Engine (G6BA – GSL 2.7)

GENERAL

SPECIFICATIONS E97CEC21

Description	Specifications	Limit
General		
Type	V-type, DOHC	
Number of cylinder	6	
Bore	86.7mm (3.4133in.)	
Stroke	75mm (2.9528in.)	
Total displacement	2,656cc	
Compression ratio	10 : 1	
Firing order	1-2-3-4-5-6	
Valve timing		
Intake valve		
Opens (BTDC)	6°	
Closes (ABDC)	46°	
Exhaust valve		
Opens (BBDC)	44°	
Closes (ATDC)	8	
Camshaft		
Drive mechanism	Cogged type belt	
Cam height		
Intake	43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)	43.45mm (1.7106in.)
Exhaust	43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)	43.45mm (1.7106in.)
Journal diameter	25.964 ~ 25.980mm (1.0222 ~ 1.0228in.)	25.914mm (1.0202in.)
Bearing oil clearance	0.02 ~ 0.061mm (0.0007 ~ 0.0024in.)	0.1mm (0.0039in.)
End play	0.1 ~ 0.15mm (0.0039 ~ 0.0059in.)	
Cylinder head		
Flatness of cylinder head surface	Max. 0.03mm (0.0012in.)	0.05mm (0.0020in.)
Flatness of manifold mounting surface		
Intake	Max. 0.15mm (0.0059in.)	0.15mm (0.0059in.)
Exhaust	Max. 0.15mm (0.0059in.)	0.15mm (0.0059in.)
Valve guides hole diameter		
0.05 (0.002) O.S.	11.05 ~ 11.068mm (0.435 ~ 0.436in.)	
0.25 (0.010) O.S.	11.25 ~ 11.268mm (0.443 ~ 0.444in.)	
0.50 (0.020) O.S.	11.50 ~ 11.518mm (0.453 ~ 0.453in.)	
Intake valve seat ring hole diameter		
0.3 (0.012) O.S.	33.300 ~ 33.325mm (1.311 ~ 1.312in.)	
Exhaust valve seat ring hole diameter		
0.3 (0.012) O.S.	28.600 ~ 28.621mm (1.126 ~ 1.127in.)	
Valve		
Overall length		
Intake	96.1mm (3.783in.)	
Exhaust	97.15mm (3.825in.)	
Stem diameter		
Intake	5.965 ~ 5.98mm (0.235 ~ 0.2354in.)	
Exhaust	5.95 ~ 5.965mm (0.234 ~ 0.235in.)	
Face angle	45° ~ 45.5°	
Margin		
Intake	1.0mm (0.0394in.)	0.5mm (0.0197in.)
Exhaust	1.3mm (0.0512in.)	0.8mm (0.0315in.)
Clearance (Stem-to-guide)		
Intake	0.02 ~ 0.05mm (0.008 ~ 0.0020in.)	0.10mm (0.0039in.)
Exhaust	0.030 ~ 0.065mm (0.0012 ~ 0.0026in.)	0.13mm (0.0051in.)

Description	Specifications	Limit
Valve spring		
Free length	42.5mm (1.6732in.)	41.5mm (1.6339in.)
Load	21kg/35mm (48.4lb/1.3780in.)	21.9kg/34mm (48.4lb/1.3386in.)
Out of squareness	Max. 1.5°	Max. 3°
Piston		
Diameter (Standard)	86.68 ~ 86.71mm (3.413 ~ 3.414in.)	
Clearance (Piston-to-cylinder)	0.01 ~ 0.03mm (0.0004 ~ 0.0012in.)	
Ring groove width		
No.1	1.230 ~ 1.250mm (0.0484 ~ 0.0492in.)	
No.2	1.220 ~ 1.240mm (0.0480 ~ 0.0488in.)	
Oil	2.515 ~ 2.535mm (0.0990 ~ 0.0998in.)	
Piston for service	0.25mm (0.010in.), 0.50mm (0.020in.)	
Piston ring		
Number of rings per piston	3	
Compression ring	2	
Oil ring	1	
Compression ring type		
No.1	Inner bevel type	
No.2	Taper type	
Oil ring type	3-piece type	
Ring end gap		
No.1	0.20 ~ 0.35mm (0.0079 ~ 0.0138in.)	0.8mm (0.031in.)
No.2	0.37 ~ 0.52mm (0.0146 ~ 0.0205in.)	0.8mm (0.031in.)
Oil ring side rail	0.2 ~ 0.7mm (0.0079 ~ 0.0276in.)	1.0mm (0.039in.)
Ring side clearance		
No.1	0.04 ~ 0.08mm (0.0016 ~ 0.0031in.)	0.1mm (0.004in.)
No.2	0.03 ~ 0.07mm (0.0012 ~ 0.0028in.)	0.1mm (0.004in.)
Rings for service	0.25mm (0.010in.), 0.50mm (0.020in.)	
Connecting rod		
Piston pin installation force	2,450 ~ 12,225N (250 ~ 1,250kg, 551 ~ 2,755lb)	
Side clearance (big end)	0.10 ~ 0.25mm (0.0039 ~ 0.0098in.)	0.4mm (0.016in.)
Bend	0.05mm or less/100mm (0.0020in. or less/3.937in.)	
Bearing oil clearance	0.018 ~ 0.036mm (0.0007 ~ 0.0014in.)	0.1mm (0.004in.)
Crankshaft		
Journal O.D.	61.982 ~ 62.000mm (2.4402 ~ 2.4409in.)	
Pin O.D.	47.982 ~ 48.000mm (1.8891 ~ 1.8898in.)	
Out-of-round, taper of journal and pin	Max. 0.003mm (0.0012in.)	
Taper of journal and pin	Max. 0.005mm (0.00020in.)	
End play	0.070 ~ 0.250mm (0.0028 ~ 0.0098in.)	0.4mm (0.016in.)
Main bearing clearance	0.004 ~ 0.022mm (0.0002 ~ 0.0009in.)	0.1mm (0.004in.)
Cylinder block		
Cylinder bore	86.7mm (3.4134in.)	
Flatness of gasket surface	Max. 0.03mm (0.0012in.)	0.05mm (0.002in.)
Out-of-round of cylinder bore	Max. 0.02mm (0.0008in.)	
Oil pump		
Body clearance	0.100 ~ 0.181mm (0.0039 ~ 0.0071in.)	
Side clearance	0.040 ~ 0.095mm (0.0016 ~ 0.0037in.)	
Relief spring		
Free height	43.8mm (1.724in.)	
Load	4.6kg/39.3mm (10lb/1.548in.)	

Description	Specifications	Limit
Oil filter Type Engine oil pressure Cooling method Cooling system quantity	 Cartridge, full flow 50kPa (7.3psi) or more [Conditions : Oil temperature is 75 to 90°C (167 to 194°F)] Engine coolant cooling, forced circulation with electric fan 7.0lit (7.4U.S.qts., 6.1Imp.qts)	
Theromstat Type Normal opening temperature Opening temperature range Wide open temperature	 Wax pellet type with jiggle valve 82 ± 2.0°C (179.6 ± 3.6°F) 80 ~ 84°C (176 ~ 183.2°F) 95°C (203°F)	
Radiator cap Main valve opening pressure Main valve closing pressure Vacuum valve opening pressure	 107.9 ± 14.7kPa (1.1 ± 0.15kg/cm², 15.65 ± 2.13psi) 83.4kPa (0.85kg/cm², 12.1psi) -6.86kPa (-0.07kg/cm², -1.00psi)	
Air cleaner Type Element	 Dry Paper type	
Exhaust pipe Muffler Suspend system	 Expansion reaonance type Rubber hangers	

SERVICE STANDRDS

Standard value	
Coolant concentration	
Tropical areas	40%
Other areas	50%

COOLANT

Engine coolant	Ethlylen glycol base for aluminum radiator

SEALANT

Engine coolant temperature sensor	LOCTITE 262 or equivalent, Three bond No.1324 or equivalent.
Oil pressure switch	3M ATD No.8660 or Three bond No.1141E
PCV valve	LOCTITE 242 or equivalent

TIGHTENING TORQUE

Item	Nm	kgf.cm	lbf.ft
Camshaft sprocket bolt	90 ~ 110	900 ~ 1,100	65 ~ 85
Cylinder head cover bolt	8 ~ 10	80 ~ 100	5.8 ~ 7.2
Main bearing cap bolt M10 M8	 27~33 + (90°~94°) 13~19 + (90°~94°)	 270~300 + (90°~94°) 130~190 + (90°~94°)	 19.5~24 + (90°~94°) 10~14 + (90°~94°)
Connecting rod bolt	16~20 + (90°~94°)	160~200 + (90°~94°)	12~15 + (90°~94°)
Cylinder head bolt(Cold engine)	25 + (58°~62°) + (43°~47°)	250 + (58°~62°) + (43°~47°)	18 + (58°~62°) + (43°~47°)
Oil pan drain plug	35 ~ 45	350 ~ 450	25 ~ 33
Lower oil pan bolt	10 ~ 12	100 ~ 120	7 ~ 9
Upper oil pan bolt [10 × 38mm (0.937 × 1.4961in.)] [8 × 22mm (0.3150 × 0.8661in.)] [161.5mm (6.3582in.)] [152.5mm (6.0039in.)]	 30 ~ 42 19 ~ 28 5 ~ 7 5 ~ 7	 300 ~ 420 190 ~ 280 50 ~ 70 50 ~ 70	 22 ~ 30 14 ~ 20 4 ~ 5 4 ~ 5
Oil screen bolt	15 ~ 22	150 ~ 220	11 ~ 16
Oil pump case bolt	12 ~ 15	120 ~ 150	9 ~ 11
Oil relief valve plug	40 ~ 50	400 ~ 500	29 ~ 36
Oil pressure switch	15 ~ 22	150 ~ 220	11 ~ 16
Oil pressure cover screw	8 ~ 12	80 ~ 120	6 ~ 9
Oil filter	12 ~ 16	120 ~ 160	9 ~ 12
Drive plate and adapte	73 ~ 77	730 ~ 770	53 ~ 56
Air cleaner body installation bolt	8 ~ 12	80 ~ 120	6 ~ 9
Surge tank stay	15 ~ 20	150 ~ 200	11 ~ 14
Air intake surge tank to intake manifold(bolt)	15 ~ 20	150 ~ 200	11 ~ 14
Air intake surge tank to intake manifold(nut)	15 ~ 20	150 ~ 200	11 ~ 14
Intake manifold to cylinder head	19 ~ 21	190 ~ 210	14 ~ 15
Heat protector exhaust manifold	17 ~ 22	170 ~ 220	12 ~ 16
Exhaust manifold to cylinder head (Self-locking nut)	30 ~ 35	300 ~ 350	22 ~ 26
Oil level gauge guide to engine	12 ~ 15	120 ~ 150	9 ~ 11
Water outlet fitting bolt	17 ~ 20	170 ~ 200	12 ~ 14
Power steering oil pump bracket to cylinder head	17 ~ 26	170 ~ 260	12 ~ 19
Crank position sensor wheel screw	5 ~ 6	50 ~ 60	3.6 ~ 4.3
Engine mounting insulator bolt	50 ~ 65	500 ~ 650	36 ~ 47
Engine mounting bracket nut	60 ~ 80	600 ~ 800	43 ~ 58
Engine mounting bracket bolt	60 ~ 80	600 ~ 800	43 ~ 58
Engine support bracket bolt	60 ~ 70	600 ~ 700	43 ~ 51
Front roll stopper bracket sub frame bolt	50 ~ 65	500 ~ 650	36 ~ 47

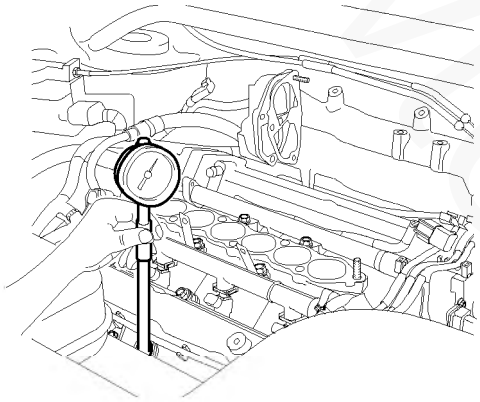
Item	Nm	kgf.cm	lbf.ft
Front roll stopper insulator bolt and nut	50 ~ 65	500 ~ 650	36 ~ 47
Rear roll stopper bracket to sub frame	50 ~ 65	500 ~ 650	36 ~ 47
Rear roll stopper insulator bolt and nut	50 ~ 65	500 ~ 650	36 ~ 47
Transaxle mounting bracket bolt	50 ~ 65	500 ~ 650	36 ~ 47
Transaxle mounting insulator bolt	90 ~ 110	900 ~ 1,100	65 ~ 80
Fuel hose clamp to rear cylinder head assembly	12 ~ 15	120 ~ 150	9 ~ 11
Transaxle mounting plate	10 ~ 12	100 ~ 120	7 ~ 9
Rear plate	10 ~ 12	100 ~ 120	7 ~ 9
Oil seal case	10 ~ 12	100 ~ 120	7 ~ 9
Crankshaft pulley bolt	180 ~ 190	1,800 ~ 1,900	130 ~ 138
Timing belt cover bolt	10 ~ 12	100 ~ 12	7 ~ 9
Engine hanger bracket to engine	20 ~ 27	200 ~ 270	14 ~ 20
Alternator mounting bracket to engine	20 ~ 30	200 ~ 300	14 ~ 22
Alternator mounting nut (Engine front case side)	20 ~ 30	200 ~ 300	14 ~ 22
Alternator mounting bolt (Alternator mounting bracket side)	20 ~ 30	200 ~ 300	14 ~ 22
Starter to transmission(nut)	20 ~ 30	200 ~ 300	14 ~ 22
Starter to transmission(bolt)	27 ~ 34	270 ~ 340	20 ~ 25
Drive belt pulley bolt	35 ~ 55	350 ~ 550	25 ~ 40
Drive belt tensioner bolt	20 ~ 27	200 ~ 270	14 ~ 20
Engine coolant pump to cylinder block bolt (Head mark "7" mark)	15 ~ 22	150 ~ 220	11 ~ 16
Engine coolant temperature sensor	20 ~ 40	200 ~ 400	14 ~ 29
Engine coolant inlet fitting attaching bolt	17 ~ 20	170 ~ 200	12 ~ 14
Throttle body to surge tank bolt	15 ~ 20	150 ~ 200	11 ~ 14
Oxygen sensor to exhaust manifold	40 ~ 50	400 ~ 500	29 ~ 36
Front exhaust pipe to exhaust manifold nut	30 ~ 40	300 ~ 400	22 ~ 29
Front exhaust pipe to catalytic converter bolt	40 ~ 60	400 ~ 600	29 ~ 43
Catalytic converter to center exhaust pipe nut	40 ~ 60	400 ~ 600	29 ~ 43
Center exhaust pipe to main muffler nut	40 ~ 60	400 ~ 600	29 ~ 43
Main muffler hanger support bracket bolt	10 ~ 15	100 ~ 150	7 ~ 11
Delivery pipe installation bolt	10 ~ 15	100 ~ 150	7 ~ 11
Timing belt tensioner pulley bolt	43 ~ 55	430 ~ 550	31 ~ 40
Timing belt idler puley bolt	50 ~ 60	500 ~ 600	36 ~ 43
Timing blelt tensioner arm fixed bolt	35 ~ 55	350 ~ 550	25 ~ 40
Auto tensioner fixed bolt	20 ~ 27	200 ~ 270	14 ~ 20
Accelerator cable bracket	4 ~ 6	40 ~ 60	3 ~ 4
Spark plug	20 ~ 30	200 ~ 300	14 ~ 22

COMPRESSION

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 6 spark plugs.
4. Check cylinder compression pressure
   a. Insert a compression gauge into the spark plug hole.



EDQF165A

   b. While cranking the engine, measure the compression pressure.

NOTE

Always use a fully charged battery to obtain engine speed of 250 rpm or more.

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

NOTE

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

Compression pressure : 1,420kPa (14.5kgf/cm², 206psi) Minimum pressure : 1,270kPa (13kgf/cm², 184psi) Difference between each cylinder : 100kPa (1.0kgf/cm², 15psi) or less

   d. 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 (b) 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. (See EE group - ignition)
6. Install ignition coils. (See EE group - ignition)

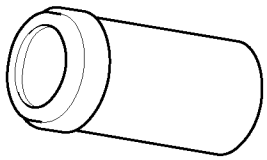
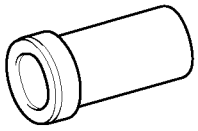
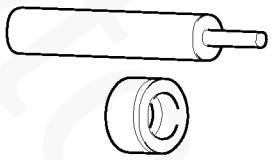
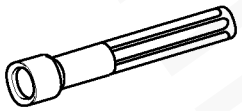
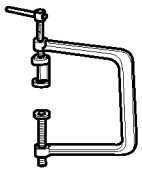
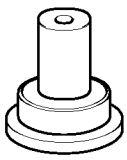
TROUBLESHOOTING EAE1F8CD

Symption	Suspect area	Remedy (See page)
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings (Oil cousumption 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 consumprion 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 replace 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.

Symptom	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-connecting rod clearance	• Inspect the piston, piston pin and the connecting rod. • Repair or replace as required.
	Excessive connecting bearing rod clearance	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft. • The crankshaft journal.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearing. • The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required : • 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 journals. • The cylinder block crankshaft

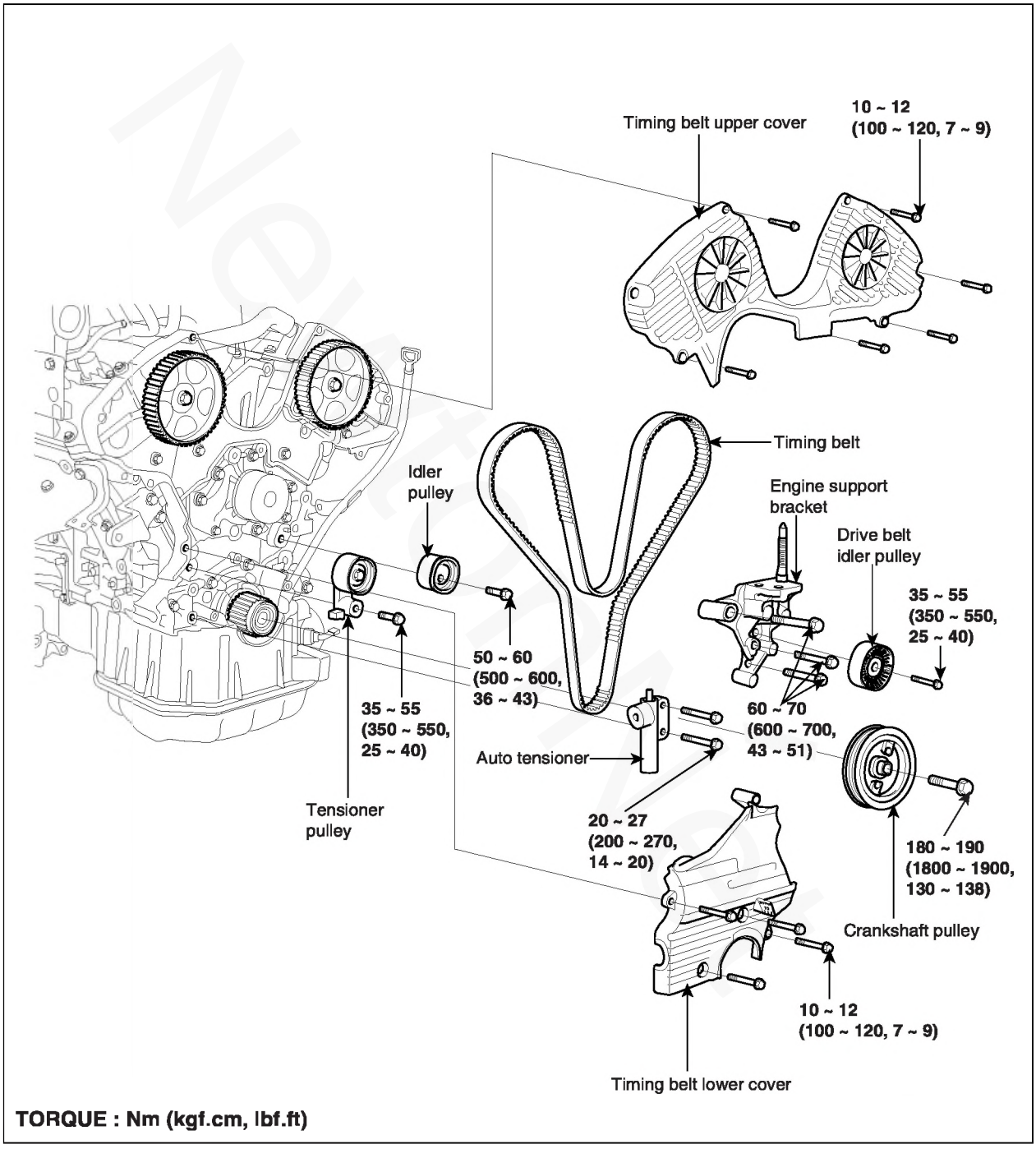
Symption	Suspect area	Remedy (See page)
Engine will not crank-crankshaft will not rotate	Hydraulically locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain 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.
	Bend or broken connecting rod.	1. Inspect connecing rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

SPECIAL TOOLS E4E4BACD

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 EDKA010A	Installation of the front oil seal
Camshaft oil seal installer (09214-21000)	 EDDA005B	Installation of the camshaft oil seal
Valve guide installer (09221-3F100 A/B)	 ECKA010B	Remove and installation of the valve guide
Valve stem oil seal installer (09222-22001)	 ECKA010A	Installation of the valve stem oil seal
Valve spring compressor & adaptor (09222-28000, 09222-28100)	 EDDA005C	Removal and installation of the intake or exhaust valve
Crankshaft rear oil seal installer (09231-33000)	 EDDA005F	1. Installation of the engine rear oil seal 2. Installation of the crankshaft rear oil seal

TIMING SYSTEM

COMPONENT EB323873

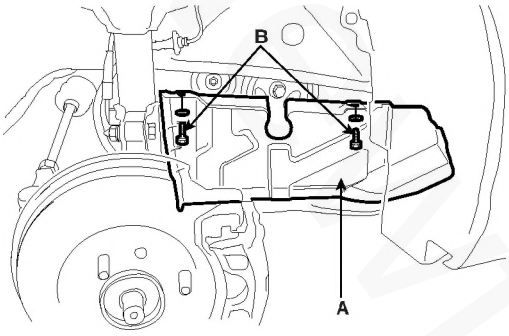


EDQF200A

REMOVAL EF2F0D8C

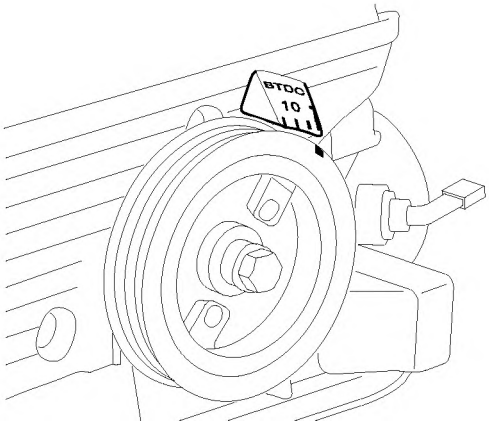
Engine removal is not required for this procedure.

1. Remove the engine cover.
2. Remove RH front wheel.
3. Remove 2bolts(B) and RH side cover(A).



KXDSE16A

4. Turn the crankshaft pulley, and align its groove with timing mark " T" of the timing belt cover.

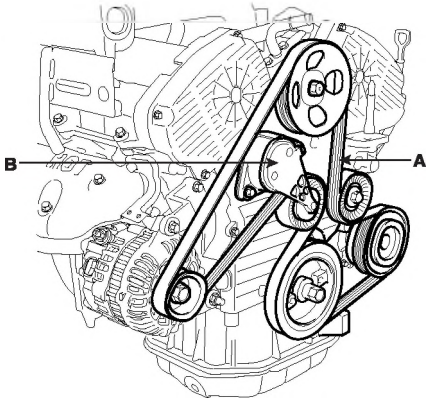


EDQF102A

NOTE

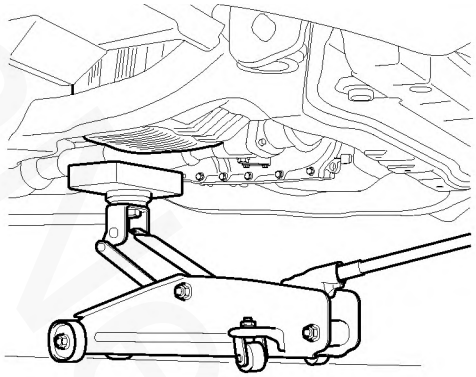
Always turn the crankshaft clockwise.

5. Remove drive belt(A) and belt tensioner(B).



EDQF100A

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

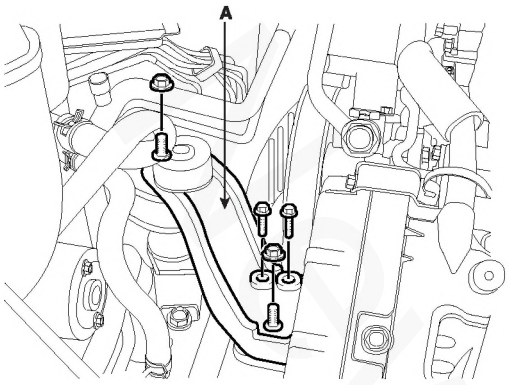


ECKD102A

NOTE

Place wooden block between the jack and engine oil pan.

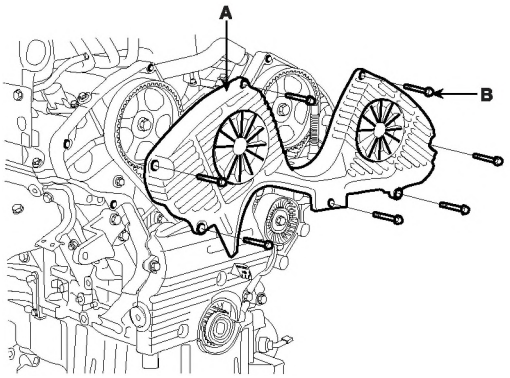
2) Remove the 2bolts, 2nuts and engine mount bracket(A).



EDQF017A

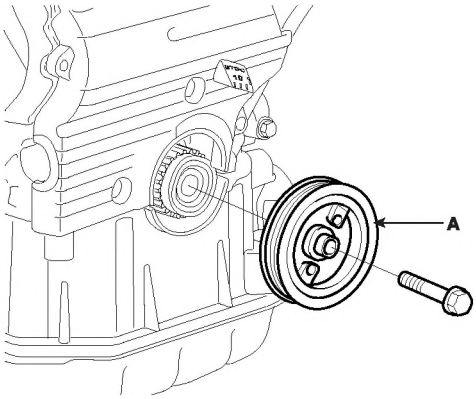
7. Remove the power steering pump. (See ST group - power steering pump)

8. Remove the 7bolts(B) and timing belt upper cover(A).



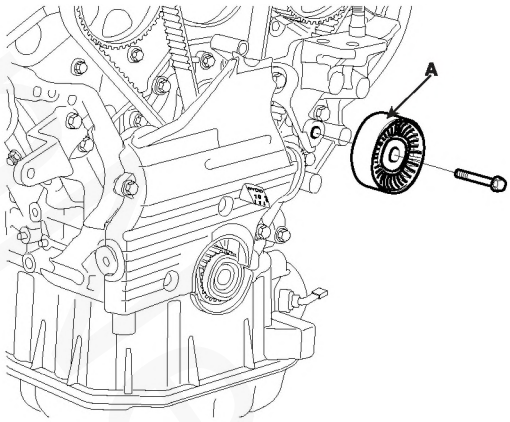
EDQF103A

9. Remove the crankshaft pulley bolt and crankshaft pulley(A).



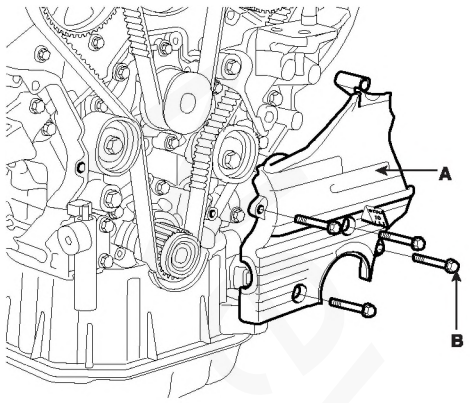
EDQF104A

10. Remove the drive belt idler pulley(A).



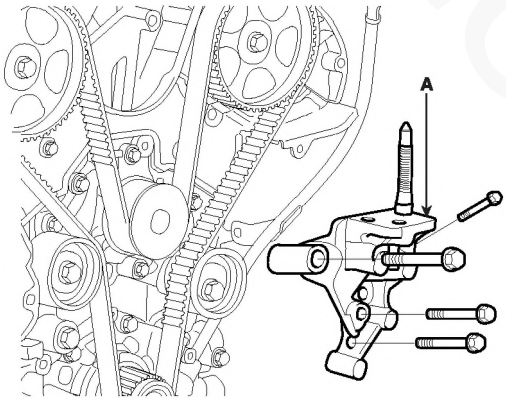
EDQF105A

11. Remove the 4bolts(B) and timing belt lower cover(A).



EDQF105B

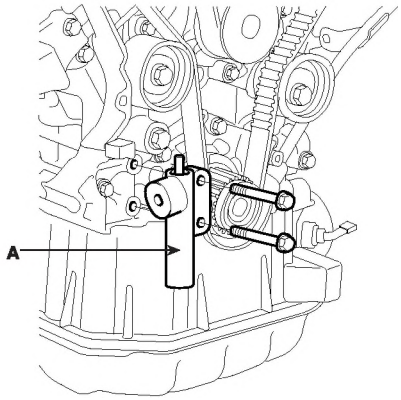
12. Remove the engine support bracket(A).



EDQF106A

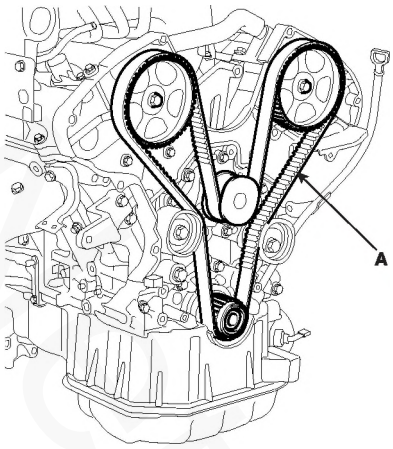
13. Check that timing marks of the camshaft timing pulleys and cylinder head covers are aligned.
    If not, turn the crankshaft 1revolution(360°).

14. Remove timing belt tensioner.
    Alternately loosen the 2bolts, and remove the tensioner(A).



EDQF107A

15. Remove the timing belt(A).

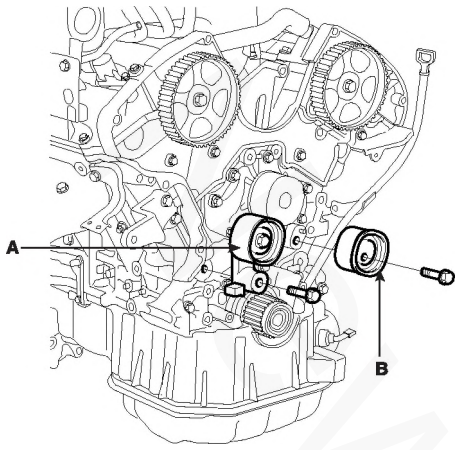


EDQF108A

NOTE

If the timing belt is reused, make an arrow indicating the turning direction to make sure that the belt is reinstalled in the same direction as before.

16. Remove the tensioner pulley(A) and timing belt idler pulley(B).



EDQF110A

17. Remove the crankshaft sprocket.

18. Remove camshaft sprockets.
Hold the hexagonal head wrench portion of the camshaft with a wrench and remove the bolt and camshaft sprocket.

⚠ ***CAUTION***

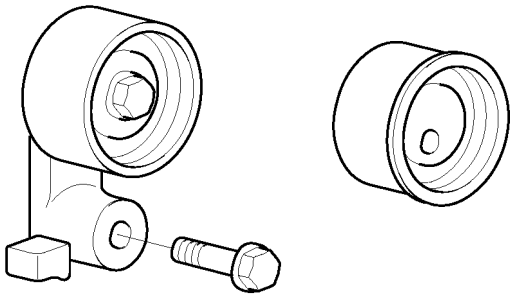
Be careful not to damage the cylinder head and valve lifter with the wrench.

INSPECTION EDAFCA96

SPOCKETS, TENSIONER, IDLER

1. Check the camshaft sproket, crankshaft sprocket, tensioner pulley, and idler pulley for abnormal wear, cracks, or damage. Replace as necessary.

2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace as necessary.



EDQF111A

3. Replace the pulley if there is a grease leak from its bearing.

TIMING BELT

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.*

INSTALLATION E1ED1397

1. Install the crankshaft sprocket.
   Align the pulley set key with the key groove the crankshaft sprocket and slide on the crankshaft sprocket.
2. Install the camshaft sprockets and tighten the bolts to the specified torque.
   1) Temporarily install the camshaft sprocket bolts.
   2) Hold the hexagonal head wrench portion of the camshaft with a wrench, and tighten the camshaft sprocket bolts.

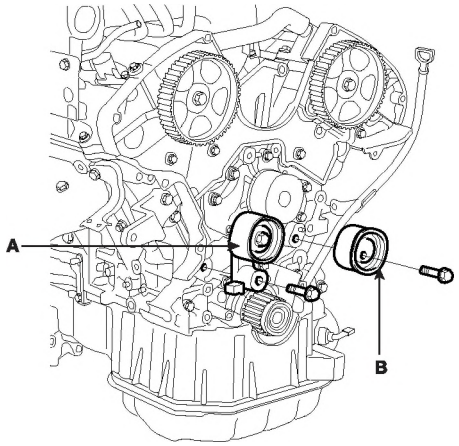
Tightening torque
Camshaft sprocket bolt
90 ~ 110Nm (900 ~ 1100kgf.cm, 65 ~ 80lbf.ft)

3. Install the idler pulley(B) and the tensioner pulley(A).

Tightening torque
Idler pulley bolt
50 ~ 60Nm (500 ~ 600kgf.cm, 36 ~ 43lbf.ft)
Tensioner arm fixed bolt
35 ~ 55Nm (350 ~ 550kgf.cm, 25 ~ 40lbf.ft)

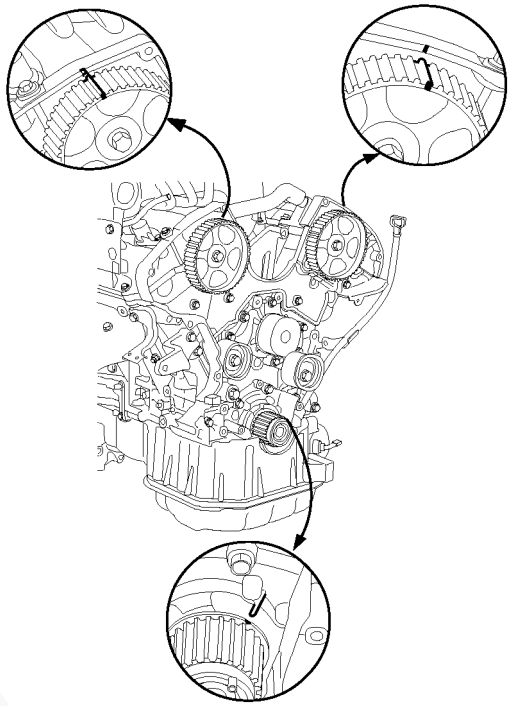
NOTE

Insert and install the idler pulley to the roll pin that is pressed in the water pump boss.



EDQF110A

4. Align the timing marks of the camshaft sprocket and crankshaft sprocket with the No.1 piston placed at top dead center and its compression stroke.

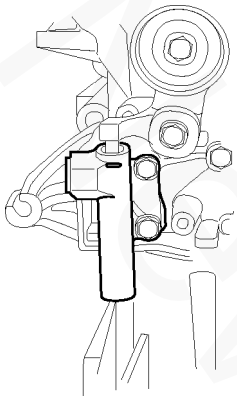


EDQF109A

5. Set timing belt tensioner.
   1) Using a press, slowly press in the push rod.
   2) Align the holes of the push rod and housing pass a set pin through the holes to keep the setting position of the push rod.
   3) Release the press.
6. Install the timing belt tensioner.
   1) Temporarily install the tensioner with the 2bolts.

2) Alternately tighten the 2bolts.

Tightening torque
20 ~ 27Nm (200 ~ 270kgf.cm, 14 ~ 20lbf.ft)

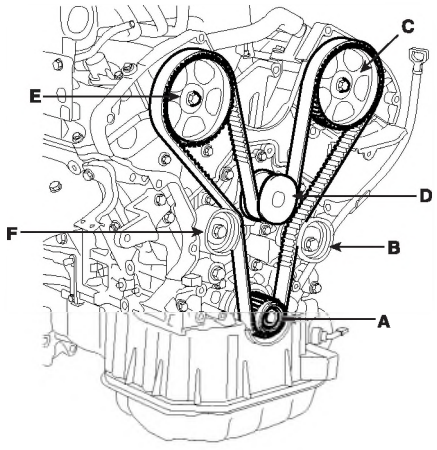


EDQF161A

7. Install the timing belt.

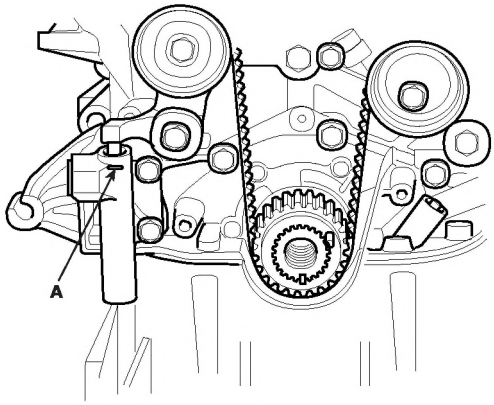
1) Remove any oil or water on the sprockets, and keep them clean.

2) Install the tming belt in this order.
Crankshaft sprocket(A) → Idler pulley(B) → Camshaft sprocket LH side(C) → Water pump pulley(D) → Camshaft sprocket RH side(E) → Tensioner pulley(F).



EDQF108B

8. Remove the set pin(A) from the tensioner.

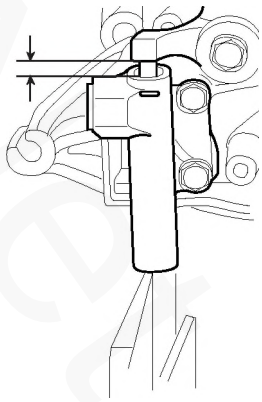


EDQF162A

9. Timing belt tensioner checking.

1) Rotate the crankshaft 2turns clockwise and measure the projected length of the auto tensioner at TDC(#1 compression stroke) after 5 minutes.

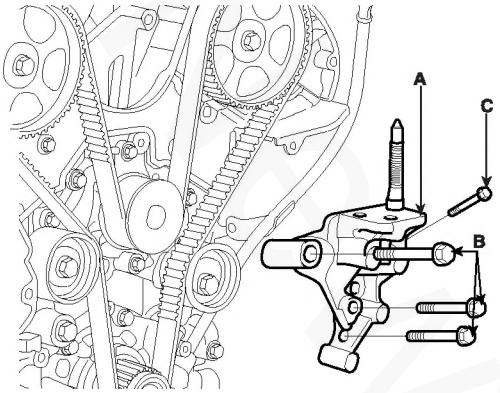
2) The projected length should be 7 ~ 9mm (0.27 ~ 0.31in.)



EDQF163A

10. Install the engine support bracket(A).

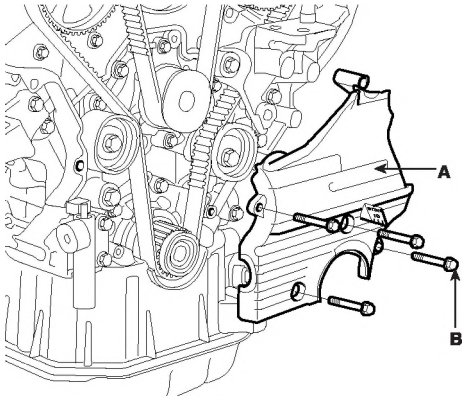
Tightening torque
B : 60 ~ 70Nm (600 ~ 700kgf.cm, 43 ~ 51lbf.ft)
C : 15 ~ 22Nm (150 ~ 220kgf.cm, 11 ~ 16lbf.ft)



EDQF106B

11. Install the timing belt lower cover(A) with 4bolts(B).

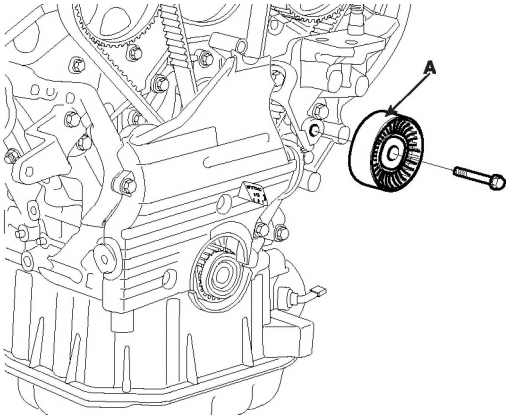
Tightening torque
Timing belt cover bolt
10 ~ 12Nm (100 ~120kgf.cm, 7 ~ 9lbf.ft)



EDQF105B

12. Install the drive belt idler pulley(A).

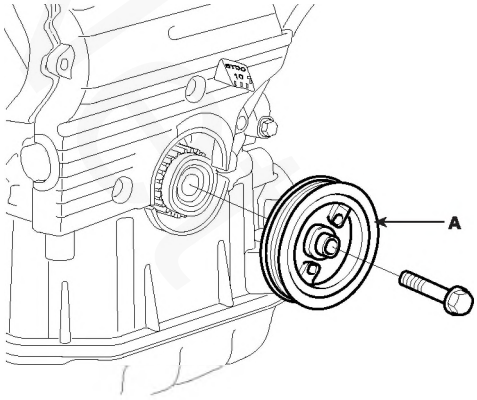
Tightening torque
Idler pulley bolt
35 ~ 55Nm (350 ~ 550kgf.cm, 25 ~ 40lgf.ft)



EDQF105A

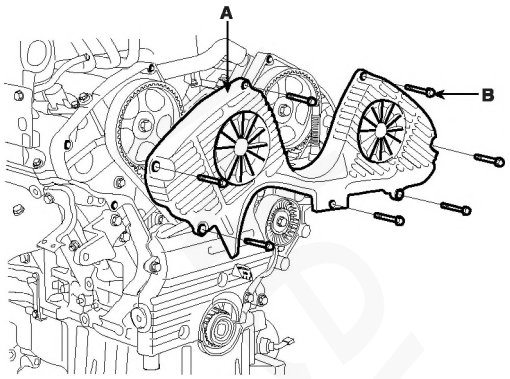
13. Install the crankshaft pulley(A).
Make sure that crankshaft sprocket pin fits the small hole in the pulley.

Tightening torque
Crankshaft pulley bolt
180 ~ 190Nm (1800 ~ 1900kgf.cm, 130 ~ 138lbf.ft)



EDQF104A

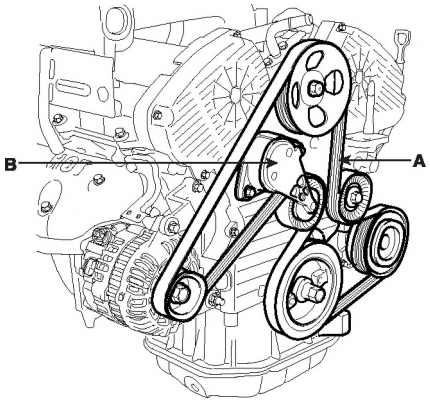
14. Install the timing belt upper cover(A) with 7bolts(B).



EDQF103A

15. Install the power steering pump. (See ST group - power steering pump)

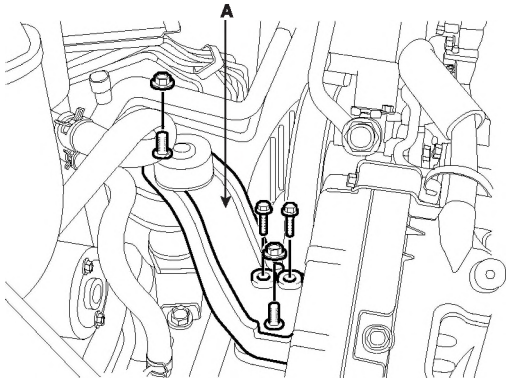
16. Install the drive belt tensioner(B) and drive belt(A).



EDQF100A

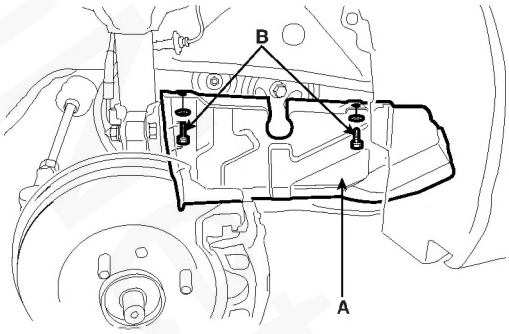
17. Install the engine mount bracket.
Install engine mount bracket with 2nuts and 2bolt.

Tightening torque
60 ~ 80Nm (600 ~ 800kgf.cm, 44 ~ 59lbf.ft)



EDQF017A

18. Install RH side cover(A) with 2bolts(B).



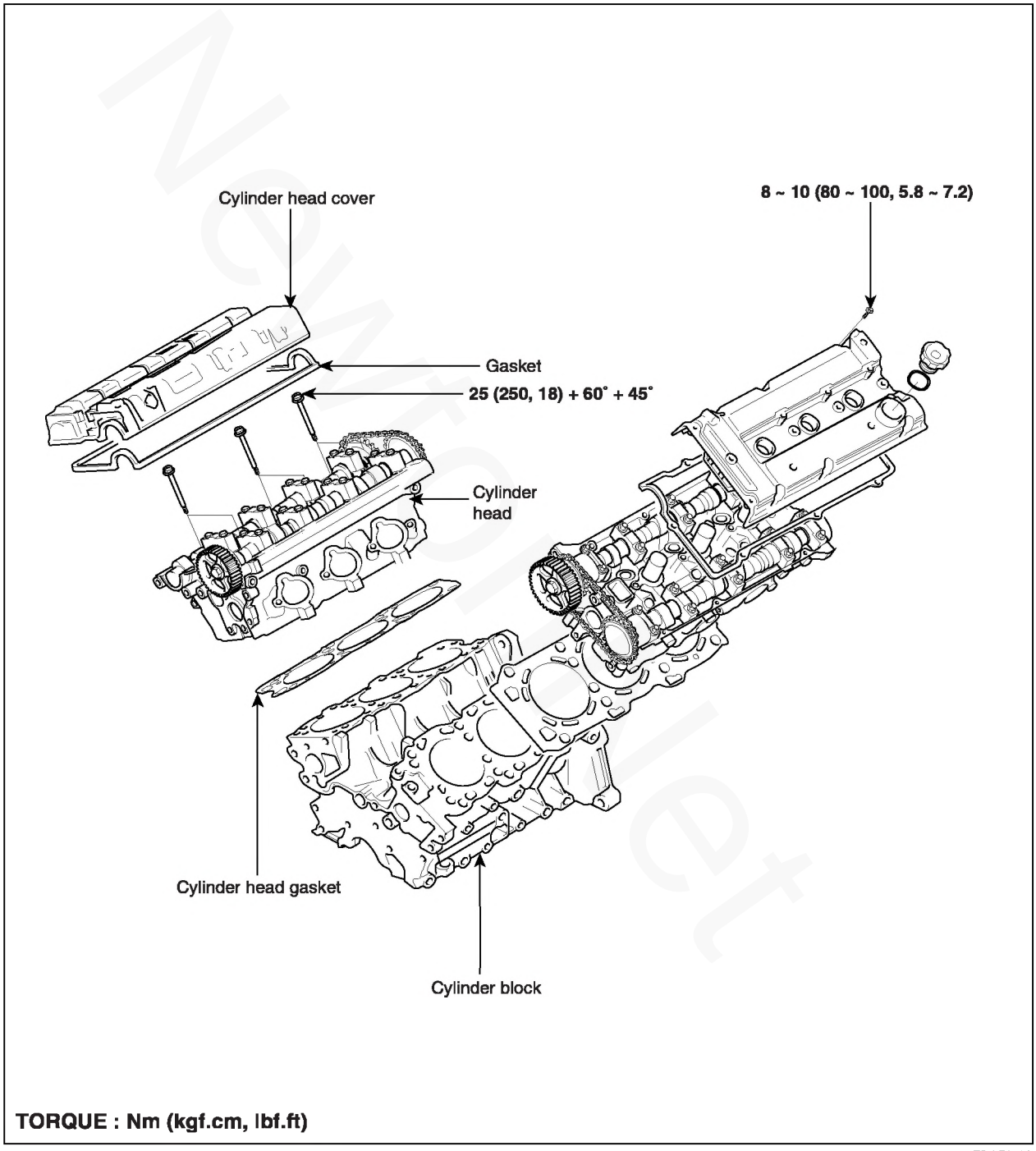
KXDSE16A

19. Install RH front wheel.

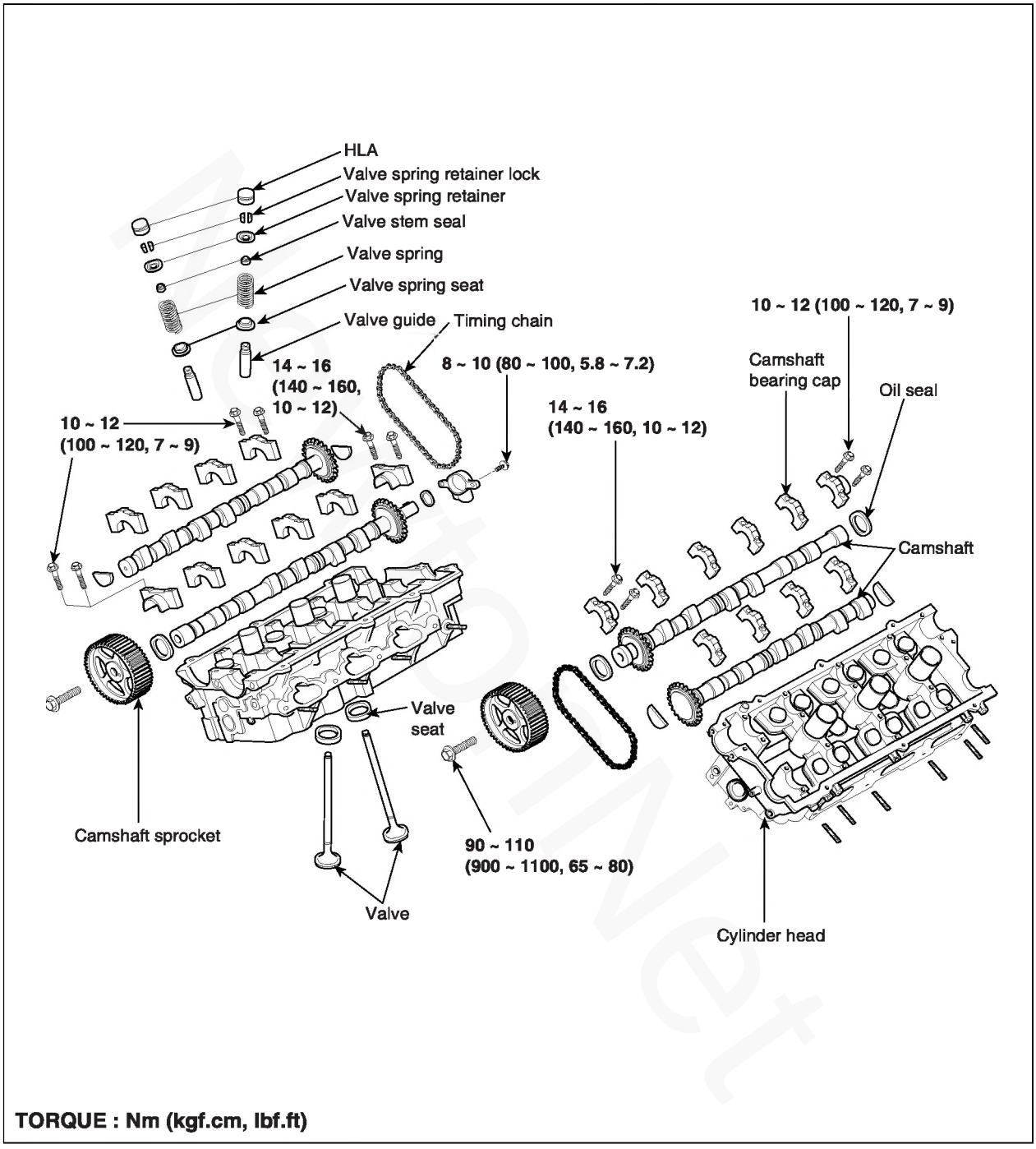
20. Install engine cover.

CYLINDER HEAD ASSEMBLY

COMPONENTS EAAAFFA1



EDQF201A


HLA
Valve spring retainer lock
Valve spring retainer
Valve stem seal
Valve spring
Valve spring seat
Valve guide
Timing chain
14 ~ 16 (140 ~ 160, 10 ~ 12)
8 ~ 10 (80 ~ 100, 5.8 ~ 7.2)
10 ~ 12 (100 ~ 120, 7 ~ 9)
14 ~ 16 (140 ~ 160, 10 ~ 12)
10 ~ 12 (100 ~ 120, 7 ~ 9)
Camshaft bearing cap
Oil seal
Camshaft
Valve seat
Camshaft sprocket
90 ~ 110 (900 ~ 1100, 65 ~ 80)
Valve
Cylinder head
TORQUE : Nm (kgf.cm, lbf.ft)

EDQF202A

REMOVAL EDA7EDAA

Engine removal is not required for this procedure.

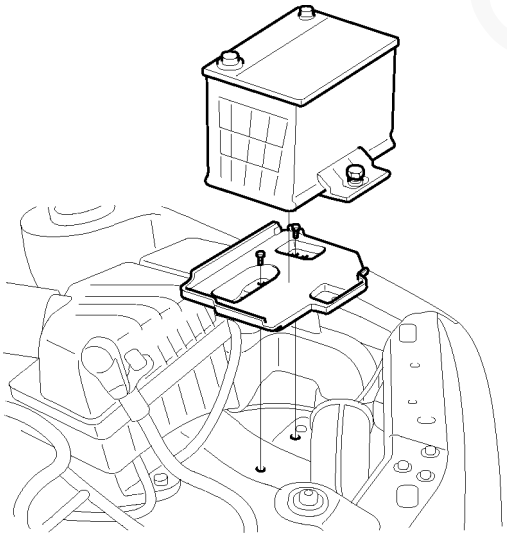
CAUTION

- ***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

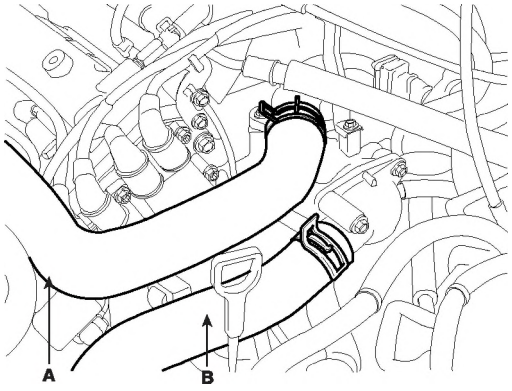
- *Mark all wiring and hoses to avoid misconnection.*
- *Inspect the timing belt before removing the cylinder head.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (See page EMA - 13).*

1. Disconnect the negative terminal from the battery.



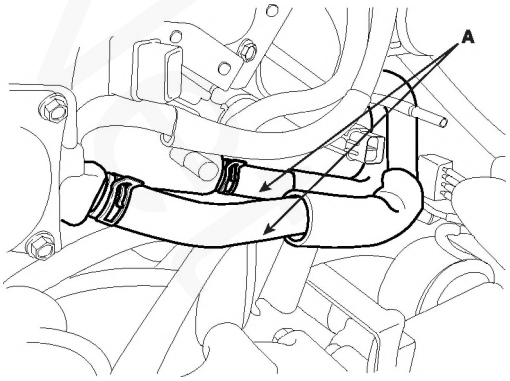
ECKD201B

2. Remove the engine cover.
3. Drain the engine coolant. (See page EMA - 72)
   Remove the radiator cap to speed draining.
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) Remove the intake air hose and air cleaner assembly.
5. Remove the upper radiator hose(A) and lower radiator hose(B).



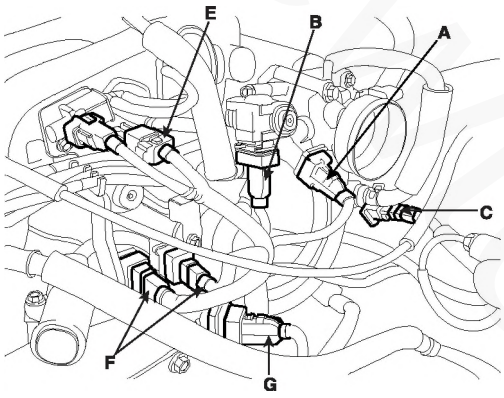
EDQF037A

6. Remove the heater hoses(A).



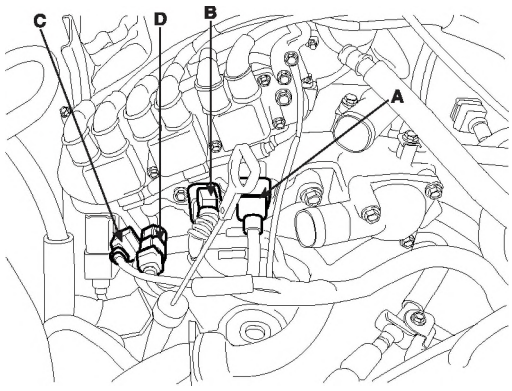
EDQF019A

7. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
   1) TPS(Throttle Position Sensor) connector(A).
   2) ISA(Idle Speed Actuator) connector(B).
   3) PCSV(Purge Control Solenoid Valve) connector(C).
   4) Injector connector(E).
   5) Knock sensor connectors(F).
   6) CMP(Camshaft Position Sensor) connector(G).



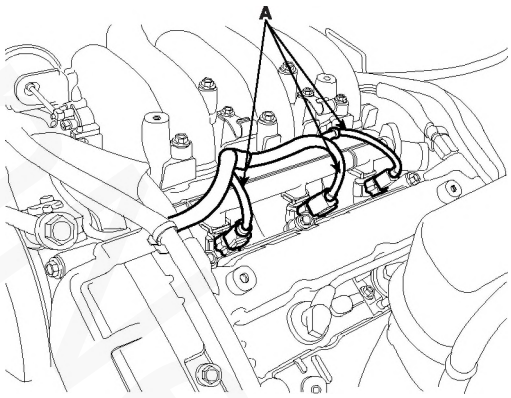
ECOF001A

   7) ECT(Engine Coolant Temperature) sensor connector(A).
   8) Ignition coil connector(B).
   9) Crankshaft position sensor connector(C).
   10) Oxygen sensor connector(D).



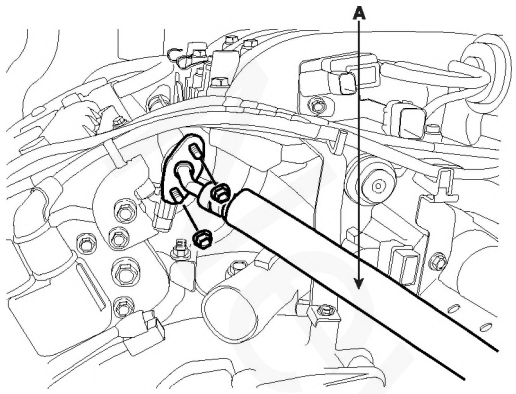
EDQF033A

   11) Three fuel injector connectors(A).



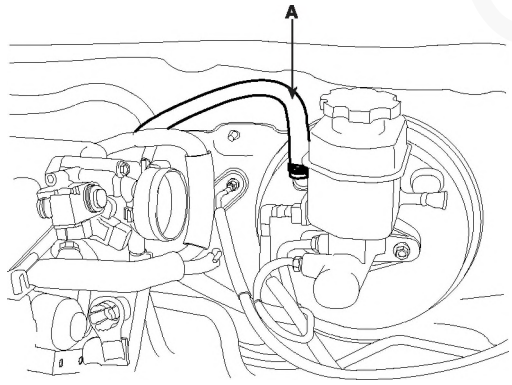
EDQF028A

8. Remove the fuel inlet hose(A) from delivery pipe.



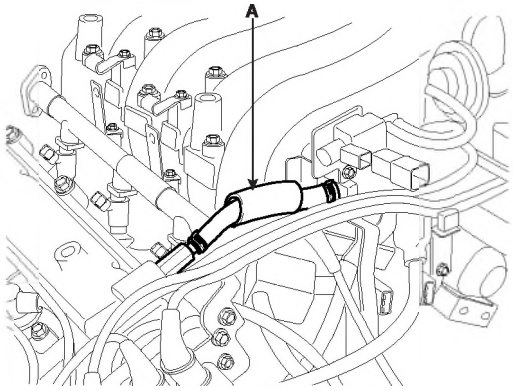
EDQF025A

9. Remove the PCSV hose.
10. Remove the brake booster vacuum hose(A).



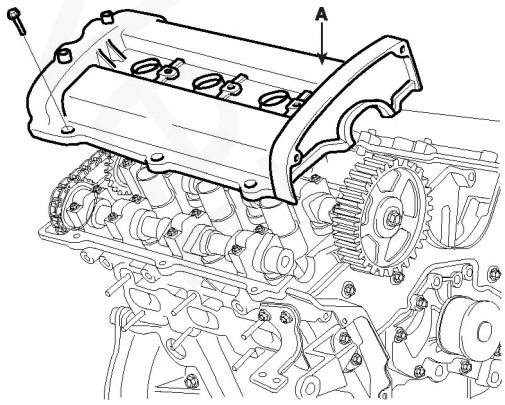
EDQF020A

11. Remove the accelerator cable by loosening the lock-nut, then slip the cable end out of the throttle linkage.
12. Remove the PCV hose(A).



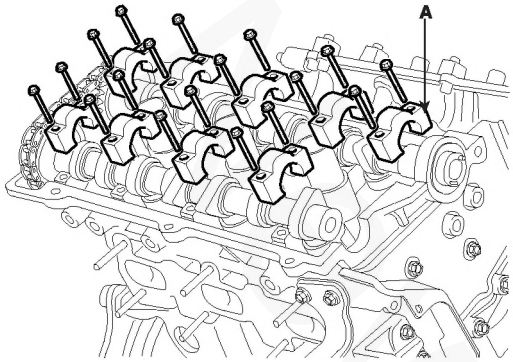
EDQF014A

13. Remove the intake manifold. (See page EMA - 88)
14. Remove the power steering pump. (See ST group - power steering pump).
15. Remove the exhaust manifold. (See page EMA - 89)
16. Remove the timing belt. (See page EMA - 13)
17. Remove the spark plug cable. (See EE group - ignition)
18. Remove the cylinder head covers(A).

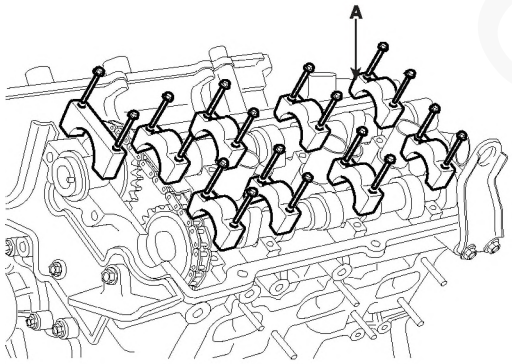


EDQF050A

19. Remove the camshaft sprocket.
20. Remove the camshaft bearing caps(A).

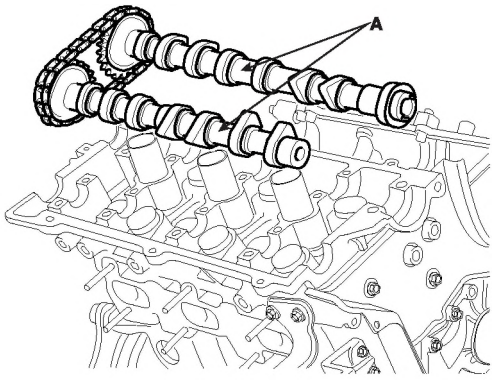


EDQF053A

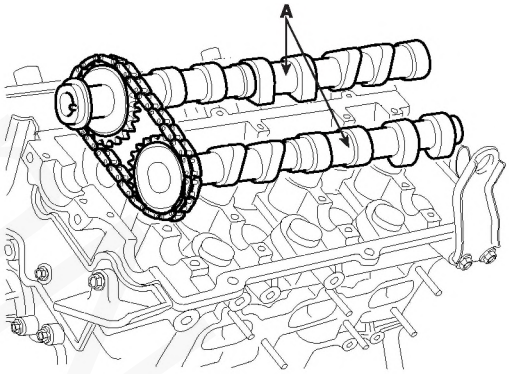


EDQF055A

21. Remove the camshafts(A).

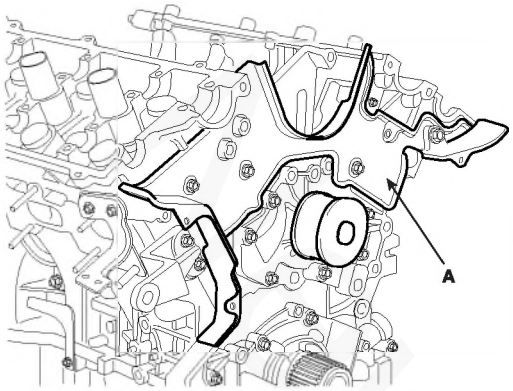


EDQF054A



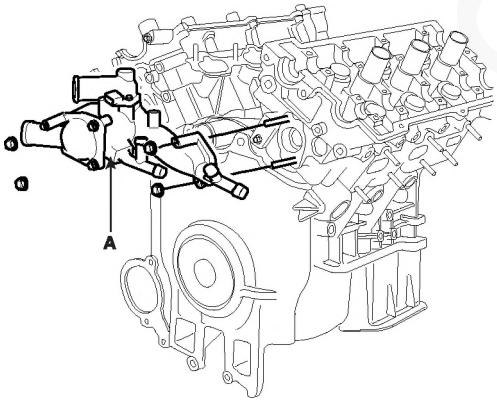
EDQF056A

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



EDQF057A

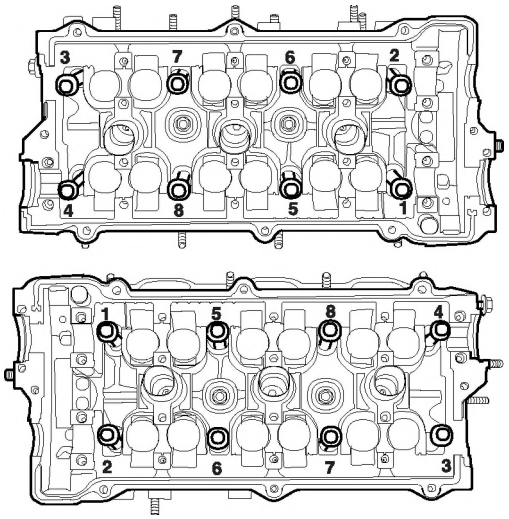
23. Remove the water temperature control assembly(A) and water pipe.



EDQF058A

24. Remove the cylinder head bolts, then remove the cylinder heads.

1) Uniformly loosen and remove the 8 cylinder head bolts on each cylinder head in several passes and in the sequence shown, then repeat for the other side, as shown. Remove the 16 cylinder head bolts and plate washer.



EDQF166A

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

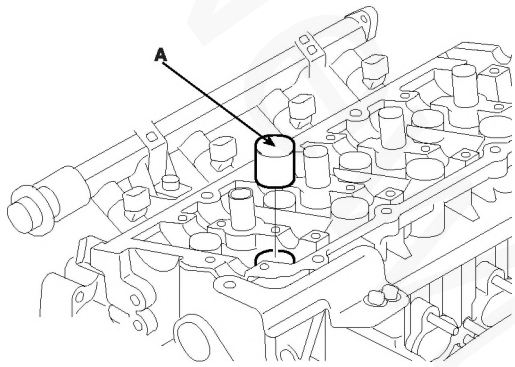
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

DISASSEMBLY E60D4118

NOTE

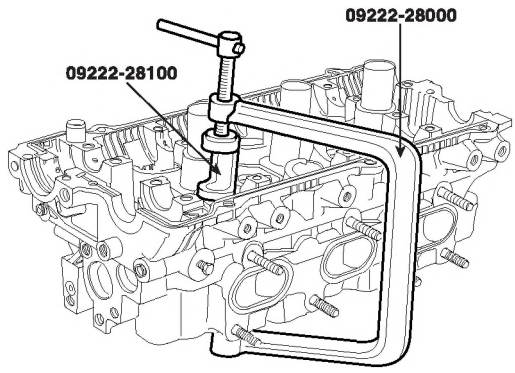
Identify HLA(Hydraulic Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove HLAs(A).



ECKD217A

2. Remove valves.
   1) Using SST(09222-28000, 09222-28100), compress the valve spring and remove retainer lock.



EDQF169A

   2) Remove the spring retainer.
   3) Remove the valve spring.
   4) Remove the valve.
   5) Using needle-nose pliers, remove the oil seal.
   6) Using a magnetic finger, remove the spring seat.

INSPECTION E29C1FBF

CLEANING

1. Clean top surfaces of pistons and cylinder block.
   1) Turn the crankshaft, and bring each piston to top dead center(TDC).
      Using a gasket scraper, remove all the carbon from the piston top surface.
   2) Using a gasket scraper, remove all the gasket material from the cylinder block surface.
   3) Using compressed air, blow carbon and oil from the bolt holes.
2. Remove gasket material.
   Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

   ⚠ ***CAUTION***

   Be careful not to scratch the cylinder block contact surface.
3. Clean combustion cambers.
   Using a wire brush, remove all the carbon from the combustion cambers.

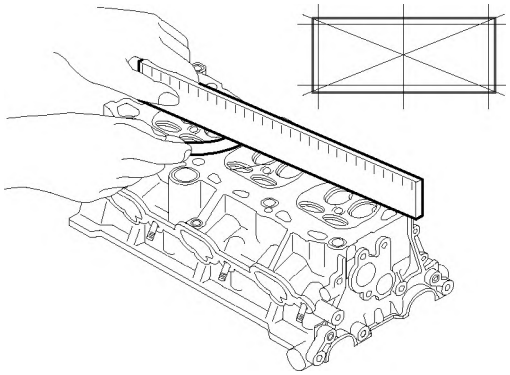
   ⚠ ***CAUTION***

   Be careful not to scratch the cylinder block contact surface.
4. Clean cylinder heads.
   Using a soft brush and solvent. throrghly clean the cylinder head.
5. Clean valves.
   1) Using a gasket scraper, chip off any carbon from the valve head.
   2) Using a wire brush throroghly clean the valve.

CYLINDER HEAD

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

Flatness of cylinder head gasket surface
Standard : Less than 0.03mm(0.0012 in.)
Limit : 0.05 mm (0.0020 in.)



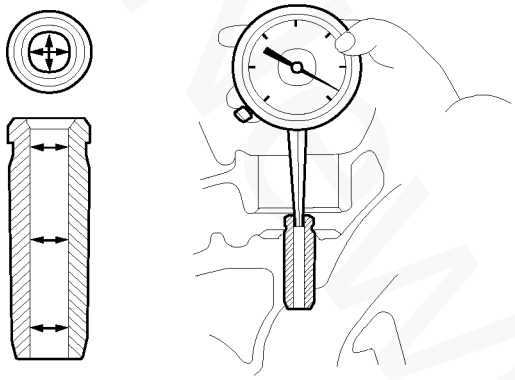
EDQF160A

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

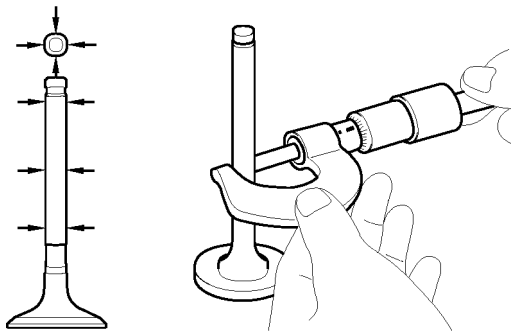
1. Inspect valve stems and valve guides.

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



ECKD219A

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



ECKD220A

   3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.
   Valve stem-to-guide clearance

[Standard]
Intake : 0.02 ~ 0.05mm (0.0008 ~ 0.0020in.)
Exhaust : 0.030 ~ 0.065mm (0.0012 ~ 0.0026in.)
[Limit]
Intake : 0.1mm (0.0040in.)
Exhaust : 0.13mm (0.0051in.)

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

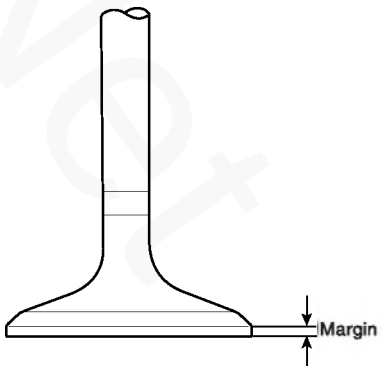
2. Inspect valves.

   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 : 1.0mm (0.0394in.)
Exhaust : 1.3mm (0.0512in.)
[Limit]
Intake : 0.5mm (0.0197in.)
Exhaust : 0.8mm (0.0315in.)



ECKD221A

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

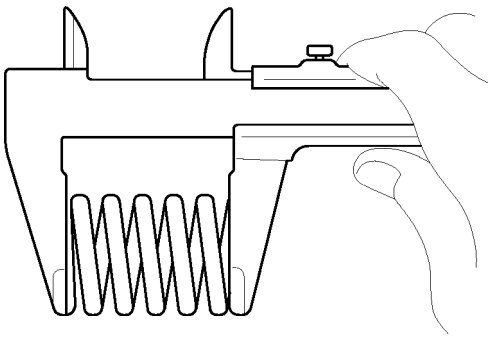
3. Inspect valve seats
Check the valve seat for evidence of overheating and improper contact with the valve face.
Replace the seat if necessary.
Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat. Recondition the valve seat 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 : 42.5mm (1.6732in.)
Load : 21kg/35mm (48.4kg/1.378mm)
[Limit]
Free height : -1.0mm (-0.0394 in.)
Out-of-square : 3°



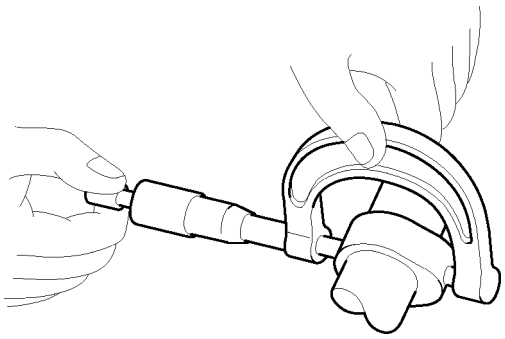
ECKD222A

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

CAMSHAFT

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

Cam height
[Standard value]
Intake : 43.95 ~44.15mm (1.7303 ~ 1.7382in.)
Exhaust : 43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)



ECKD223A

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

2. Inspect cam journals.
Using a micrometer, measure the journal diameter.

Journal diameter
Standard value
25.964 ~ 25.980mm (1.0222 ~ 1.0228in.)

If the journal diameter is not as specified, check the oil clearance.

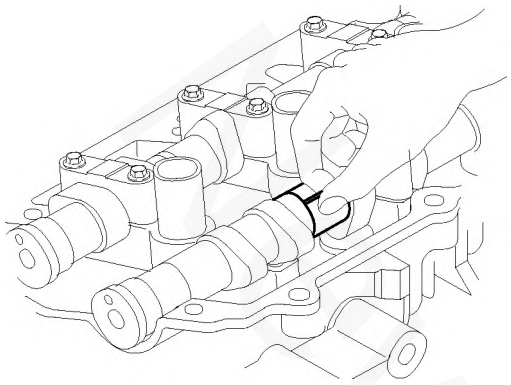
3. Inspect camshaft bearings.
Check that bearing for flaking and scoring. If the bearings are damaged, replace the bearing caps and cylinder head as a set.

4. Inspect camshaft journal oil 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 EMA - 37)

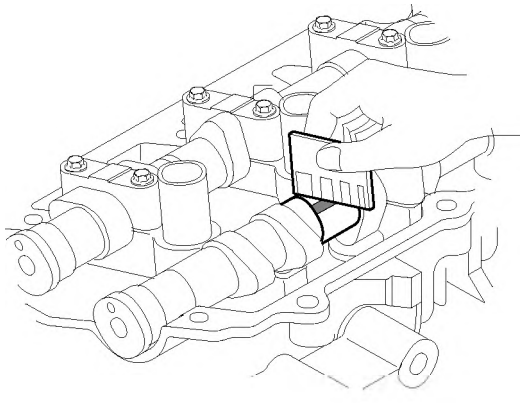
⚠ ***CAUTION***

Do not turn the camshaft.

5) Remove the bearing caps.

6) Measure the plastigage at its widest point.

Bearing oil clearance
Standard value : 0.02 ~ 0.061mm (0.0008 ~ 0.0024in.)
Limit : 0.1mm (0.0039in.)



ECKD225A

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

7) Completely remove the plastigage.

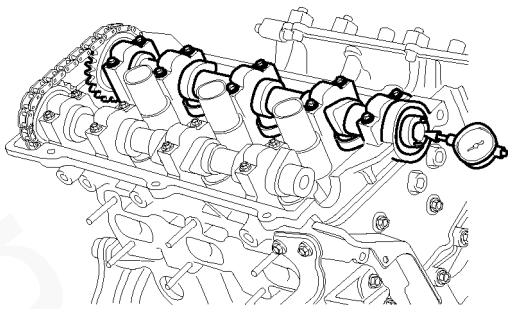
8) Remove the camshafts.

5. Inspect camshaft end play.

1) Install the camshafts. (See page EMA - 37)

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

Camshaft end play
Standard value : 0.1 ~ 0.15mm (0.004 ~ 0.0059in.)



EDQF053B

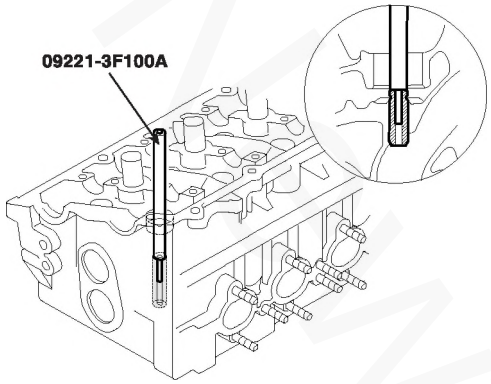
If the end play is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3) Remove the camshafts.

REPLACEMENT EED266F4

VALVE GUIDE

1. Using the SST(09221-3F100A), withdraw the old valve guide toward the bottom of cylinder head.



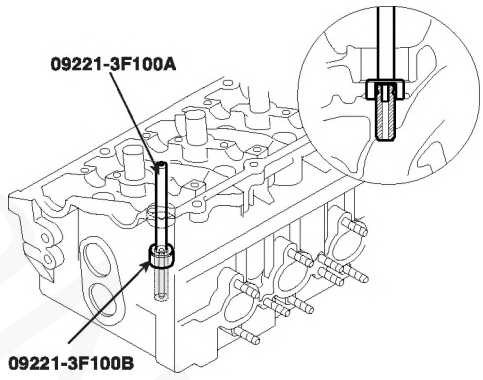
EDKD900A

2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.

3. Using the SST(09221-3F100A/B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

Over size mm(in.)	Size mark	Oversize valve guide hole size mm(in.)
0.05 (0.002)	5	11.05 ~ 11.068 (0.4350 ~ 0.4357)
0.25 (0.010)	25	11.25 ~ 11.268 (0.4429 ~ 0.4436)
0.50 (0.020)	50	11.50 ~ 11.518 (0.4528 ~ 0.4535)

Valve guide length
Intake : 39mm (1.535in.)
Exhaust : 43mm (1.693in.)



EDKD900B

4. After the valve guide is press-fitted, insert a new valve and check for proper stem -to-guide clearance.

5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

REASSEMBLY EDCA3D22

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.

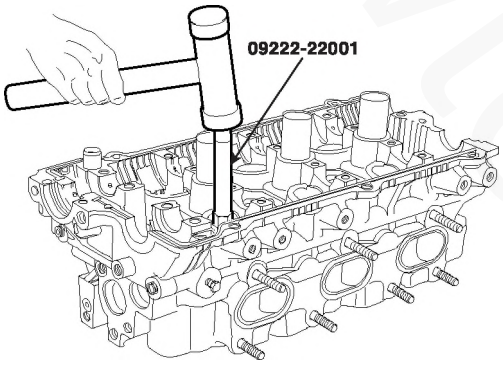
1. Install valves.

   1) Install the spring seats.

   2) Using SST(09222-22001), 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.



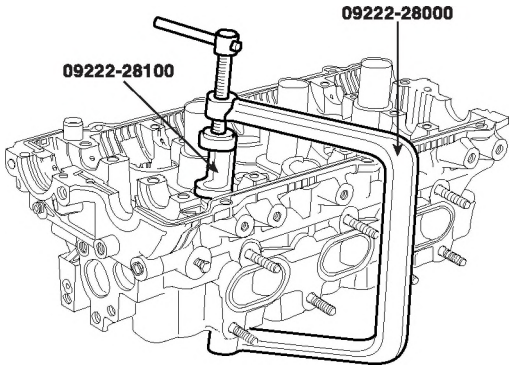
EDQF167A

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

NOTE

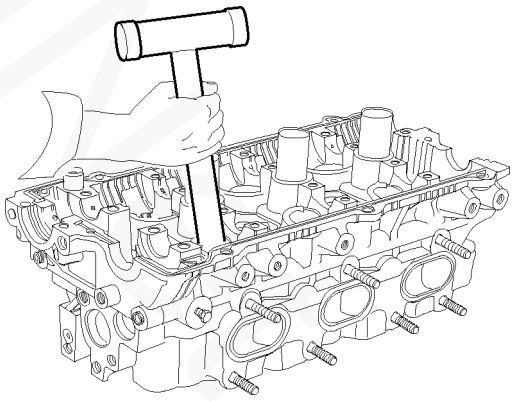
Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

   4) Using the SST(09222-28000, 09222-28100), 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.



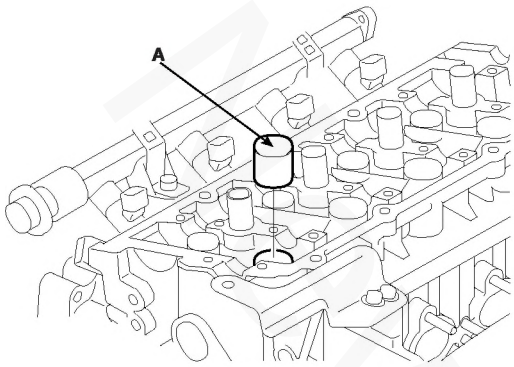
EDQF169A

   5) 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.



EDQF168A

2. Install HLAs.
   Check that the HLA rotates smoothly by hand.



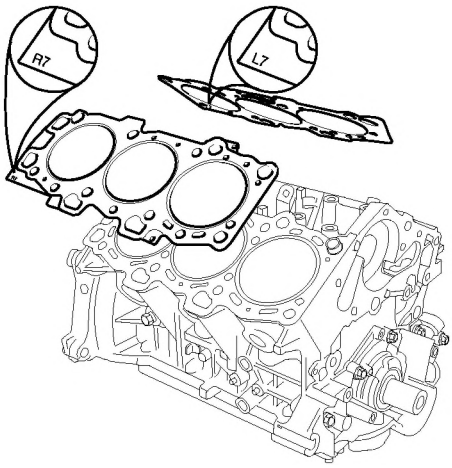
ECKD217A

INSTALLATION E1F59CAC

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 EMA - 13).*

1. Install the cylinder head gaskets on the cylinder block.



EDQF170A

NOTE

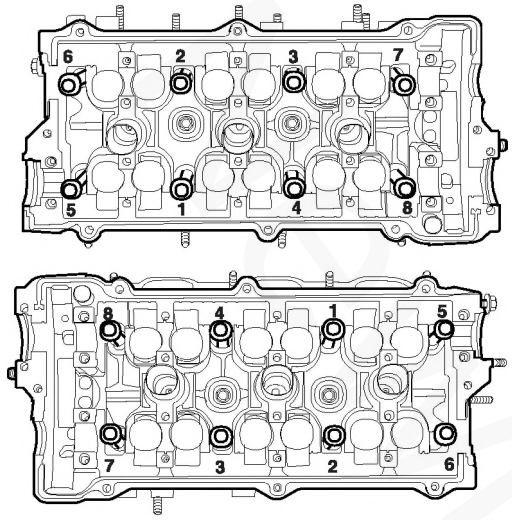
Be careful of the installation direction.

2. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.

Tightening torque
25Nm (250kgf.cm, 18lbf.ft) + 60° + 45°

   1) Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.
   2) Install the plate washer to the cylinder head bolt.

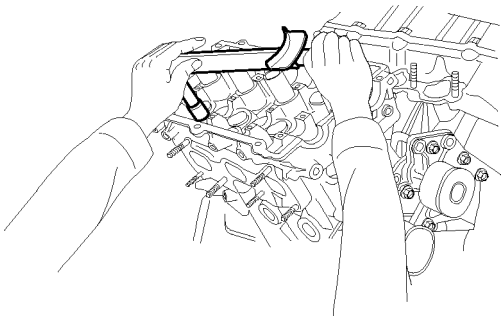
3) Install and uniformly tighten the cylinder head bolts on each cylinder head in several passes and in the sequence shown, then repeat for the other side, as shown.



EDQF166B

If only one of the cylinder head bolts dose not meet the torque specification, replace the cylinder head bolt.

Torque : 25Nm (250kgf.cm, 18lbf.ft)



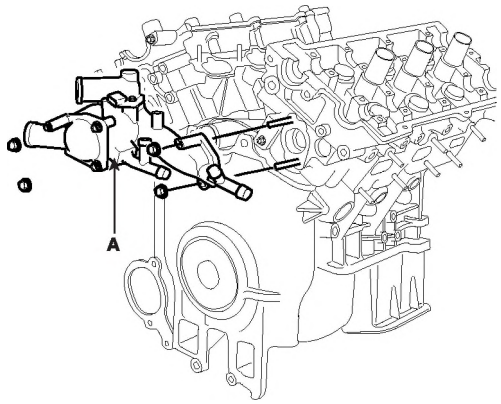
EDQF156A

4) Retighten the cylinder head bolts by 60° in the numerical order shown.

5) Retighten the cylinder head bolts by 45° in the numerical order shown.

4. Install the water pipe and water temperature control assembly(A).

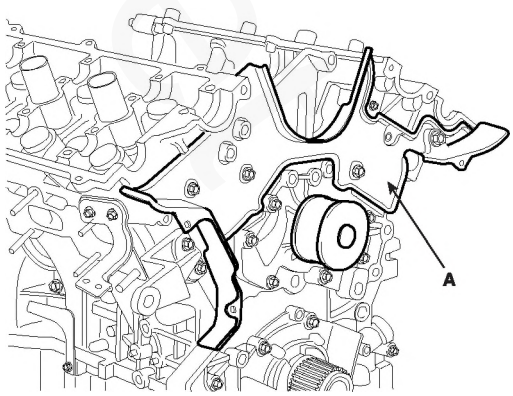
Tightening torque
Water temperature control
15 ~ 20Nm (150 ~ 200kgf.cm, 11 ~ 14lbf.ft)



EDQF058A

5. Install the timing belt rear cover(A).

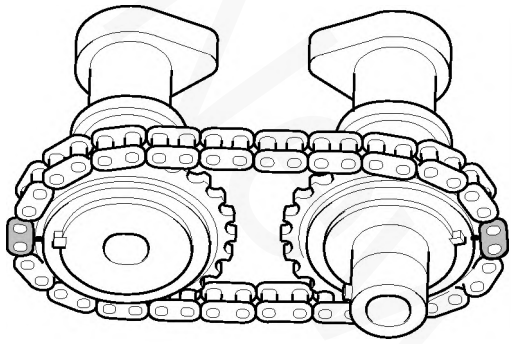
Tightening torque
Timing belt rear cover
10 ~ 12Nm (100 ~ 120kgf.cm, 7 ~ 9lbf.ft)



EDQF057A

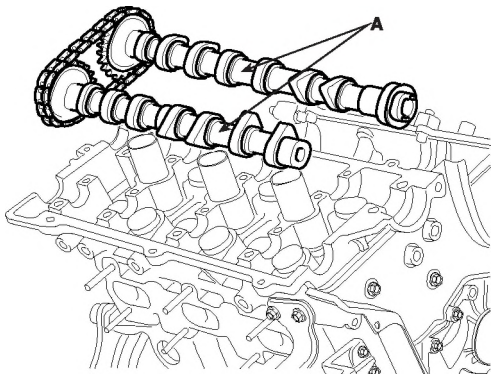
6. Install the camshafts.

1) Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown.



EDQF155A

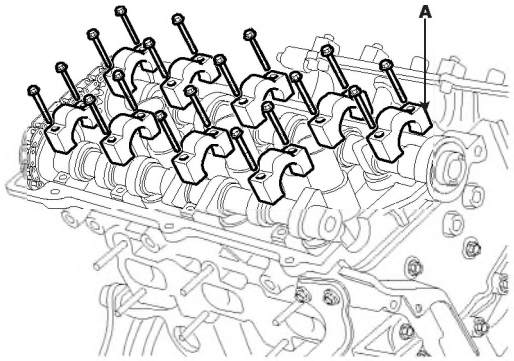
2) Install the camshaft(A).



EDQF054A

3) Install the camshaft bearing caps(A).

Tightening torque
M6(38mm) : 10 ~ 12Nm (100 ~ 120kgf.cm, 7 ~ 9lbf.ft)
M6(50mm) : 14 ~ 16Nm (140 ~ 160kgf.cm, 10 ~ 12lbf.ft)

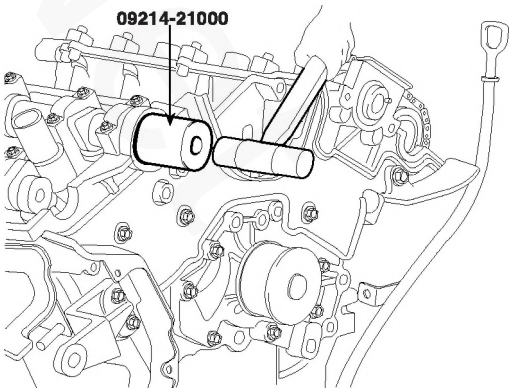


EDQF053A

NOTE

- *Apply new engine oil to the thrust portion and journal of the camshafts.*
- *Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.*

7. Using the SST (09214-21000), install the camshaft bearing oil seal.



EDQF052A

8. Install the camshaft sprocket.

1) Temporarily install the camshaft sprocket bolts.

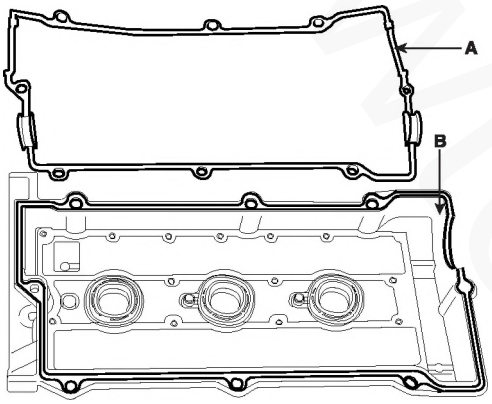
2) Hold the hexagonal head wrench portion of the camshaft with a wrench, and tighten the camshaft sprocket bolts.

Tightening torque
Camshaft sprocket bolt
90 ~ 110Nm (900 ~ 1100kgf.cm, 65 ~80lbf.ft)

9. Install semi-circular packing.

10. Install the cylinder head cover.

1) Install the cylinder head cover gasket(A) in the groove of the cylinder head cover(B).



EDQF171A

NOTE

- *Before installing the head cover gasket, thoroughly clean the head cover gasket and the groove.*
- *When installing, make sure the head cover gasket is seated securely in the corners of the recesses with no gap.*

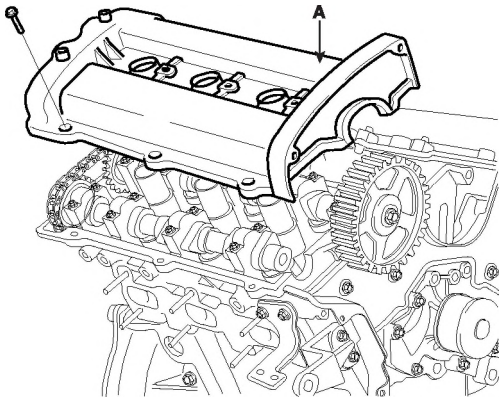
2) Apply liquid gasket to the head cover gasket at the corners of the recess.

NOTE

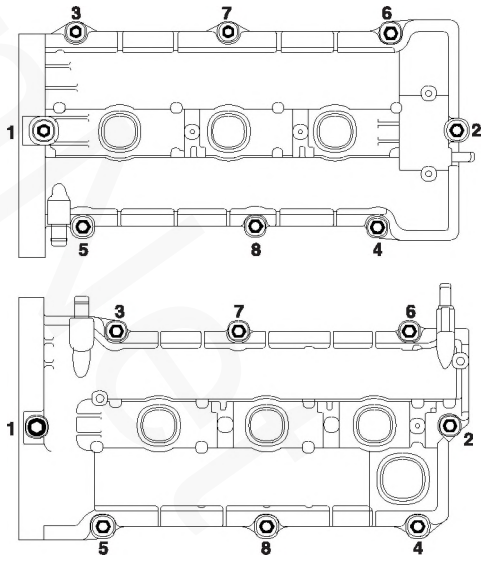
- *Use liquid gasket, loctite No.5699.*
- *Check that the mating surfaces are clean and dry before applying liquid gasket.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

3) Install the cylinder head covers(A) with the 16bolts. Uniformly tighten the bolts in several passes.

Tightening torque
8 ~ 10Nm (80 ~ 100kgf.cm, 6 ~ 7.4lbf.ft)



EDQF050A



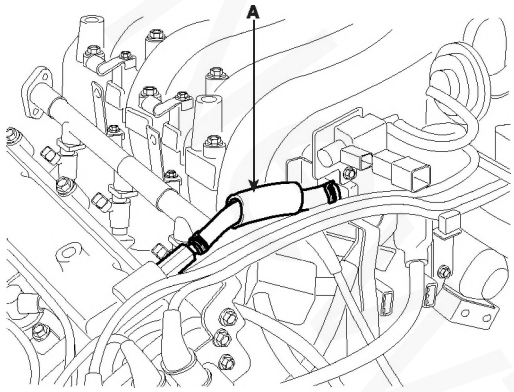
EDQF172A

11. Install the spark plug cable. (See EE group - ignition)

12. Install the timing belt. (See page EMA - 17).

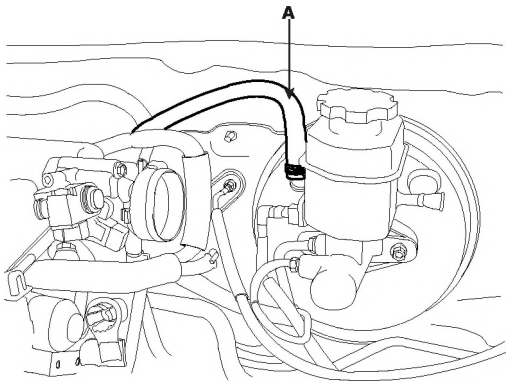
13. Install the exhaust manifold. (See page EMA - 91)

14. Install the power steering pump. (See ST group - power steering pump)
15. Install the intake manifold. (See page EMA - 90)
16. Install the PCV hose(A).



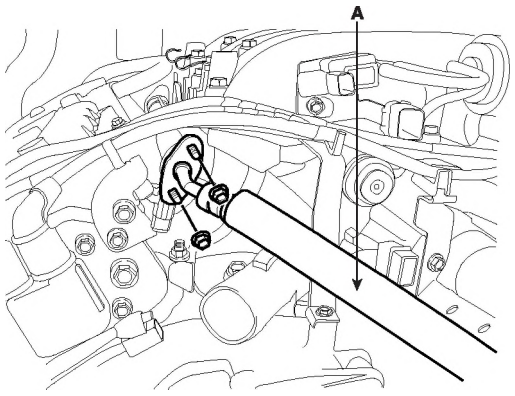
EDQF014A

17. Install the accelerator cable.
18. Install the brake booster vacuum hose(A).



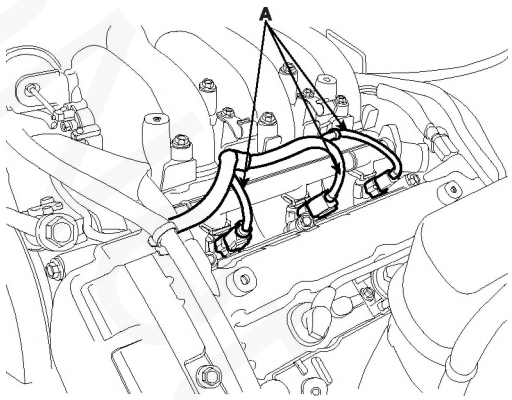
EDQF020A

19. Install the PCSV hose.
20. Install the fuel inlet hose(A).



EDQF025A

21. Install the engine wire harness connectors and wire harness clamps to the cylinder head and the intake manifold.
    1) Three fuel injector connectors(A).

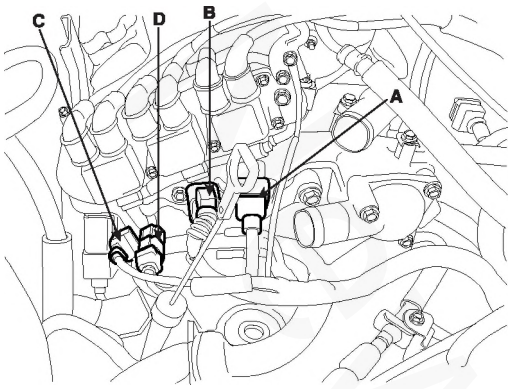


EDQF028A

    2) Oxygen sensor connector(D).
    3) Crankshaft position sensor connector(C).

4) Ignition coil connector(B).

5) ECT sensor connector(A).



EDQF033A

6) CMP(Camshaft position sensor) connector(G).

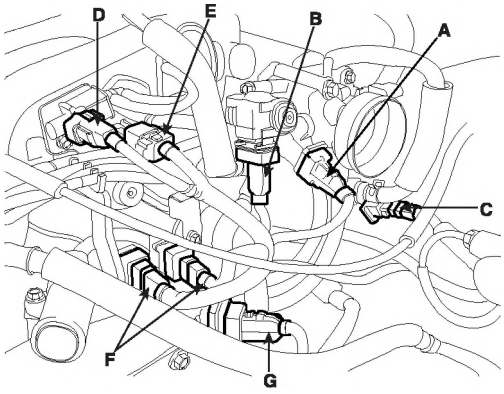
7) Knock sensor connector(F).

8) Injector connector(E).

9) PCSV(Purge Control Solenoid Valve) connector(C).

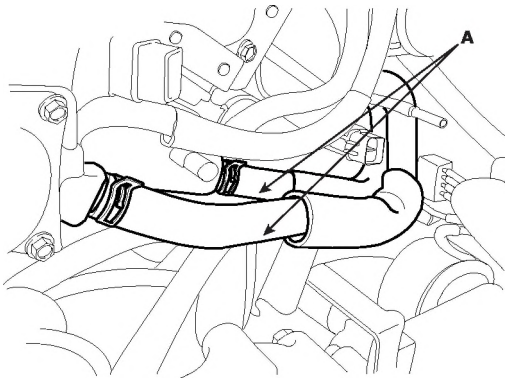
10) ISA connector(B).

11) TPS connector(A).



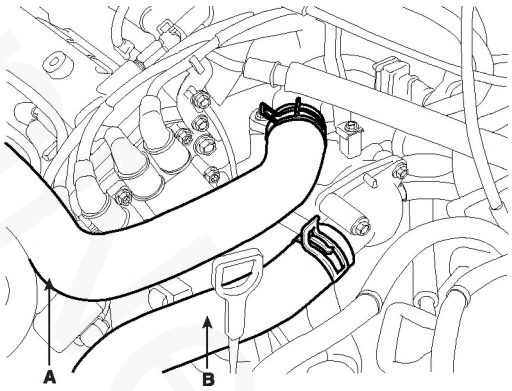
EDQF032A

22. Install the heater hoses(A).



EDQF019A

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



EDQF037A

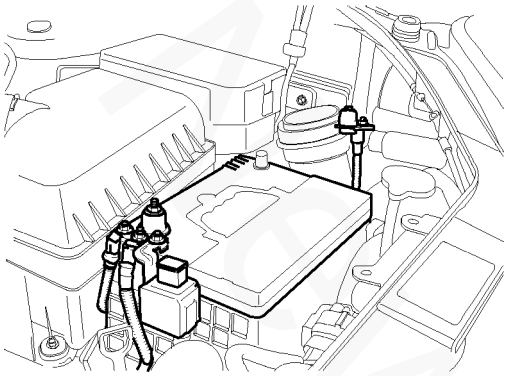
24. Install the intake air hose and air cleaner assembly.

1) Install the intake air hose and air cleaner assembly.

2) Connect the breather hose from air cleaner hose.

3) Connect the AFS connector.

25. Install the engine cover.
26. Connect the negative terminal to the battery.



EDQF040A

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 E4AD264D

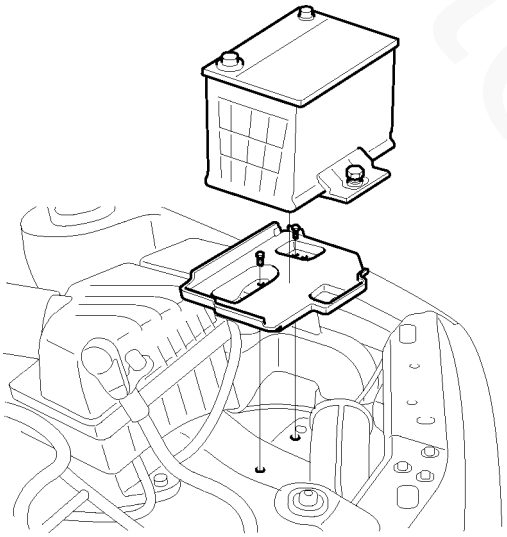
CAUTION

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

NOTE

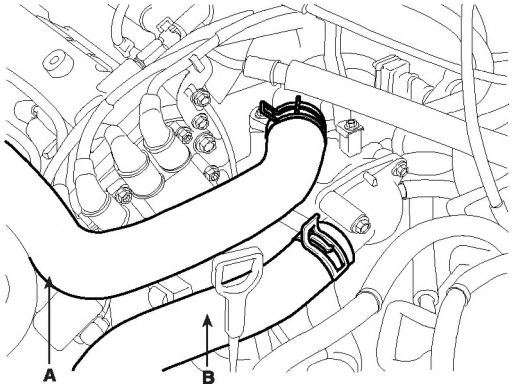
- *Mark all wiring and hoses to avoid misconnection.*
- *Inspection the timing belt before removing the cylinder head.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (See page EMA - 13)*

1. Disconnect the negative terminal from the battery.



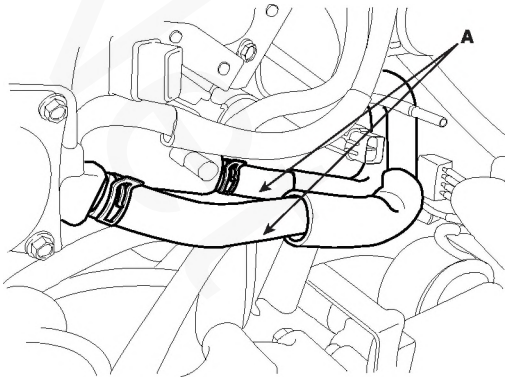
ECKD201B

2. Remove the engine cover.
3. Drain the engine coolant.
   Remove the radiator cap to speed draining.
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) Remove the intake air hose and air cleaner assembly.
5. Remove the upper radiator hose(A) and lower radiator hose(B).



EDQF037A

6. Remove the heater hoses(A).



EDQF019A

7. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.

   1) TPS(Throttle Position Sensor) connector(A).

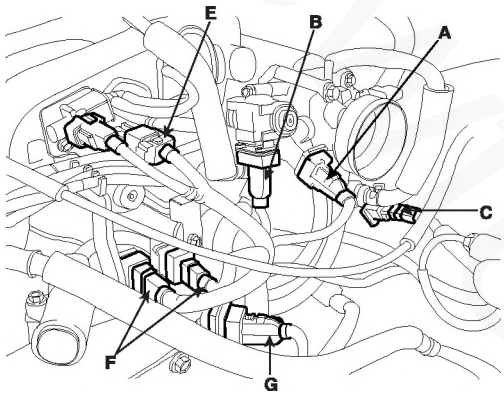
   2) ISA(Idle Speed Actuator) connector(B).

   3) PCSV(Purge Control Solenoid Valve) connector(C).

   4) Injector connector(E).

   5) Knock sensor connector(F).

   6) CMP(Camshaft Position Sensor) connector(G).



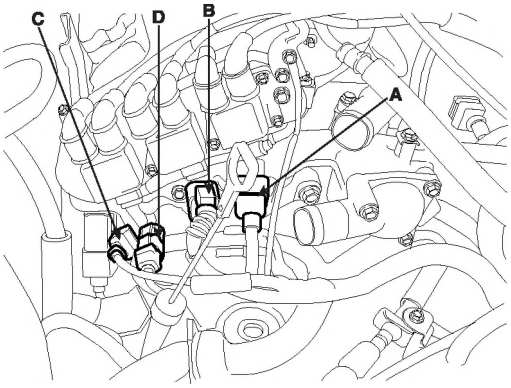
ECOF001A

   7) ECT(Engine Coolant Temperature) sensor(A) connector.

   8) Ignition coil connector(B).

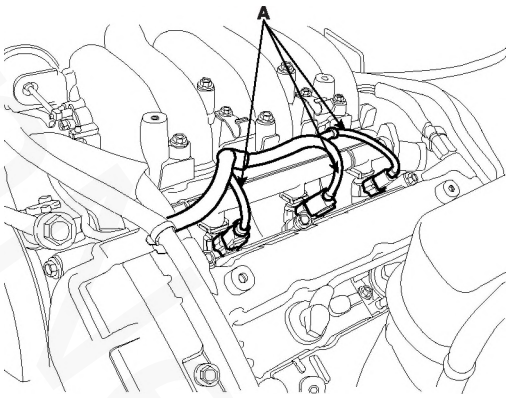
   9) Crankshaft position sensor connector(C).

   10) Rear oxygen sensor connector(D).



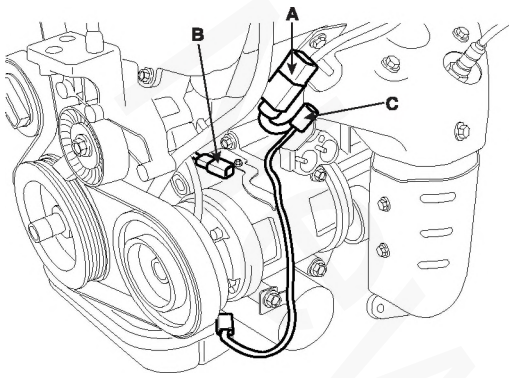
EDQF033A

   11) Three fuel injector connectors(A).



EDQF028A

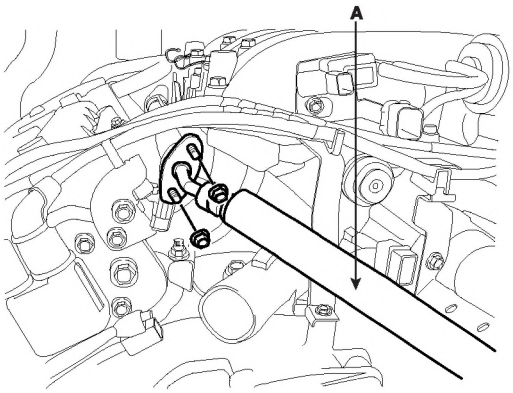
8. Disconnect front heated oxygen sensor(LH) connector(A), air compressor switch connector(B) and oil pressure sensor connector(C).



EDQF009A

9. Disconnect rear heated oxygen sensor(RH) connector.

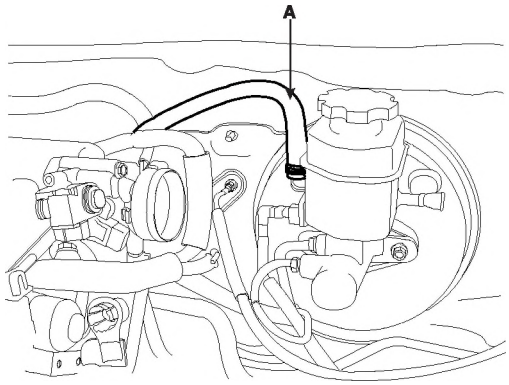
10. Remove the fuel inlet from delivery pipe(A).



EDQF025A

11. Remove the PCSV hose.

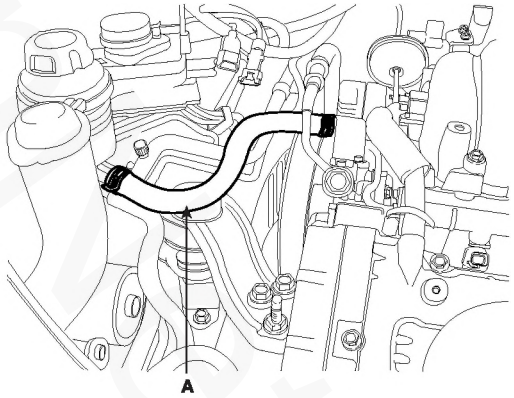
12. Remove the brake booster vacuum hose(A).



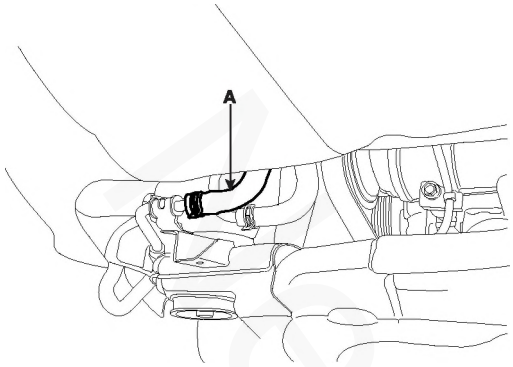
EDQF020A

13. Remove the accelerator cable by loosening the locknut, then slip the cable end out of the throttle linkage.

14. Remove the power steering pump hose(A).



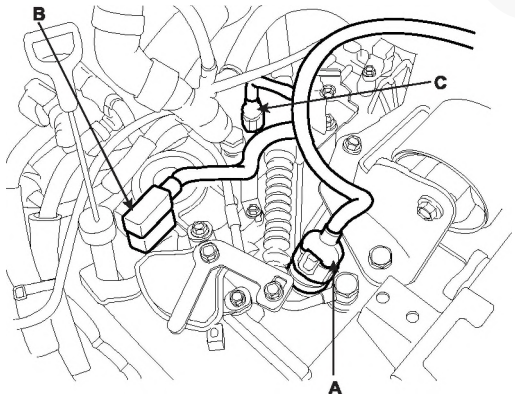
EDQF024A



EDQF021A

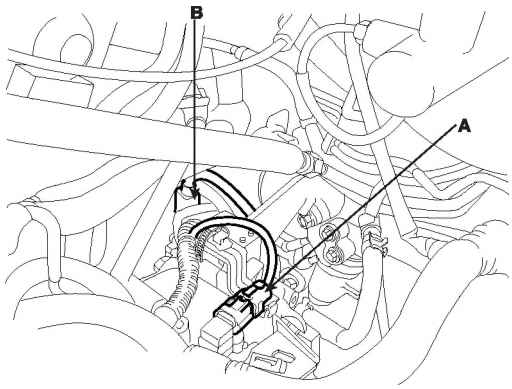
15. Remove the battery body bracket.

16. Disconnect the transaxle wire harness connector.
    a. Disconnect the inhibitor switch connector(A).
    b. Disconnect the transaxle range connector(B).
    c. Disconnect the input shaft speed connector(C).



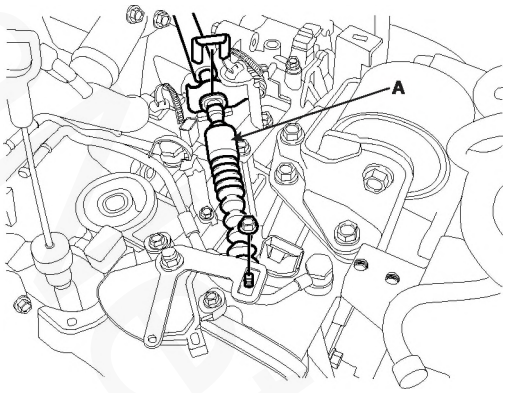
EDQF035A

d. Disconnect the output shaft speed connector(A).
e. Disconnect the vehicle speed sensor connector(B).



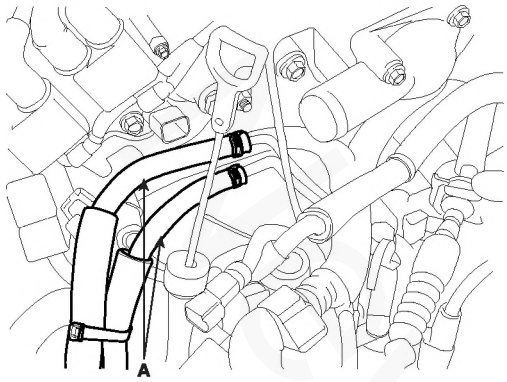
EDQF031A

17. Remove the control cable(A) transaxle range switch.



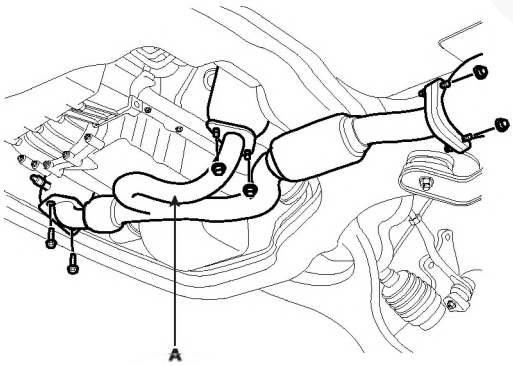
EDQF018A

18. Remove the transaxle oil cooler hoses(A/T)(A).



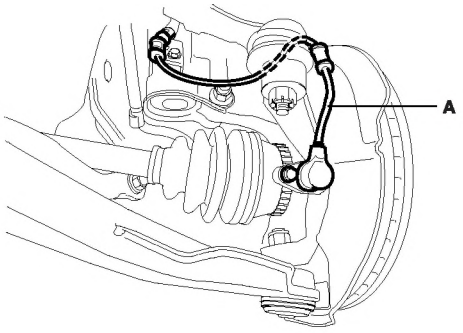
EDQF034A

19. Remove the under cover.
20. Remove the front exhaust pipe(A).



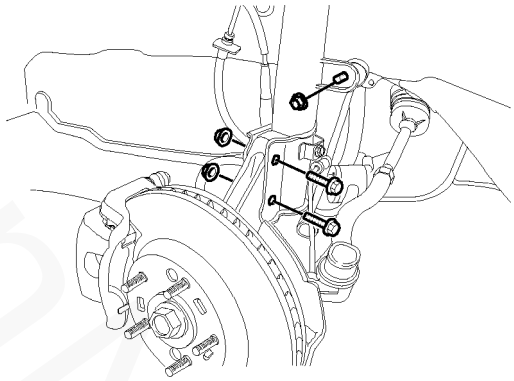
EDQF001A

21. Disconnect the ABS wheel speed sensor(A) from both front knuckles. (See DS group - front axle).



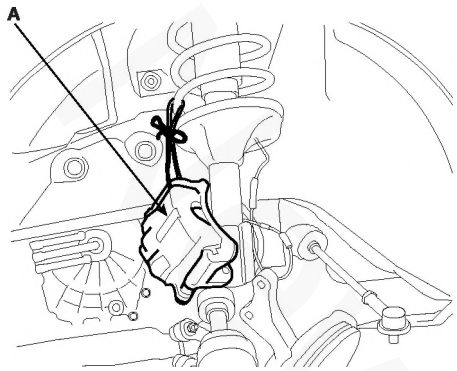
KXDSE03A

22. Remove the front strut lower mounting bolts and nuts. (See SS group - front strut).



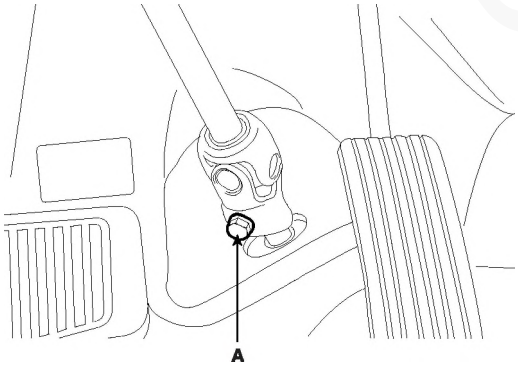
EDQF023A

23. Remove the caliper and hang the caliper assembly(A).



ECKD612A

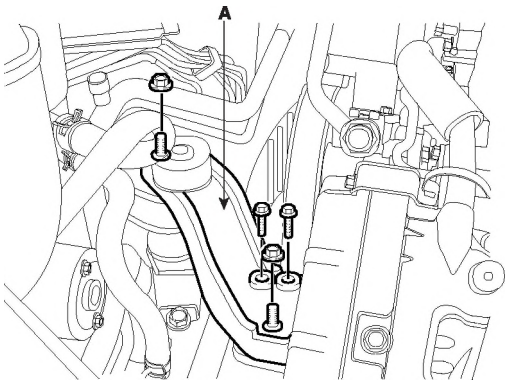
24. Remove the steering u-joint mounting bolt(A). (See ST group - steering)



ECKD616A

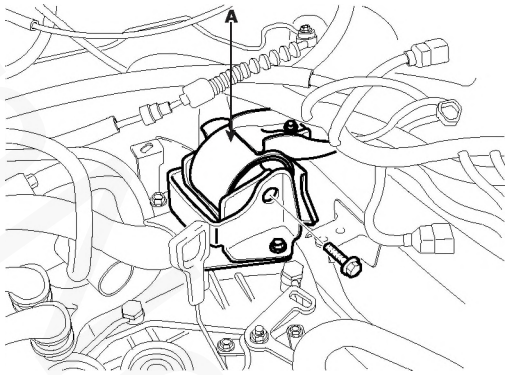
25. Install the jack for supporting engine and transaxle assembly.

26. Remove the engine mounting bracket(A).



EDQF017A

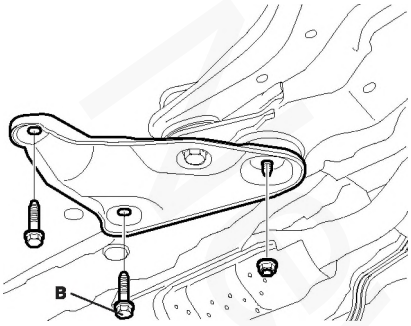
27. Remove the transaxle mounting bracket(A).



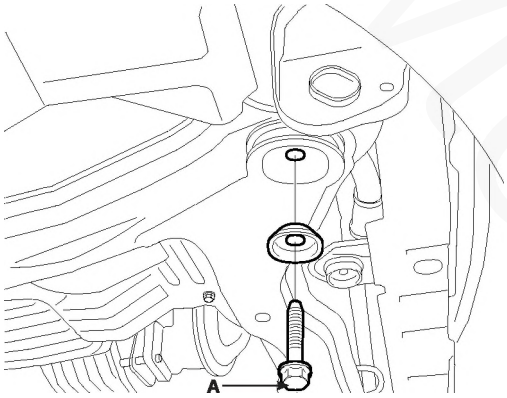
EDQF016A

28. Remove the sub frame mounting bolts and nuts.

Tightening torque
A : 160 ~ 180Nm (1600 ~ 1800kgf.cm, 118 ~ 133lbf.ft)
B : 70 ~ 90Nm (700 ~ 900kgf.cm, 52 ~ 66lbf.ft)



ECOF002A



ECKD618A

29. Jack up the vehicle.

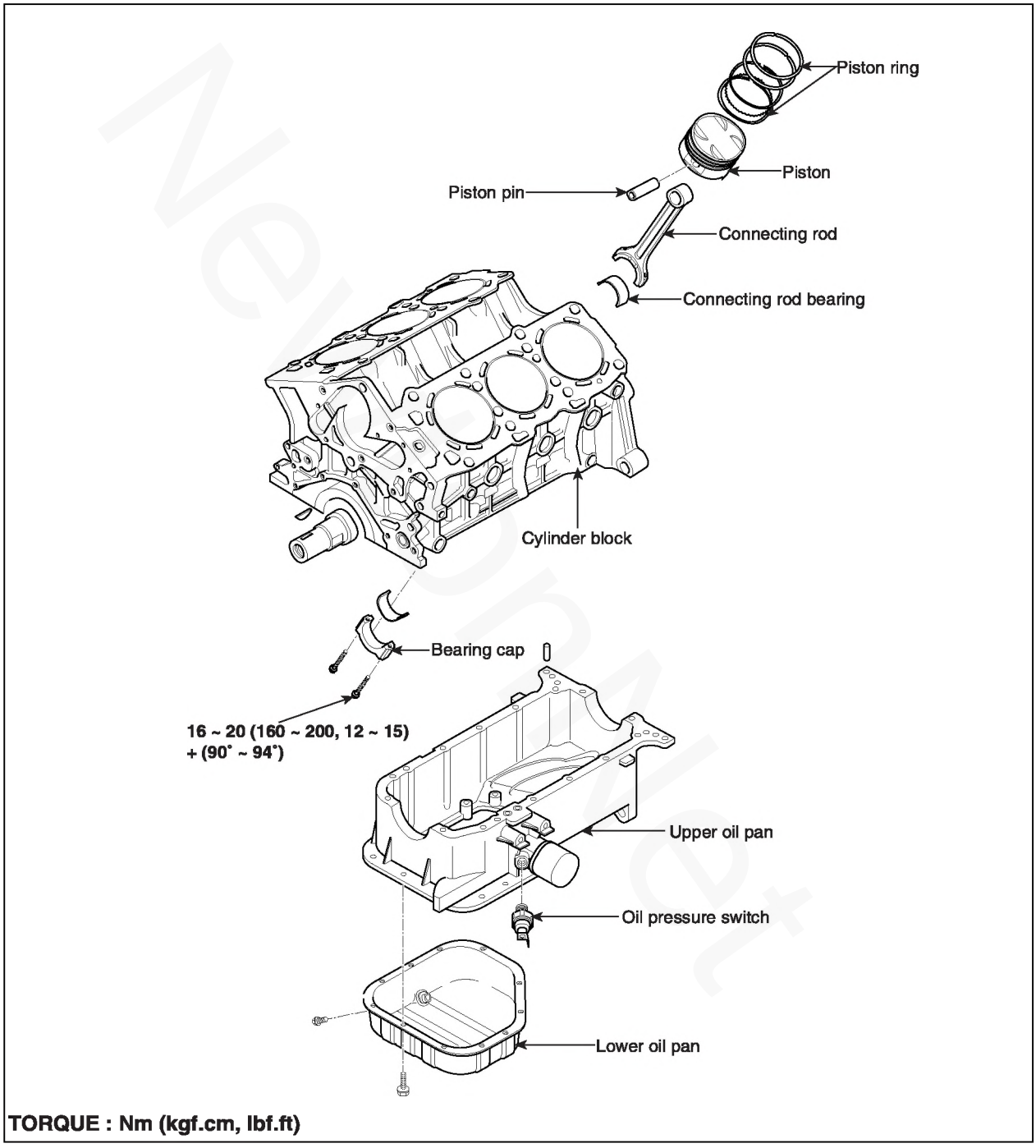
INSTALLATION EFBF5C5C

Installation is in the reverse order of removal.

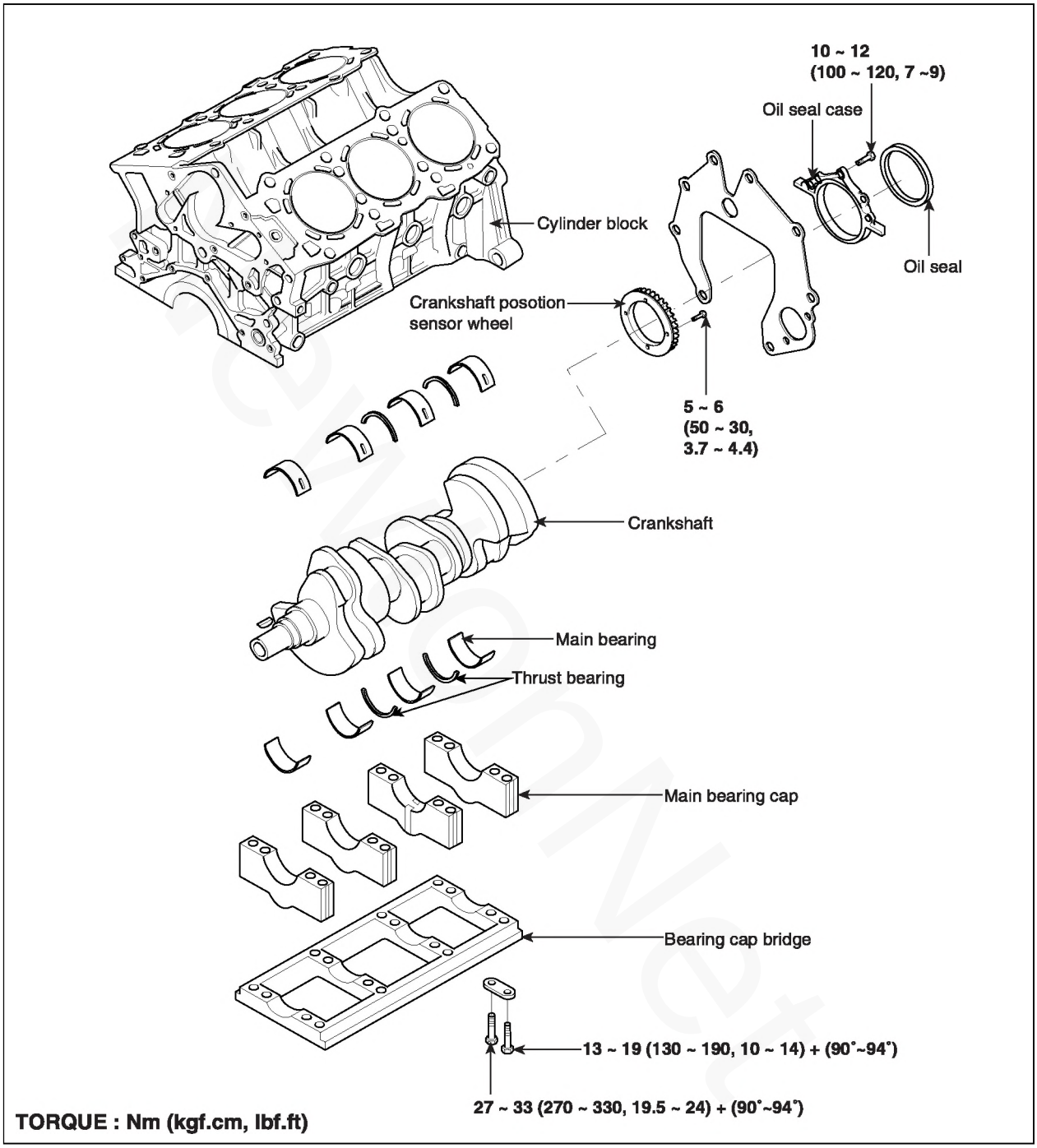
Perform the following :
- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- Clean the battery posts and cable terminals 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

COMPONENT E75D75CB



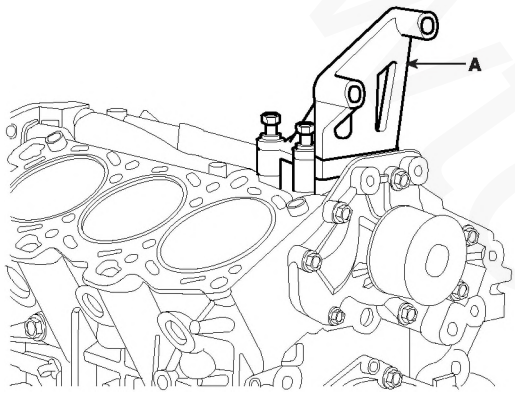
EDQF203A


10 ~ 12
(100 ~ 120, 7 ~9)
Oil seal case
Cylinder block
Oil seal
Crankshaft posotion
sensor wheel
5 ~ 6
(50 ~ 30,
3.7 ~ 4.4)
Crankshaft
Main bearing
Thrust bearing
Main bearing cap
Bearing cap bridge
13 ~ 19 (130 ~ 190, 10 ~ 14) + (90˚~94˚)
27 ~ 33 (270 ~ 330, 19.5 ~ 24) + (90˚~94˚)
TORQUE : Nm (kgf.cm, lbf.ft)

EDQF204A

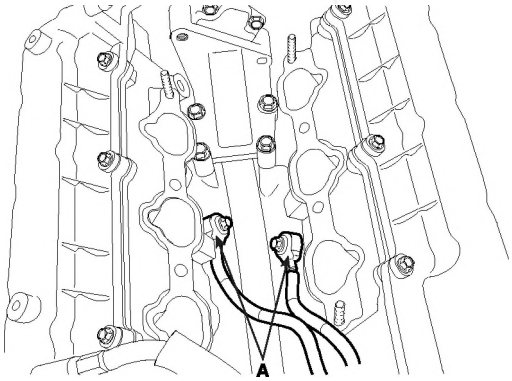
DISASSEMBLY EB8FA3DB

1. A/T : remove drive plate.
2. Install engine to engine stand for disassembly(A).
3. Remove timing belt. (See page EMA - 13)
4. Remove cylinder head. (See page EMA - 23)
5. Remove oil level gauge assembly.
6. Remove the alternator. (See EE group - alternator).
7. Remove the air compressor. (See HA group - air compressor)
8. Remove the power steering pump bracket(A).



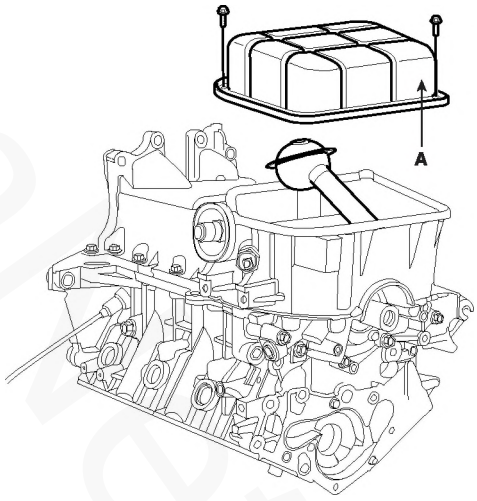
EDQF061A

9. Remove water pump. (See page EMA - 74)
10. Remove knock sensors(A).



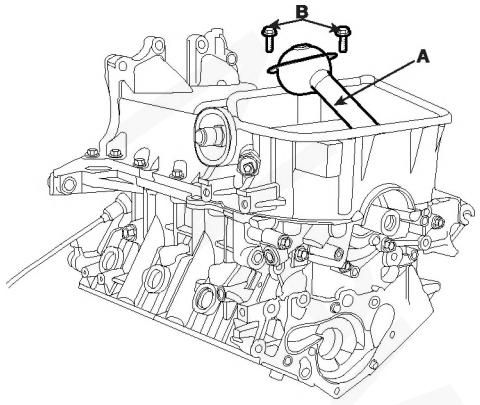
EDQF181A

11. Remove the lower oil pan(A).



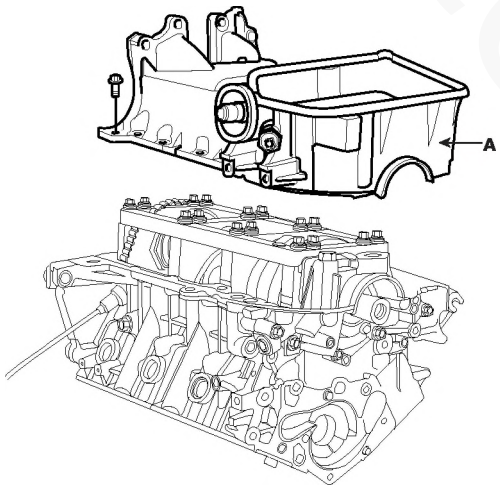
EDQF065A

12. Remove oil screen.
Remove the 2bolts(B), oil screen(A) and gasket.



EDQF066A

13. Remove the upper oil pan(A).



EDQF067A

14. Check the connecting rod end play. (See page EMA - 54)

15. Remove the connecting rod caps and check oil clearance. (See page EMA - 54)

16. Remove piston and connecting rod assemblies.

1) Using a ridge reamer, remove all the carbon from the top of the cylinder.

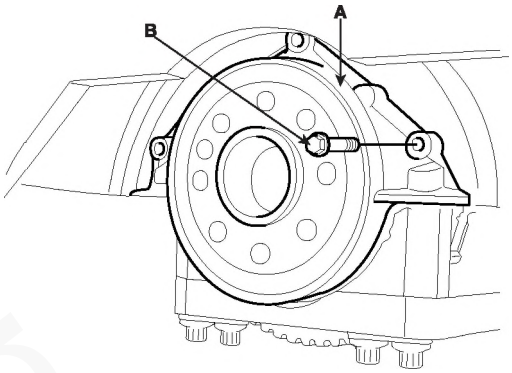
2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE

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

17. Remove front case. (See page EMA - 80)

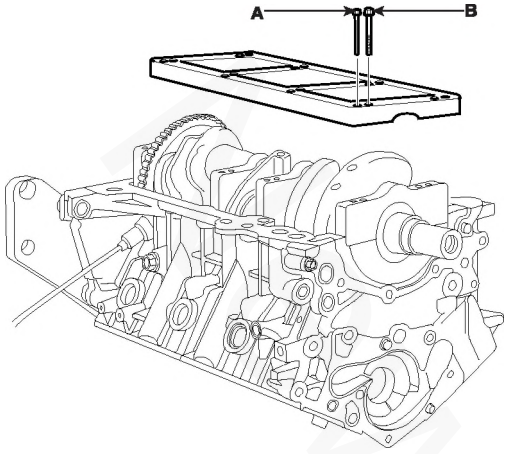
18. Remove oil seal case.
Remove the 3bolts(B) and oil seal case(A).



EDQF174B

19. Check the crankshaft end play. (See page EMA - 58)

20. Remove crankshaft bearing cap and check oil clearance. (See page EMA - 56)

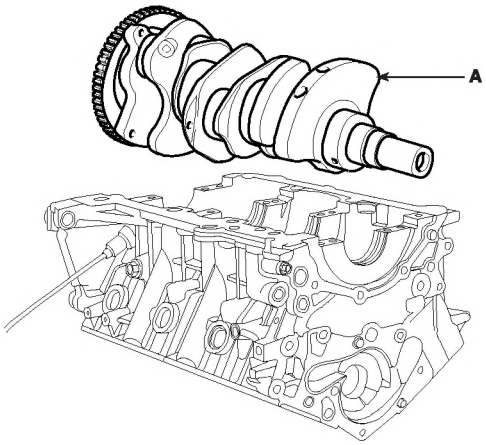


EDQF072A

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

NOTE

Arrange the main bearings and trust washers in the correct order.



EDQF074A

22. 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.

23. Remove piston rings.

1) Using a piston ring expender, remove the 2 compression rings.

2) Remove the 2side rails and oil ring by hand.

NOTE

Arrange the piston rings in the correct order only.

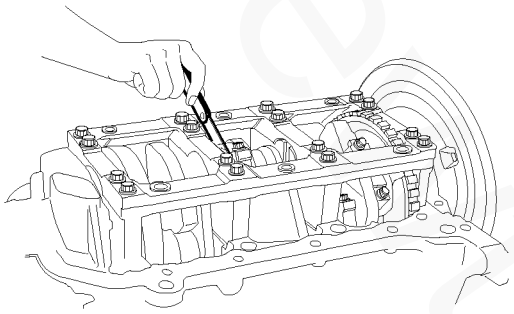
24. Disconnect connecting rod from piston.

INSPECTION EE99516D

CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.
   Using a dial indicator, 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 : 0.4mm(0.016in.)



EDQF159A

- If out-of-tolerance, replace the connecting rod assembly.
- 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 the 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.

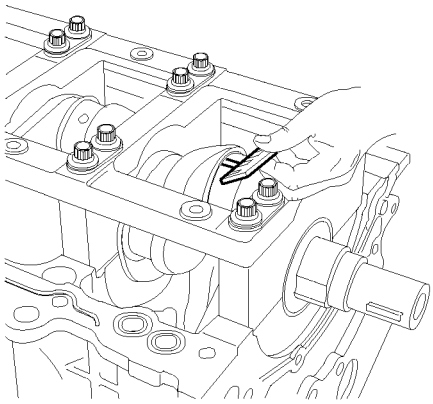
Tightening torque 16 ~ 20Nm (160 ~ 200kgf.cm, 12 ~ 15lbf.ft) + 90°

NOTE

Do not turn the crankshaft.

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

Standard oil clearance 0.018 ~ 0.036mm(0.0007 ~ 0.0014in.)



EDQF175A

   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.

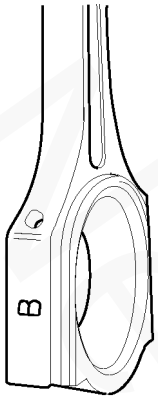
NOTE

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

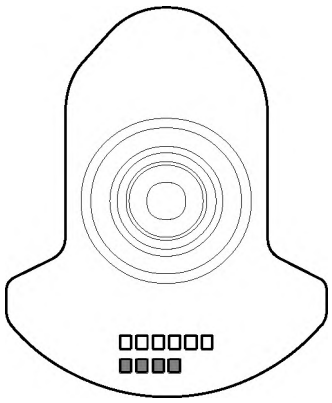


EDQF196A

Discrimination of connecting rod

CLASS	MARK	INSIDE DIAMETER
0	A	51.000 ~ 51.006mm (2.0079 ~ 2.0081in.)
1	B	51.006 ~ 51.012mm (2.0081 ~ 2.0083in.)
2	C	51.012 ~ 51.018mm (2.0083 ~ 2.0086in.)

Crankshaft pin mark location

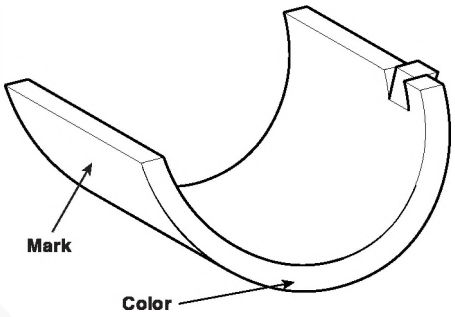


EDQF176A

Discrimination of crankshaft

CLSASS	MARK	OUTSIDE DIAMETER OF PIN
I	A	47.994 ~ 48.000mm (1.8895 ~ 1.8898in.)
II	B	47.988 ~ 47.994mm (1.8893 ~ 1.8895in.)
III	C	47.982 ~ 47.988mm (1.8890 ~ 1.8893in.)

Place of identification mark (Connecting rod bearing)



ECKD313A

Discrimination of connecting rod bearing

CLASS	MARK	THICKNESS OF BEARING
A	BLUE	1.500 ~ 1.503mm (0.0590 ~ 0.0591in.)
B	BLACK	1.497 ~ 1.500mm (0.0589 ~ 0.0590in.)
C	NONE	1.494 ~ 1.497mm (0.0588 ~ 0.0589in.)
D	GREEN	1.491 ~ 1.494mm (0.0587 ~ 0.0588in.)
E	YELLOW	1.488 ~ 1.491mm (0.0586 ~ 0.0587in.)

11) Selection

CRANKSHAFT INDENTIFICATION MARK	CONNECTING ROD IDENTIFICATION MARK	ASSEMBING CLASSIFICATION OF BEARING
I (A)	0 (A)	E (YELLOW)
	1 (B)	D (GREEN)
	2 (C)	C (NONE)
II (B)	0 (A)	D (GREEN)
	1 (B)	C (NONE)
	2 (C)	B (BLACK)
III (C)	0 (A)	C (NONE)
	1 (B)	B (BLACK)
	2 (C)	A (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.

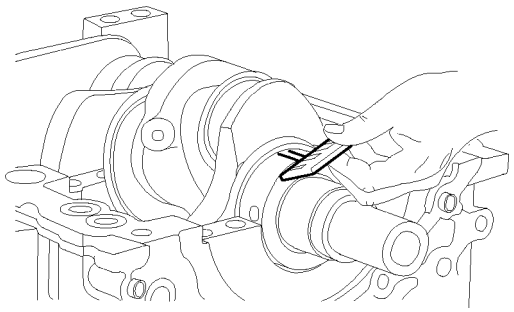
Tightening torque
M8
13 ~ 19Nm (130 ~ 190kgf.cm, 10 ~ 14lbf.ft) + 90°
M10
27 ~ 33Nm (270 ~ 330kgf.cm, 19.5 ~ 24lbf.ft) + 90°

NOTE

Do not turn the crankshaft.

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

Standard oil clearance
0.004 ~ 0.022mm (0.00016 ~ 0.00087in.)



EDQF075A

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

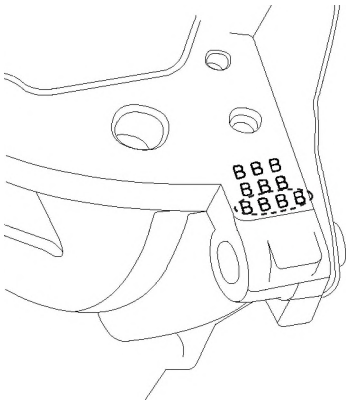
1. When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged on the thrust faces at 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 end of the block as a mark for the size of each of the 4 main journal bores.

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

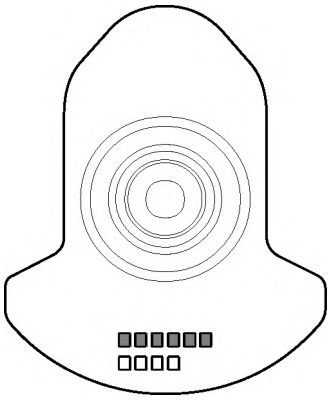


EDQF078A

Discrimination of cylinder block

CLASS	MARK	INSIDE DIAMETER
a	A	66.000 ~ 66.006mm (2.5984 ~ 2.5986in.)
b	B	66.006 ~ 66.012mm (2.5986 ~ 2.5989in.)
c	C	66.012 ~ 66.018mm (2.5989 ~ 2.5991in.)

Crankshaft journal mark location

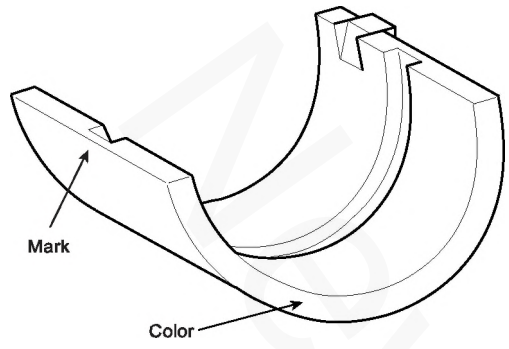


EDQF176B

Discrimination of crankshaft

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	A	61.994 ~ 62.000mm (2.4407 ~ 2.4409in.)
II	B	61.988 ~ 61.994mm (2.4405 ~ 2.4407in.)
III	C	61.982 ~ 61.988mm (2.4402 ~ 2.4405in.)

Place of identification mark (Crankshaft bearing)



ECKD316A

Discrimination of crankshaft bearing

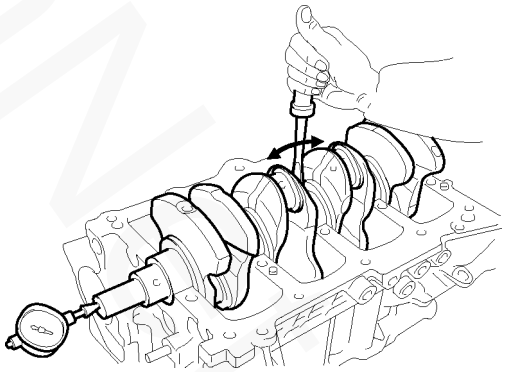
CLASS	MARK	THICKNESS OF BEARING
A	BLUE	2.007 ~ 2.010mm (0.0790 ~ 0.0791in.)
B	BLACK	2.004 ~ 2.007mm (0.0789 ~ 0.0790in.)
C	NONE	2.001 ~ 2.004mm (0.0788 ~ 0.0789in.)
D	GREEN	1.998 ~ 2.001mm (0.0787 ~ 0.788in.)
E	YELLOW	1.995 ~ 1.998mm (0.0785 ~ 0.0787in.)

Selection

CRANKSHAFT IDENTIFICATION MARK	CRANK-SHAFT BORE IDENTIFICA-TION MARK	ASSEM-BLING CLAS-SIFICATION OF BEARING
I (A)	a (A)	E (YELLOW)
	b (B)	D (GREEN)
	c (C)	C (NONE)
II (B)	a (A)	D (GREEN)
	b (B)	C (NONE)
	c (C)	B (BLACK)
III (C)	a (A)	C (NONE)
	b (B)	B (BLACK)
	c (C)	A (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.)



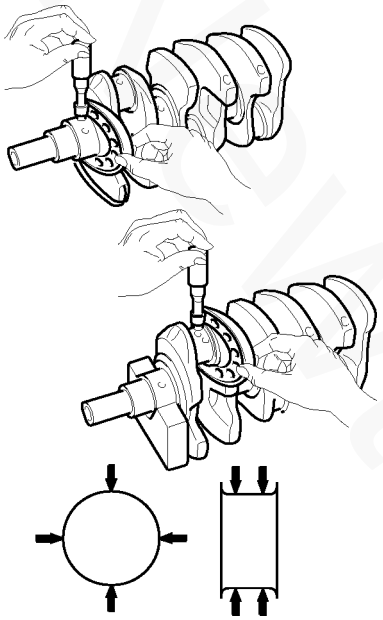
ECKD001B

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

Thrust bearing thickness
1.925 ~ 1.965mm (0.076 ~ 0.077in.)

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

Main journal diameter 61.982 ~ 62.000mm (2.4402 ~ 2.4409in.) Crank pin diameter 47.982 ~ 48.000mm (1.8890 ~ 1.8898in.)



ECKD001E

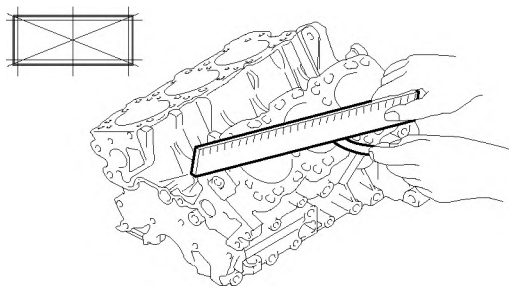
CYLINDER BLOCK

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 0.03mm(0.0012 in.) Limit : 0.05 mm (0.0020 in.)

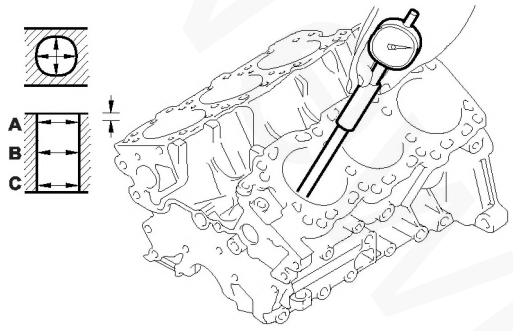


EDQF154A

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

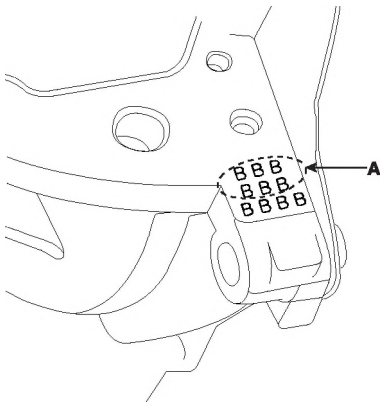
5. Inspect cylinder bore diameter
   Using a cylinder bore gauge, measure the cylinder bore diameter at position A, B and C in the thrust and axial directions.

Standard diameter
86.70 ~ 86.73mm (3.4134 ~ 3.4145in.)



EDQF153A

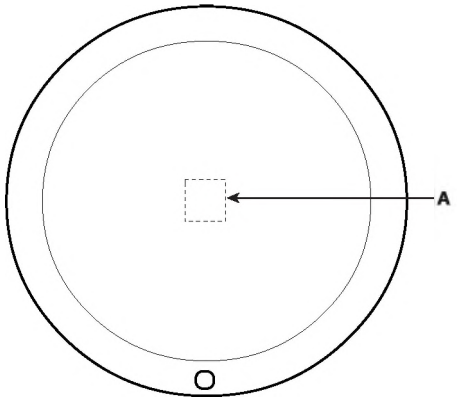
6. Check the cylinder bore size code(A) on the cylinder block bottom face.



EDQF078B

Class	Cylinder bore inner diameter	Size code
A	86.70 ~ 86.71mm (3.4133 ~ 3.4137in.)	A
B	86.71 ~ 86.72mm (3.4137 ~ 3.4141in.)	B
C	86.72 ~ 86.73mm (3.4141 ~ 3.4145in.)	C

7. Check the piston size code(A) on the piston top face.



EDQF177A

NOTE
Stamp the grade mark of basic diameter with rubber stamp.

Class	Piston diameter	Size code
A	86.68 ~ 86.69mm (3.4126 ~ 3.4130in.)	A
B	86.69 ~ 86.70mm (3.4130 ~ 3.4133in.)	None
C	86.70 ~ 86.71mm (3.4133 ~ 3.4137in.)	C

8. Select the piston related to cylinder bore class.

Clearance : 0.01 ~ 0.03mm (0.0004 ~ 0.0012in.)

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 (0.0250in.)

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 + 0.01 to 0.03mm (0.0004 to 0.0012 in.) (clearance between piston and cylinder) - 0.01 mm (0.0004 in.) (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 : 0.01 ~ 0.03mm (0.0004 ~ 0.0012 in.)

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.

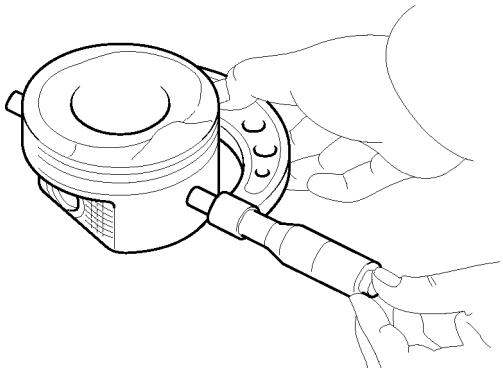
   3) Using solvent and a brush, thoroughly clean the piston.

NOTE

Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 38.5mm (1.516in.) from the top land of the piston.

Standard diameter
86.68 ~ 86.71mm (3.4126 ~ 3.4138in.)



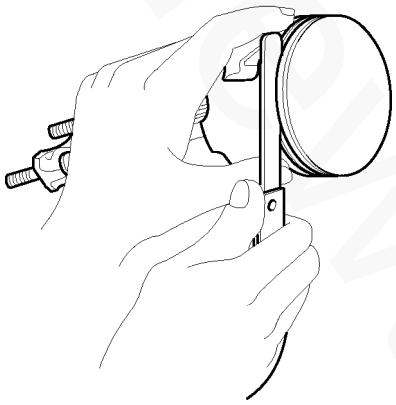
ECKD001D

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

Piston-to-cylinder clearance
0.01 ~ 0.03mm(0.0004 ~ 0.0012in.)

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
No. 1 : 0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in.)
No. 2 : 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)
Limit
No. 1 : 0.1mm (0.004in.)
No. 2 : 0.1mm (0.004in.)

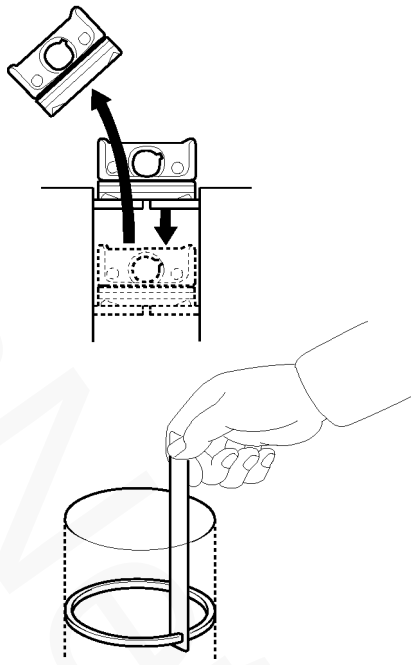


ECKD001G

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 EMA - 60, If the bore is over the service limit, the cylinder block must be rebored.(see page EMA - 60).

Piston ring end gap
Standard
No.1 : 0.20 ~ 0.35mm (0.0079 ~ 0.0138in.)
No.2 : 0.37 ~ 0.52mm (0.0146 ~ 0.0205in.)
Limit
Oil ring : 0.2 ~ 0.7mm (0.0079 ~ 0.0276in.)

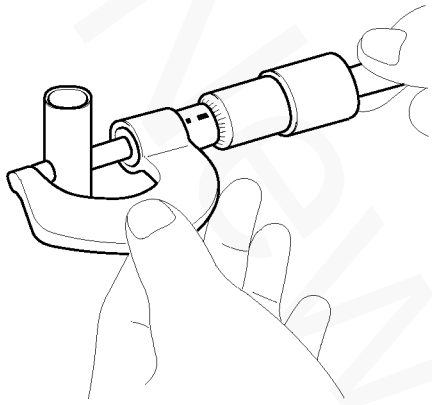


ECKD001K

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter
21.001 ~ 21.007mm (0.8268 ~ 0.8270in.)



ECKD001Z

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

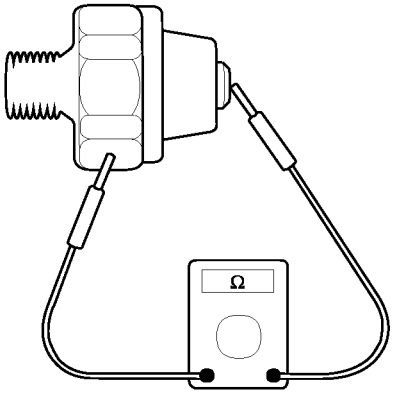
Piston pin-to-piston clearance
0.011 ~ 0.018mm (0.00043 ~ 0.00071in.)

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

Piston pin-to-connecting rod interference
0.016 ~ 0.033mm (0.00063 ~ 0.00130in.)

OIP PRESSURE SWITCH

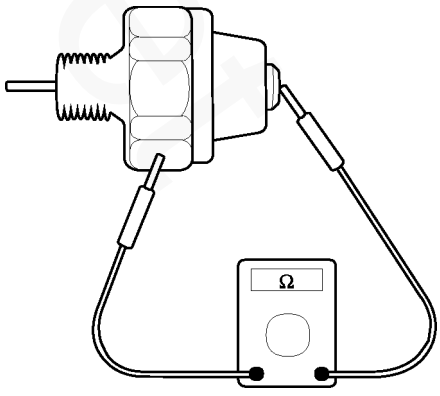
1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no continuity, replace the oil pressure switch.



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 diahragm is broken. Replace it.



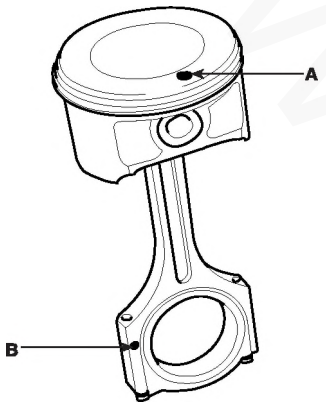
ECKD001Y

REASSEMBLY EF5F5963

NOTE

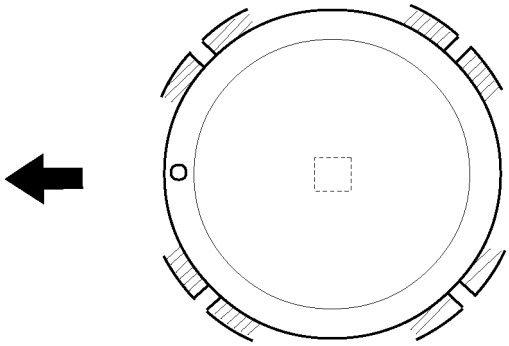
- *Thoroughly clean all parts to assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.*
- *Replace all gaskets, O-rings and oil seals with new parts.*

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



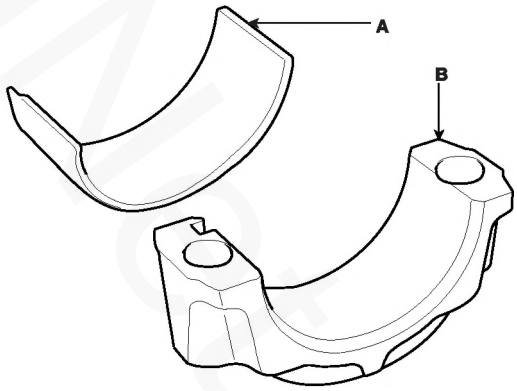
EDQF077A

2. Install piston rings.
   1) Install the oil ring expander 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.



EDQF178A

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 in the connecting rod and connecting rod cap.



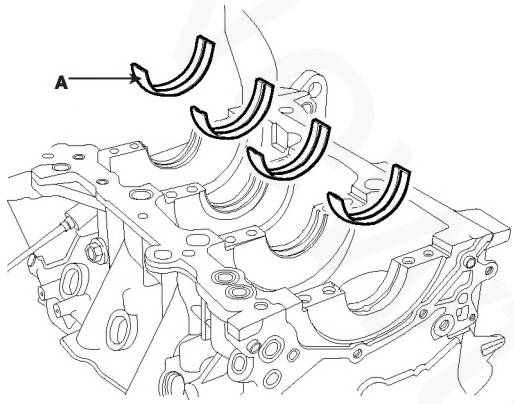
ECKD322A

4. Install main bearings.

NOTE

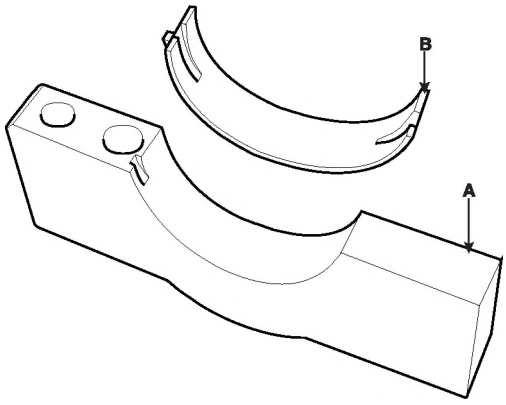
Upper 1, 2, 3, 4 bearings have an oil groove of oil holes; Lower bearings do not.

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



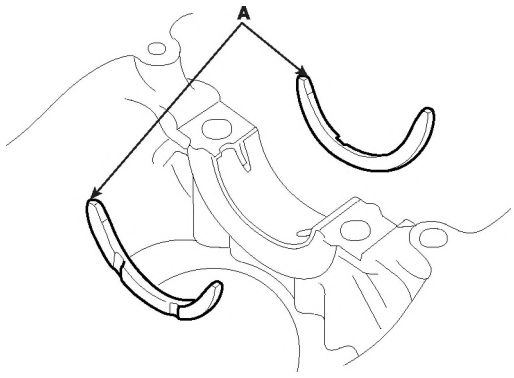
EDQF076A

2) Align the bearing claw with the claw groove of the main bearing cap(A), and push in the 4lower bearings(B).



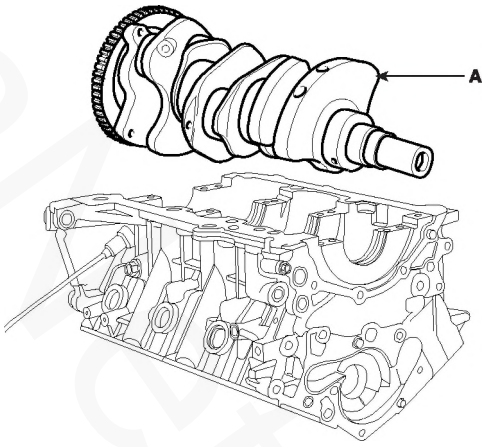
EDQF079A

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(A) on the cylinder block.



EDQF074A

7. Place main bearing caps on cylinder block.

8. Install main bearing cap bolts.

NOTE

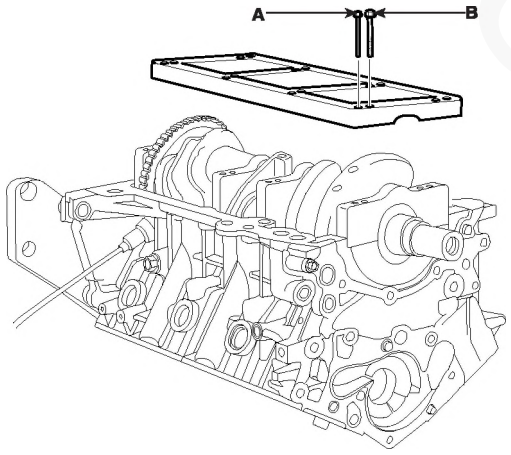
- *The main bearing cap bolts are tightened in 2 progressive steps.*
- *If any of the bearing cap bolts in broken or deformed, replace it.*

Tightening torque
Main bearing cap bolt
M8
13 ~ 19Nm (130 ~ 190kgf.cm, 10 ~ 14lbf.ft) + 90° ~ 94°
M10
27 ~ 33Nm (270 ~ 330kgf.cm, 19.5 ~ 24lbf.ft) + 90° ~ 94°

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

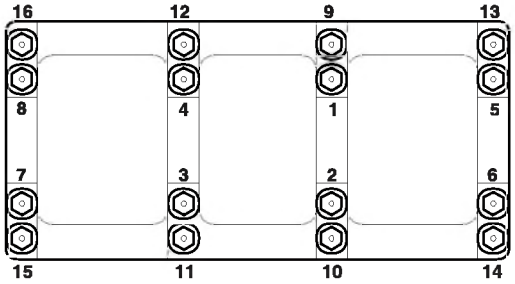
2) Install and uniformly tighten the 16bearing cap bolts, in several passes, in the sequence shown.

Tightening torque
M8(A) : 13 ~ 19Nm (130 ~ 190kgf.cm, 10 ~ 14lbf.ft)
M10(B) : 27 ~ 33Nm (270 ~ 330kgf.cm, 19.5 ~ 24lbf.ft)



EDQF072A

3) Retighten the bearing cap bolts by 90° ~ 94° in the numerical order shown.



EDQF198A

4) Check that the crankshaft turns smoothly.

9. Check crankshaft end play. (See page EMA - 58)

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.

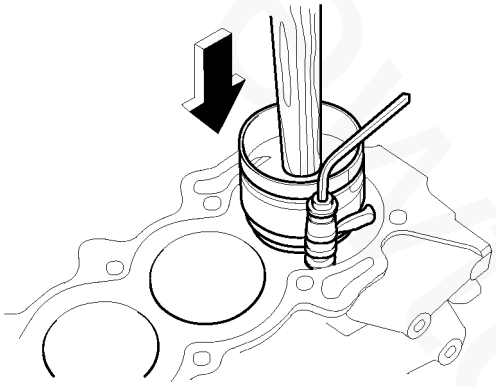
3) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.

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

Tightening torque
16 ~ 20Nm (160 ~ 200kgf.cm, 12 ~ 15lbf.ft) + 90° ~ 94°

NOTE

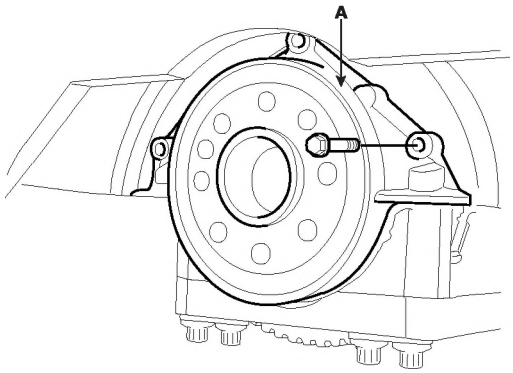
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

11. Apply liquid gasket to the oil seal case and install the oil seal case(A).

Tightening torque
10 ~ 12Nm (100 ~ 120kgf.cm, 7.3 ~ 8.8lbf.ft)



EDQF174A

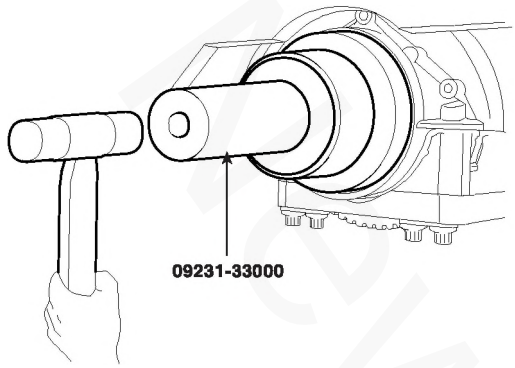
NOTE

- *Use liquid gasket MS721-40A or equivalent*
- *Check that the mating surfaces are clean and dry.*

12. Install rear oil seal.

1) Apply engine oil to a new oil seal lip.

2) Using SST(09231-33000) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.



EDQF179A

13. Install front case. (See page EMA - 83)

14. Install the upper oil pan.

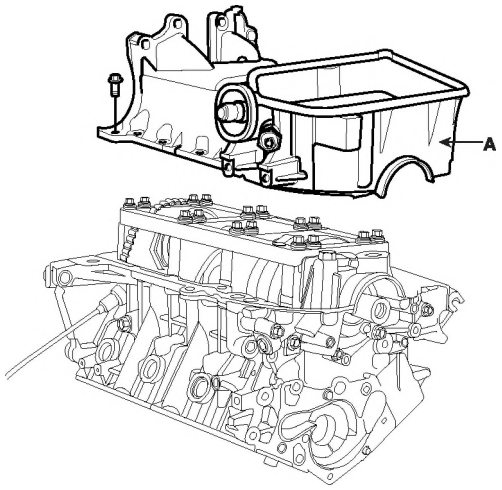
1) Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

NOTE

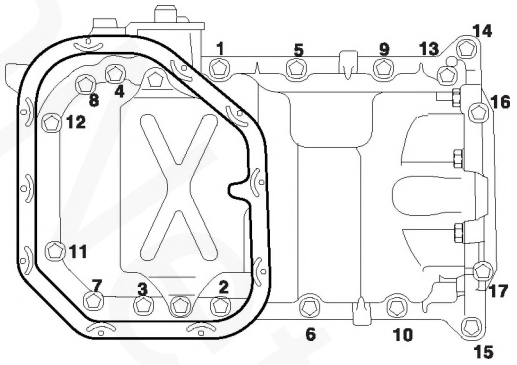
Check that the mating surfaces are clean and dry before applying liquid gasket.

2) Install the oil pan(A) with the 17bolts. Uniformly tighten the bolts in several passes.

Tightening torque
19 ~ 28Nm (190 ~ 280kgf.cm, 14 ~ 20lbf.ft) : (1 ~ 15)
5 ~ 7Nm (50 ~ 70kgf.cm, 4 ~ 5lbf.ft) : (16,17)



EDQF067A



EDQF151A

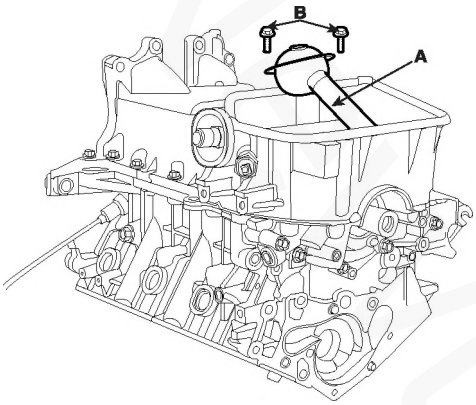
NOTE

- *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.*

15. Install oil screen.
Install a new gasket and oil screen(A) with 2bolts(B).

Tightening torque
15 ~ 22Nm (150 ~ 220kgf.cm, 11 ~ 16lbf.ft)



EDQF066A

16. Install the lower oil pan.

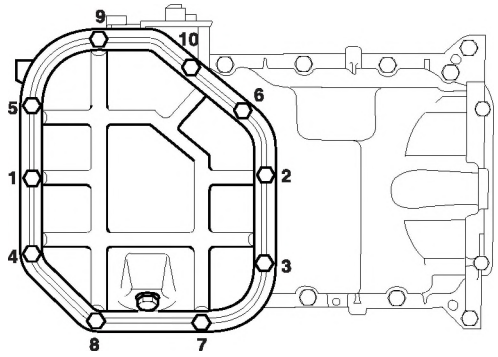
1) Apply liquid gasket as an even bead, centered between the edges of the mating surface.
Use liquid gasket MS 721-40A or equivalent.

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.*

2) Install the lower oil pan 10bolts.
Uniformly tighten the bolts serveral passes

Tightening torque
10 ~12Nm (100 ~ 120kgf.cm, 7.3 ~ 8.8lbf.ft)



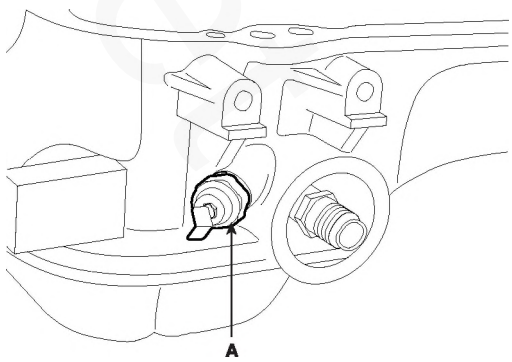
EDQF152A

17. Install oil pressure sensor.

1) Apply adhesive to 2 or 3 threads.
Adhesive : THREE BOND TB2403 or equivalent.

2) Install the oil pressure sensor(A).

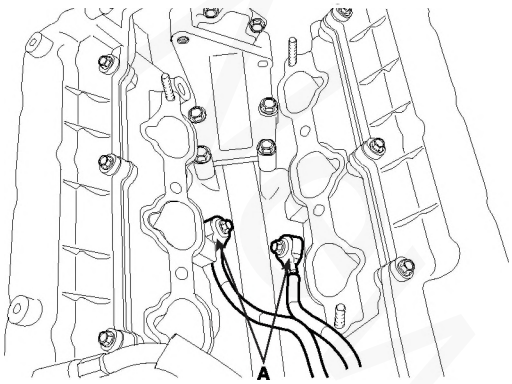
Tightening torque
15 ~ 22Nm (150 ~ 220kgf.cm, 11 ~ 16lbf.ft)



EDQF180A

18. Install knock sensor(A).

Tightening torque
17 ~ 26Nm (170 ~ 260kgf.cm, 12.5 ~ 19lbf.ft)

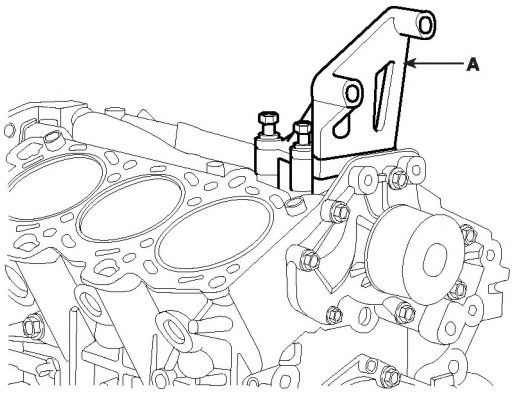


EDQF181A

19. Install water pump. (See page EMA - 75)

20. Install the power steering pump bracket(A).

Tightening torque
35 ~ 55Nm (350 ~ 550kgf.cm, 25.8 ~ 40.6lbf.ft)



EDQF061A

21. Install the air compressor. (See HA group - air compressor)

22. Install the alternator. (See EE group - alternator)

23. 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
12 ~ 15Nm (120 ~ 150kgf.cm, 9 ~ 11lbf.ft)

24. Install cylinder head. (See page EMA - 35)

25. Install timing belt. (See page EMA - 17)

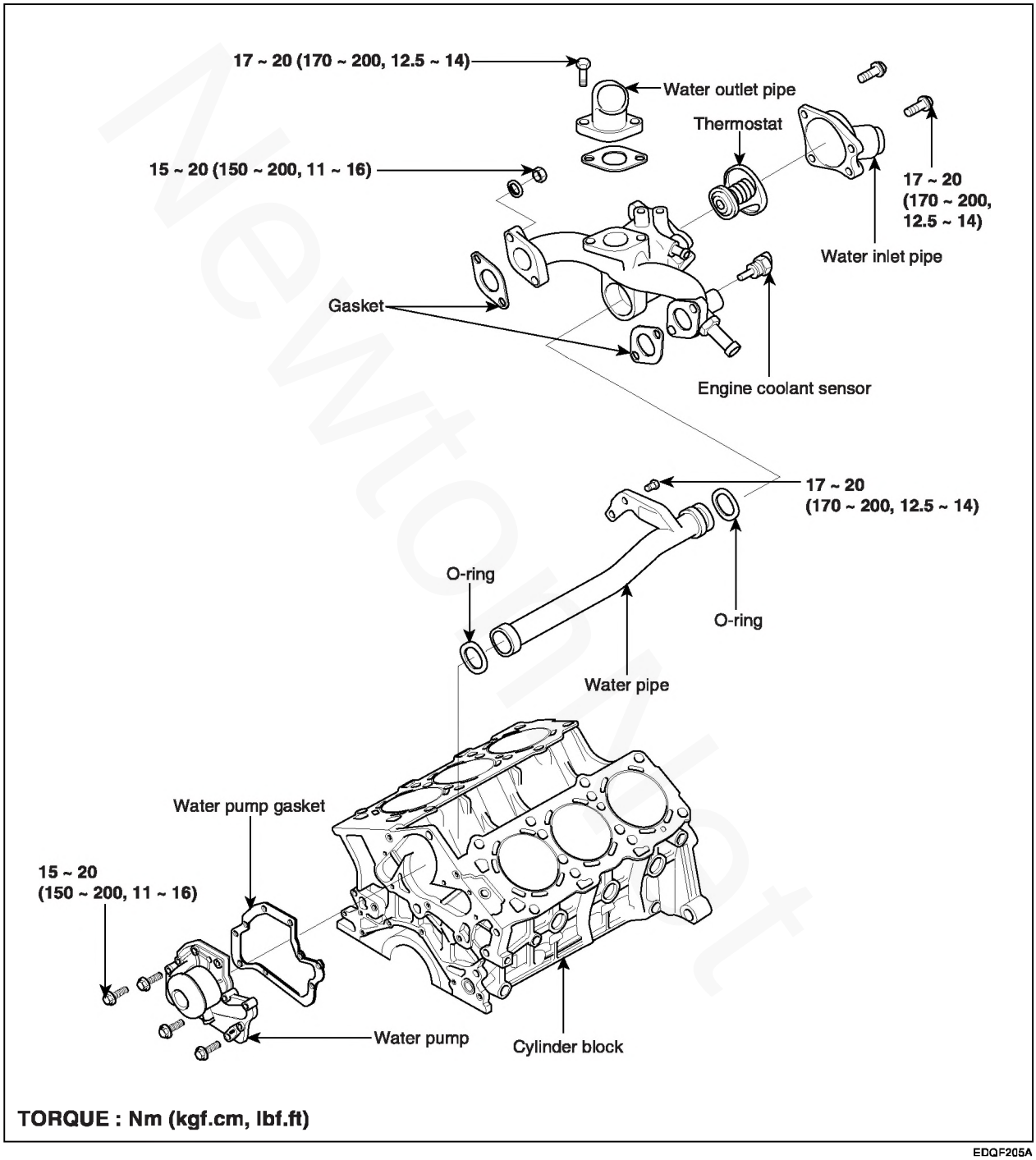
26. Remove engine stand.

27. Install drive plate.

Tightening torque
73 ~ 77Nm (730 ~ 770kgf.cm, 53 ~ 56lbf.ft)

COOLING SYSTEM

COMPONENT E9CB691B



EDQF205A

ENGINE COOLANT REFILLING AND BLEEDING EB5F0F42

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. Slide the heater temperature control lever to maximum heat. 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 slowly through the radiator cap. Gently squeeze the upper/lower hoses of the radiator so as to bleed air easily.

NOTE

- *Use only genuine antifreeze/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.***

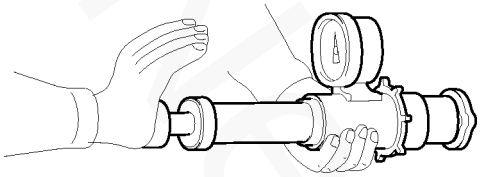
7. Start the engine and allow coolant to circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank 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 allow coolant to cool.
12. Repeat steps 6 to 11until the coolant level stays constant and all air is bleed out of the cooling system.

NOTE

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 on the pressure tester.

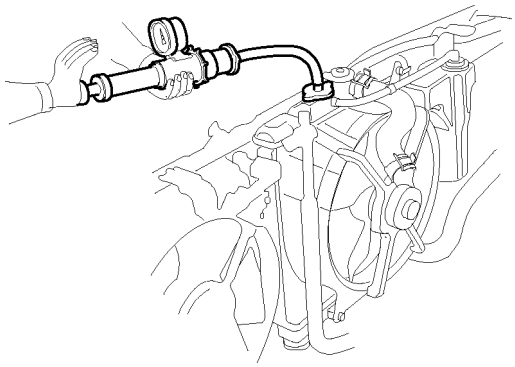


ECKD501X

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.
2. Apply a pressure tester to the radiator and apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm² 14 ~ 19psi).



ECKD501Y

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 E6B7D6BE

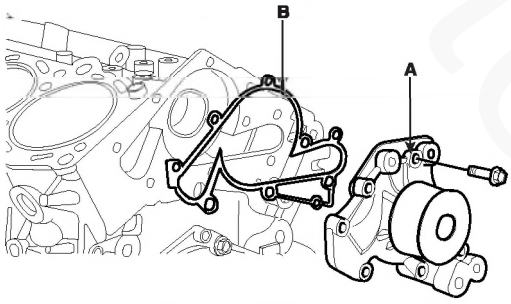
WATER PUMP

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 belts. (See page EMA - 13)
3. Remove the timing belt. (See page EMA - 13)
4. Remove the timing belt idler. (See page EMA - 16)
5. Remove the water pump.
   Remove the water pump(A) and gasket(B).



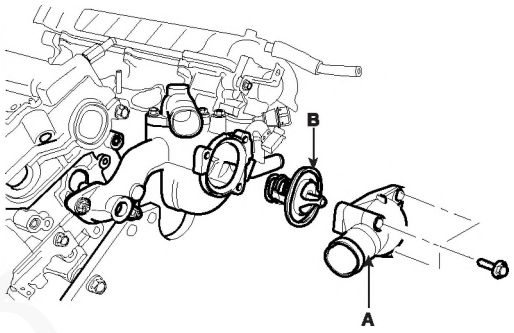
EDQF062A

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. Remove the engine cover.
2. Drain engine coolant so its level is below thermostat.
3. Remove the lower hose.
4. Remove water inlet(A) and thermostat(B).



EDQF183A

INSPECTION ED61C13B

WATER PUMP

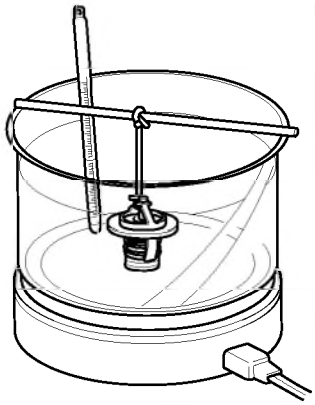
1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. 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 : 10mm(0.4in.) or more at 95°C (205°F)

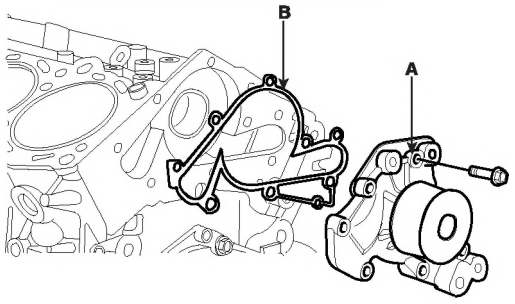
If the valve lift is not as specified, replace the thermostat.

INSTALLATION EAD083BE

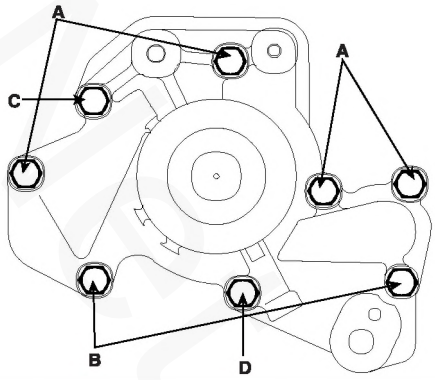
WATER PUMP

1. Install the water pump(A) and a new gasket(B) with the 8bolts.

Tightening torque 15 ~ 22Nm (150 ~ 220kgf.cm, 11 ~ 16lbf.ft)



EDQF062A



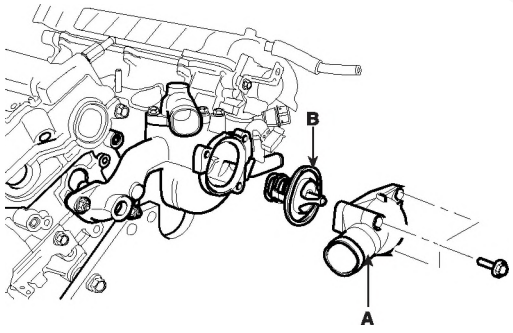
EDQF190A

Bolt	Size	Number
A	8 × 25	4
B	8 × 30	2
C	8 × 32	1
D	8 × 40	1

2. Install the timing belt idler. (See page EMA - 17)
3. Install the timing belt. (See page EMA - 17)
4. Install drive belt.
5. Fill with engine coolant. (See page EMA - 72)
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 to the thermostat(B).



EDQF183A

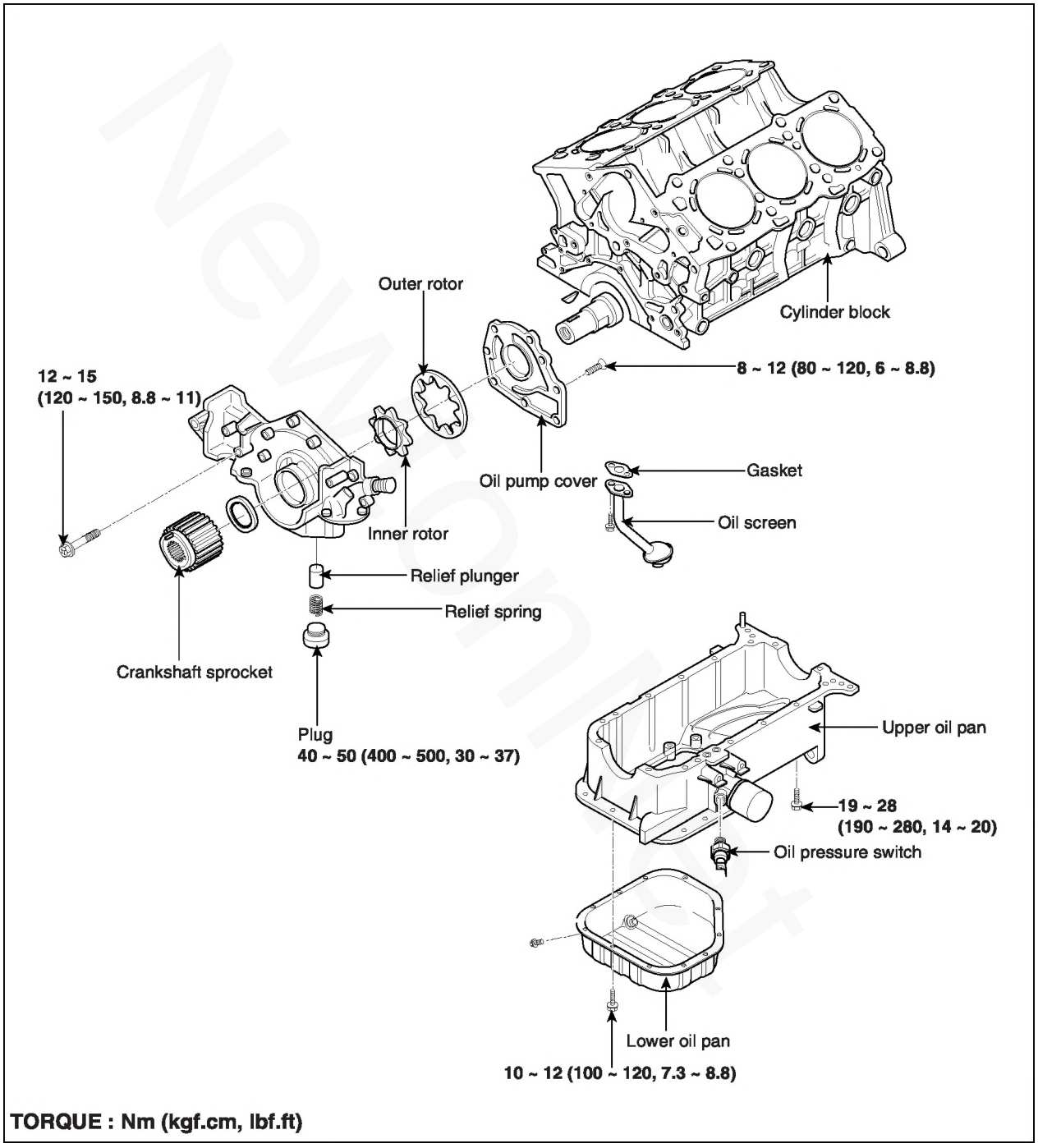
2. Install water inlet(A).

Tightening torque
17 ~ 20Nm (170 ~ 200kgf.cm, 12.5 ~ 14lbf.ft)

3. Install the lower hose.
4. Fill with engine coolant.
5. Start engine and check for leaks.

LUBRICATION SYSTEM

COMPONENT E6B3C6EA



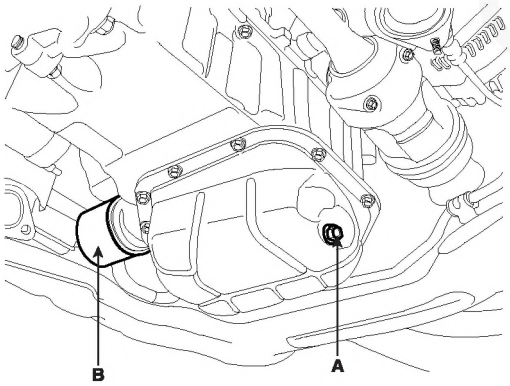
EDQF206A

OIL AND FILTER E7FBE1A4

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(A), and drain the oil into a container.



EDQF022A

2. Replace oil filter.
   a. Remove the oil filter(B).
   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.
   f. Tighten it an additional 3/4 turn.

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

Tightening torque
35 ~ 45Nm (350 ~ 450kgf.cm, 26 ~ 33lbf.ft)

   - Fill with fresh engine oil

Capacity
Drain and refill
W/Oil filter change : 4.5l (4.74U.S.qts, 3.95lmp qts)
W/O Oil filter change : 4.2l (4.30U.S.qts, 3.65lmp qts)

   - 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.

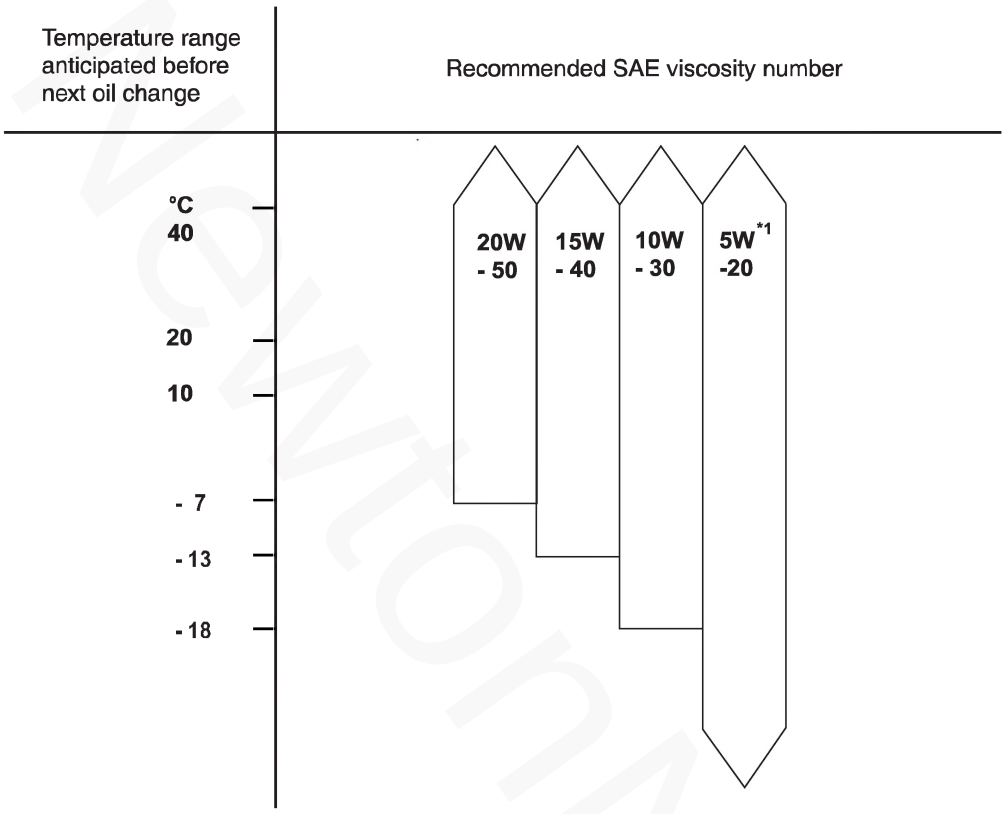
2. Check engine oil level.
   After warming up the engine and then 5 minutes after the engine stop, oil level should be between the " L" and " F" marks on the dipstick.
   If low, check for leakage and add oil up to the " F" mark.

   NOTE

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

SELECTION OF ENGINE OIL

Recommended ILSAC classification : GF3 OR ABOVE
Recommended API classification : SJ / SL OR ABOVE
Recommended SAE viscosity grades :



*1 : Recommended regardless of environment.
If not available, refer to the recommended SAE viscosity numbers.

LC8F002A

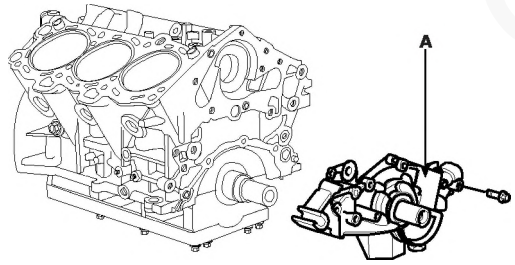
NOTE

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

1. *Satisfy the requirement of the API classification.*
2. *Have proper SAE grade number for expected ambient temperature range.*
3. *Lubricants that do not have both an SAE grade number and API service classification on the container should not be used.*

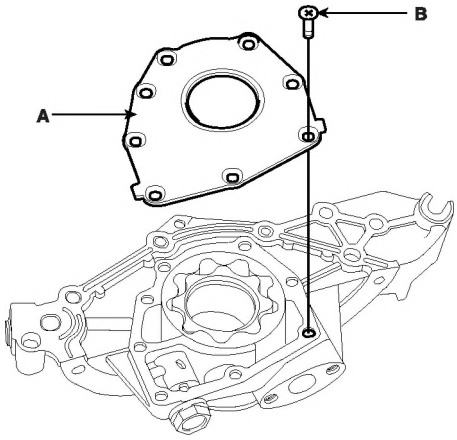
REMOVAL E0D7EC7F

1. Drain engine oil.
2. Remove RH front wheel.
3. Remove RH side cover.
4. Remove the front exhaust pipe. (See page EMA - 46)
5. Remove the alternator from engine. (See EE group - alternator)
6. Remove the drive belt. (See page EMA - 13)
7. Turn the crankshaft and align the white groove on the crankshaft pulley with the pointer on the lower cover. (See page EMA - 13)
8. Remove the timing belt. (See page EMA - 13)
9. Remove the oil pan and oil screen.(See page EMA - 51, 52)
10. Remove the oil pump case(A).



EDQF068A

1) Remove the screws(B) from the pump housing, then separate the housing and cover(A).

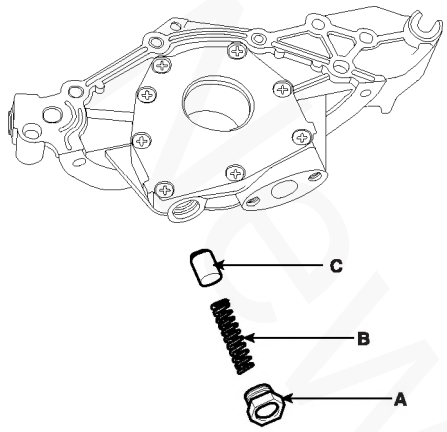


EDQF070A

2) Remove the inner and outer rotors.

DISASSEMBLY E1E5FFFC

1. Remove the relief plunger.
   Remove the plug(A), spring(B) and relief plunger(C).



EDQF069A

INSPECTION EC1BAD97

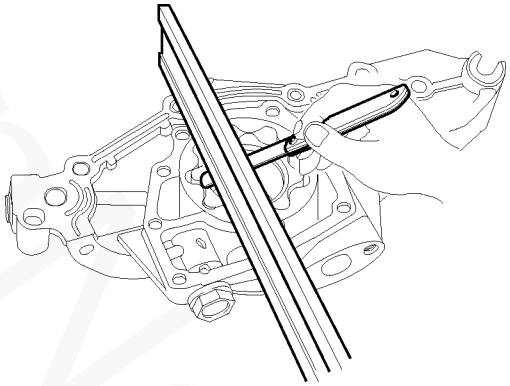
1. Inspect relief plunger.
   Coat the valve with engine oil and check that it falls smoothly into the plunger hole by its own weight.
   If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect relief valve spring.
   Inspect for distorted or broken relief valve spring.

Standard value
Free height : 43.8mm (91.724in.)
Load : 4.6kg/39.1mm (10lb/1.547in.)

3. Inspect rotor side clearance.
   Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Side clearance
0.040 ~ 0.095mm (0.0016 ~ 0.0037in.)

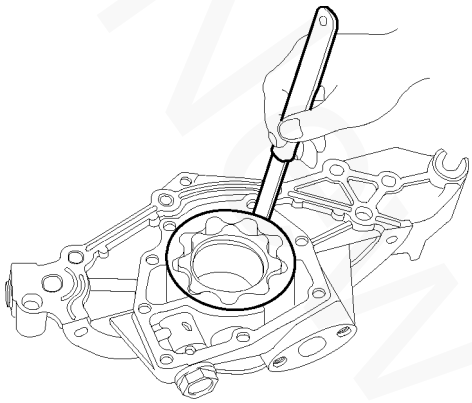


EDQF184A

If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the front case.

4. Inspect rotor body clearance.
   Using a feeler gauge, measure the clearance between the outer rotor and body.

Body clearance
0.100 ~ 0.181mm (0.0039 ~ 0.0071in.)



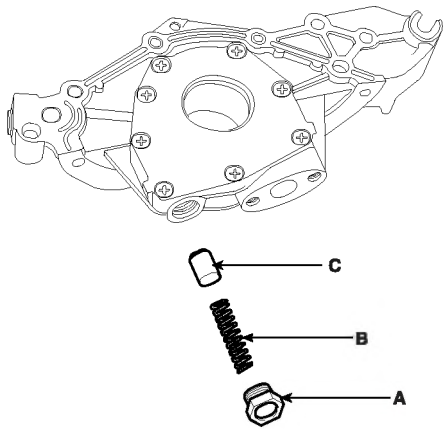
EDQF186A

If the body clearance is greater than maximum, replace the rotors as a set. If necessary, replace the front case.

REASSEMBLY E27BB309

1. Install relief plunger.
   Install relief plunger(C) and spring(B) into the front case hole, and install the plug(A).

Tightening torque
40 ~ 50Nm (400 ~ 500kgf.cm, 30 ~ 37lb.ft)



EDQF069A

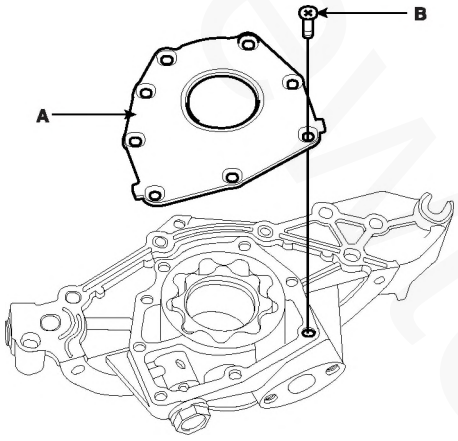
INSTALLATION ED7EB1F3

1. Install oil pump.

   1) Place the inner and outer rotors into front case with the marks facing the oil pump cover side.

   2) Install the oil pump cover(A) to front case with the 8screws(B).

Tightening torque
8 ~ 12Nm (80 ~ 120kgf.cm, 6 ~ 8.8lbf.ft)



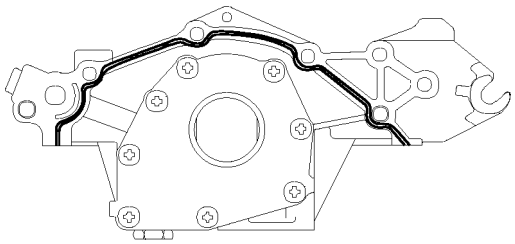
EDQF070A

2. Check that the oil pump turns freely.

3. Install the oil pump on the cylinder block.

   1) Remove any old liquid gasket and be careful not to drop any oil on the contact surfaces of the oil pump and cylinder block.
      - Using a razor blade and gasket scraper, remove all the old liquid gasket from the gasket surfaces and sealing grooves.
      - Using a non-residue solvent, clean both sealing surfaces.

   2) Apply liquid gasket to the oil pump as shown in the illustration.
      Use liquid gasket MS 721-40A.



EDQF187A

NOTE

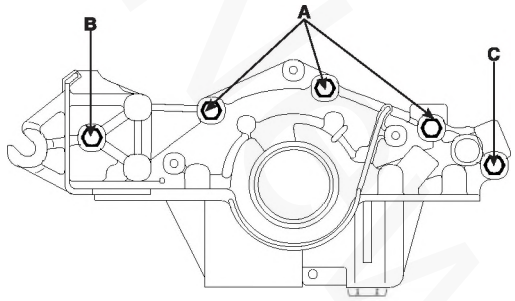
- *To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.*
- *Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.*
- *After assembly, wait at least 30 minutes before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

   3) Place a new O-ring on the cylinder block.

   4) Engage the spline teeth of the oil pump drive gear with large teeth of the crankshaft, and slide the oil pump on the crankshaft.

5) Install the oil pump with 5bolts.
Uniformly tighten the bolts in several passes.

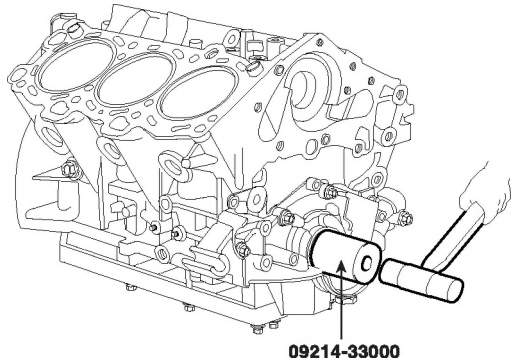
Tightening torque
12 ~ 15Nm (120 ~ 150kgf.cm, 8.8 ~ 11lbf.ft)



EDQF188A

Bolt	Size	Number
A	8 × 25	3
B	8 × 35	1
C	8 × 45	1

4. Apply a light coat of oil to the seal lip.
5. Using the special tool(09214-33000), install the oil seal.



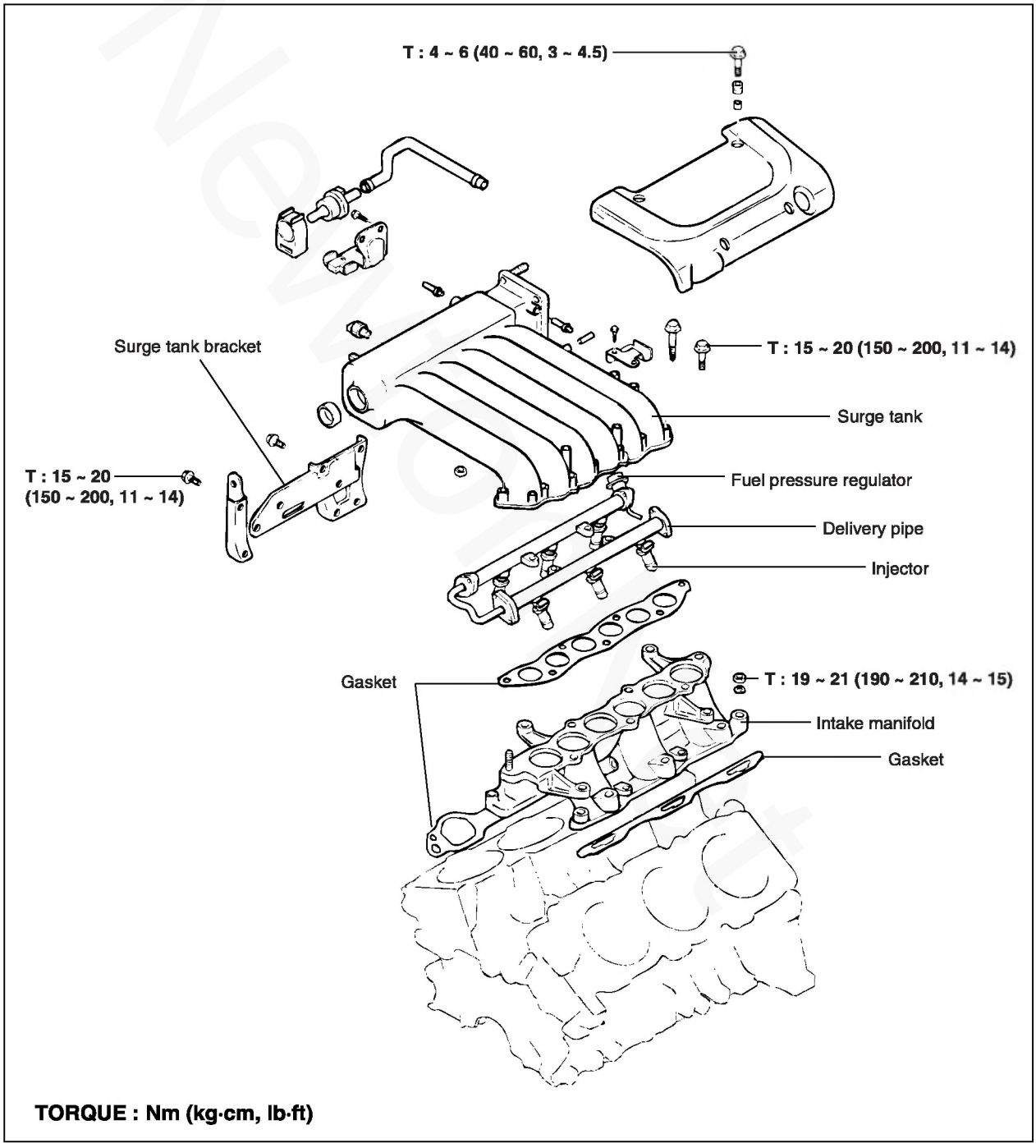
EDQF189A

6. Install the oil pan and oil screen. (See page EMA - 69)
7. Install the timing belt. (See page EMA - 17)
8. Install the drive belt.
9. Install the alternator. (See EE group - alternator)
10. Install the front exhaust pipe. (See page EMA - 91)
11. Install the RH front wheel.
12. Fill engine with oil.
13. Start engine and check for leaks.
14. Recheck engine oil level.

INTAKE AND EXHAUST SYSTEM

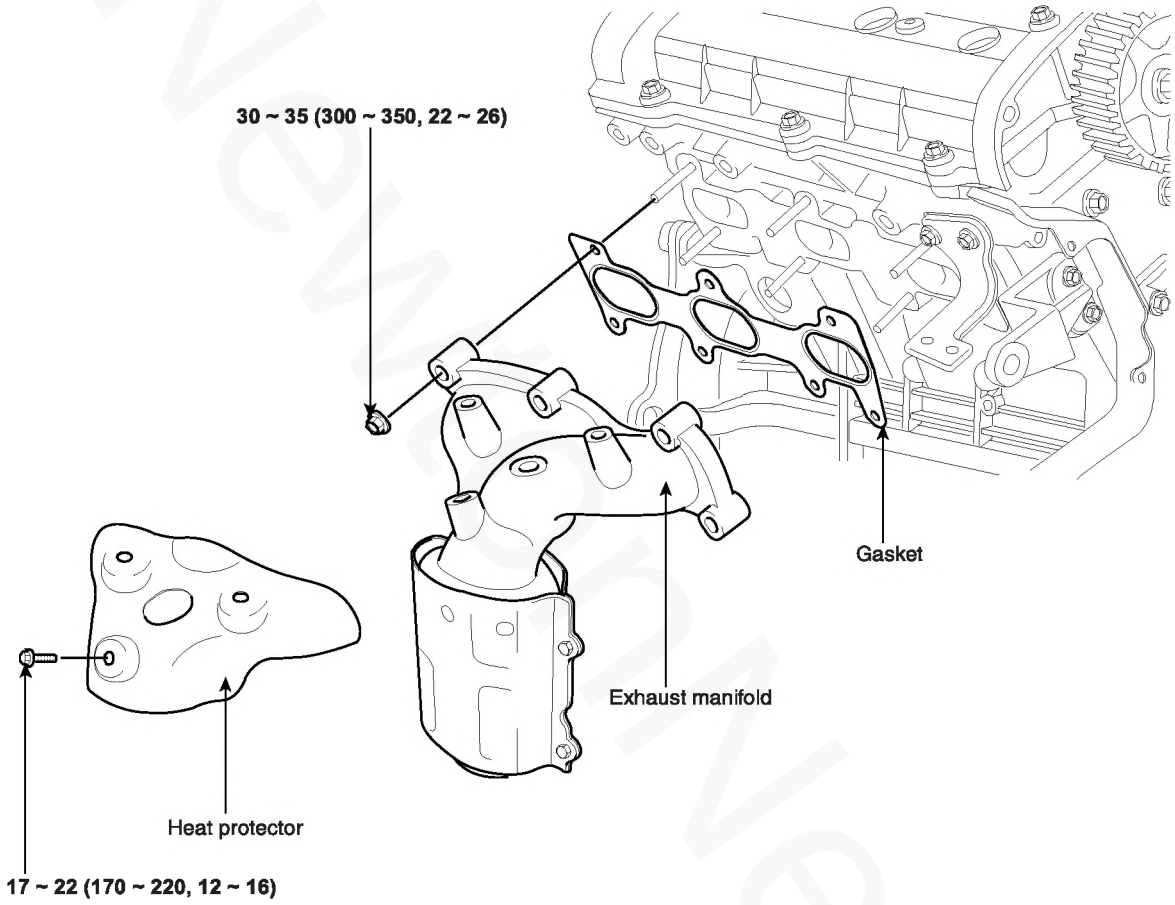
COMPONENT EC4F01D9

INTAKE MANIFOLD



ECB9505E

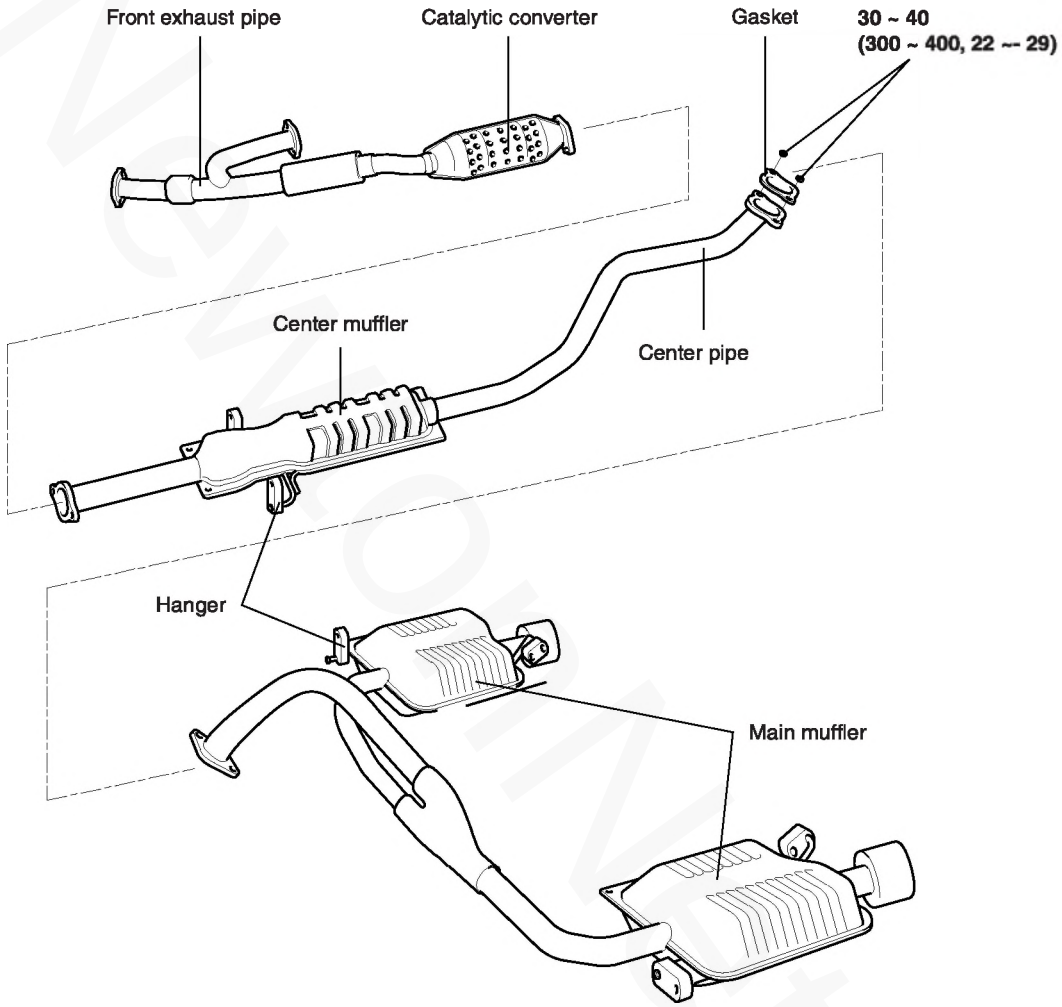
EXHAUST MANIFOLD



TORQUE : Nm (kgf.cm, lbf.ft)

EDQF209A

MUFFLER



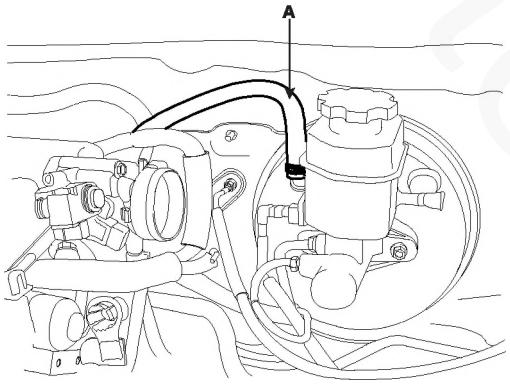
TORQUE : Nm (kg·cm, lb.ft)

EDOC160A

REMOVAL E0C67FDF

INTAKE MANIFOLD

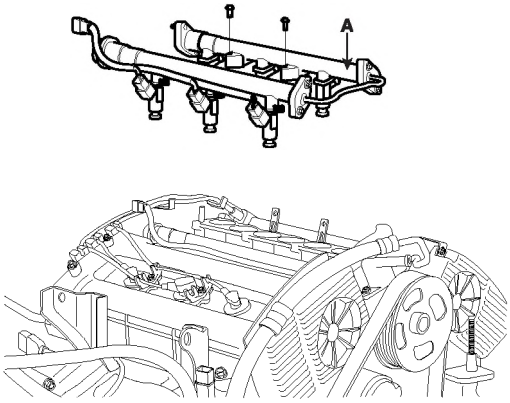
1. Remove the engine cover.
2. Remove air cleaner hose.
3. Remove surge tank assembly.
   1) Disconnect the accelerator cable.
   2) Disconnect the TPS connector.
   3) Disconnect the ISA connector.
   4) Disconnect the injector connector.
   5) Disconnect the PCSV connector.
   6) Disconnect the PCSV hose.
   7) Disconnect the brake booster vacuum hose(A).



EDQF020A

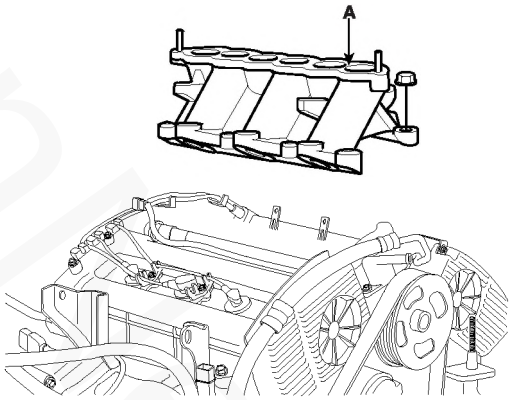
   8) Disconnect the PCV hose.
   9) Disconnect the IAT sensor connector.
   10) Remove the surge tank stay.
   11) Remove the surge tank assembly.

4. Remove the injector assembly(A).



EDQF007A

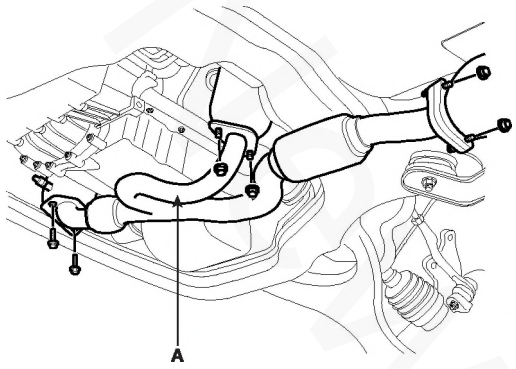
5. Remove the intake manifold(A) and gasket.



EDQF063A

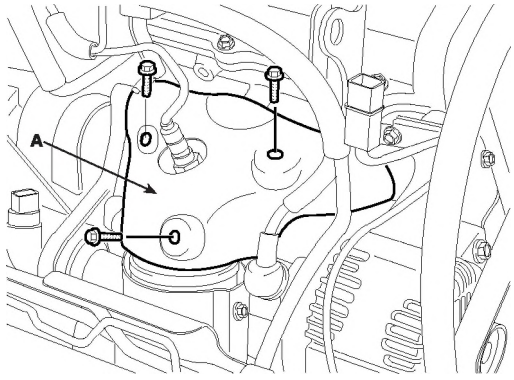
EXHAUST MANIFOLD

1. Remove the under cover.
2. Remove the front exhaust pipe(A).



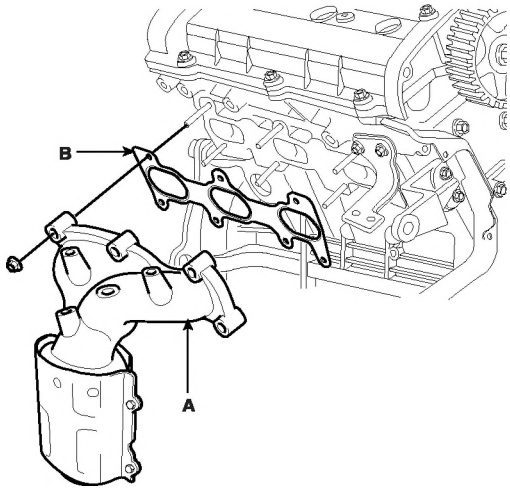
EDQF001A

3. Disconnect the oxygen sensor connector.
4. Remove the heat protector(A).



EDQF003A

5. Remove the exhaust manifold(A) and gasket(B).



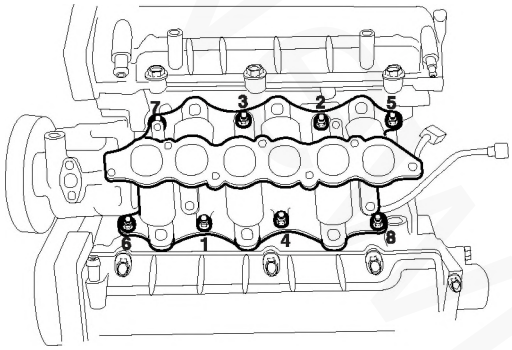
EDQF064A

INSTALLATION EE1ADD75

INTAKE MANIFOLD

1. Install the intake manifold and gasket.

Tightening torque
19 ~ 21Nm (190 ~ 210kgf.cm, 14 ~ 15lbf.ft)



EDQF164A

2. Install the injector assembly. (See FL group - injector)
3. Install the surge tank assembly.
   1) Install the surge tank assembly.

Tightening torque
15 ~ 20Nm (150 ~ 200kgf.cm, 11 ~ 15lbf.ft)

   2) Install the surge tank stay.

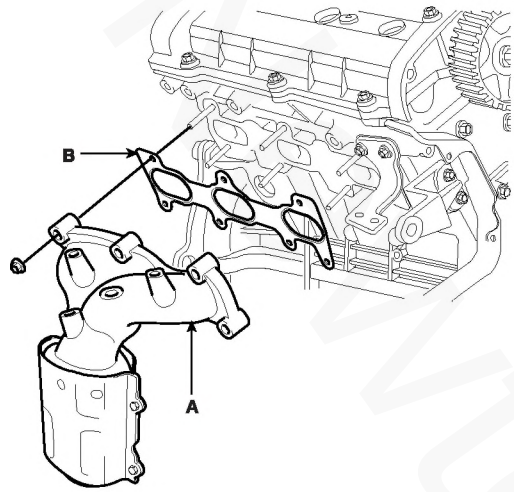
Tightening torque
15 ~ 20Nm (150 ~ 200kgf.cm, 11 ~ 15lbf.ft)

   3) Install the ground cable.
   4) Connect the IAT sensor connector.
   5) Connect the PCV hose.
   6) Connect the brake booster vacuum hose.
   7) Connect the PCSV hose.
   8) Connect the PCSV connector.
   9) Connect the injector connector.
   10) Connector the ISA connector.
   11) Connector the TPS connector.
   12) Connector the actuator cable.
4. Install the air cleaner hose.
5. Install the engine cover.

EXHAUST MANIFOLD

1. Install the exhaust manifold(A) and gasket(B).

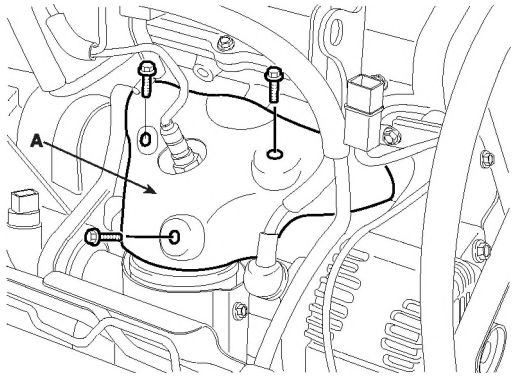
Tightening torque
30 ~ 35Nm (300 ~ 350kgf.cm, 22 ~ 26lbf.ft)



EDQF064A

2. Install the heat protector(A).

Tightening torque
17 ~ 22Nm (170 ~ 220kgf.cm, 12 ~ 16lbf.ft)

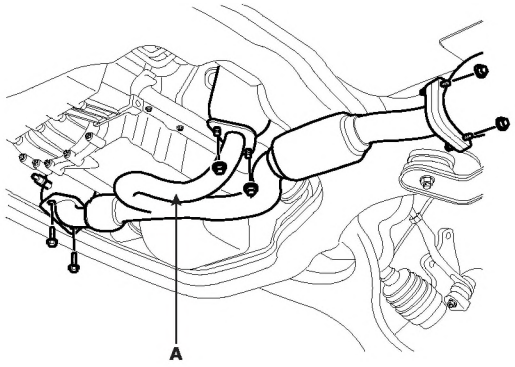


EDQF003A

3. Connect the oxygen sensor connector.

4. Install the front exhaust pipe(A).

Tightening torque
30 ~ 40Nm (300 ~ 400kgf.cm, 22 ~ 30lbf.ft)



EDQF001A

5. Install the under cover.