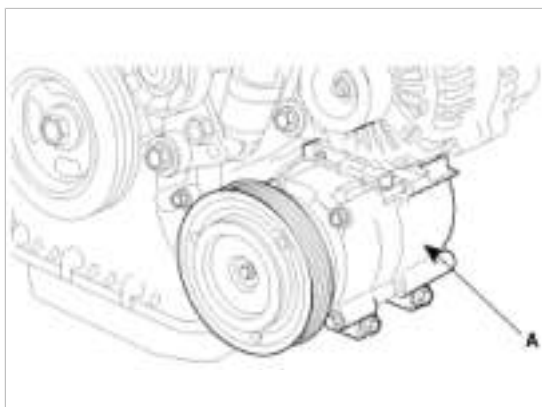


REMOVAL

- Use fender covers to avoid damaging painted surfaces.
 - To avoid damage, unplug the wiring connectors carefully while holding the connector portion.
-
- Mark all wiring and hoses to avoid misconnection.
 - Inspection the timing belt before removing the cylinder head.
 - Turn the crankshaft pulley so that the No.1 piston is at top dead center.

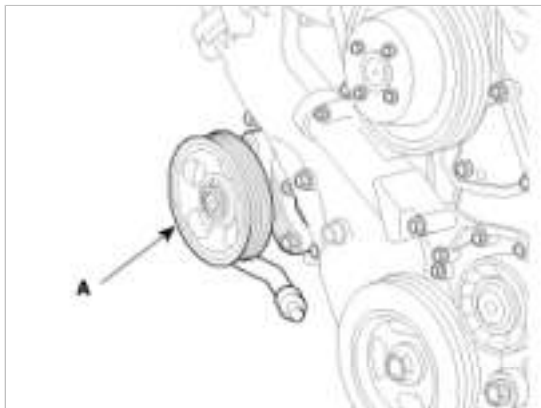
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor(A) from engine.



9. Remove alternator(A) from engine.



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

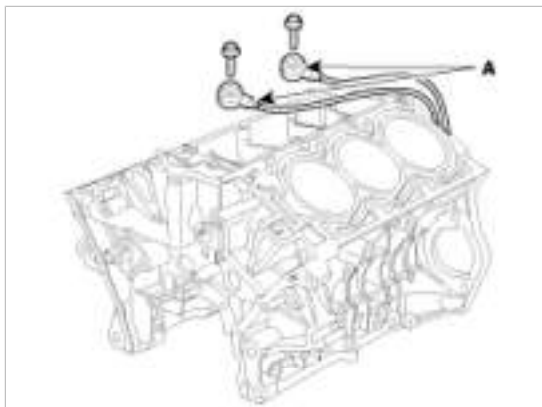


INSTALLATION

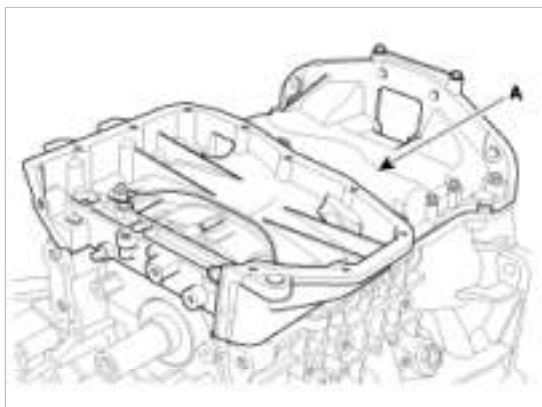
1. Install power steering pump.
2. Install alternator.
3. Install air compressor
4. Install oil filter assembly.
5. Install oil pump.
6. Install cylinder head.
7. Install water temperature control assembly.
8. Install timing chain.
9. Install intake manifold.
10. Install exhaust manifold.

DISASSEMBLY

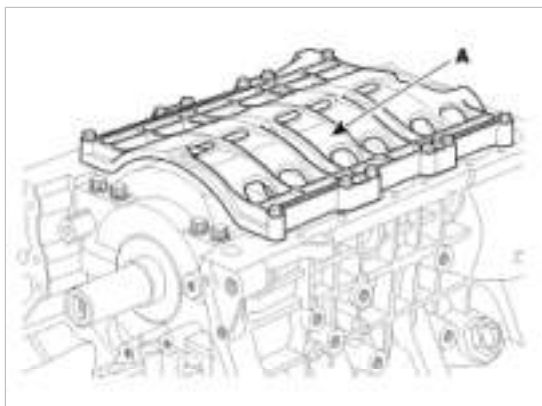
1. Remove drive plate.
2. Remove knock sensor(A).



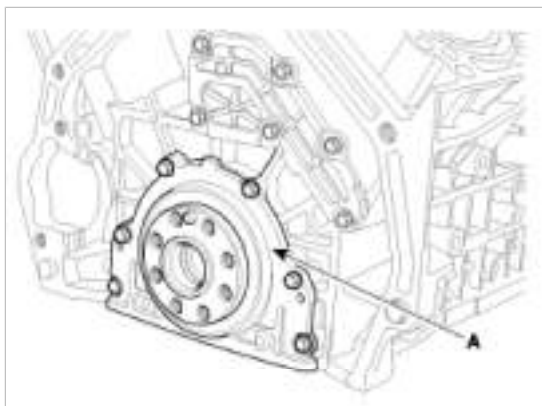
3. Remove upper oil pan(A).



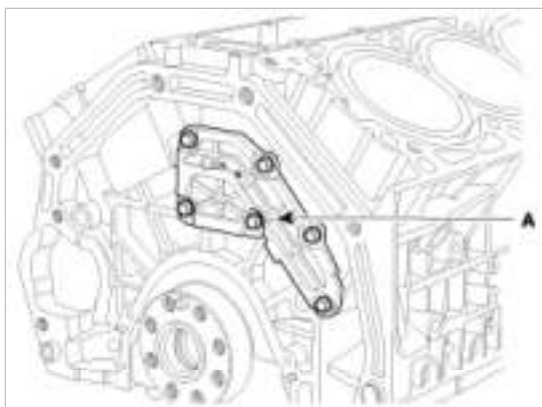
4. Remove baffle plate(A).



5. Remove rear oil seal case(A).



6. Remove oil drain cover(A).



7. Check the connecting rod end play.

8. Check the connecting rod oil clearance.

9. Remove piston and connecting rod assemblies.

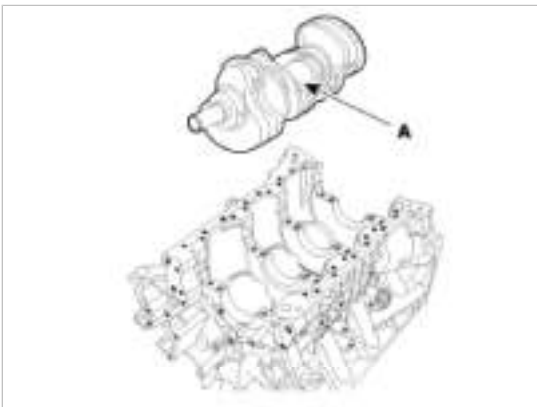
- (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
- (2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

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

10. Remove crankshaft main bearing cap and check oil clearance.

11. Check the crankshaft end play.

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



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

13. Check fit between piston and piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace piston and piston pin as a set.

14. Remove piston rings.

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

Arrange the piston rings in the correct order only.

15. Disconnect connecting rod from piston.

INSPECTION

CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.

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

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



- A. If out-of-tolerance, install a new connecting rod.
 - B. If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
- (1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
 - (2) Remove 2 connecting rod cap bolts.
 - (3) Remove the connecting rod cap and bearing half.
 - (4) Clean the crank pin and bearing.
 - (5) Place plastigage across the crank pin.
 - (6) Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

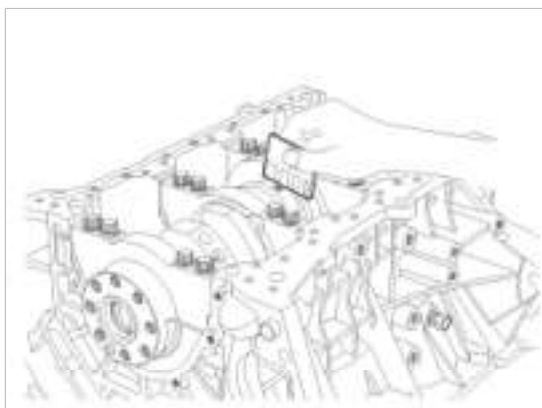
17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

Do not turn the crankshaft.

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

Standard oil clearance

0.038 ~ 0.056mm(0.0015 ~ 0.0022in)



- (9) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

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

- (10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

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

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

CONNECTING ROD MARK LOCATION

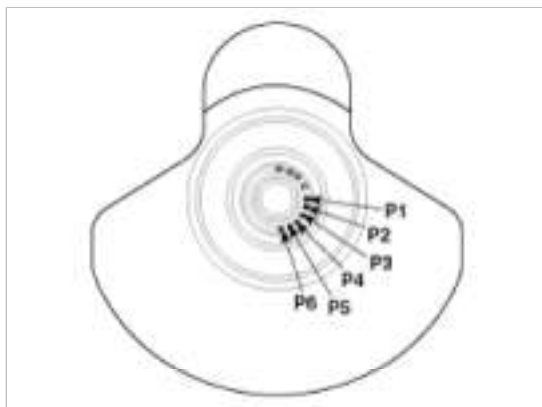


DISCRIMINATION OF CONNECTING ROD

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

CRANKSHAFT PIN MARK LOCATION

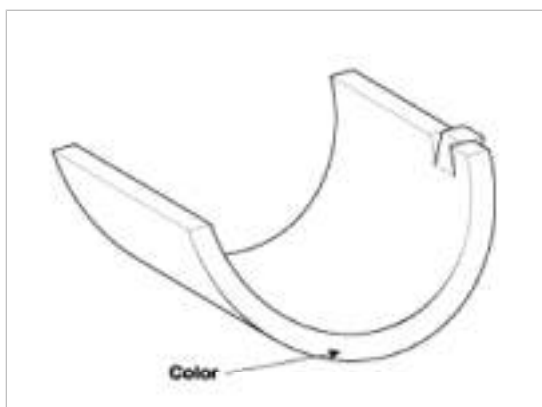
DISCRIMINATION OF CRANKSHAFT



DISCRIMINATION OF CRANKSHAFT

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

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



DISCRIMINATION OF CONNECTING ROD BEARING

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

(0.0591 ~ 0.0593in)

(11) Selection

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

3. Check the crankshaft bearing oil clearance.

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

Tightening torque

49.00Nm(5.0 kgf.m, 36.16lb-ft) + 90°

19.60 Nm(2.0 kgf.m, 14.46lb-ft)+ 120°

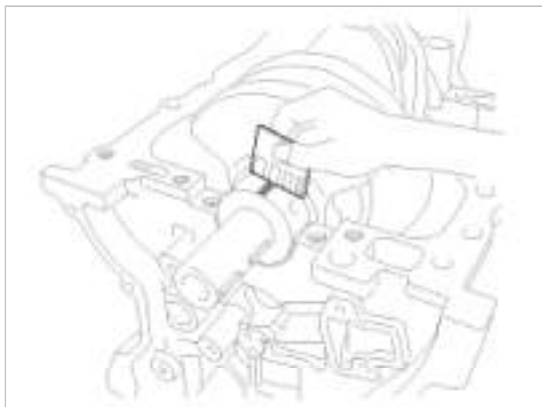
29.40 ~ 31.36Nm(3.0 ~ 3.2 kgf.m, 21.70 ~ 23.14lb-ft)

Do not turn the crankshaft.

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

Standard oil clearance

0.022 ~ 0.040mm(0.0009 ~ 0.0016in)



- (6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a

new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

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

- (7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

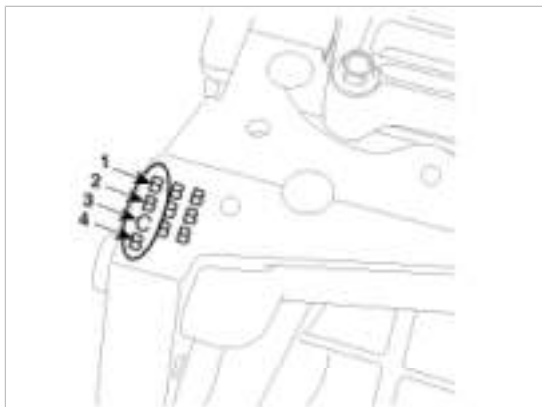
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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

Crankshaft bore mark location

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

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



DISCRIMINATION OF CYLINDER BLOCK

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

CRANKSHAFT JOURNAL MARK LOCATION

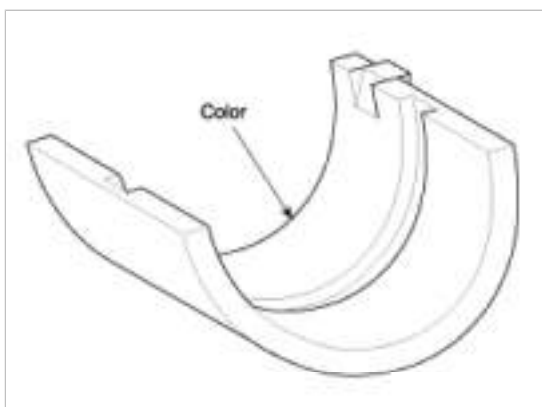
DISCRIMINATION OF CRANKSHAFT



DISCRIMINATION OF CRANKSHAFT

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

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



DISCRIMINATION OF CRANKSHAFT BEARING

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

(0.0892 ~ 0.0893in.)

SELECTION

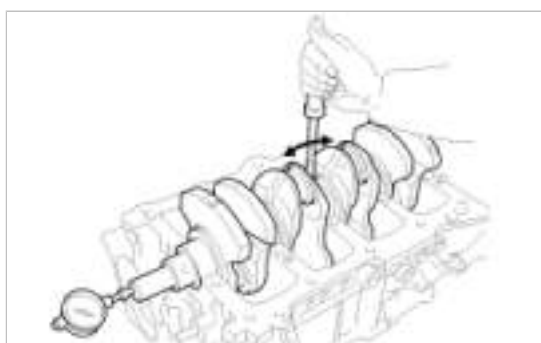
		CRANKSHAFT BORE IDENTIFICATION MARK		
		a(A)	b(B)	c(C)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

4. Check crankshaft end play.

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

Standard end play

0.10 ~ 0.28mm (0.0039 ~ 0.0110in.)



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

Thrust bearing thickness

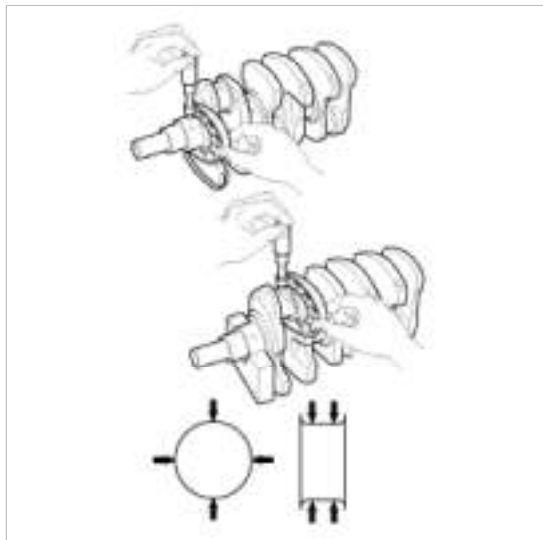
2.41 ~ 2.45mm(0.0949 ~ 0.0964in)

5. Inspect main journals and crank pins

Using a micrometer, measure the diameter of each main journal and crank pin.

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

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



CONNECTING RODS

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

Allowable bend of connecting rod :

0.05mm / 100mm (0.0020 in./3.94 in.) or less

Allowable twist of connecting rod :

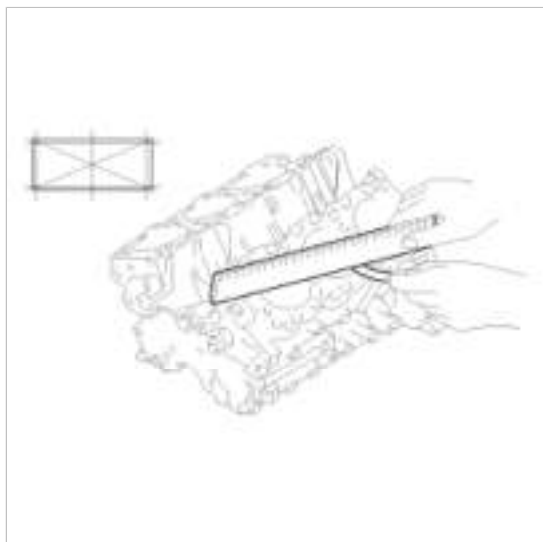
0.1mm / 100mm (0.0039 in./3.94 in.) or less

CYLINDER BLOCK

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

Flatness of cylinder block gasket surface

Standard : Less than 0.05mm(0.0020 in.), Less than 0.02mm(0.0008 in.) / 150 x 150



4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

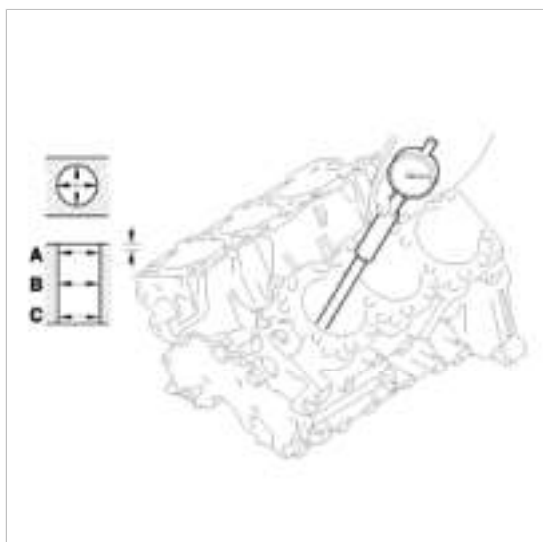
5. Inspect cylinder bore diameter

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

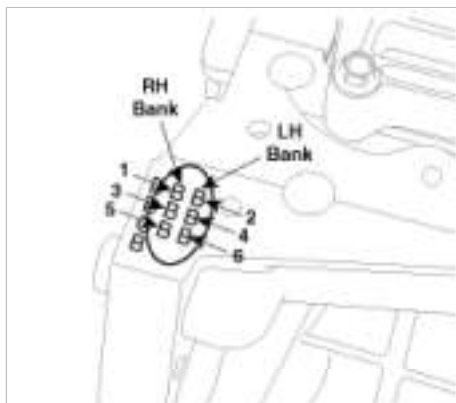
Standard diameter

92.00 ~ 92.03mm(3.6220 ~ 3.6232in) - 3.3L

96.00 ~ 96.03mm(3.7795 ~ 3.7807in) - 3.8L

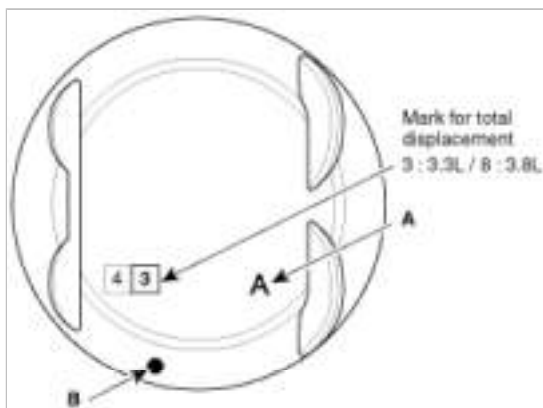


6. Check the cylinder bore size code on the cylinder block.



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

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



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

8. Select the piston related to cylinder bore class.

Clearance :

0.03 ~ 0.05mm(0.0012 ~ 0.0020in)

PISTON AND RINGS**1. Clean piston**

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

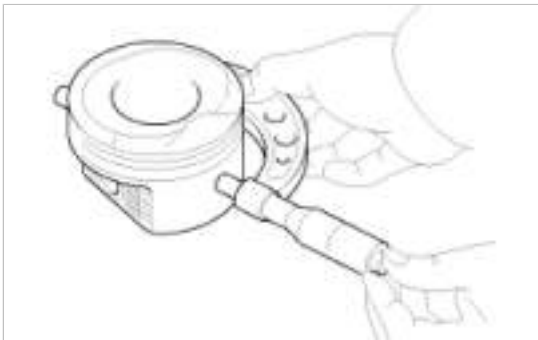
Do not use a wire brush.

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

Standard diameter

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

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



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

Piston-to-cylinder clearance

0.03 ~ 0.05mm(0.0012 ~ 0.0020in)

- 4. Inspect the piston ring side clearance.

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

Piston ring side clearance**Standard**

No.1 : 0.03 ~ 0.07mm(0.0012 ~ 0.0027in)

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

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

Limit

No.1 : 0.1mm(0.004in)

No.2 : 0.1mm(0.004in)

Oil ring : 0.2mm(0.008in)



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

5. Inspect piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

Piston ring end gap

Standard

No.1 : 0.17 ~ 0.32mm(0.0067 ~ 0.0126in)

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

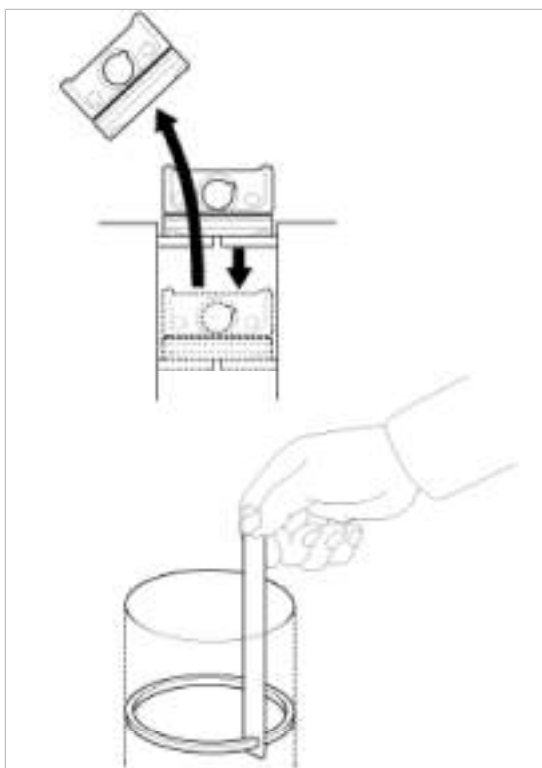
Oil ring : 0.20 ~ 0.70mm(0.0079 ~ 0.0275in)

Limit

No.1 : 0.6mm(0.0236in)

No.2 : 0.7mm(0.0275in)

Oil ring : 0.8mm(0.0315in.)



PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001 ~ 23.006mm(0.9055 ~ 0.9057in)



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

Piston pin-to-piston clearance

0.010 ~ 0.020mm(0.0004 ~ 0.0008in)

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

Piston pin-to-connecting rod interference

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

REASSEMBLY

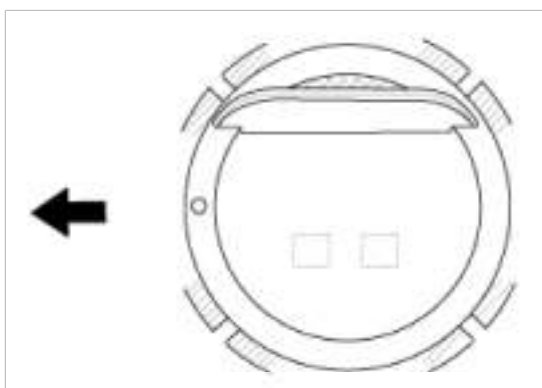
- Thoroughly clean all parts to assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

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



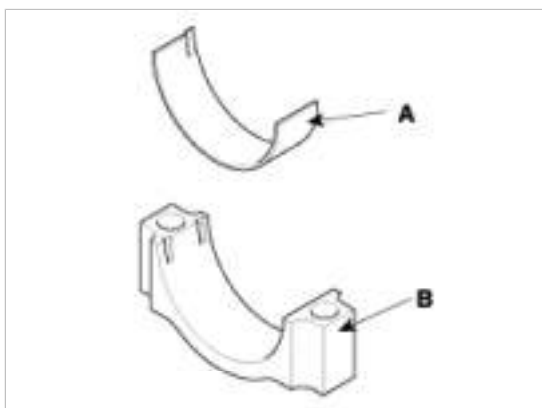
2. Install piston rings.

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



3. Install connecting rod bearings.

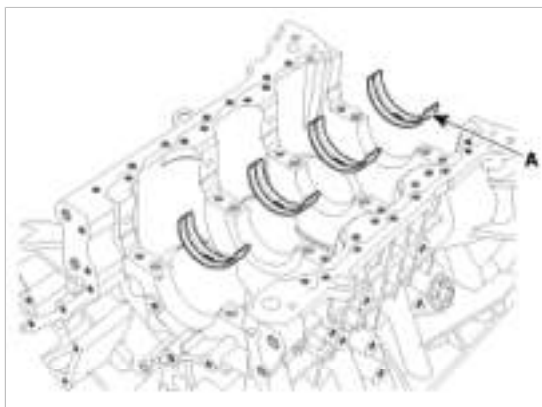
- (1) Align the bearing claw with the groove of the connecting rod or connecting rod cap.
- (2) Install the bearings(A) in the connecting rod and connecting rod cap(B).



4. Install main bearings.

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

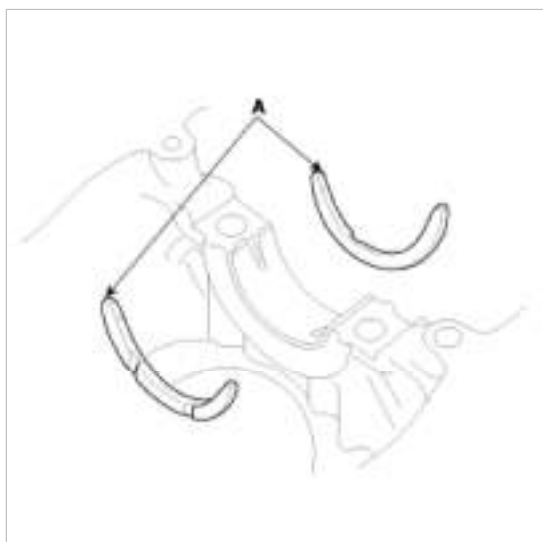
- (1) Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings(A).



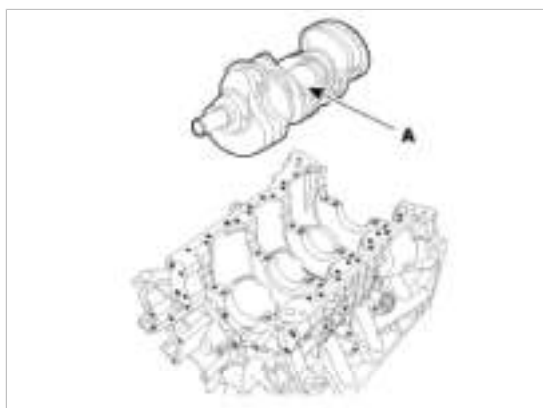
(2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lowerbearings.

5. Install thrust bearings.

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



6. Place crankshaft on the cylinder block.



7. Place main bearing caps on cylinder block.

8. Install main bearing cap bolts.

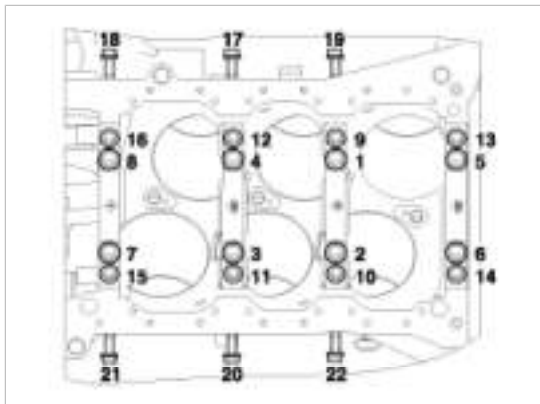
(1) Install and uniformly tighten the bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

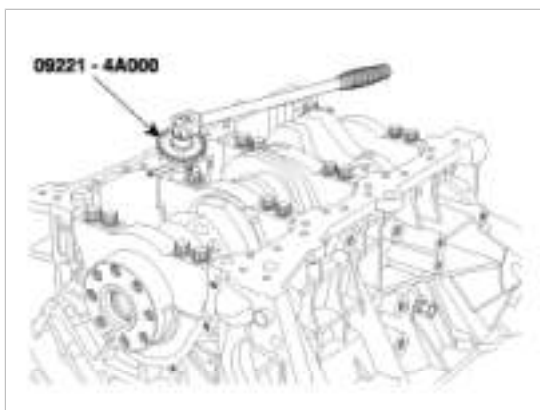
Main bearing cap bolt

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

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



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



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

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

- (1) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- (2) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
- (3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

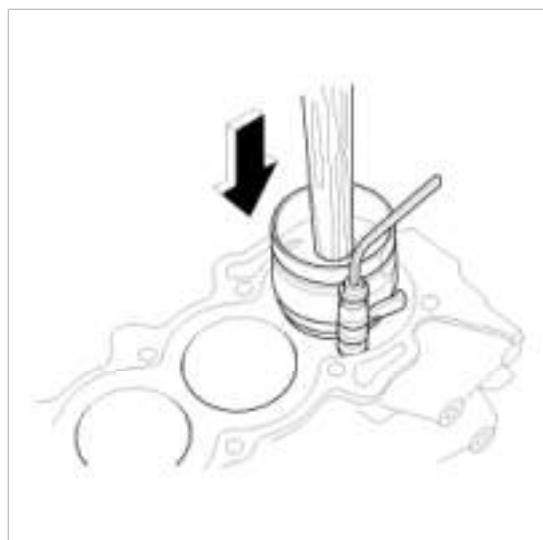
Tightening torque

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

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



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

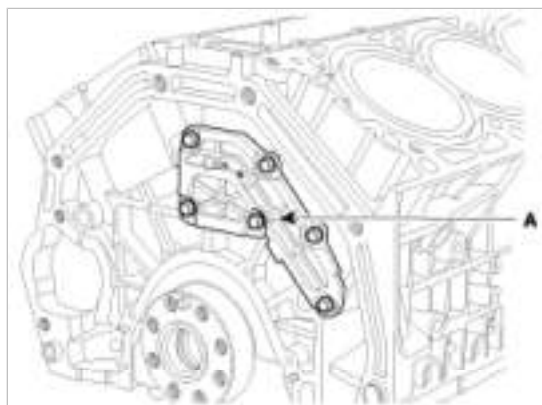


11. Check the connecting rod end play.

12. Install oil drain cover.

Tightening torque

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



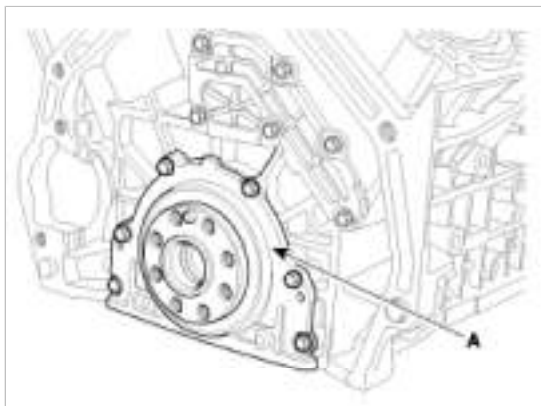
- Make clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling oil drain cover, the liquid sealant TB1217H should be applied oil drain cover.
- The part must be assembled within 5 minutes after sealant was applied.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



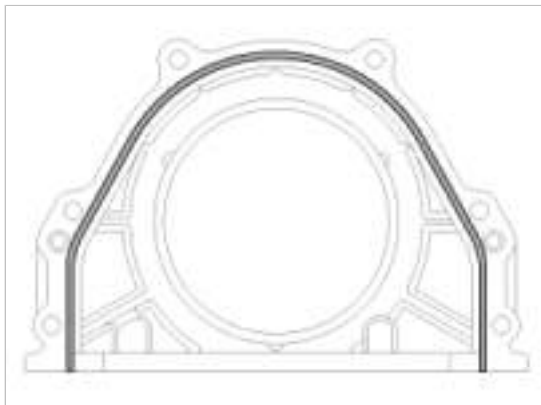
13. Install rear oil seal case.

Tightening torque

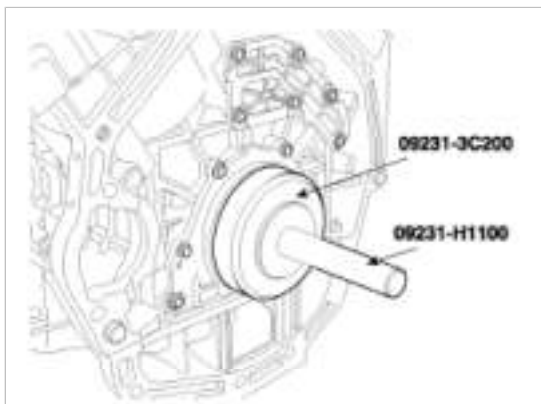
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lb-ft)



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



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



15. Install baffle plate.

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

Tightening torque

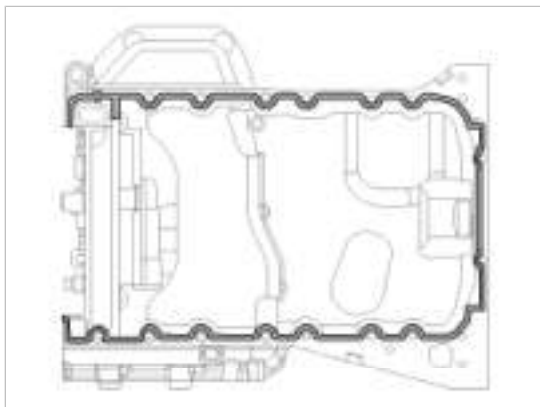
9.80 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.68lb-ft)



16. Install upper oil pan.

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

Bead width : 2.5mm(0.1in.)



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

C. Install oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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

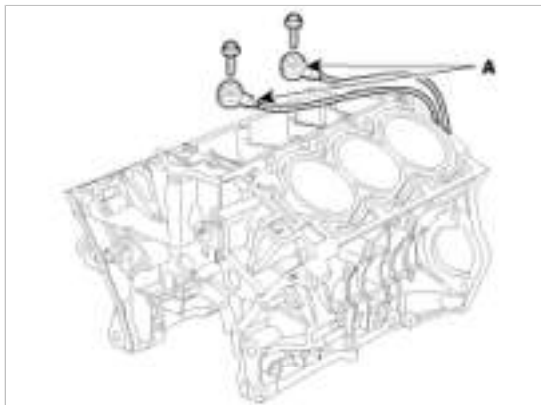


D. After assembly, wait at least 30 minutes before filling the engine with oil.

17. Install knock sensor.

Tightening torque

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



18. Install drive plate.

Tightening torque

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