

Engine Mechanical System

GENERAL

ENGINE AND TRANSAXLE ASSEMBLY

TIMING SYSTEM
TIMING CHAIN

CYLINDER HEAD ASSEMBLY

ENGINE BLOCK

COOLING SYSTEM

LUBRICATION SYSTEM

INTAKE AND EXHAUST SYSTEM
INTAKE MANIFOLD
EXHAUST MANIFOLD
EXHAUST PIPE

GENERAL

SPECIFICATION EE6CF939

Description		Specifications		Limit	
		G6DB - 3.3	G6DA - 3.8		
General					
Type		V-type, DOHC			
Number of cylinders		6			
Bore		92mm (3.6220in)	96mm (3.7795in)		
Stroke		83.8mm (3.2992in)	87.0 mm(3.4252in)		
Total displacement		3,342cc (203.86cu.in)	3.778cc (230.55cu.in)		
Compression ratio		10.4			
Firing order		1-2-3-4-5-6			
Valve timing					
Intake	Opens(ATDC)	14°	10°		
	Closes(ABDC)	66°	66°		
Exhaust	Opens(BBDC)	52°	52°		
	Closes(ATDC)	0°	0°		
Cylinder head					
Flatness of gasket surface		Less than 0.05mm (0.0019in) [Less than 0.02mm (0.0008in) / 150x150]			
Flatness of manifold mounting	Intake	Less than 0.1mm(0.0039in) [Less than 0.03mm(0.001in)/110x110]			
	Exhaust	Less than 0.1mm(0.0039in) [Less than 0.03mm(0.001in)/110x110]			
Camshaft					
Cam height	LH Camshaft	Intake	46.3mm (1.8228in)	46.8mm (1.8425in)	
		Exhaust	45.8mm (1.8031in)		
	RH Camshaft	Intake	46.3mm (1.8228in)	46.8mm(1.8425in)	
		Exhaust	45.8mm (1.8031in)		
Journal outer diameter	LH ,RH Camshaft	Intake	No.1: 27.964 ~ 27.978mm (1.1009 ~ 1.1015in) No.2,3,4: 23.954 ~ 23.970mm (0.9430 ~ 0.9437in)		
		Exhaust	No.1: 27.964 ~ 27.978mm (1.1009 ~ 1.1015in) No.2,3,4: 23.954 ~ 23.970mm (0.9430 ~ 0.9437in)		
Bearing oil clearance	LH ,RH Camshaft	Intake	No.1: 0.027 ~ 0.057mm (0.0011 ~ 0.0022in) No.2,3,4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in)		
		Exhaust	No.1: 0.027 ~ 0.057mm (0.0011 ~ 0.0022in) No.2,3,4: 0.030 ~ 0.067mm (0.0012 ~ 0.0026in)		

Description	Specifications		Limit
	G6DB - 3.3	G6DA - 3.8	
End play	→	0.02 ~ 0.18mm (0.0008 ~ 0.0071in)	
Valve			
Valve length	Intake	105.27mm(4.1445in)	
	Exhaust	105.50mm (4.1535in)	
Stem outer diameter	Intake	5.465 ~ 5.480mm (0.2151 ~ 0.2157in)	
	Exhaust	5.458 ~ 5.470mm (0.2149 ~ 0.2153in)	
Face angle		45.25° ~ 45.75°	
Thickness of valvehead(margin)	Intake	1.56 ~ 1.86mm (0.06142 ~ 0.07323in)	
	Exhaust	1.73 ~ 2.03mm (0.06811 ~ 0.07992in)	
Valve stem to valve guide clearance	Intake	0.020 ~ 0.047mm (0.00078 ~ 0.00185in)	0.07mm (0.00275in)
	Exhaust	0.030 ~ 0.054mm (0.00118 ~ 0.00212in)	0.09mm (0.00354in)
Valve guide			
Inner diameter	Intake	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
	Exhaust	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
Length	Intake	41.8 ~ 42.2mm (1.6457 ~ 1.6614in)	
	Exhaust	41.8 ~ 42.2mm (1.6457 ~ 1.6614in)	
Valve seat			
Width of seat contact	Intake	1.15 ~ 1.45mm (0.05118 ~ 0.05709in)	
	Exhaust	1.35 ~ 1.65mm (0.05315 ~ 0.06496in)	
Seat angle	Intake	44.75° ~ 45.20°	
	Exhaust	44.75° ~ 45.20°	
Valve spring			
Free length		43.86mm (1.7267in)	
Load		19.3±0.8kg/34.0mm (42.7±1.8 lb/1.3386in)	
		42.3±1.3kg/24.2mm (93.3±2.9 lb/0.9527in)	
Out of squareness		Less than 1.5°	
MLA			
MLA outer diameter	Intake	34.964 ~ 34.980mm (1.3765 ~ 1.3772in)	
	Exhaust	34.964 ~ 34.980mm (1.3765 ~ 1.3772in)	
Cylinder head tappet bore inner diameter	Intake	35.000 ~ 35.025mm (1.3779 ~ 1.3789in)	
	Exhaust	35.000 ~ 35.025mm (1.3779 ~ 1.3789in)	
MLA to tappet bore clearance	Intake	0.020 ~ 0.061mm (0.0008 ~ 0.0024in)	0.07mm(0.0027in)
	Exhaust	0.020 ~ 0.061mm (0.0008 ~ 0.0024in)	0.07mm(0.0027in)
Valve clearance			

Description		Specifications		Limit
		G6DB - 3.3	G6DA - 3.8	
Intake		0.17 ~ 0.23mm (0.0067 ~ 0.0090in)		0.10 ~ 0.30mm (0.0039 ~ 0.0118in)
Exhaust		0.27 ~ 0.33mm (0.0106 ~ 0.0129in)		0.20 ~ 0.40mm (0.0078 ~ 0.0157in)
Cylinder block				
Cylinder bore		92.00 ~ 92.03mm (3.6220 ~ 3.6232in)	96.00 ~ 96.03mm (3.7795 ~ 3.7807in)	
Flatness of gasket surface		Less than 0.05mm (0.0019in) [Less than 0.02mm (0.0008in) / 150x150]		
Piston				
Piston outer diameter		91.96 ~ 92.00mm (3.6205 ~ 3.6220in)	95.96 ~ 95.99mm (3.7779 ~ 3.7791in)	
Piston to cylinder clearance		→	0.03 ~ 0.05mm (0.0012 ~ 0.0020in)	
Ring groove width	No. 1 ring groove	→	1.22 ~ 1.24 (0.0480 ~ 0.0488in)	1.26mm (0.0496in)
	No. 2 ring groove	1.22 ~ 1.24mm (0.0480 ~ 0.0488in)		1.26mm (0.0496in)
	Oil ring groove	2.01 ~ 2.03mm (0.0791 ~ 0.0799in)		2.05mm (0.0807in)
Piston ring				
Side clearance	No. 1 ring	→	0.03 ~ 0.07mm (0.0012 ~ 0.0027in)	0.1mm (0.004in)
	No. 2 ring	0.03 ~ 0.07mm (0.0012 ~ 0.0027in)		0.1mm (0.004in)
	Oil ring	0.06 ~ 0.15mm (0.0024 ~ 0.0059in)		0.2mm (0.008in)
End gap	No. 1 ring	0.17 ~ 0.32mm (0.0067 ~ 0.0126in)		0.6mm (0.0236in)
	No. 2 ring	0.32 ~ 0.47mm (0.0126 ~ 0.0185in)		0.7mm (0.0275in)
	Oil ring	0.20 ~ 0.70mm (0.0078 ~ 0.0275in)		0.8mm (0.0315in)
Piston pin				
Piston pin outer diameter		→	23.001 ~ 23.006mm (0.9055 ~ 0.9057in)	
Piston pin hole inner diameter		→	23.016 ~ 23.021mm (0.9061 ~ 0.9063in)	
Piston pin hole clearance		→	0.01 ~ 0.02mm (0.0039 ~ 0.0078in)	
Connecting rod small end inner diameter		22.974 ~ 22.985mm (0.9045 ~ 0.9049in)		
Connecting rod				
Connecting rod big end inner diameter		58.000 ~ 58.018mm (2.2834 ~ 2.2842in)		
Connecting rod bearing oil clearance		→	0.038 ~ 0.056mm (0.0015 ~ 0.0022in)	
Side clearance		0.1 ~ 0.25mm (0.0039 ~ 0.0098in)		
Crankshaft				
Main journal outer diameter		68.942 ~ 68.960mm (2.7142 ~ 2.7149in)		
Pin journal outer diameter		54.954 ~ 54.972mm (2.1635 ~ 2.1642in)		

Description		Specifications		Limit
		G6DB - 3.3	G6DA - 3.8	
Main bearing oil clearance		0.022 ~ 0.040mm (0.0008 ~ 0.0016in)		
End play		0.10 ~ 0.28mm (0.0039 ~ 0.0110in)		
Oil pump				
Relief valve opening pressure		450 ~ 550kPa (4.59 ~ 5.61kgf/cm ² , 65.28 ~ 79.79psi)		
Engine oil				
Oil quantity (Oil pan)		4.5 ~ 5.5L(4.76 ~ 5.81U.S.qus, 3.96 ~ 4.84Imp.qts)		
Oil quantity (Oil filter)		0.4L(0.42U.S.qus, 0.35Imp.qts)		
Oil quantity (Drain and refill)		5.2L(5.49U.S.qus, 4.58Imp.qts)		
Oil quality		Above SJ or SL		
Oil pressure		130kPa(1.32kgf/cm ² , 18.77psi) [at 1000rpm, 110°C(230°F)]		
Cooling system				
Cooling method		Forced circulation with electrical fan		
Coolant quantity		9.0L(9.40U.S.qus, 7.83Imp.qts)		
Thermostat	Type	Wax pellet type		
	Opening temperature	82±2°C (179.6±35.6°F)		
	Fully opened temperature	95°C (203°F)		
	Full lift	more than 10mm (0.3937in)		
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm ² , 13.51 ~ 17.78psi)		
	Vacuum valve opening pressure	0.98 ~ 4.90 kpa (0.01 ~ 0.05kg/cm ² , 0.14 ~ 0.71 psi)		
Water temperature sensor				
Type		Thermister type		
Resistance	20°C (68°F)	2.31 ~ 2.59k		
	80°C(176°F)	0.3222 k		

TIGHTENING TORQUE

Item	Quantity	Nm	kgf.m	lb.ft
Crankshaft pulley bolt	1	284.2 ~ 303.8	29.0 ~ 31.0	209.76 ~ 224.22
Timing chain cover bolt B	17	18.62 ~ 21.56	1.9 ~ 2.2	13.74 ~ 15.91
Timing chain cover bolt C	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt D	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63
Timing chain cover bolt E	1	58.80 ~ 68.80	6.0 ~ 7.0	43.40 ~ 50.63
Timing chain cover bolt F	2	24.50 ~ 26.46	2.5 ~ 2.7	18.08 ~ 19.53
Timing chain cover bolt G	4	21.56 ~ 23.52	2.2 ~ 2.4	15.91 ~ 17.36
Timing chain cover bolt H	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt I	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain cover bolt J	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cam to cam guide bolt	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain auto tensioner nut	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Timing chain guide bolt	4	19.60 ~ 24.50	2.0 ~ 2.5	14.17 ~ 18.08
Oil pump chain cover bolt	3	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain tensioner bolt	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain guide bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil pump chain sprocket bolt	1	18.62 ~ 21.56	1.9 ~ 2.2	13.74 ~ 15.91
Lower oil pan bolt	13	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Drive belt auto tensioner bolt(M12)	1	81.4 ~ 85.3	8.3 ~ 8.7	60.0 ~ 62.9
Drive belt auto tensioner bolt(M8)	1	29.4 ~ 33.3	3.0 ~ 3.4	21.7 ~ 24.6
Drive belt idler bolt	1	53.90 ~ 57.82	5.5 ~ 5.9	39.78 ~ 42.67
OCV(oil control valve) bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cylinder head bolt	16	39.2 + 120° + 90°	4.0 + 120° + 90°	28.93+ 120° + 90°
Cylinder head bolt	1	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
CVVT & exhaust cam sprocket bolt	4	64.68 ~ 76.44	6.6 ~ 7.8	47.74 ~ 56.42
Camshaft bearing cap bolt	32	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Cylinder head cover bolt	38	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Connecting rod bearing bolt	12	19.60 + 90°	2.0 + 90°	14.46 + 90°
Main bearing cap inner bolt(M11)	8	49.00 + 90°	5.0 + 90°	36.16 + 90°
Main bearing cap outer bolt(M8)	8	19.60 + 120°	2.0 + 120°	14.46 + 120°
Main bearing cap side bolt(M8)	6	29.40 ~ 31.36	3.0 ~ 3.2	21.70 ~ 23.14
Oil drain cover bolt	6	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Rear oil seal case bolt	6	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Baffle plate bolt	12	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Upper oil pan bolt	16	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68

GENERAL

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Item	Quantity	Nm	kgf.m	lb.ft
Knock sensor bolt	2	15.68 ~ 23.52	1.6 ~ 2.4	11.57 ~ 17.36
Drive plate bolt	8	71.54 ~ 75.46	7.3 ~ 7.7	52.80 ~ 55.69
Oil filter cap	1	24.50	2.5	18.08
Oil drain bolt	1	34.30 ~ 44.10	3.5 ~ 4.5	25.31 ~ 32.55
Oil pump bolt	3	19.60 ~ 23.52	2.0 ~ 2.4	14.47 ~ 17.36
Oil filter body bolt	10	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Oil filter body cover bolt	11	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water vent hose bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump bolt(Timing chain cover bolt L)	1	21.56 ~ 26.46	2.2 ~ 2.7	15.91 ~ 19.53
Water pump bolt(Timing chain cover bolt K)	4	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Water pump pulley bolt	4	7.84 ~ 9.80	0.8 ~ 1.0	5.78 ~ 7.23
Water temp. control nut	4	19.6 ~ 23.52	2.0 ~ 2.4	14.5 ~ 17.36
Water temp. control bolt	2	19.6 ~ 23.52	2.0 ~ 2.4	14.5 ~ 17.36
Water inlet pipe bolt	3	16.66 ~ 19.60	1.7 ~ 2.0	12.30 ~ 14.47
Air vent pipe bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Intake manifold bolt	6	26.5 ~ 31.4	2.7 ~ 3.2	19.5 ~ 23.1
Intake manifold nut	2	18.62 ~ 23.52	1.9 ~ 2.4	13.74 ~ 17.36
Surge tank bolt	1	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Exhaust manifold stay bolt	4	52.0 ~ 56.9	5.3 ~ 5.8	38.3 ~ 42.0
Surge tank bolt	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Breather pipe bolt	2	9.80 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.68
Surge tank bracket bolt	2	27.44 ~ 31.36	2.8 ~ 3.2	20.25 ~ 23.14
ETC bracket bolt	2	15.68 ~ 25.48	1.6 ~ 2.6	11.57 ~ 18.80
Exhaust manifold nut	16	39.20 ~ 44.10	4.0 ~ 4.5	28.93 ~ 32.55
Heat protector bolt	6	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Front muffler	2	39.20 ~ 58.80	4.0 ~ 6.0	28.93 ~ 43.40

INSPECTION ECE1FCC3

COMPRESSION PRESSURE

NOTE

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

1. Warm up and stop engine.
Allow the engine to warm up to normal operating temperature.
2. Remove ignition coils. (Refer to Ignition in FL Group)
3. Remove spark plugs.
Using a 16mm plug wrench, remove the 6 spark plugs.
4. Check cylinder compression pressure.
 - a. Insert a compression gauge into the spark plug hole.
 - b. Fully open the throttle.
 - c. After 7times of cranking the engine, measure the compression pressure.

NOTE

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

- d. Repeat steps (a) through (c) for each cylinder.

NOTE

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

Compression pressure :
1,225kPa (12.5kgf/cm², 177psi) - 200 ~ 250rpm
Minimum pressure :
1,078kPa (11.0kgf/cm², 156psi)

- e. 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 (a) through (c) 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.

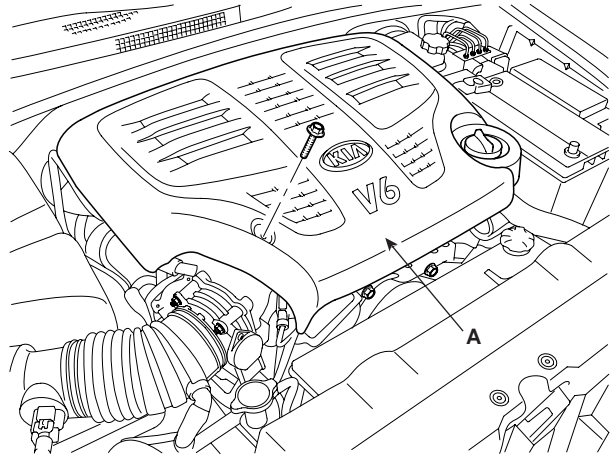
5. Reinstall spark plugs.
6. Install ignition coils. (See EE group - ignition)

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

NOTE

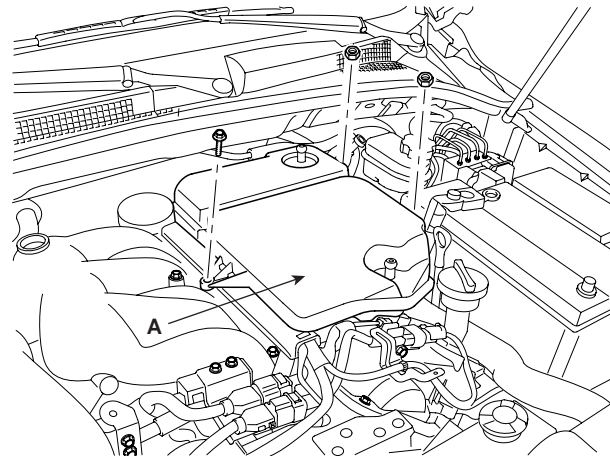
Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C) and cylinder head is installed on the cylinder block.

1. Remove the engine cover(A).



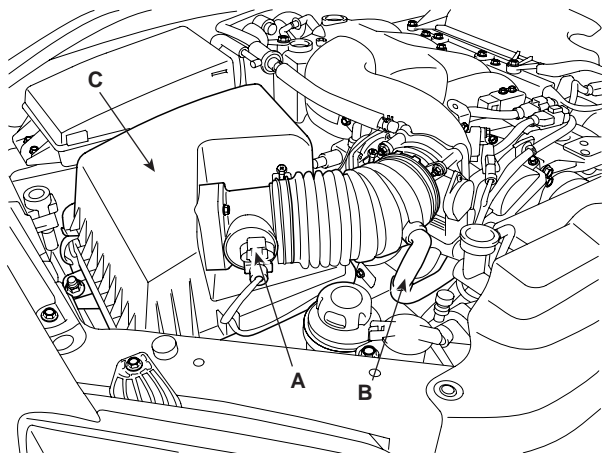
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2. Remove the engine room resonator(A).



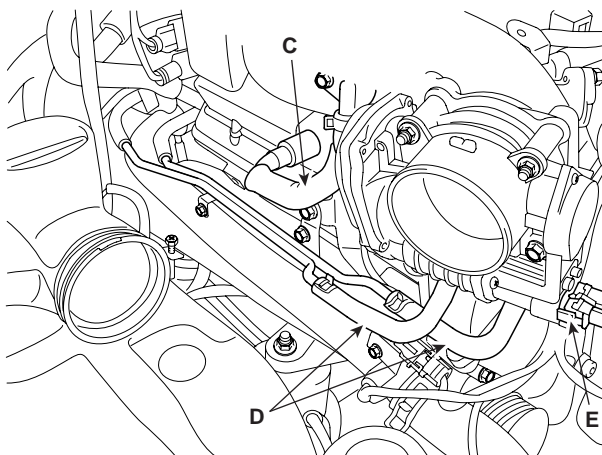
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3. After disconnecting the MAF sensor connector(A) and the breather hose(B), remove the air cleaner assembly(C).

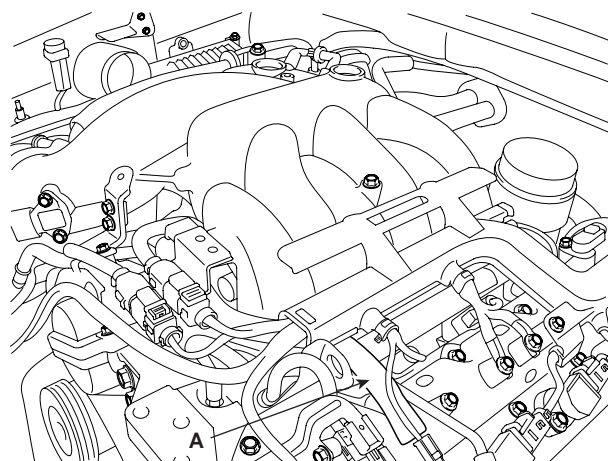


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4. Disconnect the other breather hose(A), the Purge Control Solenoid Valve(PCSV) hose, the Positive Crankcase Ventilation (PCV) hose(C) and the Electronic Throttle Control(ETC) cooling hoses(D) and connector(E).



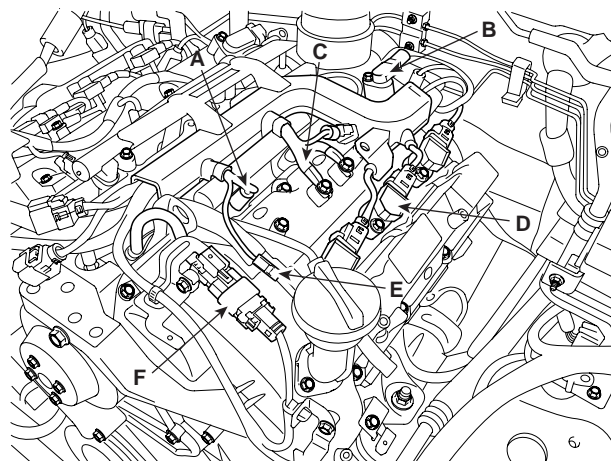
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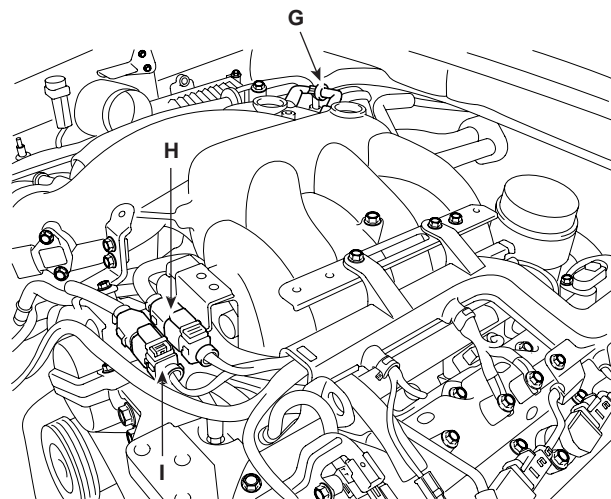
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5. Remove the wiring over the surge tank.

- 1) Disconnect the injection harness connector(A).
- 2) Disconnect the camshaft position sensor(CMP) harness connector(B).
- 3) Disconnect the ground line(C).
- 4) Disconnect the ignition coil harness connector(D).
- 5) Disconnect the condenser connector(E).
- 6) Disconnect the variable induction system(VIS) solenoid valve connector(G).
- 7) Disconnect the oil control valve(OCV) harness connector(F).
- 8) Disconnect the injector wiring(H) and ignition coil wiring(I).



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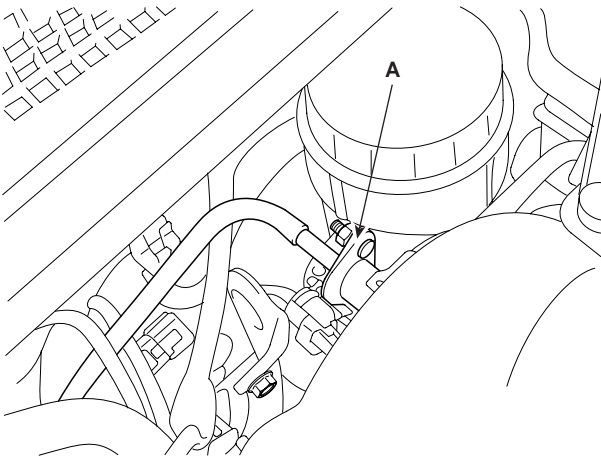


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EMA -10

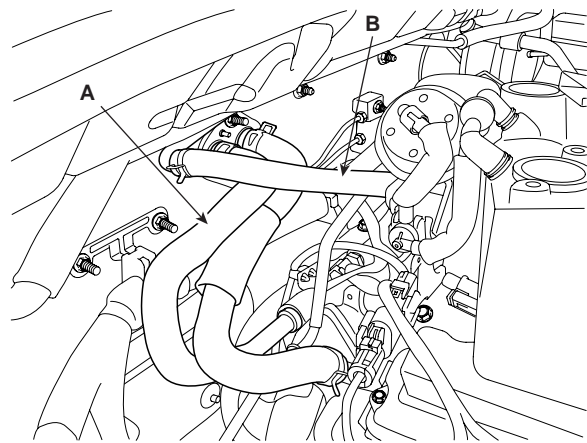
ENGINE MECHANICAL SYSTEM

6. Disconnect the fuel hose tube(A).



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7. Remove heater hose(A) and disconnect the brake vacuume hose(B).

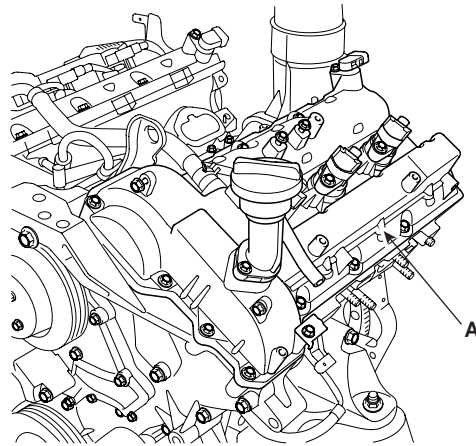


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8. Disconnect the surge tank stay.

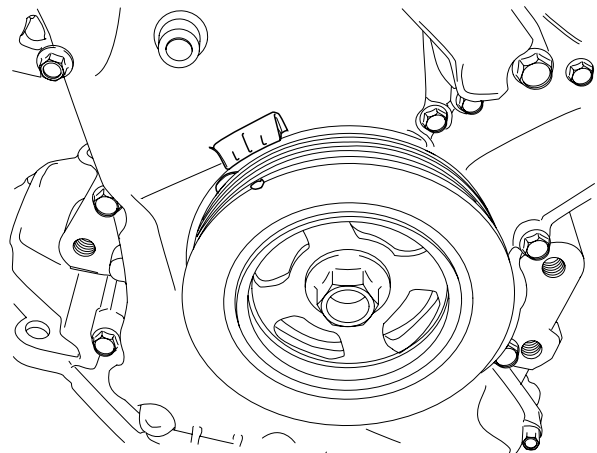
9. Remove the surge tank.

10. Loosen the cylinder head cover bolts and then remove the cover(A) and gasket.



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11. Set No.1 cylinder to TDC/compression.
a. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

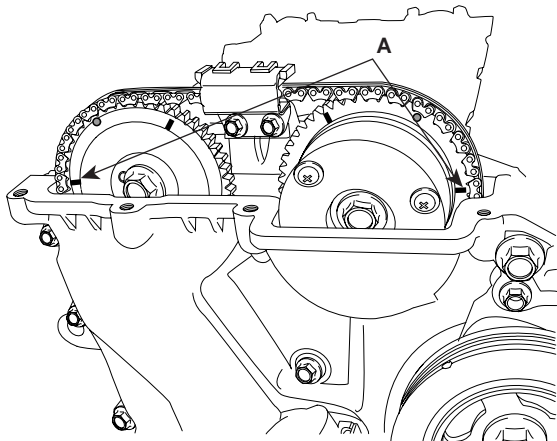


KDRF108A

- b. Check that the mark(A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft one revolution (360°)

NOTE

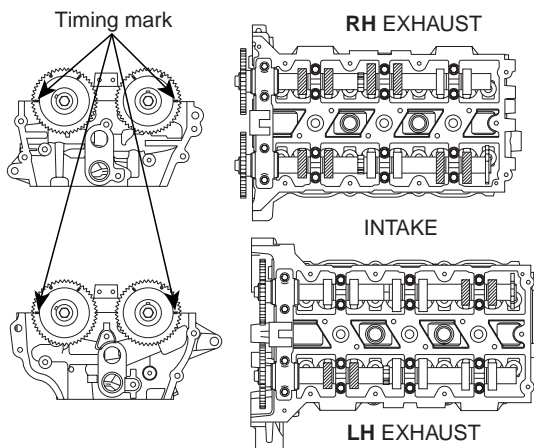
Do not rotate engine counterclockwise



KDRF113A

12. Inspect the valve clearance.

- a. Check only the valve indicated as shown. [No. 1 cylinder : TDC/Compression] measure the valve clearance.



EDRF021A

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

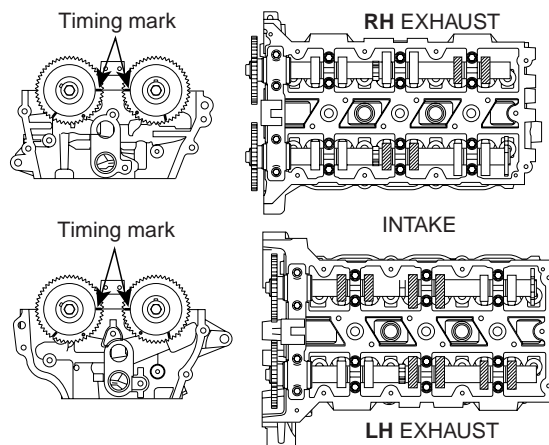
Exhaust : 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)

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

NOTE

Do not rotate engine counterclockwise

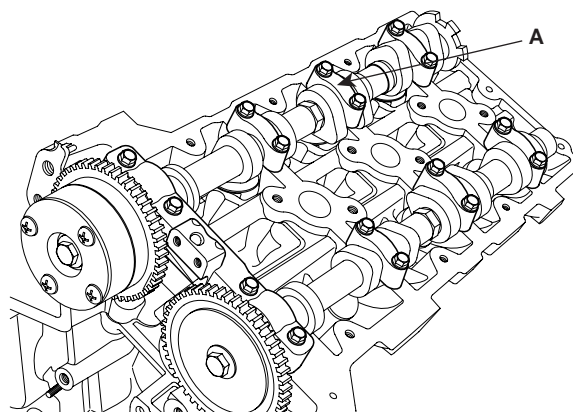
- c. Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance.



EDRF022A

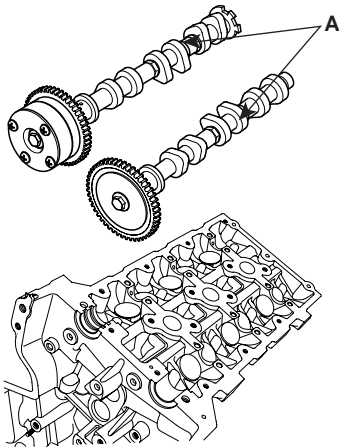
13. Adjust the intake and exhaust valve clearance.

- a. Set the No.1 cylinder to the TDC/compression.
- b. Mark on the timing chain on the basis of the marking on sprocket and CVVT.
- c. Remove the timing chain.
- d. Remove the camshaft bearing caps(A).



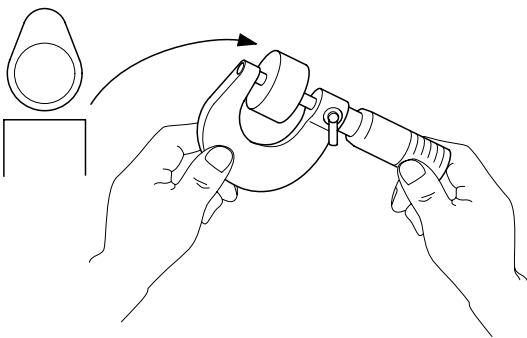
KDRF196A

- e. Remove the camshaft assembly(A).



KDRF197A

- f. Remove MLAs.
g. Measure the thickness of the removed tappet using a micrometer.



EDKE889D

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

Exhaust : $N = T + [A - 0.30\text{mm}(0.0118\text{in.})]$

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

 **NOTE**

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

- j. Place a new tappet on the cylinder head.

 **NOTE**

Applying engine oil at the selected tappet on the periphery and top surface.

- k. Install the intake and exhaust camshaft.
l. Install the bearing caps.
m. Install the timing chain.
n. Turn the crankshaft two turns in the operating direction(clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks.
o. Recheck the valve clearance.

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

[Specification]

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

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

TROUBLESHOOTING

EB9DDED8

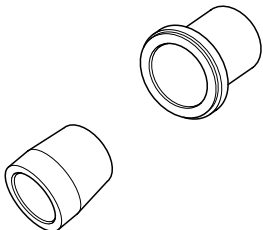
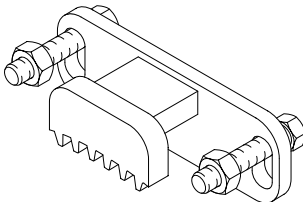
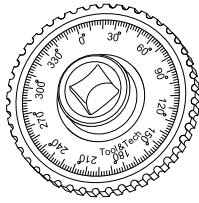
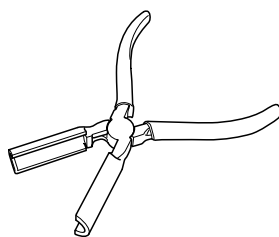
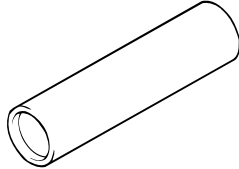
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improperly installed engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or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

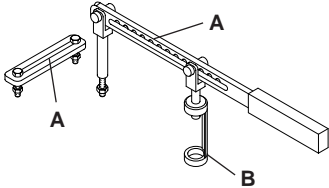
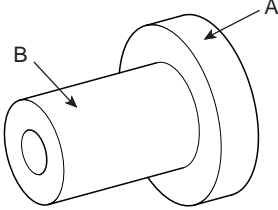
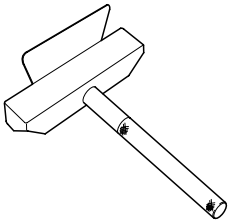
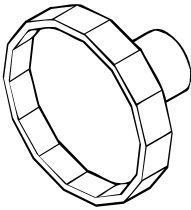
Symptom	Suspect area	Remedy
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul style="list-style-type: none">• Inspect the camshaft lobes.• Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	<ul style="list-style-type: none">• Inspect the oil pan.• Inspect the oil pump screen.• Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	<ul style="list-style-type: none">• Inspect the oil pump screen.• Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	<ul style="list-style-type: none">• Inspect the piston, piston pin and cylinder bore.• Repair as required.
	Excessive piston pin-to-piston clearance.	<ul style="list-style-type: none">• Inspect the piston, piston pin and the connecting rod.• Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. <ul style="list-style-type: none">• The connecting rod bearings.• The connecting rods.• The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. <ul style="list-style-type: none">• The crankshaft bearings.• The crankshaft main journals.• The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	<ul style="list-style-type: none">• Verify the piston pins and connecting rods are installed correctly.• Repair as required.

Symptom	Suspect area	Remedy
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance .	Inspect the following components and repair as required : <ul style="list-style-type: none">• The connecting rod bearings.• The connecting rods.• The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. <ul style="list-style-type: none">• The crankshaft bearings.• The crankshaft main journals.• The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder. <ul style="list-style-type: none">• Coolant/antifreeze in cylinder.• Oil in cylinder.• Fuel in cylinder.	<ol style="list-style-type: none">1. Remove spark plugs and check for fluid.2. Inspect for broken head gasket.3. Inspect for cracked engine block or cylinder head.4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	<ol style="list-style-type: none">1. Inspect timing chain and gears.2. Repair as required.
	Material in cylinder. <ul style="list-style-type: none">• Broken valve• Piston material• Foreign material	<ol style="list-style-type: none">1. Inspect cylinder for damaged components and/or foreign materials.2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	<ol style="list-style-type: none">1. Inspect crankshaft and connecting rod bearing.2. Repair as required.
	Bent or broken connecting rod.	<ol style="list-style-type: none">1. Inspect connecting rods.2. Repair as required.
	Broken crankshaft.	<ol style="list-style-type: none">1. Inspect crankshaft.2. Repair as required.

SPECIAL SERVICE TOOLS

E787872C

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-3C100)	 KDRF233A	Installation of the front oil seal
Flywheel stopper (09231-3C300)	 KCRF030D	Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)	 LCAC030A	Installation of bolts & nuts needing an angular method
Valve stem seal remover (09222-29000)	 KDRF232A	Remover of the valve stem seal
Valve stem seal remover (09222-3C100)	 LCAC030D	Installation of the valve stem seal

Tool (Number and name)	Illustration	Use
Valve spring compressor & holder (09222-3K000) (09222-3C300)	 <p>ECRF003A</p>	Removal and installation of the intake or exhaust valve A : 09222-3K000 B : 09222-3C300 (holder)
Crankshaft rear oil seal installer (09231-3C200) (09231-H1100)	 <p>ACRF003A</p>	Installation of the crankshaft rear oil seal A : 09231-3C200 B : 09231-H1100
Oil pan remover (09215-3C000)	 <p>KDRF219A</p>	Removal of oil pan
Oil filter wrench (09263-3C100)	 <p>B6327000</p>	Removal and installation of the oil filter

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL E31DBAFC

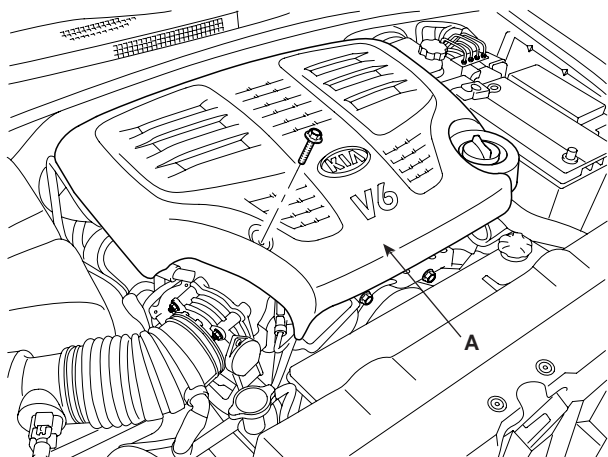
CAUTION

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

NOTE

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

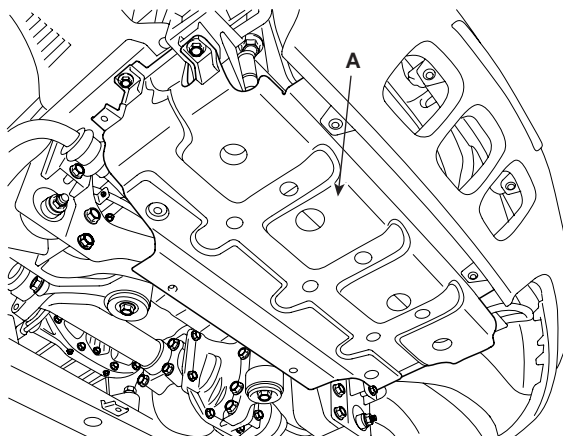
1. Remove the engine cover(A).



SBLM16001L

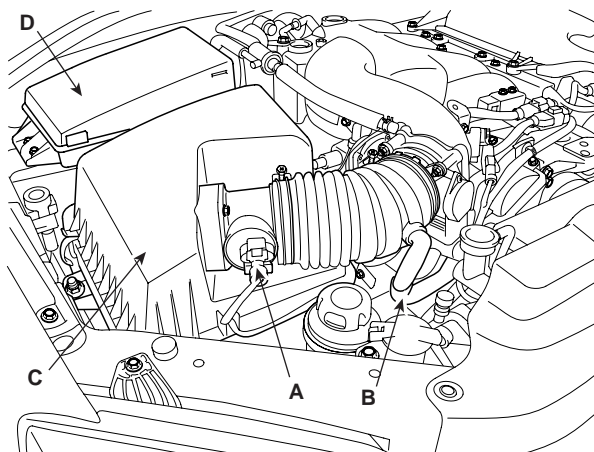
2. Recover refrigerant by opening the high & low pressure pipe caps and connecting the refrigerant station(Refer to Air conditioning system in HA Group).

3. Remove the under cover(A).



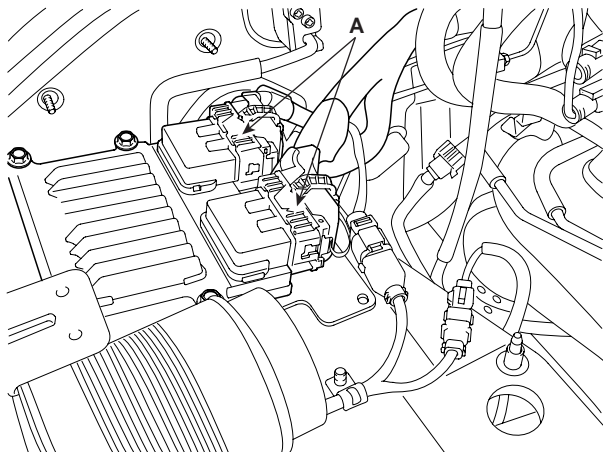
SBLM16016L

4. Drain engine oil, transaxle fluid and engine coolant.
5. Disconnect the neagative terminal from the battery and remove the battery(A).
6. Remove the intake air hose and air cleaner assembly.
 - 1) Disconnect the MAF connector(A).
 - 2) Disconnect the breather hose(B) from air cleaner hose.
 - 3) Remove the intake air hose and air cleaner assembly(C) with the resonator(D).



SBLM16113L

7. Disconnect the PCM connectors(A).



SBLM16009L

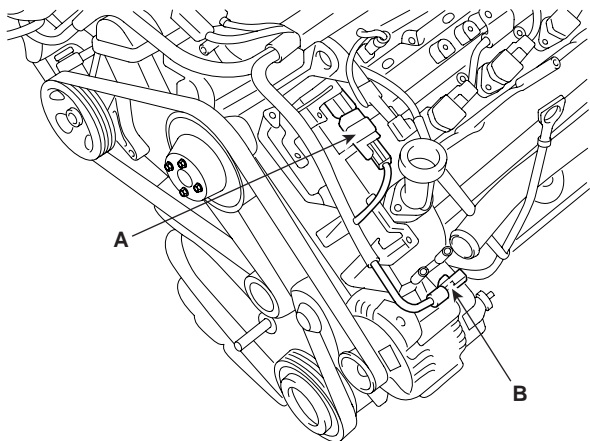
8. Remove the battery tray while recovering refrigerant.

9. Disconnect the high and low pressure pipes from the radiator or the compressor.(Refer to Air conditioning system in HA Group).

10. Remove the radiator.(Refer to Radiator in this Group).

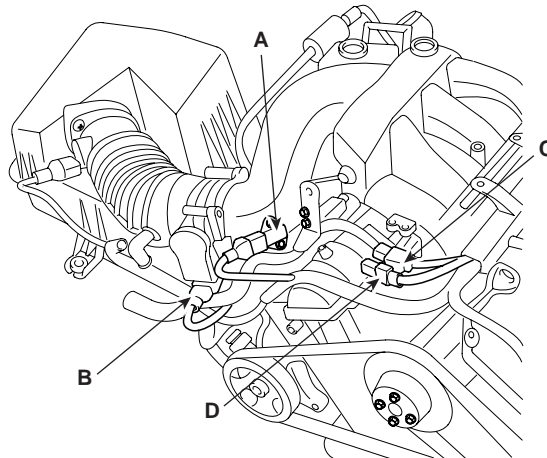
11. Disconnect the engine wiring harness connectors.

1) Disconnect the oil control valve(OCV) harness connector(A) and the knock sensor(LH) harness connector(B)



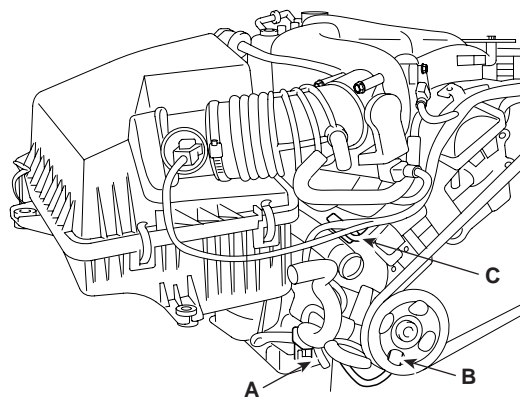
SBLM16010L

2) Disconnect the MAP(A), ETC(B), ignition coil harness connector(C) and the injection harness connector(D).



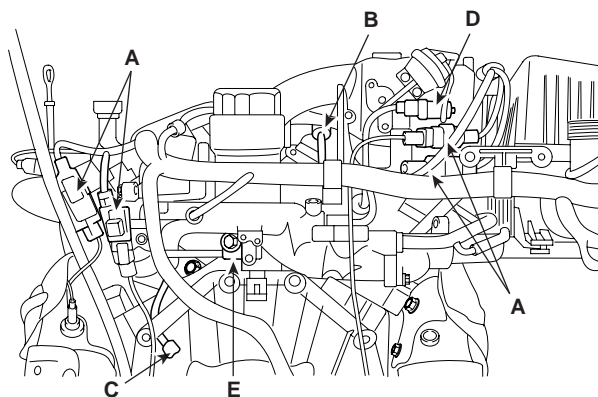
SBLM16011L

3) Disconnect the battery connector(A), the power steering switch connector(B) and the knock sensor(RH) harness connector(C).



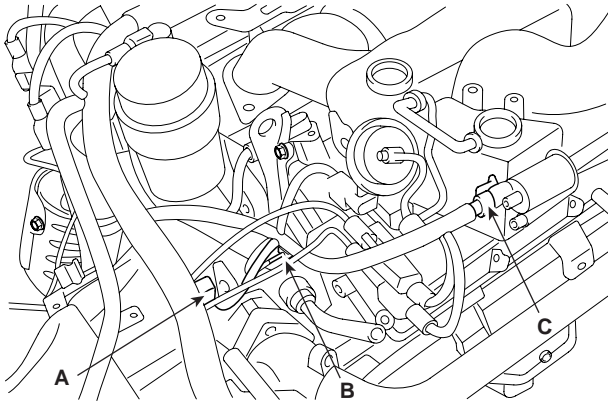
SBLM16012L

4) Disconnect the oxygen sensors(A), CMP(B), CKP(C), VIV(D) and the condenser harness connector(E).



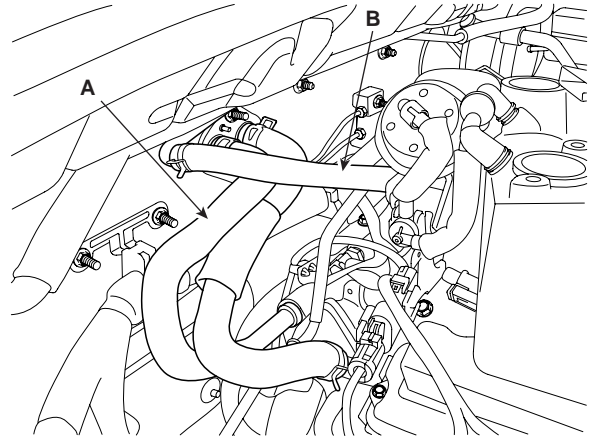
SBLM16013L

- 5) Disconnect the water temperature sensor(WTS) harness connector(A), the oil temperature sensor(OTS) harness connector(B) and the purge control solenoid valve(PCSV) harness connector(C).



SBLM16014L

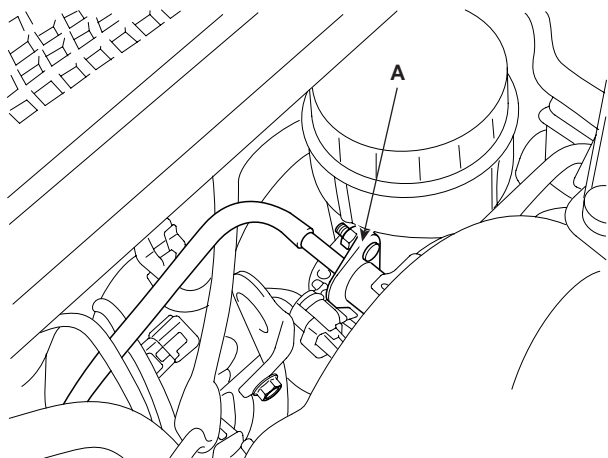
16. Remove heater hose(A) and disconnect the brake vacuume hose(B).



SBLM16017L

12. Disconnect the transaxle wire harness connector and remove the transaxle assembly.(Refer to Transaxle system in AT Group).

13. Disconnect the fuel hose tube(A).



SBLM16015L

17. Remove the exhaust and intake manifold covers.(Refer to Intake and exhaust system in this Group).

18. Remove the power steering pump assembly.(Refer to Power steering pump in ST Group).

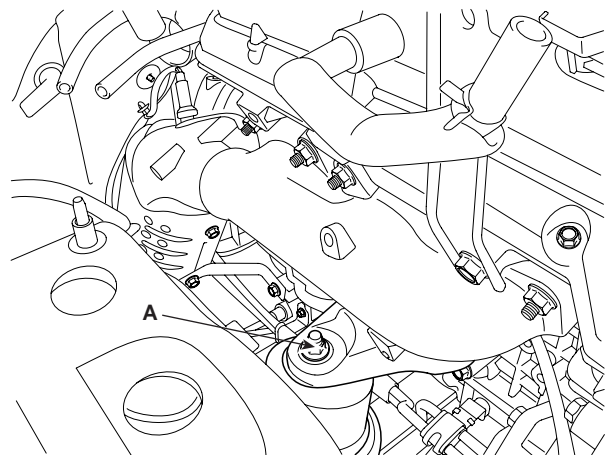
19. Remove the hood assembly.(Refer to Hood in BD Group).

20. Install a jack for supporting the engine assembly.

21. Remove the engine mounting brackets(A).

14. Disconnect the front exhaust muffler with the exhaust manifolds.

15. Remove the front wheels and tires.(Refer to Suspension system in SS Group).



SBLM16018L

22. Jack up the engine assembly in order to remove the engine from the vehicle.

INSTALLATION EAD5D6B1

Installation is in the reverse order of removal.

Perform the following :

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

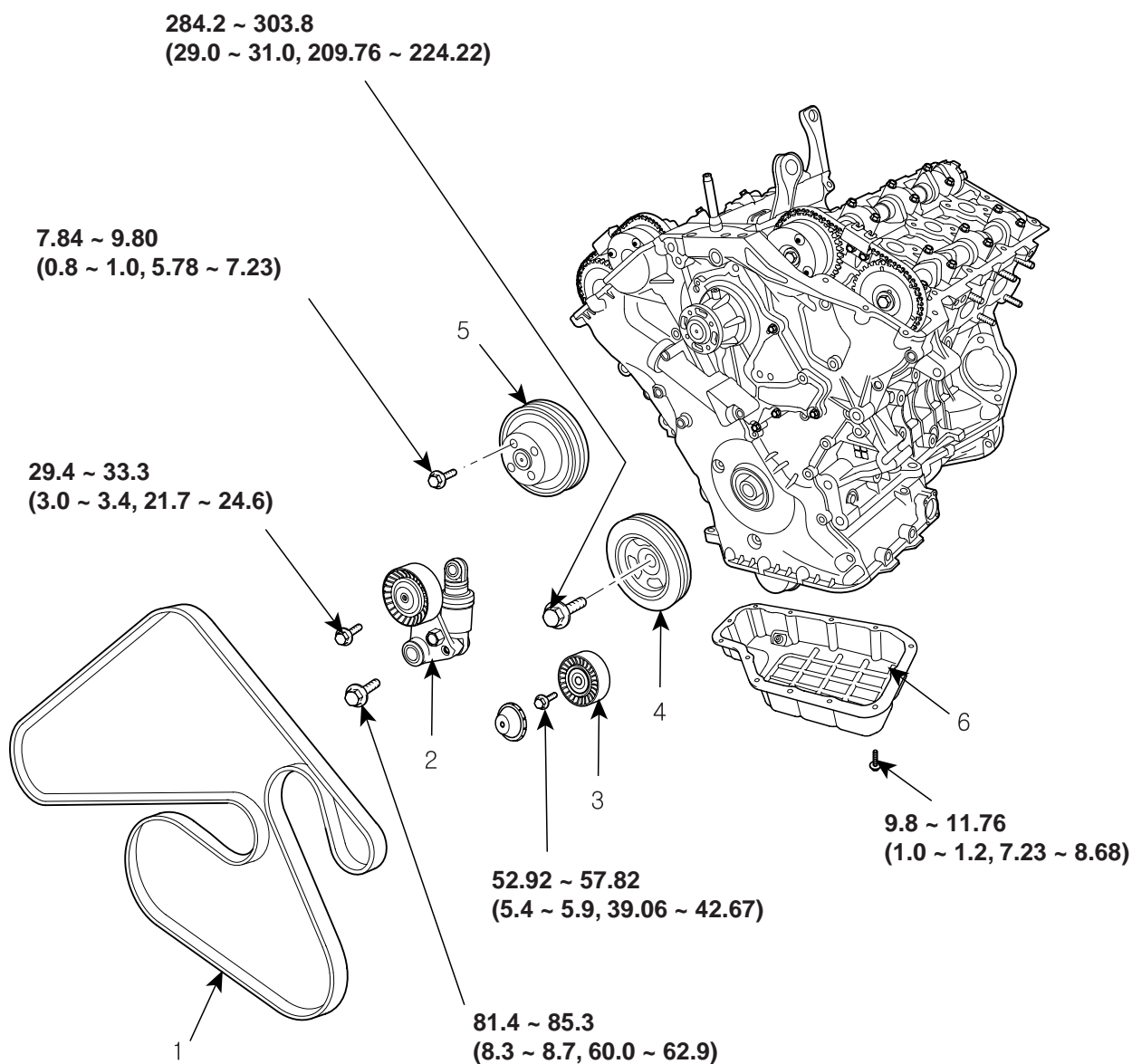
After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

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

TIMING SYSTEM

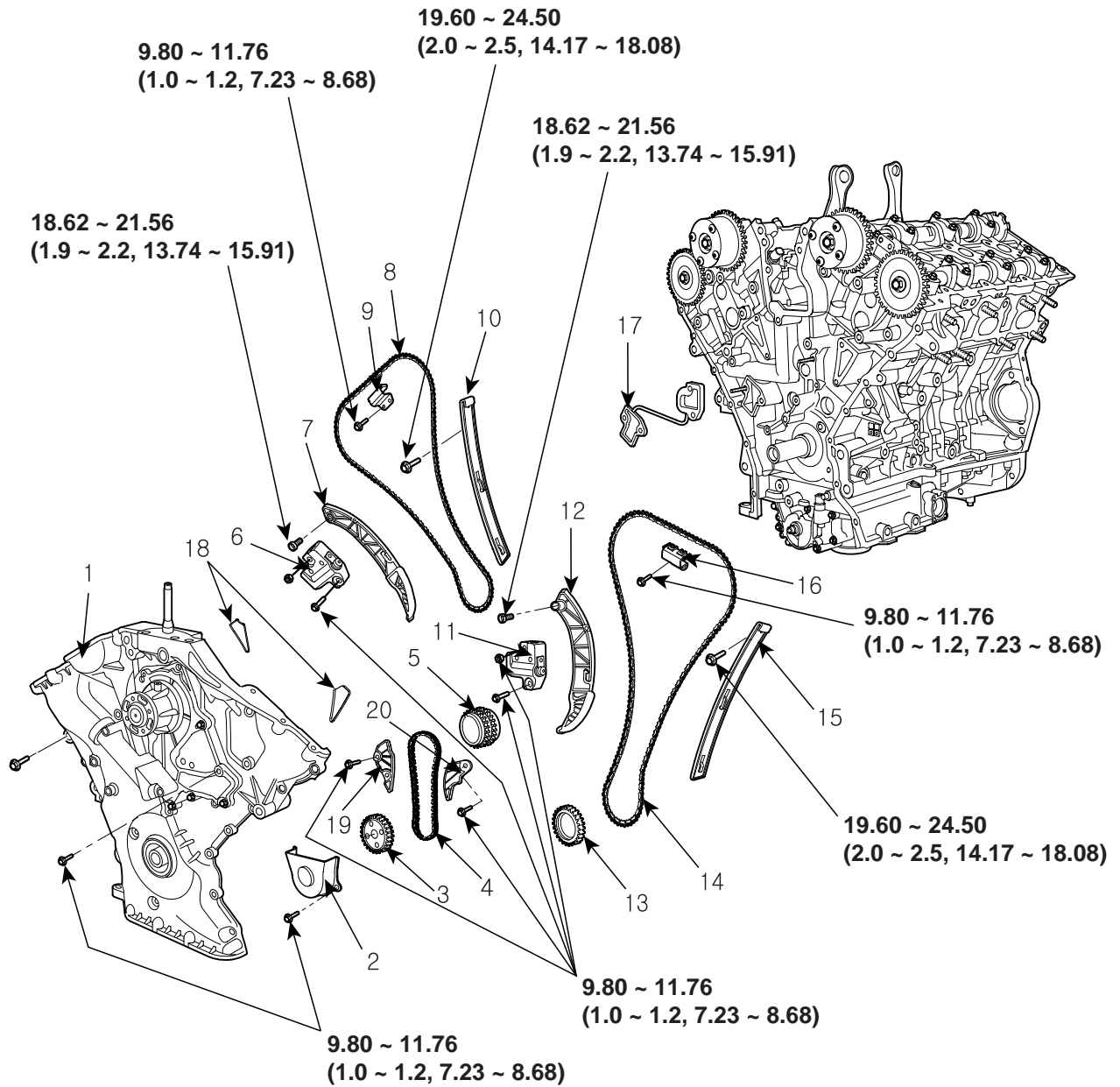
TIMING CHAIN

COMPONENTS EFFAFA9E



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

- 1. Drive belt
- 2. Drive belt tensioner
- 3. Idler
- 4. Damper pulley
- 5. Water pump pulley
- 6. Oil pan



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

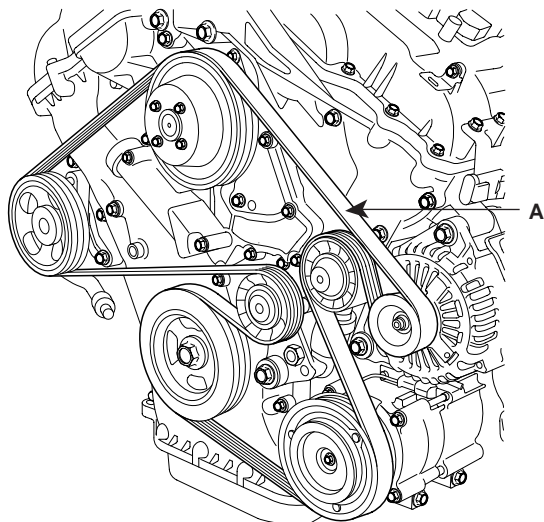
- | | | |
|--------------------------------|---------------------------------|---------------------------------|
| 1. Timing chain cover | 8. Timing chain | 15. Timing chain guide |
| 2. Oil pump chain cover | 9. Cam to cam guide | 16. Cam to cam guide |
| 3. Oil pump sprocket | 10. Timing chain guide | 17. Tensioner adapter |
| 4. Oil pump chain | 11. Timing chain auto tensioner | 18. Gasket |
| 5. Crankshaft sprocket | 12. Timing chain tensioner arm | 19. Oil pump chain guide |
| 6. Timing chain auto tensioner | 13. Crankshaft sprocket | 20. Oil pump tensioner assembly |
| 7. Timing chain tensioner arm | 14. Timing chain | |

EDRF002A

REMOVAL EE688815

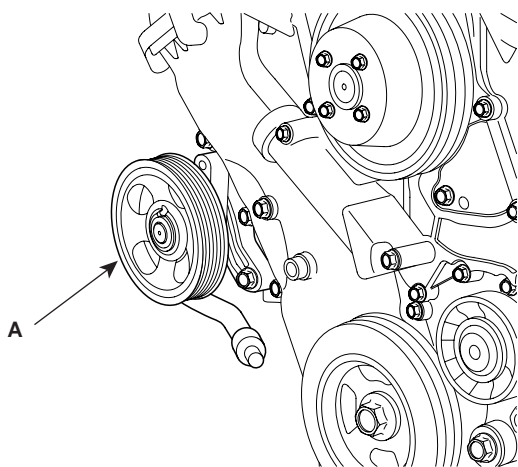
Engine removal is required for this procedure.

1. Remove the drive belt(A).



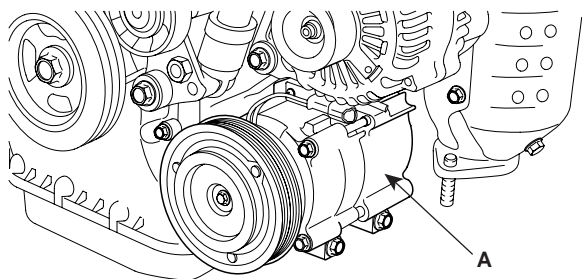
SBLM16101L

2. Remove the power steering pump(A).



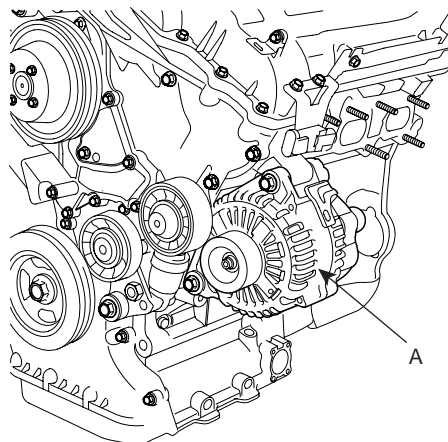
KDRF102A

3. Remove the air compressor(A).



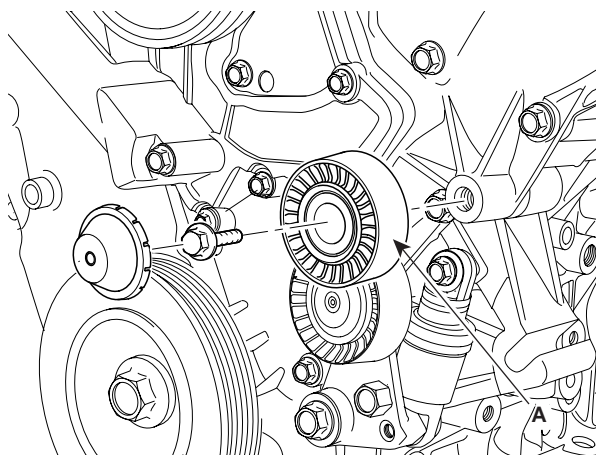
KDRF103A

4. Remove the alternator(A).



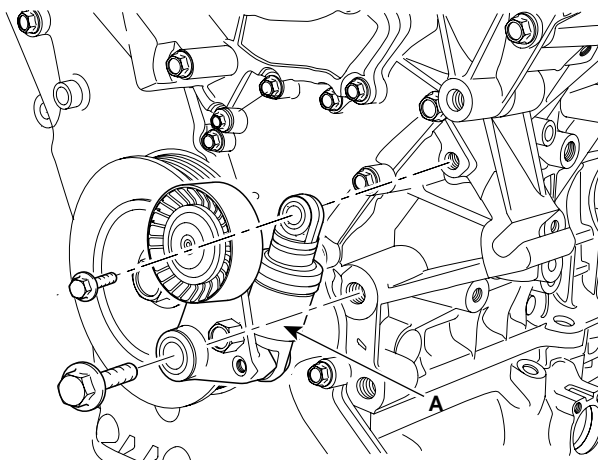
KDRF104A

5. Remove drive belt idler(A).



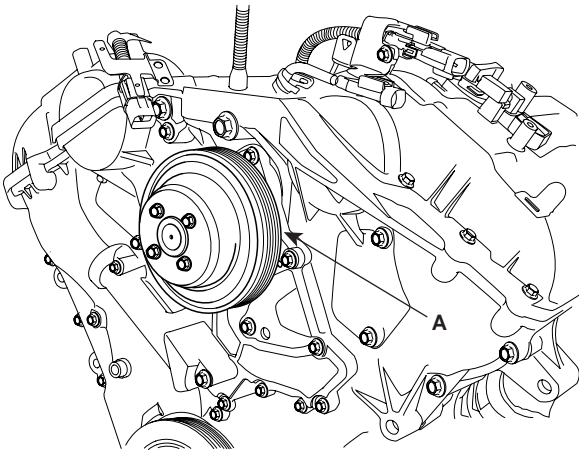
KDRF105A

6. Remove drive belt auto tensioner(A).



KDRF106A

7. Remove water pump pulley(A).



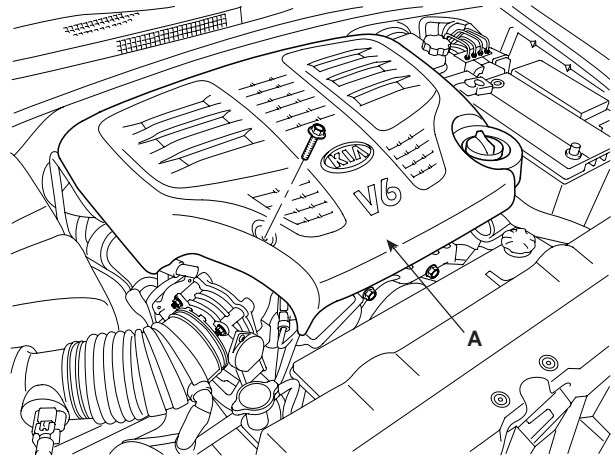
KDRF107A

8. Remove intake manifold.

DISASSEMBLY

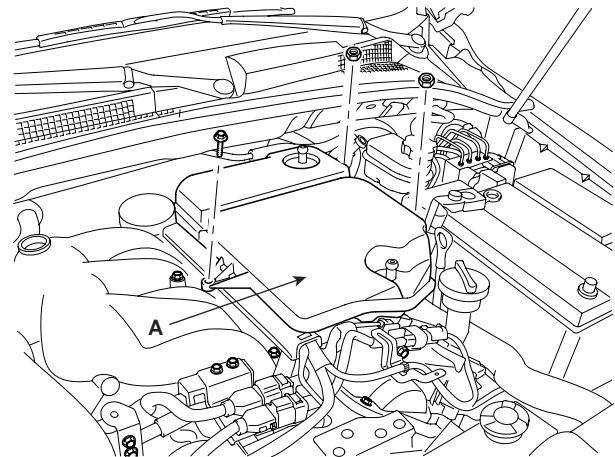
ECE9DBD5

1. Remove the engine cover.



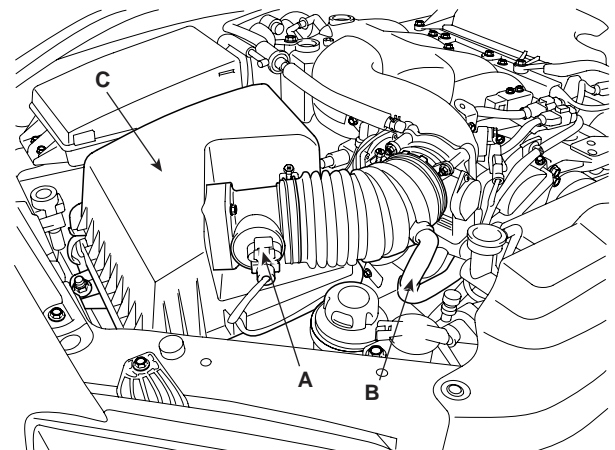
SBLM16001L

2. Remove the engine room resonator(A).



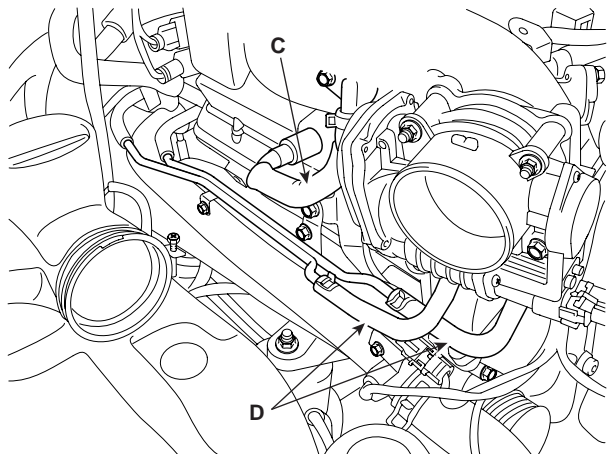
SBLM16003L

3. After disconnecting the MAF sensor connector(A) and the breather hose(B), remove the air cleaner assembly(C).

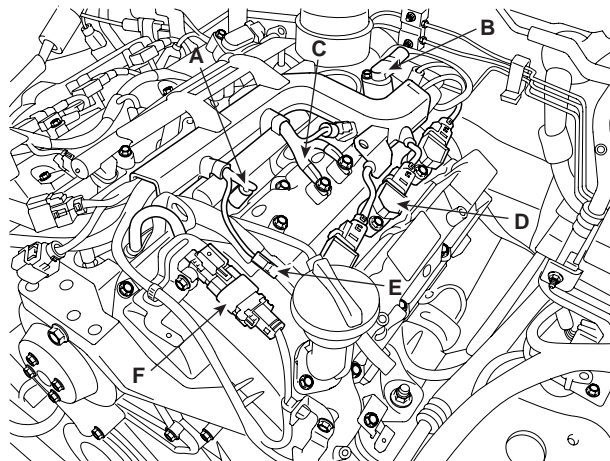


SBLM16002L

4. After disconnecting the other breather hose(A), the Purge Control Solenoid Valve(PCSV) hose(B), the Positive Crankcase Ventilation (PCV) hose(C) and the Electronic Throttle Control(ETC) cooling hoses(D), remove the surge tank assembly(E).

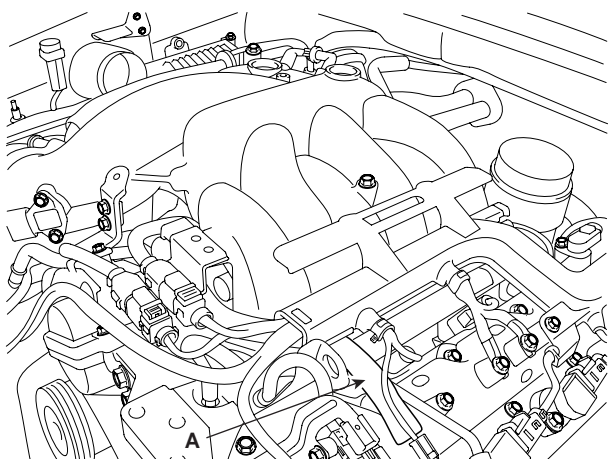


SBLM16004L

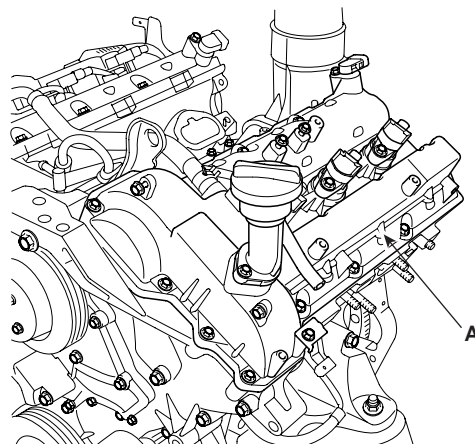


SBLM16006L

6. Loosen the cylinder head cover bolts and then remove the cover(A) and gasket.



SBLM16005L



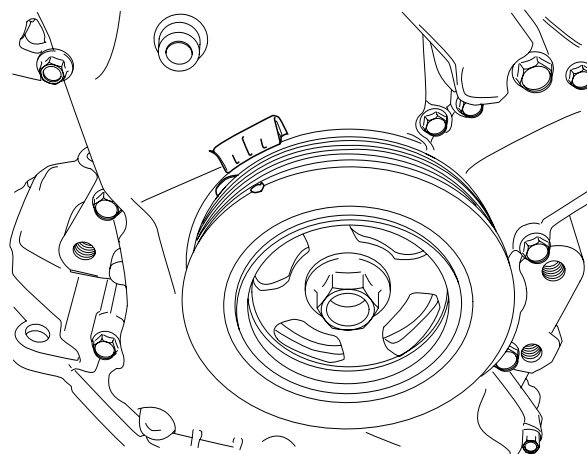
SBLM16007L

5. Remove the wiring over the surge tank.
- 1) Disconnect the injection harness connector(A).
 - 2) Disconnect the camshaft position sensor(CMP) harness connector(B).
 - 3) Disconnect the ground lines(C).
 - 4) Disconnect the ignition coil harness connector(D).
 - 5) Disconnect the condenser connector(E).
 - 6) Disconnect the oil control valve(OCV) harness connector(F).

7. Set No.1 cylinder to TDC/compression.
- a. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

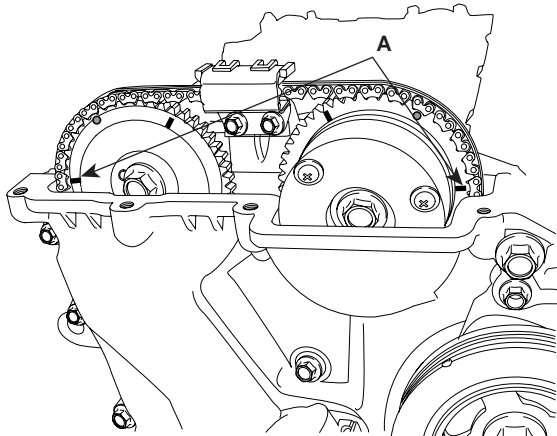
NOTE

Do not rotate engine counterclockwise.



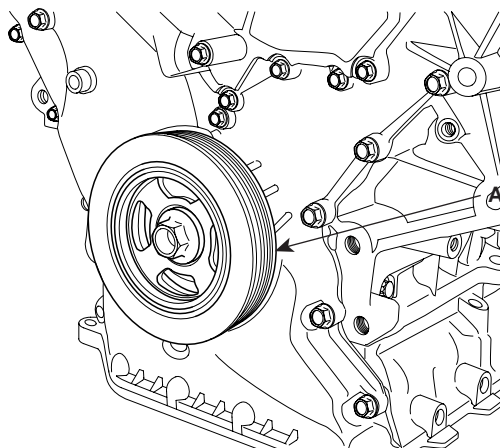
KDRF108A

- b. Check that the mark(A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft one revolution (360°).



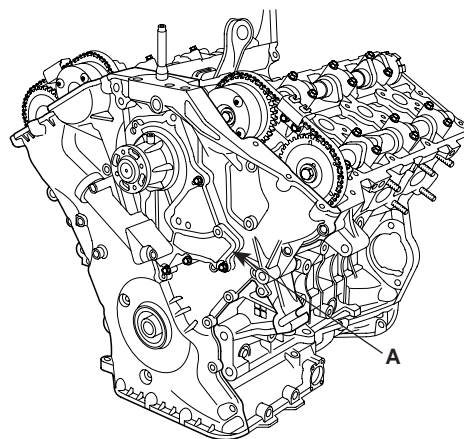
KDRF113A

9. Remove the crankshaft damper pulley(A).



KDRF109A

10. Remove the timing chain cover(A).

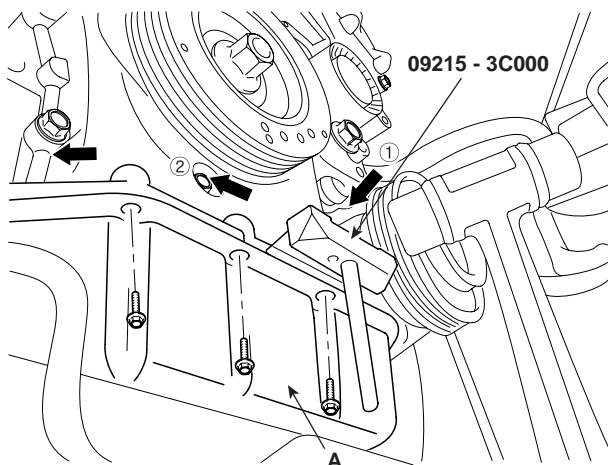


KDRF115A

NOTE

Do not rotate engine counterclockwise.

8. Remove the lower oil pan(A). Insert the blade of SST(09215-3C000) between the upper oil pan and lower oil pan, and cut off applied sealer and removed lower oil pan.



SBLM16019L

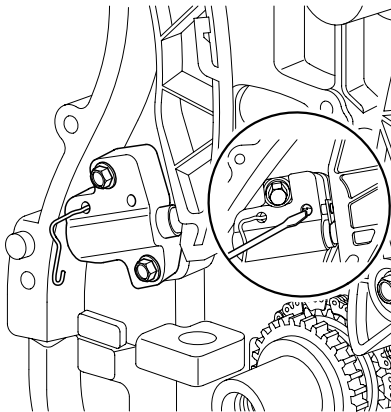
CAUTION

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of arrow.
- After tapping the SST with a plastic hammer along the direction of 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 can result in damage of the SST.

NOTE

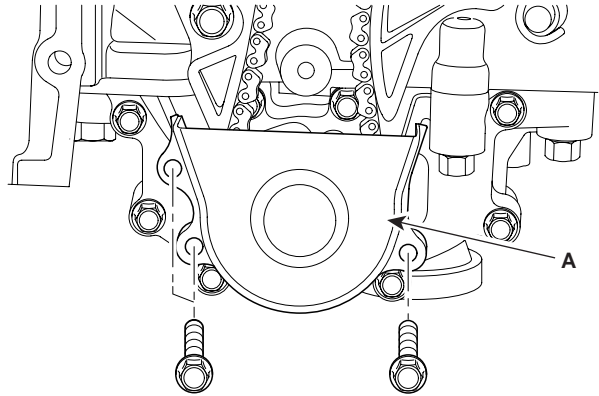
- Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.
- Mark on the timing chain on the basis of the marking on sprocket and CVVT.

11. Install a set pin after compressing the timing chain tensioner.



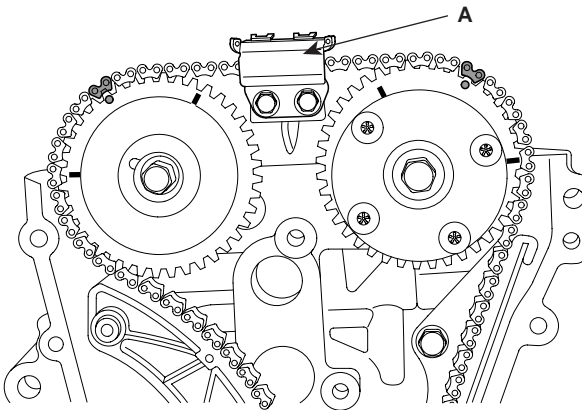
KCRF105A

14. Remove oil pump chain cover(A).



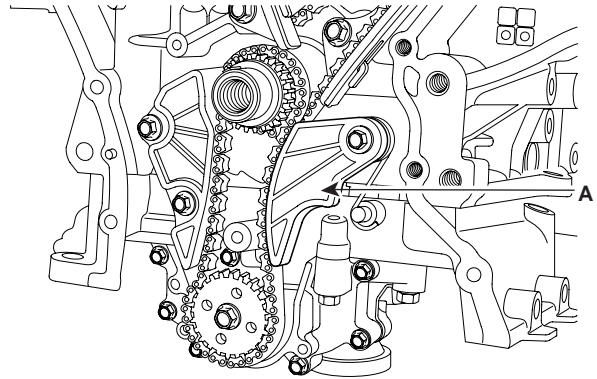
KDRF185A

12. Remove RH cam-to-cam guide(A).



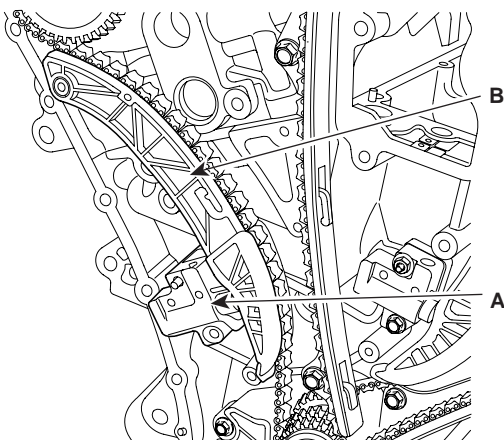
KDRF116A

15. Remove oil pump chain tensioner assembly(A).



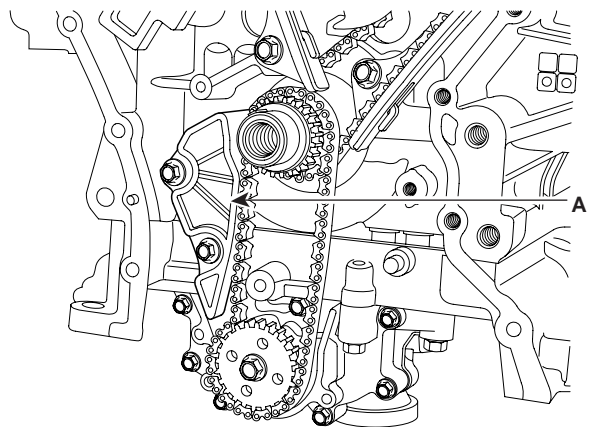
KDRF119A

13. Remove RH timing chain auto tensioner(A) and RH timing chain tensioner arm(B).



KDRF117A

16. Remove oil pump chain guide(A).

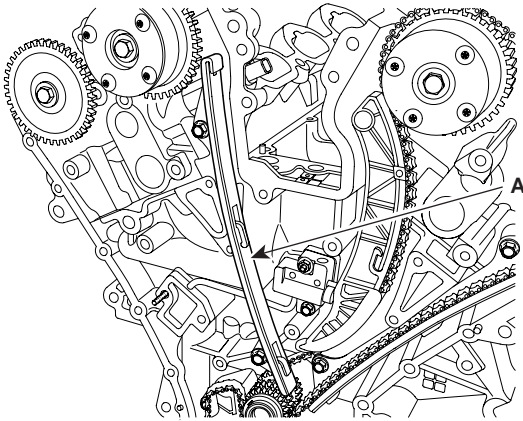


KDRF120A

17. Remove RH timing chain.

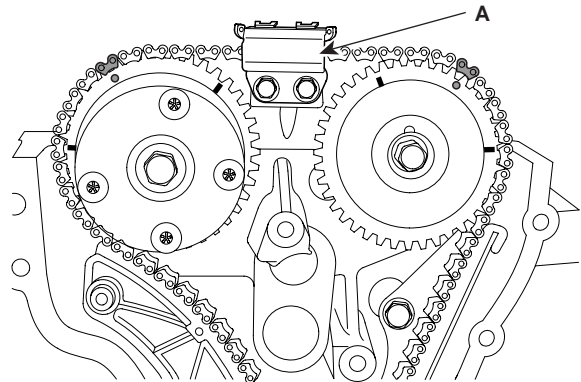
TIMING SYSTEM

18. Remove RH timing chain guide(A).



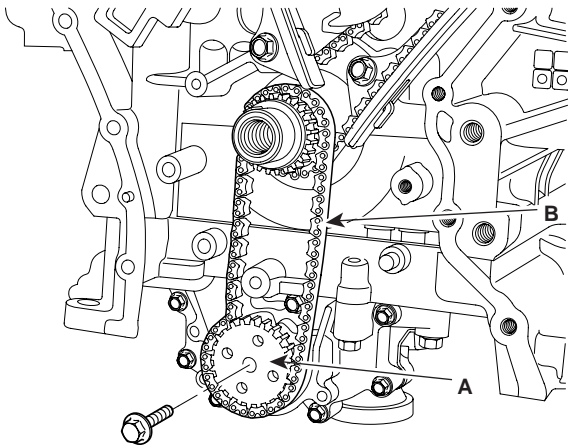
KDRF118A

21. Remove LH cam-to-cam guide(A).



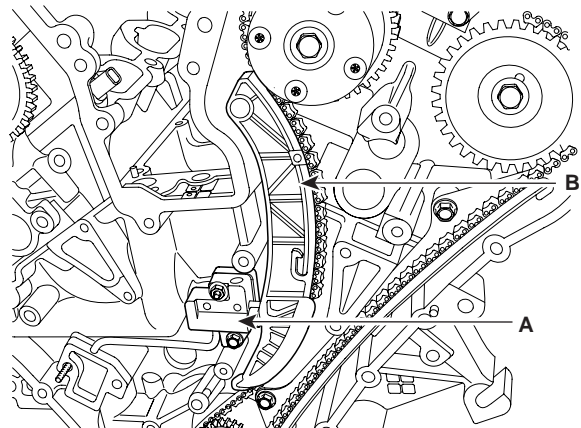
KDRF123A

19. Remove oil pump chain sprocket(A) and oil pump chain(B).



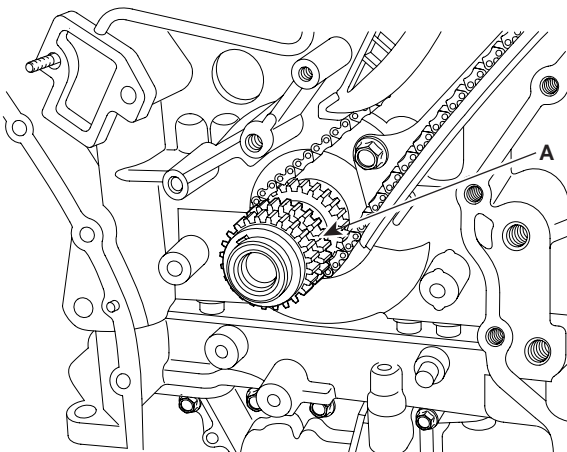
KDRF121A

22. Remove LH timing chain auto tensioner(A) and LH timing chain tensioner arm(B).



KDRF124A

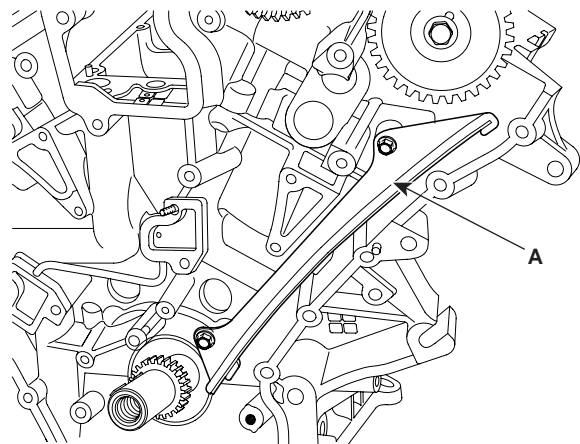
20. Remove crankshaft sprocket(A)(O/P & RH camshaft drive).



KDRF122A

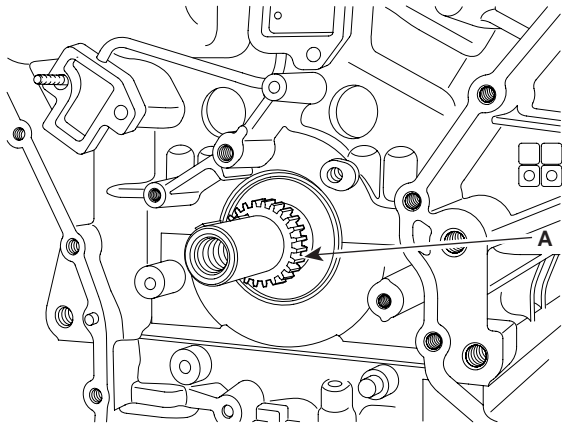
23. Remove LH timing chain.

24. Remove LH timing chain guide(A).



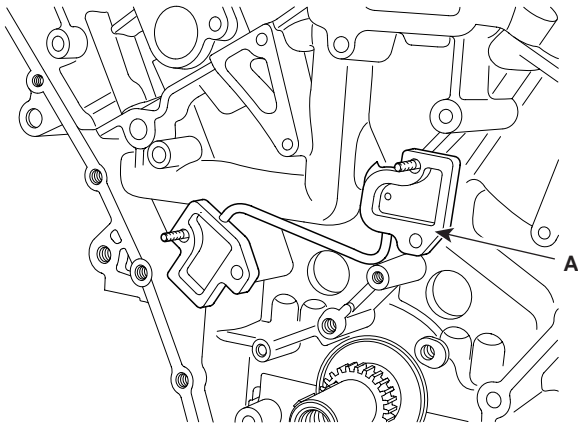
KDRF125A

25. Remove crankshaft sprocket(A)(LH camshaft drive).



KDRF126A

26. Remove tensioner adapter assembly(A).



KDRF127A

INSPECTION E33C7CDB

SPROCKETS, CHAIN TENSIONER, CHAIN GUIDE, CHAIN TENSIONER ARM

1. Check the camshaft 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.

BELT, IDLER, BELT TENSIONER, PULLEY

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

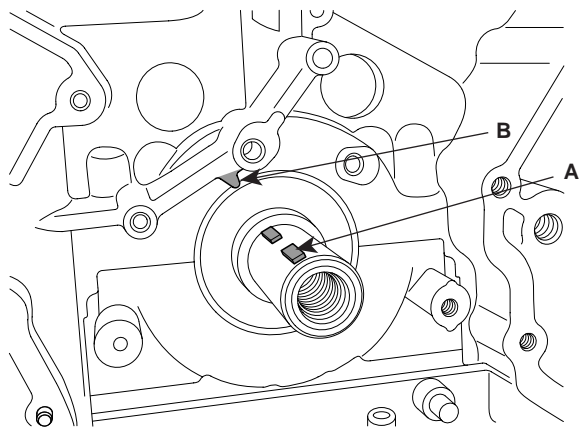
NOTE

- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water and steam.

3. Inspect the idler for easy and smooth rotation and check for play or noise.

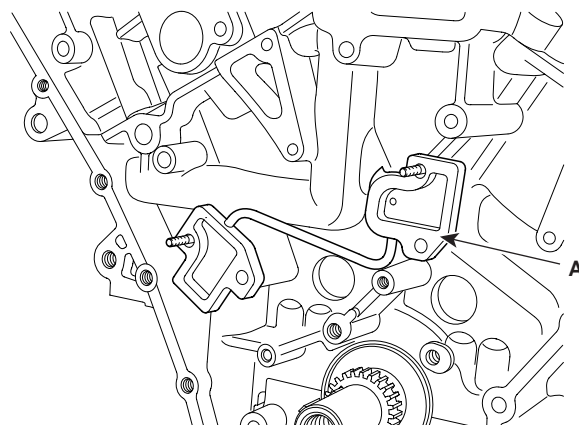
REASSEMBLY E0BF1C9F

1. The key(A) of crankshaft should be aligned with the timing mark(B) of timing chain cover. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



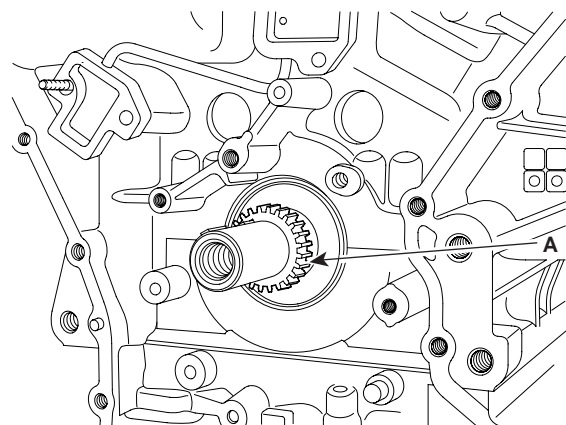
KDRF128A

2. Install tensioner adapter assembly(A).



KDRF127A

3. Install crankshaft sprocket(A)(LH camshaft drive).

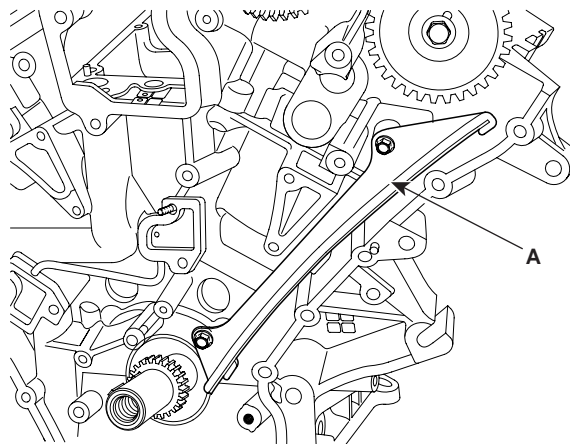


KDRF126A

4. Install LH timing chain guide(A).

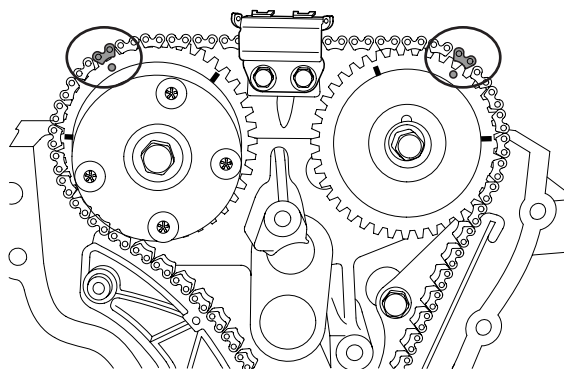
Tightening torque

19.60 ~ 24.50Nm(2.0 ~ 2.5kgf.m, 14.17 ~ 18.08lb-ft)



KDRF125A

5. Install LH timing chain.
To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure.
Crankshaft sprocket(A) Timing chain guide(B)
Exhaust camshaft sprocket(C) Intake camshaft sprocket(D).
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain.



KDRF123B

6. Install LH timing chain tensioner arm(B).

Tightening torque

18.62 ~ 21.56Nm(1.9 ~ 2.2kgf.m, 13.74 ~ 15.91lb-ft)

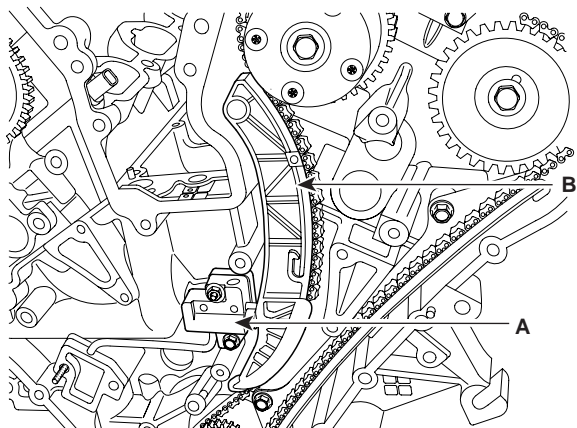
EMA -32

ENGINE MECHANICAL SYSTEM

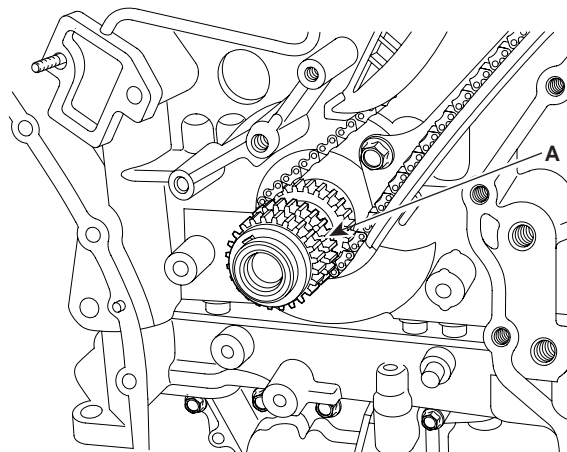
7. Install chain tensioner(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF124A



KDRF122A

10. Install oil pump chain(B) and oil pump sprocket(A).

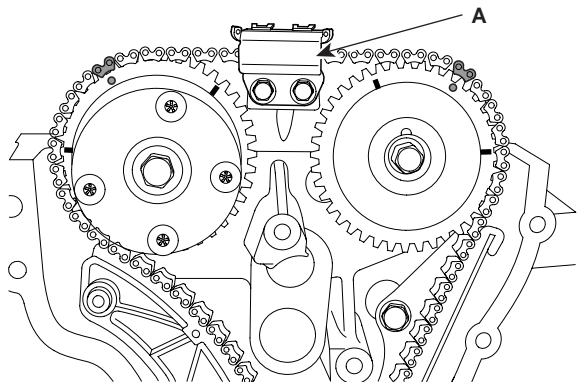
Tightening torque

18.62 ~ 21.56Nm(1.9 ~ 2.2kgf.m, 13.74 ~ 15.91lb-ft)

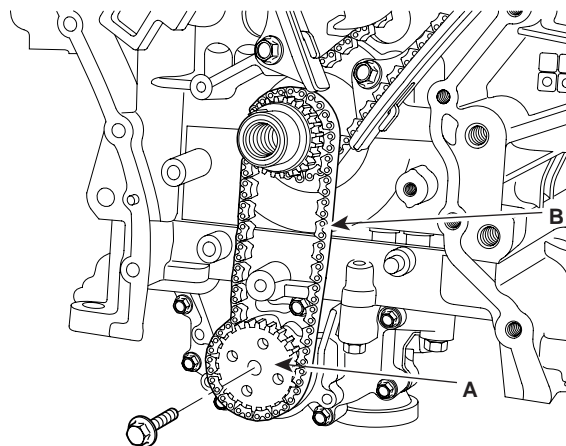
8. Install LH cam-to-cam guide(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF123A



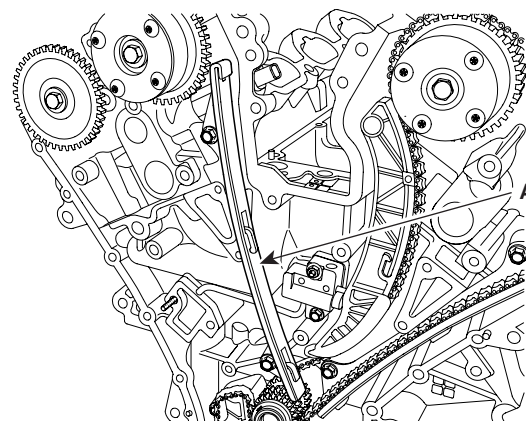
KDRF121A

11. Install RH timing chain guide(A).

Tightening torque

19.60 ~ 24.50Nm(2.0 ~ 2.5kgf.m, 14.17 ~ 18.08lb-ft)

9. Install crankshaft sprocket(A)(O/P & RH camshaft drive).

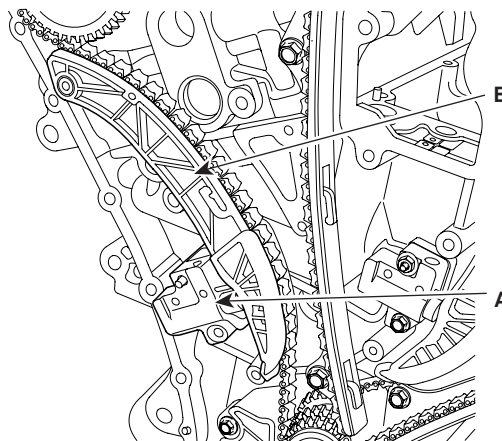


KDRF118A

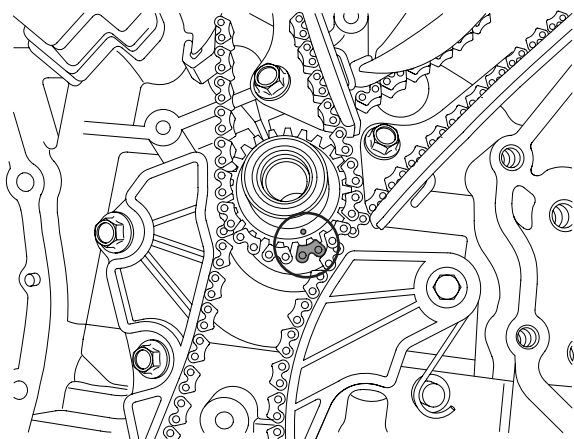
TIMING SYSTEM

12. Install RH timing chain.

To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure.
Crankshaft sprocket(A) Intake camshaft sprocket(B) Exhaust camshaft sprocket(C).
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain.



KDRF117A

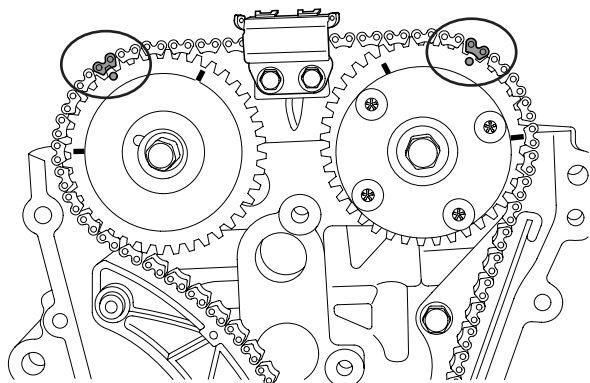


KDRF129A

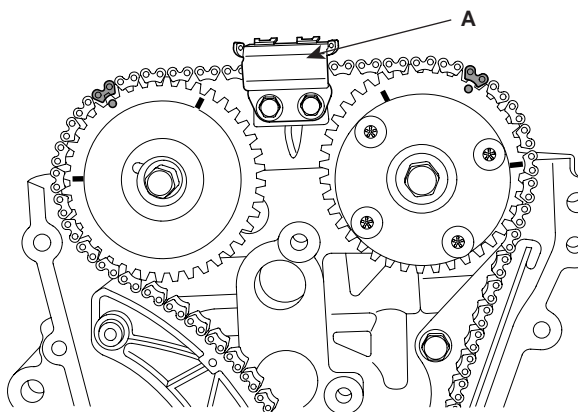
15. Install RH cam-to-cam guide(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF116B



KDRF116A

13. Install RH timing chain tensioner arm(B).

14. Install RH timing chain auto tensioner(A).

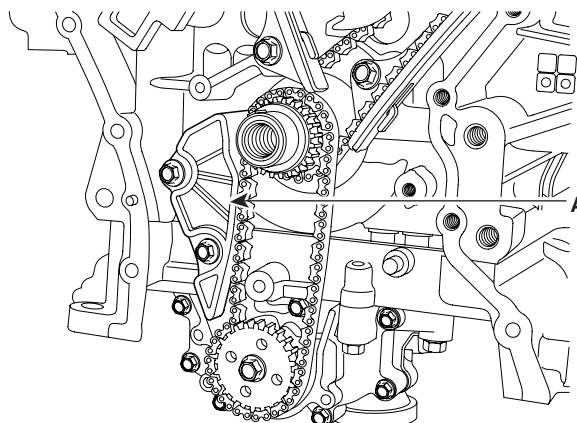
Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

16. Install oil pump chain guide(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

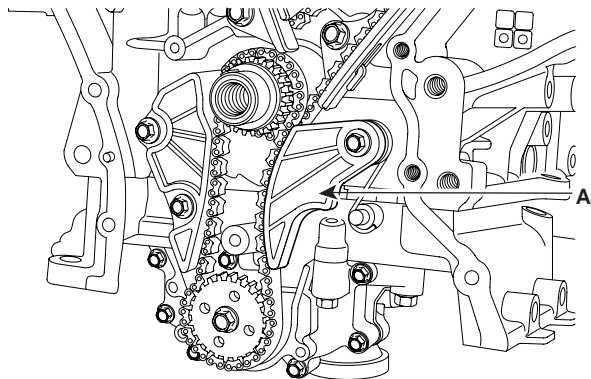


KDRF120A

17. Install oil pump chain tensioner assembly(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



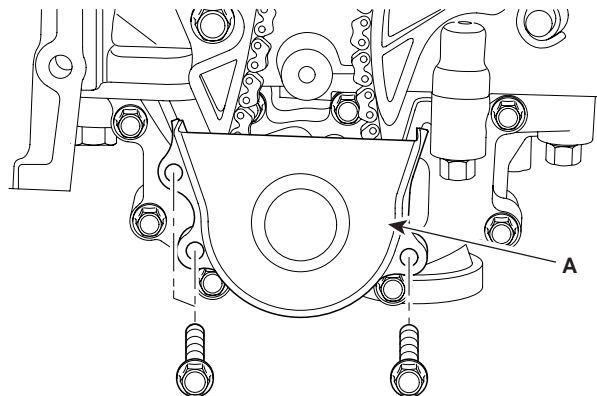
KDRF119A

18. Pull out the pins of hydraulic tensioner (LH & RH).

19. Install oil pump chain cover(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF185A

20. After rotating crankshaft 2 revolutions in regular direction(clockwise viewed from front), confirm the timing mark.

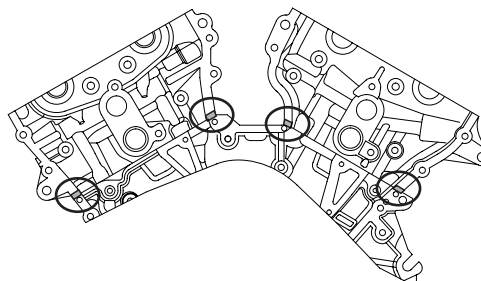
NOTE

Always turn the crankshaft clockwise.

21. Install timing chain cover.

- a. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and lower oil pan) must be free of engine oil and ETC.
- b. Before assembling the timing chain cover, the liquid sealant TB1217H should be applied on the gap between cylinder head and cylinder block. The part must be assembled within 5 minutes after sealant was applied.

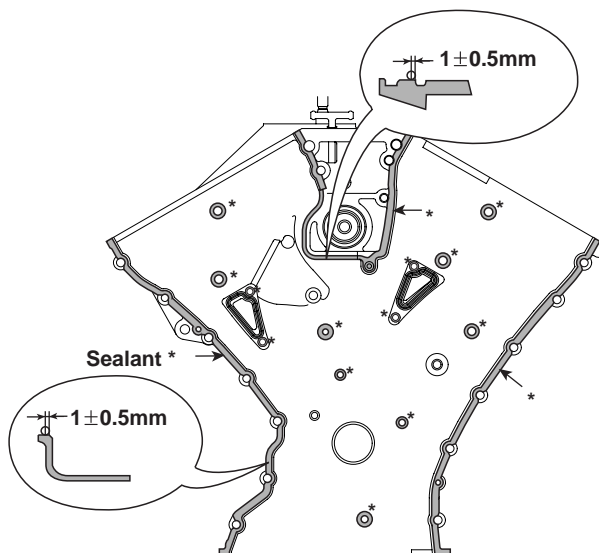
Bead width : 2.5mm(0.1in.)



KDRF134A

- c. After applying liquid sealant TB1217H on timing chain cover. The part must be assembled within 5 minutes after sealant was applied. Sealant should be applied without discontinuity. Sealant should also be applied all around the two holes of the dowel pins.

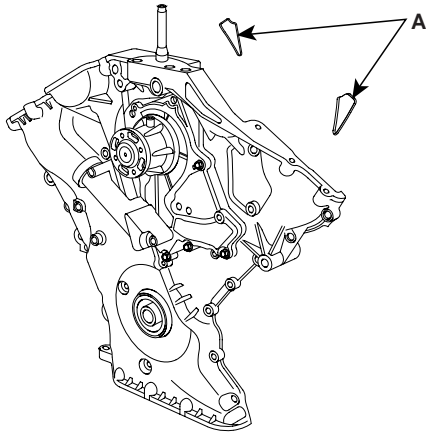
Bead width : 2.5mm(0.1in.)



SBLM16200L

TIMING SYSTEM

- d. Install the new gasket(A) to the timing chain cover.

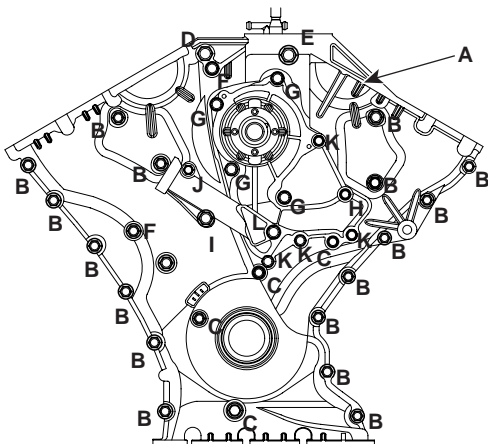


KDRF220A

- e. 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

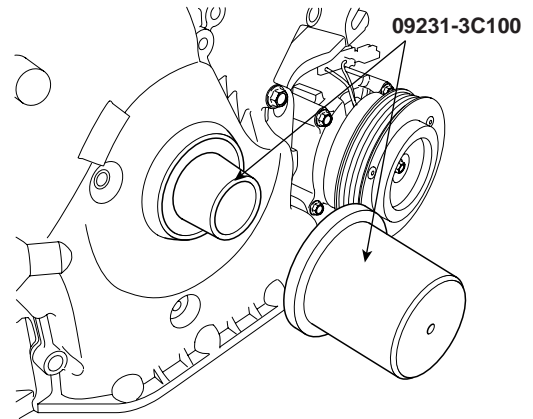
- B(17): 18.62 ~ 21.56Nm(1.9 ~ 2.2kgf.m, 13.74 ~ 15.91lb-ft)
- C(4): 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)
- D(1): 58.80 ~ 68.80Nm(6.0 ~ 7.0kgf.m, 43.40 ~ 50.63lb-ft)
- E(1): 58.80 ~ 68.80Nm(6.0 ~ 7.0kgf.m, 43.40 ~ 50.63lb-ft)
- F(2): 24.50 ~ 26.46Nm(2.5 ~ 2.7kgf.m, 18.08 ~ 19.53lb-ft)
- G(4): 21.56 ~ 23.52Nm(2.2 ~ 2.4kgf.m, 15.91 ~ 17.36lb-ft)
- H(1): 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)
- I(1): 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)
- J(1): 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)
- K(4): 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)
- L(1): 21.56 ~ 26.46Nm(2.2 ~ 2.7kgf.m, 15.91 ~ 19.53lb-ft) - New bolt



ECBF033A

- f. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.

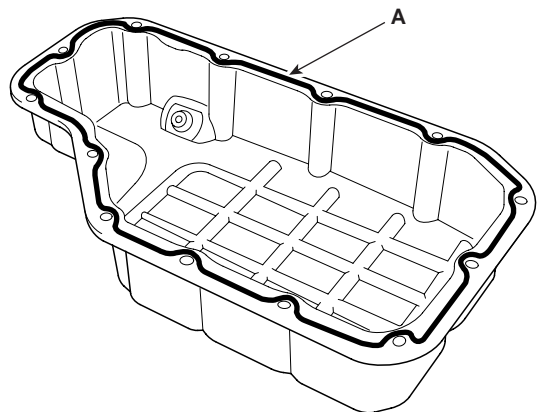
- 22. Using SST(09231-3C100), install timing chain cover oil seal.



ECRF050A

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

Bead width : 2.5mm(0.1in.).

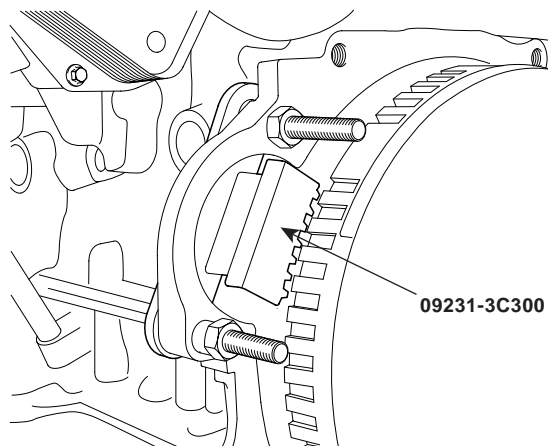


SBLM16020L

CAUTION

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket of the inner threads of the bolt holes.

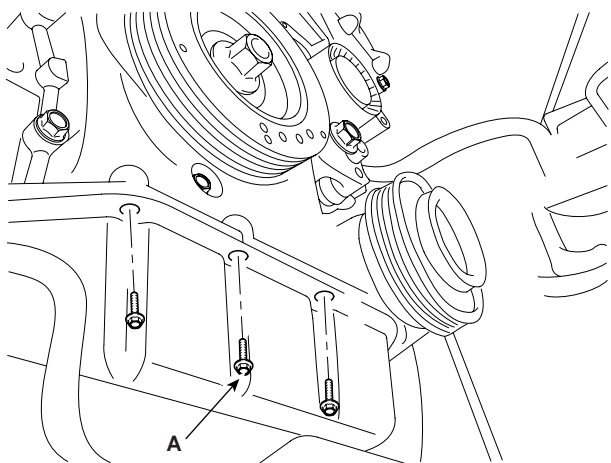
- e. Install oil pan(A).
Uniformly tighten the bolts in several passes.



ECRF061A

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



SBLM16102L

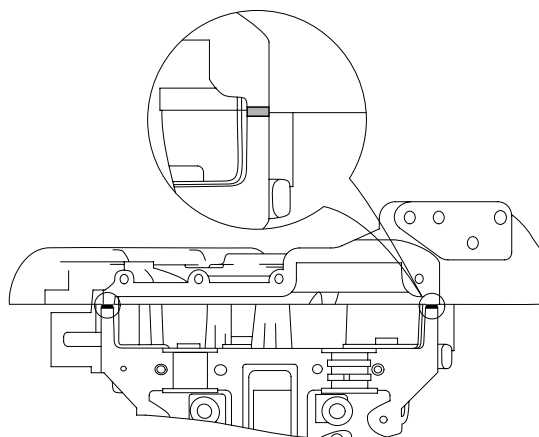
24. Using SST(09231-3C300) install crankshaft damper pulley(A).

Tightening torque

284.2 ~ 303.8Nm(29.0 ~ 31.0kgf.m, 209.76 ~ 224.22lb-ft)

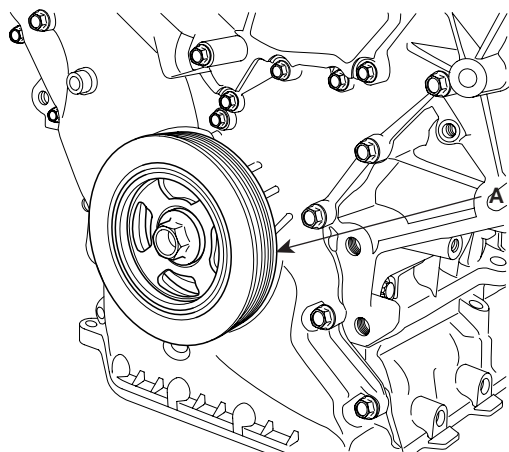
25. Install cylinder head cover.

- a. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- b. After applying sealant(TB1217H), it should be assembled within 5 minutes. Bead width : 2.5mm(0.1in.)



KDRF231A

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

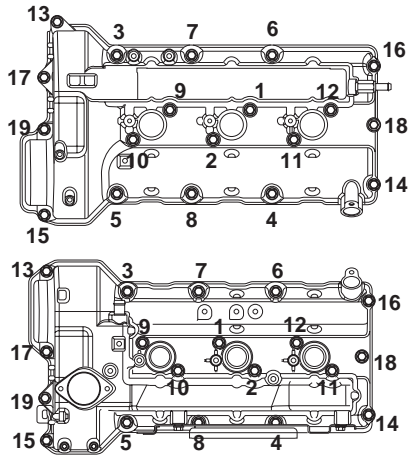


KDRF109A

- d. Install the cylinder head cover bolts as following method.

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

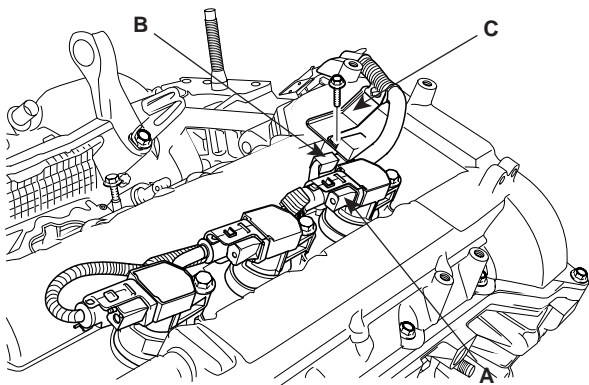


SBLM16201L

CAUTION

Do not reuse cylinder head cover gasket.

- e. Install ignition coil
- f. Connect RH ignition coil connector(A), condenser connector(B) and install wiring bracket(C).



KDRF111A

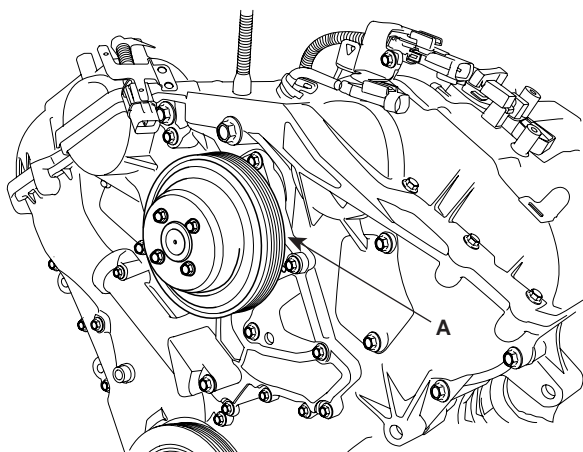
- g. Install connector bracket from LH cylinder head cover.

INSTALLATION E0ED79CB

1. Install intake manifold.
2. Install water pump pulley(A).

Tightening torque

7.84 ~ 9.80Nm(0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lb-ft)

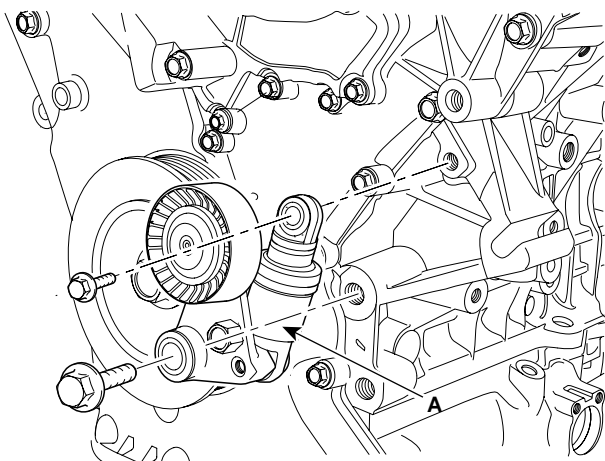


KDRF107A

3. Install drive belt auto tensioner(A).

Tightening torque

81.4 ~ 85.3Nm(8.3 ~ 8.7kgf.m, 60.0 ~ 62.9lb-ft)
29.4 ~ 33.3Nm(3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft)

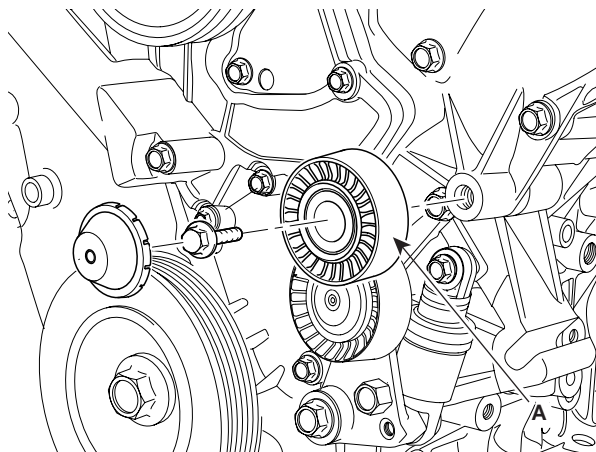


KDRF106A

4. Install drive belt idler(A).

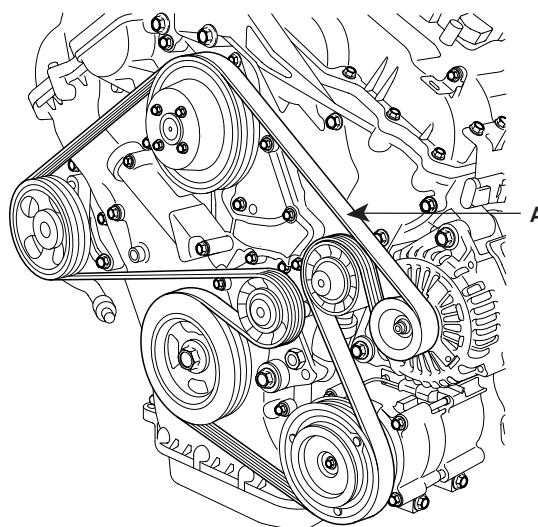
Tightening torque

52.92 ~ 57.82Nm(5.4 ~ 5.9kgf.m, 39.06 ~ 42.67lb-ft)



KDRF105A

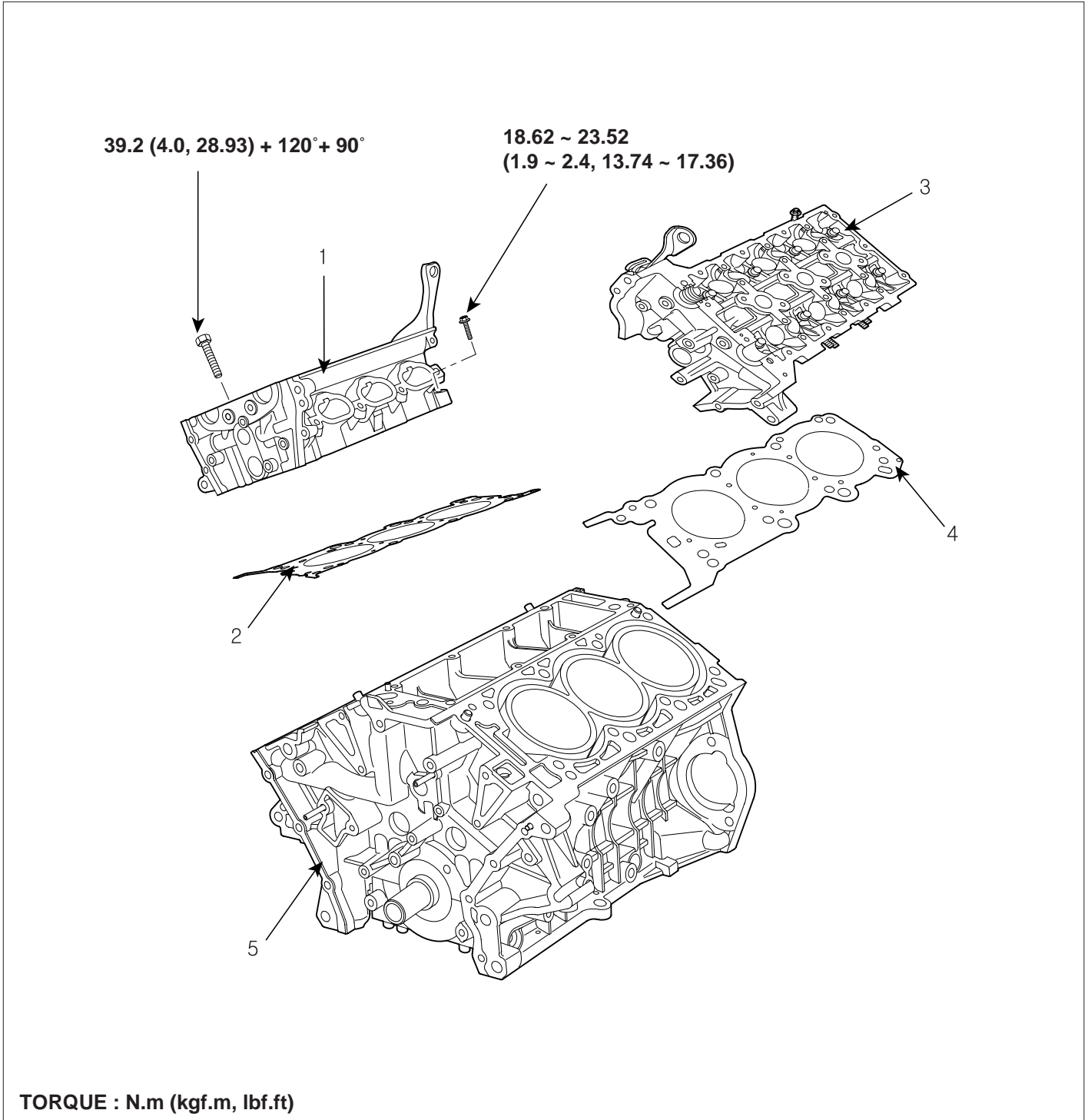
5. Install alternator
6. Install air compressor
7. Install power steering pump.
8. Install drive belt(A).
Crankshaft pulley A/C pulley idler pulley alternator pulley water pump pulley P/S pump pulley tensioner pulley.
Rotate auto tensioner arm in the counter - clockwise moving auto tensioner pulley bolt with wrench.
After putting belt on auto tensioner pulley, release the auto tensioner pulley slowly.



SBLM16101L

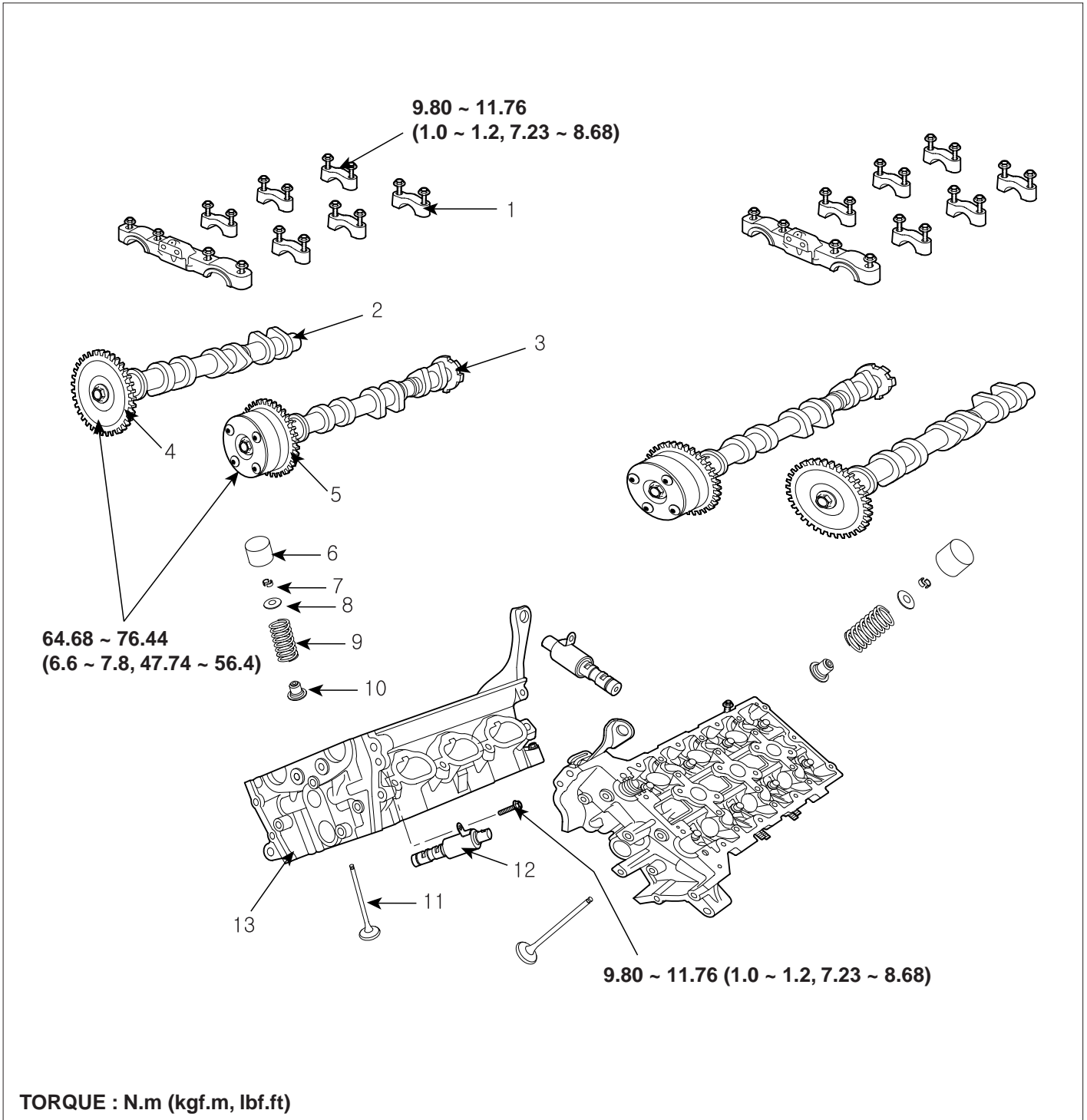
CYLINDER HEAD ASSEMBLY

COMPONENTS EEECDC0



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

- 1. RH cylinder head
- 2. RH cylinder head gasket
- 3. LH cylinder head
- 4. LH cylinder head gasket
- 5. Cylinder block



- | | | |
|------------------------------|---------------------|-------------------|
| 1. Camshaft bearing cap | 6. MLA | 11. Valve |
| 2. Exhaust camshaft | 7. Retainer lock | 12. OCV |
| 3. Intake camshaft | 8. Retainer | 13. Cylinder head |
| 4. Exhaust camshaft sprocket | 9. Valve spring | |
| 5. CVVT assembly | 10. Valve stem seal | |

EDRF004A

CYLINDER HEAD ASSEMBLY

EMA -41

REMOVAL EC0F8ABA

CAUTION

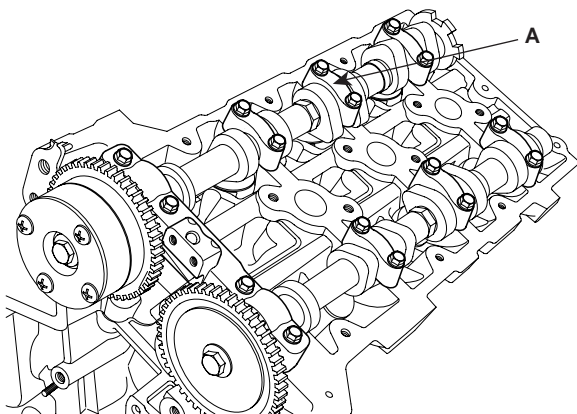
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To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

NOTE

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

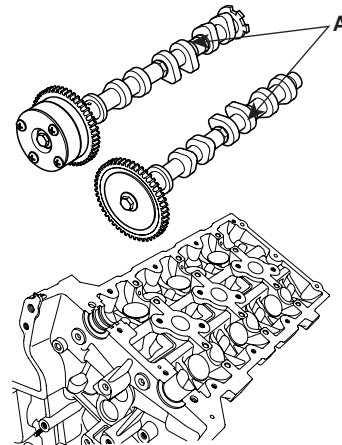
Engine removal is required for this procedure.

1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove camshaft bearing cap(A).



KDRF196A

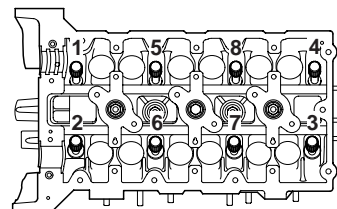
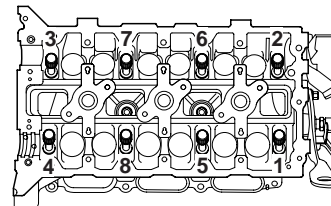
6. Remove camshaft assembly(A).



KDRF197A

7. Remove cylinder head bolts, then remove cylinder head.

- 1) Uniformly loosen and remove the 16 cylinder head bolts, in several passes, in the sequence shown. Remove the 16 cylinder head bolts and plate washers.



KDRF199A

CAUTION

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

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

CAUTION

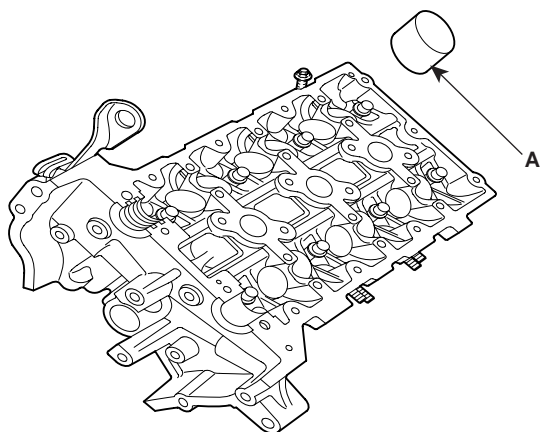
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

DISASSEMBLY EC0C0D1E

 **NOTE**

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

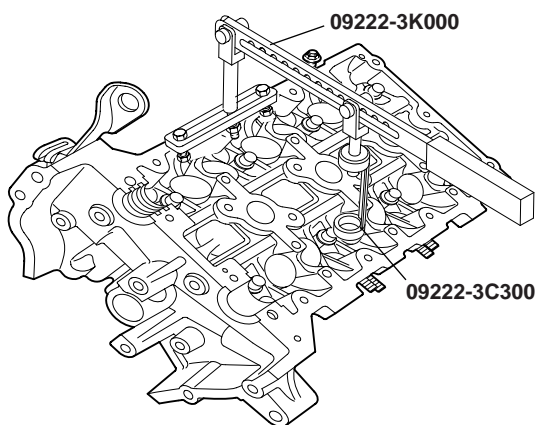
1. Remove MLAs(A).



KDRF200A

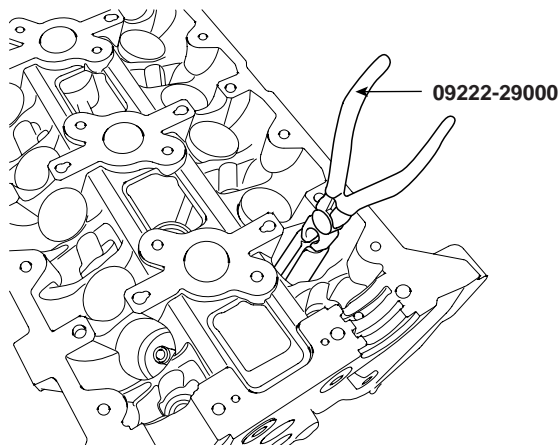
2. Remove valves.

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



KDRF201A

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

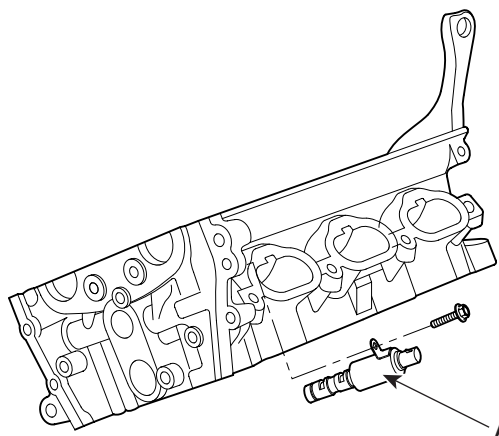


KDRF234A

 **NOTE**

Do not reuse old valve stem seals.

3. Remove OCV(A).



KDRF202A

INSPECTION EA4BD93A

CYLINDER HEAD

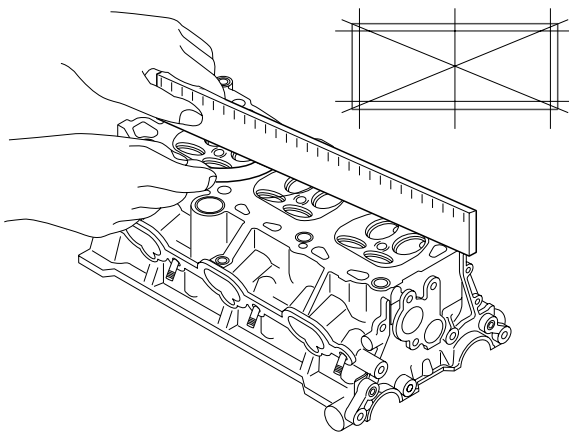
1. Inspect for flatness.
Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface

Standard : Less than 0.05mm(0.002in.) [Less than 0.02mm(0.0008in.)/150x150]

Flatness of manifold gasket surface

Standard : Less than 0.03mm(0.001in.)/110x110



EDQF160A

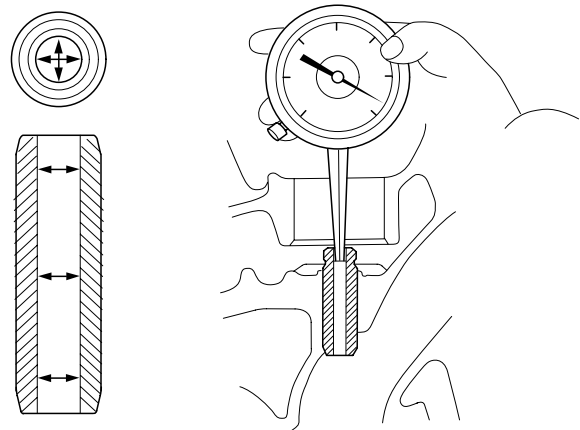
2. Inspect for cracks.
Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

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 I.D.

Intake / Exhaust : 5.500 ~ 5.512mm (0.216 ~ 0.217in.)



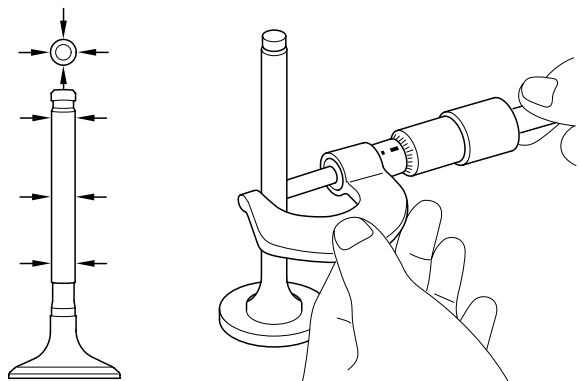
ECBF034A

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

Valve stem O.D.

Intake : 5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)

Exhaust : 5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)



KCRF227A

- 3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance

[Standard]

Intake : 0.020 ~ 0.047mm (0.0008 ~ 0.0018in.)

Exhaust : 0.030 ~ 0.054mm (0.0012 ~ 0.0021in.)

[Limit]

Intake : 0.07mm (0.0027in.)

Exhaust : 0.09mm (0.0035in.)

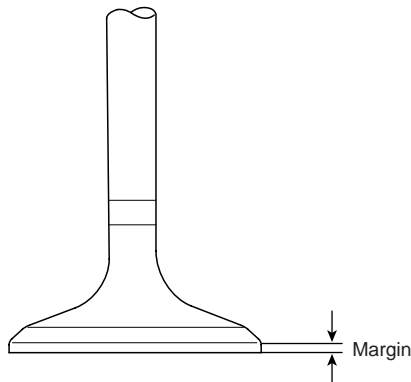
2. Inspect valves.
 - 1) Check the valve is ground to the correct valve face angle.
 - 2) Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
 - 3) Check the valve head margin thickness. If the margin thickness is less than minimum, replace the valve.

Margin

[Standard]

Intake : 1.56 ~ 1.86mm(0.06142 ~ 0.07323in.)

Exhaust : 1.73 ~ 2.03mm(0.06811 ~ 0.07992in.)



ECKD221A

- 4) Check the valve length.

Length

Intake : 105.27mm (4.1445in)

Exhaust : 105.50mm (4.1535in)

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

3. Inspect valve seats
Check the valve seat for evidence of overheating and improper contact with the valve face.

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

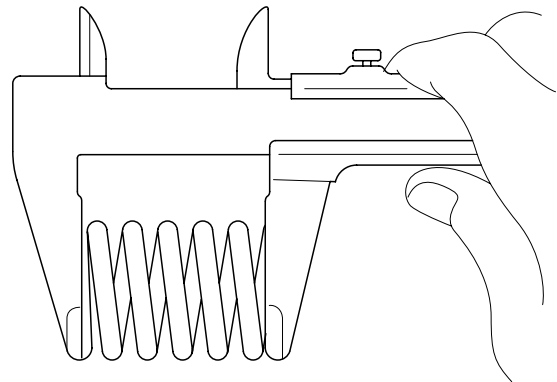
4. Inspect valve springs.
 - 1) Using a steel square, measure the out-of-square of the valve spring.
 - 2) Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 43.86mm (1.7267in.)

Out-of-square : 1.5°



KCRF205A

CYLINDER HEAD ASSEMBLY

EMA -45

MLA

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

MLA O.D.

Intake/Exhaust : 34.964 ~ 34.980mm(1.3765 ~ 1.3771in.)

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

Tappet bore I.D.

Intake/Exhaust : 35.000 ~ 35.025mm(1.3779 ~ 1.3789in.)

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

MLA to tappet bore clearance

[Standard]

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

[Limit]

Intake/Exhaust : 0.07mm(0.0027in.)

CAMSHAFT

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

Cam height

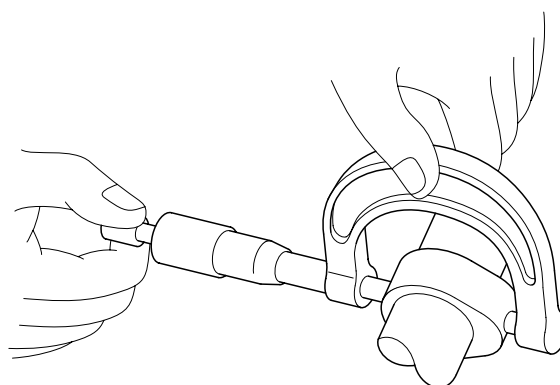
[Standard value]

Intake :

46.3mm (1.8228in.)(3.3L)

46.8mm (1.8425in.)(3.8L)

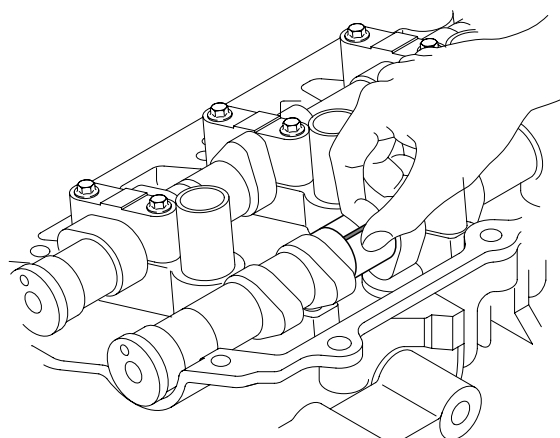
Exhaust : 45.8mm (1.8031in.)



KCRF206A

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

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



KCRF207A

- 4) Install the bearing caps.

 **CAUTION**

Do not turn the camshaft.

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

Bearing oil clearance

[Standard value]

Intake

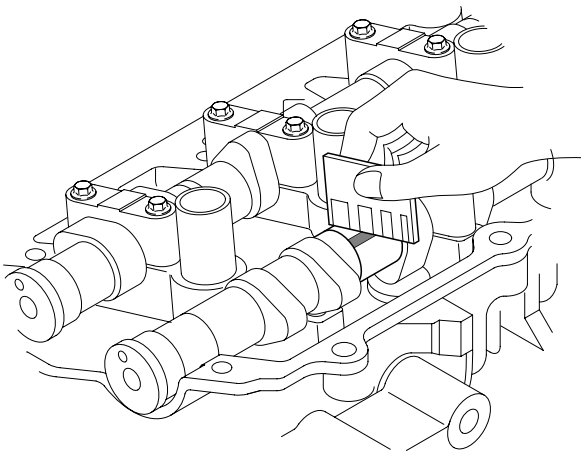
No.1 journal : 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.)

No.2,3,4,, journal : 0.030 ~ 0.067mm
(0.0012 ~ 0.0026in.)

Exhaust

No.1 journal : 0.020 ~ 0.057mm (0.0008 ~ 0.0022in.)

No.2,3,4,, journal : 0.030 ~ 0.067mm
(0.0012 ~ 0.0026in.)



KCRF208A

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.

3. Inspect camshaft end play.

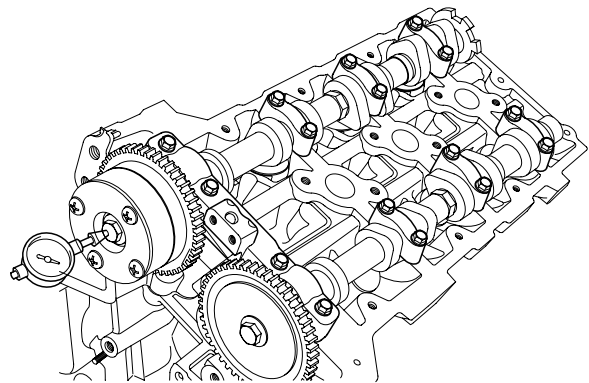
- 1) Install the camshafts.
- 2) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value]

0.056 ~ 0.064mm(0.0022 ~ 0.0025in) - 3.3L

0.02 ~ 0.18mm (0.0008 ~ 0.0071in) - 3.8L



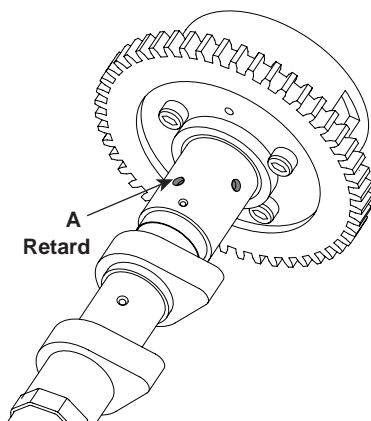
KDRF196B

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

- 3) Remove the camshafts.

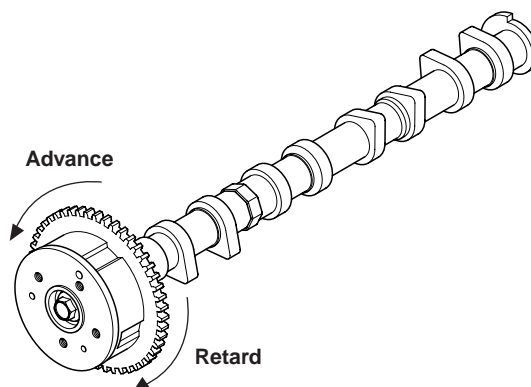
CVVT ASSEMBLY

1. Inspect CVVT assembly.
 - 1) Check that the CVVT assembly will not turn.
 - 2) Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.



ECRF015A

- 4) Under the condition of (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.



SBLM16202L

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

- 5) Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no disturbance.

 **NOTE**

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

Standard: Movable smoothly in the range about 22.5°

- 6) Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (clockwise).

REASSEMBLY ED39E8BC

 **NOTE**

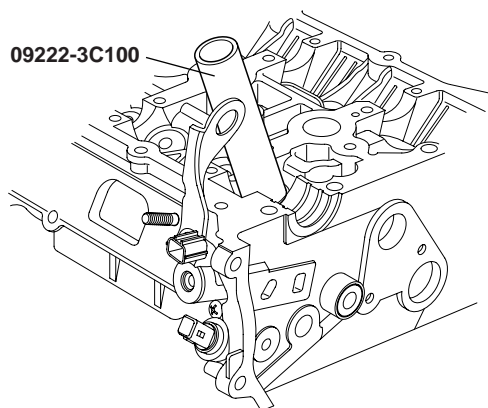
Thoroughly clean all parts to be assembled.
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
Replace oil seals with new ones.

1. Install valves.

- 1) Using SST(09222-3C100), push in a new oil seal.

 **NOTE**

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



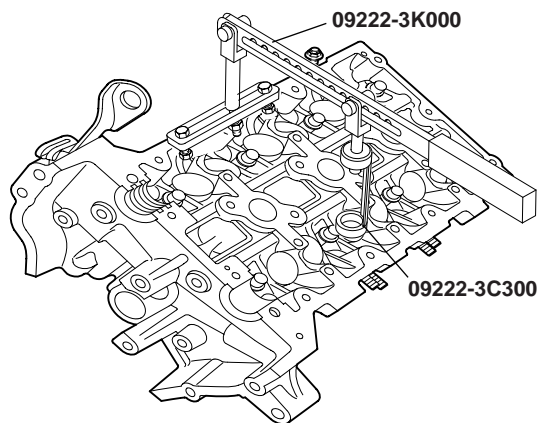
KCRF120B

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

 **NOTE**

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

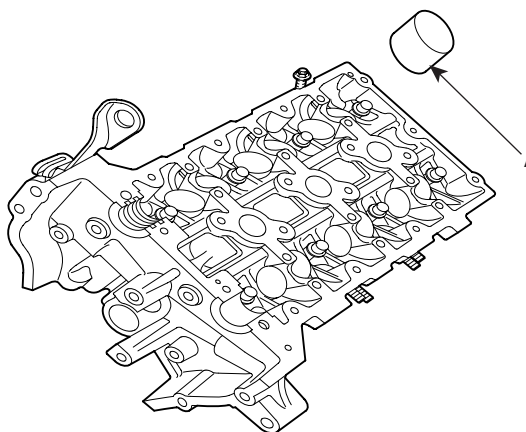
- 3) Using the SST(09222 - 3K000, 09222-3C300), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



KDRF201A

- 4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.

2. Install MLAs.
Check that the MLA rotates smoothly by hand.



KDRF200A

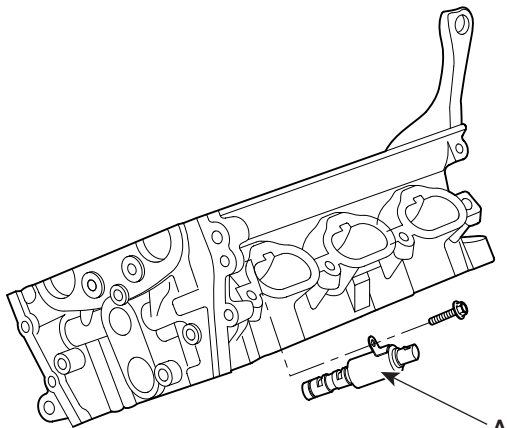
 **NOTE**

MLA can be reinstalled in its original position.

3. Install OCV(A).

Tightening torque

9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF202A

NOTE

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

CAUTION

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

INSTALLATION

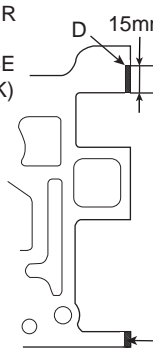
E63A6A04

NOTE

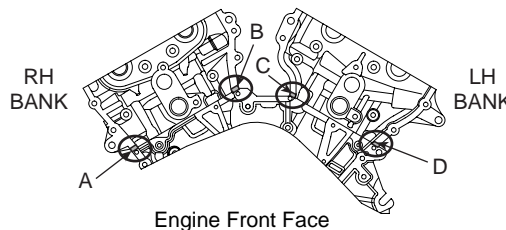
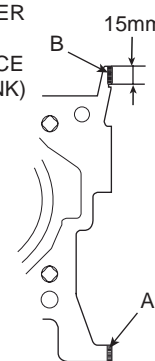
- Thoroughly clean all parts to be assembled.
- Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.

1. Install the cylinder head.
 - a. The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
 - b. Apply sealant on cylinder block top face before assembling cylinder head gaskets. The part must be assembled within 5 minutes after sealant was applied.

CYLINDER BLOCK TOP FACE (LH BANK)



CYLINDER BLOCK TOP FACE (RH BANK)



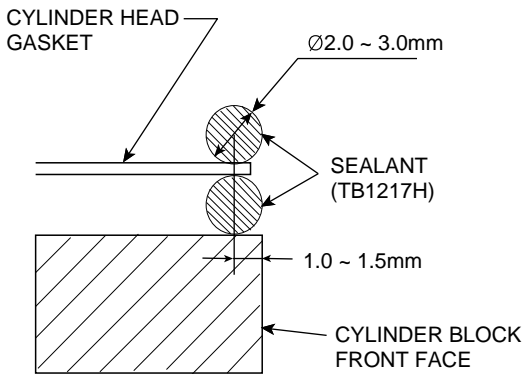
Engine Front Face

ECBF017A

NOTE

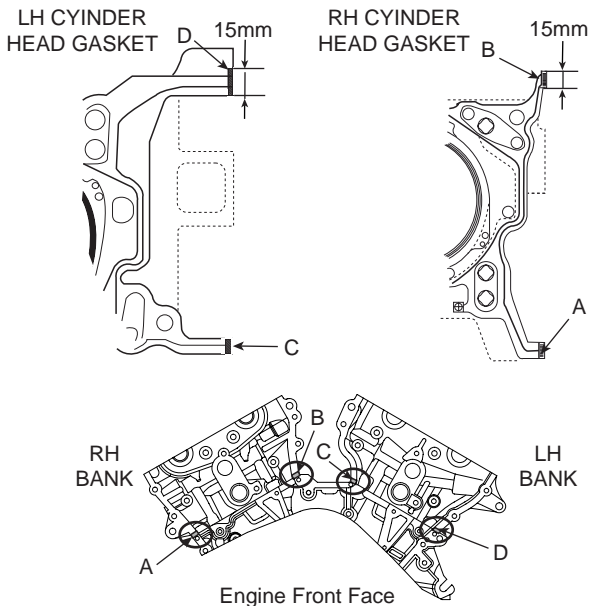
Refer to below illustration to apply the sealant.

Bead width : 2.0~3.0 mm
 Sealant locations : 1.0~1.5mm from block surface
 Recommended sealant :Liquid sealant TB1217H



ECBF018A

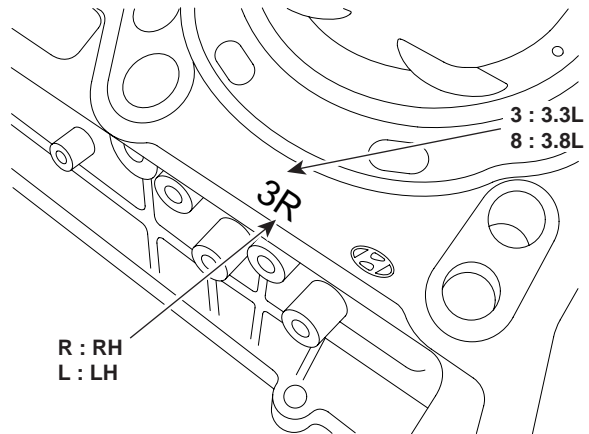
- c. Apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block. The part must be assembled within 5 minutes after sealant was applied.



ECBF019A

NOTE

Be careful of the installation direction.

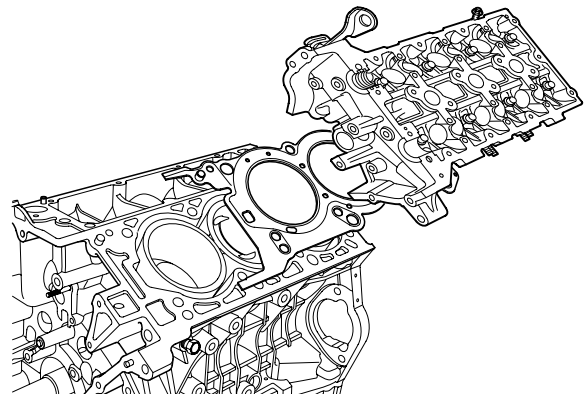


KDRF203A

- d. Install the cylinder head.

NOTE

Remove the extruded sealant after assembling cylinder heads.



KDRF198A

2. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
 - 1) Do not apply engine oil on the threads and under the heads of the cylinder head bolts.
 - 2) Using SST(09221-4A000), install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque

1st step : 39.2Nm (4.0kgf.m, 28.9lb-ft)

2nd step : 120°

3rd step : 90°

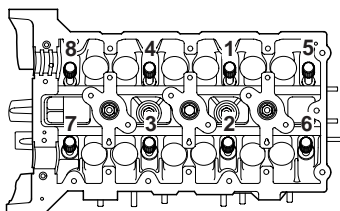
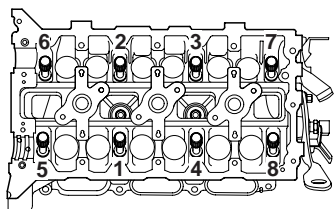
18.62 ~ 23.52Nm(1.9 ~ 2.4kgf.m, 13.74 ~ 17.36lb-ft)(A)

CYLINDER HEAD ASSEMBLY

EMA -51

NOTE

Always use new cylinder head bolt.

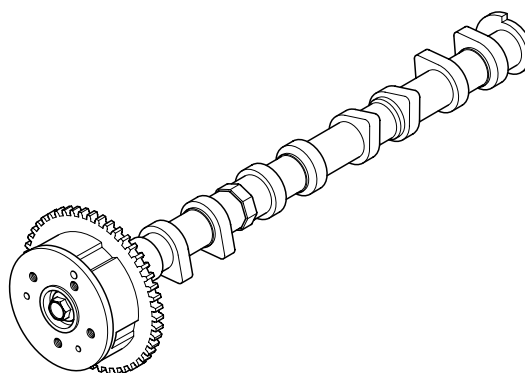


KDRF199B

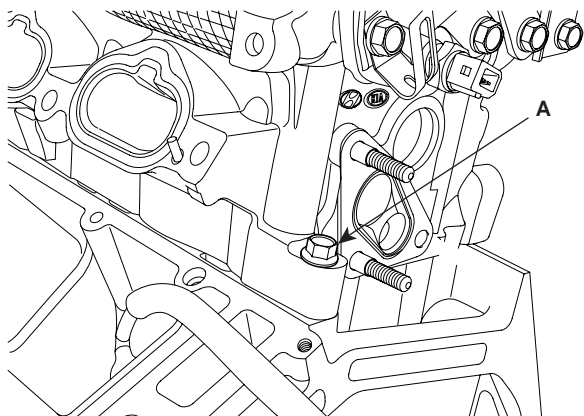
4. Install the CVVT and camshaft sprocket.

Tightening torque

64.68 ~ 76.44Nm(6.6 ~ 7.8 kgf.m, 47.74 ~ 56.4lb-ft)



KCRF122A



ECBF035A

NOTE

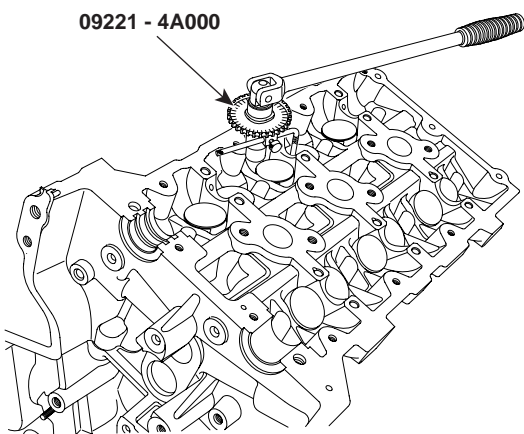
- Install camshaft-inlet to dowel pin of CVVT assembly .
At this time, attend not to be installed to oil hole of camshaft-inlet.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when camshaft is installed to dowel pin of CVVT assembly.

5. Install camshafts(A).

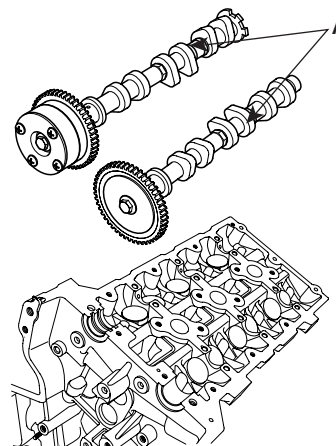
NOTE

- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Be careful the right, left bank, intake, exhaust side before assembling.

09221 - 4A000

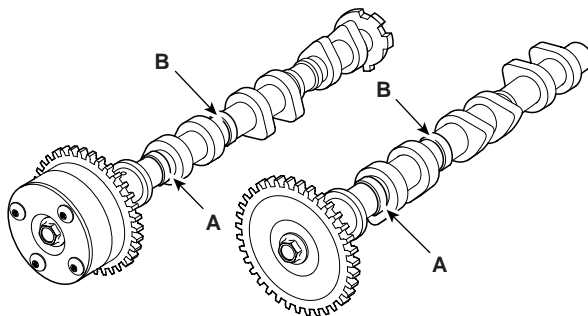
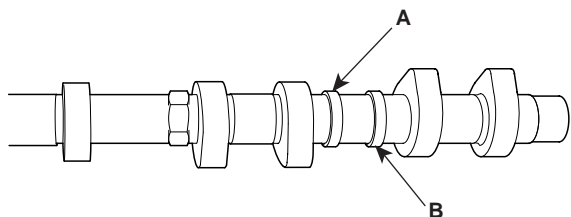


KDRF223A



KDRF197A

INTAKE CAMSHAFT



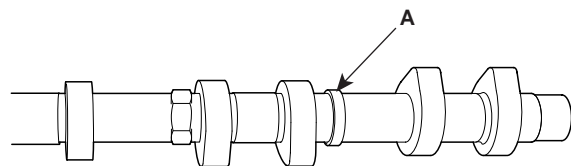
SBLM16209L

KDRF226A

	LH	RH
3.3L	A: Ø27mm(1.0630in.) B: Ø27mm(1.0630in.)	A: Ø30mm(1.1811in.) B: Ø30mm(1.1811in.)
3.8L	A: Ø30mm(1.1811in.) B: Ø27mm(1.0630in.)	A: Ø27mm(1.0630in.) B: Ø30mm(1.1811in.)

	LH	RH
3.3L	A: Ø30mm(1.1811in.) B: Ø27mm(1.0630in.)	A: Ø30mm(1.1811in.) B: Ø27mm(1.0630in.)
3.8L	A: Ø30mm(1.1811in.) B: Ø27mm(1.0630in.)	A: Ø30mm(1.1811in.) B: Ø27mm(1.0630in.)

EXHAUST CAMSHAFT



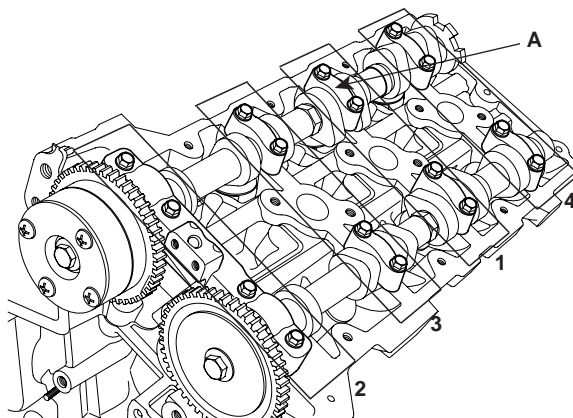
6. Install camshaft bearing caps with the order below.

Tightening torque

1st step : 5.9Nm(0.6kgf.m, 4.3lb-ft)
2nd step : 9.80 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

KDRF227A

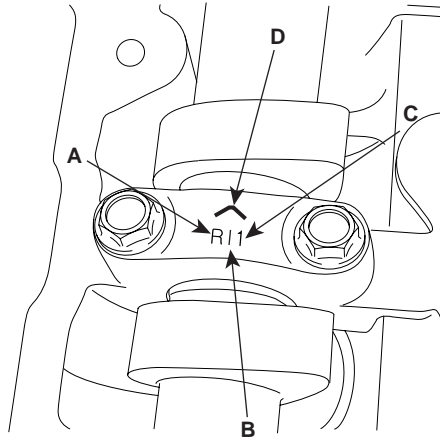
	LH	RH
3.3L/3.8L	A: Ø27mm(1.0630in.)	A: Ø30mm(1.1811in.)



UCBF008A

 **NOTE**

Be careful the right, left bank, intake, exhaust side before assembling.



ECBF036A

-
- A : L(LH),R(RH)
B : I(Intake),None(Exhaust)
C : Journal number
D : Front mark
-

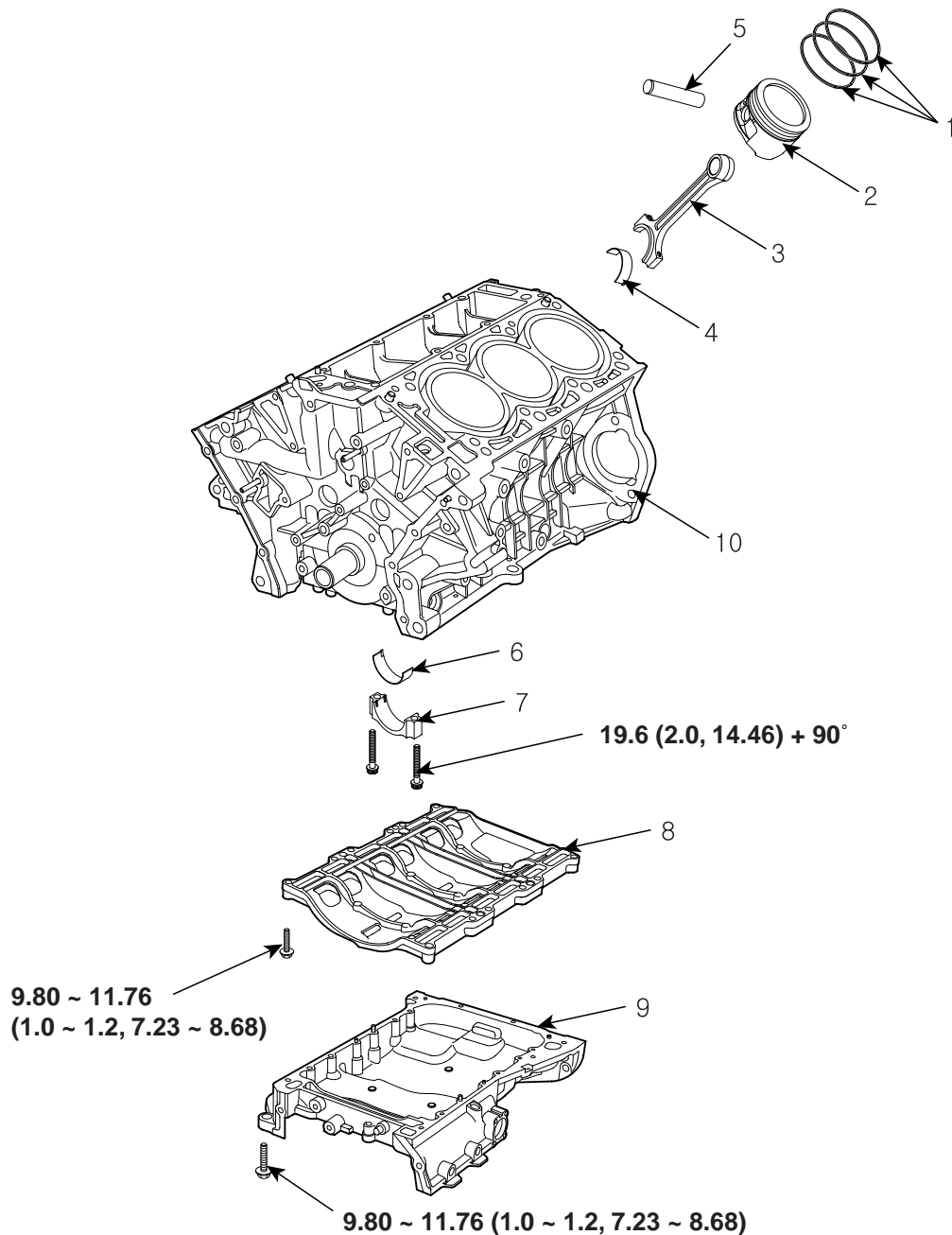
 **CAUTION**

Rotate the crankshaft not to contact the valves to the pistons by making the pistons below 10mm(0.3937in.) from the top of cylinder block.

7. Install water temperature control assembly.
8. Install timing chain.
9. Check and adjust valve clearance.
10. Install the exhaust manifold.
11. Install the intake manifold.

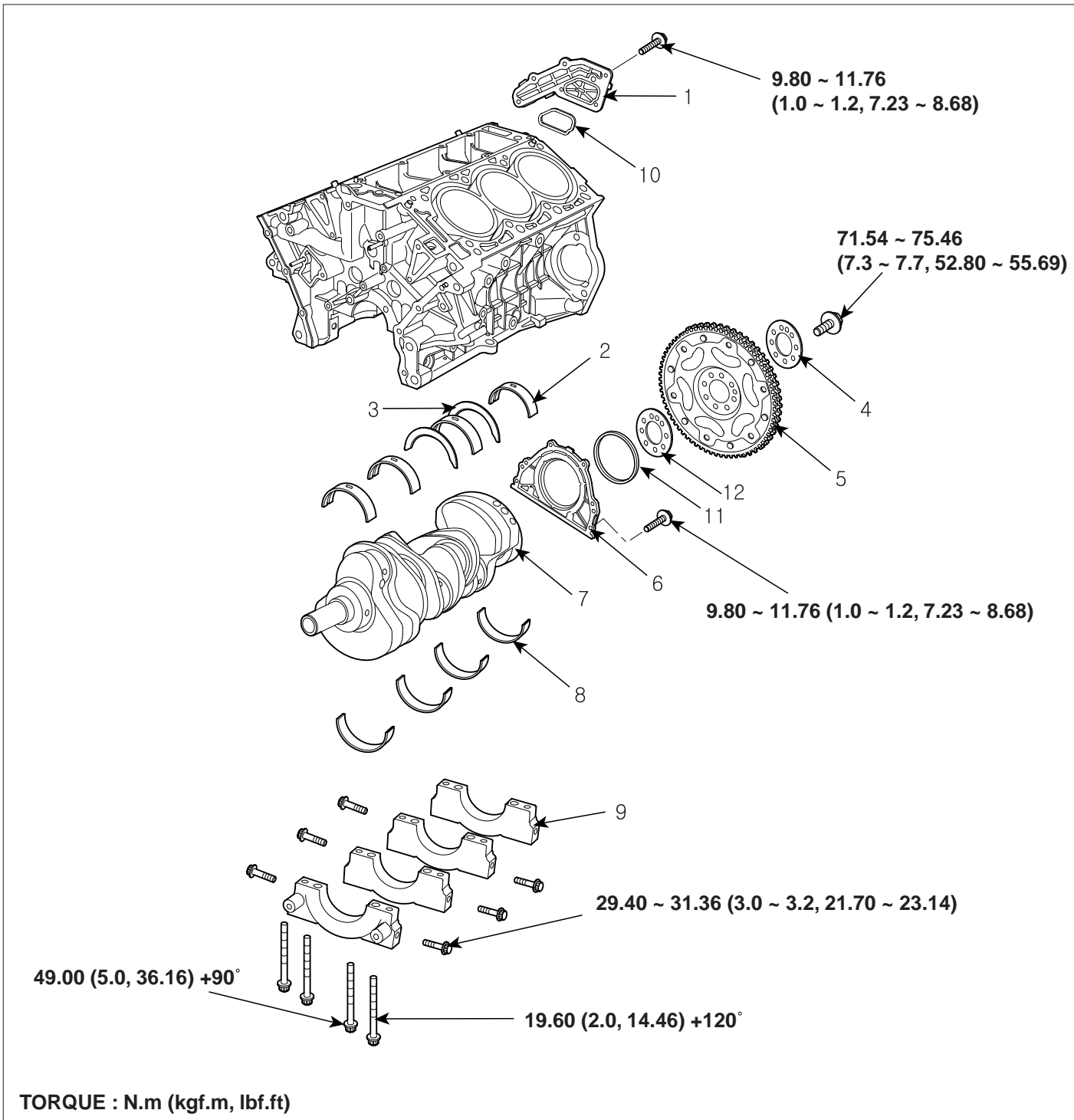
ENGINE BLOCK

COMPONENTS EF6DC04B



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

- | | |
|---------------------------------|---------------------------------|
| 1. Piston ring | 6. Connecting rod lower bearing |
| 2. Piston | 7. Connecting rod bearing cap |
| 3. Connecting rod | 8. Baffle plate |
| 4. Connecting rod upper bearing | 9. Upper oil pan |
| 5. Piston pin | 10. Cylinder block |



- 1. Oil drain cover
- 2. Crankshaft upper bearing
- 3. Thrust bearing
- 4. Plate adapter
- 5. Drive plate
- 6. Rear oil seal case

- 7. Crankshaft
- 8. Crankshaft lower bearing
- 9. Main bearing cap
- 10. Oil drain cover gasket
- 11. Rear oil seal
- 12. Crank adapter

SBLM16203L

REMOVAL E4DADBA3

 CAUTION

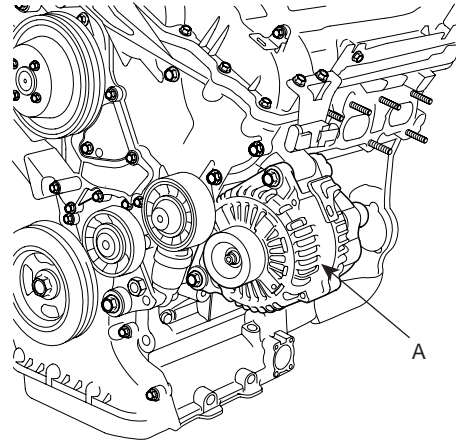
- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

 NOTE

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No.1 piston is at top dead center.

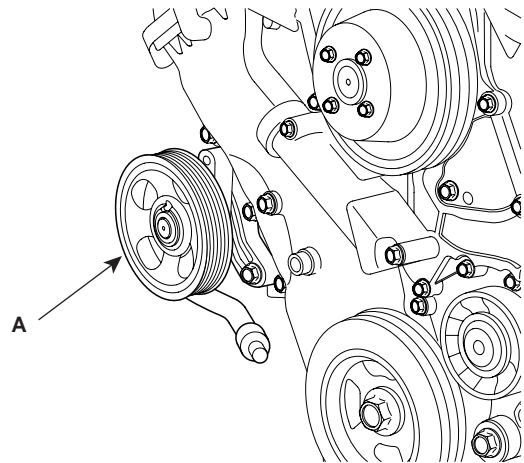
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor(A) from engine.

9. Remove alternator(A) from engine.

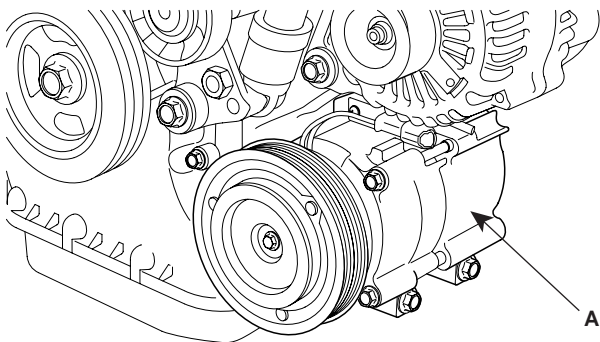


KDRF104A

10. Remove power steering pump(A) from engine.



KDRF102A



SBLM16103L

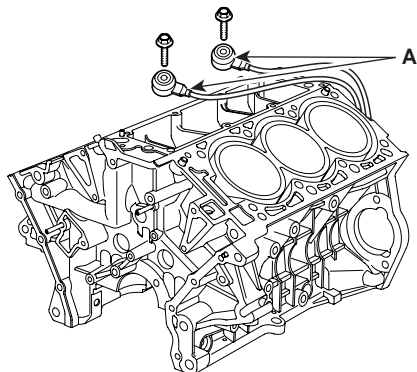
ENGINE BLOCK

EMA -57

DISASSEMBLY

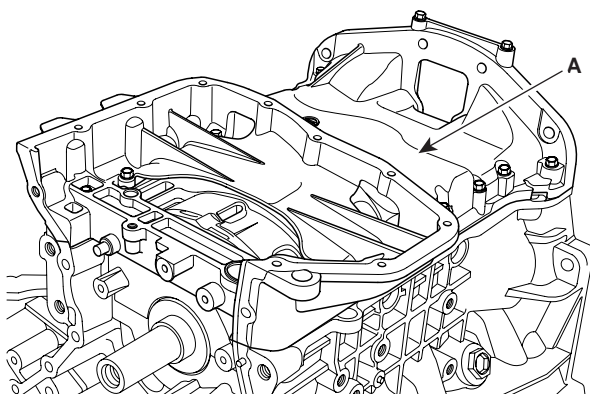
EBCBF7FE

1. Remove drive plate.
2. Remove knock sensor(A).



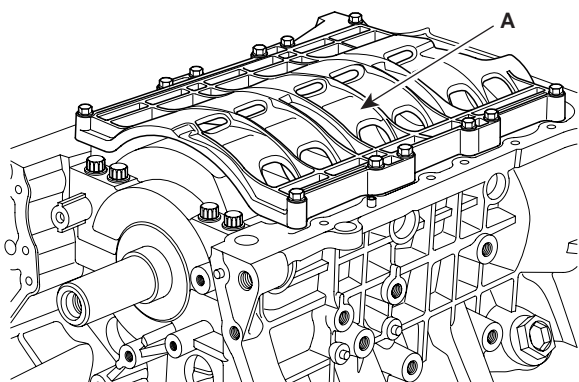
KDRF205A

3. Remove upper oil pan(A).



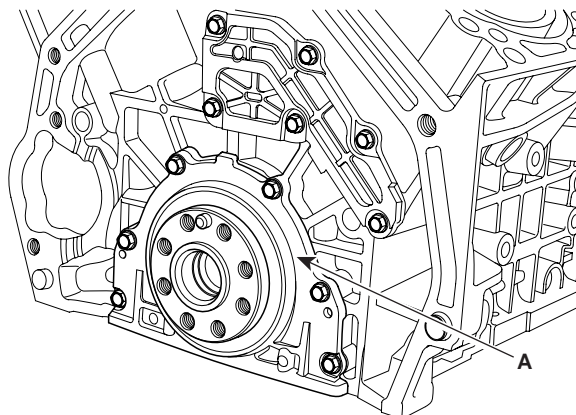
KDRF206A

4. Remove baffle plate(A).



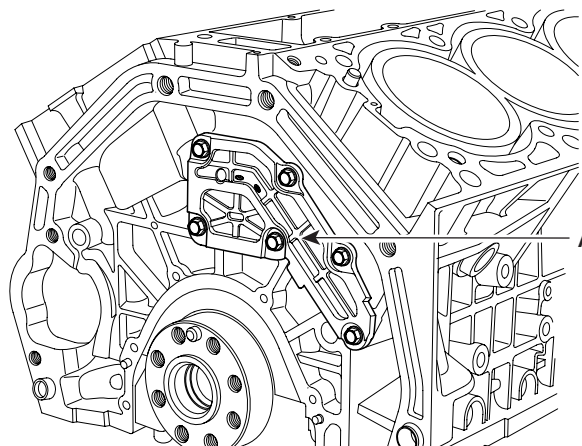
KDRF207A

5. Remove rear oil seal case(A).



KDRF208A

6. Remove oil drain cover(A).



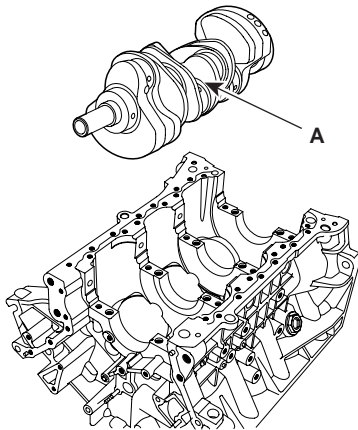
KDRF209A

7. Check the connecting rod end play.
8. Check the connecting rod oil clearance.
9. 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.

NOTE

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

10. Remove crankshaft main bearing cap and check oil clearance.
11. Check the crankshaft end play.
12. Lift the crankshaft(A) out of engine, being careful not to damage journals.



KDRF210A

NOTE

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

13. 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 piston and piston pin as a set.
14. Remove piston rings.
 - 1) Using a piston ring expander, remove the 2 compression rings.
 - 2) Remove 2 side rails and the spacer by hand.

NOTE

Arrange the piston rings in the correct order only.

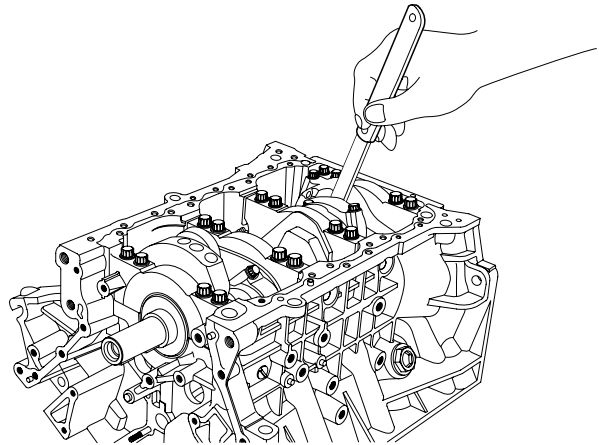
15. Disconnect connecting rod from piston.

INSPECTION EAA56C18

CONNECTING ROD AND CRANKSHAFT

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

Standard end play : 0.1~ 0.25mm(0.004 ~ 0.010in.)



KDRF211A

- If out-of-tolerance, install a new connecting rod.
 - If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
 - 1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
 - 2) Remove 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.
 - 6) Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

19.6Nm (2.0kgf.m, 14.46lbf.ft) + 90°

NOTE

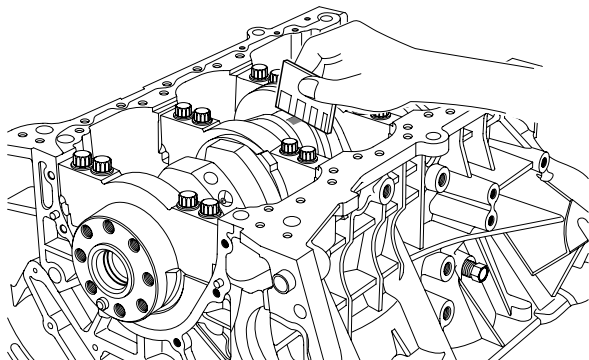
Do not turn the crankshaft.

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

8) Measure the plastigage at its widest point.

Standard oil clearance

0.038 ~ 0.056mm(0.0015 ~ 0.0022in)



KDRF212A

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.

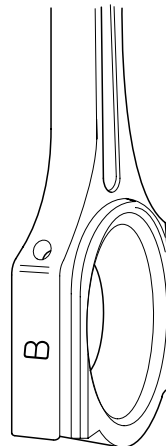
NOTE

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

CAUTION

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

CONNECTING ROD MARK LOCATION



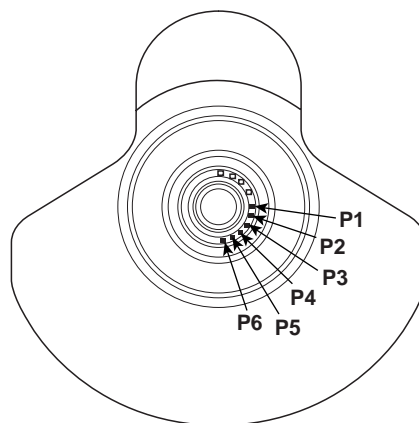
EDQF196A

DISCRIMINATION OF CONNECTING ROD

CLASS	MARK	INSIDE DIAMETER
0	a	58.000 ~ 58.006mm (2.2834 ~ 2.2837in.)
1	b	58.006 ~ 58.012mm (2.2837 ~ 2.2839in.)
2	c	58.012 ~ 58.018mm (2.2839 ~ 2.2842in.)

CRANKSHAFT PIN MARK LOCATION

DISCRIMINATION OF CRANKSHAFT

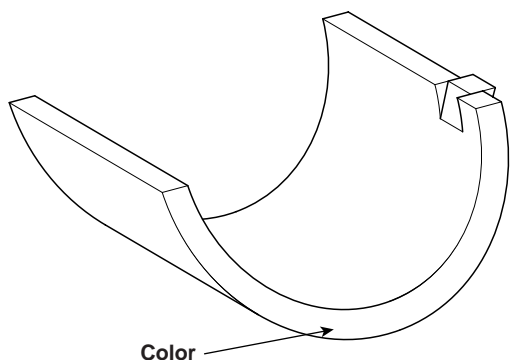


ECBF037A

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF PIN
I	1 or A	54.966 ~ 54.972mm (2.1640 ~ 2.1642in.)
II	2 or B	54.960 ~ 54.966mm (2.1638 ~ 2.1640in.)
III	3 or C	54.954 ~ 54.960mm (2.1635 ~ 2.1638in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



ECRF021A

DISCRIMINATION OF CONNECTING ROD BEARING

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	1.514 ~ 1.517mm (0.0596 ~ 0.0597in.)
D	BLACK	1.511 ~ 1.514mm (0.0595 ~ 0.0596in.)
C	BROWN	1.508 ~ 1.511mm (0.0594 ~ 0.0595in.)
B	GREEN	1.505 ~ 1.508mm (0.0593 ~ 0.0594in.)
A	YELLOW	1.502 ~ 1.505mm (0.0591 ~ 0.0593in.)

11) Selection

		CONNECTING ROD IDENTIFICATION MARK		
		0(a)	1(b)	2(c)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

3. Check the crankshaft bearing oil clearance.

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

Tightening torque

49.00Nm(5.0 kgf.m, 36.16lb-ft) + 90°
 19.60 Nm(2.0 kgf.m, 14.46lb-ft)+ 120°
 29.40 ~ 31.36Nm(3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14lb-ft)

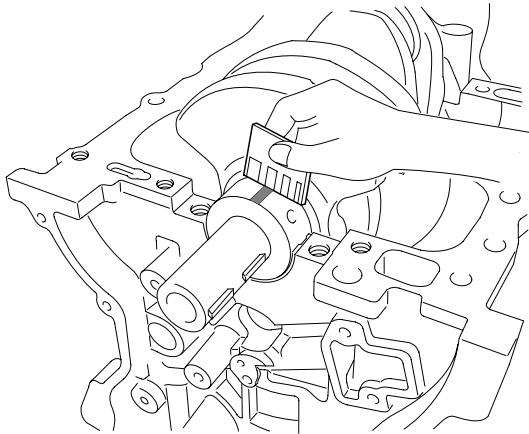
 **NOTE**

Do not turn the crankshaft.

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

Standard oil clearance

0.022 ~ 0.040mm(0.0009 ~ 0.0016in)



KCRF170A

- 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.

- 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.

NOTE

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

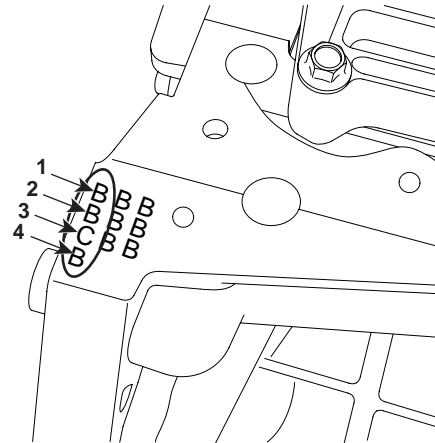
CAUTION

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

Crankshaft bore mark location

Letters have been stamped on the block as a mark for the 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.



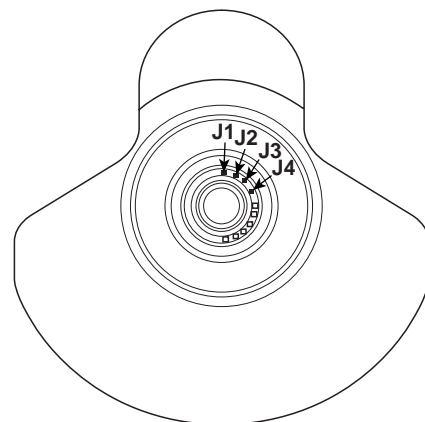
ECBF038A

DISCRIMINATION OF CYLINDER BLOCK

CLASS	MARK	INSIDE DIAMETER
a	A	73.500 ~ 73.506mm (2.8937 ~ 2.8939in.)
b	B	73.506 ~ 73.512mm (2.8939 ~ 2.8942in.)
c	C	73.512 ~ 73.518mm (2.8942 ~ 2.8944in.)

CRANKSHAFT JOURNAL MARK LOCATION

DISCRIMINATION OF CRANKSHAFT

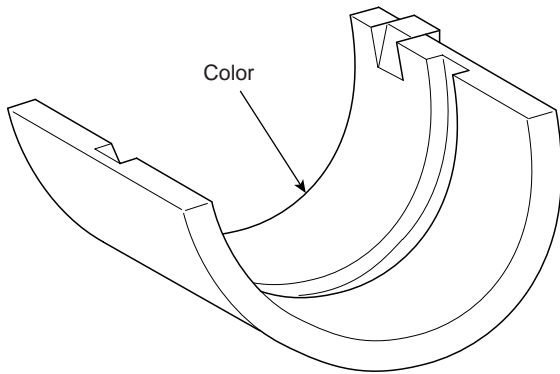


ECBF039A

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	A	68.954 ~ 68.960mm (2.7147 ~ 2.7150in.)
II	B	68.948 ~ 68.954mm (2.7145 ~ 2.7147in.)
III	C	68.942 ~ 68.948mm (2.7142 ~ 2.7145in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



ECRF022A

DISCRIMINATION OF CRANKSHAFT BEARING

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	2.277 ~ 2.280mm (0.0896 ~ 0.0897in.)
D	BLACK	2.274 ~ 2.277mm (0.0895 ~ 0.0896in.)
C	BROWN	2.271 ~ 2.274mm (0.0894 ~ 0.0895in.)
B	GREEN	2.268 ~ 2.271mm (0.0893 ~ 0.0894in.)
A	YELLOW	2.265 ~ 2.268mm (0.0892 ~ 0.0893in.)

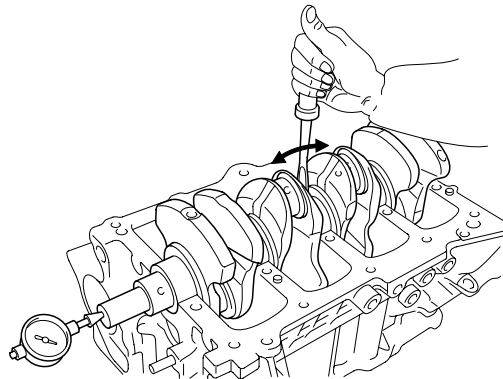
SELECTION

		CRANKSHAFT BORE IDENTIFICATION MARK		
		a(A)	b(B)	c(C)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

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

Standard end play

0.10 ~ 0.28mm (0.0039 ~ 0.0110in.)



ECKD001B

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

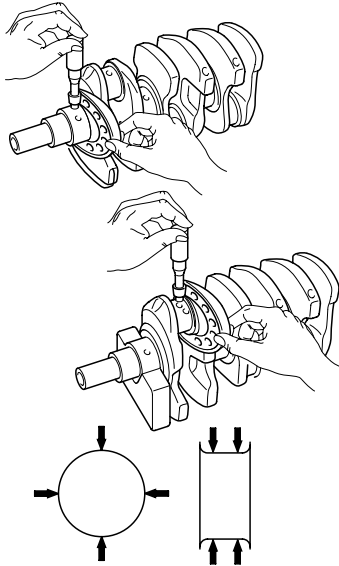
Thrust bearing thickness

2.41 ~ 2.45mm(0.0949 ~ 0.0964in)

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

Main journal diameter : 68.942 ~ 68.960mm(2.7142 ~ 2.7149in)

Crank pin diameter : 54.954 ~ 54.972mm(2.1635 ~ 2.1642in.)



ECKD001E

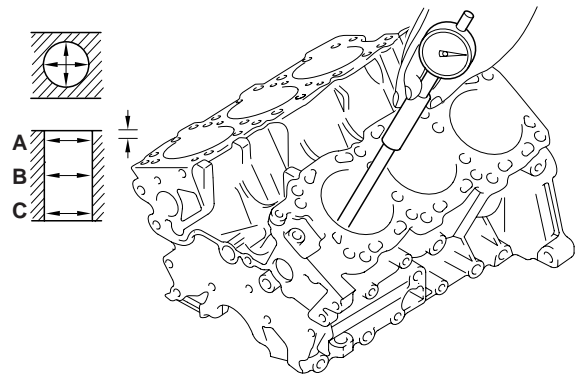
CONNECTING RODS

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

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

CYLINDER BLOCK

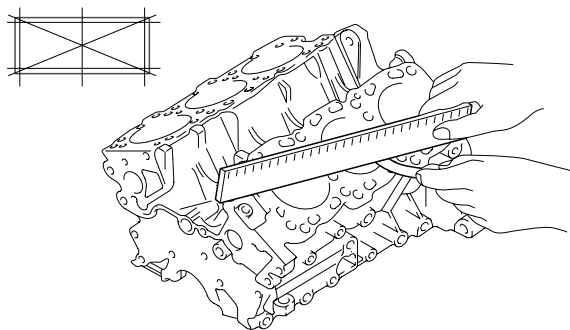
1. Remove gasket material.
Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
2. Clean cylinder block
Using a soft brush and solvent, thoroughly clean the cylinder block.
3. Inspect top surface of cylinder block for flatness.
Using a precision straight 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(0.0020 in.), Less than 0.02mm(0.0008in.) / 150 x 150

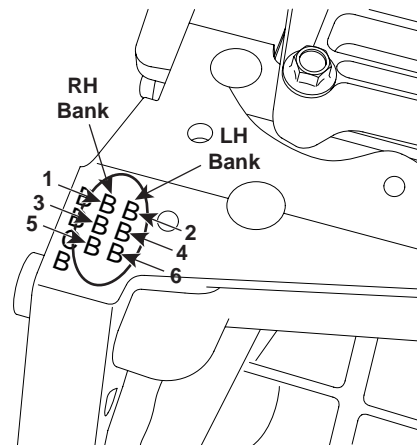
EDQF153A

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



EDQF154A

4. Inspect cylinder bore diameter
Visually check the cylinder for vertical scratches. 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.



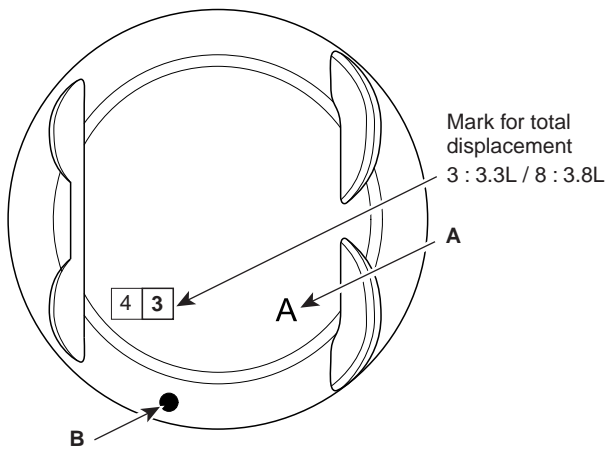
ECBF002A

Class	Size code	Cylinder bore inner diameter	
		3.3L	3.8L
A	A	92.00~92.01mm (3.6220 ~ 3.6224in)	96.00 ~ 96.01mm (3.7795 ~ 3.7799in)
B	B	92.01~92.02mm (3.6224 ~ 3.6228in)	96.01 ~ 96.02mm (3.7799 ~ 3.7803in)
C	C	92.02~92.03mm (3.6228 ~ 3.6232in)	96.02 ~ 96.03mm (3.7803 ~ 3.7807in)

Standard diameter

92.00 ~ 92.03mm(3.6220 ~ 3.6232in) - 3.3L
96.00 ~ 96.03mm(3.7795 ~ 3.7807in) - 3.8L

7. Check the piston size code(A) and the front mark(B) on the piston top face.



SBLM16114L

Class	Size code	Piston outer diameter	
		3.3L	3.8L
A	A	91.96~91.97mm (3.6205 ~ 3.6209in.)	95.96 ~ 95.97mm (3.7779 ~ 3.7783in)
B	B	91.97~91.98mm (3.6209 ~ 3.6213in.)	95.97 ~ 95.98mm (3.7783 ~ 3.7787in)
C	C	91.98~91.99mm (3.6213 ~ 3.6219in.)	95.98 ~ 95.99mm (3.7787 ~ 3.7791in)

8. Select the piston related to cylinder bore class.

Clearance :

0.03 ~ 0.05mm(0.0012 ~ 0.0020in)

PISTON AND RINGS

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



NOTE

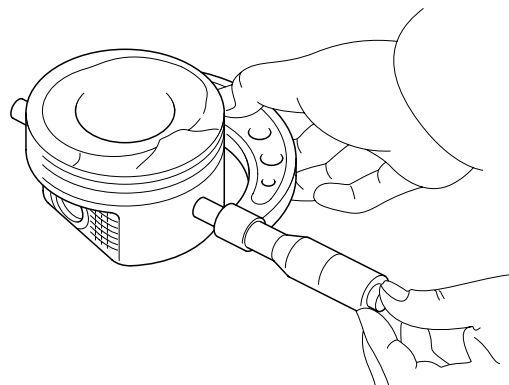
Do not use a wire brush.

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

Standard diameter

91.96 ~ 91.99mm(3.6205~ 3.6216in) - 3.3L

95.96 ~ 95.99mm(3.7779 ~ 3.7791in) - 3.8L



ECKD001D

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

Piston-to-cylinder clearance

0.03 ~ 0.05mm(0.0012 ~ 0.0020in)

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 : 0.03 ~ 0.07mm(0.0012 ~ 0.0027in)

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

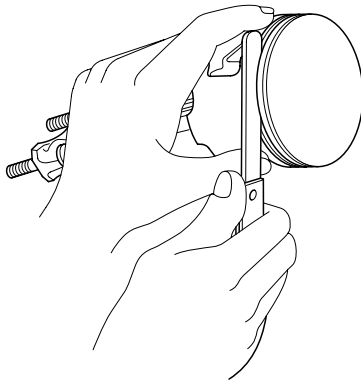
Oil ring : 0.06 ~ 0.15mm(0.0024 ~ 0.0059in)

Limit

No.1 : 0.1mm(0.004in)

No.2 : 0.1mm(0.004in)

Oil ring : 0.2mm(0.008in)



ECKD001G

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 : 0.17 ~ 0.32mm(0.0067 ~ 0.0126in)

No.2 : 0.32 ~ 0.47m(0.0126 ~ 0.0185in)

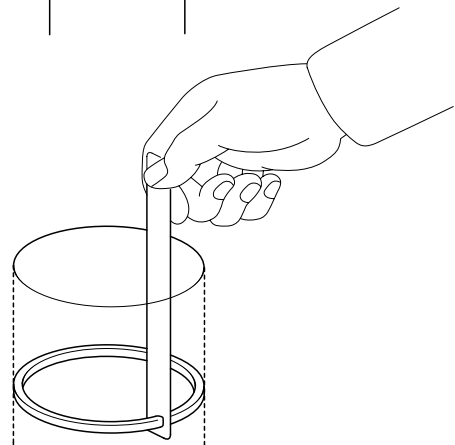
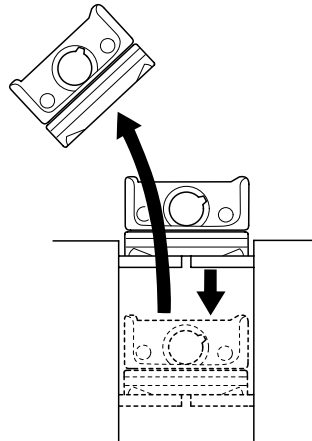
Oil ring : 0.20 ~ 0.70mm(0.0079 ~ 0.0275in)

Limit

No.1 : 0.6mm(0.0236in)

No.2 : 0.7mm(0.0275in)

Oil ring : 0.8mm(0.0315in.)



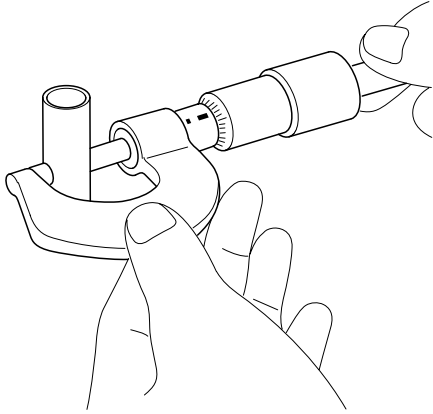
ECKD001K

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001 ~ 23.006mm(0.9055 ~ 0.9057in)



ECKD001Z

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

Piston pin-to-piston clearance

0.010 ~ 0.020mm(0.0004 ~ 0.0008in)

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

Piston pin-to-connecting rod interference

-0.032 ~ -0.016mm(-0.0012 ~ -0.00063in)

REASSEMBLY

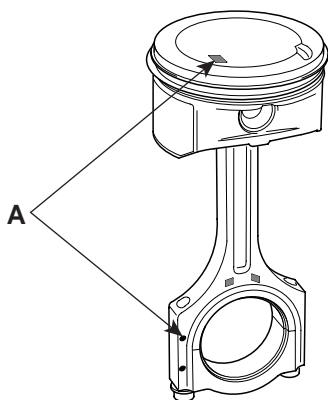
E2B1FCB7

 **NOTE**

- 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 piston and connecting rod.

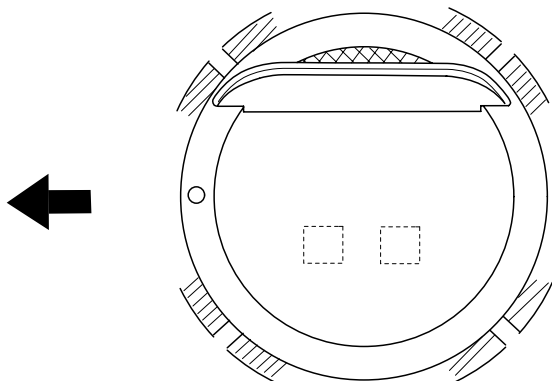
- 1) Use a hydraulic press for installation.
- 2) The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



KCRF168A

2. Install piston rings.

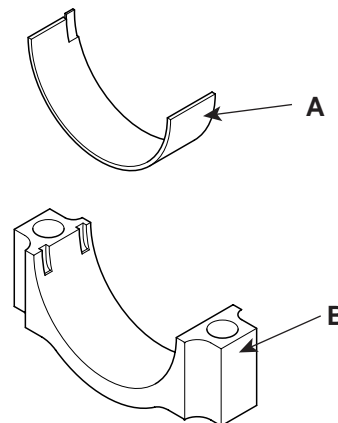
- 1) Install the oil ring spacer and 2 side rails by hand.
- 2) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
- 3) Position the piston rings so that the ring ends are as shown.



ECKD321A

3. Install connecting rod bearings.

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



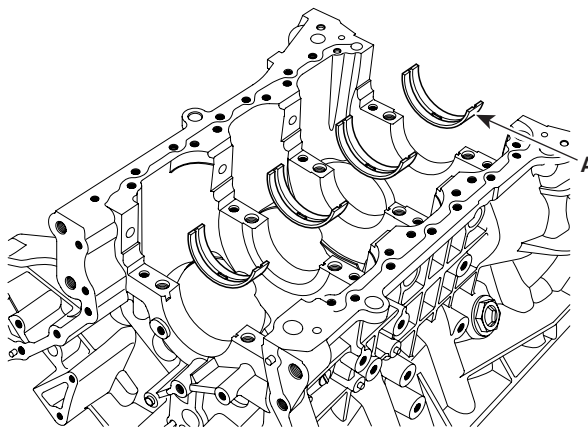
KCRF118B

4. Install main bearings.

 **NOTE**

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

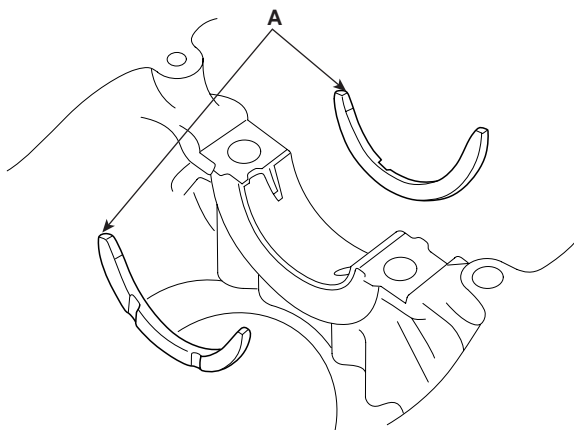
- 1) Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings(A).



KDRF216A

- 2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.

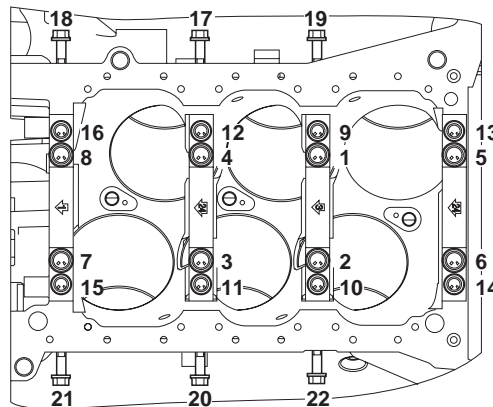
5. Install thrust bearings.
Install the 2 thrust bearings(A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

NOTE

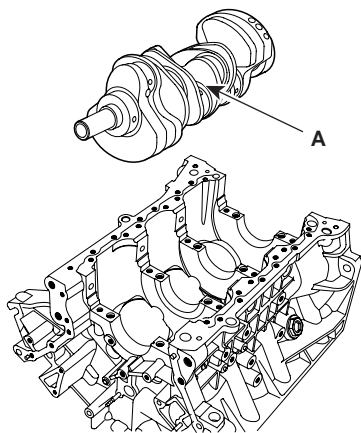
- Always use new main bearing cap bolt.
- If any of the bearing cap bolts is broken or deformed, replace it.



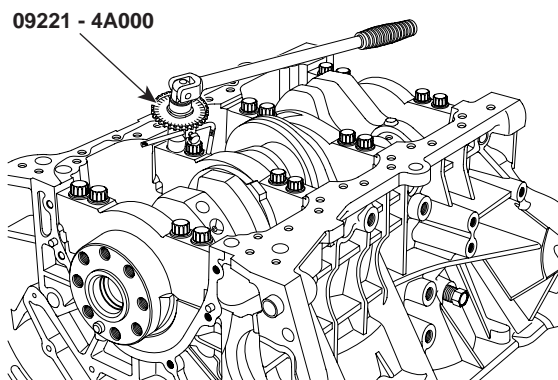
KDRF140A

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

6. Place crankshaft on the cylinder block.



KDRF210A



KDRF224A

7. Place main bearing caps on cylinder block.
8. Install main bearing cap bolts.
1) Install and uniformly tighten the bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

Main bearing cap bolt

- 49.00Nm(5.0 kgf.m, 36.16lb-ft) + 90° (1 ~ 8)
19.60 Nm(2.0 kgf.m, 14.46lb-ft)+ 120° (9 ~ 16)
29.40 ~ 31.36Nm(3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14lb-ft) (17 ~ 22)

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

NOTE

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

- 1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.

EMA -70

ENGINE MECHANICAL SYSTEM

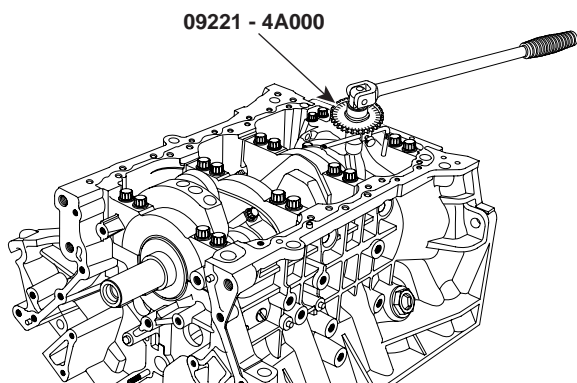
- 2) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
- 3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

11. Check the connecting rod end play.
12. Install oil drain cover.

Tightening torque

19.6Nm (2.0kgf.m, 14.46lb-ft) + 90°

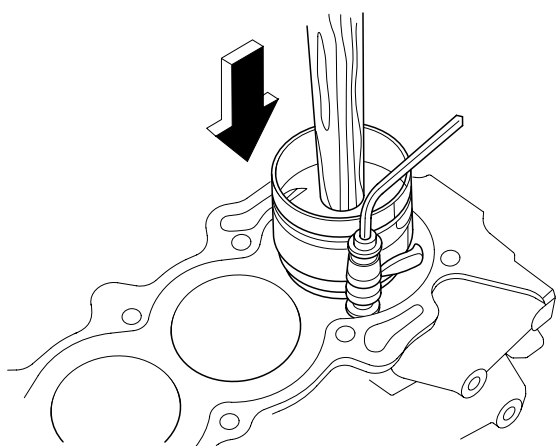
Use SST(09221-4A000), install connecting rod bearing cap bolts.



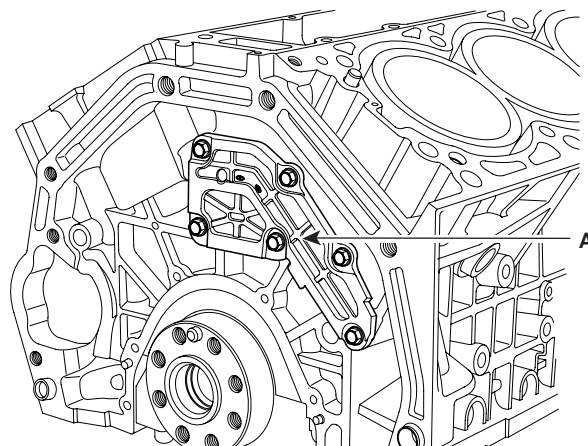
KDRF225A

NOTE

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



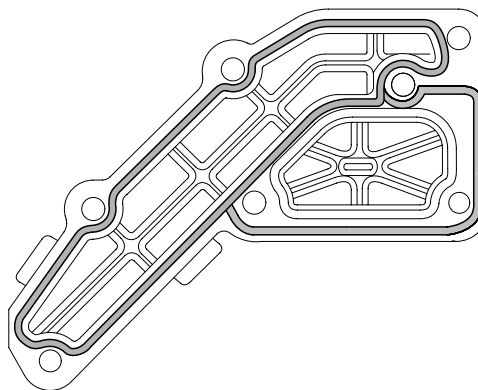
ECKD001F



KDRF209A

NOTE

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling oil drain cover, the liquid sealant TB1217H should be applied oil drain cover.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

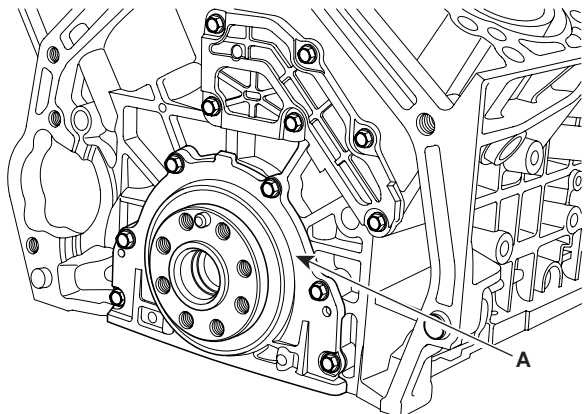


ECBF003A

13. Install rear oil seal case.

Tightening torque

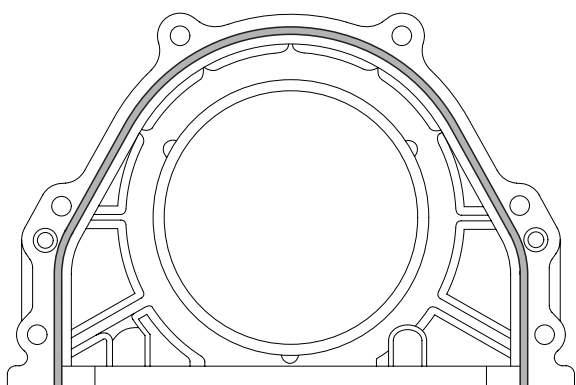
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lb-ft)



KDRF208A

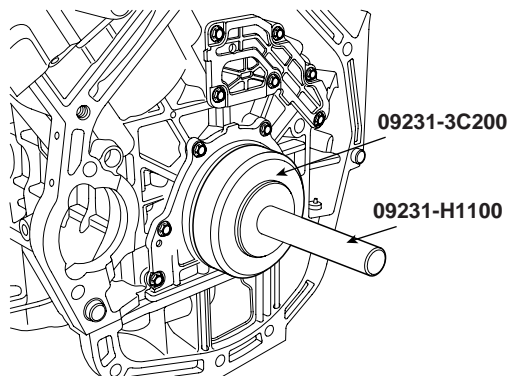
NOTE

- Make clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling rear oil seal case, the liquid sealant TB1217H should be applied rear oil seal case.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.



KDRF218A

14. Using SST(09231-3C200, 09231-H1100), install rear oil seal.

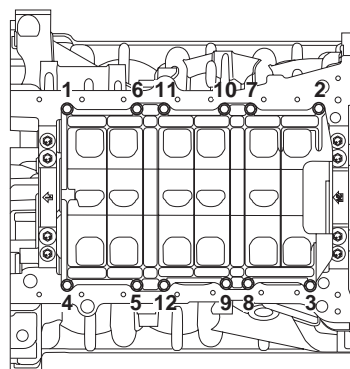


KDRF237A

15. Install baffle plate.
Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown.

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF135A

EMA -72

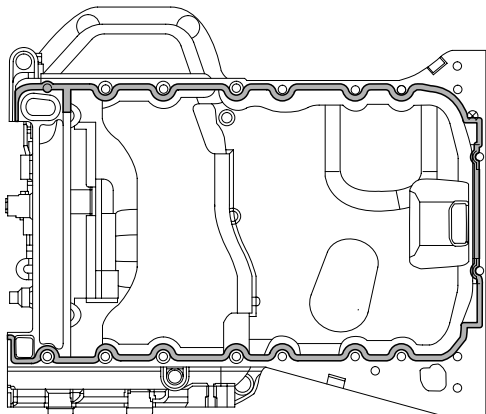
ENGINE MECHANICAL SYSTEM

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

- f. After assembly, wait at least 30 minutes before filling the engine with oil.
17. Install knock sensor.

Tightening torque
15.68 ~ 23.52Nm (1.6 ~ 2.4kgf.m, 11.57 ~ 17.36lb-ft)

Bead width : 2.5mm(0.1in.)



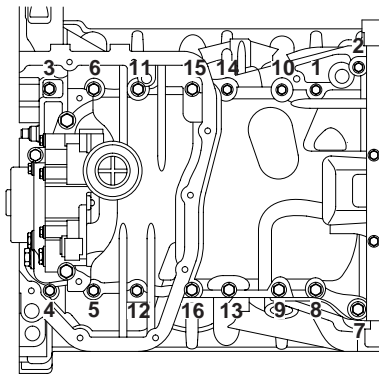
KDRF130A

CAUTION

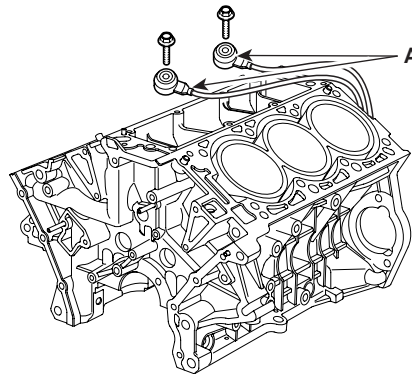
- **Make clean the sealing face before assembling two parts.**
- **Remove harmful foreign matters on the sealing face before applying sealant**
- **When applying sealant gasket, sealant must not be protruded into the inside of oil pan.**
- **To prevent leakage of oil, apply sealant gasket at the inner threads of the bolt holes.**

- e. Install oil pan.
Uniformly tighten the bolts in several passes.

Tightening torque
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF131A



KDRF205A

18. Install drive plate.

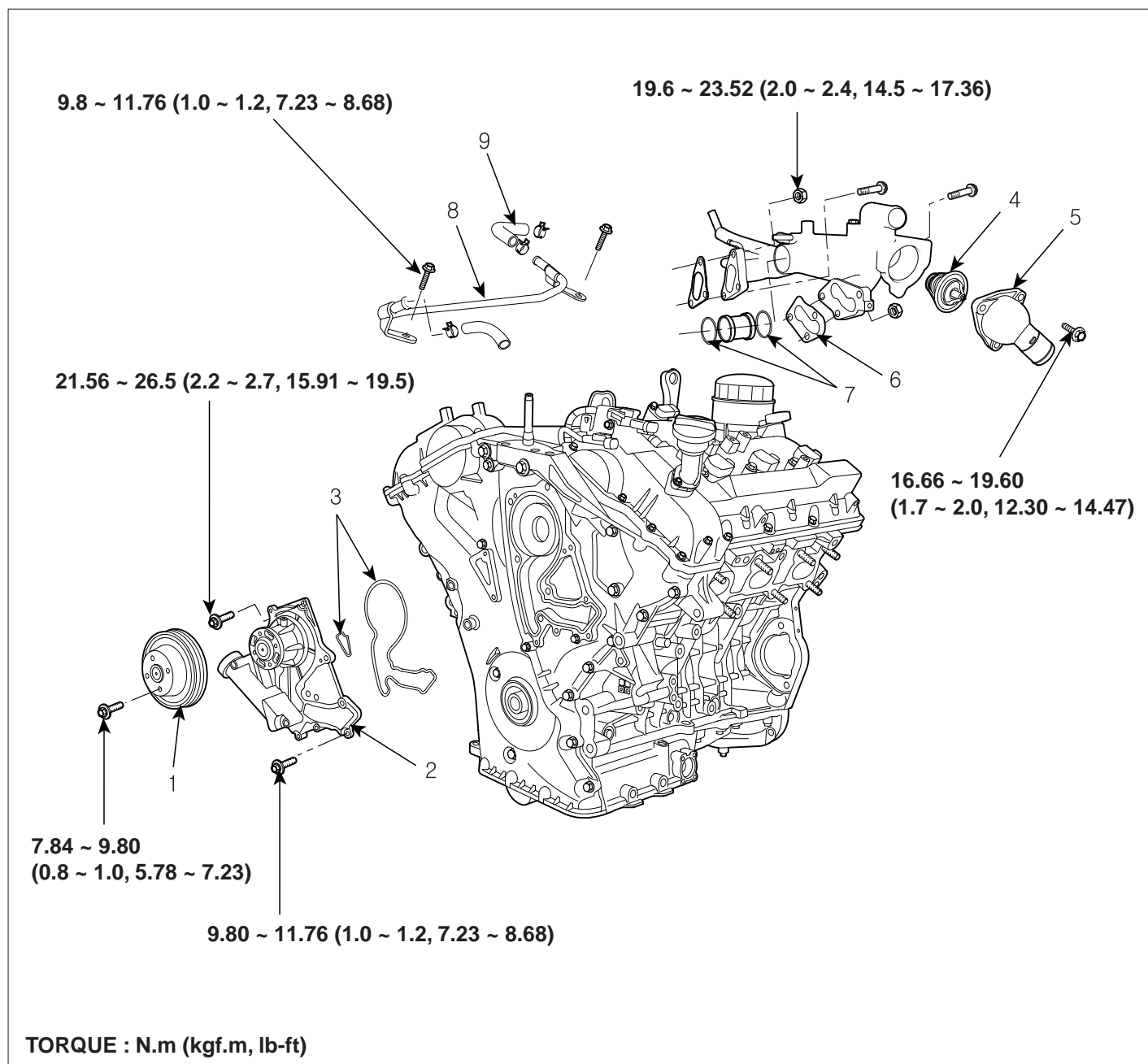
Tightening torque
71.54 ~ 75.46Nm (7.3 ~ 7.7kgf.m, 52.80 ~ 55.69lb-ft)

INSTALLATION EC9DBCE3

1. Install power steering pump.
2. Install alternator.
3. Install air compressor
4. Install oil filter assembly.
5. Install oil pump.
6. Install cylinder head.
7. Install water temperature control assembly.
8. Install timing chain.
9. Install intake manifold.
10. Install exhaust manifold.

COOLING SYSTEM

COMPONENTS E6DF76AB



- 1. Water pump pulley
- 2. Water pump
- 3. Water pump gasket
- 4. Thermostat

- 5. Water inlet pipe
- 6. Gasket
- 7. O - ring
- 8. Air vent pipe
- 9. Hose

SBLM16104L

INSPECTION E60AA7F9

ENGINE COOLANT REFILLING AND BLEEDING

 **WARNING**

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

 **CAUTION**

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

1. Make sure the engine and radiator are cool to the touch.
2. Remove radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
6. Fill fluid mixture with coolant and water(4 : 6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

 **NOTE**

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

 **CAUTION**

- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.

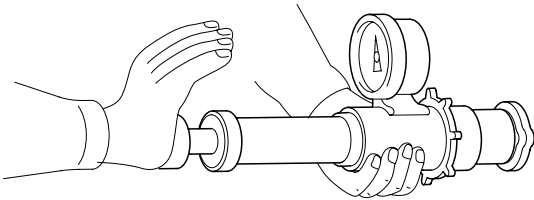
7. Start the engine and run coolant circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
11. Stop the engine and wait coolant gets cool.
12. Repeat 6 to 11 until the coolant level doesn't fall any more, bleed air out of the cooling system.

 **NOTE**

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

CAP TESTING

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

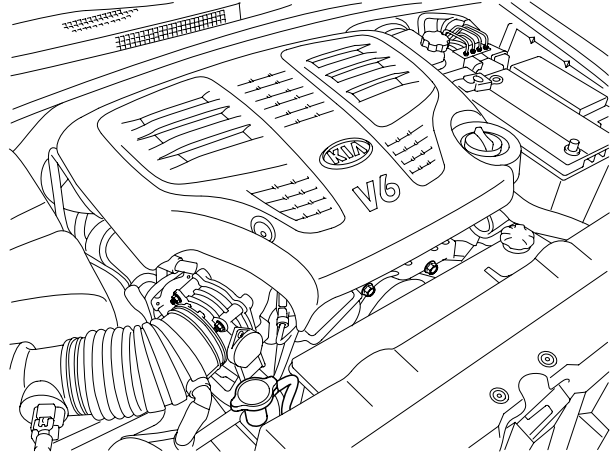


ECKD501X

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

TESTING

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.



SBLM16105L

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

NOTE

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

COOLING SYSTEM

EMA -77

REMOVAL EECA3D1E

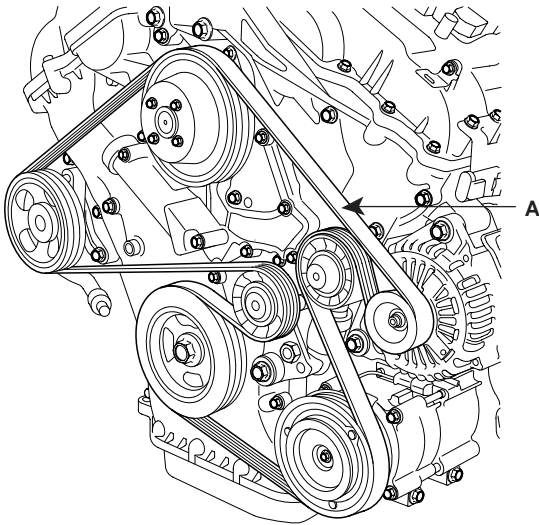
WATER PUMP

1. Drain the engine coolant.

⊗ WARNING

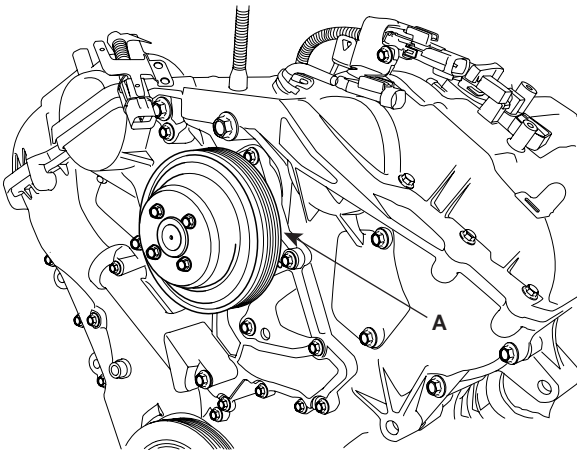
System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove drive belt(A).



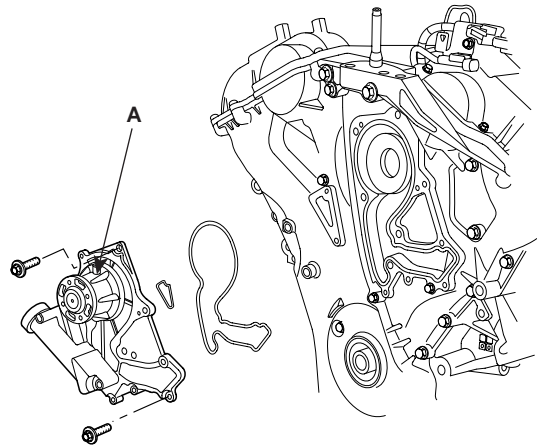
SBLM16101L

3. Remove the 4 bolts and pump pulley(A).



KDRF107A

4. Remove the cooling fan shroud.
5. Remove the water pump(A) and gasket.



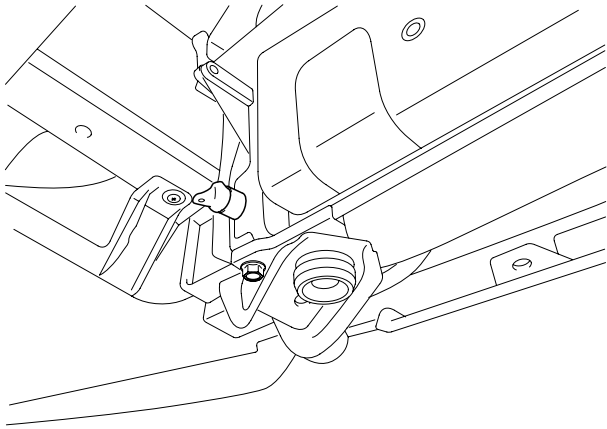
SBLM16106L

EMA -78

ENGINE MECHANICAL SYSTEM

RADIATOR

1. Drain engine coolant.

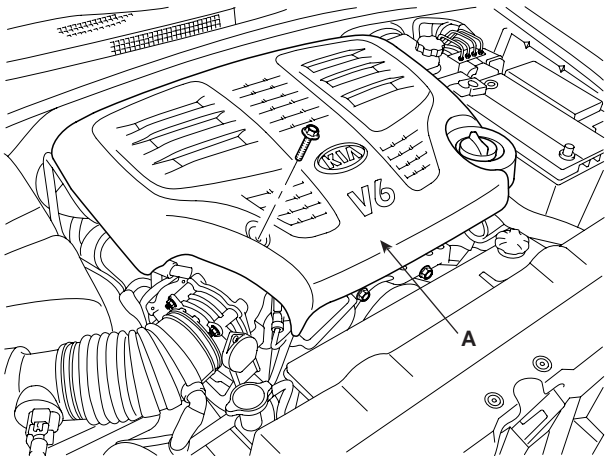


SBLM16021L

⊗ WARNING

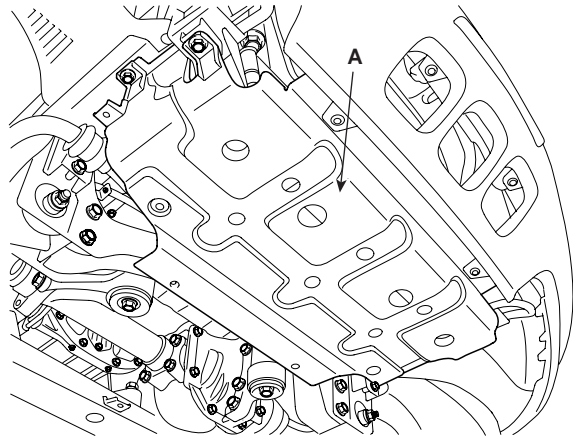
System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove the engine cover(A).



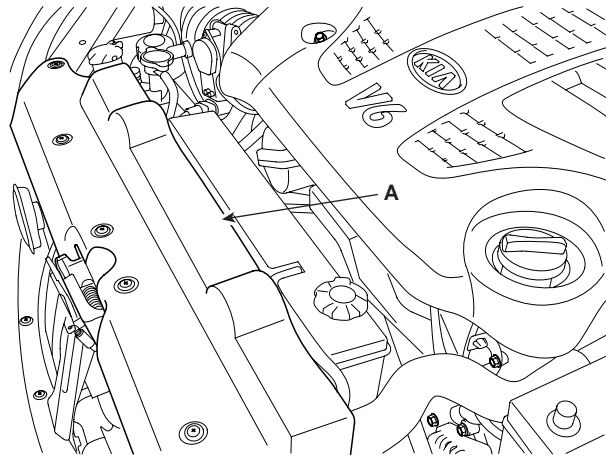
SBLM16001L

3. Remove the under cover(A).



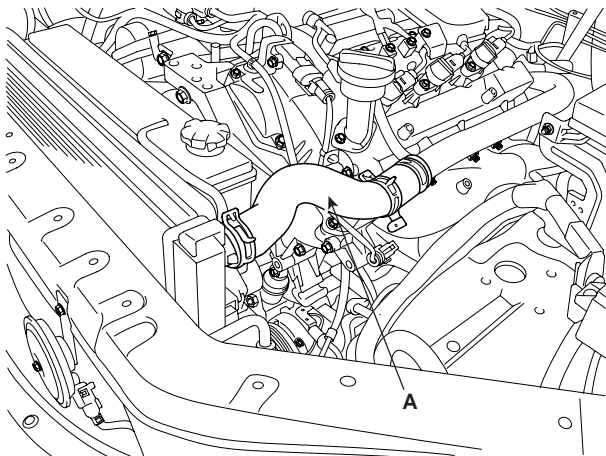
SBLM16016L

4. Remove the radiator grille upper cover(A).

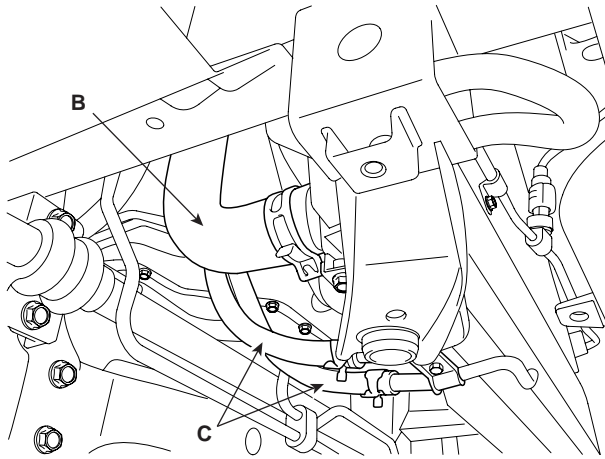


SBLM16022L

5. Disconnect the radiator upper hose(A) and lower hose(B) and the automatic transaxle fluid cooler hoses(C).

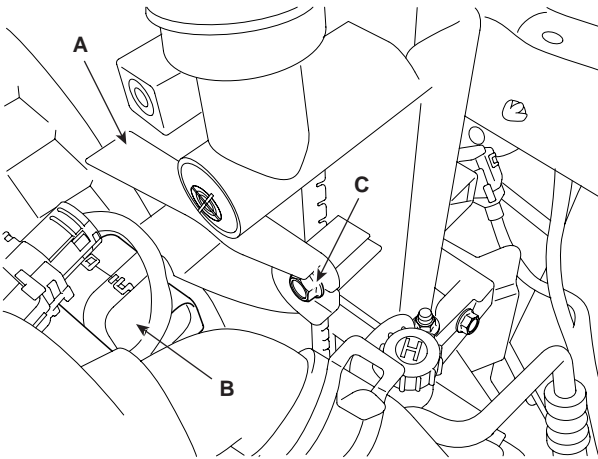


SBLM16023L



SBLM16024L

6. Remove the radiator from the condenser by removing bolts.(Refer to Condenser in HA Group).
7. Remove the cooling fan shroud(A) after disconnecting cooling fan harness connector(B) and loosening the mounting bolts(C).

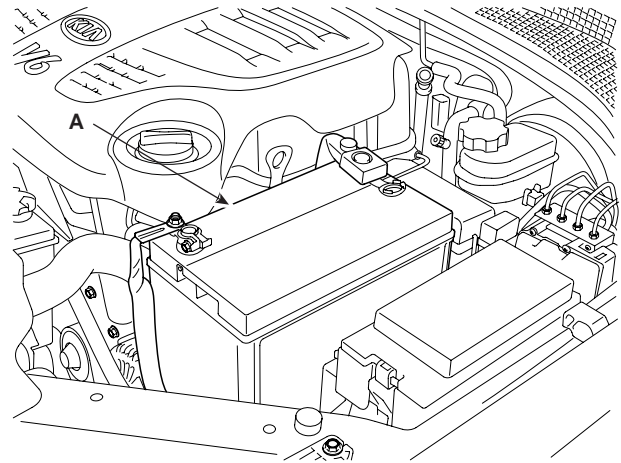


SBLM16025L

8. Remove the radiator assembly.

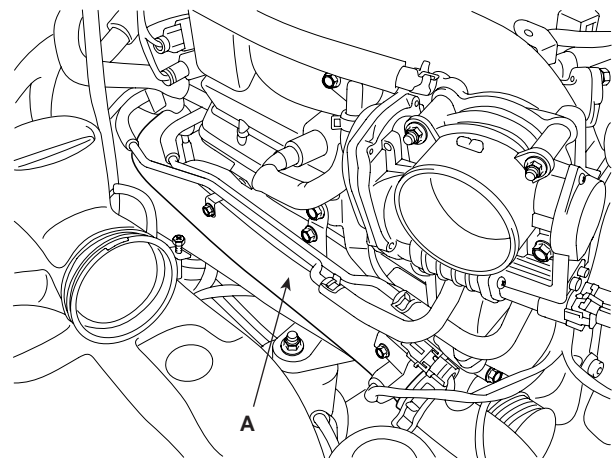
WATER TEMPERATURE CONTROL ASSEMBLY

1. Drain the engine coolant.
2. Remove air cleaner assembly.
3. Remove the automatic transaxle oil gauge.
4. Remove the battery assembly(A).

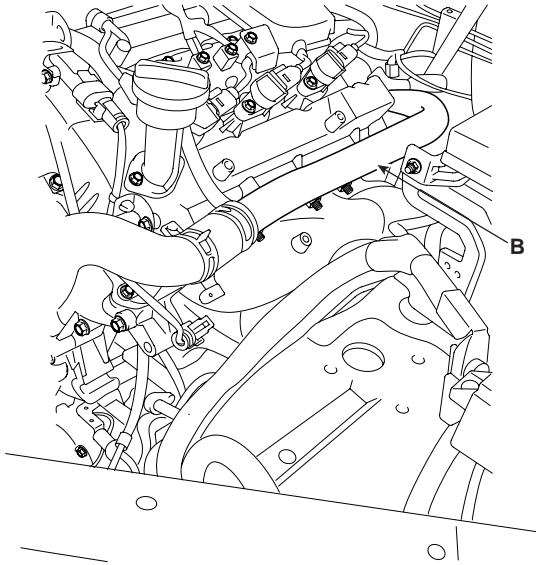


SBLM16008L

5. Disconnect the RH/LH cooling pipes(A, B).

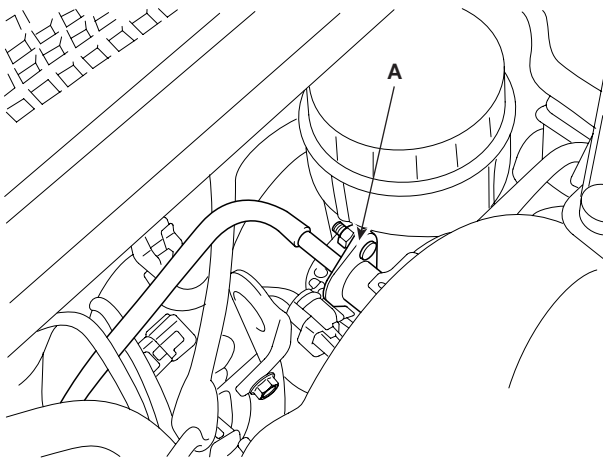


SBLM16115L



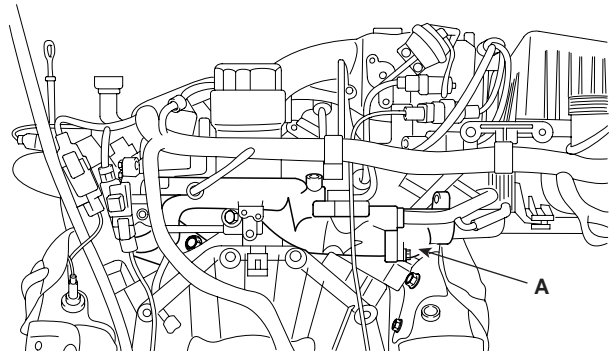
SBLM16116L

6. Disconnect WTS connector.
7. Disconnect heater hose, water vent hose and water hose from water temperature control assembly.
8. Remove the fuel pipe(A).



SBLM16015L

9. Remove water temperature control assembly(A).



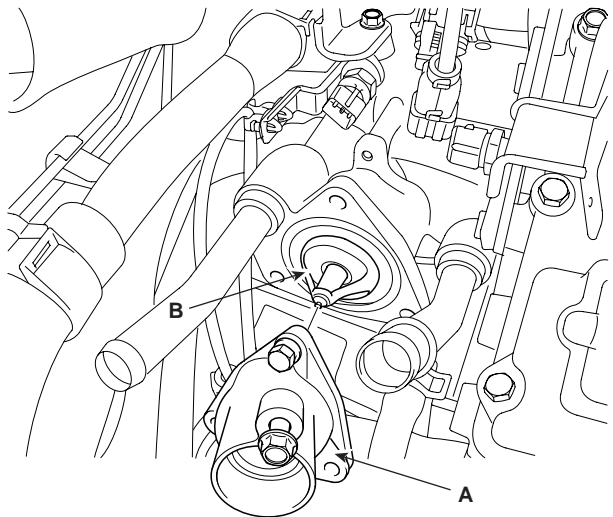
SBLM16204L

THERMOSTAT

 **NOTE**

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

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



SBLM16026L

INSPECTION EEE5DC80

WATER PUMP

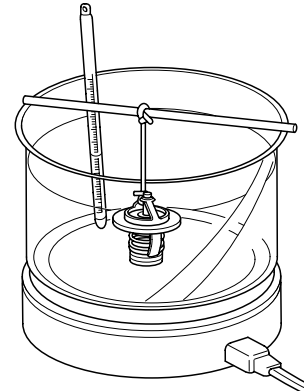
1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective.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

 **NOTE**

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

THERMOSTAT

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



ECKD503B

2. Check the valve opening temperature.
Valve opening temperature : 82°C (177°F)
Full opening temperature : 95°C (205°F)
If the valve opening temperature is not as specified, replace the thermostat.
3. Check the valve lift.
Valve lift : Min. 10mm (0.4in.) at 95°C (205°F)
If the valve lift is not as specified, replace the thermostat.

EMA -82

ENGINE MECHANICAL SYSTEM

INSTALLATION EFD4FFC4

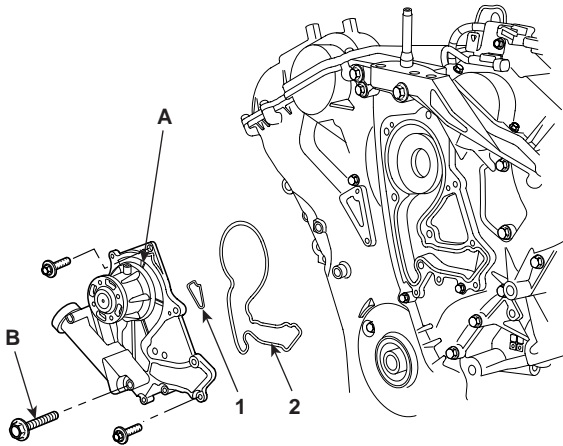
WATER PUMP

1. Install the water pump(A) and a new gasket(1, 2) with 12 bolts.

Tightening torque

21.56 ~ 23.52Nm (2.2 ~ 2.4kgf.m, 15.91 ~ 17.36lb-ft)

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



SBLM16205L

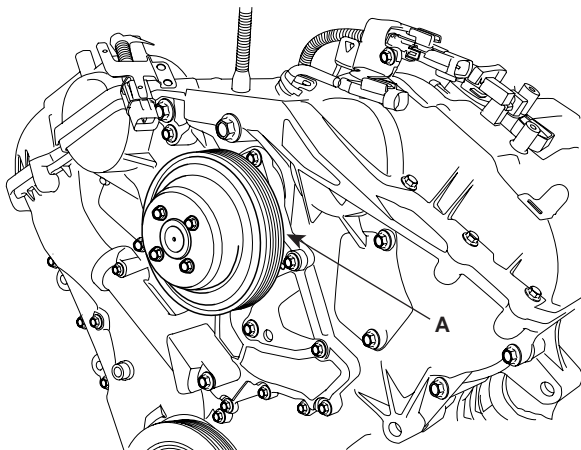
NOTE

- Make clean the contact face before assembly.
- When replacing a water pump, always use new gasket(1, 2).
- When reassembling a water pump, replace the bolt(B) with a new one.

2. Install the 4 bolts and pump pulley(A).

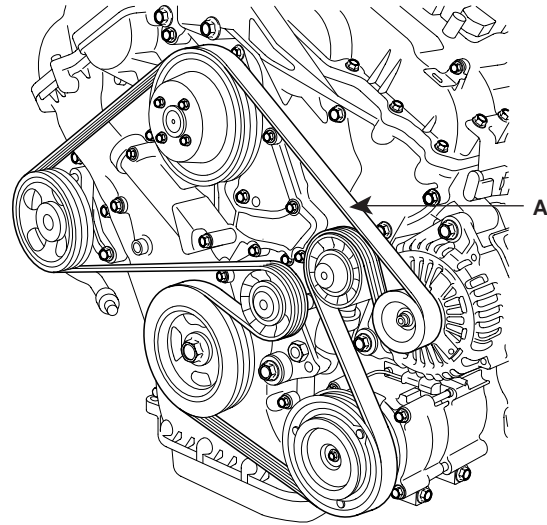
Tightening torque

7.84 ~ 9.80Nm (0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lb-ft)



KDRF107A

3. Install drive belt(A).



SBLM16101L

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

COOLING SYSTEM

EMA -83

WATER TEMPERATURE CONTROL ASSEMBLY

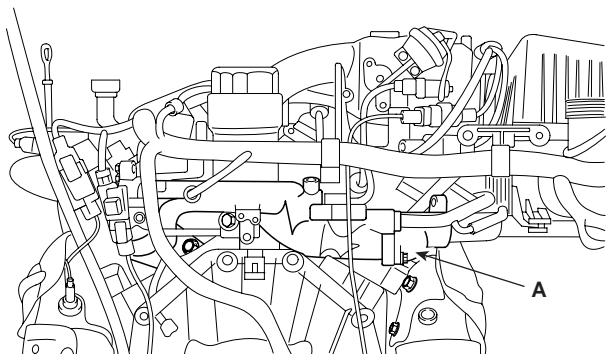
 **NOTE**

Make clean the contact face before assembly.

1. Install water temperature control assembly(A) and new gasket.

Tightening torque

19.6 ~ 23.52Nm (2.0 ~ 2.4kgf.m, 14.5 ~ 17.36lb-ft)

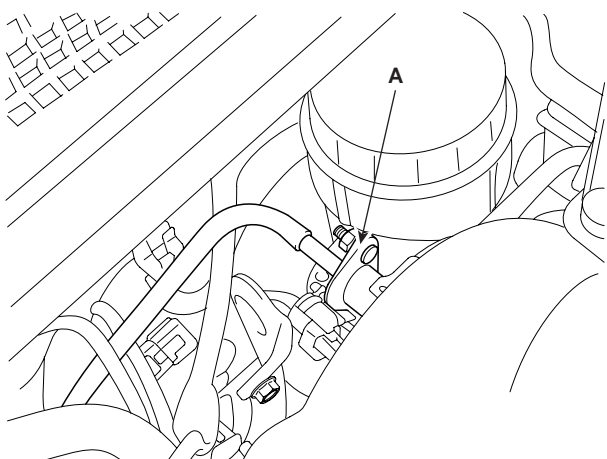


SBLM16204L

 **NOTE**

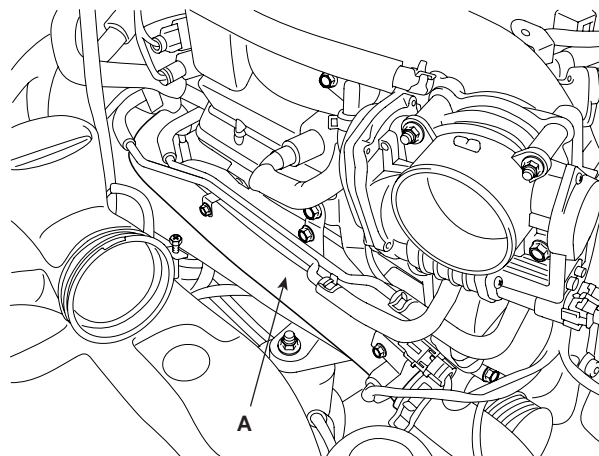
Use new O-rings(C) when reassembling.

2. Connect water hoses to the water temperature control assembly.
3. Install the fuel pipe(A).

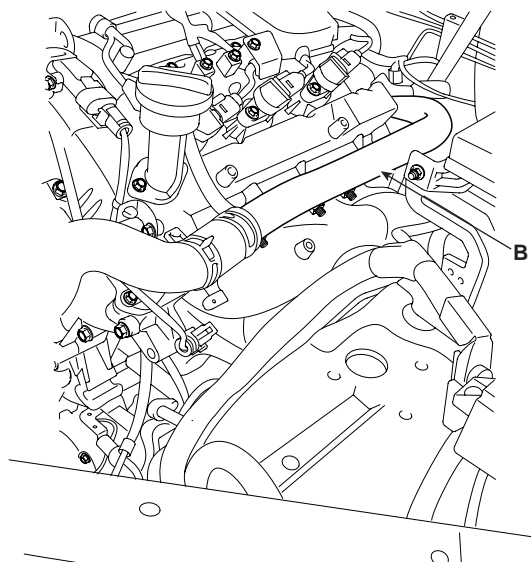


SBLM16015L

4. Connect WTS connector.
5. Connect the RH/LH cooling pipes(A, B).

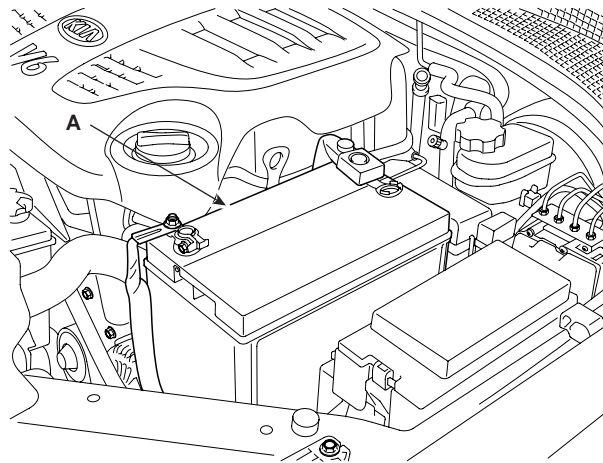


SBLM16115L



SBLM16116L

6. Install the battery assembly(A).

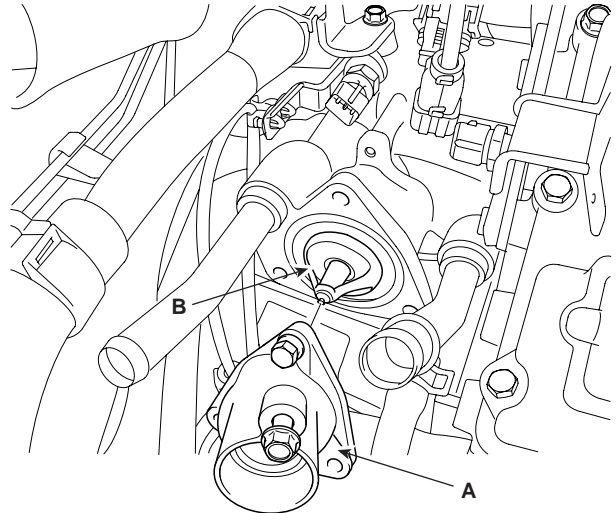


SBLM16008L

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

THERMOSTAT

1. Place thermostat in thermostat housing.
 - 1) Install the thermostat with the jiggle valve upward.
 - 2) Install a new thermostat(B).



SBLM16026L

2. Install water inlet(A).

Tightening torque

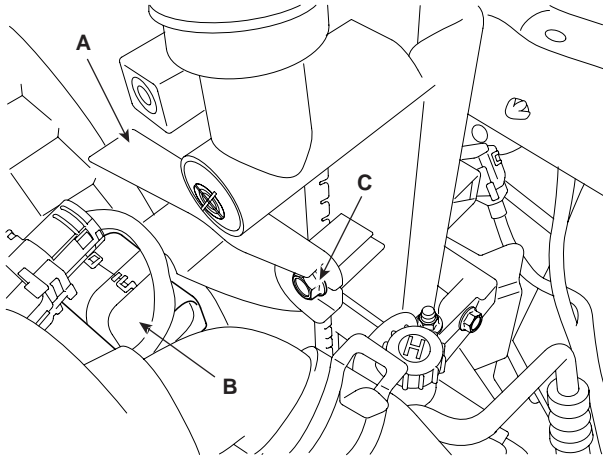
16.66 ~ 19.60Nm (1.7 ~ 2.0kgf.m, 12.30 ~ 14.47lb-ft)

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

COOLING SYSTEM

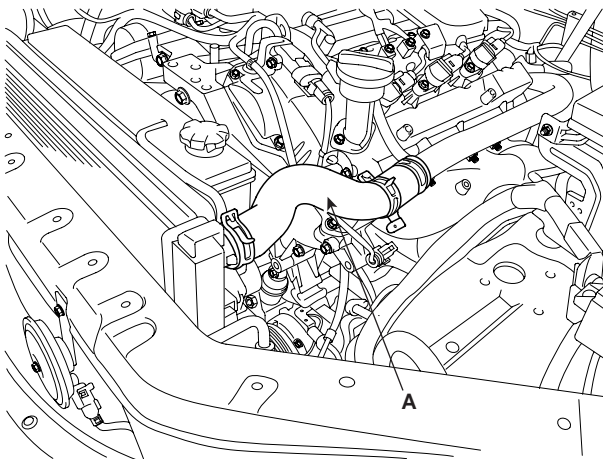
RADIATOR

1. Install the radiator assembly.
2. Install the cooling fan shroud(A) by connecting cooling fan harness connector(B) and tightening the mounting bolts(C).

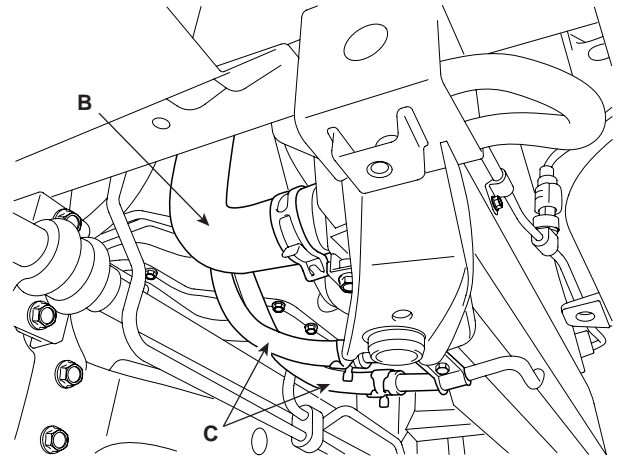


SBLM16025L

3. Install the radiator with the condenser by tightening bolts.(Refer to Condenser in HA Group).
4. Connect the radiator upper hose(A) and lower hose(B) and the automatic transaxle fluid cooler hoses(C).

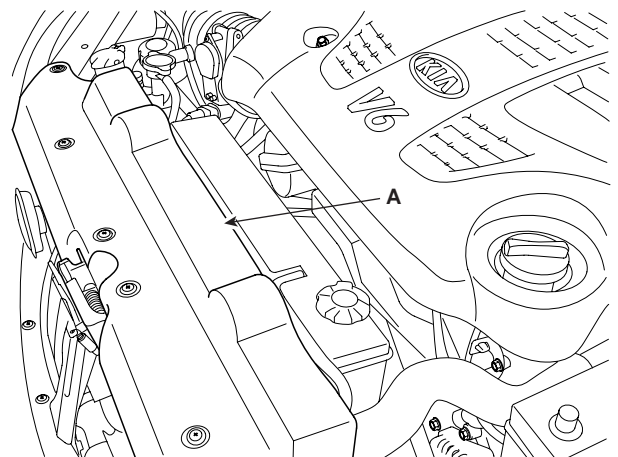


SBLM16023L



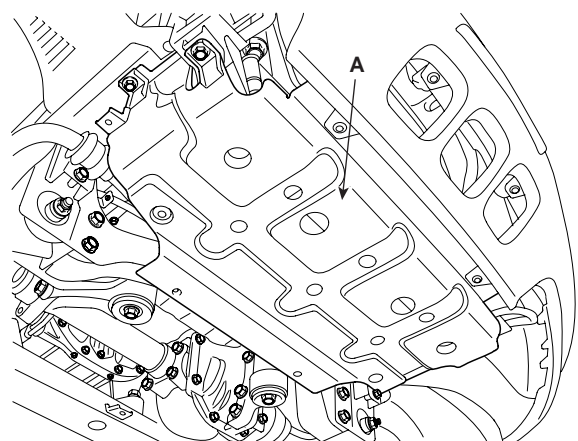
SBLM16024L

5. Install the radiator grille upper cover(A).



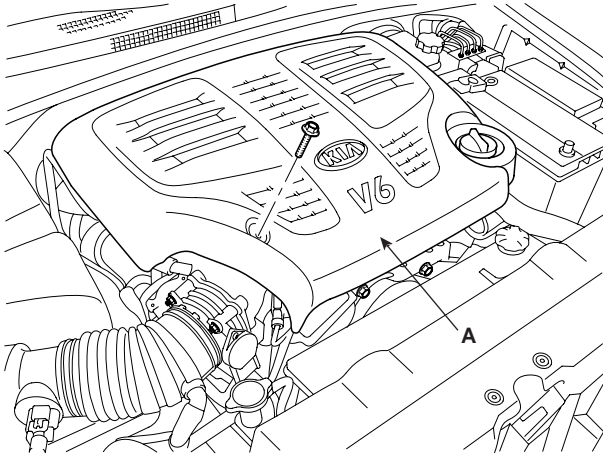
SBLM16022L

6. Install the under cover(A).



SBLM16016L

7. Install the engine cover(A).

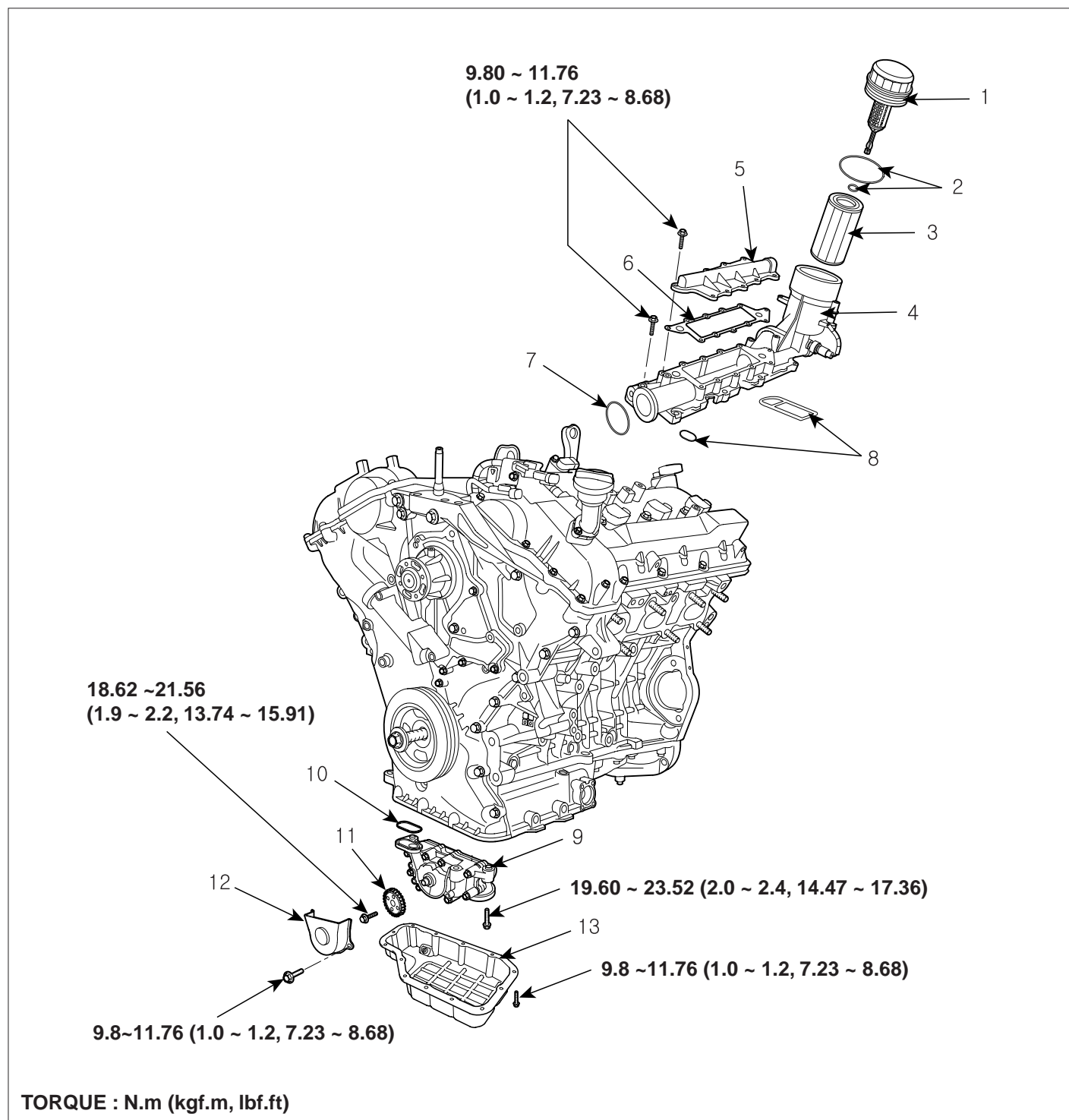


SBLM16001L

8. Refill engine coolant.

LUBRICATION SYSTEM

COMPONENTS E35BD1AA



- 1. Oil filter cap
- 2. O - ring
- 3. Oil filter element
- 4. Oil filter body
- 5. Oil filter body cover

- 6. Gasket
- 7. O - ring
- 8. Gasket
- 9. Oil pump
- 10. Gasket

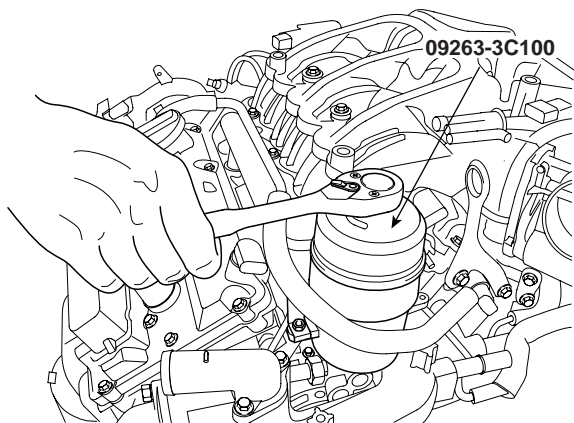
- 11. Oil pump sprocket
- 12. Oil pump chain cover
- 13. Lower oil paon

OIL AND FILTER E5D0D7D0

 CAUTION

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

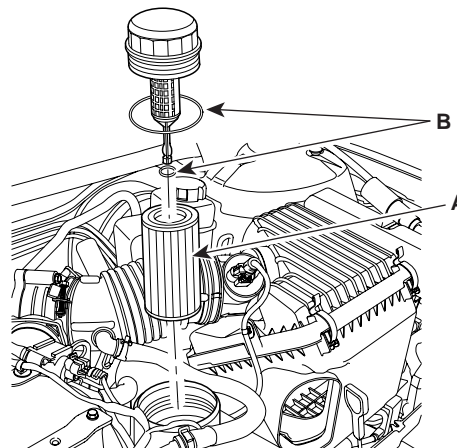
1. Park the car on level ground. Start the engine and let it warm up.
2. Turn the engine off and open the hood. Remove the engine cover.
3. Wait for 5minutes after loosening the oil filter cap by turning it counterclockwise with SST(09263-3C100) to drain well the oil in the oil filter.



ECRF051A

4. Drain the engine oil.
 - a. Remove the oil filler cap.
 - b. After lifting the car, remove the oil drain plug and drain the oil into a container.
5. Replace oil filter.
 - a. Disconnect the oil filter cap from oil filter body.
 - b. Remove the oil filter element.
 - c. Check and clean the oil filter installation surface.

- d. Check the part number of the new oil filter is as same as old one.
- e. Install new oil filter element(A) and two new O-rings(B).



KDRF188A

- f. Apply clean engine oil to the new O-rings. Lightly screw the oil filter cap into place, and tighten it until the O-ring contacts the seat.
- g. Finally tighten it again by specified tightening torque.

Tightening torque

24.50Nm (2.5kgf.m, 18.08lb-ft)

 CAUTION

When replacing a oil filter, the water temperature control(WTC) assembly should not be stained with oil.

6. Refill with engine oil.
 - a. Install the oil drain plug with a new gasket.

Tightening torque

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

- b. Fill with fresh engine oil, after remove the engine oil level gauge.

Capacity

Oil filter : 0.4L(0.42U.S.qus, 0.35Imp.qts)

Drain and refill : 5.2L(5.49U.S.qus, 4.58Imp.qts)

- c. Install the oil filler cap and oil level gauge.

7. Start the engine and check to be sure no oil is leaking from the drain plug or oil filter.
8. Recheck engine oil level.

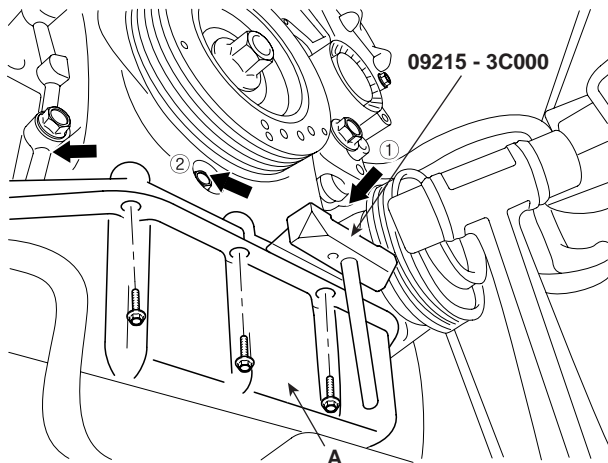
LUBRICATION SYSTEM

EMA -89

REMOVAL EEB453AF

OIL PUMP

1. Drain engine oil.
2. Remove the front member.(Refer to Front suspension system in SS Group).
3. Using SST(09215-3C000) remove lower oil pan(A).

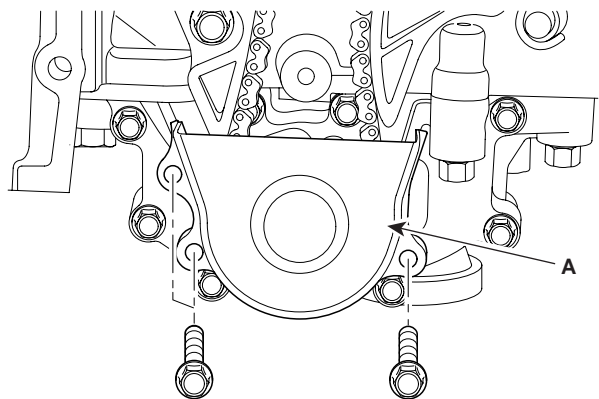


SBLM16019L

CAUTION

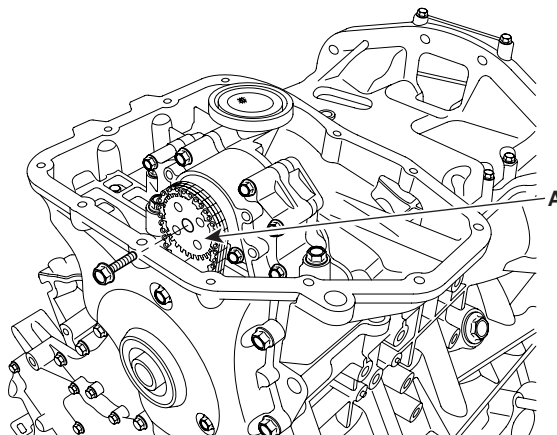
- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of arrow.
- After tapping the SST with a plastic hammer along the direction of arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It can result in damage of the SST.

4. Remove oil pump chain cover(A).



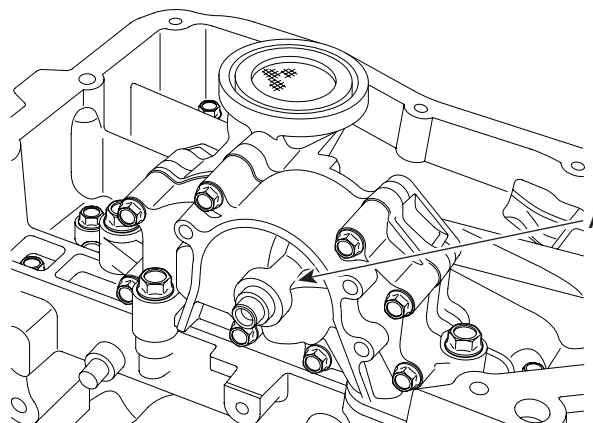
KDRF185A

5. Remove oil pump chain sprocket(A).



KDRF189A

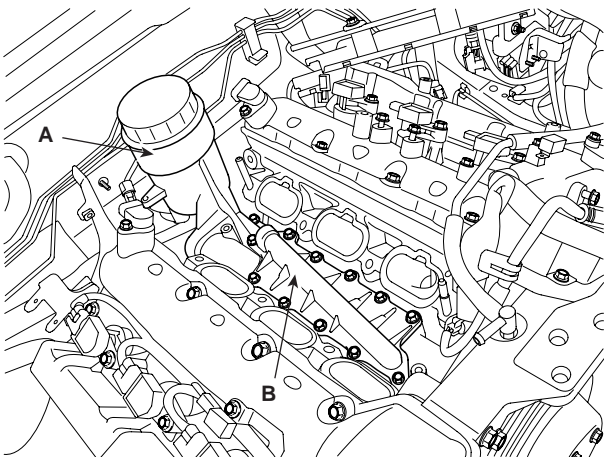
6. Remove oil pump(A).



KDRF190A

OIL FILTER ASSEMBLY

1. Remove the engine assembly.(Refer to Engine and transaxle assembly in this Group).
2. Loosen the oil filter cap by turning it counterclockwise to drain well the oil in the oil filter.
3. Remove surge tank and intake manifold.
4. Disconnect oil pressure switch connector.
5. Drain engine coolant.
6. Disconnect water hoses from water temperature control assembly.
7. Remove water temperature control assembly.
8. Remove oil filter body cover(B).
9. Remove oil filter body(A).



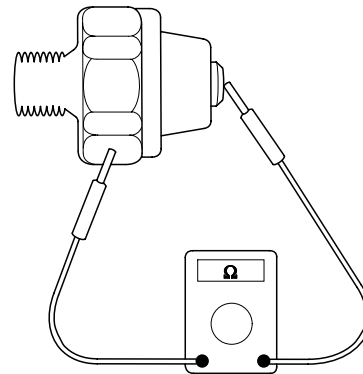
SBLM16027L

INSPECTION

E9C606A4

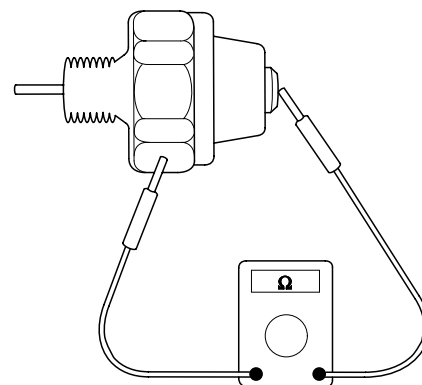
OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



ECKD001W

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50kpa (7psi) vacuum is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



ECKD001Y

ENGINE OIL EAA26A7C

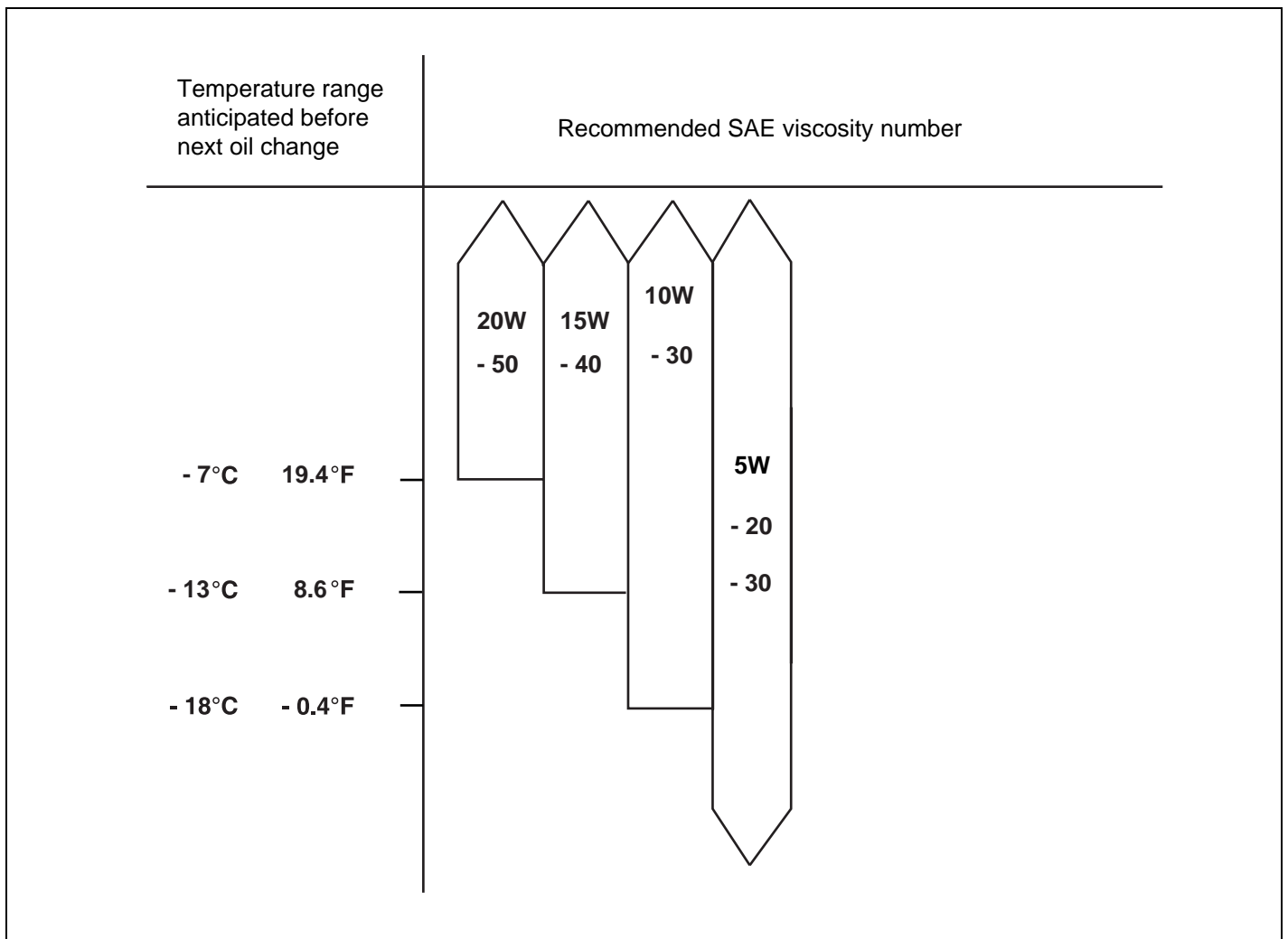
 **NOTE**

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

1. Check engine oil quality.
Check the oil for deterioration, entry of water, discoloring or thinning.
If the quality is visibly poor, replace the oil.
2. Check engine oil level.
After warming up the engine and then 5 minutes after the engine stop, oil level should be between the "L" and "F" marks on the dipstick.
If low, check for leakage and add oil up to the "F" mark.

SELECTION OF ENGINE OIL

Recommended API classification : Above SJ or SL
Recommended SAE viscosity grades : 5W-20
If 5W-20 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.



SBLM16108L

 **NOTE**

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

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

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

INSTALLATION EF2EDF0E

OIL PUMP

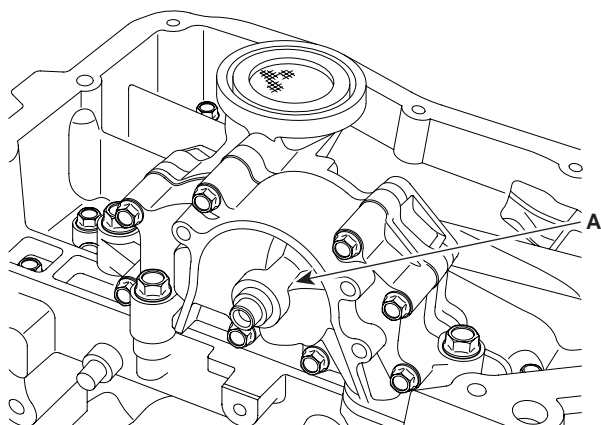
1. Install oil pump(A).

Tightening torque

19.60 ~ 23.52Nm (2.0 ~ 2.4kgf.m, 14.47 ~ 17.36lb-ft)

NOTE

Always use a new O-ring.

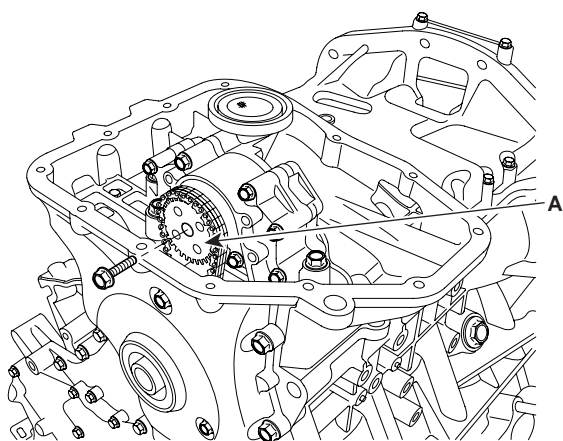


KDRF190A

2. Install oil pump sprocket(A) and oil pump chain on the oil pump.

Tightening torque

18.62 ~ 21.56Nm (1.9 ~ 2.2kgf.m, 13.74 ~ 15.91lb-ft)

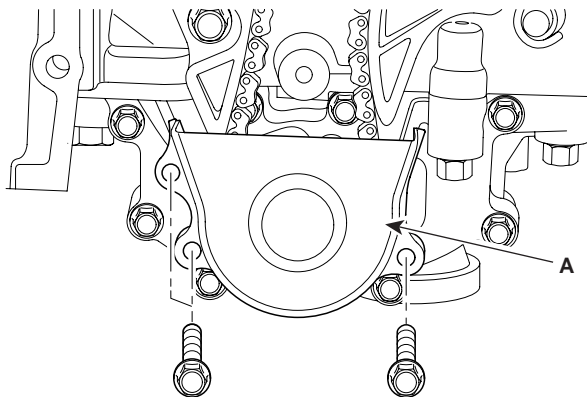


KDRF189A

3. Install oil pump chain cover(A).

Tightening torque

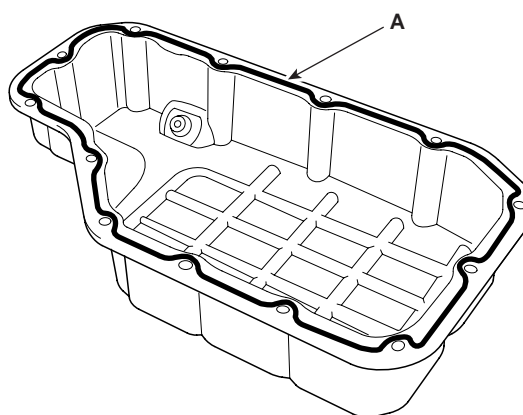
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF185A

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

Bead width : 2.5mm(0.1in.)



SBLM16020L

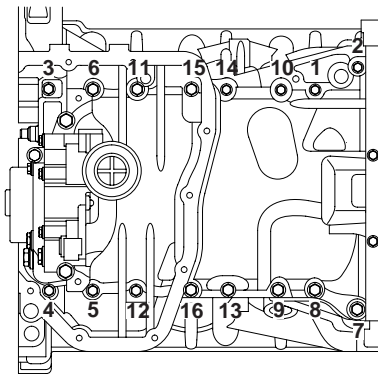
CAUTION

- **Make clean the sealing face before assembling two parts.**
- **Remove harmful foreign matters on the sealing face before applying sealant**
- **When applying sealant gasket, sealant must not be protruded into the inside of oil pan.**
- **To prevent leakage of oil, apply sealant gasket of the inner threads of the bolt holes.**

- e. Install upper oil pan.
Uniformly tighten the bolts in several passes.

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



KDRF131A

- f. Install the front member.(Refer to Front suspension system in SS Group).
g. After assembly, wait at least 30 minutes before filling the engine with oil.

OIL FILTER ASSEMBLY

1. Install oil filter body and new O-rings.

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

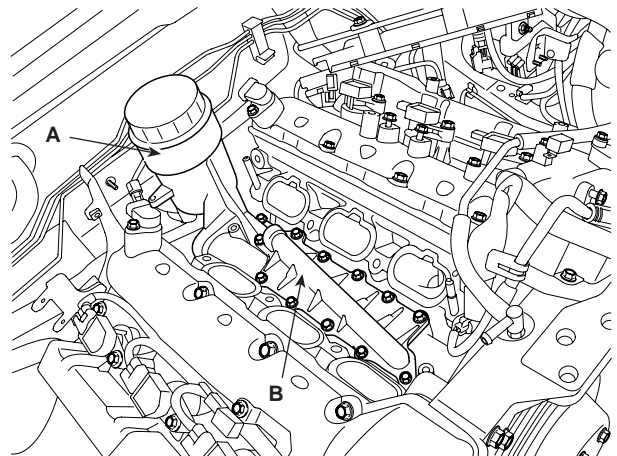
NOTE

- *All rubber gasket must be no damaged by assembling parts.*
- *Be careful of the knock sensor connector.*
- *Always use a new O-ring*

2. Install oil filter body cover(B) and new gasket on the oil filter body(A).

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



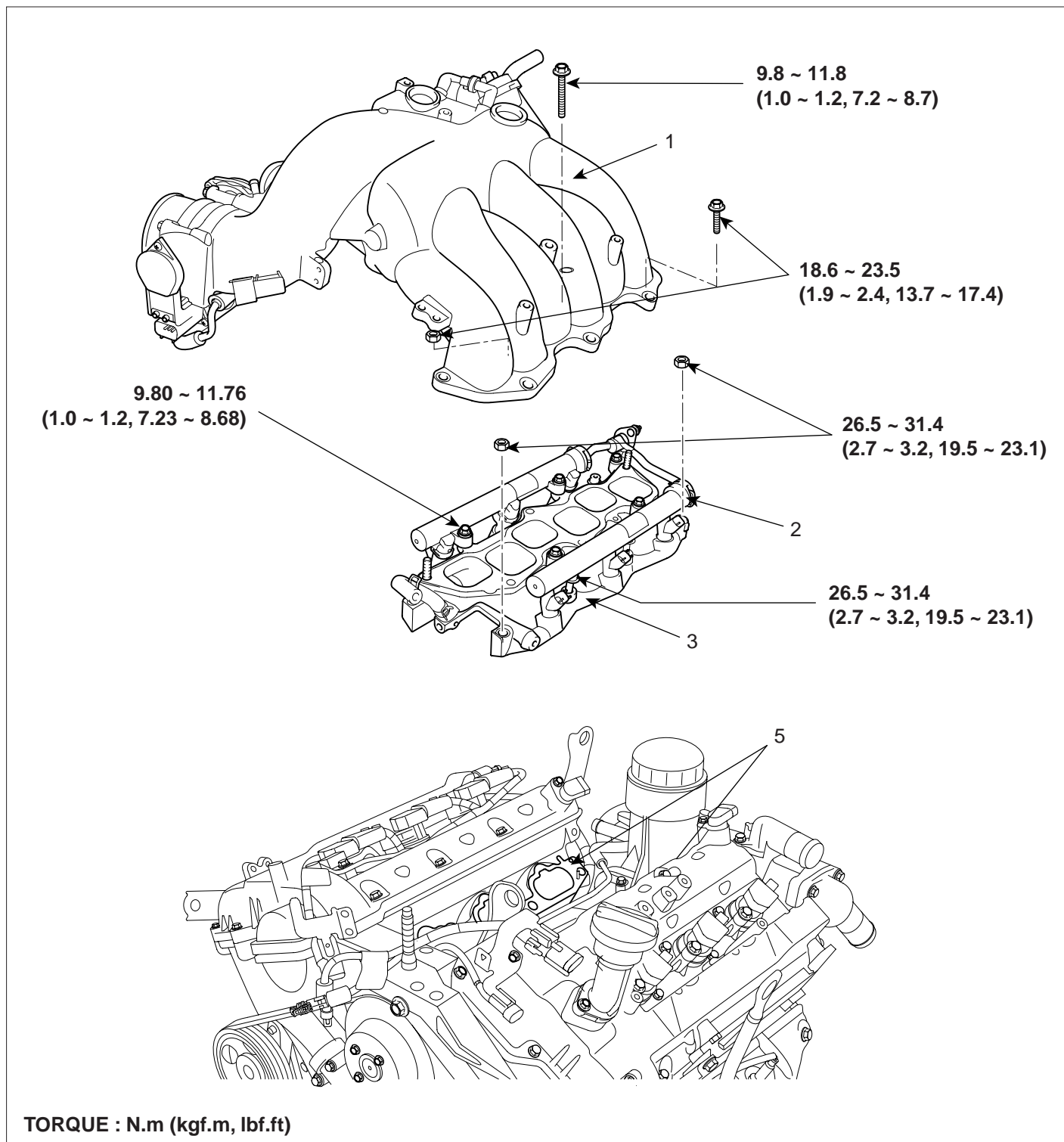
SBLM16027L

3. Install the water temperature control assembly.
4. Connect the water hoses on the water temperature control assembly.
5. Connect the oil pressure switch connector.
6. Install the intake manifold and surge tank.
7. Fill with engine coolant.
8. Start engine and check for leaks.
9. Recheck engine coolant level.

INTAKE AND EXHAUST SYSTEM

INTAKE MANIFOLD

COMPONENTS EEBEB0E3



- 1. Surge tank
- 2. Delivery pipe
- 3. Intake manifold

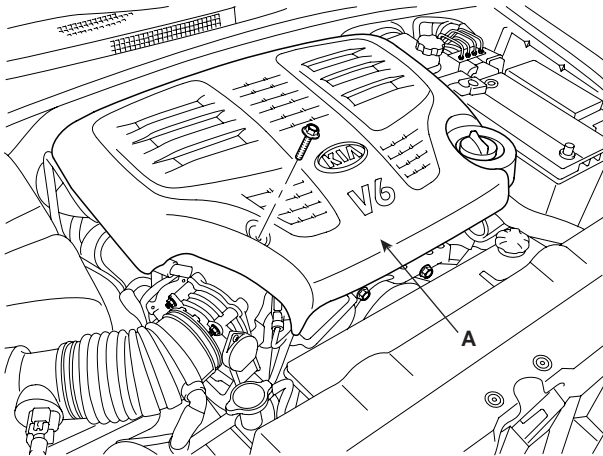
- 4. Surge tank gasket
- 5. Intake manifold gasket

INTAKE AND EXHAUST SYSTEM

EMA -95

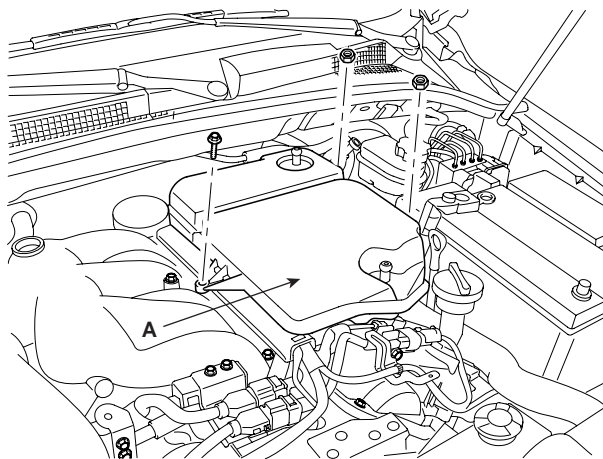
REPLACEMENT E6783A17

1. Remove the engine cover.



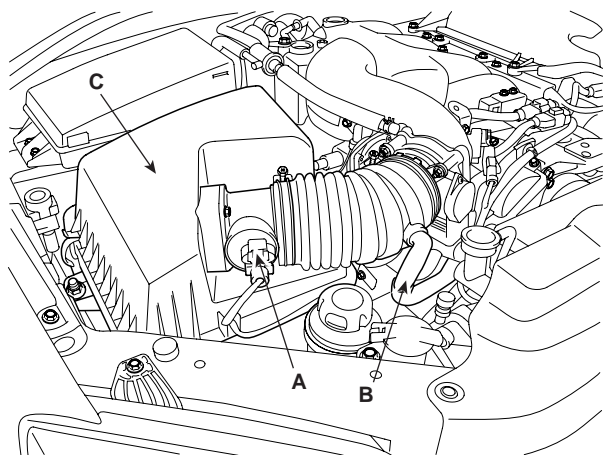
SBLM16001L

2. Remove the engine room resonator(A).



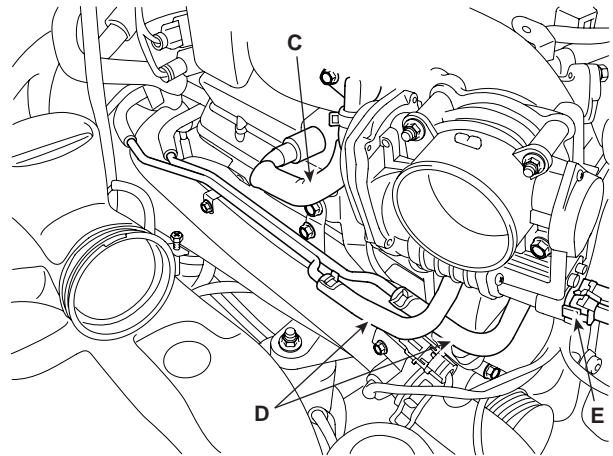
SBLM16003L

3. After disconnecting the MAF sensor connector(A) and the breather hose(B), remove the air cleaner assembly(C).



SBLM16002L

4. Disconnect the other breather hose(A), the Purge Control Solenoid Valve(PCSV) hose, the Positive Crankcase Ventilation (PCV) hose(C) and the Electronic Throttle Control(ETC) cooling hoses(D) and connector(E).

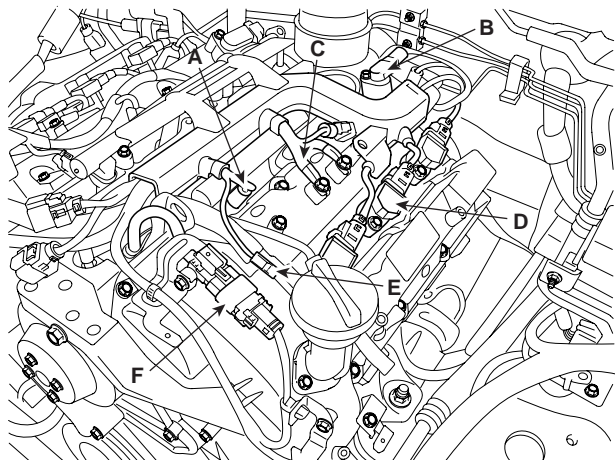


SBLM16208L

5. Remove the wiring over the surge tank.

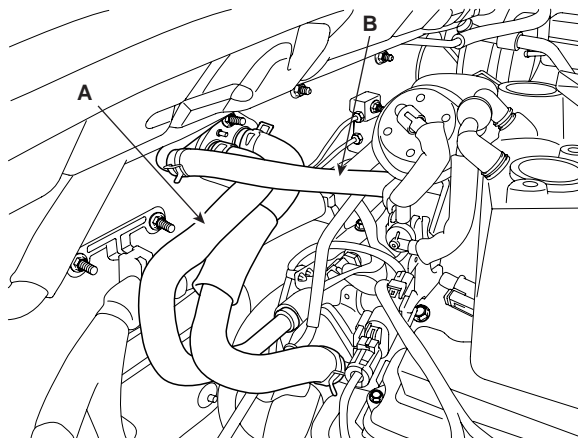
- 1) Disconnect the injection harness connector(A).
- 2) Disconnect the camshaft position sensor(CMP) harness connector(B).
- 3) Disconnect the ground line(C).
- 4) Disconnect the ignition coil harness connector(D).
- 5) Disconnect the condenser connector(E).
- 6) Disconnect the variable induction system(VIS) solenoid valve connector(G).
- 7) Disconnect the oil control valve(OCV) harness connector(F).

- 8) Disconnect the injector wiring(H) and ignition coil wiring(I).

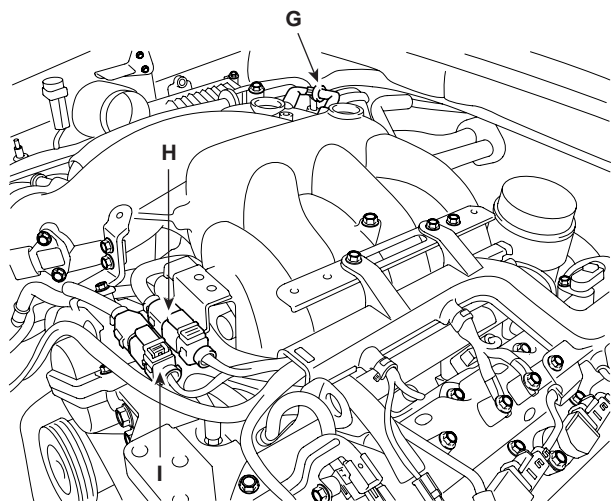


SBLM16006L

7. Remove heater hose(A) and disconnect the brake vaccume hose(B).

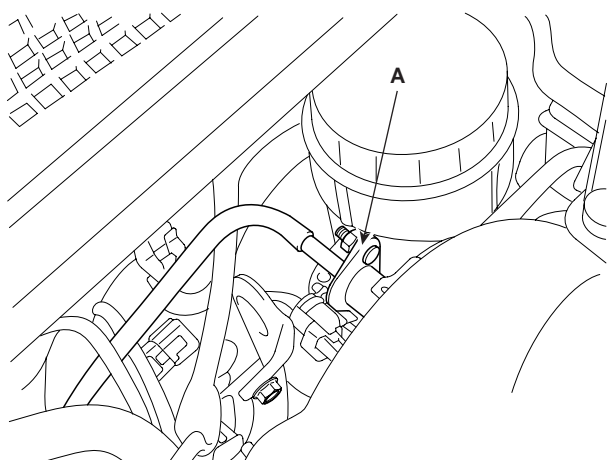


SBLM16017L



SBLM16206L

6. Disconnect the fuel hose tube(A).



SBLM16015L

8. Disconnect the surge tank stay.
9. Remove the surge tank.
10. Disconnect the injector connectors.
11. Disconnect the water hose on intake manifold from the nipple on the chain cover.
12. Remove the delivery pipe and intake manifold as an assembly.

NOTE

Except such cases as defects of injectors or pipe, do not disassemble a delivery pipe from an intake manifold because it is one of the fuel system parts, or you may have some problem in fuel system.

13. Install intake manifold and new gasket on the cylinder head.

Tightening torque

1st : 3.9 ~ 5.9Nm (0.4 ~ 0.6kgf.m, 2.9 ~ 4.3lb-ft)

2nd

Bolt : 26.5 ~ 31.4Nm (2.7 ~ 3.2kgf.m, 19.5 ~ 23.1lb-ft)

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

3rd : Repeat 2nd step twice or more.

INTAKE AND EXHAUST SYSTEM

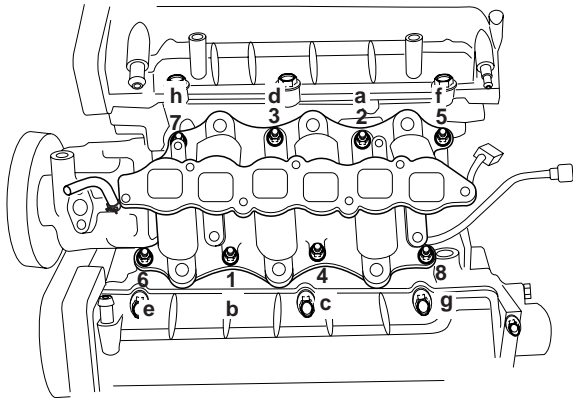
EMA -97

NOTE

Be careful of the installation direction.

a - h : 1st step order

1 ~ 8 : 2nd step order



SBLM16207L

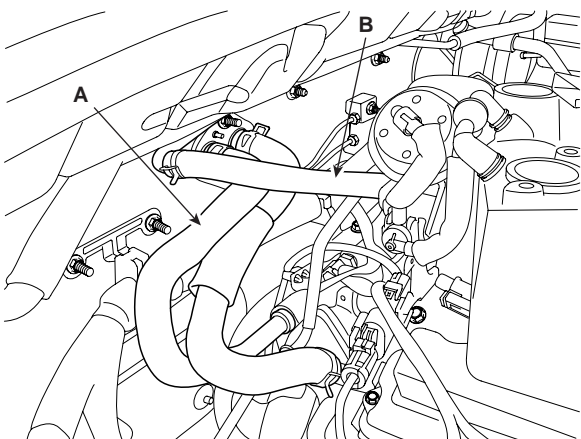
14. Connect the water hose on intake manifold to the nipple on the chain cover.
15. Install delivery pipe.(Refer to Delivery pipe in FL Group).
16. Install the surge tank and new gasket on the intake manifold.

Tightening torque

Long bolt : 9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m,
7.23 ~ 8.68lb-ft)

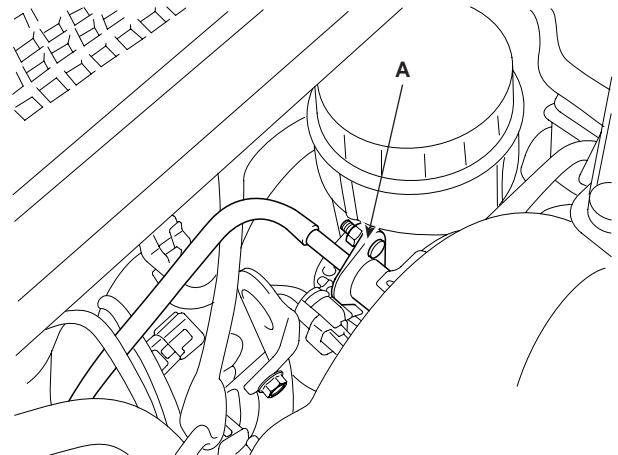
Short bolt, nut : 18.6 ~ 23.5Nm (1.9 ~
2.4kgf.m, 13.7 ~ 17.4lb-ft)

17. Connect heater hose(A) and the brake vacuum hose(B).



SBLM16017L

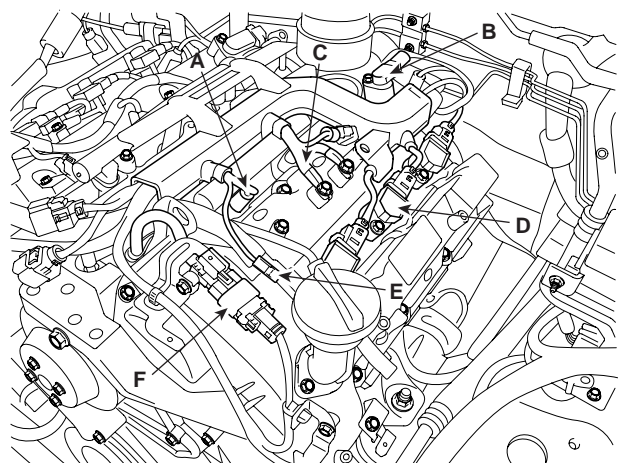
18. Connect the fuel hose tube(A).



SBLM16015L

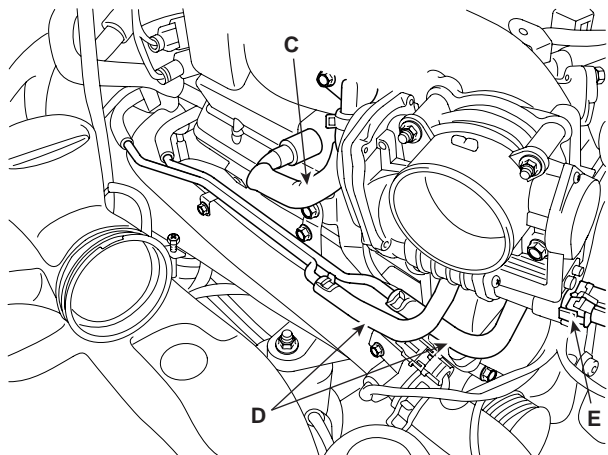
19. Connect the wiring over the surge tank.

- 1) Connect the injection harness connector(A)
- 2) Connect the camshaft position sensor(CMP) harness connector(B).
- 3) Connect the ground lines(C).
- 4) Connect the ignition coil harness connector(D).
- 5) Connect the condenser connector(E).
- 6) Connect the variable induction system(VIS) solenoid valve connector(G).
- 7) Connect the oil control valve(OCV) harness connector(F).



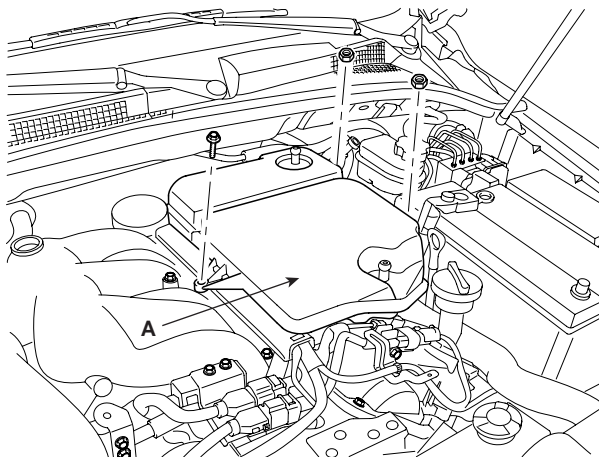
SBLM16006L

20. Connect the other breather hose(A), the Positive Crankcase Ventilation (PCV) hose(C) and the Electronic Throttle Control(ETC) cooling hoses(D), ETC connector(E).



SBLM16208L

22. Install the engine room resonator(A).

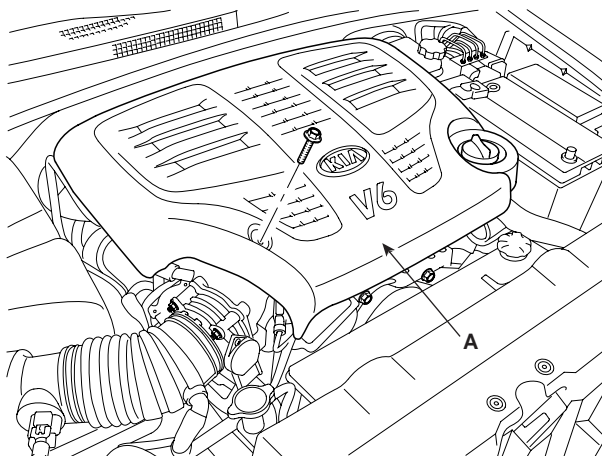


SBLM16003L

Tightening torque

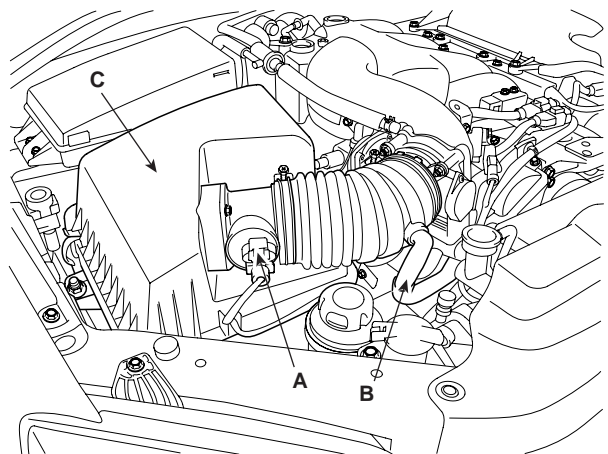
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

23. Remove the engine cover(A).



SBLM16001L

21. After connecting the MAF sensor connector(A) and the breather hose(B), install the air cleaner assembly(C).



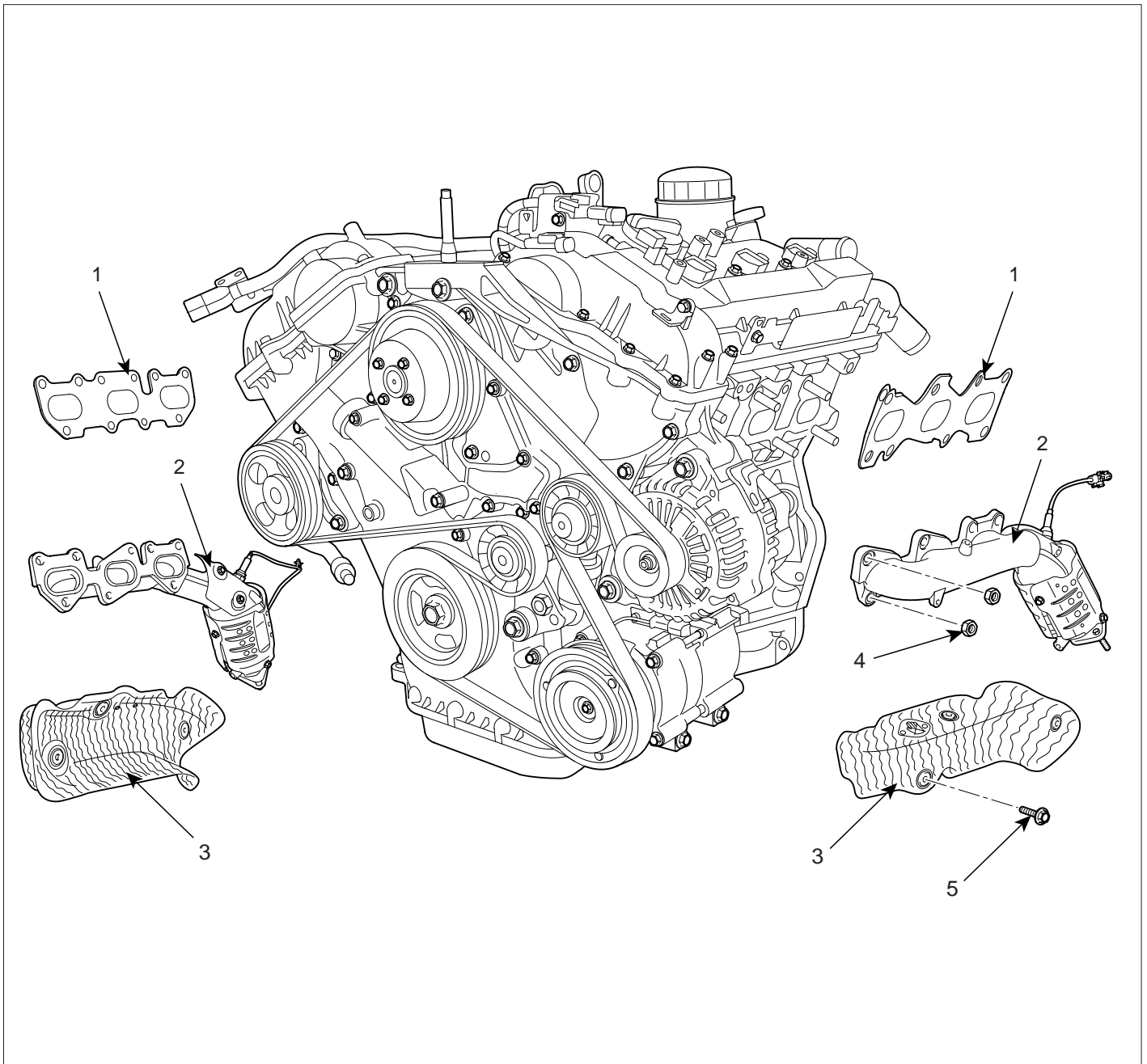
SBLM16002L

Tightening torque

9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)

EXHAUST MANIFOLD

COMPONENTS E1D30F79



- 1. Gasket
- 2. Exhaust manifold
- 3. Heat protector

- 4. Self - locking flange nut
- 5. Flange bolt

SBLM16110L

EMA -100

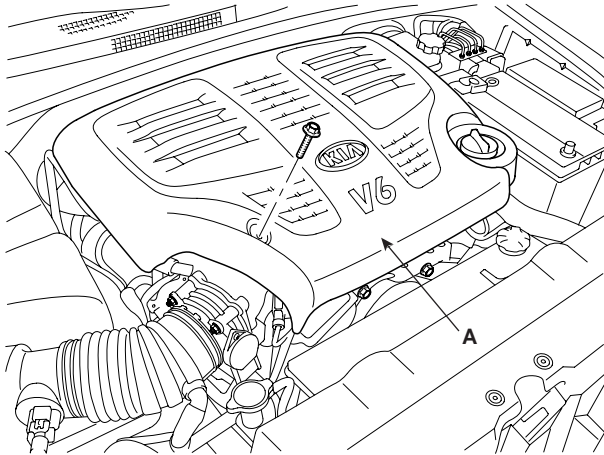
ENGINE MECHANICAL SYSTEM

REPLACEMENT

E2C05B4E

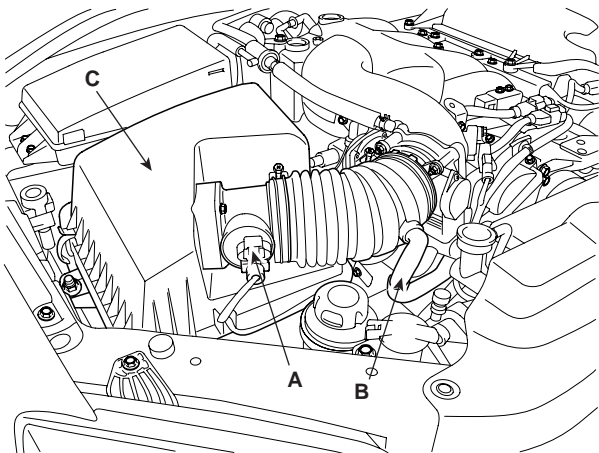
[RH SIDE OR BANK 1]

1. Remove the engine cover(A).



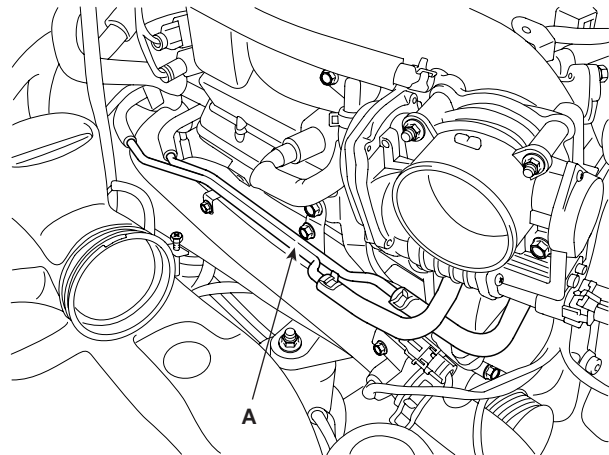
SBLM16001L

2. After disconnecting the MAF sensor connector(A) and the breather hose(B), remove the air cleaner assembly(C).



SBLM16002L

3. Remove the RH cooling pipe(A).



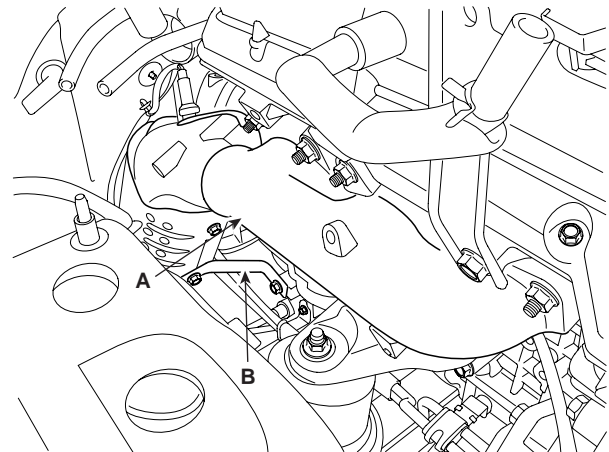
SBLM16111L

4. Remove the RH exhaust manifold heat protector.

CAUTION

Handle the heat protector with caution not to be deformed.

5. After removing the under cover, disconnect the exhaust manifolds from the front muffler.
6. Remove the RH exhaust manifold(A) and the stay(B).



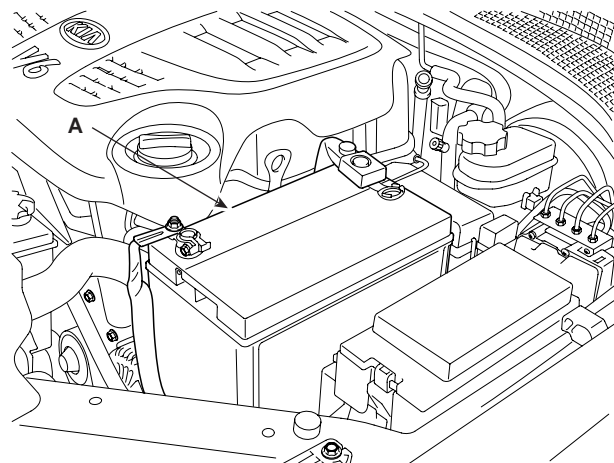
SBLM16117L

INTAKE AND EXHAUST SYSTEM

EMA -101

[LH SIDE OR BANK 2]

1. Remove the engine oil level gauge.
2. Remove the battery assembly(A).



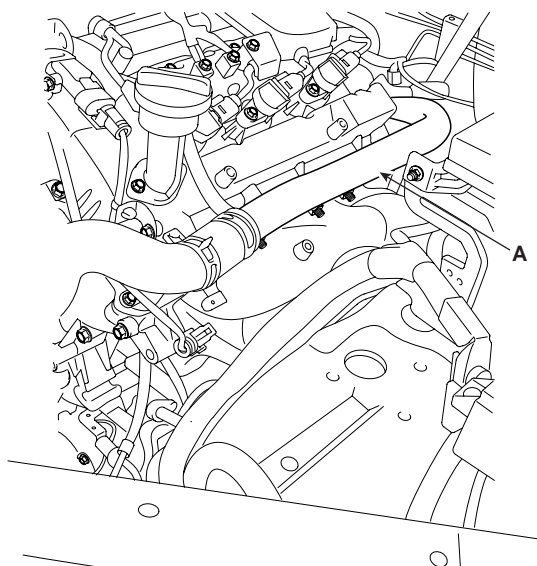
SBLM16008L

3. Remove the LH exhaust manifold heat protector.

CAUTION

Handle the heat protector with caution not to be deformed.

4. Remove the LH cooling pipe(A).

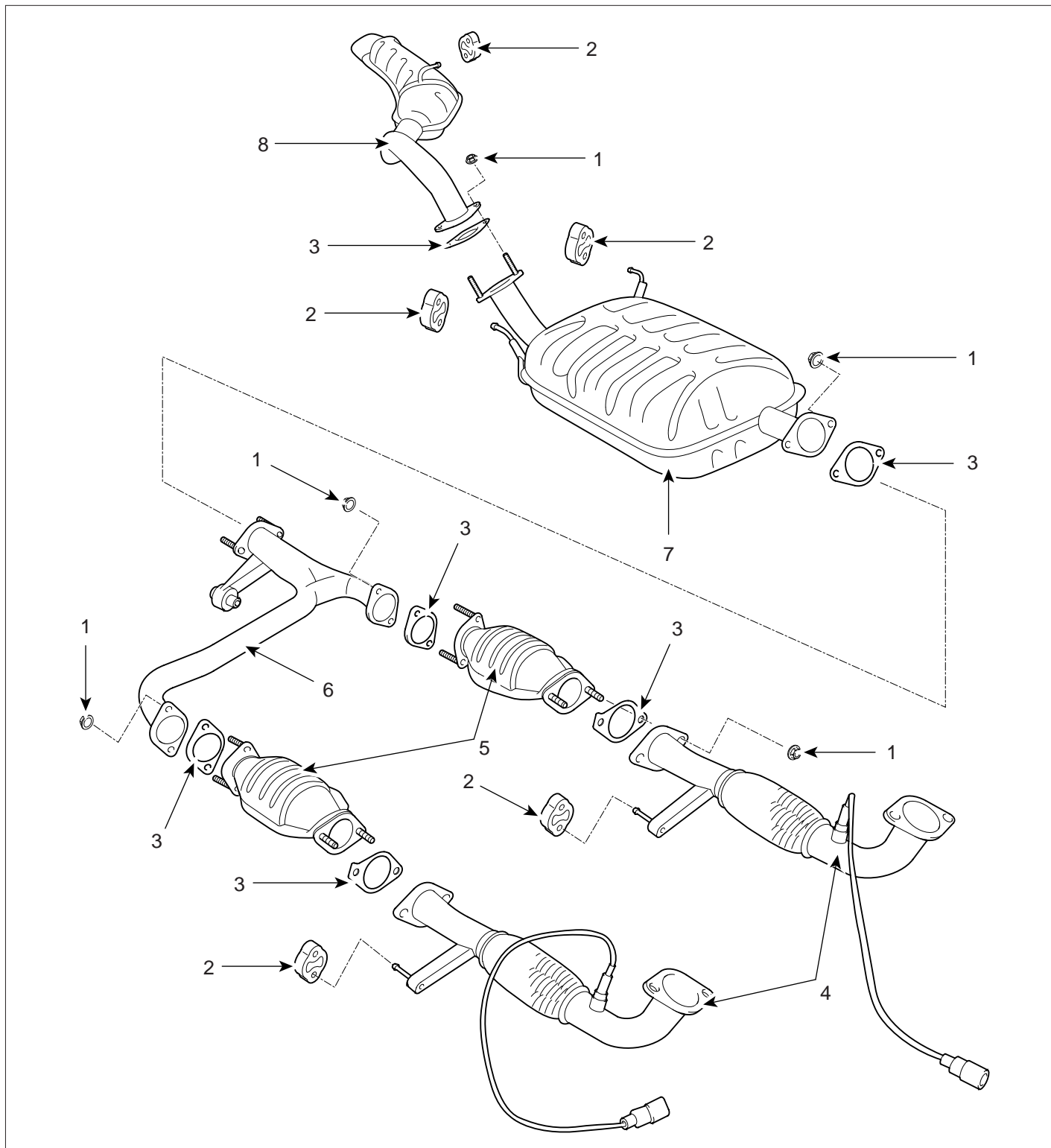


SBLM16120L

5. Remove the automatic transaxle fluid oil level gauge.
6. Disconnect the oil pressure switch harness connector and the battery ground line.
7. After removing the under cover, disconnect the exhaust manifolds from the front muffler.
8. Remove the LH exhaust manifold.
9. To install, reverse the removal procedure.

EXHAUST PIPE

COMPONENTS EEE4783F



- 1. Self-locking nut
- 2. Hanger
- 3. Gasket
- 4. Front muffler

- 5. Catalytic converter
- 6. Center muffler
- 7. Main muffler
- 8. Tail pipe assembly