Engine Mechanical System

General Information

Specifications

Description			Specifications (D6EA)	Limit	
General					
Туре			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			680 RPM		
Firing order			1-2-3-4-5-6		
Valve timing					
Intake valve	Opens		BTDC 13°		
	Closes		ABDC 34°		
Exhaust valve	Opens		BBDC 55°	0	
	Closes		ATDC 15°		
Cylinder head					
Flatness of cylinder head gasket surface		face	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.)		
	Lii GaillSiiall	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 diam-	LH camshaft	Intake	24.947 ~ 24.960mm(0.9822~0.9827in.)		
eter		Exhaust			
	Intake	Intake			
	RH camshaft Exhaust				
Bearing oil clearance			0.040 ~ 0.074mm(0.0016~0.0029in.)		
End play			0.05 ~ 0.15mm(0.0020~0.0059in.)		
Valve					

General Information

EM-3

Description		Specifications (D6EA)	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-	Intake	1.5mm(0.0590in.)	
head (margin)	Exhaust	1.5mm(0.0590in.)	
Valve stem to valve	Intake	0.025 ~ 0.052mm(0.0010~0.0020in.)	
guide clearance	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			0
Free length		48.2mm(1.8976in,)	
Load		175±8N/33.5mm	
	رو سامانه (مسئول	278±20N/24.8mm	
Out of squareness		1.5° or less	3°
Valve seat	ں تعمیرکاران خود	اولین سامانه دیجیتار	
0 1	Intake	44.5° ~ 45°	
Seat angle	Exhaust	44.5° ~ 45°	
Valve contacting wi-	Intake	1.39 ~ 1.43mm(0.0547~0.0563in.)	
dth	Exhaust	1.39 ~ 1.43mm(0.0547~0.0563in.)	
Piston			
Piston outer diamete	r	83.926 ~ 83.956mm3.3042~3.3053in.)	
Piston to cylinder cle	arance	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.)	

Engine Mechanical System

Description		Specifications (D6EA)	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 diam	eter	30.994 ~ 31.000mm(1.2202~1.2205in.)	
Piston pin hole inner	diameter	31.014 ~ 31.021mm(1.2210~1.2213in.)	
Piston pin hole cleara	ance	0.014 ~ 0.027mm(0.0006~0.0011in.)	
Connecting rod small er	I end bore inner diamet-	31.020 ~ 31.031mm(1.2212~1.2216in.)	
Connecting rod small e	end bore hole clearanc-	0.020 ~ 0.037mm(0.0008~0.0014in.)	
Connecting rod			
Connecting rod big e	nd bore inner diameter	66.500 ~ 66.518mm(2.6181~2.6188in.)	
Connecting rod beari	ng 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.)	0
Crankshaft			
Main journal outer dia	ameter	75.982 ~ 76.000mm(2.9914~2.9921in.)	
Pin journal outer diar	neter 9	63.482 ~ 63.500mm(2.4993~2.5000in.)	
Main bearing oil clear	rance	0.030 ~ 0.048mm(0.0012~0.0019in.)	
End play	ں تعمیرکاران خود	0.1 ~ 0.3mm(0.0039~0.0118in.)	
Cylinder block			
Cylinder bore inner d	iameter	84.000 ~ 84.030mm(3.3071~3.3083in.)	
Cylinder block journa	l 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 (CKP wheel part)		0.25mm(0.0098in.)	
Engine oil			
Oil quantity	Total	7.8 L (8.24 US qt, 6.86 Imp qt)	When replacing a s- hort engine or a blo- ck assembly
,	Oil pan	6.4 L (6.76 US qt, 5.62 Imp qt)	
	Drain and refill	7.4 L (7.81 US qt, 6.50 Imp qt)	Including oil filter

General Information

EM-5

Description		Specifications (D6EA)	Limit
	Classification	ACEA C3 (with DPF), ACEA B4 (without DPF)	
Oil grade	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubrication System"
Oil pressure (at idle)		78.45kPa (0.8kg/cm², 11.38psi) or above	Oil temperature in oil pan : 80°C (176° F)
Cooling system			
Cooling method		Forced circulation with electrical fan	
Coolant quantity		Approx. 14.7L (15.54 US qt, 12.94lmp qt)	
	Туре	Wax pellet type	
Thermostat	Opening temperature	82±2°C(176.0~183.2°F) (lift: 0.35mm(0.0138in.))	
	Opening temperature	ing 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)	

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Engine Mechanical System

Tightening Torques

ltem	N.m	kgf.m	lb-ft
Cylinder block			
Oil jet mounting	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Bed plate bolts	(61.8~65.7)+(120°~1 24°)	(6.3~6.7)+(120°~124°)	(45.6~48.5)+(120°~1 24°)
Engine mounting nuts	88.5 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Engine mounting bracket bolts	49.1 ~ 58.9	5.0 ~ 6.0	36.2 ~ 43.4
Engine support bracket bolts	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
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
Fly wheel	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+ <mark>58°~6</mark> 2°
Alternator bracket	42.2 ~ 54.0	4.3 ~ 5.5	31.1 ~ 39.8
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
Camshaft bearing ladder bolt	13.7 ~ 15.7	1.4 ~ 1.6	10.1 ~ 11.6
Camshaft position sensor mounting	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

General Information

EM-7

Item	N.m	kgf.m	lb-ft			
Cylinder head bolt	(56.9 ~ 60.8) + (88 ~ 92°) + (118 ~ 122°)	(5.8 ~ 6.2) + (88 ~ 92 °) + (118 ~ 122°)	(42.0 ~ 44.8) + (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 mounting bracket bolt	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8			
Radiator mounting bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7			
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	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5			
Intake and exhaust system	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			
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 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			
		•				

Engine Mechanical System

Item	N.m	kgf.m	lb-ft
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 nut	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





General Information

EM-9

Compession Pressure Inspection

MOTICE

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

MOTICE

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

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

MNOTICE

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)

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Engine Mechanical System

Special Service Tools

Tool (Number and name)	Illustration	Use
Compression gauge (09351-27000)	LCGF148A	Checking engine compression pressure
Compression gauge adapter	253.716.0	Checking engine compression pressure
(09351-3A000)		Checking engine compression pressure
	LCGF060A	
Camshaft locking tool (09231-3A000)	SENEM7091D	Fixation of timing chain and camshaft sprocket
Crankshaft pulley holder (09231-2J100)	SHMEM8202D	Removal and installation of crankshaft pulley bolt.
Valve stem oil seal installer		Installation of valve stem oil seals
(09222-2A000)	LCAC030D	installation of valve stern oil seals

General Information

EM-11

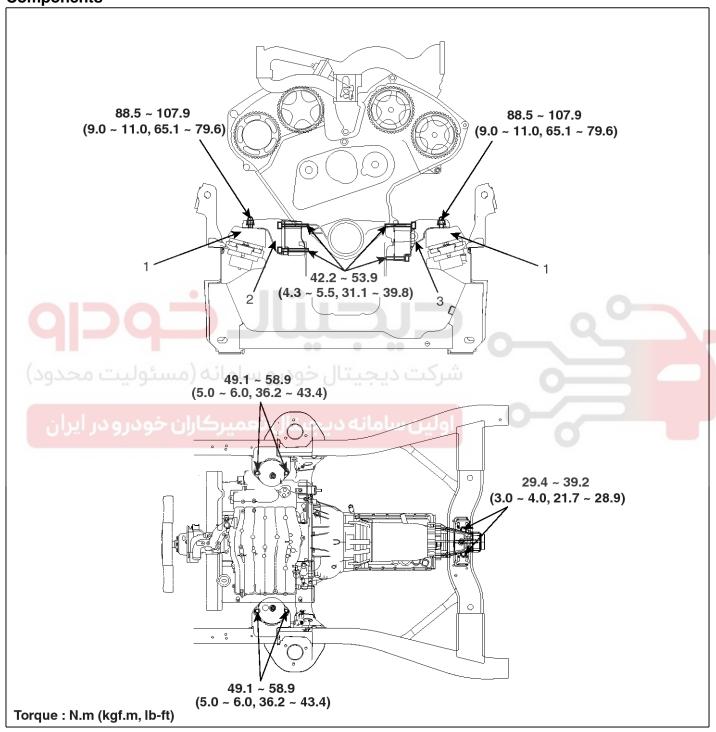
Tool (Number and name)	Illustration	Use
Valve spring compressor (09222-3K000) Valve spring compressor ad- apter (09222-2A100)	09222-3K000 09222-2A100	Removal and installation of intake and exhaust valves
	LCGF059A	
Crankshaft rear oil seal inst- aller (09231-H1210) Handle (09231-H1100)	09231-H1100 09231-H1210	Installation of crankshaft rear oil seal
	SENEM7233D	
Glow plug installer (09367-3C100)		Removal and installation of glow plug
مسئولیت محدود)	ئت دیجیتال خودرو سامانه (ه	شرا
	SHMEM8220D	

Engine Mechanical System

Engine And Transaxle Assembly

Engine Mounting

Components



SHMEM9200L

- 1. Engine mounting bracket assembly
- 2. Engine support bracket (RH)

3. Engine support bracket (LH)

Engine And Transaxle Assembly

EM-13

Engine And Transaxle Assembly

Removal

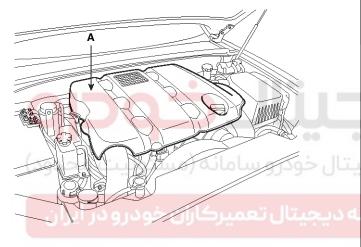
ACAUTION

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

MOTICE

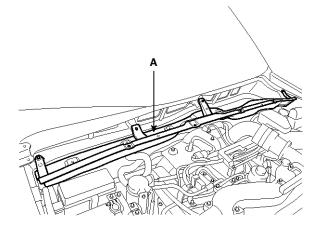
Mark all wiring and hoses to avoid misconnection.

- 1. After recovering refrigerant, drain coolant and oil from the engine and the transaxle.
- 2. Remove the transaxle assembly first. (Refer to MT or AT group)
- 3. Remove the engine cover (A).



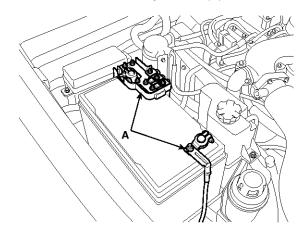
SHMEM8001D

- 4. Remove the hood assembly. (Refer to BD group)
- 5. Remove the cowl cover and wiper arm. (Refer to BD group)
- 6. Remove the cowl top cover (A).



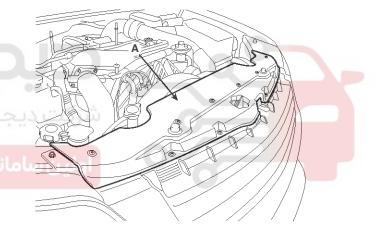
SHMEM8002D

7. Disconnect the battery cables (A).



SHMEM8003D

8. Remove the radiator grille upper guard (A).



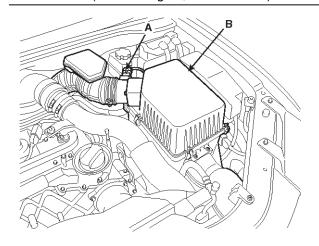
SHMEM8014D

Engine Mechanical System

9. Disconnect the Air flow sensor connector (A), and remove the air cleaner assembly (B).

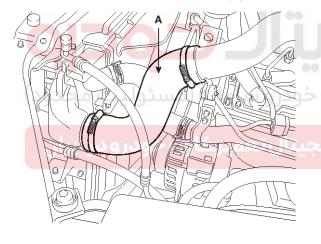
Tightening torque:

 $7.8 \stackrel{-}{\sim} 9.8 \text{N.m} \; (0.8 \stackrel{-}{\sim} 1.0 \text{kgf.m,} \; 5.8 \stackrel{-}{\sim} 7.2 \text{lb-ft})$



SHMEM8004D

10. Remove the intercooler inlet hose (A).

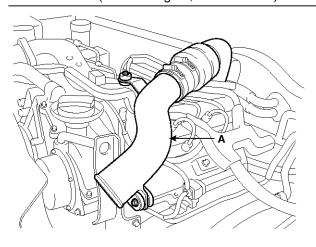


SHMEM8005D

11. Remove the intercooler inlet hose and pipe assembly (A).

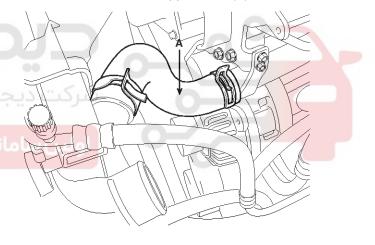
Tightening torque:

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



SHMEM8006D

12. Remove the radiator upper hose (A).

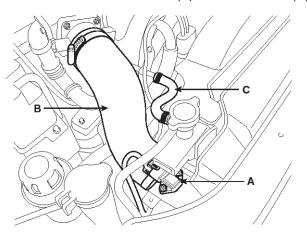


SHMEM8016D

Engine And Transaxle Assembly

EM-15

13. Disconnect the BPS connector (A), and then Remove the intercooler outlet hose (B) and water hose (C).



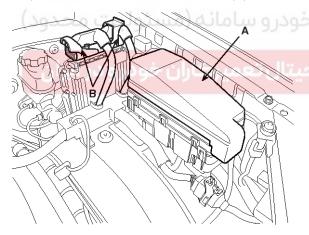
SHMEM8007D

14. Remove the engine wirings.

MOTICE

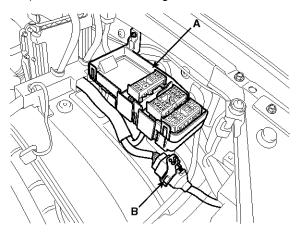
Disconnect the wirings and ground lines from the vehicle body side, and then remove the wirings with the engine.

- 1) Remove the fuse box cover (A).
- 2) Disconnect the ECM connector (B).



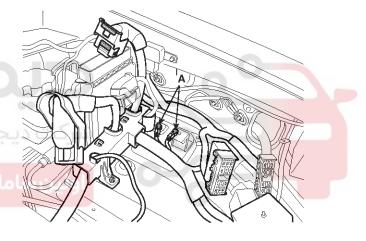
SHMEM8008D

- 3) Remove the fuse box tray (A).
- 4) Disconnect the wiring connection connector (B).



SHMEM8009D

5) Disconnect the ground line (A).

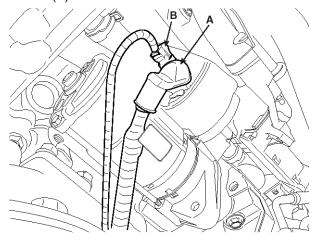


SHMEM8010D

- 6) Disconnect the air compressor connector.
- 7) Disconnect the alternator connector and cable.

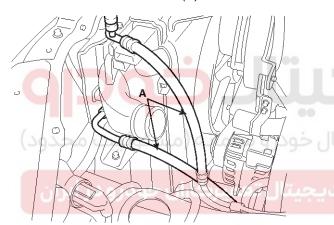
Engine Mechanical System

8) Disconnect the starter cable (A) and connector (B).

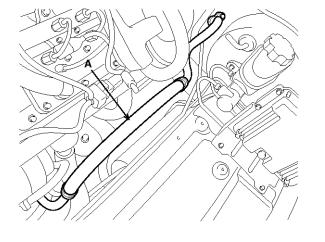


SHMEE8006D

15. Remove the suction hoses (A).

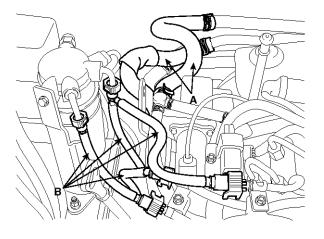


SHMEM8011D



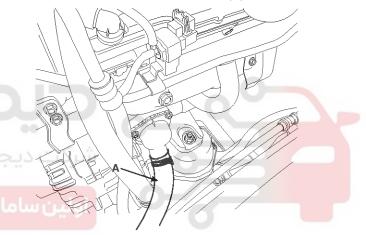
SHMEM8012D

16. Remove the heater hoses (A) and fuel hoses (B).



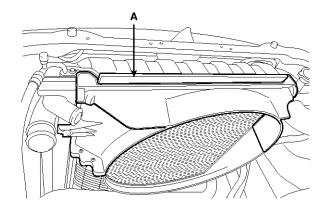
SHMEM8013D

17. Remove the radiator lower hose (A).



SHMEM8073D

18. Remove the radiator upper shroud (A).



SHMEM8015D

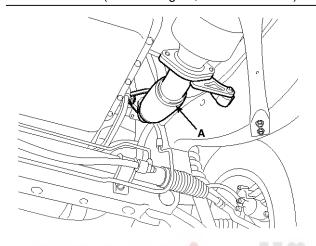
Engine And Transaxle Assembly

EM-17

- 19. Remove the power steering oil hose from the power steering pump. (Refer to ST group)
- 20. Remove the ATF cooler pipe bracket from the upper oil pan.
- 21. Remove the front muffler (A).

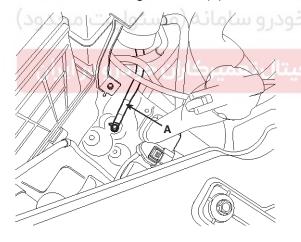
Tightening torque:

 $39.2 \sim 58.8 \text{N.m} \ (4.0 \sim 6.0 \text{kgf.m}, \ 28.9 \sim 43.4 \text{lb-ft})$



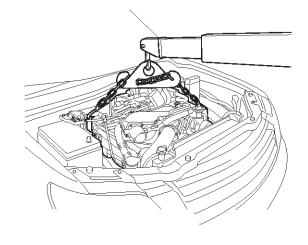
SHMEM8049D

22. Remove the power steering oil reservoir tank, and then disconnect the ground line (A).



SHMEM8017D

23. Install the jack to the engine hanger.



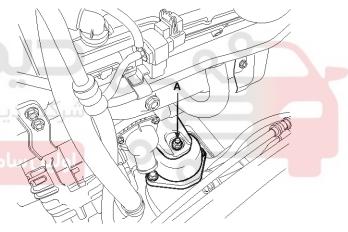
SHMEM8018D

24. Remove the engine mounting nut (A).

Tightening torque:

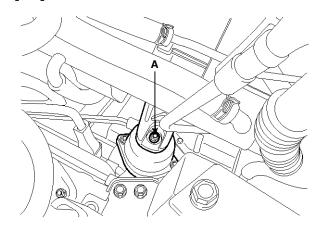
 $88.3 \sim 107.9$ N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)





SHMEM8020D

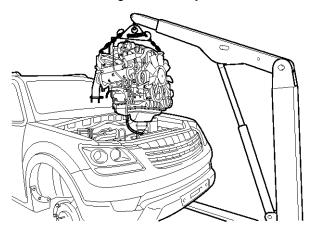
[RH]



SHMEM8019D

Engine Mechanical System

25. Remove the engine assembly from vehicle.



SHMEM8021D

MNOTICE

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.
- 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.

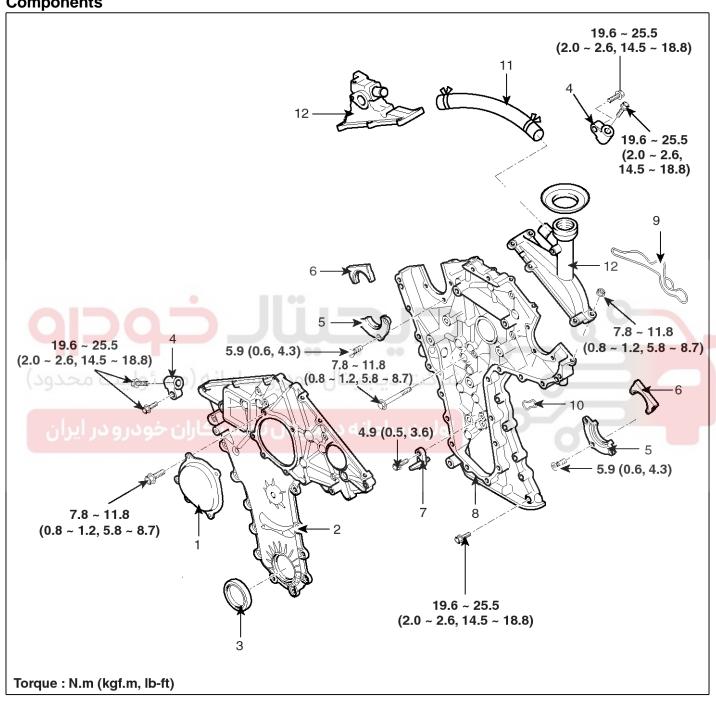
Timing System

EM-19

Timing System

Timing Chain

Components

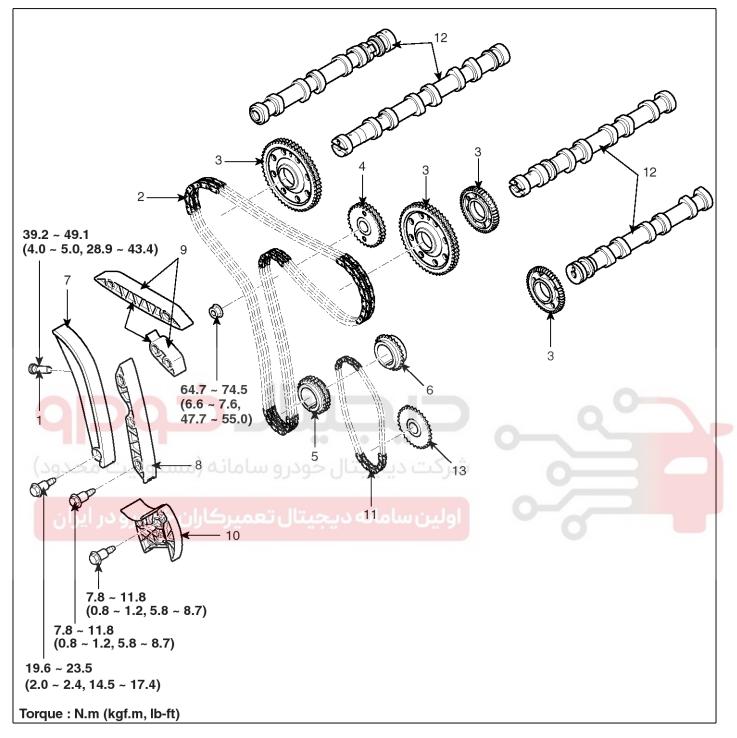


SHMEM9201L

- 1. High pressure pump service cover
- 2. Chain front cover
- 3. Front oil seal
- 4. Chain case bracket
- 5. Lower head seal
- 6. Upper head seal
- 7. Chain oil jet
- 8. Chain case

- 9. Upper O-ring
- 10. Lower O-ring
- 11. Inlet hose
- 12. Chain case cap

Engine Mechanical System



SHMEM9202L

- 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

Timing System

EM-21

Removal

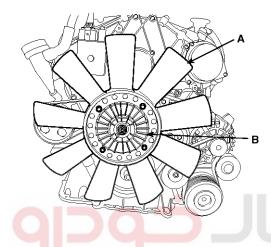
ACAUTION

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

MNOTICE

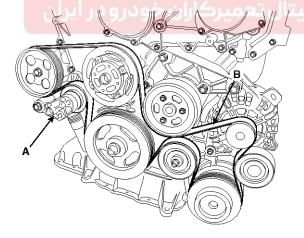
Mark all wiring and hoses to avoid misconnection.

1. Remove the cooling fan (A) and pan clutch (B).



SHMEM8026D

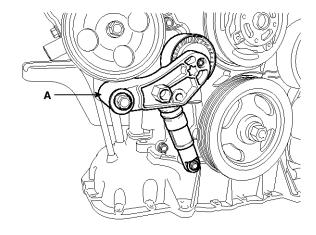
2. Compressing the tensioner (A) with a wrench in a left hand by turning it clockwise, start removing the drive belt (B) from the water pump side idler.



SHMEM8027D

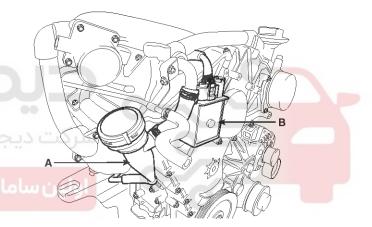
MNOTICE

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. 3. Remove the drive belt tensioner (A).



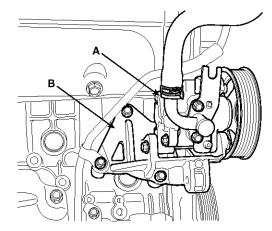
SHMEM8028D

4. Remove the oil separator & pipe (A), and glow control unit (B).



SHMEM8029D

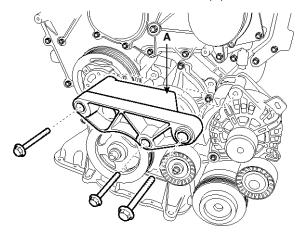
5. Remove the power steering pump (A) and bracket (B).



SHMEM8030D

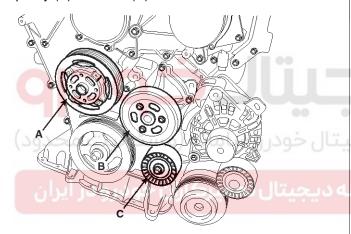
Engine Mechanical System

6. Remove the alternator bracket (A).



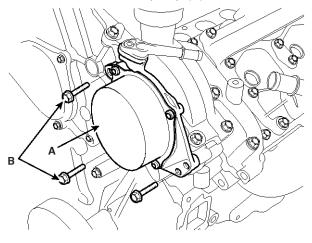
SHMEM8031D

7. Remove the fan pulley assembly (A), water pump pulley (B) and Idler (C).



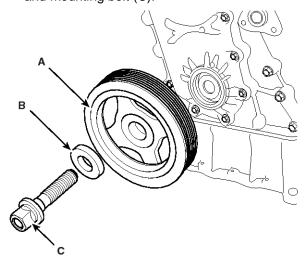
SHMEM8032D

8. Remove the vacuum pump (A).



SENEM7065D

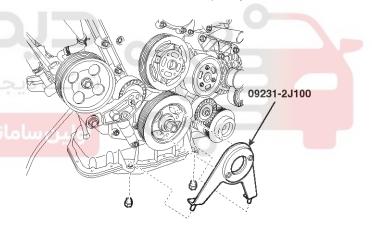
9. Remove the crankshaft pulley (A) with its washer (B) and mounting bolt (C).



SENEM7062D

MOTICE

Use the SST (09231-2J100) to fix the crankshaft when remove the crankshaft pulley bolt.

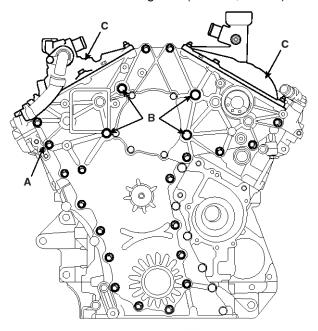


SHMEM8201D

Timing System

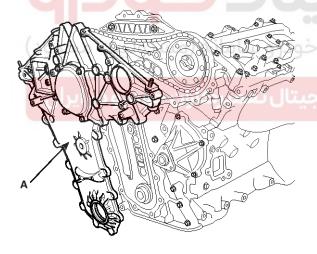
EM-23

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



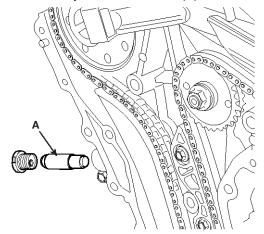
SENEM7061D

11. Remove the front chain cover (A).



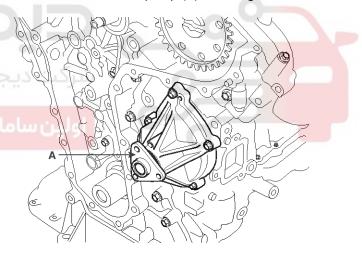
SENEM7060D

12. Remove the hydraulic tensioner (A).



SENEM7058D

- 13. Remove the timing chain with the chain guide and the tensioner lever.
- 14. Remove the high pressure fuel pump sprocket.
- 15. Remove the upper head seal.
- 16. Remove the water pump (A) with its gasket.

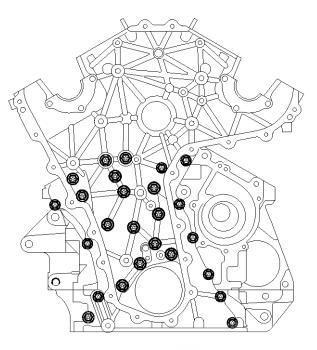


SENEM7056D

- 17. Remove the high pressure pump. (Refer to FL group)
- 18. Remove the camshaft and the cylinder head assembly.

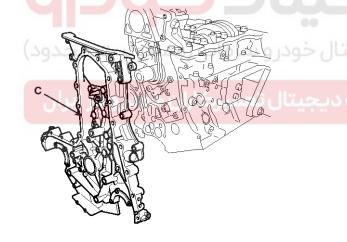
Engine Mechanical System

19. Remove the chain case mounting bolts.



SENEM7024D

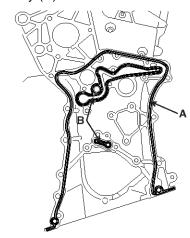
20. Remove the chain case assembly (C).



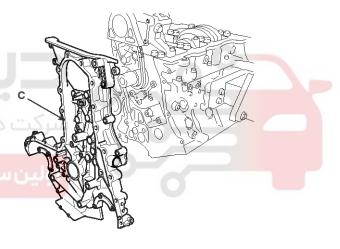
SENEM7023D

Installation

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



SENEM7022D



SENEM7023D

Timing System

EM-25

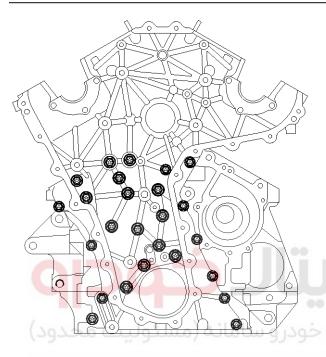
2. Tighten the chain case mounting bolts with the specified torque.

Tightening torque

6×16(★):

13.7 \sim 15.7N.m (1.4 \sim 1.6kgf.m, 10.1 \sim 11.6lb-ft) 8 \times 35(\spadesuit) :

 $19.6 \sim 25.5$ N.m ($2.0 \sim 2.6$ kgf.m, $14.5 \sim 18.8$ lb-ft)

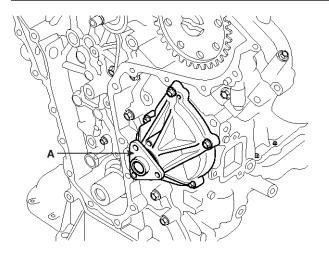


SENEM7024D

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

Tightening torque:

 $9.8 \sim 11.8 \text{N.m} \ (1.0 \sim 1.2 \text{kgf.m}, \ 7.2 \sim 8.7 \text{lb-ft})$



SENEM7056D

- 4. Install the high pressure pump.
- 5. Install the camshaft and the cylinder head assembly.
- 6. Applying sealant, install the upper head seal.
- 7. Install the high pressure fuel pump sprocket.

Tightening torque:

64.7 ~ 74.5N.m (6.6 ~ 7.6kgf.m, 47.7 ~ 55.0lb-ft)

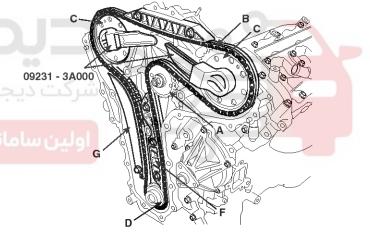
- 8. Install the timing chain (B), aligning the timing marks (E) on the camshaft sprocket (C) and the crankshaft sprocket (D).
- 9. After timing chain's installation, fix the camshaft system by using the SST(09231-3A000).
- 10. Install the chain guide (F) and the tensioner lever (G).

Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)

MOTICE

If you have difficulty in installing of the lower chain guide, turn the drive plate or move the SST a little bit.



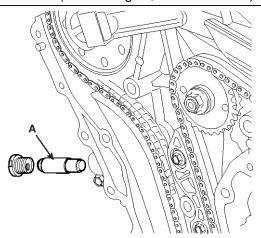
SENEM7057D

Engine Mechanical System

11. Install the hydraulic tensioner (A).

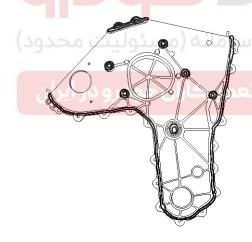
Tightening torque:

 $39.2 \sim 49.0$ Nm ($4.0 \sim 5.0$ kgf.m, $28.9 \sim 36.2$ lb-ft)

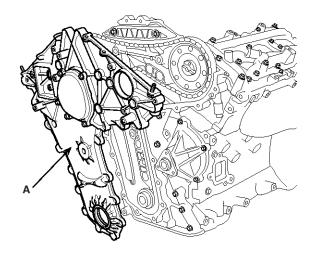


SENEM7058D

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



SENEM7059D



SENEM7060D

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

Tightening torque

A - 20EA:

 $7.8 \sim 11.8 \text{N.m} \ (0.8 \sim 1.2 \text{kgf.m}, 5.8 \sim 8.7 \text{lb-ft})$

B - 4EA:

19.6 ~ 25.5N.m (2.0 ~ 2.6kgf.m, 14.5 ~ 18.8lb-ft)

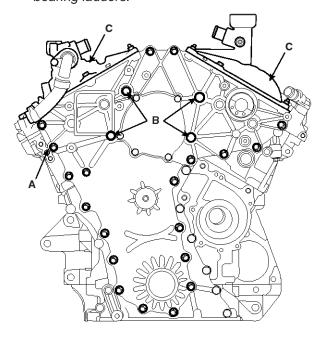
15. Applying sealant on the groove of the chain caps (C), install the caps within a fifteen minutes.

Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)

MOTICE

Install it after removing sealant from the camshaft bearing ladders.



SENEM7061D

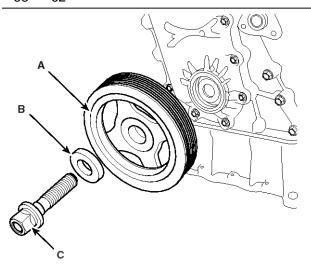
Timing System

EM-27

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

Tightening torque:

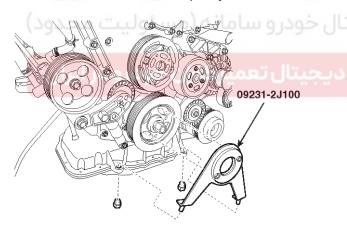
186.3 \sim 205.9Nm (19.0 \sim 21.0kgf.m, 137.4 \sim 151.8lb-ft) + 58° \sim 62°



SENEM7062D

MOTICE

Use the SST (09231-2J100) to fix the crankshaft when install the crankshaft pulley bolt.



SHMEM8201D

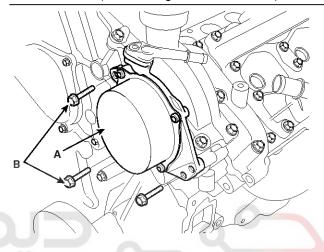
17. Install the vacuum pump (A).

MOTICE

- 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:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)

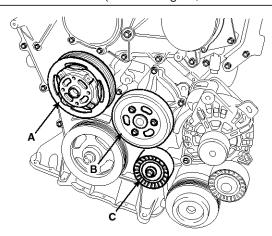


SENEM7065D

18. Install the fan pulley assembly (A), water pump pulley(B) and Idler (C).

Tightening torque

A: 63.7 ~ 73.5N.m (6.5 ~ 7.5kgf.m, 47.0 ~ 54.2lb-ft)
B: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)
C: 34.3 ~ 44.1N.m (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)



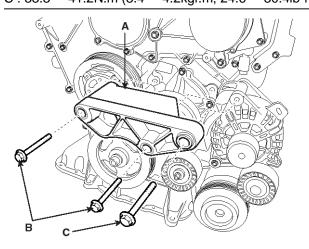
SHMEM8032D

Engine Mechanical System

19. Install the alternator bracket (A).

Tightening torque

B : 42.2 \sim 53.9N.m (4.3 \sim 5.5kgf.m, 31.1 \sim 39.8lb-ft) C : 33.3 \sim 41.2N.m (3.4 \sim 4.2kgf.m, 24.6 \sim 30.4lb-ft)

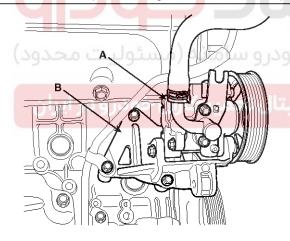


SHMEM8077D

20. Install the power steering pump (A) and bracket (B).

Tightening torque:

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

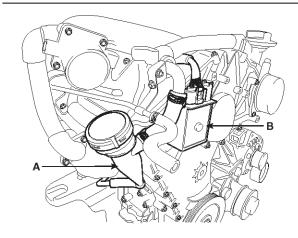


SHMEM8030D

21. Install the oil separator & pipe (A), and glow control unit (B).

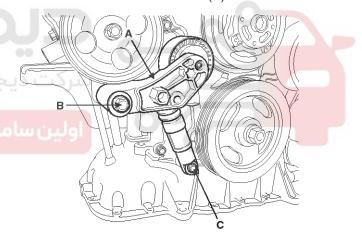
Tightening torque

A : 7.8 \sim 11.8N.m (0.8 \sim 1.2kgf.m, 5.8 \sim 8.7lb-ft) B : 8.8 \sim 13.7N.m (0.9 \sim 1.4kgf.m, 6.5 \sim 10.1lb-ft)



SHMEM8029D

22. Install the drive belt tensioner (A).

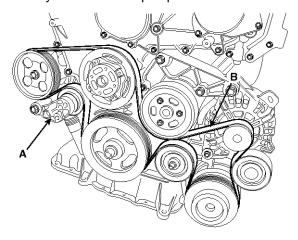


SHMEM8078D

Timing System

EM-29

23. Compressing the tensioner (A) with a wrench in a left hand by turning it clockwise, put on the drive belt (B) lastly with the water pump side idler.



SHMEM8027D

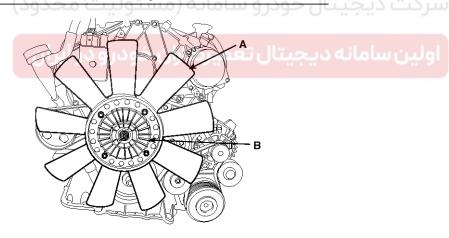
MNOTICE

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.

24. Install the cooling fan (A) and pan clutch (B).

Tightening torque:

 $9.8 \sim 11.8 \text{N.m} \ (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$



SHMEM8026D

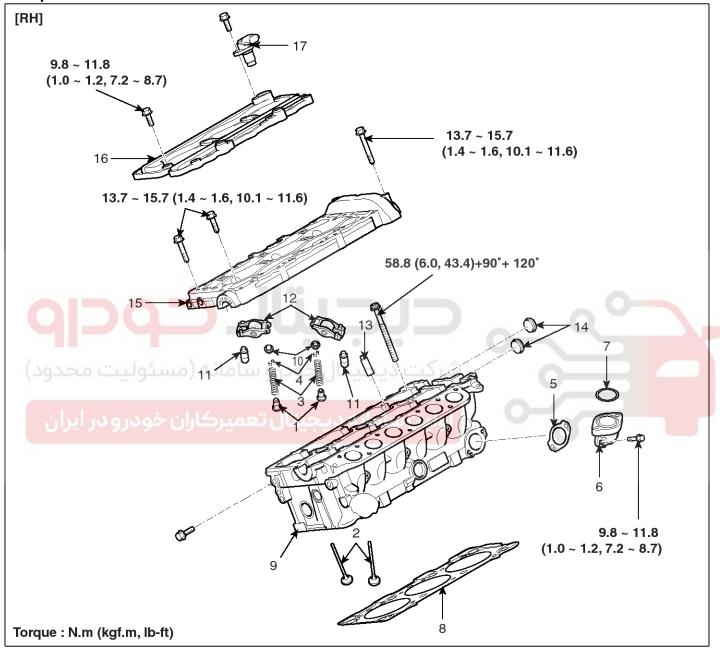


Engine Mechanical System

Cylinder Head Assembly

Cylinder Head

Components



SHMEM9203L

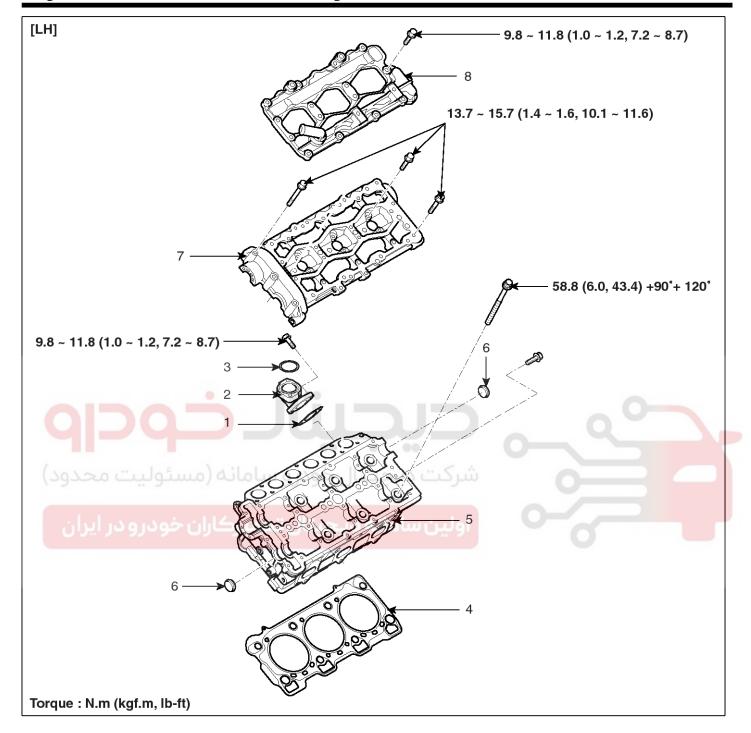
- 1. Valve stem seal
- 2. Valve
- 3. Valve spring
- 4. Valve spring retainer lock
- 5. Water outlet fitting gasket
- 6. Water outlet fitting

- 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)

Cylinder Head Assembly

EM-31



SHMEM9204L

- 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

Engine Mechanical System

Removal

- 1. Remove the timing chain. (Refer to Timing system in this group)
- 2. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 3. Remove the injectors, high pressure pipe and delivery pipe. (Refer to FL group)
- 4. Remove the glow plug wiring.

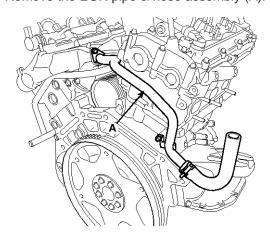
MOTICE

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.

5. Remove the water outlet pipe (A).

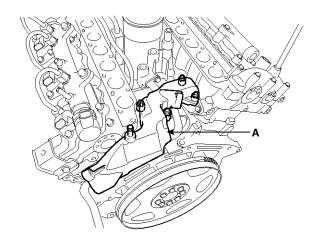


6. Remove the EGR pipe & hose assembly (A).



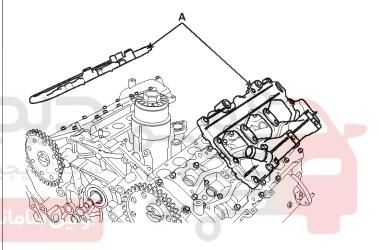
SHMEM8034D

7. Remove the water outlet duct (A).



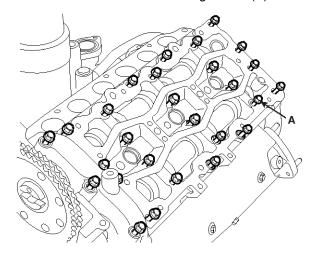
SHMEM8035D

8. Remove the cylinder head cover (A).



SENEM7053D

9. Remove the camshaft bearing ladder (A).

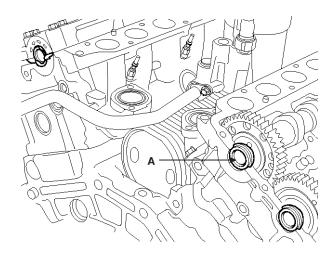


SENEM7050D

10. Remove the sealing caps (A).

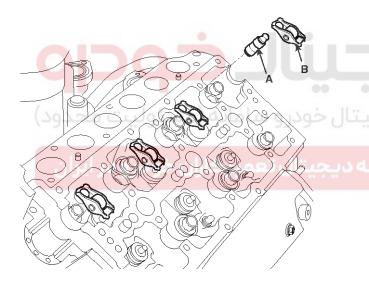
Cylinder Head Assembly

EM-33



SENEM7049D

- 11. Remove the camshafts.
- 12. Remove the cam follower assembly (B) and HLA (Hydraulic Lash Adjuster) (A).

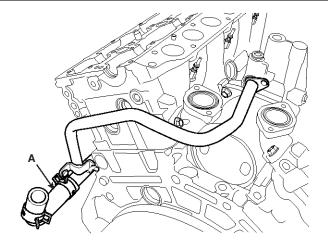


SENEM7045D

MOTICE

After 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.

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



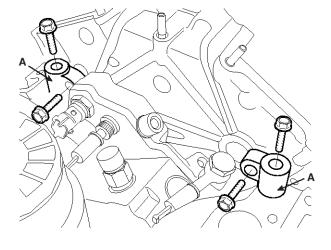
SENEM7043D

14. Use the SST (09367-3C100), remove the glow plugs (A).



SHMEM8221D

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



SENEM7040D

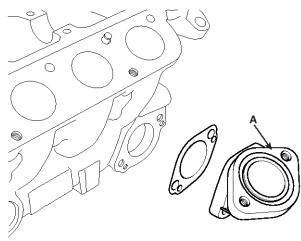
SENEM7037D

EM-34

Engine Mechanical System

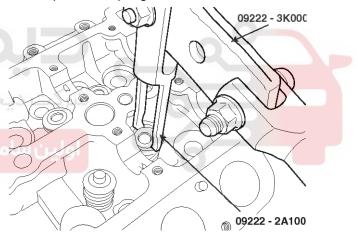


1. Remove the water outlet fitting (A).



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.

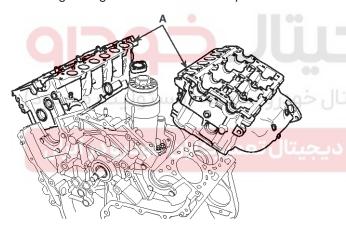
SENEM7041D

16. Remove the cylinder head bolts.

MOTICE

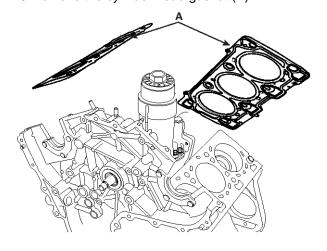
Do not reuse the cylinder head bolts.

17. Remove the cylinder head (A) quietly in order not to damage the gasket with the bottom part of the end.



SENEM7038D

18. Remove the cylinder head gasket (A).



Cylinder Head Assembly

EM-35

Reassembly

MNOTICE

- · 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.

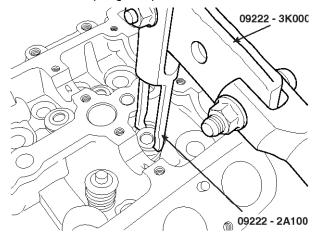
MOTICE

- 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.

MOTICE

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.

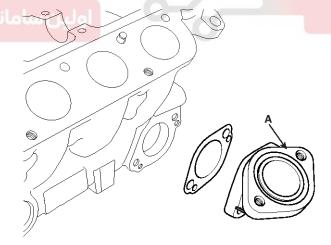


SENEM7033D

- 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:

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

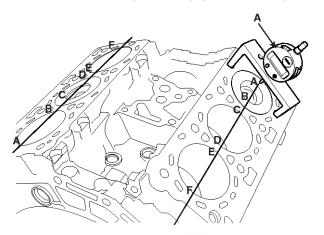


SENEM7034D

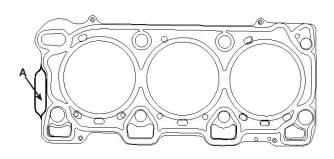
Engine Mechanical System

Installation

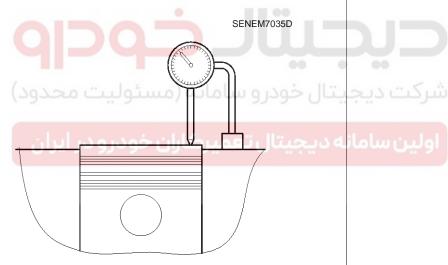
- 1. Clean the cylinder head and the cylinder block surfaces contacting with their gaskets.
- 2. Select the cylinder head gasket.
 - 1) Measure the piston protrusion from the upper cylinder block face on the twelve places (A \sim F for each bank) at TDC (top dead center).



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



SENEM7036D



LCGF129A

Cylinder Head Assembly

EM-37

Grade(A)		Α	В	С
Average of piston protrusion		0.310 ~ 0.410mm	0.410 ~ 0.510mm	0.510 ~ 0.610mm
Limit of each rank extant		0.460mm	0.560mm	-
Gasket thickness(compressed)		1.1 ± 0.04mm	1.2 ± 0.04 mm	1.3 ± 0.04 mm
Part No.	Part No. Left bank		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.

MOTICE

Be careful of the installation direction.

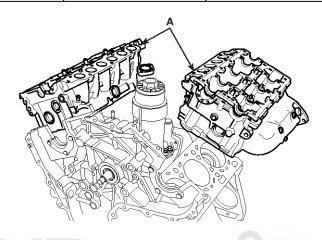


SENEM7037D

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.



SENEM7038D

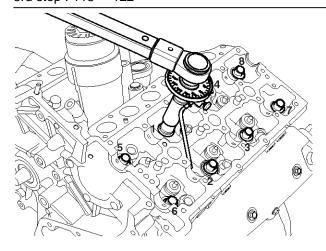
- 5. ce the cylinder head quietly in order not to damage the gasket with the bottom part of the end.
 - 1) Tighten the eight cylinder head bolts on each bank, in several passes, in the sequence shown.

Tightening torque

1st step: 56.9 ~ 60.8 N.m (5.8 ~ 6.2 kgf.m, 42.0 ~ 44.8

lbf-ft)

2nd step : 88 ~ 92° 3rd step : 118 ~ 122°



SENEM7039D

MOTICE

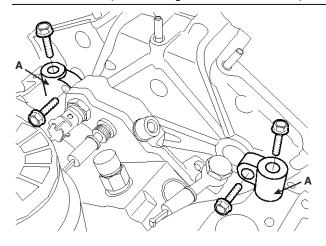
Do not reuse the cylinder head bolts.

Engine Mechanical System

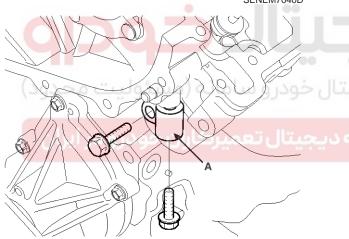
Install the timing chain case bracket (A). Tighten the vertical-direction bolts slightly first and then the horizontal-direction ones and the vertical-direction ones with the specified torque below.

Tightening torque:

 $19.6 \sim 25.5$ N.m ($2.0 \sim 2.6$ kgf.m, $14.5 \sim 18.8$ lb-ft)



SENEM7040D

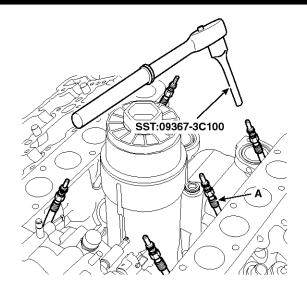


SENEM7041D

7. Use the SST (09367-3C100), install the glow plugs (A).

Tightening torque:

 $7.8 \sim 10.8 \text{N.m} \ (0.8 \sim 1.1 \text{kgf.m}, 5.8 \sim 8.0 \text{lb-ft})$

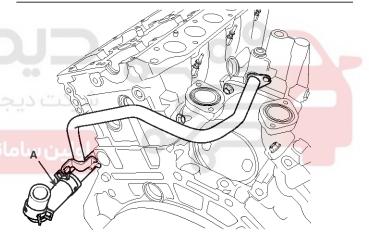


SHMEM8221D

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

Tightening torque:

 $9.8 \sim 11.8 \text{N.m} (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$



SENEM7043D

9. Install the camshafts and measure the end play.

Camshaft end play

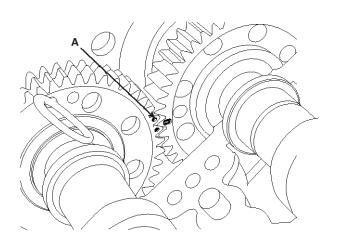
Standard : $0.05 \sim 0.15$ mm ($0.0020 \sim 0.0059$ in)



Align the marks (A) on the sprockets.

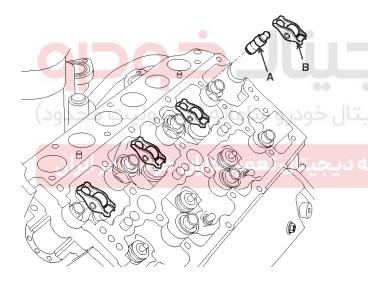
Cylinder Head Assembly

EM-39



SENEM7046D

- 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).

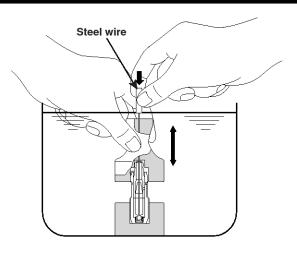


SENEM7045D

- 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.
- 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.

MOTICE

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

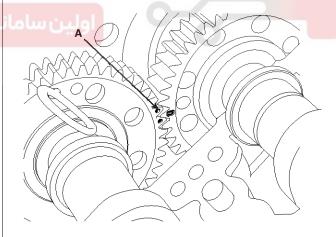
MOTICE

After installed on engine, lash adjuster might give out unusual noise. If air is mingled then apply slow racing (Approx. one minute for 1 racing) from idle to 3000rpm and is removed from adjuster.

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

⚠CAUTION

Align the marks (A) on the sprockets.

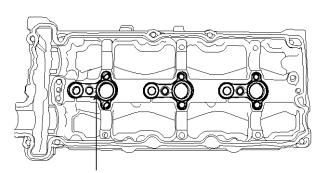


SENEM7046D

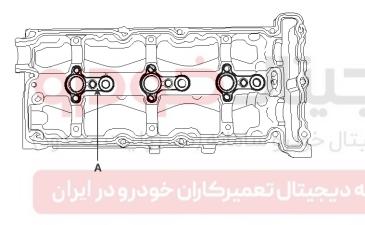
- 14. Pressing the exhaust camshafts, take out the pin from their sprockets.
- 15. Put the ladder gaskets (A) on the camshaft bearing ladder.

Engine Mechanical System

SENEM7049D



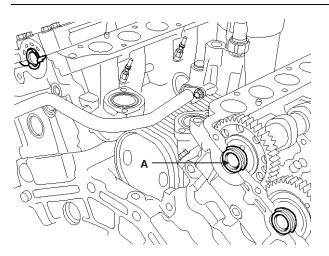
SENEM7047D



SENEM7048D

16.Install the sealing caps (A) with applying sealant on the grooves (4 places) at the circumference.

Sealant : LOCTITE 5902 Bead Width : \emptyset 2.2 \pm 0.4 mm



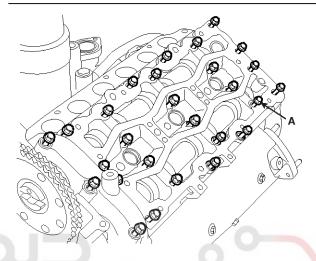
MNOTICE

Reassemble the camshaft bearing ladder within 15 minutes after applying sealant on the grooves.

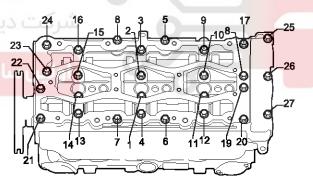
17. Install the camshaft bearing ladder (A) with the sequence and the torque below.

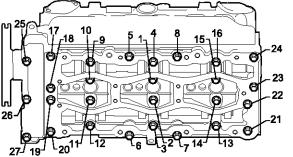
Tightening torque:

 $13.7 \sim 15.7$ N.m (1.4 ~ 1.6 kgf.m, $10.1 \sim 11.6$ lb-ft)



SENEM7050D



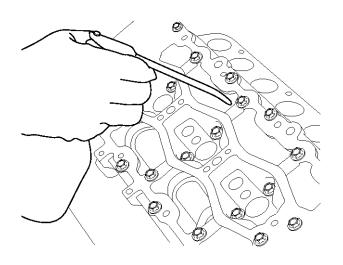


SENEM7051D

18. Apply oil on the camshafts sufficiently.

Cylinder Head Assembly

EM-41

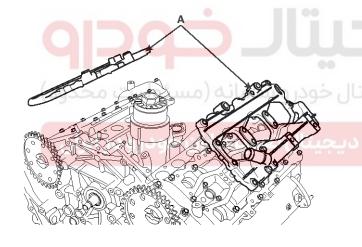


SENEM7052D

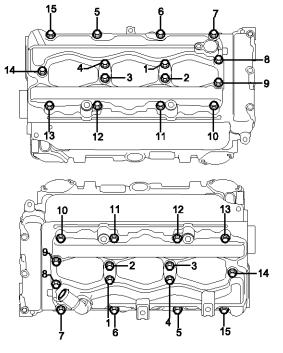
19.Install the cylinder head cover (A) with the sequence and the torque below.

Tightening torque:

 $9.8 \simeq 11.8 \text{N.m} \; (1.0 \simeq 1.2 \text{kgf.m}, \, 7.2 \simeq 8.7 \text{lb-ft})$



SENEM7053D

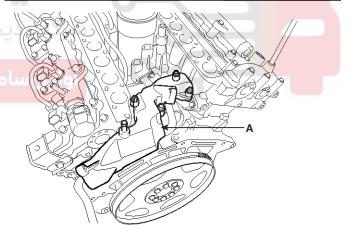


SENEM7054D

20. Install the water outlet duct (A).

Tightening torque:

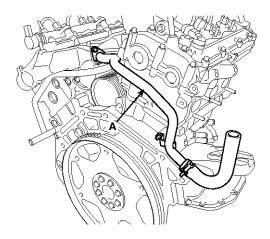
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SHMEM8035D

21. Install the EGR pipe & hose assembly (A).

Engine Mechanical System



SHMEM8034D

22. Install the water outlet pipe (A).

Tightening torque:

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





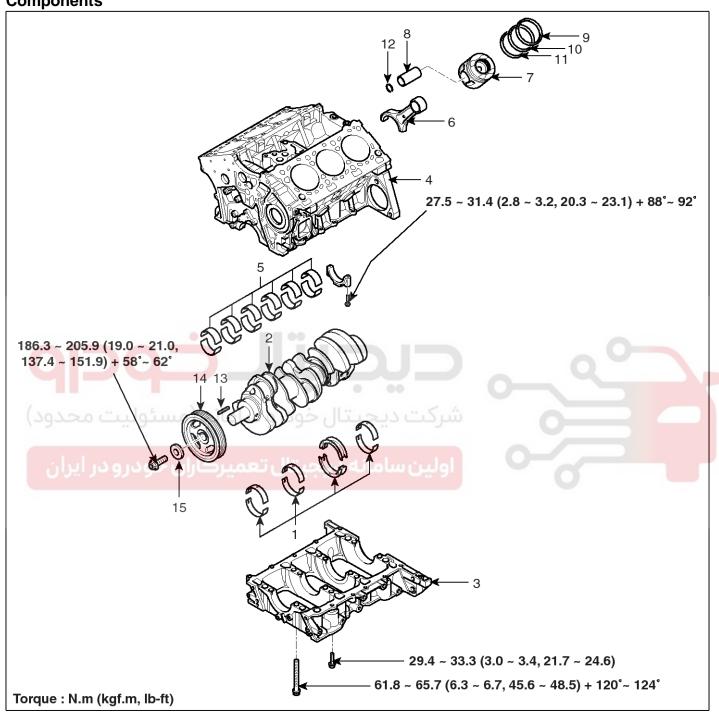
SHMEM8033D

- 23. Install the glow plug wiring.
- 24.Install the injectors, high pressure pipe and delivery pipe. (Refer to FL group)
- 25.Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 26.Install the timing chain. (Refer to Timing system in this group)

EM-43

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

Engine Mechanical System

Disassembly

1. Remove the connecting rod caps.

MOTICE

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.

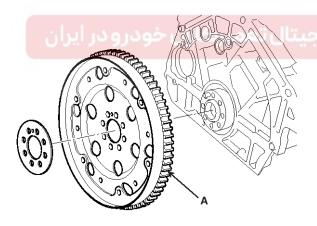
MOTICE

- Keep the connecting rod and the cap with its bearings together.
- Arrange the piston and connecting rod assemblies in the correct order.
- Remove the piston and conecting rod assembly.
 Using a press machine, remove the piston pin from the piston.
- 4. Remove the piston rings.

MOTICE

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).

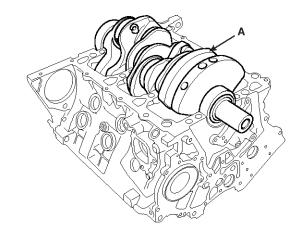


SENEM7011D

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

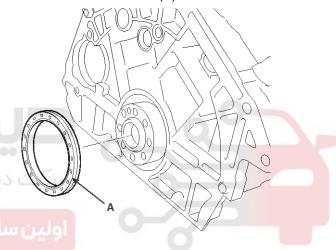
MNOTICE

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



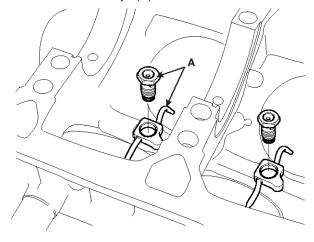
SENEM7004D

8. Remove the rear oil seal(A).



SENEM7010D

9. Remove the oil jet(A).



SENEM7002D

EM-45

Inspection

Connecting Rod

- 1. Check the connecting rod bearing oil clearance.
 - 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) Reassembe the lower bearings and the connecting rod caps and tighten the bolts with the specified torque below.

Tightening torque:

27.5 \sim 31.4Nm (2.8 \sim 3.2kgf.m, 20.3 \sim 23.1lb-ft) + 88° \sim 92°

MOTICE

- · 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 identificati- on mark	Connecting rod big end inner diameter identification mark	Assembling classifi- cation of upper bear- ings(identification mark)	
	A	Red	0.024~0.050(0.0009~0.0020)
A	В	Red	0.030~0.056(0.0012~0.0022)
	С	Yellow	0.026~0.052(0.0010~0.0020)
(20200000000000000000000000000000000000	A	Red	0.030~0.056(0.0012~0.0022)
(39356 Cup	B B	Yellow	0.026~0.052(0.0010~0.0 <mark>020)</mark>
alul avass	C	Yellow	0.032~0.058(0.0013~0.0023)
بحرو حر ایران	A	Yellow	0.026~0.052(0.0010~0.0020)
С	В	Yellow	0.032~0.058(0.0013~0.0023)
	С	Blue	0.028~0.054(0.0011~0.0021)

Engine Mechanical System

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.

ACAUTION

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.

UNOTICE

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

ACAUTION

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



SENEM7227D

Discrimination Of Crankshaft Pin Journal

	Mark	Crankshaft pin journal outer diameter
	Α	63.494 ~ 63.500 mm(2.4998~2.5000 in.)
	В	63.488 ~ 63.494 mm(2.4995~2.4998 in.)
1	С	63.482 ~ 63.488 mm(2.4993~2.4995 in.)



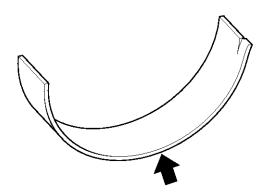
SENEM7226D

Discrimination Of Connecting Rod

Mark	Connecting rod big-end inner diameter
А	66.500 ~ 66.506 mm(2.6181~2.6183 in.)
В	66.506 ~ 66.512 mm(2.6183~2.6186 in.)
С	66.512 ~ 66.518 mm(2.6186~2.6188 in.)

EM-47

Connecting Rod Bearing Mark Location



SENEM7014D

Discrimination Of Connecting Rod Upper Bearing

Size code	Color	Connecting rod upper bearing thick- ness
Α	Blue	1.497 ~ 1.507mm (0.0589 ~ 0.0593in.)
В	Yellow	1.487 ~ 1.497mm (0.0585 ~ 0.0589in.)
С	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		
		Α	В	С
	Α	Red	Red	Yellow
Crankshaft pin journal mark	В	Red	Yellow	Yellow
Journal Mark	С	Yellow	Yellow	Blue

- 2. Check the connecting rods.
 - 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.



Engine Mechanical System

torque below.

Tightening torque:

step

8) Tighten the No.17~25 bolts with the specified

 $29.4 \sim 33.3$ Nm ($3.0 \sim 3.4$ kgf.m, $21.7 \sim 24.6$ lb-ft) - 1st

Crankshaft

- 1. Check the crankshaft bearing oil clearance.
 - 1) To check main bearing-to-journal oil clearance, remove the bed plate and lower bearings.
 - 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.

MNOTICE

- 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($18\rightarrow20\rightarrow21$) with the specified torque.

Tightening torque:

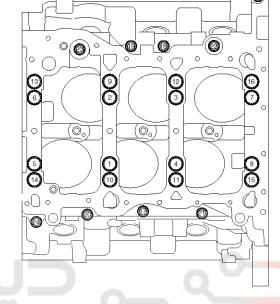
 $29.4 \sim 33.3$ Nm ($3.0 \sim 3.4$ kgf.m, $21.7 \sim 24.6$ lb-ft)

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

Tightening torque:

61.8 \sim 65.7Nm (6.3 \sim 6.7kgf.m, 45.6 \sim 48.5lb-ft) - 1st step

 $120^{\circ} \sim 124^{\circ}$ - 2nd step



SENEM7007D

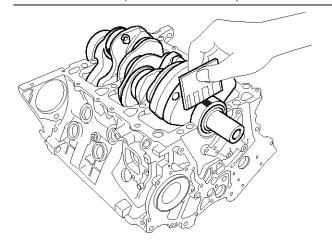
MNOTICE

Do not rotate the crankshaft.

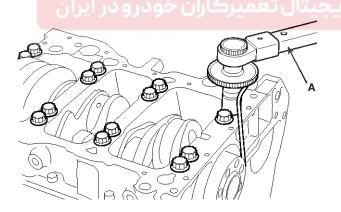
9) Remove the bed plate and lower bearing again, and measure the widest part of the plastigage.

Standard oil clearance:

 $0.030 \sim 0.048$ mm (0.0012 ~ 0.0019 in)



SENEM7200D



SENEM7008D

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

EM-49

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.

ACAUTION

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.

UNOTICE

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.

ACAUTION

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.

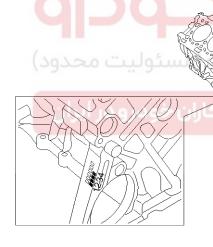
Crankshaft Journal Bore Mark Location



SENEM7001D

Crankshaft Main Journal Mark Location

Mark	Crankshaft main journal outer diameter
Α	75.994 ~ 76.000 mm(2.9919~2.9921 in.)
В	75.988 ~ 75.994 mm(2.9916~2.9919 in.)
С	75.982 ~ 75.988 mm(2.9914~2. <mark>9916</mark> in.)



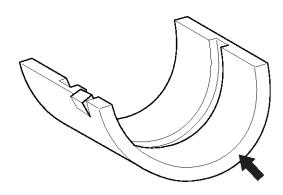
SENEM7018D

Crankshaft Journal Bore Mark Location

Mark	Cylinder block journal bore inner diameter
Α	80.000 ~ 80.006 mm(3.1496~3.1498 in.)
В	80.006 ~ 80.012 mm(3.1498~3.1501 in.)
С	80.012 ~ 80.018 mm(3.1501~3.1503 in.)

Engine Mechanical System

Crankshaft Main Bearing Mark Location



SENEM7201D

Discrimination Of Crankshaft Main Bearing

Size code	Color	Crankshaft bearing thickness
Α	Red	1.994 ~ 1.997mm (0.0785 ~ 0.0786in.)
В	Blue	1.991 ~ 1.994mm (0.0784 ~ 0.0785in.)
С	<u> </u>	1.9 <mark>88 ~ 1</mark> .991mm (0.0783 ~ 0.0784in.)
D	Yellow	1.985 ~ 1.988mm (0.0781 ~ 0.0783in.)
₹70	Green	1.982 ~ 1.985mm (0.0780 ~ 0.0781in.)

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

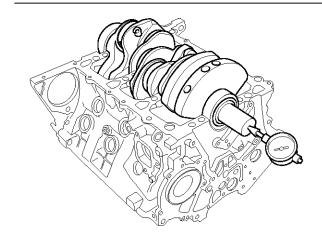
Crankshaft Main Bearing Selection Table

Crankshaft main bearing		Crankshaft bore mark		
		Α	В	С
	Α	Green	Yellow	-
Crankshaft main journal mark	В	Yellow	-	Blue
Journal Mark	С	-	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 : $0.1 \sim 0.3$ mm ($0.0039 \sim 0.118$ in)



SENEM7202D

EM-51

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)

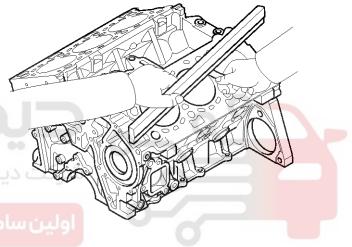


Cylinder Block

- 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.
- 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



Engine Mechanical System

- 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.

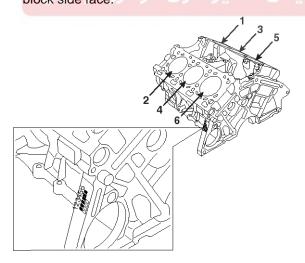
Standard diameter:

84.000 ~ 84.030mm (3.3071 ~ 3.3083in)



SENEM7205D

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

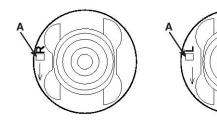


SHMEM9210L

Discrimination Of Cylinder Bore Size

Mark	Cylinder bore inner diameter
А	84.000 ~ 84.010 mm(3.3071~3.3075 in.)
В	84.010 ~ 84.020 mm(3.3075~3.3079 in.)
С	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
Α	83.926 ~ 83.936 mm(3.3042~3.3046 in.)
В	83.936 ~ 83.946 mm(3.3046~3.3050 in.)
С	83.946 ~ 83.956 mm(3.3050~3.30 <mark>53 in.</mark>)

8. Select the piston related to cylinder bore class.

Piston-to-cylinder clearance:

 $0.064 \sim 0.084$ mm ($0.0025 \sim 0.0033$ in.)

EM-53

Cylinder Boring

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

MOTICE

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

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

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

ACAUTION

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.)

MOTICE

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.

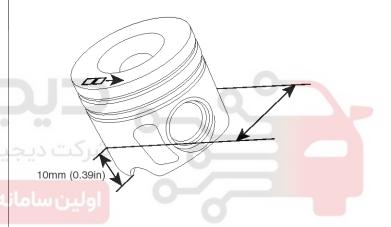
MOTICE

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

Engine Mechanical System

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

Piston-to-cylinder clearance:

 $0.064 \sim 0.084$ mm ($0.0025 \sim 0.0033$ in.)

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: $0.102 \sim 0.146$ mm ($0.0040 \sim 0.0057$ in.) No.2: $0.08 \sim 0.12$ mm ($0.0031 \sim 0.0047$ in.) Oil ring: $0.03 \sim 0.07$ mm ($0.0012 \sim 0.0028$ in.)



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 : $0.20 \sim 0.35$ mm ($0.0079 \sim 0.0138$ in.) No.2 : $0.40 \sim 0.60$ mm ($0.0157 \sim 0.0236$ in.) Oil ring : $0.25 \sim 0.50$ mm($0.0098 \sim 0.0197$ in.)



ECKD001K

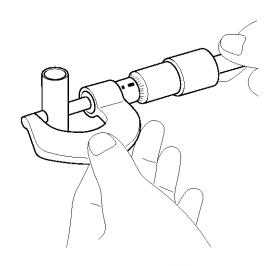
EM-55

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 :

 $0.014 \sim 0.027 \text{mm} \ (0.0006 \sim 0.0011 \text{in})$

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

Piston pin-to-connecting rod interference :

 $0.020 \sim 0.037$ mm ($0.0008 \sim 0.014$ in)

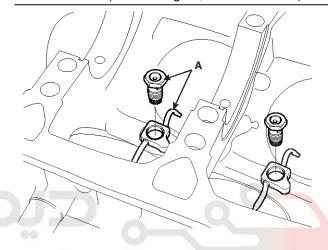
Reassembly

MOTICE

- · 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)



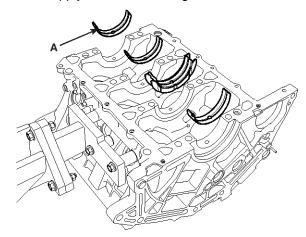
SENEM7002D

2. Install the crankshaft main bearings(A).

MOTICE

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

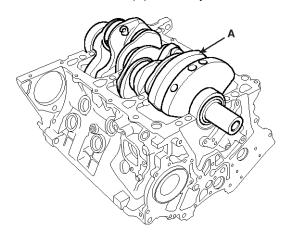
 Aligning the bearing claw with the groove of the cylinder block, push in the four upper bearings(A).
 Apply oil on the bearings at this moment.



SENEM7003D

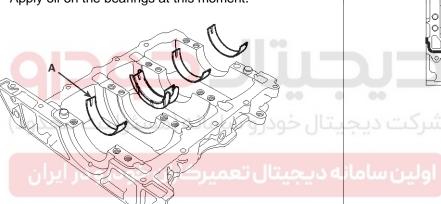
Engine Mechanical System

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



SENEM7004D

 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.

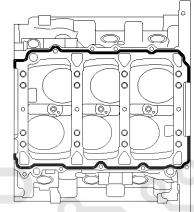


SENEM7005D

5. Place the bed plate on the cylinder block.

WNOTICE

- 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

EM-57

6. Install the bedplate bolts.

MOTICE

- 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)

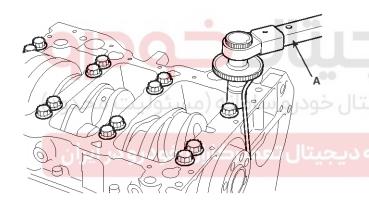
 Tighten the No.1~16 bolts in two steps with the specified torque and angle below.

Do not reuse the No.1 \sim 16 bolts.

Tightening torque:

61.8 $^{\sim}$ 65.7Nm (6.3 $^{\sim}$ 6.7kgf.m, 45.6 $^{\sim}$ 48.5lb-ft) - 1st step

 $120^{\circ} \sim 124^{\circ}$ - 2nd step

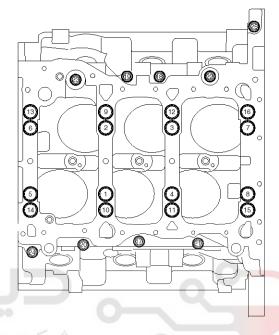


SENEM7008D

- 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 \sim 33.3Nm (3.0 \sim 3.4kgf.m, 21.7 \sim 24.6lb-ft) - 1st step

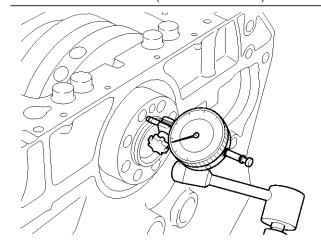


SENEM7007D

- 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)

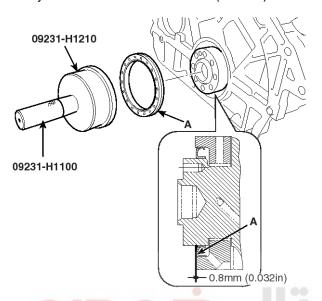


SENEM7009D

Engine Mechanical System

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

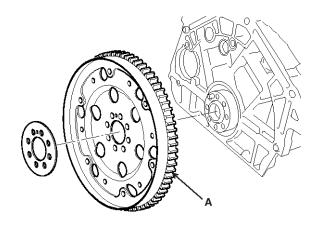
MOTICE

- 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:

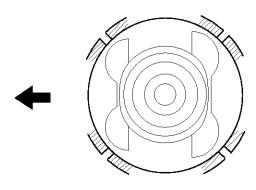
 $117.7 \sim 127.5$ Nm ($12.0 \sim 13.0$ kgf.m, $86.8 \sim 94.0$ lb-ft)



SENEM7011D

10. Install the piston rings.

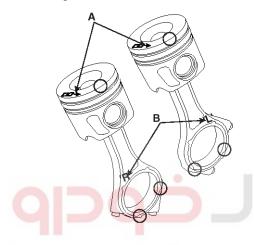
- No.1 and No.2 piston rings assemble the rings with the 'Y' marks on the edge of the rings facing the cylinder head side. One end gap is placed at 180° opposite position with the other.
- 2) Oil ring the end gap of the oil ring should be located with 180° to that of coil spring and 90° to that of No.1 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

EM-59

- 11. Assemble the piston and connecting rod.
 - 1) Set the snap ring in one side of piston pin hole.
 - 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.



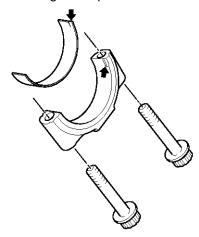
SHMEM8106D

MOTICE

Marking the parts at the 'O' 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.



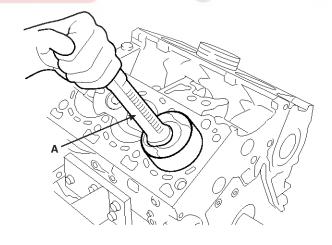
SENEM7300D

13. Install the piston and connecting rod assembly.

MOTICE

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

- 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.



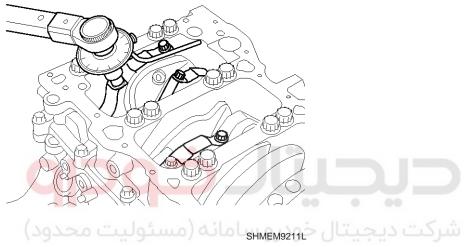
SENEM7015D

Engine Mechanical System

- 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 $^{\sim}$ 31.4Nm (2.8 $^{\sim}$ 3.2kgf.m, 20.3 $^{\sim}$ 23.1lb-ft) $^{+}$ 88 $^{\circ}$ $^{\sim}$ 92 $^{\circ}$



MOTICE

- 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.



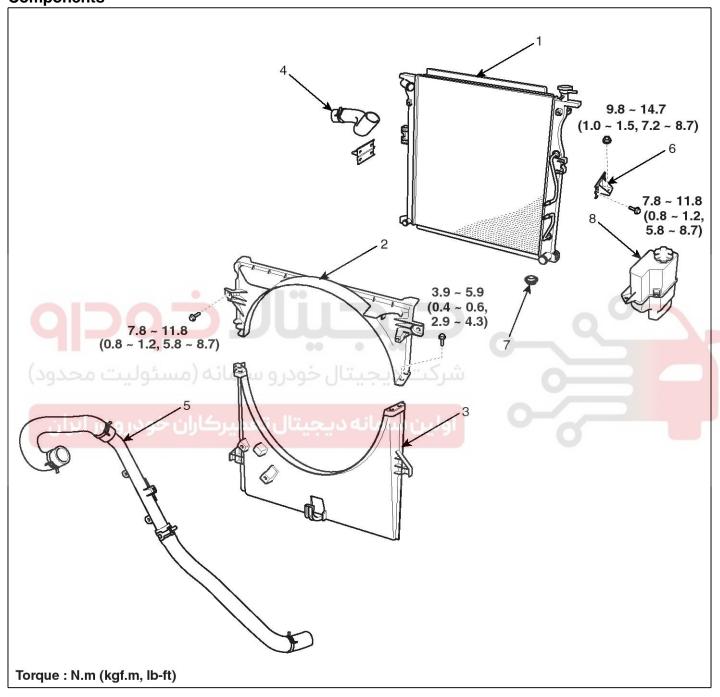
Cooling System

EM-61

Cooling System

Radiator

Components



SHMEM9205L

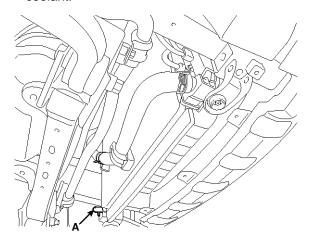
- 1. Radiator assembly
- 2. Radiator upper shroud
- 3. Radiator lower shroud
- 4. Radiator upper hose

- 5. Radiator lower hose
- 6. Radiator mounting bracket
- 7. Radiator mounting insulator
- 8. Coolant reservoir tank

Engine Mechanical System

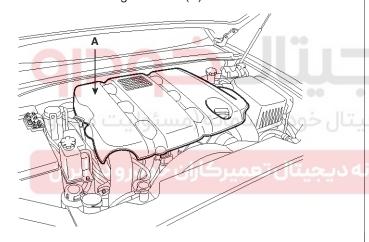
Replacement

1. Loosen the drain plug (A) and drain the engine coolant.



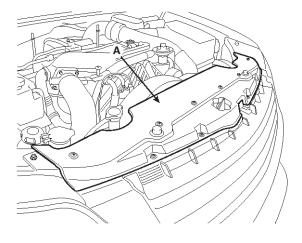
SHMEM8053D

2. Remove the engine cover (A).



SHMEM8001D

3. Remove the radiator grille upper guard (A).

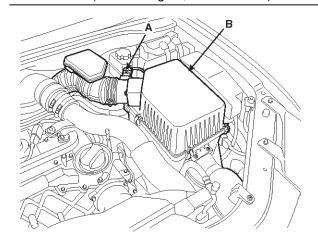


SHMEM8014D

4. Disconnect the AFS connector (A), and then remove the air cleaner assembly (B).

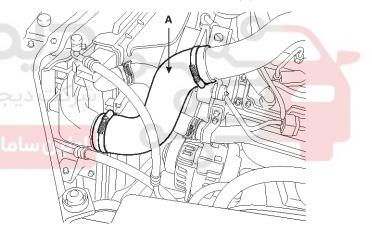
Tightening torque:

 $7.8 \sim 9.8$ N.m (0.8 ~ 1.0 kgf.m, $5.8 \sim 7.2$ lb-ft)



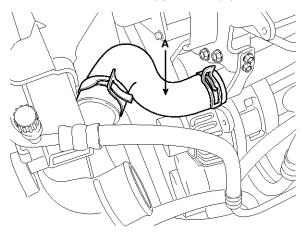
SHMEM8004D

5. Remove the intercooler inlet hose (A).



SHMEM8005D

6. Remove the radiator upper hose (A).

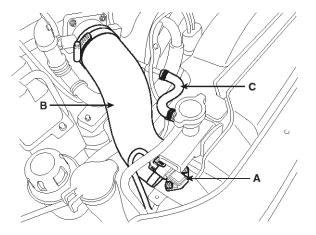


Cooling System

EM-63

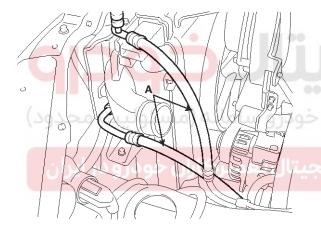
SHMEM8016D

7. Disconnect the BPS connector (A), and then Remove the intercooler outlet hose (B) and water hose (C).



SHMEM8007D

8. Disconnect the A/C pipe(A).

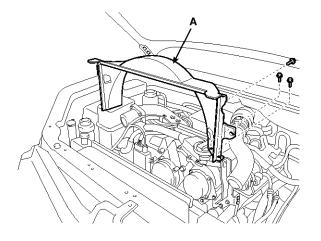


SHMEM8011D

9. Remove the radiator upper shroud (A).

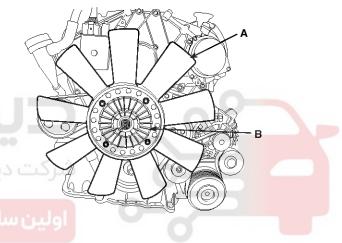
Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)



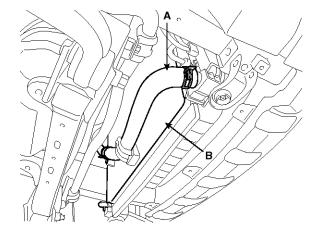
SHMEM8043D

10. Remove the cooling fan (A) and pan clutch (B).



SHMEM8026D

Remove the radiator lower hose (A) and lower shroud
 (B).



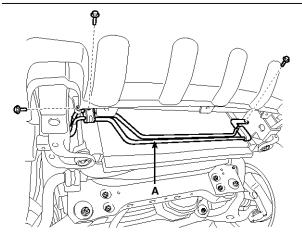
SHMEM8103D

- 12. Remove the ATF cooler hoses.
- 13. Remove the power steering oil cooler tube (A) from the cooling module.

Engine Mechanical System

Tightening torque:

 $8.8 \sim 10.8 \text{N.m} \; (\; 0.9 \sim 1.1 \text{kgf.m}, \; 6.5 \sim 8.0 \text{lb-ft})$

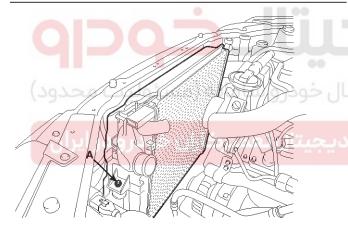


SHMEM8044D

14. Remove the radiator mounting bracket nut (A).

Tightening torque:

 $9.8 \sim 14.7 \text{N.m}$ ($1.0 \sim 1.5 \text{kgf.m}, 7.2 \sim 10.8 \text{lb-ft})$

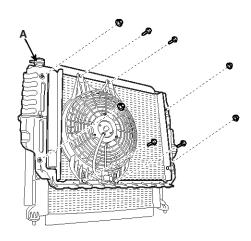


SHMEM8109D

15. Remove the air guard (A).

Tightening torque:

7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

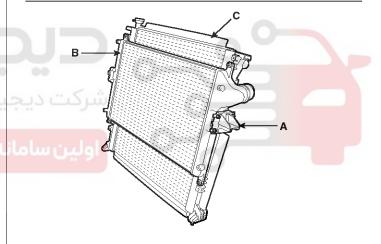


SHMEM8110D

16. Remove the radiator mounting bracket (A) and then separate the intercooler (B) and radiator assembly (C).

Tightening torque:

7.8 $^{\sim}$ 11.8N.m (0.8 $^{\sim}$ 1.2kgf.m, 5.8 $^{\sim}$ 8.7lb-ft)



SHMEM8048D

- 17. Installation is reverse order of removal.
- 18. Fill with engine coolant.
- 19. Start engine and check for leaks.

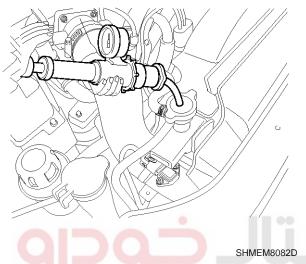
Cooling System

EM-65

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.



- 4. Inspect for engine coolant leaks and a drop in pressure.
- 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.

UNOTICE

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

Check Engine Coolant Level At Reservoir Tank

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-nitrite, and non-borate coolant or equivalent to 'F' line.

Cheek 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 around the radiator cap.
- 3. If excessive dirty, clean the cooling system and replace coolant.
- 4. Reinstall the radiator cap.



Engine Mechanical System

Coolant

Replacement And Air Bleeding

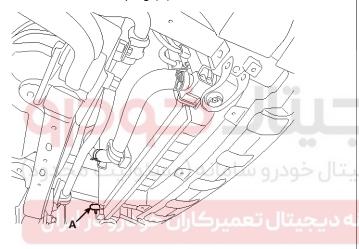
⚠ CAUTION

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.

MOTICE

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. Make sure the engine and radiator are cool to the touch.
- 2. Open the radiator cap.
- 3. Loosen the drain plug (A), and drain the coolant.



SHMEM8053D

- 4. Tighten the radiator drain plug securely.
- 5. After draining engine coolant in the reservoir tank, clean the tank.
- 6. Fill the radiator with water through the radiator cap and tighten the cap.

MNOTICE

To that the air in radiator is flown off easily, slowly pour water and press the upper/lower radiator hoses.

- 7. After warming up the engine until the cooling fan operates several times, accelerate it at idle.
- 8. Wait until the engine is cool.
- 9. Repeat the step 1 to 8 until the drained water is clean.
- 10. Fill fluid mixture with coolant and water(5 : 5) (Tropical region – 4:6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

MOTICE

- Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 35% minimum.

Coolant concentrations less than 35% may not provide sufficient protection against corrosion or freezing.

 Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.

ACAUTION

- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.
- 11. Start the engine and run coolant circulates.
- 12. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
- 13. Repeat 11 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
- 14.Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
- 15. Run the vehicle under idle until the cooling fan operates $2 \sim 3$ times.
- 16. Stop the engine and wait coolant gets cool.
- 17. Repeat 10 to 15 until the coolant level doesn't fall any more, bleed air out of the cooling system.

MNOTICE

As it is to bleed air out to the cooling system and refill coolant when coolant gets cool completely, recheck the coolant level in the reservoir tank for 2 ~ 3 days after replacing coolant.

Coolant capacity: 14.7L (15.5us.qts, 12.9lmp.qts)

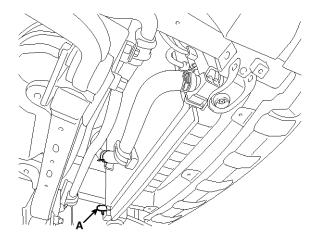
Cooling System

EM-67

Water pump

Replacement

1. Loosen the drain plug (A) and drain the engine coolant.

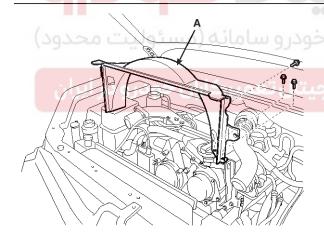


SHMEM8053D

2. Remove the radiator upper shroud (A).

Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)

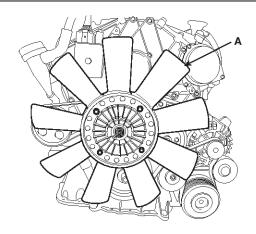


SHMEM8043D

3. Remove the cooling fan (A).

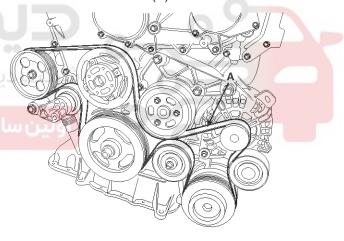
Tightening torque:

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



SHMEM8084D

4. Remove the drive belt (A).



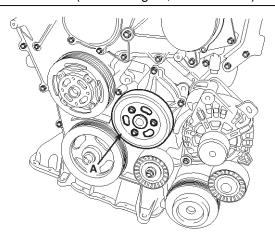
SHMEM8085D

Engine Mechanical System

5. Remove the water pump pulley (A).

Tightening torque:

 $9.8 \sim 11.8 \text{N.m} \; (1.0 \sim 1.2 \text{kgf.m}, \, 7.2 \sim 8.7 \text{lb-ft})$

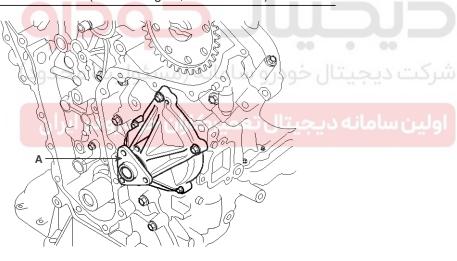


SHMEM8087D

6. Remove the water pump (A).

Tightening torque:

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





SENEM7056D

7. Installation is reverse order of removal.

Cooling System

EM-69

Troubleshooting Water Pump

Symptoms		Possibl	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, repl- ace a water pump.
	mp		warriing up.	 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 th- e water pump.	 Poor material. If any cra- ck found, replace the wa- ter pump.
ک محدود) در ایران	From bearingsFrom mechanical seals	ببيار	engine, check noise with a stethosco-	 If there is no noise, reuse the water pump (do not replace it).
	Impeller interferen- ce		pe. شرکت	If there is any noise from the water pump, remove the drive belt and rechec- k.
	عمیرکاران خودر	Inspection after removing a drive belt	After removing a water pump and a drive belt, check	If there is noise, reuse the water pump. Check other drive line parts.
			noise again.	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 impellerLoosened 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.

Engine Mechanical System

Thermostat

Replacement

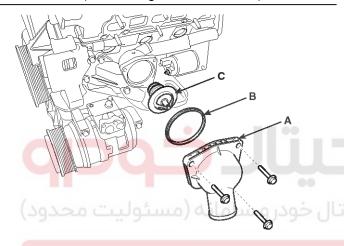
MOTICE

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 (C) with its gasket (B) after taking off the water inlet fitting (A) from the water temperature control assembly.

Tightening torque:

 $7.8 \sim 9.8 \text{N.m} \ (0.8 \sim 1.0 \text{kgf.m}, 5.8 \sim 7.2 \text{lb-ft})$



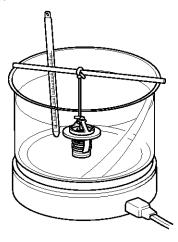
3. Installation is reverse order of removal.

MOTICE

- Install the thermostat (C) with the jiggle valve upward.
- 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.

Inspection

1. Immerse the thermostat in water and gradually heat the water.



KCRF226A

2. Check the valve opening temperature.

Valve opening temperature : 82±1.5°C (179.6±2.7°F) Full opening temperature : 95°C (203°F)

If the valve opening temperature is not as specified, replace the thermostat.

3. Check the valve lift.

Valve lift: 10 mm (0.39in) or more at 95°C (203°F)

If the valve lift is not as specified, replace the thermostat.

Cooling System

EM-71

Troubleshooting

Thermostat

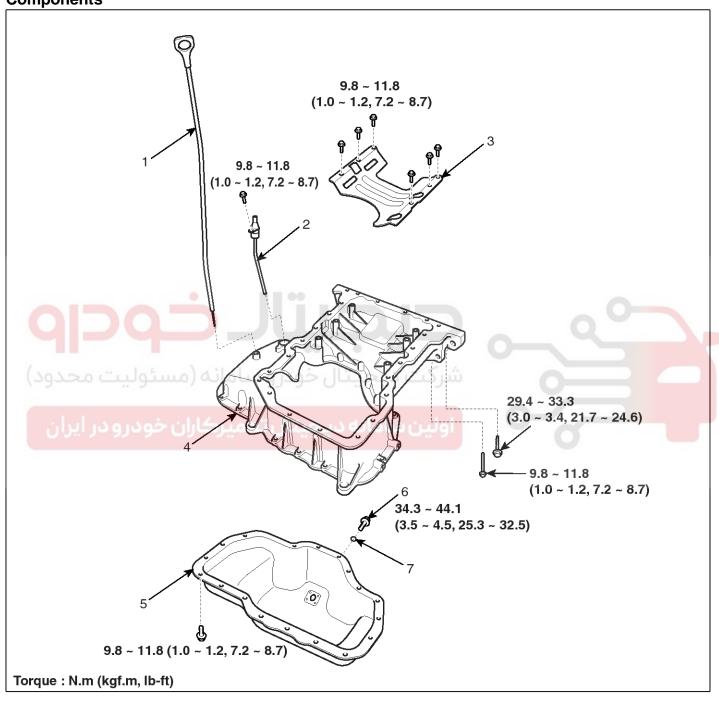
Symptoms		Possible Causes			Remedy		
Coolant leakage	•	From the thermostat gasket	Check the mounting bolts	•	Check the torque of the mounting bolts	•	Retighten the bolts and check leakage again.
			Check the gasket for damage	•	Check gasket or seal for damage	•	Replace gaskets and reuse the thermostat.
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	ys	Check DTCs Check connection of the fan clutch or the fan motor. If the fan clutch is alwaconnected, there will be 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	ي د	Engine overheated Thermogauge indicates 'HI'	Visually check after removing the radiator cap.	3	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.	op	After removing the thermostat, check it works properly. Check the thermostatens at the valve opening mperature.	•	Replace the thermostat, if it doesn't work properly .

Engine Mechanical System

Lubrication System

Oil Pump

Components



SHMEM9206L

- 1. Oil level gauge
- 2. Nipple
- 3. Baffle plate
- 4. Upper oil pan

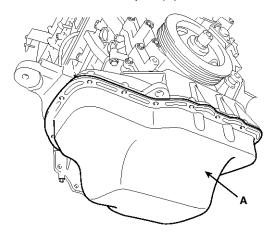
- 5. Lower oil pan
- 6. Drain plug
- 7. Gasket

Lubrication System

EM-73

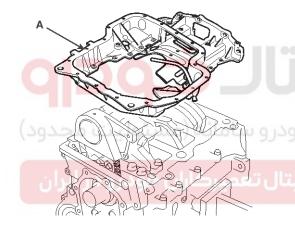
Removal

1. Remove the lower oil pan (A).



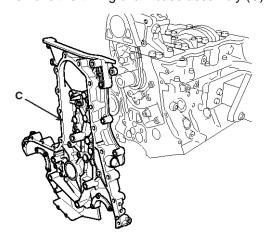
SHMEM8037D

2. Remove the upper oil pan (A).



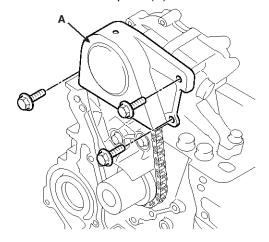
SHMEM8099D

- 3. Remove the timing chain. (Refer to Timing system in this group)
- 4. Remove the timing chain case assembly (C).



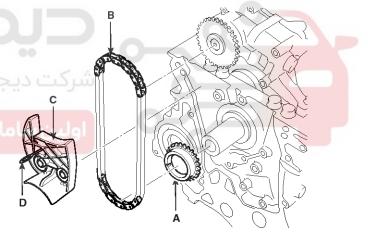
SENEM7023D

5. Remove the baffle plate (A).



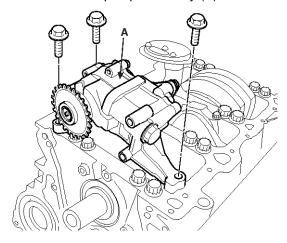
SENEM7021D

- 6. Remove the oil pump chain tensioner (C) , after Insert a pin (D) into the tensioner hole.
- 7. Remove the oil pump chain (B) and crankshaft sprocket (A).



SENEM7020D

8. Remove the oil pump assembly (A).



Engine Mechanical System

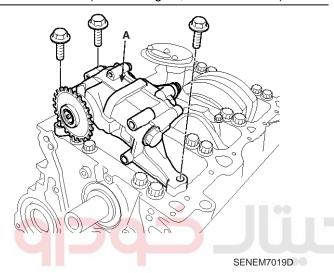
SENEM7019D

Installation

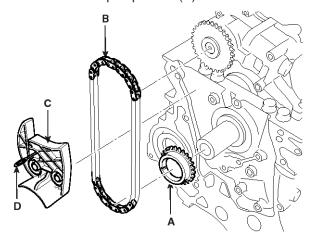
- Before installing the oil pump and screen assembly on the bed plate, check if the O-ring is seated properly and not damaged.
- 2. Install the oil pump and screen assembly with the specified torque.

Tightening torque:

 $19.6 \sim 26.5$ N.m ($2.0 \sim 2.7$ kgf.m, $14.5 \sim 19.5$ lb-ft)



- 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).



SENEM7020D

6. Install the oil pump chain tensioner (C) and remove the stopper pin (D) from the tensioner.

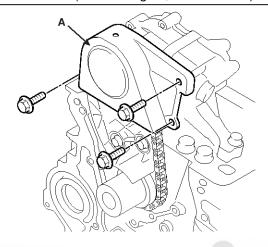
Tightening torque:

 $7.8 \sim 11.8$ N.m ($0.8 \sim 1.2$ kgf.m, $5.8 \sim 8.7$ lb-ft)

7. Install the baffle plate (A).

Tightening torque:

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



SENEM7021D

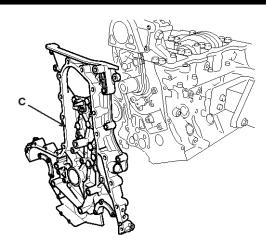
8. After applying sealant (A) on the groove and checking if the O-rings are seated securely, Install the timing chain case assembly (C) in fifteen minutes.



SENEM7022D

Lubrication System

EM-75



SENEM7023D

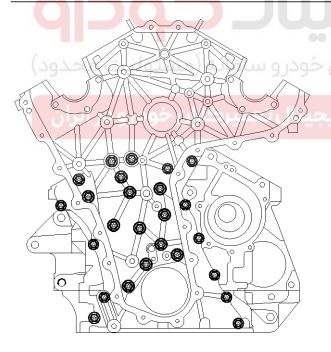
9. Tighten the mounting bolts of the chain case with the specified torque below.

Tightening torque

 $6 \times 16 (\bigstar)$: 7.8 \sim 11.8 N.m (0.8 \sim 1.2 kgf.m, 5.8 \sim 8.7 lb-ft)

 $8{\times}35(\blacktriangle)$: 19.6 \sim 25.5 N.m (2.0 \sim 2.6 kgf.m, 14.5 \sim

18.8 lb-ft)

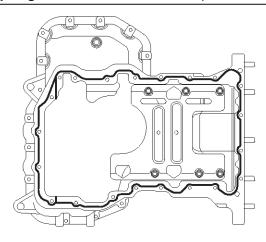


SENEM7024D

- 10.Install the timing chain. (Refer to Timing system in this group)
- 11. Apply liquid gasket on the upper oil pan assembly shown as below.

Bead width: Ø 3.0 mm (0.012 in.)

Liquid gasket: LOCTITE 5900 or equivalent



SHMFM8024D

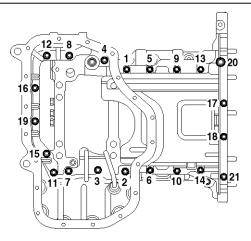
MNOTICE

- Apply sealant cautiously to prevent sealant from coming in the oil pan during installation.
- After applying sealant, assemble the oil pan in five minutes.
- 12. Tighten the upper oil pan mounting bolts with the order and the specified torque below.

Tightening torque

No.1~19 bolt : 9.8 \sim 11.8N.m (1.0 \sim 1.2kgf.m, 7.2 \sim 8.7lb-ft)

No.20, 21 bolt : 29.4 \sim 33.3Nm (3.0 \sim 3.4kgf.m, 21.7 \sim 24.6lb-ft)



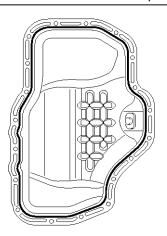
SHMEM8025D

Engine Mechanical System

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

Bead width: Ø 3.0 mm (0.012 in.)

Liquid gasket: LOCTITE 5900 or equivalent



SHMEM8022D

MOTICE

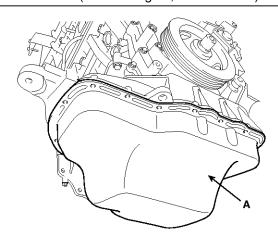
- Apply sealant cautiously to prevent sealant from coming in the oil pan during installation.
- After applying sealant, assemble the oil pan in five minutes.

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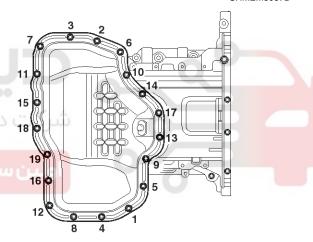
14. Tighten the lower oil pan mounting bolts with the order and the specified torque below.

Tightening torque:

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



SHMEM8037D



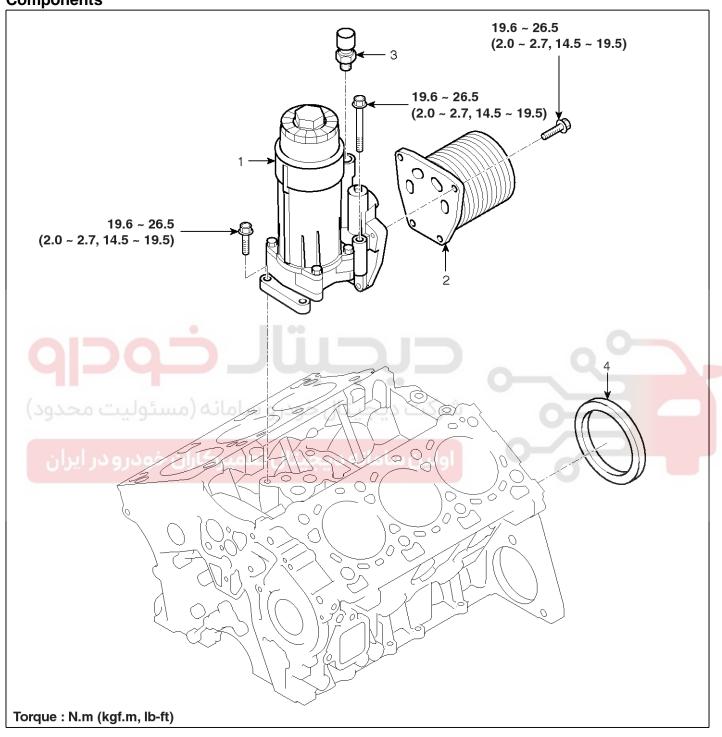
SHMEM8023D

Lubrication System

EM-77

Oil Cooler

Components



SENEM9010L

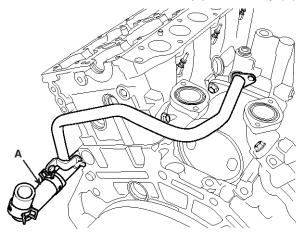
- 1. Oil filter assembly
- 2. Oil cooler assembly

- 3. Oil pressure sensor
- 4. Rear oil seal

Engine Mechanical System

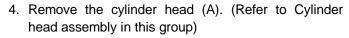
Replacement

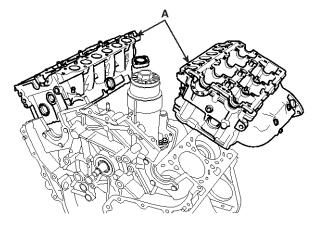
- 1. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 2. Remove the water hose and pipe assembly (A).



SENEM7043D

3. Remove the water outlet duct (A).





SENEM7038D

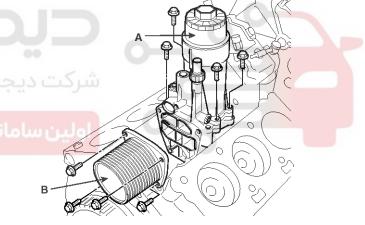
5. Remove the oil filter (A) and oil cooler (B).

Tightening torque:

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



SHMEM8035D



SENEM7030D

6. Installation is reverse order of removal.

MOTICE

Check if there are rubber pickings between the oil filter and the block or the oil cooler. If so, apply engine oil.

Lubrication System

EM-79

Engine Oil

Inspection

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.

MOTICE

Do not fill with engine oil above the "F" mark.



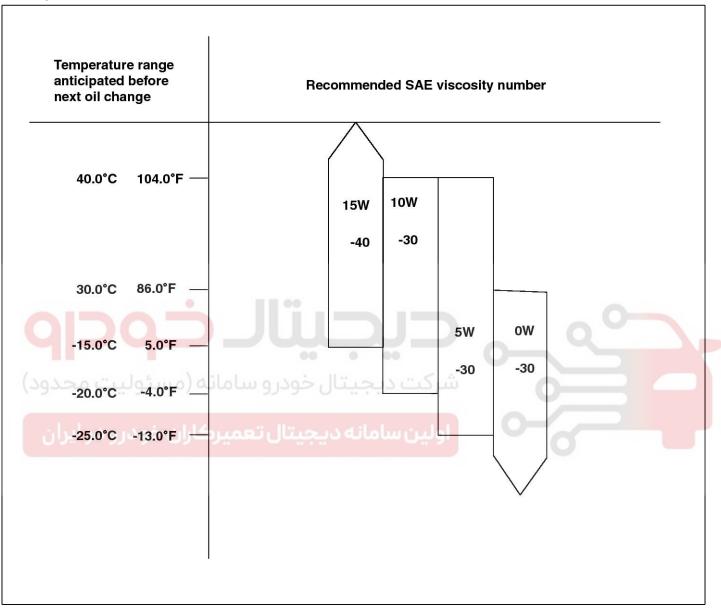


Engine Mechanical System

Selection Of Engine Oil

ACEA classification: C3 (with DPF), B4 (without DPF) SAE viscosity grades: Refer to the recommended SAE

viscosity number



SENEM0102L

MOTICE

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.

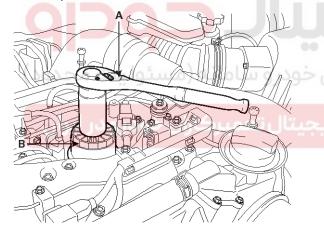
Lubrication System

EM-81

Replacement

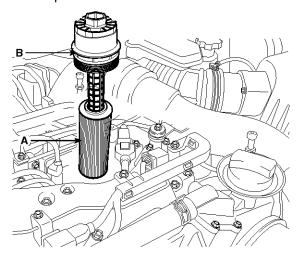
MOTICE

- 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.
 - Using a wrench(32mm 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.



SHMEM8036D

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



SHMEM8098D

- 1) Remove the filter paper assembly (A).
- 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 fixed.

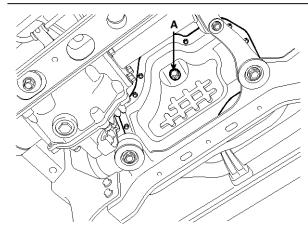
Tightening torque:

24.5N.m (2.5kgf.m, 18.1lb-ft)

- 4. Opening the oil filler cap and removing the oil pan drain plug, drain engine oil thoroughly.
- Reassemble the drain plug (A) with a new gasket. Do not reuse the gasket removed.

Tightening torque:

34.3 ~ 44.1N.m (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lb-ft)



SHMEM8057D

Engine Mechanical System

6. Fill new engine oil.

Capacity

Total: 7.8 L (8.24 US qt, 6.86 lmp qt)
Oil pan: 6.4 L (6.76 US qt, 5.62 lmp qt)

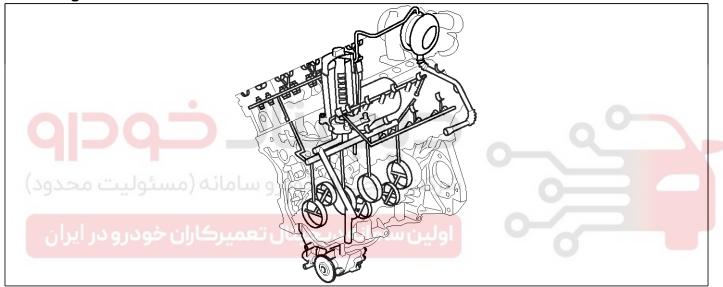
Drain and refill including oil filter: 7.4 L (7.81 US qt, 6.50

Imp qt)

ACAUTION

- 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.

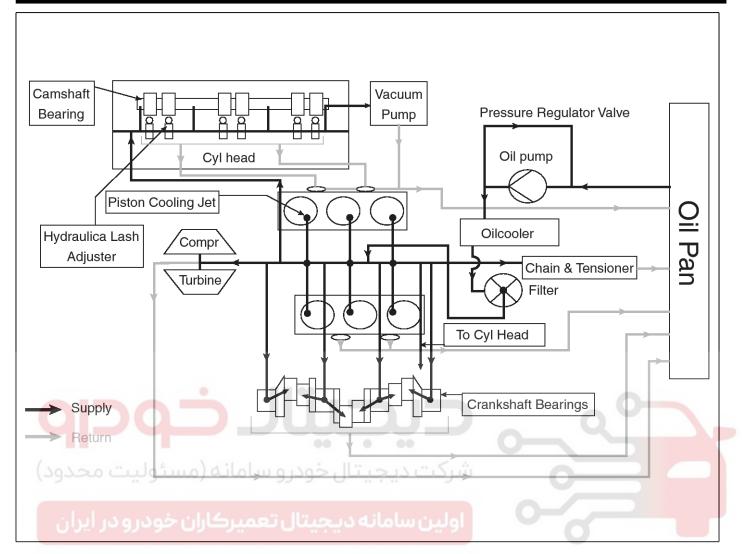
Flow Diagram



SENEM7093D

Lubrication System

EM-83



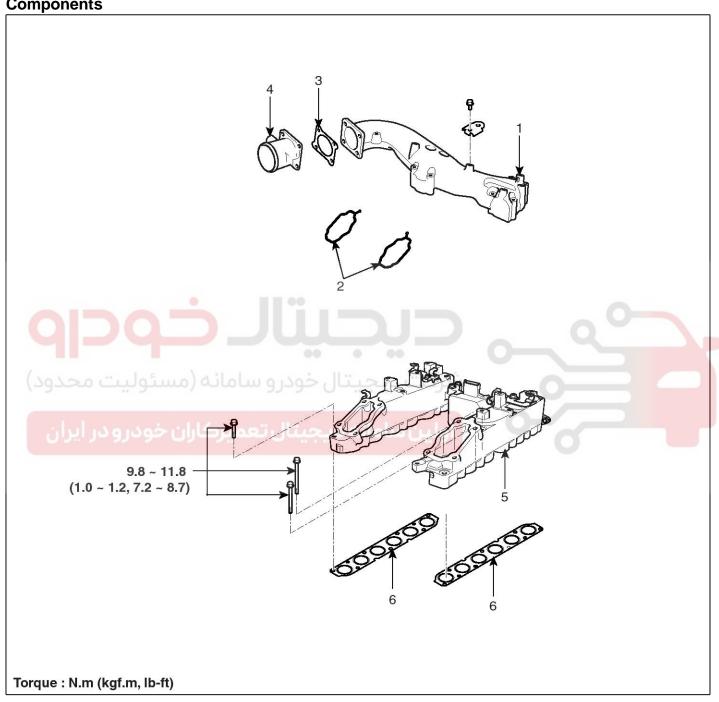
SENEM7001L

Engine Mechanical System

Intake And Exhaust System

Intake Manifold

Components



SHMEM9207L

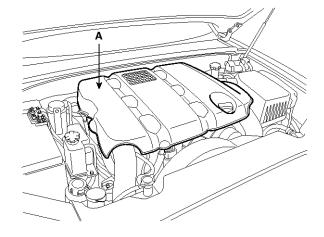
- 1. Inlet upper manifold assembly
- 2. Inlet manifold gasket
- 3. Throttle body gasket

- 4. Throttle body assembly
- 5. Inlet lower manifold & swirl control valve assembly
- 6. Inlet lower manifold gasket

EM-85

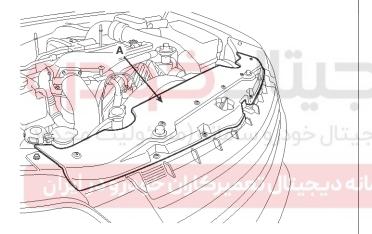
Replacement

1. Remove the engine cover (A).



SHMEM8001D

2. Remove the radiator grille upper guard (A).

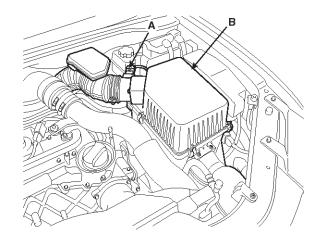


SHMEM8014D

3. Disconnect the AFS connector (A), and then remove the air cleaner assembly (B).

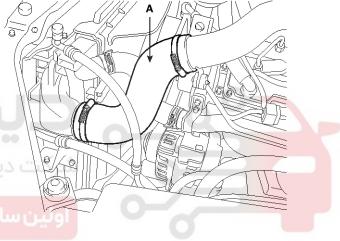
Tightening torque:

 $7.8 \sim 9.8 \text{N.m} \ (0.8 \sim 1.0 \text{kgf.m}, \, 5.8 \sim 7.2 \text{lb-ft})$



SHMEM8004D

4. Remove the intercooler inlet hose (A).

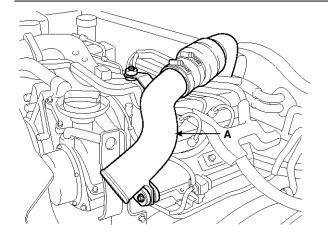


SHMEM8005D

5. Remove the intercooler inlet hose & pipe assembly (A).

Tightening torque:

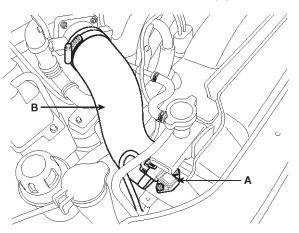
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SHMEM8006D

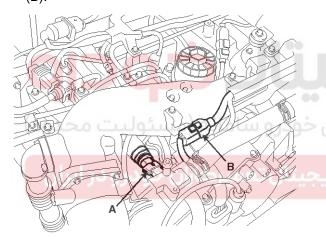
Engine Mechanical System

6. Disconnect the BPS connector (A), and then Remove the intercooler outlet water hose (B).



SHMEM8088D

7. Disconnect the RPS connector (A), glow connector (B).

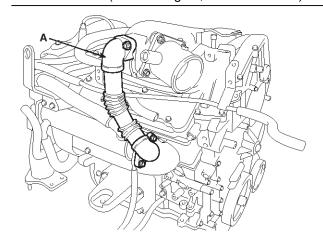


SHMEM8089D

8. Remove the EGR pipe (A).

Tightening torque:

 $19.6 \sim 26.5 \text{N.m} \ (2.0 \sim 2.7 \text{kgf.m}, \ 14.5 \sim 19.5 \text{lb-ft})$

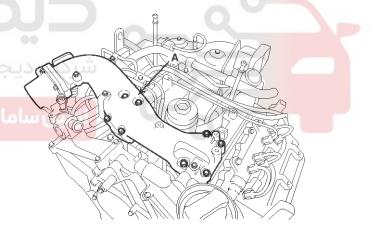


SHMEM8100D

9. Remove the inlet upper manifold (A).

Tightening torque:

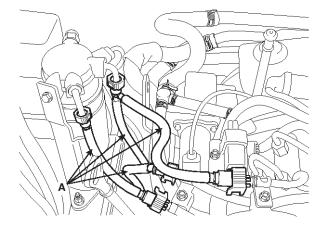
 $9.8 \sim 11.8 \text{N.m} \ (1.0 \sim 1.2 \text{kgf.m}, \ 7.2 \sim 8.7 \text{lb-ft})$



SHMEM8039D

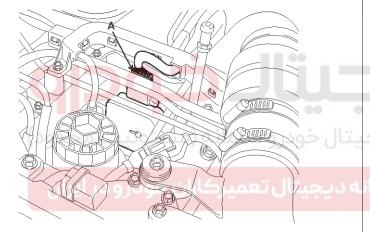
EM-87

10. Remove the fuel hoses (A).



SHMEM8096D

11. Remove the variable swirl control actuator connector (A).

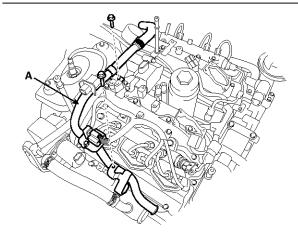


SHMEM8090D

- 12. Remove the fuel feed and return hose and pipe.
- 13. Remove the high pressure fuel pipe (rail to rail).
- 14. Remove the blow-by gas recirculation system such as the oil separator pipes and hoses.

Tightening torque:

 $7.8 \sim 11.8$ N.m ($0.8 \sim 1.2$ kgf.m, $5.8 \sim 8.7$ lb-ft)

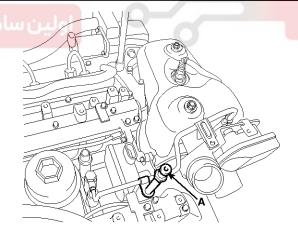


SHMEM8041D

15. Loosen the engine cover mounting bolt (A), and remove the turbocharger oil feed pipe from the lower inlet manifold.

Tightening torque:

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



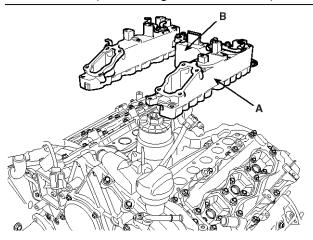
SHMEM8042D

Engine Mechanical System

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

Tightening torque:

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

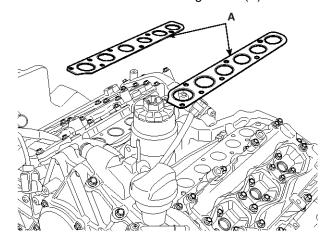


SHMEM8091D

⚠ 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.

17. Remove the inlet manifold gaskets (A).



SENEM7097D

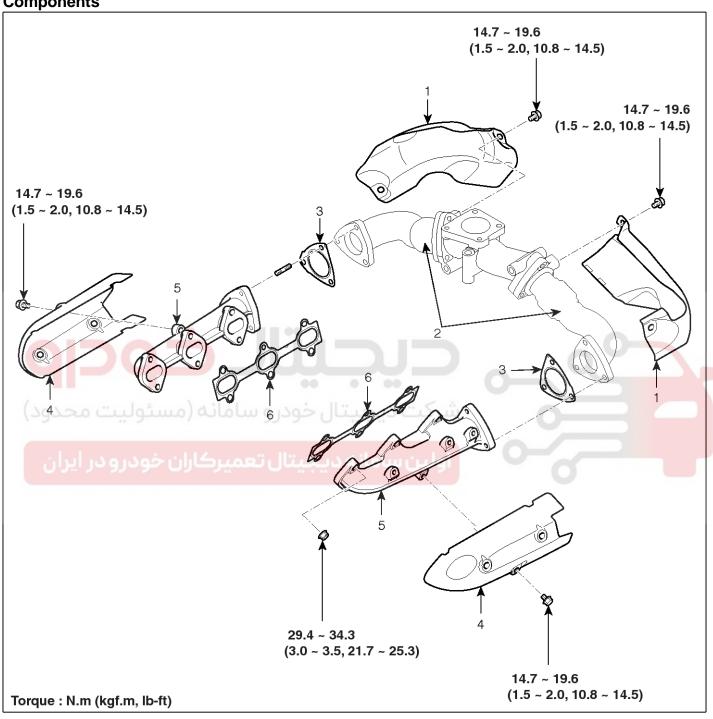
18. Installation is reverse order of removal with a new gasket.



EM-89

Exhaust Manifold

Components



SENEM9013L

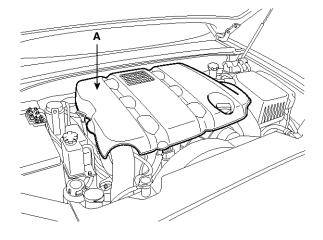
- 1. Exhaust pipe protector
- 2. Exhaust pipe
- 3. Exhaust pipe gasket

- 4. Exhaust manifold heat protector
- 5. Exhaust manifold
- 6. Exhaust manifold gasket

Engine Mechanical System

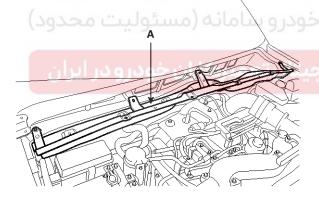
Replacement [RH]

- 1. Drain the engine coolant.
- 2. Remove the engine cover (A).



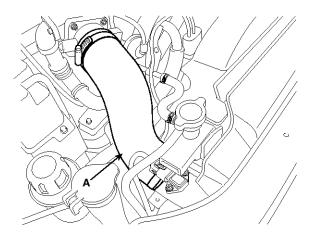
SHMEM8001D

- 3. Remove the cowl cover, windshield wiper and arm. (Refer to BE group)
- 4. Remove the cowl top cover (A).



SHMEM8002D

5. Remove the intercooler outlet hose (A).

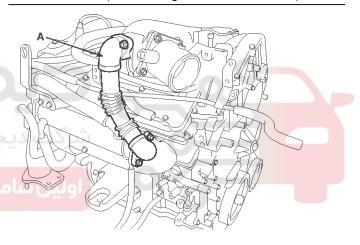


SHMEM8111D

6. Remove the EGR pipe (A).

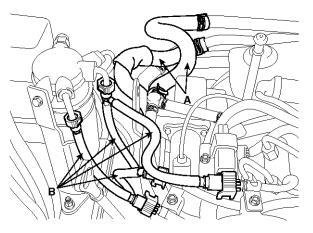
Tightening torque:

 $19.6 \sim 26.5 \text{N.m} \ (2.0 \sim 2.7 \text{kgf.m}, \ 14.5 \sim 19.5 \text{lb-ft})$



SHMEM8100D

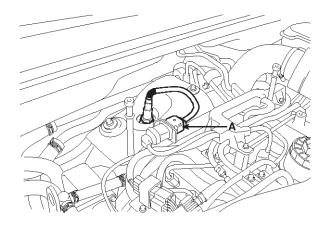
- 7. Remove the coolant reservoir tank.
- 8. Remove the heater hoses (A) and fuel hoses (B).



SHMEM8013D

EM-91

- 9. Remove the oil level gauge.
- 10. Disconnect the lambda sensor connector (A).

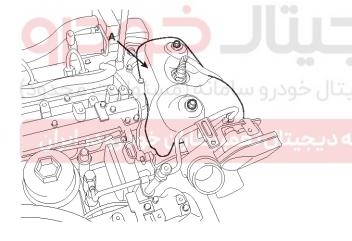


SHMEM8094D

11. Remove the turbocharger heat protector (A).

Tightening torque:

14.7 \sim 19.6N.m (1.5 \sim 2.0kgf.m, 10.8 \sim 14.5lb-ft)

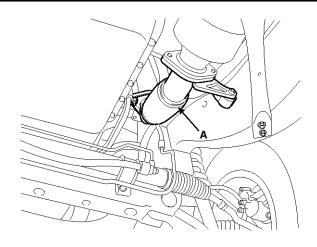


SHMEM8112D

12. Remove the front muffler (A).

Tightening torque:

 $39.2 \sim 58.8$ N.m (4.0 ~ 6.0 kgf.m, $28.9 \sim 43.4$ lb-ft)

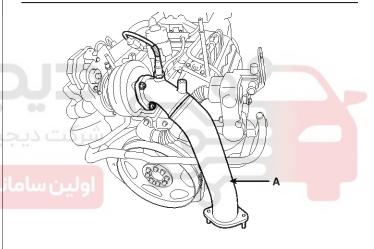


SHMEM8049D

13. Remove the exhaust fitting assembly (A).

Tightening torque:

 $29.4 \sim 34.3$ N.m ($3.0 \sim 3.5$ kgf.m, $21.7 \sim 25.3$ lb-ft)



SHMEM8050D

14. Remove the water pipe (A) and then remove the EGR pipe (B) and EGR cooler assembly (C).

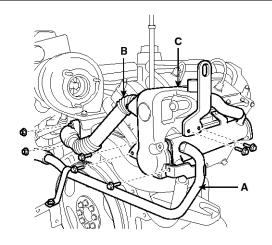
Tightening torque

A : 9.8 $^{\sim}$ 11.8N.m (1.0 $^{\sim}$ 1.2kgf.m, 7.2 $^{\sim}$ 8.7lb-ft)

B : 29.4 \sim 34.3N.m (3.0 \sim 3.5kgf.m, 21.7 \sim 25.3lb-ft)

C : 19.6 \sim 26.5N.m (2.0 \sim 2.7kgf.m, 14.5 \sim 19.5lb-ft)

Engine Mechanical System

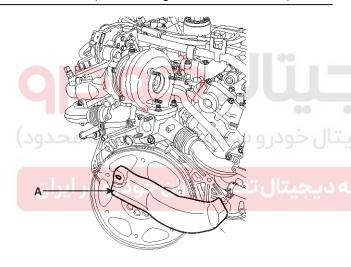


SHMEM8051D

15. Remove the RH exhaust pipe protector (A).

Tightening torque:

 $14.7 \sim 19.6$ N.m ($1.5 \sim 2.0$ kgf.m, $10.8 \sim 14.5$ lb-ft)

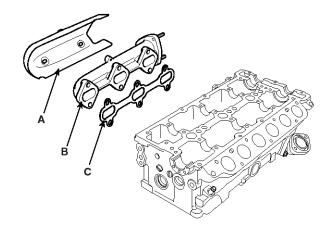


SHMEM8113D

16. Remove the heat protector (A), exhaust manifold (B) and gasket (C).

Tightening torque

A : 14.7 \sim 19.6N.m (1.5 \sim 2.0kgf.m, 10.8 \sim 14.5lb-ft) B : 29.4 \sim 34.3N.m (3.0 \sim 3.5kgf.m, 21.7 \sim 25.3lb-ft)

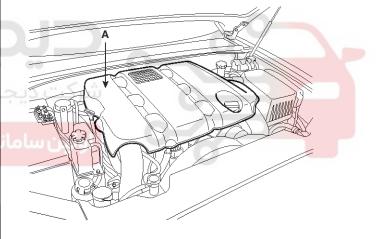


SHMEM8203D

17. Installation is reverse order of removal with a new gasket.

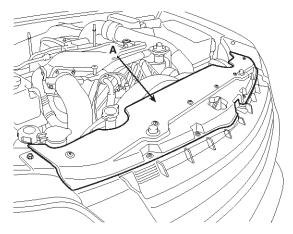
[LH]

- 1. Drain the engine coolant.
- 2. Remove the engine cover (A).



SHMEM8001D

3. Remove the radiator grille upper guard (A).



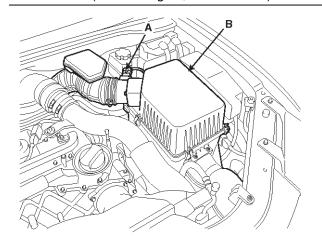
EM-93

SHMEM8014D

4. Disconnect the AFS connector (A), and then remove the air cleaner assembly (B).

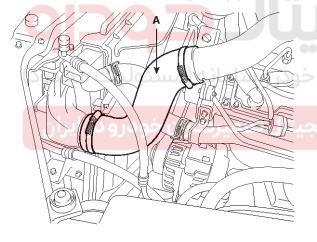
Tightening torque:

7.8 \sim 9.8N.m (0.8 \sim 1.0kgf.m, 5.8 \sim 7.2lb-ft)



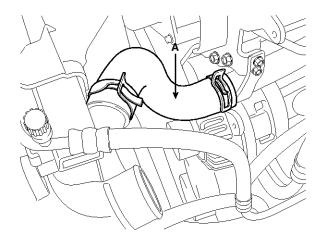
SHMEM8004D

5. Remove the intercooler inlet hose (A).



SHMEM8005D

6. Remove the radiator upper hose (A).

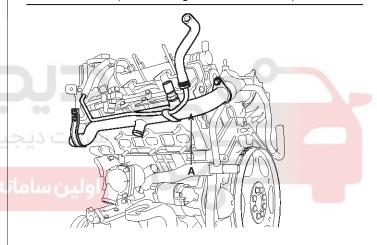


SHMEM8016D

7. Remove the water outlet pipe (A).

Tightening torque:

 $9.8 \sim 11.8 \text{N.m} (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$

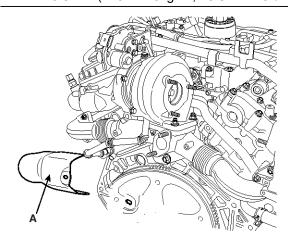


SHMEM8033D

8. Remove the LH exhaust pipe protector (A).

Tightening torque:

 $14.7 \sim 19.6$ N.m ($1.5 \sim 2.0$ kgf.m, $10.8 \sim 14.5$ lb-ft)



Engine Mechanical System

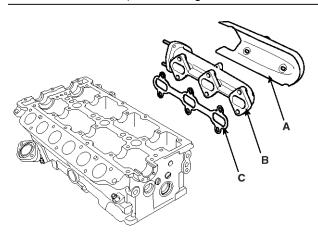
SHMEM8114D

9. Remove the heat protector (A), exhaust manifold (B) and gasket (C).

Tightening torque

A : 14.7 \sim 19.6N.m (1.5 \sim 2.0kgf.m, 10.8 \sim 14.5lb-ft)

B : 29.4 \sim 34.3N.m (3.0 \sim 3.5kgf.m, 21.7 \sim 25.3lb-ft)



SHMEM8115D

10.Installation is reverse order of removal with a new gasket.

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

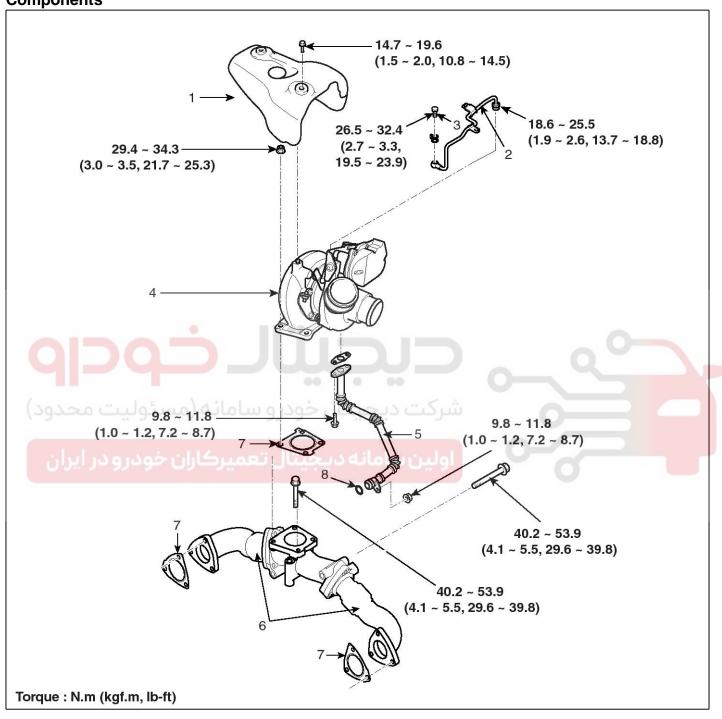
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



EM-95

Turbo Charger

Components



SHMEM9208L

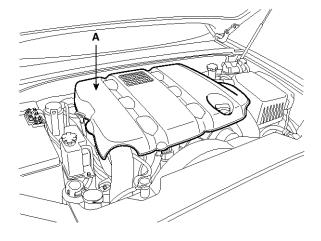
- 1. Turbocharger heat protector
- 2. Oil feed pipe
- 3. Oil feed pipe eye bolt
- 4. Turbocharger

- 5. Oil return pipe
- 6. Exhaust pipe
- 7. Gasket
- 8. O-ring

Engine Mechanical System

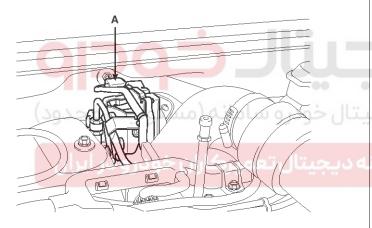
Replacement

- 1. Drain the engine coolant.
- 2. Remove the engine cover (A).



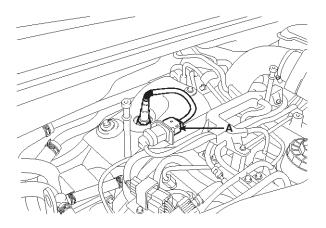
SHMEM8001D

3. Disconnect the VGT control actuator connector (A).



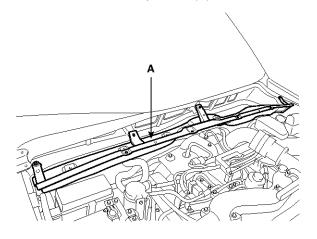
SHMEM8093D

4. Disconnect the lambda sensor connector (A).



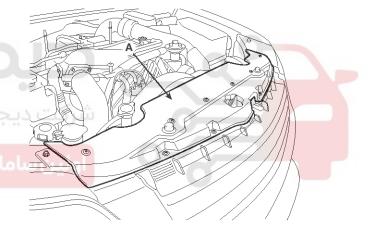
SHMEM8094D

- 5. Remove the cowl cover, windshield wiper and arm. (Refer to BE group)
- 6. Remove the cowl top cover (A).



SHMEM8002D

7. Remove the radiator grille upper guard (A).



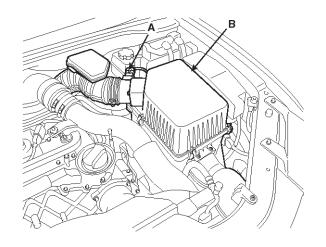
SHMEM8014D

8. Disconnect the AFS connector (A), and then remove the air cleaner assembly (B).

Tightening torque:

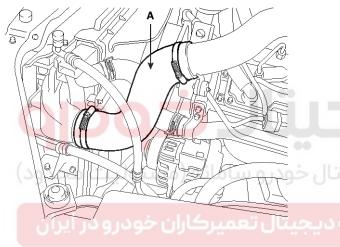
 $7.8 \sim 9.8 \text{N.m} \ (0.8 \sim 1.0 \text{kgf.m}, 5.8 \sim 7.2 \text{lb-ft})$

EM-97



SHMEM8004D

9. Remove the intercooler inlet hose (A).

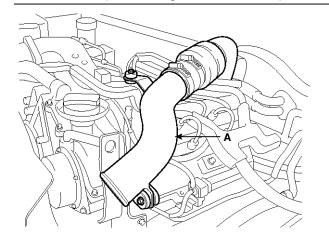


SHMEM8005D

10.Remove the intercooler inlet hose & pipe assembly (A).

Tightening torque:

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

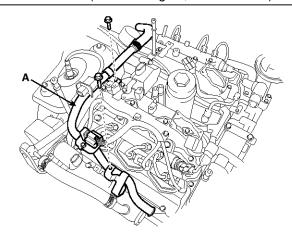


SHMEM8006D

11. Remove the blow-by gas recirculation system such as the oil separator pipes and hoses.

Tightening torque:

 $7.8 \sim 11.8$ N.m ($0.8 \sim 1.2$ kgf.m, $5.8 \sim 8.7$ lb-ft)



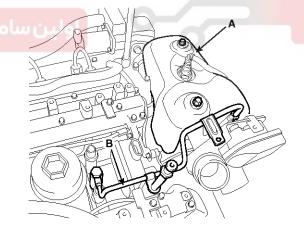
SHMEM8041D

12. Remove the turbocharger heat protector (A) and oil feed pipe (B).

Tightening torque

A : 14.7 \sim 19.6N.m (1.5 \sim 2.0kgf.m, 10.8 \sim 14.5lb-ft) B : 26.5 \sim 32.4N.m (2.7 \sim 3.3kgf.m, 19.5 \sim 23.9lb-ft) -bolt

 $18.6 \sim 25.5$ N.m ($1.9 \sim 2.6$ kgf.m, $13.7 \sim 18.8$ lb-ft) - nut



SHMEM8101D

13. Remove the heater hoses (A) and fuel hoses (B).

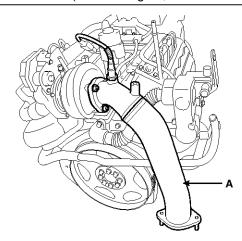
Engine Mechanical System

SHMEM8049D

16. Remove the exhaust fitting assembly (A).

Tightening torque:

 $29.4 \sim 34.3$ N.m ($3.0 \sim 3.5$ kgf.m, $21.7 \sim 25.3$ lb-ft)



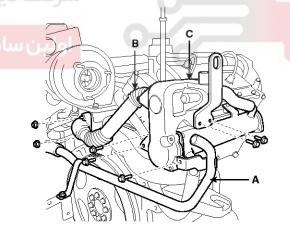
SHMEM8050D

17. Remove the water pipe (A) and then remove the EGR pipe (B) and EGR cooler assembly (C).

Tightening torque

A: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft) B: 29.4 ~ 34.3N.m (3.0 ~ 3.5kgf.m, 21.7 ~ 25.3lb-ft)

C: $19.6 \sim 26.5$ N.m $(2.0 \sim 2.7$ kgf.m, $14.5 \sim 19.5$ lb-ft)

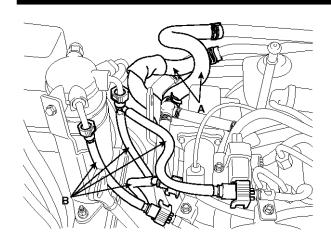


SHMEM8051D

18. Remove the exhaust pipe heat protectors (A).

Tightening torque:

 $14.7 \sim 19.6 \text{N.m} \text{ (} 1.5 \sim 2.0 \text{kgf.m, } 10.8 \sim 14.5 \text{lb-ft)}$

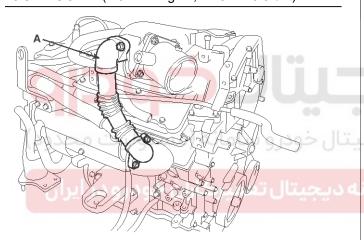


SHMEM8013D

14. Remove the EGR pipe (A).

Tightening torque:

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

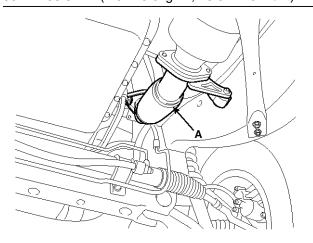


SHMEM8100D

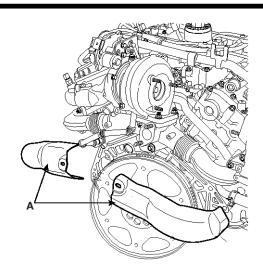
15. Remove the front muffler (A).

Tightening torque:

 $39.2 \sim 58.8$ N.m (4.0 ~ 6.0 kgf.m, $28.9 \sim 43.4$ lb-ft)



EM-99

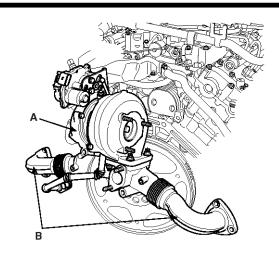


SHMEM8107D

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

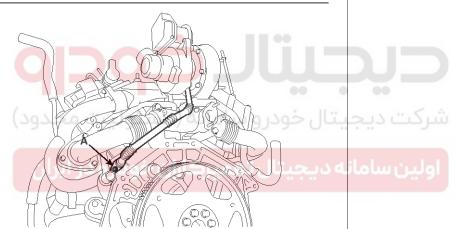
Tightening torque:

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



SHMEM8108D

21. Installation is reverse order of removal.





SHMEM8116D

MOTICE

Remove the pipe with the turbocharger.

20. Remove the turbocharger (A) & exhaust pipe (B) assembly.

Tightening torque

A : $40.2 \sim 53.9$ N.m ($4.1 \sim 5.5$ kgf.m, $29.6 \sim 39.8$ lb-ft)

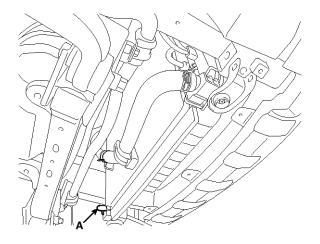
B: 29.4 \sim 34.3N.m (3.0 \sim 3.5kgf.m, 21.7 \sim 25.3lb-ft)

Engine Mechanical System

Intercooler

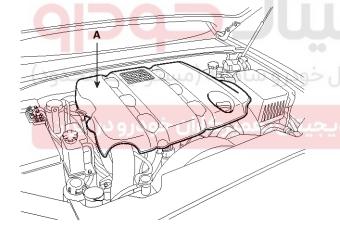
Replacement

1. Loosen the drain plug (A) and drain the engine coolant.



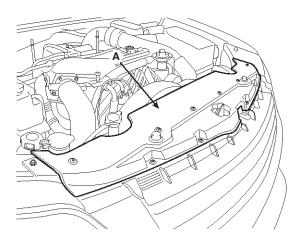
SHMEM8053D

2. Remove the engine cover (A).



SHMEM8001D

3. Remove the radiator grille upper guard (A).

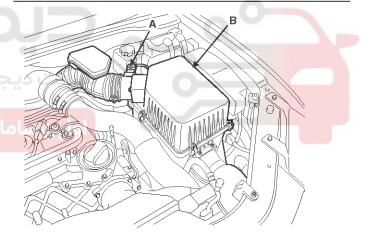


SHMEM8014D

4. Disconnect the AFS connector (A), and then remove the air cleaner assembly (B).

Tightening torque:

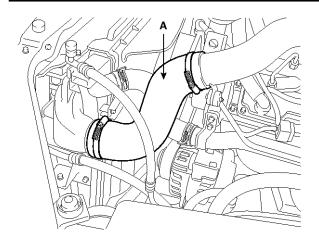
 $7.8 \sim 9.8$ N.m (0.8 ~ 1.0 kgf.m, $5.8 \sim 7.2$ lb-ft)



SHMEM8004D

5. Remove the intercooler inlet hose (A).

EM-101



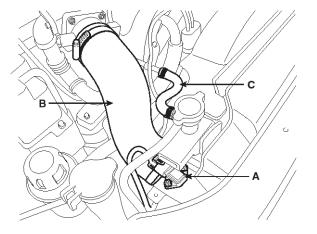
SHMEM8005D

6. Remove the radiatot upper hose (A).



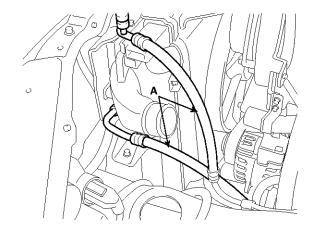
SHMEM8016D

7. Disconnect the BPS connector (A), and then Remove the intercooler outlet hose (B) and water hoss (C).



SHMEM8007D

8. Remove the suction hoses (A).

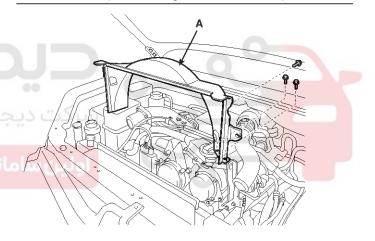


SHMEM8011D

9. Remove the radiator upper shroud (A).

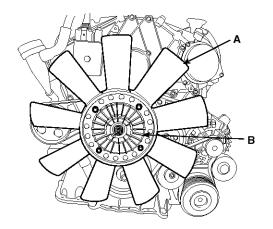
Tightening torque:

 $7.8 \sim 11.8 \text{N.m} \ (0.8 \sim 1.2 \text{kgf.m}, \, 5.8 \sim 8.7 \text{lb-ft})$



SHMEM8043L

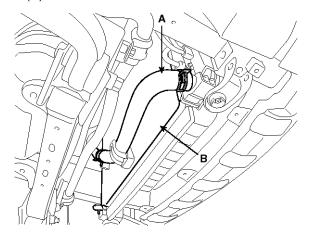
10. Remove the cooling fan (A) and pan clutch (B).



SHMEM8026D

Engine Mechanical System

11. Remove the radiator lower hose (A) and lower shroud (B).

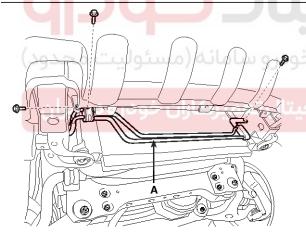


SHMEM8103D

- 12. Remove the ATF cooler hoses.
- 13. Remove the power steering oil cooler tube (A) from the cooling module.

Tightening torque:

 $8.8 \sim 10.8 \text{N.m} (0.9 \sim 1.1 \text{kgf.m}, 6.5 \sim 8.0 \text{lb-ft})$

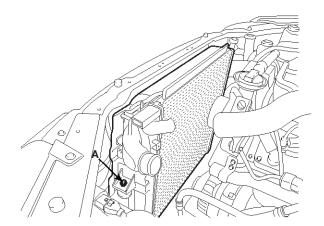


SHMEM8044D

14. Remove the radiator mounting bracket nut (A).

Tightening torque:

 $9.8 \sim 14.7 \text{ N.m}$ ($1.0 \sim 1.5 \text{ kgf.m}$, $7.2 \sim 10.8 \text{ lb-ft}$)

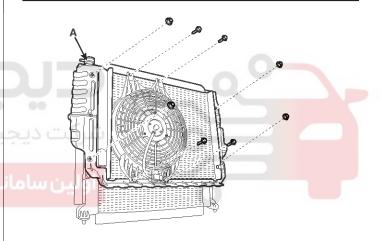


SHMEM8109D

15. Remove the air guard (A).

Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)



SHMEM8110D

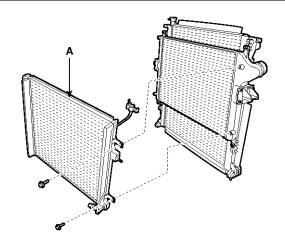
16. Loosen the condenser (A) and intercooler mounting bolts.

Tightening torque:

 $7.8 \sim 11.8$ N.m (0.8 ~ 1.2 kgf.m, $5.8 \sim 8.7$ lb-ft)

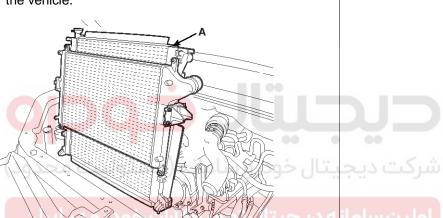
EM-103

SHMEM8048D



SHMEM8047D

17. Remove the intercooler & radiator assembly (A) from the vehicle.

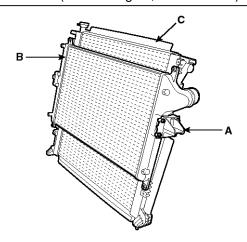


SHMEM8119D

18. Remove the radiator mounting bracket (A) and then separate the intercooler (B) and radiator assembly (C).

Tightening torque:

 $7.8 \sim 11.8 \text{N.m} \ (0.8 \sim 1.2 \text{kgf.m}, \, 5.8 \sim 8.7 \text{lb-ft})$



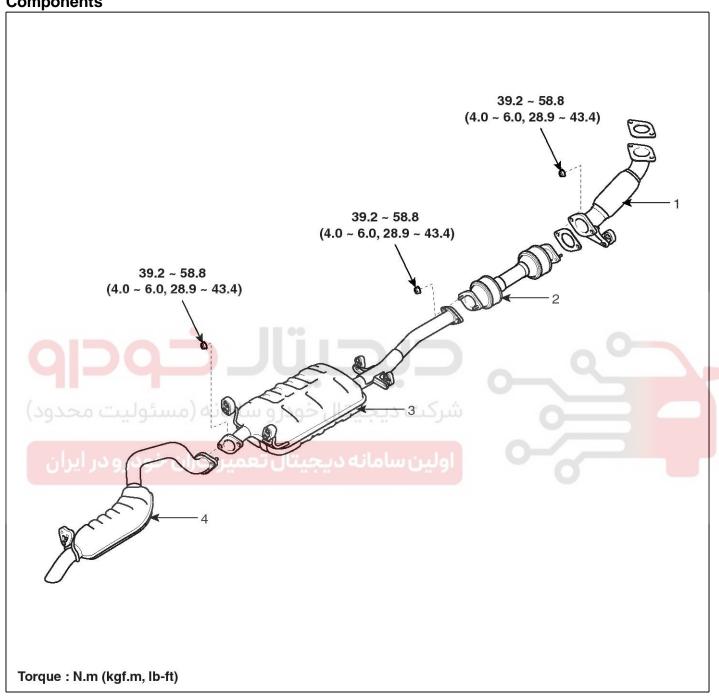
- 19. Inatallation is reverse order of removal.
- 20. Fill with engine coolant.
- 21. Start engine and check for leaks.



Engine Mechanical System

Muffler

Components



SHMEM9209L

- 1. Front muffler
- 2. Catalytic converter

- 3. Main muffler
- 4. Tail pipe

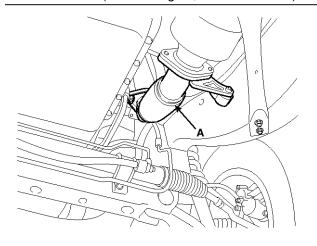
EM-105

Replacement

1. Remove the front muffler (A).

Tightening torque:

 $39.2 \sim 58.8$ N.m (4.0 ~ 6.0 kgf.m, $28.9 \sim 43.4$ lb-ft)

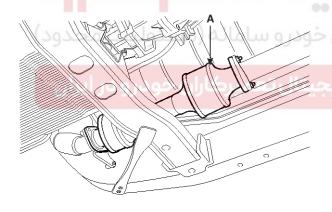


SHMEM8049D

2. Remove the catalytic converter (A).

Tightening torque:

 $39.2 \sim 58.8$ N.m (4.0 ~ 6.0 kgf.m, $28.9 \sim 43.4$ lb-ft)

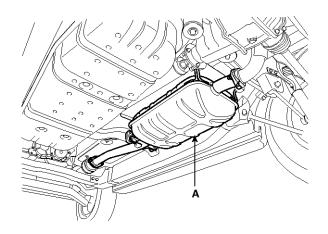


SHMEM8054D

3. Remove the main muffler (A).

Tightening torque :

39.2 \sim 58.8N.m (4.0 \sim 6.0kgf.m, 28.9 \sim 43.4lb-ft)

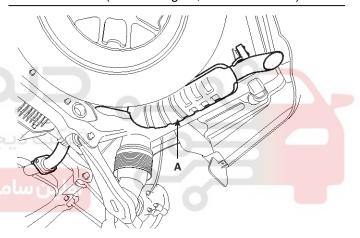


SHMEM8055D

4. Remove the tail pipe (A).

Tightening torque:

 $39.2 \sim 58.8 \text{N.m} \ (4.0 \sim 6.0 \text{kgf.m}, \ 28.9 \sim 43.4 \text{lb-ft})$



SHMEM8056D