the timing gear case cover.	Align the mark (C) on the crankshaft pulley with the mating surface (D) of the cylinder block and the bed plate.

39.Install the timing gear case and torque tighten the mounting bolts to the specified torque.

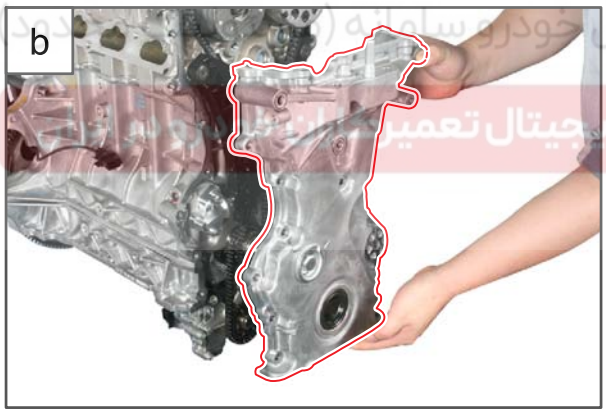
a. Replace the chain tensioner plug cap with O-ring (A) and front oil seal (B) with new ones. Apply sealant to the rear side of the timing gear case cover (sealant part number: 661 989 56 A0).



Apply a light coat of grease to the inner surface of the crankshaft front oil seal (B).



Apply sealant to the 3 holes in the center.

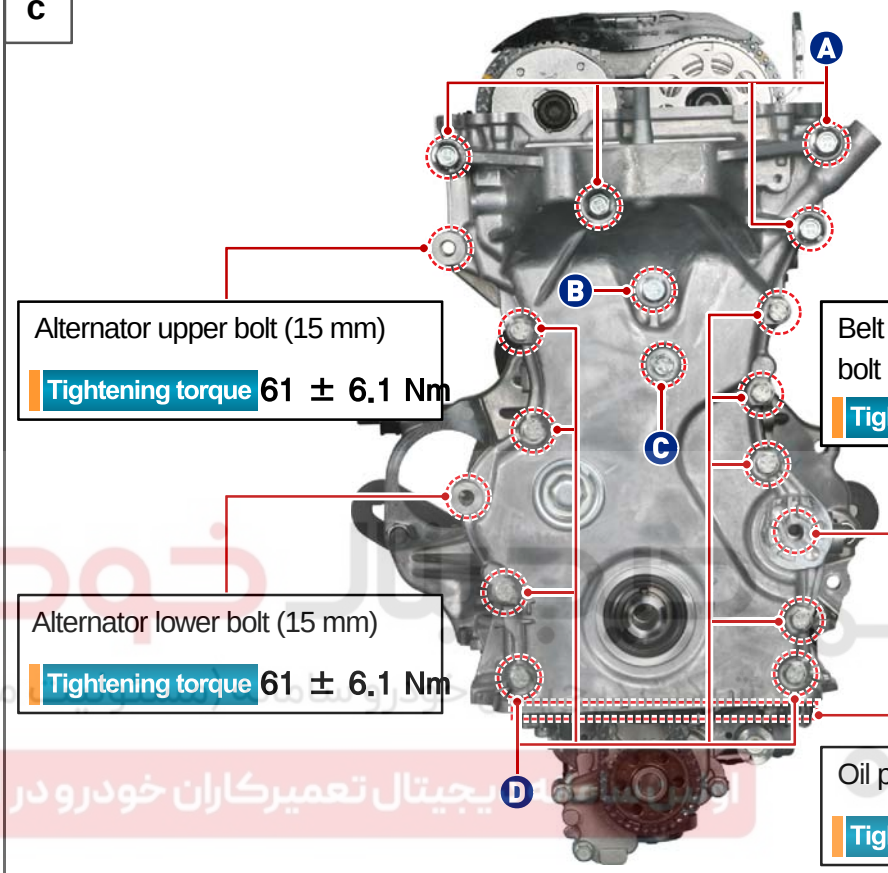


b. Install the timing gear case cover.

Modification basis	
Application basis	
Affected VIN	

c. Torque tighten the mounting bolts (A), (B), (C), and (D) for the timing gear case cover to the specified torque.

c



Alternator upper bolt (15 mm)
Tightening torque 61 ± 6.1 Nm

Belt tensioner mounting bolt (17 mm)
Tightening torque 61 ± 2.0 Nm

Alternator lower bolt (15 mm)
Tightening torque 61 ± 6.1 Nm

Oil pan mounting bolt (10 mm)
Tightening torque 10 ± 1.0 Nm

No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	15	80	4	
B		50	1	
C	13	45	1	
D		30	9	

CAUTION

To protect the timing gear case from damage, remove the bolts in sequence as follows:
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

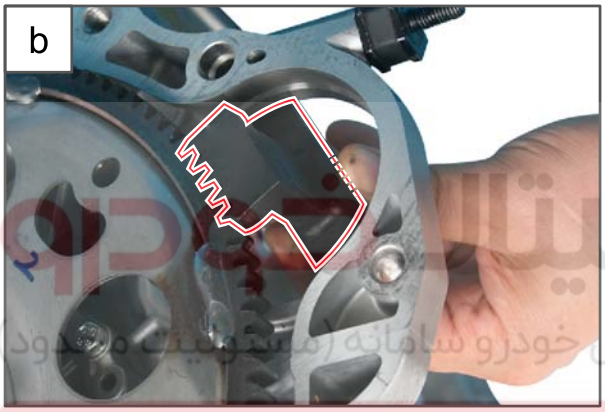
36.Install the crankshaft pulley and torque tighten the mounting bolt to the specified torque.

a

a. Remove the crankshaft pulley.

Crankshaft pulley and mounting bolt

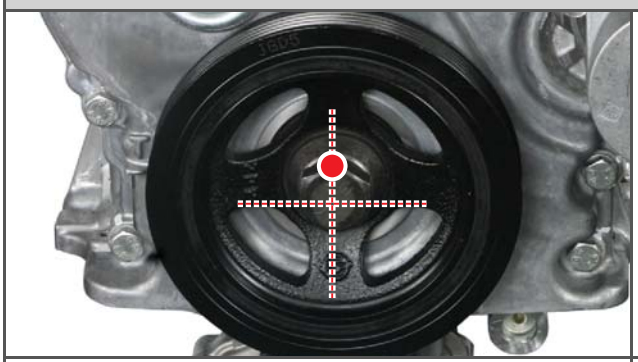
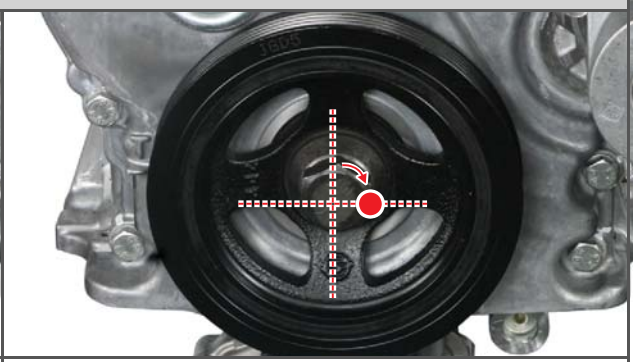

b



b. Secure the drive plate using the flywheel fixture and torque tighten the mounting bolt (27 mm) for the crankshaft pulley to the specified torque.

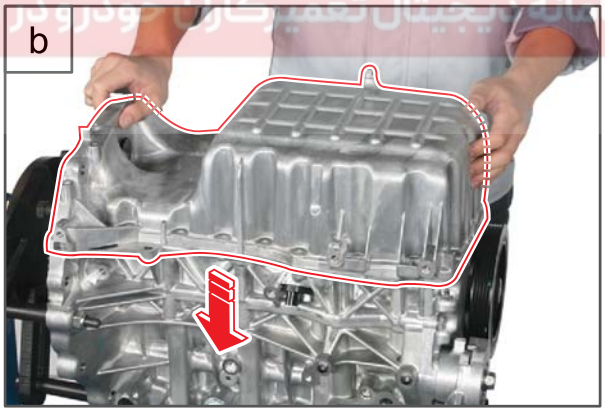
Flywheel fixture


Sequence	Tightening torque
1	220 Nm
2	

Angle tightening crankshaft pulley mounting bolt	
	
Paint mark on each bolt after the 1st torque tightening.	sequence at the time of 2nd tightening.

37.Install the oil pan to the engine and torque tighten the mounting bolts to the specified torque.

a. Apply sealant on the oil pan before fitting it. (sealant part No.: 661 989 56 A0).

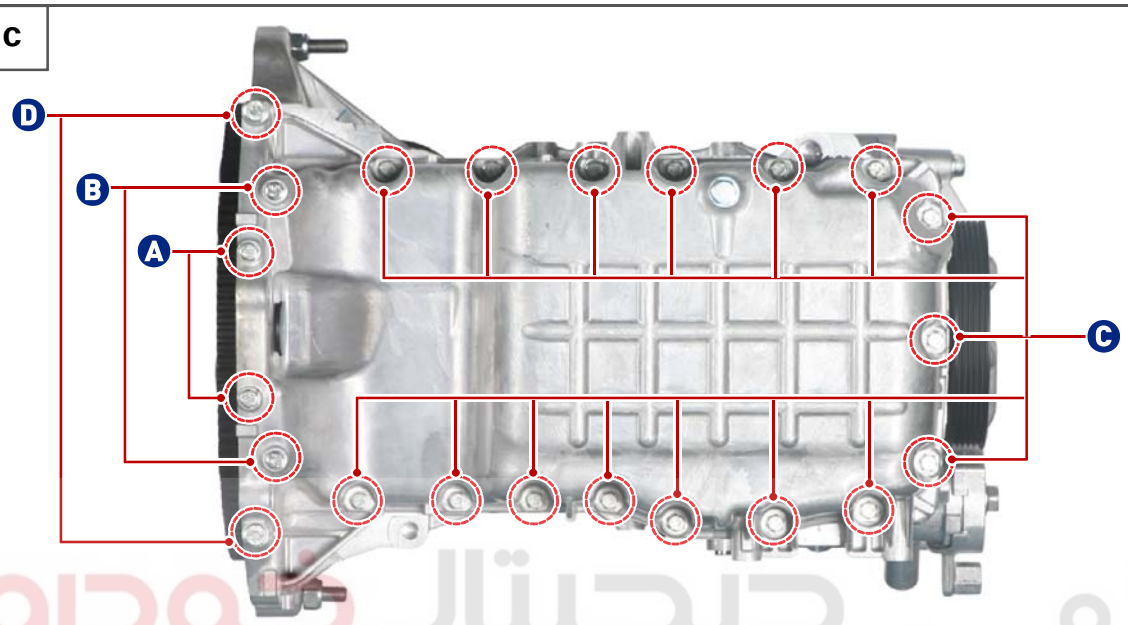


b. Install the oil pan.

Modification basis	
Application basis	
Affected VIN	

c. Torque tighten the oil pan mounting bolts (A), (B), (C), and (D) under the engine assembly to the specified torque.

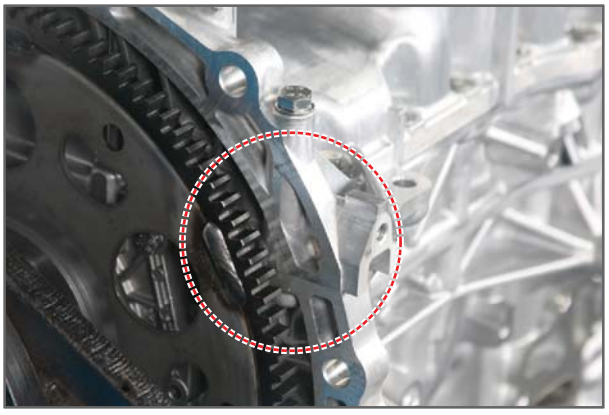
c



No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	10	115	2	
B		105	2	
C		25	16	
D	13	80	2	

CAUTION

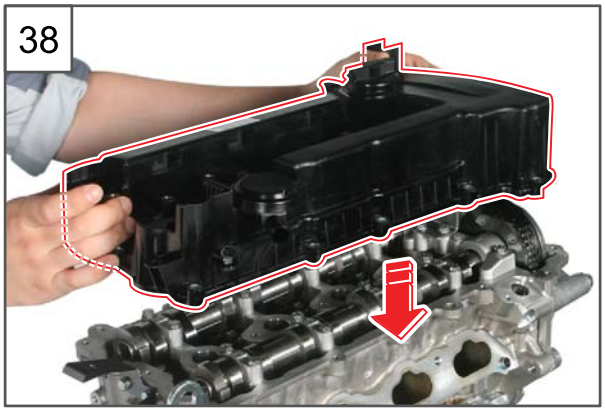
Tighten the mounting bolts from the ones in the center to the outer ones diagonally to protect the oil pan from damage.



CAUTION

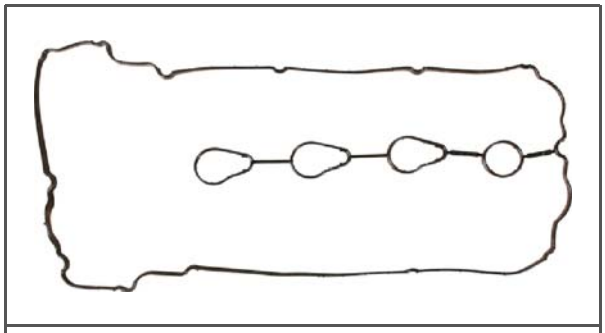
Tighten the mounting bolt after checking the difference in height between the oil pan and the cylinder block.

Height difference specification	0.2 mm or lower

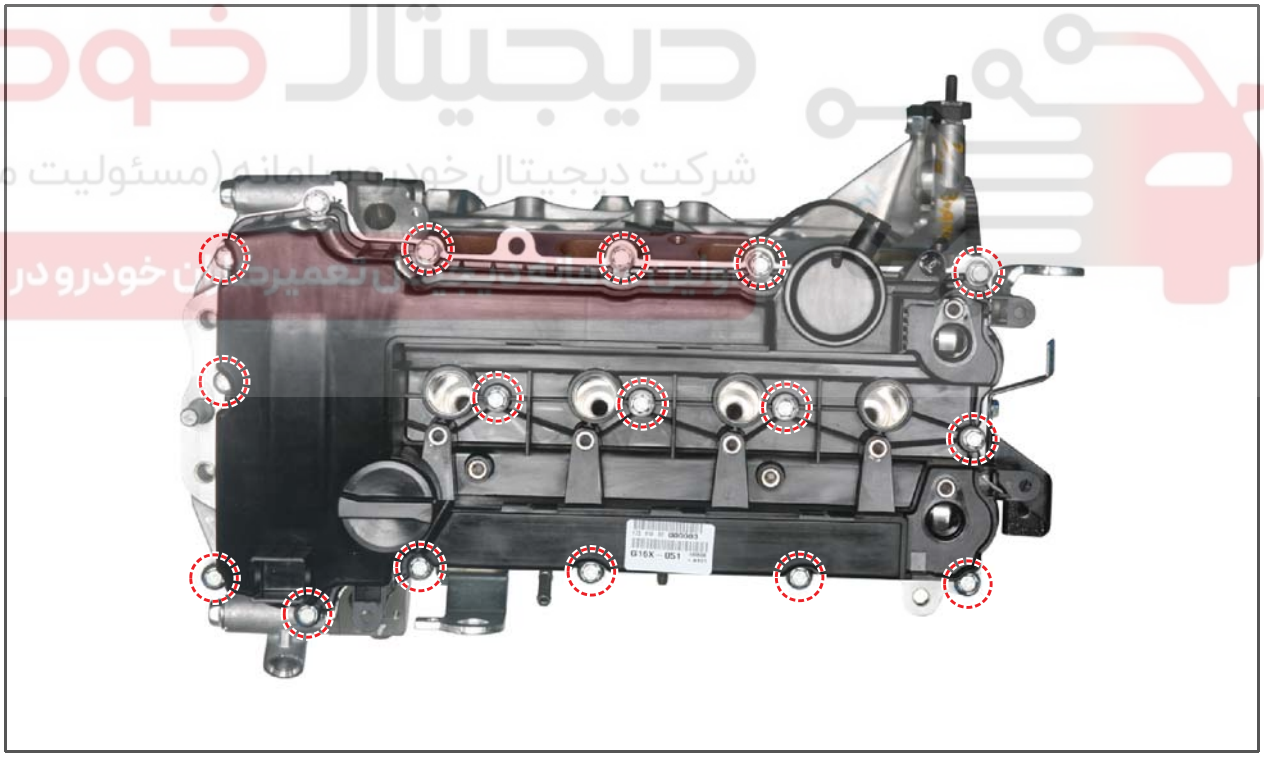


38. Mount the cylinder head cover and torque tighten the 16 bolts (10 mm) to the specified torque.

Tightening torque 10 ± 1.0 Nm



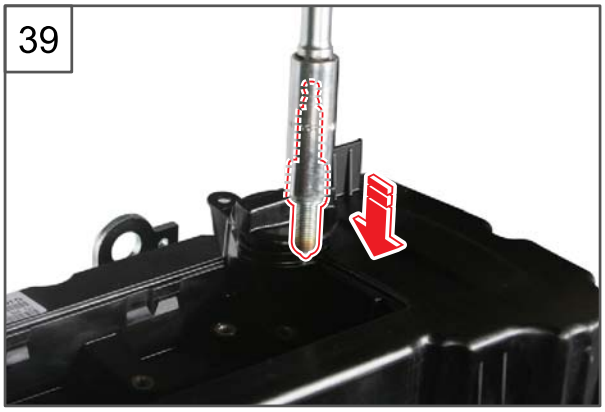
Replace the cylinder head cover gasket with a new one.



CAUTION

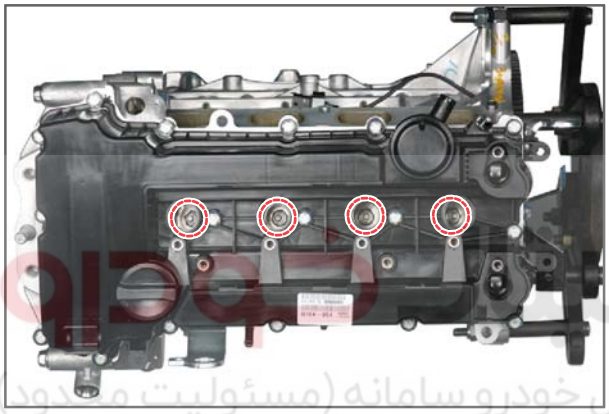
Tighten the mounting bolts in several steps to prevent damage to the cylinder head cover.
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

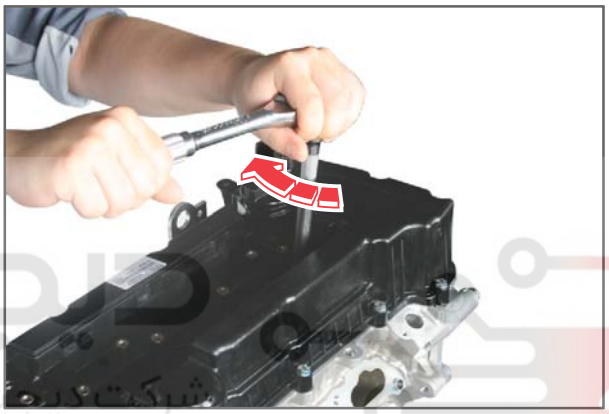
Modification basis	
Application basis	
Affected VIN	



39.Fit the 4 ignition plugs and torque tighten them to the specified torque. (Spark plug: 16 mm)

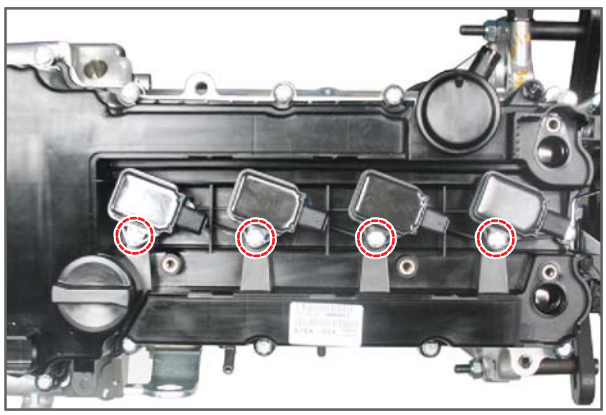
Tightening torque 20 ± 2.5 Nm





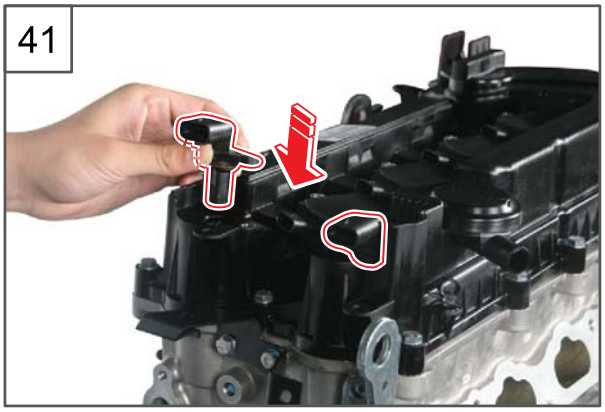
40.Install the 4 ignition coils and torque tighten the 4 mounting bolts (10 mm) to the specified torque.

Tightening torque 10 ± 1.0 Nm



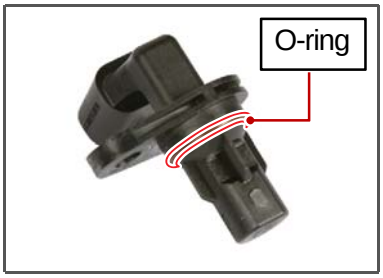
Modification basis	
Application basis	
Affected VIN	

41



41.Install the intake/exhaust cam position sensors and torque tighten the 2 mounting bolts (10 mm) to the specified torque.

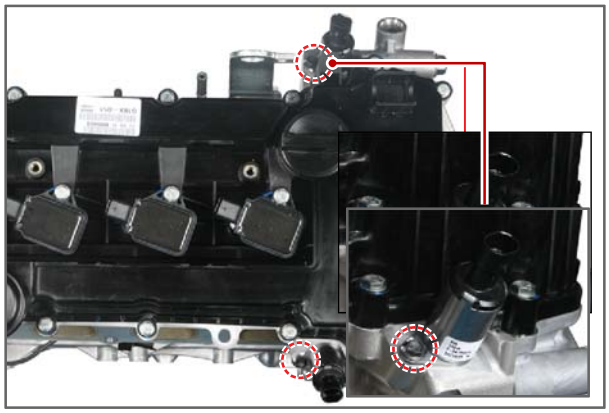
Tightening torque 10 ± 1.0 Nm



NOTE

Replace the O-ring for the cam position sensor with a new one.

42



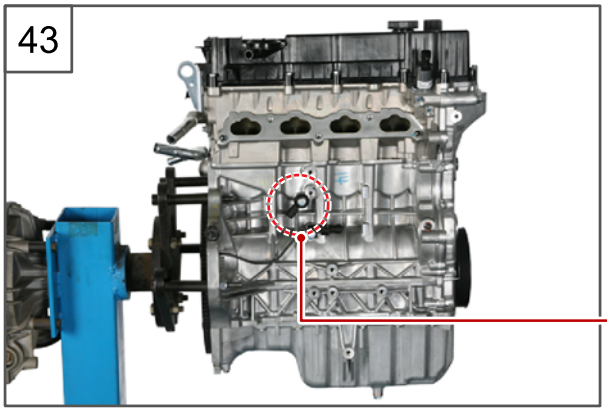
42.Install the intake/exhaust OCVs and torque tighten the 2 mounting bolts (8 mm) to the specified torque.

Tightening torque 8 ± 1.0 Nm

NOTE

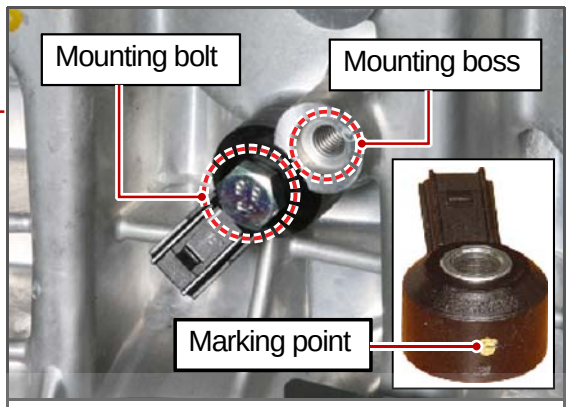
Replace the OCV O-ring with a new.

43



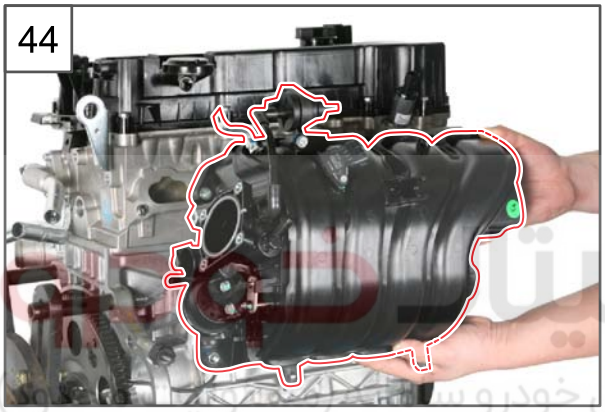
43.Install the knock sensor and torque tighten the mounting bolt (13 mm) to the specified torque.

Tightening torque 25 ± 2.5 Nm

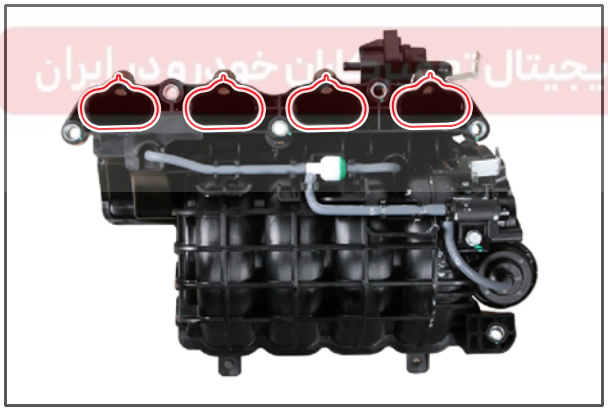


Match the mark on the knock sensor with the mounting boss when installing.

44

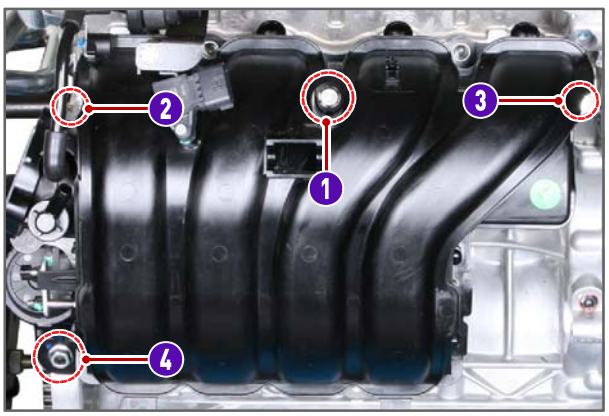


44.Install the intake manifold assembly and torque tighten the mounting bolts and nuts to the specified torque.



NOTE

Replace the intake manifold gasket with a new one.

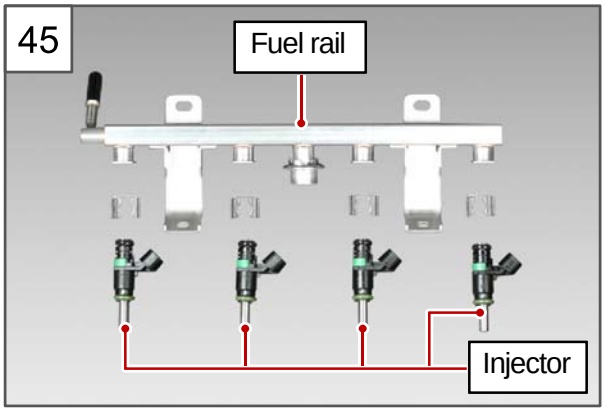


NOTE

Tighten the 4 mounting bolts/nuts (13 mm) for the intake manifold from the inside to the outside in sequence.

Tightening torque 25 ± 2.5 Nm

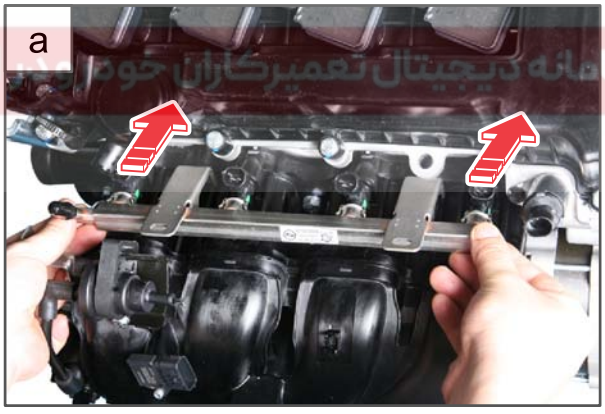
Modification basis	
Application basis	
Affected VIN	



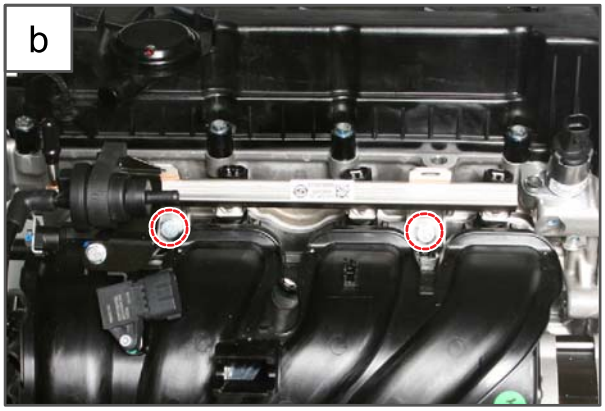
45. Install to the fuel rail assembly with the injectors to the intake manifold and torque tighten the mounting bolts to the specified torque.

NOTE

Replace the 4 upper and lower O-rings of the injector with new ones.



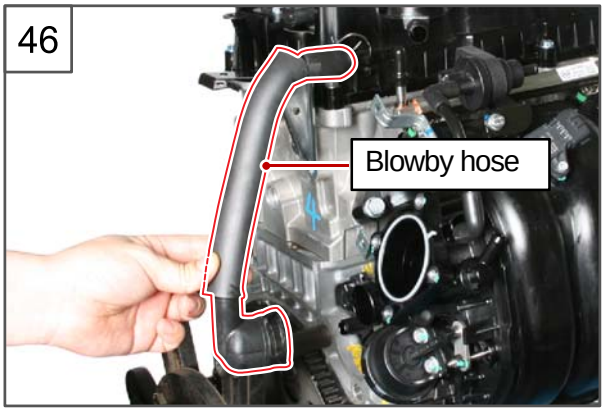
a. Make sure that the injectors fitted to the fuel rail assembly are inserted into the injector holes of the intake manifold.



b. Torque tighten the 2 mounting bolts (13 mm) for the fuel rail assembly to the specified torque.

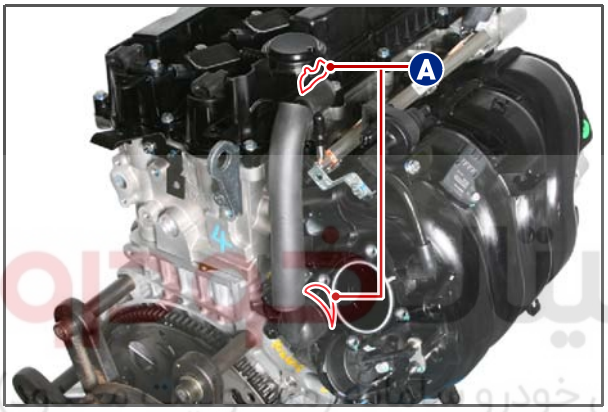
Tightening torque 25 ± 2.5 Nm

46



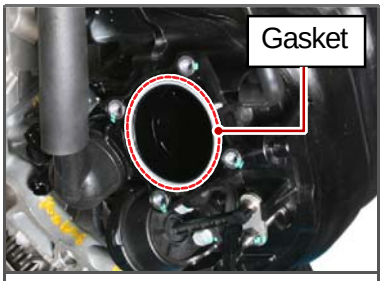
46.Fit the blowby hose and engage the 2 clamps (A).

Exploded view - blowby hose

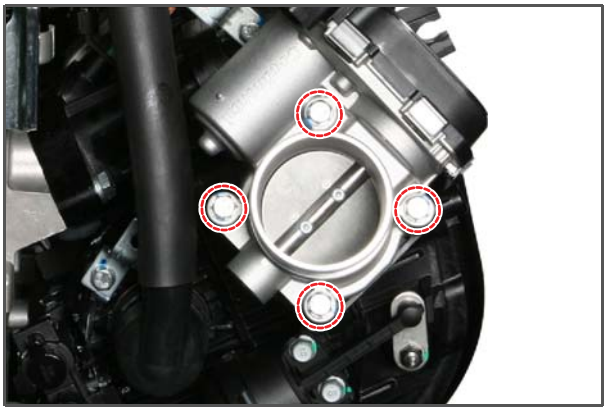


47

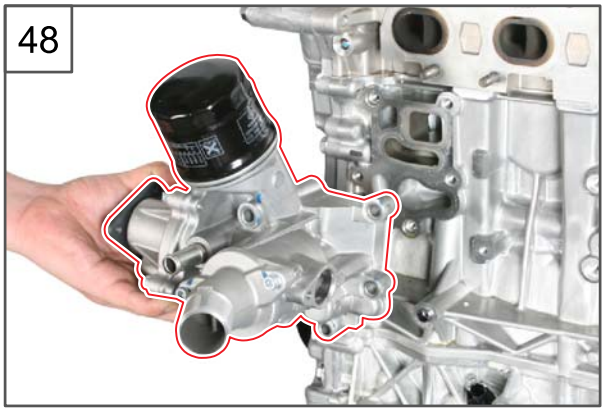
47.Install the electronic throttle body to the intake manifold and torque tighten the 4 mounting bolts (10 mm) to the specified torque.



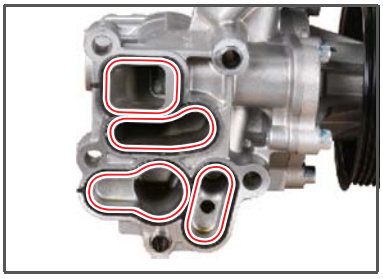
Replace the electronic throttle body gasket with a new one.



Modification basis	
Application basis	
Affected VIN	

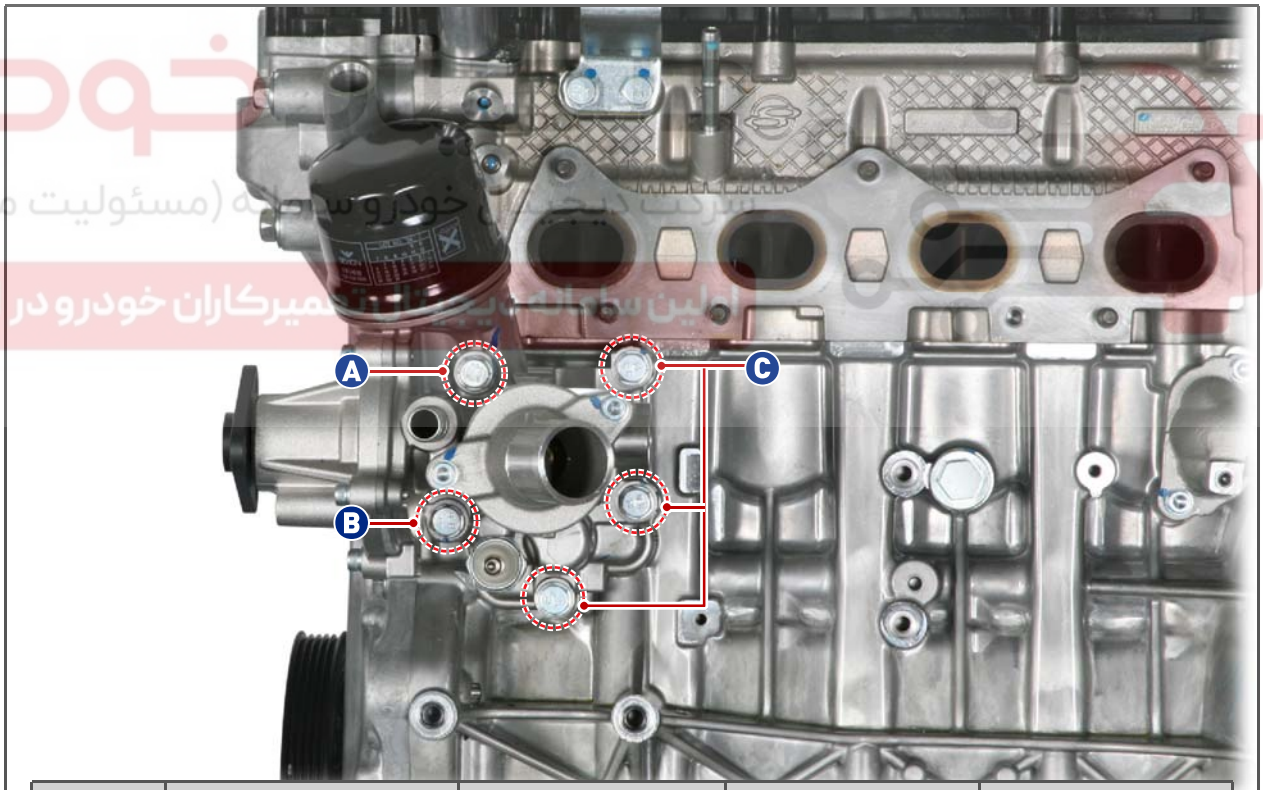


48.Install the oil filter module and torque tighten the 5 mounting bolts (13 mm) to the specified torque.



NOTE

Replace the oil filter module gasket with a new one.

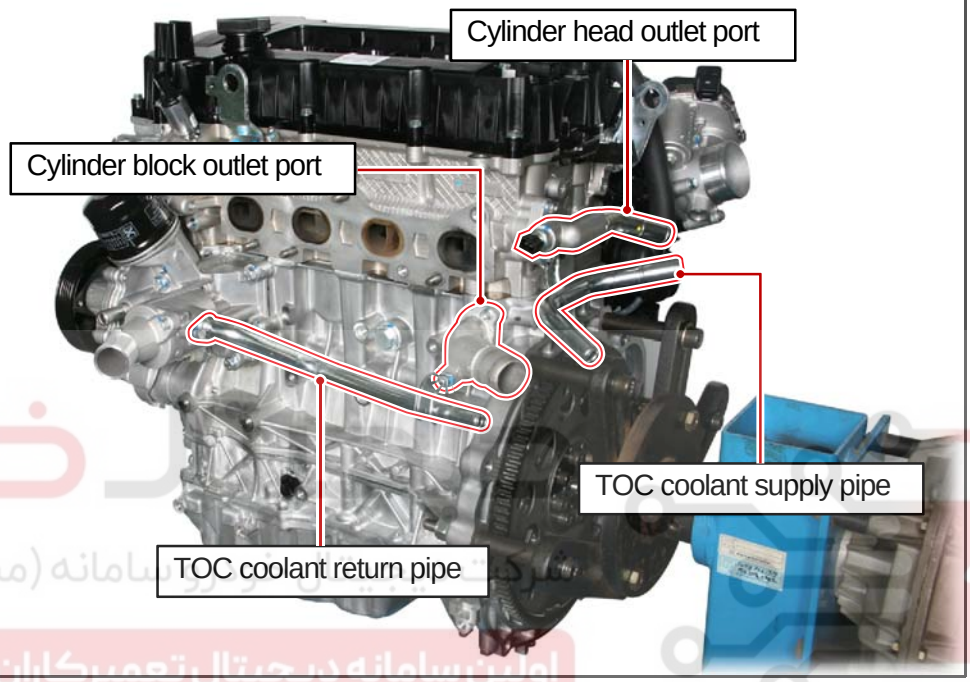


No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	13	60	1	25 ± 2.5 Nm
B		105	1	
C		40	3	

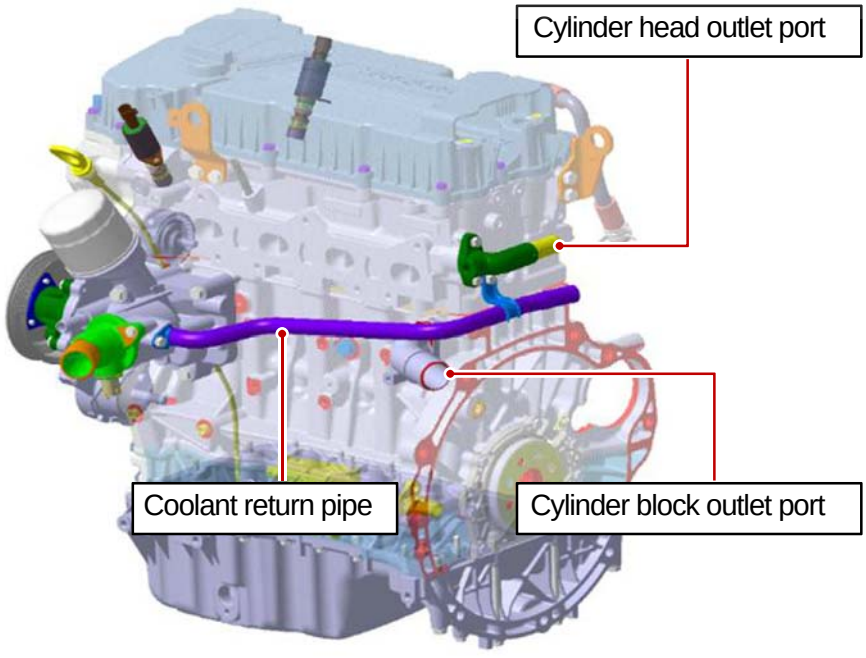
NOTE

This procedure is based on the vehicle with A/T. Keep in mind that the appearance of the coolant pipe may be different from the one described in this manual.

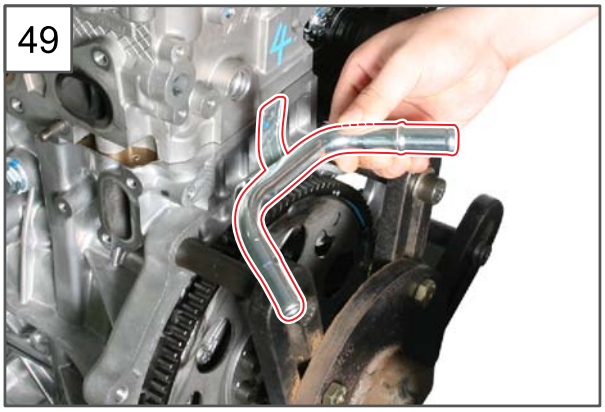
For a vehicle with A/T



For a vehicle with M/T

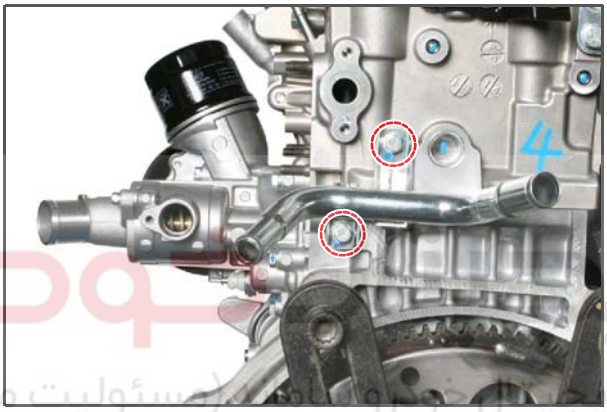


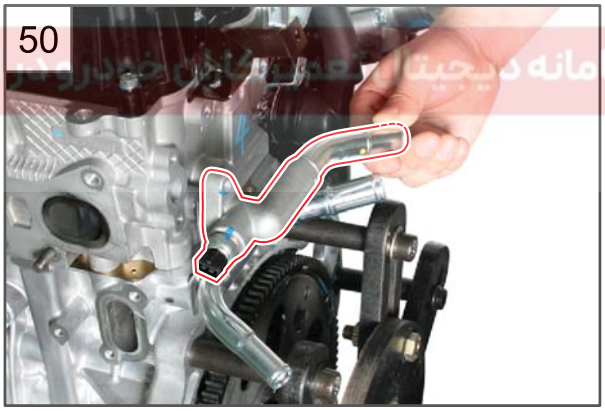
Modification basis	
Application basis	
Affected VIN	



49.Fit the TOC coolant supply pipe and torque tighten the 2 mounting bolts (10 mm) to the specified torque.

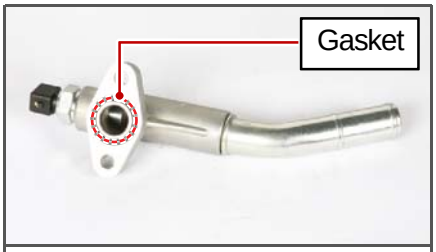
Tightening torque 10 ± 1.0 Nm



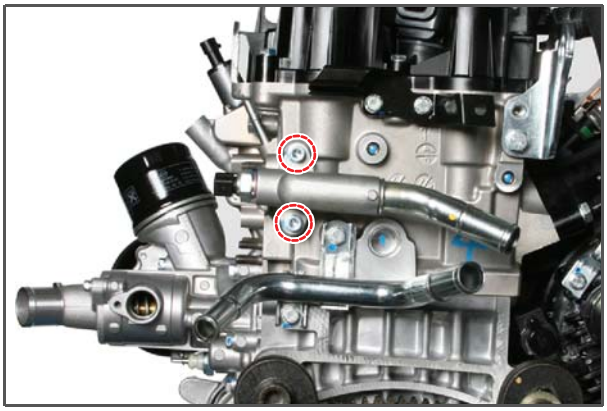


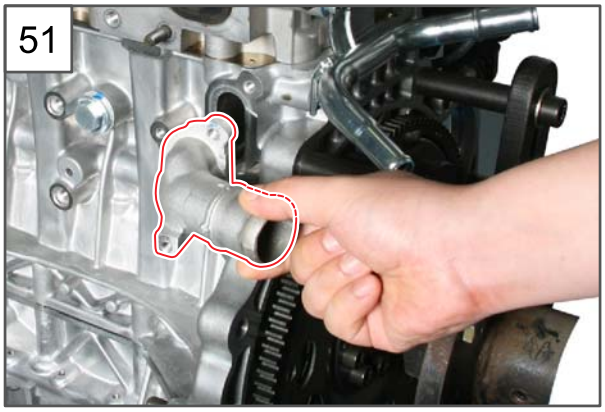
50.Install the cylinder head outlet port and torque tighten the 2 hexagon mounting bolts (5 mm) to the specified torque.

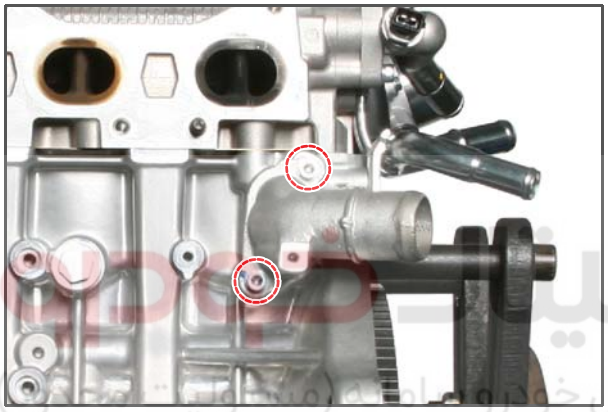
Tightening torque 10 ± 1.0 Nm



Replace the cylinder head outlet port gasket with a new one.

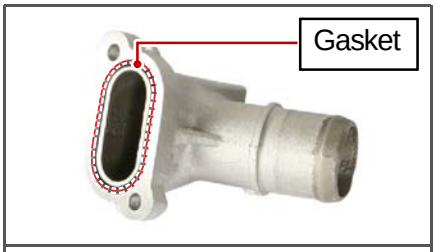




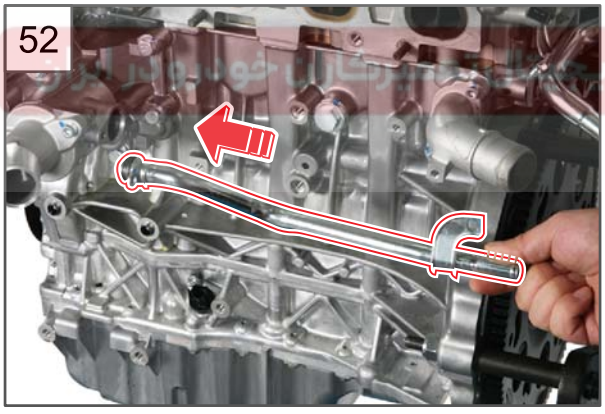


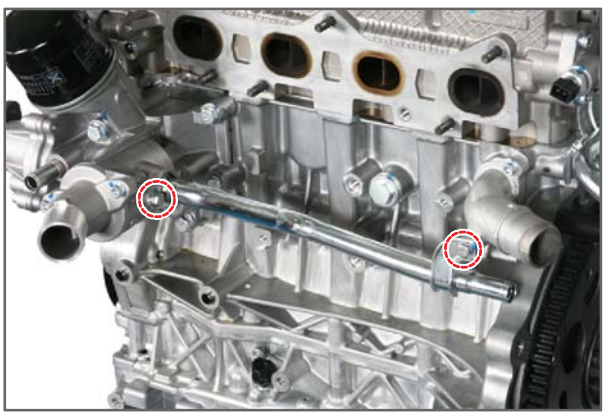
51. Install the cylinder block outlet port and torque tighten the 2 hexagon mounting bolts (5 mm) to the specified torque.

Tightening torque 10 ± 1.0 Nm



Replace the cylinder block outlet port gasket with a new one.





52. Push in the TOC coolant return pipe in the direction of the arrow shown in the picture to install it and torque tighten the 2 mounting bolts (10 mm) to the specified torque.

Tightening torque 10 ± 1.0 Nm

Replace the TOC coolant return pipe O-ring with a new one.

Modification basis	
Application basis	
Affected VIN	

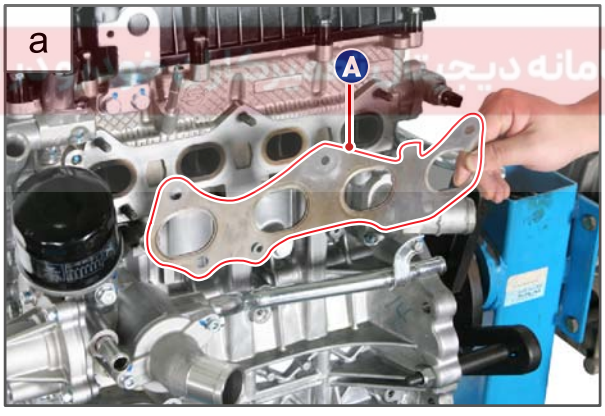
53.Install the exhaust manifold assembly and torque tighten the mounting bolts and nuts to the specified torque.

53

NOTE

Replace the exhaust manifold gasket with a new one installing.

a



a. Install a new exhaust manifold gasket.

CAUTION

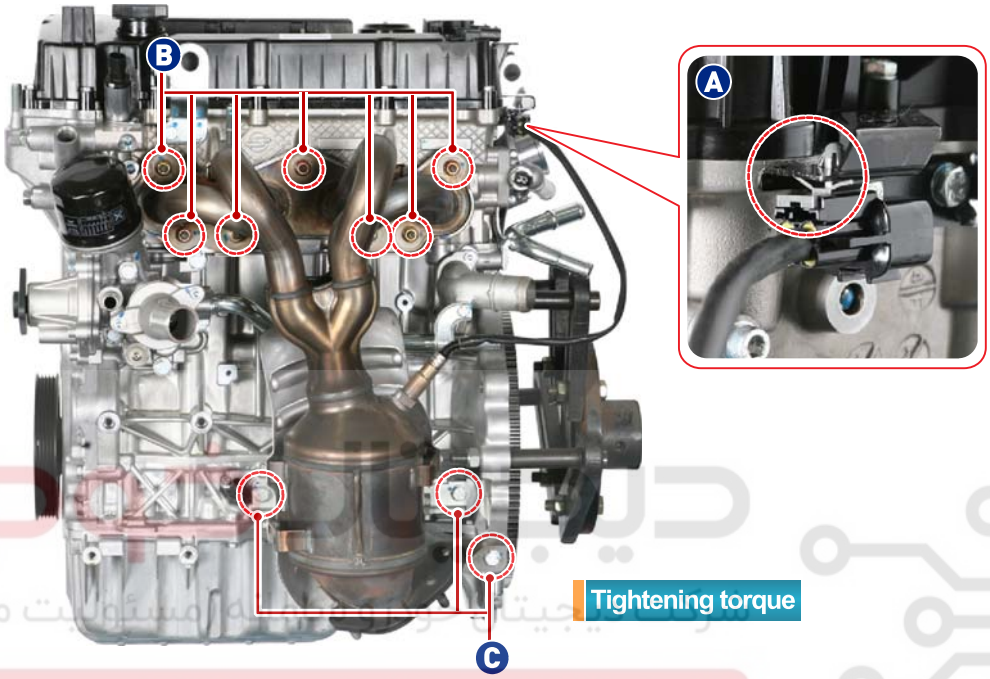
Make sure that the installation boss is located between the No. 3 and No. 4 cylinders.

b

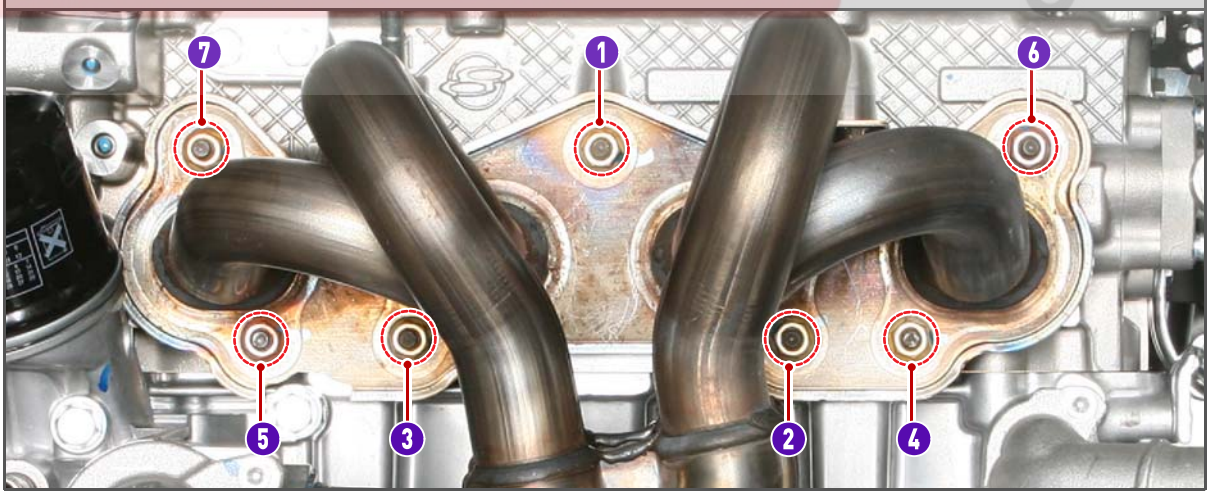
b. Install the exhaust manifold assembly.

c. Fit the retaining key (A) for the front oxygen sensor connector and tighten the 3 mounting bolts (B, 13 mm) for the exhaust manifold bracket and 7 mounting nuts (C, 12 mm) for the exhaust manifold to the specified torque in the sequence specified below. (tighten the mounting bolts from B to C)

c



Installation sequence for mounting nuts



CAUTION

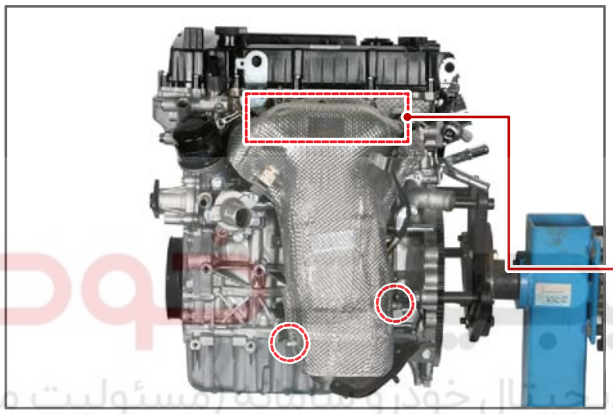
- Tighten the mounting nuts slowly in two or more stages to prevent distortion of the exhaust manifold and cylinder head.
- Replace the mounting nuts with new ones when installing the exhaust manifold.

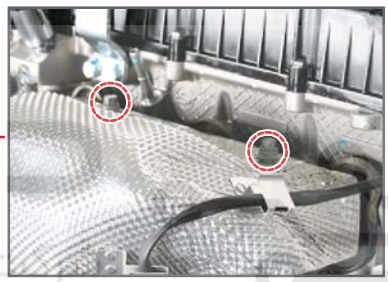
Modification basis	
Application basis	
Affected VIN	

54

54.Install the exhaust manifold heat protector and torque tighten the 4 mounting bolts (10 mm) to the specified torque.

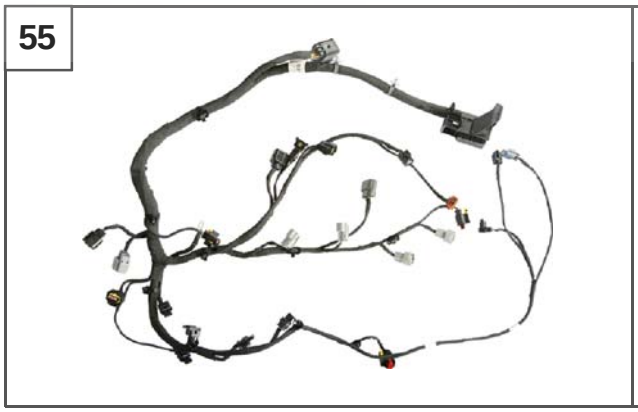
Tightening torque 10 ± 1.0 Nm

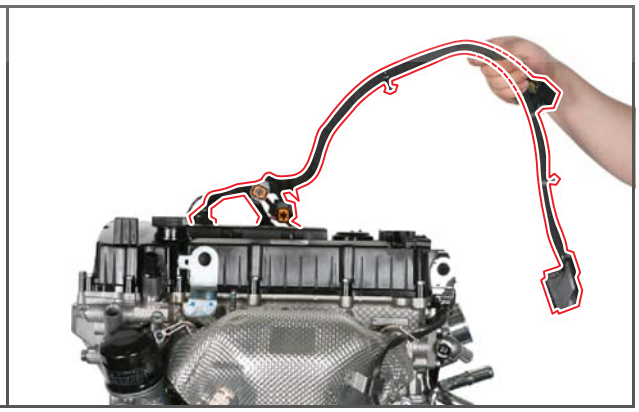




55.Connect each connector of the engine main wiring to the connections to install the engine main wiring to the engine.

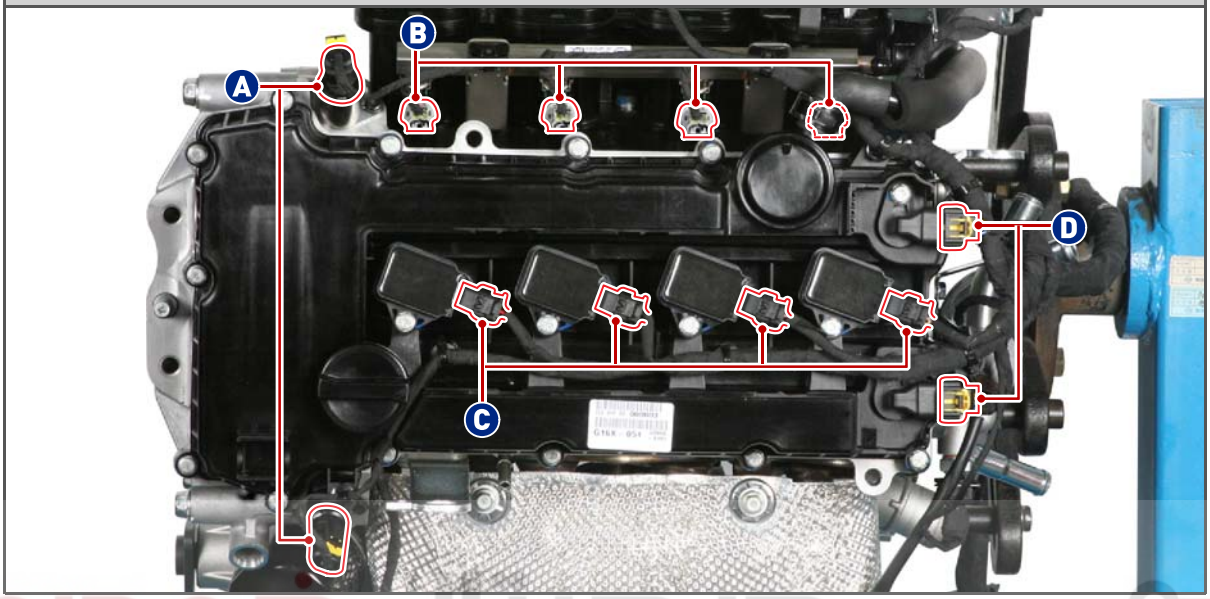
55



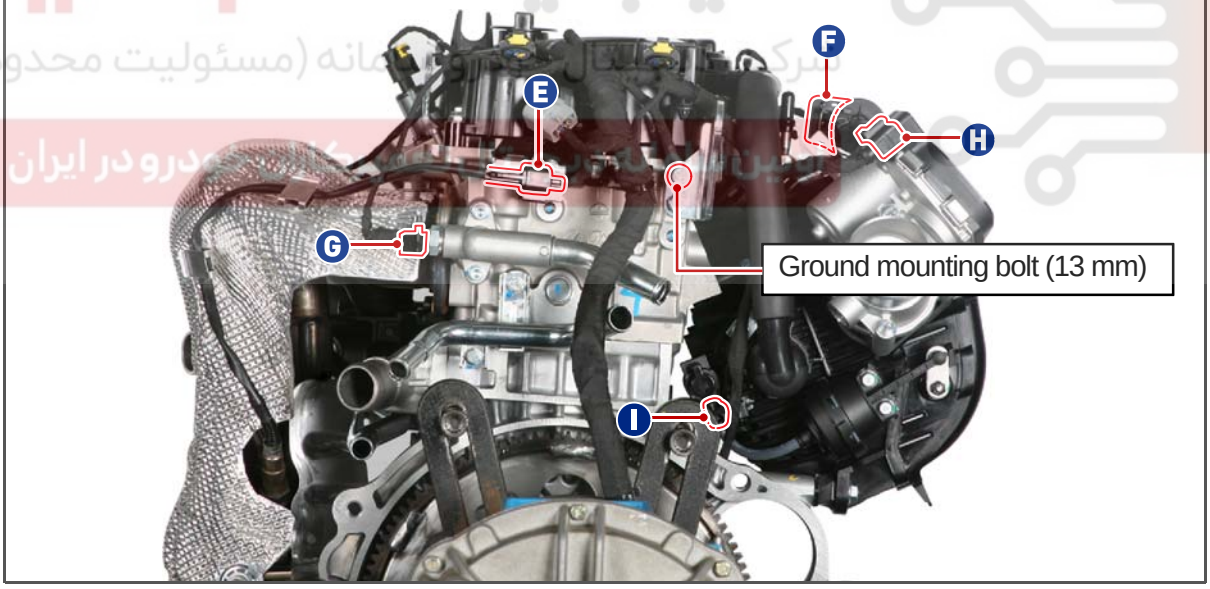


Modification basis	
Application basis	
Affected VIN	

Cylinder head cover side



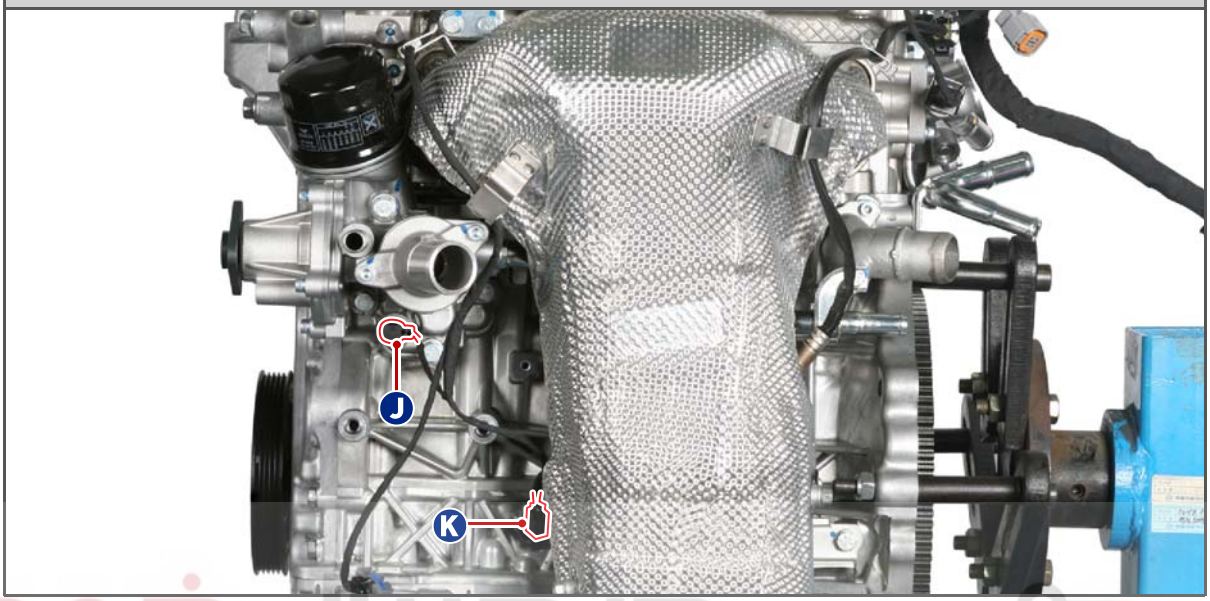
Rear side of engine



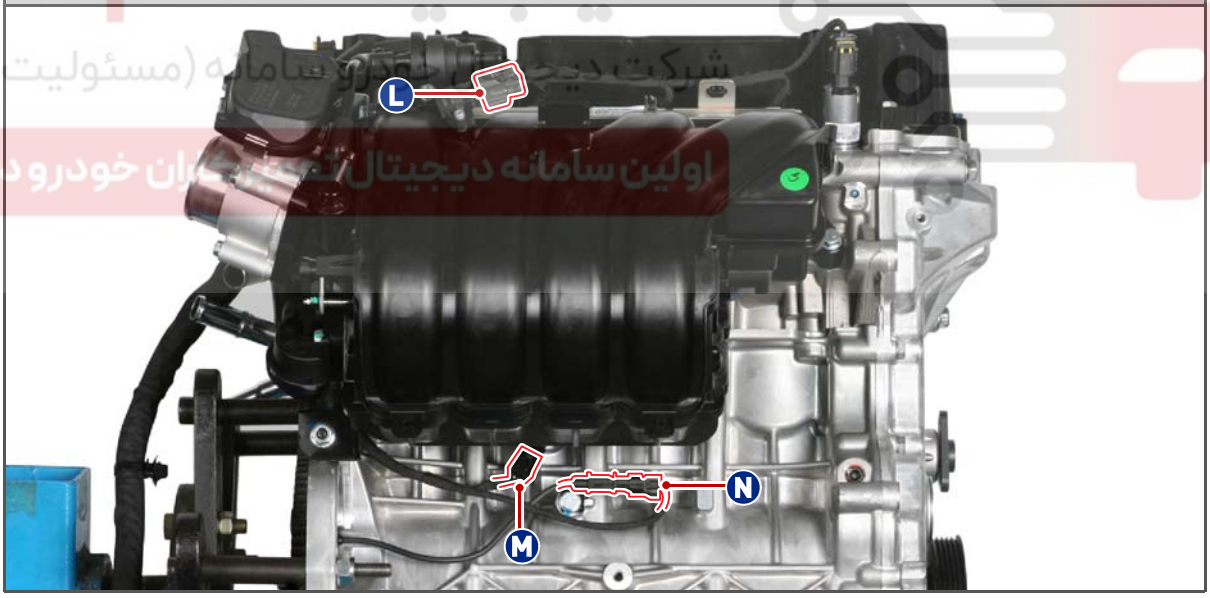
A. Intake/exhaust OCV connectors
B. Injector connector
C. Ignition coil Connector
D. Intake/exhaust cam position sensor connector
E. Front oxygen sensor connector
F. PCV connector
G. Coolant temperature sensor connector
H. Electronic throttle body connector
I. VIS solenoid valve connector

Modification basis	
Application basis	
Affected VIN	

Exhaust side



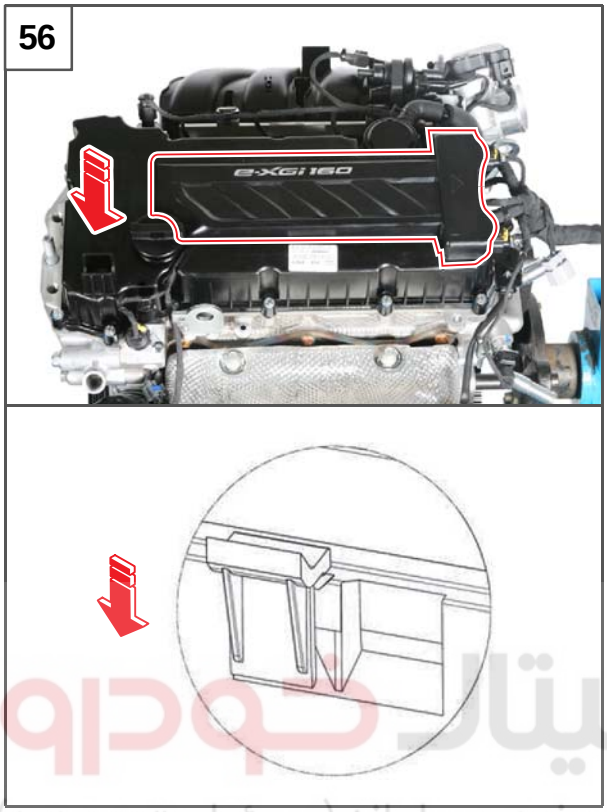
Intake side



J. Oil pressure switch connector
K. VOP solenoid valve connector
L. T-MAP sensor connector
M. Knock sensor connector
N. Crankshaft position sensor connector

Modification basis	
Application basis	
Affected VIN	

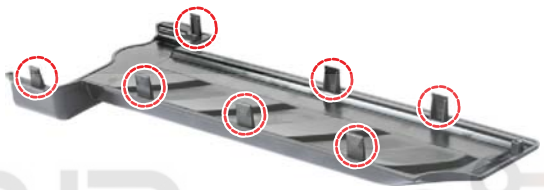
56



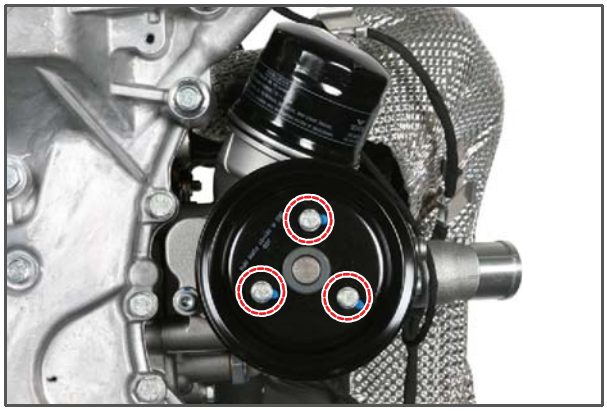
56.Install the ignition coil cover to the cylinder head cover.

NOTE
Install the ignition coil cover in vertical direction.

Ignition coil cover mountings - 7 points



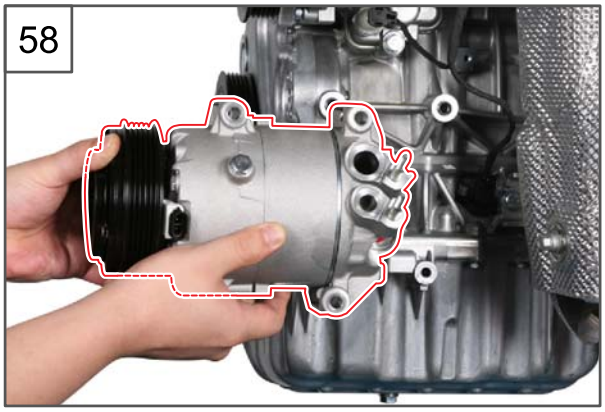
57



57.Install the water pump pulley and torque tighten the 3 mounting bolts (10 mm) to the specified torque.

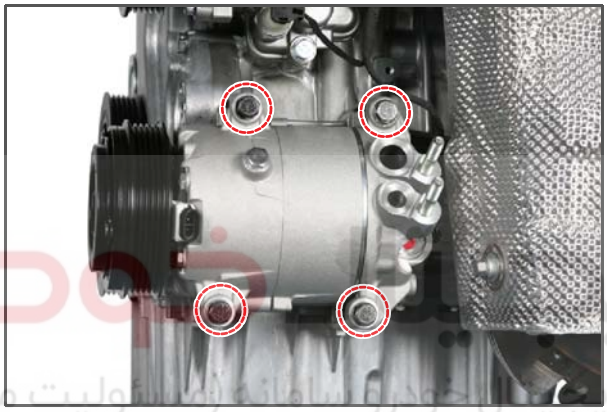
Tightening torque 10 ± 1.0 Nm

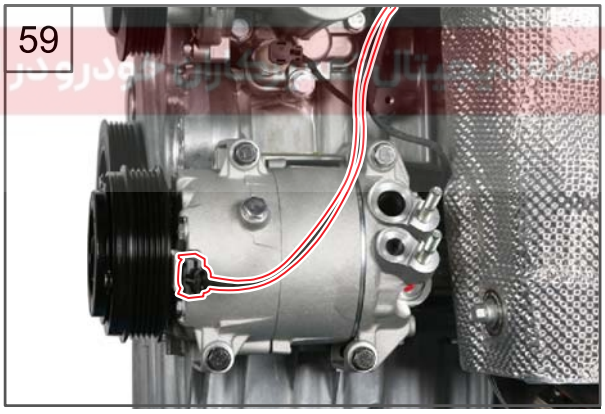
Modification basis	
Application basis	
Affected VIN	



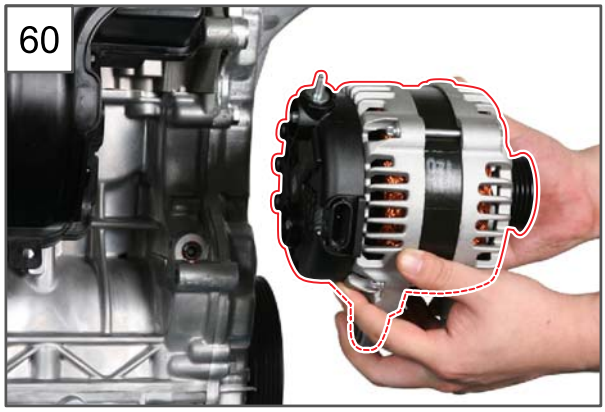
58.Install the A/C compressor and torque tighten the 4 mounting bolts (13 mm) to the specified torque.

Tightening torque 25 ± 2.5 Nm



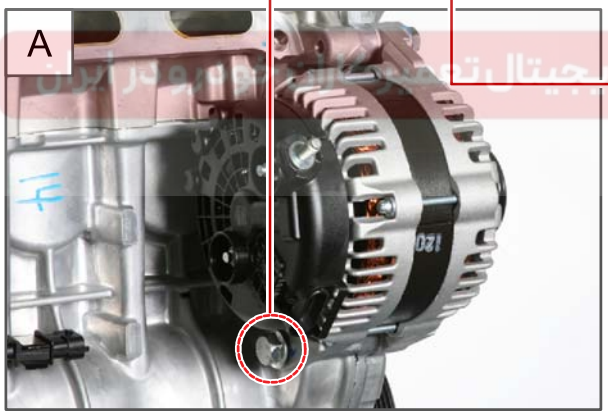


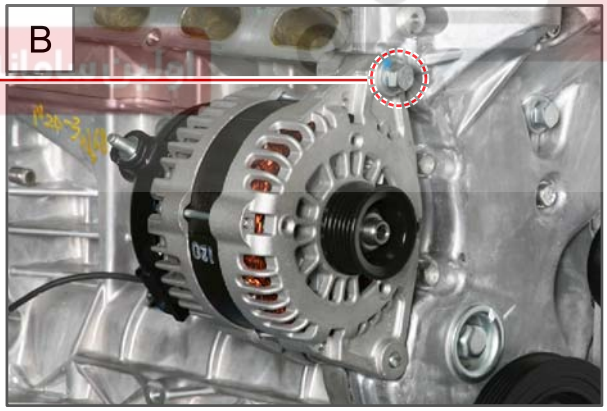
59.Connect the A/C compressor connector.



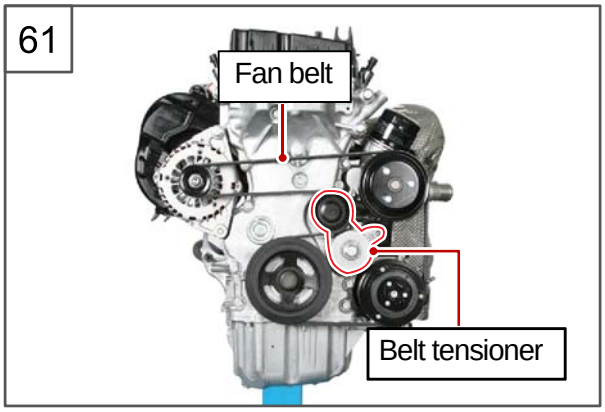
60.Install the alternator and tighten the mounting bolt (A, 17 mm) and bolt (B, 15 mm) to the specified torque.

Tightening torque 61 ± 6.1 Nm

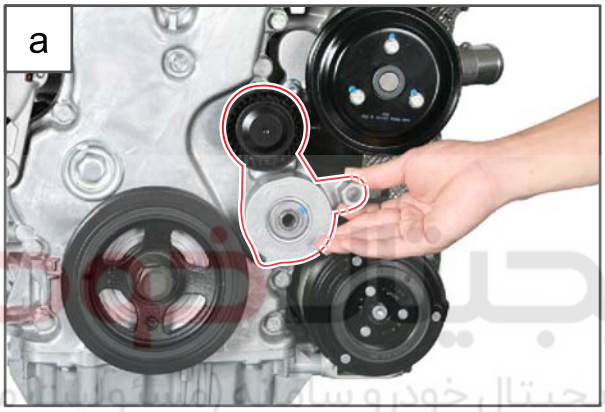




Modification basis	
Application basis	
Affected VIN	



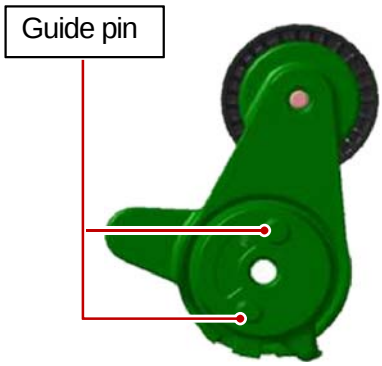
61. Install the fan belt and belt tensioner as follows:

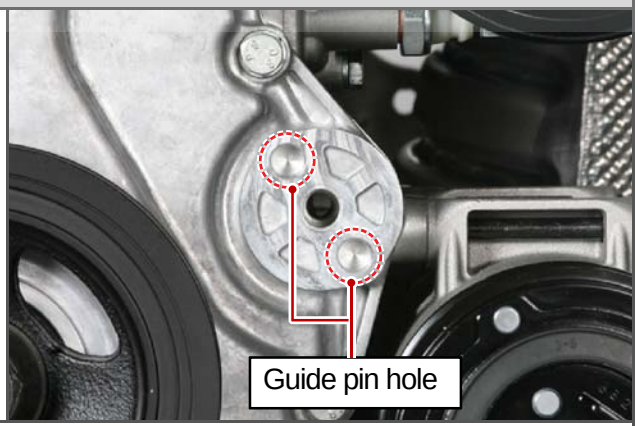


a. Install the belt tensioner and torque tighten the mounting bolt (17 mm) to the specified torque.

Tightening torque 61 ± 2.0 Nm

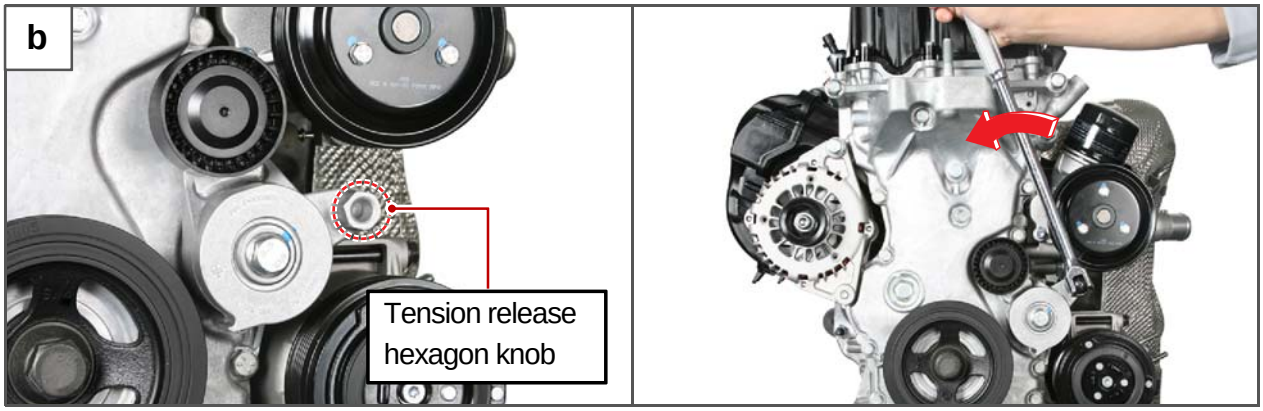
Notes on the belt tensioner installation





Install the belt tensioner by making sure the guide pins on the rear face of the belt tensioner are seated on the guide pin holes on the timing gear case cover.

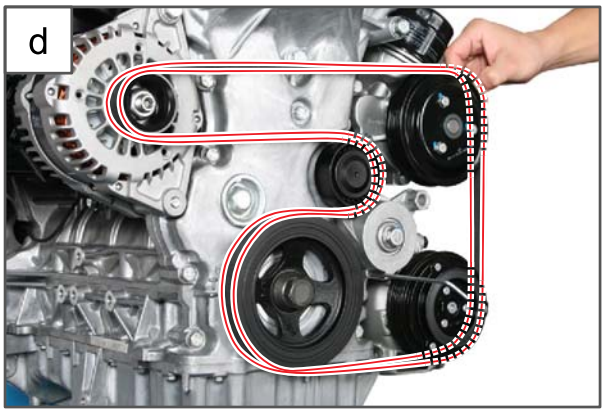
b. Turn the belt tensioner release hexagon knob (19 mm) counterclockwise using a special tool to relieve the tension.



CAUTION

Do not apply excessive force to the fully compressed belt tensioner when releasing the tension. Failure to do so may lead to deformation of the belt tensioner.

c. After releasing the tension of the belt tensioner, secure the belt tensioner by fitting a retaining pin (B,



d. Fit the fan belt and remove the retaining pin for the belt tensioner.

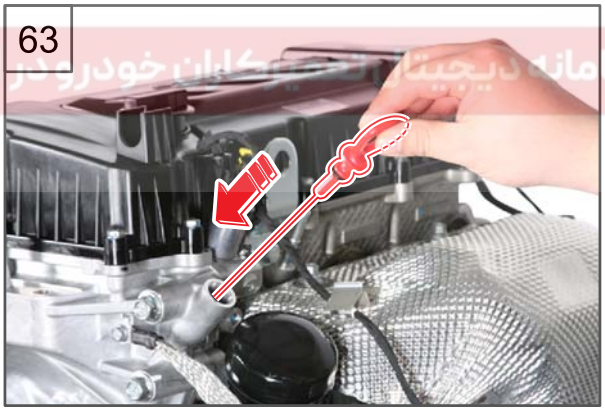
Modification basis	
Application basis	
Affected VIN	

62

62.Install the engine ground cable and torque tighten the mounting bolt (10 mm) to the specified torque.

Tightening torque 10 ± 1.0 Nm

63



63.Insert the oil dipstick gauge.

Memo