

# Engine (D4FA - DSL 1.5)

## GENERAL

SPECIFICATIONS .....	EMA - 2
TIGHTENING TORQUE .....	EMA - 6
COMPRESSION PRESSURE	
INSPECTION .....	EMA - 9
TROUBLESHOOTING .....	EMA - 10
SPECIAL SERVICE TOOL .....	EMA - 13

## TIMING SYSTEM

COMPONENTS .....	EMA - 16
REMOVAL .....	EMA - 18
INSTALLATION .....	EMA - 25

## ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL .....	EMA - 34
INSPECTION .....	EMA - 41

## CYLINDER HEAD ASSEMBLY

COMPONENTS .....	EMA - 42
REMOVAL .....	EMA - 44
DISASSEMBLY .....	EMA - 46
INSPECTION .....	EMA - 47
REASSEMBLY .....	EMA - 52
INSTALLATION .....	EMA - 53

## ENGINE BLOCK

COMPONENTS .....	EMA - 58
DISASSEMBLY .....	EMA - 59
INSPECTION .....	EMA - 60
REASSEMBLY .....	EMA - 69

## COOLING SYSTEM

COMPONENTS .....	EMA - 74
ENGINE COOLANT REFILLING AND BLEEDING .....	EMA - 76
RADIATOR CAP TESTING .....	EMA - 77
RADIATOR LEAKAGE TESTING .....	EMA - 77
REMOVAL .....	EMA - 78
INSPECTION .....	EMA - 80
INSTALLATION .....	EMA - 81

## LUBRICATION SYSTEM

COMPONENTS .....	EMA - 84
OIL AND FILTER REPLACEMENT .....	EMA - 85
SELECTION OF ENGINE OIL .....	EMA - 86
REMOVAL .....	EMA - 87
DISASSEMBLY .....	EMA - 87
INSPECTION .....	EMA - 88
REASSEMBLY .....	EMA - 88
INSTALLATION .....	EMA - 89

## INTAKE AND EXHAUST SYSTEM

COMPONENTS	
INTAKE AND EXHAUST	
MANIFOLD .....	EMA - 90
EXHAUST PIPE .....	EMA - 91
REMOVAL	
INTAKE MANIFOLD .....	EMA - 92
EXHAUST MANIFOLD .....	EMA - 94
EXHAUST PIPE .....	EMA - 96



# GENERAL

## SPECIFICATIONS E284EBC0

Description		Specifications (D4FA)	Limit
<b>General</b>			
Type	In-line, DOHC		
Number of cylinders	4		
Bore	75mm (2.9528in)		
Stroke	84.5mm (3.3268in)		
Total displacement	1,493 cc (91.11 cu.in)		
Compression ratio	17.8 : 1		
Firing order	1-3-4-2		
<b>Valve timing</b>			
Intake valve	Opens (BTDC)	6°	
	Closes (ABDC)	34°	
Exhaust valve	Opens (BBDC)	46°	
	Closes (ATDC)	4°	
<b>Cylinder head</b>			
Flatness of gasket surface		0.03mm (0.0012in) for width 0.09mm (0.0035in) for length	
Flatness of manifold mounting surface	Intake	0.025mm (0.0010in) for width 0.160mm (0.0063in) for length	
	Exhaust	0.025mm (0.0010in) for width 0.160mm (0.0063in) for length	
<b>Camshaft</b>			
Cam height	LH camshaft	Intake	35.452 ~ 35.652mm (1.3957 ~ 1.4036in)
		Exhaust	35.700 ~ 35.900mm (1.4055 ~ 1.4134in)
	RH camshaft	Intake	35.537 ~ 35.737mm (1.3991 ~ 1.4070in)
		Exhaust	35.452 ~ 35.652mm (1.3957 ~ 1.4036in)
Journal outer Diameter	LH camshaft	20.944 ~ 20.960mm (0.8246 ~ 0.8252in)	
	RH camshaft	20.944 ~ 20.960mm (0.8246 ~ 0.8252in)	
Bearing oil clearance		0.040 ~ 0.077mm (0.0016 ~ 0.0030in)	
End play		0.10 ~ 0.20mm (0.0039-0.0079in)	
<b>Valve</b>			
Valve length	Intake	93.0mm (3.6614in)	
	Exhaust	93.7mm (3.6890in)	
Stem outer diameter	Intake	5.455 ~ 5.470mm (0.2148 ~ 0.2154in)	
	Exhaust	5.435 ~ 5.450mm (0.2140 ~ 0.2146in)	
Face angle		45.5° ~ 45.75°	

Description		Specifications (D4FA)	Limit
Thickness of valve head (margin)	Intake	1.1mm (0.0433in)	
	Exhaust	1.2mm (0.0472in)	
Valve stem to valve guide clearance	Intake	0.030 ~ 0.057mm (0.0012 ~ 0.0022in)	
	Exhaust	0.050 ~ 0.077mm (0.0020 ~ 0.0030in)	
<b>Valve guide</b>			
Inner diameter	Intake	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
	Exhaust	5.500 ~ 5.512mm (0.2165 ~ 0.2170in)	
Length	Intake	31.3 ~ 31.7mm (1.2323 ~ 1.2480in)	
	Exhaust	31.3 ~ 31.7mm (1.2323 ~ 1.2480in)	
<b>Valve seat</b>			
Width of seat contact	Intake	0.8 ~ 1.4mm (0.0315 ~ 0.0551in)	
	Exhaust	1.2 ~ 1.8mm (0.0472 ~ 0.0709in)	
Seat angle	Intake	45° ~ 45°30'	
	Exhaust	45° ~ 45°30'	
<b>Valve spring</b>			
Free length		44.9mm (1.7677in)	
Load		17.5±0.9kg/32.0mm(38.6±2.0 lb/1.2598in)	
		31.0±1.6kg/23.5mm(68.3±3.5 lb/0.9252in)	
Out of squareness		Less than 1.5°	3°
<b>Cylinder block</b>			
Cylinder bore		75.000 ~ 75.030mm (2.9528 ~ 2.9539in)	
Flatness of gasket surface		Less than 0.05mm (0.0020in) (Overhaul) Less than 0.03mm (0.0012in) (Per 1 Cylinder)	
<b>Piston</b>			
Piston outer diameter		74.930 ~ 74.960mm (2.9500 ~ 2.9512in)	
Piston to cylinder clearance		0.060 ~ 0.080mm (0.0024 ~ 0.0031in)	
Ring groove width	No. 1 ring groove	1.83 ~ 1.85mm (0.0720 ~ 0.0728in)	
	No. 2 ring groove	1.82 ~ 1.84mm (0.0717 ~ 0.0724in)	
	Oil ring groove	3.02 ~ 3.04mm (0.1189 ~ 0.1197in)	
<b>Piston ring</b>			
Side clearance	No. 1 ring	0.09 ~ 0.13mm (0.0035 ~ 0.0051in)	
	No. 2 ring	0.08 ~ 0.12mm (0.0031 ~ 0.0047in)	
	Oil ring	0.03 ~ 0.07mm (0.0012 ~ 0.0028in)	
End gap	No. 1 ring	0.20 ~ 0.35mm (0.0079 ~ 0.0138in)	
	No. 2 ring	0.35 ~ 0.50mm (0.0138 ~ 0.0197in)	
	Oil ring	0.20 ~ 0.40mm (0.0079 ~ 0.0157in)	
<b>Piston pin</b>			
Piston pin outer diameter		27.995 ~ 28.000mm (1.1022 ~ 1.1024in)	

Description		Specifications (D4FA)	Limit
Piston pin hole inner diameter		28.004 ~ 28.010mm (1.1025 ~ 1.1028in)	
Piston pin hole clearance		0.004 ~ 0.015mm (0.0002 ~ 0.0006in)	
Connecting rod small end hole inner diameter		28.022 ~ 28.034mm (1.1032 ~ 1.1037in)	
Connecting rod small end hole clearance		0.022 ~ 0.039mm (0.0009 ~ 0.0015in)	
<b>Connecting rod</b>			
Connecting rod big end inner diameter		49.000 ~ 49.018mm (1.9291 ~ 1.9298in)	
Connecting rod bearing oil clearance		0.025 ~ 0.043mm (0.0010 ~ 0.0017in)	
Side clearance		0.050 ~ 0.302mm (0.0020 ~ 0.0119in)	0.4mm (0.0157in)
<b>Crankshaft</b>			
Main journal outer diameter		53.972 ~ 53.990mm (2.1249 ~ 2.1256in)	
Pin journal outer diameter		45.997 ~ 46.015mm (1.8109 ~ 1.8116in)	
Main bearing oil clearance		0.024 ~ 0.042mm (0.0009 ~ 0.0017in)	
End play		0.08 ~ 0.28mm (0.0031 ~ 0.110in)	
<b>Flywheel</b>			
Runout		0.1mm (0.0039in)	0.13mm (0.0051in)
<b>Oil pump</b>			
Side clearance	Inner rotor	0.040 ~ 0.085mm (0.0016 ~ 0.0033in)	
	Outer rotor	0.040 ~ 0.090mm (0.0016 ~ 0.0035in)	
Body clearance		0.120 ~ 0.185mm (0.0047 ~ 0.0073in)	
Relief valve opening pressure		490±49.0kpa (5±0.5kg/cm <sup>2</sup> , 71±7.1psi)	
<b>Engine oil</b>			
Oil quantity (Total)		5.3 L (5.60 US qt, 4.66 Imp qt)	
Oil quantity (Oil pan)		4.8 L (5.07 US qt, 4.22 Imp qt)	
Oil quantity (Oil filter)		0.5 L (0.53 US qt, 0.44 Imp qt)	
Oil quality		Above API CH-4, Above ACEA B4	
Oil pressure (Idle) (Oil temperature : 80°C)		78.4kpa (0.8kg/cm <sup>2</sup> , 11.3psi)	
<b>Cooling system</b>			
Cooling method		Forced circulation with cooling fan	
Coolant quantity		5.3 ~ 5.5L (5.60 ~ 5.81US qt, 4.66 ~ 4.84Imp qt)	
Thermostat	Type	Wax pellet type	
	Opening temperature	85±1.5°C (185.0±2.7°F) (Lift : 0.35mm(0.0138in))	
	Pull opening temperature	100°C (212°F) (Lift : 8mm(0.3150in))	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm <sup>2</sup> , 13.51 ~ 17.78psi)	
	Vacuum valve opening pressure	0.98 ~ 4.90 kpa (0.01 ~ 0.05kg/cm <sup>2</sup> , 0.14 ~ 0.71 psi)	



Description		Specifications (D4FA)	Limit
<b>Water temperature sensor</b>			
Type		Thermister type	
Resistance	20°C (68°F)	2.45±0.14 kΩ	
	80°C (176°F)	0.3222 kΩ	

## TIGHTENING TORQUE

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb-ft
<b>Cylinder block</b>				
Engine support bracket bolt	4	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Piston cooling oil jet bolt	4	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Drive belt auto tensioner bolt	2	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Drive belt auto tensioner mounting bracket bolt	3	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
<b>Engine mounting</b>				
Engine mounting bracket and body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting insulator and engine mounting support bracket fixing nut	1	68.6 ~ 93.2	7.0 ~ 9.5	50.6 ~ 68.7
Engine mounting support bracket and engine support bracket fixing bolt	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting support bracket and engine support bracket fixing nut	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket and body fixing bolt	4	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting insulator and transaxle support bracket fixing bolt	3	68.6 ~ 93.2	7.0 ~ 9.5	50.6 ~ 68.7
Roll rod bracket and sub frame fixing bolt	4	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod and roll rod support bracket fixing bolt, nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
<b>Main moving system</b>				
Connecting rod cap bolt	8	12.7 + 90°	1.3 + 90°	9.4 + 90°
Crankshaft main bearing cap bolt (long)	10	24.5 + 90°	2.5 + 90°	18.1 + 90°
Crankshaft main bearing cap bolt (short)	10	32.4 ~ 36.3	3.3 ~ 3.7	23.9 ~ 26.8
Flywheel bolt (M/T)	8	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Drive plate bolt (A/T)	8	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
<b>Timing chain</b>				
Timing chain cover bolt (8 X 70)	7	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (8 X 60)	2	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (8 X 35)	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing chain cover bolt (6 X 35)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt (6 X 28)	7	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain case bolt (8 X 22)	4	24.5 ~ 30.4	2.5 ~ 3.1	18.1 ~ 22.4
Timing chain case bolt (8 X 32)	1	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Timing chain case bolt (6 X 35)	1	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Engine hanger (front)	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Crankshaft pulley bolt	1	225.6 ~ 245.2	23.0 ~ 25.0	166.4 ~ 180.8
Camshaft chain sprocket bolt	1	68.6 ~ 73.5	7.0 ~ 7.5	50.6 ~ 54.2
High pressure pump chain sprocket bolt	1	64.7 ~ 74.5	6.6 ~ 7.6	47.7 ~ 55.0

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb-ft
Timing chain guide (1) bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain guide (2) bolt	1	9.8 ~ 13.7	1.0 ~ 1.4	7.2 ~ 10.1
Timing chain "A" auto tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain "C" auto tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
<b>Cylinder head</b>				
Engine cover bolt	4	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Cylinder head cover bolt	13	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Camshaft bearing cap bolt (Reamer bolt)	16	12.7 ~ 13.7	1.3 ~ 1.4	9.4 ~ 10.1
Camshaft bearing cap bolt (Standard bolt)	6	12.7 ~ 13.7	1.3 ~ 1.4	9.4 ~ 10.1
Engine hanger bolt (Front)	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Engine hanger bolt (Rear)	1	47.1 ~ 51.0	4.8 ~ 5.2	34.7 ~ 37.6
Cylinder head bolt	10	49.0+90°+120°	5.0+90°+120°	36.2+90°+120°
<b>Cooling system</b>				
Water pump pulley bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt (8 X 50)	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water pump bolt (8 X 70)	1	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Thermostat housing bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Thermostat housing nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water return pipe assembly bolt	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Water temperature sensor	1	24.5 ~ 34.3	2.5 ~ 3.5	18.1 ~ 25.3
Water outlet fitting nut	2	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
<b>Lubrication system</b>				
Oil filter assembly bolt	4	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil cooler assembly bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil filter upper cap	1	24.5	2.5	18.1
Oil level gauge bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pan bolt (6 X 20)	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (6 X 65)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan bolt (6 X 85)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan and transaxle fixing bolt	3	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Oil pan drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil screen nut	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch	1	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
<b>Intake and exhaust system</b>				
Intake manifold and cylinder head fixing nut	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Intake manifold and cylinder head fixing bolt	7	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Exhaust manifold and cylinder head fixing nut	8	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3

Item	Quantity	Tightening torque		
		N.m	kgf.m	lb-ft
Exhaust manifold heat cover and exhaust manifold fixing bolt	3	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
WCC assembly fixing nut	3	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Air cleaner lower cover fixing bolt	3	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Throttle body and surge tank fixing bolt	4	18.6 ~ 27.5	1.9 ~ 2.8	13.7 ~ 20.3
Exhaust manifold and front muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front muffler fixing clip bolt	1	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front muffler and center muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center muffler and main muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

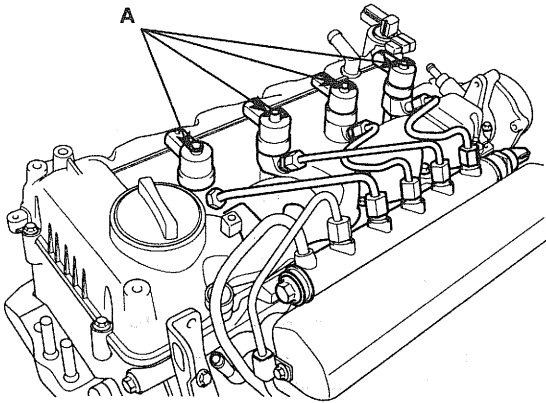
## COMPRESSION PRESSURE INSPECTION

EA53A61E

### NOTE

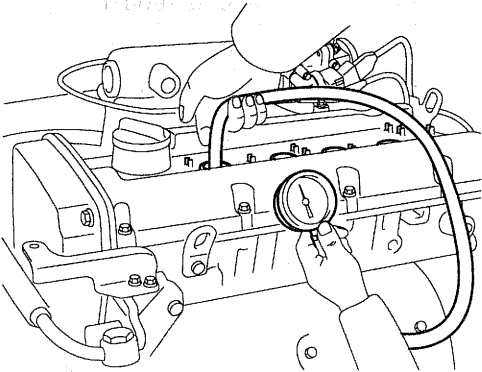
If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. Warm up and stop engine.  
Allow the engine to warm up to normal operating temperature.
2. Remove the injectors. (Refer to FLB Gr.)



LCGF003A

3. Check the cylinder compression pressure.
  - 1) Insert a compression gauge into the injector hole.



ECKD001X

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

### NOTE

Always use a fully charged battery to obtain engine speed of 300rpm or more.

- 4) Repeat step 1) through 3) for each cylinder.

### NOTE

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

---

Compression pressure(Standard) :  
2,353kPa (24.0kg/cm<sup>2</sup>, 341psi) (260 rpm)  
Minimum pressure :  
2,059kPa (21.0kg/cm<sup>2</sup>, 298psi)  
Difference between each cylinder :  
294.20kPa (3.0kg/cm<sup>2</sup>, 42.67psi) or less

---

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

4. Reinstall the injectors.

## TROUBLESHOOTING

E2396869

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

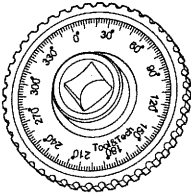
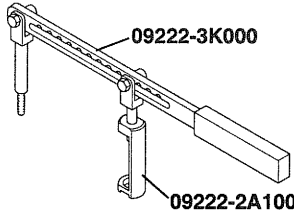
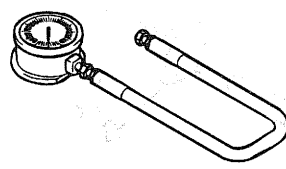
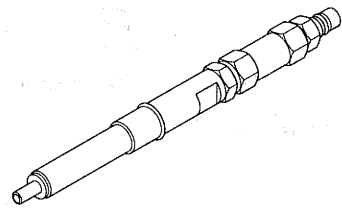
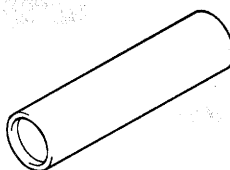
Symptom	Suspect area	Remedy
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	Inspect the oil pan. Inspect the oil pump screen.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

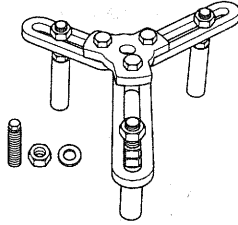
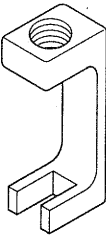
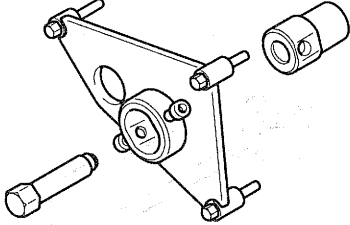
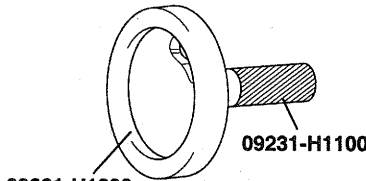
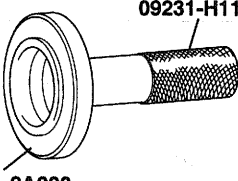
Symptom	Suspect area	Remedy
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. <ul style="list-style-type: none"> <li>• Coolant/antifreeze in cylinder.</li> <li>• Oil in cylinder.</li> <li>• Fuel in cylinder.</li> </ul>	Remove injectors and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
	Foreign material in cylinder. <ul style="list-style-type: none"> <li>• Broken valve.</li> <li>• Piston material.</li> <li>• Foreign material.</li> </ul>	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft. Repair or replace as required.

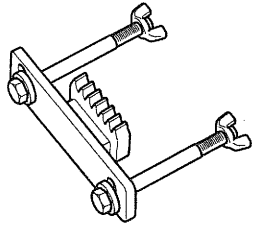
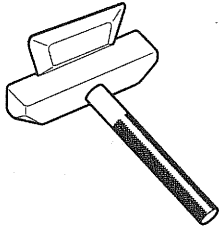
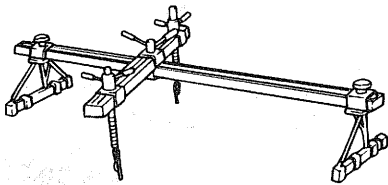


SPECIAL SERVICE TOOLS

E986315E

Tool (Number and name)	Illustration	Use
Torque angle adapter (09221-4A000)	 <p style="text-align: right;">LCAC030A</p>	Installation of bolts & nuts needing an angular method
Valve spring compressor (09222-3K000) Valve spring compressor adapter (09222-2A100)	 <p style="text-align: right;">LCGF059A</p>	Removal and installation of intake and exhaust valves
Compression gauge (09351-27000)	 <p style="text-align: right;">LCGF148A</p>	Checking engine compression pressure
Compression gauge adapter (09351-2A000)	 <p style="text-align: right;">LCGF060A</p>	Checking engine compression pressure
Valve stem oil seal installer (09222-2A000)	 <p style="text-align: right;">LCAC030D</p>	Installation of valve stem oil seals

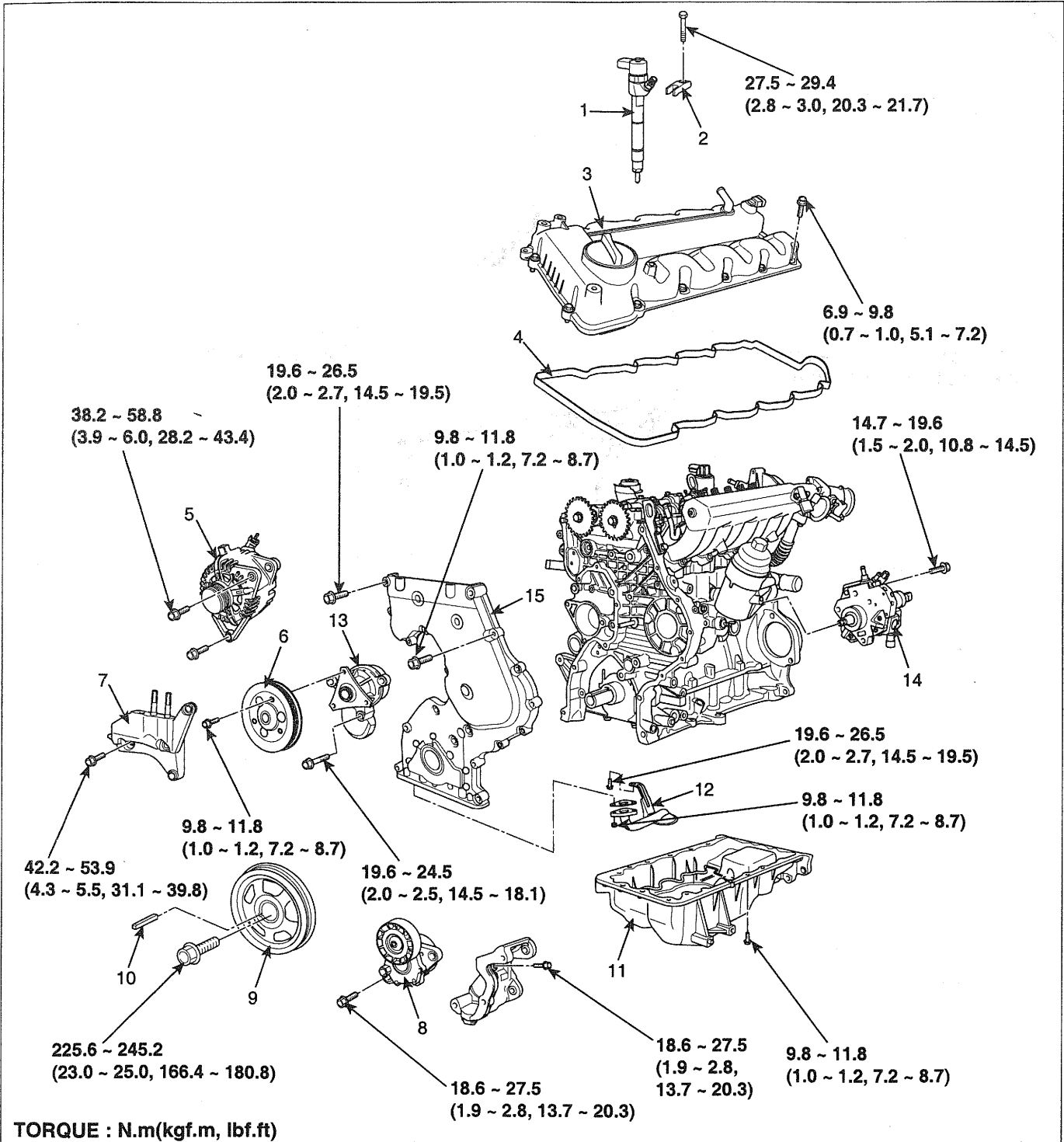
Tool (Number and name)	Illustration	Use
Injector remover (09351-4A200)	 <p style="text-align: right;">LCGF061A</p>	Removal of injectors
Injector remover adapter (09351-2A100)	 <p style="text-align: right;">LCGF062A</p>	Removal of injectors
High pressure pump sprocket remover (09331-2A000)	 <p style="text-align: right;">LCGF063B</p>	Removal of high pressure pump sprocket
Crankshaft rear oil seal installer (09231-H1200) Handle (09231-H1100)	 <p style="text-align: right;">LCGF157A</p>	Installation of crankshaft rear oil seal
Front cover oil seal installer (09231-2A000) Handle (09231-H1100)	 <p style="text-align: right;">LCGF158A</p>	Installation of front cover oil seal

Tool (Number and name)	Illustration	Use
Flywheel stopper (09231-2A100)	 B314A200	Removal and installation of crankshaft pulley bolt.
Oil pan remover (09215-3C000)	 ACJF125A	Removal of oil pan
Engine support fixture & adapter (09200-38001, 09200-1C000)	 AMJF002B	Support of engine

# TIMING SYSTEM

## TIMING CHAIN

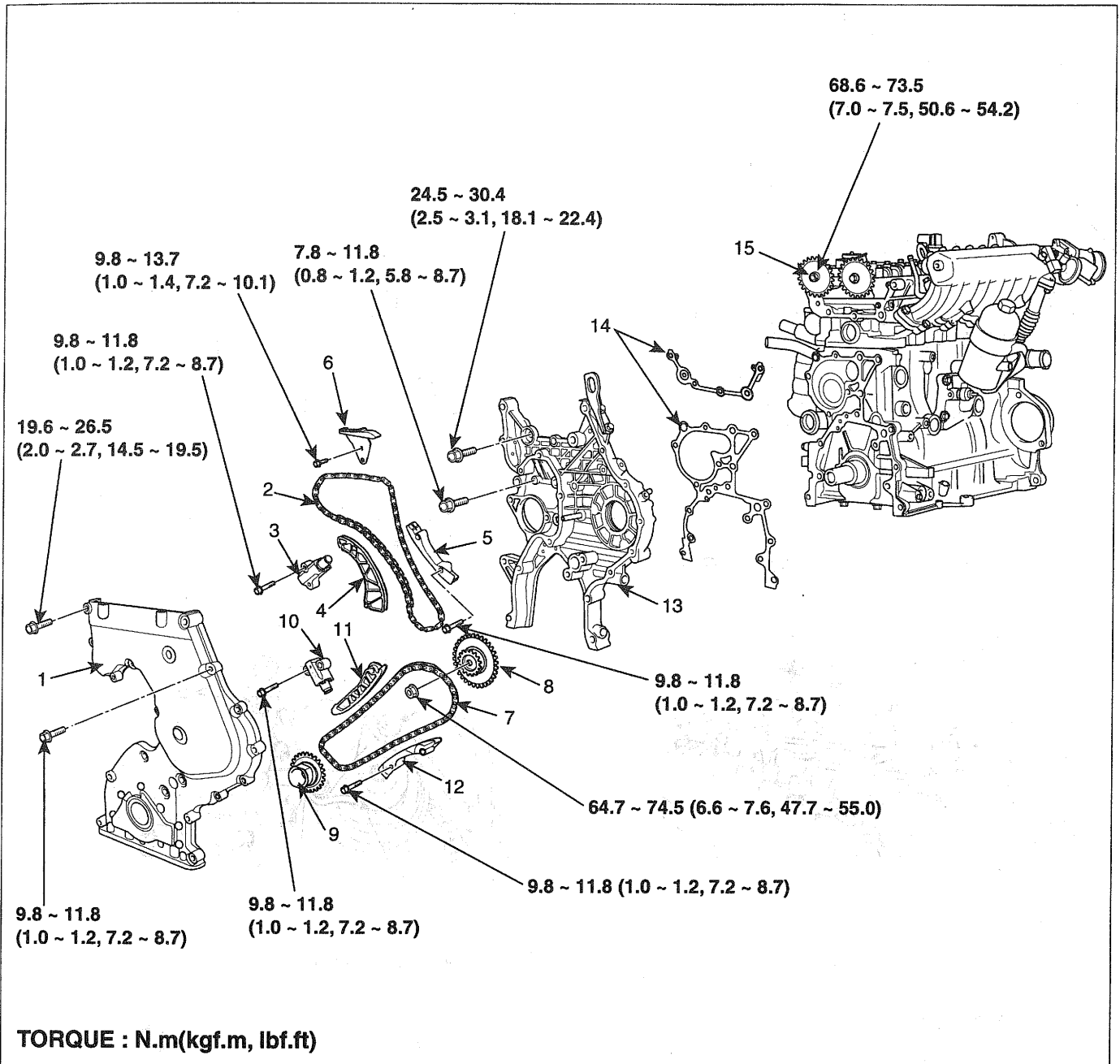
### COMPONENT E85E1C8A



- 1. Injector
- 2. Injector clamp
- 3. Cylinder head cover
- 4. Cylinder head gasket
- 5. Alternator

- 6. Water pump pulley
- 7. Engine support bracket
- 8. Drive belt auto tensioner
- 9. Crankshaft pulley
- 10. Key

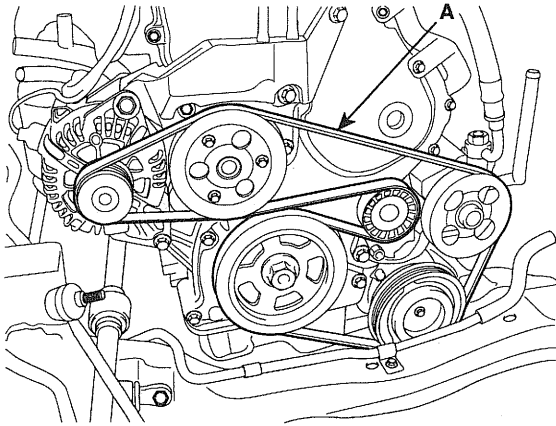
- 11. Oil pan
- 12. Oil strainer
- 13. Water pump
- 14. High pressure pump
- 15. Timing chain cover



**REMOVAL** E5A01FA9

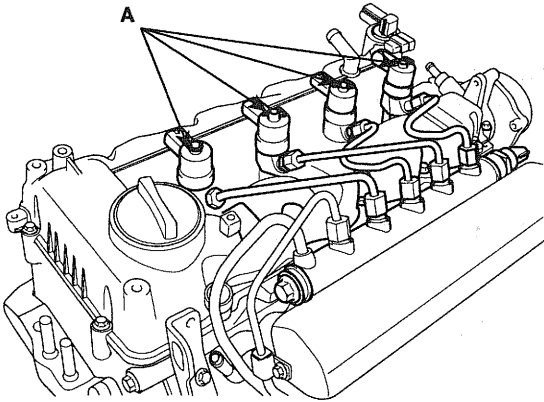
Engine removal is not required for this procedure.

1. Remove the drive belt(A).



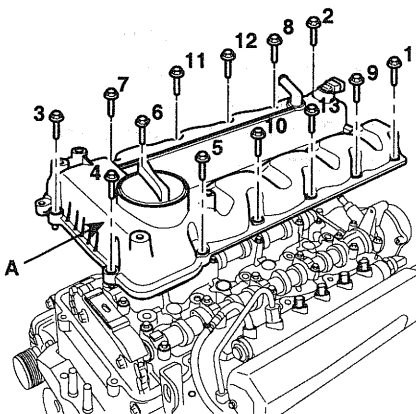
ACGF031A

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



LCGF003A

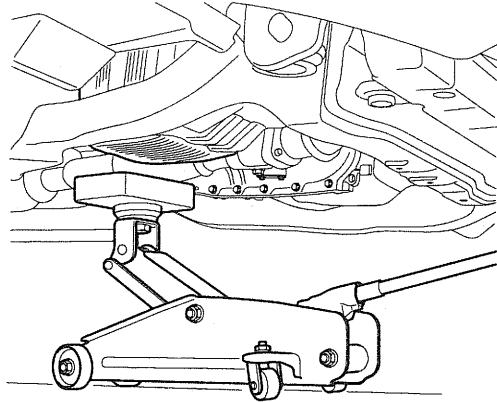
3. Remove the cylinder head cover(A).



LCGF004A

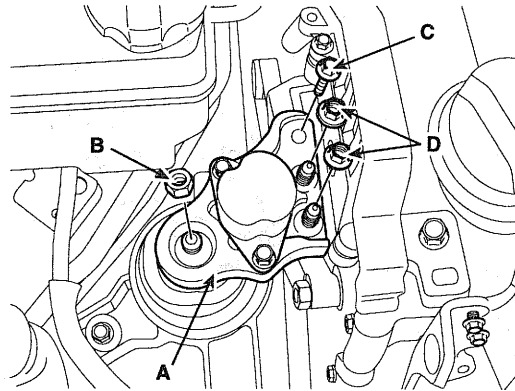
4. Remove the engine mounting support bracket.

- 1) Set the jack to the engine oil pan



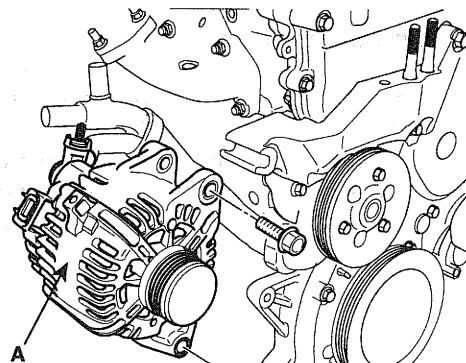
LDIF001A

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



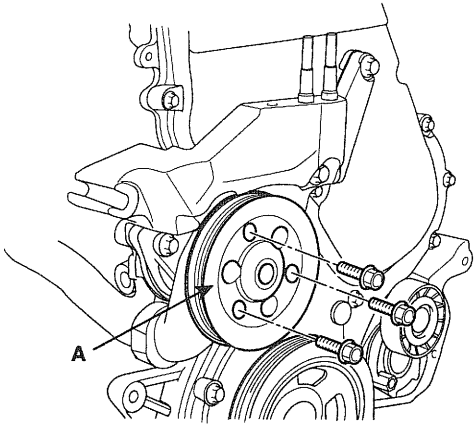
KDPF015A

5. Remove the alternator(A).



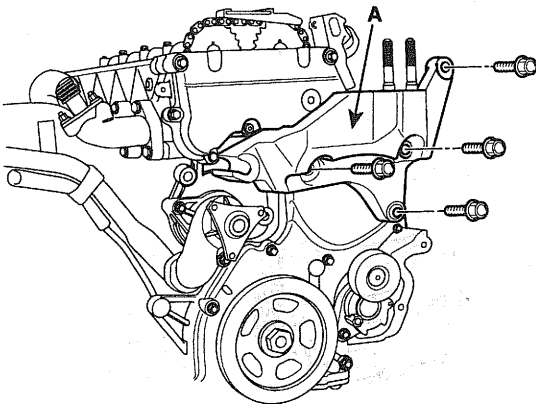
LCGF005A

6. Remove the water pump pulley(A).



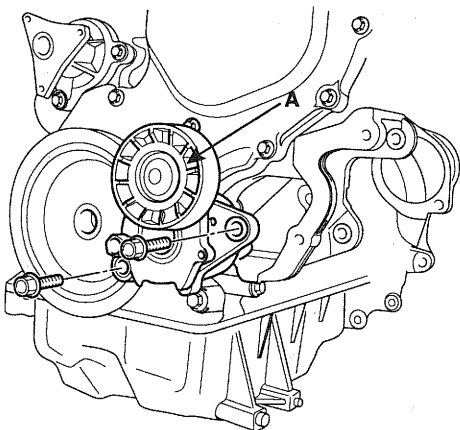
LCGF006A

7. Remove the engine support bracket(A).



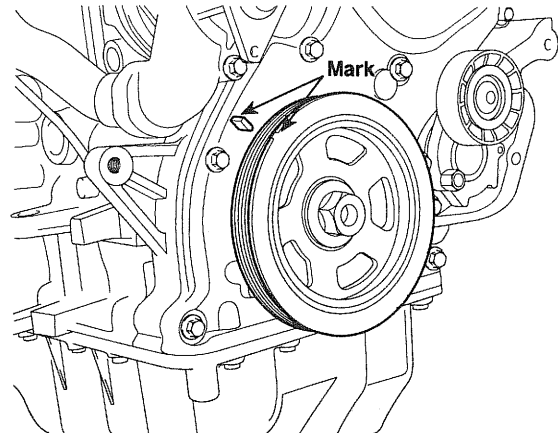
LCGF007A

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



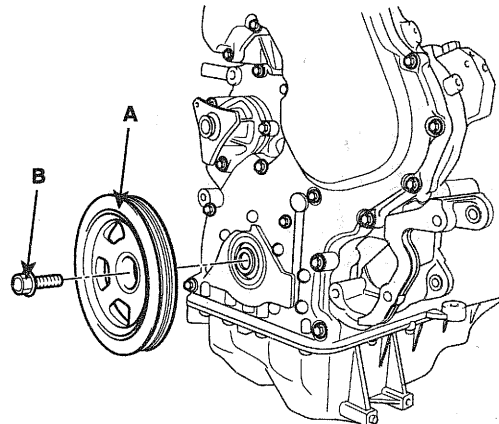
LCGF008A

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



LCGF089A

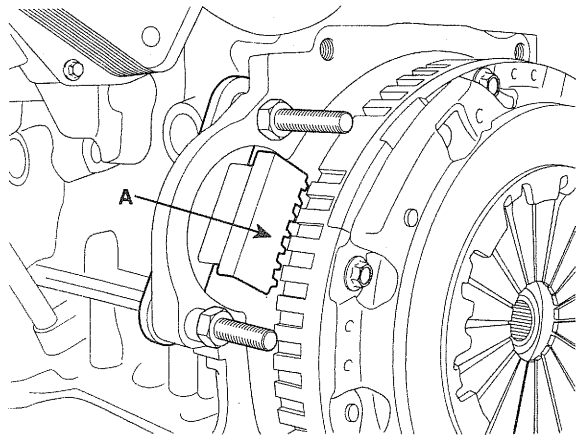
10. Remove the crankshaft pulley bolt(B) and crankshaft pulley(A).



LCGF009A

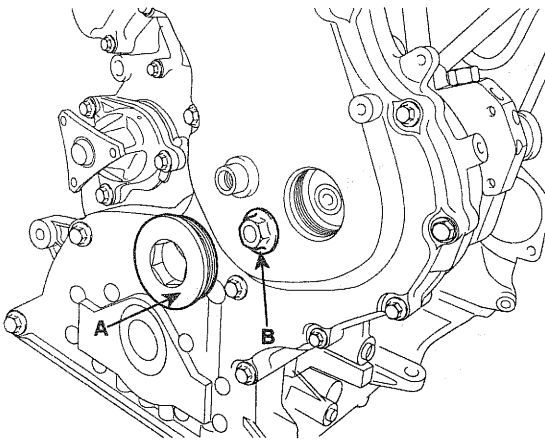
**NOTE**

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



LCGF090A

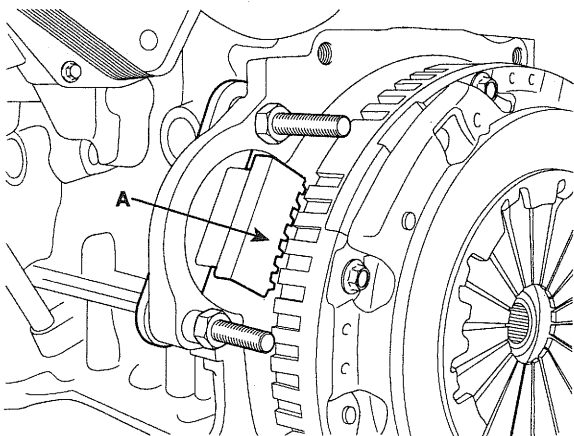
11. Remove the high pressure pump sprocket nut(B) after remove the timing chain cover plug(A).



LCGF091A

**NOTE**

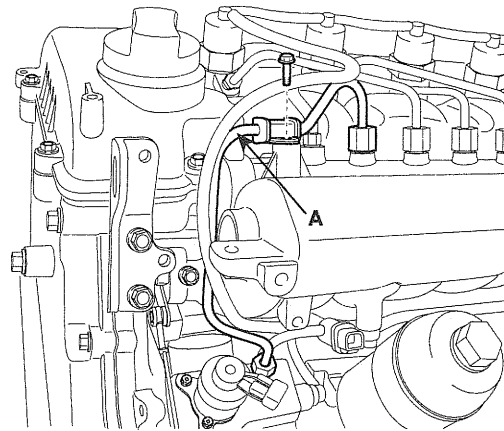
- Use the SST(flywheel stopper, 09231-2A100) to remove the high pressure pump sprocket nut.



LCGF090A

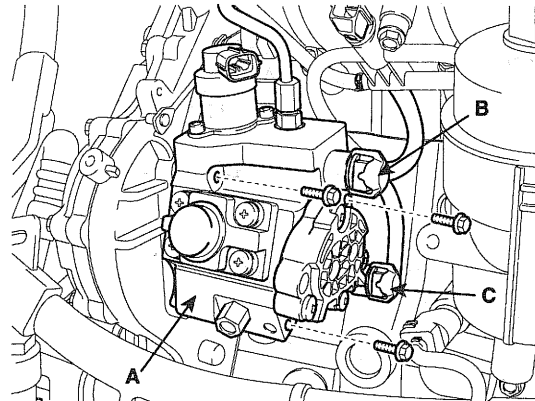
- Replace O-ring of plug(A) with a new one when reinstalling the plug.

12. Remove the high pressure pump pipe(A). (Refer to FLB Gr.)



ADJF034A

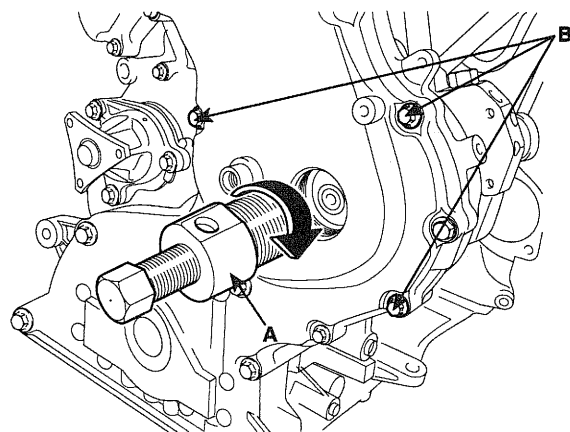
13. Remove the high pressure pump(A) fixing bolts and fuel hoses(B,C).



ADJF044A

14. Install the SST(high pressure pump sprocket stopper, 09331-2A000)(A) to sprocket rotating it clockwise.

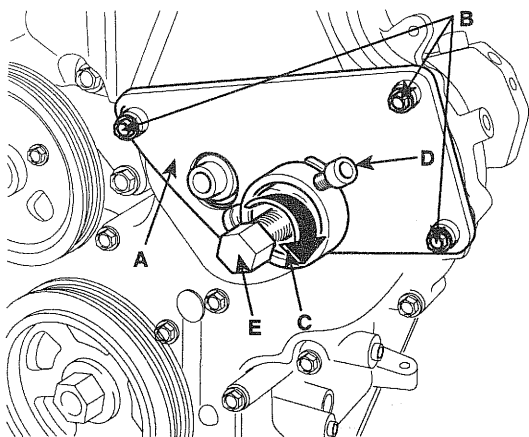
15. Remove the timing chain cover bolt(three bolts)(B).



LCGF159A

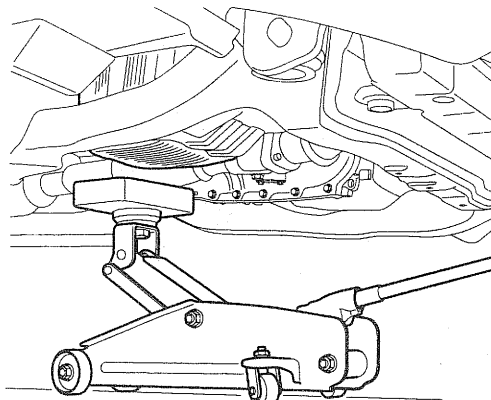


16. Install the SST(high pressure pump sprocket remover, 09331-2A000)(A) to timing chain cover with three long bolts(B).
17. Fix the high pressure pump remover(A) and sprocket stopper(C) with two fixing bolts(D).
18. Rotate the bolt(E) clockwise till high pressure pump is pushed out.
19. Remove the SST(09331-2A000) after remove the high pressure pump.



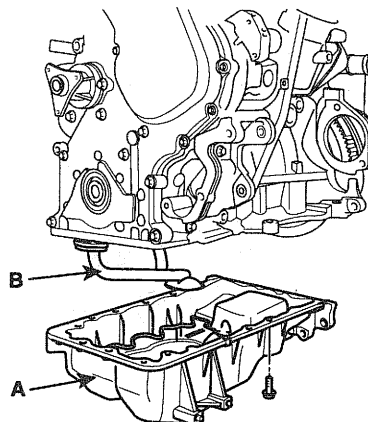
LCGF160A

21. Remove the jack from oil pan.



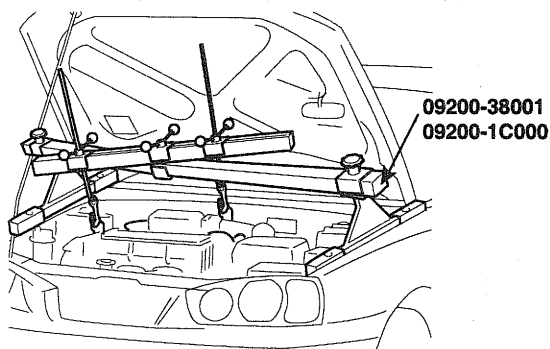
LDIF001A

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



LCGF010A

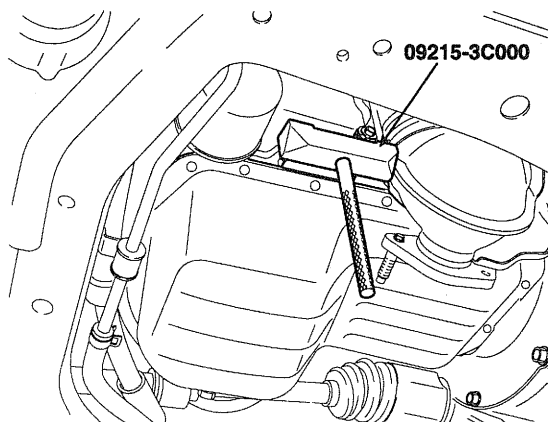
20. Install the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, on the engine hanger bracket.



LCGF150A

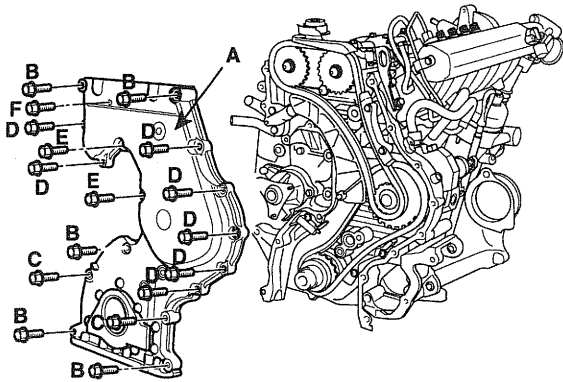
**NOTE**

Using the SST(09215-3C000) and remove the oil pan. Be careful not damage the contact surfaces of oil pan.



ACJF127B

24. Remove the timing chain cover(A)

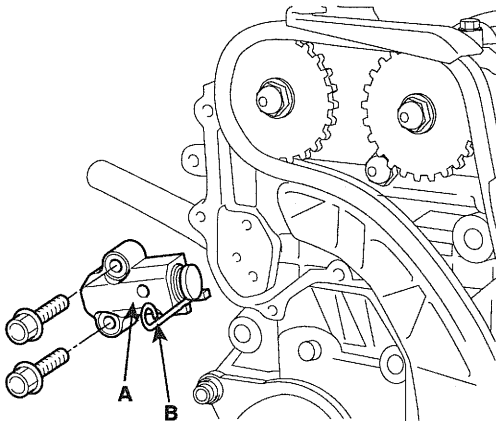


LCGF011A

**NOTE**

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

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

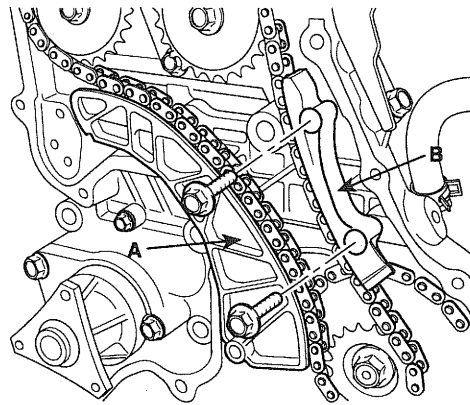


LCGF012A

**NOTE**

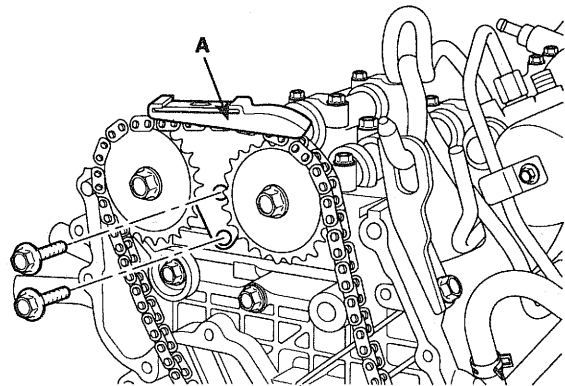
Before removing auto-tensioner, install a set pin(B) (ø2.5 mm steel wire) after compressing the tensioner.

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



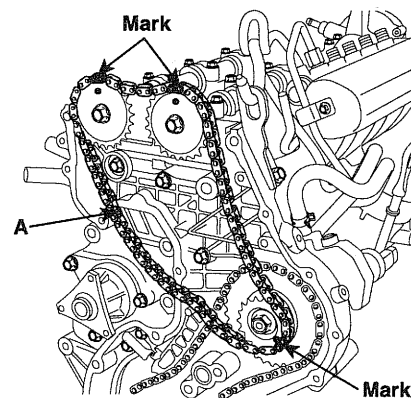
LCGF013A

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



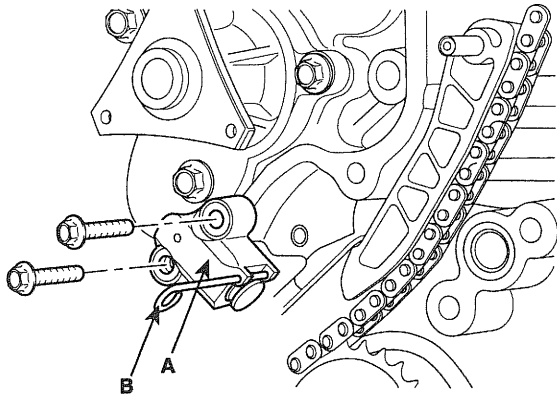
LCGF014A

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



LCGF015A

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

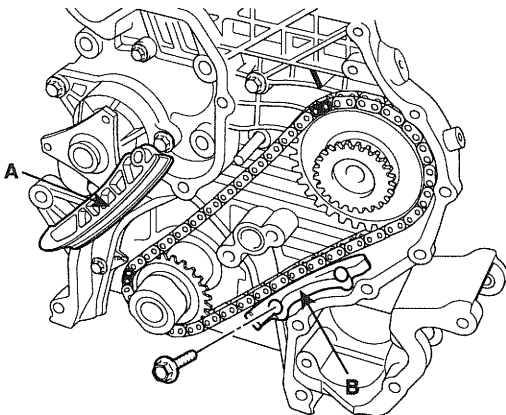


LCGF016A

**NOTE**

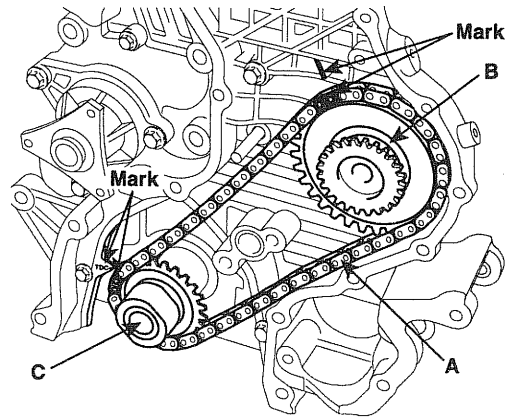
*Before removing auto-tensioner, install a set pin(B) (ø2.5 mm steel wire) after compressing the tensioner.*

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



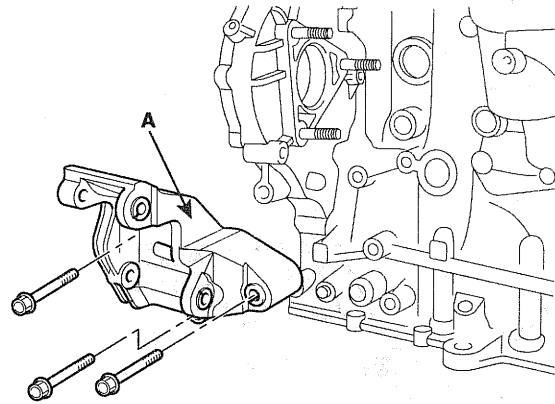
LCGF017A

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



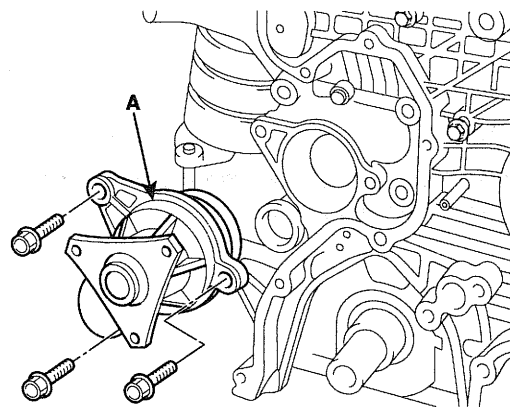
LCGF024A

32. Remove the tensioner mounting bracket(A).



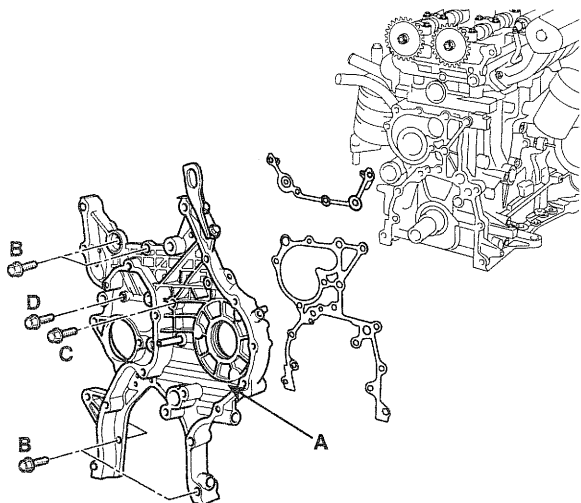
LCGF025A

33. Remove the water pump(A).



LCGF026A

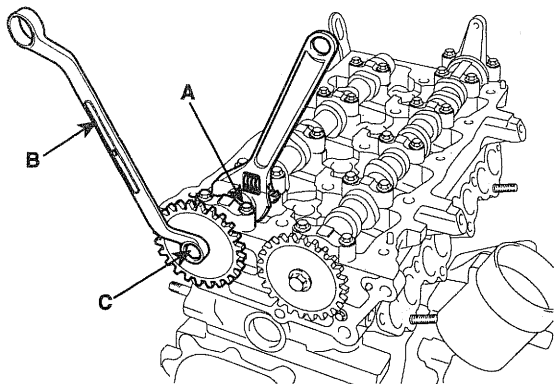
34. Remove the timing chain case(A).  
(Engine removal is required for this procedure)



LCGF027A

35. Remove the camshaft sprocket.

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



LCGF028A

**CAUTION**

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

INSTALLATION E95FE08A

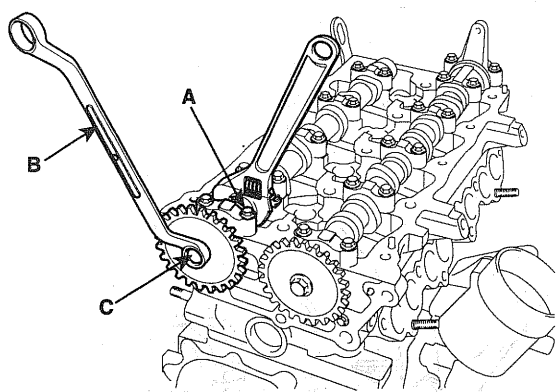
Engine removal is not required for this procedure.

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

---

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

---



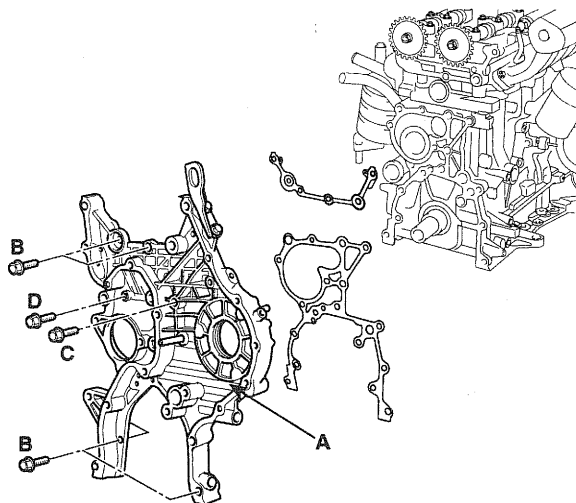
LCGF028A

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

---

Tightening torque :  
Bolt(B) :24.5 ~ 30.4N.m (2.5 ~ 3.1kgf.m,  
18.1 ~ 22.4lb-ft)  
Bolt(C) :18.6 ~ 27.5N.m (1.9 ~ 2.8kgf.m,  
13.7 ~ 20.3lb-ft)  
Bolt(D) : 7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

---



LCGF027A

3. Install the water pump(A).

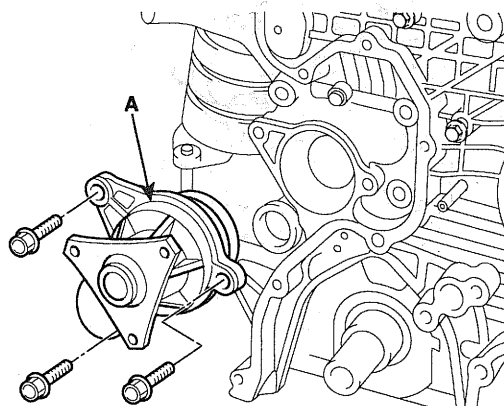
---

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

---

**!** CAUTION

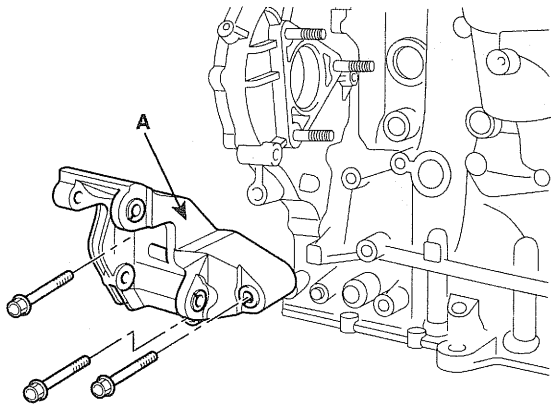
Apply coolant to the o-ring before installing the water pump.



LCGF026A

4. Install the tensioner mounting bracket(A).

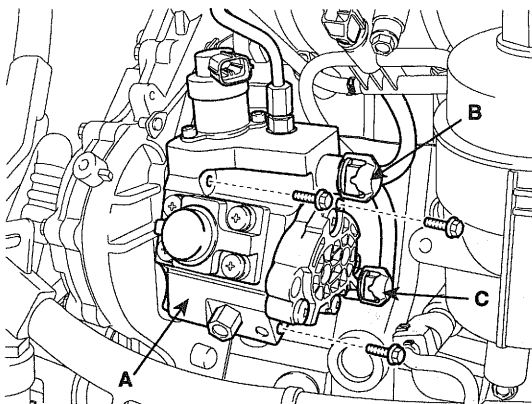
Tightening torque :  
 18.6 ~ 27.5N.m (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lb-ft)



LCGF025A

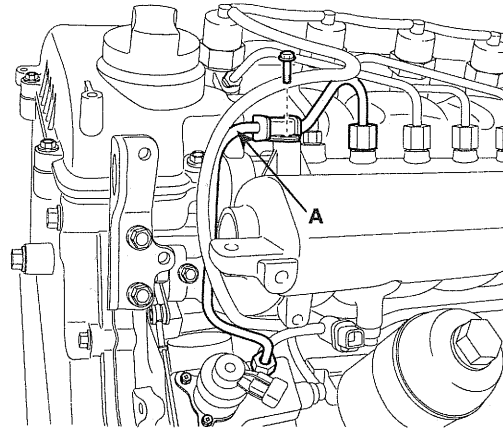
5. Install the high pressure pump(A).

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



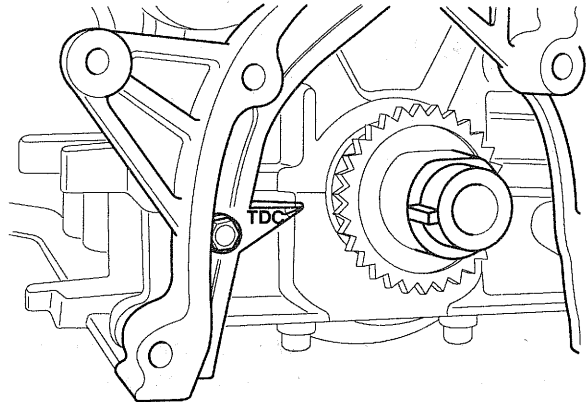
ADJF044A

6. Install the high pressure pipe(A). (Refer to FLB Gr)



ADJF034A

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

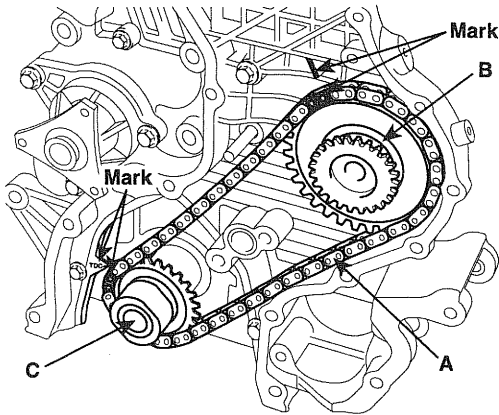


LCGF093A

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

**NOTE**

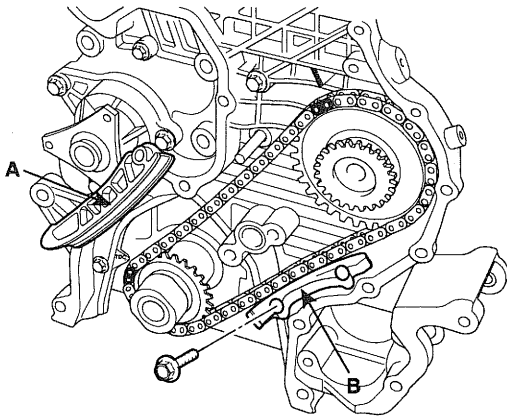
The timing mark of high pressure pump sprocket should be aligned with timing mark on the timing chain case.



LCGF024A

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

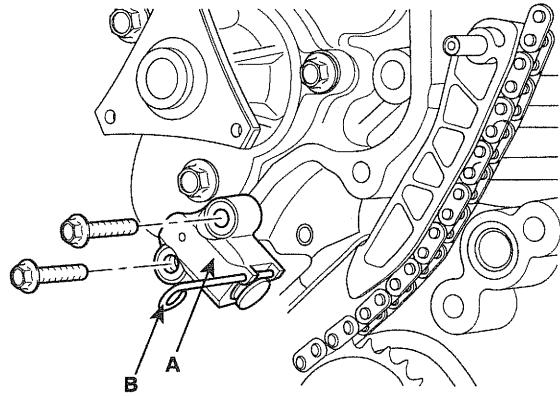
Tightening torque :  
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



LCGF017A

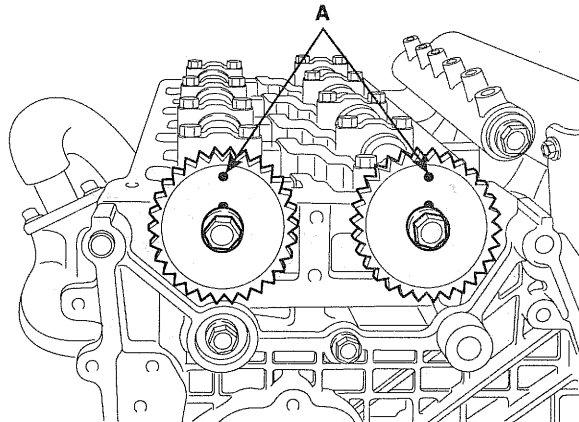
- Install the timing chain "A" auto tensioner(A) and then remove set pin(B).

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



LCGF016A

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

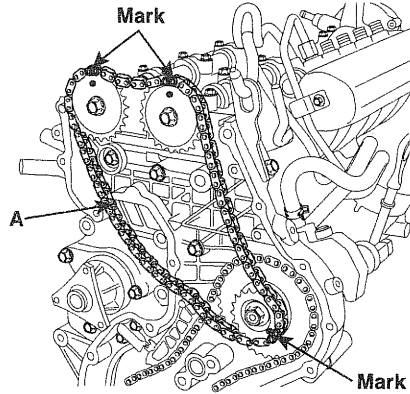


LCGF094A

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

**NOTE**

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

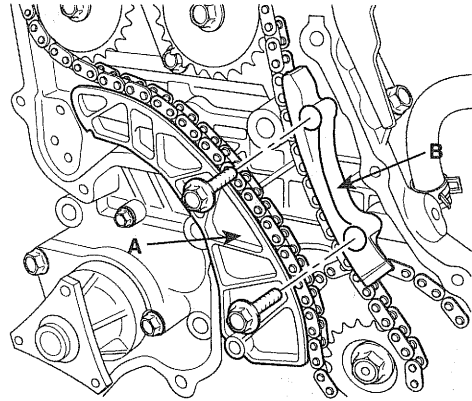


LCGF015A

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

Tightening torque :

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

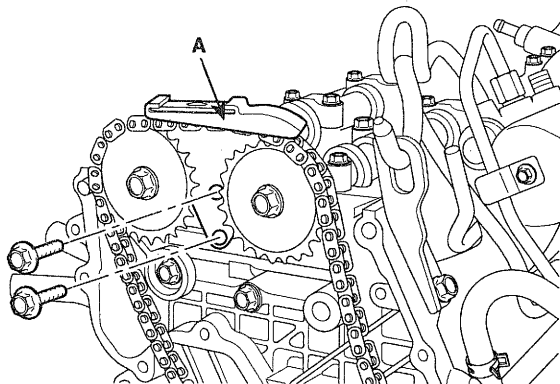


LCGF013A

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

Tightening torque :

9.8 ~ 13.7N.m (1.0 ~ 1.4kgf.m, 7.2 ~ 10.1lb-ft)

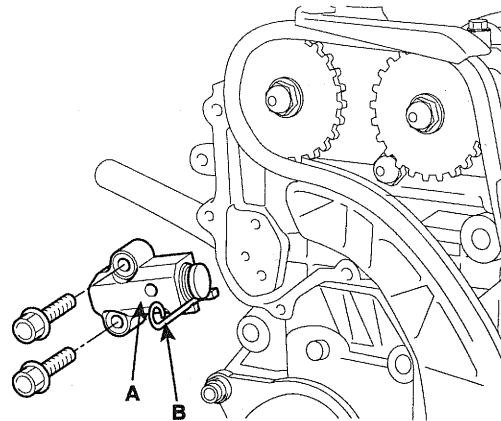


LCGF014A

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

Tightening torque :

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

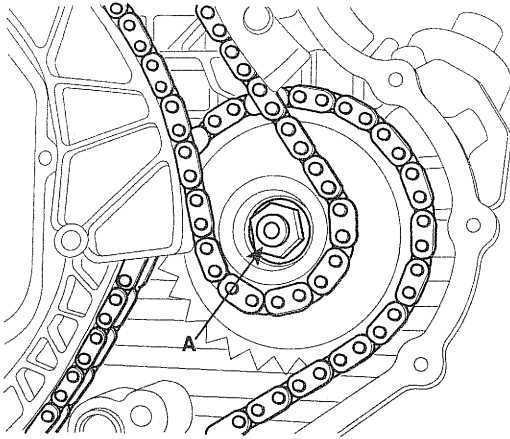


LCGF012A



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

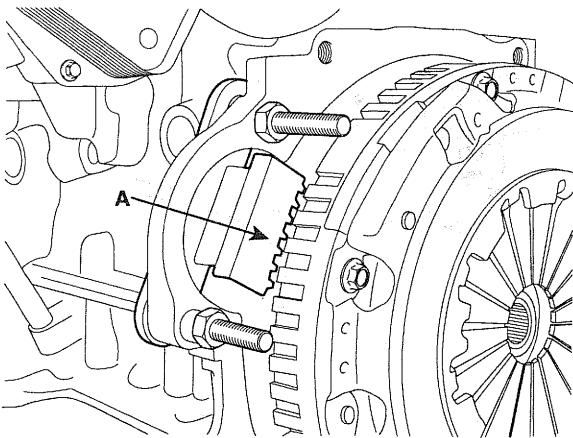
Tightening torque :  
64.7 ~ 74.5N.m (6.6 ~ 7.6kgf.m, 47.7 ~ 55.0lb-ft)



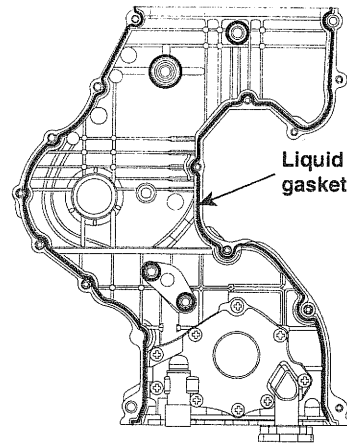
LCGF095A

**NOTE**

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



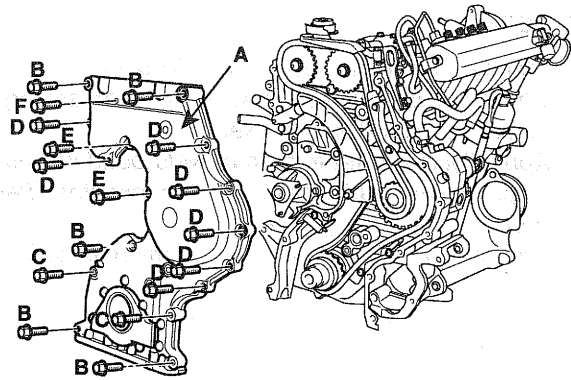
LCGF090A



LCGF096A

19. Install the timing chain cover(A).

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



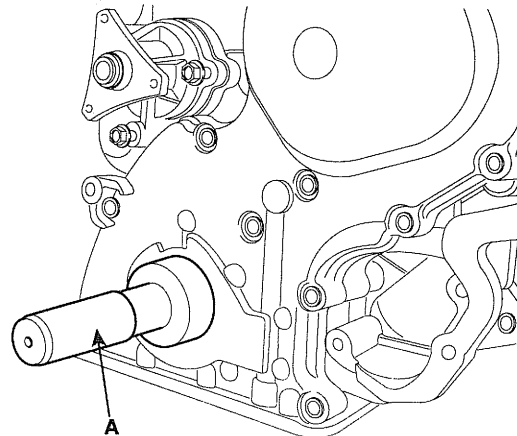
LCGF011A

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

**NOTE**

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

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



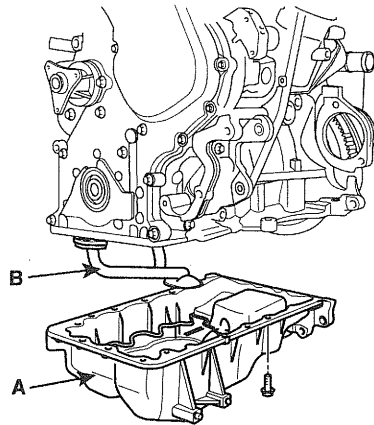
LCGF097A

21. Install the oil strainer(B).

Tightening torque :

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

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

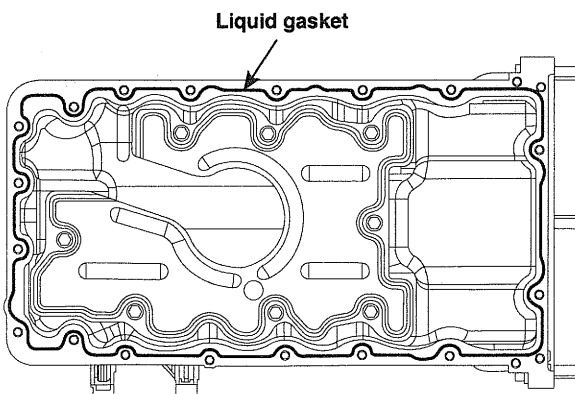


LCGF010A

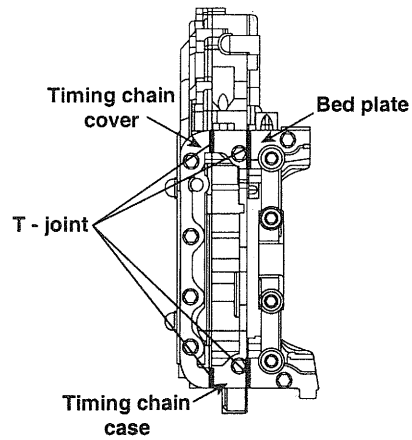
22. Apply liquid gasket evenly to the mating surface of oil pan.

**NOTE**

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



LCGF098A



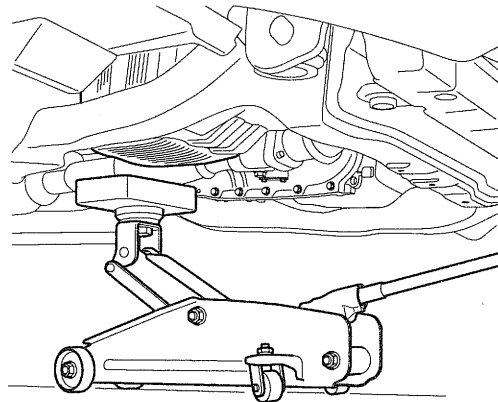
LCGF099A

23. Install the oil pan(A).

Tightening torque :

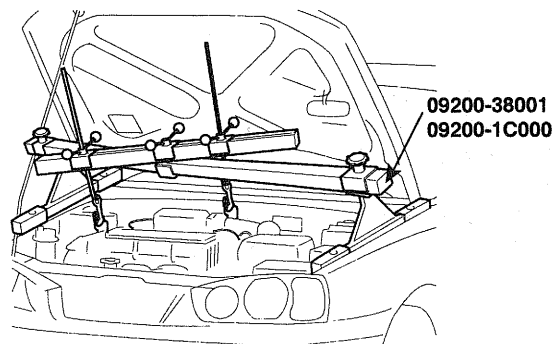
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

24. Set the jack to the engine oil pan



LDIF001A

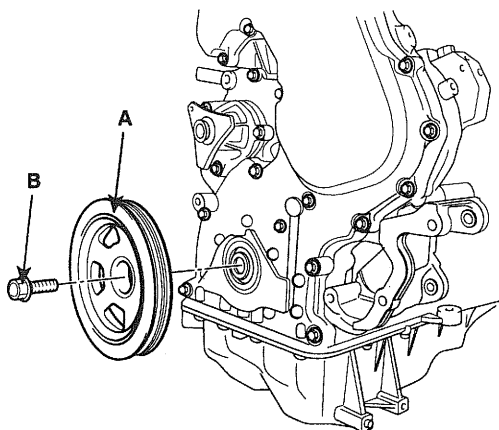
25. Remove the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, from the engine hanger bracket.



LCGF150A

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

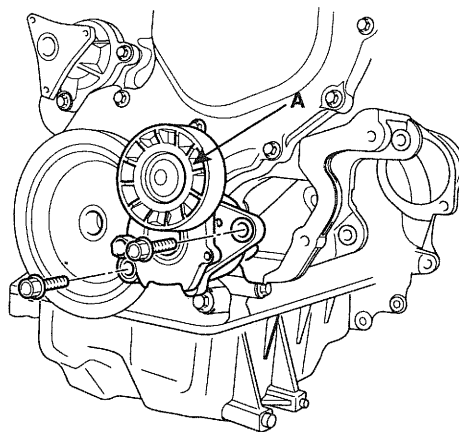
Tightening torque :  
225.6 ~ 245.2N.m (23.0 ~ 25.0kgf.m, 166.4 ~ 180.8lb-ft)



LCGF009A

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

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



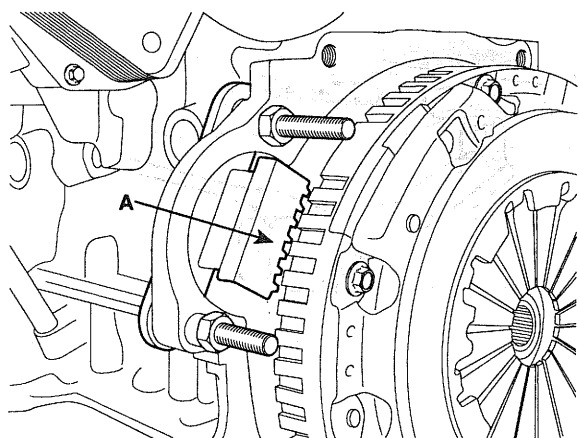
LCGF008A

**NOTE**

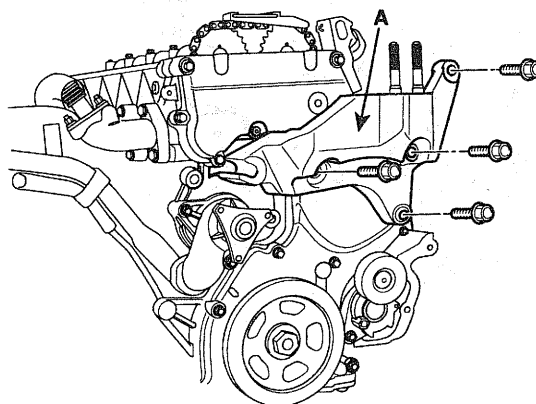
Use the SST(flywheel stopper, 09231-2A100) to install the crankshaft pulley bolt, after remove the starter.

28. Install the engine support bracket(A).

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



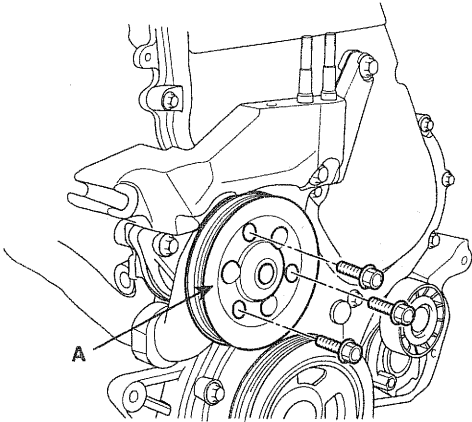
LCGF090A



LCGF007A

29. Install the water pump pulley(A).

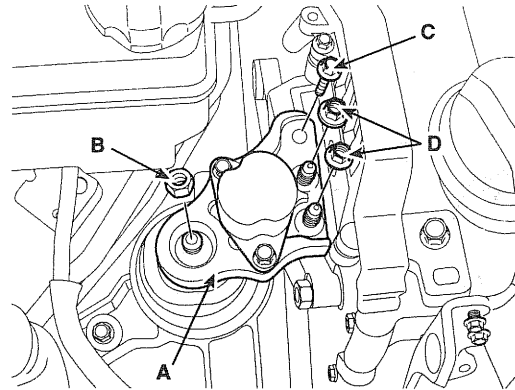
Tightening torque :  
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



LCGF006A

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

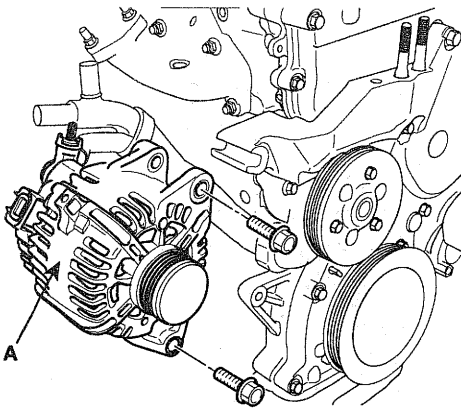
Tightening torque :  
Nut(B) : 68.6 ~ 93.2N.m(7.0 ~ 9.5kgf.m, 50.6~ 68.7lb-ft)  
Bolt(C), Nut(D) : 49.0 ~ 63.7N.m(5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



KDPF015A

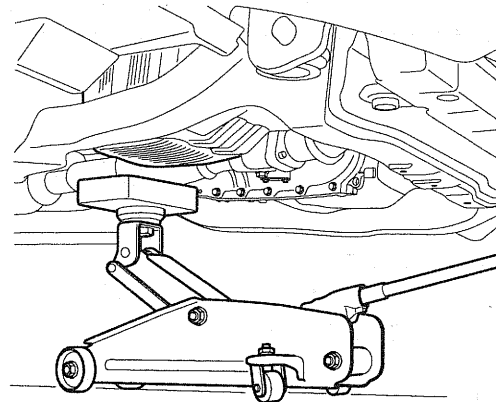
30. Install the alternator(A).

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



LCGF005A

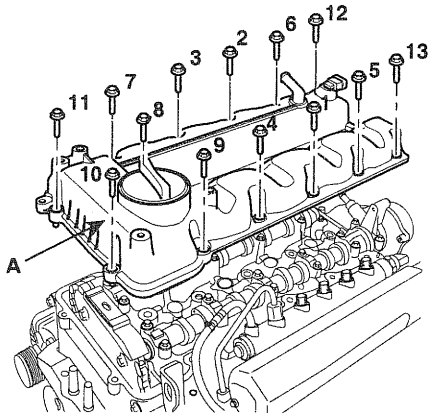
32. Remove the jack from oil pan



LDIF001A

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

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

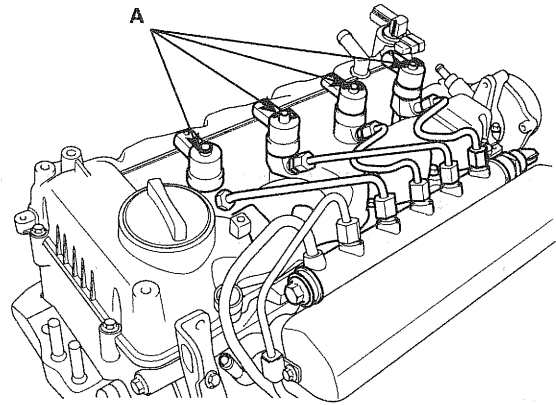


LCGF161A

**NOTE**

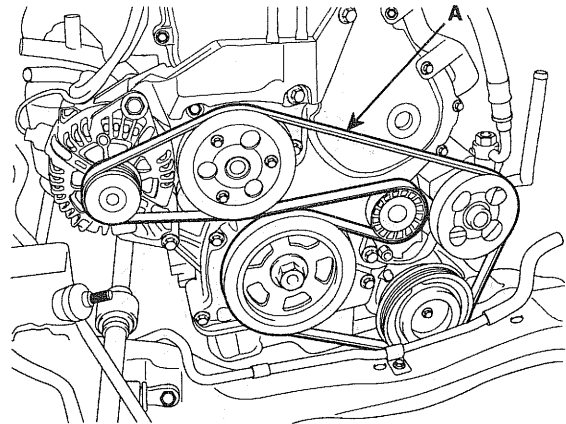
- Standard liquid gasket : LOCTITE 5900
- Check that the mating surfaces are clean and dry before applying liquid gasket.
- Apply liquid gasket in a 3mm wide bead without stopping.
- Assemble the cylinder head cover in 5 minutes after applying the liquid gasket.
- After assembly, wait at least 30 minutes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

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

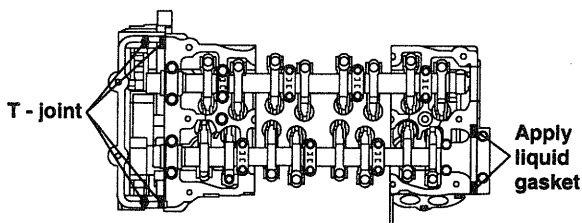


LCGF003A

35. Install the drive belt(A).



ACGF031A



LCGF100A

# ENGINE AND TRANSAXLE ASSEMBLY

## REMOVAL EAFAC803

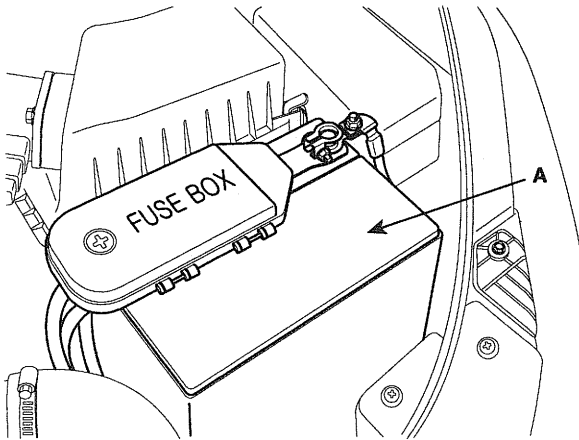
### CAUTION

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

### NOTE

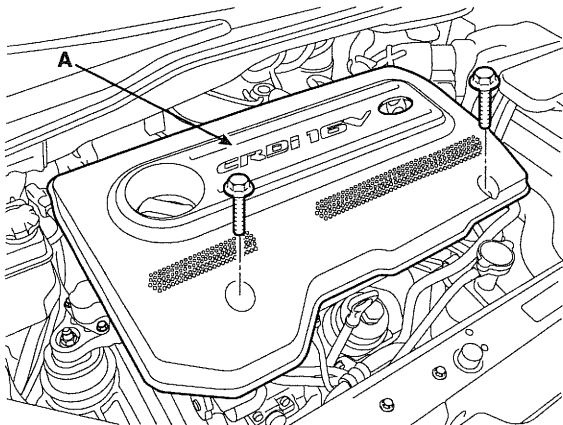
- Mark all wiring and hoses to avoid misconnection.

1. Remove the battery(A).



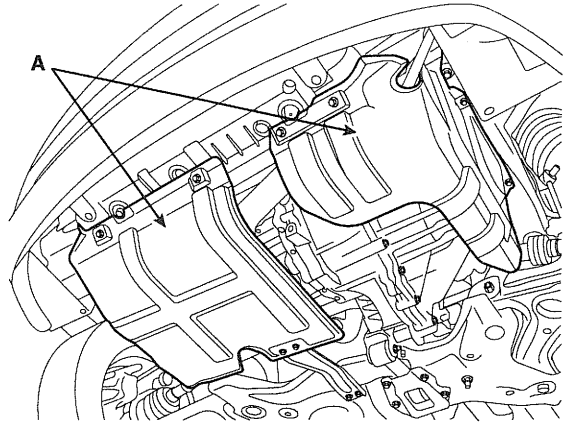
ADJF001A

2. Remove the engine cover(A).



KDPF001A

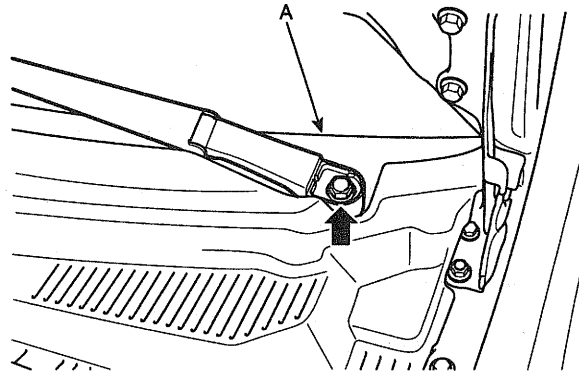
3. Remove the under cover(A).



KDPF002A

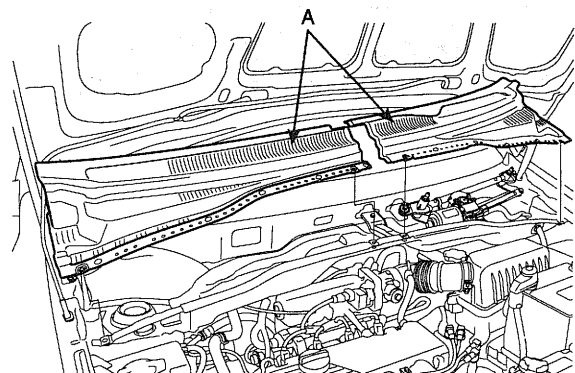
4. Drain the engine coolant. (Refer to EMA- 76)  
Remove the radiator cap to speed draining.

5. Remove the wiper arm(A).



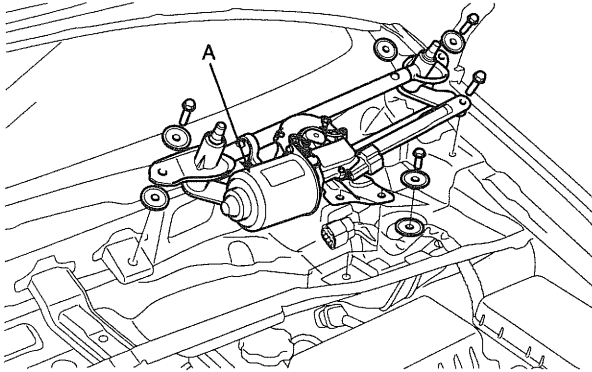
KDPF020A

6. Remove the cowl top cover(A).



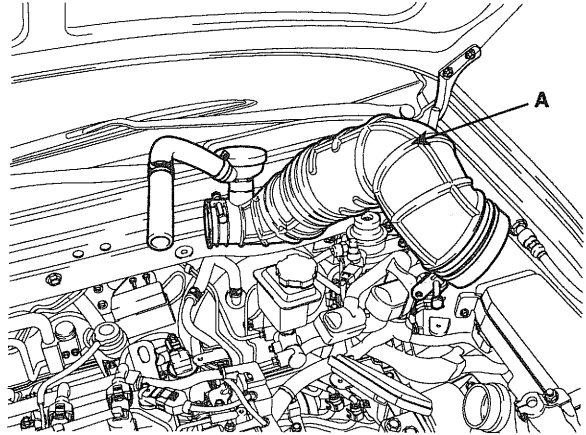
KDPF021A

7. Remove the wiper motor link assembly (A).



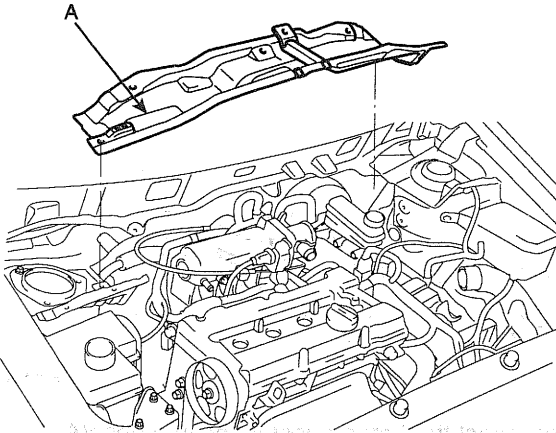
KDPF022A

3) Remove the air intake hose(A).



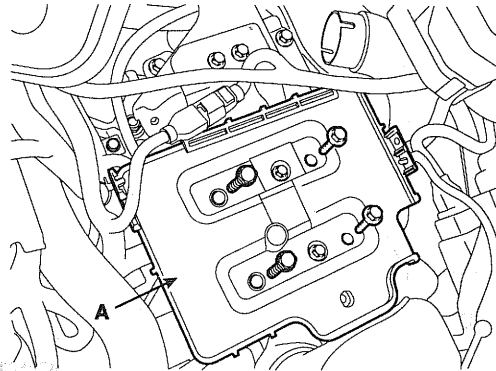
ADJF004A

8. Remove the cowl under panel(A).



KDPF023A

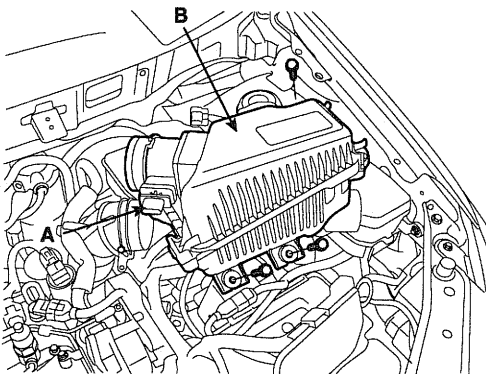
10. Remove the battery tray(A).



KDPF004A

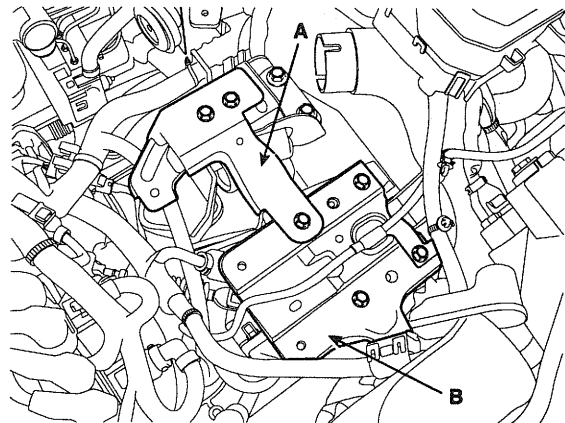
9. Remove the intake air hose and air cleaner assembly.

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



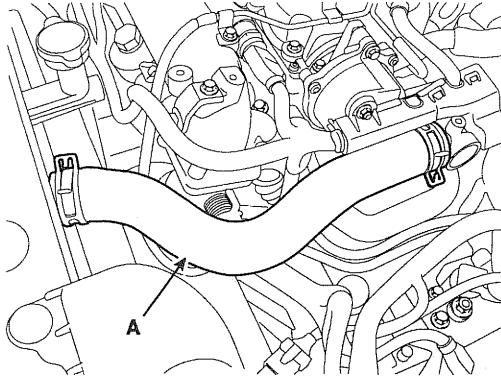
KDPF003A

11. Remove the air cleaner bracket(A) and battery tray bracket(B).



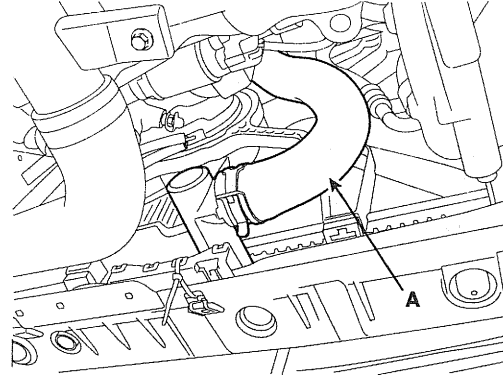
KCPF004A

12. Remove the upper radiator hose(A).



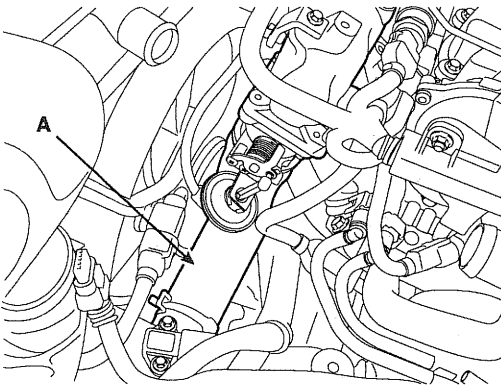
KDPF005A

15. Remove the lower radiator hose(A).



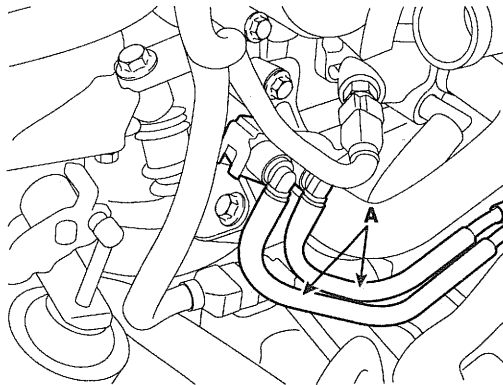
KDPF008A

13. Remove the inter cooler upper hose(A).



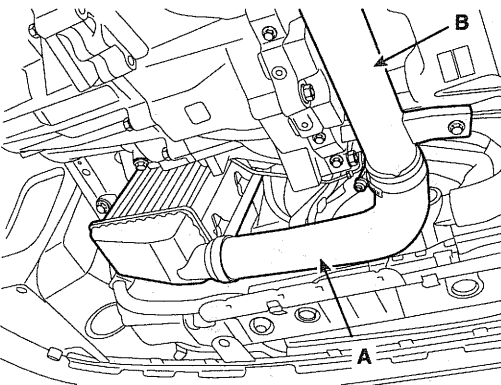
KDPF006A

16. Disconnect the fuel hose(A).



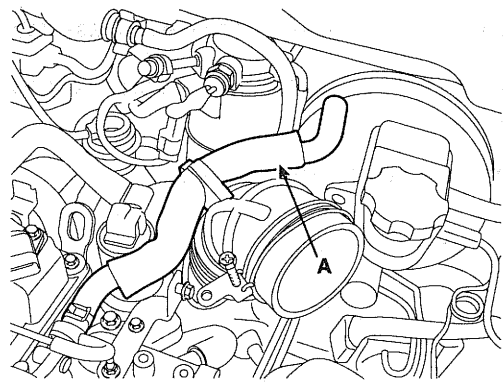
KDPF009A

14. Remove the intercooler lower hose(A) and pipe(B).



KDPF007A

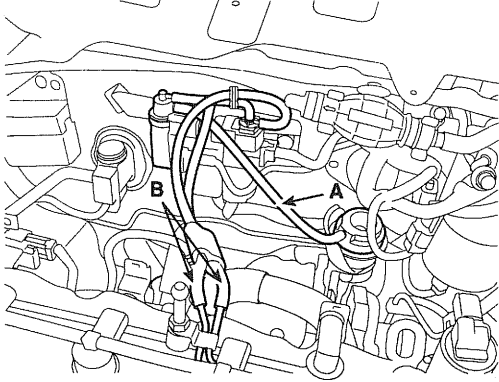
17. Disconnect the brake booster vacuum hose(A).



KDPF010A

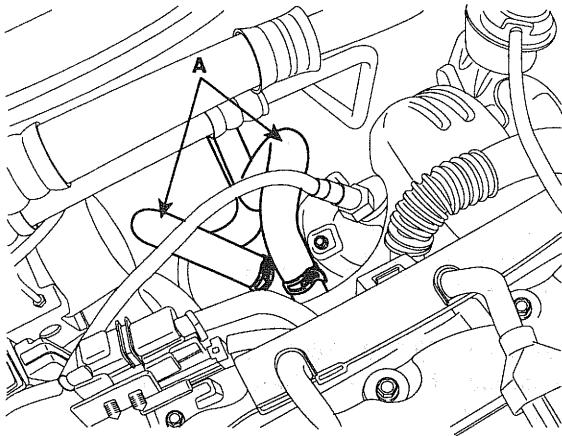


18. Remove the VGT actuator vacuum hose(A) and solenoid valve vacuum hose(B).



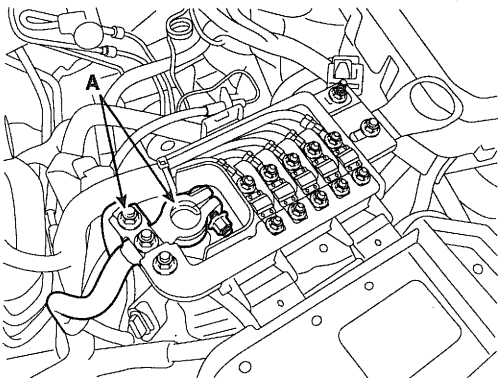
KDPF011A

19. Remove the heater hose(A).



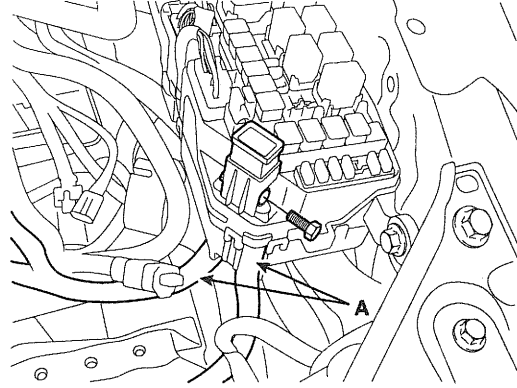
KDPF028A

20. Disconnect the battery (+) terminal (A) from fuse box.



KDPF012A

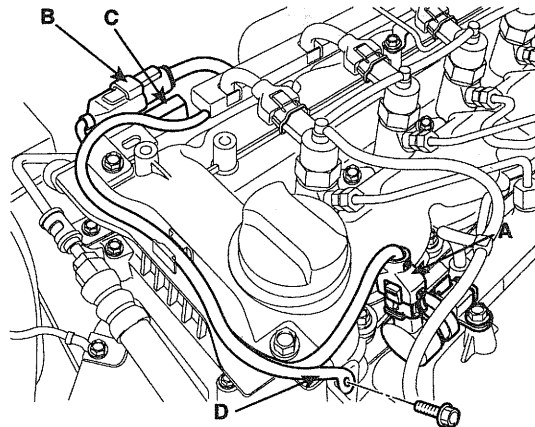
21. Disconnect the engine harness (A) from fuse box.



KDPF013A

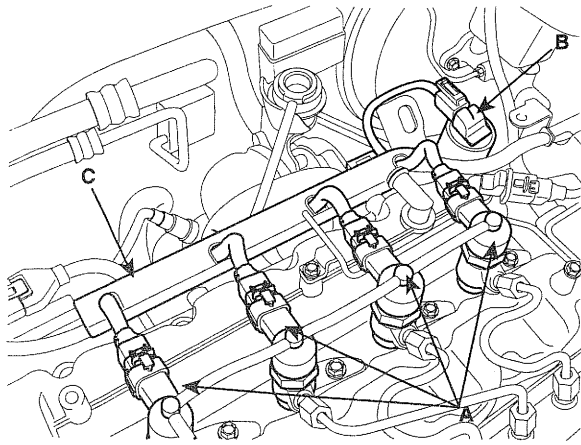
22. Remove the engine wire harness connectors and wire harness clamps from cylinder head and the intake manifold.

- 1) Disconnect the common rail pressure regulator connector(A).
- 2) Disconnect the lambda sensor connector(B).
- 3) Disconnect the glow plug connector(C).
- 4) Disconnect the ground cable (D).



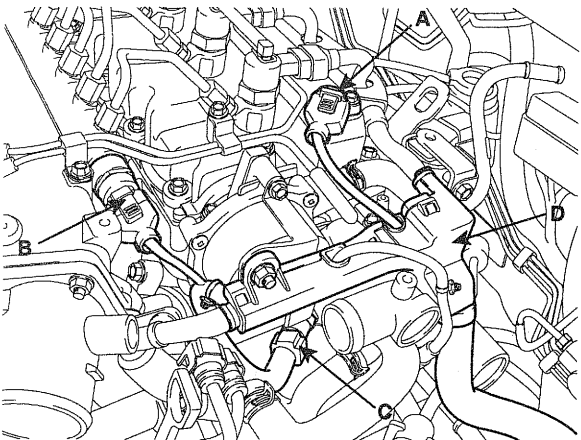
KDPF024A

- 5) Disconnect the injector connector(A).
- 6) Disconnect the EGR(Emission Gas Recirculation) solenoid valve connector(B).
- 7) Remove the harness protector(C).



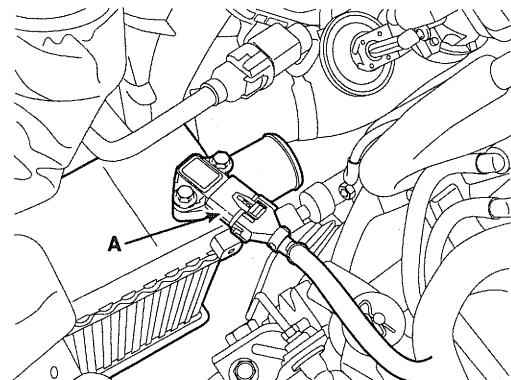
KDPF025A

- 8) Disconnect the CMP(Camshaft Position Sensor) connector (A).
- 9) Disconnect the common rail pressure sensor connector (B).
- 10) Disconnect the water temperature sensor connector (C).
- 11) Remove the engine wire harness bracket(D).



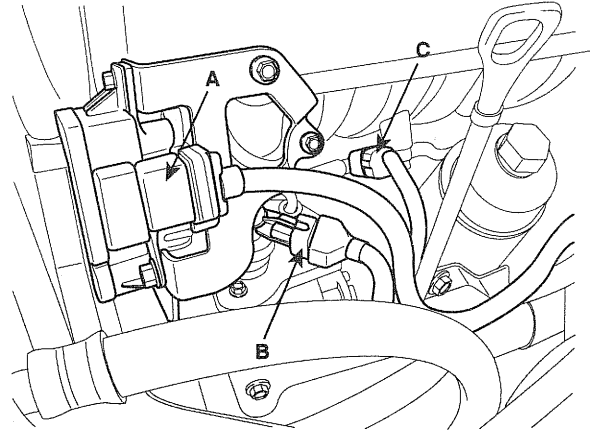
ADJF016A

- 12) Disconnect the MAP sensor connector(A).



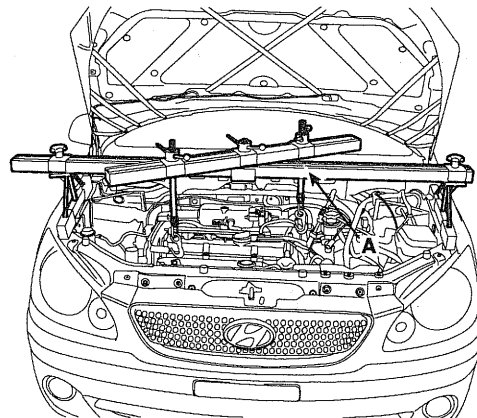
KDPF014A

- 13) Disconnect the swirl valve actuator connector(A).
- 14) Disconnect the fuel pressure regulator connector(B).
- 15) Disconnect the fuel temperature sensor connector (C).



ADJF019A

- 23. Remove the transaxle wire harness connectors and control cable from transaxle (Refer to TR group).
- 24. Recovering refrigerant and remove the high & low pressure pipe. (Refer to HA group - air conditioner compressor).
- 25. Install the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter, on the engine hanger bracket.



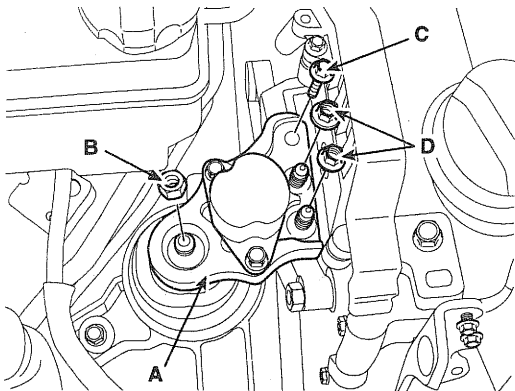
KCPF007A

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

Tightening torque :

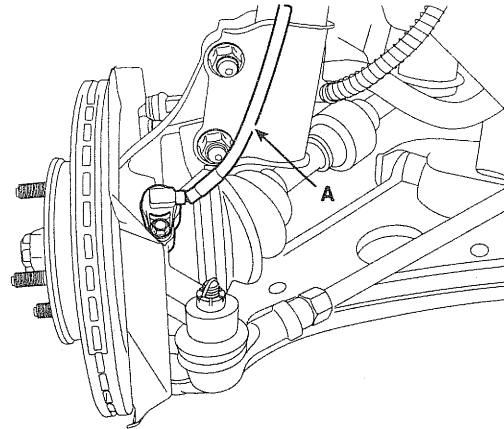
Nut (B) : 68.6 ~ 93.2N.m (7.0~ 9.5kgf.m,50.6 ~ 68.7lb-ft)

Bolt(C),Nut(D):49.0~63.7N.m(5.0~6.5kgf.m,36.2~47.0lb-ft)



KDPF015A

29. Remove the ABS wheel speed sensor(A).

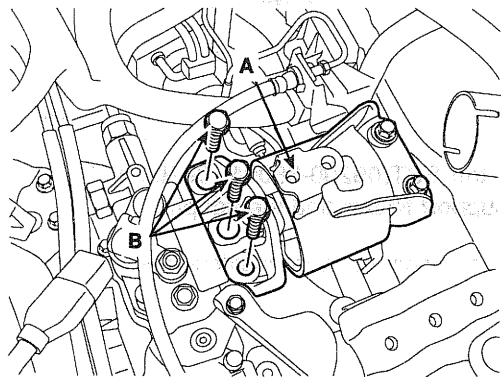


KCPF010A

27. Remove the transaxle mounting bracket(A).

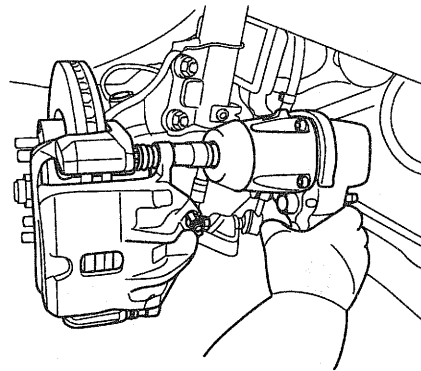
Tightening torque :

Bolt (B) : 68.6 ~ 93.2N.m (7.0~ 9.5kgf.m, 50.6 ~ 68.7lb-ft)



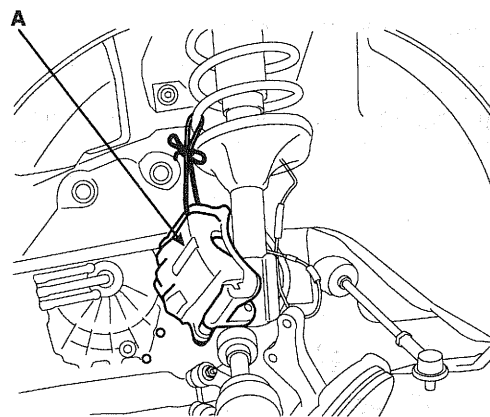
KDPF016A

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



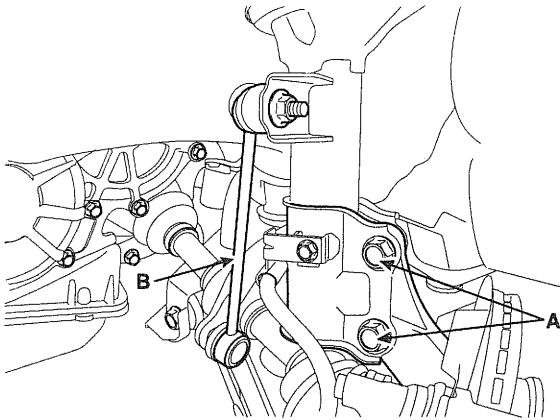
LCGF139A

28. Remove the front tires.



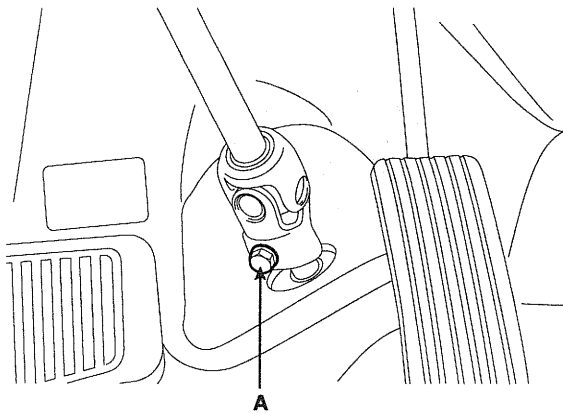
LCGF140A

31. Remove the knuckle mounting bolts(A) and the stabilizer link(B).



KCPF011A

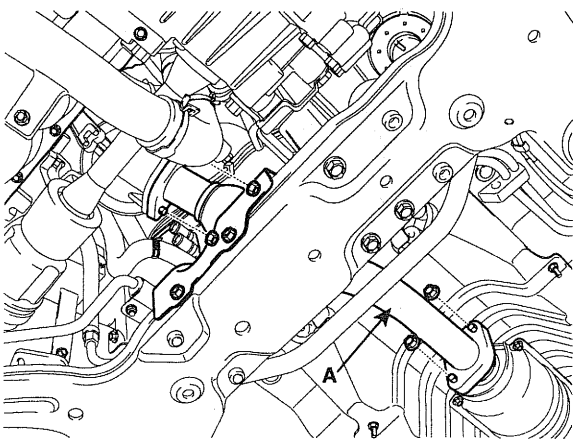
32. Remove the steering u-joint mounting bolt(A).



LCGF142A

33. Remove the front muffler(B).

Tightening torque :  
29.4 ~ 39.2N.m(3.0 ~ 4.0kgf.m,21.7 ~ 28.9lb-ft)



KDPF029A

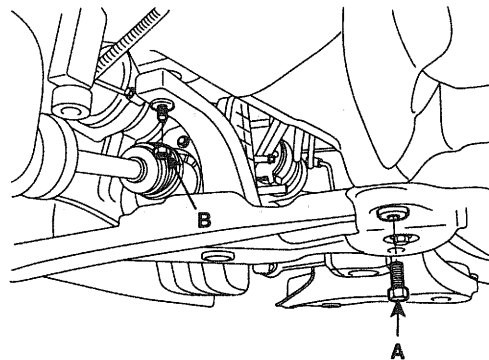
34. Using a floor jack, support the engine and transaxle assembly.

 **NOTE**

After removing the sub frame mounting bolt , the engine and transaxle assembly may fall downward, and so support them securely with floor jack.  
Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

35. Remove the cross member mounting bolts and nuts.

Tightening torque :  
68.6 ~ 93.2N.m(7.0 ~ 9.5kgf.m,50.6 ~ 68.7lb-ft)



KDPF026A

36. Remove the SST(09200-38001, 09200-1C000), the engine support fixture and the adapter.

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

 **NOTE**

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

**INSTALLATION** ECD86743

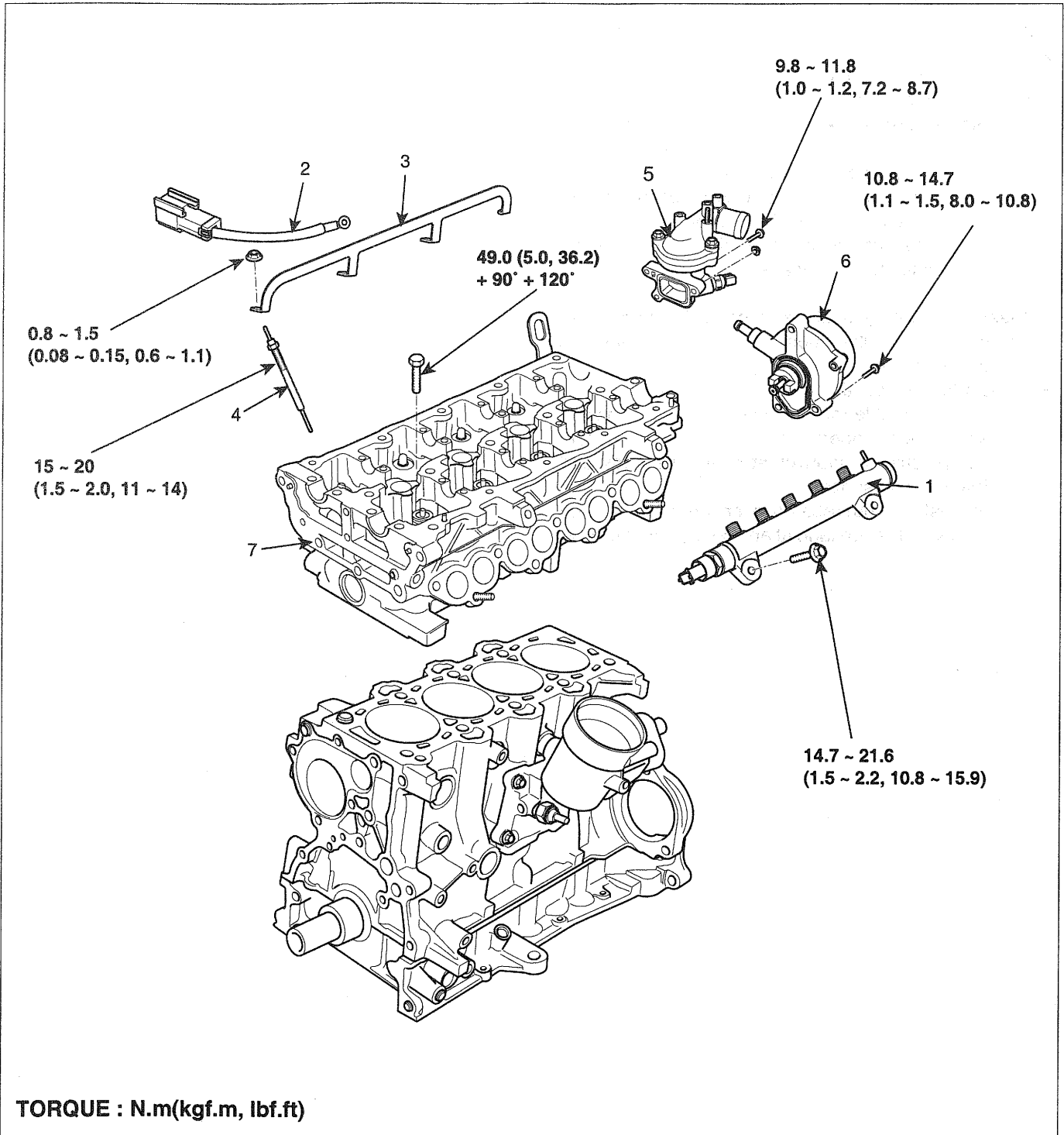
Installation is in the reverse order of removal.

Perform the following :

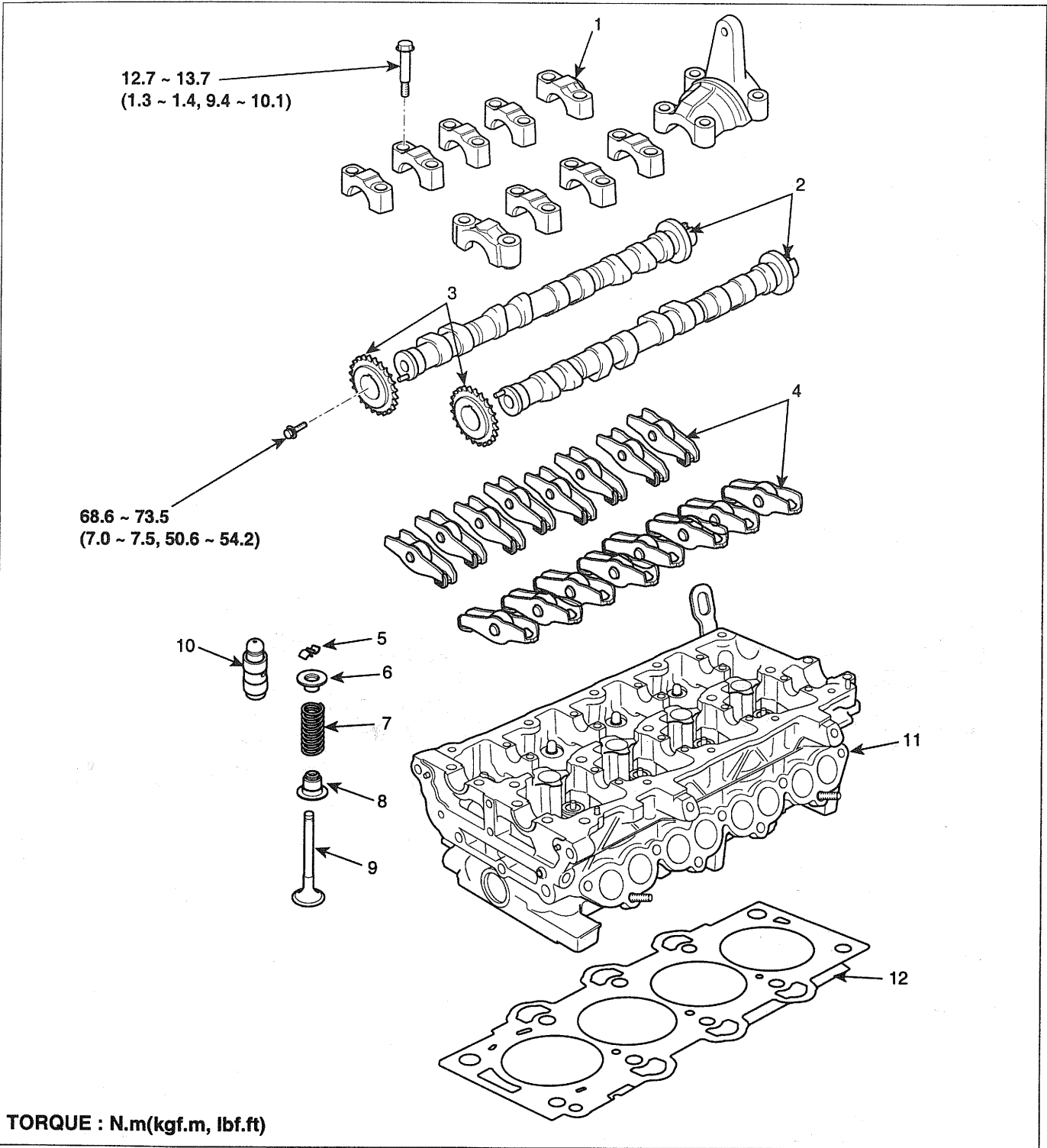
- Adjust the shift cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator and reservoir tank with engine coolant.
- Place the heater control knob on “ HOT” position.
- Bleed air from the cooling system.
  - Start engine and let it run until it warms up. (until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

# CYLINDER HEAD ASSEMBLY

COMPONENT E9EC962A



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



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

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

## REMOVAL E7827144

Engine removal is required for this procedure.

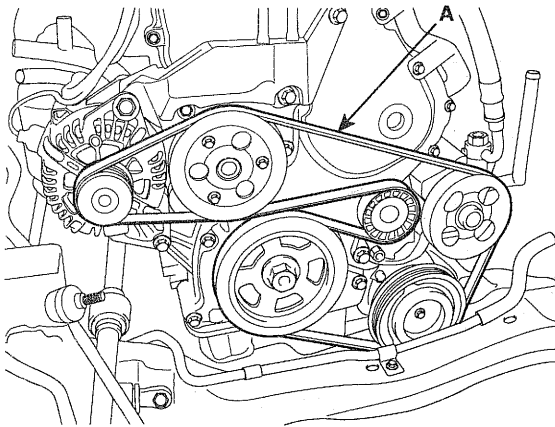
**CAUTION**

- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.

**NOTE**

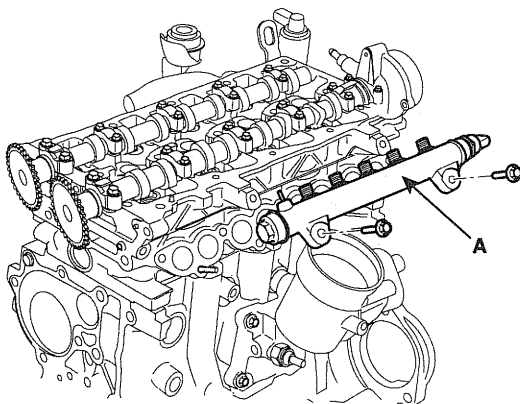
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Remove the drive belt(A).



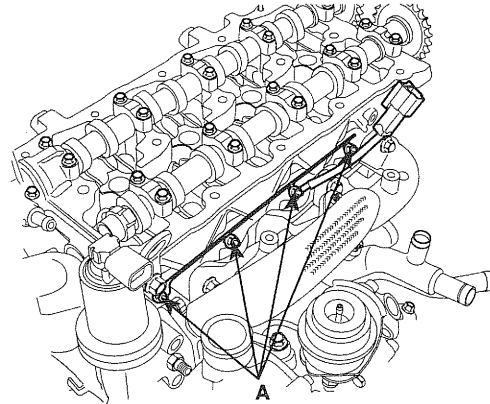
ACGF031A

2. Remove the timing chain. (Refer to EMA-18)
3. Remove the intake and exhaust manifold. (Refer to EMA-94)
4. Remove the delivery pipe(A).



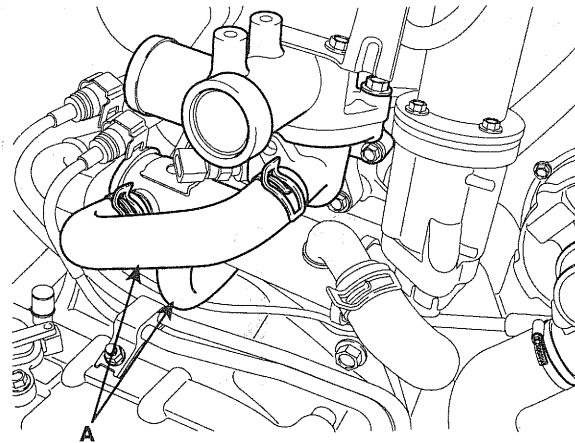
LCGF040A

5. Remove the glow plug(A).



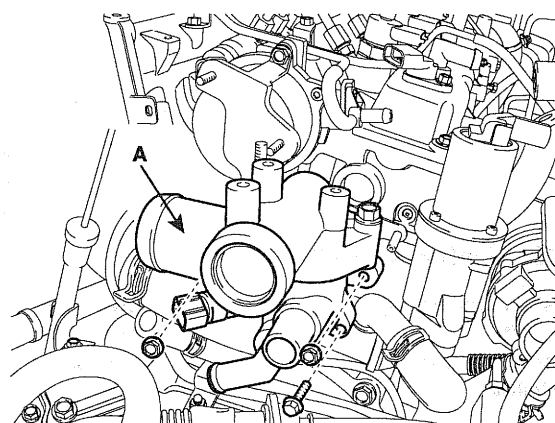
LCGF041A

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



ADJF047A

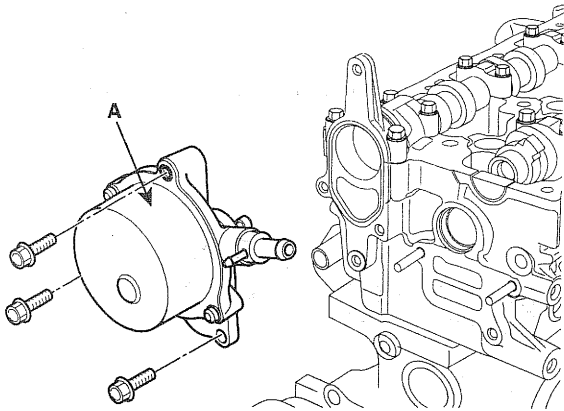
7. Remove the thermostat housing(A).



ADJF046A

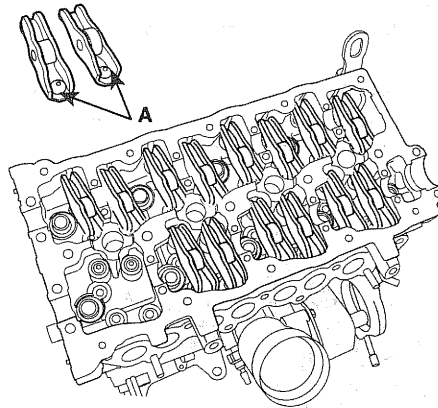


8. Remove the vacuum pump(A).



LCGF044A

11. Remove the cam follower(A).

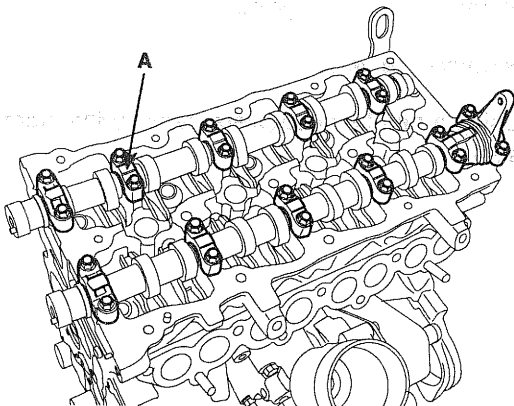


LCGF047A

9. Remove the camshaft bearing caps(A).

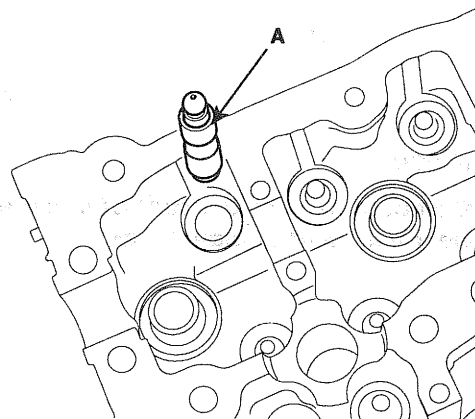
**NOTE**

Mark the camshaft bearing caps to be able to re-assemble in the original position and direction.



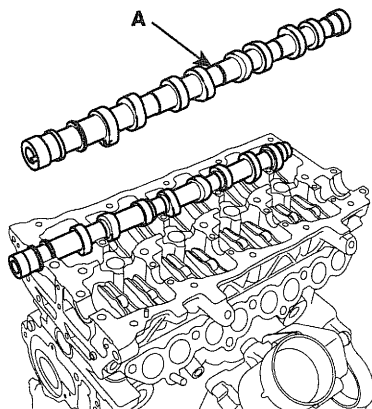
LCGF045A

12. Remove the HLA(Hydraulic Lash Adjust).



LCGF048A

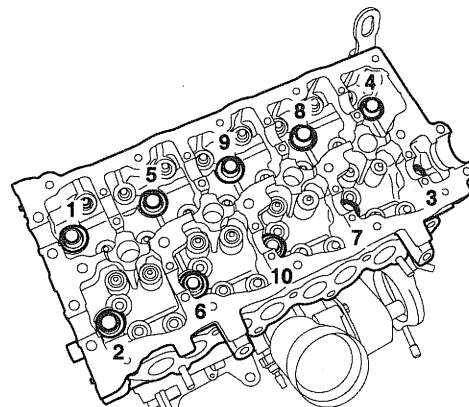
10. Remove the camshaft(A).



LCGF046A

13. Remove the cylinder head bolts, then remove the cylinder head.

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

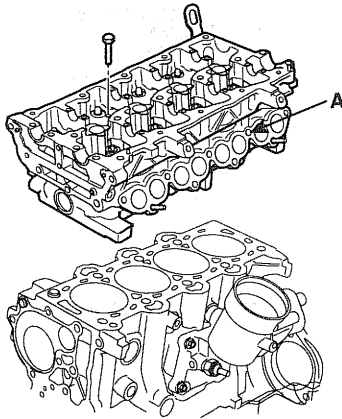


LCGF049A

**⚠ CAUTION**

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

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



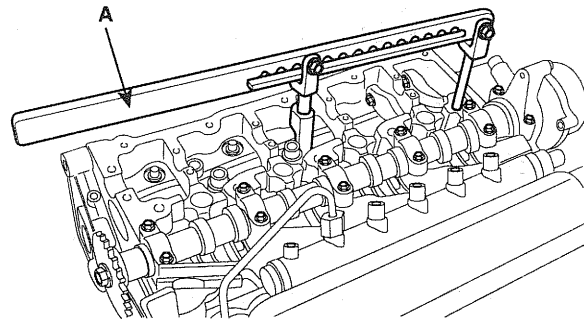
LCGF050A

**⚠ CAUTION**

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

**DISASSEMBLY** EBC5B0B5

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



LCGF101A

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

**INSPECTION** E45A23A8

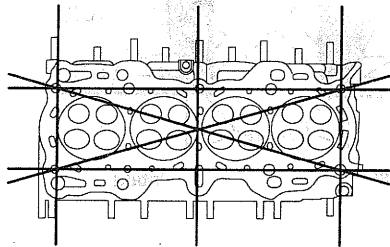
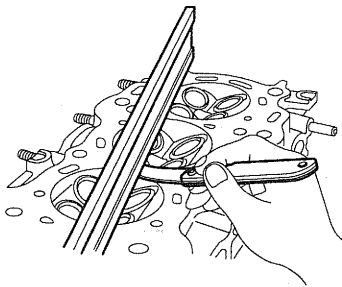
**CYLINDER HEAD**

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

---

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

---



ECKD001H

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

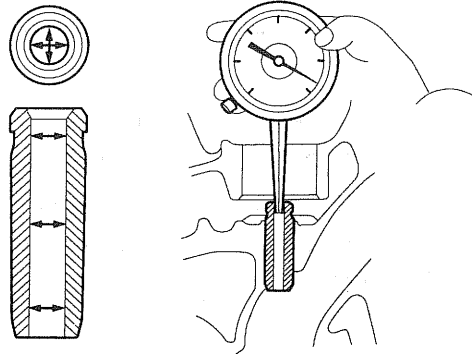
**VALVE AND VALVE SPRING**

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

---

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

---



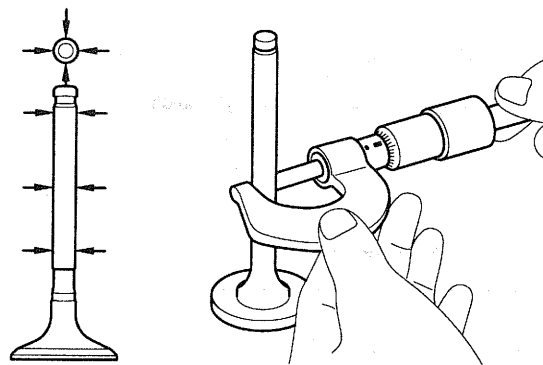
ECKD219A

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

---

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

---



ECKD220A

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

---

Valve stem- to-guide clearance

Intake : 0.030 ~ 0.057mm (0.0012 ~ 0.0022in)

Exhaust : 0.050 ~ 0.077mm (0.0020 ~ 0.0030in)

---

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

2. Inspect the valves.

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

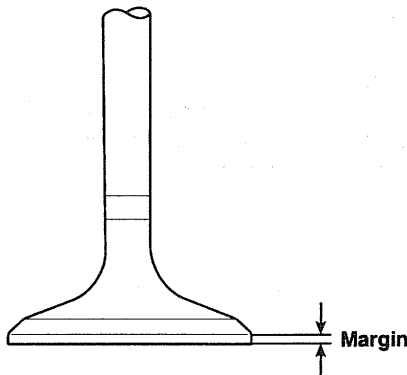
---

Margin

Intake : 1.1mm (0.0433in)

Exhaust : 1.2mm (0.0472in)

---



ECKD221A

4) Check the valve length.

---

Length

Intake : 93.0mm (3.6614in)

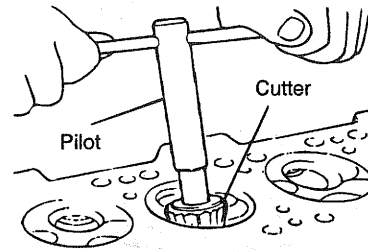
Exhaust : 93.7mm (3.6890in)

---

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

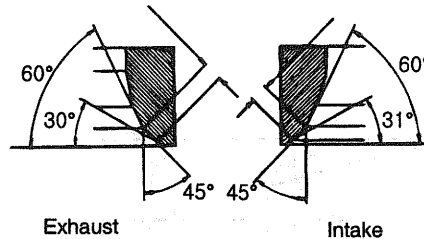
3. Inspect the valve seats.

- 1) Check the valve seat for evidence of overheating and improper contact with the valve face. Replace the seat if necessary.
- 2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.
- 3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.



1.2 ~ 1.8 mm

0.8 ~ 1.4 mm



BCGE009B

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

---

**Valve spring**
**Standard**

Free height : 44.9mm (1.7677in)

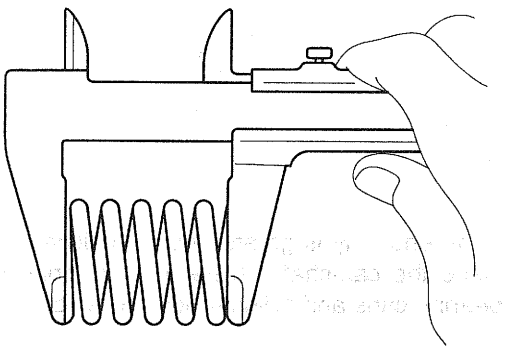
Load : 17.5±0.9kg/32.0mm (38.6±2.0lb/1.2598in)

31.0±1.6kg/23.5mm (68.3±3.5lb/0.9252in)

Out of square : Less than 1.5°

**Limit**

Out of square : 3°



ECKD222A

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

**CAMSHAFT**

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

**Cam height****LH Camshaft**

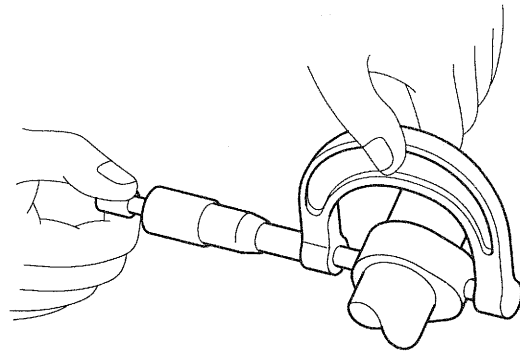
Intake : 35.452 ~ 35.652mm (1.3957 ~ 1.4036in)

Exhaust : 35.700 ~ 35.900mm (1.4055 ~ 1.4134in)

**RH Camshaft**

Intake : 35.537 ~ 35.737mm (1.3991 ~ 1.4070in)

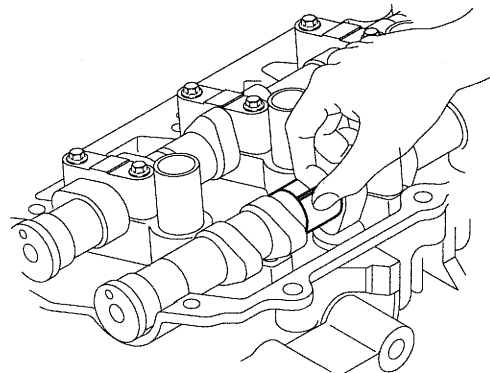
Exhaust : 35.452 ~ 35.652mm (1.3957 ~ 1.4036in)



ECKD223A

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

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



ECKD224A

- 4) Install the bearing caps and tighten the bolts with specified torque. (Refer to EMA-55)

---

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

---

**! CAUTION**

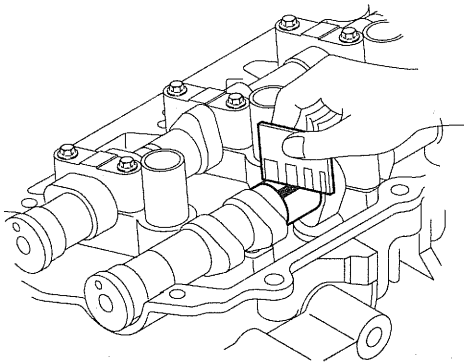
**Do not turn the camshaft.**

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

---

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

---



ECKD225A

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

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

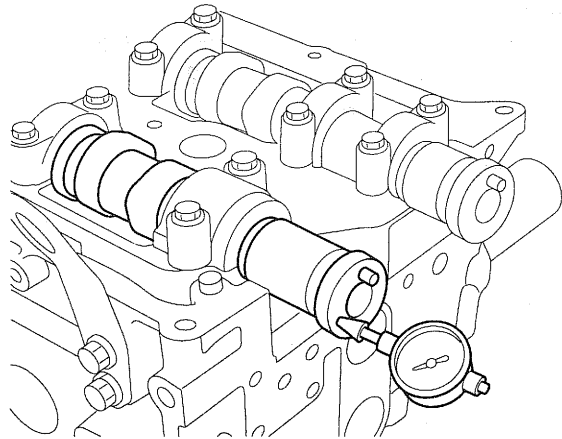
3. Inspect the camshaft end play.

- 1) Install the camshafts. (Refer to EMA-55)
- 2) Using a dial indicator, measure the end play while moving the camshaft back and forth.

---

Camshaft end play  
Standard : 0.1 ~ 0.2mm (0.0039 ~ 0.0079in)

---



LCGF127A

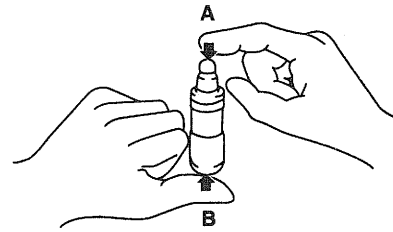
If the end play is greater than specification, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- 3) Remove the camshafts.

HLA (HYDRAULIC LASH ADJUSTER)

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

If B moves, replace the HLA.



LCGF128A

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

**REASSEMBLY** EB6B9E0F**NOTE**

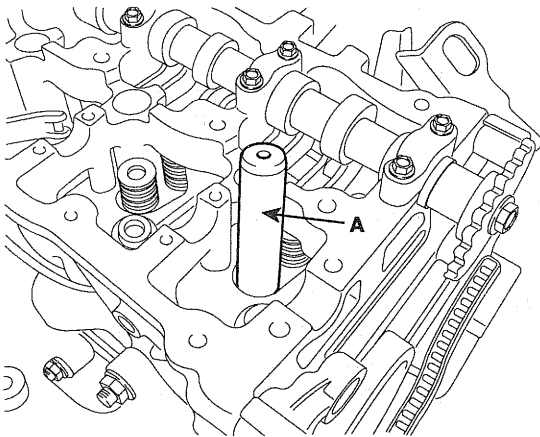
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Replace oil seals with new ones.

## 1. Install the valves.

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

**NOTE**

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



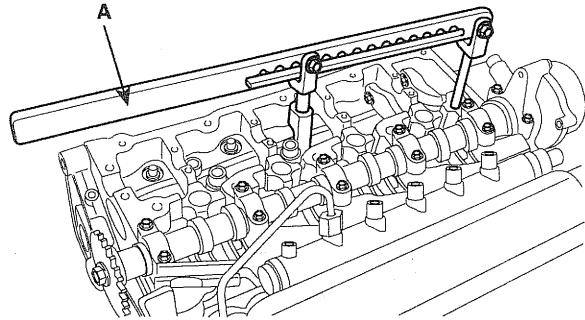
LCGF102A

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

**NOTE**

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

- 3) Using the SST(09222-2A100, 09222-3K000)(A), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



LCGF101A

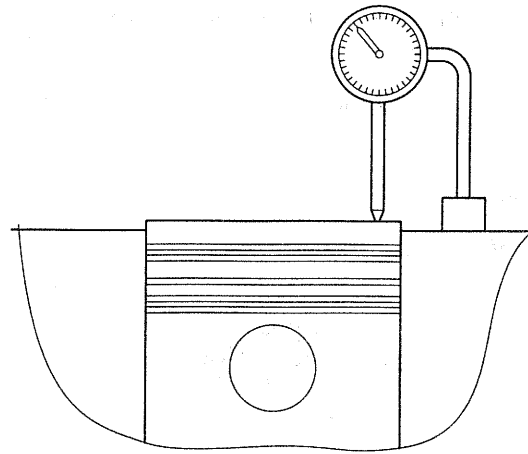
- 4) Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.



INSTALLATION EEFEB3B

**NOTE**

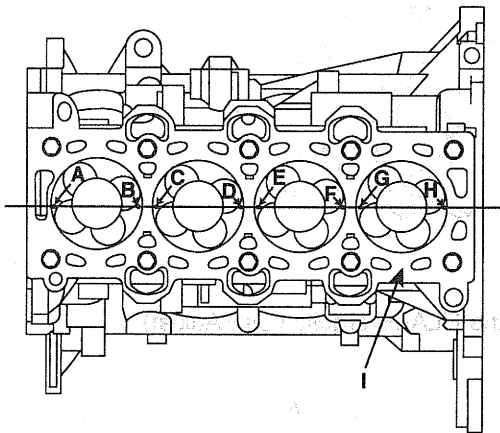
- Thoroughly clean all parts to be assembled.
- Always use a new cylinder head and manifold gasket.
- Always use a new cylinder head bolt.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No.1 piston at TDC.



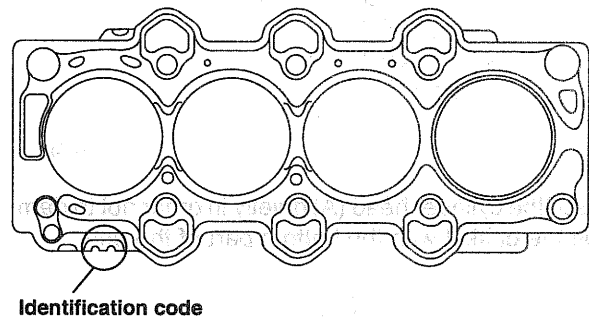
LCGF129A

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




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



ACGF012A



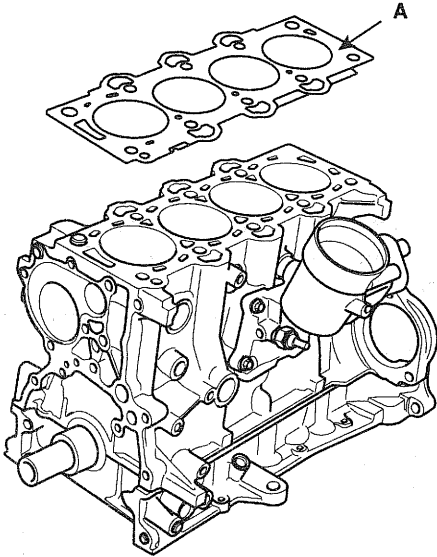
LCGF104A

Displacement	1.5 L		
Average of piston protrusion	0.035 ~ 0.105mm (0.0014 ~ 0.0041in)	0.105 ~ 0.175mm (0.0041 ~ 0.0069in)	0.175 ~ 0.245mm (0.0069 ~ 0.0096in)
Gasket thickness	1.00 ~ 1.15mm (0.0394 ~ 0.0453in)	1.05 ~ 1.20mm (0.0413 ~ 0.0472in)	1.10 ~ 1.25mm (0.0433 ~ 0.0492in)
Limit of each rank extant	0.14mm (0.0055in)	0.21mm (0.0083in)	-
Identification code	 LCGF130A	 LCGF132A	 LCGF131A

- 3) Install the gasket so that the identification mark faces toward the timing chain side.
3. Install the cylinder head gasket(A) on the cylinder block.

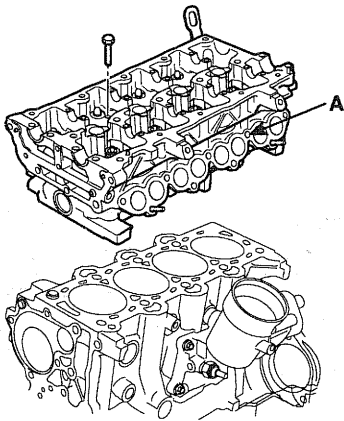
**NOTE**

Be careful of the installation direction.



ACGF013A

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



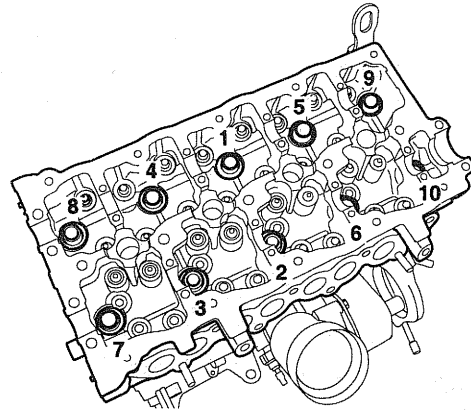
LCGF050A

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

Tightening torque :  
49.0N.m (5.0kgf.m, 36.2lb-ft)+90° + 120°

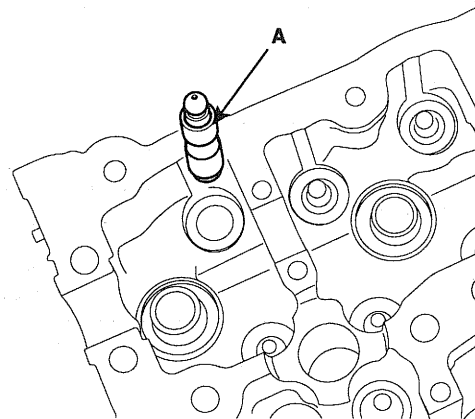
**NOTE**

Do not reuse the cylinder head bolts.



LCGF153A

6. Install the HLA(Hydraulic Lash Adjust).

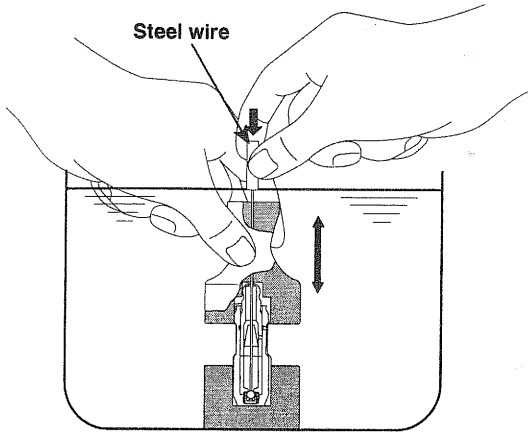


LCGF048A

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

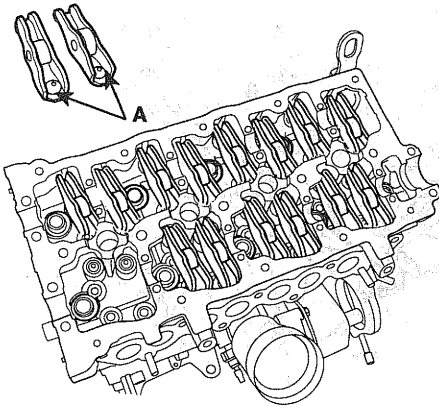
**NOTE**

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



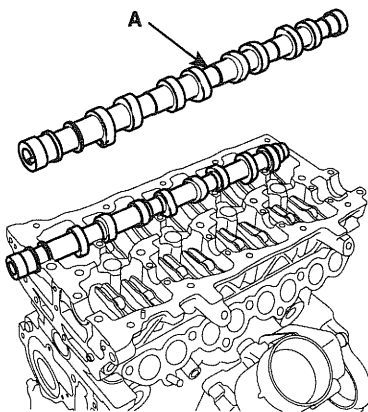
LCGF133A

7. Install the cam follower(A).



LCGF047A

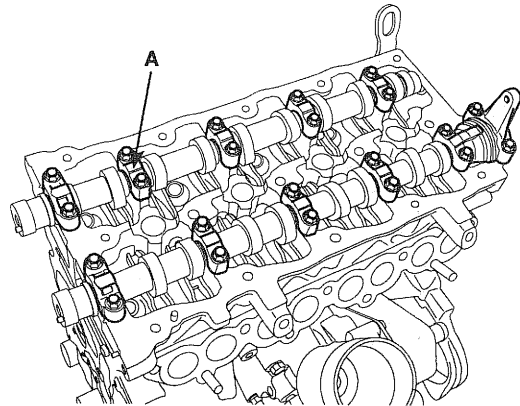
8. Install the camshaft(A).



LCGF046A

9. Install the camshaft bearing caps(A).

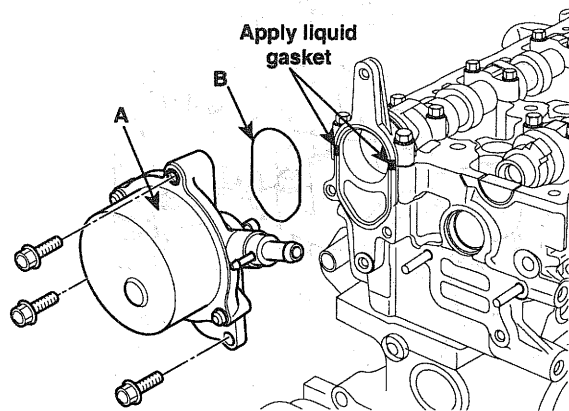
Tightening torque :  
12.7 ~ 13.7N.m (1.3 ~ 1.4kgf.m, 9.4 ~ 10.1lb-ft)



LCGF045A

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

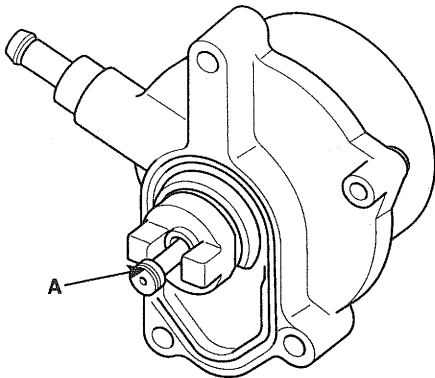
Tightening torque :  
10.8 ~ 14.7N.m (1.1 ~ 1.5kgf.m, 8.0 ~ 10.8lb-ft)



LCGF154A

**NOTE**

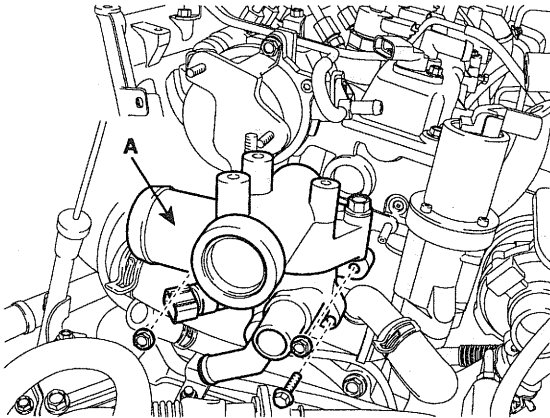
Apply engine oil to the O-ring(A) of vacuum pump shaft before assembling vacuum pump.



LCGF126A

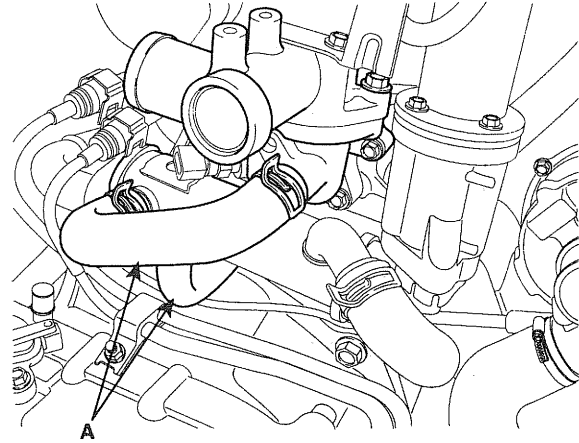
11. Install the thermostat housing(A).

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



ADJF046A

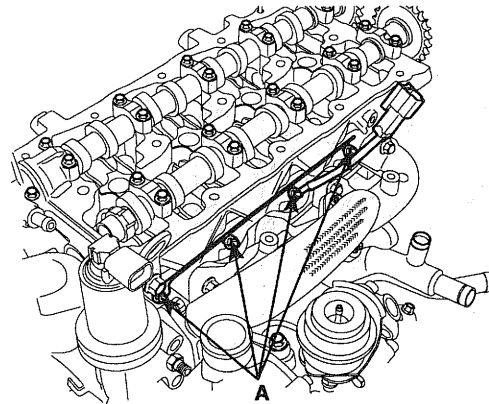
12. Reconnect the water hose(A) to thermostat housing.



ADJF047A

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

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



LCGF041A

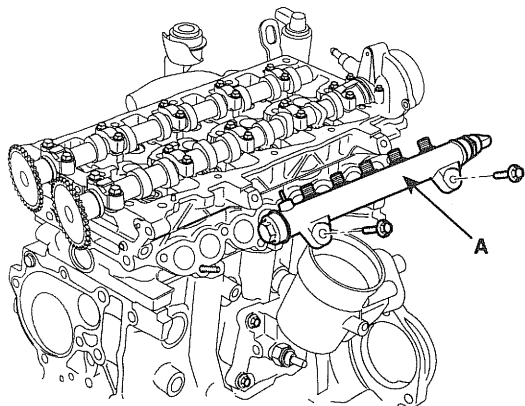
14. Install the delivery pipe(A).

---

Tightening torque :

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

---



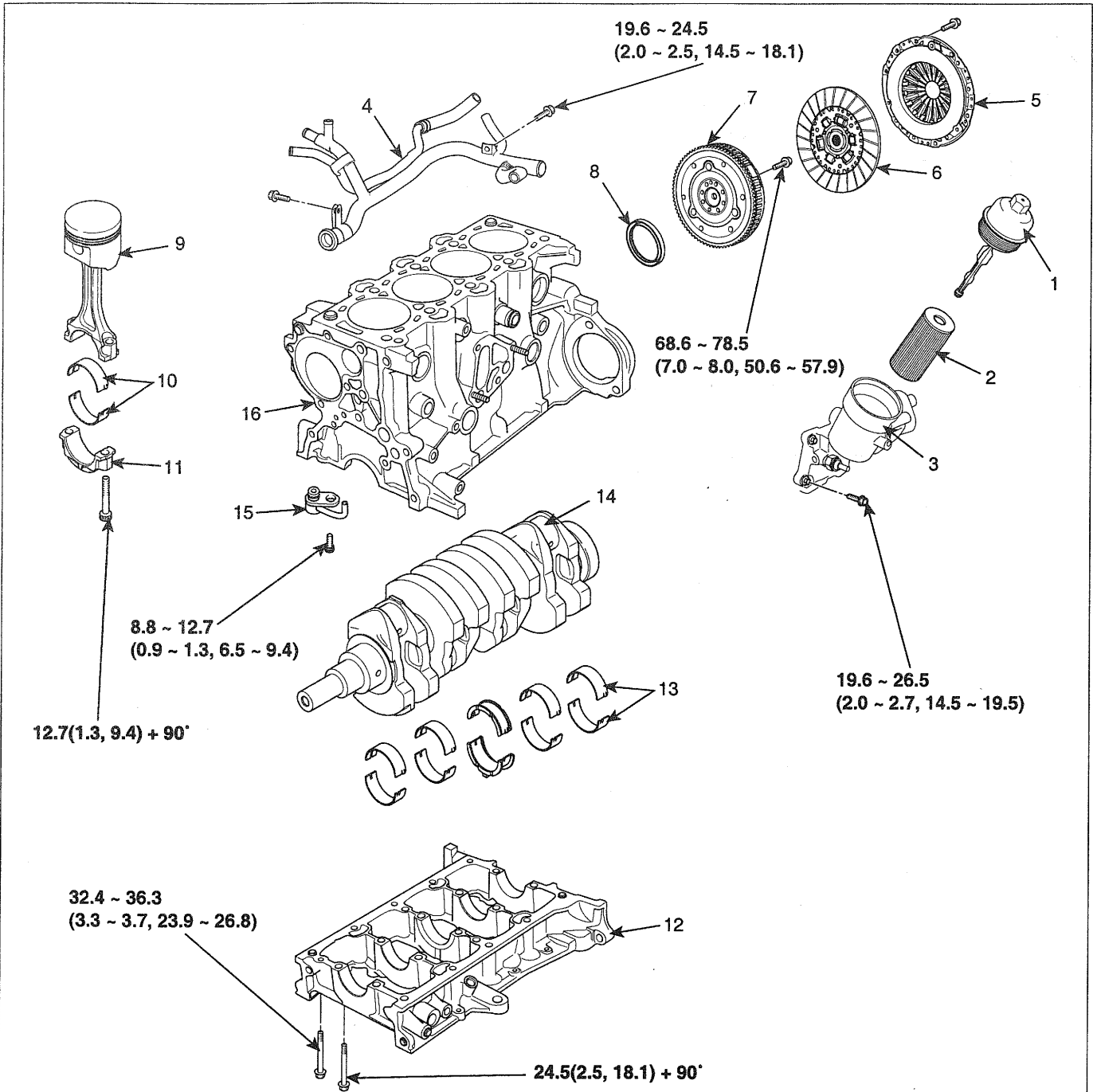
LCGF040A

15. Install the intake and exhaust manifold. (Refer to EMA-92)
16. Install the timing chain. (Refer to EMA-25)
17. Install the drive belt.

# ENGINE BLOCK

CYLINDER BLOCK E80C8E3F

## COMPONENT



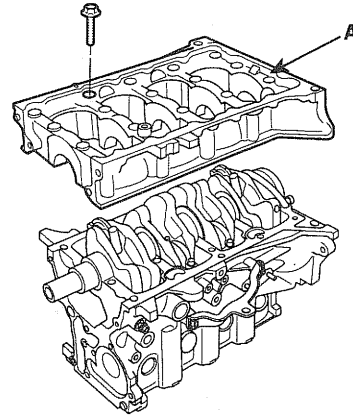
**TORQUE : N.m(kgf.m, lbf.ft)**

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

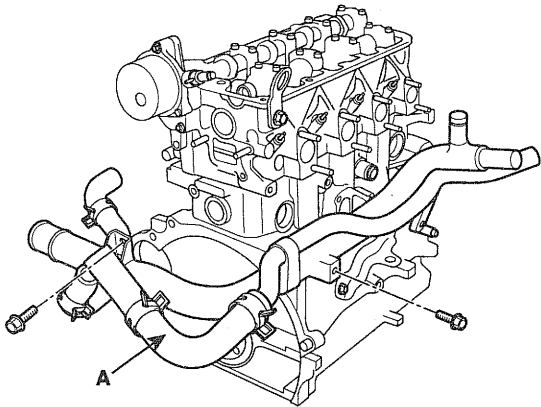
DISASSEMBLY E69CD7DF

1. M/T : Remove the fly wheel.
2. A/T : Remove the drive plate.
3. Install the engine to engine stand for disassembly.
4. Remove the timing chain. (Refer to EMA-18)
5. Remove the intake manifold and exhaust manifold. (Refer to EMA-92)
6. Remove the cylinder head. (Refer to EMA-44)
7. Remove the water pipe.

9. Remove the bed plate(A).



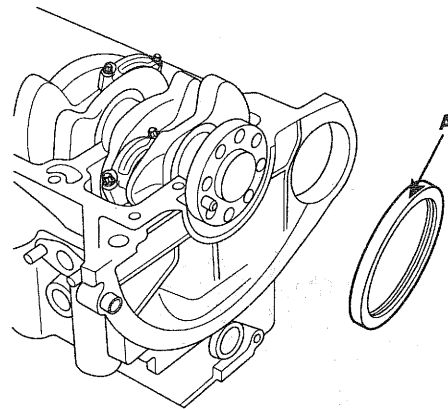
LCGF054A



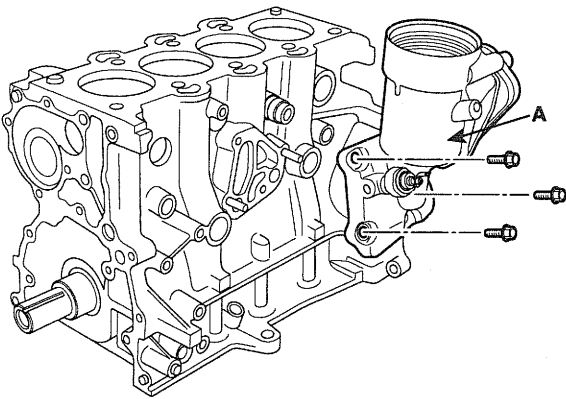
LCGF052A

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

10. Remove the rear oil seal(A).



LCGF055A

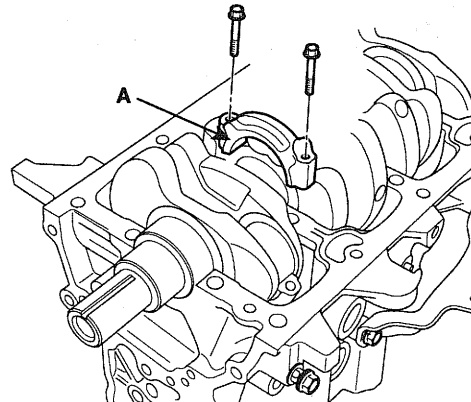


ACGF053A

11. Remove the connecting rod cap(A).

**NOTE**

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



LCGF056A

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

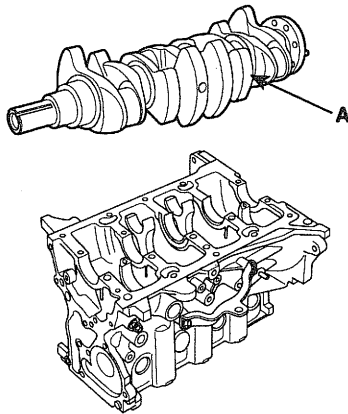
 **NOTE**

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

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

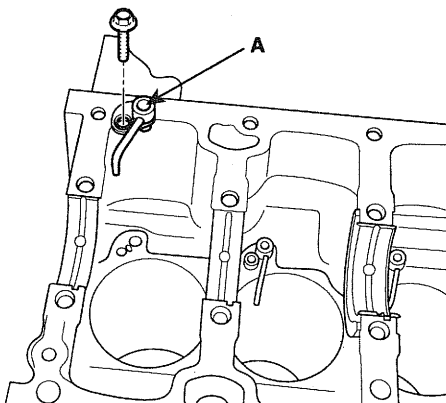
 **NOTE**

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



LCGF057A

14. Remove the oil jet(A).



LCGF058A

15. Check fit between piston and piston pin.  
Try to move the piston back and forth on the piston pin.  
If any movement is felt, replace the piston and pin as a set.
16. Remove the piston rings.

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

 **NOTE**

Arrange the piston rings in the correct order only.

17. Remove the connecting rod from the piston.  
Using a press, remove the piston pin from piston.



INSPECTION ECA43B76

CONNECTING ROD

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

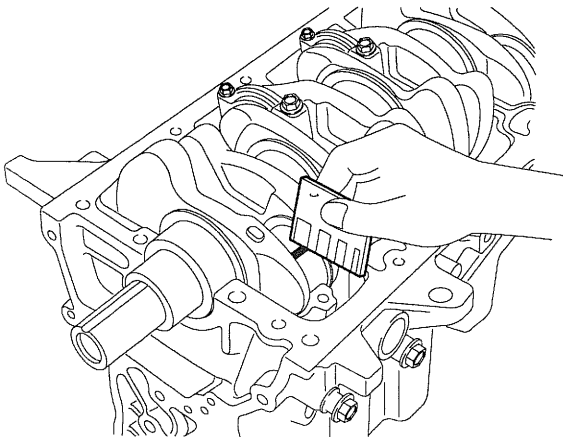
Tightening torque :  
12.7N.m (1.3kgf.m, 9.4lb-ft) + 90°

**NOTE**

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

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

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



LCGF107A

- 9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to connecting rod bearing selection table. EMA-62)  
Recheck the oil 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.( Refer to connecting rod bearing selection table. EMa-62)  
Recheck the oil clearance.

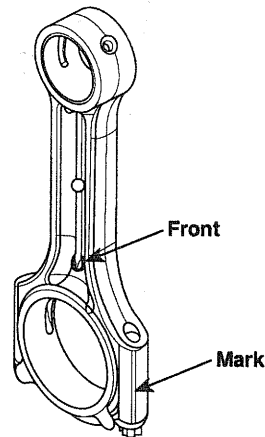
**NOTE**

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

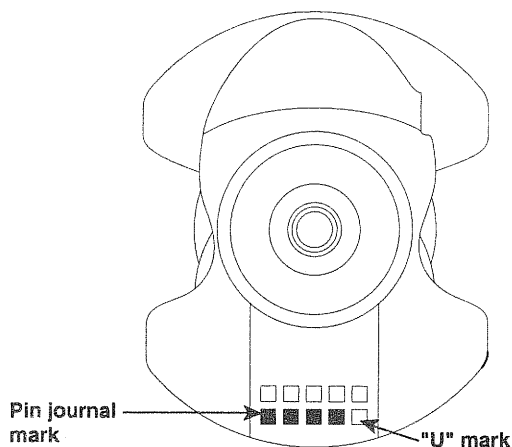


LCGF108A

DISCRIMINATION OF CONNECTING ROD

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

**CRANKSHAFT PIN JOURNAL MARK LOCATION**

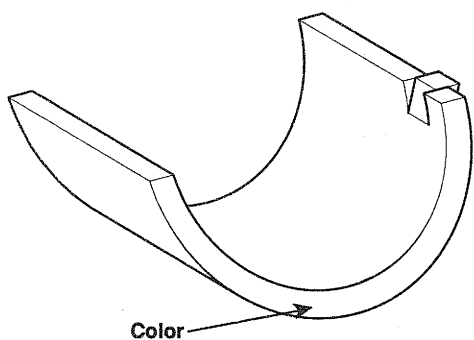


ACAE163B1

**DISCRIMINATION OF CRANKSHAFT PIN JOURNAL**

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

**CONNECTING ROD BEARING MARK LOCATION**



LCGF143A

**DISCRIMINATION OF CONNECTING ROD BEARING**

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

11) Select the bearing by using selection table.

**CONNECTING ROD BEARING SELECTION TABLE**

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

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

---

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

---

CRANKSHAFT

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

Tightening torque :

Long bolts : 24.5N.m(2.5kgf.m, 18.1lb-ft) + 90°

Short bolts : 32.4~36.3N.m(3.3~3.7kgf.m, 23.9~26.8lb-ft)

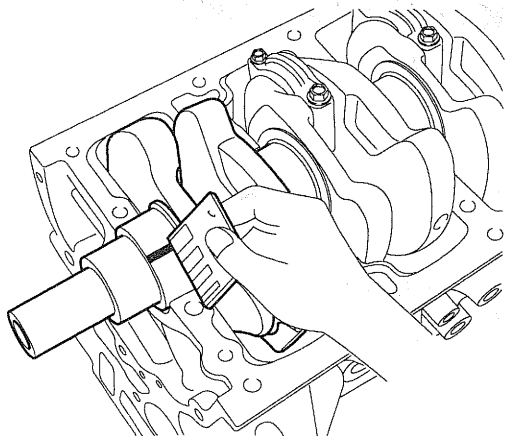
**NOTE**

Do not turn the crankshaft.

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

Standard oil clearance :

0.024 ~ 0.042mm (0.0009 ~ 0.0017in)



LCGF109A

- 6) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to crankshaft main bearing selection table, EMA-63)  
Recheck the oil clearance.

**CAUTION**

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

- 7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to crankshaft main bearing selection table, EMA-63)  
Recheck the oil clearance.

**NOTE**

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

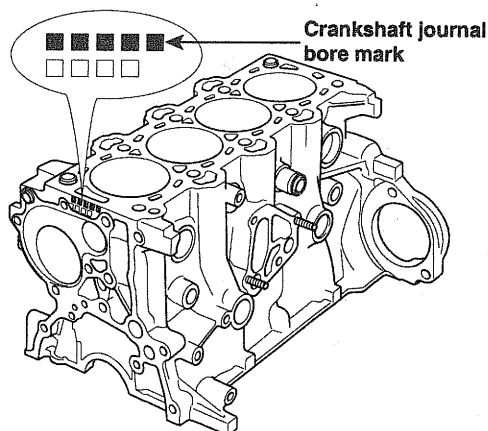
**CAUTION**

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.

**CYLINDER BLOCK CRANKSHAFT JOURNAL BORE MARK LOCATION**

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

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

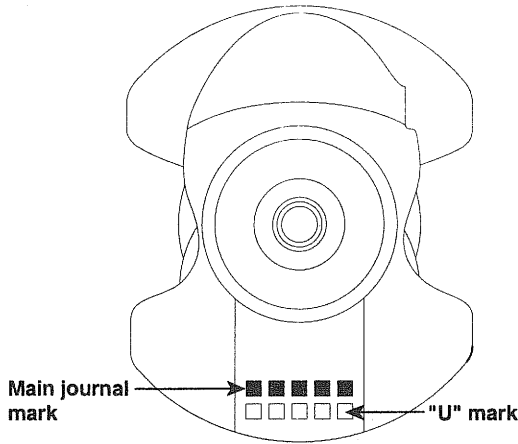


LCGF144A

**DISCRIMINATION OF CYLINDER BLOCK CRANKSHAFT JOURNAL BORE**

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

**CRANKSHAFT MAIN JOURNAL MARK LOCATION**

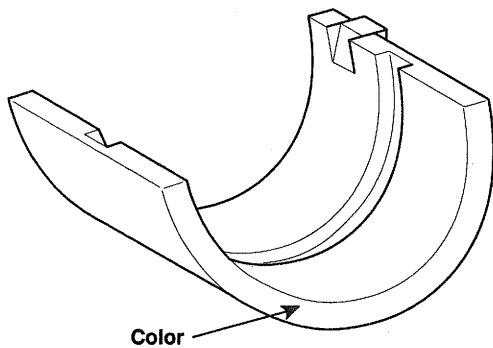


ACAE163B2

**DISCRIMINATION OF CRANKSHAFT MAIN JOURNAL**

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

**CRANKSHAFT MAIN BEARING MARK LOCATION**



BCGE030A1

**DISCRIMINATION OF CRANKSHAFT MAIN BEARING**

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

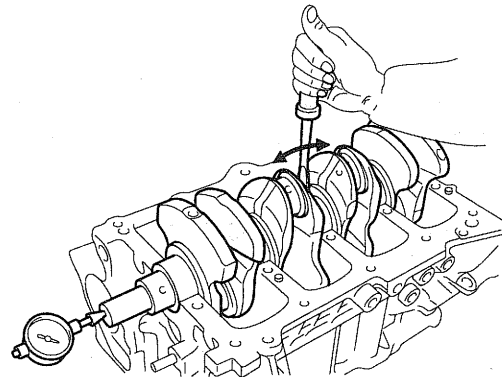
8) Select the bearing by using selection table.

**CRANKSHAFT MAIN BEARING SELECTION TABLE**

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

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

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



ECKD001B

If the end play is greater than maximum, replace the center main bearing as a set.

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

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

---

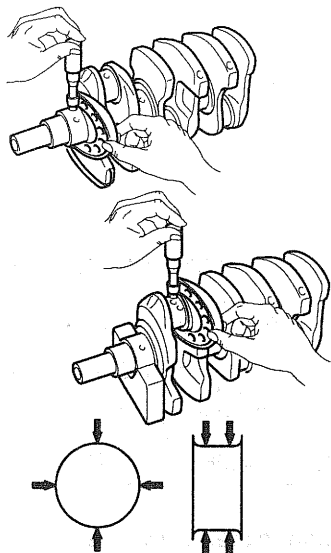
Main journal diameter :

53.972 ~ 53.990mm (2.1249 ~ 2.1256in)

Pin journal diameter :

45.997 ~ 46.015mm (1.8109 ~ 1.8116in)

---



ECKD001E

## CYLINDER BLOCK

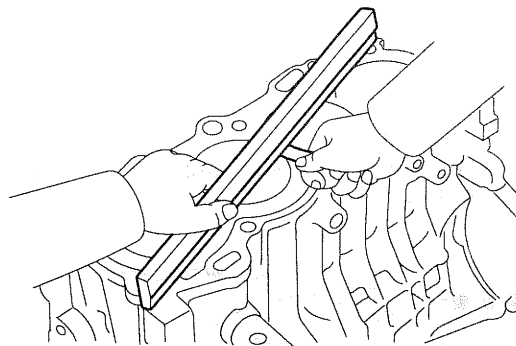
1. Remove the gasket material.  
Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
2. Clean the cylinder block  
Using a soft brush and solvent, thoroughly clean the cylinder block.
3. Inspect the top surface of cylinder block for flatness.  
Using a precision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

---

Flatness of cylinder block gasket surface

Less than 0.05mm (0.0020in)

---

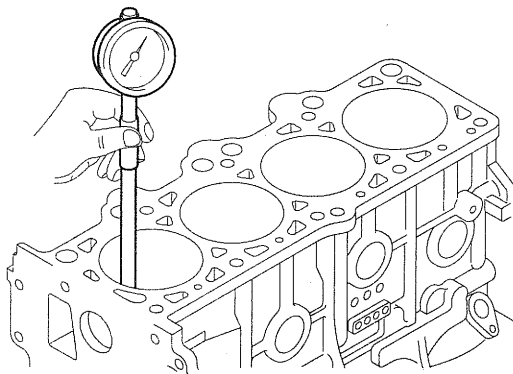


ECKD001L

4. Inspect the cylinder bore.  
Visually check the cylinder for vertical scratches.  
If deep scratches are present, replace the cylinder block.

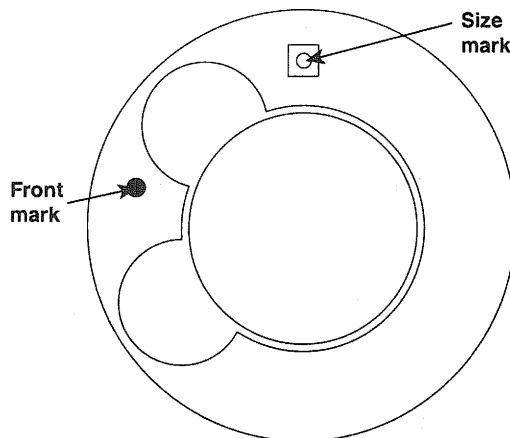
- Inspect the cylinder bore diameter.  
Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

Standard diameter :  
75.00 ~ 75.03mm (2.9528 ~ 2.9539in)



ECKD318A

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



LCGF110A

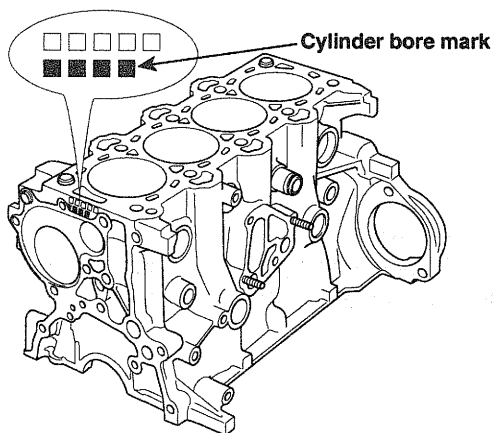
**DISCRIMINATION OF PISTON OUTER DIAMETER**

Mark	Piston outer diameter
A	74.930 ~ 74.940mm (2.9500 ~ 2.9504in)
B	74.940 ~ 74.950mm (2.9504 ~ 2.9508in)
C	74.950 ~ 74.960mm (2.9508 ~ 2.9512in)

- Select the piston related to cylinder bore class.

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

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



LCGF155A

**DISCRIMINATION OF CYLINDER BORE SIZE**

Mark	Cylinder bore inner diameter
A	75.000 ~ 75.010mm (2.9528 ~ 2.9531in)
B	75.010 ~ 75.020mm (2.9531 ~ 2.9535in)
C	75.020 ~ 75.030mm (2.9535 ~ 2.9539in)

## BORING CYLINDER

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

 **NOTE**

*The size of piston is stamped on top of the piston.*

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

---

New bore size = piston O.D + 0.02 to 0.04mm (0.0008 to 0.0016in) (clearance between piston and cylinder) - 0.01mm (0.0004in) (honing margin.)

---

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

 **CAUTION**

**To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.**

- 5.hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

---

Standard : 0.02 ~ 0.04mm (0.0008 ~ 0.0016in)

---

 **NOTE**

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

## PISTON AND PISTON RINGS

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

 **NOTE**

*Do not use a wire brush.*

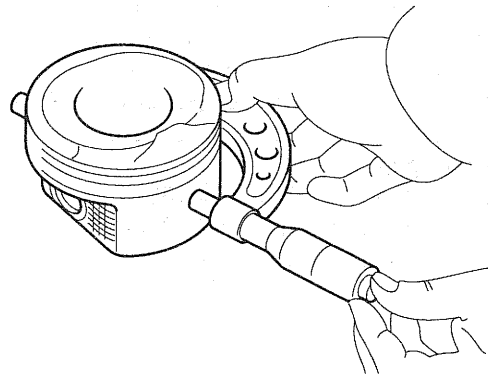
2. The standard measurement of the piston outside diameter is taken 10mm (0.39in) from bottom land of the piston.

---

Standard diameter :

74.93 ~ 74.96mm (2.9500 ~ 2.9512in)

---



ECKD001D

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

---

Piston-to-cylinder clearance :

0.06 ~ 0.08mm (0.0024 ~ 0.0031in)

---

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

---

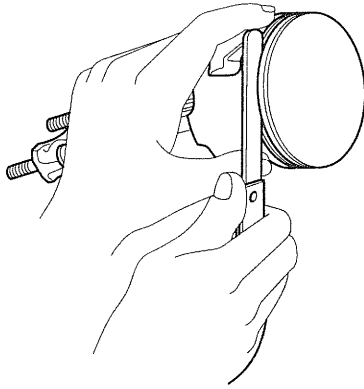
Piston ring side clearance

No.1 : 0.09 ~ 0.13mm (0.0035 ~ 0.0051in)

No.2 : 0.08 ~ 0.12mm (0.0031 ~ 0.0047in)

Oil ring : 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)

---



ECKD001G

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

5. Inspect the piston ring end gap.

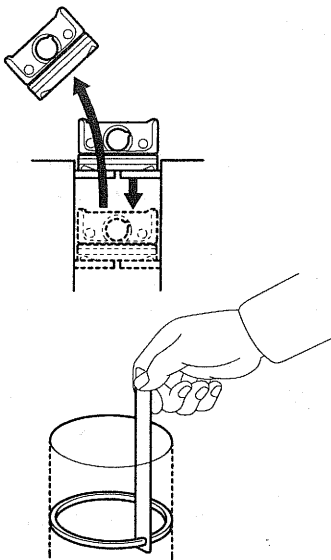
To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored. (Refer to EMA-66)

Piston ring end gap

No.1 : 0.20 ~ 0.35mm (0.0079 ~ 0.0138in)

No.2 : 0.35 ~ 0.50mm (0.0138 ~ 0.0197in)

Oil ring : 0.20 ~ 0.40mm(0.0079 ~ 0.0157in)



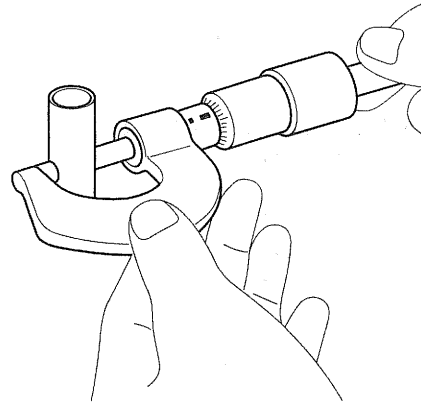
ECKD001K

## PISTON PINS

1. Measure the outer diameter of piston pin.

Piston pin diameter :

27.995 ~ 28.000mm (1.1022 ~ 1.1024in)



ECKD001Z

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

Piston pin-to-piston clearance :

0.004 ~ 0.015mm (0.0002 ~ 0.0006in)

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

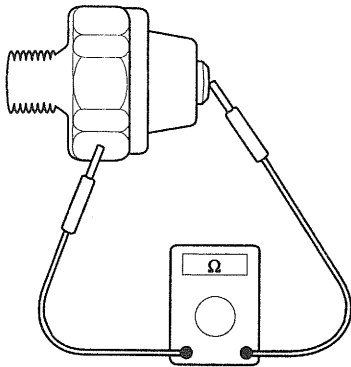
Piston pin-to-connecting rod interference :

0.022 ~ 0.039mm (0.0009 ~ 0.0015in)



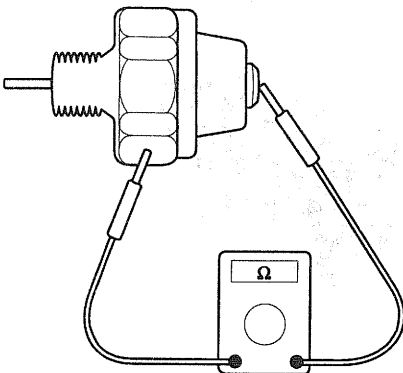
## OIL PRESSURE SWITCH

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



ECKD001W

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.



ECKD001Y

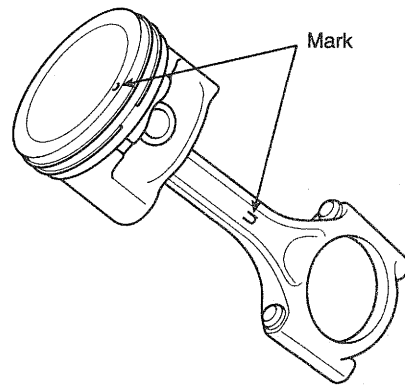
3. If there is no continuity when a 49.0kpa (0.5kg/cm<sup>2</sup>, 7.1psi) vacuum is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

## REASSEMBLY EFACC32C

 **NOTE**

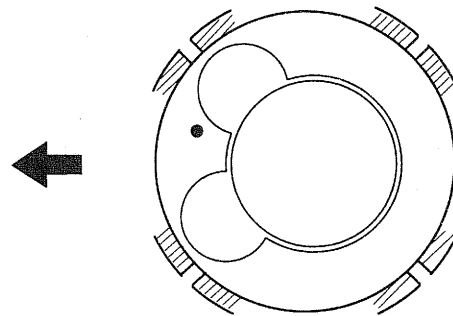
- Thoroughly clean all parts to assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

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



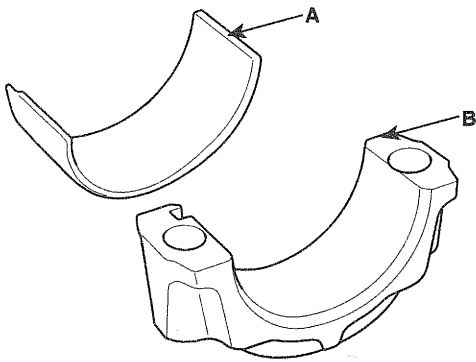
BCGE018A

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



LCGF145A

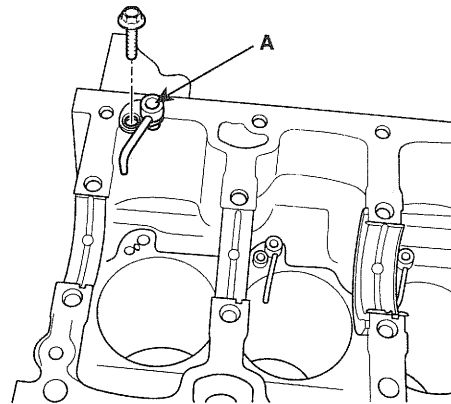
3. Install the connecting rod bearings.
  - 1) Align the bearing claw with the groove of the connecting rod or connecting rod cap.
  - 2) Install the bearings(A) in the connecting rod and connecting rod cap(B).



ECKD322A

5. Install the oil jet(A).

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



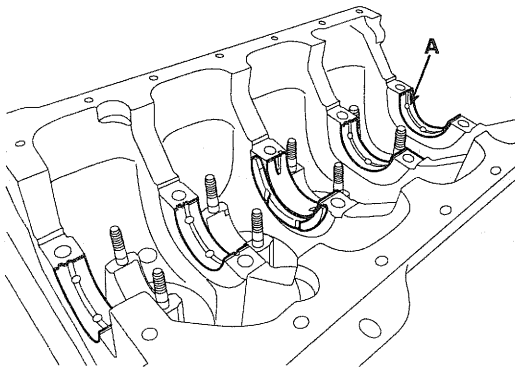
LCGF058A

4. Install the crankshaft main bearings.

**NOTE**

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

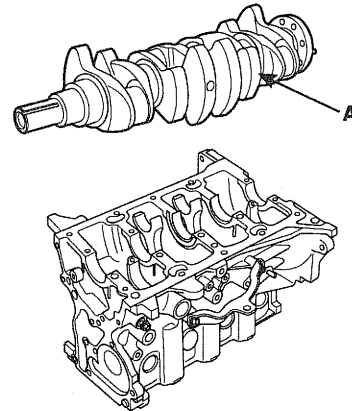
- 1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).



ECKD323A

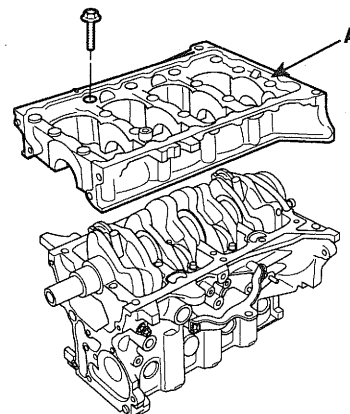
- 2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

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



LCGF057A

7. Place the bed plate (A) on the cylinder block.



LCGF054A

**NOTE**

- Standard liquid gasket : LOCTITE 5205, HYLO-MAR3000, Dreibond 5105
- Check that the mating surfaces are clean and dry before applying liquid gasket.
- Apply liquid gasket in a 3mm wide bead without stopping.
- Assemble the bed plate in 5 minutes after applying the liquid gasket.
- After assembly, wait at least 30 minutes before filling the engine with oil.

8. Install the bed plate bolts.

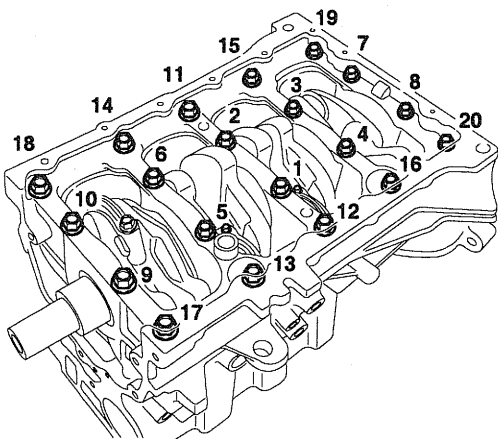
**NOTE**

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

- 1) Apply a light coat of engine oil on the threads and under the bed plate bolts.
- 2) Install and uniformly tighten the bed plate bolts, in several passes, in the sequence shown.
  - a. Tighten the 11,17, 20 bolts.
  - b. Tighten the 1 ~ 10 bolts in the sequence shown by the specified torque.
  - c. Loosen the 11, 17, 20 bolts.
  - d. Tighten the 11 ~ 20 bolts in the sequence shown by the specified torque.

**Tightening torque :**

Long bolts(1~10) : 24.5N.m (2.5kgf.m, 18.1lb-ft) + 90°  
 Short bolts(11~20) : 32.4~36.3N.m (3.3~3.7kgf.m, 23.9~26.8lb-ft)



LCGF111A

- 3) Check that the crankshaft turns smoothly.

9. Check the crankshaft end play. (EMA-64)

10. Install the piston and connecting rod assemblies.

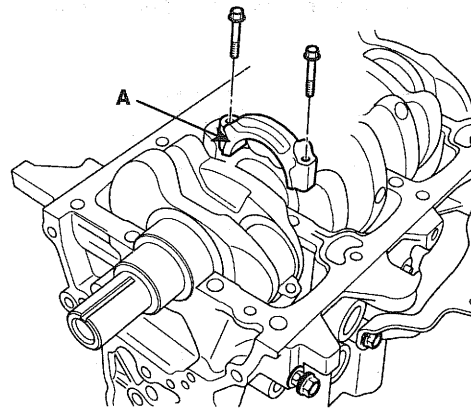
**NOTE**

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

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

**Tightening torque :**

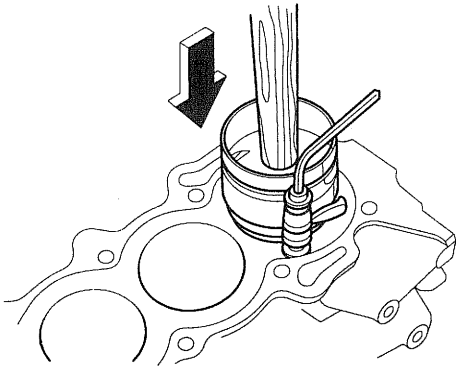
12.7N.m (1.3kgf.m, 9.4lb-ft) + 90°



LCGF056A

**NOTE**

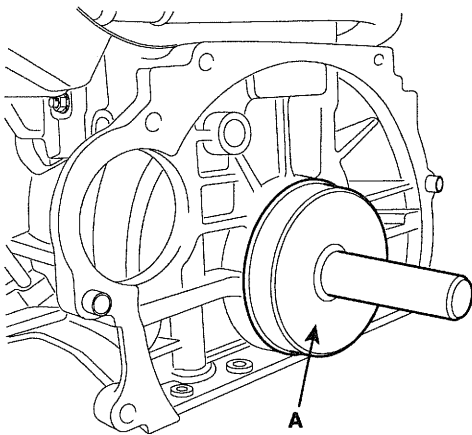
Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.



ECKD001F

11. Install the rear oil seal.

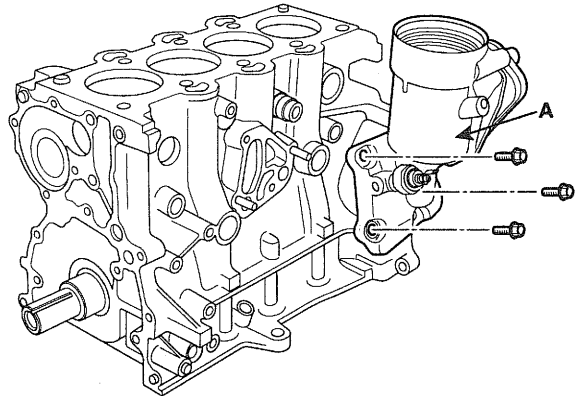
- 1) Apply engine oil to a new oil seal lip.
- 2) Using the SST(09231-H1200, 09231-H1100)(A) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.



LCGF112A

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

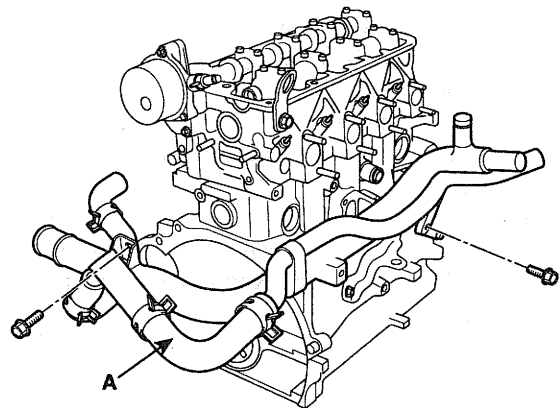
Tightening torque :  
19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)



ACGF053A

13. Install the water pipe(A).

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



ACGF052A

14. Install the cylinder head. (Refer to EMA-53)
15. Install the intake manifold and exhaust manifold. (Refer to EMA-92)
16. Install the timing chain. (Refer to EMA-25)
17. Remove the engine stand.
18. A/T :install the drive plate.

---

Tightening torque :

68.6 ~ 78.5N.m (7.0 ~ 8.0kgf.m, 50.6 ~ 57.9lb-ft)

---

19. M/T :install the fly wheel.

---

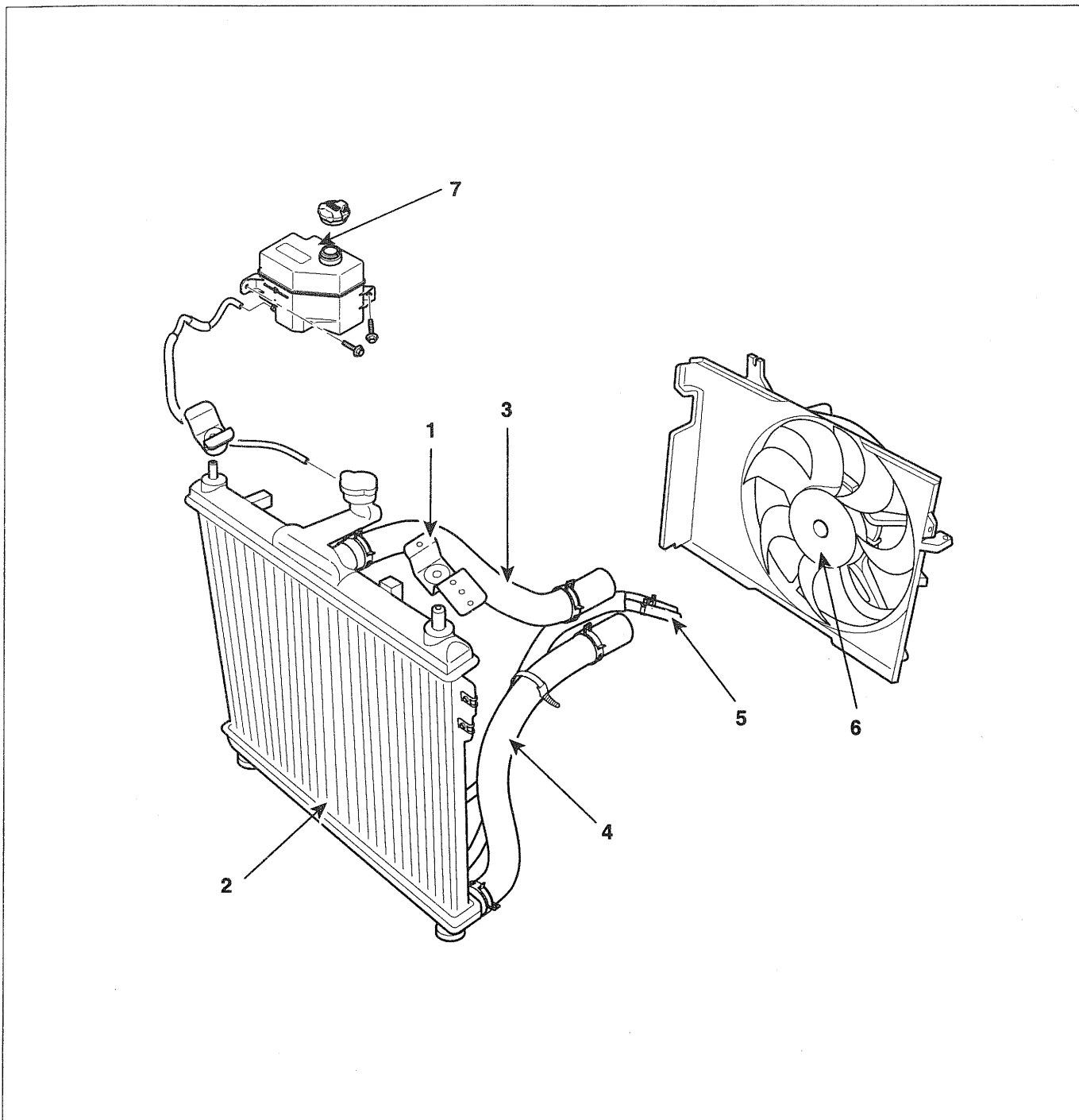
Tightening torque :

68.6 ~ 78.5N.m (7.0 ~ 8.0kgf.m, 50.6 ~ 57.9lb-ft)

---

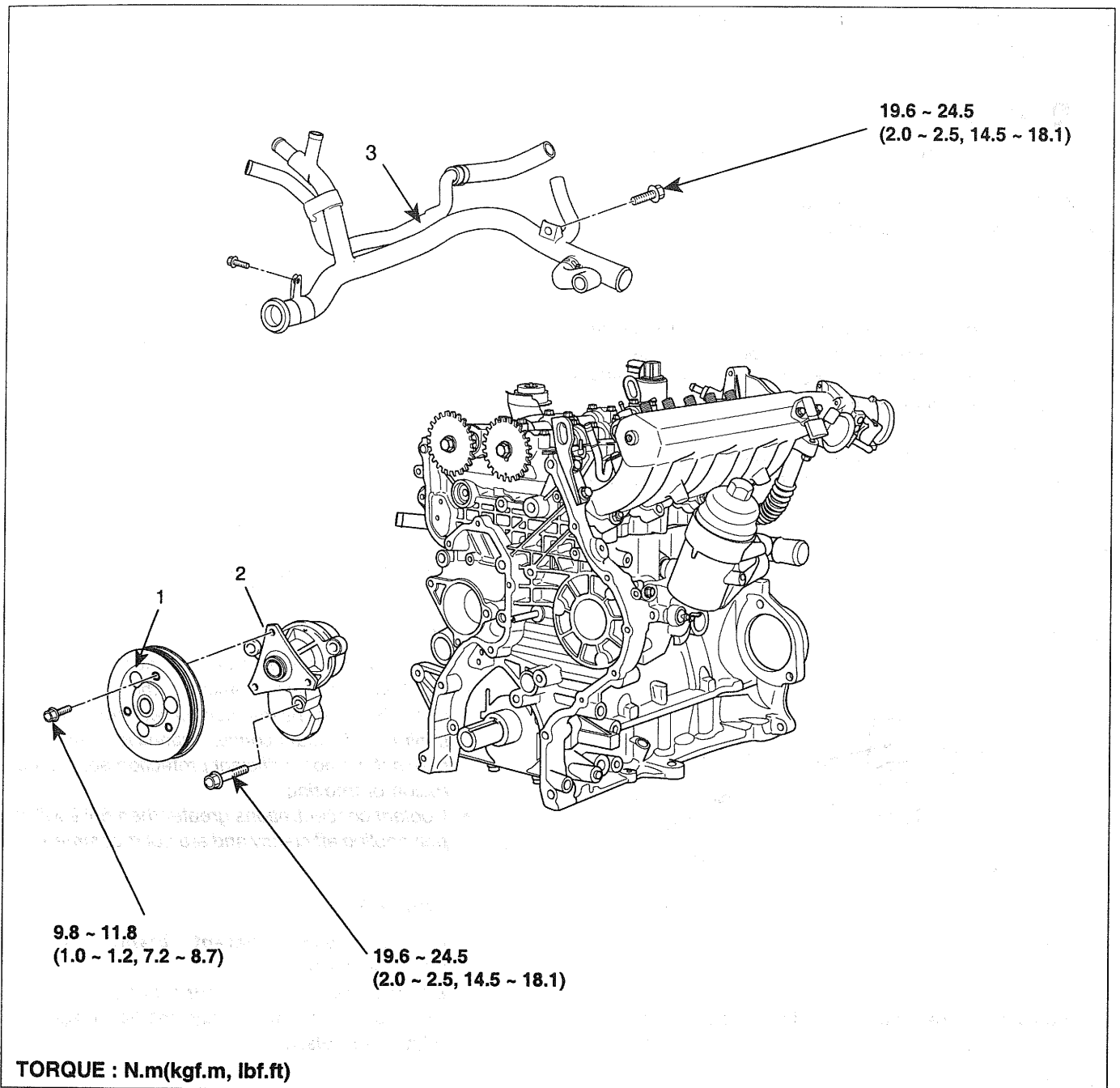
# COOLING SYSTEM

COMPONENT E5292B02



- 1. Radiator mounting bracket
- 2. Radiator
- 3. Radiator upper hose
- 4. Radiator lower hose

- 5. ATF oil cooler hose
- 6. cooling fan assembly
- 7. coolant reservoir tank



- 1. Water pump pulley
- 2. Water pump

- 3. Water pipe

## ENGINE COOLANT REFILLING AND BLEEDING

E95CC35E

### ⊗ WARNING

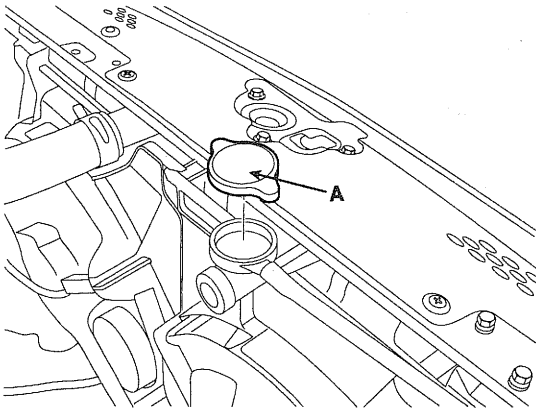
Never remove the radiator cap when the engine is hot.

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

### ⚠ CAUTION

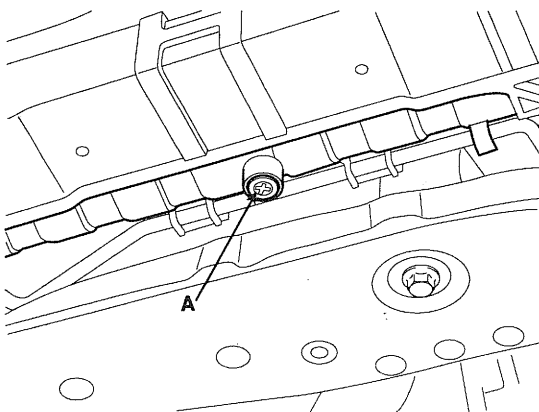
When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts of the paint. If any coolant spills, rinse it off immediately.

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



ACJF034A

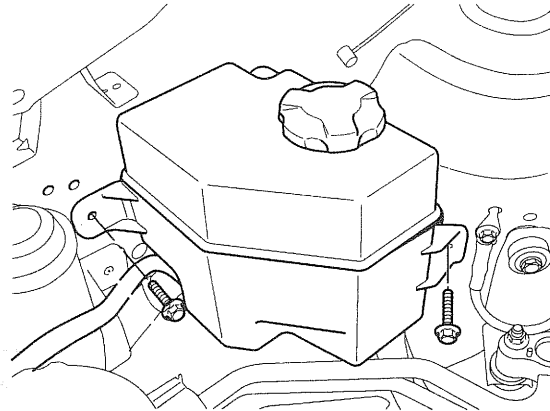
- Loosen the drain plug(A), and drain the coolant.



ACJF036A

- Tighten the radiator drain plug(A) securely.

- Remove the coolant reservoir tank. Drain the coolant and reinstall the coolant reservoir tank. Fill the coolant reservoir tank to the MAX mark with the coolant.



ACJF037A

- Fill fluid mixture with coolant and water slowly through the radiator cap. Gently squeeze the upper/ lower hoses of the radiator so as to bleed air easily.

### 📖 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 of 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.

- Start the engine and allow coolant to circulate. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
- Repeat 7 until the cooling fan 3 ~ 5 times and bleed air sufficiently out of the cooling system.
- Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
- Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
- Stop the engine and allow coolant to cool.
- Repeat step 6 to 11 until the coolant level stays constant and all air is bled out of the cooling system.



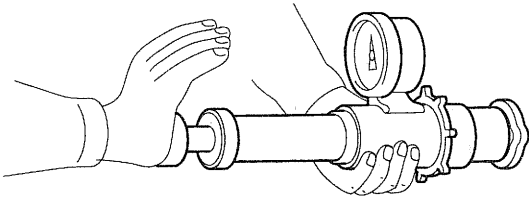
 **NOTE**

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

Coolant capacity : 5.3 ~ 5.51 liters(5.60 ~ 5.81 US qt, 4.66 ~ 4.84 Imp qt)

**RADIATOR CAP TESTING**

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

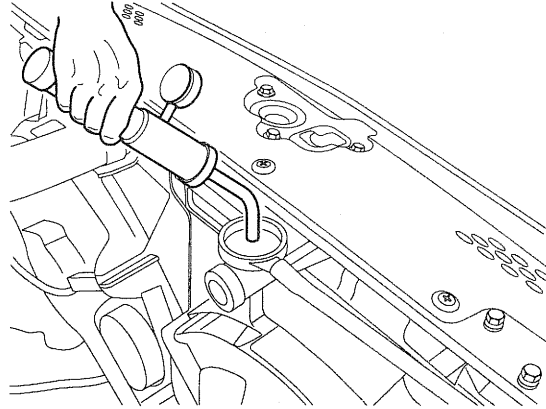


ECKD501X

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

**RADIATOR LEAKGE TEST**

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



ACJF035A

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.

## REMOVAL EA7C85D9

## WATER PUMP

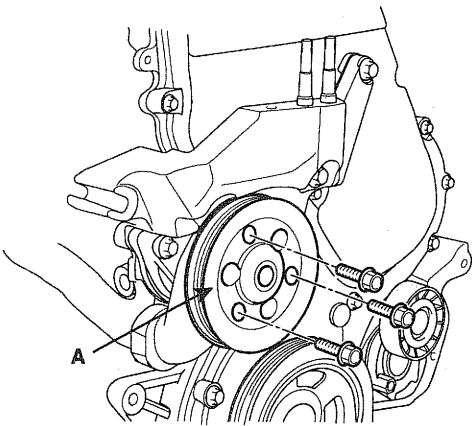
1. Drain the engine coolant.

**⊗ WARNING**

System is under high pressure when the engine is hot.

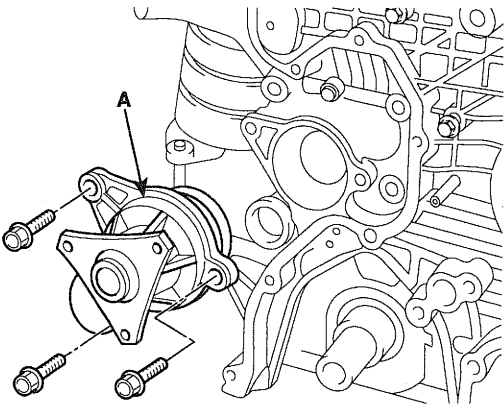
To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

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



LCGF006A

4. Remove the water pump(A).



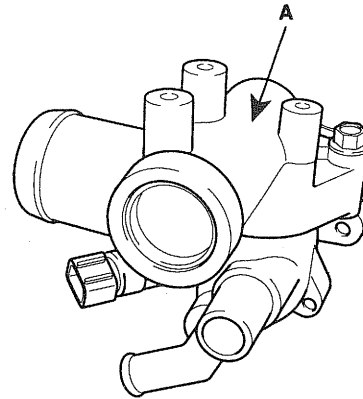
LCGF026A

## THERMOSTAT

**📖 NOTE**

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

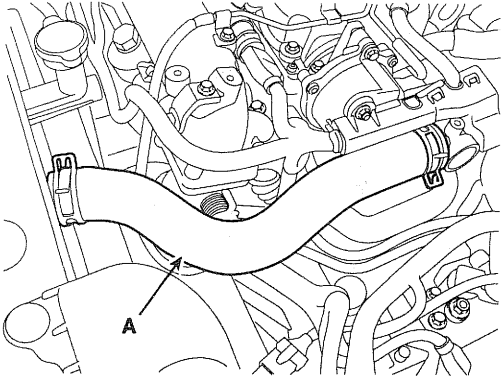
1. Drain the engine coolant so its level is below thermostat.
2. Remove the water outlet fitting(A), gasket and thermostat.



ADJF048A

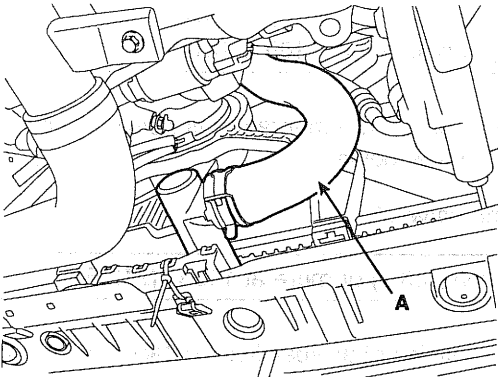
**RADIATOR**

1. Drain the engine coolant.  
Remove the radiator cap to speed draining.
2. Remove the upper radiator hose(A).



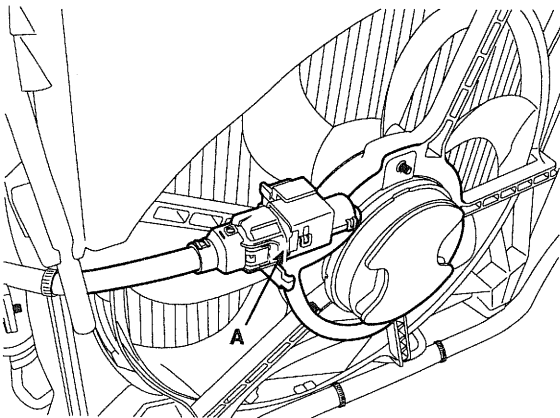
KDPF005A

3. Remove the lower radiator hose(A).



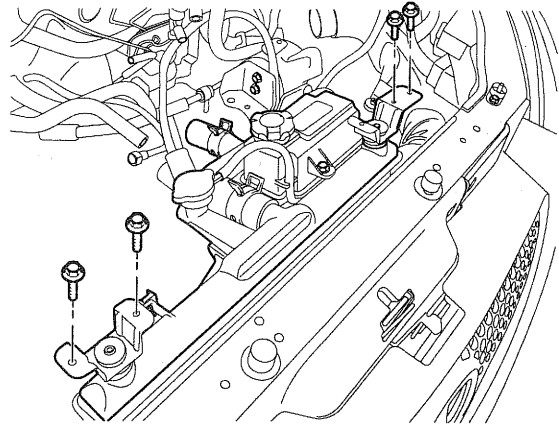
KDPF008A

4. Disconnect the fan motor connector(A).



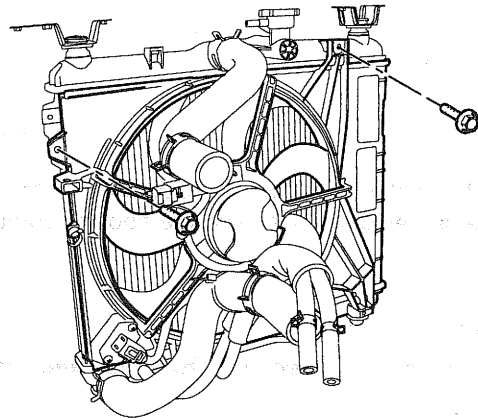
KCPF014A

5. Remove the radiator upper bracket, then pull up the radiator.



KCPF015A

6. Remove the cooling fan assembly (A).



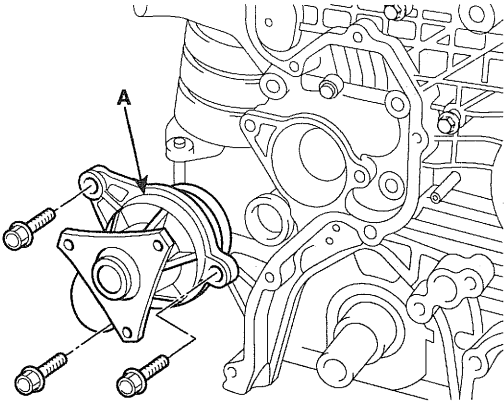
KCPF017A

## INSPECTION

EBB47DC5

## WATER PUMP

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.



LCGF026A

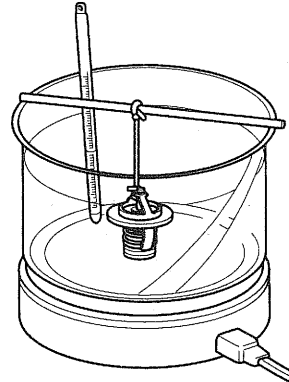
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

**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 :  $85 \pm 1.5^\circ\text{C}$  ( $185.0 \pm 2.7^\circ\text{F}$ )  
 (Measurement lift : 0.35mm(0.0138in))  
 Full opening temperature :  $100^\circ\text{C}$  ( $212^\circ\text{F}$ )

---

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

3. Check the valve lift.

---

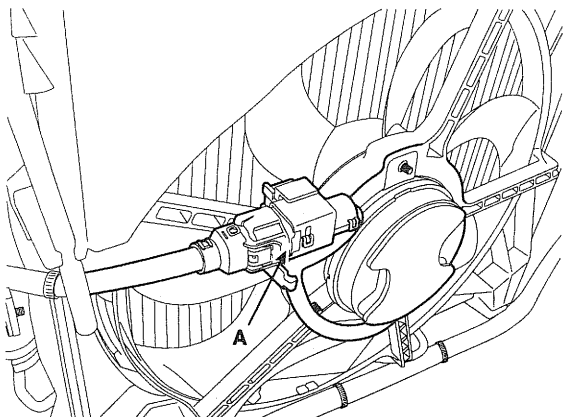
Valve lift : 8mm(0.3in) or more at  $100^\circ\text{C}$  ( $212^\circ\text{F}$ )

---

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

## COOLING FAN

1. Disconnect the cooling fan motor connector.



KCPF014A

2. Check if motor speed is low when power and ground are connected to the NO.1 and NO.3 terminals.
3. Check if motor speed is high when power and ground are connected to the NO.2 and NO.3 terminals.

## INSTALLATION

ED8B41E1

## WATER PUMP

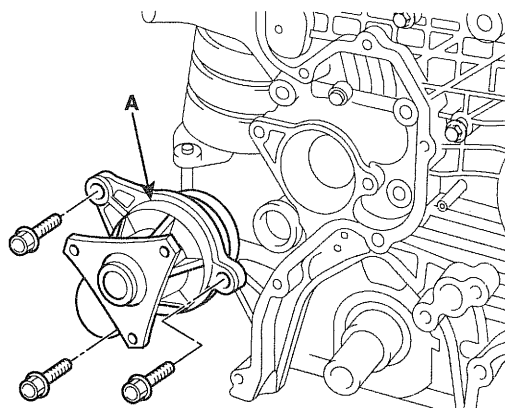
1. Install the water pump(A) and a new gasket.

Tightening torque :

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

**CAUTION**

*Apply coolant to the O-ring before installing the water pump.*

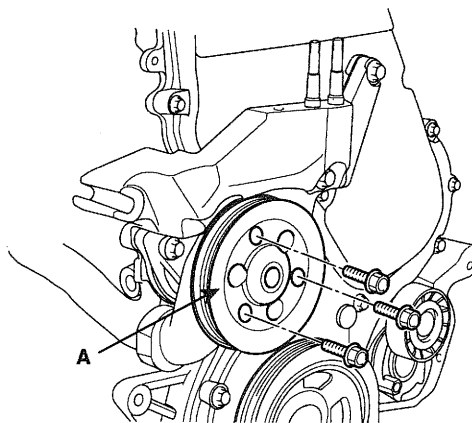


LCGF026A

2. Install the water pump pulley(A).

Tightening torque :

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



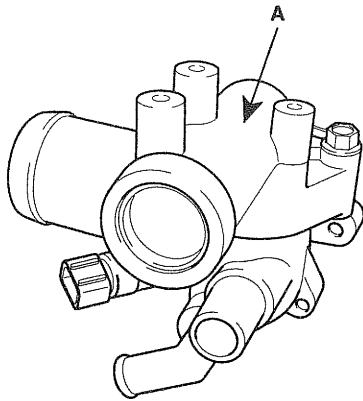
LCGF006A

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

## THERMOSTAT

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

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



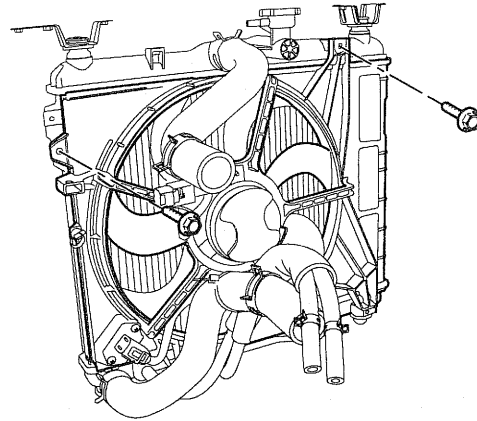
ADJF048A

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

## RADIATOR

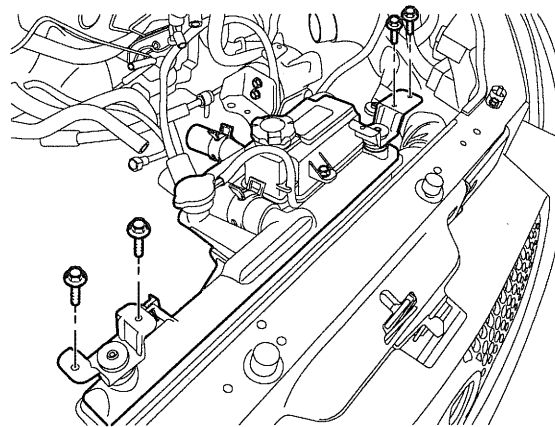
1. Install the cooling fan assembly (A).

Tightening torque :  
6.9 ~ 10.8N.m (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



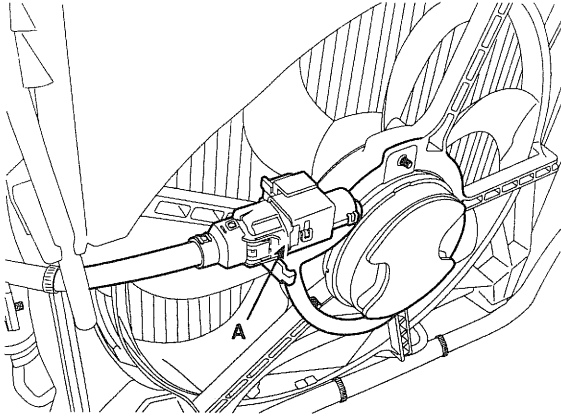
KCPF017A

2. Install the radiator.
3. Install the radiator upper bracket.



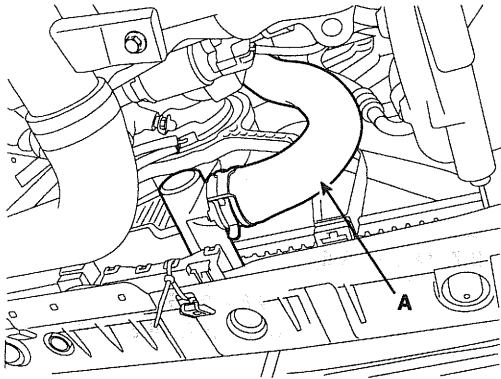
KCPF015A

4. Connect the fan motor connector( A).



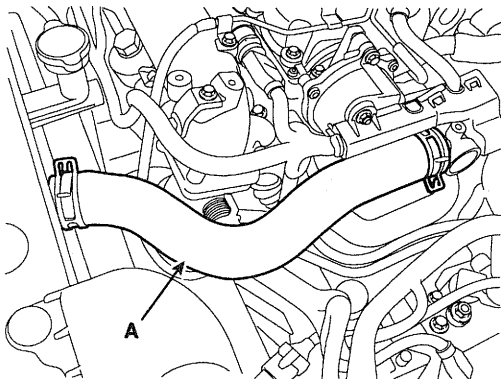
KCPF014A

5. Install the lower radiator hose(A).



KDPF008A

6. Install the upper radiator hose(A).

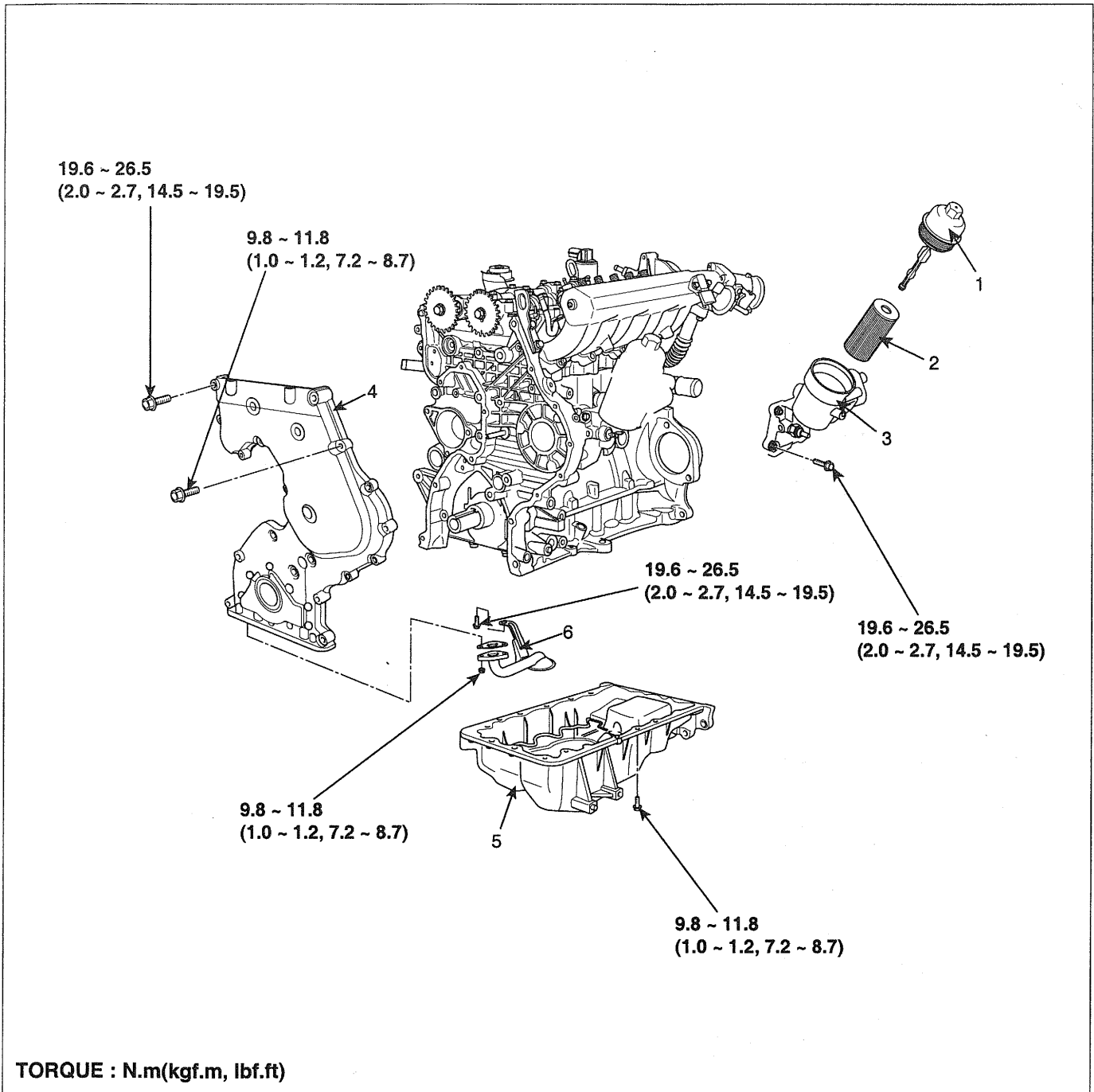


KDPF005A

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

# LUBRICATION SYSTEM

COMPONENT E206D0D5



- 1. Oil filter cap
- 2. Oil filter
- 3. Oil filter housing & oil cooler assembly

- 4. Timing chain cover
- 5. Oil pan
- 6. Oil strainer



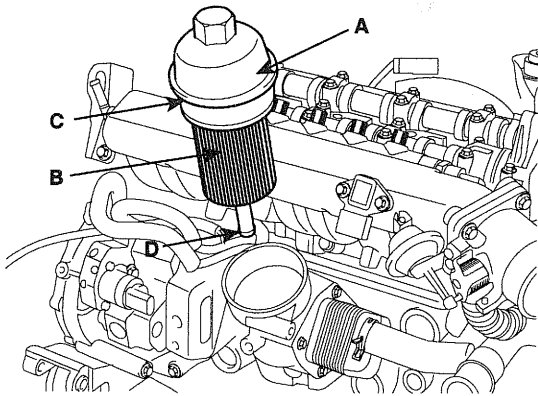
## OIL AND FILTER REPLACEMENT

EF3CA4CE

**⚠ CAUTION**

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

1. Drain the engine oil.
  - 1) Remove the oil filler cap.
  - 2) Loosen the oil filter cap until O-ring(C) appears. Be careful for oil not to overflow.
  - 3) Remove the oil drain plug, and drain the oil into a container.
2. Replace the oil filter(B).
  - 1) Remove the oil filter upper cap(A).



ACGF035A

- 2) Replace the O-ring(C,D) of oil filter cap with a new one. Inspect the threads and O-ring(C,D). Wipe off the seat on the oil filter cap, then apply a light coat of oil to the oil filter upper cap O-ring(C,D).
- 3) Install the new oil filter by hand to the upper cap.

- 4) After the rubber seal seats, tighten the oil filter clockwise.

---

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

---

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

---

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

---

- 2) Fill with fresh engine oil.

---

Oil Capacity  
Total : 5.3 L (5.60 US qt, 4.66 Imp qt)  
Oil pan : 4.8 L (5.07 US qt, 4.22 Imp qt)  
Oil filter : 0.5 L (0.53 US qt, 0.44 Imp qt)

---

**⚠ CAUTION**

**When filling engine oil, fill half of full capacity and do the remainings in 10 minutes.**

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

**INSPECTION**

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

**📖 NOTE**

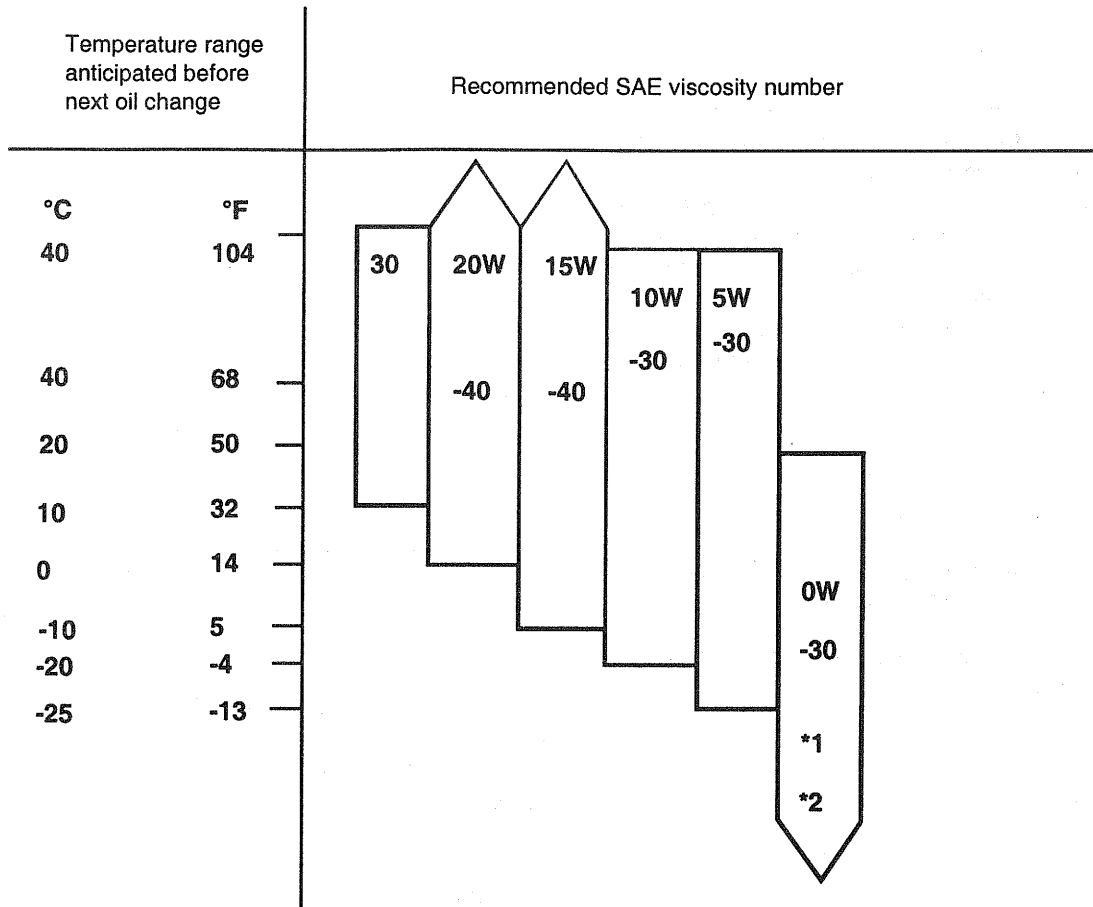
**Do not fill with engine oil above the " F " mark.**

**SELECTION OF ENGINE OIL**

Recommended API classification : CH-4 OR ABOVE

Recommended ACEA classification : B4 OR ABOVE

Recommended SAE viscosity grades :



**\*1 Restricted by driving condition and environment.  
Not recommended for sustained high speed vehicle operation**

LDJF007A

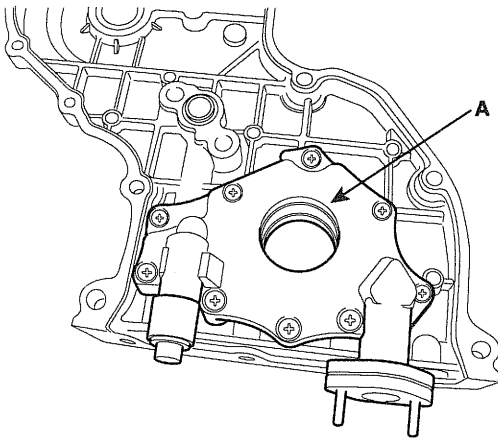
**NOTE**

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

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

**REMOVAL** E706E185**OIL PUMP**

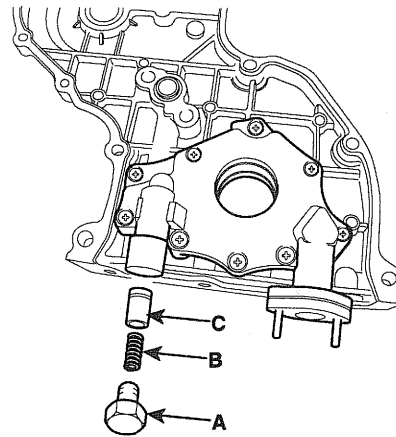
1. Drain the engine oil.
2. Remove the drive belts.
3. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing chain cover.
4. Remove the Oil pan
5. Remove the timing chain cover. (Refer to EMA-18~22, step1~24)
6. Remove the oil pump cover(A) from the timing chain cover.



LCGF115A

**DISASSEMBLY** E44C949E**RELIEF PLUNGER**

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



ACGF116A

7. Remove the inner rotor and outer rotor.

**INSPECTION** E1596F2A

1. Inspect the relief plunger.  
Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight.  
If it does not, replace the relief plunger. If necessary, replace the front case.
2. Inspect the rotor side clearance.  
Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

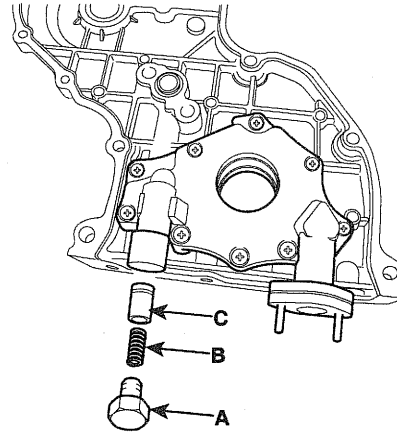
Side clearance	Outer rotor	0.04 ~ 0.09mm (0.0016 ~ 0.0035in)
	Inner rotor	0.04 ~ 0.085mm (0.0016 ~ 0.0033in)

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

**REASSEMBLY** E7FFCFF4**RELIEF PLUNGER**

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

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



ACGF116A

## INSTALLATION E465BA84

## OIL PUMP

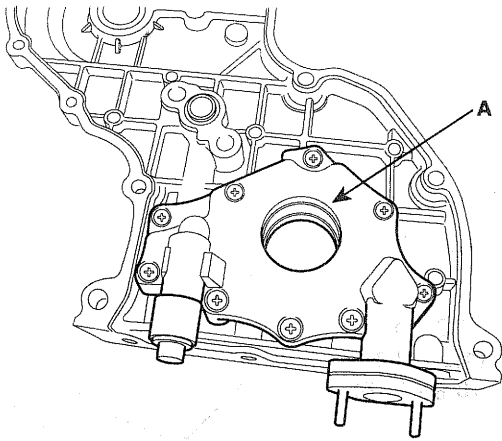
1. Install the oil pump.
  - 1) Place the inner and outer rotors into front case with the marks facing the oil pump cover side.
  - 2) Install the oil pump cover(A) to timing chain cover with the screws.

---

Tightening torque :

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

---



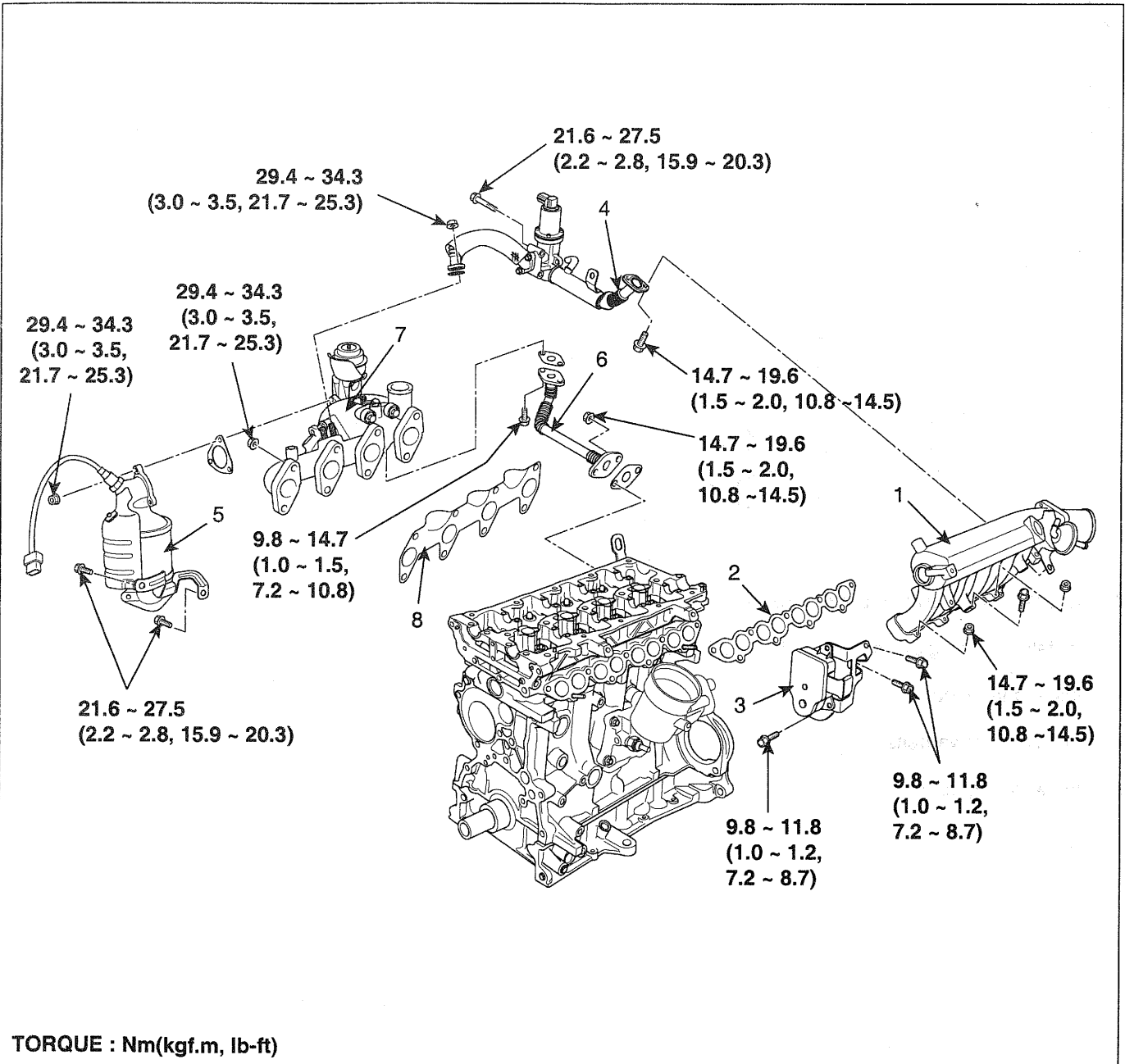
LCGF115A

2. Check that the oil pump turns freely.
3. Install the timing chain cover. (Refer to EMA-29~33)
4. Install the oil pan.
5. Install the drive belts.
6. Fill with engine oil.

# INTAKE AND EXHAUST SYSTEM

## INTAKE AND EXHAUST MANIFOLD E57F3CD0

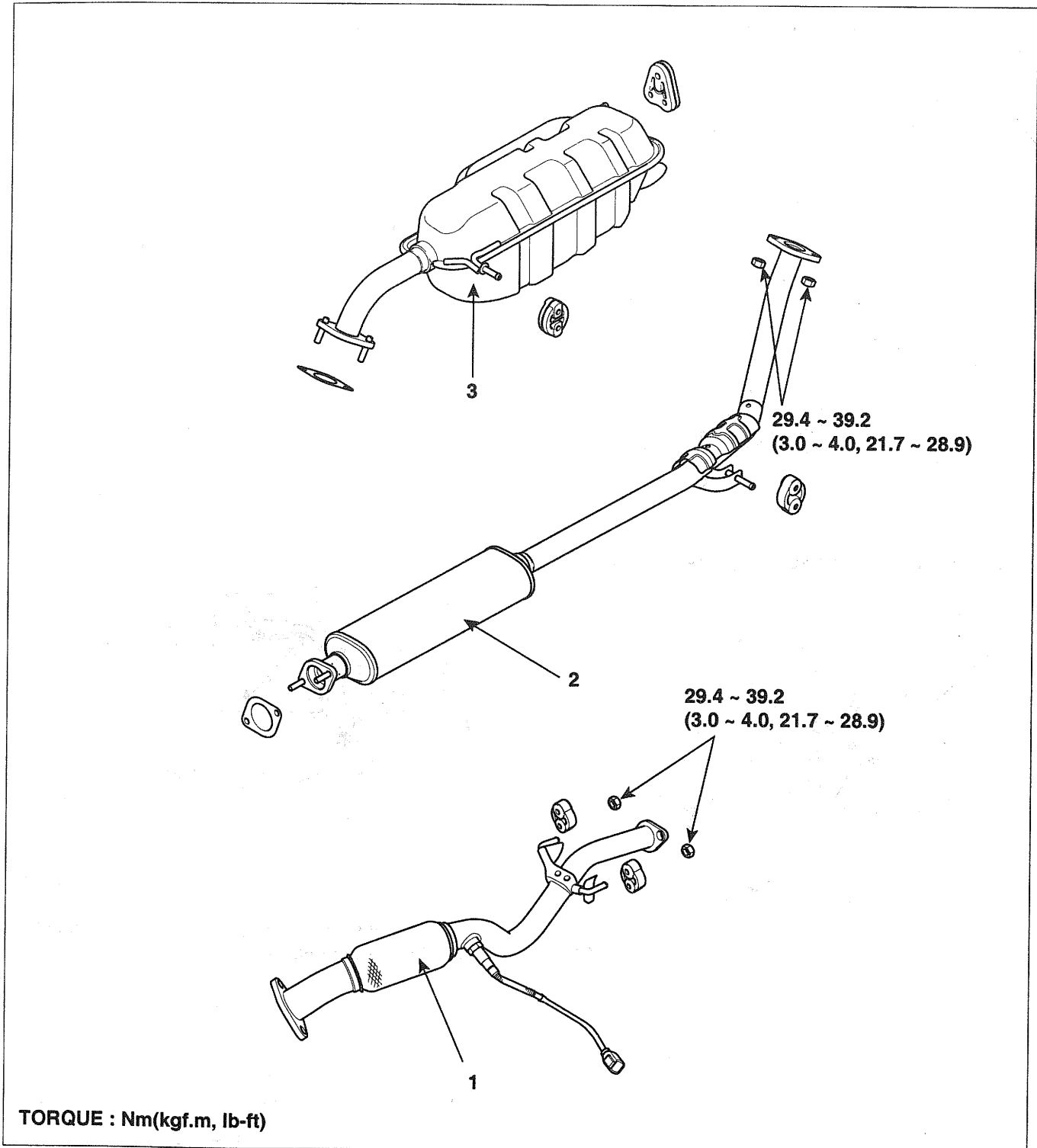
### COMPONENT



- |                              |  |
|------------------------------|--|
| 1. Intake manifold           | 5. Catalytic converter assembly              |
| 2. Intake manifold gasket    | 6. Turbo charger oil return pipe             |
| 3. Swirl valve actuator      | 7. Turbo charger & exhaust manifold assembly |
| 4. EGR valve & pipe assembly | 8. Exhaust manifold gasket                   |

EXHAUST PIPE

COMPONENT



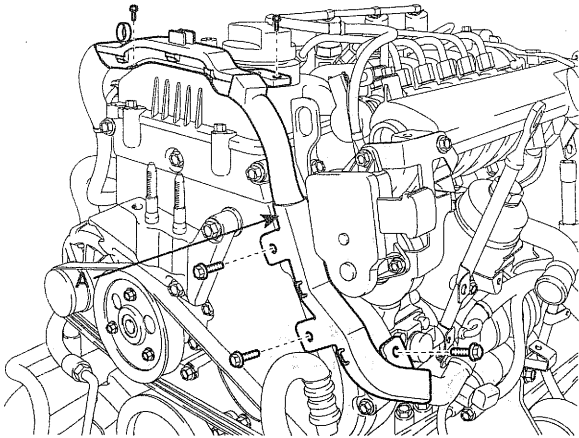
- 1. Front muffler
- 2. Center muffler

3. Main muffler

**REMOVAL** E7366CB8**INTAKE MANIFOLD**

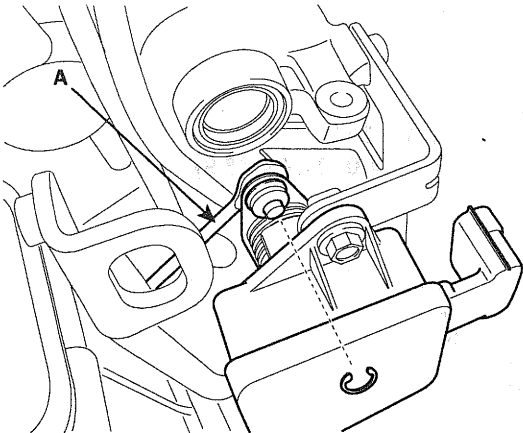
1. Remove the engine harness protector(A) mounting bolts.

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



ADJF031A

2. Remove the swirl valve actuator rod(A).



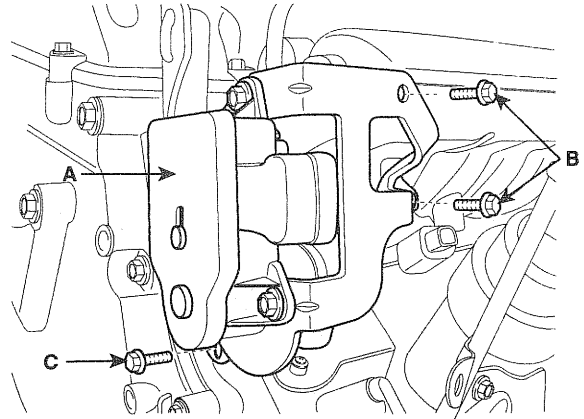
ADJF032A

3. Remove the swirl valve actuator(A).

Tightening torque :

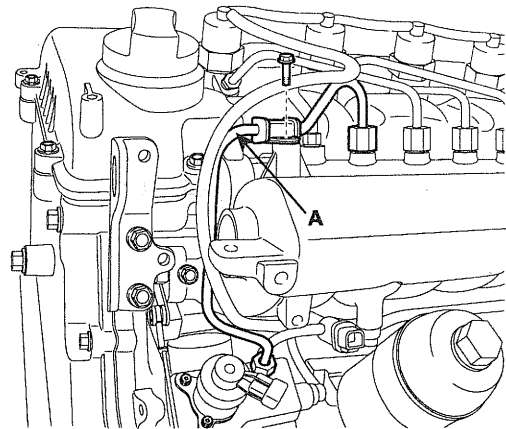
Bolt(B) : 9.8 ~ 11.8 Nm (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Bolt(C) : 6.9 ~ 10.8 Nm (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



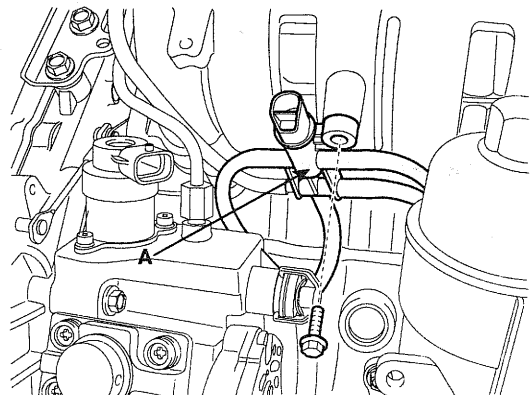
ADJF033A

4. Remove the high pressure pipe(A). (Refer th FLB Gr.)



ADJF034A

5. Remove the fuel temperature sensor mounting bolt(A). (Refer th FLB Gr.)

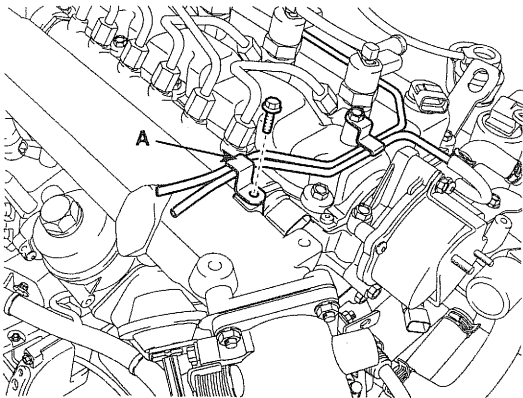


ADJF035A



6. Remove the vacuum pipe(A) mounting bolt.

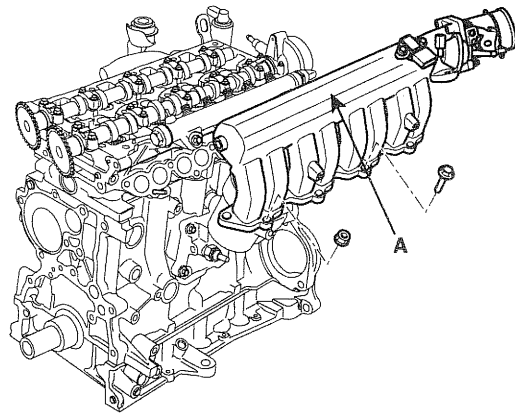
Tightening torque :  
6.9 ~ 10.8 Nm (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



ADJF036A

8. Remove the intake manifold(A).

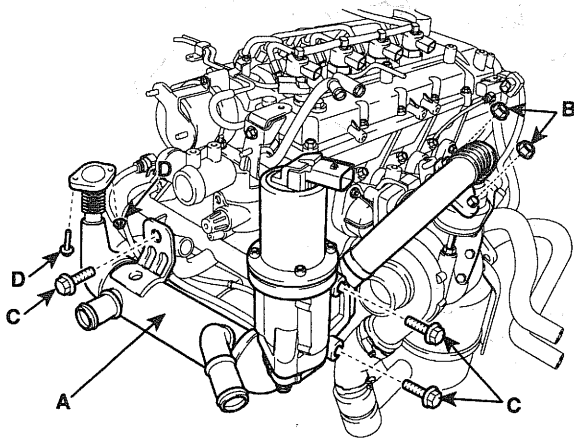
Tightening torque :  
14.7 ~ 19.6 Nm (1.5 ~ 2.0 kgf.m, 10.8 ~ 14.5 lb-ft)



LCGF032A

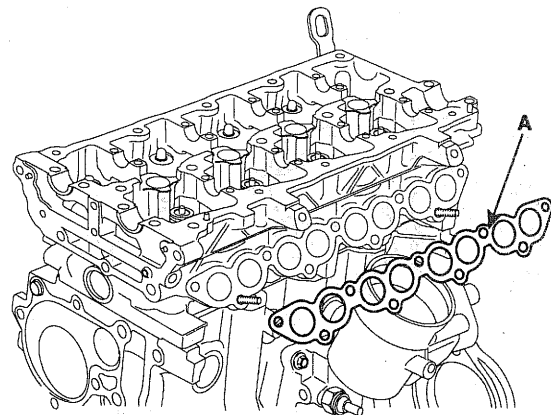
7. Remove the EGR cooler and EGR valve assembly(A).

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



ADJF053A

9. Remove the intake manifold gasket(A).



LCGF033A

10. Installation is in the reverse order of removal.

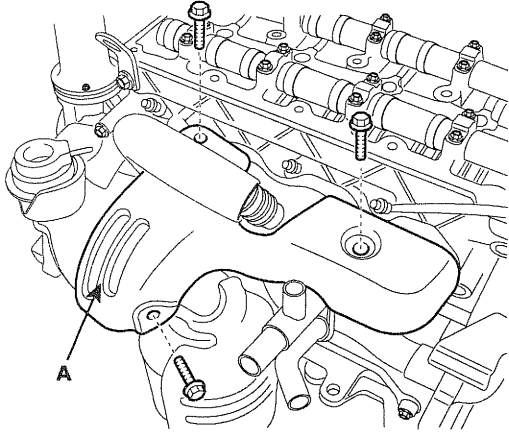
**EXHAUST MANIFOLD**

1. Remove the heat protector(A).

---

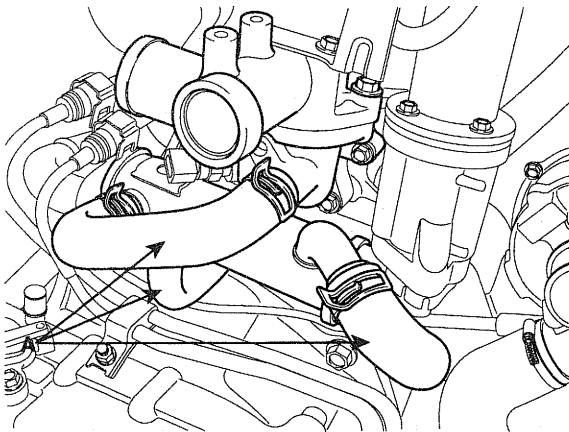
Tightening torque :  
 14.7 ~ 19.6 Nm (1.5 ~ 2.0 kgf.m, 10.8 ~ 14.5 lb-ft)

---



LCGF117A

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



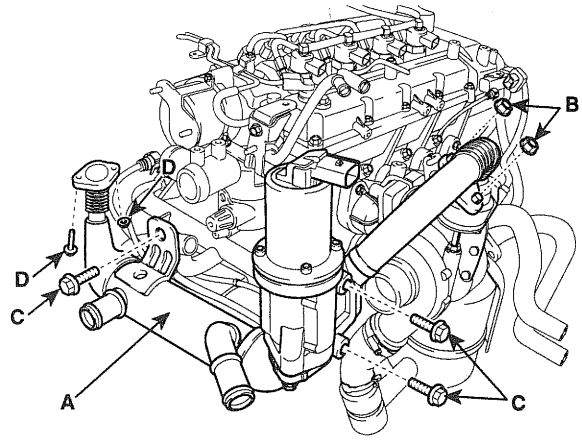
ADJF038A

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

---

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

---



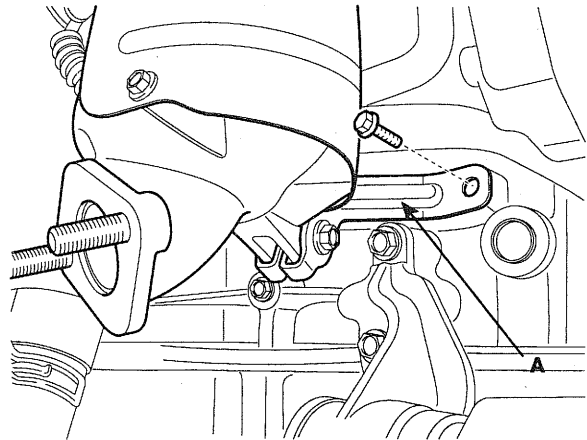
ADJF053A

4. Remove the catalytic converter stay(A).

---

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

---



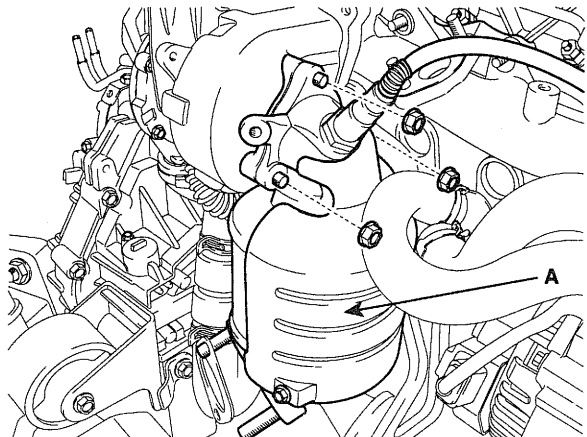
ADJF040A

5. Remove the catalytic converter(A).

---

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

---



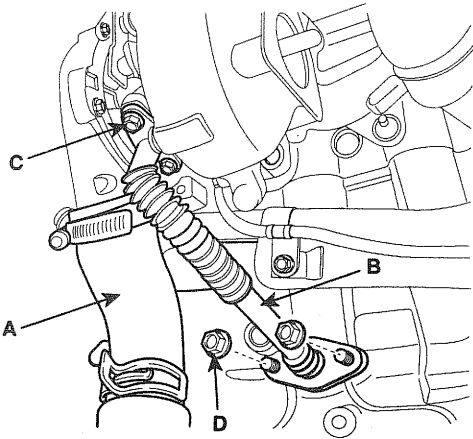
ADJF041A

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

Tightening torque :

Nut(C) : 9.8 ~ 14.7 Nm (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)

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

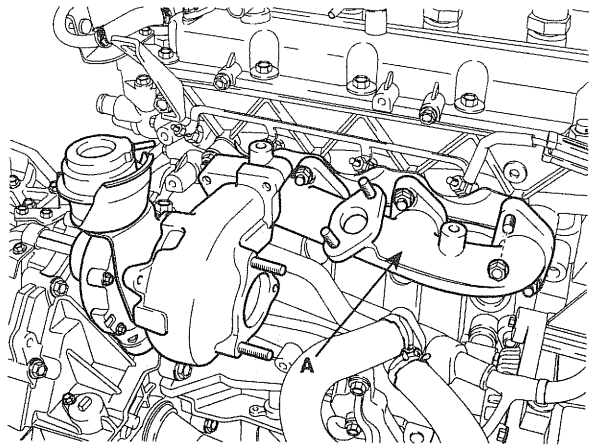


ADJF051A

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

Tightening torque :

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

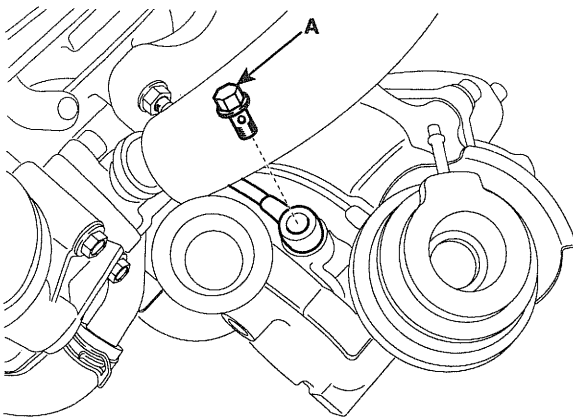


ADJF043A

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

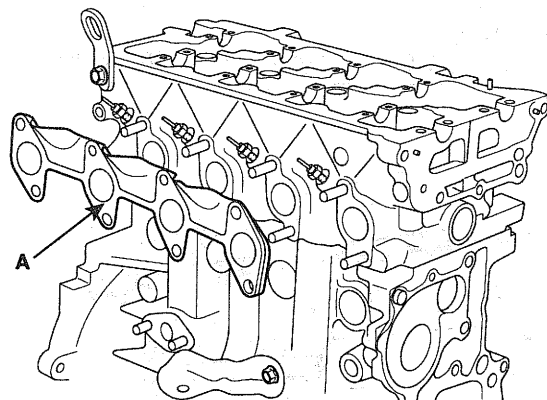
Tightening torque :

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



LCGF118A

9. Remove the exhaust manifold gasket(A) .



LCGF037A

10. Installation is in the reverse order of removal.

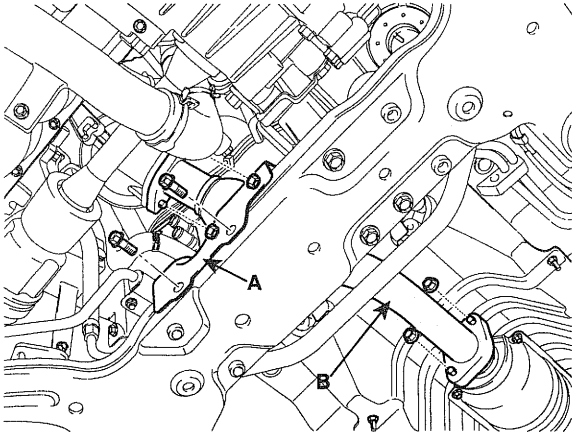
## EXHAUST PIPE

1. Remove the front muffler(B).

---

Tightening torque :  
29.4 ~ 39.2 Nm (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)

---



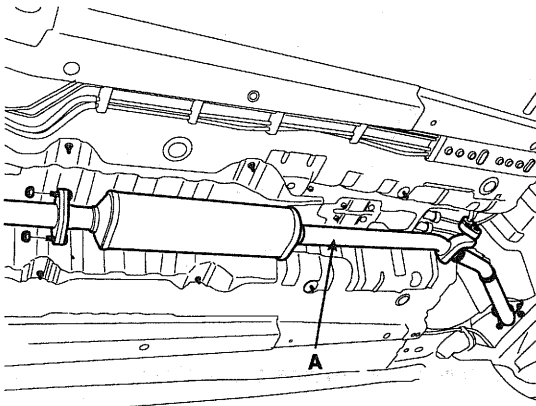
ADJF026A

2. Remove the center muffler(A).

---

Tightening torque :  
29.4 ~ 39.2 Nm (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)

---



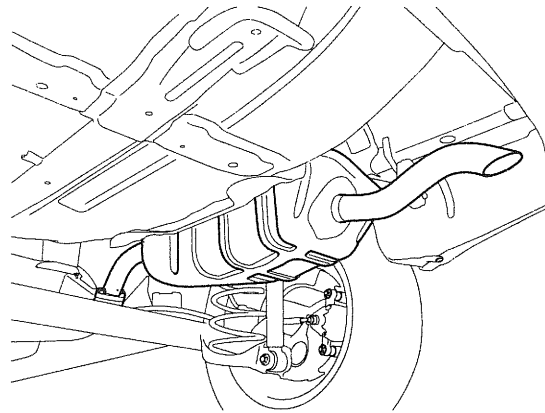
ACJF050A

3. Remove the main muffler(A).

---

Tightening torque :  
29.4 ~ 39.2 Nm (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)

---



ACJF054A

4. Installation is in the reverse order of removal.