Engine (G4KC - GSL 2.4)

GENERAL

SPECIFICATIONS E925C1E3

Description	Specifications	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinder	4	
Bore	88mm (3.464in)	
Stroke	97mm (3.819in.)	
Total displacement	2359cc (143.90cu.in.)	
Compression ratio	10.5	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Opens	ATDC 11° ~ BTDC 34°	
Closes	ABDC 22° ~ ABDC 67°	
Exhaust		
Opens (BBDC)	34°	
Closes (ATDC)	10°	
Valve		
Valve length		
Intake	113.18mm (4.4559in.)	112.93mm (4.4460in)
Exhaust	105.89mm (4.1689in.)	105.74mm (4.1629in)
Stem O.D.		
Intake	5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)	
Exhaust	5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)	
Face angle	45.25° ~ 45.75°	
Margin		
Intake	1.02mm (0.0401in.)	
Exhaust	1.09mm (0.0429in.)	
Valve stem to valve guide clearance		
Intake	0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)	0.07mm (0.00275in.)
Exhaust	0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)	0.09mm (0.00354in.)
Valve guide		
Length		
Intake	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	
Exhaust	43.8 ~ 44.2mm (1.7244 ~ 1.7401in.)	
Valve seat		
Width of seat contact		
Intake	1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)	
Exhaust	1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)	
Seat angle	44.75° ~ 45.10°	
Valve spring		
Free length	47.44mm (1.8677in.)	
Load	19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in.) 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)	
Squarences	1.5° MAX.	

Description	Specifications	Limit
Valve clearance Cold (20°C[68°F]) Intake Exhaust	 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.) 0.27 ~ 0.33mm (0.0106 ~ 0.0129in,)	 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.) 0.20 ~ 0.40mm (0.0078 ~ 0.0157in.)
Cylinder head Flatness of gasket surface Flatness of manifold mounting surface Oversize rework dimensions of	 Max. 0.05mm (0.0019in.) Max. 0.10mm (0.0039in.)	
Cylinder block Cylinder bore Out-of-round and taper of cylinder bore Clearance with piston (To set limits to new parts)	 88.00 ~ 88.03mm (3.4645 ~ 3.4657in.) Less than 0.05mm (0.0019in.) 0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)	
Piston O.D (To set limits to new parts) Ring groove width No.1 No.2 Oil ring Service oversize	 87.97 ~ 88.00mm (3.4634 ~ 3.4645in.) 1.22 ~ 1.24mm (0.0480 ~ 0.0488in.) 1.22 ~ 1.24mm (0.0480 ~ 0.0488in.) 2.01 ~ 2.03mm (0.0791 ~ 0.0799in.) 0.25, 0.50mm (0.010, 0.020in.) oversize	 1.26mm (0.0496in.) 1.26mm (0.0496in.) 2.05mm (0.0807in.)
Piston ring Side clearance No.1 No.2 Oil ring End gap No.1 No.2 Oil ring side rail Service oversize	 0.03 ~ 0.07mm (0.0012 ~ 0.0027in.) 0.03 ~ 0.07mm (0.0012 ~ 0.0027in.) 0.06 ~ 0.15mm (0.0024 ~ 0.0059in.) 0.15 ~ 0.30mm (0.0059 ~ 0.0118in.) 0.30 ~ 0.45mm (0.0118 ~ 0.0177in.) 0.20 ~ 0.70mm (0.0078 ~ 0.0275in.) 0.25, 0.50mm(0.010, 0.020in.) oversize	 0.1mm (0.004in.) 0.1mm (0.004in.) 0.2mm (0.008in.) 0.6mm (0.0236in.) 0.7mm (0.0275in.) 0.8mm (0.0315in.)
Connecting rod Bend Twist Connecting rod big end to crankshaft side clearance	 0.05mm (0.0020in.) or less 0.1mm (0.004in.) or less 0.100 ~ 0.250mm (0.0039 ~ 0.010in.)	 0.35mm (0.0138in.)
Connecting rod bearing Oil clearance (To seat limits to new parts)	 0.028 ~ 0.046mm (0.0011 ~ 0.0018in.)	 0.05mm (0.0019in.)

Description	Specifications	Limit
Camshaft		
Cam height		
Intake	43.80mm (1.7244in.)	
Exhaust	45.00mm (1.7716in.)	
Journal O.D.		
Intake	No.1 : 30mm (1.1811in.) No.2,3,4,5 : 24mm (0.9449in.)	
Exhaust	No.1 : 40mm (1.5748in.) No.2,3,4,5 : 24mm (0.9449in.)	
Bearing oil clearance		
Intake	No.1 : 0.020 ~ 0.057mm (0.00078 ~ 0.00224in.) No.2,3,4,5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)	0.09mm (0.0035in.) 0.12mm (0.0047in.)
Exhaust	No.1,2,3,4,5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)	0.12mm (0.0047in.)
End play	0.1 ~ 0.22mm (0.0039 ~ 0.0086in.)	0.24mm (0.0094in.)
Crankshaft		
Pin O.D.	47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)	
Journal O.D.	51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)	
End play	0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)	
Crankshaft bearing		
Oil clearance	0.026 ~ 0.048mm (0.0010 ~ 0.0019in.)	
Cooling method	Water-cooled, pressurized. Forced circulation with electrical fan	
Radiator		
Type	Pressurized corrugated fin type	
Radiator cap		
Main valve opening pressure	83 ~ 110kpa (12 ~ 16psi, 0.83 ~ 1.1kg/cm²)	
Vacuum valve opening pressure	-7kpa (-100psi, -0.07kg/cm²) or less	
Thermostat		
Type	Wax pellet type with jiggle valve	
Valve opening temperature	82°C (177°F)	
Full-opening temperature	95°C (201°F)	
Coolant pump	Centrifugal type impeller	
Drive belt		
Type	V-ribbed belt	
Engine coolant temperature sensor		
Type	Heat-sensitive thermistor type	
Resistance	2.31 ~ 2.59KΩ at 20°C (68°F)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

SERVICE STANDRDS

Standard value	
Antifreeze	Maxture ratio of anti-freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50%

TIGHTENING TORQUE

Item	Quantity	N.m	kgf.m	lbf.ft
Ladder frame bolt (M8 x 55)	4	23.52 ~ 27.44	2.4 ~ 2.8	17.35 ~ 20.24
Ladder frame bolt (M8 x 103)	6	23.52 ~ 27.44	2.4 ~ 2.8	17.35 ~ 20.24
Balance shaft module bolt	4	16.66 + 60° + 60°	1.7 + 60° + 60°	12.29 + 60° + 60°
Timing chain cover bolt (M8)	6	18.62 ~ 22.54	1.9 ~ 2.3	13.74 ~ 16.63
Timing chain cover bolt (M6)	7	7.84 ~ 9.8	0.8 ~ 1.0	5.78 ~ 7.23
Oil pan bolt (M6 x 10)	16	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Oil pan bolt (M8 x 103)	2	26.46 ~ 30.38	2.7 ~ 3.1	19.52 ~ 22.41
Engine support bracket bolt (M10 x 40)	1	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Engine support bracket bolt (M10 x 45)	2	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Engine support bracket bolt (M8 x 30)	1	19.6 ~ 24.5	2.0 ~ 2.5	14.46 ~ 18.07
Camshaft bearing cap bolt (M6)	16	10.78 ~ 12.74	1.1 ~ 1.3	7.95 ~ 9.39
Camshaft bearing cap bolt (M8)	4	27.44 ~ 31.36	2.8 ~ 3.2	20.24 ~ 23.14
Cylinder head bolt	10	34.3 + 90° + 90°	3.5 + 90° +90°	25.3 + 90° + 90°
Engine hanger bolt	2	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52
Cylinder head cover bolt	18	7.84 ~ 9.8	0.8 ~ 1.0	5.78 ~ 7.23
Crankshaft pulley bolt	1	166.6 ~ 176.4	17 ~ 18	122.9 ~ 130.13
Flywheel bolt	7	117.6 ~ 127.4	12 ~ 13	86.75 ~ 93.98
Drive plate bolt	7	117.6 ~ 127.4	12 ~ 13	86.75 ~ 93.98
Timing chain tensioner bolt	2	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Timing chain tensioner arm bolt	1	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Timing chain guide bolt	3	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
OCV bolt	1	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
CVVT & camshaft sprocket bolt	1	53.9 ~ 63.7	5.5 ~ 6.5	39.7 ~ 47.0
Balance shaft chain tensioner arm bolt	1	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Balance shaft chain guide bolt	2	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Balance shaft chain tensioner bolt	2	9.8 ~ 11.76	1.0 ~ 1.2	7.23 ~ 8.67
Water pump bolt	5	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52
A/C bracket bolt	4	19.6 ~ 23.52	2.0 ~ 2.4	14.46 ~ 17.35
P/S bracket bolt	2	44.1 ~ 53.9	4.5 ~ 5.5	32.53 ~ 39.70
Tensioner & idler bracket bolt	7	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Water temp. control bolt	2	14.7 ~ 21.56	1.5 ~ 2.2	10.84 ~ 15.90
Water temp. control nut	1	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52

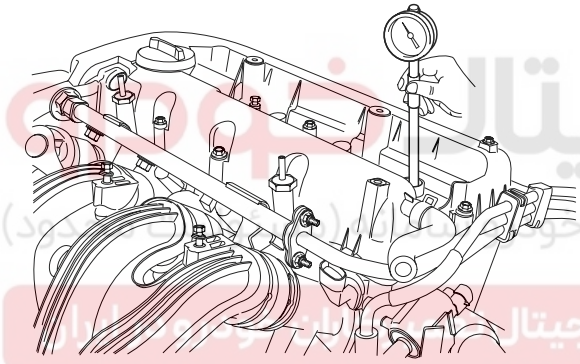
Item	Quantity	N.m	kgf.m	lbf.ft
Water inlet pipe bolt	2	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52
Oil level gauge assembly bolt	1	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Ignition coil bolt	4	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Intake manifold bolt	3	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Intake manifold nut	2	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Intake manifold stay bolt	4	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Exhaust manifold heat protector bolt	4	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Exhaust manifold nut	7	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Exhaust manifold stay bolt (M8)	2	18.62 ~ 27.44	1.9 ~ 2.8	13.74 ~ 20.24
Exhaust manifold stay bolt (M10)	1	51.94 ~ 57.82	5.4 ~ 5.9	38.3 ~ 42.6
Front muffler bolt	2	39.2 ~ 58.8	4.0 ~ 6.0	28.92 ~ 43.37
Engine cover nut	2	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Engine cover mounting bracket bolt	2	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Crankshaft position sensor bolt	1	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Oxygen sensor	1	34.3 ~ 44.1	3.5 ~ 4.5	25.30 ~ 32.53
Knock sensor	1	16.66 ~ 25.48	1.7 ~ 2.6	12.29 ~ 18.79
Oil temperature sensor	1	19.6 ~ 39.2	2.0 ~ 4.0	14.46 ~ 28.92
Camshaft position sensor	1	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Oil pressure switch	1	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Main bearing cap bolt	10	26.46 + 45°	2.7 + 45°	19.52 + 45°
Oil filter	1	11.76 ~ 15.68	1.2 ~ 1.6	8.67 ~ 11.57
Connecting rod bearing cap bolt	8	19.6 + 90°	2.0 + 90°	14.46 + 90°

COMPRESSION E6F7C0C1

NOTE

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

1. Warm up and stop engine.
   Allow the engine to warm up to normal operating temperature.
2. Remove ignition coils. (See EE group - ignition)
3. Remove spark plugs.
   Using a 16mm plug wrench, remove the 4 spark plugs.
4. Check cylinder compression pressure.
   a. Insert a compression gauge into the spark plug hole.



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   b. Fully open the throttle.
   c. While cranking the engine, measure the compression pressure.

NOTE

Always use a fully charged battery to obtain engine speed of 200 rpm or more.

   d. Repeat steps (a) through (c) for each cylinder.

NOTE

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

Compression pressure : 1,283kPa (13.0kgf/cm², 185psi) Minimum pressure : 1,135kPa (11.5kgf/cm², 164psi) Difference between each cylinder : 100kPa (1.0kgf/cm², 15psi) or less

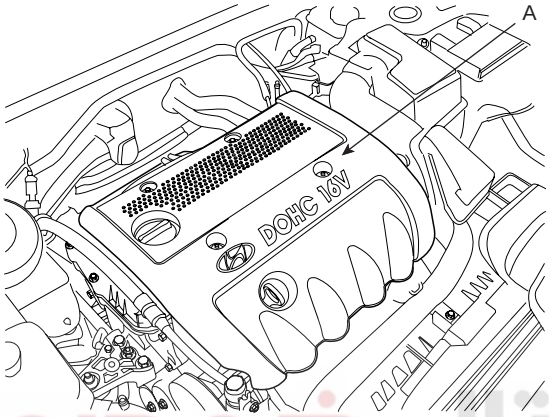
   e. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for cylinders with low compression.
      - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
      - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
5. Reinstall spark plugs.
6. Install ignition coils. (See EE group - ignition)

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

NOTE

Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C) and cylinder head is installed on the cylinder block.

1. Remove the engine cover(A).



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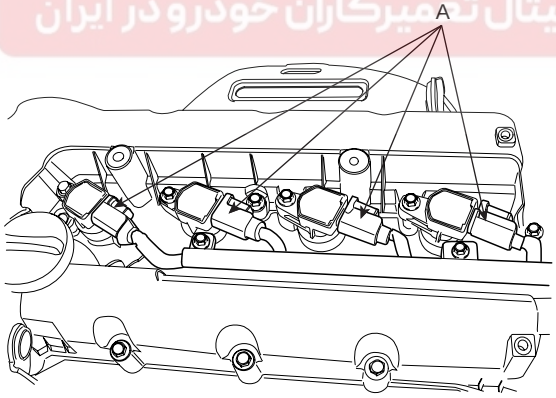
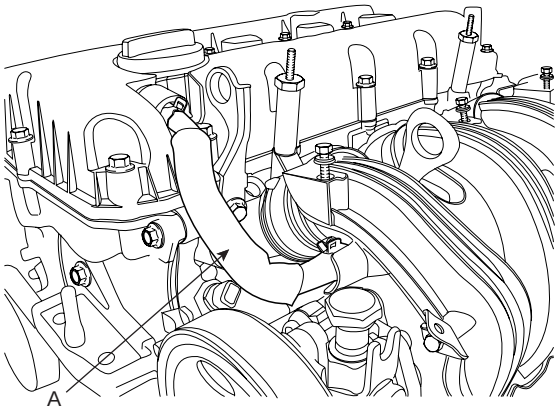
2. Remove the cylinder head cover.
   a. Disconnect the ignition coil connect(A) and remove the ignition coil.



KCRF131A

   b. Disconnect the P.C.V hose(A) and the breather hose from the cylinder head cover.



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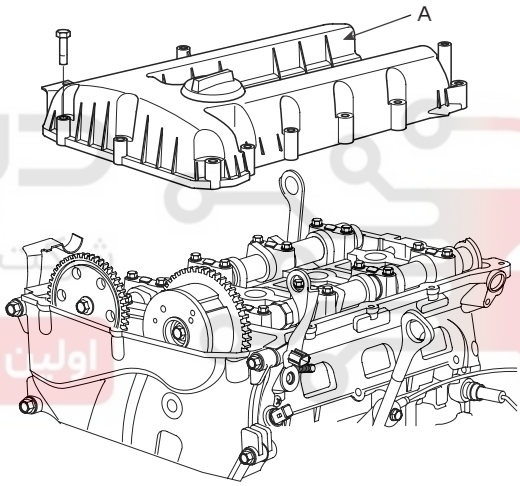
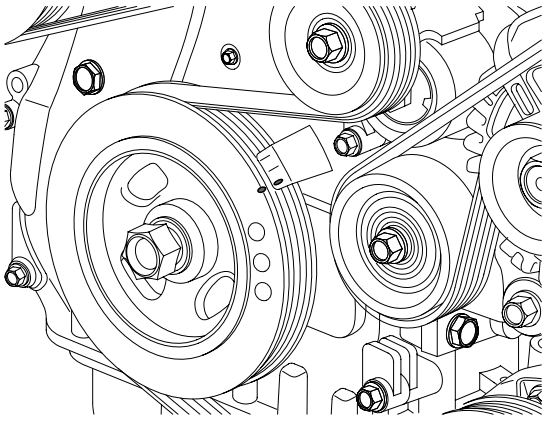
   c. Loosen the cylinder head cover bolts and then remove the cover(A) and gasket.



KCRF115A

3. Set No.1 cylinder to TDC/compression.
   a. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.



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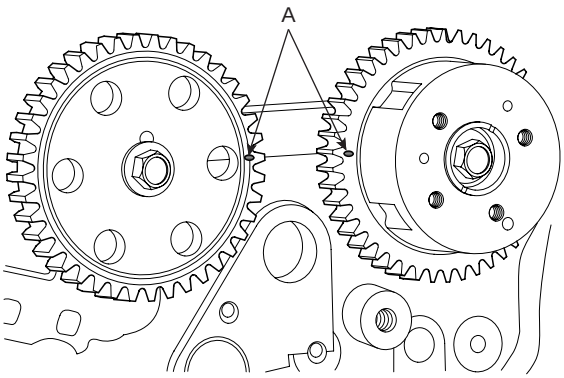
b. Check that the mark(A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration.
If not, turn the crankshaft one revolution (360°)



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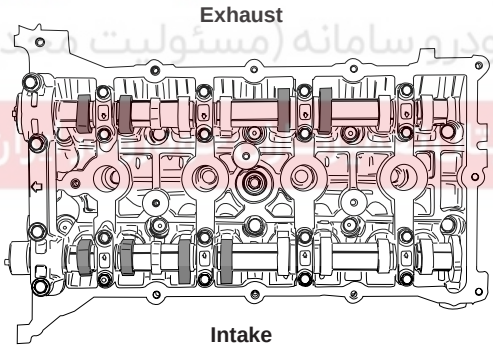
4. Inspect the valve clearance.
a. Check only the valve indicated as shown. [No. 1 cylinder : TDC/Compression] measure the valve clearance.



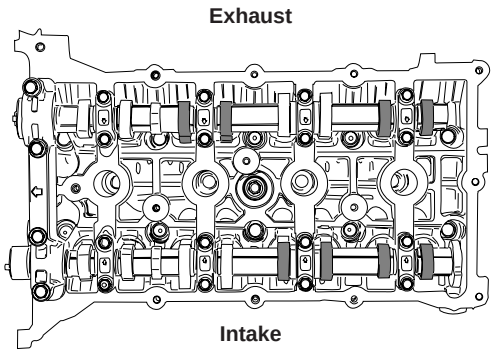
No1. Cylinder TDC/compression

ECRF001A

· Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.
· Record the out-of-specification valve clearance measurements. They will be used later to determine the required replaement adjusing tappet.

Valve clearance
Specification
Engine coolant temperature : 20°C [68°F]
Limit
Intake : 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)
Exhaust : 0.20 ~ 0.40mm (0.0079 ~ 0.0157in.)

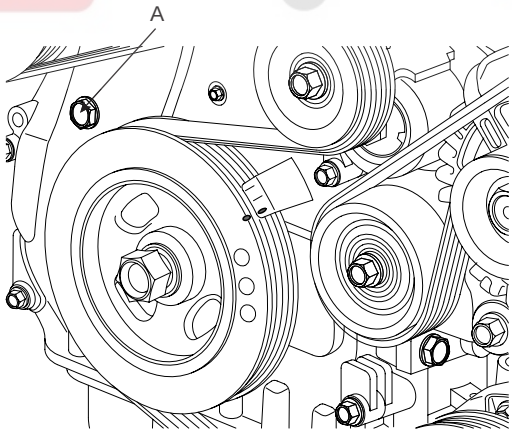
b. Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.
c. Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance.



No4. Cylinder TDC/compression

ECRF002A

5. Adjust the intake and exhaust valve clearance.
a. Set the No.1 cylinder to the TDC/compression. (See page EM - 8)
b. Marks on the timing chain and camshaft timing sprockets.
c. Remove the service hole bolt(A) of the timing chain cover.



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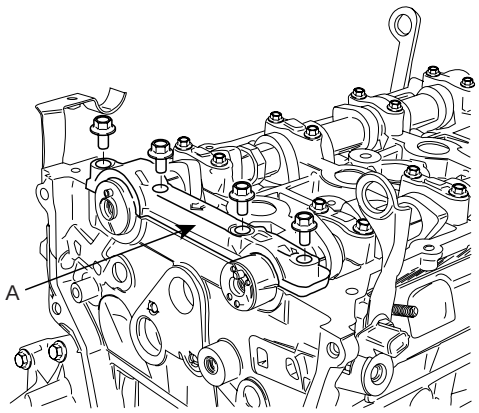
CAUTION

The bolt must not be reused once it has been assembled.

d. Insert a thin rod in the service hole of the timing chain cover and release the ratchet.

e. Remove the front camshaft bearing cap(A).



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f. Remove the exhaust camshaft sprocket.
g. Remove the exhaust camshaft bearing cap and exhaust camshaft. (See page EM - 35)
h. Remove the intake camshaft bearing cap and intake camshaft. (See page EM - 35)

CAUTION

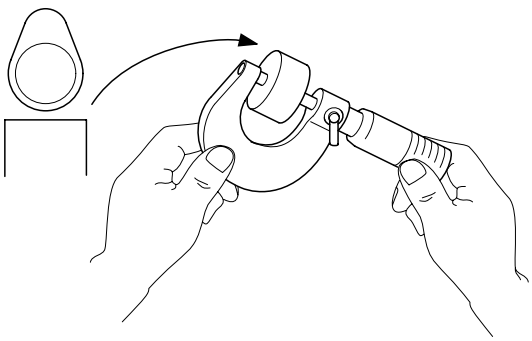
When disconnect the timing chain from the camshaft timing sprocket, holding the timing chain.

i. Tie a timing chain with a string.

CAUTION

Be careful not to drop anything inside timing chain cover.

j. Measure the thickness of the removed tappet using a micrometer.



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k. Calculate the thickness of a new tappet so that the valve clearance comes within the specificified value.

Valve clearance (Engine coolant temperature : 20°C)
T : Thickness of removed tappet
A : Measured valve clearance
N : Thickness of new tappet
Intake : N = T + [A - 0.20mm(0.0079in.)]
Exhaust : N = T + [A-0.30mm (0.0118in.)]

l. Select a new tappet with a thickness as close as possible to the caculated value.

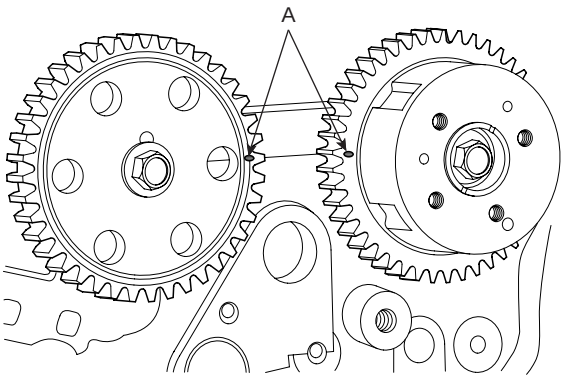
NOTE

Shims are available in 47size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.690mm (0.1452in.)

m. Place a new tappet on the cylinder head.
n. Hold the timing chain, and place the intake camshaft and timing sprocket assembly.
o. Align the matchmarks on the timing chain and camshaft timing sprocket.
p. Install the intake and exhaust camshaft. (See page EM - 44)
q. Install the front bearing cap. (See page EM - 44)
r. Install the sevice hole bolt.

Tightening torque
12 ~ 15N.m (1.2 ~ 1.5kgf.m, 8.8 ~ 11.0lbf.ft)

s. Turn the crankshaft two turns in the operating direction(clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks.



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t. Recheck the valve clearance.

Valve clearance (Engine coolant temperature : 20°C)
[Specification]
Intake : 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)
Exhaust : 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)

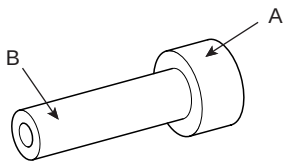
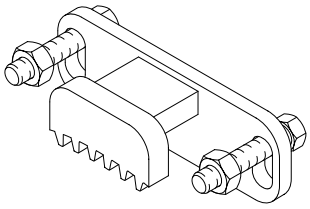
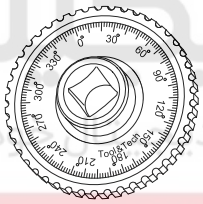
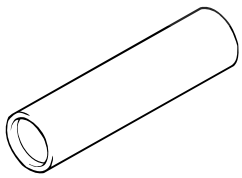
TROUBLESHOOTING EA865ECE

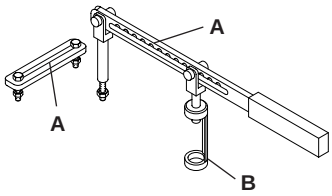
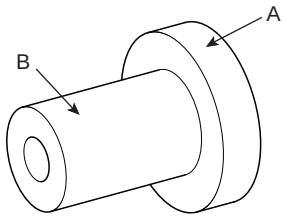
Symption	Suspect area	Remedy (See page)
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings Loose or improperly engine filwheel	Replace the crankshaft and bearings as required. Repair or replace the flywheel as required.
	Worn piston rings (Oil cousnmption may or may not 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 buidup on the valve stem)	Repair or replace as required
	Excessive worn or mis-aligned timing chain	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption	• Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. • Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	• Inspect the cylinder for a loss of compression. • Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity	• Drain the oil. • Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or repalce as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stetched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	• Inspect the camshaft lobes. • Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required

Symption	Suspect area	Remedy (See page)
Lower engine noise, regardless of engine speed	Low oil pressure	Repair or required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	• Inspect the oil pan. • Inspect the oil pump screen. • Repair or replace as required.
	Oil pump screen loose, damaged or restircted.	• Inspect the oil pump screen. • Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	• Inspect the piston, piston pin and cylinder bore. • Repair as required.
	Excessive piston pin-to-piston 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. • The connecting rod bearings. • The connecting rods. • The crankshaft pin journals.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block
	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 : • The connecting rod bearings. • The connecting rods. • The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.

Symption	Suspect area	Remedy (See page)
Engine will not crank-crankshaft will not rotate	Hydraulically locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecing rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

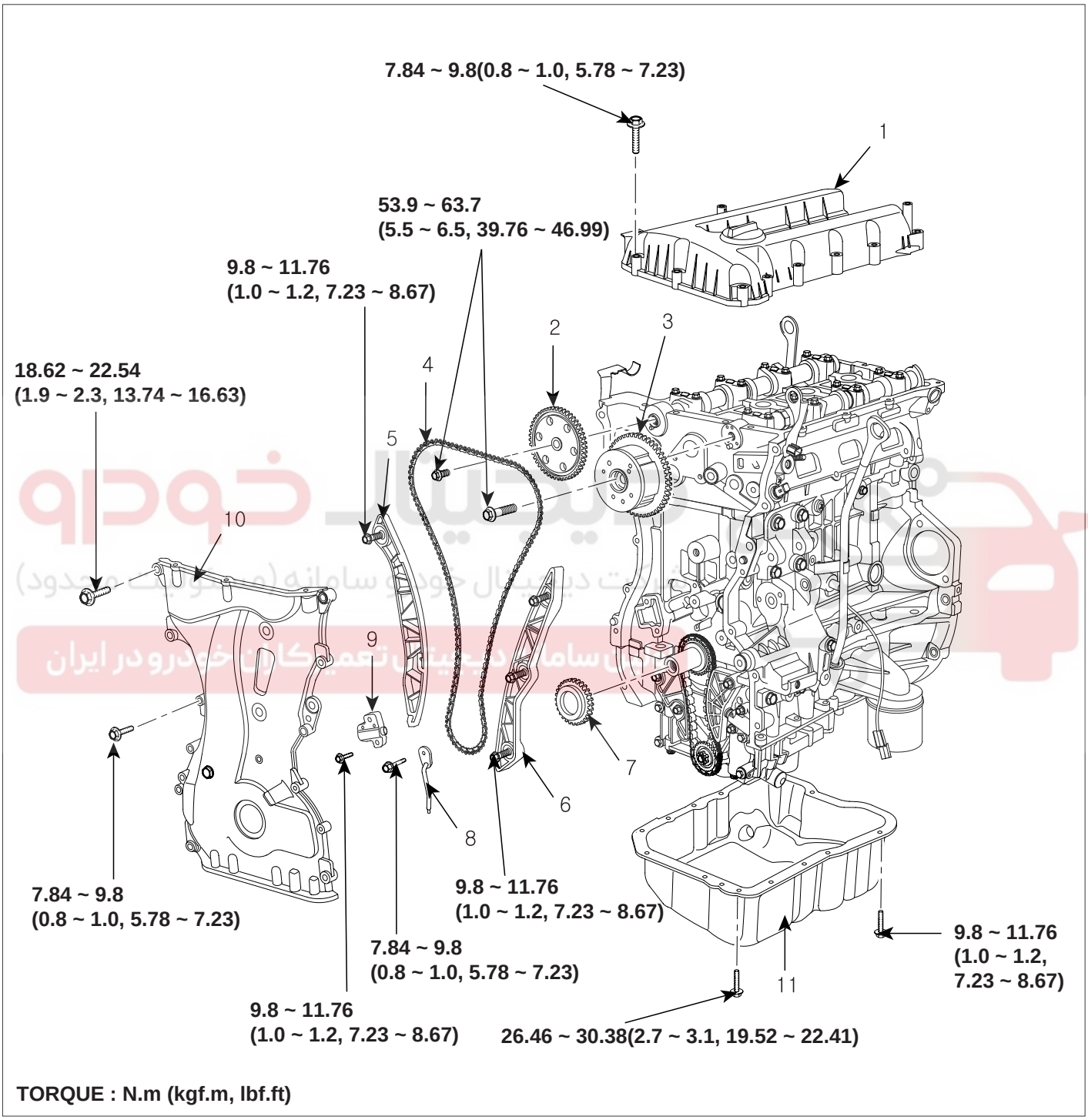
SPECIAL TOOLS E12DA3A1

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-3K000) (09231-H1100)	 ACRF002A	Installation of the front oil seal A : 09214-3K000 B : 09231-H1100
Flywheel stopper (09231-3K000)	 KCRF030D	Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)	 LCAC030A	Installtion of bolts & nuts needing an angular method
Valve stem oil seal installer (09222-4A000)	 LCAC030D	Installation of the valve stem oil seal

Tool (Number and name)	Illustration	Use
Valve spring compressor & holder (09222-3K000) (09222-3K100)	 ECRF003A	Removal and installation of the intake or exhaust valve A : 09222-3K000 B : 09222-3K100 (holder)
Crankshaft rear oil seal installer (09214-3K100) (09231-H1100)	 ACRF003A	Installation of the crankshaft rear oil seal A : 09214-3K100 B : 09231-H1100

TIMING SYSTEM

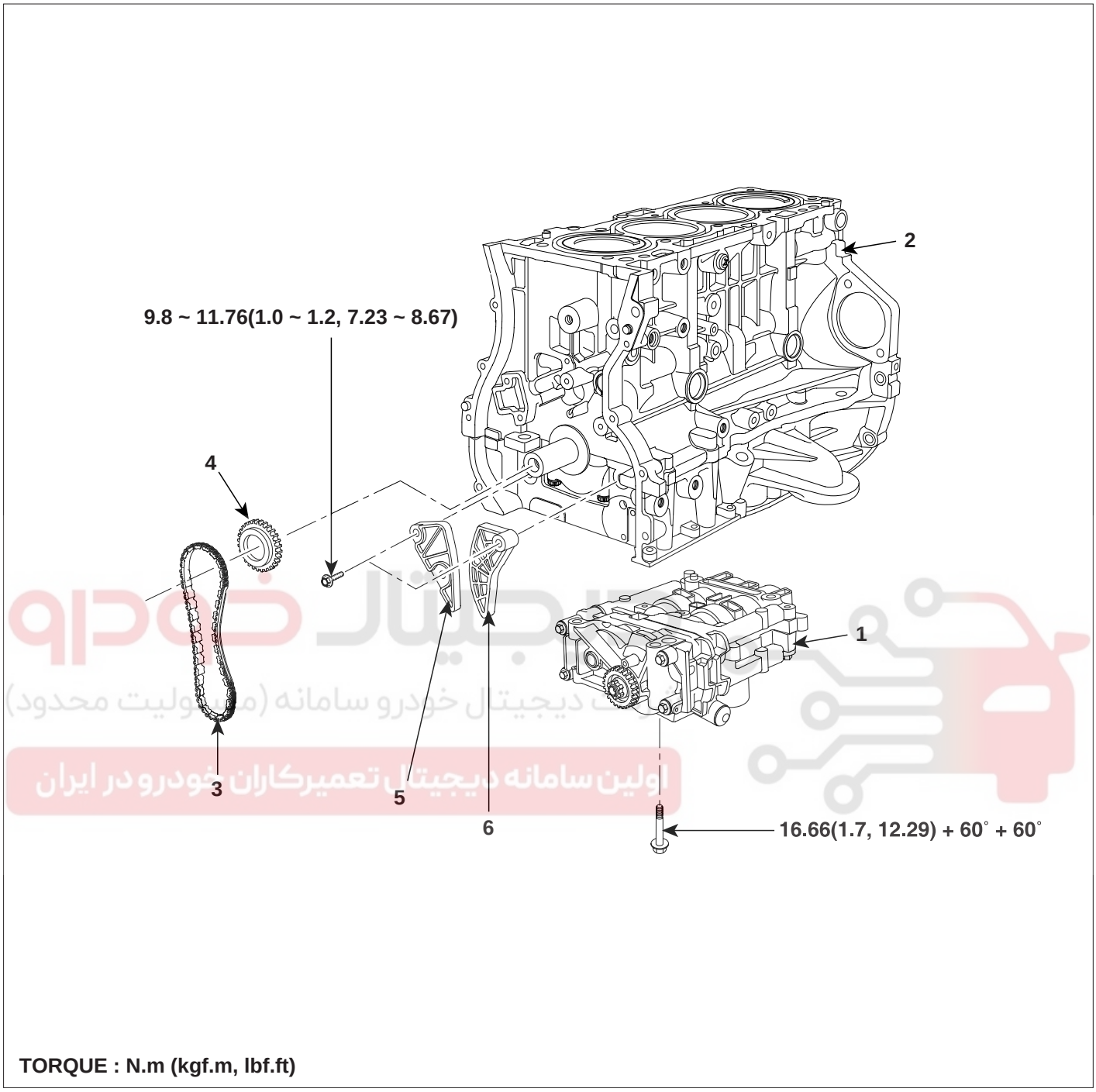
COMPONENT EA04D90F



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

1. Cylinder head cover
2. Exhaust camshaft sprocket
3. CVVT assembly
4. Timing chain
5. Timing chain tensioner arm
6. Timing chain guide
7. Crankshafe sprocket
8. Oil jet
9. Timing chain tensioner
10. Timing chain cover
11. Oil pan

ECRF004A



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

1. Balance shaft module
2. Cylinder block
3. Balance shaft chain
4. Balance shaft chain sprocket
5. Balance shaft chain guide
6. Balance shaft chain tensioner arm

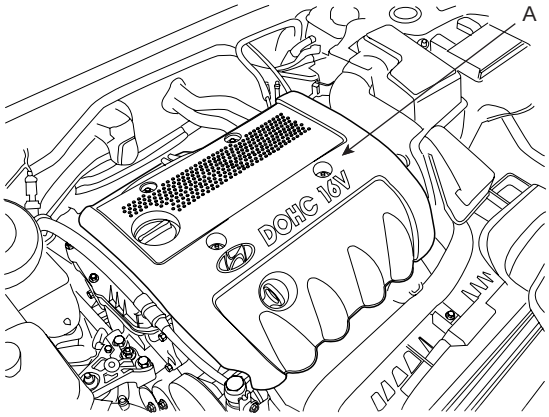
ECRF005A

REMOVAL EE9F0A26

Engine removal is not required for this procedure.

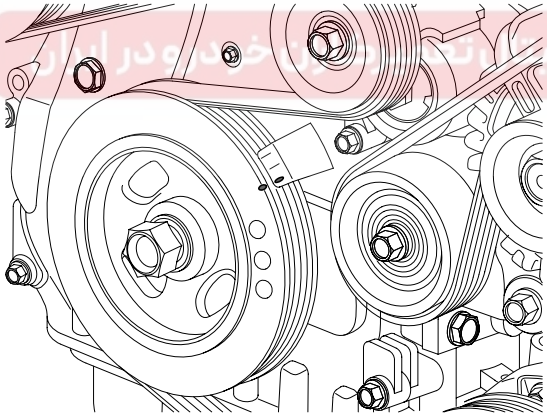
TIMING CHAIN

1. Remove the engine cover(A).



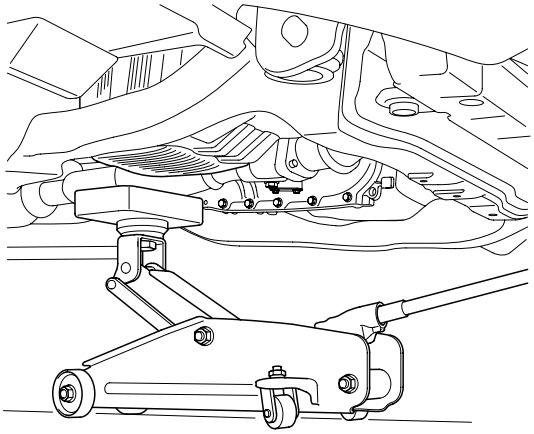
KCRF146A

2. Remove RH front wheel.
3. Remove RH side cover.
4. Set No.1 cylinder to TDC/compression



KCRF107A

5. Remove the engine mount bracket.
   1) Set the jack to the engine oil pan.

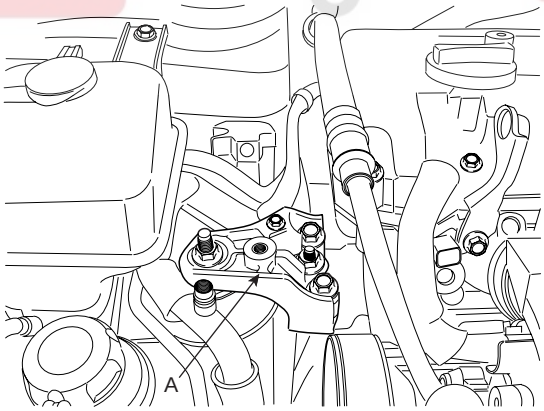


ECKD102A

NOTE

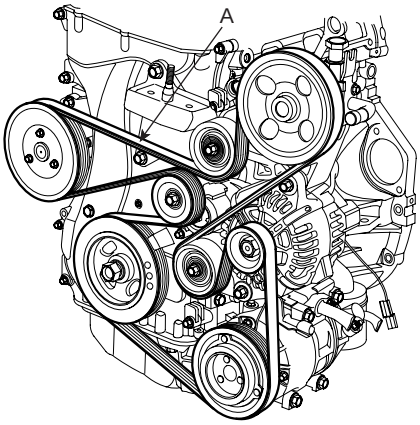
Place wooden block between the jack and engine oil pan.

   2) Remove the 2bolts, 2nuts and engine mount bracket(A).



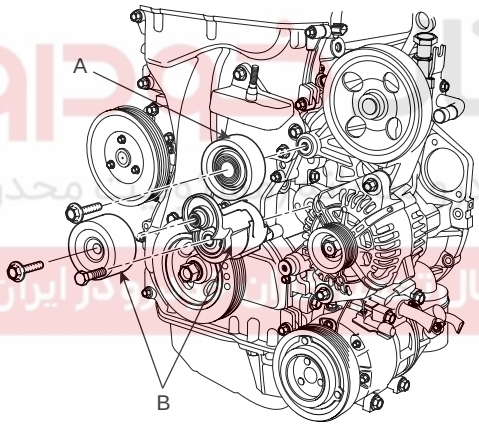
KCRF137A

6. Temporarily loosen the water pump pulley bolts.
7. Remove drive belt(A).



KCRF108A

8. Remove the idler pulley(A).



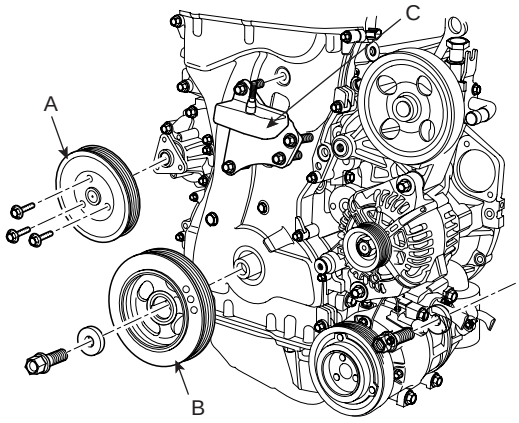
KCRF109A

9. Remove the drive belt tensioner pulley and tensioner(B).

NOTE

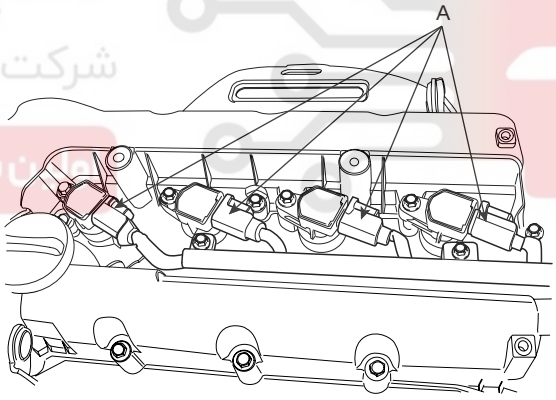
Tensioner pulley bolt is left - handed screw.

10. Remove the water pump pulley(A).



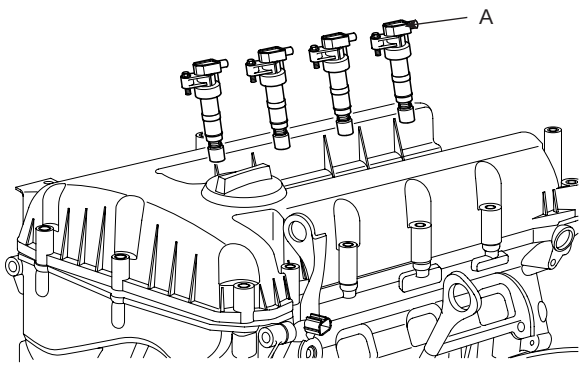
KCRF110A

11. Remove the crankshaft pulley(B).
12. Remove the engine support bracket(C).
13. Disconnect the ignition coil connector(A).



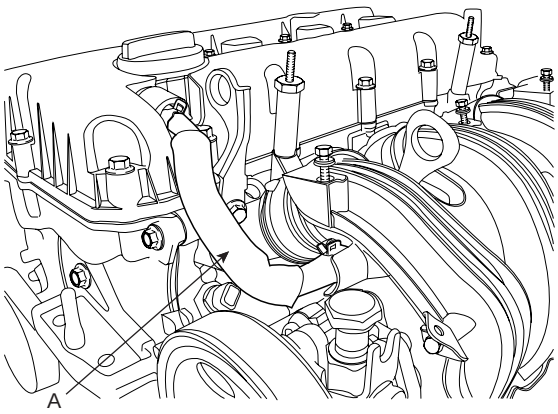
KCRF131A

14. Remove the ignition coil(A).



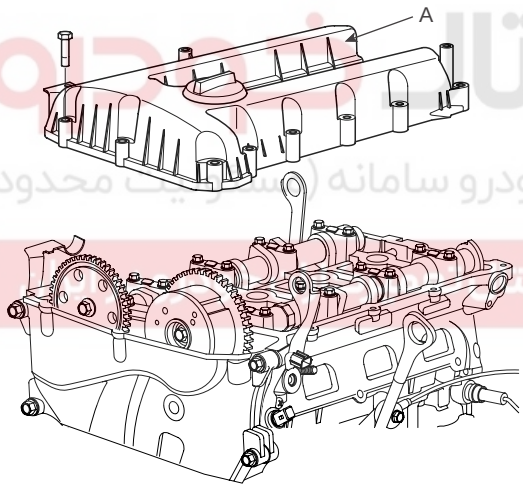
KCRF111A

15. Remove the PCV hose(A) and breather hose from the cylinder head cover.



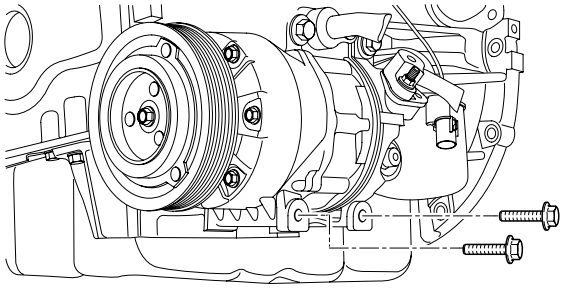
KCRF141E

16. Loosen the cylinder head cover bolts and then remove the cylinder head cover(A) and gasket.



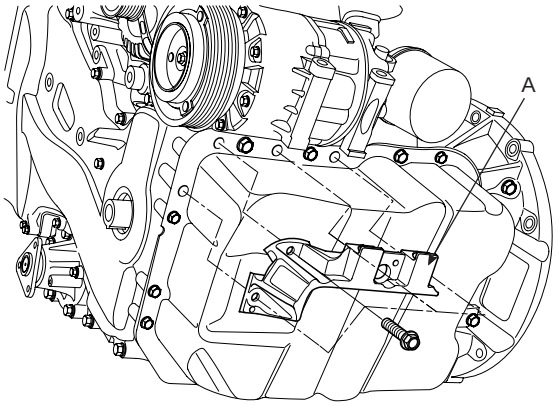
KCRF115A

17. Remove the compressor lower bolts.



KCRF112A

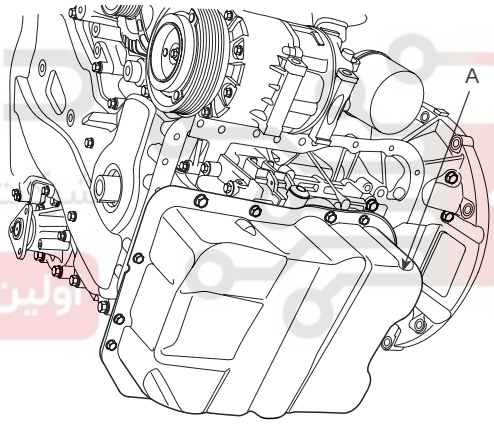
18. Remove the compressor bracket(A).



KCRF113A

19. Drain the engine oil.

20. Remove the oil pan.

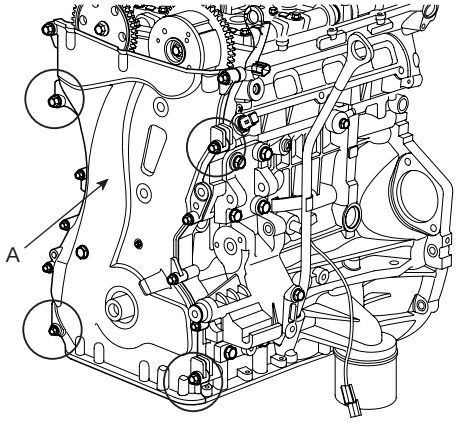


KCRF114A

CAUTION

Be careful not to damage the contact surfaces of cylinder block and oil pan.

21. Remove the timing chain cover(A) by prying the portions between the cylinder head and cylinder block with a screwdriver.



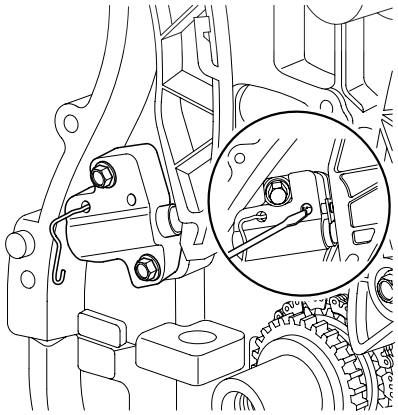
KCRF106A

CAUTION

Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

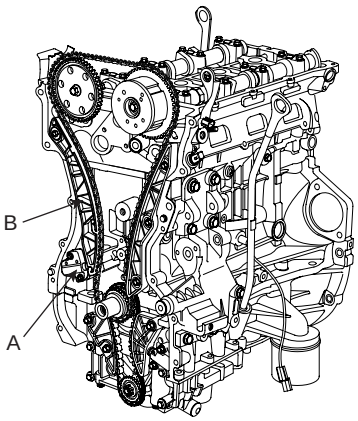
22. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.

23. Install a set pin after compressing the timing chain tensioner.



KCRF105A

24. Remove the timing chain tensioner(A).

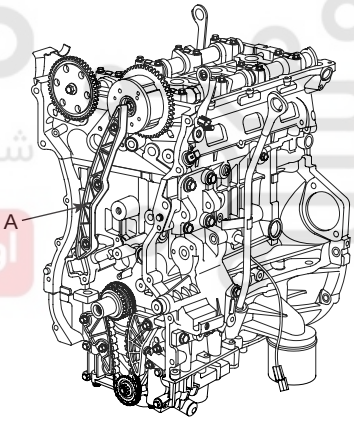


KCRF104A

25. Remove the timing chain tensioner arm(B).

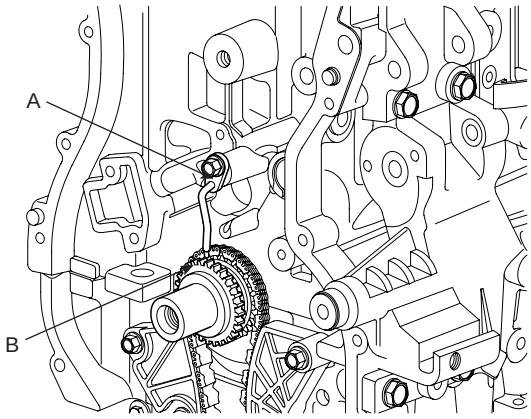
26. Remove the timing chain.

27. Remove the timing chain guide(A).



KCRF103A

28. Remove the timing chain oil jet(A).

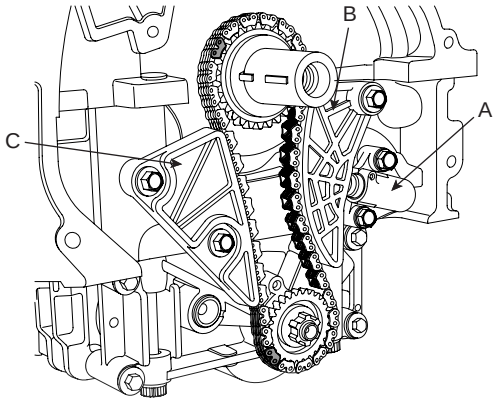


KCRF101A

29. Remove the crankshaft chain sprocket(B).

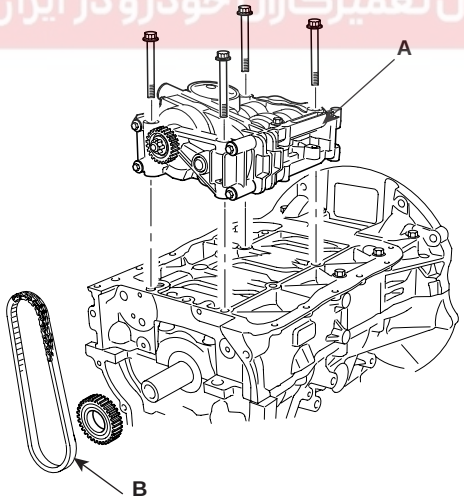
BALANCE SHAFT CHAIN

1. Remove the timing chain.
2. Install a set pin after compressing the balance shaft chain tensioner.
3. Remove the balance shaft chain tensioner(A).



KCRF117A

4. Remove the balance shaft chain tensioner arm(B).
5. Remove the balance shaft chain guide(C).
6. Remove the balance shaft module(A) and balance shaft chain(B).



KCRF165A

INSPECTION EADD7FF9

SPOCKETS, CHAIN TENSIONER, CHAIN GUIDE, CHAIN TENSIONER ARM

1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage.
   Replace as necessary.
3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

BELT, IDLER, BELT TENSIONER, PULLEY

1. Check the belt for oil or dust deposits.
   Replace, if necessary.
   Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt.

   NOTE

   - *Do not bend, twist or turn the timing belt inside out.*
   - *Do not allow the timing belt to come into contact with oil, water and steam.*

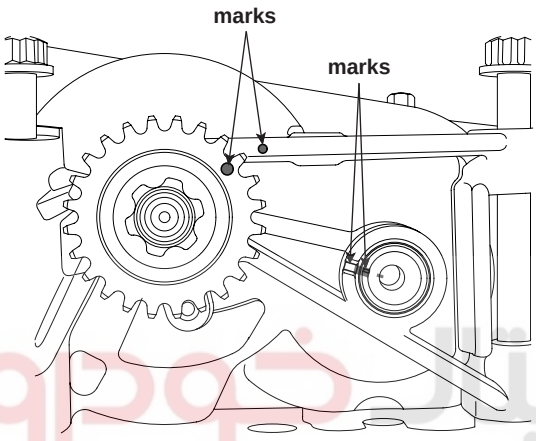
3. Inspect the idler for easy and smooth rotation and check for play or noise.

INSTALLATION E63EF00A

BALANCE SHAFT CHAIN

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.

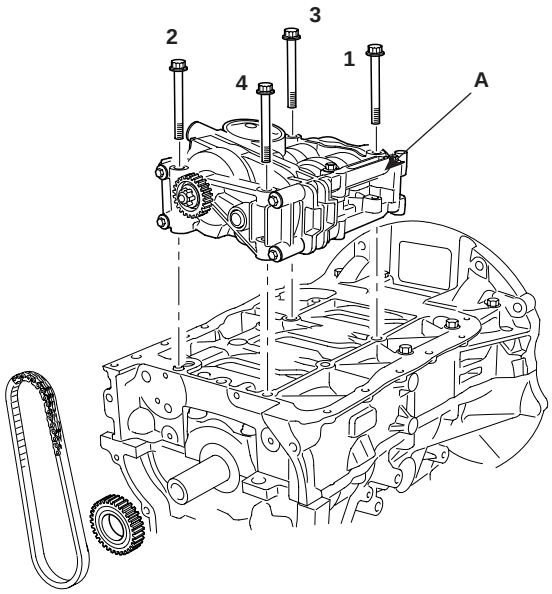
2. Confirm the balance shaft module timing mark. Timing marks to be visually aligned with centers of adjacent cast timing notches.



ECRF006A

3. Install balance shaft module that the timing mark of balance shaft module sprocket should be matched with the timing mark (color link) of balance shaft chain.

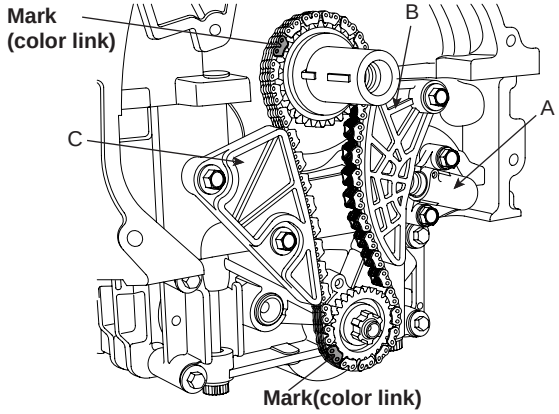
Tightening torque
16.66N.m(1.7kgf.m, 12.3lbf.ft) + 60° + 60°



KCRF165B

4. Install the balance shaft chain guide(C).

Tightening torque
9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)



ECRF007A

5. Install the balance shaft tensioner arm(B).

Tightening torque
9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

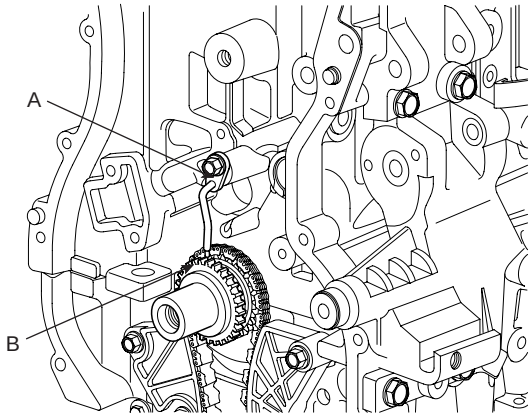
6. Install the balance shaft tensioner(A) and remove the set pin.

Tightening torque
9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

7. Confirm the timing marks.

TIMING CHAIN

1. Install crankshaft chain sprocket(B).



KCRF101A

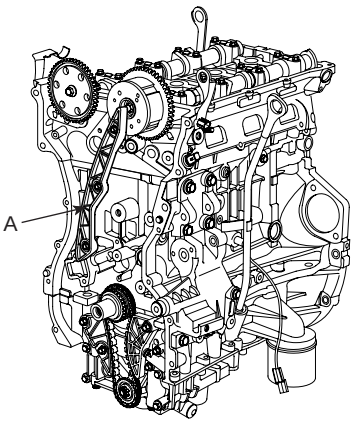
2. Install timing chain oil jet(A).

Tightening torque
7.84 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lbf.ft)

3. Set crankshaft that the key of crankshaft should be aligned with the mating surface of main bearing cap. Put the intake, exhaust camshaft assembly that the TDC mark of intake sprocket and exhast sprocket should be aligned with the top surface of cylinder head. As a result of this, place the piston on No.1 cylinder at the top dead center on compression stroke.

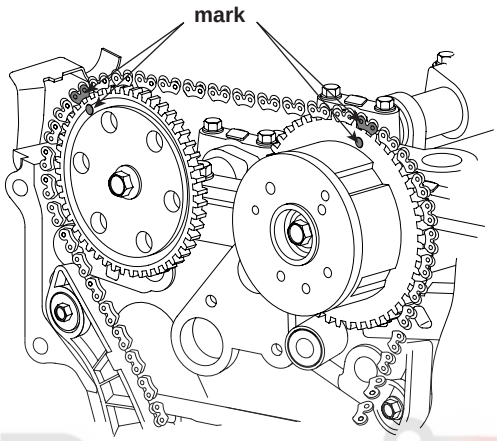
4. install timing chain guide(A).

Tightening torque
9.8 ~ 11.6N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

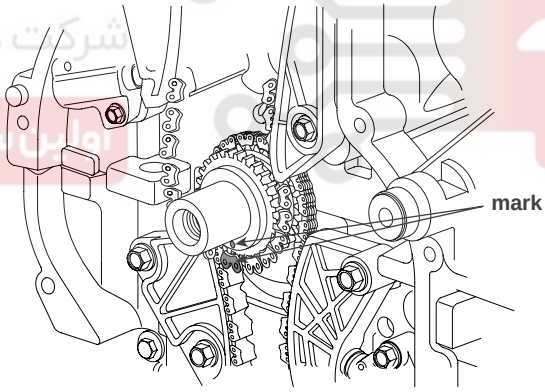


KCRF103A

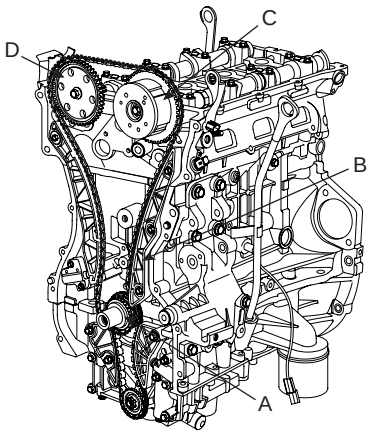
5. Install timing chain.
To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure.
Crankshaft sprocket(A) -> Timing chain guide(B) -> Intake camshaft sprocket(C) -> Exhaust camshaft sprocket(D).
The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain.



ECRF030A



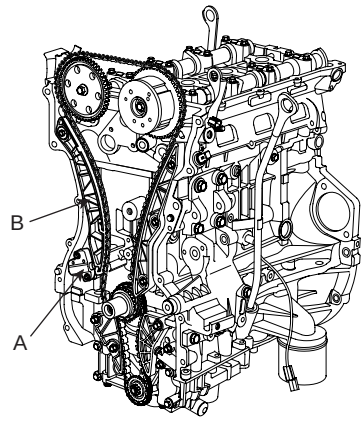
ECRF031A



KCRF104B

6. Install timing chain tensioner arm(B).

Tightening torque
9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

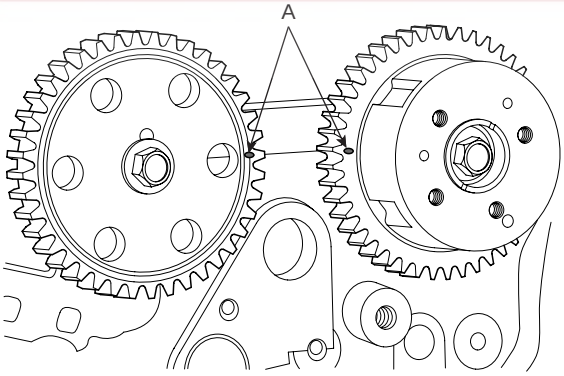


KCRF104A

7. Install timing chain auto tensioner(A) and remove set pin.

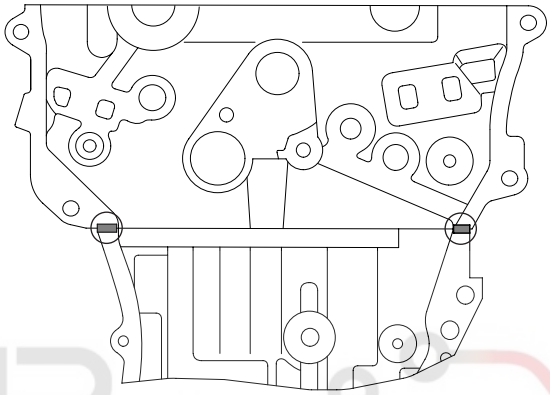
Tightening torque
9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

8. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.



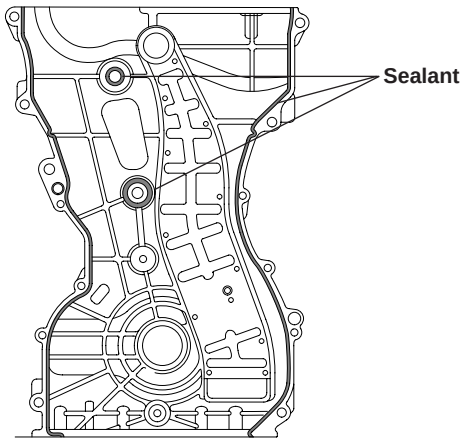
ACRF007A

9. Install timing chain cover.
   a. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and ladder frame) must be free of engine oil and ETC.
   b. Before assembling the timing chain cover, the liquid sealant Loctite 5900 should be applied on the gap between cylinder head and cylinder block.
   The part must be assembled within 5 minutes after sealant was applied.
   Bead width : 2.5mm(0.1in.)



ECRF008A

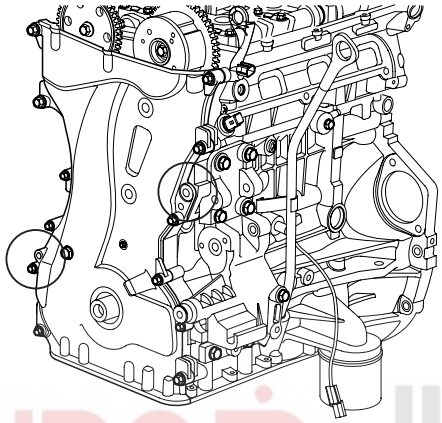
   c. After applying liquid sealant Loctite 5900 on timing chain cover.
   The part must be assembled within 5 minutes after sealant was applied.
   Selant should be applied without discontinuity.
   Bead width : 2.5mm(0.1in.)



ECRF009A

d. The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover to be in exact position.

Tightening torque
M6 : 7.84 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lbf.ft)
M8 : 18.62 ~ 22.54N.m(1.9 ~ 2.3kgf.m, 13.74 ~ 16.63lbf.ft)

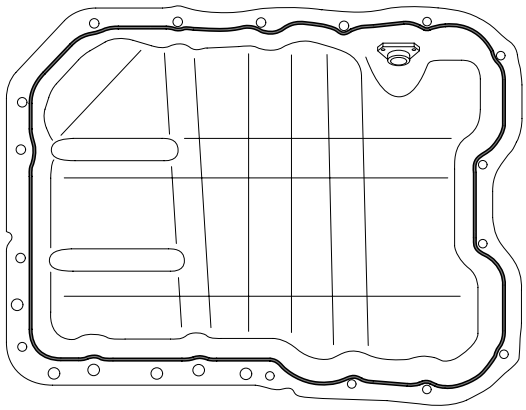


ECRF010A

e. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.

10. Install oil pan.
    a. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
    b. Before assebling the oil pan, the liquid sealant Loctite 5900 should be applied on oil pan.
    The part must be assembled within 5 minutes after the sealant was applied.

Sealant : Loctite 5900 or equivalent(MS 721-40A)



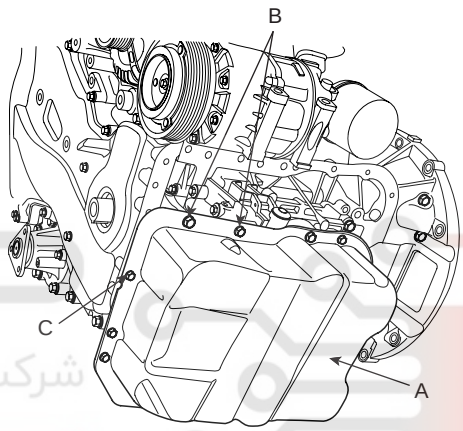
KCRF179A

CAUTION

- ***When applying sealant gasket, sealant must not be protruded into the inside of oil pan.***
- ***To prevent leakage of oil, apply sealant gasket ot the inner threads of the bolt holes.***

c. Install oil pan(A).
Uniformly tighten the bolts in several passes.

Tightening torque
M8(B) : 26.46 ~ 30.38N.m(2.7 ~ 3.1kgf.m, 19.52 ~ 22.41lbf.ft)
M6(C) : 9.8 ~ 11.76N.m(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)

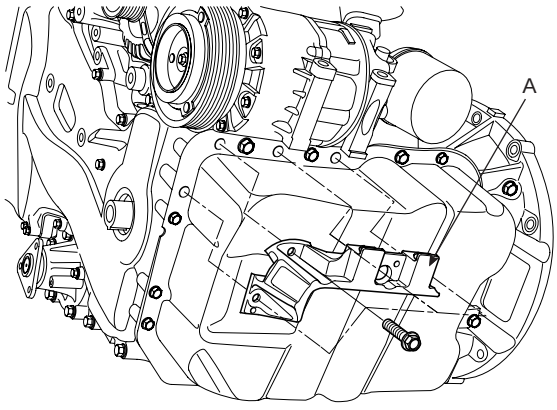


KCRF114B

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

11. Install air compressor bracket(A).

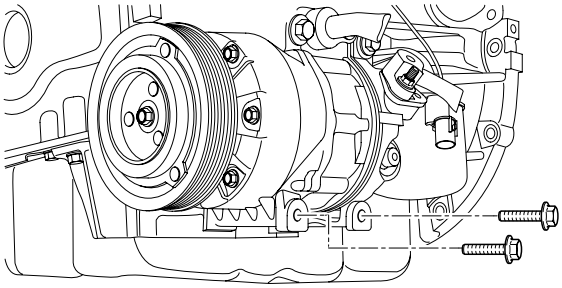
Tightening torque
19.6 ~ 23.52N.m(2.0 ~ 2.4kgf.m, 14.46 ~ 17.35lbf.ft)



KCRF113A

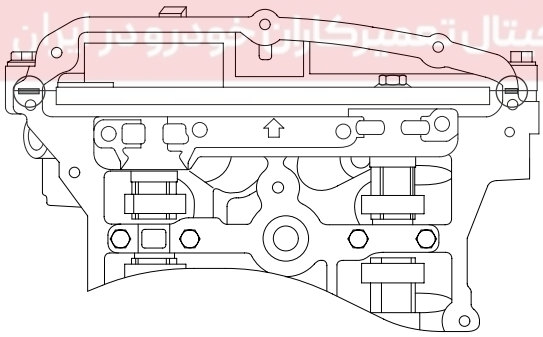
12. Install air compressor bolt

Tightening torque
19.6 ~ 24.5N.m(2.0 ~ 2.5kgf.m, 14.46 ~ 18.07lbf.ft)



KCRF112A

13. Install cylinder head cover.
    a. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
    b. After applying sealant, it should be assembled within 5 minutes.
    Bead width : 2.5mm(0.1in.)

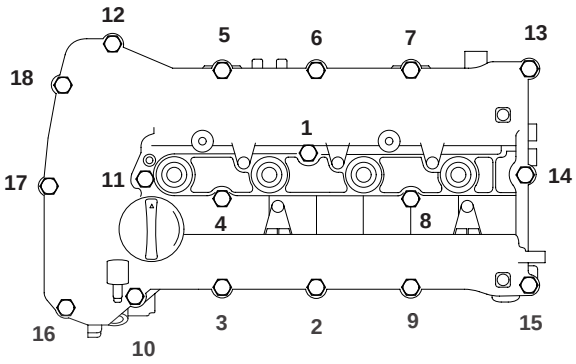


ECRF011A

    c. The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

    d. Install the cylinder head coer bolts as following method.

Tightening torque
1st step : 3.92 ~ 5.88N.m(0.4 ~ 0.6kgf.m, 2.89 ~ 4.34lbf.ft)
2st step : 7.84 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lbf.ft)



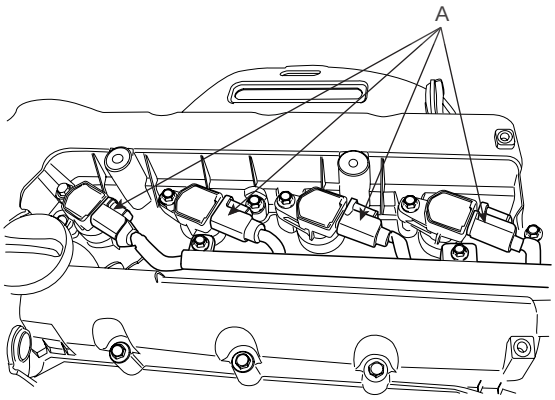
KCRF180A

CAUTION

Do not reuse cylinder head cover gasket.

14. Install ignition coil (See EE group-ignition)

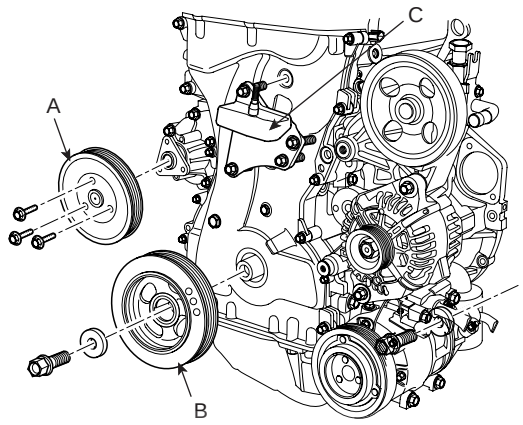
15. Connect ignition coil connector(A).



KCRF131A

16. Install engine support bracket(C).

Tightening torque
M10 : 39.2 ~ 44.1N.m(4.0 ~ 4.5kgf.m, 28.92 ~ 32.53lbf.ft)
M8 : 19.6 ~ 24.5N.m(2.0 ~ 2.5kgf.m, 14.46 ~ 18.07lbf.ft)



KCRF110A

17. Using flywheel stopper, install crankshaft pulley(B).

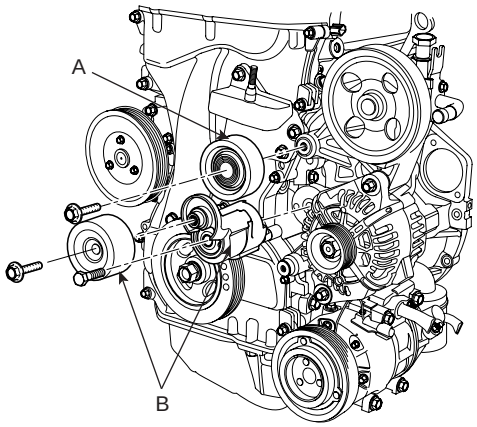
Tightening torque
166.6 ~ 176.4N.m(17 ~ 18kgf.m, 122.9 ~ 130.13lbf.ft)

18. Install water pump pulley(A).

Tightening torque
7.84 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.78 ~ 7.23lbf.ft)

19. Install drive belt tensioner(B) and tensioner pulley.

Tightening torque
53.9 ~ 63.7N.m(5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lbf.ft)



KCRF109A

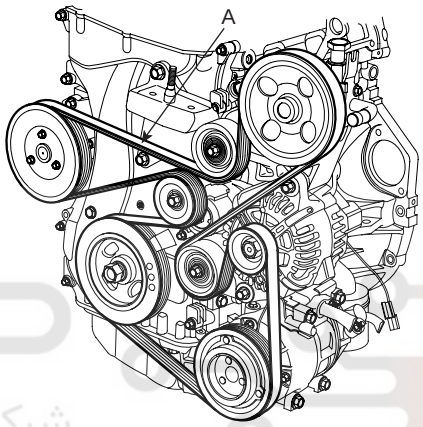
NOTE

Tensioner pulley bolt is left-handed screw.

20. Install idler pulley(A)

Tightening torque
53.9 ~ 63.7N.m(5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lbf.ft)

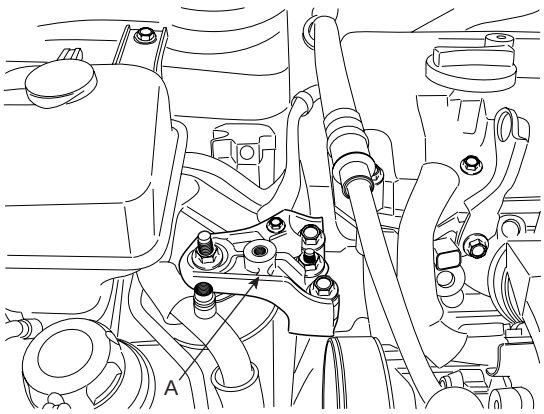
21. Install drive belt(A)
Crankshaft pulley -> A/C pulley -> alternator pulley -> idler pulley -> P/C pump pulley -> idler pulley -> water pump pulley -> tensioner pulley.
Rotate auto tensioner arm in the counter - clockwise moving auto tensioner pulley bolt with wrench.
After putting belt on auto tensioner pulley, release the auto tensioner pulley slowly.



ECRF012A

22. Install engine mounting bracket(A).

Tightening torque
63.7 ~ 83.3N.m(6.5 ~ 8.5kgf.m, 47.0 ~ 61.4lbf.ft)



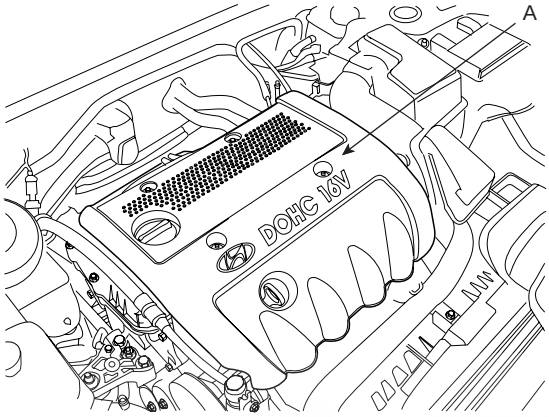
KCRF137A

23. Install RH side cover.

24. Install RH front wheel.

25. Install engine cover(A).

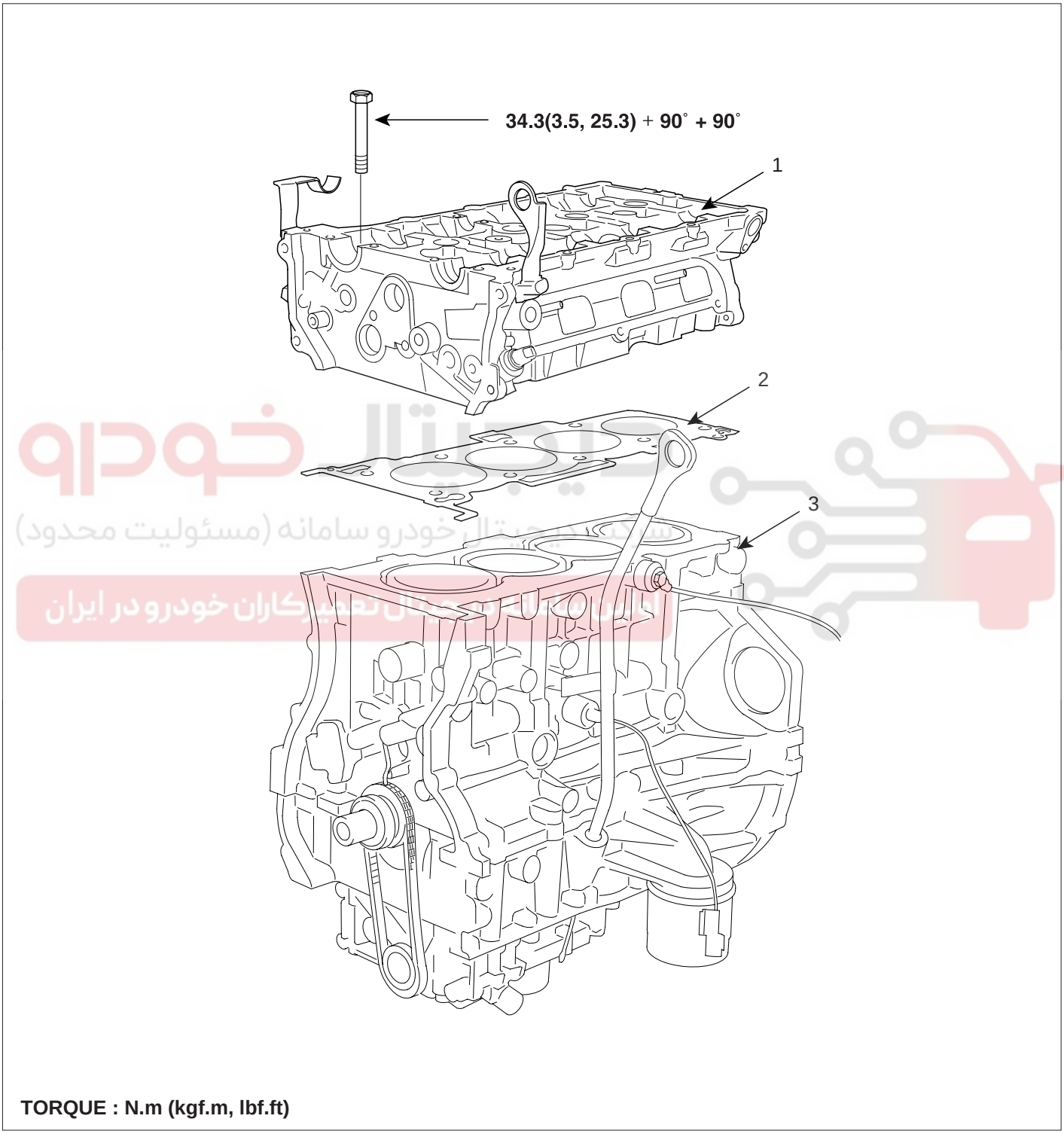
Tightening torque
3.92 ~ 5.88N.m(40 ~ 60kgf.cm, 2.89 ~ 4.34lbf.ft)



KCRF146A

CYLINDER HEAD ASSEMBLY

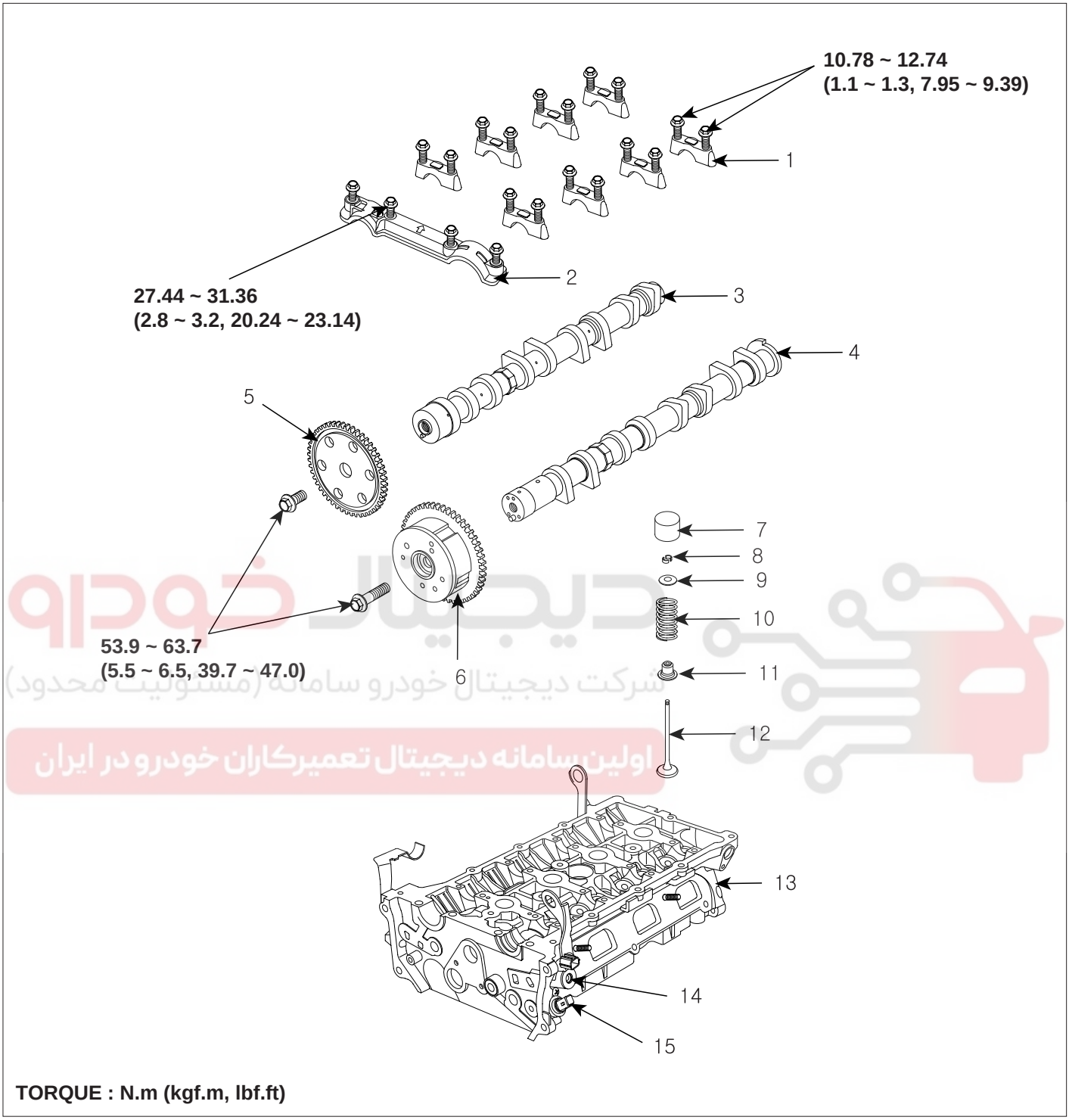
COMPONENTS EEAFB45C



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

1. Cylinder head
2. Cylinder head gasket
3. Cylinder block

ECRF013A



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

1. Camshaft bearing cap
2. Camshaft front bearing cap
3. Exhaust camshaft
4. Intake camshaft
5. Exhaust camshaft sprocket
6. CVVT assembly
7. MLA
8. Retainer lock
9. Retainer
10. Valve spring
11. Valve stem seal
12. Valve
13. Cylinder head
14. OCV
15. OTS

ECRF014A

REMOVAL EED0AA3B

Engine removal is not required for this procedure.

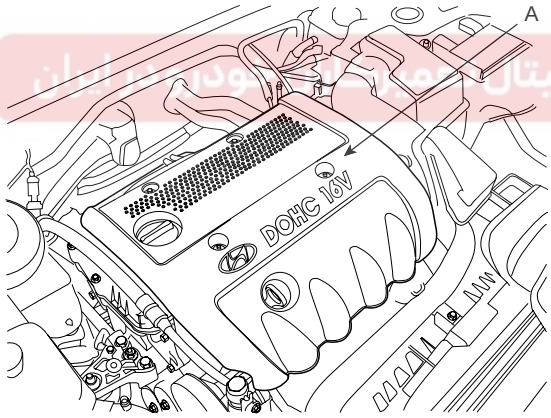
CAUTION

- ***Use fender covers to avoid damaging painted surfaces.***
- ***To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.***
- ***When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.***
- ***To avoid damage, unplug the wiring connectors carefully while holding the connector portion.***

NOTE

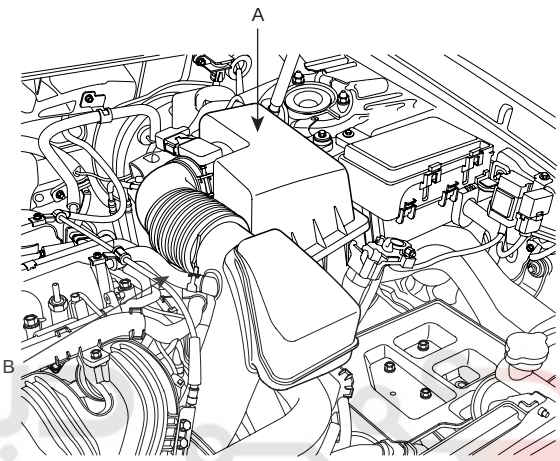
- *Mark all wiring and hoses to avoid misconnection.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (See page EM-8)*

1. Disconnect the negative terminal from the battery.
2. Remove engine cover(A).



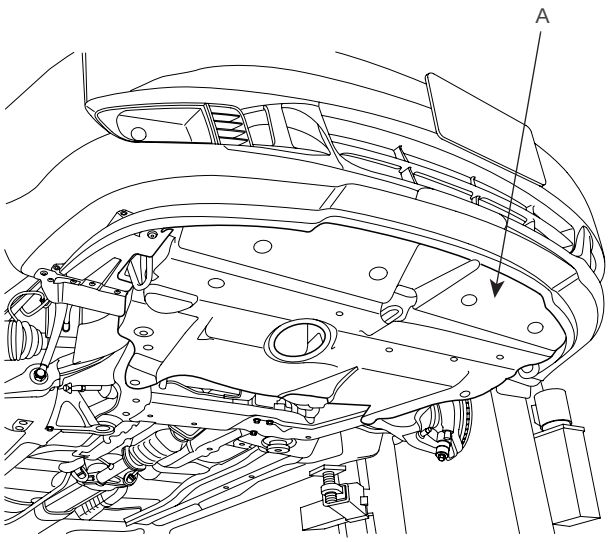
KCRF146A

3. Remove air duct.
4. Remove the intake air hose and air cleaner assembly.
   1) Disconnect the AFS connector.
   2) Disconnect the breather hose(B) from air cleaner hose.
   3) Disconnect the ECM connector. (See FL group)
   4) Remove the intake air hose and air cleaner assembly(A).



ACRF011A

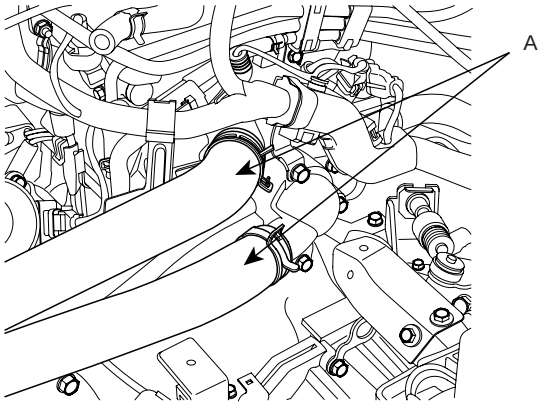
5. Remove front wheels.
6. Remove under cover(A).



KMRE009H

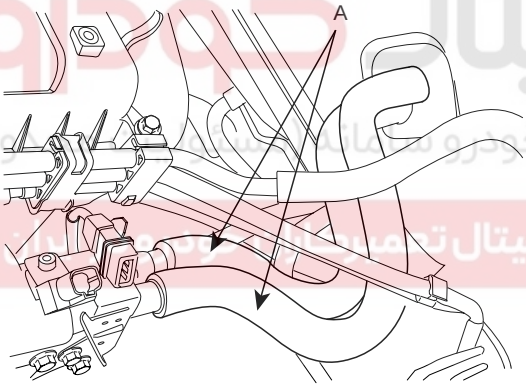
7. Drain the engine coolant.
   Remove the radiator cap to speed draining.

8. Remove the upper and lower radiator hose(A).



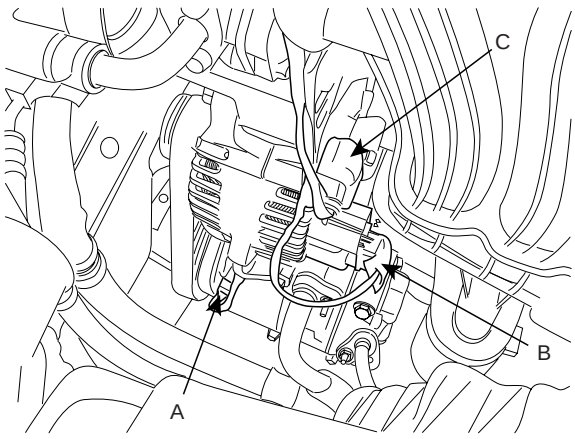
KCRF124A

9. Remove the heater hoses(A).



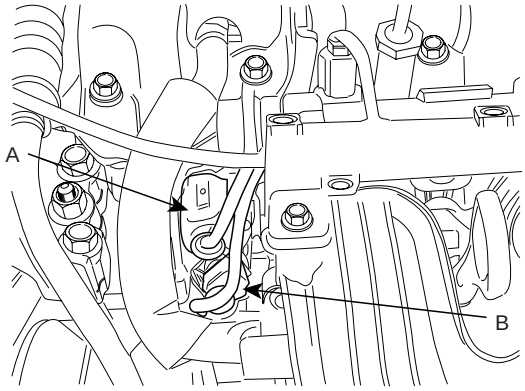
KCRF133A

10. Disconnect A/C switch(A), alternator connector(B), and oil pressure switch(C).



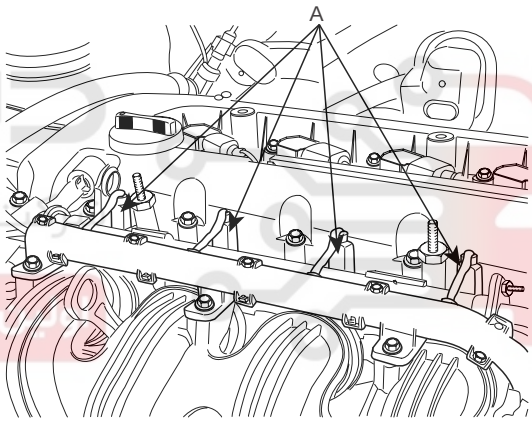
KCRF126A

11. Disconnect OCV connector(A) and OTS connector(B).



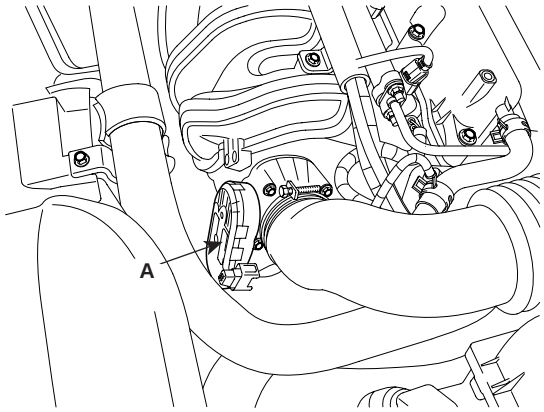
KCRF127A

12. Disconnect injector connectors(A).



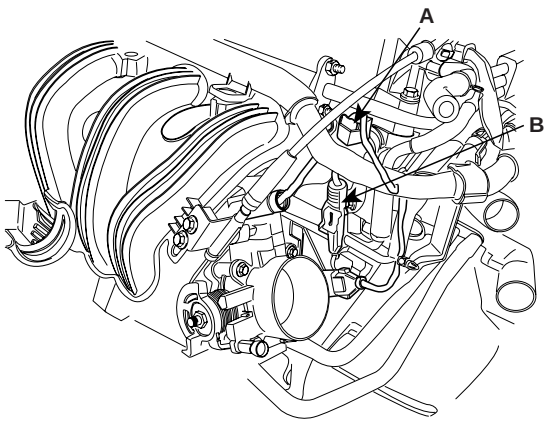
KCRF128A

13. Disconnect ETS connector(A)



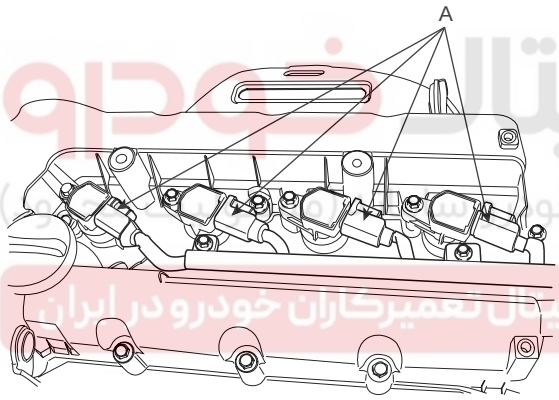
ECRF032A

14. Disconnect CMP connector(A), and knock sensor connector(B).



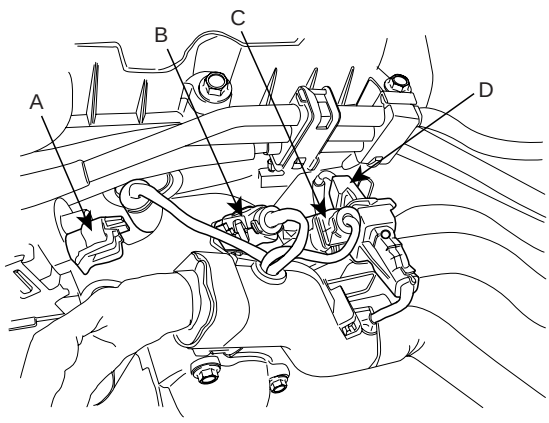
ECRF029A

15. Disconnect ignition coil connectors(A).



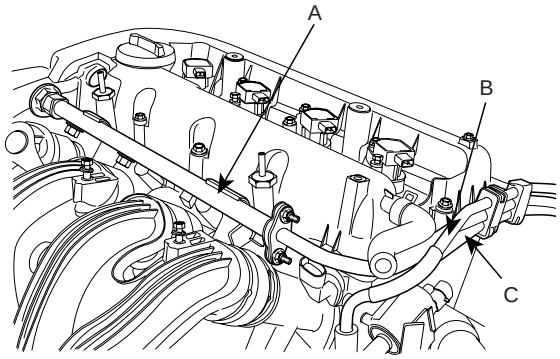
KCRF131A

16. Disconnect PCSV connector(A), WTS connector(B), condenser connector(C), and CKP sensor connector(D).



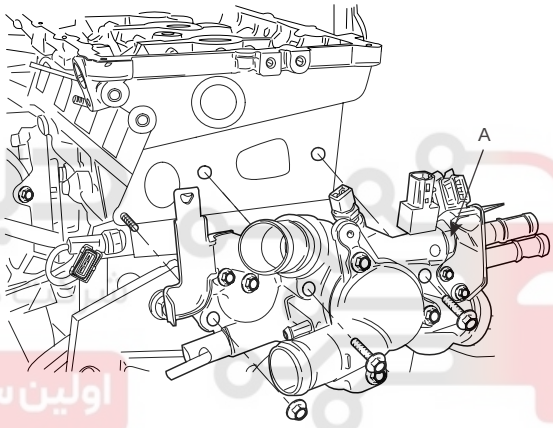
KCRF132A

17. Remove delivery pipe(A), brake vacuum hose(B), and PCSV hose(C).



KCRF134A

18. Remove water temp control assembly(A).



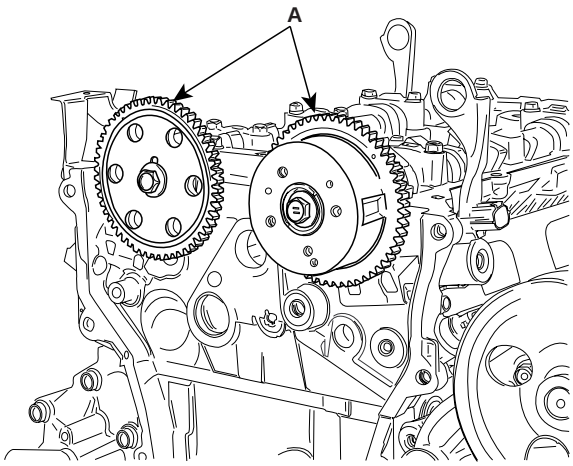
ACRF012A

19. Remove intake manifold. (See page EM - 85)

20. Remove exhaust manifold. (See page EM - 87)

21. Remove timing chain. (Seepage EM - 8)

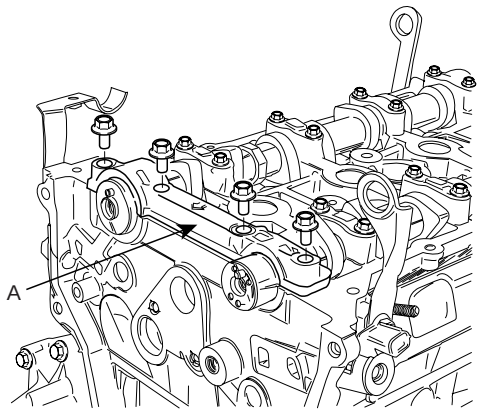
22. Remove CVVT assembly and camshaft sprocket(A).



KCRF151A

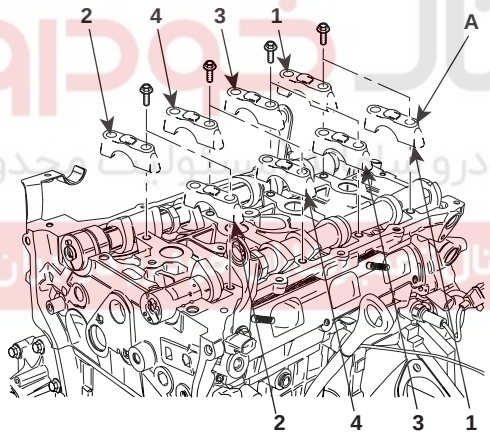
23. Remove camshaft.

1) Remove front camshaft bearing cap(A).



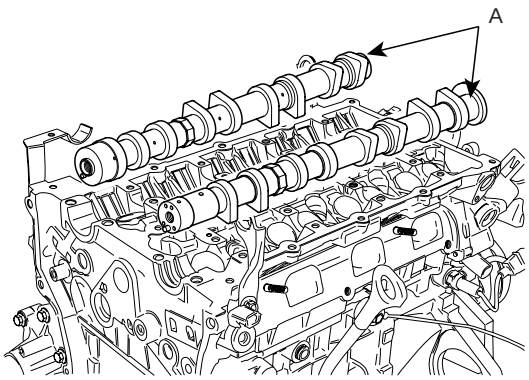
KCRF153A

2) Remove camshaft bearing cap(A), in the sequence shown.



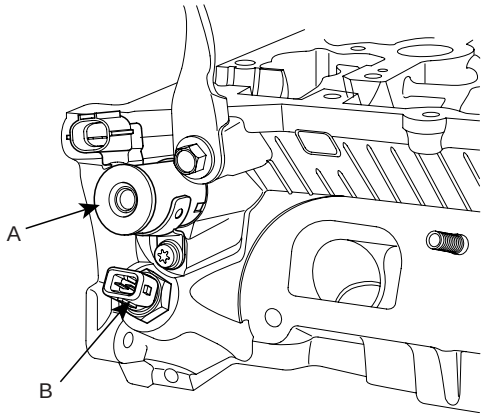
ACRF020A

3) Remove camshafts(A)



KCRF155A

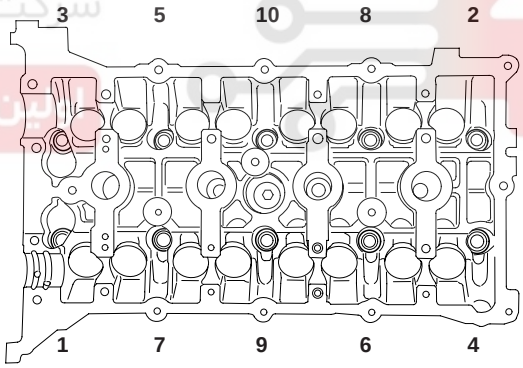
24. Remove OCV(A) and OTS(B).



KCRF119A

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

1) Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.



KCRF162A

CAUTION

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

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

CAUTION

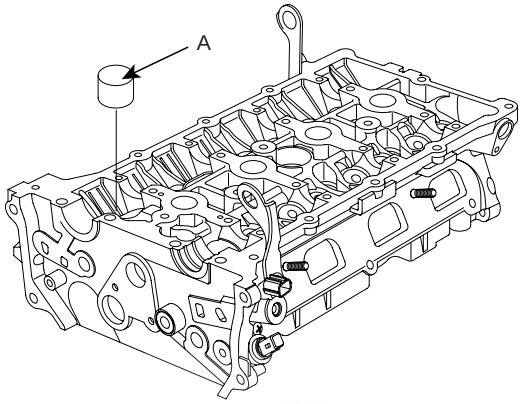
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

DISASSEMBLY E37BB06C

NOTE

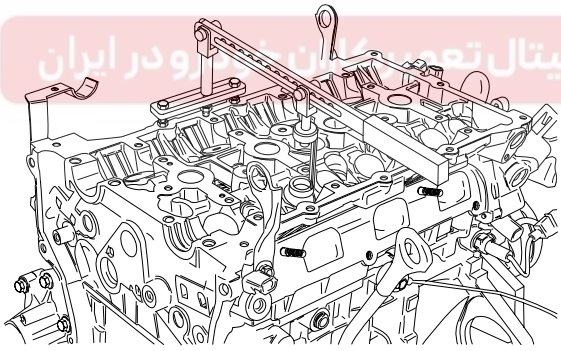
Identify MLA(Mechanical Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove MLAs(A).



KCRF125A

2. Remove valves.
   1) Using SST(09222-3K000, 09222-3K100), compress the valve spring and remove retainer lock.



KCRF125B

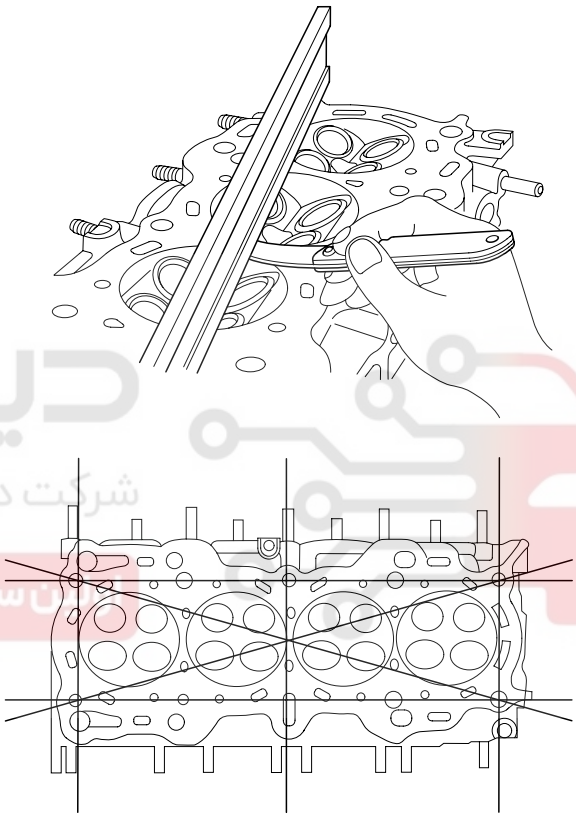
   2) Remove the spring retainer.
   3) Remove the valve spring.
   4) Remove the valve.
   5) Using needle-nose pliers, remove the valve stem seal.

INSPECTION E8F0BC5D

CYLINDER HEAD

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

Flatness of cylinder head gasket surface
Standard : Less than 0.05mm(0.002in.)



ECKD001H

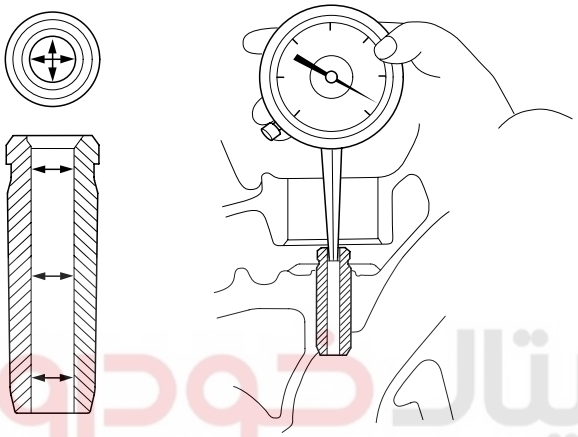
2. Inspect for cracks.
   Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

   1) Using a caliper gauge, measure the inside diameter of the valve guide.

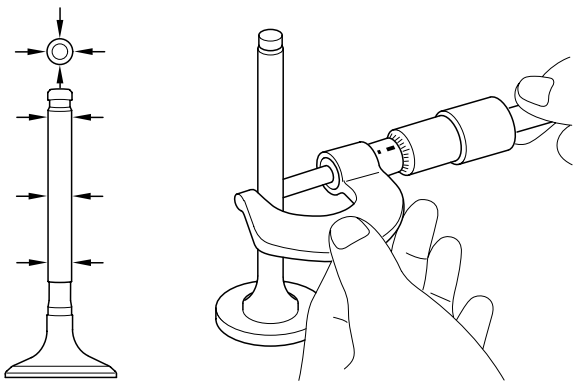
Valve guid I.D.
Intake / Exhaust : 5.500 ~ 5.512mm (0.216 ~ 0.217in.)



ECKD219A

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

Valve stem O.D.
Intake : 5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)
Exhaust : 5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)



ECKD220A

   3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance
[Standard]
Intake : 0.020 ~ 0.047mm (0.0008 ~ 0.0018in.)
Exhaust : 0.030 ~ 0.054mm (0.0012 ~ 0.0021in.)
[Limit]
Intake : 0.07mm (0.0027in.)
Exhaust : 0.09mm (0.0035in.)

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

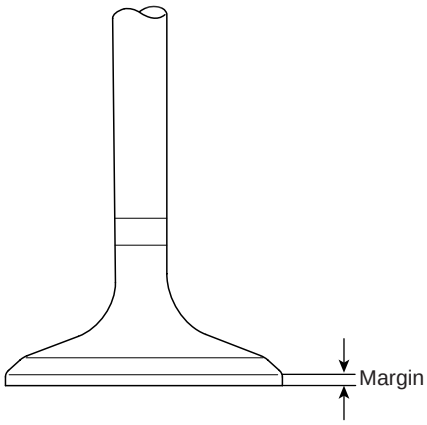
2. Inspect valves.

   1) Check the valve is ground to the correct valve face angle.

   2) Check that the surface of the 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 minimum, replace the valve.

Margin
[Standard]
Intake : 1.02mm(0.0401in.)
Exhaust : 1.09mm(0.0429in.)



ECKD221A

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

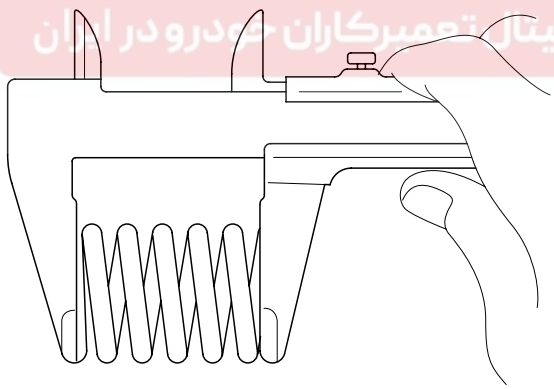
3. Inspect valve seats
Check the valve seat for evidence of overheating and improper contact with the valve face.
Replace the seat if necessary.
Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat. Recondition the valve seat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

4. Inspect valve springs.

1) Using a steel square, measure the out-of-square of the valve spring.

2) Using a vernier calipers, measure the free length of the valve spring.

Valve spring
[Standard]
Free height : 47.44mm (1.8677in.)
Out-of-square : 1.5°



ECKD222A

If the free length is not as specified, replace the valve spring.

MLA

1. Inspect MLA.
Using a micrometer, measure the MLA outside diameter.

MLA O.D.
Intake/Exhaust : 31.964 ~ 31.980mm(1.2584 ~ 1.2590in.)

2. Using a caliper gauge, measure MLA tappet bore inner diameter of cylinder head.

Tappet bore I.D.
Intake/Exhaust : 32.000 ~ 32.025mm(1.2598 ~ 1.2608in.)

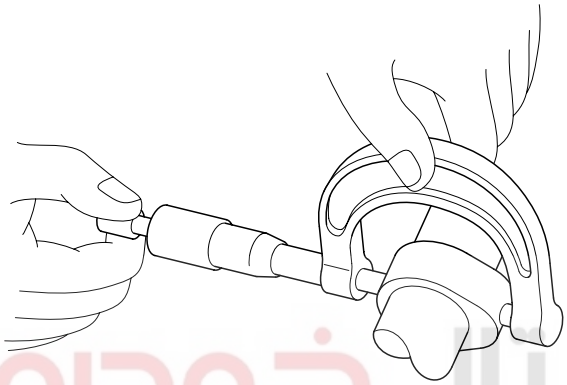
3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

MLA to tappet bore clearance
[Standard]
Intake/Exhaust : 0.020 ~ 0.061mm(0.0008 ~ 0.0024in.)
[Limit]
Intake/Exhaust : 0.07mm(0.0027in.)

CAMSHAFT

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

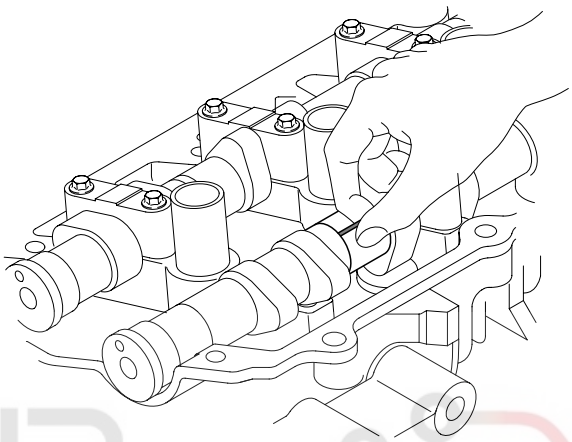
Cam height
[Standard value]
Intake : 43.70 ~ 43.90mm (1.7204 ~ 1.7283in.)
Exhaust : 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)



ECKD223A

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

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



ECKD224A

   4) Install the bearing caps. (See page EM - 44)

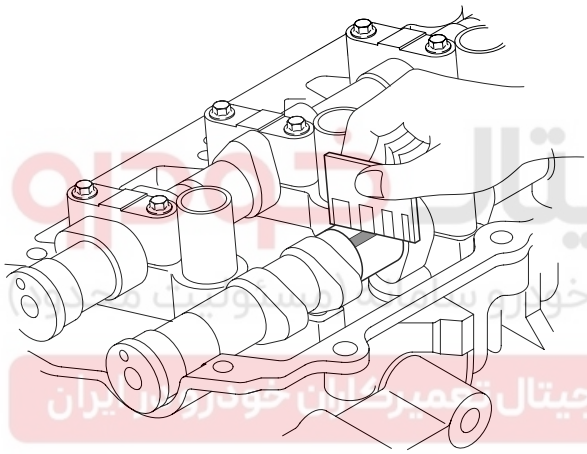
CAUTION

Do not turn the camshaft.

5) Remove the bearing caps.

6) Measure the plastigage at its widest point.

Bearing oil clearance
[Standard value]
Intake
No.1 journal : 0.02 ~ 0.057mm (0.0008 ~ 0.0022in.)
No.2,3,4,5, journal : 0.045 ~ 0.082mm (0.0018 ~ 0.0032in.)
Exhaust : 0.045 ~ 0.082mm (0.0018 ~ 0.0032in.)
[Limit] :
Intake
No.1 journal : 0.09mm (0.0035in.)
No.2,3,4,5 journal : 0.12mm (0.0047in.)
Exhaust : 0.12mm (0.0047in.)



ECKD225A

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

7) Completely remove the plastigage.

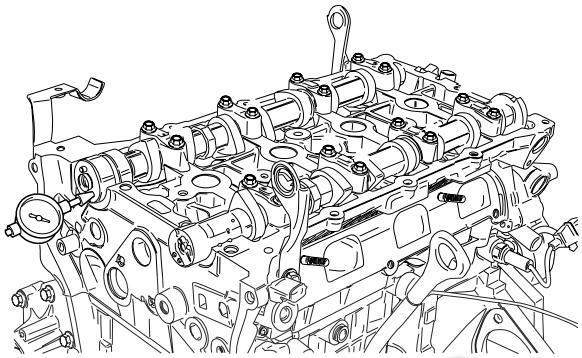
8) Remove the camshafts.

3. Inspect camshaft end play.

1) Install the camshafts. (See page EM - 44)

2) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play
[Standard value] : 0.10 ~ 0.22mm(0.004 ~ 0.0087in.)
[Limit] : 0.24mm (0.0094in.)



KCRF151B

If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

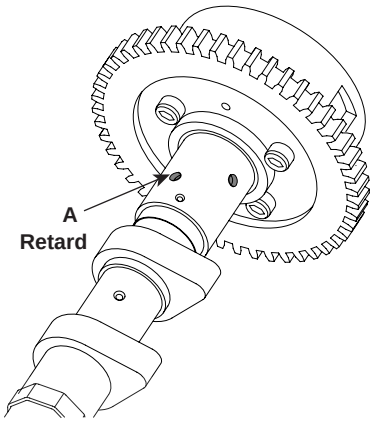
3) Remove the camshafts.

CVVT ASSEMBLY

1. Inspect CVVT assembly.

   1) Check that the CVVT assembly will not turn.

   2) Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.



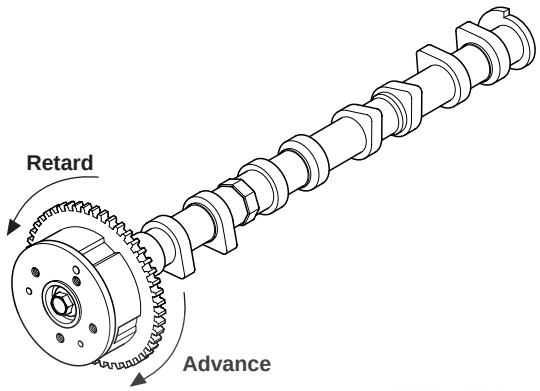
ECRF015A

   3) Wind tape around the tip of the air gun and apply air of approx. 150kpa(1.5kgf/cm², 21psi) to the port of the camshaft.
   (Perform this order to release the lock pin for the maximum delay angle locking.)

NOTE

When the oil splashes, wipe it off with a shop rag and the likes.

   4) Under the condition of (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.
   Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.



ECRF016A

   5) Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no disturbance.

Standard:	Movable smoothly in the range about 22.5°

   6) Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (counter clockwise).

REASSEMBLY ED38378A

NOTE

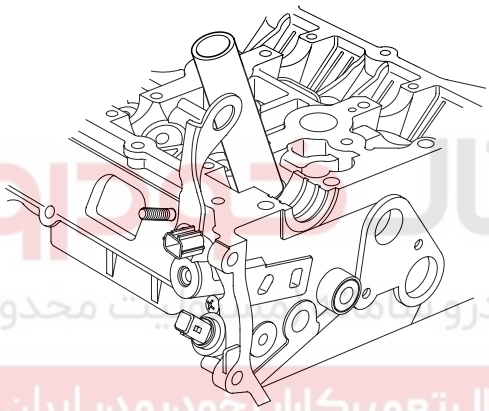
Thoroughly clean all parts to be assembled.
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
Replace oil seals with new ones.

1. Install valves.

   1) Using SST(09222-4A000), push in a new oil seal.

NOTE

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



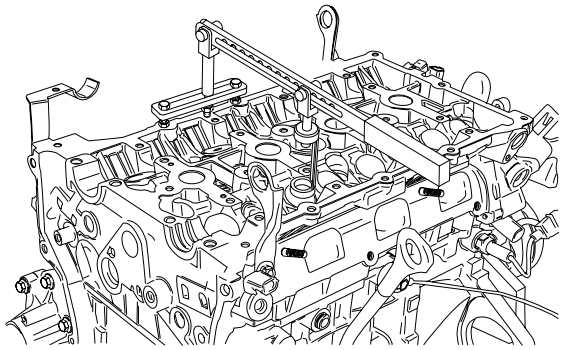
KCRF120A

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

NOTE

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

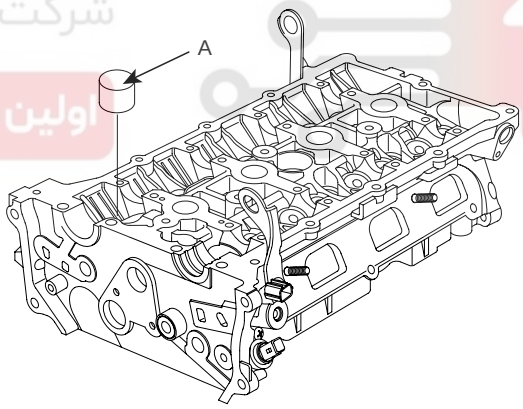
   3) Using the SST(09222-3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



KCRF125B

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

2. Install MLAs.
   Check that the MLA rotates smoothly by hand.



KCRF125A

NOTE

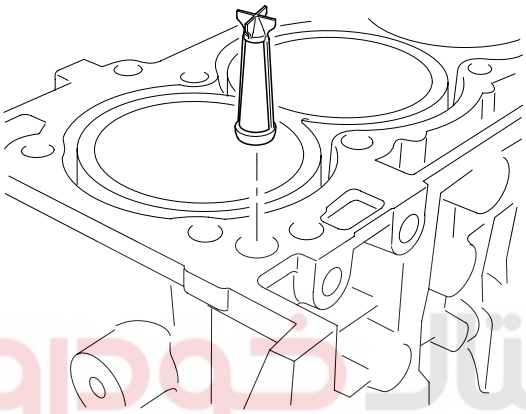
MLA can be reinstalled in its original position.

INSTALLATION ECAF2F73

NOTE

- *Thoroughly clean all parts to be assembled.*
- *Always use a new head and manifold gasket.*
- *The cylinder head gasket is a metal gasket. Take care not to bend it.*
- *Rotate the crankshaft, set the No.1 piston at TDC. (See page EM - 8)*

1. Install OCV filter.

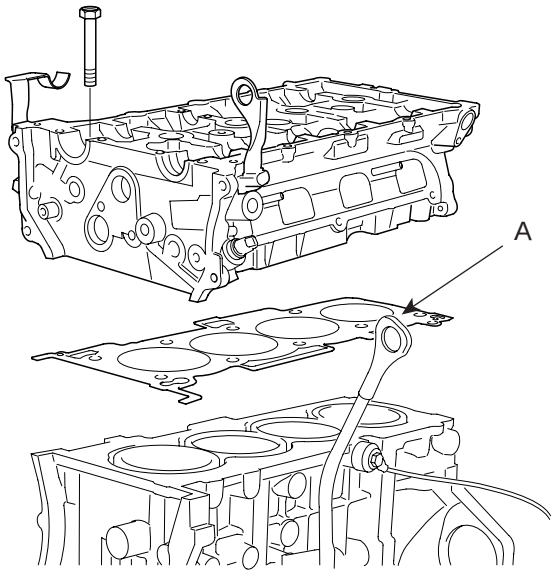


KCRF176A

NOTE

Keep clean te OCV filter.

2. Install the cylinder head gasket(A) on the cylinder block.



KCRF163A

NOTE

Be careful of the installation direction.

3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.

4. Install cylinder head bolts.

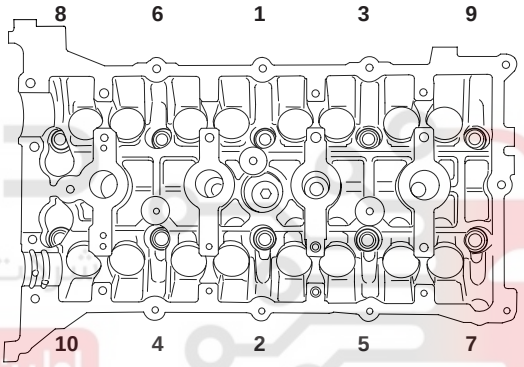
   1) Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.

   2) Using triple square hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque
34.3Nm (3.5kgf.m, 25.3lbf.ft) + 90° + 90°

NOTE

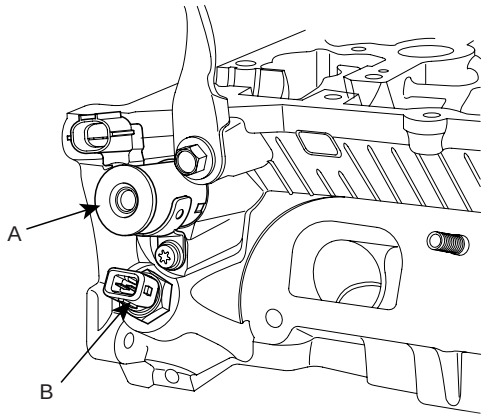
Always use new cylinder head bolt.



KCRF162B

5. Install OCV(A) and OTS (B).

Tightening torque
OCV : 9.8 ~ 11.76Nm(1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)
OTS : 19.6 ~ 23.52Nm(2.0 ~ 2.4kgf.m, 14.46 ~ 17.35lbf.ft)



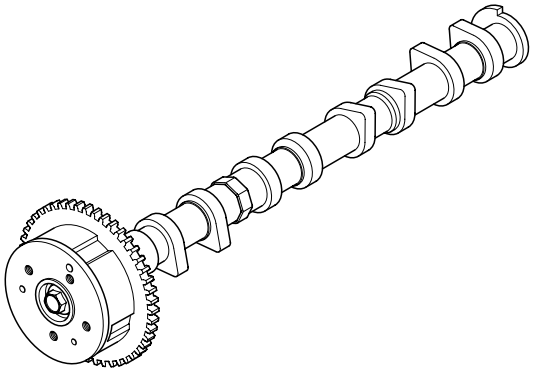
KCRF119A

CAUTION

- ***Do not reuse the OCV when dropped.***
- ***Keep clean the OCV.***
- ***Do not hold the OCV sleeve during servicing.***
- ***When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.***

6. Install the CVVT and camshaft sprocket.

Tightening torque
53.9 ~ 63.7Nm(5.5 ~ 6.5 kgf.m, 39.7 ~ 47.0lbf.ft)

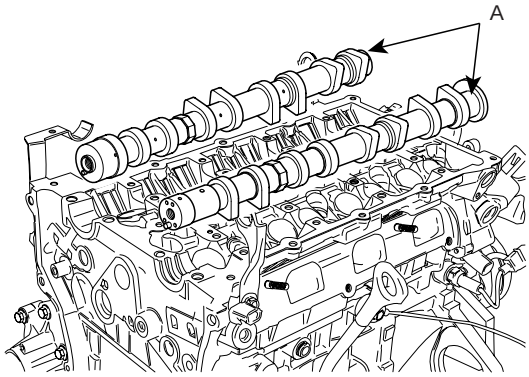


KCRF122A

NOTE

Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.

7. Install camshafts (A).



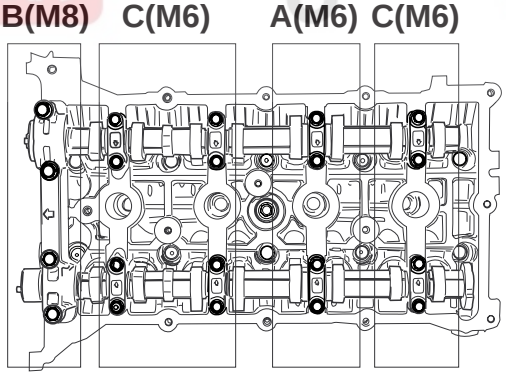
KCRF155A

NOTE

Apply a light coat of engine oil on camshaft journals.

8. Install camshaft bearing caps in their proper locations.
Tightening order.
Group A → Group B → Group C.

Tightening torque
M6 : 10.78 ~ 12.74Nm(1.1 ~ 1.3kgf.m, 7.95 ~ 9.39lbf.ft)
M8 : 27.44 ~ 31.36Nm(2.8 ~ 3.2kgf.m, 20.24 ~ 23.14 lbf.ft)

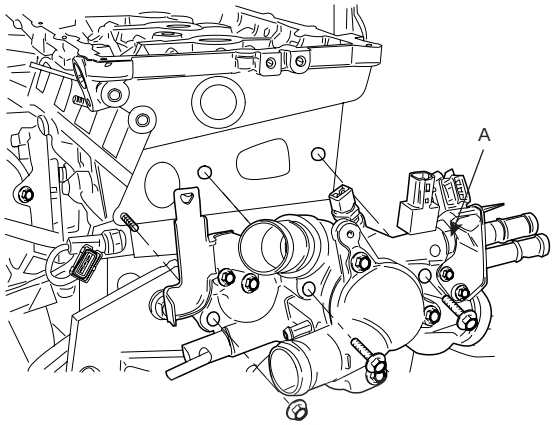


ECRF017A

9. Install timing chain. (See page EM - 23)
10. Check and adjust valve clearance. (See page EM - 8)
11. Install the exhaust manifold. (See apge EM - 87)
12. Install the intake manifold. (See page EM - 87)

13. Install water temp control assembly (A).

Tightening torque
Bolt : 14.7 ~ 21.56Nm(1.5 ~ 2.2kgf.m, 10.84 ~ 15.90lbf.ft)
Nut : 19.6 ~ 26.46Nm(2.0 ~ 2.7kgf.m, 14.46 ~ 19.52lbf.ft)

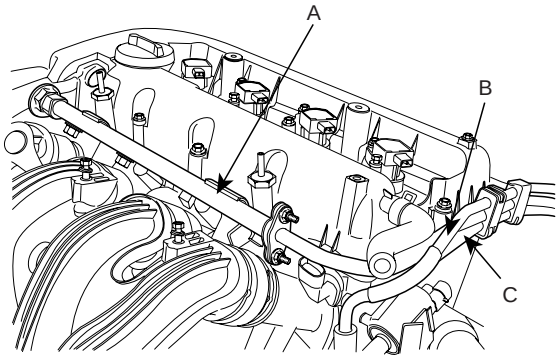


ACRF012A

NOTE

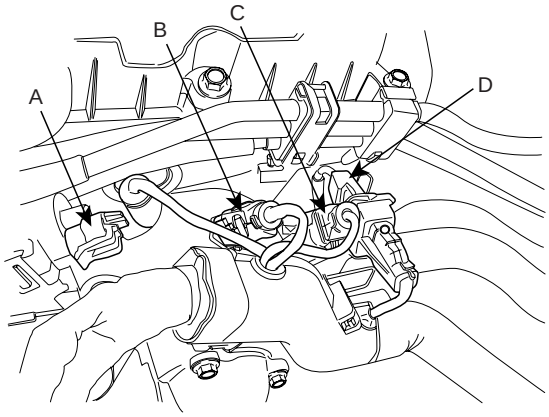
- *Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.*
- *Insert after wetting O-ring or inner surface of thermostat housing.*
- *Always use a new O-ring.*

14. Install delivery pipe (A), brake hose(B), and PCSV hose (C).



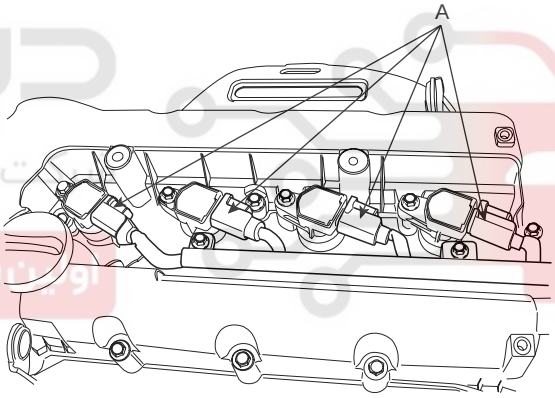
KCRF134A

15. Connect PCSV connector (A), WTS connector (B), condenser connector (C), and CKP sensor connector (D).



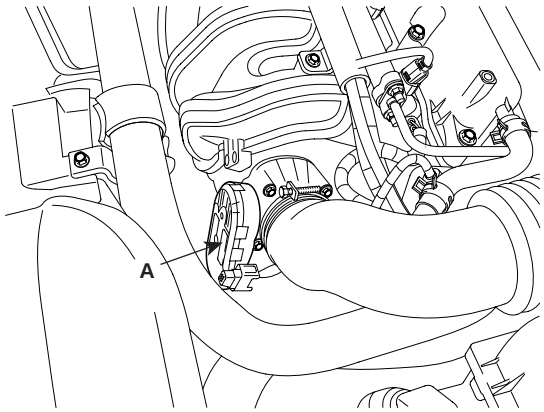
KCRF132A

16. Install ignition coil connector (A).



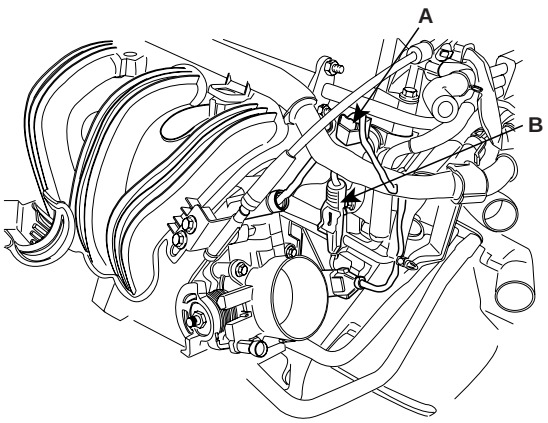
KCRF131A

17. Connect ETS connector(A)



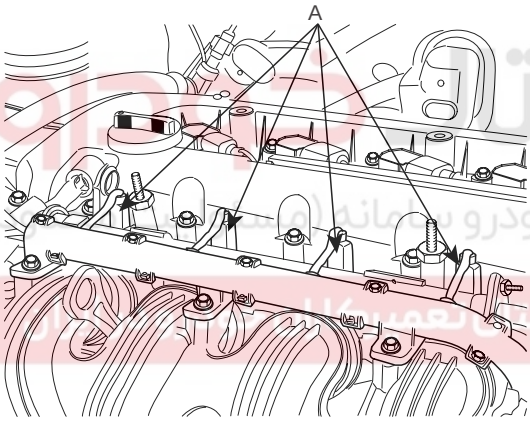
ECRF032A

18. Connect CMP connector (A), and knock sensor connector (B).



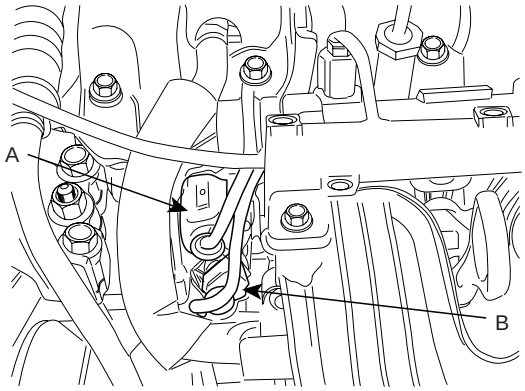
ECRF029A

19. Connect injector connectors (A).



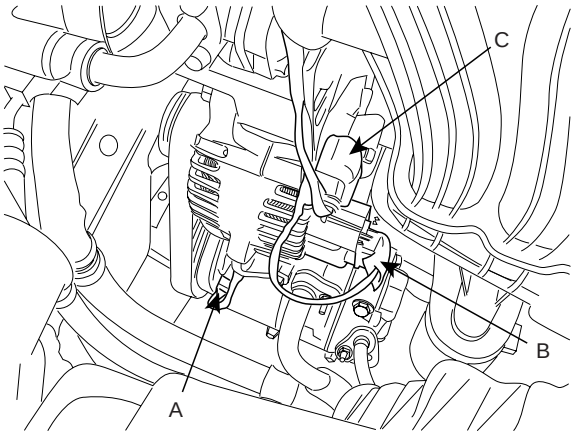
KCRF128A

20. Connect OCV connector (A) and OTS connector (B).



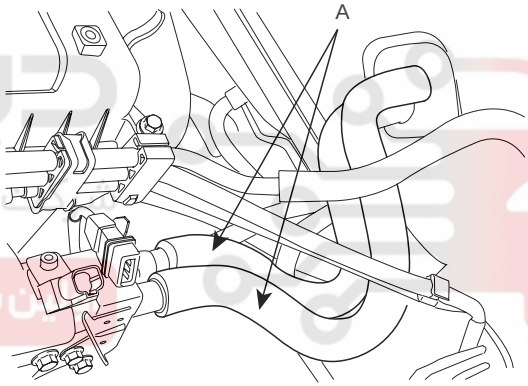
KCRF127A

21. Connect A/C switch (A), alternator connect (B), and oil pressure switch (C).



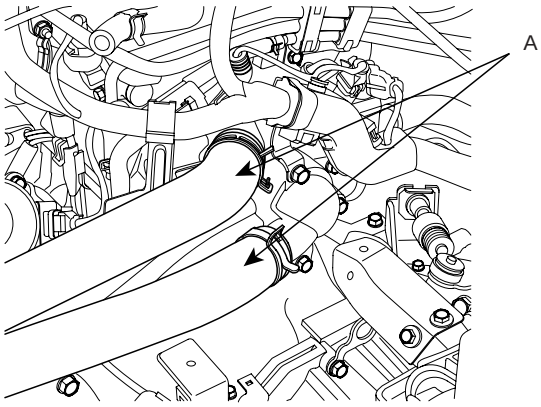
KCRF126A

22. Install heater hoses(A).



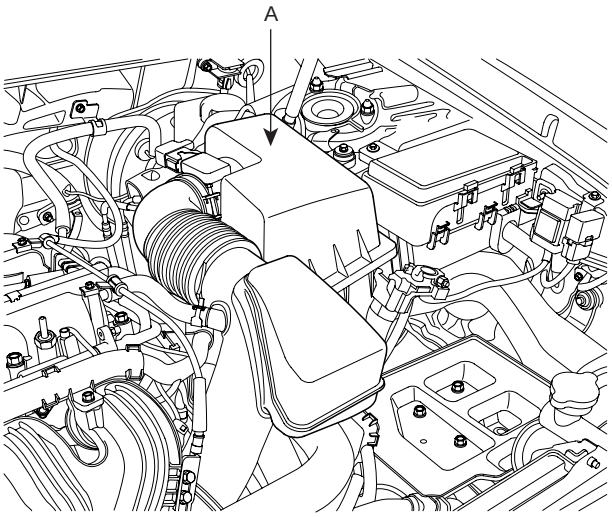
KCRF133A

23. Install the upper radiator hose and lower radiator hose(A).



KCRF124A

24. Install the intake air hose and air cleaner assembly.



KMRE009A

25. Install the engine cover (A).
26. Connect the negative terminal to the battery.
27. Filll with engine coolant.
28. Start the engine and check for leaks.
29. Recheck engine coolant level and oil level.

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL E5A225DF

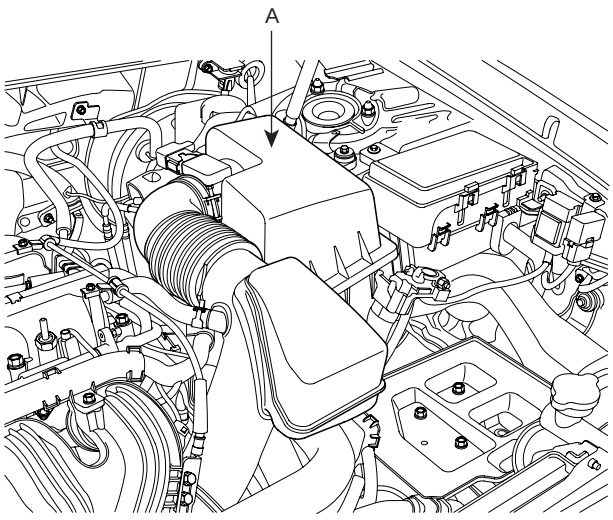
CAUTION

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

NOTE

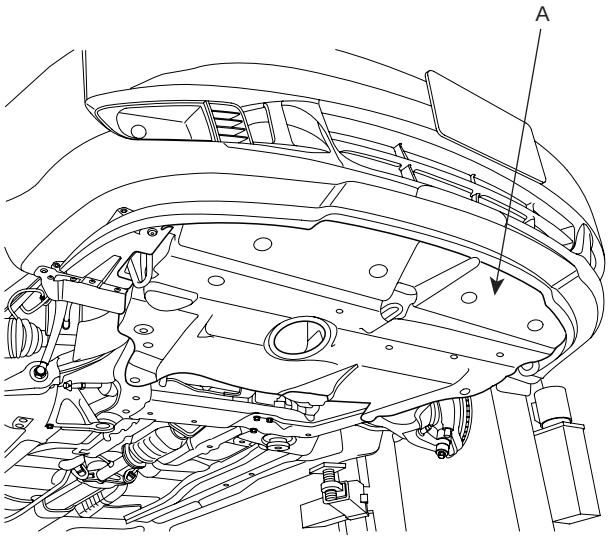
- *Mark all wiring and hoses to avoid misconnection.*
- *Inspection the timing belt before removing the cylinder head.*
- *Turn the crankshaft pulley so that the No.1 piston is at top dead center. (See page EM - 8)*

1. Disconnect the neagative terminal from the battery.
2. Remove the engine cover.
3. Remove the air duct.
4. Remove the intake air hose and air cleaner assembly.
   1) Disconnect the AFS connector.
   2) Disconnect the breather hose from air cleaner hose.
   3) Disconnect the ECM connector. (See FL group)
   4) Remove the intake air hose and air cleaner(A).



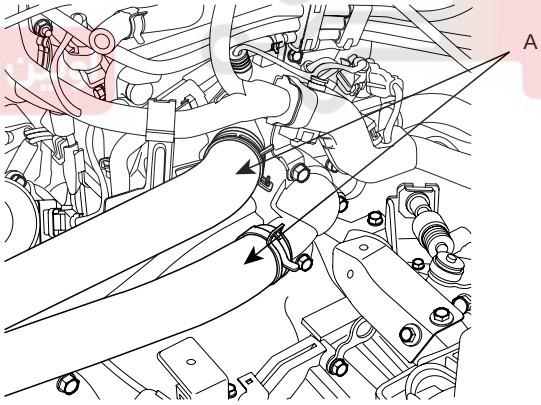
KMRE009A

5. Remove front wheels.
6. Remove under cover(A).



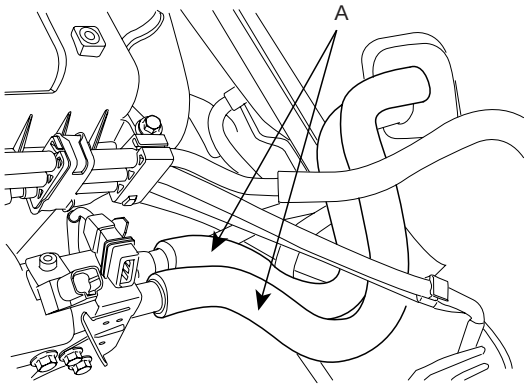
KMRE009H

7. Drain the engine coolant.
   Remove the radiator cap to speed draining.
8. Remove the upper radiator hose and lower radiator hose(A).



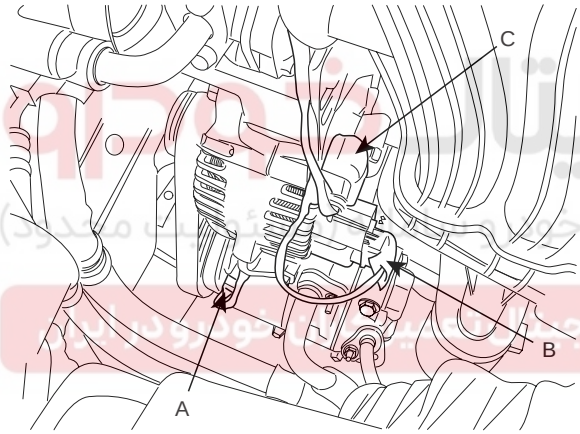
KCRF124A

9. Remove the heater hoses(A).



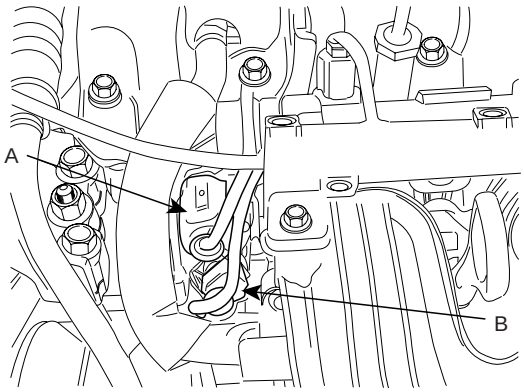
KCRF133A

10. Disconnect A/C switch(A), alternator connector(B) and pressure switch(C).



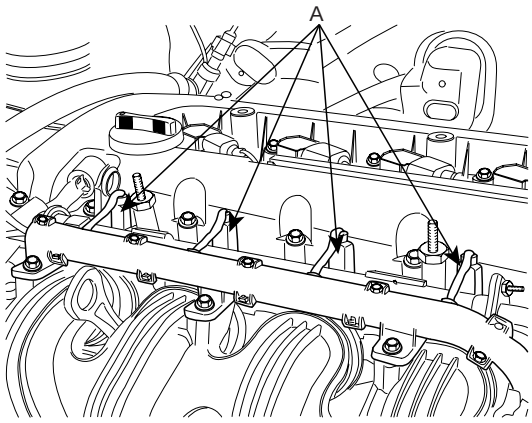
KCRF126A

11. Disconnect OCV connector(A) and OTS connector(B).



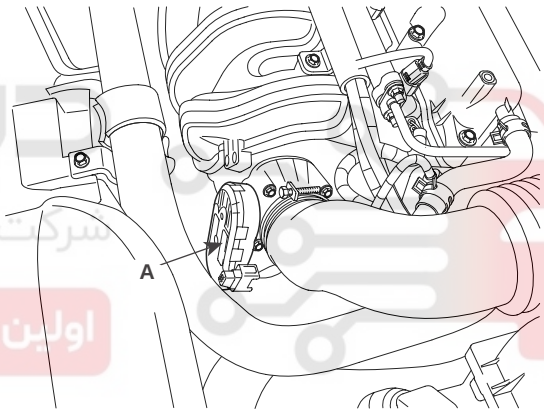
KCRF127A

12. Disconnect injector connectors(A).



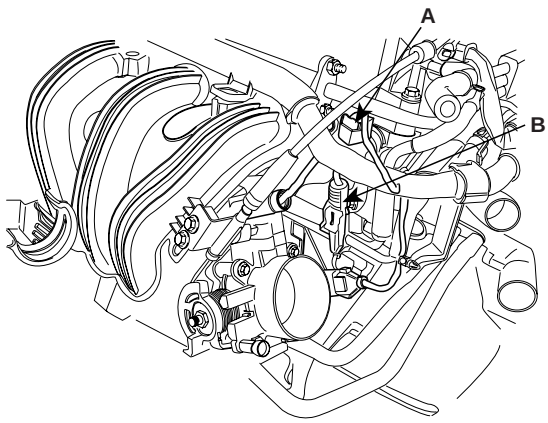
KCRF128A

13. Disconnect ETS connector(A)



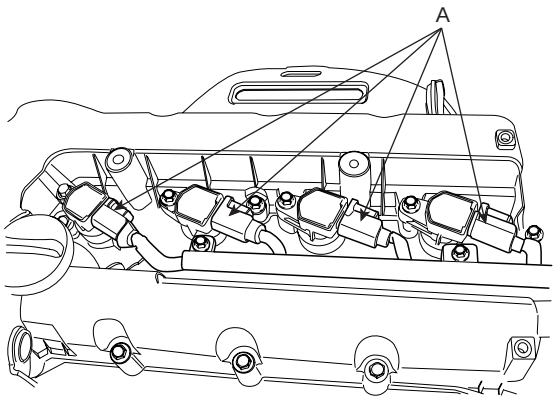
ECRF032A

14. Disconnect CMP connector(A), and knock sensor connector(B).



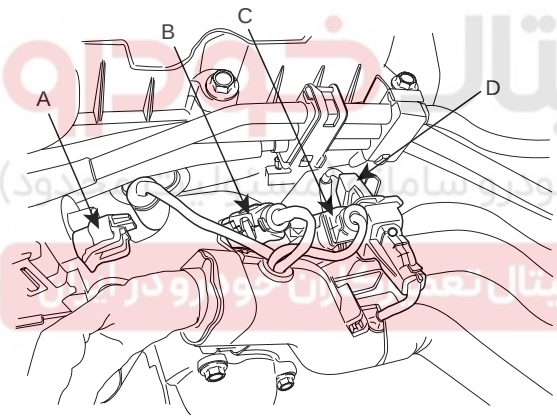
ECRF029A

15. Disconnect ignition coil connectors(A).



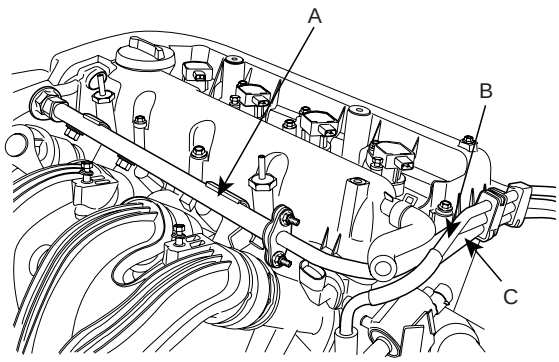
KCRF131A

16. Disconnect PCSV connector(A), WTS connector(B), condenser connector(C), and CKP sensor connector(D).



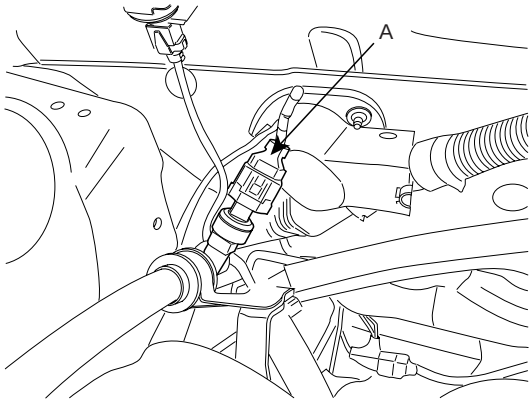
KCRF132A

17. Remove delivery pipe(A), brake vacuum hose(B), and PCSV hose(C).



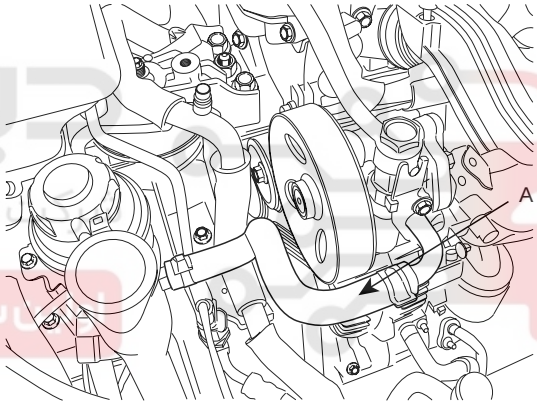
KCRF134A

18. Disconnect P/S pump oil pressure switch connector(A).



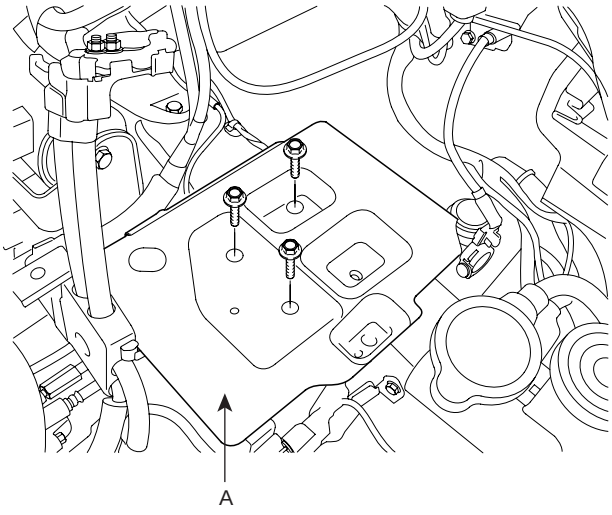
KCRF135A

19. Remove P/S pump hose(A).



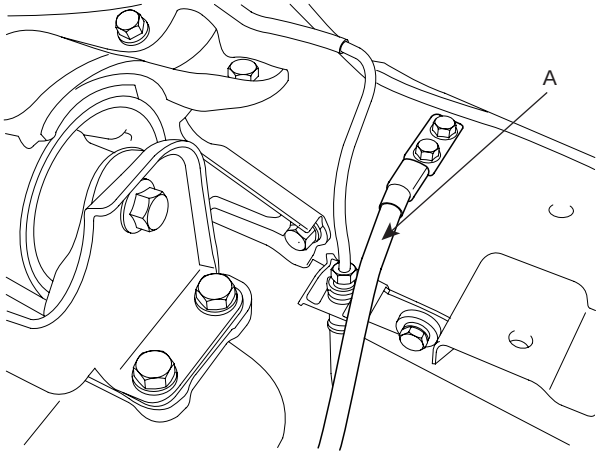
KCRF136A

20. Remove the battery body bracket.(A).



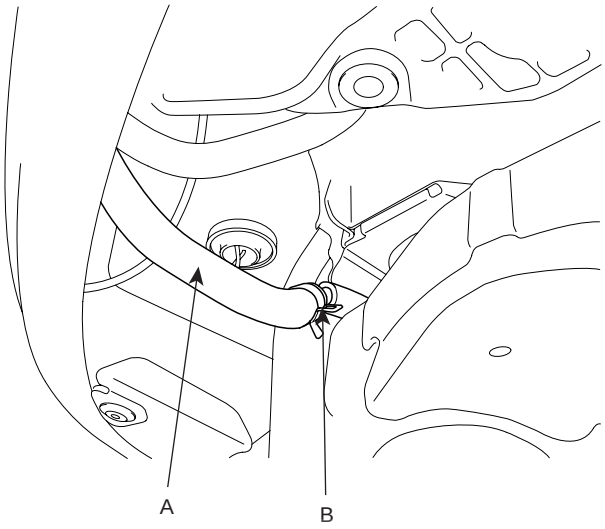
KMRE009B

21. Disconnect the ground cable from the transaxle.



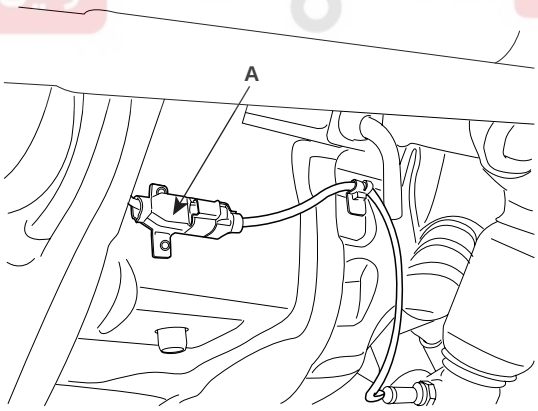
KMRE009C

22. Disconnect the transaxle wire harness connector. (A/T).
    a. Disconnect the inhibitor switch connector.
    b. Disconnect the transaxle range connector.
    c. Disconnect the input shaft speed connector.
    d. Disconnect the output shaft speed connector.
    e. Disconnect the vehicle speed sensor connector.
    f. Remove control cable transaxle range switch.
23. Drain transaxle oil.
24. Disconnect EPS connector. (See ST group)
25. Remove lower arm ball joint. (SeeDS group)
26. Remove tile rod end ball joint. (See DS group)
27. Remove stabilizer link. (See SS group)
28. Remove power steering return hose(A) and drain power steering oil.



KMRE009J

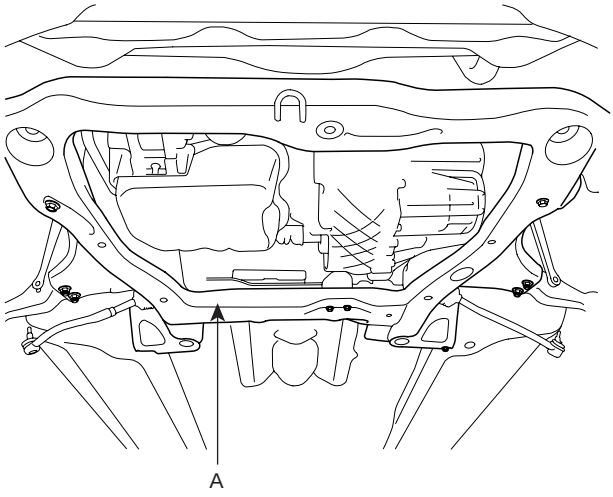
29. Remove front roll stopper mounting bolt.
30. Remove rear roll stopper mounting bolt.
31. Remove steering u-joint mounting (See ST group)
32. Disconnect oxygen sensor connetor(A).



ECRF018A

33. Remove front exhaust pipe.

34. Install jack and remove sub-frame(A).

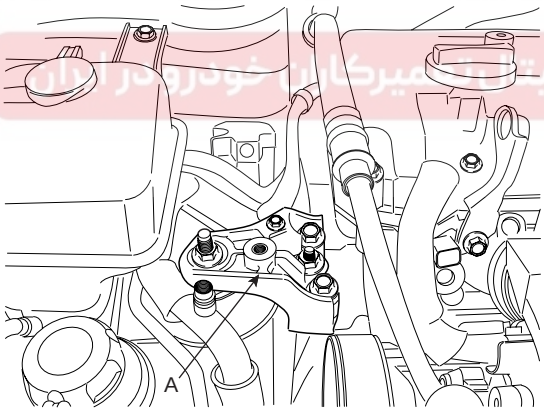


KMRE009R

35. Remove drive shaft from transaxle.

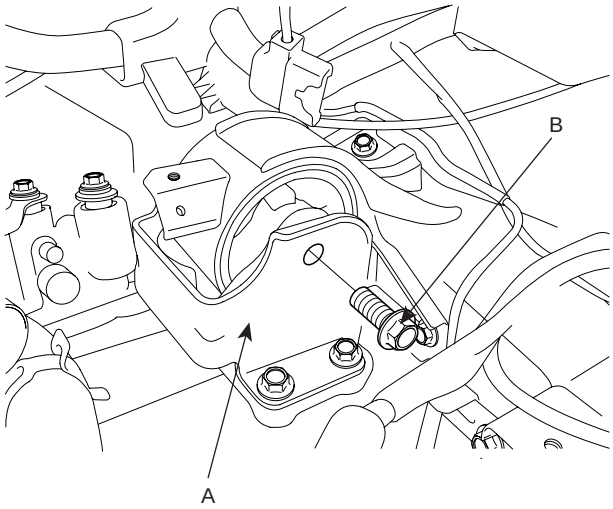
36. Install jack for supporting engine and transaxle assembly.

37. Remove the engine mounting bracket(A).



KCRF137A

38. Remove the transaxle mounting bracket(A).



KMRE009T

39. Jack up the vehicle.

INSTALLATION E2B2CFC8

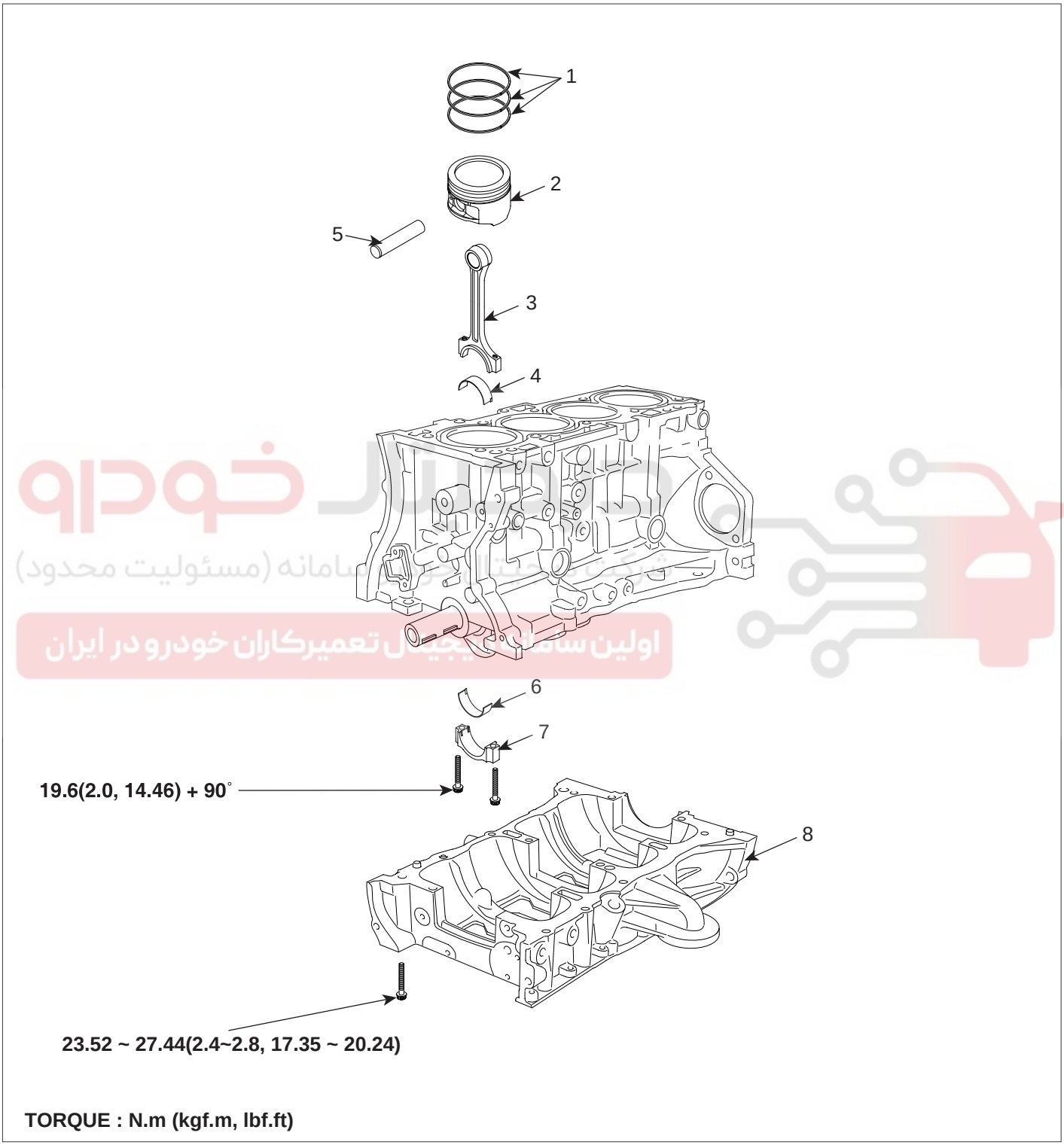
Installation is in the reverse order of removal.

Perform the following :

- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
  After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressureizes.
  Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

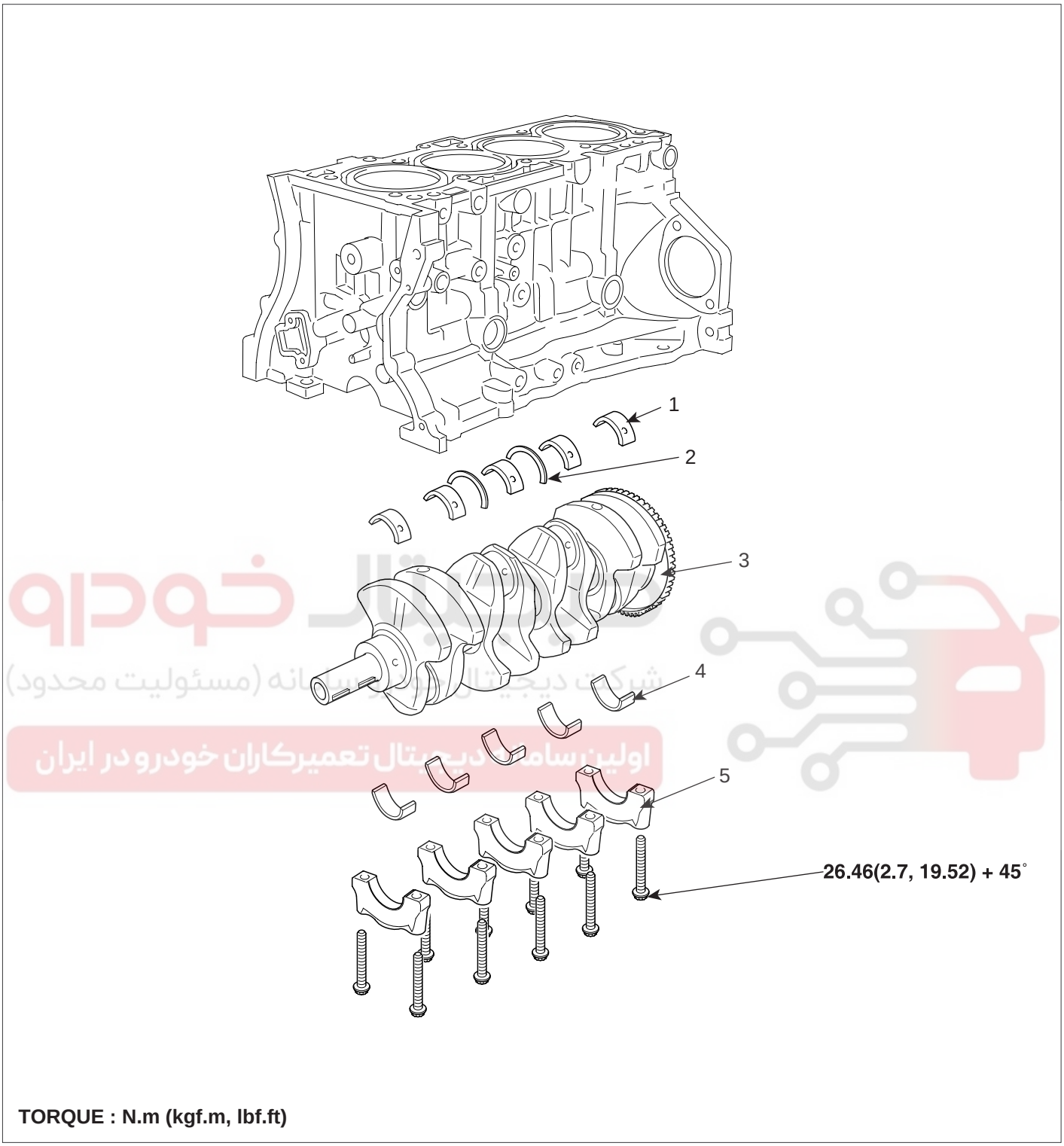
ENGINE BLOCK

COMPONENTS E4334AB3



1. Piston ring
2. Piston
3. Connecting rod
4. Connecting rod upper bearing
5. Piston pin
6. Connecting rod lower bearing
7. Connecting rod bearing cap
8. Ladder frame

ECRF019A



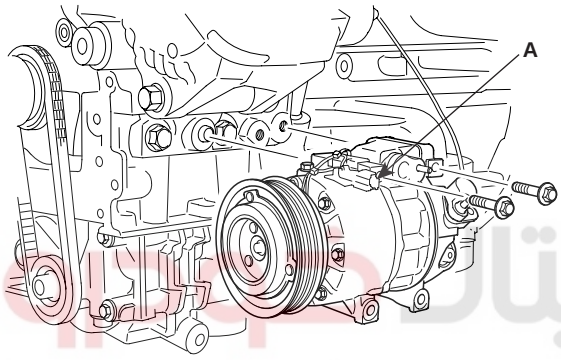
TORQUE : N.m (kgf.m, lbf.ft)

1. Crankshaft upper bearing
2. Thrust bearing
3. Crankshaft
4. Crankshaft lower bearing
5. Main bearing cap

ECRF020A

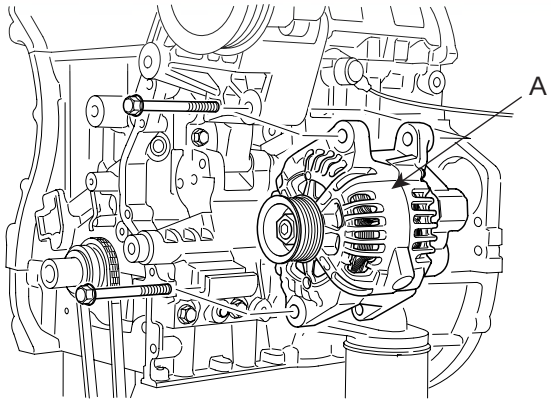
DISASSEMBLY ECC1D070

1. M/T : remove flywheel.
2. A/T : remove drive plate.
3. Install engine to engine stand for disassembly.
4. Remove timing chain. (See page EM - 18)
5. Remove cylinder head. (See page EM - 32)
6. Remove A/C compressor(A) from engine. (See HA group)



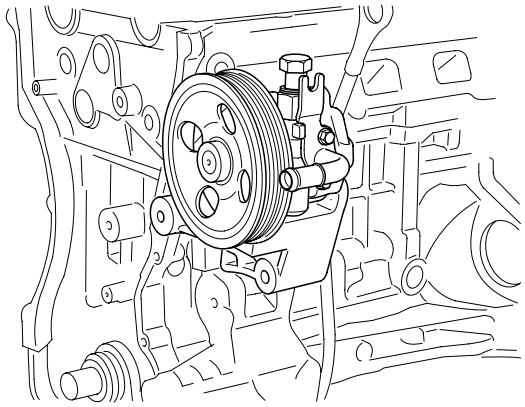
KCRF158A

7. Remove alternator(A) from engine. (See EE group)



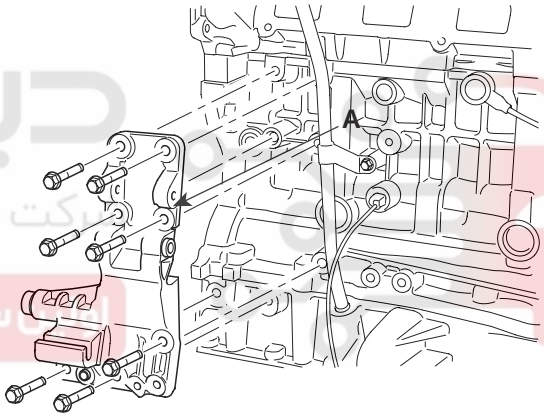
KCRF159A

8. Remove power steering pump and bracket. (See ST group)



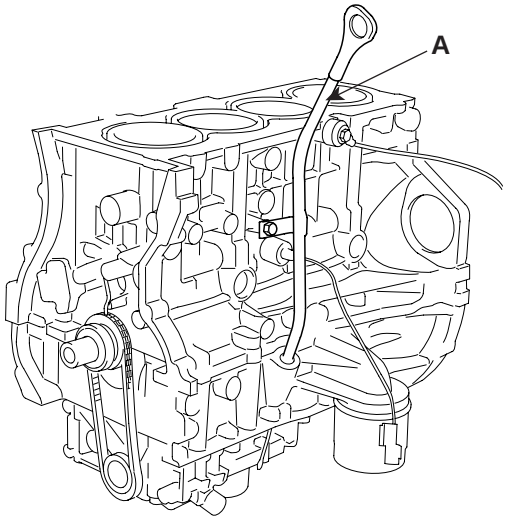
KCRF160A

9. Remove tensioner assembly integrated bracket(A).



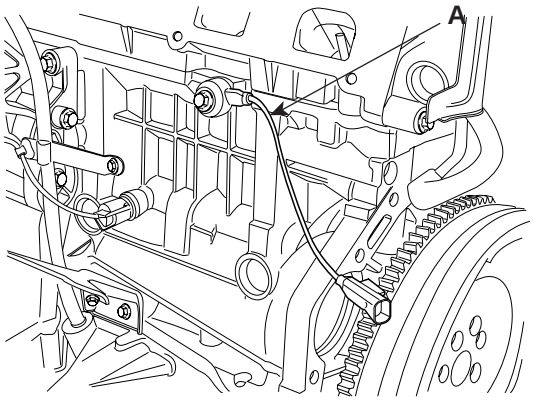
KCRF161A

10. Remove oil level gauge assembly(A).



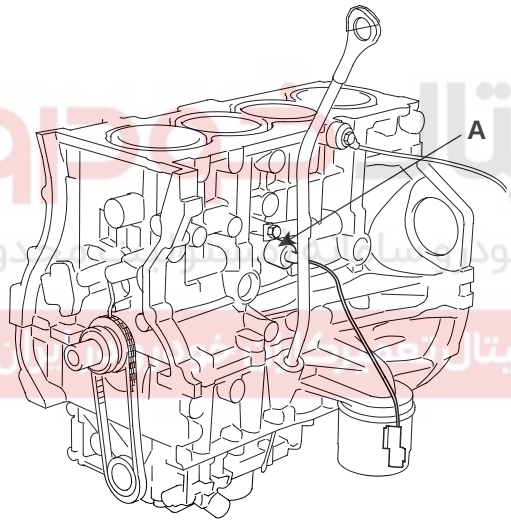
KCRF163B

11. Remove knock sensor(A).



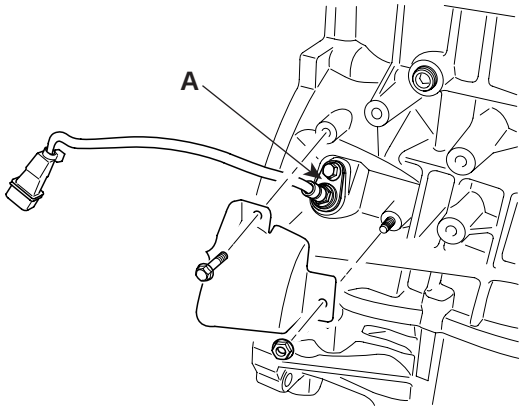
KCRF143A

12. Remove oil pressure sensor(A).



KCRF163C

13. Remove CKP sensor(A).

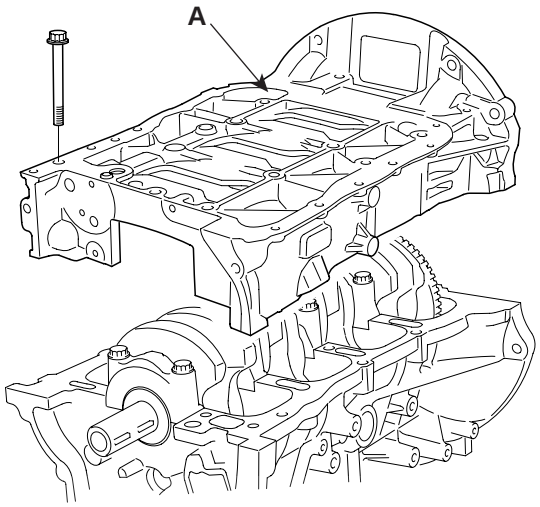


KCRF164A

14. Remove water pump. (See page EM - 76)

15. Remove balance shaft module. (See page EM - 81)

16. Remove ladder frame(A).



KCRF167A

17. Check the connecting rod end play. (See page EM - 58)

18. Remove the connecting rod caps and check oil clearance. (See page EM - 59)

19. 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.

NOTE

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

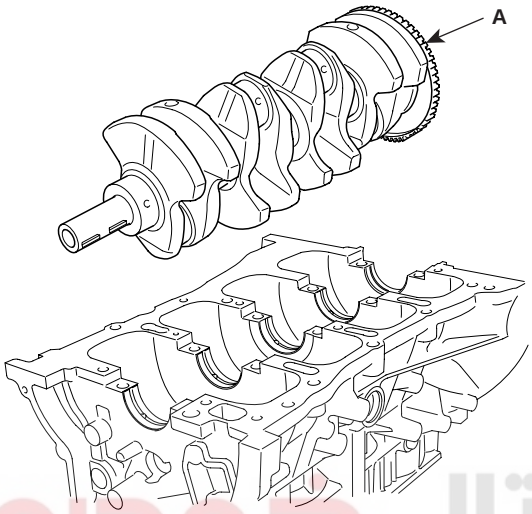
20. Remove crankshaft bearing cap and check oil clearance. (See page EM - 61)

21. Check the crankshaft end play. (See page EM - 63)

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

NOTE

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



KCRF172A

23. 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.
24. Remove piston rings.
    1) Using a piston ring expender, remove the 2 compression rings.
    2) Remove 2 side rails and the spacer by hand.

NOTE

Arrange the piston rings in the correct order only.

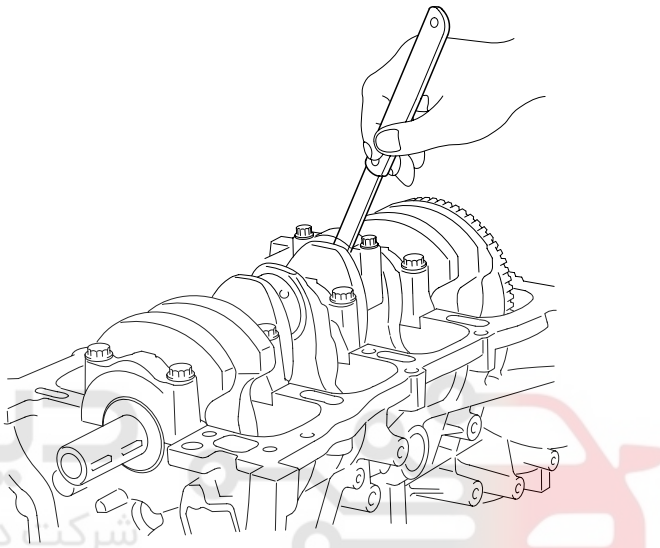
25. Disconnect connecting rod from piston.

INSPECTION E29CBA34

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.) Maximum end play : 0.35mm(0.0138in.)



KCRF169B

- If out-of-tolerance, install a new connecting rod.
- If still out-of-tolerance, replace the crankshaft.

2. Check the connecting road 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 19.6Nm (2.0kgf.m, 14.46lbf.ft) + 90°

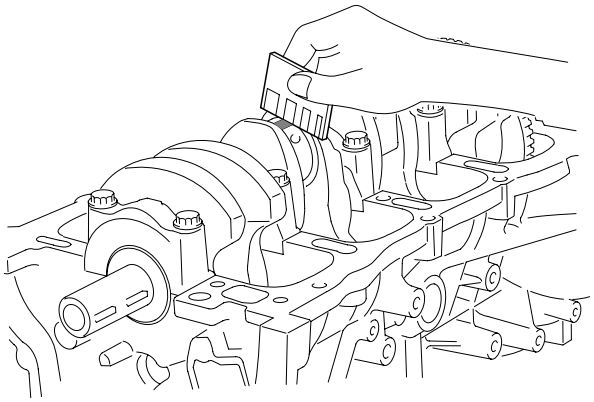
NOTE

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
0.028 ~ 0.046mm(0.0011 ~ 0.0018in.)



KCRF169A

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.

CAUTION

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

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

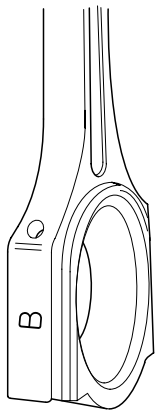
NOTE

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

CAUTION

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

CONNECTING ROD MARK LOCATION

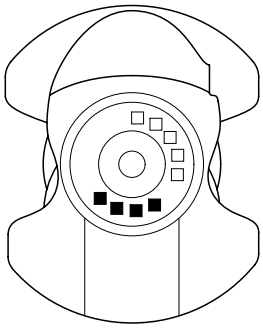


EDQF196A

DISCRIMINATION OF CONNECTING ROD

CLASS	MARK	INSIDE DIAMETER
a	A	51.000 ~ 51.006mm (2.0079 ~ 2.0081in.)
b	B	51.006 ~ 51.012mm (2.0081 ~ 2.0083in.)
c	C	51.012 ~ 51.018mm (2.0083 ~ 2.0085in.)

CRANKSHAFT PIN MARK LOCATION DISCRIMINATION OF CRANKSHAFT

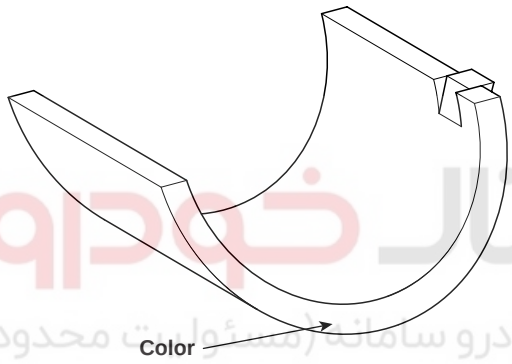


ACGE063Z

DISCRIMINATION OF CRANKSHAFT

CLSASS	MARK	OUTSIDE DIAMETER OF PIN
I	1	47.966 ~ 47.972mm (1.8884 ~ 1.8886in.)
II	2	47.960 ~ 47.966mm (1.8881 ~ 1.8884in.)
III	3	47.954 ~ 47.960mm (1.8879 ~ 1.8881in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING) DISCRIMINATION OF CONNECTING ROD BEARING



ECRF021A

DISCRIMINATION OF CONNECTING ROD BEARING

CLASS	MARK	THICKNESS OF BEARING
AA	BLUE	1.514 ~ 1.517mm (0.0596 ~ 0.0597in.)
A	BLACK	1.511 ~ 1.514mm (0.0595 ~ 0.0596in.)
B	NONE	1.508 ~ 1.511mm (0.0594 ~ 0.0595in.)
C	GREEN	1.505 ~ 1.508mm (0.0593 ~ 0.0594in.)
D	YELLOW	1.502 ~ 1.505mm (0.0591 ~ 0.0593in)

11) Selection

CRANKSHAFT INDENTIFICATION MARK	CONNECT-ING ROD IDENTIFICA-TION MARK	ASSEMBING CLASSIFI-CATION OF BEARING
I (1)	a (A)	D (YELLOW)
	b (B)	C (GREEN)
	c (C)	B (NONE)
II (2)	a (A)	C (GREEN)
	b (B)	B (NONE)
	c (C)	A (BLACK)
III (3)	a (A)	B (NONE)
	b (B)	A (BLACK)
	c (C)	AA (BLUE)

3. Check the crankshaft bearing oil clearance.

   1) To check main bearing-to-journal oil clearance, remove the main caps and bearing halves.

   2) Clean each main journal and bearing half with a clean shop tower.

   3) Place one strip of plastigage across each main journal.

   4) Reinstall the bearings and caps, then torque the bolts.

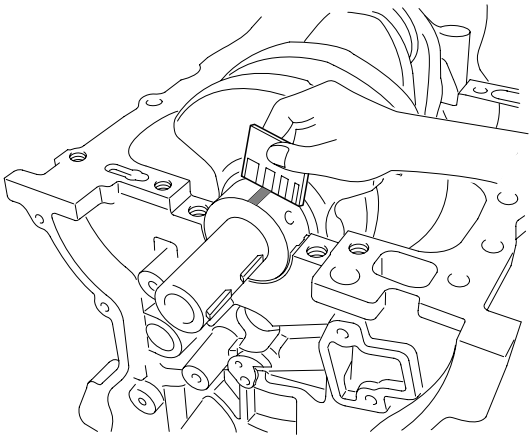
Tightening torque
26.46Nm (2.7kgf.m, 19.52lbf.ft) + 45°

NOTE

Do not turn the crankshaft.

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

Standard oil clearance
0.026 ~ 0.048mm (0.0010 ~ 0.0019in.)



KCRF170A

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.

CAUTION

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.

NOTE

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

CAUTION

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

CONNECTING 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.

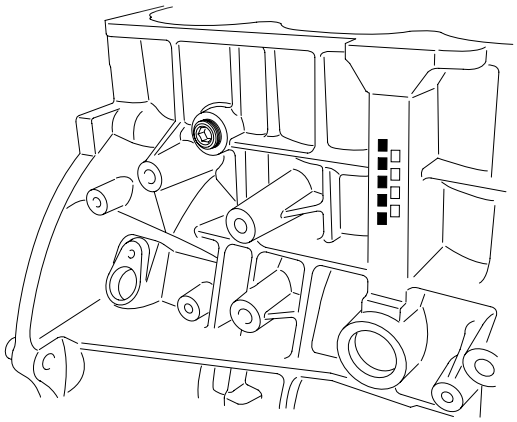
3. Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

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

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.

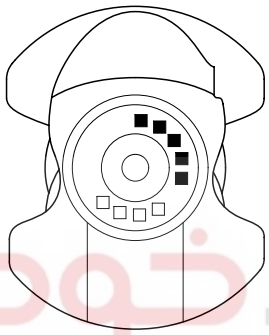


KCRF175C

DISCRIMINATION OF CYLINDER BLOCK

CALSS	MARK	INSIDE DIAMETER
a	A	56.000 ~ 56.006mm (2.2047 ~ 2.2049in.)
b	B	56.006 ~ 56.012mm (2.2049 ~ 2.2052in.)
c	C	56.012 ~ 56.018mm (2.2052 ~ 2.2054in.)

CRANKSHAFT JOURNAL MARK LOCATION DISCRIMINATION OF CRANKSHAFT

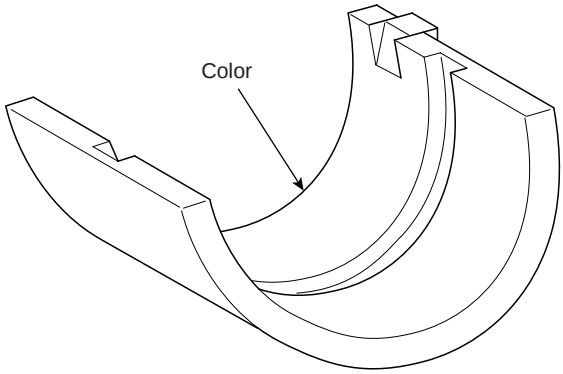


ACGE084Z

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	1	51.954 ~ 51.960mm (2.0454 ~ 2.0456in.)
II	2	51.948 ~ 51.954mm (2.0452 ~ 2.0454.)
III	3	51.942 ~ 51.948mm (2.0449 ~ 2.0452in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING) DISCRIMINATION OF CRANKSHAFT BEARING



ECRF022A

DISCRIMINATION OF CRANKSHAFT BEARING

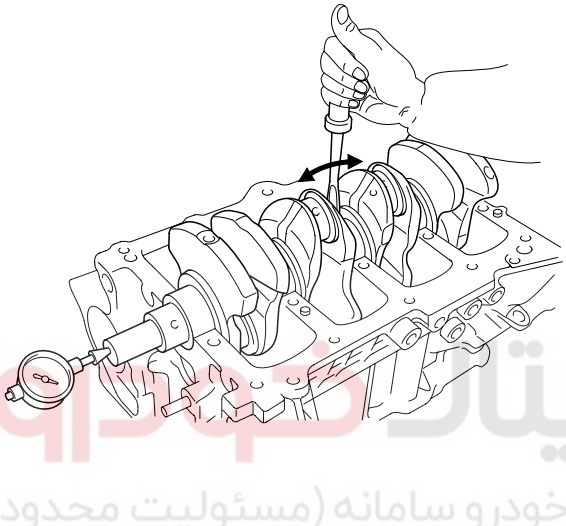
CLASS	MARK	THICKNESS OF BEARING
AA	BLUE	2.026 ~ 2.029mm (0.0797 ~ 0.0798in.)
A	BLACK	2.023 ~ 2.026mm (0.0796 ~ 0.0797in.)
B	NONE	2.020 ~ 2.023mm (0.0795 ~ 0.0796in.)
C	GREEN	2.017 ~ 2.020mm (0.0794 ~ 0.795in.)
D	YELLOW	2.014 ~ 2.017mm (0.0793 ~ 0.0794in.)

SELECTION

CRANKSHAFT IDENTIFICATION MARK	CRANK-SHAFT BORE IDENTIFICA-TION MARK	ASSEM-BLING CLAS-SIFICATION OF BEARING
I (1)	a (A)	D (YELLOW)
	b (B)	C (GREEN)
	c (C)	B (NONE)
II (2)	a (A)	C (GREEN)
	b (B)	B (NONE)
	c (C)	A (BLACK)
III (3)	a (A)	B (NONE)
	b (B)	A (BLACK)
	c (C)	AA (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
0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)
Limit : 0.30mm (0.0118in.)



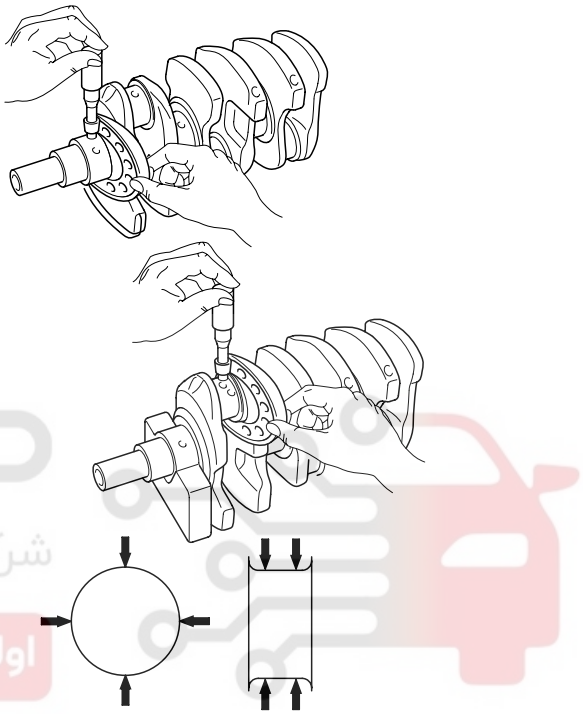
ECKD001B

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

Thrust bearing thickness
1.925 ~ 1.965mm(0.0758 ~ 0.07736in.)

5. Inspect main journals and crank pins
   Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter : 51.942 ~ 51.960mm
(2.0449 ~ 2.0456in.)
Crank pin diameter : 47.954 ~ 47.972mm
(1.8879 ~ 1.8886in.)



ECKD001E

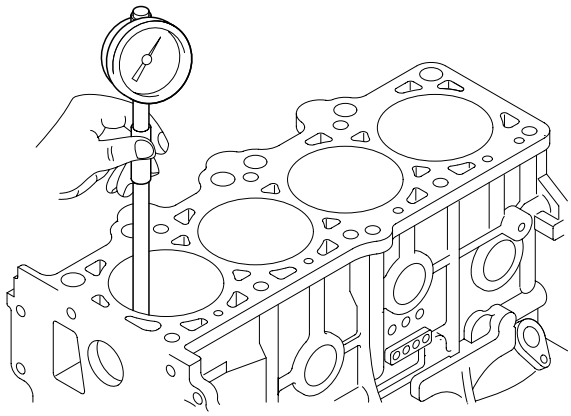
CYLINDER BLOCK

1. Remove gasket material.
   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

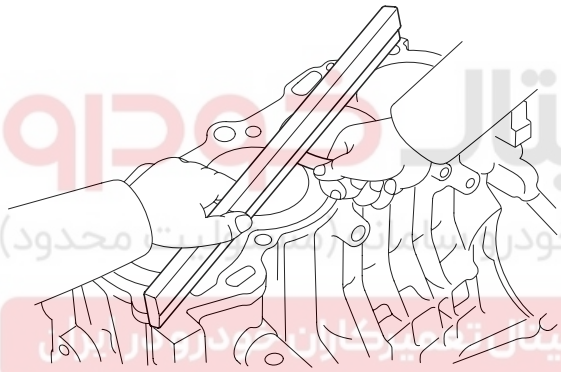
2. Clean cylinder block
   Using a soft brush and solvent, thoroughly clean the cylinder block.

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.)



ECKD318A



ECKD001L

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

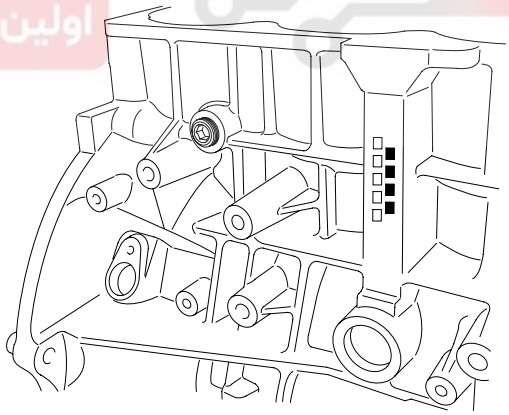
5. Inspect cylinder bore diameter
   Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial directions.

Standard diameter
88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)

NOTE

Measure position(from the bottom of the cylinder block)
:
110.7mm(4.3582in.)/160mm(6.2992in.)/210mm(8.2677in.)

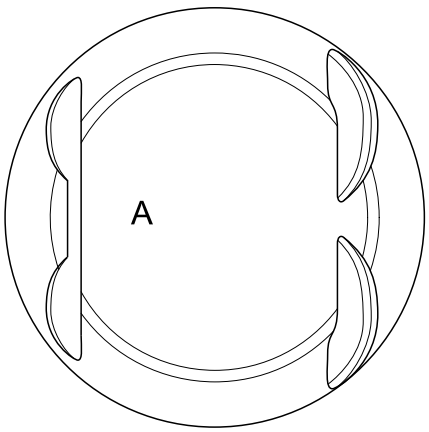
6. Check the cylinder bore size code on the cylinder block.



KCRF175B

Class	Cylinder bore inner diameter	Size code
A	88.00 ~ 88.01mm (3.4645~ 3.4649in.)	A
B	88.01 ~ 88.02mm (3.4649~ 3.4653in.)	B
C	88.02 ~ 88.03mm (3.4653~ 3.4657in.)	C

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



ECKE320B

NOTE

Stamp the grade mark of basic diameter with rubber stamp.

Class	Piston outer diameter	Size code
A	87.97 ~ 87.98mm (3.4633 ~ 3.4637in.)	A
B	87.98 ~ 87.99mm (3.4637 ~ 3.4641in.)	None
C	87.99 ~ 88.00mm (3.4641 ~ 3.4645in.)	C

8. Select the piston related to cylinder bore class.

Clearance : 0.02 ~ 0.04mm (0.00078 ~ 0.00157in.)

Boring cylinder

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

Identification Mark	Size
0.25	0.25mm (0.010in.)
0.50	0.50mm (0.020in.)

NOTE

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

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

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

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

CAUTION

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

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

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

NOTE

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

PISTON AND 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.

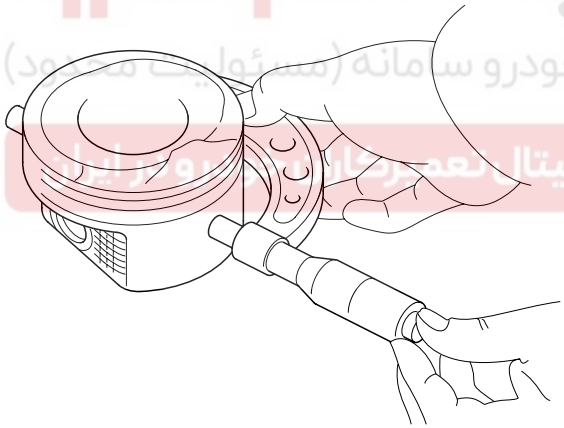
   3) Using solvent and a brush, thoroughly clean the piston.

   NOTE

   Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 47 mm (1.85 in.) from the top land of the piston.

Standard diameter
87.97 ~ 88.00mm (3.4633~ 3.4645in.)



ECKD001D

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

Piston-to-cylinder clearance
0.02 ~ 0.04mm(0.0008 ~ 0.0016in.)

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.)

ECKD001G

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 on page EM - 64 If the bore is over the service limit, the cylinder block must be rebored. (See page EM - 65)

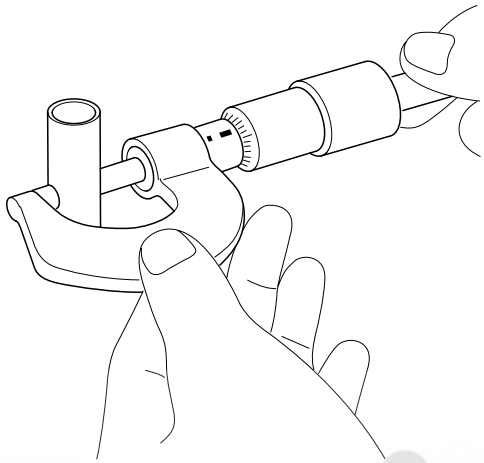
Piston ring end gap
Standard
No.1 : 0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)
No.2 : 0.30 ~ 0.45m (0.0118 ~ 0.0177in.)
Oil ring : 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)
Limit
No.1 : 0.6mm (0.0236in.)
No.2 : 0.7mm (0.0275in.)
Oil ring : 0.8mm (0.0315in.)

ECKD001K

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter
21.001 ~ 21.006mm (0.8268 ~ 0.8270in.)



ECKD001Z

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

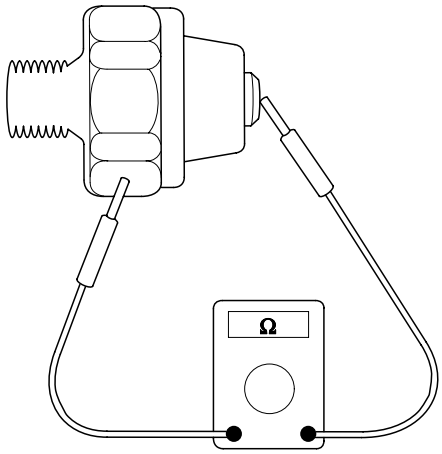
Piston pin-to-piston clearance
0.01 ~ 0.02mm (0.0004 ~ 0.0008in.)

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

Piston pin-to-connecting rod interference
0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)

OIP PRESSURE SWITCH

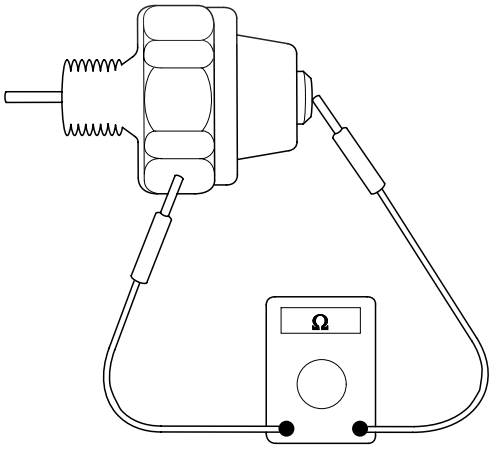
1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no continuity, replace the oil pressure switch.



ECKD001W

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

3. If there is no continuity when a 50kpa (7psi) vacuum is applied throgh the oil hole, the switch is operaing properly.
Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



ECKD001Y

REASSEMBLY E611FEC0

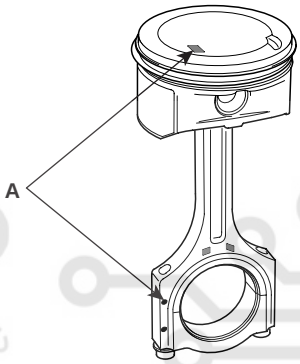
NOTE

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

1. Assemble 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.



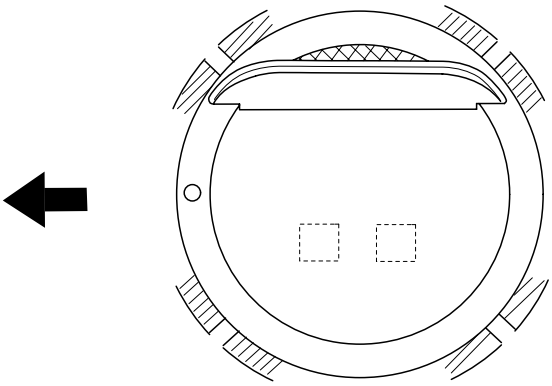
KCRF168A

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.

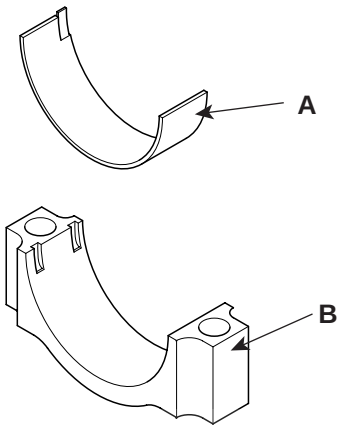


ECKD321A

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).



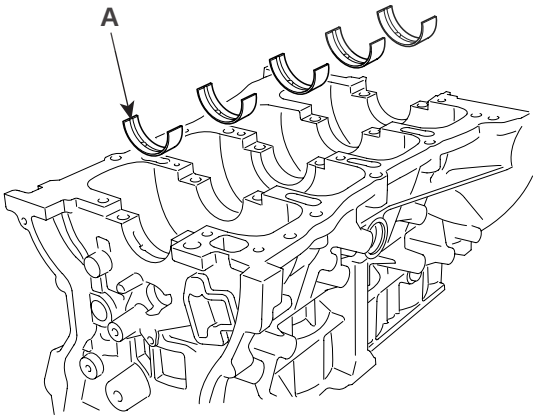
KCRF118B

4. Install main bearings.

   NOTE

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

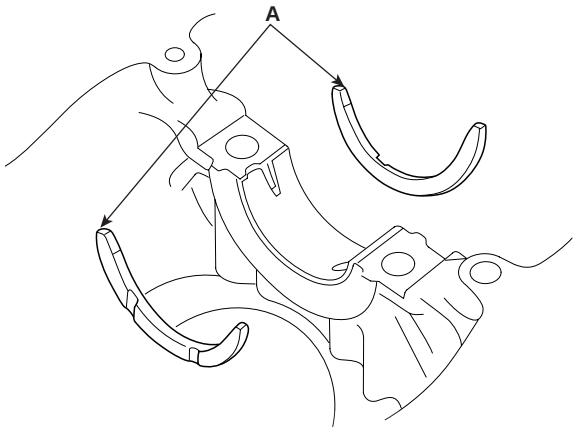
   1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).



KCRF173A

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

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.



ECKD324A

6. Place crankshaft on the cylinder block.

7. Place main bearing caps on cylinder block.

8. Install main bearing cap bolts.

Tightening torque
Main bearing cap bolt
26.46Nm (2.7kgf.m, 19.52lb.ft) + 45°

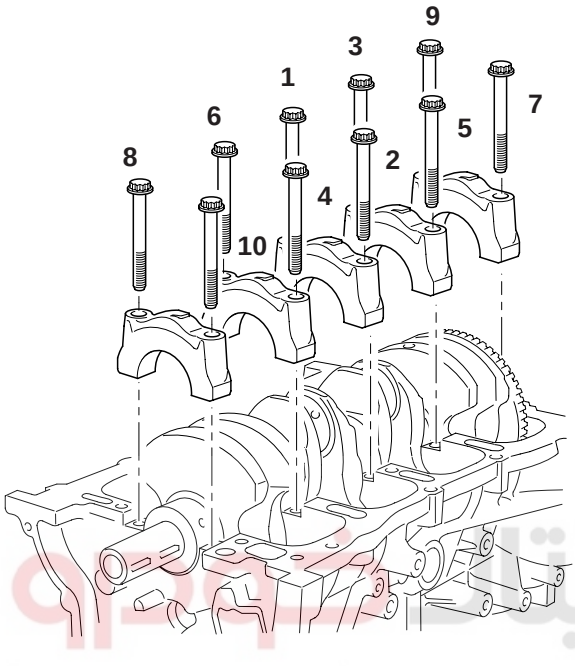
NOTE

- *The main bearing cap bolts are tightened in 2 progressive steps.*
- *If any of the bearing cap bolts in broken or deformed, replace it.*

   1) Apply a light coat of engine oil on the threads and under the bearing cap bolts.

2) Install and uniformly tighten the 10 bearing cap bolts(A), in several passes, in the sequence shown.

Tightening torque: 26.46Nm (2.7kgf.m, 19.52lbf.ft)



KCRF171A

3) Retighten the bearing cap bolts by 45° in the numerical order shown.

4) Check that the crankshaft turns smoothly.

9. Check crankshaft end play. (See page EM - 63)

10. Install piston and connecting rod assemblies.

NOTE

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

1) Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.

2) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.

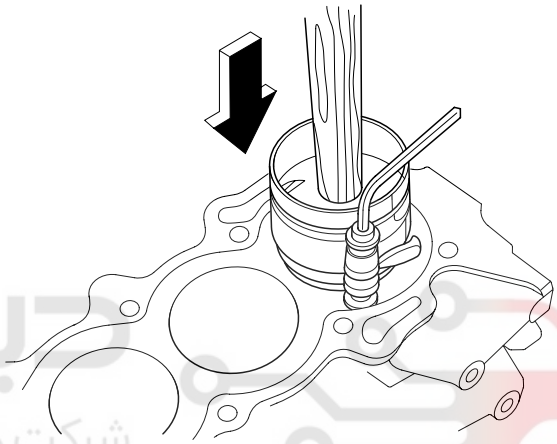
3) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.

4) Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque
19.6Nm (2.0kgf.m, 14.46lbf.ft) + 90°

NOTE

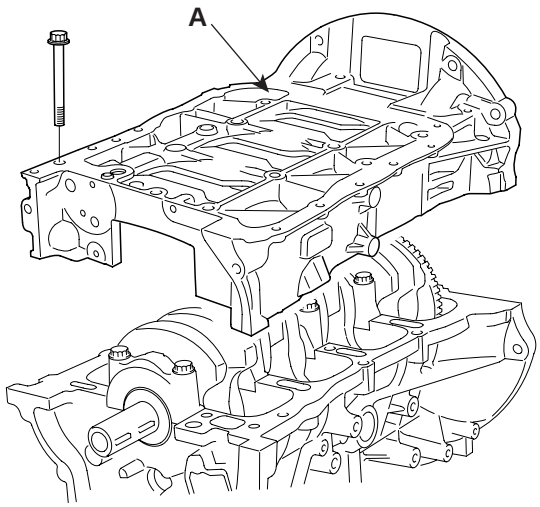
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

11. Install ladder frame(A) with 10 bolts.

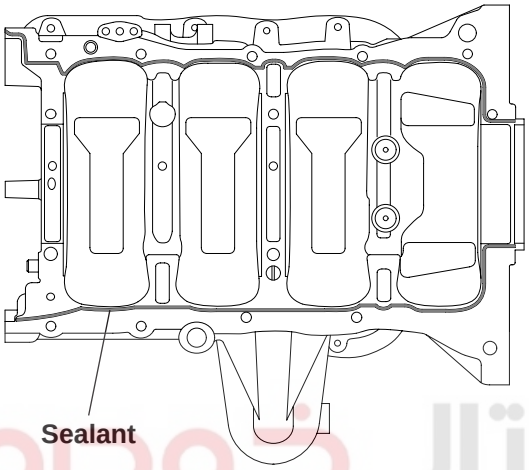
Tightening torque
23.52 ~ 27.44Nm (2.4 ~ 2.8kgf.m, 17.35 ~ 20.24lbf.ft)



KCRF167A

NOTE

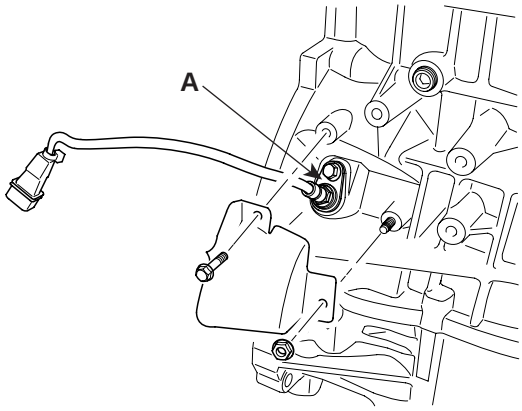
- *Be assembling ladder frame, the liquid sealant Loctite 5900 should be applied ladder frame.*
- *The part must be assembled within 5 minutes after sealant was applied.*
- *Apply sealant to the inner threads of the bolt holes.*



ECRF023A

12. Install rear oil seal.
    1) Apply engine oil to a new oil seal lip.
    2) Using SST(09231-H1100, 09214-3K100) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
13. Install balance shaft module. (See page EM - 81)
14. Install water pump. (See page EM - 78)
15. Install CKP sensor(A) and sensor cover.

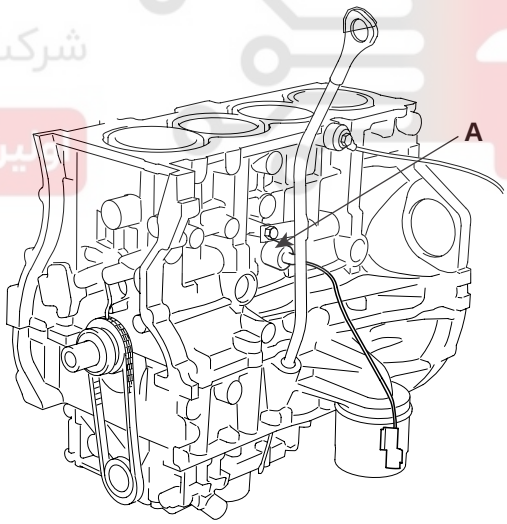
Tightening torque
3.92 ~ 5.88Nm (0.4 ~ 0.6kgf.m, 2.89 ~ 4.34lbf.ft)



KCRF164A

16. Install oil pressure sensor.
    1) Apply adhesive to 2 or 3 threads.
    Adhesive : MS 721-39(B) or equivalent.
    2) Install the oil pressure sensor (A).

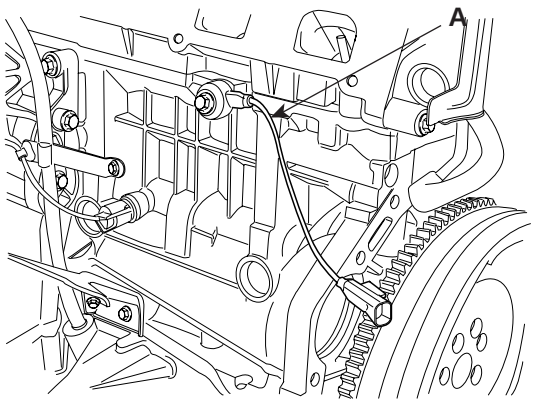
Tightening torque
7.84 ~ 11.76Nm (0.8 ~ 1.2kgf.m, 5.78 ~ 8.67lbf.ft)



KCRF163C

17. Install knock sensor(A).

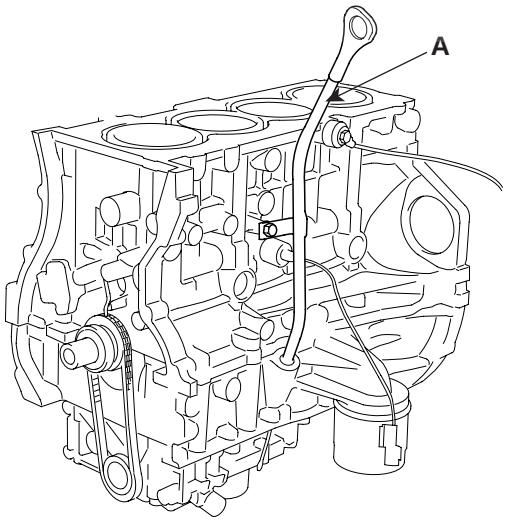
Tightening torque
16.66 ~ 25.48Nm (1.7 ~ 2.6kgf.m, 12.29 ~ 18.78lbf.ft)



KCRF143A

18. Install oil level gauge assembly.
    1) Install a new O-ring on the oil level gauge.
    2) Apply engine oil on the O-ring.
    3) Install the oil level gauge assembly(A) with the bolt.

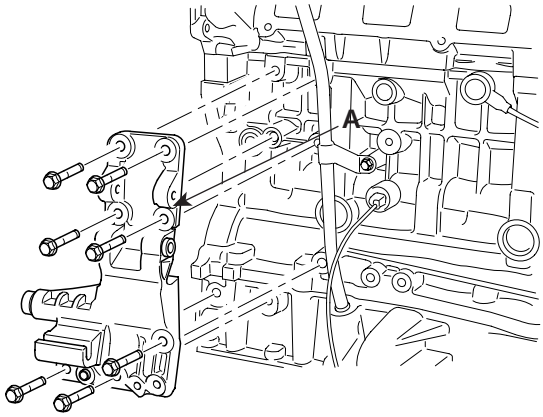
Tightening torque
7.84 ~ 11.76Nm (0.8 ~ 1.2kgf.m, 5.78 ~ 8.67lbf.ft)



KCRF163B

19. Install tensioner assembly integrated bracket(A).

Tightening torque
39.2 ~ 44.1Nm (4.0 ~ 4.5kgf.m, 28.92 ~ 32.53lbf.ft)



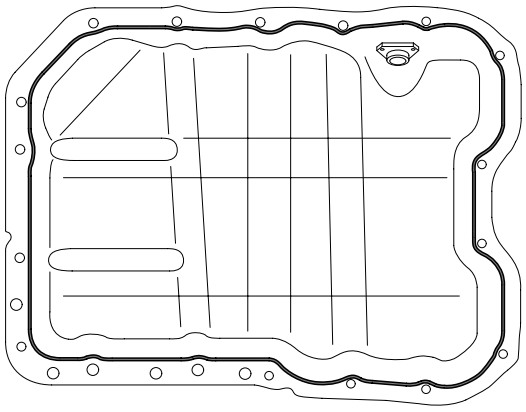
KCRF161A

20. Install power steering pomp bracket and power steering pump. (See ST group)
21. Install alternator. (See EE group)
22. Install A/C compressor. (See HA group)
23. Install cylinder head. (See page EM - 43)
24. Install timing chain. (See page EM - 23)
25. Install oil pan.
    1) Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

NOTE

Check that the mating surfaces are clean and dry before applying liquid gasket.

2) Apply liquid gasket as an even bead, centered between the edges of the mating surface.
Use liquid gasket LOCTITE5900 or equivalent(MS721-40A).



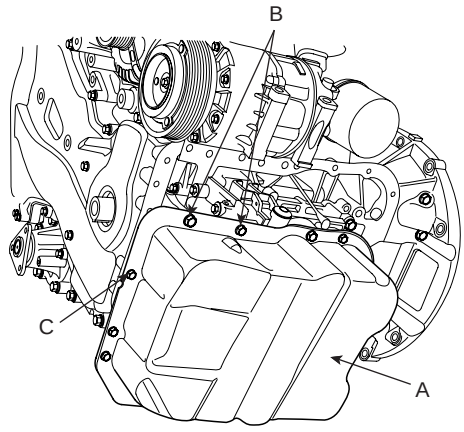
KCRF179A

NOTE

- *To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.*
- *Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

3) Install the oil pan(A).
Uniformly tighten the bolts in several passes.

Tightening torque
M8(B) : 26.46 ~ 30.38Nm (2.7 ~ 3.1kgf.m, 19.52 ~ 22.41lbf.ft)
M6(C) : 9.8 ~ 11.76Nm (1.0 ~ 1.2kgf.m, 7.23 ~ 8.67lbf.ft)



KCRF114B

26. Remove engine stand.

27. A/T : Install drive plate.

Tightening torque
117.6 ~ 127.4Nm (12 ~ 13kgf.m, 86.75 ~ 93.98lbf.ft)

28. M/T : Install flywheel.

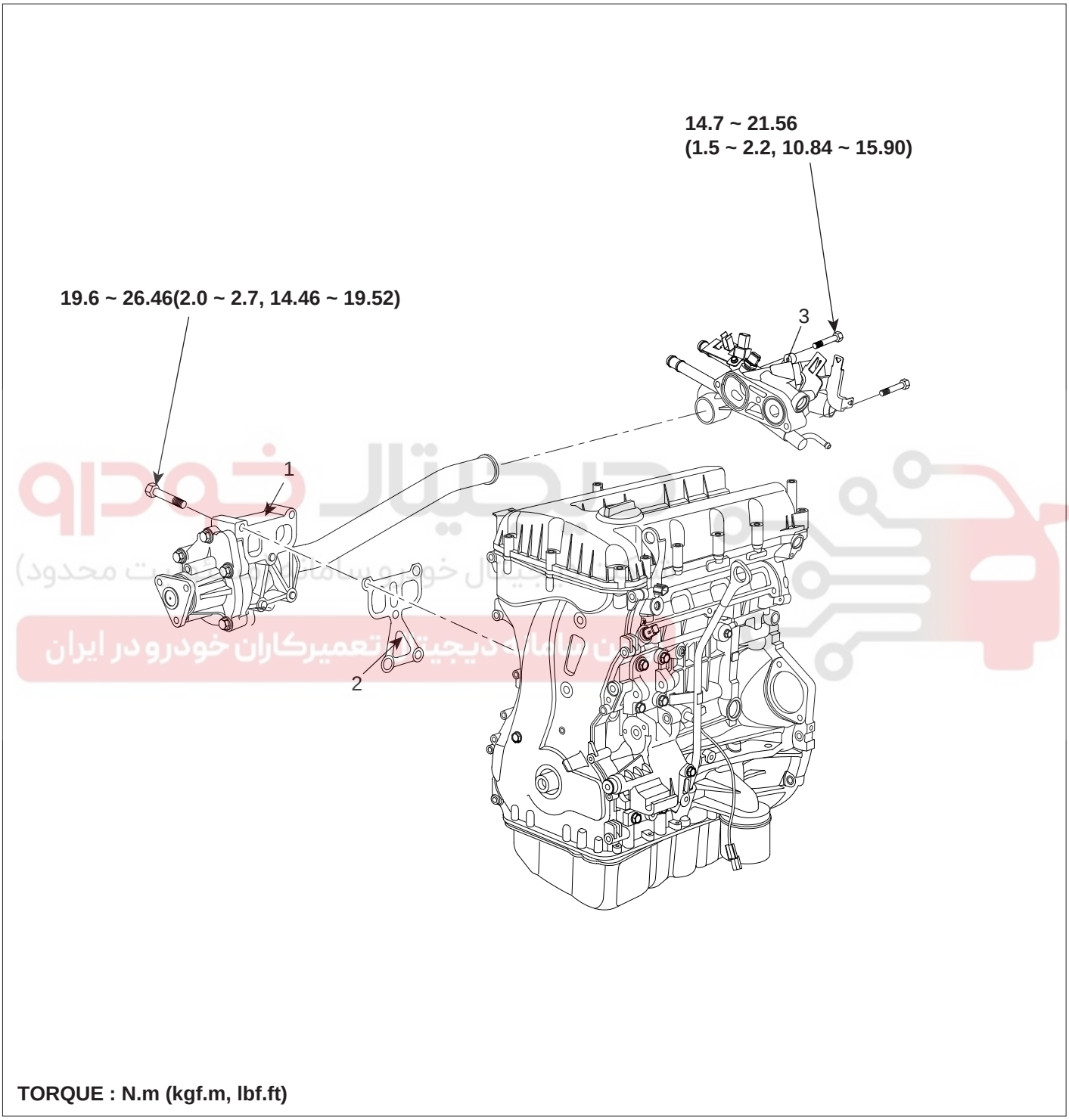
Tightening torque
117.6 ~ 127.4Nm (12 ~ 13kgf.m, 86.75 ~ 93.98lbf.ft)

NOTE

- *Always use new flywheel(drive plate) bolts.*
- *Install and uniformly tighten the 7 bolts, in several passes.*

COOLING SYSTEM

COMPONENT EAD71A6B



1. Water pump
2. Water pump gasket
3. Water temp control assembly

ECRF024A

ENGINE COOLANT REFILLING AND BLEEDING EA7427B9

WARNING

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

CAUTION

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

1. Make sure the engine and radiator are cool to the touch.
2. Remove radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
6. Fill fluid mixture with coolant and water(4 : 6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

NOTE

- *Use only genuine antifreese/coolant.*
- *For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum. Coolant concentrations less than 50% may not provide sufficient protection against corrosion or freezing.*
- *Coolant concentrations greater then 60% will impair cooling efficiency and are not recommended.*

CAUTION

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

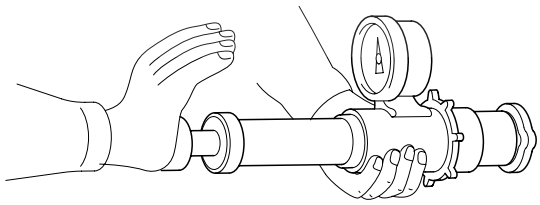
7. Start the engine and run coolant circulates. When the cooling fan operates and coolant curculates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
11. Stop the engine and wait coolant gets cool.
12. Repeat 6 to 11 until the coolant level doesn't fall any more, bleed air out of the cooling system.

NOTE

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.

CAP TESTING

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

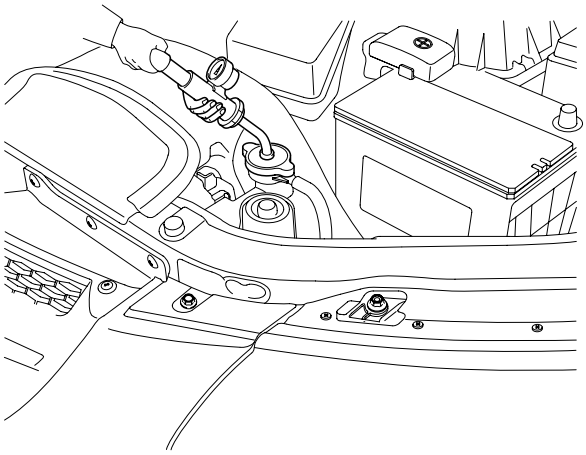


ECKD501X

2. Apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm², 14 ~ 19psi)
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

TESTING

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.



KCRF184A

2. Apply a pressure tester to the radiator and apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm² 14 ~ 18psi).
3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTE

Check for engine oil in the coolant and/or coolant in the engine oil.

REMOVAL EDFCAE62

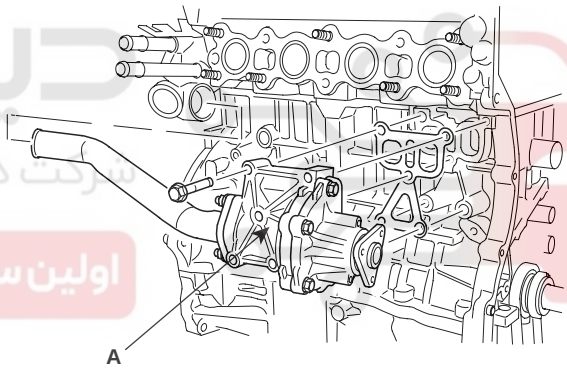
WATER PUMP

1. Drain the engine coolant.

WARNING

System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove drive belt.
3. Remove exhaust manifold. (See apge EM - 87)
4. Remove the water pump.
   1) Remove the 4 bolts and pump pulley.
   2) Remove the water pump(B) and gasket.



KCRF157A

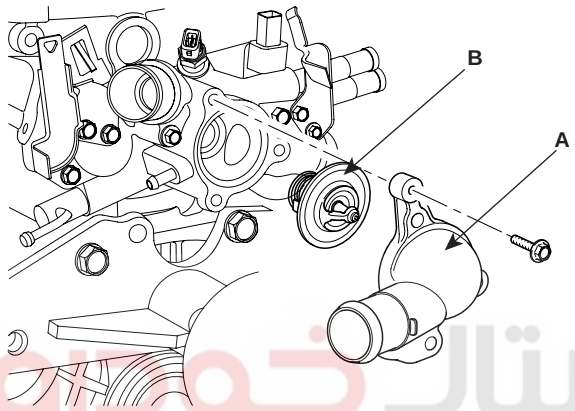
5. Remove water inlet pipe nut.

THERMOSTAT

NOTE

Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

1. Drain engine coolant so its level is below thermostat.
2. Remove water inlet(A) and thermostat(B).



KCRF123A

INSPECTION E463BFFA

WATER PUMP

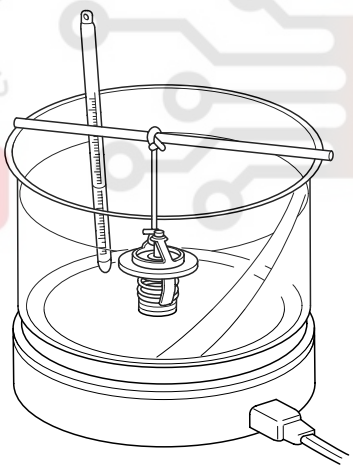
1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly

NOTE

A small amount of "weeping" from the bleed hole is normal.

THERMOSTAT

1. Immerse the thermostat in water and gradually heat the water.



ECKD503B

2. Check the valve opening temperature.

Valve opening temperature : 82°C (177°F) Full opening temperature : 95°C (205°F)

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

3. Check the valve lift.

Valve lift : 8mm (0.3in.) or more at 95°C (205°F)

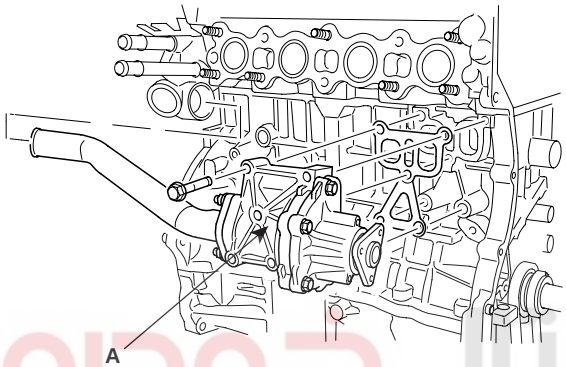
If the valve lift is not as specified, replace the thermostat.

INSTALLATION EF66AB7A

WATER PUMP

1. Install the water pump.
   1) Install the water pump(A) and a new gasket with the 5 bolts.

Tightening torque
19.6 ~ 26.46Nm (2.0 ~ 2.7kgf.m, 14.46 ~ 19.52lbf.ft)



KCRF157A

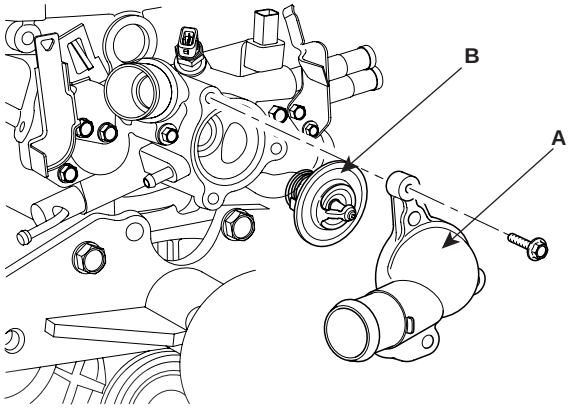
   2) Install the 4 bolts and pump pulley.
2. Install water inlet pipe nut.

Tightening torque
19.6 ~ 26.46Nm (2.0 ~ 2.7kgf.m, 14.46 ~ 19.52lbf.ft)

3. Install exhaust manifold. (See page EM - 87)
4. Install drive belt.
5. Fill with engine coolant.
6. Start engine and check for leaks.
7. Recheck engine coolant level.

THERMOSTAT

1. Place thermostat in thermostat housing.
   1) Install the thermostat with the jiggle valve upward.
   2) Install a new thermostat(B).



KCRF123A

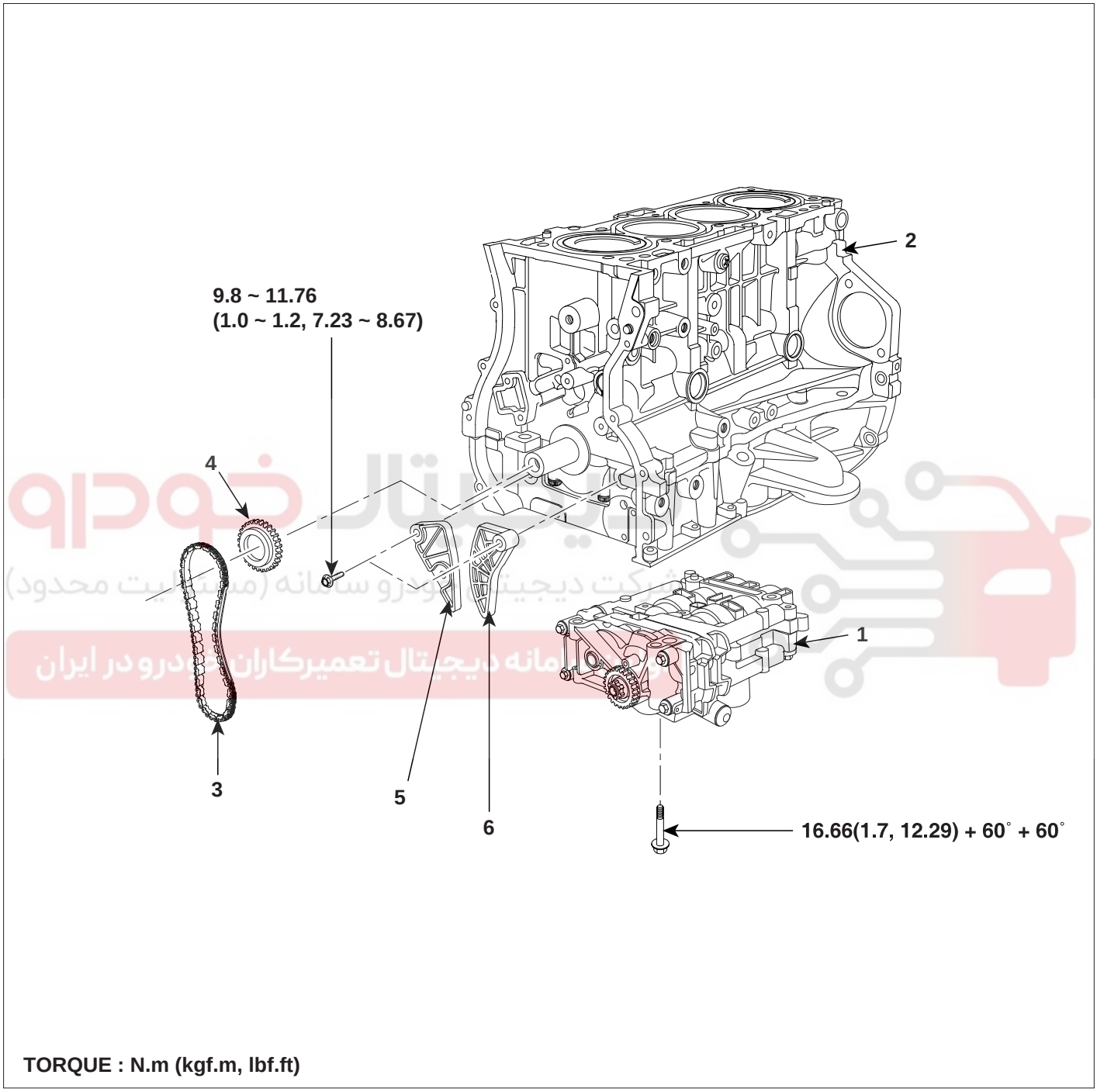
2. Install water inlet(A).

Tightening torque
14.7 ~ 21.56Nm (1.5 ~ 2.2kgf.m, 10.84 ~ 15.90lbf.ft)

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

LUBRICATION SYSTEM

COMPONENT EF78887C



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

1. Balance shaft module
2. Cylinder block
3. Balance shaft chain
4. Balance shaft chain sprocket
5. Balance shaft chain guide
6. Balance shaft chain tensioner arm

ECRF025A

OIL AND FILTER EC274EF9

CAUTION

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

1. Drain engine oil.
   a. Remove the oil filter cap.
   b. Remove the oil drain plug, and drain the oil into a container.
2. Replace oil filter.
   a. Remove the oil filter.
   b. Check and clean the oil filter installation surface.
   c. Check the part number of the new oil filter is as same as old one.
   d. Apply clean engine oil to the gasket of a new oil filter.
   e. Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

Tightening torque
11.76 ~ 15.68Nm (1.2 ~ 1.6kgf.m, 8.67 ~ 11.57lbf.ft)

3. Refill with engine oil filter.
   a. Clean and install the oil drain plug with a new gasket.

Tightening torque
39.2 ~ 44.1Nm (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lbf.ft)

   b. Fill with fresh engine oil

Capacity
Drain and refill
W/Oil filter change : 4.0l (4.23U.S.qts, 3.52lmp qts)
W/O Oil filter change : 3.7l (3.90U.S.qts, 3.26lmp qts)

   c. Install the oil filter cap.

4. Start engine and check for oil leaks.
5. Recheck engine oil level.

INSPECTION

1. Check engine oil quality
   Check the oil for deterioration, entry of water, discoloring or thinning.
   If the quality is visibly poor, replace the oil.

2. Check engine oil level.
   After warming up the engine and then 5 minutes after the engine stop, oil level should be between the " L" and " F" marks on the dipstick.
   If low, check for leakage and add oil up to the " F" mark.

NOTE

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

SELECTION OF ENGINE OIL

Recommended API classification : SJ OR ABOVE

Recommended SAE viscosity grades : 5W-20

NOTE

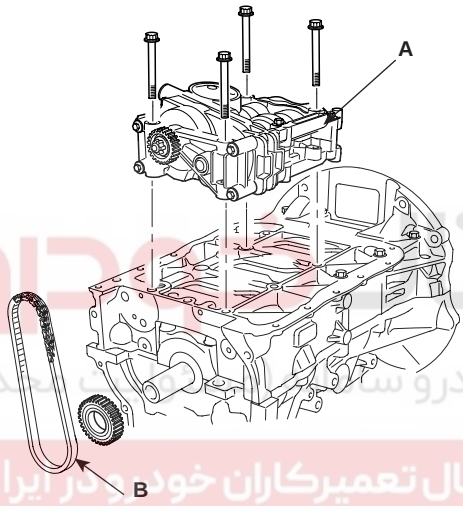
For best performance and maximum protection of all types of operation, select only those lubricants whitch :

- *Satisfy the requirement of the API classification.*
- *Have proper SAE grade number for expected ambient temperature range.*

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

REMOVAL E7F8189A

1. Drain engine oil.
2. Remove the drive belt.
3. Turn the crankshaft and align the white groove on the crankshaft pulley with the pointer on the lower cover. (See page EM - 8)
4. Remove the oil pan. (See page EM - 20)
5. Remove the timing chain. (See page EM - 18)
6. Remove balance shaft chain(B) and balance shaft module(A).

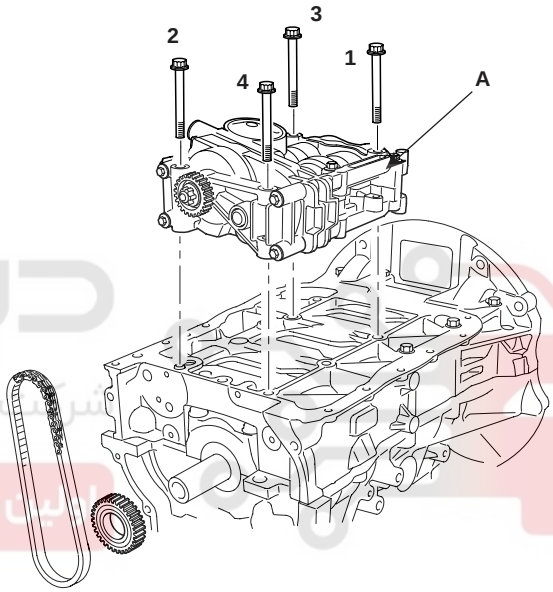


KCRF165A

INSTALLATION E666CED4

1. Install balance shaft chain.
2. Confirm the balance shaft module timing mark. Timing marks to be visually aligned with centers of adjacent cast timing notches. (See page EM - 23)
3. Install balance shaft module that the timing mark of balance shaft module sprocket should be matched with the timing mark (color link) of balance shaft chain.

Tightenig torque
16.66Nm (1.7kgf.m, 12.3lbf.ft) + 60°+ 60°



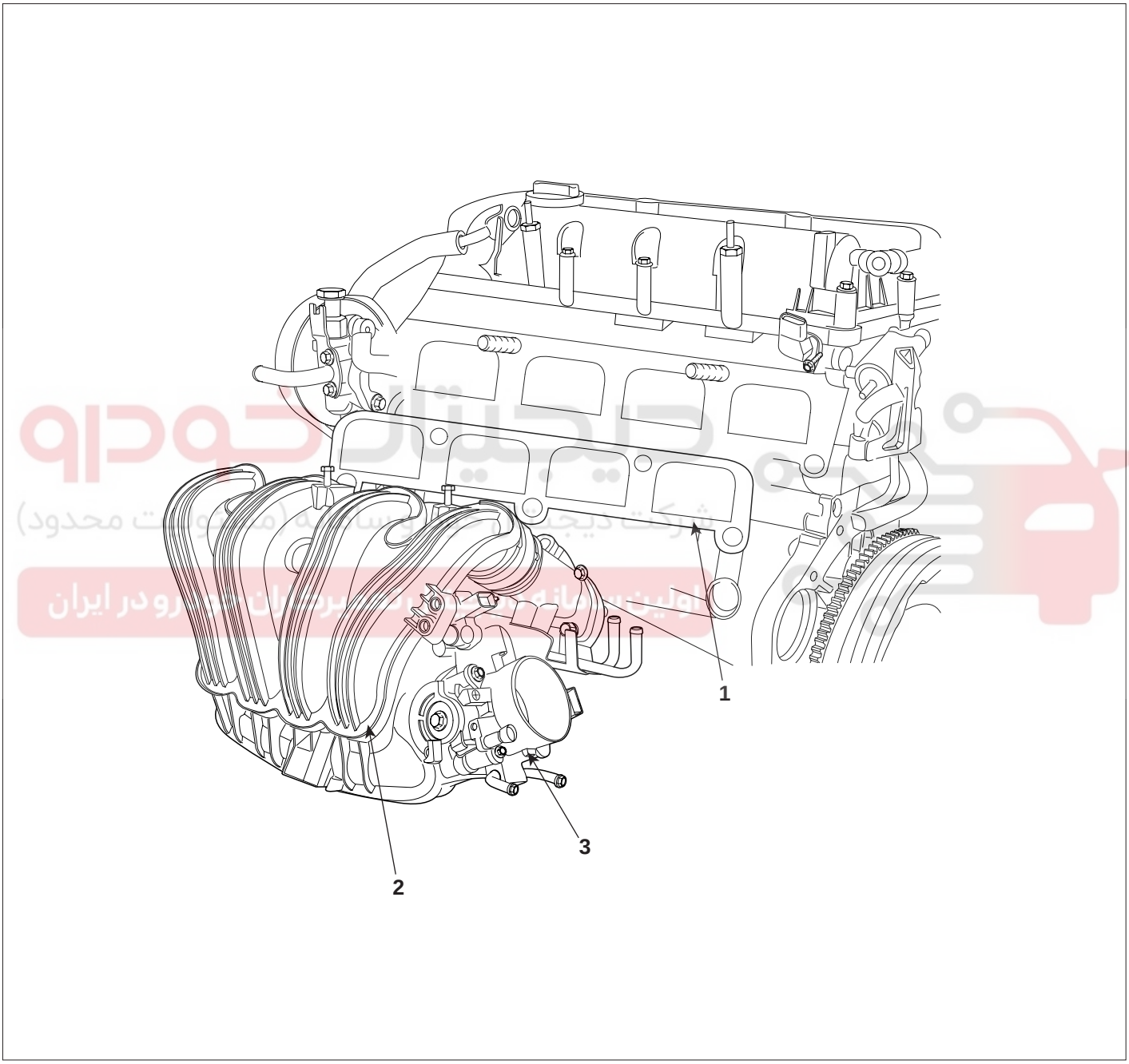
KCRF165B

4. Install timing chain. (See page EM - 24)
5. Install oil pan. (See apge EM - 26)
6. Fill with engine oil.
7. Start engine and check for leaks.

INTAKE AND EXHAUST SYSTEM

COMPONENT EF4AF4DE

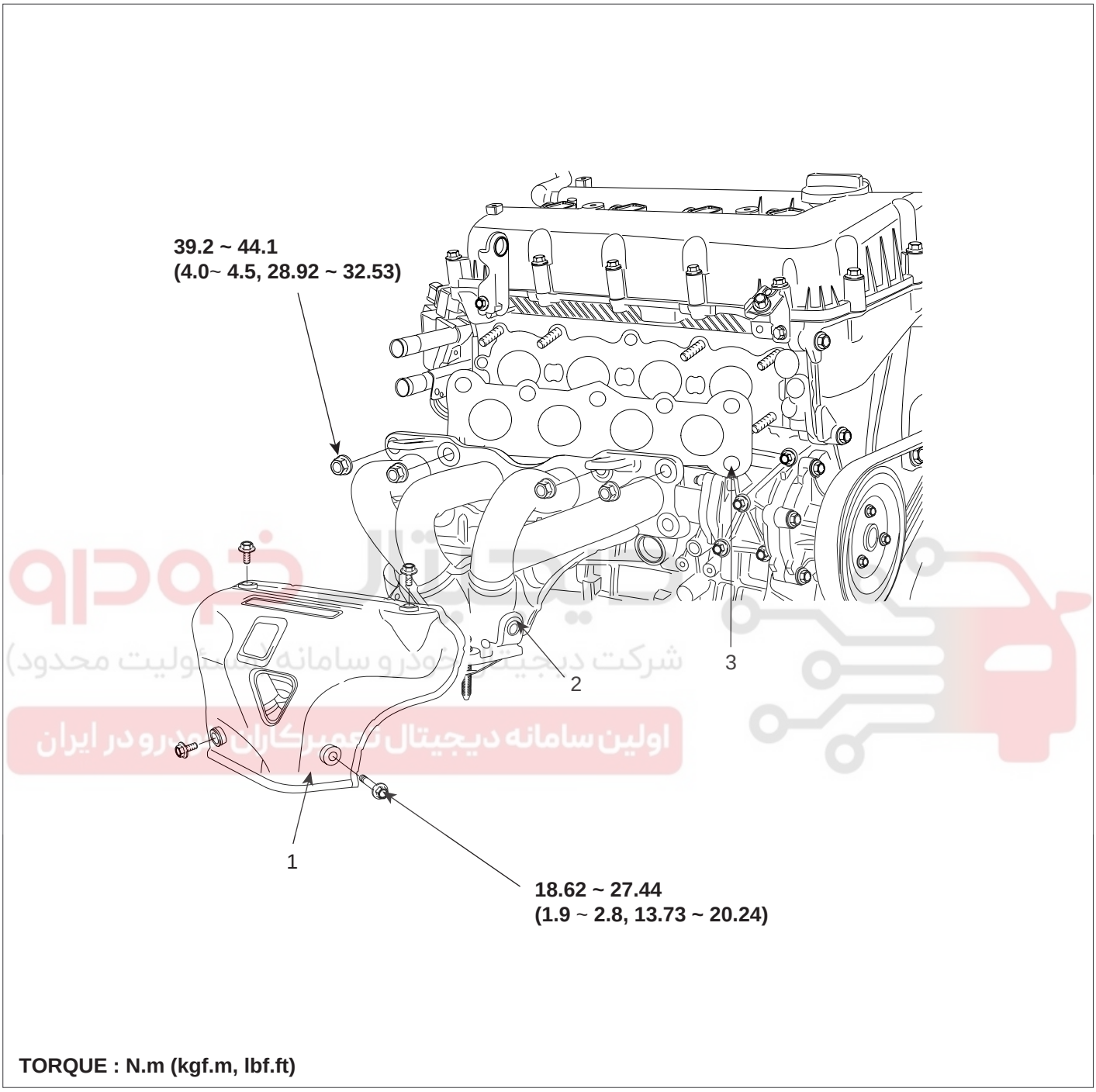
INTAKE MANIFOLD



1. Intake manifold gasket
2. Intake manifold assembly
3. Throttle body

ECRF026A

EXHAUST MANIFOLD

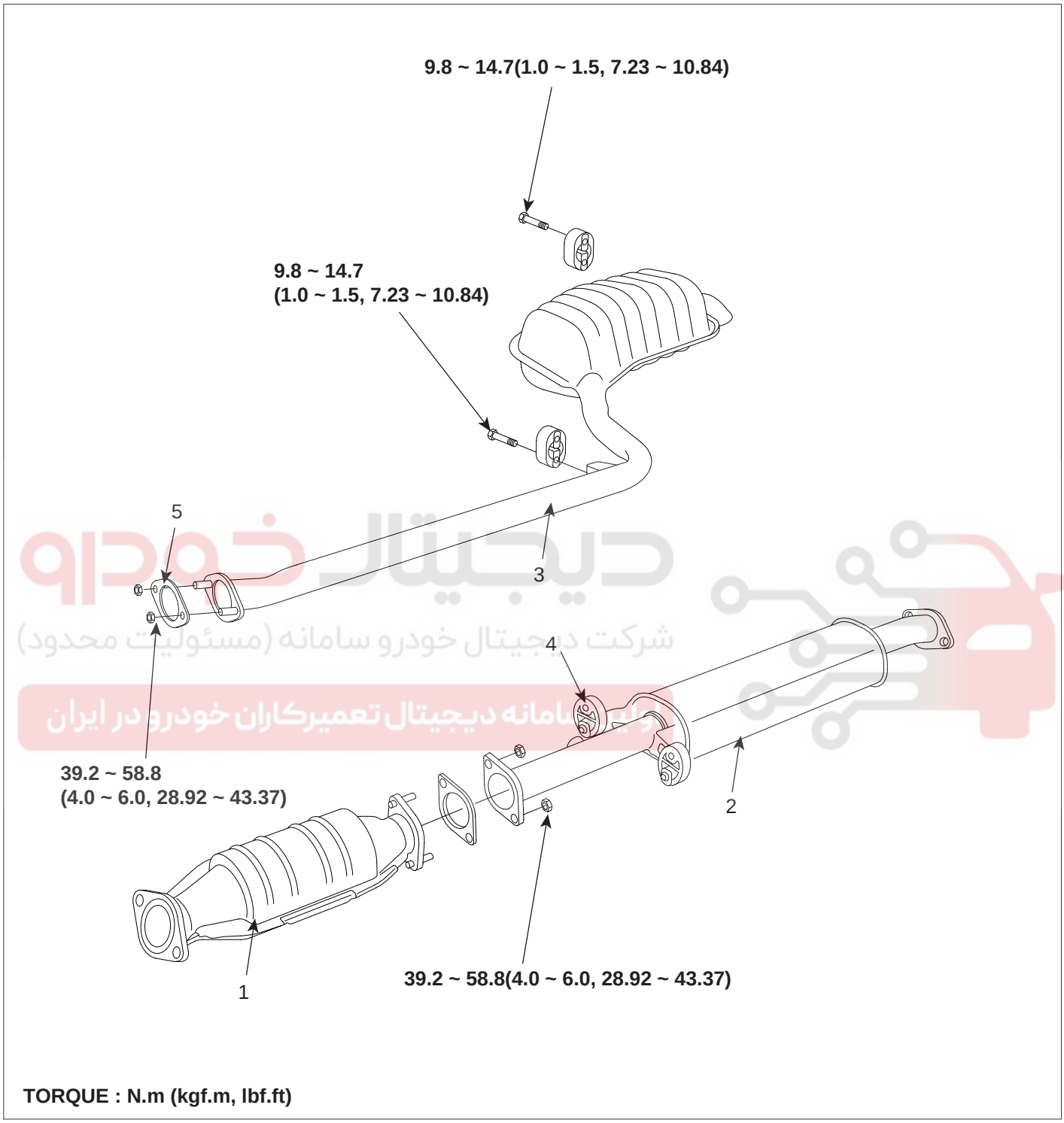


TORQUE : N.m (kgf.m, lbf.ft)

1. Heat protector
2. Exhaust manifold
3. Exhaust manifold gasket

ECRF027A

MUFFLER



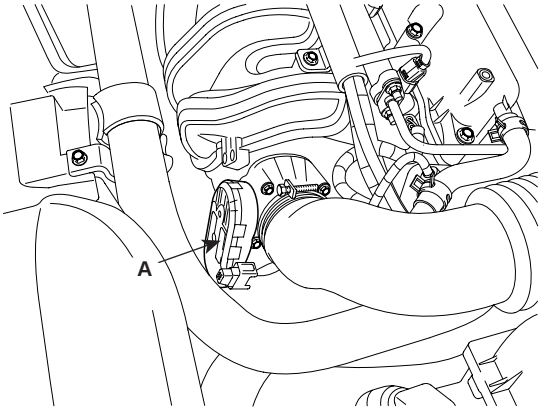
1. Catalytic converter
2. Center muffler
3. Main muffler
4. Rnbber hanger
5. Gasket

ECRF028A

REMOVAL E00DFD23

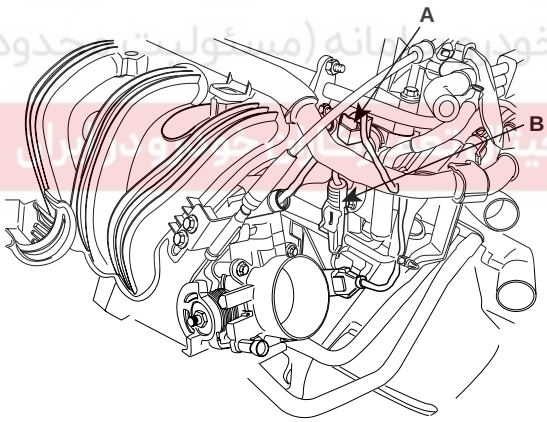
INTAKE MANIFOLD

1. Remove the engine cover. (See page EM - 18)
2. Disconnect ETS connector(A)



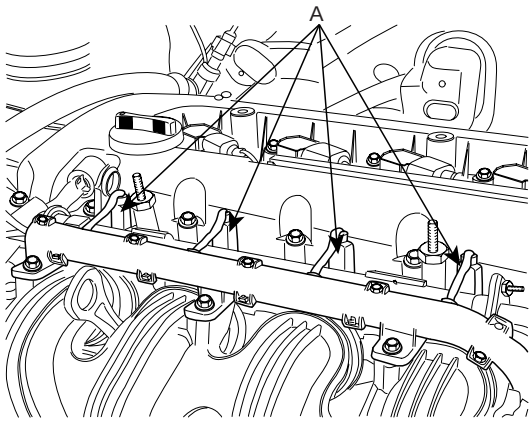
ECRF032A

3. Disconnect CMP connector(A), and knock sensor connector(B).



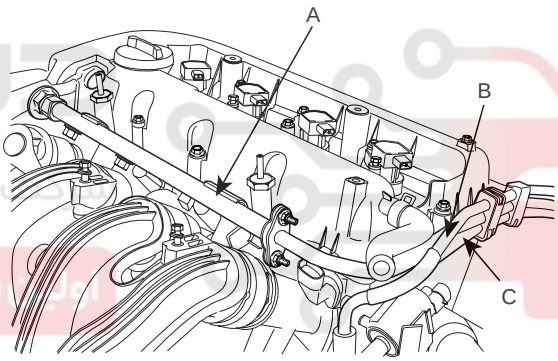
ECRF029A

4. Disconnect injector connector(A).



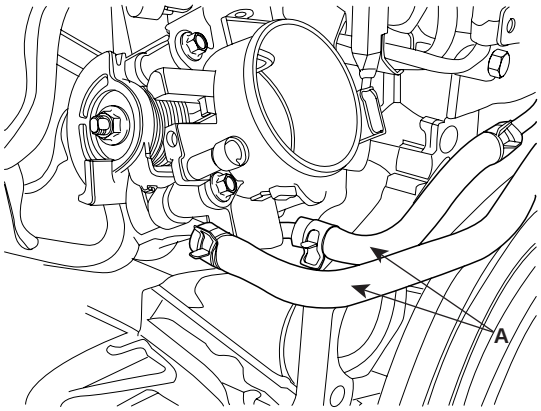
KCRF128A

5. Remove the delivery pipe(A), brake vacuum hose(B), and PCSV hose(C).



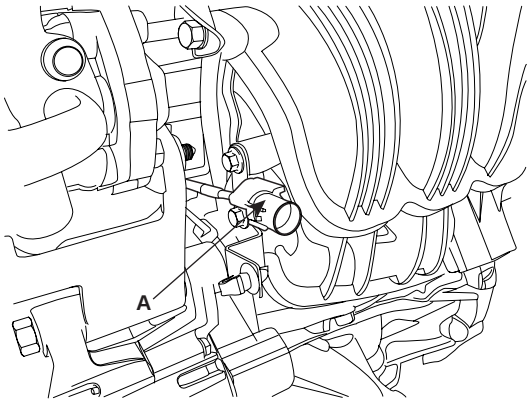
KCRF134A

6. Remove coolant hose(A) from throttle body.



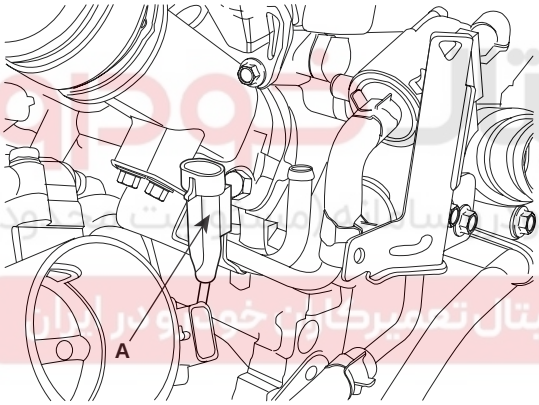
KCRF141B

7. Remove oil pressure switch connector(A) from bracket.



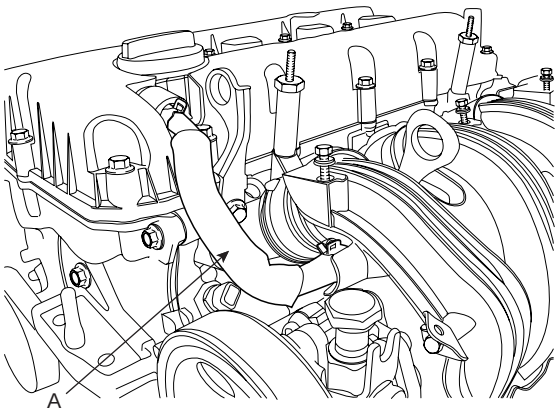
KCRF141A

8. Remove knock sensor connector(A) from bracket.



KCRF141C

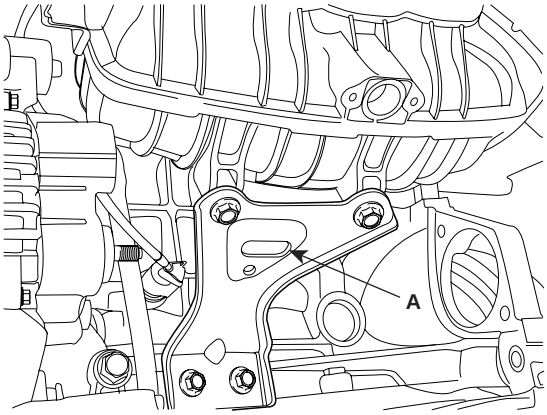
9. Remove PCV hose(A).



KCRF141E

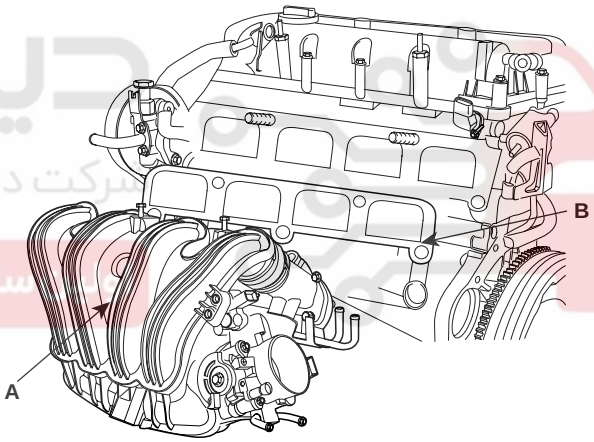
10. Remove oil level gauge.

11. Remove intake manifold stay(A).



KCRF141D

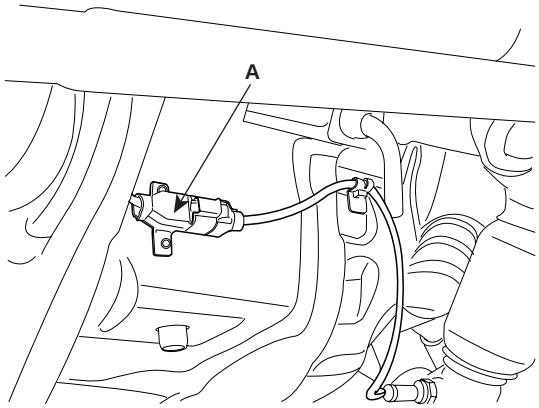
12. Remove intake manifold(A) and gasket(B).



KCRF142A

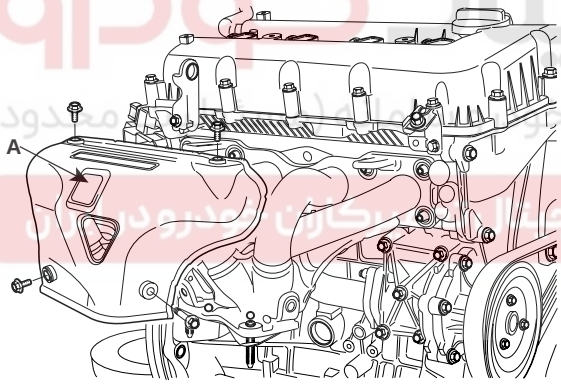
EXHAUST MANIFOLD

1. Remove the oxygen sensor connector.



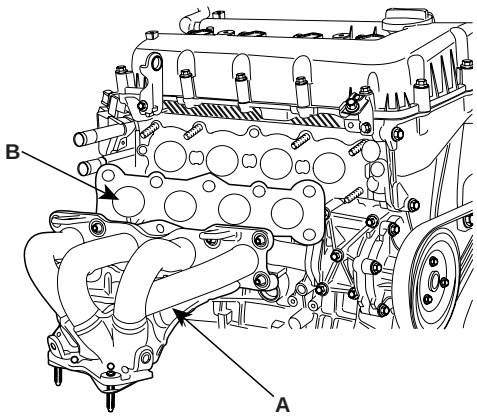
ECRF018A

2. Remove the front muffler.
3. Remove the heat protector.



KCRF138A

4. Remove exhaust manifold stay bolt.
5. Remove exhaust manifold(A) and gasket(B).



KCRF140A

INSTALLATION EB2ED2B1

EXHAUST MANIFOLD

1. Install gasket and exhaust manifold.

Tightening torque
39.2 ~ 44.1N.m(4.0 ~ 4.5kgf.m, 28.92 ~ 32.53lbf.ft)

2. Install exhaust manifold stay bolt.

Tightening torque
51.94 ~ 57.82N.m(5.4 ~ 5.9kgf.m, 38.3 ~ 42.6lbf.ft)

3. Install heat protector.

Tightening torque
18.6 ~ 27.44N.m(1.9 ~ 2.8kgf.m, 13.7 ~ 20.2lbf.ft)

4. Install front muffler.

Tightening torque
39.2 ~ 58.8N.m(4.0 ~ 6.0kgf.m, 28.92 ~ 43.37lbf.ft)

5. Connect oxygen sensor connector.

INTAKE MANIFOLD

1. Install gasket and intake manifold.

Tightening torque
18.62 ~ 27.44N.m(1.9 ~ 2.8kgf.m, 13.7 ~ 20.2lbf.ft)

2. Install intake manifold stay.

Tightening torque
18.6 ~ 27.44N.m(1.9 ~ 2.8kgf.m, 13.7 ~ 20.2lbf.ft)

3. Install oil level gauge
4. Install PCV hose
5. Install air cleaner assembly.
6. Install engine cover.