General Information

Specifications

Description			Specifications	Limit
General				
Type			V-type, DOHC	
Number of cylinder			6	
Bore			84.0mm(3.3071 in.)	
Stroke			89.0mm(3.5039 in.)	
Total displacement			2,959 cc	
Compression ratio			17.3 ± 0.5 : 1	
Idle rpm			720 RPM	
Firing order			1-2-3-4-5-6	
Valve timing				
Intake valve	Opens		BTDC 13°	
	Closes		ABDC 34°	
Exhaust valve	Opens		BBDC 55°	
	Closes		ATDC 15°	
Cylinder head				
Flatness of cylinder head gasket surface			0.05mm(0.0020 in.) 0.03mm(0.0012in.) - 100mm×100mm 0.01mm(0.0004in.) - 20mm×20mm	
Flatness of manifold gasket surface	Intake		0.016mm(0.0006in.) 0.013mm(0.0005in.) - 25mm×25mm	
	Exhaust		0.016mm(0.0006in.) 0.013mm(0.0005in.) - 25mm×25mm	
Camshaft				
Cam height	LH camshaft	Intake	36.000 ~ 40.152mm(1.4173~1.5808in.)	
		Exhaust	36.000 ~ 40.477mm(1.4173~1.5936in.)	
	RH camshaft	Intake	36.000 ~ 40.152mm(1.4173~1.5808in.)	
		Exhaust	36.000 ~ 40.477mm(1.4173~1.5936in.)	
Journal outer diameter	LH camshaft	Intake	24.947 ~ 24.960mm(0.9822~0.9827in.)	
		Exhaust		
	RH camshaft	Intake		
		Exhaust		
Bearing oil clearance			0.040 ~ 0.074mm(0.0016~0.0029in.)	
End play			0.05 ~ 0.15mm(0.0020~0.0059in.)	
Valve				

Description		Specifications	Limit
Valve length	Intake	99.3mm(3.9094in.)	
	Exhaust	99.3mm(3.9094in.)	
Stem outer diameter	Intake	5.960 ~ 5.975mm(0.2346~0.2352in.)	
	Exhaust	5.955 ~ 5.970mm(0.2344~0.2350in.)	
Face angle		45.00° ~ 45.25°	
Thickness of valve-head (margin)	Intake	1.5mm(0.0590in.)	
	Exhaust	1.5mm(0.0590in.)	
Valve stem to valve guide clearance	Intake	0.025 ~ 0.052mm(0.0010~0.0020in.)	
	Exhaust	0.030 ~ 0.057mm(0.0012~0.0022in.)	
Valve guide			
Inner diameter	Intake	6.000 ~ 6.012mm(0.2362~0.2367in.)	
	Exhaust	6.000 ~ 6.012mm(0.2362~0.2367in.)	
Length	Intake	36.25 ~ 36.75mm(1.4272~1.4468in.)	
	Exhaust	36.25 ~ 36.75mm(1.4272~1.4468in.)	
Valve spring			
Free length		48.2mm(1.8976in,)	
Load		175±8N/33.5mm	
		278±20N/24.8mm	
Out of squareness		1.5° or less	3°
Valve seat			
Seat angle	Intake	44.5° ~ 45°	
	Exhaust	44.5° ~ 45°	
Valve contacting wi-dth	Intake	1.39 ~ 1.43mm(0.0547~0.0563in.)	
	Exhaust	1.39 ~ 1.43mm(0.0547~0.0563in.)	
Piston			
Piston outer diameter		83.926 ~ 83.956mm3.3042~3.3053in.)	
Piston to cylinder clearance		0.064 ~ 0.084mm(0.0025~0.0033in.)	
Ring groove width	No. 1 ring groove	2.434 ~ 2.454mm(0.0958~0.0966in.)	
	No. 2 ring groove	1.82 ~ 1.84mm(0.0717~0.0724in.)	
	Oil ring groove	3.02 ~ 3.04mm(0.1189~0.1197in.)	
Piston ring			
Side clearance	No. 1 ring	0.102 ~ 0.146mm(0.0040~0.0057in.)	
	No. 2 ring	0.08 ~ 0.12mm(0.0031~0.0047in.)	
	Oil ring	0.03 ~ 0.07mm(0.0012~0.0028in.)	

Description		Specifications	Limit
End gap	No. 1 ring	0.20 ~ 0.35mm(0.0079~0.0138in.)	
	No. 2 ring	0.40 ~ 0.60mm(0.0157~0.0236in.)	
	Oil ring	0.25 ~ 0.50mm(0.0098~0.0197in.)	
Piston pin			
Piston pin outer diameter		30.994 ~ 31.000mm(1.2202~1.2205in.)	
Piston pin hole inner diameter		31.014 ~ 31.021mm(1.2210~1.2213in.)	
Piston pin hole clearance		0.014 ~ 0.027mm(0.0006~0.0011in.)	
Connecting rod small end bore inner diameter		31.020 ~ 31.031mm(1.2212~1.2216in.)	
Connecting rod small end bore hole clearance		0.020 ~ 0.037mm(0.0008~0.0014in.)	
Connecting rod			
Connecting rod big end bore inner diameter		66.500 ~ 66.518mm(2.6181~2.6188in.)	
Connecting rod bearing oil clearance		0.024 ~ 0.058mm(0.0009~0.0023in.)	
Side clearance between connecting rod and pistion		0.007 ~ 0.024mm(0.0003~0.0009in.)	
Crankshaft			
Main journal outer diameter		75.982 ~ 76.000mm(2.9914~2.9921in.)	
Pin journal outer diameter		63.482 ~ 63.500mm(2.4993~2.5000in.)	
Main bearing oil clearance		0.030 ~ 0.048mm(0.0012~0.0019in.)	
End play		0.1 ~ 0.3mm(0.0039~0.0118in.)	
Cylinder block			
Cylinder bore inner diameter		84.000 ~ 84.030mm(3.3071~3.3083in.)	
Cylinder block journal bore inner diameter		80.000 ~ 80.018mm(3.1496~3.1503in.)	
Flatness of gasket surface		0.042mm(0.0017in.) or less (width) 0.096mm(0.0038in.) or less (length) 0.012mm(0.0005in.) or less (50mm×50mm)	
Drive plate			
Runout		0.25mm(0.0098in.)	
Engine oil			
Oil quantity	Total	7.7 L (8.14 US qt, 6.78 Imp qt)	When replacing a short engine or a block assembly
	Oil pan	6.2 L (6.55 US qt, 5.46 Imp qt)	
	Drain and refill	7.2 L (7.61 US qt, 6.34 Imp qt)	Including oil filter
Oil grade	Classification	ACEA C3 (with DPF), ACEA B4 (without DPF)	Refer to the "Lubrication System"
	SAE viscosity grade	Recommended SAE viscosity number	

Description		Specifications	Limit
Oil pressure(at idle)		78.45kPa (0.8kg/cm², 11.38psi) or above	Oil temperature in oil pan : 80℃ (176 ˚F)
Cooling system			
Cooling method		Forced circulation with electrical fan	
Coolant quantity		9.8~11.5 L(10.36~12.15 USqt, 8.62~10.12Impqt)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82±2˚C(176.0~183.2˚F) (lift : 0.35mm(0.0138in.))	
	Opening temperature	95˚C(203.0˚F) (lift 10mm(0.3937in.) or more)	
Turbocharger			
Cooling method		Air cooling type	
Actuator		Electrical	
Turbine	Control type	Variable Geometry Turbocharger (VGT)	

Tightening Torques

Item	N.m	kgf.m	lb-ft
Cylinder block			
Oil jet mounting	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Ladder frame bolts	61.8~65.7+120°~124°	6.3~6.7+120°~124°	45.6~48.5+120°~124°
Sub frame stay bolts and nuts	68.6 ~ 88.3	7.0 ~ 9.0	50.6 ~ 65.1
Sub frame mounting bolts and nuts	137.3 ~156.9	14.0 ~ 16.0	101.3 ~ 115.7
Engine mounting support bracket bolts and nuts	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Engine support bracket	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Front roll stopper and sub frame member bolt	49.0 ~63.7	5.0 ~ 6.5	36.2 ~ 47.0
Connecting rod cap bolt	27.5~31.4+88°~92°	2.8~3.2+88°~92°	20.3~23.1+88°~92°
Driveplate	117.7 ~127.5	12.0 ~ 13.0	86.8 ~ 94.0
Timing system			
Drive belt tensioner upper mounting	82.6 ~ 84.3	7.4 ~ 8.6	53.6 ~ 62.2
Drive belt tensioner lower mounting	28.4 ~ 34.3	2.9 ~ 3.5	21.0 ~ 25.3
Timing chain case bolt(6×16)	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Timing chain case bolt(8×35)	19.6 ~ 25.5	2.0 ~ 2.6	14.5 ~ 18.8
High pressure fuel pump	64.7 ~ 74.5	6.6 ~ 7.6	47.7 ~ 55.0
Timing chain tensioner lever bolt	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Timing chain guide bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Crankshaft bolt	186.3~205.9+58°~62°	19.0~21.0+58°~62°	137.4~151.9+58°~62°
Alternator bracket	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Alternator	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Front chain cover bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Front chain cover bolt	19.6 ~ 25.5	2.0 ~ 2.6	14.5 ~ 18.8
Chain cap assembly bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Vacuum pump	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Drive belt idler	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Idler pulley	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Cylinder head			
Fuel feed and return hose or pipe	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Engine hanger bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Water outlet fitting	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head cover bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Camshaft bearing ladder bolt	13.7 ~ 15.7	1.4 ~ 1.6	10.1 ~ 11.6

Item	N.m	kgf.m	lb-ft
Camshaft position sensor mounting	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head bolt	58.8+88°~92°+118°~122°	6.0+88°~92°+118° ~ 122°	43.4+88°~92°+118°~122°
Cooling system			
Water pump pulley bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Thermostat housing	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Water outlet duct bolts	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Radiator upper mounting bracket	6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
Shroud mounting bolts	4.9 ~ 7.8	0.5 ~ 0.8	3.6 ~ 5.8
Lubrication system			
Oil pump assembly	19.6 ~ 26.5	2.0 ~ 2.7	14.5~ 19.5
Oil pump chain tensioner	7.6~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Baffle plate	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil filter and cooler assembly	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil gauge bracket	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil filter cap	24.5	2.5	18.1
Upper oil pan bolt 1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan bolt 2	29.4 ~ 33.3	3.0 ~ 3.4	21.7 ~ 24.6
Lower oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolt	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Intake and exhaust system			
Inlet lower manifold assembly	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Inlet upper manifold assembly	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Exhaust gas recirculation valve mounting	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Exhaust gas recirculation exhaust pipe	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Turbocharger and warm-up catalytic converter heat protector	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Turbocharger and warm-up catalytic converter mounting	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Warm-up catalytic converter bracket mounting	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Turbocharger oil return pipe bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Turbocharger oil feed pipe nut	18.6 ~ 25.5	1.9 ~ 2.6	13.7 ~ 18.8
Turbocharger oil feed pipe eyebolt	26.5 ~ 32.4	2.7 ~ 3.3	19.5 ~ 23.9
Turbocharger oil feed pipe mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

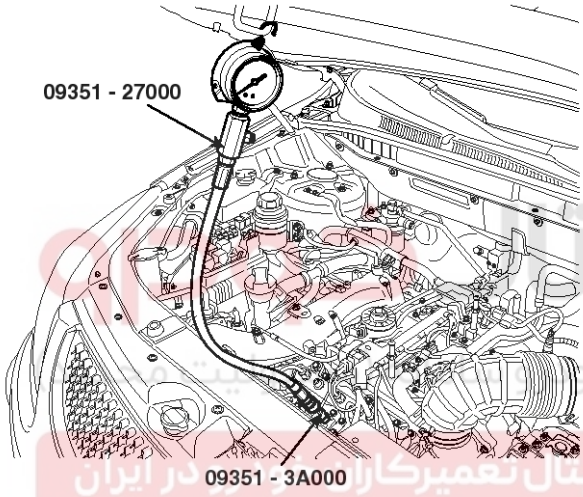
Item	N.m	kgf.m	lb-ft
Turbocharger mounting bolt	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 35.3
Exhaust pipe heat protector	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Heater pipe and hose bracket mounting	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Turbocharger and exhaust pipe assembly mounting bolt	40.2 ~ 53.9	4.1 ~ 5.5	29.7 ~ 39.8
Turbocharger and exhaust pipe assembly mounting bolt	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Exhaust manifold mounting	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Exhaust manifold heat protector mounting	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Front muffler mounting nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

Compression Pressure Inspection

NOTICE

- *If the there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.*
- *Whenever removing injectors for compression pressure inspection, replace the gaskets with new ones and tighten them with the specified torque.*

1. Warm up engine until the normal operating temperature(80~95°C(176-203°F)).
2. Remove the injectors. (Refer to Injector in FL Group)
3. Check the cylinder compression pressure.
   1) Insert a compression gauge SST(09351-27000, 09351-3A000) into the injector hole.



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   2) Fully open the throttle.
   3) While cranking the engine, measure the compression pressure.

      NOTICE

      Always use a fully charged battery to obtain engine speed of 220rpm or more.

   4) Repeat step 1) though 3) for each cylinder.

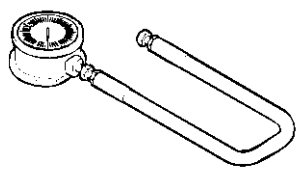
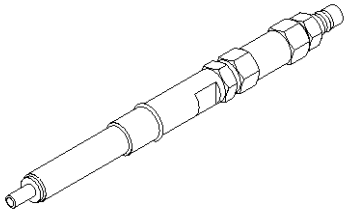
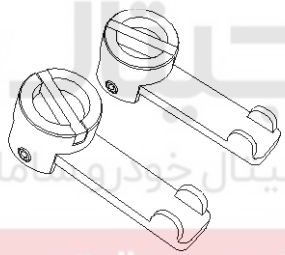
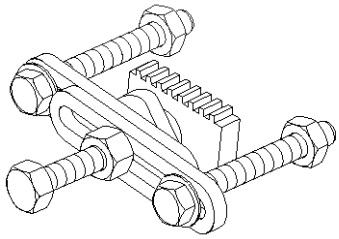
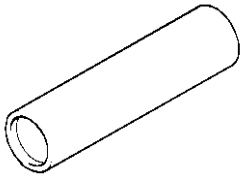
      NOTICE

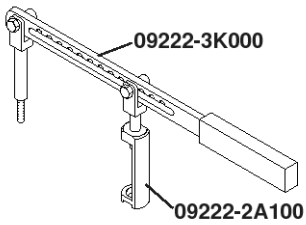
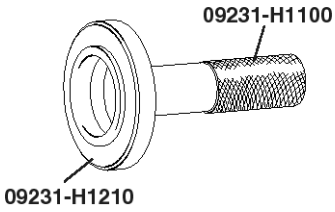
      This measurement must be done in as short a time as possible.

Compression pressure :
2,745.85kPa (28.0kg/cm², 398.25psi) (220 rpm)
Minimum pressure :
2,255.52kPa (23.0kg/cm², 327.14psi)

   5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat step 1) through 3) for cylinders with low compression.
      - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
      - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
      - If pressure doesn't rise despite dropping oil on the pistons because of low pressure in the neighboring cylinders, it can be caused by a poor cylinder head gasket or stained oil or coolant in the cylinder head.
4. Reinstall the injectors. (Refer to Injector in FL Group)

Special Service Tools

Tool (Number and name)	Illustration	Use
Compression gauge (09351-27000)	 LCGF148A	Checking engine compression pressure
Compression gauge adapter (09351-3A000)	 LCGF060A	Checking engine compression pressure
Camshaft locking tool (09231-3A000)	 SENEM7091D	Fixation of timing chain and camshaft sprocket
Flywheel stopper (09231-2A100)	 SHDEM6201D	Removal and installation of crankshaft pulley bolt.
Valve stem oil seal installer (09222-2A000)	 LCAC030D	Installation of valve stem oil seals

Tool (Number and name)	Illustration	Use
Valve spring compressor (09222-3K000) Valve spring compressor adapter (09222-2A100)	 LCGF059A	Removal and installation of intake and exhaust valves
Crankshaft rear oil seal installer (09231-H1210) Handle (09231-H1100)	 SENEM7233D	Installation of crankshaft rear oil seal

Engine And Transaxle Assembly

Removal

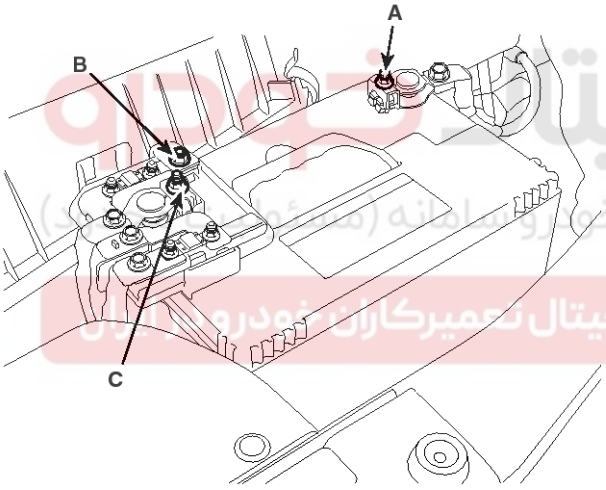
CAUTION

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

NOTICE

- *Mark all wiring and hoses to avoid misconnection.*

1. After recovering refrigerant, drain coolant and oil from the engine and the transaxle.
2. Remove the nut(A) from the (-) terminal of the battery.
3. Remove the nut(B) from the (+) terminal of the battery.
4. Remove the nut(C) from the (+) terminal of the battery.



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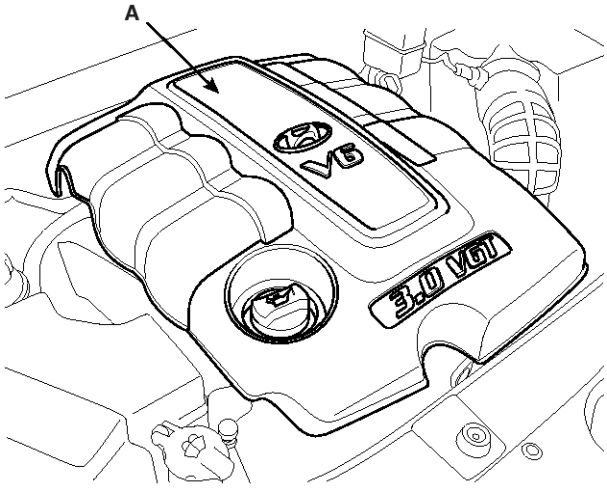
5. Remove the engine cover(A).

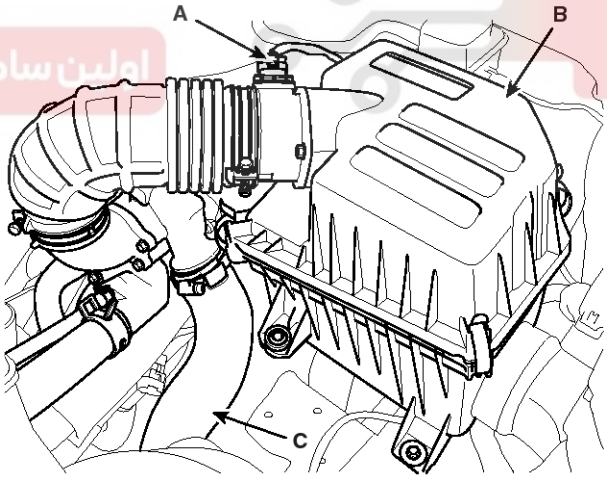


SENEM7070D

6. Disconnect the Air flow sensor connector(A) and remove the air cleaner assemlby(B) and the intercooler hose(C).

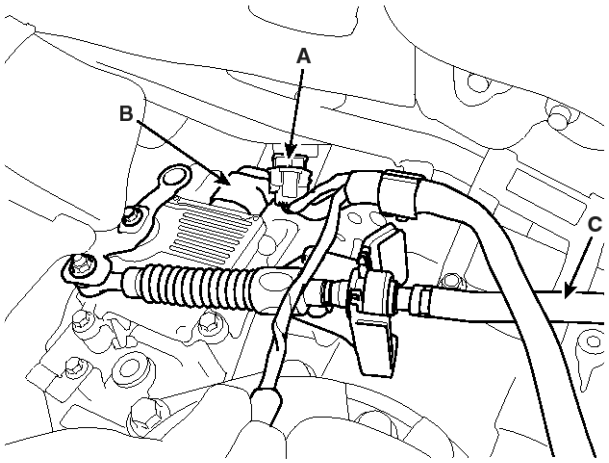
NOTICE

Using a plier, take off the cap. After it removed, there will be another (-) cap which you can use a (-) driver.



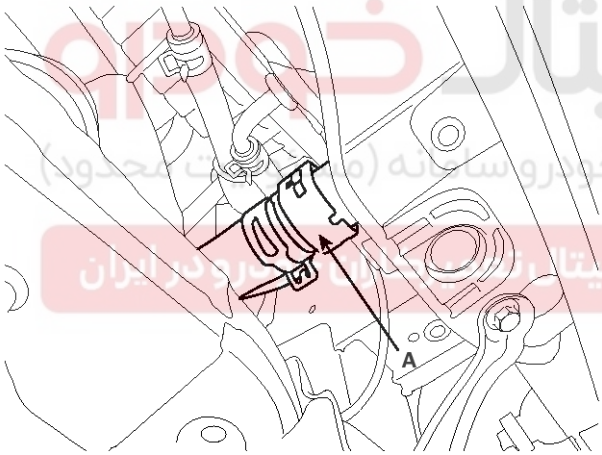
SENEM7071D

7. Disconnect the transaxle side gound line, crankshaft position sensor(CKP) connector(A) and transaxle control module(TCM) connector(B) and remove the shift cable(C).



SENEM7072D

8. Remove the radiator upper and lower hoses(A).

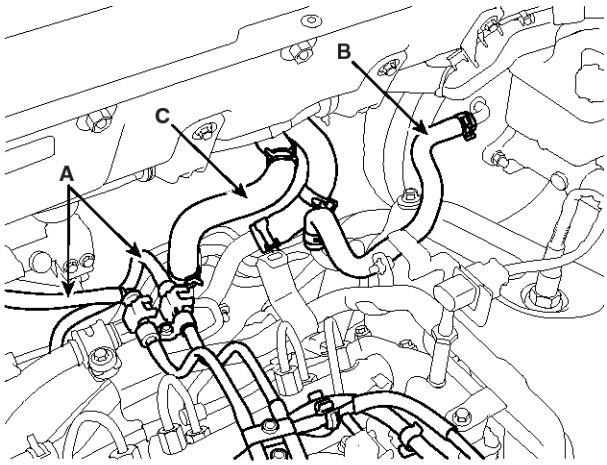


SENEM7073D

NOTICE

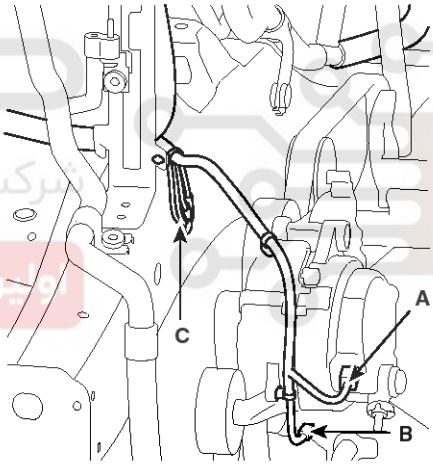
When removing a lower hose, it is possible to disconnect the hose without loosening the clamp because it has a quick-connector-type connector.

9. Disconnect the fuel hoses(A), brake vacuum hose(B) and heater hoses(C).



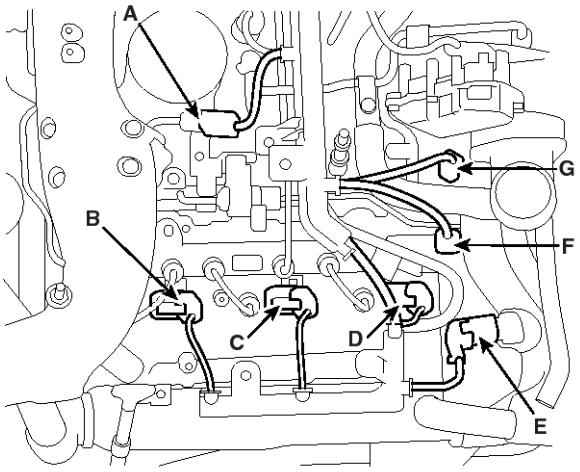
SENEM7074D

10. Remove the engine wire harness connectors and control cable from the engine.



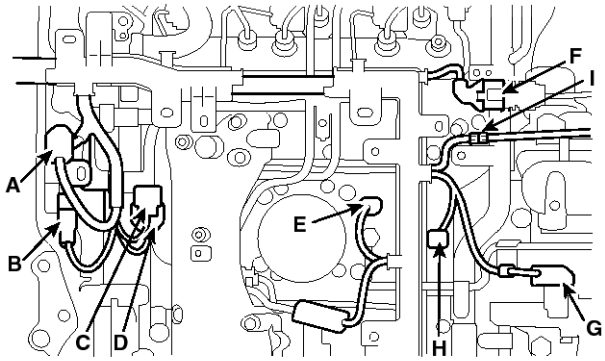
SENEM7075D

1) Disconnect the alternator connector(A).
2) Disconnect the air conditioning compressor connector(B).
3) Disconnect the engine front side ground line(C).



SENEM7076D

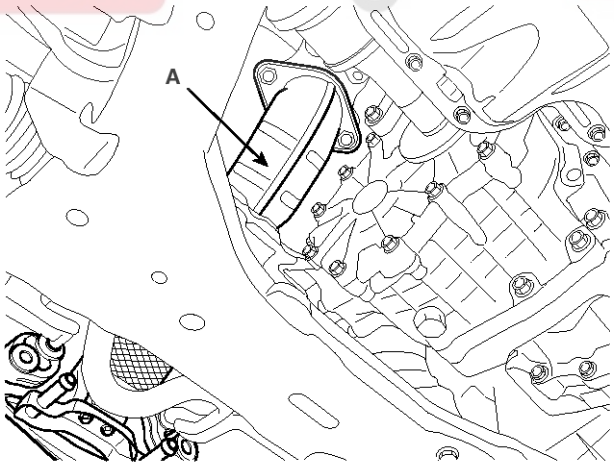
4) Disconnect the fuel meter and temperature sensor(A).
5) Disconnect the No. 2/4/6 injector connectors(B/C/D).
6) Disconnect the exhaust gas recirculation(EGR) actuator connector(E).
7) Disconnect the rail pressure valve connector(F).
8) Disconnect the engine coolant temperature(ECT) sensor connector(G).



SENEM0101L

9) Disconnect the glow plug control unit(GCU) connectors(A,B).
10) Disconnect the rail pressure sensor connector(C).
11) Disconnect the injector and camshaft position sensor(CMP) extection connector(D).
12) Disconnect the oil pressure switch(E).
13) Disconnect the lambda sensor connector(F).
14) Disconnect the electric VGT sensor connector(G).
15) Disconnect the swirl actuator connector(H).
16) Disconnect the exhaust gas temperature sensor connector (I). (if equipped with DPF)
17) Disconnect the gound line from the engine room junctino box.

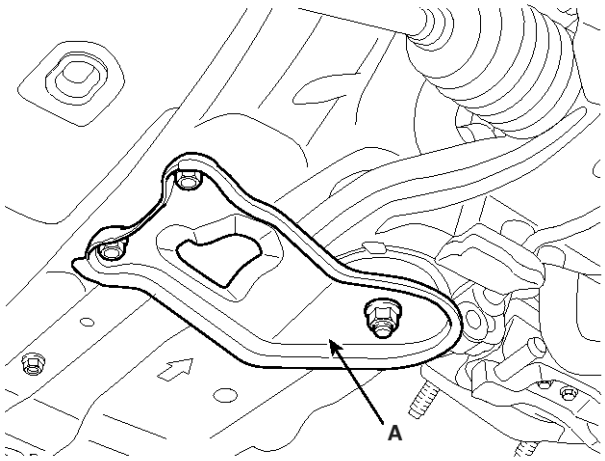
11. Disconnect the intercooler hose and the automatic transaxle fluid(ATF) cooler hose.
12. Remove the power steering return hose.
13. Remove the under cover.
14. Drain power steering oil.
15. Remove the front wheels and tires.
16. Disconnect the driveshafts from the front axles by removing the driveshaft lock-pins, lock-nuts and the washers.
17. Disconnect the lower arm ball joint mounting, the stabilizer bar link and the steering tie rod mounting.
18. Remove the steering joint mounting bolt.
19. Remove the front muffler(A).



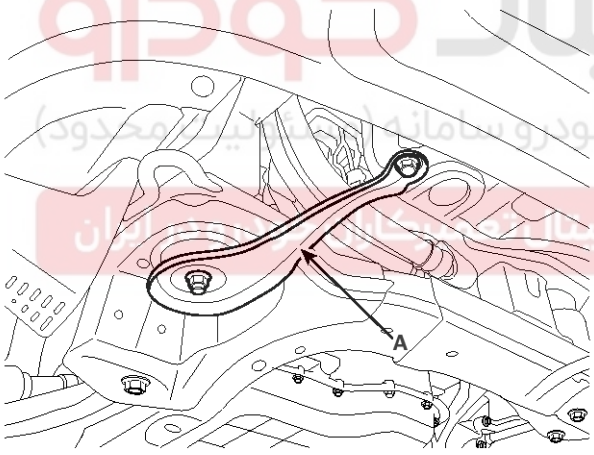
SENEM7078D

20. For the vehicles equipped with 4WD system, remove the propella shaft.
21. Remove the subframe stay(A) bolts and nuts.

Tightening torque :
68.6 ~ 88.3Nm (7.0 ~ 9.0kgf.m, 50.6 ~ 65.1lb-ft)



SENEM7079D



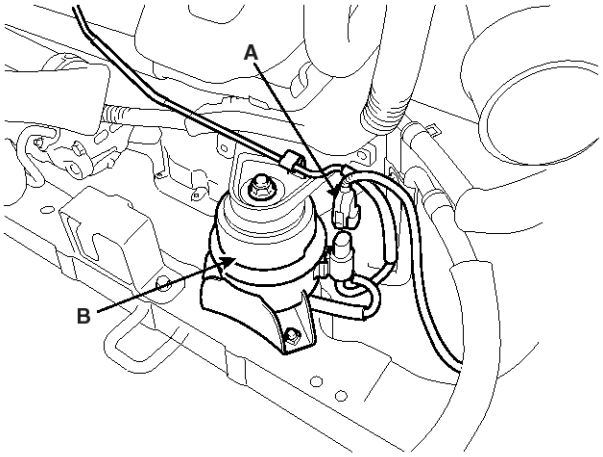
SENEM7080D

22. After removing the accustic shied, remove the transaxle mounting under bolts.
23. Remove the drive plate bolts.

Tightening torque :
117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)

24. Remove the front roll stopper under mounting bolts and disconnect the electric controlled mounting(ECM) solenoid connector(A).

Tightening torque :
49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



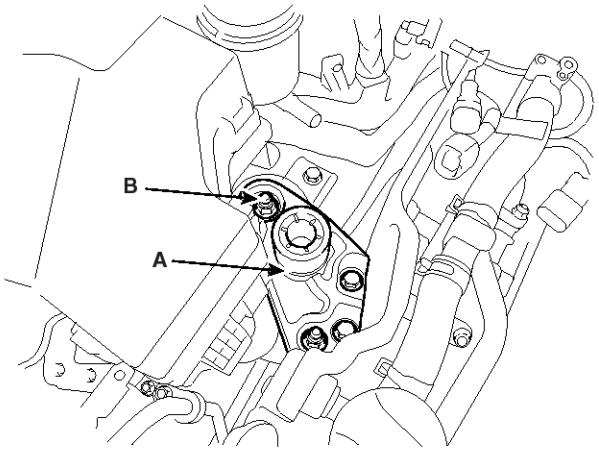
SENEM7081D

25. Using a floor jack, support the engine and transaxle assembly.

NOTICE
Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

26. Remove the engine mounting support bracket(A).

Tightening torque :
63.7 ~ 83.4Nm (6.5 ~ 8.5kgf.m, 47.0 ~ 61.5lb-ft)
78.5 ~ 103.0Nm (8.0~10.5kgf.m, 57.9~75.9lb-ft) - Nut B



SENEM7082D

27. Remvoe the transaxle mounting bracket(A).(Refer to Transaxle in 'AT' Group).
28. Remove the sub frame bolts and nuts.

Tightening torque :
137.3 ~ 156.9Nm (14.0 ~ 16.0kgf.m, 101.3 ~ 115.7lb-ft)

29. Remove the engine and transaxle assembly by lifting vehicle.

NOTICE
When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

Installation

Installation is in the reverse order of removal.

Perform the followings :

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

Engine Mounting

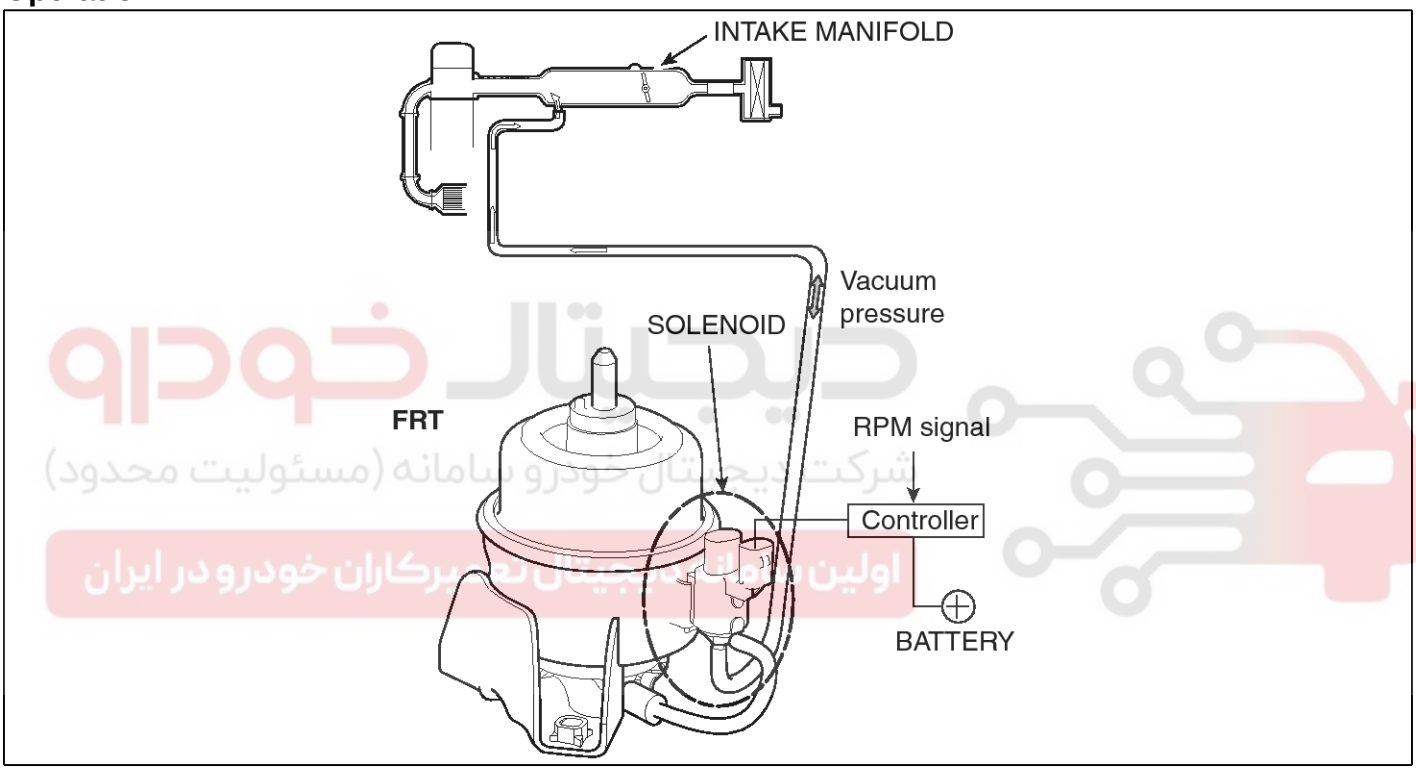
Description

Electronic Controlled Mounting(ECM)(it can also be called 'Semi-active mounting') , unlike hydraulic mountings before, is a controllable hydraulic mounting which gives a high damping value in driving and also reduce viblation with a low damping value and a spring coefficient at idle.

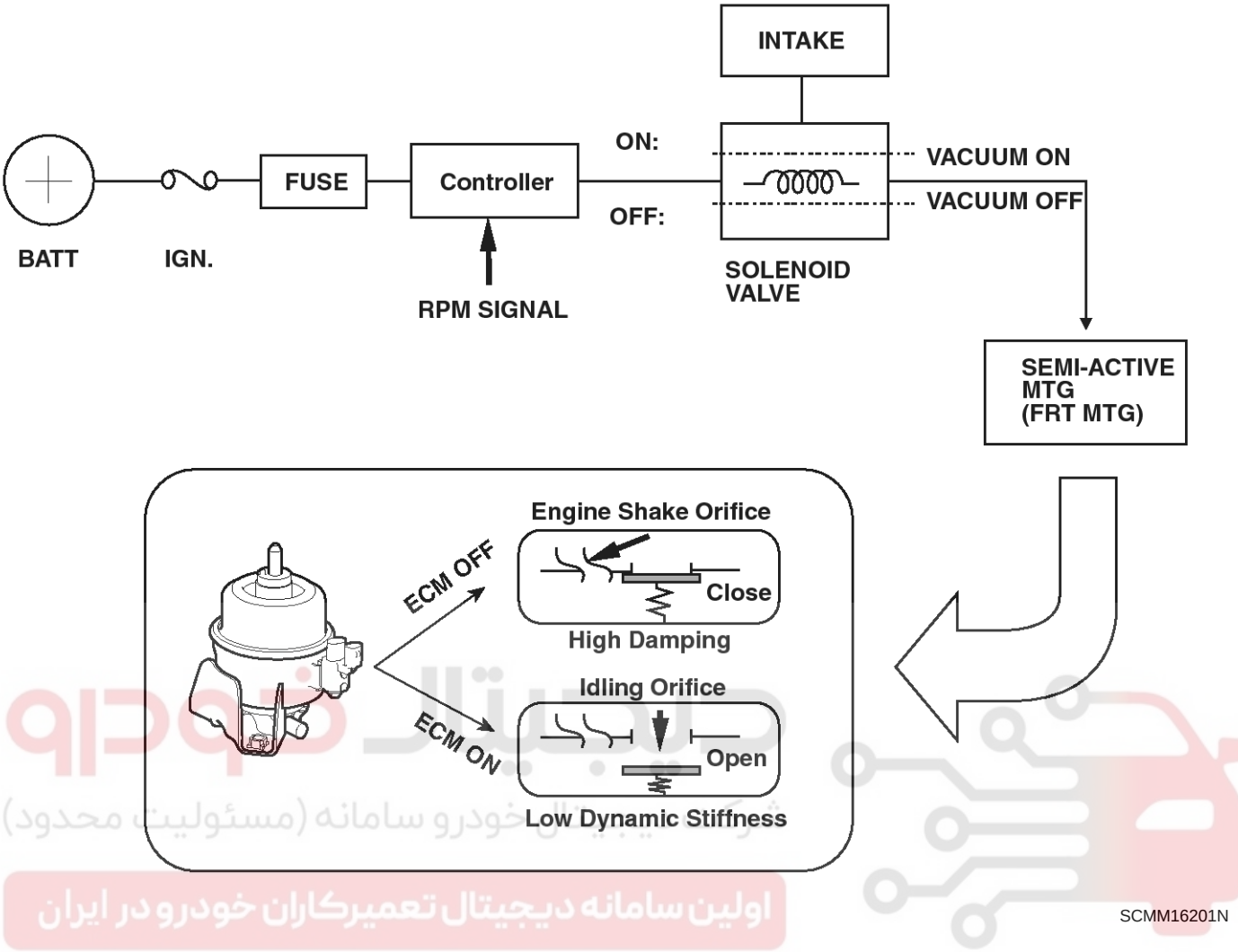
This system is composed of a control module, solenoid valve and a diaphragm for ON/OFF in it.

At idle, the control module receives a RPM signal and give it to the solenoid valve. As the valve opens or closes, vacuum pressure in the intake system goes to the diaphragm for opening the orifice. By opening the orifice, the mounting has a low damping value and a low spring coefficient for reducing viblation.

Operation



SENM17200L



Troubleshooting

The engine vibrates excessively when idling.

Check idle speed:
Warm up the engine to mornal operating temperature (the cooling fan comes on).

Is the idle speed less than 880rpm?

NO → Adjust the idle speed to the regulation spec.

YES

Check the front mounting control system:

1. Fully depress the brake pedal and shift the transaxle in 'D' range.

2. Have an assistant connect and disconnect the 2P connector from the front mount control solenoid valve.

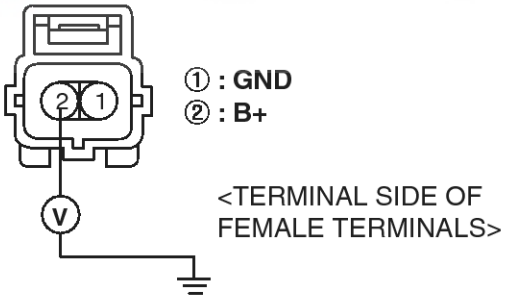
Is there a noticeable change in idle smoothness when the

YES → Reconnect the 2P connector to the solenoid valve. (The front mounting control system is OK).

NO

Test the front mount control solenoid valve wire:

1. Shift to 'N' or 'P' position.
2. Disconnect the 2P connector from the enfine mount control solenoid valve.
3. Measure voltage between the power terminal and body ground.



Is there battery voltage?

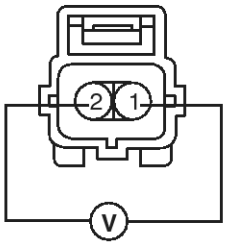
NO → - Repair open in power wire between the connector and the fuse.
- Check or replace relay or fuse.

YES

SENM17100L

Test the front mount control solenoid valve wire:

1. Measure voltage betweem the terminals of the connector.



<TERMINAL SIDE OF FEMALE TERMINALS>

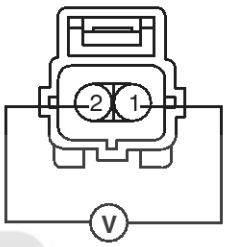
Is there battery voltage?

NO → - Repair open betweem the terminals of the connector.
- If the wire is OK, check the input/output signals to the controller and substitute a known-good controller and recheck.

YES

Test the front mount control solenoid valve wire:

1. Raise the engine speed above 1040rpm.
2. Measure voltage betweem the terminals of the connector.



<TERMINAL SIDE OF FEMALE TERMINALS>

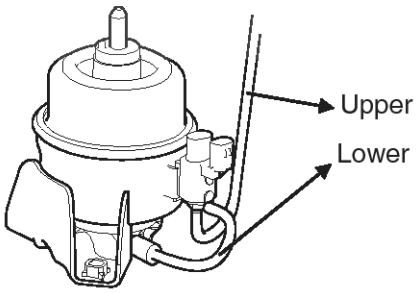
Is there battery voltage?

YES → - Repair short in ground wire between the controller and the connector.
- If the wire is OK, check the input signal to the controller and substitute a known-good controller and recheck.

NO

Test the front mount and vacuum hose:

1. Disconnect the lower vacuum hose from the front mount solenoid valve, and connect a vacuum pump/gauge to the hose.
2. Apply vacuum(more than 350mmHg) for 20 senconds.

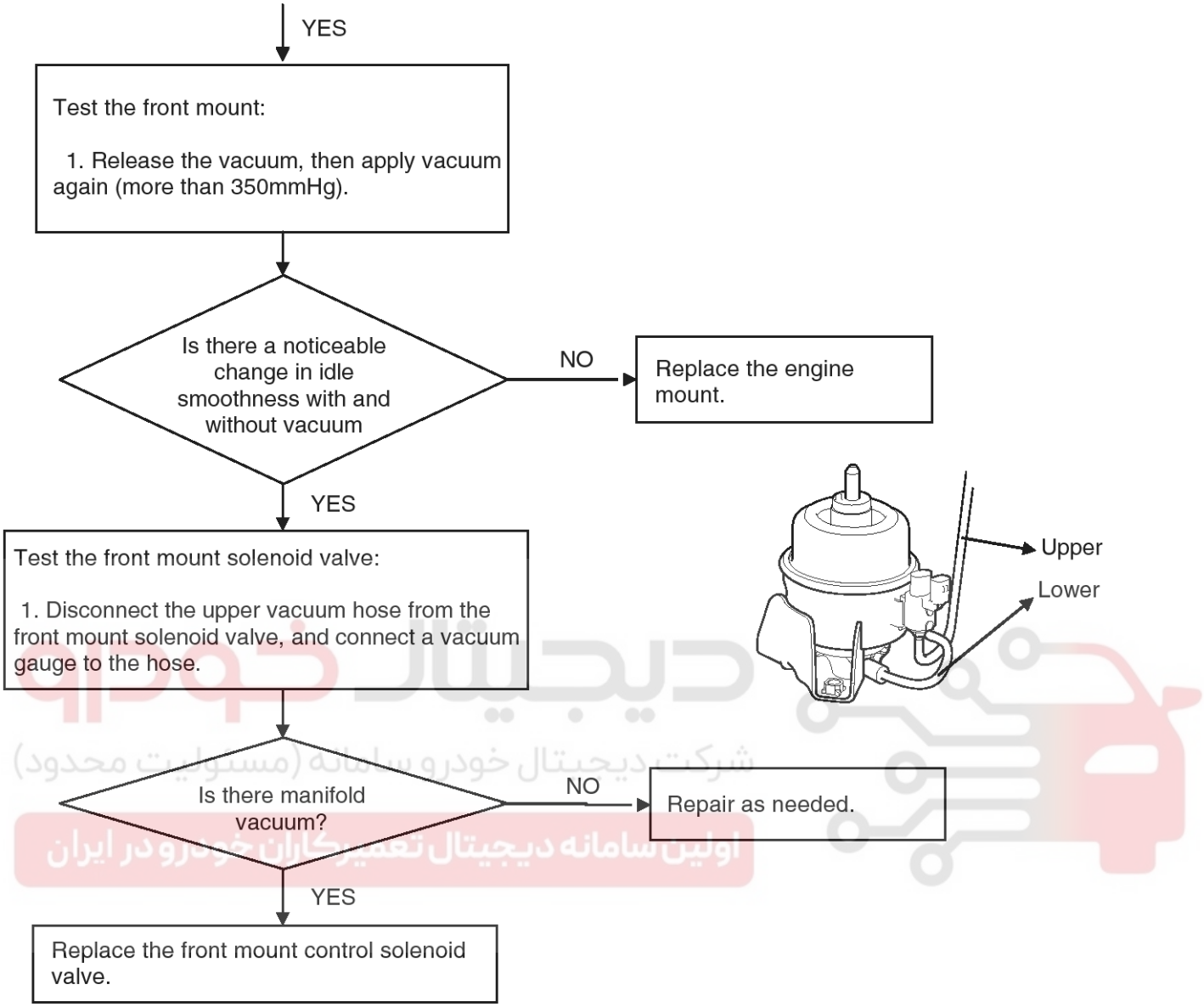


Does the engine mount hold vacuum?

NO → - Replace the vacuum hose.
- Replace the engine mount.

YES

SENM17101L

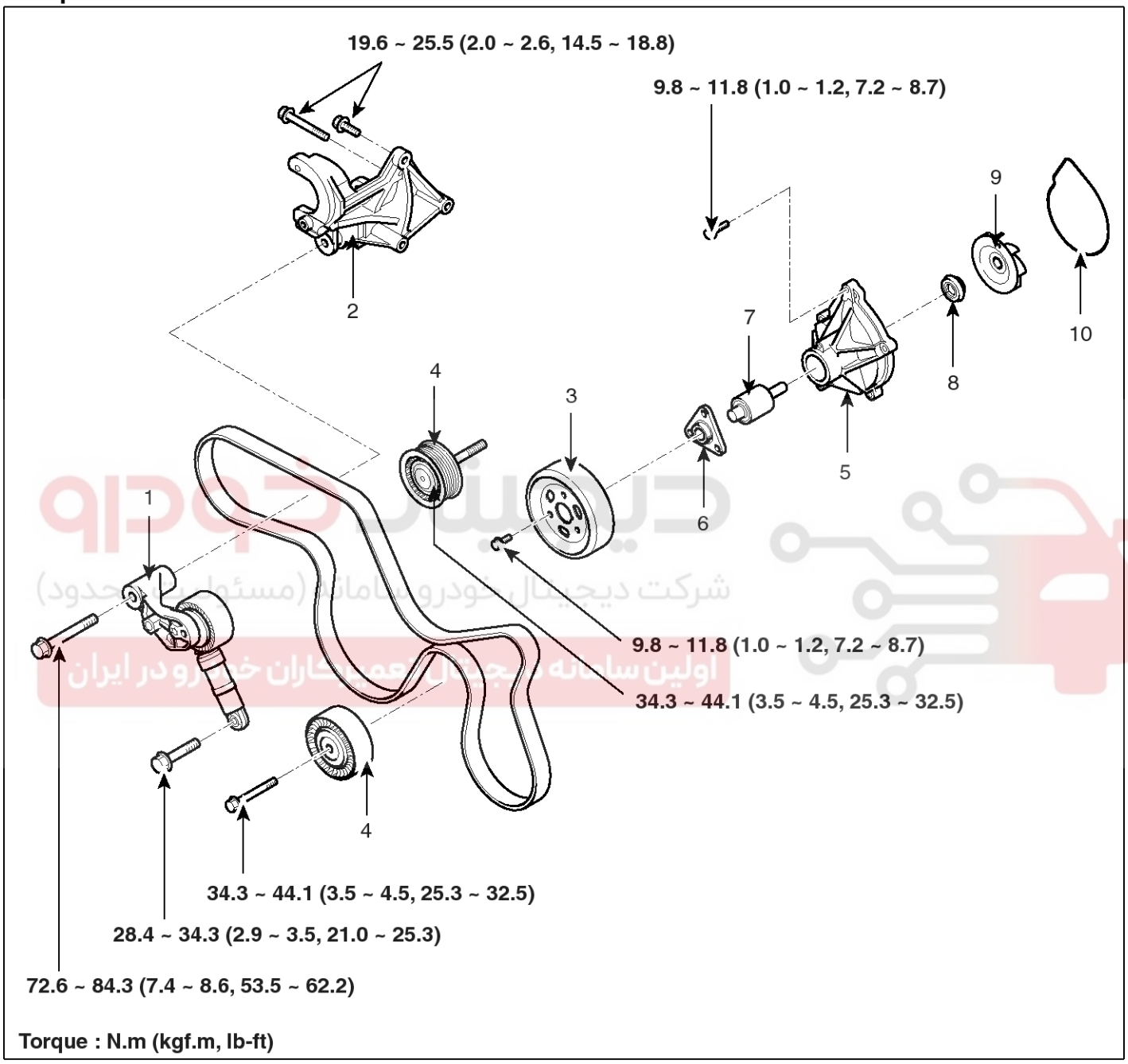


SCMM16204N

Timing System

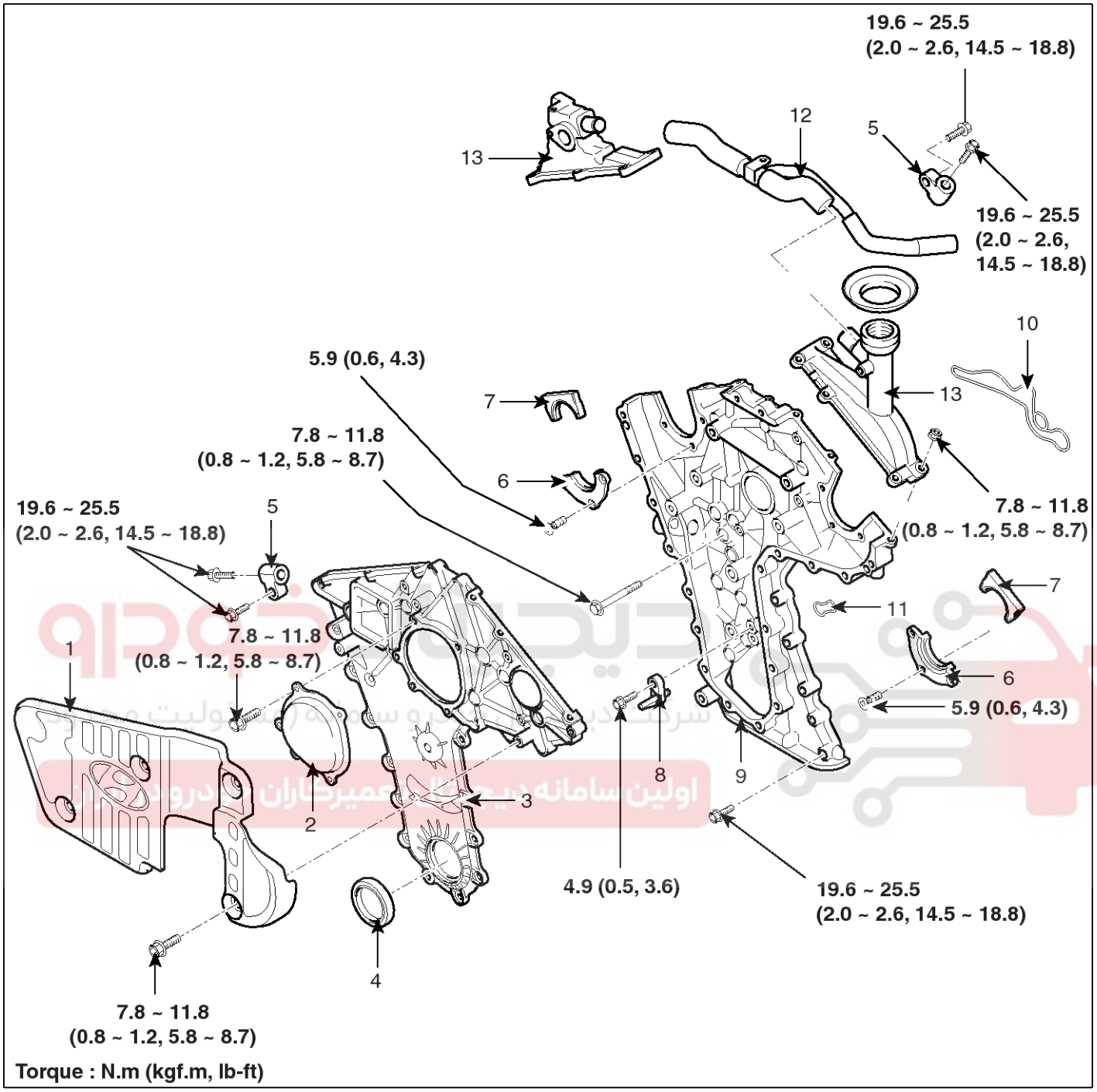
Timing Chain

Components



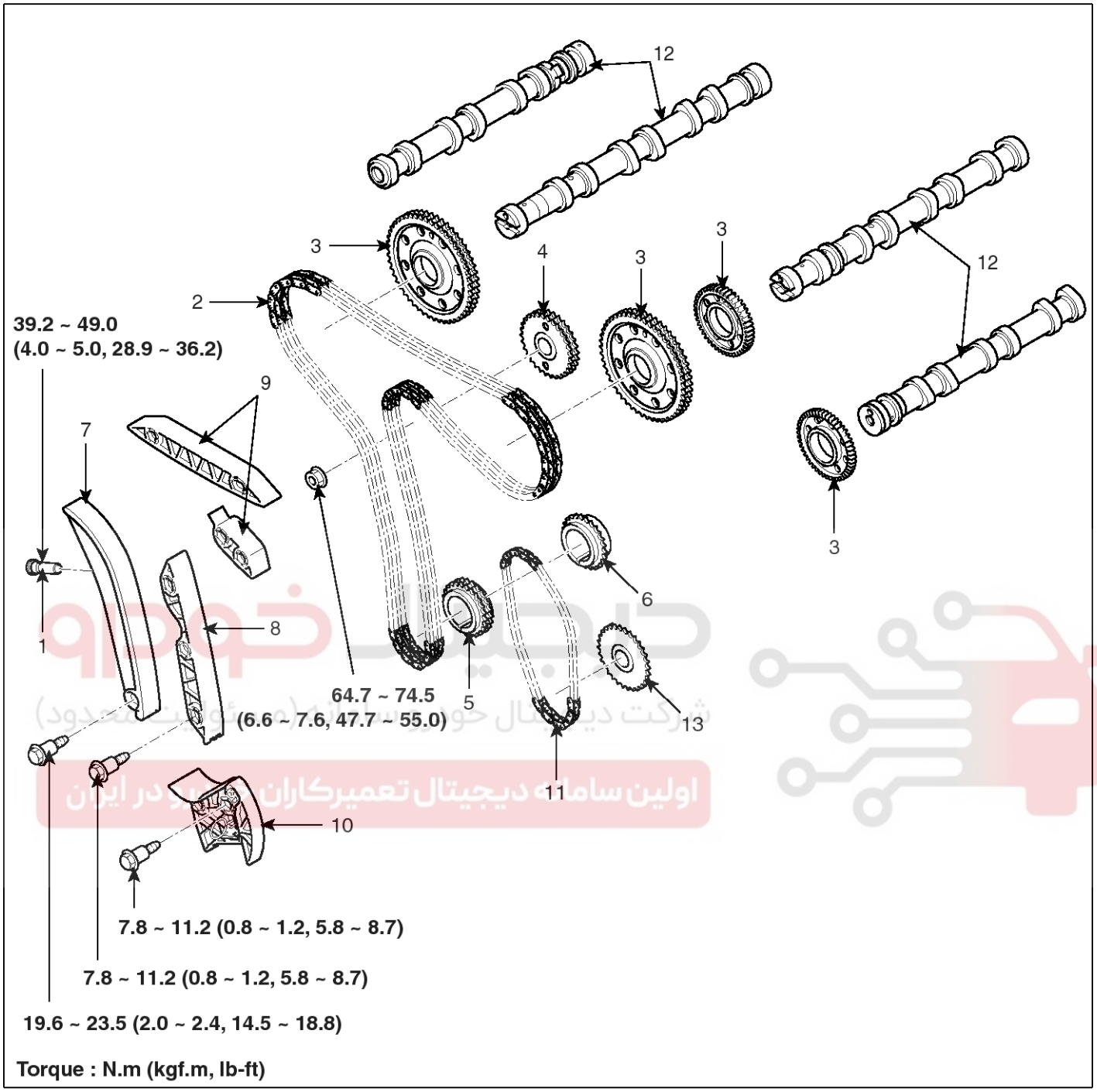
SENEM9001L

1. Drive belt tensioner
2. Power steering bracket
3. Water pump pulley
4. Drive belt idler
5. Water pump
6. Water pump pulley flange
7. Water pump bearing
8. Seal unit
9. Water pump impeller
10. Water pump gasket



SENEM9002L

1. Front cover
2. High pressure pump service cover
3. Chain front cover
4. Front oil seal
5. Chain case bracket
6. Lower head seal
7. Upper head seal
8. Chain oil jet
9. Chain case
10. Upper O-ring
11. Lower O-ring
12. Inlet hose
13. Chain case cap



SENEM9003L

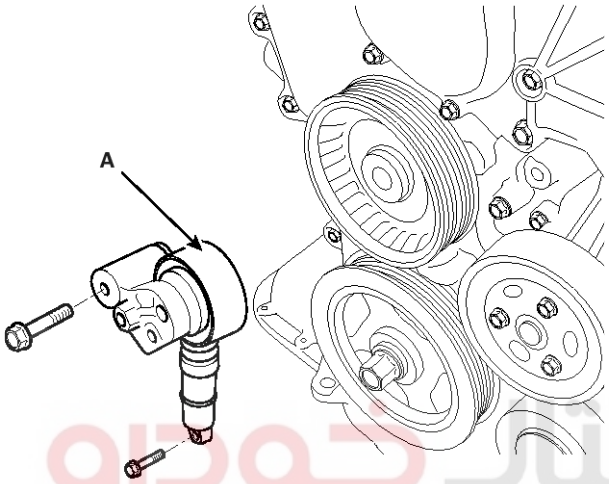
1. Hydraulic tensioner
2. Timing chain
3. Camshaft sprocket
4. High pressure pump sprocket
5. Crankshaft sprocket
6. Oil pump sprocket
7. Tensioner lever
8. Lower chain guide
9. Upper chain guide
10. Oil pump chain tensioner
11. Oil pump chain
12. Camshaft
13. Oil pump drive sprocket

Removal

1. Compressing the tensioner with a wrench in a left hand by turning it clockwise, start removing the drivebelt from the water pump side idler.

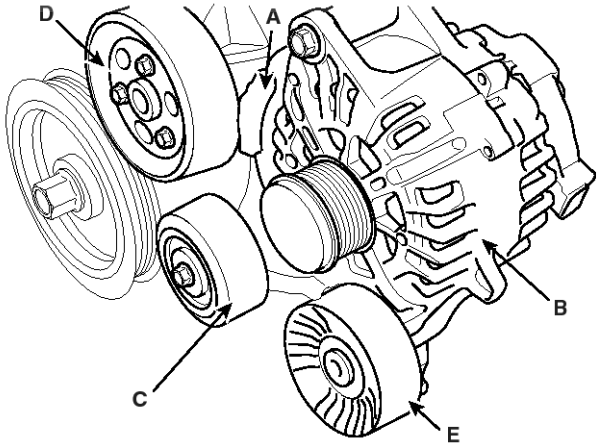
   NOTICE
   Conform to what is described above because tension of the belt in this engine is higher than ones of other engines for preventing a slip.

2. Remove the drive belt tensioner(A).



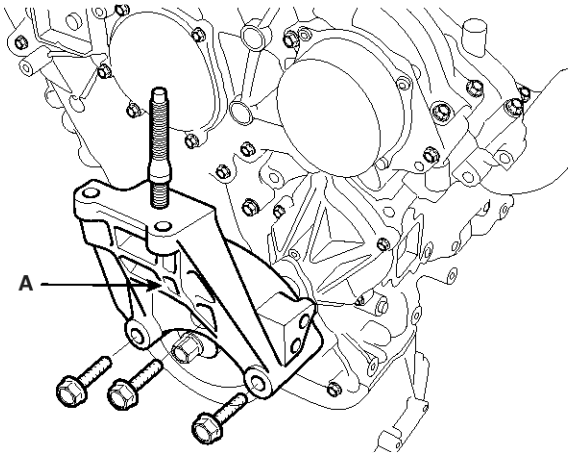
SENEM7068D

3. Remove the power steering bracket.
4. Remove the idler pulley(E).
5. Remove the water pump pulley(D).
6. Remove the drive belt idler(C).
7. Remove the alternator(B) with its bracket(A).



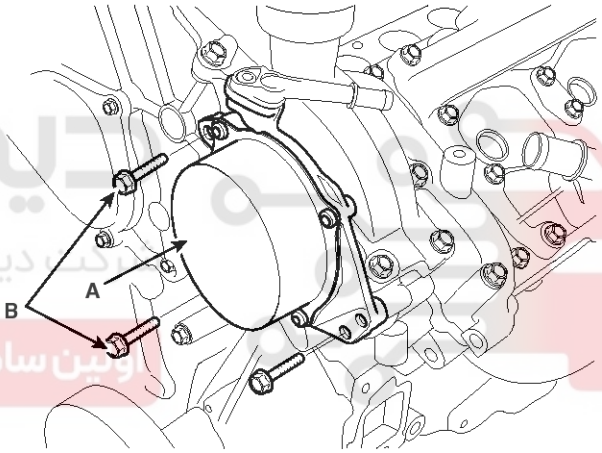
SENEM7067D

8. Remove the engine hanger.
9. Remove the engine support bracket(A).



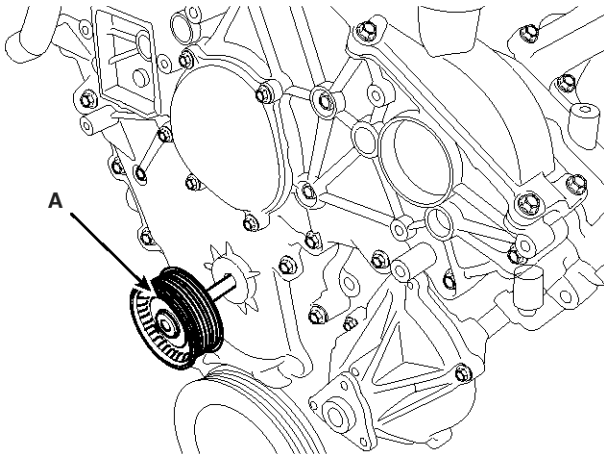
SENEM7066D

10. Remove the vacuum pump(A).



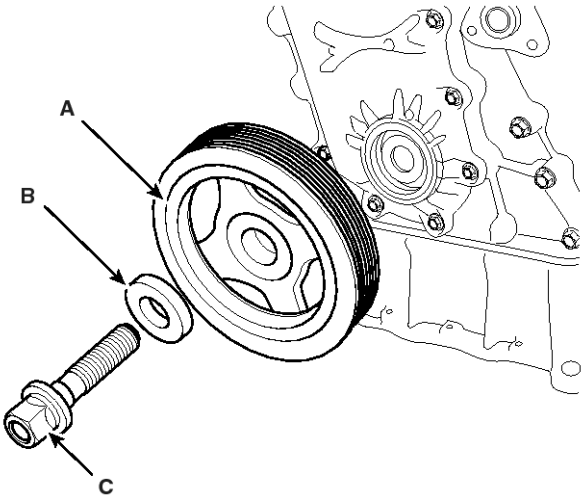
SENEM7065D

11. Remove the vacuum pump(A).



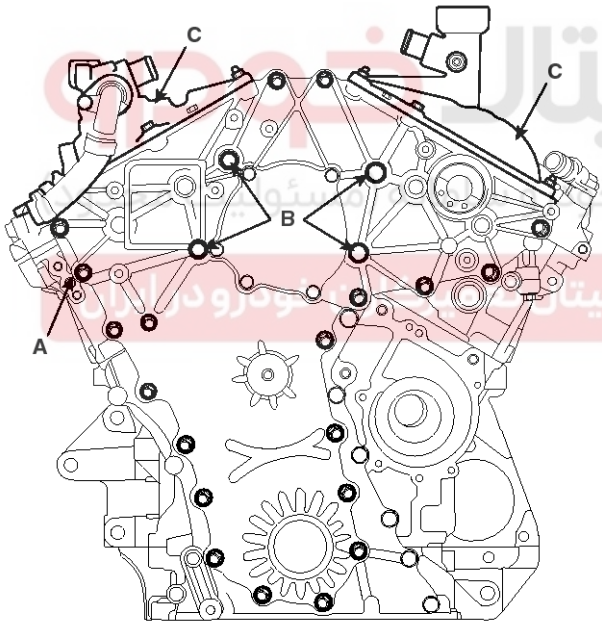
SENEM7064D

12. Remove the crankshaft pulley(A) with its washer(B) and mounting bolt(C).



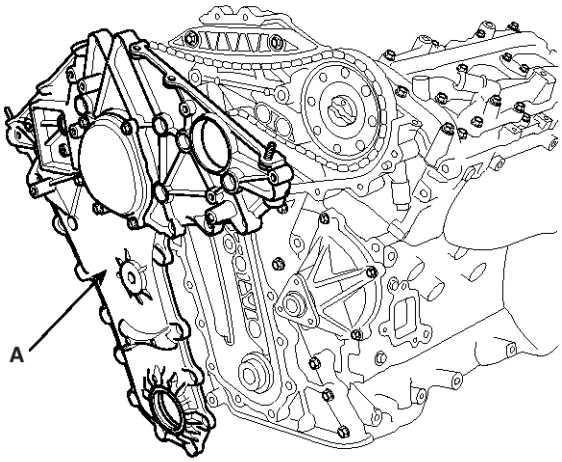
SENEM7062D

13. Remove the chain caps(C) and loosen the front chain cover mounting bolts(A-20EA, B-4EA).



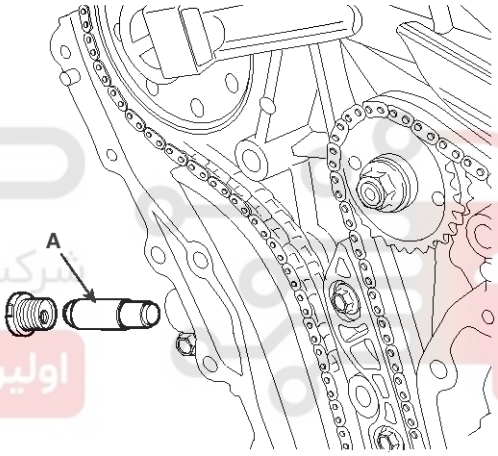
SENEM7061D

14. Remove the front chain cover(A).



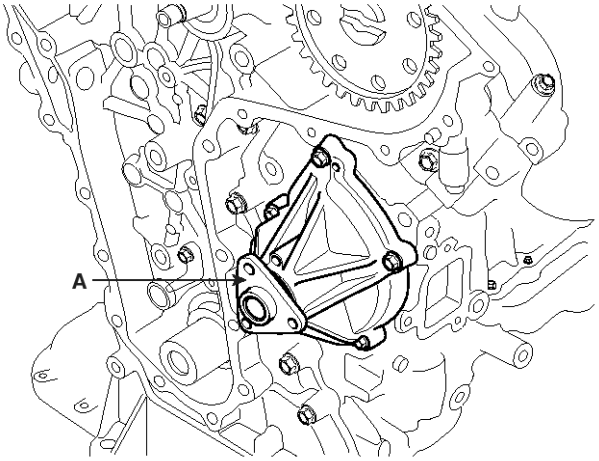
SENEM7060D

15. Remove the hydraulic tensioner(A).



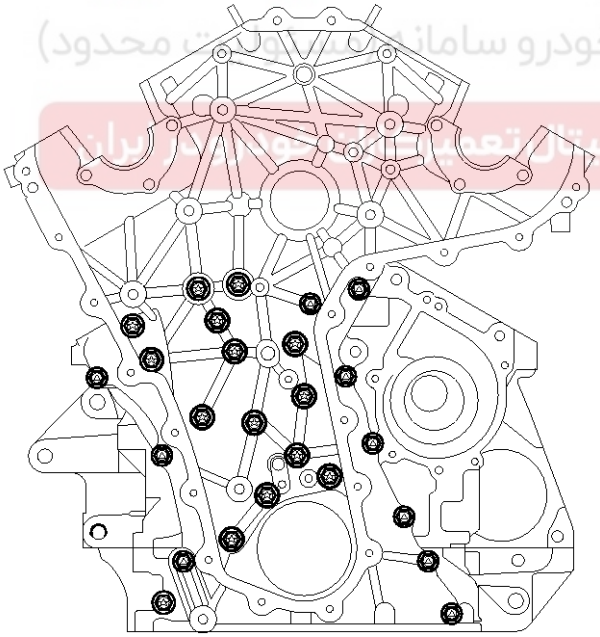
SENEM7058D

16. Remove the timing chain with the chain guide and the tensioner lever.
17. Remove the high pressure fuel pump sprocket(A).
18. Remove the upper head seal.
19. Remove the water pump(A) with its gasket.



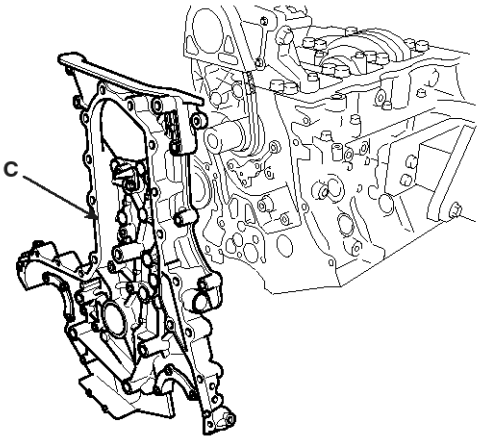
SENEM7056D

20. Remove the high pressure pump.
21. Remove the chain case mounting bolts.



SENEM7024D

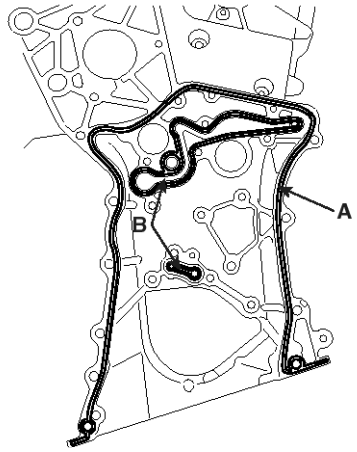
22. Remove the chain case assembly(C).



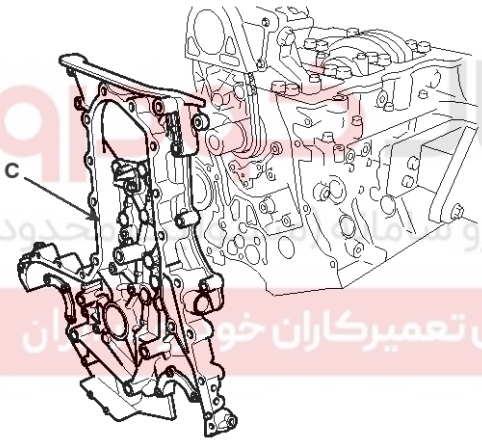
SENEM7023D

Installation

1. Applying sealant(A) on the groove and checking the O-rings(B) seated firmly, install the chain case assemlby(C) within fifteen minutes.



SENEM7022D



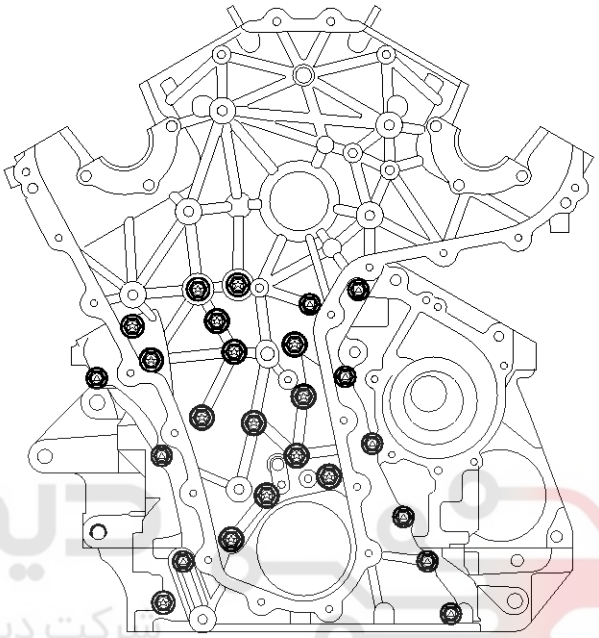
SENEM7023D

2. Tighten the chain case mounting bolts with the specified torque.

Tightening torque :

13.7 ~ 17.7Nm (1.4 ~ 1.8kgf.m, 10.1 ~ 13.0lb-ft) - 6×16(★)

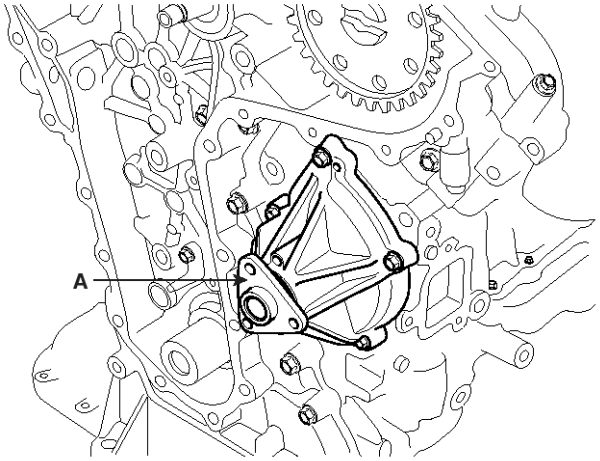
19.6 ~ 25.5Nm (2.0 ~ 2.6kgf.m, 14.5 ~ 18.8lb-ft) - 8×35(▲)



SENEM7024D

3. Install the water pump(A) with a new gasket.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) - 6×16(★)



SENEM7056D

4. Install the high pressure pump.
5. Applying sealant, install the upper head seal.
6. Install the high pressure fuel pump sprocket(A).

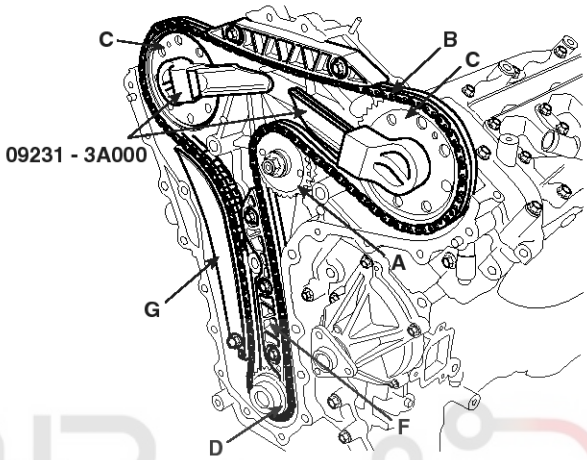
Tightening torque :
64.7 ~ 74.5Nm (6.6 ~ 7.6kgf.m, 47.7 ~ 55.0lb-ft)

7. Install the timing chain(B), aligning the timing marks(E) on the camshaft sprocket(C) and the crankshaft sprocket(D).
8. After timing chain's installation, fix the camshaft system by using the SST(09231-3A000).

9. Install the chain guide(F) and the tensioner lever(G).

Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft) - chain guide
19.6 ~ 23.5Nm (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft) - tensioner lever

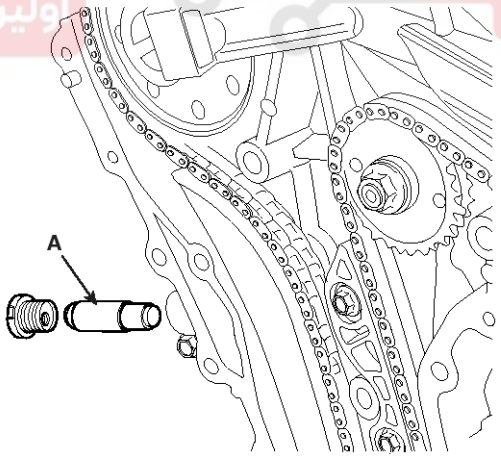
NOTICE
If you have diffculty in installing of the lower chain guide, turn the driveplate or move the SST a little bit.



SENEM7057D

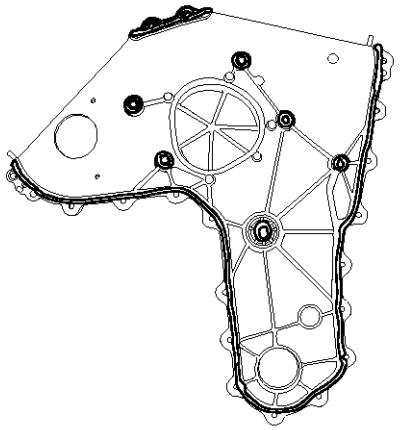
10. Install the hydraulic tensioner(A).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

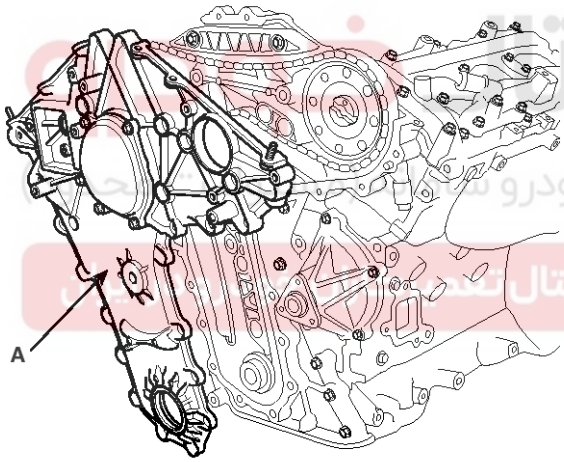


SENEM7058D

11. Confirm that the timing marks are on the right positon and remove the SST(09351-3A000).
12. Applying sealant on the front chain cover sealing surface, install the front chain cover within a fifteen minutes.



SENEM7059D



SENEM7060D

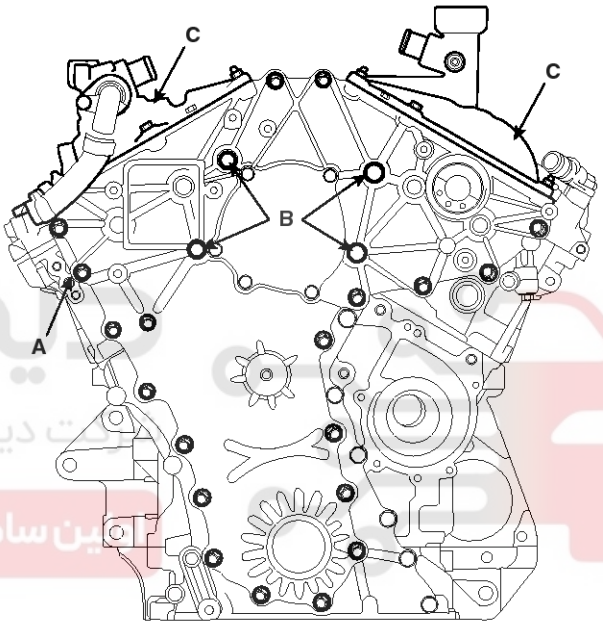
13. Tighten the front chain cover mounting bolts(A-20EA, B-4EA).

Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft) - 20EA
19.6 ~ 25.5Nm (2.0 ~ 2.6kgf.m, 14.5 ~ 18.8lb-ft) - 4EA

14. Applying sealant on the groove of the chain caps(C), install the caps within a fifteen minutes.

Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

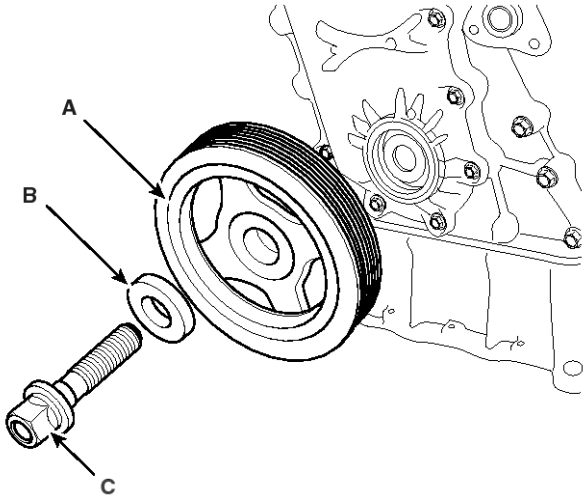
NOTICE
Install it after removing sealant from the camshaft bearing ladders.



SENEM7061D

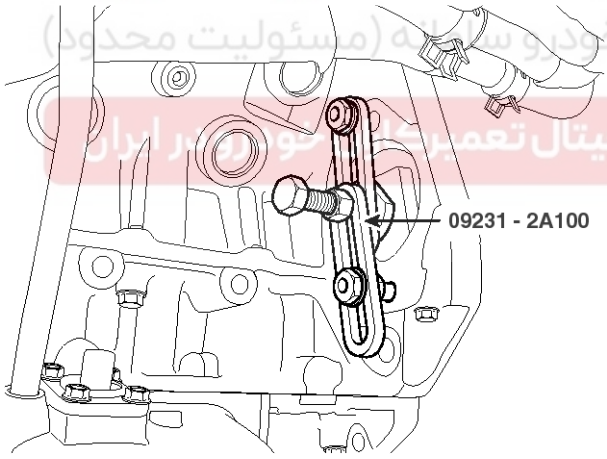
15. Install the crankshaft pulley(A) with its washer(B) and tighten the mounting bolt(C).

Tightening torque :
186.3 ~ 205.9Nm (19 ~ 21kgf.m, 137.4 ~ 151.8lb-ft) + 58˚ ~ 62˚



SENEM7062D

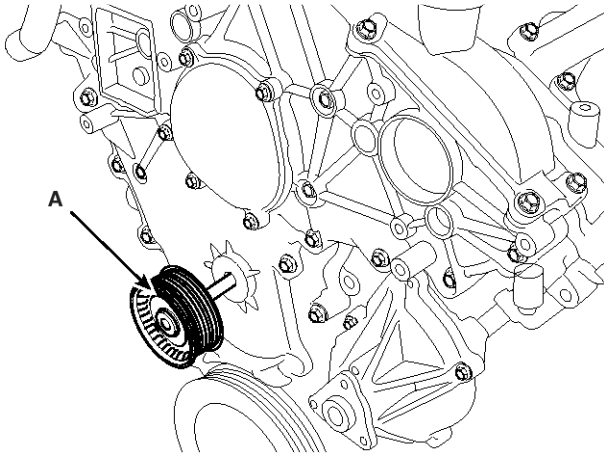
NOTICE
After removing the starter and installing the SST(09231-2A100), tighten the crankshaft bolt.



SENEM7063D

16. Install the drive belt idler(A).

Tightening torque :
34..3 ~ 44.1Nm (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)

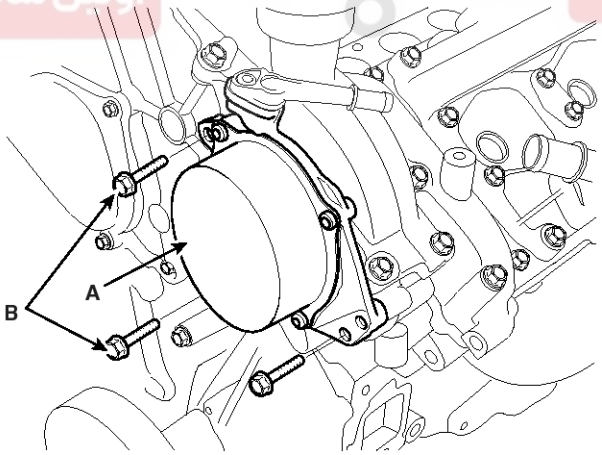


SENEM7064D

17. Install the vacuum pump(A).

NOTICE
- *When reassembling, check if the O-ring is damaged and apply sealant.*
- *Align the nod of the pump.*
- *The two bolts(B) of the three mounting ones should be sealed with the LOCTITE.*

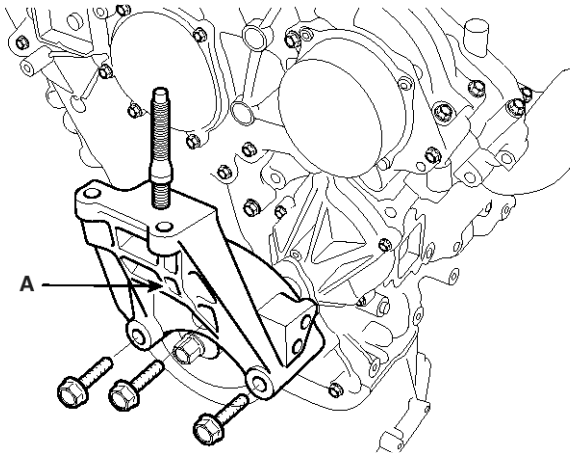
Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



SENEM7065D

18. Install the engine support bracket(A).

Tightening torque :
42.2 ~ 53.9Nm (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lb-ft)



SENEM7066D

19. Install the engine hanger.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

20. Install the alternator(B) with its bracket(A).

Tightening torque :
29.4 ~ 41.2Nm (3.0 ~ 4.2kgf.m, 21.7 ~ 30.4lb-ft) - alternator
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft) - bracket

21. Install the drive belt idler(C).

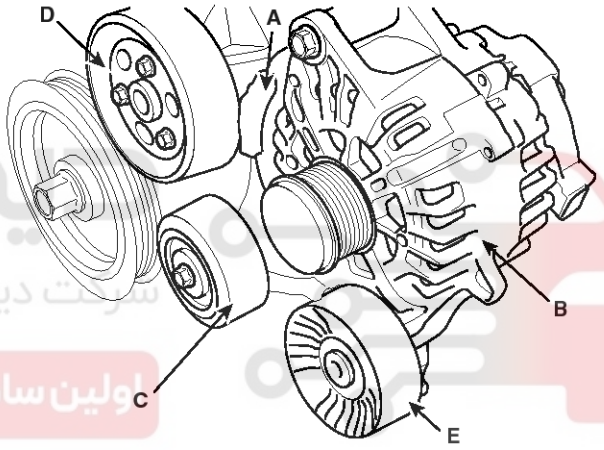
Tightening torque :
34.3 ~44.1Nm (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)

22. Install the water pump pulley(D).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

23. Install the idler pulley(E).

Tightening torque :
34.3 ~ 44.1Nm (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)



SENEM7067D

24. Install the power steering bracket.
25. Install the drive belt tensioner(A).

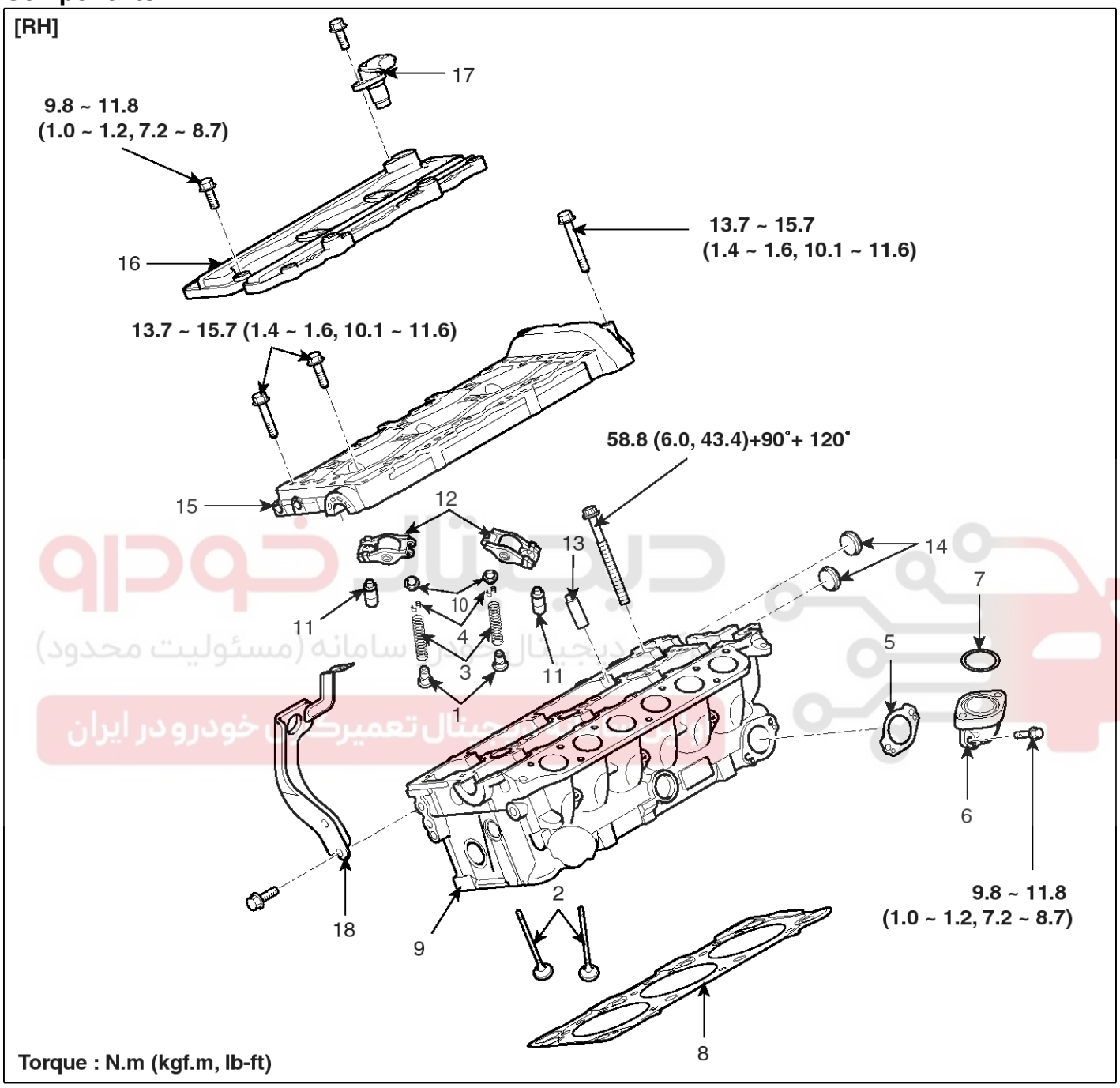
Tightening torque :
72.6 ~ 84.3Nm (7.4 ~ 8.6kgf.m, 53.5 ~ 62.2lb-ft) - upper
28.4 ~ 34.3Nm (2.9 ~ 3.5kgf.m, 21.0 ~ 25.3lb-ft) - lower

26. Compressing the tensioner with a wrench in a left hand by turning it clockwise, put on the belt lastly with the water pump side idler.

NOTICE
Conform to what is described above because tension of the belt in this engine is higher than ones of other engines for preventing a slip.

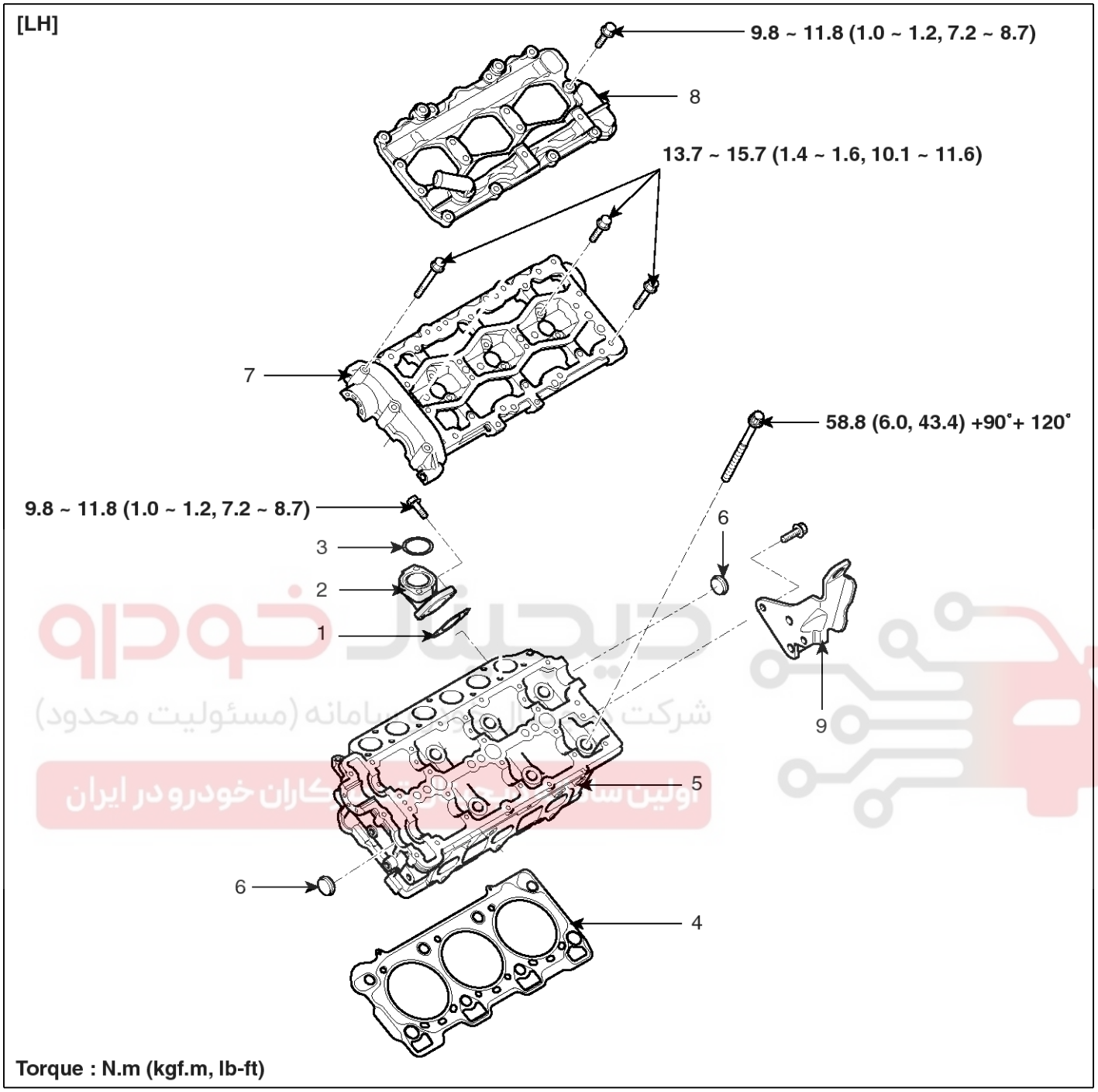
Cylinder Head Assembly

Components



SENEM9004L

1. Valve stem seal
2. Valve
3. Valve spring
4. Valve spring retainer lock
5. Water outlet fitting gasket
6. Water outlet fitting
7. Water outlet fitting O-ring
8. Cylinder head gasket
9. Cylinder head
10. Valve spring upper retainer
11. Hydraulic lash adjuster(HLA)
12. Cam follower
13. Valve guide
14. Sealing cap
15. Camshaft bearing ladder
16. Cylinder head cover
17. Camshaft position sensor(CMP)
18. Engine hanger

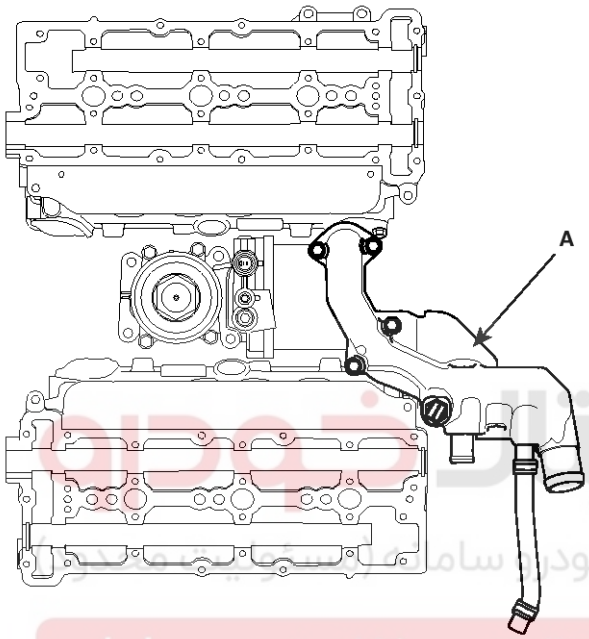


SENEM9005L

1. Water outlet fitting gasket
2. Water outlet fitting
3. Water outlet fitting O-ring
4. Cylinder head gasket
5. Cylinder head
6. Sealing cap
7. Camshaft bearing ladder
8. Cylinder head cover
9. Engine hanger

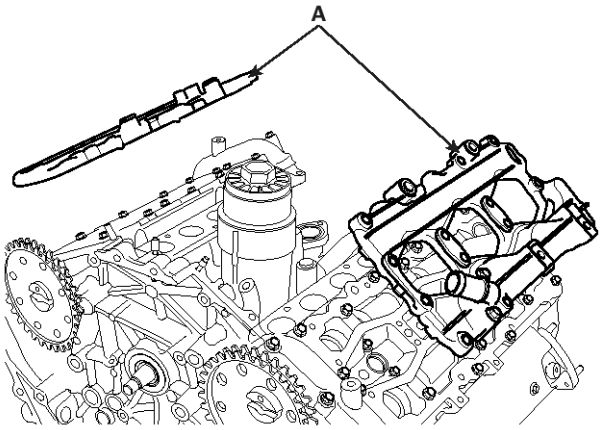
Removal

1. Remove the drive belt.
2. Remove the timing chain.
3. Remove the intake and exhaust manifold.
4. Remove the high pressure pipe, the injectors and the delivery pipe.
5. Remove the glow plug wiring.
6. Remove the water outlet duct(A).



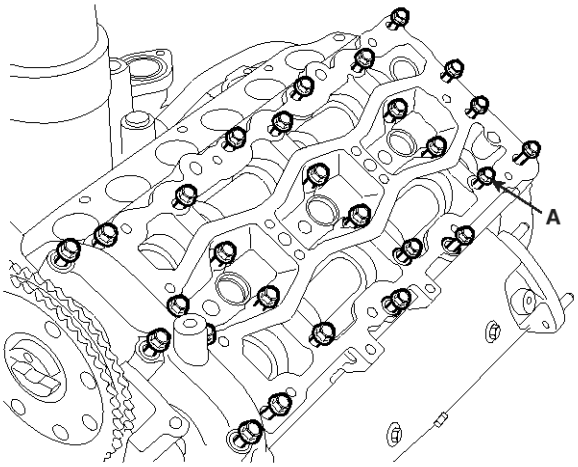
SENEM7055D

7. Remove the cylinder head cover(A).



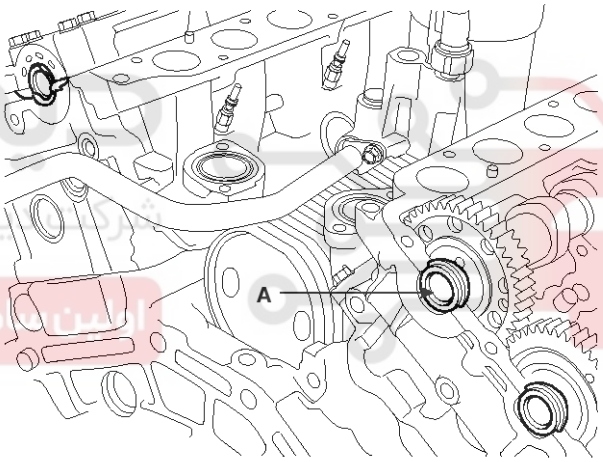
SENEM7053D

8. Remove the camshaft bearing ladder(A).



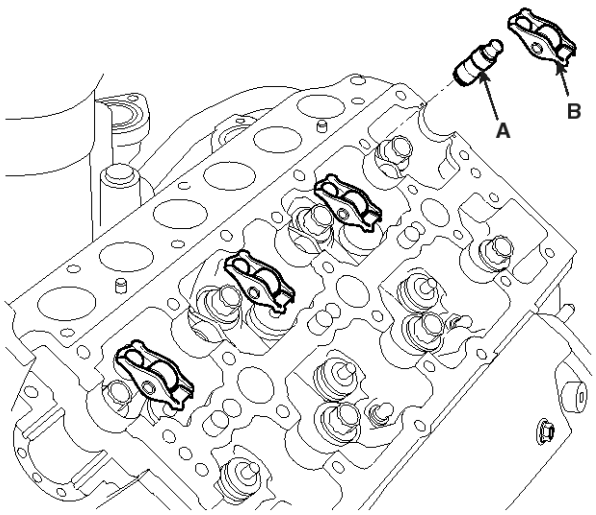
SENEM7050D

9. Remove the sealing cap(A) from the cylinder head assembly.



SENEM7049D

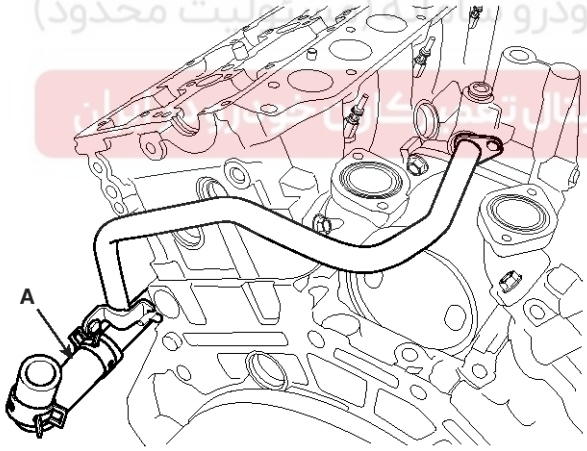
10. Remove the camshafts.
11. Remove the HLA(hydraulic lash adjuster)(A) and the cam follower assembly(B).



SENEM7045D

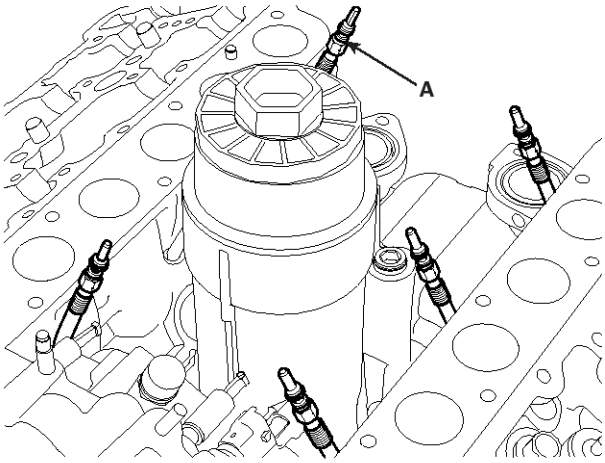
1) After you removing it, HLA shall be held upright so that oil in it should not spill and be assured that dust does not adhere to it.

12. Remove the water pipe and hose assembly(A).



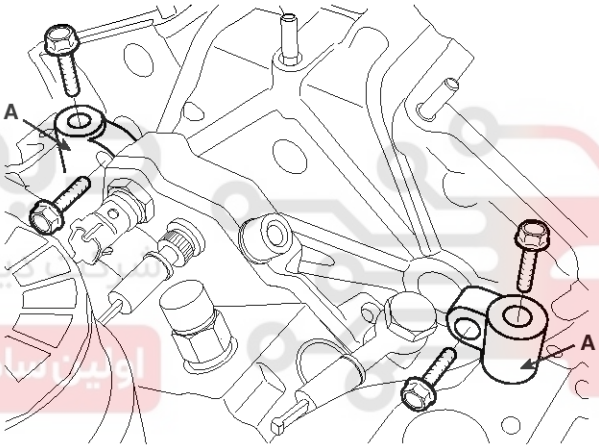
SENEM7043D

13. Remove the glow plugs(A).

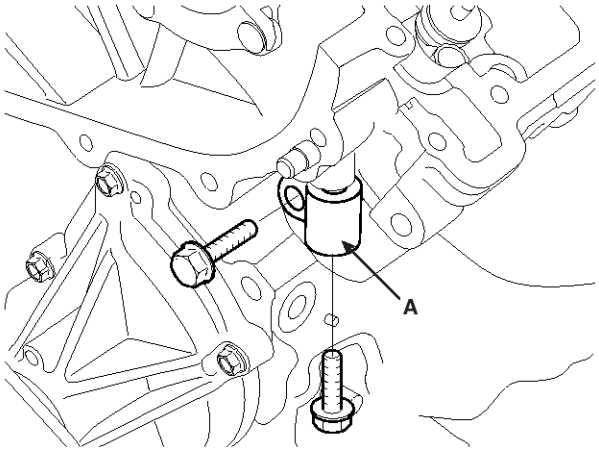


SENEM7042D

14. Remove the timing chain case bracket(A).



SENEM7040D



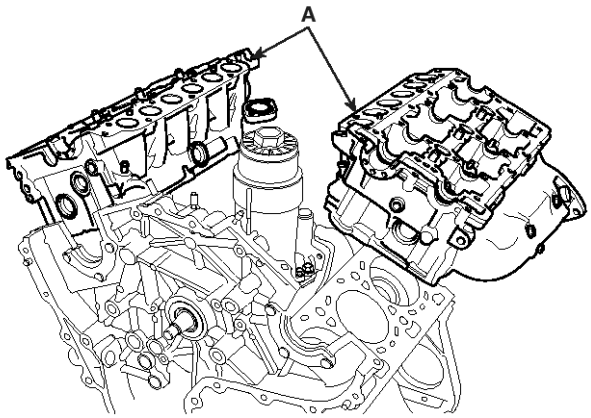
SENEM7041D

15. Remove the cylinder head bolts.

NOTICE

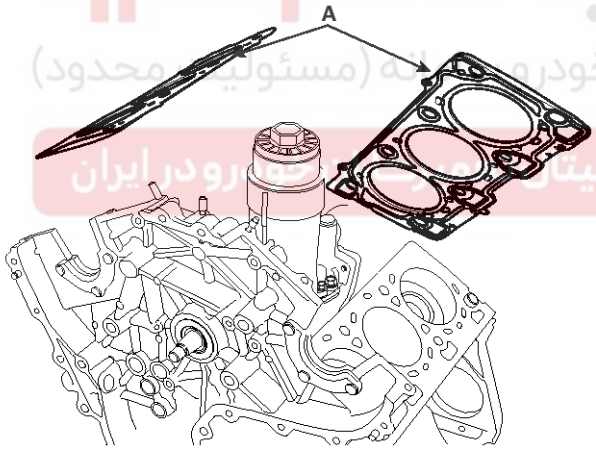
Do not reuse the cylinder head bolts more than twice.

16. Remove the cylinder head quietly in order not to damage the gasket with the bottom part of the end.



SENEM7038D

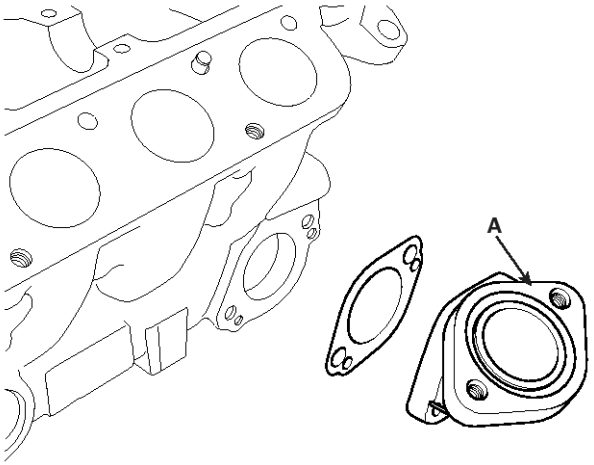
17. Remove the cylinder head gasket(A) on the cylinder block.



SENEM7037D

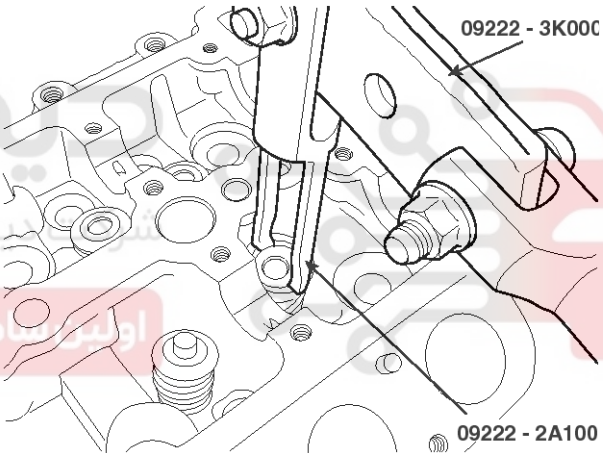
Disassembly

1. Remove the water outlet fitting(A).



SENEM7034D

2. Using the SST(09222-2A100, 09222-3K000), compress the spring and remove the retainer locks.



SENEM7033D

3. Remove the valve, valve spring and spring retainer.

Reassembly

NOTICE

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

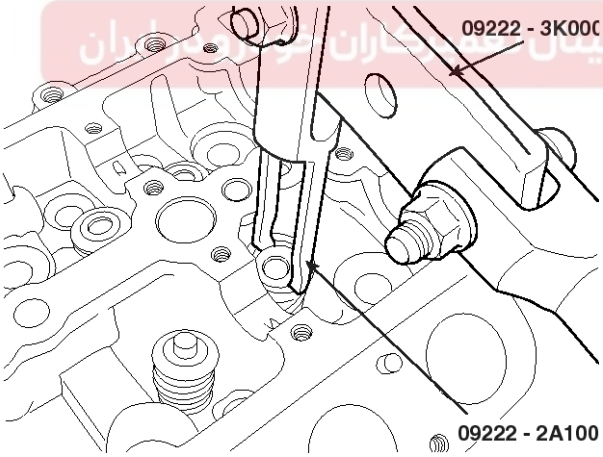
1. Install the valves.
   1) Using the SST (09222-2A000)(A), push in a new stem oil seal.

      NOTICE
      - *Do not reuse old valve stem oil seals.*
      - *Incorrect installation of the seal could result in oil leakage through the valve guides.*
      - *Apply engine oil on a valve stem seal surface contacting with a valve guide or a valve guide outer surface before installing a valve stem seal.*

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

      NOTICE
      Apply engine oil on the valves when installing.

   3) Using the SST(09222-2A100, 09222-3K000), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

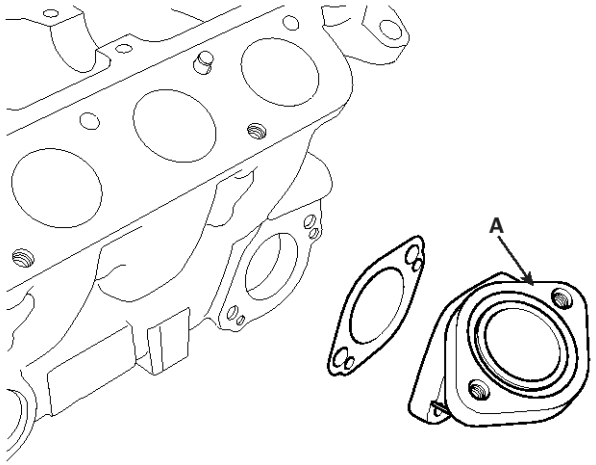


SENEM7033D

   4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.

2. Install the water outlet fitting(A).

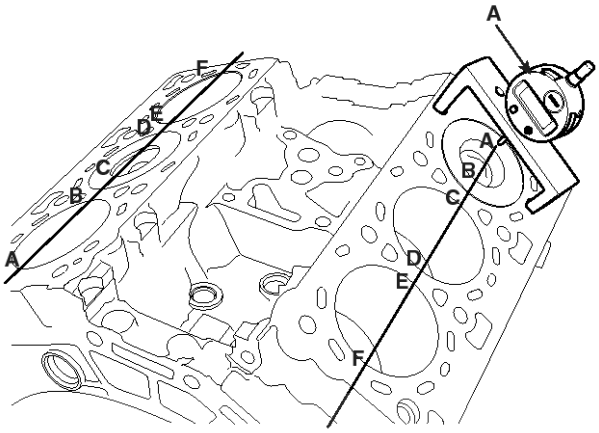
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



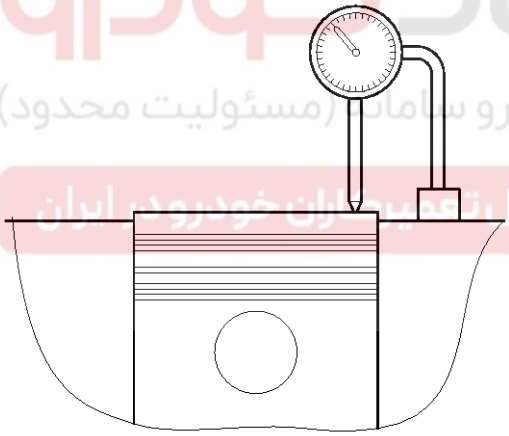
SENEM7034D

Installation

1. Clean the cylinder head and the cylinder block surfaces contacting with their gaskets.
2. Select the cylinder head gasket.
   1) Measure the piston protrusion from the upper cylinder block face on the twelve places (A ~ F for each bank) at TDC(top dead center).

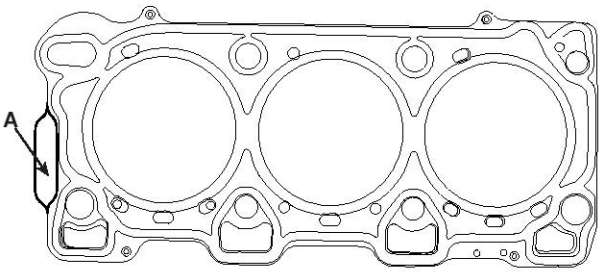


SENEM7035D



LCGF129A

   2) Select the gasket in the table below using the average value of the six piston protrusions. If an average value of a pistion is over than the each rank limit, use one rank thicker gasket than the specified one in the table below.



SENEM7036D

Grade(A)		A	B	C
Average of piston protrusion		0.310 ~ 0.410mm (0.0122~0.0161in.)	0.410 ~ 0.510mm (0.0161~0.0201in.)	0.510 ~ 0.610mm (0.0201~0.0240in.)
Limit of each rank extant		0.460mm(0.181in.)	0.560mm(0.220in.)	-
Gasket thickness(compressed)		1.1 ± 0.04mm (0.0433±0.0016in.)	1.2 ± 0.04mm (0.0472±0.0016in.)	1.3 ± 0.04mm (0.0512±0.0016in.)
Part No.	Left bank	22311 - 3A010	22311 - 3A000	22311 - 3A020
	Right bank	22312 - 3A010	22312 - 3A000	22312 - 3A020

3) Install the LH gasket so that the identification mark(A) faces toward the timing chain side.
4) Install the RH gasket so that the identification mark(A) faces toward the transaxle side.

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

NOTICE
Be careful of the installation direction.

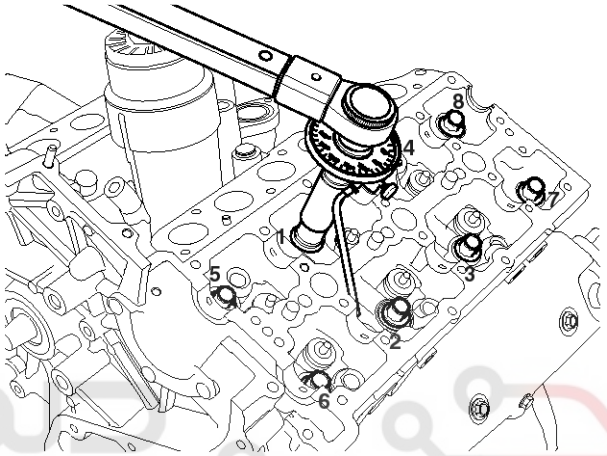
4. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the end.

CAUTION
Put on a lid on the intake port or the water outlet fitting in order for some materials such as bolts not to get inside.

5. Install the cylinder head bolts.
   1) Tighten the eight cylinder head bolts on each bank, in several passes, in the sequence shown.

Tightening torque :
1st step: 58.8N.m (6.0kgf.m, 43.4lbf.ft)
2nd step: 90˚± 2˚
3rd step: 120˚± 2˚

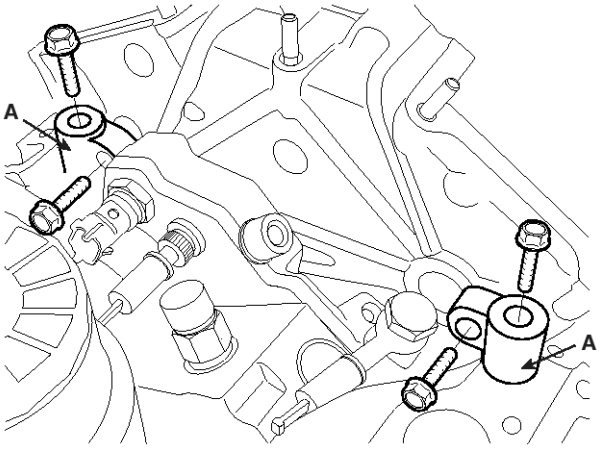
NOTICE
Do not reuse the cylinder head bolts more than twice.



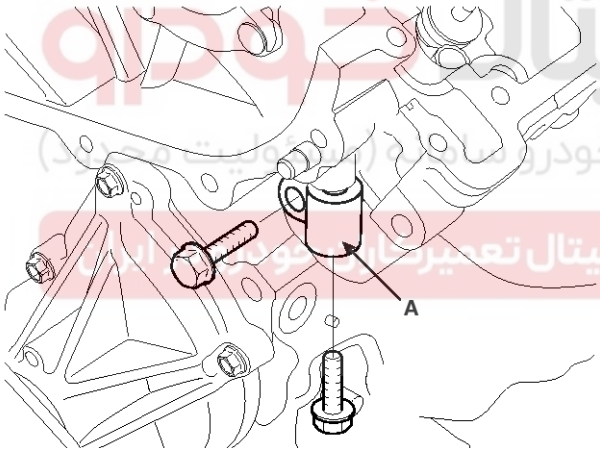
SENEM7039D

6. Install the timing chain case bracket(A). Tighten the vertical-direction bolts slightly first and then the horizontal-direction ones and the vertical-direction ones with the specified torque below.

Tightening torque :
19.6 ~ 25.5Nm (2.0 ~ 2.6kgf.m, 14.5 ~ 18.8lb-ft)



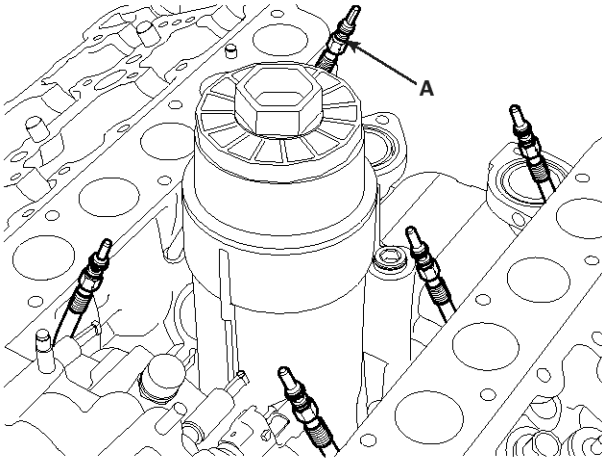
SENEM7040D



SENEM7041D

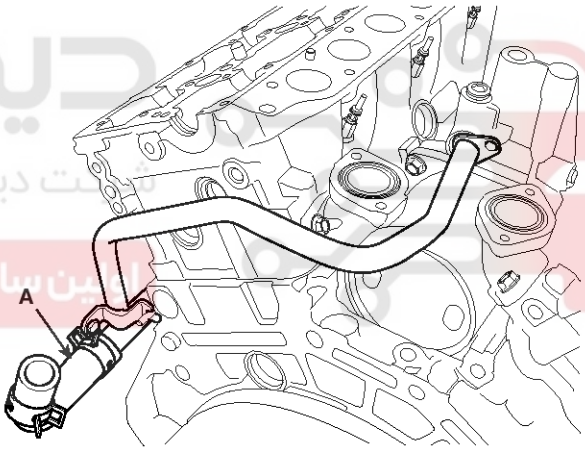
7. Tighten the glow plugs(A).

Tightening torque :
7.8 ~ 10.8Nm (0.8 ~ 1.1kgf.m, 5.8 ~ 8.0lb-ft)



SENEM7042D

8. Install the water pipe and hose assembly(A).

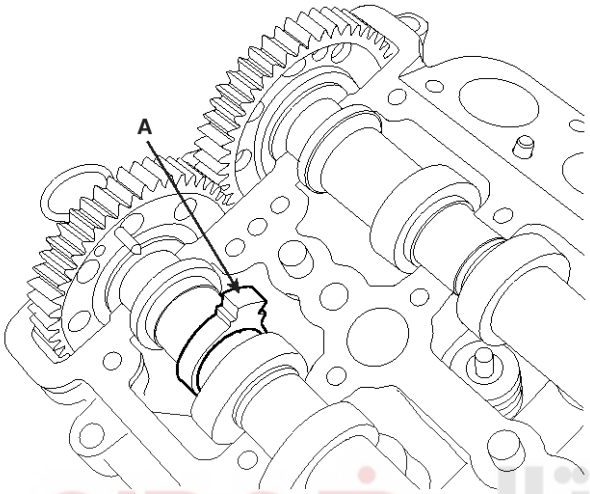


SENEM7043D

9. Install the camshafts and measure the end play.

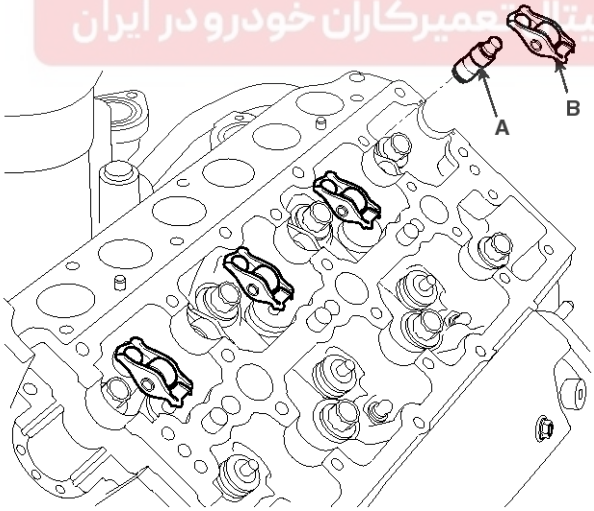
Camshaft end play
Standard : 0.05 ~ 0.15mm (0.0020 ~ 0.0059in)

CAUTION
When installing the RH exhaust camshaft, always check the location of TDC(top dead center) mark on the shaft.



SENEM7044D

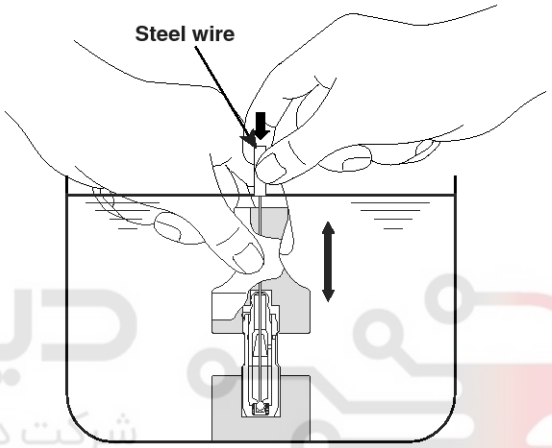
10. After measuring the end play, remove the camshafts.
11. After applying oil, install the HLA(hydraulic lash adjuster)(A) and the cam follower assembly(B).



SENEM7045D

1) Until installing, HLA shall be held upright so that oil in it should not spill and be assured that dust does not adhere to it.
2) HLA shall be inserted tenderly to the cylinder head not to spill oil from it. In case of spilling, air bent shall be done in accordance with the air bent procedure.

NOTICE
Stroke the HLA in oil 4~5 times by pushing its cap while pushing the ball down slightly by hard steel wire. (Take care not to severely push hard steel wire down since the ball weighs just several grams.)

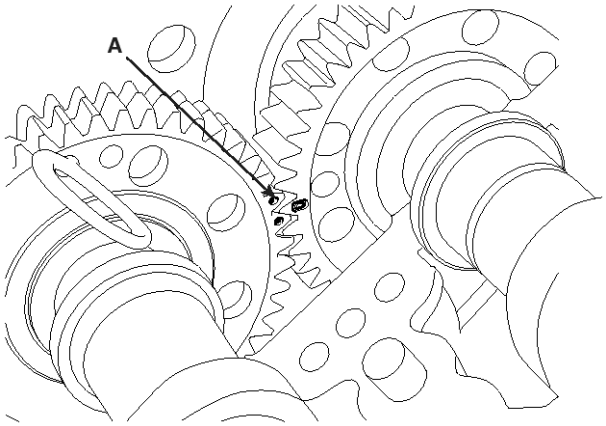


LCGF133A

12. Wipe out oil on the upper surface of the cylinder head.
13. Install the camshafts.

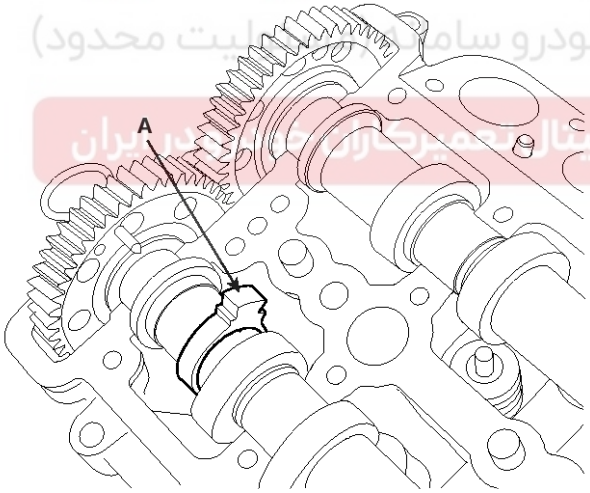
⚠CAUTION

- **Align the marks(A) on the sprockets.**



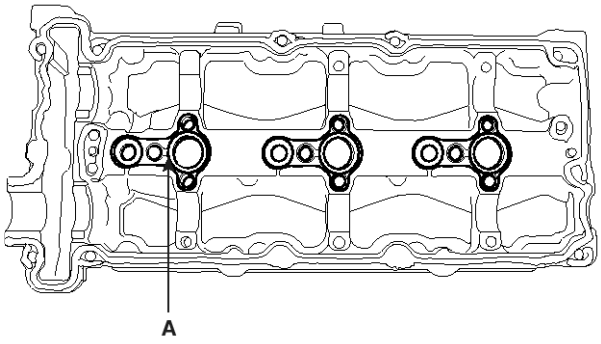
SENEM7046D

- **When installing the RH exhaust camshaft, always check the location of TDC(top dead center) mark on the shaft.**

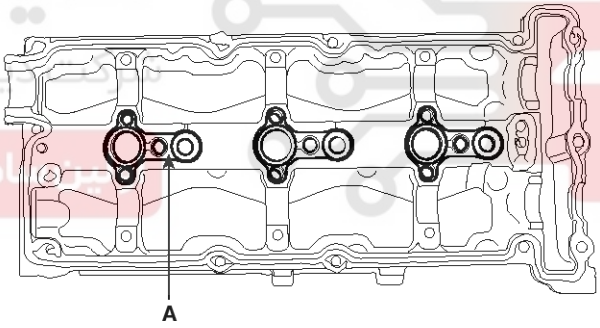


SENEM7044D

14. Pressing the exhaust camshafts, take out the pin from their sprockets.
15. Put the ladder gaskets(A) on the camshaft bearing ladder and apply sealant. Also apply some oil on the contacting surface with the camshafts.

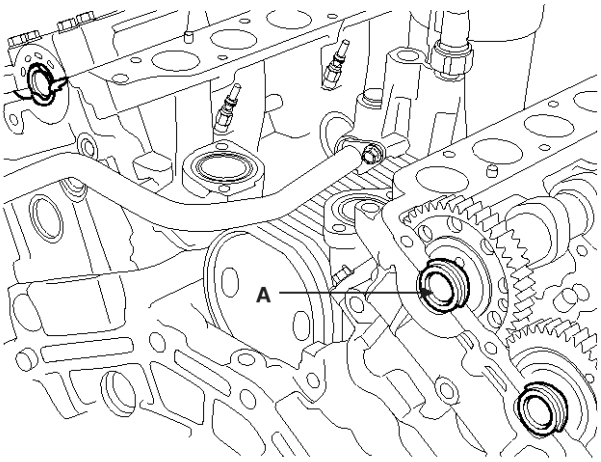


SENEM7047D



SENEM7048D

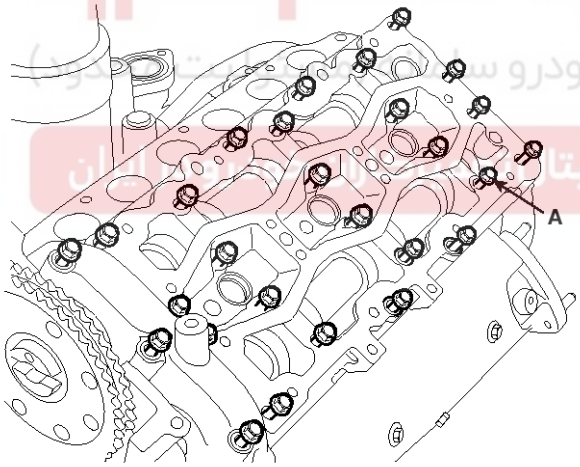
16. Install the sealing caps(A) with applying sealant(LOCTITE 5902/5900 or equivalent) on the grooves(4 places) at the circumference.



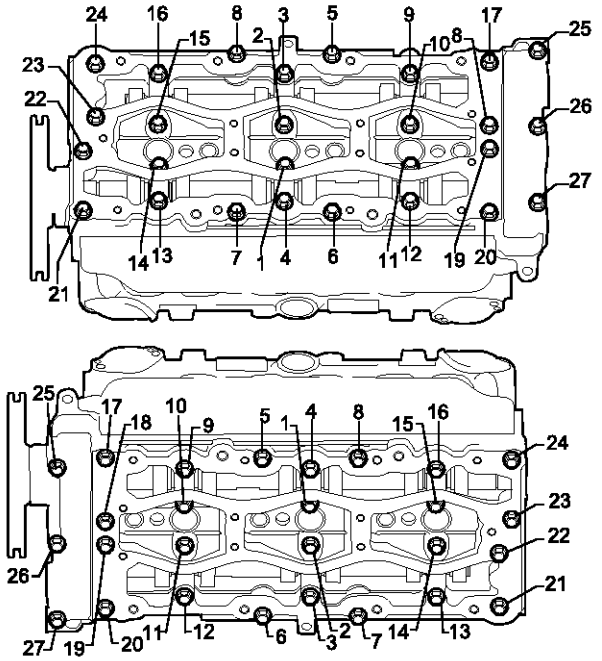
SENEM7049D

17. Install the camshaft bearing ladder(A) with the sequence and the torque below.

Tightening torque :
13.7 ~ 15.7Nm (1.4 ~ 1.6kgf.m, 10.1 ~ 11.6lb-ft)

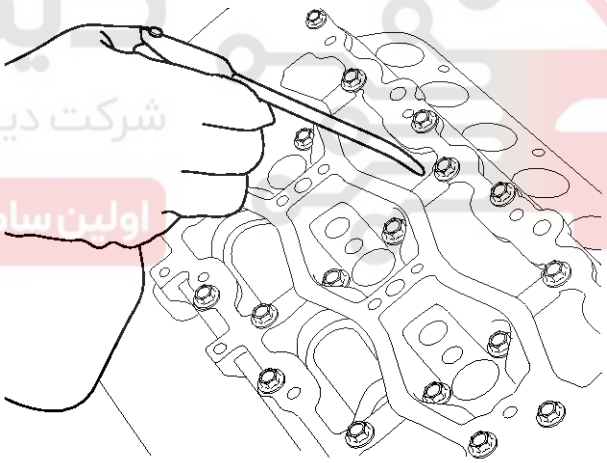


SENEM7050D



SENEM7051D

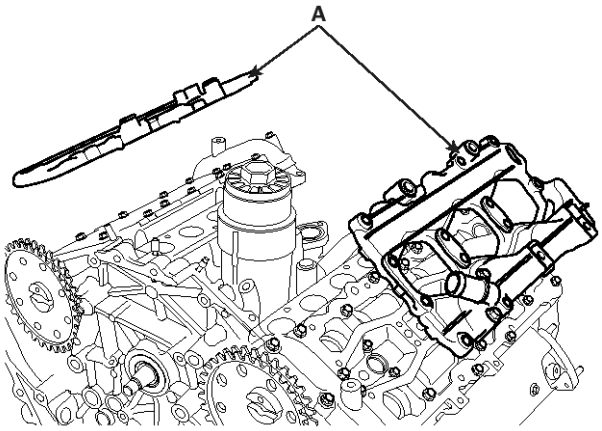
18. Apply oil on the camshafts sufficiently.



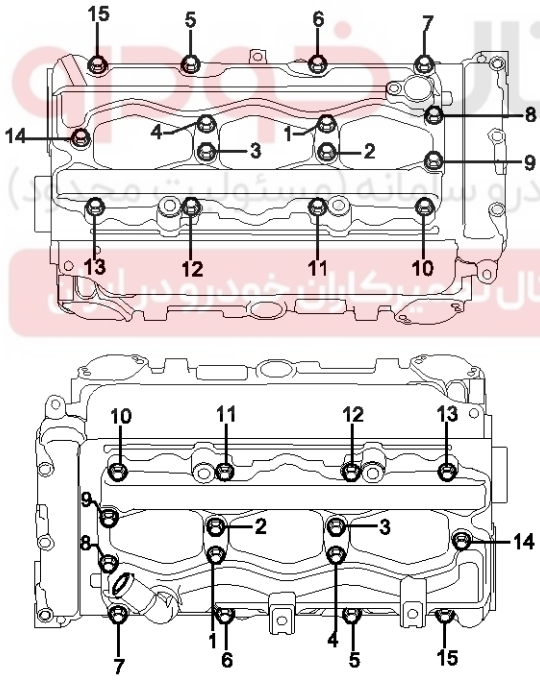
SENEM7052D

19. Install the cylinder head cover(A) with the sequence and the torque below.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7053D



SENEM7054D

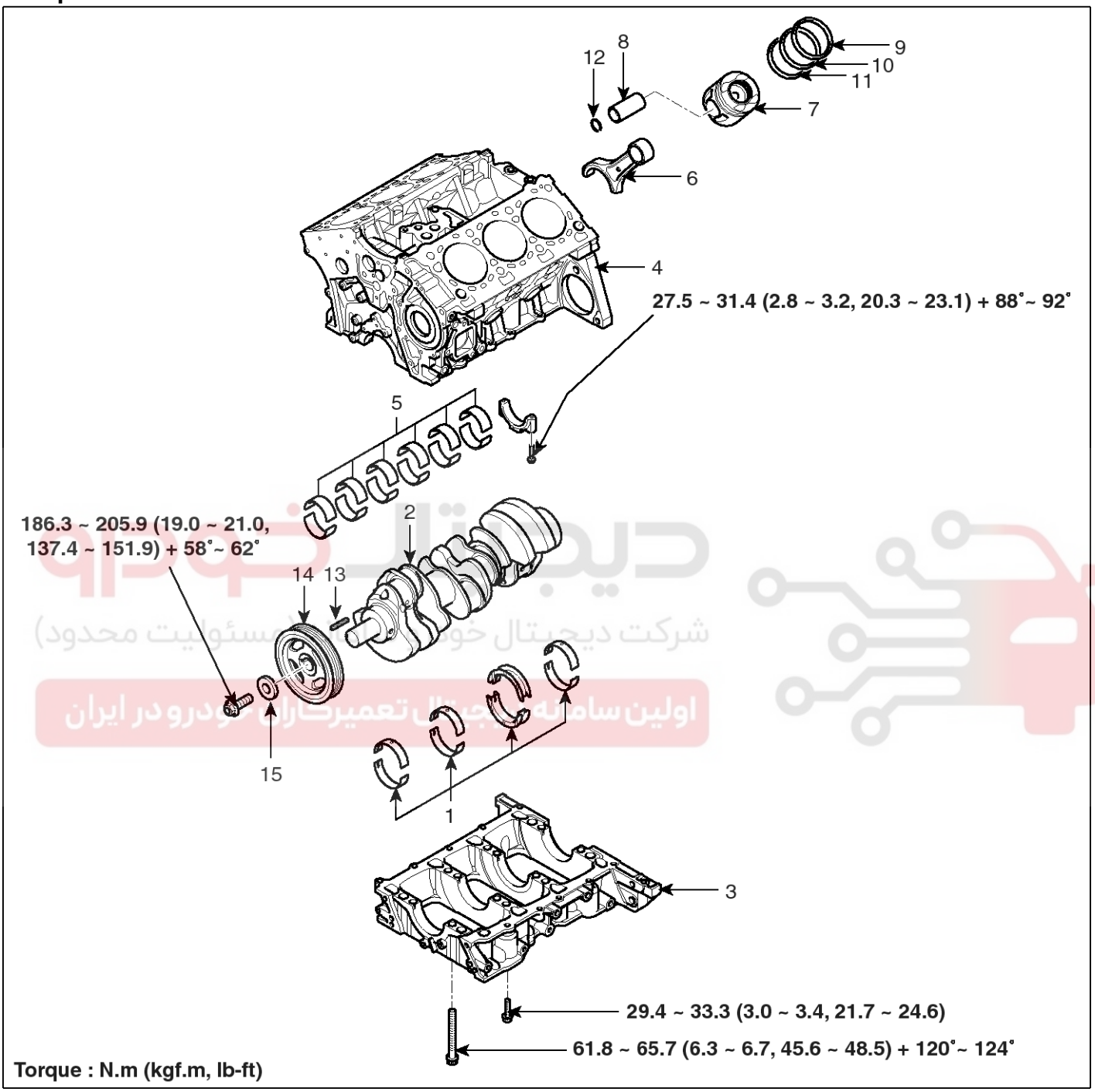
20. Install the water outlet duct(A).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

21. Install the glow plug wiring.
22. Install the delivery pipe, the injectors and the high pressure pipe.
23. Install the intake and exhaust manifold.
24. Install the timing chain.
25. Install the drive belt.

Cylinder Block

Components



SENEM9006L

1. Main bearing
2. Crankshaft
3. Bed plate
4. Cylinder block
5. Connecting rod bearing
6. Connecting rod
7. Piston
8. Piston pin
9. No. 1 piston ring
10. No. 2 piston ring
11. Oil ring
12. Snap ring
13. Crankshaft key
14. Damper pulley
15. Washer

Disassembly

1. Remove the connecting rod caps.

   NOTICE
   Mark the connecting rod caps to be able to reassemble in the original position and direction.

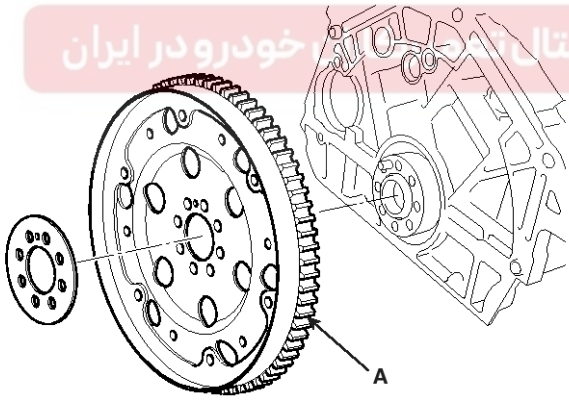
2. Remove the piston and connecting rod assembly.
   1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
   2) Push the piston, connecting rod assembly and upper bearing out of the cylinder block.

      NOTICE
      - *Keep the connecting rod and the cap with its bearings together.*
      - *Arrange the piston and connecting rod assemblies in the correct order.*

3. Remove the piston and conecting rod assembly. Using a press machine, remove the piston pin from the piston.
4. Remove the piston rings.

   NOTICE
   Arrange the piston rings in its order, having an eye to the 'Y' mark on the ring which tells you it is the upper side.

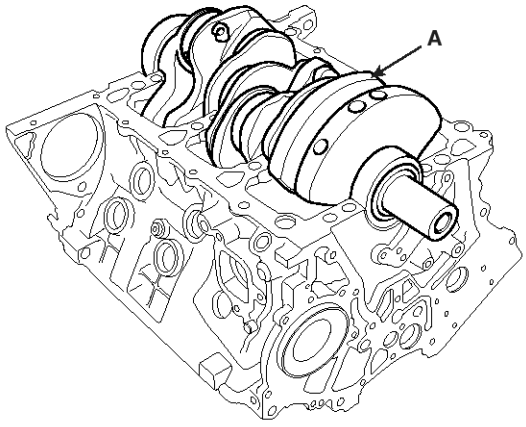
5. Remove the drive plate(A).



SENEM7011D

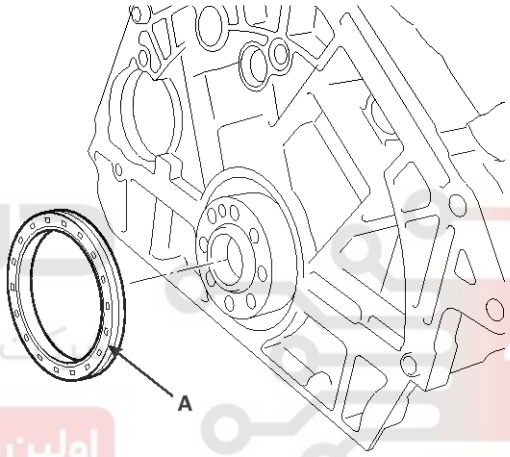
6. Remove the bedplate.
7. Lift the crankshaft(A) out of the block, being careful not to damage journals.

   NOTICE
   Arrange the main bearings and thrust bearings in the correct order.



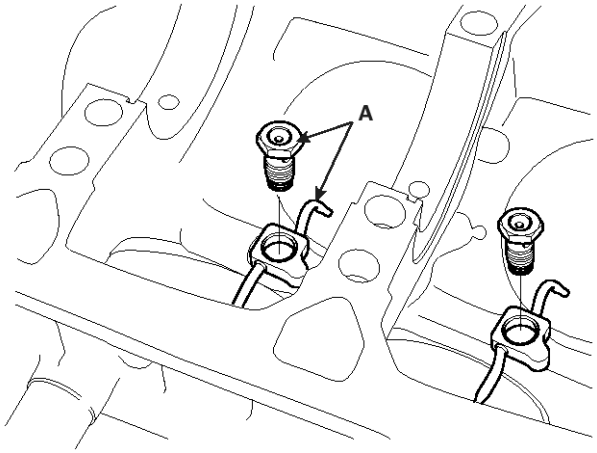
SENEM7004D

8. Remove the rear oil seal(A).



SENEM7010D

9. Remove the oil jet(A).



SENEM7002D

Inspection

Connecting Rod

1. Check the connecting rod bearing oil clearance.
   1) Check the marks on the connecting rod and rod cap for accurate reassembling.
   2) Loosen the two connecting rod cap bolts.
   3) Remove the connecting rod cap and the lower bearing.
   4) Clean up the crankshaft pin journal and its bearings.
   5) Put on the plastigage along the axis direction of the crankshaft.
   6) Reassemlbe the lower bearings and the connecting rod caps and tighten the bolts with the specified torque below.

Tightening torque :
27.5 ~ 31.4Nm (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft) + 88˚~92˚

NOTICE
- *Do not rotate the crankshaft.*
- *Do not reuse the connecting rod cap bolts.*

   7) Remove the connecting rod cap again.
   8) Measure the plastigage at its widest point.

Standard oil clearance:

Crankshaft pin outer diameter identification mark	Connecting rod big end inner diameter identification mark	Assembling classification of upper bearings(identification mark)	Oil cleareance(mm(in.))(reference value)
A	A	Red	0.024~0.050(0.0009~0.0020)
	B	Red	0.030~0.056(0.0012~0.0022)
	C	Yellow	0.026~0.052(0.0010~0.0020)
B	A	Red	0.030~0.056(0.0012~0.0022)
	B	Yellow	0.026~0.052(0.0010~0.0020)
	C	Yellow	0.032~0.058(0.0013~0.0023)
C	A	Yellow	0.026~0.052(0.0010~0.0020)
	B	Yellow	0.032~0.058(0.0013~0.0023)
	C	Blue	0.028~0.054(0.0011~0.0021)

9) If the measurement from the plastigage is out of the specification, change the bearings with new ones of the same identification color. Recheck the oil clearance.

CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust the clearance.

10) If the plastigage shows the clearance is still incorrect, try the larger or smaller bearing. Recheck the oil clearance.

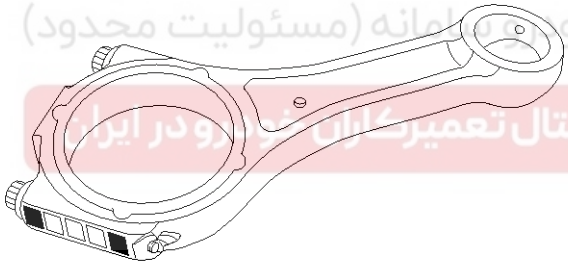
NOTICE

If the proper clearance still cannot be obtained after using the appropriate larger or smaller bearings, replace the crankshaft and restart measuring.

CAUTION

If the marks are indecipherable because of an accumulation of dirt or dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

Connecting Rod Mark Location

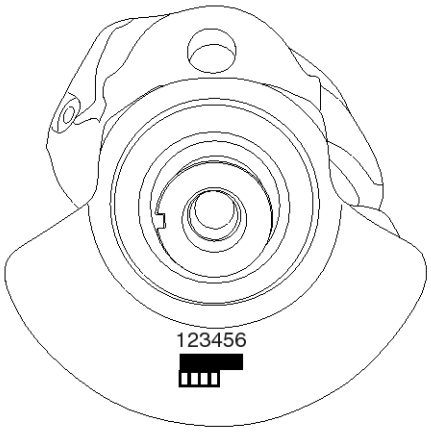


SENEM7226D

Discrimination Of Connecting Rod

Mark	Connecting rod big-end inner diameter
A	66.500 ~ 66.506 mm(2.6181~2.6183 in.)
B	66.506 ~ 66.512 mm(2.6183~2.6186 in.)
C	66.512 ~ 66.518 mm(2.6186~2.6188 in.)

Crankshaft Pin Journal Mark Location

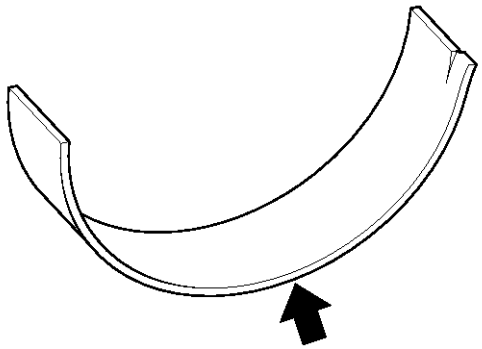


SENEM7227D

Discrimination Of Crankshaft Pin Journal

Mark	Crankshaft pin journal outer diameter
A	63.494 ~ 63.500 mm(2.4998~2.5000 in.)
B	63.488 ~ 63.494 mm(2.4995~2.4998 in.)
C	63.482 ~ 63.488 mm(2.4993~2.4995 in.)

Connecting Rod Bearing Mark Location



SENEM7014D

Discrimination Of Connecting Rod Upper Bearing

Color	Connecting rod upper bearing thickness
Blue	1.497 ~ 1.507mm (0.0589 ~ 0.0593in.)
Yellow	1.487 ~ 1.497mm (0.0585 ~ 0.0589in.)
Red	1.477 ~ 1.487mm (0.0581 ~ 0.0585in.)

Discrimination Of Connecting Rod Lower Bearing

Color	Connecting rod lower bearing thickness
-	1.485 ~ 1.489mm (0.0585 ~ 0.0586in.)

11) Select the suitable bearing by using the selection table below.

Connecting Rod Bearing Selection Table

Connecting rod bearing		Connecting rod mark		
		A	B	C
Crankshaft pin journal mark	A	Red	Red	Yellow
	B	Red	Yellow	Yellow
	C	Yellow	Yellow	Blue

2. Check the connecting rods.
   1) When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
   2) Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
   3) Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

Crankshaft

1. Check the crankshaft bearing oil clearance.
   1) To check main bearing-to-journal oil clearance, remove the bed plate and lower bearings.
   2) Clean each main journal and lower bearing with a clean shop towel.
   3) Place one strip of plastigage across each main journal.
   4) Reinstall the lower bearings and bed plate, then tighten the bolts.

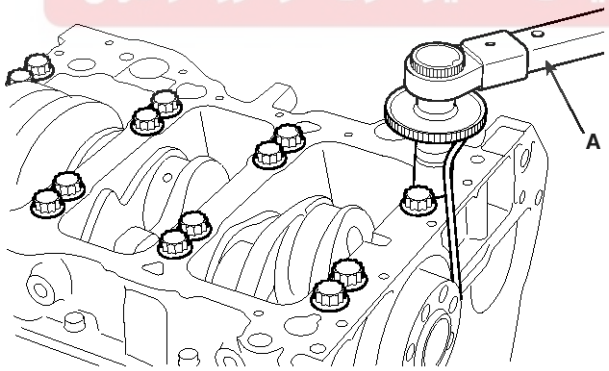
      NOTICE
      - *Reinstall the lower bearings and bed plate, then tighten the bolts.*
      - *If the bedlpate bolts are damaged or deformed, replace them with new ones.*

   5) Tighten the No.18, 20, 21 bolts in its number order(18→20→21) with the specified torque.

Tightening torque :
29.4 ~ 33.3Nm (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft)

   6) Tighten the No.1~16 bolts in two steps with the specified torque and angle below.

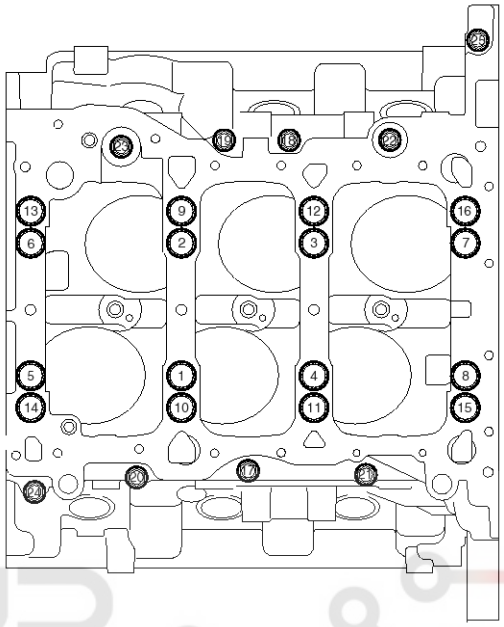
Tightening torque :
61.8 ~ 65.7Nm (6.3 ~ 6.7kgf.m, 45.6 ~ 48.5lb-ft) - 1st step
120° ~ 124° - 2nd step



SENEM7008D

   7) Loosen the bolts No. 18, 20 and 21.
   8) Tighten the No.17~25 bolts with the specified torque below.

Tightening torque :
29.4 ~ 33.3Nm (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft) - 1st step

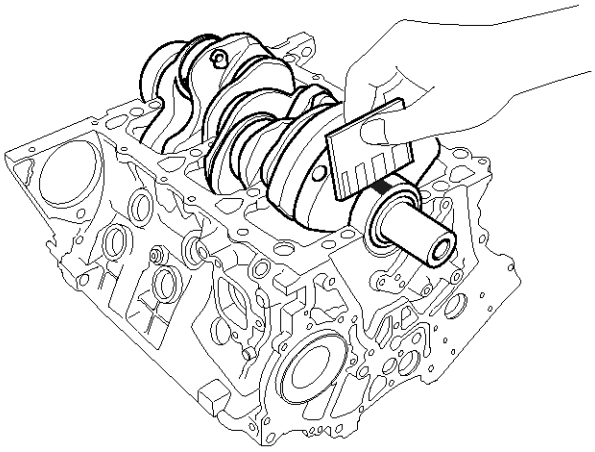


SENEM7007D

NOTICE
Do not rotate the crankshaft.

   9) Remove the bed plate and lower bearing again, and measure the widest part of the plastigage.

Standard oil clearance :
0.030 ~ 0.048mm (0.0012 ~ 0.0019in)



SENEM7200D

10) If the plastigage measurement is too wide or too narrow, remove the bearings and then install a new bearings with the same color mark. Recheck the oil clearance.

CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance.

11) If the plastigage shows the clearance is still incorrect, try the larger or smaller bearing. Recheck the oil clearance.

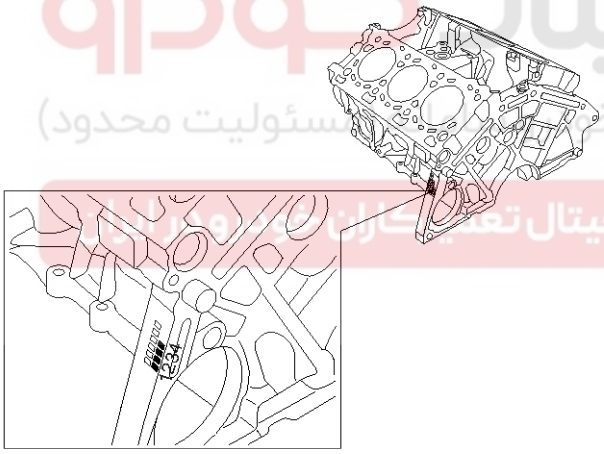
NOTICE

If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start the measurement from the first.

CAUTION

If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

Crankshaft Journal Bore Mark Location

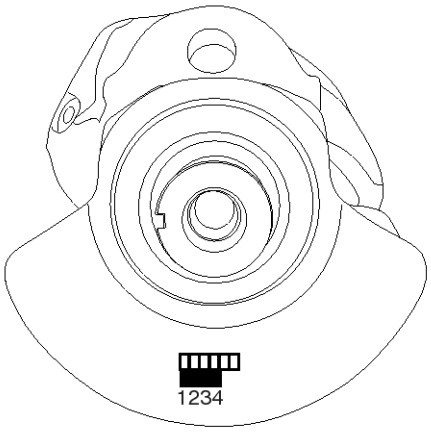


SENEM7018D

Crankshaft Journal Bore Mark Location

Mark	Cylinder block journal bore inner diameter
A	80.000 ~ 80.006 mm(3.1496~3.1498 in.)
B	80.006 ~ 80.012 mm(3.1498~3.1501 in.)
C	80.012 ~ 80.018 mm(3.1501~3.1503 in.)

Crankshaft Main Journal Mark Location

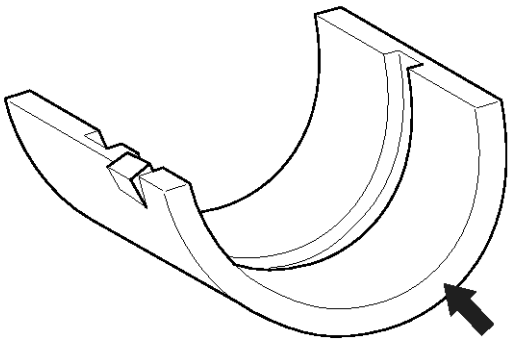


SENEM7001D

Crankshaft Main Journal Mark Location

Mark	Crankshaft main journal outer diameter
A	75.994 ~ 76.000 mm(2.9919~2.9921 in.)
B	75.988 ~ 75.994 mm(2.9916~2.9919 in.)
C	75.982 ~ 75.988 mm(2.9914~2.9916 in.)

Crankshaft Main Bearing Mark Location



SENEM7201D

Discrimination Of Crankshaft Main Bearing

Color	Crankshaft bearing thickness
Red	1.994 ~ 1.997mm (0.0785 ~ 0.0786in.)
Blue	1.991 ~ 1.994mm (0.0784 ~ 0.0785in.)
-	1.988 ~ 1.991mm (0.0783 ~ 0.0784in.)
Yellow	1.985 ~ 1.988mm (0.0781 ~ 0.0783in.)
Green	1.982 ~ 1.985mm (0.0780 ~ 0.0781in.)

12) Select the suitable bearing by using the selection table below.

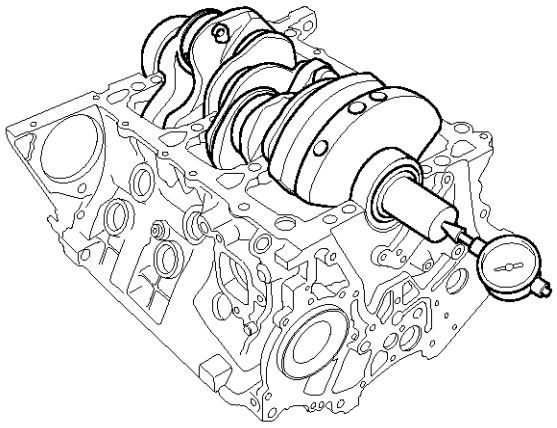
Crankshaft Main Bearing Selection Table

Crankshaft main bearing		Crankshaft bore mark		
		A	B	C
Crankshaft main journal mark	A	Green	Yellow	-
	B	Yellow	-	Blue
	C	-	Blue	Red

2. Check the crankshaft end play. Using a dial indicator, measure the clearance while prying the crankshaft back and forth.

End play

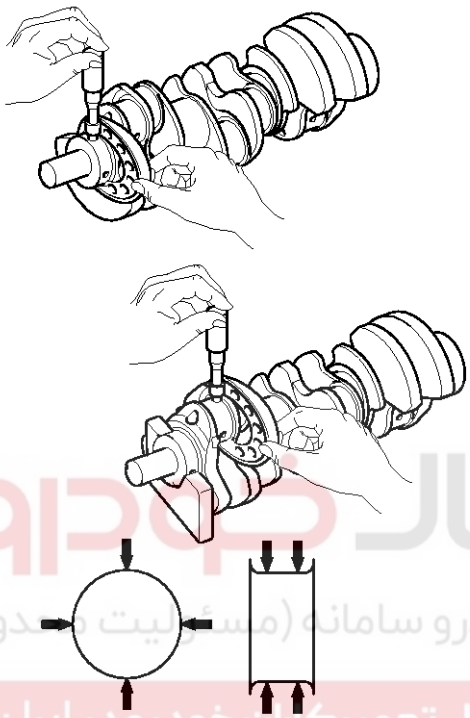
Standard : 0.1 ~ 0.3mm (0.0039 ~ 0.118in)



SENEM7202D

3. Inspect the crankshaft main journals and pin journals. Using a micrometer, measure the diameter of each main journal and pin journal.

Main journal diameter :
75.982 ~ 76.000mm (2.9914 ~ 2.9921in)
Pin journal diameter :
63.482 ~ 63.500mm (2.4993 ~ 2.5000in)

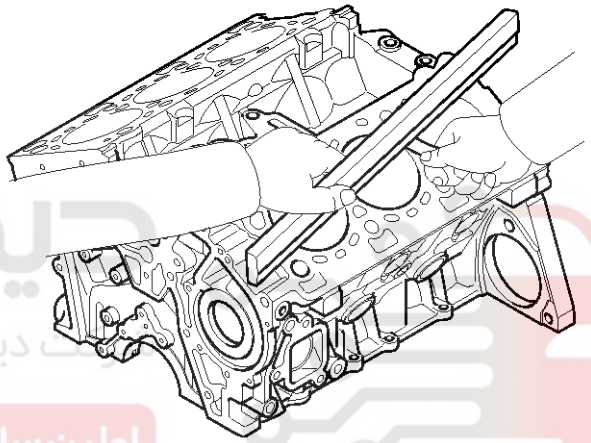


SENEM7203D

Cylinder Block

1. Remove the gasket material. Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
2. Clean the cylinder block Using a soft brush and solvent, thoroughly clean the cylinder block.
3. Inspect the top surface of cylinder block for flatness. Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

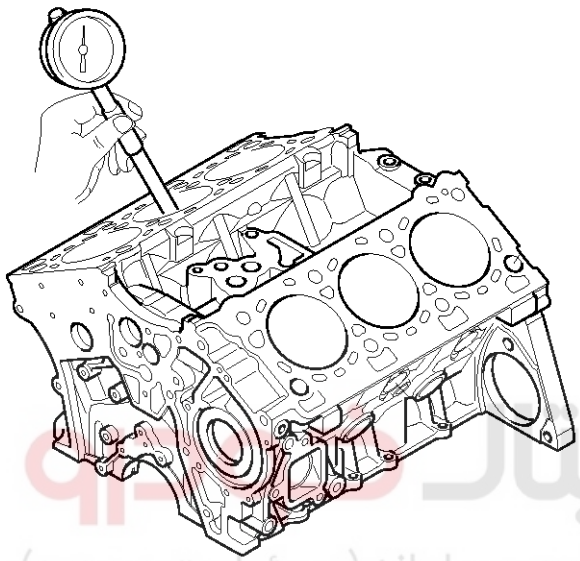
Flatness of cylinder block gasket surface
Less than 0.05mm (0.0020in)
Less than 0.042mm (0.0017in) for width
Less than 0.096mm (0.0038in) for length
Less than 0.012mm (0.0005in) for 50mm × 50mm



SENEM7204D

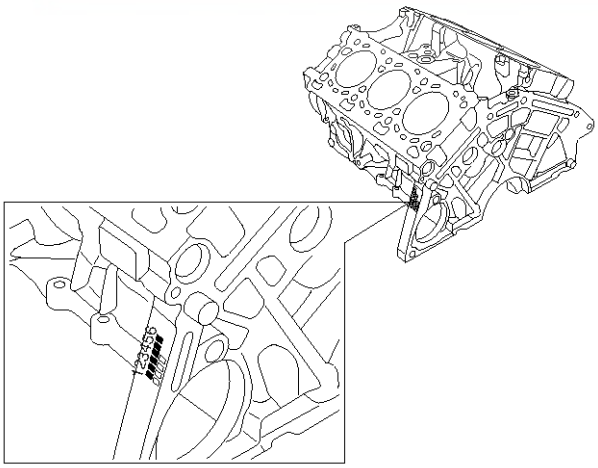
4. Inspect the cylinder bore. Visually check the cylinder for vertical scratchs. If deep scratchs are present, replace the cylinder block.
5. Inspect the cylinder bore diameter. Using a cylinder bore gauge, measure the cylinder bore diameter at position in a thrust and an axial direction.

Standard diameter :
84.000 ~ 84.030mm (3.3071 ~ 3.3083in)



SENEM7205D

6. Check the cylinder bore size code on the cylinder block side face.

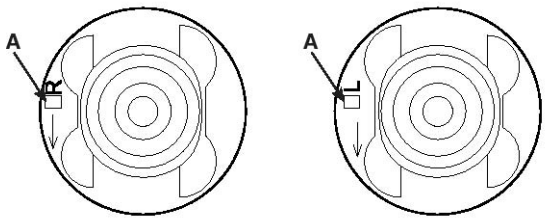


SENEM7206D

Discrimination Of Cylinder Bore Size

Mark	Cylinder bore inner diameter
A	84.000 ~ 84.010 mm(3.3071~3.3075 in.)
B	84.010 ~ 84.020 mm(3.3075~3.3079 in.)
C	84.020 ~ 84.030 mm(3.3079~3.3083 in.)

7. Check the piston size mark(A) on the piston top face.



SENEM7012D

Discrimination Of Piston Outer Diameter

Mark	Piston outer diameter
A	83.926 ~ 83.936 mm(3.3042~3.3046 in.)
B	83.936 ~ 83.946 mm(3.3046~3.3050 in.)
C	83.946 ~ 83.956 mm(3.3050~3.3053 in.)

8. Select the piston related to cylinder bore class.

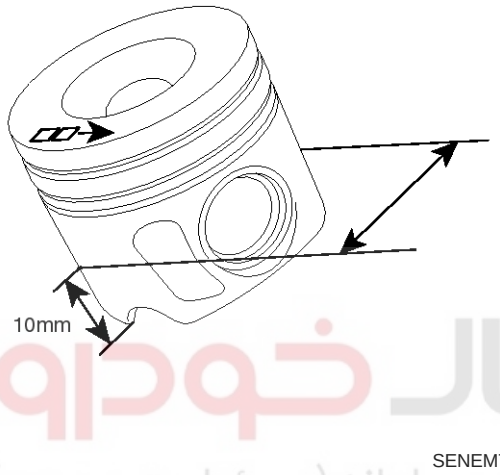
Piston-to-cylinder clearance :
0.064 ~ 0.084mm (0.0025 ~ 0.0033in.)

Cylinder Boring

1. Oversize pistons should be selected according to the largest cylinder bore.

   NOTICE
   The size mark of piston is stamped on the top surface of the piston.

2. Measure the outer diameter of the piston to be used. The standard measurement of the piston outer diameter is taken 10mm (0.39in) height from bottom land of the piston.



SENEM7228D

3. According to the measured outer diameter, calculate the new bore size.

New bore size = piston O.D + 0.064 ~ 0.084mm (0.0025 ~ 0.0033in)(clearance between piston and cylinder) - 0.01mm (0.0004in) (honing margin.)

4. Bore each of the cylinders to the calculated size.

   CAUTION
   To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.

5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

Piston-to-cylinder clearance :
0.064 ~ 0.084mm (0.0025 ~ 0.0033in.)

NOTICE
When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize.

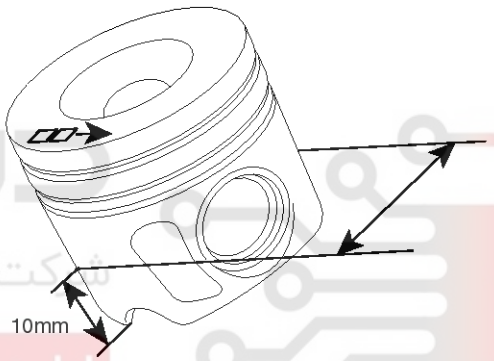
Piston And Piston Ring

1. Clean the piston.
   1) Using a gasket scraper, remove carbon from the piston top.
   2) Using a groove cleaning tool or a broken ring, clean the piston ring grooves.
   3) Using a brush with solvent, thoroughly clean the piston.

      NOTICE
      Do not use a wire brush.

2. The standard measurement of the piston outer diameter is taken 10mm (0.39in) height from bottom land of the piston.

Standard diameter :
83.926 ~ 83.956mm (3.3042 ~ 3.3053in.)



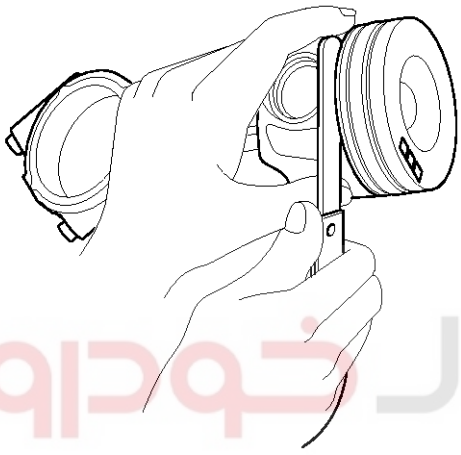
SENEM7228D

3. Calculate the difference between the cylinder bore inner diameter and the piston outer diameter.

Piston-to-cylinder clearance :
0.064 ~ 0.084mm (0.0025 ~ 0.0033in.)

4. Inspect the piston ring side clearance. Using a feeler gauge, measure the clearance between new piston ring and the wall of ring groove.

Piston ring side clearance
No.1: 0.102 ~ 0.146mm (0.0040 ~ 0.0057in.)
No.2: 0.08 ~ 0.12mm (0.0031 ~ 0.0047in.)
Oil ring: 0.03 ~ 0.07mm (0.0012 ~ 0.0028in.)



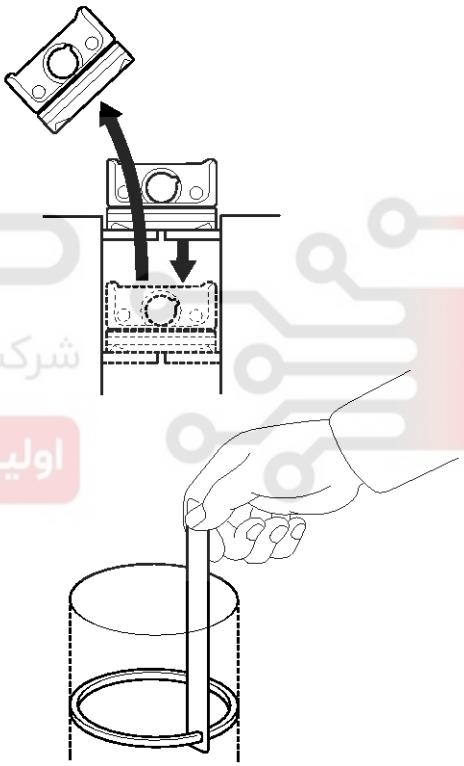
SENEM7229D

If the clearance is out of the specification above, replace the piston.

5. Inspect the piston ring end gap. To measure the piston ring end gap, insert a piston ring into the cylinder bore.

   Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored.

Piston ring end gap
No.1 : 0.20 ~ 0.35mm (0.0079 ~ 0.0138in.)
No.2 : 0.40 ~ 0.60mm (0.0157 ~ 0.0236in.)
Oil ring : 0.25 ~ 0.50mm(0.0098 ~ 0.0197in.)

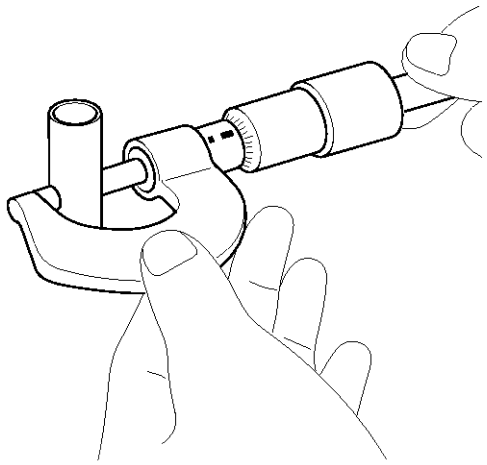


ECKD001K

Piston Pins

1. Measure the outer diameter of piston pin.

Piston pin diameter :
30.994 ~ 31.000mm (1.2202 ~ 1.2205in.)



ECKD001Z

2. Measure the piston pin-to-piston clearance.

Piston pin-to-piston clearance :
0.014 ~ 0.027mm (0.0006 ~ 0.0011in)

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

Piston pin-to-connecting rod interference :
0.020 ~ 0.037mm (0.0008 ~ 0.014in)

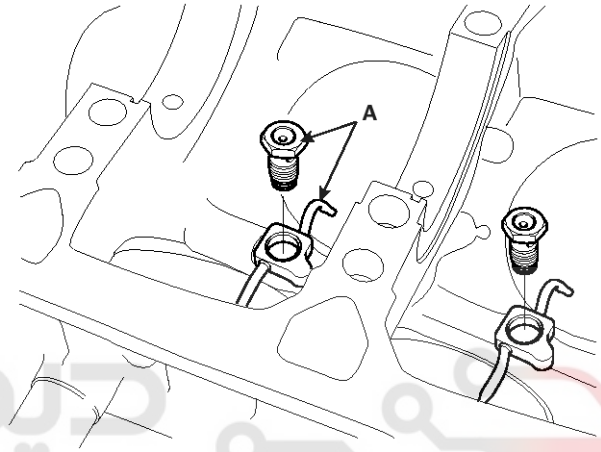
Reassembly

NOTICE

- *Thoroughly clean all parts to assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.*
- *Replace all gaskets, O-rings and oil seals with new parts.*

1. Install the oil jet(A).

Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



SENEM7002D

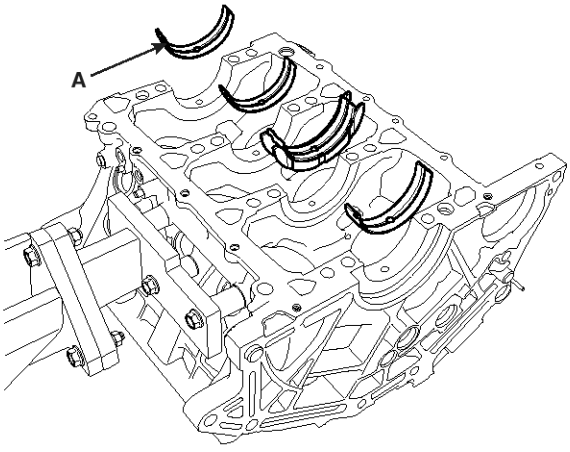
2. Install the crankshaft main bearings(A).

NOTICE

The upper bearings have the oil grooves of the oil holes ; The lower ones do not.

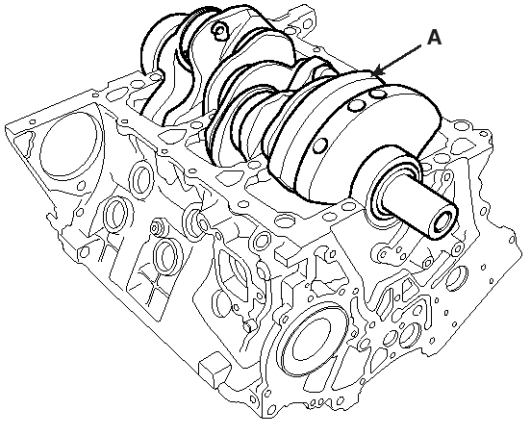
1) Aligning the bearing claw with the groove of the cylinder block, push in the four upper bearings(A).

Apply oil on the bearings at this moment.



SENEM7003D

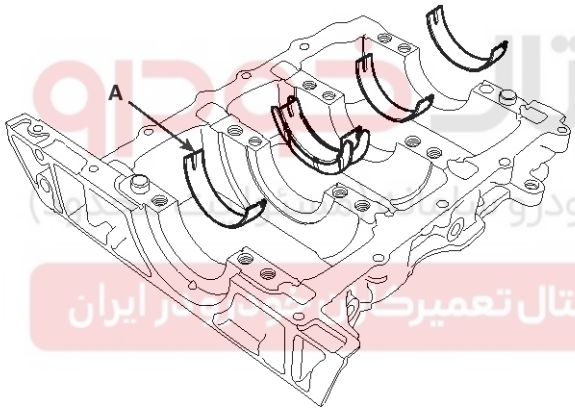
3. Place the crankshaft(A) on the cylinder block.



SENEM7004D

4. Aligning the bearing claw with the groove of the bedplate, push in the four lower bearings(A).

   Apply oil on the bearings at this moment.

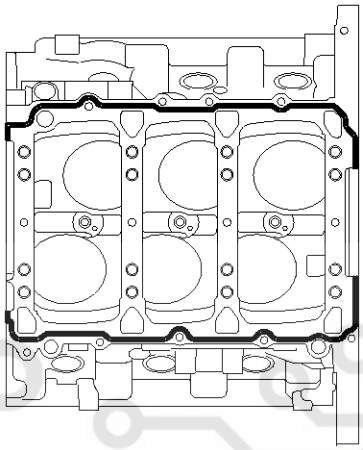


SENEM7005D

5. Place the bed plate on the cylinder block.

NOTICE

- *Standard liquid gasket : LOCTITE 5902*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.*
- *Assemble the bedplate in fifteen minutes after applying liquid gasket.*
- *After assembly, wipe out flowed-off sealant to front face and rear crankshaft oil seal housing.*



SENEM7006D

6. Install the bedplate bolts.

NOTICE

- *The bedplate bolts are tightened in several progressive steps.*
- *If any of the bedplate bolts are broken or deformed, it must be replaced.*

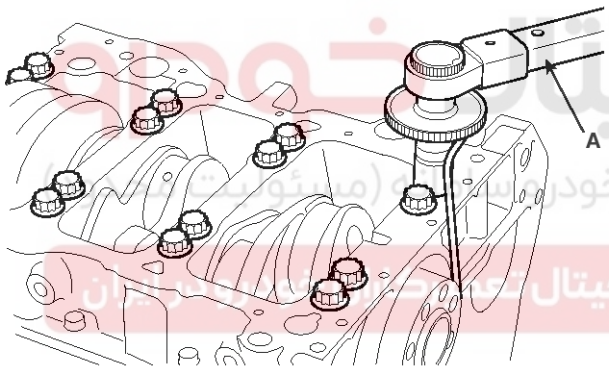
1) Tighten the No.18, 20, 21 bolts in its number order(18→20→21) with the specified torque.

Tightening torque :
29.4 ~ 33.3Nm (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft)

2) Tighten the No.1~16 bolts in two steps with the specified torque and angle below.

Do not reuse the No.1 ~ 16 bolts.

Tightening torque :
61.8 ~ 65.7Nm (6.3 ~ 6.7kgf.m, 45.6 ~ 48.5lb-ft) - 1st step
120° ~ 124° - 2nd step

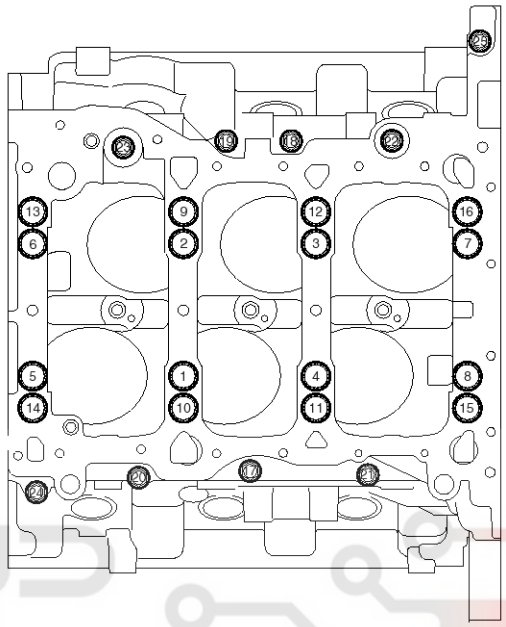


SENEM7008D

3) Loosen the bolts No. 18, 20 and 21.

4) Tighten the No.17~25 bolts with the specified torque below.

Tightening torque :
29.4 ~ 33.3Nm (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft) - 1st step

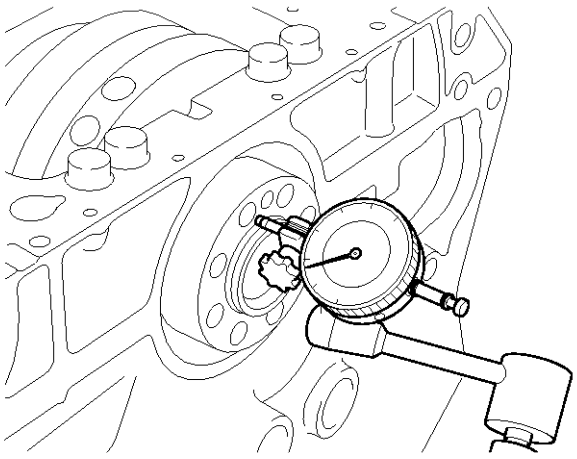


SENEM7007D

5) Check that the crankshaft rotates smoothly.

7. Check the crankshaft end play, using a dial indicator.

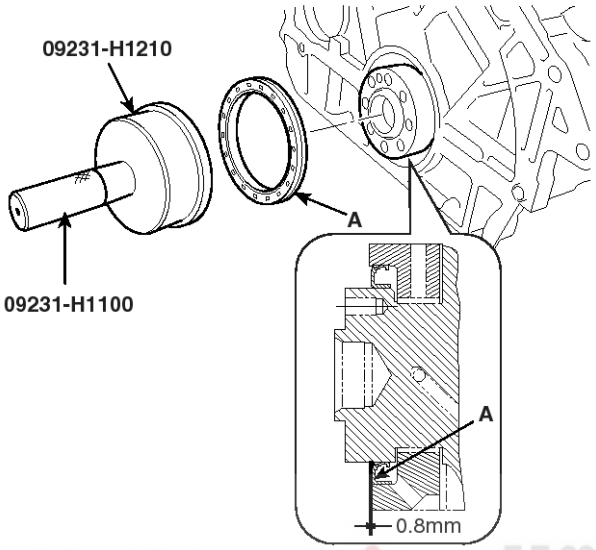
End play
Standard : 0.1 ~ 0.3mm (0.0039 ~ 0.118in)



SENEM7009D

8. Using the SST(09231-H1210, 09231-H1100) and a plastic hammer, tap in a new oil seal(A) until SST surface is flush with the cylinder block.

   At this time, the depth of the oil seal(A) from the cylinder block surface is 0.8mm(0.032in).



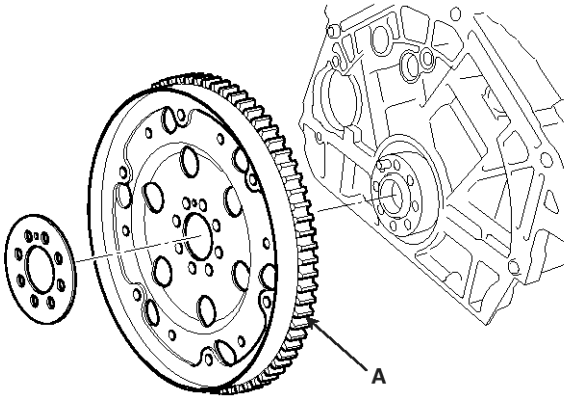
SENEM7400D

NOTICE

1. *Before assembling oil seal, the hardened sealant or injurious material located on the boundary area between cylinder block and bed plate must be removed.*
2. *Apply engine oil to a new oil seal lip.*
3. *When pressing oil seal, confirm to direction and take care not to damage oil seal.*

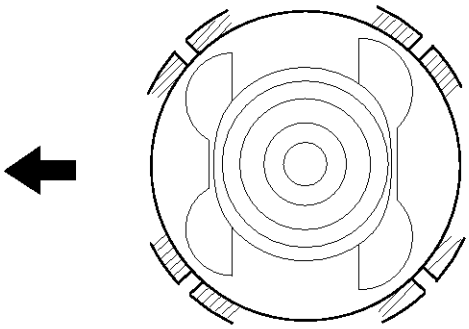
9. Install the driveplate(A).

Tightening torque :
117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)



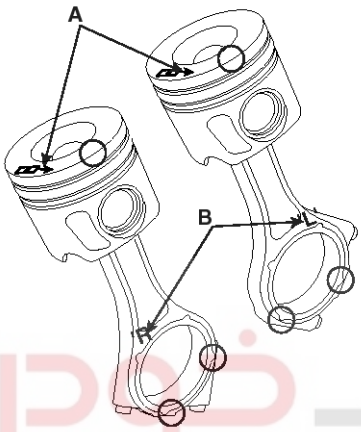
SENEM7011D

10. Install the piston rings.
    1) No.1 and No.2 piston rings - assemble the rings with the 'Y' marks on the edge of the rings facing the cylinder head side. One end gap is placed at 180˚ opposite position with the other.
    2) Oil ring - the end gap of the oil ring should be located with 180˚ to that of coil spring and 90˚ to that of No.1 ring.
    3) Check that the oil ring assembly(oil ring and coil spring) can be turned smoothly toward any(clockwise or counterclockwise) direction.
    4) Position the piston rings so that the ring ends are as shown below.



SENEM7207D

11. Assemble the piston and connecting rod.
    1) Set the snap ring in one side of piston pin hole.
    2) Apply sufficient engine oil or non-water-soluble press oil to outer surface of the piston, inner surface of piston pin hole and small end bore of the connecting rod before insering the piston pin.
    3) Insert the piston pin into the piston pin hose and the small end bore of connectong rod after setting the piston front marks(A) and the RH/LH marks(B) of the connecting rod facing to the timing chain.



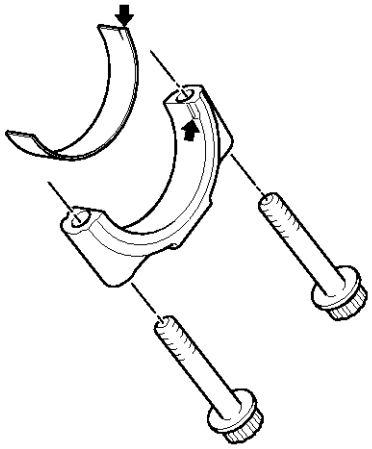
SHMEM8106D

NOTICE

Marking the parts at the '○' points in the picture above makes the reassembly work much easier for its direction.

    4) Set the snap ring in the other side after inserting the piston pin.

12. Install the connecting rod bearings.
    1) Align the bearing claw with the groove of the connecting rod cap.



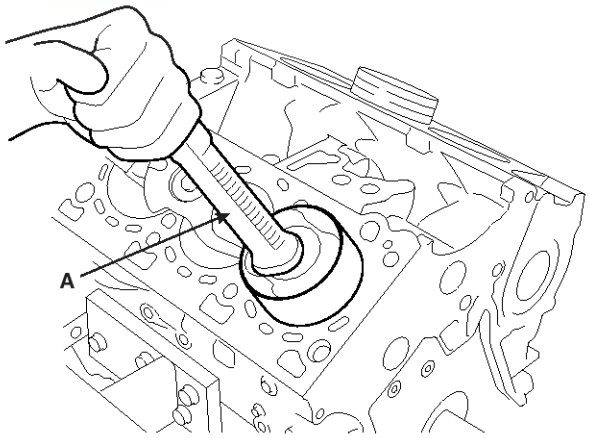
SENEM7300D

13. Install the piston and connecting rod assembly.

NOTICE

Before installing the piston, apply a coat of engine oil to the ring grooves and cylinder bores.

    1) Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
    2) Install a ring compressor, check that the rings are securely in place, position the piston in the cylinder, and tap it in using the wooden handle(A) of a hammer.



SENEM7015D

3) Stop pushing after the rings go into the cylinder, and check the connecting rod-to-crank journal alignment before pushing the piston into place again.

   Be careful for the oil jets not to be damaged by the connecting rods in this step.

4) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

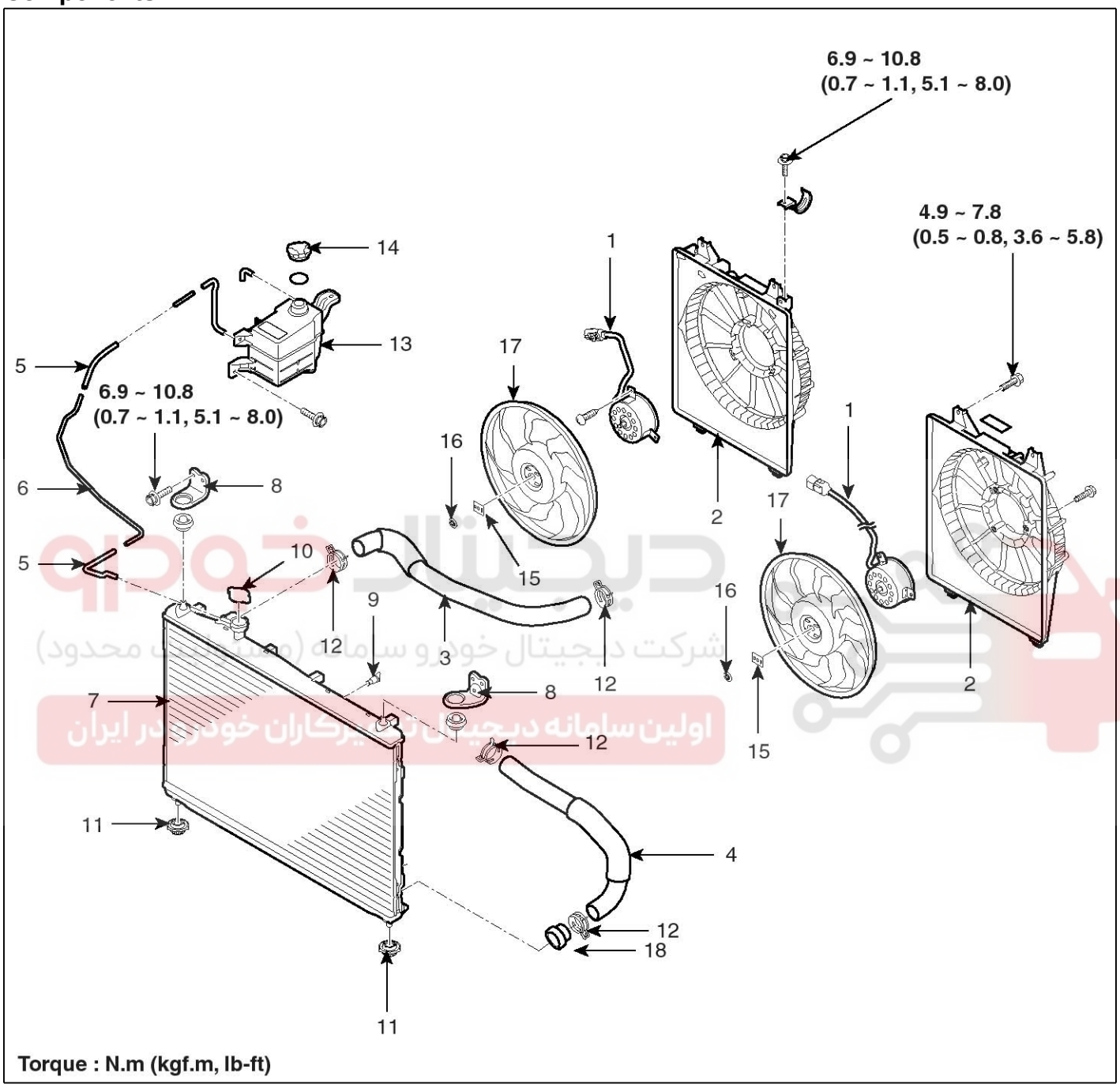
Tightening torque :
27.5 ~ 31.4Nm (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft) + 88°~ 92°

NOTICE

- *Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.*
- *Installing order: No.1 and No.4 cylinders → No.3 and No.6 cylinders → No.2 and No.5 cylinders.*
- *When installing the pistons in the order above and having a difficulty in pushing some pistons, rotating the crankshaft may make the installation easier.*

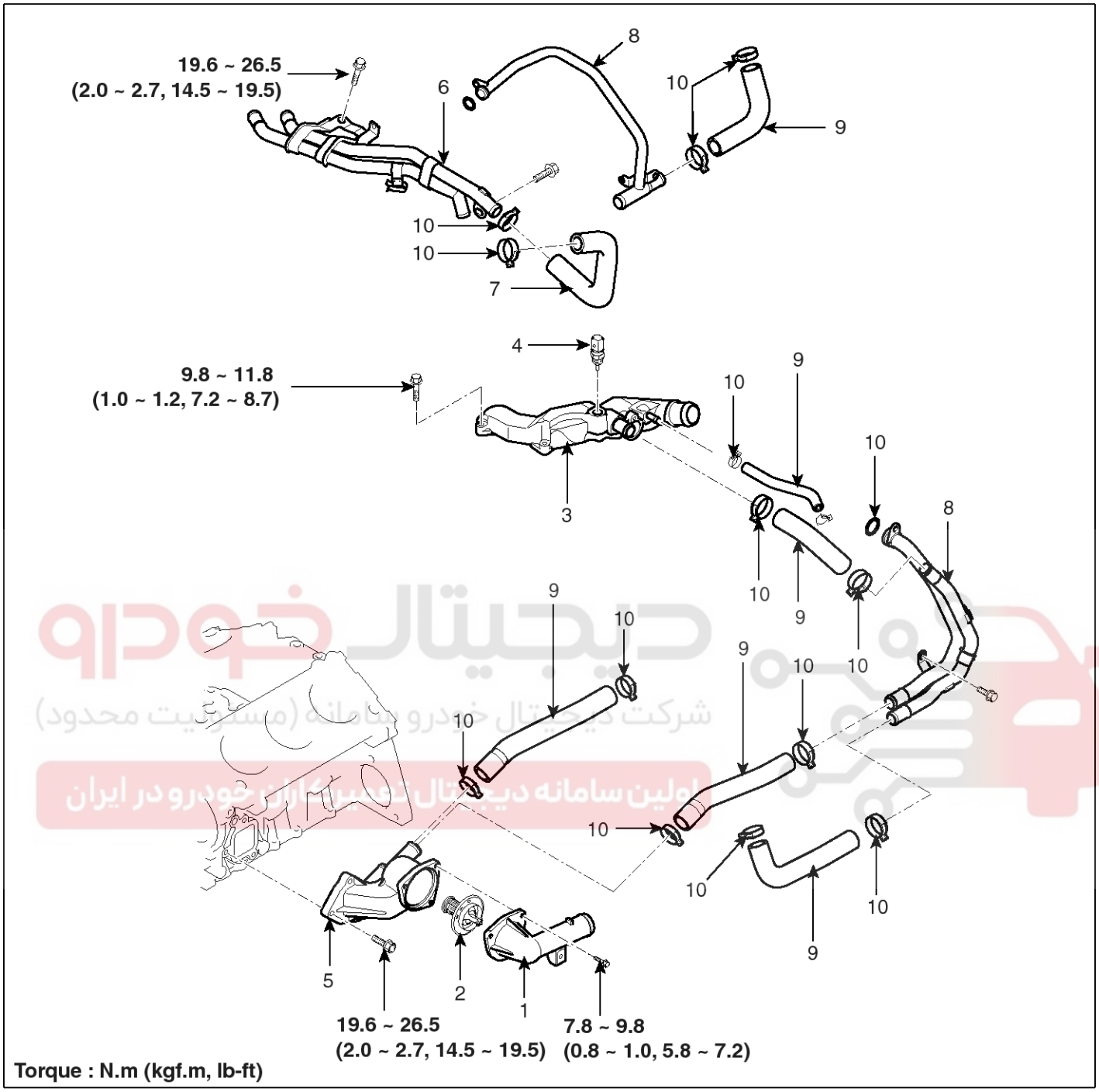
Cooling System

Components



SENEM9007L

1. Fan motor assembly
2. Shroud
3. Radiator upper hose
4. Radiator lower hose
5. Reservoir hose
6. Reservoir pipe
7. Radiator
8. Radiator upper mounting bracket
9. Drain plug
10. Radiator cap
11. Radiator lower mounting insulator
12. Clamp
13. Reservoir
14. Reservoir cap
15. Washer
16. Clip
17. Fan
18. Quick connector



SENEM9008L

1. Engine coolant inlet fitting
2. Thermostat
3. Water outlet duct
4. Engine coolant sensor
5. Engine coolant control assembly
6. Heater pipe
7. Heater hose
8. Water pipe
9. Water hose
10. Clamp

Replacement

Water Pump

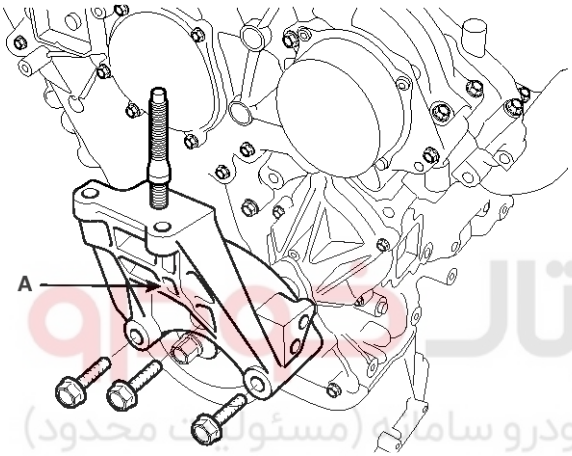
1. Drain engine coolant.

   WARNING

   The system is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove the drive belt.
3. Remove the engine support bracket(A).

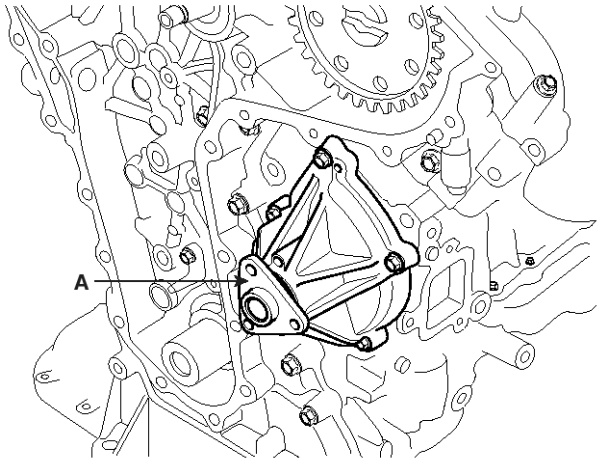
Tightening torque :
42.2 ~ 53.9Nm (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lb-ft)



SENEM7066D

4. Remove the water pump(A).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7056D

5. Installation is in the reverse order of removal.

Thermostat

NOTICE

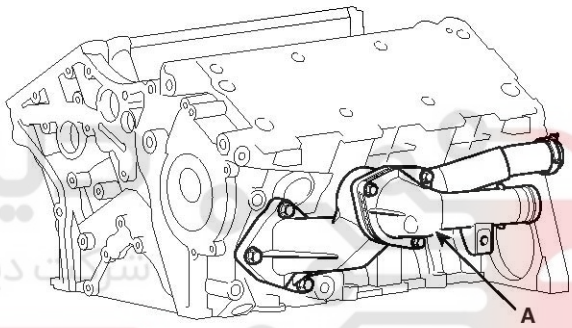
Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

1. Drain the engine coolant so its level is below thermostat.
2. Remove the thermostat with its gasket after taking off the water inlet fitting(A) from the engine coolant control assembly.

   NOTICE

   When you removing the inlet fitting, Doing this work under the vehicle is easier for its removal.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



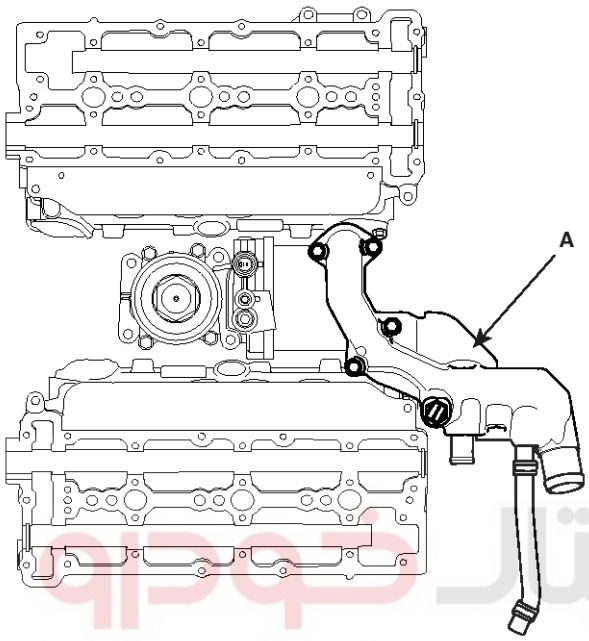
SENEM7083D

3. Installation is in the reverse order of removal.

Water Outlet Duct And Fitting

1. Remove the intake and the exhaust manifold system.
2. Remove the water outlet duct(A).

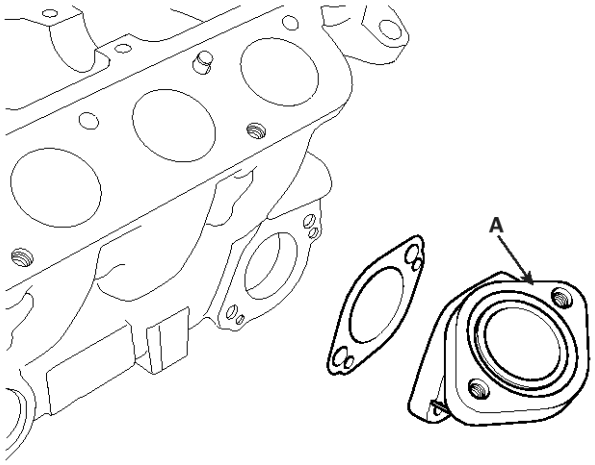
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7055D

3. Loosen the oil cooler mounting bolts for space of the outlet fitting's removal.
4. Remove the water outlet fitting(A).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7034D

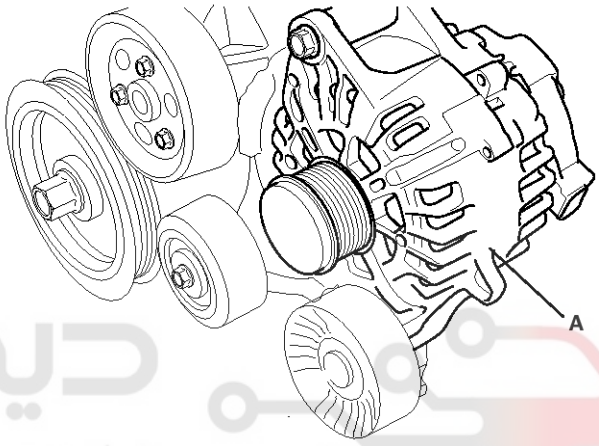
Engine Coolant Control Assembly

1. Drain engine coolant.

WARNING
The system is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove the drive belt.
3. Remove the alternator(A).

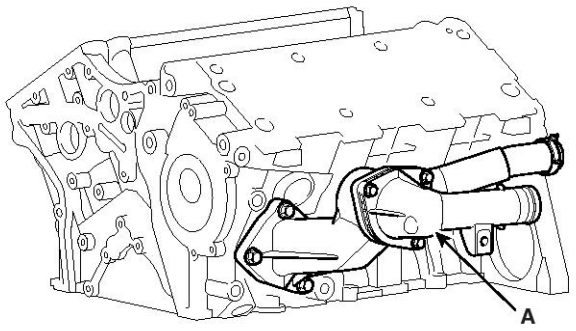
Tightening torque :
29.4 ~ 41.2Nm (3.0 ~ 4.2kgf.m, 21.7 ~ 30.4lb-ft)



SENEM7215D

4. Remove the engine coolant control assembly(A).

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7083D

5. Installation is in the reverse order of removal.

Radiator

1. Connect an R-134a refrigerant Recovery/Recycling/Charging System to the high and the low-pressure service ports to recover refrigerant and drain coolant.
2. Remove the nut(A) from the (-) terminal of the battery.

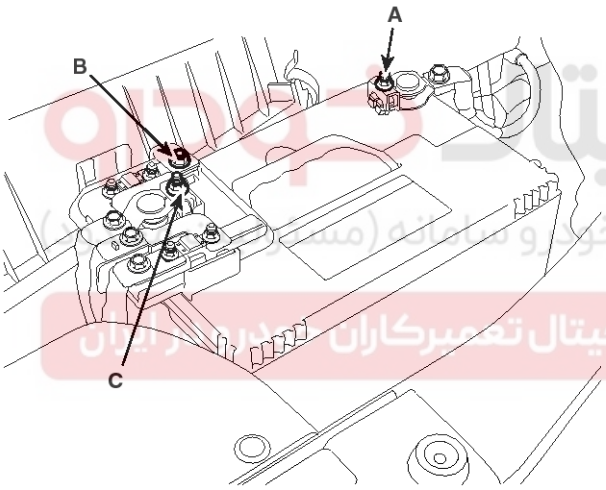
Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

3. Remove the nut(B) from the (+) terminal of the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

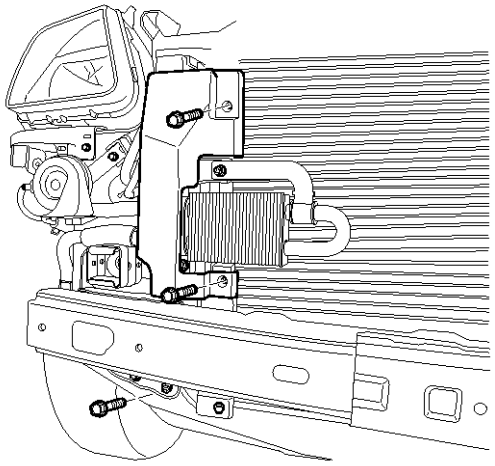
4. Remove the nut(C) from the (+) terminal and the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

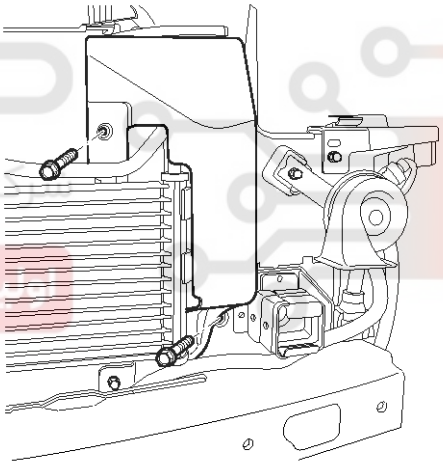


SENEM7069D

5. Remove the front bumper.(Refer to Front bumper in BD Group).
6. Remove the condenser cover mounting bolts and the condenser cover.

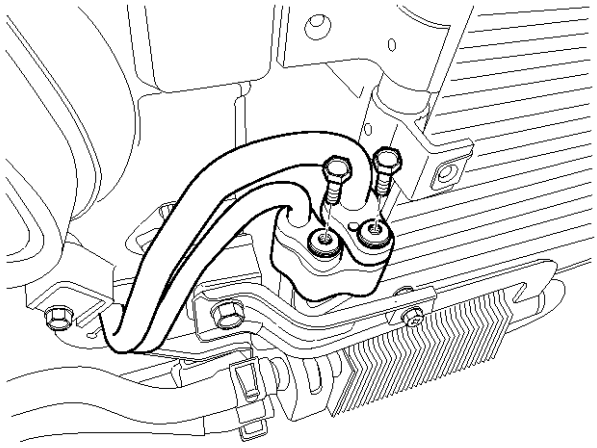


SENEM7311D



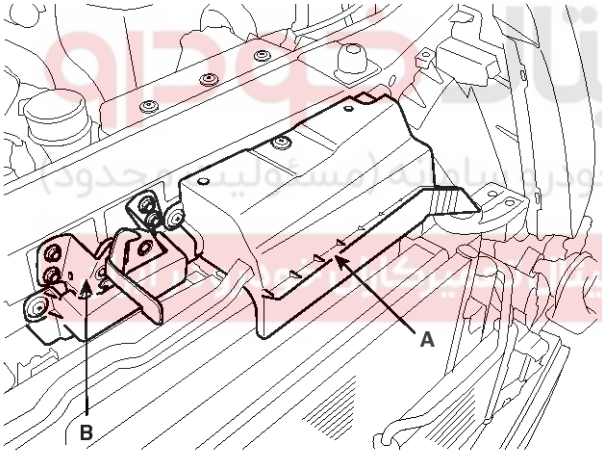
SENEM7312D

7. Disconnect the refrigerant pipes by loosening the pipe mounting bolts.

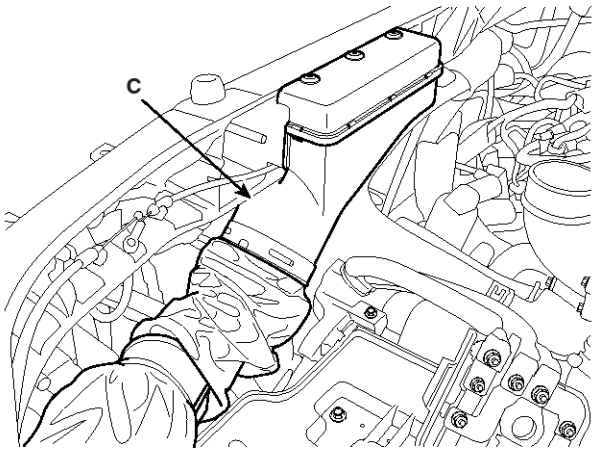


SENEM7310D

8. Remove the air duct cover(A), the air duct(C) and the hood locker(B).

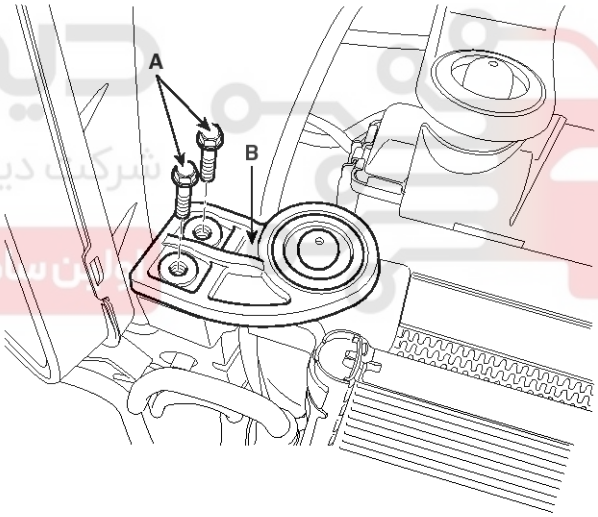


SENEM7084D



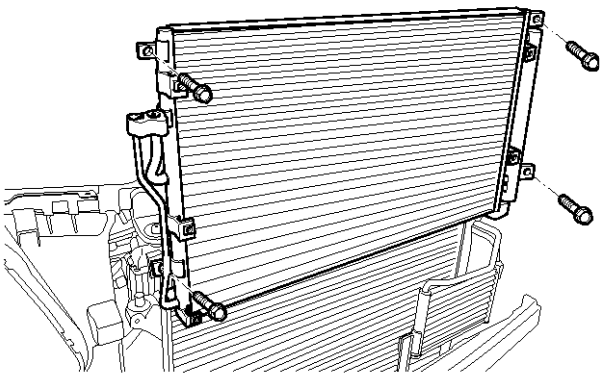
SENEM7085D

9. Remove the power steering oil cooler and the automatic transaxle oil cooler with their brackets.
10. Remove the intercooler bracket(B) by loosening its mounting bolts(A).



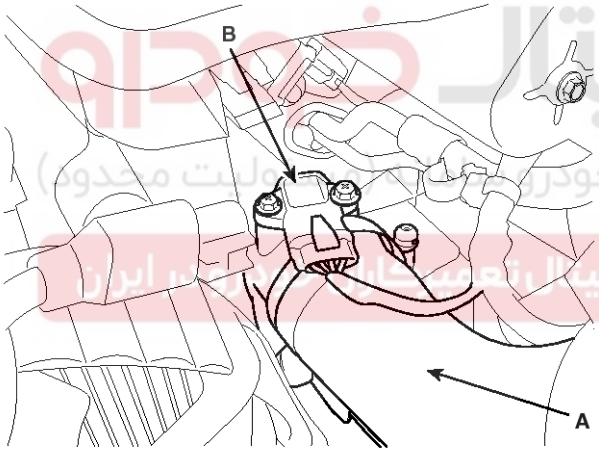
SENEM7301D

11. Remove the condenser bracket mounting bolts and pull up the condenser for its removal.



SENEM7302D

12. Remove the passenger side intercooler hose(A) after disconnecting the BPS(booster pressure sensor) connector(B).



SENEM7087D

13. Remove the oil gauge.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

14. Remove the inlet upper manifold.

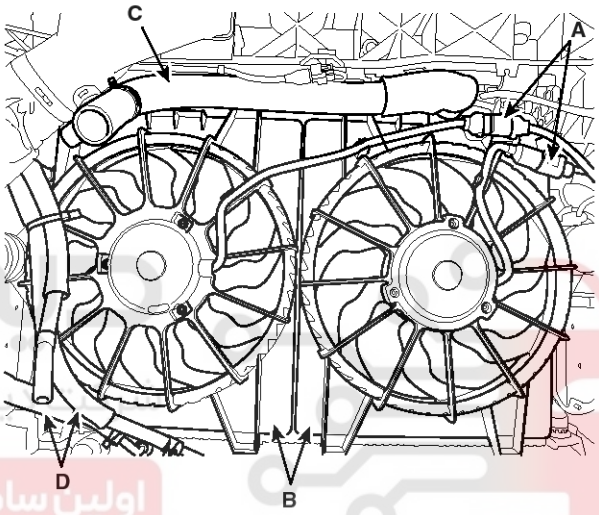
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

15. Disconnect the fan motor connector(A), loosen the shroud mounting bolts and remove the shroud(B).

Tightening torque :
4.9 ~ 7.8Nm (0.5 ~ 0.8kgf.m, 3.6 ~ 5.8lb-ft)

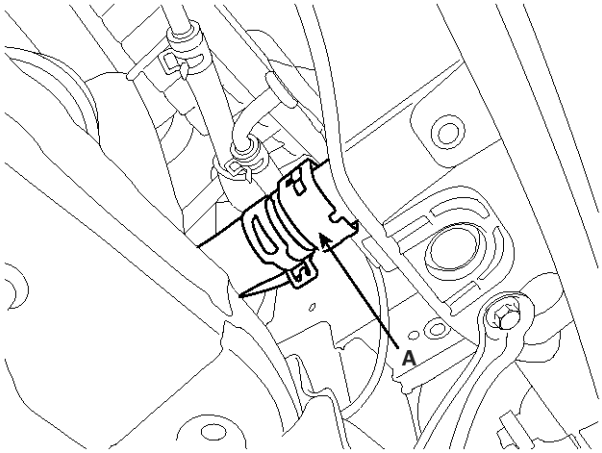
16. Remove the radiator hose(C).

17. Remove the oil cooler hose(D) clamps.



SENEM7088D

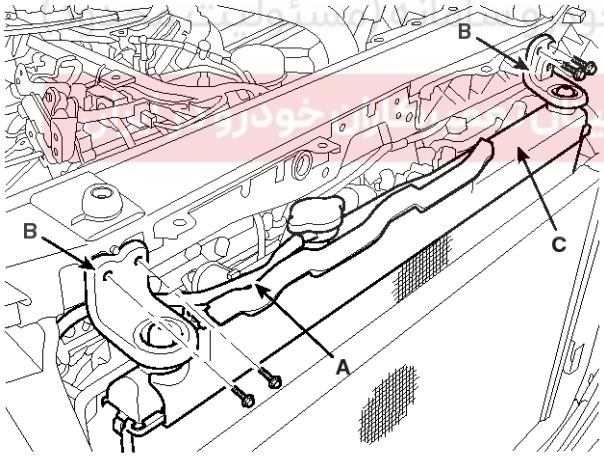
18. When you removing the radiator lower hose, it can be done just by hand without removing its clamp because it has a quick connector type connector(A).



SENEM7073D

19. Disconnect the reservior hose(A) around the radiator cap.
20. Remove the radiator upper mounting bracket(B) and the radiator assembly(C).

Tightening torque :
6.9 ~ 10.8Nm (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



SENEM7089D

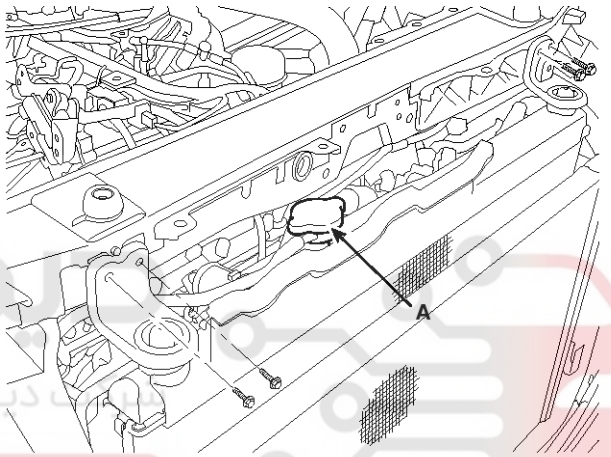
21. Installation is in the reverse order of removal.

Engine Coolant

CAUTION
Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

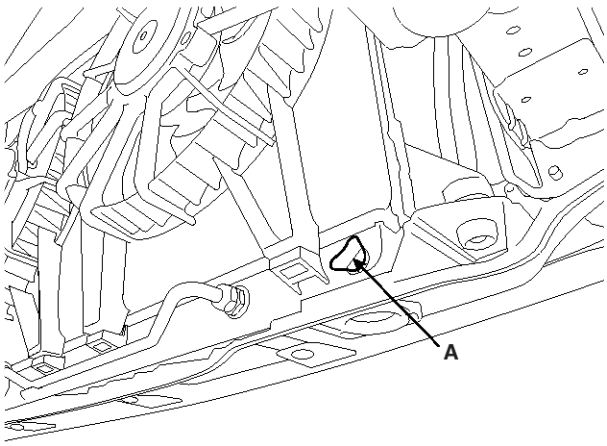
NOTICE
When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

1. Turn the heater temperature control knob to maximum. Make sure the engine and radiator are cool enough to touch.
2. Open the radiator cap(A).



SENEM7216D

3. Remove the drain plug(A) and drain coolant.



SENEM7092D

4. Tighten the radiator drain plug(A) securely after draining.
5. Remove the coolant reservoir tank, drain coolant and reinstall the coolant reservoir tank. Fill the reservoir tank to the 'F' mark with coolant.
6. Fill fluid mixture(coolant 5 : water 5) with coolant and water slowly through the radiator cap. Gently squeeze the upper/ lower hoses of the radiator so as to bleed air easily.

NOTICE

- *Use only genuine antifreeze/coolant.*
- *For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum. Coolant concentrations less than 35% may not provide sufficient protection against corrosion of freezing.*
- *Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.*

CAUTION

- **Do not mix different brands of antifreeze/coolants.**
- **Do not use additional rust inhibitors or antirust products; they may not be compatible with coolant.**

7. Start the engine and allow coolant to circulate. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat step 7 until the cooling fan 3 ~ 5times operating and bleed air sufficiently out of the cooling system.
9. Fill the reservoir to the 'F' line with coolant.
10. Stop the engine and allow coolant to be cool.
11. Repeat step 6 to 10 until the coolant level stays constant and bleed air completely out of the cooling system.

NOTICE

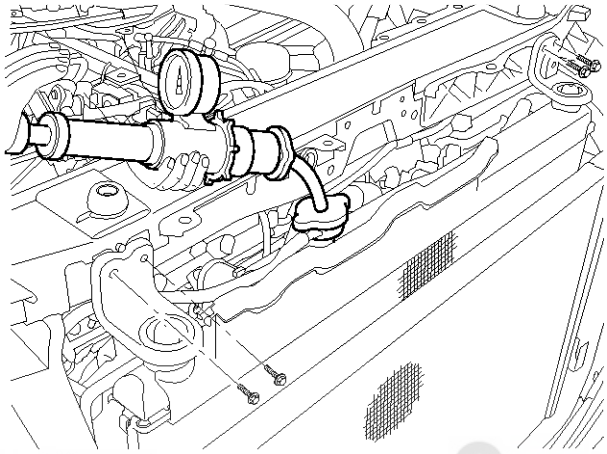
Recheck the coolant level in the reservoir tank for 2 ~ 3 days after replacing coolant.

Coolant capacity :
9.8 ~ 11.5L (10.36 ~ 12.15US qt, 8.62 ~ 10.12Imp qt)

Inspection

Radiator Leakage

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install a pressure tester on it.
2. Warm up the engine.
3. Apply the pressure of 137.29kpa (1.4kg/cm², 19.91psi) to the radiator with the tester.



SENEM7213D

4. Inspect for engine coolant leaks and a drop in pressure.
5. If the pressure drops, check hoses, the radiator and the water pump for leakage. If there is no leakage, inspect the heater core, the cylinder block and the cylinder head.
6. Remove the tester and reinstall the radiator cap.

NOTICE

Check for engine oil in coolant and/or coolant in engine oil.

Check Engine Coolant Level At Reservoir

1. The engine coolant level should be between the 'L' and 'F' lines, when the engine is cold. If low, check for leaks and add quality-qualified engine coolant from HMC. If you can't get any quality-qualified coolant, add similar high quality mono-ethylene glycol based non-silicate, non-amine, non-mitrite, and non-borate coolant or equivalent to 'F' line.

Check Engine Coolant Quality

1. Wait until engine is cool, and then carefully remove the radiator cap.
2. Check if there is any excessive deposits of rust or scale aroung the radiator cap.
3. If excessive dirty, clean the cooling system and replace coolant.
4. Reinstall the radiator cap.

Troubleshooting

Water Pump

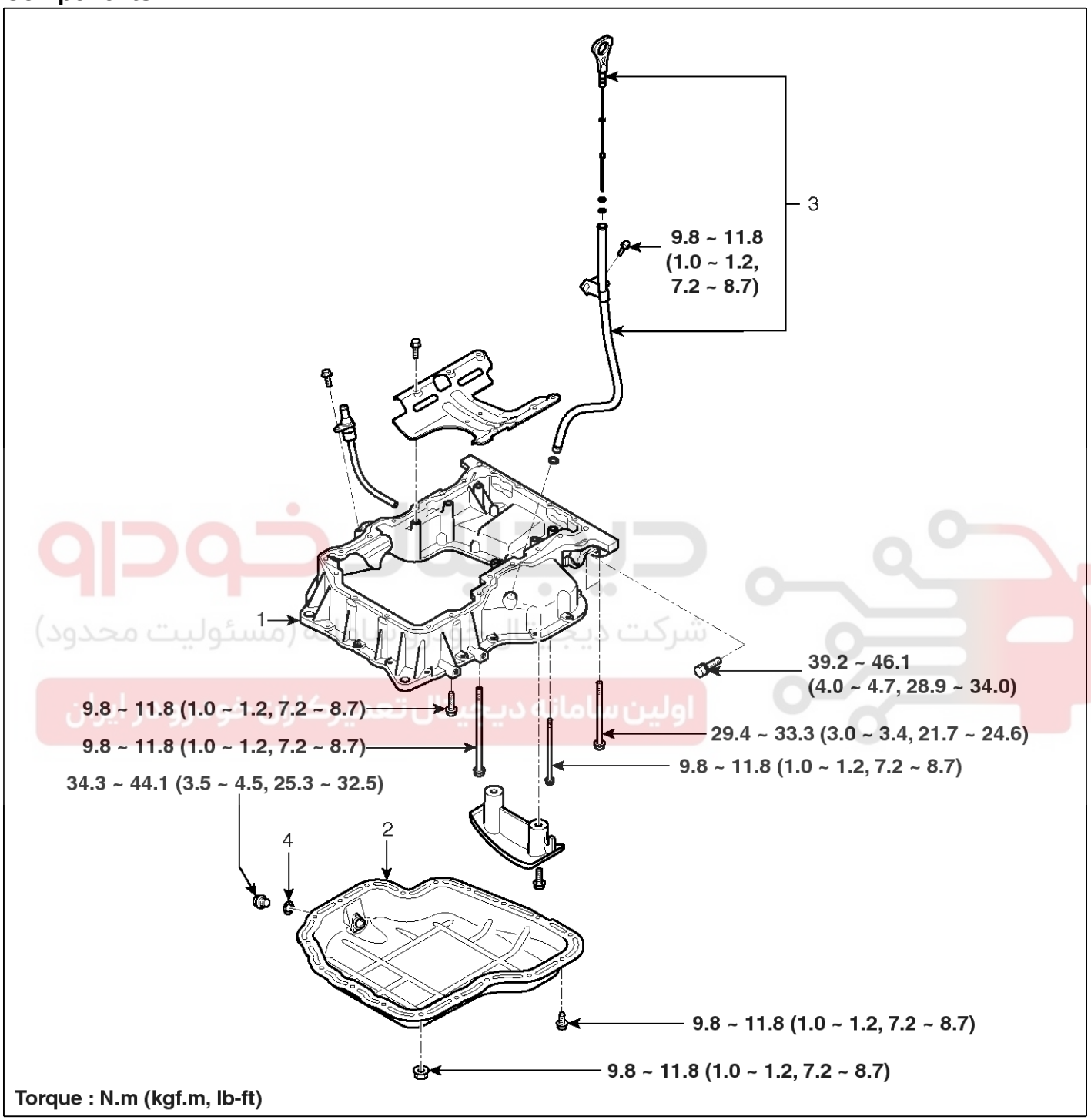
Symptoms		Possible Causes		Remedy
Coolant leakage	• From the bleed hole of the water pump	Visually check	• Check leaks after about ten-minute warming up.	• If coolant still leaks, replace a water pump. • If leakage stops, reuse the water pump (Do not replace the pump with a new one).
	• From gaskets or bolts		• Check the tightening of the water pump mounting bolts.	• Retighten the mounting bolts.
			• Check damage of gaskets or inflow of dust.	• Replace the gasket and clean dust off.
	• From outer surface of water pump		• Check the material or any cracks of the water pump.	• Poor material. If any crack found, replace the water pump.
Noise	• From bearings • From mechanical seals • Impeller interference	Inspection with a stethoscope	• After starting the engine, check noise with a stethoscope.	• If there is no noise, reuse the water pump (do not replace it). • If there is any noise from the water pump, remove the drive belt and recheck.
		Inspection after removing a drive belt	• After removing a water pump and a drive belt, check noise again.	• If there is noise, reuse the water pump. Check other drive line parts. • If there is no noise, replace the water pump with a new one.
		Inspection after removing a water pump	• After removing a water pump and a drive belt, check noise again.	• If there is any interference between them, replace the water pump with a new one.
Overheating	• Damaged impeller • Loosened impeller	Loosened impeller	• Corrosion of the impeller wing	• Check engine coolant. • Poor coolant quality / Maintenance check
			• Impeller seperation from the shaft	• Replace the water pump.

Thermostat

Symptoms		Possible Causes		Remedy
Coolant leakage	• From the thermostat gasket	Check the mounting bolts	• Check the torque of the mounting bolts	• Retighten the bolts and check leakage again.
		Check the gasket for damage	• Check gasket or seal for damage	• Replace gaskets and reuse the thermostat.
Cooled excessively	• Low heater performance (cool air blowed-out) • Thermogauge indicates 'LOW'	Visually check after removing the radiator cap.	• Insufficient coolant or leakage.	• After refilling coolant, recheck.
		GDS check & Starting engine	• Check DTCs • Check connection of the fan clutch or the fan motor. ※ If the fan clutch is always connected, there will be a noise at idle.	• Check the engine coolant sensor, wiring and connectors. • Replace the componants .
		Remove the thermostat and inspect	• Check if there are dusts or chips in the thermostat valve. • Check adherence of the thermostat.	• Clean the thermostat valve and reuse the thermostat. • Replace the thermostat, if it doesn't work properly .
Heated excessively	• Engine overheated • Thermogauge indicates 'HI'	Visually check after removing the radiator cap.	• Insufficient coolant or leakage. ※ Be careful when removing a radiator cap of the overheated vehicle. • Check air in cooling system.	• After refilling coolant, recheck. • Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.
		GDS check & Starting engine	• Check DTCs • Check the fan motor performance as temperature varies. • Check if the fan clutch slips. • Check the water pump adherence or impeller damaged.	• Check the engine coolant sensor, wiring and connectors. • Check the fan motor, the relay and the connector. • Replace the fan clutch, if it doesn't work properly. • Replace the water pump, if it doesn't work properly .
		Immerse the thermostat in boiling water and inspection.	• After removing the thermostat, check it works properly. ※ Check the thermostat opens at the valve opening temperature.	• Replace the thermostat, if it doesn't work properly .

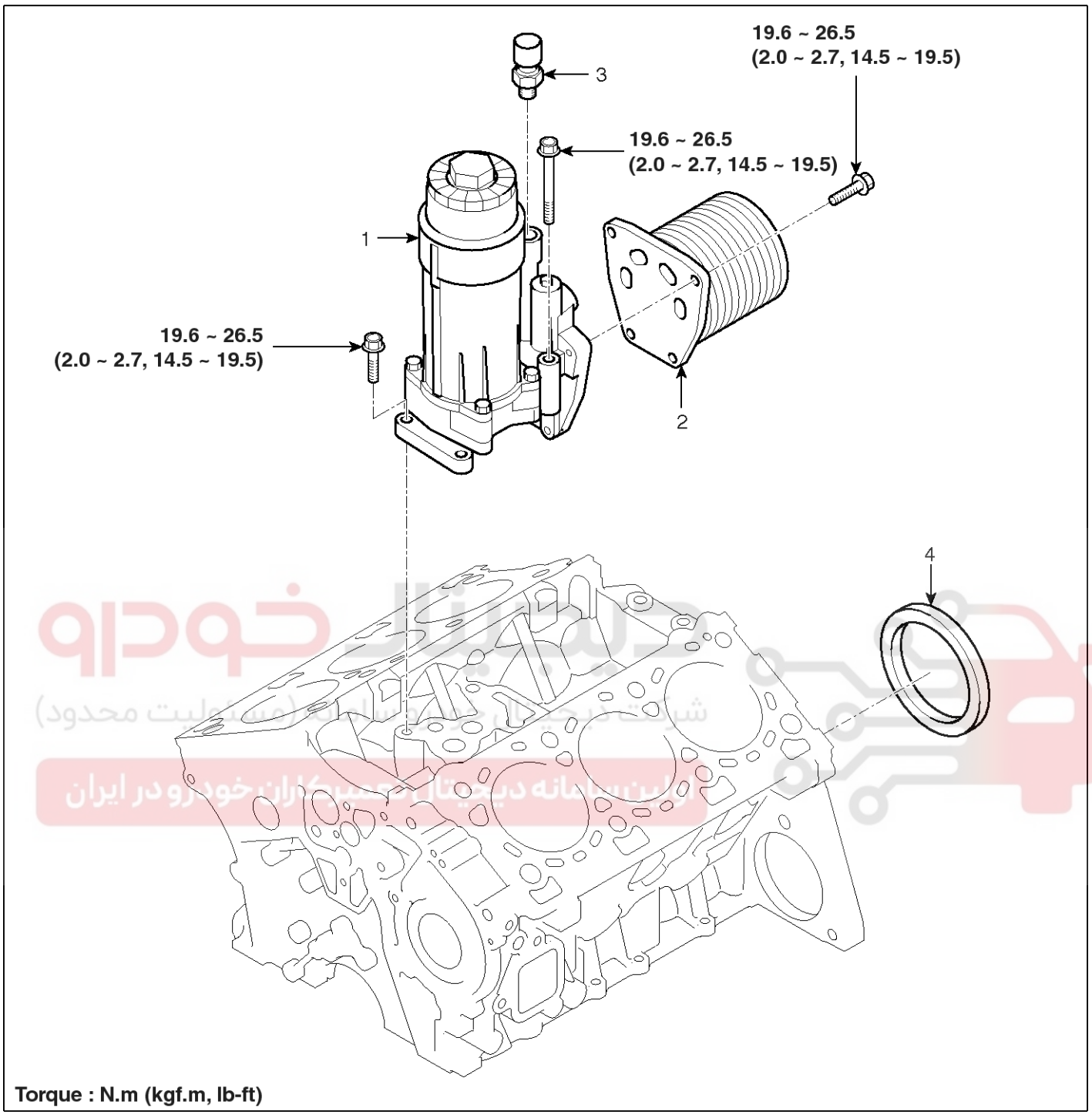
Lubrication System

Components



SENEM9009L

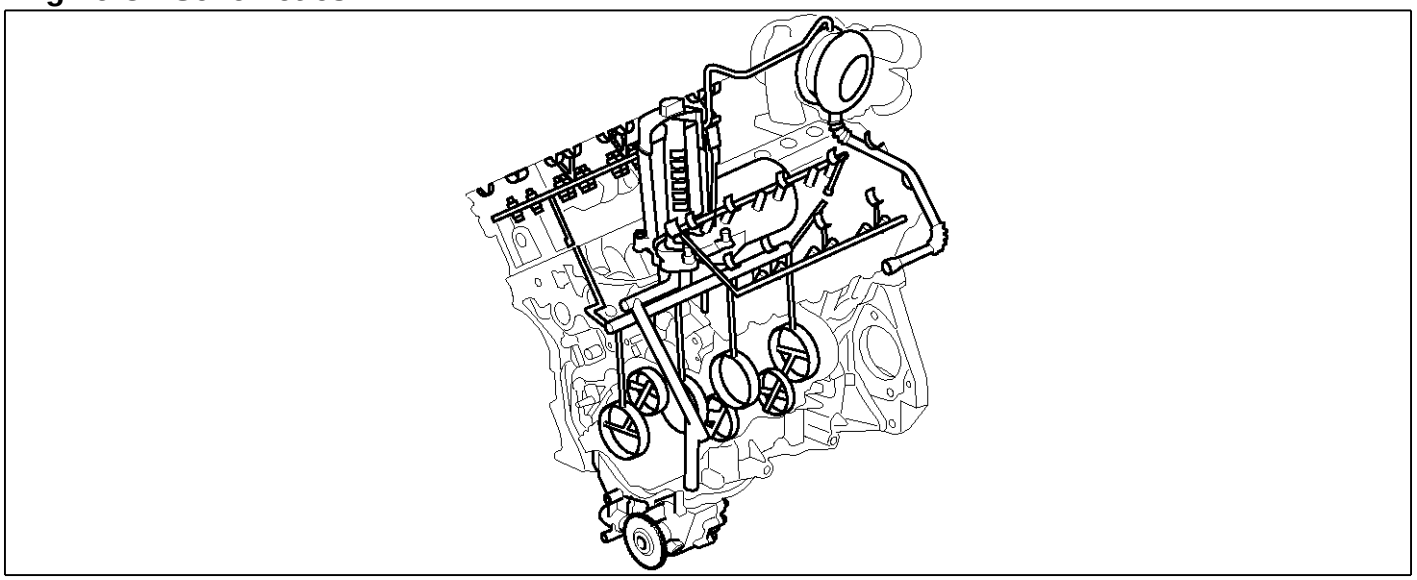
1. Upper oil pan
2. Lower oil pan
3. Oil level gauge assembly
4. Drain plug gasket
5. Drain plug



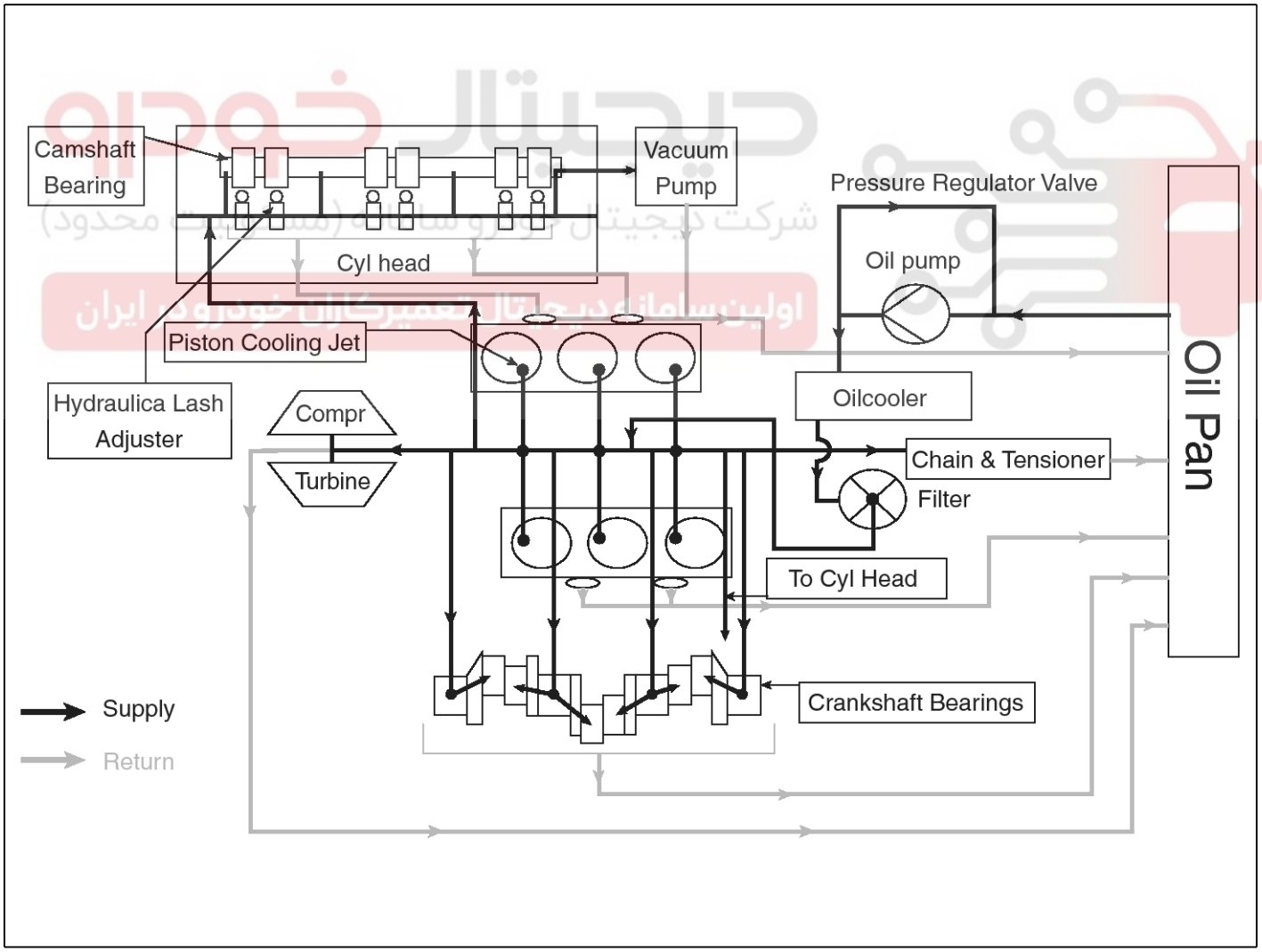
SENEM9010L

1. Oil filter assembly
2. Oil cooler assembly
3. Oil pressure sensor
4. Rear oil seal

Engine Oil Schemetics



SENEM7093D



SENEM7001L

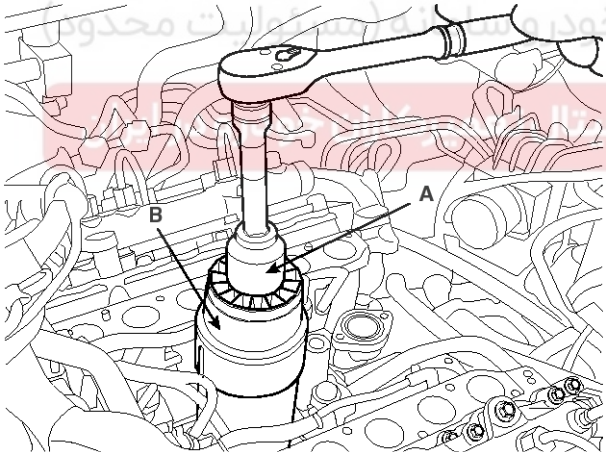
Replacement

Oil And Filter

⚠CAUTION

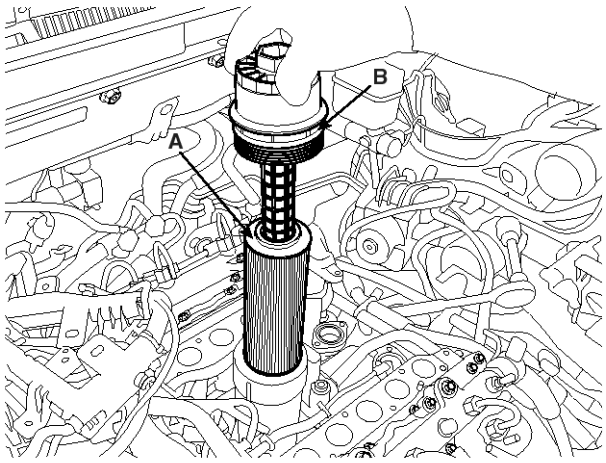
- **Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.**
- **In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.**

1. Remove the oil filter cap.
   1) Using a wrench(36mm or equivalent), loosen the oil filter cap slowly. Be careful not to drop engine oil because the oil filter paper is removed with its cap at this moment.



SENEM7094D

2. Remove the oil filter paper(A) and its O-ring(B) from its cap.



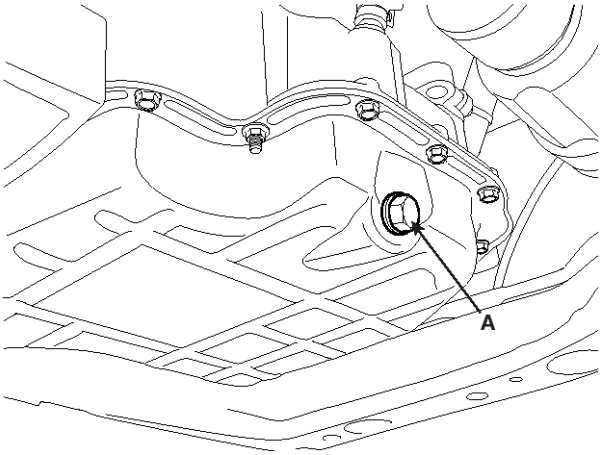
SENEM7095D

   1) Remove the filter paper assembly(A).
   2) Replace the filter paper assembly and O-ring(B) with new ones which is supplied as a service kit and do not reuse the O-ring removed.
3. Assemble the oil filter cap with the filter fixted.

Tightening torque :
24.5Nm (2.5kgf.m, 18.1lb-ft)

4. Opening the oil filler cap and removing the oil pan drain plug, drain engine oil thoroughly.

5. Reassemble the drain plug with a new gasket. Do not reuse the gasket removed.



SENEM7032D

Tightening torque :
34.3 ~ 44.1Nm (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)

6. Fill new engine oil through the oil filler pipe.

[Capacity]
Total : 7.7L (8.14US qt, 6.78lmp qts)
Oil pan : 6.2L (6.55US qt, 5.46lmp qts)
Drain and refil including oil filter :
7.2L (7.61US qt, 6.34lmp qt)

⚠CAUTION

- **Fill a half oil of the total amount first and do the rest again after about one minute later,**
- **Do not fill oil over the 'F' line, checking the level with the oil level gauge.**

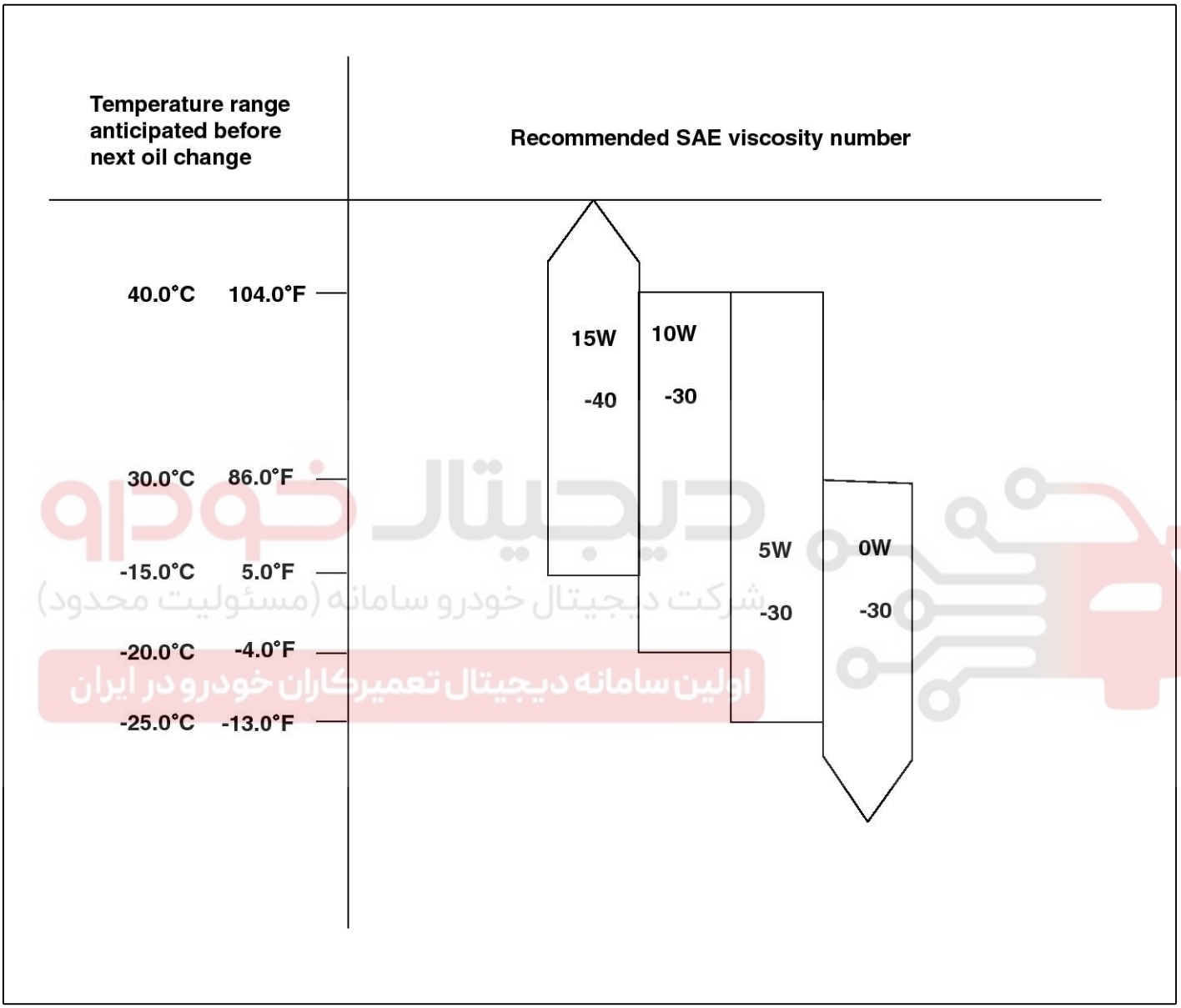
7. Start engine and check for oil leaks.
8. Recheck the engine oil level.

Inspection

Selection Of Engine Oil

ACEA classificaton : C3 (with DPF), B4 (without DPF)

SAE viscosity grades : Refer to the recommended SAE viscosity number



SENEM0102L

NOTICE

For best performance and maximum protection of all types of operation, select only those lubricants which :

1. *Satisfy the requirement of the ACEA classification.*
2. *Have proper SAE grade number for expected ambient temperature range.*
   - *Lubricants that do not have both an SAE grade number and ACEA service classification on the container should not be used.*
   - *The ACEA certified engine oil is required as a service engine oil. Only in case that ACEA certified engine oil is not available, the API certified engine oil (API CH-4 or above) is allowed restrictively.*
   - *For the vehicle equipped with DPF, the service engine oil quality should meet the ACEA C3 grade. However, oil refill with small amount of ACEA B4 grade between oil change intervals is possible.*

Engine Oil

1. Check the engine oil quality.

   Check the oil deterioration, entry of water, discoloring of thinning.

   If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

   After warming up the engine and then 5 minutes after the engine stop, oil level should be between the “L” and “F” marks in the dipstick.

   If low, check for leakage and add oil up to the “F” mark.

NOTICE

Do not fill with engine oil above the “F” mark.

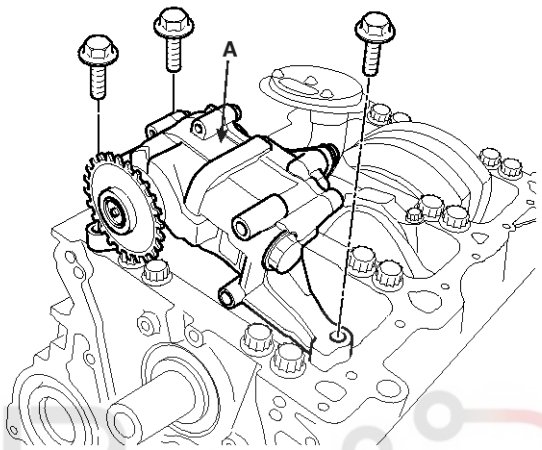
Installation

Oil Pump

1. Before installing the oil pump and screen assembly on the bed plate, check if the O-ring is seated properly and not damaged.
2. Install the oil pump and screen assembly with the specified torque.

Tightening torque :

19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

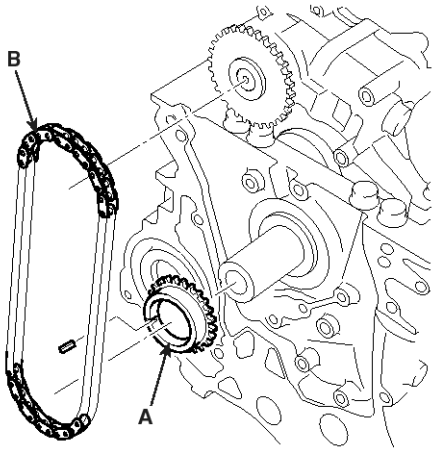


SENEM7019D

3. Check if the oil pump works properly.
4. With the cylinder block, bed plate, crankshaft piston assembly, connecting rod assembly and the oil pump assembly installed, insert the crankshaft sprocket(A) in the crankshaft, aligning the No.1 piston at the BDC(bottom dead center).

5. Install the oil pump chain(B) and the oil pump chain tensioner and remove the pin from the tensioner.

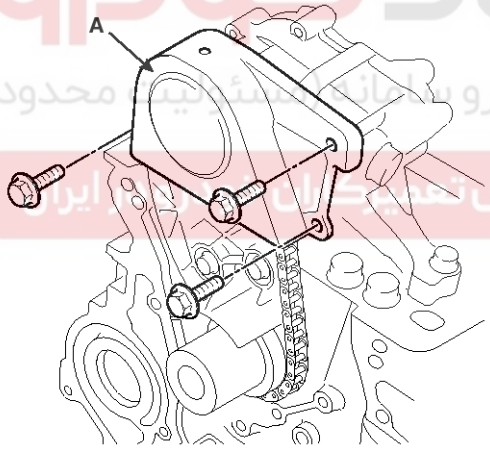
Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



SENEM7020D

6. Install the baffle plate(A).

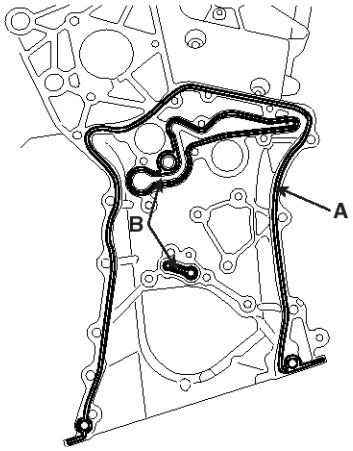
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



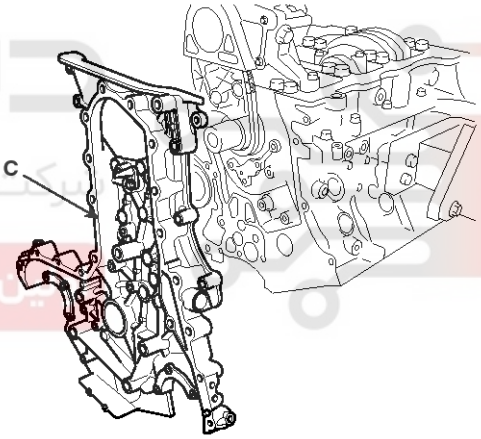
SENEM7021D

Oil Pan

1. Install the oil pump.
2. After applying sealant(A) on the groove and checking if the O-rings are seated securely, Install the timing chain case assembly(C) in fifteen minutes.



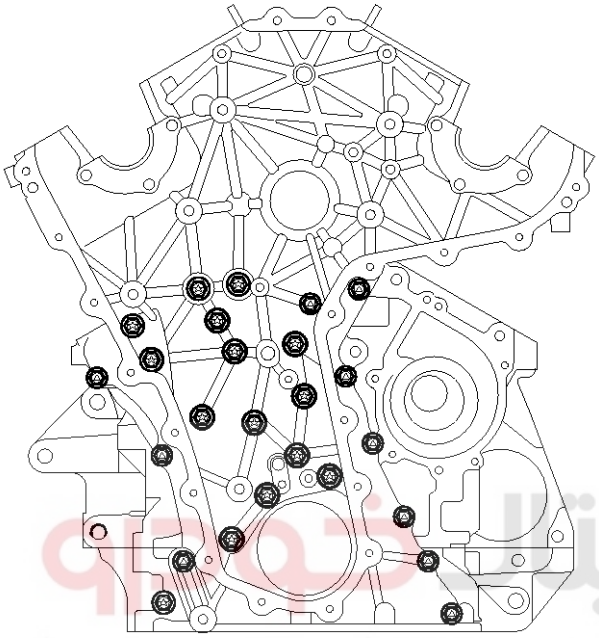
SENEM7022D



SENEM7023D

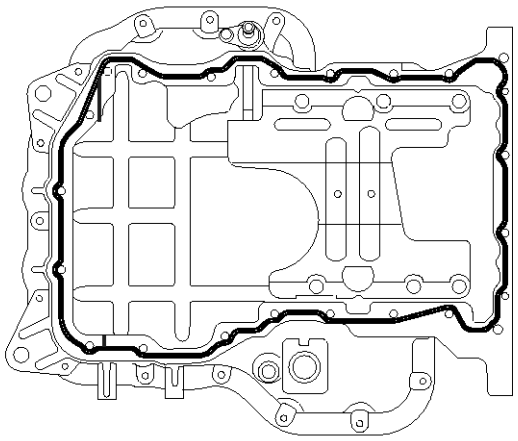
3. Tighten the mounting bolts of the chain case with the specified torque below.

Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft) - 6×16(★)
19.6 ~ 25.5Nm (2.0 ~ 2.6kgf.m, 14.5 ~ 18.8lb-ft) - 8×35(▲)



SENEM7024D

4. Apply liquid gasket on the upper oil pan assembly shown as below.



SENEM7025D

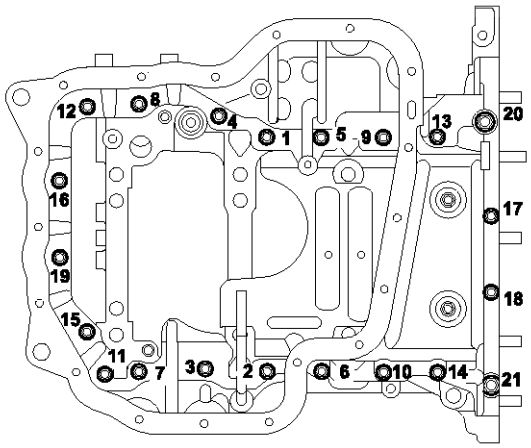
Liquid gasket: LOCTITE 5900 or equivalent

NOTICE

- *Apply sealant cautiously to prevent sealant from coming in the oil pan during installation.*
- *After applying sealant, assemble the oil pan in fifteen minutes.*

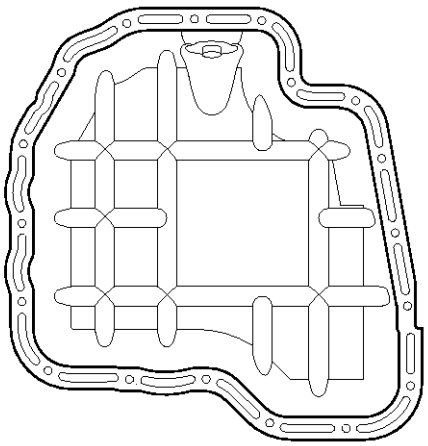
5. Tighten the mounting bolts with the oreder and the specified torque below.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) - all bolts except 20,21
29.4 ~ 33.3Nm (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft) - 20,21 bolts



SENEM7026D

6. Apply liquid gasket on the lower oil pan assembly shown as below.



SENEM7027D

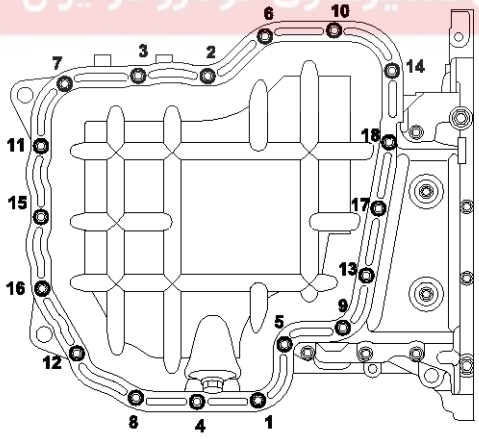
Liquid gasket: LOCTITE 5900 or equivalent

NOTICE

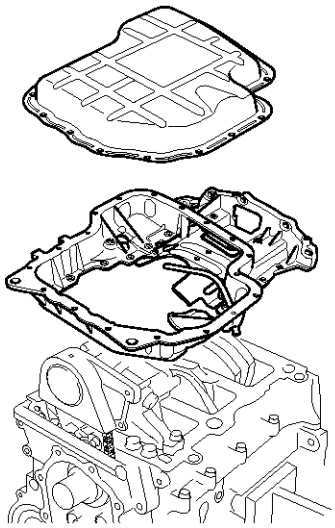
- *Apply sealant cautiously to prevent sealant from coming in the oil pan during installation.*
- *After applying sealant, assemble the oil pan in fifteen minutes.*

7. Tighten the mounting bolts with the oreder and the specified torque below.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7028D

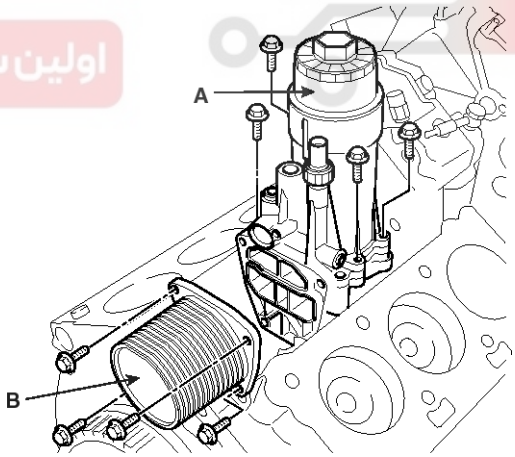


SENEM7029D

Oil Filter And Cooler Assembly

1. Assemble the oil cooler(B) to the oil filter(A).
2. Install the oil filter and cooler assembly to the cylinder block.
3. Check if there are rubber packings between the oil filter and the block or the oil cooler. If so, apply engine oil.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~19.5lb-ft)



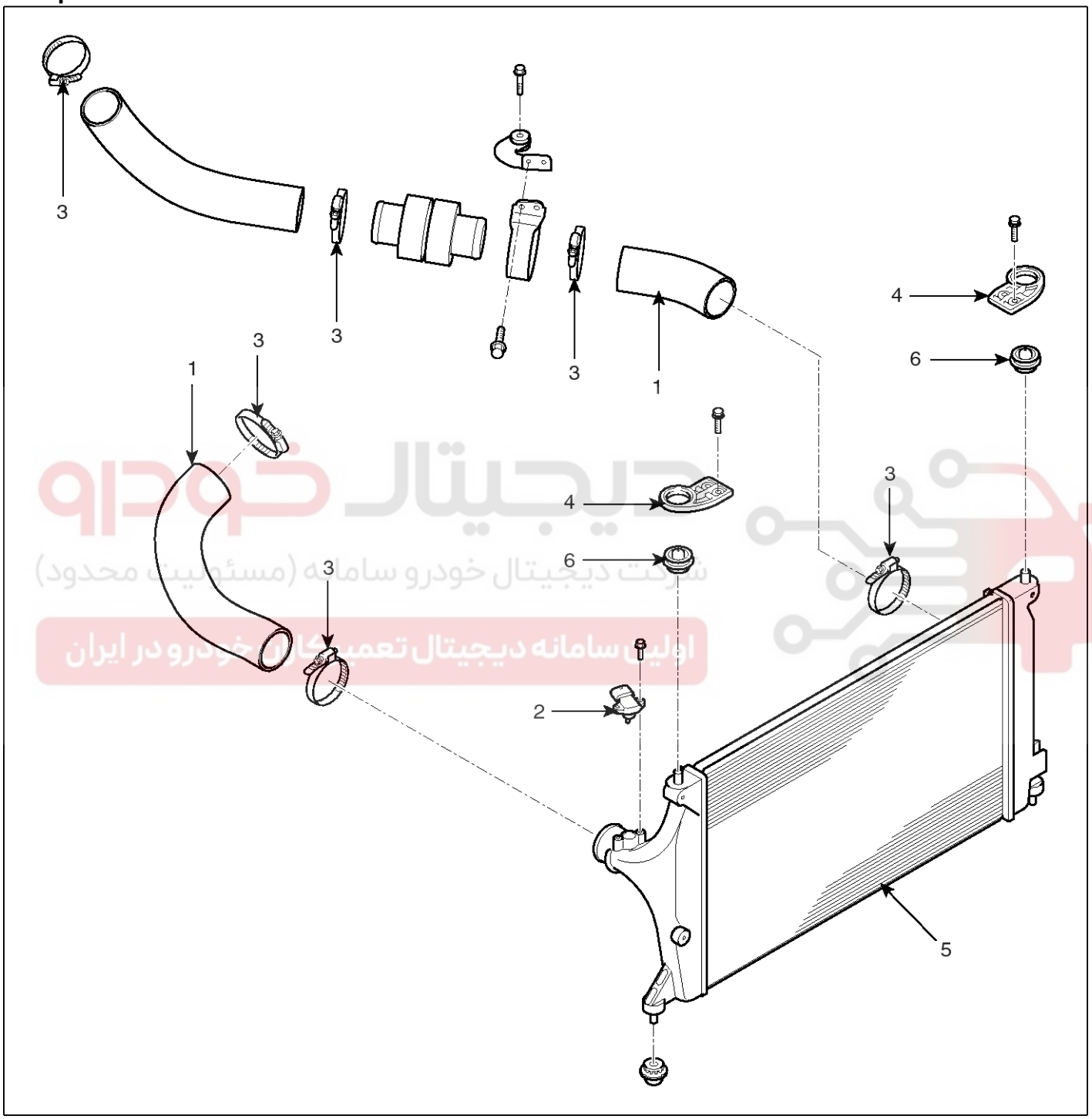
SENEM7030D

4. Install the water outlet duct and then the intake and exhaust system.

Intake And Exhaust System

Intercooler

Components



SENEM9011L

1. Intercooler hose
2. Booster Pressure Sensor(BPS)
3. Clamp
4. Intercooler mounting bracket
5. Intercooler assembly
6. Intercooler mounting insulator

Removal

1. Connect an R-134a refrigerant Recovery/Recycling/Charging System to the high and the low-pressure service ports to recover refrigerant and drain coolant.
2. Remove the nut(A) from the (-) terminal of the battery.

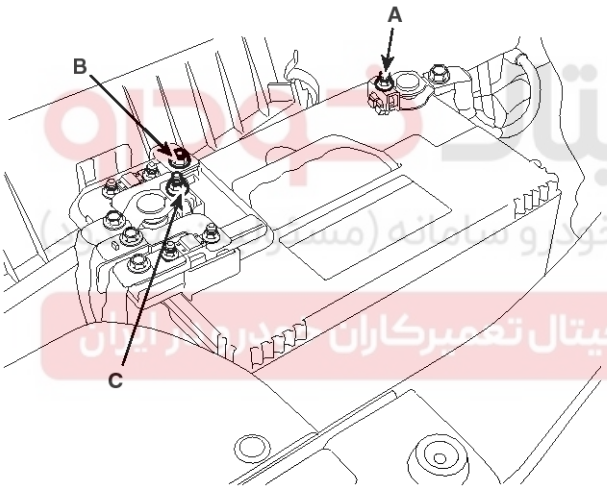
Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

3. Remove the nut(B) from the (+) terminal of the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

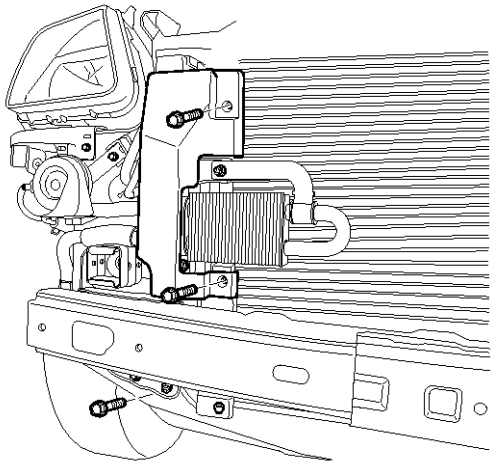
4. Remove the nut(C) from the (+) terminal and the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

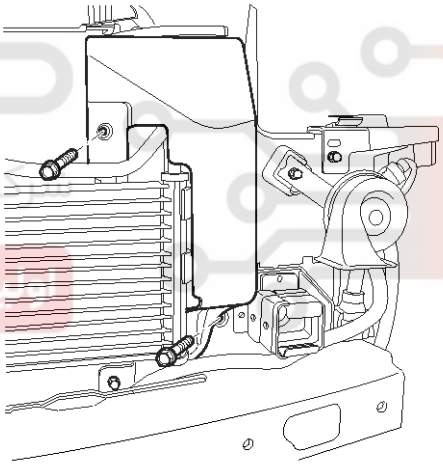


SENEM7069D

5. Remove the front bumper.(Refer to Front bumper in BD Group).
6. Remove the condenser cover mounting bolts and the condenser cover.

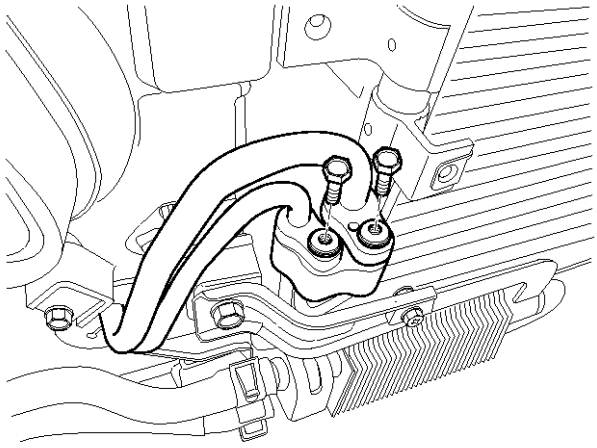


SENEM7311D



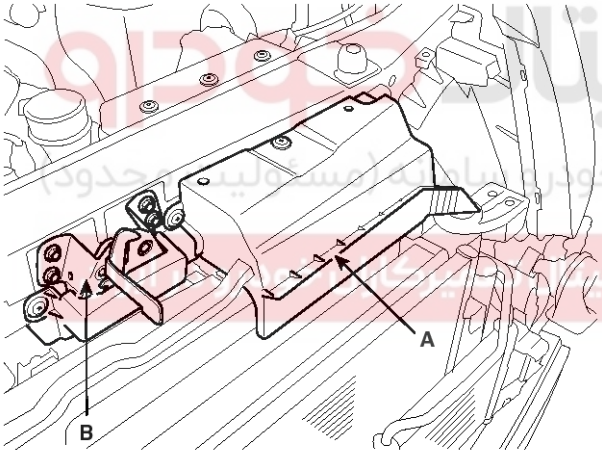
SENEM7312D

7. Disconnect the refrigerant pipes by loosening the pipe mounting bolts.

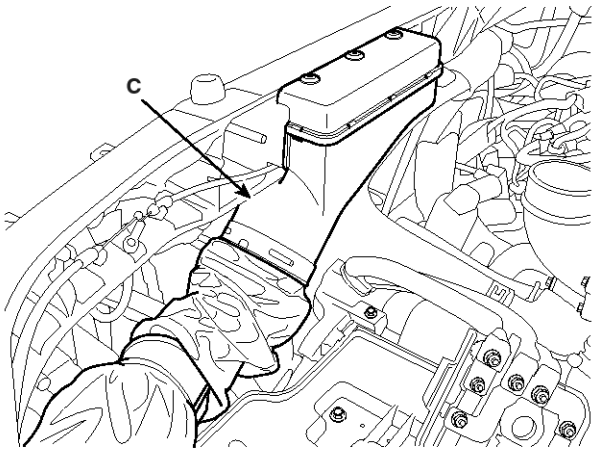


SENEM7310D

8. Remove the air duct cover(A), the air duct(C) and the hood locker(B).

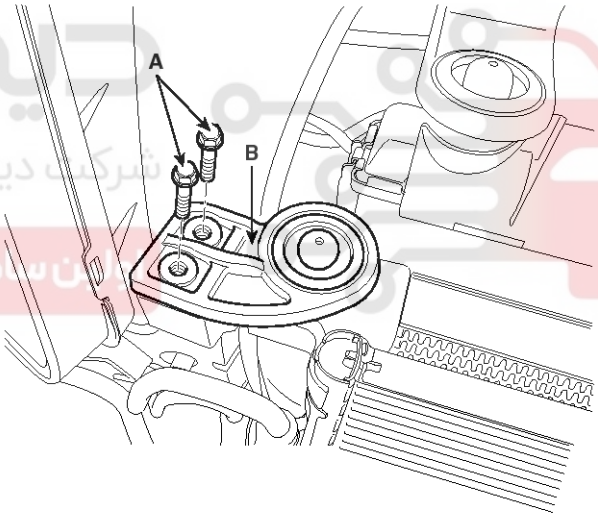


SENEM7084D



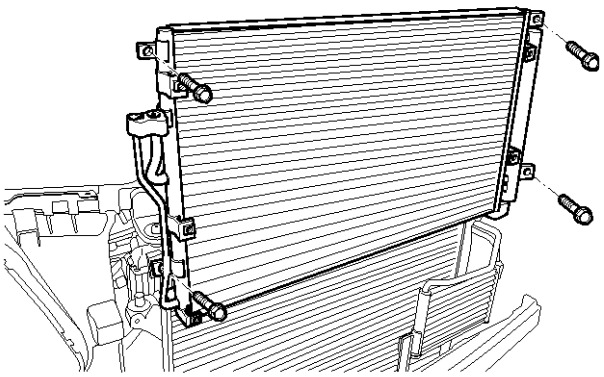
SENEM7085D

9. Remove the power steering oil cooler and the automatic transaxle oil cooler with their brackets.
10. Remove the intercooler bracket(B) by loosening its mounting bolts(A).



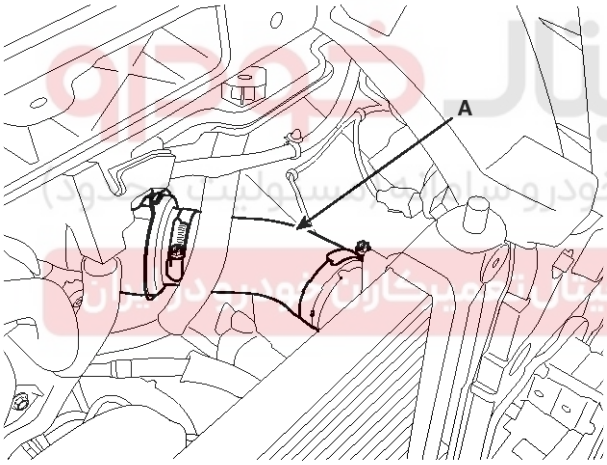
SENEM7301D

11. Remove the condenser bracket mounting bolts and pull up the condenser for its removal.

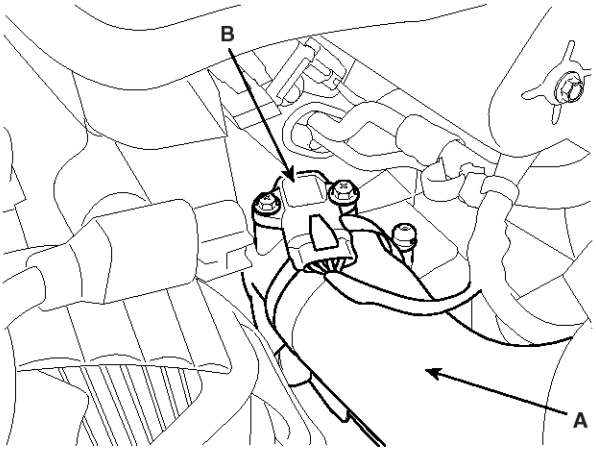


SENEM7302D

12. Remove the intercooler hoses(A). When you remove the passenger side hose, disconnect the BPS(booster pressure sensor) connector(B).



SENEM7086D



SENEM7087D

13. Remove the oil gauge.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

14. Remove the inlet upper manifold.

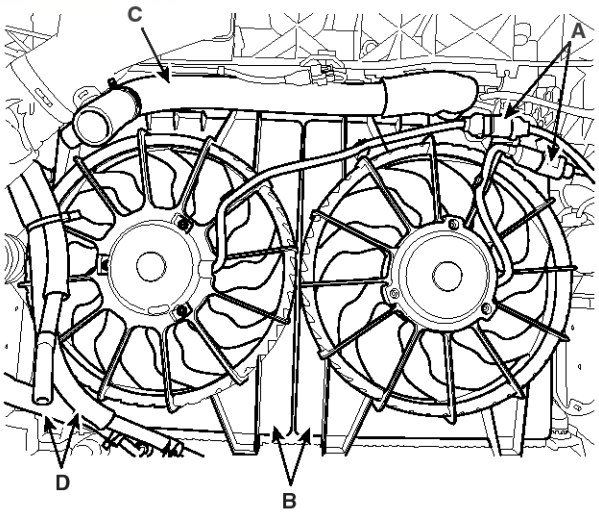
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

15. Disconnect the fan motor connector(A), loosen the shroud mounting bolts and remove the shroud(B).

Tightening torque :
4.9 ~ 7.8Nm (0.5 ~ 0.8kgf.m, 3.6 ~ 5.8lb-ft)

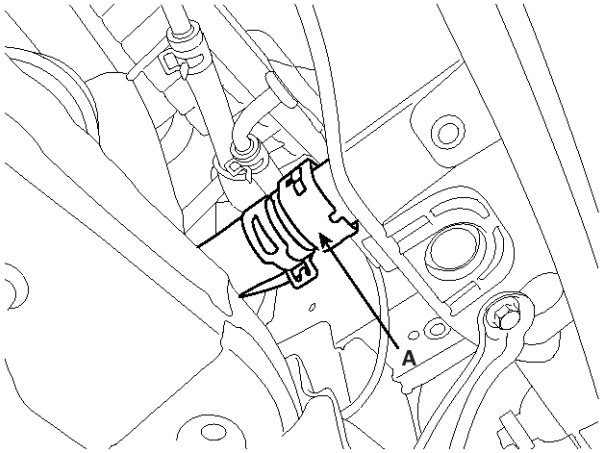
16. Remove the radiator hose(C).

17. Remove the oil cooler hose(D) clamps.



SENEM7088D

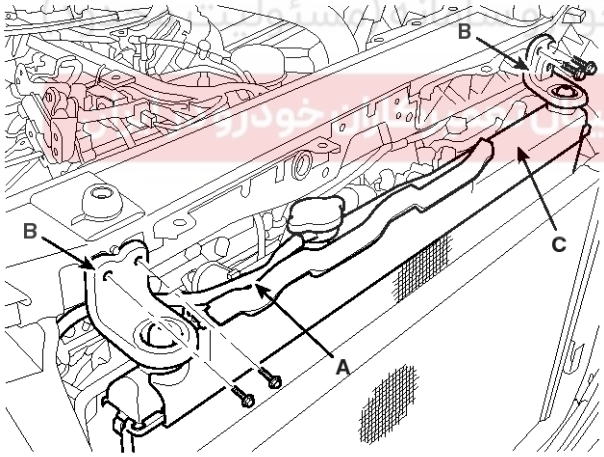
18. When you removing the radiator lower hose, it can be done just by hand without removing its clamp because it has a quick connector type connector(A).



SENEM7073D

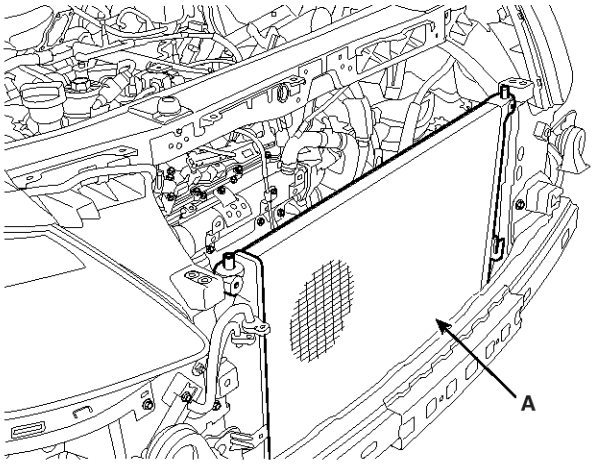
19. Disconnect the reservior hose(A) around the radiator cap.
20. Remove the radiator upper mounting bracket(B) and the radiator assembly(C).

Tightening torque :
6.9 ~ 10.8Nm (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



SENEM7089D

21. Remove the intercooler assembly(B) after taking off the brackets(A).



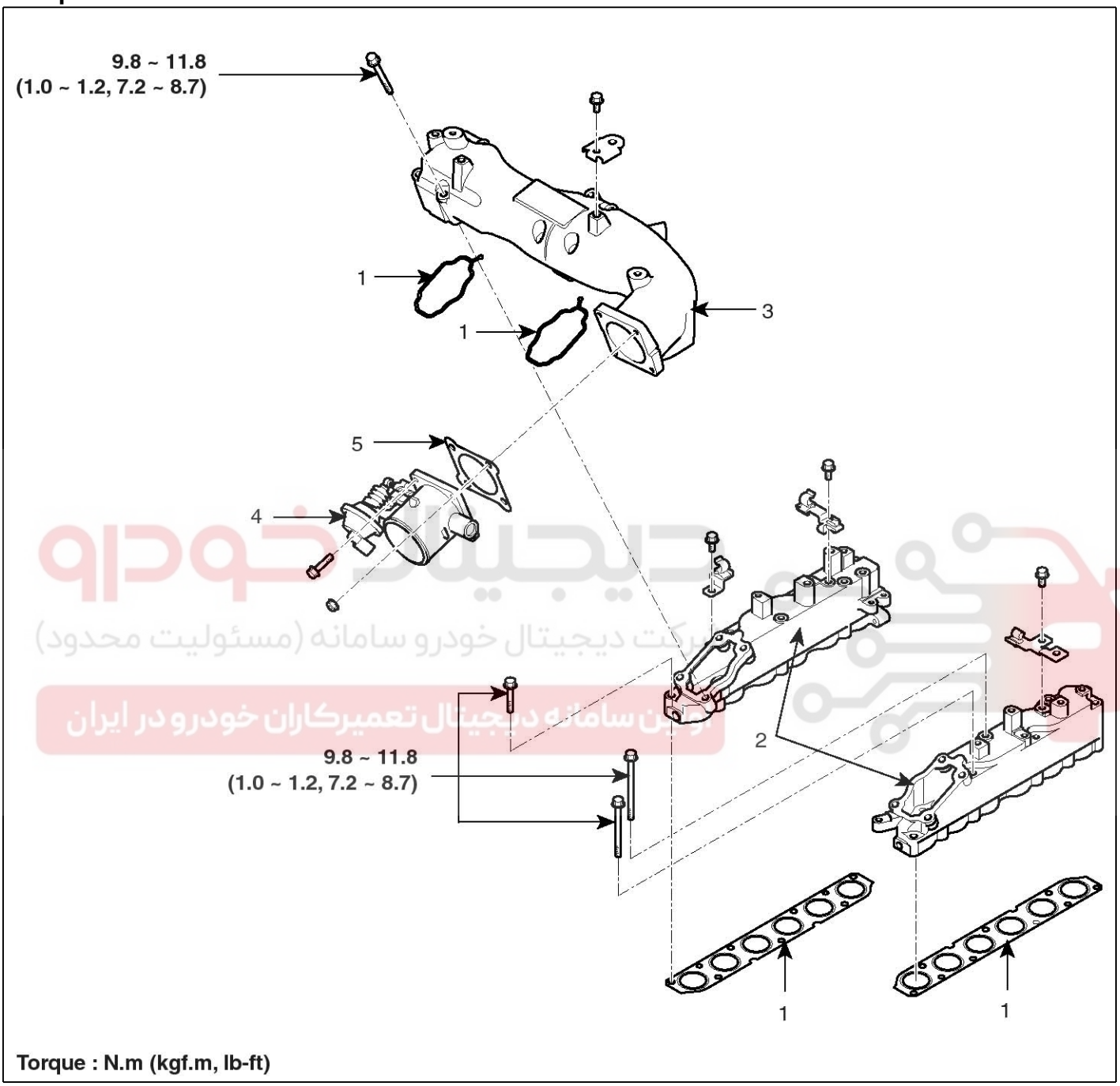
SENEM7090D

Installation

Installation is in the reverse order of removal.

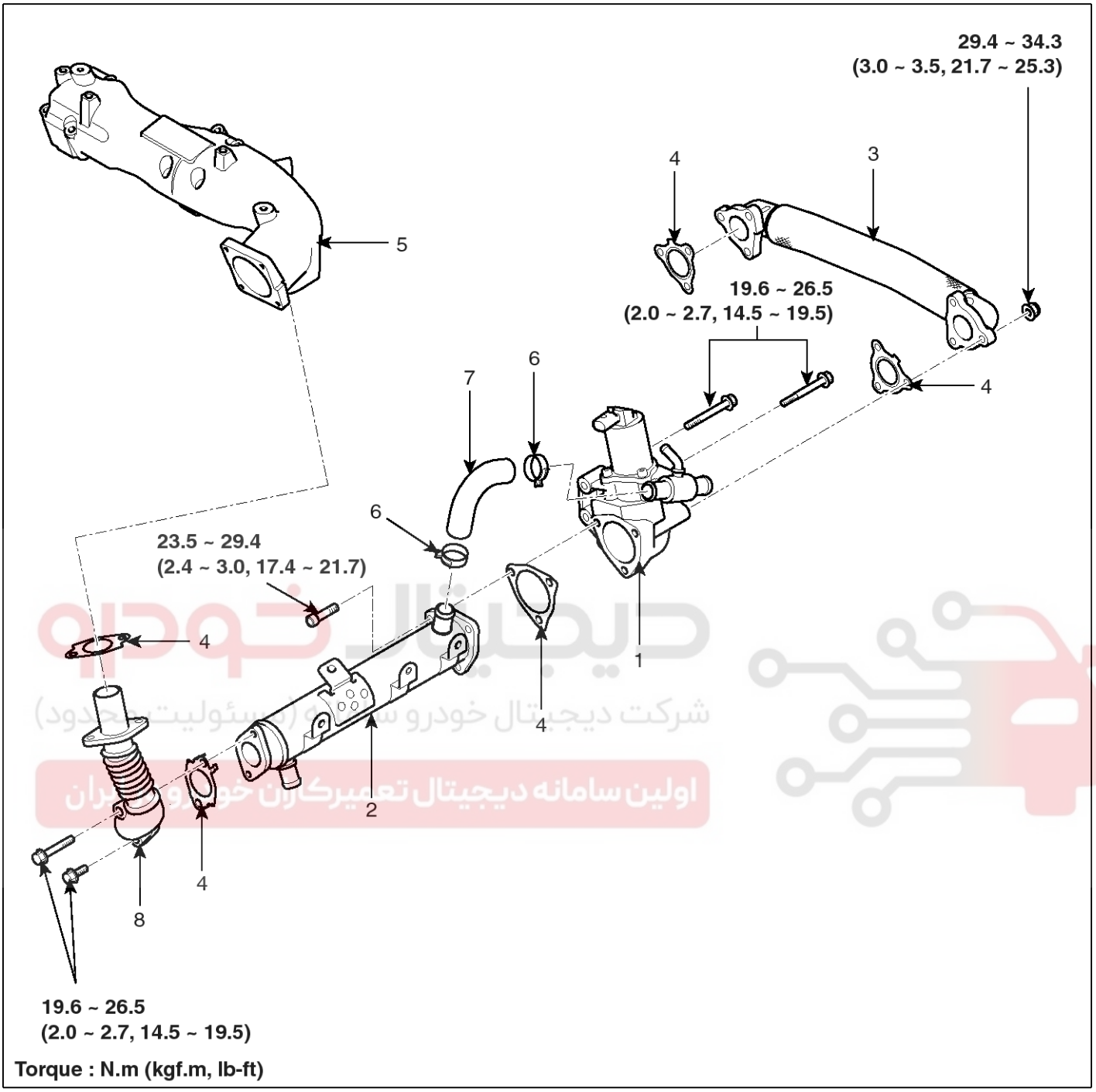
Intake Manifold

Components



SENEM9012L

1. Inlet manifold gasket
2. Inlet lower manifold assembly
3. Inlet upper manifold assembly
4. Throttle body assembly
5. Throttle body gasket

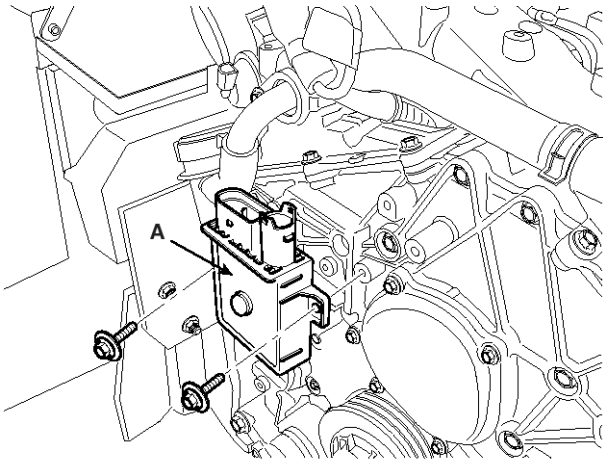


SENEM9015L

1. EGR(Exhaust Gas Recirculation) valve
2. EGR cooler
3. EGR exhaust pipe
4. Gasket
5. Inlet upper manifold assembly
6. Clamp
7. EGR cooler hose
8. EGR cooler pipe

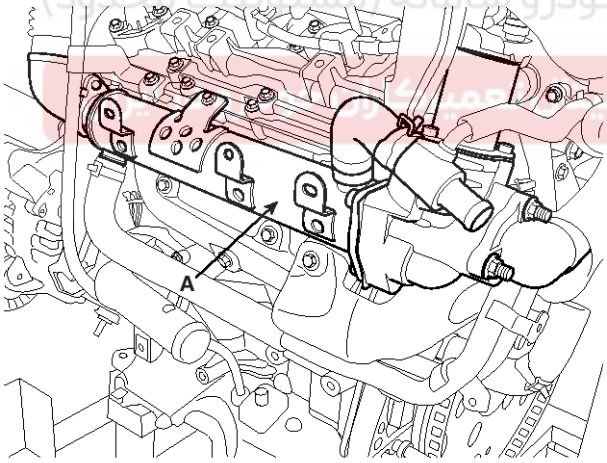
Removal

1. Remove the inlet upper manifold assembly.
2. Remove the glow control unit(A).



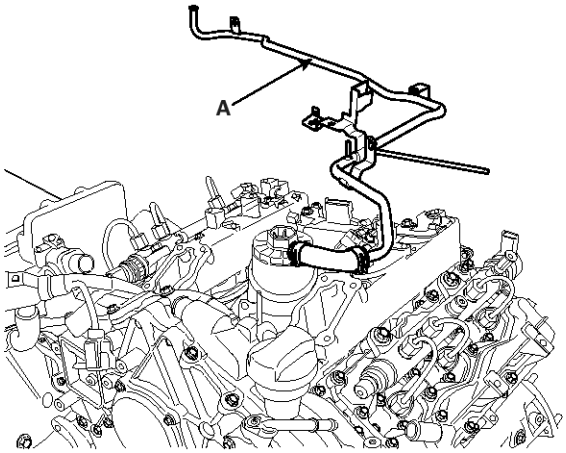
SENEM7104D

3. Remove the CMP sensor.
4. Remove the fuel feed and return hose or pipe.
5. Remove the high pressure fuel pipe(rail to rail).
6. Remove the oil level gauge.
7. Remove the EGR system(A).



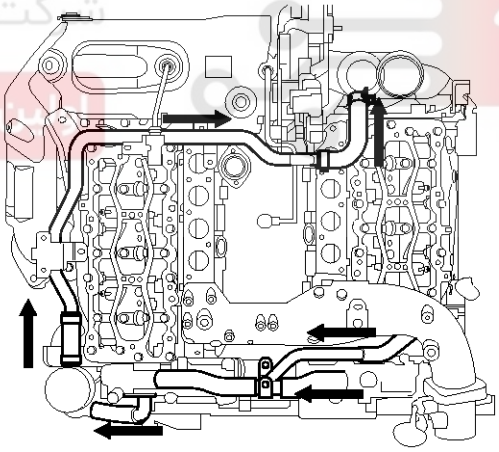
SENEM7102D

8. Remove the engine hanger.
9. Remove the vacuum pipe(A).



SENEM7100D

10. Remove the high pressure fuel pipe(rail to pump).
11. Remove the common rail system.
12. Remove the high pressure fuel pipe(rail to injector).
13. Remove the injector packings.
14. Remove the injectors.(Refer to Injector in FL Group).
15. Remove the blow-by gas recirculation system such as the oil seperator pipes and hoses.



SENEM7103D

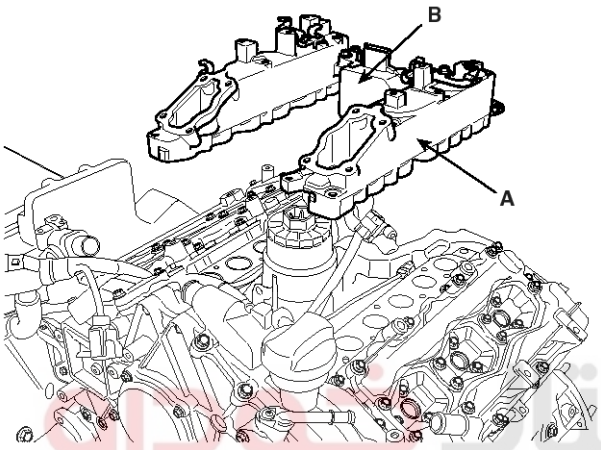
16. Remove the inlet lower manifold assembly(A).

⚠CAUTION

The inlet lower manifold assembly(A) is the assembly including the swirl control actuator(B).

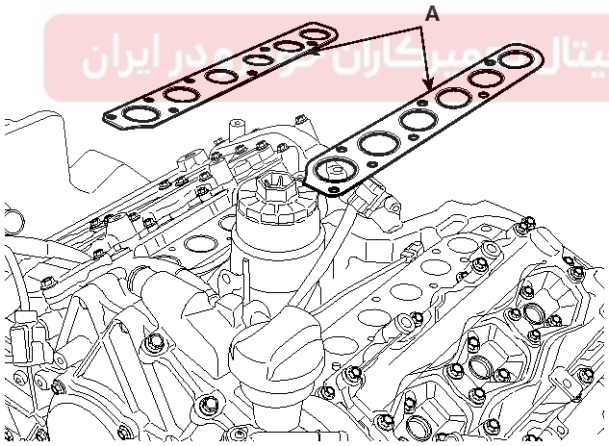
Do NOT disassemble the swirl control actuator from the inlet lower manifold.

Disassembly and reassembly may change the setting specification of the two link shafts which are connected between the inlet lower manifold and the swirl control actuator.



SENEM7098D

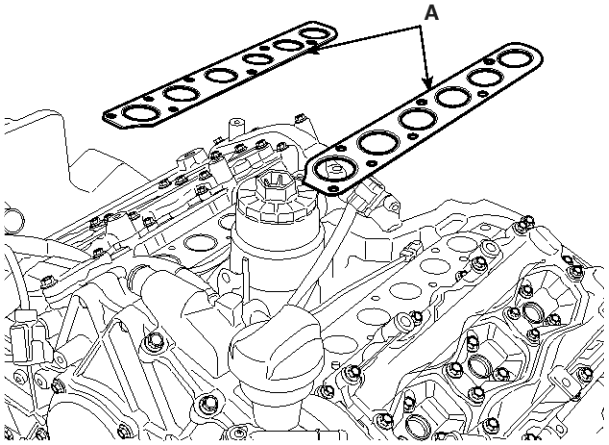
17. Remove the inlet manifold gaskets(A).



SENEM7097D

Installation

1. Install the inlet manifold gaskets(A).



SENEM7097D

2. Install the inlet lower manifold assembly(A).

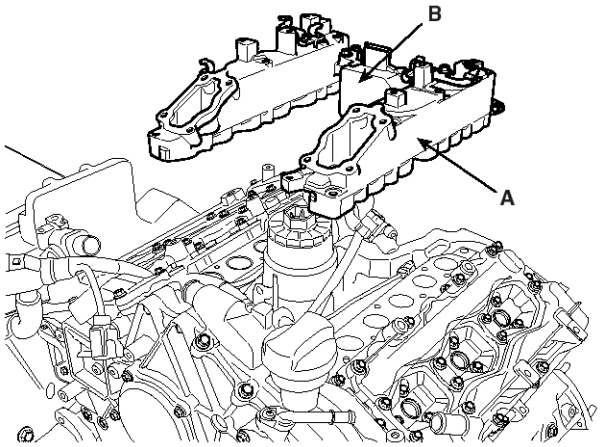
⚠CAUTION

The inlet lower manifold assembly(A) is the assembly including the swirl control actuator(B).

If you have already disassembled the swirl control actuator from the inlet lower manifold, you should throw them away and install a new inlet lower manifold assembly including the swirl control actuator.

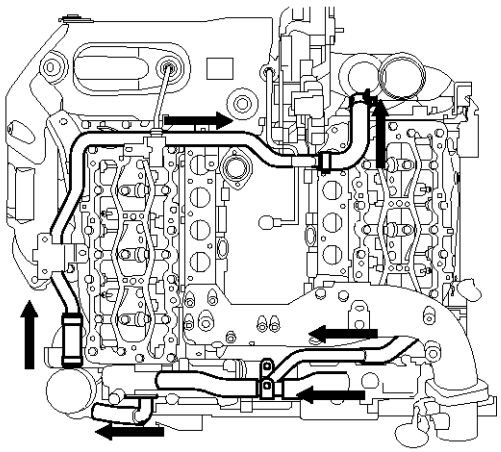
Disassembly and reassembly may change the setting specification of the two link shafts which are connected between the inlet lower manifold and the swirl control actuator.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



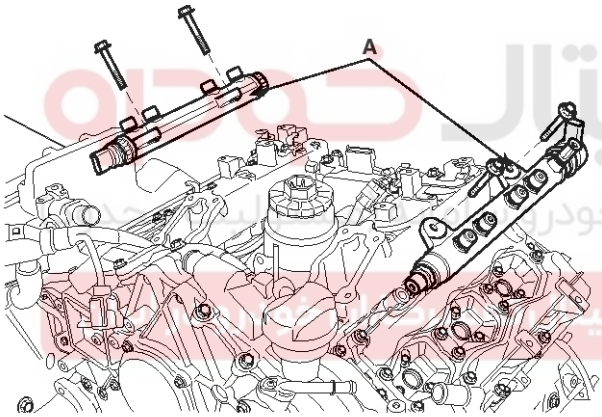
SENEM7098D

3. Install the blow-by gas recirculation system such as the oil seperator pipes and hoses.



SENEM7103D

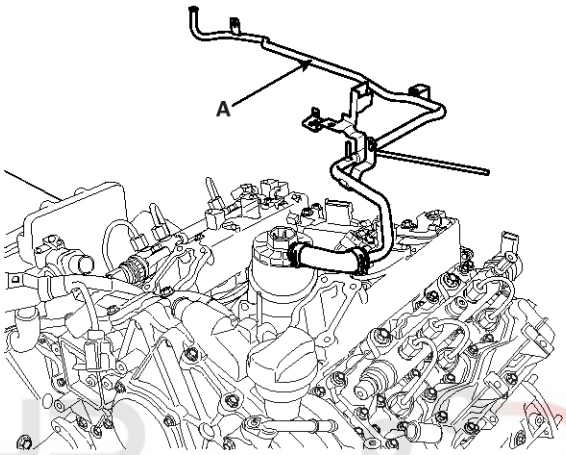
4. Tighten the common rail(A) slightly for the installation of the high pressure pipes.



SENEM7099D

5. Install the injectors with inserting the packings.(Refer to Injector in FL Group).
6. Check if the packings are seated well.
7. Install the high pressure fuel pipe(rail to injector).
8. Tighten the common rail with the specifed torque.
9. Install the high pressure fuel pipe(rail to pump).
10. Install the vacuum pipe(A).

Tightening torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



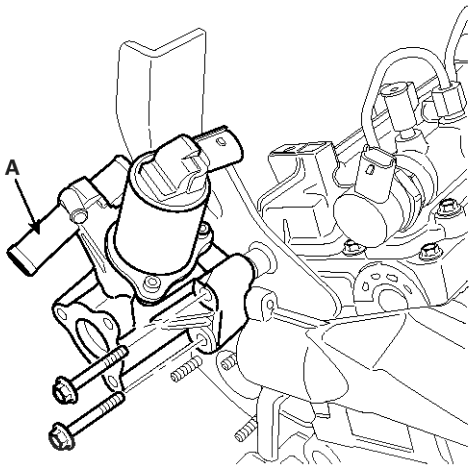
SENEM7100D

11. Install the engine hanger.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

12. Install the EGR system(A).
    1) When installing the EGR cooler and valve assembly, tighten the lower bolt(A) first of the two valve mounting bolts(2EA).

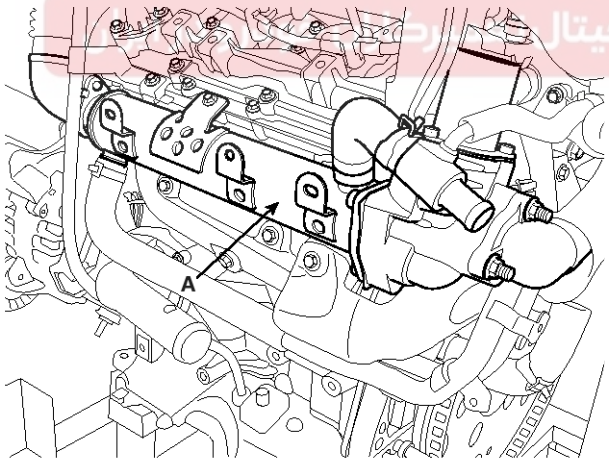
Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7101D

    2) Install the rest EGR cooler and valve assembly mounting bolts with the specified torque below.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7102D

13. Install the oil level gauge.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

14. Instal the high pressure fuel pipe(rail to rail).
15. Install the fuel feed and return hose or pipe.

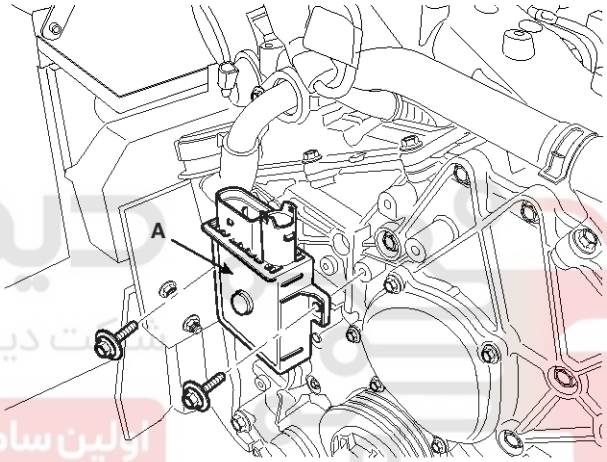
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

16. Install the CMP sensor.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

17. Install the glow control unit(A).

Tightening torque :
6.9 ~ 10.8Nm (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



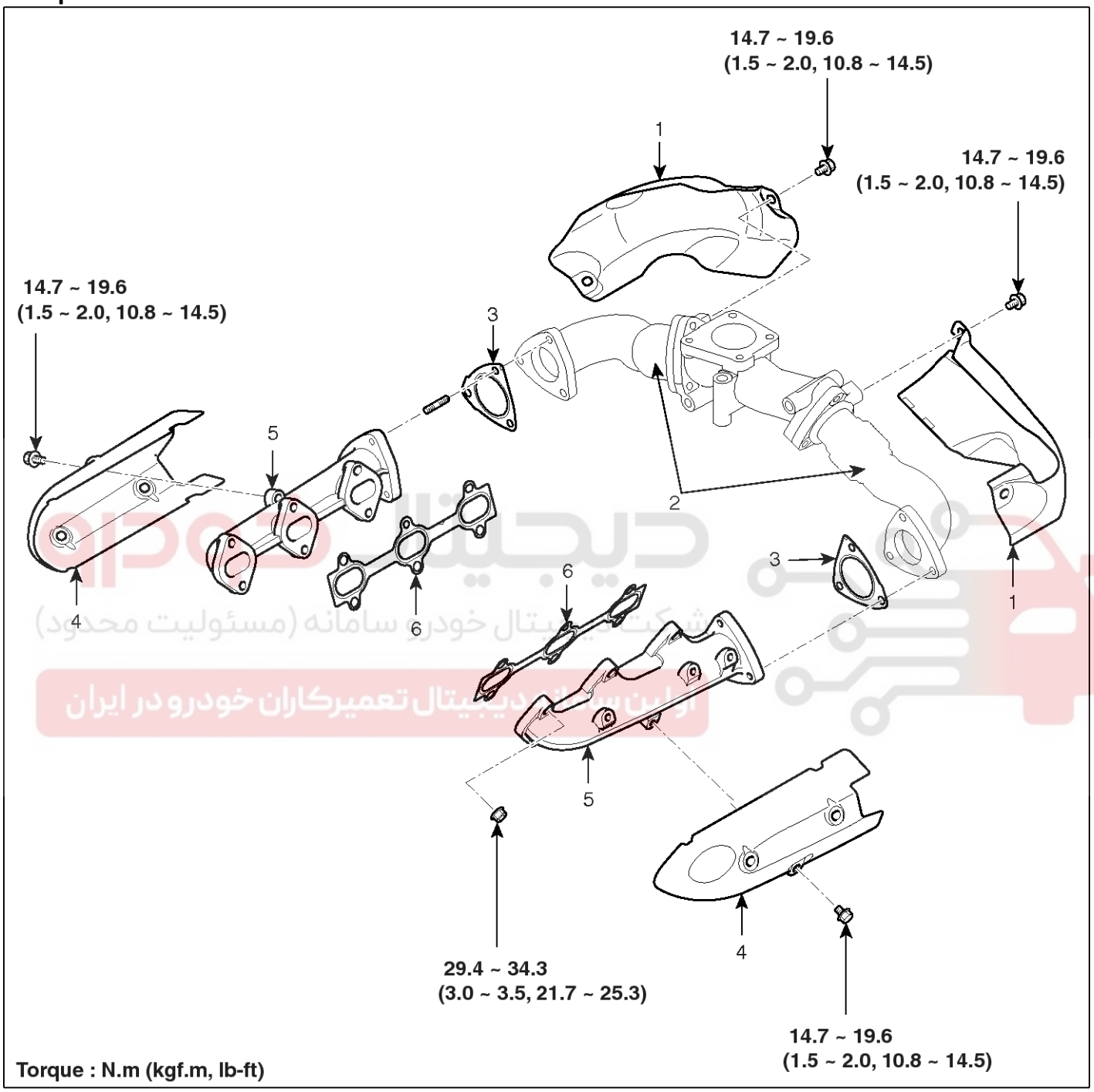
SENEM7104D

18. After seating the inlet manifold gasket, install the inlet upper manifold assembly.

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

Exhaust Manifold

Components



SENEM9013L

1. Exhaust pipe protector
2. Exhaust pipe
3. Exhaust pipe gasket
4. Exhaust manifold heat protector
5. Exhaust manifold
6. Exhaust manifold gasket

Replacement

1. Remove the nut(A) from the (-) terminal of the battery.

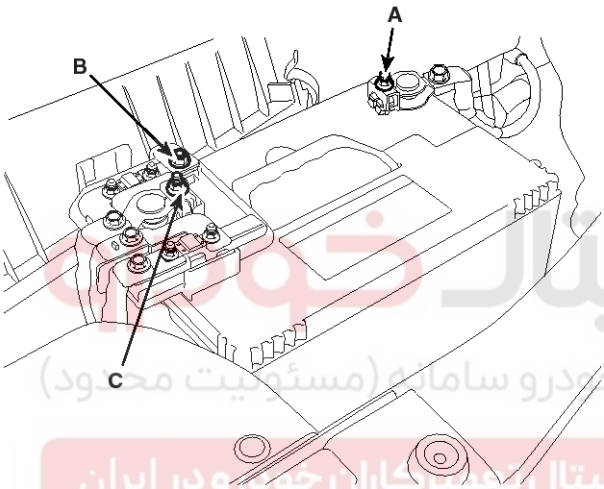
Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

2. Remove the nut(B) from the (+) terminal of the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

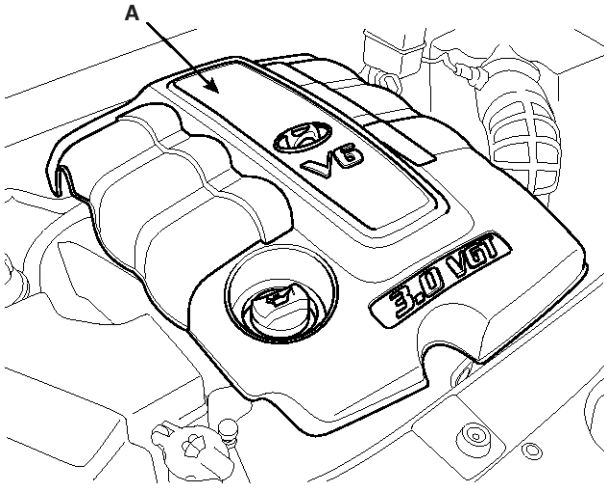
3. Remove the nut(C) from the (+) terminal and the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SENEM7069D

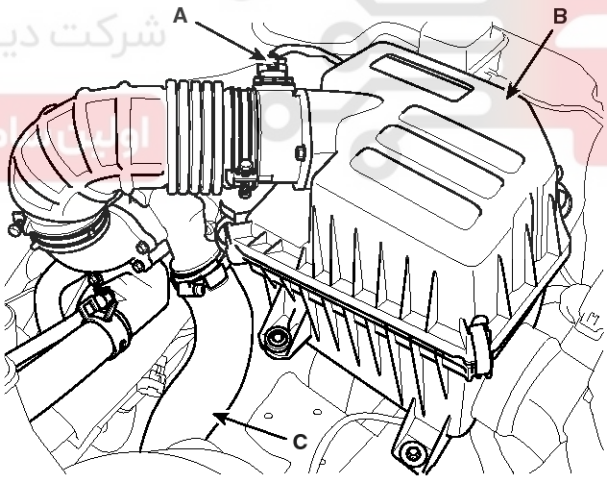
4. Remove the engine cover(A) and pads.



SENEM7070D

5. Disconnect the Air flow sensor connector(A) and remove the air cleaner assemlby(B) and the intercooler hose(C).

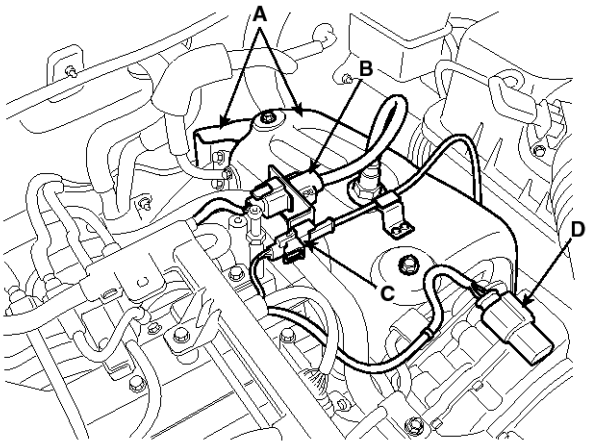
NOTICE
Using a plier, take off the cap. After it removed, there will be another (-) cap which you can use a (-) driver.



SENEM7071D

6. Remove the heat protectors (A), the lambda sensor connector (B), the exhaust gas temperature sensor connector (C) (if equipped with DPF) and the electronic VGT actuator connnector (D).

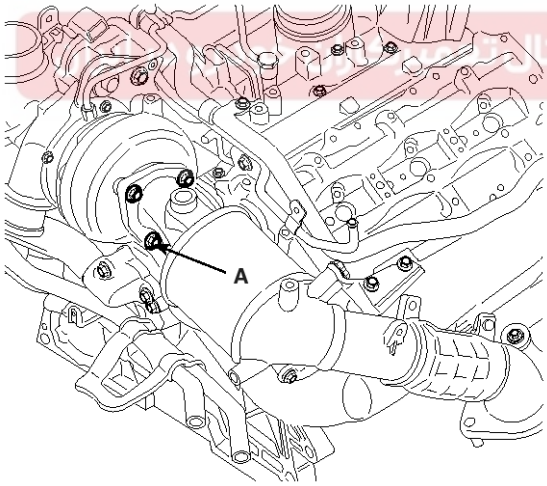
Tightening torque :
14.7 ~ 19.6Nm (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)



SENEM0001L

7. Remove the three mounting bolts(A) for the WCC(warm-up catalytic converter) and the turbocharger.

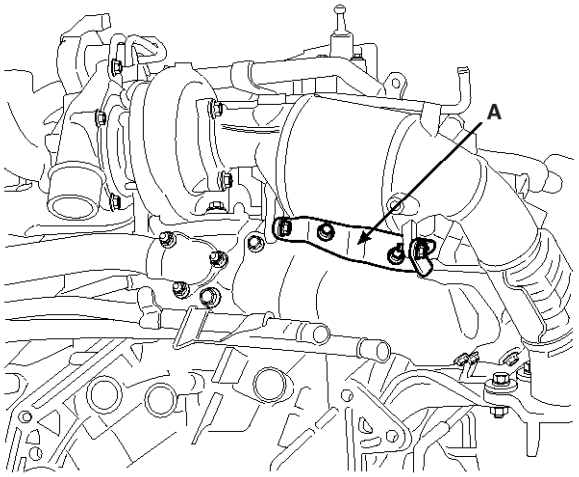
Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



SENEM7106D

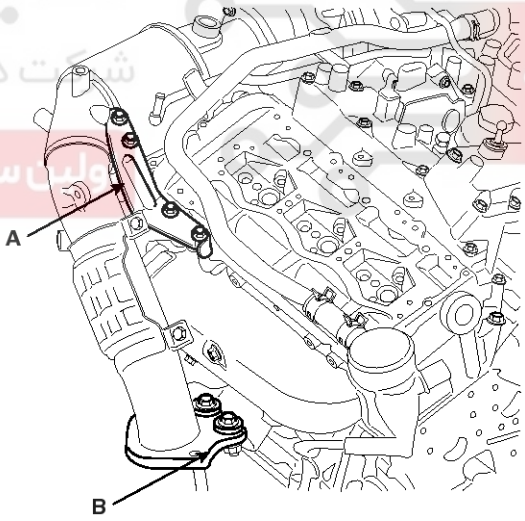
8. Remove the WCC(warm-up catalytic converter) brackets(A,B).

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft) - A



SENEM7107D

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~19.5lb-ft) - A
42.2 ~ 53.9Nm (4.3 ~5.5kgf.m, 31.1 ~ 39.8lb-ft) - B

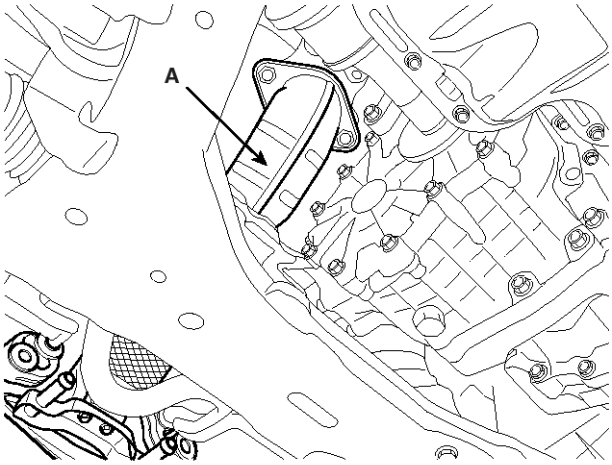


SENEM7108D

NOTICE
Remove the two lower mounting bolts(B) under the vehicle after removing the under cover.

9. Remove the front muffler(A) with the WCC(warm-up catalytic converter).

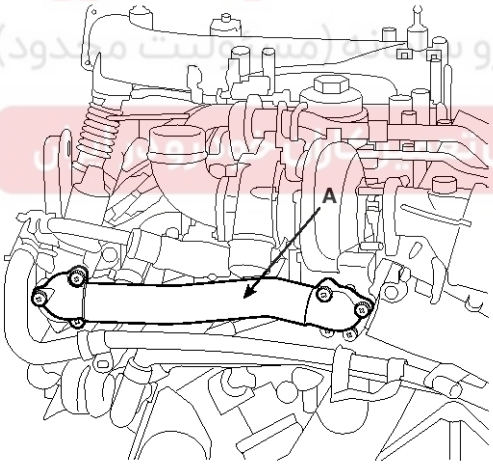
Tightening torque :
19.6 ~ 26.5Nm (4.0 ~ 6.0kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7078D

10. Remove the EGR exhaust pipe(A).

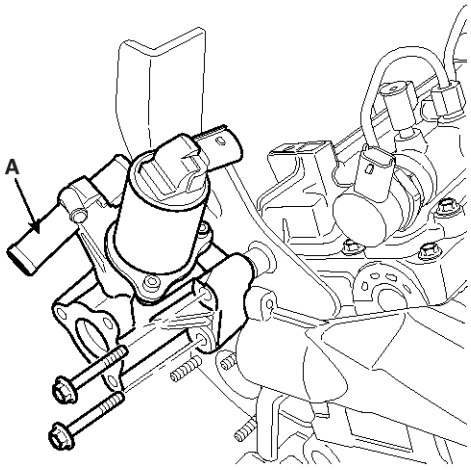
Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



SENEM7109D

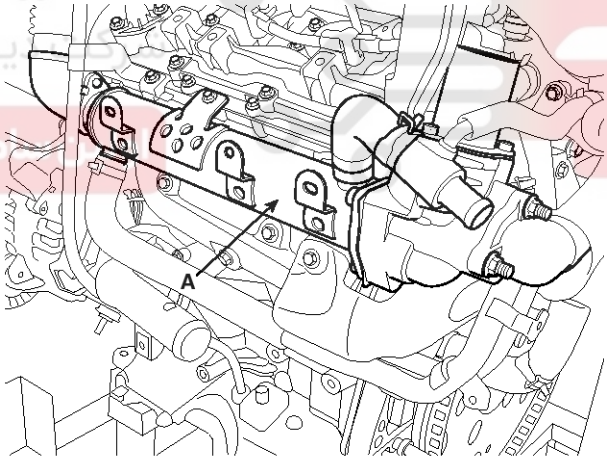
11. Remove the EGR cooler and valve assembly(A) with the engine hanger. Remove the engine coolant pipe and hose assembly at this moment.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7101D

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

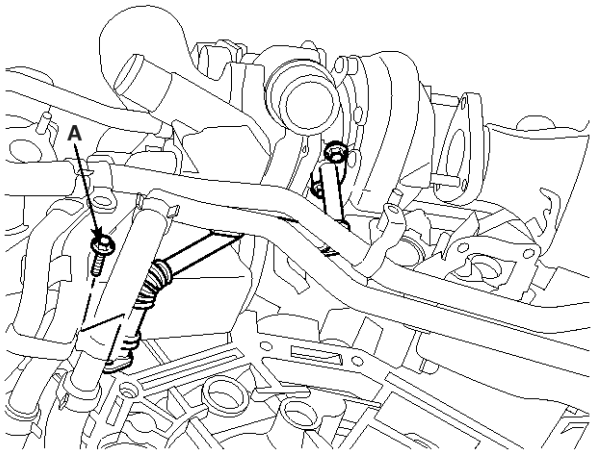


SENEM7102D

12. Remove the oil return pipe bolts(A).

NOTICE
Remove the pipe with the turbocharger.

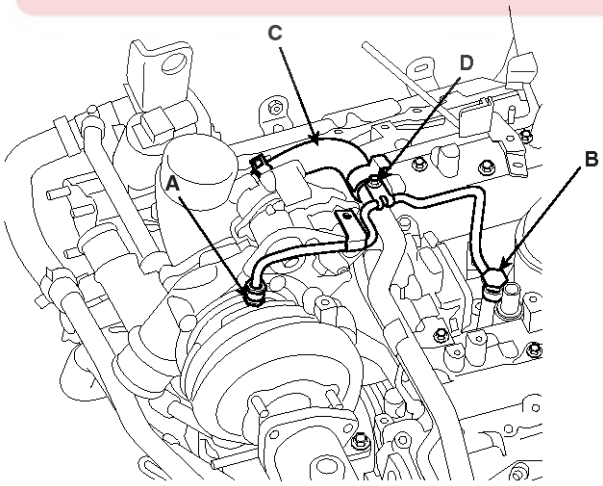
Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SENEM7110D

13. Remove the oil feed pipe and the blow-by hose(C).

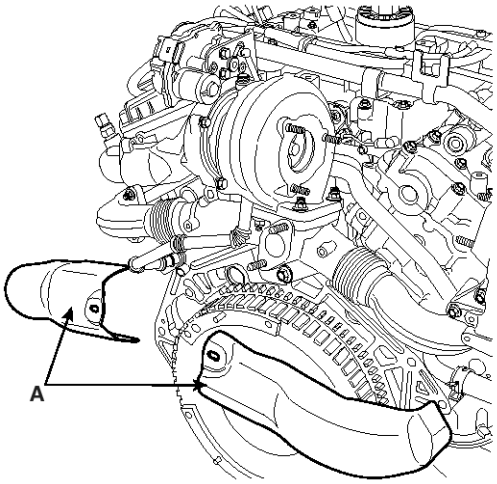
Tightening torque :
18.6 ~ 25.5Nm (1.9 ~ 2.6kgf.m, 13.7 ~ 18.8lb-ft) - oil feed pipe nut(A)
26.5 ~ 32.4Nm (2.7 ~ 3.3kgf.m, 19.5 ~ 23.9lb-ft) - iol feed pipe eye bolt(B)
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) - oil feed pipe mounting bolt(D)



SENEM7111D

14. Remove the protectors(A) for the cooling pipe and hose and the exhaust pipes.

Tightening torque :
14.7 ~ 19.6Nm (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)



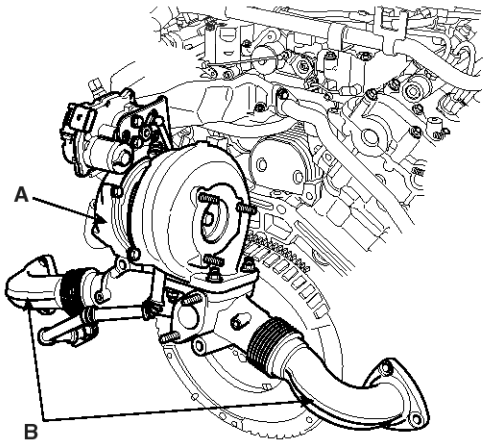
SENEM7114D

15. Remove the bolts(2EA) for mounting the heater pipe and hose bracket on the transaxle.

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~2.7kgf.m, 14.5 ~ 19.5lb-ft)

16. Remove the turbocharger(A) with the exhaust pipes(B).

Tightening torque :
40.2 ~ 53.9Nm (4.1 ~ 5.5kgf.m, 29.7 ~ 39.8lb-ft)
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



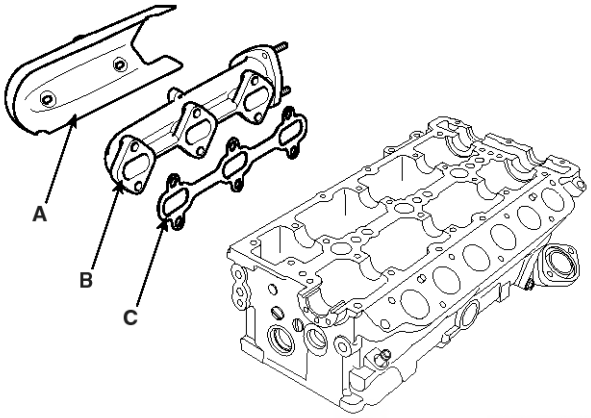
SENEM7115D

17. After removing the exhaust manifold heat protector(A), remove the manifold(B) and the gasket(C).

Tightening torque :

14.7 ~ 19.6Nm (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft) - Heat protector

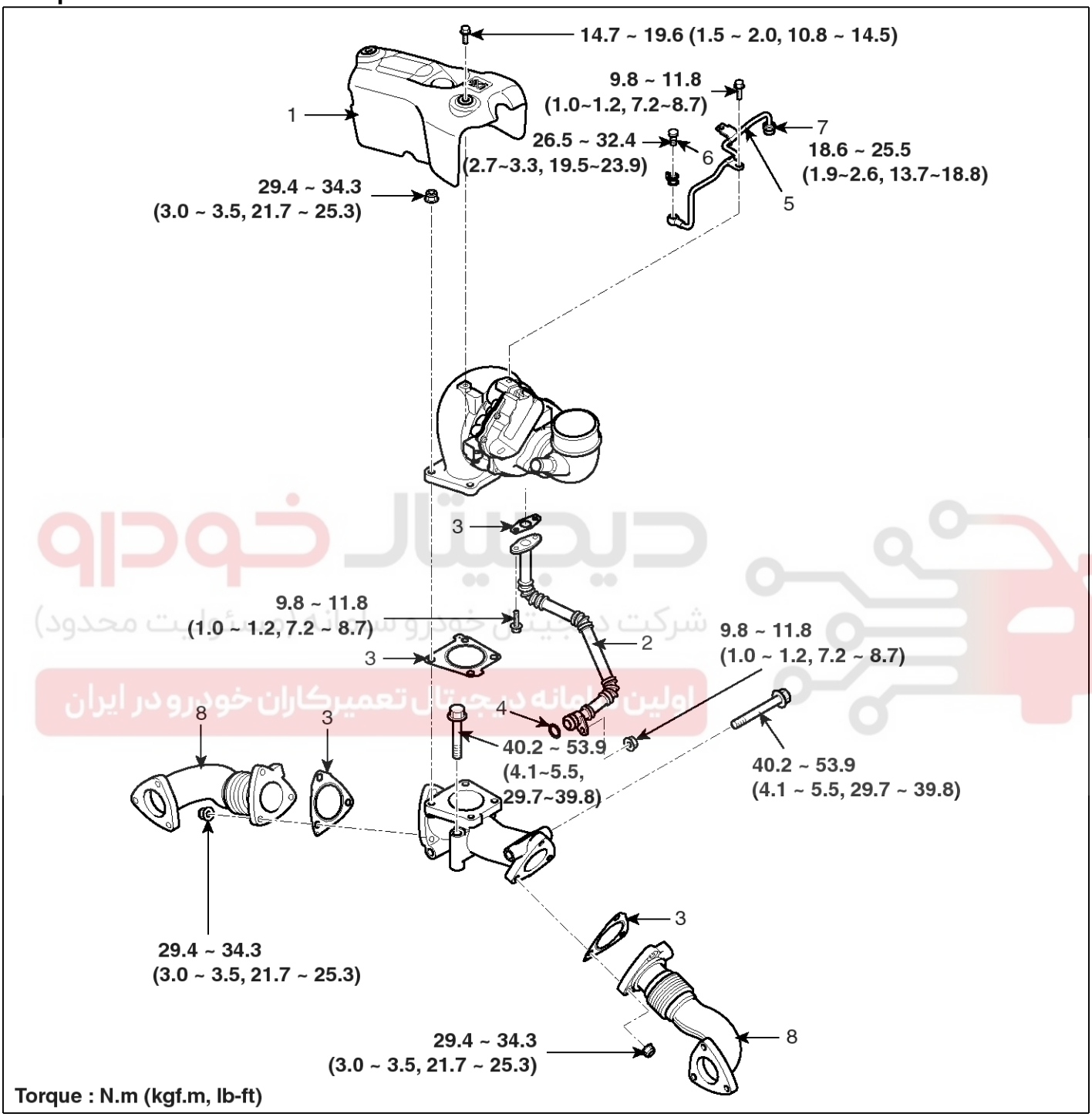
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft) - Exhaust manifold



SENEM7116D

Turbo Charger

Components



SENEM9014L

1. Turbocharger heat protector
2. Oil return pipe
3. Gasket
4. O-ring
5. Oil feed pipe
6. Oil feed pipe eye bolt
7. Oil feed pipe nut
8. Exhaust pipe

Replacement

1. Remove the nut(A) from the (-) terminal of the battery.

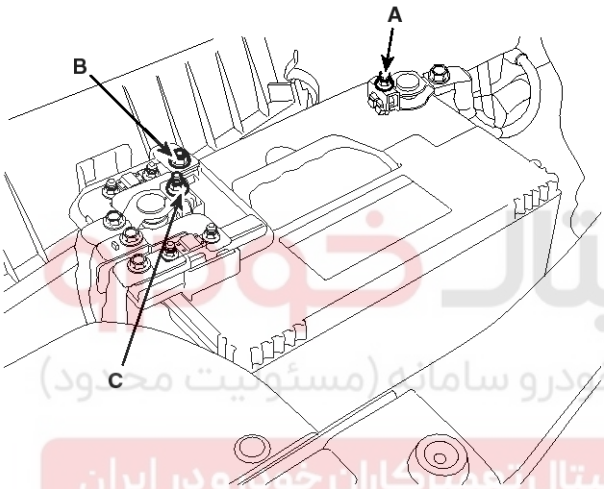
Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

2. Remove the nut(B) from the (+) terminal of the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

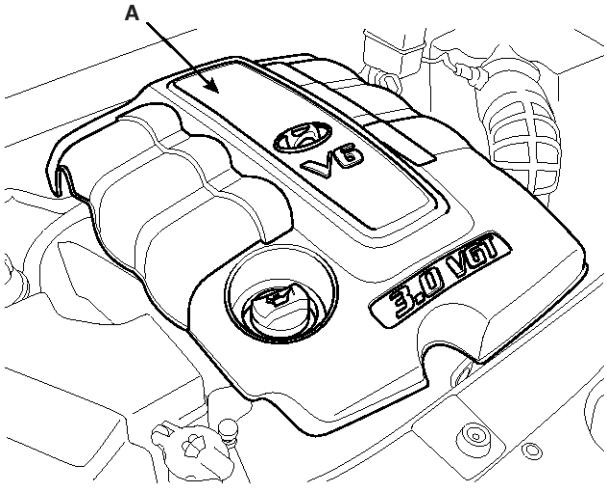
3. Remove the nut(C) from the (+) terminal and the battery.

Tightening torque :
7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SENEM7069D

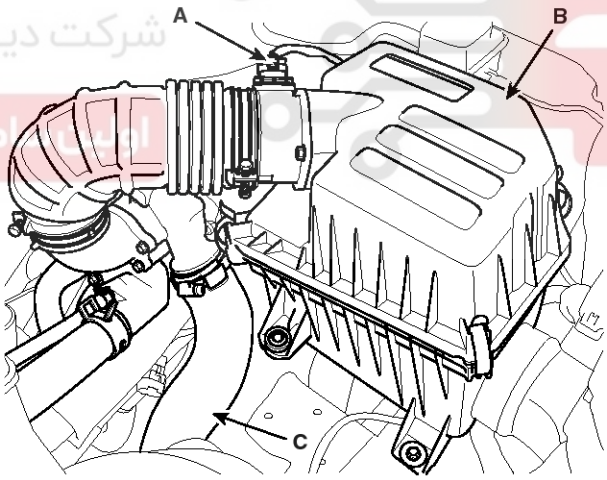
4. Remove the engine cover(A) and pads.



SENEM7070D

5. Disconnect the Air flow sensor connector(A) and remove the air cleaner assemlby(B) and the intercooler hose(C).

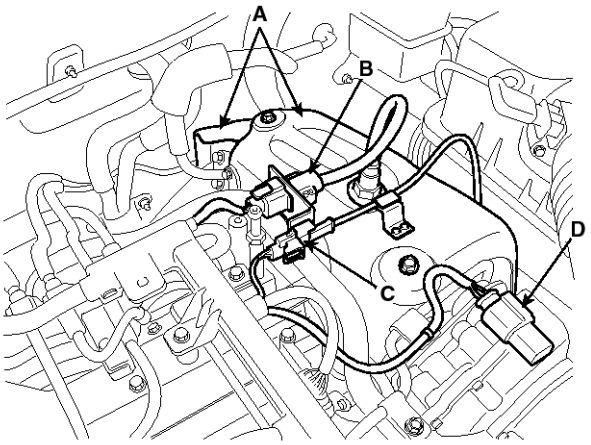
NOTICE
Using a plier, take off the cap. After it removed, there will be another (-) cap which you can use a (-) driver.



SENEM7071D

6. Remove the heat protectors (A), the lambda sensor connector (B), the exhaust gas temperature sensor connector (C) (if equipped with DPF) and the electronic VGT actuator connnector (D).

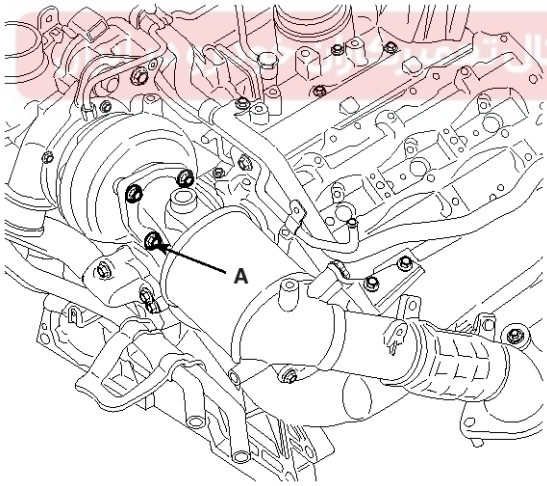
Tightening torque :
14.7 ~ 19.6Nm (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)



SENEM0001L

7. Remove the three mounting bolts(A) for the WCC(warm-up catalytic converter) and the turbocharger.

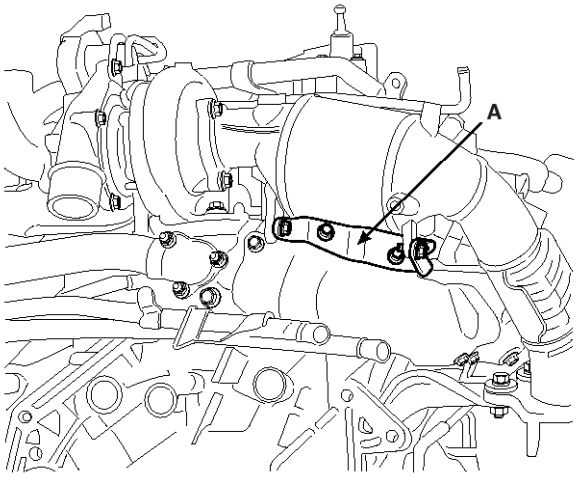
Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



SENEM7106D

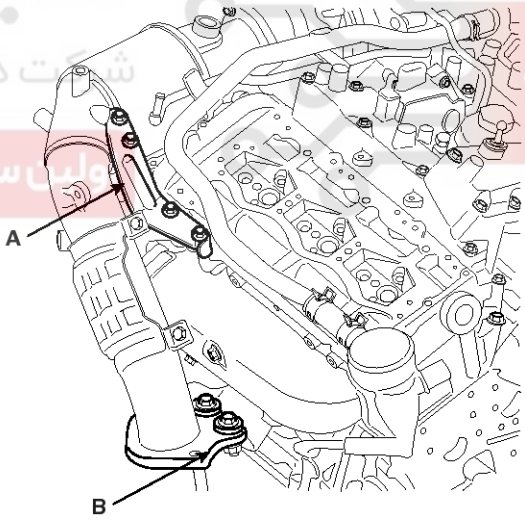
8. Remove the WCC(warm-up catalytic converter) brackets(A,B).

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



SENEM7107D

Tightening torque :
19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)
42.2 ~ 53.9Nm (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lb-ft)



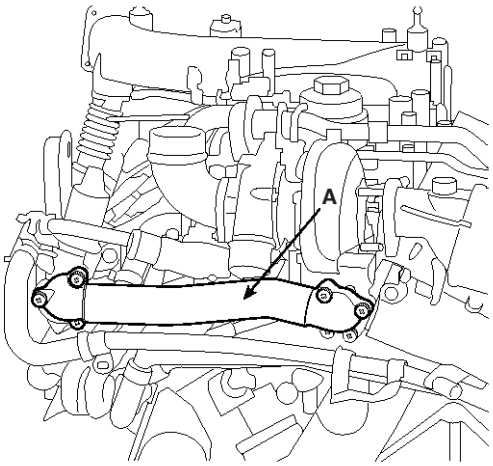
SENEM7108D

NOTICE

Remove the two lower mounting bolts(B) under the vehicle after removing the under cover. You don't need to remove the bolts thoroughly.

9. Remove the EGR exhaust pipe(A).

Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)

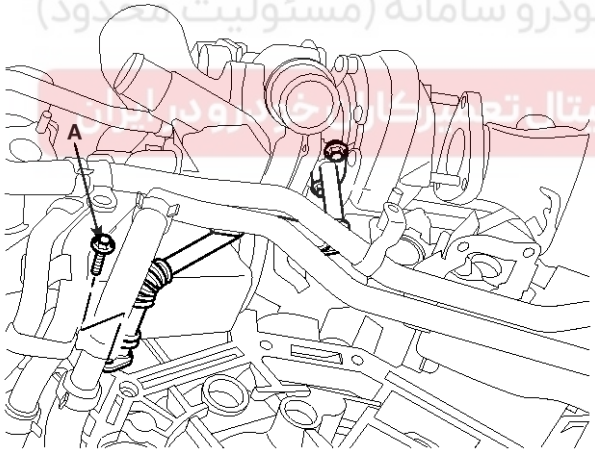


SENEM7109D

10. Remove the oil return pipe bolts(A).

Tightening torque :
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

NOTICE
Remove the pipe with the turbocharger.

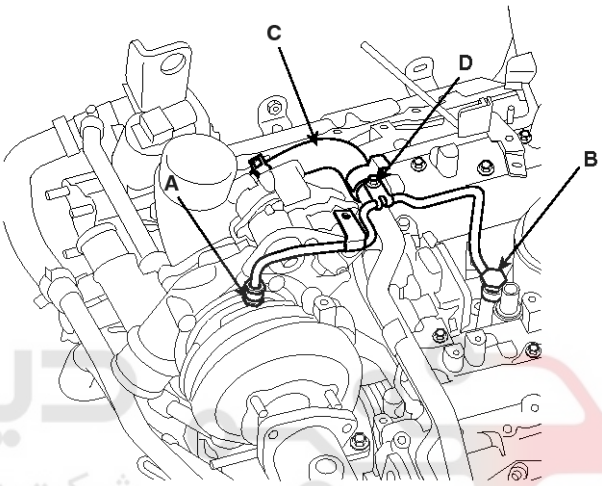


SENEM7110D

11. Remove the oil feed pipe and the blow-by hose(C).

Tightening torque :
18.6 ~ 25.5Nm (1.9 ~ 2.6kgf.m, 13.7 ~ 18.8lb-ft) - oil feed pipe nut(A)
26.5 ~ 32.4Nm (2.7 ~ 3.3kgf.m, 19.5 ~ 23.9lb-ft) - oil feed pipe eye bolt(B)
9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) - oil feed pipe mounting bolt(D)

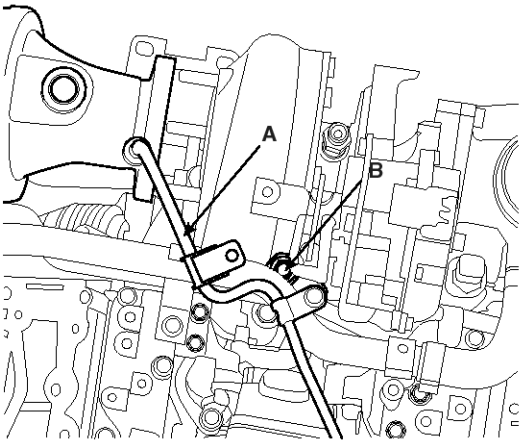
WARNING
When install the turbocharger oil feed pipe eye-bolt, always use a new gasket.



SENEM7111D

12. After pushing the WCC(warm-up catalytic converter) and the oil feed pipe(A), remove the turbocharger mounting nut(B).

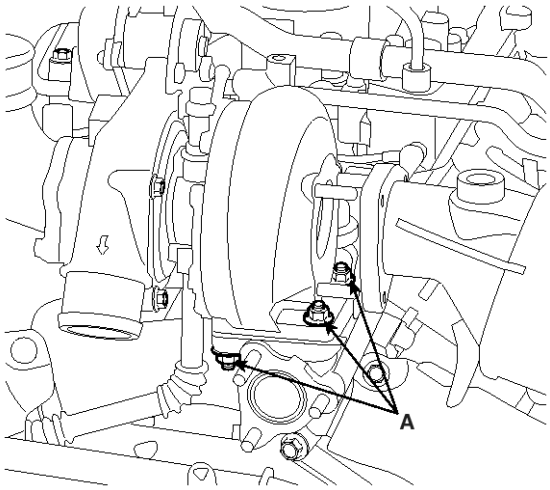
Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)



SENEM7112D

13. After removing the rest turbocharger mounting nuts(A), take off the turbocharger by lifting up.

Tightening torque :
29.4 ~ 34.3Nm (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)

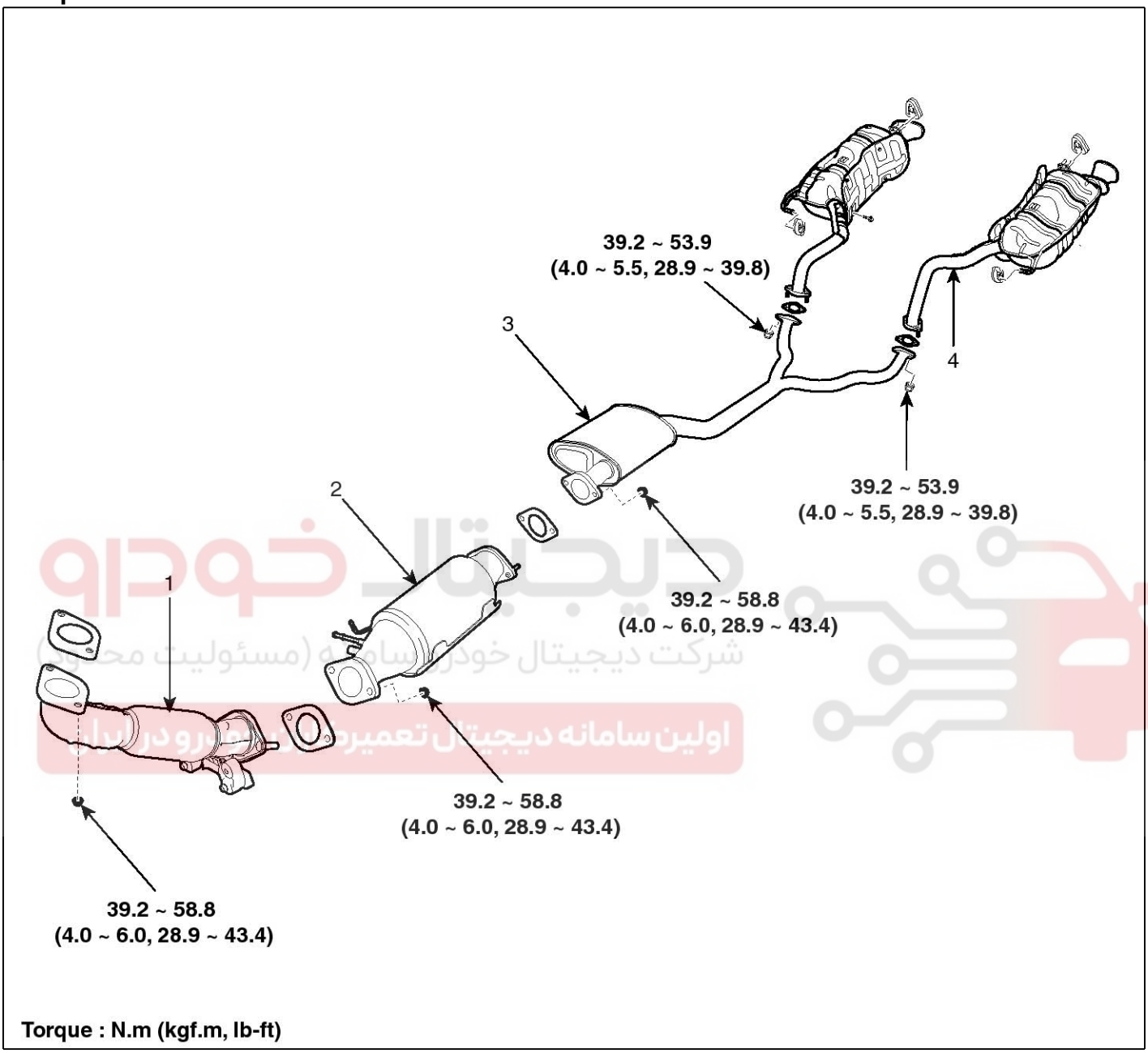


SENEM7113D

14. Installation is in the reverse order of removal.

Muffler

Components



SENEM0002L

1. Front muffler
2. Catalytic converter or DPF
3. Center muffler
4. Main muffler