General Information

Specifications

Description		Specifications		Limit
		Standard	Low Power	
General				
Type		In-line, DOHC		
Number of cylinders		4		
Bore		84.0mm (3.3071in)		
Stroke		90.0mm (3.5433in)		
Total displacement		1995cc (121.75cu.in)		
Compression ratio		16.0 : 1	16.5 : 1	
Firing order		1-3-4-2		
Valve timing				
Intake valve	Opens (BTDC)	10°		
	Closes (ABDC)	28°		
Exhaust valve	Opens (BBDC)	54°		
	Closes (ATDC)	4°		
Cylinder head				
Flatness of gasket surface		0.03mm (0.0012in) for width, 0.09mm (0.0035in) for length 0.012mm / 50x50mm (0.0005in / 1.9685x1.9685in)		
Flatness of manifold mounting surface		0.025mm (0.0010in) for width, 0.160mm (0.0063in) for length		
Camshaft				
Cam height	Intake	40.094mm (1.5785in)		
	Exhaust	40.425mm (1.5915in)		
Journal outer diameter	Intake	25.947 ~ 25.960mm (1.0215 ~ 1.0220in)		
	Exhaust	25.947 ~ 25.960mm (1.0215 ~ 1.0220in)		
Bearing oil clearance		0.040 ~ 0.074mm (0.0016 ~ 0.0029in)		
End play		0.05 ~ 0.15mm (0.0020 ~ 0.0059in)		
Valve				
Valve length	Intake	108.3mm (4.2638in)		
	Exhaust	108.2mm (4.2598in)		
Stem outer diameter	Intake	5.933 ~ 5.953mm (0.2336 ~ 0.2344in)		
	Exhaust	5.905 ~ 5.925mm (0.2325 ~ 0.2333in)		
Face angle		45.0° ~ 45.5°		

Description		Specifications		Limit
		Standard	Low Power	
Thickness of valve head (margin)	Intake	1.25mm (0.0492in)		
	Exhaust	1.25mm (0.0492in)		
Valve stem to valve guide clearance	Intake	0.022 ~ 0.067mm (0.0009 ~ 0.0026in)		
	Exhaust	0.050 ~ 0.095mm (0.0020 ~ 0.0037in)		
Valve guide				
Inner diameter	Intake	5.975 ~ 6.000mm (0.2352 ~ 0.2362in)		
	Exhaust	5.975 ~ 6.000mm (0.2352 ~ 0.2362in)		
Length	Intake	46.3 ~ 46.7mm (1.8228 ~ 1.8386in)		
	Exhaust	46.3 ~ 46.7mm (1.8228 ~ 1.8386in)		
Valve seat				
Width of seat contact	Intake	1.2 ~ 1.6mm (0.0472 ~ 0.0630in)		
	Exhaust	1.2 ~ 1.6mm (0.0472 ~ 0.0630in)		
Seat angle	Intake	44.5° ~ 45.0°		
	Exhaust	44.5° ~ 45.0°		
Valve spring				
Free length		44.0mm (1.7323in)		
Load		19.9±1.0kg/36.6mm (44±2lb/1.4409in) 44.1±2.2kg/27.6mm (97±5lb/1.0866in)		
Out of squareness		Less than 1.5° / 1.15mm (0.0453in)		
Cylinder block				
Cylinder bore		84.000 ~ 84.030mm (3.3071 ~ 3.3083in)		
Flatness of gasket surface		0.05mm (0.0020in) 0.012mm / 50x50mm (0.0005in / 1.9685x1.9685in)		
Piston				
Piston outer diameter		83.915 ~ 83.945mm (3.3037 ~ 3.3049in)		
Piston to cylinder clearance		0.075 ~ 0.095mm (0.0030 ~ 0.0037in)		
Ring groove width	No. 1 ring	2.61mm (0.1028in)		
	No. 2 ring	2.06 ~ 2.08mm (0.0811 ~ 0.0819in)		
	Oil ring	3.02 ~ 3.04mm (0.1189 ~ 0.1197in)		
Piston ring				
Side clearance	No. 1 ring	0.102 ~ 0.146mm (0.0040 ~ 0.0057in)		
	No. 2 ring	0.070 ~ 0.110mm (0.0028 ~ 0.0043in)		
	Oil ring	0.030 ~ 0.070mm (0.0012 ~ 0.0028in)		

Description		Specifications		Limit
		Standard	Low Power	
End gap	No. 1 ring	0.18 ~ 0.33mm (0.0071 ~ 0.0130in)		
	No. 2 ring	0.35 ~ 0.55mm (0.0138 ~ 0.0217in)		
	Oil ring	0.25 ~ 0.50mm (0.0098 ~ 0.0197in)		
Piston pin				
Piston pin outer diameter		33.991 ~ 33.997mm (1.3382 ~ 1.3385in)		
Piston pin hole inner diameter		34.004 ~ 34.010mm (1.3387 ~ 1.3390in)		
Piston pin hole clearance		0.007 ~ 0.019mm (0.0003 ~ 0.0007in)		
Connecting rod small end hole inner diameter		34.020 ~ 34.032mm (1.3394 ~ 1.3398in)		
Connecting rod small end hole clearance		0.023 ~ 0.041mm (0.0009 ~ 0.0016in)		
Connecting rod				
Connecting rod big end inner diameter		51.000 ~ 51.018mm (2.0079 ~ 2.0086in)		
Connecting rod bearing oil clearance		0.024 ~ 0.052mm (0.0009 ~ 0.0020in)		
End play		0.05 ~ 0.31mm (0.0020 ~ 0.0122in)		
Crankshaft				
Main journal outer diameter		60.000 ~ 60.018mm (2.3622 ~ 2.3629in)		
Pin journal outer diameter		48.000 ~ 48.018mm (1.8898 ~ 1.8905in)		
Main bearing oil clearance		0.026 ~ 0.044mm (0.0010 ~ 0.0017in)		
End play		0.07 ~ 0.25mm (0.0028 ~ 0.0098in)		
Flywheel				
Runout		0.4mm (0.0157in)		0.13mm (0.0051in)
Drive plate				
Runout		0.5mm (0.0197in)		0.13mm (0.0051in)
Oil pump				
Relief valve opening pressure		490±49.0kPa (5±0.5kg/cm², 71±7.1psi)		
Engine oil				
Oil quantity	Total	9.6L (10.14 US qt, 8.44 Imp qt)		When replacing a short engine or a block assembly
	Oil pan	7.3L (7.71 US qt, 5.28 Imp qt)		
	Drain and refill	8.0L (8.45 US qt, 7.04 Imp qt)		Including oil filter

Description		Specifications		Limit
		Standard	Low Power	
Oil grade	Recommendation (For Europe)	ZIC LS 5W-30, KIXX D1 5W-30, QUARTZ INEO MC3 5W-30, HELIX ULTRA AP 5W-30		If not available, refer to the recommended ACEA classification and SAE viscosity number.
	Classification	With DPF: ACEA C3 Without DPF: ACEA B4		Satisfy the requirement of the ACEA classification.
	SAE viscosity grade	Recommended SAE viscosity number		Refer to the "Lubrication System"
Oil pressure (at idle)		78.45kPa (0.8kg/cm², 11.38psi) or above		Oil temperature in oil pan : 80℃ (176˚F)
Cooling system				
Cooling method		Forced circulation with water pump		
Coolant quantity	MT	8.5L (8.98 US qt, 7.48 Imp qt)		
	AT	8.4L (8.88 US qt, 7.39 Imp qt)		
Thermostat	Type	Wax pellet type		
	Valve opening temperature	82±2˚C (179.6±3.6˚F) (at 0.35mm (0.0138in) lift)		
	Pull open lift	10mm (0.3937in) or more at 95˚C (203˚F)		
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kPa (0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi)		
	Vacuum valve opening pressure	Max. 6.86 kPa (0.07kg/cm², 1.00 psi)		
Water temperature sensor				
Type		Thermister type		
Resistance	20˚C (68˚F)	2.45±0.14 kΩ		
	110˚C (176˚F)	0.1471±0.002 kΩ		

Tightening Torques

Item	N.m	kgf.m	lb-ft
Engine mounting			
Engine mounting bracket to body fixing bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting bracket to body fixing nut	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting insulator to engine mounting support bracket fixing nut	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine mounting support bracket to timing chain cover fixing bolt	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Engine mounting support bracket to timing chain cover fixing nut	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Transaxle mounting bracket to body fixing bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to body fixing nut	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to transaxle fixing bolt	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Roll rod bracket to sub frame fixing bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod insulator to roll rod mounting support bracket fixing nut	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.0
Cylinder block			
Engine support bracket bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Rear oil seal case assembly bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Piston cooling oil jet bolt	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Main moving system			
Connecting rod cap bolt	[27.5~31.4] + [88°~92°]	[2.8~3.2] + [88°~92°]	[20.3~23.1] + [88°~92°]
Crankshaft main bearing cap bolt	49.0 + 120°	5.0 + 120°	36.2 + 120°
Drive plate bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Flywheel bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Timing chain			
Drive belt idler bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Drive belt tensioner bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Fead system bracket assembly bolt (8X40)	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Fead system bracket assembly bolt (8X25)	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Fead system bracket assembly bolt (10X45)	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Timing chain cover bolt (8X35)	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Timing chain cover bolt (6X30)	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Timing chain cover bolt (6X16)	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Crankshaft damper pulley bolt	196.1 + 60°	20 + 60°	144.7 + 60°

Item	N.m	kgf.m	lb-ft
Camshaft chain sprocket bolt	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
High pressure pump chain sprocket nut	78.5 ~ 93.2	8.0 ~ 9.5	57.9 ~ 68.7
High pressure pump bolt	24.5 ~ 28.4	2.5 ~ 2.9	18.1 ~ 21.0
High pressure pump chain sprocket service plug	73.5 ~ 88.3	7.5 ~ 9.0	54.2 ~ 65.1
Timing chain "A" guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "B" guide bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "A" auto tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "B" auto tensioner bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "A","B" tensioner lever bolt	29.4 ~ 31.4	3.0 ~ 3.2	21.7 ~ 23.1
Cylinder head			
Cylinder head cover bolt	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
Camshaft bearing cap bolt	10.8 ~ 12.7	1.1 ~ 1.3	8.0 ~ 9.4
Cylinder head bolt	78.5 + 120° + 120°	8.0 + 120° + 120°	57.9 + 120° + 120°
Cylinder head side bolt	30.4 ~ 34.3	3.1 ~ 3.5	22.4 ~ 25.3
Vacuum pump bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Cooling system			
Water pump pulley bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Water pump cover bolt	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water pump bolt	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water inlet pipe fixing bolt	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water outlet pipe fixing bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Engine coolant temperature sensor	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Water inlet fitting bolt	16.7 ~ 22.6	1.7 ~ 2.3	12.3 ~ 16.6
Radiator upper cover bolt	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
Radiator upper bracket bolt	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
Lubrication system			
Oil filter&cooler assembly bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil cooler bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil filter drain bolt	10	1.0	7.4
Oil filter cap	31.5 ~ 38.5	3.2 ~ 3.9	23.2 ~ 28.4
Oil drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil level gauge guide fixing bot	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan and transaxle case fixing bolt	39.2 ~ 46.1	4.0 ~ 4.7	28.9 ~ 34.0
Lower oil pan bolt and nut	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7

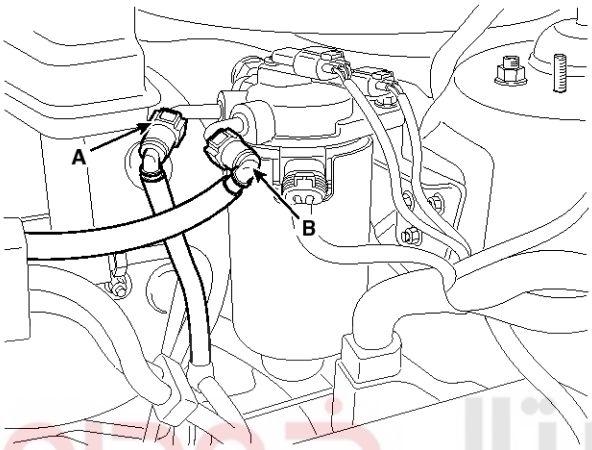
Item	N.m	kgf.m	lb-ft
Oil pump module bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Ladder frame bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pressure switch	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil level sensor	8.8 ~ 9.8	0.9 ~ 1.0	6.5 ~ 7.2
Intake and exhaust system			
Intake manifold bolt and nut	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Exhaust manifold nut	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Exhaust manifold heat protector bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
DPF(or WCC) converter assembly heat protector bolt	17.7 ~ 21.6	1.8 ~ 2.2	13.0 ~ 15.9
DPF(or WCC) converter assembly support bracket bolt	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
DPF(or WCC) converter assembly and turbocharger fixing nut	49.0 ~ 68.6	5.0 ~ 7.0	36.2 ~ 50.6
Turbocharger oil feed pipe upper bolt	11.8 ~ 17.7	1.2 ~ 1.8	8.7 ~ 13.0
Turbocharger oil feed pipe lower bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Turbocharger oil drain pipe bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Turbocharger oil drain pipe nut	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Turbocharger assembly nut	49 ~ 68.6	5.0 ~ 7.0	36.2 ~ 50.6
Intake air control valve bolt and nut	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
EGR pipe assembly bolt (8X25)	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
EGR pipe assembly bolt (6X14)	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
EGR cooler bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
EGR cooler nut	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
EGR & thermostat housing assembly bolt	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Intercooler bracket bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intercooler pipe&hose fixing clamp	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
Intercooler pipe fixing bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Air cleaner lower cover fixing bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake air hose fixing clamp	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6
DPF(or WCC) converter assembly and front muffler fixing nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front muffler and center muffler fixing nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler and main muffler fixing nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

Compression Pressure Inspection

NOTICE

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

1. Warm up the engine until the coolant temperature becomes 80~95˚C(176~203˚F).
2. Remove the fuel inlet (A) and the outlet hose (B) from the fuel filter.



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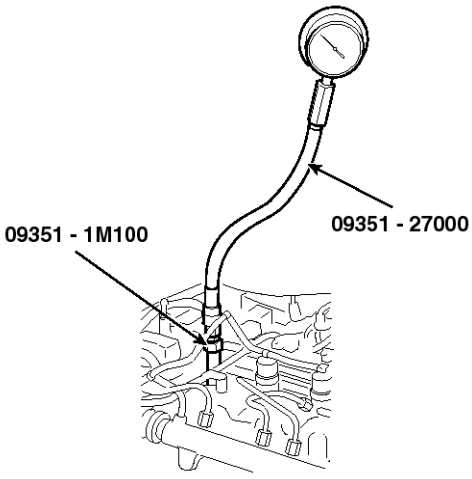
3. Crank the engine in order to exhaust fuel in the high pressure pump.

NOTICE

Gather residual fuel by putting the return hose into a proper vessel.

4. Remove the injection pipe, injector and washer. (Refer to FL group).
5. Measure the cylinder compression pressure.
   1) Insert the SST(09351-27000, 09351-1M100) into the injector hole.



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   2) Cranking the engine, measure the pressure.

NOTICE

Use the complete charging battery for the engine to crank at the speed of 200rpm or more.

   3) Do the above step 1)~2) again for each cylinder.

NOTICE

This work must be done in as short time as possible.

Compression pressure :
2157.45kPa (22kg/cm², 312.91psi) (200rpm)
Minimum pressure :
1863.25kPa (19kg/cm², 270.24psi)
Difference between each cylinder :
294.20kPa (3.0kg/cm², 42.67psi)

   4) If, in one or more cylinders, the measured value is below the limit, fill a little engine oil into the injector holes of the cylinders, repeat the step 1)~2) and measure the compression pressure again.
      - If the re-measured pressure becomes higher, wear or damage of the piston ring or cylinder surface can be the cause.
      - If the re-measured pressure does not become higher, adherence or poor contact of the valves or inferior gasket can be the cause.
6. Install the injectors, washers and the injector pipes. (Refer to FL group).
7. Install the inlet and the outlet hoses to the fuel filter.

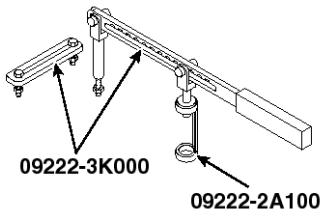
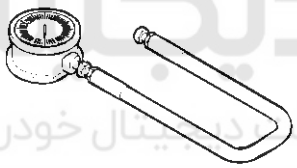
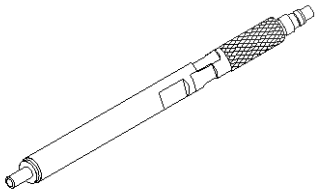
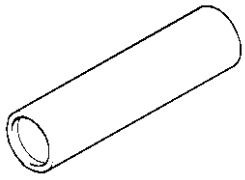
Troubleshooting

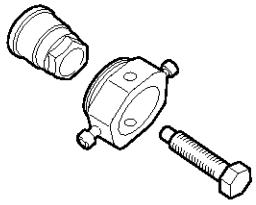
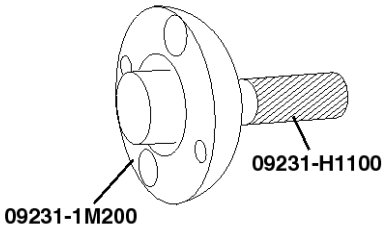
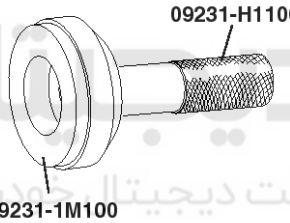
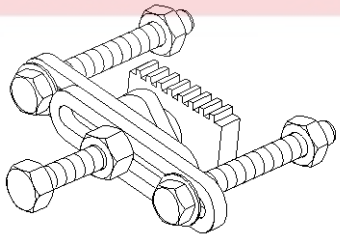
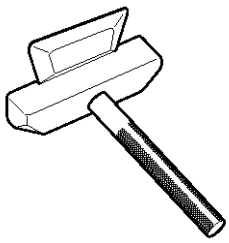
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. 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.
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.

Symptom	Suspect area	Remedy
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.
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.

Symptom	Suspect area	Remedy
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	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 sprocket.	Inspect timing chain and sprocket. 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

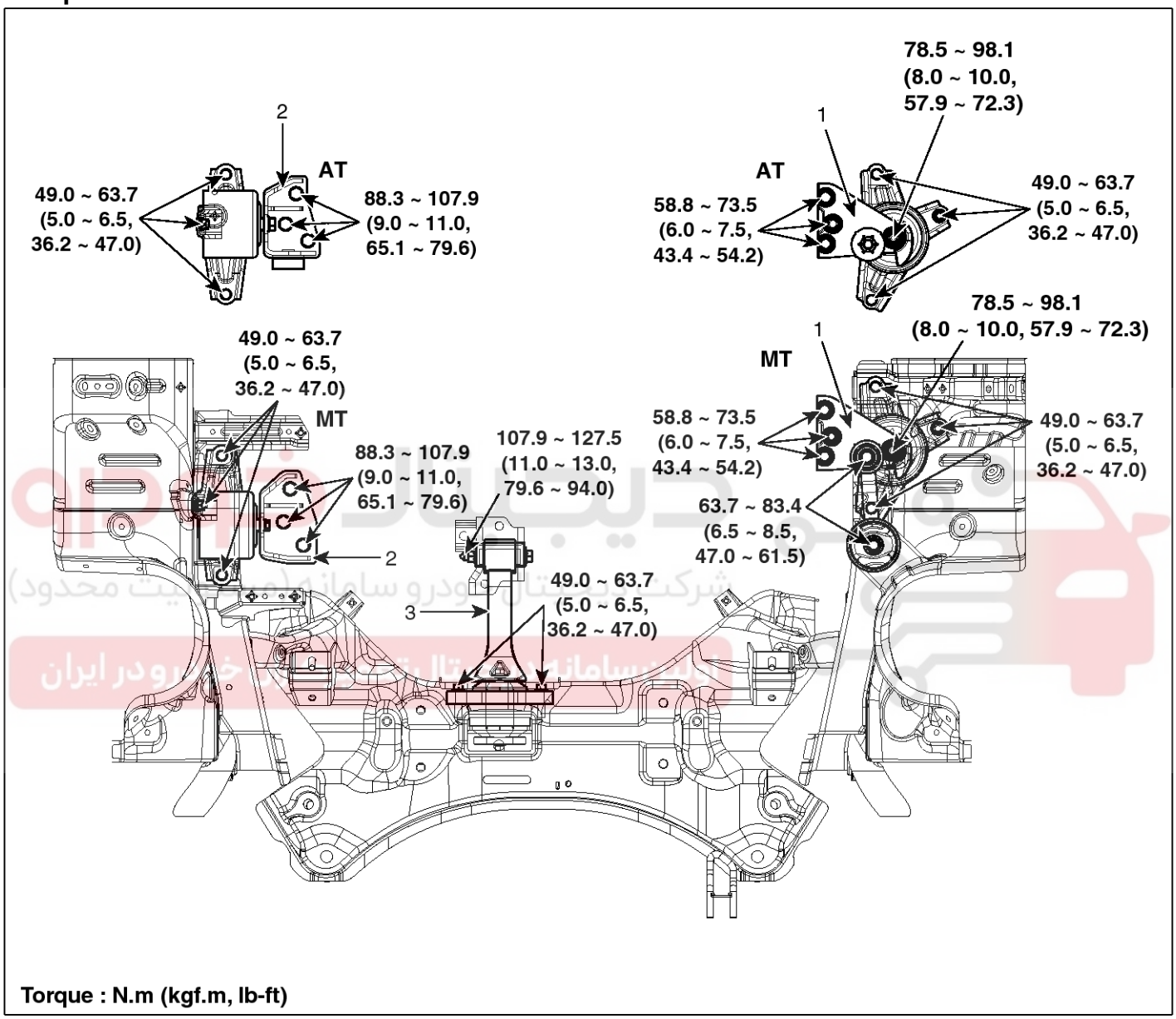
Tool (Number and name)	Illustration	Use
Torque angle adapter (09221-4A000)	 LCAC030A	Installation of bolts & nuts needing an angular method
Valve spring compressor (09222-3K000) Valve spring compressor adapter (09222-2A100)	 SXMEM9346D	Removal and installation of intake and exhaust valves
Compression gauge (09351-27000)	 LCGF148A	Checking engine compression pressure
Compression gauge adapter (09351-1M100)	 SXMEM9397D	Checking engine compression pressure
Valve stem seal installer (09222-1M100)	 LCAC030D	Installation of valve stem seals

Tool (Number and name)	Illustration	Use
High pressure pump sprocket remover (09331-1M100)	 SXMEM9347D	Removal of high pressure pump sprocket
Crankshaft rear oil seal installer (09231-1M200) Handle (09231-H1100)	 SXMEM9390D	Installation of crankshaft rear oil seal
Crankshaft front oil seal installer (092311M100) Handle (09231-H1100)	 SXMEM9391D	Installation of front cover oil seal
Ring gear stopper (09231-2B100)	 SHDEM6201D	Removal and installation of crankshaft pulley bolt.
Oil pan remover (09215-3C000)	 ACJF125A	Removal of oil pan

Engine And Transaxle Assembly

Engine Mounting

Components



Torque : N.m (kgf.m, lb-ft)

SSLEM0101L

1. Engine mounting bracket
2. Transaxle mounting bracket
3. Roll rod bracket

Engine And Transaxle Assembly

Removal

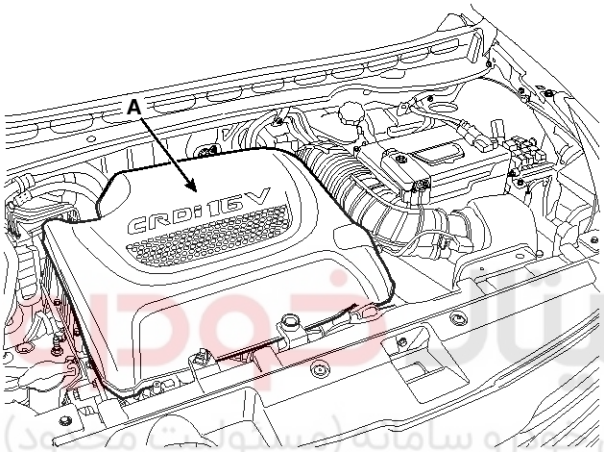
CAUTION

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

NOTICE

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

1. Remove the engine cover (A).



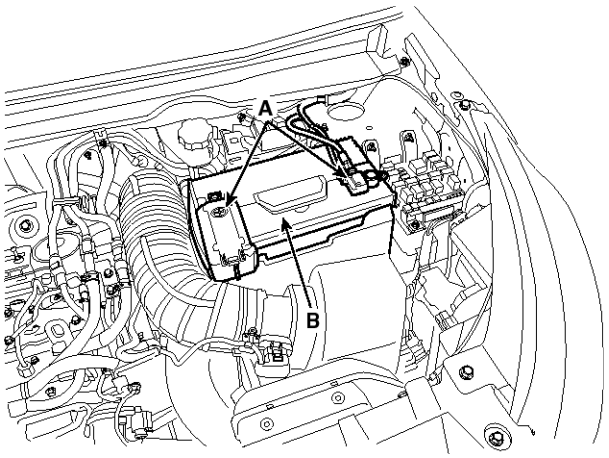
SSLEM0026D

2. Disconnect the battery terminal (A).

Tightening torque :
(-) terminal (without battery sensor): 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
(-) terminal (with battery sensor): 4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)
(+) terminal : 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

3. Remove the battery (B) after removing the mounting bracket.

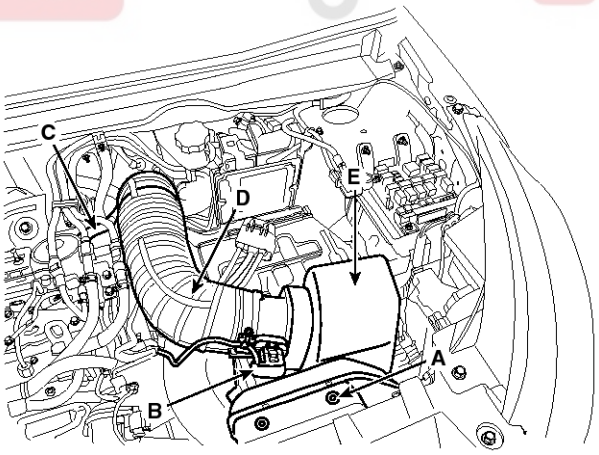
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SSLEM0017D

4. Remove the air cleaner assembly.
   1) Remove the air duct (A).
   2) Disconnect the air flow sensor (AFS) connector (B).
   3) Disconnect the breather hose (C).
   4) Remove the intake air hose (D) and air cleaner assembly (E).

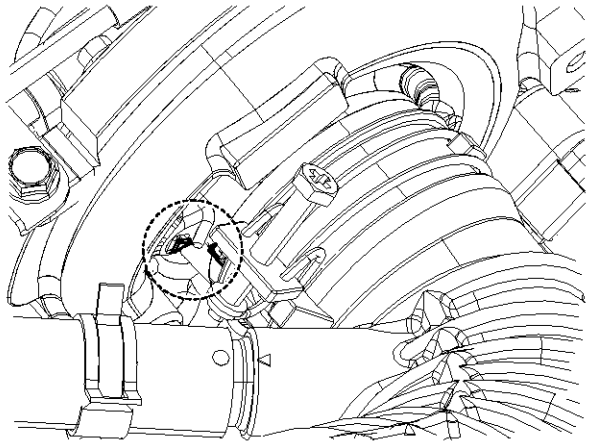
Tightening torque :
Clamps: 2.9 ~ 4.9N.m (0.3 ~ 0.5kgf.m, 2.2 ~ 3.6lb-ft)
Bolts: 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLEM0011D

NOTICE

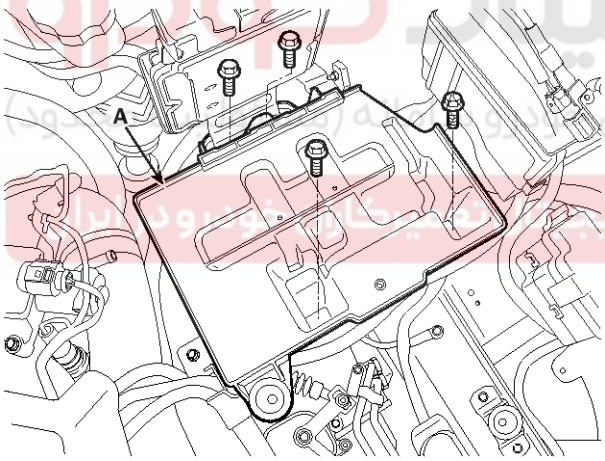
Align the mark of the air intake hose and compressor.



SSLEM0023D

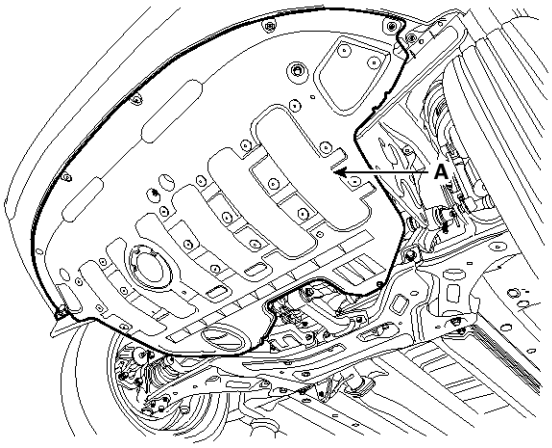
5. Remove the battery tray (A).

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



SLMEM0005D

6. Remove the under cover (A).



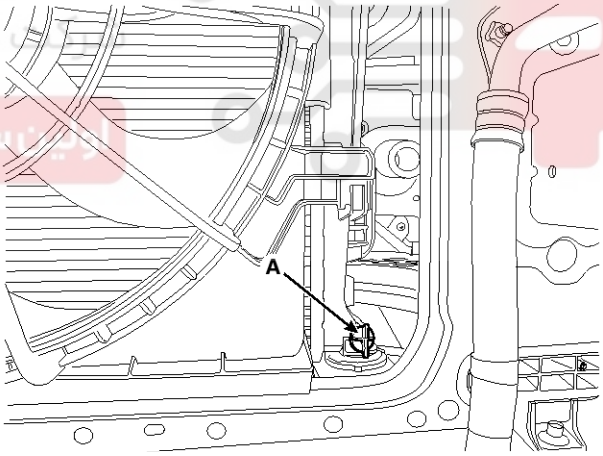
SSLEM0002D

7. Loosen the drain plug (A), and drain the coolant. Open the radiator cap to make rapid draining.

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.

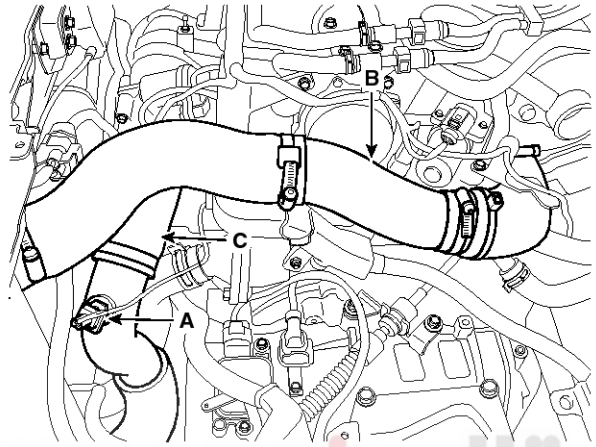


SSLEM0003D

8. Disconnect the intake air temperature sensor connector (A) and remove the intercooler inlet pipe & hose (B) and outlet pipe & hose (C).

Tightening torque :
Clamps: 4.9 ~ 6.9N.m (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft)
Bolt: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

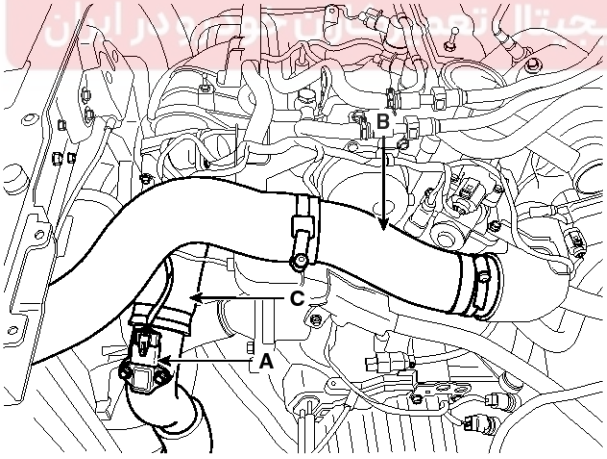
[Standard]



SLMEM0006D

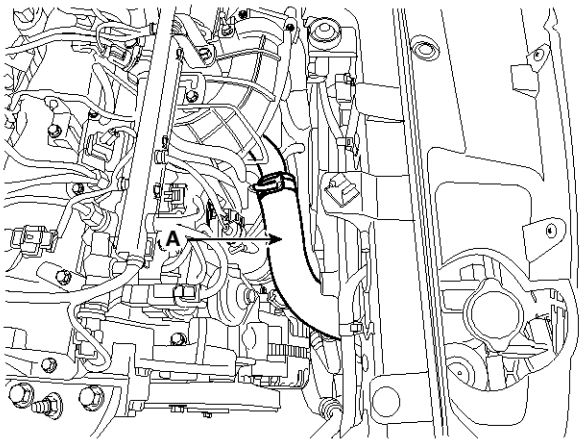
Disconnect the boost pressure sensor (BPS) connector (A) and remove the intercooler inlet pipe & hose (B) and outlet pipe & hose (C).

[Low Power]

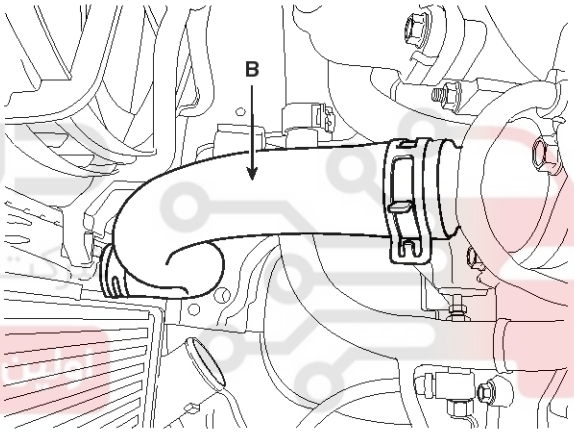


SELEM0003L

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



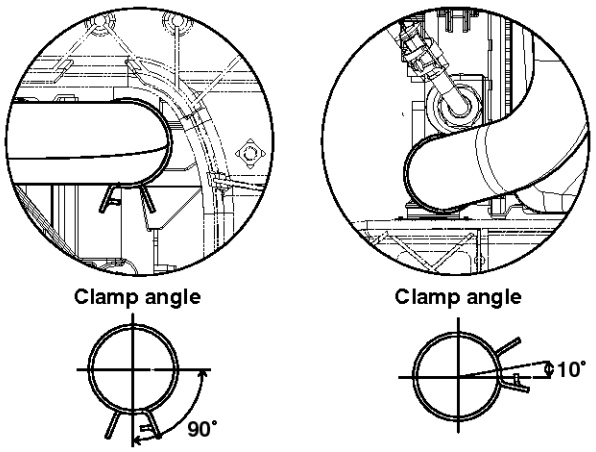
SSLEM0013D



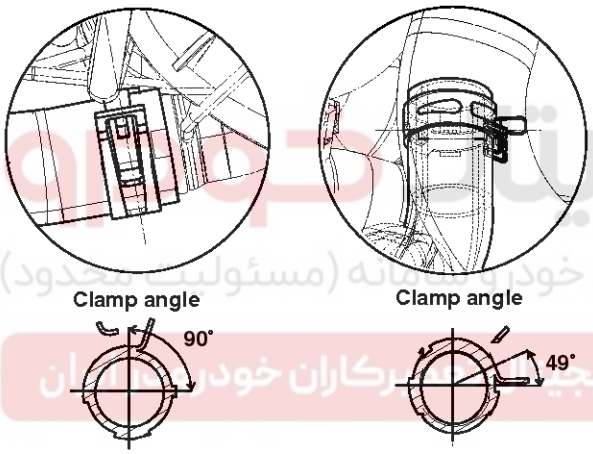
SXMEM9008D

NOTICE

Install the radiator hoses as shown illustrations.

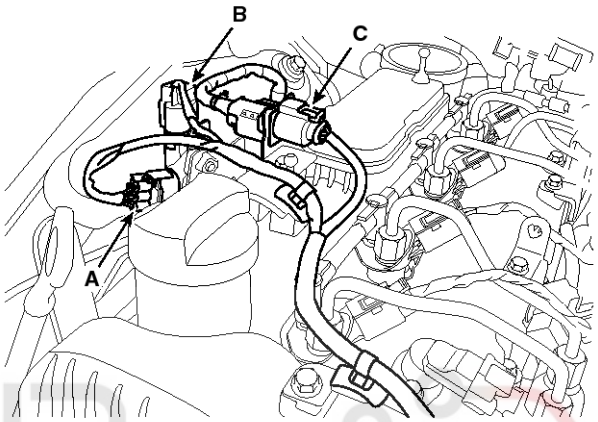


SSLEM0113L



SSLEM0114L

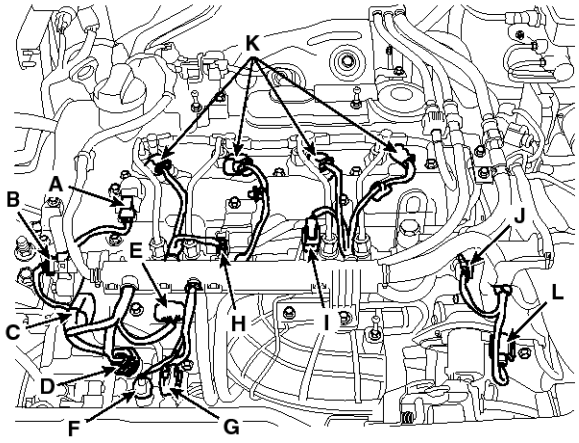
10. Disconnect the engine wire harness connectors and remove the wire harness clamps from the cylinder head cover and the intake manifold.
    1) Disconnect the difference pressure sensor connector (A). (With DPF) [Euro - 5 only]
    2) Disconnect the exhaust gas temperature sensor connector (B). (With DPF) [Euro - 5 only]
    3) Disconnect the lambda sensor connector (C). [Euro - 4/5 only]



SXMEM9009D

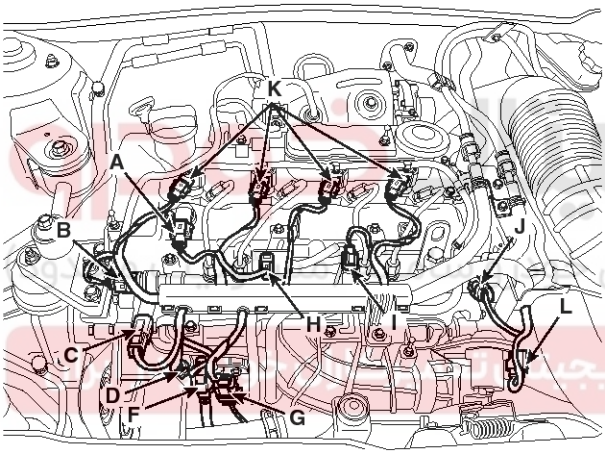
    4) Disconnect the cam position sensor (CMPS) connector (A).
    5) Disconnect the rail pressure sensor connector (B).
    6) Disconnect the glow plug connector (C).
    7) Disconnect the fuel pressure regulator valve connector (D).
    8) Disconnect the boost pressure sensor (BPS) connector (E). (Standard only)
    9) Disconnect the oil pressure switch connector (F).
    10) Disconnect the crankshaft position sensor (CKPS) connector (G).
    11) Disconnect the EGR cooling valve connector (H). [Euro - 4/5 only]
    12) Disconnect the fuel temperature sensor connector (I).
    13) Disconnect the rail pressure regulator valve connector (J).
    14) Disconnect the injector connectors (K).
    15) Disconnect the air control valve connector (L).

[Standard]



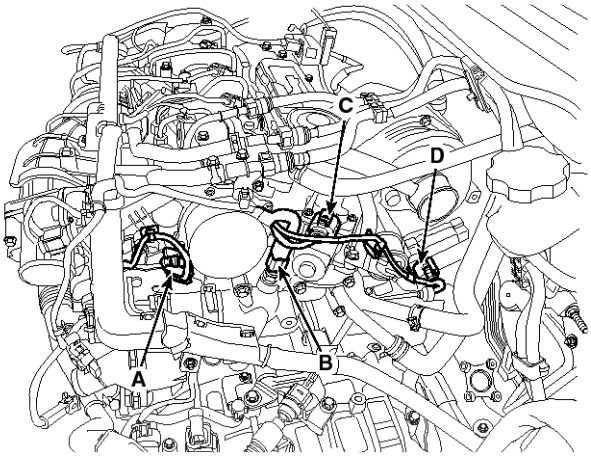
SXMEM9010D

[Low Power]



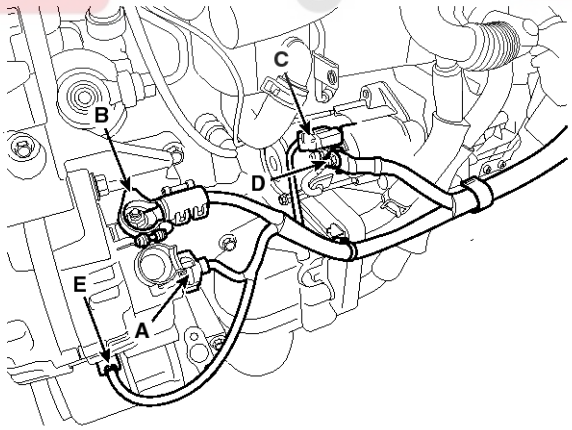
SELEM0001L

16) Disconnect the variable swirl control actuator connector (A). [Euro - 4/5 only]
17) Disconnect the engine coolant temperature sensor (ECTS) connector (B).
18) Disconnect the E-VGT actuator connector (C).
19) Disconnect the EGR actuator connector (D).



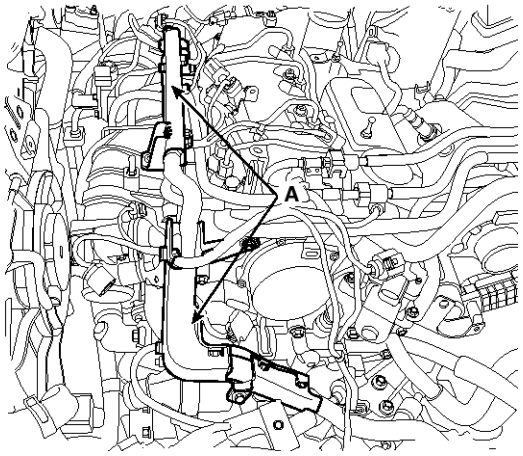
SSLEM0004D

20) Disconnect the alternator connector (A) and the cable (B).
21) Disconnect the starter connector (C) and the cable (D).
22) Disconnect the air compressor switch connector (E).



SLMEM0055D

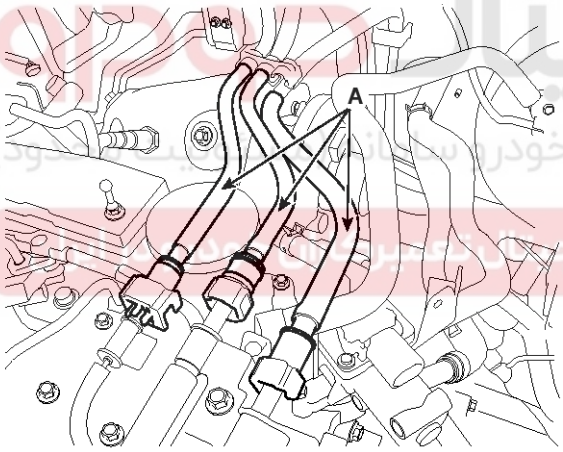
11. Disconnect the wire harness connectors, control cable and ground line. (Refer to MT or AT group)
12. Remove the wire harness protector (A).



SLMEM0057D

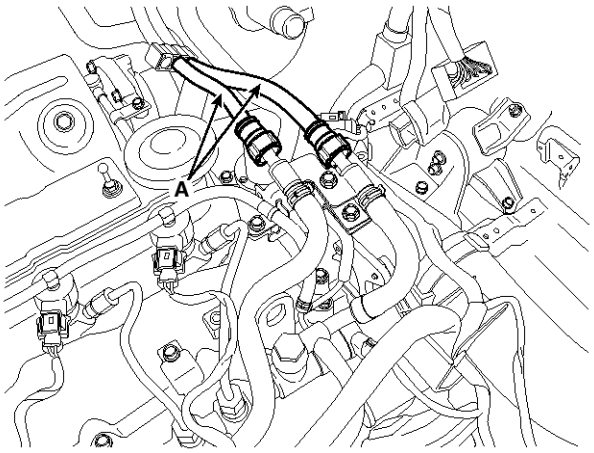
13. Disconnect the fuel hoses (A).

[Standard]



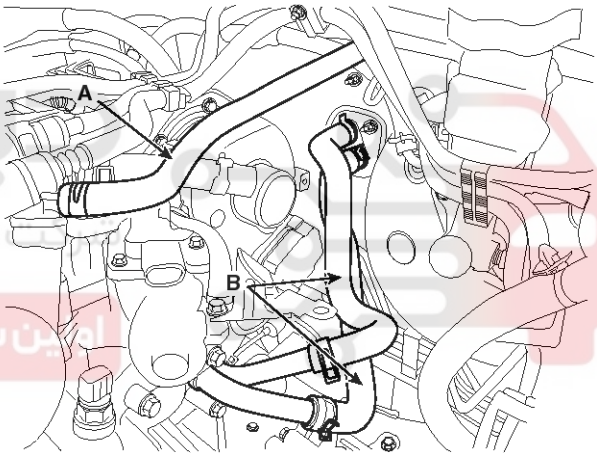
SLMEM0058D

[Low Power]



SELEM0002L

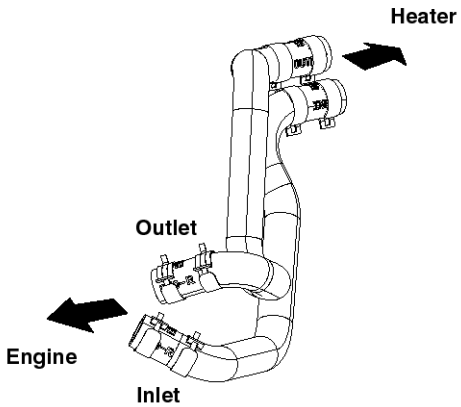
14. Disconnect the brake vacuum hose (A), heater hose (B).



SSLEM0012D

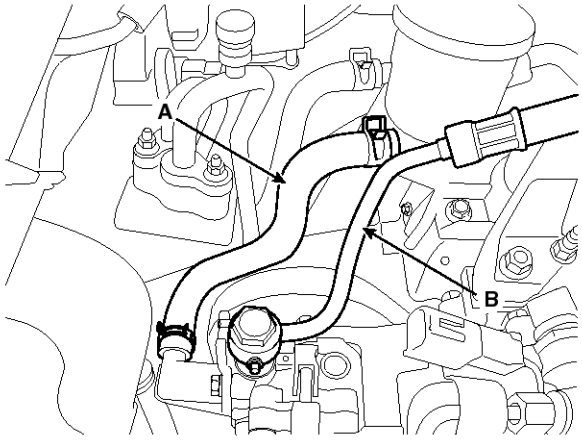
NOTICE

Install the heater hoses as shown illustrations.

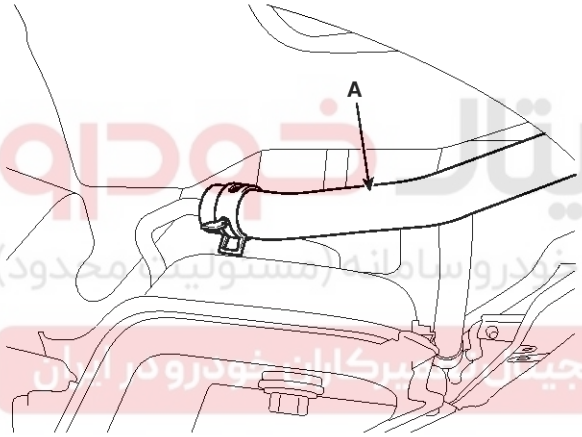


SSLEM0019D

15. Disconnect the power steering oil hose (A), pressure hose (B). (Only HPS type) (Refer to ST group)

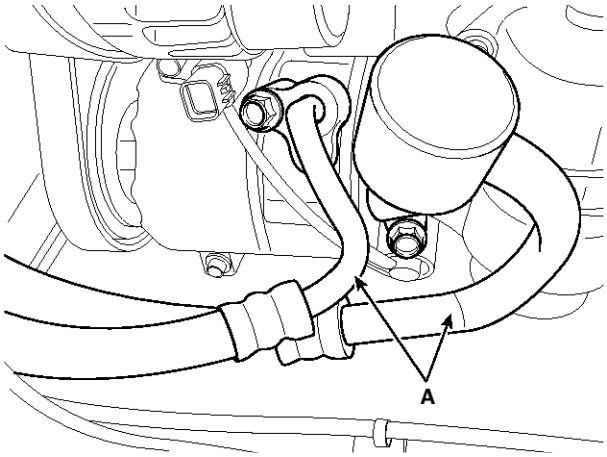


SSLEM1001L



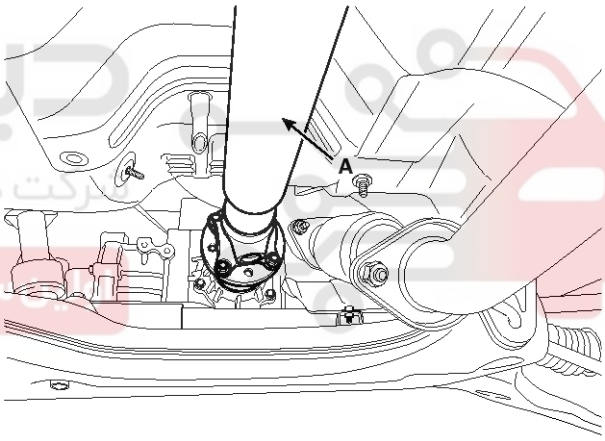
SXMEM9018D

16. After recovering refrigerant, disconnect the air compressor high and low pressure pipes (A). (Refer to HA group)



SLMEM0008D

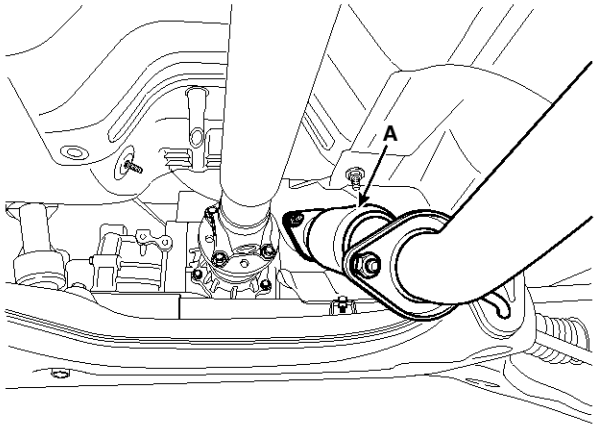
17. Remove the propeller shaft (A). (Refer to DS group)



SLMEM0010D

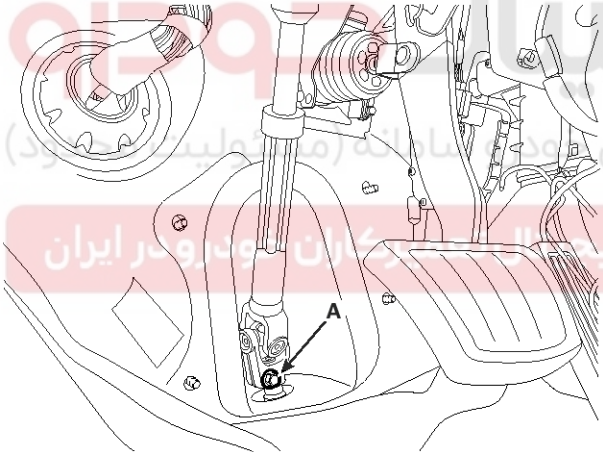
18. Remove the front muffler (A).

Tightening torque :
39.2 ~ 58.8N.m (4.0 ~ 6.0kgf.m, 28.9 ~ 43.4lb-ft)



SLMEM0051D

19. Remove the steering u-joint mounting bolt (A). (Refer to ST group)

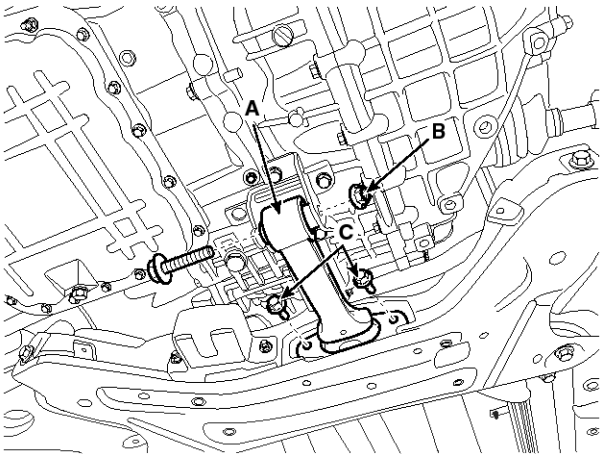


SLMEM0012D

20. Remove the front wheels. (Refer to SS group)
21. Remove the shock absorber mounting, the stabilizer bar link mounting, the lower arm ball joint mounting, and the steering tie rod mounting. (Refer to SS, ST group)
22. Remove the drive shaft from the axle hub. (Refer to DS group)

23. Remove the roll rod bracket (A).

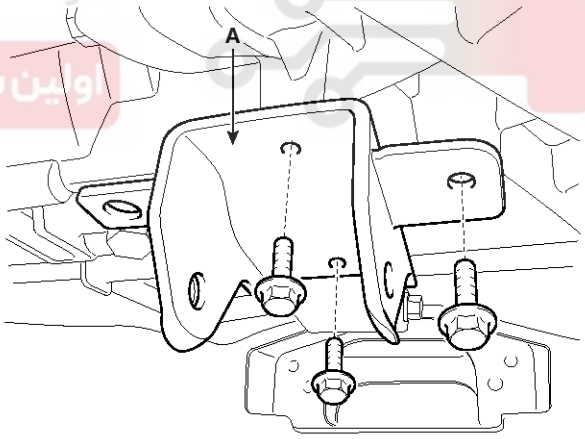
Tightening torque :
Nut(A) : 107.9 ~ 127.5N.m (11.0 ~ 13.0kgf.m, 79.6 ~ 94.0lb-ft)
Bolts(B), Nuts(C) :176.5 ~ 196.1N.m (18.0 ~ 20.0kgf.m, 130.2 ~ 144.7lb-ft)



SSLEM0020D

24. Remove the roll rod mounting support bracket (A).

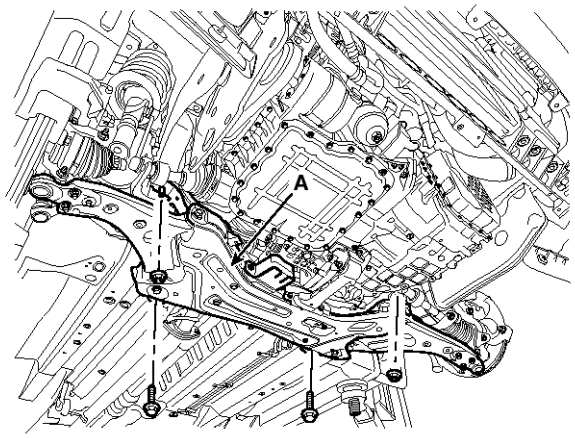
Tightening torque :
44.1 ~ 58.8N.m (4.5 ~ 6.0kgf.m, 32.5 ~ 43.4lb-ft)



SSLM10019D

25. Support the sub frame (A) with a jack and then remove the sub frame bolts and nuts. (Refer to SS group)

Tightening torque :
176.5 ~ 196.1N.m (18.0 ~ 20.0kgf.m, 130.2 ~ 144.7lb-ft)



SSLEM0016D

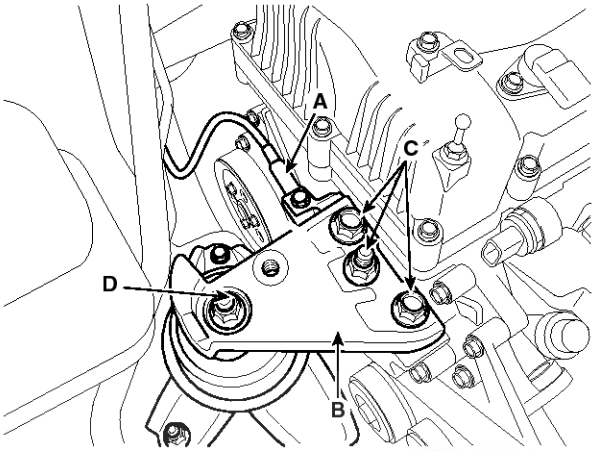
NOTICE

- *After removing the sub frame mounting bolts & nuts, 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.*

26. Support the engine assembly with a floor jack.

27. Disconnect the ground cable (A), and then remove the engine mounting support bracket (B).

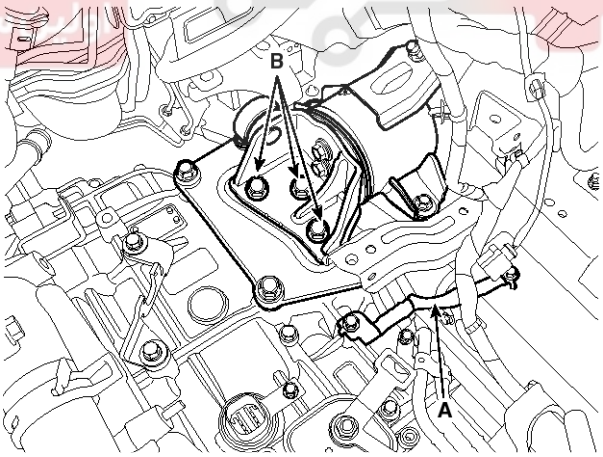
Tightening torque :
Nut(D) : 78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)
Bolt and nuts(C) : 58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.4 ~ 54.2 lb-ft)



SSLEM1201L

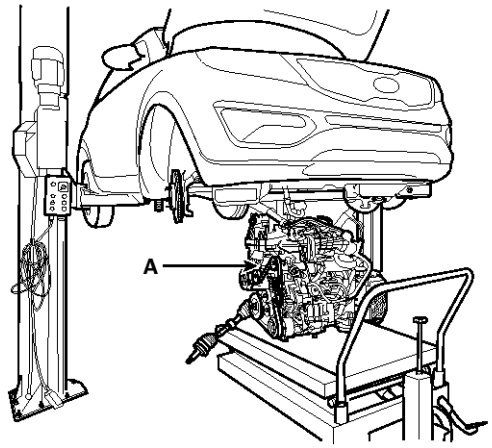
28. Disconnect the ground cable (A), and then remove the transaxle mounting bracket bolts (B).

Tightening torque :
88.3 ~ 107.9N.m (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)



SSLEM0102D

29. Remove the engine and transaxle assembly (A) by lifting vehicle.



SSLEM0005D

CAUTION

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.

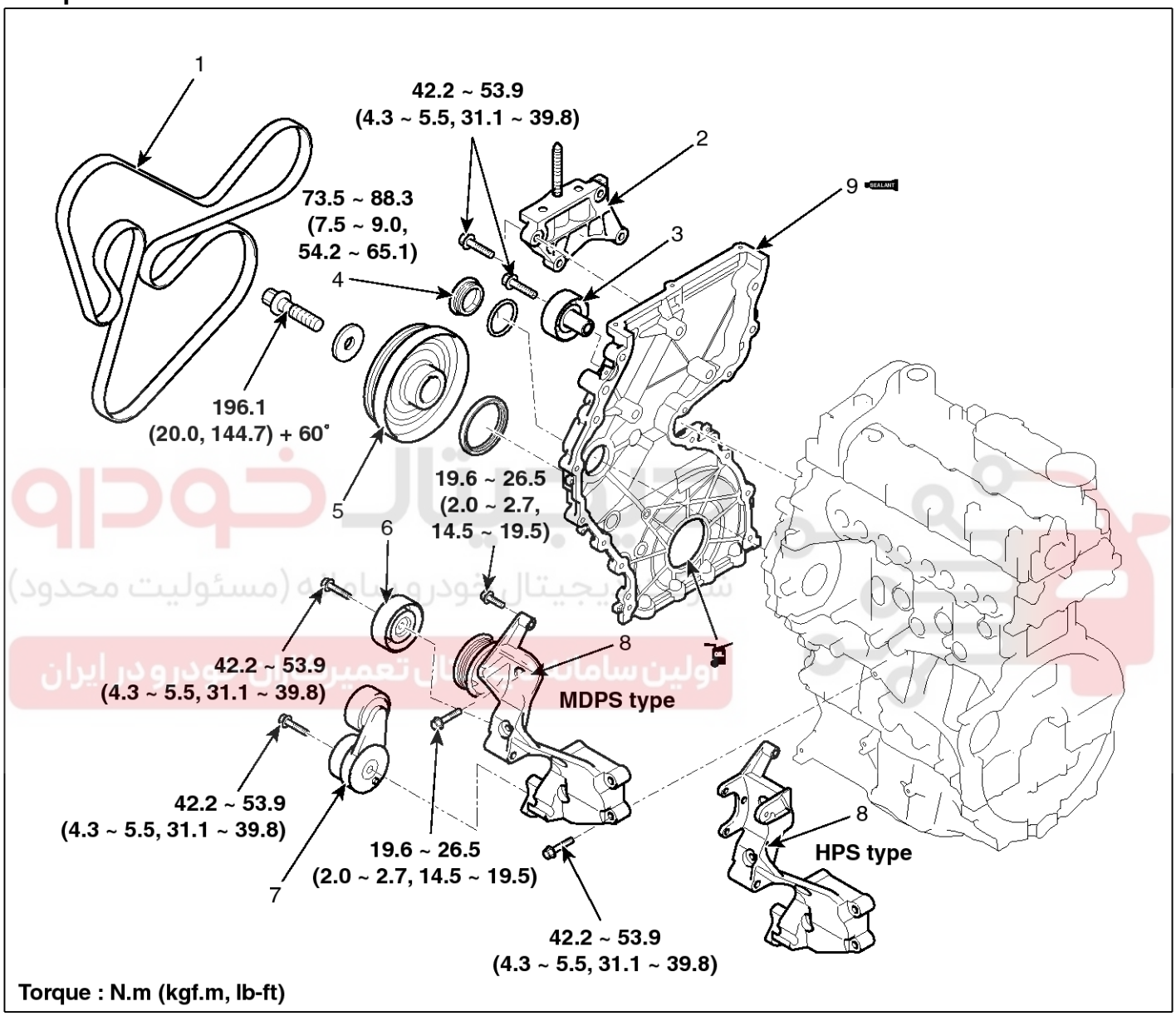
Perform the following :

- Adjust the shift cable.
- Refill engine with engine oil.
- Refill transaxle with fluid.
- Clean the battery posts and cable terminals with sandpaper and assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
  - If the engine does not run immediately after assembling the fuel line, remove trapped air and be pressurized in the fuel line by operating the low pressure fuel pump using the GDS.
  - Check for fuel leakage at any point in the fuel lines.
- Refill radiator with engine coolant.
- Bleed air from the cooling system.
  - Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
  - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
  - Put radiator cap on tightly, then run the engine again and check for leaks.

Timing System

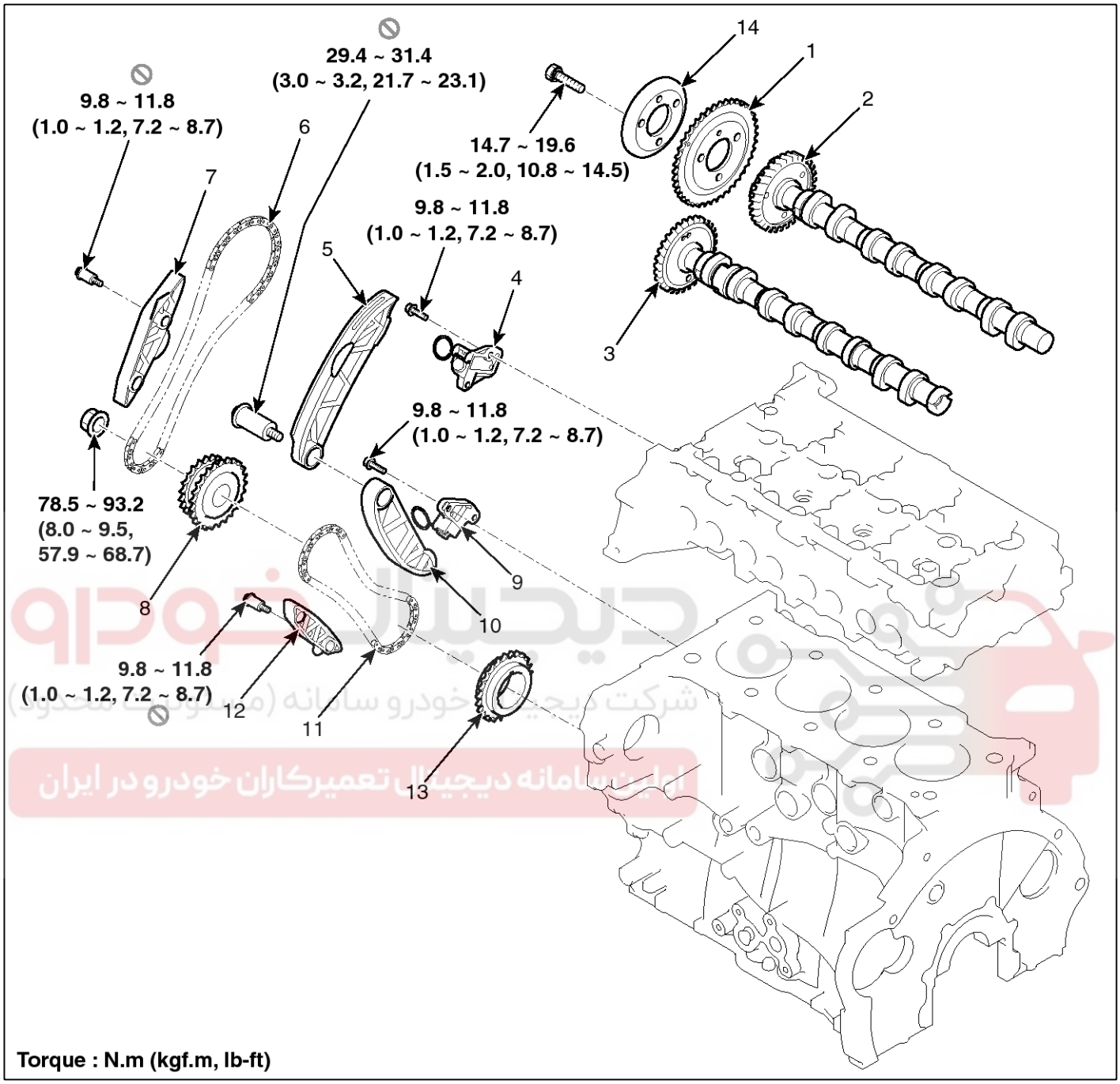
Timing Chain

Components



SSLEM0103L

1. Drive belt
2. Engine support bracket
3. Idler (#2)
4. High pressure pump chain sproket service plug
5. Crankshaft damper pulley
6. Idler (#1)
7. Drive belt tensioner
8. Fead system bracket assembly
9. Timing chain cover



SSLEM0104L

1. Camshaft chain sprocket
2. Exhaust camshaft gear
3. Intake camshaft gear
4. Timing chain "B" auto tensioner
5. Timing chain "B" tensioner lever
6. Timing chain "B"
7. Timing chain "B" guide
8. High pressure pump chain sprocket
9. Timing chain "A" auto tensioner
10. Timing chain "A" tensioner lever
11. Timing chain "A"
12. Timing chain "A" guide
13. Crankshaft chain sproket
14. Dumy mass

Removal

Engine removal is not required for this procedure.

CAUTION

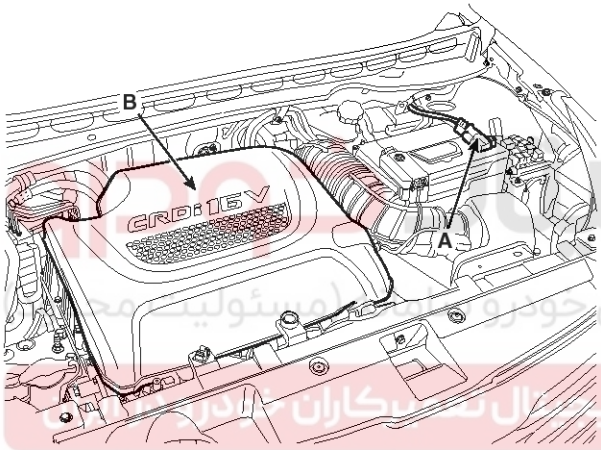
- **Use fender covers to avoid damaging painted surfaces.**
- **To avoid damage, unplug the wiring connectors carefully while holding the connector portion.**

NOTICE

- *Mark all wiring and hoses to avoid misconnection.*
- *Turn the crankshaft pulley, and align its groove with the timing mark of the timing chain cover.*

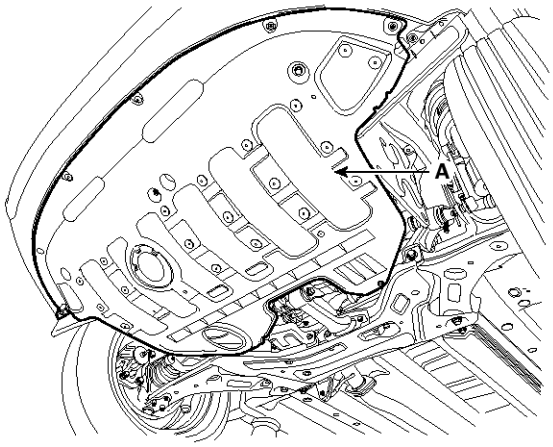
  (No.1 cylinder TDC/compression position)

1. Disconnect the negative terminal (A) from the battery.
2. Remove the engine cover (B).



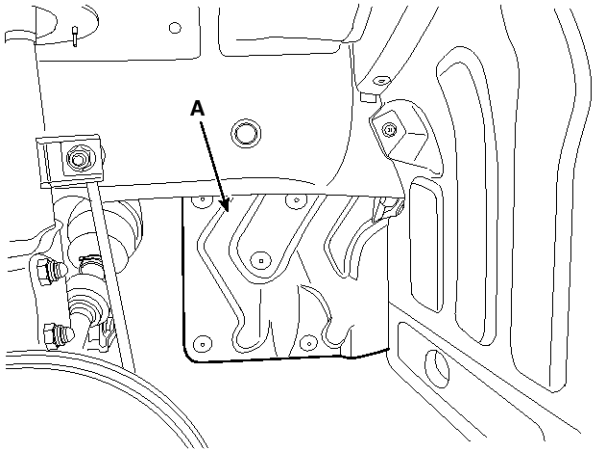
SSLEM0001D

3. Remove the under cover (A).



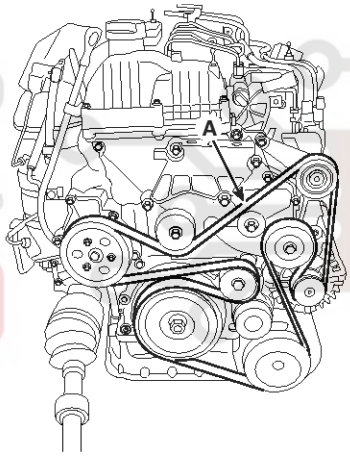
SSLEM0002D

4. Remove the RH front wheel and the side cover (A).



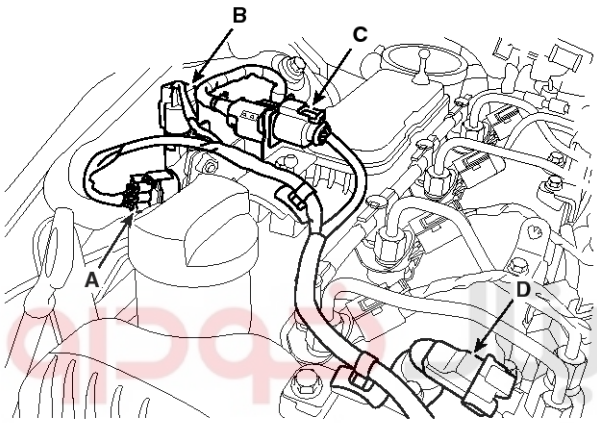
SSLEM0006D

5. Using the hexagon wrench, turn the tensioner counterclockwise and loosen. Then remove the drive belt (A).



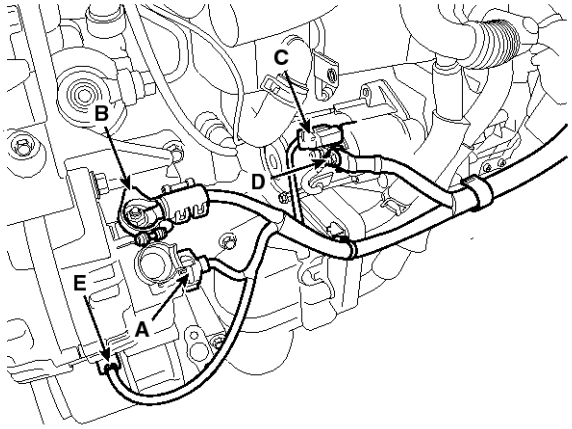
SLMEM0028D

6. Disconnect the engine wire harness connectors and remove the wire harness clamps from the cylinder head cover.
   1) Disconnect the difference pressure sensor connector (A). (With DPF) [Euro - 5 only]
   2) Disconnect the exhaust gas temperature sensor connector (B). (With DPF) [Euro - 5 only]
   3) Disconnect the lambda sensor connector (C). [Euro - 4/5 only]
   4) Disconnect the cam position sensor (CMPS) connector (D).



SXMEM9309D

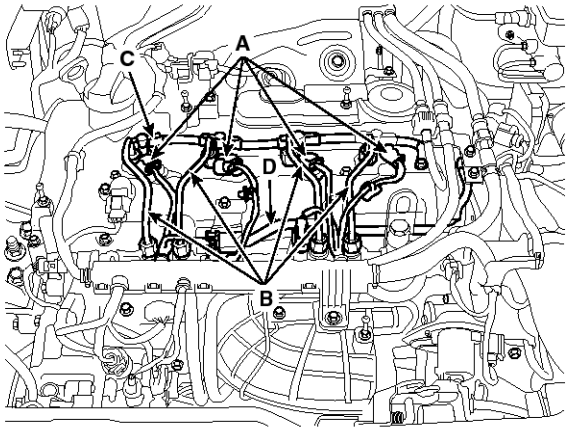
   5) Disconnect the alternator connector (A) and the cable (B).
   6) Disconnect the starter connector (C) and the cable (D).
   7) Disconnect the air compressor switch connector (E).



SLMEM0055D

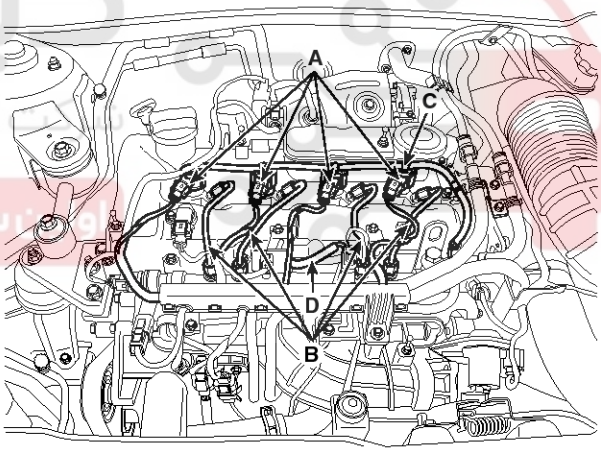
7. Disconnect the injector connectors (A) and remove the injectors, the high pressure pipes (B), the fuel return hose (C) and EGR vacuum hose (D) [Euro - 4/5 only]. (Refer to FL group)

[Standard]



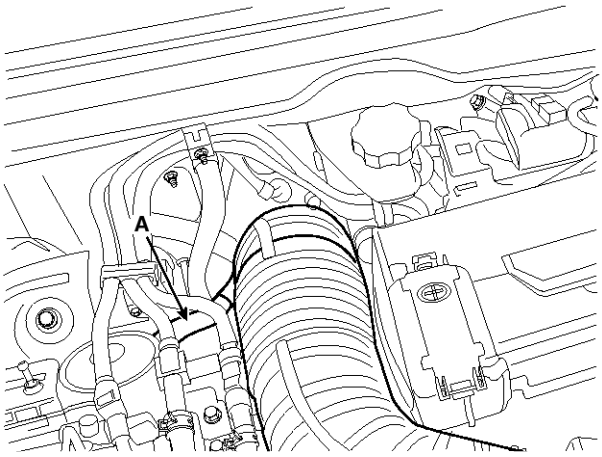
SXMEM9310D

[Low Power]



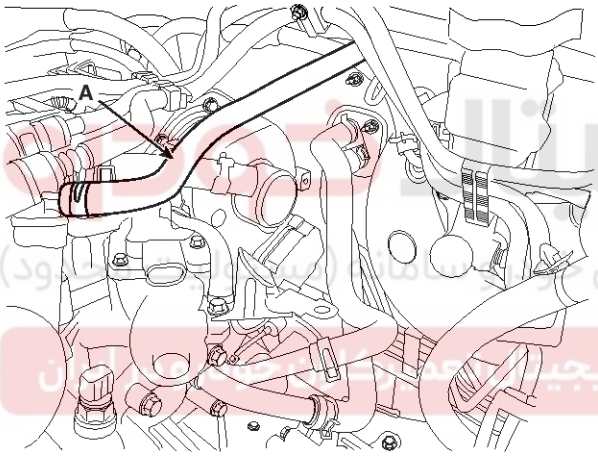
SELEM0004L

8. Disconnect the breather hose (A)



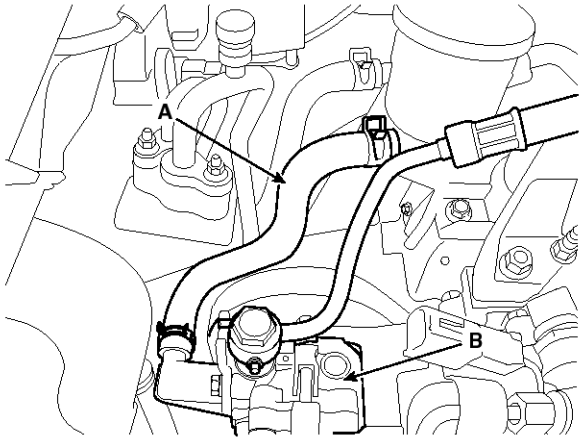
SSLEM0042D

9. Disconnect the brake vacuum hose (A).



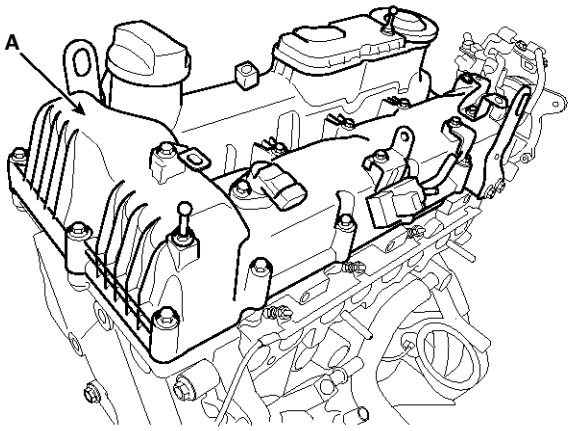
SSLEM0022D

10. Disconnect the power steering oil hose (A) and remove the power steering pump (B). (Only HPS type) (Refer to ST group)



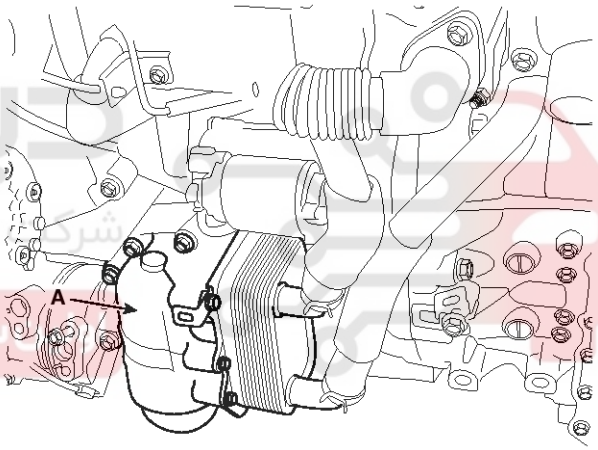
SCMEM0105D

11. Remove the cylinder head cover (A).



SXMEM9027D

12. Drain the engine oil, and then remove the oil filter&cooler assembly (A).

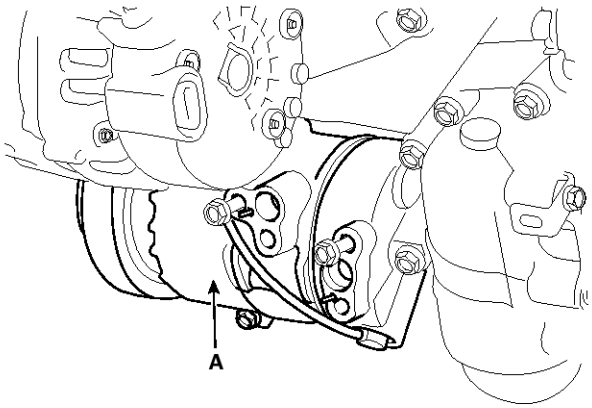


SLMEM0017D

NOTICE

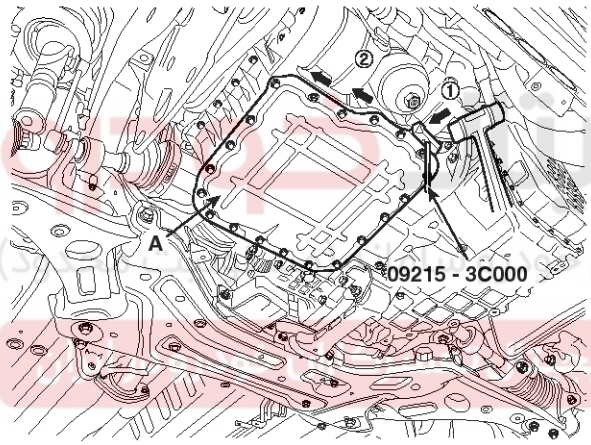
Drain the engine oil in the oil filter before removing the assembly. (Refer to Lubrication system in this group)

13. Remove the air compressor (A). (Refer to HA group)



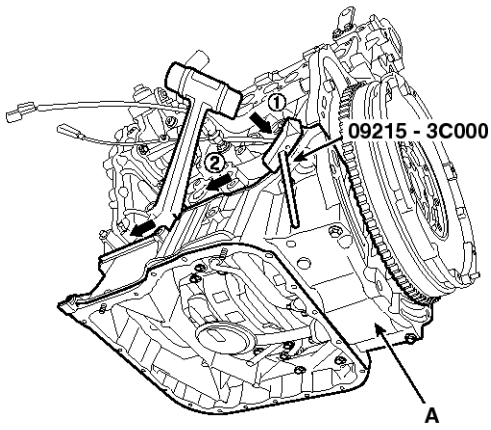
SLMEM0053D

14. Remove the lower oil pan (A).



SSLEM0032D

15. Remove the upper oil pan (A).



SLMEM0029D

NOTICE

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

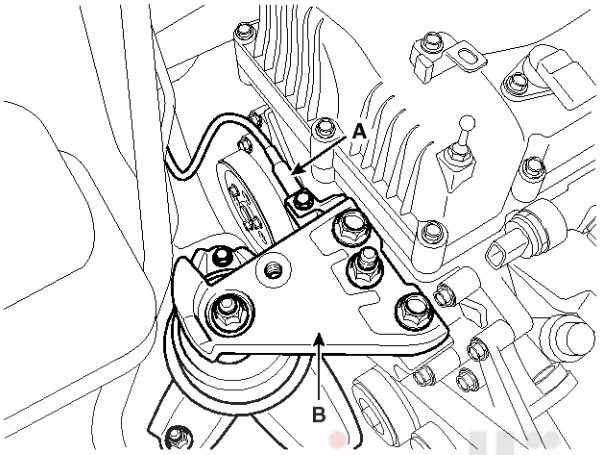
CAUTION

- **Insert the SST between the oil pan and cylinder block (or upper oil pan) by tapping it with a plastic hammer in the direction of ① arrow.**
- **After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the oil pan, remove it from cylinder block (or upper oil pan).**
- **Do not turn over the SST abruptly without tapping. It may be result in damage of the SST.**

16. Remove the engine mounting bracket.
    1) Set the jack to the bottom of the cylinder block.

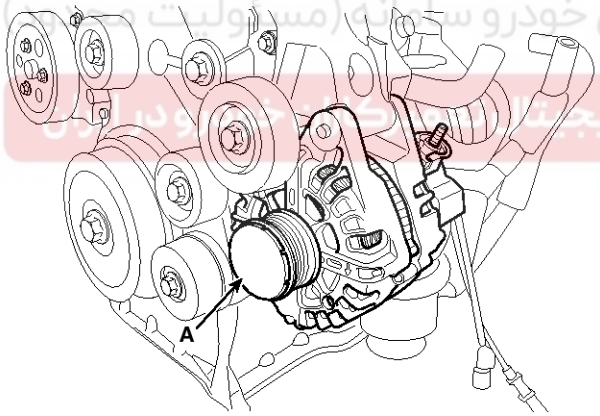
       ⚠CAUTION
       Be careful not to damage the balance shaft & oil pump module.

    2) Disconnect the ground cable (A), and then remove the engine mounting bracket (B).



SSLEM0024D

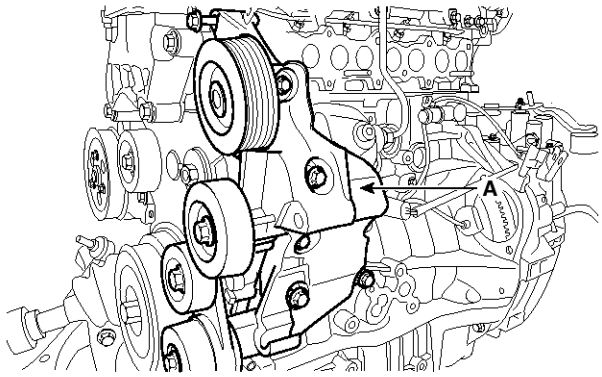
17. Remove the alternator (A).



SLMEM0065D

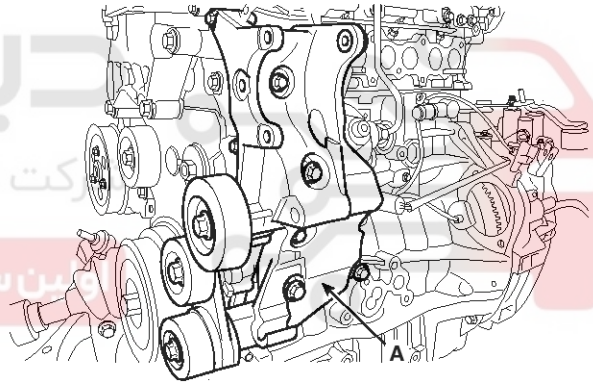
18. Remove the fead system bracket assembly (A).

[MDPS Type]



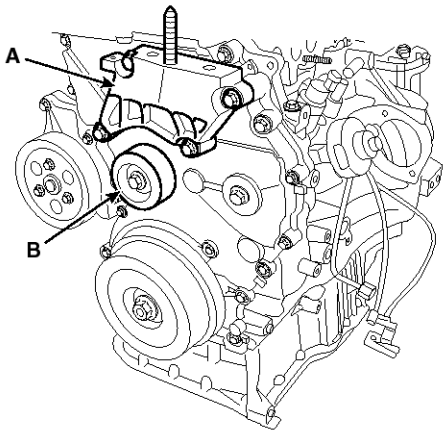
SLMEM0067D

[HPS Type]



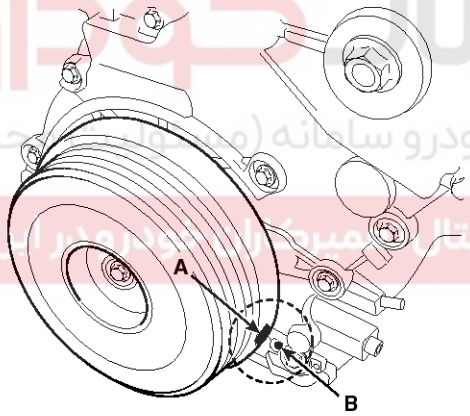
SXMEM9032D

19. Remove the engine support bracket (A) and the drive belt idler (B).



SXMEM9033D

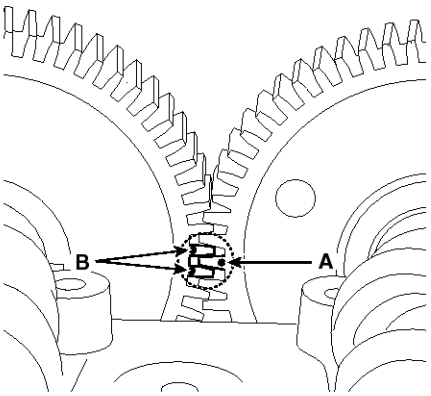
20. Set the No.1 cylinder to TDC/compression position.
    1) Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover.



SXMEM9312D

NOTICE
Do not rotate engine counterclockwise.

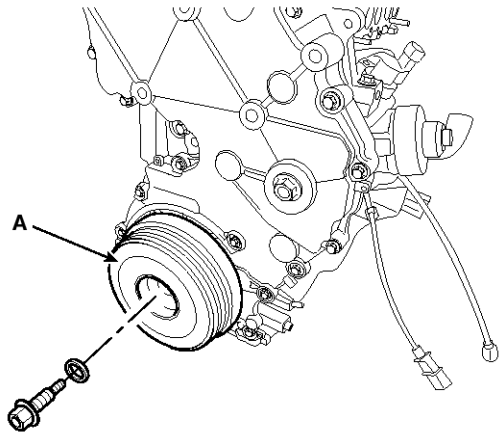
    2) Check that the timing mark (A) of the exhaust camshaft timing gear and the timing mark (B) of the intake camshaft timing gear are aligned as shown in the illustration.



SXMEM9035D

NOTICE
If not, turn the crankshaft one revolution (360°). (Do not rotate engine counterclockwise.)

21. Remove the crankshaft damper pulley (A).



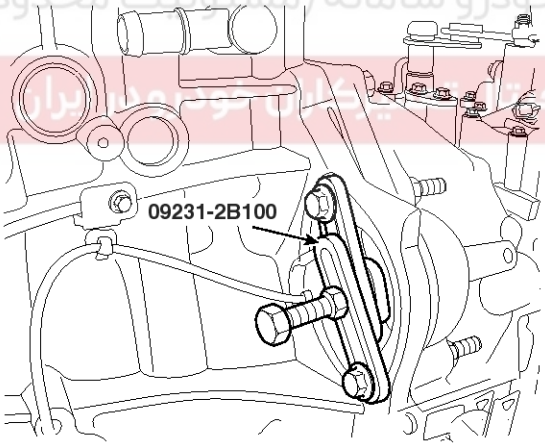
SXMEM9034D

CAUTION

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

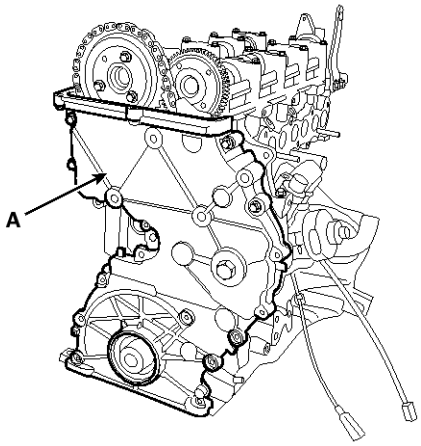
NOTICE

Use the SST (ring gear stopper, 09231-2B100) to remove the crankshaft pulley bolt, after remove the starter.



SLMEM0066D

22. Remove the timing chain cover (A)

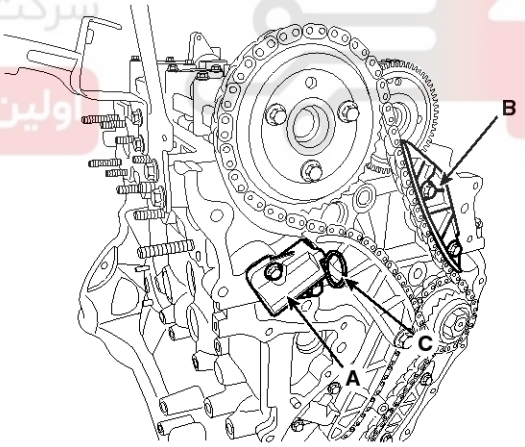


SXMEM9040D

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.)

23. Remove the timing chain "B" auto tensioner (A) and guide (B).

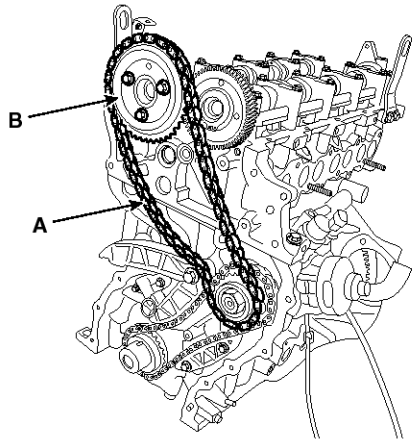


SXMEM9041D

NOTICE

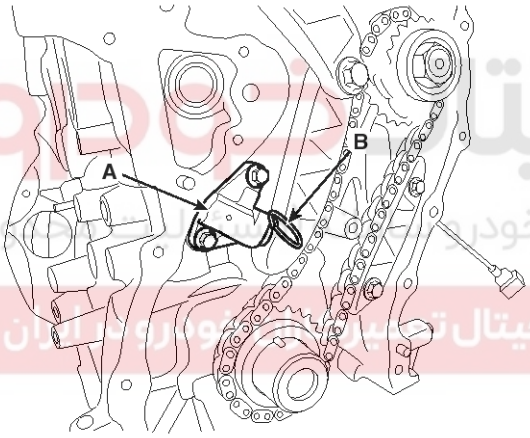
Before removing the auto tensioner, install a set pin (C) (ø2.5 mm steel wire) after compressing the tensioner.

24. Remove the timing chain "B" (A) with the camshaft sprocket (B).



SXMEM9042D

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

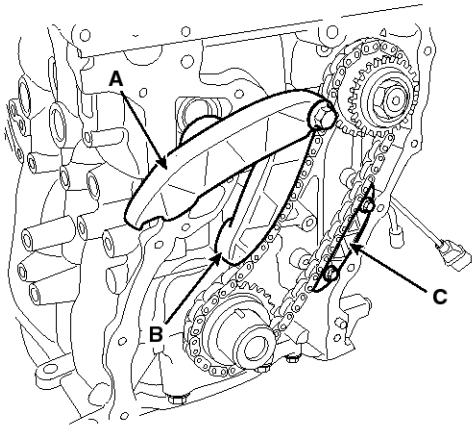


SXMEM9043D

NOTICE

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

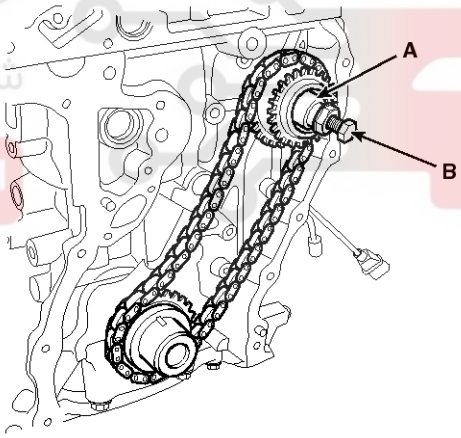
26. Remove the timing chain "B" lever (A), the timing chain "A" lever (B) and the timing chain “A” guide (C).



SXMEM9044D

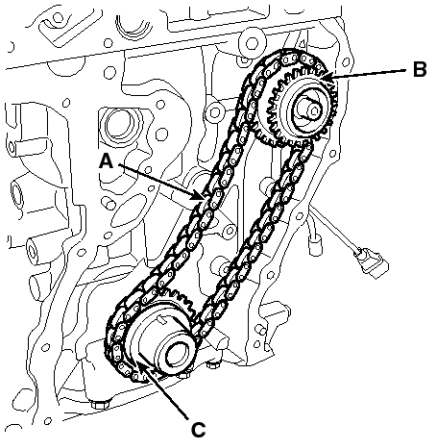
27. After removing the high pressure pump sprocket nut, install the sprocket stopper (A) of the SST (high pressure pump remover, 09331-1M100).

28. Rotate the bolt (B) of the SST clockwise till the high pressure pump sprocket is pushed out.



SXMEM9393D

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

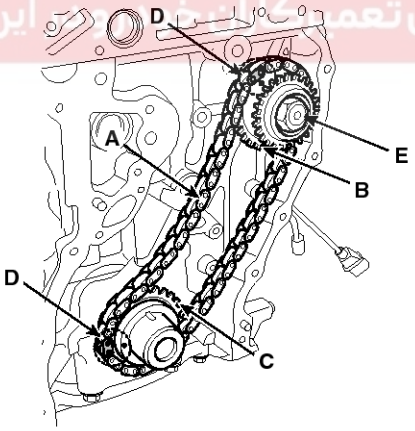


SXMEM9045D

Installation

1. After assembling the timing chain "A" (A) with the timing marks (D) of the high pressure pump sprocket (B) and the crankshaft sprocket (C) aligned, install the sprockets on each shaft. Tighten the high pressure pump nut.

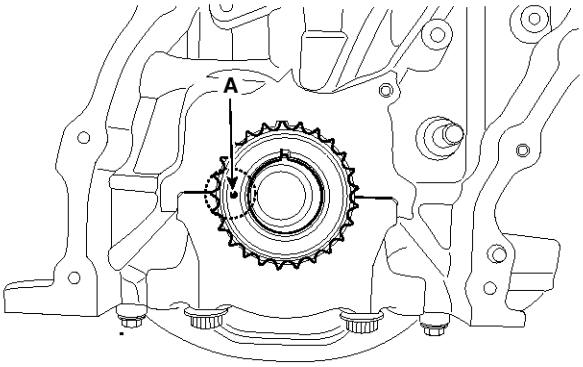
Tightening torque :
78.5 ~ 93.2N.m (8.0 ~ 9.5kgf.m, 57.9 ~ 68.7lb-ft)



SXMEM9314D

NOTICE

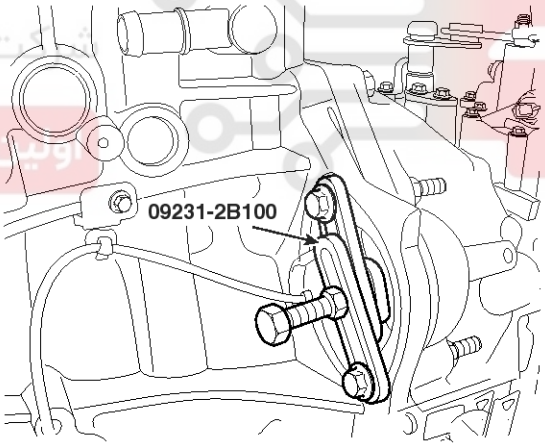
Set the timing mark (A) of the crankshaft sprocket to be aligned with the cylinder block. As a result of this, the piston of the No.1 cylinder will be at the top dead center on compression stroke.



SXMEM9047D

NOTICE

Use the SST (ring gear stopper, 09231-2B100) to tighten the high pressure pump sprocket nut.

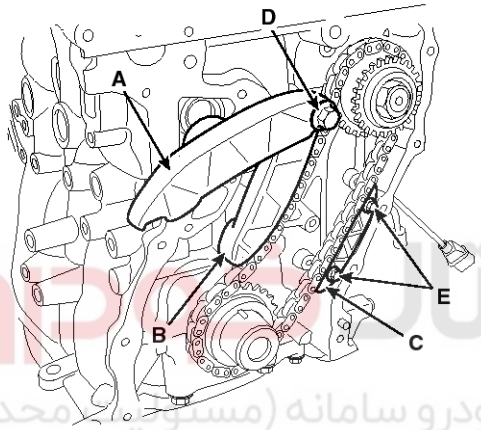


SLMEM0066D

2. Install the timing chain "B" lever (A), the timing chain "A" lever (B) and the timing chain “A” guide (C).

Tightening torque :
Bolt(D): 29.4 ~ 31.4N.m (3.0 ~ 3.2kgf.m, 21.7 ~ 23.1lb-ft)
Bolts(E): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

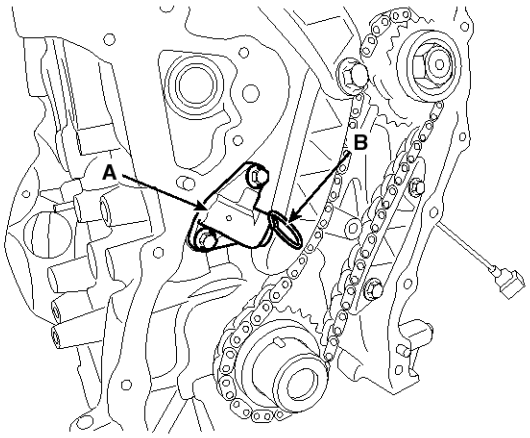
NOTICE
Do not reuse the tensioner lever and guide fixing bolt. If necessary, the bolt can be reused after removing hardening sealant and then appling sealant (LOCTITE 262, THREEBOND 1324N or equvalent) on the thread of the bolt.



SXMEM9394D

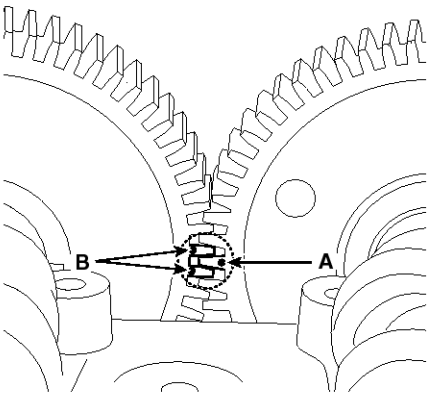
3. Install the timing chain "A" auto tensioner (A), and then remove the set pin (B).

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



SXMEM9043D

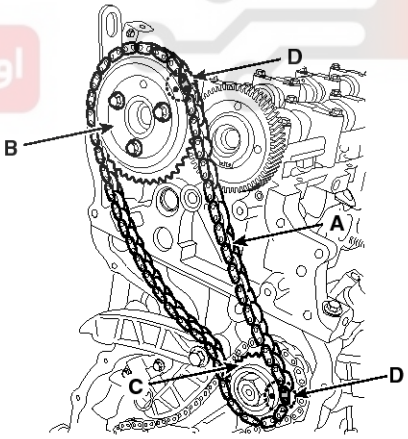
4. Check that the timing mark (A) of the exhaust camshaft timing gear and the timing mark (B) of the intake camshaft timing gear are aligned as shown in the illustration.



SXMEM9035D

5. After assembling the timing chain "B" (A) with the timing marks (D) of the high pressure pump sprocket (C) and the camshaft sprocket (B) aligned, install the cam shaft sprocket on the exhaust cam shaft gear.

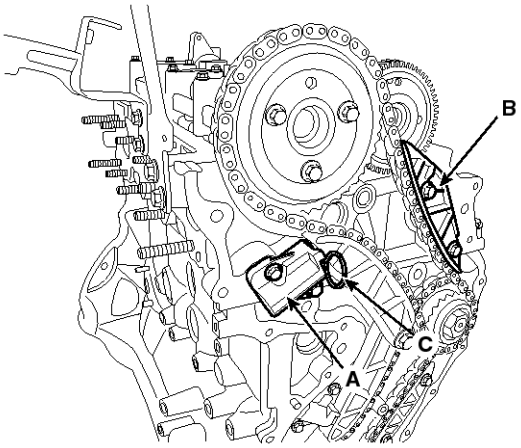
Tightening torque :
14.7 ~ 19.6N.m (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)



SXMEM9315D

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

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

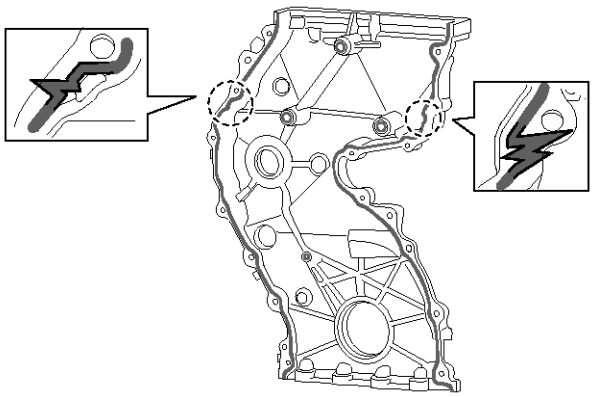


SXMEM9041D

7. Apply liquid gasket evenly on the mating surface of timing chain cover.

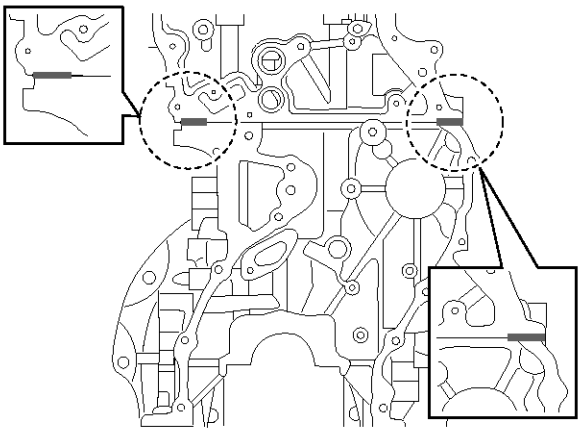
NOTICE

- *Standard liquid gasket : LOCTITE 5900H or equivalent*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Install the timing chain cover in 5 minutes after applying the liquid gasket.*
- *Apply liquid gasket in a 3mm wide bead without stopping.*
- *Remove hardened sealant located on the front between the bock and head.*
- *Apply liquid gasket in a 4mm wide bead by a "z" shape on the T-joint.*



SSLEM0041D

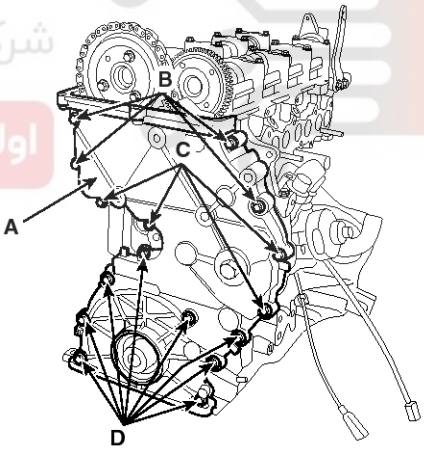
- *Apply liquid gasket on the front between the bock and head.*



SXMEM9049D

8. Install the timing chain cover (A).

Tightening torque :
Bolts (B) : 19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)
Bolts (C, D) : 7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

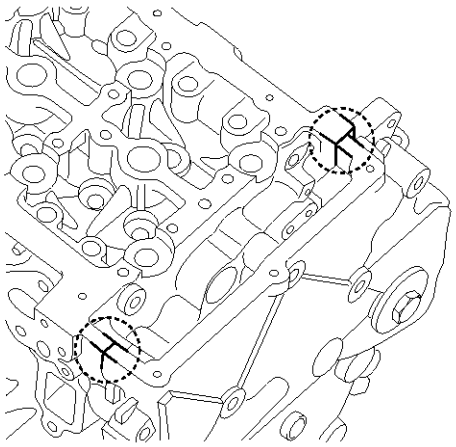


SXMEM9385D

NOTICE

Check the unevenness between the timing chain cover and cylinder head.

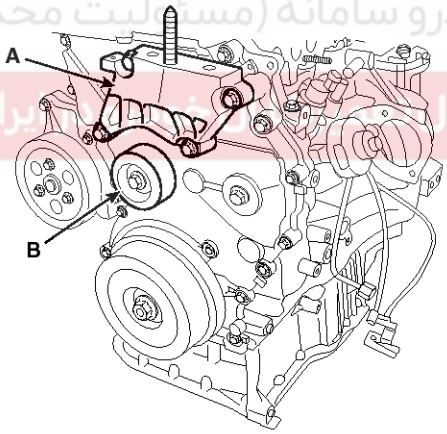
Unevenness : 0.20mm(0.0079in) or less



SXMEM9050D

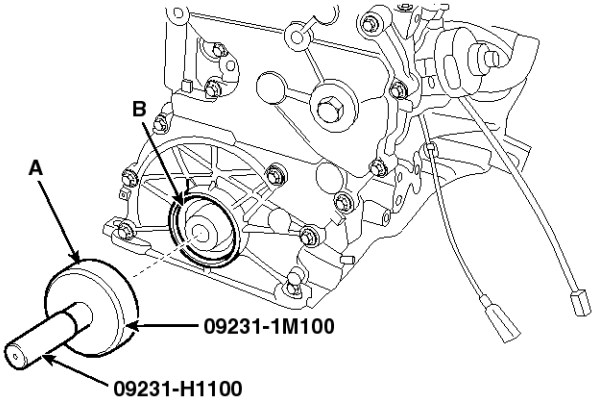
9. Install the engine support bracket (A) and the drive belt idler (B).

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



SXMEM9033D

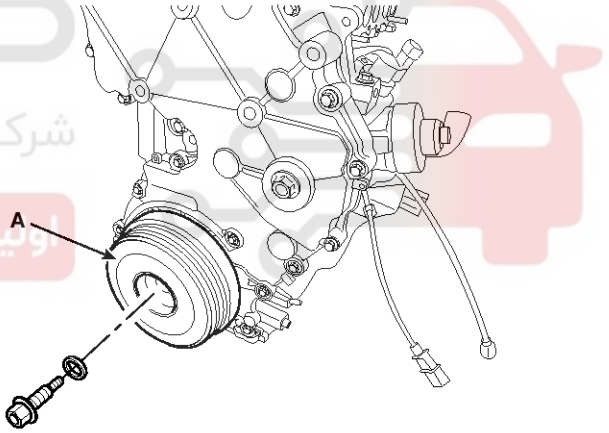
10. Install the front oil seal by using SST (09231-1M100, 09231-H1100)(A).



SXMEM9317D

11. Install the crankshaft damper pulley (A).

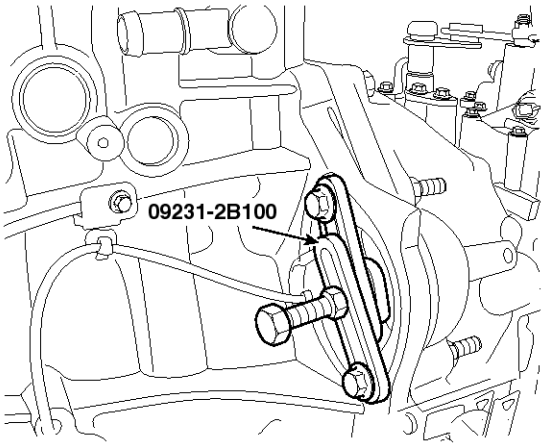
Tightening torque :
196.1N.m (20.0kgf.m, 144.7lb-ft) + 60°



SXMEM9034D

NOTICE

Use the SST (ring gear stopper, 09231-2B100) to tighten crank shaft damper pulley bolt.



SLMEM0066D

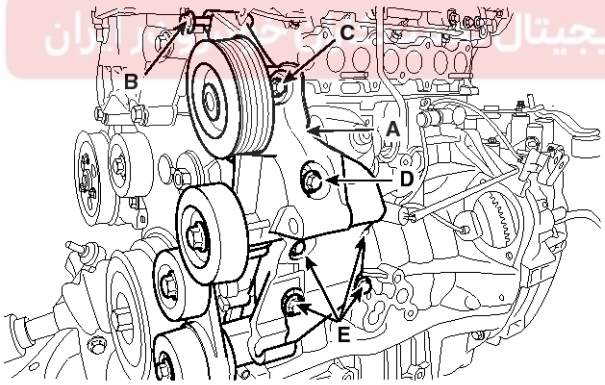
12. Install the fead system bracket assembly (A).

Tightening torque :

Bolts (B, C, D) : 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

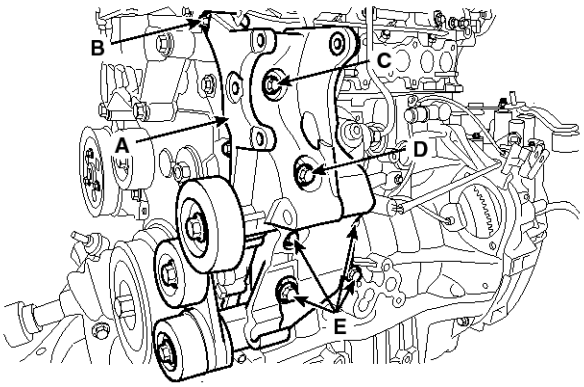
Bolts (E) : 42.2 ~ 53.9N.m (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lb-ft)

[MDPS Type]



SLMEM0080D

[HPS Type]

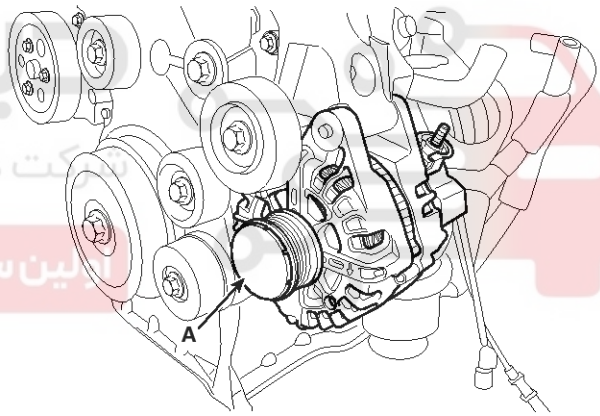


SXMEM9386D

13. Install the alternator (A).

Tightening torque :

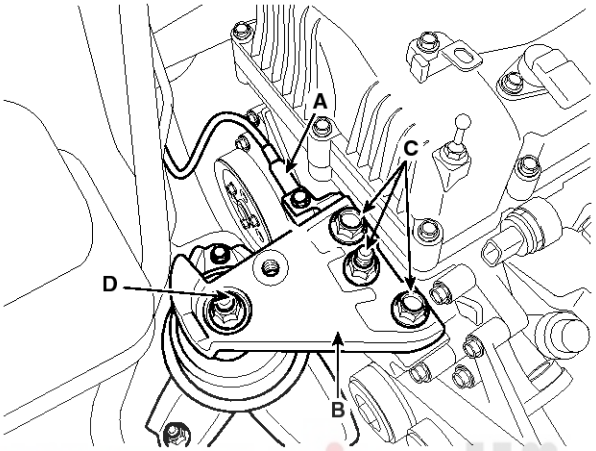
49.0 ~ 63.7N.m (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



SLMEM0065D

14. Install the engine mounting bracket (B), and then connect the ground cable (A).

Tightening torque :
Nut(D) : 78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)
Bolt and nuts(C) : 58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.4 ~ 54.2 lb-ft)



SSLEM1201L

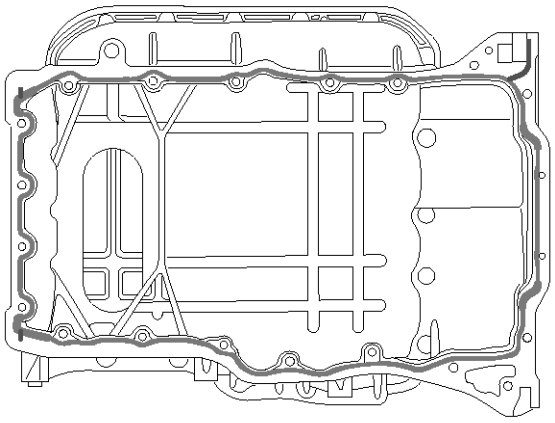
15. Remove the jack from the bottom of the cylinder block.
16. Apply liquid gasket evenly to the mating surface of the upper oil pan.

NOTICE

- *Standard liquid gasket : LOCTITE 5900H or equivalent*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 4mm (5mm or above for T-joint and 3.5mm for rear oil seal) wide bead without stopping.*
- *Install the oil pan in 5 minutes after applying the liquid gasket.*
- *After installing the oil pan, wait at least 30 minutes before filling the engine with oil.*
- *Remove liquid gasket overreached from the rear oil seal area after installing.*
- *Remove liquid gasket overreached from the contact surface between the cylinder bock and timing chain cover before installing the upper oil pan.*

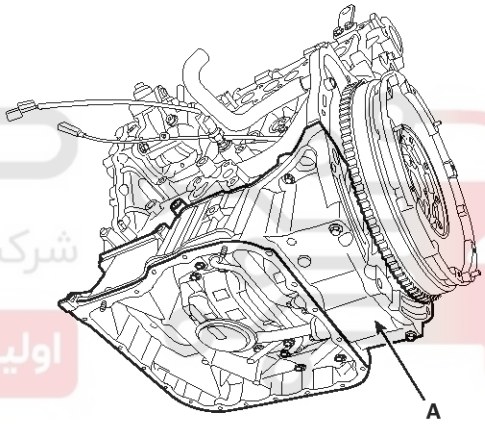
CAUTION

Be careful not to apply an excessive amount of liquid gasket or by a wrong path. If the liquid gasket flows into the holes for installing the rear oil seal case assembly, it may cause the boss crack or contamination.



SXMEM9051D

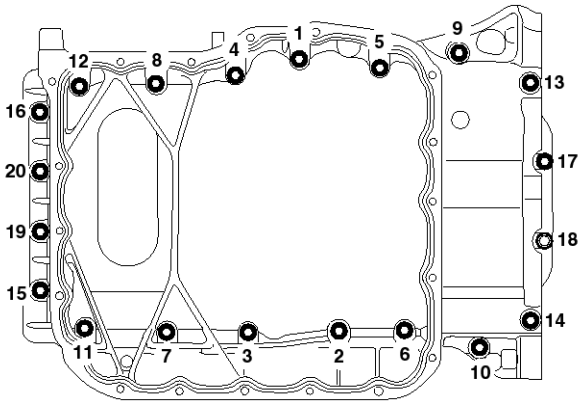
17. Install the upper oil pan (A).



SLMEM0063D

1) Tighten the bolts in the sequence shown.

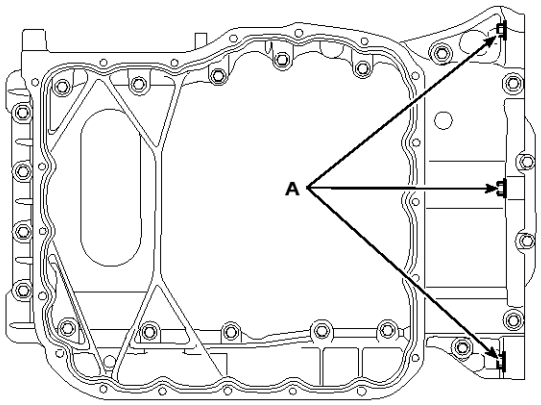
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SXMEM9052D

2) Tighten the bolts (A) for transaxle case.

Tightening torque :
39.2 ~ 46.1N.m (4.0 ~ 4.7kgf.m, 28.9 ~ 34.0lb-ft)

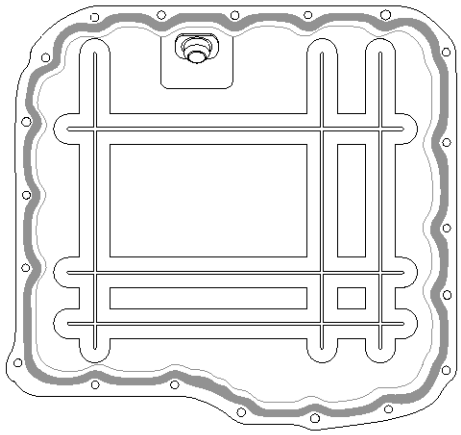


SXMEM9319D

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

NOTICE

- *Standard liquid gasket : LOCTITE 5900H or equivalent*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 4mm wide bead without stopping.*
- *Install the oil pan in 5 minutes after applying the liquid gasket.*
- *After installing the oil pan, wait at least 30 minutes before filling the engine with oil.*

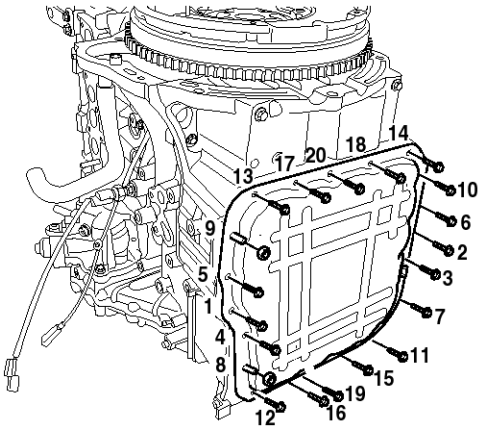


SXMEM9401D

19. Install the lower oil pan.

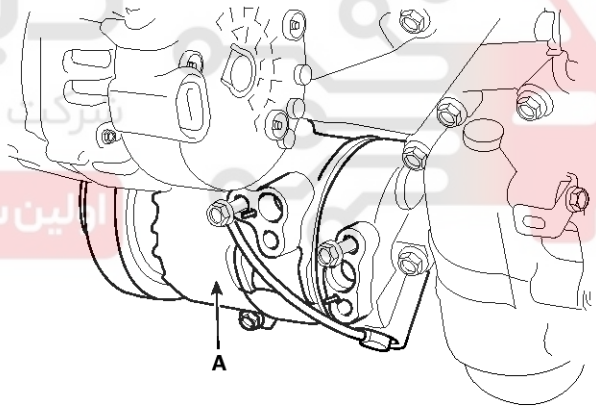
Tighten the bolts in the sequence shown.

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



SXMEM9038D

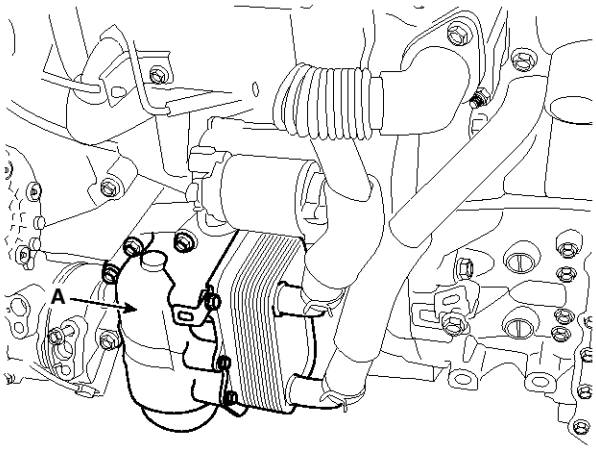
20. Install the air compressor (A). (Refer to HA group)



SLMEM0053D

21. Install the oil filter&cooler assembly (A).

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

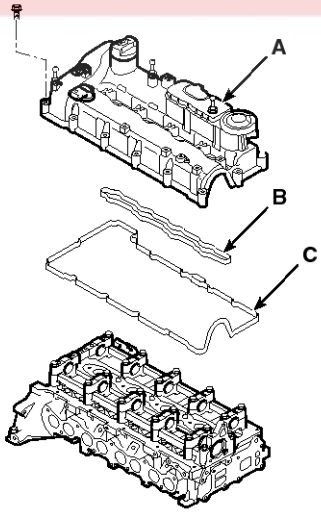


SLMEM0017D

CAUTION

- **When installing the oil filter&cooler assembly, check the existence of two O-rings on the mating surface to the cylinder block, and tighten the 4 upper bolts first then tighten the other lower bolt.**
- **Always use new O-ring.**

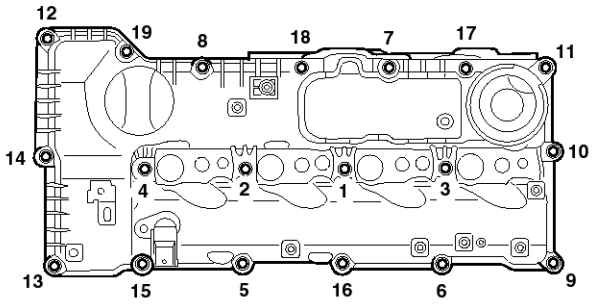
22. Install the cylinder head cover (A) with new head cover gaskets (B, C).



SXMEM9389D

Install the cylinder head cover bolts as following method.

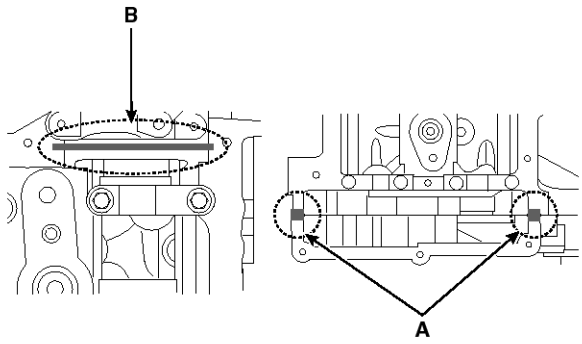
Tightening torque :
Step 1 : 3.9 ~ 5.9N.m (0.4 ~ 0.6kgf.m, 2.9 ~ 4.3lb-ft)
Step 2 : 8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0lb-ft)



SXMEM9053D

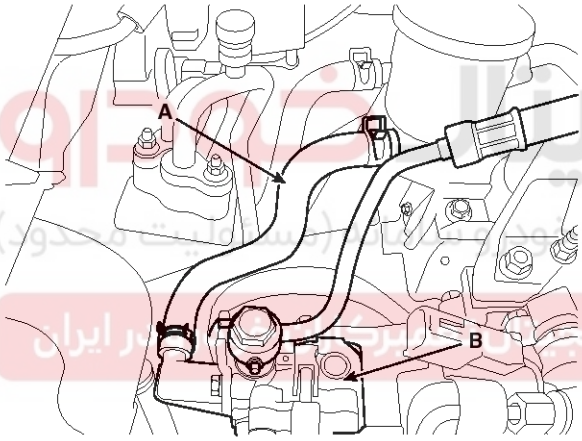
NOTICE

- *Standard liquid gasket : LOCTITE 5900H or equivalent*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Install the cylinder head cover in 5 minutes after applying the liquid gasket.*
- *After installing, wait at least 30 minutes before filling the engine with oil.*
- *Remove the harmful material (engine oil, cutting oil and etc) located in the upper area of the cylinder head and the timing chain cover before installing the cylinder head cover.*
- *Remove hardened sealant located in the upper area between the cylinder head and the timing chain cover.*
- *Before installing the cylinder head cover, check that the protrusion of the head cover gasket is assembled exactly into the slot of the head cover.*
- *Before installing the cylinder head cover, apply liquid gasket to the T-joints on the upper area between the cylinder head and the timing chain cover and the rear area of the cam carrier.*



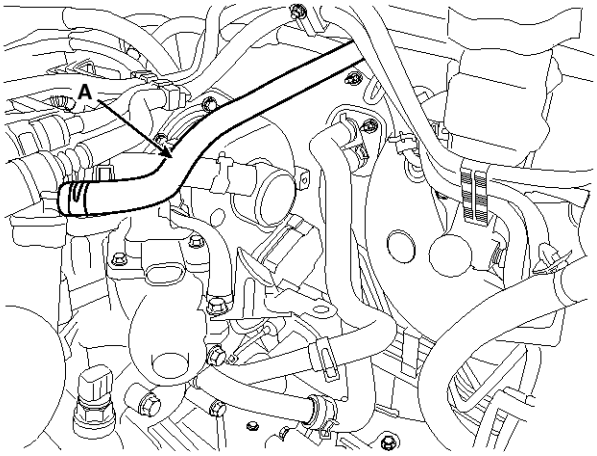
SXMEM9054D

23. Install the power steering pump (B) and connect the power steering oil hoses (A). (Only HPS type) (Refer to ST group)



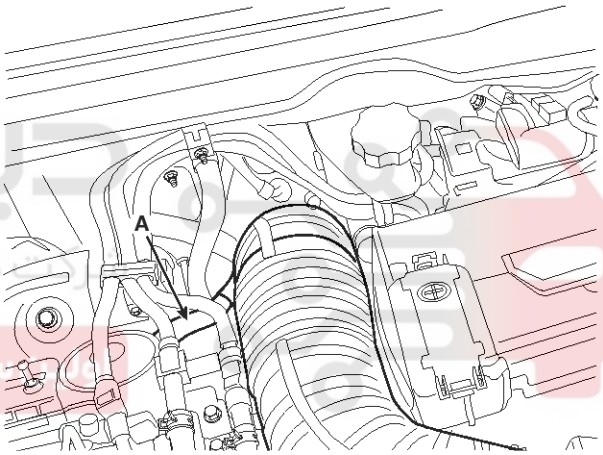
SCMEM0105D

24. Connect the brake vacuum hose (A).



SSLEM0022D

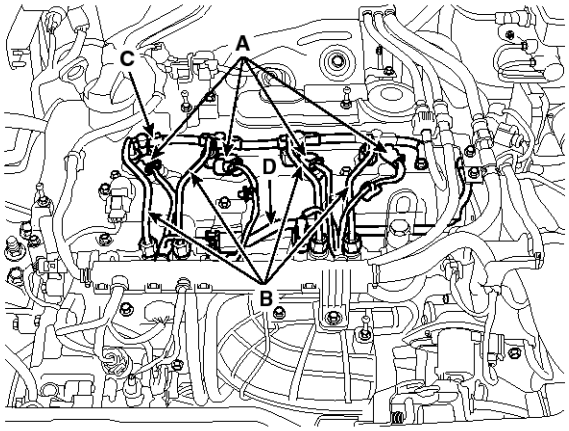
25. Connect the breather hose (A)



SSLEM0042D

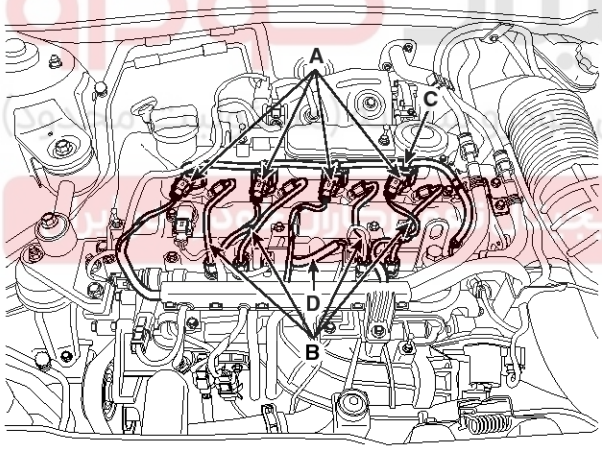
26. Install the injectors and connect the high pressure pipes (B), the fuel return hose (C), EGR vacuum hose (D) [Euro - 4/5 only] and then the injector connectors (A). (Refer to FL group)

[Standard]



SXMEM9310D

[Low Power]

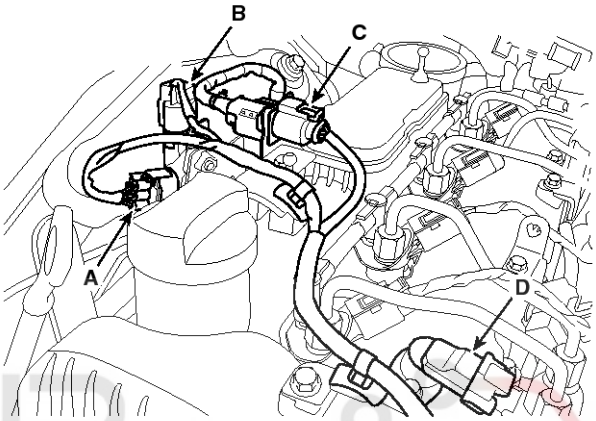


SELEM0004L

NOTICE

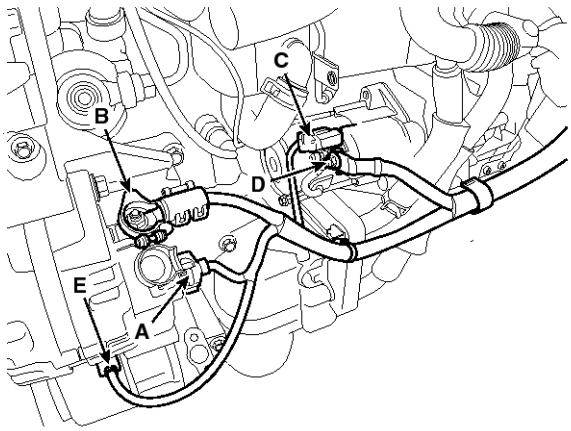
Do not reuse the high pressure pipe and injector gasket.

27. Connect the engine wire harness connectors.
    1) Connect the difference pressure sensor connector (A). (With DPF) [Euro - 5 only]
    2) Connect the exhaust gas temperature sensor connector (B). (With DPF) [Euro - 5 only]
    3) Connect the lambda sensor connector (C). [Euro - 4/5 only]
    4) Connect the cam position sensor (CMPS) connector (D).



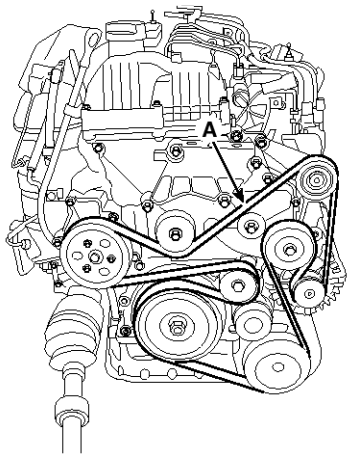
SXMEM9309D

    5) Connect the alternator connector (A) and the cable (B).
    6) Connect the starter connector (C) and the cable (D).
    7) Connect the air compressor switch connector (E).



SLMEM0055D

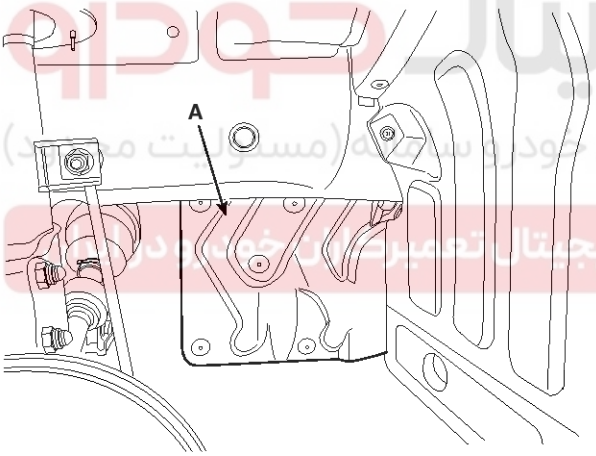
28. Install the drive belt (A).



SLMEM0028D

29. Install the side cover (A), and then install the RH front wheel.

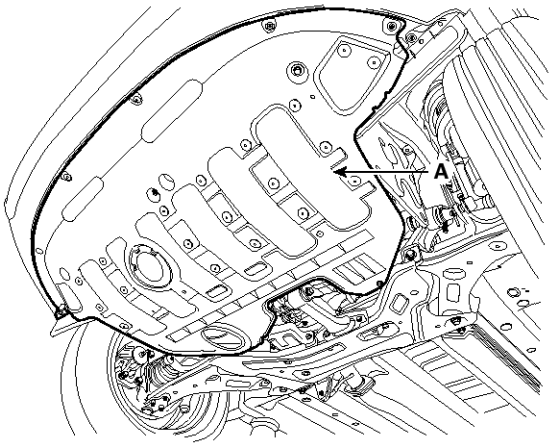
Tightening torque :
8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0lb-ft)



SSLEM0006D

30. Install the under cover (A).

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

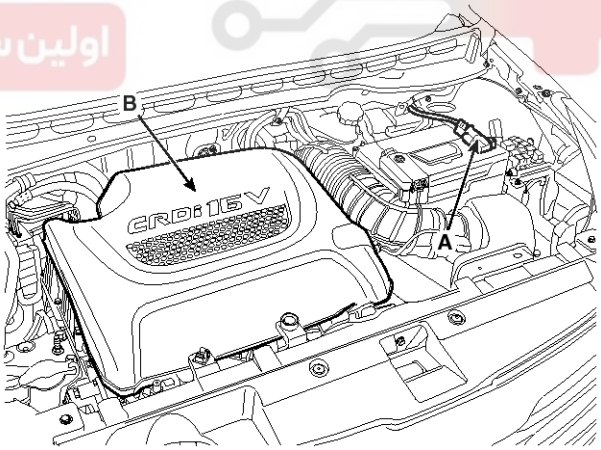


SSLEM0002D

31. Install the engine cover (B).

32. Connect the negative terminal (A) to the battery.

Tightening torque :
Without battery sensor : 7.9 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
With battery sensor : 4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

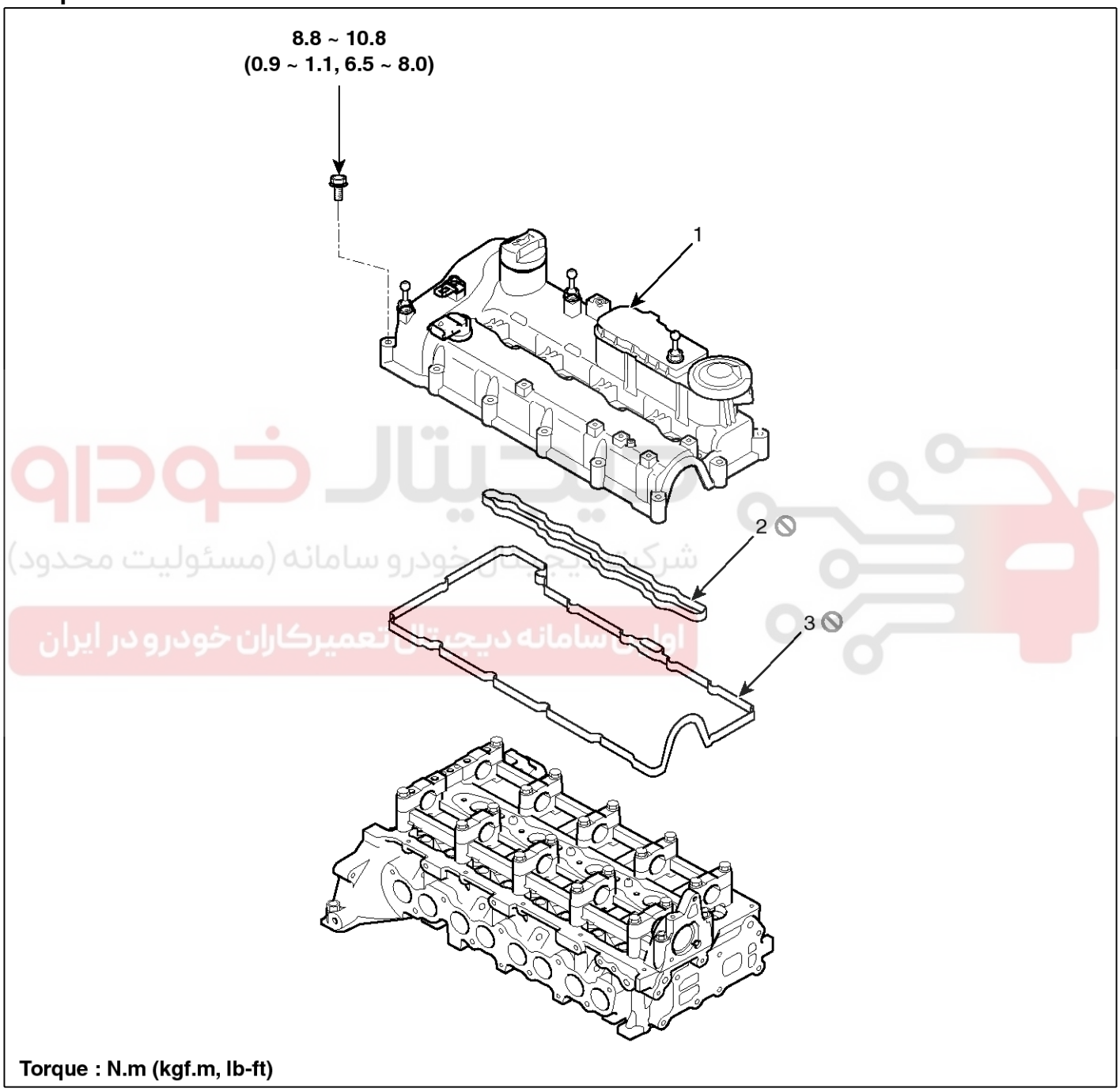


SSLEM0001D

Cylinder Head Assembly

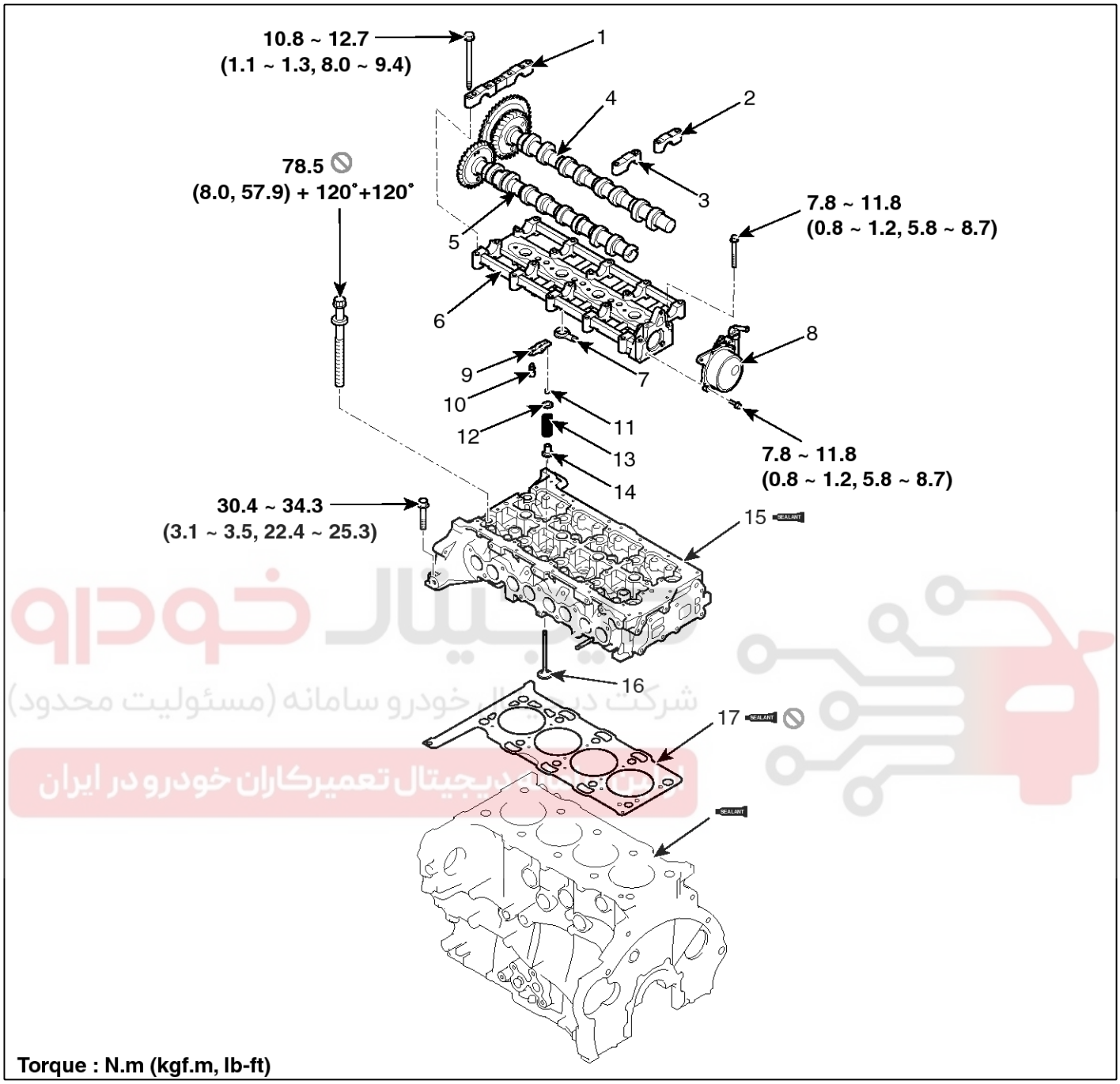
Cylinder Head

Components



SSLEM0105L

1. Cylinder head cover
2. Cylinder head sub gasket
3. Cylinder head main gasket



SSLEM0106L

1. Front camshaft bearing cap
2. Exhaust camshaft bearing cap
3. Intake camshaft bearing cap
4. Exhaust camshaft
5. Intake camshaft
6. Cam carrier
7. Cam carrier gasket
8. Vacuum pump
9. Cam follower
10. HLA(Hydraulic Lash Adjuster)
11. Valve spring retainer lock
12. Valve spring retainer
13. Valve spring
14. Valve stem seal
15. Cylinder head
16. Valve
17. Cylinder head gasket

Removal

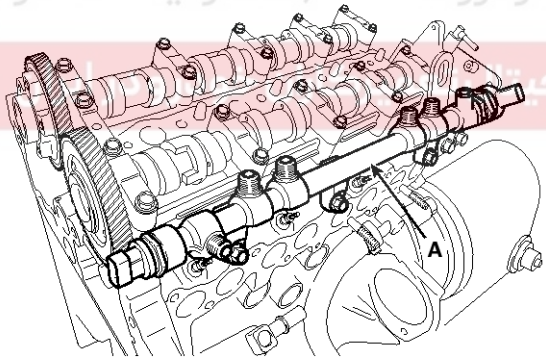
CAUTION

- **Use fender covers to avoid damaging painted surfaces.**
- **To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20˚C [68˚F]) before removing it.**
- **When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.**
- **To avoid damage, unplug the wiring connectors carefully while holding the connector portion.**

NOTICE

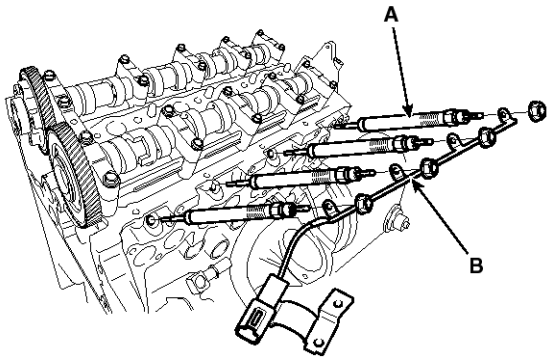
- *Mark all wiring and hoses to avoid misconnection.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center.*

1. Remove the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
2. Remove the timing chain. (Refer to Timing chain in this group)
3. Remove the common rail (A). (Refer to FL group)



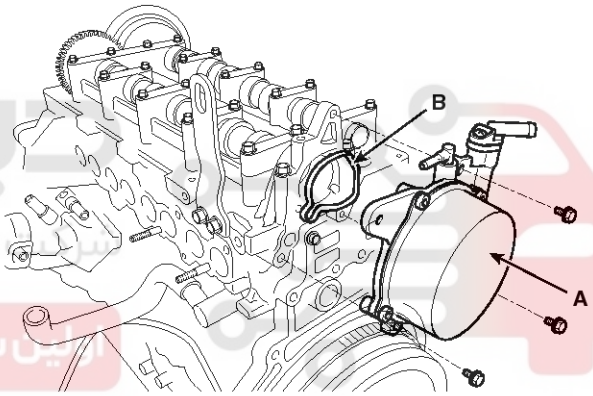
SCMEM0107D

4. Remove the glow plug (A) and the wiring & plate (B).



SCMEM0108D

5. Remove the vacuum pump (A) with the O-ring (B).



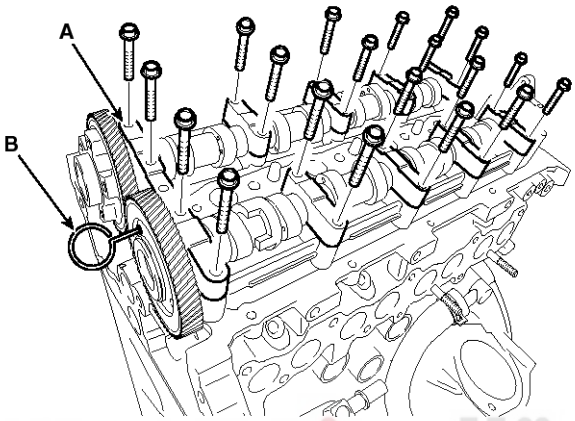
SXMEM9096D

6. Inserting an assembly pin (B) into the intake camshaft scissors gear. (Standard only)
7. Remove the camshaft bearing caps (A).

NOTICE

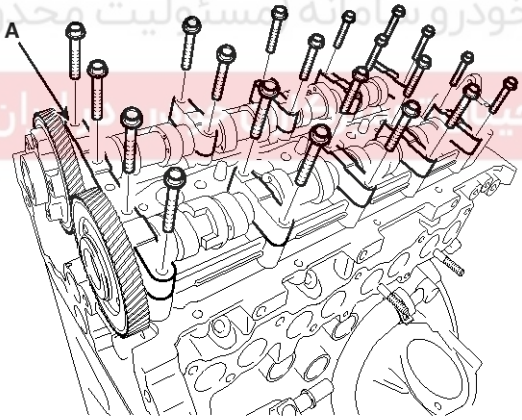
Mark the camshaft bearing caps to be able to reassemble in the original position and direction.

[Standard]



SXMEM9097D

[Low Power]

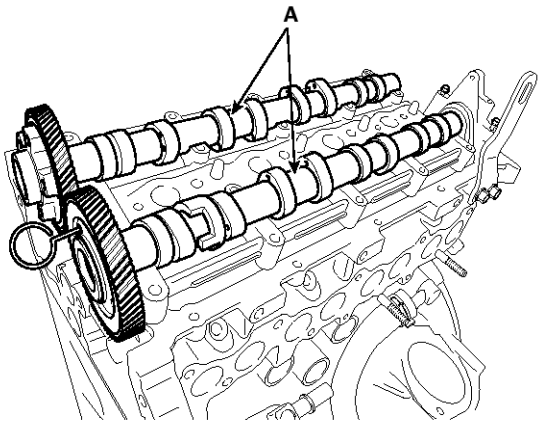


SELEM0005L

CAUTION

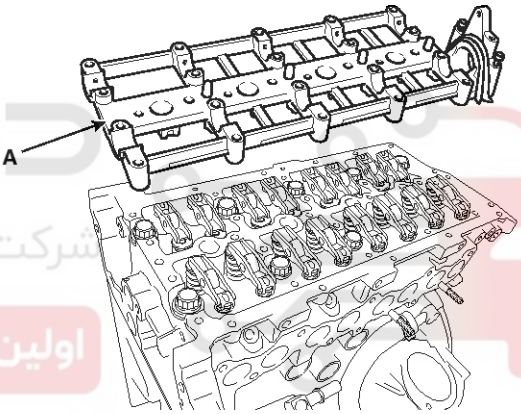
If the intake camshaft is removed when the assembly pin is not installed on the scissors gear of the intake camshaft, the main gear and scissors gear are distorted. In this csae, assemble a pin on the intake camshaft with the main gear and scissors gear aligned and then install the camshaft.

8. Remove the intake and exhaust camshaft (A).



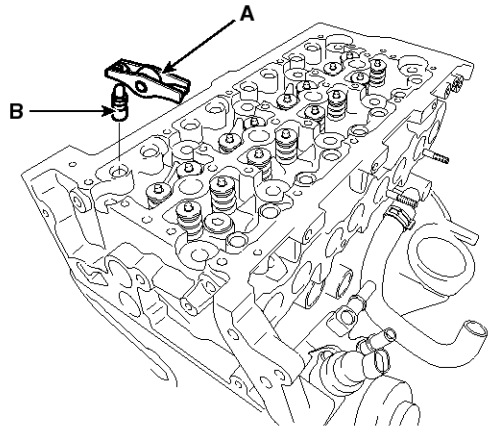
SXMEM9098D

9. Remove the cam carrier (A).



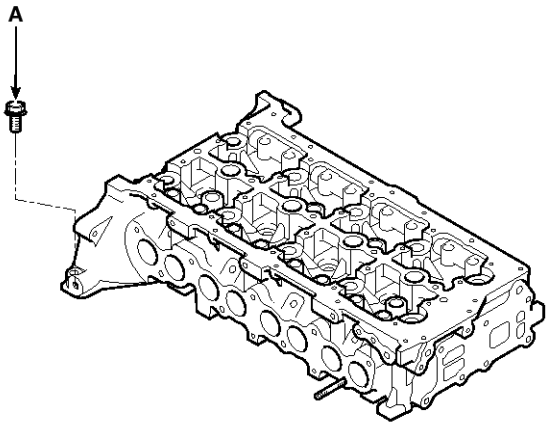
SXMEM9099D

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



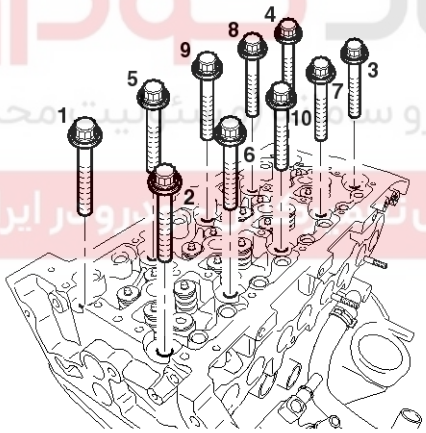
SXMEM9100D

11. Remove the cylinder head bolts, then remove the cylinder head.
    1) Remove the cylinder head side bolt (A).



SXMEM9387D

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



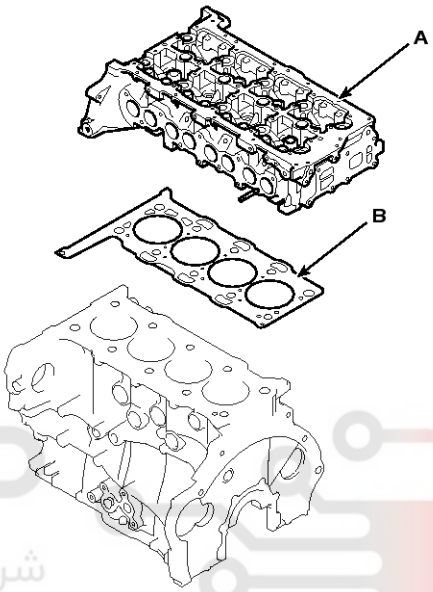
SXMEM9101D

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

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

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

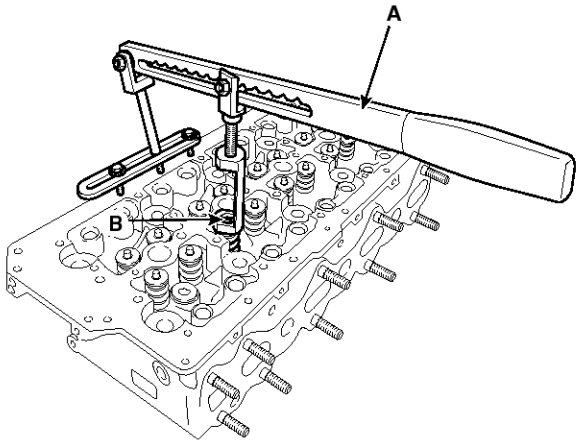
    4) Remove the cylinder head gasket (B).



SXMEM9321D

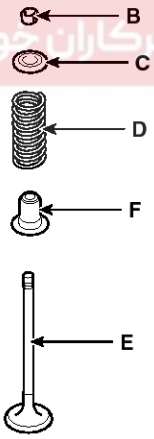
Disassembly

1. Remove the valves.
   1) Using the SST (09222-3K000, 09222-2A100) (A), compress the valve spring and remove the retainer lock.



SXMEM9102D

   2) Remove the spring retainer (C).
   3) Remove the valve spring (D).
   4) Remove the valve (E).
   5) Using a needle-nose pliers, remove the stem seal (F).



SXMEM9322D

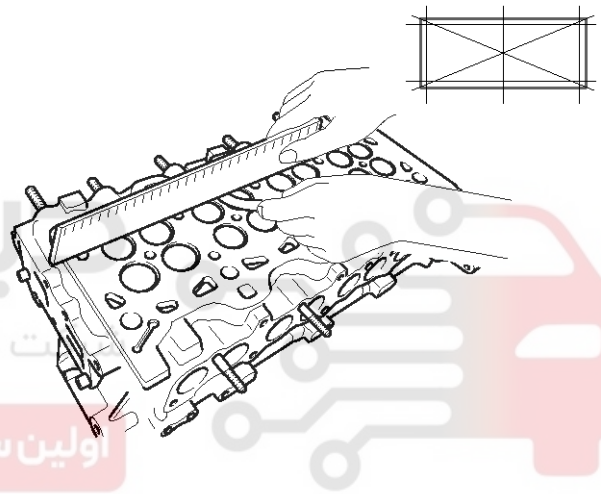
Inspection

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
Less than 0.012mm/50X50mm (0.0005in/1.9685X1.9685in)
Flatness of manifold mating surface :
Less than 0.025mm (0.0010in) for width
Less than 0.160mm (0.0063in) for length



SXMEM9103D

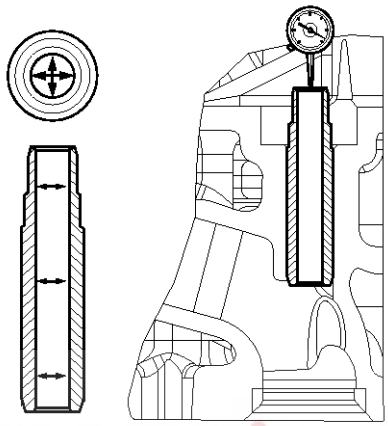
2. Inspect for cracks.

   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.

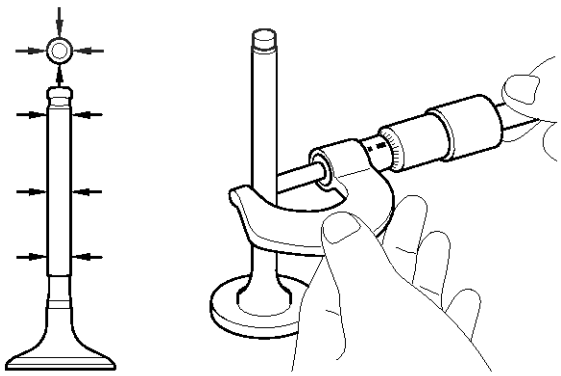
Valve guide inner diameter :
Intake : 5.975 ~6.000mm (0.2352 ~ 0.2362in)
Exhaust : 5.975 ~6.000mm (0.2352 ~ 0.2362in)



SXMEM9104D

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

Valve stem outer diameter
Intake : 5.933 ~ 5.953mm (0.2336 ~ 0.2344in)
Exhaust : 5.905 ~ 5.925mm (0.2325 ~ 0.2333in)



ECKD220A

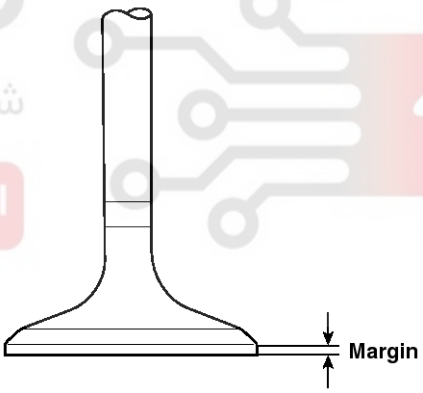
   3) Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

Valve stem- to-guide clearance
Intake : 0.022 ~ 0.067mm (0.0009 ~ 0.0026in)
Exhaust : 0.050 ~ 0.095mm (0.0020 ~ 0.0037in)

If the clearance is greater than specification, replace the valve or the cylinder head.

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 : 1.25mm (0.0492in)
Exhaust : 1.25mm (0.0492in)



ECKD221A

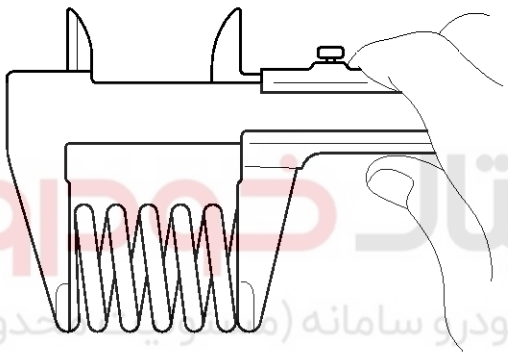
   4) Check the valve length.

Length
Intake : 108.3mm (4.2638in)
Exhaust : 108.2mm (4.2598in)

   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. If the valve seat is worn, replace the cylinder head.
   2) Check the valve guide for wear. If the valve guide is worn, replace the cylinder head.

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

Valve spring
Standard
Free height : 44.0mm (1.7323in)
Load : 19.9±1.0kg/36.6mm (44±21lb/1.4409in)
44.1±2.2kg/27.6mm (97±5lb/1.0866in)
Out of square : Less than 1.5° / 1.15mm (0.0453in)

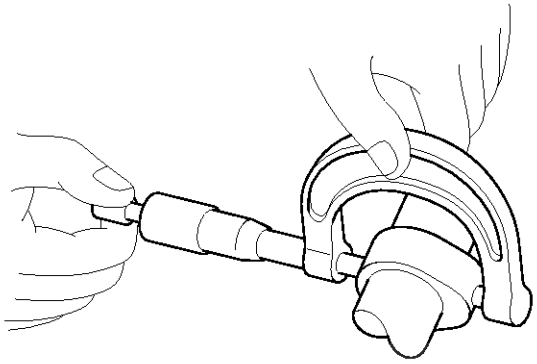


ECKD222A

Camshaft

1. Inspect the cam lobes.
   Using a micrometer, measure the cam lobe height.

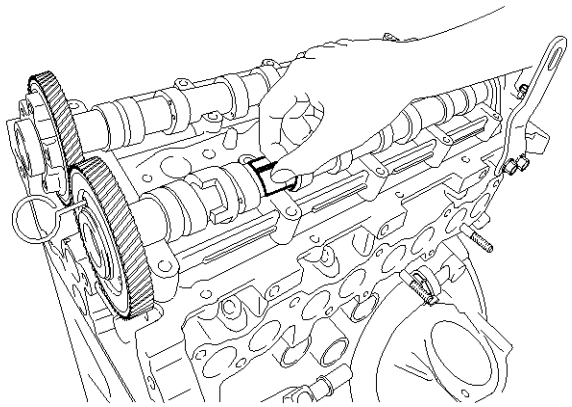
Cam height
Intake : 40.094mm (1.5785in)
Exhaust : 40.425mm (1.5915in)



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.



SXMEM9323D

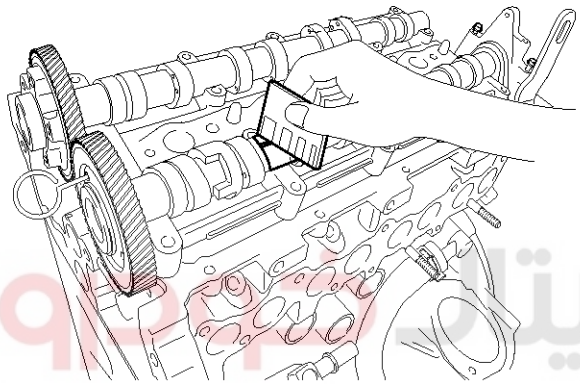
4) Install the bearing caps and tighten the bolts with specified torque.

Tightening torque :
10.0 ~ 12.7N.m (1.1 ~ 1.3kgf.m, 8.0 ~ 9.4lb-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 ~ 0.074mm (0.0016 ~ 0.0029in)



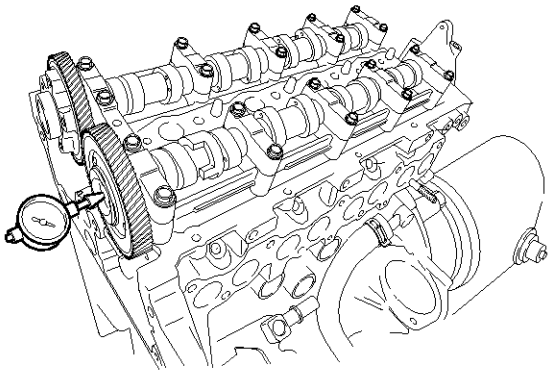
SXMEM9334D

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 : 0.05 ~ 0.15mm (0.0020 ~ 0.0059in)



SXMEM9324D

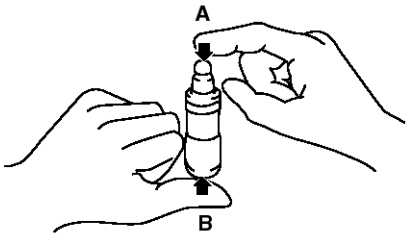
If the end play is greater than specification, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

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

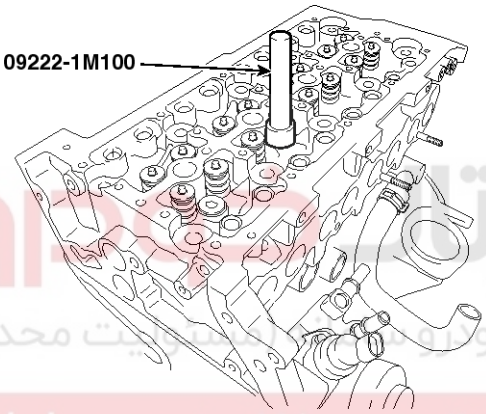
- *Thoroughly clean all parts to be assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surface.*
- *Replace valve stem seals with new ones.*

1. Install the valves.
   1) Using the SST (09222-1M100), push in a new stem seal.

      NOTICE

      Do not reuse old valve stem oil seals.

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



SXMEM9325D

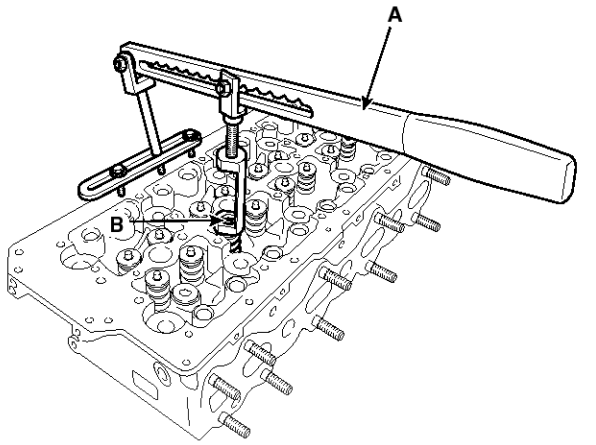
   2) Install the valve, valve spring and spring retainer.

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

      Before releasing the valve spring compressor, ensure that the retainer locks are correctly in place after pushing down and releasing the compressor handle 2 ~ 3 times.



SXMEM9102D

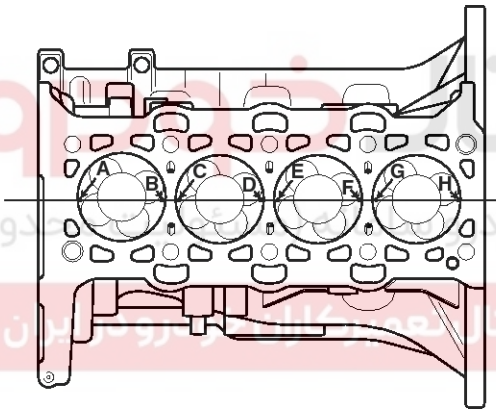
Installation

NOTICE

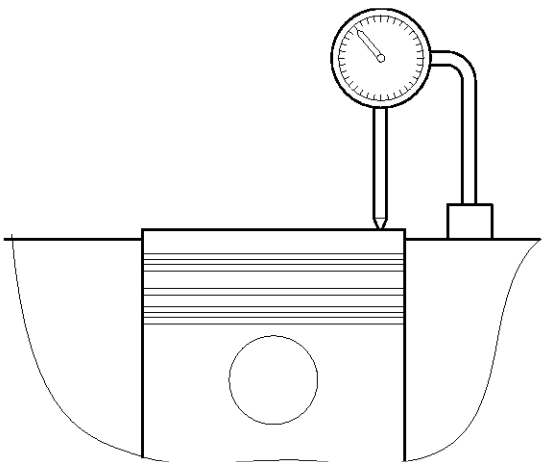
- *Thoroughly clean all parts to be assembled.*
- *Always use a new cylinder head and manifold gasket.*
- *Always use a new cylinder head bolt.*
- *The cylinder head gasket is a metal gasket. Take care not to bend it.*
- *Rotate the crankshaft, set the No.1 piston at TDC.*

1. Clean the gasket mating surfaces of the cylinder head and block to remove oil, dust and scratches.
2. Select the cylinder head gasket.
   1) Measure the piston protrusion from the upper cylinder block face on 8 places (A ~ H) at TDC.

      Measure on the crankshaft center line considering the piston migration.

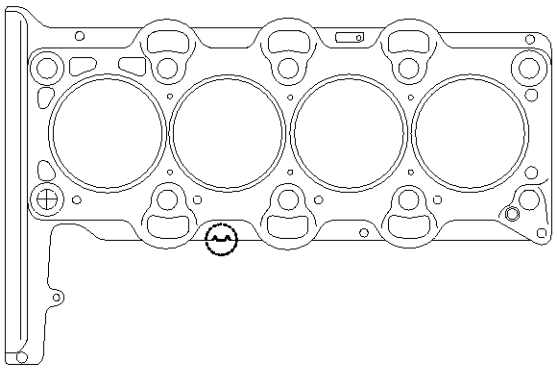


SXMEM9105D



LCGF129A

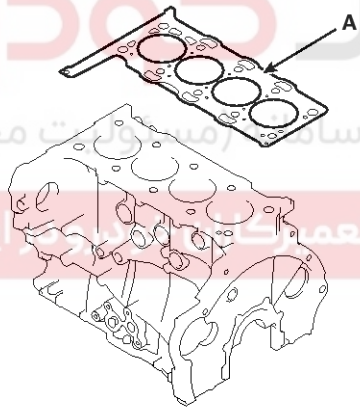
   2) Select the gasket in the table below using the average value of piston protrusions. Although even the only 1 point is over than the each rank limit, use 1 rank upper gasket than specified in the table below.



SXMEM9106D

Displacement	2.0L		
Average of piston protrusion	0.410 ~ 0.531mm (0.0161 ~ 0.0209in)	0.531 ~ 0.602mm (0.0209 ~ 0.0237in)	0.602 ~ 0.672mm (0.0237 ~ 0.0265in)
Gasket thickness	1.15 ~ 1.25mm (0.0453 ~ 0.0492in)	1.25 ~ 1.35mm (0.0492 ~ 0.0531in)	1.35 ~ 1.45mm (0.0531 ~ 0.0571in)
Limit of each rank extant	0.581mm (0.0229in)	0.652mm (0.0257in)	0.722mm (0.0284in)
Identification code	LCGF130A	 LCGF132A	 LCGF131A

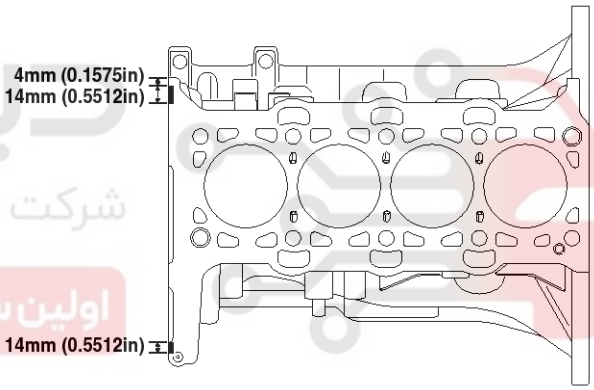
3. Install the cylinder head gasket (A) on the cylinder block.



SXMEM9326D

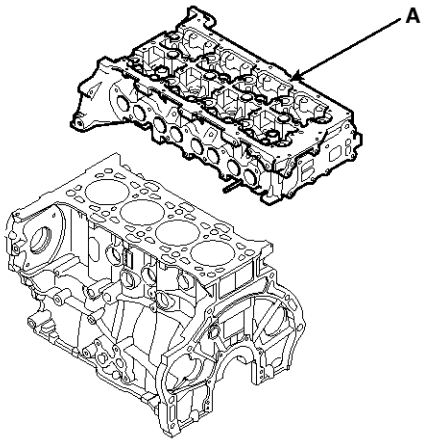
NOTICE

- *Apply sealant on cylinder block top face before assembling cylinder head gaskets and apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block.*
- *Apply sealant (LOCTITE 5902 or equivalent) and assemble the cylinder head within 15 minutes.*
- *Seat the cylinder head gasket on the cylinder head firmly.*
- *Be careful not to damage the bead and coating of the cylinder head gasket before and after assembling the cylinder head gasket.*



SXMEM9327L

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

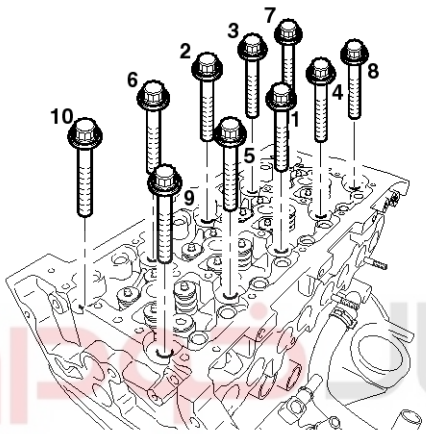


SXMEM9328D

5. Install the cylinder head bolts.
   1) Do not apply engine oil on the cylinder head bolts.
   2) Using SST(09221-4A000), install and tighten the 10 cylinder head bolts, in several passes, in the sequence shown.

Tightening torque :
78.5N.m (8.0kgf.m, 57.9lb-ft) + 120° + 120°

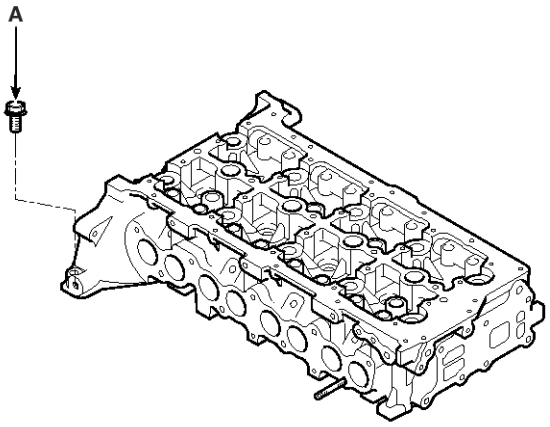
NOTICE
Do not reuse the cylinder head bolts.



SXMEM9329D

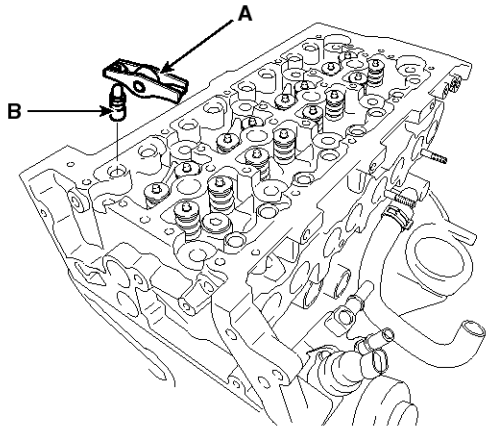
   3) Install the cylinder head side bolt (A).

Tightening torque :
30.4 ~ 34.3N.m (3.1 ~ 3.5kgf.m, 22.4 ~ 25.3lb-ft)



SXMEM9387D

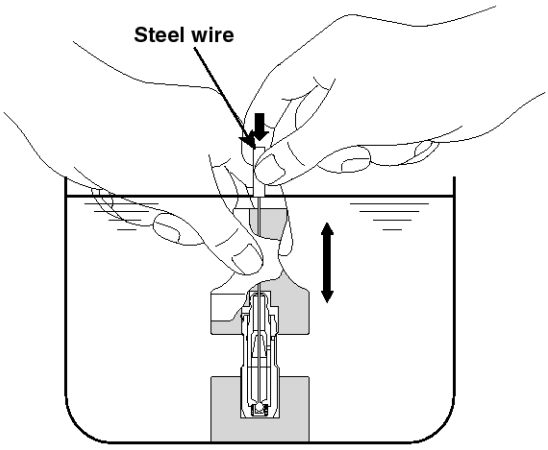
6. Install the hydraulic lash adjuster (HLA) (B) and cam follower (A).



SXMEM9100D

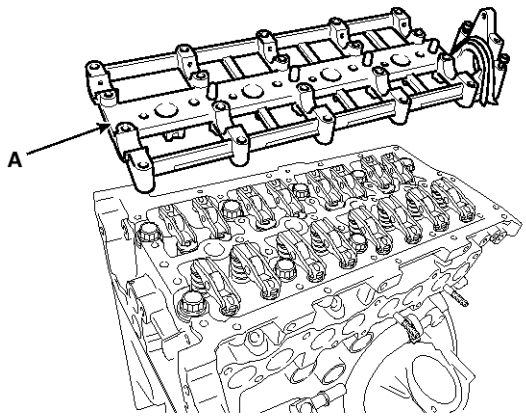
   1) Until installing HLA shall be held upright so that engine oil in HLA should not spill and assured that dust does not adhere to HLA.
   2) HLA shall be inserted tenderly to the cylinder head not to spill engine oil from HLA. In case of spilling, air bent shall be done in accordance with the air bent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

NOTICE
Stroke HLA in engine 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

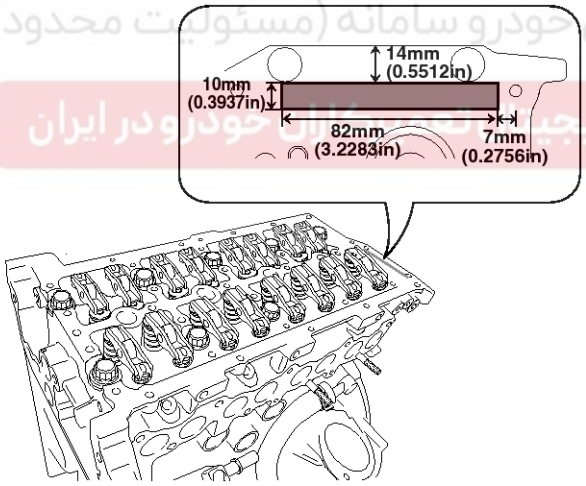
7. Install the cam carrier (A) with a new gasket.



SXMEM9099D

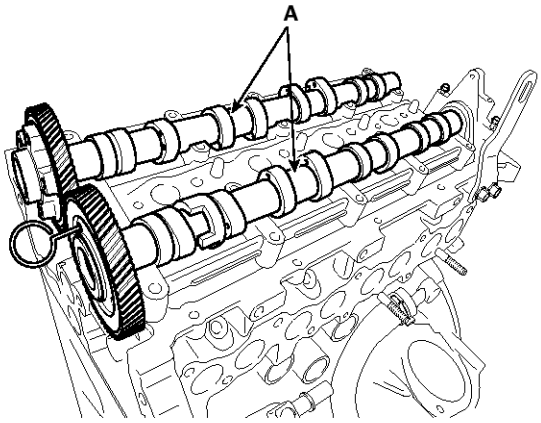
NOTICE

- *Apply sealant (LOCTITE 518, THREEBOND 1389 or equivalent) to the rectangular area at the rear of the cylinder head before assembling the cam carrier.*
- *Remove the extruded sealant after assembling cam carrier.*



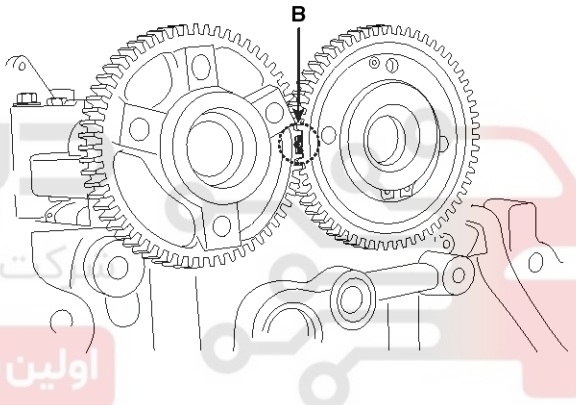
SXMEM9331L

8. Install the camshafts (A) with the timing marks (B,C) aligned.



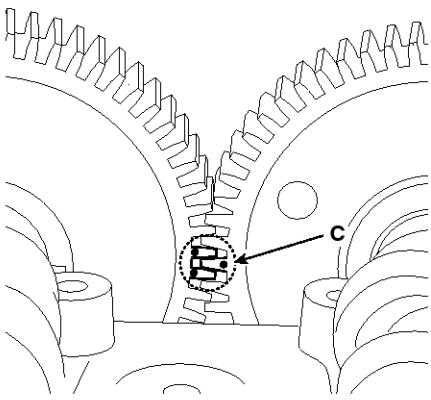
SXMEM9098D

[Front]



SXMEM9395D

[Rear]



SXMEM9330D

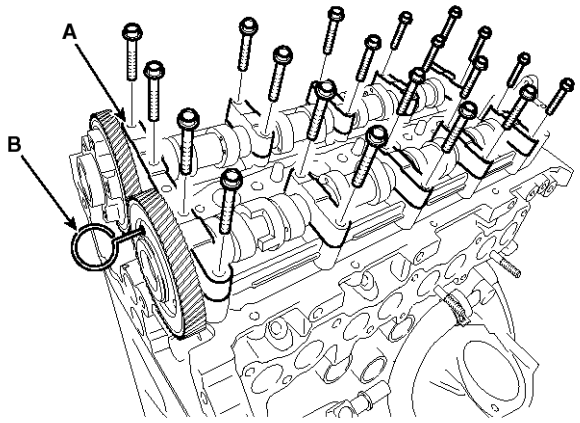
CAUTION

When assembling the camshafts, check the front amd rear timing marks on the gears.

9. Install the camshaft bearing caps (A).
10. Remove the assembly pin (B). (Standard only)

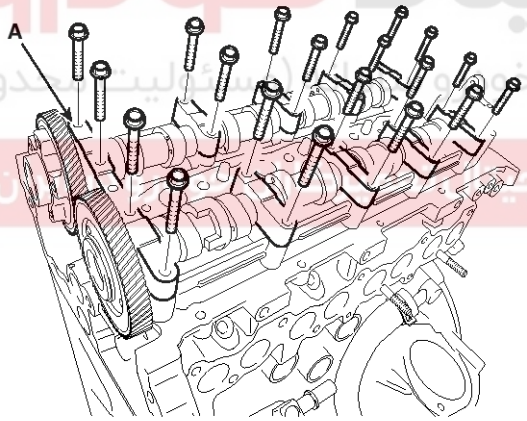
Tightening torque :
10.8 ~ 12.7N.m (1.1 ~ 1.3kgf.m, 8.0 ~ 9.4lb-ft)

[Standard]



SXMEM9097D

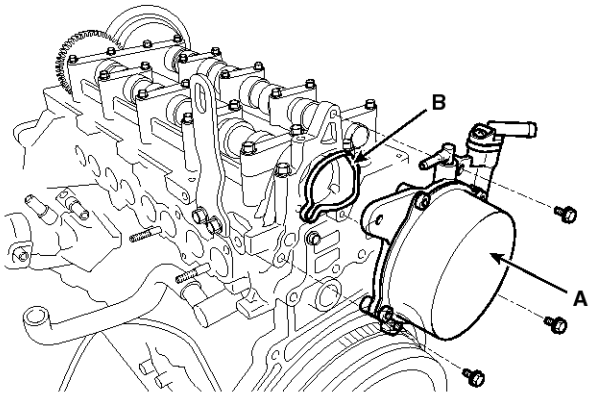
[Low Power]



SELEM0005L

11. Install the vacuum pump (A) with a new O-ring (B).

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

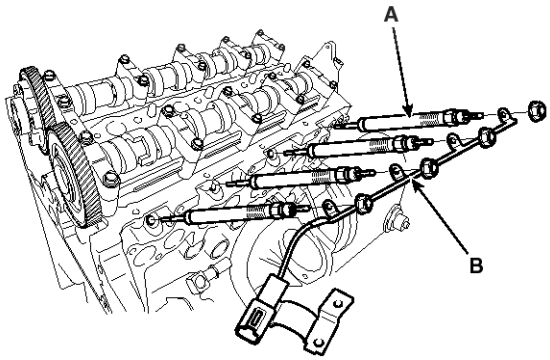


SXMEM9096D

⚠CAUTION
Be careful not to miss the O-ring out of the vacuum pump before installing the vacuum pump.

12. Install the glow plug (A) and the wiring & glow plug plate (B).

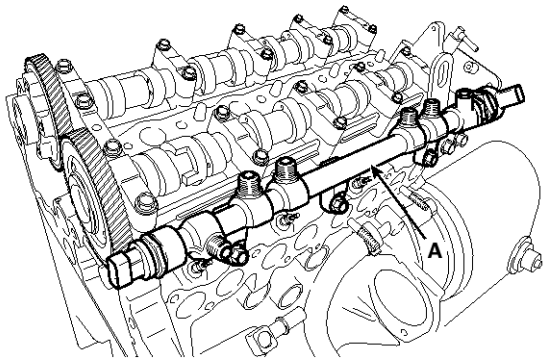
Tightening torque :
Glow plug : 15 ~ 20N.m (1.5 ~ 2.0kgf.m, 11 ~ 14lb-ft)
Plate nut : 0.8~1.5N.m (0.08 ~ 0.15kgf.m, 0.6 ~ 1.1lb-ft)



SCMEM0108D

13. Install the common rail (A). (Refer to FL group)

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



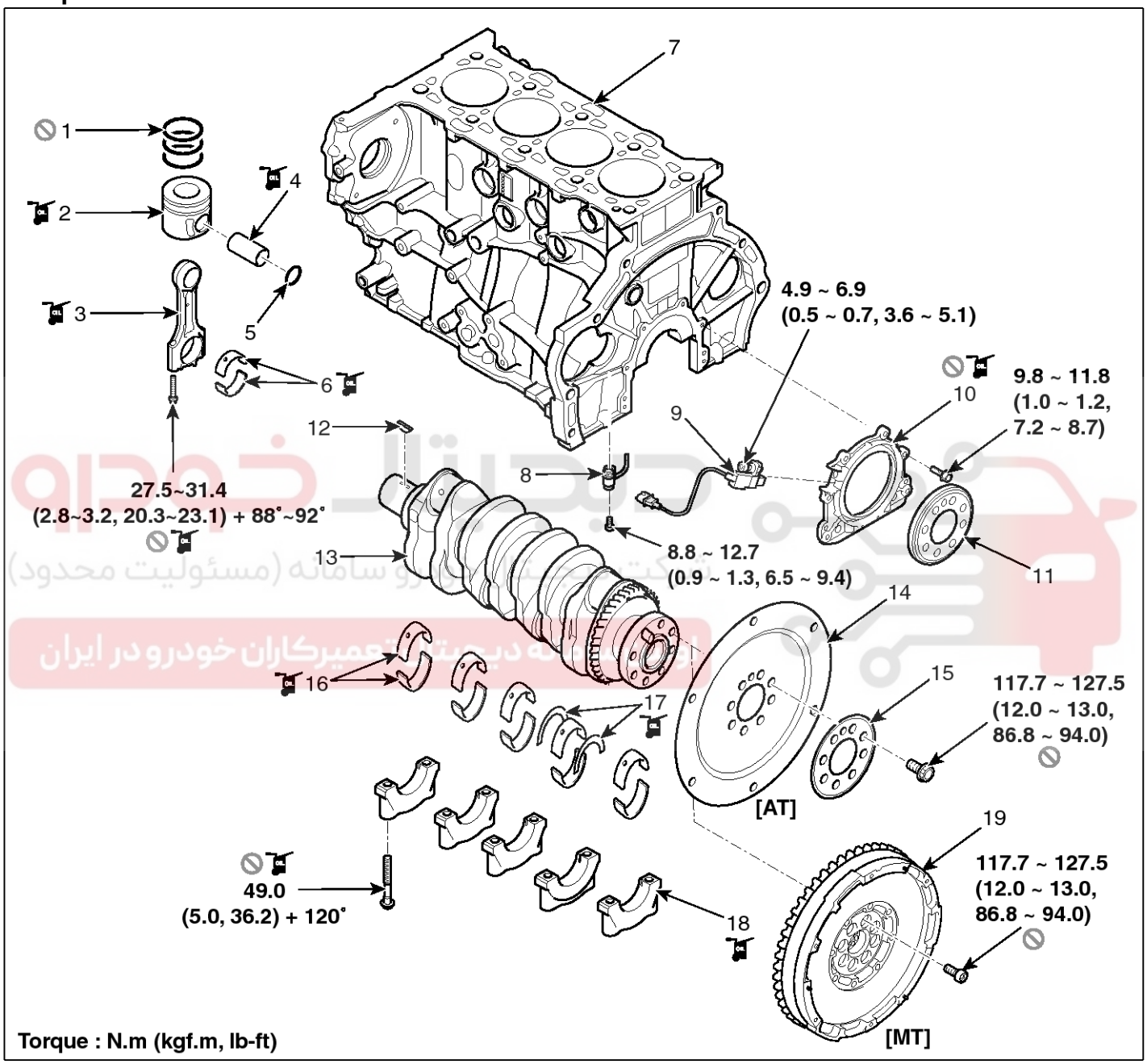
SCMEM0107D

14. Install the timing chain. (Refer to Timing chain in this group)
15. Install the intake and exhaust manifold. (Refer to Intake ad exhaust system in this group)

Cylinder Block

Cylinder Block

Components



SSLEM0107L

1. Piston ring
2. Piston
3. Connecting rod
4. Piston pin
5. Snap ring
6. Connecting rod bearing
7. Cylinder block
8. Oil jet
9. Crankshaft position sensor (CKPS)
10. Rear oil seal case assembly
11. Encorder
12. Crankshaft key
13. Crankshaft
14. Drive plate
15. Adapter plate
16. Crankshaft main bearing
17. Crankshaft thrust bearing
18. Crankshaft main bearing cap
19. Flywheel

Disassembly

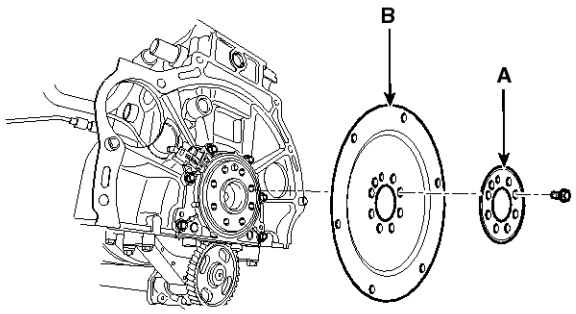
CAUTION

- **Use fender covers to avoid damaging painted surfaces.**
- **To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.**
- **When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.**
- **To avoid damage, unplug the wiring connectors carefully while holding the connector portion.**

NOTICE

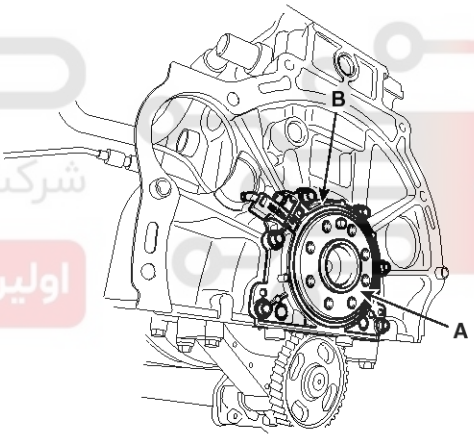
- *Mark all wiring and hoses to avoid misconnection.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center.*

1. Remove the engine assembly from the vehicle. (Refer to Engine and transaxle assembly in this group)
2. Install the engine to engine stand for disassembly.
3. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
4. Remove the timing chain. (Refer to Timing chain in this group)
5. Remove the cylinder head. (Refer to Cylinder head in this group)
6. Remove the high pressure pump. (Refer to FL group)
7. Remove the water pump assembly. (Refer to Cooling system in this group)
8. AT: Remove the adapter plate (A) and drive plate (B).
   MT: Remove the flywheel.



SLMEM0083D

9. Remove the encorder (A) and the rear oil seal case assembly (B).



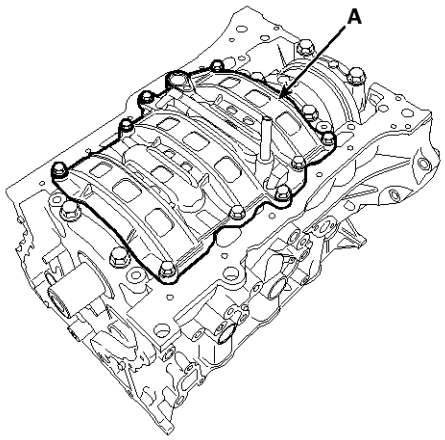
SLMEM0081D

CAUTION

- **Do not reuse the rear oil seal case assembly.**
- **Do not place a magnatic substance around the encorder.**
- **Be careful not to scratch or damage the encorder by falling down or impacting on.**
- **Keep the encorder from liquid sealant and other harmful materials.**

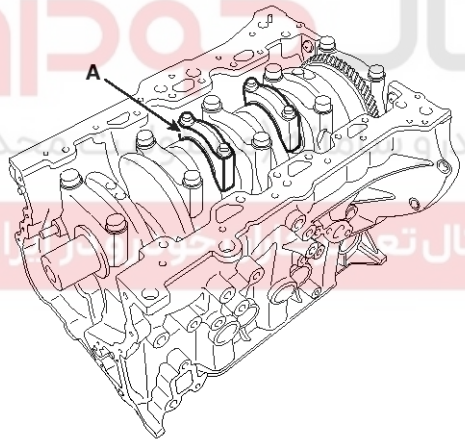
10. Remove the oil pump module. (Refer to Lubrication system)

11. Remove the ladder frame (A).



SLMEM0031D

12. Remove the piston and connecting rod assemblies.
    1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
    2) Remove the connecting rod cap (A).



SXMEM9108D

NOTICE

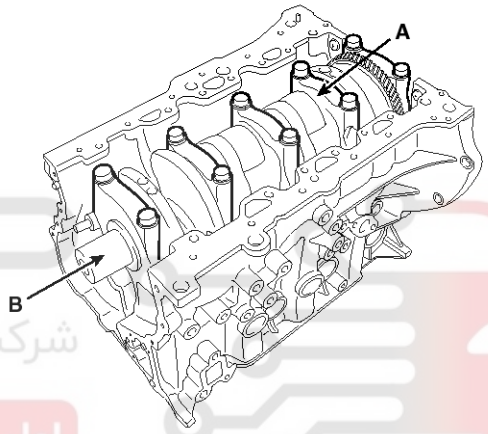
Mark the connecting rod, and caps to be able to reassemble in the original position and direction.

    3) Push the piston and connecting rod assembly with upper bearing through the top of the cylinder block.

NOTICE

- *Keep the connecting rod ands cap with their bearings assembled together.*
- *Arrange the piston and connecting rod assemblies in the correct order.*
- *Mark the piston and connecting rod assemblies to be able to reassemble in the original position.*

13. Remove the main bearing caps (A) and then lift the crankshaft (B) out of the cylinder block, being careful not to damage journals.

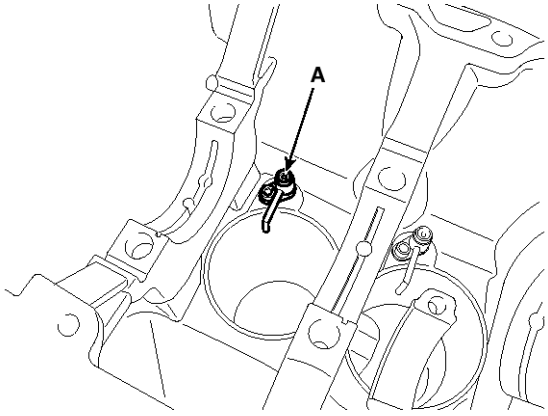


SXMEM9109D

NOTICE

- *Arrange the main bearings and thrust bearings in the correct order.*
- *Keep the main bearing caps with their bearings assembled together.*

14. Remove the oil jet (A).



SXMEM9110D

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.

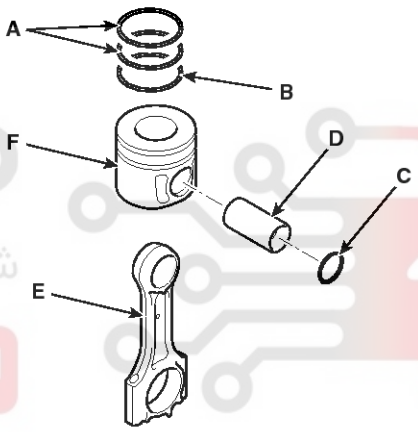
1) Using a piston ring expender, remove the 2 compression rings (A).
2) Remove the oil ring and coil spring (B) by hand.

CAUTION
Do not apply excessive force to remove the oil ring from piston. It may cause to break the oil ring.

NOTICE
Arrange the piston rings in the correct order only.

17. Remove the connecting rod from the piston.

1) Remove the snap ring (C) from the piston.
2) Using a press, remove the piston pin from piston.
3) Disassemble the piston (F) and connecting rod (E).



SXMEM9333D

Inspection

Connecting Rod

1. Check the end play between piston and connecting rod.

End play
Standard : 0.05 ~ 0.31mm (0.0020 ~ 0.0122in)

- If out-of-tolerance, install a new connecting rod.
- If still out-of-tolerance, replace the crankshaft.

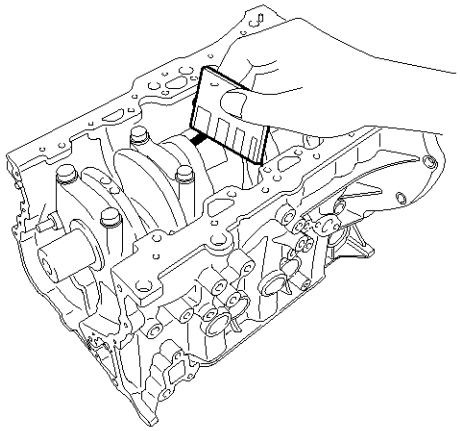
2. Check the connecting rod bearing oil clearance.
   1) Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.
   2) Remove the 2 connecting rod cap bolts.
   3) Remove the connecting rod cap and lower bearing.
   4) Clean the crankshaft pin journal and bearing.
   5) Place a plastigage across the crankshaft pin journal.
   6) Reinstall the lower bearing and cap, and tighten the nuts.

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

NOTICE
Do not turn the crankshaft.
Do not reuse the connection rod cap bolts.

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

Standard oil clearance
0.024 ~ 0.052mm (0.0009 ~ 0.0020in)



SXMEM9351D

   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.

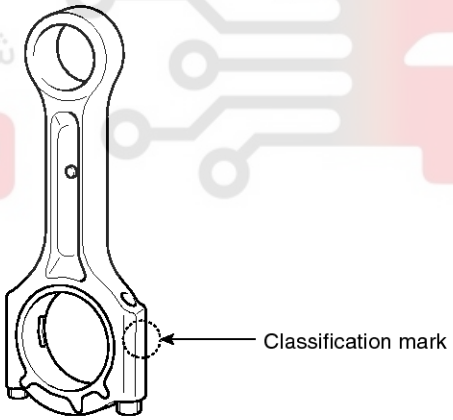
   10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing.

      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

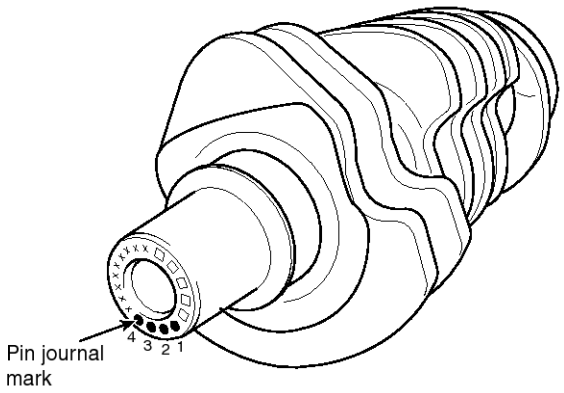


SLMEM0103L

Discrimination Of Connecting Rod

Class (Mark)	Connecting rod big-end inner diameter
A(A)	51.000 ~ 51.006mm (2.0079 ~ 2.0081in)
B(B)	51.006 ~ 51.012mm (2.0081 ~ 2.0083in)
C(C)	51.012 ~ 51.018mm (2.0083 ~ 2.0086in)

Crankshaft Pin Journal Mark Location

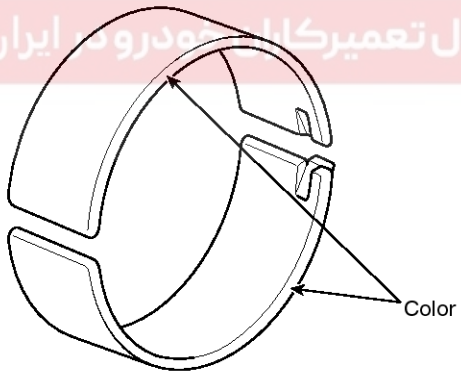


SXMEM9112L

Discrimination Of Crankshaft Pin Journal

Class (Mark)	Crankshaft pin journal outer diameter
I(A)	48.012 ~ 48.018mm (1.8902 ~ 1.8905in)
II(B)	48.006 ~ 48.012mm (1.8900 ~ 1.8902in)
III(C)	48.000 ~ 48.006mm (1.8898 ~ 1.8900in)

Connecting Rod Bearing Mark Location



SXMEM9113L

Discrimination Of Connecting Rod Bearing

Class (Color)	Connecting rod bearing thickness	
	Upper	Lower
A (Blue)	1.472 ~ 1.477mm (0.0580 ~ 0.0581in)	1.478 ~ 1.481mm (0.0582 ~ 0.0583in)
B (Black)	1.477 ~ 1.482mm (0.0581 ~ 0.0583in)	1.481 ~ 1.484mm (0.0583 ~ 0.0584in)
C (Red)	1.482 ~ 1.487mm (0.0583 ~ 0.0585in)	1.484 ~ 1.487mm (0.0584 ~ 0.0585in)

11) Select the bearing by using selection table.

Connecting Rod Bearing Selection Table

Connecting rod bearing		Connecting rod mark		
		A(A)	B(B)	C(C)
Crank shaft pin journal mark	I(A)	A(Blue)	A(Blue)	B(Black)
	II(B)	A(Blue)	B(Black)	C(Red)
	III(C)	B(Black)	C(Red)	C(Red)

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

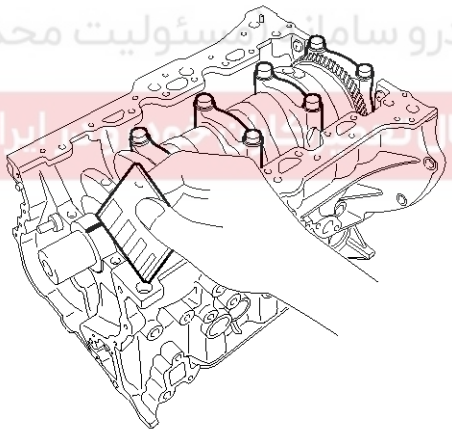
1. Check the crankshaft bearing oil clearance.
   1) To check main bearing-to-journal oil clearance, remove the bearing caps with their lower bearings.
   2) Clean each main journal and lower bearing with a clean shop towel.
   3) Place one strip of plastigage across each main journal.
   4) Reinstall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

Tightening torque :
49.0N.m (5.0kgf.m, 36.2lb-ft) + 120°

NOTICE
- *Do not turn the crankshaft.*
- *Do not reuse the main bearing cap bolts.*

   5) Remove the bearing caps with their lower bearing again, and measure the widest part of the plastigage.

Standard oil clearance :
0.026 ~ 0.044mm (0.0010 ~ 0.0017in)



SXMEM9352D

   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.

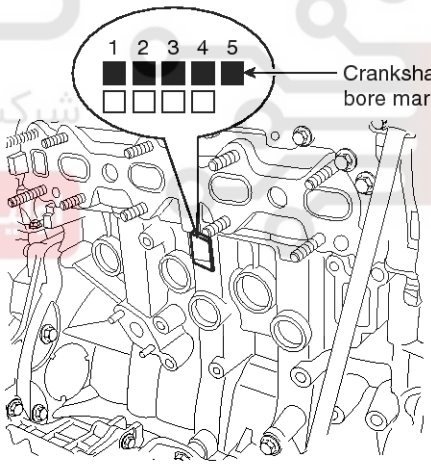
      NOTICE
      If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

      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 side 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.

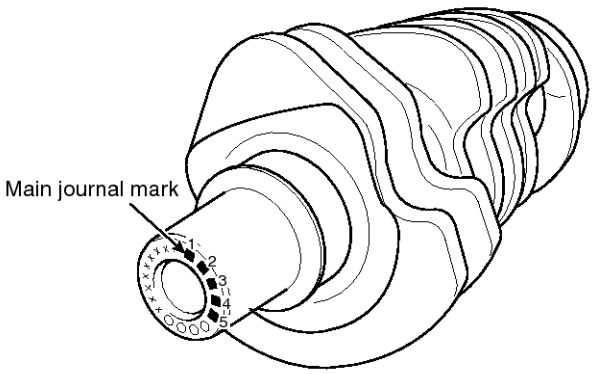


SXMEM9114L

Discrimination Of Cylinder Block Crankshaft Journal Bore

Class (Mark)	Cylinder block journal bore inner diameter
A(A)	64.000 ~ 64.006mm (2.5197 ~ 2.5199in)
B(B)	64.006 ~ 64.012mm (2.5199 ~ 2.5202in)
C(C)	64.012 ~ 64.018mm (2.5202 ~ 2.5204in)

Crankshaft Main Journal Mark Location

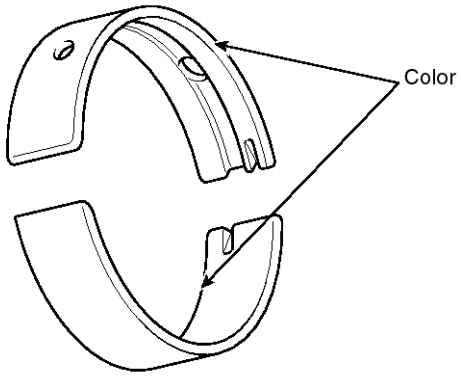


SXMEM9353L

Discrimination Of Crankshaft Main Journal

Class (Mark)	Crankshaft main journal outer diameter
I(A)	60.012 ~ 60.018mm (2.3627 ~ 2.3629in)
II(B)	60.006 ~ 60.012mm (2.3624 ~ 2.3627in)
III(C)	60.000 ~ 60.006mm (2.3622 ~ 2.3624in)

Crankshaft Main Bearing Mark Location



SXMEM9115L

Discrimination Of Crankshaft Main Bearing

Class (Color)	Crankshaft main bearing thickness
A (Blue)	1.975 ~ 1.978mm (0.0778 ~ 0.0779in)
B (Black)	1.978 ~ 1.981mm (0.0779 ~ 0.0780in)
C (Red)	1.981 ~ 1.984mm (0.0780 ~ 0.0781in)
D (Green)	1.984 ~ 1.987mm (0.0781 ~ 0.0782in)
E (Yellow)	1.987 ~ 1.990mm (0.0782 ~ 0.0783in)

8) Select the bearing by using selection table.

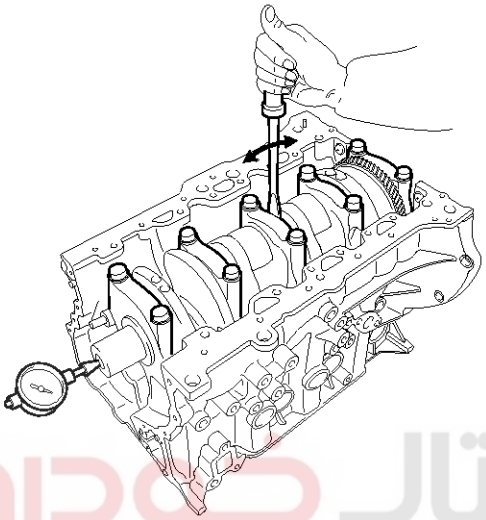
Crankshaft Main Bearing Selection Table

Crankshaft main bearing		Cylinder block crankshaft journal bore mark		
		A(A)	B(B)	C(C)
Crankshaft main journal mark	I(A)	A(Blue)	B(Black)	C(Red)
	II(B)	B(Black)	C(Red)	D(Green)
	III(C)	C(Red)	D(Green)	E(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 : 0.07 ~ 0.25mm (0.0028 ~ 0.098in)
Limit : 0.30mm (0.0118in)



SXMEM9354D

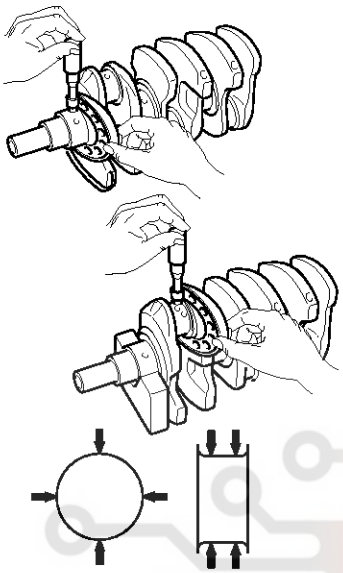
If the end play is greater than specification, replace the thrust bearings as a set.

Thickness of thrust bearing :
1.925 ~ 1.965mm (0.0758 ~ 0.0774in)

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 :
60.000 ~ 60.018mm (2.3622 ~ 2.3629in)
Pin journal diameter :
48.000 ~ 48.018mm (1.8898 ~ 1.8905in)



ECKD001E

Cylinder Block

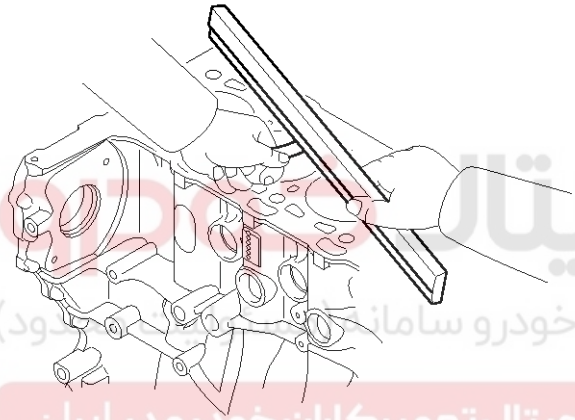
1. Remove the gasket material.

   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)



SXMEM9355D

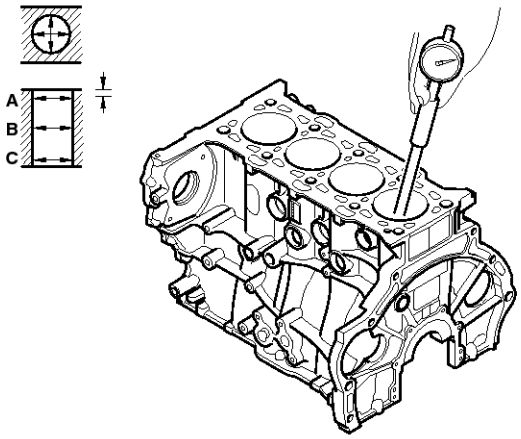
4. Inspect the cylinder bore.

   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.

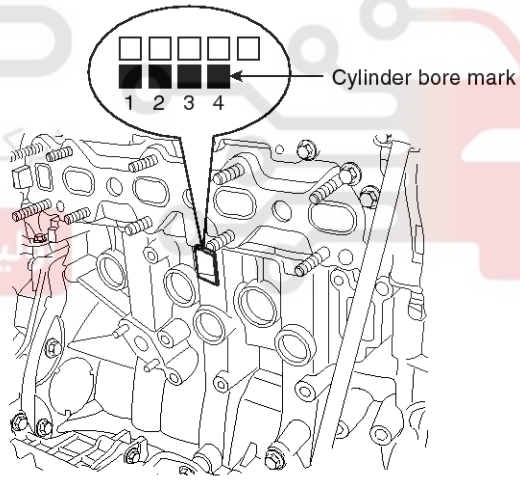
Standard diameter :
84.000 ~ 84.030mm (3.3071 ~ 3.3083in)



SXMEM9356D

A: 10mm (0.3937in)
B: 80mm (3.1496in)
C: 150mm (5.9055in)

6. Check the cylinder bore size mark on the side of the cylinder block.

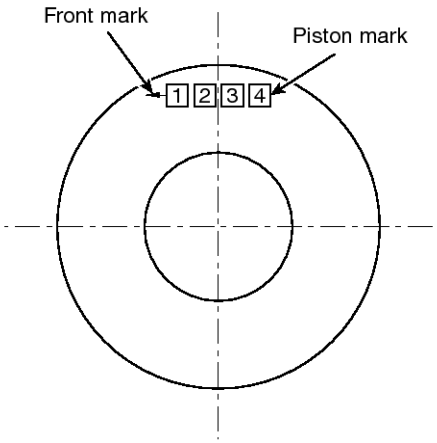


SXMEM9357L

Discrimination Of Cylinder Bore Size

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

7. Check the piston size mark on the piston top face.



SXMEM9306L

Discrimination Of Piston

Item	Mark
1	Engine - 0 : 2.0L
2	Power - S : Standard - L : Low power
3	Piston grade - A - B - C
4	Ring - G : For General region - None : Except General region

Discrimination Of Piston Outer Diameter

Class (Mark)	Piston outer diameter
A(A)	83.915 ~ 83.925mm (3.3037 ~ 3.3041in)
B(B)	83.925 ~ 83.935mm (3.3041 ~ 3.3045in)
C(C)	83.935 ~ 83.945mm (3.3045 ~ 3.3049in)

8. Select the piston related to cylinder bore class.

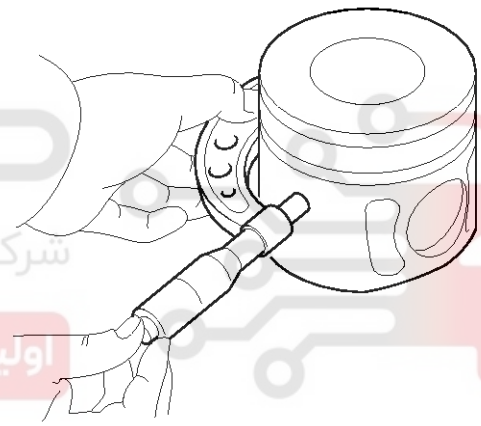
Piston-to-cylinder clearance :
0.075 ~ 0.095mm (0.0030 ~ 0.0037in)

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 :
83.915 ~ 83.945mm (3.3037 ~ 3.3049in)



SXMEM9358D

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

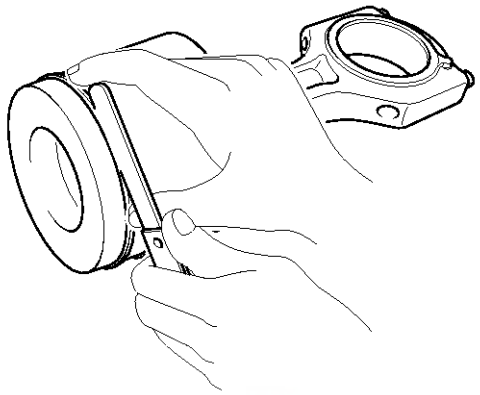
Piston-to-cylinder clearance :
0.075 ~ 0.095mm (0.0030 ~ 0.0037in)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

No.1 : 0.102 ~ 0.146mm (0.0040 ~ 0.0057in)
No.2 : 0.070 ~ 0.110mm (0.0028 ~ 0.0043in)
Oil ring : 0.030 ~ 0.070mm (0.0012 ~ 0.0028in)



SXMEM9359D

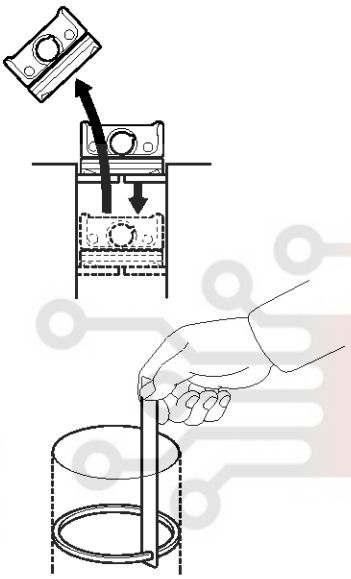
If the clearance is greater than maximum, replace the piston.

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 : 0.18 ~ 0.33mm (0.0071 ~ 0.0130in)
No.2 : 0.35 ~ 0.50mm (0.0138 ~ 0.0297in)
Oil ring : 0.25 ~ 0.50mm (0.0098 ~ 0.0197in)

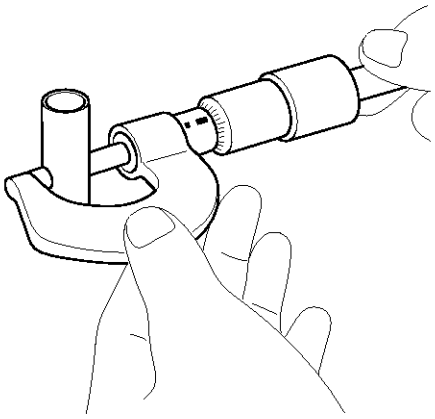


ECKD001K

Piston Pins

1. Measure the outer diameter of piston pin.

Piston pin diameter :
33.991 ~ 33.997mm (1.3382 ~ 1.3385in)



ECKD001Z

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

Piston pin-to-piston clearance :
0.007 ~ 0.019mm (0.0003 ~ 0.0007in)

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

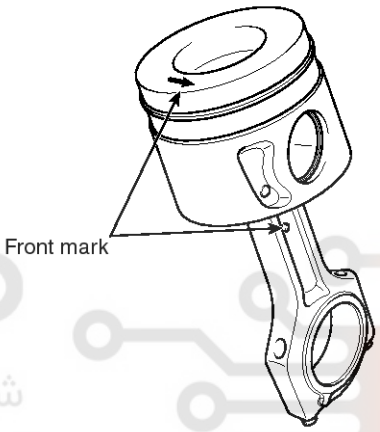
Piston pin-to-connecting rod interference :
0.023 ~ 0.041mm (0.0009 ~ 0.0016in)

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 the connecting rod.
   1) Install the snap ring in one side of the piston pin hole.
   2) Align the piston front mark and the connecting rod front mark.



SXMEM9116L

   3) Insert the piston pin into the piston pin hole and the small end bore of connecting rod.
   4) Install the snap ring in the other side after inserting the piston pin.

NOTICE

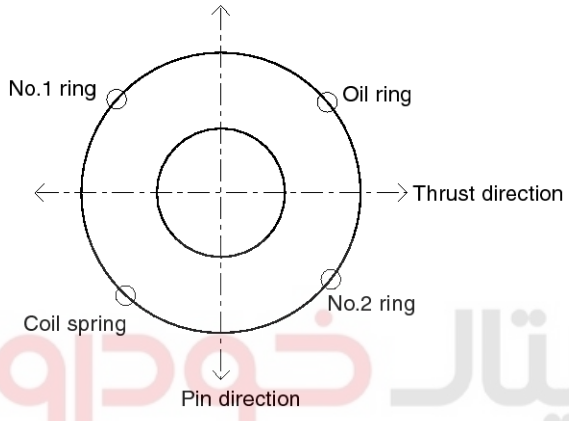
Apply a sufficient amount of engine oil to outer surface of the piston, inner surface of piston pin hole and small end bore of the connecting rod before inserting the piston pin.

CAUTION

- **Be careful not to damage and scratch the small end bore, piston pin hole and piston pin when insering the piston pin.**
- **Set the snap ring firmly so that the snap ring can contact with the whole groove of the piston pin hole.**

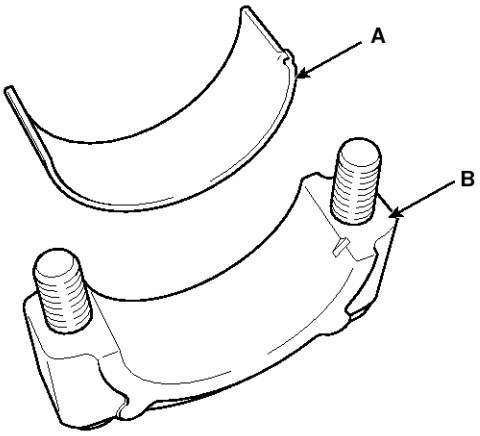
2. Install the piston rings.
   1) Install the oil ring with the coil spring by hand.
   2) Using a piston ring expander, install the 2 compression rings with the maker mark facing upward.
   3) Position the piston rings so that the ring ends are as shown. (The No.1 ring should be on the opposite side of the No.2 ring and the oil ring should be on the opposite side of the coil spring.)

Example)



SXMEM9360L

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



SXMEM9117D

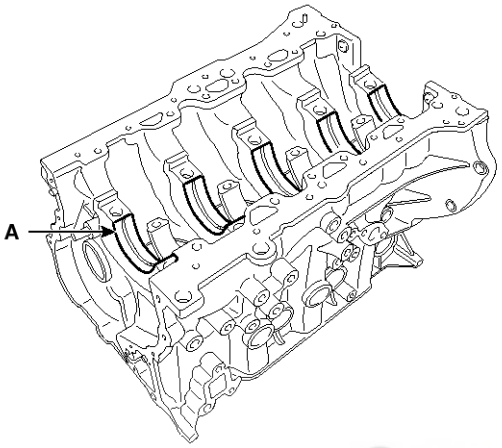
   2) Apply a coat of engine oil after assembling the bearings.

4. Install the crankshaft main bearings.

NOTICE

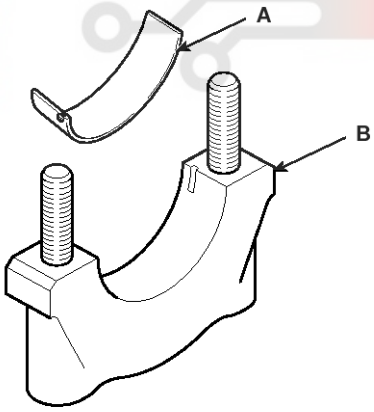
Upper bearings have an oil groove of oil holes ; Lower bearings do not.

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



SXMEM9118D

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

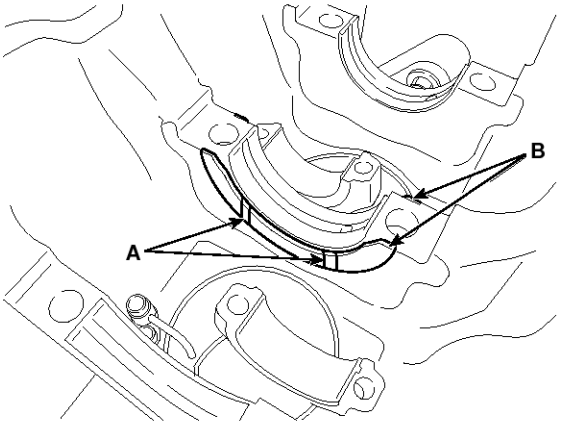


SXMEM9119D

   3) Apply a coat of engine oil after assembling the main bearings.

5. Install the thrust bearings (No.4 journal).

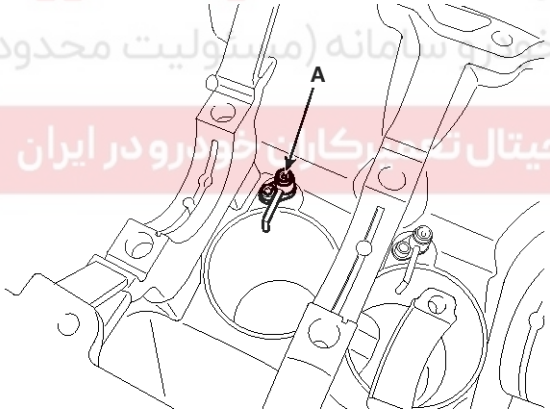
   Install the 2 thrust bearings (B) on both sides of the No.4 journal of the cylinder block with the oil groove (A) facing out.



SXMEM9120D

6. Install the oil jet (A).

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



SXMEM9110D

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

   Apply a coat of engine oil to the pin and main journals after assembling the crankshaft.

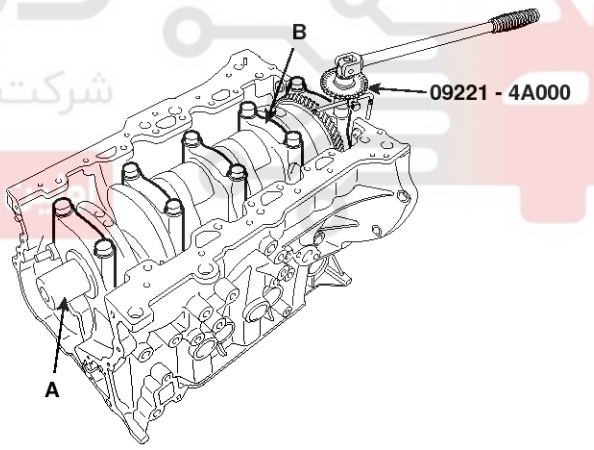
8. Install the main bearing caps (B) and tighten the cap bolts.

   NOTICE
   - *Do not reuse the bearing cap bolts.*
   - *Be sure to assemble the main bearing caps in correct order.*
   - *Install the main bearing cap with the arrow facing the front of the engine.*
   - *Tighten all the main bearing cap bolts with the specified torque first, and then retighten all the bolts with the specified angle.*

   1) Apply a light coat of engine oil on the threads of the bolts.
   2) Tighten all the bolts with the specified torque in numerical order.
   3) Tighten all the bolts with the specified angle in numerical order.

Tightening torque :
49.0N.m (5.0kgf.m, 36.2lb-ft) + 120°

Using the SST (09221-4A000), tighten the bolts.



SXMEM9361D

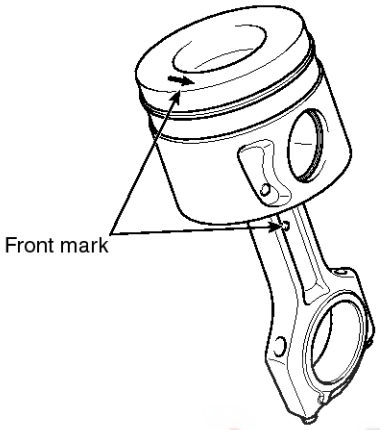
   4) Check that the crankshaft turns smoothly.

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.*
- *Install the pistion and connecting rod assembly with the front marks facing the front of the engine.*

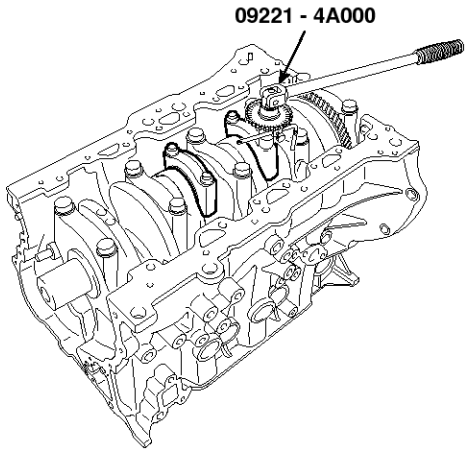


SXMEM9116L

1) 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.
2) Stop after the ring compressor pops free, and check the connecting rod-to-crank journal alignment before pushing the piston into place.
3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

Tightening torque :
27.5~31.4N.m (2.8~3.2kgf.m, 20.3~33.1lb-ft) + 88°~92°

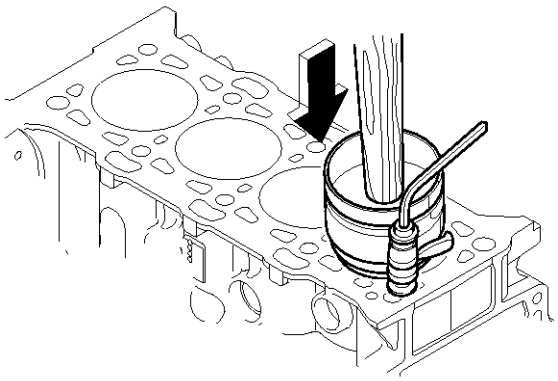
Using the SST (09221-4A000), tighten the bolts.



SXMEM9362D

NOTICE

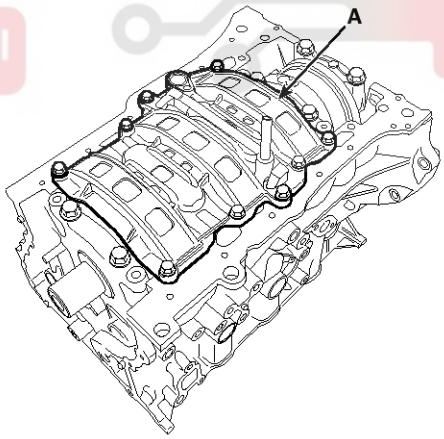
- *Do not reuse the connecting rod cap bolts.*
- *Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.*



SXMEM9363D

11. Check the end play between piston and connecting rod.
12. Install the ladder frame (A).

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

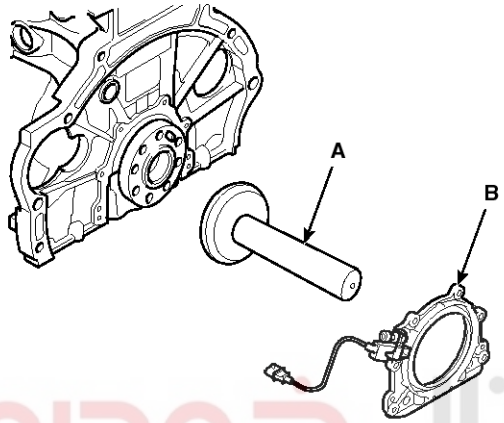


SLMEM0031D

13. Install the oil pump medule. (Refer to Lubrication system in this group)

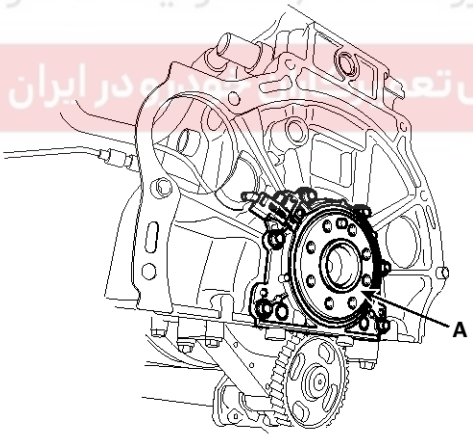
14. Install new rear oil seal case assembly and the encorder.
    1) Install the SST (09231-1M200, 09231-H110)(A) on the crankshaft.
    2) Push in the rear oil seal case assembly (B) by hand and then tighten the bolts.

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



SXMEM9396D

3) Install the encorder (A).

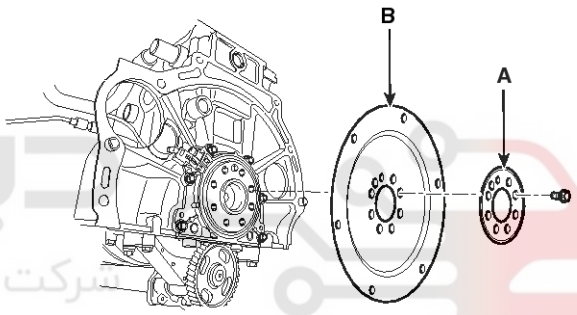


SLMEM0082D

⚠CAUTION
- **Apply a coat of engine oil around PTFE seal before installing the rear oil seal assembly.**
- **Be careful not to damage and twist the PTFE seal.**
- **Remove harmful materials on the crankshaft flenge and use the SST to prevent the PTFE seal from being damaged and twisted.**
- **Insert the dust cover completely into the slot of the cylinder block and then confirm the assembly with the sensor cable.**
- **Do not reuse the rear oil seal case assembly.**
- **When keeping the SST, keep away from foreign sub stances and be careful not tobe scratched.**
- **When installing the rear oil seal case assembly, do not hold the lip portion.**

15. AT : Install the drive plate (B) and adapter plate (A).
    MT : Install the flywheel.

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



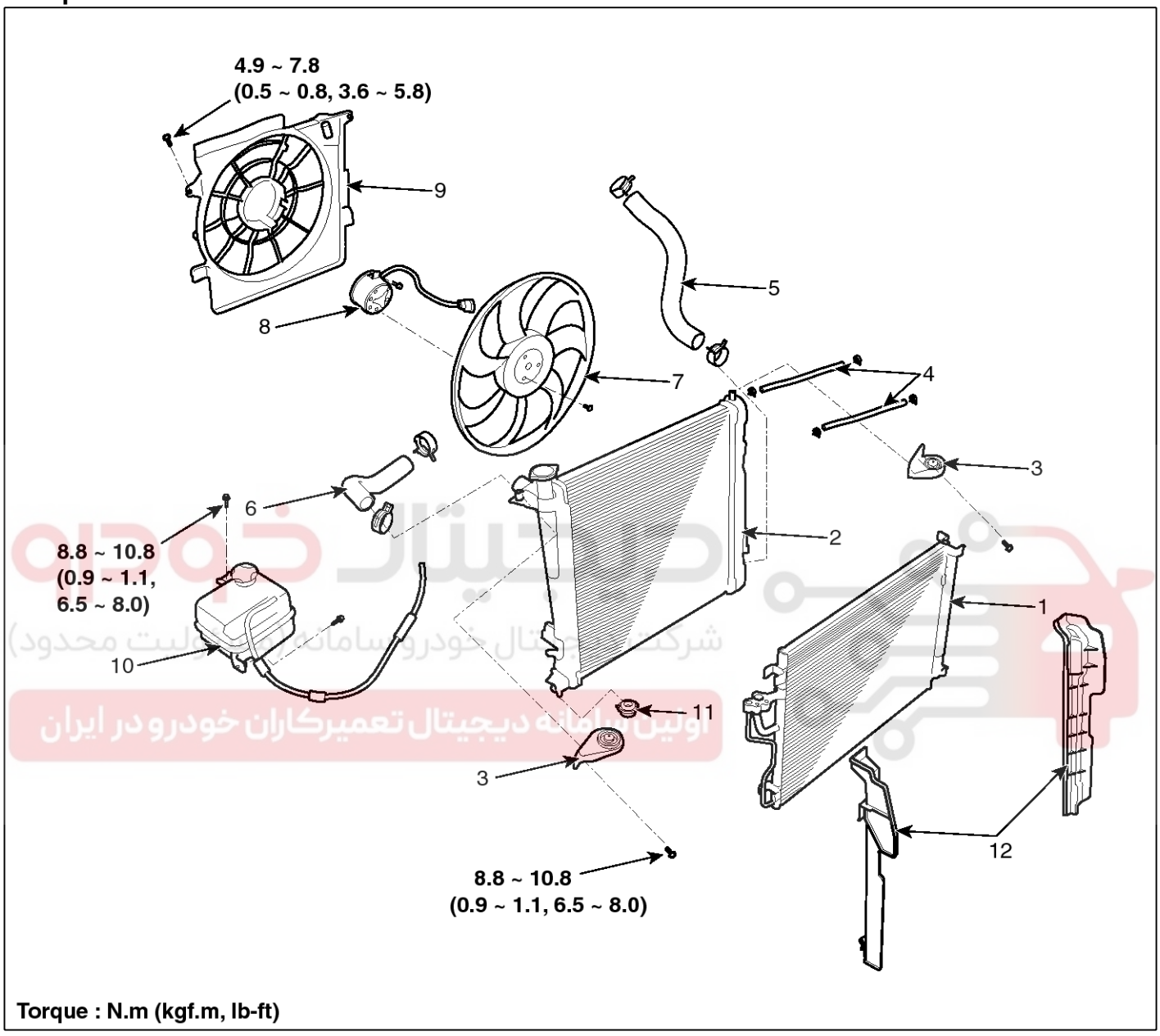
SLMEM0083D

⚠CAUTION
Do not reuse the drive plate bolts and flywheel bolts.

16. Install the water pump assembly. (Refer to Cooling system in this group)
17. Install the high pressure pump. (Refer to FL group)
18. Install the cylinder head. (Refer to Cylinder head in this group)
19. Install the timing chain. (Refer to Timing chain in this group)
20. Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
21. Remove the engine from a engine stand.
22. Install the engine assembly in the vehicle. (Refer to Engine and transaxle assembly in this group)

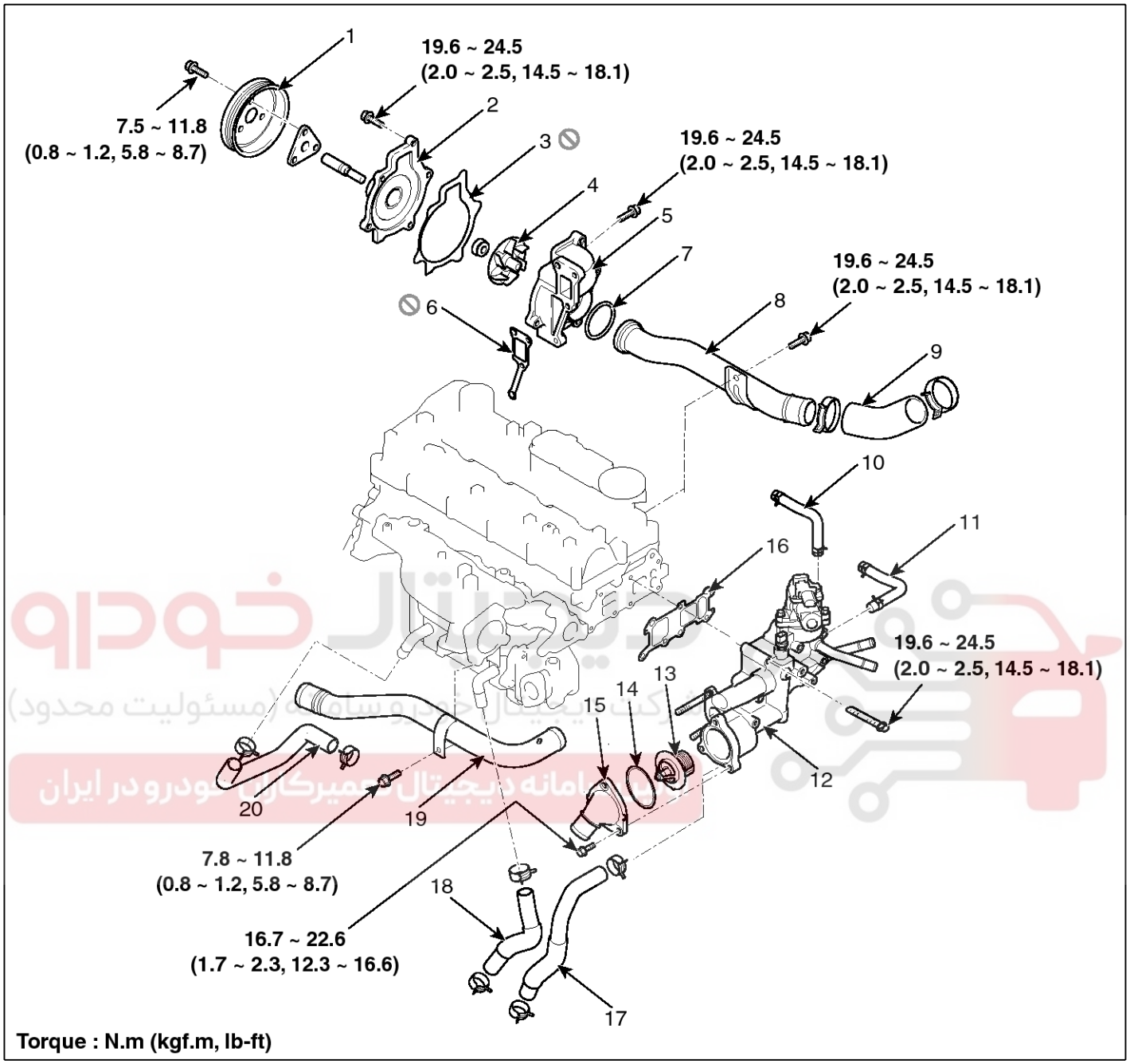
Cooling System

Components



SSLEM0014L

1. A/C condenser
2. Radiator
3. Radiator upper mounting bracket
4. ATF cooler hose
5. Radiator lower hose
6. Radiator upper hose
7. Cooling fan
8. Fan motor
9. Cooling fan shroud
10. Reservoir tank
11. Radiator lower mounting bracket
12. Air guard



SSLEM0108L

1. Water pump pulley
2. Water pump body
3. Water pump gasket
4. Water pump impeller
5. Water pump cover
6. Water pump cover gasket
7. Water inlet pipe O-ring
8. Water inlet pipe
9. Water inlet hose
10. Turbocharger water inlet hose
11. Turbocharger water outlet hose
12. EGR & thermostat housing assembly
13. Thermostat
14. Thermostat O-ring
15. Water inlet fitting
16. EGR & thermostat housing assembly gasket
17. Oil cooler return hose
18. Oil cooler hose
19. Water outlet pipe
20. EGR cooler hose

Coolant

Engine Coolant Refilling And Bleeding

WARNING

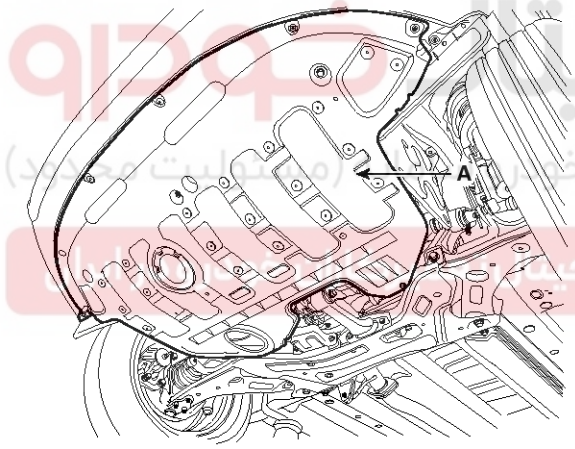
Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

CAUTION

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

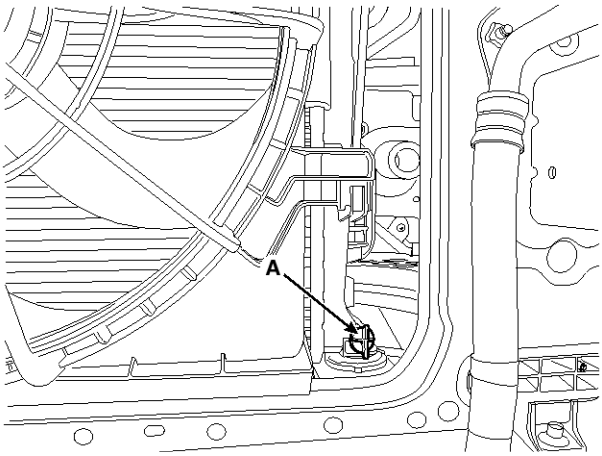
1. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap.
3. Remove the under cover (A).

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



SSLEM0002D

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



SSLEM0003D

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

   NOTICE

   To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.
8. Start the engine and allow to come to normal operating temperature. Wait for the cooling fans to turn on several times. Accelerate the engine to aid in purging trapped air. Shut engine off.
9. Wait until the engine is cool.
10. Repeat steps 1 to 9 until the drained water runs clear.

11. Fill fluid mixture with coolant and water(55~60%) (except for North America, Europe and China : 45~50%) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

NOTICE

- *Use only genuine antifreeze/coolant.*
- *For best corrosion protection, the coolant concentration must be maintained year-round at 55% (except for North America, Europe and China : 45%) minimum.*

  Coolant concentrations less than 55% (except for North America, Europe and China : 45%) may not provide sufficient protection against corrosion or 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.**

12. Start the engine and run coolant circulates.

    When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
13. Repeat step 12 until the cooling fan 3~5 times and bleed air sufficiently out of the cooling system.
14. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
15. Run the vehicle under idle until the cooling fan operates 2~3 times.
16. Stop the engine and wait coolant gets cool.
17. Repeat steps 11 to 16 until the coolant level doesn't fall any more, bleed air out of the cooling system.

NOTICE

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

Coolant capacity :

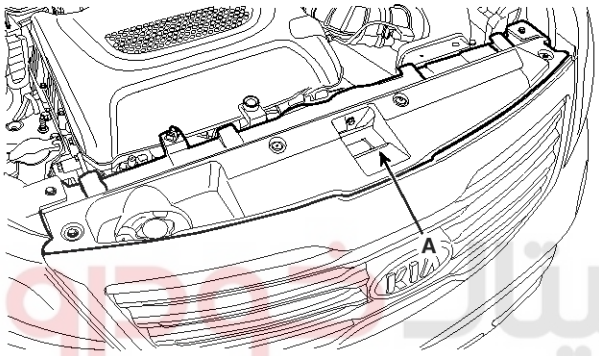
MT : 8.5L (8.98US qt, 7.48lmp qt)

AT : 8.4L (8.88US qt, 7.39lmp qt)

Radiator

Removal and Installation

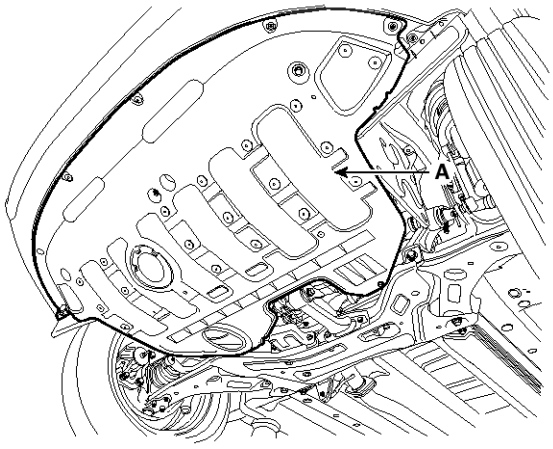
1. Disconnect the battery terminal. (Refer to Engine and transaxle assembly in this group)
2. Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
3. Remove the battery and battery tray. (Refer to Engine and transaxle assembly in this group)
4. Remove the radiator grill upper cover (A). (Refer to BD group)



SSLEM0028D

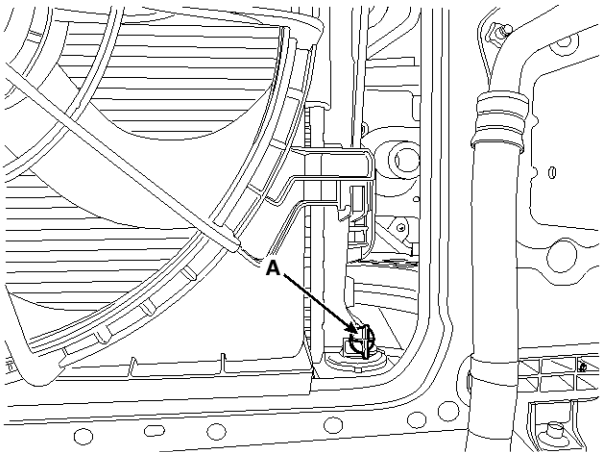
5. Remove the under cover (A).

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



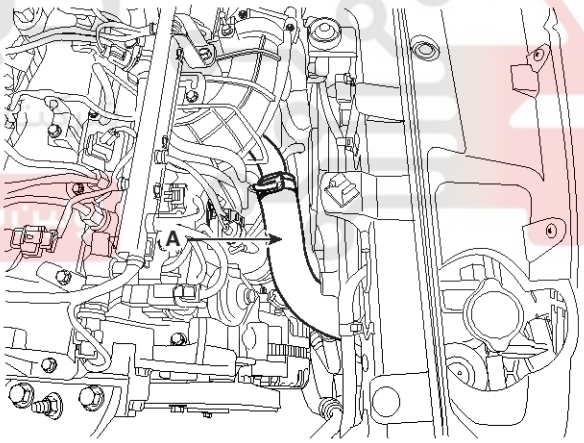
SSLEM0002D

6. Loosen the drain plug (A), and drain the coolant. Remove the radiator cap to drain with speed.

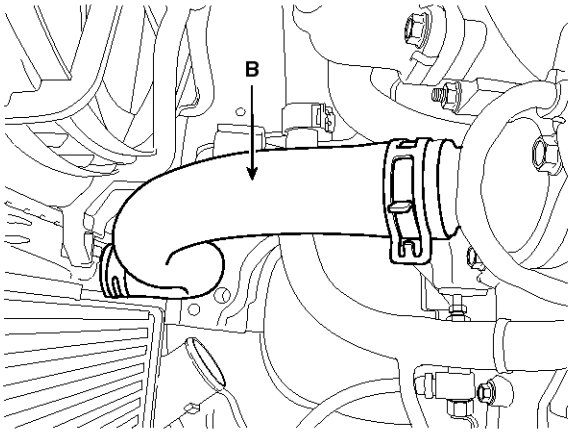


SSLEM0003D

7. Disconnect the radiator upper hose (A) and lower hose (B).



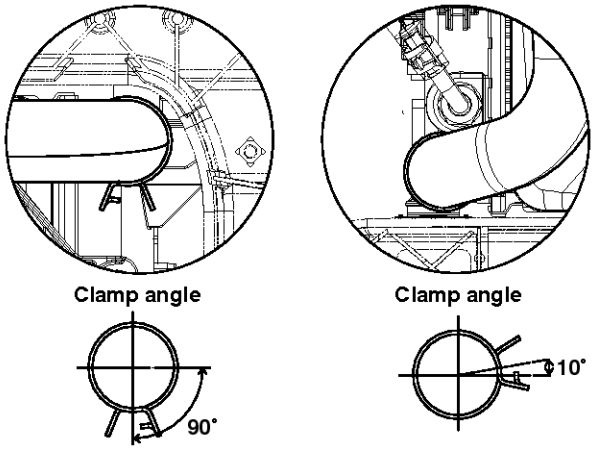
SSLEM0013D



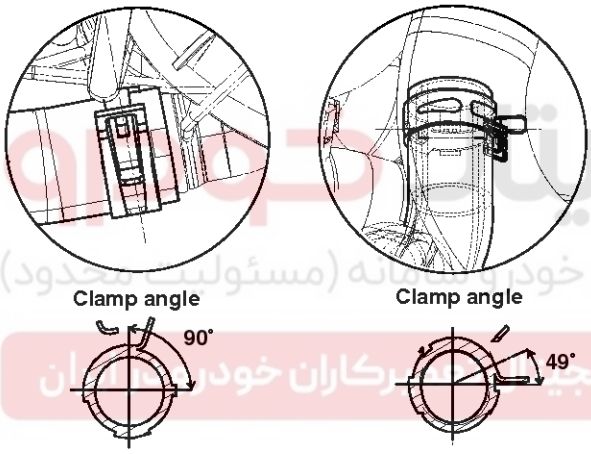
SXMEM9008D

NOTICE

Install the radiator hoses as shown illustrations.

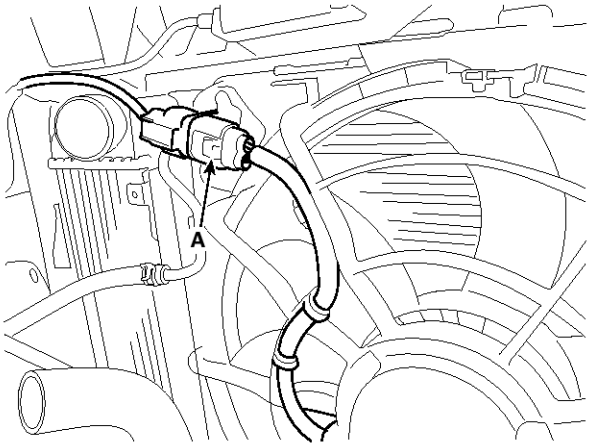


SSLEM0113L



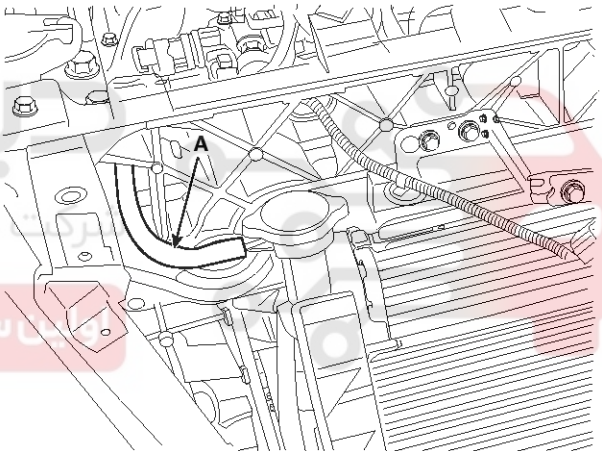
SSLEM0114L

8. Remove the ATF cooler hose. (Refer to AT group)
9. Disconnect the fan motor connector (A).



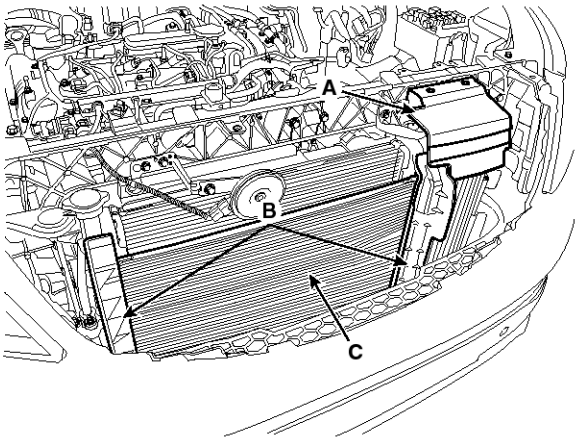
SLMEM0020D

10. Disconnect the over flow hose (A).



SSLEM0025D

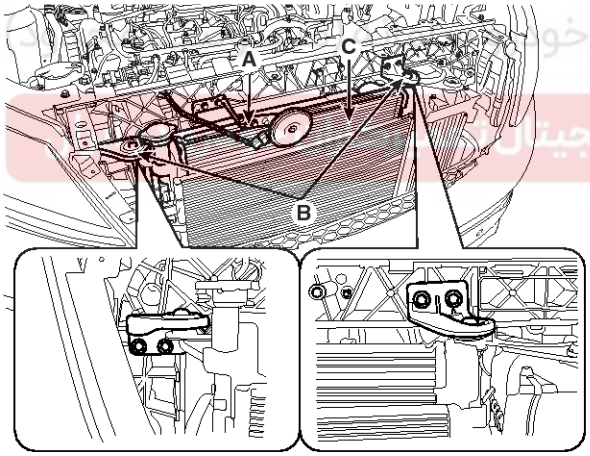
11. Remove the upper cover (A), air guard (B) and then remove the A/C condenser (C) from the radiator assembly.



SSLEM0007D

12. Disconnect the horn bracket (A).
13. Remove the radiator upper mounting bracket (B) and then lift up the radiator.

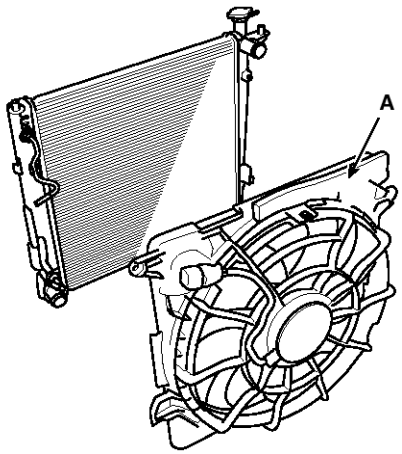
Tightening torque :
8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0lb-ft)



SSLEM0008D

14. Remove the upper cover and then remove the cooling fan (A) from the radiator.

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



SLMEM0021D

15. Installation is reverse order of removal.
16. Fill the radiator with coolant and check for leaks.

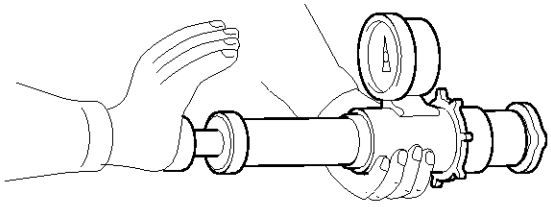
NOTICE

- *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 engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.*
  - *Put the radiator cap on tightly, then run engine again and check for leaks.*

Inspection

Radiator Cap

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

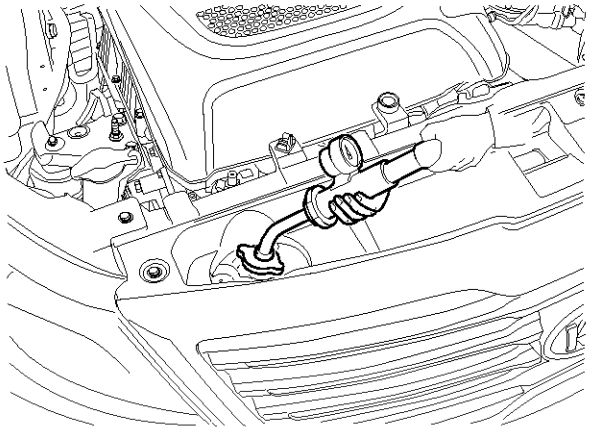


ECKD501X

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).



SSLEM0040D

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.

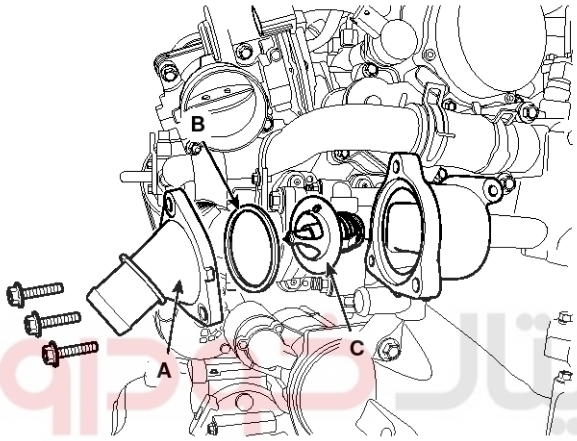
Thermostat

Removal

NOTICE

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

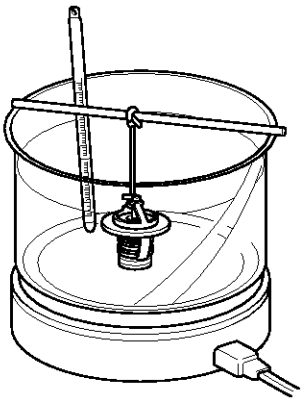
1. Drain the engine coolant so its level is below thermostat.
2. Remove the water inlet fitting (A), O-ring (B) and thermostat (C).



SXMEM9367D

Inspection

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



ECKD503B

2. Check the valve opening temperature.

Valve opening temperature : 82±2˚C (179.6±3.6˚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 : 10mm(0.3937in) or more at 95˚C (203˚F)

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

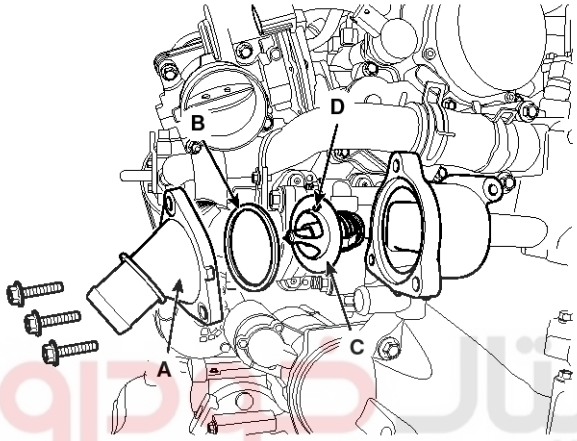
Installation

1. Place the thermostat (C) in thermostat housing with a new O-ring (B).

   ⚠CAUTION
   Place the thermostat with the jiggle valve (D) upward.

2. Install the water inlet fitting (A).

Tightening torque :
16.7 ~ 22.6N.m (1.7 ~ 2.3kgf.m, 12.3 ~ 16.6lb-ft)



SXMEM9074D

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

Troubleshooting

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

Water pump

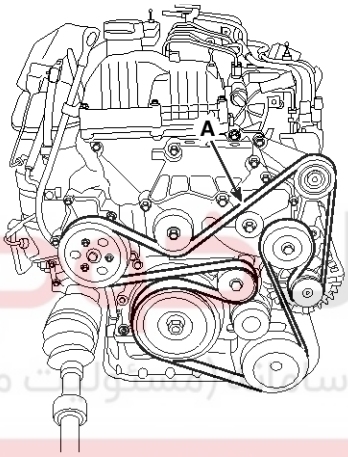
Removal

1. Drain the engine coolant.

   WARNING
   System is under high pressure when the engine is hot.

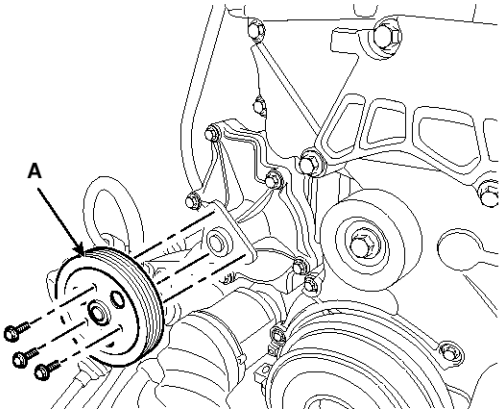
   To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Using the hexagon wrench, turn the tensioner counterclockwise and loosen. Then remove the drive belt (A).



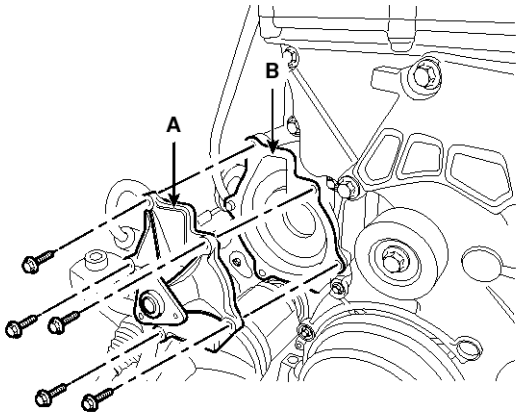
SLMEM0028D

3. Remove the water pump pulley (A).



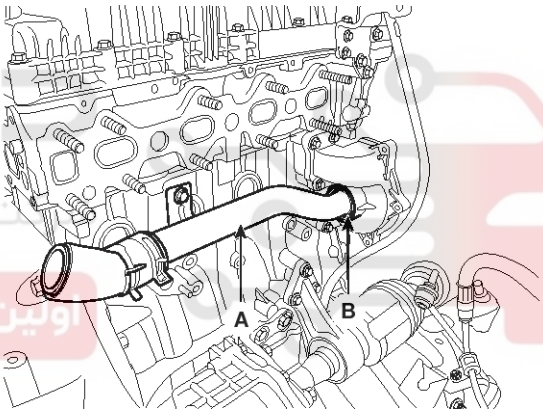
SXMEM9088D

4. Remove the water pump (A) with the gasket (B).



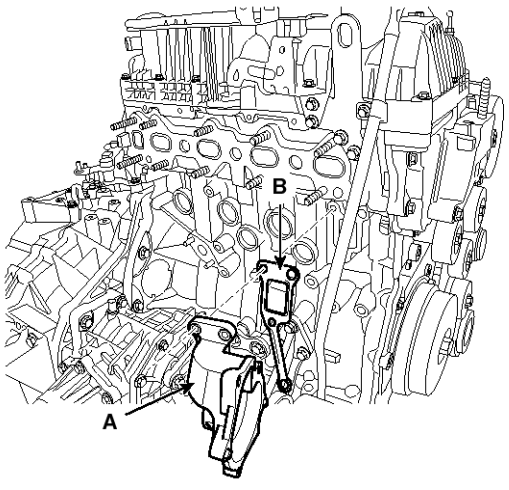
SXMEM9089D

5. Remove the water inlet pipe (A) with the O-ring (B).



SXMEM9090D

6. Remove the water pump cover (A) with the gasket (B).



SXMEM9091D

Inspection

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

NOTICE

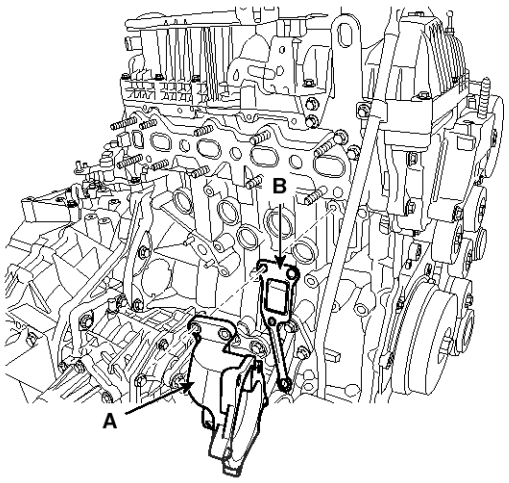
A small amount of "weeping" from the bleed hole is normal.

Installation

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

Tightening torque :

19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)

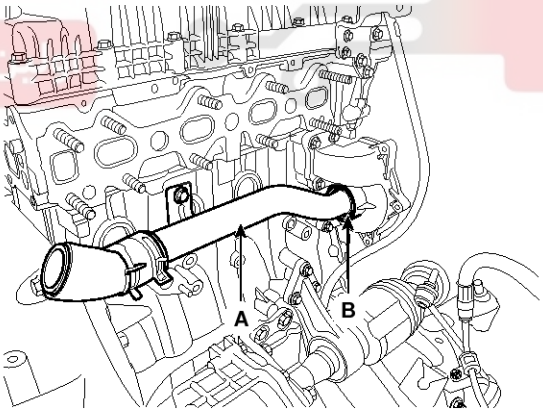


SXMEM9091D

2. Install the water inlet pipe (A) with a new O-ring (B).

Tightening torque :

19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)



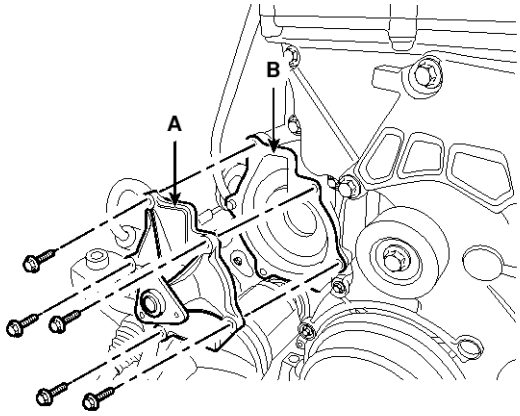
SXMEM9090D

CAUTION

When installing the water pipe into water housing, keep the surface of O-ring from dust and oil and be careful no to damage the surface of the O-ring. And apply a coat of alhorm(BW-0431) or equivalent (not engine oil).

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

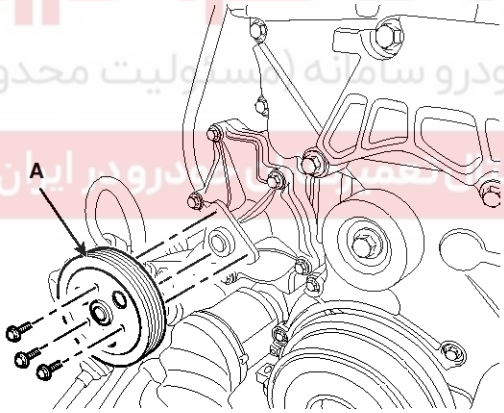
Tightening torque :
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)



SXMEM9089D

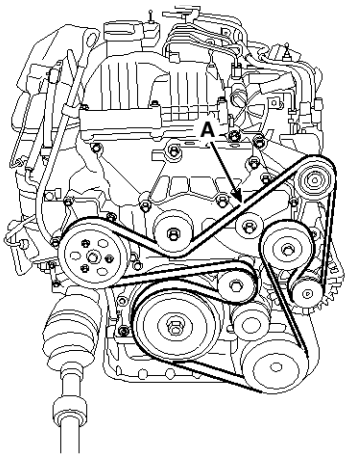
4. Install the water pump pulley (A).

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



SXMEM9088D

5. Install the drive belt (A).



SLMEM0028D

6. Fill with engine coolant.
7. Start engine and check for leaks.
8. Recheck engine coolant level.

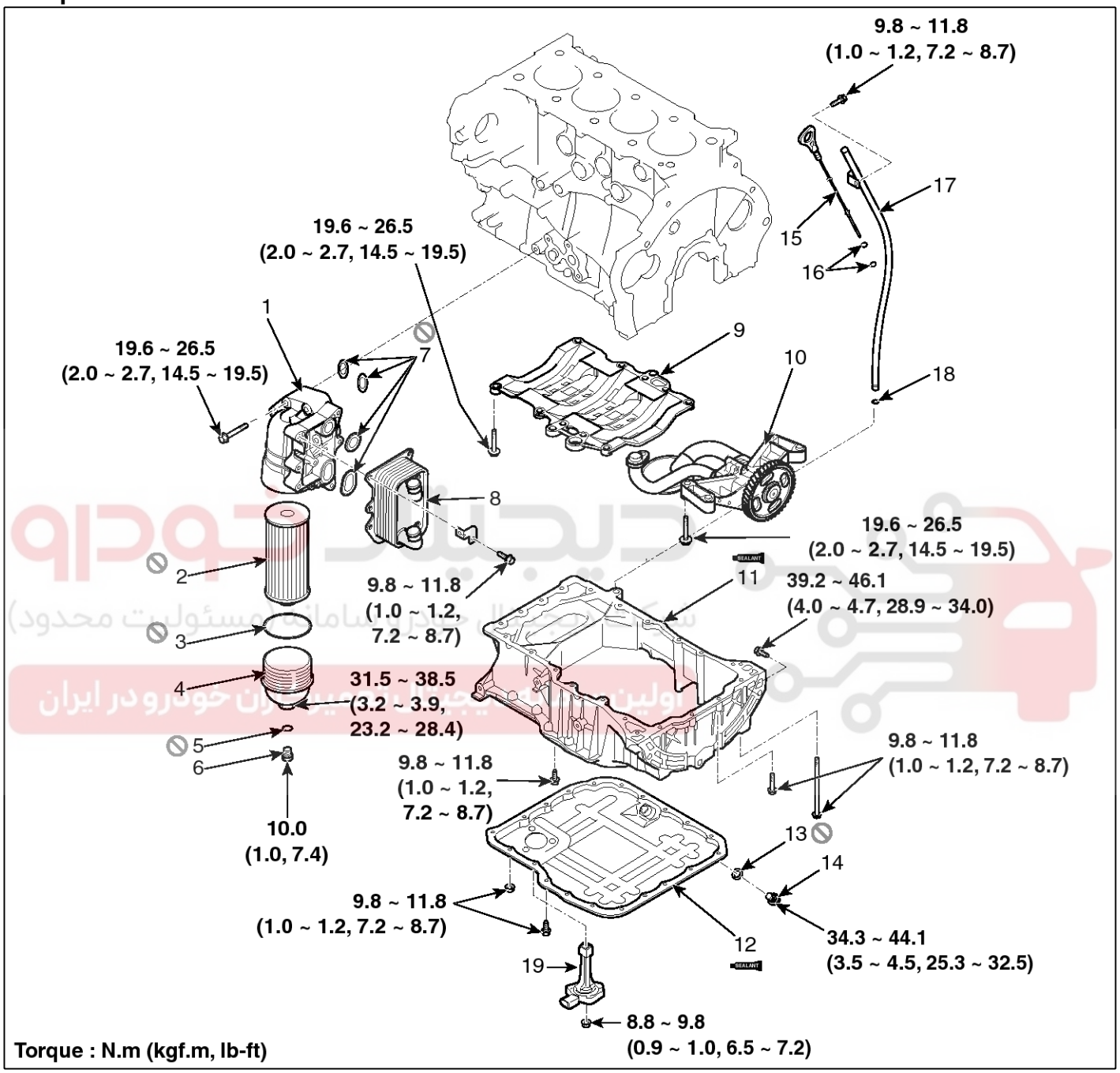
Troubleshooting

Water Pump

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

Lubrication System

Components



SSLEM1002L

1. Engine oil filter housing
2. Engine oil filter element
3. Filter cap O-ring
4. Filter cap
5. Drain bolt O-ring
6. Drain bolt
7. Filter housing O-ring
8. Engine oil cooler
9. Ladder frame
10. Oil pump module
11. Upper oil pan
12. Lower oil pan
13. Drain plug gasket
14. Drain plug
15. Oil level gauge
16. Oil level gauge O-ring
17. Oil level gauge guide
18. Oil level gauge guide O-ring
19. Oil level sensor (if equipped)

Engine Oil

Engine Oil And Filter Replacement

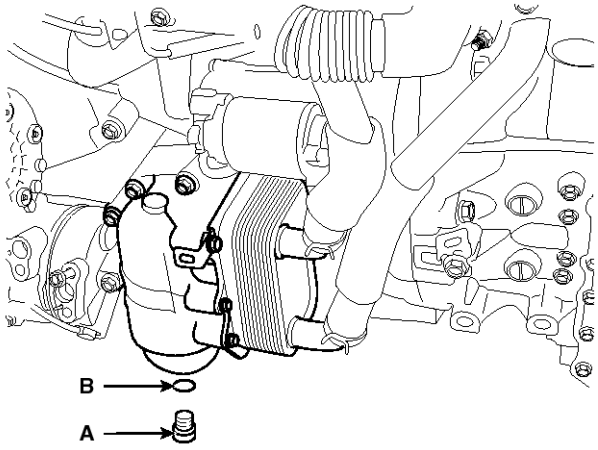
⚠CAUTION

- **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.**
- **Be careful not to contaminate near parts when replacing engine oil.**
- **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.

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

2. Replace the oil filter (B).
   1) Remove the drain bolt (A) on the bottom of the oil filter cap and drain the oil in the oil filter. Replace the O-ring (B) of the drain bolt with a new one.



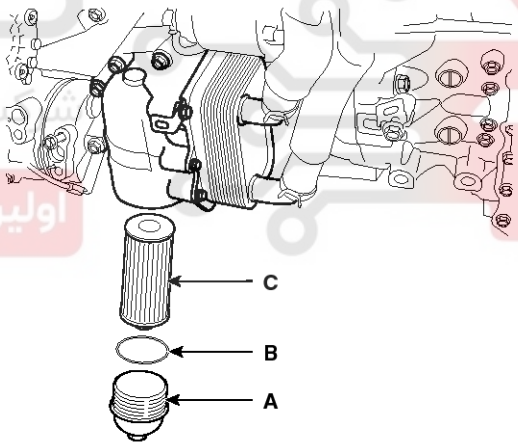
SLMEM0077D

   2) Remove the oil filter cap (A).
   3) Replace the O-ring (B) of the oil filter cap with a new one.

      Inspect the threads and O-ring (B) of the filter cap. Wipe off the seat on the oil filter cap, then apply a light coat of oil to the oil filter cap O-ring (B).
   4) Install the new oil filter element (C).
   5) Lightly screw the oil filter cap into place, and tighten it until the O-ring contacts the seat.

      Finally tighten it again by specified tightening torque.
   6) Tighten the drain bolt by specified tightening torque.

Tightening torque :
Drain bolt : 10N.m (1.0kgf.m, 7.4lb-ft)
Oil filter cap : 31.5 ~ 38.5N.m (3.2 ~ 3.9kgf.m, 23.2 ~ 28.4lb-ft)



SLMEM0078D

⚠CAUTION

Before installing new engine oil filter element, be sure to clean residual oil inside of the oil filter housing and oil filter cap and on the threads of the oil filter cap.

If not, residual oil will come out of the oil filter housing and cap and it may be mistaken as an oil leak.

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 ~ 32.5lb-ft)

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

CAUTION
Fill half amount of total oil first and then do the rest after 1 minute or more.

Capacity
Total : 9.6L (10.14US.qt., 8.44lmp.qt.)
Oil pan : 7.3L (7.71US.qt., 6.42lmp.qt.)
Drain and refill including oil filter :
8.0L (8.45US.qt., 7.04lmp.qt.)

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

Inspection

1. Check the engine oil quality.

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

   If the quality is visibly poor, replace the oil.
2. Check the engine oil level.

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

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

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

Selection Of Engine Oil

Recommendation - For Europe

If not available, refer to the recommended ACEA classification and SAE viscosity number.

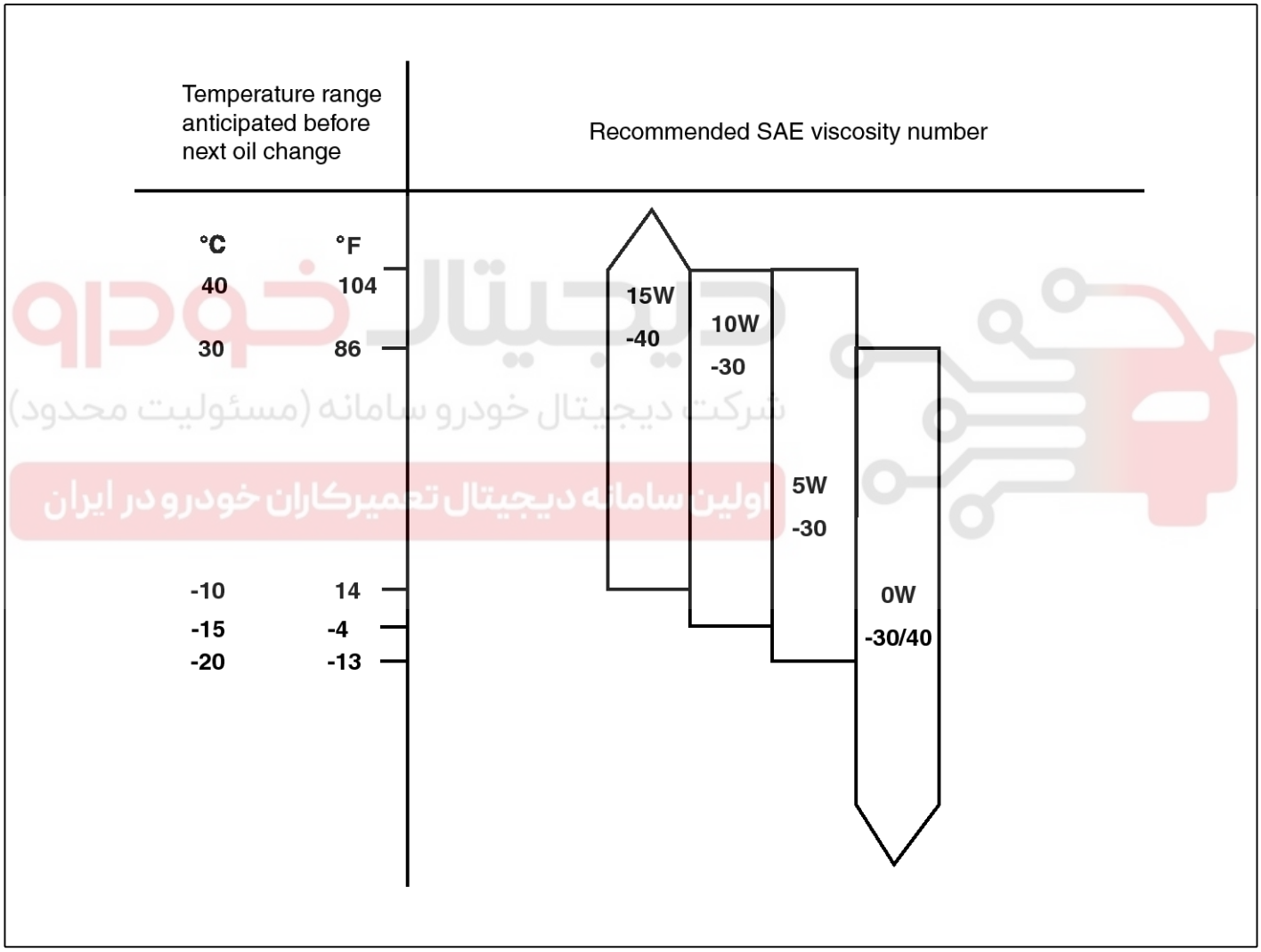
Supplier	Product
SK	ZIC LS 5W-30
Chevron	KIXX D1 5W-30
Total	QUARTZ INEO MC3 5W-30
Shell	HELIX ULTRA AP 5W-30

Classification

- With DPF: ACEA C3
- With DPF: ACEA B4

SAE viscosity grade

Refer to the recommended SAE viscosity number



SVQEM0053L

NOTICE

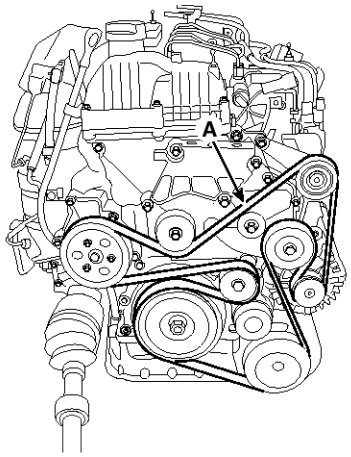
For best performance and maximum protection of all types of operation, select only those lubricants which :

1. *Satisfy the requirement of the ACEA classification.*
2. *Have proper SAE grade number for expected ambient temperature range.*
   - *Lubricants that do not have both an SAE grade number and ACEA service classification on the container should not be used.*
   - *For the vehicle equipped with DPF, the service engine oil quality should meet the ACEA C3 grade. However, oil refill with small amount of ACEA B4 grade between oil change intervals is possible.*

Oil Pump

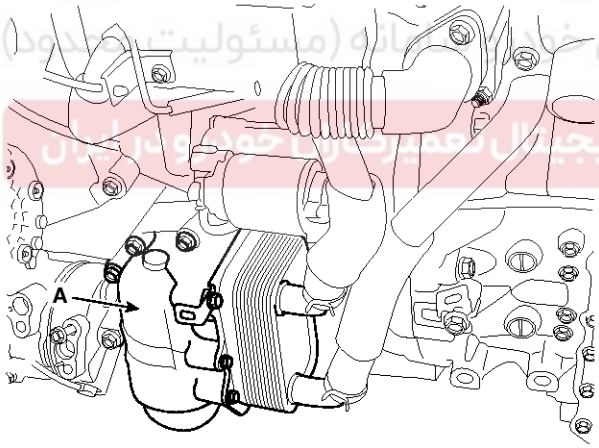
Removal

1. Using the hexagon wrench, turn the tensioner counterclockwise and loosen. Then remove the drive belt (A).



SLMEM0028D

2. Drain the engine oil, and then remove the oil filter&cooler assembly (A).

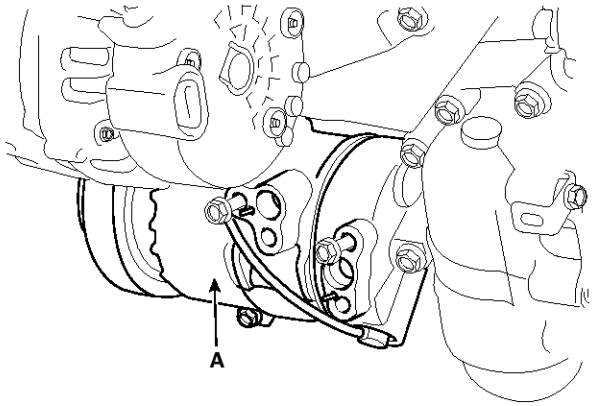


SLMEM0017D

NOTICE

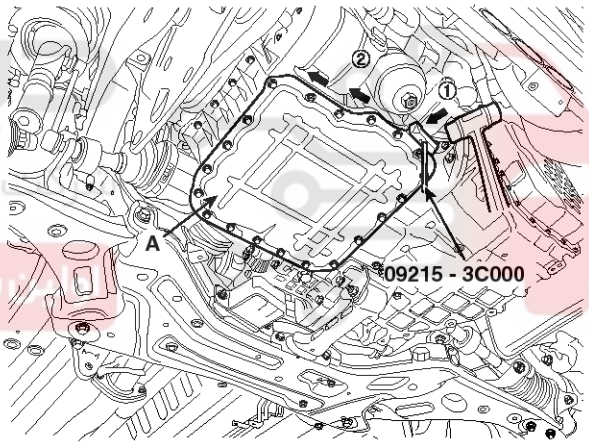
Drain the engine oil in the oil filter before removing the oil filter&cooler assembly.

3. Remove the air compressor (A). (Refer to HA group)



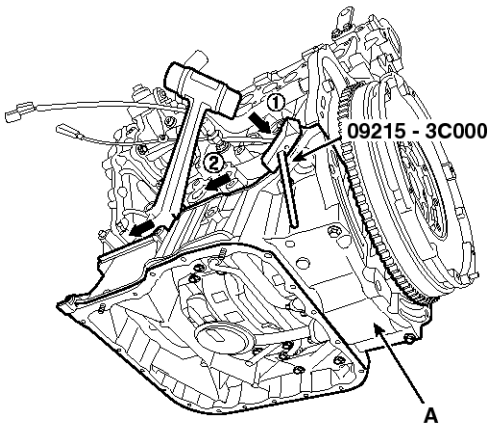
SLMEM0053D

4. Remove the lower oil pan (A).



SSLEM0032D

5. Remove the upper oil pan (A).



SLMEM0029D

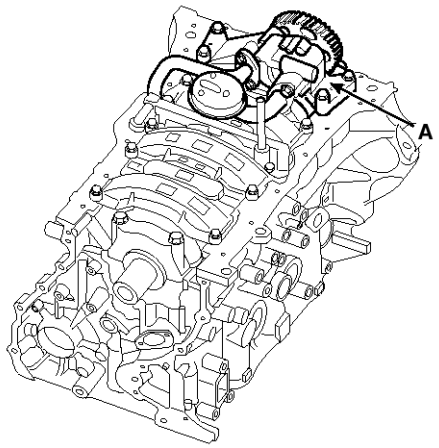
NOTICE

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

CAUTION

- **Insert the SST between the oil pan and cylinder block (or upper oil pan) by tapping it with a plastic hammer in the direction of ① arrow.**
- **After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the oil pan, remove it from cylinder block (or upper oil pan).**
- **Do not turn over the SST abruptly without tapping. It may be result in damage of the SST.**

6. Remove the oil pump module (A).

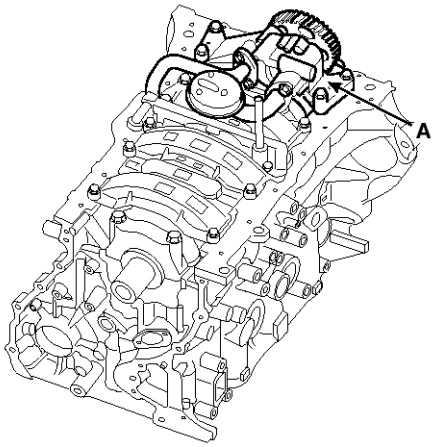


SSLEM0009D

Installation

1. Install the oil pump module (A).

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



SSLEM0009D

CAUTION

- **When assembling the oil pump module, check the O-ring at the end of the pipe, and take care not to be damaged.**
- **Do not disassemble the oil pump module.**

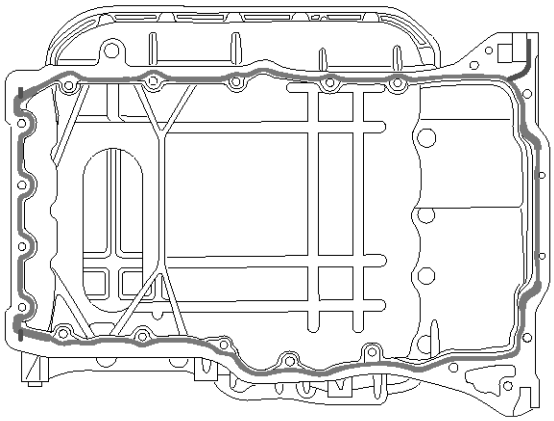
2. Apply liquid gasket evenly to the mating surface of the upper oil pan.

NOTICE

- *Standard liquid gasket : LOCTITE 5900H or equivalent.*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 4mm (5mm or above for T-joint and 3.5mm for rear oil seal) wide bead without stopping.*
- *Install the oil pan in 5 minutes after applying the liquid gasket.*
- *After installing the oil pan, wait at least 30 minutes before filling the engine with oil.*
- *Remove liquid gasket overreached from the rear oil seal area after installing.*
- *Remove liquid gasket overreached from the contact surface between the cylinder bock and timing chain cover before installing the upper oil pan.*

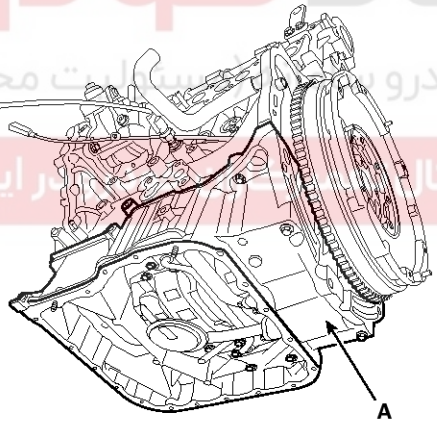
CAUTION

Be careful not to apply an excessive amount of liquid gasket or by a wrong path. If the liquid gasket flows into the holes for installing the rear oil seal case assembly, it may cause the boss crack or contamination.



SXMEM9051D

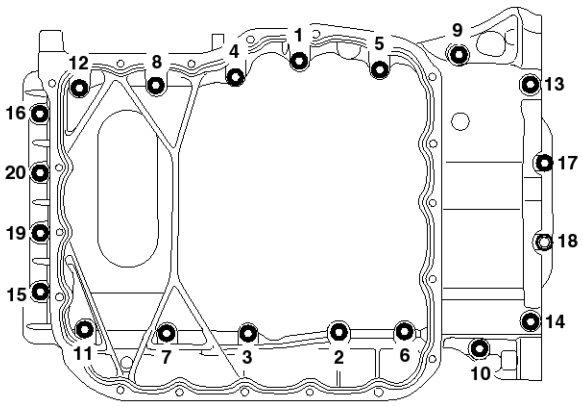
3. Install the upper oil pan(A).



SLMEM0063D

1) Tighten the bolts in the sequence shown.

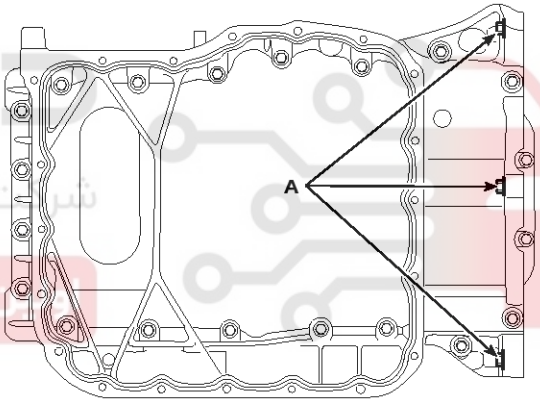
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SXMEM9052D

2) Tighten the bolts (A) for transaxle case.

Tightening torque :
39.2 ~ 46.1N.m (4.0 ~ 4.7kgf.m, 28.9 ~ 34.0lb-ft)

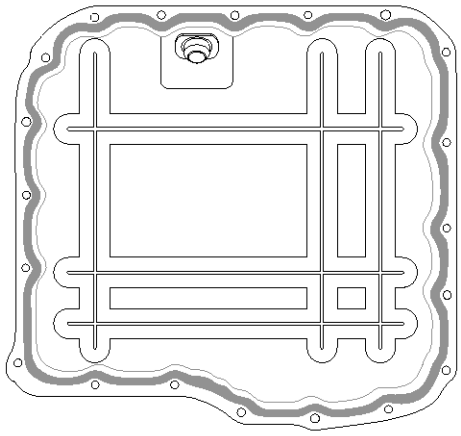


SXMEM9319D

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

NOTICE

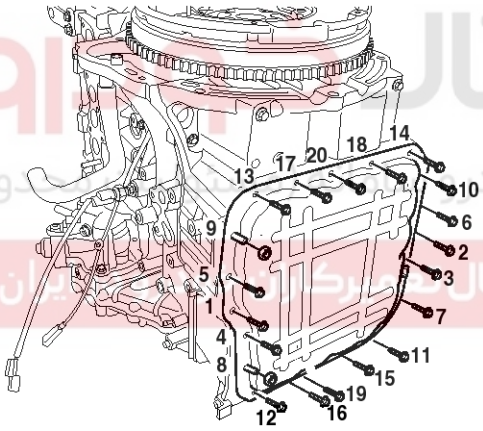
- *Standard liquid gasket : LOCTITE 5900H or equivalent.*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *Apply liquid gasket in a 4mm wide bead without stopping.*
- *Install the oil pan in 5 minutes after applying the liquid gasket.*
- *After installing the oil pan, wait at least 30 minutes before filling the engine with oil.*



SXMEM9401D

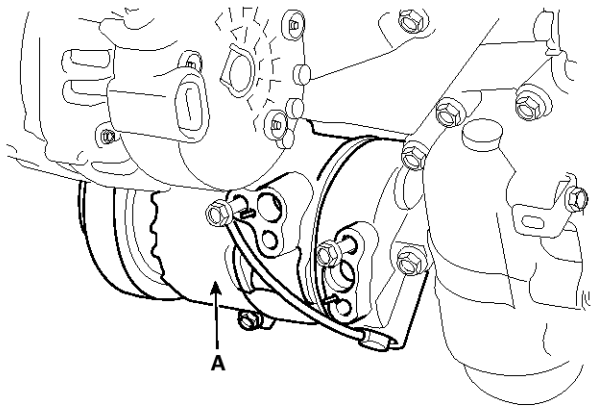
5. Install the lower oil pan.
   Tighten the bolts in the sequence shown.

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



SXMEM9038D

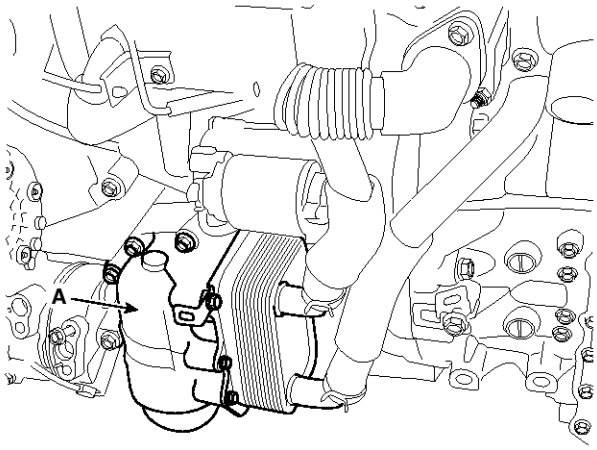
6. Install the air compressor (A). (Refer to HA group)



SLMEM0053D

7. Install the oil filter&cooler assembly (A).

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

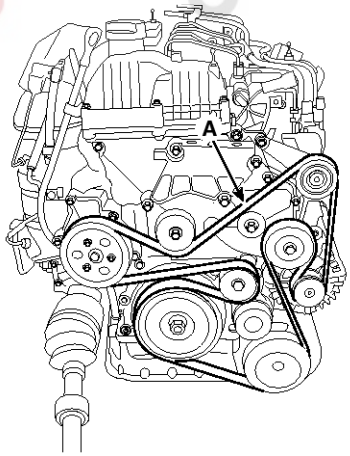


SLMEM0017D

NOTICE
Always use a new O-ring.

CAUTION
When installing the oil filter&cooler assembly, check the existence of two O-rings on the mating surface to the cylinder block, and tighten the 4 upper bolts first then tighten the other lower bolt.

8. Install the drive belt (A).



SLMEM0028D

9. Refill with engine oil.

Oil Filter&Cooler Assembly

Removal and Installation

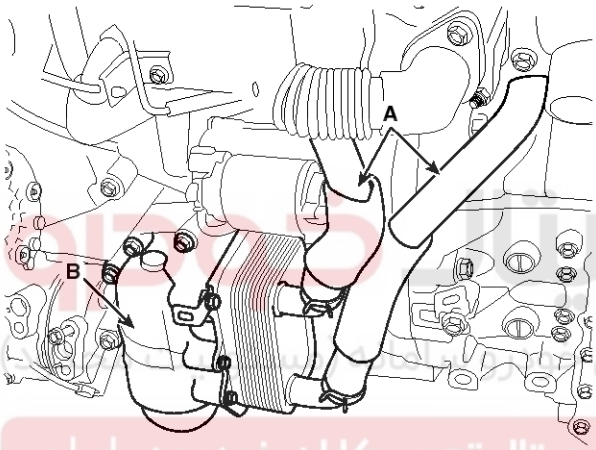
1. Drain the engine oil.
2. Disconnect the oil cooler hoses(A)

CAUTION

When removing and reinstalling the oil cooler hoses, do not apply the excessive force. It may cause the coolant leakage by deformation of the cooler nipple.

3. Install the oil filter&cooler assembly(B).

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



SLMEM0068D

NOTICE

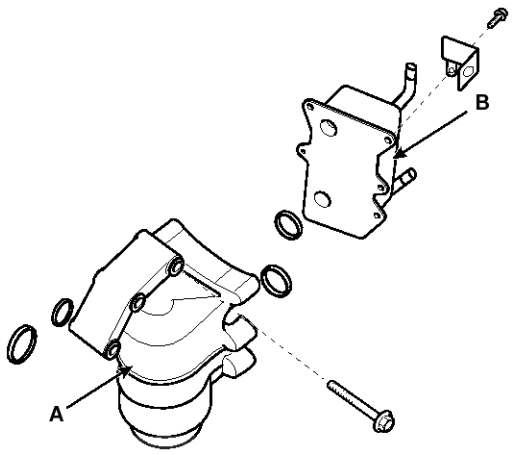
Always use a new O-ring.

CAUTION

When installing the oil filter&cooler assembly, check the existence of two O-rings on the mating surface to the cylinder block, and tighten the 4 upper bolts first then tighten the other lower bolt.

4. Remove the oil cooler(B) from the oil filter(A).

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



SXMEM9087D

NOTICE

Always use a new O-ring.

CAUTION

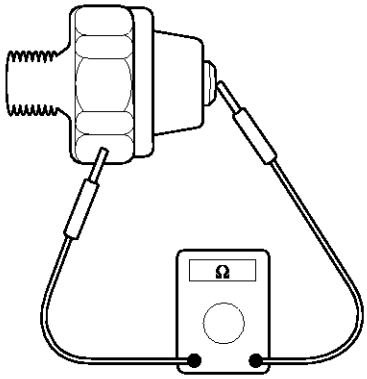
When installing the oil cooler, check the existence of two O-rings on the mating surface to the oil filter.

5. Installation is in the reverse order of removal.

Oil Pressure Switch

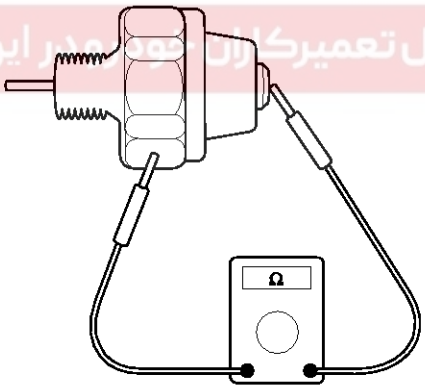
Inspection

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) is applied through the oil hole, the switch is operating properly.

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

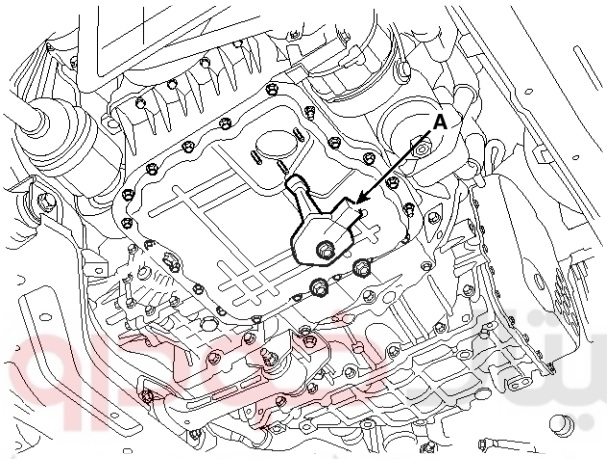
Oil Level Sensor

Removal and Installation

When the oil sensor signal fault occurs, refer to the DTC guide.

1. Drain the engine oil.
2. Remove the oil level sensor (A) from the oil pan after disconnecting the connector.

Tightening torque:
8.8 ~ 9.8N.m (0.9 ~ 1.0kgf.m, 6.5 ~ 7.2lb-ft)



SLMEM0062L

3. Installation is reverse order of removal, with a new gasket.

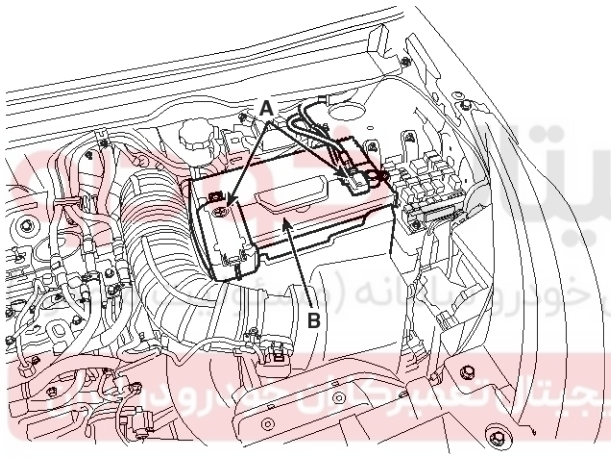
Intake And Exhaust System

Intercooler

Removal and Installation

1. Disconnect the battery terminal (A), and then remove the battery (B).

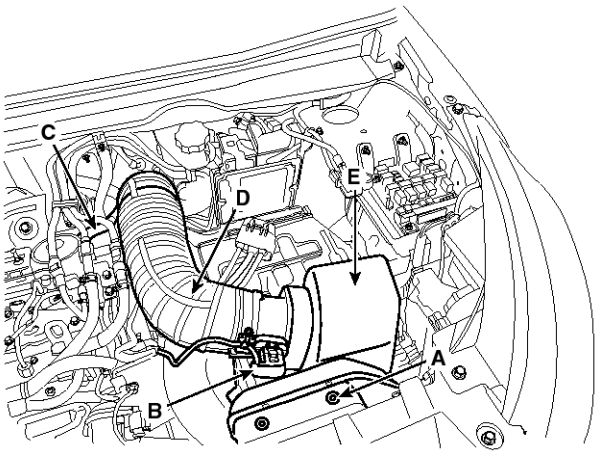
Tightening torque :
(-) terminal (without battery sensor): 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
(-) terminal (with battery sensor): 4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)
(+) terminal : 7.9 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
Bracket bolt : 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SSLEM0017D

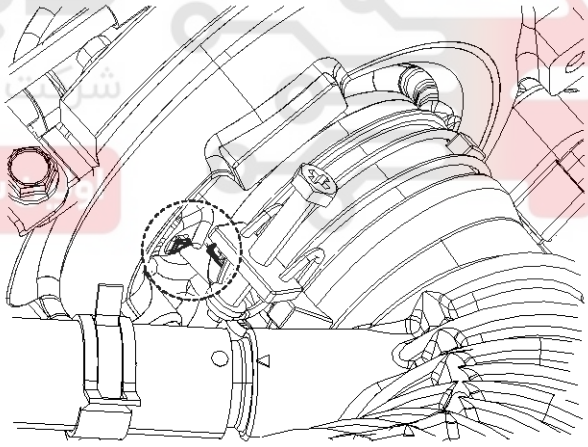
2. Remove the air cleaner assembly.
   1) Remove the air duct (A).
   2) Disconnect the air flow sensor (AFS) connector (B).
   3) Disconnect the breather hose (C).
   4) Remove the intake air hose (D) and air cleaner assembly (E).

Tightening torque :
Clamps: 2.9 ~ 4.9N.m (0.3 ~ 0.5kgf.m, 2.2 ~ 3.6lb-ft)
Bolts: 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLEM0011D

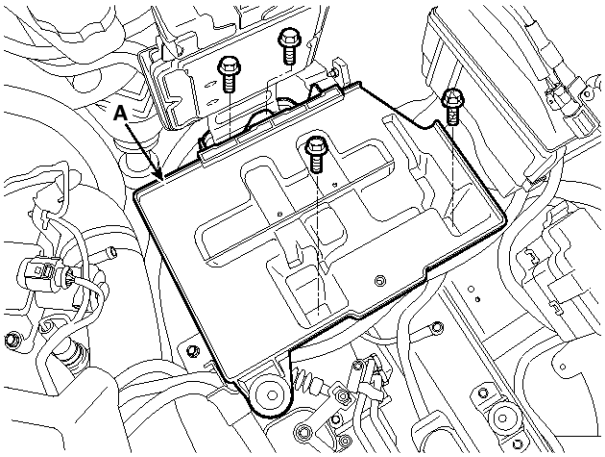
NOTICE
Align the mark of the air intake hose and compressor.



SSLEM0023D

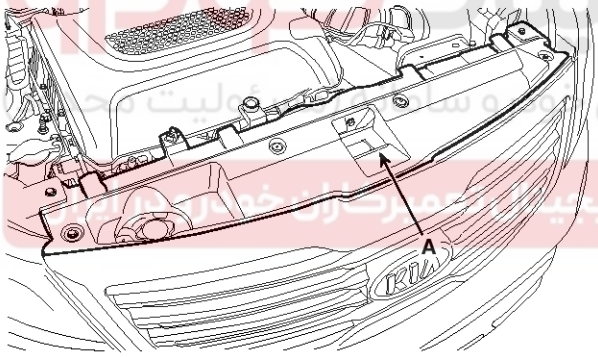
3. Remove the battery tray (A).

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



SLMEM0005D

4. Remove the radiator grill upper cover (A). (Refer to BD group)

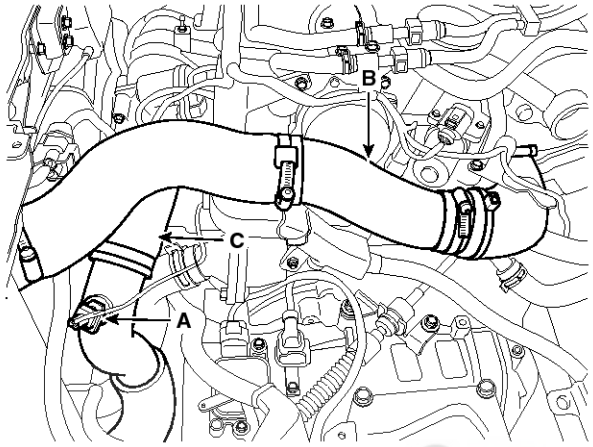


SSLEM0028D

5. Disconnect the intake air temperature sensor connector (A) and remove the intercooler inlet pipe&hose (B) and outlet pipe&hose (C).

Tightening torque :
Clamps: 4.9 ~ 6.9N.m (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft)
Bolt: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

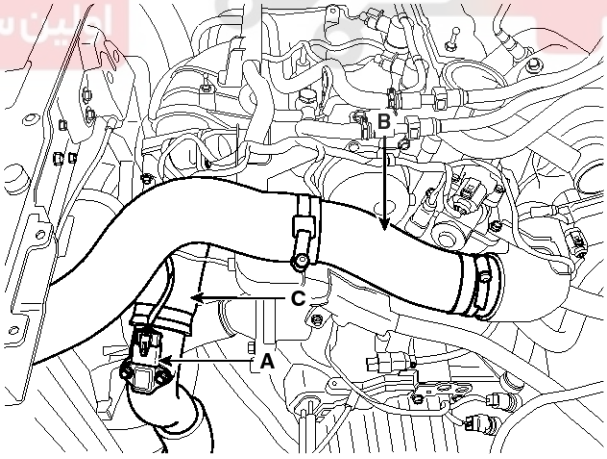
[Standard]



SLMEM0006D

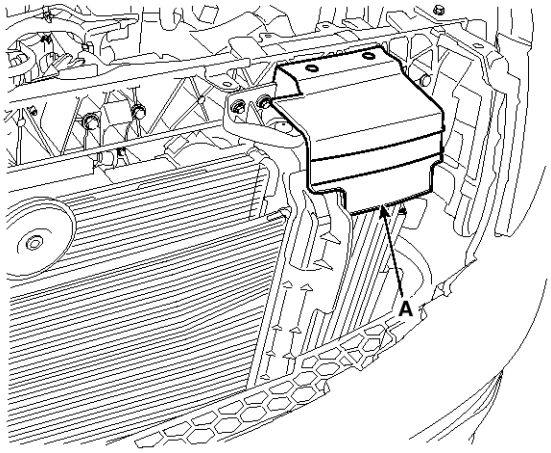
Disconnect the boost pressure sensor (BPS) connector (A) and remove the intercooler inlet pipe & hose (B) and outlet pipe & hose (C).

[Low Power]



SELEM0003L

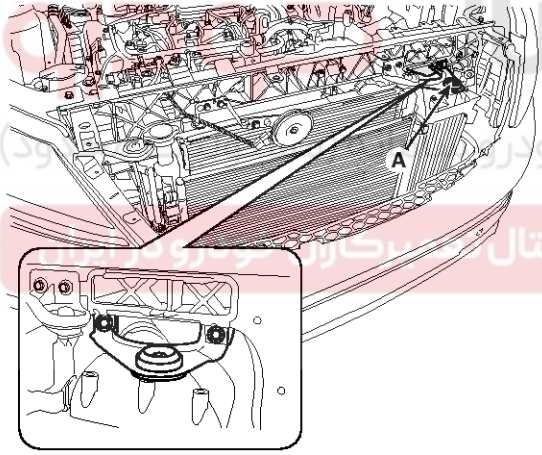
6. Remove the upper cover (A).



SSLEM0029D

7. Remove the upper bracket (A) and then remove the intercooler assembly.

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

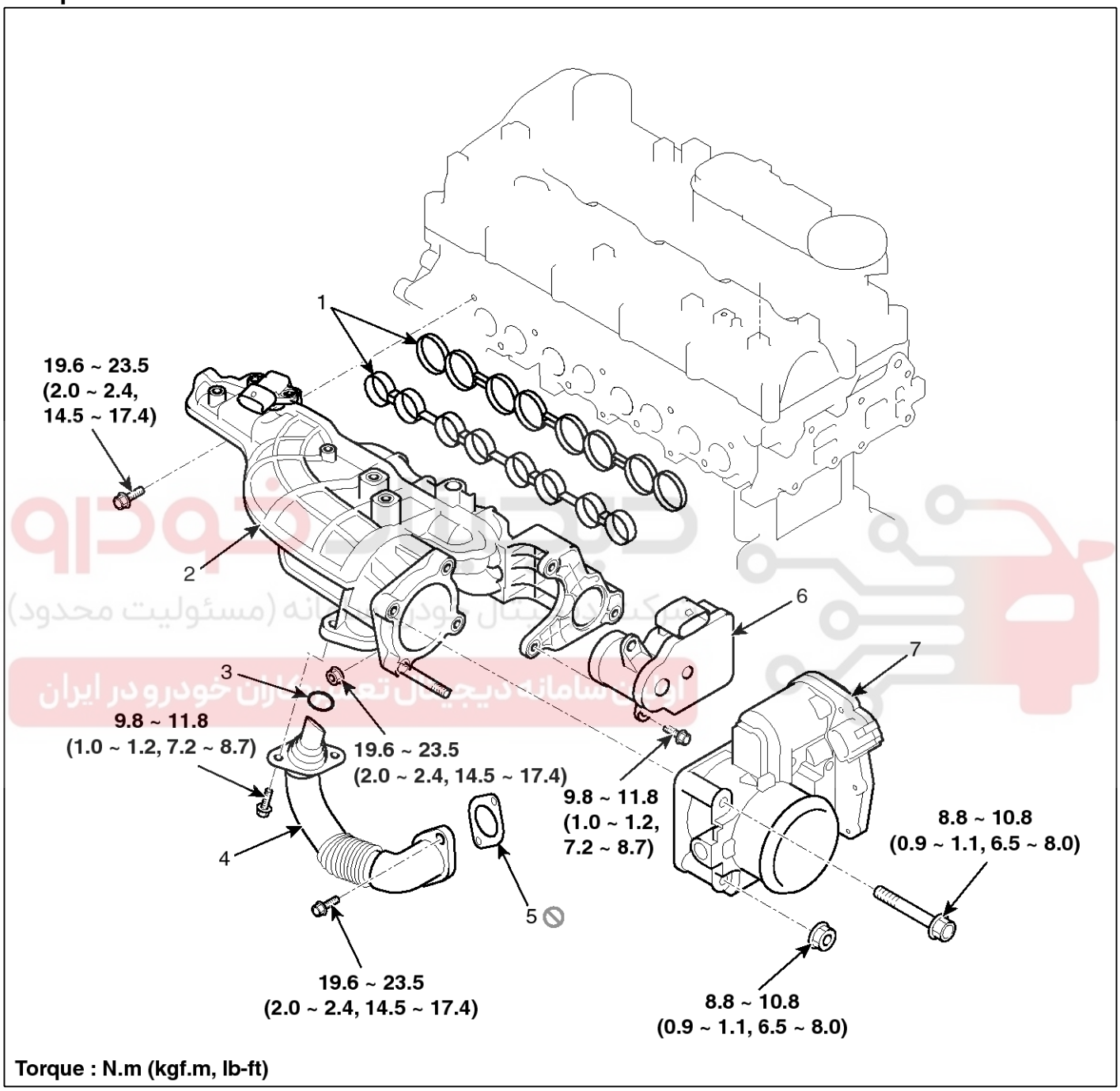


SSLEM0031D

8. Installation is the reverse order of removal.

Intake Manifold

Components

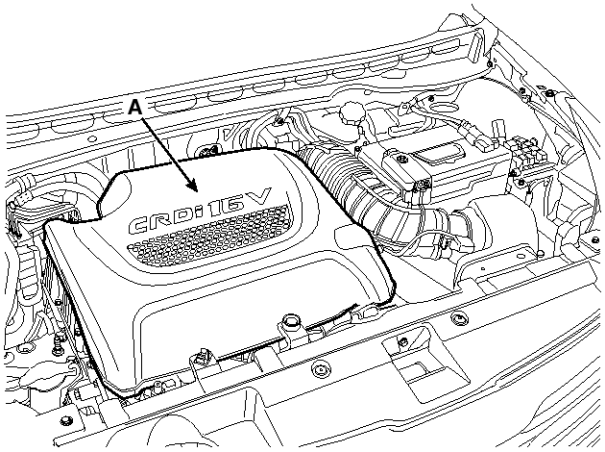


SSLEM0110L

1. Intake manifold gasket
2. Intake manifold
3. EGR pipe assembly O-ring [Euro - 4/5 only]
4. EGR pipe assembly [Euro - 4/5 only]
5. EGR pipe assembly gasket [Euro - 4/5 only]
6. Variable swirl control valve [Euro - 4/5 only]
7. Intake air control valve

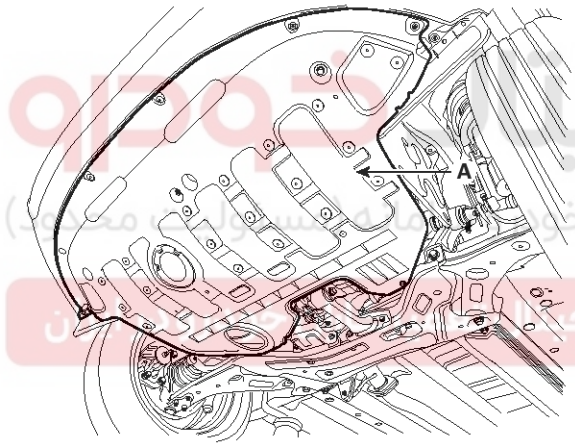
Removal and Installation

1. Remove the engine cover (A).



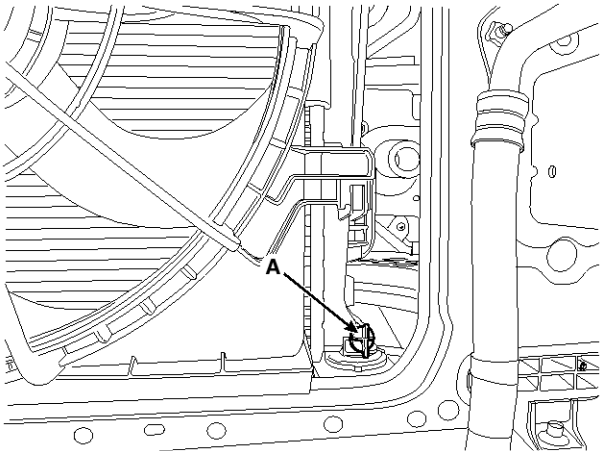
SSLEM0026D

2. Remove the under cover (A).



SSLEM0002D

3. Loosen the radiator drain plug (A) and drain the engine coolant. Remove the radiator cap to speed draining.



SSLEM0003D

WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused escaping from the radiator.

4. Disconnect the battery terminal (A), and then remove the battery (B).

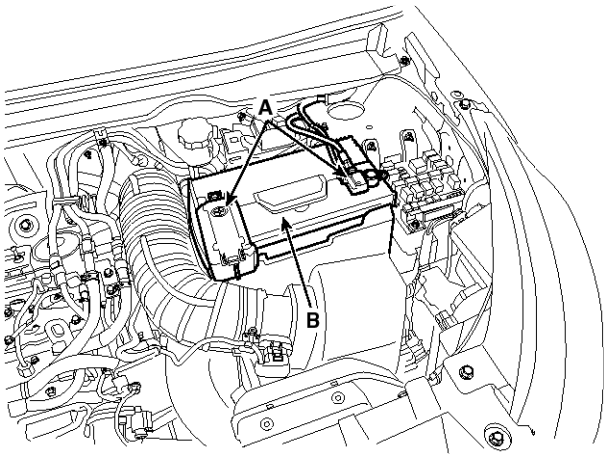
Tightening torque :

(-) terminal (without battery sensor): 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

(-) terminal (with battery sensor): 4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

(+) terminal : 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)

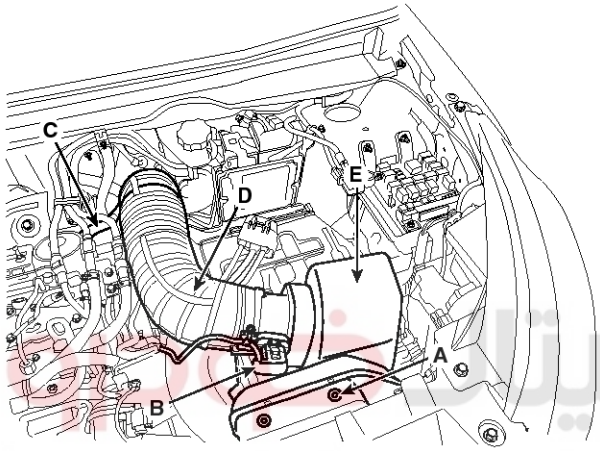
Bracket bolt : 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SSLEM0017D

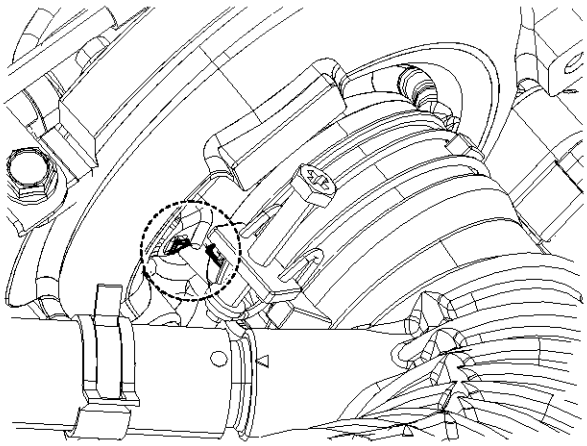
5. Remove the air cleaner assembly.
   1) Remove the air duct (A).
   2) Disconnect the air flow sensor (AFS) connector (B).
   3) Disconnect the breather hose (C).
   4) Remove the intake air hose (D) and air cleaner assembly (E).

Tightening torque :
Clamps: 2.9 ~ 4.9N.m (0.3 ~ 0.5kgf.m, 2.2 ~ 3.6lb-ft)
Bolts: 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLEM0011D

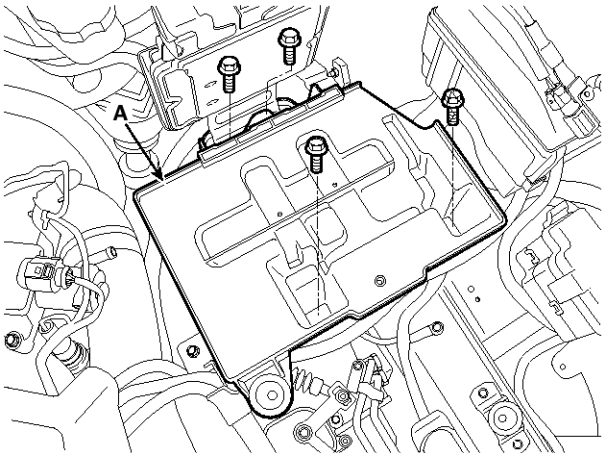
NOTICE
Align the mark of the air intake hose and compressor.



SSLEM0023D

6. Remove the battery tray (A).

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

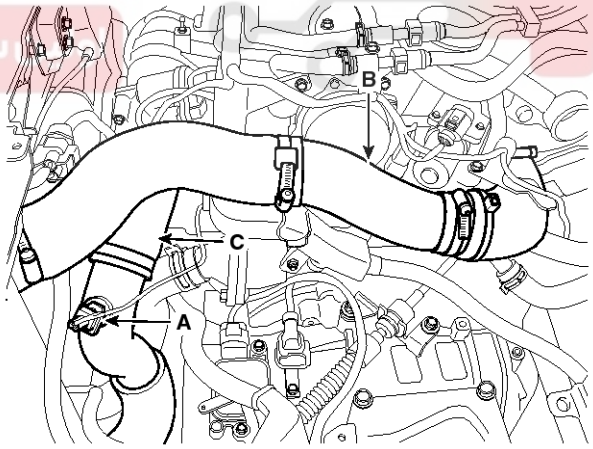


SLMEM0005D

7. Disconnect the intake air temperature sensor connector (A) and remove the intercooler inlet pipe&hose (B) and outlet pipe&hose (C).

Tightening torque :
Clamps: 4.9 ~ 6.9N.m (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft)
Bolt: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

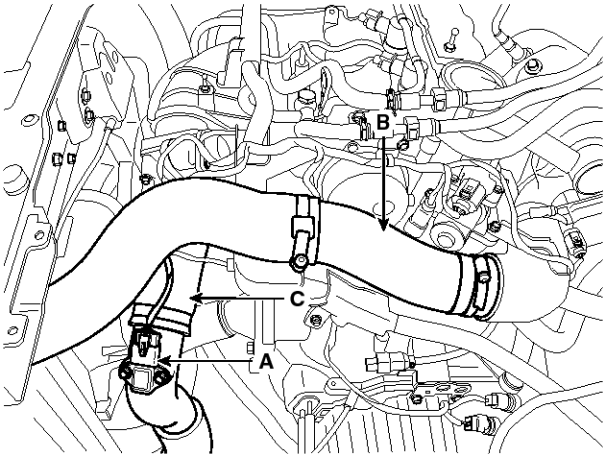
[Standard]



SLMEM0006D

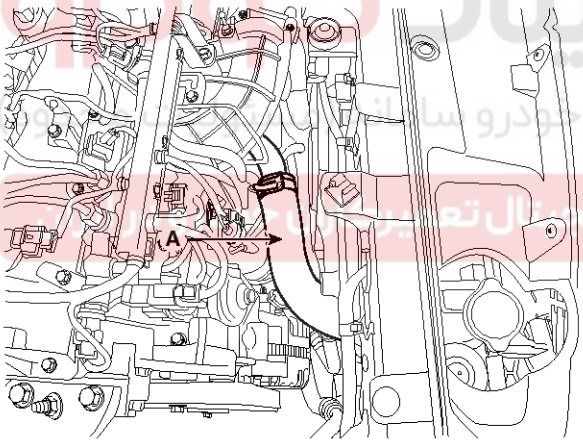
Disconnect the boost pressure sensor (BPS) connector (A) and remove the intercooler inlet pipe & hose (B) and outlet pipe & hose (C).

[Low Power]

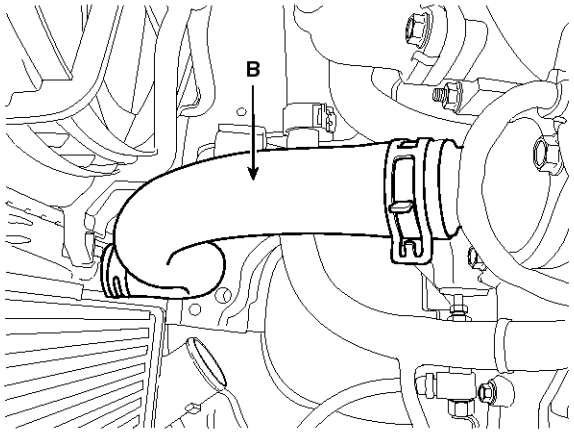


SELEM0003L

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



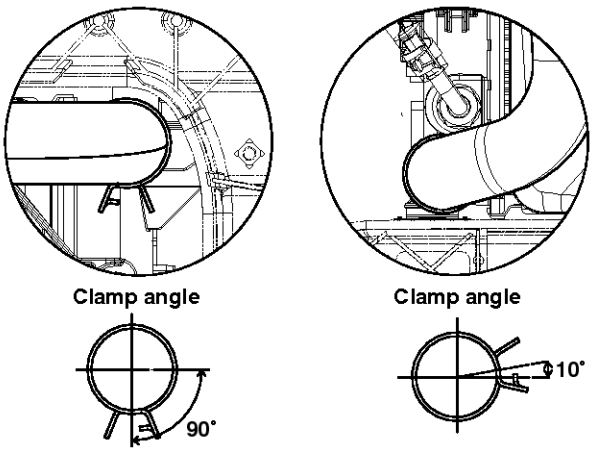
SSLEM0013D



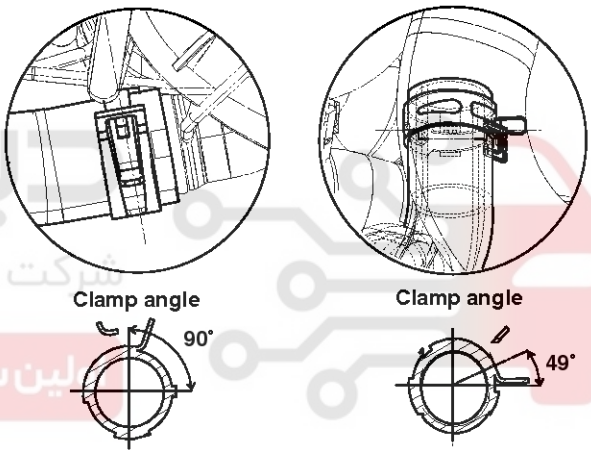
SXMEM9008D

NOTICE

Install the radiator hoses as shown illustrations.

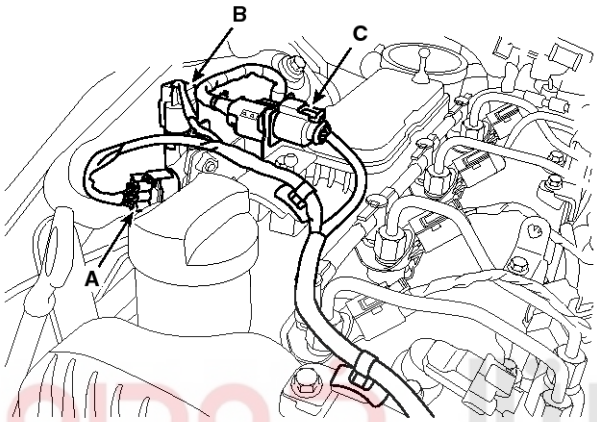


SSLEM0113L



SSLEM0114L

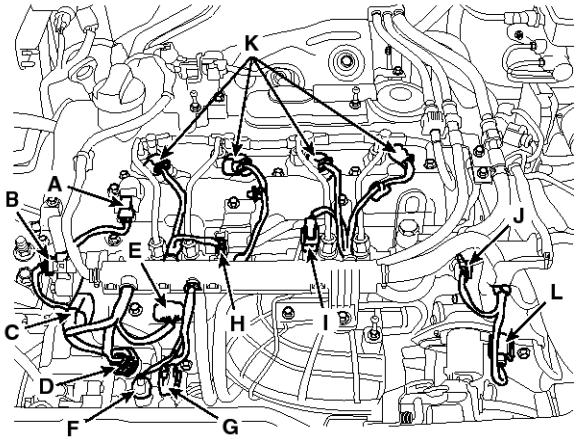
9. Disconnect the engine wire harness connectors and remove the wire harness clamps from the cylinder head cover and the intake manifold.
   1) Disconnect the difference pressure sensor connector (A). (With DPF) [Euro - 5 only]
   2) Disconnect the exhaust gas temperature sensor connector (B). (With DPF) [Euro - 5 only]
   3) Disconnect the lambda sensor connector (C). [Euro - 4/5 only]



SXMEM9009D

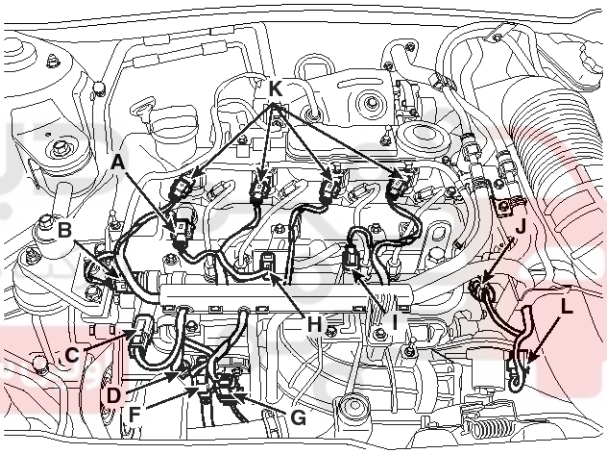
   4) Disconnect the cam position sensor (CMPS) connector (A).
   5) Disconnect the rail pressure sensor connector (B).
   6) Disconnect the glow plug connector (C).
   7) Disconnect the fuel pressure regulator valve connector (D).
   8) Disconnect the boost pressure sensor (BPS) connector (E). (Standard only)
   9) Disconnect the oil pressure switch connector (F).
   10) Disconnect the crankshaft position sensor (CKPS) connector (G).
   11) Disconnect the EGR cooling valve connector (H). [Euro - 4/5 only]
   12) Disconnect the fuel temperature sensor connector (I).
   13) Disconnect the rail pressure regulator valve connector (J).
   14) Disconnect the injector connectors (K).
   15) Disconnect the air control valve connector (L).

[Standard]



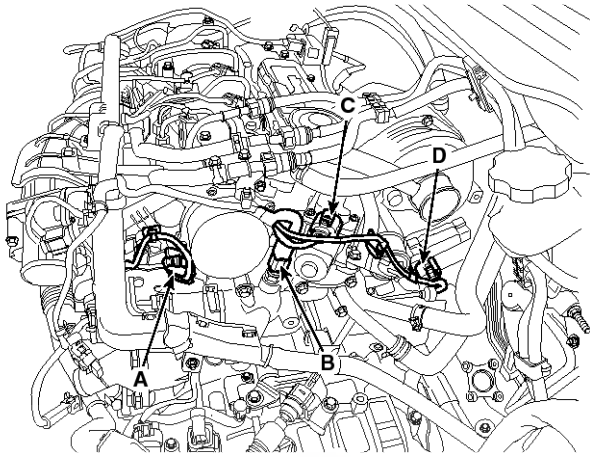
SXMEM9010D

[Low Power]



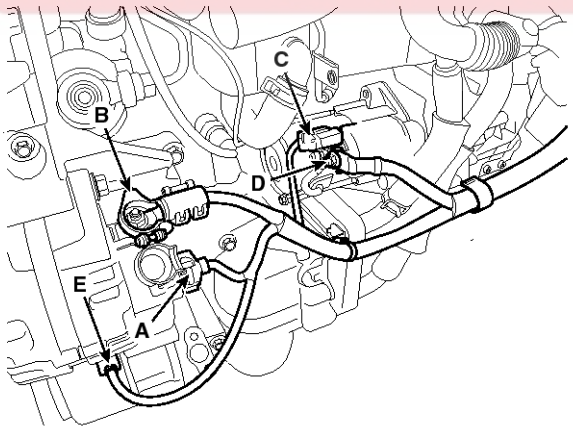
SELEM0001L

16) Disconnect the variable swirl control actuator connector (A). [Euro - 4/5 only]
17) Disconnect the engine coolant temperature sensor (ECTS) connector (B).
18) Disconnect the E-VGT actuator connector (C).
19) Disconnect the EGR actuator connector (D).



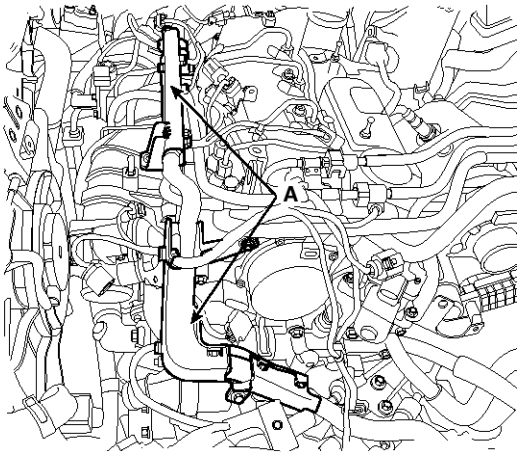
SSLEM0004D

20) Disconnect the alternator connector (A) and the cable (B).
21) Disconnect the starter connector (C) and the cable (D).
22) Disconnect the air compressor switch connector (E).



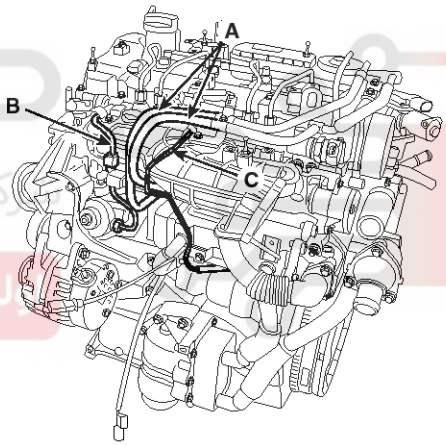
SLMEM0055D

10. Remove the wire harness protector (A).



SLMEM0057D

11. Disconnect the fuel hose (A), the high pressure pipes (B), and EGR vacuum hose (C) [Euro - 4/5 only]. (Refer to FL group)

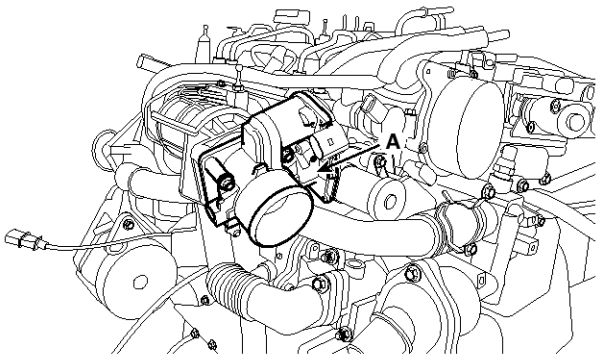


SLMEM0069D

NOTICE
Do not reuse the high pressure pipe.

12. Remove the air control valve (A).

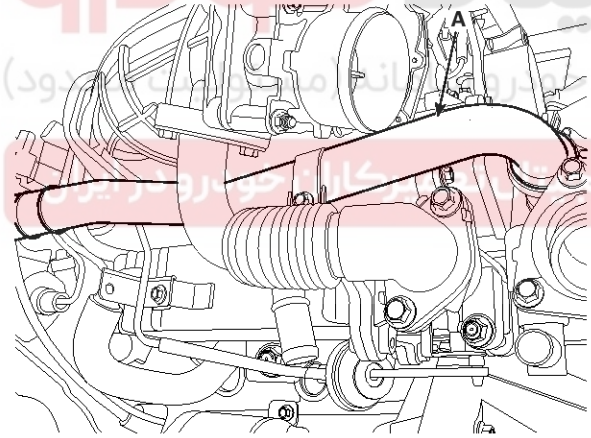
Tightening torque :
8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0lb-ft)



SLMEM0070D

13. Remove the water outlet pipe (A).

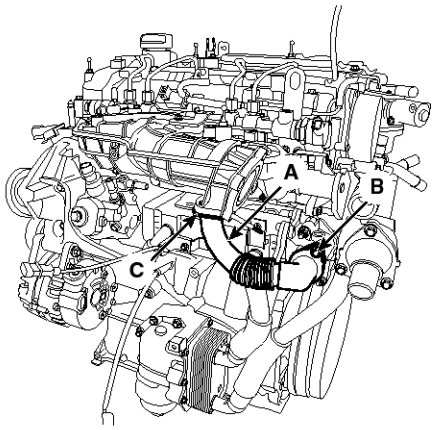
Tightening torque :
7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



SLMEM0071D

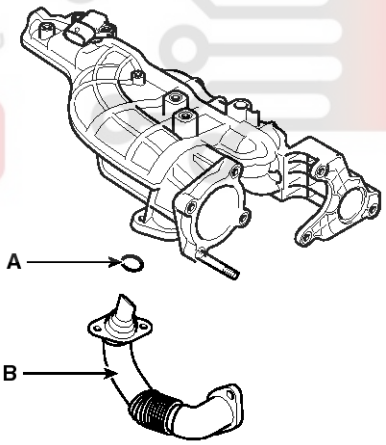
14. Remove the EGR pipe assembly (A). [Euro - 4/5 only]

Tightening torque :
Bolts(B): 19.6 ~ 23.5N.m (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft)
Bolts(C): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SLMEM0072D

When installing the EGR pipe assembly, make sure to insert the O-ring(A) to intake manifold before installing EGR pipe(B).

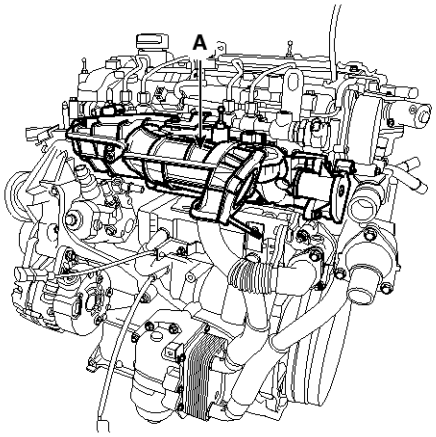


SVQEM0002D

NOTICE
Always use a new O-ring.

CAUTION
If installing an EGR pipe with O-ring inserted to the intake manifold, the O-ring may be damaged and this can cause an exhaust gas leakage.

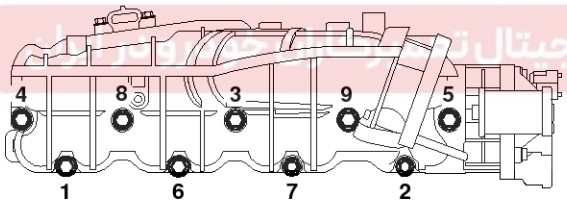
15. Remove the intake manifold (A) with the gasket.



SLMEM0073D

When installing the intake manifold, tighten the bolts and nuts with pre-torque first, and then tighten the bolts and nuts with specified torque in the sequence shown.

Tightening torque :
19.6 ~ 23.5N.m (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft)



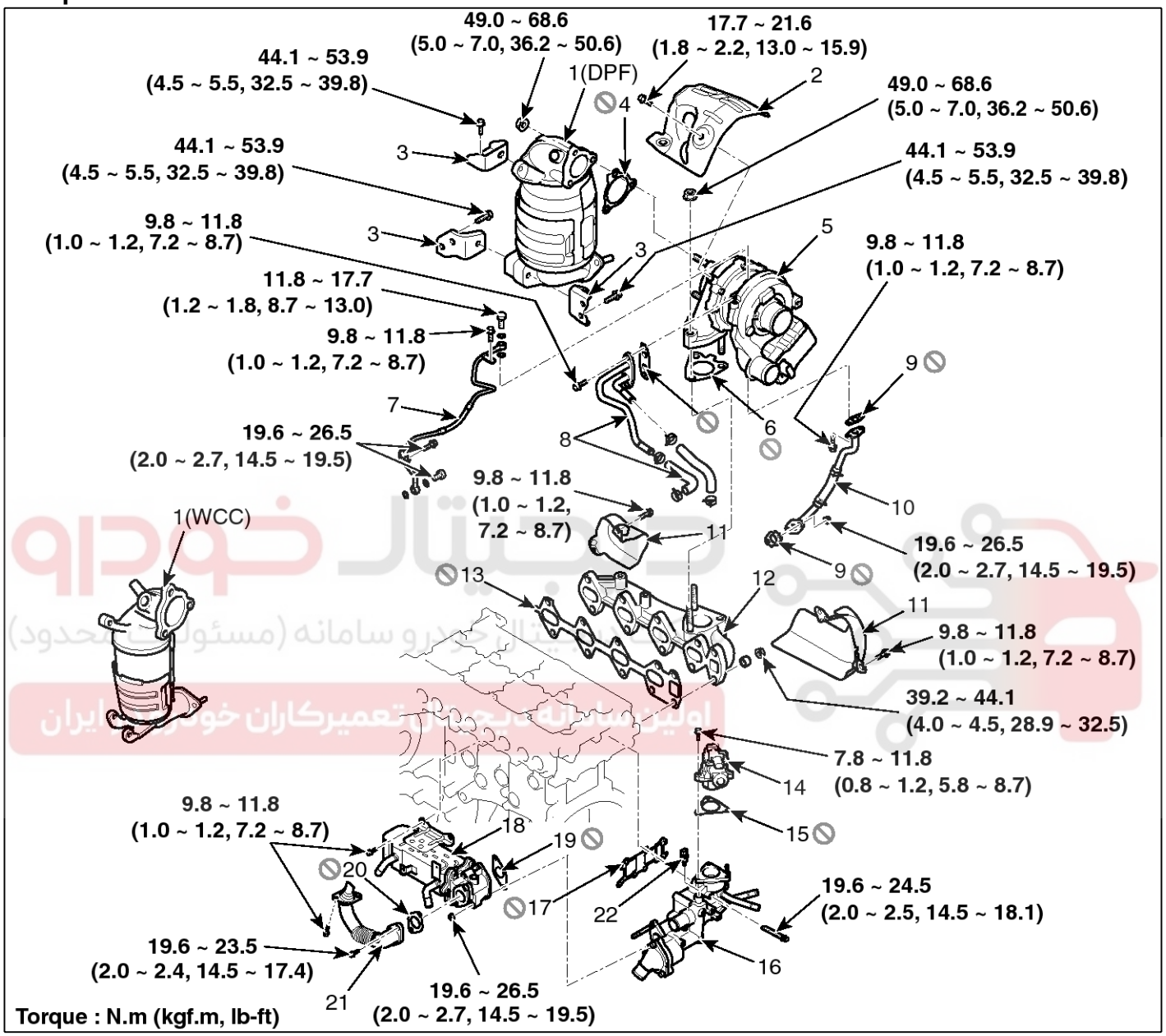
SXMEM9060D

⚠CAUTION
Be careful not to have a foreign substance come into the inlet port.

16. Installation is the reverse order of removal.

Exhaust Manifold

Components

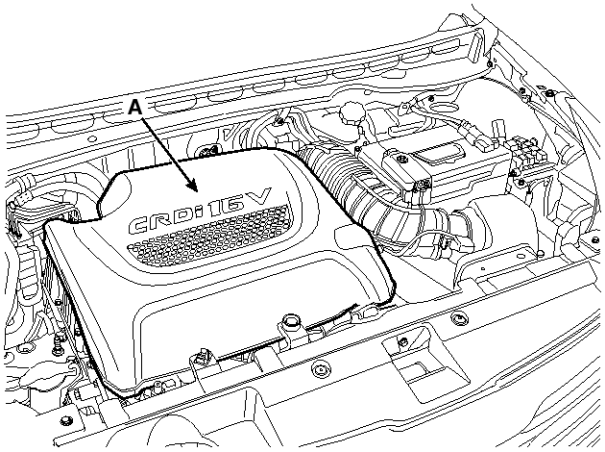


SSLEM0111L

1. DPF(or WCC) converter assembly
2. DPF(or WCC) converter assembly heat protector
3. Support bracket
4. DPF(or WCC) converter assembly gasket
5. Turbocharger assembly
6. Turbocharger assembly gasket
7. Turbocharger oil feed pipe
8. Turbocharger water pipe & hose (Standard only)
9. Turbocharger oil drain pipe gasket
10. Turbocharger oil drain pipe
11. Exhaust manifold heat protector
12. Exhaust manifold
13. Exhaust manifold gasket
14. EGR valve
15. EGR valve gasket
16. EGR & thermostat housing assembly
17. EGR & thermostat housing assembly gasket
18. EGR cooler [Euro - 4/5 only]
19. EGR cooler gasket [Euro - 4/5 only]
20. EGR cooler pipe assembly gasket [Euro - 4/5 only]
21. EGR cooler pipe assembly [Euro - 4/5 only]
22. Engine coolant temperature sensor

Removal and Installation

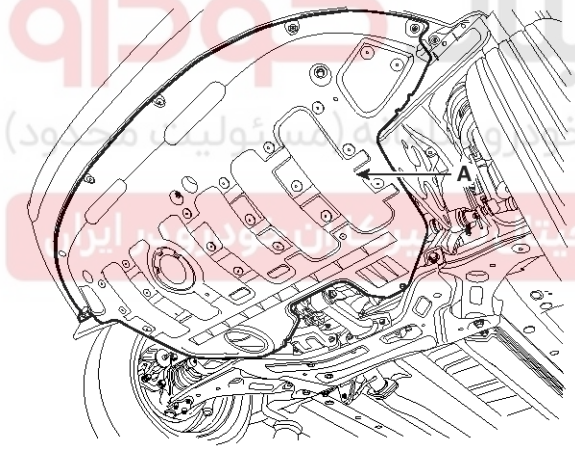
1. Remove the engine cover (A).



SSLEM0026D

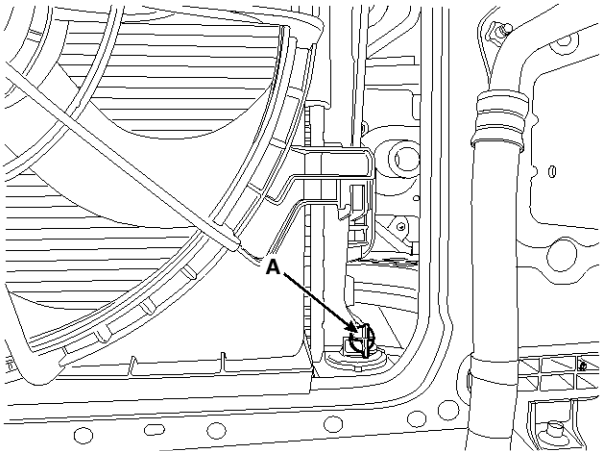
2. Remove the under cover (A).

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



SSLEM0002D

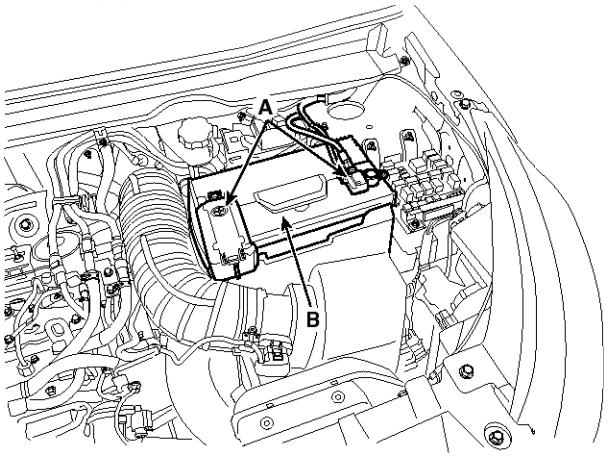
3. Loosen the radiator drain plug (A) and drain the engine coolant. Remove the radiator cap to speed draining.



SSLEM0003D

4. Disconnect the battery terminal (A), and then remove the battery (B).

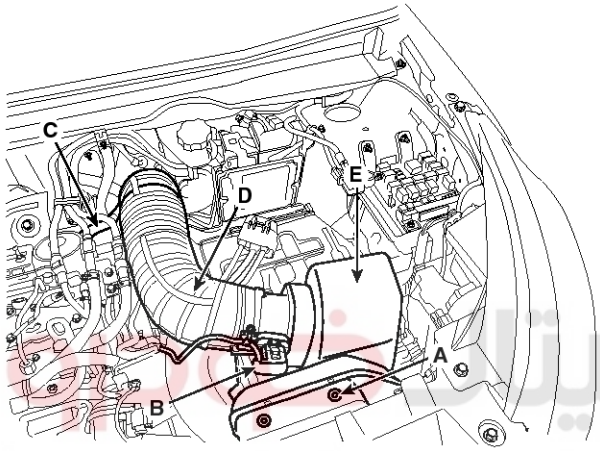
Tightening torque :
(-) terminal (without battery sensor): 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
(-) terminal (with battery sensor): 4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)
(+) terminal : 7.9 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)
Bracket bolt : 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SSLEM0017D

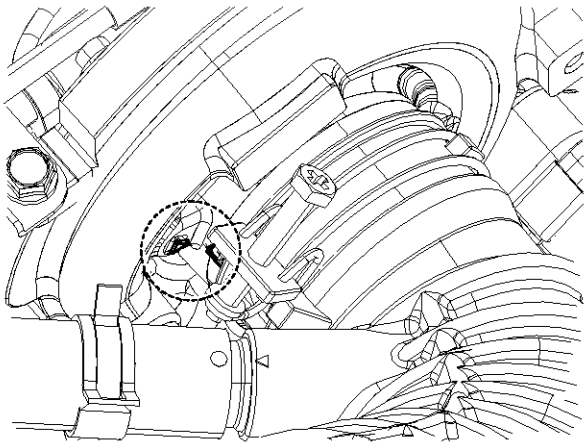
5. Remove the air cleaner assembly.
   1) Remove the air duct (A).
   2) Disconnect the air flow sensor (AFS) connector (B).
   3) Disconnect the breather hose (C).
   4) Remove the intake air hose (D) and air cleaner assembly (E).

Tightening torque :
Clamps: 2.9 ~ 4.9N.m (0.3 ~ 0.5kgf.m, 2.2 ~ 3.6lb-ft)
Bolts: 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLEM0011D

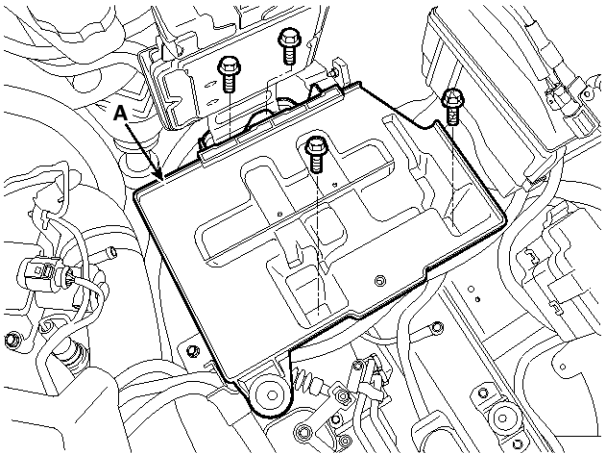
NOTICE
Align the mark of the air intake hose and compressor.



SSLEM0023D

6. Remove the battery tray (A).

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

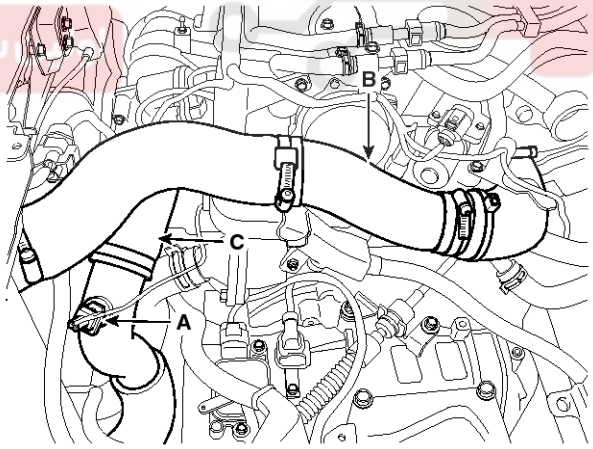


SLMEM0005D

7. Disconnect the intake air temperature sensor connector (A) and remove the intercooler inlet pipe&hose (B) and outlet pipe&hose (C).

Tightening torque :
Clamps: 4.9 ~ 6.9N.m (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft)
Bolt: 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

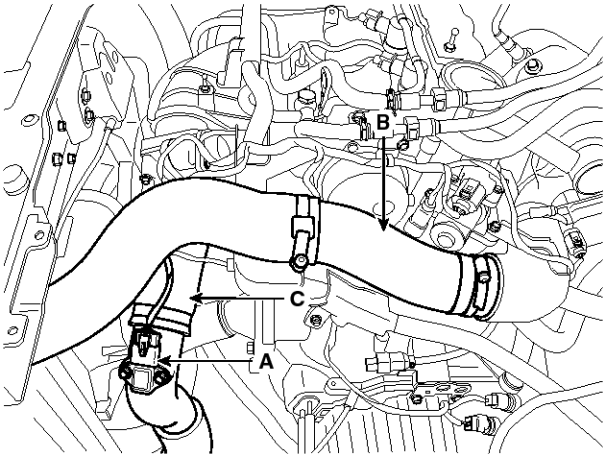
[Standard]



SLMEM0006D

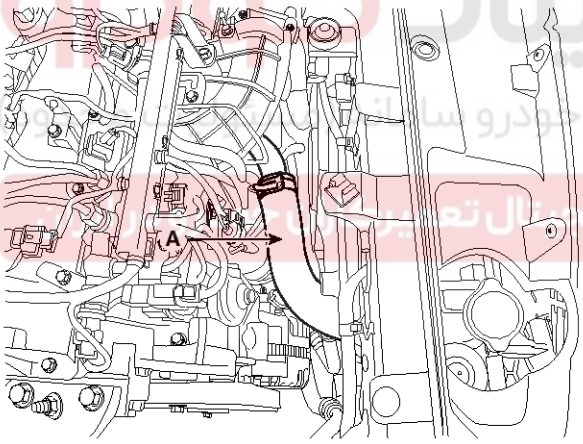
Disconnect the boost pressure sensor (BPS) connector (A) and remove the intercooler inlet pipe & hose (B) outlet pipe & hose (C).

[Low Power]

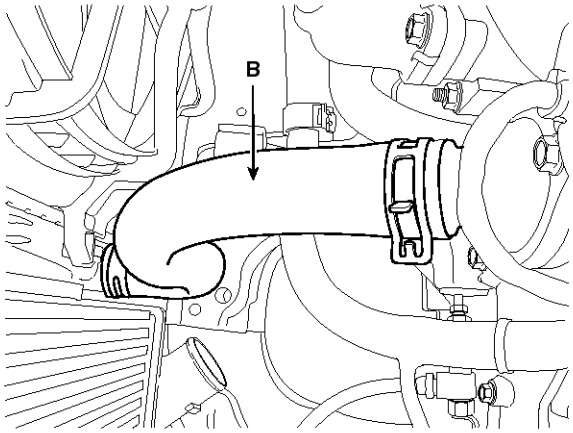


SELEM0003L

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



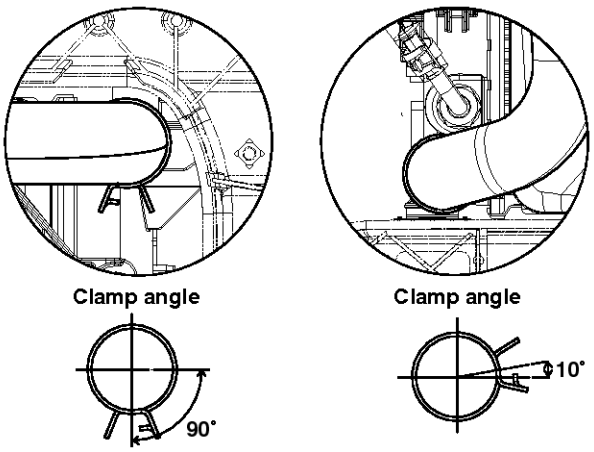
SSLEM0013D



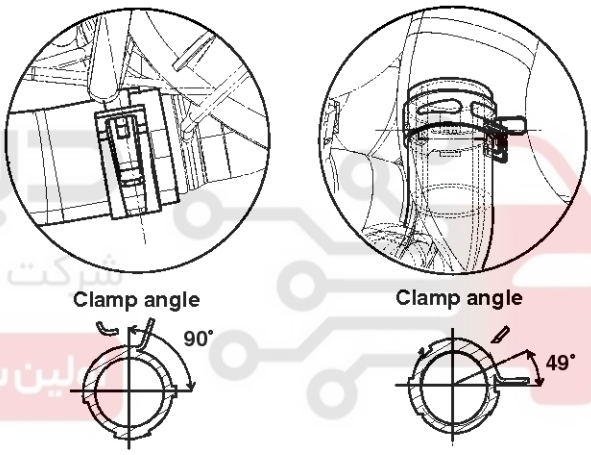
SXMEM9008D

NOTICE

Install the radiator hoses as shown illustrations.

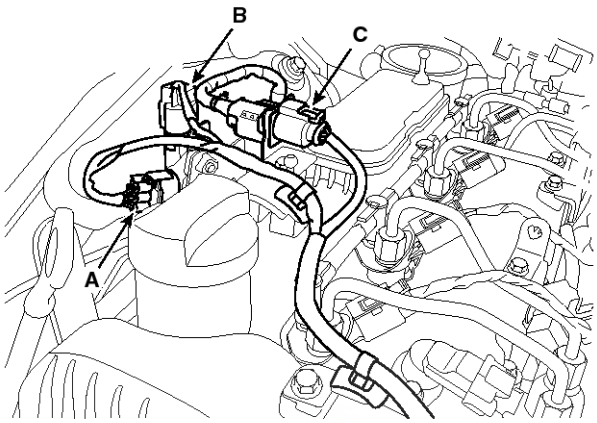


SSLEM0113L



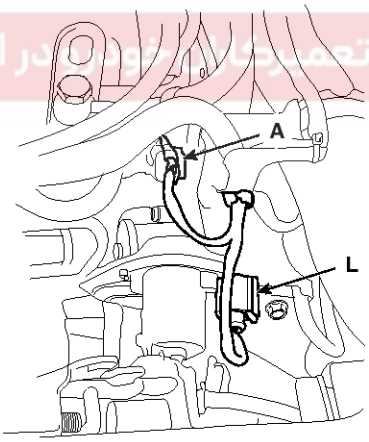
SSLEM0114L

9. Disconnect the engine wire harness connectors.
   1) Disconnect the difference pressure sensor connector (A). (With DPF) [Euro - 5 only]
   2) Disconnect the exhaust gas temperature sensor connector (B). (With DPF) [Euro - 5 only]
   3) Disconnect the lambda sensor connector (C). [Euro - 4/5 only]



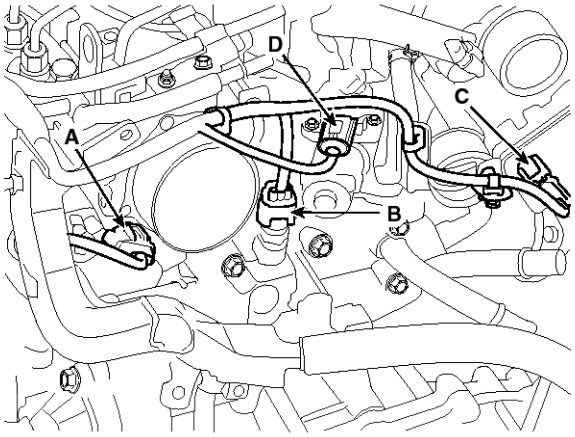
SXMEM9009D

   4) Disconnect the rail pressure regulator valve connector (A).
   5) Disconnect the air control valve connector (B).



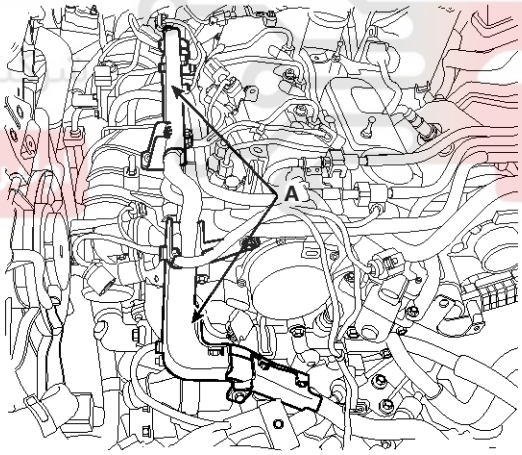
SXMEM9373D

   6) Disconnect the variable swirl control actuator connector (A). [Euro - 4/5 only]
   7) Disconnect the engine coolant temperature sensor (ECTS) connector (B).
   8) Disconnect the E-VGT actuator connector (C).
   9) Disconnect the EGR actuator connector (D).



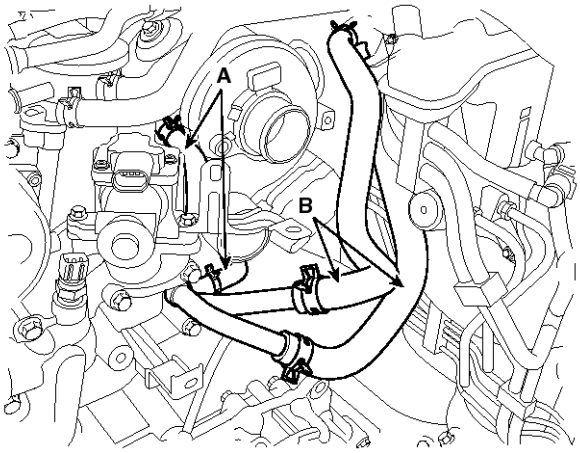
SLMEM0056D

10. Remove the wire harness protector (A).



SLMEM0057D

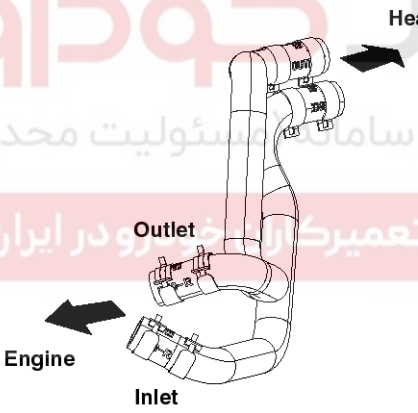
11. Disconnect the turbocharger water hose (A). (Standard only)
12. Disconnect the heater hose (B).



SLMEM0052D

NOTICE

Install the heater hoses as shown illustrations.

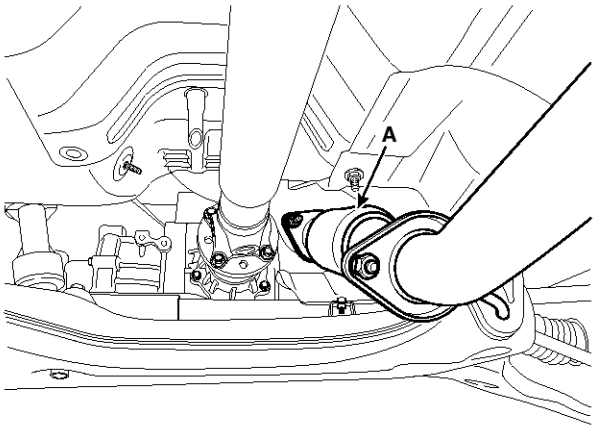


SSLEM0019D

13. Remove the front muffler (A).

Tightening torque :

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

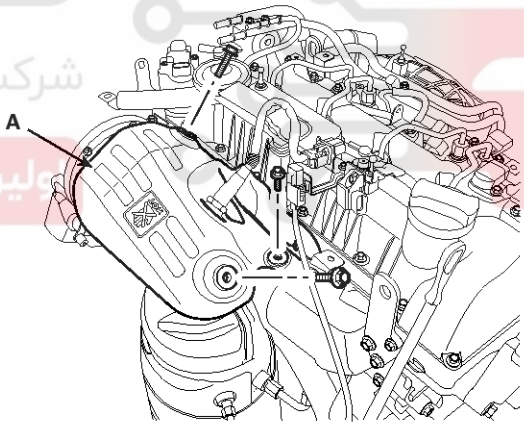


SLMEM0051D

14. Remove the DPF(or WCC) heat protector (A).

Tightening torque :

17.7 ~ 21.6N.m (1.8 ~ 2.2kgf.m, 13.0 ~ 15.9lb-ft)

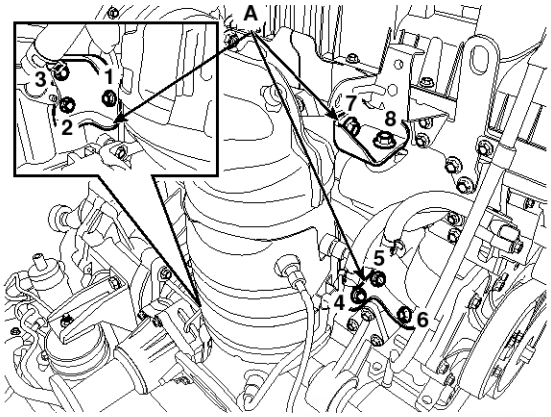


SXMEM9061D

15. Remove the DPF (or WCC) converter assembly support bracket (A).

Tightening torque :
44.1 ~ 53.9N.m (4.5 ~ 5.5kgf.m, 32.5 ~ 39.8lb-ft)

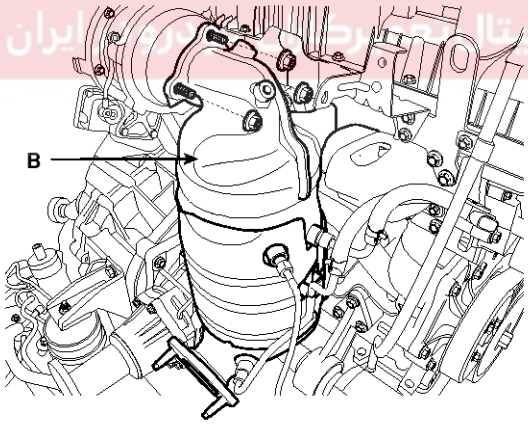
When installing the exhaust manifold, tighten the bolts with pre-torque first, and then tighten the bolts with specified torque in the sequence shown.



SXMEM9063D

16. Remove the DPF(or WCC) converter assembly (A).

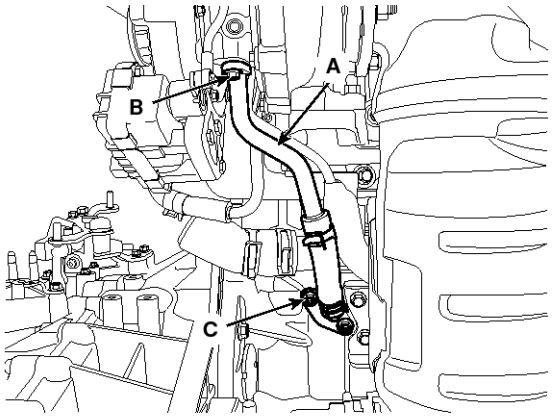
Tightening torque :
49.0 ~ 68.6N.m (5.0 ~ 7.0kgf.m, 36.2 ~ 50.6lb-ft)



SXMEM9062D

17. Remove the turbocharger oil drain pipe (A).

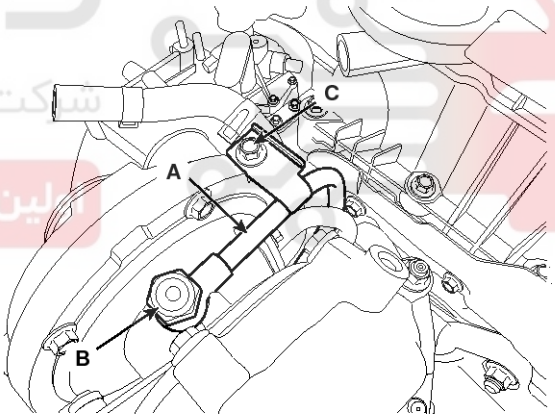
Tightening torque :
Bolts(B): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)
Nuts(C): 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



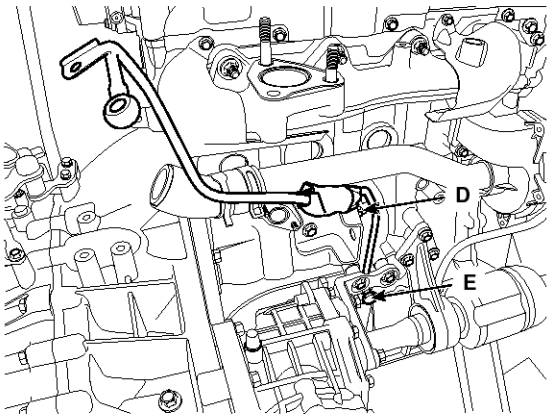
SXMEM9064D

18. Remove the turbocharger oil feed pipe (A).

Tightening torque :
Bolt(B): 11.8 ~ 17.7N.m (1.2 ~ 1.8kgf.m, 8.7 ~ 13.0lb-ft)
Bolt(C): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)
Bolts(D, E): 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



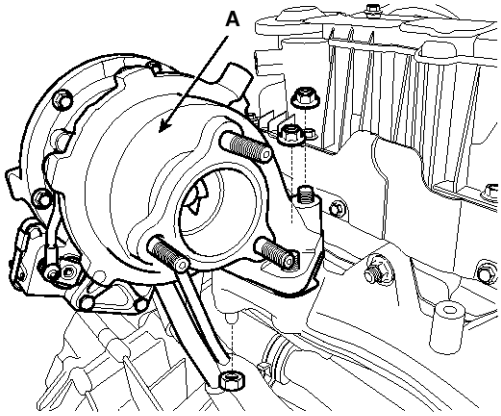
SXMEM9065D



SXMEM9066D

19. Remove the turbocharger assembly (A).

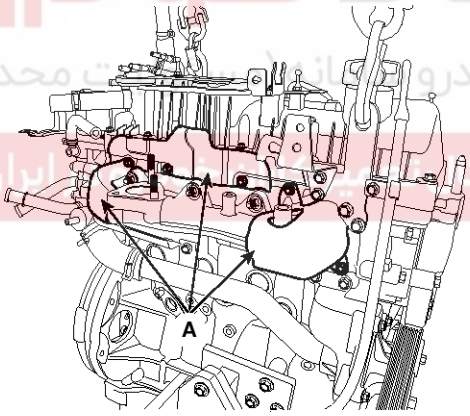
Tightening torque :
49.0 ~ 68.6N.m (5.0 ~ 7.0kgf.m, 36.2 ~ 50.6lb-ft)



SXMEM9067D

20. Remove the exhaust manifold heat protector (A).

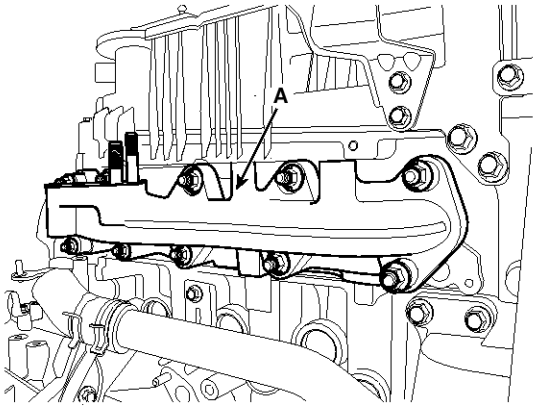
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SXMEM9068D

21. Remove the exhaust manifold (A) with the gasket.

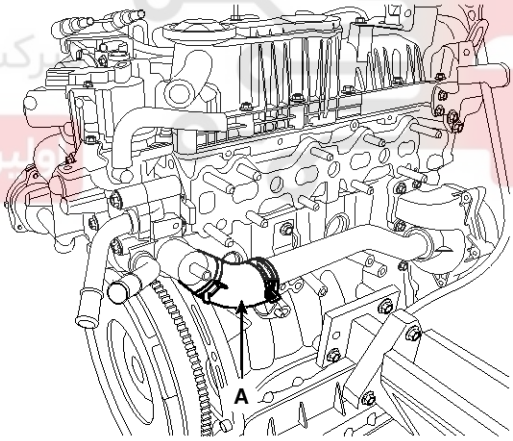
Tightening torque :
39.2 ~ 44.1N.m (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lb-ft)



SXMEM9069D

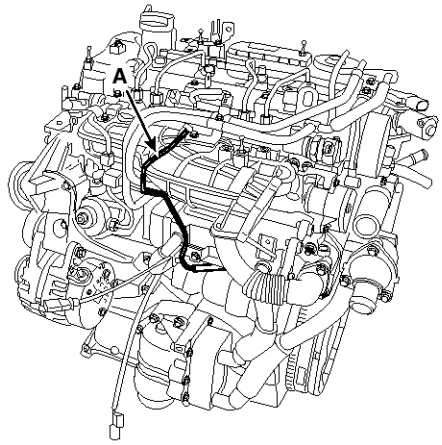
⚠CAUTION
When installing the bushes, have the large portion facing the cylinder block.

22. Disconnect the water inlet hose (A).



SXMEM9070D

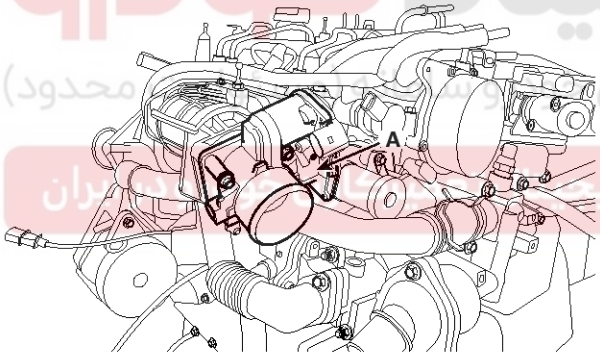
23. Remove the EGR vacuum pipe (A). (Refer to FL group) [Euro - 4/5 only]



SLMEM0074D

24. Remove the air control valve (A).

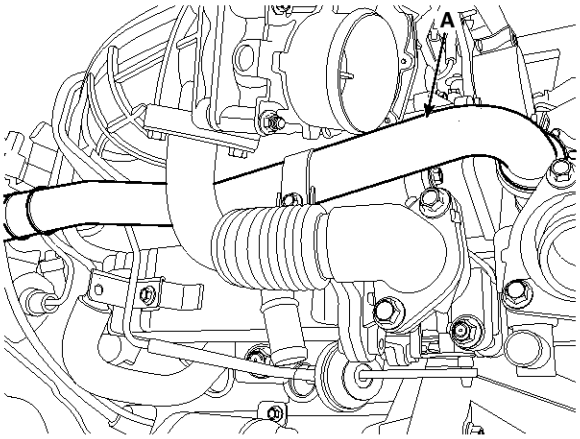
Tightening torque :
8.8 ~ 10.8N.m (0.9 ~ 1.1kgf.m, 6.5 ~ 8.0lb-ft)



SLMEM0070D

25. Remove the water outlet pipe (A).

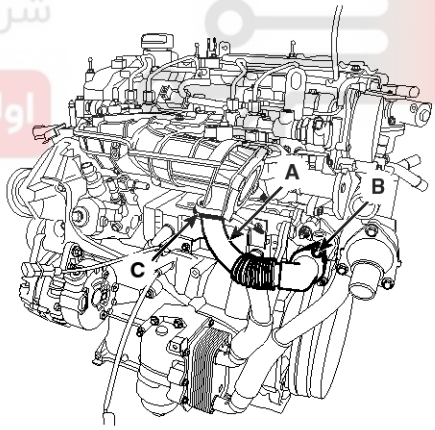
Tightening torque :
7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



SLMEM0071D

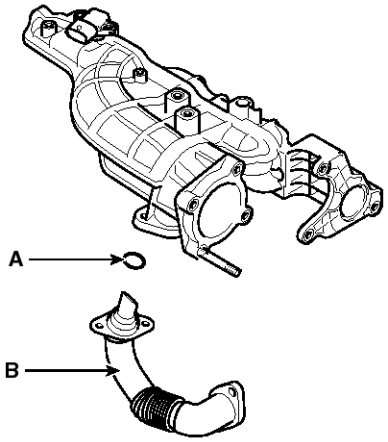
26. Remove the EGR pipe assembly (A). [Euro - 4/5 only]

Tightening torque :
Bolts(B): 19.6 ~ 23.5N.m (2.0 ~ 2.4kgf.m, 14.5 ~ 17.4lb-ft)
Bolts(C): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SLMEM0072D

When installing the EGR pipe assembly, make sure to insert the O-ring(A) to intake manifold before installing EGR pipe(B).



SVQEM0002D

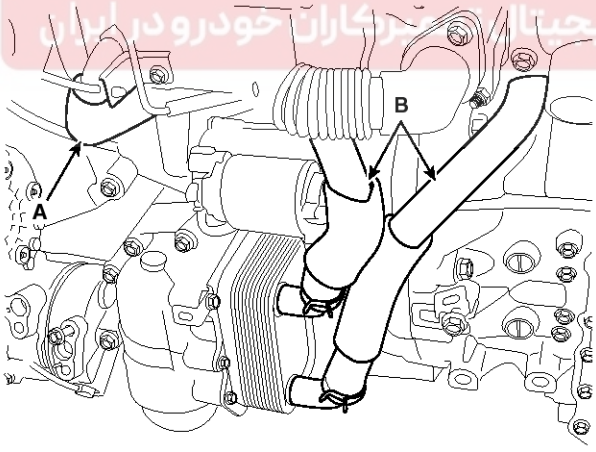
NOTICE

Always use a new O-ring.

CAUTION

If installing an EGR pipe with O-ring inserted to the intake manifold, the O-ring may be damaged and this can cause an exhaust gas leakage.

27. Remove the EGR cooler hose (A) [Euro - 4/5 only] and oil cooler hoses (B).



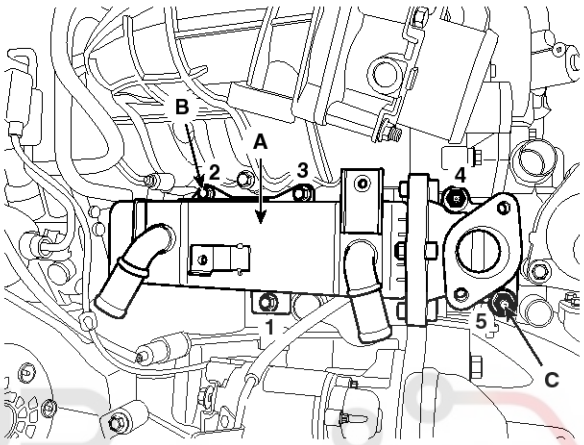
SLMEM0075D

28. Remove the EGR cooler (A). [Euro - 4/5 only]

Tightening torque :

Bolt(B): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)
Nut(C): 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

When installing the EGR cooler, tighten the bolts and nuts with pre-torque first, and then tighten the bolts and nuts with specified torque in the sequence shown.

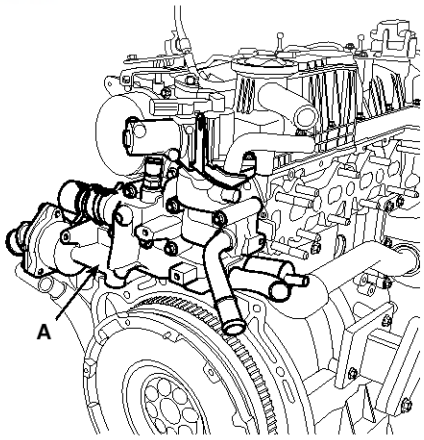


SLMEM0076D

29. Remove the EGR & thermostat housing assembly (A).

Tightening torque :

19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)



SXMEM9073D

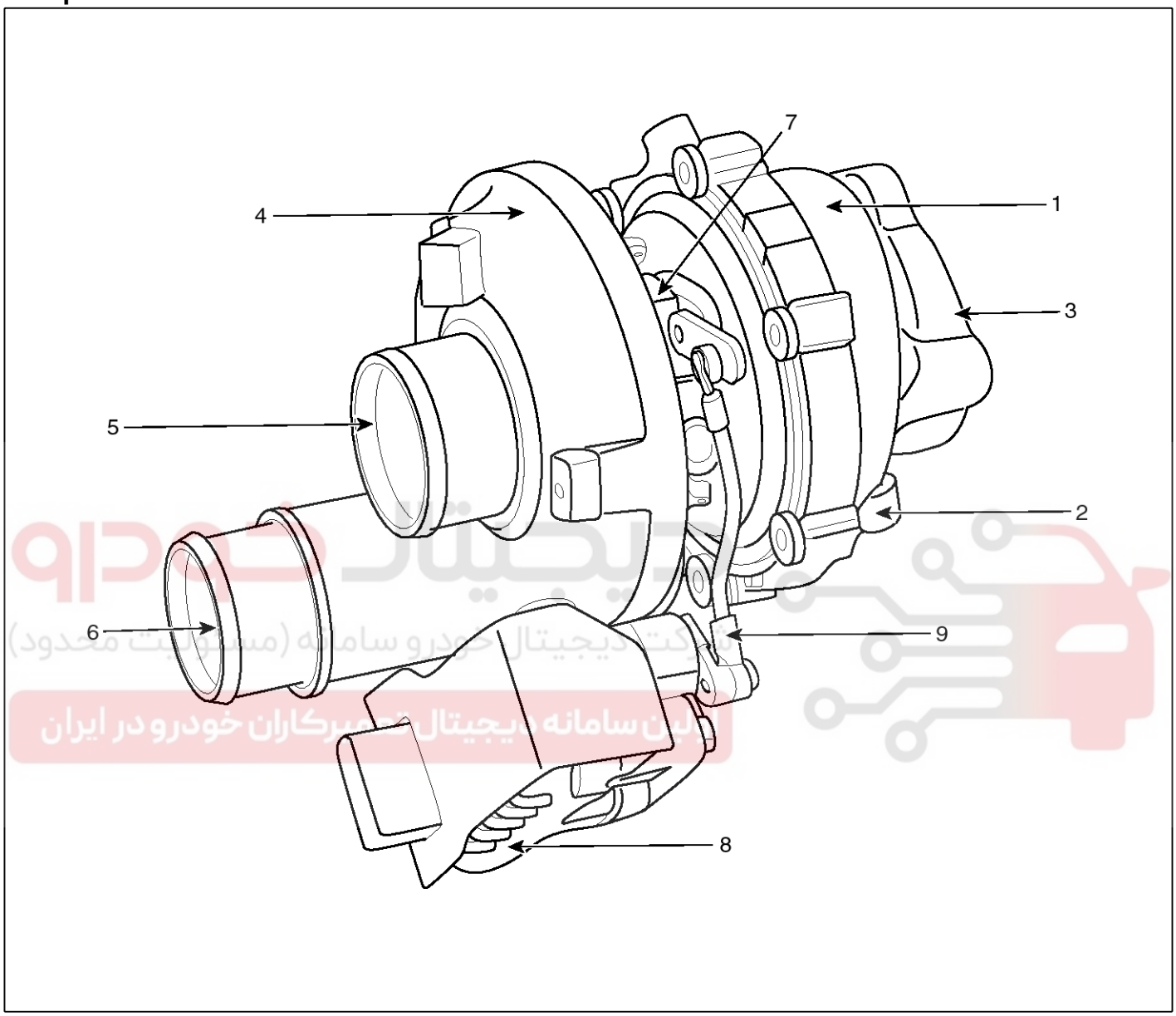
30. Installation is the reverse order of removal.

NOTICE

When installing, replace with new gaskets.

Turbo Charger

Components

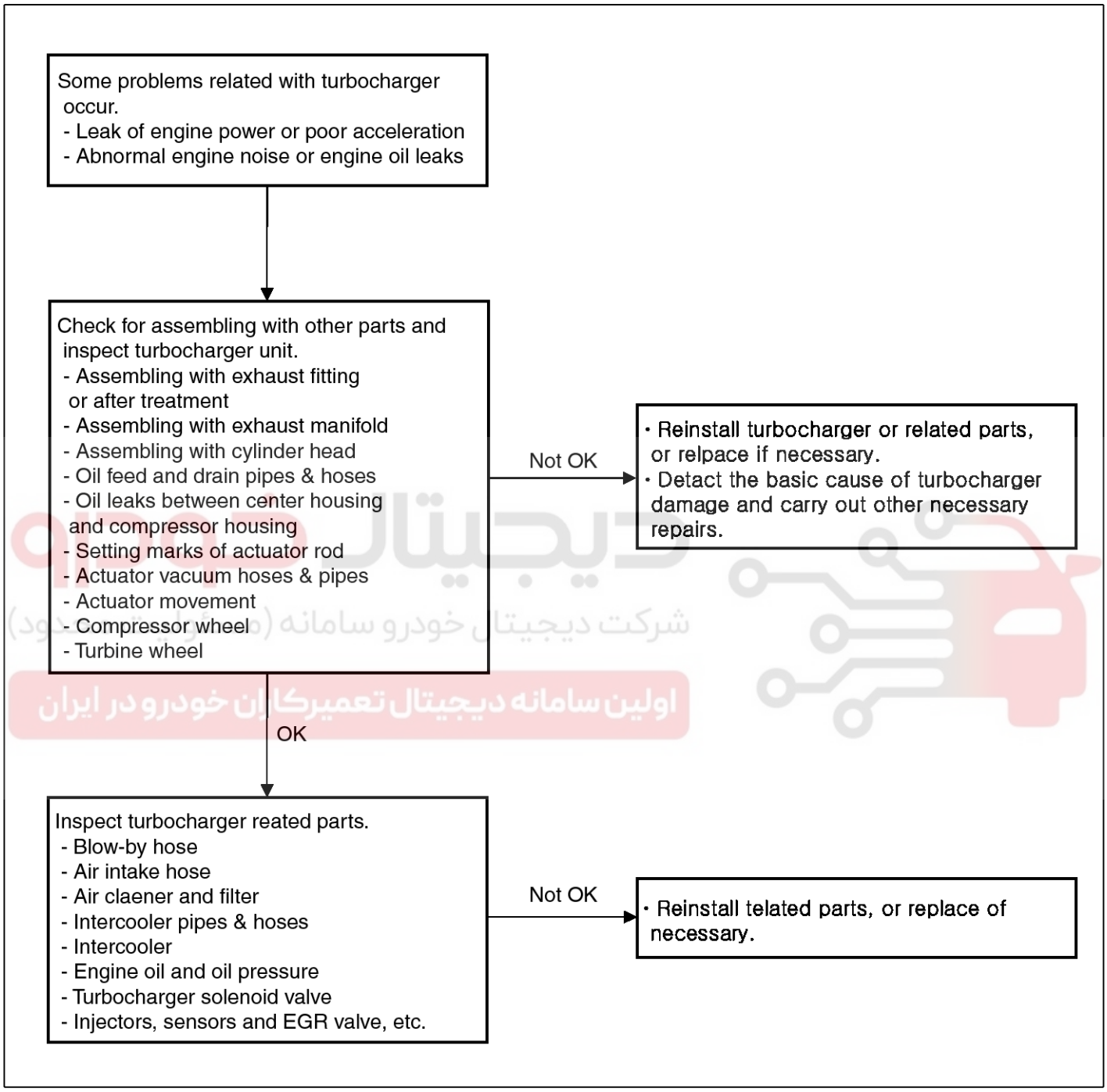


SSLEM0030D

1. Turbine housing
2. Turbine inlet
3. Turbine outlet
4. Compressor housing
5. Compressor inlet
6. Compressor outlet
7. Center housing
8. Actuator
9. Actuator rod

On-vehicle Inspection

Turbocharger Diagnostic Flow



SELEM0010L

If any problem related with turbocharger, such as lack of engine power, poor acceleration, abnormal engine noise or oil leaks, may occur, check the turbocharger according to the procedure as follows.

1. Check for assembling of the turbocharger and the exhaust fitting (or the after treatment).
   - Check if a gasket is installed.
   - Check if mounting bolts (or nuts) are tightened properly.
   - Check if there is a gas leak.
   - Check if there is any damage, such as crack, on the parts.

   If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

   If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.
2. Check for assembling of the turbocharger and the exhaust manifold.
   - Check if a gasket is installed.
   - Check if the mounting bolts (or nuts) are tightened properly.
   - Check if there is a gas leak.
   - Check if there is any damage, such as crack, on the parts.

   If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

   If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.
3. Check for assembling of the exhaust manifold and the cylinder head.
   - Check if a gasket is installed.
   - Check if the mounting bolts (or nuts) are tightened properly.
   - Check if there is a gas leak.

   If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

   If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or install a new gasket if necessary.
4. Check the turbocharger oil feed pipe & hose and oil drain pipe & hose.
   - Check if a gasket is installed.
   - Check if the mounting bolts are tightened properly.
   - Check if the clamps are positioned in place.
   - Check if the oil pipes & hoses are damaged (bent, crushed, torn or cracked).

   If a gas leak occur as a gasket was not installed or mounting bolts were tightened inadequately, it may cause oil leaks.

   If the oil feed pipe & hose is damaged, engine oil is not supplied sufficiently to the turbocharger then it may damage the turbocharger. If the oil drain pipe & hose is damaged and clogged, engine oil is not drained smoothly then it may cause oil leaks from the turbocharger.

   If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.
5. Check for oil leaks between center housing and compressor housing.
   - Check if the mounting bolts are tightened properly.
   - Check if there is an oil leak.

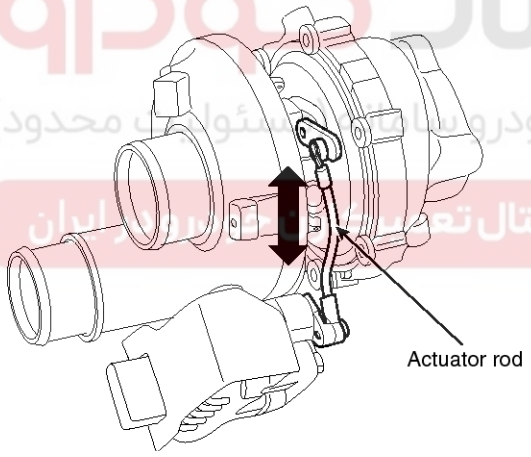
   If the O-ring (gasket) between the center housing and the compressor housing is damaged, it may cause oil leaks.

   If an oil leak is detected, replace the turbocharger with a new one.

6. Check the turbocharger actuator vacuum hoses & pipes.
   - Check if the vacuum hose is connected to the actuator properly.
   - Check if the vacuum hoses & pipes are damaged (bent, detached or torn).
   - Check if there is any damage, such as crack, on the vacuum pipes.
   - Check if the vacuum hoses are connected to inlet or outlet of the solenoid valve correctly.

   If the vacuum pipes & hoses are damaged or disconnected, the actuator does not work properly then it may cause lack of engine power and poor acceleration.

   If the vacuum hoses & pipes are damaged, replace them with new ones.
7. Check the turbocharger actuator.
   - Electronic actuator: Check for movement of the actuator rod when a forced actuator operating mode is performed by GDS. (Refer to DTC guide)



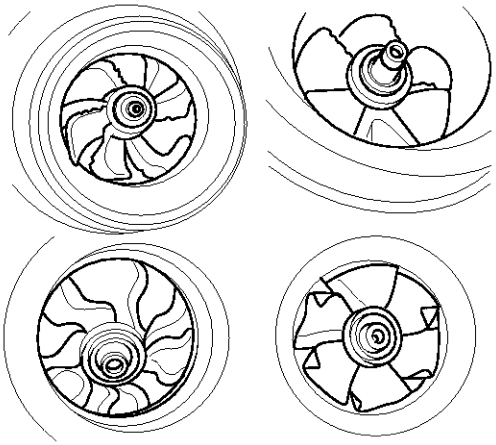
SELEM0016L

If the turbocharger actuator is damaged, it may cause lack of engine power and poor acceleration.

If the actuator rod does not move, replace the turbocharger with a new one.

8. Check the turbocharger compressor wheel.
   - Check if the compressor wheel is damaged (bent or deformed).
   - Check if the compressor wheel rotates smoothly.

   EX)



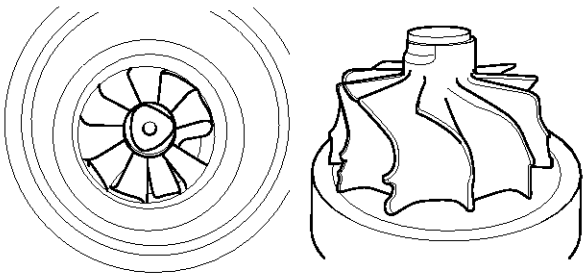
SELEM0007L

If the compressor wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.

If the compressor wheel are damaged or deformed, replace the turbocharger with new ones.

9. Check the turbocharger turbine wheel.
   - Check if the turbine wheel is damaged.
   - Check if the turbine wheel rotates smoothly.

   EX)



SELEM0008L

If the turbine wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.

If the turbine wheel are damaged or deformed, replace the turbocharger with new ones.

If any problem is not detected in the turbocharger, check the turbocharger-related parts according to the procedure as follows.

1. Check the blow-by hose. (Refer to FL group)
   - Check if the breather hose is damaged (bent, clogged).
   - Check if the positive crankcase ventilation (PCV) valve is clogged.

   If the breather hose is bent or clogged, the internal pressure in the engine increases then engine oil is not supplied smoothly to the turbocharger. So it may cause damage of the turbocharger and oil leaks.

   If the cause of the problem is detected, replace the breather hose or the related parts with new ones.
2. Check the air intake hose connected to the turbocharger.
   - Check if the air intake hose is damaged (bent, crushed, detached or torn).

   If a cross-section of the hose diminishes as the air intake hose is bent or crushed, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of the turbocharger and oil leaks. If the air intake hose is detached or torn, a foreign substance goes into the turbocharger and causes damage of it.

   If the air intake hose is damaged, replace it with a new one.
3. Check the air cleaner.
   - Check the air cleaner filter for pollution state.
   - Check the air cleaner filter for water influx.
   - Check the air cleaner cover for dirtiness.
   - Check if the air cleaner filter is a genuine part..

   If the air cleaner filter is moistened or polluted excessively or a non-genuine part is used, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of the turbocharger and oil leaks. .

   If the air cleaner filter is moistened or polluted excessively, replace it with a new one.

   NOTICE
   Replace the air cleaner filter according to the maintenance schedule.
4. Check the intercooler hoses & pipes.
   - Check if the intercooler hoses & pipes are connected properly.
   - Check if the intercooler hoses & pipes are damaged (bent, detached or torn).
   - Check if there is any damage, such as crack, on the intercooler pipes.
   - Check if the clamps are positioned in place.

   If the intercooler hoses & pipes are damaged or disconnected, oil leaks may occur from the hoses & pipes and the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

   If the intercooler hoses & pipes are damaged, replace them with new ones.

   NOTICE
   Use new clamps when replacing the hoses & pipes.
5. Check the intercooler.
   - Check if the intercooler tubes and tanks are damaged (oil leak or crack).

   If the intercooler is damaged, the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

   If the intercooler is damaged, replace them with a new one.

   NOTICE
   Use new clamps when replacing the intercooler.
6. Check the engine oil.
   - Check the engine oil level.
   - Check the engine oil for discoloration, water influx and viscosity degradation.
   - Check the engine oil grade.

   If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

   If the cause of the problem is detected, add or change engine oil.

   NOTICE
   Change the engine oil according to the maintenance schedule.

7. Check the engine oil pressure.
   - Engine oil pressure: Check the oil pressure using an oil pressure gauge after removing the oil pressure switch on the cylinder block.
   - Check the engine oil screen in the oil pan if the engine oil level is low. Then check the injectors for gas leaks if foreign substances are accumulated on the oil screen.

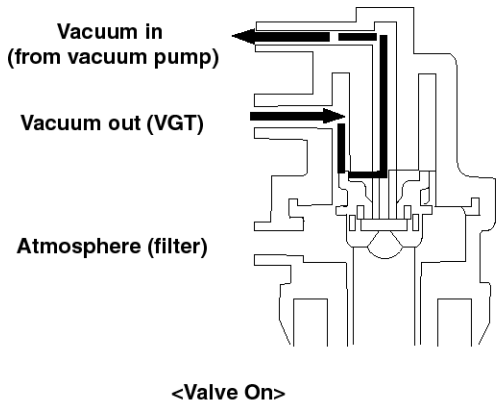
   If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

   If the cause of the problem is detected, add or change engine oil. If foreign substances are accumulated on the oil screen, wash the oil screen and replace the injector's washer with a new one after checking the injectors for gas leaks. Check the engine oil-related parts, such as oil pump, if necessary.

   NOTICE

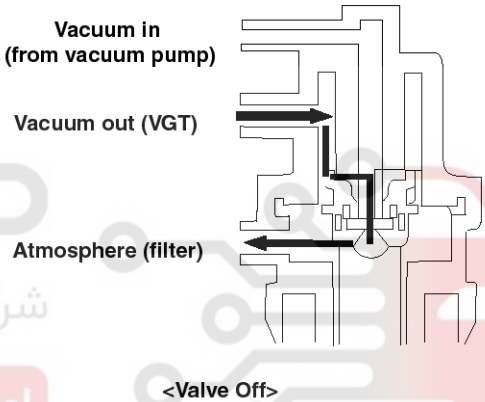
   As the turbocharger rotates at high speed of 100,000 rpm or above, deterioration of engine oil can cause damage of the turbocharger bearings. Check engine oil for discoloration, water influx, viscosity degradation and oil pressure lowering.

8. Check the solenoid valve of turbocharger. (Refer to DTC guide)
   - Damage of the solenoid valve: Check if vacuum is generated at the disconnected vacuum hose from the actuator when a forced actuator operating mode is performed by GDS..
   - Clog of the solenoid valve filter: Check if vacuum is released when a forced actuator operating mode is performed from max. duty (95%) to min. duty (5%) by GDS. (If the solenoid valve filter is clogged, the vacuum won't be released or it will take a long time to be released.)



<Valve On>

SELEM0009L



<Valve Off>

SELEM0017L

If the solenoid valve is damaged, the actuator does not work properly then it may cause lack of engine power and poor acceleration. If the solenoid valve filter is clogged, vacuum is not released then it may cause damage of the turbocharger by overrunning.

If the solenoid valve is damaged, replace it with a new one.

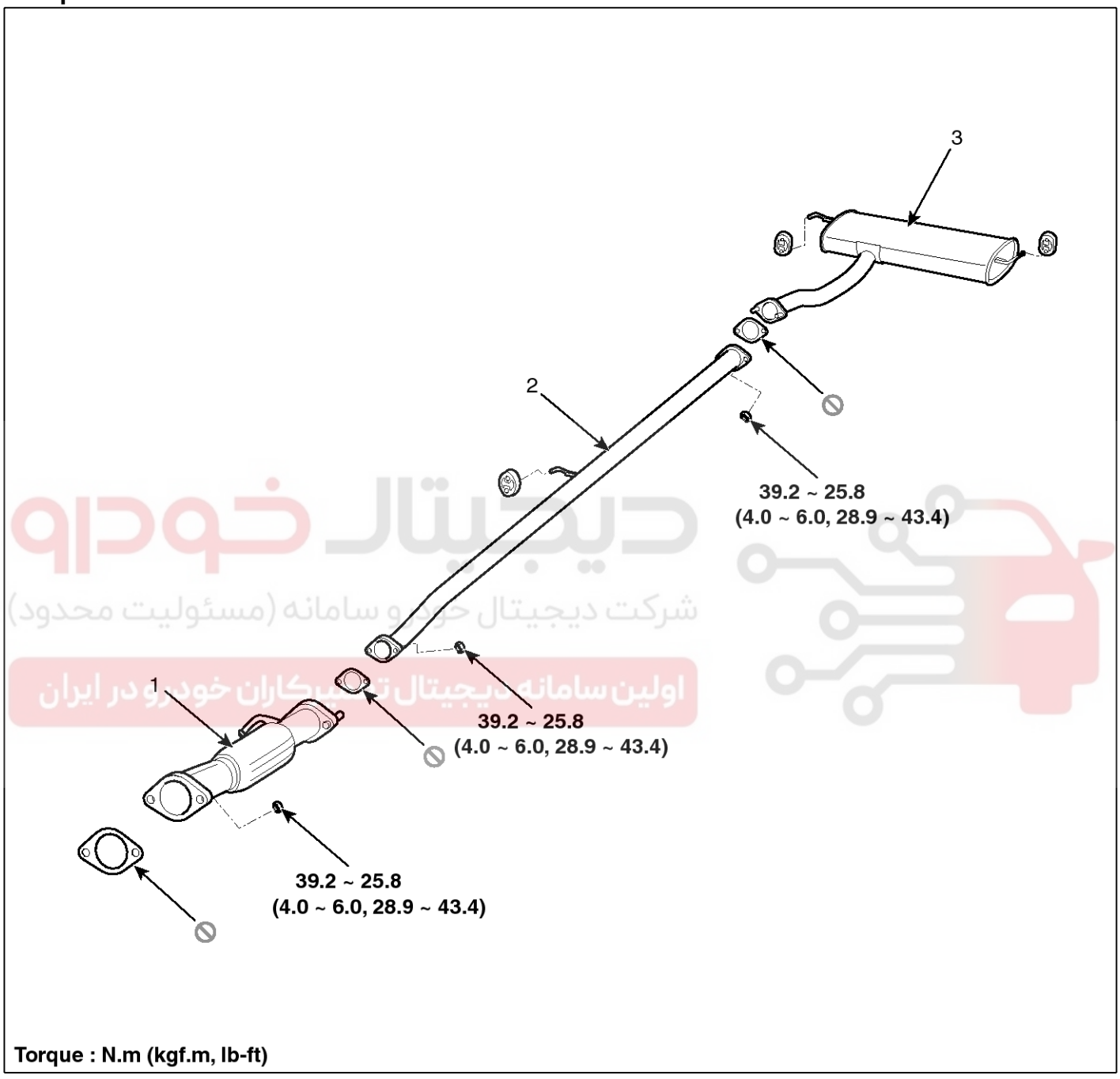
9. Check the injectors, sensors, EGR valve, etc. (Refer to FL group)
   - Check if the injectors operate properly.
   - Check if the sensors, such as the mass air flow sensor (MAFS), intake air temperature sensor (IATS), boost pressure sensor (BPS), operate properly.
   - Check if the exhaust gas recirculation (EGR) valve operates properly.

   If the injectors, sensors, EGR valve and etc. don't work properly, it may cause lack of engine power.

   If the cause of the problem is detected, replace the related parts with new ones.

Muffler

Components



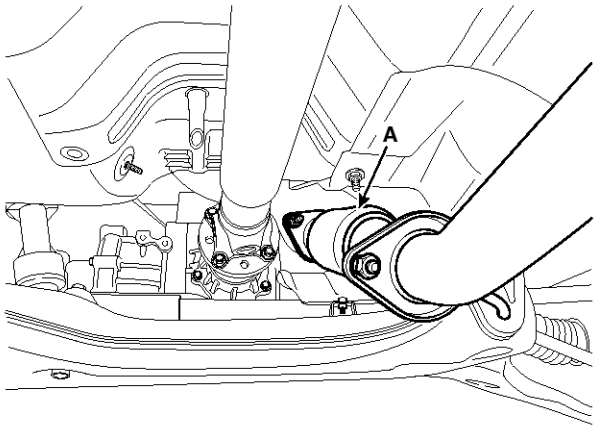
SSLEM0112L

1. Front muffler
2. Center muffler
3. Main muffler

Removal and Installation

1. Remove the front muffler (A).

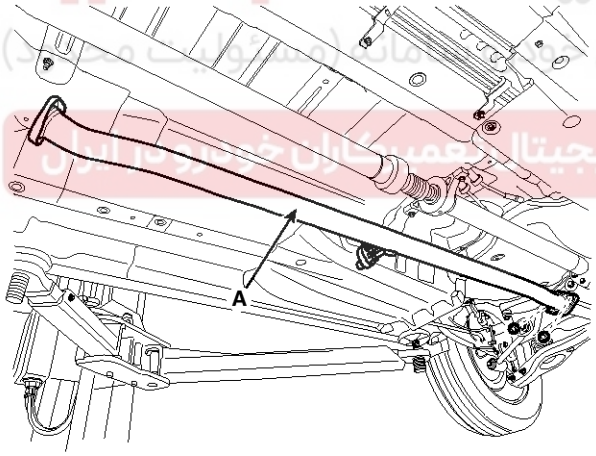
Tightening torque :
39.2 ~ 58.9N.m (4.0 ~ 6.0kgf.m, 28.9 ~ 43.4lb-ft)



SLMEM0051D

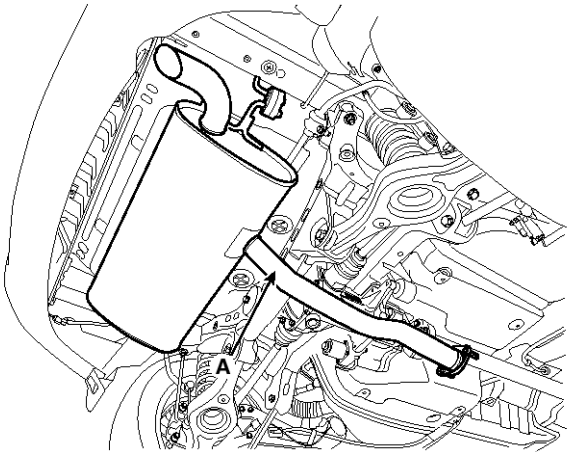
2. Remove the center muffler (A).

Tightening torque :
39.2 ~ 58.9N.m (4.0 ~ 6.0kgf.m, 28.9 ~ 43.4lb-ft)



SSLEM0015D

3. Remove the main muffler (A).



SSLEM0010D

4. Installation is the reverse order of removal.

NOTICE
When installing, replace with new gaskets.