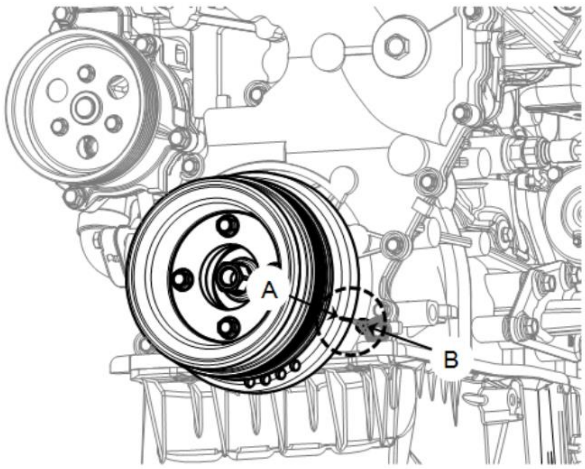
Ⅰ. Engine Mechanical System

Symptom	Suspect area	Remedy
Low engine noise regardless of engine speed	Low oil pressure	Repair or replace damaged components as required.
	Loose or damaged flywheel	Repair or replace the flywheel.
	Damaged contact area between oil pan and the oil pump screen	Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Loose, damaged or restricted oil pump Screen	Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance	Inspect the piston and cylinder bore. Repair as required.
	Excessive piston pin-to-bore clearance	Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. · Connecting rod bearings · Connecting rods · Crankshaft · Crankshaft journals
	Excessive crankshaft bearing clearance	Inspect the following components and repair as required. · Crankshaft bearings · Crankshaft journals
	Incorrect piston, piston pin and connecting rod installation	Verify the piston pins and connecting rods are installed correctly. Repair as required.
Engine noise under load	Low oil pressure	Repair or replace as required
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. · Connecting rod bearings · Connecting rods · Crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components and repair as required. · Crankshaft bearings. · Crankshaft journals · Cylinder block crankshaft bearing bore

Removal

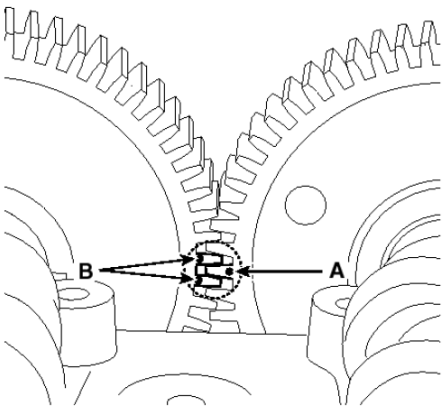
1. Remove the cylinder head cover.
   (Refer to Cylinder Head Assembly – "Cylinder Head Cover")
2. Set the piston of No. 1 cylinder to the TDC(Top Dead Center) on compression stroke.
   1) Turn the crankshaft pulley clockwise and align the timing mark of timing chain cover(B) with the timing mark of damper pulley.(A)



NOTICE

Do not rotate engine counterclockwise.

   2) Check that the timing mark (A) of the exhaust camshaft timing gear and the timing mark (B) of the intake camshaft timing gear are aligned as shown in the illustration.



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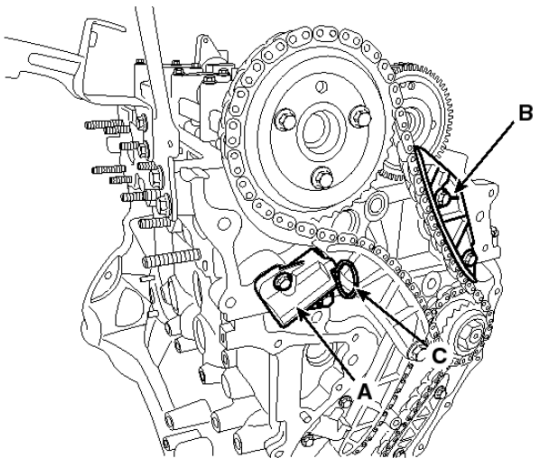
Information

If the timing marks do not match, rotate the crank shaft clockwise once(360˚).
(Do not rotate engine counterclockwise.)

3. Remove the timing chain cover.
   (Refer to Timing System – "Timing Chain Cover")
4. Remove the timing chain "B" auto tensioner(A) and guide(B).



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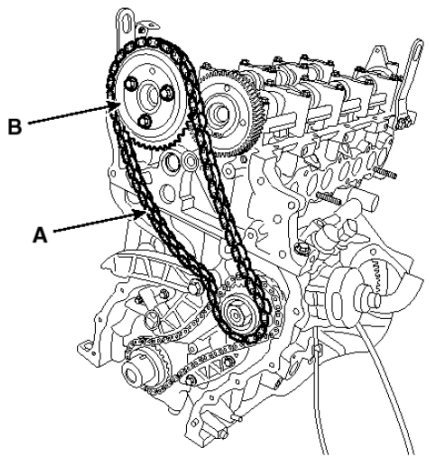
Information

Before removing the auto tensioner, install a set pin© (Φ2.5㎜ steel wire) after compressing the tensioner.

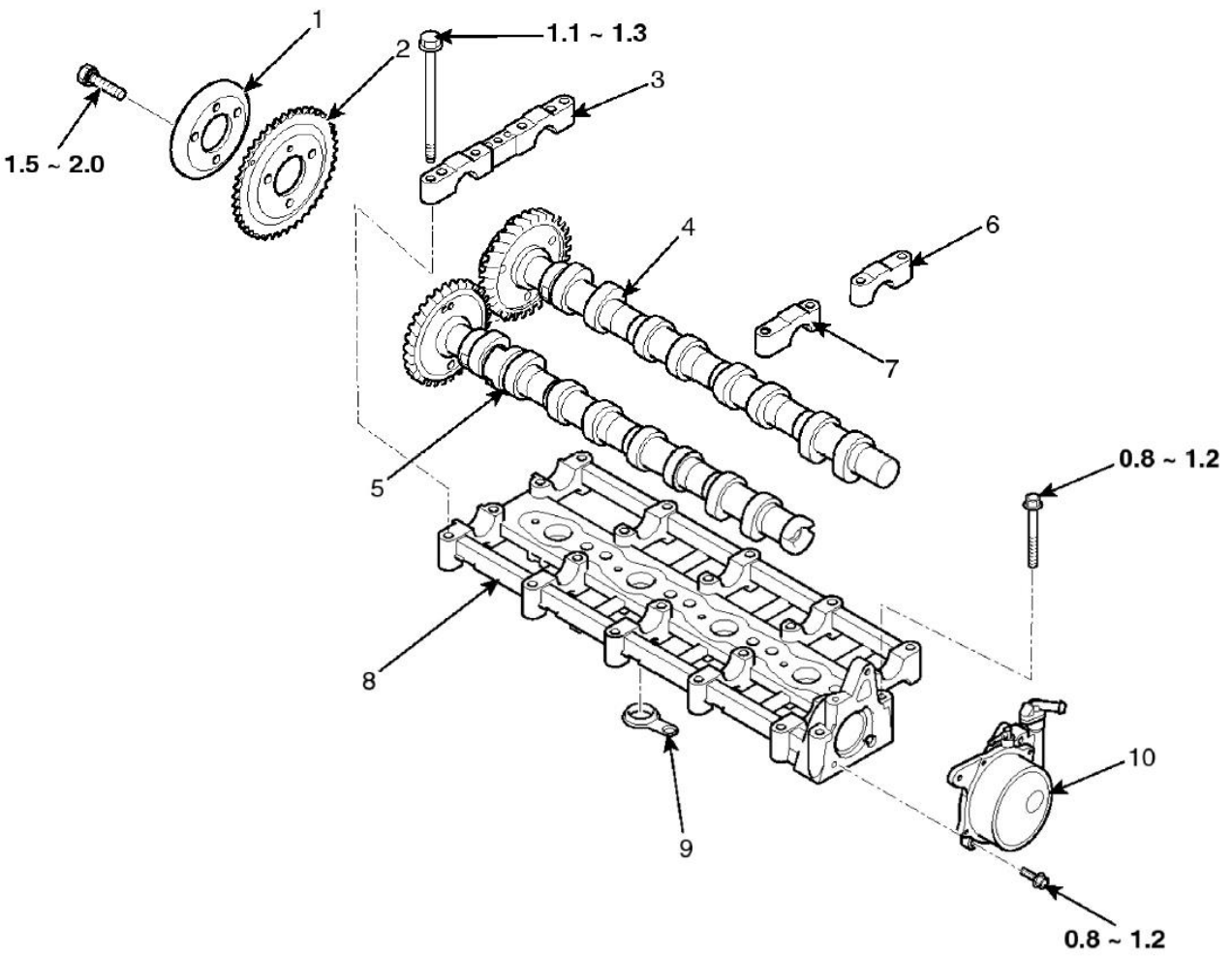
5. Remove the timing chain "B"(A) with the camshaft sprocket(B).



SXMEM9042D

Cam Shaft

Components

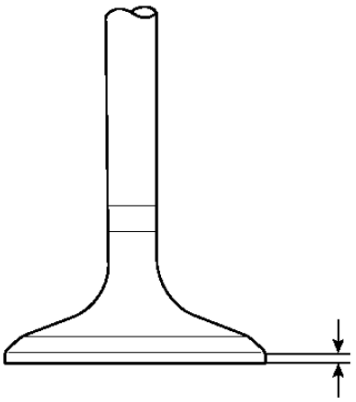


Torque : kgf · m

1. Dummy mass
2. Camshaft chain sprocket
3. Front camshaft bearing cap
4. Exhaust camshaft
5. Intake camshaft
6. Exhaust camshaft bearing cap
7. Intake camshaft bearing cap
8. Cam carrier
9. Cam carrier gasket
10. Vacuum pump

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

Margin : Intake 1.25㎜, Exhaust 1.25㎜



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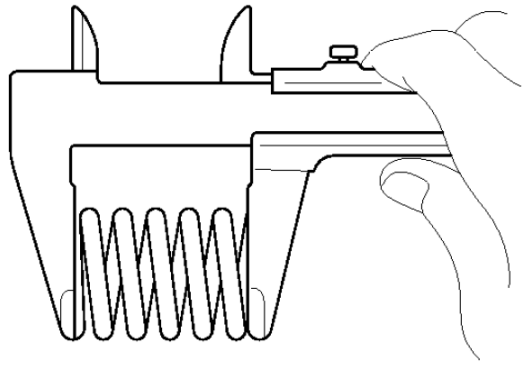
   (4) Check the valve length.

Length : Intake 108.3㎜, Exhaust 108.2㎜

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

3. Inspect the valve seats.
   (1) Check the valve seat for evidence of overheating and improper contact with the valve face. If the valve seat is worn, replace the cylinder head.
   (2) Check the valve guide for wear.
   If the valve guide is worn, replace the cylinder head.

4. Inspect the valve springs.
   (1) Using a right angle gauge, measure the perpendicularity of valve spring.
   (2) Using a vernier calipers, measure the free length of valve spring.



ECKD222A

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

Valve spring :
Free length : 44.0㎜
Load : 19.9±1.0kg/36.6㎜, 44.1±2.2kg/27.6㎜
Perpendicularity : Less than 1.5˚(Less than 1.5㎜)

Disassembly

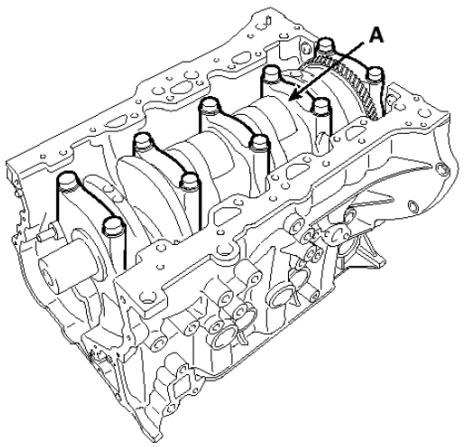
NOTICE

· To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature(20℃) before removing it.
· When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
· To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

· Mark all wiring and hoses to avoid misconnection.
· Turn the crankshaft damper pulley so that the piston of No. 1 cylinder is at TDC(Top Dead Center) on compression stroke.

1. Remove the engine assembly from the vehicle.
2. Remove the flywheel and the flywheel housing.
3. Remove the encoder and the rear oil seal case assembly.
   (Refer to Cylinder Block – “Rear Oil Seal”)
4. Install the engine assembly to engine stand for disassembly.
5. Remove the intake manifold.
   (Refer to Intake and Exhaust System – “Intake Manifold”)
6. Remove the EGR & thermostat housing assembly.
   (Refer to Cooling System – “Water Temperature Control Assembly”)
7. Remove the exhaust manifold.
   (Refer to Intake and Exhaust System – “Exhaust Manifold”)
8. Remove the lower oil pan and upper oil pan.
   (Refer to Lubrication System – “Oil Pan”)
9. Remove the balance shaft & oil pump module.
   (Refer to Lubrication System – “Balance Shaft & Oil Pump”)
10. Remove the timing chain.
    (Refer to Timing System – “Timing Chain”)
11. Remove the cylinder head.
    (Refer to Cylinder Head Assembly – “Cylinder Head”)
12. Remove the high pressure fuel pump.
    (Refer to Engine Control/Fuel System – “High Pressure Pump”)
13. Remove the water pump assembly.
    (Refer to Cooling System – “Water Pump”)
14. Remove the piston and connecting rod assemblies.
    (Refer to Cylinder Block – “Piston and Connecting Rod”)
15. Check the crankshaft main bearing oil clearance.
16. Remove the main bearing caps.(A)



17. Check the crankshaft end play.

Disassembly

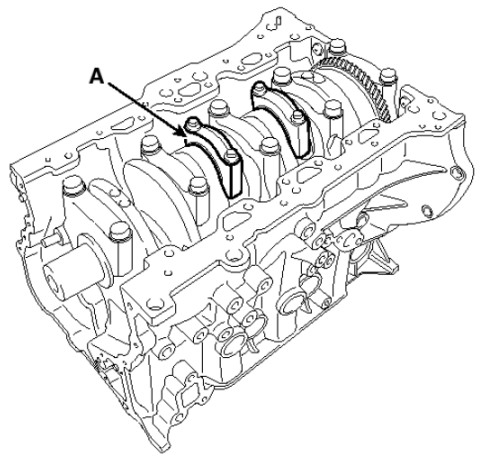
NOTICE

· To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature(20℃) before removing it.
· When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
· To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

· Mark all wiring and hoses to avoid misconnection.
· Turn the crankshaft damper pulley so that the piston of No. 1 cylinder is at TDC(Top Dead Center) on compression stroke.

1. Remove the engine assembly from the vehicle.
2. Remove the flywheel and the flywheel housing.
3. Remove the encoder and the rear oil seal case assembly.
   (Refer to Cylinder Block – "Rear Oil Seal")
4. Install the engine assembly to engine stand for disassembly.
5. Remove the intake manifold.
   (Refer to Intake and Exhaust System – "Intake Manifold")
6. Remove the EGR & thermostat housing assembly.
   (Refer to Cooling System – "Water Temperature Control Assembly")
7. Remove the exhaust manifold.
   (Refer to Intake and Exhaust System – "Exhaust Manifold")
8. Remove the lower oil pan and upper oil pan.
   (Refer to Lubrication System – "Oil Pan")
9. Remove the balance shaft & oil pump module.
   (Refer to Lubrication System – "Balance Shaft & Oil Pump")
10. Remove the timing chain.
    (Refer to Timing System – "Timing Chain")
11. Remove the cylinder head.
    (Refer to Cylinder Head Assembly – "Cylinder Head")
12. Check the connecting rod side clearance.
13. Check the connecting rod bearing cap oil clearance.
14. Remove the piston and connecting rod assemblies.
    (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
    (2) Remove the connecting rod bearing caps.(A)



SXMEM9108D

Information

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

    (3) Push the piston and connecting rod assembly with upper bearing through the top of the cylinder block.

Information

· Keep the connecting rod and caps with their bearings assembled together.
· Arrange the piston and connecting rod assemblies in the correct order.
· Mark the piston and connecting rod assemblies to be able to reassemble in the original position.

15. Check fit between piston and piston pin.
    Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin as a set.
16. Disassemble the piston rings.
    (1) Using a piston ring expender, remove the 2 compression rings.(A)
    (2) Remove the oil ring and coil spring(B) by hand.

NOTICE

Do not apply excessive force to remove the oil ring from piston. It may cause to break the oil ring.

Information

Arrange the piston rings in the correct order only.

Coolant

Engine Coolant Refilling and Bleeding

⚠WARNING

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

NOTICE

Be careful not to spill coolant on belts, electrical devices, etc. when exchanging coolant.

1. Make sure the engine and radiator are cool to touch.
2. Remove the radiator cap.
3. Loosen the drain plug and drain the engine coolant.
4. Tighten the radiator drain plug securely after draining the engine coolant.
5. After draining engine coolant in the reservoir tank, clean the tank.
6. Fill the radiator with water through the radiator cap and tighten the cap.

Information

To make it easier for the air inside to escape., pour the coolant slowly.
To most effectively bleed the air, press on the upper/lower radiator hose

7. After warm up the engine, stop the engine and wait until the engine is cool.
8. Repeat steps 1 to 7 until the drained water runs clear.
9. Fill fluid mixture of coolant and water (45~50%) slowly through the radiator cap. At this time, push the upper/lower hoses of the radiator so as to bleed air easily.

NOTICE

· Use only genuine antifreeze/coolant.
· For best corrosion protection, the coolant concentration must be maintained at 45% minimum. If the coolant concentration is less than 45%, it will not provide sufficient protection against corrosion or freezing.
· Coolant concentration greater than 60% will impair cooling efficiency and are not recommended.

NOTICE

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

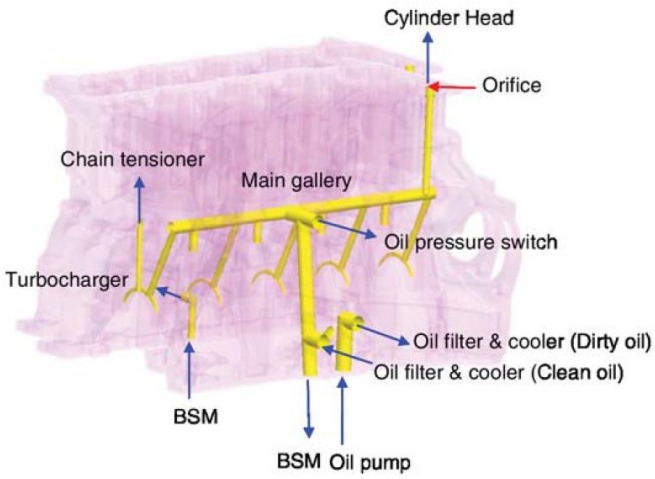
10. Start the engine and perform a no-load operation until the coolant circulates. When coolant circulation begins, replenish the coolant through the radiator filler.
11. Repeat step 10 to drain enough air from the cooling system.
12. Install the radiator cap and fill the reservoir tank to the “MAX”(or “F”) line with coolant.
13. Stop the engine and wait coolant gets cool.
14. Repeat steps 9 to 13 until the coolant level doesn’t fall any more, bleed air out of the cooling system.

Information

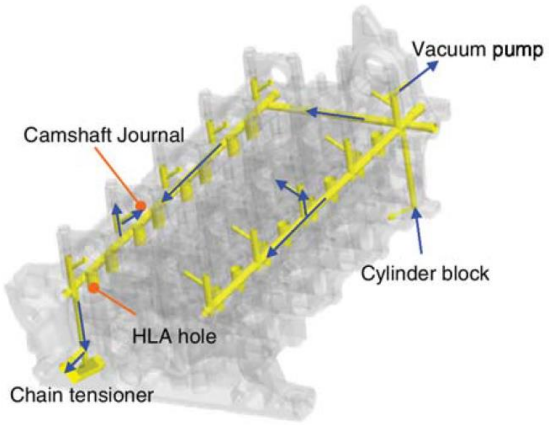
As it is to bleed air out to the cooling system and refill coolant when coolant gets cool completely, recheck the coolant level in the reservoir tank for 2~3 days after replacing coolant.

(2) Apply a coat of engine oil after assembling the bearings.

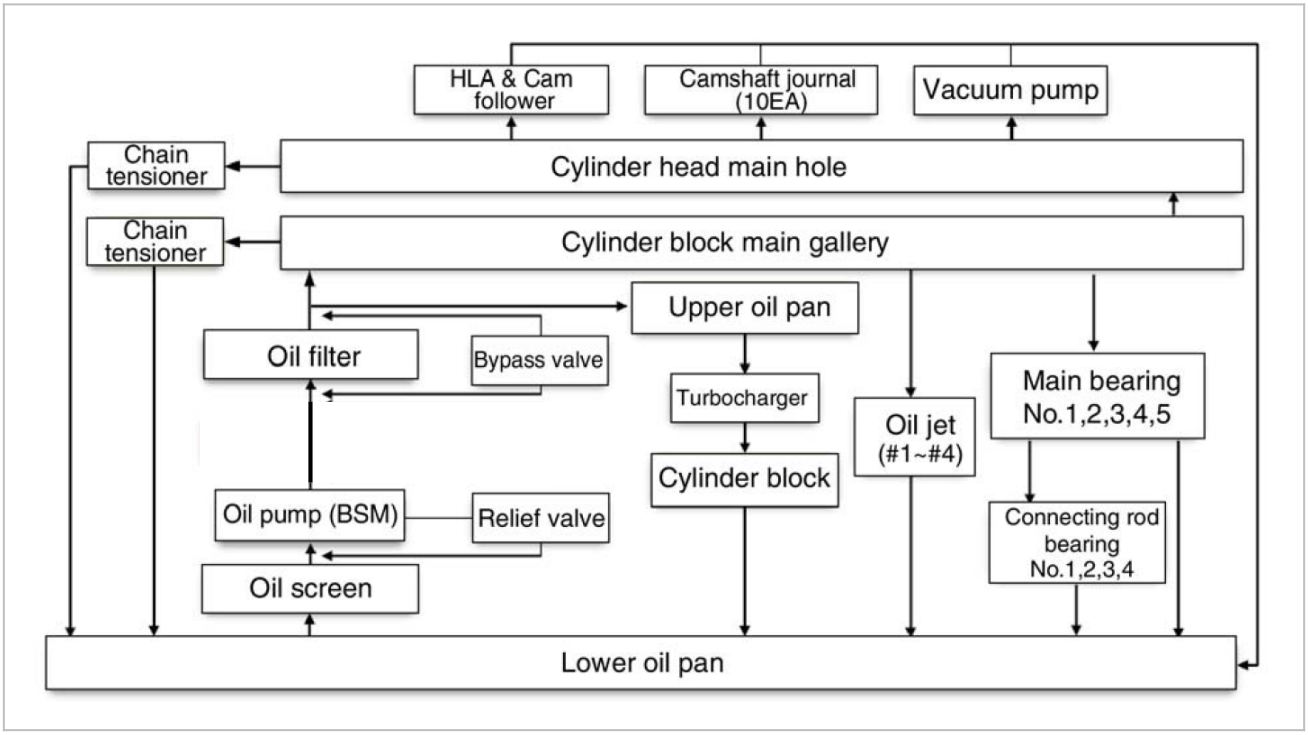
Engine Oil Flow Diagram



[Cylinder Block]



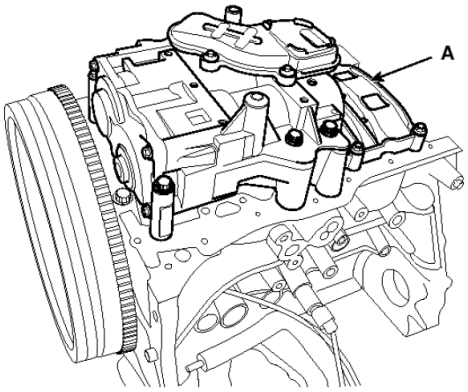
[Cylinder Head]



Balance shaft & Oil pump

Removal

1. Remove the lower and upper oil pan.
   (Refer to Lubrication System – "Oil Pan")
2. Remove the balance shaft & oil pump moduel(A).

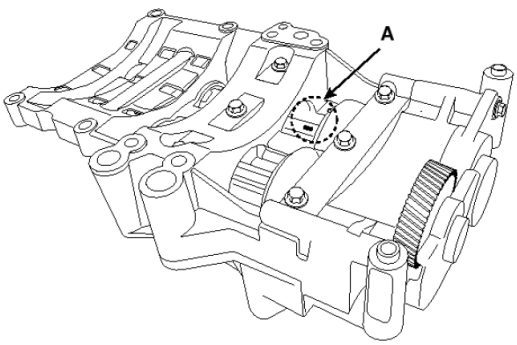


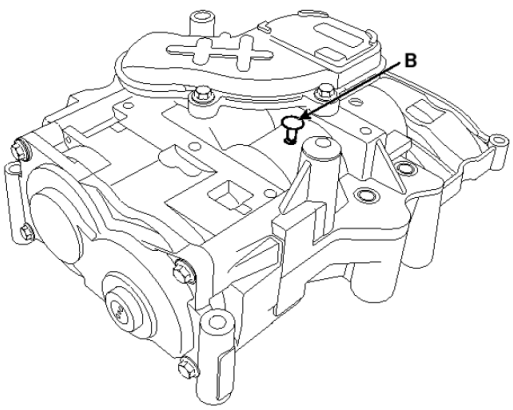
⚠ CAUTION

Do not disassemble and reassemble the balance shaft & oil pump module as it is supplied with assembly.

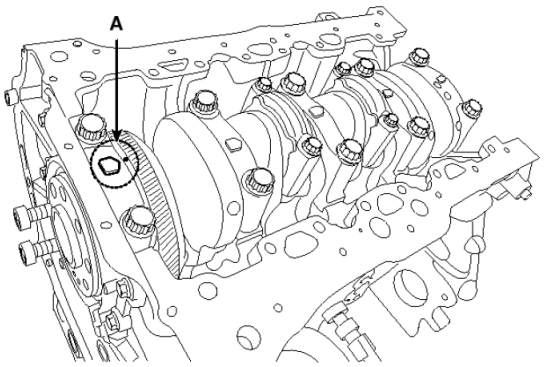
Installation

1. After adjusting the timing mark (A) of the balance shaft, insert the timing pin (B).



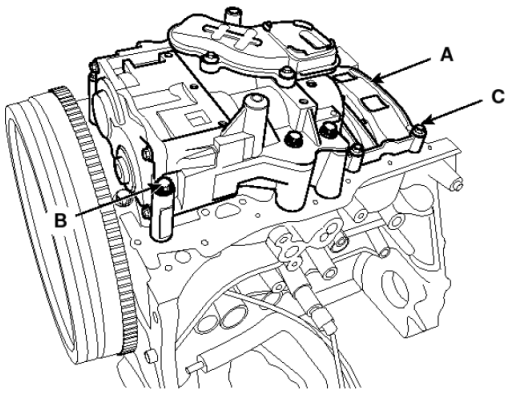


2. Rotate the crank shaft damper pulley clockwise to the TDC position and verify that the timing mark (A) of the crank gear matches.



3. Reinstall the balance shaft & oil pump module (A).

Tightening Torque
Bolt(B) : 3.1 ~ 3.5kgf.m, Bolt(C) : 2.0 ~ 2.4kgf.m



Removal and Installation

⚠ CAUTION

To avoid getting burned by exhaust heating parts, wait until the engine coolant temperature drops below normal temperature(20℃).

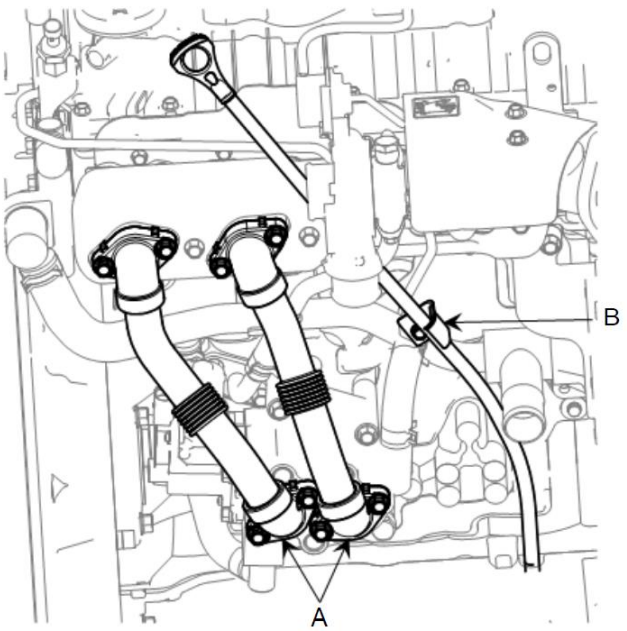
· To avoid damaging the turbocharger, wait until the engine coolant temperature drops below normal temperature(20℃) before removing it.
· When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
· To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

· Mark all wiring and hoses to avoid misconnection.
· Do not reuse all gaskets and replace with new gaskets

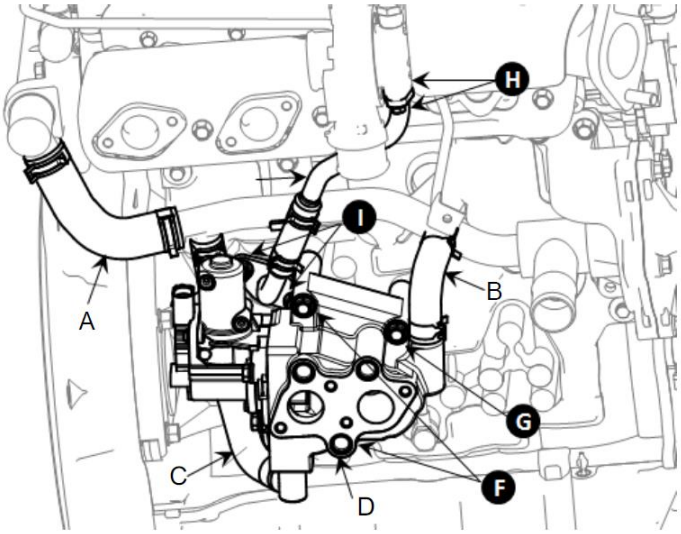
1. Disconnect the wiring connectors and harness clamps and remove the connector brackets around the exhaust manifold.
2. After removing the EGR pipe(A) and the gasket together, remove the oil level gauge & guide(B).

Tightening Torque
A : 2.0 ~ 2.5kgf.m, B : 0.8 ~ 1.2kgf.m



3. Remove the water pump hose(A) and the water inlet pipe hose(B) and the EGR valve hose(C) in sequence.
4. Remove the EGR valve housing(D)and the turbo oil return pipe(E).

Tightening Torque
F : 4.3 ~ 4.5kgf.m, G : 2.0 ~ 2.5kgf.m
H : 0.8 ~ 1.2kgf.m, I : 1.5 ~ 2.0kgf.m



5. After removing the water inlet pipe(A), remove the turbocharger feed pipe(B).

Tightening Torque
B : 0.8 ~ 1.2kgf.m, C : 2.0 ~ 2.5kgf.m, D : 4.3 ~ 4.5kgf.m