

EMA-2

Engine Mechanical System

General Information

Specifications

Description		Specifications	Limit
General			
Type	V-type, DOHC		
Number of cylinder	6		
Bore	86.7mm(3.4134in.)		
Stroke	75mm(2.9528in.)		
Total displacement	2,656cc		
Compression ratio	10.4		
Firing order	1-2-3-4-5-6		
Valve timing			
Intake valve	Opens (ATDC)	4° ~ -56°	
	Closes (ABDC)	60° ~ 0°	
Exhaust valve	Opens (BBDC)	46°	
	Closes (ATDC)	10°	
Cylinder head			
Flatness of gasket surface		0.03mm(0.0012in.) or less	0.05mm(0.0020in.)
Flatness of manifold mounting	Intake	0.15mm(0.0059in.) or less	
	Exhaust	0.15mm(0.0059in.) or less	
Camshaft			
Cam height	LH Camshaft	Intake	44.5mm(1.7520in.)
		Exhaust	44.5mm(1.7520in.)
	RH Camshaft	Intake	44.5mm(1.7520in.)
		Exhaust	44.5mm(1.7520in.)
Journal outer diameter	LH Camshaft	Intake	27.964 ~ 27.980mm(1.1009 ~ 1.1016in.)
		Exhaust	27.964 ~ 27.980mm(1.1009 ~ 1.1016in.)
	RH Camshaft	Intake	27.964 ~ 27.980mm(1.1009 ~ 1.1016in.)
		Exhaust	27.964 ~ 27.980mm(1.1009 ~ 1.1016in.)
Bearing oil clearance	Intake	0.020 ~ 0.057mm(0.0008 ~ 0.0022in.)	
	Exhaust	0.020 ~ 0.057mm(0.0008 ~ 0.0022in.)	
End play		0.1 ~ 0.2mm(0.0039 ~ 0.0079in.)	
Valve			
Valve length	Intake	110.1mm(4.3346in.)	
	Exhaust	111.1mm(4.3740in.)	

General Information

EMA-3

Description		Specifications	Limit
Stem outer diameter	Intake	5.965 ~ 5.980mm(0.2348 ~ 0.2354in.)	
	Exhaust	5.950 ~ 5.965mm(0.2343 ~ 0.2348in.)	
Face angle		45° ~ 45.5°	
Thickness of valvehead(margin)	Intake	1.0mm(0.0394in.)	
	Exhaust	1.3mm(0.0512in.)	
Valve stem to valve guide clearance	Intake	0.020 ~ 0.050mm(0.0008 ~ 0.0020in.)	0.10mm(0.0039in.) or less
	Exhaust	0.035 ~ 0.065mm(0.0014 ~ 0.0026in.)	0.13mm(0.0051in.) or less
Valve guide			
Inner diameter	Intake	6.000 ~ 6.015mm(2.2362 ~ 2.2368in.)	
	Exhaust	6.000 ~ 6.015mm(2.2362 ~ 2.2368in.)	
Length	Intake	45.8 ~ 46.2mm(1.8031 ~ 1.8189in.)	
	Exhaust	46.8 ~ 47.2mm(1.8425 ~ 1.8583in.)	
Valve spring			
Free length		46.8mm(1.8425in.)	
Load	Height: 35mm	180.5 ~ 199.5N(18.4 ~ 20.3Kgf, 40.6 ~ 44.8lb)	
	Height: 26.5mm	342 ~ 378N(34.9 ~ 38.6Kgf, 76.9 ~ 85.1lb)	
Out of squareness		1.5° or less	
MLA(Mechanical Lash Adjuster)			
MLA outer diameter	Intake	29.964 ~ 29.980mm(1.1797 ~ 1.1803in.)	
	Exhaust	29.964 ~ 29.980mm(1.1797 ~ 1.1803in.)	
Cylinder head tappet bore inner diameter	Intake	30.000 ~ 30.025mm(1.1811 ~ 1.1821in.)	
	Exhaust	30.000 ~ 30.025mm(1.1811 ~ 1.1821in.)	
MLA to tappet bore clearance	Intake	0.020 ~ 0.061mm(0.0008 ~ 0.0024in.)	0.07mm(0.0027in.) or less
	Exhaust	0.020 ~ 0.061mm(0.0008 ~ 0.0024in.)	0.07mm(0.0027in.) or less
Valve clearance (Engine coolant temperature 20°C [68°F])			
Intake		0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust		0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0078 ~ 0.0157in.)
Cylinder block			
Cylinder bore		86.70 ~ 86.73mm (3.4134 ~ 3.4146in.)	

EMA-4

Engine Mechanical System

Description		Specifications	Limit
Flatness of gasket surface		Less than 0.05mm (0.0019in.) [Less than 0.02mm (0.0008in.) / 150x150]	
Piston			
Piston outer diameter		86.67 ~ 86.70mm(3.4122 ~ 3.4134in.)	
Piston to cylinder clearance		0.02 ~ 0.04mm(0.0008 ~ 0.0016in.)	
Ring groove width	No. 1 ring groove	1.23 ~ 1.25mm (0.0484 ~ 0.0492in.)	
	No. 2 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in.)	
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)	
Piston O.S.		0.25mm(0.0098in.), 0.50mm(0.0197in.)	
Piston ring			
Side clearance	No. 1 ring	0.04 ~ 0.08mm(0.0016 ~ 0.0031in.)	0.1mm(0.0039in.)
	No. 2 ring	0.03 ~ 0.07mm(0.0012 ~ 0.0027in.)	0.1mm(0.0039in.)
	Oil ring	0.06 ~ 0.15mm(0.0024 ~ 0.0059in.)	0.2mm(0.0079in.)
End gap	No. 1 ring	0.15 ~ 0.30mm(0.0059 ~ 0.0118in.)	0.6mm(0.0236in.)
	No. 2 ring	0.30 ~ 0.45mm(0.0118 ~ 0.0177in.)	0.7mm(0.0275in.)
	Oil ring	0.20 ~ 0.70mm(0.0078 ~ 0.0275in.)	0.8mm(0.0315in.)
Piston ring O.S.		0.25mm(0.0098in.), 0.50mm(0.0197in.)	
Piston pin			
Piston pin outer diameter		21.001 ~ 21.007mm(0.8268 ~ 0.8270in.)	
Piston pin hole inner diameter		21.014 ~ 21.023mm(0.8273 ~ 0.8277in.)	
Piston pin hole clearance		0.011 ~ 0.018mm(0.0004 ~ 0.0007in.)	3 Grade
Connecting rod small end inner diameter		20.974 ~ 20.985mm(0.8257 ~ 0.8262in.)	
Connecting rod small end hole interference		0.016 ~ 0.033mm(0.0006 ~ 0.0013in.)	
Connecting rod			
Connecting rod big end inner diameter		51.000 ~ 51.018mm(2.0079 ~ 2.0086in.)	
Connecting rod bearing oil clearance		0.018 ~ 0.036mm(0.0007 ~ 0.0014in.)	
Side clearance		0.1 ~ 0.25mm (0.0039 ~ 0.0098in.)	0.4mm(0.0157in.)
Crankshaft			
Main journal outer diameter		61.982 ~ 62.000mm(2.4402 ~ 2.4409in.)	
Pin journal outer diameter		47.982 ~ 48.000mm(1.8891 ~ 1.8898in.)	
Main bearing oil clearance		0.004 ~ 0.022mm(0.0002 ~ 0.0009in.)	
End play		0.07 ~ 0.25mm(0.0028 ~ 0.0098in.)	0.30mm(0.0118in.)
Oil pump			
Relief valve opening pressure		490.33 ~ 588.40kPa (5.0 ~ 6.0kgf/cm ² , 71.12 ~ 85.34 psi)	
Engine oil			

General Information

EMA-5

Description		Specifications	Limit
Oil quantity	Total	4.8 L (5.07 US qt, 4.22 Imp qt)	When replacing a short engine or a block assembly
	Oil pan	4.2 L (4.43 US qt, 3.69 Imp qt)	
	Drain and refill	4.5 L (4.75 US qt, 3.95 Imp qt)	Including oil filter
Oil grade	Recommendation (except Middle East)	5W-20/GF4&SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubrication System"
Oil pressure (at 1000rpm)		130kPa (1.32kg/cm ² , 18.77psi) or above	Oil temperature in oil pan : 110±2°C (230 ± 36°F)
Cooling system			
Cooling method		Forced circulation with electrical fan	
Coolant quantity		8.2~8.3L(8.66~8.77U.S.qts,7.22~7.30Imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82±2°C (179.6±35.6°F)	
	Fully opened temperature	95°C (203°F)	
	Full lift	10mm (0.3937in.) or more	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25 kg/cm ² , 13.51 ~ 17.78psi)	
	Vacuum valve opening pressure	0.98 ~ 4.90 kpa (0.01 ~ 0.05 kg/cm ² , 0.14 ~ 0.71 psi)	
Engine coolant temperature sensor			
Type		Thermister type	
Resistance	20°C (68°F)	2.31 ~ 2.59 kΩ	
	80°C(176°F)	0.3222 kΩ	

EMA-6

Engine Mechanical System

Tightening Torques

Item	Quantity	Nm	kgf.m	lb-ft
Oil seal case bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Main bearing cap bolt(M10)	8	(26.5~32.4) + (90~95°)	(2.7~3.3) + (90~95°)	(19.5~23.9) + (90~95°)
Main bearing cap bolt(M8)	8	(12.7~18.6) + (90~95°)	(1.3~1.9) + (90~95°)	(9.4~13.7) + (90~95°)
Rear plate bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump case bolt(8×25)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil pump case bolt(8×35)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing Oil pump case bolt(8×65)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing Oil relief plug	1	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Oil filter bracket bolt(8×35)	4	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil filter bracket bolt(8×65)	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil filter insert	1	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Timing belt cover bolt	21	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan bolt(8×22)	15	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Upper oil pan bolt(163.5mm)	1	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
Upper oil pan bolt(154.5mm)	1	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
Lower oil pan bolt	11	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Engine support bracket bolt(10×94)	2	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
Engine support bracket bolt(10×102.5)	1	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
Camshaft bearing cap bolt(6×38)	24	10.8 ~ 12.7	1.1 ~ 1.3	8.0 ~ 9.4
Camshaft bearing cap bolt(8×38)	12	20.6 ~ 25.5	2.1 ~ 2.6	15.2 ~ 18.8
Cylinder head bolt	16	(22.6~26.5) + (58~62°) + (43~47°)	(2.3~2.7) + (58~62°) + (43~47°)	(16.6~19.5) + (58~62°) + (43~47°)
Cylinder head cover bolt	22	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Crankshaft pulley bolt	1	166.7 ~ 176.5	17.0 ~ 18.0	123.0 ~ 130.2
Drive plate bolt	8	71.6 ~ 75.5	7.3 ~ 7.7	52.8 ~ 55.7
Connecting rod bearing cap bolt	12	(17.7~21.6) + (90~94°)	(1.8~2.2) + (90~94°)	(13.0~15.9) + (90~94°)
OCV(Oil Control Valve) bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
CVVT & exhaust cam sprocket bolt	4	66.7 ~ 78.5	6.8 ~ 8.0	49.2 ~ 57.9
Timing chain auto tensioner bolt	4	10.8 ~ 12.7	1.1 ~ 1.3	8.0 ~ 9.4
Camshaft sprocket bolt	2	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Timing belt idler bolt	1	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4

General Information

EMA-7

Item	Quantity	Nm	kgf.m	lb-ft
Timing belt tensioner bolt	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing belt tensioner arm bolt	1	34.3 ~ 53.9	3.5 ~ 5.5	25.3 ~ 39.8
Water pump bolt(8×20)	3	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Water pump bolt(8×25)	4	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Drive belt idler bolt	1	34.3 ~ 53.9	3.5 ~ 5.5	25.3 ~ 39.8
Drive belt tensioner bolt	1	34.3 ~ 53.9	3.5 ~ 5.5	25.3 ~ 39.8
Water pipe bolt	1	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Water temp. control assembly nut	4	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Oil level gauge bolt	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil screen bolt	2	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Water outlet fitting bolt	3	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Water inlet fitting bolt	2	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Water inlet fitting nut	1	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Surge tank bolt(8×28)	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Surge tank bolt(8×80)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Surge tank nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intake manifold bolt	4	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	4	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Surge tank bracket bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold bolt	14	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Heat protect bolt	6	16.7 ~ 21.6	1.7 ~ 2.2	12.3 ~ 15.9
Front muffler bolt	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

EMA-8

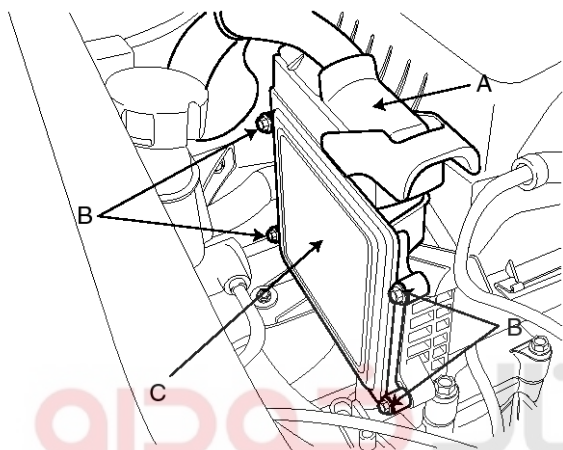
Engine Mechanical System

Compression Pressure Inspection

NOTICE

If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. Warm up the engine until the normal operating temperature becoming 80~95°C(176~203°F).
2. Remove the surge tank.
3. Remove the ignition coil connectors(A) and ignition coils(B).



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4. Using a 16mm plug wrench, remove the 6 spark plugs.

5. Check cylinder compression pressure.
 - 1) Insert a compression gauge into the spark plug hole.
 - 2) Open the throttle fully.
 - 3) With the fully-open throttle in cranking, measure the compression pressure.

NOTICE

Always use a fully charged battery to get the engine speed of 250 rpm or more.

Repeat steps 1) through 3) for each cylinder.

NOTICE

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

Compression pressure:

1,176.79kPa (12.0kgf/cm², 170.68psi) - 200 ~ 250rpm

Minimum pressure:

1,029.69kPa (10.5kgf/cm², 149.34psi)

Difference between cylinders:

98.07kPa (1.0kgf/cm², 14.22psi)

- 4) If the compression pressure in 1 or more cylinders is lower than the specification above, pour a small amount of engine oil into the cylinder through the spark plug hole, repeat the steps (1) through (3) for the cylinder and measure the pressure again.
 - If adding oil increases the pressure up, the piston rings or cylinder bores might be worn or damaged.
 - If the pressure doesn't increase, a valve may be sticking or seating may be improper, or there may be leakage from the gasket.
6. Reinstall the spark plugs.
7. Install the ignition coils and connect ignition coil connectors.
8. Install the surge tank.

General Information

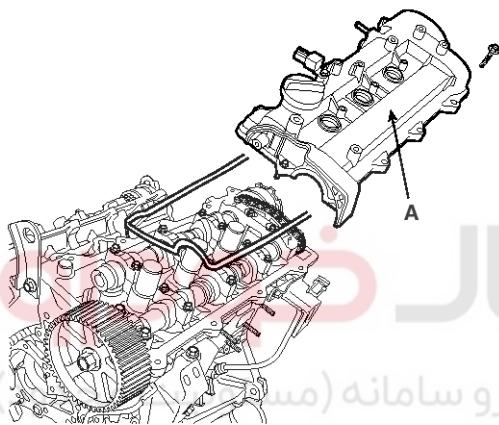
EMA-9

Valve Clearance Inspection And Adjustment

NOTICE

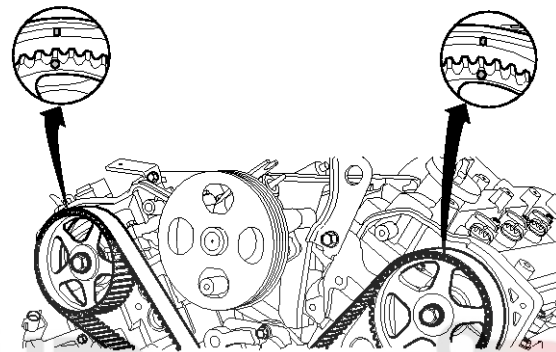
Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ (59~77°F)) and cylinder head is installed on the cylinder block.

1. Remove the engine cover.
2. Remove air cleaner assembly.
3. Remove the surge tank.
4. Remove the cylinder head cover.
 - 1) Disconnect the ignition coil connector and remove the ignition coil.
 - 2) Remove the cylinder head cover.



5. Set the piston of the No.1 cylinder to TDC(Top Dead Center) position.

- 1) Turn the crankshaft pulley clockwise and align its groove with the timing mark "T" of the timing chain cover.
- 2) Check that the timing marks of the camshaft sprocket are in straight line on that of the cylinder head cover surface as shown in the illustration. It makes the piston of the No.1 cylinder position at TDC.



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NOTICE

If not, turn the crankshaft one revolution clockwise.

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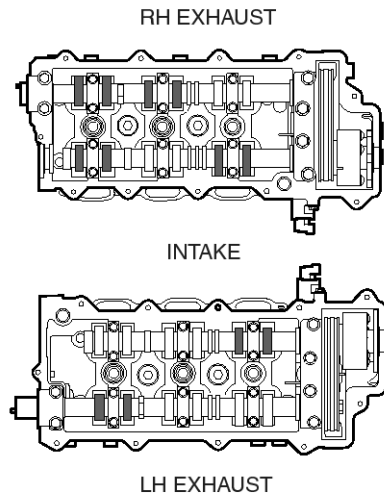
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EMA-10

Engine Mechanical System

6. Inspect the intake and the exhaust valve clearance.

- 1) With the piston of the No.1 cylinder positioning at TDC, the valves which can be measured its clearance are as shown below.



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Measurement method.

- Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.
- Record the out-of-specification valve clearance measurements. They will be used later to determine the required adjusting tappet for replacement.

Specification

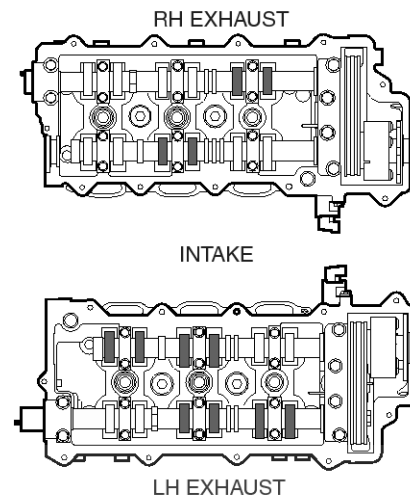
Limit (Engine coolant temperature : 20°C [68°F])

Intake : 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)

Exhaust : 0.20 ~ 0.40mm (0.0079 ~ 0.0157in.)

- 2) Turn the crankshaft pulley one revolution (360°) clockwise and align the groove with the timing mark "T" of the timing chain cover.

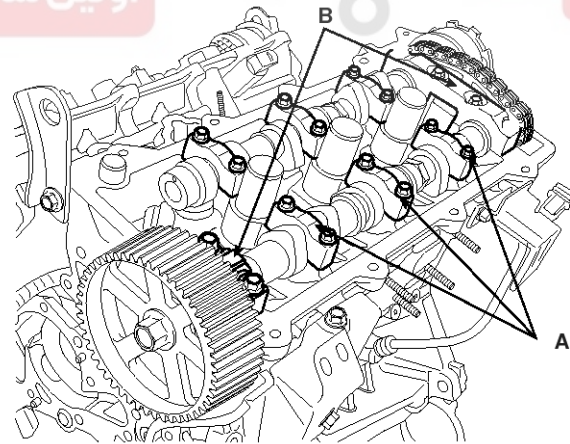
- 3) With the piston of the No.4 cylinder positioning at TDC, the valves which can be measured its clearance are as shown below.



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7. Adjust the intake and the exhaust valve clearances.

- 1) Set the piston of the No.1 cylinder to the TDC/position.
- 2) Remove the timing belt.
- 3) Remove the camshaft bearing caps(A, B).

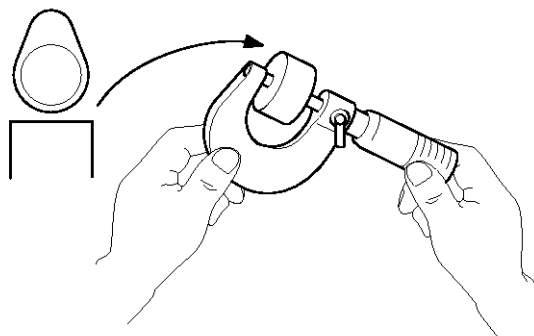


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General Information

EMA-11

- 4) Remove the camshaft assembly.
- 5) Remove MLA(Mechanical Lash Adjuster)s.
- 6) Measure the thickness of the removed tappet using a micrometer.



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- 7) Calculate the thickness of a new tappet so that the valve clearance comes within the specified value.

T : Thickness of removed tappet

A : Measured valve clearance

N : Thickness of new tappet

Intake : $N = T + [A - 0.20\text{mm}(0.0079\text{in.})]$

Exhaust : $N = T + [A - 0.25\text{mm}(0.0098\text{in.})]$

- 8) Select a new tappet with a thickness as close as possible to the calculated value.

NOTICE

Tappets are available with 41 different size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.600mm (0.1417in.)

- 9) Place a new tappet on the cylinder head.

NOTICE

Apply engine oil on the periphery surface of the selected tappet.

- 10) Install the intake and exhaust camshafts.
- 11) Install the bearing caps.
- 12) Install the timing belt.
- 13) Turn the crankshaft two revolutions in the operating direction(clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks(A).
- 14) Recheck the valve clearance.

Specification (Engine coolant temperature: 20°C[68°F])

Intake : 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)

Exhaust : 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)

EMA-12

Engine Mechanical System

Troubleshooting

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improper engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption.	<ul style="list-style-type: none"> Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. Coolant consumption may or may not cause the engine to overheat. 	<ul style="list-style-type: none"> Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul style="list-style-type: none"> Inspect the cylinder for a loss of compression. Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	<ul style="list-style-type: none"> Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	<ul style="list-style-type: none"> Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul style="list-style-type: none"> Inspect the camshaft lobes. Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.

General Information

EMA-13

Symptom	Suspect area	Remedy
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	<ul style="list-style-type: none"> Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	<ul style="list-style-type: none"> Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	<ul style="list-style-type: none"> Inspect the piston, piston pin and cylinder bore. Repair as required.
	Excessive piston pin-to-piston clearance.	<ul style="list-style-type: none"> Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. <ul style="list-style-type: none"> The connecting rod bearings. The connecting rods. The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. <ul style="list-style-type: none"> The crankshaft bearings. The crankshaft main journals. The cylinder block.
Incorrect piston, piston pin and connecting rod installation	<ul style="list-style-type: none"> Verify the piston pins and connecting rods are installed correctly. Repair as required. 	
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance .	Inspect the following components and repair as required : <ul style="list-style-type: none"> The connecting rod bearings. The connecting rods. The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. <ul style="list-style-type: none"> The crankshaft bearings. The crankshaft main journals. The cylinder block.

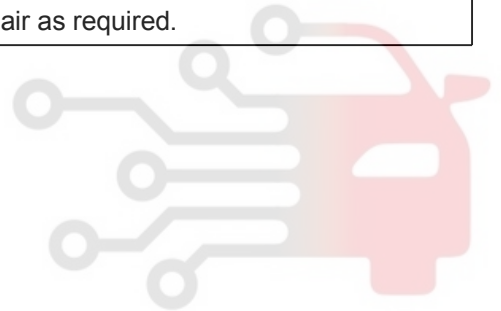
EMA-14

Engine Mechanical System

Symptom	Suspect area	Remedy
Engine will not crank- crankshaft will not rotate.	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	1. Inspect crankshaft. 2. Repair as required.

دیجیتال خودرو
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

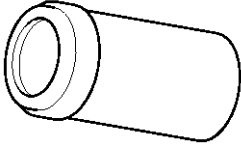

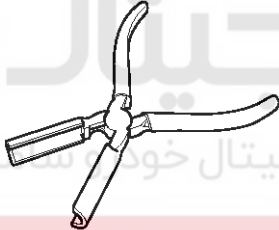
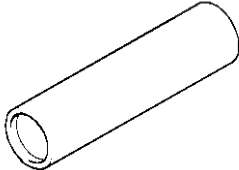
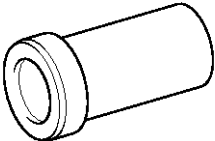
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



General Information

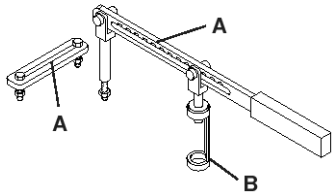
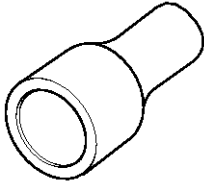

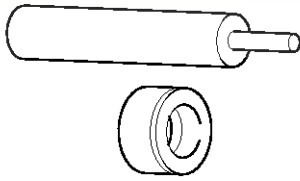
EMA-15

Special Service Tools

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 <p style="text-align: center;">EDKA010A</p>	Installation of the front oil seal
Torque angle adapter (09221-4A000)	 <p style="text-align: center;">LCAC030A</p>	Installation of bolts & nuts needing an angular method
Valve stem seal remover (09222-29000)	 <p style="text-align: center;">KDRF232A</p>	Removal of the valve stem seal
Valve stem seal installer (09222-22001)	 <p style="text-align: center;">LCAC030D</p>	Installation of the valve stem seal
Camshaft oil seal installer (09214-21000)	 <p style="text-align: center;">EDDA005B</p>	Installation of the camshaft oil seal

EMA-16

Engine Mechanical System

Tool (Number and name)	Illustration	Use
Valve spring compressor & holder (09222-3K000) (09222-3C300)	 <p style="text-align: center;">ECRF003A</p>	Removal and installation of the intake or exhaust valves. A : 09222-3K000 B : 09222-3C300 (holder)
Crankshaft rear oil seal installer (09231-33000)	 <p style="text-align: center;">LDLG032A</p>	Installation of the crankshaft rear oil seal
Oil pan remover (09215-3C000)	 <p style="text-align: center;">KDRF219A</p>	Removal of oil pan
Valve guide installer (09221-3F100 A/B)	 <p style="text-align: center;">ECKA010B</p>	Removal and installation of the valve guide

Engine And Transaxle Assembly

EMA-17

Engine And Transaxle Assembly

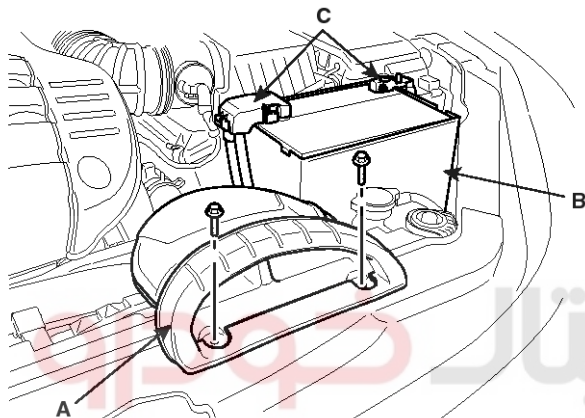
Removal

⚠ CAUTION

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

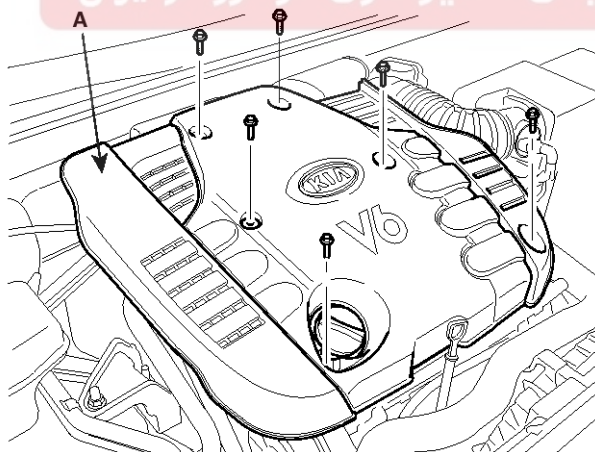
📌 NOTICE

- Mark all wiring and hoses to avoid misconnection.
1. Remove the air duct(A) and the battery(B) after disconnecting the terminals(C) from the battery.



LDLG001A

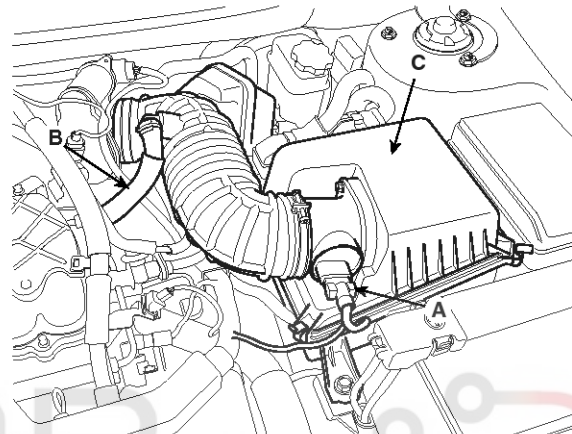
2. Remove the engine cover(A).



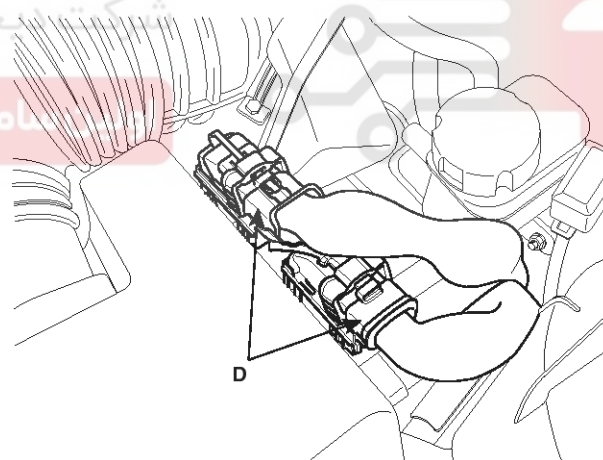
LDLG002A

3. Remove the intake air hose and air cleaner assembly.

- 1) Disconnect the MAF connector(A).
- 2) Disconnect the breather hose(B) from air cleaner hose.
- 3) Remove the intake air hose and air cleaner assembly(C).
- 4) Disconnect the PCM connectors(D).



SMGM29008N

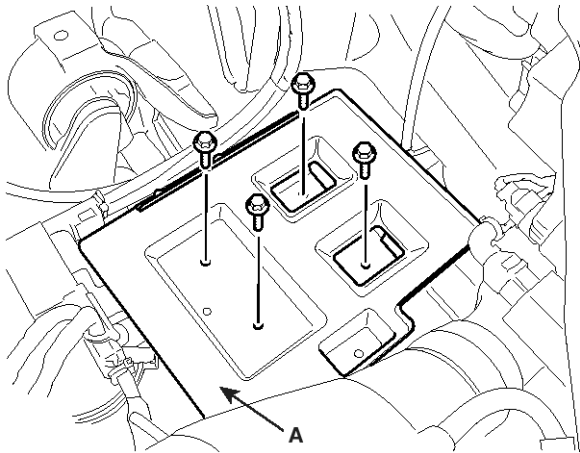


LDLG061A

EMA-18

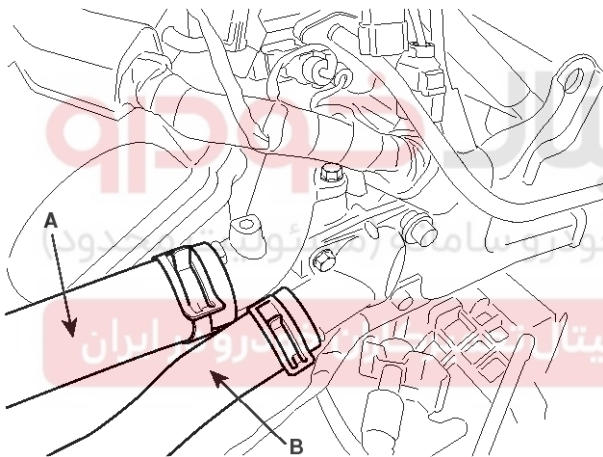
Engine Mechanical System

4. Remove the battery tray(A) while recovering refrigerant.



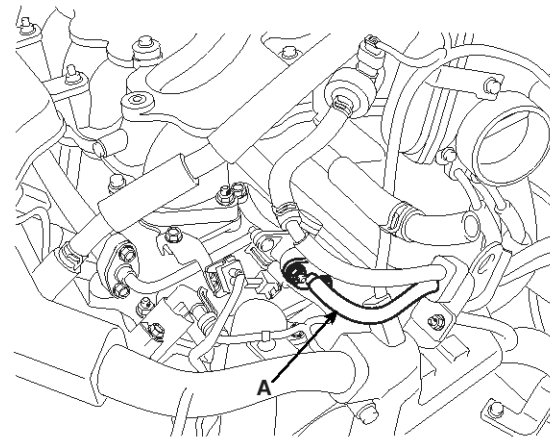
LDLG004A

5. Remove the upper radiator hose(A) and lower radiator hose(B).



LDLG008A

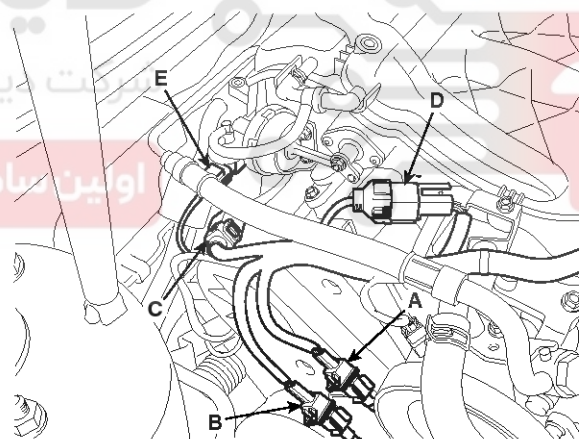
6. Remove the transaxle oil cooler hoses(A/T vehicles only).
7. Remove the fuel inlet hose(A) from the delivery pipe.



SMGM29006N

8. Disconnect the engine wiring harness connectors.

- 1) Disconnect the No.1/No.2 knock sensor connectors(A, B), the injector connector (C), the ignition coil harness(D) and the No.1 VIS(Variable Induction System) connector(E).

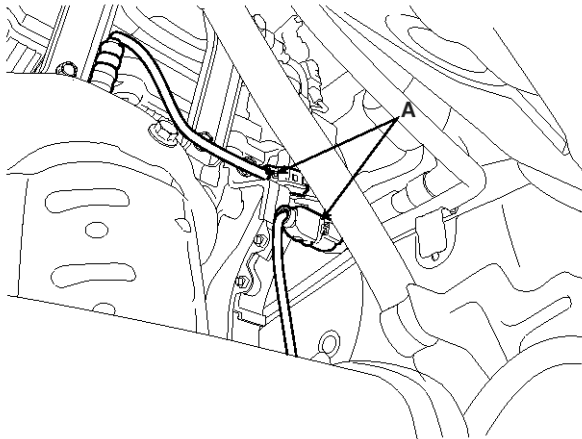


SMGM29007N

Engine And Transaxle Assembly

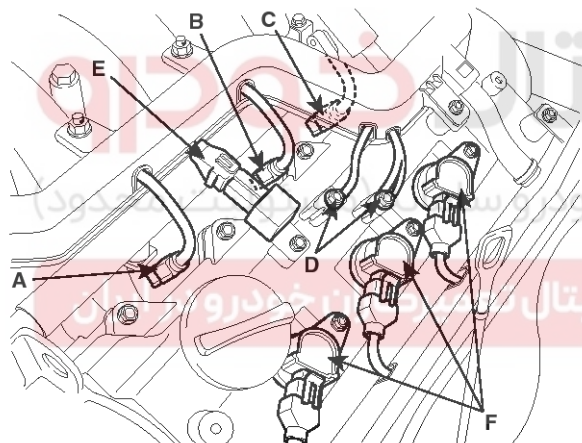
EMA-19

- 2) Disconnect the bank 1 front/rear O2 sensor connectors(A).



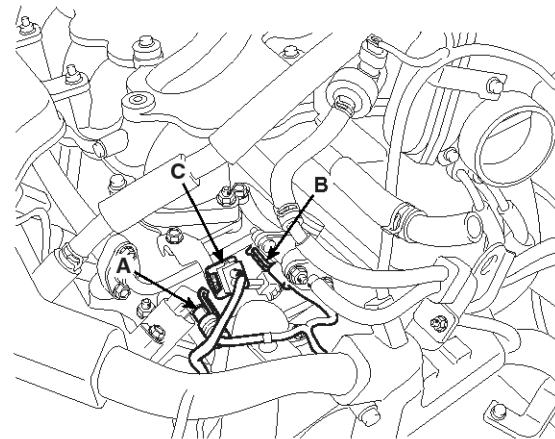
KCBF160A

- 3) Disconnect the injection connectors(A,B,C), the ground lines(D), the condenser connector(E) and the Ignition coil connectors(F).



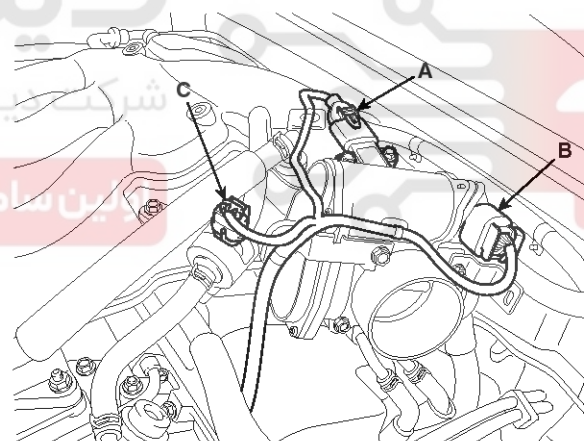
SMGM16014N

- 4) Disconnect the No.1/No.2 OCV(Oil Control Valve) connectors(A, B) and the OTS(Oil Temperature Sensor) connector(C).



SMGM29009N

- 5) Disconnect the MAPS(Manifold Absolute Pressure Sensor) connector(A), the ETC(Electronic Throttle Control) connector(B) and the PCSV(Purge Control Solenoid Valve) connector(C).

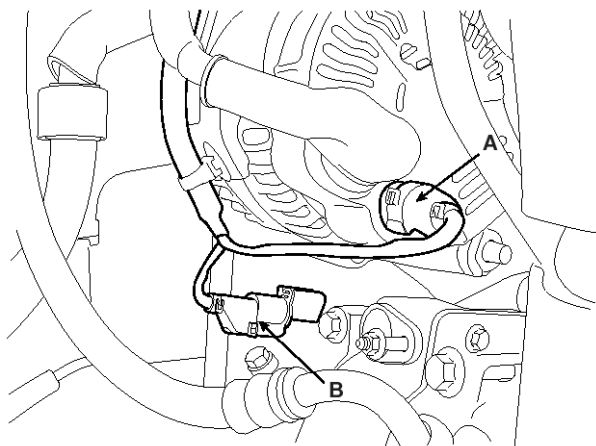


SMGM29010N

EMA-20

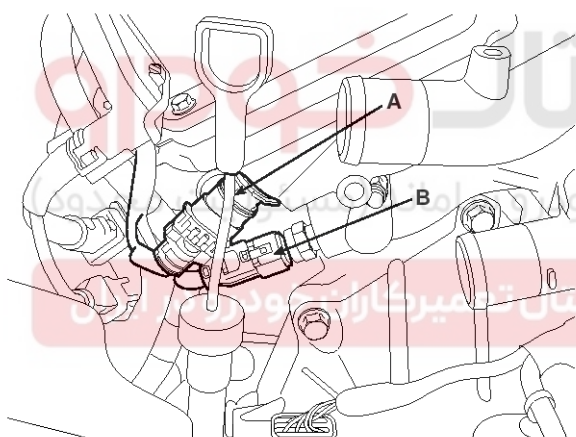
Engine Mechanical System

- 6) Disconnect the generator connector(A) and the air conditioning compressor connector(B).



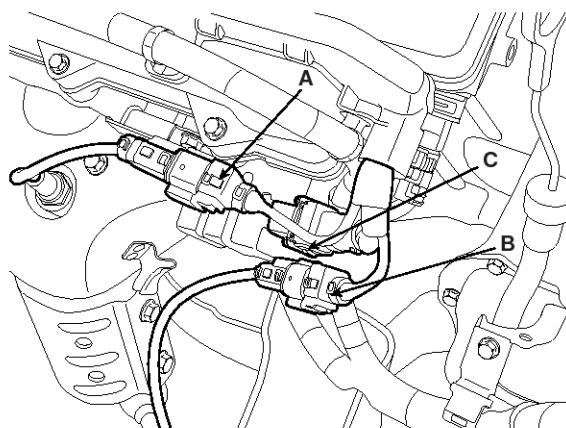
KCBF151A

- 7) Disconnect the bank 2 CMP sensor connector(A) and the WTS(Water Temperature Sensor) connector(B).



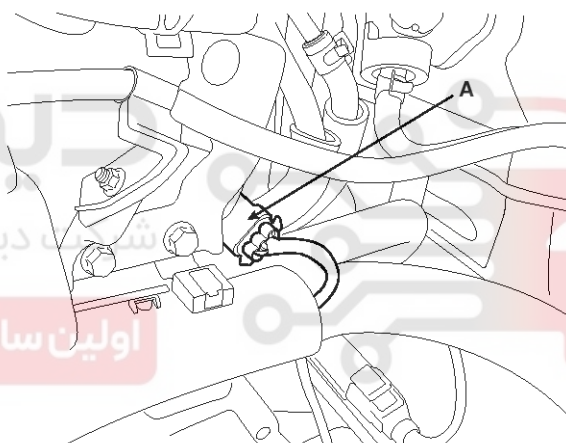
KCBF155A

- 8) Disconnect the bank 2 front/rear O2 sensor connectors(A,B) and the CKP sensor connector(C).



KCBF154A

- 9) Disconnect the bank 1 CMP sensor connector(A).

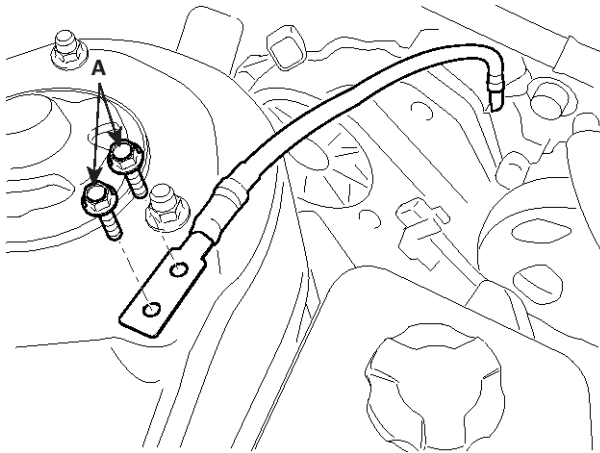


KCBF152A

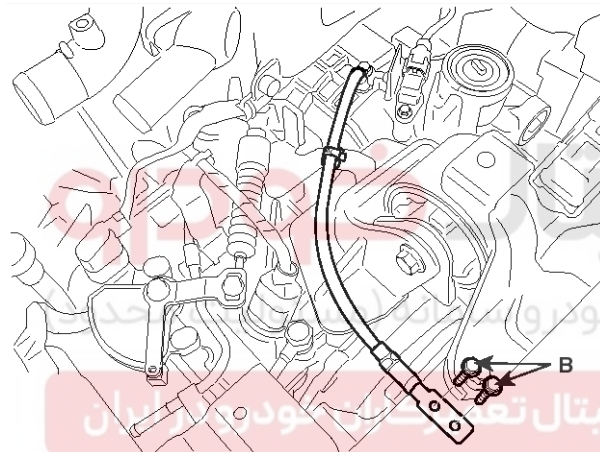
Engine And Transaxle Assembly

EMA-21

9. Disconnect ground lines(A,B) from the engine and the transaxle assembly.

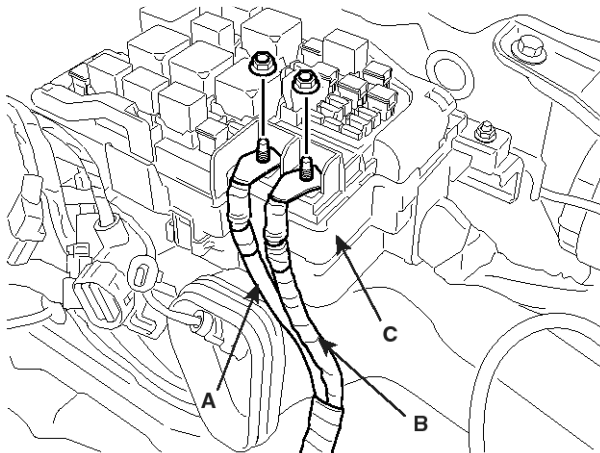


LDLG009A



LDLG010A

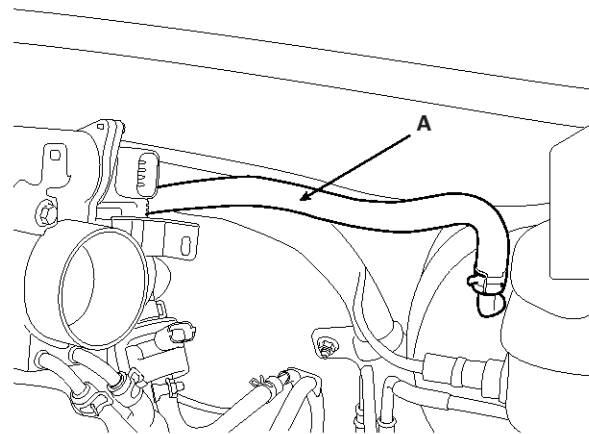
10. Disconnect the battery wirings(A,B) from the engine room fuse & relay box(C).



LDLG011A

11. Remove the heater hoses.

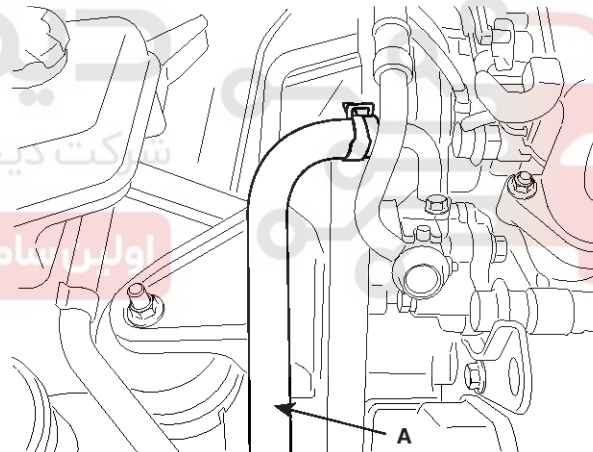
12. Disconnect the brake vacume hose(A).



LDLG036A

13. Disconnect the transaxle wiring harness connectors.(Refer to AT group).

14. After draining or gathering power steering fluid, disconnect the power steering hose(A).

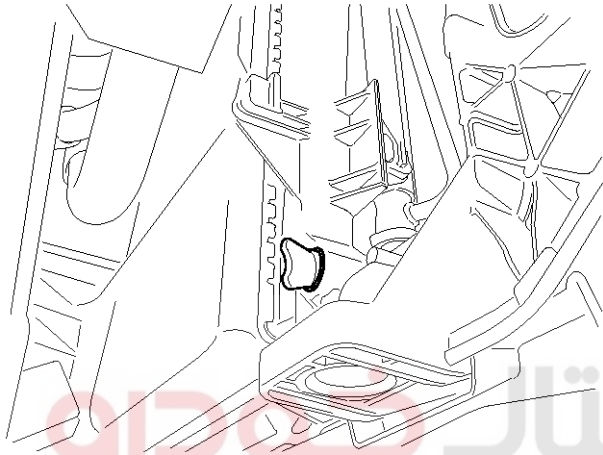


LDLG012A

EMA-22

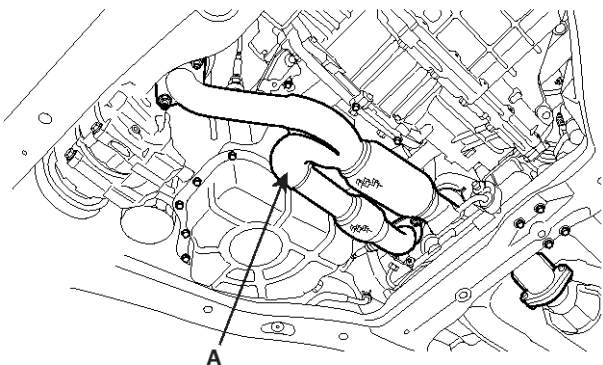
Engine Mechanical System

15. Remove the steering column shaft joint bolt. (Refer to ST group).
16. Disconnect the air conditioning compressor hoses. (Refer to HA group).
17. Remove the front wheels and tires. (Refer to DS group).
18. Lifting the vehicle, remove the under cover.
19. Drain the engine coolant, engine oil and transaxle fluid. Remove the radiator cap to speed coolant draining.



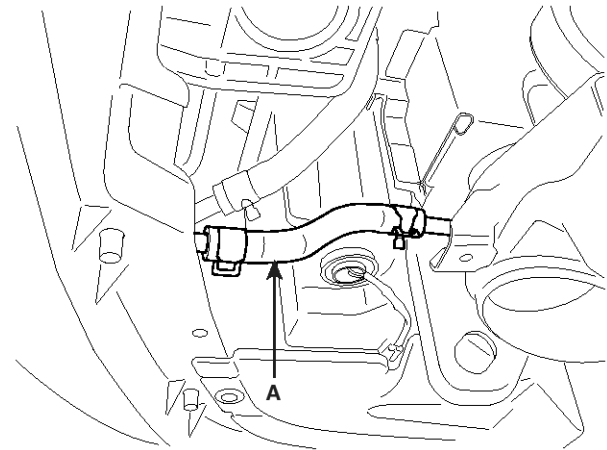
LDLG007A

20. Remove the brake caliper. (Refer to DS group).
21. Disconnect the ABS connectors. (Refer to BR group).
22. Disconnect the stabilizer bar link from the struts. (Refer to SS group).
23. Remove the knockles from the struts. (Refer to DS group).
24. Remove the front muffler(A).



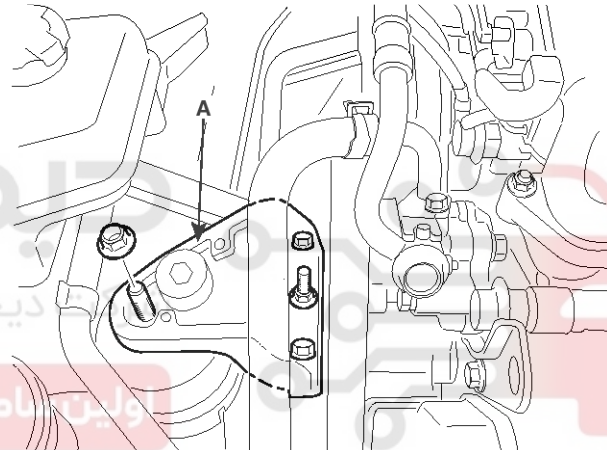
LDLG069A

25. Disconnect the power steering return hose(A).



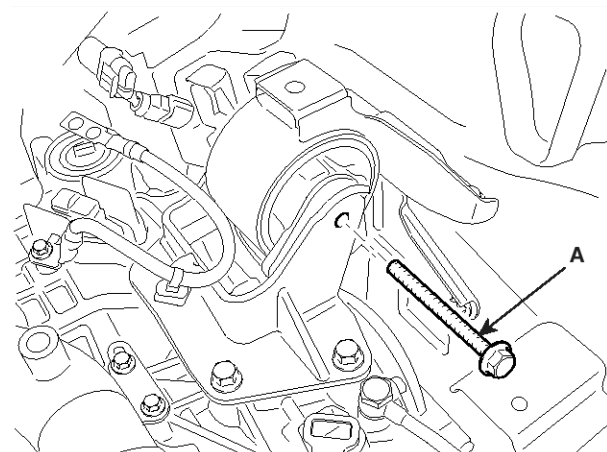
LDLG014A

26. Remove the engine mounting bracket(A).



LDLG064A

27. Remove the transaxle mounting bracket(A).



LDLG013A

Engine And Transaxle Assembly

EMA-23

28. Supporting the engine and transaxle assembly with a jack, remove the assembly from the vehicle by loosening the subframe mounting bolts and lifting up the vehicle slowly.

NOTICE

When removing 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 following :

- Adjust the shift cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- Clean the battery posts and cable terminals with "sandpaper" "assemble" them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.

After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

Repeat this operation two or three times, then check for fuel leakage at any point in the fuel lines.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

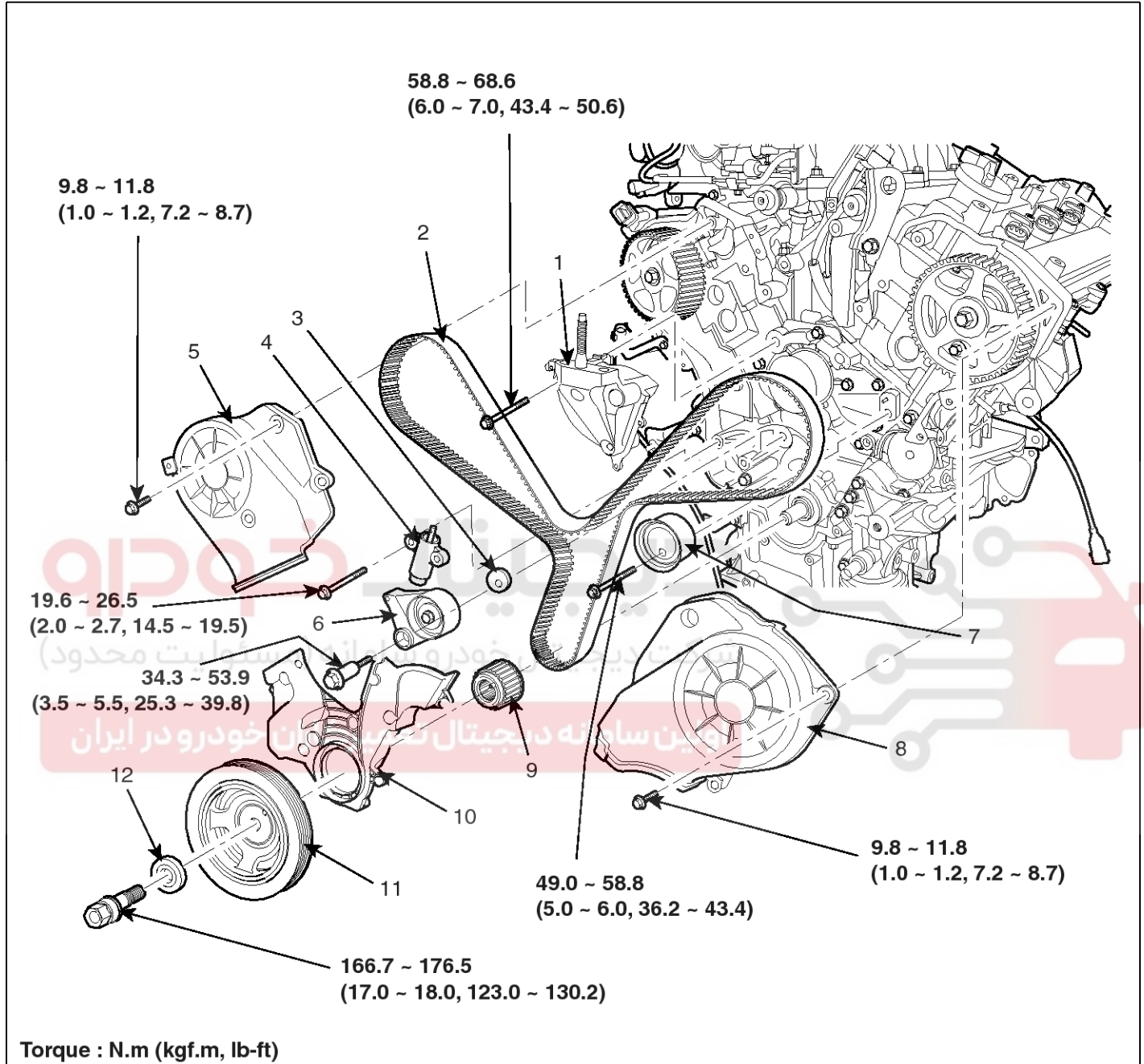


EMA-24

Engine Mechanical System

Timing System

Components



SMGM19010N

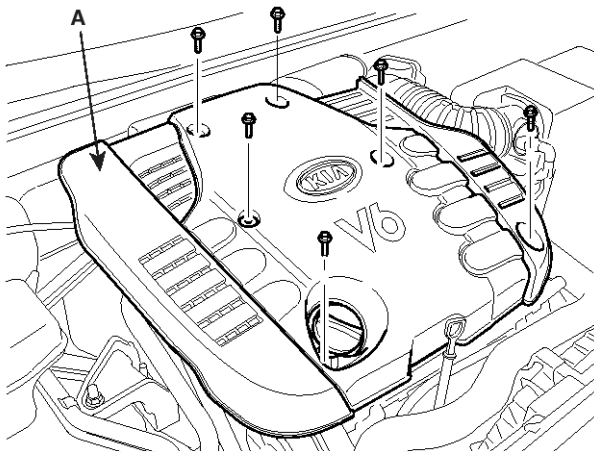
- | | | |
|----------------------------------|---------------------------------------|-----------------------------|
| 1. Engine support bracket | 5. Bank 1 timing belt upper cover | 9. Crankshaft sprocket |
| 2. Timing belt | 6. Timing belt tensioner arm assembly | 10. Timing belt lower cover |
| 3. Tensioner arm assembly washer | 7. Idler pulley | 11. Damper pulley |
| 4. Timing belt auto tensioner | 8. Bank 2 timing belt upper cover | 12. Special washer |

Timing System

EMA-25

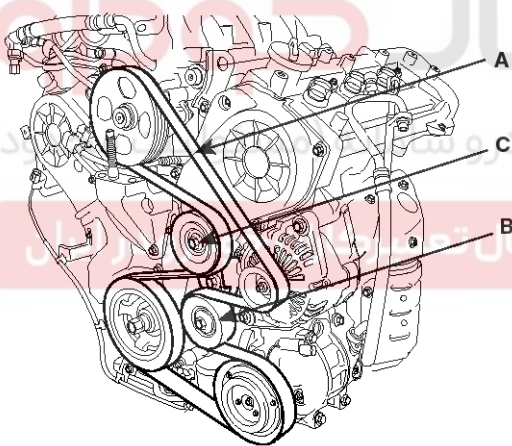
Removal

1. Remove the engine cover(A).



LDLG002A

2. Remove the front right wheel and tire.
3. Remove the right side cover.
4. Remove the drive belt(A), the idler(B) and the tensioner(C).

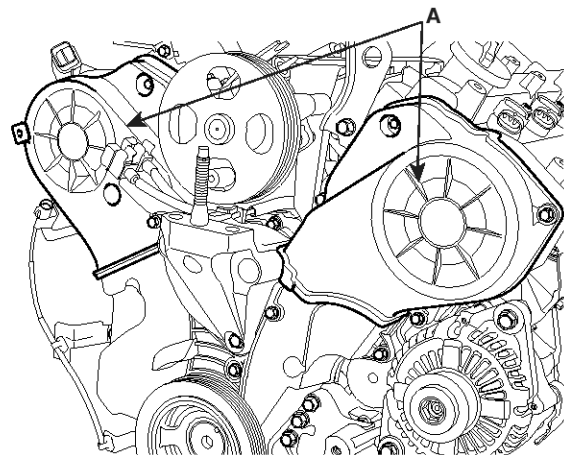


KCBF105B

NOTICE

In removing the drive belt, fix a tool in the auto tensioner pulley bolt and turn the bolt counter clockwise.

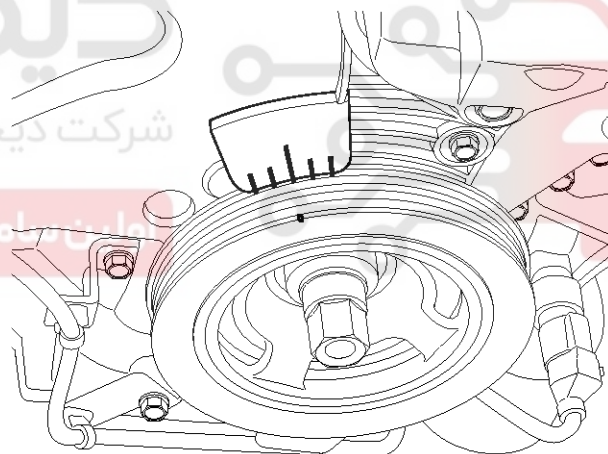
5. Remove the timing belt upper cover(A).



KCBF106A

6. Align the groove of the pulley with the timing mark of the timing belt cover by turning the crankshaft pulley clockwise. Check if the timing mark of the camshaft sprocket is aligned with that of the cylinder head cover.

(No.1 cylinder piston at TDC)



KCBF107A

EMA-26

Engine Mechanical System

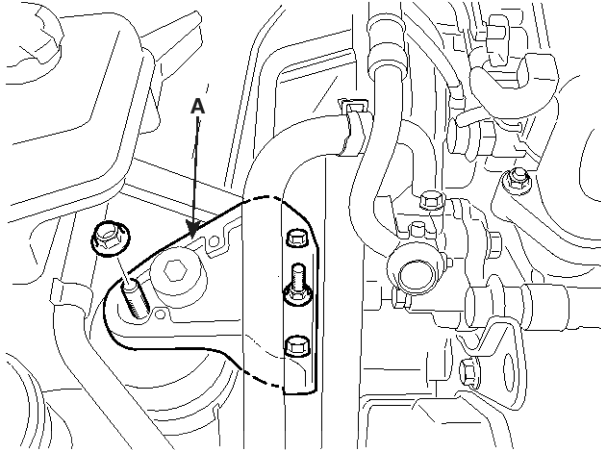
7. Remove the engine mounting bracket.

- 1) Sustain the engine oil pan with a jack.

CAUTION

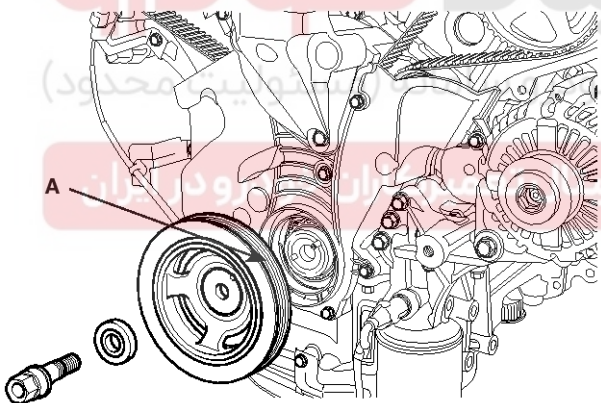
Put a wooden or rubber block between the jack and the engine oil pan.

- 2) Remove the engine mounting bracket(A).



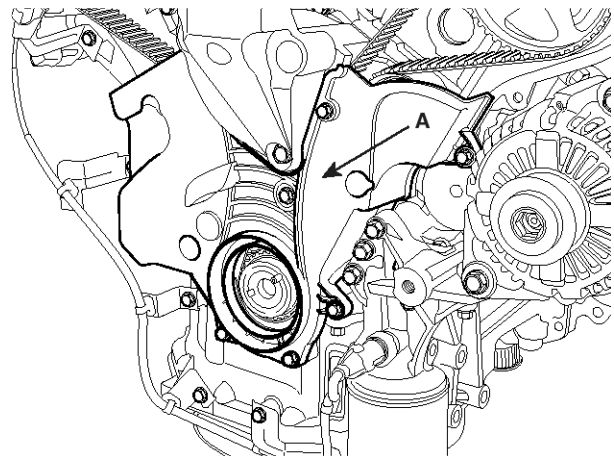
LDLG064A

8. Remove the crankshaft damper pulley(A).



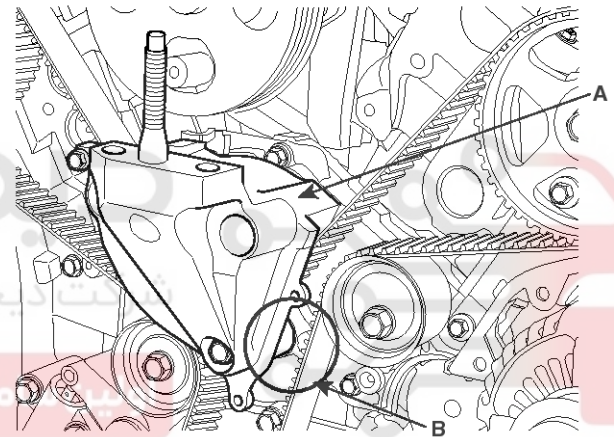
KCBF109A

9. Remove the timing belt lower cover(A).



KCBF110A

10. Remove the engine support bracket(A).



LDLG065A

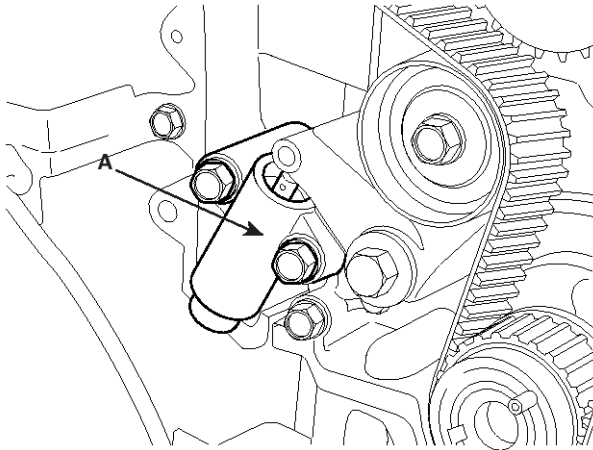
NOTICE

After removal, a small amount of engine coolant may drain from point (B).

Timing System

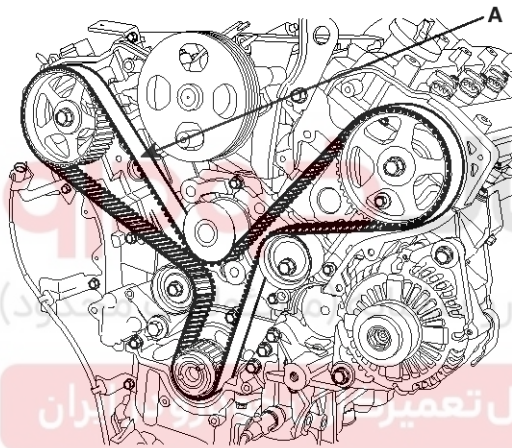
EMA-27

11. Remove the timing belt auto tensioner(A).



KCBF112A

12. Remove the timing belt(A).

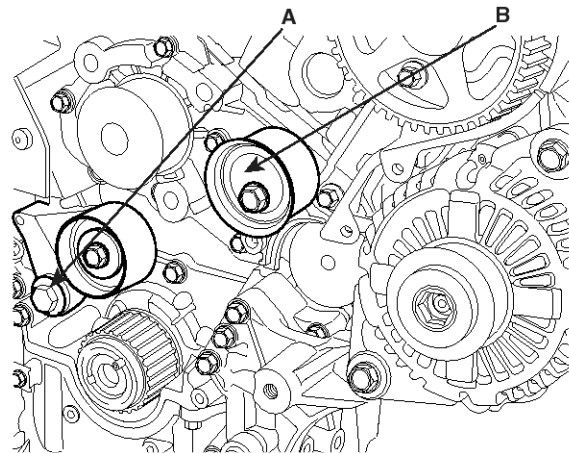


KCBF113A

NOTICE

Mark the direction of rotation on the timing belt.

13. Remove the tensioner arm assembly(A) and the idler(B).



KCBF114A

14. Remove the crankshaft sprocket.

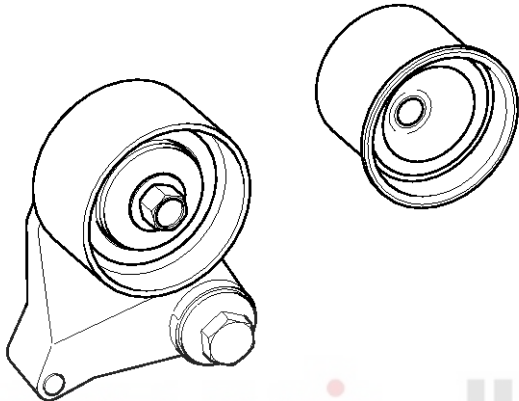
EMA-28

Engine Mechanical System

Inspection

Sprockets, Tensioner, Idler

1. Check the camshaft sprocket and crankshaft sprocket, tensioner pulley and idler pulley for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner and the idler for easy and smooth rotation and check for play or noise. Replace as necessary.



KCBF115A

3. Replace the tensioner and the idler if grease has leaked from the bearings.

Timing Belt

1. Check the belt for oil or dust deposits. Replace, if necessary.
Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt.

NOTICE

- Do not bend, twist or turn the timing belt inside out.
 - Do not allow the timing belt to come into contact with oil, water and steam.
3. Inspect the idler for easy and smooth rotation and check for play or noise.

Installation

1. Install the crankshaft sprocket.
2. Install the tensioner arm assembly(A) and the idler(B).

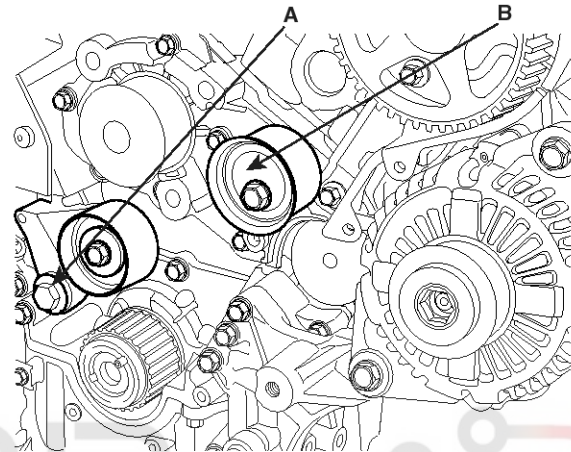
Tightening torque

Tensioner arm bolt :

34.3 ~ 53.9Nm(3.5 ~ 5.5kgf.m, 25.3~ 39.8lb-ft)

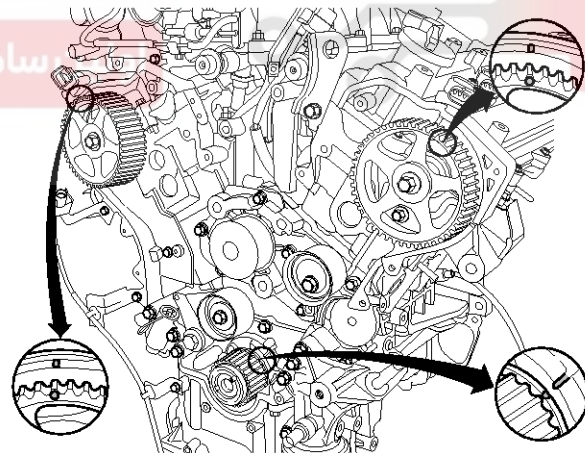
Idler pulley bolt :

49.0 ~ 58.8Nm(5.0 ~ 6.0kgf.m, 36.2~ 43.4lb-ft)



KCBF114A

3. Ensure the timing marks on the camshaft and the crankshaft sprockets.



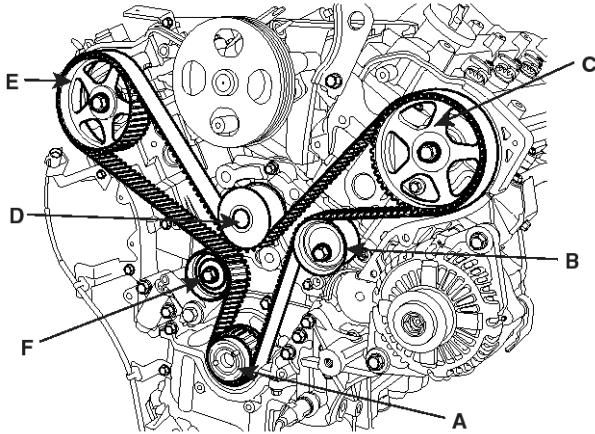
LDLG066A

Timing System

EMA-29

4. Install the timing belt.

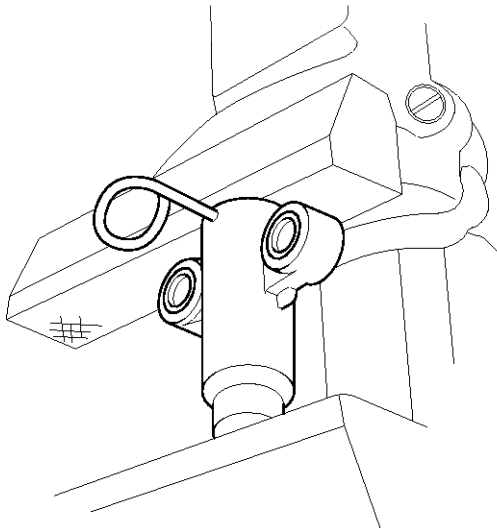
Crankshaft sprocket(A) → Idler(B) → Bank 2 exhaust camshaft sprocket(C) → Water pump pulley(D) → Bank 1 exhaust camshaft sprocket(E) → Tensioner pulley(F).



LDLG067A

5. Install the timing belt auto tensioner.

- 1) Make the tensioner stand for about five minutes before installing.
- 2) Press the rod with the weight, 150 ~ 200N.
- 3) If the rod is stiff, insert a set-pin with pressing the rod slowly. If not, press the rod 2 ~ 3 times from the maximum length to 2.9mm (the position in which the two holes of the rod and the body can be at one).
- 4) Check for stiffness. If there is, insert a set-pin and otherwise, replace the auto-tensioner.



SMGM16028N

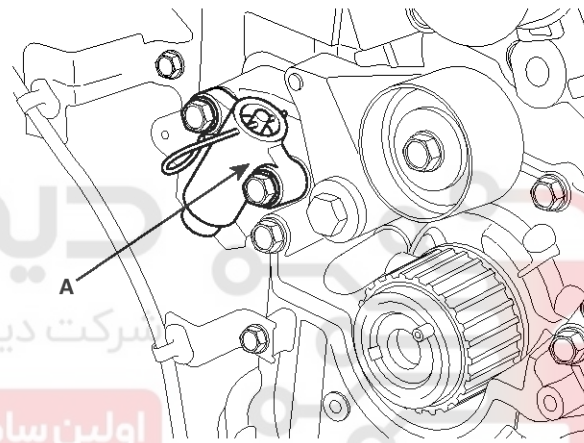
NOTICE

- Do not lay down the auto tensioner.
- Do not compress the rod suddenly. Compress the rod with the weight less than 4000N.
- When reinstalling the auto tensioner, ensure proper orientation.
- Do not press the rod any more when its projection from the body is 2.5mm.
- Keep the auto-tensioner stand at room temperature in winter.

- 5) Install the auto tensioner(A) to the front case with the set-pin inserted.

Tightening torque

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



KCBF117A

EMA-30

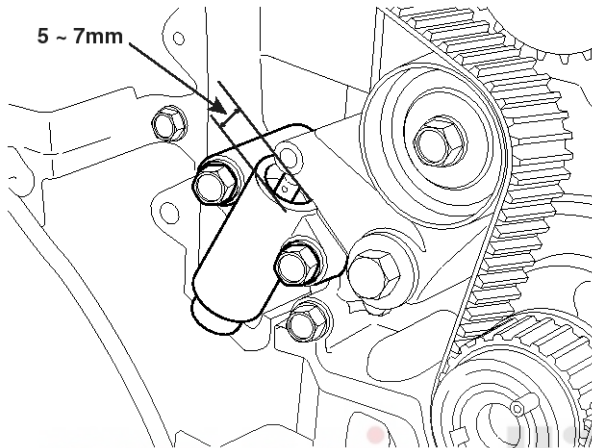
Engine Mechanical System

6. Remove the auto tensioner set-pin.
7. Check the tension of the timing belt.
 - 1) Turn the crankshaft 2 revolutions clockwise, and set the number one cylinder to TDC.

After 5minutes, measure the length of the projected rod.

Specification

5 ~ 7mm(0.1969 ~ 0.2756in.)

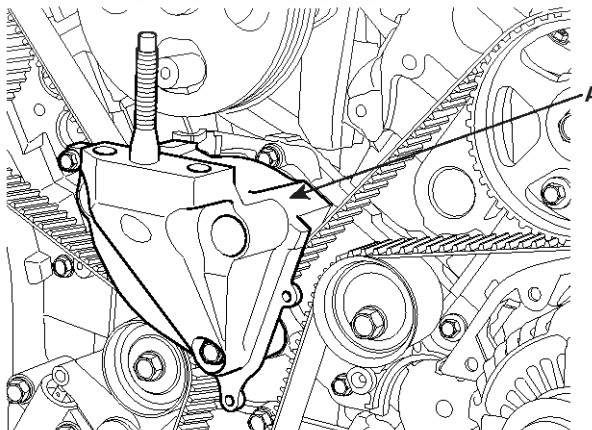


KCBF112B

- 2) Ensure the locations of the timing marks for each sprocket.
8. Install the engine support bracket(A).

Tightening torque

58.8 ~ 68.6Nm(6.0 ~ 7.0kgf.m, 43.4 ~ 50.6lb-ft)



LDLG068A

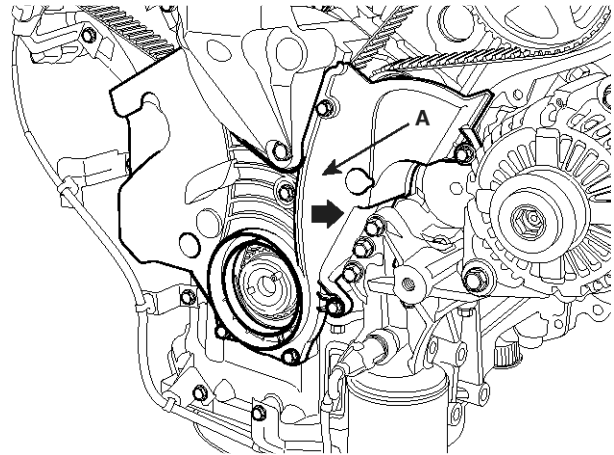
CAUTION

- Check for the length of the bolts.(Upper-2EA/Lower-1EA).
- Use a torque wrench by all means.

9. Install the timing belt lower cover.

Tightening torque

9.8 ~ 11.8Nm(1.0 ~ 1.2kgf.m, 7.8 ~ 8.7lb-ft)



SMGM16029N

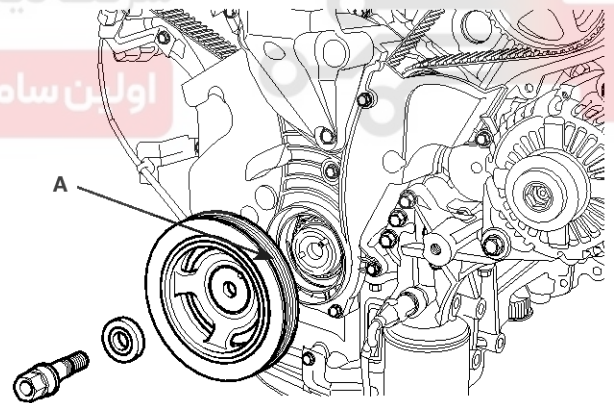
NOTICE

Align the holes of the bolts by pushing the left timing belt lower cover to left a little bit.

10. Install the crankshaft damper pulley(A).

Tightening torque

166.7 ~ 176.5Nm(17.0 ~ 18.0kgf.m, 123.0 ~ 130.2lb-ft)



KCBF109A

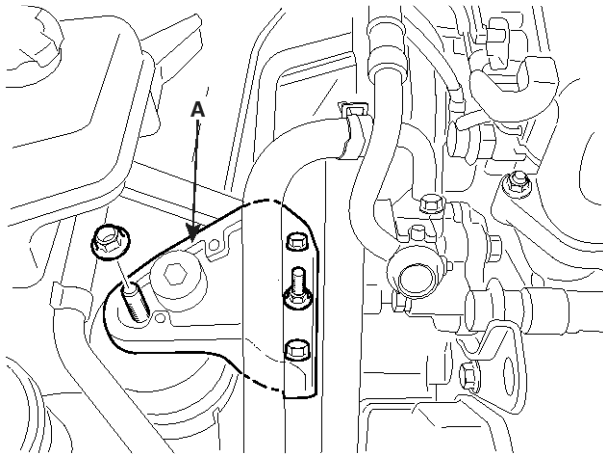
Timing System

EMA-31

11. Install the engine mounting bracket(A).

Tightening torque

63.7 ~ 83.4Nm(6.5 ~ 8.5kgf.m, 47.0 ~ 61.5lb-ft)

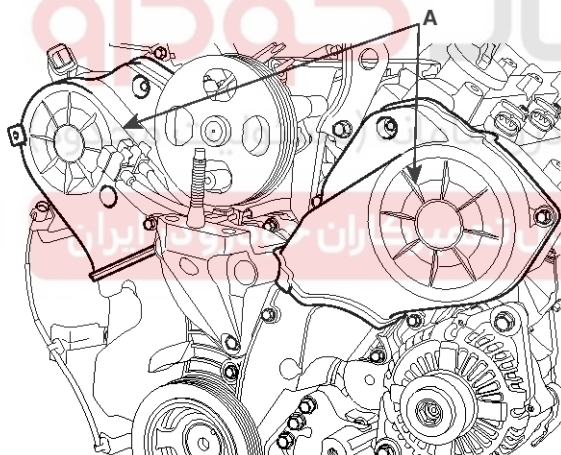


LDLG064A

12. Install the timing belt upper cover(A).

Tightening torque

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



KCBF106A

13. Install the drive belt tensioner(C).

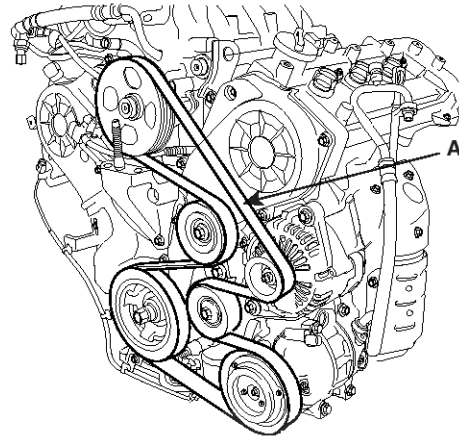
Tightening torque

34.3 ~ 53.9Nm(3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)

14. Install the drive belt idler and the drive belt(A).

Tightening torque

34.3 ~ 53.9Nm(3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)



KCBF105A

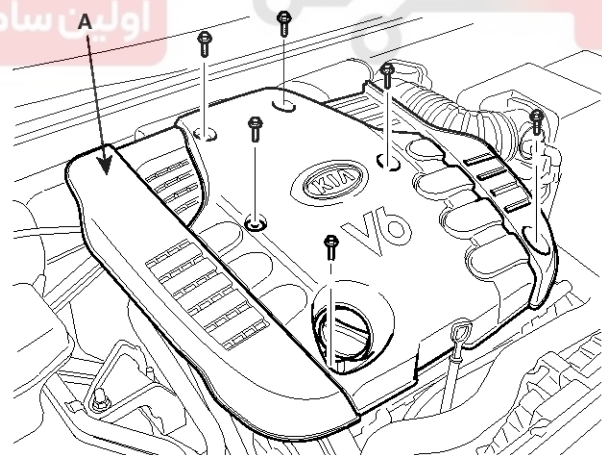
15. Install the right side cover.

16. Install the front right wheel and tire.

17. Install the engine cover(A).

Tightening torque

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



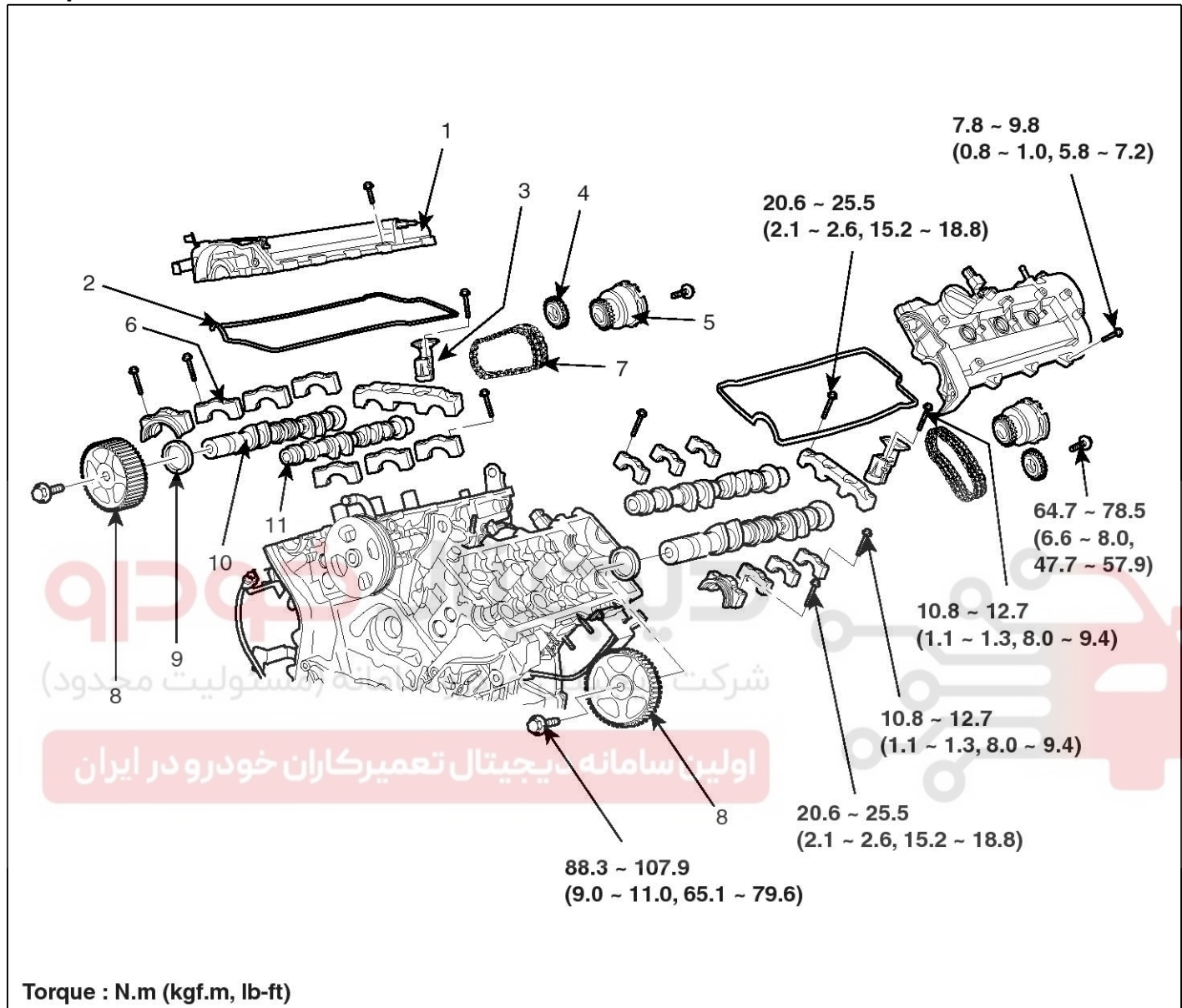
LDLG002A

EMA-32

Engine Mechanical System

Cylinder Head Assembly

Components

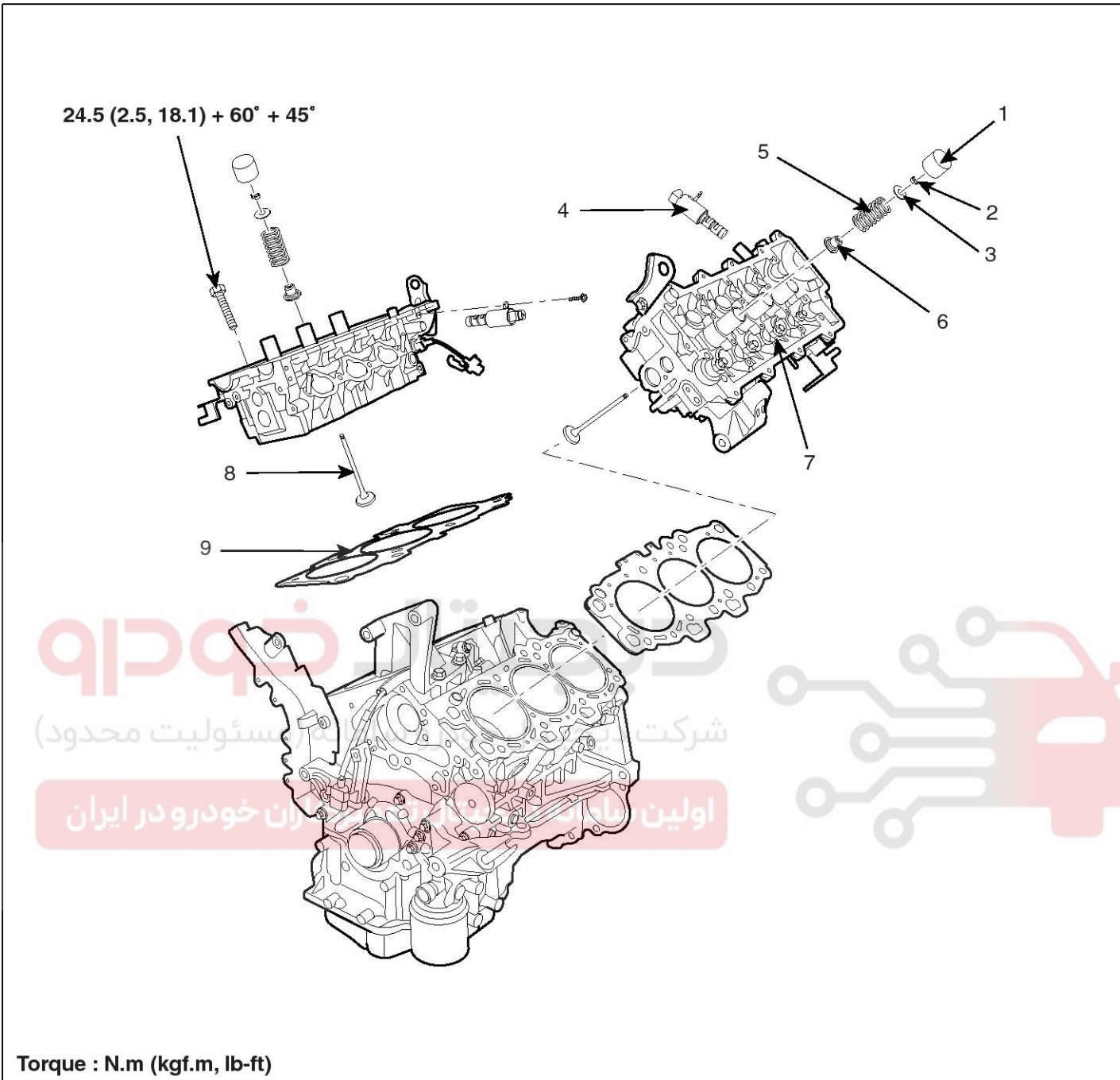


SMGM19011N

- | | |
|------------------------------------|------------------------------|
| 1. Cylinder head cover | 7. Timing chain |
| 2. Cylinder head cover gasket | 8. Exhaust camshaft sprocket |
| 3. Timing chain auto tensioner | 9. Camshaft oil seal |
| 4. Exhaust camshaft chain sprocket | 10. Exhaust camshaft |
| 5. CVVT assembly | 11. Intake camshaft |
| 6. Camshaft bearing cap | |

Cylinder Head Assembly

EMA-33



SMGM19012N

- 1. MLA(Mechanical Lash Adjuster)
- 2. Retainer lock
- 3. Retainer
- 4. OCV(Oil Control Valve)
- 5. Valve spring

- 6. Valve stem seal
- 7. Cylinder head
- 8. Valve
- 9. Cylinder head gasket

EMA-34

Engine Mechanical System

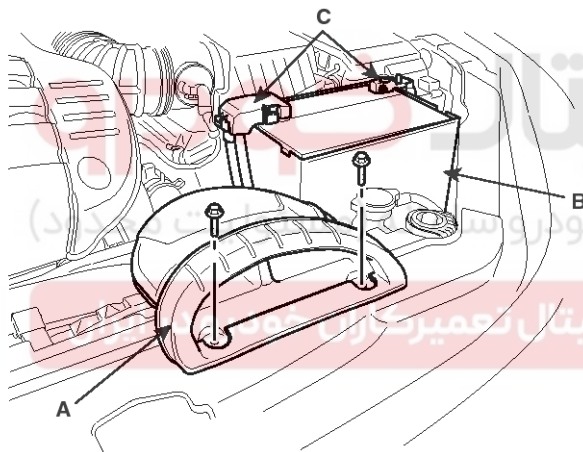
Removal

⚠ CAUTION

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

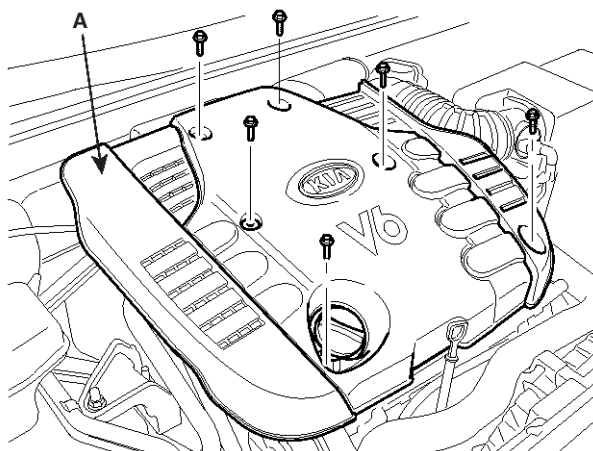
📄 NOTICE

- Mark all wiring and hoses to avoid misconnection.
 - Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
1. Remove the air duct(A) and the battery(B) after disconnecting the terminals(C) from the battery.



LDLG001A

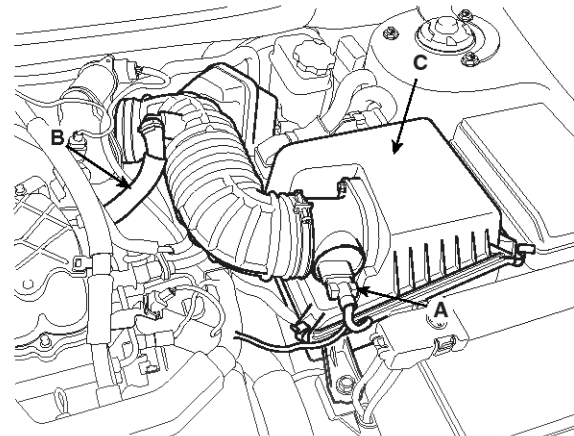
2. Remove the engine cover(A).



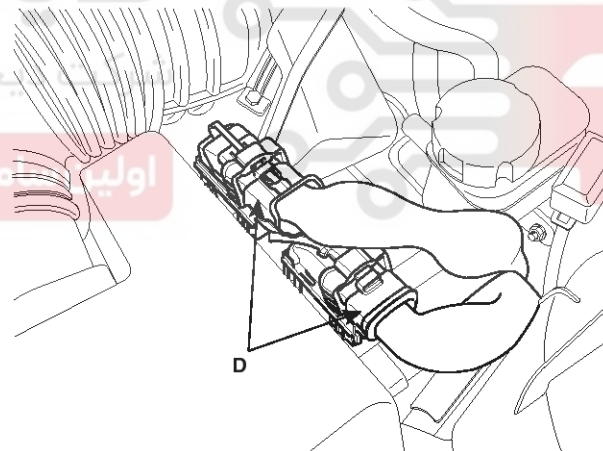
LDLG002A

3. Remove the intake air hose and air cleaner assembly.

- 1) Disconnect the MAF connector(A).
- 2) Disconnect the breather hose(B) from air cleaner hose.
- 3) Remove the intake air hose and air cleaner assembly(C).
- 4) Disconnect the PCM connectors(D).



SMGM29008N

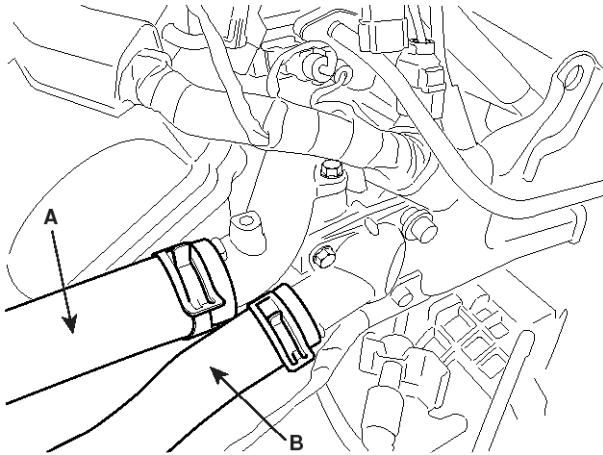


LDLG061A

Cylinder Head Assembly

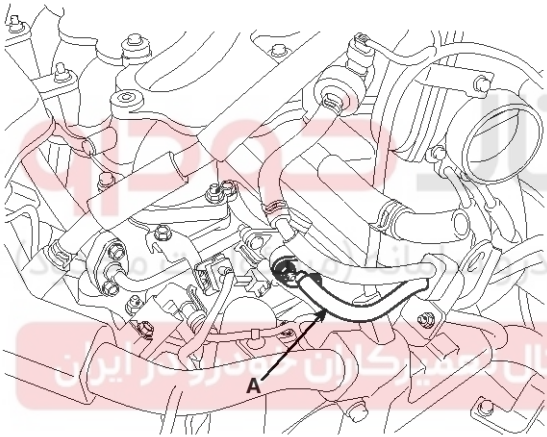
EMA-35

4. Remove the upper radiator hose(A) and lower radiator hose(B).



LDLG008A

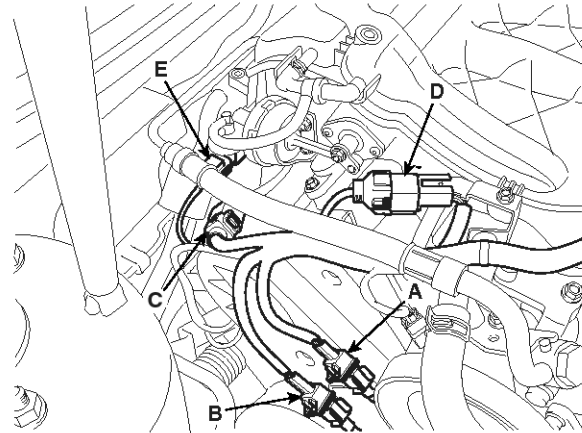
5. Remove the fuel inlet hose(A) from the delivery pipe.



SMGM29006N

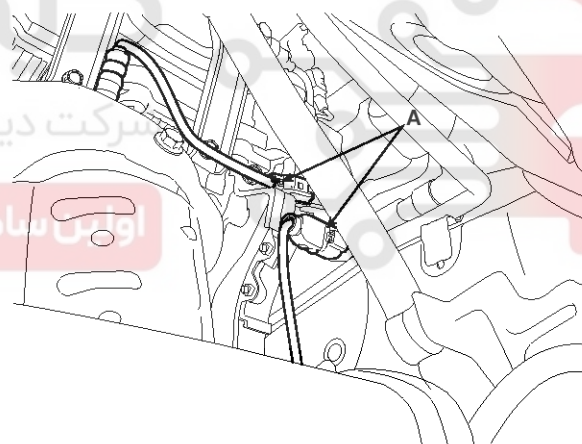
6. Disconnect the engine wiring harness connectors.

- 1) Disconnect the No.1/No.2 knock sensor connectors(A, B), injector connector (C), the ignition coil harness(D) and the No.1 VIS(Variable Induction System) connector(E).



SMGM29007N

- 2) Disconnect the bank 1 front/rear O2 sensor connectors(A).

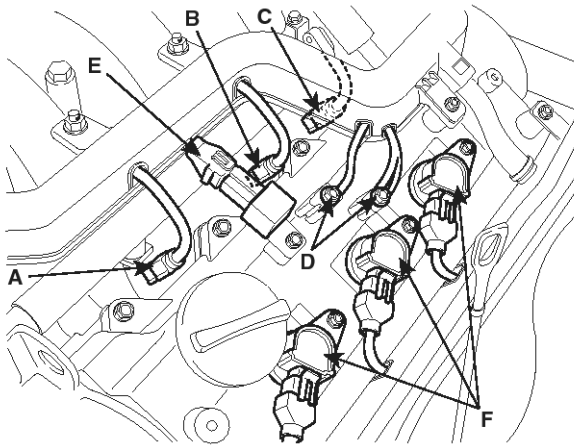


KCBF160A

EMA-36

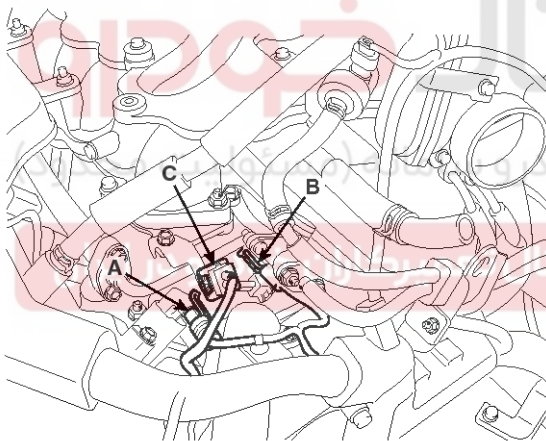
Engine Mechanical System

- 3) Disconnect the injection connectors(A, B, C), the ground lines(D), the condensor connector(E) and the Ignition coil connectors(F).



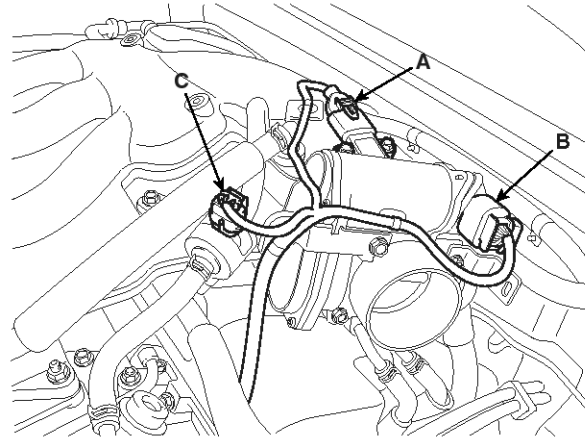
SMGM16014N

- 4) Disconnect the No.1/No.2 OCV (Oil Control Valve) connectors (A, B), and the OTS (Oil Temperature Sensor) connector (C).



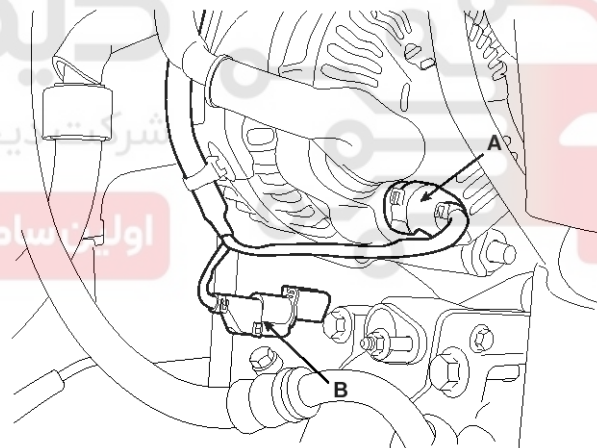
SMGM29009N

- 5) Disconnect the MAPS(Manifold Absolute Pressure Sensor) connector(A), the ETC(Electronic Throttle Control) connector(B) and the PCSV(Purge Control Solenoid Valve) connector(C).



SMGM29010N

- 6) Disconnect the generator connector(A) and the air conditioning compressor connector(B).

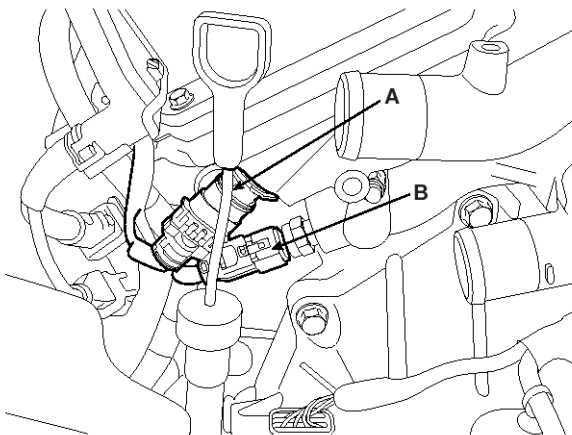


KCBF151A

Cylinder Head Assembly

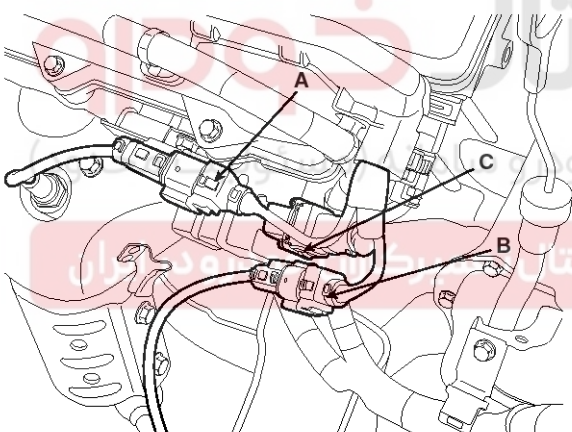
EMA-37

- 7) Disconnect the bank 2 CMP sensor connector(A) and the ECT(Engine Coolant Temperature) sensor connector(B).



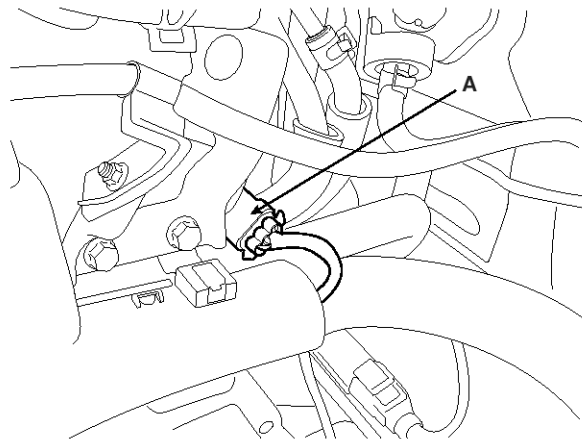
KCBF155A

- 8) Disconnect the bank 2 front/rear O2 sensor connectors(A,B) and the CKP sensor connector(C).



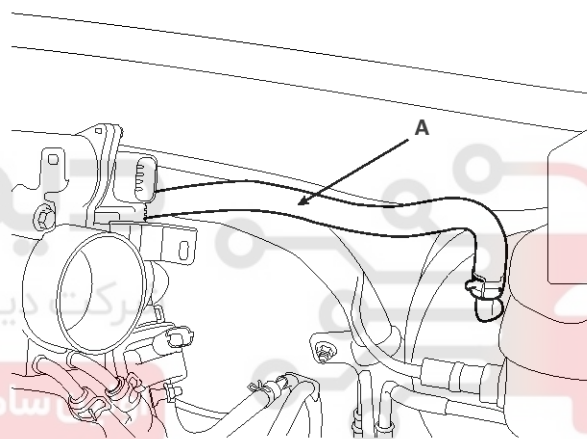
KCBF154A

- 9) Disconnect the bank 1 CMP sensor connector(A).



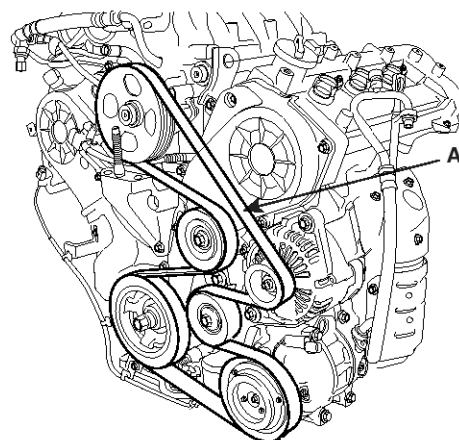
KCBF152A

- 7. Disconnect the brake vacuum hose(A).



LDLG036A

- 8. Remove the heater hoses.
- 9. Remove the drive belt(A).

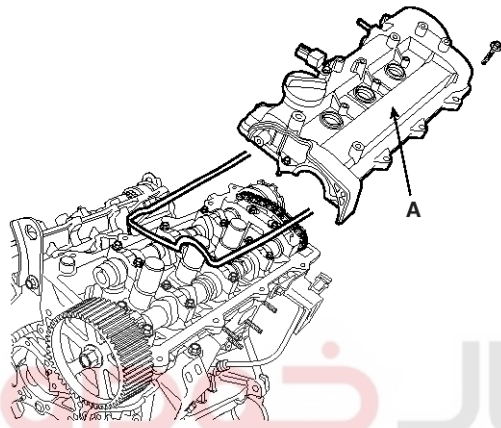


KCBF105A

EMA-38

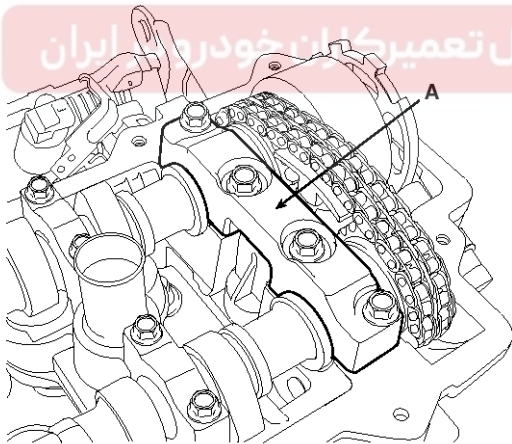
Engine Mechanical System

- 10. Remove the power steering pump.(Refer to 'ST' group).
- 11. Remove the exhaust manifold assembly.(Refer to 'Intake and exhaust system').
- 12. Remove the intake manifold assembly.(Refer to 'Intake and exhaust system').
- 13. Remove the timing belt.(Refer to 'Timing system').
- 14. Remove the ignition coils.
- 15. Remove the water temp. control assembly.
- 16. Remove the cylinder head cover(A).



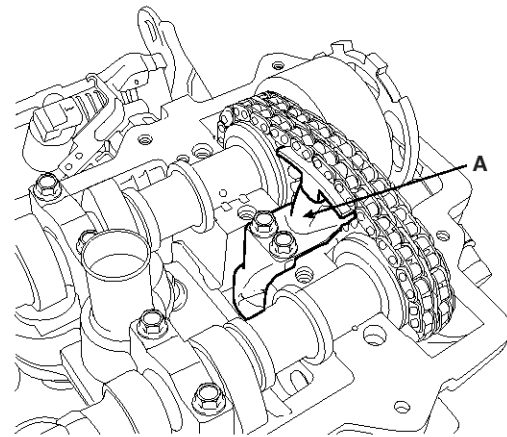
SMGM16010N

- 17. Remove the camshaft bearing cap(A).



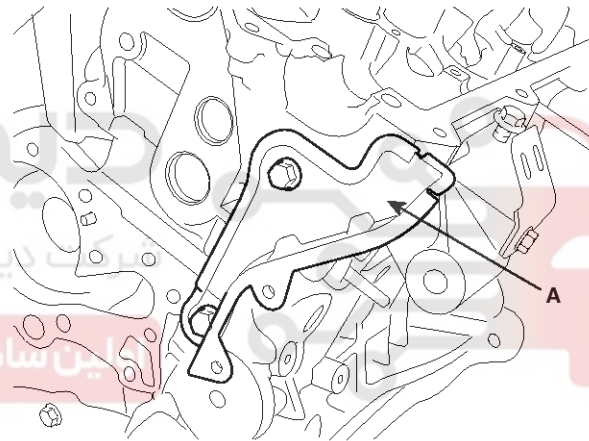
KCBF167A

- 18. Remove the timing chain tensioner(A).



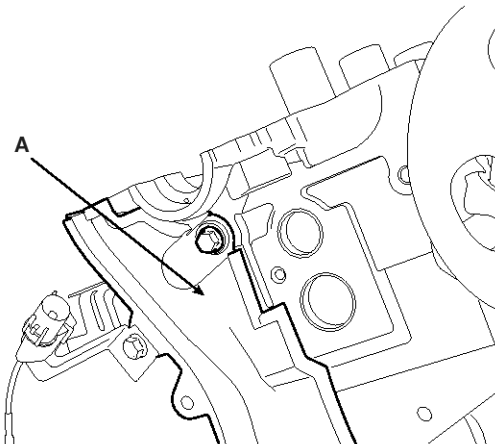
SMGM16023N

- 19. Remove the camshaft.
- 20. Remove the bank 2 timing belt rear cover(A).



KCBF170A

- 21. Remove the bank 1 timing belt rear cover(A).

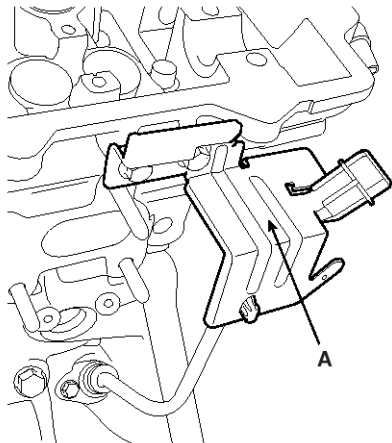


KCBF171A

Cylinder Head Assembly

EMA-39

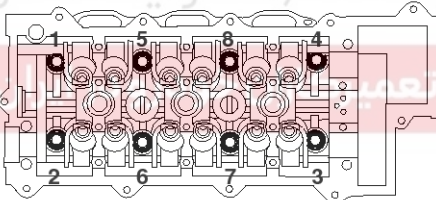
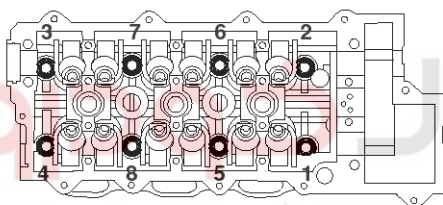
22. Remove the CKP sensor connector bracket(A).



KCBF172A

23. Remove the cylinder head assembly.

- 1) Remove the bolts in 2~3 steps as following orders.



KCBF176A

CAUTION

If the bolts are not removed as the order, the deformation of the head assembly can be occurred.

- 2) Put the cylinder head assembly on a wooden block after removal from the cylinder block.

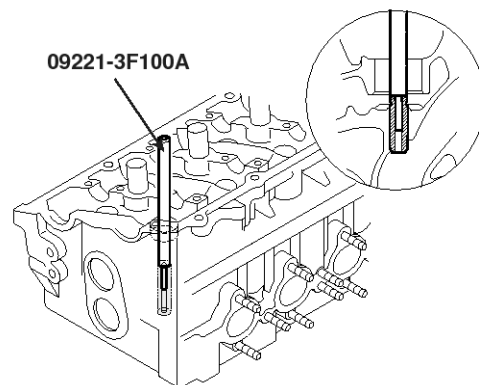
CAUTION

Ensure that the surface between the cylinder head and the block is not damaged.

Replacement

Valve Guide

1. Using the SST(09221-3F100A), remove the valve guide from the downside of the cylinder head assembly.



EDKD900A

2. Reprocess the valve guide hole for the oversized valve guide newly installed.
3. Using the SST(09221-3F100A/B), insert the valve guide in the upside of the cylinder head assembly. Be aware of the difference in length between the intake and the exhaust valve guides.

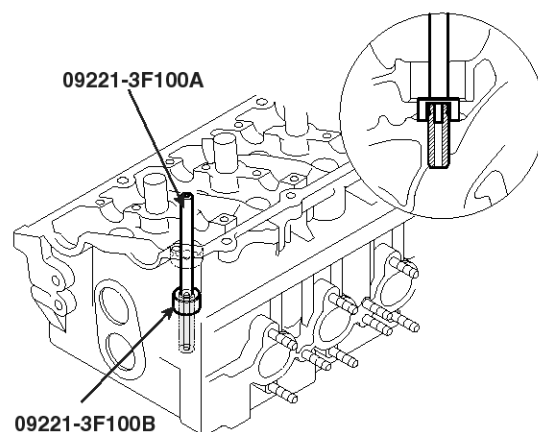
Specification

Intake valve guide:

45.8 ~ 46.2mm(1.8031 ~ 1.8189in.)

Exhaust valve guide:

46.8 ~ 47.2mm(1.8425 ~ 1.8583in.)



EDKD900B

EMA-40

Engine Mechanical System

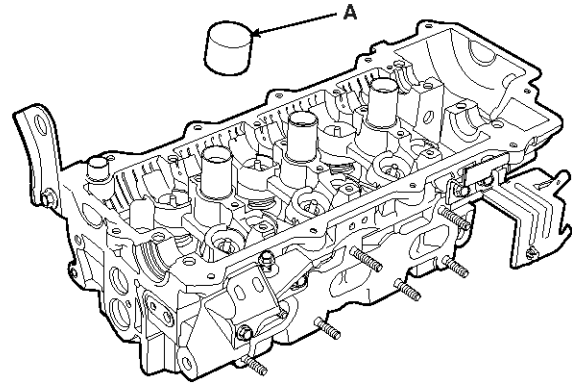
4. After installing the valve guides, insert new valves and check the clearance between the valve stems and the valve guides.
5. After replacing the valve guides, check if they are properly installed with the valve seats. Reprocess valve seats if necessary.

Disassembly

NOTICE

Identify MLA(Mechanical Lash Adjuster), valves and valve springs as they are removed so that each item can be reinstalled in its original position.

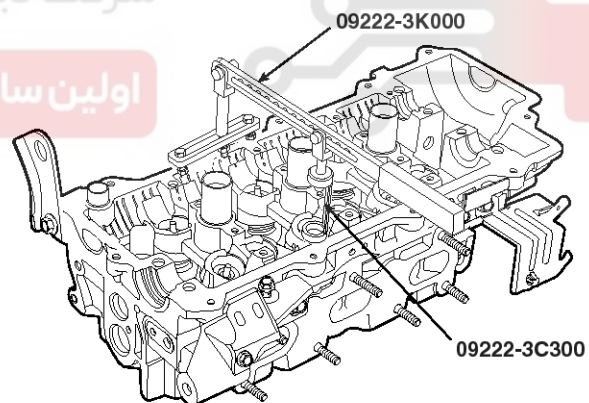
1. Remove MLA(Mechanical Lash Adjuster)s(A).



KCBF173D

2. Remove valves.

- 1) Using SST(09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.



KCBF173C

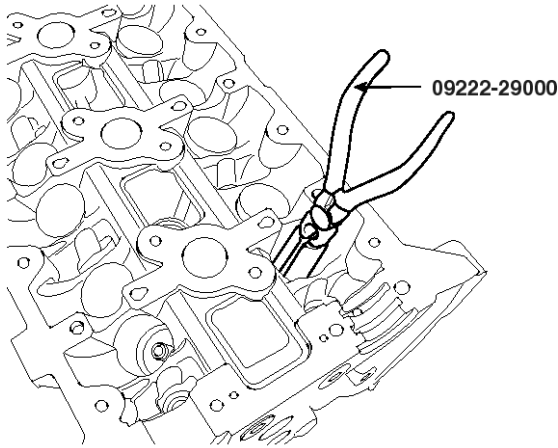
دیجیتال خودرو
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Cylinder Head Assembly

EMA-41

- 2) Remove the spring retainer.
- 3) Remove the valve spring.
- 4) Remove the valve.
- 5) Using SST(09222-29000), remove the valve stem seal.

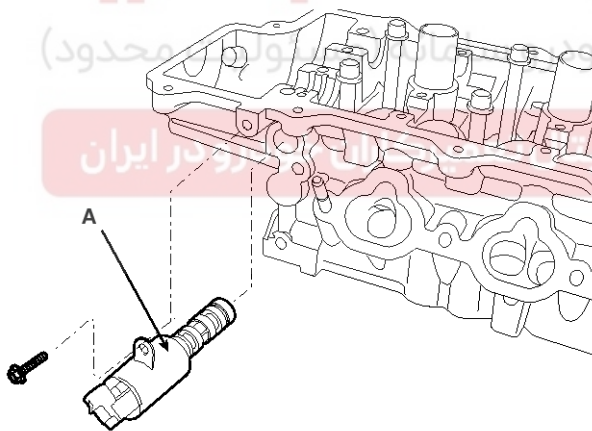


KDRF234A

NOTICE

Do not reuse the removed valve stem seals.

3. Remove OCV(Oil Control Valve)(A).



KCBF166A

Inspection

Cylinder Head

1. Inspect for flatness.

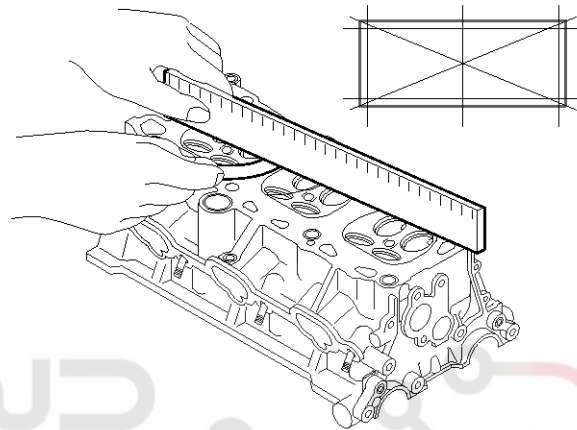
Using a precision straight edge and feeler gauge, measure the surface contacting cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface

Standard : 0.03mm(0.0012in.) or less

Flatness of manifold gasket surface

Standard : 0.15mm(0.0059in.) or less



EDQF160A

2. Inspect for cracks.

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

EMA-42

Engine Mechanical System

Valve And Valve Spring

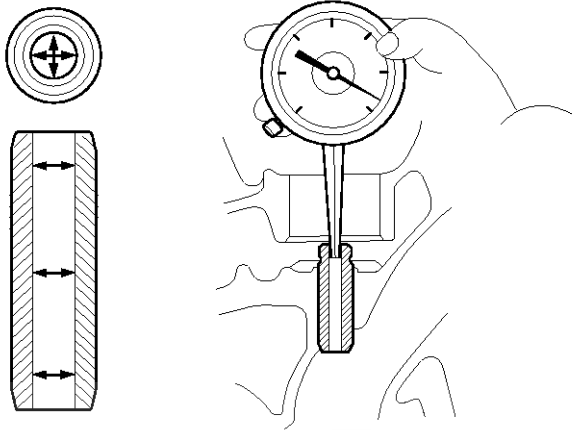
1. Inspect valve stems and valve guides.

- 1) Using a caliper gauge, measure the inside diameter of the valve guide.

Valve guide inside diameter

Intake / Exhaust :

6.000 ~ 6.015mm (2.2362 ~ 2.2368in.)



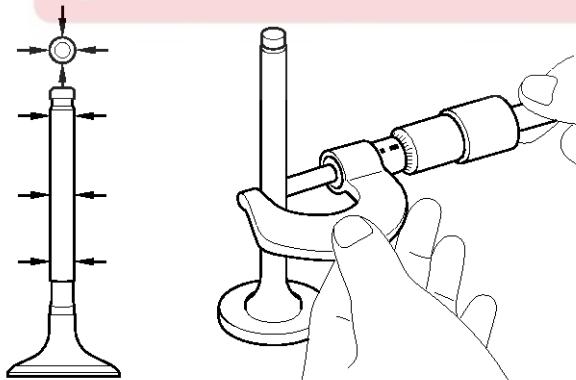
ECBF034A

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

Valve stem outer diameter

Intake : 5.965 ~ 5.980mm (0.2348 ~ 0.2354in.)

Exhaust : 5.950 ~ 5.965mm (0.2343 ~ 0.2348in.)



KCRF227A

- 3) Calculate the clearance between the valve guides and the stems by difference between the valve stem measured diameter and the valve guide measured inside diameter.

Valve stem-to-guide clearance

[Standard]

Intake : 0.020 ~ 0.050mm (0.0008 ~ 0.0020in.)

Exhaust : 0.035 ~ 0.065mm (0.0014 ~ 0.0026in.)

[Limit]

Intake : 0.10mm (0.0039in.) or less

Exhaust : 0.13mm (0.0051in.) or less

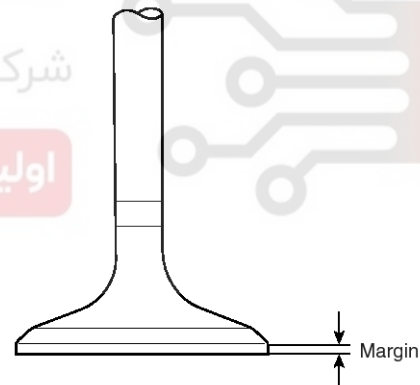
2. Inspect valves.

- 1) Check the valve face angle.
- 2) Check that the surface of the valve for wear.
If the valve face is worn, replace the valve.
- 3) Check the valve head margin thickness.
If the margin thickness is less than the specification, replace the valve.

Specification

Intake : 1.0mm(0.0394in.)

Exhaust : 1.3mm(0.0512in.)



ECKD221A

- 4) Check the valve length.

Length

Intake : 110.1mm(4.3346in)

Exhaust : 111.1mm(4.3740in)

- 5) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, replace the valve.

Cylinder Head Assembly

EMA-43

3. Inspect valve seats
 - 1) Check the valve seat for evidence of overheating or improper contact with the valve face.
If the valve seat is worn, replace cylinder head.
 - 2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace the valve guide first.
 - 3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.
4. Inspect valve springs.
 - 1) Using a steel square, measure the out-of-square of the valve spring.
 - 2) Using vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 46.8mm (1.8425in.)

Out-of-square : 1.5° or less

MLA(Mechanical Lash Adjuster)

1. Inspect MLA.
Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust :

29.964 ~ 29.980mm(1.1797 ~ 1.1803in.)

2. Using a caliper gauge, measure MLA tappet bore inner diameter of cylinder head.

Tappet bore I.D.

Intake/Exhaust :

30.000 ~ 30.025mm(1.1811 ~ 1.1821in.)

3. Calculate the clearance by subtracting MLA outside diameter measurement from tappet bore inside diameter measurement.

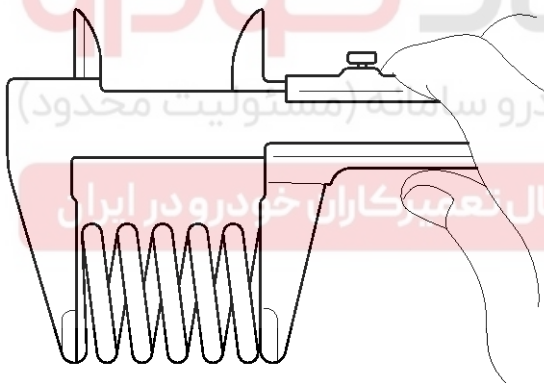
MLA to tappet bore clearance

[Standard]

Intake/Exhaust : 0.020 ~ 0.061mm(0.0008 ~ 0.0024in.)

[Limit]

Intake/Exhaust : 0.07mm(0.0027in.) or less



KCRF205A

EMA-44

Engine Mechanical System

Camshaft

1. Inspect cam lobes.

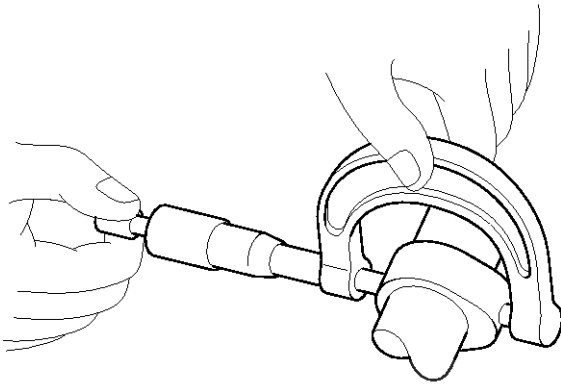
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake : 44.5mm (1.7520in.)

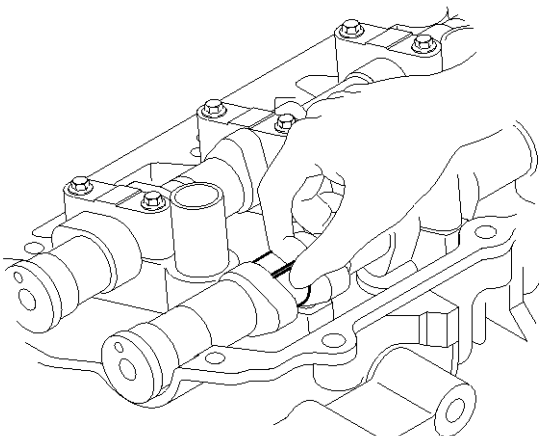
Exhaust : 44.5mm (1.7520in.)



KCRF206A

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

2. Check the cam lobe surface for wear or damage. If necessary, replace it.
3. Inspect camshaft journal clearance.
 - 1) Clean the bearing caps and camshaft journals.
 - 2) Place the camshafts on the cylinder head.
 - 3) Lay a strip of plastigage across each of the camshaft journals.



SMGM16024N

- 4) Install the bearing caps with the tightening torque.

⚠ CAUTION

Do not turn the camshaft.

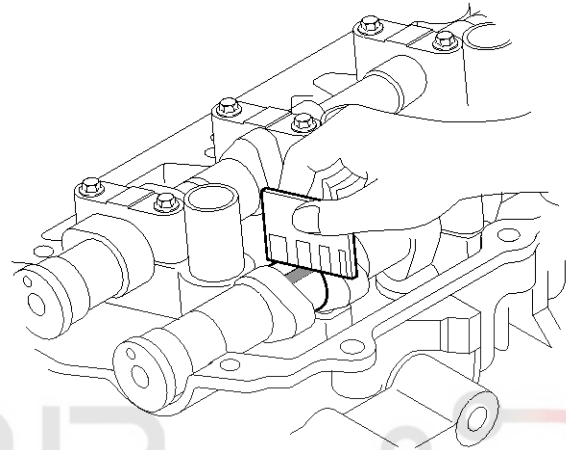
- 5) Remove the bearing caps.
- 6) Measure the plastigage at its widest point.

Bearing oil clearance

[Standard value]

Intake : 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.)

Exhaust : 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.)



SMGM16025N

If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the cylinder head.

- 7) Completely remove the plastigage.
- 8) Remove the camshafts.

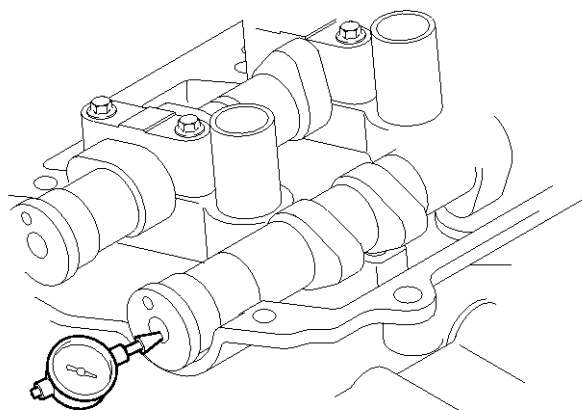
Cylinder Head Assembly

EMA-45

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

Camshaft end play

[Standard value] : 0.1 ~ 0.2mm(0.0039 ~ 0.0079in.)



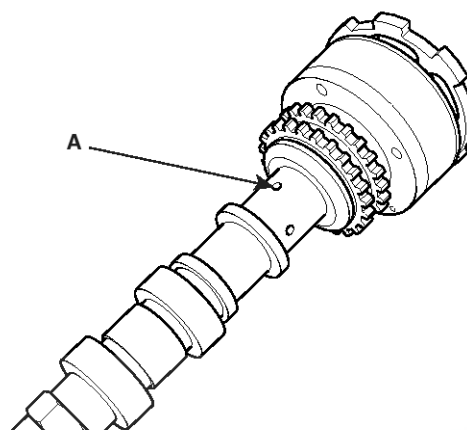
KCBF173E

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

- 3) Remove the camshafts.

CVVT Assembly

1. Inspect CVVT assembly.
 - 1) Fix the CVVT assembly with a vice. Ensure that the cam lobe and journal is not damaged.
 - 2) Check that the CVVT assembly will not turn. It should not be turned.
 - 3) Apply vinyl tape to the retard hole except the one(A) indicated by the arrow in the illustration.



KCBF188A

- 4) Wind tape around the tip of the air gun and apply air of approx. 150kpa(1.5kgf/cm², 21psi) to the port of the camshaft.
(Perform this in order to release the lock pin for the maximum delay angle locking.)

NOTICE

When the oil splashes, wipe it off with a shop rag.

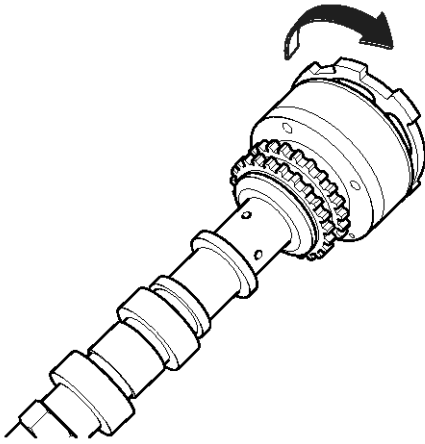
- 5) After the lock pin released, the CVVT assembly can turned in advanced direction.
If the air applied is leaked much, the lock pin can not be released.
- 6) Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no resistance to movement.

Standard: Movable smoothly in the range about 30°

EMA-46

Engine Mechanical System

- 7) Turn the CVVT assembly with your hand in retard direction and lock it at the maximum delay angle position.



KCBF188B

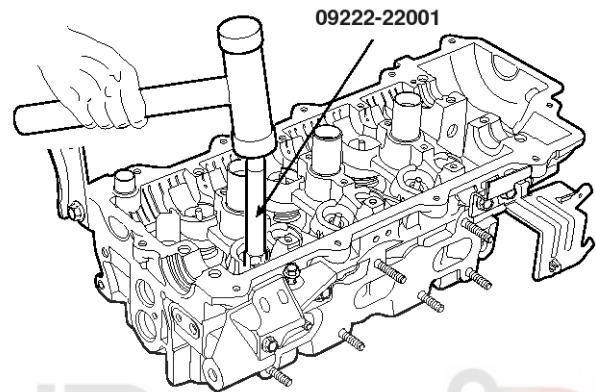
Reassembly

NOTICE

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

1. Install valves.

- 1) Using SST(09222-22001), push in a new valve stem seal with applying engine oil.



KCBF173B

NOTICE

- Do not reuse old valve stem seals.

Incorrect installation of the seal could result in oil leakage past the valve guides.

- Reassemble the valve stem seals

- 2) After applying engine oil on the outer surface of each valve stem, insert the valve in the valve guide.

Install the valve, valve spring and spring retainer.

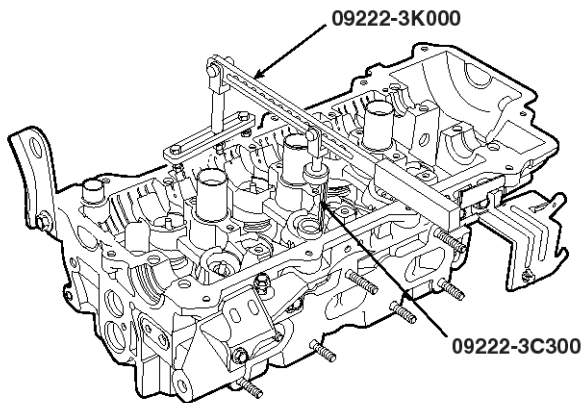
NOTICE

When installing valve springs, the side coated with enamel should face toward the valve spring retainer

Cylinder Head Assembly

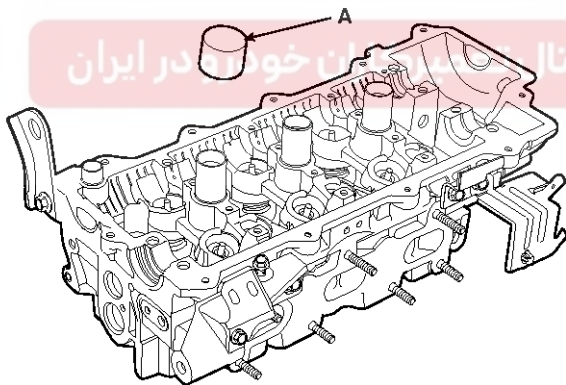
EMA-47

- 3) Using the SST(09222 - 3K000, 09222-3C300), compress the springs and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



KCBF173C

- 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 MLAs with engine oil applied on its surface. Check that the MLA rotates smoothly by hand.



KCBF173D

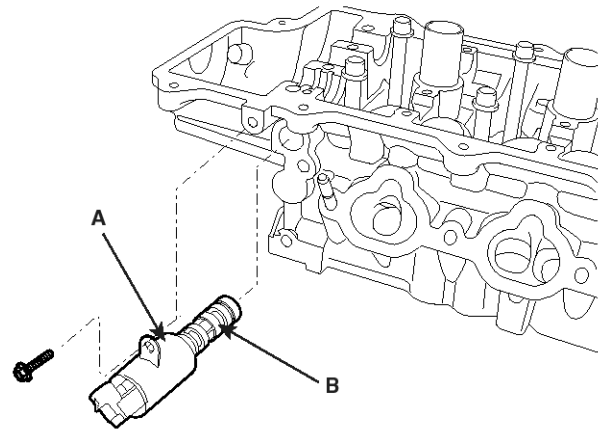
NOTICE

MLA should be reinstalled in its original position.

3. Install OCV(Oil Control Valve)(A).

Tightening torque

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



KCBF166B

NOTICE

- To install OCV with gray colored connector into RH bank.
- To install OCV with black colored connector into LH bank.

CAUTION

- Do not reuse the OCV when dropped.
- Keep clean the OCV.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine while holding the OCV yoke.
- If there is dust on the filter(B) of the OCV, clean it all.

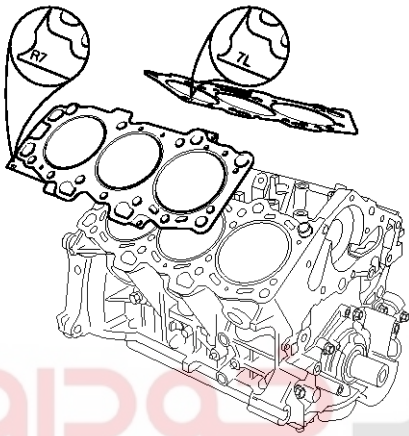
EMA-48

Engine Mechanical System

Installation

NOTICE

- Thoroughly clean all parts to be assembled.
 - Always use a new head and manifold gasket.
 - The cylinder head gasket is a metal gasket. Take care not to bend it.
 - Rotate the crankshaft to set the No.1 cylinder piston at TDC.
1. After putting the cylinder head gasket on the cylinder block, install the cylinder head.



KCBF191A

CAUTION

Ensure the LH/RH classification of the cylinder head gasket when installing.

2. Tighten the cylinder head bolts with the plain washers in several steps as following order.

NOTICE

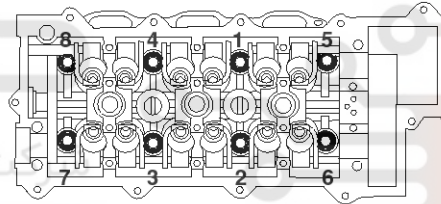
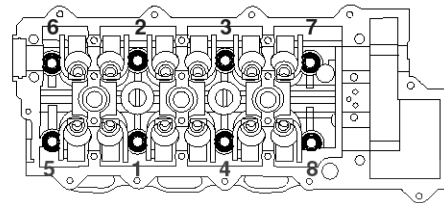
- In assembling washers, the marked surface should face upward.
- In installing the cylinder head bolts, apply engine oil on the thread of the bolts and the surface of the washers.

CAUTION

Always use new cylinder head bolts.

Tightening torque

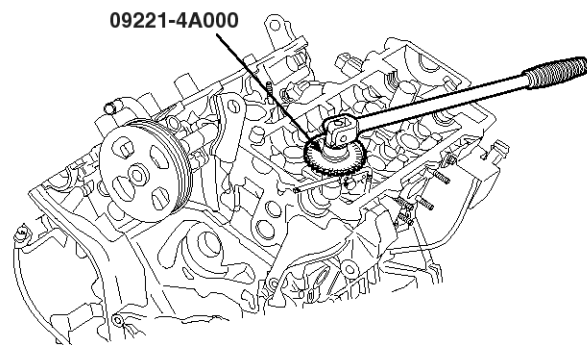
22.6~26.5Nm (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 58~62° + 43~47°



KCBF176B

NOTICE

Using the SST(09221-4A000), tighten the bolts which need to be tightened with the angular tightening method.



LDLG063A

Cylinder Head Assembly

EMA-49

3. Install the CVVT assembly and camshaft chain sprocket with the dowel pin in the CVVT installed to the intake camshaft. Ensure that the pin will not be installed in the hole for oil feeding.

Tightening torque

66.7~78.5Nm(6.8~8.0kgf.m, 49.2~57.9lb-ft)

NOTICE

After tightening the CVVT bolts, rotate the CVVT assembly housing counterclockwise by hand to seat the lock pin in the CVVT assembly in good position.

CAUTION

Fix the hexagonal part of the camshaft in a vice when tightening the CVVT bolts. Do not fix the CVVT housing or sprocket in a vice.

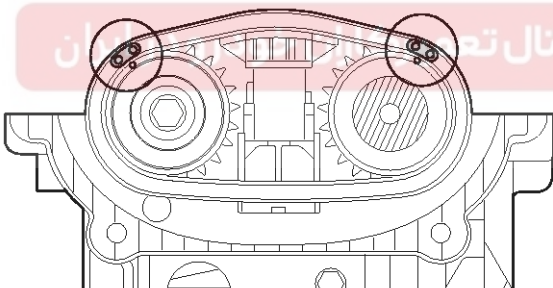
4. Install the camshaft in the cylinder head assembly.
 - 1) Align the timing marks of the intake and exhaust camshaft chain sprockets and the timing chain.

CAUTION

Both timing marks should face upward for reassembly.

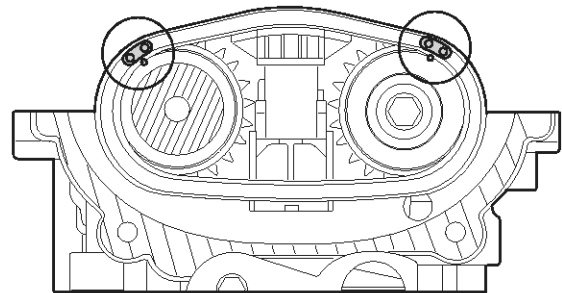
- 2) Install the intake and exhaust camshafts on the cylinder head with the timing marks aligned.

LH camshaft chain timing mark



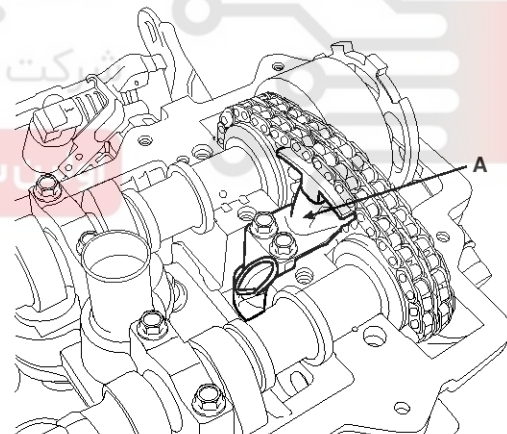
SVQEM9032D

RH camshaft chain timing mark



SVQEM8033D

5. Install the timing chain tensioner.
 - 1) Insert the set pin by pressing the timing chain tensioner.
 - 2) Install the chain tensioner(A) in the cylinder head assembly.
 - 3) Remove the set pin from the tensioner after installing.



KCBF168A

EMA-50

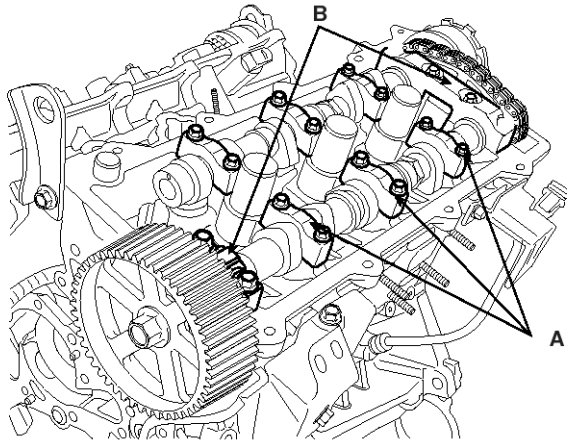
Engine Mechanical System

6. Install the camshaft bearing caps.

Tightening torque

Bearing cap bolt(A: 6×38) :
10.8~12.7Nm(1.1~1.3kgf.m, 8.0~9.4lb-ft)

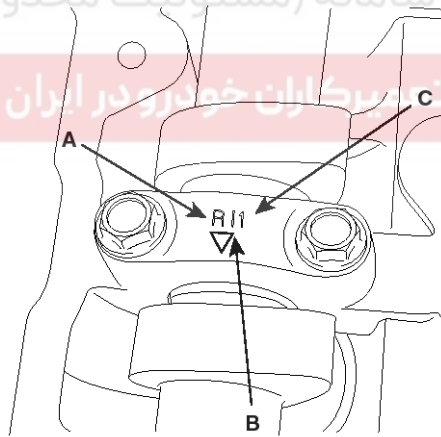
Bearing cap bolt(B: 8×38) :
20.6~22.5Nm(2.1~2.6kgf.m, 15.2~18.8lb-ft)



KCBF169A

NOTICE

When installing the bearing caps, check the marks on them as shown below and install them in its proper position.



SMGM16026N

A(LH/RH HEAD): L(LH), R(RH)

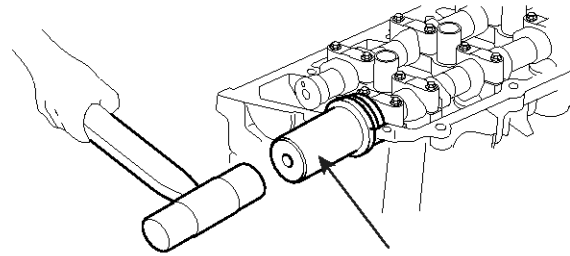
B(Intake/Exhaust): I(Intake), E(Exhaust)

C(Cap no.): 1,2,3

CAUTION

When installing the bearing caps, turn the crankshaft to place a piston in the middle of the block because interference between valves and pistons can occur.

7. Using the SST(09214-21000), install the camshaft oil seal.



09214 - 21000

KCBF190A

NOTICE

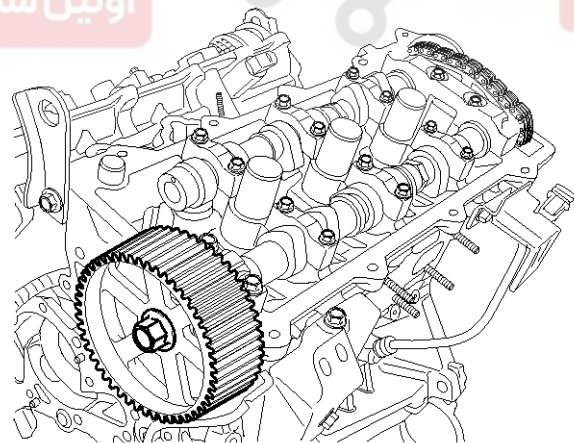
- Before installing, apply engine oil.
- The camshaft cap surface should adhere to the cylinder head assembly.
- Do not press an eccentric load.

8. Install the camshaft sprocket.

- 1) Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt.

Tightening torque

88.3 ~ 107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)



SVQEM8038D

Cylinder Head Assembly

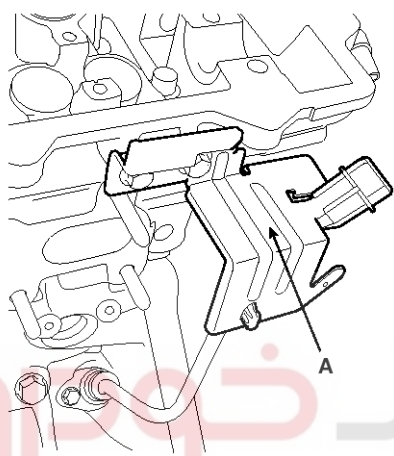
EMA-51

- 2) In case that the camshaft is replaced with new one, inspect the valve clearances and then install appropriate MLA tappet. (Refer to Valve clearance inspection and adjustment)

⚠ CAUTION

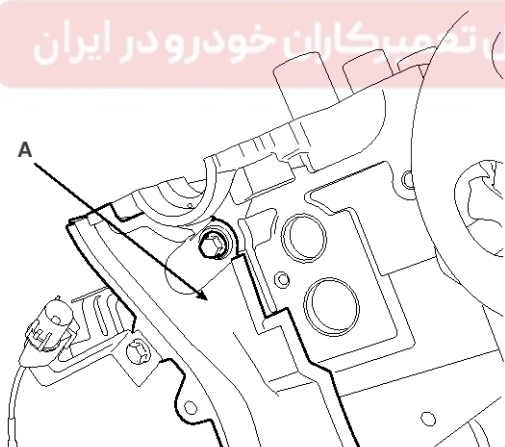
To prevent the valve from interfering with the piston, rotate the crankshaft sprocket at 3 pitches counterclockwise from the No.1 cylinder piston at TDC position before inspecting the valve clearances.

9. Install the CKP sensor connector bracket(A).



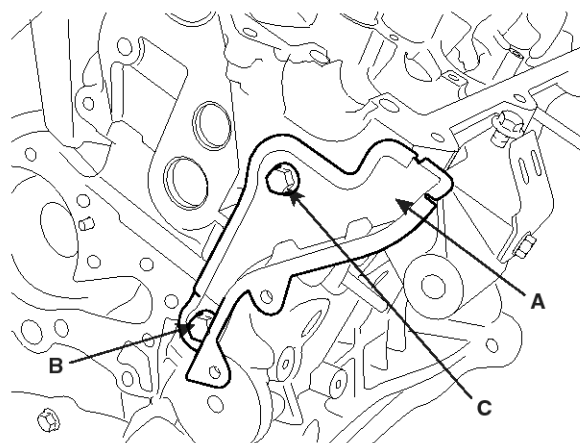
KCBF172A

10. Install the bank 1 timing belt rear cover(A).



KCBF171A

11. Install the bank 2 timing belt rear cover(A).



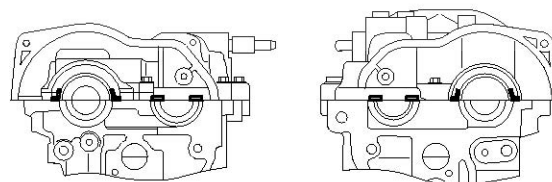
KCBF170B

⚠ NOTICE

The length of the bolt B is longer than that of the bolt C.

12. Install the cylinder head cover.

- 1) Remove oil, dust or sealant on the upper surface of the cylinder before assembling cylinder head cover.
- 2) Assemble the cylinder head cover in five minutes after applying liquid gasket(LOCTITE 5900) on the camshaft cap and packing part.



SMGM16027N

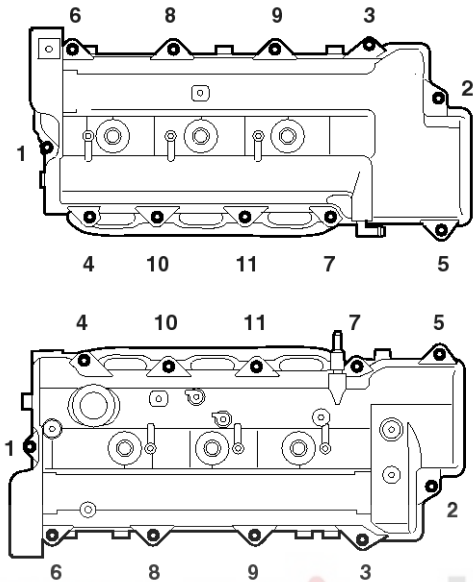
EMA-52

Engine Mechanical System

- 3) Tighten the cylinder head cover bolts as following order(A).

Tightening torque

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



KCBF175A

NOTICE

- Do not start engine for thirty minutes after assembling the cylinder head cover.
- Do not reuse the cylinder head cover gasket.

13. Install the timing belt.

- 1) Align the timing marks of the LH/RH camshaft sprockets.

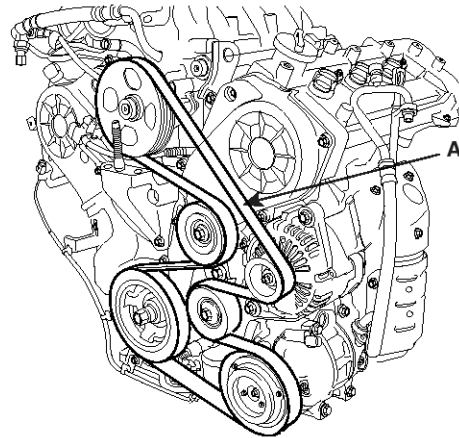
CAUTION

To prevent the valve from interfering with the piston, rotate the crankshaft sprocket at 3 pitches counterclockwise from the No.1 cylinder piston at TDC position before aligning the timing marks of the camshaft sprockets.

- 2) After aligning the timing marks of the camshaft sprockets, rotate the crankshaft sprocket at 3 pitches clockwise then align the timing mark of the crankshaft sprocket to set the crankshaft to the No.1 cylinder piston at TDC position.

- 3) Install the timing belt. (Refer to Timing system)

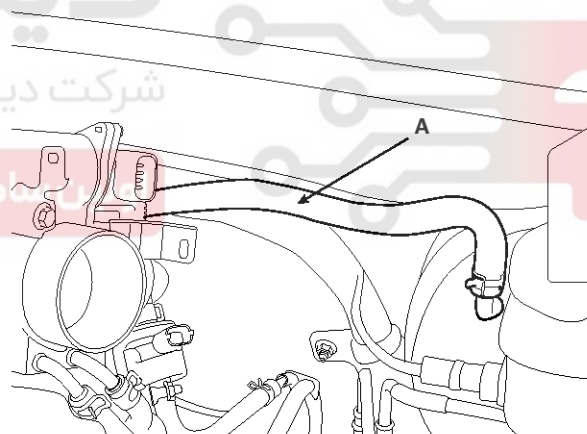
14. Install the water temp. control assembly.
 15. Install the intake manifold assembly.
 16. Install the exhaust manifold assembly.
 17. Install the power steering pump. (Refer to 'ST' group).
 18. Install the drive belt(A).



KCBF105A

19. Install the heater hose.

20. Connect the brake vacuum hose(A).



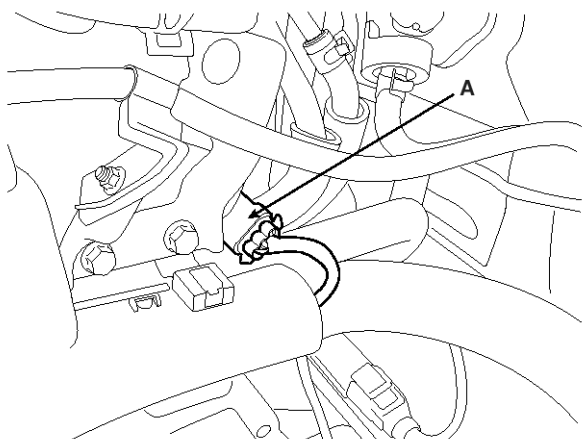
LDLG036A

Cylinder Head Assembly

EMA-53

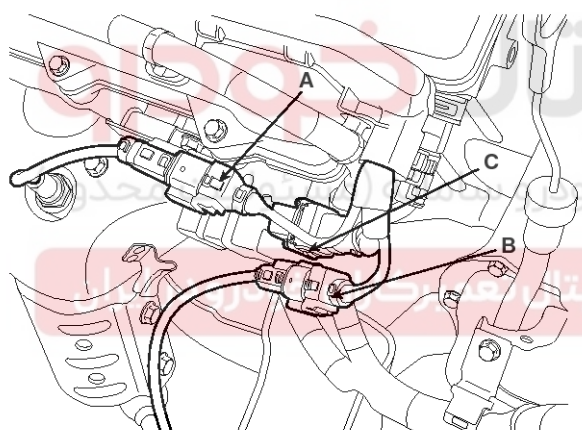
21. Connect the engine wiring harness connectors.

1) Connect the bank 1 CMP sensor connector(A).



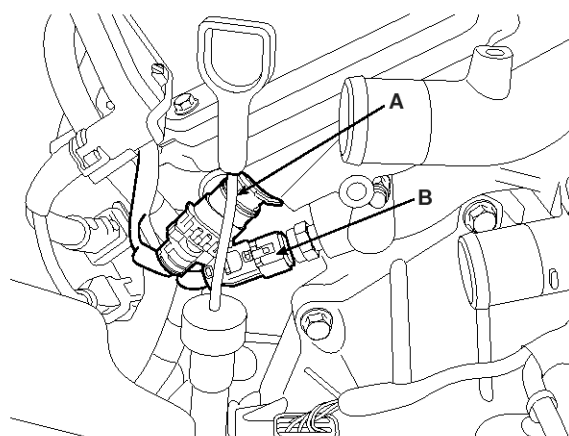
KCBF152A

2) Connect the bank 2 front/rear O2 sensor connectors(A,B) and the CKP sensor connector(C).



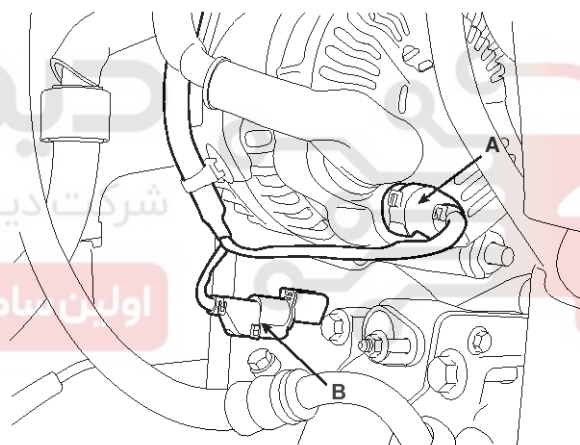
KCBF154A

3) Connect the bank 2 CMP sensor connector(A) and the WTS(Water Temperature Sensor) connector(B).



KCBF155A

4) Connect the generator connector(A) and the air conditioning compressor connector(B).

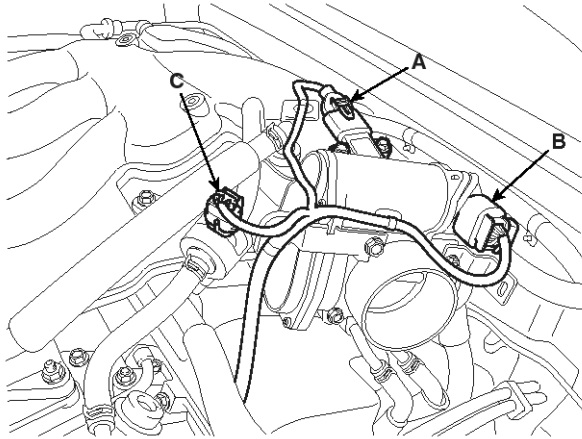


KCBF151A

EMA-54

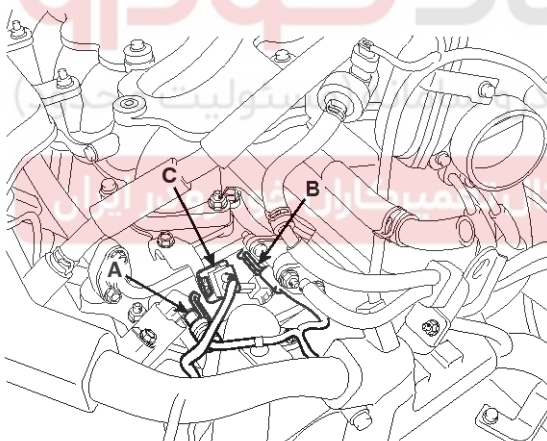
Engine Mechanical System

5) Connect the MAPS(Manifold Absolute Pressure Sensor) connector(A), the ETC(Electronic Throttle Control) connector(B) and the PCSV(Purge Control Solenoid Valve) connector(C).



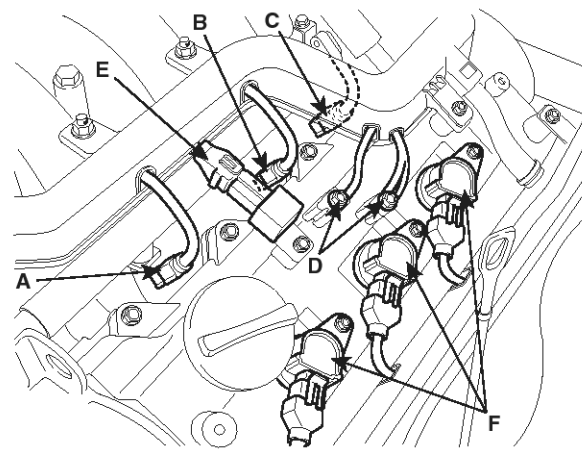
SMGM29010N

6) Connect the No.1/No.2 OCV(Oil Control Valve) connectors(A, B) and the OTS(Oil Temperature Sensor) connector(C).



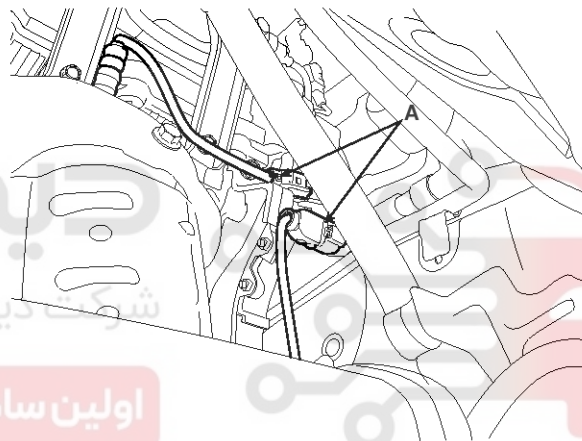
SMGM29009N

7) Connect the injection connectors(A,B,C), the ground lines(D), the condensor connector(E) and the Ignition coil connectors(F).



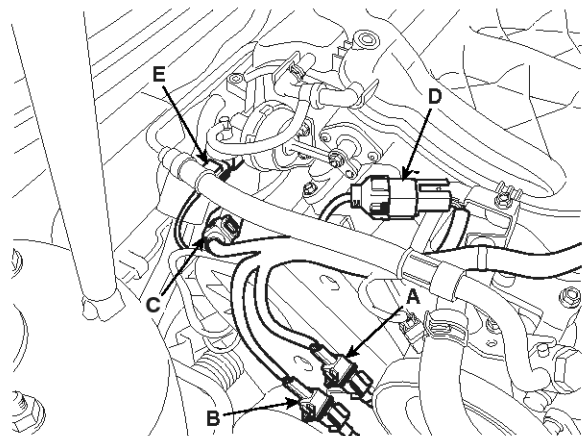
SMGM16014N

8) Connect the bank 1 front/rear O2 sensor connectors(A).



KCBF160A

9) Connect the No.1/No.2 knock sensor connectors(A, B), the injector connector (C), the ignition coil harness(D) and the No.1 VIS(Variable Induction System) connector(E).

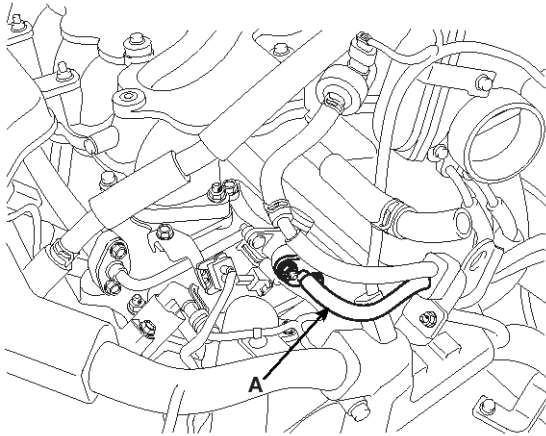


SMGM29007N

Cylinder Head Assembly

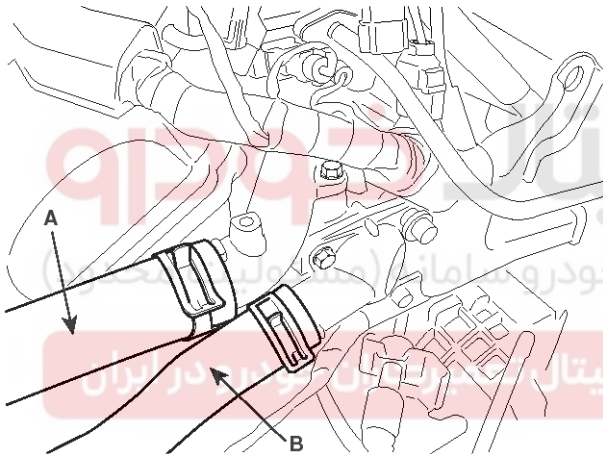
EMA-55

22. Install the fuel inlet hose(A) to the delivery pipe.



SMGM29006N

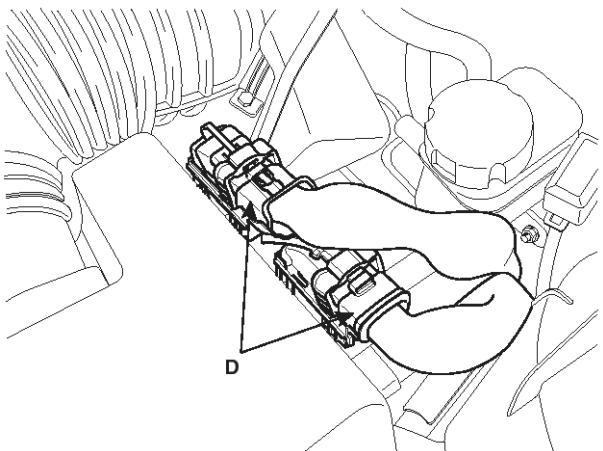
23. Install the upper radiator hose(A) and lower radiator hose(B).



LDLG008A

24. Install the intake air hose and air cleaner assembly.

1) Connect the PCM connectors(D).

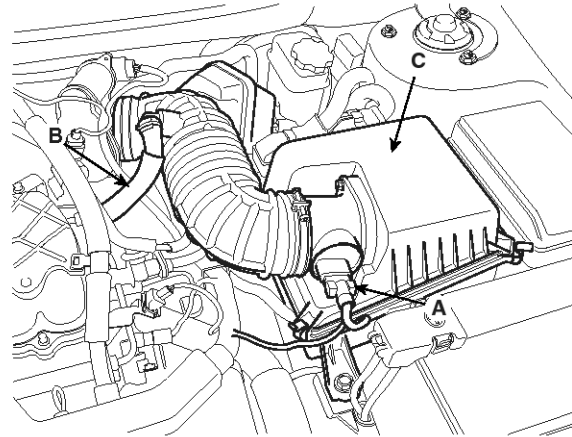


LDLG061A

2) Install the intake air hose and air cleaner assembly(C).

3) Connect the breather hose(B) from air cleaner hose.

4) Connect the MAF connector(A).

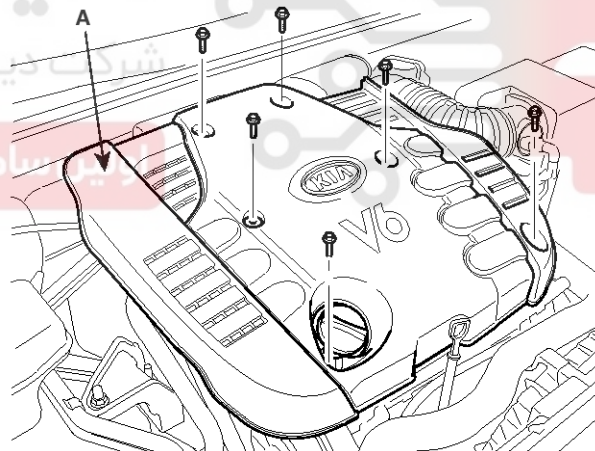


SMGM29008N

25. Install the engine cover(A).

Tightening torque

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



LDLG002A

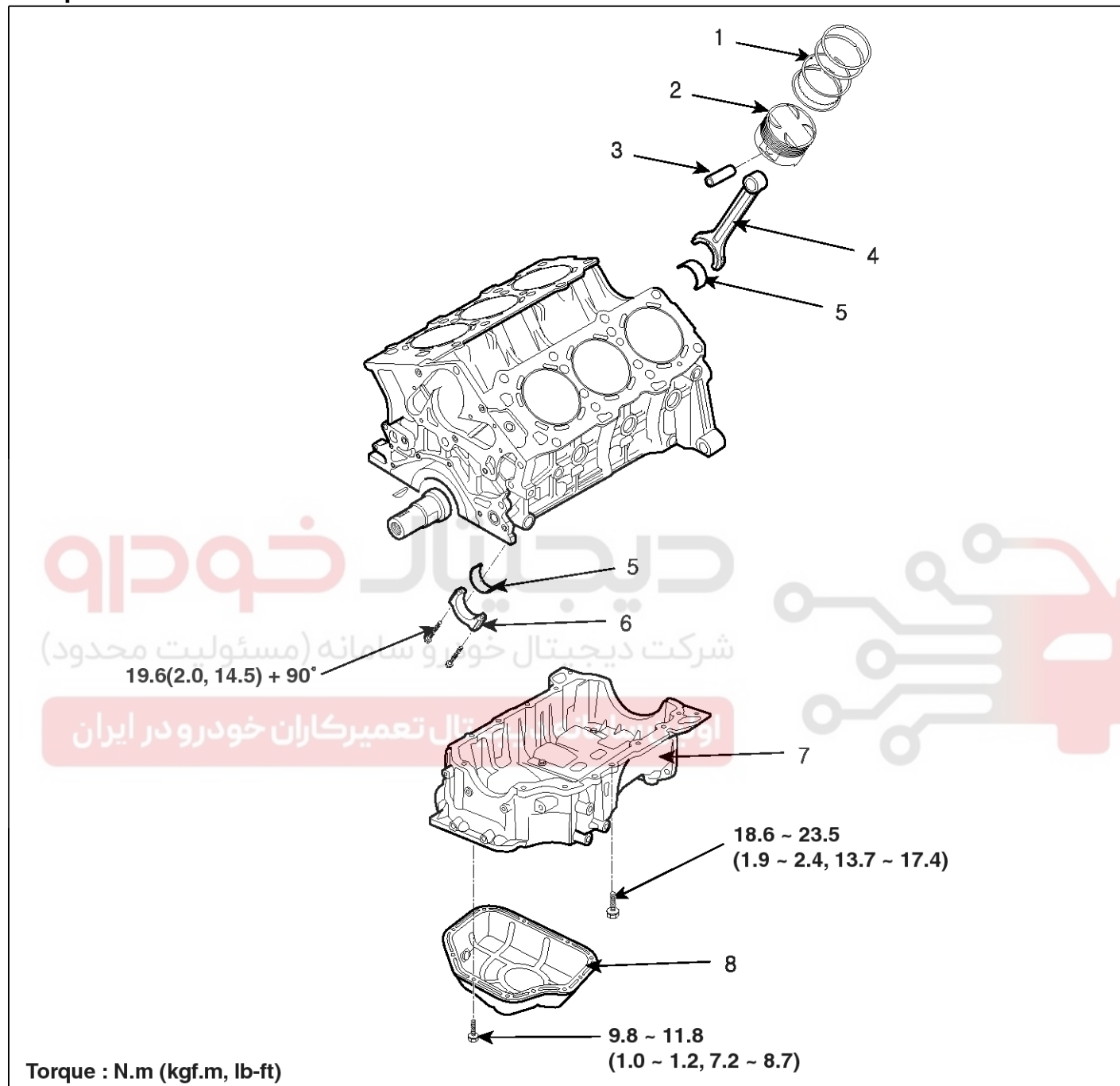
26. Refill engine coolant.

EMA-56

Engine Mechanical System

Cylinder Block

Components



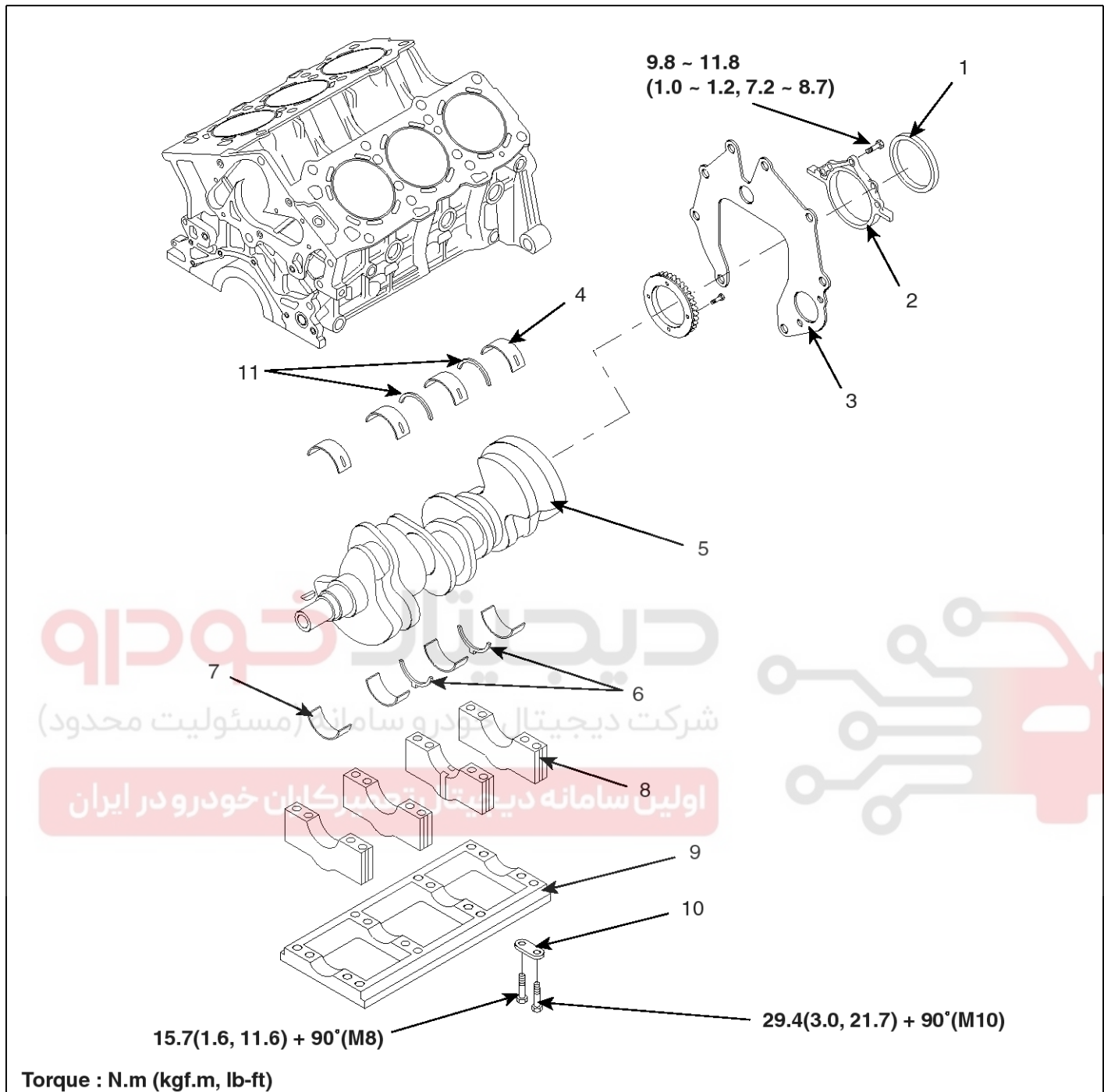
SMGM19013N

- 1. Piston ring
- 2. Piston
- 3. Piston pin
- 4. Connecting rod

- 5. Connecting rod bearing
- 6. Connecting rod cap
- 7. Upper oil pan
- 8. Lower oil pan

Cylinder Block

EMA-57



SMGM19014N

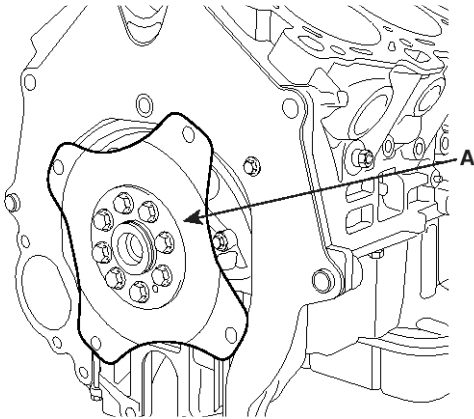
- | | |
|-----------------------------|-----------------------------|
| 1. Rear oil seal | 7. Crankshaft lower bearing |
| 2. Rear oil seal case | 8. Main bearing cap |
| 3. Rear plate | 9. Bearing cap bridge |
| 4. Crankshaft upper bearing | 10. Bearing cap bolt washer |
| 5. Crankshaft | 11. Upper thrust bearing |
| 6. Lower thrust bearing | |

EMA-58

Engine Mechanical System

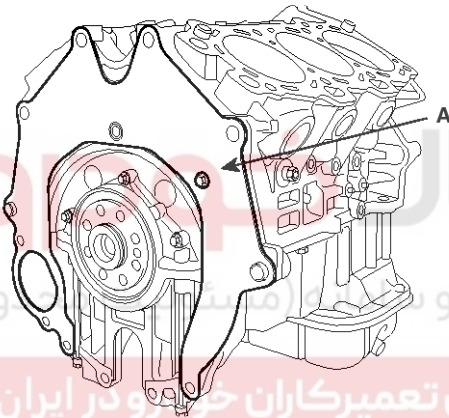
Removal

1. Remove the drive plate(A).



KCBF120A

2. Remove the rear plate(A).

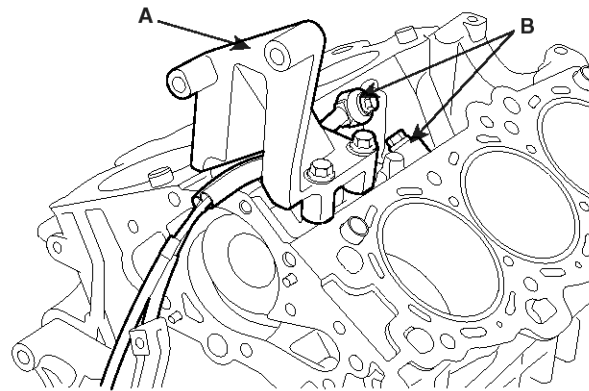


KCBF121A

3. Remove timing belt.
4. Remove intake manifold.
5. Remove exhaust manifold.
6. Remove generator from engine.(Refer to 'ST' group).
7. Remove power steering pump from engine.(Refer to 'HA' group).
8. Remove cylinder head.
9. Remove A/C compressor from engine.(Refer to 'EE' group).
- 10.Remove water pump assembly.

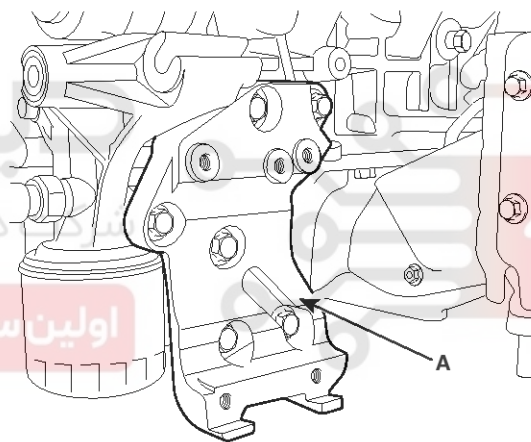
Disassembly

1. Remove the power steering pump bracket(A) and the knock sensor(B).



KCBF122A

2. Remove the air conditioning compressor bracket(A).

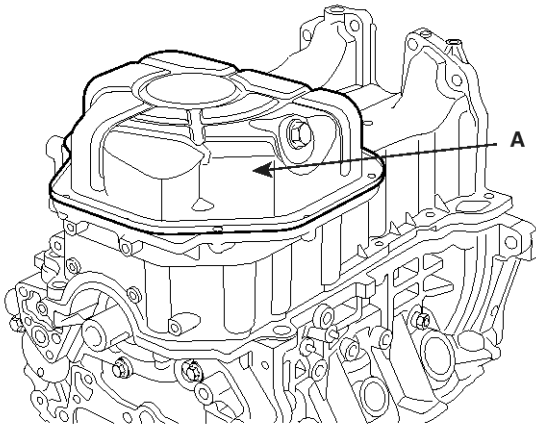


KCBF138A

Cylinder Block

EMA-59

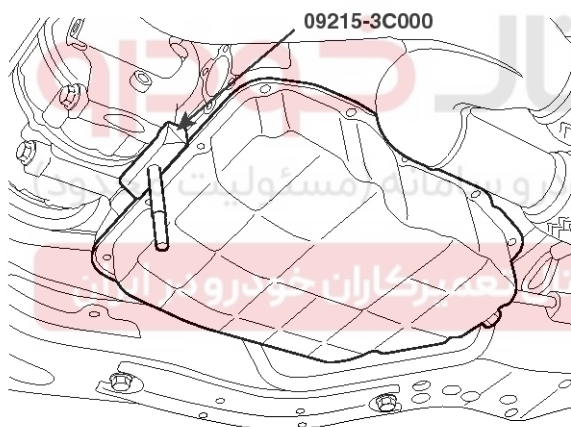
3. Remove the lower oil pan(A).



KCBF123A

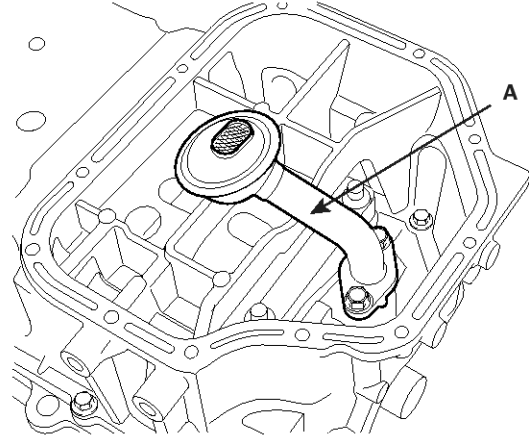
⚠ CAUTION

When removing the oil pan, use the SST(09215-3C000) not to damage the contacting surface of the oil pan.



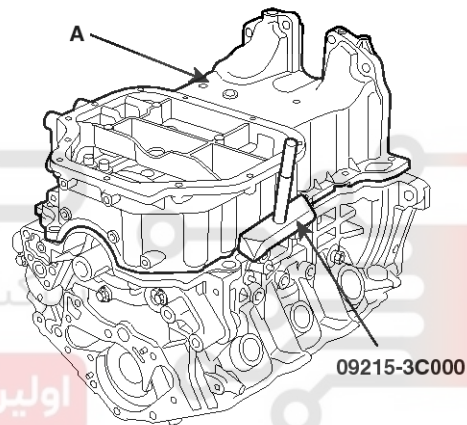
KCBF184A

4. Remove the oil screen(A).



KCBF124A

5. Remove the upper oil pan(A).



KCBF125B

⚠ CAUTION

When removing the oil pan, use the SST(09215-3C000) not to damage the contacting surface of the oil pan.

6. Check the connecting rod side clearance.
7. Check the connecting rod bearing oil clearance.
8. Remove the piston and connecting rod assemblies.

📌 NOTICE

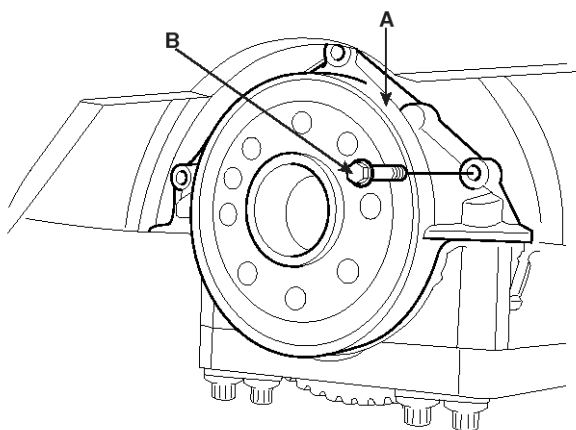
- Keep the bearings the connecting rods and the caps together.
- Arrange the piston and connecting rod assemblies in the correct order.

9. Remove the oil pump case.

EMA-60

Engine Mechanical System

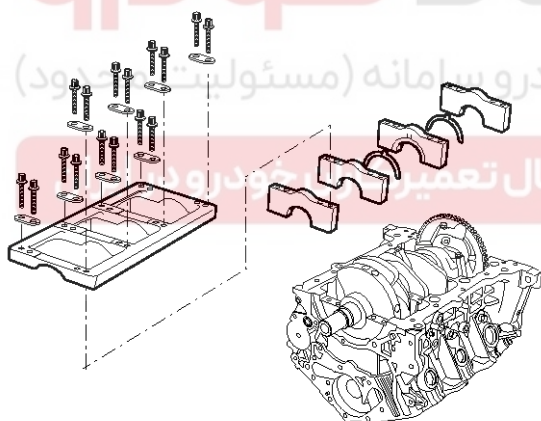
10. Remove the oil seal case(A).



EDQF174B

11. Check the crankshaft end play.

12. Remove the crankshaft bearing cap and check oil clearance.

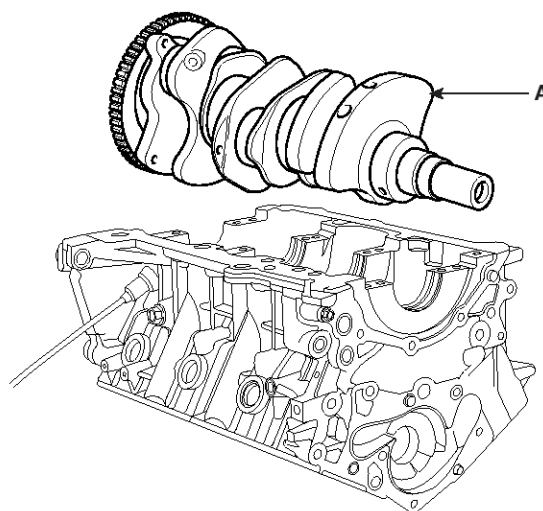


KCBF126A

NOTICE

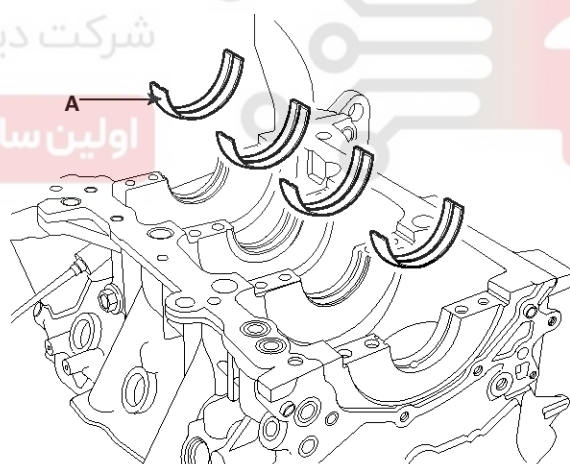
Arrange the bearings and the bearing caps in order.

13. Lift the crankshaft(A) out of the block, being careful not to damage journals.



EDQF074A

14. Remove and arrange the main bearings and thrust bearings in the correct order.

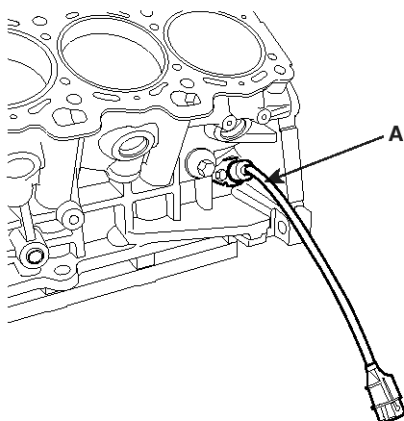


EDQF076A

Cylinder Block

EMA-61

15. Remove the CKP sensor(A).



KCBF128A

16. Check the free play between a piston and a piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and the piston pin as a set.

17. Remove the piston rings.

- 1) Using a piston ring expander, remove the 2 compression rings.
- 2) Remove the 2 side rails and the oil ring by hand.

NOTICE

Arrange the piston rings in the correct order only.

18. Disconnect the connecting rod from the piston.

Using a press, remove the piston pin from the piston.
(Press-in load : 2451.7 ~ 12258.3N(250 ~ 1250kg, 551.2 ~ 2755.81lb)

Inspection

Connecting Rod And Crankshaft

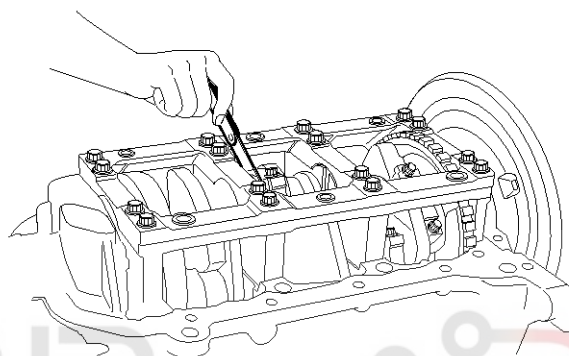
1. Check the connecting rod side clearance.

Using a feeler gauge, measure the side clearance while moving the connecting rod back and forth.

Specification

Standard : 0.1 ~ 0.25mm(0.0039 ~ 0.0098in.)

Limit : 0.4mm(0.0157in.)



EDQF159A

- If out-of-tolerance, install a new connecting rod.
 - If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
 - 1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
 - 2) Remove the 2 connecting rod cap bolts.
 - 3) Remove the connecting rod cap and the lower bearing.
 - 4) Clean the crankshaft pin journal and the bearing.
 - 5) Place a plastigage across the crankshaft pin.
 - 6) Reinstall the lower bearing and the connecting rod cap and torque the bolts.

Tightening torque

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 90~94°

NOTICE

Do not turn the crankshaft.

CAUTION

Always use new connecting rod cap bolts.

- 7) Remove the connecting rod cap again.

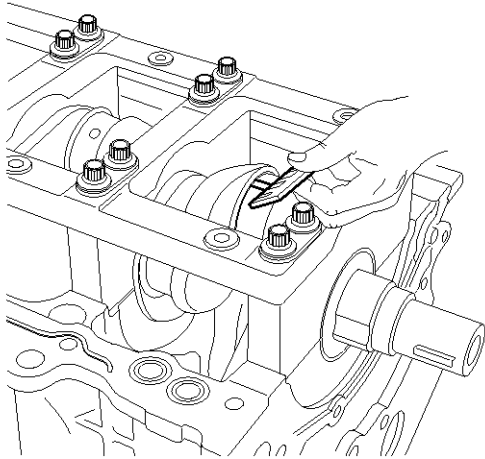
EMA-62

Engine Mechanical System

8) Measure the plastigage at its widest point.

Standard oil clearance

0.018 ~ 0.036mm(0.0007 ~ 0.0014in.)



EDQF175A

9) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

CAUTION

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

10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

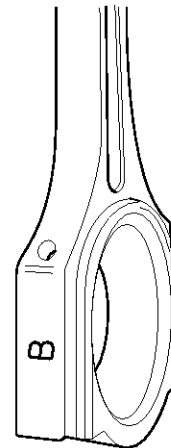
NOTICE

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

CAUTION

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

Connecting Rod Mark Location



EDQF196A

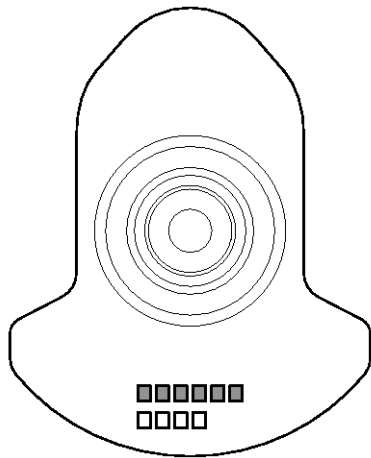
Discrimination Of Connecting Rod

Class	Mark	Inside Diameter
0	a	51.000 ~ 51.006mm (2.0079 ~ 2.0081in.)
1	b	51.006 ~ 51.012mm (2.0081 ~ 2.0083in.)
2	c	51.012 ~ 51.018mm (2.0083 ~ 2.0086in.)

Cylinder Block

EMA-63

Crankshaft Pin Mark Location Discrimination Of Crankshaft

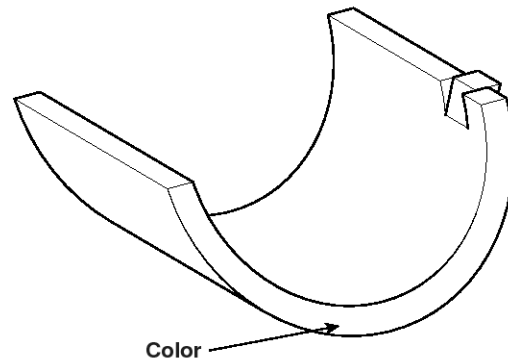


EDQF176B

Discrimination Of Crankshaft

Class	Mark	Outside Diameter Of Pin
I	1 or A	47.994 ~ 48.000mm (1.8895 ~ 1.8898in.)
II	2 or B	47.988 ~ 47.994mm (1.8893 ~ 1.8895in.)
III	3 or C	47.982 ~ 47.988mm (1.8891 ~ 1.8893in.)

Place Of Identification Mark (Connecting Rod Bearing)



ECRF021A

Discrimination Of Connecting Rod Bearing

Class	Mark	Thickness Of Bearing
A	Blue	1.5000 ~ 1.503mm (0.0591 ~ 0.0592in.)
B	Black	1.497 ~ 1.500mm (0.0589 ~ 0.0591in.)
C	-	1.494 ~ 1.497mm (0.0588 ~ 0.0589in.)
D	Green	1.491 ~ 1.494mm (0.0587 ~ 0.0588in.)
E	Yellow	1.488 ~ 1.491mm (0.0586 ~ 0.0587in.)

11) Select the proper connecting rod bearing from the table below.

		Connecting Rod Identification Mark		
		0(A)	1(B)	2(C)
Crankshaft Indentification Mark	I(A)	E (Yellow)	D (Green)	C (-)
	II(B)	D (Green)	C (-)	B (Black)
	III(C)	C (-)	B (Black)	A (Blue)

EMA-64

Engine Mechanical System

3. Check the connecting rod.
 - 1) When reinstalling, check the cylinder numbers on the connecting rods and the caps. When installing a new connecting rod, the notches for bearing fixing on the connecting rods and caps should face the same direction.
 - 2) If one or both edge of the connecting rod thrust surface is damaged, replace the rod. If the inner surface of the rod is damaged or rough, also replace it.
 - 3) Using a connecting rod aligner, measure the bent or torsion of the rod. If the measurement is near the specification, adjust the rod with a press. If the rod is bent or twisted excessively, replace it.

Bending : 0.05mm/100mm(0.0020in./3.9370in.)

Torsion : 0.1mm/100mm(0.0039in./3.9370in.)

NOTICE

When assembling the rod without a bearing, there should be no difference.

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

Tightening torque

M8 : 12.7~18.6Nm (1.3~1.9kgf.m, 9.4~13.7lb-ft) + 90~95°

M10 : 26.5~32.4Nm (2.7~3.3kgf.m, 19.5~23.9lb-ft) + 90~95°

NOTICE

Tighten the bolts in order.

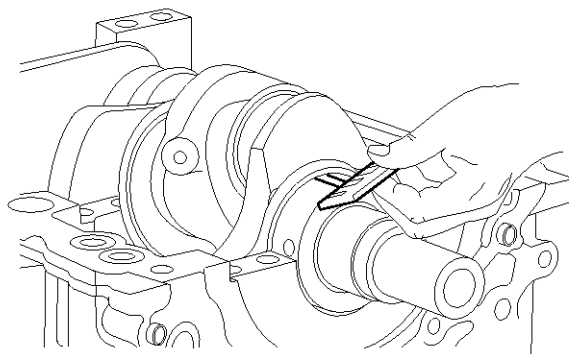
CAUTION

Always use new main bearing cap bolts.

- 5) Remove the cap and bearing again, and measure the widest part of the plastigage.

Standard oil clearance

0.004~ 0.022mm (0.0002 ~ 0.0009in.)



EDQF075A

- 6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

CAUTION

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

Cylinder Block

EMA-65

7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

NOTICE

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

CAUTION

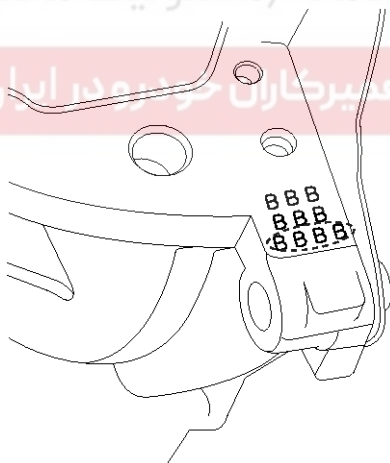
If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the each size of the 4 main journal bores.

No.1 journal stamping mark starts from the front of the engine.

Use the size marks which are stamped on the block and the crankshaft for the journal bore inner diameter and the journal outer diameter to choose the correct bearings.



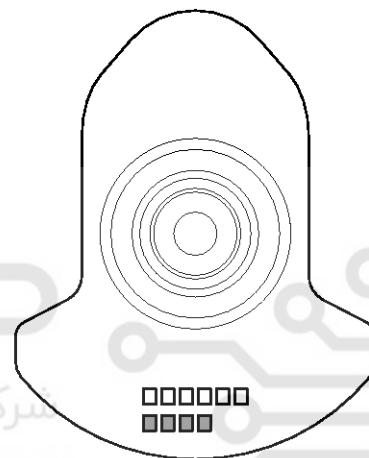
EDQF078A

Discrimination Of Cylinder Block

Class	Mark	Inside Diameter
a	A	66.000 ~ 66.006mm (2.5984 ~ 2.5987in.)
b	B	66.006 ~ 66.012mm (2.5987 ~ 2.5989in.)
c	C	66.012 ~ 66.018mm (2.5989 ~ 2.5991in.)

Crankshaft Journal Mark Location

Discrimination Of Crankshaft



EDQF176A

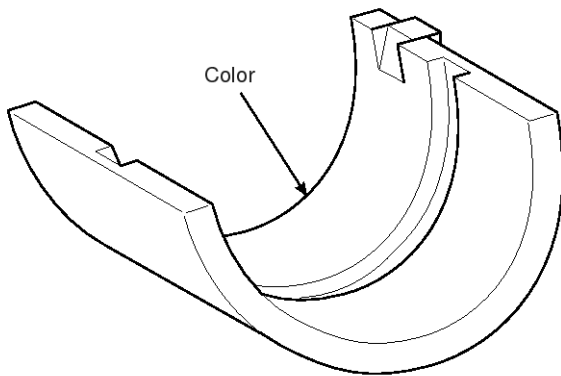
Discrimination Of Crankshaft

Class	Mark	Outside Diameter Of Journal
I	A	61.994 ~ 62.000mm (2.4407 ~ 2.4409in.)
II	B	61.988 ~ 61.994mm (2.4405 ~ 2.4407in.)
III	C	61.982 ~ 61.988mm (2.4402 ~ 2.4405in.)

EMA-66

Engine Mechanical System

Place Of Identification Mark (Crankshaft Bearing)



ECRF022A

Discrimination Of Crankshaft Bearing

Class	Mark	Thickness Of Bearing
A	Blue	2.007 ~ 2.010mm (0.0790 ~ 0.0791in.)
B	Black	2.004 ~ 2.007mm (0.0789 ~ 0.0790in.)
C	-	2.001 ~ 2.004mm (0.0788 ~ 0.0789in.)
D	Green	1.998 ~ 2.001mm (0.0787 ~ 0.0788in.)
E	Yellow	1.995 ~ 1.998mm (0.0785 ~ 0.0787in.)

Selection Table

		Crankshaft Bore Identification Mark		
		a(A)	b(B)	c(C)
Crankshaft Identification Mark	I(A)	E (Yellow)	D (Green)	C (-)
	II(B)	D (Green)	C (-)	B (Black)
	III(C)	C (-)	B (Black)	A (Blue)

5. Check crankshaft end play.

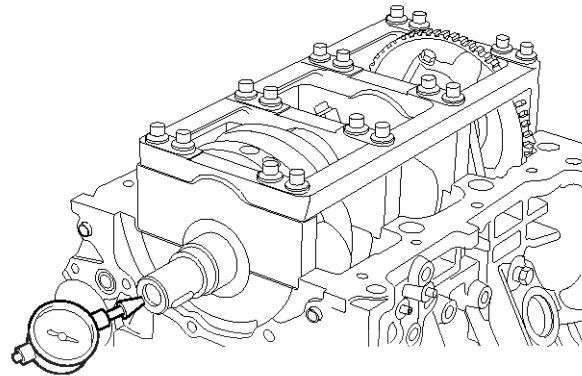
Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard end play

0.07 ~ 0.25mm (0.0028 ~ 0.0098in.)

[Limit]

0.3mm(0.0118in.)



KCBF127A

If the end play is greater than the maximum, replace the center bearing.

Thrust bearing thickness

1.925 ~ 1.965mm(0.0758 ~ 0.0774in.)

Cylinder Block

EMA-67

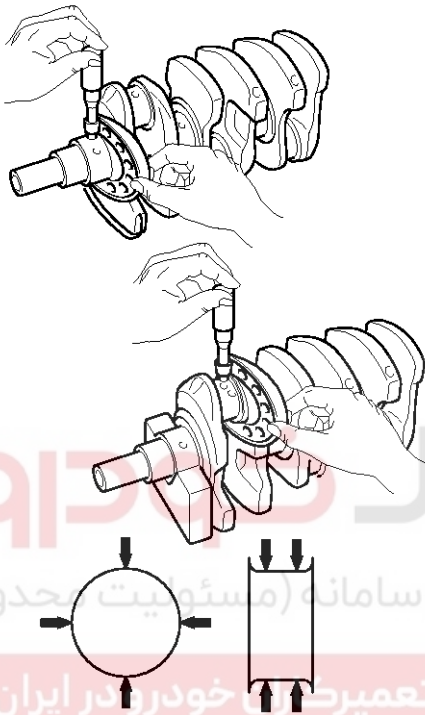
6. Inspect the main journals and the pin journals of the crankshaft.
7. Using a micrometer, measure the outer diameter of each main journal and pin journal.

Main journal diameter :

61.982~ 62.000mm (2.4402 ~ 2.4409in.)

Crank pin diameter :

47.982 ~ 48.000mm (1.8891 ~ 1.8898in.)



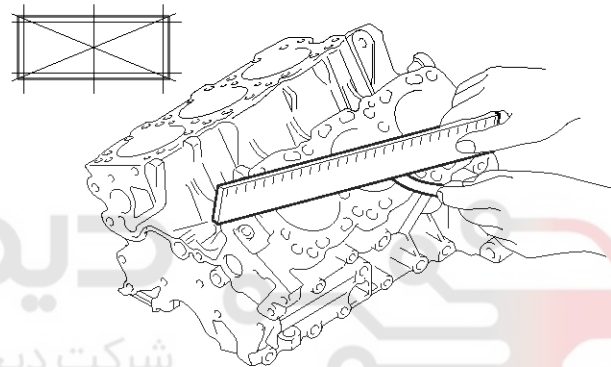
KCRF212A

Cylinder Block

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

Flatness of cylinder block gasket surface

Standard : 0.03mm(0.0012in.) or less



LDLG044A

4. Inspect cylinder bore diameter
Visually check the cylinder for vertical scratches.
If deep scratches are present, replace the cylinder block or process the piston to be oversized.

EMA-68

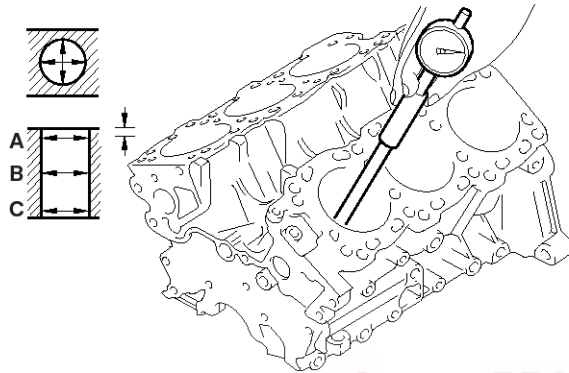
Engine Mechanical System

5. Inspect the cylinder bore diameter

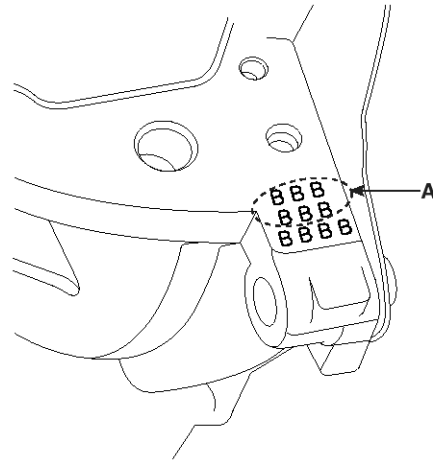
Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial directions.

Standard diameter

86.70 ~ 86.73mm (3.4134 ~ 3.4146in.)



6. Check the cylinder bore size code(A) on the cylinder block.

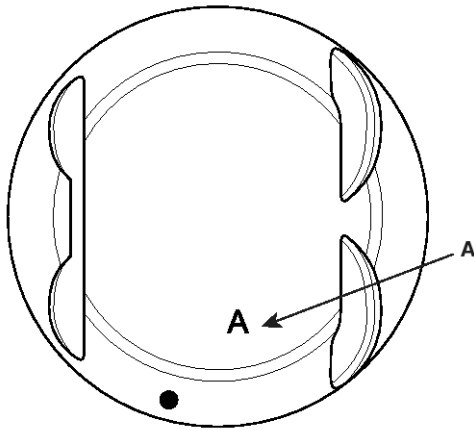


Class	Size code	Cylinder bore inner diameter
A	A	86.70 ~ 86.71mm (3.4134 ~ 3.4138in.)
B	B	86.71 ~ 86.72mm (3.4138 ~ 3.4142in.)
C	C	86.72 ~ 86.73mm (3.4142 ~ 3.4146in.)

Cylinder Block

EMA-69

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



KCBF176D

Class	Size code	Piston outer diameter
A	A	86.67 ~ 86.68mm (3.4122 ~ 3.4126in.)
B	B	86.68 ~ 86.69mm (3.4126 ~ 3.4130in.)
C	C	86.69 ~ 86.70mm (3.4130 ~ 3.4134in.)

8. Select the proper piston related to the cylinder bore class.

Clearance : 0.02 ~ 0.04mm(0.0008 ~ 0.0016in.)

Cylinder Boring

1. The over size piston is chosen on the maximum inner diameter of the cylinder.

NOTICE

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

2. Measure the outer diameter of the piston which is installed before.
3. Calculate the new bore size with the measurement in the step 2.

New bore size = measured outer diameter of piston + 0.02 ~ 0.04mm(0.0008~0.0016in.)[clearance] - 0.01mm(0.0004in.)[for honing]

4. Bore the cylinder to the calculated size.

CAUTION

Bore the cylinders in firing order to prevent the cylinders from be twisted by high temperature.

5. Stop boring and start honing for the proper clearance.
6. Measure the clearance between a piston and a cylinder.

Specification

0.02 ~ 0.04mm(0.0008 ~ 0.0016in.)

NOTICE

Bore all the cylinders with the same over size.

EMA-70

Engine Mechanical System

Piston And Rings

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

NOTICE

Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 14 mm (0.5512 in.) from the bottom of the piston.

Standard diameter

86.67 ~ 87.00(3.4122 ~ 3.4252in.)



LDLG045A

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

Piston-to-cylinder clearance

0.02 ~ 0.04mm(0.0008 ~ 0.0016in.)

4. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between a new piston ring and the ring groove.

Piston ring side clearance

Standard

No.1 : 0.04 ~ 0.08mm (0.0016 ~ 0.0031in.)

No.2 : 0.03 ~ 0.07mm (0.0012 ~ 0.0027in.)

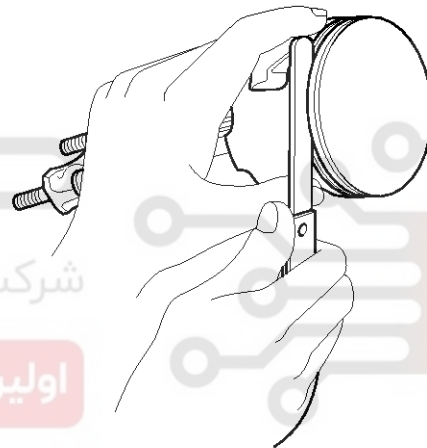
Oil ring : 0.06 ~ 0.15mm (0.0024 ~ 0.0059in.)

Limit

No.1 : 0.1mm (0.004in.)

No.2 : 0.1mm (0.004in.)

Oil ring : 0.2mm (0.008in.)



LDLG045A

If the clearance is greater than the maximum, replace the piston.

Cylinder Block

EMA-71

5. Inspect 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 ring. If the gap is too large, recheck the cylinder bore diameter. If the bore is over the service limit, the cylinder block must be replaced or bored

Piston ring end gap

Standard

No.1 : 0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)

No.2 : 0.30 ~ 0.45mm (0.0118 ~ 0.0177in.)

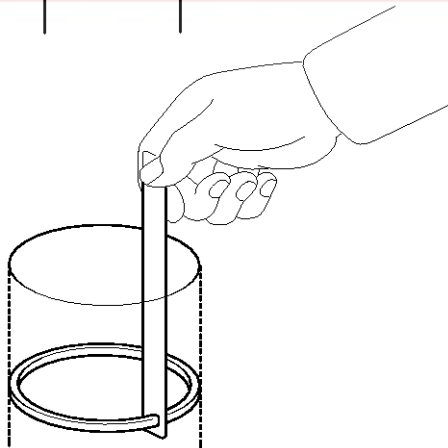
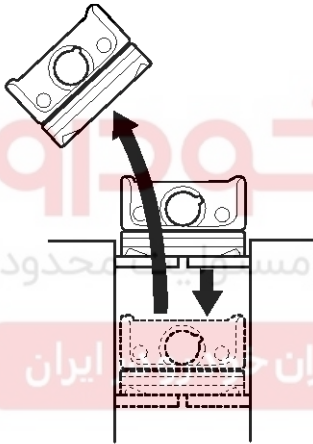
Oil ring : 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)

Limit

No.1 : 0.6mm (0.0236in.)

No.2 : 0.7mm (0.0275in.)

Oil ring : 0.8mm (0.0315in.)



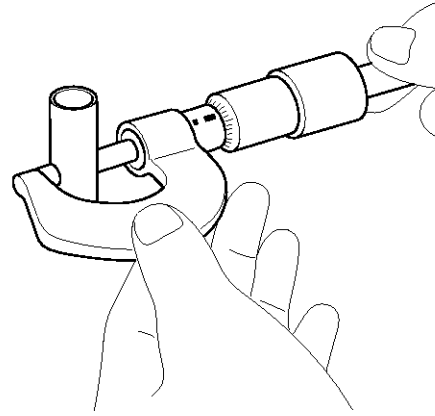
ECKD001K

Piston Pins

1. Measure the outer diameter of the piston pin.

Piston pin outerdiameter

21.001 ~ 21.007mm (0.8268 ~ 0.8270in.)



ECKD001Z

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

Piston pin-to-piston clearance

0.011 ~ 0.018mm (0.0004 ~ 0.0007in.)

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

Piston pin-to-connecting rod interference

-0.033 ~ -0.016mm (-0.0013 ~ -0.0006in.)

EMA-72

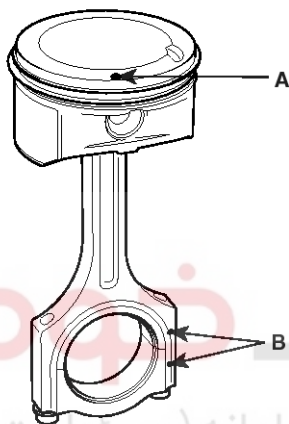
Engine Mechanical System

Reassembly

NOTICE

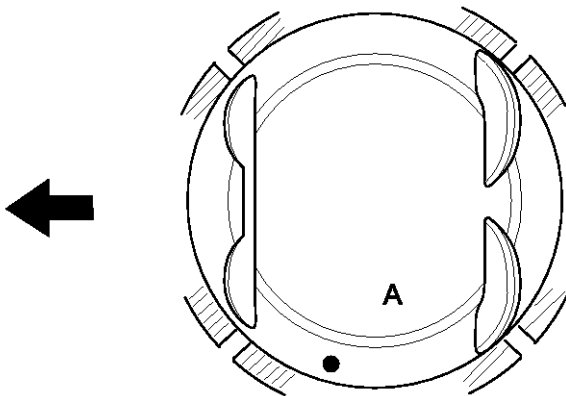
- Thoroughly clean all parts before reassembling.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

1. Assemble the piston and the connecting rod.
 - 1) Use a hydraulic press for installation.
 - 2) The piston front mark(A) and the connecting rod front mark must face the timing belt side of the engine.



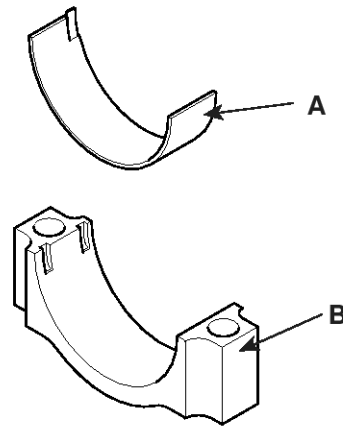
KCBF176E

2. Install piston rings.
 - 1) Install the oil ring spacer and 2 side rails by hand.
 - 2) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 - 3) Position the piston rings so that the ring ends are as shown.



KCBF176F

3. Install the connecting rod bearings.
 - 1) Align the bearing(A) claw with the groove of the connecting rod or connecting rod cap(B).
 - 2) Install the bearings(A) in the connecting rod and connecting rod cap(B).



KCRF118B

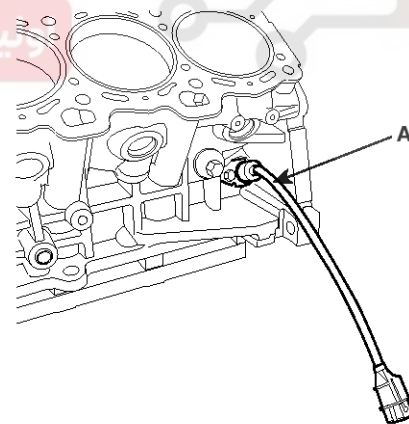
CAUTION

When reassembling the connecting rods and the caps, ensure the front marks on them.

4. Install the CKP sensor(A).

Tightening torque :

6.9 ~ 9.8Nm(0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



KCBF128A

Cylinder Block

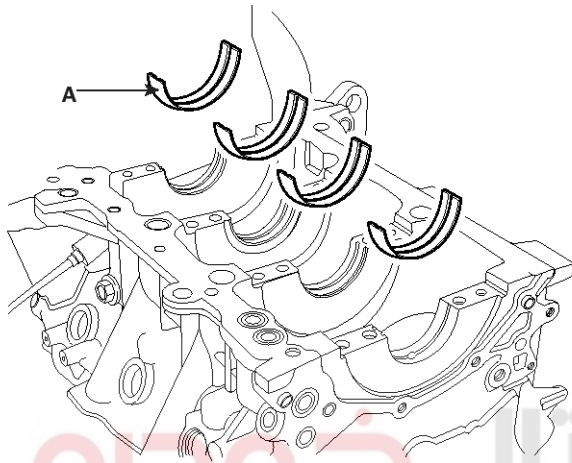
EMA-73

5. Install main bearings.

NOTICE

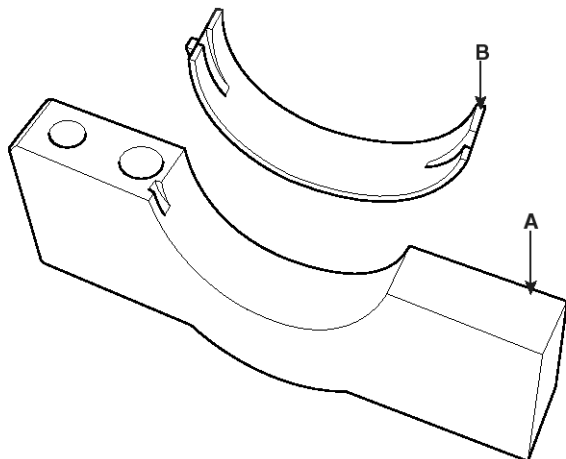
Upper bearings have the oil grooves of the oil holes; Lower bearings do not.

- 1) Aligning the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings(A).



EDQF076A

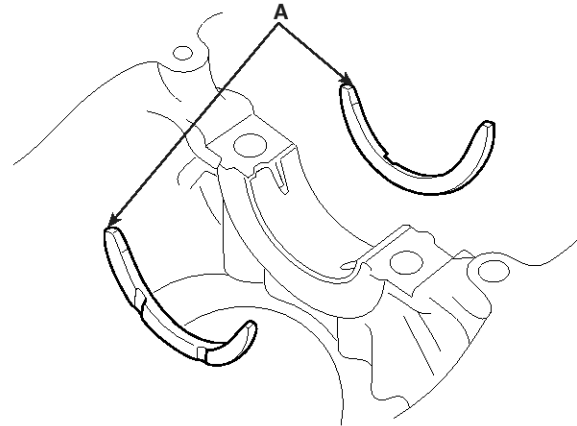
- 2) Aligning the bearing claw with the claw groove of the main bearing cap, push in the 4 lower bearings(B) on the bearing caps(A).



EDQF079A

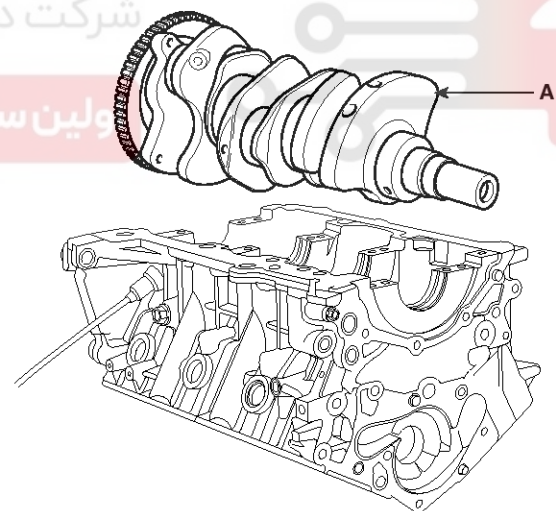
6. Install thrust bearings.

Install the 2 thrust bearings(A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

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



EDQF074A

EMA-74

Engine Mechanical System

8. Place main bearing caps on cylinder block.
9. Install main bearing cap bolts.
 - 1) Install and uniformly tighten the bearing cap bolts, in two steps, in the sequence shown.

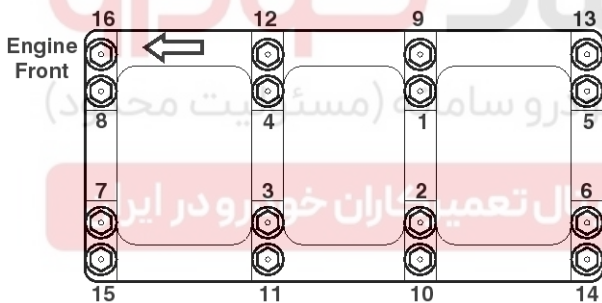
Tightening torque

M8 : 12.7~18.6Nm (1.3~1.9kgf.m, 9.4~13.7lb-ft) + 90~95°

M10 : 26.5~32.4Nm (2.7~3.3kgf.m, 19.5~23.9lb-ft) + 90~95°

NOTICE

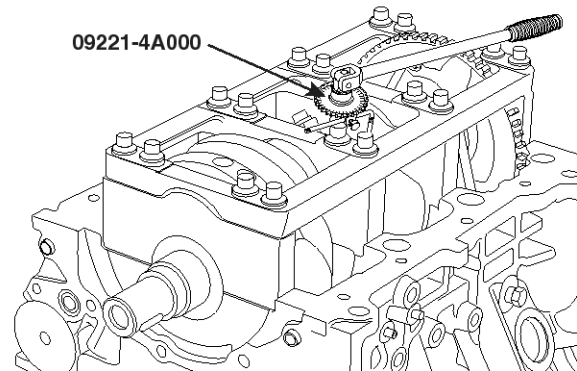
- Use new main bearing cap bolt with engine oil applied.
- If any of the bearing cap bolts are broken or deformed, replace it.
- Washers have their direction(Up/Down)
- Assemble the bearing cap bridge on which its arrow mark faces the engine front.
- Before tightening, make the bearing caps be seated on the block firmly.



LDLG046A

NOTICE

Use SST(09221-4A000), install main bearing cap bolts.



KCBF127B

- 2) Check that the crankshaft turns smoothly.
10. Check crankshaft end play.
11. Install the piston and connecting rod assemblies.

NOTICE

- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.
- When installing the piston, ensure that the coat on the cylinder wall is not damaged or scratched.

- 1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- 2) Stop inserting the piston when the ring inserted in the cylinder and check the alignment of the journal and the connecting rod.

Cylinder Block

EMA-75

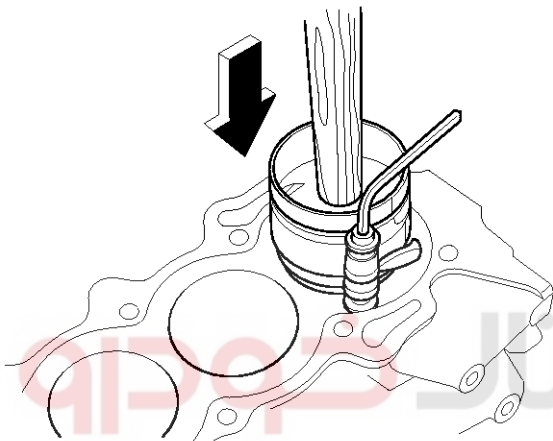
- 3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 90~94°

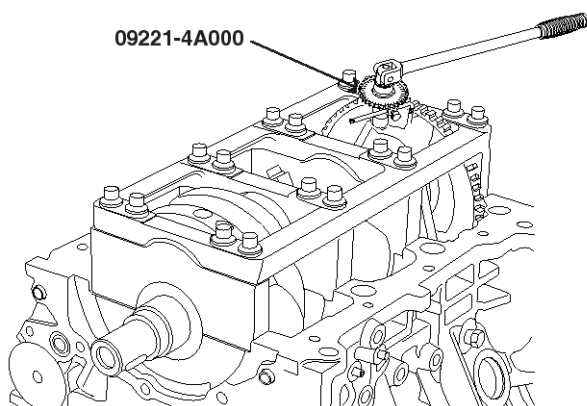
NOTICE

- Always use new connecting rod bolts.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

- Use SST(09221-4A000), install connecting rod bearing cap bolts.

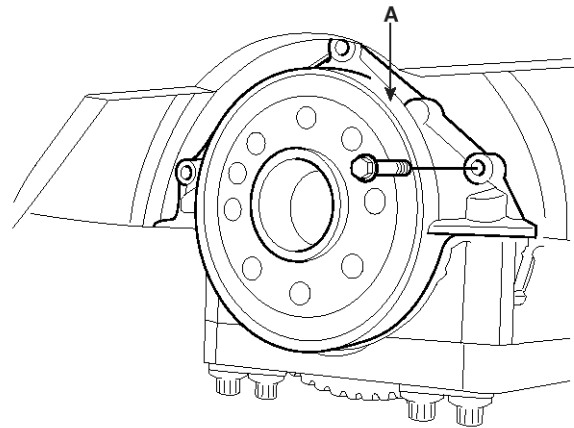


KCBF127C

12. Install the rear oil seal case.

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lb-ft)

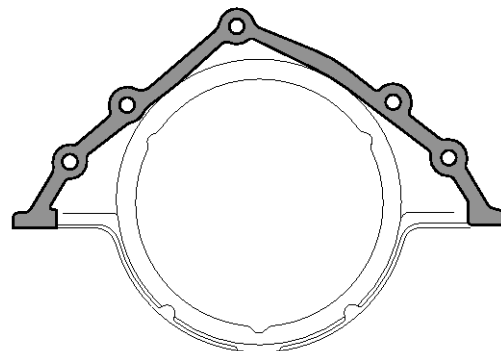


EDQF174A

- 1) Make clean the sealing face before assembling two parts.

NOTICE

- Remove harmful foreign materials on the sealing face before applying sealant
 - Apply sealant to the inner threads of the bolt holes.
- 2) Assembling rear oil seal case, the liquid sealant TB1217H should be applied to the rear oil seal case.
- The part must be assembled within 5 minutes after sealant was applied.



KCBF129A

EMA-76

Engine Mechanical System

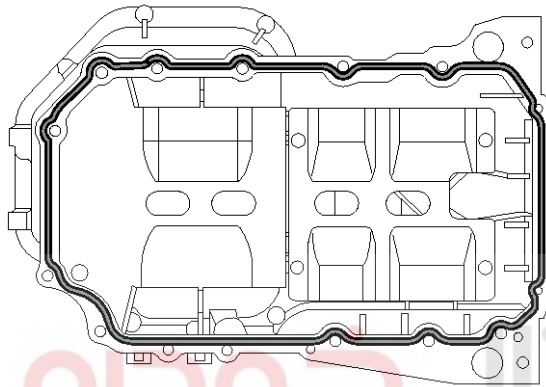
13. Using SST(09231-33000), install rear oil seal after applying engine oil on the rip of the oil seal.

14. Install the oil pump case.

15. Install upper oil pan.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) Before assembling the oil pan, the liquid sealant TB1217H should be applied on upper oil pan.

The part must be assembled within 5 minutes after the sealant was applied.



KCBF130A

NOTICE

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

3) Install upper oil pan.

Uniformly tighten the bolts in several passes.

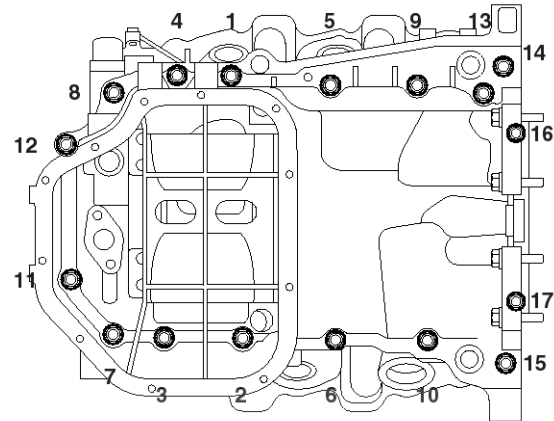
Tightening torque

Bolts 1~15 :

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

Bolts 16, 17 :

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

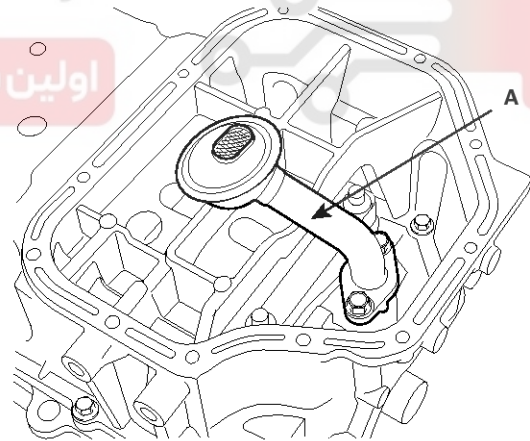


KCBF131A

16. Install the oil screen(A).

Tightening torque

14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



KCBF124A

Cylinder Block

EMA-77

17. Install the lower oil pan.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) Before assembling the oil pan, the liquid sealant TB1217H should be applied on lower oil pan.

The part must be assembled within 5 minutes after the sealant was applied.

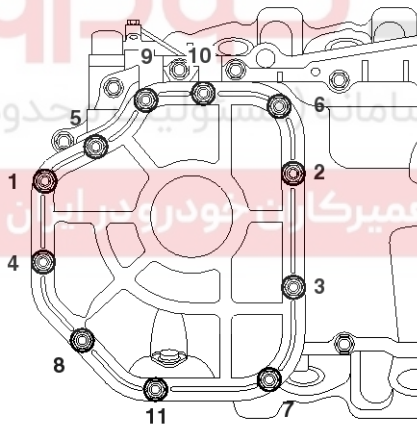
NOTICE

- Clean the sealing face before assembling two parts.
 - Remove harmful foreign materials on the sealing face before applying sealant.
 - When applying sealant gasket, sealant must not protrude into the inside of oil pan.
 - To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- 3) Install lower oil pan.

Uniformly tighten the bolts in several passes.

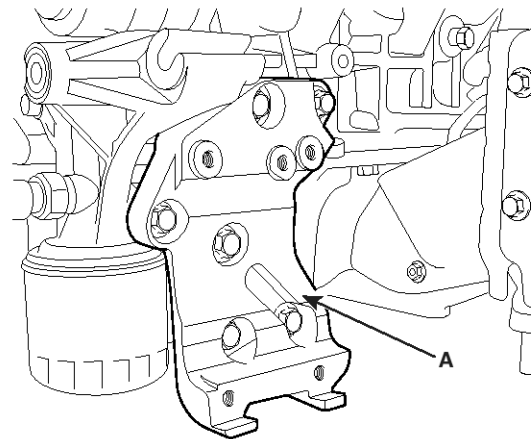
Tightening torque

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



KCBF133A

18. Install the air conditioning compressor bracket(A).
(Refer to 'HA' group)

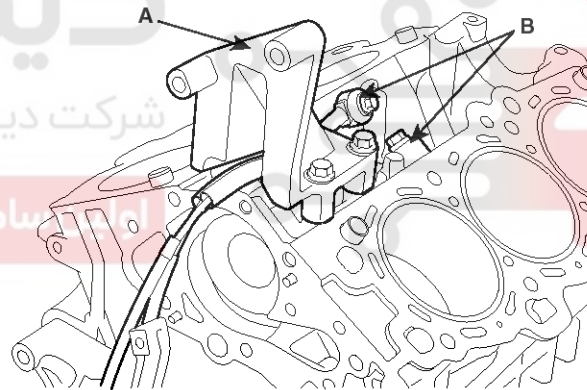


KCBF138A

19. Install the power steering pump bracket(A) and the knock sensor(B).

Tightening torque

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



KCBF122A

CAUTION

- On Bank 1, the black knock sensor connector should be installed and on Bank 2, the gray one should.

EMA-78

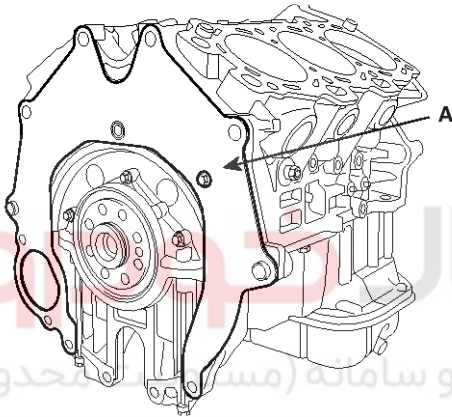
Engine Mechanical System

Installation

1. Install the water pump.
2. Install the air conditioning compressor.(Refer to 'HA' group).
3. Install the cylinder head.
4. Install the power steering pump.(Refer to 'ST' group).
5. Install the generator.
6. Install the intake manifold.
7. Install the exhaust manifold.
8. Install the timing belt.
9. Install the rear plate(A).

Tightening torque

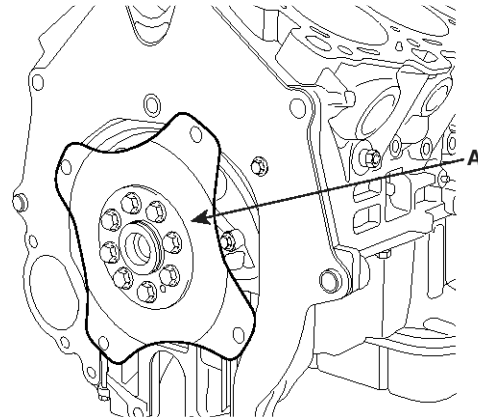
9.8 ~ 11.8Nm(1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



10. Install the drive plate(A).

Tightening torque

71.6 ~ 75.5Nm(7.3 ~ 7.7kgf.m, 52.8 ~ 55.7lb-ft)



KCBF120A



شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

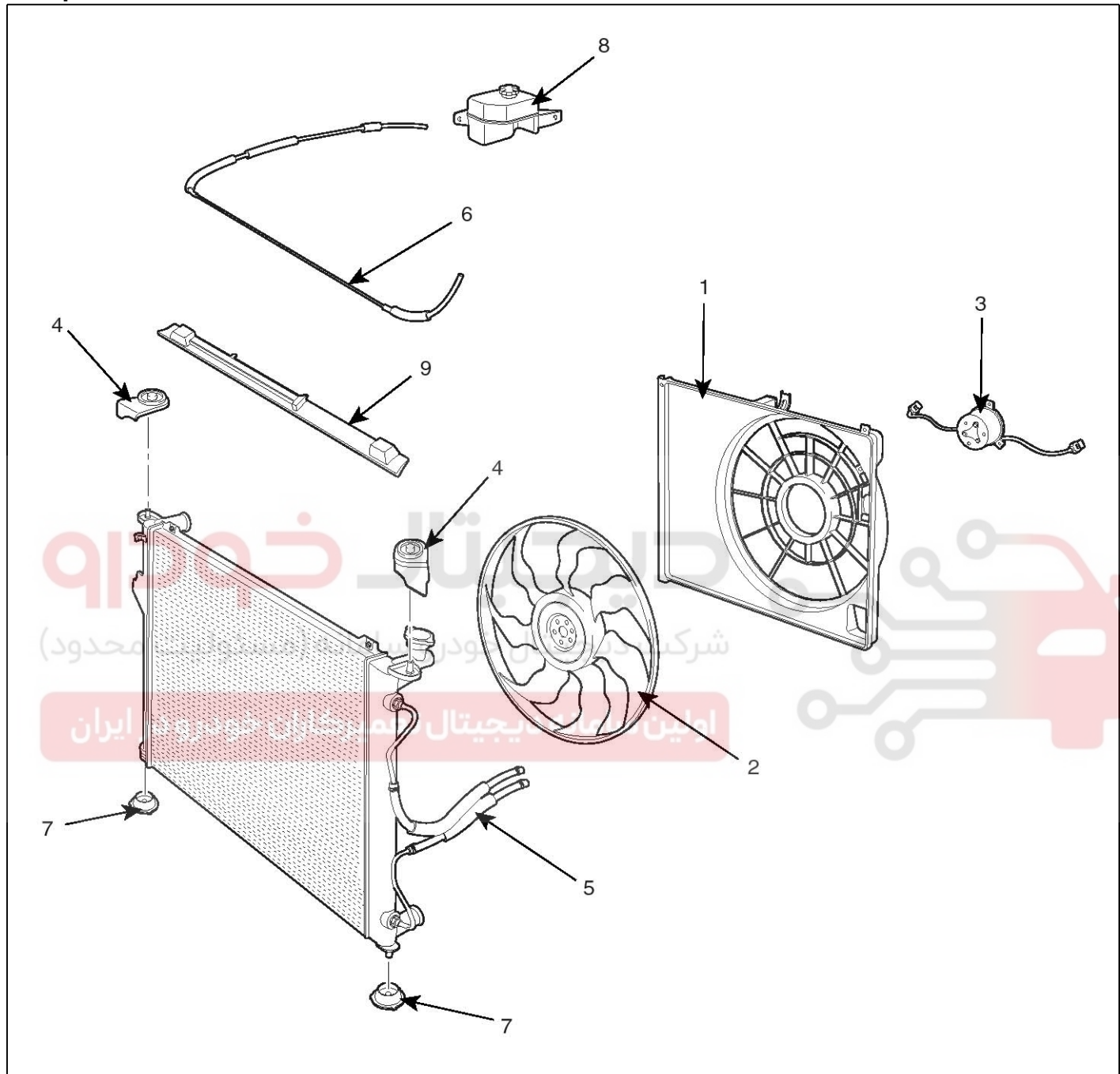
KCBF121A

Cooling System

EMA-79

Cooling System

Components

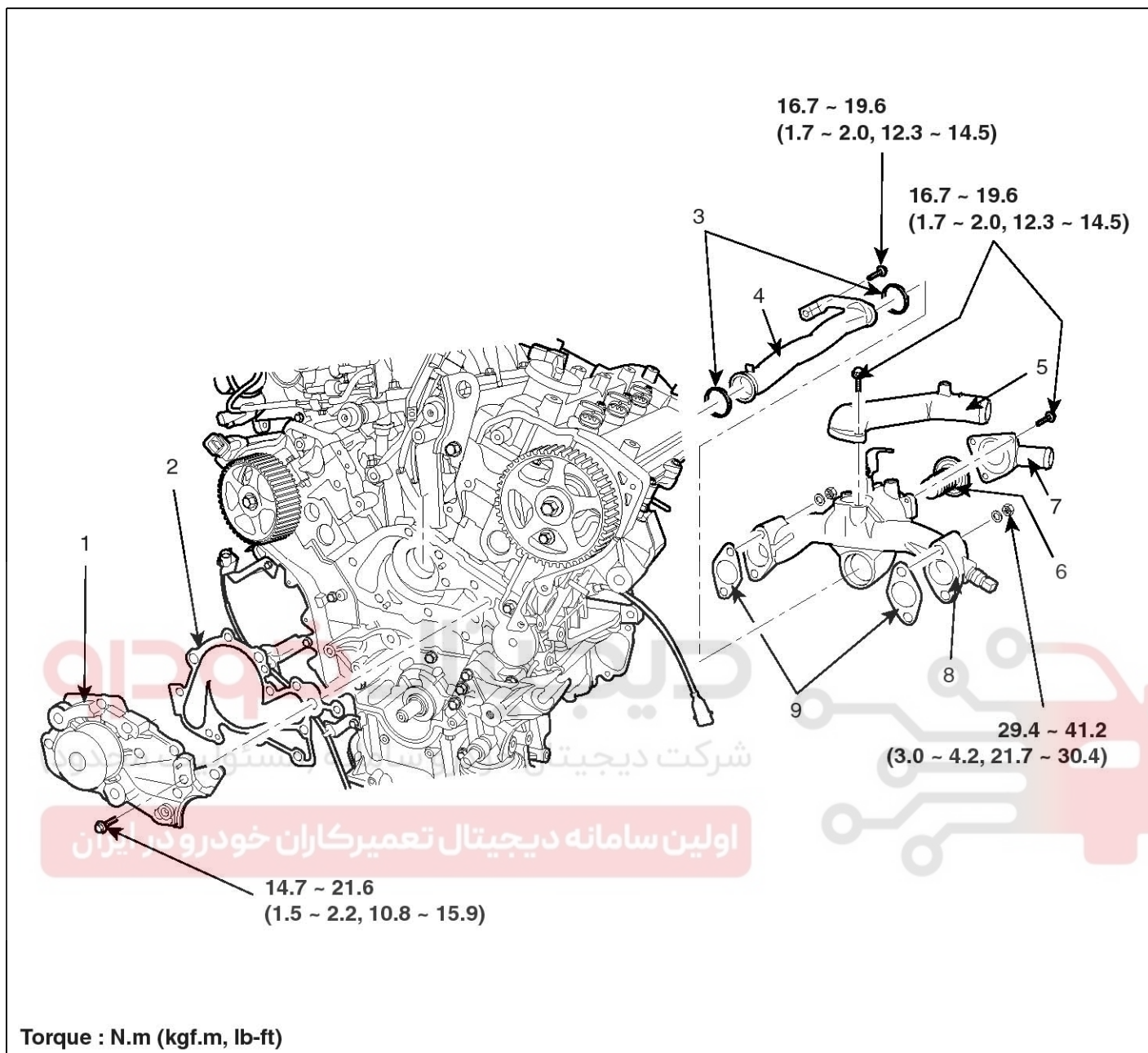


SMGM19015N

- | | | |
|-------------------|------------------------------------|--------------------------------------|
| 1. Fan cover | 4. Radiator upper mounting bracket | 7. Radiator lower mounting insulator |
| 2. Fan | 5. Oil cooler assembly | 8. Radiator reservoir |
| 3. Motor assembly | 6. Water pipe assembly | 9. Cover |

EMA-80

Engine Mechanical System



SMGM19016N

- 1. Water pump
- 2. Water pump gasket
- 3. Water pipe O-ring

- 4. Water inlet pipe
- 5. Water outlet fitting
- 6. Thermostat

- 7. Water inlet fitting
- 8. Water temp. control assembly
- 9. Water temp. control assembly gasket

Cooling System

EMA-81

Engine Coolant Refilling And Bleeding

⚠WARNING

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.

⚠CAUTION

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.

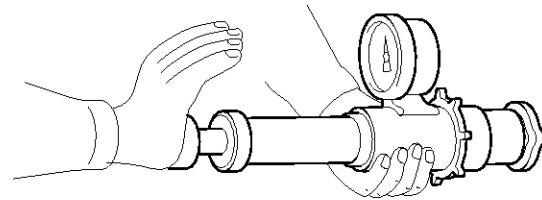
1. Make sure the engine and radiator are cool to the touch.
2. Open the radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.
5. Remove, drain and clean the reservoir tank.
6. Fill water slowly through the radiator cap. Push the upper/lower hoses of the radiator so as to bleed air easily.
7. Warm the engine until the cooling fan operates 2~3 times.
Accelerate the engine 2~3 times without load.
8. Wait until the engine is cold.
9. Repeat the steps 1~8 until the water drained is clean.
10. Fill fluid mixture with coolant and water(4 : 6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as to bleed air easily.
11. Start the engine and run so coolant circulates.
When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
12. Repeat 11 until the cooling fan cycles 3 ~ 5 times and bleed air sufficiently out of the cooling system.
13. Install the radiator cap and fill the reservoir tank to the "MAX"(or "F") line with coolant.
14. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
15. Stop the engine and wait until coolant gets cool.
16. Repeat 10 to 15 until the coolant level doesn't fall any more, bleeding air out of the cooling system.

📌NOTICE

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

Cap Testing

1. Remove the radiator cap, wet its seal with engine coolant, and install it to a pressure tester.



ECKD501X

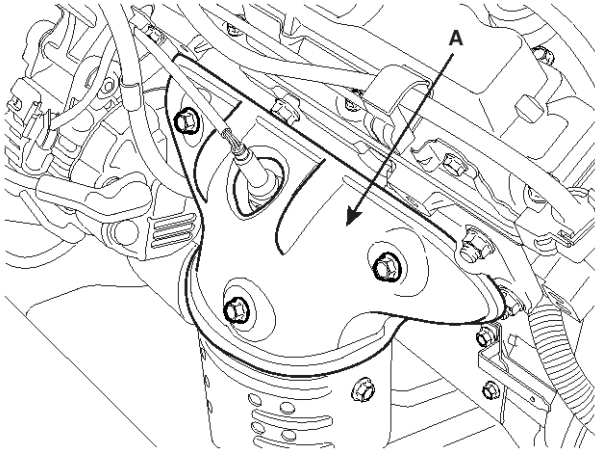
2. Apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm², 14 ~ 19psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

EMA-82

Engine Mechanical System

Testing

1. Wait until engine is cool, then carefully remove the radiator cap. Fill the radiator with engine coolant and install a pressure tester on it.



KDRF184A

2. Apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm² 14 ~18psi).
3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTICE

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

Removal

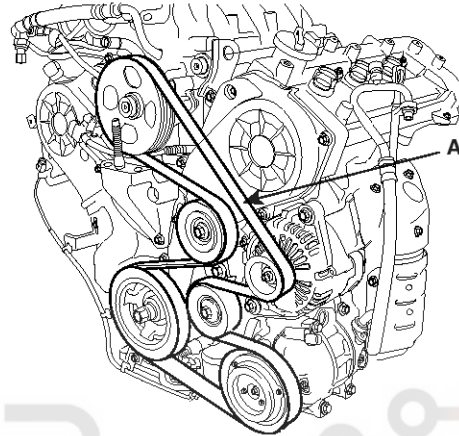
Water Pump

1. Drain the engine coolant.

WARNING

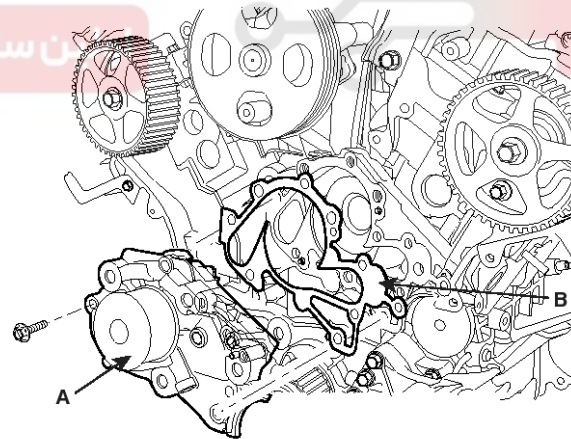
System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove drive belt(A).



KCBF105A

3. Remove the timing belt.
4. Remove the water pump(A) and gasket(B).



KCBF136A

CAUTION

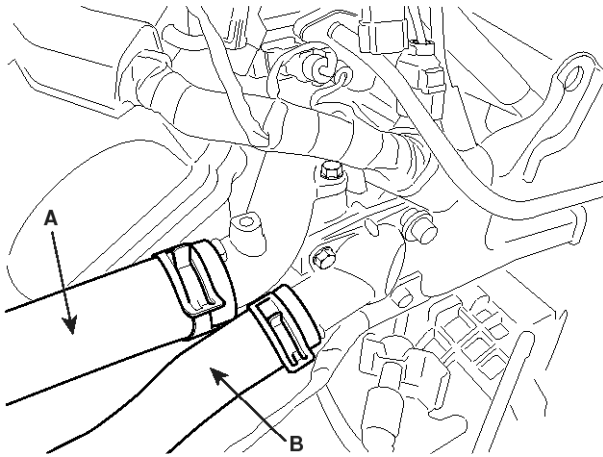
Do not reuse the water pump gasket disassembled.

Cooling System

EMA-83

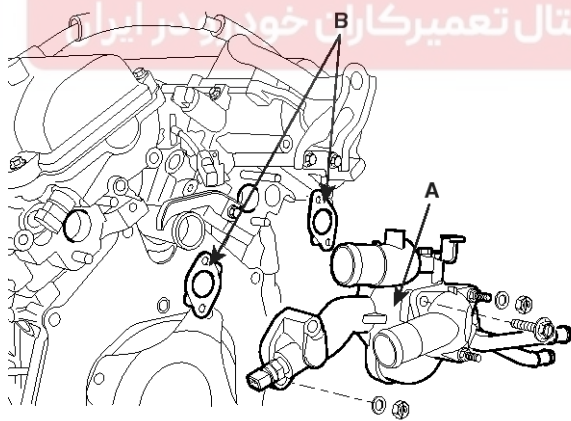
Water Temperature Control Assembly

1. Drain the engine coolant.
2. Remove the air cleaner assembly.
3. Disconnect the radiator upper and lower hose(A, B).



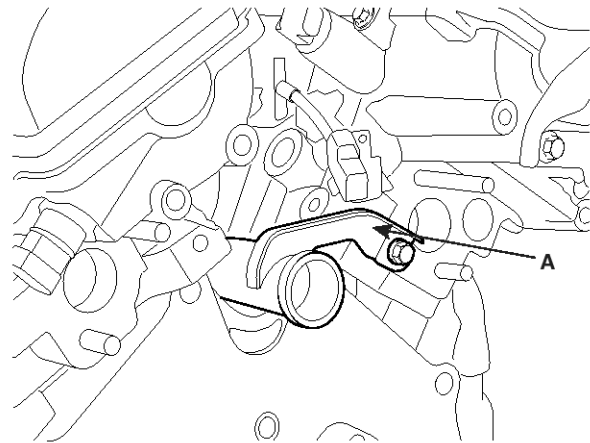
LDLG008A

4. Disconnect the ECT(Engine Coolant Temperature) sensor connector.
5. Remove the coolant hose related to the heater hoses and the ECT(Engine Coolant Temperature) system.
6. Remove wiring protector.
7. Remove water temperature control assembly(A) and the gaskets(B).



SMGM16012N

8. Remove the water pipe(A).



KCBF140A

EMA-84

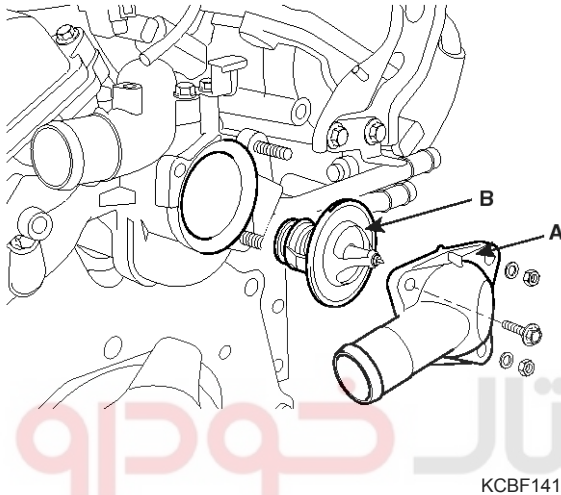
Engine Mechanical System

Thermostat

NOTICE

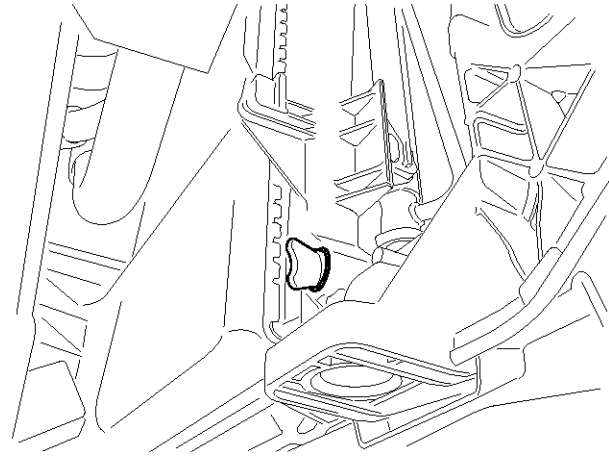
Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

1. Drain engine coolant so its level is below thermostat.
2. Remove the coolant inlet pitting(A) and the thermostat(B).

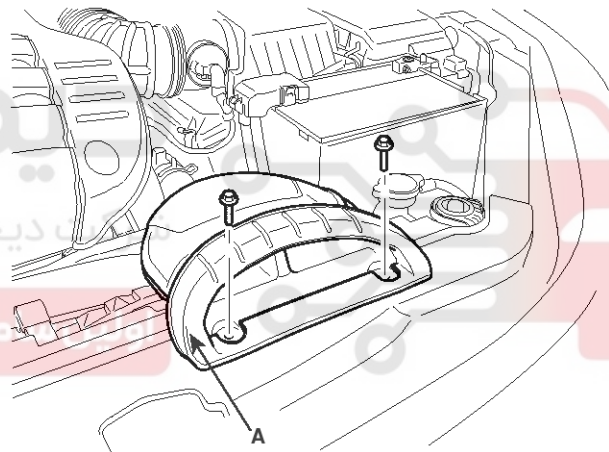


Radiator

1. Drain the engine coolant. Remove the radiator cap to speed coolant draining.



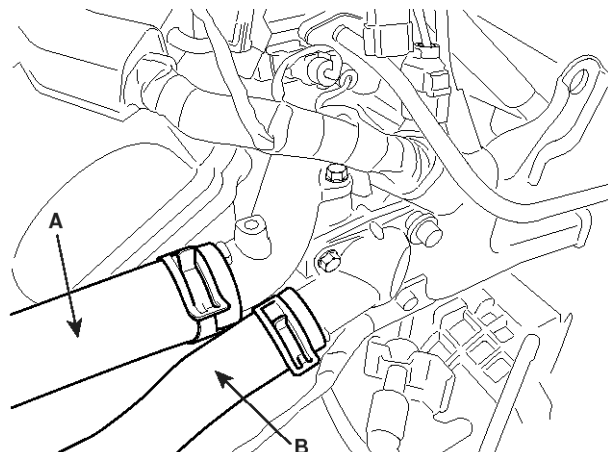
2. Remove the air duct(A).



Cooling System

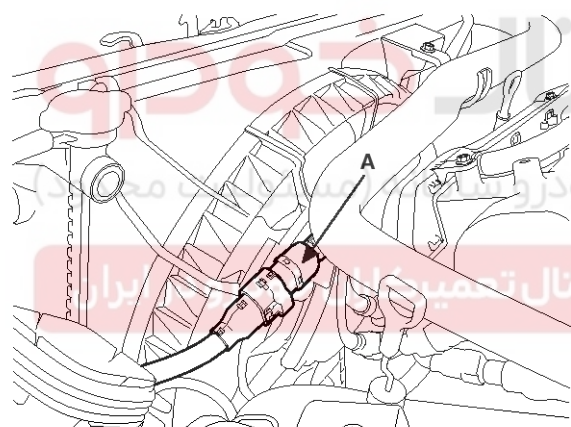
EMA-85

3. Remove the upper radiator hose(A) and lower radiator hose(B).



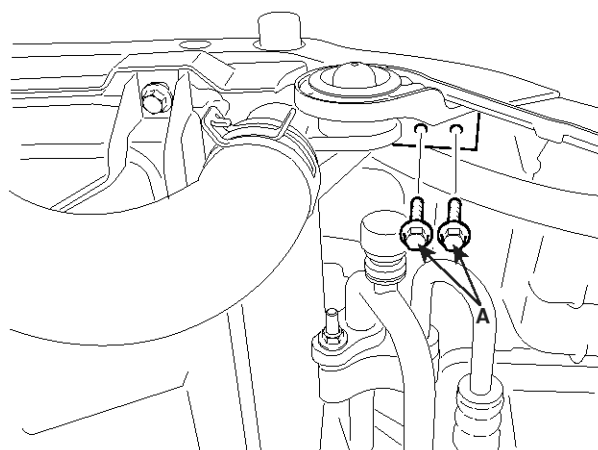
LDLG008A

4. Disconnect the transaxle oil cooler hoses(refer to 'AT' group).
5. Disconnect the radiator fan connector(A).



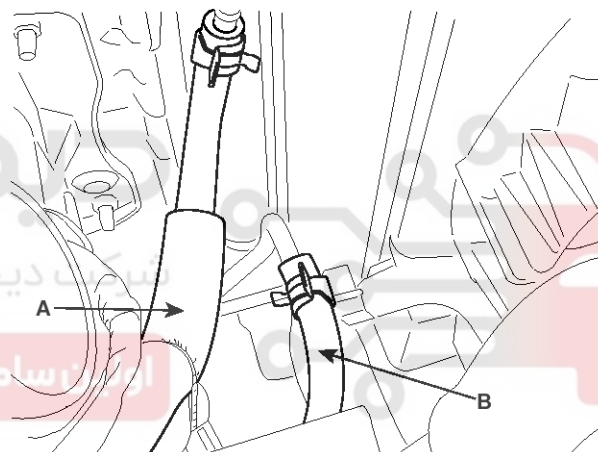
KCBF159A

6. Remove the radiator mounting bolts(A).



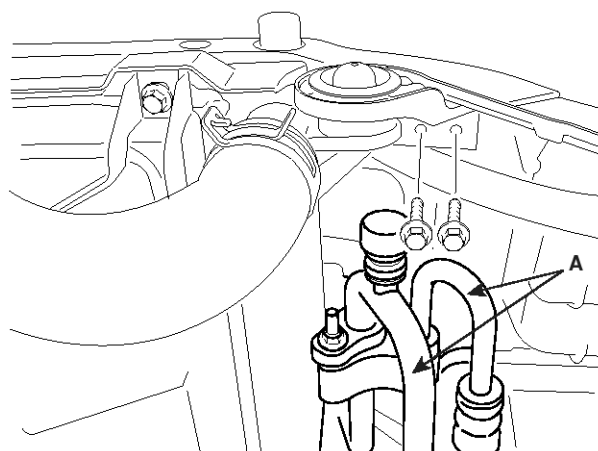
LDLG015A

7. Disconnect the ATF(Automatic Transaxle Fluid) cooler hoses(A,B) from the radiator.



LDLG016A

8. Disconnect the air conditioning tube hoses(A).

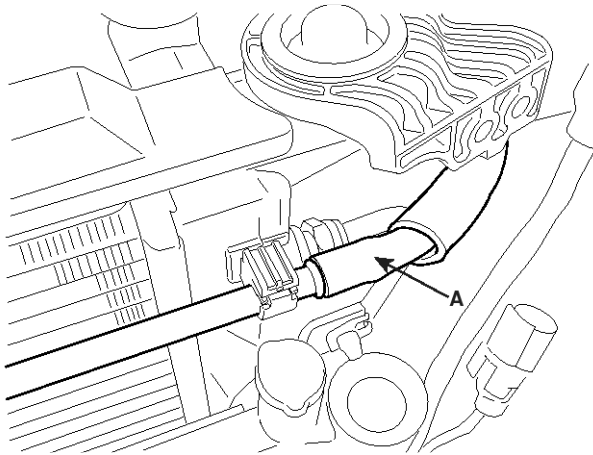


LDLG050A

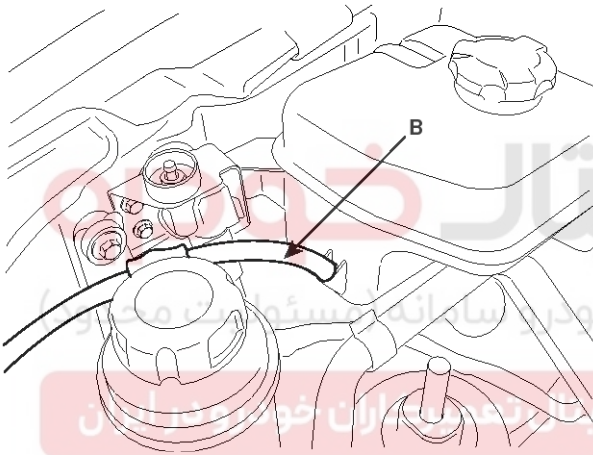
EMA-86

Engine Mechanical System

9. Disconnect the engine coolant reservoir tank hose(A,B).



LDLG018A



LDLG017A

10. Remove the radiator assembly with a condenser from the vehicle.

Inspection

Water Pump

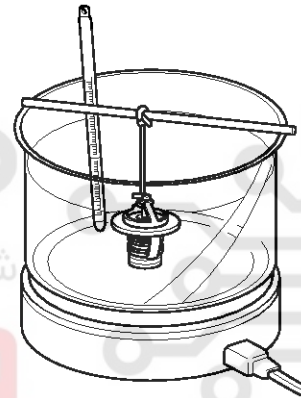
1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

NOTICE

A small amount of "weeping" from the bleed hole is normal.

Thermostat

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



ECKD503B

2. Check the valve opening temperature.

Valve opening temperature : 82°C (177°F)

Full opening temperature : 95°C (205°F)

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

3. Check the valve lift.

Valve lift : Min. 10mm (0.4in.) at 95°C (205°F)

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

Cooling System

EMA-87

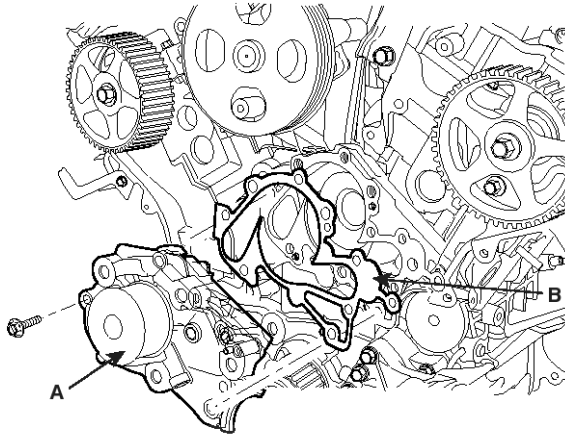
Installation

Water Pump

1. Install the water pump(A) and a new gasket(B) with the bolts.

Tightening torque

14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)

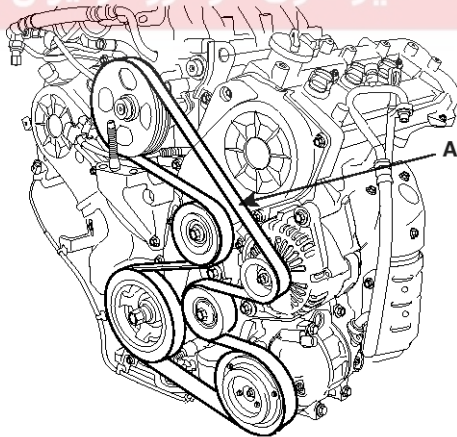


KCBF136A

NOTICE

- Clean the contacting face before assembling.
- Do not reuse the water pump gasket disassembled.

2. Install the timing belt.
3. Install drive belt(A).



KCBF105A

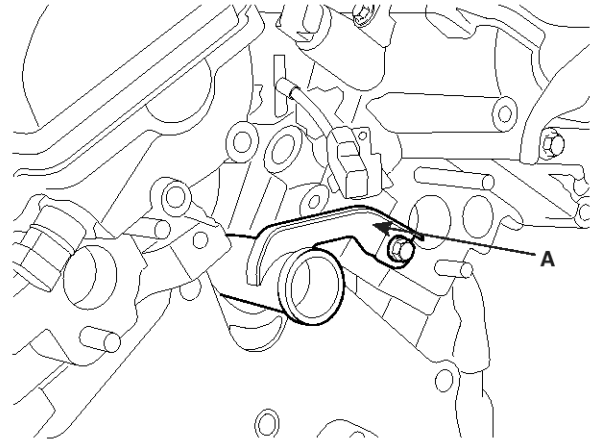
4. Fill with engine coolant.
5. Start engine and check for leaks.
6. Recheck engine coolant level.

Water Temperature Control Assembly

1. Install the water pipe(A).

Tightening torque

16.7 ~ 19.6Nm (1.7 ~ 2.0kgf.m, 12.3 ~ 14.5lb-ft)

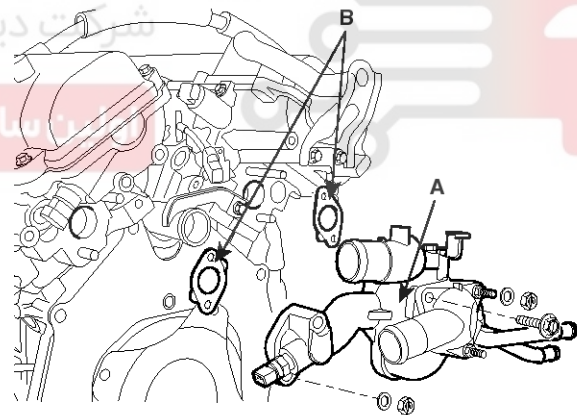


KCBF140A

2. Install the water temperature control assembly(A) with a new gasket(B).

Tightening torque

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



SMGM16012N

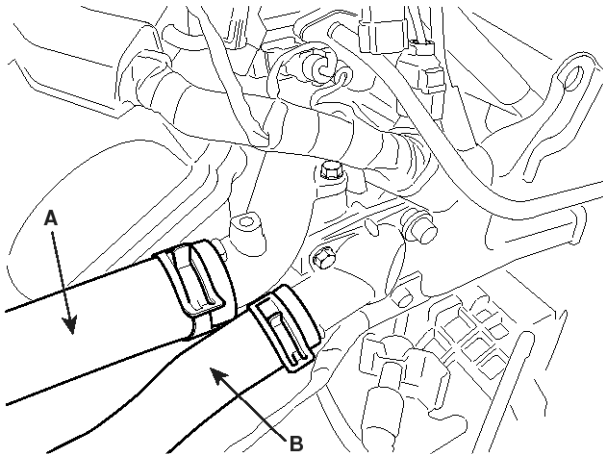
NOTICE

Use new O-rings and wet them with water or coolant when reassembling.

EMA-88

Engine Mechanical System

3. Install the wiring protector.
4. Connect the heater hose and ECT hose.
5. Connect the ECT sensor connector.
6. Connect the radiator upper and the lower hose(A).

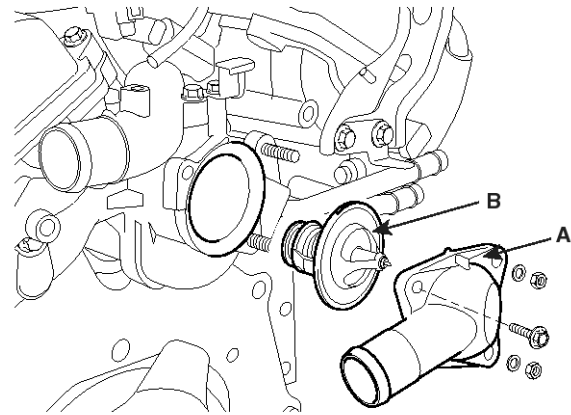


LDLG008A

7. Install the air cleaner assembly.
8. Fill with engine coolant.
9. Start engine and check for leaks.
10. Recheck engine coolant level.

Thermostat

1. Place thermostat(B) in coolant inlet pitting(A).
Install the thermostat with the jiggle valve upward.



KCBF141A

2. Install the coolant inlet pitting(A).

Tightening torque

16.66 ~ 19.60Nm (1.7 ~ 2.0kgf.m, 12.30 ~ 14.47lb-ft)

3. Fill with engine coolant.
4. Start engine and check for leaks.

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

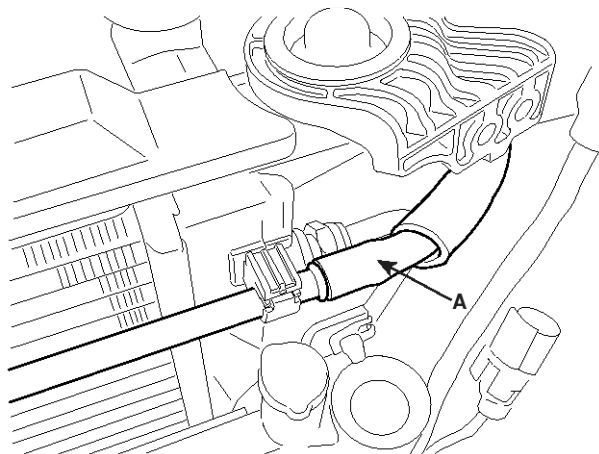
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Cooling System

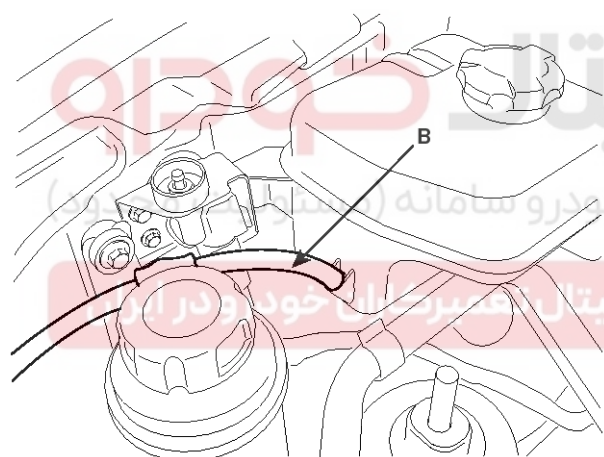
EMA-89

Radiator

1. Install the radiator assembly with a condensor to the vehicle.
2. Connect the engine coolant reservoir tank hose(A,B).

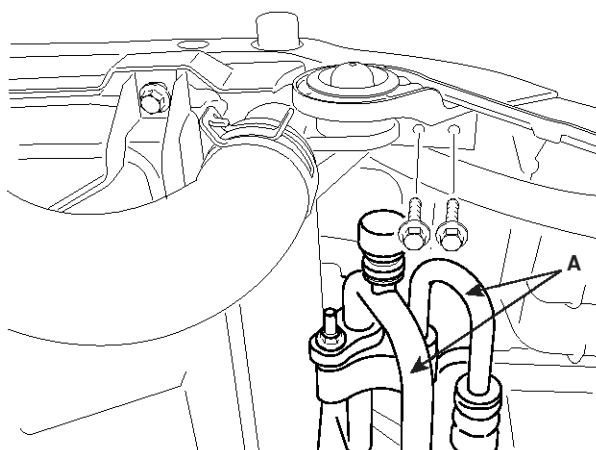


LDLG018A



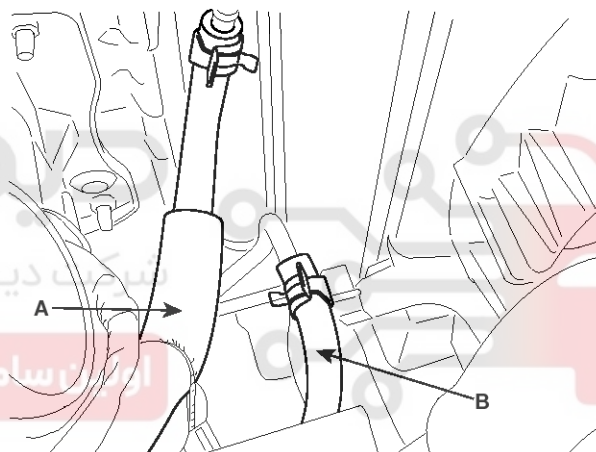
LDLG017A

3. Connect the air conditioning tube hoses(A).



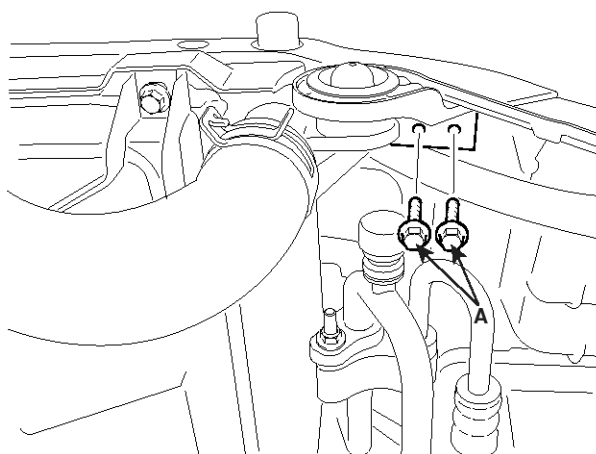
LDLG050A

4. Clamp the ATF(Automatic Transaxle Fluid) cooler hoses(A,B) to the radiator.



LDLG016A

5. Install the radiator mounting bolts(A).

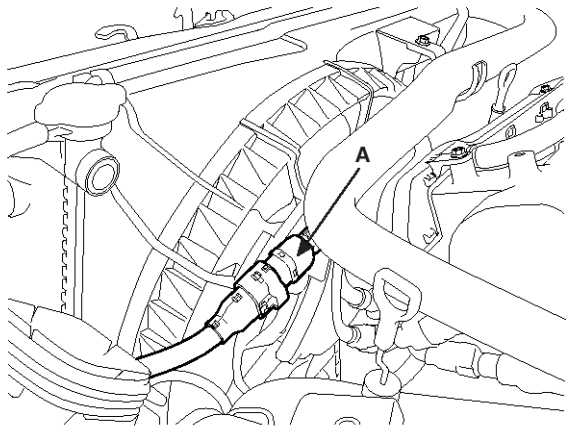


LDLG015A

EMA-90

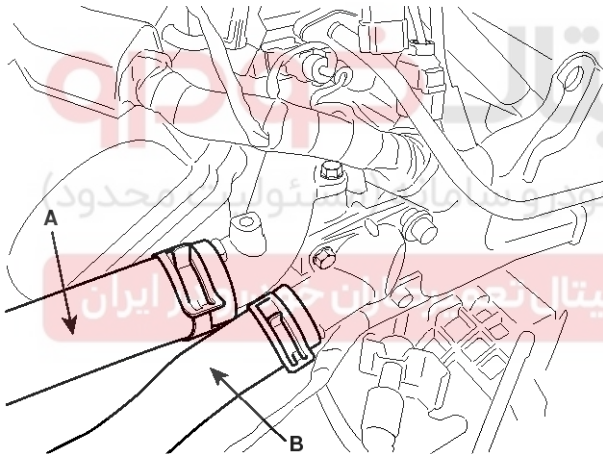
Engine Mechanical System

6. Connect the radiator fan connector(A).



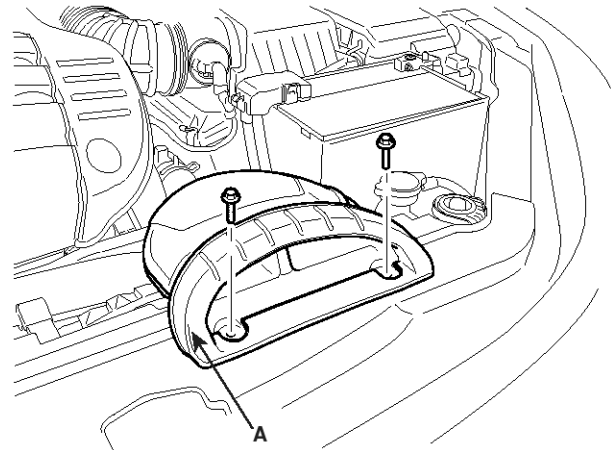
KCBF159A

7. Connect the transaxle oil cooler hoses.(Refer to 'AT' group).
 8. Install the upper radiator hose(A) and lower radiator hose(B).



LDLG008A

9. Install the air duct(A).



LDLG049A

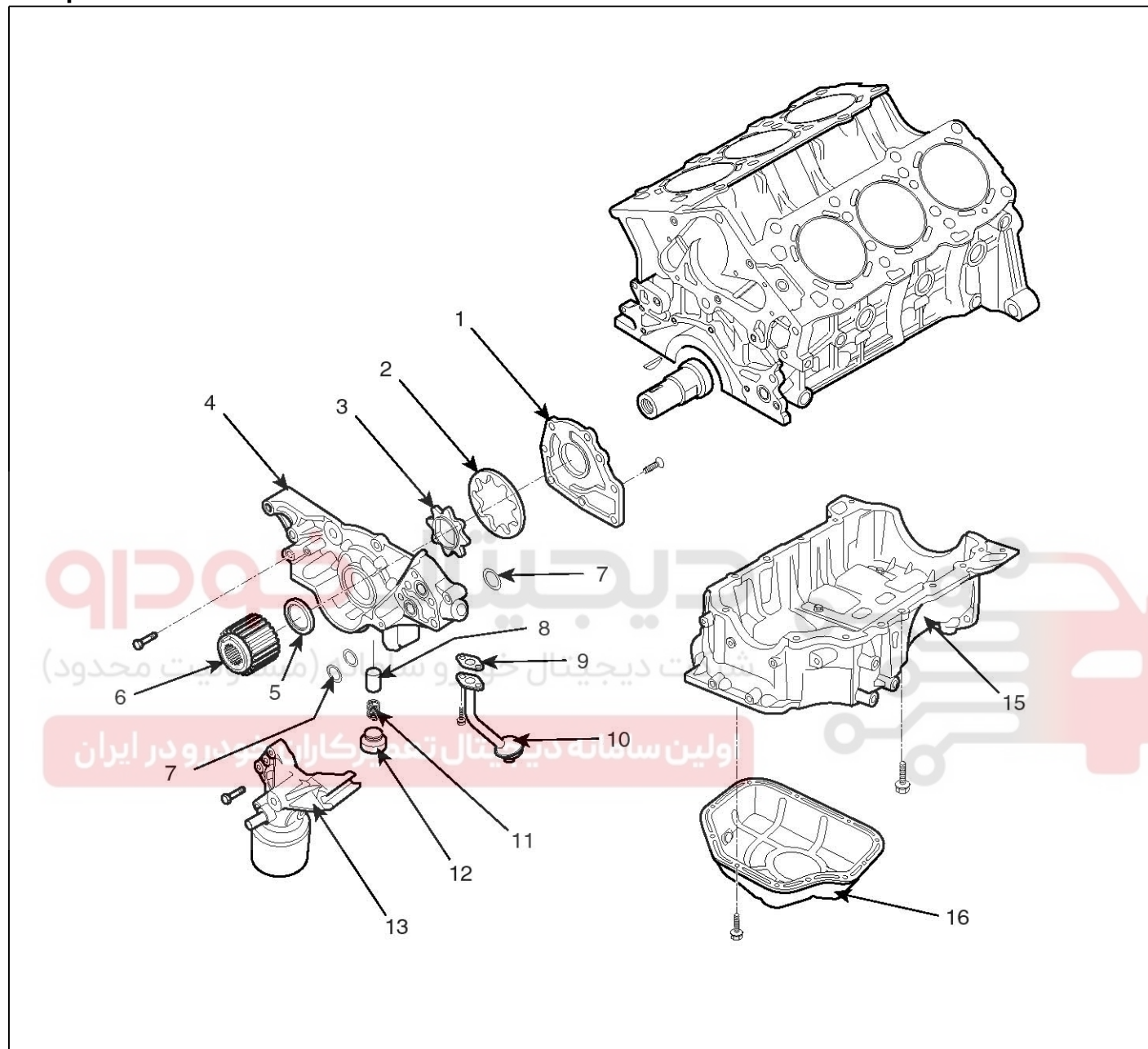
10. Refill with engine coolant.

Lubrication System

EMA-91

Lubrication System

Components



SMGM19017N

- | | | |
|-------------------------|------------------------|------------------------|
| 1. Oil pump cover | 6. Crankshaft sprocket | 11. Relief spring |
| 2. Oil pump outer rotor | 7. O-ring | 12. Plug |
| 3. Oil pump inner rotor | 8. Relief plunger | 13. Oil filter bracket |
| 4. Oil pump case rotor | 9. Oil screen gasket | 14. Upper oil pan |
| 5. Oil seal | 10. Oil screen | 15. Lower oil pan |

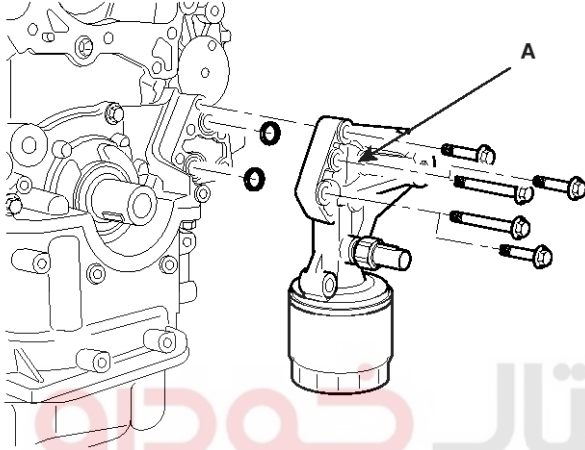
EMA-92

Engine Mechanical System

Removal

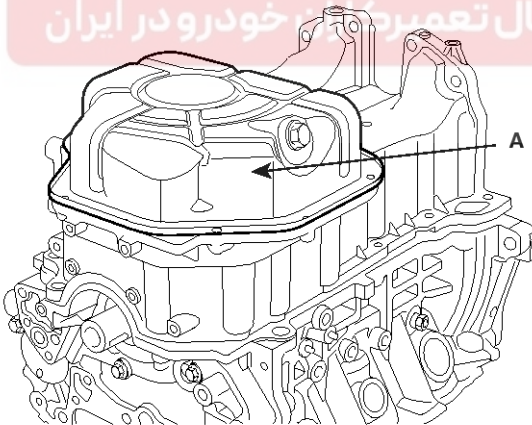
Oil Pump Case

1. Drain engine oil.
2. Remove the front right wheel and tire.
3. Remove the front right side cover.
4. Remove the front muffler.
5. Remove the generator.
6. Remove the timing belt.
7. Remove the oil filter bracket(A).



KCBF147A

8. Using SST(09215-3C000), remove the lower oil pan(A).

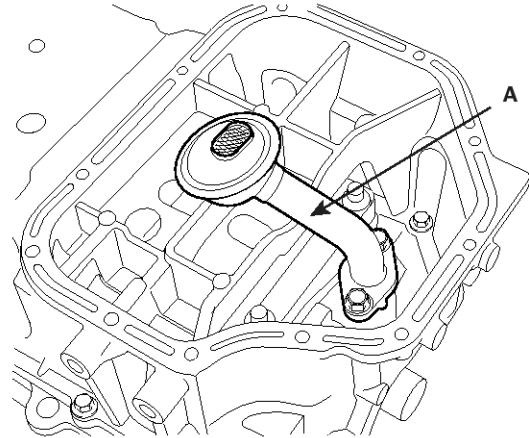


KCBF123A

⚠ CAUTION

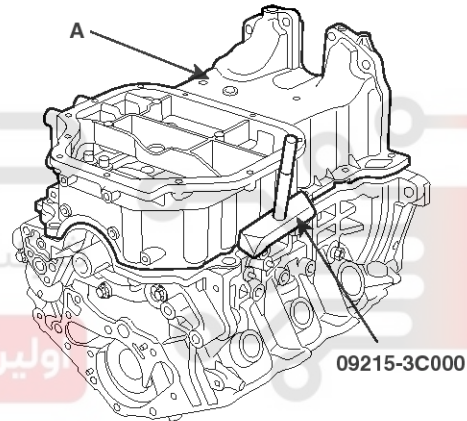
Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

9. Remove the oil screen(A).



KCBF124A

10. Remove the upper oil pan, using the SST(09215-3C000)(A).



09215-3C000

KCBF125B

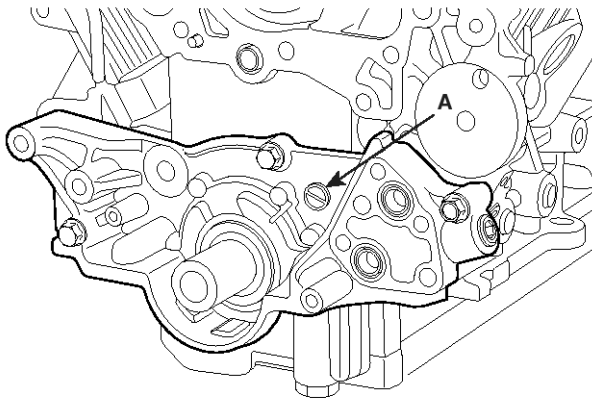
⚠ CAUTION

Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

Lubrication System

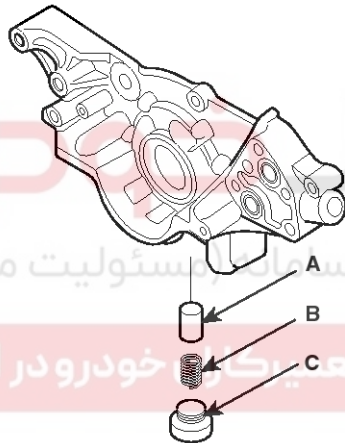
EMA-93

11. Remove the oil pump case(A).



KCBF163A

12. After removing the plug(C), remove the relief spring(B) and the relief plunger(A).



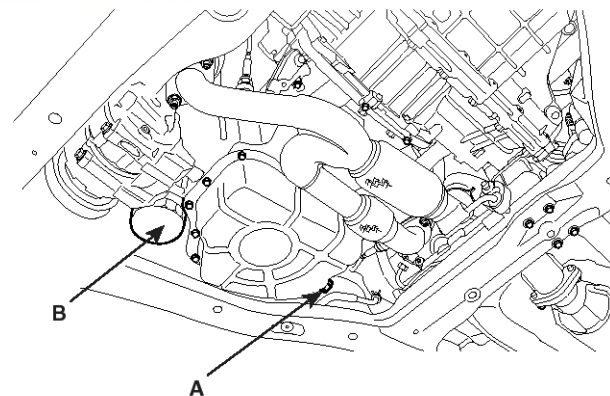
KCBF163C

Replacement Oil And Filter

⚠ CAUTION

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Wear protective clothing and gloves in order to minimize the length and frequency of contact of your skin to used oil. 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 environment, used oil or used oil filter must be disposed only at designated disposal sites.

1. Park the car on a level ground.
Start the engine and let it warm up.
2. Turn the engine off.
3. Drain engine oil.
 - 1) Remove the oil filler cap.
 - 2) After lifting the car, remove the oil drain plug(A) and drain oil into a container.
4. Replace the oil filter.
 - 1) Remove the oil filter(B).



KCBF162A

EMA-94

Engine Mechanical System

- 2) Check the part number of a new oil filter is as the same as that of the old one.
- 3) Replace the oil filter.
- 4) Tighten it slightly until the o-ring of the filter cap contacting on its position.
- 5) Tighten it with the specified torque.

Tightening torque

16.7 ~ 24.5Nm(1.7 ~ 2.5kgf.m, 12.3 ~ 18.1lb-ft)

5. Refill with engine oil.

- 1) Install the oil drain plug with a new gasket.

Tightening torque

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

- 2) Fill with fresh engine oil, after removing the engine oil level gauge.

Capacity

Total : 4.8 L (5.07 US qt, 4.22 Imp qt)

Oil pan : 4.2 L (4.43 US qt, 3.69 Imp qt)

Drain and refill including oil filter :

4.5 L (4.75 US qt, 3.95 Imp qt)

- 3) Install the oil filler cap and the oil level gauge.
6. Start the engine and ensure that no oil is leaking from the drain plug or the oil filter.
7. Recheck engine oil level.

Inspection

Relief Spring

1. Check the relief plunger.

Apply engine oil on the plunger and check that it moves smoothly in the hole. If it does not, replace the plunger or the front case only in necessary cases.

2. Check the relief valve spring.

Check deformation or damage of the relief valve spring.

Specification

Free length : 43.8mm(1.7244in.)

Load : 36.3N(3.7kg, 8.21b) ± 3.9N(0.4kg, 0.9lb) / 40.1mm(1.5787in.)



اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

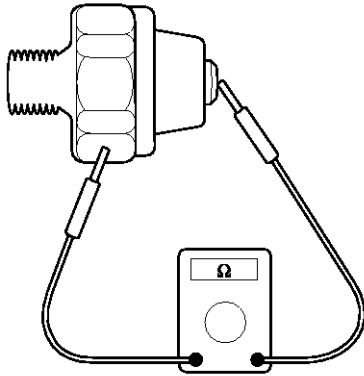
Lubrication System

EMA-95

Oil Pressure Switch

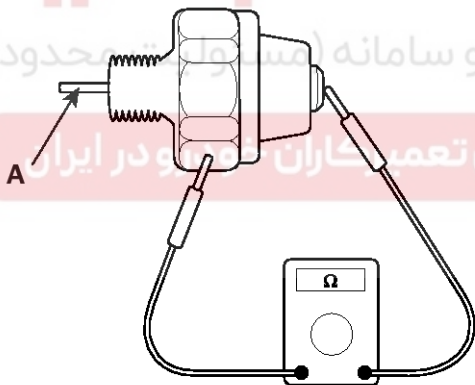
1. Check the continuity between the terminal and the body with an ohmmeter.

If there is no continuity, replace the oil pressure switch.



ECKD001W

2. Check the continuity between the terminal and the body when its hole is pushed by a fine rod(A). If there is continuity with pressed, replace the switch.



LDLG052A

3. If there is no continuity when the pressure 49.3kpa (0.5kg/cm², 7.11psi) is applied through the oil hole, the switch is operating properly.

Check for air leakage. If air leaks, the diaphragm is broken. Replace the switch.

Engine Oil

1. Check engine oil quality.

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

If the quality is visibly poor, replace oil.

2. Check the engine oil level.

After warming up the engine, make the engine stand still for five minutes or more. The oil level should be between the 'L' and 'F' marks on the dipstick, then.

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

NOTICE

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



EMA-96

Engine Mechanical System

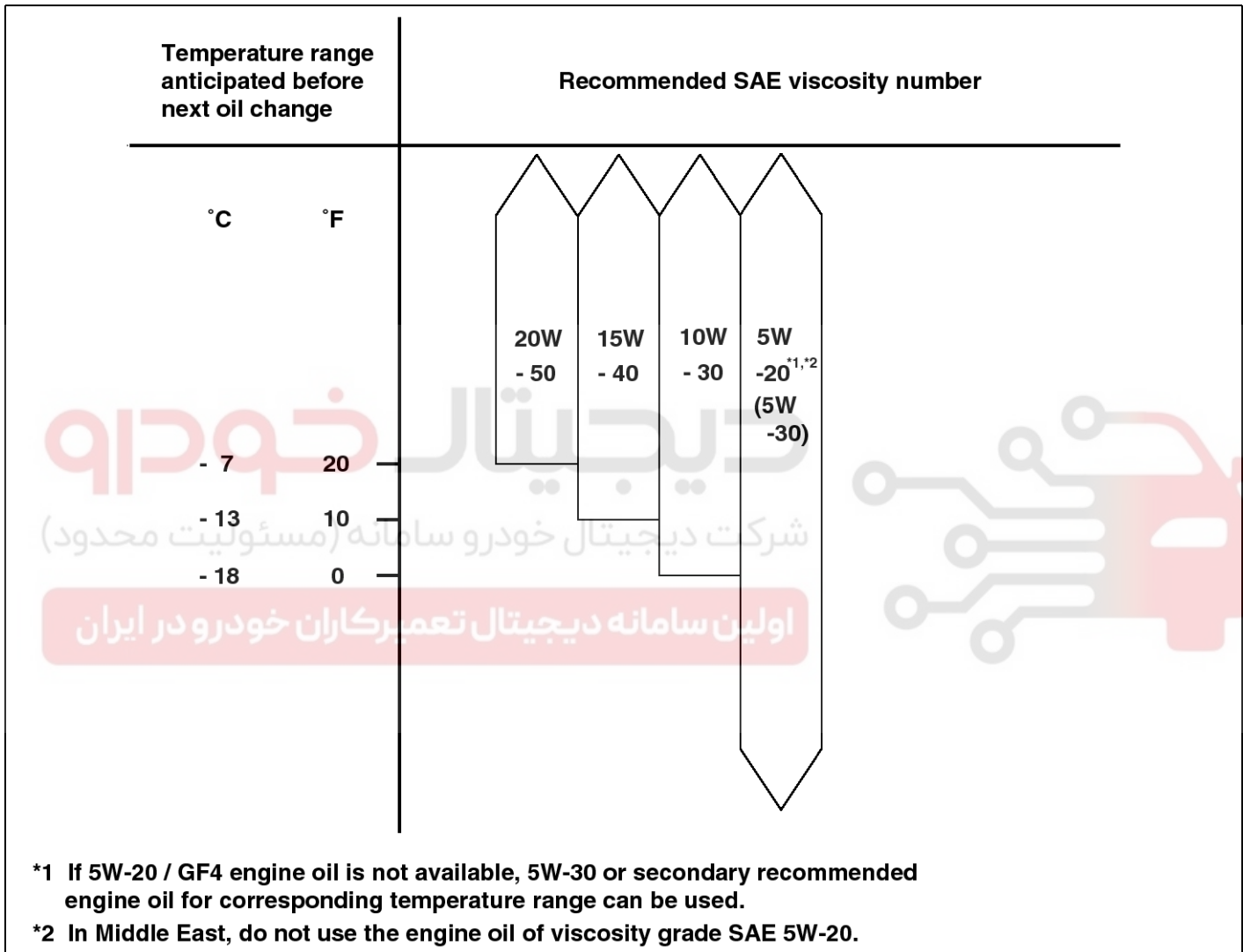
Selection Of Engine Oil

Recommendation (except Middle East) : 5W-20/GF4&SM
 (If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.)

API classification : SL, SM or above

ILSAC classification : GF3, GF4 or above

SAE viscosity grade : Refer to the recommended SAE viscosity number.



SAMM29103L

NOTICE

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

- Satisfy the requirement of the API or ILSAC classification.
- Have proper SAE grade number for expected ambient temperature range.

Lubricants that do not have both an SAE grade number and API or ILSAC service classification on the container

should not be used.

Lubrication System

EMA-97

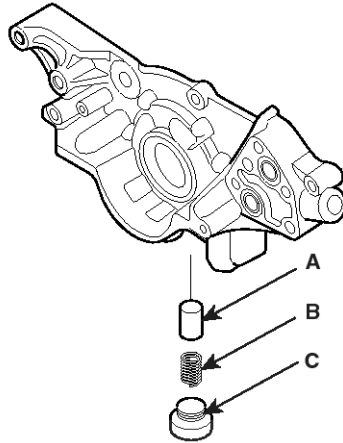
Installation

Oil Pump Case

1. Assembly the relief spring(B) and the relief plunger(A) and tighten the plug(C).

Tightening torque

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



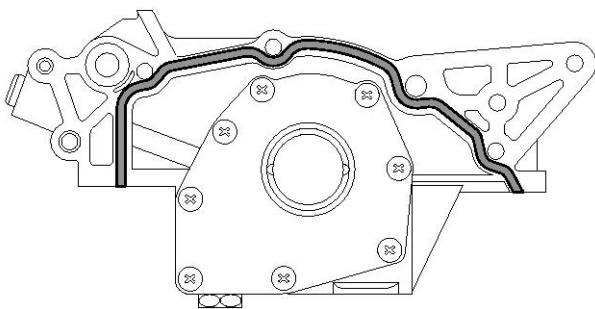
KCBF163C

2. Install oil pump case.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan.

The part must be assembled within 5 minutes after the sealant was applied.

Bead width : 2.5mm(0.0984in.)



KCBF134A

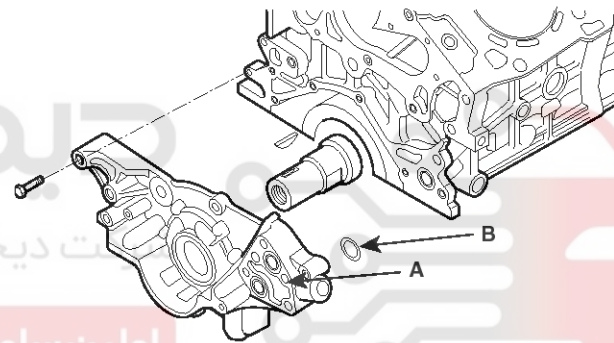
⚠ CAUTION

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
- After assembly, wait at least 30 minutes before filling the engine with oil.

- 3) Install the oil pump case(A).

Tightening torque

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



LDLG070A

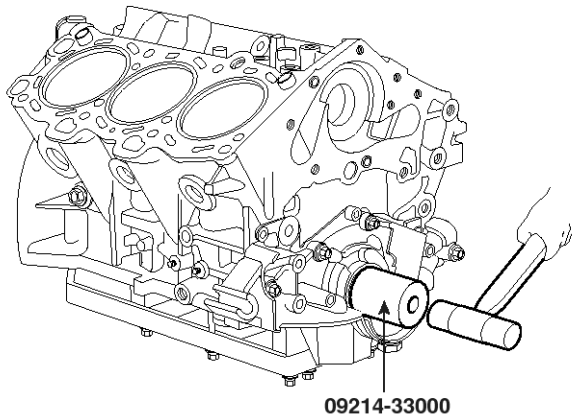
⚠ CAUTION

In the installation of the oil pump, always use a new o-ring(B).

EMA-98

Engine Mechanical System

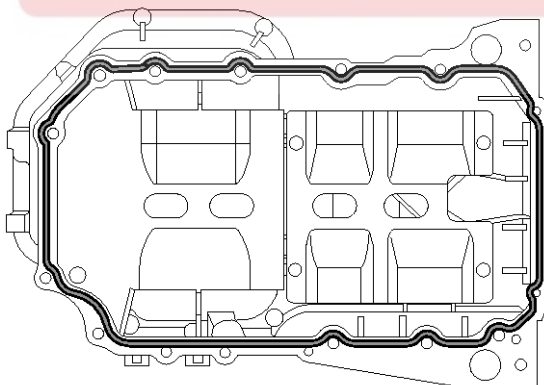
3. Using the SST(09214~33000), install the oil pump case oil seal.



EDQF189A

4. Install the upper oil pan.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan. The part must be assembled within 5 minutes after the sealant was applied.



KCBF130A

CAUTION

- Make clean the sealing face before assembling two parts.
 - Remove harmful foreign materials on the sealing face before applying sealant.
 - When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
 - To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
 - After assembly, wait at least 30 minutes before filling the engine with oil.
- 3) Fix the oil pan and tighten the bolts in several steps uniformly.

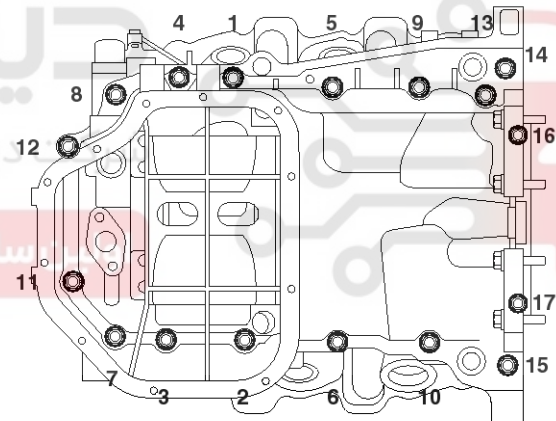
Tightening torque

Bolts 1~15 :

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

Bolts 16,17 :

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



KCBF131A

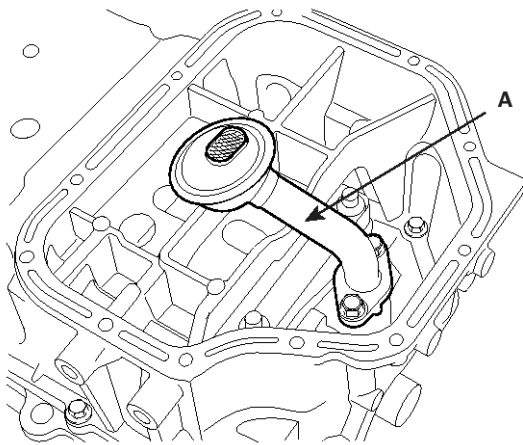
Lubrication System

EMA-99

5. Install the oil screen.

Tightening torque

14.7 ~ 21.6Nm(1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



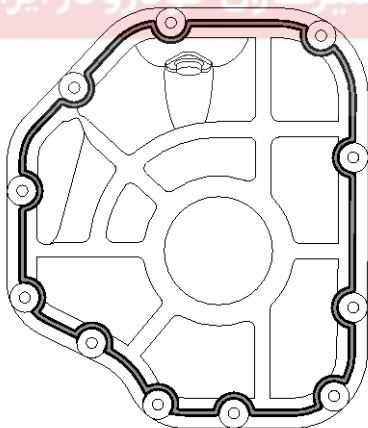
KCBF124A

NOTICE

Always use a new gasket.

6. Install the lower oil pan.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) Before assembling the oil pan, the liquid sealant TB1217H should be applied on the oil pan.
The part must be assembled within 5 minutes after the sealant was applied.



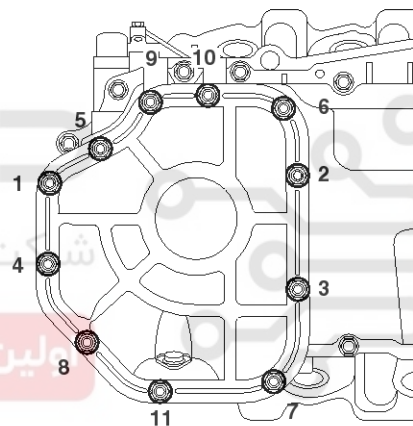
KCBF132A

CAUTION

- Make clean the sealing face before assembling two parts.
 - Remove harmful foreign materials on the sealing face before applying sealant.
 - When applying sealant gasket, sealant must not be protrude into the inside of oil pan.
 - To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.
 - After assembly, wait at least 30 minutes before filling the engine with oil.
- 3) Fix the oil pan and tighten the bolts in several steps uniformly.

Tightening torque

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



KCBF133A

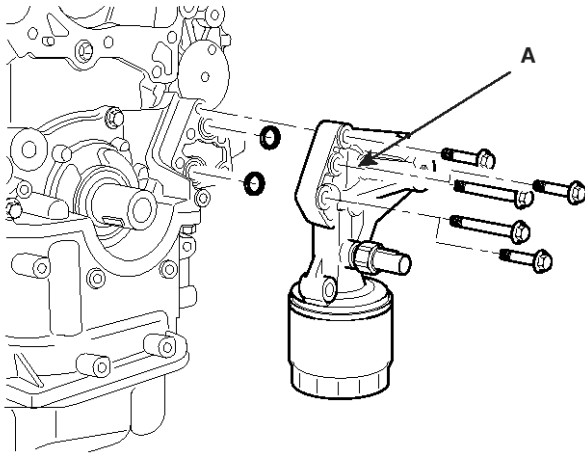
EMA-100

Engine Mechanical System

7. Install the oil filter bracket(A).

Tightening torque

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



KCBF147A

CAUTION

Always use a new O-ring.

8. Install the timing belt, the generator and the front muffler.
9. Install the front right side cover and the wheel and tire.
10. Fill with engine coolant.
11. Start engine and check for leaks.
12. Recheck engine coolant level.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

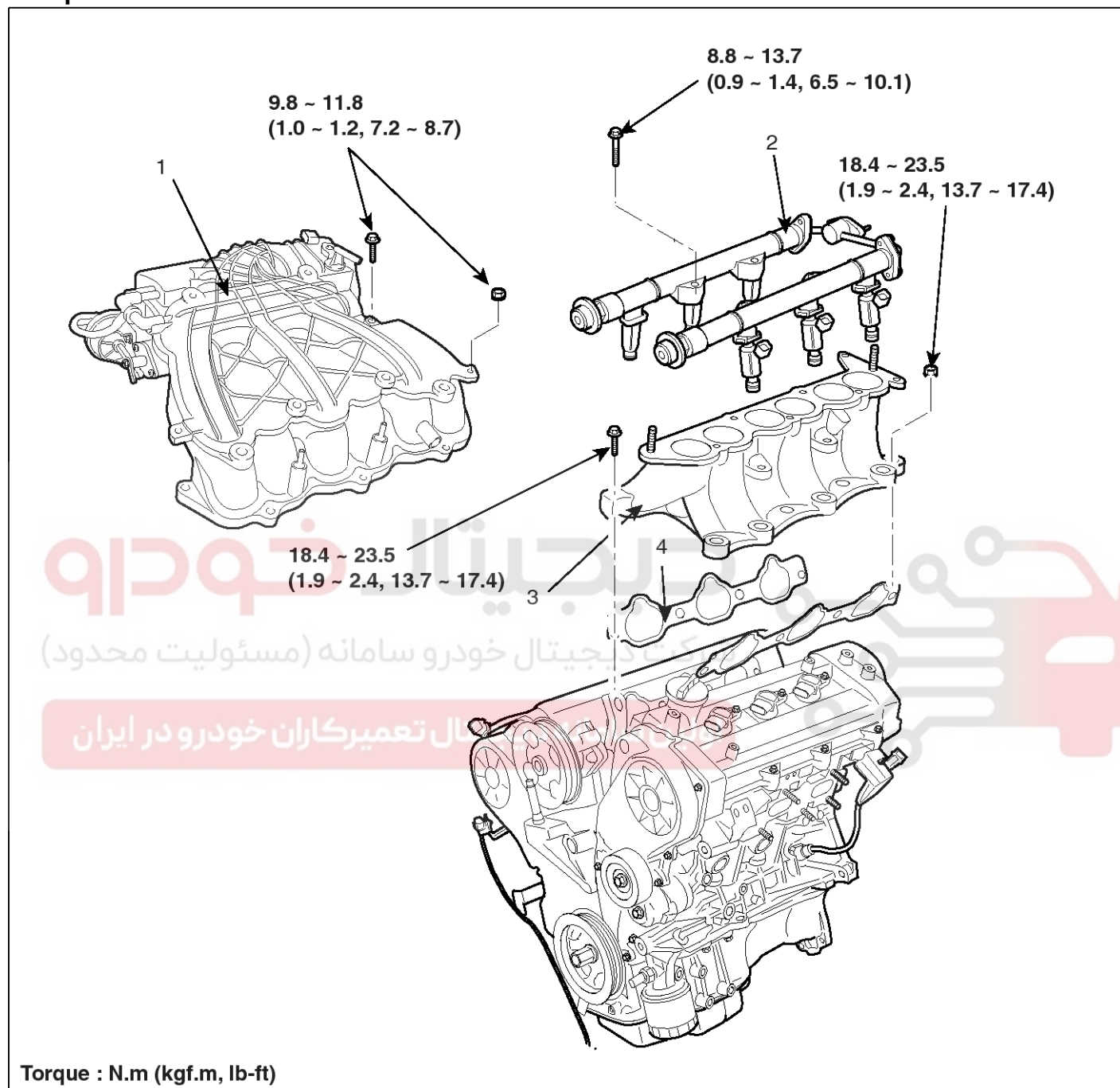


Intake And Exhaust System

EMA-101

Intake And Exhaust System

Components



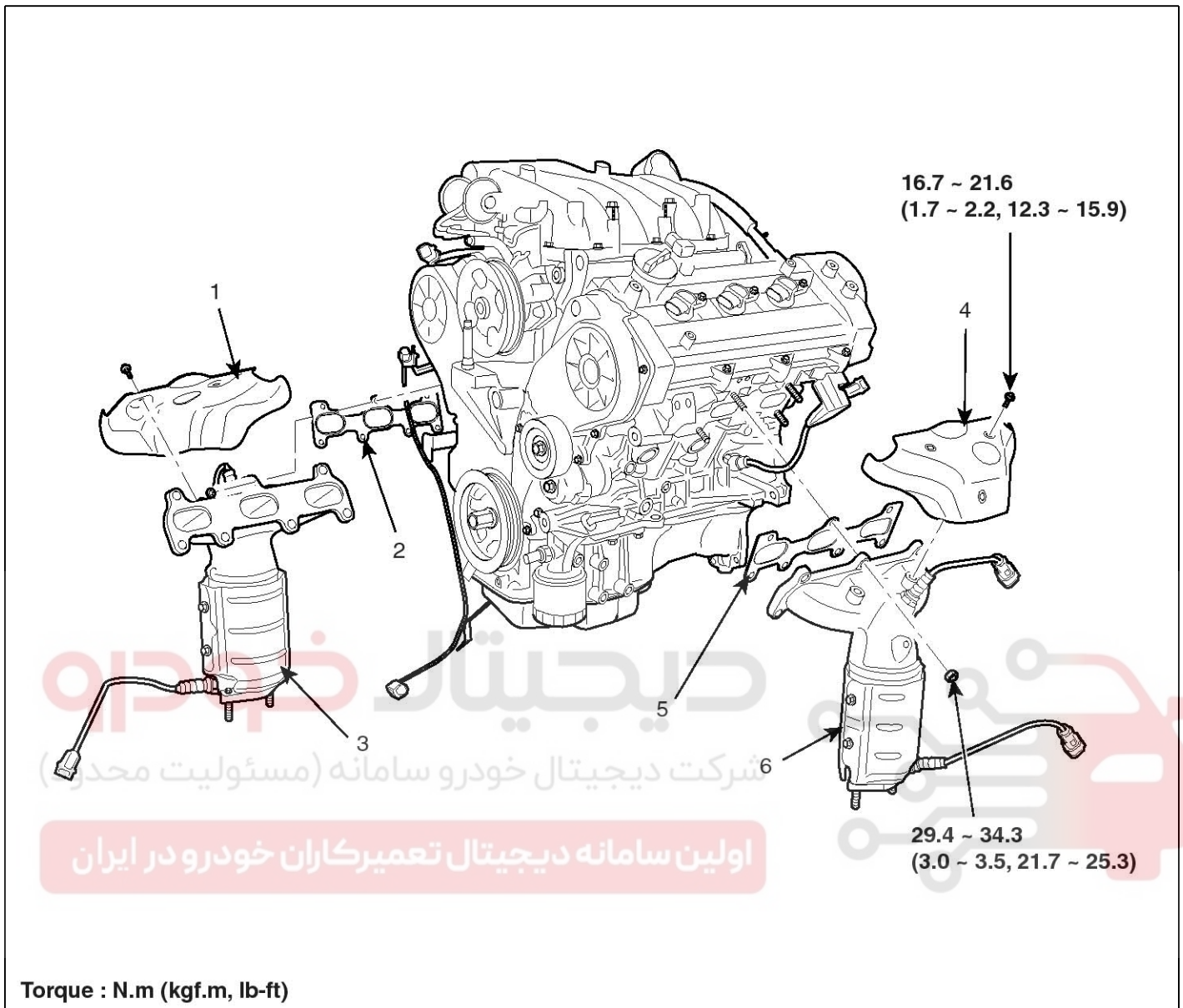
SMGM29004N

- 1. Surge tank
- 2. Delivery pipe

- 3. Intake manifold
- 4. Intake manifold gasket

EMA-102

Engine Mechanical System



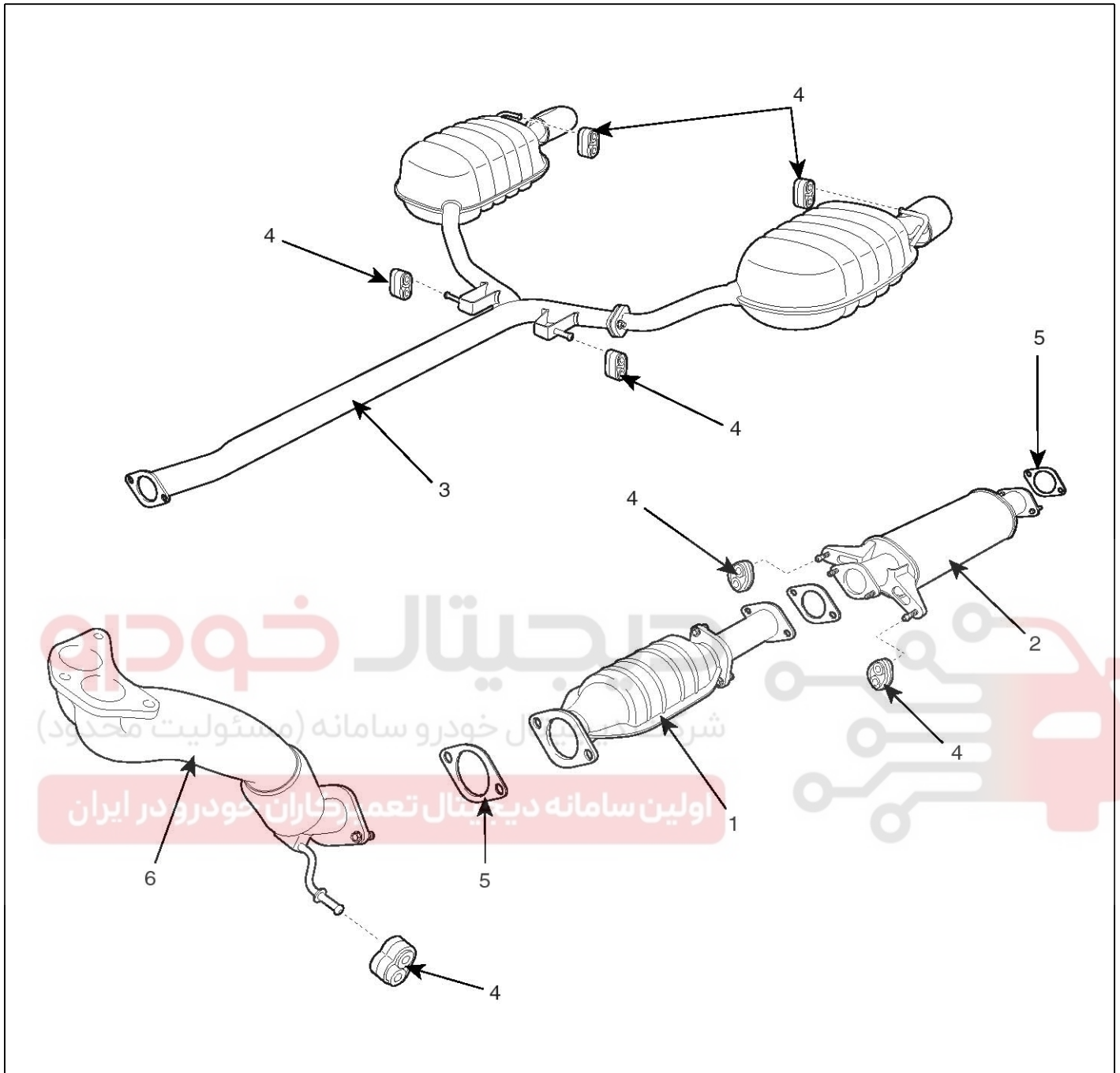
SMGM19018N

1. Bank 1 heat protector
2. Bank 1 exhaust manifold
3. Bank 1 exhaust gasket

4. Bank 2 protector
5. Bank 2 exhaust manifold gasket
6. Bank 2 exhaust manifold

Intake And Exhaust System

EMA-103



SMGM19019N

- 1. Catalytic convert
- 2. Center muffler
- 3. Main muffler

- 4. Lever hanger
- 5. Gasket
- 6. Front muffler

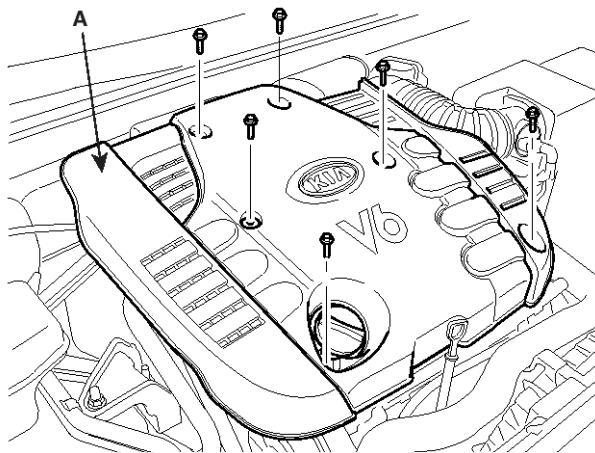
EMA-104

Engine Mechanical System

Removal

Intake Manifold Assembly

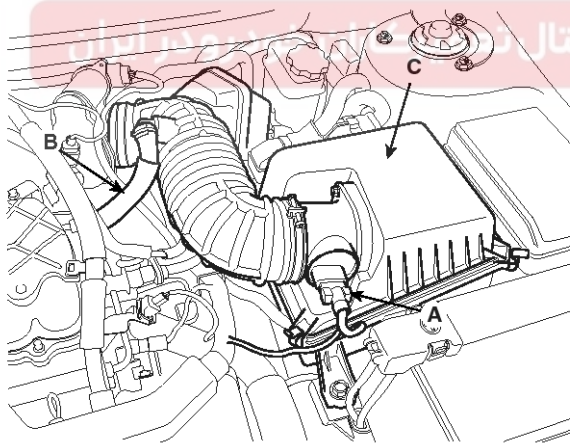
1. Remove the engine cover(A).



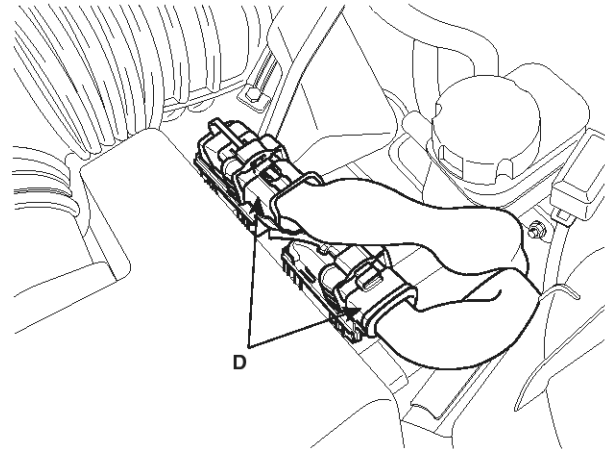
LDLG002A

2. Remove the intake air hose and air cleaner assembly.

- 1) Disconnect the MAF connector(A).
- 2) Disconnect the breather hose(B) from air cleaner hose.
- 3) Remove the intake air hose and air cleaner assembly(C).
- 4) Disconnect the PCM connectors(D).



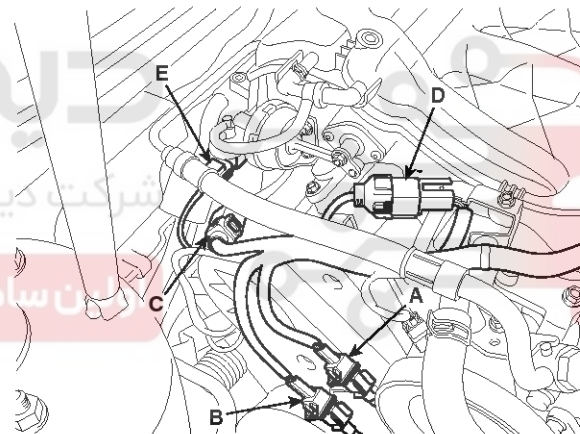
SMGM29008N



LDLG061A

3. Disconnect the engine wiring harness connectors.

- 1) Disconnect the No.1/No.2 knock sensor connectors (A, B) the injector connector (C), the ignition coil harness connector (D) and VIS (Variable Induction System) connector (E).

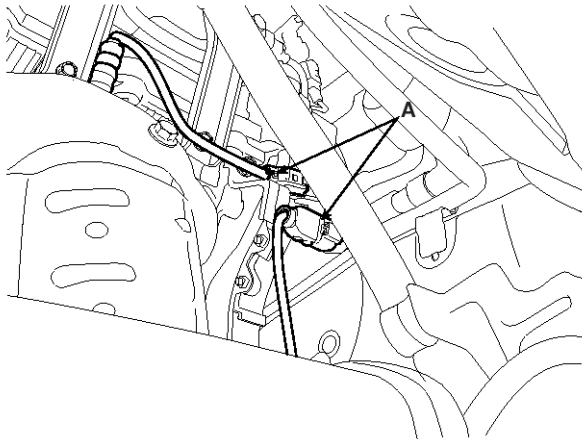


SMGM29007N

Intake And Exhaust System

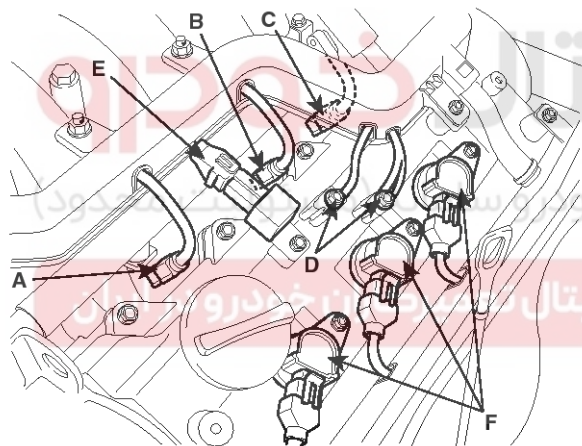
EMA-105

- 2) Disconnect the bank 1 front/rear O2 sensor connectors(A).



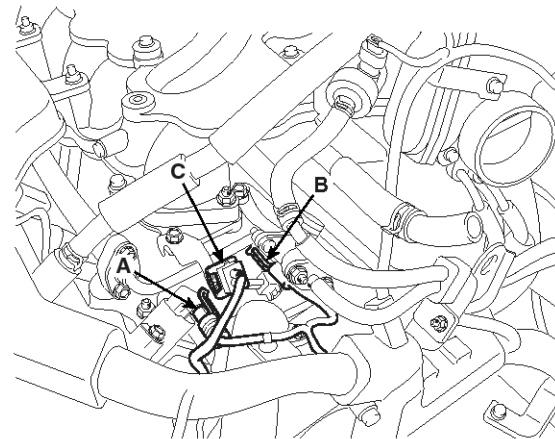
KCBF160A

- 3) Disconnect the injection connectors(A,B,C), the ground lines(D), the condenser connector(E) and the Ignition coil connectors(F).



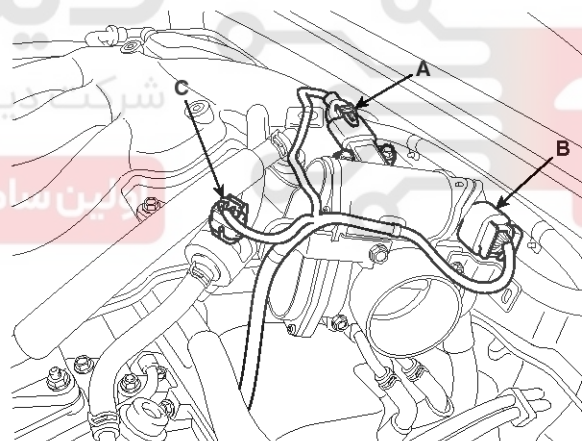
SMGM16014N

- 4) Disconnect the No.1/No.2 OCV(Oil Control Valve) connectors(A, B) and the OTS(Oil Temperature Sensor) connector(C).



SMGM29009N

- 5) Disconnect the MAPS(Manifold Absolute Pressure Sensor) connector(A), the ETC(Electronic Throttle Control) connector(B) and the PCSV(Purge Control Solenoid Valve) connector(C).

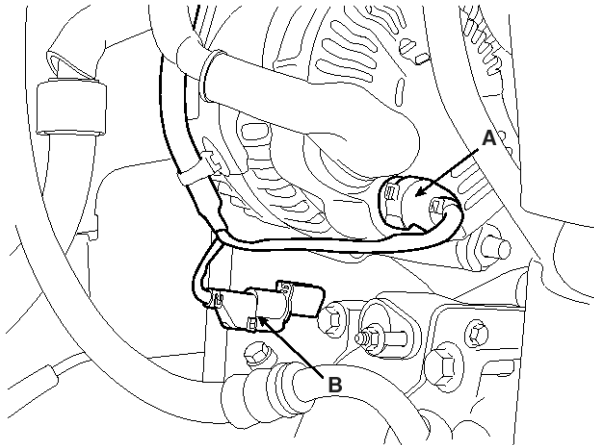


SMGM29010N

EMA-106

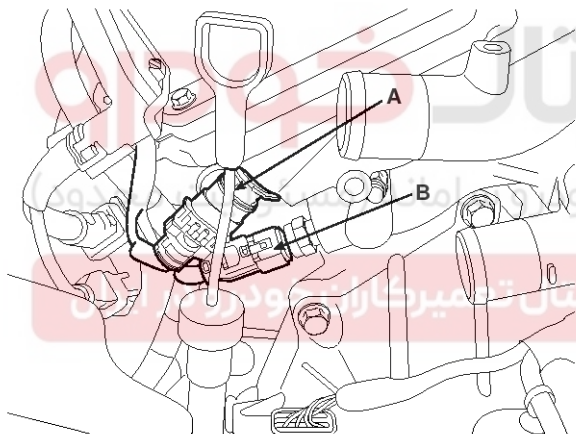
Engine Mechanical System

- 6) Disconnect the generator connector(A) and the air conditioning compressor connector(B).



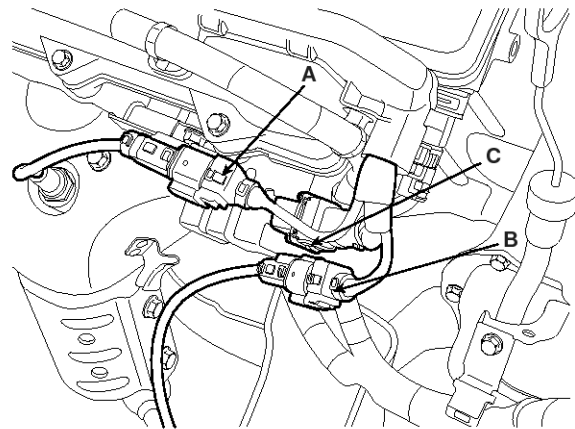
KCBF151A

- 7) Disconnect the bank 2 CMP sensor connector(A) and the ECT(Engine Coolant Temperature) sensor connector(B).



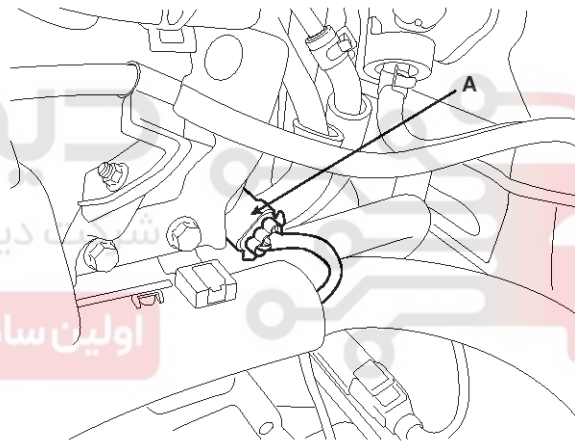
KCBF155A

- 8) Disconnect the bank 2 front/rear O2 sensor connectors(A,B) and the CKP sensor connector(C).



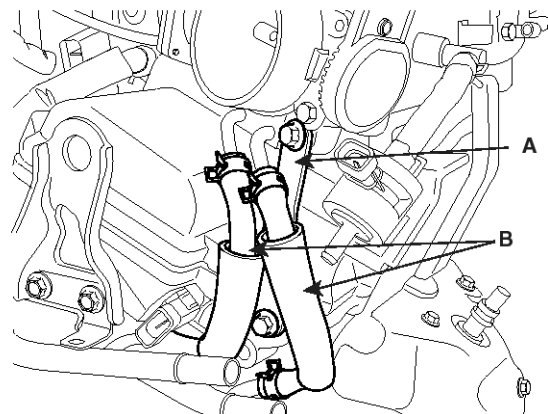
KCBF154A

- 9) Disconnect the bank 1 CMP sensor connector(A).



KCBF152A

4. Remove the ETC(Electric Throttle Control) bracket(A) and the cooling hoses(B).

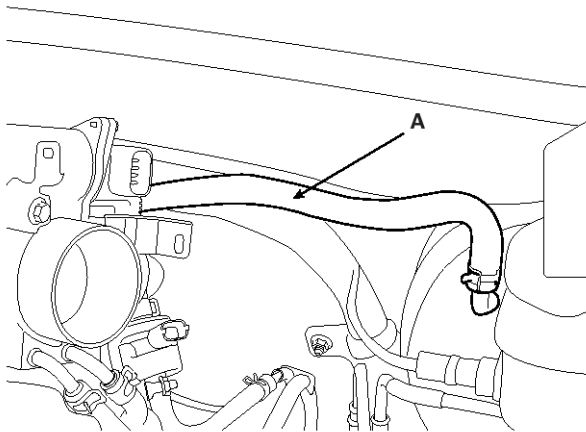


KCBF179A

Intake And Exhaust System

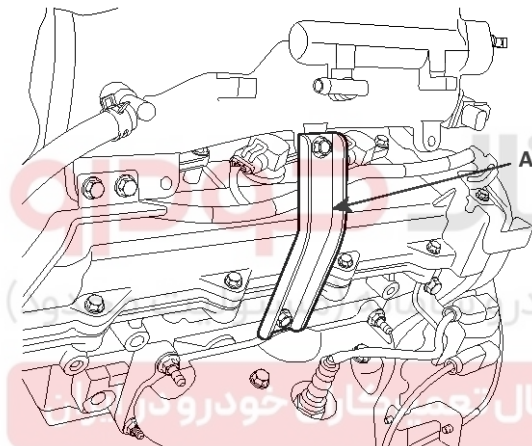
EMA-107

5. Disconnect the brake vacuume hose(A).



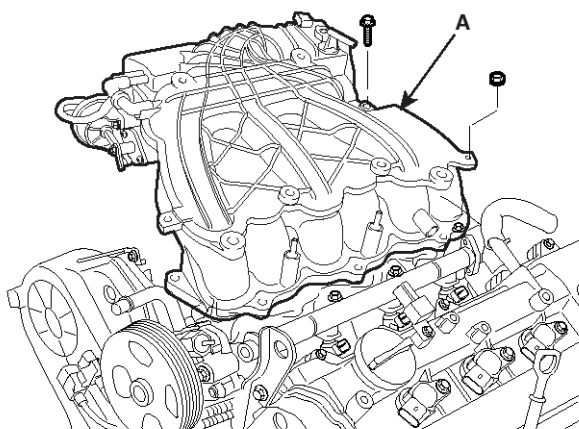
LDLG036A

6. Remove the surge tank mounting bracket(A).



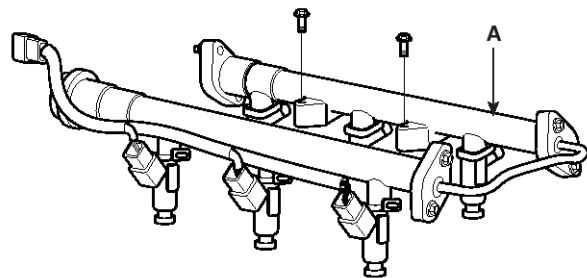
KCBF178A

7. Remove the surge tank(A).



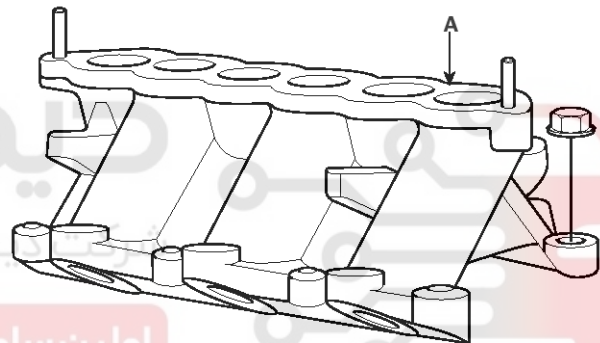
SMGM19020N

8. Remove the delivery pipe assembly(A).



SMGM16030N

9. Remove the intake manifold assembly(A).



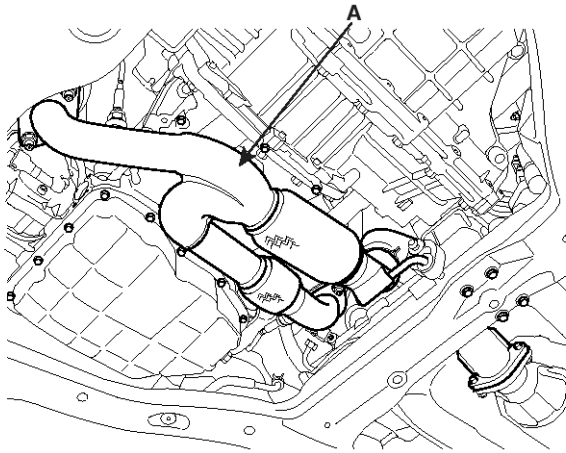
SMGM16020N

EMA-108

Engine Mechanical System

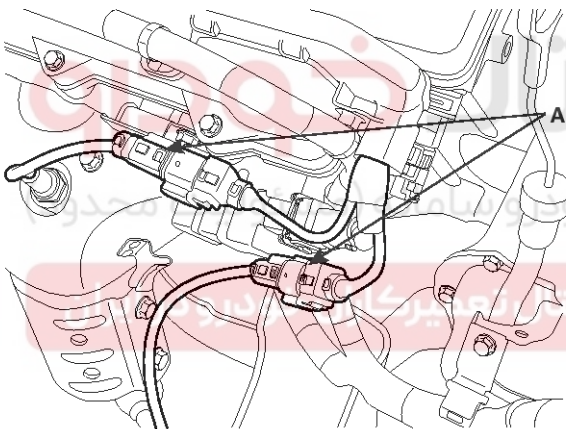
Exhaust Manifold Assembly

1. Remove the under cover.
2. Remove the front muffler(A).

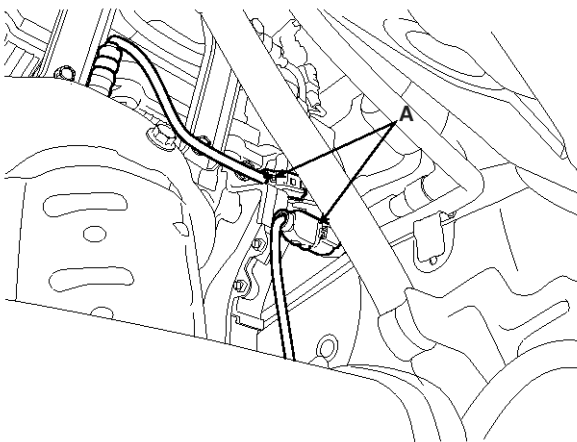


KCBF102A

3. Disconnect the oxygen sensor connectors(A).



KCBF154B



KCBF160A

4. Remove the oil level gauge.
5. Remove the heat protector.
6. Remove the exhaust manifold assembly.



Intake And Exhaust System

EMA-109

Installation

Intake Manifold Assembly

1. Install the intake manifold assembly with a new gasket to a cylinder head assembly. Tighten the bolts in two steps.

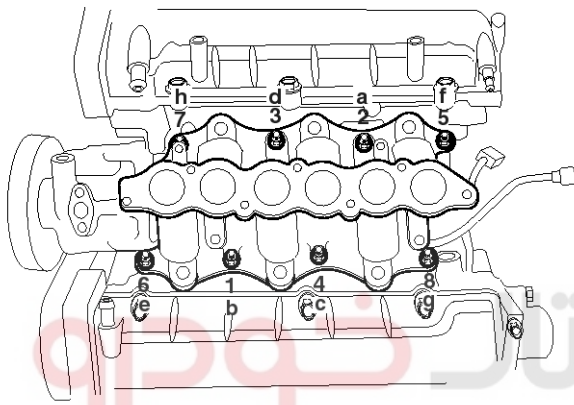
Tightening torque

Step 1(a~h) :

3.9~5.9Nm(0.4~0.6kgf.m, 2.9~4.3lb-ft)

Step 2(1~8) :

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



KCBF201A

⚠ CAUTION

When installing the gasket on the cylinder head, check the identification marks(LH/RH) not to be installed wrong.

2. Install the delivery pipe.
3. Connect the LH injector connector.
4. Install the surge tank.

Tightening torque

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

5. Install the surge tank mounting bracket.

Tightening torque

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

6. Install the ETC(Electronic Throttle Control) system fixing bracket.
7. Connect the hoses and connectors.
8. Install the air cleaner assembly.
9. Install the engine cover.

Exhaust Manifold Assembly

1. Install the exhaust manifold assembly with a new gasket.

Tightening torque

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

2. Install the heat protector.

Tightening torque

16.7~21.6Nm(1.7~2.2kgf.m, 12.3~15.9lb-ft)

3. Install the front muffler assembly.

Tightening torque

39.2~58.8Nm(4.0~6.0kgf.m, 28.9~43.4lb-ft)

4. Connect the oxygen sensor connector.
5. Install the under cover.