# **Engine Mechanical System**

### **General Information**

### **Specifications**

Description		Specifications	Limit
General			
Туре		In-line, DOHC	
Number of cylinders	;	4	
Bore [2.0L/2.4L]		86mm (3.385in.) / 88mm (3.464in.)	
Stroke [2.0L/2.4L]		86mm (3.385in.) / 97mm (3.819in.)	
Total displacement	[2.0L/2.4L]	1998cc (121.92cu.in) / 2359cc (143.90cu.in)	
Compression ratio		10.5 ± 0.3 : 1	
Firing order		1-3-4-2	
Valve timing			
lately a value	Opens	ATDC 7° ~ BTDC 38°	
Intake valve	Closes	ABDC 67° ~ 22°	
Full about out on	Opens	BBDC 44° ~ 4°	0
Exhaust valve	Closes	ATDC 0° ~ 40°	
Valve clearance [E	ngine coolant tempe	erature : 20°C (68°F)]	
Intake valve		0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust valve	تعميركاران خو	0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0079 ~ 0.0157in.)
Camshaft			
Cam height	Intake	44.2mm (1.7401in.)	
Carrineignt	Exhaust	45.0mm (1.7716in.)	
Journal outer diam-	Intake	No.1 : \$\psi\$ 30mm (1.1811in.) No.2,3,4,5 : \$\psi\$ 24mm (0.9449in.)	
eter	Exhaust	No.1 : \$\psi\$ 36mm (1.4173in.) No.2,3,4,5 : \$\psi\$ 24mm (0.9449in.)	
Bearing oil clearan-	Intake	No.1 : $0.022 \sim 0.057$ mm ( $0.00087 \sim 0.00224$ in.) No.2,3,4,5 : $0.045 \sim 0.082$ mm ( $0.00177 \sim 0.00323$ in.	No.1 : 0.090mm (0.00 354in.)
ce	Exhaust	No.1 : 0 $\sim$ 0.032mm (0 $\sim$ 0.00126in.) No.2,3,4,5 : 0.045 $\sim$ 0.082mm (0.00177 $\sim$ 0.00323in.	No.2,3,4,5 : 0.120mm (0.00472in.)
End play		0.04 ~ 0.16mm (0.0016 ~ 0.0063in.)	0.20mm (0.0078in.)
Valve			
Wall a land	Intake	113.18mm (4.4559in.)	112.93mm (4.4461in)
Valve length	Exhaust	105.84mm (4.1669in.)	105.59mm (4.1571in)

**EMA-3** 

Stem outer diameter	Desc	ription	Specifications	Limit
Thickness of valve head (margin)	Stem outer diamet-	Intake	5.465 ~ 5.480mm (0.21516 ~ 0.21575in.)	
Thickness of valve head (margin)  Thickness of valve head (margin)  Exhaust  1.09mm (0.0429in.)  Valve stem to valve guide clearance  Exhaust  1.09mm (0.00078 ~ 0.00185in.)  0.070mm (0.00275in.)  Exhaust  0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)  0.090mm (0.00354in.)  MLA outer diameter  31.964 ~ 31.980mm (1.2584 ~ 1.2590in.)  Tappet bore inner diameter  32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)  MLA to tappet bore clearance  0.020 ~ 0.061mm (0.00078 ~ 0.00240in.)  0.070mm (0.00275in.)  Valve guide  Length  Intake  43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)  Exhaust  43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)  Intake  5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)  Exhaust  5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)  Valve seat  Width of seat contact and the seat on the seat contact and the seat of the seat	er Exhaust		5.458 ~ 5.470mm (0.21488 ~ 0.21535in.)	
Exhaust   1.09mm (0.0429in.)   1.09mm (0.00275in.)   1.090mm (0.00354in.)   1.09mm (0.00118 - 0.00212in.)   0.090mm (0.00354in.)   1.09mm (0.00078 - 0.00212in.)   0.090mm (0.00354in.)   1.09mm (0.00078 - 0.00240in.)   0.070mm (0.00275in.)   1.09mm (0.021654 - 0.21701in.)   1.09mm (0.21654 - 0.21701in.)   1.09mm (0.21654 - 0.21701in.)   1.09mm (0.0531 - 0.0649in.)   1.09mm (0.0039in.)   1.09mm (0.0039in.)   1.09mm (0.0039in.)   1.09mm (0.00039in.)   1.09mm (0.0	Face angle		45.25° ~ 45.75°	
Valve stem to valve guide clearance   Exhaust	Thickness of valve	Intake	1.02mm (0.0401in.)	
Secondary   Seco	head (margin)	Exhaust	1.09mm (0.0429in.)	
MLA outer diameter	Valve stem to valve	Intake	$0.020 \sim 0.047$ mm ( $0.00078 \sim 0.00185$ in.)	0.070mm (0.00275in.)
Tappet bore inner diameter   32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)   0.070mm (0.00275in.)	guide clearance	Exhaust	$0.030 \sim 0.054$ mm ( $0.00118 \sim 0.00212$ in.)	0.090mm (0.00354in.)
MLA to tappet bore clearance   0.020 ~ 0.061mm (0.00078 ~ 0.00240in.)   0.070mm (0.00275in.)	MLA outer diameter		31.964 $\sim$ 31.980mm (1.2584 $\sim$ 1.2590in.)	
Valve guide         Intake         43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)           Exhaust         43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)           Inner diameter         Intake         5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)           Valve seat         Width of seat contact         Intake         1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)           Width of seat contact         Exhaust         1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)           Seat angle         Intake         44.75° ~ 45.10°           Exhaust         1.90 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)           Valve spring         Intake         Less than 1.5°           Cylinder head         Less than 0.02mm (0.0007in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)           Flatness of manifold mounting surface         Less than 0.10mm (0.00039in.)           Exhaust         Less than 0.10mm (0.0039in.)           Piston         85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Tappet bore inner di	ameter	32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)	
Intake	MLA to tappet bore	clearance	$0.020 \sim 0.061$ mm ( $0.00078 \sim 0.00240$ in.)	0.070mm (0.00275in.)
Exhaust	Valve guide			
Exhaust   43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)     Intake   5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)     Exhaust   5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)     Valve seat   Intake   1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)     act   Exhaust   1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)     Seat angle   Intake   44.75° ~ 45.10°     Exhaust   44.75° ~ 45.10°     Exhaust   44.75° ~ 45.10°     Valve spring   Intake   47.44mm (1.8677in.)     Load   19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)     Out of squareness   Less than 0.05mm (0.0019in.) for total area     Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)     Flatness of manifold mounting surface   Exhaust   Less than 0.10mm (0.0039in.)     Fiston   Piston outer diameter [2.0L/2.4L]   85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Longth	Intake	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	
Seat angle   Exhaust   5,500 ~ 5,512mm (0.21654 ~ 0.21701in.)	Length	Exhaust	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	
Exhaust	Inner diameter	Intake	5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)	
Intake	inner diameter	Exhaust	5.500 ~ 5.512mm (0.21654 ~ 0.21701in.)	
Exhaust   1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)	Valve seat			
Intake	Width of seat cont-	Intake	1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)	
Exhaust   44.75° ~ 45.10°	act	Exhaust	1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)	
Valve spring         Free length       47.44mm (1.8677in.)         Load       19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)         Out of squareness       Less than 1.5°         Cylinder head         Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)         Flatness of manifold mounting surface         ld mounting surface       Exhaust         Less than 0.10mm (0.0039in.)         Piston         Piston outer diameter [2.0L/2.4L]       85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Soot angle	Intake	44.75° ~ 45.10°	
Free length         47.44mm (1.8677in.)           Load         19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)           Out of squareness         Less than 1.5°           Cylinder head         Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)           Flatness of manifold mounting surface         Intake         Less than 0.10mm (0.0039in.)           Id mounting surface         Exhaust         Less than 0.10mm (0.0039in.)           Piston         85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Seat angle	Exhaust	44.75° ~ 45.10°	
19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)	Valve spring			
Section   Sect	Free length		47.44mm (1.8677in.)	
Cylinder head           Less than 0.05mm (0.0019in.) for total area           Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)           Flatness of manifo- Intake         Less than 0.10mm (0.0039in.)           Less than 0.10mm (0.0039in.)           Piston           Piston outer diameter [2.0L/2.4L]         85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Load		·	
Less than 0.05mm (0.0019in.) for total area	Out of squareness		Less than 1.5°	
Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.)	Cylinder head			
Less than 0.10mm (0.0039in.)	Flatness of gasket surface		Less than 0.02mm (0.0007in.) for a section of	
Piston         85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Flatness of manifo-	Intake	Less than 0.10mm (0.0039in.)	
Piston outer diameter [2.0L/2.4L]		Exhaust	Less than 0.10mm (0.0039in.)	
87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)	Piston			
Piston to cylinder clearance $0.015 \sim 0.035 \text{mm} \ (0.00059 \sim 0.00138 \text{in.})$	Piston outer diamete	er [2.0L/2.4L]	· · · · · · · · · · · · · · · · · · ·	
	Piston to cylinder cle	earance	$0.015 \sim 0.035$ mm ( $0.00059 \sim 0.00138$ in.)	

# **Engine Mechanical System**

Desc	cription	Specifications	Limit
	No. 1 ring	1.235 ~ 1.250mm (0.04862 ~ 0.04921in.)	1.260mm (0.04961in.)
Ring groove width	No. 2 ring	1.230 ~ 1.250mm (0.04843 ~ 0.04921in.)	1.260mm (0.04961in.)
	Oil ring	2.010 ~ 2.025mm (0.07913 ~ 0.07972in.)	2.050mm (0.08071in.)
Piston ring			
	No. 1 ring	$0.050 \sim 0.080$ mm ( $0.00197 \sim 0.00315$ in.)	0.100mm (0.00394in.)
Side clearance	No. 2 ring	0.040 ~ 0.080mm (0.00157 ~ 0.00315in.)	0.100mm (0.00394in.)
	Oil ring	0.060 ~ 0.125mm (0.00236 ~ 0.00492in.)	0.200mm (0.00787in.)
	No. 1 ring	0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)	0.60mm (0.0236in.)
End gap	No. 2 ring	0.37 ~ 0.52mm (0.0145 ~ 0.0204in.)	0.70mm (0.0275in.)
	Oil ring	0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)	0.80mm (0.0315in.)
Piston pin			
Piston pin outer dia	meter	21.001 ~ 21.006mm (0.82681 ~ 0.82701in.)	
Piston pin hole inne	er diameter	21.019 ~ 21.024mm (0.82752 ~ 0.82771in.)	
Piston pin hole clea	rance	0.013 ~ 0.023mm (0.00051 ~ 0.00091in.)	_
Connecting rod small end hole inner dia- meter		20.974 ~ 20.985mm (0.82575 ~ 0.82618in.)	
Piston pin-to-connecting rod interference		0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)	
Connecting rod	jumi / www g	مرحه دیجیدان حودر	
Connecting rod big end inner diameter		51.000 ~ 51.018mm (2.00787 ~ 2.00858in.)	
Connecting rod bearing oil clearance		0.031 ~ 0.045mm (0.00122 ~ 0.00177in.)	0.050mm ( 0.00197in. )
Side clearance		0.10 ~ 0.25mm (0.0039 ~ 0.0098in.)	0.35mm (0.0138in.)
Crankshaft			
Main journal outer of	diameter	51.942 ~ 51.960mm (2.04496 ~ 2.04567in.)	
Pin journal outer dia	ameter	47.954 ~ 47.972mm (1.88795 ~ 1.88866in.)	
Main bearing oil cle	clearance 0.020 ~ 0.038mm (0.00079 ~ 0.00150in.)		0.100mm (0.00394in.)
End play		0.07 ~ 0.25mm (0.0028 ~ 0.0098in.)	0.30mm (0.0118in.)
Cylinder block			
Cylinder bore [2.0L/	/2.4L]	86.00 ~ 86.03mm (3.3858 ~ 3.3870in.) / 88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)	
Flatness of gasket surface		Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.)×100mm (3.9370in.)	
Engine oil	•		•

**EMA-5** 

Description		Specifications	Limit
	Total [2.0L/2.4L]	4.7L (1.24U.S.gal., 4.97U.S.qt., 4.13lmp.qt.) / 5.5L (1.45U.S.gal., 5.81U.S.qt., 4.84lmp.qt.)	When replacing a short engine or block assembly
Oil quantity	Oil pan [2.0L/2.4L]	3.8L (1.00U.S.gal., 4.01U.S.qt., 3.34lmp.qt.) / 4.2L (1.11U.S.gal., 4.44U.S.qt., 3.70lmp.qt.)	
	Drain and refill [2.0 L/2.4L]	4.1L (1.08U.S.gal., 4.33U.S.qt., 3.61Imp.qt.) / 4.6L (1.21U.S.gal., 4.86U.S.qt., 4.05Imp.qt.)	Including oil filter
	Recommendation	For Europe: 5W-30/ACEA A5 (ZIC LD 5W-30, KIXX G1 LL, QUARTZ HKS G-310, QUARTZ INEO MC3 5W-30, HELIX ULTRA AH-E 5W -30, HELIX ULTRA 5W-40, TITAN SUPERSYN LONG LIFE 5W-30/40) For Middle East: 5W-30/ACEA A5 For General: 5W-20/GF4&SM	If not available, refer to the recommended ACEA, API or ILSAC classification and SA- E viscosity number.
Oil grade	Classification	For Europe: ACEA A3, A5 For Middle East: ACEA A5 API SL, SM or above ILSAC GF4 or above For General: API SL, SM or above ILSAC GF4 or above	Satisfy the requirement of the ACEA, API or ILSAC classification.
ولیت محدود)	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubricat- ion System".
Oil pressure (at 1,00	00rpm) [2.0L/2.4L]	108kPa (1.1kgf/cm², 15.6psi) or above / 147kPa (1.5kgf/cm², 21.3psi) or above	Oil temperature (oil pan): 110±2°C (230 ±35.6°F)
Cooling system			
Cooling method		Water-cooled, pressurized. Forced circulation with water pump	
Coolant quantity		6.7~6.8L (1.77~1.80 U.S.gal., 7.08~7.19 U.S.qt., 5.9 0~5.98 Imp.qt.)	
Coolant avantitu	2.0L	6.7~6.8L (1.77~1.80 U.S.gal., 7.08~7.19 U.S.qt., 5.9 0~5.98 Imp.qt.)	
Coolant quantity	2.4L	6.8~7.0L (1.80~1.85 U.S.gal., 7.19~7.40 U.S.qt., 5.9 8~6.16 Imp.qt.)	
	Туре	Wax pellet type	
Thermostat	Opening temperature	82±1.5°C (179.6±34.7°F)	
	Full opening valve I-ift/temperature	More than 8mm (0.3in.) / 95°C (203°F)	
Dodieter cos	Main valve opening pressure	93.16 ~ 122.58kPa (0.95 ~ 1.25kgf/cm², 13.51 ~ 17.78psi)	
Radiator cap	Vacuum valve ope- ning pressure	0 ~ 6.86 kPa (0 ~ 0.07kgf/cm², 0 ~ 0.99psi)	

# **Engine Mechanical System**

### **Tightening Torques**

ltem	Quantity	N.m	kgf.m	lb-ft
Engine mounting				
Engine mounting bracket to body fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting bracket to body fixing nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting insulator to engine mounting support bracket fixing nut	1	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine mounting support bracket to timing chain cover fixing bolt	1	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Engine mounting support bracket to timing chain cover fixing nut	2	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Transaxle mounting bracket to body fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to body fixing nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to transaxle fixing bolt	3	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ <b>7</b> 9.6
Roll rod bracket to sub frame fixing bolt	خودر و س	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod insulator to roll rod mounting support bracket fixing nut	1	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.0
Timing system			0	
Idler bolt	2	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Drive belt tensioner pulley bolt	1	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Drive belt tensioner bolt	1	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Crankshaft pulley bolt	1	166.6 ~ 176.4	17.0 ~ 18.0	122.9 ~ 130.1
Timing chain cover service hole bolt	1	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Timing chain cover bolt (M6×25)	7	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Timing chain cover bolt (M8×28)	7	18.6 ~ 22.5	1.9 ~ 2.3	13.7 ~ 16.6
Timing chain cover bolt (M8×30)	1	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Timing chain cover bolt (M10×40)	1	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Timing chain cover bolt (M10×45)	2	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5
Timing chain tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain oil jet bolt	1	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2

**EMA-7** 

Item	Quantity	N.m	kgf.m	lb-ft	
Cylinder head					
Engine cover mounting bracket bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Ignition coil bolt	4	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3	
Cylinder head cover bolt	18	[3.9~5.9] + [7.8~9.8]	[0.4~0.6] + [0.8~1.0]	[2.9~4.3] + [5.8~7.2]	
CVVT bolt (LH/RH)	2	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0	
Camshaft bearing cap bolt (M6) (LH/RH)	16	[5.9] + [10.8~12.7]	[0.6] + [1.1~1.3]	[4.3] + [8.0~9.4]	
Camshaft bearing cap bolt (M8)	4	[14.7] + [27.5 ~ 31.4]	[1.5] + [2.8~3.2]	[10.8] + [20.3~23.1]	
Cylinder head bolt	10	[32.4~36.3] + [90~9 5°] + [90~95°]	[3.3~3.7] + [90~95°] + [90~95°]	[23.9~26.8] + [90~95 °] + [90~95°]	
Engine hanger bolt (Front/Rear)	2	27.5 ~ 31.4	2.8 ~ 3.2	20.3 ~ 23.1	
Camshaft position sensor (CMPS) (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Oil control valve (OCV) bolt (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Cylinder block	1100				
Tensioner assembly intergrated bracket bolt	MDPS:5 HPS:6	39.2 ~ 44.1	4.0 ~ 4.5	28.9 ~ 32.5	
Flywheel bolt	7.3	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9	
Drive plate bolt	7	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9	
Oil filter bracket bolt	4	21.6 ~ 26.5	2.2 ~ 2.7	15.9 ~ 19.5	
Ladder frame bolt	10	[8.8~9.8] + [17.7~20 .6] + [27.5~31.4]	[0.9~0.1] + [1.8~2.1] + [2.8~3.2]	[6.5~7.2] + [13.0~15. 2] + [20.3~23.1]	
Connecting rod bearing cap bolt	8	[17.7~21.6] + [88~9 2°]	[1.8~2.2] + [88~92°]	[13.0~15.9] + [88~92 °]	
Main bearing cap bolt	10	[14.7] + [27.5~31.4] + [120~125°]	[1.5] + [2.8~3.2] + [1 20~125°]	[10.8] + [20.3~23.1] + [120~125°]	
Crankshaft position sensor (CKPS) bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
CKPS cover bolt (M6)	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
CKPS cover bolt (M8)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4	
Knock sensor bolt	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4	

# **Engine Mechanical System**

Item	Quantity	N.m	kgf.m	lb-ft	
Lubrication system	_ubrication system				
Oil drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5	
Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6	
Oil level gauge assembly bolt	1	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7	
A/C compressor bracket bolt	4	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4	
Oil pan bolt (M6)	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Oil pan bolt (M9)	2	30.4 ~ 34.3	3.1 ~ 3.5	22.4 ~ 25.3	
Oil pump chain tensioner bolt [2.0L]	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Oil pump chain guide bolt [2.0L]	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Oil pump bolt [2.0L]	3	[7.8~11.8] + [17.7~2 1.6] + [27.5~31.4]	[0.8~1.2] + [1.8~2.2] + [2.8~3.2]	[5.8~8.7] + [13.0~15. 9] + [20.3~23.1]	
BSM chain tensioner arm bolt [2.4L]	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
BSM chain guide bolt [2.4L]	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
BSM chain tensioner bolt [2.4L]	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Blance shaft module (BSM) bolt (M9 ×181.5) - 4 bolt type [2.4L]	4	[22.6~26.5] + [103~ 107°]	[2.3~2.7] + [103~10 7°]	[16.6~19.5] + [103~ 107°]	
Blance shaft module (BSM) bolt (M9 × 181.5) - 6 bolt type [2.4L]	وه خودرو س	[22.6~26.5] + [88~9 2°]	[2.3~2.7] + [88~92°]	[16.6~1 <mark>9.5] + [88</mark> ~92 °]	
Blance shaft module (BSM) bolt (M9 ×95) - 6 bolt type [2.4L]	2	[22.6~26.5] + [43~4 7°]	[2.3~2.7] + [43~47°]	[16.6~19.5] + [43~47	
Oil pressure switch	1	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7	
Cooling system					
Water pump pulley bolt	3	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2	
Water pump sub assembly bolt	5	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	
Water pump cover bolt	5	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4	
Water inlet fitting bolt	3	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7	
Water temperature control assembly nut	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4	
Water temperature control assembly bolt	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5	
Water inlet pipe bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7	

### **EMA-9**

Item	Quantity	N.m	kgf.m	lb-ft
Intake and exhaust system				
Air intake hose clamp bolt	2	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6
Air cleaner asembly bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Electronic throttle control (ETC) module bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intake manifold stay bolt	4	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold bolt	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oxygen sensor (Front/Rear)	2	44.1 ~ 49.0	4.5 ~ 5.0	32.5 ~ 36.2
Exhaust manifold heat protector bolt	3	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Exhaust manifold stay bolt (M8)	2	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Exhaust manifold stay bolt (M10)	2	51.9 ~ 57.8	5.3 ~ 5.9	38.3 ~ 42.6
Exhaust manifold nut	8	49.0 ~ 53.9	5.0 ~ 5.5	36.2 ~ 39.7
Catalytic converter / muffler nut	- 8	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4



اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

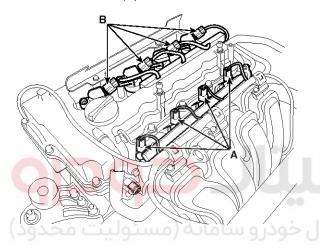
## **Engine Mechanical System**

### **Compression Pressure Inspection**

#### MOTICE

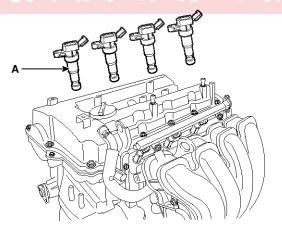
If the there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

- Warm up and stop engine.
   Allow the engine to warm up to normal operating temperature.
- 2. Remove the engine cover.
- 3. Disconnect the injector connectors (A) and ignition coil connectors (B).



SSLM10001D

4. Remove ignition coils (A).

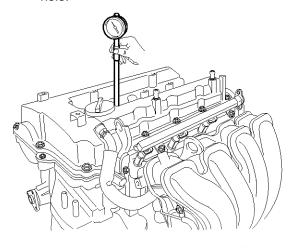


SSLM10002D

5. Remove spark plugs.

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

- 6. Check cylinder compression pressure.
  - 1) Insert a compression gauge into the spark plug hole.



SSLM10120D

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

#### MNOTICE

Always use a fully charged battery to obtain engine speed of 200 rpm or more.

4) Repeat steps (1) through (3) for each cylinder.

#### **MOTICE**

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

#### Compression pressure:

1,283kPa (13.0kgf/cm<sup>2</sup>, 185psi) / 200 ~ 250rpm

#### Minimum pressure:

1,135kPa (11.5kgf/cm<sup>2</sup>, 164psi)

### Difference between each cylinder:

100kPa (1.0kgf/cm², 15psi) or less

- 5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (1) through (3) for cylinders with low compression.
  - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
  - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

**EMA-11** 

- 7. Reinstall spark plugs.
- 8. Install ignition coils.

#### **Tightening torque:**

 $3.9 \sim 5.9$ N.m (0.4  $\sim 0.6$ kgf.m,  $2.9 \sim 4.3$ lb-ft)

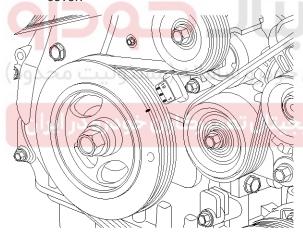
- 9. Connect the injector connectors and ignition coil connectors.
- 10. Some DTC's may exist after the inspection test and may need to be manually cleared with GDS.

### **Valve Clearance Inspection And Adjustment**

#### MOTICE

Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C (68°F)) and cylinder head is installed on the cylinder block.

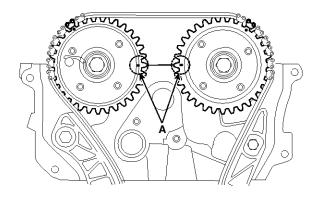
- 1. Remove the cylinder head cover. (Refer to Timing system in this group)
- 2. Set No.1 cylinder to TDC/compression.
  - Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.



SSLM10003D

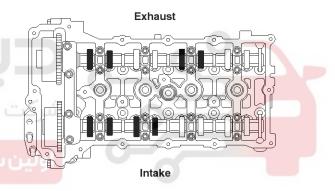
Check that the TDC marks (A) of the CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration.

If not, turn the crankshaft one revolution (360°)



SVGEM0154D

- 3. Inspect the valve clearance.
  - Check only the valve indicated as shown.
     Measure the valve clearance.



[No.1 cylinder:TDC/Compression]

SVGM11101L

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

#### Valve clearance

Specification

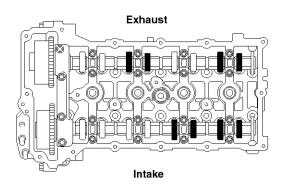
Engine coolant temperature: 20°C [68°F]

Limit

Intake :  $0.10 \sim 0.30$ mm ( $0.0039 \sim 0.0118$ in.) Exhaust :  $0.20 \sim 0.40$ mm ( $0.0079 \sim 0.0157$ in.)

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

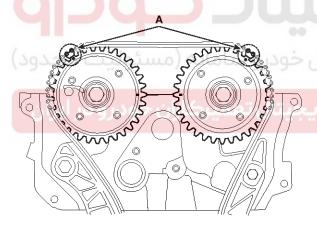
3) Check only valves indicated as shown. Measure the valve clearance.



[No.4 cylinder: TDC/Compression]

SVGM11102L

- 4. Adjust the intake and exhaust valve clearance.
  - 1) Set the No.1 cylinder to the TDC/compression.
  - Mark the timing chains (A) on the timing marks of the CVVT sprockets.

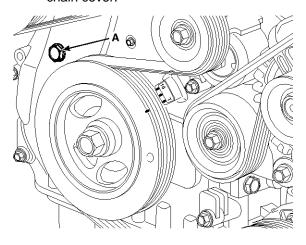


SVGEM0160D

3) Turn the crankshaft pulley 15° clockwise.

## **Engine Mechanical System**

4) Remove the service hole bolt(A) of the timing chain cover.

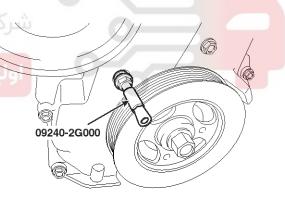


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The bolt must not be reused once it has been assembled.

5) Insert the SST (09240-2G000) in the service hole of the timing chain cover and release the ratchet.



SVGM11103L

- 6) Remove the front camshaft bearing cap.
- 7) Remove the exhaust camshaft bearing cap and exhaust camshaft.
- 8) Remove the intake camshaft bearing cap and intake camshaft.

#### CAUTION

When disconnecting the timing chain from the CVVT sprocket, tie or hold the timing chain so it does not fall into the timing cover.

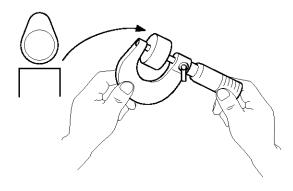
### **EMA-13**

9) Tie down timing chain so that it doesn't move.

#### CAUTION

Be careful not to drop anything inside timing chain cover.

10) Measure the thickness of the removed tappet using a micrometer.



EDKE889D

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

# Valve clearance [Engine coolant temperature : 20°C(68°F)]

T: Thickness of removed tappet

A : Measured valve clearance

N: Thickness of new tappet

Intake : N = T + [A - 0.20mm (0.0079in.)]Exhaust : N = T + [A - 0.30mm (0.0118in.)]

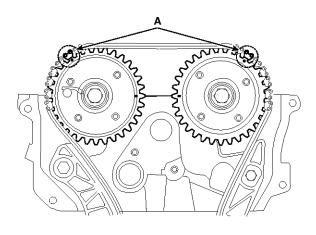
12) Select a new tappet with a thickness as close as possible to the calculated value.

#### **MNOTICE**

Shims are available in 47 size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.690mm (0.1452in.)

- 13) Place a new tappet on the cylinder head.
- 14) Hold the timing chain, and install the intake camshaft and CVVT assembly.

15) Align the timing marks (A) on the timing chains and CVVT sprockets.



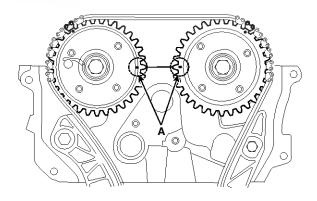
SVGEM0160D

- 16) Install the exhaust camshaft and CVVT assembly.
- 17) Install the front bearing cap.
- 18) Install the service hole bolt after removing the SST from the service hole.

#### Tightening torque:

11.8 ~ 14.7N.m (1.2 ~ 1.5kgf.m, 8.7 ~ 10.8lb-ft)

19) Turn the crankshaft two turns in the operating direction(clockwise), and then check that the TDC marks (A) of the CVVT sprockets are in straight line on the cylinder head surface.



SVGEM0154D

20) Recheck the valve clearance.

# Valve clearance [Engine coolant temperature : 20°C(68°F)]

[Specification]

Intake :  $0.17 \sim 0.23$ mm ( $0.0067 \sim 0.0090$ in.) Exhaust :  $0.27 \sim 0.33$ mm ( $0.0106 \sim 0.0129$ in.)

# **Engine Mechanical System**

### **Troubleshooting**

Symption	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings Loose or out of specification engine flyw- heel	Replace the crankshaft and bearings as required. Repair or replace the flywheel as required.
	Worn piston rings (Oil consumption may or may not cause t he 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 buidup on the valve stem)	Repair or replace as required
	Excessive worn or mis-aligned timing chain Out of specification valve clearances	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption	<ul> <li>Faulty cylinder head gasket or other damage to the cylinder head and engine block cooling system.</li> <li>Coolant consumption may or may not cause the engine to overheat.</li> </ul>	or damage to the coolant passages and/or a faulty head gasket.
/	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
ن خودرو در ایران	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul> <li>Inspect the cylinder for a loss of compression.</li> <li>Repair or replace as required.</li> </ul>
Engine noise on start-up, but only lasting a few sec-	Incorrect oil viscosity	<ul><li>Drain the oil.</li><li>Install the correct viscosity oil.</li></ul>
onds. (Check and compare with known good vehicle to determine normal condition.)	Worn crankshaft thrust bearing.	<ul> <li>Inspect the thrust bearing and crankshaft.</li> <li>Repair or replace as required.</li> </ul>

**EMA-15** 

Symption	Suspect area	Remedy
Upper engine noise, rega-	Low oil pressure	Repair or replace as required.
rdless of engine speed.	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stetched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable .	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul><li>Inspect the camshaft lobes.</li><li>Replace the timing camshaft and valve lifters as required.</li></ul>
	Out of specification valve clearances Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair or replace 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 or replace as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required
Lower engine noise, rega-	Low oil pressure	Repair or required.
rdless of engine speed	Loose or damaged flywheel.	Repair or replace the flywheel.
ر بخودرودر ایران	Damaged oil pan, contacting the oil pump screen.	<ul><li>Inspect the oil pan.</li><li>Inspect the oil pump screen.</li><li>Repair or replace as required.</li></ul>
037 37 7	Oil pump screen loose, damaged or restricted.	<ul><li>Inspect the oil pump screen.</li><li>Repair or replace as required.</li></ul>
	Excessive piston-to-cylinder bore clearance.	<ul> <li>Inspect the piston, piston pin and cylinder bore.</li> <li>Repair or replace as required.</li> </ul>
	Excessive piston pin-to-piston clearance	<ul> <li>Inspect the piston, piston pin and the connecting rod.</li> <li>Repair or replace as required.</li> </ul>
	Excessive connecting rod bearing clearance	Inspect the following components and repair or replace as required.  The connecting rod bearings.  The connecting rods.  The crankshaft pin journals.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair or replace as required.  The crankshaft bearings.  The crankshaft main journals.  The cylinder block
	Incorrect piston, piston pin and connecting rod installation	<ul> <li>Verify the piston pins and connecting rods are installed correctly.</li> <li>Repair as required.</li> </ul>

# **Engine Mechanical System**

Symption	Suspect area	Remedy
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair or replace as required:  The connecting rod bearings.  The connecting rods.  The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair or replace as required.  The crankshaft bearings.  The crankshaft main journals.  The cylinder block.
Engine will not crank-cra- nkshaft will not rotate	Hydraulically locked cylinder  Coolant/antifreeze in cylinder.  Oil in cylinder.  Fuel in cylinder	<ol> <li>Remove spark plugs and check for fluid.</li> <li>Inspect for broken head gasket.</li> <li>Inspect for cracked engine block or cylinder head.</li> <li>Inspect for a sticking fuel injector and/or leaking fuel regulator.</li> </ol>
	Broken timing chain and/or timing chain and/or timing chain gears.	<ol> <li>Inspect timing chain and gears.</li> <li>Repair as required.</li> </ol>
مسئولیت محدود)	Material in cylinder     Broken valve     Piston material     Foreign material	<ol> <li>Inspect cylinder for damaged components and/or foreign materials.</li> <li>Repair or replace as required.</li> </ol>
ن خودرو در ایران	Seized crankshaft or connecting rod bearings.	<ol> <li>Inspect crankshaft and connecting rod bearing.</li> <li>Repair as required.</li> </ol>
	Bent or broken connecting rod.	<ol> <li>Inspect connecing rods.</li> <li>Repair as required.</li> </ol>
	Broken crankshaft	Inspect crankshaft.     Repair as required.

**EMA-17** 

**Special Service Tools** 

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-3K000) (09231-H1100)	A ACRESONA	Installation of the front oil seal A: 09214-3K000 (installer) B: 09231-H1100 (handle)
N. I II	ACRF002A	
Valve stem seal installer (09222-4A000)		Installation of the valve stem seal
	LCAC030D	
Valve spring compressor (09222-3K000) (09222-3K100)	A B	Removal and installation of the intake or exhaust valve A: 09222-3K000 (compressor) B: 09222-3K100 (holder)
مانه (مسئولیت محدود)	SYFEM0182N	ů O
Crankshaft rear oil seal installer (09214-3K100) (09231-H1100)	ACRF003A	Installation of the crankshaft rear oil seal  A: 09214-3K100 (installer)  B: 09231-H1100 (handle)
Ring gear stopper	ACKF003A	Removal and installation of crankshaft pulley
(09231-2B100)		bolt.
	SHDEM6201D	
Ring gear stopper (09231-3D100)		Removal and installation of crankshaft pulley bolt.
	SVGEM1001D	

# **Engine Mechanical System**

Tool (Number and name)	Illustration	Use
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method of adjustment.
	LCAC030A	
Timing chain tensioner ratchet holder (09240-2G000)	SMGEM8007D	Timing chain tension release in vehicle inspection and adjustment of valve clearance.
Oil pan remover (09215-3C000)	ACJF125A	Removal of oil pan

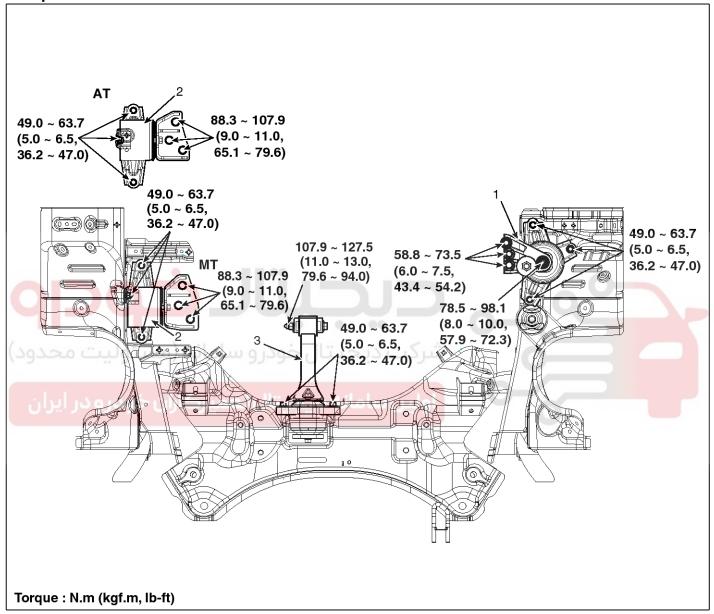
# **Engine And Transaxle Assembly**

**EMA-19** 

## **Engine And Transaxle Assembly**

### **Engine Mounting**

Components



SSLM10100L

- 1. Engine mounting support bracket
- 2. Transaxle mounting bracket

3. Roll rod bracket

## **Engine Mechanical System**

### **Engine And Transaxle Assembly**

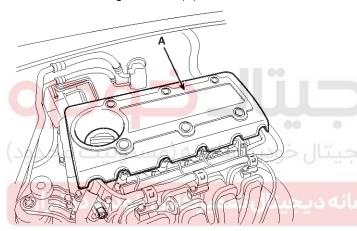
#### Removal

### **ACAUTION**

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

#### MOTICE

- Mark all wiring and hoses to avoid misconnection.
- To release the fuel system pressure before removing the engine assembly, start the engine with the fuel pump relay removed. And then turn off the ignition switch after engine stops.
- 1. Remove the engine cover (A).



SSLM10004D

2. Disconnect the battery terminals (A). Disconnect the negative terminal first.

#### Tightening torque:

(+) terminal:

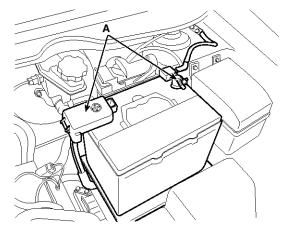
 $7.8 \sim 9.8$ N.m (0.8  $\sim 1.0$ kgf.m,  $5.8 \sim 7.2$ lb-ft)

(-) terminal (without battery sensor):

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

(-) terminal (with battery sensor):

 $4.0 \sim 6.0 \text{N.m}$  (0.4  $\sim$  0.6kgf.m, 3.0  $\sim$  4.4lb-ft)

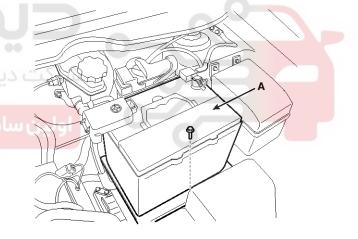


SSLM10005D

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

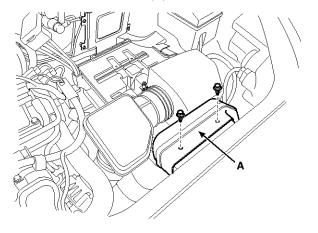
#### **Tightening torque:**

 $8.8 \sim 13.7 \text{N.m}$  (0.9  $\sim 1.4 \text{kgf.m}$ , 6.5  $\sim 10.1 \text{lb-ft}$ )



SSLM10122D

4. Remove the air duct (A).



SSLM10006D

## **Engine And Transaxle Assembly**

### **EMA-21**

- 5. Remove the air cleaner assembly.
  - 1) Disconnect the breather hose (A) and brake booster intensifier hose (AT only).
  - 2) Disconnect the air intake hose and then remove the air cleaner assembly (B).

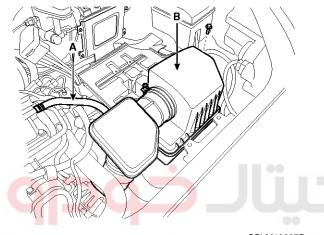
#### **Tightening torque**

Hose clamp bolt:

2.9  $\sim$  4.9N.m (0.3  $\sim$  0.5kgf.m, 2.2  $\sim$  3.6lb-ft)

Air cleaner assembly bolts:

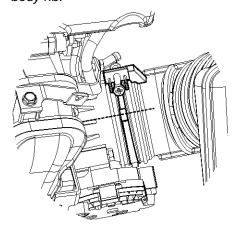
 $7.8 \sim 9.8$ N.m (0.8  $\sim 1.0$ kgf.m,  $5.8 \sim 7.2$ lb-ft)



SSLM10007D

#### MOTICE

- Install the air intake hose while the plate of the hose clamp must be in line with the stopper of the hose.
- Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



SSLM10101D

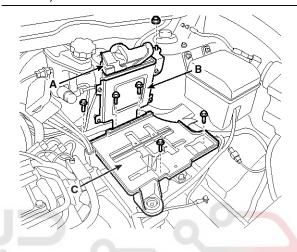
6. Disconnect the ECM connectors (A) and then remove the ECM (B) and the battery tray (C).

#### **Tightening torque**

ECM bracket nut : 9.8  $\sim$  14.7N.m (1.0  $\sim$  1.5gf.m, 7.2  $\sim$  10.8lb-ft)

ECM bracket bolts : 21.6  $^{\sim}$  32.4N.m (2.2  $^{\sim}$  3.3kgf.m, 15.9  $^{\sim}$  23.9lb-ft)

Battery tray bolts : 8.8  $\sim$  13.7N.m (0.9  $\sim$  1.4kgf.m, 6.5  $\sim$  10.1lb-ft)

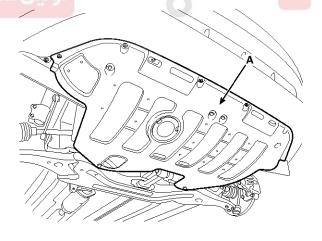


SSLM10008D

7. Remove the under cover (A).

#### **Tightening torque:**

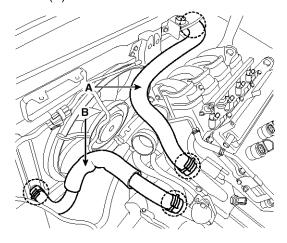
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)



SSLM10009D

### 8. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to drain with speed. (Refer to Cooling system in this group)

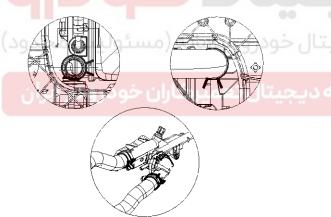
9. Disconnect the radiator upper hose (A) and lower hose (B).



SSLM10011D

### MOTICE

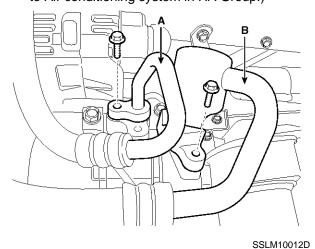
Install the radiator hoses as shown illustrations.



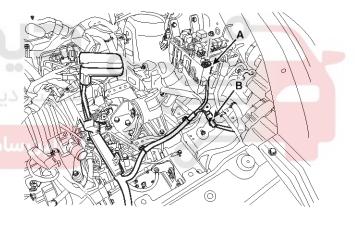
SSLM10102N

# **Engine Mechanical System**

10. Recover the refrigerant and then remove the high pressure pipe (A) and low pressure pipe (B). (Refer to Air conditioning system in HA Group.)



11. Disconnect the (+) cable (A) from the fuse/relay box and the front connector (B).

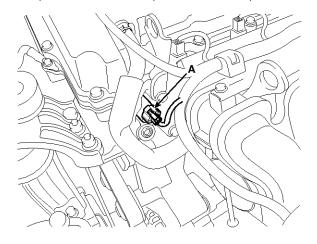


SLMM10007D

## **Engine And Transaxle Assembly**

### **EMA-23**

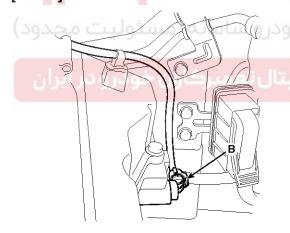
- 12. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - 1) The intake OCV (Oil control valve) connector (A)



SSLM10013D

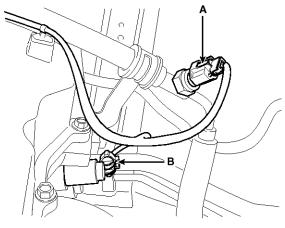
The power steering oil pressure switch connector
 (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B)

### [MDPS]



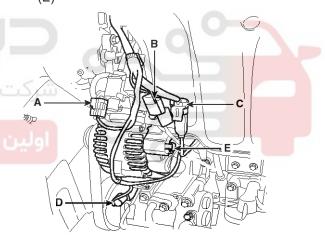
SSLM10014L

### [HPS]



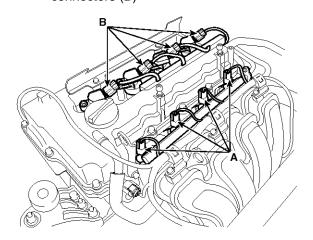
SVGEM0008D

3) The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)



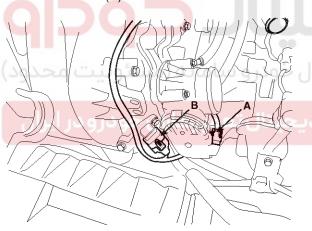
SSLM10123D

# 4) The injector connectors (A) and the ignition coil connectors (B)



SSLM10001D

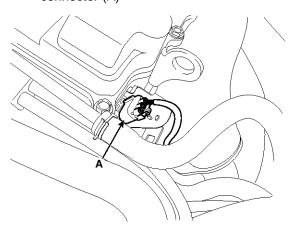
5) The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



SVGEM0110D

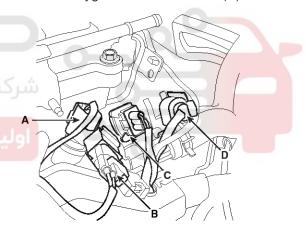
# **Engine Mechanical System**

6) The exhaust CMPS (Camshaft position sensor) connector (A)



SSLM10151N

7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the front oxygen sensor connector (D)

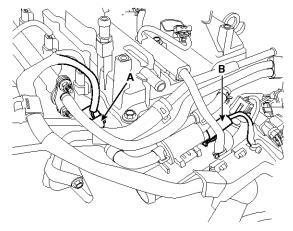


SSLM10158L

## **Engine And Transaxle Assembly**

### **EMA-25**

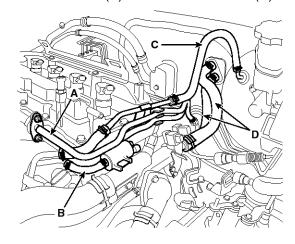
 The intake CMPS (Camshaft position sensor) connector (A) and the PCSV (Purge control solenoid valve) connector (B)



SSLM10103E

13. Remove the transaxle wire harness connectors (A) and control cable (B) from the transaxle. (Refer to AT or MT group).

15. Disconnect the fuel hose (A), the PCSV (Purge control solenoid valve) hose (B), the brake booster vacuum hose (C) and the heater hoses (D).



SSLM10016D

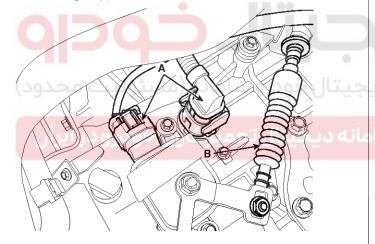
Heater

SSLM10104D

#### **MNOTICE**

**Engine** 

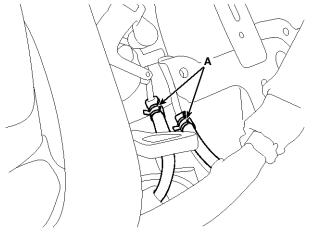
Install the heater hoses as shown illustrations.



SVGEM0116D

SSLM10136D

14. Disconnect the ATF cooler hoses (A).



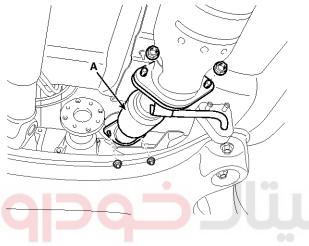
Inlet

### 16. Disconnect the power steering oil return hose for drain the oil, and then remove the hose that connecting between the power steering oil pump assembly and the reservoir tank. (Refer to ST group, HPS type only)

17. Remove the front muffler (B) after removing the front oxygen sensor connector (A) from the bracket.

#### **Tightening torque:**

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



SSLM10017D

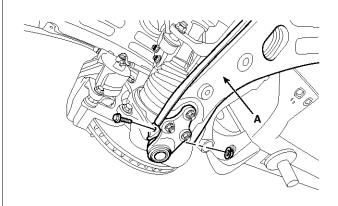
18. Remove the steering u-joint mounting bolt (A). (Refer to ST group)



SSLM10015D

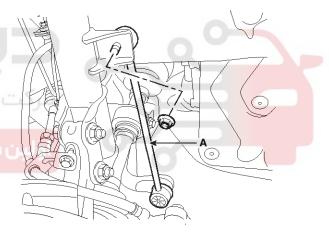
## **Engine Mechanical System**

19. Remove the front wheels. (Refer to SS group)20. Remove the lower arms (A). (Refer to SS group)



SSLM10139D

21. Remove the stabilizer bar links (A). (Refer to SS group)

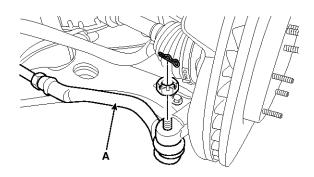


SSLM10140D

# **Engine And Transaxle Assembly**

**EMA-27** 

22. Remove the tie rod ends (A). (Refer to ST group)



SSLM10141D

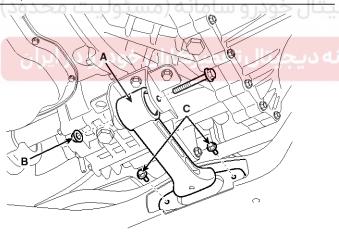
23. Disconnect the drive shafts from the axle hubs. (Refer to DS group)

24. Remove the roll rod bracket (A).

**Tightening torque:** 

Nut (B) : 107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.0 lb-ft)

Bolt (C) :  $49.0 \sim 63.7$  N.m (5.0  $\sim 6.5$  kgf.m,  $36.2 \sim 47.0$  lb-ft)

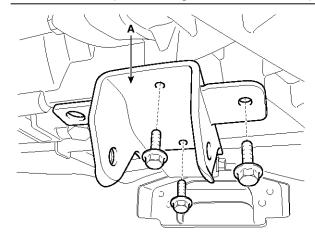


SSLM10018D

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

#### **Tightening torque:**

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

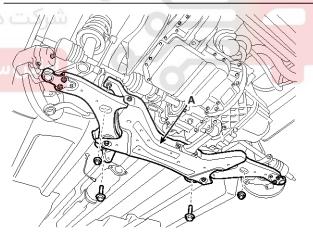


SSLM10019D

26. Support the sub frame (A) with a floor jack, and then remove the sub frame mounting bolts and nuts.

### Tightening torque:

176.5  $\sim$  196.1 N.m (18.0  $\sim$  20.0 kgf.m, 130.2  $\sim$  144.7 lb-ft)



SSLM10020D

#### **MNOTICE**

- After removing the sub frame mounting bolts and 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.

## **Engine Mechanical System**

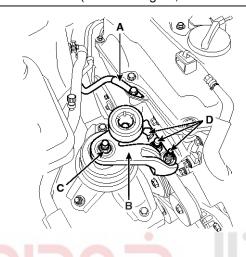
27. Disconnect the ground line (A), and then remove the engine mounting support bracket (B).

#### **Tightening torque:**

Nut (C) : 78.5  $\simeq$  98.1 N.m (8.0  $\simeq$  10.0 kgf.m, 57.9  $\simeq$  72.3 lb-ft)

Bolt and nuts (D):

 $58.8 \sim 73.5 \text{ N.m} (6.0 \sim 7.5 \text{ kgf.m}, 43.4 \sim 54.2 \text{ lb-ft})$ 

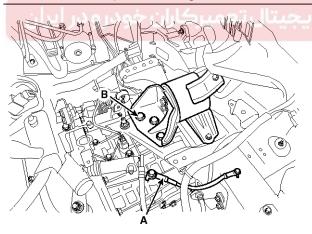


SSLEM1200L

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

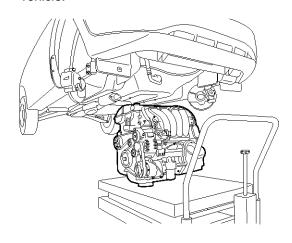
#### **Tightening torque:**

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



SSLM10106D

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



SSLM10021D

### **A**CAUTION

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

### **Engine And Transaxle Assembly**

**EMA-29** 

#### Installation

Installation is in the reverse order of removal.

#### Perform the following:

- · Adjust a shift cable.
- · Refill engine with engine oil.
- Refill a transaxle with fluid.
- · Refill power steering fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
  - After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
  - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.
- 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.



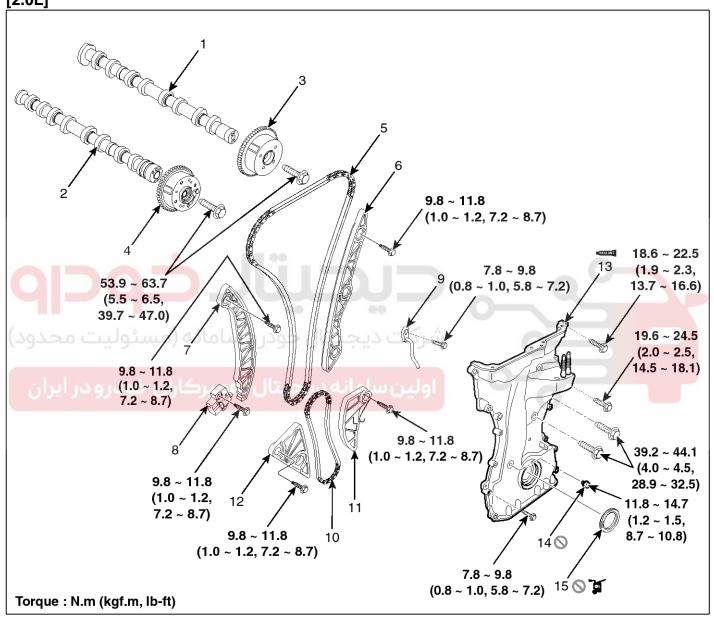
### **Engine Mechanical System**

### **Timing System**

### **Timing Chain**

### Components

[2.0L]



SSLM10159L

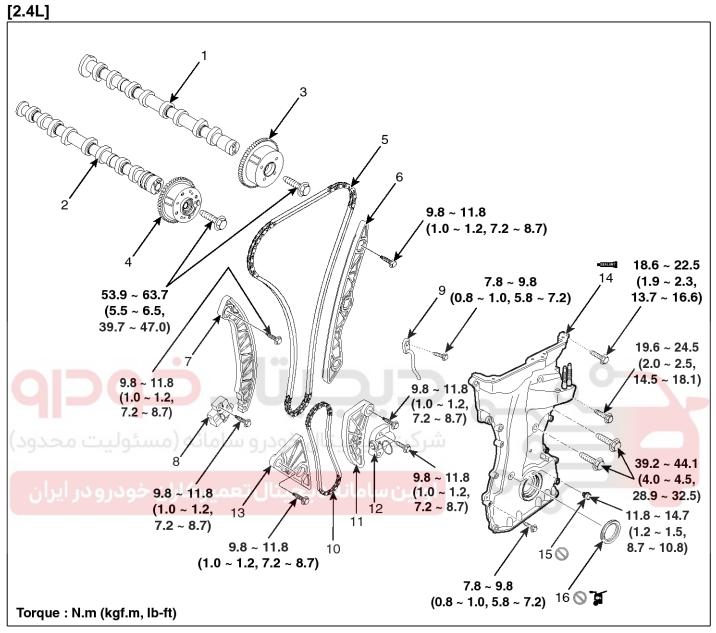
- Intake camshaft
- 2. Exhaust camshaft
- 3. Intake CVVT assembly
- 4. Exhaust CVVT assembly
- 5. Timing chain

- 6. Timing chain guide
- 7. Timing chain tensioner arm
- 8. Timing chain tensioner
- 9. Timing chain oil jet
- 10. Oil pump chain

- 11. Oil pump chain mechanical tensioner arm
- 12. Oil pump chain guide
- 13. Timing chain cover
- 14. Service hole bolt
- 15. Crankshaft front oil seal

## **Timing System**

**EMA-31** 



SVGM11107L

- 1. Intake camshaft
- 2. Exhaust camshaft
- 3. Intake CVVT assembly
- 4. Exhaust CVVT assembly
- 5. Timing chain

- 6. Timing chain guide
- 7. Timing chain tensioner arm
- 8. Timing chain tensioner
- 9. Timing chain oil jet
- 10. Balance shaft chain
- 11. Balance shaft chain tensioner arm
- 12. Balance shaft chain tensioner
- 13. Balance shaft chain guide
- 14. Timing chain cover
- 15. Service hole bolt
- 16. Crankshaft front oil seal

### **Engine Mechanical System**

#### Removal

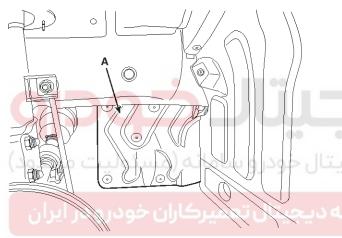
#### **CAUTION**

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

#### **MNOTICE**

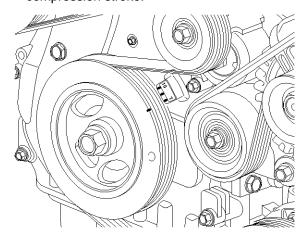
Mark all wiring and hoses to avoid misconnection.

- 1. Remove the engine cover.
- 2. Disconnect the battery negative terminal.
- 3. Remove the RH front wheel. (Refer to SS group)
- 4. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
- 5. Remove the RH side cover.



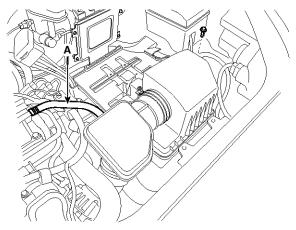
SSLEM0006D

Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover to set the piston of No.1 cylinder to the top dead center on compression stroke.



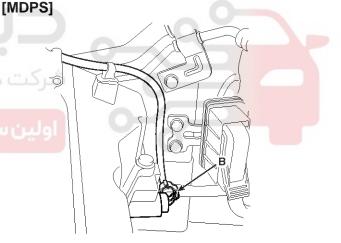
SSLM10003D

7. Disconnect the breather hose (A).

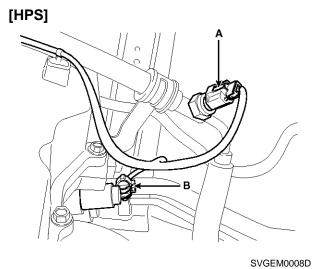


SSLM10108D

 Disconnect the power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B) and then remove the wiring from the cylinder head cover.



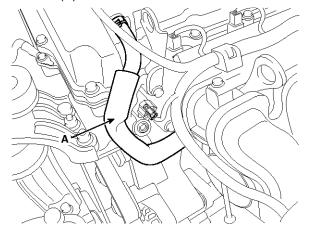
SSLM10014L



# **Timing System**

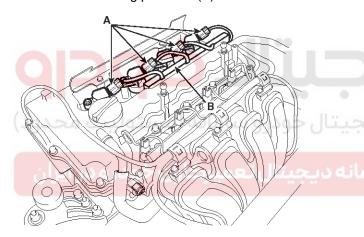
**EMA-33** 

9. Disconnect the PCV (Positive crankcase ventilation) hose (A).



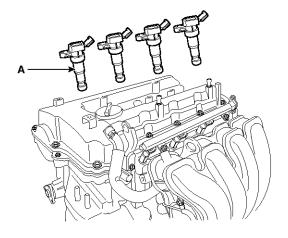
SSLM10109D

10. Disconnect the ignition coil connectors (A) and then remove the wiring protector (B).



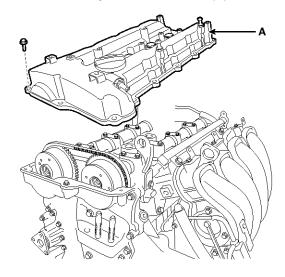
SSLM10110D

11. Remove the ignition coils (A).



SSLM10002D

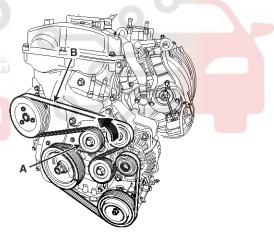
12. Remove the cylinder head cover (A).



SSLM10024D

13. Remove the drive belt (B) after turning the drive belt tensioner (A) counterclockwise.

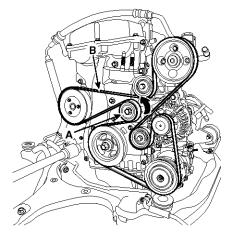




SSLM10022D

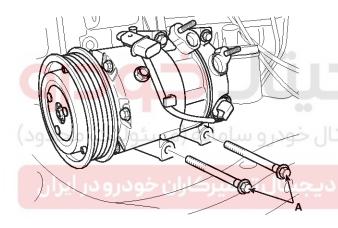
## **Engine Mechanical System**

### [HPS]



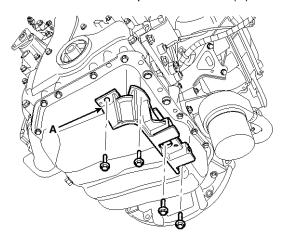
SVGEM0153D

14. Remove the A/C compressor lower bolts (A).



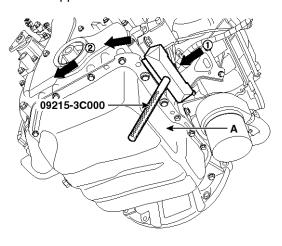
SYFEM0145N

15. Remove the A/C compressor bracket (A).



SYFEM0039N

- 16. Drain the engine oil.
- 17. Remove the oil pan (A). Insert the blade of SST (09215-3C000) between the ladder frame and oil pan. Cut off applied sealer and remove the lower oil pan.



SVGM11110L

#### MOTICE

Loosen one oil pan bolt near each corner of the oil pan leaving the bolts held in by about 2 threads. Then remove all other pan bolts.

#### MOTICE

- Insert the SST between the oil pan and the ladder frame 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 the ladder frame.
- Do not turn over the SST abruptly without tapping. It is result in damage of the SST.
- Be careful not to damage the contact surfaces of ladder frame and lower oil pan.

# **Timing System**

**EMA-35** 

18. Set the jack to the edge of ladder frame.

#### **MNOTICE**

Put the wooden block between ladder frame and jack.

### **A**CAUTION

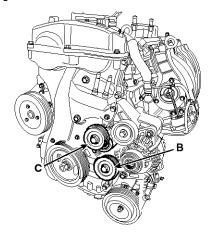
Be careful not to damage the balance shaft & oil pump module.

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

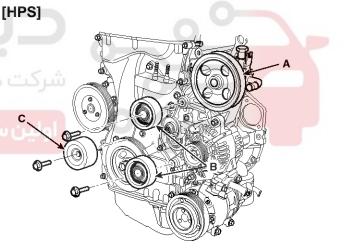


- 20. Separate the power steering oil pump (A) from the bracket. (Refer to ST group)
- 21. Remove the idler (B) and the drive belt tensioner pulley (C).

#### [MDPS]



SSLM10023L



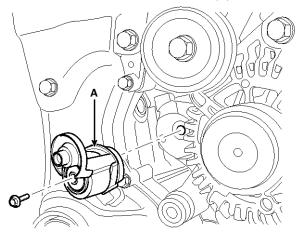
SYFEM0053D



Tensioner pulley bolt is left-handed screw.

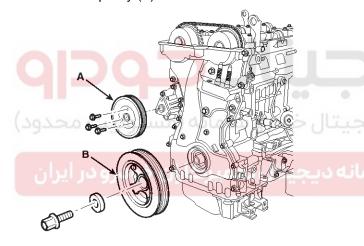
## **Engine Mechanical System**

22. Remove the drive belt tensioner (A).



SYFEM0038N

23. Remove the water pump pulley (A) and the crankshaft pulley (B).

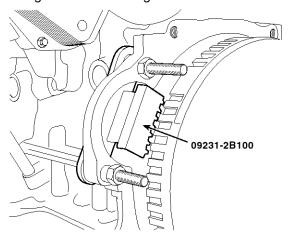


SYFEM0031D

#### MOTICE

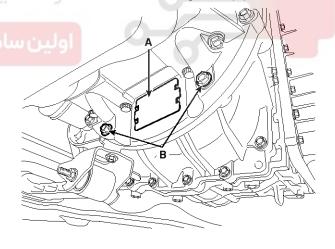
There are two methods to hold the ring gear when installing or removing the crankshaft damper pulley.

• Install the SST (09231-2B100) to hold the ring gear after removing the starter.



SVGM20026D

- Install the SST (09231-3D100) to hold the ring gear after removing the dust cover.
  - 1. Remove the dust cover (A) on the bottom of the ladder frame and unfasten the two transaxle mounting bolts (B).

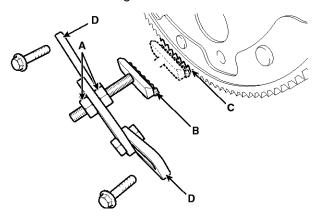


SVGEM1003D

## **Timing System**

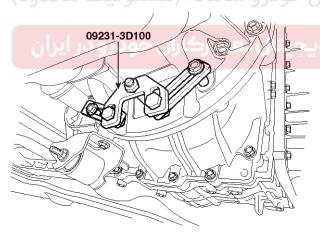
**EMA-37** 

- 2. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.
- 3. Adjust the angle of the links (D) so that the two transaxle mounting bolts can be fastened to the original mounted holes.



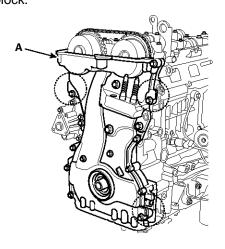
SVGEM1002D

4. Install the SST (09231-3D100) using the two transaxle mounting bolts and spacers. Tighten the bolts and nuts of the holder and links securely.



SVGEM1004D

24. Remove the timing chain cover (A) by gently prying the portions between the cylinder head and cylinder



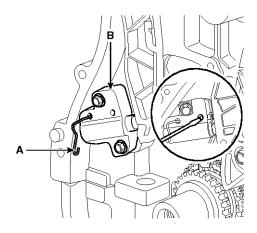
SVGEM0180D

#### **A**CAUTION

Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

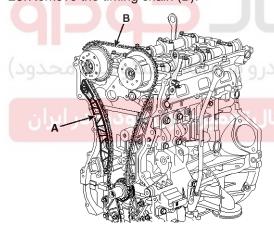
25. Make sure that the key of crankshaft is aligned with the mating surface of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.

# 26. Release the ratchet using a thin rod. Compress the piston and then insert a stopper pin (A) into the hole on the ratchet to hold the compressed piston. Remove the timing chain tensioner (B).



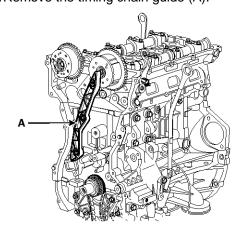
SVGEM0163D

- 27. Remove the timing chain tensioner arm (A).
- 28. Remove the timing chain (B).



SVGEM0164D

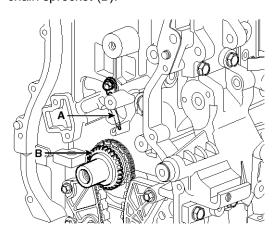
29. Remove the timing chain guide (A).



SLMM10049D

# **Engine Mechanical System**

30. Remove the timing chain oil jet (A) and the crankshaft chain sprocket (B).



SUNM19116N

31. Remove the balance shaft chain. (Refer to Lubrication system in this group)

#### Inspection

# Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

- Check the CVVT sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
  - 2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
  - 3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

#### Drive belt, Idler, Pulley

- 1. Check the idler for excessive oil leakage, abnormal rotation or vibration. Replace if necessary.
- 2. Check belt for maintenance and abnormal wear of V-ribbed part. Replace if necessary.
- 3. Check the pulleys for vibration in rotation, oil or dust deposit of V-ribbed part. Replace if necessary.

# **Timing System**

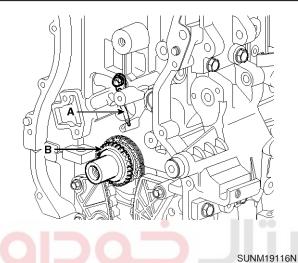
### **EMA-39**

#### Installation

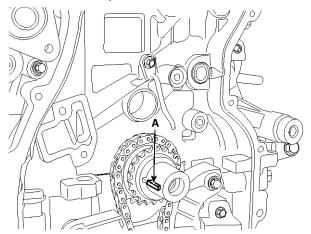
- 1. Install the balance shaft chain. (Refer to Lubrication system in this group)
- 2. Install the crankshaft chain sprocket (B) and the timing chain oil jet (A).

#### **Tightening torque:**

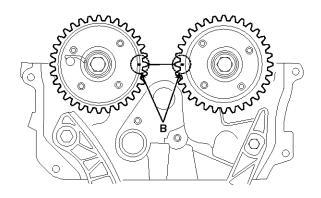
 $7.8 \sim 9.8 \text{N.m} \ (0.8 \sim 1.0 \text{kgf.m}, 5.8 \sim 7.2 \text{lb-ft})$ 



3. Set the crankshaft so that the key (A) of crankshaft will be aligned with the mating surface of main bearing cap. Put the intake and exhaust camshaft assembly so that the TDC marks (B) of the intake and exhaust CVVT sprockets will be aligned with the top surface of cylinder head. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



SYFEM0146N

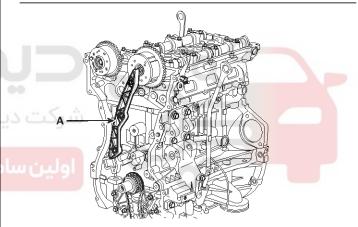


SYFEM0109N

4. Install the timing chain guide (A).

#### **Tightening torque:**

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

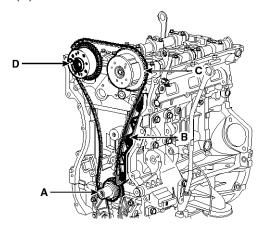


SLMM10049D

# **Engine Mechanical System**

Install the timing chain. To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure.

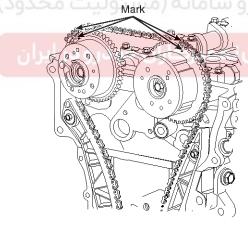
Crankshaft sprocket (A)  $\rightarrow$  Timing chain guide (B)  $\rightarrow$  Intake CVVT sprocket (C)  $\rightarrow$  Exhaust CVVT sprocket (D).



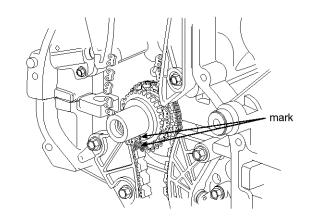
SVGEM0183D

#### MOTICE

The timing marks of each sprocket should be matched with timing marks (color link) of timing chain when installing the timing chain.



SLMM10046N

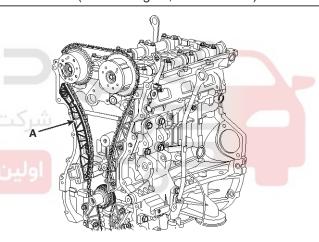


SLMM10047N

6. Install the timing chain tensioner arm (A).

#### **Tightening torque:**

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



SVGEM0165D

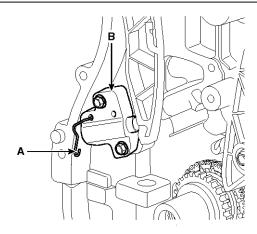
# **Timing System**

**EMA-41** 

7. Install the timing chain auto tensioner (B) and remove the stopper pin (A).

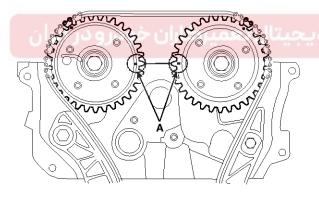
#### **Tightening torque:**

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



SSLM10113D

8. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm that the TDC marks (A) on the intake and exhaust CVVT sprockets aligned with the top surface of cylinder head.

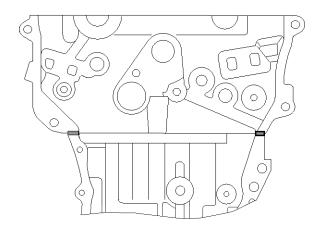


SVGEM0154D

- 9. Install the timing chain cover.
  - 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
  - The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and ladder frame) must be free of engine oil and etc.

3) Before assembling the timing chain cover, liquid sealant Loctite 5900H or equivalent should be applied on the gap between cylinder head and cylinder block. The part must be assembled within 5 minutes after sealant was applied.

Bead width: 2.5mm (0.10in.)

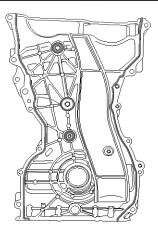


SVGEM0141D

4) After applying liquid sealant Loctite 5900H or equivalent on the timing chain cover.

The part must be assembled within 5 minutes after sealant was applied. Continuous bead of sealant should be applied to prevent any path of oil leakage.

Bead width: 3.0mm (0.12in.)



SYFEM0011N

5) The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover to be in exact position.

#### **Tightening torque:**

Bolts A (M6×25):

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

Bolts B (M8×28):

 $18.6 \sim 22.5$ N.m ( $1.9 \sim 2.3$ kgf.m,  $13.7 \sim 16.6$ lb-ft)

Bolt C (M8×30):

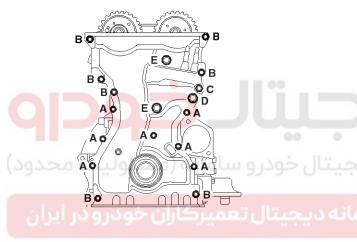
19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)

Bolt D (M10×40):

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

Bolts E (M10×45):

 $39.2 \sim 44.1$ N.m ( $4.0 \sim 4.5$ kgf.m,  $28.9 \sim 32.5$ lb-ft)



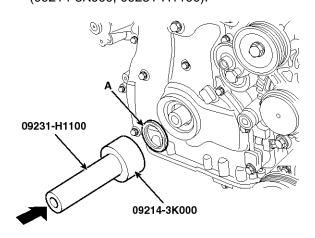
SVGEM0017D



The engine starting or pressure tests should not be performed within 30 minutes after the timing chain cover was assembled.

# **Engine Mechanical System**

10.Install the crankshaft front oil seal (A) using SST (09214-3K000, 09231-H1100).



SSLM10114D

11. Install the water pump pulley (A) and the crankshaft pulley (B).

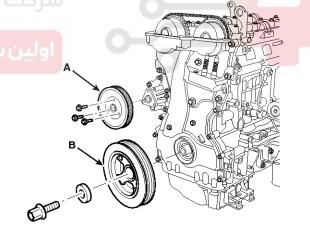
#### Tightening torque:

Water pump pulley (A):

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

Crankshaft pulley (B):

166.6 ~ 176.4N.m (17.0 ~ 18.0kgf.m, 122.9 ~ 130.1lb-ft)



SYFEM0031D

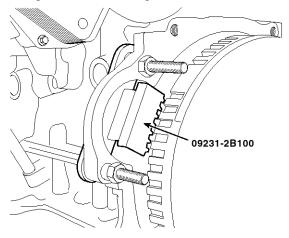
# **Timing System**

### **EMA-43**

#### **MOTICE**

There are two methods to hold the ring gear when installing or removing the crankshaft damper pulley.

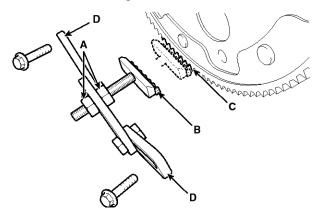
• Install the SST (09231-2B100) to hold the ring gear after removing the starter.



SVGM20026D

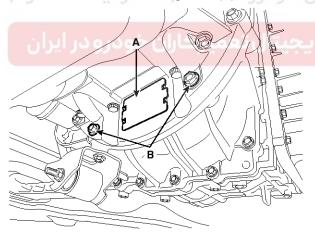
- Install the SST (09231-3D100) to hold the ring gear after removing the dust cover.
  - 1. Remove the dust cover (A) on the bottom of the ladder frame and unfasten the two transaxle mounting bolts (B).

- 2. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.
- 3. Adjust the angle of the links (D) so that the two transaxle mounting bolts can be fastened to the original mounted holes.

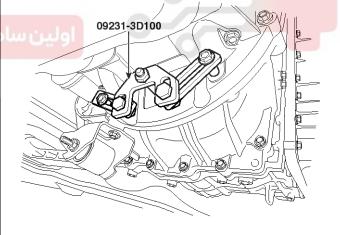


SVGEM1002D

4. Install the SST (09231-3D100) using the two transaxle mounting bolts and spacers. Tighten the bolts and nuts of the holder and links securely.



SVGEM1003D



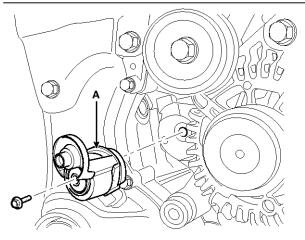
SVGEM1004D

# **Engine Mechanical System**

12. Install the drive belt tensioner (A).

#### Tightening torque:

53.9  $\sim$  63.7N.m (5.5  $\sim$  6.5kgf.m, 39.7  $\sim$  47.0lb-ft)



SYFEM0038N

13. Install the idler (B) and the drive belt tensioner pulley (C).

#### Tightening torque:

Idler (B):

53.9 ~ 63.7N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lb-ft)

Drive belt tensioner pulley (C):

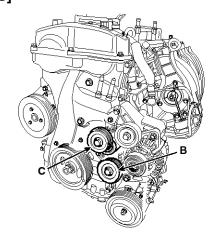
53.9  $\sim$  63.7N.m (5.5  $\sim$  6.5kgf.m, 39.7  $\sim$  47.0lb-ft)

#### **A**CAUTION

Tensioner pulley bolt is left-handed screw.

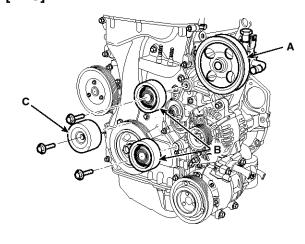
14. Install the power steering oil pump (A). (Refer to ST group)

#### [MDPS]



SSLM10023L

#### [HPS]



SYFEM0053D

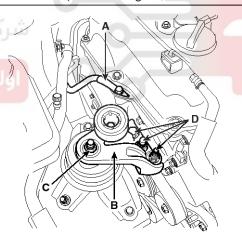
15. Install the engine mounting support bracket (B) and connect the ground line (A).

#### **Tightening torque:**

Nut (C) : 78.5  $\sim$  98.1 N.m (8.0  $\sim$  10.0 kgf.m, 57.9  $\sim$  72.3 lb-ft)

Bolt and nuts (D):

58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.4 ~ 54.2 lb-ft)



SSLEM1200L

# **Timing System**

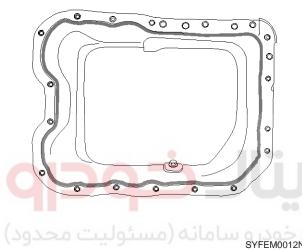
**EMA-45** 

16. Remove the jack from the ladder frame.

17. Install the oil pan.

- 1) Using a gasket scraper, remove all the old sealant material from the gasket surfaces.
- 2) Before assembling the oil pan, liquid sealant Loctite 5900H, Threebond 1217H or equivalent should be applied on oil pan. The part must be assembled within 5 minutes after sealant was applied.

Bead width: 2.5mm (0.10in.)



#### CAUTION

- When applying sealant gasket, sealant must not be protruded into the inside of
- · To prevent leakage of oil, apply sealant gasket on the inner threads of the bolt holes.

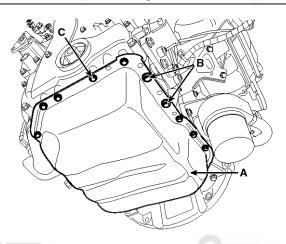
3) Install the oil pan (A). Uniformly tighten the bolts in several passes.

#### **Tightening torque**

Bolts B (M9):

 $30.4 \sim 34.3$ N.m (3.1  $\sim 3.5$ kgf.m, 22.4  $\sim 25.3$ lb-ft) Bolts C (M6):

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



SVGEM0149D

#### **CAUTION**

After assembly, wait at least 30 minutes before filling the engine with oil.

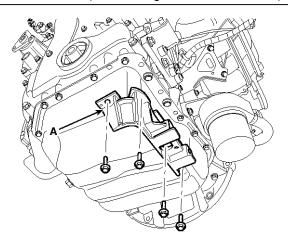
#### MOTICE

Always use a new drain plug gasket.

18. Install the A/C compressor bracket (A).

#### Tightening torque:

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



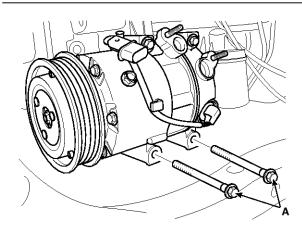
SYFEM0039N

# **Engine Mechanical System**

19. Install the A/C compressor lower bolts (A).

#### Tightening torque:

20.0  $\sim$  33.0N.m (2.04  $\sim$  3.36kgf.m, 14.8  $\sim$  24.3lb-ft)



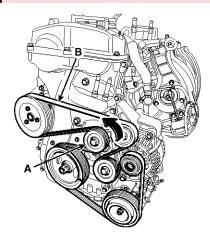
SYFEM0145N

#### 20. Install the drive belt (B).

Crankshaft pulley → A/C pulley → Alternator pulley → Idler #1 pulley → Power steering oil pump pulley (HPS only) → Idler #2 pulley → Water pump pulley → Tensioner pulley.

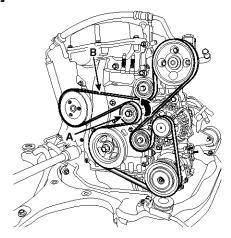
Rotate the drive belt tensioner arm (A) counterclockwise moving the tensioner pulley bolt with wrench. After putting the belt on the tensioner pulley, release the tensioner pulley slowly.

#### [MDPS]



SSLM10022D

#### [HPS]

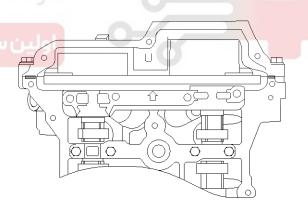


SVGEM0153D

#### 21. Install cylinder head cover.

- The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- 2) After applying sealant, it should be assembled within 5 minutes.

Bead width: 2.5mm (0.10in.)



SNFEM8045D

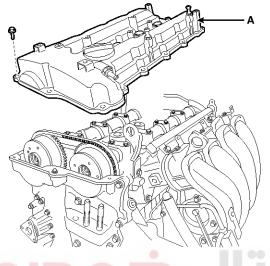
# **Timing System**

**EMA-47** 

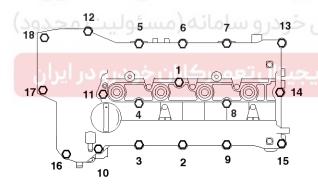
3) Install the cylinder head cover (A) by tightening the bolts as following method.

#### **Tightening torque**

1st step: 3.9  $\sim$  5.9N.m (0.4  $\sim$  0.6kgf.m, 2.9  $\sim$  4.3lb-ft) 2nd step: 7.8  $\sim$  9.8N.m (0.8  $\sim$  1.0kgf.m, 5.8  $\sim$  7.2lb-ft)



SSLM10024D



SNFEM8046D

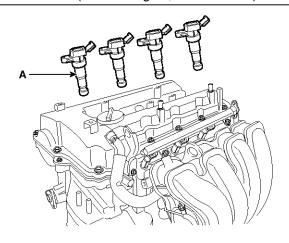
#### **A**CAUTION

- · Do not reuse cylinder head cover gasket.
- The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

22. Install the ignition coils (A).

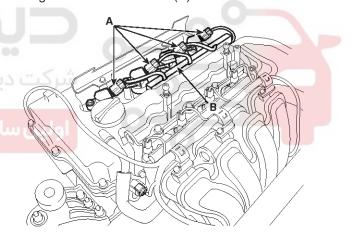
#### Tightening torque:

 $3.9 \sim 5.9$ N.m (0.4  $\sim$  0.6kgf.m, 2.9  $\sim$  4.3lb-ft)



SSLM10002D

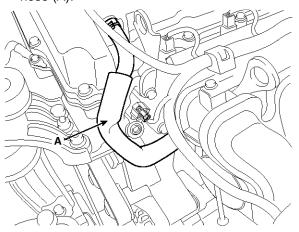
23. Install the wiring protector (B), and then connect the ignition coil connectors (A).



SSLM10110D

# **Engine Mechanical System**

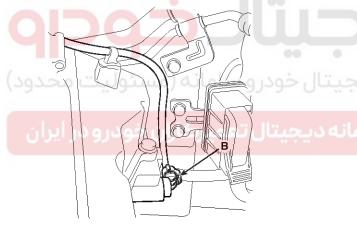
24. Connect the PCV (Positive crankcase ventilation) hose (A).



SSLM10109D

25. Connect the power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B).

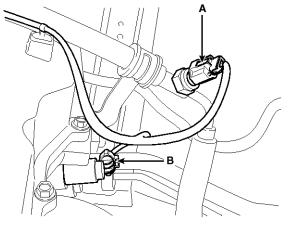
#### [MDPS]



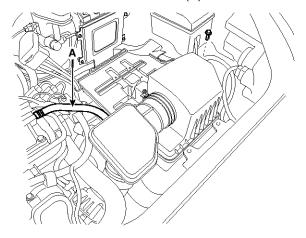
SSLM10014L

SVGEM0008D





26. Connect the breather hose (A).



SSLM10108D

27. Install the RH side cover.

#### Tightening torque:

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

- 28. Install the under cover. (Refer to Engine and transaxle assembly in this group)
- 29. Install the RH front wheel. (Refer to SS group)
- 30. Connect the battery negative terminal.

#### **Tightening torque:**

Without battery sensor:

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

With battery sensor:

 $4.0 \sim 6.0$ N.m (0.4  $\sim$  0.6kgf.m, 3.0  $\sim$  4.4lb-ft)

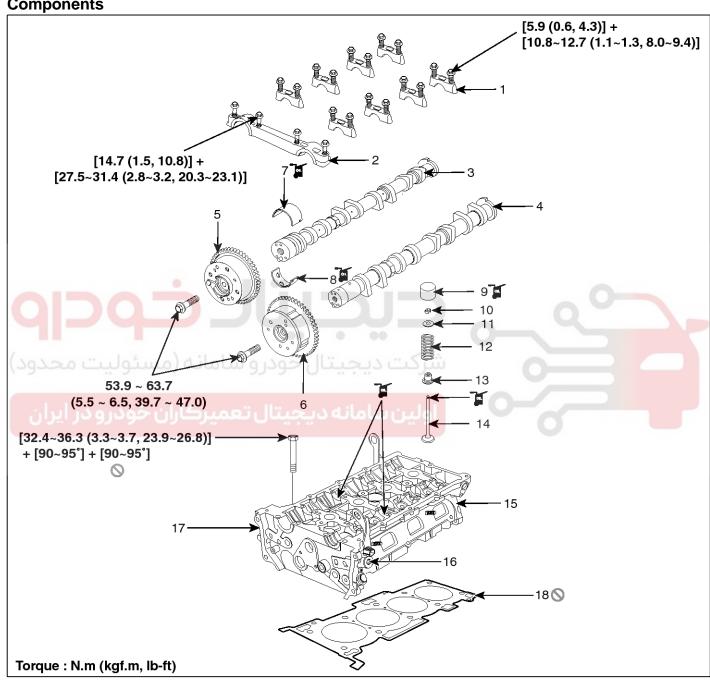
31. Install the engine cover.

**EMA-49** 

### **Cylinder Head Assembly**

### **Cylinder Head**

Components



SSLM10142N

- 1. Camshaft bearing cap
- 2. Camshaft front bearing cap
- 3. Exhaust camshaft
- 4. Intake camshaft
- 5. Exhaust CVVT assembly
- 6. Intake CVVT assembly
- 7. Exhaust camshaft upper bearing
- 8. Exhaust camshaft lower bearing
- 9. MLA (Mechanical lash adjuster)
- 10. Retainer lock
- 11. Retainer
- 12. Valve spring

- 13. Valve stem seal
- 14. Valve
- 15. Cylinder head
- 16. Intake OCV (Oil control valve)
- 17. Exhaust OCV (Oil control valve)
- 18. Cylinder head gasket

### **Engine Mechanical System**

#### Removal

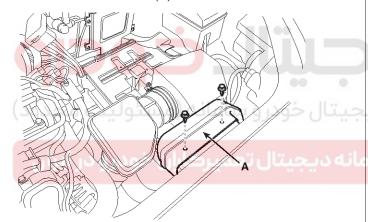
#### **A**CAUTION

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

#### **MOTICE**

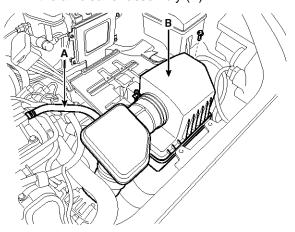
Mark all wiring and hoses to avoid misconnection.

- 1. Remove the engine cover.
- 2. Disconnect the battery negative terminal.
- 3. Remove the air duct (A).



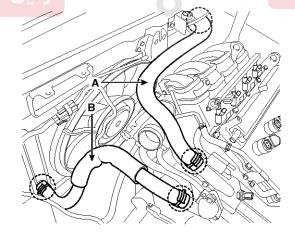
SSLM10006D

- 4. Remove the air cleaner assembly.
  - 1) Disconnect the breather hose (A) and brake booster intensifier hose (AT only).
  - 2) Disconnect the air intake hose and then remove the air cleaner assembly (B).



SSLM10007D

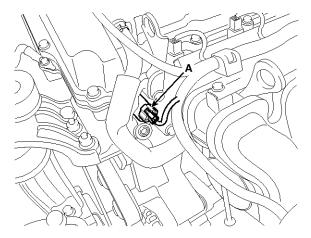
- 5. Remove the RH front wheel. (Refer to SS group)
- 6. Remove the under cover and RH side cover. (Refer to Timing system in this group)
- 7. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to drain with speed. (Refer to Cooling system in this group)
  - 8. Disconnect the radiator upper hose (A) and lower hose (B).



SSI M10011D

### **EMA-51**

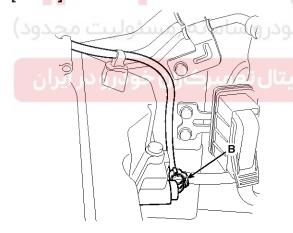
- 9. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - 1) The intake OCV (Oil control valve) connector (A)



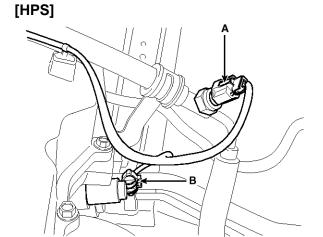
SSLM10013D

The power steering oil pressure switch connector
 (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B)

#### [MDPS]

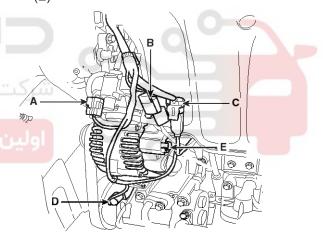


SSLM10014L



SVGEM0008D

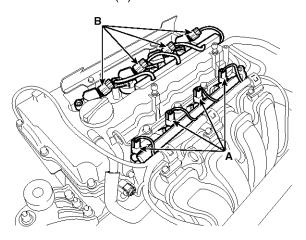
3) The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)



SSLM10123D

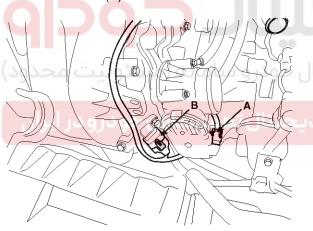
# **Engine Mechanical System**

4) The injector connectors (A) and the ignition coil connectors (B).



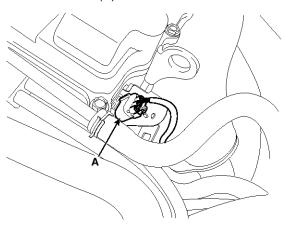
SSLM10001D

5) The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



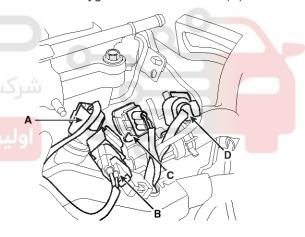
SVGEM0110D

6) The exhaust CMPS (Camshaft position sensor) connector (A)



SSLM10151N

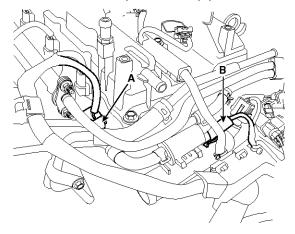
7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the front oxygen sensor connector (D)



SSLM10158L

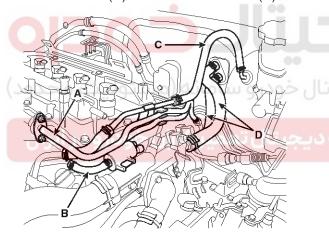
### **EMA-53**

8) The intake CMPS (Camshaft position sensor) connector (A) and the PCSV (Purge control solenoid valve) connector (B)



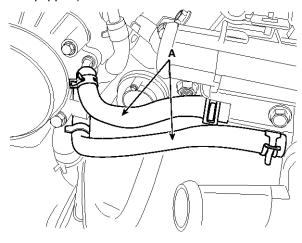
SSLM10103D

10. Disconnect the fuel hose (A), the PCSV (Purge control solenoid valve) hose (B), the brake booster vacuum hose (C) and the heater hoses (D).



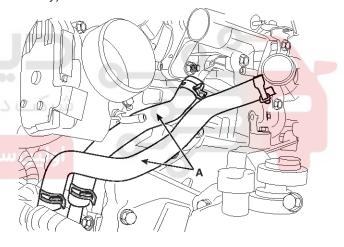
SSLM10016D

11. Disconnect the throttle body coolant hoses (A). (if equipped)



SVGM11117L

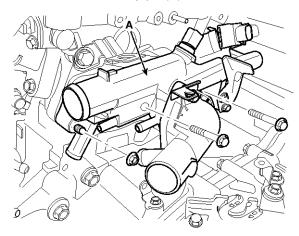
12. Disconnect the oil cooler coolant hoses (A). (2.4L only)



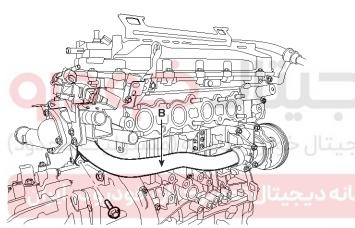
SYFEM0048N

# **Engine Mechanical System**

13. Remove the water temperature control assembly (A) with the water inlet pipe (B).



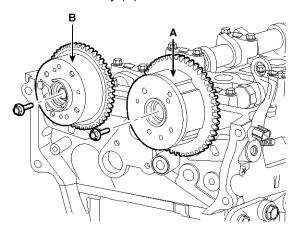
SYFEM0049N



SSLM10144D

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

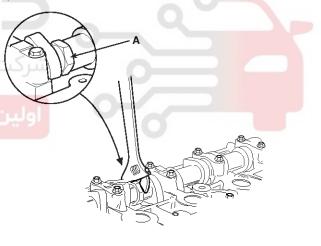
16. Remove the intake CVVT assembly (A) and exhaust CVVT assembly (B).



SVGEM0167D

#### **MNOTICE**

When removing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position A.

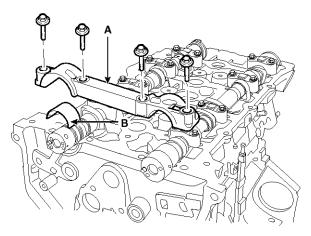


STDM19324L

### **EMA-55**

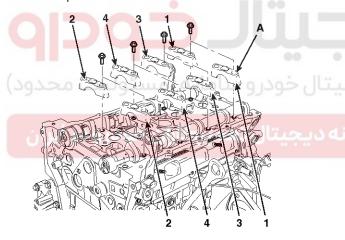
17. Remove the camshaft.

1) Remove the front camshaft bearing cap (A) with the upper bearing (B).



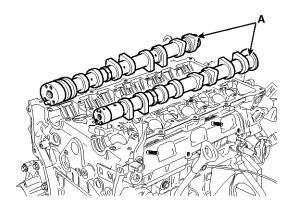
SYFEM0015N

2) Remove the camshaft bearing cap (A) in the sequence shown.



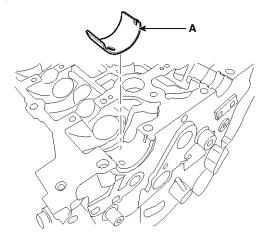
SUNM19125N

3) Remove the camshafts (A).



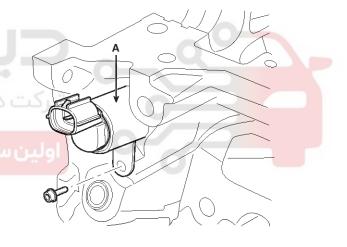
STGEM9111D

4) Remove the exhaust camshaft lower bearing (A).



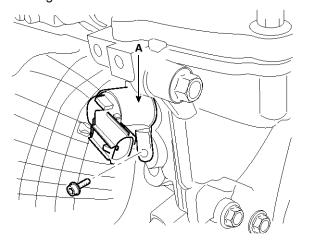
SYFEM0018N

18. Remove the intake OCV (Oil control valve) (A) using a torx wrench.



SYFEM0019N

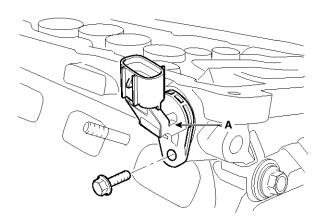
19. Remove the exhaust OCV (Oil control valve) (A) using a torx wrench.



SYFEM0050N

# **Engine Mechanical System**

20. Remove the intake CMPS (Camshaft position sensor) (A).



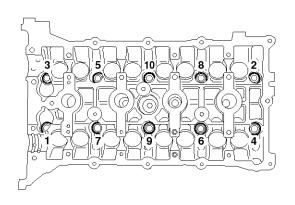
SSLM10116D

21.Remove the exhaust CMPS (Camshaft position sensor) (A) after removing the engine hanger and cam position sensor cover (B).



SYFEM0024N

- 22. Remove the cylinder head.
  - Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.



SNFEM8086L

#### **A**CAUTION

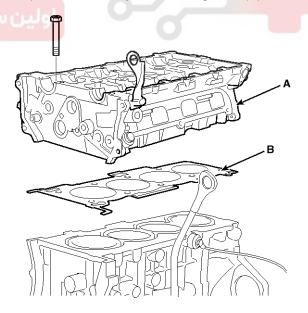
Head warpage or cracking could result from removing bolts in an incorrect order.

2) Lift the cylinder head (A) from the dowels on the cylinder block and place 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.

3) Remove the cylinder head gasket (B).



SVGEM0168D

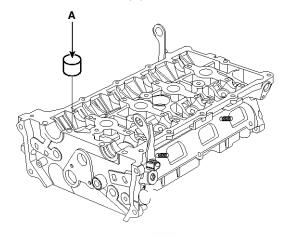
### **EMA-57**

#### Disassembly

#### **MOTICE**

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

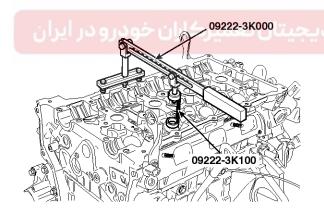
1. Remove the MLAs (A).



SNFEM8081D

#### 2. Remove the valves.

1) Using SST (09222-3K000, 09222-3K100), compress the valve spring and remove retainer lock.



SVGEM0169D

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

#### **MNOTICE**

Do not reuse old valve stem seals.

# Inspection Cylinder Head

1. Inspect for flatness.

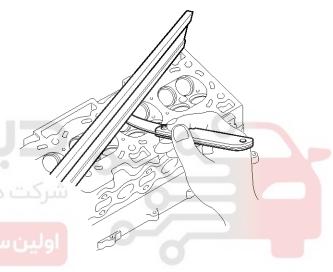
Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

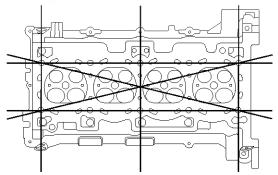
#### Flatness of cylinder head gasket surface

Standard: Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) X 100mm (3.9370in.)

Flatness of manifold mounting surface (Intake/Exhaust)

Standard: Less than 0.10mm (0.0039in.)





STQM39031D

#### 2. Inspect for cracks.

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

inside

diameter

### **EMA-58**

# **Engine Mechanical System**

valve

3) Subtract the valve stem diameter measurement

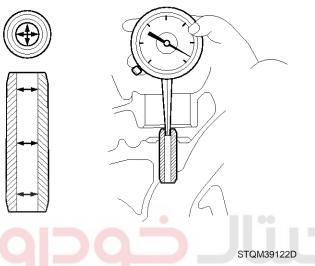
guide

#### **Valve And Valve Spring**

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

#### Valve guide inner diameter

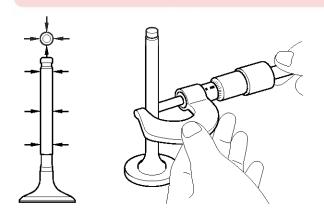
Intake / Exhaust :  $5.500 \sim 5.512$ mm (0.21654  $\sim 0.21701$ in.)



 Using a micrometer, measure the diameter of the valve stem.

#### Valve stem outer diameter

Intake :  $5.465 \sim 5.480$ mm (0.21516  $\sim$  0.21575in.) Exhaust :  $5.458 \sim 5.470$ mm (0.214988  $\sim$  0.21535in.)



KCRF227A

### Valve stem-to-guide clearance

measurement.

the

[Standard]

from

Intake :  $0.020 \sim 0.047$ mm ( $0.00078 \sim 0.00185$ in.) Exhaust :  $0.030 \sim 0.054$ mm ( $0.00118 \sim 0.00212$ in.)

[Limit]

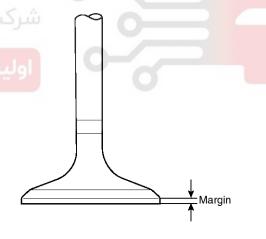
Intake: 0.070mm (0.00275in.) Exhaust: 0.090mm (0.00354in.)

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

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

# Valve head thickness (Margin) [Standard]

Intake: 1.02mm(0.0401in.) Exhaust: 1.09mm(0.0429in.)



ECKD221A

If the margin thickness is less than minimum, replace the valve.

4) Check the valve length.

#### Valve length

[Standard]

Intake: 113.18mm(4.4559in.) Exhaust: 105.84mm(4.1669in.)

[Limit]

Intake: 112.93mm(4.4461in.) Exhaust: 105.59m(4.1571in.)

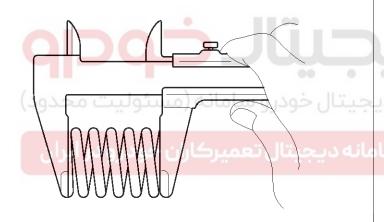
### **EMA-59**

- 5) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.
- 3. Inspect the valve seats
  - Check the valve seat for evidence of overheating and improper contact with the valve face.
     Replace the cylinder head if necessary.
  - 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 the valve spring.
  - 2) Using a vernier calipers, measure the free length of the valve spring.

#### Valve spring

[Standard]

Free height: 47.44mm (1.8677in.) Out-of-square: Less than 1.5°



KCRF205A

If the free length is not as specified, replace the valve spring.

#### MLA (Mechanical Lash Adjuster)

1. Inspect the MLA.

Using a micrometer, measure the MLA outside diameter.

#### MLA outer diameter:

31.964 ~ 31.980mm (1.2584 ~ 1.2590in.)

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

#### Tappet bore inner diameter:

32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)

3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

#### MLA to tappet bore clearance

[Standard] :  $0.020 \sim 0.061$ mm ( $0.00078 \sim 0.00240$ in.)

[Limit]: 0.070mm (0.00275in.)

#### Camshaft

1. Inspect the cam lobes.

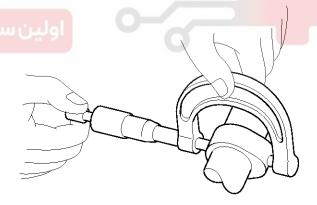
Using a micrometer, measure the cam lobe height.

#### Cam height

[Standard value]

Intake: 44.10 ~ 44.30mm (1.7362 ~ 1.7440in.)

Exhaust: 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)



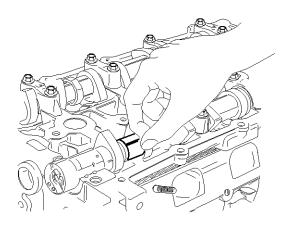
KCRF206A

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

2. Check the surface of the camshaft jurnal for wear. If the jurnal is worn excessively, replace the camshaft.

# **Engine Mechanical System**

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



SVGEM0111D

4) Install the bearing caps.



Do not turn the camshaft.

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

#### Bearing oil clearance

[Standard value]

Intake:

No.1:  $0.022 \sim 0.057$ mm ( $0.00087 \sim 0.00224$ in.)

No.2, 3, 4, 5 :  $0.045 \sim 0.082$ mm ( $0.00177 \sim 0.00323$ in.)

Exhaust:

No.1:  $0 \sim 0.032$ mm ( $0 \sim 0.00126$ in.)

No.2, 3, 4, 5 :  $0.045 \sim 0.082$ mm ( $0.00177 \sim 0.00323$ in.)

[Limit]

Intake:

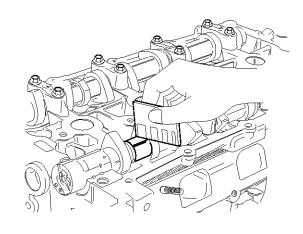
No.1: 0.090mm (0.00354in.)

No.2, 3, 4, 5: 0.120mm (0.00472in.)

Exhaust:

No.1: 0.090mm (0.00354in.)

No.2, 3, 4, 5: 0.120mm (0.00472in.)



SVGEM0112D

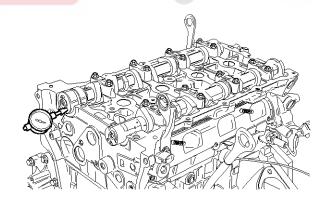
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- 7) Completely remove the plastigage.
- 8) Remove the camshafts.
- 4. 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 value] :  $0.04 \sim 0.16$ mm ( $0.0016 \sim 0.0063$ in.)

[Limit]: 0.20mm (0.0078in.)



SUNM19128N

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

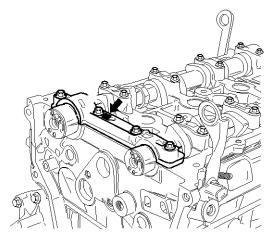
3) Remove the camshafts.

### **EMA-61**

#### **Exhaust Camshaft Bearing**

1. Check the cylinder head bore mark.

#### **Cylinder Head Bore Identification Mark**



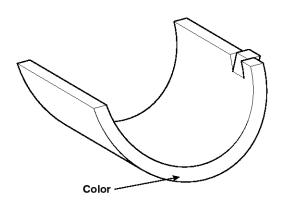
SUNM19129N

#### **Cylinder Head Specifications**

Class	Mark	Exhaust No.1 Inside Diameter Of Cylinder Head Bore
а	A	40.000 ~ 40.008mm (1.57480 ~ 1.5751in.)
p (2922	B B	40.008 ~ 40.016mm (1.57511 ~ 1.57543in.)
ران	رو څر اي	40.016 ~ 40.021mm (1.57543 ~ 1.57563in.)

2. Select class of camshaft bearing same as class of cylinder head as shown on the table below.

# **Exhaust Camshaft Bearing Identification Mark**



ECRF021A

#### **Exhaust Camshaft Bearing Specifications**

Cylinder Head Bore Class	Bearing Class For Installing (Color)	Thickness Of Beari- ng		
a (A)	C (Green)	1.996~2.000mm (0.07858~0.07874in.)		
b (B)	B (None)	2.000 <mark>~2.004mm</mark> (0.07874~ <mark>0.078</mark> 90in.)		
c (C)	A (Black)	2.004~2.008mm (0.07890~0.07905in.)		

**Oil clearance :**  $0 \sim 0.032$ mm ( $0 \sim 0.00126$ in.)

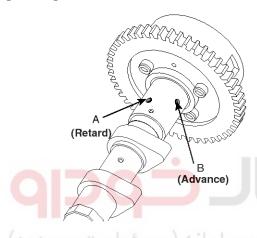
# **Engine Mechanical System**

#### **CVVT Assembly**

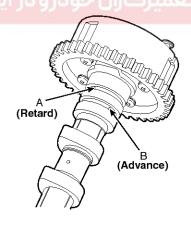
- 1. Inspect CVVT assembly.
  - 1) Fix the camshaft using a vise. Be careful not to damage the cam lobe and journal.
  - Check that the CVVT assembly will not turn.
  - 3) Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.

Verify the hold to tape and the hole to put air in.

#### [Intake]



#### [Exhaust]



SXMM19074L

4) Wind tape around the tip of the air gun and apply air of approx. 150kPa(1.5kgf/cm<sup>2</sup>, 21psi) to the port of the camshaft.

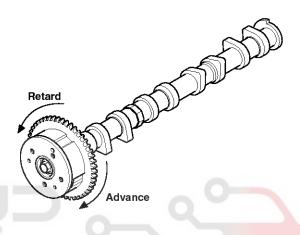
(Perform this in order to release the lock pin.)

#### MOTICE

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

5) With air applied, as in step(3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.



ECRF016A

6) Turn the CVVT assembly back and forth and check the movable range and that there is no disturbance.

#### Standard:

Should move smoothly in a range from about 22.5° (Intake) / 20.0° (Exhaust)

- 7) Turn the intake CVVT assembly with your hand and lock it at the maximum retard angle position (counter clockwise).
- 8) Turn the exhaust CVVT assembly with your hand and lock it at the maximum advance angle position (clockwise).

### **EMA-63**

#### Reassembly

#### **MOTICE**

Thoroughly clean all parts to be assembled.

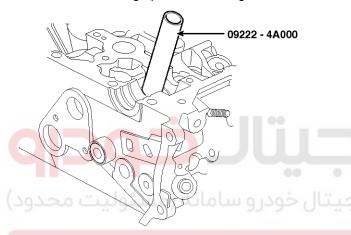
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.

Replace oil seals with new ones.

- 1. Install valves.
  - 1) Using SST(09222-4A000), push in a new oil seal.

#### **MNOTICE**

- · Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.



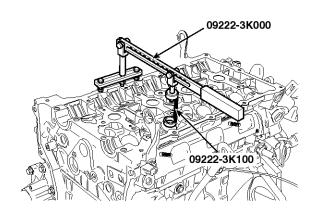
# SYFEM0116N

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

#### MOTICE

Place 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, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

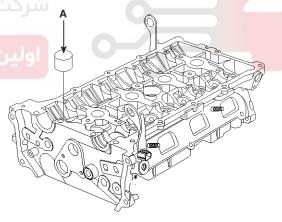


SVGEM0169D

#### **MNOTICE**

Do not press down the valve spring retainer more than 10mm (0.4in.).

- 4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.
- Install the MLAs after appling engine oil.Check that the MLA rotates smoothly by hand.



SNFEM8062D

#### **MNOTICE**

MLA can be reinstalled in its original position.

However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block.

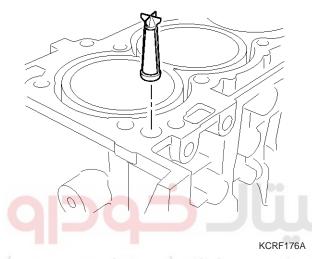
Refer to General information in EM section for Valve Clearance checking and adjustment procedure.

# **Engine Mechanical System**

#### Installation

#### **MNOTICE**

- Thoroughly clean all parts to be assembled.
- · Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.
- 1. Install the OCV (Oil control valve) filter.



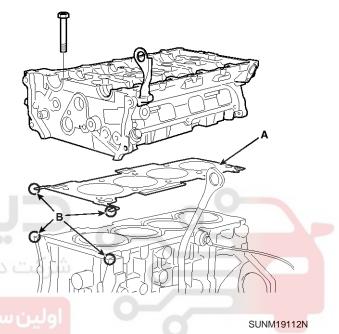
**⚠CAUTION**Keep the OCV filter clean.

انه دیجیتال تعمیرکاران خودرو در ایران

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

#### **MNOTICE**

- Be careful of the installation direction.
- Apply liquid gasket (Loctite 5900H or equivalent) on the edge of cylinder head gasket upside and downside. (At the position 'B')
- After applying sealant, assemble the cylinder head in five minutes.



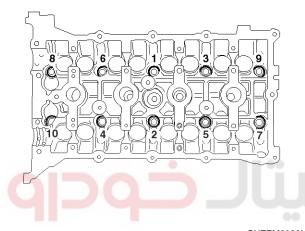
3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.

### **EMA-65**

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

#### Tightening torque:

 $32.4\sim36.3$ Nm ( $3.3\sim3.7$ kgf.m,  $23.9\sim26.8$ lb-ft) +  $90\sim95^{\circ}$  +  $90\sim95^{\circ}$ 



SNFEM8088L

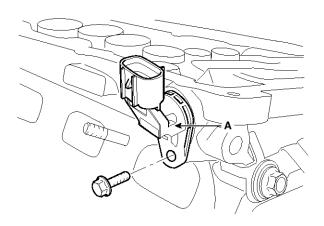


Always use new cylinder head bolt.

5. Install the intake CMPS (Camshaft position sensor) (A).

#### Tightening torque:

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

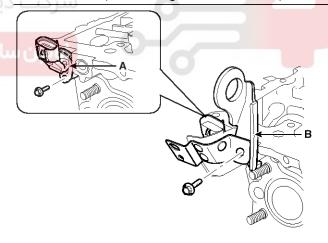


SSLM10116D

Install the exhaust CMPS (Camshaft position sensor)
 (A) and the engine hanger and cam position sensor cover (B).

#### Tightening torque:

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



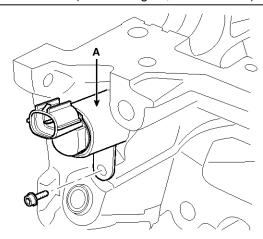
SYFEM0024N

# **Engine Mechanical System**

7. Install the intake OCV (Oil control valve) (A).

#### Tightening torque:

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

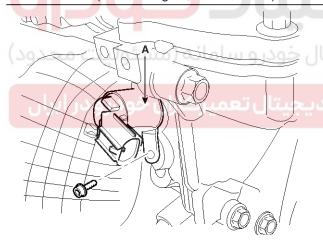


SYFEM0019N

8. Install the exhaust OCV (Oil control valve) (A).

#### **Tightening torque:**

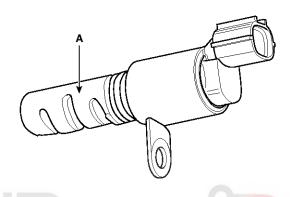
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SYFEM0050N

#### **A**CAUTION

- · Do not reuse the OCV when dropped.
- Keep the OCV filter clean.
- Do not hold the OCV sleeve (A) during servicing.
- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.



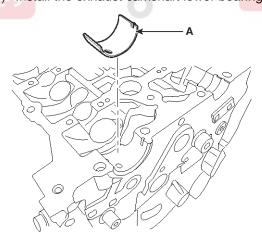
SYFEM0021N

9. Install the camshafts.

#### **MNOTICE**

Apply a light coat of engine oil on camshaft journals.

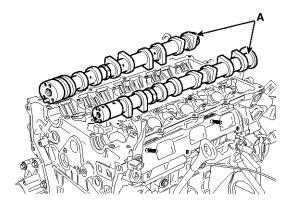
1) Install the exhaust camshaft lower bearing (A).



SYFEM0018N

**EMA-67** 

2) Install the camshafts (A).



STGEM9111D

3) Install the exhaust camshaft upper bearing (A) to the front bearing cap.



SNFEM8016D

4) Install camshaft bearing caps (A) in their proper locations.

Tightening order

 $\mathsf{Group} \; \mathsf{A} \to \mathsf{Group} \; \mathsf{B} \to \mathsf{Group} \; \mathsf{C}.$ 

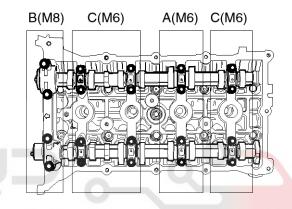
#### Tightening torque:

Step 1

M6: 5.9N.m (0.6kgf.m, 4.3lb-ft) M8: 14.7N.m (1.5kgf.m, 10.8lb-ft)

Step 2

M6 : 10.8  $\sim$  12.7N.m (1.1  $\sim$  1.3kgf.m, 8.0  $\sim$  9.4lb-ft) M8 : 27.5  $\sim$  31.4N.m (2.8  $\sim$  3.2kgf.m, 20.3  $\sim$  23.1lb-ft)



SUNM16115D

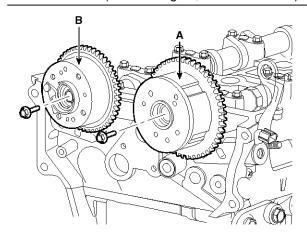
### **A**CAUTION

Be careful not to change the position and direction of bearing caps.

10.Install the intake CVVT assembly (A) and exhaust CVVT assembly (B).

#### Tightening torque:

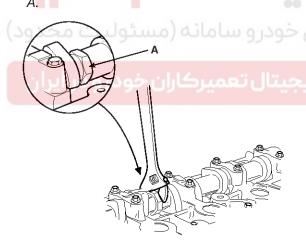
 $53.9 \sim 63.7 \text{N.m} \ (5.5 \sim 6.5 \text{kgf.m}, \ 39.7 \sim 47.0 \text{lb-ft})$ 



SVGEM0167D

#### **MOTICE**

When installing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position



STDM19324L

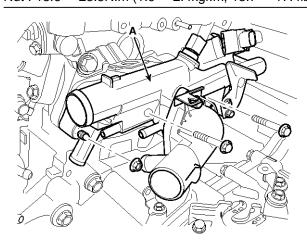
- 11.Install the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 12.Install the timing chain. (Refer to Timing system in this group)
- 13. Check and adjust the valve clearance. (Refer to General information in this group)

# **Engine Mechanical System**

14. Install the water temperature control assembly (A) with the water inlet pipe (B).

#### Tightening torque:

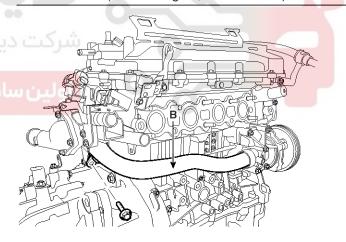
Bolts : 14.7  $\sim$  19.6N.m (1.5  $\sim$  2.0kgf.m, 10.8  $\sim$  14.5lb-ft) Nut : 18.6  $\sim$  23.5N.m (1.9  $\sim$  2.4kgf.m, 13.7  $\sim$  17.4lb-ft)



SYFEM0049N

#### Tightening torque:

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



SSLM10144D

#### **MOTICE**

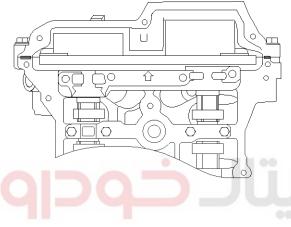
- Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.
- Insert after wetting O-ring or inner surface of thermostat housing.
- Always use a new O-ring.

### **EMA-69**

15. Install cylinder head cover.

- The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- 2) After applying sealant (Loctite 5900H or equivalent), it should be assembled within 5 minutes.

Bead width: 2.5mm (0.10in.)

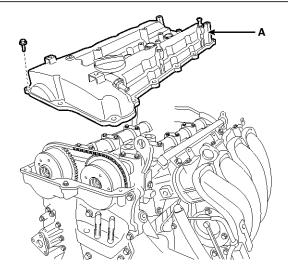


SNFEM8045D

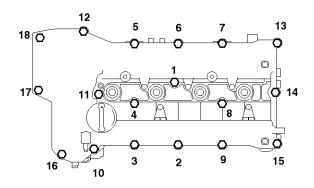
3) Install the cylinder head cover (A) by tightening the bolts as following method.

#### Tightening torque:

1st step: 3.9 ~ 5.9N.m(0.4 ~ 0.6kgf.m, 2.9 ~ 4.3lb-ft) 2nd step: 7.8 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLM10024D

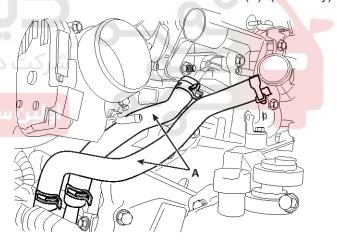


SNFEM8046D

#### **A**CAUTION

- · Do not reuse cylinder head cover gasket.
- The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

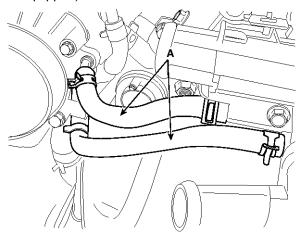
16. Connect the oil cooler coolant hoses (A). (2.4L only)



SYFEM0048N

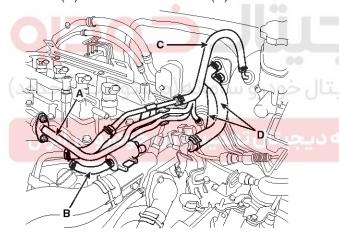
# **Engine Mechanical System**

17. Connect the throttle body coolant hoses (A). (if equipped)



SVGM11117L

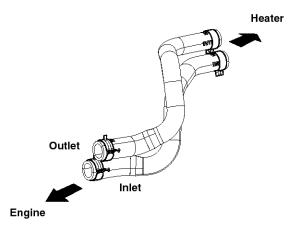
18. Connect the fuel hose (A), the PCSV (Purge control solenoid valve) hose (B), the brake booster vacuum hose (C) and the heater hoses (D).



SSLM10016D

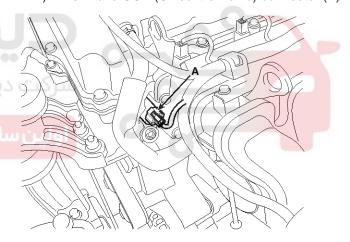
#### **MNOTICE**

Install the heater hoses as shown illusstrations.



SSLM10104D

- 19. Connect the wiring connectors and harness clamps, and install the wiring and protectors to the cylinder head and intake manifold.
  - 1) The intake OCV (Oil control valve) connector (A)

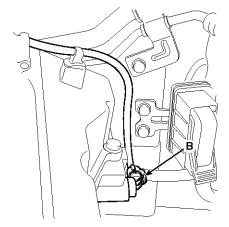


SSLM10013D

### **EMA-71**

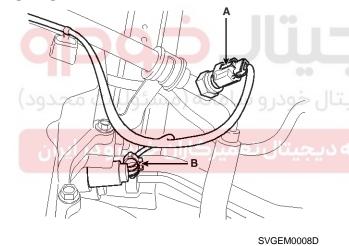
 The power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B)

#### [MDPS]



SSLM10014L

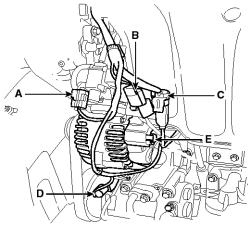
[HPS]



knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)

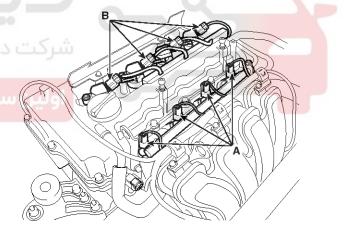
3) The VIS (Variable intake system) connector (A),

the OPS (Oil pressure switch) connector (B), the



SSLM10123D

4) The injector connectors (A) and the ignition coil connectors (B).

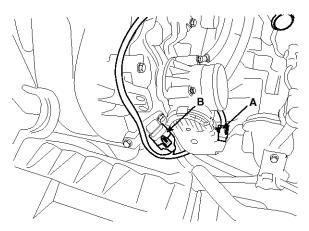


SSLM10001D

# **Engine Mechanical System**

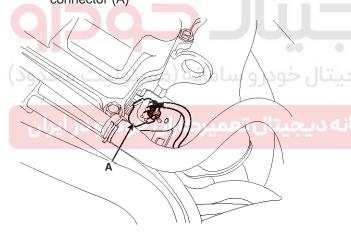
The ETC (Electronic throttle control) connector

 (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



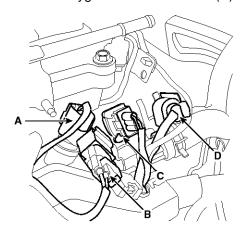
SVGEM0110D

6) The exhaust CMPS (Camshaft position sensor) connector (A)



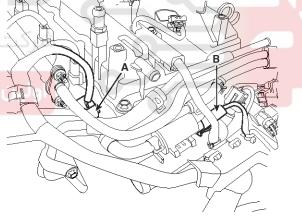
SSLM10151N

7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the front oxygen sensor connector (D)



SSLM10158L

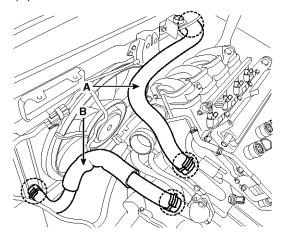
8) The intake CMPS (Camshaft position sensor) connector (A) and the PCSV (Purge control solenoid valve) connector (B)



SSLM10103D

**EMA-73** 

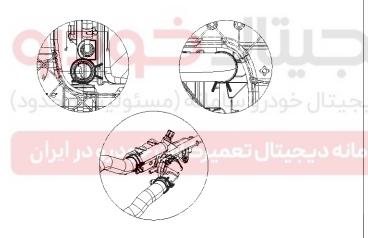
20. Connect the radiator upper hose (A) and lower hose (B).



SSLM10011D

#### MOTICE

Install the radiator hoses as shown illustrations.



SSLM10102N

- 21.Install the under cover and RH side cover. (Refer to Timing system in this group)
- 22. Remove the RH front wheel. (Refer to SS group)

23. Install the air cleaner assembly.

 Install the air cleaner assembly (B) and then connect the air intake hose and the brake booster intensifier hose.

#### Tightening torque

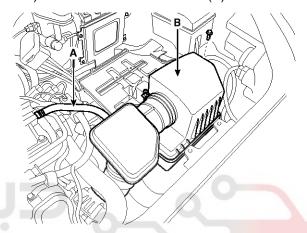
Hose clamp bolt :

 $2.9 \sim 4.9 \text{N.m} (0.3 \sim 0.5 \text{kgf.m}, 2.2 \sim 3.6 \text{lb-ft})$ 

Air cleaner assembly bolts:

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

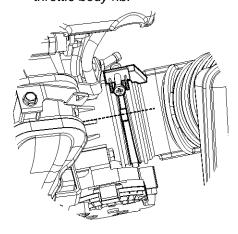
2) Connect the breather hose (A).



SSLM10007D

#### MOTICE

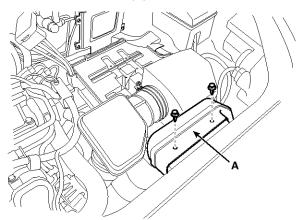
- Install the air intake hose while the plate of the hose clamp must be in line with the stopper of the hose.
- Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



SSLM10101D

## **Engine Mechanical System**

24. Install the air duct (A).



SSLM10006D

25. Connect the battery negative terminal.

#### **Tightening torque:**

Without battery sensor:

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

With battery sensor:

 $4.0 \sim 6.0$ N.m (0.4  $\sim 0.6$ kgf.m,  $3.0 \sim 4.4$ lb-ft)

تال خودرو سامانه (مسئولیت محدود)

انه دیجیتال تعمیرکاران خودرو در ایران

26. Install the engine cover.

Perform the following:

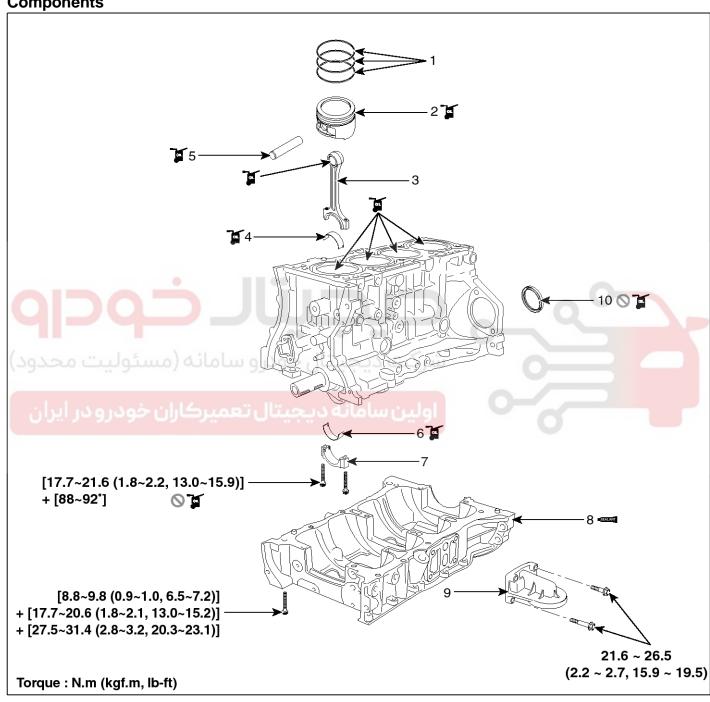
- · Adjust a shift cable.
- Refill engine with engine oil.
- · Refill a transaxle with fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- · Inspect for fuel leakage.
  - After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
  - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line
- 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.

**EMA-75** 

### **Cylinder Block**

### **Cylinder Block**

**Components** 

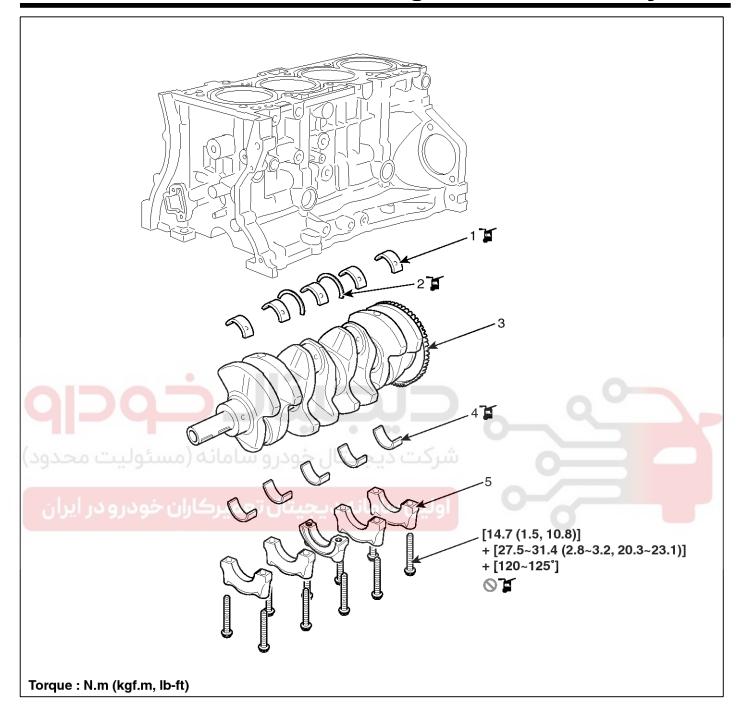


SVGM11118L

- 1. Piston ring
- 2. Piston
- 3. Connecting rod
- 4. Connecting rod upper bearing
- 5. Piston pin

- 6. Connecting rod lower bearing
- 7. Connecting rod bearing cap
- 8. Ladder frame
- 9. Oil filter bracket
- 10. Crankshaft rear oil seal

# **Engine Mechanical System**



SVGM11119L

- 1. Crankshaft upper bearing
- 2. Thrust bearing
- 3. Crankshaft

- 4. Crankshaft lower bearing
- 5. Main bearing cap

### **EMA-77**

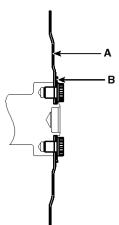
#### Disassembly

#### **ACAUTION**

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

#### MOTICE

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at top dead center.
- Remove the engine assembly from the vehicle. (Refer to Engine and transaxle assembly in this group)
- 2. Install the engine to an engine stand for disassembly.
- 3. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- Remove the timing chain. (Refer to Timing system in this group)
- 5. Remove the cylinder head assembly. (Refer to Cylinder head in this group)
- 6. AT: Remove the drive plate (A) and the adapter plate (B).

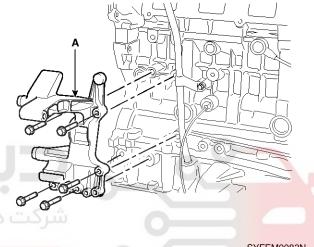


KCRF224A

MT: Remove the flywheel.

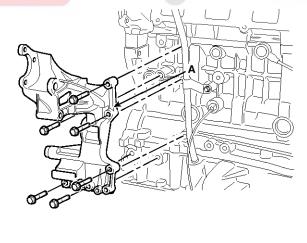
- Remove the balance shaft & oil pump assembly. (Refer to Lubrication system in this group)
- 8. Remove the A/C compressor. (Refer to HA group)
- 9. Remove the alternator. (Refer to EE group)
- 10. Remove the water pump assembly. (Refer to Cooling system in this group)
- Remove the power steering oil pump. (Refer to ST group)
- 12. Remove the tensioner assembly integrated bracket (A).

#### [MDPS]



SYFEM0083N

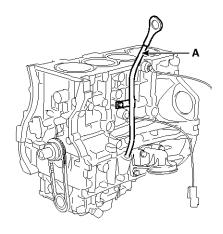
[HPS]



SVGEM0021D

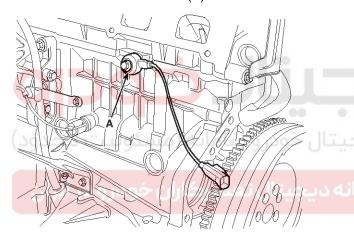
## **Engine Mechanical System**

13. Remove the oil level gauge tube (A).



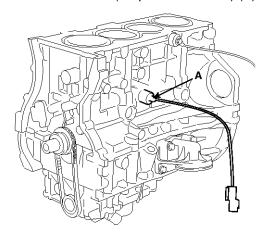
SXMM19108D

14. Remove the knock sensor (A).



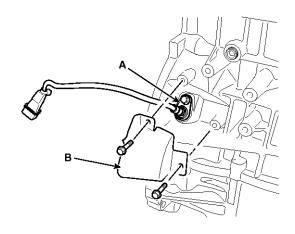
SSLM10145D

15. Remove the OPS (Oil pressure switch) (A).



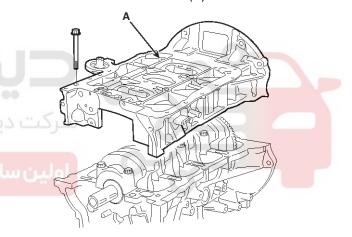
SXMM19109D

16. Remove the CKPS (Crankshaft position sensor) (A) after removing the cover (B).



SSLM10124D

17. Remove the ladder frame (A).



STGEM9037D

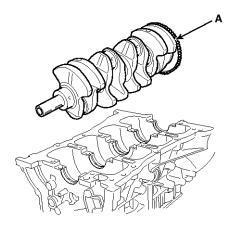
- 18. Check the connecting rod end play.
- 19. Remove the connecting rod caps and check oil clearance.
- 20. Remove piston and connecting rod assemblies.
  - 1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
  - 2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

#### MOTICE

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

**EMA-79** 

- 21.Remove crankshaft bearing cap and check oil clearance.
- 22. Check the crankshaft end play.
- 23. Lift the crankshaft (A) out of the engine, being careful not to damage journals.



KCRF172A

#### MOTICE

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

24. 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.

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

#### MOTICE

Arrange the piston rings in the correct order only.

26. Disconnect connecting rod from piston.

Remove the piston pin from the piston using a hydraulic press.

#### Inspection

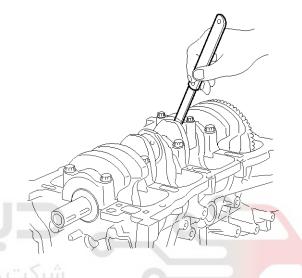
#### **Connecting Rod**

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

#### End play:

Standard:  $0.10 \sim 0.25 \text{mm} (0.0039 \sim 0.0098 \text{in.})$ 

Limit: 0.35mm (0.0138in.)



KCRF169B

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

#### **Tightening torque**

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

#### **MNOTICE**

Do not turn the crankshaft.

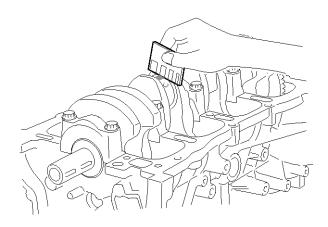
7) Remove 2 bolts, connecting rod cap and bearing half.

## **Engine Mechanical System**

8) Measure the plastigage at its widest point.

#### Standard oil clearance

 $0.031 \sim 0.045$ mm (0.00122  $\sim 0.00177$ in.)



KCRF169A

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

#### **CAUTION**

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

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

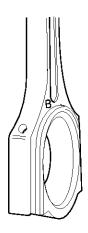
#### **MNOTICE**

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

#### **A**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 Identification Mark**

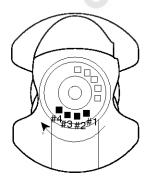


SNFEM8089L

#### **Connecting Rod Specifications**

Class	Mark	Inside Diameter		
а	А	51.000 ~ 51.006mm (2.00787 ~ 2.00811in.)		
b	В	51.006 ~ 51.012mm (2.00811 ~ 2.00834in.)		
شرکت	С	51.012 ~ 51.018mm (2.00834 ~ 2.00858in.)		

#### **Crankshaft Pin Identification Mark**



SNFEM8090L

#### **MNOTICE**

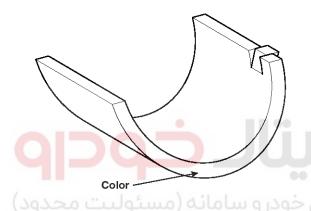
Conform to read stamping order as shown arrow direction from #1.

### **EMA-81**

#### **Crankshaft Specifications**

Class	Mark	Outside Diameter Of Pin		
I	1	47.966 ~ 47.972mm (1.88842 ~ 1.88866in.)		
II	2	47.960 ~ 47.966mm (1.88819 ~ 1.88842in.)		
III	3	47.954 ~ 47.960mm (1.88795 ~ 1.88819in.)		

# **Connecting Rod Bearing Identification Mark**



ECRF021A

#### **Connecting Rod Bearing Specifications**

Class	Mark	Thickness Of Bearing		
AA	Blue	$1.515 \sim 1.518$ mm (0.05965 $\sim$ 0.05976in.)		
А	Black	$1.512 \sim 1.515$ mm (0.05953 $\sim$ 0.05965in.)		
В	None	$1.509 \sim 1.512$ mm (0.05941 $\sim$ 0.05953in.)		
С	Green	1.506 ~ 1.509mm (0.05929 ~ 0.05941in.)		
D	Yellow	1.503 ~ 1.506mm (0.05917 ~ 0.05929in.)		

11) Select a connecting rod bearing using the selection chart.

#### **Selection Chart For Connecting Rod Bearings**

Crankshaft Indentif - ication Mark	Connecting Rod Identifica- tion Mark	Assembing CI- assification Of Bearing
	a (A)	D (Yellow)
I (1)	b (B)	C (Green)
	c (C)	B (None)
	a (A)	C (Green)
II (2)	b (B)	B (None)
	c (C)	A (Black)
	a (A)	B (None)
III (3)	b (B)	A (Black)
	c (C)	AA (Blue)

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

#### Allowable bend of connecting rod:

0.05mm (0.0020 in.) or less for 100mm (3.94 in.)

#### Allowable twist of connecting rod:

0.10mm (0.0039 in.) or less for 100mm (3.94 in.)

## **Engine Mechanical System**

#### Crankshaft

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

#### **Tightening torque**

14.7N.m (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°

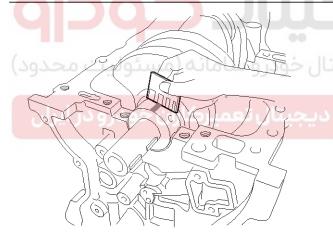
#### **MNOTICE**

Do not turn the crankshaft.

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

#### Standard oil clearance

0.020 ~ 0.038mm (0.00079 ~ 0.00150in.)



KCRF170A

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

#### CAUTION

Do not file, shim, or scrape the bearings or the caps to adjust clearance. 7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

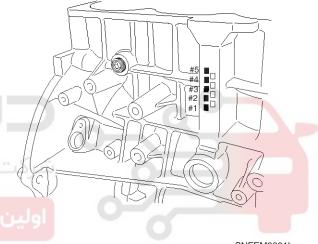
#### MOTICE

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

#### **ACAUTION**

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

#### **Crankshaft Bore Identification Mark**



SNFEM8091L

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

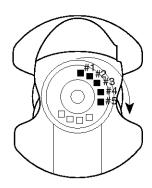
Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

#### **Cylinder Block Specifications**

Calss	Mark	Inside Diameter		
а	А	56.000 ~ 56.006mm (2.20472 ~ 2.20496in.)		
b	B 56.006 ~ 56.012mm (2.20496 ~ 2.20519in.)			
С	С	56.012 ~ 56.018mm (2.20519 ~ 2.20543in.)		

**EMA-83** 

#### **Crankshaft Journal Identification Mark**



SNFEM8092L

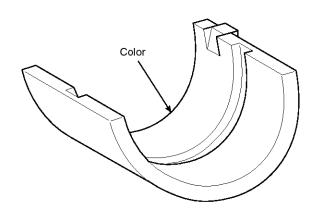
#### MOTICE

Conform to read stamping order as shown arrow direction from #1.

#### **Crankshaft Specifications**

Class	Mark	Outside Diameter Of Journal		
71	1	51.954 ~ 51.960mm (2.04543 ~ 2.04567in.)		
محدود)	ئولىت 2	51.948 ~ 51.954mm (2.04519 ~ 2.04543in.)		
. ایران	فودودا	51.942 ~ 51.948mm (2.04496 ~ 2.04519in.)		

#### **Crankshaft Bearing Identification Mark**



ECRF022A

#### **Crankshaft Bearing Specifications**

Class	Mark	Thickness Of Bearing		
AA	Blue	2.026 ~ 2.029mm (0.07976 ~ 0.07988in.)		
А	Black	2.023 ~ 2.026mm (0.07965 ~ 0.07976in.)		
В	None	2.020 ~ 2.023mm (0.07953 ~ 0.07965in.)		
С	Green	2.017 ~ 2.020mm (0.07941 ~ 0.7953in.)		
D	Yellow	2.014 ~ 2.017mm (0.07929 ~ 0.07941in.)		

8) Select a crankshaft bearing using the selection

#### **Selection Chart For Crankshaft Bearings**

Crankshaft Identifi- cation Mark	Crankshaft Bore Identific - ation Mark	Assembling Classification Of Bearing	
	a (A)	D (Yellow)	
I (1)	b (B)	C (Green)	
شرکت	c (C)	B (None)	
	a (A)	C (Green)	
II (2)	b (B)	B (None)	
	c (C)	A (Black)	
	a (A)	B (None)	
III (3)	b (B)	A (Black)	
	c (C)	AA (Blue)	

## **Engine Mechanical System**

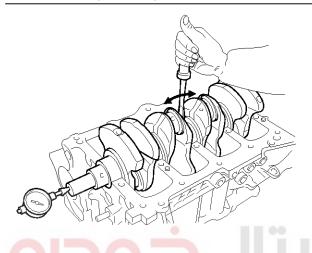
2. Check crankshaft end play.

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

#### **End play**

Standard :  $0.07 \sim 0.25$ mm ( $0.0028 \sim 0.0098$ in.)

Limit: 0.30mm (0.0118in.)



If the end play is greater than maximum, replace the

KCRF211A

thrust bearings as a set.

#### Thrust bearing thickness

1.925 ~ 1.965mm (0.07579 ~ 0.07736in.)

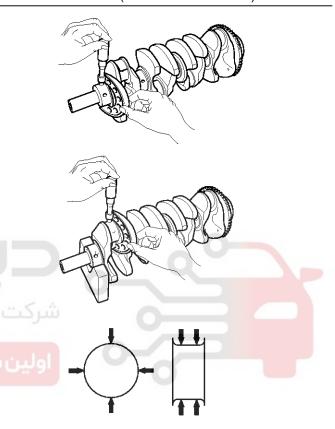
 Inspect main journals and crank pins.
 Using a micrometer, measure the diameter of each main journal and crank pin.

#### Main journal diameter :

51.942 ~ 51.960mm (2.04496 ~ 2.04567in.)

#### Crank pin diameter :

47.954 ~ 47.972mm (1.88795 ~ 1.88866in.)



SYFEM0124N

### **EMA-85**

#### Cylinder Block

1. Remove gasket material.

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

2. Clean cylinder block

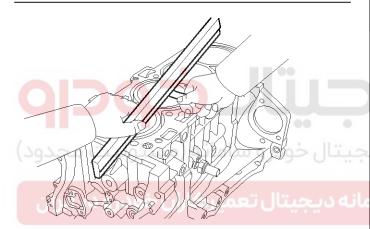
Using a soft brush and solvent, thoroughly clean the cylinder block.

3. Inspect top surface of cylinder block for flatness.

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

#### Flatness of cylinder block gasket surface

Standard: Less than 0.05mm (0.0019in.) for all Less than 0.02 (0.0007in.) for 100mm (3.9370in.) x 100mm (3.9370in.)



SYFEM0125N

4. Inspect cylinder bore diameter.

Visually check the cylinder for vertical scratchs.

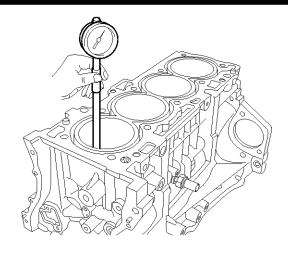
If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter.

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

#### Standard diameter

[2.0L] :  $86.00 \sim 86.03$ mm (3.3858  $\sim$  3.3870in.) [2.4L] :  $88.00 \sim 88.03$ mm (3.4645  $\sim$  3.4657in.)



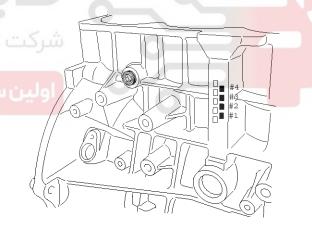
SYFEM0126N

#### **MNOTICE**

Measurement position points (from the bottom of the cylinder block)

: 110.7mm(4.3582in.)/160mm(6.2992in.)/210mm(8.2 677in.)

Check the cylinder bore size code on the cylinder block.



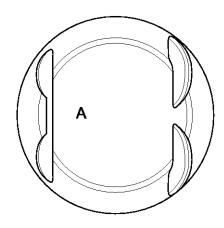
SNFEM8093L

#### **Cylinder Bore Inner Diameter**

Size Co- de	2.0L	2.4L
А	$86.00 \sim 86.01$ mm (3.3858 $\sim$ 3.3862in.)	88.00 ~ 88.01mm (3.4645~ 3.4649in.)
В	86.01 ~ 86.02mm (3.3862~ 3.3866in.)	88.01 ~ 88.02mm (3.4649~ 3.4653in.)
С	86.02 ~ 86.03mm (3.3866~ 3.3870in.)	88.02 ~ 88.03mm (3.4653~ 3.4657in.)

## **Engine Mechanical System**

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



ECKE320B

#### **MOTICE**

Stamp the grade mark of basic diameter with rubber stamp.

#### Piston Outer Diameter

Size Code	2.0L	2.4L
حدود)	85.975 ~ 85.985mm (3.3848~ 3.3852in.)	87.975 ~ 87.985mm (3.46358~ 3.46397in.)
В	85.985 ~85.995mm (3.3852~ 3.3856in.)	87.985 ~ 87.995mm (3.46397~ 3.46436in.)
С	85.995 ~ 86.005mm (3.3856~ 3.3860in.)	87.995 ~88.005mm (3.46436~ 3.46476in.)

8. Select the piston related to cylinder bore class.

**Clearance :**  $0.015 \sim 0.035$ mm  $(0.00059 \sim 0.00138$ in.)

#### **Piston And Rings**

- 1. Clean 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.

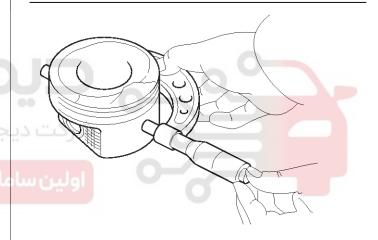
#### **MNOTICE**

Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 17mm (0.67in.) from the top land of the piston.

#### Standard diameter

[2.0] : 85.975  $\sim$  86.005mm (3.38484  $\sim$  3.38602in.) [2.4] : 87.975  $\sim$  88.005mm (3.46358  $\sim$  3.46476in.)



KCRF215A

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

#### Piston-to-cylinder clearance

 $0.015 \sim 0.035$ mm ( $0.00059 \sim 0.00138$ in.)

**EMA-87** 

4. Inspect the piston ring side clearance.

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

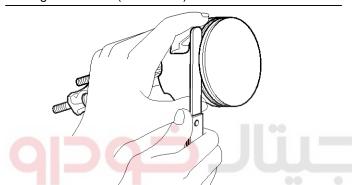
#### Piston ring side clearance

Standard

No.1 : 0.050  $\sim$  0.080mm (0.00197  $\sim$  0.00315in.) No.2 : 0.040  $\sim$  0.080mm (0.00157  $\sim$  0.00315in.) Oil ring : 0.060  $\sim$  0.125mm (0.00236  $\sim$  0.00492in.)

Limit

No.1: 0.100mm (0.00394in.) No.2: 0.100mm (0.00394in.) Oil ring: 0.200mm (0.00787in.)



ولین سا بانه د KCRF216A تعمیرکاران خودرو در ایران

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

5. Inspect piston ring end gap.

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

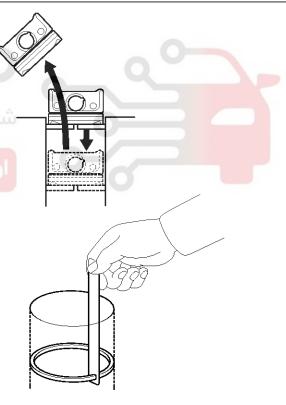
#### Piston ring end gap

Standard

No.1 : 0.15  $\sim$  0.30mm (0.0059  $\sim$  0.0118in.) No.2 : 0.37  $\sim$  0.52m (0.0145  $\sim$  0.0204in.) Oil ring : 0.20  $\sim$  0.70mm (0.0079  $\sim$  0.0275in.)

Limit

No.1: 0.60mm (0.0236in.) No.2: 0.70mm (0.0275in.) Oil ring: 0.80mm (0.0315in.)



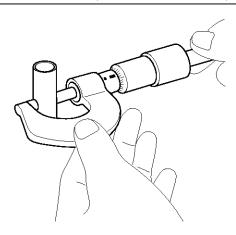
KCRF217A

#### **Piston Pins**

1. Measure the diameter of the piston pin.

#### Piston pin diameter

21.001 ~ 21.006mm (0.82681 ~ 0.82701in.)



KCRF218A

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

#### Piston pin-to-piston clearance

0.013 ~ 0.023m (0.00051 ~ 0.00091in.)

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

Piston pin-to-connecting rod interference  $0.016 \sim 0.032 \text{mm} (0.00063 \sim 0.00126 \text{in.})$ 

### **Engine Mechanical System**

#### Reassembly

#### MOTICE

- Thoroughly clean all parts to assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.
- 1. Assemble the piston and connecting rod.
  - Before pressing the piston pin, apply a coat of lubricant oil to the piston pin outer and connecting rod.

#### CAUTION

- Take care that piston pin is not to be damaged during pressing process.
- When replace the piston pin, check the piston pin outer diameter and connecting rod small end inner diameter as below.

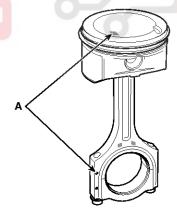
#### Piston pin outer diameter:

21.001 ~ 21.006mm (0.82681 ~ 0.82701in)

#### Connecting rod small end inner diameter:

20.974 ~ 20.985mm (0.82575 ~ 0.82618in)

 The piston front mark and the connecting rod front mark (A) must face the timing chain side of the engine.



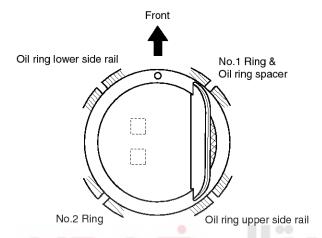
KCRF168A

3) Use a hydraulic press for installation.

**Pressing load :**  $250 \sim 1250 \text{kg} (551.2 \sim 2755.7 \text{lb})$ 

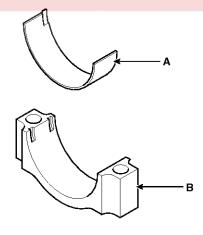
**EMA-89** 

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



SVGM11120L

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



KCRF118B

#### **CAUTION**

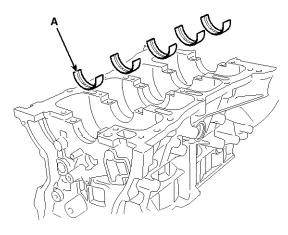
Be careful not to change the position of bearing caps.

4. Install the main bearings.

#### MOTICE

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

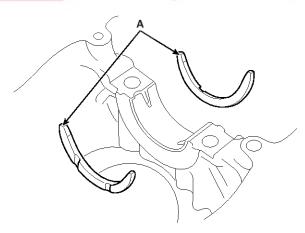
1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).



KCRF173A

- Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.
- 5. Install the thrust bearings.

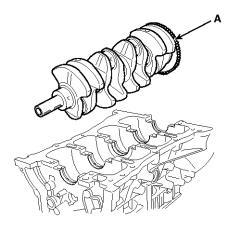
Install the 2 thrust bearings(A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



KCRF222A

## **Engine Mechanical System**

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



KCRF172A

- 7. Place the main bearing caps on cylinder block.
- 8. Install the main bearing cap bolts.

#### **A**CAUTION

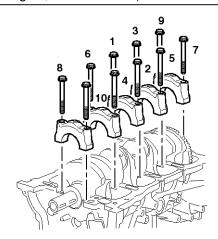
Always use new main bearing cap bolts.

#### MOTICE

- The main bearing cap bolts are tightened in 3 progressive steps.
- If any of the bearing cap bolts in broken or deformed, replace it.
  - Apply a light coat of engine oil on the threads and under the bearing cap bolts.
  - 2) Using the SST (09221-4A000), install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

#### **Tightening torque**

14.7N.m (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°



KCRF171A

Check that the crankshaft turns smoothly.

9. Check crankshaft end play.

10. Install piston and connecting rod assemblies.

#### MOTICE

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

- Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
- 2) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- 3) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
- 4) Apply engine oil to the bolt threads. Using the SST (09221-4A000), install the rod caps with bearings, and torque the bolts.

#### **Tightening torque**

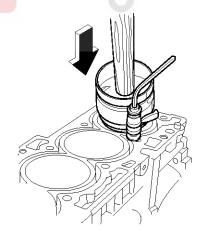
17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

#### **CAUTION**

Always use new connecting rod cap bolts.

#### MOTICE

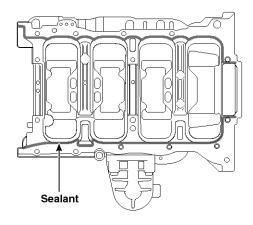
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



SYFEM0131N

**EMA-91** 

11. Apply liquid gasket to the mating surface of cylinder block and ladder frame.



SYFEM0132N

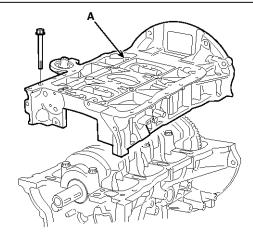
#### MOTICE

- When assembling ladder frame, the liquid sealant Loctite 5900H, Threebond 1217H or equivalent should be applied ladder frame.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.
- 12.Install ladder frame (A) with 10 bolts, in several passes, in sequence shown.

#### **Tightening torque**

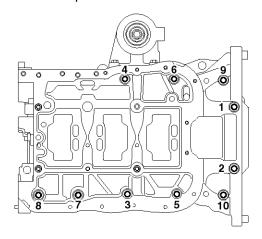
Step 1 : 8.8  $\sim$  9.8N.m (0.9  $\sim$  1.0kgf.m, 6.5  $\sim$  7.2lb-ft) Step 2 : 17.7  $\sim$ 20.6N.m (1.8  $\sim$  2.1kgf.m, 13.0  $\sim$ 

Step 3 : 27.5  $\sim$  31.4N.m (2.8  $\sim$  3.2kgf.m, 20.3  $\sim$  23.1lb-ft)



STGEM9037D

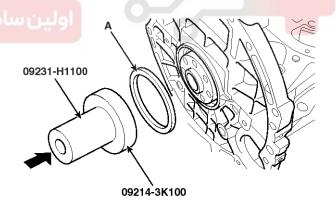
- 1) Tighten the bolts in order number as shown with the 3 steps.
- 2) Loosen the bolts as reverse tightening order.
- 3) Tighten the bolts in order number as shown with the 3 steps.



SVGEM0018D

13. Install rear oil seal.

- 1) Apply engine oil to a new oil seal lip.
- 2) Using SST(09231-H1100, 09214-3K100) and a hammer, tap in the oil seal (A) until its surface is flush with the rear oil seal retainer edge.



SSLM10118D

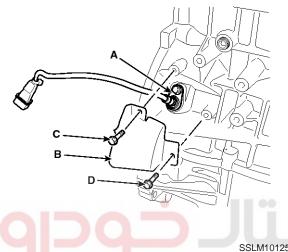
## **Engine Mechanical System**

14. Install CKPS (Crankshaft position sensor) (A) and sensor cover (B).

#### **Tightening torque**

CKPS (A):  $9.8 \sim 11.8 \text{N.m} \ (1.0 \sim 1.2 \text{kgf.m}, 7.2 \sim 8.7 \text{lb-ft})$ M6 Bolt (C): 9.8  $\sim$  11.8N.m (1.0  $\sim$  1.2kgf.m, 7.2  $\sim$ 

M8 Bolt (D): 18.6  $\sim$  23.5N.m (1.9  $\sim$  2.4kgf.m, 13.7  $\sim$ 17.4lb-ft)



SSLM10125D

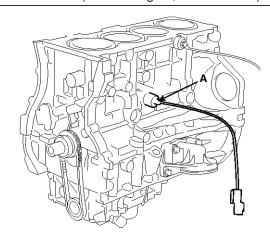
15. Install OPS (Oil pressure switch).

1) Apply adhesive to 2 or 3 threads. Adhesive: MS 721-39(B) or equivalent.

2) Install the oil pressure switch (A).

#### **Tightening torque**

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

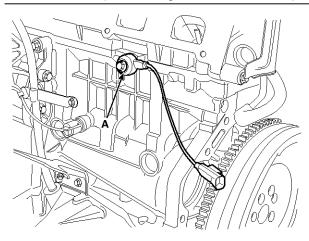


SXMM19109D

16. Install knock sensor (A).

#### **Tightening torque**

 $18.6 \sim 23.5$ N.m ( $1.9 \sim 2.4$ kgf.m,  $13.7 \sim 17.4$ lb-ft)



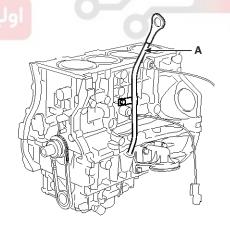
SSLM10145D

17. Install oil level gauge assembly.

- 1) Install a new O-ring on the oil level gauge.
- 2) Apply engine oil on the O-ring.
- 3) Install the oil level gauge assembly (A) with the bolt.

#### **Tightening torque**

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



SXMM19108D

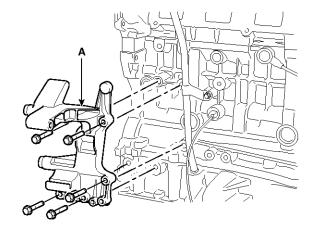
**EMA-93** 

18. Install tensioner assembly integrated bracket (A).

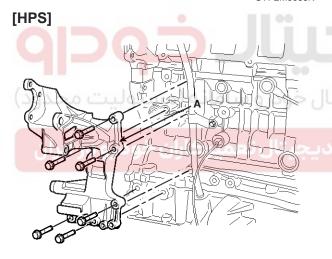
#### **Tightening torque**

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

#### [MDPS]



SYFEM0083N



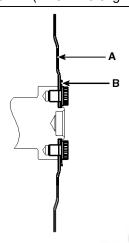
SVGEM0021D

- 19.Install the power steering oil pump. (Refer to ST group)
- 20.Install the water pump. (Refer to Cooling system in this group)
- 21. Install the alternator. (Refer to EE group)
- 22.Install the balance shaft & oil pump assembly. (Refer to Lubrication system in this group)
- 23. Install the cylinder head assembly. (Refer to Cylinder head in this group)
- 24.Install the timing chain. (Refer to Timing system in this group)

- 25. Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
- 26. Remove the engine from the engine stand.
- 27.AT: Install the drive plate (A) and the adapter plate (B).

#### Tightening torque:

117.7 ~ 127.5N.m (12.0 ~ 13.0kgf.m, 86.8 ~ 93.9lb-ft)



KCRF224A

MT : Install the flywheel.

#### MOTICE

- Always use new drive plate (or flywheel) bolts.
- Apply sealant to the screw part (10mm (0.39in) from the end of the bolt) when reusing the drive plate (or flywheel) bolts.

Sealant: Three bond 2403, Loctite 200 or 204

- Install and uniformly tighten the 7 bolts, in several passes.
- 28. Install the engine assembly on the vehicle. (Refer to Engine and transaxle assembly in this group)

Add all fluids to their normal operating levels.

## **Engine Mechanical System**

### **Cooling System**

#### Coolant

#### **Refilling And Bleeding**

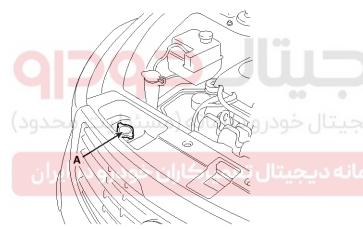
#### **WARNING**

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

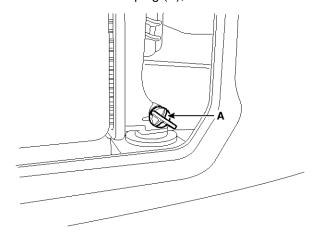
When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

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



SSLM10126D

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



SSLM10010D

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

#### MOTICE

To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.

- 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.
- 8. Wait until the engine is cool.
- 9. Repeat steps 1 to 8 until the drained water runs clear.
- 10. 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.

#### MOTICE

- 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.

## **Cooling System**

**EMA-95** 

- 11. Start the engine and run until coolant circulates.
  When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
- 12. Repeat 11 until the cooling fan 3  $\sim$  5 times and bleed air sufficiently out of the cooling system.
- 13.Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.
- 14. Run the vehicle under idle until the cooling fan operates 2  $\sim$  3 times.
- 15. Stop the engine and wait coolant gets cool.
- 16. Repeat 10 to 15 until the coolant level doesn't fall any more, bleed air out of the cooling system.

#### **MOTICE**

It takes time to bleed out all the air in the cooling system. Refill coolant when coolant gets cool completely, when recheck the coolant level in the reservoir tank for 2~3 days after replacing coolant.

#### **Coolant capacity:**

2.0L: 6.7~6.8L (1.77~1.80 U.S.gal., 7.08~7.19 U.S.qt.,

5.90~5.98 lmp.qt.)

2.4L: 6.8~7.0L (1.80~1.85 U.S.gal., 7.19~7.40 U.S.qt.,

5.98~6.16 lmp.qt.)

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

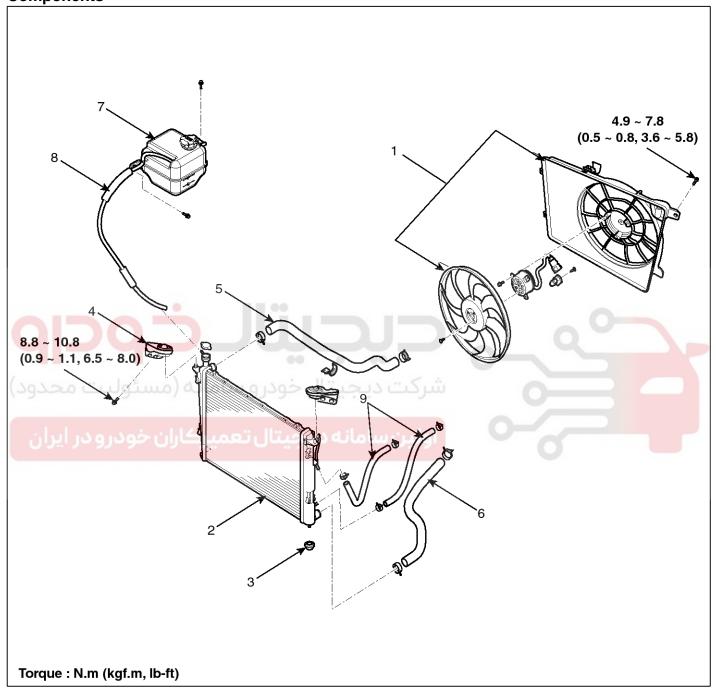
اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



# **Engine Mechanical System**

#### **Radiator**

Components



SSLM10038N

- 1. Cooling fan assembly
- 2. Radiator assembly
- 3. Mounting insulator
- 4. Radiator mounting bracket
- 5. Radiator upper hose

- 6. Radiator lower hose
- 7. Reservoir tank
- 8. Over flow hose
- 9. ATF cooler hose

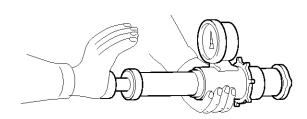
## **Cooling System**

**EMA-97** 

#### Inspection

#### **Radiator Cap Testing**

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



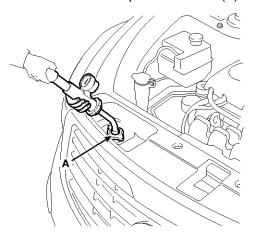
ECKD501X

- 2. Apply a pressure of 93.16  $\sim$  122.58kPa (0.95  $\sim$  1.25kgf/cm<sup>2</sup>, 13.51  $\sim$  17.78psi).
- 3. Check for a drop in pressure.
- 4. If the pressure drops, replace the cap.

انه دیجیتال تعمیرکاران خودرو در ایران

#### **Radiator Leakage Test**

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 (A).



SSLM10135D

- 2. Apply a pressure tester to the radiator and apply a pressure of 93.16  $\sim$  122.58kPa (0.95  $\sim$  1.25kgf/cm², 13.51  $\sim$  17.78psi).
- 3. Inspect for engine coolant leaks and a drop in pressure.
- 4. Remove the tester and reinstall the radiator cap.

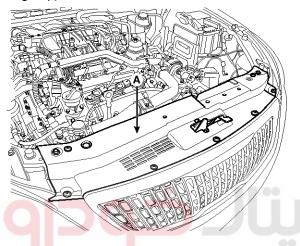
#### MOTICE

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

## **Engine Mechanical System**

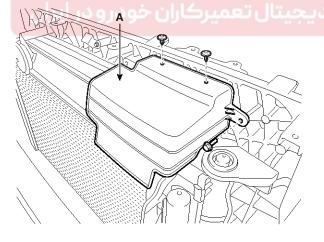
#### **Removal and Installation**

- 1. Disconnect the battery terminals. (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 guard. (Refer to BD group)



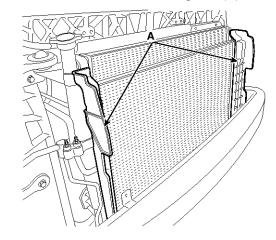
SVGM20010D

- 5. Remove the horn bracket. (Refer to BE group)
- 6. Remove the radiator upper cover (A).



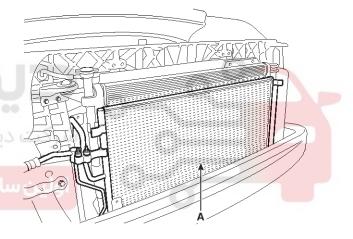
SSLM10025D

7. Remove the radiator front air guard (A).



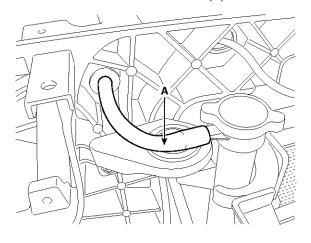
SSLM10026D

8. Seperate the condenser (A) from the radiator.



SSLM10027

9. Disconnect the over flow hose (A) from the radiator.



SSLM10028D

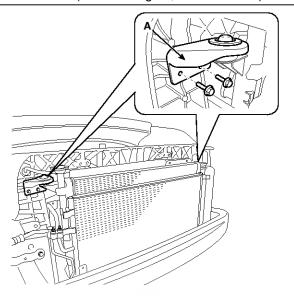
# **Cooling System**

**EMA-99** 

10. Remove the radiator mounting bracket assembly (A).

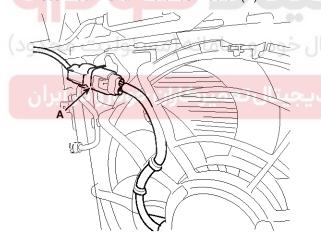
#### Tightening torque:

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



SSLM10029D

11. Disconnect the fan motor connector (A).

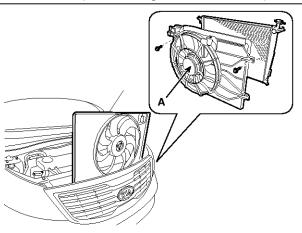


SLMM10034D

12. Remove the cooling fan assembly (A).

#### Tightening torque:

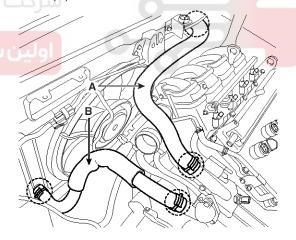
 $4.9 \sim 7.8 \text{ N.m} (0.5 \sim 0.8 \text{ kgf.m}, 3.6 \sim 5.8 \text{ lb-ft})$ 



SSLM10030D

- 13. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
- 14. Loosen the drain plug, and drain the engine coolant.

  Remove the radiator cap to drain with speed.
- 15. Disconnect the radiator upper hose (A) and lower hose (B).

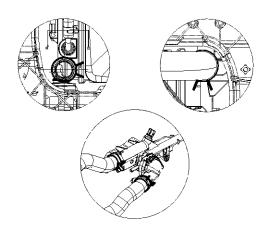


SSLM10011D

## **Engine Mechanical System**

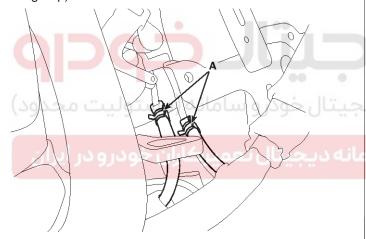
#### **MNOTICE**

Install the radiator hoses as shown illustrations.



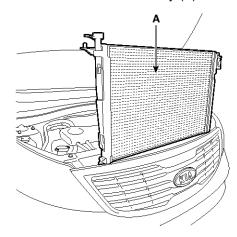
SSLM10102N

16. Disconnect the ATF cooler hoses. (Refer to AT group)



SSLM10136D

17. Remove the radiator assembly (A).



SSLM10031D

- 18. Installation is the reverse order of removal.
- 19. Fill the radiator with coolant and check for leaks.

#### **MNOTICE**

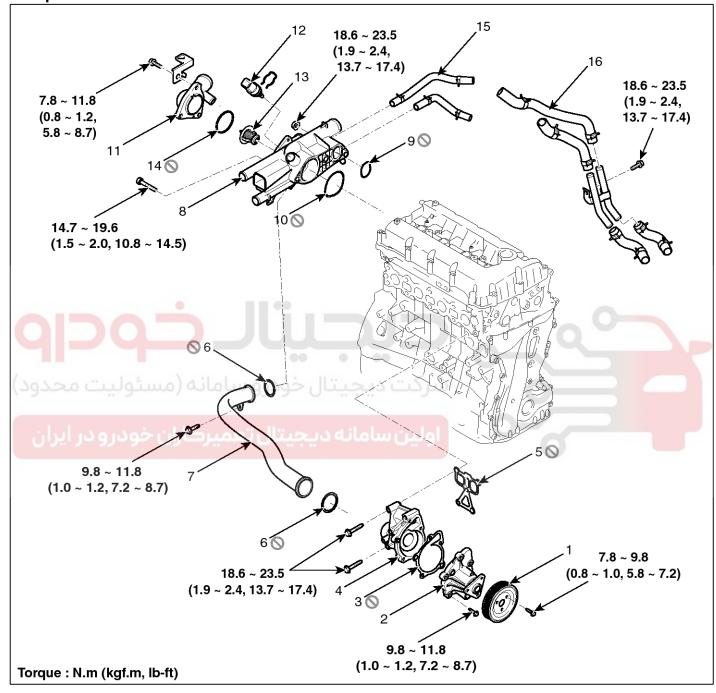
- Bleed air from the cooling system.
  - Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)
  - Turn off engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.
  - Put the radiator cap on tightly, then run engine again and check for leaks.

## **Cooling System**

**EMA-101** 

### Water pump

### Components



SSLM10146N

- 1. Water pump pulley
- ter pump housing)
- 3. Water pump housing gasket
- 4. Water pump cover
- 5. Water pump gasket
- 6. Water inlet pipe gasket (O-ring)
- 7. Water inlet pipe
- 2. Water pump sub assembly (Wa- 8. Water temperature control assembly
  - 9. Water temperature control assembly g- 14. Thermostat gasket asket A
  - 10. Water temperature control assembly pped) gasket B
  - 11. Water inlet fitting

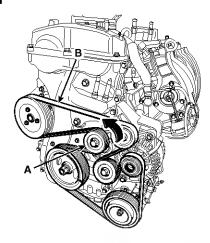
- 12. Engine coolant temperature sensor
- 13. Thermostat
- 15. Throttle body coolant hose (if equi-
- 16. Oil cooler coolant hose (2.4L only)

## **Engine Mechanical System**

#### **Removal and Installation**

- 1. Loosen the drain plug, and then drain the engine coolant. Remove the radiator cap to drain with speed.
- 2. Remove the drive belt (B) after turning the drive belt tensioner (A) counterclockwise.

#### [MDPS]



[HPS]

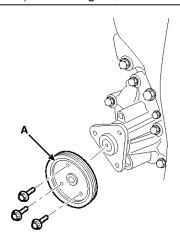


SVGEM0153D

3. Remove the water pump pulley (A).

#### Tightening torque:

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

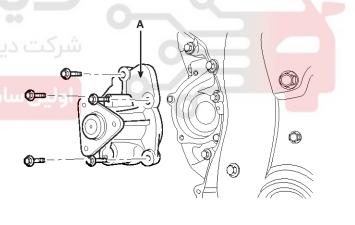


SYFEM0164N

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

#### **Tightening torque:**

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



SYFEM0064N

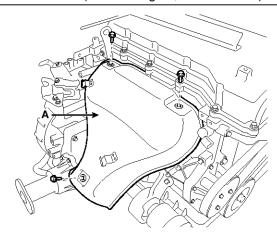
## **Cooling System**

**EMA-103** 

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

#### Tightening torque:

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



SSLM10032D

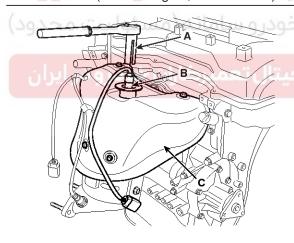
#### **Tightening torque**

Oxygen sensor:

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

Heat protector bolts:

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

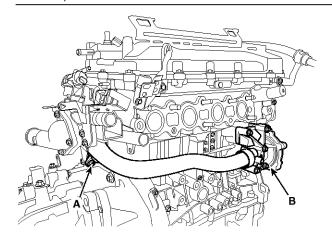


SYFEM0085N

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

#### Tightening torque:

Bolt (A) : 9.8  $\sim$  11.8N.m (1.0  $\sim$  1.2kgf.m, 7.2  $\sim$  8.7lb-ft) Bolts (B) : 18.6  $\sim$  23.5N.m (1.9  $\sim$  2.4kgf.m, 13.7  $\sim$  17.4lb-ft)



SVGEM0174D

- 7. Installation is reverse order of removal with a new water pump gasket.
- 8. Fill the engine coolant.
- 9. Start the engine and check for leaks.
- 10. Recheck the coolant level.

#### Inspection

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

#### **MNOTICE**

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

# **Engine Mechanical System**

### Troubleshooting

**Water Pump** 

Sy	mptoms	Possibl	e Causes	Remedy
Coolant leakage	From the bleed hole of the water pu-	Visually check	Check leaks after about ten-minute	If coolant still leaks, replace a water pump.
	тр		warming up.	If leakage stops, reuse the water pump (Do not replace the pump with a new one).
	From gaskets or bolts		Check the tightening of the water pump mounting bolts.	Retighten the mounting bolts.
			Check damage of gaskets or inflow of dust.	
	From outer surface of water pump		Check the material or any cracks of th- e water pump.	Poor material. If any cra- ck found, replace the wa- ter pump.
Noise	<ul><li>From bearings</li><li>From mechanical seals</li></ul>	Inspection with a stet- hoscope	engine, check nois- e with a stethosco-	If there is no noise, reuse the water pump (do not replace it).
یت محدود)	Impeller interferen- ce	ت دیجیتال خودر رسامانه دیجیتال		If there is any noise from the water pump, remove the drive belt and recheck.
		Inspection after removing a drive belt	<ul> <li>After removing a water pump and a drive belt, check</li> </ul>	If there is noise, reuse the water pump. Check other drive line parts.
			noise again.	If there is no noise, replace the water pump with a new one.
		Inspection after removing a water pump	After removing a water pump and a drive belt, check noise again.	If there is any interference between them, replace the water pump with a new one.
Overheating	Damaged 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.

## **Cooling System**

**EMA-105** 

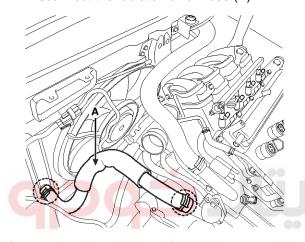
#### **Thermostat**

#### Removal and Installation

#### MOTICE

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

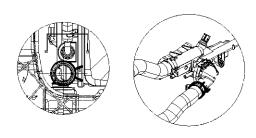
- 1. Drain engine coolant so its level is below thermostat.
- 2. Disconnect the radiator lower hose (A).



SSI M10127D

#### MOTICE

Install the radiator hoses as shown illustrations.

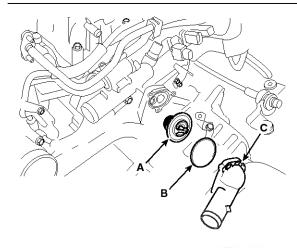


SSLM10128N

3. Remove water inlet fitting (C), gasket (B) and thermostat (A).

#### Tightening torque:

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



SXMM19026D

4. Installation is reverse order of removal.

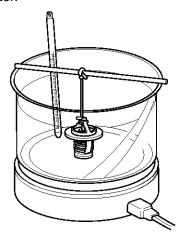
#### **A**CAUTION

- Install the thermostat with the jiggle valve upward.
- When assembling the thermostat, place the thermostat on the housing with a protrusion of thermostat matching with a groove of the housing and install the gasket and inlet fitting. Be careful the thermostat doesn't get out of the groove on the housing.
- 5. Fill the engine coolant.
- 6. Start the engine and check for leaks.
- 7. Recheck the coolant level.

## **Engine Mechanical System**

#### Inspection

1. Immerse the thermostat in water and gradually heat



KCRF226A

2. Check the valve opening temperature.

Valve opening temperature: 82  $\pm$  1.5°C (179.6  $\pm$ 34.7°F)

Full opening temperature: 95°C (203°F)

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

3. Check the valve lift.

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

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



# **Cooling System**

**EMA-107** 

### **Troubleshooting**

Symptoms		Possible Causes		Remedy	
Coolant leakage	From the therm- ostat 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 re- use the thermostat.	
Cooled excessively	ormance (cool air blows-out)	Visually check after removing the radiator cap.		After refilling coolant, re- check.	
	Thermogauge indicates 'LOW'	GDS check & Starting engine	<ul> <li>Check DTCs</li> <li>Check the fan motor performance as temperature varies.</li> <li>Check connection of the fan clutch or the fan motor.</li> <li>If the fan clutch is always connected, there will be a noise at idle.</li> </ul>	Check the fan motor, the	
<b>صحود)</b>	سامانه (مسئول	Remove the thermostat and inspect	<ul> <li>Check if there are dusts or chips in the thermostat valve.</li> <li>Check adherence of the thermostat.</li> </ul>	ve and reuse the thermo- stat.	

# **Engine Mechanical System**

Symptoms	Poss	sible Causes	Remedy
Heated excessively  • Engine overheated • Thermogauge indicates 'HI'	Visually check after removing the radiator cap.		· · · · · · · · · · · · · · · · · · ·
	GDS check & Starting engine	<ul> <li>Check DTCs</li> <li>Check the fan motor performance as temperature varies.</li> <li>Check if the fan clutch slips.</li> <li>Check the water pump adherence or impeller damaged.</li> </ul>	nnectors.  Check the fan motor, the relay and the connector. Replace the fan clutch, if it doesn't work properly.
سامانه (مسئولیت محدود)	Immerse the thermostat in boiling water and inspection.	3	if it doesn't work properly

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### **Lubrication System**

**EMA-109** 

### **Lubrication System**

#### **Engine Oil**

#### Oil And Filter Replacement

#### **ACAUTION**

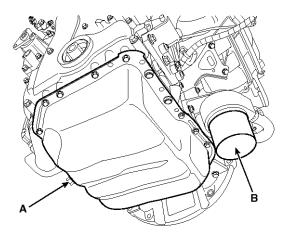
- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length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

Start the engine and let it warm up.

- 2. Drain engine oil.
  - 1) Remove the oil filler cap.
  - 2) After lifting the car, remove the oil drain plug (A) and drain oil into a container.
- 3. Replace the oil filter (B).
  - 1) Remove the oil filter.
  - 2) Check and clean the oil filter installation surface.
  - 3) Check the part number of the new oil filter is as same as old one.
  - 4) Apply clean engine oil to the gasket of a new oil filter.
  - 5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
  - 6) Tighten it with the torque below.

#### Tightening torque:

11.8 ~ 15.7N.m (1.2 ~ 1.6kgf.m, 8.7 ~ 11.6lb-ft)



SVGEM0178D

4. Install the oil drain plug with a new gasket.

#### Tightening torque:

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

Fill with new engine oil, after removing the engine oil level gauge.

#### Capacity:

2.0L

Total: 4.7 L (1.24 U.S.gal., 4.97 U.S.qt., 4.13 lmp.qt.)

Oil pan: 3.8 L (1.00 U.S.gal., 4.01 U.S.qt., 3.34 Imp.qt.) Drain and refill including oil filter:

4.1 L (1.08 U.S.gal., 4.33 U.S.qt., 3.61 Imp.qt.)

2.4L

Total: 5.5 L (1.43 U.S.gal., 5.71 U.S.qt., 4.75 lmp.qt.)

Oil pan: 4.2 L (1.11 U.S.gal., 4.44 U.S.qt., 3.70 Imp.qt.) Drain and refill including oil filter:

4.6 L (1.21 U.S.gal., 4.86 U.S.qt., 4.05 Imp.qt.)

- 6. Install the oil filler cap.
- 7. Start engine and check for oil leaks and check the oil gauge or light for an indication of oil pressure.
- 8. Recheck the engine oil level.

# **Engine Mechanical System**

## 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 engine warm up stop the engine wait 5 minutes then check the oil level.

Oil level should be befween the "L" and "F" marks on the dipstick.

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

## **MNOTICE**

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

# جینال خودرو سامانه (مسئولیت محدود)

# نه دیجیتال تعمیرکاران خودرو در ایران

## **Selection Of Engine Oil**

#### Recommendation

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

- For Europe: 5W-30/ACEA A5

Supplier	Product
SK	ZIC LD5W-30
Chevron	KIXX G1 LL
Total	QUARTZ HKS G-310
	QUARTZ INEO MC3 5W-30
Shell	HELIX ULTRA AH-E 5W-30 HELIX ULTRA 5W-40
Fuchs	TITAN SUPERSYN LONG LIFE 5W-30/40

- For Middle East: 5W-30/ACEA A5

For General: 5W-20/GF4&SM

#### Classification

- For Europe: ACEA A3, A5

For Middle East: ACEA A5

API SL, SM or above

ILSAC GF4 or above

- For General: API SL, SM or above

ILSAC GF4 or above

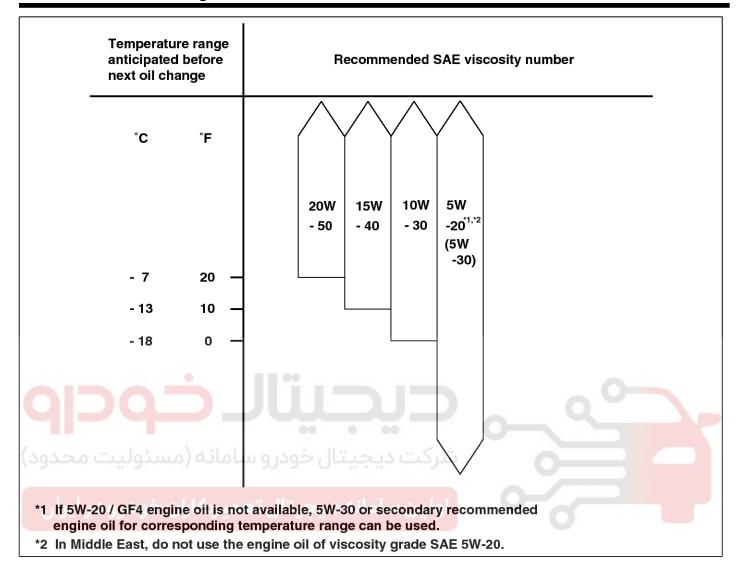
#### **SAE viscosity grade**

For Europe: 5W-30, 5W-40

- For Middle East and General: Refer to the

recommended SAE viscosity number

**EMA-111** 



SAMM29103L

## MOTICE

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

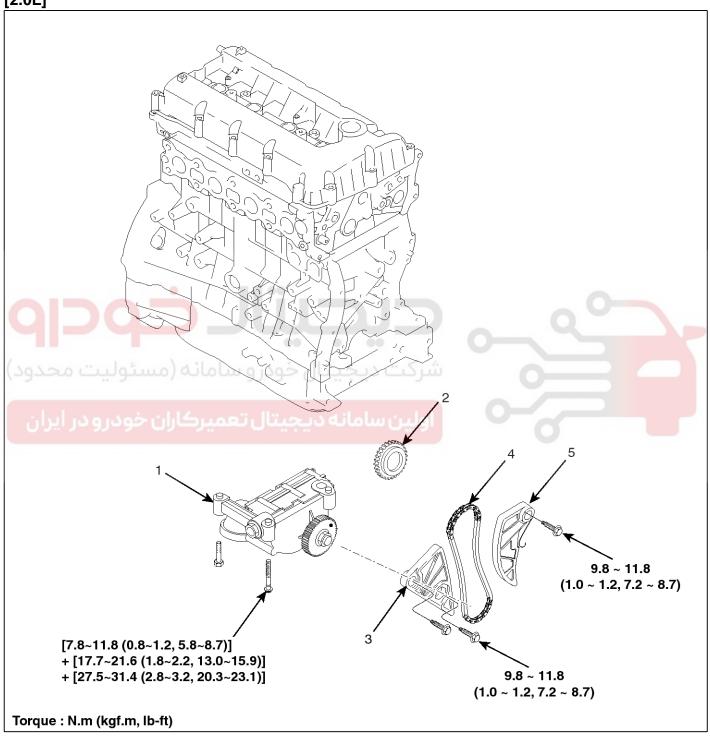
- 1. Satisfy the requirement of the ACEA, API or ILSAC classification.
- 2. Have proper SAE grade number for expected ambient temperature range.
- Lubricants that do not have both an SAE grade number and ACEA, API or ILSAC service classification on the container should not be used.

# **Engine Mechanical System**

## **Balance Shaft & Oil Pump**

## Components

[2.0L]

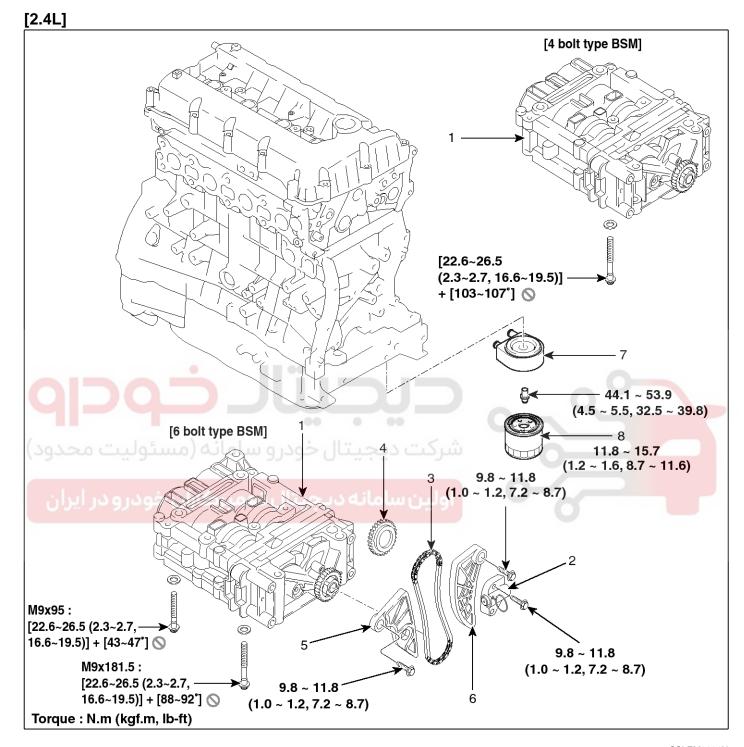


SLMM10009N

- 1. Oil pump
- 2. Oil pump chain sprocket
- 3. Oil pump chain guide

- 4. Oil pump chain
- 5. Oil pump chain mechanical tensioner

## **EMA-113**



SSLEM0004N

- 1. Balance shaft & oil pump assembly
- 2. Balance shaft chain tensioner
- 3. Balance shaft chain
- 4. Balance shaft chain sprocket

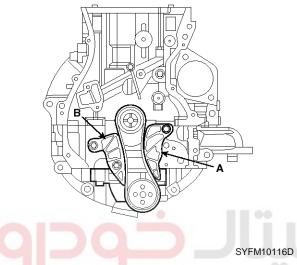
- 5. Balance shaft chain guide
- 6. Balance shaft chain tensioner arm
- 7. Oil cooler
- 8. Oil filter

# **Engine Mechanical System**

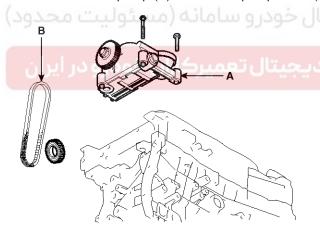
## Removal

## [2.0L]

- Remove the timing chain.
   (Refer to timing system in this group)
- 2. Remove the oil pump chain mechanical tensioner (A).
- 3. Remove the oil pump chain guide (B).



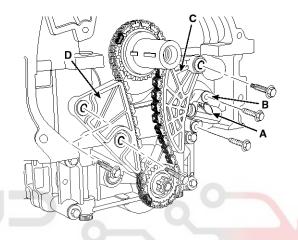
4. Remove the oil pump (A) with the oil pump chain (B).



SYFM10115D

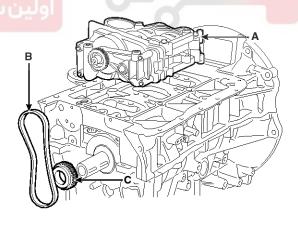
## [2.4L]

- 1. Remove the timing chain. (Refer to Timing system in this group)
- 2. Install a stopper pin (A) after compressing the balance shaft chain tensioner.
- Remove the balance shaft chain hydraulic tensioner (B).
- 4. Remove the balance shaft chain tensioner arm (C).
- 5. Remove the balance shaft chain guide (D).



SVGEM0176D

Remove the balance shaft & oil pump module (A) with the chain (B) and sprocket (C).



SSLM10156N



Do not disassemble the balance shaft & oil pump module.

## **EMA-115**

# Installation [2.0L]

- The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
- Assemble the crankshaft sprocket on the crankshaft as the front mark on the crankshaft sprocket to be outward.
- 3. Tighten the oil pump tensioner (A) bolt after placing the tensioner spring on the dowel pin located in ladder frame, and then insert stopper pin (B) to fix the tensioner.

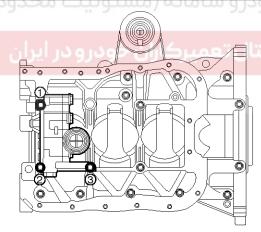
#### Tightening torque:

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

- 4. Assemble the oil pump chain on the crankshaft sprocket.
- 5. Assemble the oil pump assembly (C) on the ladder frame as placing oil pump sprocket in to oil pump.

#### Tightening torque:

7.8~11.8N.m (0.8~1.2kgf.m, 5.8~8.7lb.ft) + 17.7~21.6N.m (1.8~2.2kgf.m, 13.0~15.9lb.ft) + 27.5~31.4N.m (2.8~3.2kgf.m, 20.3~23.1lb.ft)



SMGEM8011D

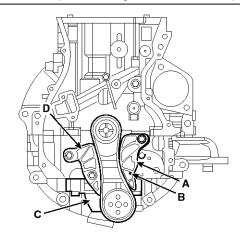
#### Bolting order

- a. Assemble the bolts in order number as shown with seating torque 26.5 N.m (2.7kgf.m, 19.5 lb-ft)
- b. Unfasten the bolts as reverse bolting order. (3-2-1)
- c. Assemble the bolts as specified bolting order in same increments as follows.

6. Install the oil pump chain guide (D) then remove the stopper pin.

#### Tightening torque:

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

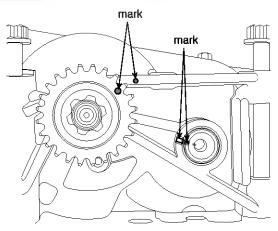


SSLM10119D

## [2.4L]

- The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
- Confirm the balance shaft & oil pump module timing mark.

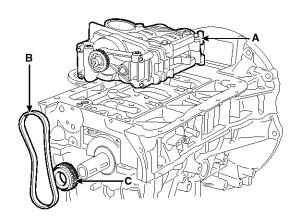
Timing marks to be visually aligned with centers of adjacent cast timing notches.



SNFEM8095L

# **Engine Mechanical System**

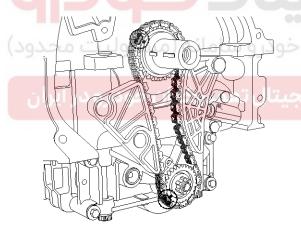
3. Install balance shaft & oil pump module (A) with the chain (B) and sprocket (C).



SSLM10156N

#### MOTICE

The timing marks of balance shaft & oil pump module sprocket and crankshaft sprocket should be matched with the timing marks (color link) of balance shaft chain.



SVGEM0177D

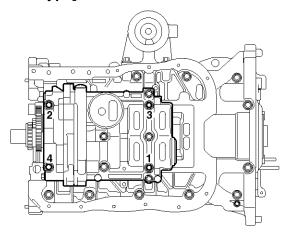
## Tightening order

- Tighten the bolts in order number as shown with seating torque 26.5 N.m (2.7kgf.m, 19.5 lb-ft) and then loosen the bolts as reverse tightening order (4-3-2-1).
- Using the SST (09221-4A000), tighten the bolts as specified tightening order in same increments as follows.

## Tightening torque:

22.6~26.5N.m (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 103~107°

## [4 bolt type]



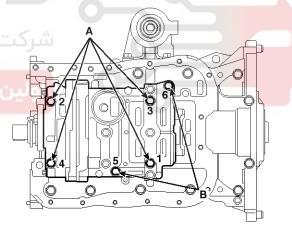
STGEM9042D

## Tightening torque:

Bolts (A) (M9x181.5) : 22.6~26.5N.m (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 88~92°

Bolts (B) (M9x95) : 22.6~26.5N.m (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 43~47°

## [6 bolt type]



SSLEM0001N

**EMA-117** 

4. Install the balance shaft chain guide (D).

## Tightening torque:

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

5. Install the balance shaft chain tensioner arm (C).

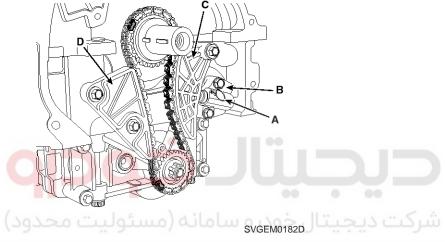
## **Tightening torque:**

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

6. Install the balance shaft chain hydraulic tensioner (B) then remove the stopper pin (A).

## Tightening torque:

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



- 7. Confirm the timing marks.
- 8. Install the timing chain. (Refer to Timing system in this group)

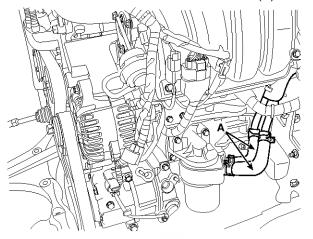


# **Engine Mechanical System**

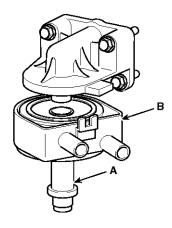
## Oil Cooler

## Removal

- 1. Loosen the drain plug, and drain the coolant. Remove the radiator cap to speed draining.
- 2. Disconnect the oil cooler coolant hoses (A).

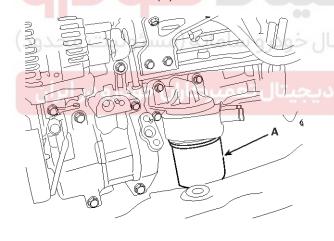


4. Loosen the mounting bolt (A) and remove the oil cooler assembly (B).



SXMM19017D





SXMM19031D

SYFEM0163N



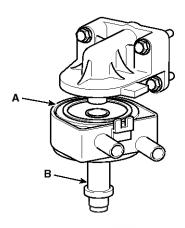
## **EMA-119**

## Installation

 Apply a light coat of engine oil to the oil cooler packing surface (A), and then install the oil cooler with fix bolt (B).

## **Tightening torque:**

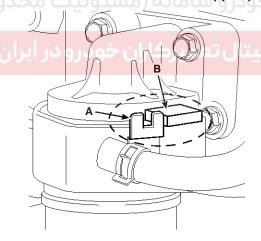
 $44.1 \sim 53.9 \text{ N.m}$  ( $4.5 \sim 5.5 \text{ kgf.m}$ ,  $32.5 \sim 39.8 \text{ lb-ft}$ )



SXMM19032D

## **A**CAUTION

Fix position of oil cooler stopper(A) where oil cooler resists on ladder frame stopper (B).



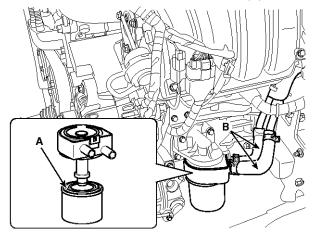
SXMM19033D

2. Apply a light coat of engine oil to the oil filter packing surface (A), and then install the oil filter.

#### Tightening torque:

11.8  $\sim$  15.7 N.m (1.2  $\sim$  1.6 kgf.m, 8.7  $\sim$  11.6 lb-ft)

3. Connect the oil cooler coolant hoses (B).



SYFEM0137N

4. Fill the radiator with coolant and check for leaks.

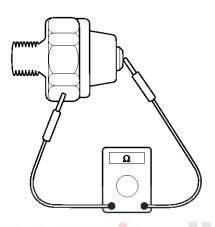
# **Engine Mechanical System**

## **Oil Pressure Switch**

## Inspection

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

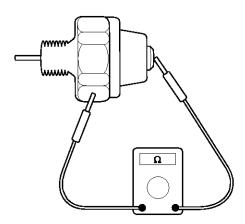
If there is no continuity, replace the oil pressure switch.



KCRF219A

- 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.
- 3. If there is no continuity when a 50kPa (0.50kgf/cm², 7.25psi) is applied through the oil hole, the switch is operaing properly.

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



KCRF220A

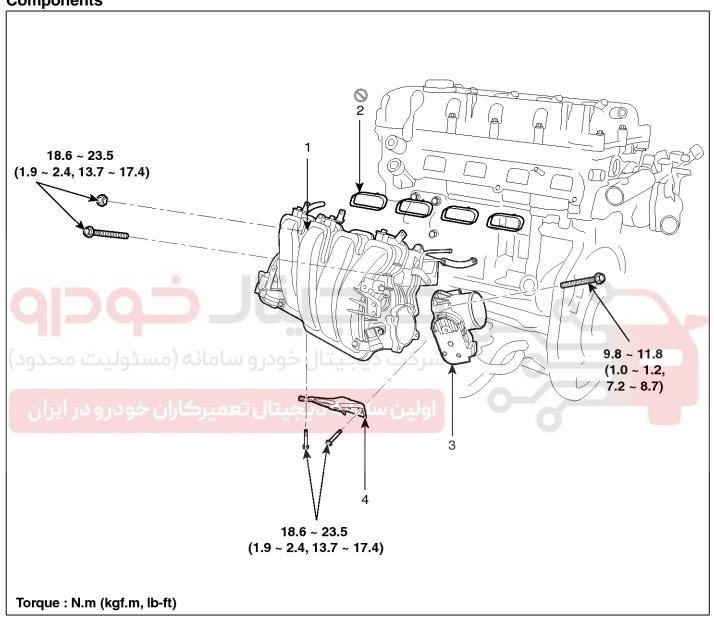


**EMA-121** 

# **Intake And Exhaust System**

## **Intake Manifold**

Components



SVGM11127L

- 1. Intake manifold assembly
- 2. Intake manifold gasket

- 3. ETC (Electronic throttle body)
- 4. Intake manifold stay

# **Engine Mechanical System**

#### Removal and Installation

- 1. Remove the engine cover.
- 2. Disconnect the battery negative terminal.

#### **Tightening torque:**

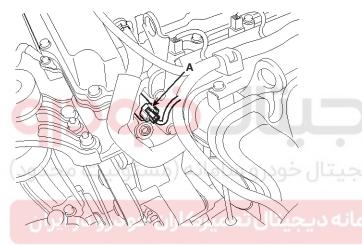
Without battery sensor:

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

With battery sensor:

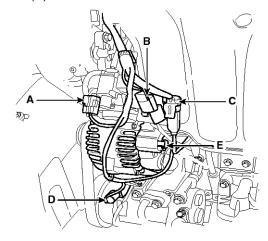
 $4.0 \sim 6.0 \text{N.m}$  (0.4  $\sim$  0.6kgf.m, 3.0  $\sim$  4.4lb-ft)

- 3. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
- 4. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
  - 1) The intake OCV (Oil control valve) connector (A)



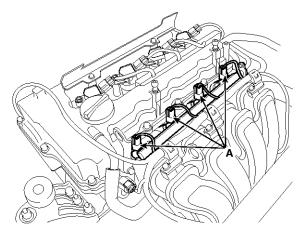
SSLM10013D

 The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)



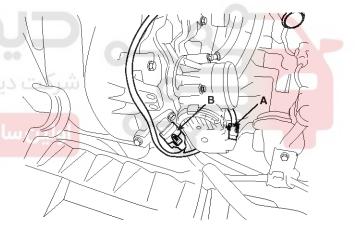
SSLM10123D

3) The injector connectors (A)



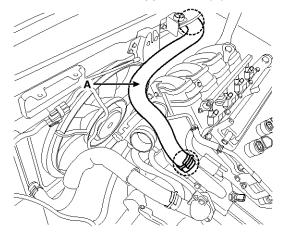
SSLM10130D

 The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



SVGEM0110D

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

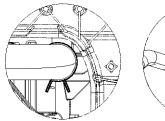


SSLM10131D

**EMA-123** 

## **MOTICE**

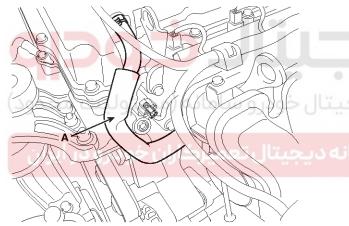
Install the radiator hoses as shown illustrations.





SSLM10148N

6. Disconnect the PCV (Positive crankcase ventilation) hose (A).

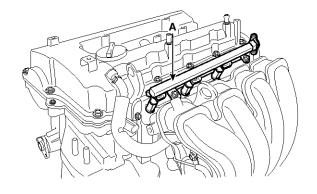


SSLM10109D

7. Remove the delivery pipe & injector assembly (A). (Refer to FL group)

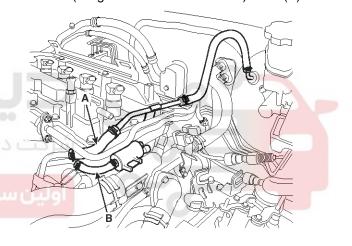
## Tightening torque :

18.6  $\simeq$  23.5N.m (1.9  $\simeq$  2.4kgf.m, 13.7  $\simeq$  17.4lb-ft)



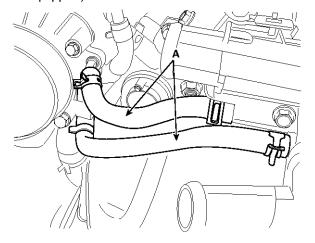
SSLM10147D

8. Disconnect the brake booster vacuum hose (A) and PCSV (Purge control solenoid valve) hose (B).



SSLM10132D

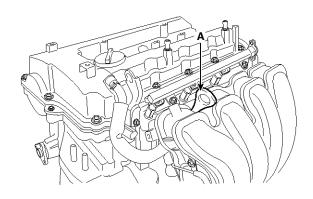
9. Disconnect the throttle body coolant hoses (A). (if equipped)



SVGM11117L

# **Engine Mechanical System**

10. Remove the oil level gauge (A).

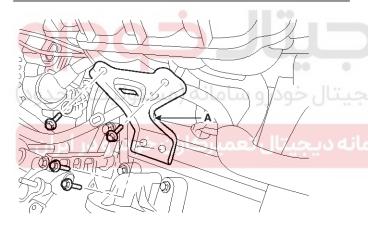


SSLM10133D

11. Remove the intake manifold stay (A).

## Tightening torque:

18.6  $\sim$  23.5N.m (1.9  $\sim$  2.4kgf.m, 13.7  $\sim$  17.4lb-ft)

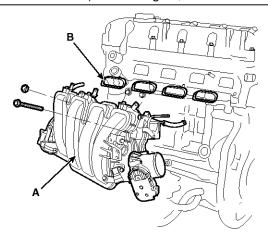


SYFEM0068N

12. Remove the intake manifold (A) with the gasket (B).

## Tightening torque:

18.6  $\sim$  23.5N.m (1.9  $\sim$  2.4kgf.m, 13.7  $\sim$  17.4lb-ft)

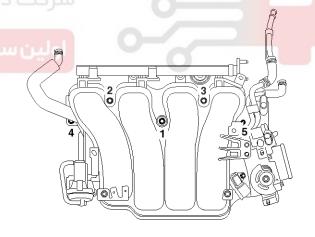


SVGEM0179D

#### **MNOTICE**

When installing, replace with new gaskets.

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



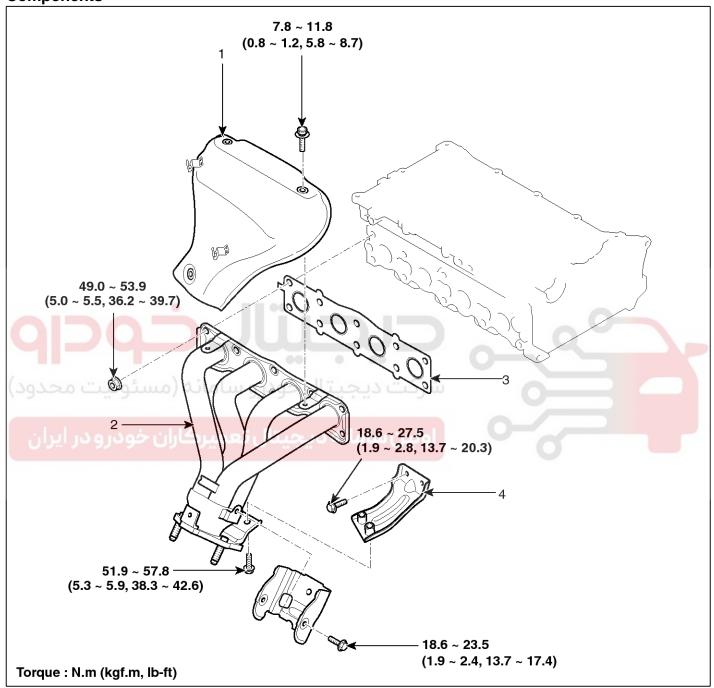
SVGEM0019D

13. Installation is reverse order of removal.

**EMA-125** 

## **Exhaust Manifold**

Components



SSLM10039N

- 1. Heat protector
- 2. Exhaust manifold

- 3. Exhaust manifold gasket
- 4. Exhaust manifold stay

# **Engine Mechanical System**

#### **Removal and Installation**

- 1. Remove the engine cover.
- 2. Disconnect the battery negative terminal.

#### **Tightening torque:**

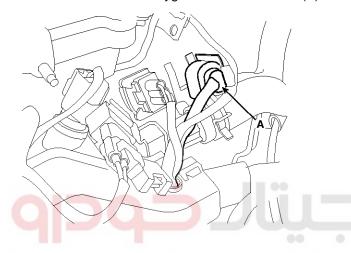
Without battery sensor:

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

With battery sensor:

 $4.0 \sim 6.0 \text{N.m}$  (0.4  $\sim$  0.6kgf.m, 3.0  $\sim$  4.4lb-ft)

3. Disconnect the front oxygen sensor connector (A).

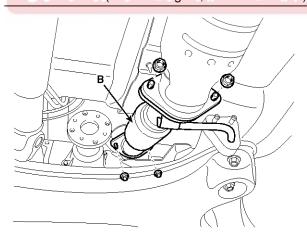


SYFEM0142N

4. Remove the front muffler (A).

## **Tightening torque:**

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

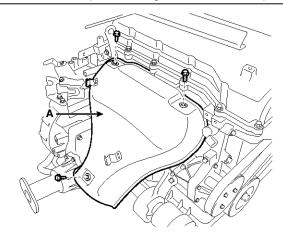


SSLM10137D

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

## Tightening torque:

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



SSLM10032D

6. Remove the exhaust manifold stay (A).

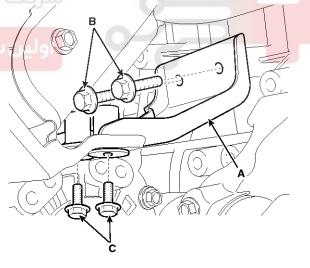
## **Tightening torque:**

M8 bolts(B): 18.6  $\sim$  27.5N.m (1.9  $\sim$  2.8kgf.m, 13.7  $\sim$ 

20.3lb-ft)

M10 bolts(C): 51.9  $\sim$  57.8.m (5.3  $\sim$  5.9kgf.m, 38.3  $\sim$ 

42.6lb-ft)



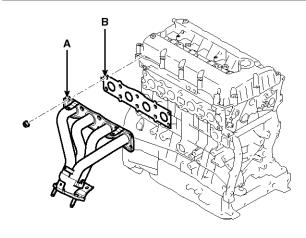
SSLM10033D

**EMA-127** 

7. Remove the exhaust manifold (A) with the gasket (B).

## **Tightening torque**

 $49.0 \sim 53.9$ N.m ( $5.0 \sim 5.5$ kgf.m,  $36.2 \sim 39.7$ lb-ft)

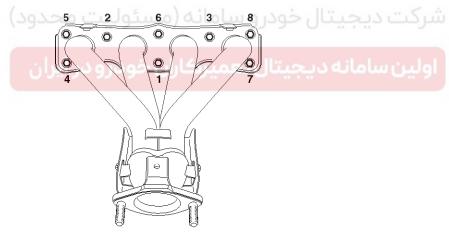


SSLM10134D

#### **MOTICE**

When installing, replace with a new gasket.

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



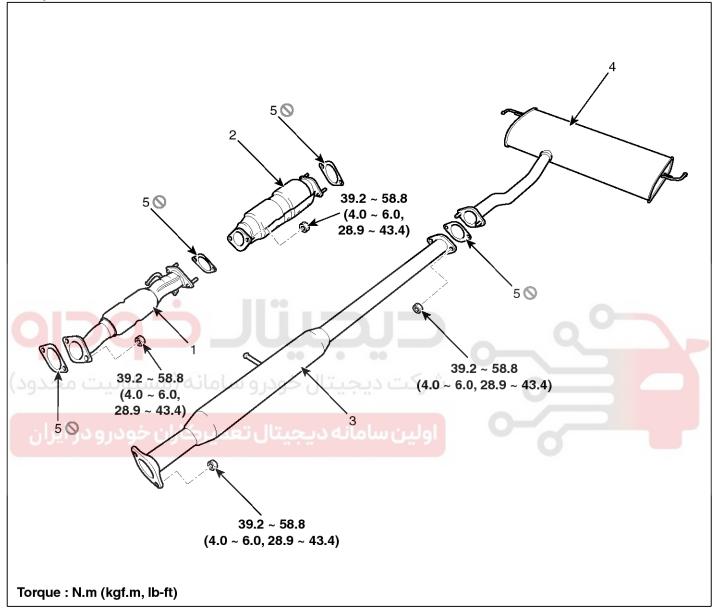
SSLM10034D

8. Installation is reverse order of removal.

# **Engine Mechanical System**

## Muffler

## Components



SSLM10040N

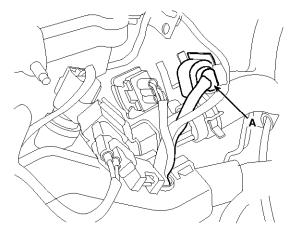
- 1. Front muffler
- 2. Catalytic converter
- 3. Center muffler

- 4. Main muffler
- 5. Gasket

## **EMA-129**

#### **Removal and Installation**

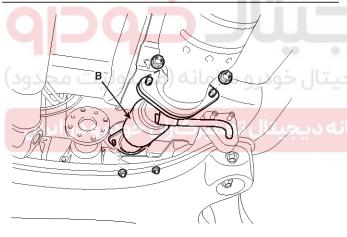
1. Remove the front muffler (B) after disconnecting the front oxygen sensor connector (A).



SYFEM0142N

## **Tightening torque:**

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



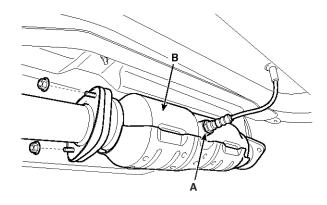
SSLM10137D

2. Remove the catalytic converter (B) after removing the rear oxygen sensor (A).

#### Tightening torque:

Oxygen sensor (A): 44.1  $\sim$  49.0 N.m (4.5  $\sim$  5.0 kgf.m, 32.5  $\sim$  36.2 lb-ft)

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

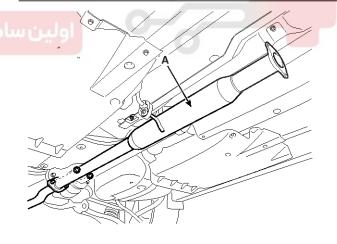


SSLM10035D

3. Remove the center muffler (A).

## Tightening torque:

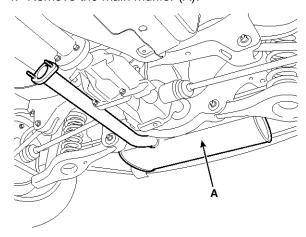
 $39.2 \sim 58.8 \text{ N.m}$  (4.0  $\sim 6.0 \text{ kgf.m}$ ,  $28.9 \sim 43.4 \text{ lb-ft}$ )



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# **Engine Mechanical System**

4. Remove the main muffler (A).



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5. Installation is the reverse order of removal.

## **MOTICE**

When installing, replace with new gaskets.



