General Information

SPECIFICATIONS

Description			Specifications (D4FB)	Limit
General				
Type			In-line, DOHC	
Number of cylinders			4	
Bore			77.2mm (3.0394in)	
Stroke			84.5mm (3.3268in)	
Total displacement			1,582 cc (96.54 cu.in)	
Compression ratio			17.3 : 1	
Firing order			1-3-4-2	
Valve timing				
Intake valve	Opens (ATDC)		17°5' ± 4°	
	Closes (ABDC)		14°6' ± 4°	
Exhaust valve	Opens (BBDC)		23°25' ± 4°	
	Closes (ATDC)		20° ± 4°	
Cylinder head				
Flatness of gasket surface			0.03mm (0.0012in) for width 0.09mm (0.0035in) for length	
Flatness of manifold mounting surface	Intake		0.025mm (0.0010in) for width 0.160mm (0.0063in) for length	
	Exhaust		0.025mm (0.0010in) for width 0.160mm (0.0063in) for length	
Camshaft				
Cam height	LH camshaft	Intake	35.452 ~ 35.652mm (1.3957 ~ 1.4036in)	
		Exhaust	35.700 ~ 35.900mm (1.4055 ~ 1.4134in)	
	RH camshaft	Intake	35.537 ~ 35.737mm (1.3991 ~ 1.4070in)	
		Exhaust	35.452 ~ 35.652mm (1.3957 ~ 1.4036in)	
Journal outer Diameter	LH camshaft		20.944 ~ 20.960mm (0.8246 ~ 0.8252in)	
	RH camshaft		20.944 ~ 20.960mm (0.8246 ~ 0.8252in)	
Bearing oil clearance			0.040 ~ 0.077mm (0.0016 ~ 0.0030in)	
End play			0.10 ~ 0.20mm (0.0039-0.0079in)	
Valve				
Valve length	Intake		93.0mm (3.6614in)	
	Exhaust		93.7mm (3.6890in)	
Stem outer diameter	Intake		5.455 ~ 5.470mm (0.2148 ~ 0.2154in)	
	Exhaust		5.435 ~ 5.450mm (0.2140 ~ 0.2146in)	

Description		Specifications (D4FB)	Limit
Face angle		45.5° ~ 45.75°	
Thickness of valve head (margin)	Intake	1.1mm (0.0433in)	
	Exhaust	1.2mm (0.0472in)	
Valve stem to valve guide clearance	Intake	0.030 ~ 0.057mm (0.0012 ~ 0.0022in)	
	Exhaust	0.050 ~ 0.077mm (0.0020 ~ 0.0030in)	
Valve guide			
Inner diameter	Intake	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
	Exhaust	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
Length	Intake	31.3 ~ 31.7mm (1.2323 ~ 1.2480in)	
	Exhaust	31.3 ~ 31.7mm (1.2323 ~ 1.2480in)	
Valve seat			
Width of seat contact	Intake	0.8 ~ 1.4mm (0.0315 ~ 0.0551in)	
	Exhaust	1.2 ~ 1.8mm (0.0472 ~ 0.0709in)	
Seat angle	Intake	45° ~ 45°30'	
	Exhaust	45° ~ 45°30'	
Valve spring			
Free length		44.9mm (1.7677in)	
Load		17.5±0.9kg/32.0mm(38.6±2.0 lb/1.2598in)	
		31.0±1.6kg/23.5mm(68.3±3.5 lb/0.9252in)	
Out of squareness		Less than 1.5°	3°
Cylinder block			
Cylinder bore		77.200 ~ 77.230mm (3.0394 ~ 3.0405in)	
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Piston			
Piston outer diameter		77.130 ~ 77.160mm (3.0366 ~ 3.0378in)	
Piston to cylinder clearance		0.060 ~ 0.080mm (0.0024 ~ 0.0031in)	
Ring groove width	No. 1 ring groove	1.83 ~ 1.85mm (0.0720 ~ 0.0728in)	
	No. 2 ring groove	1.82 ~ 1.84mm (0.0717 ~ 0.0724in)	
	Oil ring groove	3.02 ~ 3.04mm (0.1189 ~ 0.1197in)	
Piston ring			
Side clearance	No. 1 ring	0.09 ~ 0.13mm (0.0035 ~ 0.0051in)	
	No. 2 ring	0.08 ~ 0.12mm (0.0031 ~ 0.0047in)	
	Oil ring	0.03 ~ 0.07mm (0.0012 ~ 0.0028in)	

Description		Specifications (D4FB)	Limit
End gap	No. 1 ring	0.20 ~ 0.35mm (0.0079 ~ 0.0138in)	
	No. 2 ring	0.35 ~ 0.50mm (0.0138 ~ 0.0197in)	
	Oil ring	0.20 ~ 0.40mm (0.0079 ~ 0.0157in)	
Piston pin			
Piston pin outer diameter		27.995 ~ 28.000mm (1.1022 ~ 1.1024in)	
Piston pin hole inner diameter		28.004 ~ 28.010mm (1.1025 ~ 1.1028in)	
Piston pin hole clearance		0.004 ~ 0.015mm (0.0002 ~ 0.0006in)	
Connecting rod small end hole inner diameter		28.022 ~ 28.034mm (1.1032 ~ 1.1037in)	
Connecting rod small end hole clearance		0.022 ~ 0.039mm (0.0009 ~ 0.0015in)	
Connecting rod			
Connecting rod big end inner diameter		49.000 ~ 49.018mm (1.9291 ~ 1.9298in)	
Connecting rod bearing oil clearance		0.025 ~ 0.043mm (0.0010 ~ 0.0017in)	
Side clearance		0.10 ~ 0.25mm (0.0039 ~ 0.0098in)	0.4mm (0.0157in)
Crankshaft			
Main journal outer diameter		53.972 ~ 53.990mm (2.1249 ~ 2.1256in)	
Pin journal outer diameter		45.997 ~ 46.015mm (1.8109 ~ 1.8116in)	
Main bearing oil clearance		0.024 ~ 0.042mm (0.0009 ~ 0.0017in)	
End play		0.08 ~ 0.28mm (0.0031 ~ 0.110in)	
Flywheel			
Runout		0.1mm (0.0039in)	0.13mm (0.0051in)
Oil pump			
Side clearance	Inner rotor	0.040 ~ 0.085mm (0.0016 ~ 0.0033in)	
	Outer rotor	0.040 ~ 0.090mm (0.0016 ~ 0.0035in)	
Body clearance		0.120 ~ 0.185mm (0.0047 ~ 0.0073in)	
Relief valve opening pressure		490±49.0kpa (5±0.5kg/cm², 71±7.1psi)	
Engine oil			
Oil quantity (Total)		5.7 L (6.02 US qt, 5.01 Imp qt)	
Oil quantity (Oil pan)		4.8 L (5.07 US qt, 4.22 Imp qt)	
Oil quantity (Drain and refill including oil filter)		5.3 L (5.60 US qt, 4.66 Imp qt)	
Oil quality		ABOVE API CH-4 or ACEA B4 (with CPF:C3)	
Oil pressure (Idle) (Oil temperature : 80°C)		78.4kpa (0.8kg/cm², 11.3psi)	
Cooling system			
Cooling method		Forced circulation with cooling fan	
Coolant quantity		6.97 L (7.37 US qt, 6.13 Imp qt)	

Description		Specifications (D4FB)	Limit
Thermostat	Type	Wax pellet type	
	Opening temperature	85±1.5˚C (185.0±2.7˚F)	
	Pull opening temperature	100˚C (212˚F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi)	
	Vacuum valve openingpressure	0.98 ~ 4.90 kpa (0.01 ~ 0.05kg/cm², 0.14 ~ 0.71 psi)	
Water temperature sensor			
Type		Thermister type	
Resistance	20˚C (68˚F)	2.45±0.14 kΩ	
	80˚C (176˚F)	0.3222 kΩ	

TIGHTENING TORQUE

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb.ft
Cylinder block				
Engine support bracket bolt	4	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Piston cooling oil jet bolt	4	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Drive belt auto tensioner bolt	2	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Drive belt auto tensioner mounting bracket bolt	3	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Engine mounting				
Engine mounting bracket and body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting insulator and engine mounting support bracket fixing nut	1	68.6 ~ 93.2	7.0 ~ 9.5	50.6 ~ 68.7
Engine mounting support bracket and engine support bracket fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting support bracket and engine support bracket fixing nut	1	49.0 ~63.7	5.0 ~6.5	36.2 ~47.0
Transaxle mounting bracket and body fixing bolt	4	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting insulator and transaxle support bracket fixing bolt	1	88.3 ~ 107.9	9.0 ~11.0	65.1 ~79.6
Front roll stopper bracket and sub frame fixing bolt (10 X 45)	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper bracket and sub frame fixing bolt (10 X 25)	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper insulator and front roll stopper support bracket fixing bolt,nut	1	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb.ft
Rear roll stopper bracket and sub frame fixing bolt (10 X 60)	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper bracket and sub frame fixing bolt (10 X 40)	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper insulator and rear roll stopper support bracket fixing bolt,nut	1	49.0 ~63.7	5.0 ~6.5	36.2 ~47.0
Main moving system				
Connecting rod cap bolt	8	12.7 + (87~93°)	1.3 + (87~93°)	9.4 + (87~93°)
Crankshaft main bearing cap bolt (long)	10	(22.6~26.5) + (90~94°)	(2.3~2.7) + (90~94°)	(16.6~19.5) + (90~94°)
Crankshaft main bearing cap bolt (short)	10	32.4 ~ 36.3	3.3 ~ 3.7	23.9 ~ 26.8
Flywheel bolt (M/T)	8	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Drive plate bolt (A/T)	8	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Timing chain				
Timing chain cover bolt (8 X 70)	7	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (8 X 60)	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (8 X 35)	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (6 X 35)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt (6 X 28)	7	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain case bolt (8 X 22)	4	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Timing chain case bolt (8 X 32)	1	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Timing chain case bolt (6 X 35)	1	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Engine hanger (front)	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Crankshaft pulley bolt	1	225.6 ~ 245.2	23.0 ~ 25.0	166.4 ~ 180.8
Camshaft chain sprocket bolt	1	68.6 ~ 73.5	7.0 ~ 7.5	50.6 ~ 54.2
High pressure pump chain sprocket bolt	1	64.7 ~ 74.5	6.6 ~ 7.6	47.7 ~ 55.0
Timing chain guide (1) bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide (2) bolt	1	9.8 ~ 13.7	1.0 ~ 1.4	7.2 ~ 10.1
Timing chain "A" auto tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "C" auto tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head				
Engine cover bolt	5	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Cylinder head cover bolt	13	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap bolt (mark 10)	16	12.7 ~ 13.7	1.3 ~ 1.4	9.4 ~ 10.1
Camshaft bearing cap bolt (mark 9)	6	12.7 ~ 13.7	1.3 ~ 1.4	9.4 ~ 10.1

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb.ft
Engine hanger bolt	2	28.4 ~ 32.4	2.9 ~ 3.3	21.0 ~ 23.9
Cylinder head bolt	10	(47.1~51.0) + (88~92°) + (118~122°)	(4.8~5.2) + (88~92°) + (118~122°)	(34.7~37.6) + (88~92°) + (118~122°)
Cooling system				
Water pump pulley bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt (8 X 50)	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water pump bolt (8 X 70)	1	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Thermostat housing bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Thermostat housing nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water return pipe assembly bolt	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water temperature sensor	1	19.6 ~ 39.2	2.0 ~ 4.0	14.5 ~ 28.9
Water inlet fitting nut	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Lubrication system				
Oil filter assembly bolt	4	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil cooler assembly bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil filter upper cap	1	24.5	2.5	18.1
Oil level gauge bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pan bolt (6 X 20)	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (6 X 65)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (6 X 85)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan and transaxle fixing bolt	3	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Oil pan drain bolt	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil screen nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch	1	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Intake and exhaust system				
Intake manifold and cylinder head fixing nut	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Intake manifold and cylinder head fixing bolt	7	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Exhaust manifold and cylinder head fixing nut	8	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Exhaust manifold heat protector bolt	3	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
WCC assembly fixing nut	3	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Air cleaner lower cover fixing bolt	3	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Throttle body and surge tank fixing bolt	4	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb.ft
Exhaust manifold and front muffler fixing bolt	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front muffler fixing clip bolt	1	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front muffler and center muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler and main muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

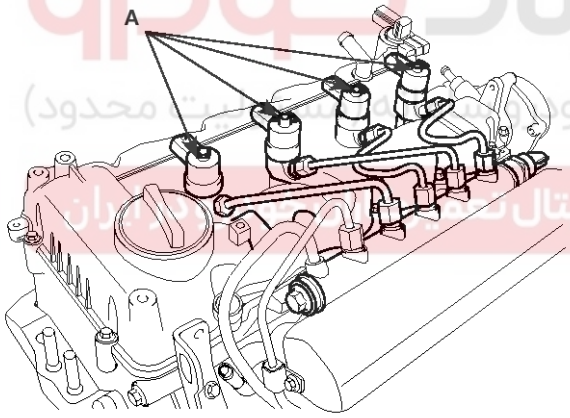
INSPECTION

COMPESSION PRESSURE

NOTICE

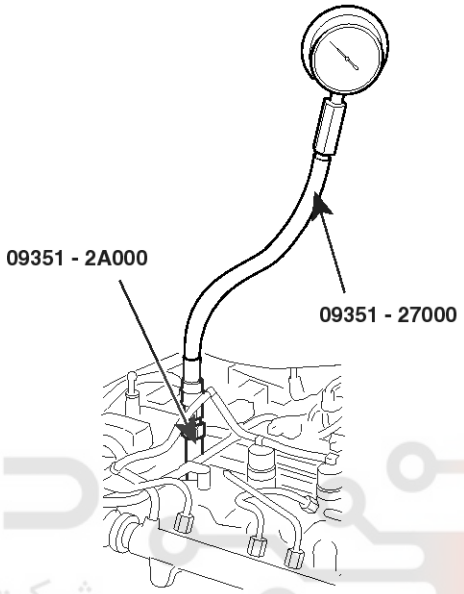
- *If the there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.*
- *Whenever removing injectors for compression pressure inspection, replace the gaskets with new ones and tighten them with the specified torque.*

1. Warm up engine until the normal operating temperature.
2. Remove the injectors. (Refer to FL Gr.)



LCGF003A

3. Check the cylinder compression pressure.
   1) Insert a compression gauge SST(09351-27000, 09351-2A000) into the injector hole.



SLDEM6115D

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

      NOTICE

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

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

      NOTICE

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

Compression pressure :
2,157.45kPa (22.0kg/cm², 312.91psi) (200 rpm)
Minimum pressure :
1,863.25kPa (19kg/cm², 270.24psi)
Difference between each cylinder :
98.07kPa (1.0kg/cm², 14.22psi) or less

   5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat step 1) through 3) for cylinders with low compression.

- If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

4. Reinstall the injectors. (Refer to FL Gr.)

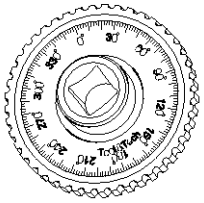
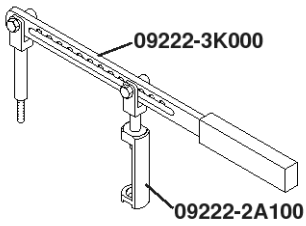
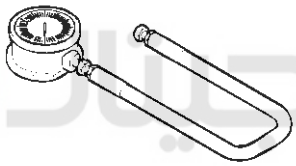
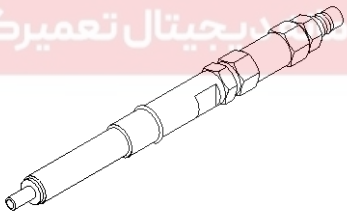
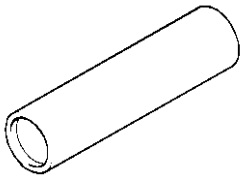
TROUBLESHOOTING

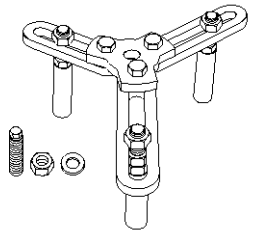
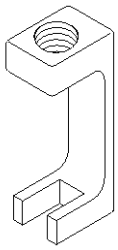
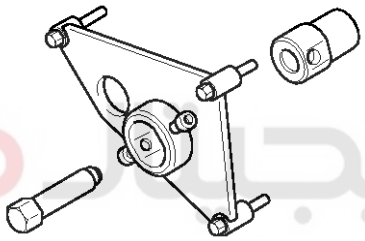
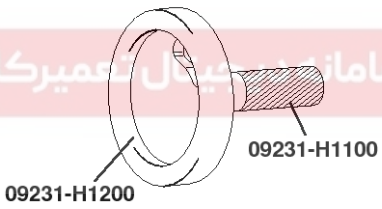
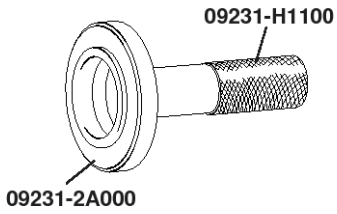
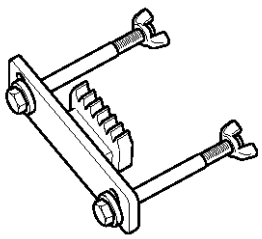
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. 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 can cause the valve not to close properly.)	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	• Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system. • Coolant consumption may or may not cause the engine to overheat.	• 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, valve 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)	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.	Drain the oil. Refill with the correct viscosity oil.
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft . Repair or replace as required.

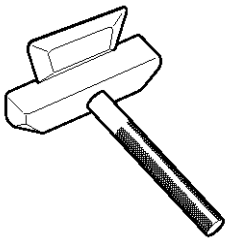
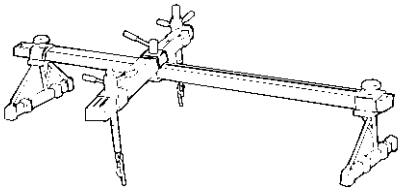
Symptom	Suspect area	Remedy
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes. Replace the 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.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore. Repair as required.
	Excessive piston pin-to-bore clearance.	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. • The connecting rod bearings. • The connecting rods. • The crankshaft. • The crankshaft journal.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation.	Verify the piston pins and connecting rods are installed correctly. Repair as required.

Symptom	Suspect area	Remedy
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. • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals. • The cylinder block crankshaft bearing bore.
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	Remove injectors and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
	Foreign material in cylinder. • Broken valve. • Piston material. • Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft. Repair or replace as required.

SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Use
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method
Valve spring compressor (09222-3K000) Valve spring compressor adapter (09222-2A100)		Removal and installation of intake and exhaust valves
Compression gauge (09351-27000)		Checking engine compression pressure
Compression gauge adapter (09351-2A000)		Checking engine compression pressure
Valve stem oil seal installer (09222-2A000)		Installation of valve stem oil seals

Tool (Number and name)	Illustration	Use
Injector remover (09351-4A200)		Removal of injectors
Injector remover adapter (09351-2A100)		Removal of injectors
High pressure pump sprocket remover (09331-2A000)		Removal of high pressure pump sprocket
Crankshaft rear oil seal installer (09231-H1200) Handle (09231-H1100)		Installation of crankshaft rear oil seal
Front cover oil seal installer (09231-2A000) Handle (09231-H1100)		Installation of front cover oil seal
Flywheel stopper (09231-2A100)		Removal and installation of crankshaft pulley bolt.

Tool (Number and name)	Illustration	Use
Oil pan remover (09215-3C000)		Removal of oil pan
Engine support fixture and a-dapter (09200-38001, 09200-1C000)		Engine fixing

Engine And Transaxle Assembly

REMOVAL

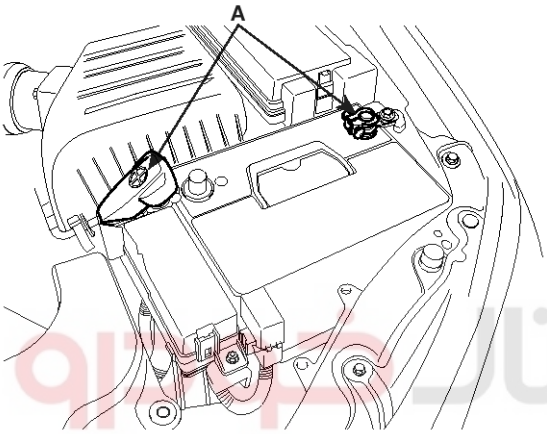
CAUTION

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

NOTICE

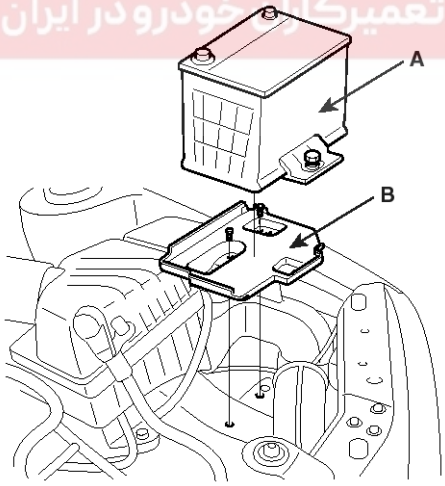
- *Mark all wiring and hoses to avoid misconnection.*

1. Disconnect the battery terminals(A).



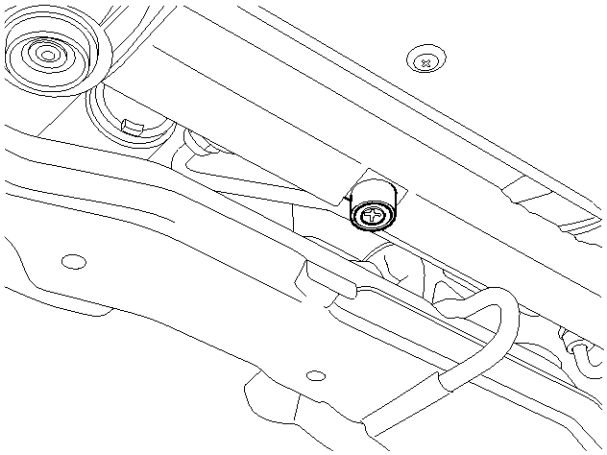
LCGF064A

2. Remove the battery(A) and battery tray(B).



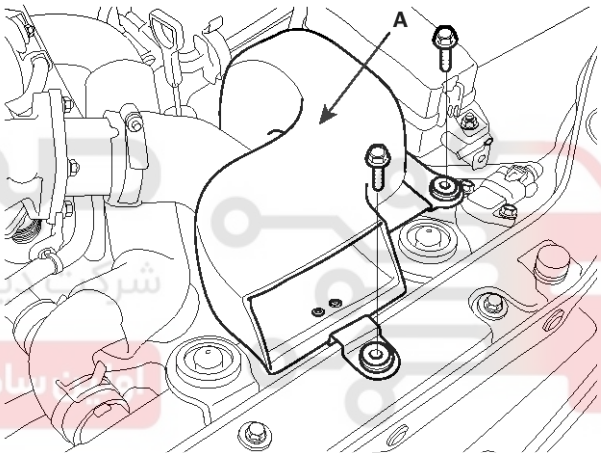
SLDEM6103D

3. Remove the engine cover.
4. Drain the engine coolant. Remove the radiator cap to speed draining.



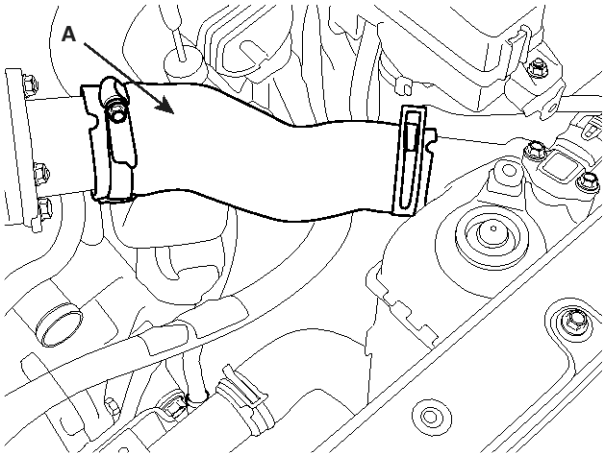
SLDEM6001D

5. Remove the air duct(A).



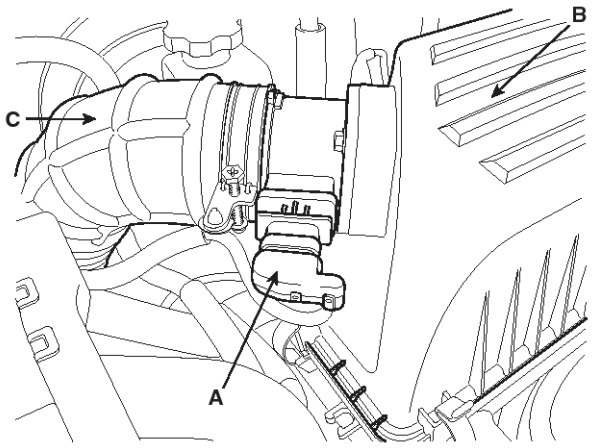
SLDEM6002D

6. Remove the intake hose(A).



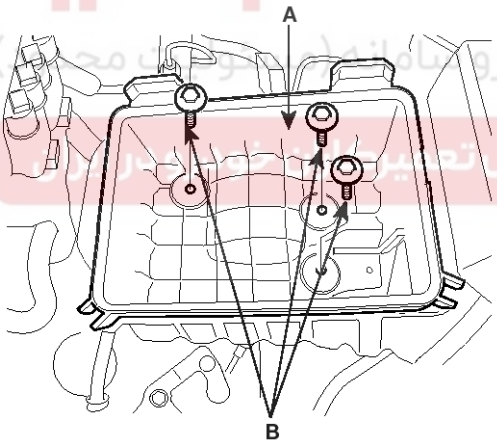
SLDEM6009D

7. Remove the air cleaner assembly.
   1) Disconnect the AFS(Air Flow Sensor) connector(A).



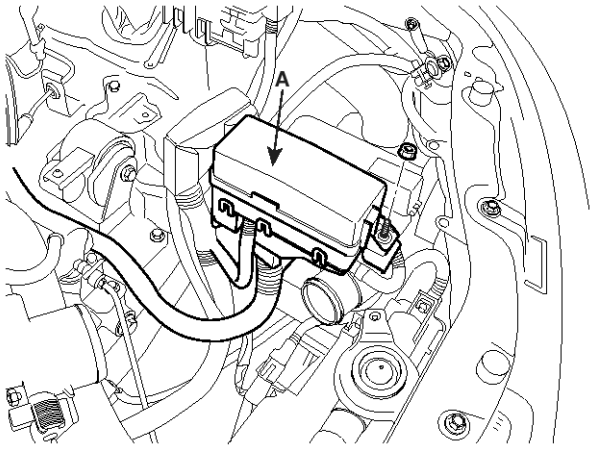
SLDEM6121D

   2) Remove the air cleaner upper cover(B).
   3) Remove the air hose(C).
   4) Remove the air cleaner element.
   5) Remove the bolts(B) and air cleaner lower cover(A).



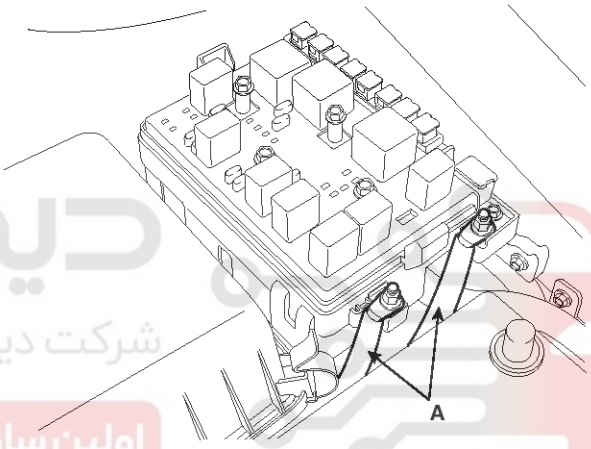
LCGF136A

8. Remove the main relay box(A).



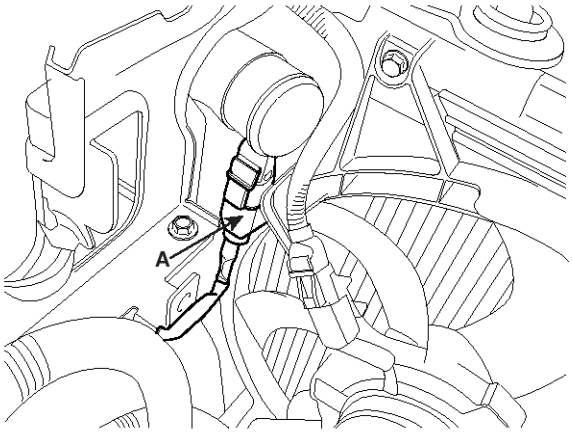
LCGF067A

9. Remove the wiring(A) from fuse box.



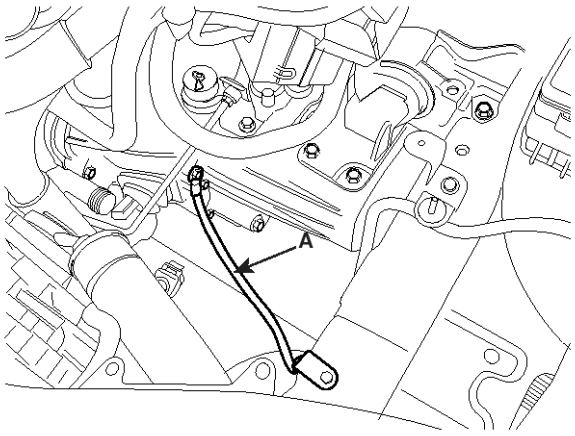
SLDEM6122D

10. Remove the connector(A).

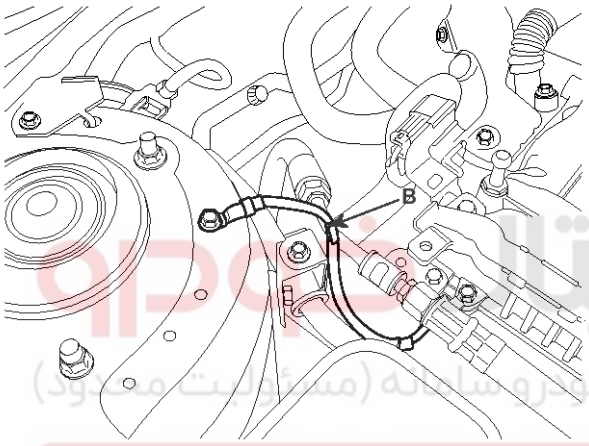


LCGF068A

11. Remove the ground cable from transaxle(A) and cylinder head(B).

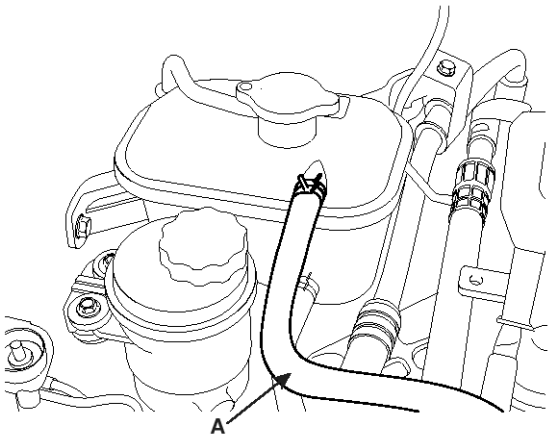


LCGF069A



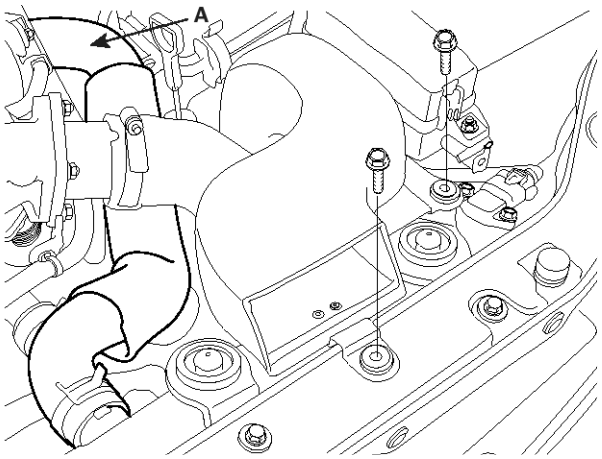
LCGF070A

12. Remove the coolant reservoir tank hose(A).



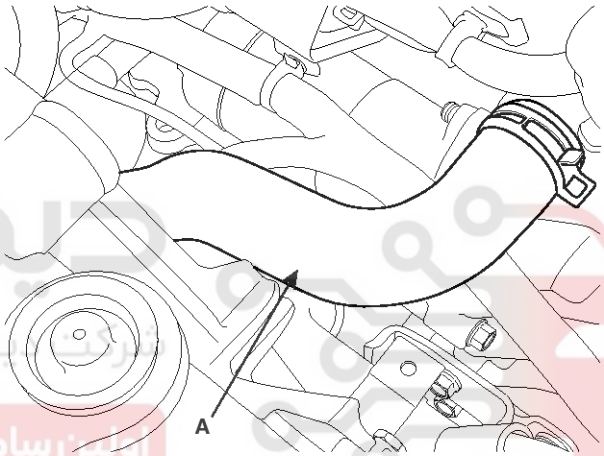
LCGF071A

13. Remove the radiator upper hose(A).



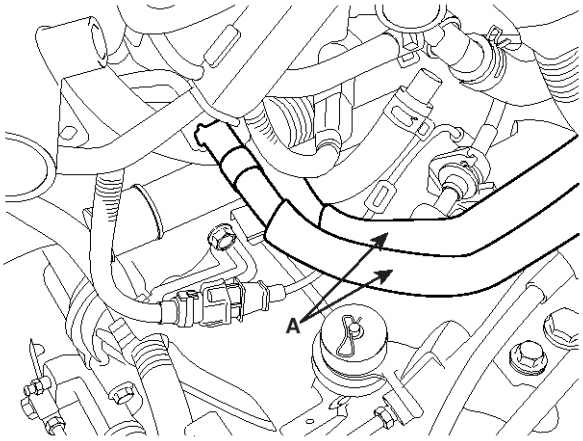
SLDEM6110D

14. Remove the radiator lower hose(A).



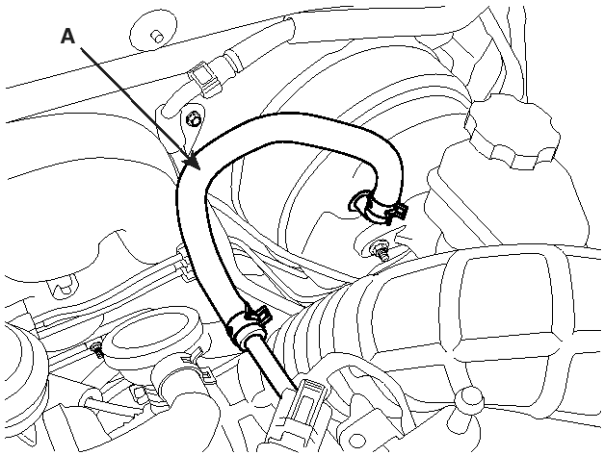
SLDEM6003D

15. Remove the fuel hose(A).



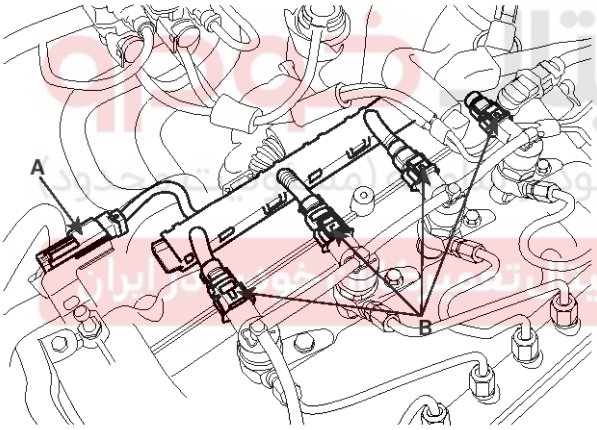
LCGF074A

16. Remove the brake vacuum hose(A).



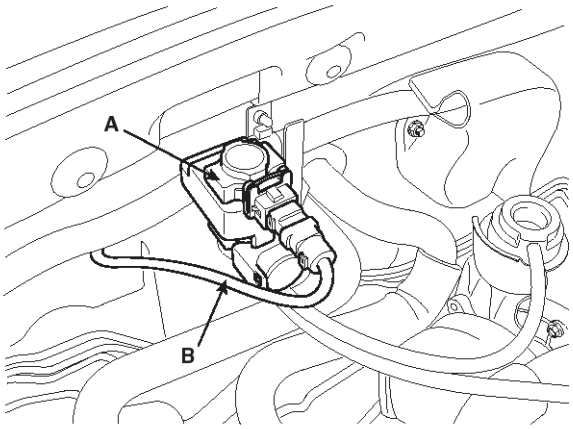
SLDEM6010D

17. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
    1) Disconnect the glow plug connector(A).
    2) Disconnect the injector connector(B).



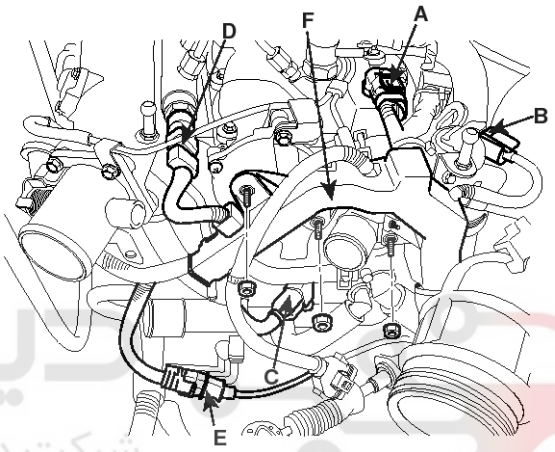
LCGF076A

3) Disconnect the vacuum solenoid valve connector(A) and vacuum hose(B).



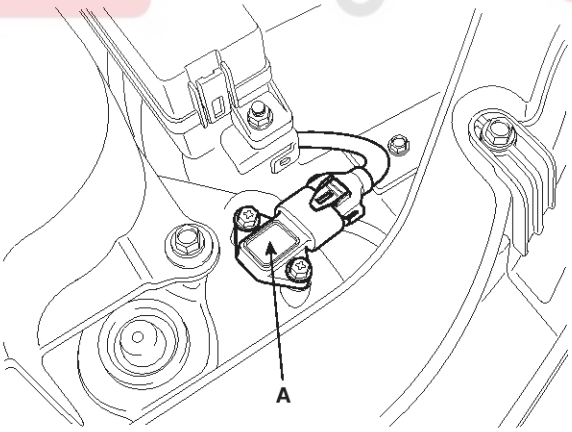
SLDEM6123D

4) Disconnect the CMP(Camshaft position sensor) connector(A).
5) Disconnect the EGR(Emission Gas Recirculation) solenoid valve connector(B).
6) Disconnect the water temperature sensor connector(C).
7) Disconnect the common rail pressure sensor connector(D).
8) Disconnect the CKP(Crankshaft Position Sensor) connector(E).
9) Remove the engine wire harness bracket(F).



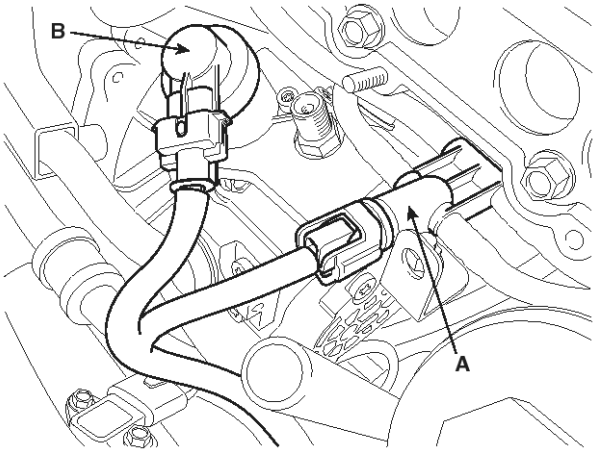
LCGF078A

10) Disconnect the MAP sensor connector(A).



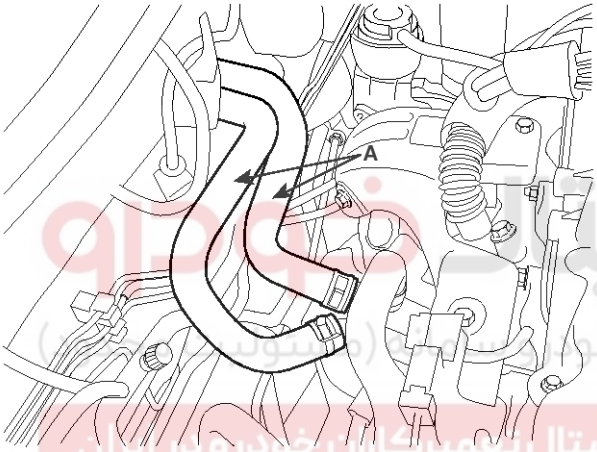
SLDEM6124D

11) Disconnect the fuel temperature sensor connector(A).
12) Disconnect the fuel pressure regulator connector(B).



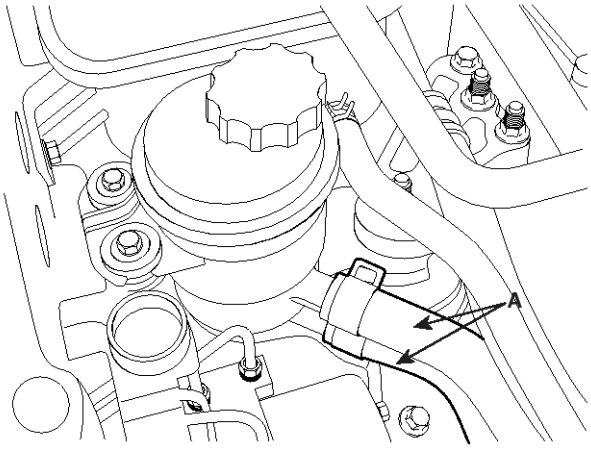
SLDEM6125D

18. Remove the heater hose(A).



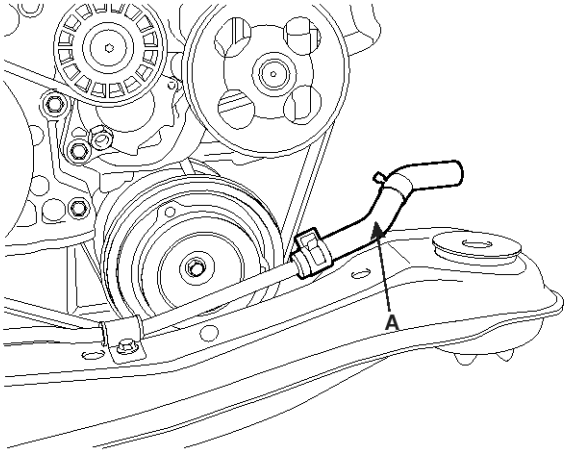
LCGF080A

19. Remove the power steering oil hose(A) and drain the power steering oil.



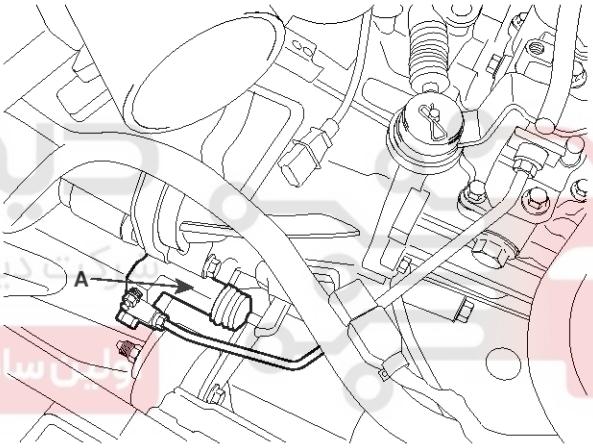
LCGF081A

20. Remove the power steering return hose(A).



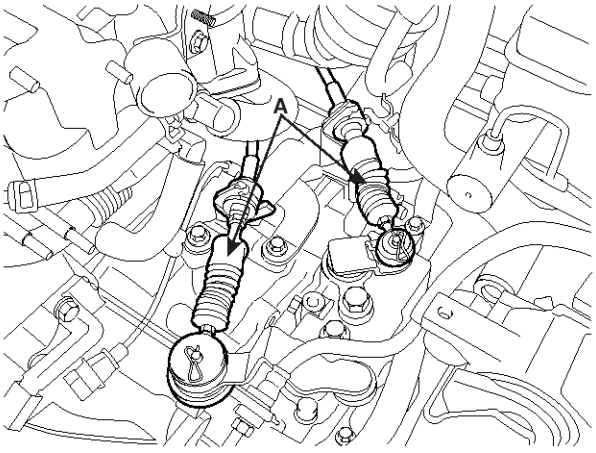
LCGF082A

21. Remove the transaxle wire harness connectors and control cable from transaxle(M/T).
    1) Remove the clutch release cylinder(A).



LCGF083A

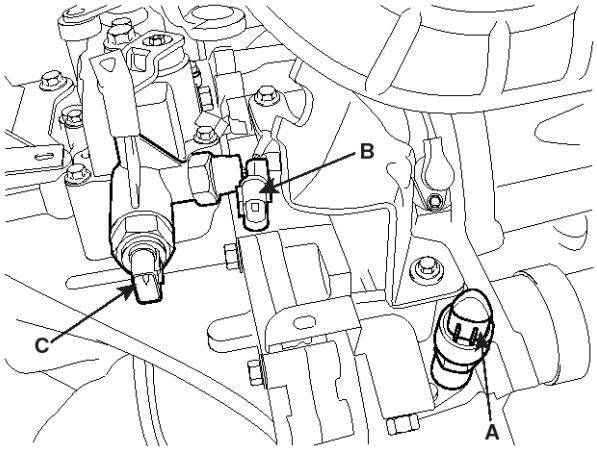
    2) Remove the transaxle control cable(A).



LCGF084A

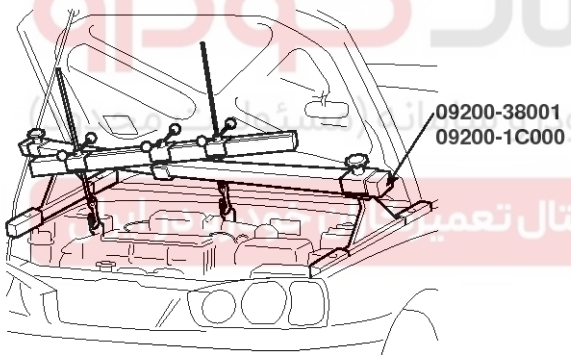
    3) Disconnect the vehicle speed sensor connector(A).

4) Disconnect the back lamp switch connector(B).
5) Disconnect the neutral switch connector(C).



LCGF085A

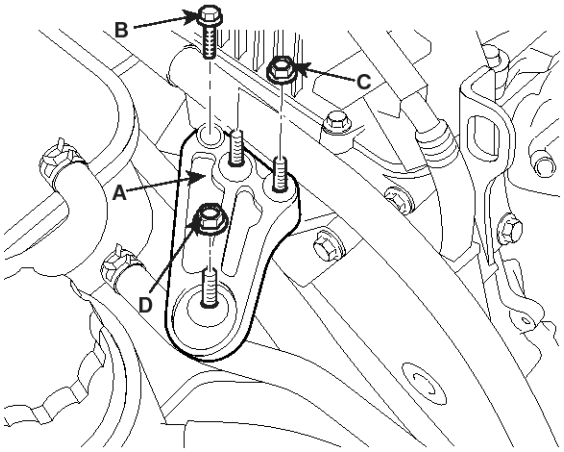
22. Install the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, on the engine and transaxle assembly.



LCGF137A

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

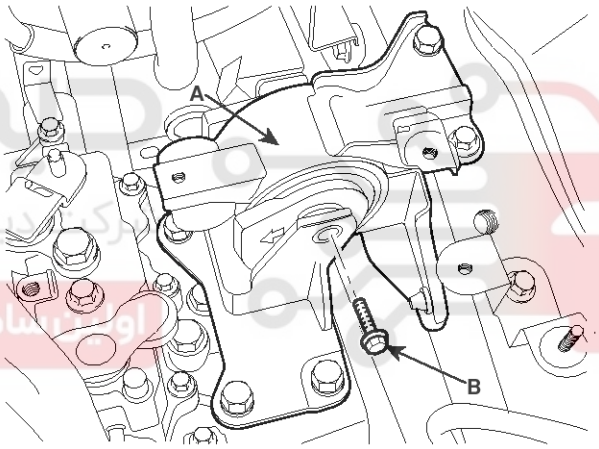
Tightening torque :
Nut(D) : 68.6 ~ 93.2N.m (7.0 ~ 9.5kgf.m, 50.6 ~ 68.7lbf.ft)
Bolt(B),Nut(C) : 49.0 ~ 63.7N.m
(5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lbf.ft)



LCGF086A

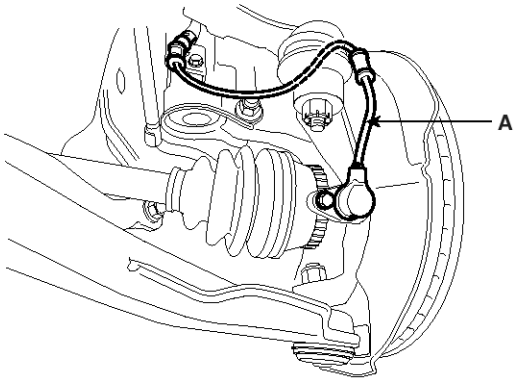
24. Remove the transaxle mounting bracket(A).

Tightening torque :
Bolt(B) : 88.3 ~ 107.9N.m (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lbf.ft)



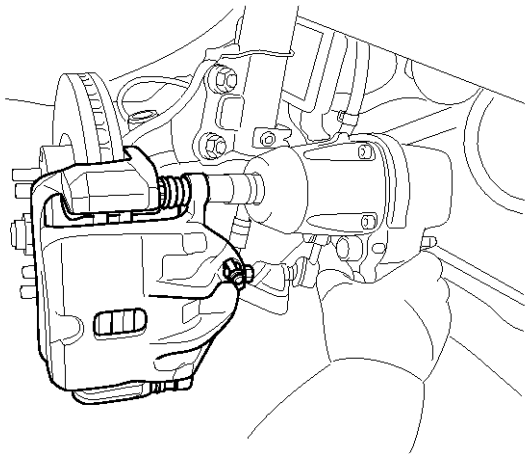
LCGF087A

25. Remove the front tires.
26. Remove the ABS wheel speed sensor(A).

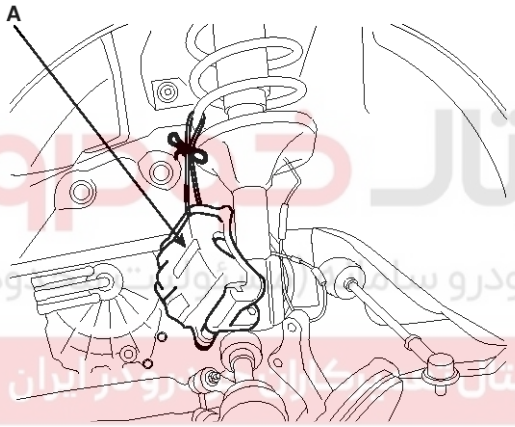


LCGF138A

27. Remove the caliper and hang assembly(A).

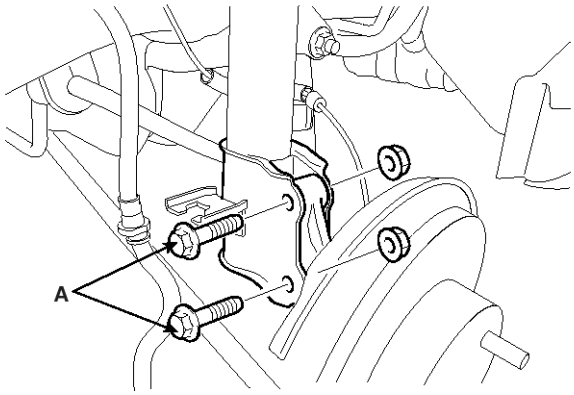


SLDEM6118D



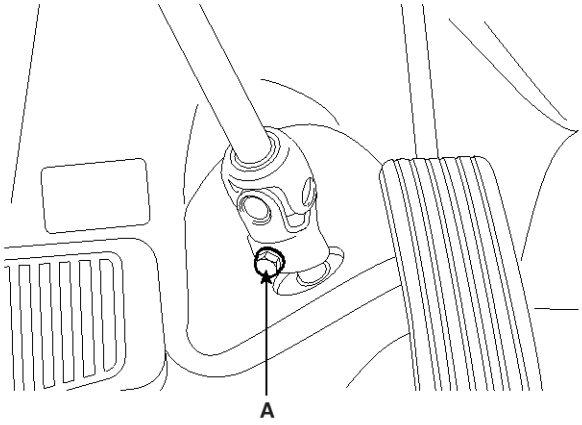
LCGF140A

28. Remove the knuckle mounting bolts(A).



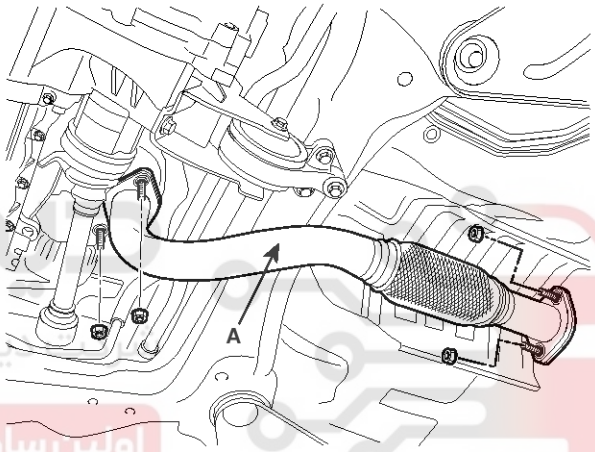
LCGF141A

29. Remove the steering u-joint mounting bolt(A).



LCGF142A

30. Remove the front muffler(A).



LCGF088A

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

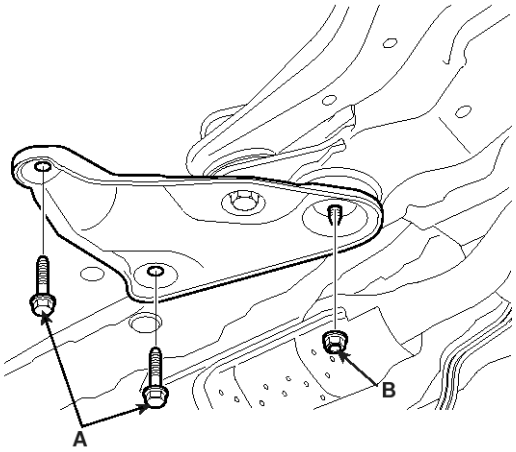
NOTICE

After removing the sub frame mounting bolt , the engine and transaxle assembly may fall downward, and so support them securely with floor jack.

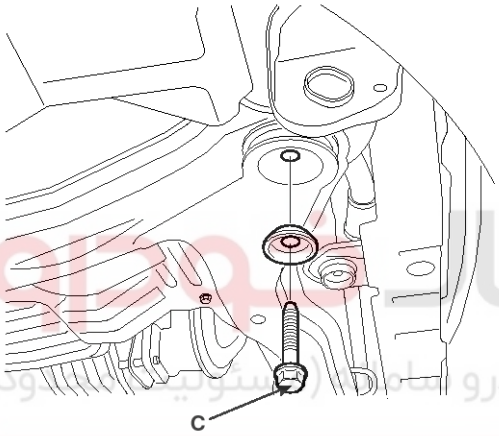
Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

32. Remove the sub frame bolts and nuts.

Tightening torque :
Bolt(A) : 39.2 ~ 53.9N.m (4.0 ~ 5.5kgf.m, 28.9 ~ 39.8lbf.ft)
Nut(B),Bolt(C) : 156.9 ~ 176.5N.m
(16.0 ~ 18.0kgf.m, 115.7 ~ 130.2lbf.ft)



LCGF156A



LCGF152A

33. Remove the engine support fixture and the adapter.
34. Remove the engine and transaxle assembly by lifting vehicle.

NOTICE

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

INSTALLATION

Installation is in the reverse order of removal.

Perform the following :

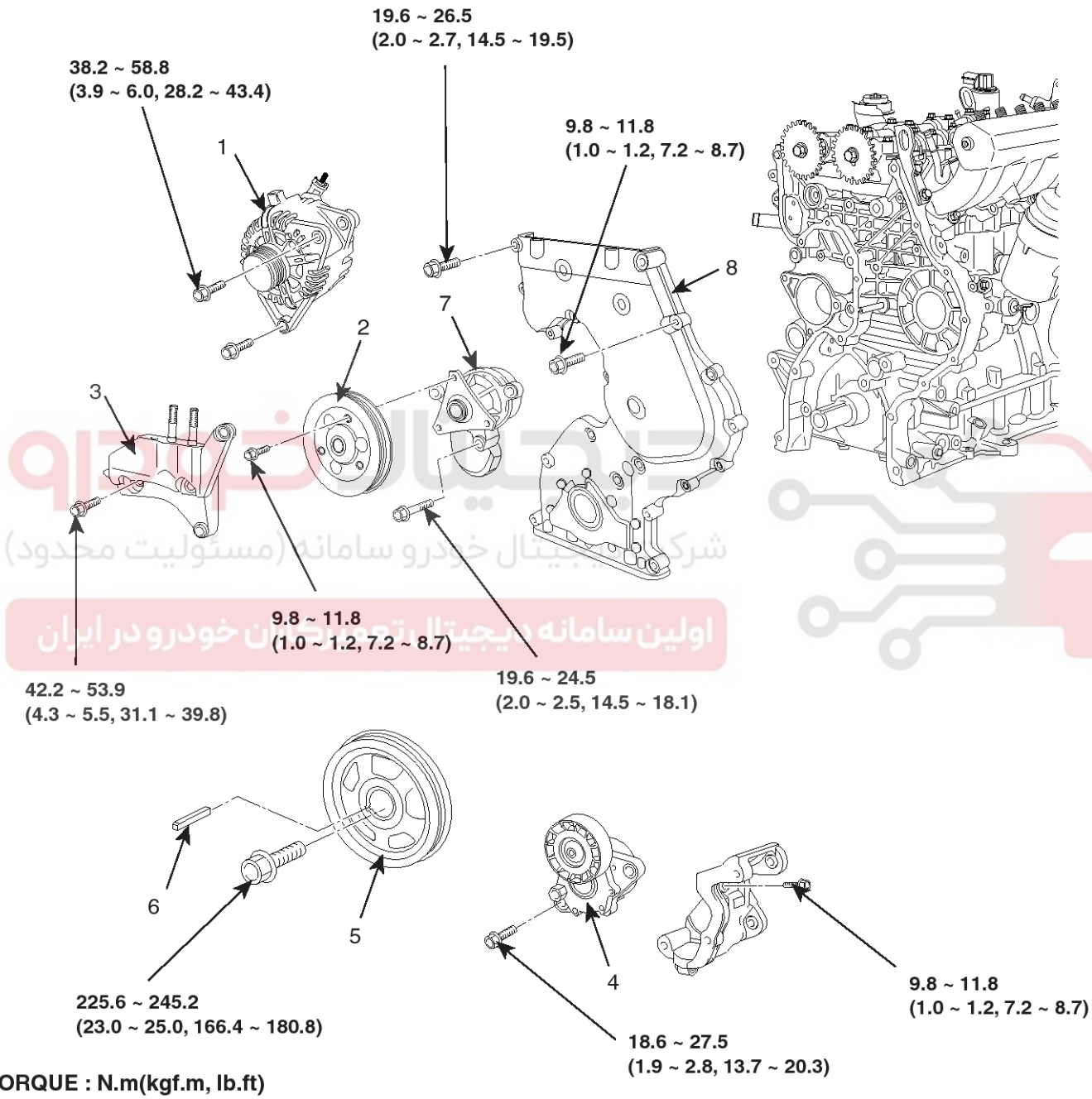
- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator and reservoir tank with engine coolant.
- Place the heater control knob on "HOT" positon.
- Bleed air from the cooling system
  - Start engine and let it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

Timing System

Timing System

Timing Chain

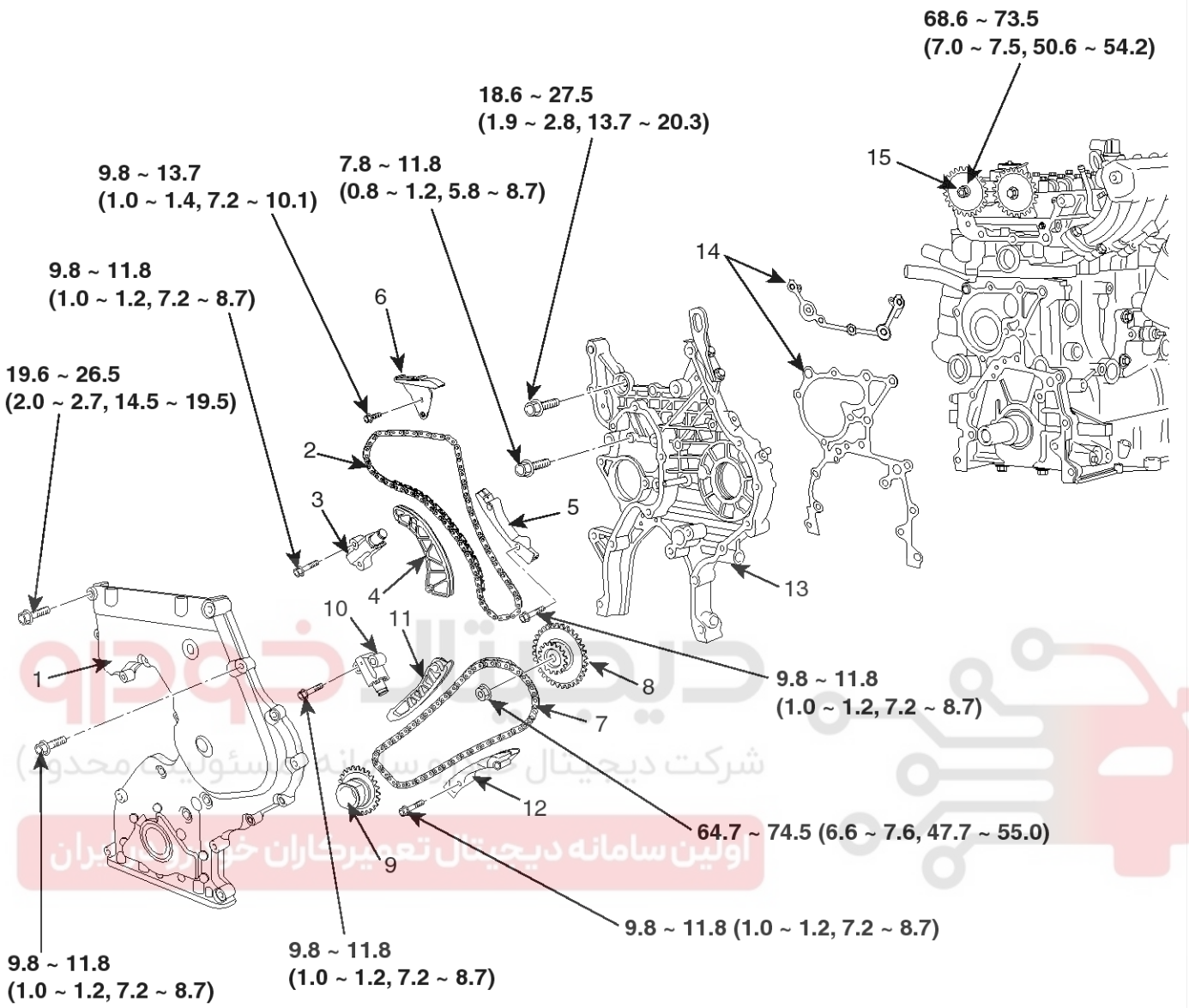
COMPONENTS



TORQUE : N.m(kgf.m, lb.ft)

1. Alternator
2. Water pump pulley
3. Engine support bracket
4. Drive belt auto tensioner
5. Crankshaft pulley
6. Key
7. Water pump
8. Timing chain cover

SLDEM6100L



TORQUE : N.m(kgf.m, lb.ft)

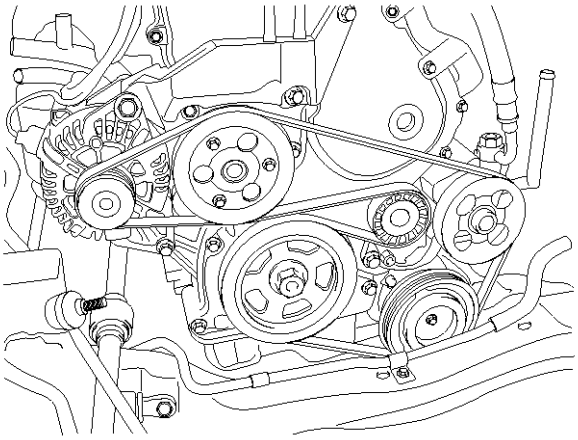
1. Timing chain cover
2. Timing chain "C"
3. Timing chain "C" auto tensioner
4. Timing chain "C" lever
5. Timing chain guide "1"
6. Timing chain guide "2"
7. Timing chain "A"
8. High pressure pump sprocket
9. Crankshaft sprocket
10. Timing chain "A" auto tensioner
11. Timing chain "A" lever
12. Timing chain guide "1"
13. Timing chain case
14. Timing chain case gasket
15. Camshaft sprocket

SLDEM6101L

REMOVAL

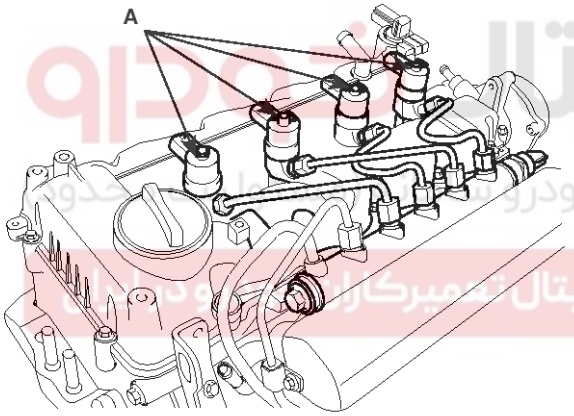
Engine removal is not required for this procedure.

1. Remove the drive belt.



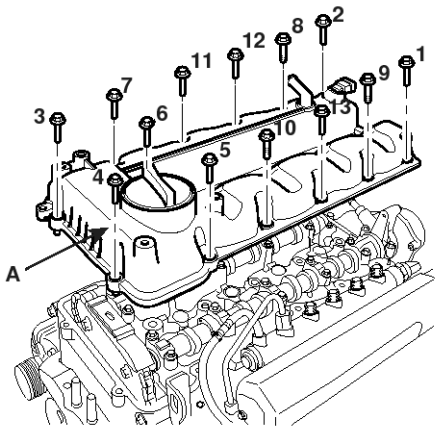
LCGF149A

2. Remove the injector(A). (Refer to FL Gr.)



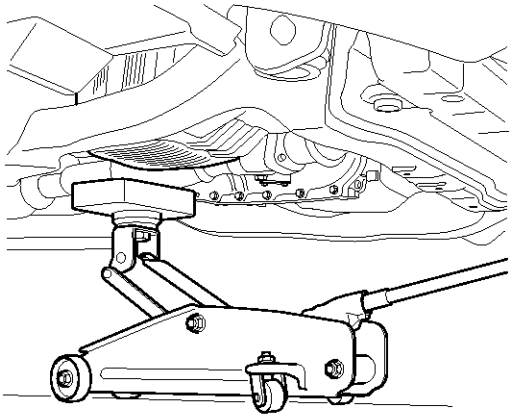
LCGF003A

3. Remove the cylinder head cover(A).



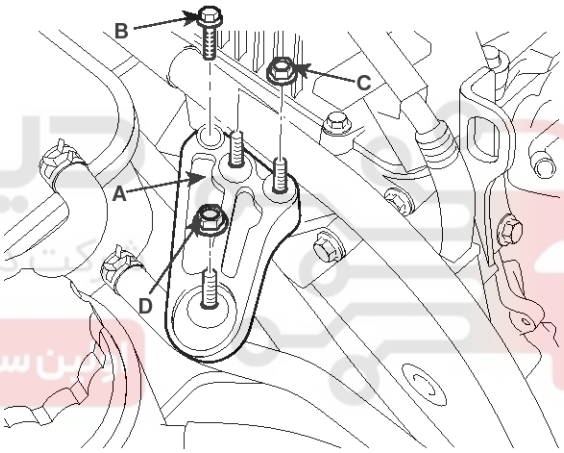
LCGF004A

4. Remove the engine mounting support bracket.
   1) Set the jack to the engine oil pan



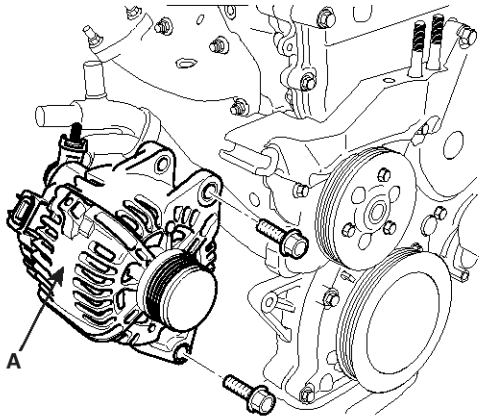
LDIF001A

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



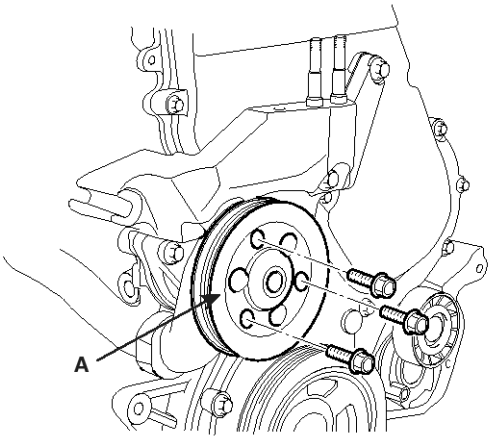
LCGF086A

5. Remove the alternator(A).



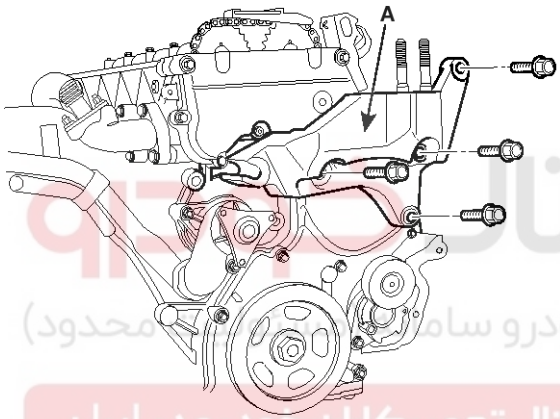
LCGF005A

6. Remove the water pump pulley(A).



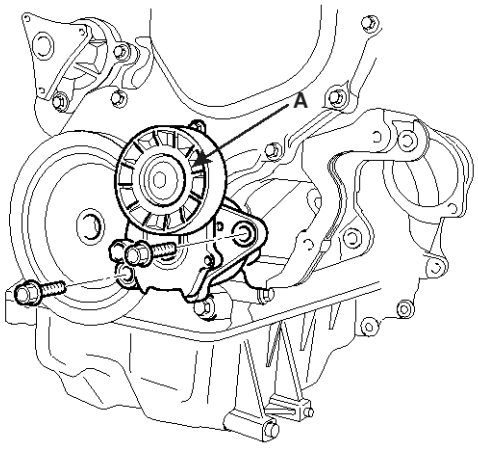
LCGF006A

7. Remove the engine support bracket(A).



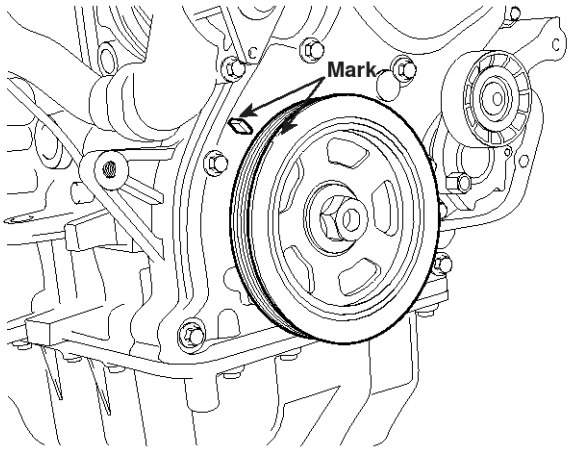
LCGF007A

8. Remove the drive belt auto tensioner(A).



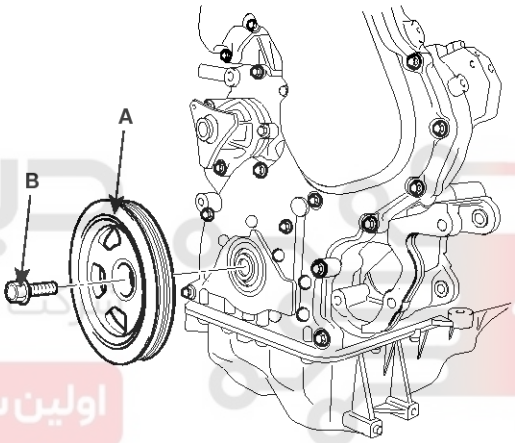
LCGF008A

9. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing chain cover. (No.1 cylinder compression TDC position)



LCGF089A

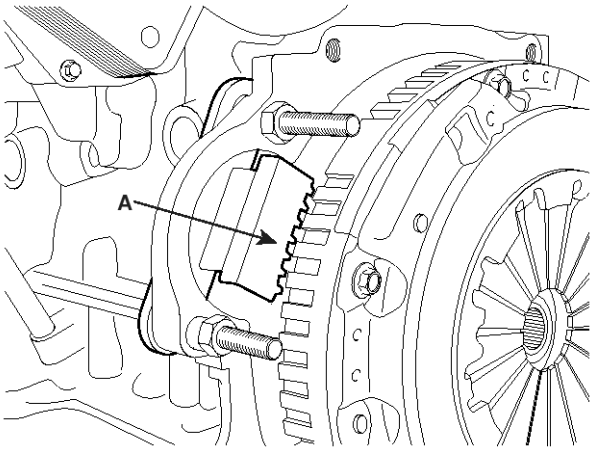
10. Remove the crankshaft pulley bolt(B) and crankshaft pulley(A).



LCGF009A

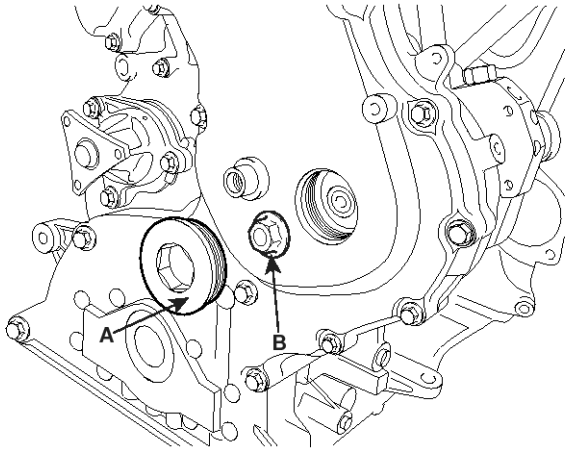
NOTICE

Use the SST(flywheel stopper, 09231-2A100)(A) to remove the crankshaft pulley bolt, after remove the starter.



LCGF090A

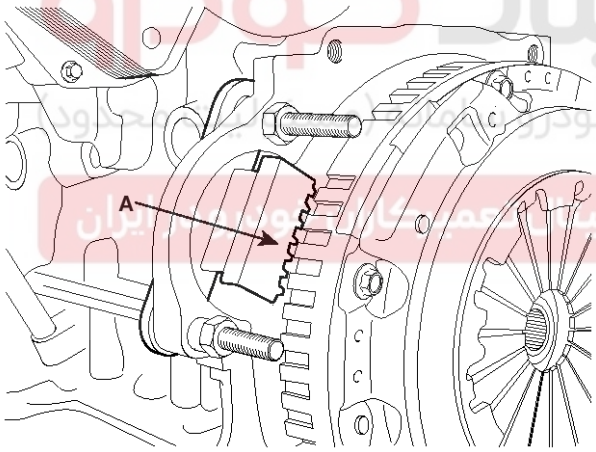
11. Remove the high pressure pump sprocket nut(B) after remove the timing chain cover plug(A).



LCGF091A

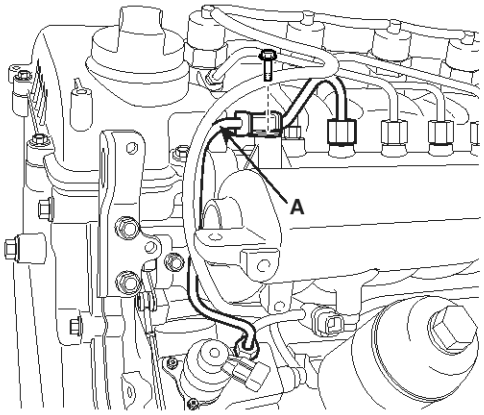
NOTICE

- *Use the SST(flywheel stopper, 09231-2A100) to remove the high pressure pump sprocket nut.*
- *Replace O-ring of plug(A) with a new one when reinstalling the plug.*



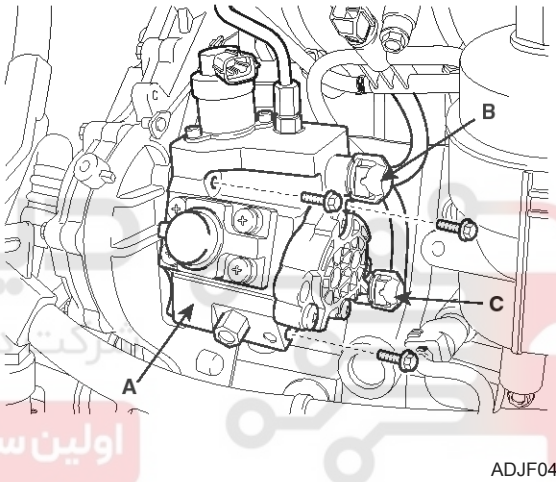
LCGF090A

12. Remove the high pressure pipe(A).



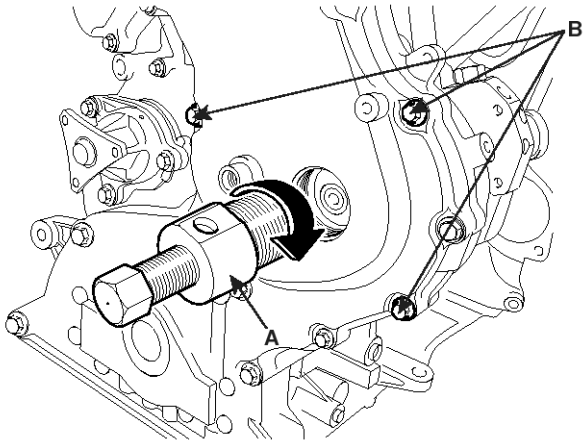
ADJF034A

13. Remove the mounting bolts of the high pressure pump(A) and the fuel hoses(B, C).



ADJF044A

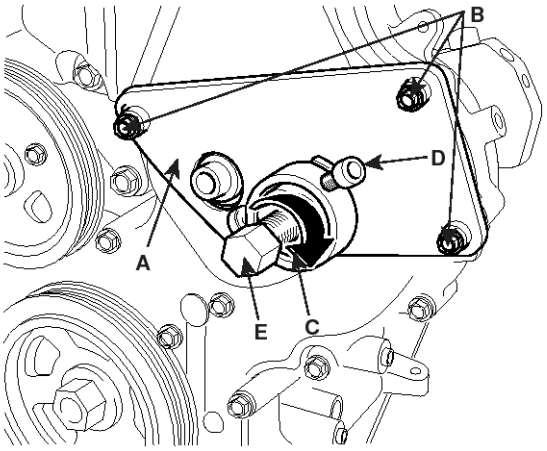
14. Install the SST(high pressure pump sprocket stopper, 09331-2A000)(A) to sprocket rotating it clockwise.
15. Remove the timing chain cover bolt(three bolts)(B).



LCGF159A

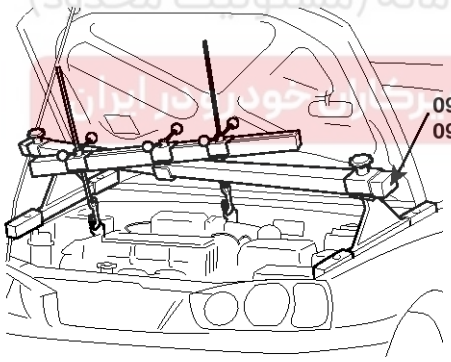
16. Install the SST(high pressure pump sprocket remover, 09331-2A000)(A) to timing chain cover with three long bolts(B).

17. Fix the high pressure pump remover(A) and sprocket stopper(C) with two fixing bolts(D).
18. Rotate the bolt(E) clockwise till high pressure pump is pushed out.
19. Remove the SST(09331-2A000) after remove the high pressure pump.



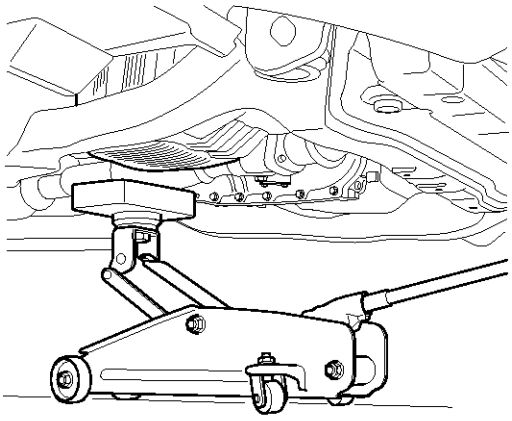
LCGF160A

20. Install the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, on the enine hanger bracket.



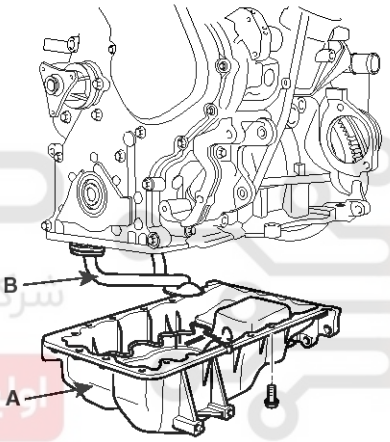
LCGF150A

21. Remove the jack from oil pan.



LDIF001A

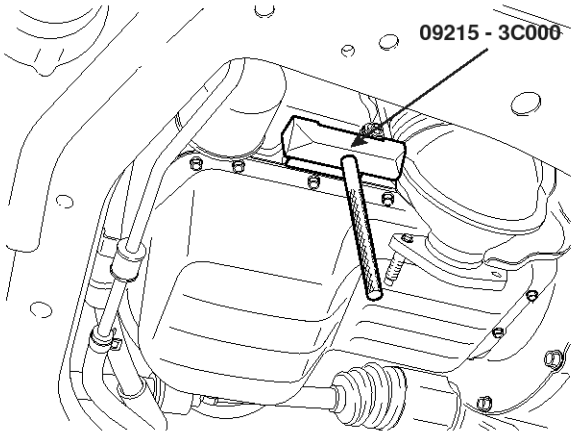
22. Remove the oil pan(A).
23. Remove the oil strainer(B).



LCGF010A

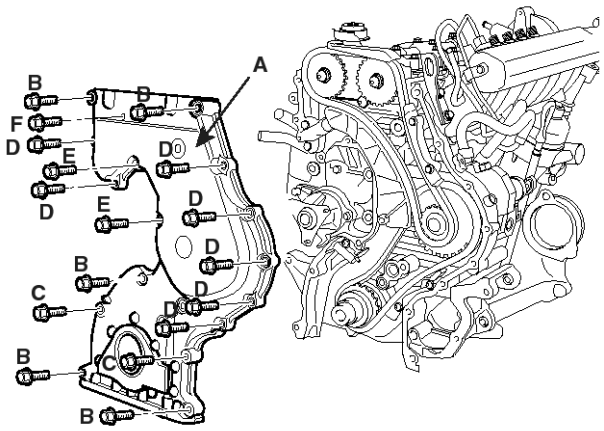
NOTICE

When removing the oil pan, use the SST(09215-3C000) in order not to damage the surface between the cylinder block and the oil pan.



ACGF127A

24. Remove the timing chain cover(A)

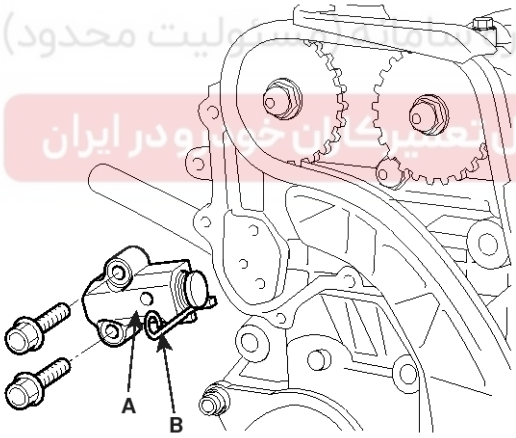


SLDEM6102D

NOTICE

Remove thoroughly sealant and oil etc left at the sealing surface after remove the chain cover and oil pan. (If any impurities are left at the sealing face, oil may leak after reassembly even with the sealant application.)

25. Remove the timing chain "C" auto tensioner(A).

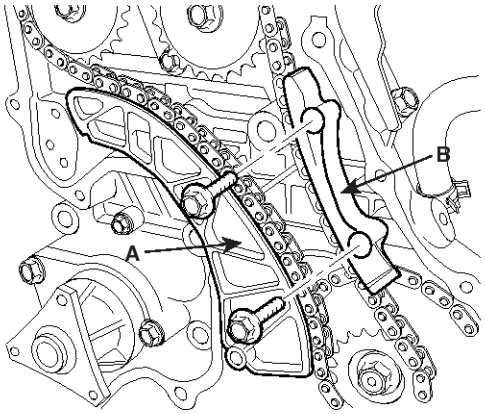


LCGF012A

NOTICE

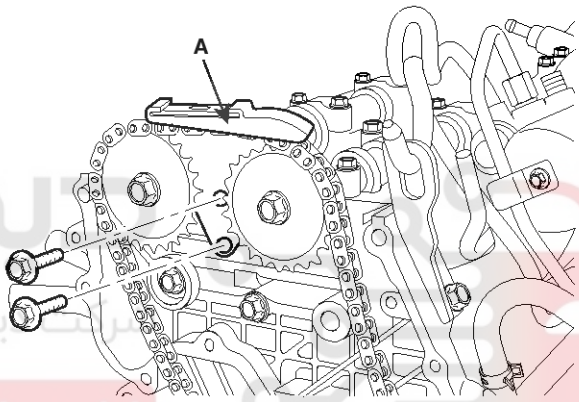
Before removing auto-tensioner, install a set pin(B) (ø2.5 mm steel wire) after compressing the tensioner.

26. Remove the timing chain "C" lever(A) and the timing chain guide "1"(B).



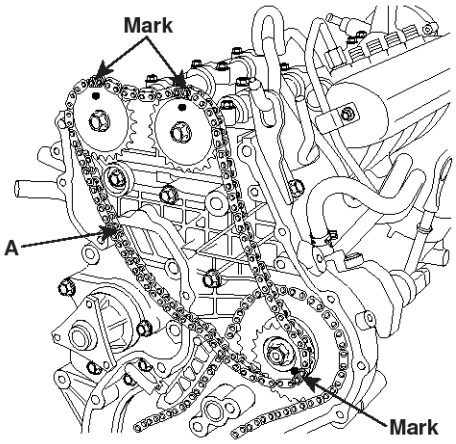
LCGF013A

27. Remove the timing chain guide "2"(A).



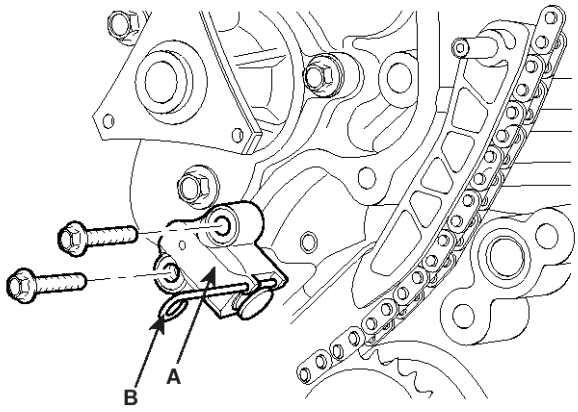
LCGF014A

28. Remove the timing chain "C"(A).



LCGF015A

29. Remove the timing chain "A" auto tensioner(A).

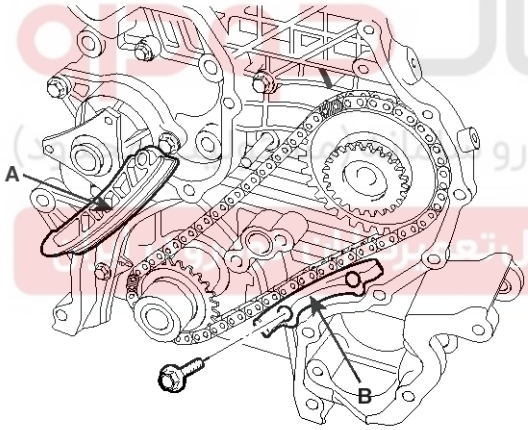


LCGF016A

NOTICE

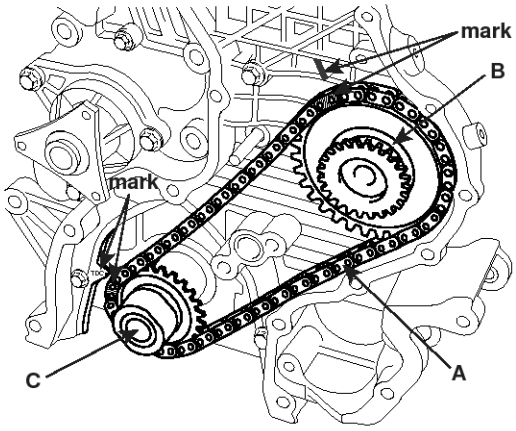
Before removing auto-tensioner, install a set pin(B) (ø2.5 mm steel wire) after compressing the tensioner.

30. Remove timing chain "A" lever(A) and the timing chain guide "1"(B).



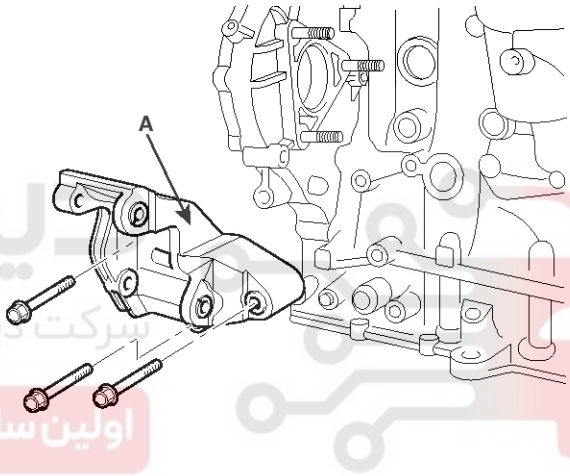
LCGF017A

31. Remove the timing chain "A"(A)with high pressure pump sprocket(B) and crankshaft sprocket(C).



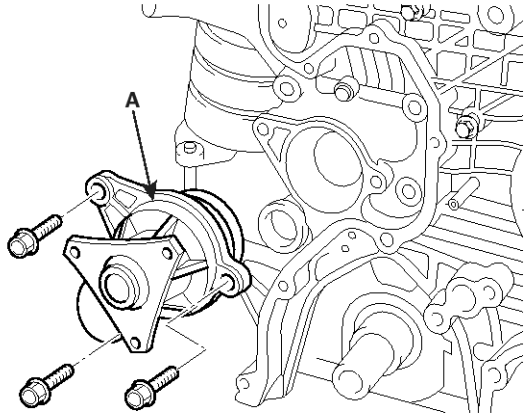
LCGF024A

32. Remove the power steering pump bracket(A).



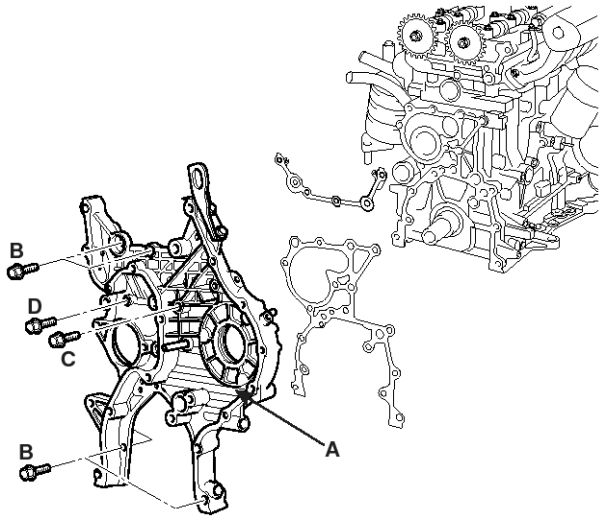
LCGF025A

33. Remove the water pump(A).



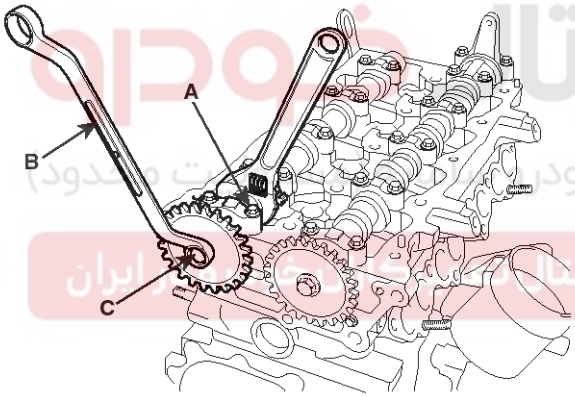
LCGF026A

34. Remove the timing chain case(A).
(Engine removal is required for this procedure)



LCGF027A

35. Remove the camshaft sprocket.
    1) Hold the portion(A) of the camshaft with a hexagonal wrench, and remove the bolt(C) with a wrench(B) and remove the camshaft sprocket.



LCGF028A

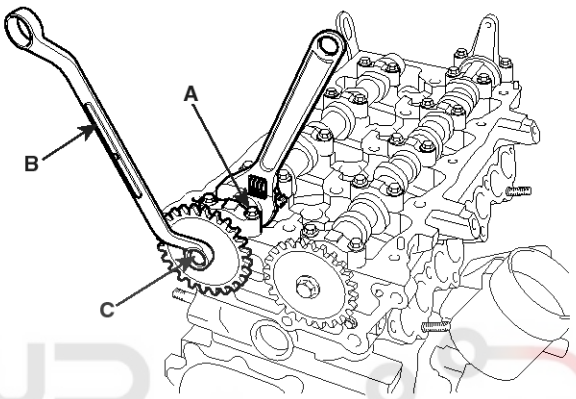
⚠CAUTION
Be careful not to damage the cylinder head and valve lifter with the wrench.

INSTALLATION

Engine removal is not required for this procedure.

1. Install the camshaft sprocket and tighten the bolt to the specified torque.
    1) Temporarily install the camshaft sprocket bolt(C).
    2) Hold the portion(A) of the camshaft with a hexagonal wrench, and tighten the bolt(C) with a wrench(B).

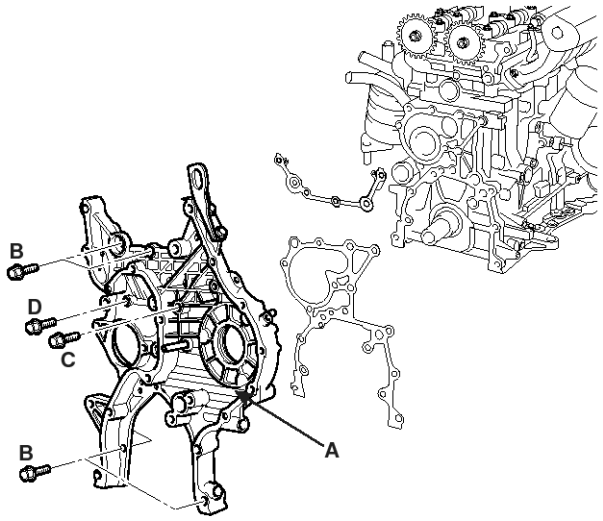
Tightening torque :
68.6 ~ 73.5N.m (7.0 ~ 7.5kgf.m, 50.6 ~ 54.2lbf.ft)



LCGF028A

2. Install the timing chain case(A) with new gasket.
   (Engine removal is required for this procedure)

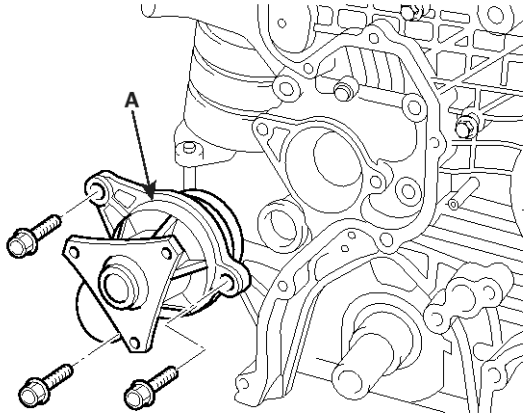
Tightening torque :
Bolt(B,C) :18.6 ~ 27.5N.m (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lbf.ft)
Bolt(D) : 7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lbf.ft)



LCGF027A

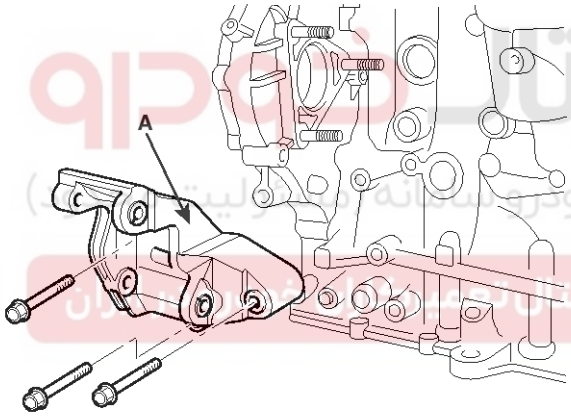
3. Install the water pump(A).

Tightening torque :
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lbf.ft)



LCGF026A

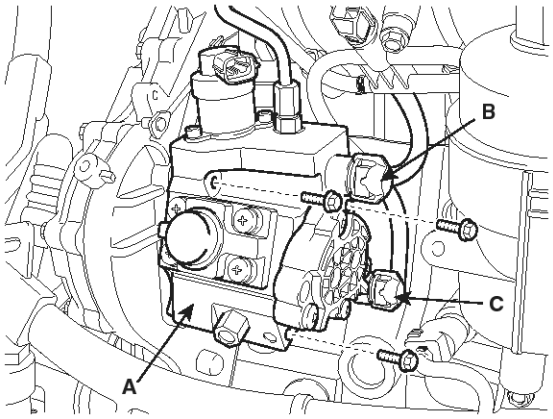
4. Install the power steering pump bracket(A).



LCGF025A

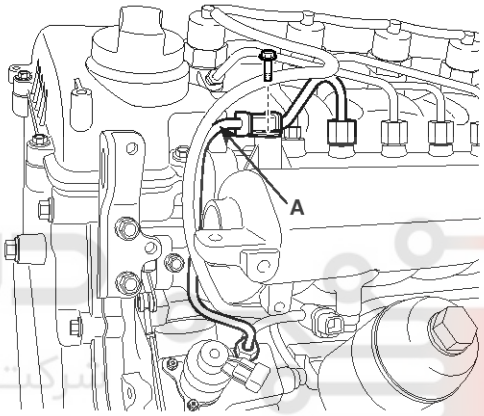
5. Install the high pressure pump(A), connecting the hoses(B, C).

Tightening torque :
14.7 ~ 19.6N.m (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lbf.ft)



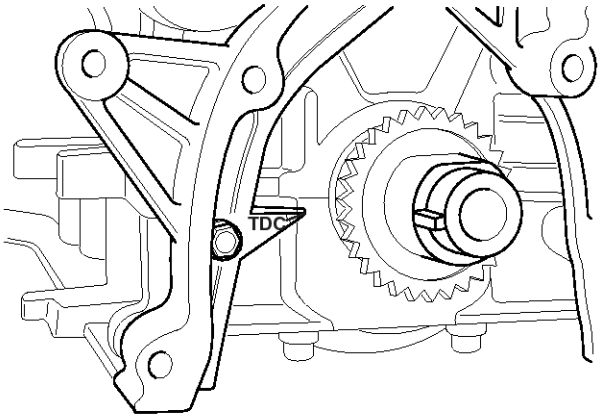
ADJF044A

6. Install the high pressure pipe(A).



ADJF034A

7. Set the key of crankshaft sprocket to be aligned with the timing mark of timing chain case. As a result of this, place the piston on No.1 cylinder at the top dead center on compression stroke.

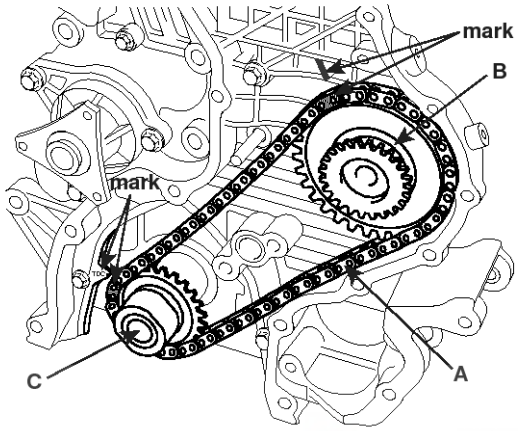


LCGF093A

8. After install timing chain "A" with high pressure pump sprocket(B) equipped at the crankshaft sprocket(C), and then install high pressure pump sprocket at the high pressure pump shaft.

NOTICE

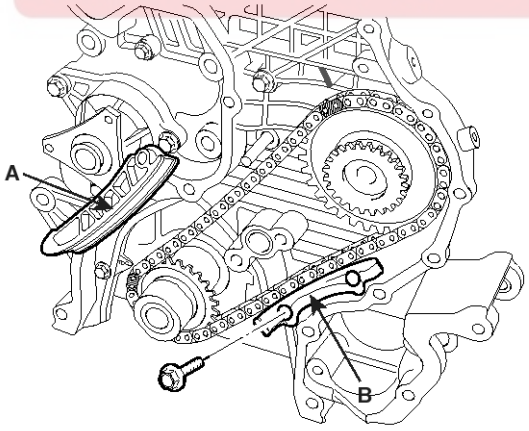
The timing mark of high pressure pump sprocket should be aligned with timing mark on the timing chain case.



LCGF024A

9. Pretighten the high pressure pump sprocket nut.
10. Install timing chain "A" lever(A) and the timing chain guide "1"(B).

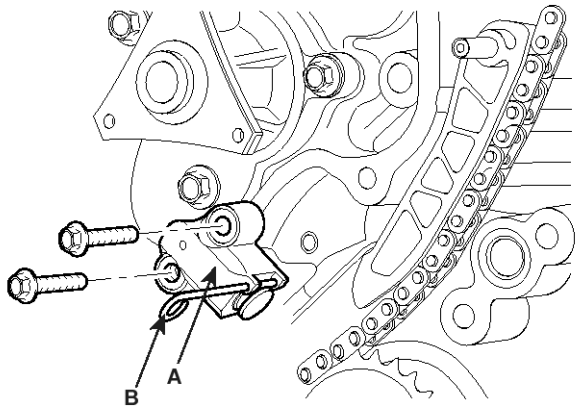
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF017A

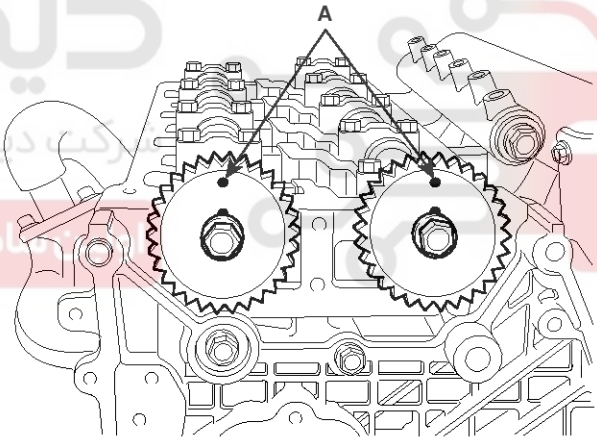
11. Install the timing chain "A" auto tensioner(A) and then remove set pin(B).

Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF016A

12. Align the timing mark(A) of camshaft sprocket on the vertical center line of crankshaft.

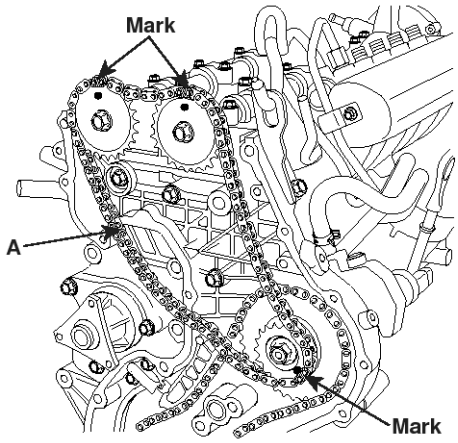


LCGF094A

13. Install the timing chain "C"(A) as following procedure. High pressure pump sprocket -> LH camshaft sprocket -> RH camshaft sprocket

NOTICE

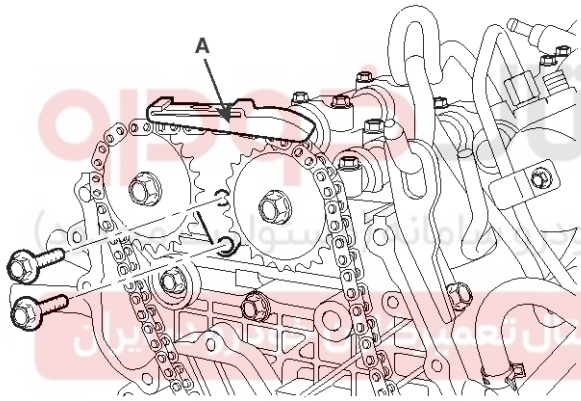
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain as shown below illustration.



LCGF015A

14. Install the timing chain guide "2"(A).

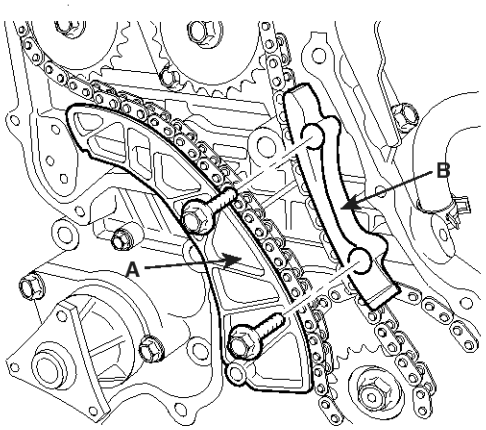
Tightening torque :
9.8 ~ 13.7N.m (1.0 ~ 1.4kgf.m, 7.2 ~ 10.1lbf.ft)



LCGF014A

15. Install the timing chain "C" lever(A) and the timing chain guide "1"(B).

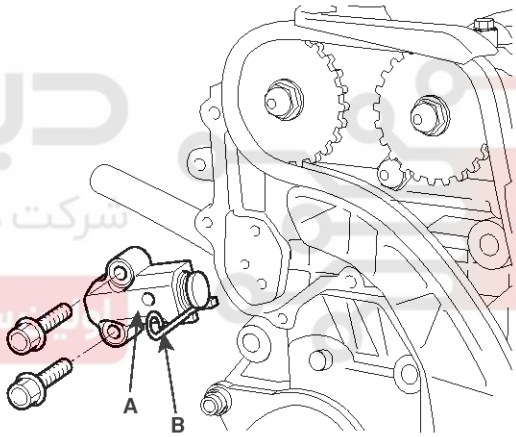
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF013A

16. Install the timing chain "C" auto tensioner(A) and then remove set pin(B).

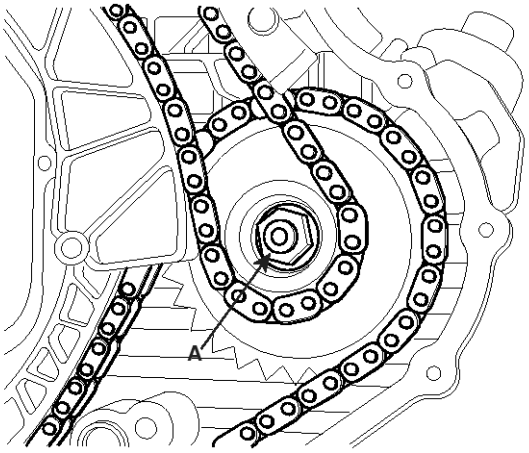
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF012A

17. Install the high pressure pump sprocket nut(A).

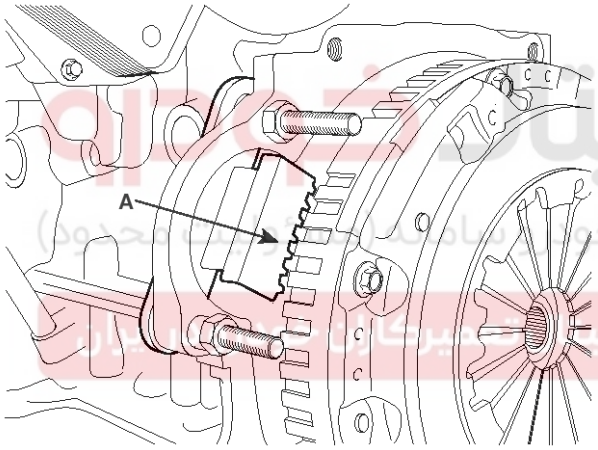
Tightening torque :
64.7 ~ 74.5N.m (6.6 ~ 7.6kgf.m, 47.7 ~ 55.0lbf.ft)



LCGF095A

NOTICE

Use the SST(flywheel stopper, 09231-2A100)(A) to tighten the high pressure pump sprocket nut, after remove the starter.

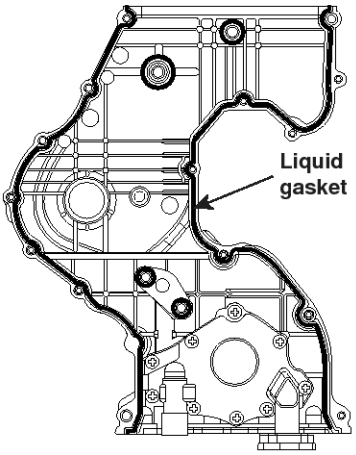


LCGF090A

18. Apply liquid gasket evenly to the mating surface of timing chain cover.

NOTICE

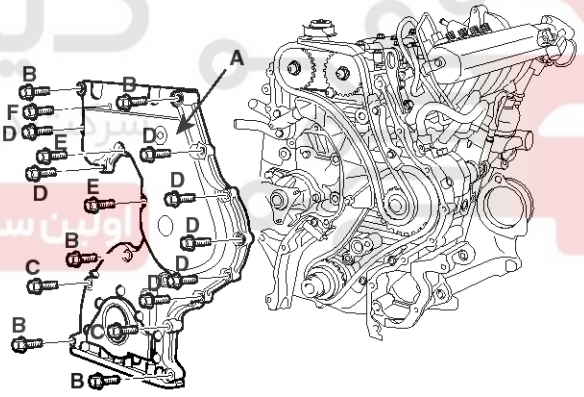
- *Standard liquid gasket : LOCTITE 5900*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Assemble the timing chain cover in 5 minutes after applying the liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.*



LCGF096A

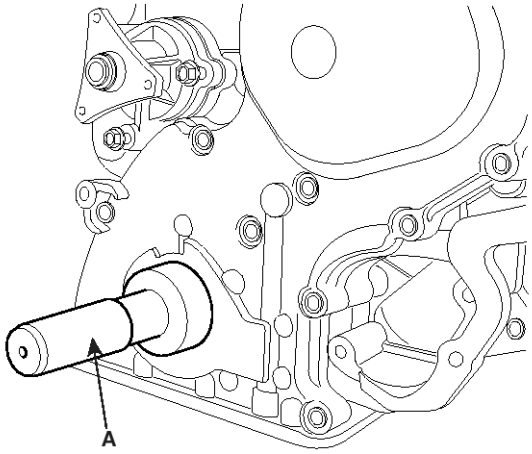
19. Install the timing chain cover(A).

Tightening torque :
Bolt (B,C,F) :
19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lbf.ft)
Bolt(D,E) : 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF011A

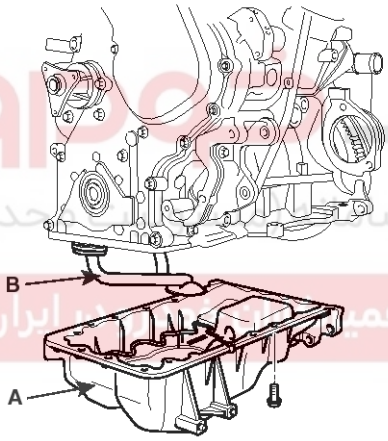
20. Install the front oil seal by using SST(09231-2A000, 09231-H1100)(A).



LCGF097A

21. Install the oil strainer(B).

Tightening torque :
Bolts : 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lbf.ft)
Nuts : 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)

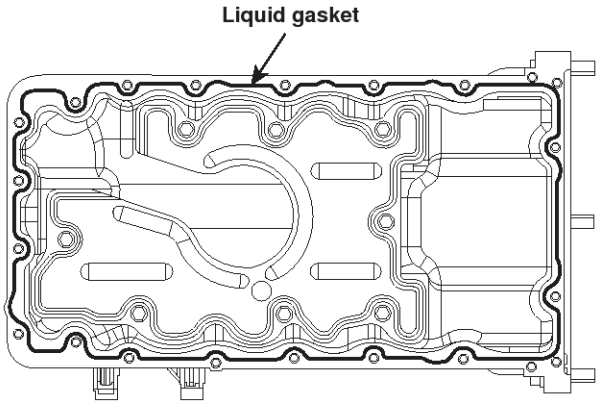


LCGF010A

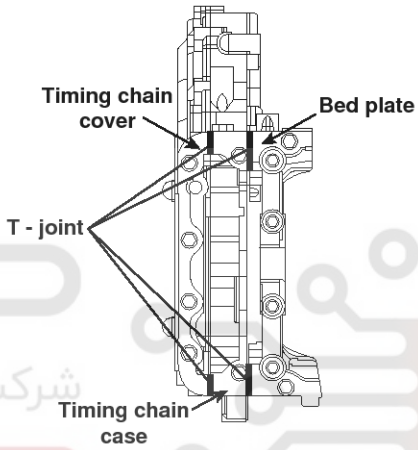
22. Apply liquid gasket evenly to the mating surface of oil pan.

NOTICE

- *Standard liquid gasket : LOCTITE 5900*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.Assemble the oil pan in 5 minutes after applying the liquid gasket.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*
- *Apply liquid gasket to T-joint before assembling oil pan.*



LCGF098A

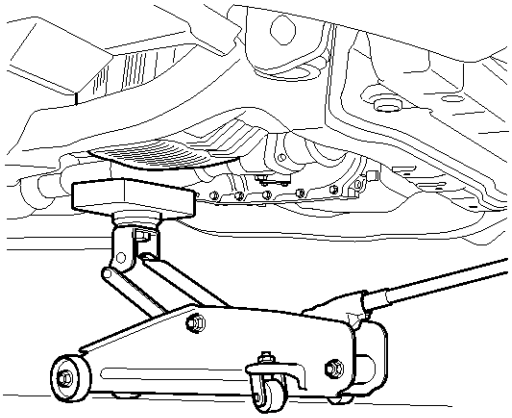


LCGF099A

23. Install the oil pan(A).

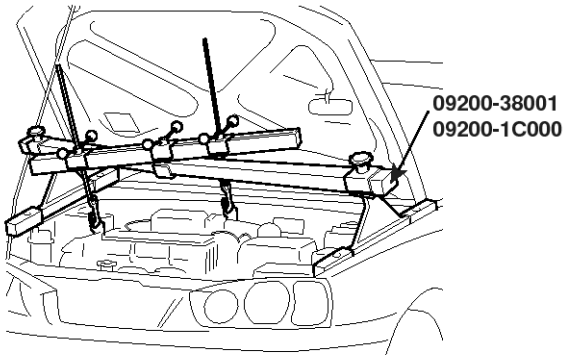
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)

24. Set the jack to the engine oil pan



LDIF001A

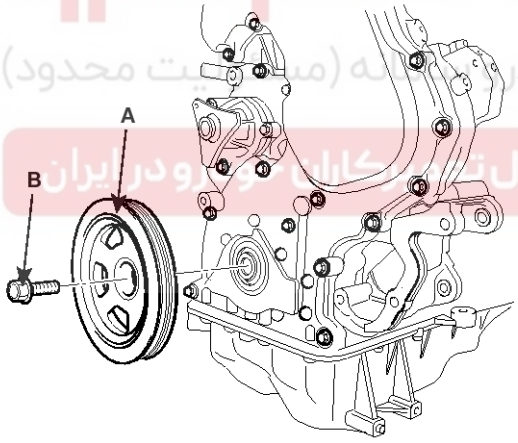
25. Remove the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, from the engine hanger bracket.



LCGF150A

26. Install the crankshaft pulley(A) and crankshaft pulley bolt(B).

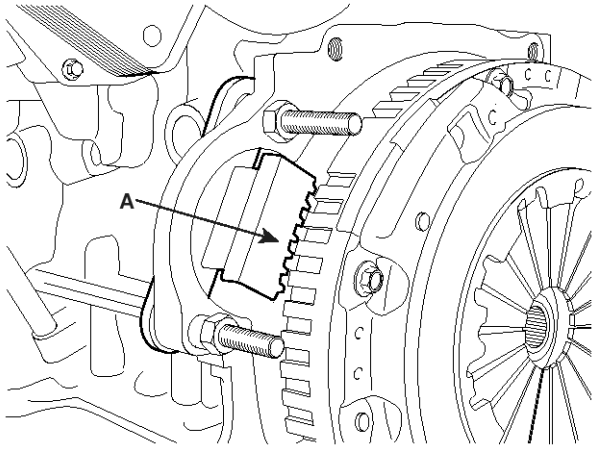
Tightening torque :
225.6 ~ 245.2N.m (23.0 ~ 25.0kgf.m, 166.4 ~ 180.8lbf.ft)



LCGF009A

NOTICE

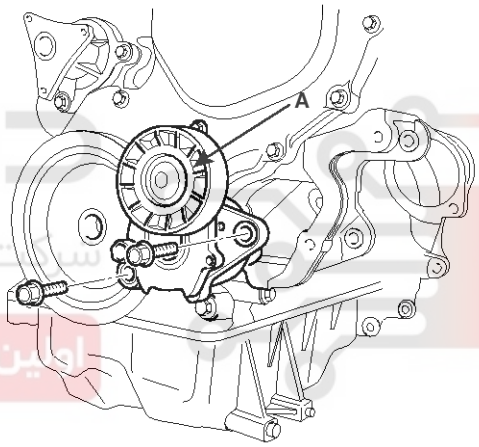
Use the SST(flywheel stopper, 09231-2A100) to Install the crankshaft pulley bolt, after remove the starter.



LCGF090A

27. Install the drive belt auto tensioner(A).

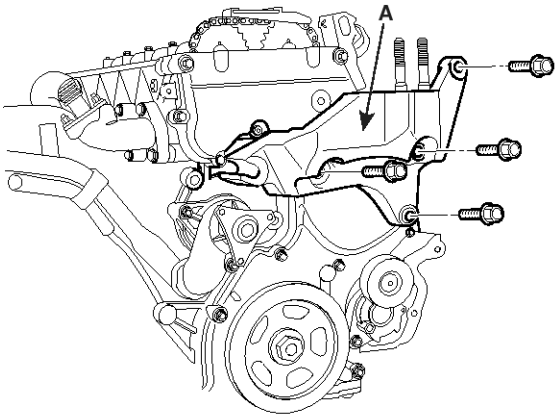
Tightening torque :
18.6 ~ 27.5N.m (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lbf.ft)



LCGF008A

28. Install the engine support bracket(A).

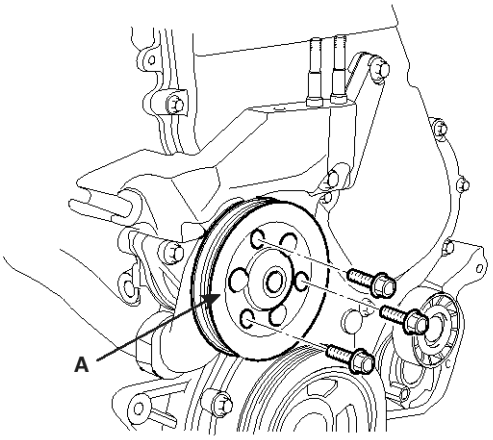
Tightening torque :
42.2 ~ 53.9N.m (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lbf.ft)



LCGF007A

29. Install the water pump pulley(A).

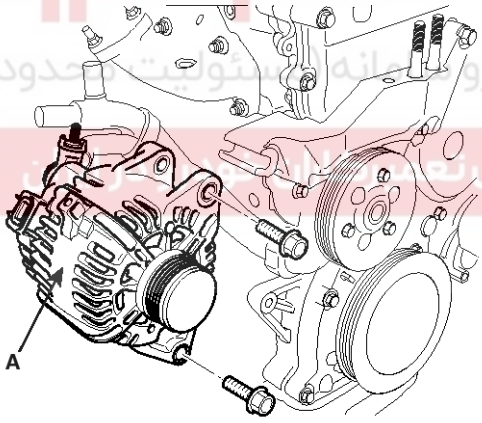
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF006A

30. Install the alternator(A).

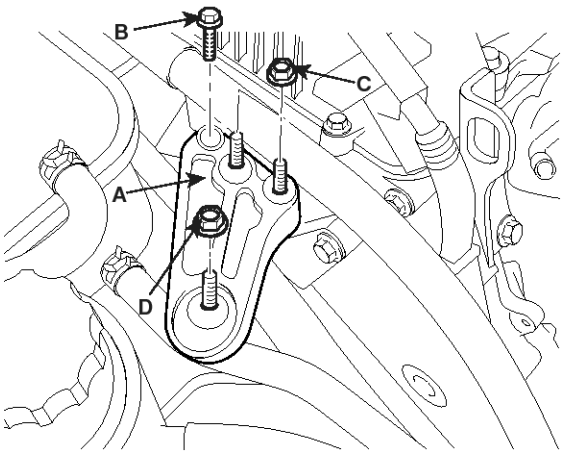
Tightening torque :
38.2 ~ 58.8N.m (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lbf.ft)



LCGF005A

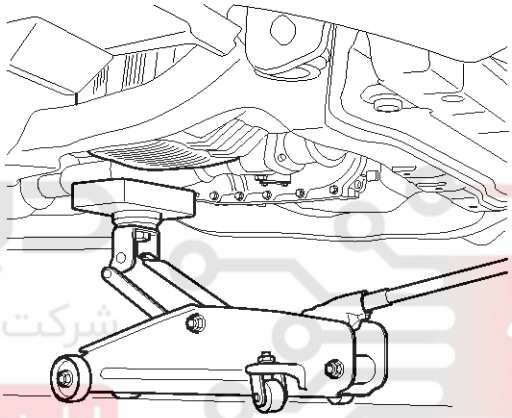
31. Install the engine mounting support bracket(A).

Tightening torque :
Nut(D) : 68.6 ~ 93.2N.m(7.0 ~ 9.5kgf.m, 50.6~ 68.7lbf.ft)
Bolt(B), Nut(C) : 49.0 ~ 63.7N.m(5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lbf.ft)



LCGF086A

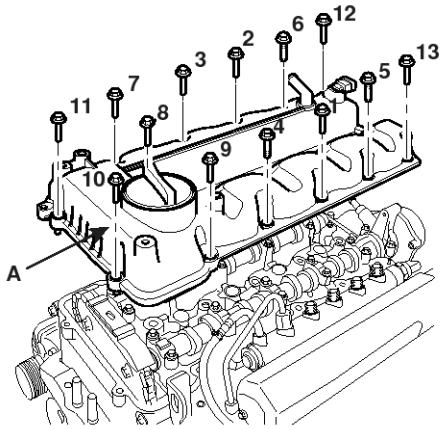
32. Remove the jack from oil pan



LDIF001A

33. Install the cylinder head cover(A) with new head cover gasket.

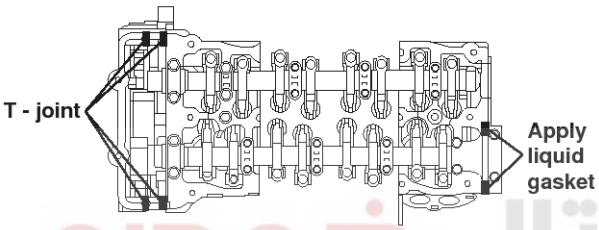
Tightening torque :
7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lbf.ft)



LCGF161A

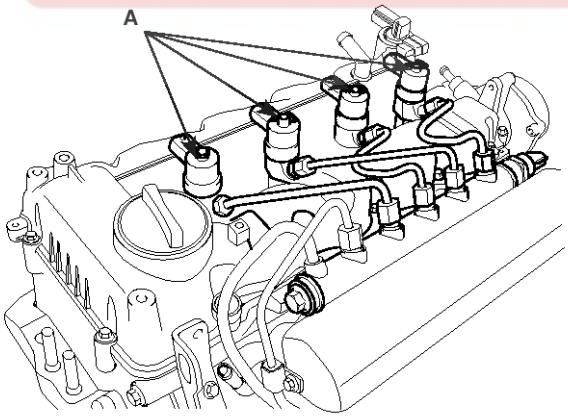
NOTICE

- *Standard liquid gasket : LOCTITE 5900*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.*
- *Assemble the cylinder head cover in 5 minutes after applying the liquid gasket.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*
- *Apply liquid gasket to T-joint before assembling cylinder head cover.*



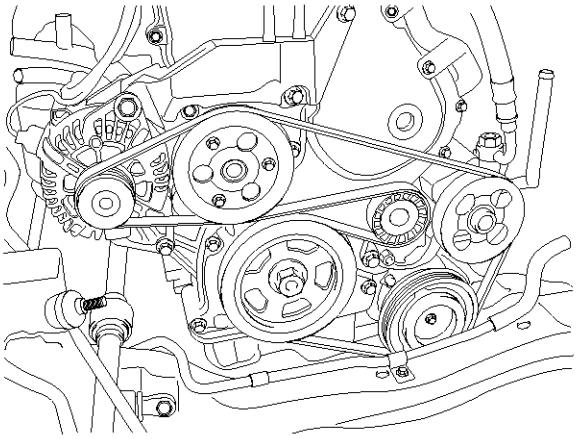
LCGF100A

34. Install the injector(A). (Refer to FL Gr.)



LCGF003A

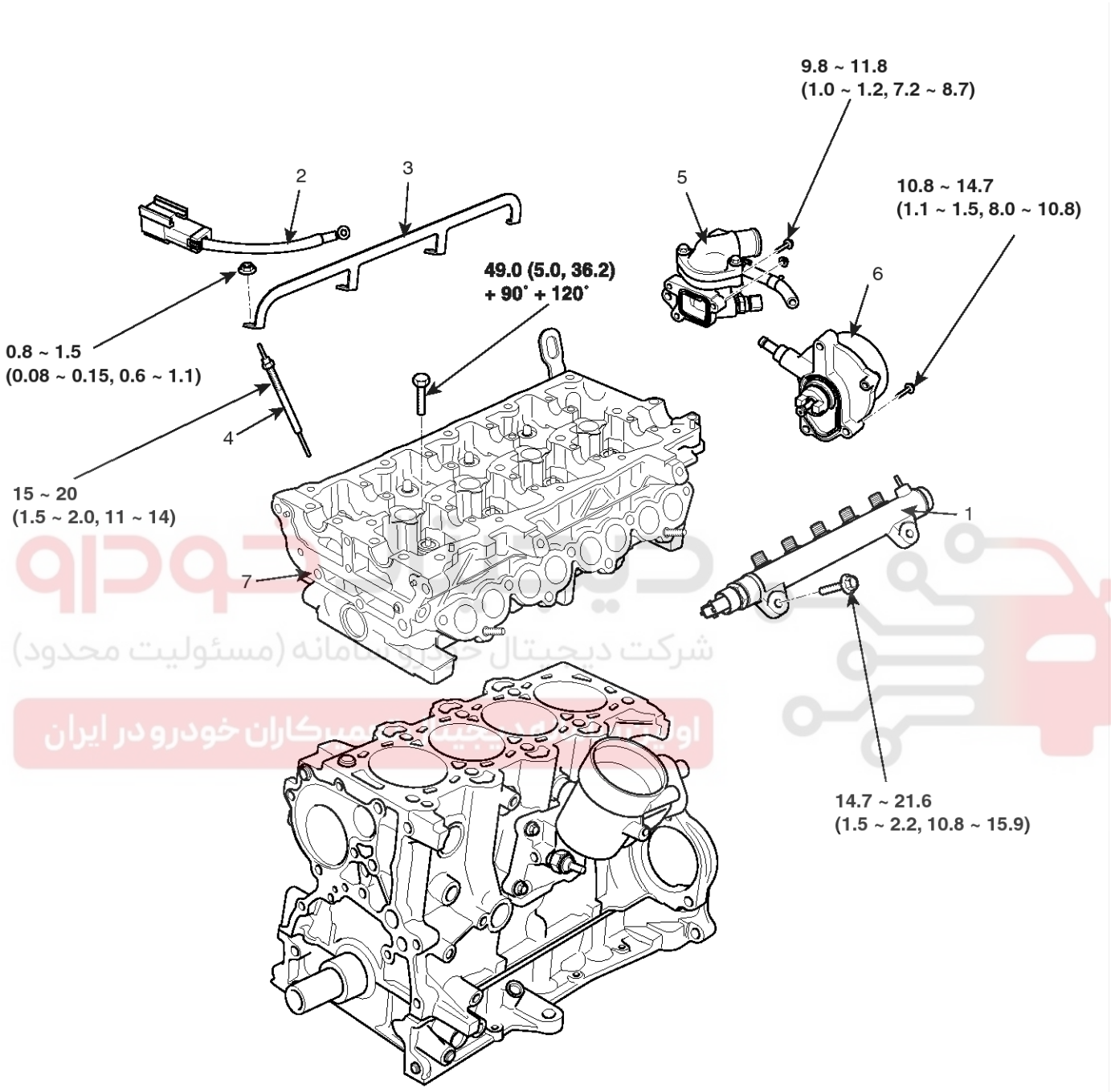
35. Install the drive belt.



LCGF149A

Cylinder Head Assembly

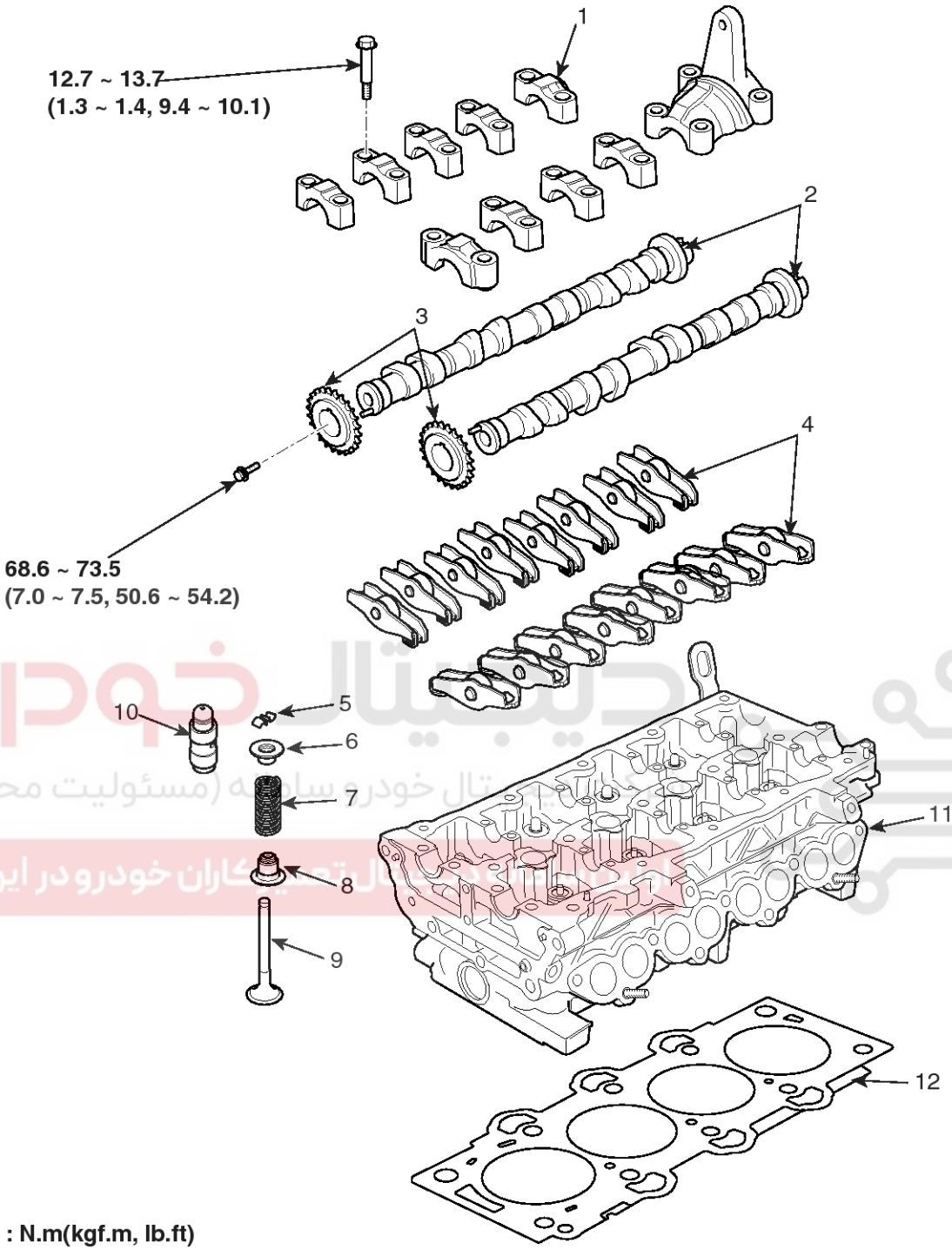
COMPONENTS



TORQUE : N.m(kgf.m, lb.ft)

1. Common rail
2. Glow plug connector
3. Glow plug plate
4. Glow plug
5. Thermostat housing
6. Vacuum pump
7. Cylinder head

SLDEM6112L



TORQUE : N.m(kgf.m, lb.ft)

1. Camshaft bearing cap
2. Camshaft
3. Camshaft sprocket
4. Cam follwer
5. Valve spring retainer lock
6. Valve spring retainer
7. Valve spring
8. Valve stem seal
9. Valve
10. HLA(Hydraulic Lash Adjuster)
11. Cylinder head
12. Cylinder head gasket

SLDEM6114L

REMOVAL

Engine removal is required for this procedure.

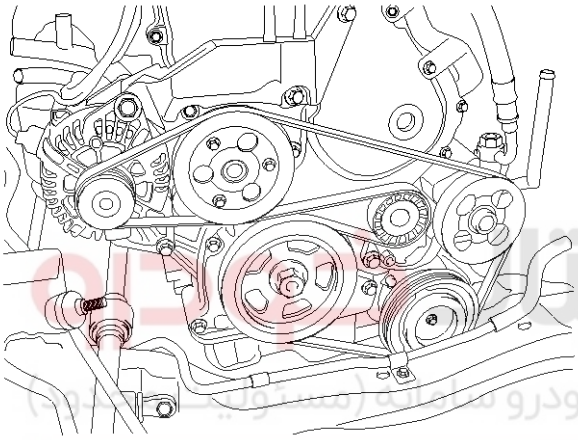
CAUTION

- **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.**

NOTICE

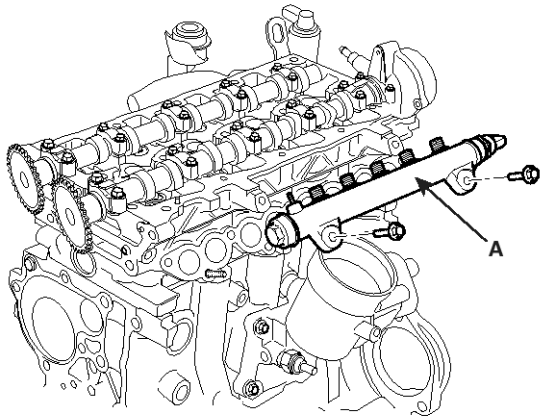
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center.*

1. Remove the drive belt.



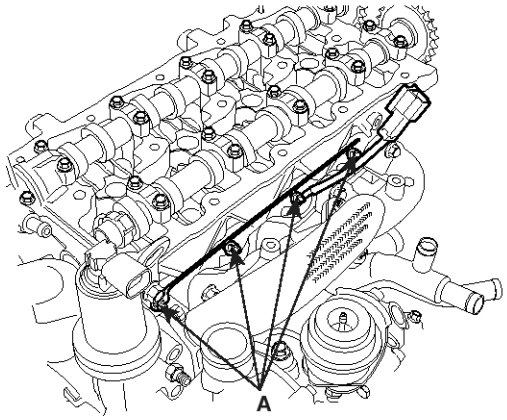
LCGF149A

2. Remove the timing chain.
3. Remove the intake and exhaust manifold.
4. Remove the delivery pipe(A).



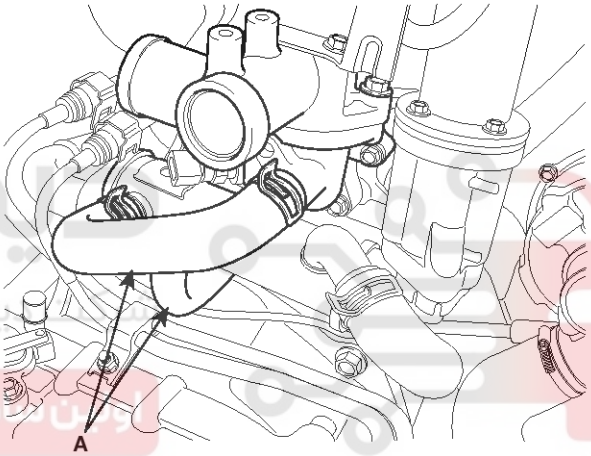
LCGF040A

5. Remove the glow plug(A).



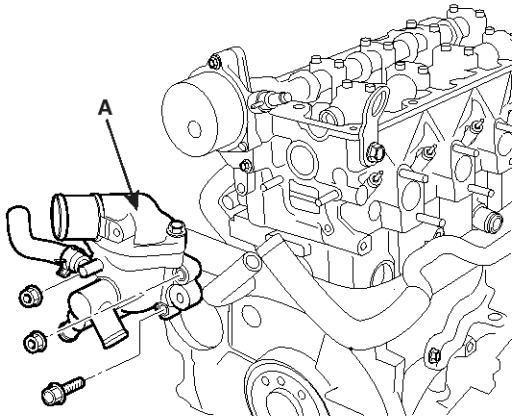
LCGF041A

6. Disconnect the water hose(A) from thermostat housing.



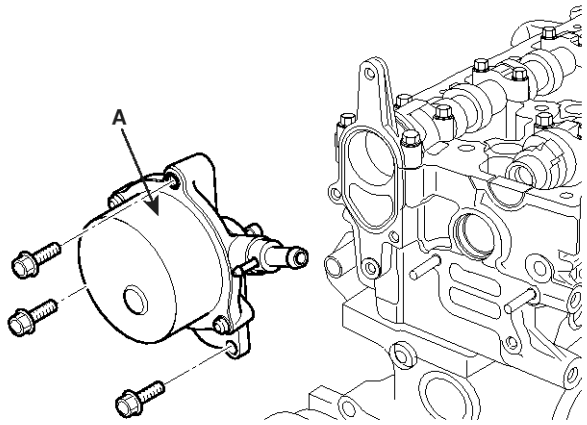
ADJF047A

7. Remove the thermostat housing(A).



LCGF043A

8. Remove the vacuum pump(A).

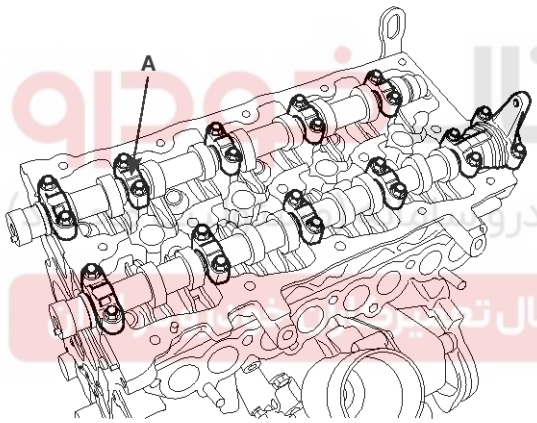


LCGF044A

9. Remove the camshaft bearing caps(A).

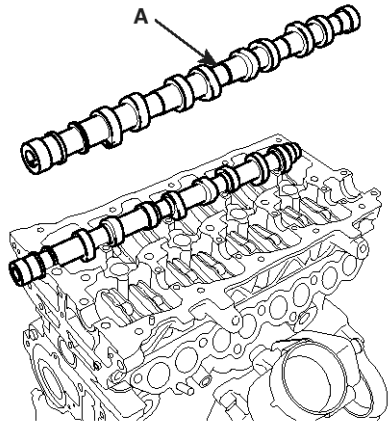
NOTICE

Mark the camshaft bearing caps to be able to reassemble in the original position and direction.



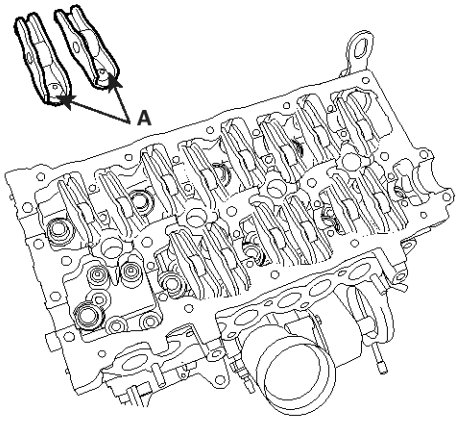
LCGF045A

10. Remove the camshaft(A).



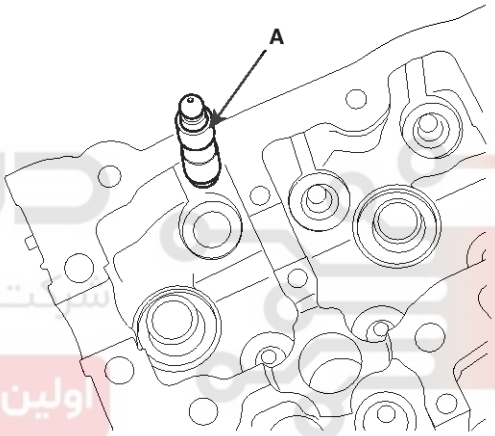
LCGF046A

11. Remove the cam follower(A).



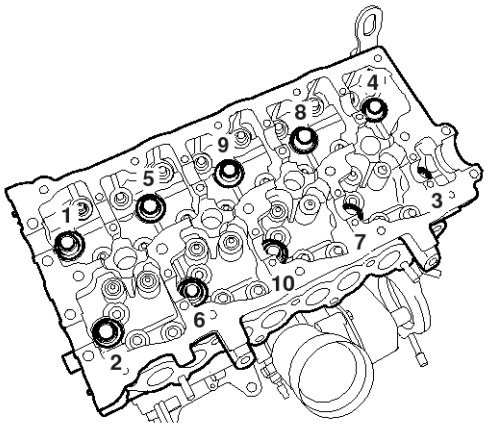
LCGF047A

12. Remove the HLA(Hydraulic Lash Adjust).



LCGF048A

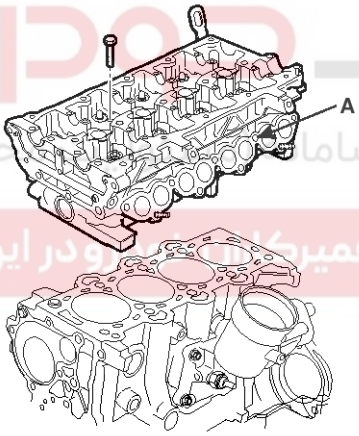
13. Remove the cylinder head bolts, then remove the cylinder head.
    1) Using bit socket (12PT), uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown.Remove the 10 cylinder head bolts.



LCGF049A

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

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

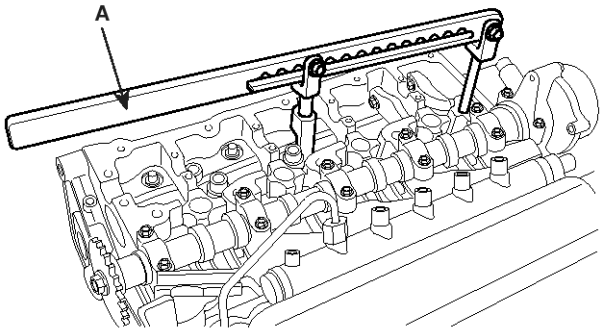


LCGF050A

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

DISASSEMBLY

1. Remove the valves.
   1) Using the SST (09222-28000, 09222-28100)(A), compress the valve spring and remove the retainer lock.



LCGF101A

   2) Remove the spring retainer.
   3) Remove the valve spring.
   4) Remove the valve.
   5) Using a needle-nose pliers, remove the stem oil seal.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface :
Less than 0.03mm (0.0012in) for width
Less than 0.09mm (0.0035in) for length
Flatness of manifold mating surface :
Less than 0.025mm (0.0010in) for width
Less than 0.160mm (0.0063in) for length

ECKD001H

2. Inspect for cracks.

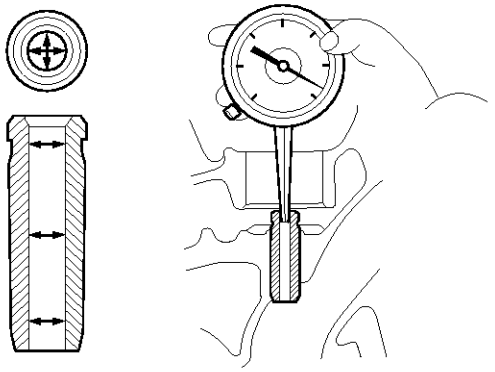
   Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

VALVE AND VALVE SPRING

1. Inspect the valve stems and valve guides.

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

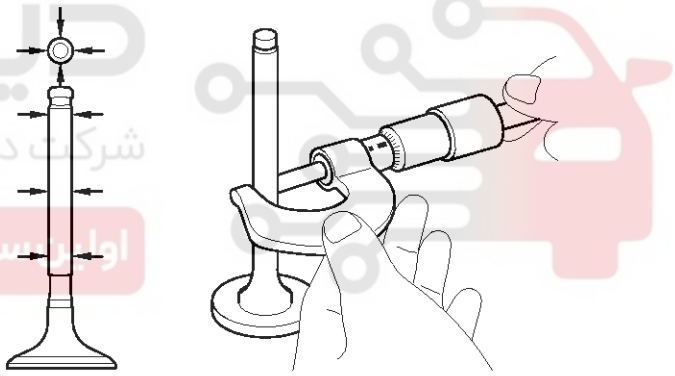
Valve guide inner diameter :
Intake : 5.500 ~ 5.512mm (0.2165 ~ 0.2170in)
Exhaust : 5.500 ~ 5.512mm (0.2165 ~ 0.2170in)



ECKD219A

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

Valve stem outer diameter
Intake : 5.455 ~ 5.470mm (0.2148 ~ 0.2154in)
Exhaust : 5.435 ~ 5.450mm (0.2140 ~ 0.2146in)



ECKD220A

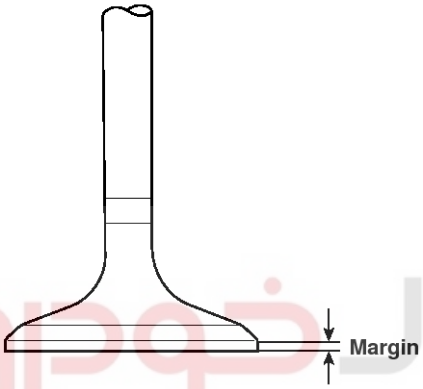
   3) Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

Valve stem- to-guide clearance
Intake : 0.030 ~ 0.057mm (0.0012 ~ 0.0022in)
Exhaust : 0.050 ~ 0.077mm (0.0020 ~ 0.0030in)

   If the clearance is greater than specification, replace the valve and valve guide.

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

Margin
Intake : 1.1mm (0.0433in)
Exhaust : 1.2mm (0.0472in)

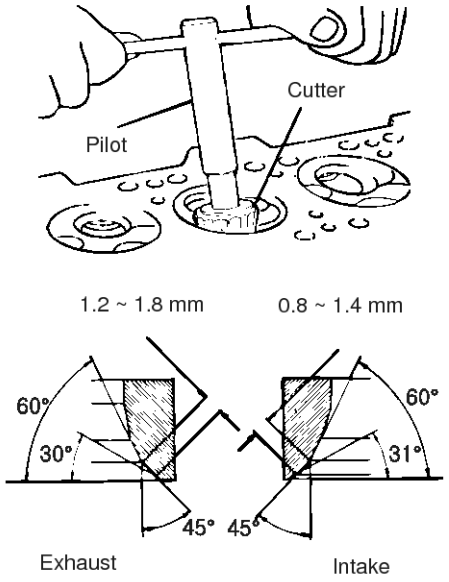


ECKD221A

   4) Check the valve length.

Length
Intake : 93.0mm (3.6614in)
Exhaust : 93.7mm (3.6890in)

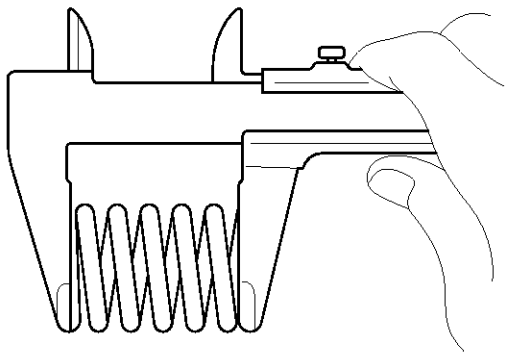
   5) Check the surface of valve stem tip for wear.
      If the valve stem tip is worn, replace the valve.
3. Inspect the valve seats.
   1) Check the valve seat for evidence of overheating and improper contact with the valve face.
      Replace the seat if necessary.
   2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.
   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.



BCGE009B

4. Inspect the valve springs.
   1) Using a steel square, measure the out-of-square of valve spring.
   2) Using a vernier calipers, measure the free length of valve spring.

Valve spring
Standard
Free height : 44.9mm (1.7677in)
Load : 17.5±0.9kg/32.0mm (38.6±2.0lb/1.2598in)
31.0±1.6kg/23.5mm (68.3±3.5lb/0.9252in)
Out of square : Less than 1.5°
Limit
Out of square : 3°



ECKD222A

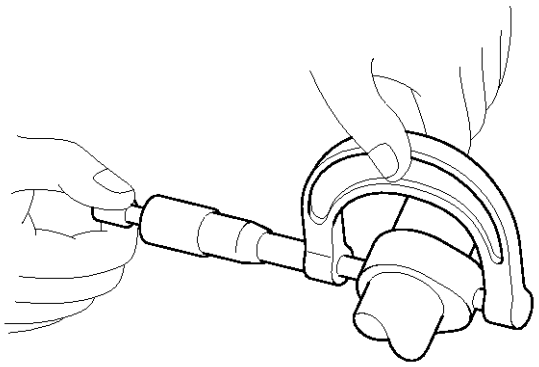
If the loads is not as specified, replace the valve spring.

CAMSHAFT

1. Inspect the cam lobes.

   Using a micrometer, measure the cam lobe height.

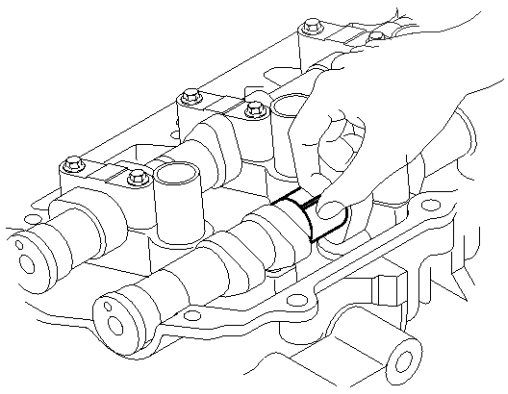
Cam height
Intake : 44.518 ~ 44.718mm (1.7527 ~ 1.7605in)
Exhaust : 44.418 ~ 44.618mm (1.7487 ~ 1.7566in)



ECKD223A

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

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



ECKD224A

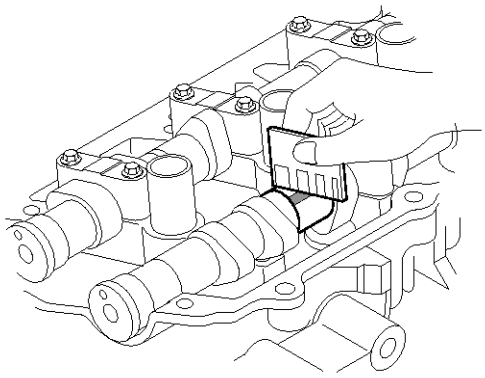
   4) Install the bearing caps and tighten the bolts with specified torque.

Tightening torque :
12.7 ~ 13.7N.m (1.3 ~ 1.4kgf.m, 9.4 ~ 10.1lbf.ft)

⚠CAUTION
Do not turn the camshaft.

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

Bearing oil clearance
0.040 ~ 0.077mm (0.0016 ~ 0.0030in)



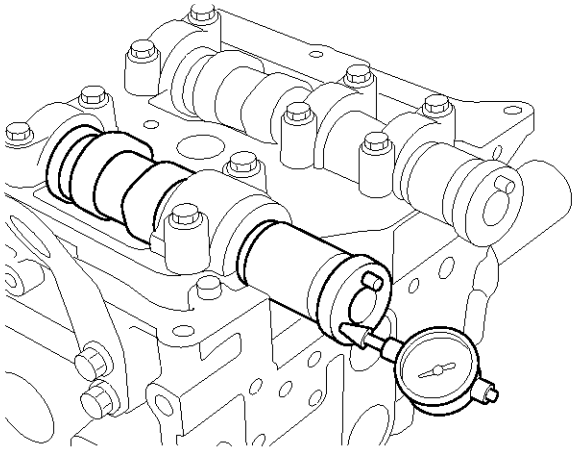
ECKD225A

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

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

3. Inspect the 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 : 0.1 ~ 0.2mm (0.0039 ~ 0.0079in)



LCGF127A

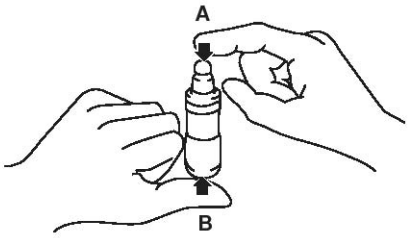
If the end play is greater than specification, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3) Remove the camshafts.

HLA (HYDRAULIC LASH ADJUSTER)

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

If B moves, replace the HLA.



LCGF128A

Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high ressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear, refer to step 7 below.
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
5. Continuous noise when the engine is running after changing the HLA.		⚠CAUTION **Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.**
6. Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.

REASSEMBLY

NOTICE

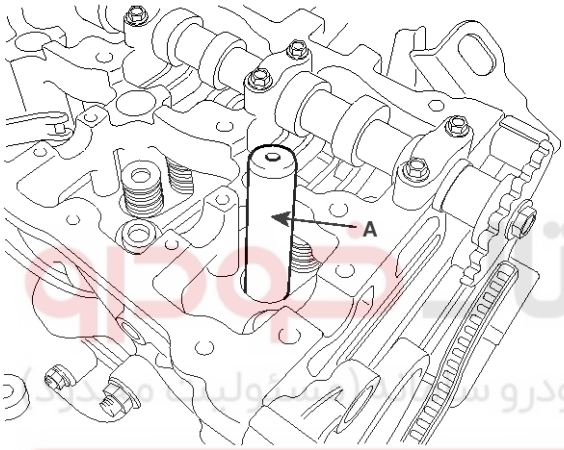
- *Thoroughly clean all parts to be assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surface.*
- *Replace oil seals with new ones.*

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

      NOTICE

      Do not reuse old valve stem oil seals.

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



LCGF102A

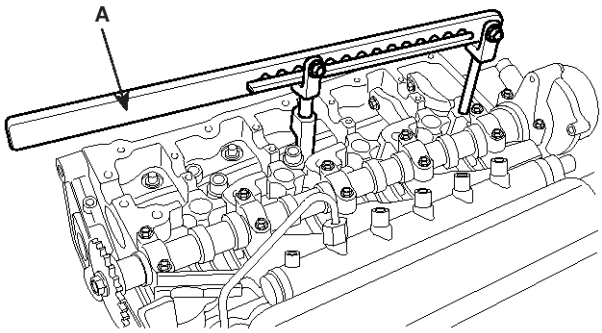
   2) Install the valve, valve spring and spring retainer.

      NOTICE

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

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

      After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



LCGF101A

   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.

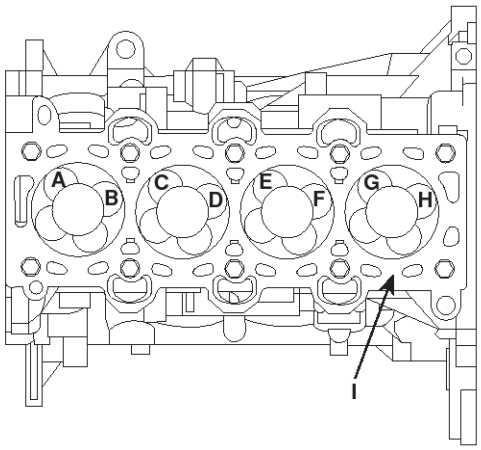
INSTALLATION

NOTICE

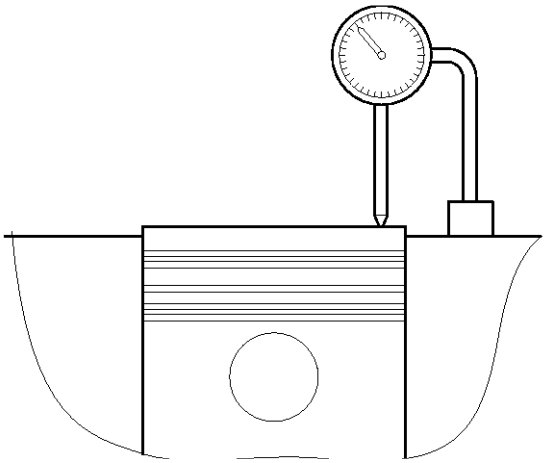
- *Thoroughly clean all parts to be assembled.*
- *Always use a new cylinder head and manifold gasket.*
- *Always use a new cylinder head bolt.*
- *The cylinder head gasket is a metal gasket. Take care not to bend it.*
- *Rotate the crankshaft, set the No.1 piston at TDC.*

1. Cylinder head dowel pins must be aligned.
2. Select the cylinder head gasket.
   1) Measure the piston protrusion from the upper cylinder block face (I) on 8 places (A ~ H) at T.D.C.

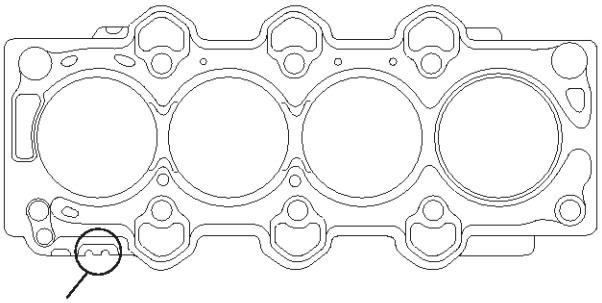
      Measure on the crankshaft center line considering the piston migration.



LCGF103A



LCGF129A



LCGF104A

2) Select the gasket in the table below using the average value of piston protrusions. Although even the only 1 point is over than the each rank limit, use 1 rank upper gasket than specified in the table below.

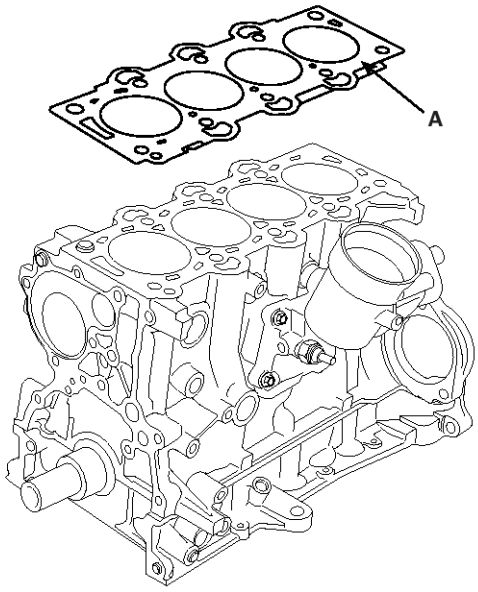
Displacement	1.6 L		
Average of piston protrusion	0.035 ~ 0.105mm (0.0014 ~ 0.0041in)	0.105 ~ 0.175mm (0.0041 ~ 0.0069in)	0.175 ~ 0.245mm (0.0069 ~ 0.0096in)
Gasket thickness	1.00 ~ 1.15mm (0.0394 ~ 0.0453in)	1.05 ~ 1.20mm (0.0413 ~ 0.0472in)	1.10 ~ 1.25mm (0.0433 ~ 0.0492in)
Limit of each rank extant	0.14mm (0.0055in)	0.21mm (0.0083in)	-
Identification code			

3) Install the gasket so that the identification mark faces toward the timing chain side.

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

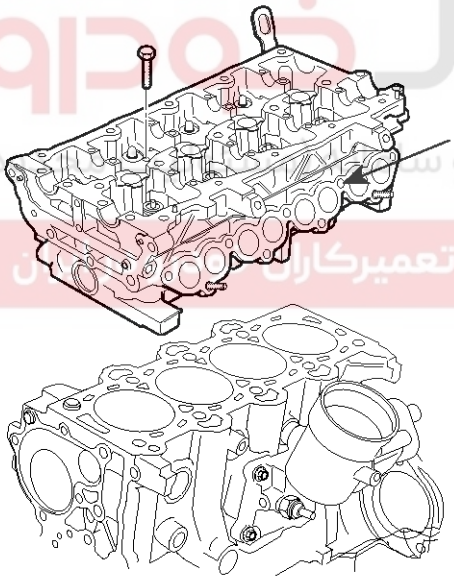
NOTICE

Be careful of the installation direction.



SLDEM6108L

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



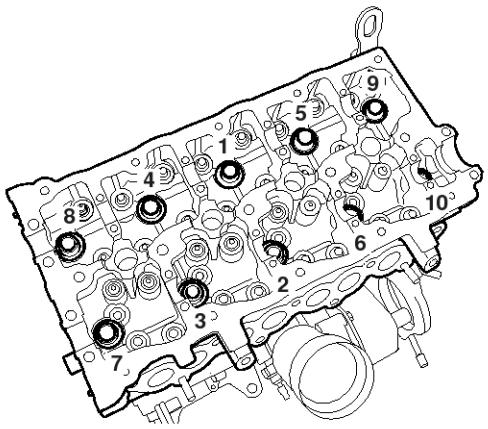
SLDEM6119D

5. Install the cylinder head bolts.
   1) Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.
   2) Using bit socket (12PT), install and tighten the 10 cylinder head bolts, in several passes, in the sequence shown.

Tightening torque :
47.1~51.0Nm (4.8~5.2kgf.m, 34.7~37.6lb-ft) + (88~92°) + (118~122°)

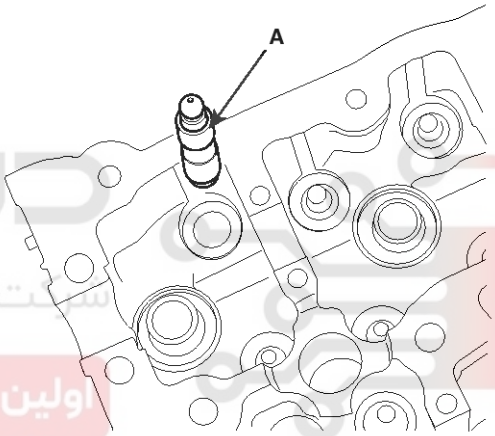
NOTICE

Do not reuse the cylinder head bolts.



LCGF153A

6. Istall the HLA(Hydraulic Lash Adjust).

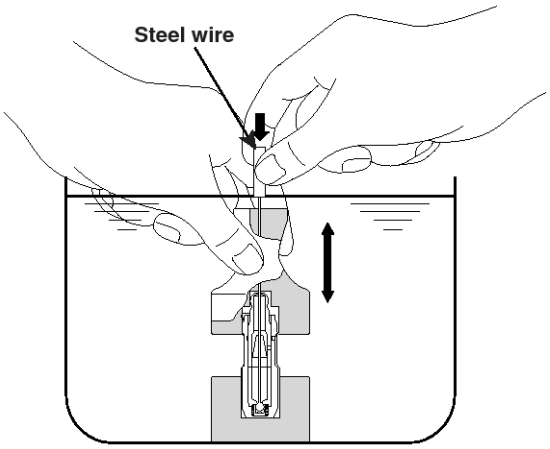


LCGF048A

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

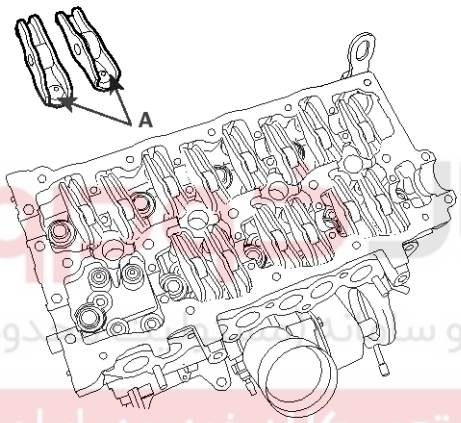
NOTICE

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



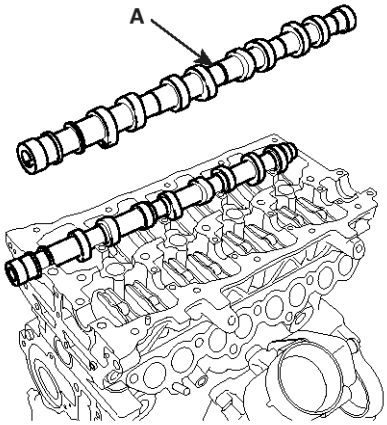
LCGF133A

7. Install the cam follower(A).



LCGF047A

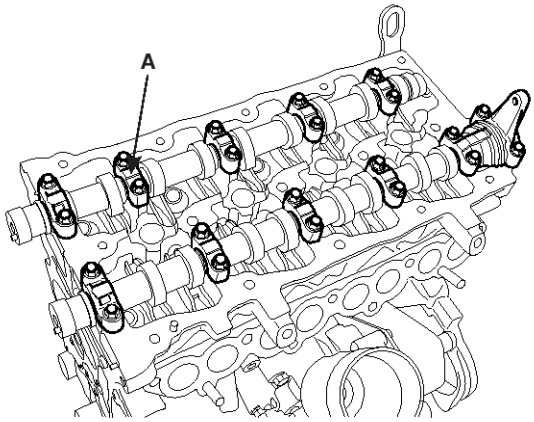
8. Install the camshaft(A).



LCGF046A

9. Install the camshaft bearing caps(A).

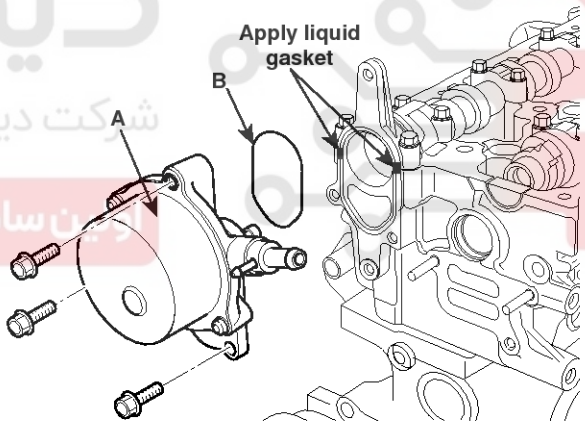
Tightening torque :
12.7 ~ 13.7N.m (1.3 ~ 1.4kgf.m, 9.4 ~ 10.1lbf.ft)



LCGF045A

10. Install the vacuum pump(A) with new gasket(B).

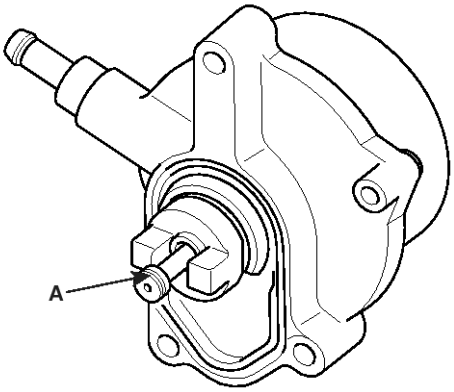
Tightening torque :
10.8 ~ 14.7N.m (1.1 ~ 1.5kgf.m, 8.0 ~ 10.8lbf.ft)



LCGF154A

NOTICE

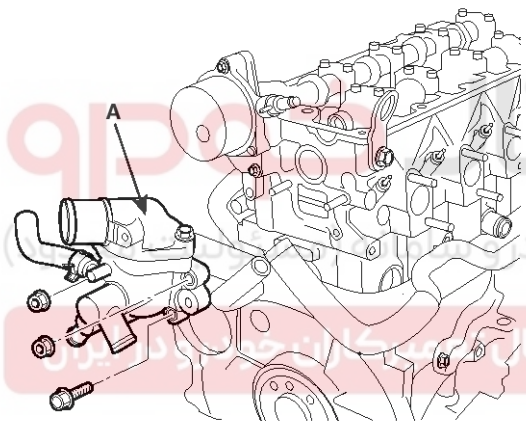
Apply engine oil to the O-ring(A) of vacuum pump shaft before assembling vacuum pump.



LCGF126A

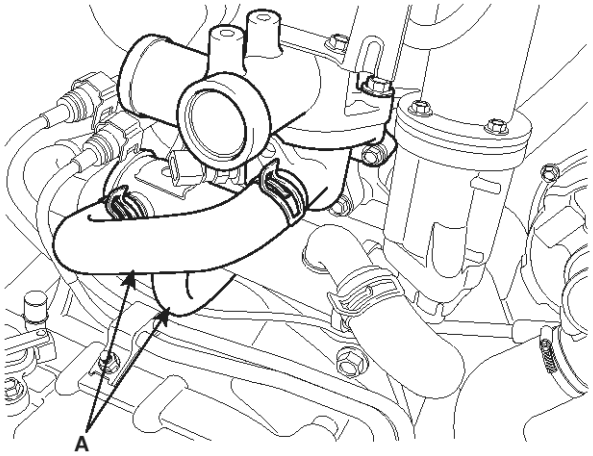
11. Install the thermostat housing(A).

Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



LCGF043A

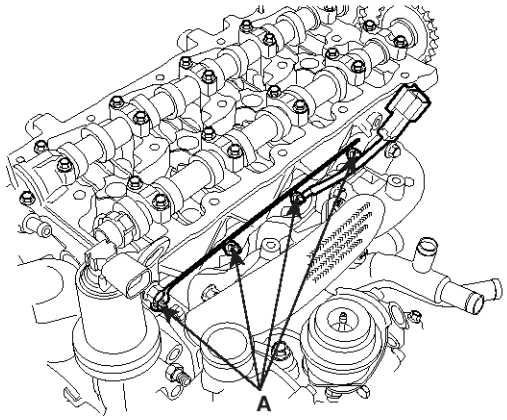
12. Reconnect the water hose(A) to thermostat housing.



ADJF047A

13. Install the glow plug(A) and glow plug plate.

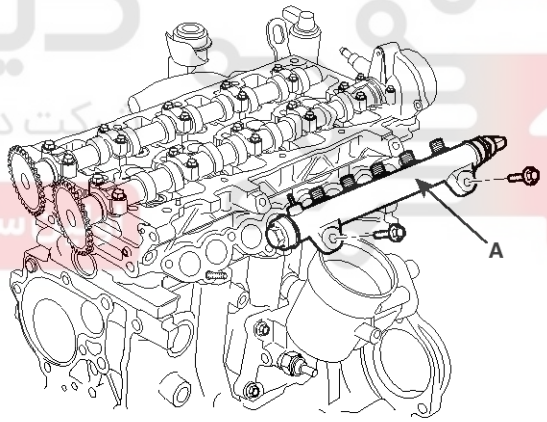
Tightening torque :
Glow plug: 15 ~ 20N.m (1.5 ~ 2.0kgf.m, 11 ~ 14lbf.ft)
Plate nut : 0.8~1.5N.m (0.08 ~ 0.15kgf.m, 0.6 ~ 1.1lbf.ft)



LCGF041A

14. Install the delivery pipe(A).

Tightening torque :
14.7 ~ 21.6N.m (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lbf.ft)

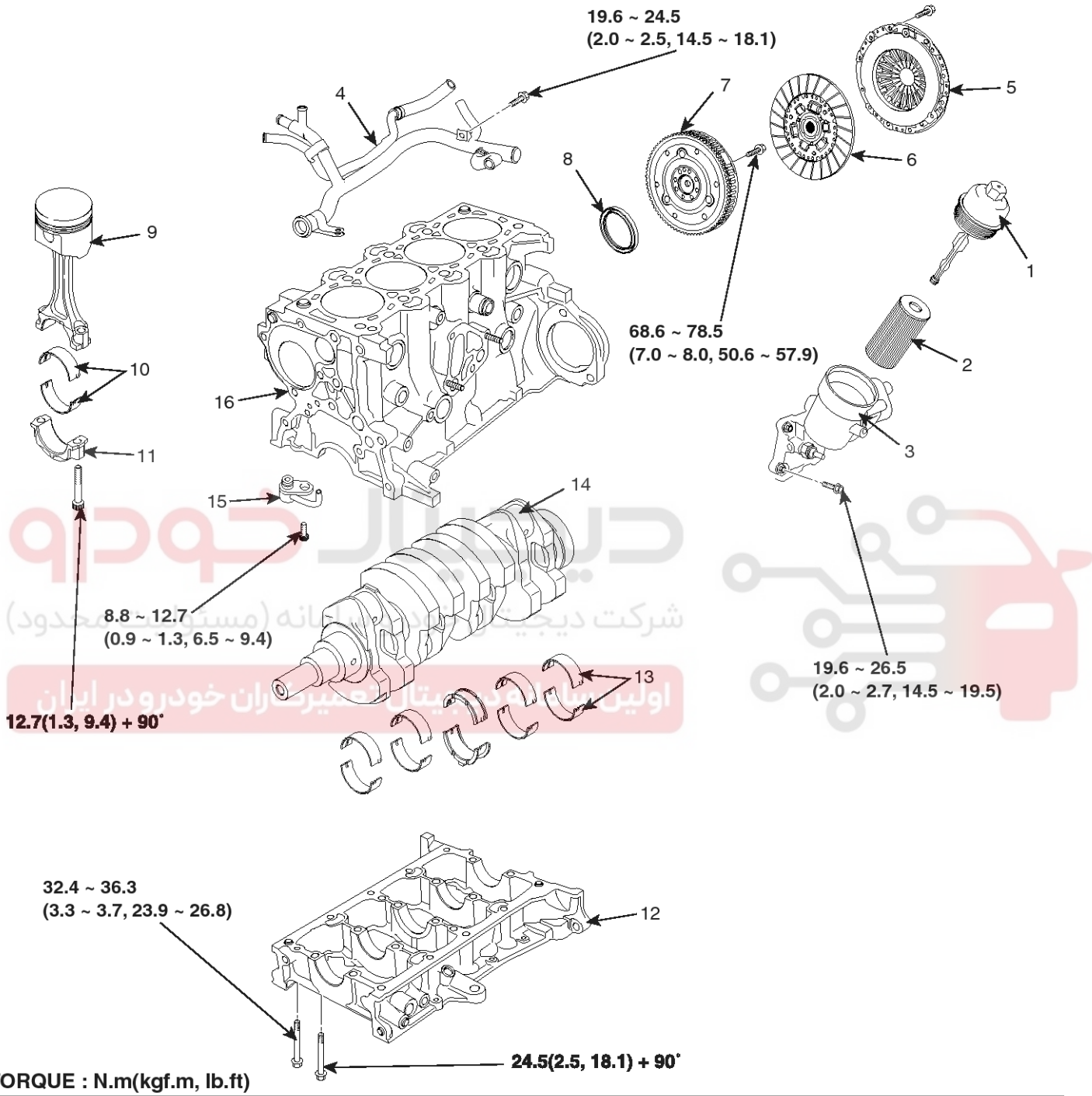


LCGF040A

15. Install the intake and exhaust manifold.
16. Install the timing chain.
17. Install the drive belt.

Cylinder Block

COMPONENTS



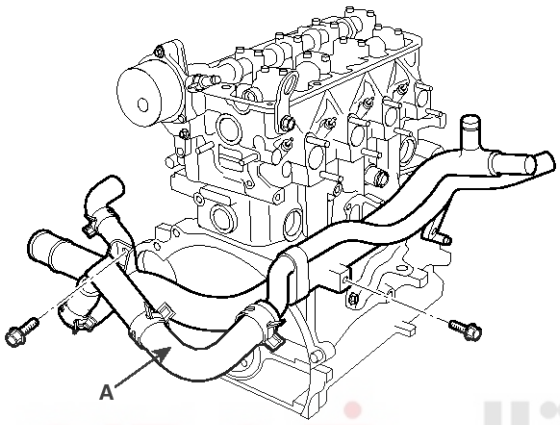
TORQUE : N.m(kgf.m, lb.ft)

1. Oil filter cap
2. Oil filter
3. Oil filter housing & oil cooler assembly
4. Water pipe
5. Clutch disk cover
6. Clutch disk
7. Flywheel
8. Crankshaft rear oil seal
9. Piston & connecting rod
10. Connecting rod bearing
11. Connecting rod cap
12. Bed plate
13. Crankshaft main bearing
14. Crankshaft
15. Oil jet
16. Cylinder block

SLDEM6113L

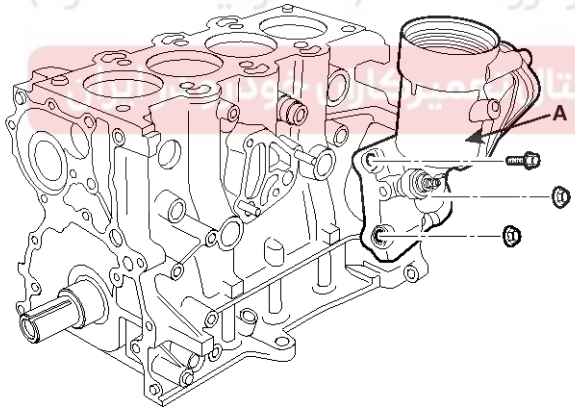
DISASSEMBLY

1. M/T : Remove the fly wheel.
2. A/T : Remove the drive plate.
3. Install the engine to engine stand for disassembly.
4. Remove the timing chain.
5. Remove the intake manifold and exhaust manifold.
6. Remove the cylinder head.
7. Remove the water pipe.



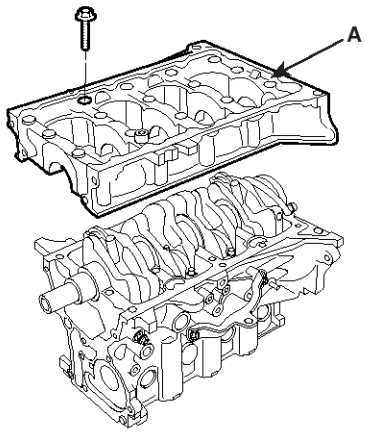
LCGF052A

8. Remove the oil filter and oil cooler assembly(A).



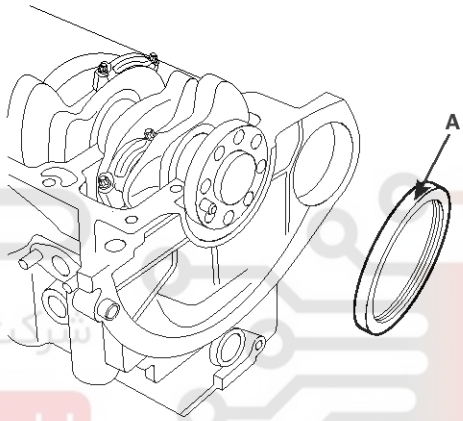
LCGF053A

9. Remove the bed plate(A).



LCGF054A

10. Remove the rear oil seal(A).

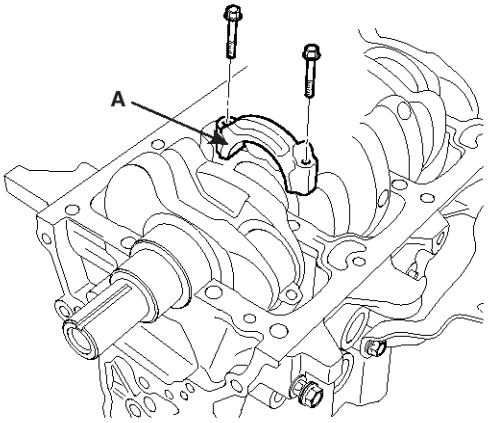


LCGF055A

11. Remove the connecting rod cap(A).

NOTICE

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

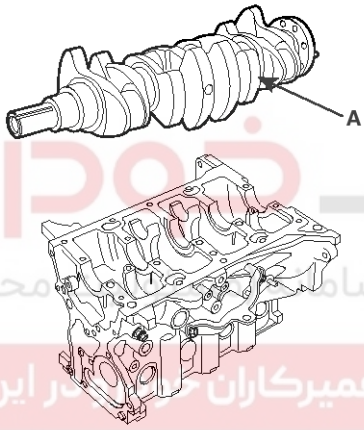


LCGF056A

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

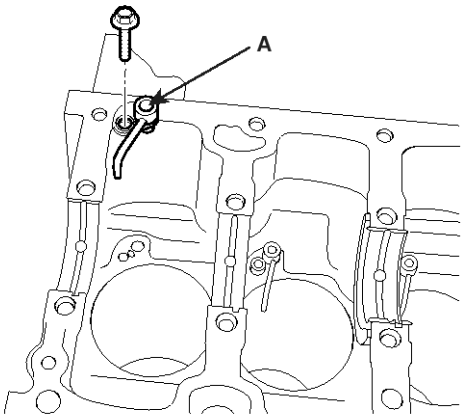
    NOTICE
    - *Keep the bearings, connecting rod and cap together.*
    - *Arrange the piston and connecting rod assemblies in the correct order.*
13. Lift the crankshaft(A) out of the engine, being careful not to damage journals.

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



LCGF057A

14. Remove the oil jet.



LCGF058A

15. Check fit between piston and piston pin.

    Try to move the piston back and forth on the piston pin.

    If any movement is felt, replace the piston and pin as a set.
16. Remove the piston rings.
    1) Using a piston ring expender, remove the 2 compression rings.
    2) Remove the 2 side rails and oil ring by hand.

    NOTICE
    Arrange the piston rings in the correct order only.
17. Remove the connecting rod from the piston.

    Using a press, remove the piston pin from piston.

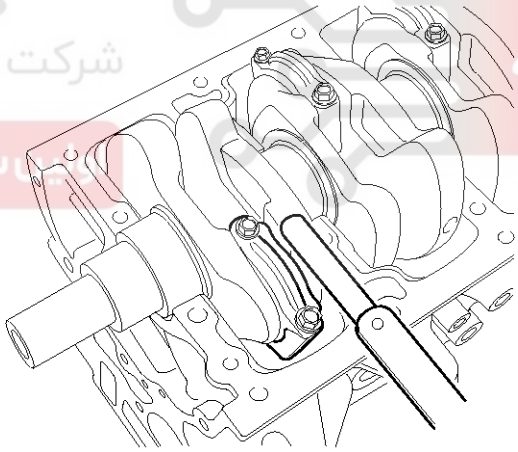
INSPECTION

CONNECTING ROD

1. Check the connecting rod end play.

   Using feeler gauge, measure the end play while moving the connecting rod back and forth.

End play
Standard : 0.1 ~ 0.25mm (0.0039 ~ 0.0098in)
Maximum : 0.4mm (0.0157in)



LCGF106A

- 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 match marks 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 lower bearing.
   4) Clean the crankshaft pin journal and bearing.
   5) Place a plastigage across the crankshaft pin journal.
   6) Reinstall the lower bearing and cap, and tighten the nuts.

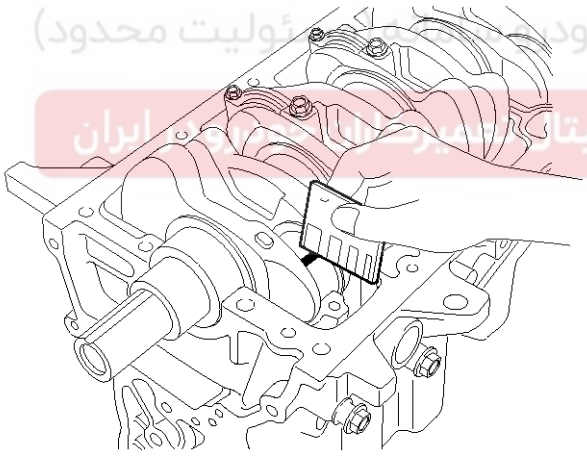
Tightening torque :
12.7Nm (1.3kgf.m, 9.4lb-ft) + (87~93°)

NOTICE
Do not turn the crankshaft.

Do not reuse the connection rod cap bolts.

   7) Remove the 2bolts, connecting rod cap and lower bearing .
   8) Measure the plastigage at its widest point.

Standard oil clearance
0.025 ~ 0.043mm (0.0010 ~ 0.0017in)



LCGF107A

   9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark.

   Recheck the oil clearance.

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

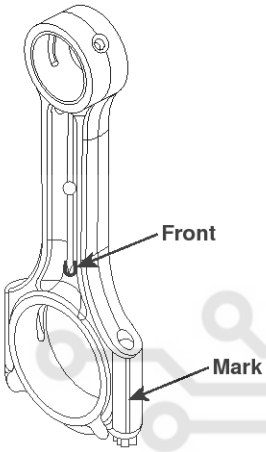
   10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing.

   Recheck the oil clearance.

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

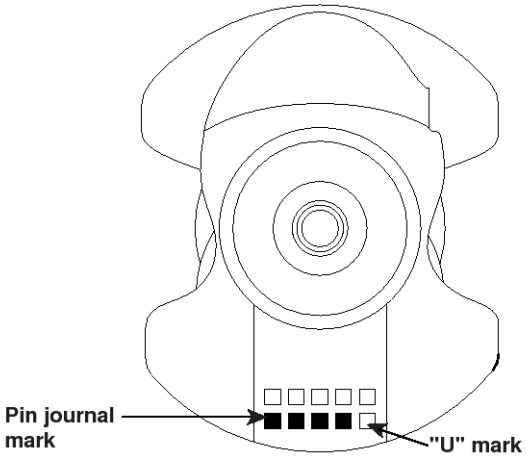


LCGF108A

Discrimination of connecting rod

Mark	Connecting rod big-end inner diameter
A	49.000 ~ 49.006mm (1.9291 ~ 1.9294 in)
B	49.006 ~ 49.012mm (1.9294 ~ 1.9296 in)
C	49.012 ~ 49.018mm (1.9296 ~ 1.9298 in)

Crankshaft pin journal mark location

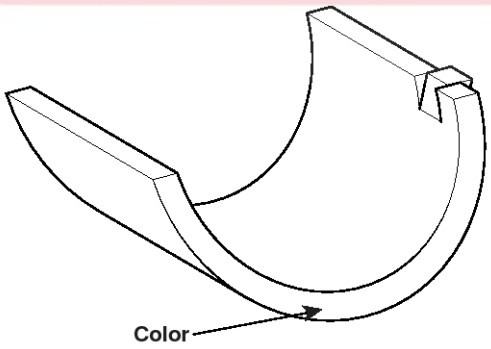


ACAE163B-1

Discrimination of crankshaft pin journal

Mark	Crankshaft pin journal outer diameter
A	46.009 ~ 46.015mm (1.8114 ~ 1.8116 in)
B	46.003 ~ 46.009mm (1.8111 ~ 1.8114 in)
C	45.997 ~ 46.003mm (1.8109 ~ 1.8111 in)

Connecting rod bearing mark location



LCGF143A

Discrimination of connecting rod bearing

Color	Connecting rod bearing thickness
Blue	1.477 ~ 1.480mm (0.0581 ~ 0.0583in)
Black	1.480 ~ 1.483mm (0.0583 ~ 0.0584in)
None	1.483 ~ 1.486mm (0.0584 ~ 0.0585in)
Green	1.486 ~ 1.489mm (0.0585 ~ 0.0586in)
Yellow	1.489 ~ 1.492mm (0.0586 ~ 0.0587in)

11) Select the bearing by using selection table.

Connecting rod bearing selection table

Connecting rod bearing		Connecting rod mark		
		A	B	C
Crank shaft pin journal mark	A	Blue	Black	None
	B	Black	None	Green
	C	None	Green	Yellow

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

Allowable bend of connecting rod :
0.05mm / 100mm (0.0020in / 3.94in) or less
Allowable twist of connecting rod :
0.1mm / 100mm (0.0039in / 3.94in) or less

CRANKSHAFT

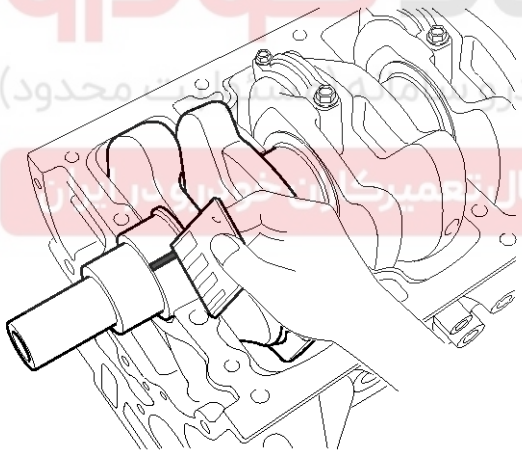
1. Check the crankshaft bearing oil clearance.
   1) To check main bearing-to-journal oil clearance, remove the bed plate and lower bearings.
   2) Clean each main journal and lower bearing with a clean shop towel.
   3) Place one strip of plastigage across each main journal.
   4) Reinstall the lower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

Tightening torque :
Long bolts : 22.6~26.5Nm (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 90~94°
Short bolts : 32.4~36.3N.m(3.3~3.7kgf.m, 23.9~26.8lbf.ft)

NOTICE
Do not turn the crankshaft.

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

Standard oil clearance :
0.024 ~ 0.042mm (0.0009 ~ 0.0017in)



LCGF109A

   6) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark.

      Recheck the oil clearance.

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

   7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing.

      Recheck the oil clearance.

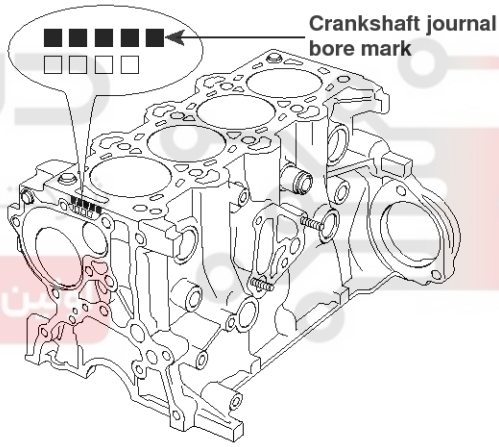
NOTICE
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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.

CYLINDER BLOCK CRANKSHAFT JOURNAL BORE MARK LOCATION

Letters have been stamped on the front face of block as a mark for the size of each of the 5 main journal bores.

Use them, and the numbers or letters stamped on the crank (marks for main journal size), to choose the correct bearings.

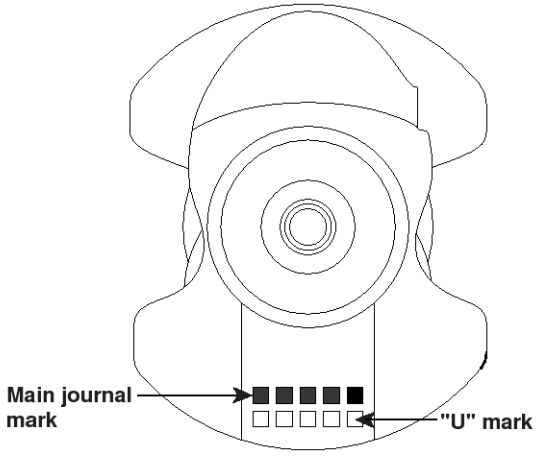


LCGF144A

Discrimination of cylinder block crankshaft journal bore

Mark	Cylinder block crankshaft journal bore inner diameter
A	58.000 ~ 58.006mm (2.2835 ~ 2.2837 in)
B	58.006 ~ 58.012mm (2.2837 ~ 2.2839 in)
C	58.012 ~ 58.018mm (2.2839 ~ 2.2842 in)

Crankshaft main journal mark location

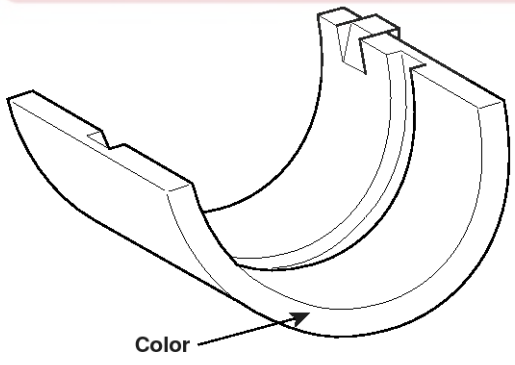


ACAE163B-2

Discrimination of crankshaft main journal

Mark	Crankshaft main journal outer diameter
A	53.984 ~ 53.990mm (2.1254 ~ 2.1256 in)
B	53.978 ~ 53.984mm (2.1251 ~ 2.1254 in)
C	53.972 ~ 53.978mm (2.1249 ~ 2.1251 in)

Crankshaft main bearing mark location



BCGE030A-1

Discrimination of crankshaft main bearing

Color	Crankshaft main bearing thickness
Blue	1.990 ~ 1.993mm (0.0783 ~ 0.0785in)
Black	1.993 ~ 1.996mm (0.0785 ~ 0.0786in)
None	1.996 ~ 1.999mm (0.0786 ~ 0.0787in)
Green	1.999 ~ 2.002mm (0.0787 ~ 0.0788in)
Yellow	2.002 ~ 2.005mm (0.0788 ~ 0.0789in)

8) Select the bearing by using selection table.

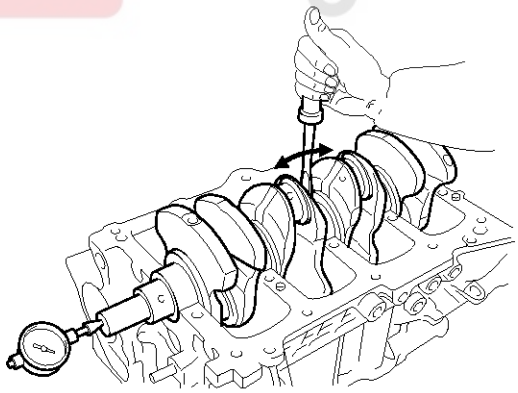
Crankshaft main bearing selection table

Crankshaft main bearing		Cylinder block crankshaft journal bore mark		
		A	B	C
Crankshaft main journal mark	A	Blue	Black	None
	B	Black	None	Green
	C	None	Green	Yelllow

2. Check the crankshaft end play.

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

End play
Standard : 0.08 ~ 0.28mm (0.0031 ~ 0.110in)
Limit : 0.30mm (0.0118in)



ECKD001B

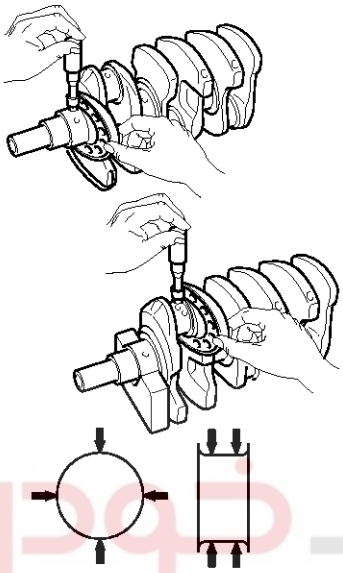
If the end play is greater than specification, replace the center main bearings as a set.

Thrust washer thickness of center main beaing :
2.335 ~ 2.385mm (0.0919 ~ 0.0939in)

3. Inspect the crankshaft main journals and pin journals.

   Using a micrometer, measure the diameter of each main journal and pin journal.

Main journal diameter :
53.972 ~ 53.990mm (2.1249 ~ 2.1256in)
Pin journal diameter :
45.997 ~ 46.015mm (1.8109 ~ 1.8116in)



ECKD001E

CYLINDER BLOCK

1. Remove the gasket material.

   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

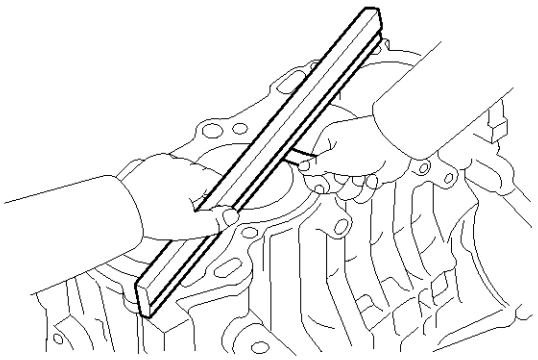
2. Clean the cylinder block

   Using a soft brush and solvent, thoroughly clean the cylinder block.

3. Inspect the top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface
Less than 0.05mm (0.0020in)



ECKD001L

4. Inspect the cylinder bore.

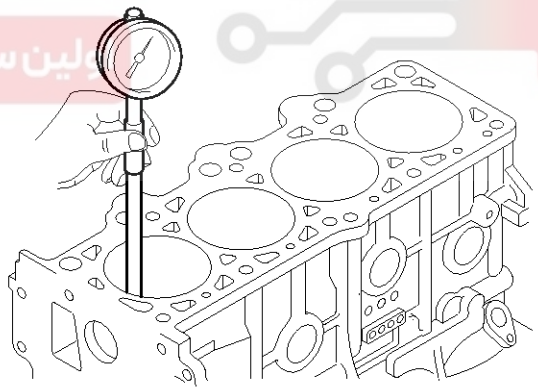
   Visually check the cylinder for vertical scratchs.

   If deep scratchs are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

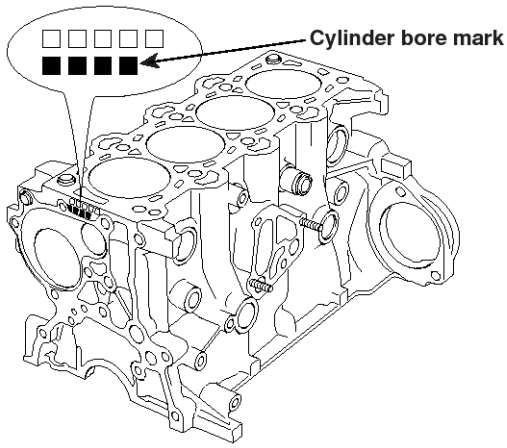
   Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

Standard diameter :
77.200 ~ 77.230mm (3.0394 ~ 3.0405in)



ECKD318A

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

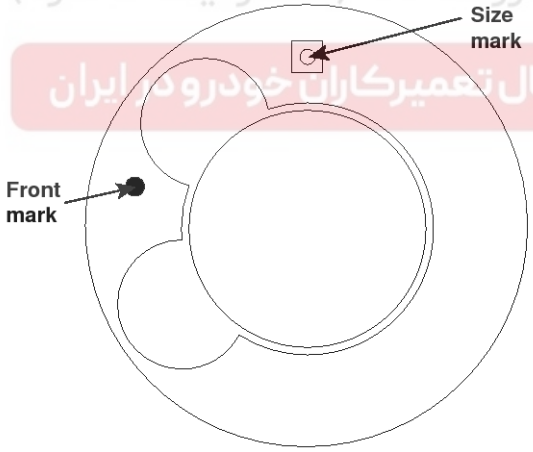


LCGF155A

Discrimination of cylinder bore size

Mark	Cylinder bore inner diameter
A	77.200 ~ 77.210mm (3.0394 ~ 3.0398 in)
B	77.210 ~ 77.220mm (3.0398 ~ 3.0402 in)
C	77.220 ~ 77.230mm (3.0402 ~ 3.0405 in)

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



LCGF110A

Discrimination of piston outer diameter

Mark	Piston outer diameter
A	77.130 ~ 77.140mm (3.0366 ~ 3.0370 in)
B	77.140 ~ 77.150mm (3.0370 ~ 3.0374 in)
C	77.150 ~ 77.160mm (3.0374 ~ 3.0378 in)

8. Select the piston related to cylinder bore class.

Piston-to-cylinder clearance :
0.060 ~ 0.080mm (0.0024 ~ 0.0031in)

Boring cylinder

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

   NOTICE
   The size of piston is stamped on top of the piston.
2. Measure the outside diameter of the piston to be used.
3. According to the measured O.D(Outer Diameter), calculate the new bore size.

New bore size = piston O.D + 0.060 to 0.080mm (0.0024 to 0.0031in) (clearance between piston and cylinder) - 0.01mm (0.0004in) (honing margin.)

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

   CAUTION
   To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.
5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

Standard : 0.060 ~ 0.080mm (0.0024 ~ 0.0031in)

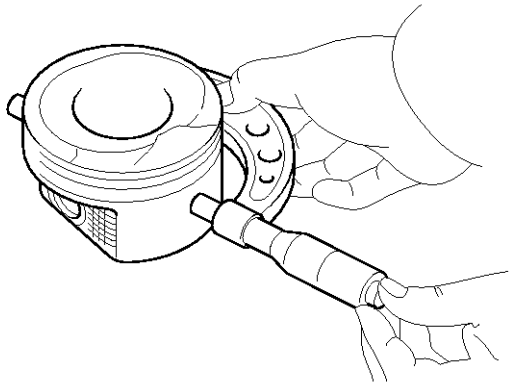
NOTICE
When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize.

PISTON AND PISTON RINGS

1. Clean the piston.
   1) Using a gasket scraper, remove the carbon from the piston top.
   2) Using a groove cleaning tool or 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 10mm (0.39in) from bottom land of the piston.

Standard diameter :
77.13 ~ 77.16mm (3.0366 ~ 3.0378in)



ECKD001D

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

Piston-to-cylinder clearance :
0.06 ~ 0.08mm (0.0024 ~ 0.0031in)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance
No.1 : 0.09 ~ 0.13mm (0.0035 ~ 0.0051in)
No.2 : 0.08 ~ 0.12mm (0.0031 ~ 0.0047in)
Oil ring : 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)

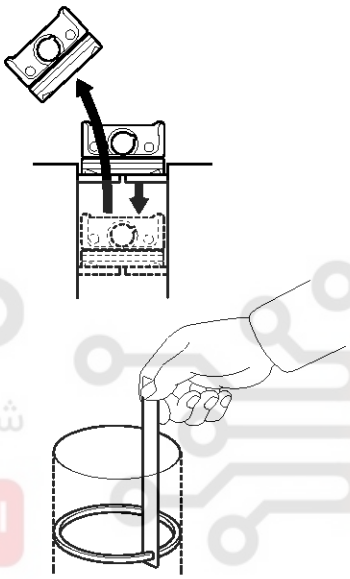
ECKD001G

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

5. Inspect the piston ring end gap.

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

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

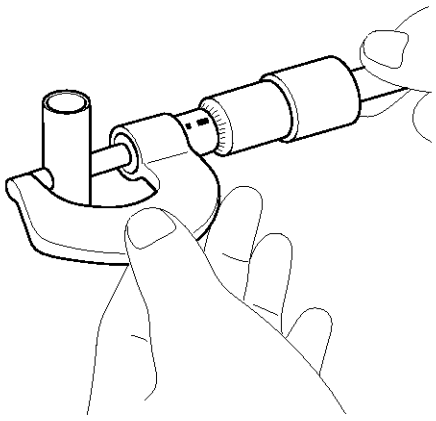


ECKD001K

PISTON PINS

1. Measure the outer diameter of piston pin.

Piston pin diameter :
27.995 ~ 28.000mm (1.1022 ~ 1.1024in)



ECKD001Z

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

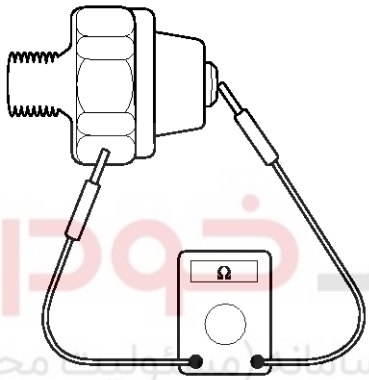
Piston pin-to-piston clearance :
0.004 ~ 0.015mm (0.0002 ~ 0.0006in)

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

Piston pin-to-connecting rod interference :
0.022 ~ 0.039mm (0.0009 ~ 0.0015in)

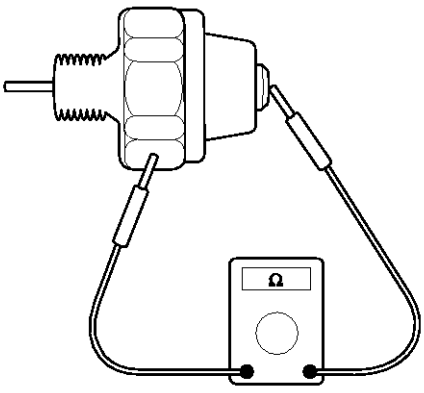
OIL PRESSURE SWITCH

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 the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.



ECKD001Y

3. If there is no continuity when a 49.0kpa (0.5kg/cm², 7.1psi) vacuum is applied through the oil hole, the switch is operating properly.

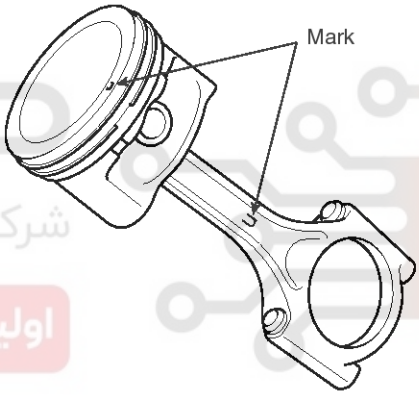
   Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

REASSEMBLY

NOTICE

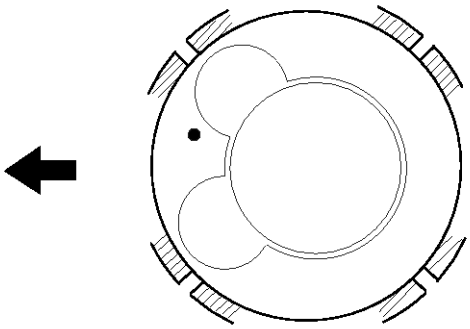
- *Thoroughly clean all parts to assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.*
- *Replace all gaskets, O-rings and oil seals with new parts.*

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



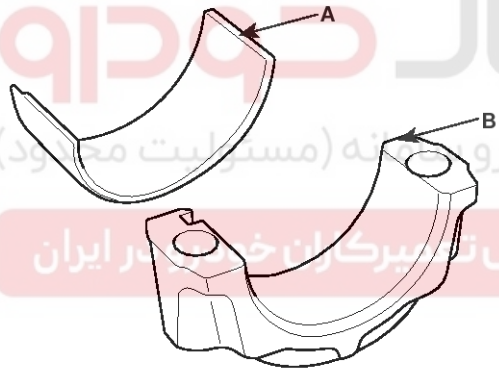
BCGE018A

2. Install the piston rings.
   1) Install the oil ring expander 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.



LCGF145A

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



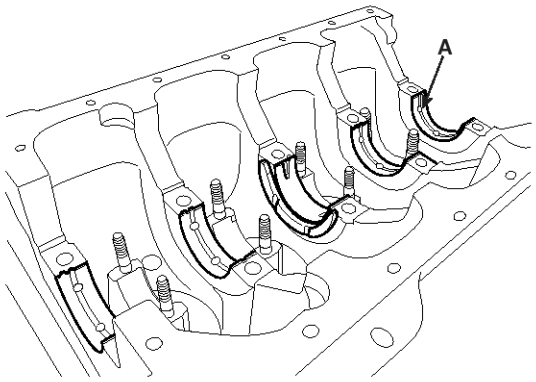
ECKD322A

4. Install the crankshaft main bearings.

NOTICE

Upper 1, 2, 4, 5 bearings have an oil groove of oil holes ; Lower bearings do not.

   1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).

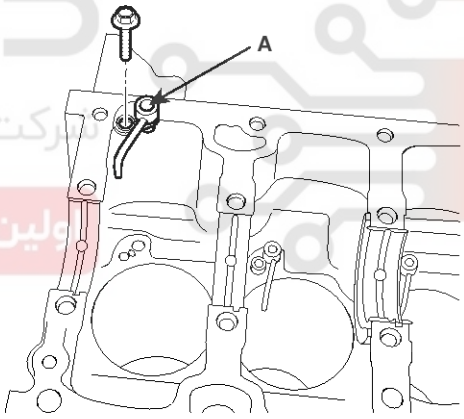


ECKD323A

   2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

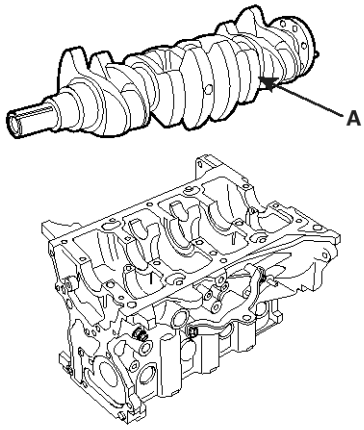
5. Install the oil jet.

Tightening torque :
8.8 ~ 12.7N.m (0.9 ~ 1.3kgf.m, 6.5 ~ 9.4lbf.ft)



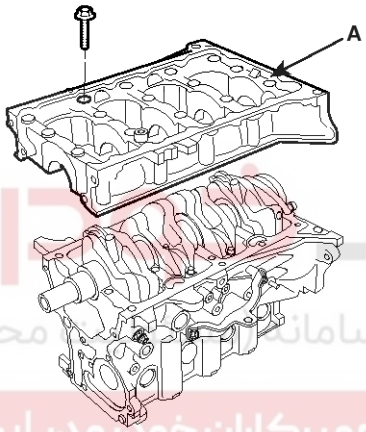
LCGF058A

6. Place the crankshaft on the cylinder block.



LCGF057A

7. Place the bed plate on the cylinder block.



LCGF054A

NOTICE

- *Standard liquid gasket : LOCTITE 5205, HYLOMAR3000, Dreibond 5105*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.*
- *Assemble the bed plate in 5 minutes after applying the liquid gasket.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

8. Install the bed plate bolts.

NOTICE

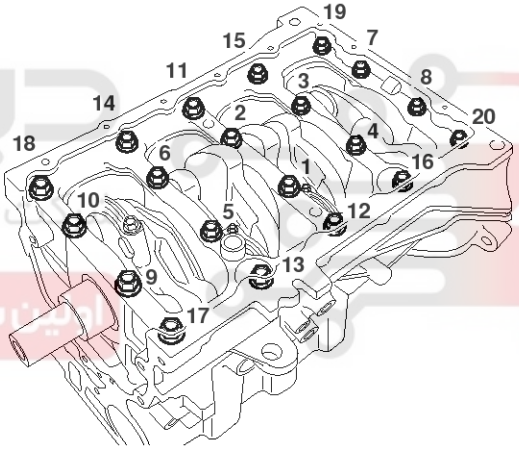
- *The bed plate bolts are tightened in 2 progressive steps.*
- *If any of the bed plate bolts in broken or deformed, replace it.*

1) Apply a light coat of engine oil on the threads and under the bed plate bolts.
2) Install and uniformly tighten the bed plate bolts(A),in several passes, in the sequence shown.

Tightening torque :
Long bolts(1~10) : 22.6~26.5Nm (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 90~94°
Short bolts(11~20) : 32.4~36.3N.m (3.3~3.7kgf.m, 23.9~26.8lbf.ft)

NOTICE

Always use new main bearing cap bolts.



LCGF111A

3) Check that the crankshaft turns smoothly.

9. Check the crankshaft end play.
10. Install the piston and connecting rod assemblies.

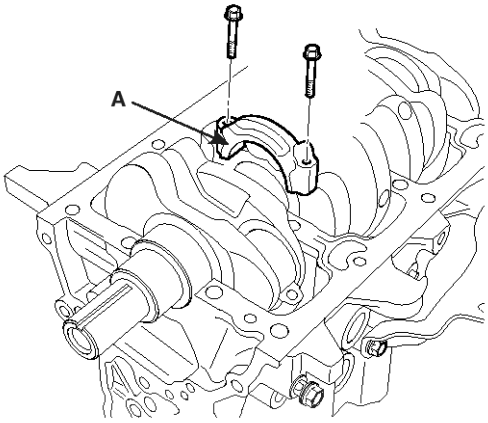
NOTICE

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

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

3) Stop after the ring compressor pops free, and check the connecting rod-to-crank journal alignment before pushing the piston into place.
4) Apply engine oil to the bolt threads. install the rod caps with bearings, and tighten the bolts.

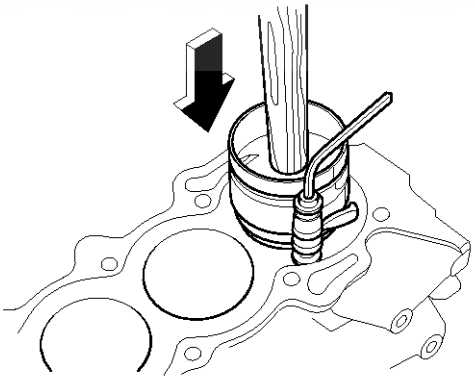
Tightening torque :
12.7Nm (1.3kgf.m, 9.4lb-ft) + (87~93°)



LCGF056A

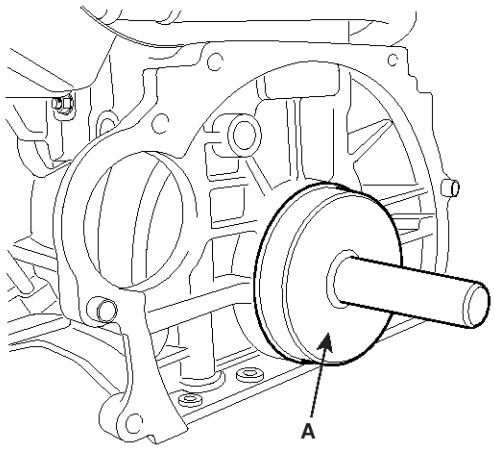
NOTICE

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



ECKD001F

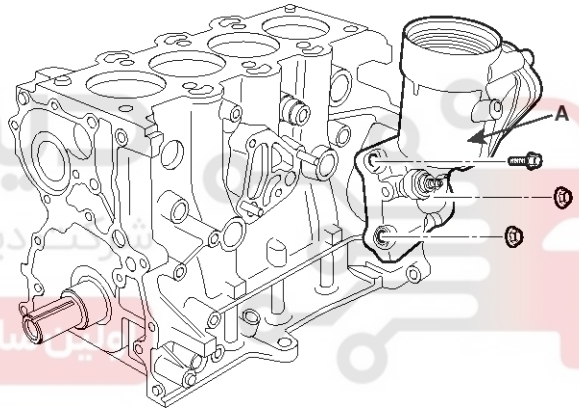
11. Install the rear oil seal.
    1) Apply engine oil to a new oil seal lip.
    2) Using the SST(09231-H1200, 09231-H1100)(A) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.



LCGF112A

12. Install the oil filter and oil cooler assembly(A).

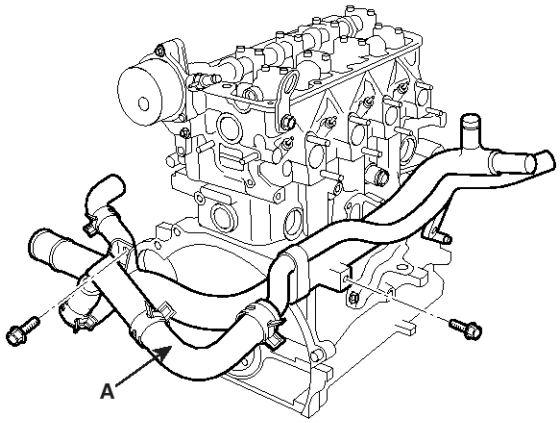
Tightening torque :
19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lbf.ft)



LCGF053A

13. Install the water pipe(A).

Tightening torque :
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lbf.ft)



LCGF052A

14. Install the cylinder head.
15. Install the intake manifold and exhaust manifold.
16. Install the timing chain.
17. Remove the engine stand.
18. A/T :install the drive plate.

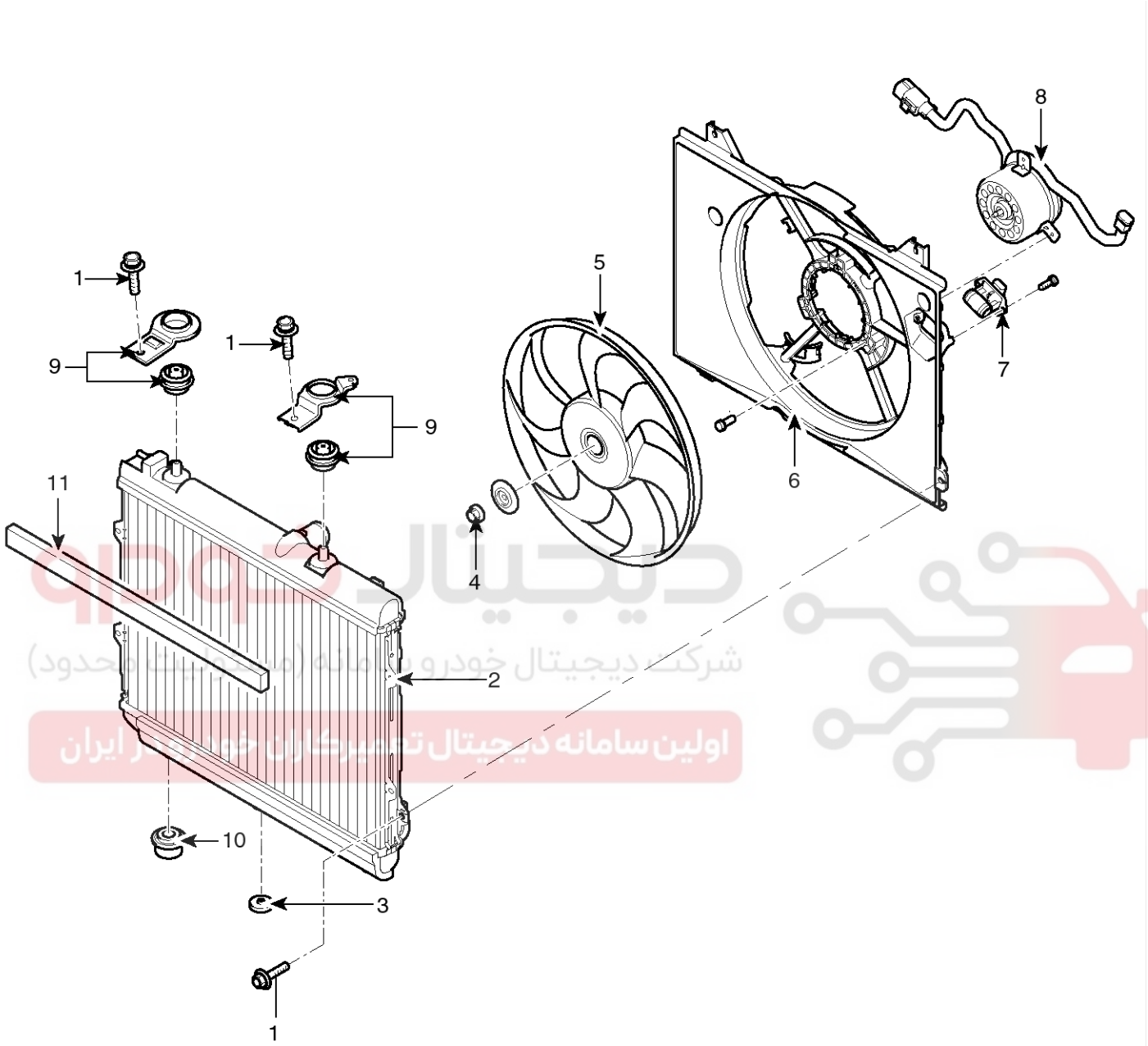
Tightening torque :
68.6 ~ 78.5N.m (7.0 ~ 8.0kgf.m, 50.6 ~ 57.9lbf.ft)

19. M/T :install the fly wheel.

Tightening torque :
68.6 ~ 78.5N.m (7.0 ~ 8.0kgf.m, 50.6 ~ 57.9lbf.ft)

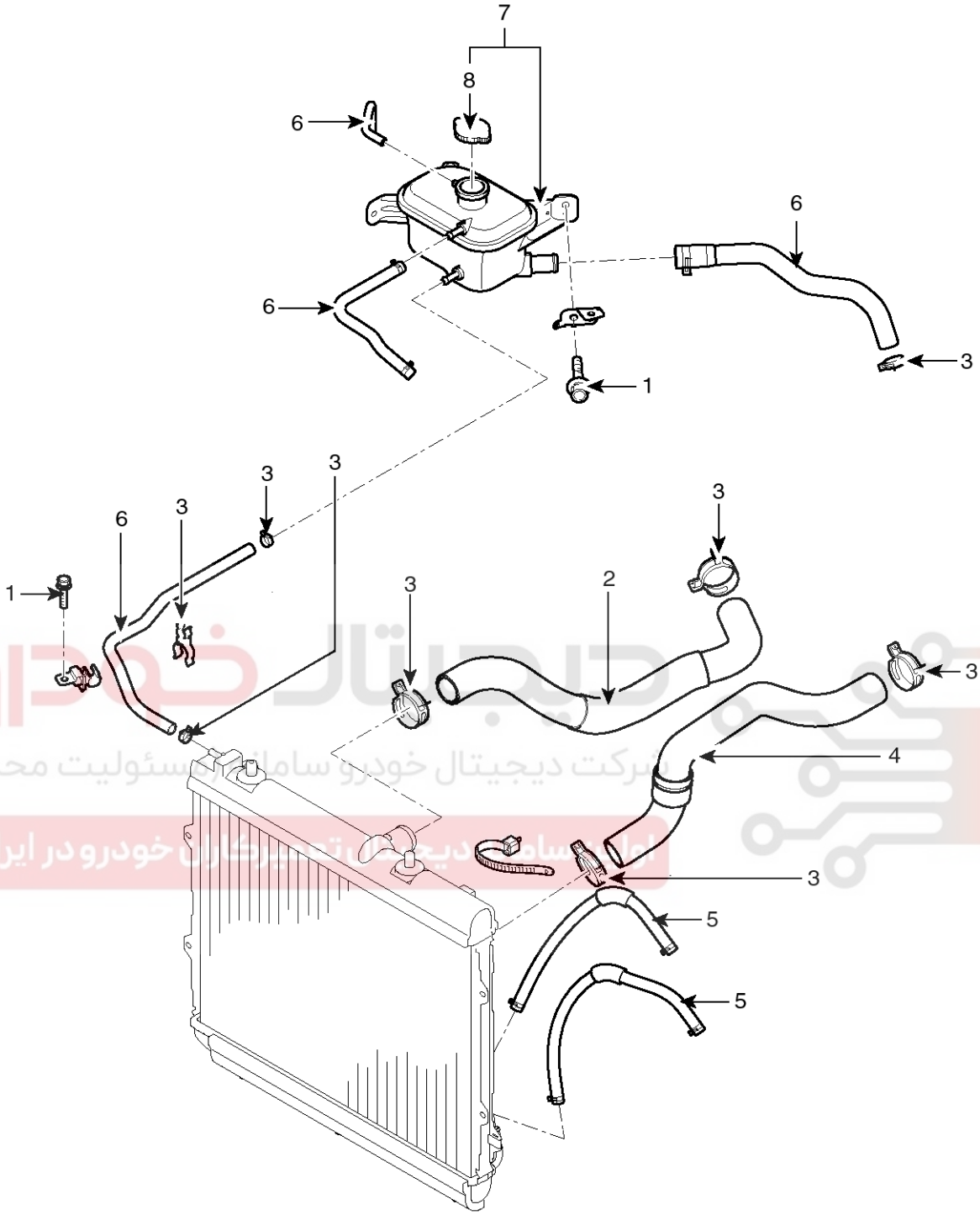
Cooling System

COMPONENT



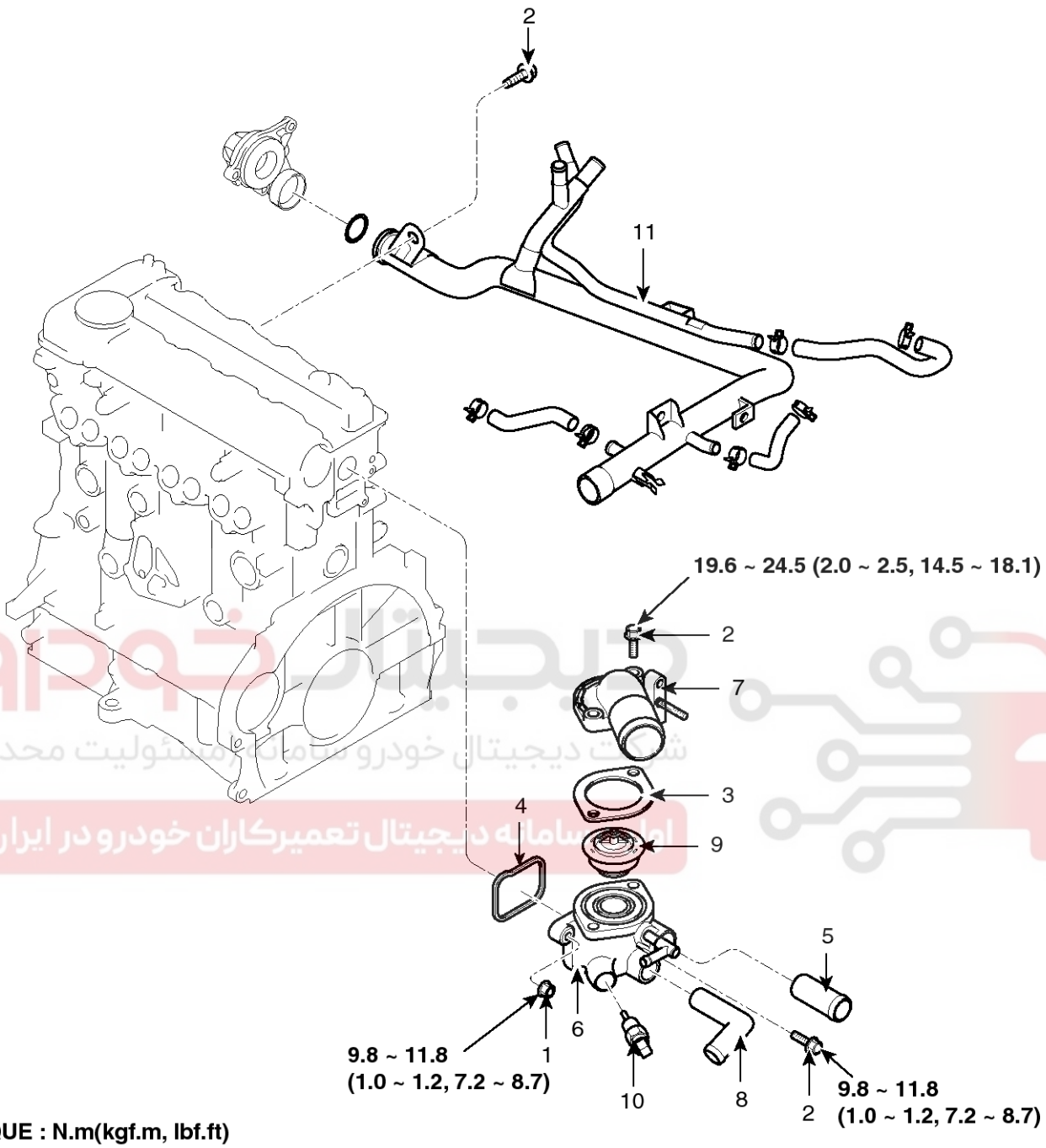
1. Bolt
2. Radiator assembly
3. Radiator drain plug
4. Nut
5. Cooling fan
6. Fan shroud
7. Resister
8. Motor assembly
9. Upper bracket
10. Lower insulator
11. Radiator seal

SLDEM6102L



1. Bolt
2. Radiator upper hose
3. Clamp
4. Radiator lower hose
5. Oil cooler hose
6. Hose
7. Reservoir
8. Radiator cap assembly

SLDEM6103L



TORQUE : N.m(kgf.m, lbf.ft)

1. Nut
2. Bolt
3. Thermostat cover gasket
4. Thermostat housing gasket
5. Heater connector
6. Thermostat housing
7. Thermostat cover
8. By-pass hose connector
9. Thermostat assembly
10. Engine coolant temperature(ECT) sensor
11. Return pipe assembly

SLDEM6104L

REPLACEMENT

ENGINE COOLANT

WARNING

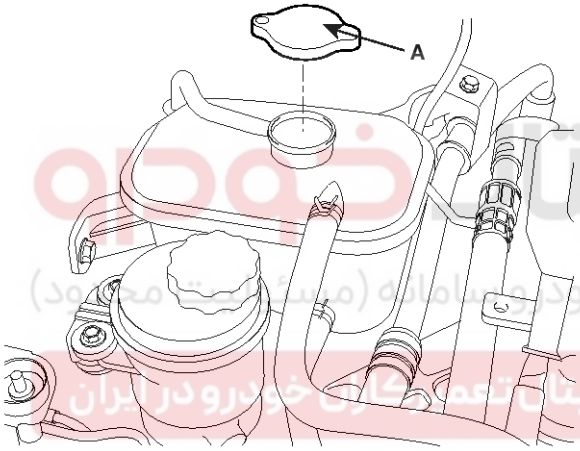
Never remove the radiator cap when the engine is hot.

Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

CAUTION

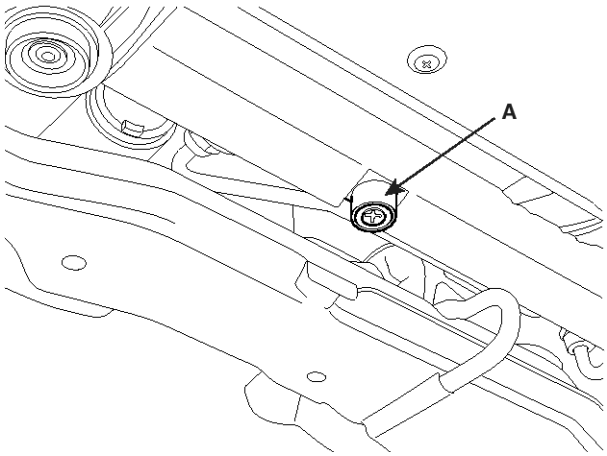
When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts of the paint. If any coolant spills, rinse it off immediately.

1. Slide the heater temperature control lever to maximum heat. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap(A).



LCGF113A

3. Loosen the drain plug(A), and drain the coolant.



SLDEM6120D

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

   NOTICE

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

   CAUTION

   - **Do not mix different brands of antifreeze/coolants.**
   - **Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.**
7. Start the engine and allow coolant to circulate. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
9. Fill the reservoir to the "MAX" line with coolant.
10. Stop the engine and allow coolant to be cool.
11. Repeat step 6 to 10 until the coolant level stays constant and all air is bleed out of the cooling system.

    NOTICE

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

Coolant capacity : 6.97 liters(7.37 US qt, 6.13 Imp qt)

REMOVAL

WATER PUMP

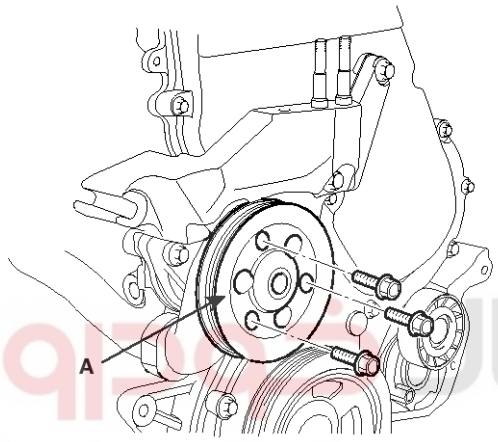
1. Drain the engine coolant.

   WARNING

   System is under high pressure when the engine is hot.

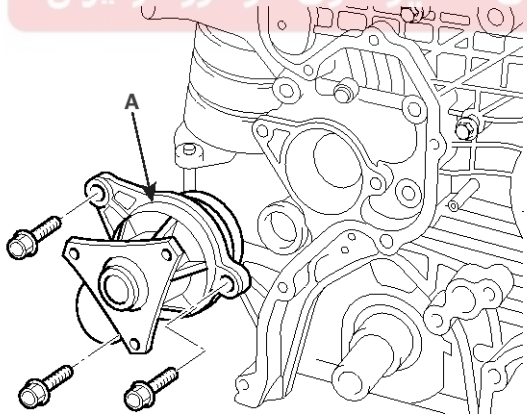
   To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove the drive belts.
3. Remove the water pump pulley(A).



LCGF006A

4. Remove the water pump(A).



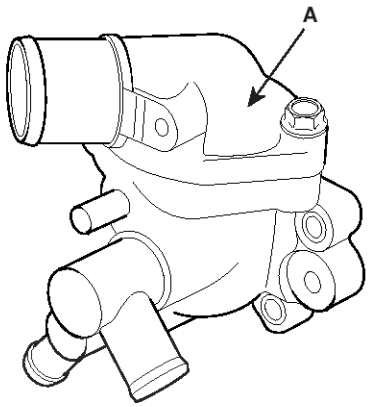
LCGF026A

THRMOSTAT

NOTICE

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

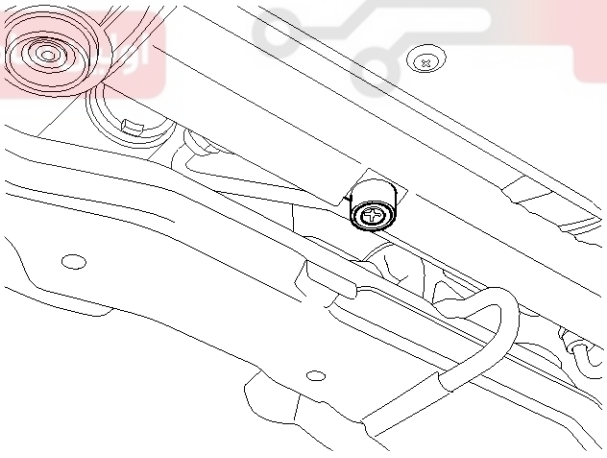
1. Drain the engine coolant so its level is below thermostat.
2. Remove the water inlet fitting(A), gasket and thermostat.



LCGF151A

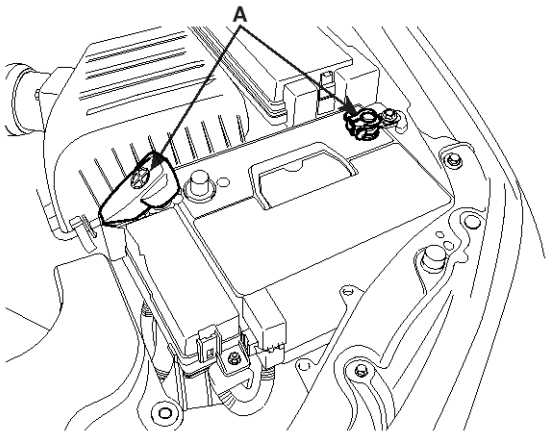
RADIATOR

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



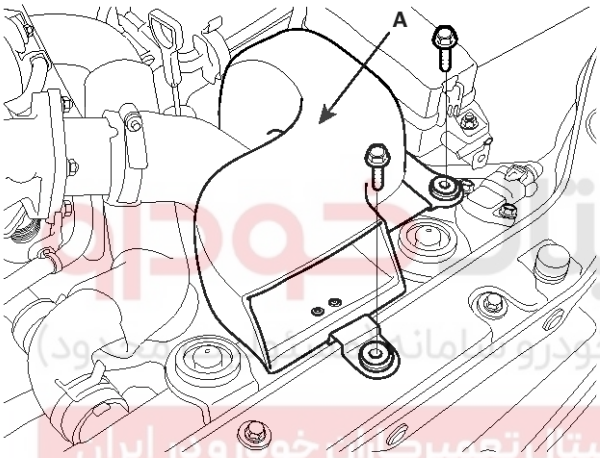
SLDEM6001D

2. Disconnect the battery terminals(A).



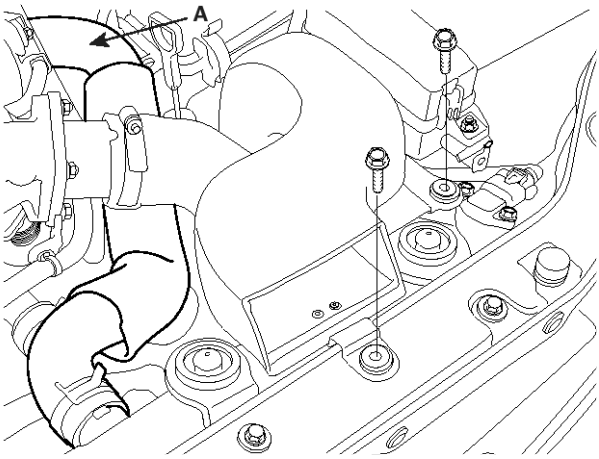
LCGF064A

3. Remove the air duct(A).



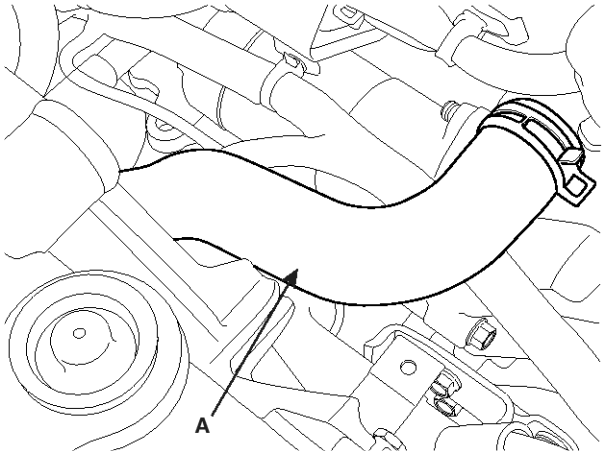
SLDEM6002D

4. Remove the radiator upper hose(A).



SLDEM6110D

5. Remove the radiator lower hose(A).

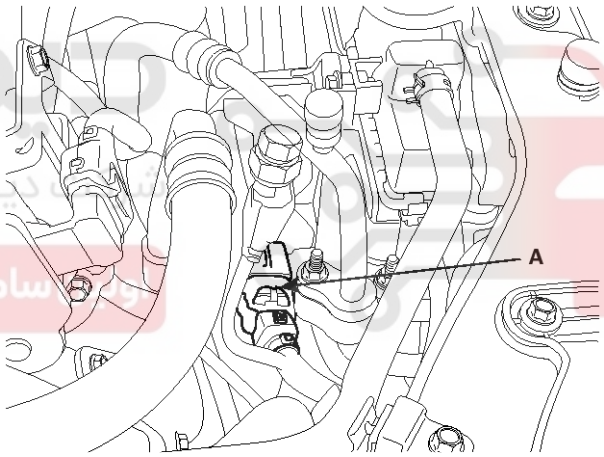


SLDEM6003D

NOTICE

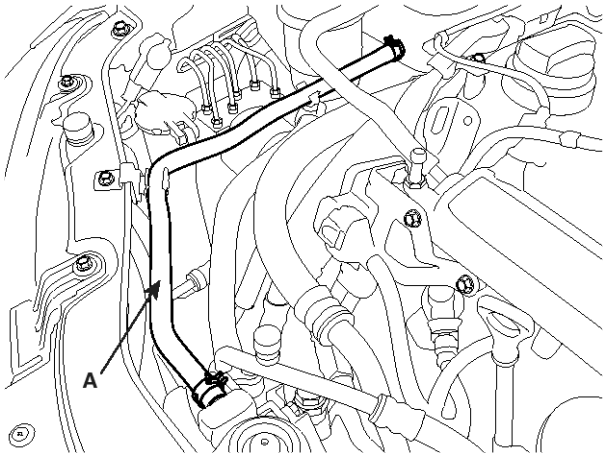
Remove the clamp on the cooling fan cover.

6. Remove automatic transaxle fluid(ATF) cooler hose.(Refer to 'AT' group).
7. Disconnect the fan motor connector(A).



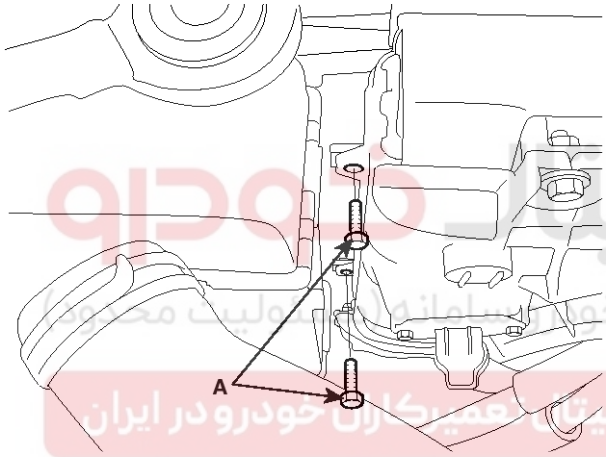
SLDEM6004D

8. Disconnect the hose(A) between the reservoir and the radiator.

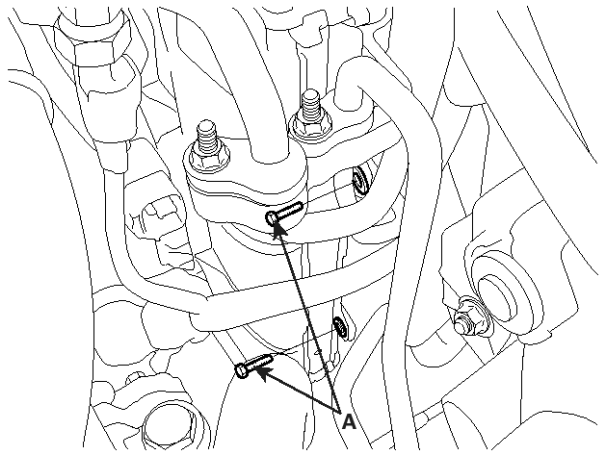


SLDEM6005D

9. Remove the radiator mounting bolts(A) and remove the radiator from condenser.

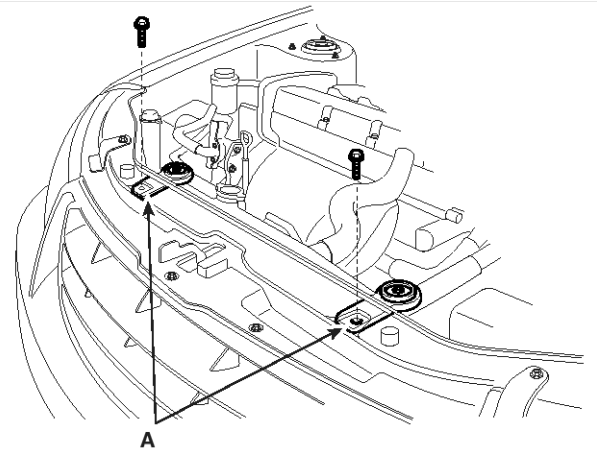


SLDEM6006D



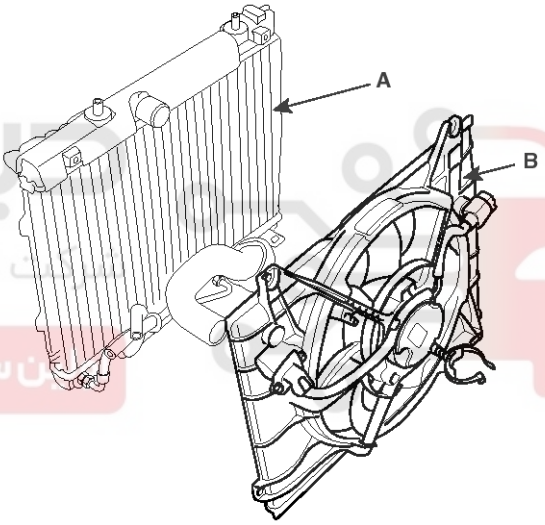
SLDEM6007D

10. Remove the radiator upper bracket(A), then pull up the radiator.



SLDEM6111D

11. Remove the cooling fan(B) from the radiator(A).

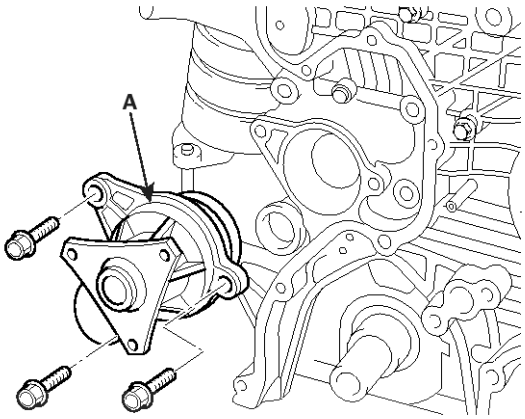


SLDEM6008D

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.



LCGF026A

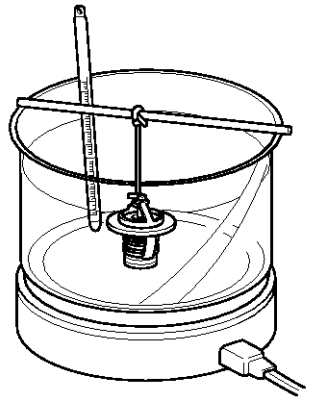
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

NOTICE

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

THERMOSTAT

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



ECKD503B

2. Check the valve opening temperature.

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

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

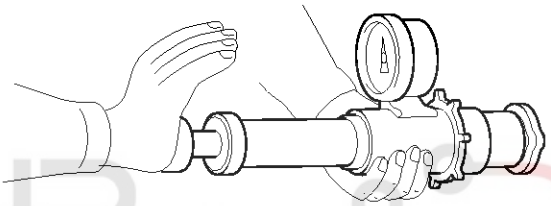
3. Check the valve lift.

Valve lift : 8mm(0.3in) or more at 95˚C (203˚F)

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

RADIATOR CAP

1. Remove the radiator cap, wet its seal with engine coolant, then install it no pressure tester.

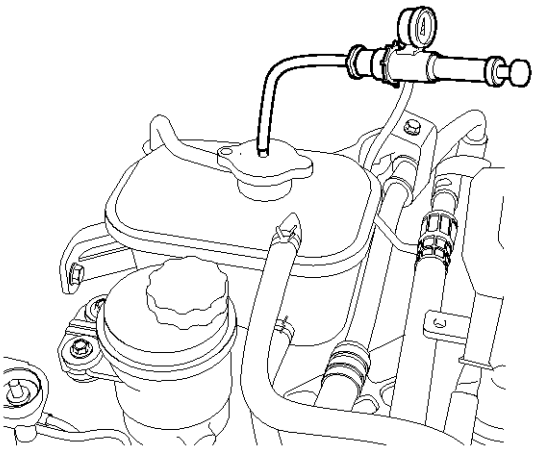


ECKD501X

2. Apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

RADIATOR LEAKAGE

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
2. Apply a pressure tester to the radiator and apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi).



LCGF114A

3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTICE

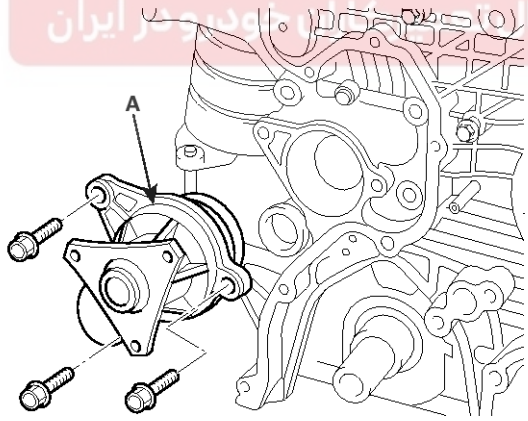
Check for engine oil in the coolant and/or coolant in the engine oil.

INSTALLATION

WATER PUMP

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

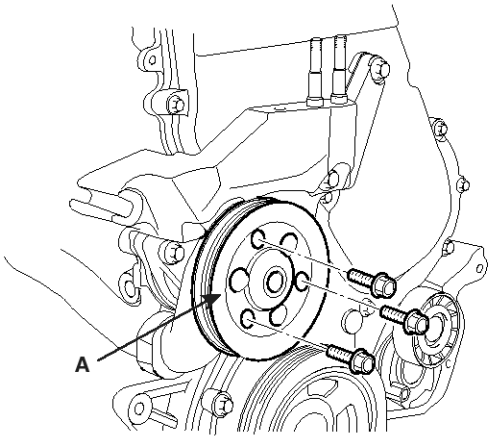
Tightening torque :
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lbf.ft)



LCGF026A

2. Install the water pump pulley(A).

Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lbf.ft)



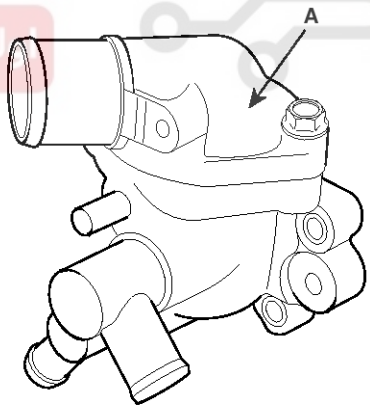
LCGF006A

3. Install the drive belts.
4. Fill with engine coolant.
5. Start engine and check for leaks.
6. Recheck engine coolant level.

THERMOSTAT

1. Place the thermostat in thermostat housing with new gasket.
2. Install the water inlet fitting(A).

Tightening torque :
14.7 ~ 19.6N.m (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lbf.ft)



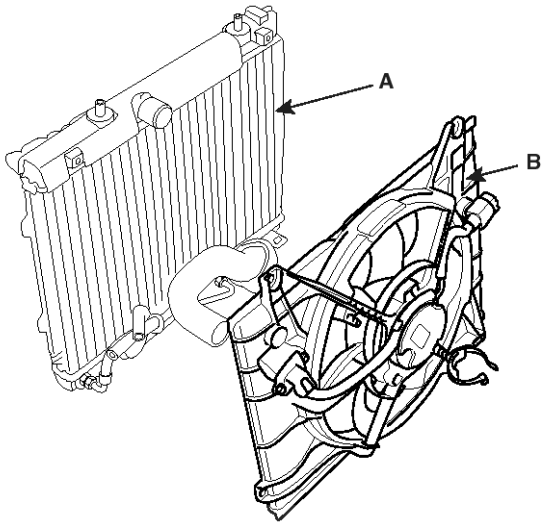
LCGF151A

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

RADIATOR

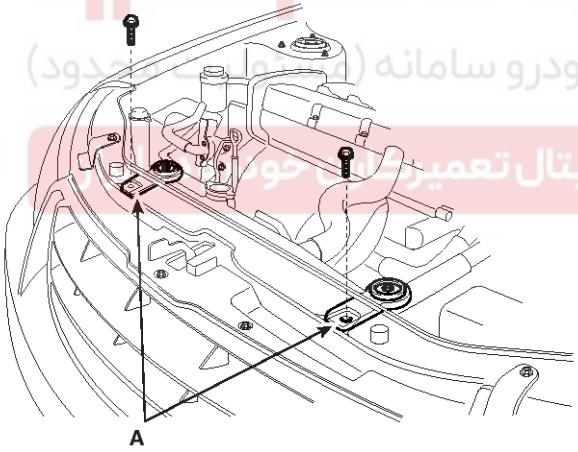
1. Install the cooling fan(B) to the radiator(A).

Tightening torque :
8.8 ~ 10.8Nm (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0 lbf.ft)



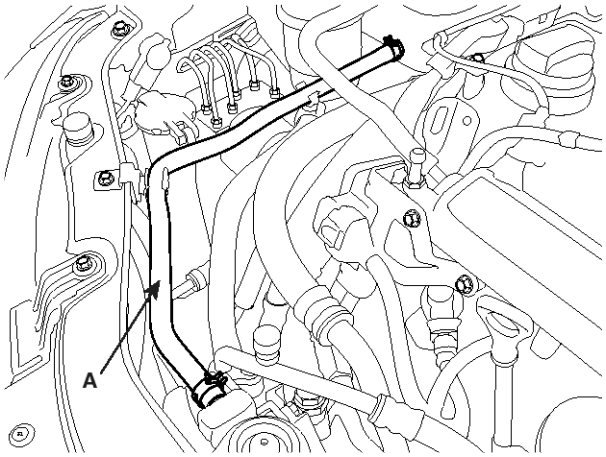
SLDEM6008D

2. Install the radiator to the air conditioning condenser and the radiator upper bracket(A).



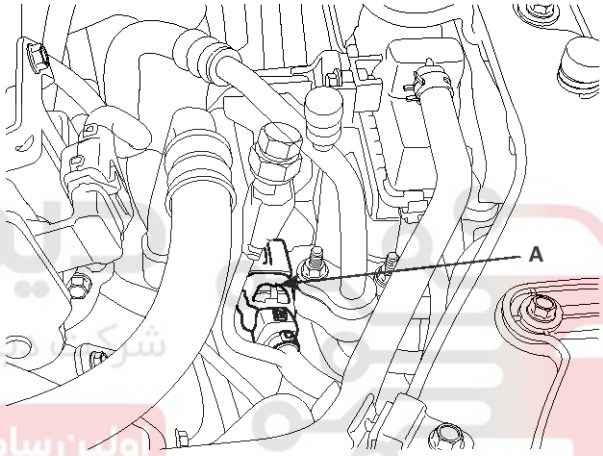
SLDEM6111D

3. Connect the hose(A) between the radiator and the reservoir.



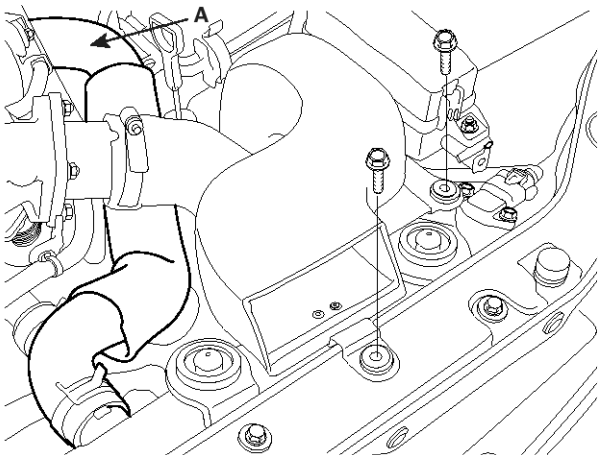
SLDEM6005D

4. Connect the fan motor connector(A).

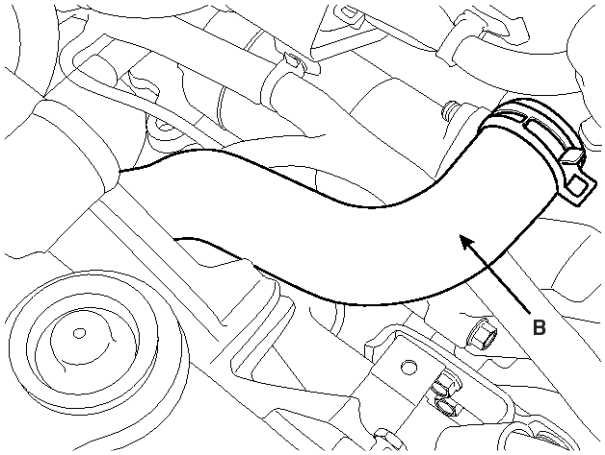


SLDEM6004D

5. Install the upper and the lower radiator hoses(A) and the automatic transaxle fluid(ATF) cooler hose.

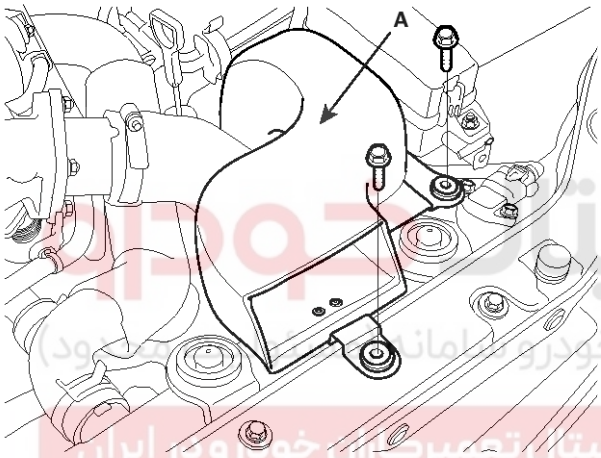


SLDEM6110D



SLDEM6109L

6. Fill with engine coolant and install the air duct(A).

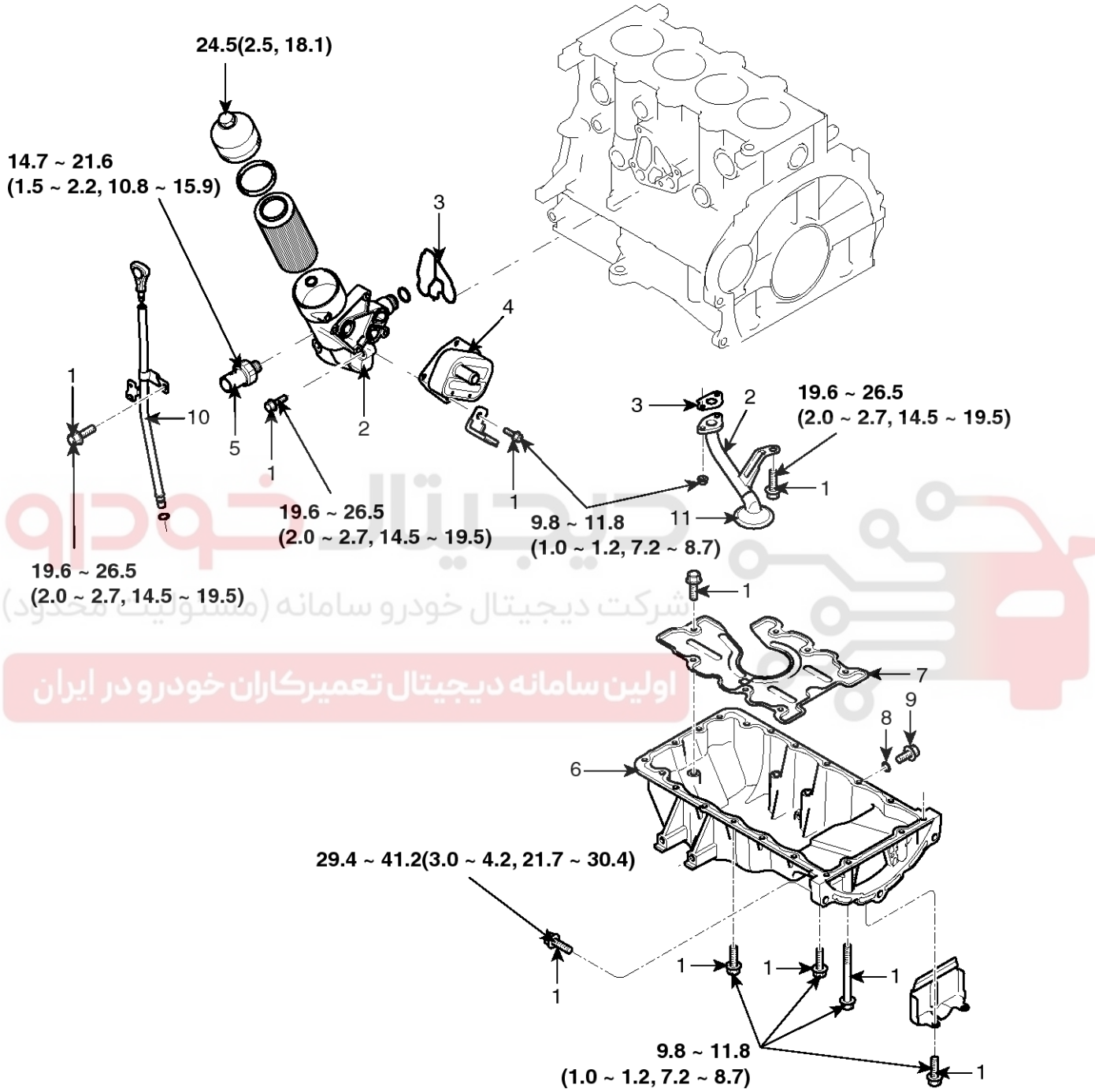


SLDEM6002D

7. Start engine and check for leaks.

Lubrication System

COMPONENTS



TORQUE : N.m(kgf.m, lb.ft)

1. Bolt
2. Engine oil filter assembly
3. Gasket
4. Oil cooler assembly
5. Oil pressure switch assembly
6. Oil pan assembly
7. Baffle plate
8. Oil drain plug gasket
9. Oil drain plug
10. Oil level gauge guide
11. Oil screen assembly

SLDEM6105L

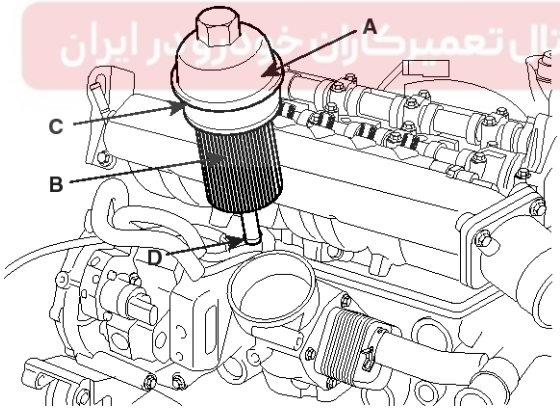
REPLACEMENT

OIL AND FILTER

⚠CAUTION

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

1. Drain the engine oil.
   1) Remove the oil filler cap.
   2) Remove the oil drain plug, and drain the oil into a container.
2. Replace the oil filter(B).
   1) Remove the oil filter upper cap(A).



SLDEM6116D

   2) Replace the O-ring(C) of oil filter cap with a new one.

      Inspect the threads and O-ring(C). Wipe off the seat on the oil filter cap, then apply a light coat of oil to the oil filter upper cap O-ring(C).
   3) Install the new oil filter by hand to the upper cap.
   4) After the rubber seal seats, tighten the oil filter clockwise.

Tightening torque :
24.5N.m(2.5kgf.m, 18.1lbf.ft)

3. Refill with engine oil.
   1) Clean and install the oil drain plug with a new gasket.

Tightening torque :
34.3 ~ 44.1N.m (3.5 ~ 4.5kgf.m, 25.3 ~ 32.5lbf.ft)

   2) Fill wih fresh engine oil.

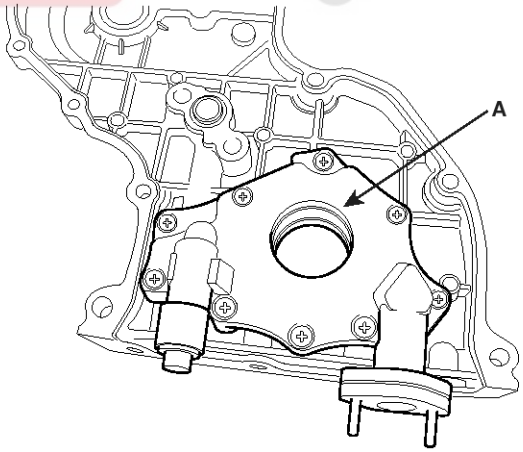
Oil Capacity
Total : 5.7 L (6.02 US qt, 5.01 Imp qt)
Oil pan : 4.8 L (5.07 US qt, 4.22 Imp qt)
Drain and refill including oil filter : 5.3 L (5.60 US qt, 4.66 Imp qt)
Oil quality : ABOVE API CH-4 or ACEA B4 (with CPF:C3)

   3) Install the oil filler cap.
4. Start engine and check for oil leaks.
5. Recheck the engine oil level.

REMOVAL

OIL PUMP

1. Drain the engine oil.
2. Remove the drive belts.
3. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing chain cover.
4. Remove the timing chain cover.
5. Remove the oil pump cover(A) from the timing chain cover.



LCGF115A

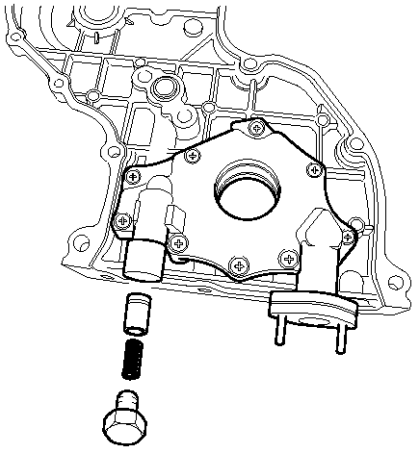
6. Remove the inner rotor and outer rotor.

DISASSEMBLY

RELIEF PLUNGER

1. Remove the relief plunger.

   Remove the plug(A), spring(B) and relief plunger(C).



LCGF116A

INSPECTION

1. Inspect the relief plunger.

   Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight.

   If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect the rotor side clearance.

   Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Side clearance	Outer rotor	0.04 ~ 0.09mm (0.0016 ~ 0.0035in)
	Inner rotor	0.04 ~ 0.085mm (0.0016 ~ 0.0033in)

   If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the front case.

SELECTION OF ENGINE OIL

Recommended API classification : CH-04

Recommended ACEA classification : B4

Recommended SAE viscosity grades :

SNFEM6100D

NOTICE

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

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

Lubricants that do not have both an SAE grade number and API service classification on the container should not be used.

ENGINE OIL

1. Check the engine oil quality.

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

   If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

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

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

NOTICE

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

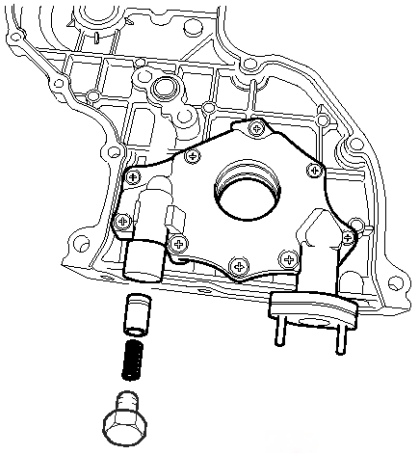
REASSEMBLY

RELIEF PLUNGER

1. Install the relief plunger.

   Install relief plunger(C) and spring(B) into the front case hole, and install the plug(A).

Tightening torque :
25.5 ~ 34.3N.m (2.6 ~ 3.5kgf.m, 18.8 ~ 25.3lbf.ft)



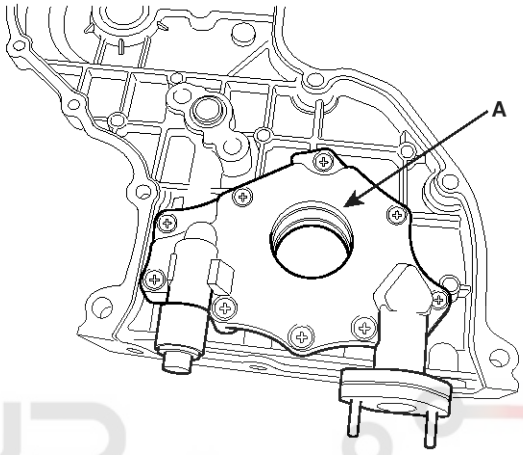
LCGF116A

INSTALLATION

OIL PUMP

1. Install the oil pump.
   1) Place the inner and outer rotors into front case with the marks facing the oil pump cover side.
   2) Install the oil pump cover(A) to timing chain cover with the screws.

Tightening torque :
5.9 ~ 8.8N.m (0.6 ~ 0.9kgf.m, 4.3 ~ 6.5lbf.ft)



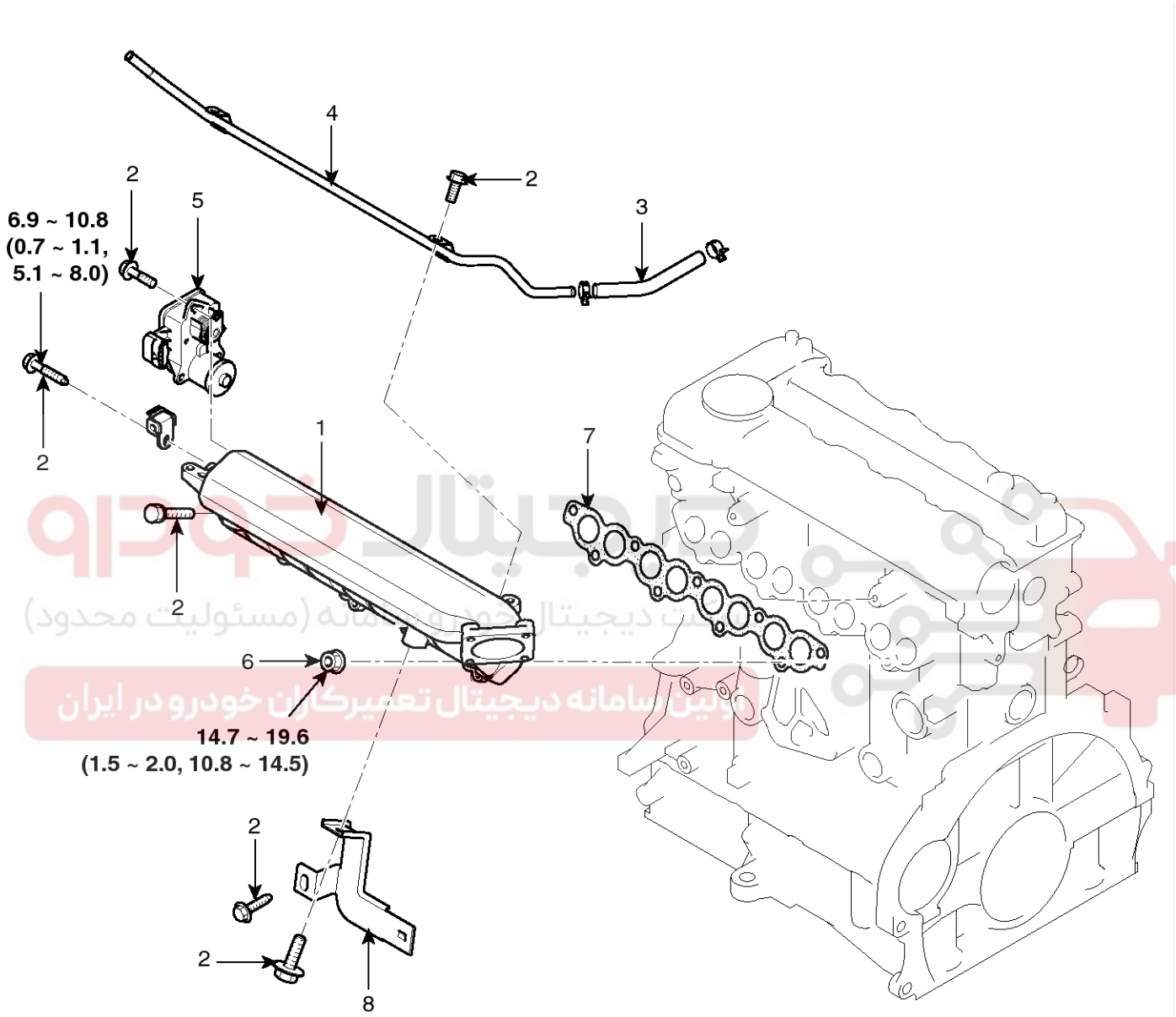
LCGF115A

2. Check that the oil pump turns freely.
3. Install the timing chain cover.
4. Install the drive belts.
5. Fill with engine oil.

Intake And Exhaust System

Intake Manifold

COMPONENTS



TORQUE : N.m(kgf.m, lb.ft)

1. Intake manifold assembly
2. Bolt
3. Bleed pipe hose
4. Bleed pipe
5. Swirl actuator
6. Nut
7. Intake manifold gasket
8. Wiring mounting bracket

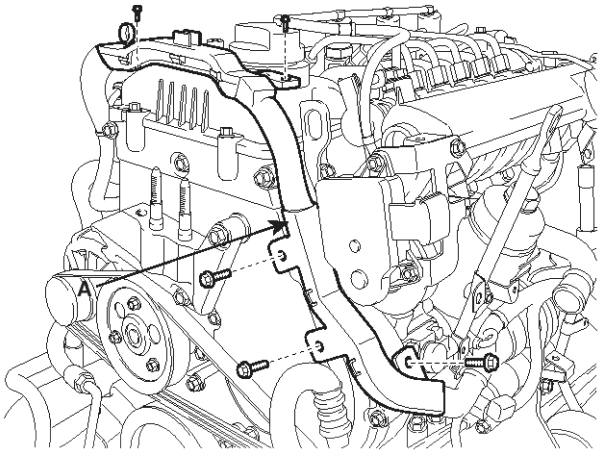
SLDEM6106L

REMOVAL

INTAKE MANIFOLD

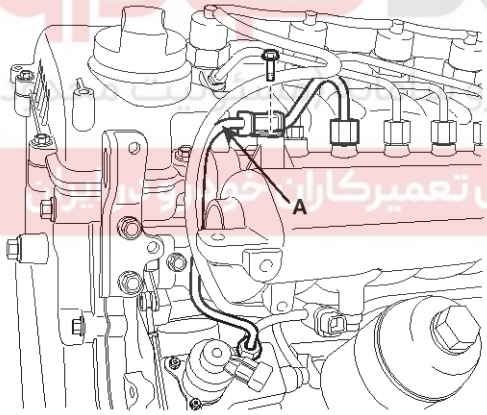
1. Remove the engine harness protector(A) mounting bolts.

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



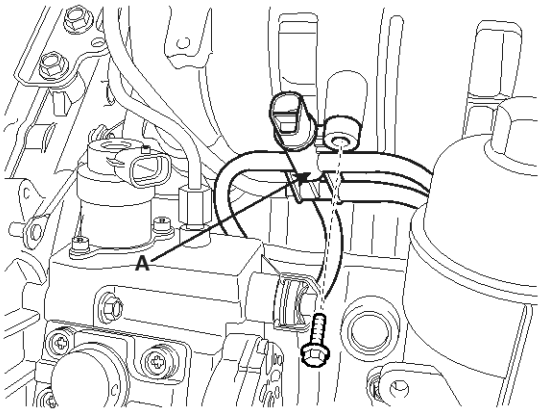
ADJF031A

2. Remove the high pressure pipe(A). (Refer th FL Gr.)



ADJF034A

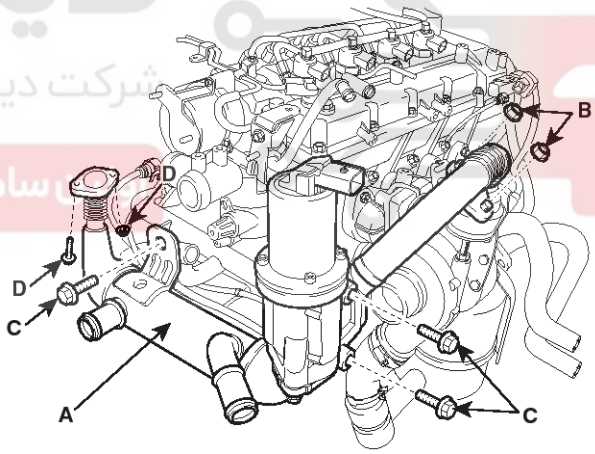
3. Remove the fuel temperature sensor mounting bolt(A). (Refer th FL Gr.)



ADJF035A

4. Remove the EGR cooler and EGR valve assembly(A).

Tightening torque :
Nut(B) : 29.4 ~ 34.3 Nm (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)
Bolt(C) : 21.6 ~ 27.5 Nm (2.2 ~ 2.8 kgf.m, 15.9 ~ 20.3 lb-ft)
Bolt & Nut(D) : 14.7 ~ 19.6 Nm (1.5 ~ 2.0 kgf.m, 10.8 ~ 14.5 lb-ft)

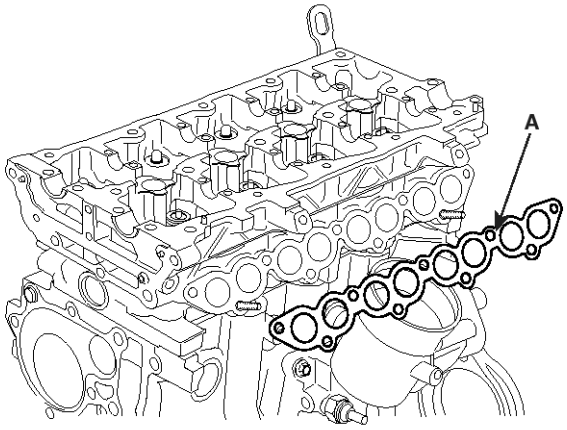


ADJF053A

5. Remove the intake manifold.

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

6. Remove the intake manifold gasket(A).

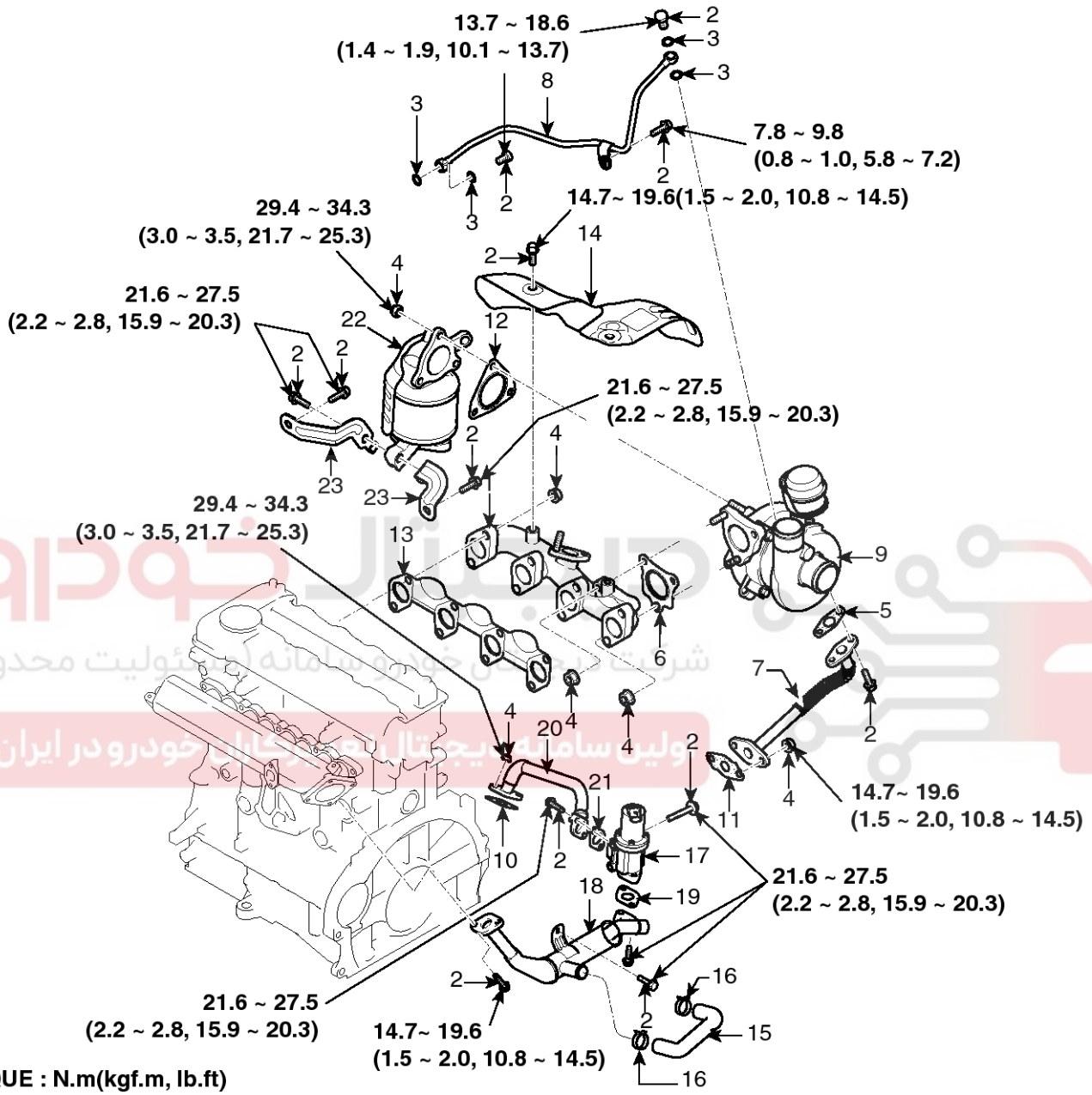


LCGF033A

7. Installation is in the reverse order of removal.

Exhaust Manifold

COMPONENTS



TORQUE : N.m(kgf.m, lb.ft)

1. Exhaust manifold assembly
2. Bolt
3. Gasket
4. Nut
5. Turbo charger oil drain gasket
6. Turbo charger intake gasket
7. Oil return pipe
8. Oil feed pipe
9. Turbo charger
10. EGR pipe gasket
11. Oil return pipe gasket
12. Turbo charger exhaust gasket
13. Exhaust manifold gasket
14. Heat protector
15. EGR cooler inner hose
16. Clamp
17. EGR valve assembly
18. EGR cooler
19. EGR valve gasket
20. EGR pipe
21. EGR pipe gasket
22. Catalytic converter
23. Bracket

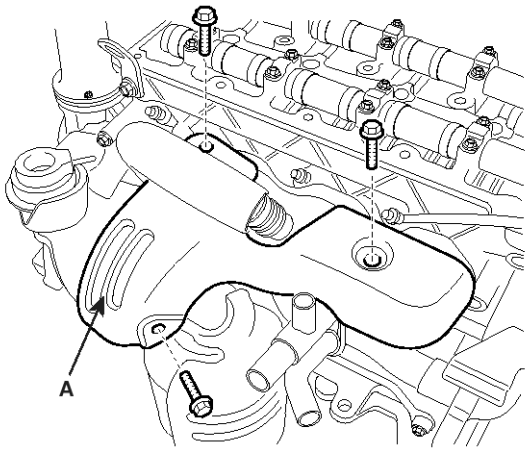
SLDEM6107L

REMOVAL

EXHAUST MANIFOLD

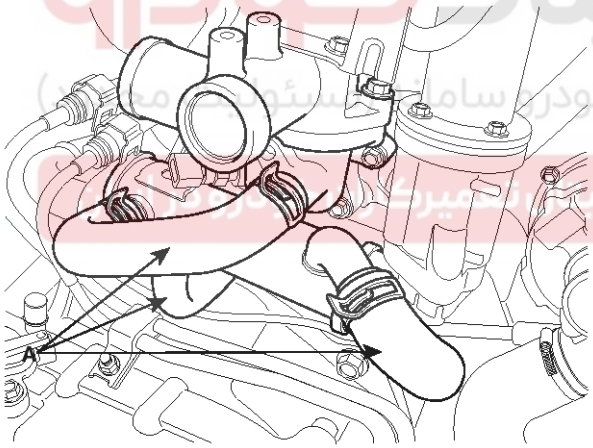
1. Remove the heat protector(A).

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



LCGF117A

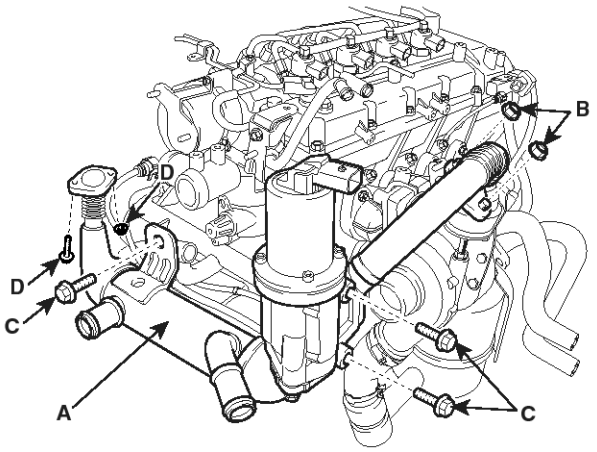
2. Remove the water hose (A) from the EGR cooler and the thermostat housing.



ADJF038A

3. Remove the EGR cooler and the EGR valve assembly(A).

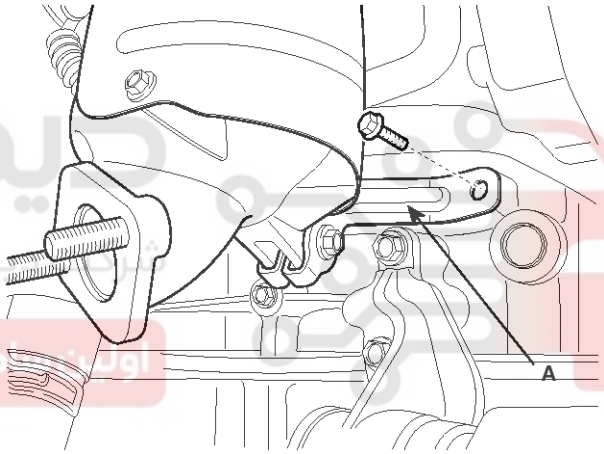
Tightening torque :
Nut(B) : 29.4 ~ 34.3 Nm (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)
Bolt(C) : 21.6 ~ 27.5 Nm (2.2 ~ 2.8 kgf.m, 15.9 ~ 20.3 lb-ft)
Bolt & Nut(D) : 14.7 ~ 19.6 Nm (1.5 ~ 2.0 kgf.m, 10.8 ~ 14.5 lb-ft)



ADJF053A

4. Remove the catalytic converter stay(A).

Tightening torque :
21.6 ~ 27.5 Nm (2.2 ~ 2.8 kgf.m, 15.9 ~ 20.3 lb-ft)



ADJF040A

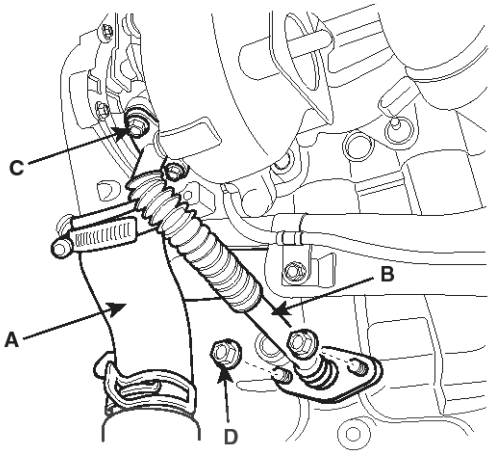
5. Remove the catalytic converter(A).

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

ADJF041A

6. Remove the inter cooler hose(A) and the oil return pipe(B).

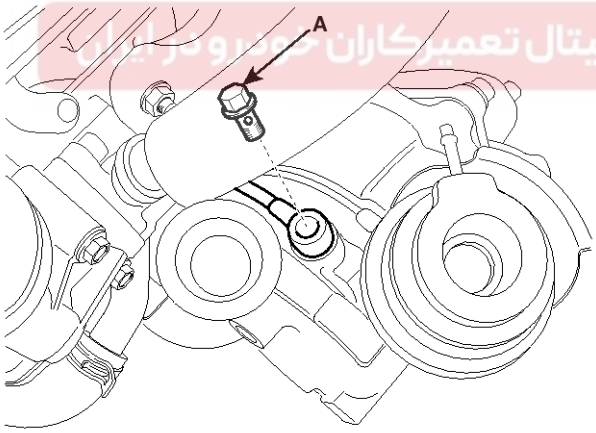
Tightening torque :
Nut(C) : 9.8 ~ 14.7 Nm (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)
Bolt(D) : 14.7 ~ 19.6 Nm (1.5 ~ 2.0 kgf.m, 10.8 ~ 14.5 lb-ft)



ADJF051A

7. Remove the eye bolt(A) from the turbo charger oil feeding pipe.

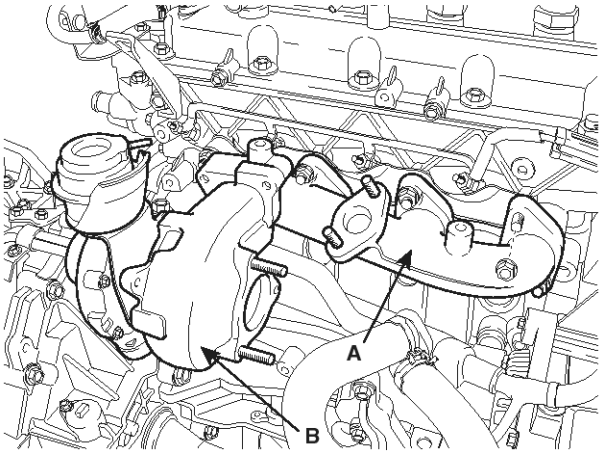
Tightening torque :
13.7 ~ 18.6 Nm (1.4 ~ 1.9 kgf.m, 10.1 ~ 13.7 lb-ft)



LCGF118A

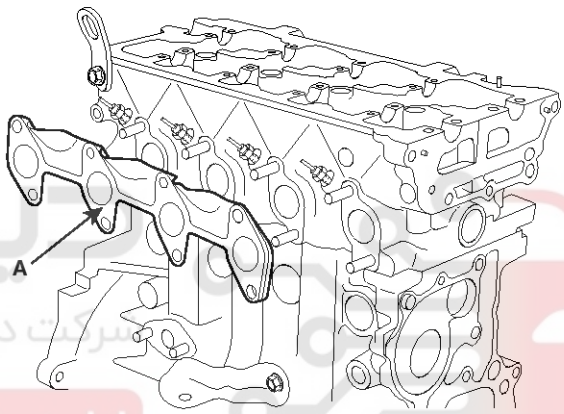
8. Remove the turbo charger(B) first and then exhaust manifold assembly(A).

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



SLDEM6117D

9. Remove the exhaust manifold gasket(A) .



LCGF037A

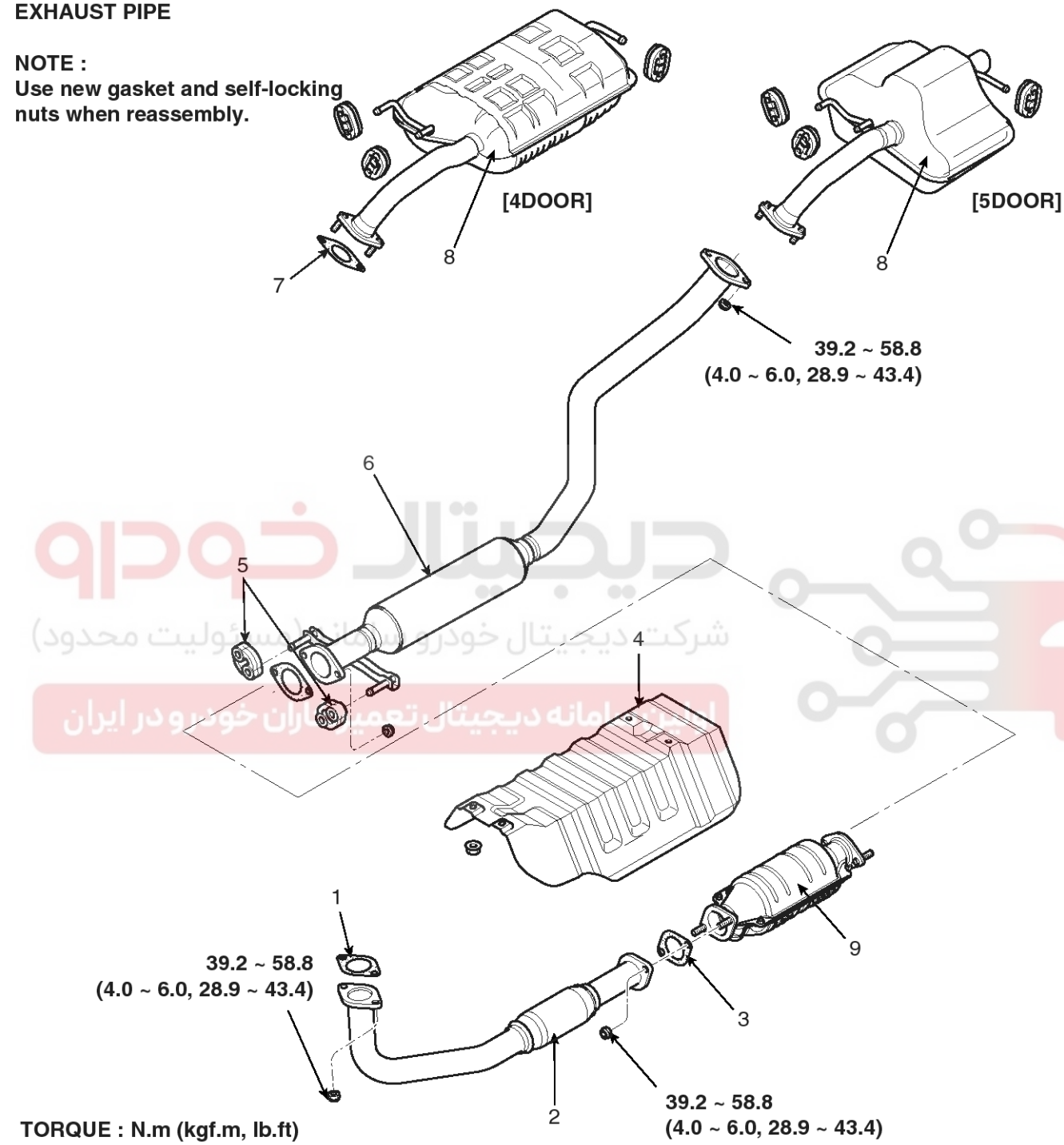
10. Installation is in the reverse order of removal.

Front Exhaust Pipe

COMPONENTS

EXHAUST PIPE

NOTE :
Use new gasket and self-locking nuts when reassembly.



TORQUE : N.m (kgf.m, lb.ft)

1. Exhaust pipe gasket
2. Exhaust front pipe
3. Exhaust pipe gasket
4. Heat protector center panel
5. Hanger
6. Exhaust center pipe
7. Exhaust pipe gasket
8. Tail pipe with muffler
9. Catalytic converter

SLDEM6110L