

# Engine (D4EB - Diesel 2.2)

**GENERAL**

**ENGINE AND TRANSAXLE ASSEMBLY**

**TIMING SYSTEM**

**CYLINDER HEAD ASSEMBLY**

**ENGINE BLOCK**

**COOLING SYSTEM**

**LUBRICATION SYSTEM**

**INTAKE AND EXHAUST SYSTEM**

# GENERAL

## SPECIFICATIONS E18A7ADE

Description		Specifications	Limit
<b>General</b>			
Type		1-type, SOHC	
Number of cylinder		4	
Bore		87mm(3.4252in.)	
Stroke		92mm(3.6220in.)	
Total displacement		2,188cc	
Compression ratio		17.3:1	
Firing order		1-3-4-2	
<b>Valve timing</b>			
Intake valve	Opens (BTDC)	7°	
	Closes (ABDC)	35°	
Exhaust valve	Opens (BBDC)	52°	
	Closes (ATDC)	6°	
<b>Cylinder head</b>			
Flatness of gasket surface		Less than 0.03mm (0.0012in) for width	
		Less than 0.09mm (0.0035in) for length	
		Less than 0.012mm (0.0005in) for 51 × 51 mm	
<b>Camshaft</b>			
Cam height	Intake	34.697mm (1.3660in)	
	Exhaust	34.571mm (1.3611in)	
Journal outer diameter		27.947 ~ 27.960mm(1.1003 ~ 1.1008in.)	
Bearing oil clearance		0.040 ~ 0.074mm (0.0016 ~ 0.0029in)	
End play		0.05 ~ 0.15mm (0.0020-0.0059in)	
<b>Valve</b>			
Valve length	Intake	95.5 ~ 95.9mm(3.7598 ~ 3.7756in.)	
	Exhaust	95.2 ~ 95.6mm(3.7480 ~ 3.7638in.)	
Stem outer diameter	Intake	5.933 ~ 5.953mm(0.2366 ~ 0.2344in.)	
	Exhaust	5.905 ~ 5.925mm(0.2325 ~ 0.2333in.)	
Face angle		45.5° ~ 46°	
Thickness of valve-head(margin)	Intake	1.5 ~ 1.7mm(0.0591 ~ 0.0669in.)	
	Exhaust	1.2 ~ 1.4mm(0.0472 ~ 0.0551in.)	
Valve stem to valve guide clearance	Intake	0.022 ~ 0.067mm(0.0009 ~ 0.0021in.)	
	Exhaust	0.050 ~ 0.095mm(0.0020 ~ 0.0037in.)	
<b>Valve guide</b>			

## TIGHTENING TORQUE

ITEM	N.m	kgf.m	lb.ft
Engine mounting bracket nuts/bolts(engine side)	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Engine mounting bracket nuts(body side)	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Engine mounting insulator bolt	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine support bracket bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Front roll stopper bracket sub frame member bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper insulator bolt/nut	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Rear roll stopper bracket sub frame member bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper insulator bolt/nut	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Transaxle mounting bracket bolt(transaxle side)	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Transaxle mounting bracket bolt(body side)	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Cylinder head cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft sprocket bolt	122.6 ~ 137.3	12.5 ~ 14.0	90.4 ~ 101.3
Camshaft bearing cap bolt	26.0 ~ 28.9	2.7 ~ 3.0	19.2 ~ 21.3
Air cleaner body mounting bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Crankshaft bolt	196.1 ~ 205.9	20.0 ~ 21.0	144.7 ~ 151.9
Damper pulley bolt	29.4 ~ 33.3	3.0 ~ 3.4	21.7 ~ 24.6
Cylinder head bolt(at cold)	63.7 + 120° + 120°	6.5 + 120° + 120°	47.0 + 120° + 120°
Timing belt auto tensioner bolt	49.0 ~ 53.9	5.0 ~ 5.5	36.2 ~ 39.8
Drive belt auto tensioner bolt	25.5 ~ 30.4	2.6 ~ 3.1	18.8 ~ 22.4
Timing belt auto tensioner adjusting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Drive belt idler bolt	45.1 ~ 50.0	4.6 ~ 5.1	33.3 ~ 36.9
Oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pressure switch	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil filter fitting	47.1 ~ 51.0	4.8 ~ 5.2	34.7 ~ 37.6
Oil filter	22.6 ~ 24.5	2.3 ~ 2.5	16.6 ~ 18.1
Oil jet bolt	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Oil pump cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Oil pump assembly	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil lever gauge	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Plug cap	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Timing belt upper cover	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Timing belt lower cover	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Flywheel	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Connecting rod cap bolt	24.5 + 90°	2.5 + 90°	18.1 + 90°
Water pump and cylinder block bolt	47.1 ~ 51.0	4.8 ~ 5.2	34.7 ~ 37.6

**TROUBLESHOOTING** E72E93DD

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

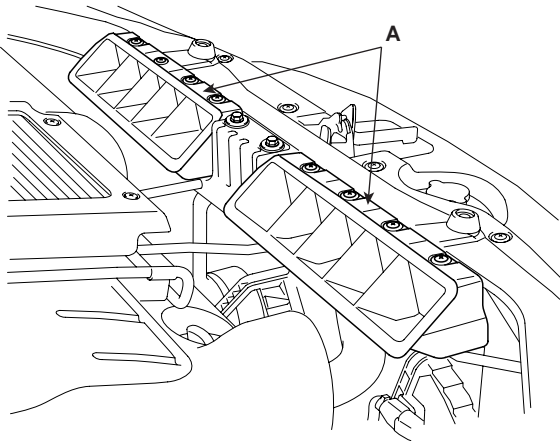
# ENGINE AND TRANSAXLE ASSEMBLY

## REMOVAL E1706BBE

### CAUTION

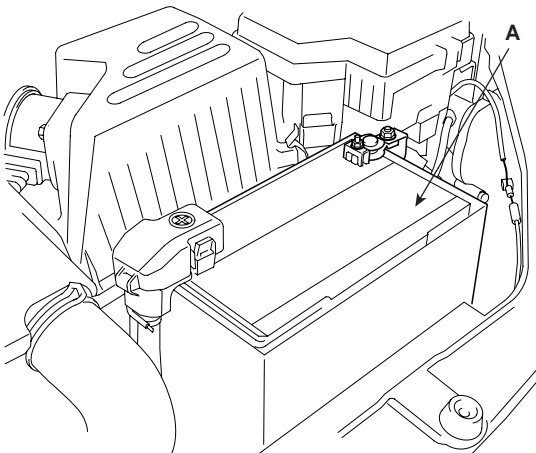
- Make sure jacks and safety stands are placed properly.
  - Make sure the vehicle will not roll off stands and fall while you are working under it.
  - Use fender covers to avoid damaging painted surface.
  - Unplug the wiring connectors carefully while holding the connector portion to avoid damage.
  - Mark all wiring and hoses to avoid misconnection.
- Also, be sure that they do not contact other wiring or hoses or interfere with other parts.

1. Remove the air duct(A).



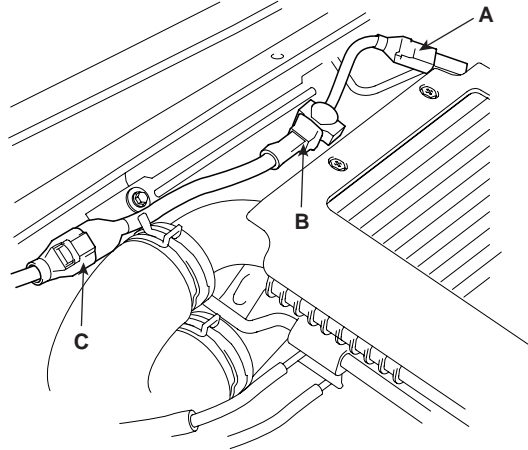
SCMEM6001D

2. Remove the battery terminals and the battery assembly(A).



SCMEM6002D

3. Remove the intercooler system.
  - 1) Disconnect the connector(C) related to the BPS(Boost Pressure Sensor)(A) and the VGT(Variable Geometry Turbocharger) solenoid valve(B).

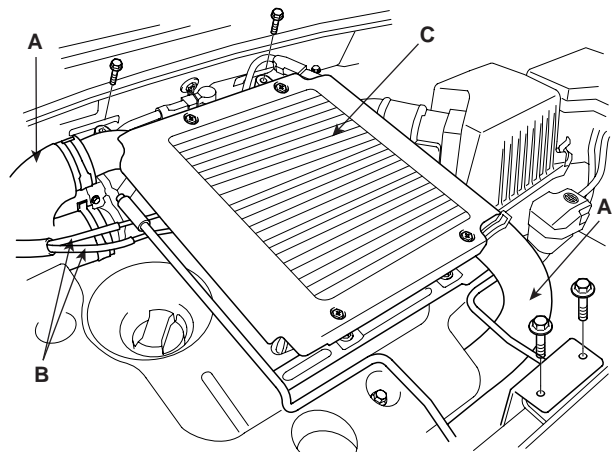


SCMEM6003D

- 2) Disconnect the intercooler hoses(A).
- 3) Disconnect the VGT(Variable Geometry Turbocharger) solenoid valve vacuum hoses(B).
- 4) Remove the intercooler hose assembly(C).

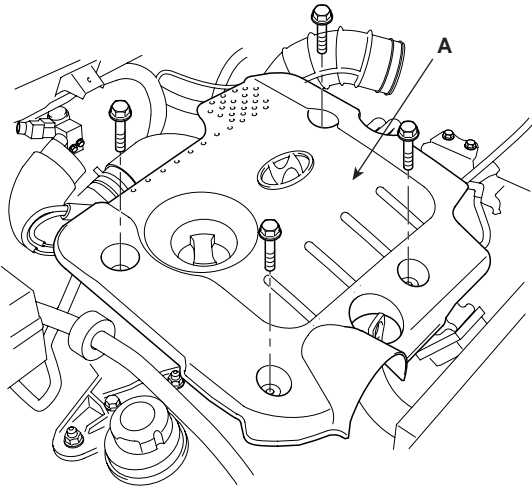
### Tightening torque :

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



SCMEM6004D

10. Remove the engine cover(A).

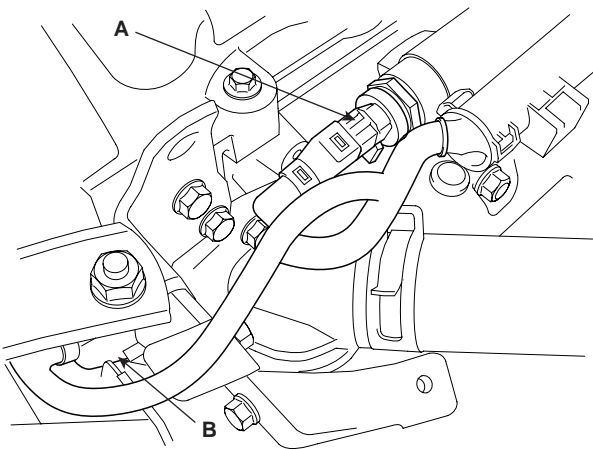


SCMEM6010D

11. Remove the hose between the intercooler and the intake system.

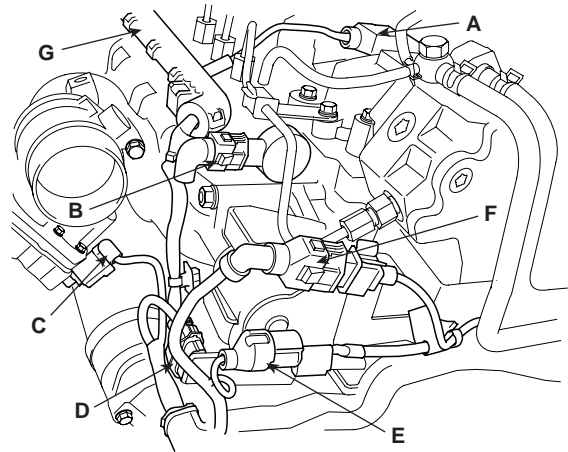
12. Remove the engine wirings.

- 1) Disconnect the rail pressure sensor connector(A) and the ECT(Engine Coolant Temperature) sensor connector(B).



SCMEM6011D

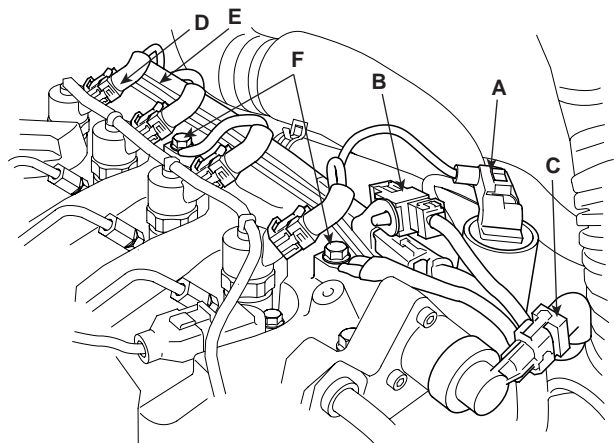
- 2) Disconnect the camshaft position sensor connector(A), the rail pressure regulator connector(B), the swirl valve actuator connector(C), the electronic throttle body actuator connector(D), the oil pressure switch connector(E) and the crankshaft position sensor connector(F) and remove the connector/wire harness protector(G).



SCMEM6012D

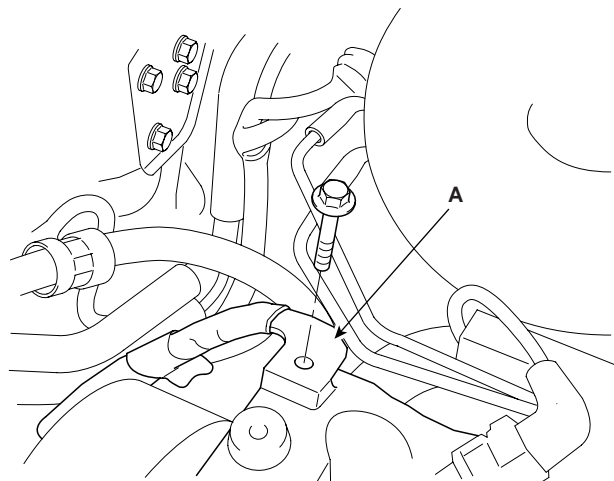
- 3) Disconnect the EGR(Exhaust Gas Recirculation) solenoid valve connector(A), the glow plug(B), the fuel pressure regulator valve connector(C), the injector(D) and the connector/wire harness protector(E).

- 4) Disconnect the ground lines(F).



SCMEM6013D

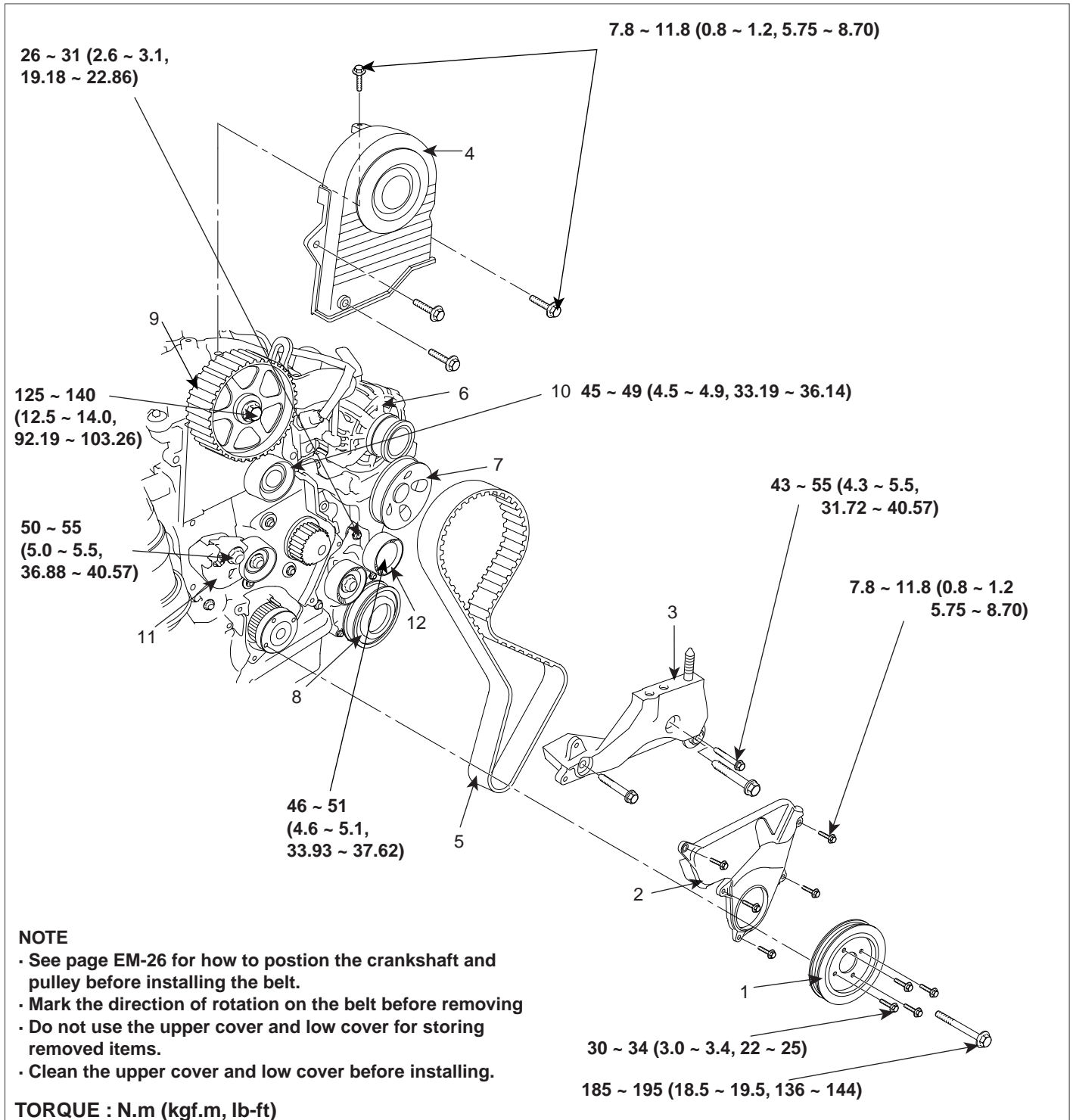
13. Disconnect the ground line from the cylinder head(A).



SCMEM6014D

# TIMING SYSTEM

## COMPONENTS E32DA029



1. Damper pulley
2. Timing belt lower cover
3. Engine support bracket
4. Timing belt upper cover
5. Timing belt
6. Alternator and vacuum pump assembly

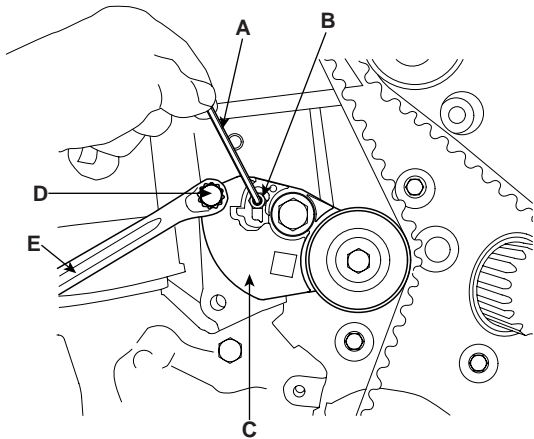
7. Power steering pump
8. Air conditioning compressor
9. Camshaft sprocket
10. Timing belt idler
11. Timing belt tensioner
12. Idler

4. Tighten the stop bolt(B) and remove the fixing pin.

**Tightening torque**

Auto tensioner adjustable bolt

10 ~ 12N.m (1.0 ~ 1.2 kgf.m, 7 ~ 9lb-ft)

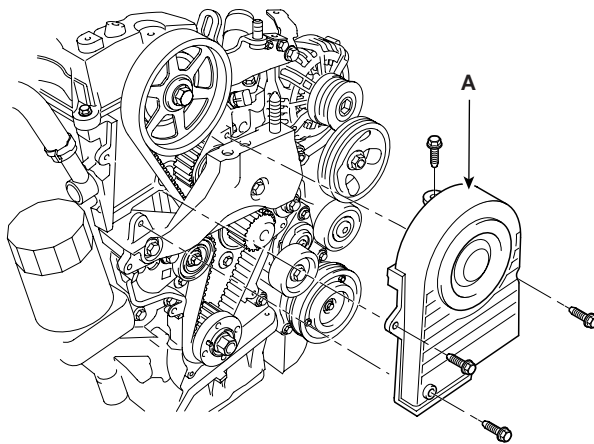


ACIE050A

- b. Install the timing belt upper cover(A) and lower cover(B).

**Tightening torque**

7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.75 ~ 8.70lb-ft)



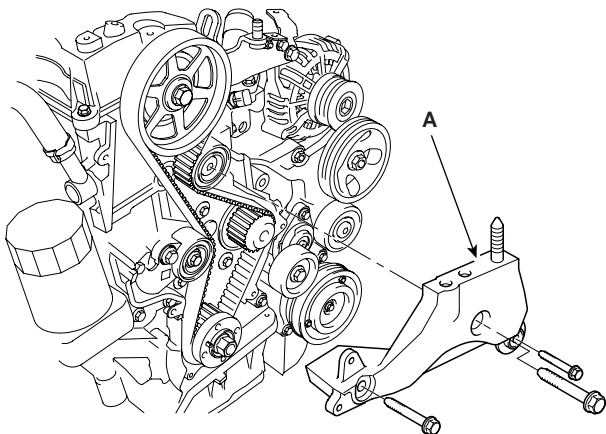
SCMEM6033D

5. Reinstall all removed components in the reverse order of removal.

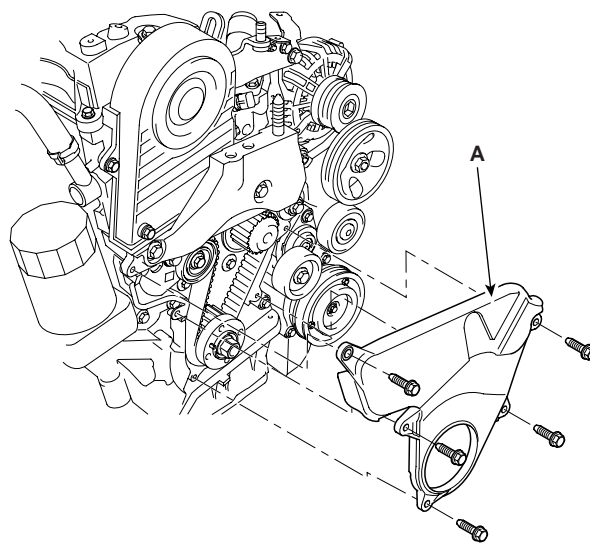
- a. Install the engine bracket(A).

**Tightening torque**

43 ~ 55N.m (4.3 ~ 5.5kgf.m, 31.72 ~ 40.57lb-ft)



SCMEM6034D



SCMEM6032D



## REMOVAL ED877421

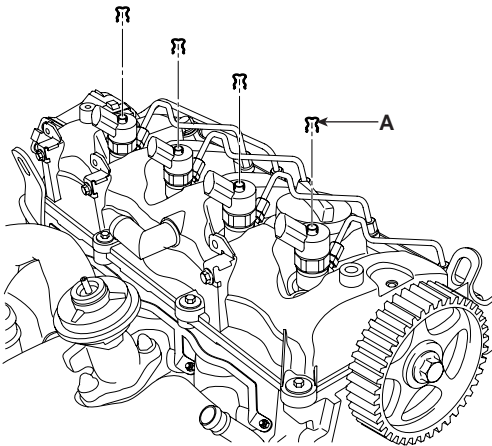
**CAUTION**

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion to avoid damage.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before loosening the retaining bolts.

**NOTE**

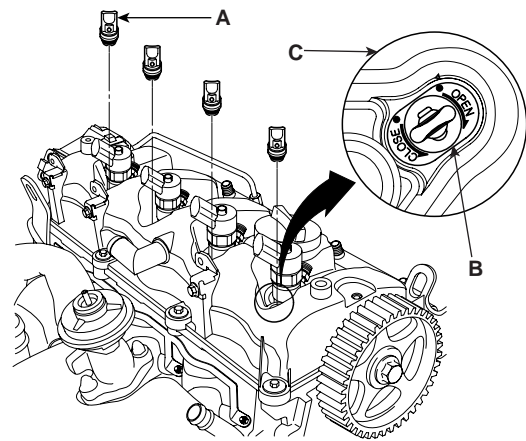
Mark all wiring and hoses to avoid misconnection. Also, be sure that they do not contact other wiring or hoses, or interfere with other parts.

1. Before removing the cylinder head, the timing belt should be removed first. Refer to the timing belt 'removal' step.
2. Disconnect the fuel return hose after removing the clips(A).



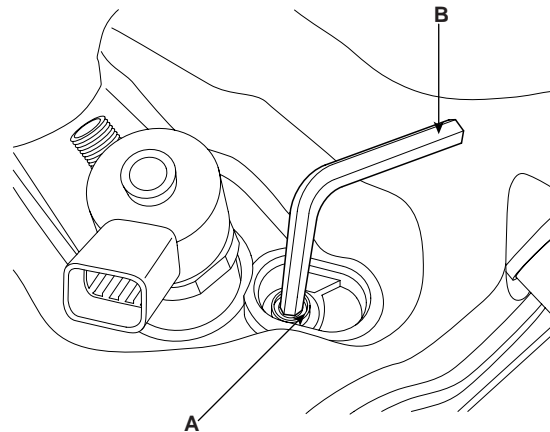
ACIE057A

3. Remove the plugs(A).
  - a. Pull the plug up slightly. (more than 1mm)
  - b. Rotate the plug 90° clockwise.
  - c. Remove the plug with inserting a (-)driver between the plug assy(B) and the cylinder head cover(C).



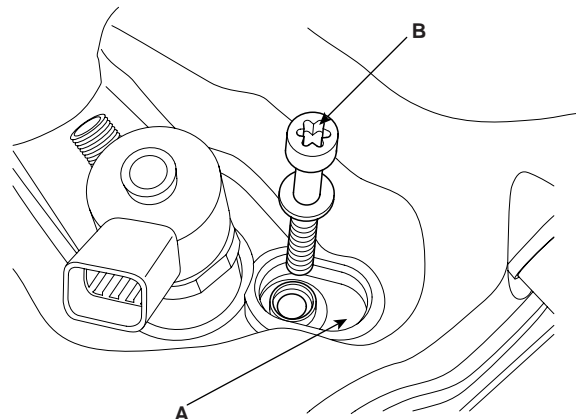
ACIE058A

4. Loosen the injector holder bolt(A) with 5mm hexagonal wrench(B).



ACIE059A

5. Pull the injector holders(A) with the bolts(B).

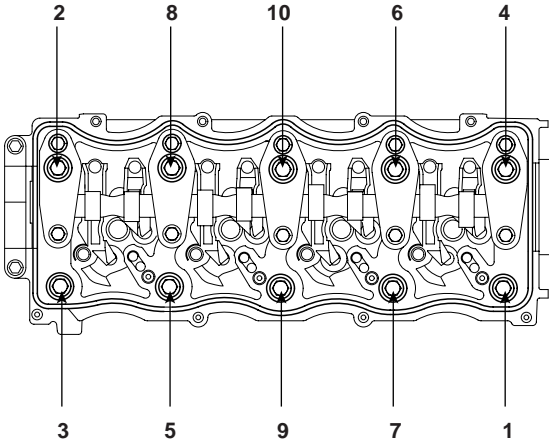


LCIF017A

**CAUTION**

To prevent warpage, unscrew the bolts in sqience 1/3 turn at a time: repeat the sequence until all bolts are loosened.

**CYLINDER HEAD BOLTS LOOSENING SEQUENCE**



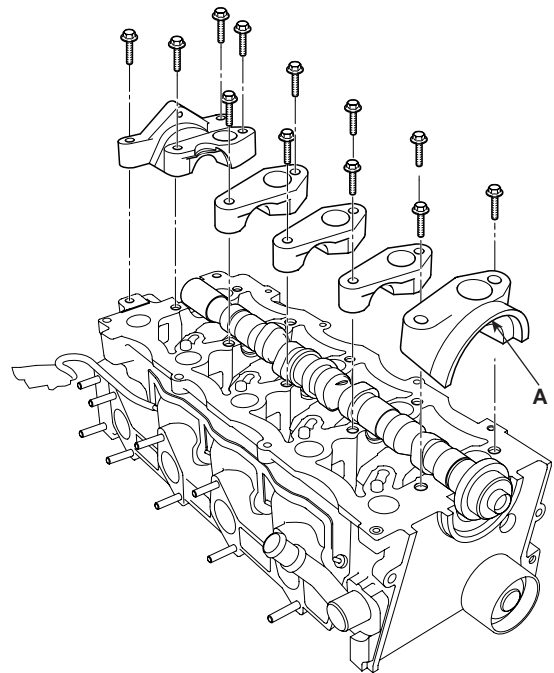
ACIE067A

**DISASSEMBLY** E9BF1486

**NOTE**

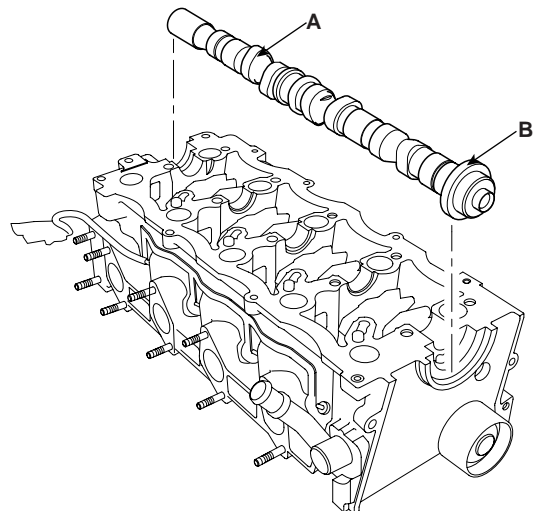
- Identify parts as they are removed to ensure re-installation in original locations.
- Inspect camshafts.

1. Remove the engine hangers, the knock bushes and the studs.
2. Remove the camshaft bearing caps(A).



ACIE068A

3. Remove the camshaft(A) with the oil seal(B).



ACIE069A

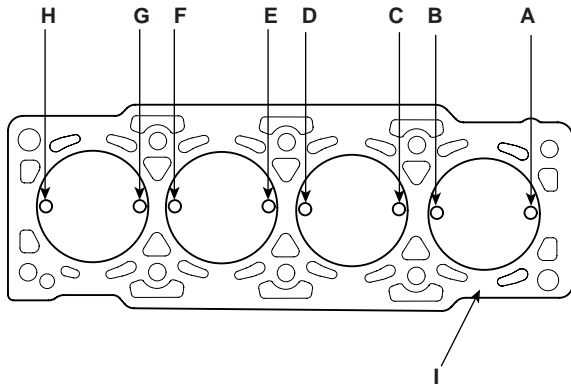
**INSTALLATION** E4F40791

Install the cylinder head in the reverse order of removal :

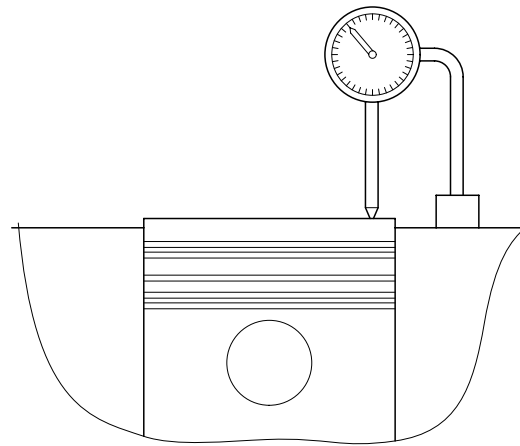
**NOTE**

- Always use a new head gasket.
- Cylinder head and cylinder block surface must be clean.
- Turn the crankshaft so the No.1 piston is at TDC(Top Dead Center).

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

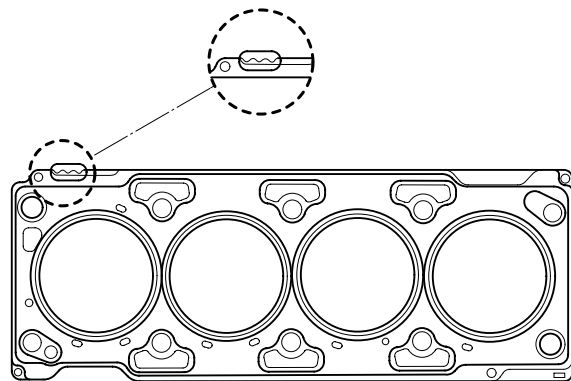


ACIE088A






ACIE089A

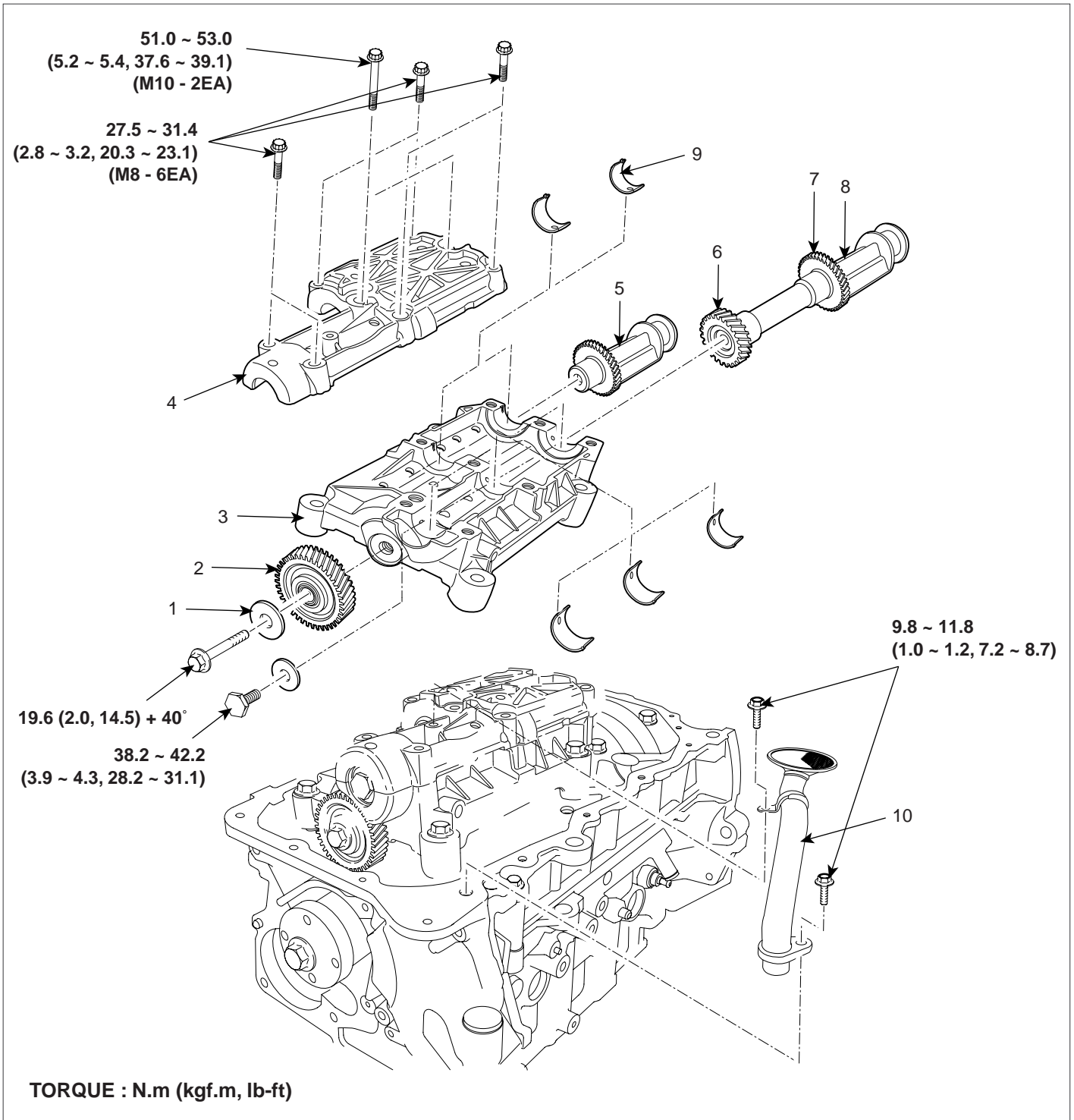
- b. Select the gasket in the table below using the average value of piston protrusions. Although even the only 1 point is over than the each rank limit, use 1 rank upper gasket than specified in the table below.



ACIE090A

Displacement	2.2 L		
	Average of piston protrusion	0.194 ~ 0.337mm (0.0079 ~ 0.013in.)	0.337 ~ 0.440mm (0.013 ~ 0.017in.)
Gasket thickness	1.1 ± 0.05mm (0.0433 ± 0.0020in.)	1.2 ± 0.05mm (0.0472 ± 0.0020in.)	1.3 ± 0.05mm (0.0512 ± 0.0020in.)
Limit of each rank extant	0.43mm (0.0169in.)	0.53mm (0.0208in.)	-
Identification code	 SCMEM6102D	 SCMEM6103D	 SCMEM6104D

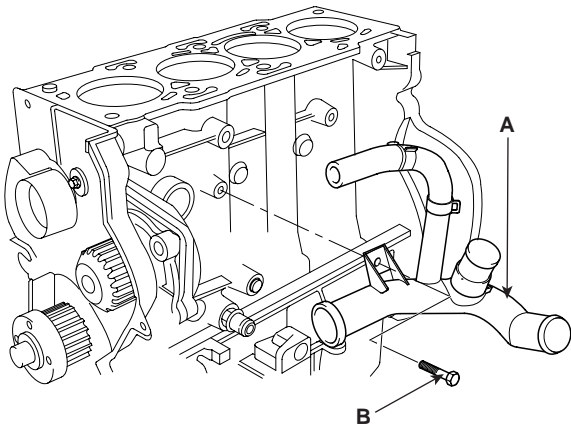
- c. Install the gasket so that the identification mark faces toward the flywheel side.



- 1. Washer
- 2. Balance shaft intermediate gear
- 3. Balance shaft upper carrier
- 4. Balance shaft lower carrier
- 5. Balance driven shaft

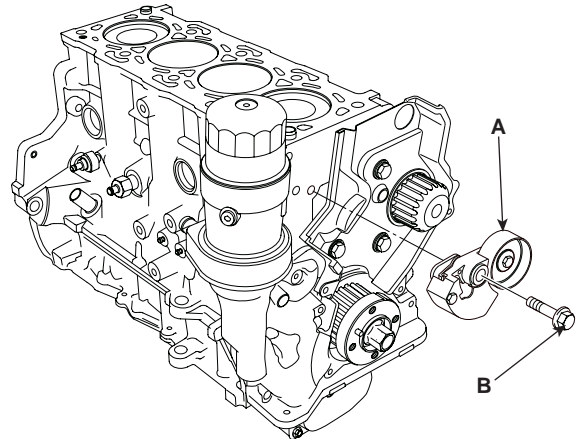
- 6. Balance shaft drive gear
- 7. Balance shaft driver gear
- 8. Balance driver shaft
- 9. Balance shaft bearing
- 10. Oil screen

13. Remove the water inlet pipe assembly(A) by loosening a bolt(B) and clamps.



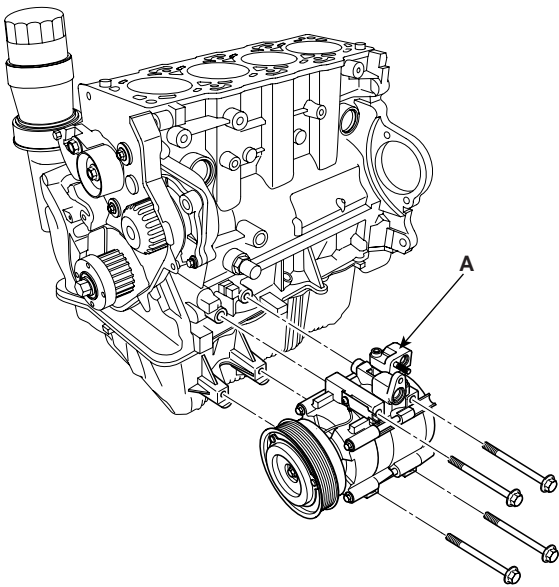
ACIE107A

15. Remove the auto-tensioner(A) by loosening the bolt(B).



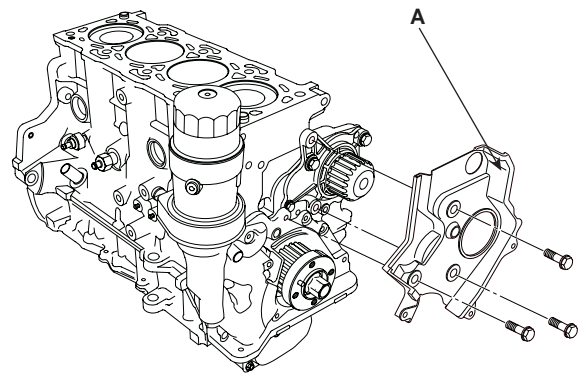
ACIE109A

14. Remove the air compressor(A). (See HA group - compressor)



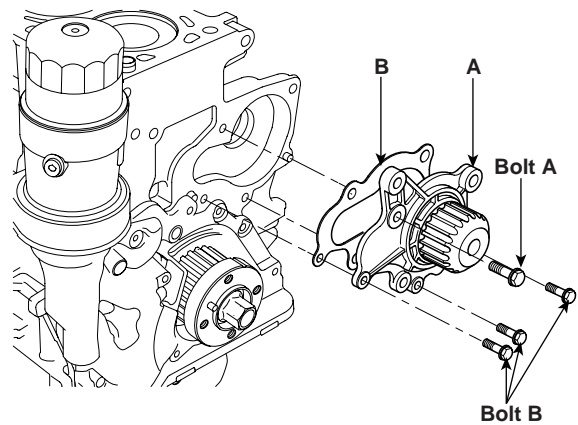
ACIE108A

16. Remove the timing belt rear cover(A).



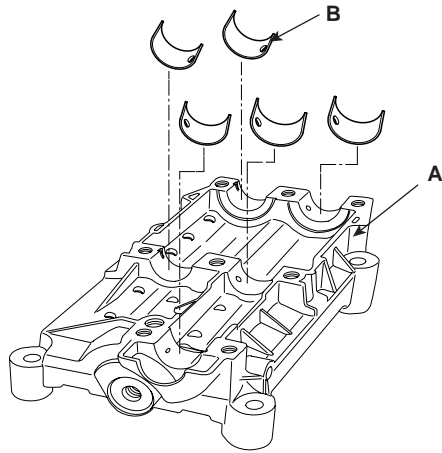
ACIE110A

17. Remove the water pump assembly(A) with the gasket(B).



LCIF027A

4. Remove the balance shaft bearing(B) from balance shaft upper carrier(A).



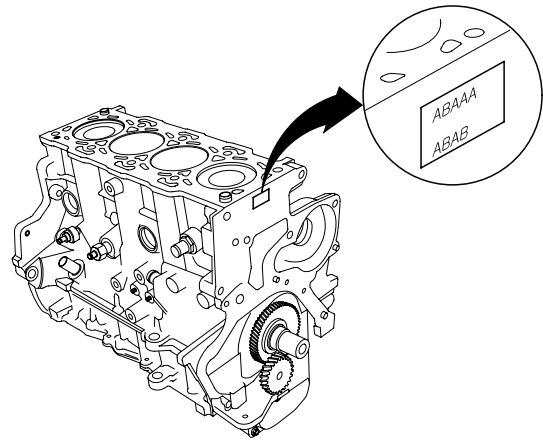
SCMEM6053D

**REPLACEMENT** E0EBB461

**MAIN BEARING SELECTION**

**Crankshaft Bore Code Location**

1. Letters have been stamped on the end of the block as a code for the size of each of the 5 main journal bores. Write down the crank bore codes. If you can't read the codes because of accumulated dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.



ACIE129A

**Discrimination of cylinder block**

Discrimination		SIZE (mm) (Inside diameter of crank bore)
Class	Mark	
A	A	Ø64 (0 ~ +0.006)
B	B	Ø64 (+0.006 ~ +0.012)
C	C	Ø64 (+0.012 ~ +0.018)

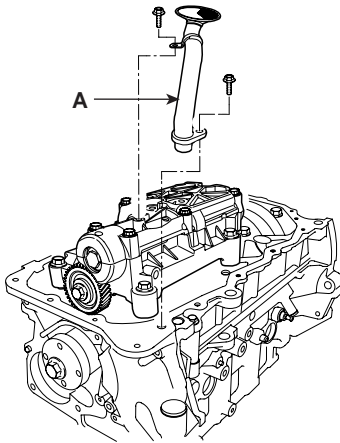
5. Install the oil screen(A) on the oil pump case(B) and the engineblock.

**Tightening torque**

10 ~ 12N.m (1.0 ~ 1.2kgf.m, 7.37 ~ 8.85lb-ft)

**NOTE**

The bolt B should be tightened after the installation of the bolt A.



SCMEM6054D

6. Clean and dry the bed plate and the oil pan mating surfaces.
7. Apply liquid gasket evenly to the bed plate mating surface of the oil pan. Install the oil pan.

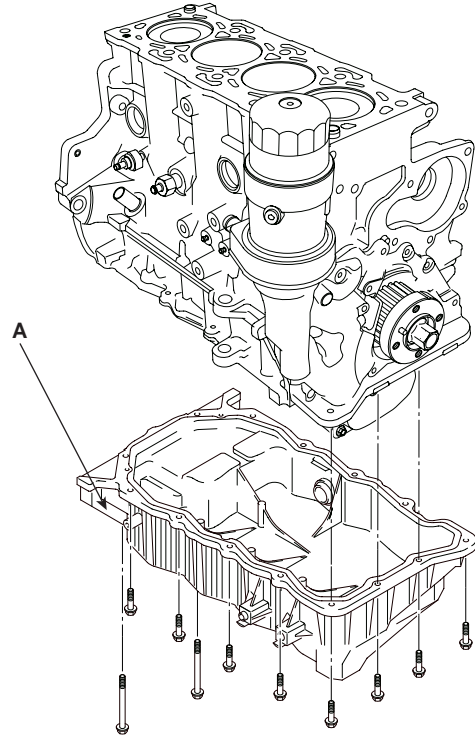
**NOTE**

- Standard liquid gasket : LOCTITE 5900
- Assemble the oil pan in 5 minutes after applying the liquid gasket.
- Apply liquid gasket in a 3mm wide bead without stopping.
- The clearance between the liquid gasket and the flange inner end should be 2 ~ 3mm.

8. Tighten the bolt in two or three steps. In the final step, tighten all bolts.

**Tightening torque**

10 ~ 12N.m (1.0 ~ 1.2kgf.m, 7.38 ~ 8.851lb-ft)

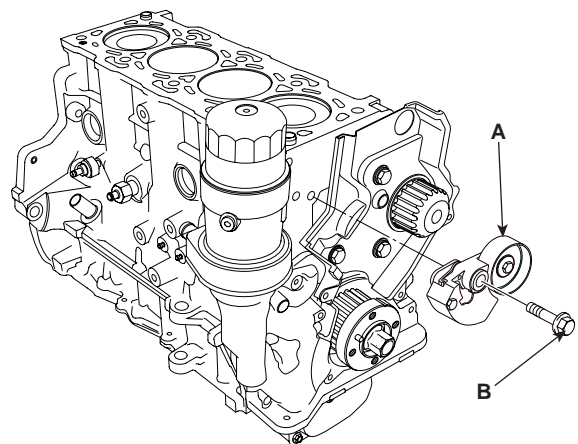


ACIE112A

**NOTE**

After installing the oil pump assembly and the oil pan, remove the oil cooler and fill the 50cc engine oil.

9. Install the water pump.
10. Install the auto-tensioner(A).



ACIE109A