

Engine Mechanical System

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GENERAL

SPECIFICATIONS (D4CB) LCAC0100

DESCRIPTION	SPECIFICATION (D4CB)	LIMIT
General		
Type	In-line, DOHC	
Number of cylinders	4	
Bore	91 mm (3.58 in)	
Stroke	96 mm (3.78 in)	
Total displacement	2497 cc (121.5 cu.in)	
Compression ratio	17.7 : 1	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Opens (BTDC)	8°	
Closes (ABDC)	38°	
Exhaust valve		
Opens (BBDC)	52°	
Closes (ATDC)	8°	
Cylinder head		
Flatness of gasket surface	0.15 mm (0.0059 in)	
Camshaft		
Cam height (LH)		
Intake	40.163 mm (1.5812 in)	
Exhaust	40.043 mm (1.5765 in)	
Cam height (RH)		
Intake	39.782 mm (1.5662 in)	
Exhaust	40.456 mm (1.5928 in)	
Journal outer Diameter	29.964 - 29.980 mm (1.1797 - 1.1803 in)	
End play	0.10 - 0.20 mm (0.0039 - 0.0079 in)	
Valve		
Valve length		
Intake	110.55 mm (4.352 in)	
Exhaust	110.55 mm (4.352 in)	
Stem outer diameter		
Intake	6.965 - 6.980 mm (0.2742 - 0.2748 in)	
Exhaust	6.935 - 6.950 mm (0.2730 - 0.2736 in)	
Face angle	45°	
Thickness of valve head (margin)		

GENERAL
EM -3

DESCRIPTION	SPECIFICATION (D4CB)	LIMIT
Intake	1.8 - 2.0 mm (0.071 - 0.079 in)	
Exhaust	1.8 - 2.0 mm (0.071 - 0.079 in)	
Valve stem to valve guide clearance		
Intake	0.020 - 0.050 mm (0.0008 - 0.0020 in)	0.1mm (0.0039in)
Exhaust	0.050 - 0.080 mm (0.0020 - 0.0031 in)	0.15mm (0.0059in)
Valve guide		
Length		
Intake	43.3 mm (1.705 in)	
Exhaust	39.4 mm (1.551 in)	
Valve seat		
Width of seat contact		
Intake	1.5 mm (0.059 in)	
Exhaust	1.7 mm (0.067 in)	
Seat angle		
Intake	45°	
Exhaust	45°	
Valve spring		
Free length	48.2 mm (1.898 in)	
Load	258 $\pm \frac{3}{4}$ 12 N/38 mm (26.3 $\pm$ 1.2 kg/38 mm, 569 $\pm \frac{3}{4}$ 26 lb/1.496 in) 505.5 $\pm \frac{3}{4}$ 24 N/28.8 mm (51.5 $\pm$ 2.4 kg /28.8 mm, 1114.4 $\pm \frac{3}{4}$ 53 lb/1.134 in)	
Cylinder block		
Cylinder bore	91.000 - 91.030 mm (3.5827 - 3.5839 in)	
Flatness of gasket surface	0.05 mm (0.0020 in)	
Piston		
Piston outer diameter	90.910 - 90.940 mm (3.5791 - 3.5803 in)	
Piston to cylinder clearance	0.080 - 0.100 mm (0.0031 - 0.0039 in)	
Ring groove width		
No. 1 ring groove	2.378 - 2.398 mm (0.0936 - 0.0944 in)	
No. 2 ring groove	2.04 - 2.06 mm (0.0803 - 0.0811 in)	
Oil ring groove	3.03 - 3.05 mm (0.1193 - 0.1201 in)	

EM -4
ENGINE MECHANICAL SYSTEM

DESCRIPTION	SPECIFICATION (D4CB)	LIMIT
Piston ring Side clearance No. 2 ring Oil ring End gap No. 1 ring No. 2 ring Oil ring	 0.05 - 0.09 mm (0.0020 - 0.0035 in) 0.04 - 0.08 mm (0.0016 - 0.0031 in) 0.25 - 0.40 mm (0.0098 - 0.0157 in) 0.50 - 0.70 mm (0.0197 - 0.0276 in) 0.20 - 0.40 mm (0.0079 - 0.0157 in)	
Piston pin Piston pin outer diameter Piston pin hole inner diameter Piston pin hole clearance Connecting rod small end hole inner diameter Connecting rod small end hole clearance	 32.993 - 32.998 mm (1.2989 - 1.2991 in) 33.000 - 33.005 mm (1.2992 - 1.2994 in) 0.002 - 0.012 mm (0.0001 - 0.0005 in) 33.020 - 33.033 mm (1.3000 - 1.3005 in) 0.022 - 0.040 mm (0.0009 - 0.0016 in)	
Connecting rod Connecting rod big end inner diameter Connecting rod bearing oil clearance	 60.000 - 60.018 mm (2.3622 - 2.3629 in) 0.024 - 0.042 mm (0.0009 - 0.0016 in)	 0.1mm(0.0039in)
Crankshaft Main journal outer diameter Pin journal outer diameter Main bearing oil clearance End play	 66.982 - 67.000 mm (2.6371 - 2.6378 in) 56.982 - 57.000 mm (2.2434 - 2.2441 in) 0.024 - 0.042 mm (0.0009 - 0.0016 in) 0.05 - 0.25 mm (0.0020 - 0.0098 in)	 0.1mm(0.0039in)
Flywheel Runout		 0.13mm(0.0051in)
Oil pump Side clearance Inner rotor Outer rotor Body clearance Relief valve opening pressure	 0.040 - 0.085 mm (0.0016 - 0.0033 in) 0.050 - 0.100 mm (0.0020 - 0.0039 in) 0.100 - 0.176 mm (0.0039 - 0.0069 in) 784.5 $\pm \frac{3}{4}$ 78.4 Kpa (8 $\pm \frac{3}{4}$ 0.8 kg/cm ² , 113.8 $\pm \frac{3}{4}$ 11.3 psi)	
Balance shaft Front journal outer diameter Rear journal outer diameter Front bush inner diameter Rear bush inner diameter Fornt bush oil clearance Rear bush oil clearance	 48.975 - 49.000 mm (1.9281 - 1.9291 in) 47.965 - 47.990 mm (1.8884 - 1.8894 in) 49.050 - 49.080 mm (1.9311 - 1.9323 in) 48.050 - 48.080 mm (1.8917 - 1.8929 in) 0.050 - 0.105 mm (0.0020 - 0.0041 in) 0.060 - 0.115 mm (0.0024 - 0.0045 in)	

GENERAL
EM -5

DESCRIPTION	SPECIFICATION (D4CB)	LIMIT
Engine oil		
Oil quantity (Total)	8.2 L	
Oil quantity (Oil pan)	7.4 L	
Oil quality	Above CE	
Cooling method		
Cooling system	Forced circulation with cooling fan	
Coolant quantity	10L	
Thermostat		
Type	Wax pellet type	
Opening temperature	82°C (180°F)	
Closing temperature	77°C (171°F)	
Pull opening temperature	95°C (203°F)	
Radiator cap		
Main valve opening pressure	107.9 $\pm$ 14.7 Kpa (1.1 $\pm$ 0.15 kg/cm ² , 15.6 $\pm$ 2.1 psi)	
Main valve closing pressure	83.4 Kpa (0.85 kg/cm ² , 12.1 psi)	
Vaccum valve opening pressure	-6.86 Kpa (-0.07 kg/cm ² , -1.00 psi)	
Water temperature sensor		
Type	Thermister type	
Resistance		
20°C (68°F)	2.45 $\pm$ 0.14 k Ω	
80°C (176°F)	0.3222 k Ω	

EM -6
ENGINE MECHANICAL SYSTEM
TIGHTENING TORQUE

LCAC0200

* Bolt size = Diameter x Length

ITEM	Quantity	Tightening torque		
		N-m	Kg-m	lb-ft
Main bearing cap bolt	10	127.5 - 137.3	13 - 14	94.0 - 101.3
Connecting rod cap nut	8	58.8 - 0 + 34.3 + 60 ~ 64°	6.0 - 0 + 3.5 + 60 ~ 64°	43.4 - 0 + 25.3 + 60 ~ 64°
Oil jet bolt	4	29.4 - 34.3	3.0 - 3.5	21.7 - 25.3
Crank shaft pulley bolt	1	274.6 - 294.2	28 - 30	202.5 - 217.0
Rear oil seal case bolt	5	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Rear plate bolt	2	7.8 - 9.8	0.8 - 1.0	5.8 - 7.2
Flywheel bolt	8	127.5 - 137.3	13 - 14	94.0 - 101.3
Water pump bolt (8 x 30)	5	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Water pump bolt (8 x 45)	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Oil cooler fixing nut	4	17.7 - 24.5	1.8 - 2.5	13.0 - 18.1
Oil cooler cover bolt (8 x 35)	8	19.6 - 25.5	2.0 - 2.6	14.5 - 18.8
Oil cooler cover bolt (8 x 60)	3	19.6 - 25.5	2.0 - 2.6	14.5 - 18.8
Oil pump bolt (8 x 22)	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Oil pump bolt (10 x 35)	1	42.2 - 53.9	4.3 - 5.5	31.1 - 39.8
Oil pump bolt (10 x 60)	1	42.2 - 53.9	4.3 - 5.5	31.1 - 39.8
Oil screen bolt	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Oil feed pipe bolt	3	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Oil filter assembly	1	21.6 - 24.5	2.2 - 2.5	15.9 - 18.1
Oil pan bolt	22	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Oil level gauge bolt	1	11.8 - 14.7	1.2 - 1.5	8.7 - 10.8
Bed plate bolt (6 x 18)	3	7.8 - 11.8	0.8 - 1.2	5.8 - 8.7
Bed plate bolt (6 x 30)	13	7.8 - 11.8	0.8 - 1.2	5.8 - 8.7
Bed plate bolt (8 x 45)	8	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Bell housing cover bolt	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
Cylinder head cover bolt	16	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Camshaft cap bolt	20	13.7 - 14.7	1.4 - 1.6	10.1 - 10.8
Cylinder head bolt	18	49.0+120°+90°	5.0 + 120°+90°	36.2+120°+90°
TDC sensor bolt	1	6.9-10.8	0.7-1.1	5.1-8.0
Water temperature sensor	1	29.4 - 39.2	3.0 - 4.0	21.7 - 28.9
Glow plug	4	14.7 - 19.6	1.5 - 2.0	10.8 - 14.5
Glow plug plate nut	4	0.8 - 1.5	0.08 - 0.15	0.6 - 1.1
Engine hanger bolt	4	18.6 - 28.4	1.9 - 2.9	13.7 - 21.0
Thermostat housing bolt	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5

GENERAL

EM -7

ITEM	Quantity	Tightening torque		
		N-m	Kg-m	lb-ft
Exhaust manifold lock nut	8	16.7 - 25.5	1.7 - 2.6	12.3 - 18.8
Exhaust manifold heat protector bolt	3	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9
Turbo charger nut	3	49.0 - 68.6	5.0 - 7.0	36.2 - 50.6
Turbo charger fitting nut	4	26.5 - 31.4	2.7 - 3.2	19.5 - 23.1
Turbo charger oil return pipe bolt	2	7.8 - 9.8	0.8 - 1.0	5.8 - 7.2
Turbo charger oil inlet pipe bolt	2	13.7 - 18.6	1.4 - 1.9	10.1 - 13.7
Turbo charger water inlet pipe bolt	2	34.3 - 49.0	3.5 - 5.0	25.3 - 36.2
Turbo charger heat protector bolt	3	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9
Intake manifold bolt (8 x 112)	4	14.7 - 19.6	1.5 - 2.0	10.8 - 14.5
Intake manifold bolt (8 x 32)	2	14.7 - 19.6	1.5 - 2.0	10.8 - 14.5
Intake manifold nut	4	14.7 - 19.6	1.5 - 2.0	10.8 - 14.5
EGR valve bolt	2	16.7 - 25.5	1.7 - 2.6	12.3 - 18.8
EGR pipe nut	4	16.7 - 25.5	1.7 - 2.6	12.3 - 18.8
Timing chain lower under cover bolt (6 x 14)	4	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain lower under cover bolt (8 x 22)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower under cover bolt (8 x 30)	3	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower under cover bolt (8 x 40)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
LH balance shaft driven gear bolt	1	33.3 - 39.2	3.4 - 4.0	24.6 - 28.9
LH balance shaft sprocket nut	1	49.0 - 58.8	5.0 - 6.0	36.2 - 43.4
RH balance shaft sprocket bolt	1	33.3 - 39.2	3.4 - 4.0	24.6 - 28.9
Timing chain guide "A" bolt (upper)	1	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain guide "A" bolt (lower)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lever "A" bolt	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain auto tensioner "A" bolt	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain guide "B" (1) bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain guide "B" (2) bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain auto tensioner "B" bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain lower front cover bolt (8 x 22)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower front cover bolt (8 x 40)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower front cover bolt (8 x 50)	6	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower front cover bolt (8 x 70)	6	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain lower front cover bolt (8 x 80)	4	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain upper under cover bolt (6 x 14)	4	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain upper under cover bolt (6 x 22)	9	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain upper under cover bolt (8 x 22)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain upper under cover bolt (8 x 40)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain upper under cover nut	1	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain guide "C" (1) bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7

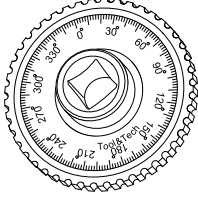
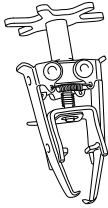
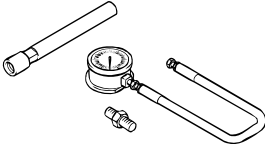
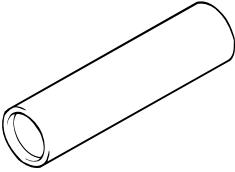
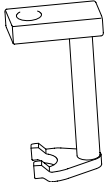
EM -8**ENGINE MECHANICAL SYSTEM**

ITEM	Quantity	Tightening torque		
		N-m	Kg-m	lb-ft
Timing chain guide "C" (2) bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain lever "C" bolt	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Timing chain auto tensioner "C" bolt	2	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
High pressure pump sprocket nut	1	64.7 - 74.5	6.6 - 7.6	47.7 - 55.0
Camshaft sprocket bolt	2	93.2 - 117.7	9.5 - 12	68.7 - 86.8
Timing chain upper front cover bolt	9	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
High pressure pump bracket bolt (8 x 35)	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
High pressure pump bracket bolt (8 x 38)	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
High pressure pump fixing nut	3	14.7 - 19.6	1.5 - 2.0	10.8 - 14.5
Common rail fixing bolt	3	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9
Injector clamp bolt	4	27.5 - 33.3	2.8 - 3.4	20.3 - 24.6
High pressure pipe (pump to rail)	1	24.5 - 28.4	2.5 - 2.9	18.1 - 21.0
High pressure pipe (injector to rail)	4	24.5 - 28.4	2.5 - 2.9	18.1 - 21.0
Water pump pulley nut	4	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Alternator bracket bolt (8 x 60)	2	18.6 - 27.5	1.9 - 2.8	13.7 - 20.3
Alternator bracket bolt (8 x 35)	2	18.6 - 27.5	1.9 - 2.8	13.7 - 20.3
Alternator fixing bolt & nut (upper)	1	18.6 - 27.5	1.9 - 2.8	13.7 - 20.3
Alternator fixing bolt & nut (lower)	1	18.6 - 27.5	1.9 - 2.8	13.7 - 20.3
Power steering pump bracket bolt (8 x 30)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Power steering pump bracket bolt (8 x 40)	3	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Power steering pump bracket bolt (8 x 75)	2	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Power steering pump fixing bolt (upper)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Power steering pump fixing bolt (lower)	1	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Air conditioner compressor fixing bolt	4	19.6 - 26.5	2.0 - 2.7	14.5 - 19.5
Drive belt pulley fixing bolt	3	47.1 - 53.0	4.8 - 5.4	34.7 - 39.1
Drive belt auto tensioner fixing bolt	1	47.1 - 53.0	4.8 - 5.4	34.7 - 39.1
Starter fixing bolt	2	26.5 - 33.3	2.7 - 3.4	14.5 - 24.6
Engine support bracket bolt	2	47.1 - 51.0	4.8 - 5.2	34.7 - 37.6

GENERAL

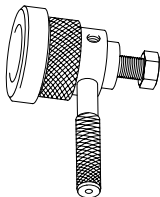
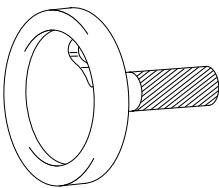
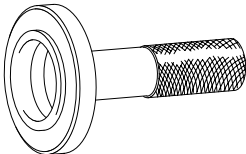
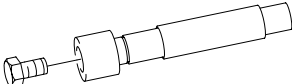
EM -9

SPECIAL TOOLS LCAC0300

Tool (Number and Name)	Illustration	Use
Torque angle adapter (09221-4A000)	 LCAC030A	Installation of bolts & nuts needing an angular method
Valve spring compressor (09222-22100)	 LCAC030B	Removal and installation of intake and exhaust valves
Compression gauge & adapter (09351-27000) (09351-4A100)	 LCAC030C	Checking engine compression pressure
Valve stem seal installer (09222-4A000)	 LCAC030D	Installation of valve stem oil seals
Injector remover (09351-4A000)	 LCAC030E	Removal of injectors

EM -10

ENGINE MECHANICAL SYSTEM

Tool (Number and Name)	Illustration	Use
High pressure pump sprocket remover (09331-4A000)	 LCAC030F	Removal of high pressure pump sprockert
Crank shaft rear oil seal installer (09231-4A100)	 LCAC030G	Installation of crank shaft rear oil seals
Timing chain lower front cover oil seal installer (09214-4A000)	 LCAC030H	Installation of timing chain lower front cover oil seal
Balance shaft drive gear bearing (bush) installer/remover (09231-4A000)	 LCAC030I	Removal and installation of LH balance shaft drive gear bearing (bush)

TROUBLESHOOTING

LCAC0400

Symptom	Probable cause	Remedy
Low compression	Damaged cylinder head gasket Worn or damaged piston rings Worn piston or cylinder Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and find out cause Repair Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine vibration	Loose engine mounting bolt Loose transmission mounting bolt Loose cross member bolt Broken transmission mounting rubber Broken engine mounting rubber	Retighten Retighten Retighten Replace Replace
Noisy valves	Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Change Replace
Connecting rod and/main bearing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and find out cause Replace
Low coolant level	Leakage of coolant Damaged radiator core joint Corroded or cracked hoses (radiator hose, heater hose, etc)	Replace Replace
	Faulty radiator cap valve or setting of spring Faulty thermostat Faulty engine coolant pump	Replace Replace Replace
Clogged radiator	Foreign material in coolant	Replace

EM -12**ENGINE MECHANICAL SYSTEM**

Symptom	Probable cause	Remedy
Abnormally high coolant temperature	Faulty thermostat Faulty radiator cap Restricted of flow in cooling system Loose or missing drive belt Faulty engine coolant pump Faulty temperature sensor wiring Faulty electric fan Faulty thermo-sensor on radiator Insufficient coolant	Replace Replace Replace Adjust or replace Replace Repair or replace Repair or replace Replace Refill coolant
Abnormally low coolant temperature	Faulty thermostat Faulty temperature sensor wiring	Replace Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection Blocked or collapsed hose and pipe	Retighten Replace
Inoperative electrical cooling fan	Damaged, fuse	Replace or repair
Exhaust gas leakage	Loose connections Broken pipe or muffler	Retighten Repair or replace
Abnormal noise	Detached baffle plate in muffler Broken rubber hanger Pipe or muffler contacting vehicle body Broken pipe or muffler	Replace Replace Correct Repair or replace

CHECKING ENGINE OIL LCAC0500

1. Position a vehicle on a level surface.
2. Turn off the engine.



NOTE

If a vehicle that has not been used for a prolonged period, run the engine for several minutes. Turn off the engine and wait for 5 minutes at least, and then check the oil level.

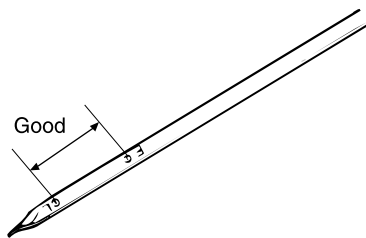
3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the "L" mark), refill to the "F" mark.



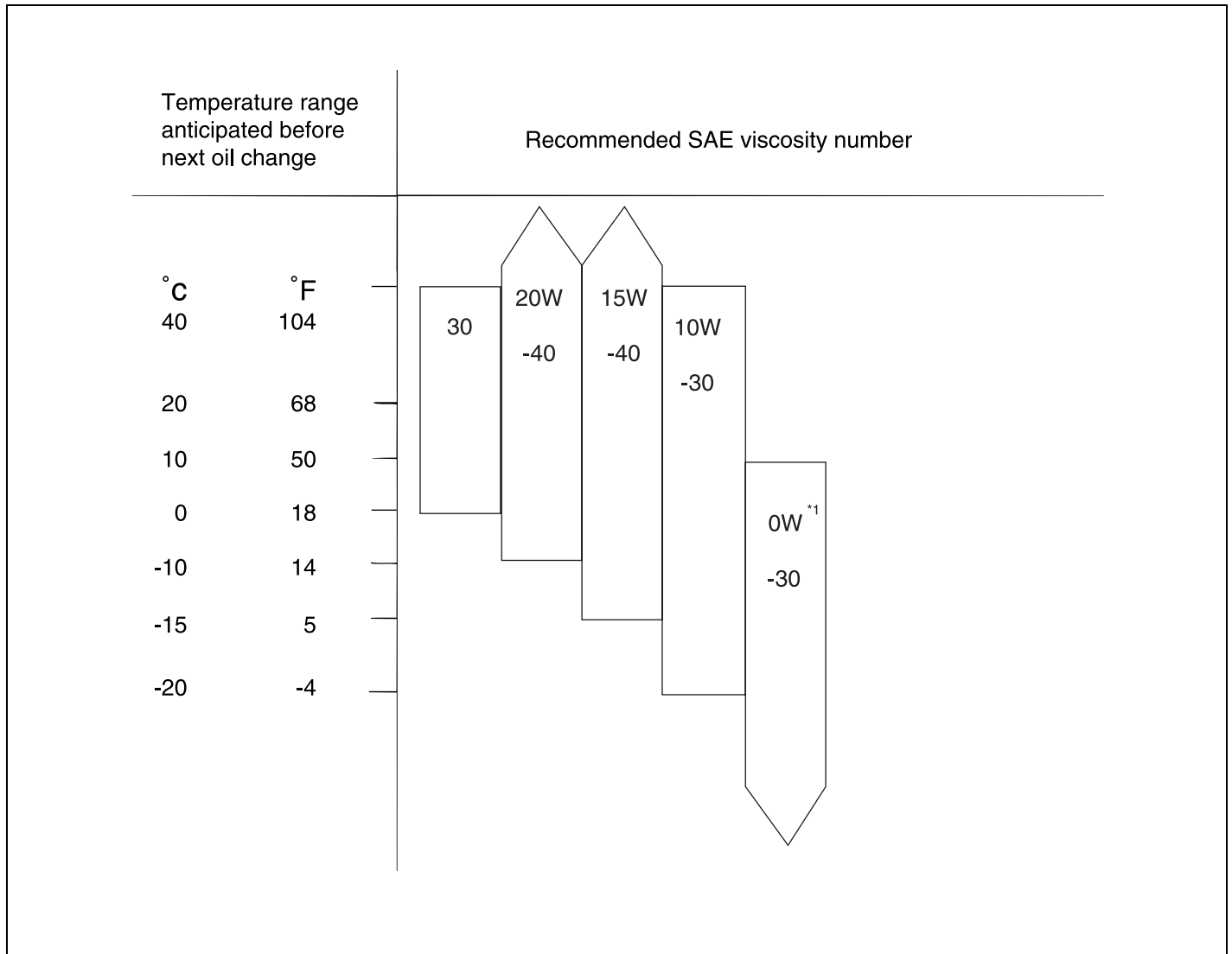
NOTE

When refilling, use the proper grade of engine oil.

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.



LCAC050A

SELECTION OF ENGINE OIL LCAC0510**Recommended API classification : ABOVE CE****Recommended SAE viscosity grades :**

LCAC051A

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

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

1. Satisfy the requirements of the API classification.
2. Have the proper SAE grade number for expected ambient temperature range.

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

CHANGING ENGINE OIL LCAC0520

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and the drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque**Oil pan drain plug :****35-45 N·m (350-450 kg·cm, 25-33 lb·ft)****NOTE**

Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

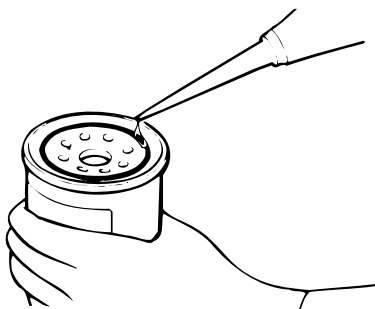
Capacity :**Drain and refill : 7.4 liter****Oil filter : 0.8 liter****Total : 8.2 liter****NOTE**

Do not overfill. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

PROCEDURE FOR REPLACING THE OIL FILTER LCAC0530

1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil of the surface of the rubber gasket.



LCAC053A

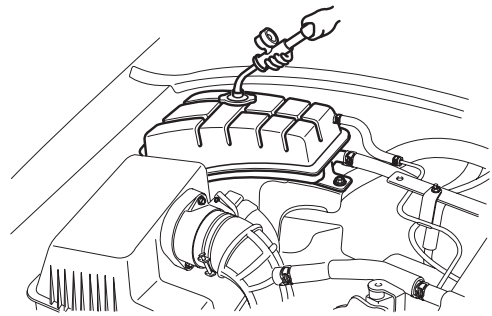
3. Tighten the oil filter of the specified torque.

Oil filter :**22 - 25 N·m (220 - 250 kg·cm, 16 - 18 lb·ft)**

4. Start and run the engine and check for engine oil leaks.
5. After stopping the engine, check the oil level and add oil as necessary.

CHECKING COOLANT LEAK LCAC0600

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 KPa (21psi, 1.53 kg/cm²) pressure. Hold it for two minutes in that condition while checking for leakage from the radiator, hoses or connections.



LCAC060A

**CAUTION**

1. **Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.**
 2. **When the tester is removed, be careful not to spill any coolant from it.**
 3. **Be sure to clean away completely any from the area.**
 4. **Be careful when installing and removing the tester and when testing, not to deform the filler neck of the radiator.**
4. If there is leakage, repair or replace with the appropriate part.

RADIATOR CAP PRESSURE TEST

LCAC0610

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

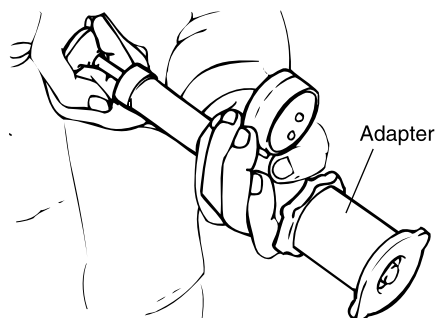
Main valve opening pressure :

107.9±14.7kPa

(1.1±0.15 kg/cm², 15.64±2.13 psi)

Main valve closing pressure :

83.4 kPa (0.85 kg/cm², 12.1 psi)



LCAC061A

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.



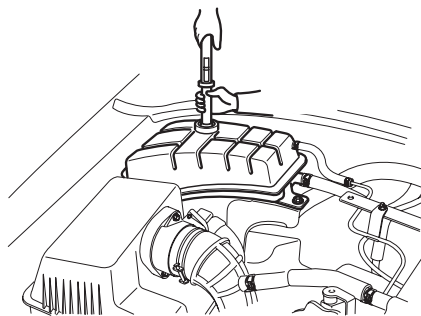
NOTE

Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.

SPECIFIC GRAVITY TEST

LCAC0620

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.



LCAC062A

GENERAL

EM -17

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

LCAC0630

Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

Example)

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

**CAUTION**

- *If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.*

- *If the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.*
- *Do not mix types of anti-freeze.*

RECOMMENDED COOLANT

Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

EM -18

ENGINE MECHANICAL SYSTEM

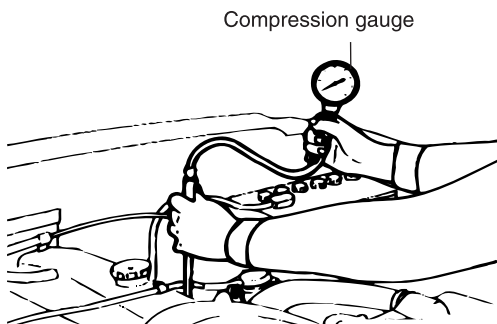
CHECKING COMPRESSION PRESSURE

LCAC0700

1. Before checking engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until the engine coolant temperature reaches 80-95°C (176-205°F).
3. Turn off the engine and remove the aircleaner element.
4. Remove the injectors.
5. Crank the engine to remove any foreign material in the cylinders.
6. Insert the compression gauge (09351 - 27000) into the injector hole.
7. Crank the engine and read the gauge.

Standard value :

2942 kpa (30 Kg/cm², 426 psi)-270rpm



LCAC070A

8. Repeat steps 6 to 7 for all cylinders, ensuring that the pressure difference for each of the cylinders is within the specified limit.

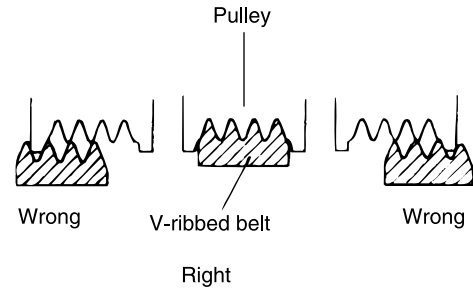
Limit : Max. 490 kpa (5.0 kg/cm², 71 psi) between cylinders

9. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the injector hole, and repeat steps 6 to 8.
 - 1) If the addition of oil causes the compression to rise, it is likely that there may be wear between the piston ring and cylinder wall.
 - 2) If compression remains the same, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

ADJUSTING DRIVE BELT AND TENSIONER

LCAC0800

1. Check that the belts are not damaged and are properly placed for the pulley grooves.



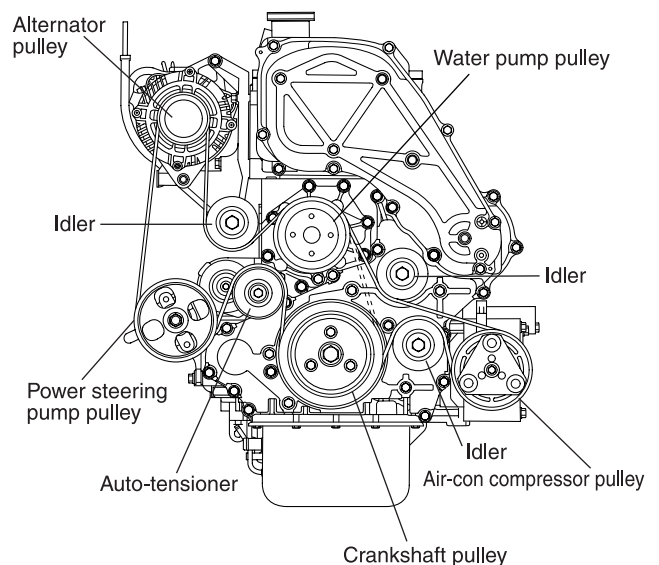
LCAC080A



CAUTION

1. When installing the V-ribbed belt, check that the V-ribs are properly aligned.
2. If noise or slippage is detected, check the belt for wear, damage, or breakage on the pulley contact surface, and check the pulley for scoring. Also check the amount that the belt is deflected.

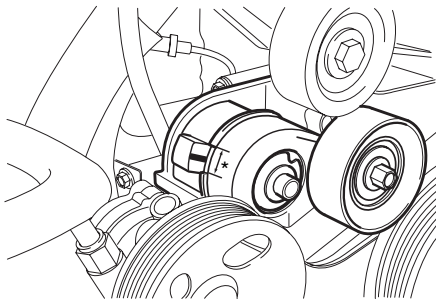
2. Install the belt in the following order.



LCAC080C

- 1) Install the belt in RH side of the auto-tensioner pulley.
Auto-tensioner pulley ⇒ Crankshaft pulley ⇒ Idler ⇒ Air conditioner compressor pulley ⇒ Idler ⇒ Water pump pulley

- 2) Install the belt in LH side of the auto-tensioner pulley.
Auto-tensioner pulley $\Rightarrow$ Power steering pump pulley $\Rightarrow$ Alternator pulley
- 3) Loosen the belt tension by turning the auto-tensioner clockwise (about 39°), and then install the belt on the idler between the alternator pulley and the water pump pulley.
3. The tensioner mark should be between the “*” position.
If not, replace the belt.

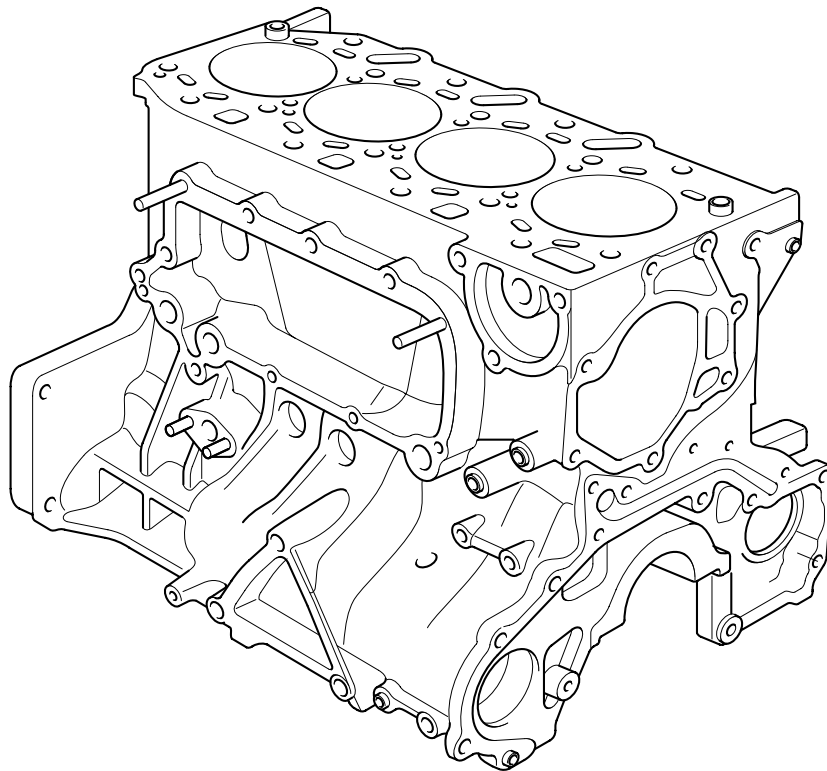


LCAC080B

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS LCAC0900



ENGINE BLOCK

EM -21

DISASSEMBLY LCAC0910

Remove the cylinder head, timing chain, timing chain cover, flywheel, pistons and crankshaft.

For further details, refer to the appropriate section.

INSPECTION LCAC0920

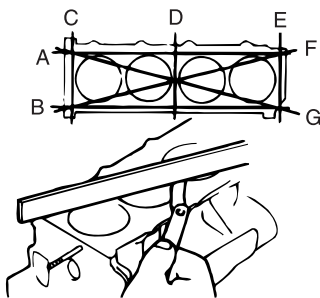
NOTE

1. Before inspection and repair, clean parts to remove dirt, oil, carbon, deposits, and scale.
2. Before cleaning the cylinder block, be sure to check for evidences of water leaks and damage.
3. Remove contaminants from oil holes with compressed air and, at the same time, make sure that they are not blocked.

1. Check for scratches, rust, and corrosion. Use also a flaw-detecting agent for the check. If defects are evident, correct or replace.
2. Using a straightedge and thickness gauge, check the cylinder block top surface for flatness. Lay the straightedge longways and crossways as indicated by A, B,... in illustration. If flatness is not within the limit, replace the cylinder block top surface is free from any traces of gasket material.

Standard value : 0.05 mm (0.002 in.)

Limit : 0.1 mm (0.004 in.)



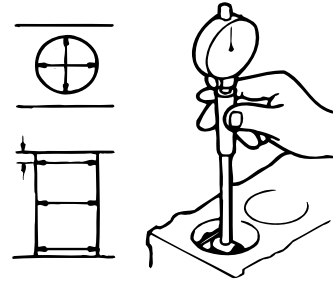
LCAC092A

3. Check cylinder wall for scratches and seizure. If defects are evident, correct (to oversize) or replace.

4. Using cylinder gauge, measure the cylinder bore. If it wears out excessively, bore the cylinder to oversize and replace the piston and piston rings. Measurement points are as shown.

Standard value :

91.000 - 91.030 mm (3.5827-3.5839 in)



LCAC092B

REASSEMBLY LCAC0930

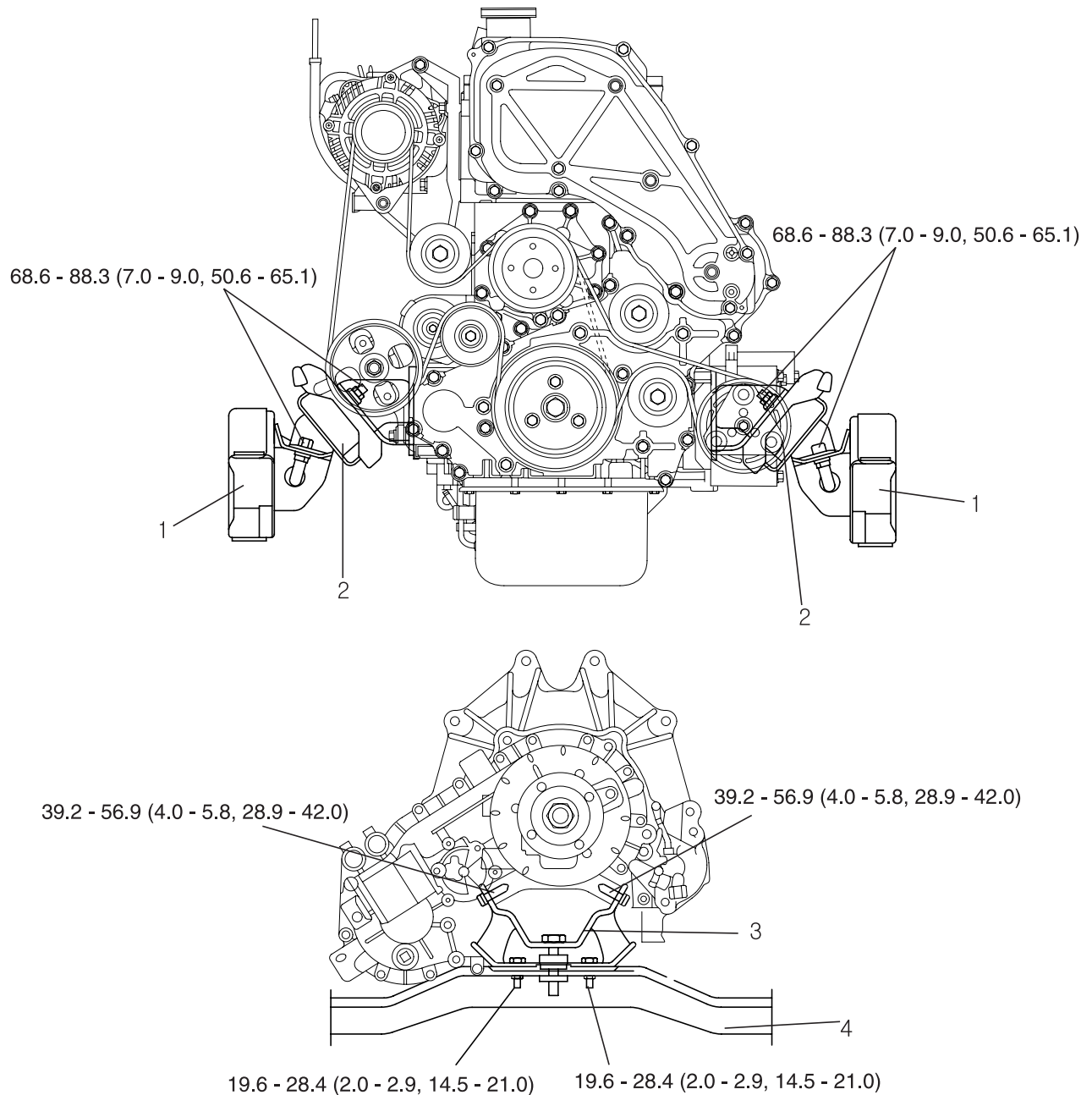
Install the following parts by referring to their respective paragraphs.

1. Crankshaft
2. Flywheel
3. Piston
4. Cylinder head
5. Timing chain
6. Timing chain cover

ENGINE MOUNTS

COMPONENTS

LCAC1000



TORQUE : N·m (kg·m, lb·ft)

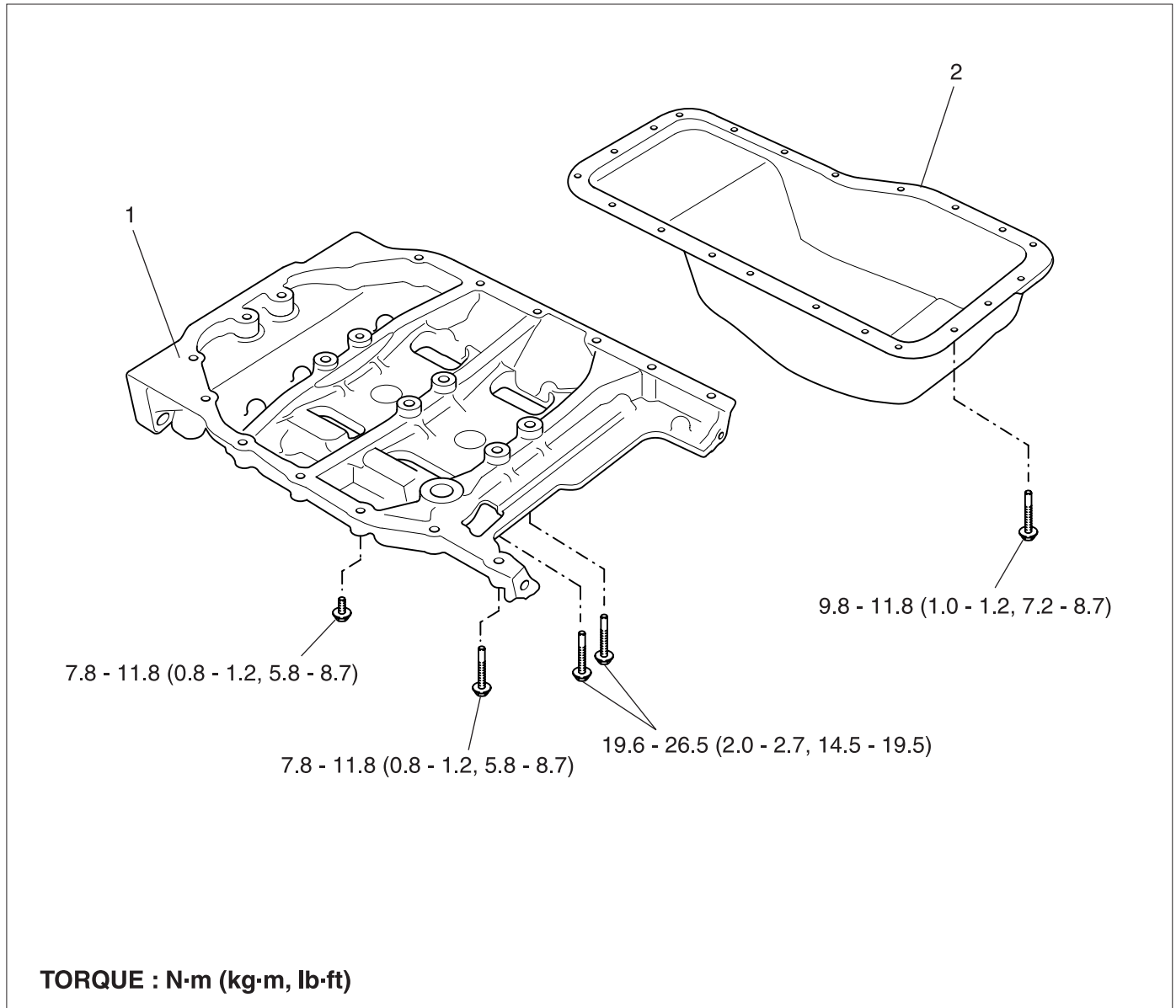
1. Frame
2. Engine mounting
3. Transmission mounting
4. Cross member

ENGINE BLOCK

EM -23

OIL PAN

COMPONENT LCAC1100



1. Bed plate
2. Oil pan

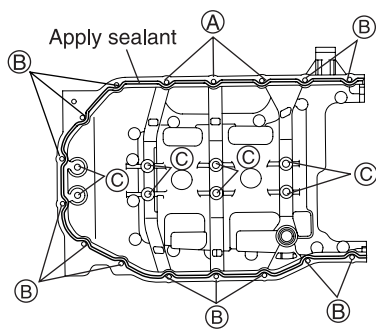
LCAC110A

INSTALLATION LCAC1110

1. Install the bed plate after apply sealant.
Clean the foreign material from mating surface before apply sealant.

Bolt	Size	Quan- tity	Tightening torque N-m (kg-m, lb-ft)
A	6 x 18	3 EA	7.8-11.8 (0.8-1.2, 5.8-8.7)
B	6 x 30	13 EA	7.8-11.8 (0.8-1.2, 5.8-8.7)
C	8 x 45	8 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)

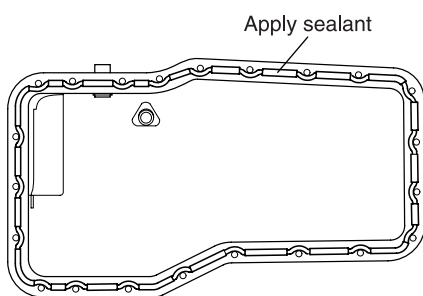
* Bolts size = Diameter x Length



LCAC111A

2. Install the oil pan after apply sealant.
Clean the foreign material from mating surface before apply sealant.

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



LCAC111B

ENGINE BLOCK

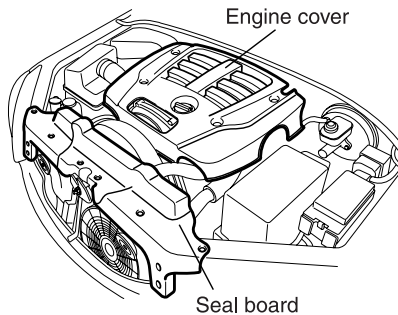
EM -25

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL (A/T EQUIPPED VEHICLE)

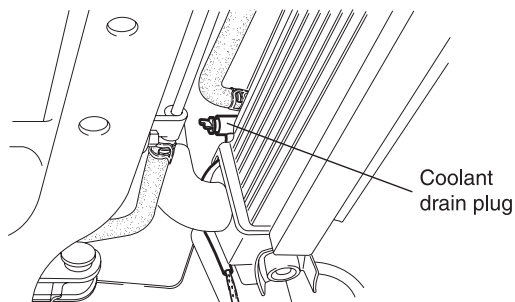
LCAC1200

1. Remove the engine hood.
2. Remove the engine cover.



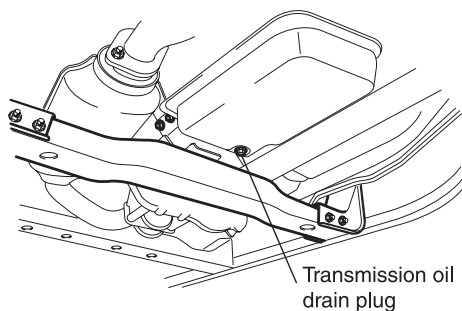
LCAC120A

3. Drain the engine coolant.



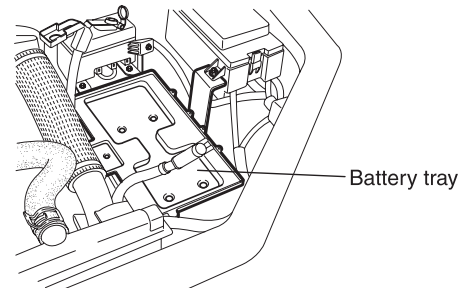
LCAC120B

4. Drain the transmission oil.



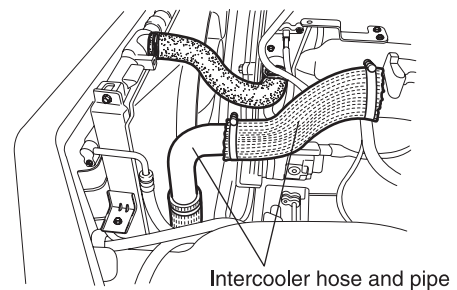
LCAC120C

5. Remove the battery and battery tray.



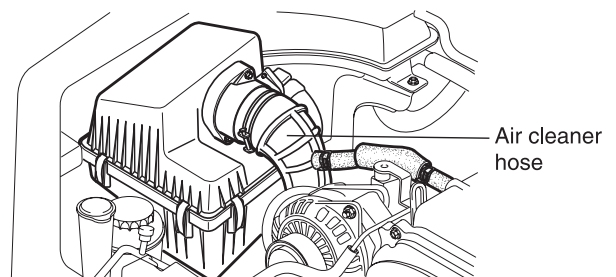
LCAC120D

6. Remove the inter cooler hose and pipe on the intake manifold side.



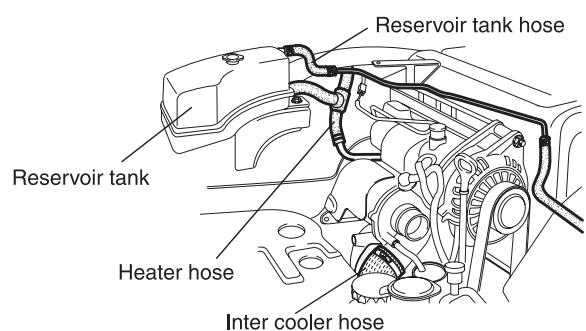
LCAC120E

7. Disconnect the air cleaner hose.



LCAC120F

8. Disconnect the engine coolant reservoir tank hose and the heater hose.

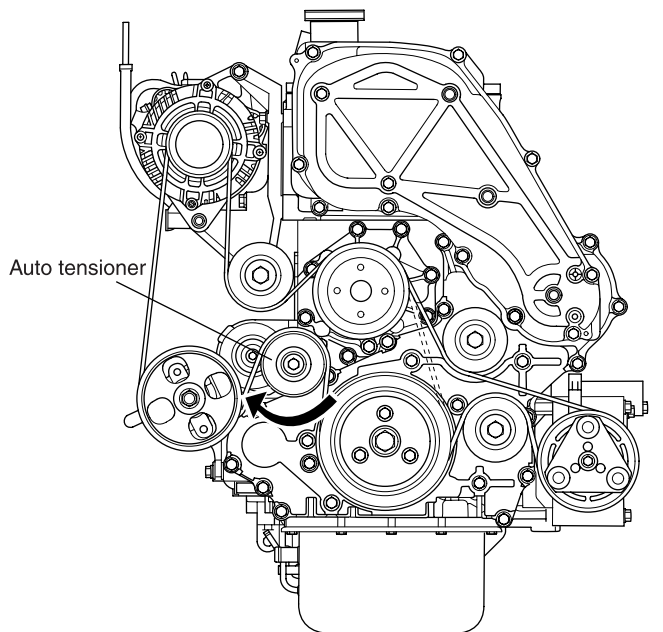


LCAC120G

EM -26

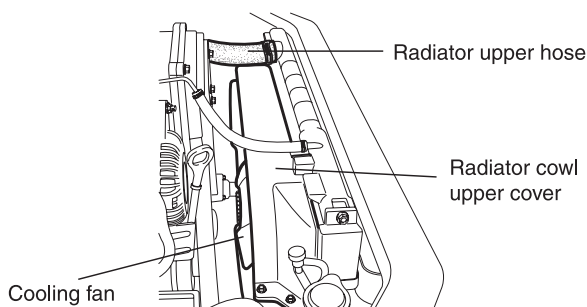
ENGINE MECHANICAL SYSTEM

9. Remove the inter cooler hose on the turbo charger side.
10. Loosen the drive belt tension by turning auto-tensioner with spanner, and then remove the drive belt.



LCAC120H

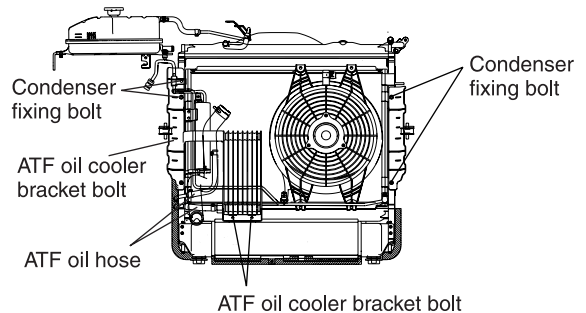
11. Disconnect the radiator upper hose and lower hose.
12. Remove the radiator cowl upper cover.



LCAC120I

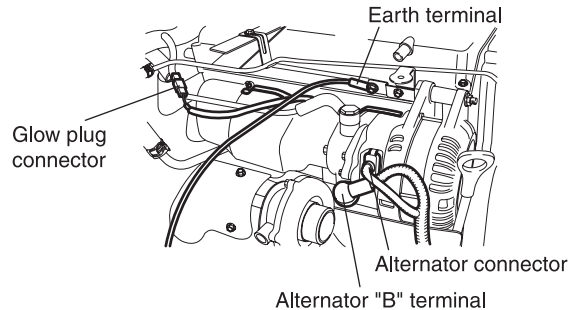
13. Remove the cooling fan.
14. Remove the radiator cowl lower cover.

15. Remove the fixing bolt of air-con condenser and ATF oil cooler bracket from the radiator assembly.



LCAC191D

16. Disconnect the ATF oil hoses.
17. Remove the radiator assembly from engine room, after remove the radiator assembly bracket fixing nut.
18. Drain the power steering oil.
19. Disconnect the power steering pump hose and pipe.
20. Disconnect the earth terminal and the glow plug connector.



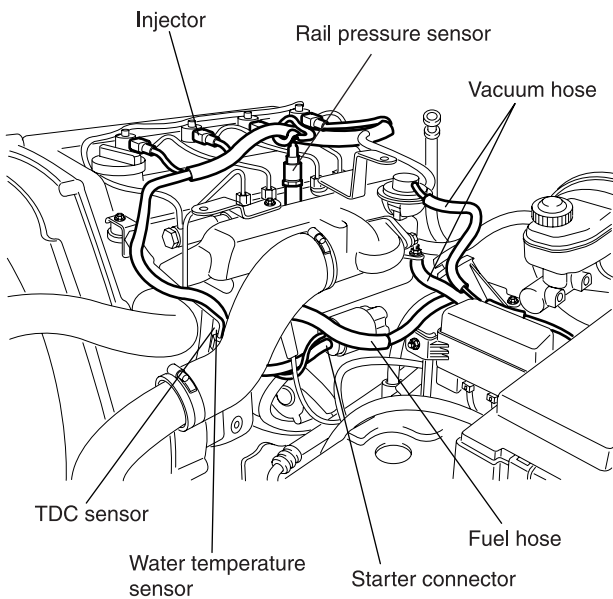
LCAC120K

21. Disconnect the alternator "B" terminal and connector.
22. Disconnect the engine oil pressure switch connector.
23. Remove the air conditioner compressor within connected hose from the cylinder block, and then fix it with a wire.

ENGINE BLOCK

EM -27

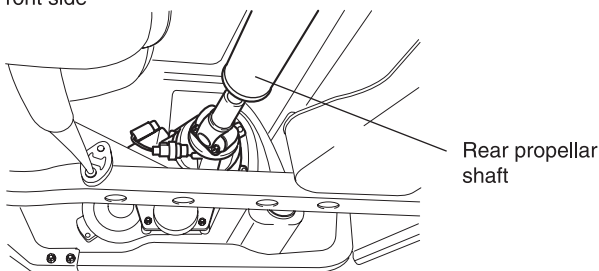
24. Disconnect the injector, TDC sensor, water temperature sensor and starter connector.



LCAC120L

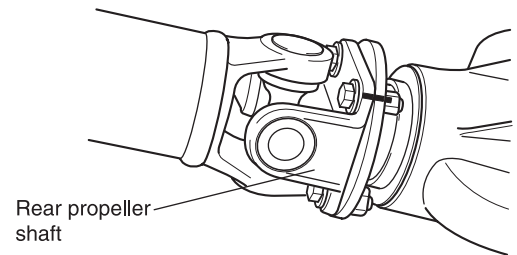
25. Disconnect the fuel hoses from the high pressure pump.
26. Disconnect the vacuum hoses from the EGR valve and intake manifold.
27. Disconnect the earth terminal from the cylinder block.
28. Remove the transmission oil level gauge pipe.
29. Remove the rear propeller shaft.

■ Front side



LCAC120M

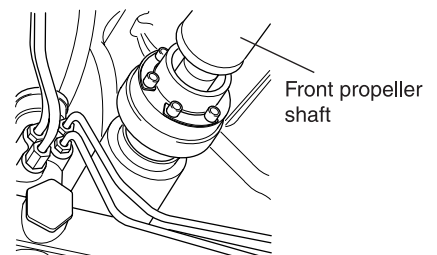
■ Rear side



LCAC120N

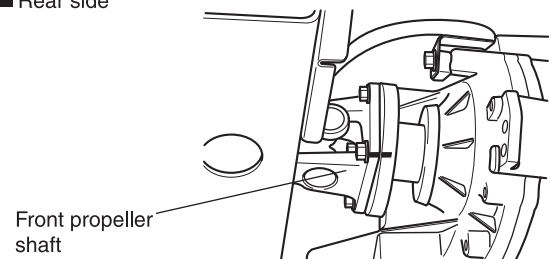
30. Remove the front propeller shaft.

■ Front side



LCAC120O

■ Rear side

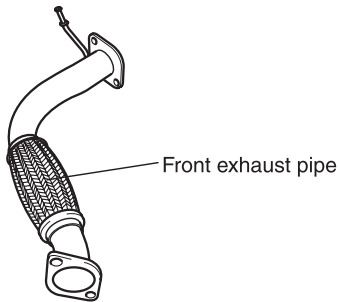


LCAC120P

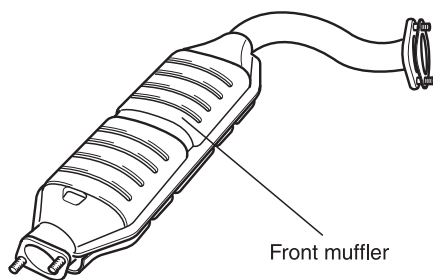
EM -28

ENGINE MECHANICAL SYSTEM

31. Remove the front exhaust pipe and muffler.



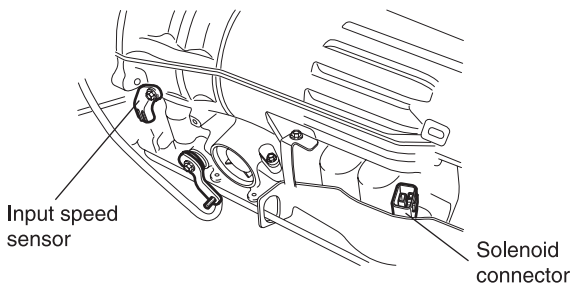
LCAC120Q



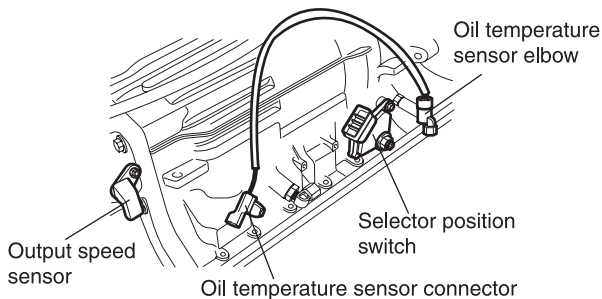
LCAC120R

32. Remove the shift cable from the transmission.

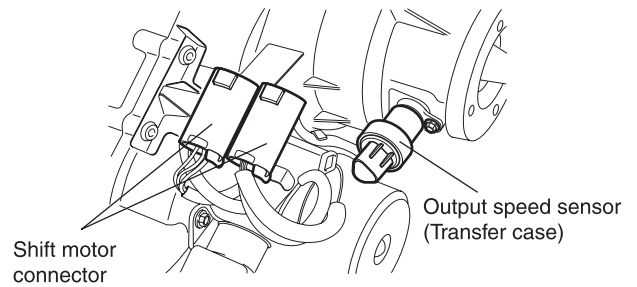
33. Disconnect the connectors (8EA) from the transmission.



LCAC120S



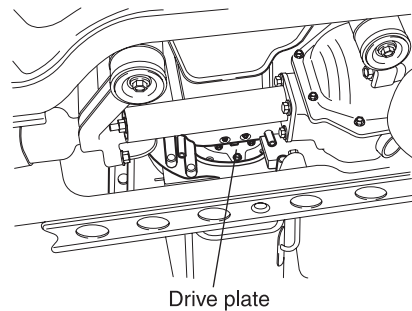
LCAC120T



LCAC120U

34. Remove the transmission oil pipes.

35. Remove the drive plate-to-torque converter fixing bolts (6EA), after remove the bell housing cover. Rotate crank shaft pulley to gain access to all bolts.

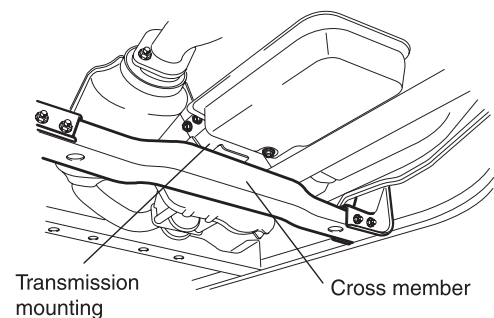


LCAC120V

36. Remove the starter.

37. Remove the transmission housing fixing bolts.

38. Remove the transmission mounting and the cross member, after support the transmission by using a jack.

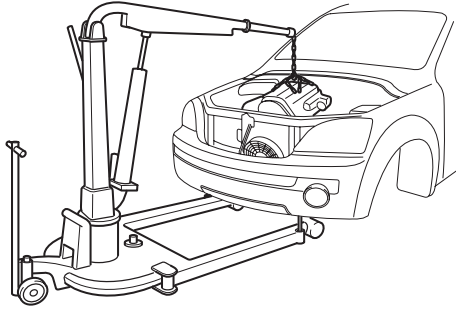


LCAC120W

ENGINE BLOCK

EM -29

39. Remove the transmission from the vehicle.
40. Remove the engine mounting.
41. Remove the engine assembly from engine room, by using a engine crane.



LCAC120X

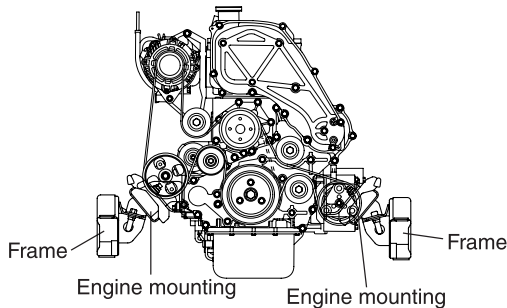
INSTALLATION (A/T EQUIPPED VEHICLE)

LCAC1210

1. Install the engine assembly to engine room, by using a engine crane.
2. Install the engine mounting.

Tightening torque

68.6-88.3 N·m (7.0- 9.0 kg·m, 50.6-65.1 lb·ft)



LCAC121A

3. Install the transmission to the vehicle by using a jack.

4. Install the transmission mounting and the cross member.

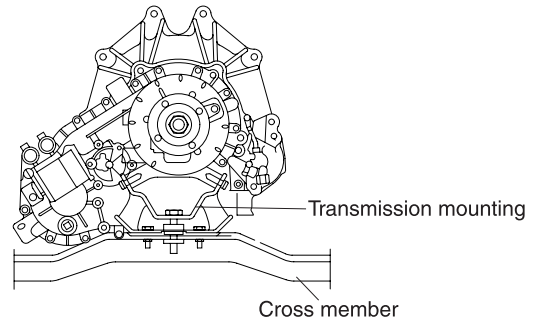
Tightening torque

Transmission to Mounting:

39.2-56.9 N·m(4.0- 5.8 kg·m, 28.9-42.0 lb·ft)

Mounting to Cross member :

19.6-28.4 N·m(2.0-2.9 kg·m, 14.5-21.0 lb·ft)



LCAC121B

5. Install the transmission housing fixing bolts.
6. Install the starter.

Tightening torque

26.5-33.3 N·m (2.7-3.4 kg·m, 19.5-24.6 lb·ft)

7. Install the drive plate-to-torque converter fixing bolts (6EA). Rotate crank shaft pulley to gain access to all bolts.
8. Install the bell housing cover.

Tightening torque

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

9. Install the transmission oil pipe.
10. Reconnect the connectors (8EA) to the transmission.
11. Install the shift cable to the transmission.
12. Install the front exhaust pipe and muffler.

Tightening torque

42.2-60.8 N·m(4.3-6.2 kg·m, 31.1-44.8 lb·ft)

13. Install the front propeller shaft.

Tightening torque :

Part time 4WD :

26.5-29.4 N·m (2.6-3.0 kg·m, 18.8-21.7 lb·ft)

Full time 4WD :

49.0-58.8 N·m (5.0-6.0 kg·m, 36.2-43.4 lb·ft)

14. Install the rear propeller shaft.

Tightening torque

49.0-58.8 N·m (5.0-6.0 kg·m, 36.2-43.4 lb·ft)

15. Install the transmission oil level gauge pipe.
16. Install the earth terminal to the cylinder block.
17. Reconnect the vacuum hoses to the EGR valve and intake manifold.
18. Reconnect the fuel hose to the high pressure pump.
19. Reconnect the injector, TDC sensor, water temperature sensor and starter connector.
20. Install the air conditioner compressor to the cylinder block.

Tightening torque

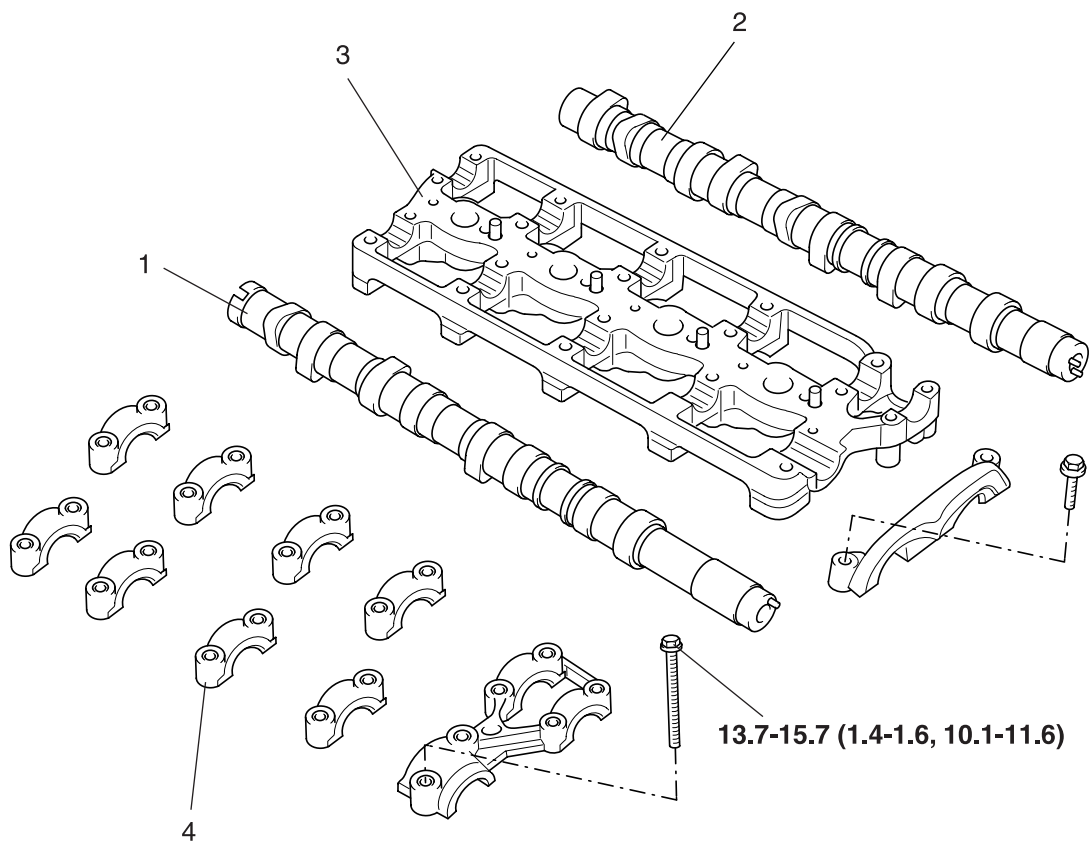
19.6-24.5 N·m (2.0-2.5 kg·m, 14.5-18.1 lb·ft)

21. To install all of parts, follow the removal procedures in the reverse order.
22. Refill the transmission oil and the power steering oil and then check for leaks.
23. Refill the engine coolant and then check for leaks.

MAIN MOVING SYSTEM

CAM SHAFT

COMPONENTS LCAC1300



TORQUE : N·m (kg·m, lb·ft)

1. RH camshaft
2. LH camshaft
3. Camshaft carrier
4. Camshaft cap

EM -32

ENGINE MECHANICAL SYSTEM

DISASSEMBLY LCAC1310

1. Remove the cylinder head cover. Refer to "Cylinder head cover".
2. Remove the timing chain "C". Refer to "Timing chain".
3. Remove the camshaft sprocket.
4. Remove the camshaft caps.
5. Remove the camshaft and camshaft carrier.

INSPECTION LCAC1320

1. Check the camshaft journals for wear. If the journals are badly worn, replace the camshaft.

End play : 0.10 - 0.20 mm (0.0039 - 0.0079 in)

Camshaft journals diameter :

29.964-29.980 mm (1.1797-1.1803 in)

2. Check the cam lobes for damage. If the lobe is damaged or worn excessively, replace the camshaft.

Cam height (LH) :

Intake : 40.163 mm (1.5812 in)

Exhaust : 40.043 mm (1.5765 in)

Cam height (RH) :

Intake : 39.782 mm (1.5662 in)

Exhaust : 40.456 mm (1.5928 in)

REASSEMBLY LCAC1330

1. Install the camshaft carrier on the cylinder head.
2. Install the camshaft on the camshaft carrier.



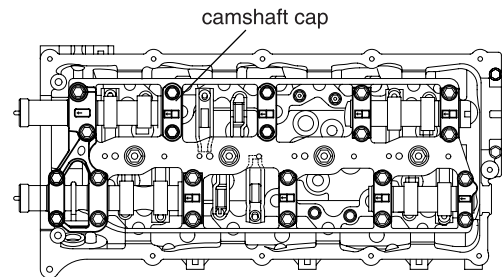
CAUTION

In assembling camshaft cap, all pistons to be in the middle position between TDC and BDC not to interfere with valves.

3. Install the camshaft caps.

Tightening torque :

13.7-15.7 N-m (1.4-1.6 kg-m, 10.1-11.6 lb-ft)



LCAC133A

4. Install the camshaft sprocket.

Tightening torque :

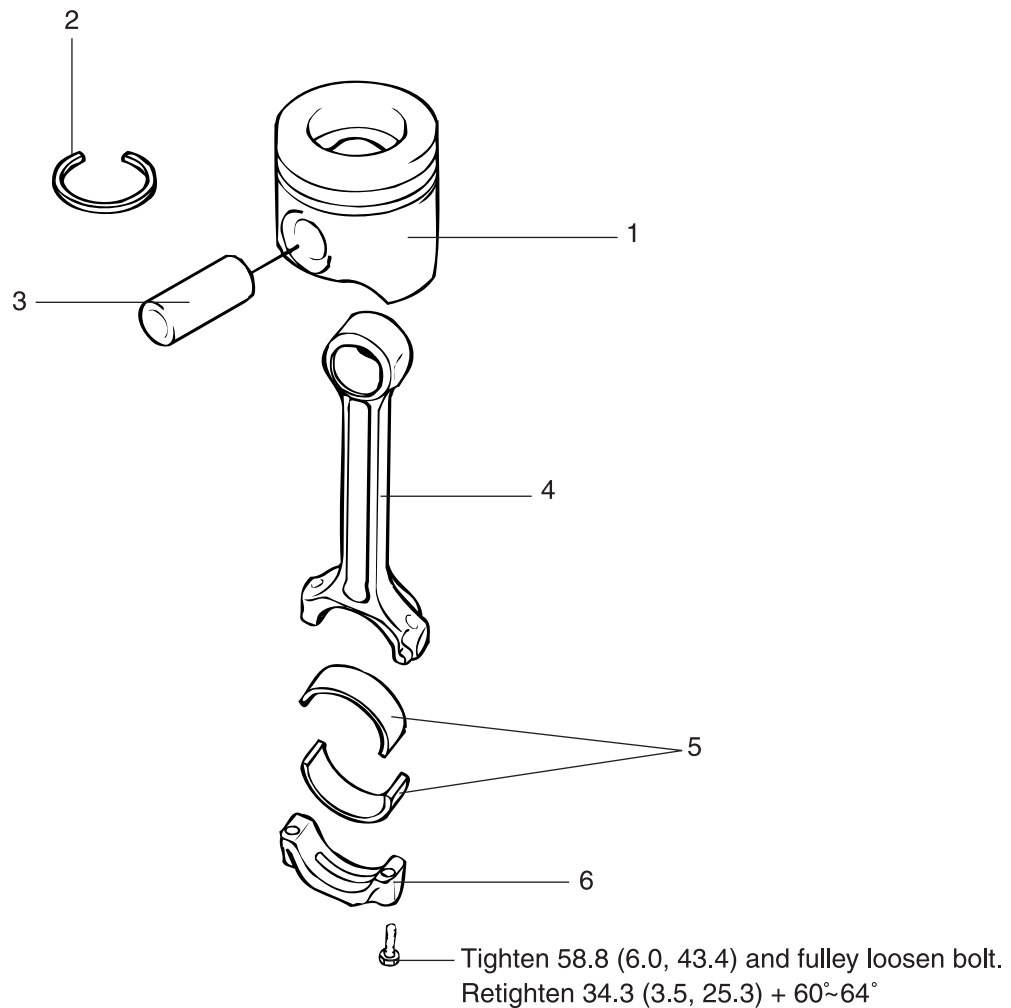
93.2-117.7 N-m (9.5-12.0 kg-m, 68.7-86.8 lb-ft)

5. Install the timing chain "C". Refer to "Timing chain".
6. Install the cylinder head cover. Refer to "Cylinder head cover".

CONNECTING ROD

COMPONENTS

LCAC1400



TORQUE : Nm (kg.m, lb.ft)

1. Piston
2. Snap ring
3. Piston pin
4. Connecting rod
5. Bearing
6. Connecting rod cap

EM -34

ENGINE MECHANICAL SYSTEM

DISASSEMBLY

LCAC1410

1. Remove the timing chain "C". Refer to "Timing chain".
2. Remove the camshaft. Refer to "Camshaft".
3. Remove the cylinder head assembly. Refer to "Cylinder head".
4. Remove the oil pan and bed plate. Refer to "Oil pan".
5. Remove the connecting rod cap.



NOTE

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

6. Remove the piston and connecting rod assembly from the cylinder block.
7. Remove the piston pin with snap ring.
8. Remove the piston from connection rod.
9. Remove the piston ring from piston.

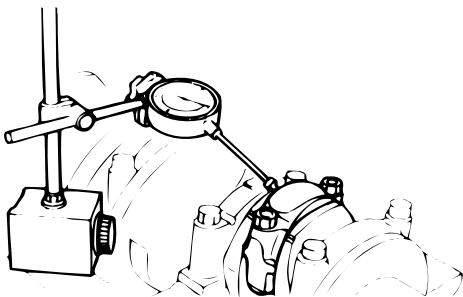
INSPECTION

LCAC1420

CONNECTING ROD BEARING

1. Before removing the connecting rod cap, measure connecting rod side clearance. If side clearance exceeds specification, replace the connecting rod.

Side clearance : 0.05 - 0.25 mm (0.0020 - 0.0098 in)



LCAC142A

2. Remove the connecting rod cap.

3. Measure connecting rod bearing oil clearance.

- 1) Remove all foreign material and oil from the pin journals and connecting rod bearing surface.
- 2) Position a plastic gauge atop the pin journals in axial direction .
- 3) Install the connecting rod cap and tighten bolts.

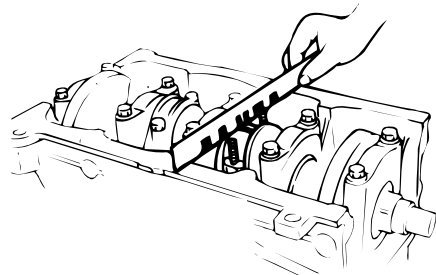
Tightening torque :

1. Tighten 58.8 N-m (6.0 kg-m, 43.4 lb-ft), and fully loosen bolt.
2. Retighten 34.3 N-m (3.5 kg-m, 25.3 lb-ft) + 60 ~ 64°

- 4) Remove the connecting rod cap, and measure oil clearance at each journal.

Oil clearance :

0.024 - 0.042 mm (0.0009 - 0.0017 in)



LCAC142B

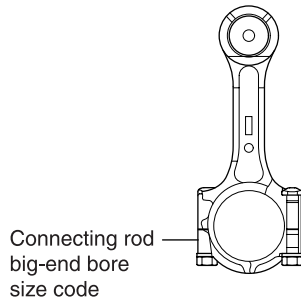
4. If oil clearance exceeds specification, replace the connecting rod bearing. Refer to "connecting rod bearing replacement".

MAIN MOVING SYSTEM**EM -35****REPLACEMENT** LCAC1430**CONNECTING ROD BEARING**

1. Check the connecting rod big-end bore size code.

**NOTE**

Record the connecting rod big-end bore size code letters on connecting rod cap as shown.



LCAC143A

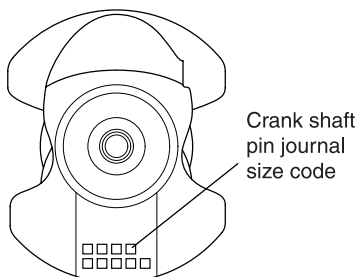
CONNECTING ROD BIG-END DIAMETER

Code	Connecting rod big-end diameter mm (in)
A	60.000 - 60.006 (2.3622 - 2.3624)
B	60.006 - 60.012 (2.3624 - 2.3627)
C	60.012 - 60.018 (2.3627 - 2.3629)

2. Check the crankshaft pin journal size code.

**NOTE**

Record the pin journal size code letters on the No. 1 crankshaft balance weight.
Reading order is from left to right as shown, with No. 1 pin journal size code shown first.



LCAC143B

CRANKSHAFT PIN JOURNAL DIAMETER

Code	Crankshaft pin journal diameter mm (in)
A	56.994 - 57.000 (2.2439 - 2.2441)
B	56.988 - 56.994 (2.2436 - 2.2439)
C	56.982 - 56.988 (2.2434 - 2.2436)

3. Choose proper connecting rod bearing in below table.

CONNECTING ROD BEARING SELECTION TABLE

Connecting rod bearing		Connecting rod big-end bore size code		
		A	B	C
Crankshaft pin journal size code	1	Green	Yellow	None
	2	Yellow	None	Blue
	3	None	Blue	Red

Connecting rod bearing oil clearance :
0.024 - 0.042 mm (0.0009 - 0.0017 in)

CONNECTING ROD BEARING THICKNESS

Color	Connecting rod bearing thickness mm (in)
Red	1.497 - 1.500 (0.0589 - 0.0591)
Blue	1.494 - 1.497 (0.0588 - 0.0589)
None	1.491 - 1.494 (0.0587 - 0.0588)
Yellow	1.488 - 1.491 (0.0586 - 0.0587)
Green	1.485 - 1.488 (0.0585 - 0.0586)

EM -36

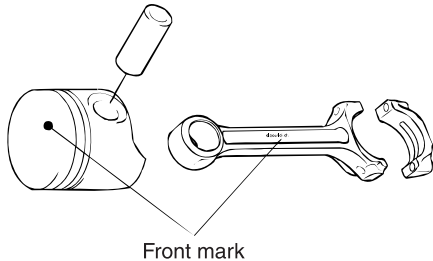
ENGINE MECHANICAL SYSTEM

REASSEMBLY

LCAC1440

PISTON PIN

1. Check the front mark of the piston and connecting rod.



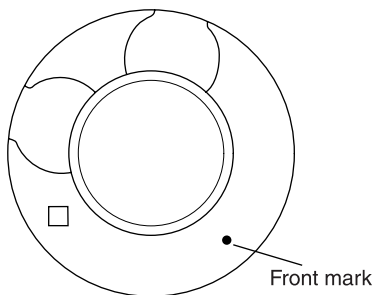
LCAC144A

2. Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position.
3. Install the snap ring.

LCAC1450

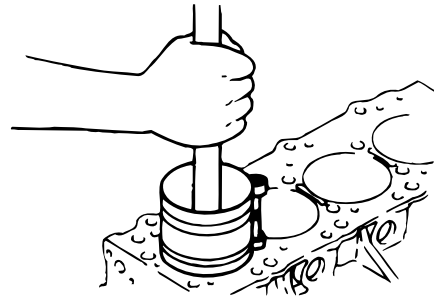
PISTON AND CONNECTING ROD ASSEMBLY

1. Insert the piston and connecting rod assembly from above the top of cylinder. Ensure that the front mark on the piston crown and that (front mark) on the connecting rod face toward the front of engine (to the crankshaft pulley side).



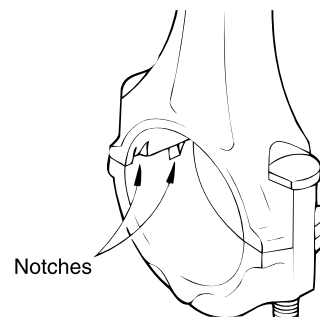
LCAC145A

2. Clamp firm the piston rings with the ring band and install the piston assembly into cylinder. Do not strike it hard into the piston, as broken piston ring or damaged crankshaft pin journal could result.



LCAC145B

3. Install the connecting rod bearing on the connecting rod and cap.



LCAC145C

4. Install the connecting rod and cap to crankshaft pin journal.

Tightening torque :

1. Tighten 58.8 N-m (6.0 kg-m, 43.4 lb-ft), and fully loosen bolt.
 2. Retighten 34.3 N-m (3.5 kg-m, 25.3 lb-ft) + 60~64°
5. Install the oil pan and bed plate. Refer to "Oil pan".
 6. Install the cylinder head assembly. Refer to "Cylinder head".
 7. Install the camshaft. Refer to "Camshaft".
 8. Install the timing chain "C". Refer to "Timing chain".

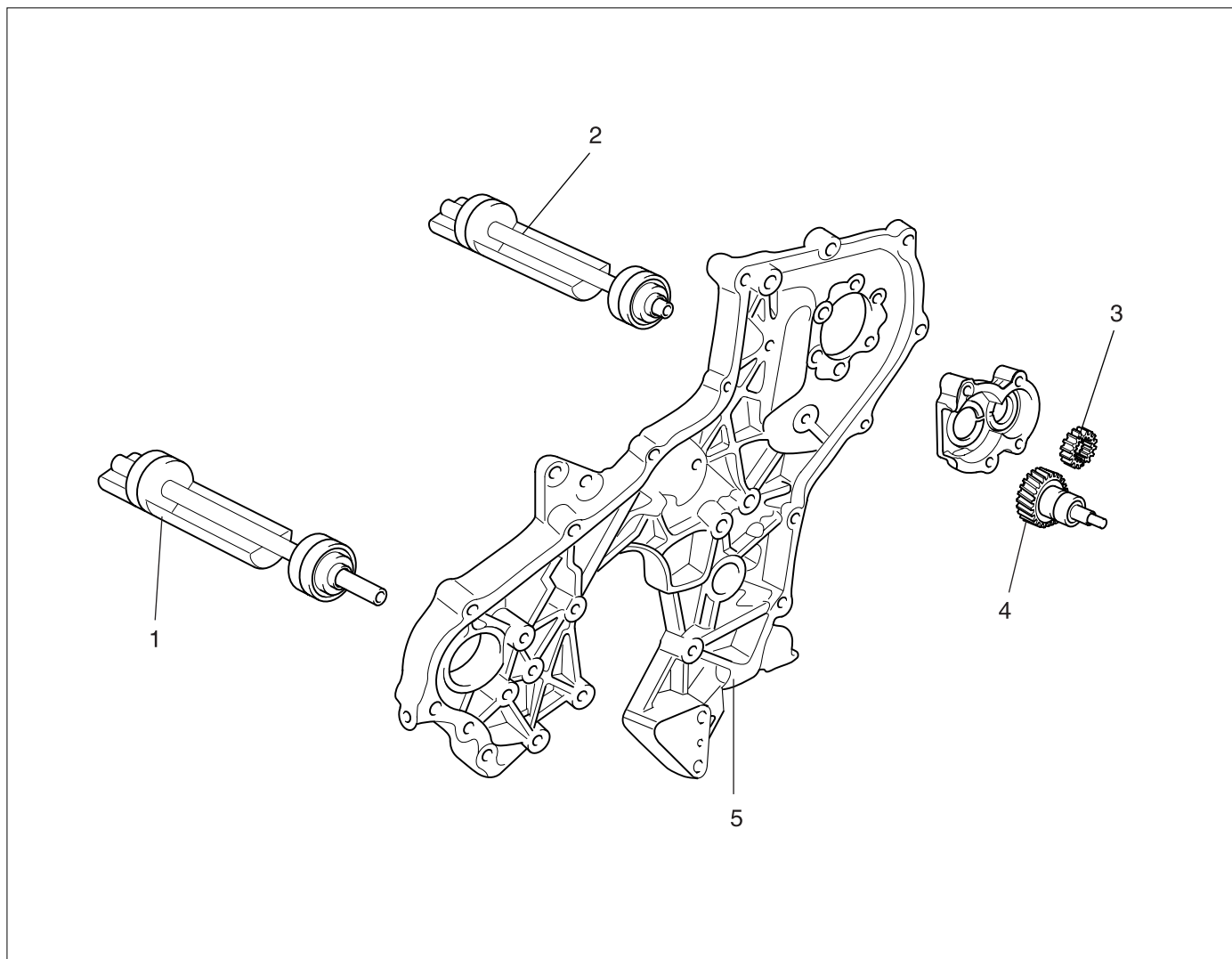
MAIN MOVING SYSTEM

EM -37

COUNTER BALANCE SHAFT

COMPONENTS

LCAC1500

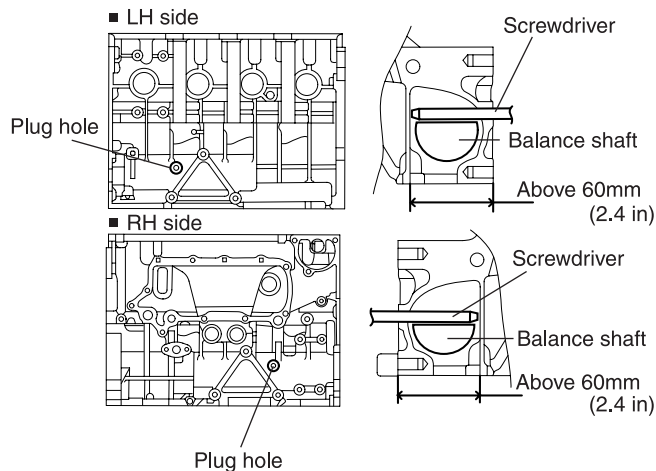


1. RH Balance shaft
2. LH Balance shaft
3. LH Balance shaft driven gear
4. LH Balance shaft drive gear
5. Timing chain lower under cover

LCAC150A

EM -38**ENGINE MECHANICAL SYSTEM****DISASSEMBLY** LCAC1510

1. Remove the timing chain A, B, C. Refer to "Timing Chain".
2. Remove the plug on the cylinder block and insert a screw driver to prevent rotation of balance shaft.



LCAC151A

3. Remove the RH balance shaft sprocket with bolt.
4. Remove the LH balance shaft sprocket with nut. Remove the LH balance shaft driven gear bolt.
5. Remove the timing chain lower under cover.
6. Remove the balance shaft.

INSPECTION LCAC1520

1. The oil holes must be free from clogging.
2. Check damage for balance shaft journal. If defects are evident, replace the balance shaft.
3. Check the balance shaft for oil clearance. If wear is excessive, replace the balance shaft or cylinder block.

Item		Specification (mm(in))
Balance shaft Journal Outer diameter	Front	48.975 - 49.000 (1.9281 - 1.9291)
	Rear	47.965 - 47.990 (1.8884 - 1.8894)
Balance shaft Bearing (Bush) Inner diameter	Front	49.050 - 49.080 (1.9311 - 1.9323)
	Rear	48.050 - 48.080 (1.8917 - 1.8929)
Oil clearance	Front	0.050 - 0.105 (0.0020 - 0.0041)
	Rear	0.060 - 0.115 (0.0024 - 0.0045)

4. Check the drive gear shaft of LH balance shaft for oil clearance. If wear is excessive, replace the drive gear or timing chain lower under cover.

Item	Specification (mm(in))
Drive gear shaft Outer diameter	23.968 - 23.980 (0.9436 - 0.9441)
Drive gear shaft bearing(bush) Inner diameter	24.004 - 24.025 (0.9450 - 0.9459)
Oil clearance	0.024 - 0.057 (0.0009 - 0.0022)

MAIN MOVING SYSTEM

EM -39

REASSEMBLY LCAC1530

1. Apply engine oil on the balance shaft journal and the balance shaft bearing (bush).
2. Insert the balance shafts into cylinder block.
3. Install the balance shaft drive gear and driven gear on the timing chain lower under cover.

Drive gear and driven gear cover :

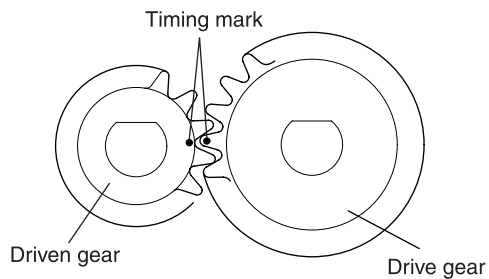
Tightening torque :

7.8-11.8 N-m (0.8-1.2 kg-m, 5.8-8.7 lb-ft)



NOTE

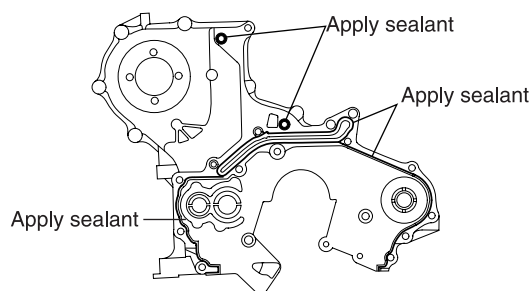
Align timing mark on the drive gear and driven gear.


LCAC153A

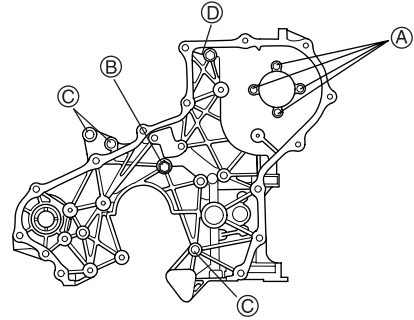
4. Apply sealant on the timing chain lower under cover after clean foreign material.

Sealant type : Lotite #5902

Bead width : 2 - 4mm (0.08 - 0.16 in)


LCAC153B

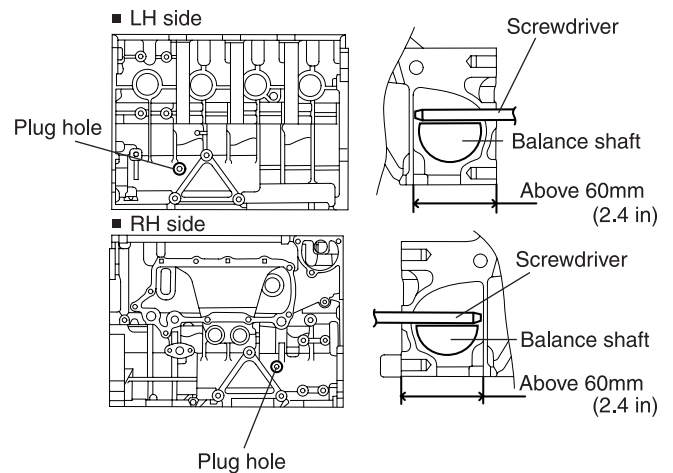
5. Install the timing chain lower under cover.


LCAC153C

Bolt	Size	Quantity	Tightening torque N-m (kg-m, lb-ft)
A	6 x 14	4 EA	9.8-11.8 (1.0-1.2, 7.2-8.7)
B	8 x 22	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
C	8 x 30	3 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
D	8 x 40	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)

* Bolts size = Diameter x Length

6. Insert a screw driver in the cylinder block plug hole. Because, prevent rotation of balance shaft.


LCAC151A

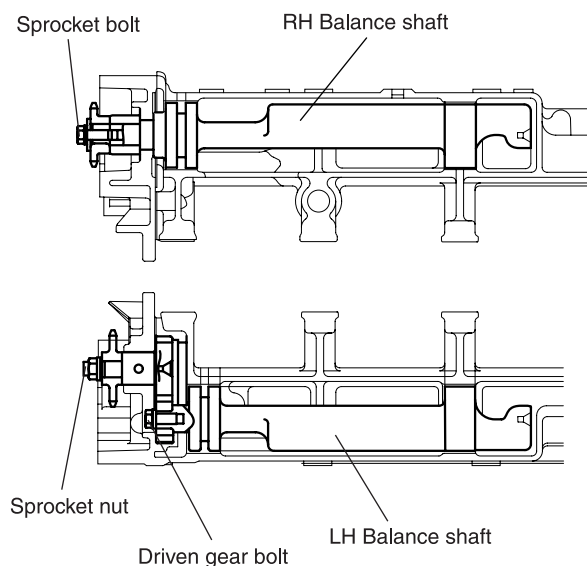
EM -40

ENGINE MECHANICAL SYSTEM

7. Install the LH balance shaft driven gear bolt(8 x 16).

Tightening torque :

33.3-39.2 N-m (3.4-4.0 kg-m, 24.6-28.9 lb-ft)



LCAC153D

8. Install the balance shaft sprocket

Tightening torque:

LH balance shaft sprocket nut:

49.0-58.8 N-m (5.0-6.0 kg-m, 36.2-43.4 lb-ft)

RH balance shaft sprocket bolt (8 x 16):

33.3-39.2 N-m (3.4-4.0 kg-m, 24.6-28.9 lb-ft)

9. Install plug on the cylinder block after remove screw driver.

Tightening torque (plug) :

14.7-21.6 N-m (1.5-2.2 kg-m, 10.8-15.9 lb-ft)

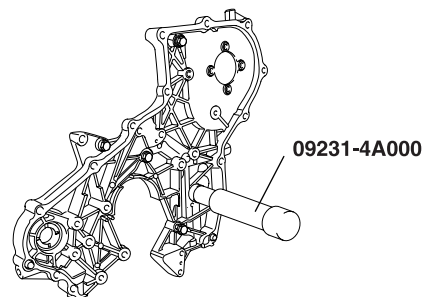
10. Install the timing chain A, B, C. Refer to "Timing chain"

REPLACEMENT

LCAC1540

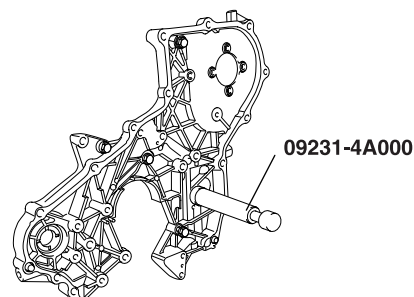
LH BALANCE SHAFT DRIVE GEAR BEARING (BUSH)

1. Use the special tool (09231-4A000) to install or remove the LH balance shaft drive gear bearing.
2. To remove the bearing, install the special tool (09231-4A000).



LCAC154A

3. When installing the bearing, apply enough fluid to the bearing surface and cover.
4. Press-fit the bearing after aligning the bearing oil hole with the timing chain lower under cover oil hole.



LCAC154B

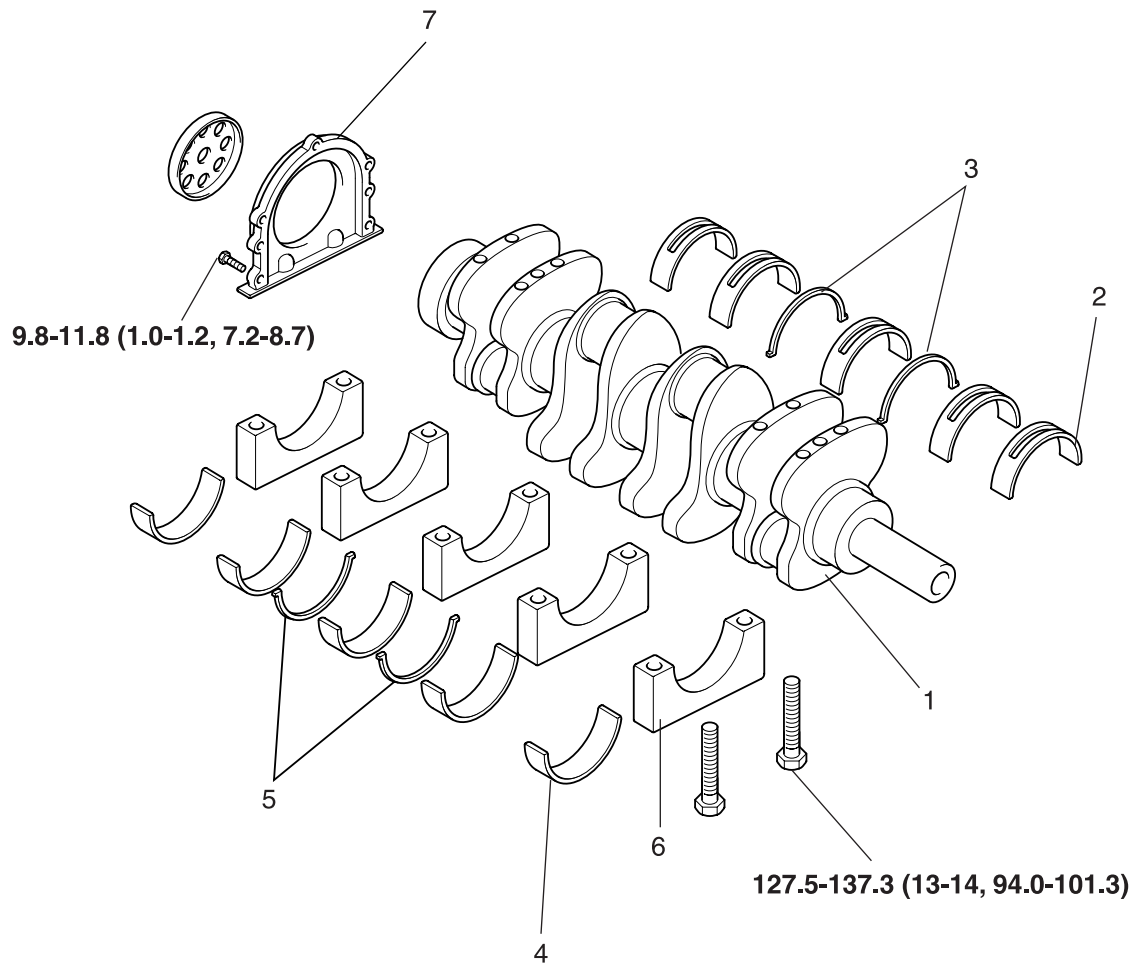
MAIN MOVING SYSTEM

EM -41

CRANK SHAFT

COMPONENTS

LCAC1600



TORQUE : N·m(kg·m, lb·ft)

- | | |
|-------------------------|-------------------------|
| 1. Crank shaft | 5. Lower thrust bearing |
| 2. Upper main bearing | 6. Main bearing cap |
| 3. Upper thrust bearing | 7. Rear oil seal case |
| 4. Lower main bearing | |

LCAC160A

EM -42

ENGINE MECHANICAL SYSTEM

DISASSEMBLY LCAC1610

1. Remove the timing chains, timing chain cover, cylinder head assembly, oil pan, bed plate and oil pump.
For details, refer to the respective chapters.
2. Remove the rear oil seal case.
3. Remove the connecting rod cap.

NOTE

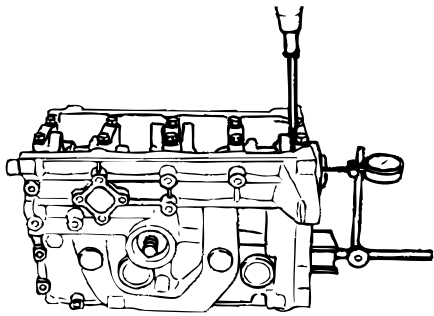
Mark the connecting rod bearing caps to be able to reassemble in the original position and direction.

4. Remove the main bearing caps and the crankshaft.
Keep the bearings in order according to the cap number.

INSPECTION LCAC1620

1. Before removing the main bearing cap, measure crankshaft end play. If end play exceeds specification, replace the thrust bearing.

End play : 0.05 - 0.25 mm (0.0020 - 0.0098 in)



LCAC162A

2. Remove the main bearing cap.
3. Measure main bearing oil clearance.
 - 1) Remove all foreign material and oil from the main journals and main bearing surface.
 - 2) Position a plastic gauge atop the main journals in axial direction .
 - 3) Install the main bearing cap and tighten bolts.

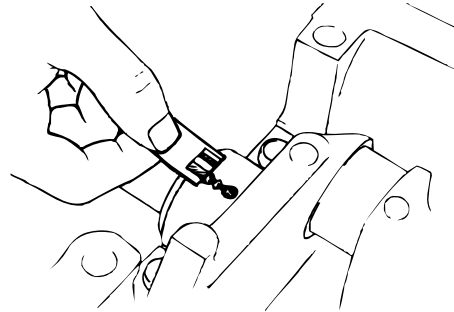
Tightening torque :

**127.5-137.3 N-m
(13-14 kg-m, 94.0-101.3 lb-ft)**

- 4) Remove the main bearing cap, and measure oil clearance at each journal.

Oil clearance :

0.024 - 0.042 mm (0.0009 - 0.0017 in)



LCAC162B

4. If oil clearance exceeds specification, replace the main bearing. Refer to "main bearing replacement".

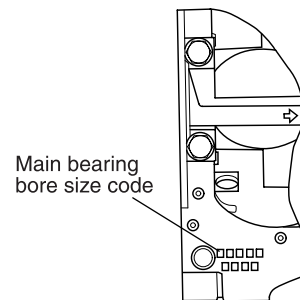
REPLACEMENT LCAC1630

MAIN JOURNAL BEARING

1. Check the cylinder block main bearing bore size code.

NOTE

Record the cylinder block main bearing bore size code letters on cylinder block as shown.
Reading order is from left to right with front main bearing bore size code shown first.



LCAC163A

CYLINDER BLOCK MAIN BEARING BORE DIAMETER

Code	Cylinder block main bearing bore diameter (mm (in))
A	71.000 - 71.006 (2.7953 - 2.7955)
B	71.006 - 71.012 (2.7955 - 2.7957)
C	71.012 - 71.018 (2.7957 - 2.7960)

MAIN MOVING SYSTEM

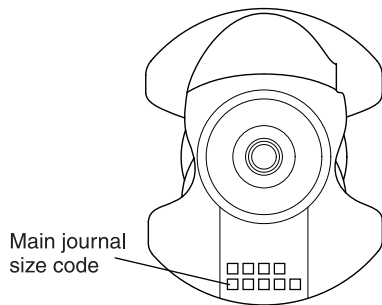
EM -43

2. Check the crankshaft main journal size code.

NOTE

Record the main journal size code letters on the crankshaft balance weight.

Reading order is from left to right as shown, with No. 1 main journal size code shown first.



LCAC163B

CRANKSHAFT MAIN JOURNAL DIAMETER

Code	Crankshaft main journal diameter (mm (in))
A	66.994 - 67.000 (2.6376 - 2.6378)
B	66.988 - 66.994 (2.6373 - 2.6376)
C	66.982 - 66.988 (2.6371 - 2.6373)

3. Choose proper main journal bearing in below table.

MAIN JOURNAL BEARING SELECTION TABLE

Main journal bearing		Cylinder block main bearing bore size code		
		A	B	C
Crankshaft pin journal Size code	A	Green	Yellow	None
	B	Yellow	None	Blue
	C	None	Blue	Red

Main journal bearing oil clearance :
0.024 - 0.042 mm (0.0009 - 0.0017 in)

MAIN JOURNAL BEARING THICKNESS

Color	Main journal bearing thickness (mm (in))
Red	1.997 - 2.000 (0.0786 - 0.0787)
Blue	1.994 - 1.997 (0.0785 - 0.0786)
None	1.991 - 1.994 (0.0784 - 0.0785)
Yellow	1.988 - 1.991 (0.0783 - 0.0784)
Green	1.985 - 1.988 (0.0781 - 0.0783)

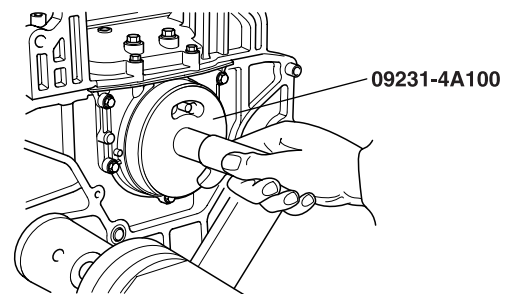
LCAC1640

REAR OIL SEAL

1. Temporarily install a new rear oil seal to the oil seal case and install the special tool (09231-4A100) through the rear oil seal case.

NOTE

Apply engine fluid to the circumference of oil seal lip.



LCAC164A

REASSEMBLY

LCAC1650

1. Install the main bearing on the cylinder block and main bearing cap.
2. Install the main bearing cap after place crankshaft and thrust bearing on the cylinder block.

Tightening torque :

127.5-137.3 N-m (13-14 kg-m, 94.0-101.3 lb-ft)

3. Install the connecting rod cap.

Tightening torque :

1. **Tighten 58.8 N-m (6.0 kg-m, 43.4 lb-ft), and fully loosen bolt.**

2. **Retighten 34.3 N-m (3.5 kg-m, 25.3 lb-ft) + 60~64°**

4. Install the rear oil seal case.

Tightening torque :

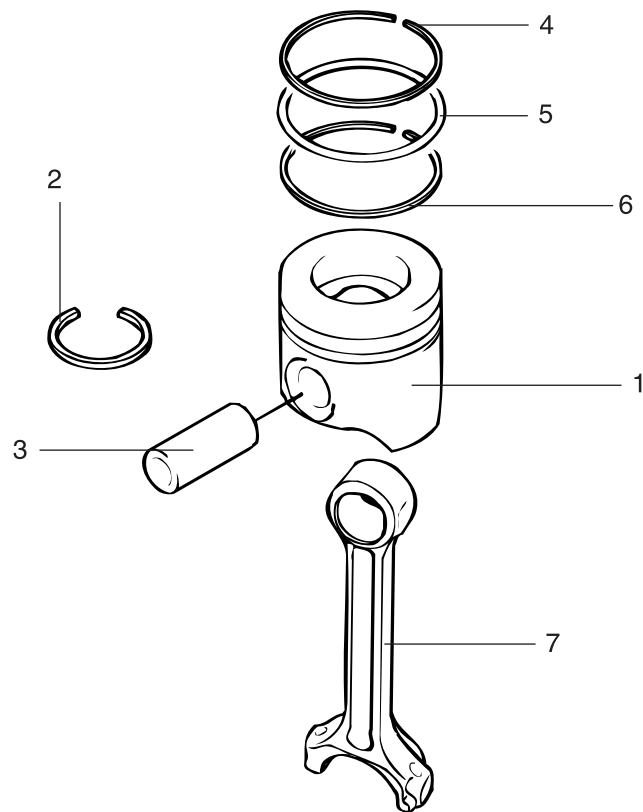
9.8-11.8 N-m (1.0-1.2 kg-m, 7.2-8.7 lb-ft)

5. Install the oil pump, bed plate, oil pan, cylinder head assembly, timing chain cover and timing chains. For details, refer to the respective chapters.

PISTON

COMPONENTS

LCAC1460



- | | |
|---------------------|---------------------|
| 1. Piston | 5. Piston ring No.2 |
| 2. Snap ring | 6. Oil ring |
| 3. Piston pin | 7. Connecting rod |
| 4. Piston ring No.1 | |

MAIN MOVING SYSTEM

EM -45

DISASSEMBLY

LCAC1410

1. Remove the timing chain "C". Refer to "Timing chain".
2. Remove the camshaft. Refer to "Camshaft".
3. Remove the cylinder head assembly. Refer to "Cylinder head".
4. Remove the oil pan and bed plate. Refer to "Oil pan".
5. Remove the connecting rod cap.



NOTE

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

6. Remove the piston and connecting rod assembly from the cylinder block.
7. Remove the piston pin with snap ring.
8. Remove the piston from connection rod.
9. Remove the piston ring from piston.

INSPECTION

LCAC1470

PISTON

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature).

Piston pin outer diameter :

32.993-32.998 mm (1.2989-1.2991 in)

Piston pin hole inner diameter :

33.000-33.005 mm (1.2992-1.2994 in)

Connecting rod small-end inner diameter :

33.020-33.033 mm (1.3000-1.3005 in)

LCAC1480

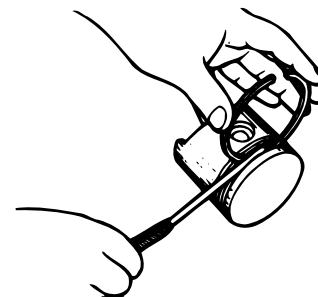
PISTON RING

1. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings.
2. When the piston requires replacement, its ring should also be replaced.
3. Measure the clearance between piston ring and ring groove.

Piston ring side clearance :

No.2 ring : 0.05-0.09 mm (0.0020-0.0035 in)

Oil ring : 0.04-0.08 mm (0.0016-0.0031 in)



LCAC148A

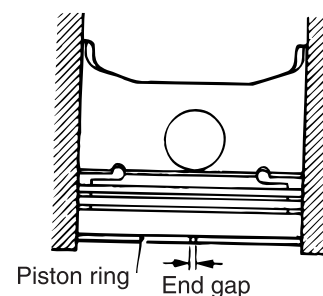
4. Place a piston ring in the cylinder bore and set it square by pushing it down with piston.
5. Measure the end gap using a thickness gauge.

Eng gap :

No.1 ring : 0.25-0.40 mm (0.0098-0.0157 in)

No.2 ring : 0.50-0.70 mm (0.0197-0.0276 in)

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



LCAC148B

EM -46

ENGINE MECHANICAL SYSTEM

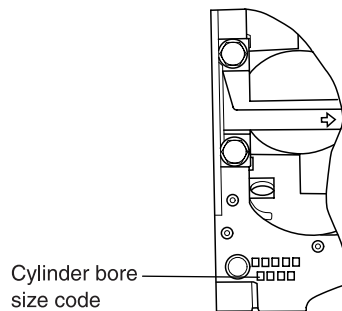
REPLACEMENT

LCAC1490

PISTON

1. Check the cylinder bore size code on the cylinder block bottom face.

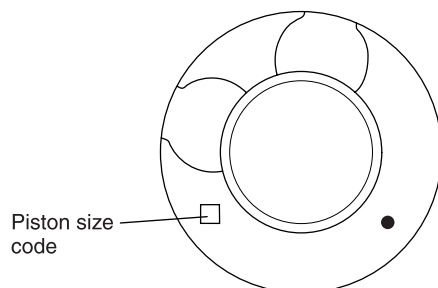
Code	Cylinder bore inner diameter (mm (in))
A	91.000-91.010 (3.5827-3.5831)
B	91.010-91.020 (3.5831-3.5835)
C	91.020-91.030 (3.5835-3.5839)



LCAC149A

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

Code	Piston outer diameter (mm (in))
A	90.910-90.920 (3.5791-3.5795)
B	90.920-90.930 (3.5795-3.5799)
C	90.930-90.940 (3.5799-3.5803)



LCAC149B

3. Select the piston related to cylinder bore size code.

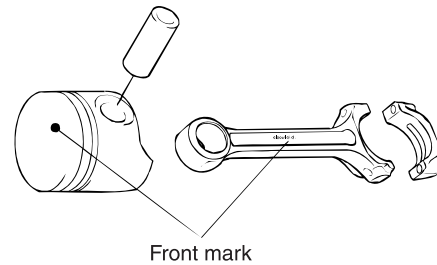
Oil clearance : 0.080-0.100 mm (0.0031-0.0039 in)

REASSEMBLY

LCAC1440

PISTON PIN

1. Check the front mark of the piston and connecting rod.



LCAC144A

2. Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position.
3. Install the snap ring.

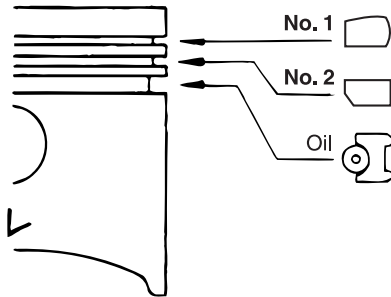
MAIN MOVING SYSTEM

EM -47

LCAC1491

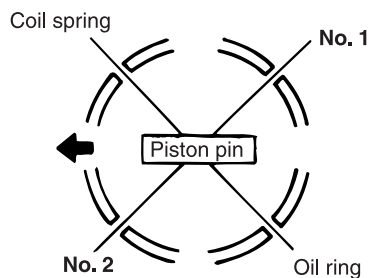
PISTON RING

1. Install the coil spring and oil ring to the piston. Then, install No.2 piston ring and No.1 piston ring in that order. Make sure that the ring side on which manufacturer and size marks are stamped, faces to the piston crown.



LCAC149C

2. Position ends of piston ring and oil rings as illustrated.

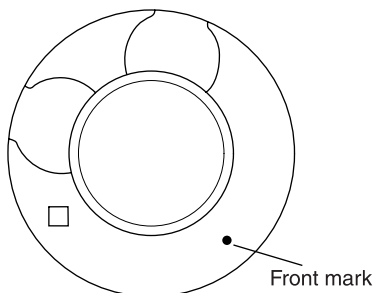


LCAC149D

LCAC1450

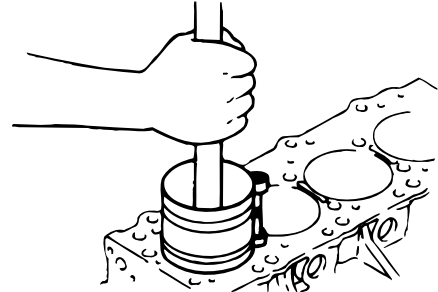
PISTON AND CONNECTING ROD ASSEMBLY

1. Insert the piston and connecting rod assembly from above the top of cylinder. Ensure that the front mark on the piston crown and that (front mark) on the connecting rod face toward the front of engine (to the crankshaft pulley side).



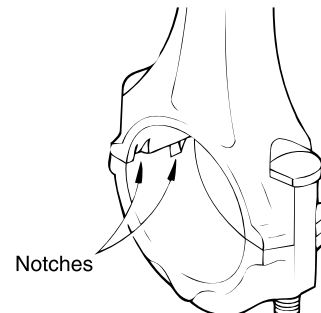
LCAC145A

2. Clamp firm the piston rings with the ring band and install the piston assembly into cylinder. Do not strike it hard into the piston, as broken piston ring or damaged crankshaft pin journal could result.



LCAC145B

3. Install the connecting rod bearing on the connecting rod and cap.



LCAC145C

4. Install the connecting rod and cap to crankshaft pin journal.

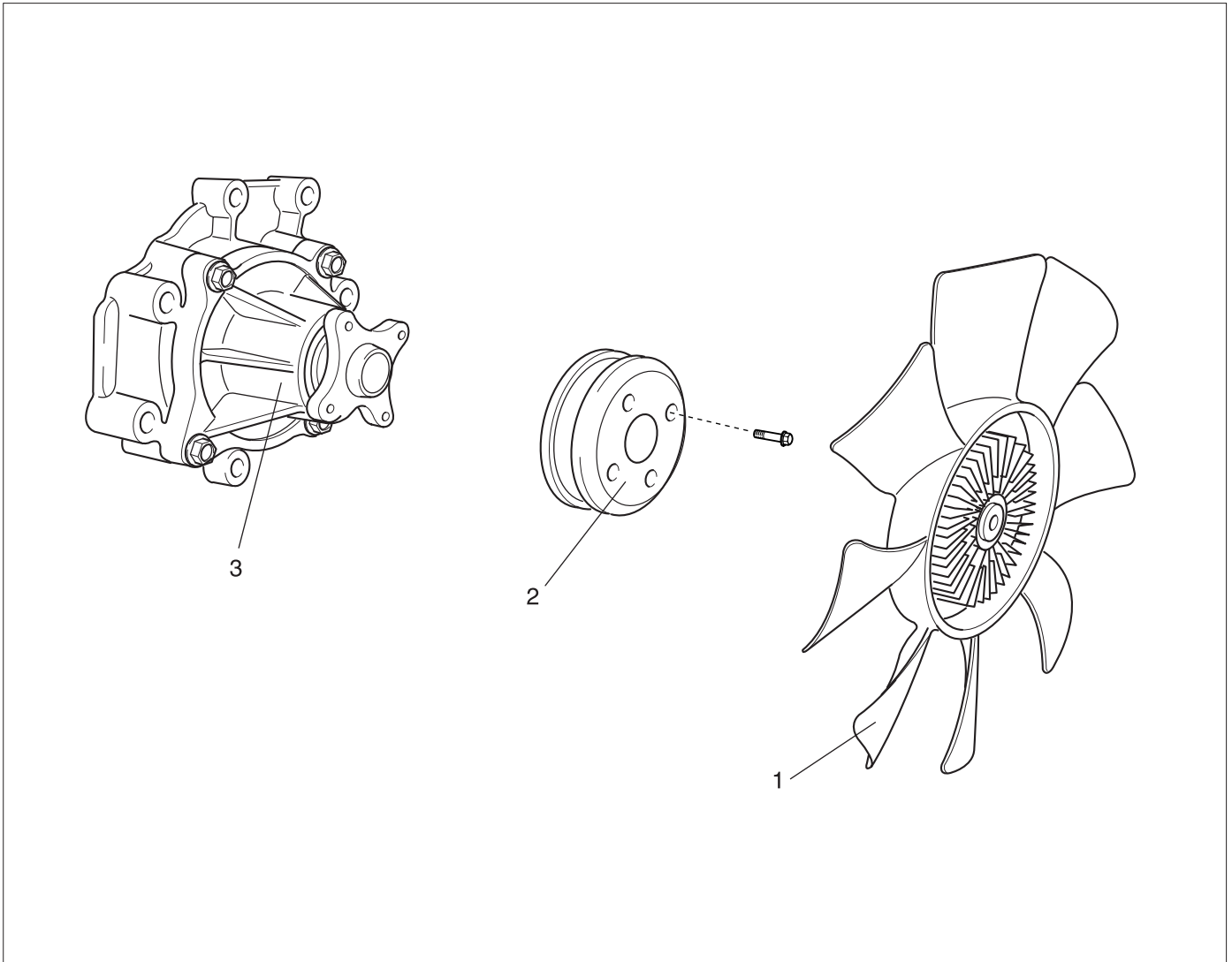
Tightening torque :

1. Tighten 58.8 N-m (6.0 kg-m, 43.4 lb-ft), and fully loosen bolt.
2. Retighten 34.3 N-m (3.5 kg-m, 25.3 lb-ft) + 60~64°
5. Install the oil pan and bed plate. Refer to "Oil pan".
6. Install the cylinder head assembly. Refer to "Cylinder head".
7. Install the camshaft. Refer to "Camshaft".
8. Install the timing chain "C". Refer to "Timing chain".

COOLING SYSTEM

ENGINE COOLANT PUMP

COMPONENTS LCAC1800



- 1. Cooling fan
- 2. Water pump pulley
- 3. Water pump

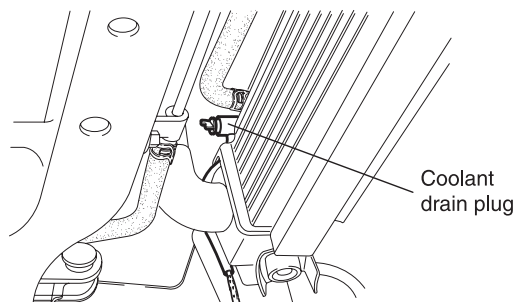
COOLING SYSTEM

EM -49

DISASSEMBLY

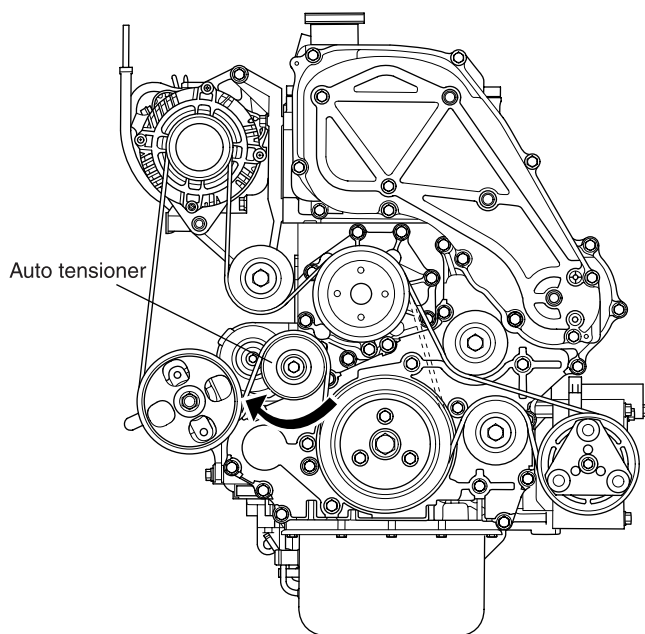
LCAC1810

1. Drain the engine coolant.



LCAC120B

2. Remove the radiator cowl upper cover.
3. Loosen the drive belt tension by turn auto-tensioner with spanner, and then remove the drive belt.



LCAC120H

4. Remove the cooling fan.
5. Remove the water pump from cylinder block.

INSPECTION

LCAC1820

1. Check the pump for cracks, damage of wear. Replace the water pump assembly if necessary.
2. Check the bearing for damage, abnormal noise, and sluggish rotation. Replace the water pump assembly if necessary.
3. Check the seal for leaks. Replace the water pump assembly if necessary.

REASSEMBLY

LCAC1830

1. Install the water pump with new gasket to the cylinder block.

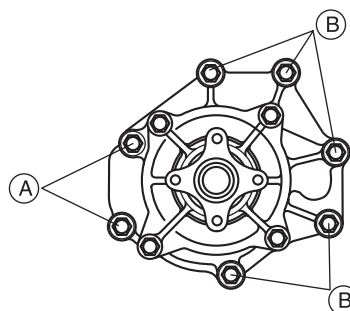
Tightening torque :

A bolts (8x45) 2EA :

19.6-26.5 N·m (2.0-2.7 kg·m, 14.5-19.5 lb·ft)

B bolts (8x45) 2EA :

19.6-26.5 N·m (2.0-2.7 kg·m, 14.5-19.5 lb·ft)

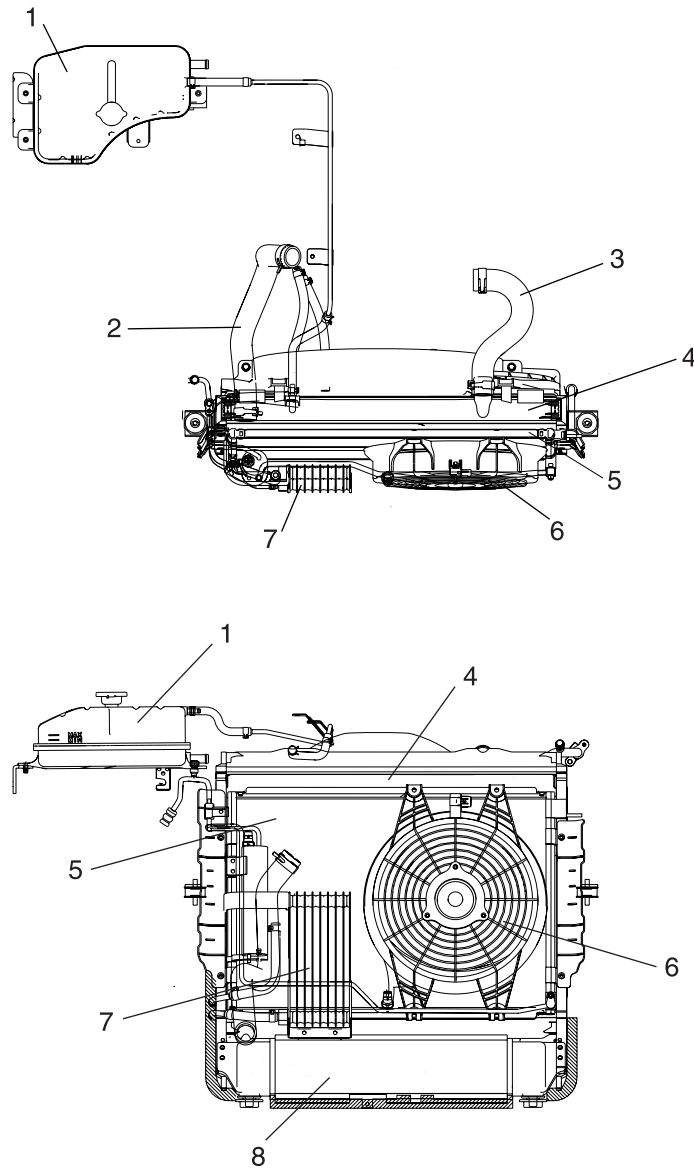


LCAC183A

2. Install the cooling fan.
3. Install the drive belt.
4. Install the radiator cowl upper cover.
5. Refill the engine coolant.

RADIATOR

COMPONENT LCAC1900



- | | |
|------------------------|------------------------------|
| 1. Reservoir tank | 5. Air conditioner condenser |
| 2. Radiator lower hose | 6. Condenser fan |
| 3. Radiator upper hose | 7. ATF oil cooler |
| 4. Radiator | 8. Inter cooler |

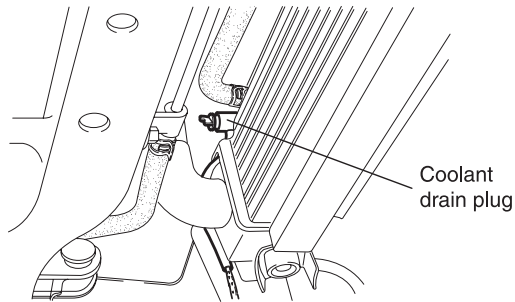
COOLING SYSTEM

EM -51

REMOVAL

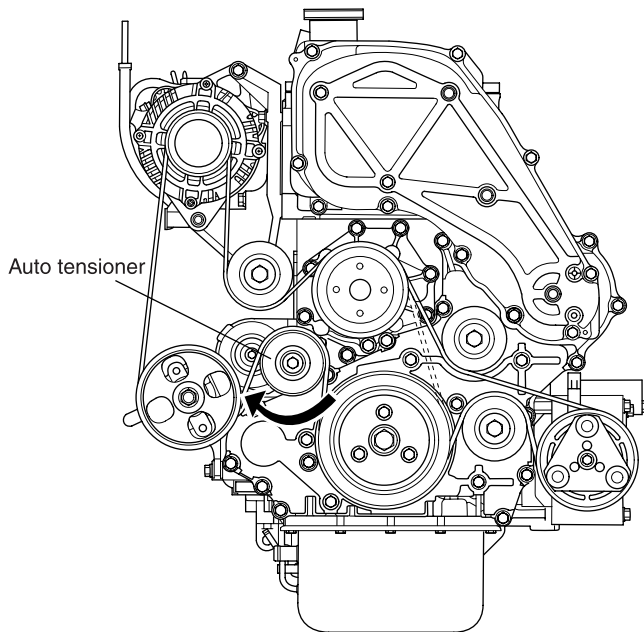
LCAC1910

1. Drain the engine coolant.



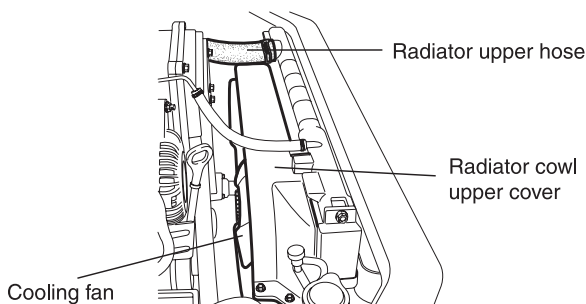
LCAC120B

2. Remove the battery negative terminal.
3. Loosen the drive belt tension by turn auto-tensioner with spanner, and then remove the drive belt.



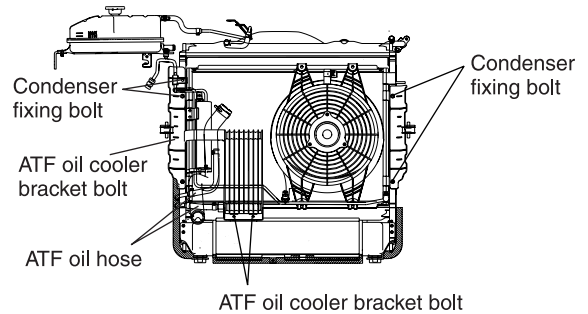
LCAC120H

4. Remove the radiator upper hose and lower hose.
5. Remove the radiator cowl upper cover.



LCAC120I

6. Remove the cooling fan.
7. Remove the radiator cowl lower cover.
8. Remove the air-con condenser fixing bolt and the ATF oil cooler bracket fixing bolt from the radiator assembly.



LCAC191D

9. Remove the ATF oil hoses.
10. Remove the radiator assembly from engine room, after remove the radiator assembly bracket fixing nut.
11. Remove the inter cooler from the radiator assembly.

INSPECTION

LCAC1920

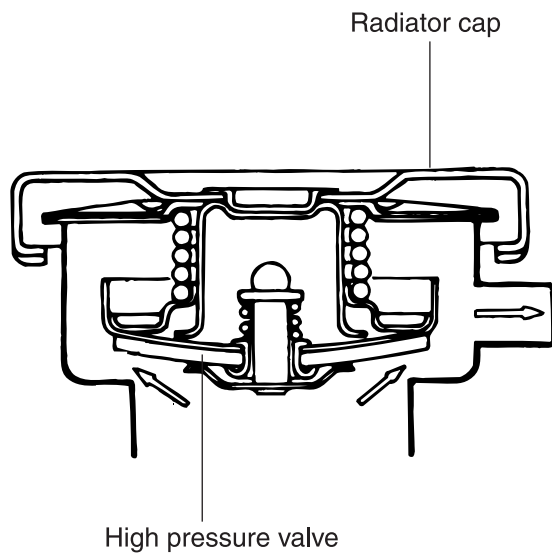
1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the ATF oil cooler hoses for cracking, damage or deterioration.

INSTALLATION LCAC1930

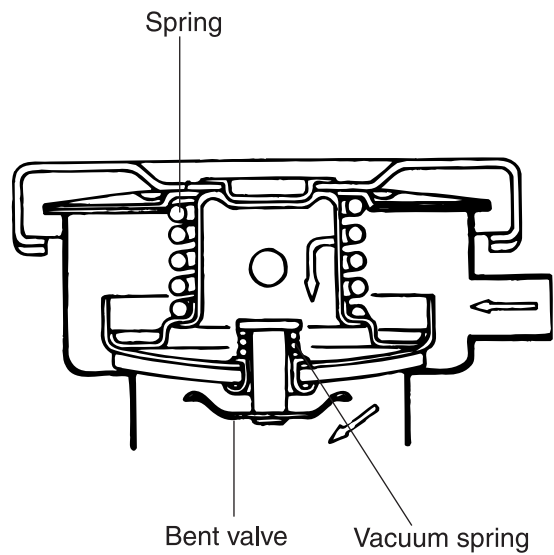
1. Install the inter cooler to the radiator assembly.
2. Install the radiator assembly to engine room.
3. Install the ATF oil hoses.
4. Install the air-con condenser and the ATF oil cooler to the radiator assembly.
5. Install the radiator cowl lower cover.
6. Install the cooling fan.
7. Install the radiator cowl upper cover.
8. Install the radiator upper hose and lower hose.
9. Install the drive belt.
10. Refill the engine coolant.

RADIATOR CAP

COMPONENTS LCAC2100



Pressure : 107.9±14.7 (1.1±0.15, 15.64±2.13)

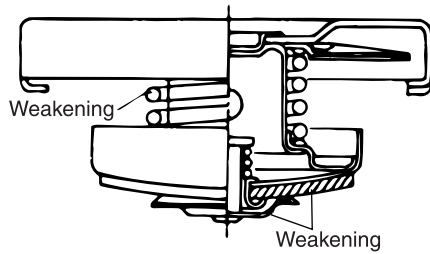


Pressure : 83.4 (0.85, 12.1)

PRESSURE : Kpa (kg/cm², psi)

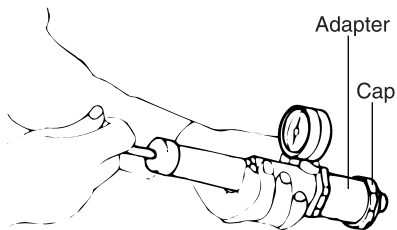
INSPECTION LCAC2110

1. Check the radiator cap for damage, cracks or weakening.



LCAC211A

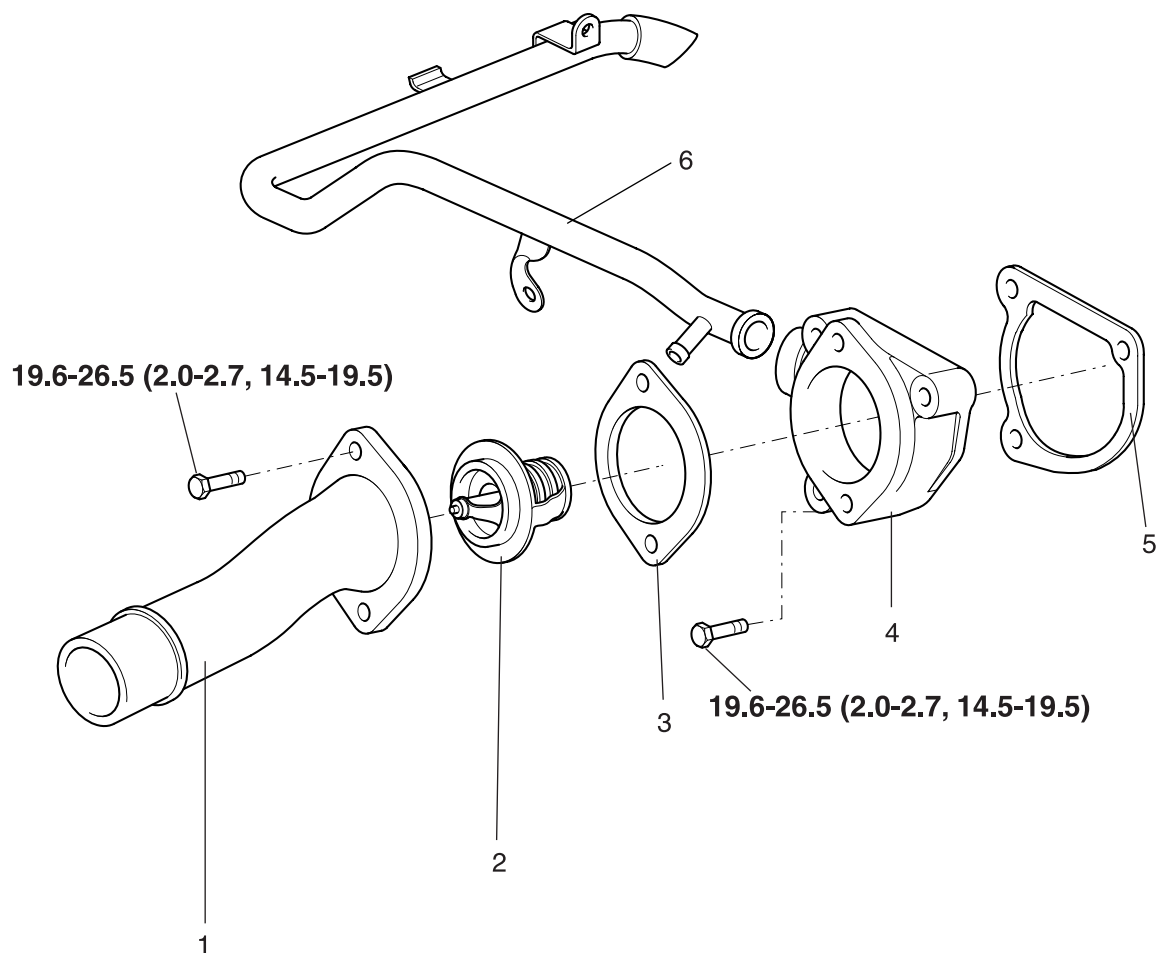
2. Connect the tester to the radiator cap.
3. Increase the pressure until the indicator stops moving.
4. Replace the radiator cap if the reading does not hold steady for about 10 seconds.



LCAC211B

THERMOSTAT

COMPONENTS LCAC2200



TORQUE : N·m (kg·m, lb·ft)

1. Water inlet fitting
2. Thermostat
3. Gasket
4. Thermostat housing
5. Gasket
6. Water pipe

EM -56

ENGINE MECHANICAL SYSTEM

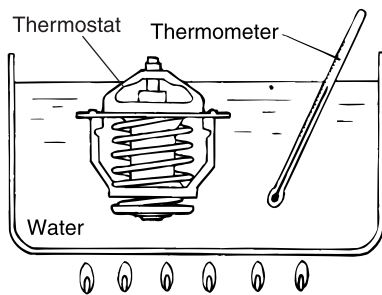
REMOVAL LCAC2210

1. Drain the coolant so its level is below the thermostat.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.

INSPECTION LCAC2220

1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Verify the temperature at which the valve begins to open.

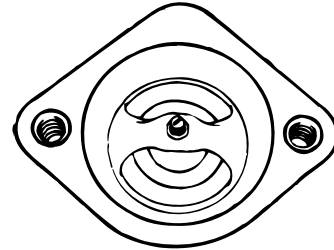
Valve opening temperature : 82°C(180°F)
Valve closing temperature : 77°C(171°F)
Full opening temperature : 95°C(203°F)



LCAC222A

INSTALLATION LCAC2230

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install the inlet fitting.



LCAC223A

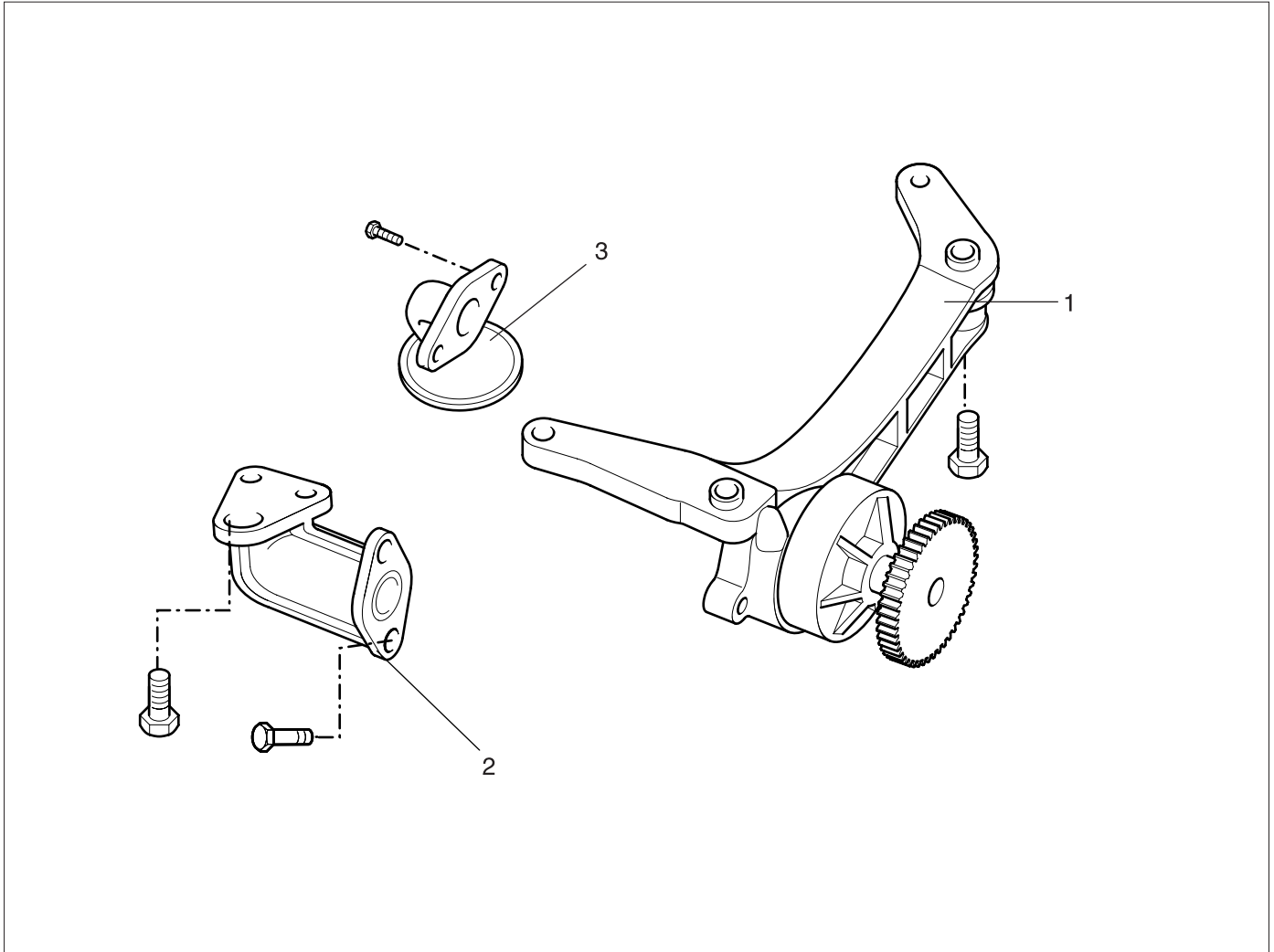
Tightening torque
Engine coolant inlet fitting bolt :
19.6 - 26.5 Nm(2.0-2.7kg.m, 14.5-19.5 lb.ft)

3. Refill the coolant.

LUBRICATION SYSTEM

OIL PUMP

COMPONENTS LCAC2300



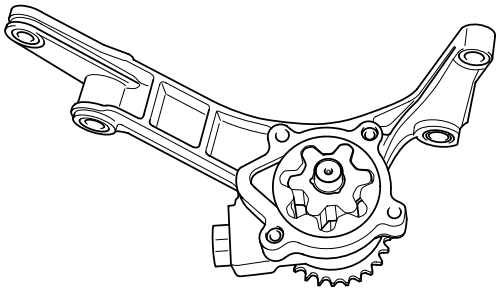
1. Oil pump
2. Oil feed pipe
3. Oil screen

EM -58**ENGINE MECHANICAL SYSTEM****DISASSEMBLY** LCAC2310

1. Drain engine oil.
2. Remove the timing chain "C" and "B". Refer to "Timing chain".
3. Remove the oil pan. Refer to "Oil pan".
4. Remove the oil feed pipe from the oil pump and bed plate.
5. Remove the oil pump assembly from the cylinder block.
6. Remove the oil screen from the oil pump.

INSPECTION LCAC2320

1. Make sure the outer rotor and inner rotor turn smoothly with no excessive play between them.
2. Check the side clearance and body clearance.



LCAC232A

Side clearance :**Inner rotor : 0.040-0.085 mm (0.0016-0.0033 in)****Outer rotor : 0.050-0.100 mm (0.0020-0.0039 in)****Body clearance (Between outer rotor and body):
0.100-0.176 mm (0.0039-0.0069 in)**

3. If clearance is excessive, replace the oil pump.

REASSEMBLY LCAC2330

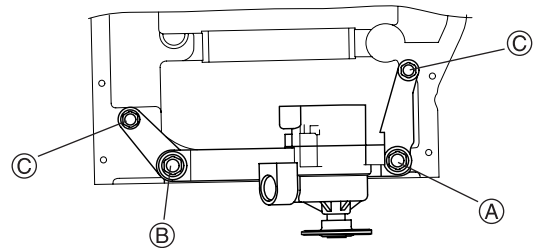
1. Install the oil screen to the oil pump.

Tightening torque :**19.6-26.5 N-m (2.0-2.7 kg-m, 14.5-19.5 lb-ft)**

2. Install the oil pump assembly to the cylinder block.

Bolt	Size	Quantity	Tightening torque N-m (kg-m, lb-ft)
A	10 x 35	1 EA	42.2-53.9 (4.3-5.5, 31.1-39.8)
B	10 x 60	1 EA	42.2-53.9 (4.3-5.5, 31.1-39.8)
C	8 x 22	2 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)

* Bolts size = Diameter x Length



LCAC233A

3. Install the oil feed pipe to the oil pump and bed plate.

Tightening torque :**19.6-26.5 N-m (2.0-2.7 kg-m, 14.5-19.5 lb-ft)**

4. Install the oil pan. Refer to "Oil pan"
5. Install the timing chain "B" and "C". Refer to "Timing chain".
6. Refill engine oil and check for oil leak.

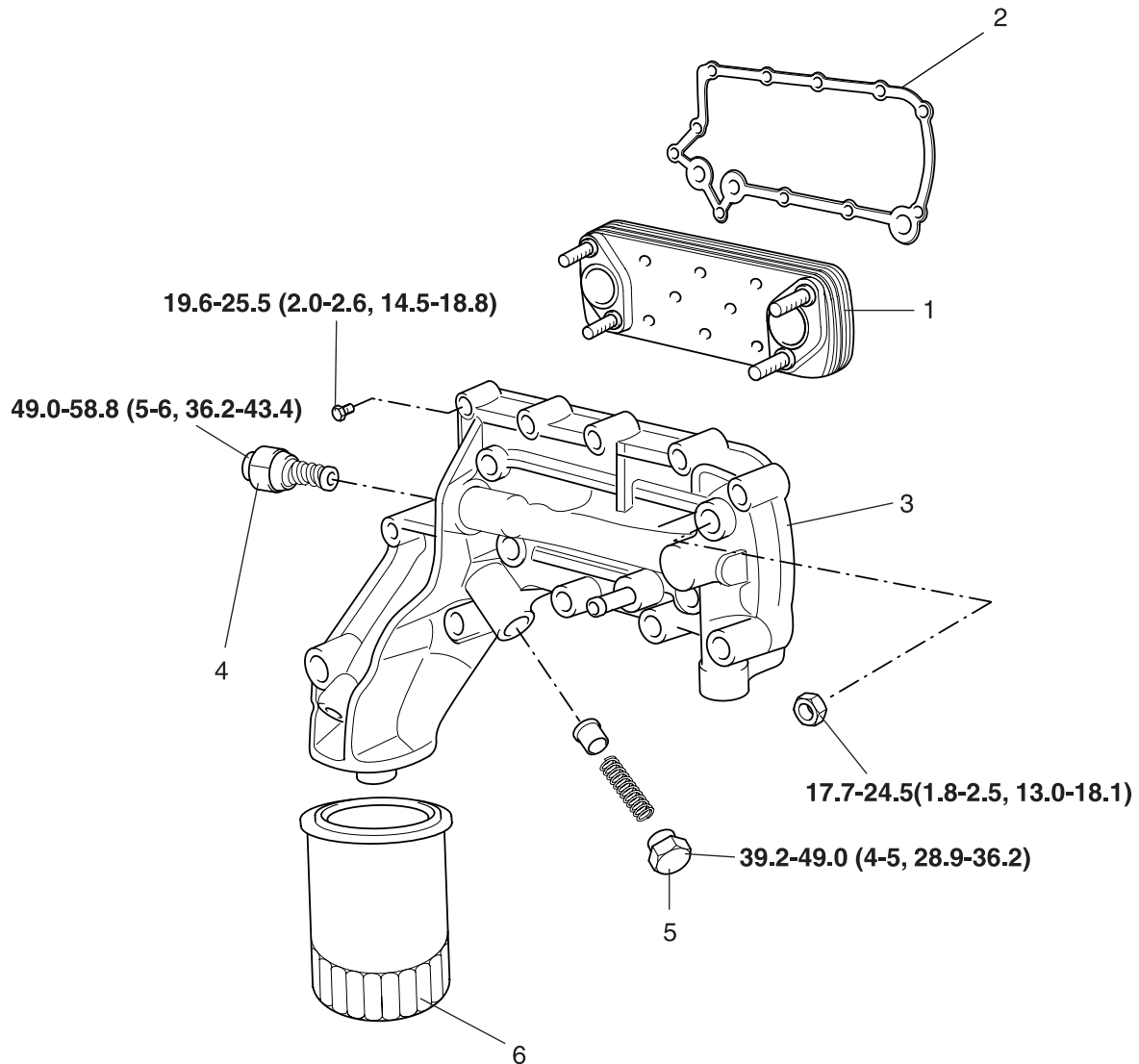
LUBRICATION SYSTEM

EM -59

OIL COOLER

COMPONENTS

LCAC2400



TORQUE : N·m (kg·m, lb·ft)

1. Oil cooler
2. Gasket
3. Oil cooler cover
4. Oil cooler by-pass valve
5. Relief valve plug
6. Oil filter

LCAC240A

REMOVAL

LCAC2410

2. Remove the engine oil filter.

1. Drain engine coolant and engine oil.

EM -60

ENGINE MECHANICAL SYSTEM

3. Remove the oil cooler assembly from the cylinder block.
4. Remove the oil cooler from the oil cooler cover.
5. Remove the oil cooler by-pass valve and the relief valve from the oil cooler cover.

LCAC2430

OIL COOLER BY-PASS VALVE

1. Check that the valve operates properly.
2. Verify the temperature at which the valve begins to open.

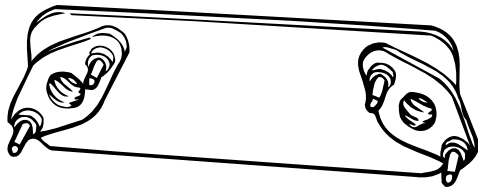
Item	Temperature iÆC (iÆF)	Lift mm (in)
Valve opening temperature	91.5-94.5 (196.7-202.1)	0.05 (0.002)
Full opening temperature	97-103 (206.6-217.4)	5 (0.197)
Full lift	150 (302)	Below 11 (0.433)

INSPECTION

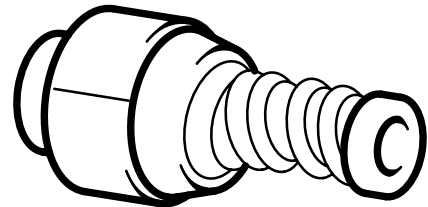
LCAC2420

OIL COOLER

1. Inspect visually the core for clogging or damage, and replace it if a problem is found.



LCAC242A

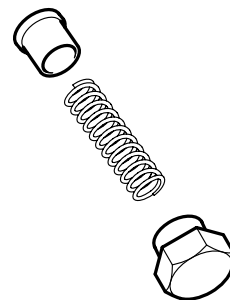


LCAC243A

LCAC2440

OIL RELIEF VALVE

1. Check the relief plunger for wear or damage.
2. Check the relief spring for weak.



LCAC244A

LUBRICATION SYSTEM

EM -61

INSTALLATION

LCAC2450

6. Check for oil and coolant leak.

1. Install the oil cooler by-pass valve and the relief valve to the oil cooler cover.

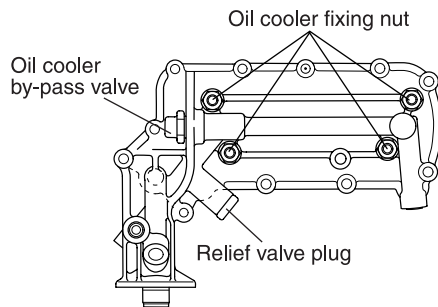
Tightening torque :

Oil cooler by-pass valve :

49.0-58.8 N-m (5-6 kg-m, 36.2-43.4 lb-ft)

Relief valve plug :

39.2-49.0 N-m (4-5 kg-m, 28.9-36.2 lb-ft)



LCAC245A

2. Install the oil cooler to oil cooler cover

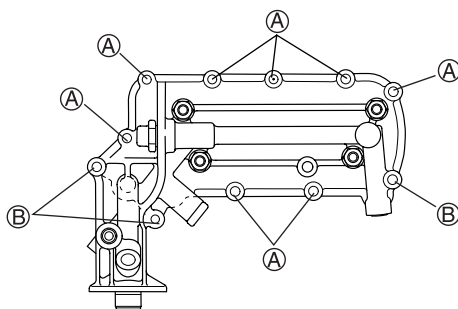
Tightening torque :

17.7-24.5 N-m (1.8-2.5 kg-m, 13.0-18.1 lb-ft)

3. Install the oil cooler assembly to the cylinder block with new gasket.

Bolt	Size	Quantity	Tightening torque N-m (kg-m, lb-ft)
A	8 x 35	8 EA	19.6-25.5 (2.0-2.6, 14.5-18.8)
B	8 x 60	3 EA	19.6-25.5 (2.0-2.6, 14.5-18.8)

Bolt size = Diameter x Length



LCAC245B

4. Install the engine oil filter.

Tightening torque :

19.6-24.5 N-m (2.0-2.5 kg-m, 14.5-18.1 lb-ft)

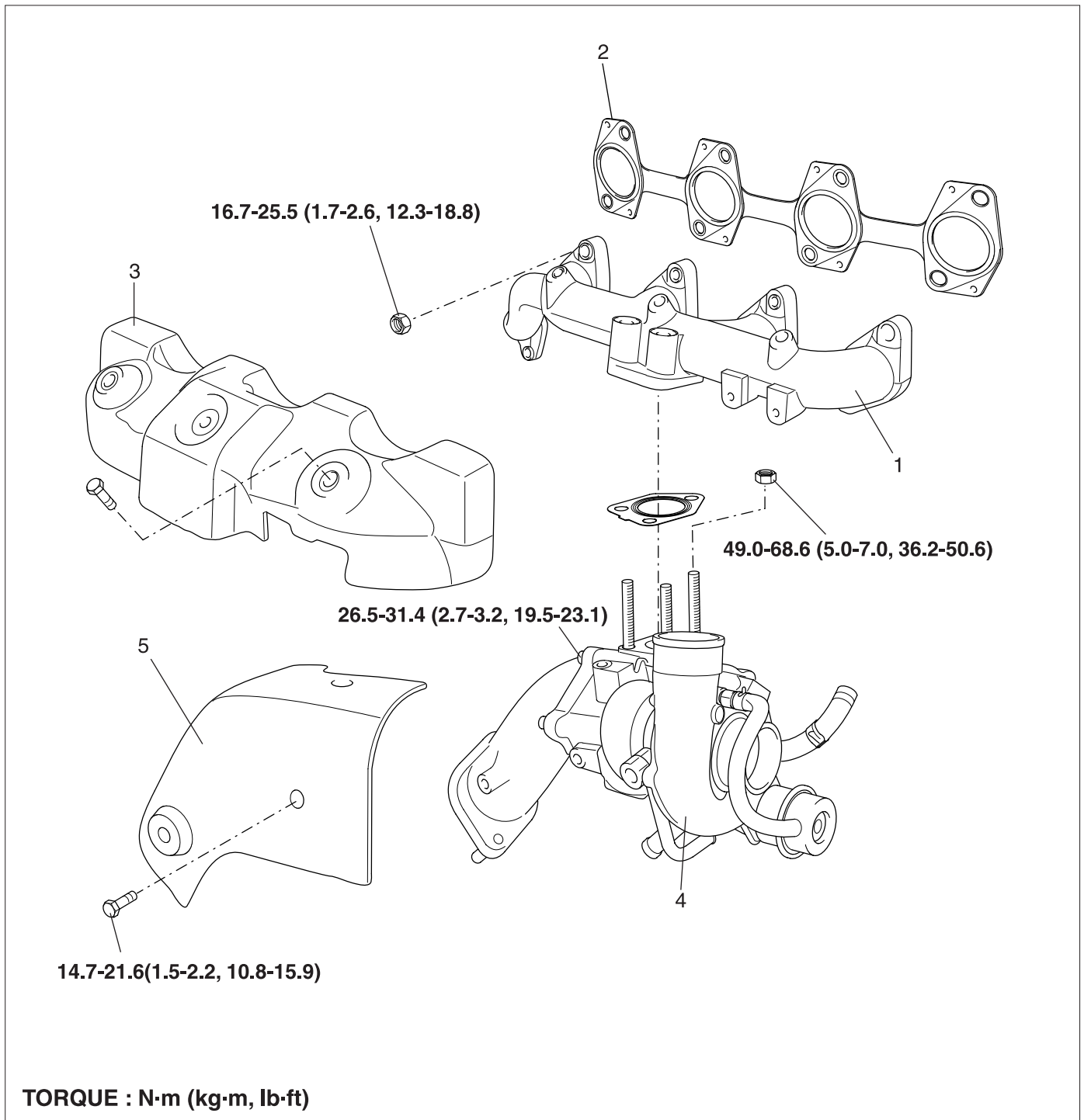
5. Refill the engine oil and engine coolant.

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

COMPONENTS

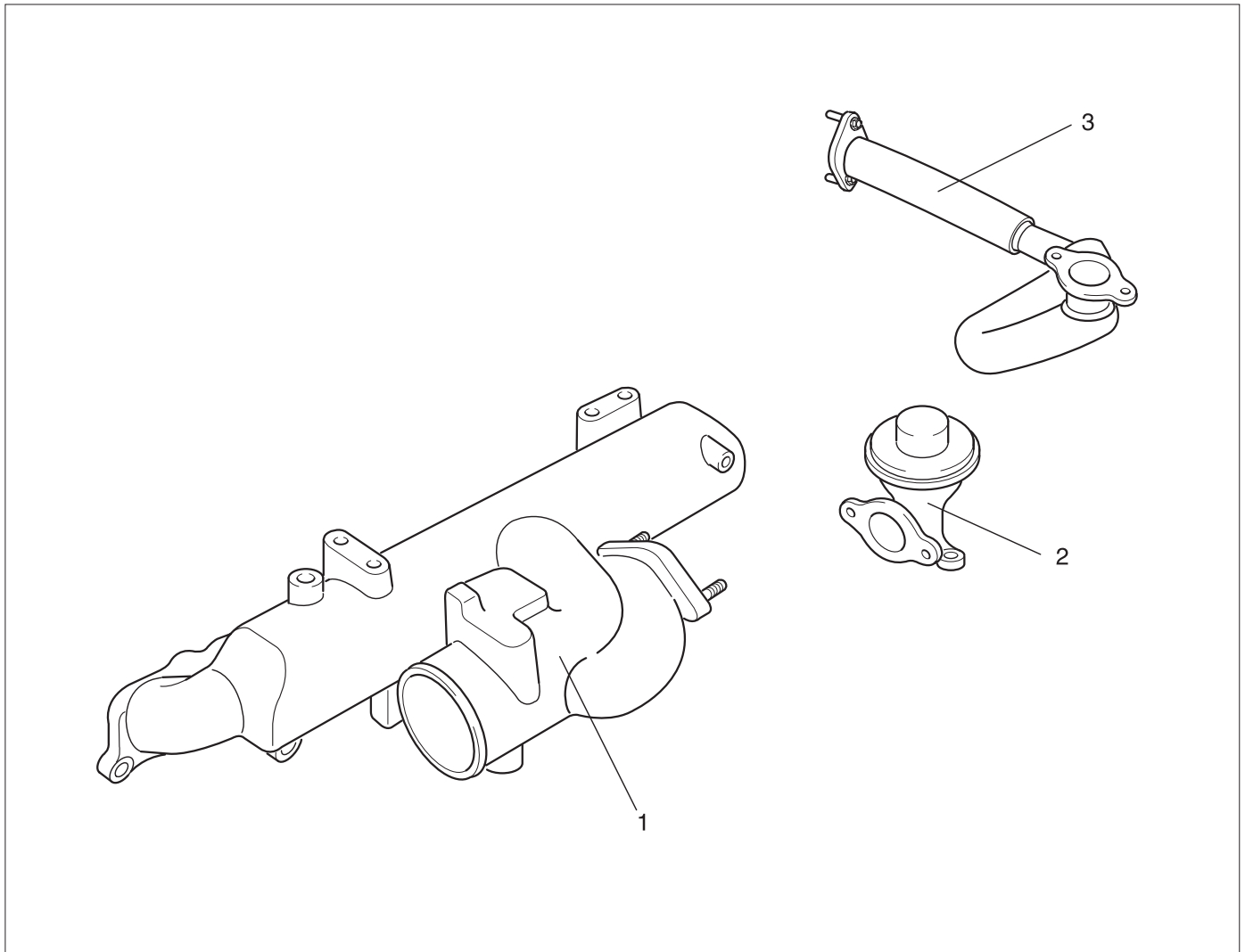
LCAC2500



1. Exhaust manifold
2. Gasket
3. Heat protector
4. Turbo charger assembly
5. Heat protector

INTAKE MANIFOLD

COMPONENTS LCAC2600



1. Intake manifold
2. EGR valve
3. EGR pipe

EM -64

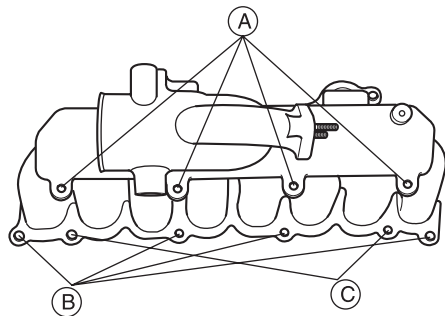
ENGINE MECHANICAL SYSTEM

INSTALLATION LCAC2610

1. Install the intake manifold with new gasket.

Bolt	Size	Quantity	Tightening torque N-m (kg-m, lb-ft)
A	8 x 112	4 EA	14.7-19.6 (1.5-2.0, 10.8-14.5)
B	8 x 32	4 EA	14.7-19.6 (1.5-2.0, 10.8-14.5)
C	Nut	2 EA	14.7-19.6 (1.5-2.0, 10.8-14.5)

* Bolts size = Diameter x Length



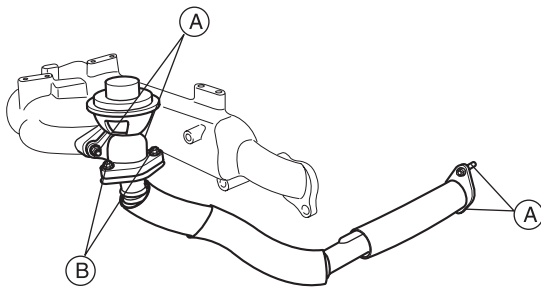
LCAC261A

2. Install the EGR valve and pipe.

Tightening torque :

A Nuts(4EA) :
16.7-25.5N-m(1.7-2.6 kg-m,12.3-18.8 lb-ft)

B Bolts(2EA) :
16.7-25.5N-m(1.7-2.6 kg-m,12.3-18.8 lb-ft)



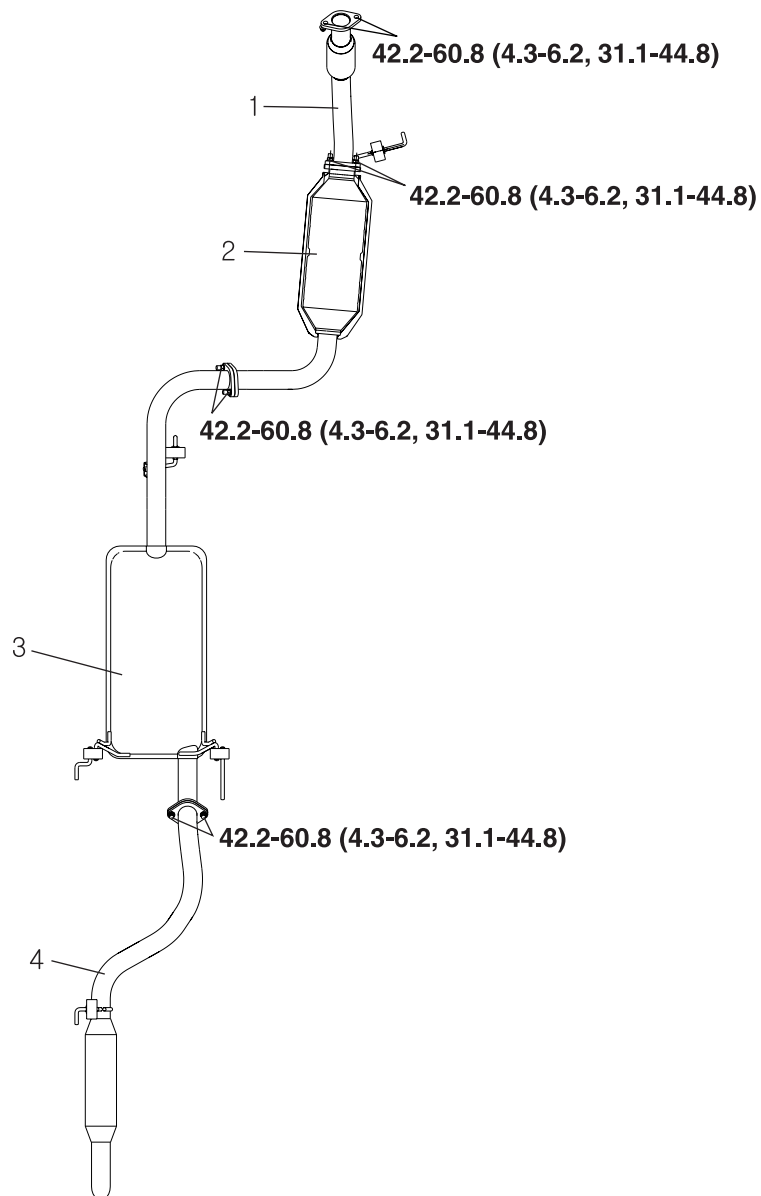
LCAC261B

INTAKE AND EXHAUST SYSTEM

EM -65

MUFFLER

COMPONENT LCAC2700



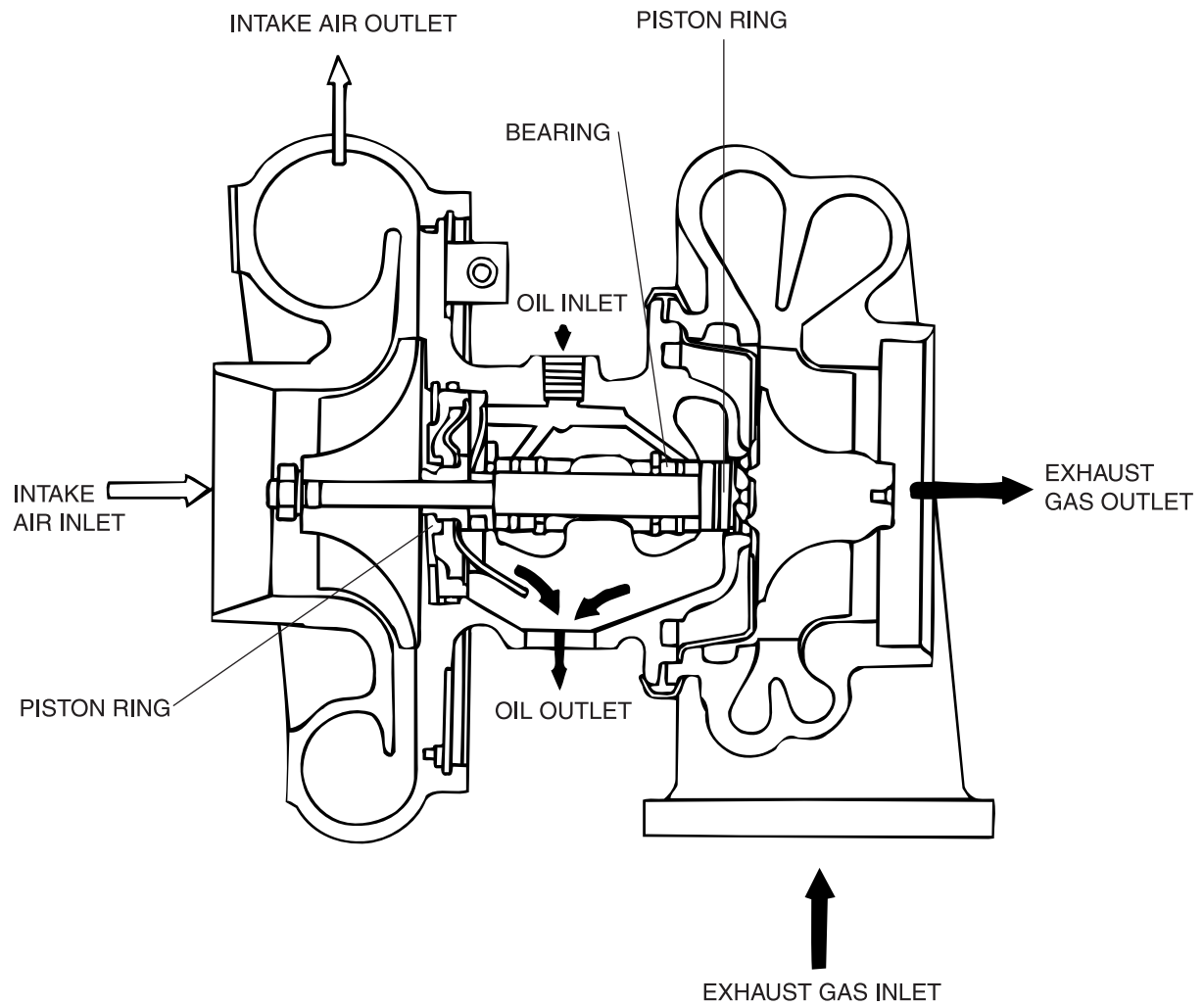
TORQUE : N·m (kg·m, lb·ft)

1. Front pipe
2. Front muffler
3. Main muffler
4. Tail pipe

LCAC270A

TURBO CHARGER (TC)

COMPONENTS LCAC2800

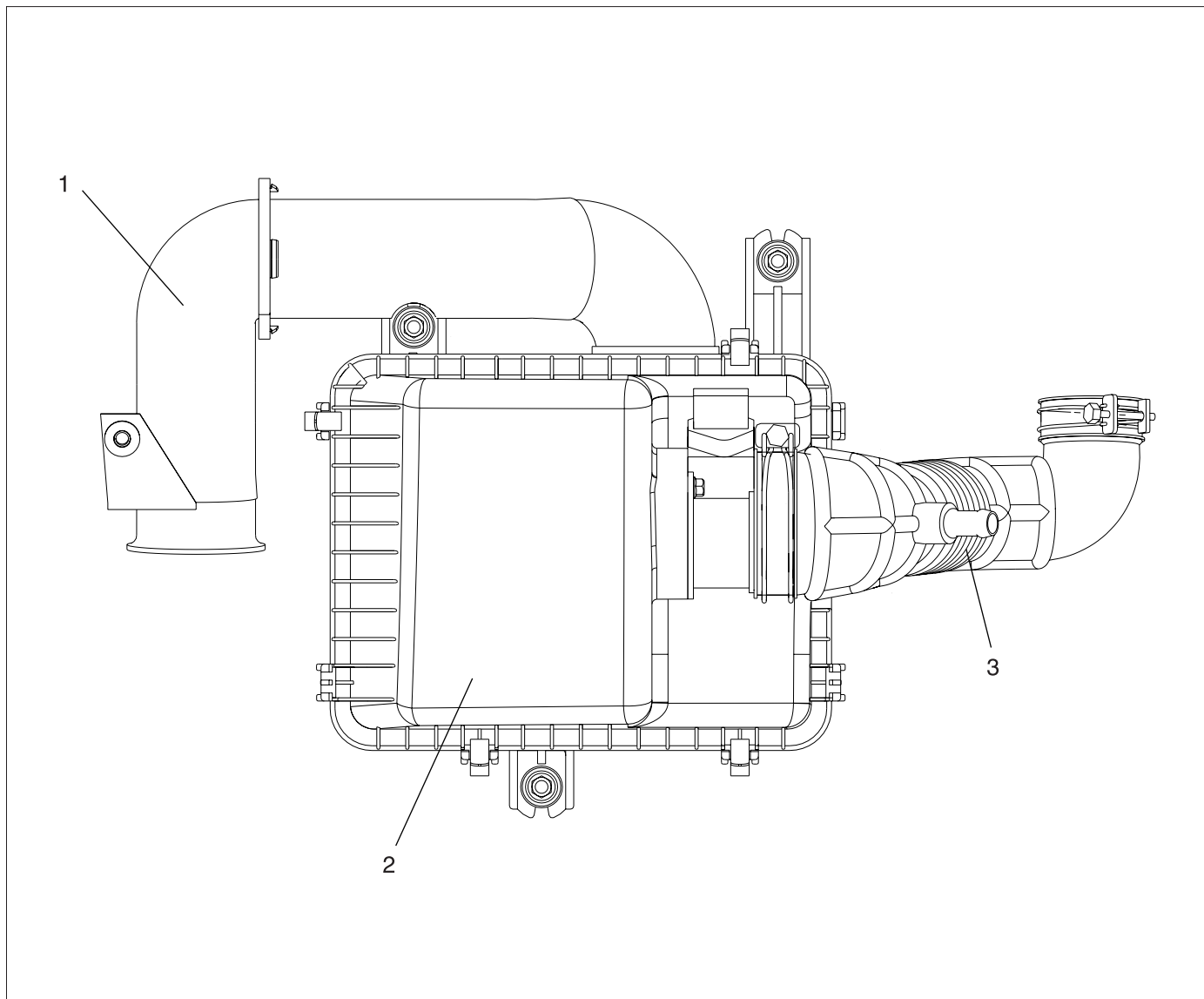


INTAKE AND EXHAUST SYSTEM

EM -67

AIR CLEANER (ACL)

COMPONENT LCAC3000



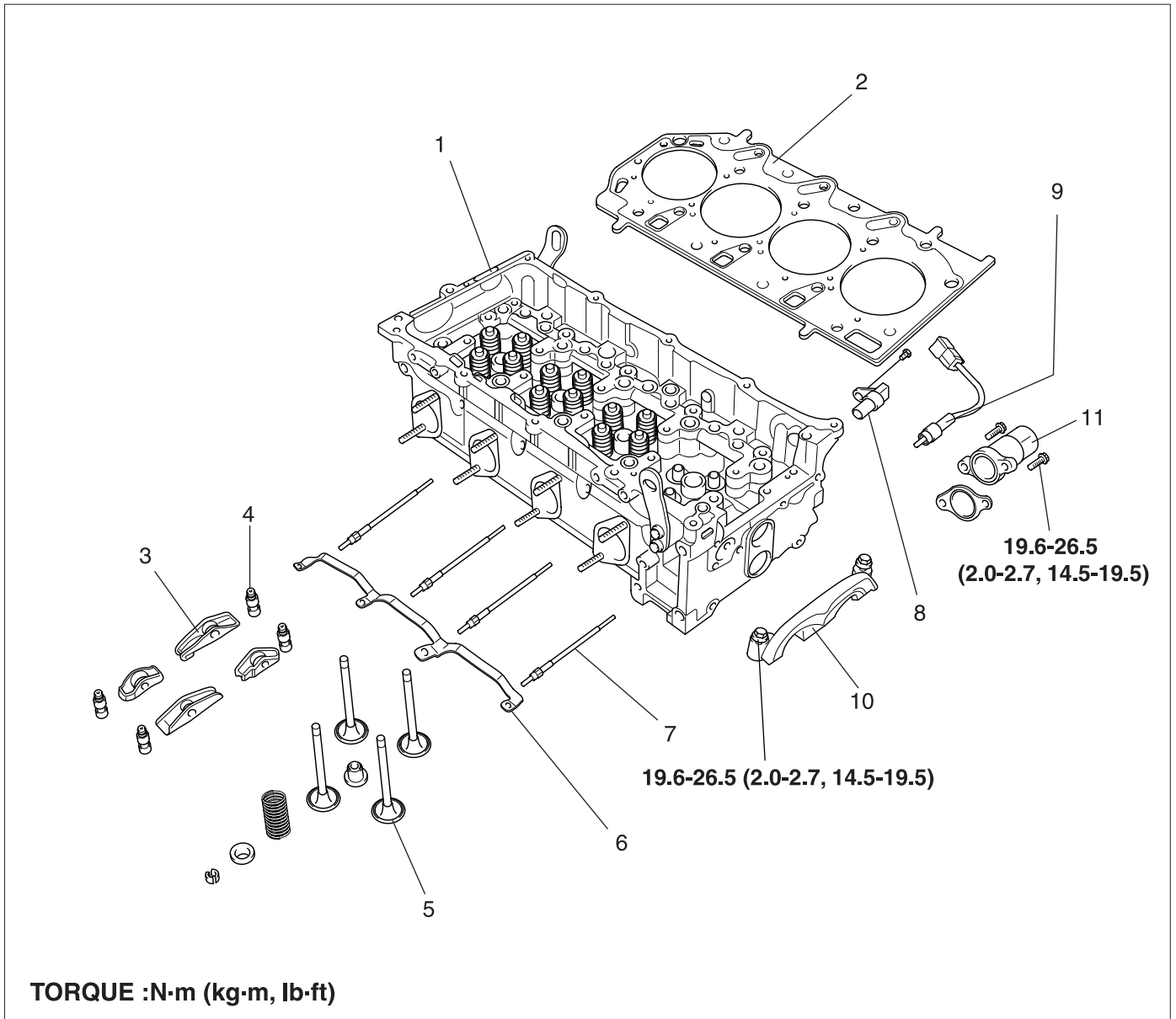
1. Air duct
2. Air cleaner assembly
3. Air hose

LCAC300A

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS LCAC3100



- | | |
|-------------------------|------------------------------|
| 1. Cylinder head | 7. Glow plug |
| 2. Cylinder head gasket | 8. TDC sensor |
| 3. Cam follow | 9. Water temperature sensor |
| 4. HLA | 10. Timing chain cover plate |
| 5. Valve | 11. Water outlet fitting |
| 6. Glow plug plate | |

CYLINDER HEAD ASSEMBLY

EM -69

DISASSEMBLY LCAC3110

CYLINDER HEAD ASSEMBLY

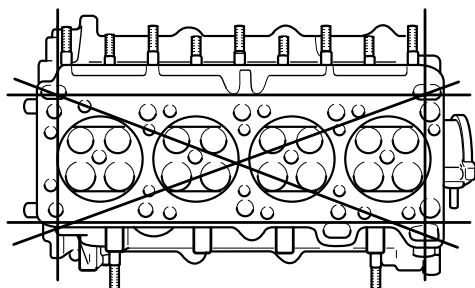
1. Disconnect the negative battery cable.
2. Drain the engine oil and engine coolant.
3. Remove the timing chain "C". Refer to "Timing chain".
4. Remove the exhaust manifold and intake manifold. Refer to "Exhaust manifold", "Intake manifold".
5. Remove the water temperature sensor.
6. Remove the TDC sensor.
7. Remove the glow plug.
8. Remove the cylinder head cover. Refer to "Cylinder head cover".
9. Remove the camshaft. Refer to "Camshaft".
10. Remove the cam follow(rocker arm) and HLA.
11. Remove the cylinder head assembly.

INSPECTION LCAC3130

CYLINDER HEAD

1. Inspect the cylinder head for damage, cracks and leakage of water and oil. Replace the cylinder head if necessary.
2. Measure cylinder head distortion in six directions shown in figure.

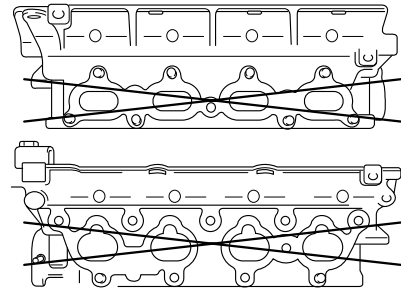
Distortion : 0.15 mm (0.0059 in)



LCAC313A

3. Measure manifold contact surface distortion in four directions shown in figure.

Distortion : 0.15 mm (0.0059 in)



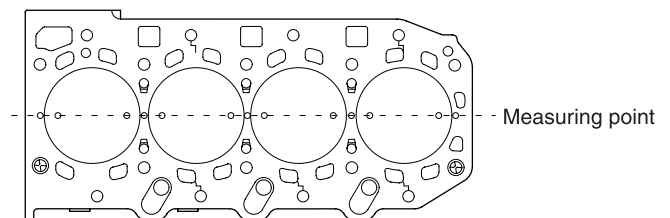
LCAC313B

4. If distortion exceeds specification, grind surface or replace cylinder head.

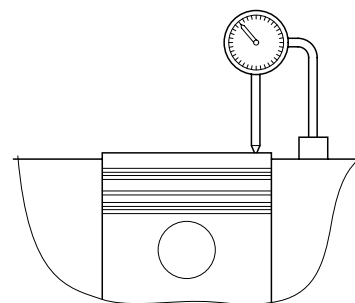
REASSEMBLY LCAC3190

CYLINDER HEAD ASSEMBLY

1. Select the cylinder head gasket.
 - 1) Measure the piston protrusion (8 places) from the upper face of the cylinder block and calculate the average of the 8 piston protrusion.



LCAC319A



LCAC319B

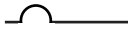
EM -70**ENGINE MECHANICAL SYSTEM**

- 2) Select the gasket from the grade A to C in the table below using the average of the 8 piston protrusion.

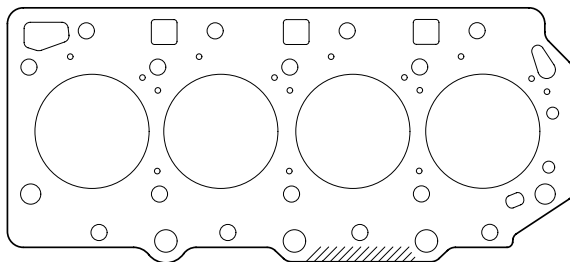
Even if only 1 point is over than the limit of piston protrusion at each grade, 1 grade upper gasket than specified below.

CYLINDER HEAD GASKET

mm (in)

Gasket grade	A	B	C
Piston Protrusion	0.056-0.117 (0.0022-0.0046)	0.117-0.178 (0.0046-0.0070)	0.178-0.240 (0.0070-0.0094)
Limit of piston protrusion	0.167 (0.0066)	0.228 (0.0090)	—
Gasket Thickness	0.92-0.98 (0.0362-0.0386)	0.97-1.03 (0.0382-0.0406)	1.02-1.08 (0.0402-0.0425)
Mark for distinguishment	—		

LCAC319H



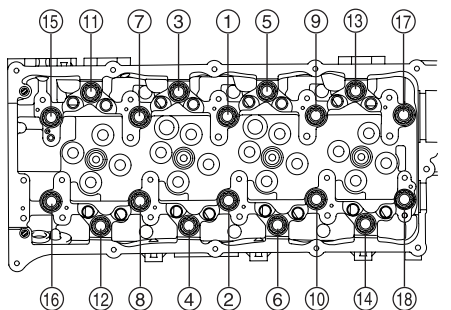
Distinguishment mark

LCAC319C

2. Install the cylinder head assembly with the cylinder head gasket.

Tightening torque :

49.0 N-m (5.0 kg-m, 36.2 lb-ft) + 120_iÆ + 90_iÆ



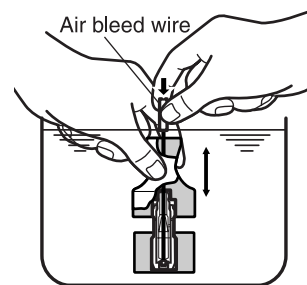
LCAC319D

3. Install the HLA to the cylinder head.

- 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.

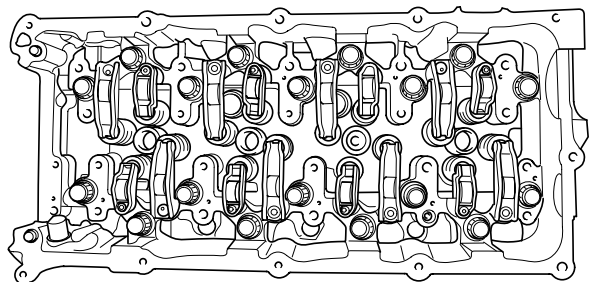
**NOTE**

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 grams.)



LCAC319E

4. Install the cam follow (rocker arm) on the HLA and valve.



LCAC319F

5. Install the camshaft. Refer to "Camshaft".
6. Install the cylinder head cover. Refer to "Cylinder head cover".

CYLINDER HEAD ASSEMBLY

EM -71

7. Install the glow plug.

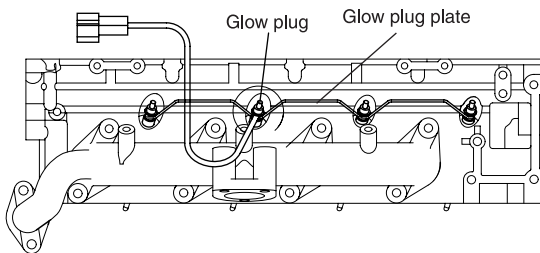
Tightening torque:

Glow plug :

15-20 N-m (1.5-2.0 kg-m, 11-15 lb-ft)

Glow plug plate nut :

0.8-1.5 N-m (8-15 kg-cm, 0.6-1.1 lb-ft)

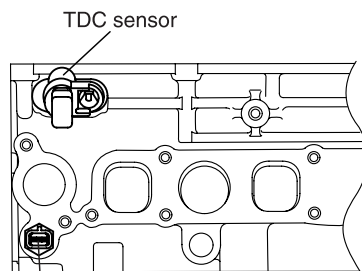


LCAC319G

8. Install the TDC sensor.

Tightening torque :

6.9-10.8 N-m (0.7-1.1 kg-m, 5.1-8.0 lb-ft)



Water temperature sensor

LCAC319I

9. Install the water temperature sensor.

Tightening torque :

29.4-39.2 N-m (3-4 kg-m, 21.7-28.9 lb-ft)

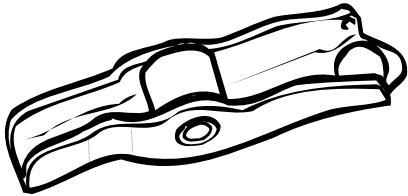
10. Install the exhaust manifold and intake manifold. Refer to "Exhaust manifold", "Intake manifold".
11. Install the timing chain "C". Refer to "Timing chain".
12. Refill the engine oil and engine coolant. Check leak oil and coolant.

ROCKER ARM

INSPECTION LCAC3170

CAM FOLLOW (ROCKER ARM)

1. Check rotation of the roller. If they do not rotate smoothly or are loose, replace them.
2. Check the roller surface. Replace if there is any dent, damage or evidence of seizure.
3. Check the valve contact surface for possible damage or evidence of seizure. Replace if necessary.



LCAC317A

CYLINDER HEAD ASSEMBLY

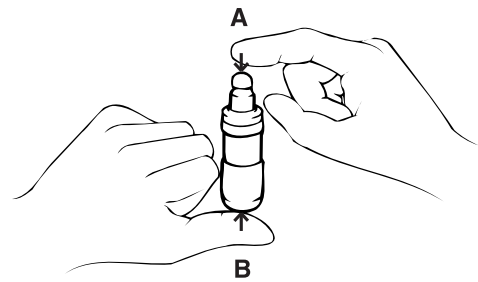
EM -73

HYDRAULIC LASH ADJUSTER
(HLA)

INSPECTION LCAC3180

HLA

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



LCAC318A

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.
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.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.  WARNING Be careful with the hot HLAS.

VALVES

REPLACEMENT

LCAC3120

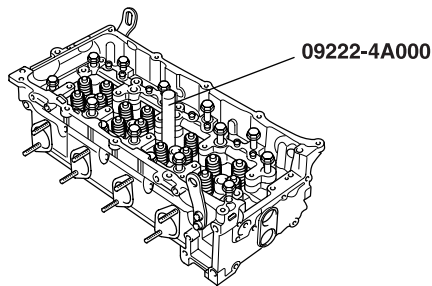
VALVE STEM SEAL

1. Remove the valve stem seal using pliers.
2. Install a new valve stem seal to the valve guide using the special tool (09222-4A000).



CAUTION

- **Do not reuse the used valve stem seal.**
- **When installing the valve stem seal, using the special tool is needed, not to leak the fluid.**



LCAC312A

INSPECTION

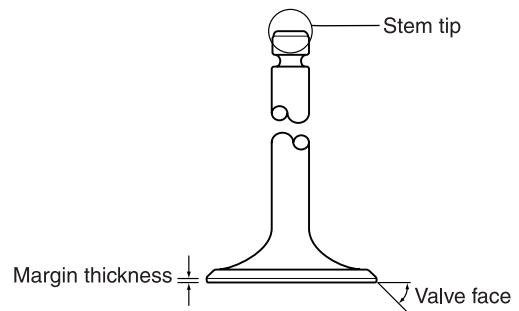
LCAC3140

VALVE AND VALVE GUIDE

1. Inspect each valve for following. Replace or resurface if necessary.
 - 1) Damage or bent stem
 - 2) Roughness or damage to face
 - 3) Damage or uneven wear of stem tip
2. Check valve head margin thickness. Replace if necessary.

Margin thickness :

Intake, Exhaust : 1.8-2.0 mm (0.071-0.079 in)

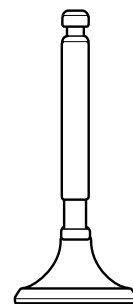


LCAC314A

3. Measure valve length.

Valve length :

Intake, Exhaust : 110.55 mm (4.352 in)



LCAC314B

CYLINDER HEAD ASSEMBLY

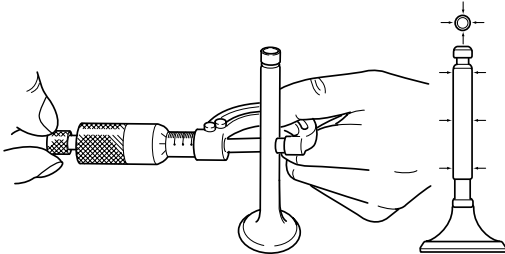
EM -75

4. Measure valve stem diameter.

Valve stem diameter :

Intake : 6.965-6.980 mm (0.2742-0.2748 in)

Exhaust : 6.935-6.950 mm (0.2730-0.2736 in)



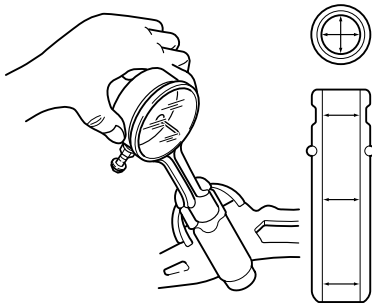
LCAC314C

5. Measure valve guide inner diameter.

Inner diameter

Intake, Exhaust :

7.000-7.015 mm (0.2756-0.2762 in)



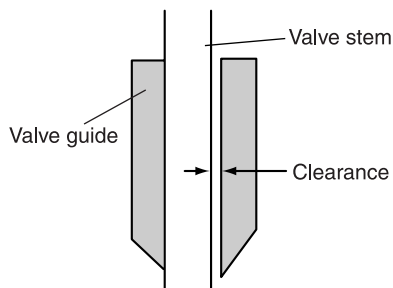
LCAC314D

6. Measure valve stem to guide clearance by subtract outer diameter of valve stem from inner diameter of corresponding valve guide.

Clearance :

Intake : 0.020-0.050 mm (0.0008-0.0020 in)

Exhaust : 0.050-0.080 mm (0.0020-0.0031 in)



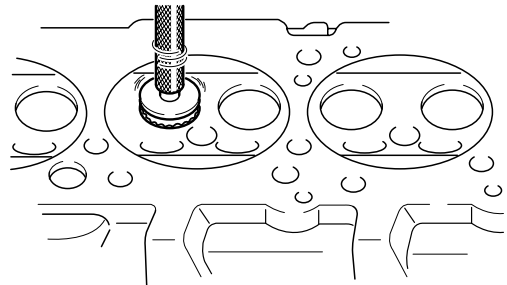
LCAC314E

7. If clearance exceeds maximum, replace valve and/or cylinder head.

LCAC3150

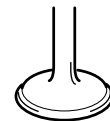
VALVE SEAT

1. Inspect contact surface of valve seat and valve face for following.
 - 1) Roughness
 - 2) Damage
2. If necessary, resurface valve seat with a 45°(Intake), 45°(Exhaust) valve seat cutter and/or resurface valve face.



LCAC315A

3. Apply a thin coat of Prussian blue to valve face.
4. Check valve seating by rotating valve against seat.
 - 1) If blue does not appear 360° around valve face, replace valve.
 - 2) If blue does not appear 360° around valve seat, resurface valve seat.



LCAC315B

EM -76

ENGINE MECHANICAL SYSTEM

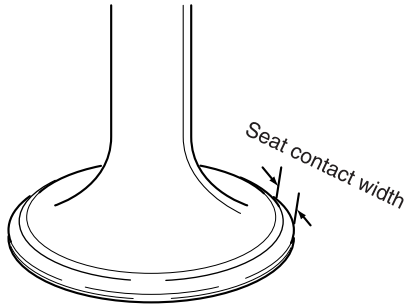
5. Check seat contact width.

LCAC3160

Seat contact width :

Intake : 1.3-1.7 mm (0.0512-0.0669 in)

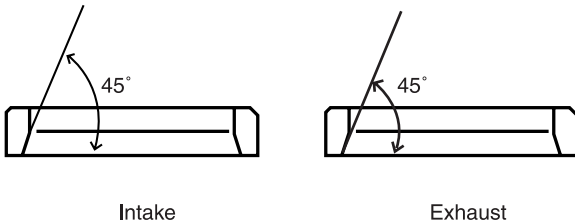
Exhaust : 1.5-1.9 mm (0.0591-0.0748 in)



LCAC315C

6. Check that valve seating position is at center of valve face.

- 1) If seating position is too high (low), correct valve seat with a 45° (Intake), 45° (Exhaust) cutter.



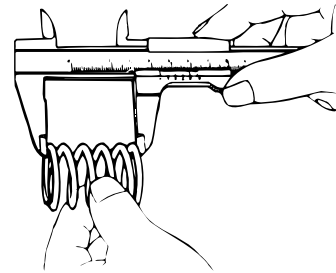
LCAC315D

7. Seat the valve to the valve seat with a lapping compound.

VALVE SPRING

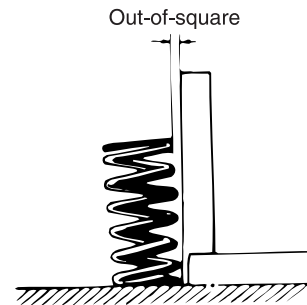
1. Inspect each valve spring for cracks or damage.
2. Check free length and out-of-square. Replace if necessary.

Free length : 48.2 mm (1.898 in)



LCAC316A

Out-of-square : Below 1.5°



LCAC316B

3. Check spring pressure, and replace it if necessary.

Spring pressure :

258 $\pm \frac{3}{4}$ 12 N / 38 mm

(26.3 $\pm$ 1.2 kg/38 mm, 569 $\pm \frac{3}{4}$ 26 lb / 1.496 in)

505.5 $\pm \frac{3}{4}$ 24 N / 28.8 mm

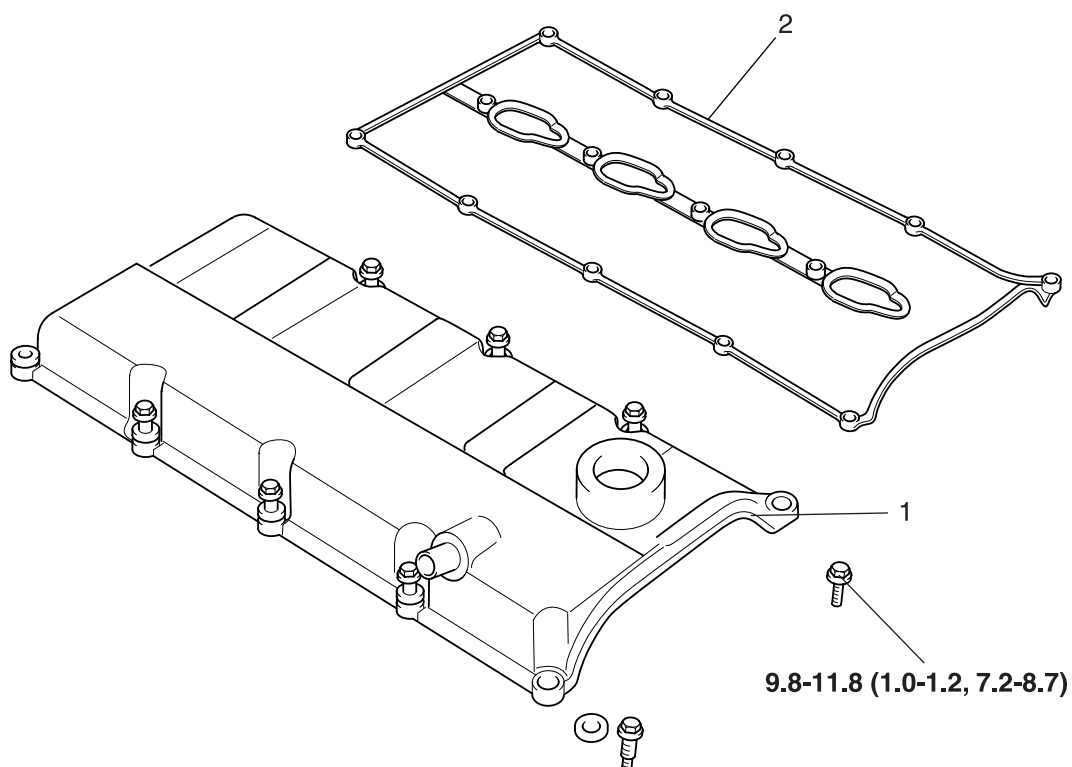
(51.5 $\pm$ 2.4 kg/28.8 mm, 1114.4 $\pm \frac{3}{4}$ 53 lb / 1.134 in)

CYLINDER HEAD ASSEMBLY

EM -77

ROKER COVER & PLUG

COMPONENTS LCAC3200



TORQUE : N·m (kg·m, lb·ft)

1. Cylinder head cover
2. Cylinder head cover gasket

REMOVAL

LCAC3210

1. Disconnect the negative battery cable.
2. Remove the high pressure pipe and the injector. Refer to "FL" (Fuel system) section.

WARNING

1. **Fuel system is subject to extremely high pressure (1350 bar(1370 kg/cm²)).**
2. **Never perform any work on injection system with engine running or within 30 seconds after stopping the engine.**
3. **Always pay attention to safety precautions.**



NOTE

When remove the injectors, set the special tool (09351-4A000) to where the injector holder removed, install a slide hammer on the special tool, using the hammer, tap upward to remove the injector.

3. Remove the cylinder head cover.

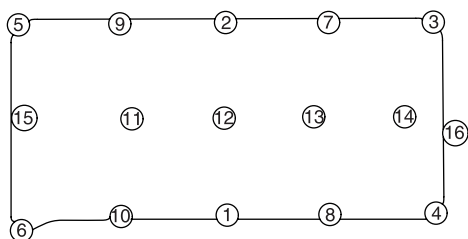
INSTALLATION

LCAC3220

1. Install the cylinder head cover.

Tightening torque :

9.8-11.8 N-m (1.0-1.2 kg-m, 7.2-8.7 lb-ft)



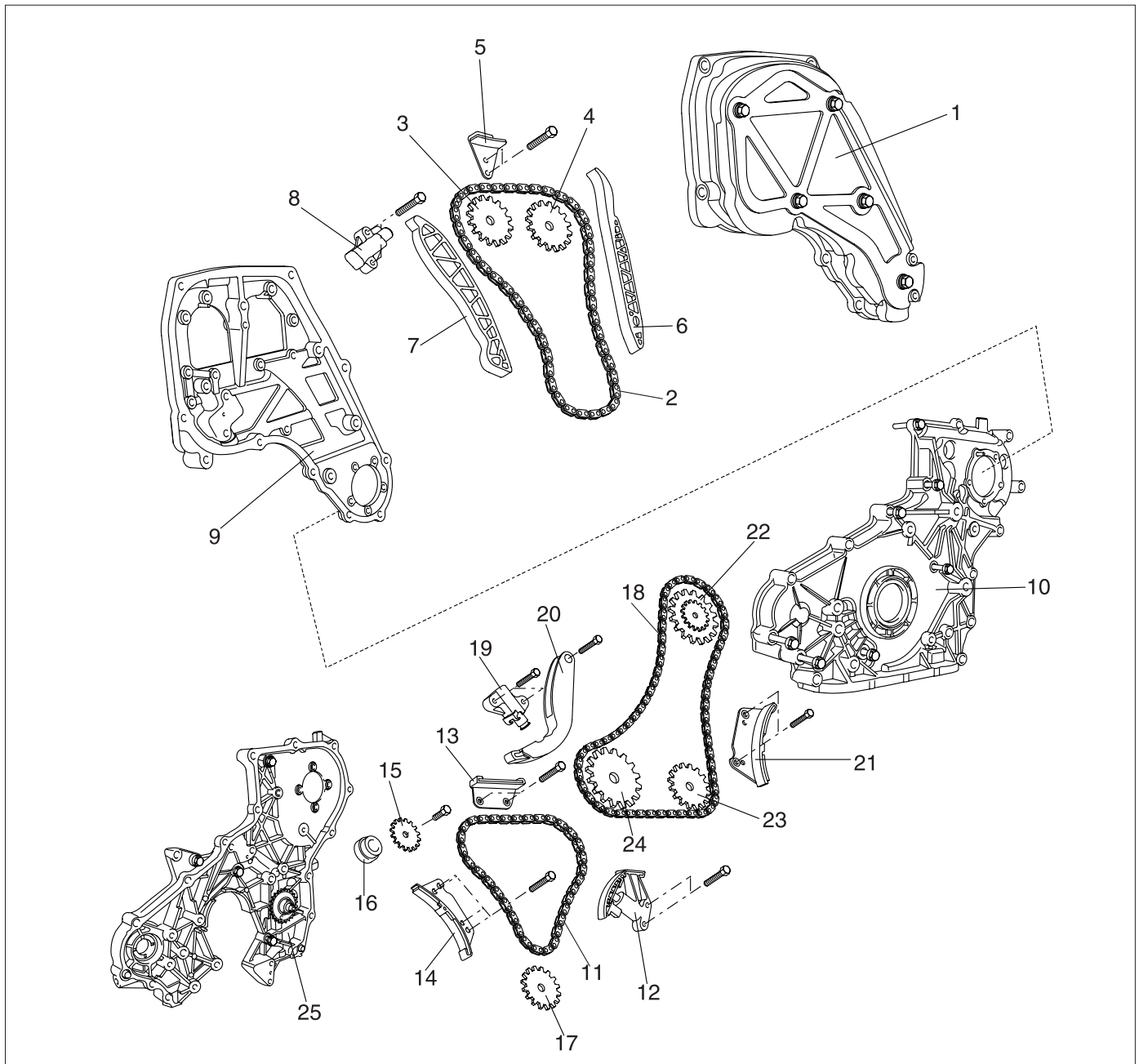
LCAC322A

2. Install the injector and the high pressure pipe. Refer to "FL" (Fuel system) section.

TIMING SYSTEM

TIMING CHAIN

COMPONENTS LCAC3300



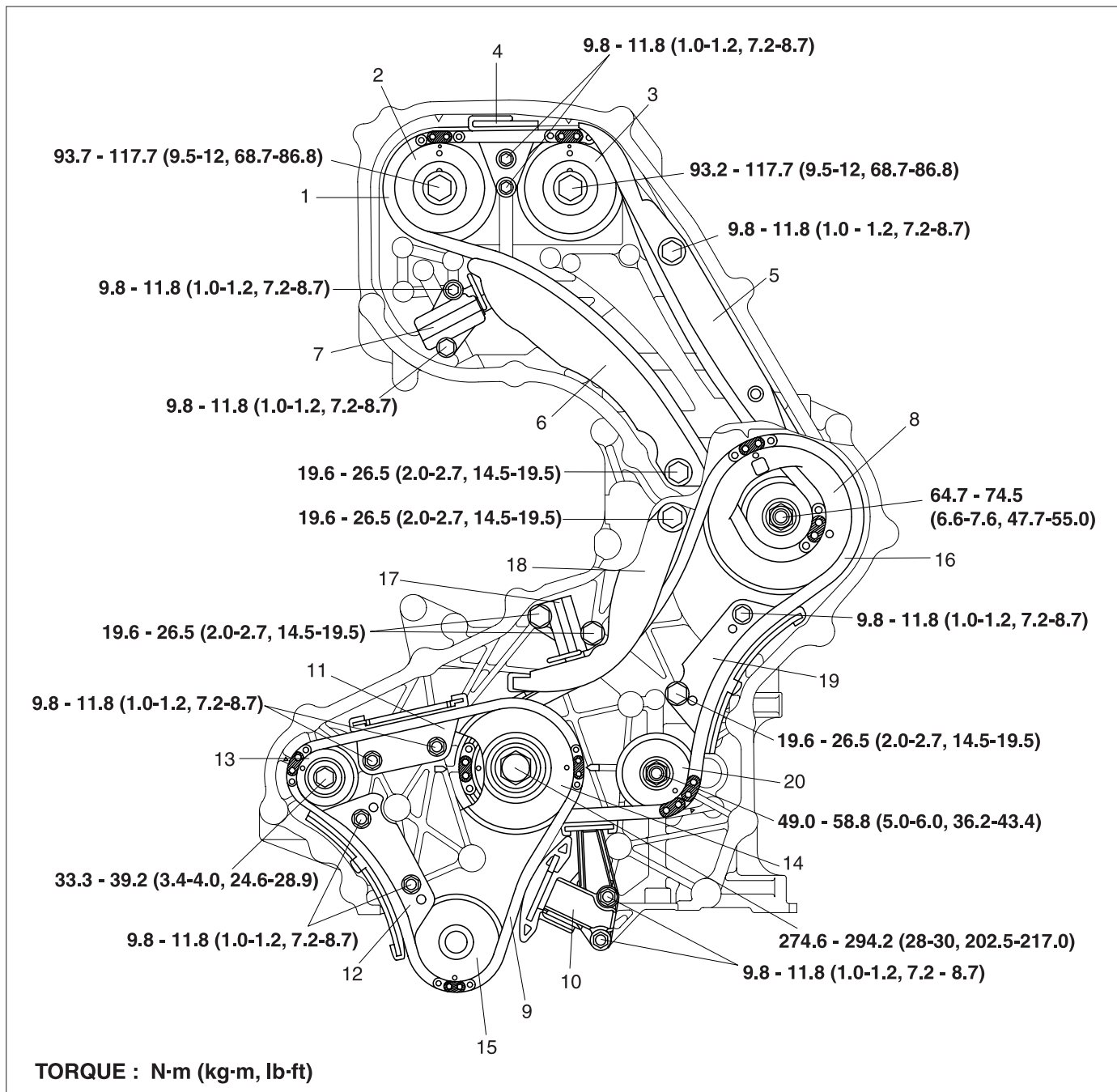
1. Timing chain upper front cover
2. Timing chain "C"
3. RH Camshaft sprocket
4. LH Camshaft sprocket
5. Guide "C(2)"
6. Guide "C(1)"
7. Lever "C"
8. Auto-tensioner "C"
9. Timing chain upper under cover

10. Timing chain lower front cover
11. Timing chain "B"
12. Auto-tensioner "B"
13. Guide "B(1)"
14. Guide "B(2)"
15. RH Balance shaft sprocket
16. Spacer
17. Oil pump sprocket
18. Timing chain "A"

19. Auto-tensioner "A"
20. Lever "A"
21. Guide "A "
22. High pressure pump sprocket
23. LH Balance shaft sprocket
24. Crank shaft sprocket
25. Timing chain lower under cover

COMPONENT

LCAC3310



1. Timing chain "C"
2. RH Camshaft sprocket
3. LH Camshaft sprocket
4. Guide "C(2)"
5. Guide "C(1)"
6. Lever "C"
7. Auto-tensioner "C"

8. High pressure pump sprocket
9. Timing chain "B"
10. Auto-tensioner "B"
11. Guide "B(1)"
12. Guide "B(2)"
13. RH Balance shaft sprocket
14. Crank shaft sprocket

15. Oil pump sprocket
16. Timing chain "A"
17. Auto-tensioner "A"
18. Lever "A"
19. Guide "A"
20. LH Balance shaft sprocket

TIMING SYSTEM

EM -81

DISASSEMBLY LCAC3320

TIMING CHAIN "C"

1. Rotate the crankshaft pulley to align the timing mark with TDC, in which No.1 piston locates at the top dead center of compression stroke.
2. Remove the timing chain upper front cover.
3. Remove the cylinder head cover.
4. Holding the slot of the camshaft with the spanner, loosen the bolts for the high-pressure pump sprocket and camshaft sprocket.
5. Remove the timing chain auto-tensioner "C".

NOTE

Before removing auto-tensioner "C", install a set pin (ø2.5mm steel wire) after compressing the tensioner so that inner parts are not missing during disassembly.

6. Remove the timing chain lever "C".
7. Remove the timing chain guide "C(1), C(2)".
8. Remove the LH and RH camshaft sprocket bolts.
9. Remove the timing chain "C" with the camshaft sprocket.
10. Remove the timing chain upper under cover.

LCAC3330

TIMING CHAIN "B"

1. Remove the timing chain "C".
2. Remove the crankshaft pulley.
3. Remove the oil pan.
4. Remove the timing chain lower front cover.
5. To prevent the rotation of RH balance shaft, remove the plug at the side of cylinder block and insert the screwdriver (or bolt) with an 8 mm(0.32in) diameter into the plughole more than 60 mm (2.4in).
6. Loosen the RH balance shaft sprocket bolt.
7. Remove the timing chain auto-tensioner "B".

NOTE

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

8. Remove the timing chain guide "B(1), B(2)".
9. Remove the RH balance shaft sprocket bolt.
10. Remove the timing chain "B" with the RH balance shaft sprocket.

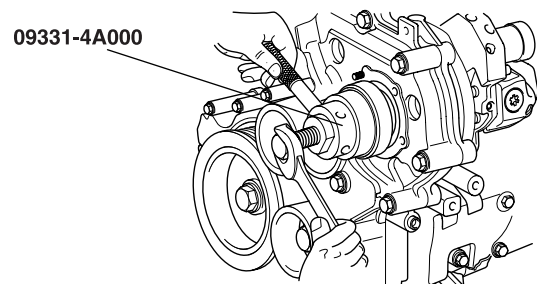
TIMING CHAIN "A" LCAC3340

1. Remove the timing chain "C" and "B".
2. Loosen the high-pressure pump sprocket.
3. Remove the timing chain auto-tensioner "A".

NOTE

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

4. Remove the timing chain lever "A".
5. Remove the timing chain guide "A".
6. Set the special tool (09331-4A000) around the high pressure pump sprocket and install a knob.



LCAC334A

7. Grab the knob with the left hand and remove the high pressure pump sprocket with a spanner.
8. Remove the timing chain "A" with the high-pressure pump sprocket.

CAUTION

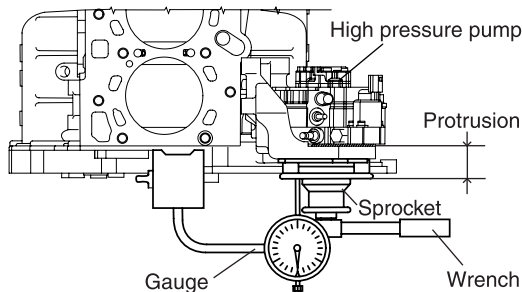
Remove thoroughly sealant and oil etc left at the sealing surface after remove the chain cover and oil pan. (If any impurities are left at the sealing face, oil may leak after reassembly even with the sealant application.)

REASSEMBLY

LCAC3350

TIMING CHAIN "A"

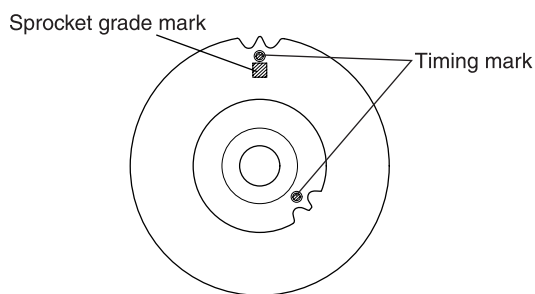
1. Check the worn of timing chain, lever, guide and sprocket and replace them if necessary.
2. Choose proper high pressure pump sprocket after measuring protrusion of sprocket
 - 1) Assemble a high-pressure pump sprocket (Grade A) tentatively to high-pressure pump.
 - 2) Install a gauge to the cylinder block as shown illustration. And then turn the high pressure pump sprocket once by using a wrench.



LCAC335A

- 3) Choose proper sprocket grade according to average of maximum and minimum value of gauge.

Grade	Color	Protrusion (mm(in))
A	Blue	34.2-35.0 (1.3465-1.3780)
B	White	33.4-34.2 (1.3150-1.3465)
C	Red	35.0-35.8 (1.3780-1.4094)



LCAC335B

3. Install the crankshaft sprocket as the timing mark of crankshaft sprocket aligns with the timing mark of lower under cover, at which No.1 piston locates at the top dead center of compression stroke.

**NOTE**

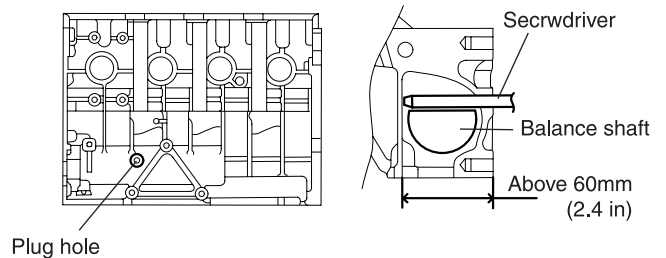
In installing crankshaft sprocket, apply oil to the O ring inside the sprocket.

4. Align the timing mark of LH balance sprocket with the timing mark of timing chain lower under cover.
5. Check the LH balance shaft whether it is located at the right position. To prevent the rotation of balance shaft, remove plug at the side of cylinder block. Insert screwdriver (or bolt) with an 8 mm (0.32in) diameter into the plughole and check whether it slides more than 60 mm(2.4in).

**NOTE**

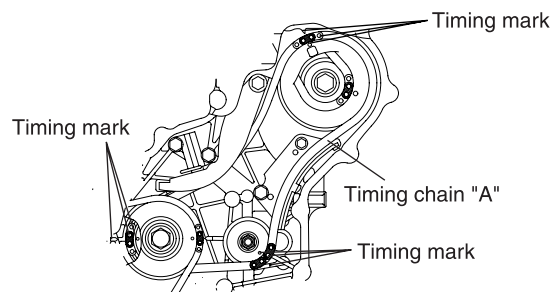
When the screwdriver (or bolt) depth is about 25-30mm(1-1.2in), rotate LH balance shaft sprocket 1 revolution. And insert the screwdriver (or bolt) again to check whether it slides more than 60mm(2.4in).

■ LH Side



LCAC335C

6. Assemble the upper bolt of timing chain guide "A" tentatively.



LCAC335D

TIMING SYSTEM

EM -83

7. Align the timing marks of sprocket and chain when high-pressure pump sprocket is not installed to pump.
8. Using the chain connected to the high-pressure pump sprocket, install as the timing marks of LH balance shaft sprocket and crankshaft sprocket align with each other.
9. Assemble the high-pressure pump sprocket to the high-pressure pump tentatively.
10. Install the other bolt of the timing chain guide "A" at the lower side and tighten it.

Tightening torque :

Upper bolt :

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

Lower bolt :

19.6-26.5N·m(2.0-2.7 kg·m, 14.5-19.5 lb·ft)

11. Install the timing chain lever "A".

Tightening torque :

19.6-26.5 N·m(2.0-2.7 kg·m, 14.5-19.5 lb·ft)

12. Install the timing chain auto-tensioner "A", and remove a set pin from the auto-tensioner.

Tightening torque :

19.6-26.5 N·m(2.0-2.7 kg·m, 14.5-19.5 lb·ft)



NOTE

After assembling timing chain, check whether chain is assembled within the rail at both sides.

13. Remove the screwdriver (or bolt) from the plughole and install the plug.

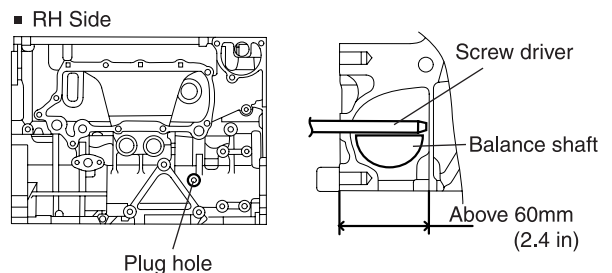
Tightening torque :

14.7-21.6 N·m(1.5-2.2 kg·m, 10.8-15.9 lb·ft)

LCAC3360

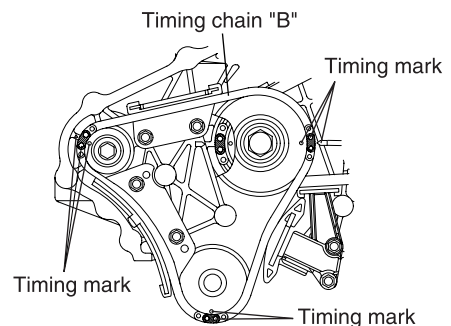
TIMING CHAIN "B"

1. Check the worn of timing chain, lever, guide and sprocket and replace them if necessary.
2. Install the timing chain "A".
3. Check the RH balance shaft whether it is located at the right position. To prevent the rotation of balance shaft, insert the screwdriver (or bolt) into the plug-hole at the side of cylinder block and check whether it slides more than 60 mm(2.4in).



LCAC336A

4. Align the timing marks of sprocket and chain when balance shaft sprocket is not installed to the balance shaft.



LCAC336B

5. Using the chain connected to RH balance shaft sprocket, install as the timing marks of crankshaft sprocket and oil pump sprocket align with each other.
6. Assemble the RH balance shaft sprocket to the balance shaft tentatively.
7. Install the timing chain guide "B(1), B(2)".

Tightening torque:

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

EM -84**ENGINE MECHANICAL SYSTEM**

8. Install the timing chain auto-tensioner "B", and remove the set pin from the auto-tensioner.

Tightening torque:

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

9. Assemble the RH balance shaft sprocket bolt.

Tightening torque:

33.3-39.2 N·m(3.4-4.0 kg·m, 24.6-28.9 lb·ft)

10. Remove the screwdriver (or bolt) from the plughole and install the plug.

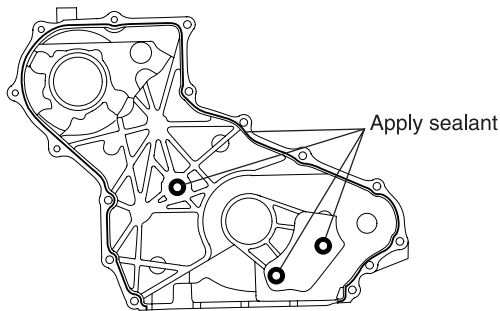
Tightening torque:

14.7-21.6 N·m(1.5-2.2 kg·m, 10.8-15.9 lb·ft)

11. Apply the sealant at the timing chain lower front cover.

Sealant type : Lotite #5902

Bead width : 2-4 mm(0.08-0.16 in)

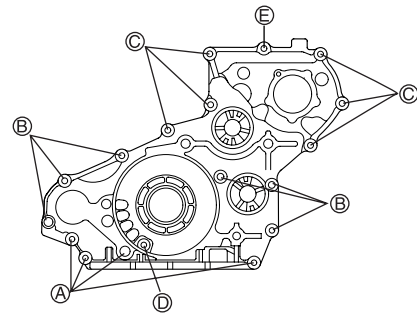


LCAC336C

12. Install the timing chain lower front cover.

Bolt	Size	Quantity	Tightening torque N-m (kg-m, lb-ft)
A	8 x 80	4 EA	9.8-11.8 (1.0-1.2, 14.5-19.5)
B	8 x 70	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
C	8 x 50	3 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
D	8 x 40	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
E	8 x 22	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)

* Bolt Size = Diameter x Length



LCAC336D

13. Install the oil pan.

**CAUTION**

Then apply the sealant additionally to prevent the oil leak to the overlapping part (T-joint: 4 points right and left of the engine), where bed plate, timing chain lower under cover, timing chain lower front cover and oil pan overlap.

LCAC3370

TIMING CHAIN "C"

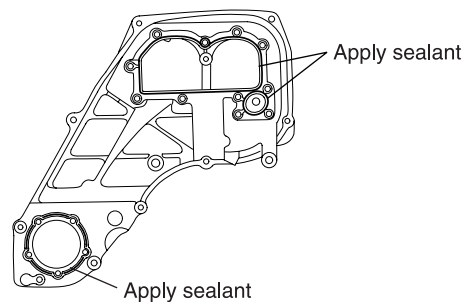
1. Check the worn of the timing chain, lever, guide and sprocket and replace them if necessary.
2. Install the timing chain "A" and "B".
3. Apply the sealant at the timing chain upper under cover.

Sealant type : Lotite #5902

Bead width : 2-4 mm (0.08-0.16 in)

**CAUTION**

Then apply the sealant additionally to prevent the oil leak to the overlapping part (T-joint : 2 points right and left of the engine), where cylinder head, timing chain cover plate and timing chain upper under cover overlap.



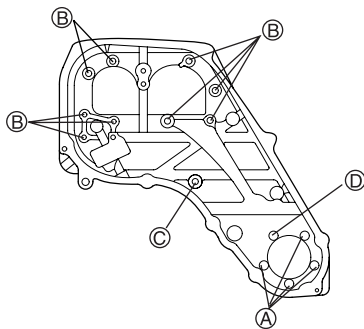
LCAC337A

TIMING SYSTEM**EM -85**

4. Install the timing chain upper under cover.

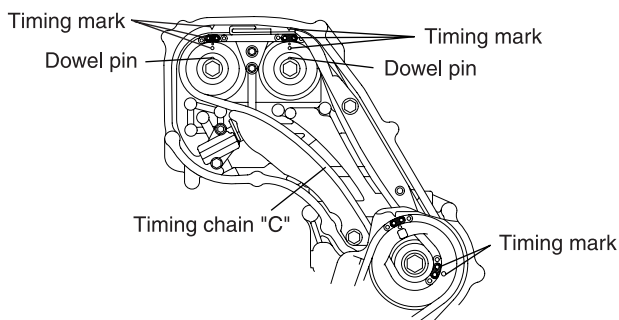
Bolt	Size	Quantity	Tightening torque N·m (kg·m, lb·ft)
A	6 x 14	4 EA	9.8-11.8 (1.0-1.2, 7.2-8.7)
B	6 x 22	9 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
C	8 x 22	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
D	8 x 40	1 EA	19.6-26.5 (2.0-2.7, 14.5-19.5)
E	Nut	1 EA	9.8-11.8 (1.0-1.2, 7.2-8.7)

* Bolt Size = Diameter x Length



LCAC337B

5. Assemble the LH camshaft sprocket tentatively, and align the timing mark with that of timing chain upper under cover.



LCAC337C

6. Align the RH camshaft dowel pin with the timing mark of the timing chain upper under cover.
7. Align the timing marks of sprocket and chain when RH camshaft sprocket is not installed to the camshaft.
8. Using the chain connected to the RH camshaft sprocket, install as the timing marks of high-pressure pump sprocket and LH camshaft sprocket align with each other.

9. Assemble the RH camshaft sprocket to the RH camshaft tentatively.

10. Install the timing chain guide "C(1), C(2)".

Tightening torque:

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

11. Install the timing chain lever "C".

Tightening torque:

19.6-26.5 N·m(2.0-2.7 kg·m, 14.5-19.5 lb·ft)

12. Install the timing chain auto-tensioner "C", and remove the set pin from the auto-tensioner.

Tightening torque:

9.8-11.8 N·m(1.0-1.2 kg·m, 7.2-8.7 lb·ft)

13. Assemble the high-pressure pump sprocket bolt.

Tightening torque:

64.7-74.5 N·m (6.6-7.6 kg·m, 47.7-55.0 lb·ft)

14. Assemble camshaft sprocket bolt.

Tightening torque:

93.2-117.7 N·m (9.5-12 kg·m, 68.7-86.8 lb·ft)

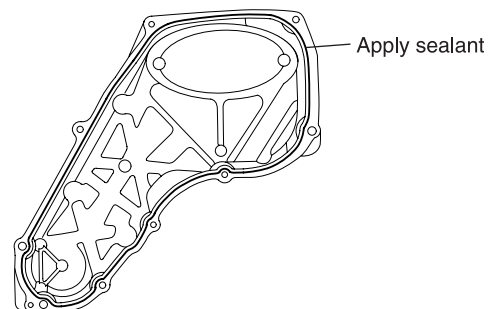
**NOTE**

Then assemble the damper pulley to the crankshaft tentatively and align the timing mark of the damper pulley to that of chain cover. And check whether timing mark of the camshaft positions at the right place finally.

15. Apply the sealant at the timing chain upper front cover.

Sealant type : Lotite #5902

Bead width : 2-4 mm (0.08-0.16 in)



LCAC337D

16. Install the timing chain upper front cover.

Tightening torque:

19.6-26.5 N·m(2.0-2.7 kg·m, 14.5-19.5 lb·ft)

REPLACEMENT LCAC3380

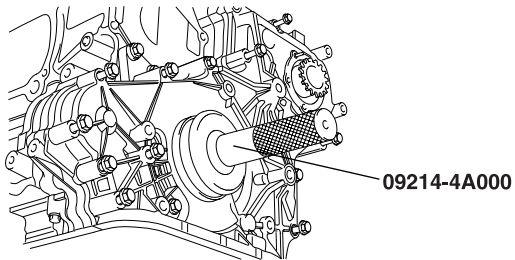
TIMING CHAIN LOWER FRONT COVER OIL SEAL

1. With the timing chain lower front cover oil seal installed, install the oil seal using the special tool (09214-4A000).



NOTE

Apply engine fluid to the circumference of oil seal lip.

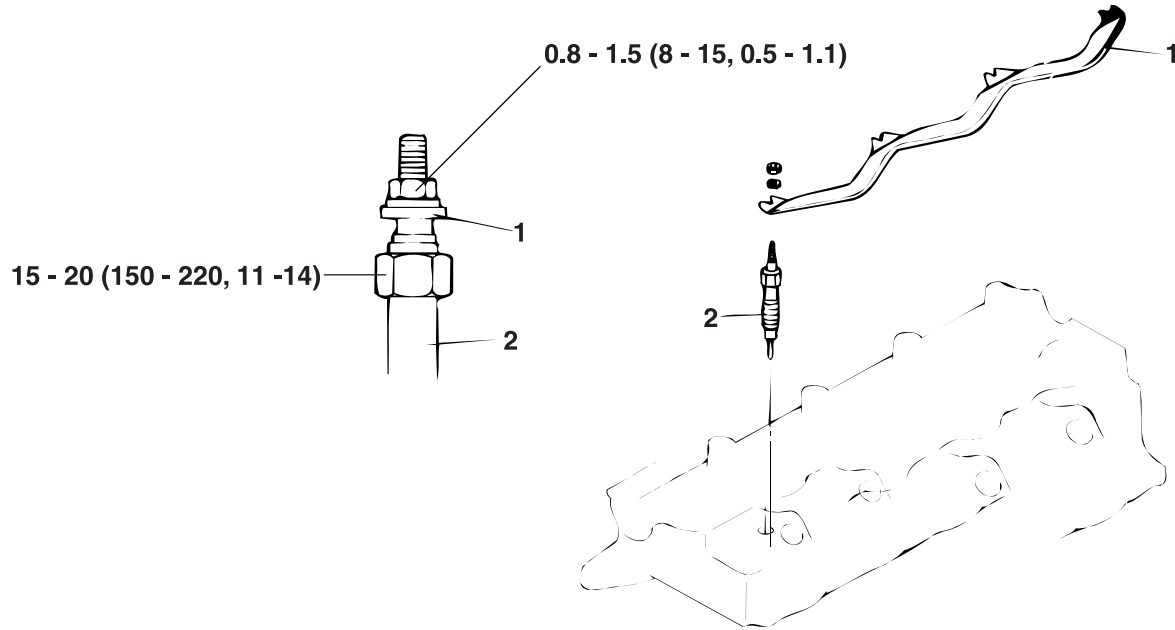


LCAC338A

PREHEATING SYSTEM

REMOVAL AND INSTALLATION LBAC1000

COMPONENTS



NOTE

Reverse the removal procedures to reinstall.

TORQUE : Nm (kg-cm, lb-ft)

1. Glow plug plate
2. Glow plug

LBAC100A

INSPECTION LBAC1100

GLOW PLUG

1. Check the continuity between the terminal and body as illustrated. Replace if discontinuity or with large resistance.

Standard value : 0.25Ω

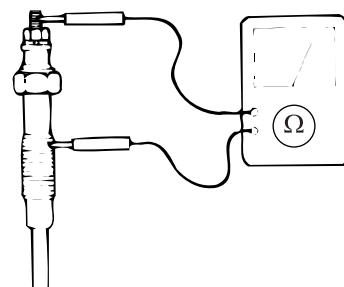


CAUTION

Remove oil from plug before measuring as glow plug resistance is very small.

2. Check for rust on glow plug plate.

3. Check glow plug for damage.



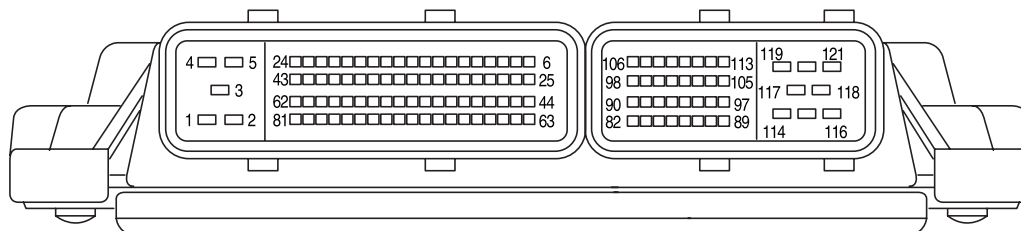
BE9C120A

DIESEL CONTROL SYSTEM

ECU

ECU TERMINAL LAYOUT

LFAC1700



LFAC170A

Terminal	Signal (Associated Function)	Connected to
1	BATTERY (-)	BATTERY Ground
2	BATTERY (-)	BATTERY Ground
3	BATTERY (-)	BATTERY Ground
4	BATTERY (+) via FUSE (10A)	MAIN RELAY
5	BATTERY (+) via FUSE (20A)	MAIN RELAY
6	-	-
7	-	-
8	-	-
9	CAN LOW	
10	CAN HIGH	
11	SMARTRA IMMOBILIZER System (Anti-Theft Protection)	SMARTRA IMMOBILIZER
12	-	-
13	SYSTEM POWER RELAY	MAIN RELAY
14	AUTO CRUISE MAIN INDICATOR LAMP	AUTO CRUISE MAIN INDICATOR LAMP
15	GLOW PLUG RELAY	GLOW PLUG RELAY
16	VACUUM MODULAR CONTROL (For EGR VALVE) Signal	VACUUM MODULAR (For EGR VALVE)
17	IMMOBILIZER INDICATOR LAMP	IMMOBILIZER INDICATOR LAMP
18	-	-
19	-	-
20	To MAIN CONDENSER FAN RELAY	MAIN CONDENSER FAN RELAY
21	To A/CON COMPRESSOR RELAY	A/CON COMPRESSOR RELAY
22	ACCELERATION PEDAL PWM Signal TOD	TOD TOD UNIT
23	AUXILIARY WATER HEATER RELAY	AUXILIARY WATER HEATER RELAY
24	-	-
25	-	-
26	-	-

DIESEL CONTROL SYSTEM
EM -89

Terminal	Signal (Associated Function)	Connected to
27	-	-
28	-	-
29	-	-
30	-	-
31	-	-
32	-	-
33	-	-
34	-	-
35	-	-
36	-	-
37	-	-
38	-	-
39	-	-
40	CRUISE CONTROL Supply	CRUISE CONTROL ACTIVATOR
41	-	-
42	-	-
43	-	-
44	-	-
45	-	-
46	-	-
47	ENGINE SPEED Signal To TACHOMETER	TACHOMETER
48	DIAGNOSIS K-LINE	SCAN TOOL CONNECTOR (Pin No.7)
49	VEHICLE SPEED Signal (From VEHICLE SPEED SENSOR)	VEHICLE SPEED SENSOR
50	-	-
51	A/CON PRESSURE S/W Input	A/CON PRESSURE S/W
52	-	-
53	-	-
54	REDUNDANT BRAKE S/W Input	BRAKE S/W
55	-	-
56	MT/AT AUTO RECOGNITION S/W (MT:Open, AT:Ground)	MT/AT AUTO RECOGNITION S/W (MT:Open, AT:Ground)
57	-	-
58	Terminal 15 (IG ON/OFF Signal)	IGNITION S/W
59	BRAKE S/W Input	BRAKE S/W
60	A/CON ON S/W Input	THERMO S/W
61	CLUTCH S/W Input	CLUTCH S/W
62	BLOWER S/W Input	BLOWER S/W
63	-	-
64	-	-

EM -90**ENGINE MECHANICAL SYSTEM**

Terminal	Signal (Associated Function)	Connected to
65	-	-
66	-	-
67	-	-
68	-	-
69	-	-
70	-	-
71	-	-
72	-	-
73	-	-
74	CRUISE CONTROL ACTIVATOR Ground	CRUISE CONTROL ACTIVATOR
75	CRUISE CONTROL ACTIVATOR Signal	CRUISE CONTROL ACTIVATOR
76	ACCELERATION PEDAL SENSOR Ground 1 (PWM)	ACCELERATION PEDAL SENSOR
77	ACCELERATION PEDAL SENSOR Signal 1 (PWM)	ACCELERATION PEDAL SENSOR
78	ACCELERATION PEDAL SENSOR Supply 1 (PWM)	ACCELERATION PEDAL SENSOR
79	ACCELERATION PEDAL SENSOR Ground 2 (PGS)	ACCELERATION PEDAL SENSOR
80	ACCELERATION PEDAL SENSOR Signal 2 (PGS)	ACCELERATION PEDAL SENSOR
81	ACCELERATION PEDAL SENSOR Supply 2 (PGS)	ACCELERATION PEDAL SENSOR
82	-	-
83	-	-
84	WATER TEMPERATURE SENSOR (WTS) Signal	WATER TEMPERATURE & GLOW UNIT SENSOR
85	WATER TEMPERATURE SENSOR (WTS) Ground	WATER TEMPERATURE & GLOW UNIT SENSOR
86	AIR TEMPERATURE SENSOR (ATS) Signal	AIR FLOW SENSOR (HFMS)
87	SMARTRA IMMOBILIZER Ground	-
88	AIR FLOW SENSOR (HFMS) Ground	AIR FLOW SENSOR (HFMS)
89	AIR FLOW SENSOR (HFMS) Signal	AIR FLOW SENSOR (HFMS)
90	RAIL PRESSURE SENSOR (RPS) Supply	RAIL PRESSURE SENSOR (RPS)
91	RAIL PRESSURE SENSOR (RPS) Signal	RAIL PRESSURE SENSOR (RPS)
92	RAIL PRESSURE SENSOR (RPS) Ground	RAIL PRESSURE SENSOR (RPS)
93	-	-
94	-	-
95	-	-
96	-	-
97	AIR FLOW SENSOR (HFMS) Supply	AIR FLOW SENSOR (HFMS)
98	-	-
99	CRANKSHAFT POSITION SENSOR (CKP) Signal (-)	CRANKSHAFT POSITION SENSOR (CKP)
100	CRANKSHAFT POSITION SENSOR (CKP) Signal (+)	CRANKSHAFT POSITION SENSOR (CKP)
101	CRANKSHAFT POSITION SENSOR (CKP) Shield	CRANKSHAFT POSITION SENSOR (CKP)
102	-	-

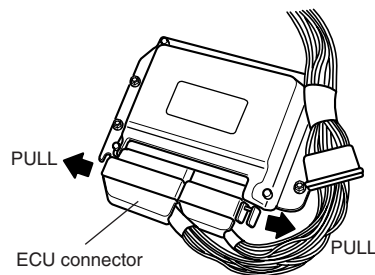
DIESEL CONTROL SYSTEM**EM -91**

Terminal	Signal (Associated Function)	Connected to
103	CAMSHAFT POSITION SENSOR (TDC) Signal	CAMSHAFT POSITION SENSOR (TDC)
104	CAMSHAFT POSITION SENSOR (TDC) Ground	CAMSHAFT POSITION SENSOR (TDC)
105	-	-
106	-	-
107	-	-
108	MPROP (SUCTION THROTTLE) HIGH SIDE	MPROP (SUCTION THROTTLE)
109	MPROP (SUCTION THROTTLE) LOW SIDE	MPROP (SUCTION THROTTLE)
110	MALFUCTION INDICATOR LAMP (MIL LAMP)	MALFUNCTION INDICATOR LAMP (MIL LAMP)
111	GLOW TIME INDICATOR LAMP	GLOW TIME INDICATOR LAMP
112	-	-
113	-	-
114	INJECTOR (CYLINDER No. 1)	INJECTOR (CYLINDER No. 1)
115	-	-
116	-	-
117	INJECTOR BANK FOR CYLINDER No.1 AND No.4	INJECTOR BANK FOR CYLINDER No.1 AND No.4
118	INJECTOR BANK FOR CYLINDER No.2 AND No.3	INJECTOR BANK FOR CYLINDER No.2 AND No.3
119	INJECTOR (CYLINDER No. 4)	INJECTOR (CYLINDER No. 4)
120	INJECTOR (CYLINDER No. 3)	INJECTOR (CYLINDER No. 3)
121	INJECTOR (CYLINDER No. 2)	INJECTOR (CYLINDER No. 2)

* S/W: Switch
A/CON: Air Conditioner

DISASSEMBLY LFAC7200

1. IG OFF and wait for 30 seconds.
2. Disconnect the battery ground terminal.
3. Lift the passenger side carpet (for LHD vehicle), and then remove the protection plate.
4. Remove the ECU mounting nuts.
5. Disconnect ECU harness connector. To do this, pull locking clip.
6. Unscrew four fixing bolts and remove ECU.



LFAC720A

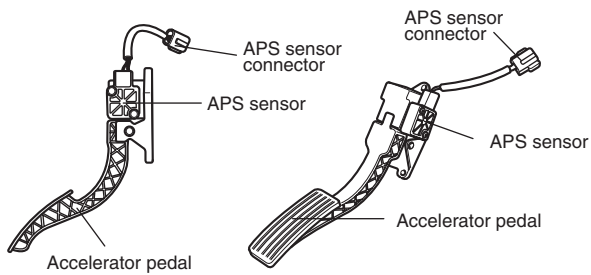
FUEL DELIVERY SYSTEM

ACCELERATOR PEDAL

DISASSEMBLY LFAC6200

Accelerator pedal is module type. It has APS (Accel. Position Sensor).

1. Unscrew fixing bolts or nuts and disconnect APS sensor connector, which senses position of accelerator pedal.
2. Disassemble APM.



LFAC620A

FUEL FILTER

DISASSEMBLY LFAC6000

Fuel filter is located aside of battery.

1. Remove the inlet hose and outlet hose.
2. Remove connectors (thermoswitch, heater and water sensor connector).
3. Unscrew fixing bolt and nut in bracket, then remove fuel filter.



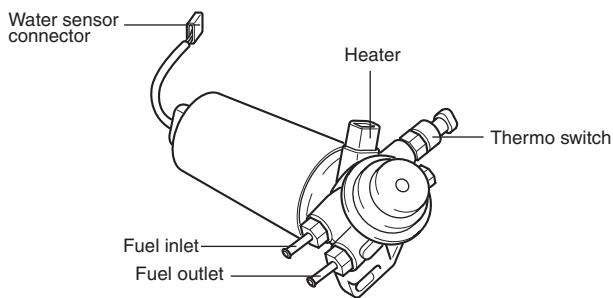
NOTE

You must be careful of fuel spillage from fuel filter.

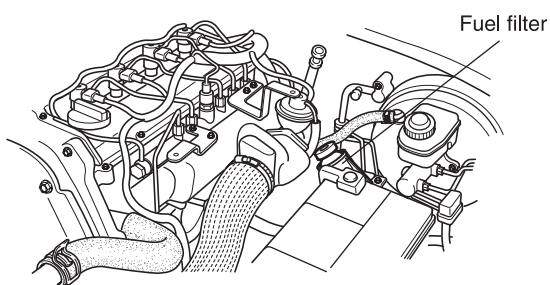
Tightening torque

Fuel filter fixing bolts and nut:

30-35N·m (305.9 - 356.9 kg·cm, 22.1 - 25.8 lbf·ft)



LFAC600A



LFAC600B

FUEL DELIVERY SYSTEM

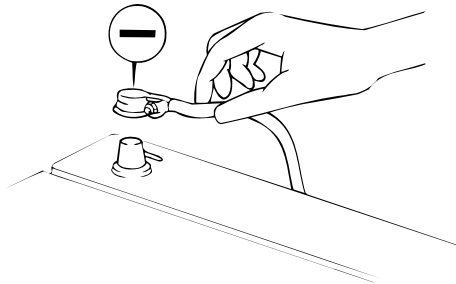
EM -95

FUEL TANK

DISASSEMBLY

LFAC6100

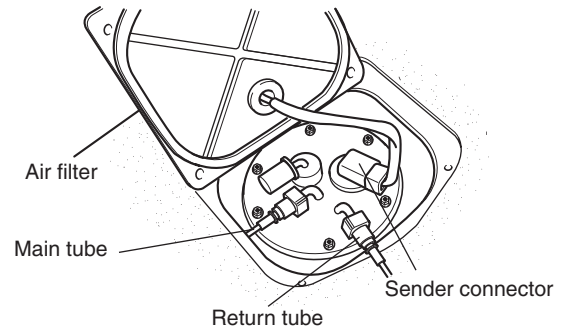
1. IG OFF.



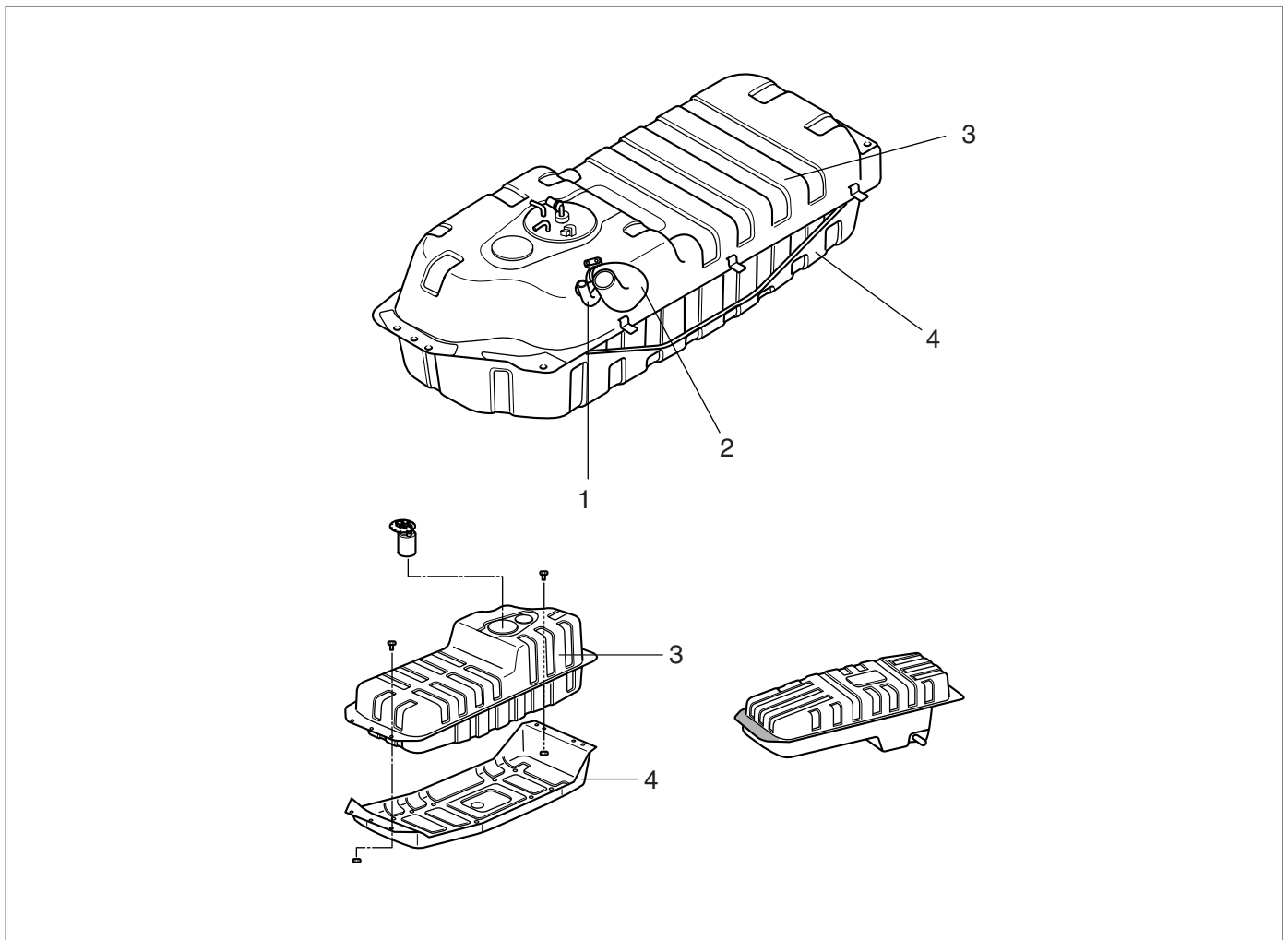
LFAC610A

2. Remove rear seat.

3. Remove carpet, and then disassemble service cover plate.
4. Disconnect the sender connector.
5. Disconnect the main and return tube.
6. Remove breather hose and joint hose in fuel filler pipe.
7. Remove fuel tank from vehicle.



LFAC610B



1. Breather hose
2. Joint hose

3. Fuel tank
4. Tank protector

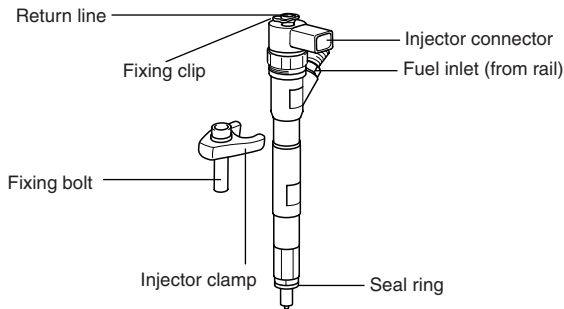
LFAC610C

DIESEL FUEL FEED SYSTEM

INJECTOR

COMPONENTS LOCATION

LFAC6800



LFAC680A



CAUTION

- **Common rail fuel injection system is subject to extremely high pressure (1350 bar).**
- **Never perform any work on injection system with engine running or within 30 seconds after stopping the engine.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors**

CLEANING

LFAC6850

It must be needed to clean the injector when injector is used again.

1. Clean the injector in vertical position in an ultra-sound bath.
2. If necessary, clean the injector body and sealing surface on the nozzle retaining nut also, using a fine cleaning cloth to remove any dirt residue. Do not remove the protection caps to do that.
3. The nozzle-shaft must only be cleaned in an ultra-sound bath and in a vertical position. A mechanical cleaning of the nozzle-shaft by wire-brush is not permitted.

DISASSEMBLY

LFAC6900

1. IG OFF.
2. Disconnect the negative battery (-) terminal.
3. Pull off the injector electric connector.



CAUTION

- **Plugs must be installed and/or uninstalled only when IG OFF.**
- **The electrical plug-connection must audibly snap in place during the installation.**
- **Do not extremely bend or squeeze the cable, do not bring them in contact with sharp edges, and also secure cables against vibrations.**

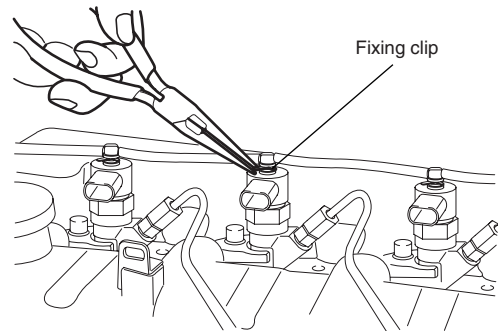
4. Unfasten the high-pressure fuel pipe at rail and injector.



CAUTION

When mounting the high-pressure pipes, fix the hexagon component of high-pressure fuel injection parts not to squeeze heavily the high-pressure fuel injection parts.

5. Remove injector return hose. To remove this, pull fixing-clip first.



LFAC690A

6. Remove injector clamp by unscrewing injector clamp bolt.



CAUTION

Before re-installing injector, clean the cylinder head bore and sealing surface.

1. **Insert the brush.**
2. **Clean the sealing surface and blow out.**

DIESEL FUEL FEED SYSTEM

EM -97

INSTALLATION LFAC7000

1. Insert a new copper sealing ring (if necessary, apply small quantity of grease to bond it to injector)



CAUTION

Whenever used inject is installed again, clamp fixing bolt and seal-ring are replaced with new one.

2. Install the injector (do not touch the nozzle tip) and sliding clamp with clamp bolt.
3. Screw the clamp bolt.

Tightening torque

Injector clamp fixing bolt:

26.5 $\pm$ $\frac{3}{4}$ N·m (270 $\pm$ $\frac{3}{4}$ kgf·cm, 19.5 $\pm$ $\frac{3}{4}$ lbf·ft)

4. Install the high-pressure pipes.

Tightening torque

Fixing high-pressure pipe:

26.5-28.4 N·m (250-290 kgf·cm, 18-20.9 lbf·ft)

5. Attach the connection of back leak rail.
Never fit without clip.



CAUTION

A fixing clip that was removed must be replaced with a new one.

6. Check the tightness of back leak rail by tugging it.
7. Attach the connector.
8. Re-connect the negative battery (-) terminal.
9. Start the engine and check the high-pressure circuit for leaks.



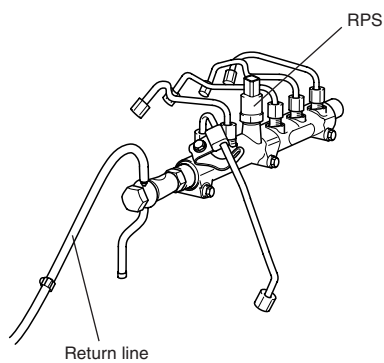
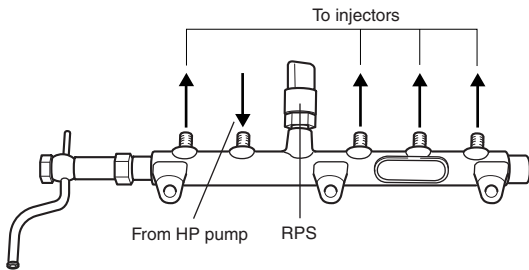
CAUTION

- ***If accidentally the HP-connector becomes loose then the complete injector must be exchanged.***
- ***After each time an injector is loosened the copper seal must be replaced, and if needed also the fastening screw with nut.***
- ***Check the fuel-system visually for any leakage. If a leakage is detected even have been used the correct torque, the component(s) must be exchanged.***

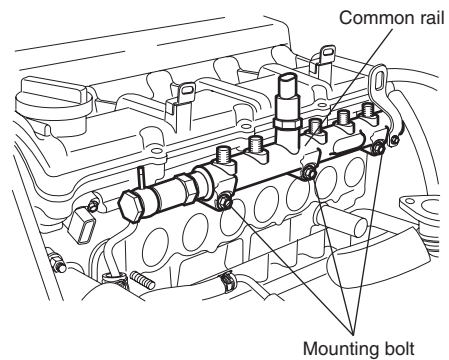
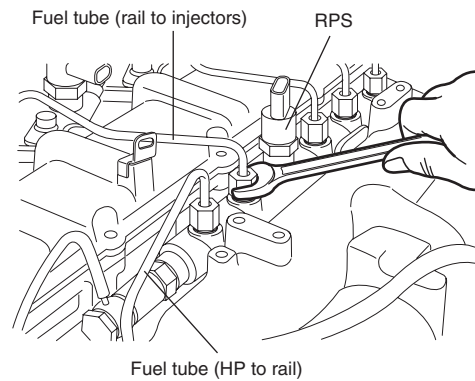
RAIL

COMPONENTS LOCATION

LFAC6500



LFAC650A



LFAC660A

DISASSEMBLY

LFAC6600



CAUTION

- **Common rail fuel injection system is subject to extremely high pressure (1350 bar).**
- **Never perform any work on injection system with engine running or within 30 seconds after stopping the engine.**
- **Always pay attention to safety precaution.**
- **Ensure the absolute cleanliness.**
- **It is not recommended to remove the injectors.**

1. Disconnect high-pressure fuel tube (rail to injector, high pressure pump to rail).
2. Disconnect return line.
3. Disconnect rail pressure sensor (RPS) connector.
4. Remove EGR valve.
5. Remove intake manifold. Refer to ENGINE MECHANICAL group.
6. Remove three mounting bolts and disassemble.



CAUTION

Be careful of fuel spillage from rail.

INSTALLATION

LFAC6700

1. Tightening the three mounting bolts

Tightening torque

Rail fixing bolt:

14.7-21.6N·m (150-220 kg·cm, 10.8-15.9 lbf·ft)

2. Assemble intake manifold. Refer to ENGINE MECHANICAL group.
3. Assemble EGR valve.
4. Connect rail pressure sensor connector.
5. Connect high-pressure tube (rail to injector, high pressure pump to rail).

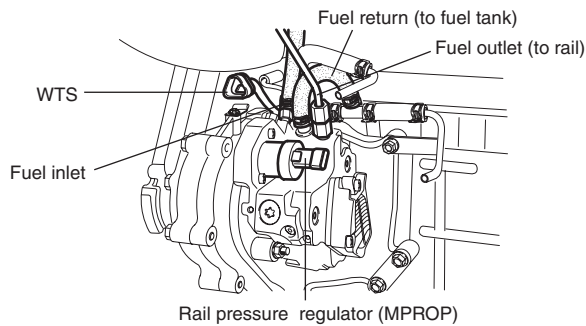
DIESEL FUEL FEED SYSTEM

EM -99

HIGH PRESSURE PUMP

COMPONENTS LOCATION

LFAC6400



LFAC640A

DISASSEMBLY

LFAC8000

1. Disassemble timing chain and high-pressure sprocket. (Refer to Gr: ENGINE MECHANICAL SYSTEM-TIMING SYSTEM)
2. Disconnect fuel tube (HP to rail) and rail pressure regulator(MPROP) connector.
3. Unscrew high-pressure mounting bolts and then disassemble high-pressure pump.

Tightening torque

High-pressure pump fixing bolt:

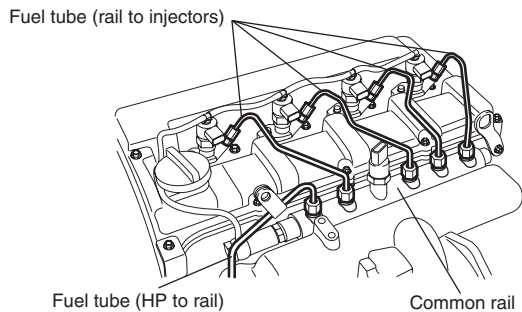
12.7-17.7 N·m (130-180 kgf·cm, 9.4-13.0 lbf·ft)

High-pressure fuel line fixing:

24.5-28.4 N·m (250-290 kgf·cm, 18.1-21.0 lbf·ft)

OTHER DIESEL FUEL FEED SYSTEM PARTS

INSTALLATION LFAC7100



LFAC710A

Tightening torque

Fuel tube fitting nut:

24.5-28.4 N·m (250-290 kg·cm, 18.1-21.0 lbf·ft)



CAUTION

- *During the installation of the lines, do not use any extreme force, or any tools.*
- *The high-pressure line must only be installed to the injector when the injector is tightly secured in its position.*
- *Tightening torque must never exceed the specification to avoid any damages to the sealing edge and to avoid that the HP-connector comes loose during the disassembly.*