Engine
(G4GC – GSL 2.0)

GENERAL

SPECIFICATIONS EE490A0A

Description	Specifications	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinder	4	
Bore	82mm (3.228in)	
Stroke	93.5mm (3.681in.)	
Total displacement	1975cc (120.52cu.in.)	
Compression ratio	10.1	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Opens (ATDC)	11°	
Closes (ABDC)	59°	
Exhaust		
Opens (BBDC)	42°	
Closes (ATDC)	6°	
Valve		
Valve length		
Intake	114.34mm (4.5016in.)	
Exhaust	116.8mm (4.598in.)	
Stem O.D.		
Intake	5.965 ~ 5.98mm (0.2348 ~ 0.2354in.)	
Exhaust	5.950 ~ 5.965mm (0.2343 ~ 0.2348in.)	
Face angle thickness of valve head (Margin)		
Intake	1.15mm (0.0452in.)	0.8mm (0.031in.)
Exhaust	1.35mm (0.0531in.)	1.0mm (0.039in.)
Valve stem to valve guide clearance		
Intake	0.02 ~ 0.05mm (0.0008 ~ 0.0019in.)	0.10mm (0.0039in.)
Exhaust	0.035 ~ 0.065mm (0.0014 ~ 0.0026in.)	0.13mm (0.0051in.)
Valve guide		
Installed dimension O.D		
Intake	46mm (1.811in.)	
Exhaust	54.5mm (2.146in.)	
Service oversize	0.05, 0.25, 0.50mm (0.002, 0.010, 0.020in.) oversize	
Valve seat		
Width of seat contact		
Intake	1.1 ~ 1.5mm (0.043 ~ 0.059in.)	
Exhaust	1.3 ~ 1.7mm (0.051 ~ 0.066in.)	
Seat angle	45°	
Oversize	0.3, 0.6mm (0.012, 0.024in.) oversize	
Valve spring		
Free length	48.86mm (1.9236in.)	
Load	18.8kg/39mm (41.45lb/1.535in.)	
Installed height	39mm (1.5354in.)	
Squarences	1.5° MAX.	

Description	Specifications	Limit
Valve clearance Cold (20°C[68°F]) Intake Exhaust	 0.20mm (0.0079in.) 0.28mm (0.0110 in,)	 0.12 ~ 0.28mm (0.0047 ~ 0.0110in.) 0.20 ~ 0.38mm (0.0079 ~ 0.0150in.)
Cylinder head Flatness of gasket surface Flatness of manifold mounting surface Oversize rework dimensions of valve seat hole Intake 0.3mm (0.012in.) O.S. 0.6mm (0.024in.) O.S. Exhaust 0.3mm (0.012in.) O.S. 0.6mm (0.024in.) O.S. Oversize rework dimensions of valve guide hole (both intake and exhaust) 0.05mm (0.002in.) O.S 0.25mm (0.010in.) O.S 0.50mm (0.020in.) O.S	 Max. 0.03mm (0.0012in.) Max. 0.15mm (0.0059in.) 33.300 ~ 33.325mm (1.3110 ~ 1.3120in.) 33.600 ~ 33.625mm (1.3228 ~ 1.3238in.) 28.800 ~ 28.821mm (1.1338 ~ 1.1346in.) 29.100 ~ 29.121mm (1.1456 ~ 1.1465in.) 11.05 ~ 11.068mm (0.435 ~ 0.4357in.) 11.25 ~ 11.268mm (0.443 ~ 0.4436in.) 11.50 ~ 11.518mm (0.453 ~ 0.4535in.)	 0.06mm (0.0024in.) 0.03mm (0.0012in.)
Cylinder block Cylinder bore Out-of-round and taper of cylinder bore Clearance with piston (To set limits to new parts)	 82.00 ~ 82.03mm (3.2283 ~ 3.2295in.) Less than 0.01mm (0.0004in.) 0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)	
Piston O.D (To set limits to new parts) Service oversize	 81.97 ~ 82.00mm (3.2271 ~ 3.2283in.) 0.25, 0.50mm (0.010, 0.020in.) oversize	
Piston ring Side clearance No.1 No.2 End gap No.1 No.2 Oil ring side rail Service oversize	 0.04 ~ 0.08mm (0.0015 ~ 0.0031in.) 0.03 ~ 0.07mm (0.0012 ~ 0.0027in.) 0.23 ~ 0.38mm (0.0090 ~ 0.0149in.) 0.45 ~ 0.60mm (0.0177 ~ 0.0236in.) 0.20 ~ 0.60mm (0.0078 ~ 0.0236in.) 0.25, 0.50mm (0.010, 0.020in.) oversize	 0.1mm (0.004in.) 1mm (0.039in.) 1mm (0.039in.) 1mm (0.039in.)
Connecting rod Bend Twist Connecting rod big end to crankshaft side clearance	 0.05mm (0.0020in.) or less 0.1mm (0.004in.) or less 0.100 ~ 0.250mm (0.0039 ~ 0.010in.)	 0.4mm (0.0157in.)
Connecting rod bearing Oil clearance (To seat limits to new parts) Undersize	 0.024 ~ 0.042mm (0.0009 ~ 0.0016in.) 0.25mm (0.01in.)	

Description	Specifications	Limit
Camshaft		
Cam height		
Intake	44.618mm (1.7566in.)	44.518mm (1.7527in.)
Exhaust	44.518mm (1.7527in.)	44.418mm (1.7487in.)
Journal O.D.	28mm (1.1023in.)	
Bearing oil clearance	0.02 ~ 0.061mm (0.0008 ~ 0.0024in.)	0.1mm (0.0039in.)
End play	0.1 ~ 0.2mm (0.004 ~ 0.008in.)	
Crankshaft		
Pin O.D.	45mm (1.77in.)	
Journal O.D.	57mm (2.244in.)	
Bend	0.03mm (0.0012in.) or less	
Out-of-round, taper of journal and pin	0.005mm (0.0002in.) or less	0.030mm (0.0012in.)
End play	0.06 ~ 0.260mm (0.0023 ~ 0.010in.)	
Undersize rework dimension of pin 0.25mm (0.010in.)	44.725 ~ 44.740mm (1.7608 ~ 1.7614in.)	
Undersize rework dimension of journal 0.25mm (0.010in.)	56.727 ~ 56.742mm (2.2333 ~ 2.2339in.)	
Crankshaft bearing		
Oil clearance	0.028 ~ 0.046mm (0.0011 ~ 0.0018in.)	
Flywheel		
Runout	0.1mm (0.0039in.)	0.13mm (0.0051in.)
Cooling method	Water-cooled, pressurized. Forced circulation with electrical fan	
Coolant		
Quantity	6 liter (6.3U.S qts, 5.2Imp. qts)	
Radiator		
Type	Pressurized corrugated fin type	
Radiator cap		
Main valve opening pressure	83 ~ 110kpa (12 ~ 16psi, 0.83 ~ 1.1kg/cm²)	
Vacuum valve opening pressure	-7kpa (-100psi, -0.07kg/cm²) or less	
Thermostat		
Type	Wax pellet type with jiggle valve	
Valve opening temperature	82°C (177°F)	
Full-opening temperature	95°C (201°F)	
Coolant pump	Centrifugal type impeller	
Drive belt		
Type	V-ribbed belt	
Engine coolant temperature sensor		
Type	Heat-sensitive thermistor type	
Resistance	2.31 ~ 2.59KΩ at 20°C (68°F)	
Oil pump		
Clearance between outer circumference and front case.	0.120 ~ 0.185mm (0.0049 ~ 0.0073in.)	
Front case tip clearance	0.025 ~ 0.069mm (0.0009 ~ 0.0027in.)	
Side clearance		
Inner gear	0.04 ~ 0.085mm (0.0016 ~ 0.0033in.)	
Outer gear	0.04 ~ 0.09mm (0.0016 ~ 0.0035in.)	
Engine oil pressure at 1500 RPM [Oil temperature is 90 to 110°C (194 to 230°F)]	245KPa (2.5kg/cm², 35.5psi)	

Description	Specifications	Limit
Relief spring Free height Load	 43.8mm (1.725in.) 3.7±0.4kg at 40.1mm (3.15±0.88lb/1.578in.)	
Air cleaner Type Element	 Dry type Unwoven cloth type	
Exhaust pipe Muffler Suspension system	 Expansion resonance type Rubber hangers	

SERVICE STANDRDS

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

TIGHTENING TORQUE

Item	Nm	kgf.cm	lbf.ft
Cylinder Block			
Front engine support bracket bolt and nut	35 ~ 50	350 ~ 500	25 ~ 37
Front roll stopper bracket bolt	70 ~ 90	700 ~ 900	51 ~ 65
Rear roll stopper bracket bolt	70 ~ 90	700 ~ 900	51 ~ 65
Rear engine support bracket bolt	40 ~ 50	400 ~ 500	30 ~ 37
Engine Mounting			
Right mounting insulator (large) nut	90 ~ 110	900 ~ 1100	65 ~ 80
Right mounting insulator (small) nut	45 ~ 60	450 ~ 600	33 ~ 44
Right mounting bracket to engine nuts and bolts	50 ~ 65	500 ~ 650	36 ~ 48
Transmission mount insulator nut	90 ~ 110	900 ~ 1100	65 ~ 80
Transmission insulator bracket to side member bolt	40 ~ 50	400 ~ 500	30 ~ 36
Rear roll stopper insulator nut	50 ~ 65	500 ~ 650	36 ~ 48
Rear roll stopper bracket to center member bolts	40 ~ 50	400 ~ 500	30 ~ 36
Front roll stopper insulator nut	50 ~ 65	500 ~ 650	36 ~ 48
Front roll stopper bracket to center member bolts.	40 ~ 50	400 ~ 500	30 ~ 36
Main Moving			
Connecting rod cap nut	50 ~ 53	500 ~ 530	36 ~ 39
Crankshaft bearing cap bolt	28~32 + (60°~64°)	280~320 + (60°~64°)	20.6~23.6 + (60°~64°)
Fly wheel M/T bolt	120 ~ 130	1200 ~ 1300	88 ~ 95
Drive plate A/T bolt	120 ~ 130	1200 ~ 1300	88 ~ 95
Engine cover	4 ~ 6	40 ~ 60	3 ~ 4
Heat protector	15 ~ 20	150 ~ 200	11 ~15
Water pipe bracket bolts	12 ~ 15	120 ~ 150	9 ~ 11
Cooling system			
Alternator support bolt and nut	20 ~ 25	200 ~ 250	14 ~ 18
Alternator lock bolt	12 ~ 15	120 ~ 150	9 ~ 11
Alternator brance mounting bolt	20 ~ 27	200 ~ 270	15 ~ 20
Coolant pump pulley bolts	8 ~ 10	80 ~ 100	6 ~ 7
Coolant pump bolts	20 ~ 27	200 ~ 270	14 ~ 19
Coolant temperature sensor	20 ~ 40	200 ~ 400	15 ~ 30
Coolant inlet fitting nuts	15 ~ 20	150 ~ 200	11 ~ 14
Thermostat housing bolts and nuts	15 ~ 20	150 ~ 200	11 ~ 14
Lubrication system			
Oil filter	12 ~ 16	120 ~ 160	9 ~ 12
Oil pan bolts	10 ~ 12	100 ~ 120	7 ~ 9
Oil pan drain plug	40 ~ 45	400 ~ 450	30 ~33
Oil screen bolts	15 ~ 22	150 ~ 220	11 ~16
Oil pressure switch	13 ~ 15	130 ~ 150	9.7 ~11

Item	Nm	kgf.cm	lbf.ft
Intake and Exhaust system			
Air cleaner body mounting bolts	8~ 10	80 ~ 100	6 ~ 7
Resonator mounting bolts	4 ~ 6	40 ~ 60	3 ~ 4
Intake manifold to cylinder head nuts and bolts	16 ~ 23	160 ~ 230	12 ~ 17
Intake manifold stay to cylinder block bolts	18 ~ 25	180 ~ 250	13 ~ 18
Throttle body to surge tank nuts	15 ~ 20	150 ~ 200	11 ~ 14
Exhaust manifold to cylinder head nuts	43 ~ 55	430 ~ 550	32 ~ 40
Exhaust manifold cover to exhaust manifold bolts	17 ~ 22	170 ~ 220	12.5 ~ 16
Oxygen sensor to front muffler	50 ~ 60	500 ~ 600	36 ~ 43
Oxygen sensor to exhaust manifold	50 ~ 60	500 ~ 600	36 ~ 43
Front exhaust pipe to exhaust manifold nuts	30 ~ 40	300 ~ 400	22 ~ 29
Front exhaust pipe bracket bolts	30 ~ 40	300 ~ 400	22 ~ 29
Front exhaust pipe to catalytic converter bolts	40 ~ 60	400 ~ 600	29 ~ 43
Main muffler hanger support bracket bolts	10 ~ 15	100 ~ 150	7 ~ 11
Cylinder head			
Cylinder head bolts - M10	25 + (60°~65°) + (60°~65°)	250 + (60°~65°) + (60°~65°)	18 + (60°~65°) + (60°~65°)
Cylinder head bolts - M12	30 + (60°~65°) + (60°~65°)	300 + (60°~65°) + (60°~65°)	22 + (60°~65°) + (60°~65°)
Intake manifold nuts	18 ~ 25	180 ~ 250	13 ~ 18
Exhaust manifold nuts	43 ~ 55	430 ~ 550	32 ~ 41
Cylinder head cover bolts	8 ~ 10	80 ~ 100	6 ~ 7
Camshaft bearing cap bolts	14 ~ 15	140 ~ 150	10 ~ 11
Oil control valve bolt	10 ~ 12	100 ~ 120	7.3 ~ 8.8
OCV Filter	41 ~ 51	410 ~ 510	30 ~ 37.6
CVVT unit to exhaust camshaft bolt	66 ~ 78	660 ~ 780	48.7~ 57.5
Rear plate bolts	8 ~ 10	80 ~ 100	6 ~ 7
Timing Belt			
Crankshaft pulley bolt	160 ~ 170	1600 ~ 1700	120 ~ 125
Camshaft sprocket bolt	100 ~ 120	1000 ~ 1200	74 ~ 89
Timing belt tensioner bolts	43 ~ 550	430 ~ 550	31 ~ 40
Timing belt cover bolts	8 ~ 10	80 ~ 100	6 ~ 7
Front case bolts	20 ~ 27	200 ~ 270	14 ~ 20
Timing belt idler bolt	43 ~ 55	430 ~ 550	31 ~ 40

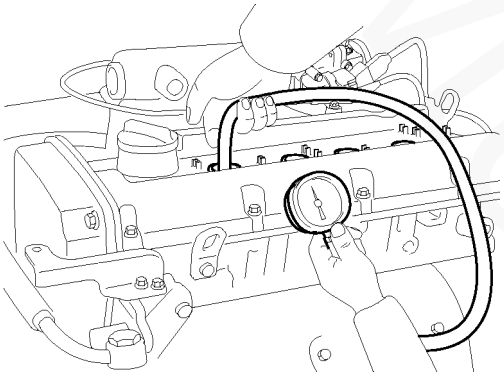
M/T : Manual Transmission
A/T : Automatic Transmission

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



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

NOTE

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

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

NOTE

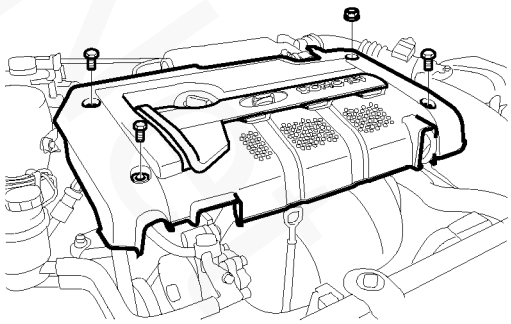
This measurement must be done in as short a time as possible.

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

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

TIMING BELT TENSION ADJUSTMENT

1. Remove the engine cover(A).



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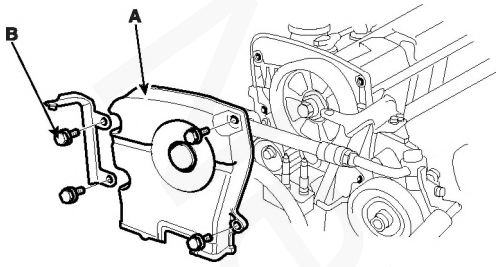
2. Remove RH front wheel.

3. Remove the 4bolts(B) and timing belt upper cover(A).



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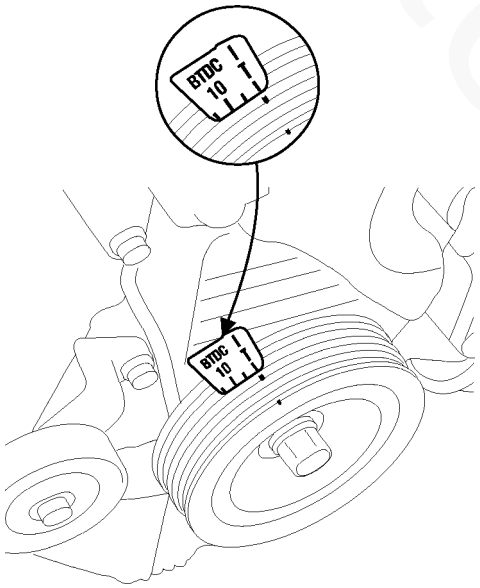
4. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing belt cover.



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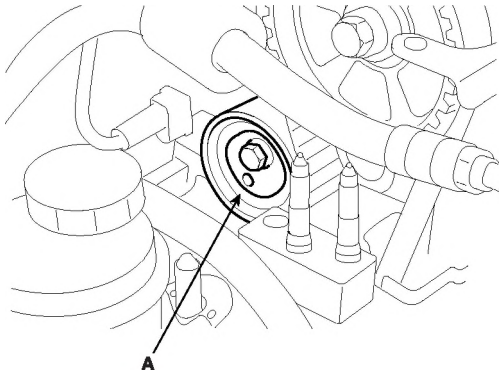
5. Temperarily loosen tensioner pulley(A) by center bolt.



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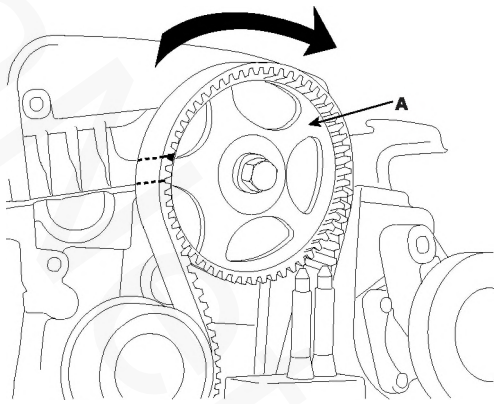
6. Timing belt tension adjusting.

   1) Rotate crankshaft in regular direction (clock wise view from front) through angle equivalent to two teeth (18°) of camshaft sprocket(A).



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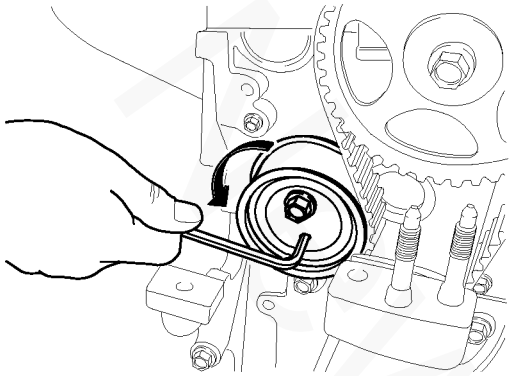
2) Give tension to timing belt rotating tensioner in arrow direction tool and set timing belt not to give slack to tension side.



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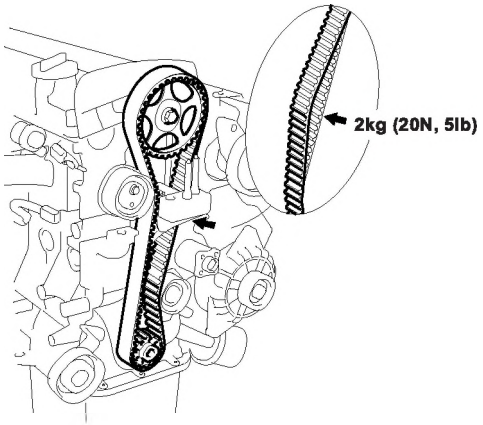
3) Tightening tensioner bolt.

Tightening torque
Tensioner bolt
43 ~ 55Nm (430 ~ 550kgf.cm, 32 ~ 40lbf.ft)

4) Recheck the belt tension, When the tension side of timing belt is pushed horizontally with a moderate force [approx. 2kg (20N, 5lb)], the timing belt cog end sags in approx. 4 ~ 6mm (0.16 ~ 0.24in.)



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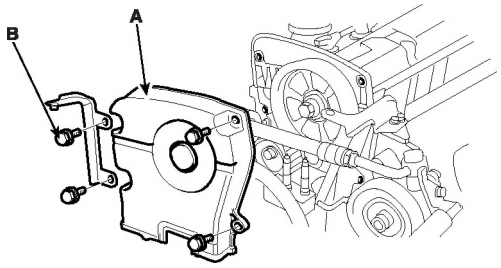
7. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing mark.

8. Install the timing belt upper cover(A) with 4bolts(B).

Tightening torque
8 ~ 10Nm (80 ~ 100kgf.cm, 6 ~ 7lbf.ft)



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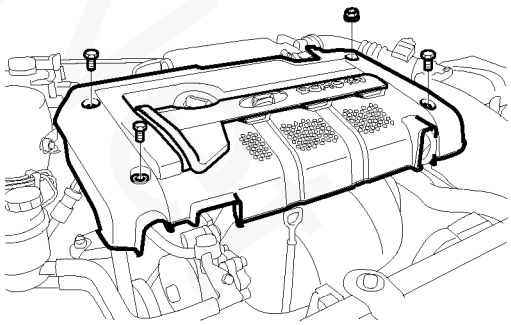
9. Install RH front wheel.

10. Install engine cover(A).



ECHE101A

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

MLA (MECHANICAL LASH ADJUSTER)

NOTE

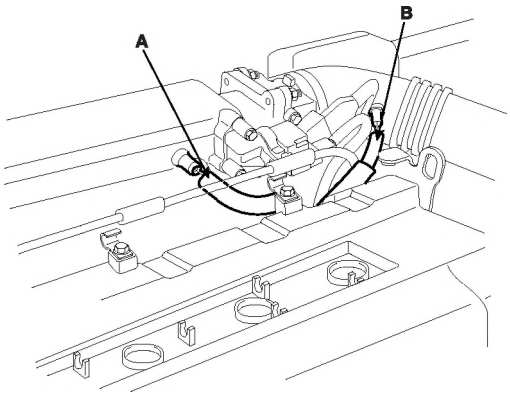
Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C) and cylinder head is installed on the cylinder block.

1. Remove the engine cover. (See page EM - 8)
2. Remove the upper timing belt cover. (See page EM - 9)
   a. Loosen the upper timing cover bolts and then remove the cover.
3. Remove the cylinder head cover.
   a. Disconnect the spark plug cables and do not pull on the spark plug by force.

NOTE

Pulling on or bending the cables may damage the conductor inside.

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



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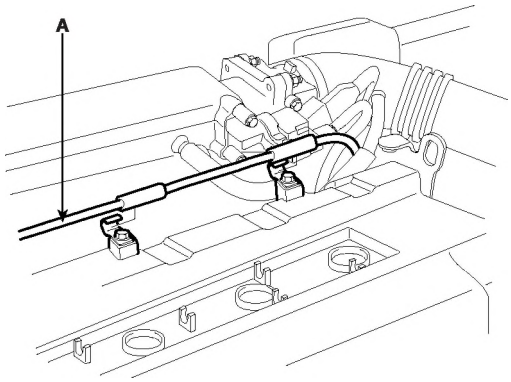
   c. Disconnect the accelerater cable(A) from the cylinder head cover.



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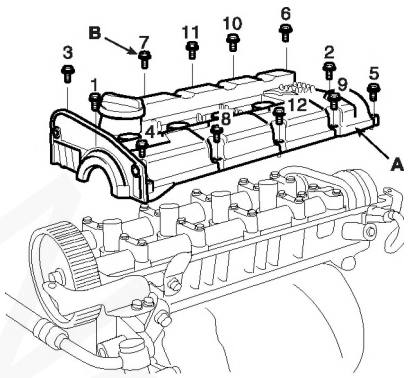
   d. Loosen the cylinder head cover bolts(B) and then remove the cover(A) and gasket.



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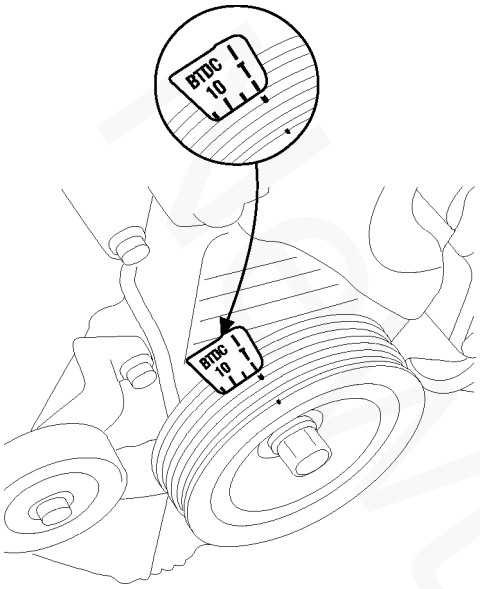
4. Set No.1 cylinder to TDC/compression.
   a. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing belt cover.



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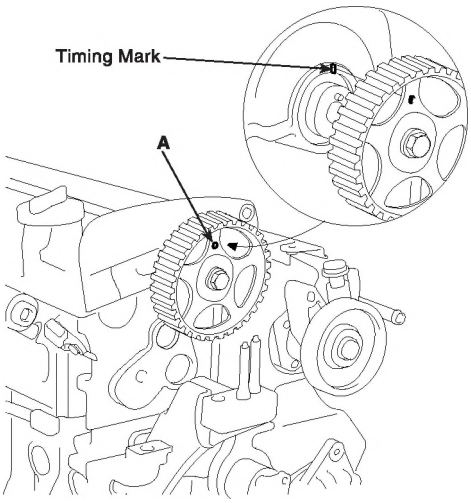
   b. Check that the hole of the camshaft timing pulley(A) is aligned with the timing mark of the bearing cap.
   If not, turn the crankshaft one revolution (360°)



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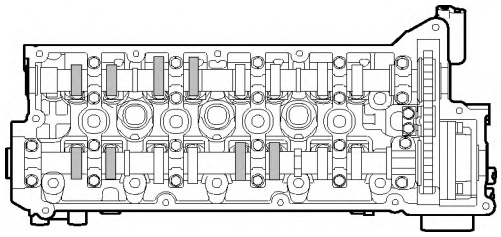
5. Inspect the valve clearance.
   a. Check only the valve indicated as shown. [No. 1 cylinder : TDC/Compression] measure the valve clearance.



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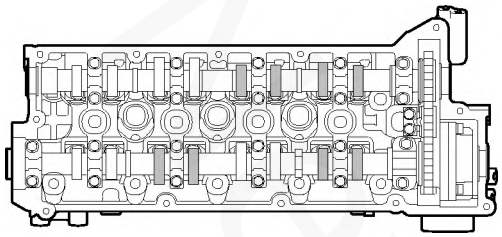
   · Using a thickness gauge, measure the clearance between the tappet shim and the base circle of camshaft.
   · Record the out-of-specification valve clearance measurements. They will be used later to determine the required replaement adjusing shim.

Valve clearance
Specification
Engine coolant temperature : 20°C [68°F]
Intake : 0.20mm (0.0079in.)
Exhaust : 0.28mm (0.0110in.)
Limit
Intake : 0.12 ~ 0.28mm (0.0047 ~ 0.0110in.)
Exhaust : 0.20 ~ 0.38mm (0.0079 ~ 0.0150in.)

   b. Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing belt cover.

c. Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance. (See procedure in step (6))



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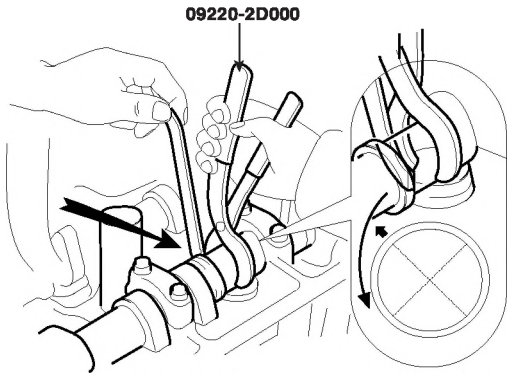
6. Adjust the intake and exhaust valve clearance.
   a. Turn the crankshaft so that the cam lobe of the camshaft on the adjusting valve is upward.
   b. Using the SST(09220-2D000), press down the valve lifter and place the stopper between the camshaft and valve lifter and remove the special tool.



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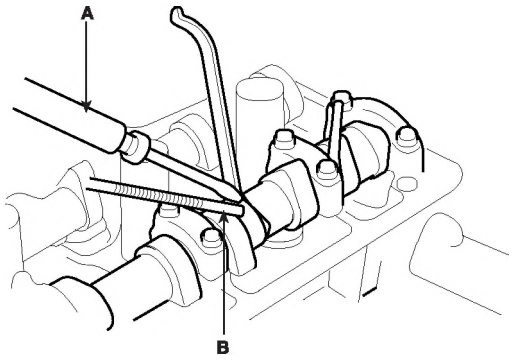
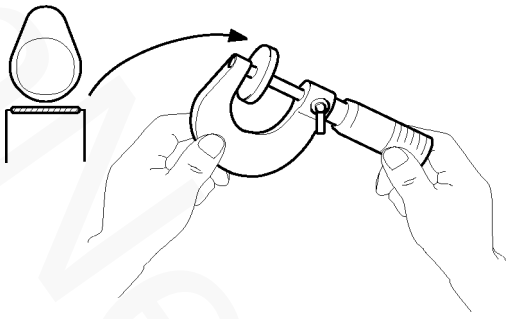
c. Remove the adjusting shim with a small screw driver(A) and magnet(B).



EDKB889C

d. Measure the thickness of the removed shim using a micrometer.



EDKB889D

e. Calculate the thickness of a new shim so that the valve clearance comes within the specificified value.

Valve clearance (Engine coolant temperature : 20°C)
T : Thickness of removed shim
A : Measured valve clearance
N : Thickness of new shim
Intake : N = T + [A - 0.20mm(0.0079in.)]
Exhaust : N = T + [A-0.28mm (0.0110in.)]

f. Select a new shim with a thickness as close as possible to the caculated value. [Refer to the Adjusting shim selection chart]

NOTE

Shims are available in 20size increments of 0.04mm (0.0016in.) from 2.00mm (0.079in.) to 2.76mm (0.1087in.)

g. Place a new adjusting shim on the valve lifter.
h. Using the SST(09220-2D000), press down the valve lifter and remove the stopper.
i. Recheck the valve clearance.

Valve clearance (Engine coolant temperature : 20°C)
[Specification]
Intake : 0.20mm (0.0079in.)
Exhaust : 0.28mm (0.0110in.)
[Limit] (After adjusting valve clearance)
Intake : 0.17 ~ 0.23mm (0.0067 ~ 0.0091in.)
Exhaust : 0.25 ~ 0.31mm (0.0098 ~ 0.0122in.)

Adjusting Shim Selection Chart (Intake)

Install shim thickness mm (in.) / Measured clearance mm (in.)		2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.11 (0.0831)	2.12 (0.0835)	2.13 (0.0839)	2.14 (0.0843)	2.15 (0.0846)	2.16 (0.0850)	2.17 (0.0854)	2.18 (0.0858)	2.19 (0.0862)	2.20 (0.0866)	2.21 (0.0870)	2.22 (0.0874)	2.23 (0.0878)	2.24 (0.0882)	2.25 (0.0886)	2.26 (0.0890)	2.27 (0.0894)	2.28 (0.0898)	2.29 (0.0902)	2.30 (0.0906)	2.31 (0.0909)	2.32 (0.0913)	2.33 (0.0917)	2.34 (0.0921)	2.35 (0.0925)	2.36 (0.0929)	2.37 (0.0933)	2.38 (0.0937)	2.39 (0.0941)	2.40 (0.0945)	2.41 (0.0949)	2.42 (0.0953)	2.43 (0.0957)	2.44 (0.0961)	2.45 (0.0965)	2.46 (0.0969)	2.47 (0.0972)	2.48 (0.0976)	2.49 (0.0980)	2.50 (0.0984)	2.51 (0.0988)	2.52 (0.0992)	2.53 (0.0996)	2.54 (0.1000)	2.56 (0.1008)	2.58 (0.1016)	2.6 (0.1024)	2.62 (0.1031)	2.64 (0.1039)	2.66 (0.1047)	2.68 (0.1055)	2.70 (0.1063)	2.72 (0.1071)	2.74 (0.1079)	2.76 (0.1087)
0.000 - 0.020	(0.0000 - 0.0008)													1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	11	11	12	12	13	13	14	14	15	15
0.021 - 0.040	(0.0008 - 0.0016)											1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	12	12	13	13	14	14	15	15	16
0.041 - 0.060	(0.0016 - 0.0024)									1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	12	12	13	13	14	14	15	15	16	16
0.061 - 0.080	(0.0024 - 0.0031)							1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	13	13	14	14	15	15	16	16	17
0.081 - 0.100	(0.0032 - 0.0039)						1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	14	14	15	15	16	16	17	17
0.101 - 0.119	(0.0040 - 0.0047)					1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	14	14	15	15	16	16	17	17	18
0.120 - 0.280	(0.0047 - 0.0110)																																																														
0.281 - 0.300	(0.0111 - 0.0118)	3	4	4	5	5	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	18	18	19	19	20	20				
0.301 - 0.320	(0.0119 - 0.0126)	4	4	5	5	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	19	19	20	20					
0.321 - 0.340	(0.0126 - 0.0134)	4	5	5	6	6	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	19	19	20	20						
0.341 - 0.360	(0.0134 - 0.0142)	5	5	6	6	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	20	20							
0.361 - 0.380	(0.0142 - 0.0150)	5	6	6	7	7	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	20	20								
0.381 - 0.400	(0.0150 - 0.0157)	6	6	7	7	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20									
0.401 - 0.420	(0.0158 - 0.0165)	6	7	7	8	8	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20										
0.421 - 0.440	(0.0166 - 0.0173)	7	7	8	8	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20											
0.441 - 0.460	(0.0174 - 0.0181)	7	8	8	9	9	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20													
0.461 - 0.480	(0.0181 - 0.0189)	8	8	9	9	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20															
0.481 - 0.500	(0.0189 - 0.0197)	8	9	9	10	10	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																	
0.501 - 0.520	(0.0197 - 0.0205)	9	9	10	10	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																			
0.521 - 0.540	(0.0205 - 0.0213)	9	10	10	11	11	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																					
0.541 - 0.560	(0.0213 - 0.0220)	10	10	11	11	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																							
0.561 - 0.580	(0.0221 - 0.0228)	10	11	11	12	12	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																									
0.581 - 0.600	(0.0229 - 0.0236)	11	11	12	12	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																											
0.601 - 0.620	(0.0237 - 0.0244)	11	12	12	13	13	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																													
0.621 - 0.640	(0.0244 - 0.0252)	12	12	13	13	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																															
0.641 - 0.660	(0.0252 - 0.0260)	12	13	13	14	14	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																	
0.661 - 0.680	(0.0260 - 0.0268)	13	13	14	14	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																			
0.681 - 0.700	(0.0268 - 0.0276)	13	14	14	15	15	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																					
0.701 - 0.720	(0.0276 - 0.0283)	14	14	15	15	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																							
0.721 - 0.740	(0.0284 - 0.0291)	14	15	15	16	16	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																									
0.741 - 0.760	(0.0292 - 0.0299)	15	15	16	16	17	17	18	18	18	18	19	19	19	19	20	20	20	20																																											
0.761 - 0.780	(0.0300 - 0.0307)	15	16	16	17	17	18	18	18	19	19	19	19	20	20	20	20																																													
0.781 - 0.800	(0.0307 - 0.0315)	16	16	17	17	18	18	19	19	19	19	20	20	20	20																																															
0.801 - 0.820	(0.0315 - 0.0323)	16	17	17	18	18	19	19	19	20	20	20	20																																																	
0.821 - 0.840	(0.0323 - 0.0331)	17	17	18	18	19	19	20	20	20	20																																																			
0.841 - 0.860	(0.0331 - 0.0339)	17	18	18	19	19	20	20	20																																																					
0.861 - 0.880	(0.0339 - 0.0346)	18	18	19	19	20	20																																																							
0.881 - 0.900	(0.0347 - 0.0354)	18	19	19	20	20																																																								
0.901 - 0.920	(0.0355 - 0.0362)	19	19	20	20																																																									
0.921 - 0.940	(0.0363 - 0.0370)	19	20	20																																																										
0.941 - 0.960	(0.0370 - 0.0378)	20	20																																																											
0.961 - 0.980	(0.0378 - 0.0386)	20																																																												

Intake valve clearance (Cold) :

0.20 mm (Spec.) 0.12 ~ 0.28mm (Limit)

Example : The 2.24 mm shim is installed, and the measured clearance is 0.450 mm. Replace the 2.24mm shim with a new No. 13 shim.

New shim thickness mm(in.)

Shim No.	Thickness		Shim No.	Thickness	
1	2.00	(0.0787)	11	2.40	(0.0945)
2	2.04	(0.0803)	12	2.44	(0.0961)
3	2.08	(0.0819)	13	2.48	(0.0976)
4	2.12	(0.0835)	14	2.52	(0.0992)
5	2.16	(0.0850)	15	2.56	(0.1008)
6	2.20	(0.0866)	16	2.60	(0.1024)
7	2.24	(0.0882)	17	2.64	(0.1039)
8	2.28	(0.0898)	18	2.68	(0.1055)
9	2.32	(0.0913)	19	2.72	(0.1071)
10	2.36	(0.0929)	20	2.76	(0.1087)

HINT : New shims have the thickness in millimeters imprinted on the face

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Adjusting Shim Selection Chart (Exhaust)

Install shim thickness mm (in.) / Measured clearance mm (in.)		2.00(0.0787)	2.02(0.0795)	2.04(0.0803)	2.06(0.0811)	2.08(0.0819)	2.10(0.0827)	2.11(0.0831)	2.12(0.0835)	2.13(0.0839)	2.14(0.0843)	2.15(0.0846)	2.16(0.0850)	2.17(0.0854)	2.18(0.0858)	2.19(0.0862)	2.20(0.0866)	2.21(0.0870)	2.22(0.0874)	2.23(0.0878)	2.24(0.0882)	2.25(0.0886)	2.26(0.0890)	2.27(0.0894)	2.28(0.0898)	2.29(0.0902)	2.30(0.0906)	2.31(0.0909)	2.32(0.0913)	2.33(0.0917)	2.34(0.0921)
0.000-0.020	(0.0000-0.0008)																					1	1	1	1	1	2	2	2	2	3
0.021-0.040	(0.0008-0.0016)																			1	1	1	1	2	2	2	2	3	3	3	3
0.041-0.060	(0.0016-0.0024)																	1	1	1	1	2	2	2	2	3	3	3	3	4	4
0.061-0.080	(0.0024-0.0031)															1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
0.081-0.100	(0.0032-0.0039)													1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
0.101-0.120	(0.0040-0.0047)											1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5
0.121-0.140	(0.0048-0.0055)									1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6
0.141-0.160	(0.0056-0.0063)							1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6
0.161-0.180	(0.0063-0.0071)						1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7
0.181-0.199	(0.0071-0.0078)					1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7
0.200-0.360	(0.0079-0.0142)																														
0.361-0.380	(0.0142-0.0150)	3	4	4	5	5	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12
0.381-0.400	(0.0150-0.0157)	4	4	5	5	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12
0.401-0.420	(0.0158-0.0165)	4	5	5	6	6	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13
0.421-0.440	(0.0166-0.0173)	5	5	6	6	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13
0.441-0.460	(0.0174-0.0181)	5	6	6	7	7	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14
0.461-0.480	(0.0181-0.0189)	6	6	7	7	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14
0.481-0.500	(0.0189-0.0197)	6	7	7	8	8	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15
0.501-0.520	(0.0197-0.0205)	7	7	8	8	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15
0.521-0.540	(0.0205-0.0213)	7	8	8	9	9	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16
0.541-0.560	(0.0213-0.0220)	8	8	9	9	10	10	11	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16
0.561-0.580	(0.0221-0.0228)	8	9	9	10	10	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17
0.581-0.600	(0.0229-0.0236)	9	9	10	10	11	11	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17
0.601-0.620	(0.0237-0.0244)	9	10	10	11	11	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18
0.621-0.640	(0.0244-0.0252)	10	10	11	11	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18
0.641-0.660	(0.0252-0.0260)	10	11	11	12	12	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19
0.661-0.680	(0.0260-0.0268)	11	11	12	12	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19
0.681-0.700	(0.0268-0.0276)	11	12	12	13	13	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20
0.701-0.720	(0.0276-0.0283)	12	12	13	13	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20
0.721-0.740	(0.0284-0.0291)	12	13	13	14	14	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20		
0.741-0.760	(0.0292-0.0299)	13	13	14	14	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20				
0.761-0.780	(0.0300-0.0307)	13	14	14	15	15	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20						
0.781-0.800	(0.0307-0.0315)	14	14	15	15	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20								
0.801-0.820	(0.0315-0.0323)	14	15	15	16	16	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20										
0.821-0.840	(0.0323-0.0331)	15	15	16	16	17	17	18	18	18	18	19	19	19	19	20	20	20	20												
0.841-0.860	(0.0331-0.0339)	15	16	16	17	17	18	18	18	19	19	19	19	20	20	20	20														
0.861-0.880	(0.0339-0.0346)	16	16	17	17	18	18	19	19	19	19	20	20	20	20																
0.881-0.900	(0.0347-0.0354)	16	17	17	18	18	19	19	19	20	20	20	20																		
0.901-0.920	(0.0355-0.0362)	17	17	18	18	19	19	20	20	20	20																				
0.921-0.940	(0.0363-0.0370)	17	18	18	19	19	20	20	20																						
0.941-0.960	(0.0370-0.0378)	18	18	19	19	20	20																								
0.961-0.980	(0.0378-0.0386)	18	19	19	20	20																									
0.981-1.000	(0.0386-0.0394)	19	19	20	20																										
1.001-1.020	(0.0394-0.0402)	19	20	20																											
1.021-1.040	(0.0402-0.0409)	20	20																												
1.041-1.060	(0.0410-0.0417)	20																													

Install shim thickness mm (in.) / Measured clearance mm (in.)		2.35(0.0925)	2.36(0.0929)	2.37(0.0933)	2.38(0.0937)	2.39(0.0941)	2.40(0.0945)	2.41(0.0949)	2.42(0.0953)	2.43(0.0957)	2.44(0.0961)	2.45(0.0965)	2.46(0.0969)	2.47(0.0972)	2.48(0.0976)	2.49(0.0980)	2.50(0.0984)	2.51(0.0988)	2.52(0.0992)	2.53(0.0996)	2.54(0.1000)	2.56(0.1008)	2.58(0.1016)	2.60(0.1024)	2.62(0.1031)	2.64(0.1039)	2.66(0.1047)	2.68(0.1055)	2.70(0.1063)	2.72(0.1071)	2.74(0.1079)	2.76(0.1087)
0.000-0.020	(0.0000-0.0008)	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	9	9	10	10	11	11	12	12	13	13
0.021-0.040	(0.0008-0.0016)	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	10	10	11	11	12	12	13	13	14
0.041-0.060	(0.0016-0.0024)	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	10	10	11	11	12	12	13	13	14	14
0.061-0.080	(0.0024-0.0031)	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	11	11	12	12	13	13	14	14	15
0.081-0.100	(0.0032-0.0039)	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	11	11	12	12	13	13	14	14	15	15
0.101-0.120	(0.0040-0.0047)	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	12	12	13	13	14	14	15	15	16
0.121-0.140	(0.0048-0.0055)	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	12	12	13	13	14	14	15	15	16	16
0.141-0.160	(0.0056-0.0063)	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	13	13	14	14	15	15	16	16	17
0.161-0.180	(0.0063-0.0071)	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	14	14	15	15	16	16	17	17
0.181-0.199	(0.0071-0.0078)	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	14	14	15	15	16	16	17	17	18
0.200-0.360	(0.0079-0.0142)																															
0.361-0.380	(0.0142-0.0150)	12	12	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	18	18	19	19	20	20				
0.381-0.400	(0.0150-0.0157)	13	13	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	19	19	20	20					
0.401-0.420	(0.0158-0.0165)	13	13	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	19	19	20	20						
0.421-0.440	(0.0166-0.0173)	14	14	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	20	20							
0.441-0.460	(0.0174-0.0181)	14	14	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	20	20								
0.461-0.480	(0.0181-0.0189)	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20									
0.481-0.500	(0.0189-0.0197)	15	15	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20										
0.501-0.520	(0.0197-0.0205)	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20											
0.521-0.540	(0.0205-0.0213)	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20													
0.541-0.560	(0.0213-0.0220)	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20															
0.561-0.580	(0.0221-0.0228)	17	17	18	18	18	18	19	19	19	19	20	20	20	20																	
0.581-0.600	(0.0229-0.0236)	18	18	18	18	19	19	19	19	20	20	20	20																			
0.601-0.620	(0.0237-0.0244)	18	18	19	19	19	19	20	20	20	20																					
0.621-0.640	(0.0244-0.0252)	19	19	19	19	20	20	20	20																							
0.641-0.660	(0.0252-0.0260)	19	19	20	20	20	20																									
0.661-0.680	(0.0260-0.0268)	20	20	20	20																											
0.681-0.700	(0.0268-0.0276)	20	20																													

New shim thickness mm(in.)

Shim No.	Thickness		Shim No.	Thickness	
1	2.00	(0.0787)	11	2.40	(0.0945)
2	2.04	(0.0803)	12	2.44	(0.0961)
3	2.08	(0.0819)	13	2.48	(0.0976)
4	2.12	(0.0835)	14	2.52	(0.0992)
5	2.16	(0.0850)	15	2.56	(0.1008)
6	2.20	(0.0866)	16	2.60	(0.1024)
7	2.24	(0.0882)	17	2.64	(0.1039)
8	2.28	(0.0898)	18	2.68	(0.1055)
9	2.32	(0.0913)	19	2.72	(0.1071)
10	2.36	(0.0929)	20	2.76	(0.1087)

HINT : New shims have the thickness in milimeters imprinted on the face

Intake valve clearance (Cold) :
0.28 mm (Spec.), 0.20 ~ 0.38 mm (Limit)
Example : The 2.24 mm shim is installed, and the measured clearance is 0.450 mm. Replace the 2.24 mm shim with a new No. 11 shim.

EDKB888E

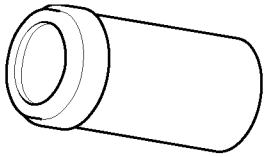
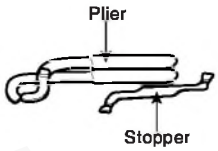
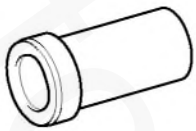
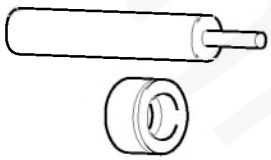
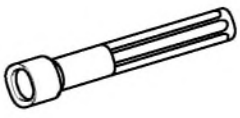
TROUBLESHOOTING E6D36B0F

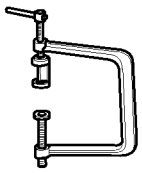
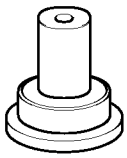
Symption	Suspect area	Remedy (See page)
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings (Oil cousnmption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss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

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

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

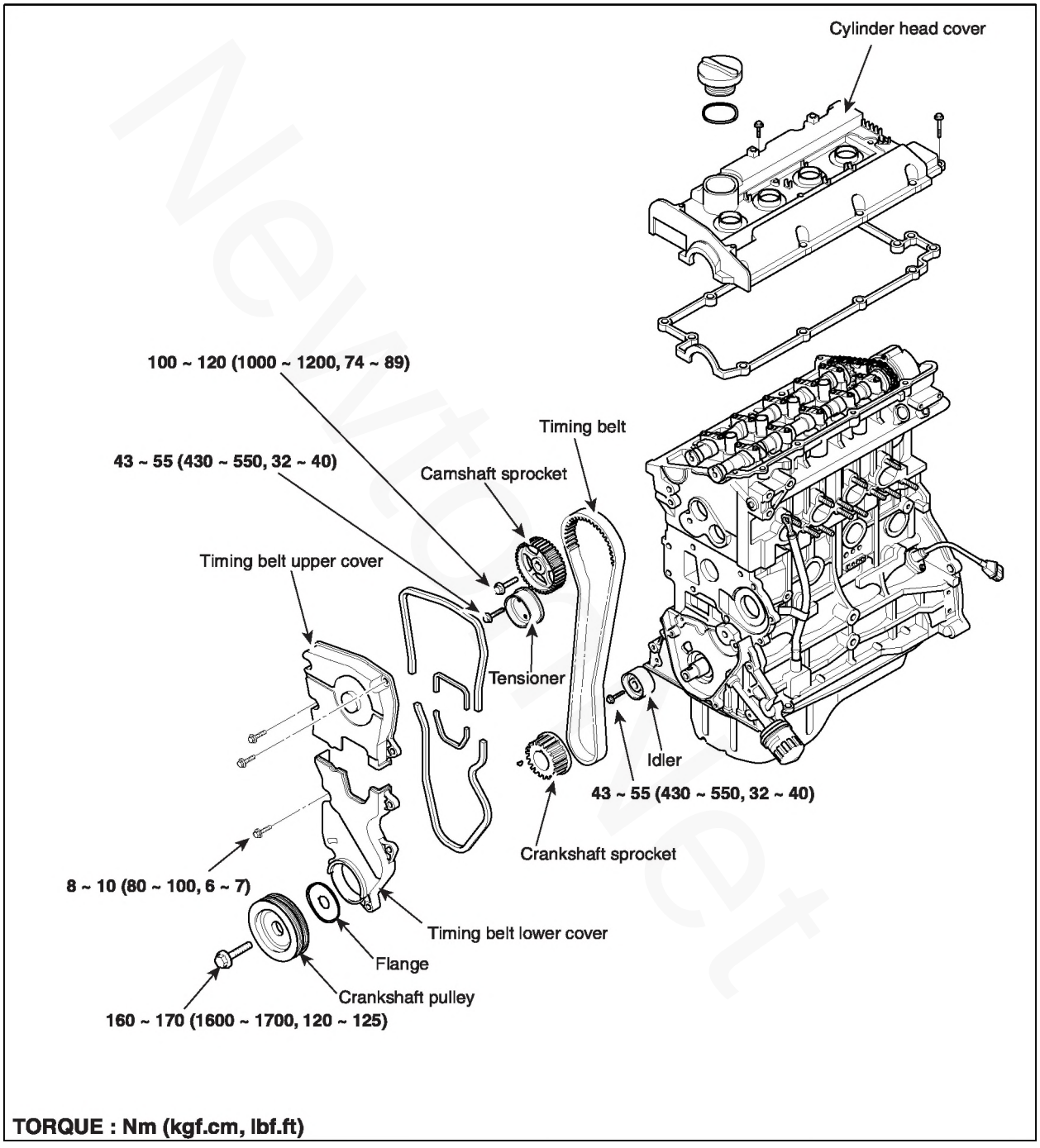
SPECIAL TOOLS EC4DCBF2

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 EDKA010A	Installation of the front oil seal
Valve clearance adjust tool set (09220-2D000)	 EDKB001A	Removal and installation of the tappet shim
Camshaft oil seal installer (09221-21000)	 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

Tool (Number and name)	Illustration	Use
Valve spring compressor & adaptor (09222-28000, 09222-28100)	 EDDA005C	Removal and installation of the intake or exhaust valve
Crankshaft rear oil seal installer (09231-21000)	 EDDA005F	1. Installation of the engine rear oil seal 2. Installation of the crankshaft rear oil seal

TIMING SYSTEM

COMPONENT ED9C5674

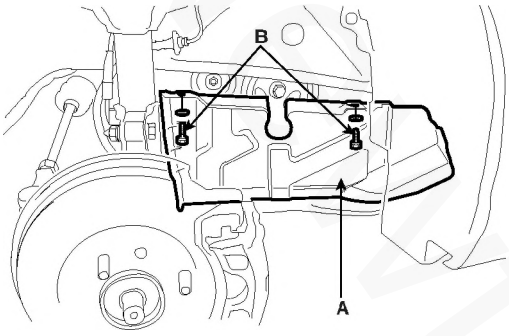


UCOG001A

REMOVAL EA165A14

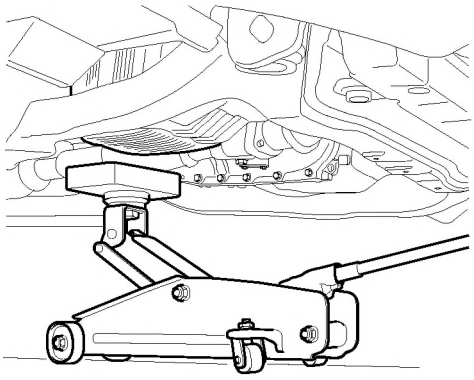
Engine removal is not required for this procedure.

1. Remove the engine cover. (See page EM - 8)
2. Remove RH front wheel.
3. Remove 2bolts(B) and RH side cover(A).



KXDSE16A

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

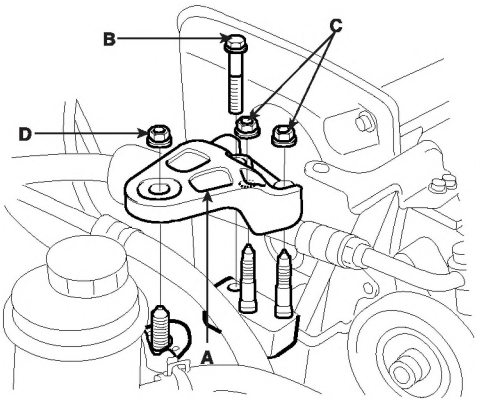


ECKD102A

NOTE

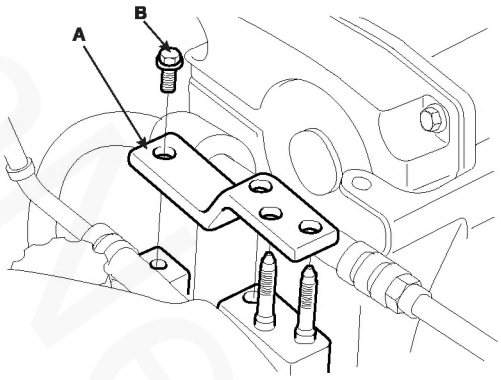
Place wooden block between the jack and engine oil pan.

   2) Remove the bolt(B), 3nuts(C, D) and engine mount bracket(A).



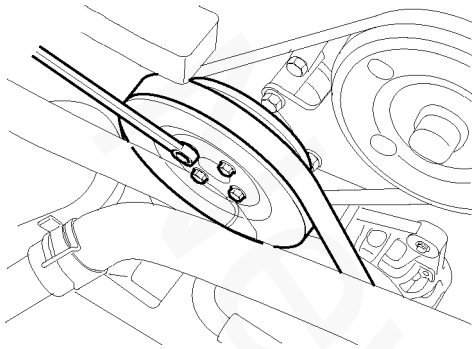
ECHE105A

   3) Remove the bolt(B) and stay plate(A).



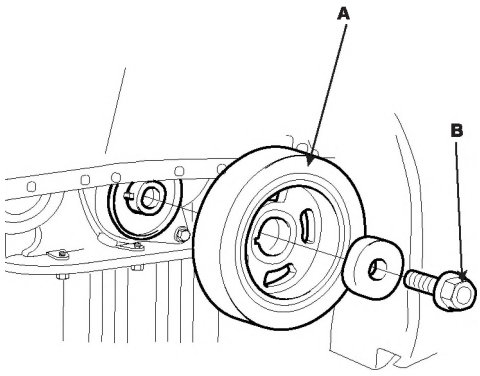
ECKD104A

5. Temporarily loosen the water pump pulley bolts.



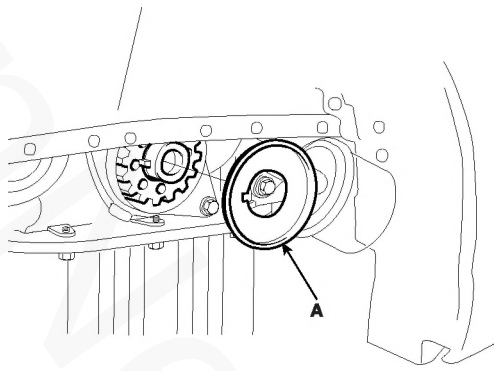
ECKD104B

6. Remove alternator belt. (See EE group - alternator)
7. Remove air compressor belt. (See HA group - air compressor)
8. Remove power steering belt. (See ST group - power steering pump)
9. Remove 4bolts and water pump pulley.
10. Remove the 4bolts and timing belt upper cover. (See page EM - 9)
11. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing belt cover. (See page EM - 9)
12. Remove the crankshaft pulley bolt(B) and crankshaft pulley(A).



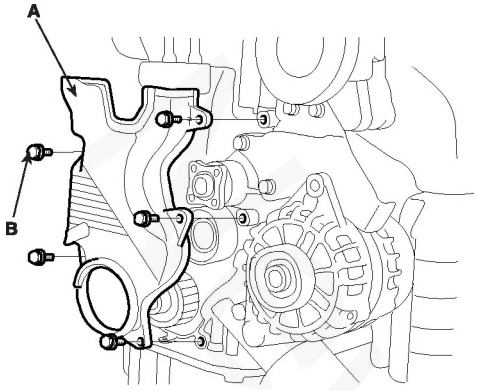
ECKD107A

13. Remove the crankshaft flange(A).



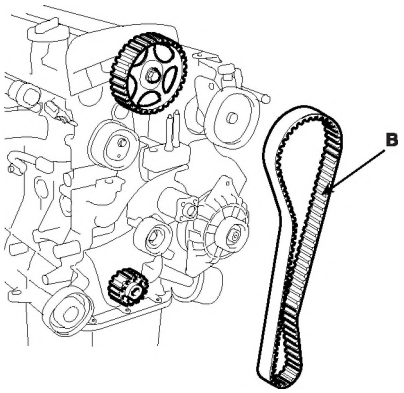
ECKD108A

14. Remove the 5bolts(B) and timing belt lower cover(A).



ECKD108B

15. Remove the timing belt tensioner(A) and timing belt(B).

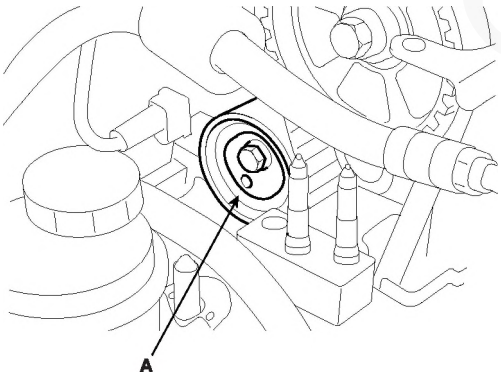


ECKD109B

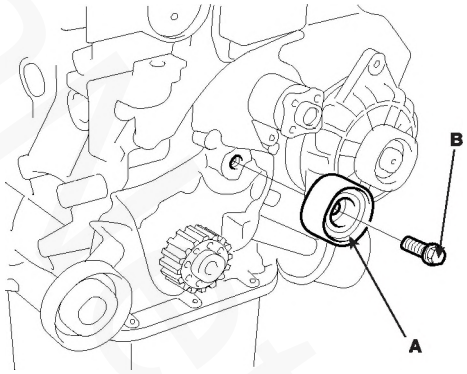
NOTE

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 bolt(B) and timing belt idler(A).

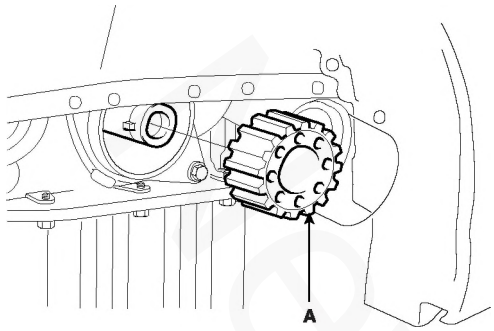


ECKD109A



ECKD109C

17. Remove the crankshaft sprocket(A).



ECKD110A

18. Remove the cylinder head cover.

    1) Remove the spark plug cable.

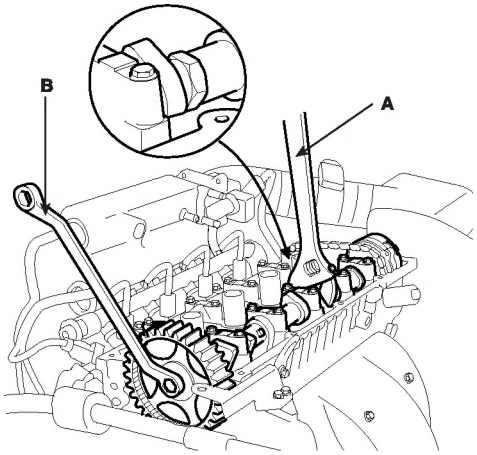
    2) Remove the accelerator cable from the cylinder head cover. (See page EM - 11)

    3) Remove the PCV(Positive Crankcase ventilation) hose and breather hose. (See page EM - 11)

    4) Remove the 12bolts and cylinder head cover. (See page EM - 11)

19. Remove camshaft sprocket.

    1) Hold the hexagonal head wrench(A) portion of the camshaft with a wrench(B), and remove the bolt and camshaft sprocket(C).



ECKD114A

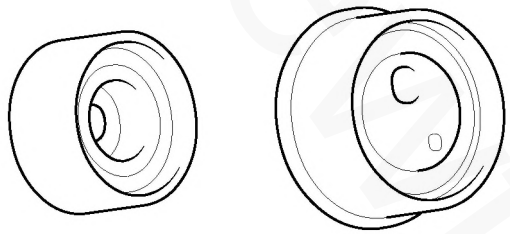
CAUTION

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

INSPECTION E1D945CE

SPOCKETS, TENSIONER, IDLER

1. Check the camshaft sprocket, 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.



ECKD115A

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.

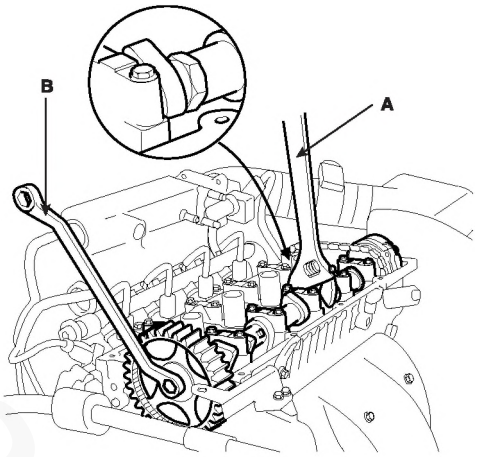
   NOTE

   - *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 E708FC0E

1. Install the camshaft sprocket and tighten the bolt to the specified torque.
   1) Temporarily install the camshaft sprocket bolt.
   2) Hold the hexagonal head wrench(A) portion of the camshaft with a wrench(B), and tighten the camshaft sprocket(C) bolt.

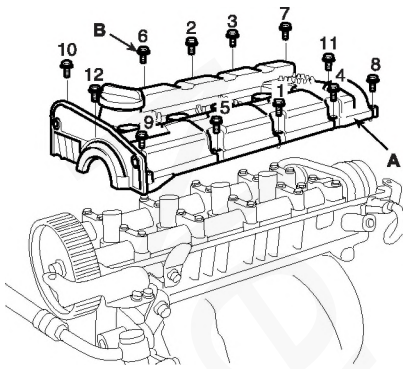
Tightening torque
Camshaft sprocket bolt
100 ~ 120Nm (1000 ~ 1200kgf.cm, 74 ~ 89lbf.ft)



ECKD114A

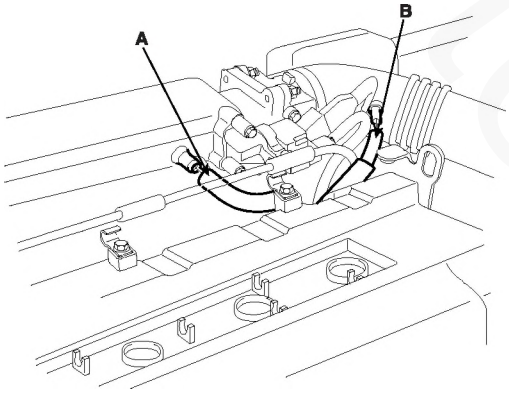
2. Install cylinder head cover.

   1) Install cylinder head cover(A) and 12bolts(B).



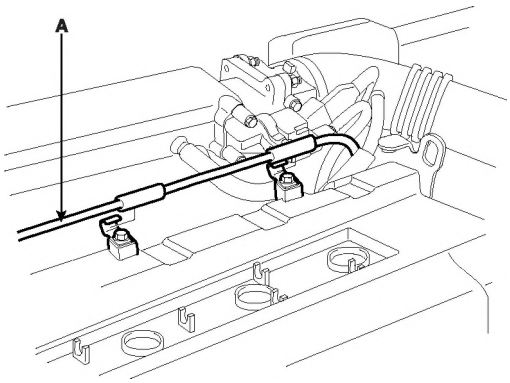
ADIE003A

   2) Install the PCV hose(A) and breather hose(B).



ECKD112A

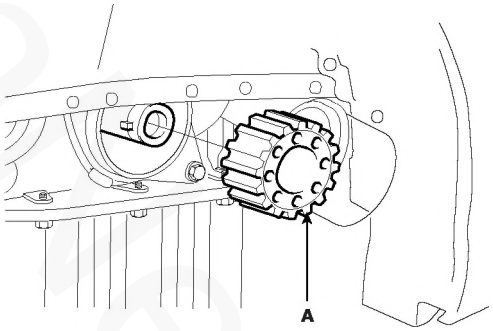
   3) Install the accelerator cable(A) from the cylinder head cover.



ECKD111A

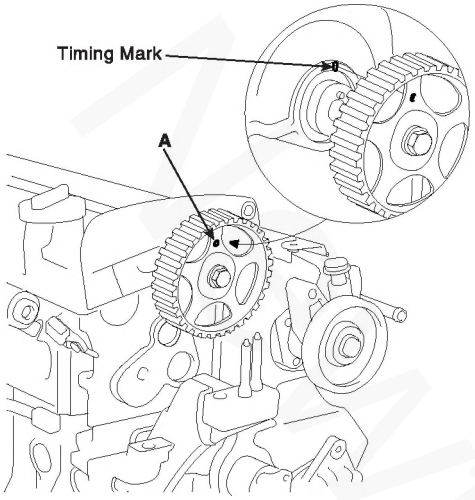
   4) Install the spark plug cable.

3. Install the crankshaft sprocket(A).

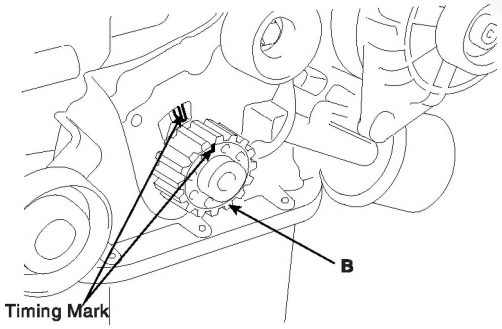


ECKD110A

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



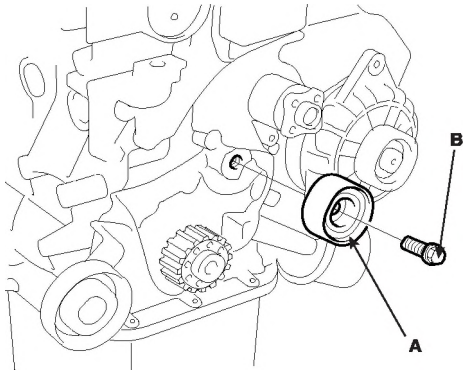
ECKD110B



ECKD110C

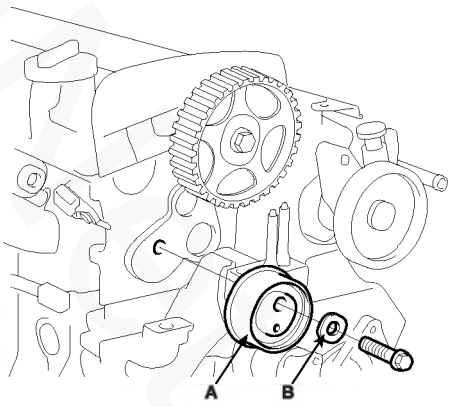
5. Install the idler pulley(A) and tighten the bolt(B) to the specified torque.

Tightening torque
Idler pulley bolt
43 ~ 55Nm (430 ~ 550kgf.m, 32 ~ 40lbf.ft)



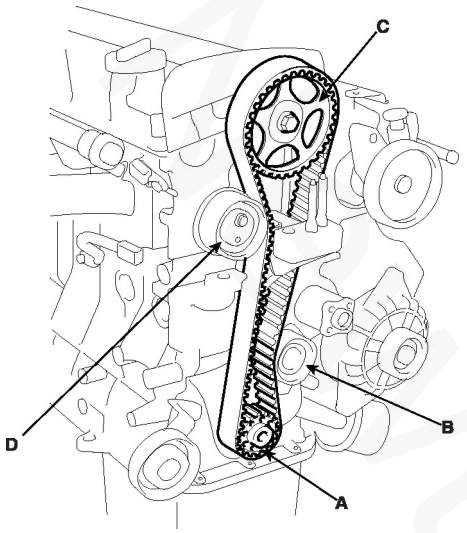
ECKD109C

6. Temporarily install the timing belt tensioner(A) with plain washer(B).



ECKD116A

7. Install the timing belt so as not to give excessive slack at the center of the belt. Install the timing belt with the following procedure.
   Crankshaft sprocket (A) → Idler pulley (B) → Camshaft sprocket (C) → timing belt tensioner (D).

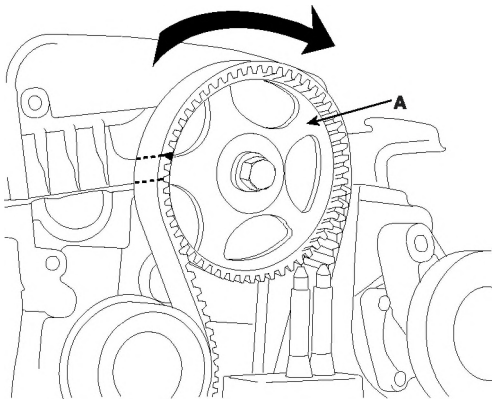


ECKD109D

8. Temporarily fasten tensioner pulley by center bolt to add force at belt.

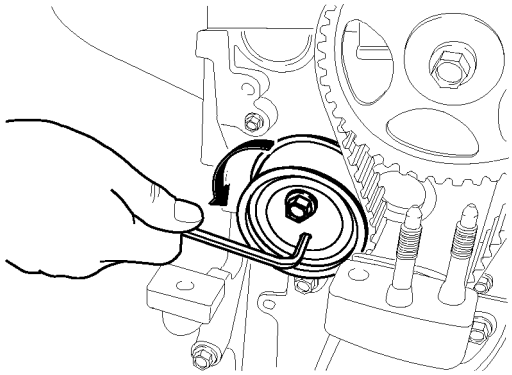
9. Timing belt tension adjusting

   1) Rotate crankshaft in regular direction (clock wise view from front) through angle equivalant to two teeth (18°) of camshaft sprocket(A).



ECKD116B

   2) Give tension to timing belt by rotating tensioner in direction of the arrow with tool and set timing belt not to give slack to tension side.

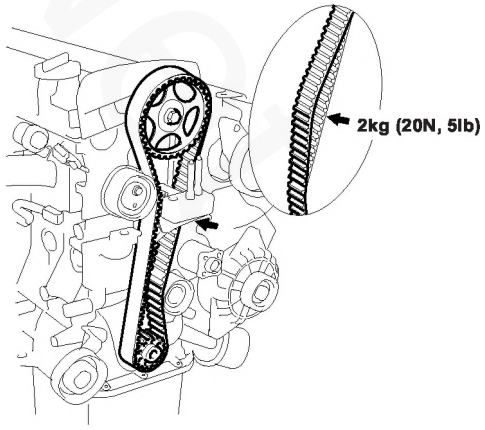


ACGE003A

   3) Tightening tensioner bolt.

Tightening torque
Tensioner bolt
43 ~ 55Nm (430 ~ 550kgf.cm, 32 ~ 40lbf.ft)

   4) Recheck the belt tension. When the tension side of timing belt is pushed horizontally with a moderate force [approx. 2kg (20N, 5lb)], the timing belt cog end sags in approx. 4 ~ 6mm (0.16 ~ 0.24in.)

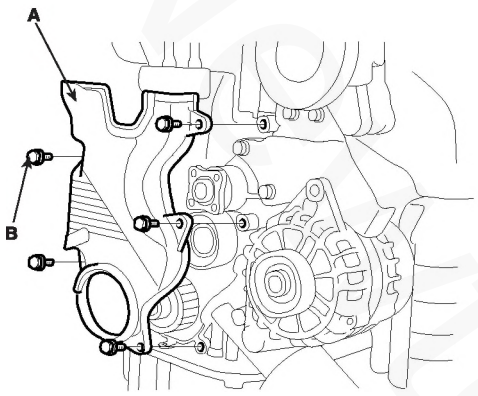


ECKD109E

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

11. Install the timing belt lower cover(A) with 5 bolts(B).

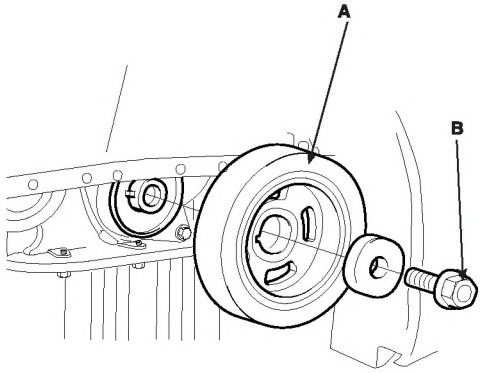
Tightening torque
Timing belt cover bolt
8 ~ 10Nm (80 ~100kg.cm, 6 ~ 7lbf.ft)



ECKD108B

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

Tightening torque
Crankshaft pulley bolt
160 ~ 170Nm (1600 ~ 1700kgf.cm, 120 ~ 125lbf.ft)



ECKD107A

13. Install the timing belt upper cover with 4bolts. (See page EM - 10)

14. Install the coolant pump pulley with 4bolts.

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

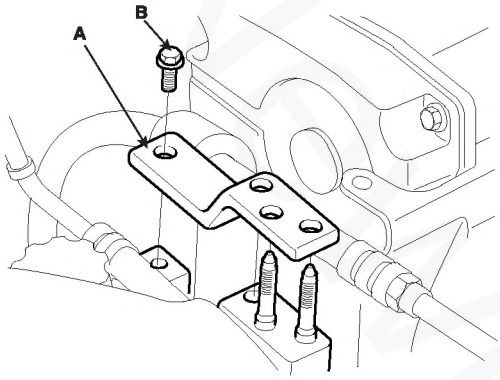
16. Install air compressor belt. (See HA group - air comperssor)

17. Install alternator belt. (See EE group- alternator)

18. Install the engine mount bracket.

    1) Install the stay plate(A) with bolt(B).

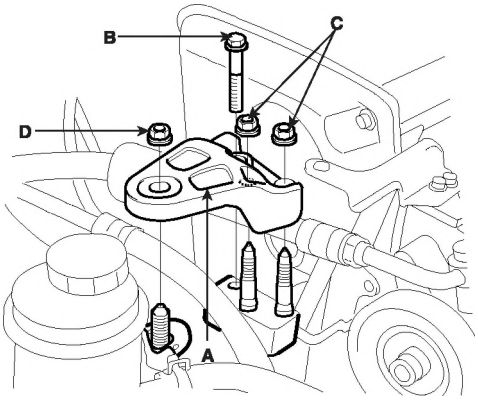
Tightening torque
Stay plate bolt
43 ~ 55Nm (430 ~ 550kgf.cm 32 ~ 40lbf.ft)



ECKD104A

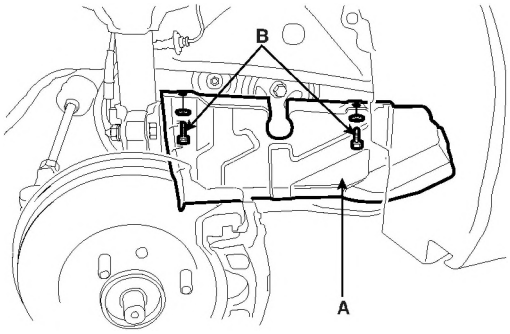
    2) Install engine mount bracket(A) with 3nuts and bolt.

Tightening torque
Bolt(B), Nuts(C)
50 ~ 60Nm (500 ~ 600kgf.ft, 37 ~ 48lbf.ft)
Nut(D) : 60 ~ 80Nm (600 ~ 800kgf.m 44 ~ 59lbf.ft)



ECHE105A

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



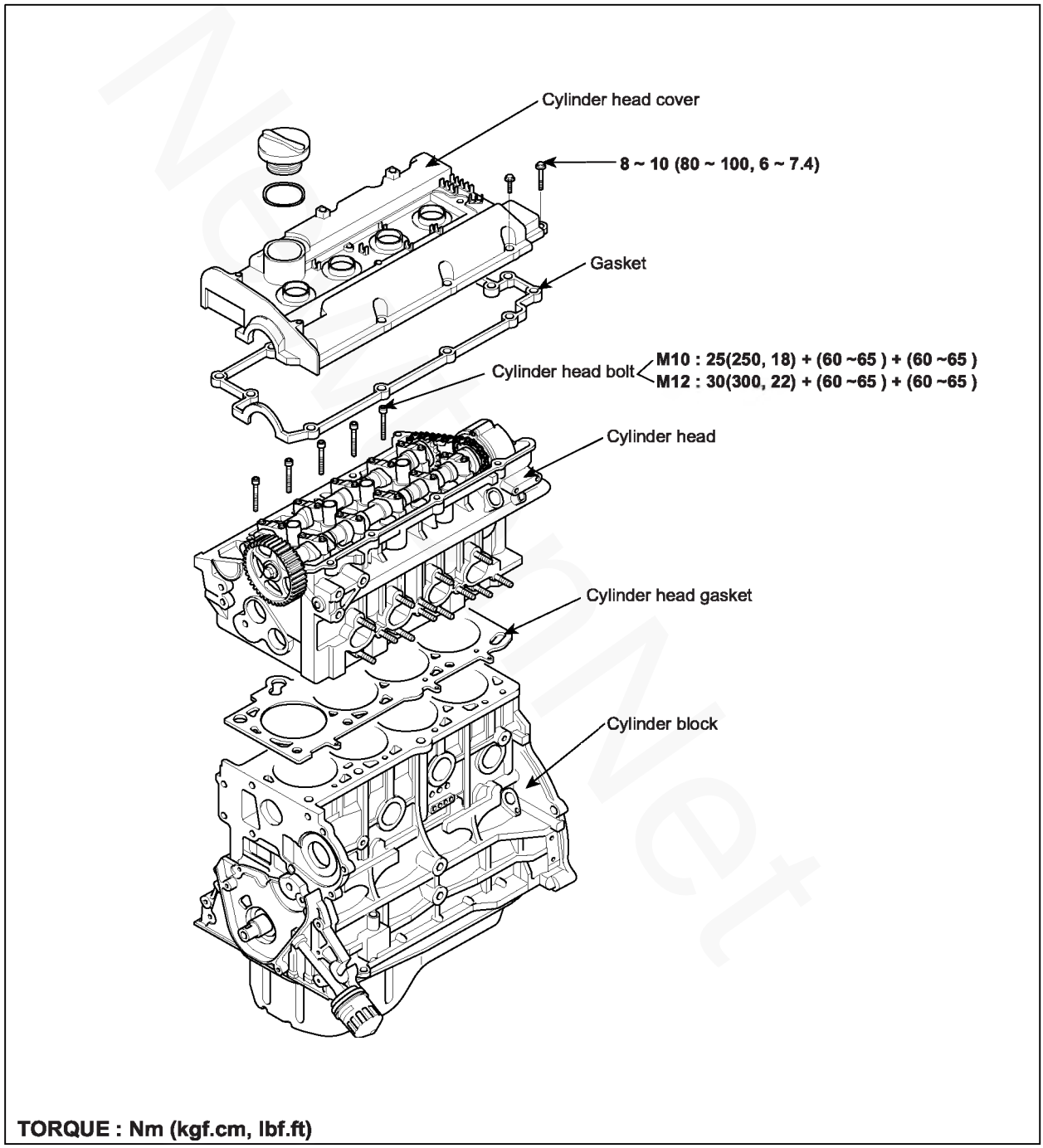
KXDSE16A

20. Install RH front wheel.

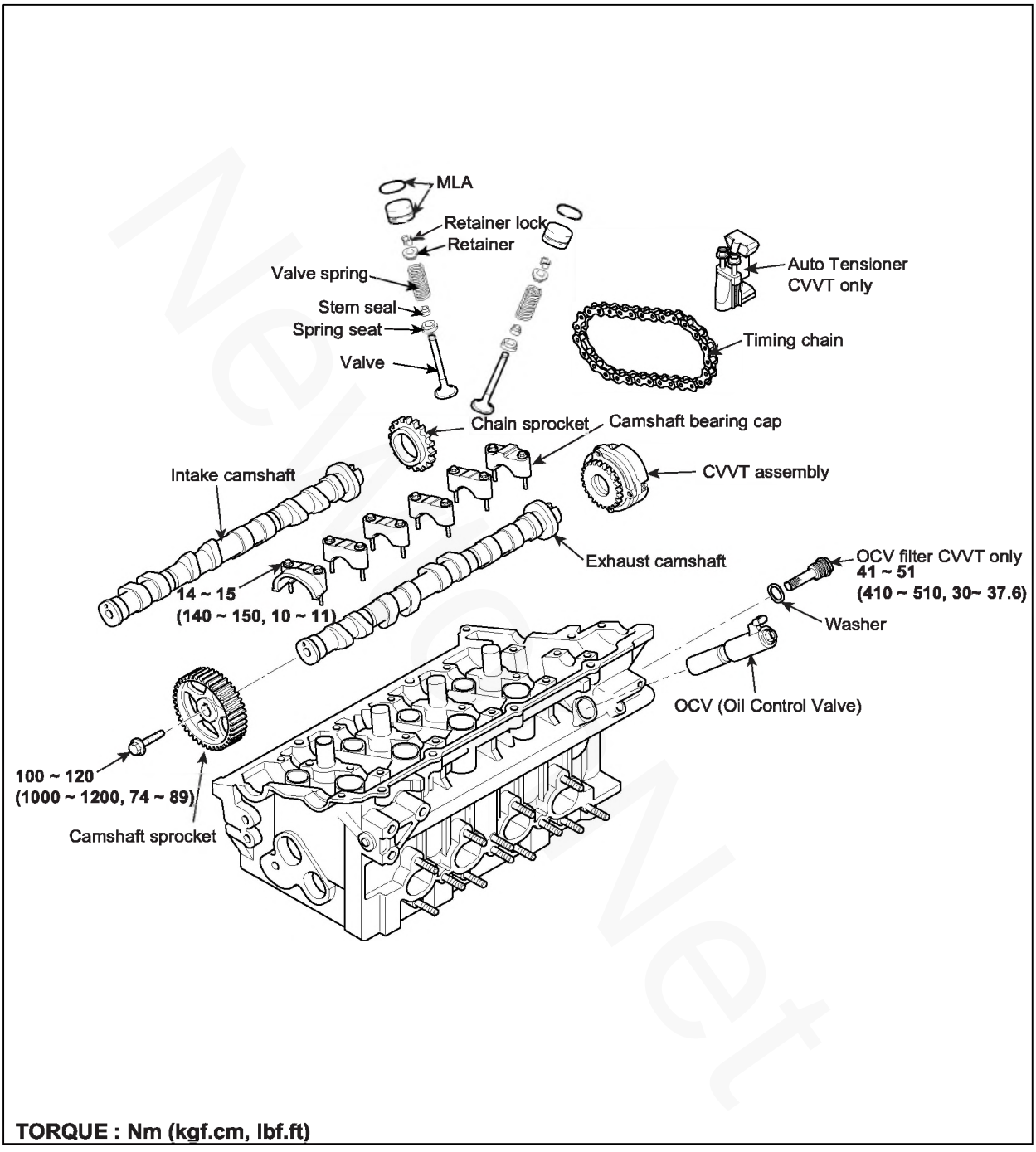
21. Install engine cover with 4bolts. (See page EM - 10)

CYLINDER HEAD ASSEMBLY

COMPONENTS EAFF5C56



ECKD002A


MLA
Retainer lock
Retainer
Valve spring
Stem seal
Spring seat
Valve
Auto Tensioner
CVVT only
Timing chain
Chain sprocket
Camshaft bearing cap
CVVT assembly
Intake camshaft
Exhaust camshaft
14 ~ 15
(140 ~ 150, 10 ~ 11)
OCV filter CVVT only
41 ~ 51
(410 ~ 510, 30~ 37.6)
Washer
OCV (Oil Control Valve)
100 ~ 120
(1000 ~ 1200, 74 ~ 89)
Camshaft sprocket
TORQUE : Nm (kgf.cm, lbf.ft)

ECKD003A

REMOVAL EDB1594A

Engine removal is not required for this procedure.

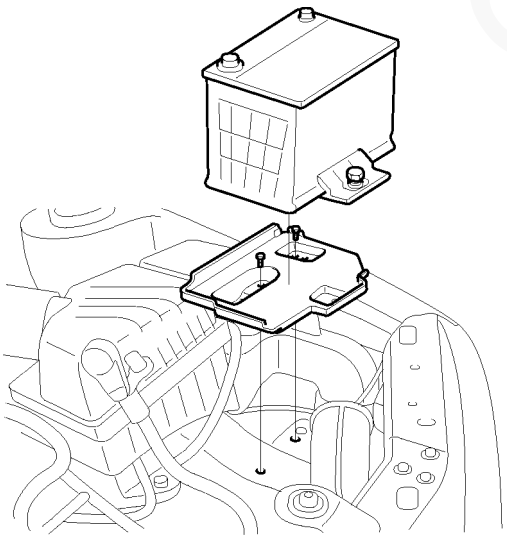
CAUTION

- ***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

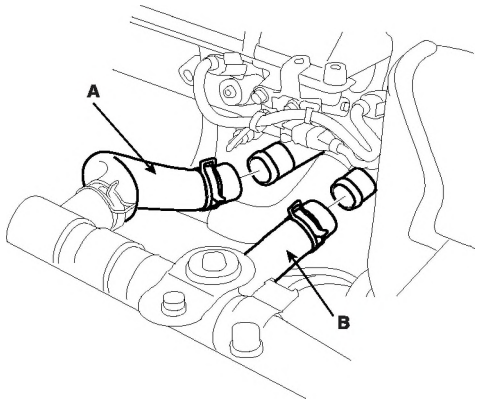
- *Mark all wiring and hoses to avoid misconnection.*
- *Inspect the timing belt before removing the cylinder head.*
- *Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (See page EM - 9)*

1. Disconnect the negative terminal from the battery.



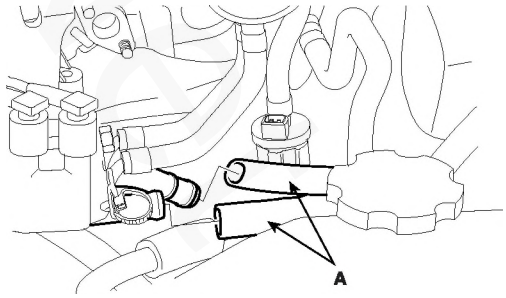
ECKD201B

2. Remove the engine cover. (See page EM - 8)
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).



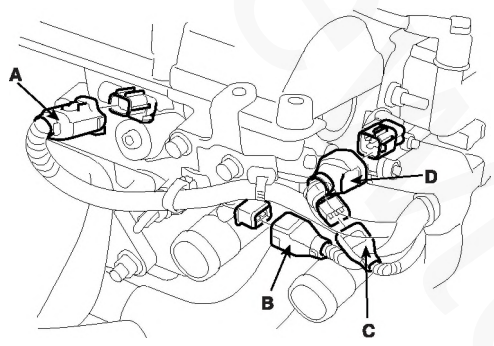
ECKD201A

6. Remove the heater hoses(A).



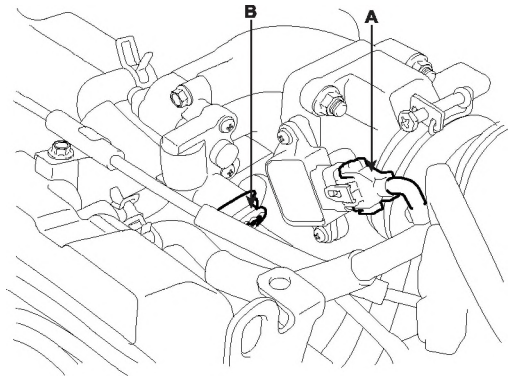
ECKD202A

7. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
   1) OCV(Oil control Valve) connector(A).
   2) Oil temperature sensor connector(B).
   3) ECT(Engine Coolant Temperature) sensor connector(C).
   4) Ignition coil connector(D).



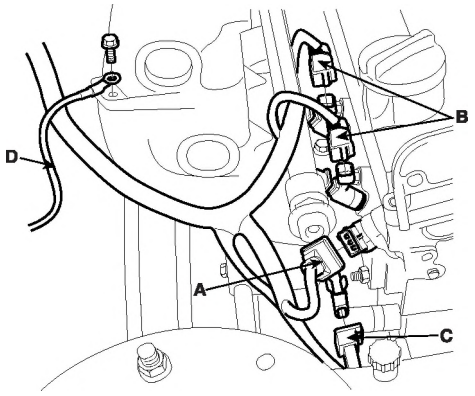
ECKD203A

   5) TPS(Throttle Position Sensor) connector(A).
   6) ISA(Idle Speed Actuator) connector(B).



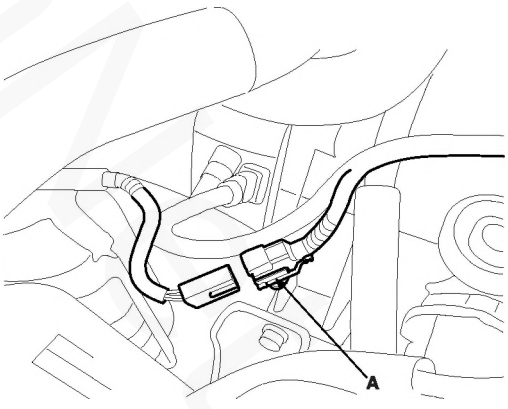
EDQF197A

   7) CMP(Camshaft Position Sensor) connector(A).
   8) Four fuel injector connectors(B).
   9) Knock sensor connector(C).
   10) Disconnect ground cable(D) from the intake manifold.



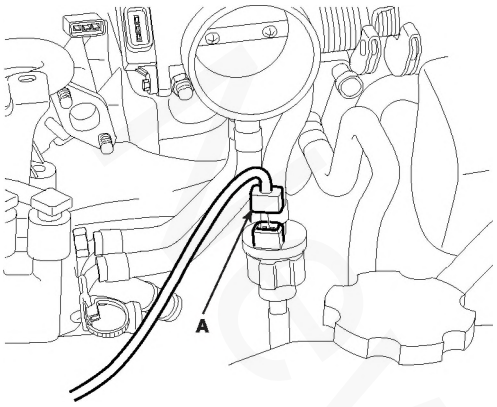
ECKD205A

   11) Front heated oxygen sensor connector(A).



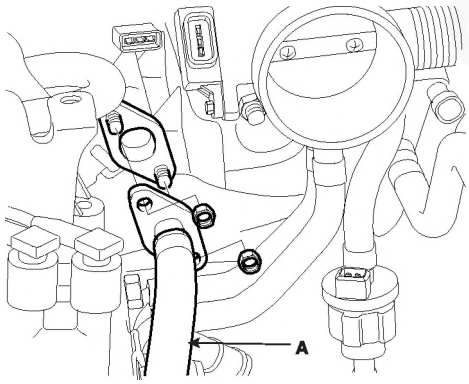
ECKD206A

12) PCSV(Purge Control Solenoid Valve) connector(A).



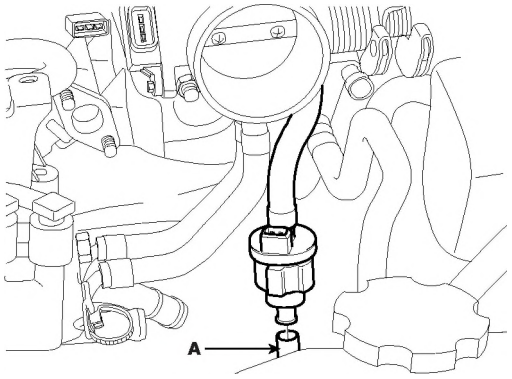
ECKD207A

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



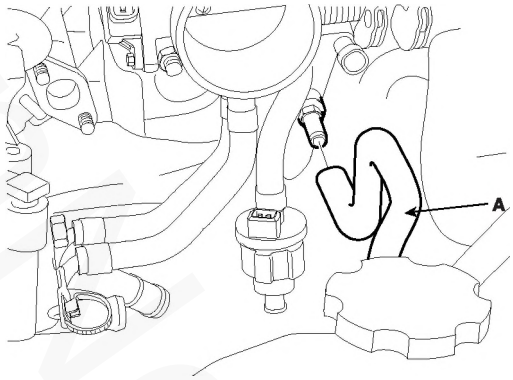
ECKD208A

9. Remove the PCSV hose(A).



ECKD209A

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

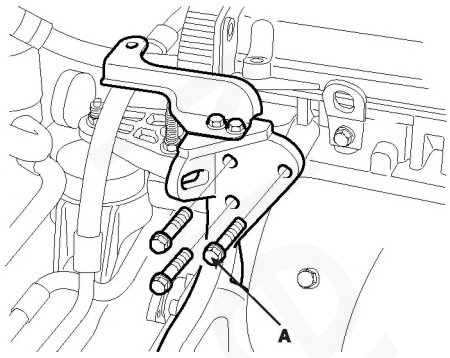


ECKD210A

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

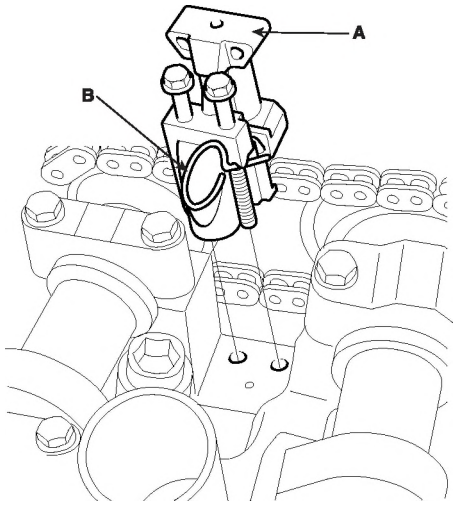
12. Remove the power steering pump. (See ST group - power steering pump)

13. Remove the power steering pump bracket bolts(A).



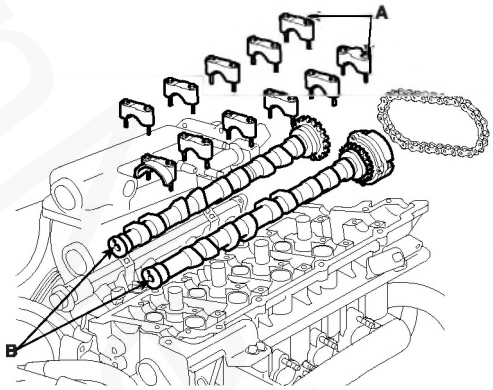
ECKD211A

14. Remove the spark plug cable. (See EE group - ignition)
15. Remove the PCV hose. (See page EM - 11)
16. Remove the cylinder head cover. (See page EM - 11)
17. Remove the timing belt. (See page EM - 23)
18. Remove the exhaust manifold. (See page EM - 102)
19. Remove the intake manifold. (See page EM - 101)
20. Remove the camshaft sprocket. (See page EM - 26)
21. Remove the timing chain auto tensioner(A).



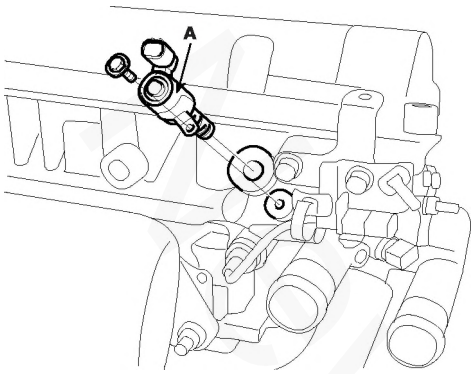
ECKD212A

22. Remove the camshaft bearing caps(A) and camshafts(B).



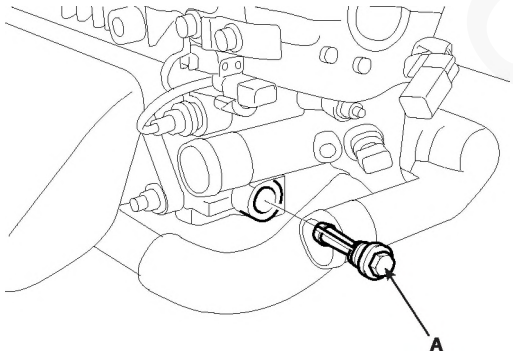
ECKD213A

23. Remove the OCV(oil control valve)(A).



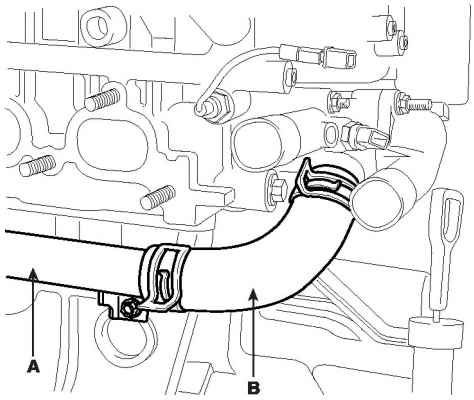
ECKD214A

24. Remove the OCV(oil control valve) filter(A).



ECKD215A

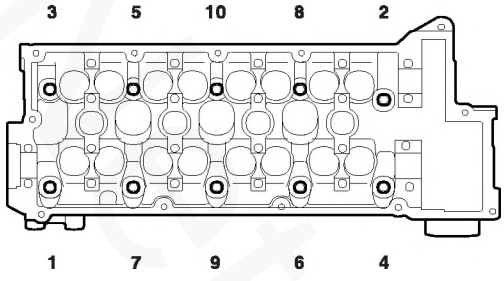
25. Remove the water hose(B) from the water pipe(A).



ACGE009A

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

    1) Using 8mm and 10mm hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.



ECKD216A

⚠ ***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

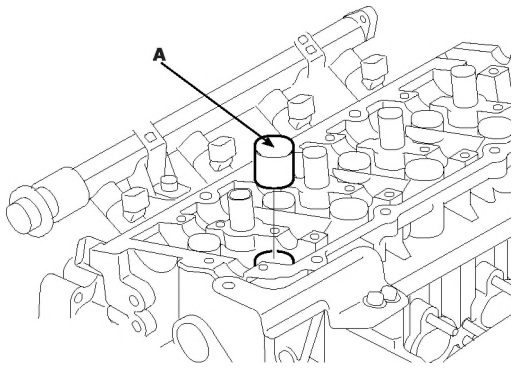
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

DISASSEMBLY E437D6BD

NOTE

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

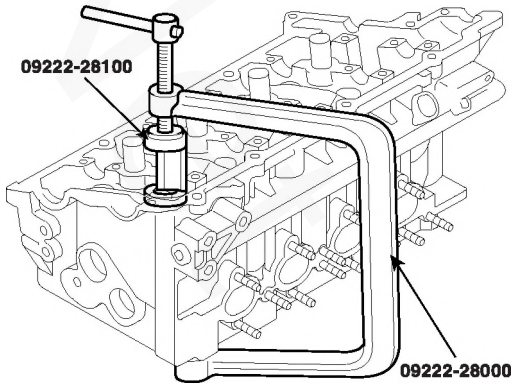
1. Remove MLAs(A).



ECKD217A

2. Remove valves.

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



ECKD218A

   2) Remove the spring retainer.

   3) Remove the valve spring.

4) Remove the valve.

5) Using needle-nose pliers, remove the oil seal.

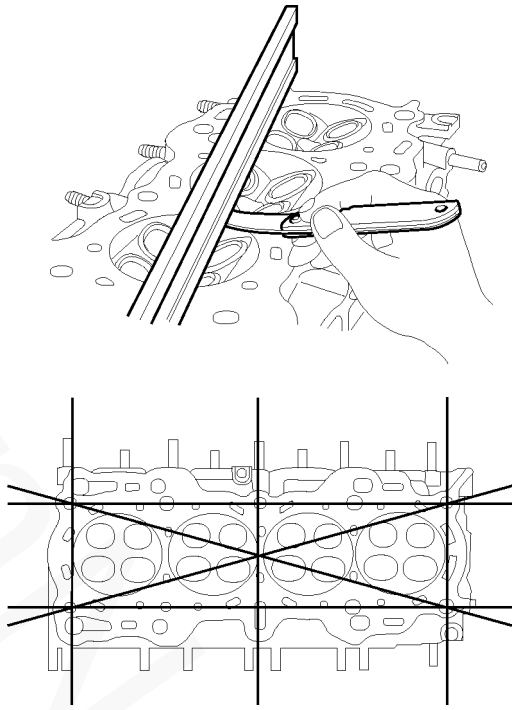
6) Using a magnetic finger, remove the spring seat.

INSPECTION EE22AEEF

CYLINDER HEAD

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

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



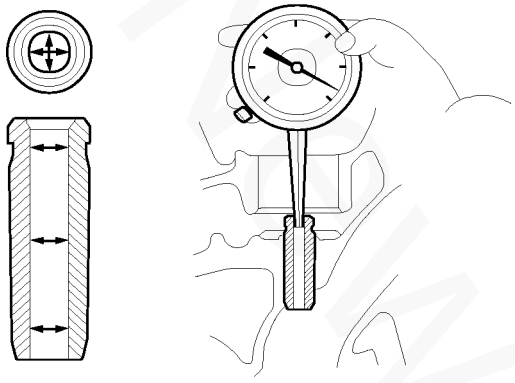
ECKD001H

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

VALVE AND VALVE SPRING

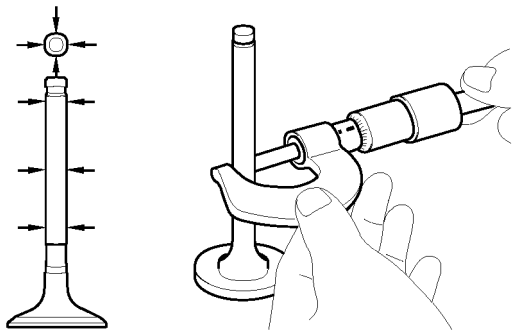
1. Inspect valve stems and valve guides.

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



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 : 0.035 ~ 0.065mm (0.0014 ~ 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.

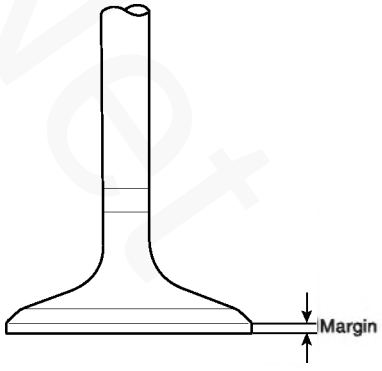
2. Inspect valves.

   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 : 1.15mm(0.0453in.)
Exhaust : 1.35mm(0.0531in.)
[Limit]
Intake : 0.8mm(0.0315in.)
Exhaust : 1.0mm(0.040in.)



ECKD221A

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

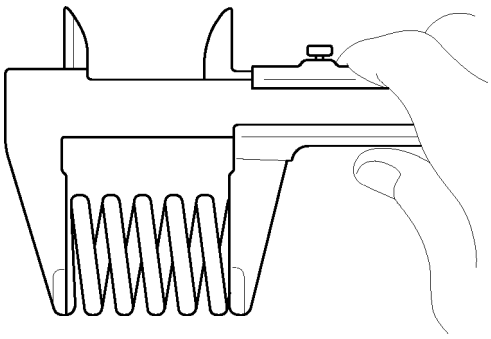
3. Inspect valve seats
Check the valve seat for evidence of overheating and improper contact with the valve face.
Replace the seat if necessary.
Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat. Recondition the valve seat 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 : 48.86mm (1.9236in.)
Load : 18.8kg/39 mm (41.45lb/1.535in.)
[Limit]
Free height : -1.0mm(-0.0394in.)
Out-of-square : 3°



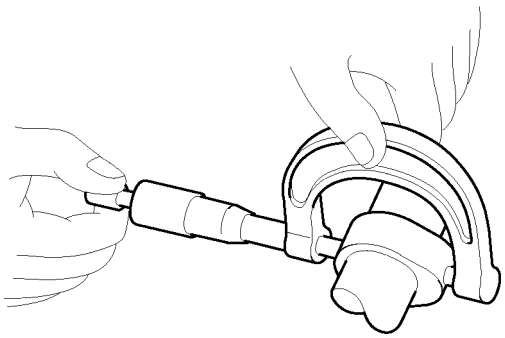
ECKD222A

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 : 44.618mm (1.7566in.)
Exhaust : 44.518mm (1.7527in.)
[Limit]
Intake : 44.518mm (1.7527in.)
Exhaust : 44.418mm (1.7487in.)



ECKD223A

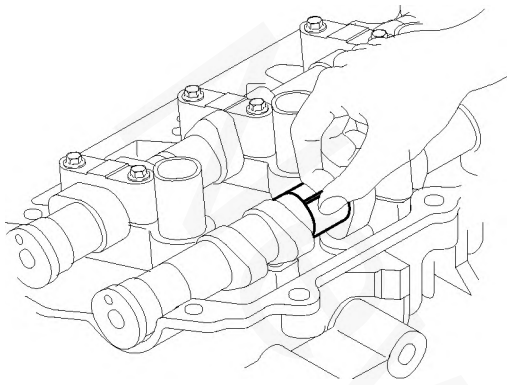
If the cam lobe height is less than minimum, replace the camshaft.

2. Inspect camshaft journal clearance.

1) Clean the bearing caps and camshaft journals.

2) Place the camshafts on the cylinder head.

3) Lay a strip of plastigage across each of the camshaft journal.



ECKD224A

4) Install the bearing caps. (See page EM - 50)

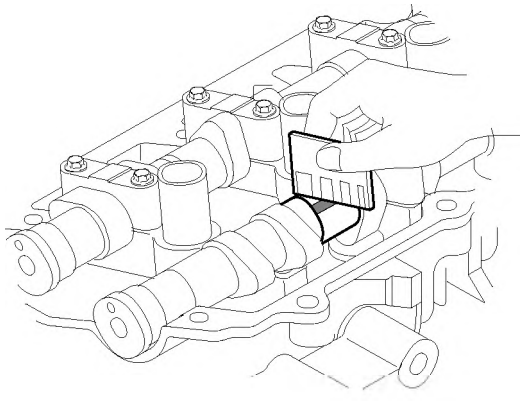
⚠ ***CAUTION***

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.

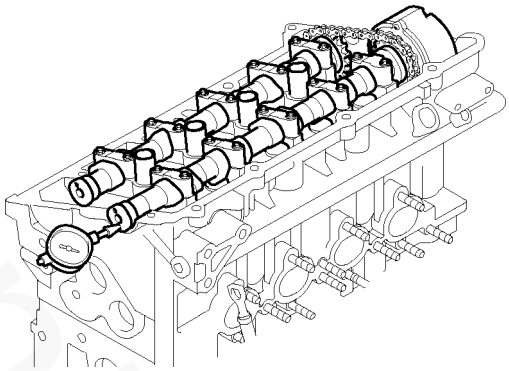
8) Remove the camshafts.

3. Inspect camshaft end play.

1) Install the camshafts. (See page EM - 50)

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

Camshaft end play
[Standard value] : 0.1 ~ 0.2mm(0.004 ~ 0.008in.)



ECKD226A

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

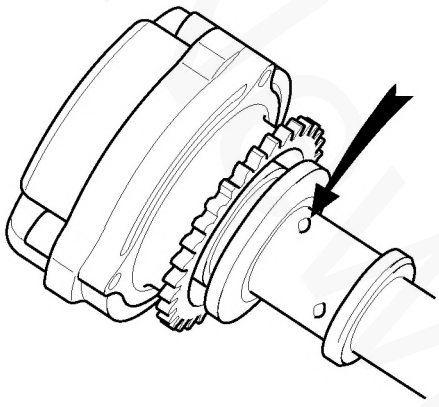
3) Remove the camshafts.

CVVT ASSEMBLY

1. Inspect CVVT assembly.

   1) Check that the CVVT assembly will not turn.

   2) Apply vinyl tape to all the parts except the one indicated by the arrow in the illustration.



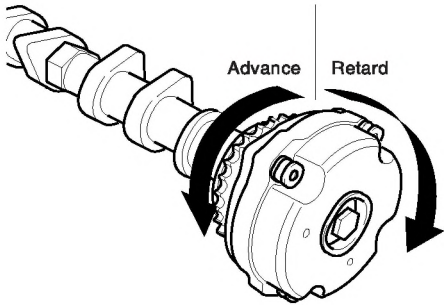
EDKD270B

   3) Wind tape around the tip of the air gun and apply air of approx. 100kpa(1kgf/cm², 14psi) to the port of the camshaft.
   (Perform this order to release the lock pin for the maximum delay angle locking.)

NOTE

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

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



BCGE010A

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

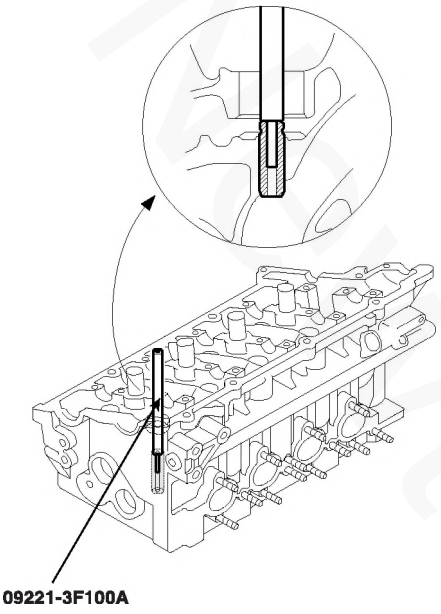
Standard: Movable smoothly in the range about 20°

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

REPLACEMENT EDD51F66

VALVE GUIDE

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



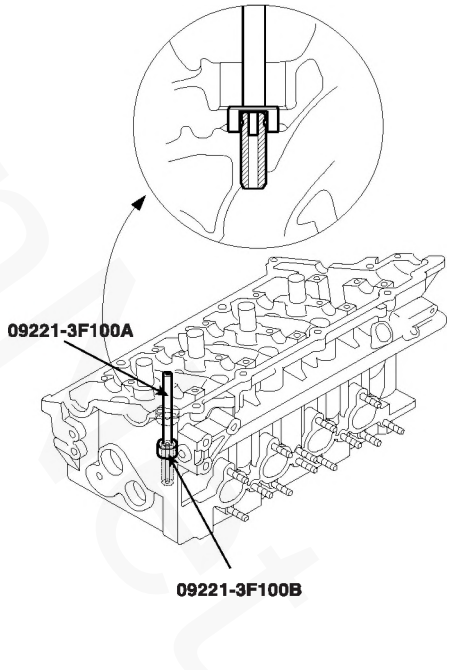
ECHE600A

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 : 46mm (1.8in.)
Exhaust : 54.5mm (2.15in.)



ECHE600B

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 E4AEFFED

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.

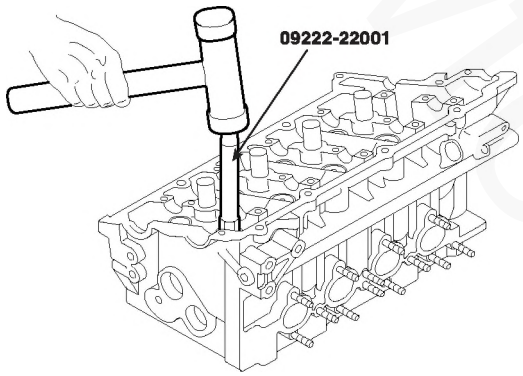
1. Install valves.

   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.



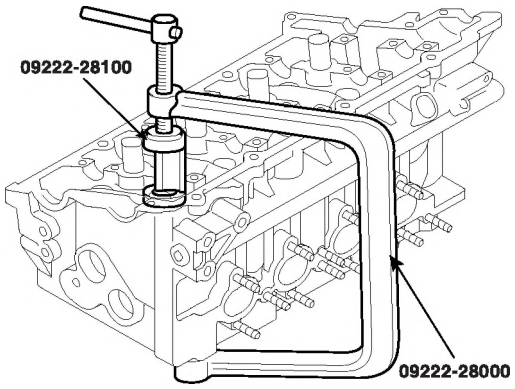
ECKD229A

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

NOTE

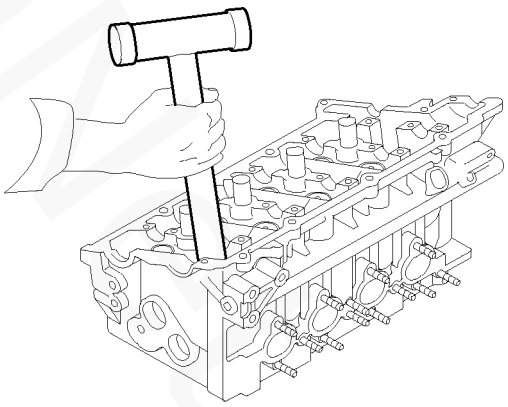
Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

   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.



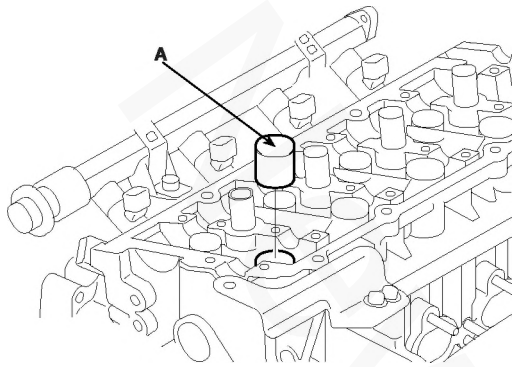
ECKD218A

   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.



ECKD230A

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



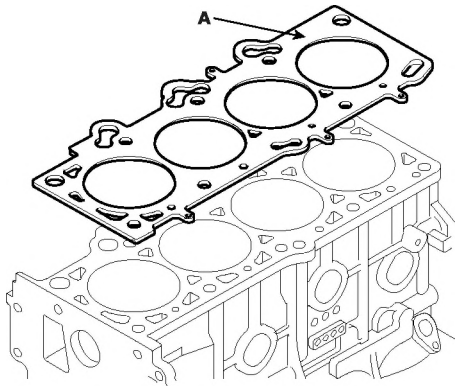
ECKD217A

INSTALLATION EB0A0CEF

NOTE

- *Thoroughly clean all parts to be assembled.*
- *Always use a new head and manifold gasket.*
- *The cylinder head gasket is a metal gasket. Take care not to bend it.*
- *Rotate the crankshaft, set the No.1 piston at TDC. (See page EM - 9)*

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



ECKD231A

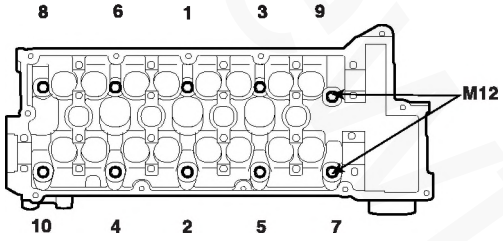
NOTE

Be careful of the installation direction.

2. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
   1) Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.

2) Using 8mm and 10mm hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

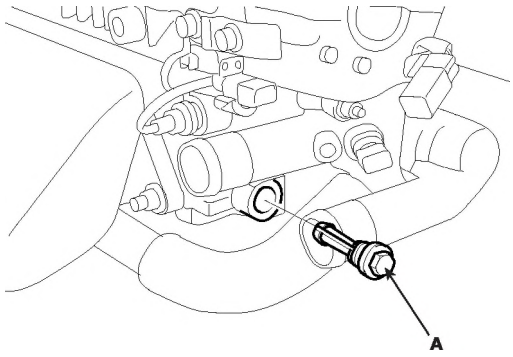
Tightening torque
M10 :
25Nm (250kgf.cm, 18lbf.ft) + (60° ~ 65°) + (60° ~ 65°)
M12 :
30Nm (300kgf.cm, 22lbf.ft) + (60° ~ 65°) + (60° ~ 65°)



ECKD232A

4. Install OCV filter(A).

Tightening torque
41 ~ 51Nm (410 ~ 510kgf.cm, 30 ~ 37.6lbf.ft)



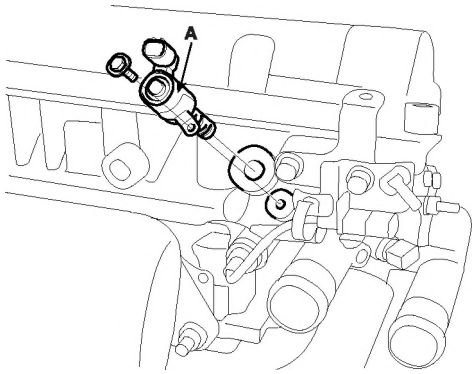
ECKD215A

NOTE

Always use a new OCV filter gasket.
Keep clean the OCV filter.

5. Install OCV(A).

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



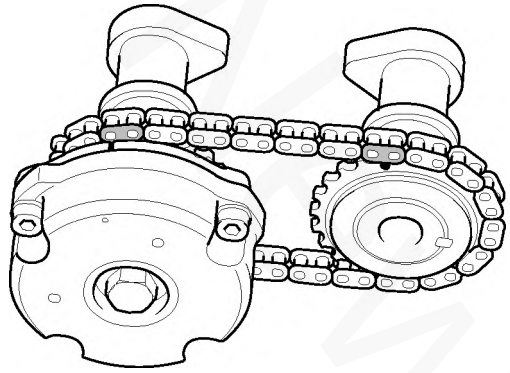
ECKD214A

CAUTION

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

6. Install the camshafts.

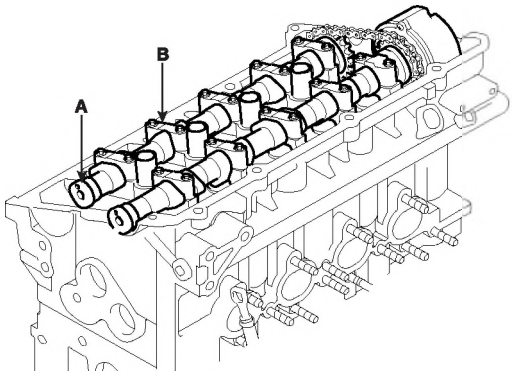
   1) Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown.



ECKD233A

   2) Install the camshafts(A) and bearing caps(B).

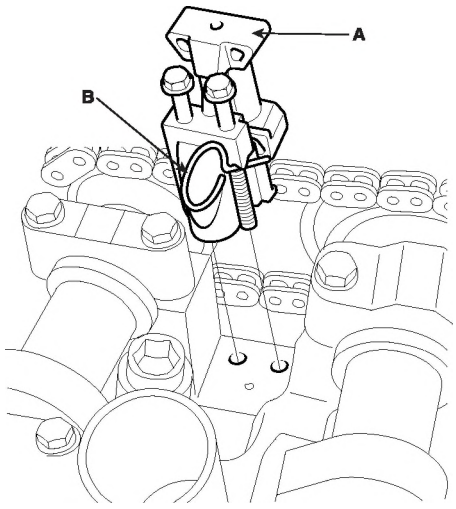
Tightening torque
14 ~ 15Nm (140 ~ 150kgf.cm, 10 ~ 11lbf.ft)



ECKD234A

   3) Install the timing chain auto tensioner(A).

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

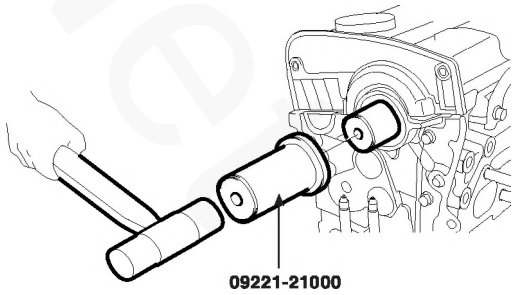


ECKD212A

   4) Remove the auto tensioner stopper pin(B).

7. Check and adjust valve clearance. (See page EM - 11)

8. Using the SST(09221-21000), install the camshaft bearing oil seal.



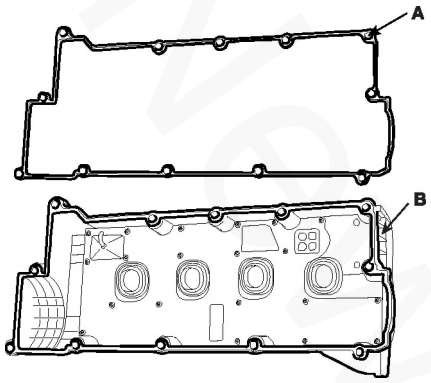
ECKD235A

9. Install the camshaft sprocket. (See page EM - 27)

10. Install the timing belt. (See page EM - 27)

11. Install the cylinder head cover.

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

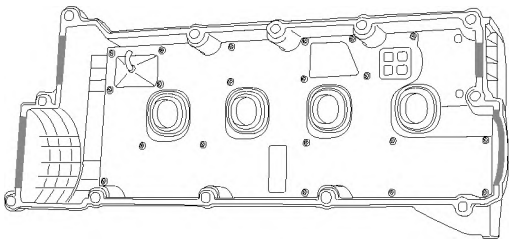


ECKD236A

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.



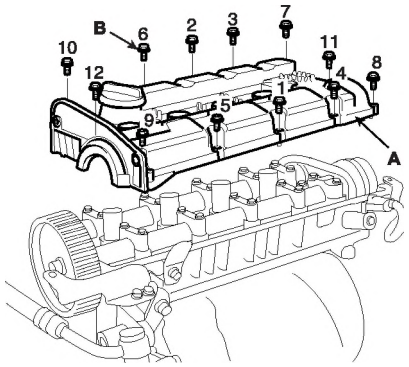
ECKD237A

NOTE

- *Use liquid gasket, loctite No. 5999.*
- *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 cover(A) with the 12bolts(B). Uniformly tighten the bolts in several passes.

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



ADIE003A

12. Install the intake manifold.

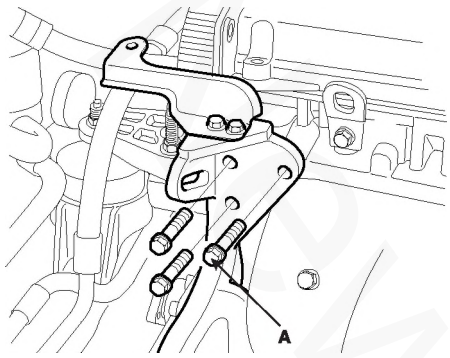
13. Install the exhaust manifold.

14. Install the PCV. (See page EM - 28)

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

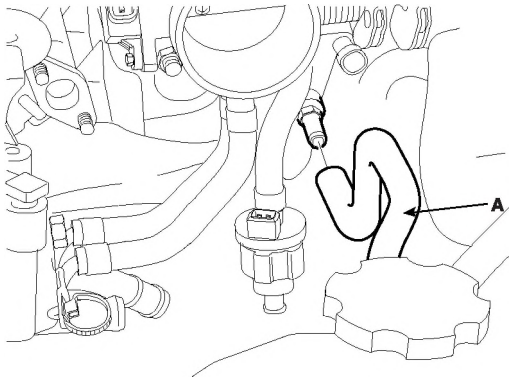
16. Install the power steering pump bracket bolts(A).

Tightening torque
35 ~ 50Nm (350 ~ 500kgf.cm, 26 ~ 37lbf.ft)



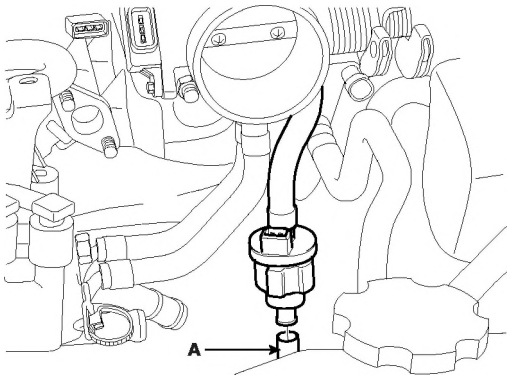
ECKD211A

17. Install the power steering pump. (See ST group - power steering pump)
18. Install the accelerator cable.
19. Install the bake booster hose(A).



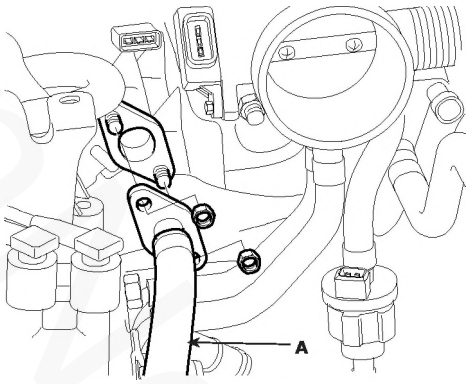
ECKD210A

20. Install the PCSV hose(A).



ECKD209A

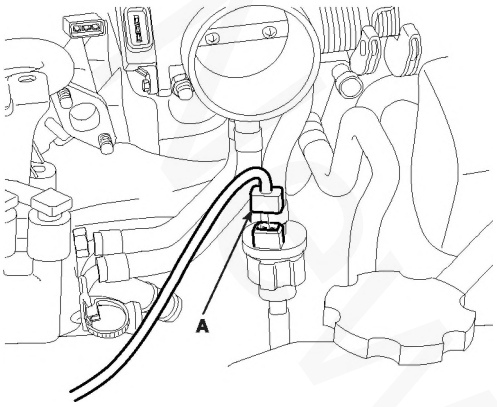
21. Install the fuel inlet hose(A).



ECKD208A

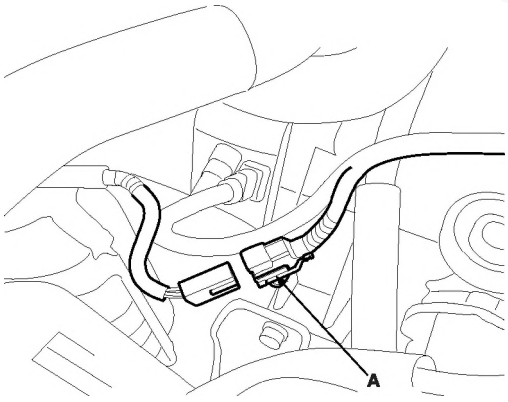
22. Install the engine wire harness connectors and wire harness clamps to the cylinder head and the intake manifold.

1) PCSV connector(A).



ECKD207A

2) Front heated oxygen sensor connector(A).



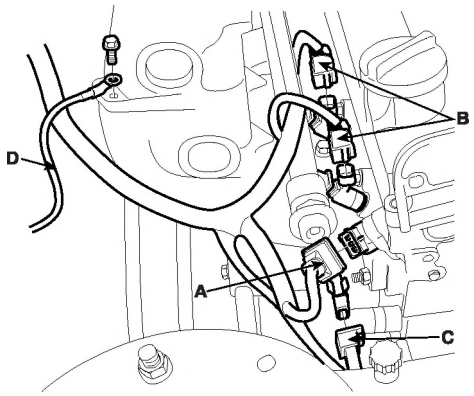
ECKD206A

3) Connect the ground cable to the intake manifold(D).

4) Knock sensor connector(C).

5) Four fuel injector connectors(B).

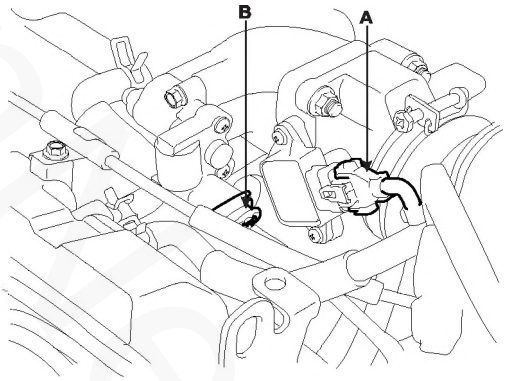
6) CMP connector(A).



ECKD205A

7) ISA connector(B).

8) TPS connector(A).



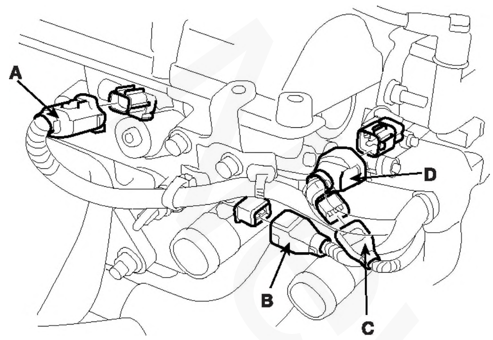
EDQF197A

9) Ignition coil connector(D).

10) ECT sensor connector(C).

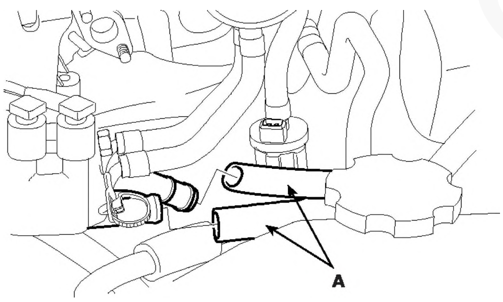
11) Oil temperature sensor connector(B).

12) OCV connector(A).



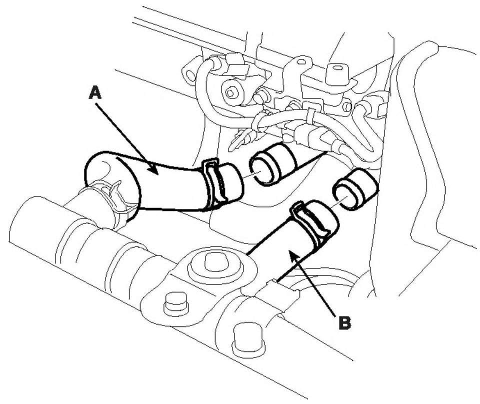
ECKD203A

23. Install the heater hoses(A).



ECKD202A

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



ECKD201A

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

26. Install the engine cover. (See page EM - 10)

27. Connect the negative terminal to the battery.

28. Filll with engine coolant.

29. Start the engine and check for leaks.

30. Recheck engine coolant level and oil level.

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL EDFA091F

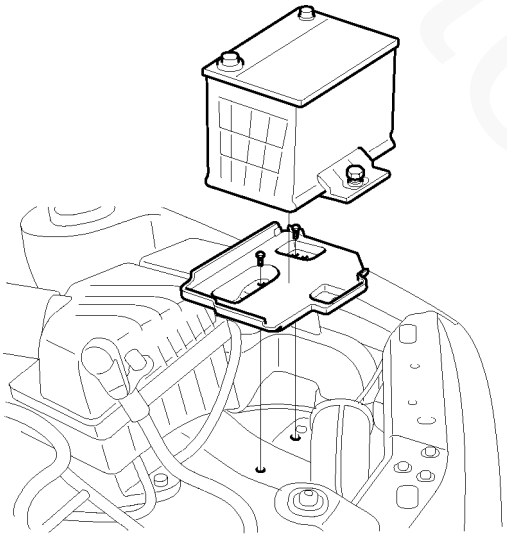
CAUTION

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

NOTE

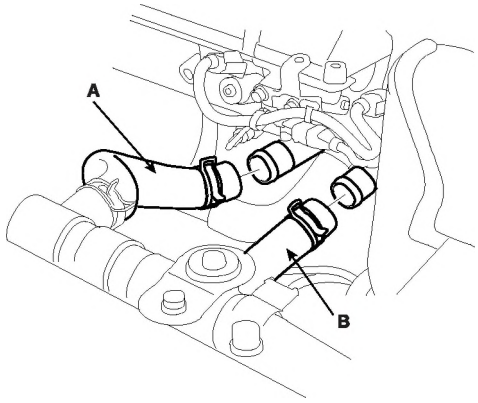
- *Mark all wiring and hoses to avoid misconnection.*
- *Inspection the timing belt before removing the cylinder head.*
- *Turn the crankshaft pulley so that the No.1 piston is at top dead center. (See page EM - 9)*

1. Disconnect the neagative terminal from the battery.



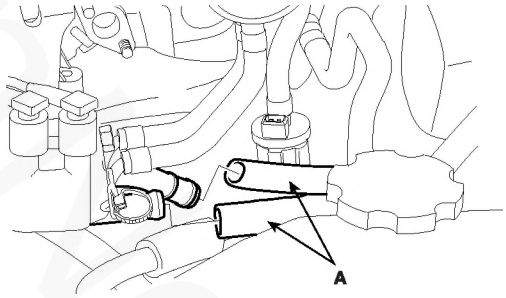
ECKD201B

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.
5. Remove the upper radiator hose(A) and lower radiator hose(B).



ECKD201A

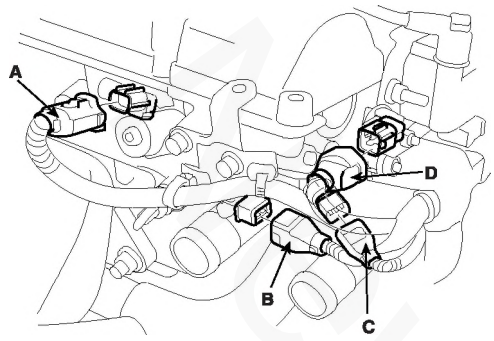
6. Remove the heater hoses(A).



ECKD202A

7. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
   1) OCV(Oil Control Valve) connector(A).
   2) Oil temperature sensor connector(B).
   3) ECT(Engine Coolant Temperature) sensor(C) connector.

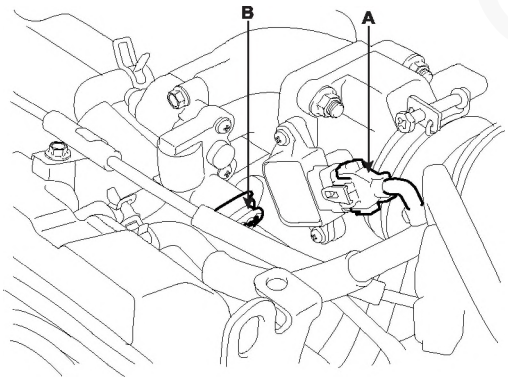
4) Ignition coil connector(D).



ECKD203A

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

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



EDQF197A

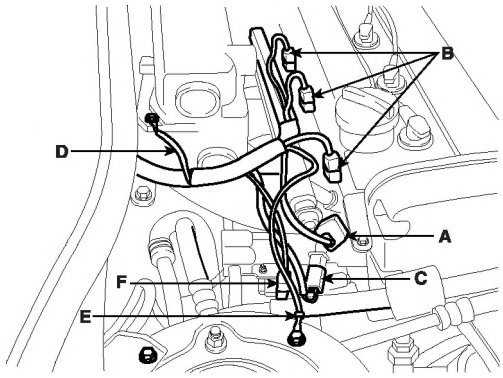
7) CMP(Camshaft Position Sensor) connector(A).

8) Four fuel injector connectors(B).

9) Knock sensor connector(C).

10) Disconnect ground cable(D) from the intake manifold.

11) Compressor switch(F).

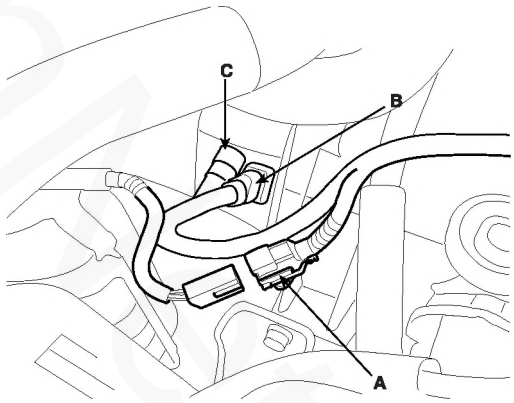


ACGE006A

12) Front heated oxygen sensor(A) connector.

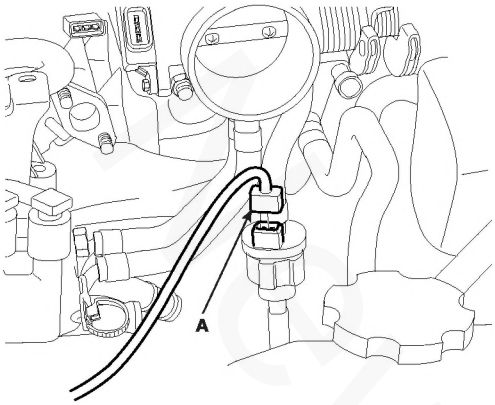
13) CKP sensor(B) connector.

14) Oil pressure switch(C) connector.



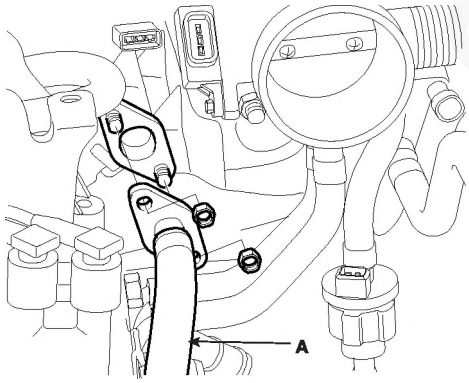
ACGE056A

15) PCSV(Purge Control Solenoid Valve)(A) connector.



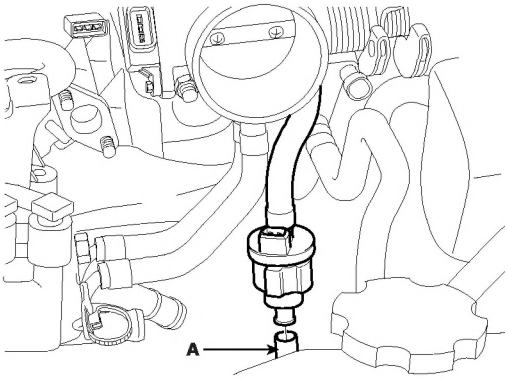
ECKD207A

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



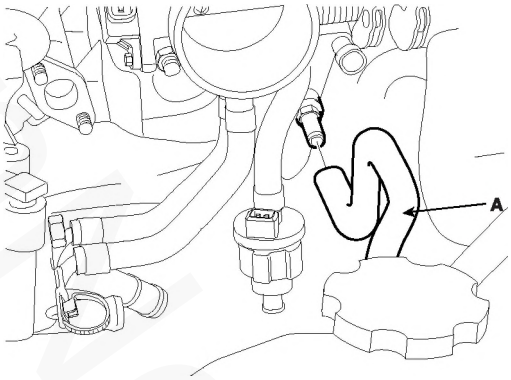
ECKD208A

9. Remove the PCSV hose(A).



ECKD209A

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



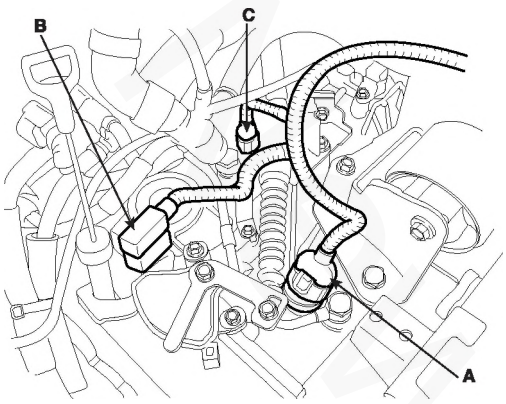
ECKD210A

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

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

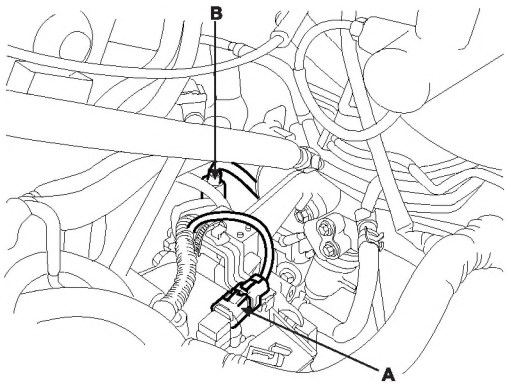
13. Remove the battery body bracket.

14. 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).



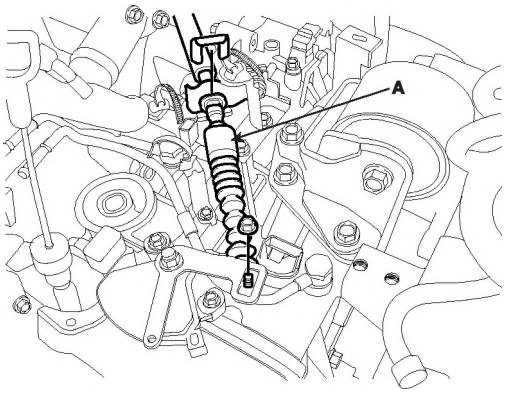
EDQF035A

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



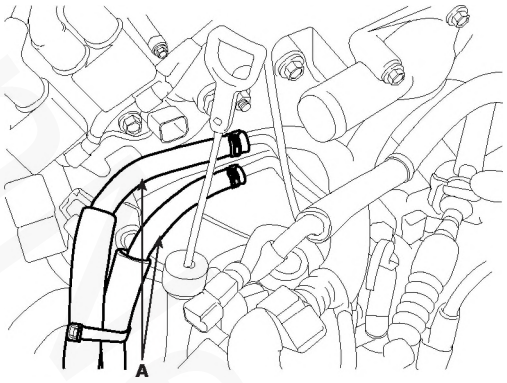
EDQF031A

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



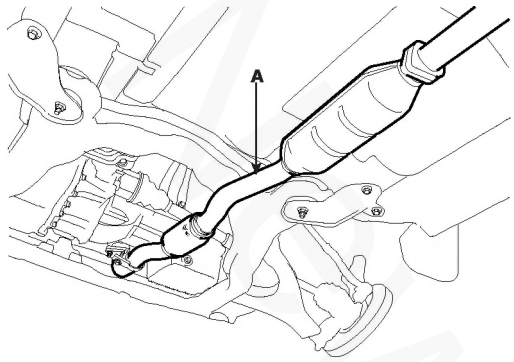
EDQF018A

16. Remove the transaxle oil cooler hose(A) (A/T).



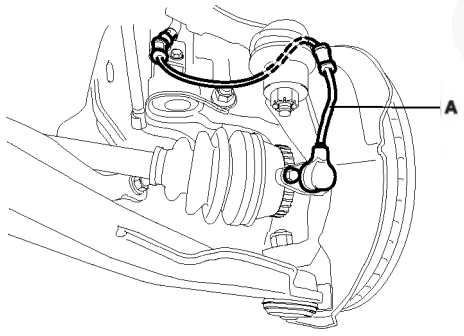
EDQF034A

17. Remove the under cover.
18. Remove the front exhaust pipe(A).



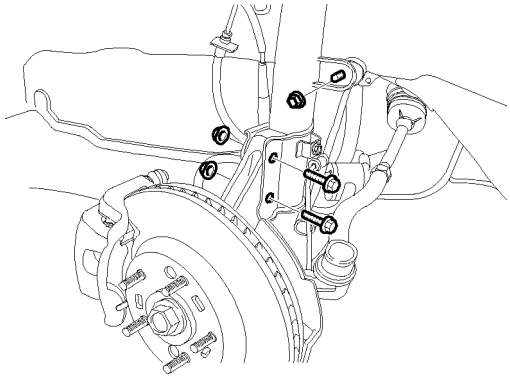
EDQF192A

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



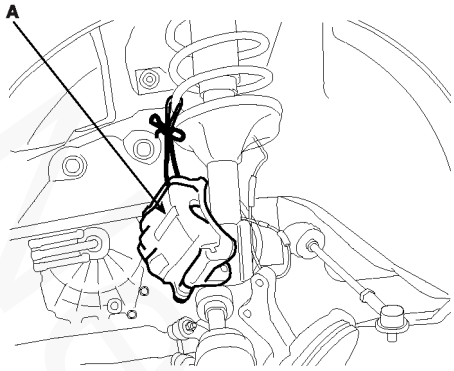
KXDSE03A

20. Remove the front strut lower mounting bolts and nuts. (See SS griup - front strut)



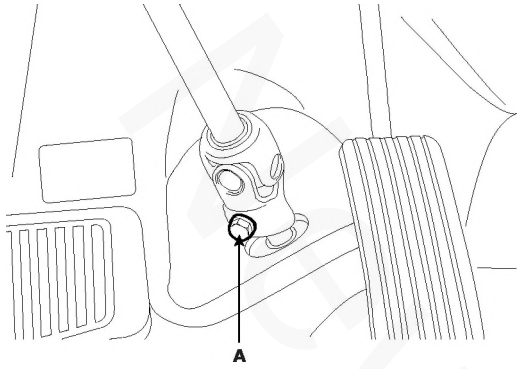
EDQF023A

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



ECKD612A

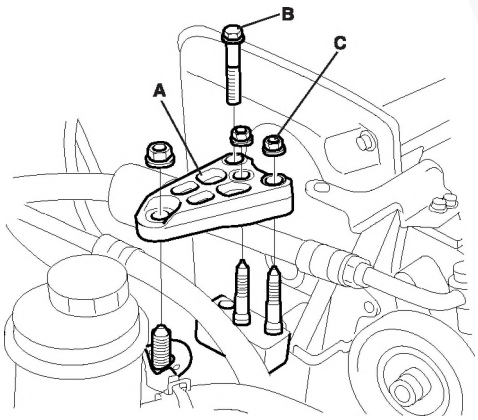
22. Remove the steering u-joint mounting bolt(A). (See ST group - steering)



ECKD616A

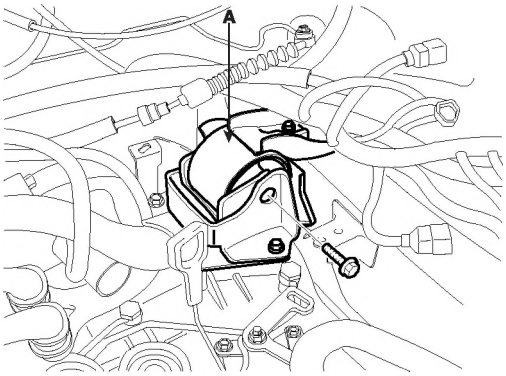
23. Install the jack for supporting engine and transaxle assembly.

24. Remove the engine mounting bracket(A).



ECKD103A

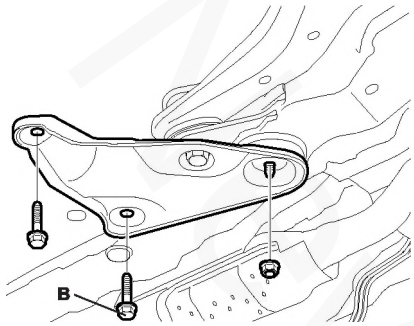
25. Remove the transaxle mounting bracket(A).



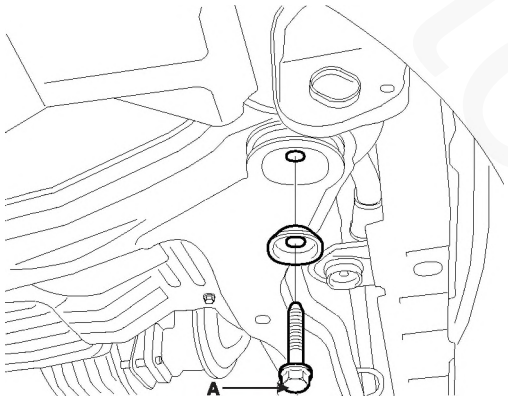
EDQF016A

26. 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 ~ 66lft.ft)



EDOF001A



ECKD618A

27. Jack up the vehicle.

INSTALLATION EC1DBCCB

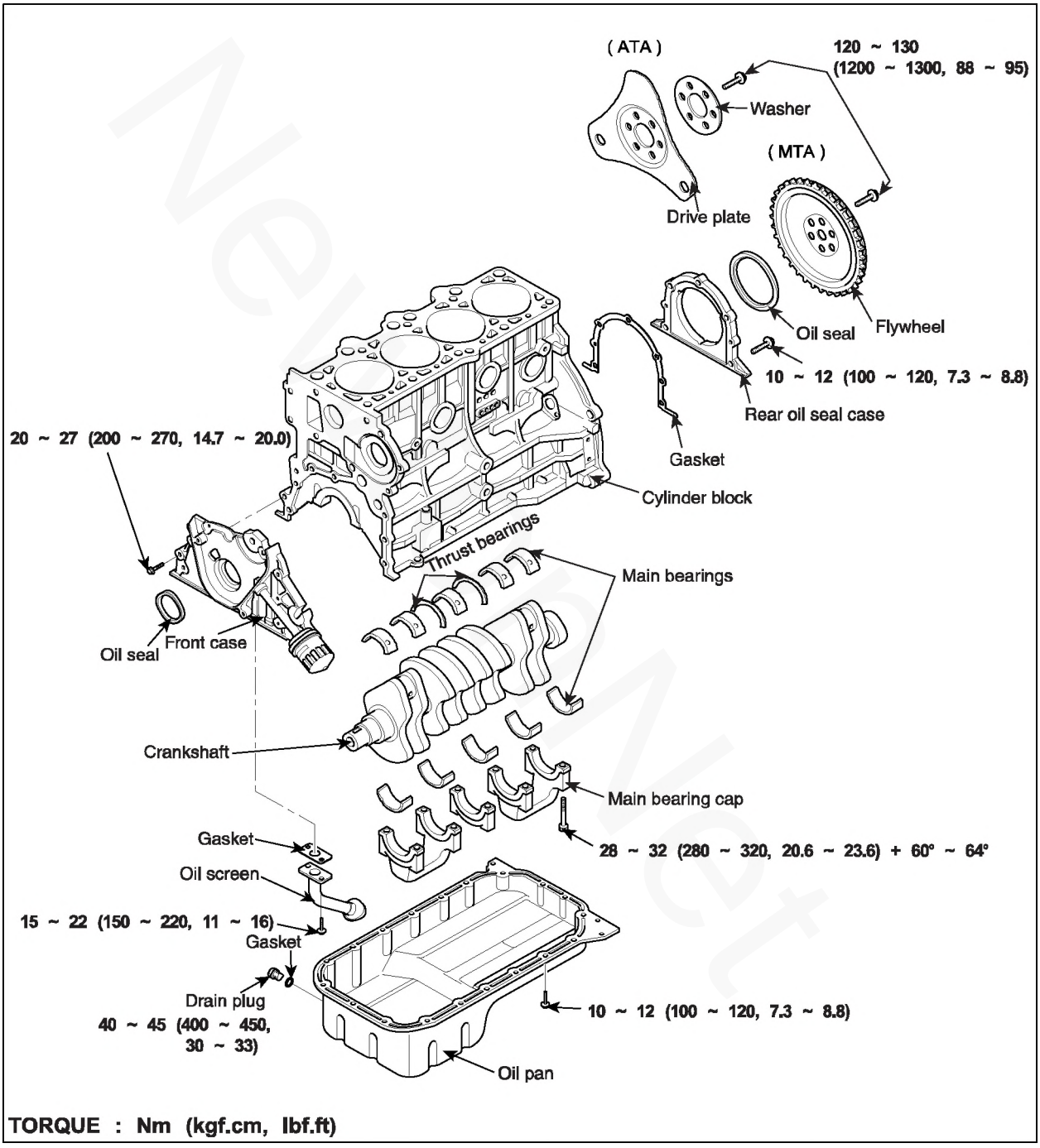
Installation is in the reverse order of removal.

Perform the following :

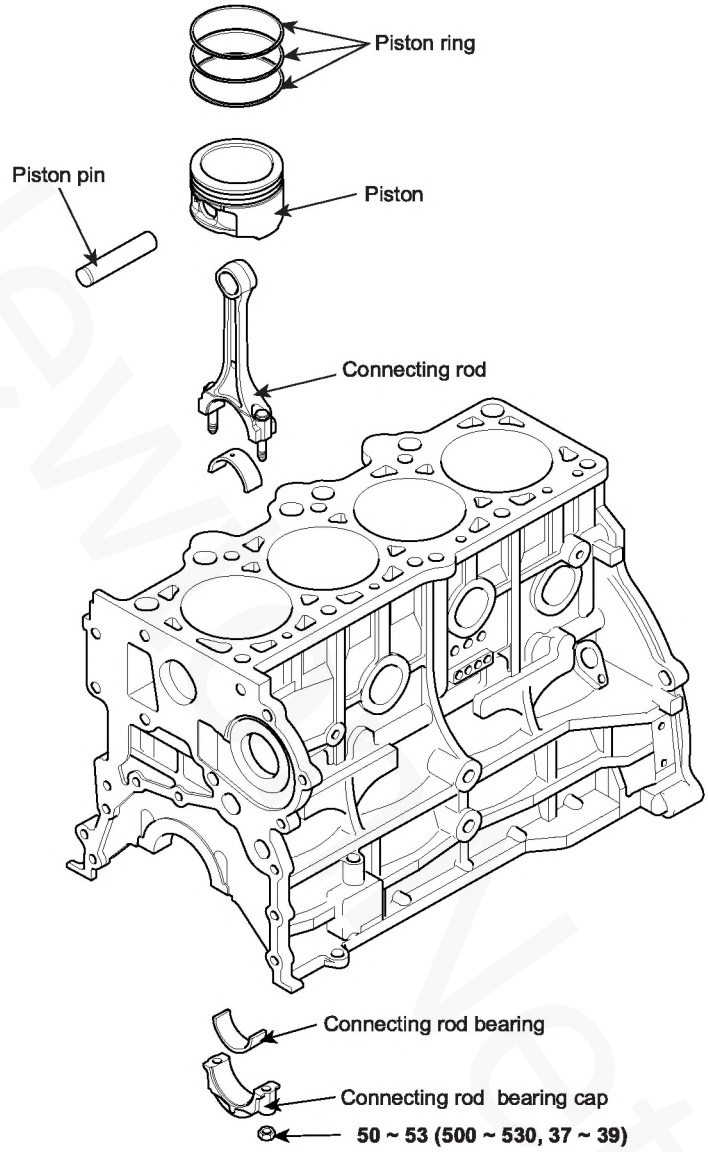
- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- Clean the battery posts and cable terminals with sandpaper assemble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

ENGINE BLOCK

COMPONENTS E3E04B86



ECKD004A

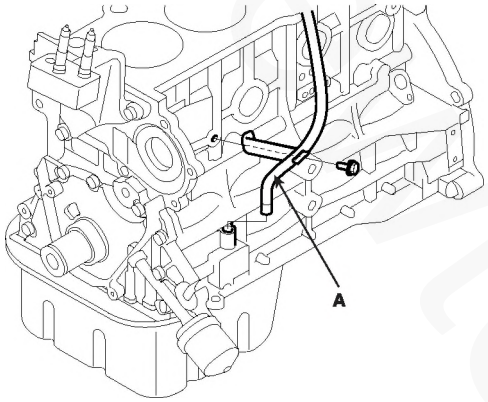


TORQUE : Nm (kgf.cm, lbf.ft)

ECKD005A

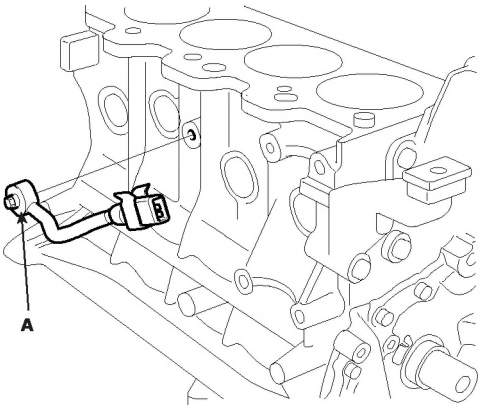
DISASSEMBLY E0A2AFBC

1. M/T : remove flywheel.
2. A/T : remove drive plate.
3. Install engine to engine stand for disassembly.
4. Remove timing belt. (See page EM - 23)
5. Remove cylinder head. (See page EM - 35)
6. Remove oil level gauge assembly(A).



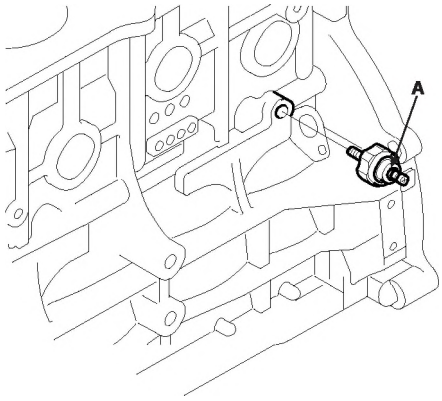
ECKD301A

7. Remove knock sensor(A).



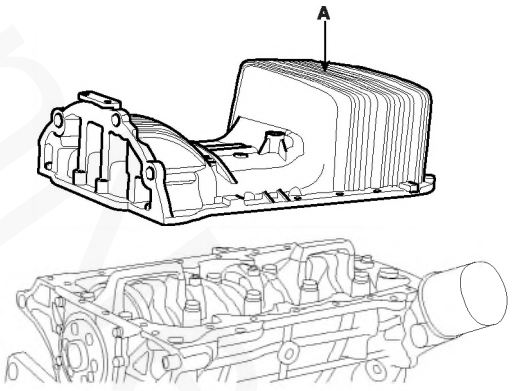
ECKD302A

8. Remove oil pressure sensor(A).



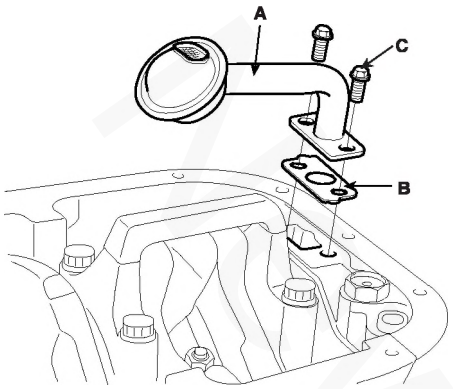
ECKD303A

9. Remove water pump. (See page EM - 85)
10. Remove oil pan(A).



ECKD304A

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



ECKD305A

12. Check the connecting rod end play. (See page EM - 66)

13. Remove the connecting rod caps and check oil clearance. (See page EM - 67)

14. Remove piston and connecting rod assemblies.

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

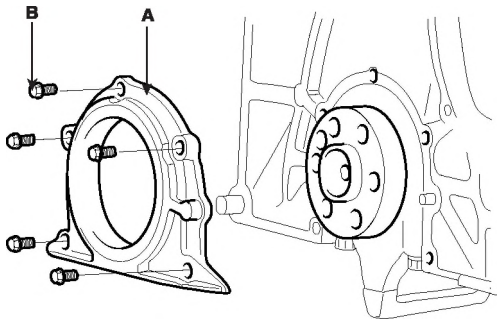
2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE

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

15. Remove front case. (See page EM - 93)

16. Remove rear oil seal case.
Remove the 5 bolts(B) and rear oil seal case(A).



ECKD306A

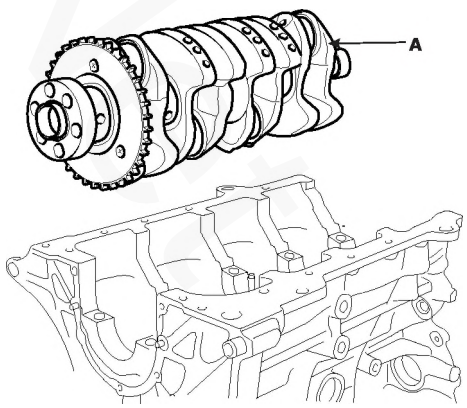
17. Remove crankshaft bearing cap and check oil clearance. (See page EM - 69)

18. Check the crankshaft end play. (See page EM - 71)

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

NOTE

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



ECKD307A

20. 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.

21. Remove piston rings.

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

2) Remove 2 side rails and the spacer by hand.

NOTE

Arrange the piston rings in the correct order only.

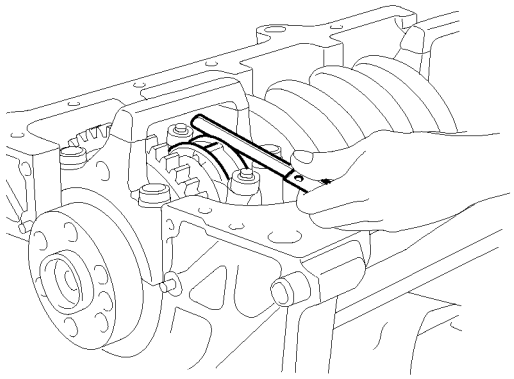
22. Disconnect connecting rod from piston.

INSPECTION EC8FCA1F

CONNECTING ROD AND CRANKSHAFT

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

Standard end play : 0.1~ 0.25mm(0.004 ~ 0.010in.)
Maximum end play : 0.4mm(0.016in.)



ECKD308A

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

2. Check the connecting road bearing oil clearance.

1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.

2) Remove 2 connecting rod cap nuts.

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 nuts.

Tightening torque
50 ~ 53Nm (500 ~ 530kgf.cm, 36.9 ~ 39lbf.ft)

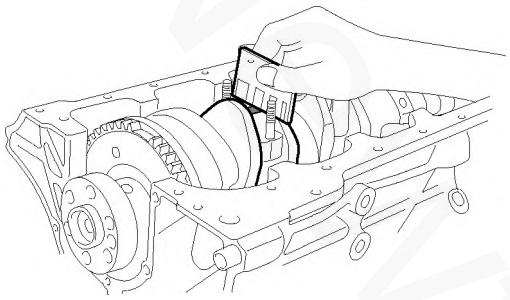
NOTE

Do not turn the crankshaft.

7) Remove 2 nuts, connecting rod cap and bearing half.

8) Measure the plastigage at its widest point.

Standard oil clearance
0.024 ~ 0.042mm(0.0009 ~ 0.0017in.)



ECKD309A

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.

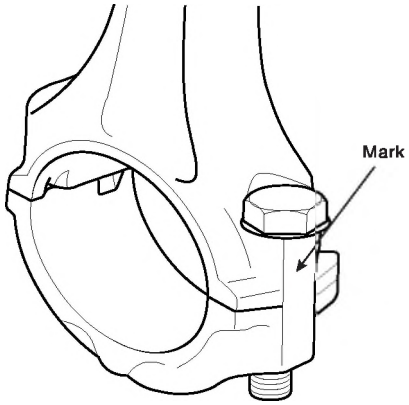
NOTE

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

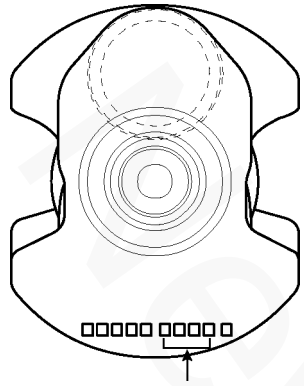


BDQE003A

DISCRIMINATION OF CONNECTING ROD

CLASS	MARK	INSIDE DIAMETER
a	A	48.00 ~ 48.006mm (1.8896 ~ 1.8899in.)
b	B	48.006 ~ 48.012mm (1.8899 ~ 1.8902in.)
c	C	48.012 ~ 48.018mm (1.8902 ~ 1.8904in.)

CRANKSHAFT PIN MARK LOCATION

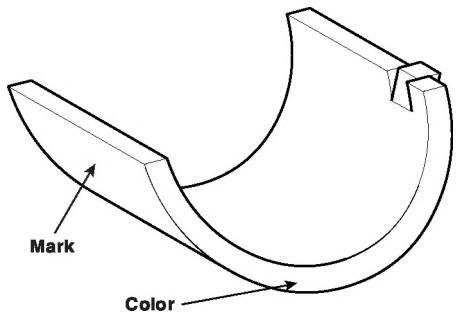


ECKD311A

DISCRIMINATION OF CRANKSHAFT

CLSASS	MARK	OUTSIDE DIAMETER OF PIN
I	1	44.960 ~ 44.966mm (1.7700 ~ 1.7703in.)
II	2	44.952 ~ 44.960mm (1.7698 ~ 1.7700in.)
III	3	44.946 ~ 44.952mm (1.7695 ~ 1.7698in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



ECKD313A

DISCRIMINATION OF CONNECTING ROD BEARING

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

11) Selection

CRANKSHAFT INDENTIFICATION MARK	CONNECTING ROD IDENTIFICATION MARK	ASSEMBING CLASSIFICATION OF BEARING
I (YELLOW)	a (WHITE)	D (YELLOW)
	b (NONE)	C (GREEN)
	c (YELLOW)	B (NONE)
II (NONE)	a (WHITE)	C (GREEN)
	b (NONE)	B (NONE)
	c (YELLOW)	A (BLACK)
III (WHITE)	a (WHITE)	B (NONE)
	b (NONE)	A (BLACK)
	c (YELLOW)	AA (BLUE)

3. Check the crankshaft bearing oil clearance.

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

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

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

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

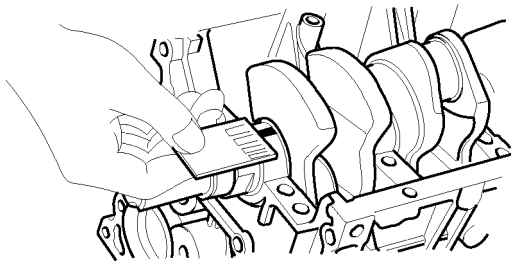
Tightening torque
30Nm (300kgf.cm, 22lbf.ft) + 60° ~ 65°

NOTE

Do not turn the crankshaft.

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

Standard oil clearance
0.028 ~ 0.046mm (0.0011 ~ 0.0018in.)



ECKD001I

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.

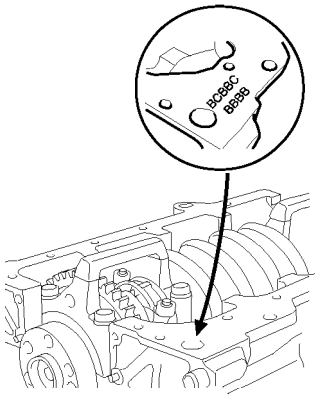
CONNECTING RODS

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 5 main journal bores.

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

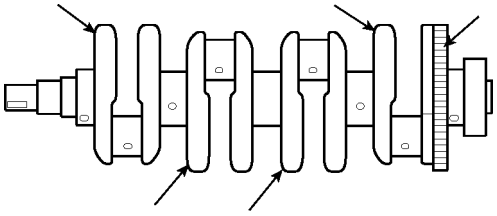


ECKD314A

DISCRIMINATION OF CYLINDER BLOCK

CALSS	MARK	INSIDE DIAMETER
a	A	61.000 ~ 61.006mm (2.4015 ~ 2.4018in.)
b	B	61.006 ~ 61.012mm (2.4018 ~ 2.4020in.)
c	C	61.012 ~ 61.018mm (2.4020 ~ 2.4023in.)

CRANKSHAFT JOURNAL MARK LOCATION

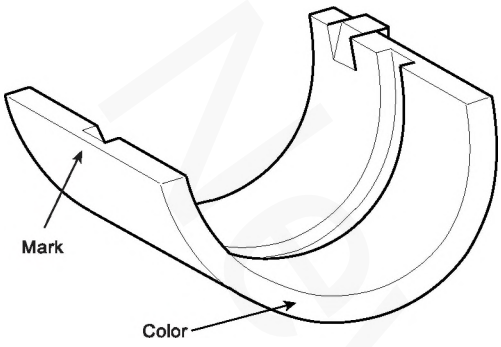


ECKD312B

DISCRIMINATION OF CRANKSHAFT

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	YELLOW	56.956 ~ 56.962mm (2.2423 ~ 2.2426in.)
II	NONE	56.948 ~ 56.956mm (2.2420 ~ 2.2423in.)
III	WHITE	56.942 ~ 56.948mm (2.2418 ~ 2.2420in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



ECKD316A

DISCRIMINATION OF CRANKSHAFT BEARING

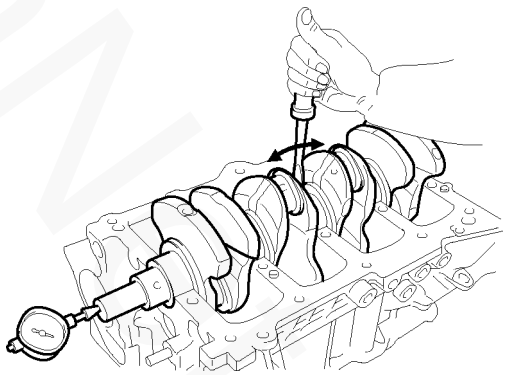
CLASS	MARK	THICKNESS OF BEARING
AA	BLUE	2.014 ~ 2.017mm (0.0793 ~ 0.0794in.)
A	BLACK	2.011 ~ 2.014mm (0.0791 ~ 0.0793in.)
B	NONE	2.008 ~ 2.011mm (0.0790 ~ 0.0791in.)
C	GREEN	2.005 ~ 2.008mm (0.0789 ~ 0.790in.)
D	YELLOW	2.002 ~ 2.005mm (0.0788 ~ 0.0789in.)

SELECTION

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

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

Standard end play
0.06 ~ 0.26mm (0.0023 ~ 0.010in.)
Limit : 0.30mm (0.0118in.)



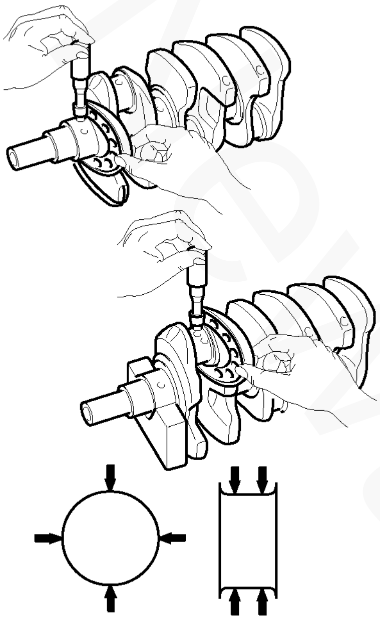
ECKD001B

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

Thrust bearing thickness
2.44 ~ 2.47mm(0.096 ~ 0.097in.)

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

Main journal diameter :	57mm (2.165in.)
Crank pin diameter :	45mm (1.77in.)



ECKD001E

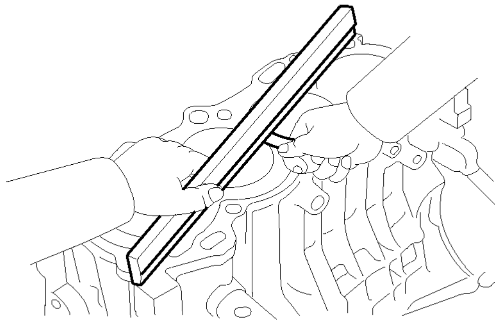
CYLINDER BLOCK

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.)

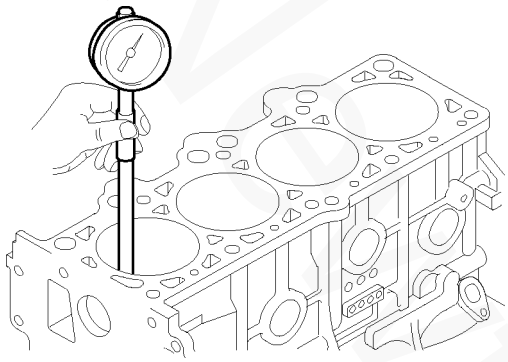


ECKD001L

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

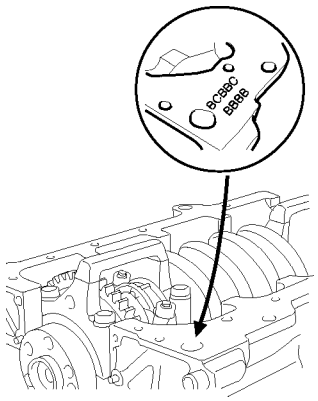
5. Inspect cylinder bore diameter
   Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial directions.

Standard diameter
82.00 ~ 82.03mm (3.2283 ~ 3.2295in.)



ECKD318A

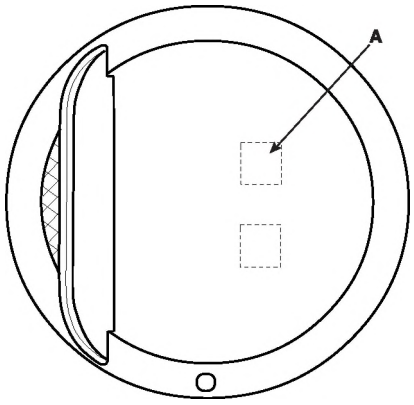
6. Check the cylinder bore size code on the cylinder block bottom face.



ECKD314A

Class	Cylinder bore inner diameter	Size code
A	82.00 ~ 82.01mm (3.228~ 3.2287in.)	A
B	82.01 ~ 82.02mm (3.2287~ 3.2291in.)	B
C	82.02 ~ 82.03mm (3.2291~ 3.2295in.)	C

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



ECKD320B

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

Class	Piston outer diameter	Size code
A	81.97 ~ 81.98mm (3.2271 ~ 3.2275in.)	A
B	81.98 ~ 81.99mm (3.2275 ~ 3.2279in.)	None
C	81.99 ~ 82.00mm (3.2279 ~ 3.2283in.)	C

8. Select the piston related to cylinder bore class.

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

BORING CYLINDER

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

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

NOTE

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

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

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

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

CAUTION

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

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

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

NOTE

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

PISTON AND RINGS

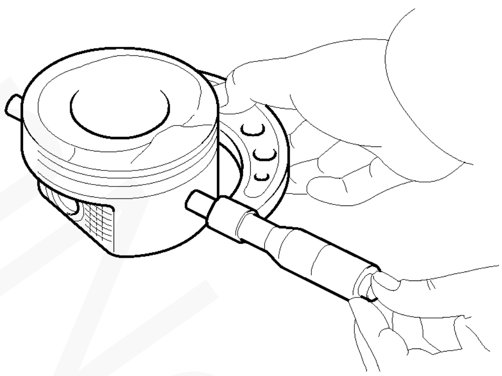
1. Clean piston
   1) Using a gasket scraper, remove the carbon from the piston top.
   2) Using a groove cleaning tool or broken ring, clean the piston ring grooves.
   3) Using solvent and a brush, thoroughly clean the piston.

NOTE

Do not use a wire brush.

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

Standard diameter
81.97 ~ 82.00mm (3.2272 ~ 3.2283in.)



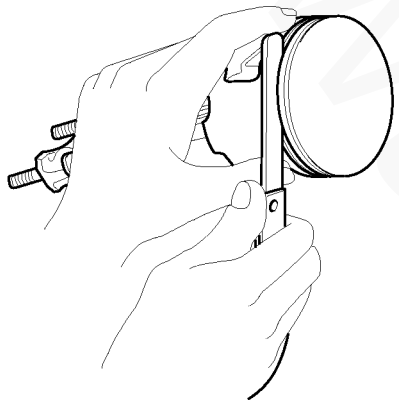
ECKD001D

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

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

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

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

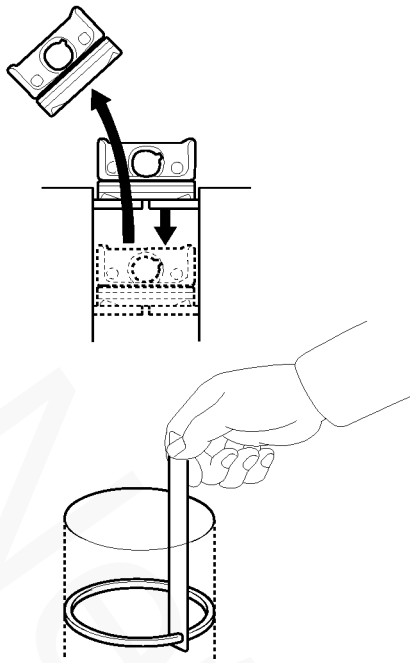


ECKD001G

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 EM - 73 If the bore is over the service limit, the cylinder block must be rebored. (See page EM - 74)

Piston ring end gap
Standard
No.1 : 0.23 ~ 0.38mm (0.0091 ~ 0.0150in.)
No.2 : 0.45 ~ 0.60mm (0.0177 ~ 0.0236in.)
Limit
No. 1, 2, oil ring : 1.0mm (0.039in.)

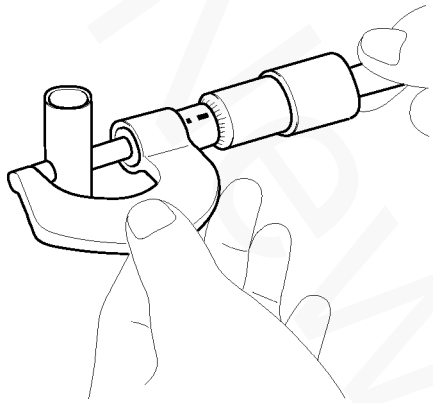


ECKD001K

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter
20.001 ~ 20.006mm (0.7874 ~ 0.7876in.)



ECKD001Z

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

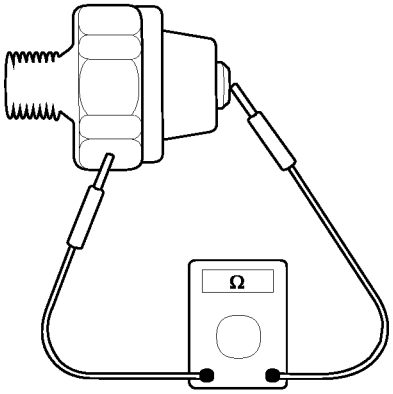
Piston pin-to-piston clearance
0.01 ~ 0.02mm (0.0004 ~ 0.0008in.)

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

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

OIP PRESSURE SWITCH

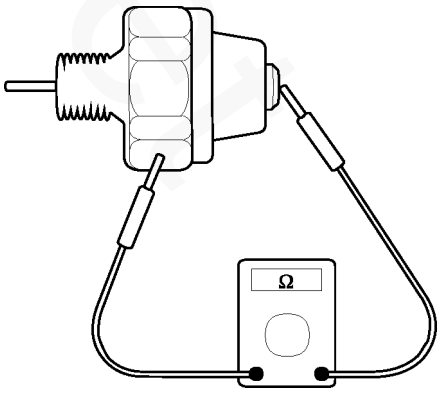
1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no continuity, replace the oil pressure switch.



ECKD001W

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

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



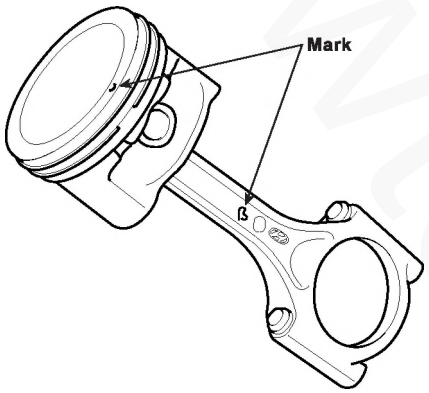
ECKD001Y

REASSEMBLY EFF6CDF3

NOTE

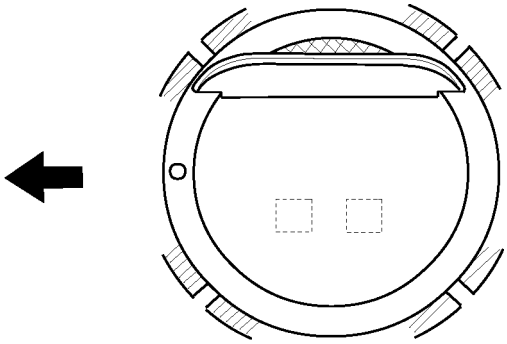
- *Thoroughly clean all parts to assembled.*
- *Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.*
- *Replace all gaskets, O-rings and oil seals with new parts.*

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



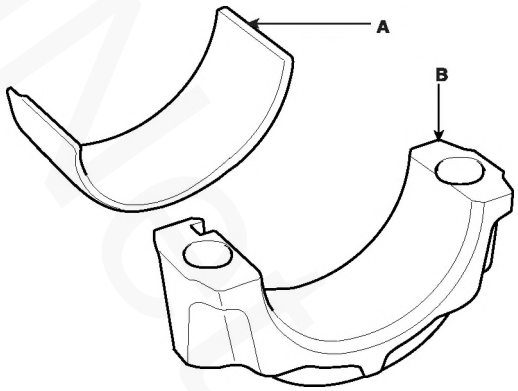
BDQE001A

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



ECKD321A

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



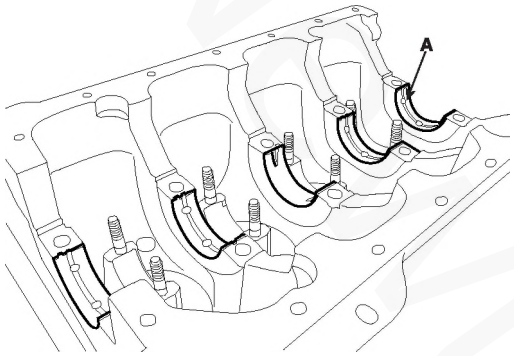
ECKD322A

4. Install main bearings.

NOTE

Upper 1,2,4,5 bearings have an oil groove of oil holes; Lower bearings do not.

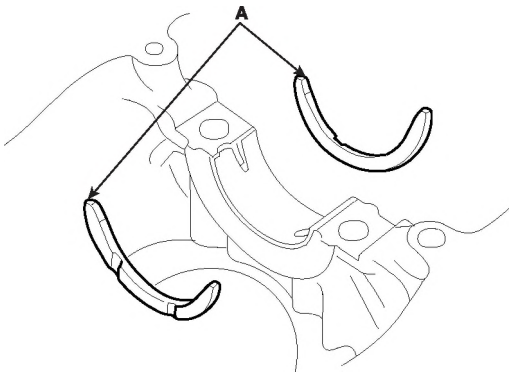
1) Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings(A).



ECKD323A

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

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



ECKD324A

6. Place crankshaft on the cylinder block.

7. Place main bearing caps on cylinder block.

8. Install main bearing cap bolts.

Tightening torque
Main bearing cap bolt
28 ~ 32Nm (280 ~ 320kgf.cm, 20.6 ~ 23.6lb.ft) + 60° ~ 64°

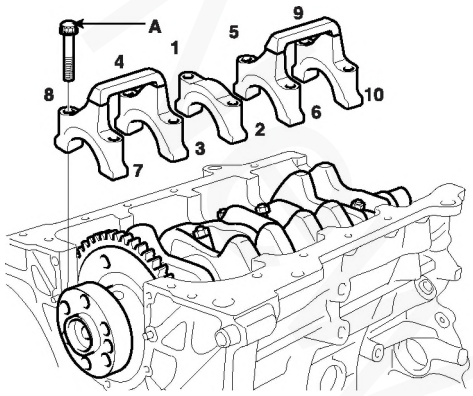
NOTE

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

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

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

Tightening torque : 30Nm (300kgf.cm, 22lbf.ft)



ECHE200A

3) Retighten the bearing cap bolts by 60°~65° in the numerical order shown.

4) Check that the crankshaft turns smoothly.

9. Check crankshaft end play. (See page EM - 71)

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.

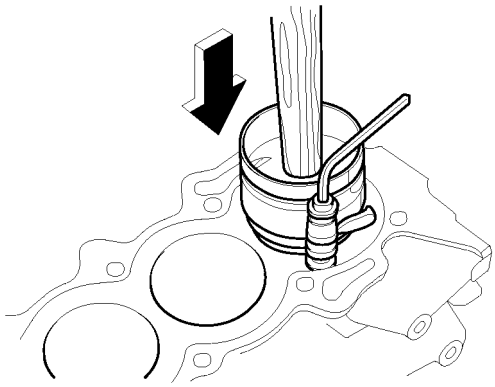
2) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.

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 nuts : 50 ~ 53Nm (500 ~ 530kgf.cm, 36.9 ~ 39lbf.ft)

NOTE

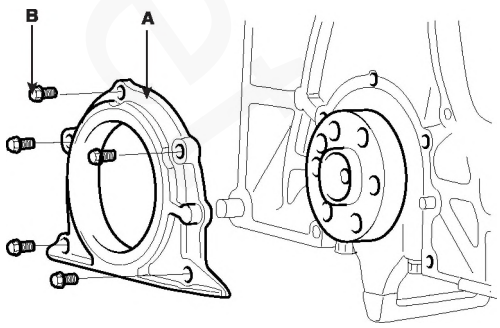
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

11. Install a new gasket and rear oil seal case(A) with 5 bolts(B).

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



ECKD306A

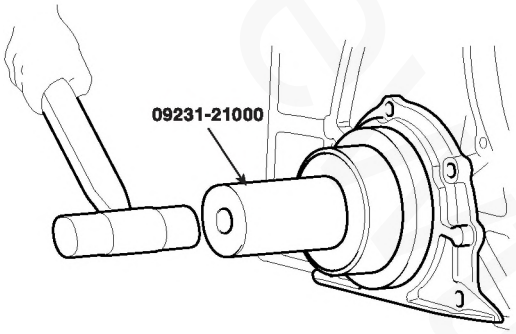
NOTE

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(09231-21000) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

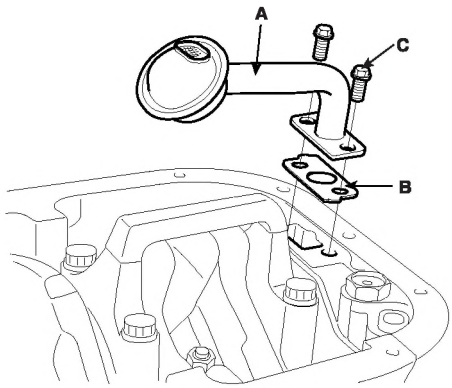


ECKD326A

13. Install front case. (See page EM - 99)

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

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



ECKD305A

15. Install oil pan.

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

NOTE

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

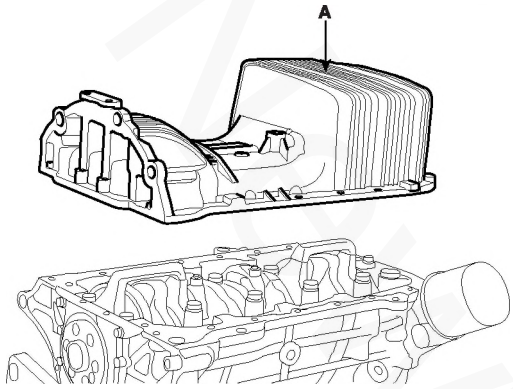
    2) Apply liquid gasket as an even bead, centered between the edges of the mating surface.
    Use liquid gasket MS 721-40A or equivalent.

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.*

3) Install the oil pan(A) with the 19 bolts. Uniformly tighten the bolts in several passes.

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



ECKD304A

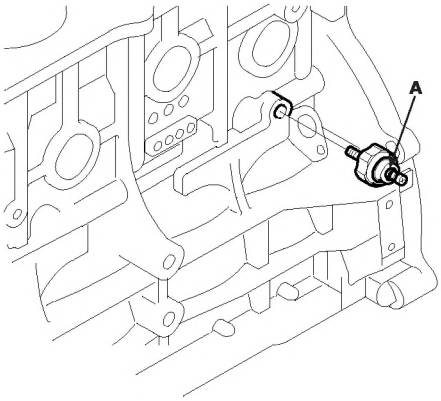
16. Install water pump. (See page EM - 88)

17. Install oil pressure sensor.

1) Apply adhesive to 2 or 3 threads. Adhesive : MS 721-39(B) or equivalent.

2) Install the oil pressure sensor (A).

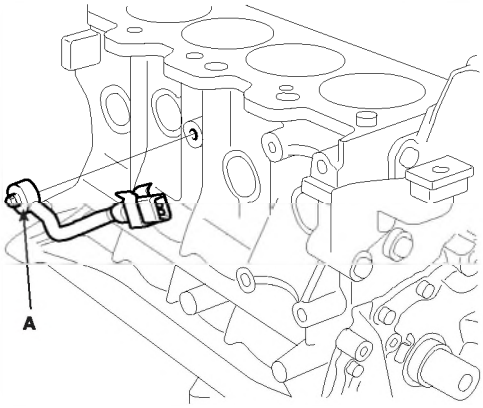
Tightening torque
15 ~ 22Nm (150 ~ 220kgf.cm, 11 ~ 16lbf.ft)



ECKD303A

18. Install knock sensor(A).

Tightening torque
17 ~ 27Nm (170 ~ 270kgf.cm, 12.5 ~ 20lbf.ft)



ECKD302A

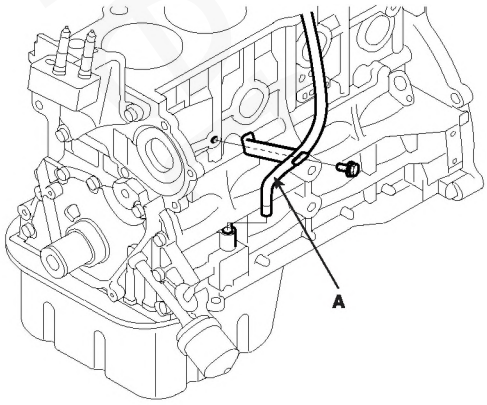
19. Install oil level gauge assembly.

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)



ECKD301A

20. Install cylinder head. (See page EM - 48)

21. Install timing belt. (See page EM - 27)

22. Remove engine stand.

23. A/T : Install drive plate.

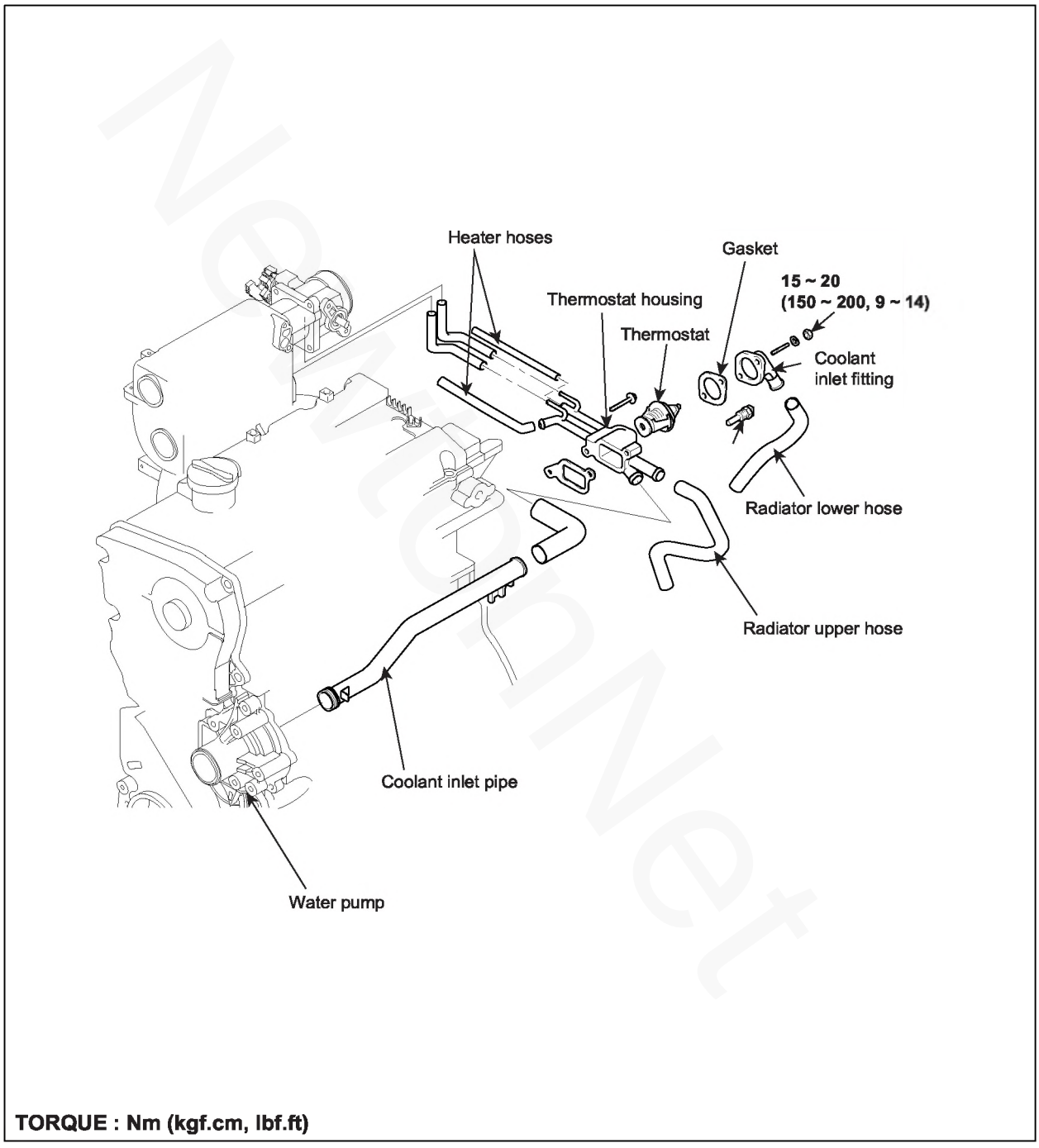
Tightening torque
120 ~ 130Nm (1200 ~ 1300kgf.cm, 89 ~ 96lbf.ft)

24. M/T : Install flywheel.

Tightening torque
120 ~ 130Nm (1200 ~ 1300kgf.cm, 89 ~ 96lbf.ft)

COOLING SYSTEM

COMPONENT E80DAED3



ECKD012A

ENGINE COOLANT REFILLING AND BLEEDING E4F4EB98

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(A) securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
6. Fill fluid mixture with coolant and water(4 : 6) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

NOTE

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

CAUTION

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

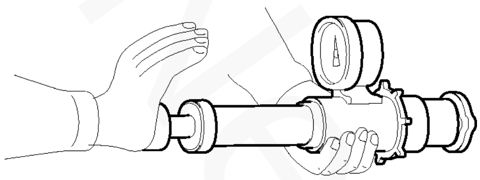
7. Start the engine and run coolant circulates.
   When the cooling fan operates and coolant curculates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank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

NOTE

Recheck the coolant level in the reservoir tank for 2 ~ 3 days after replacing coolant.

CAP TESTING

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



ECKD501X

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

TESTING

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
2. Apply a pressure tester to the radiator and apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm² 14 ~ 18psi).
3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTE

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

REMOVAL EA21BA67

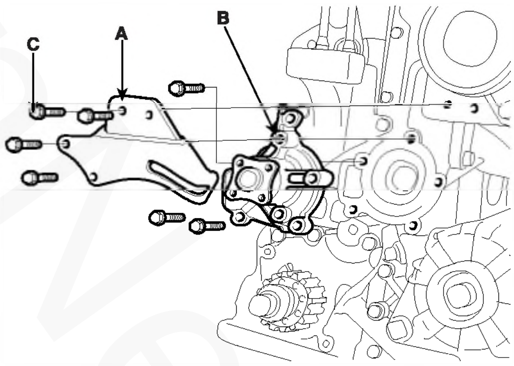
WATER PUMP

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.
3. Remove the timing belt. (See page EM - 23)
4. Remove the timing belt idler. (See page EM - 25)
5. Remove the water pump.
   1) Remove the 4 bolts and pump pulley.
   2) Remove the 2 bolts(C), then remove the alternator brace(A).
   3) Remove the water pump(B) and gasket.



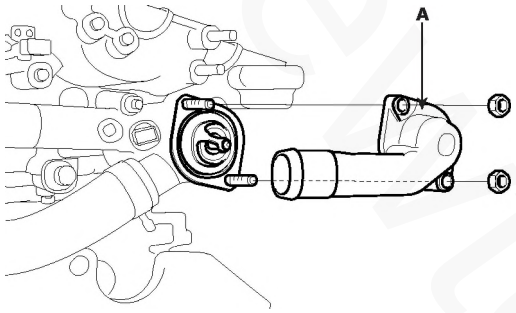
ECKD501A

THERMOSTAT

NOTE

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

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

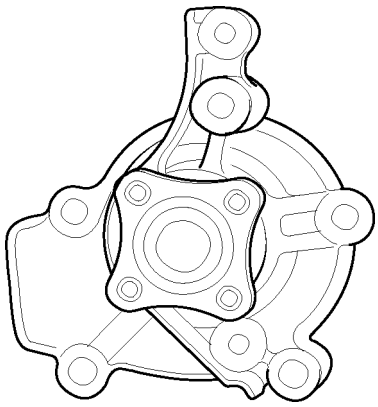


ECKD501B

INSPECTION EE14792C

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.



ECKD503A

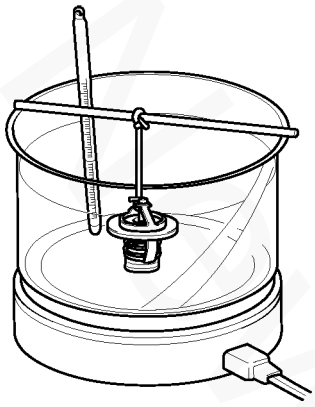
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly

NOTE

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

THERMOSTAT

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



ECKD503B

2. Check the valve opening temperature.

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

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

3. Check the valve lift.

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

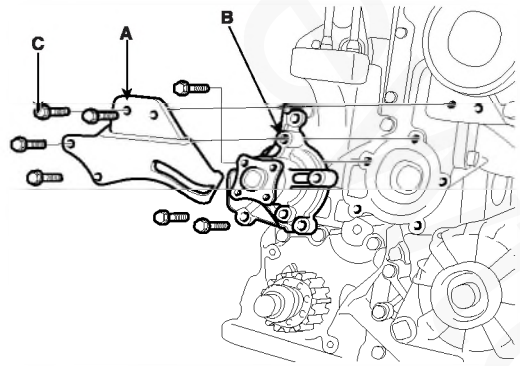
If the valve lift is not as specified, replace the thermostat.

INSTALLATION EC133513

WATER PUMP

1. Install the water pump.
   1) Install the water pump(B) and a new gasket with the 3 bolts.

Tightening torque
20 ~ 27Nm (200 ~ 270kgf.cm, 15 ~ 20lbf.ft)

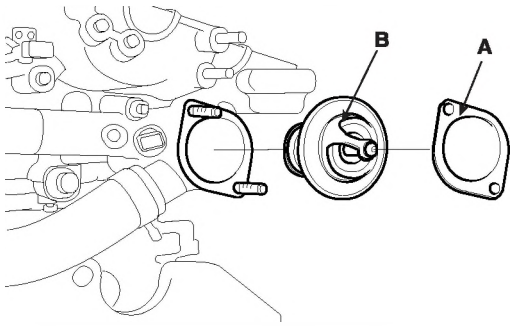


ECKD501A

   2) Install the alternator brace(A) with the 2 bolts(C).
   3) Install the 4 bolts and pump pulley.
2. Install the timing belt idler. (See page EM - 29)
3. Install the timing belt. (See page EM - 27)
4. Install drive belts.
5. Fill with engine coolant.
6. Start engine and check for leaks.
7. Recheck engine coolant level.

THERMOSTAT

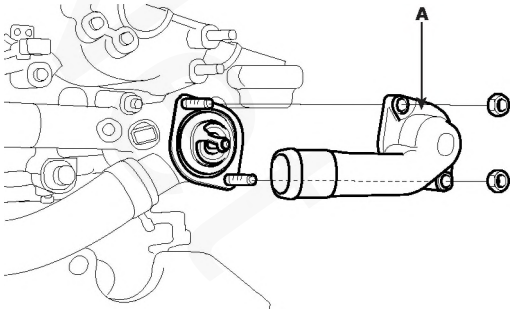
1. Place thermostat in thermostat housing.
   1) Install the thermostat with the jiggle valve upward.
   2) Install a new gasket(A) to the thermostat(B).



ECKD510A

2. Install water inlet(A).

Tightening torque
15 ~ 20Nm (150 ~ 200kgf.cm, 9 ~ 14lbf.ft)

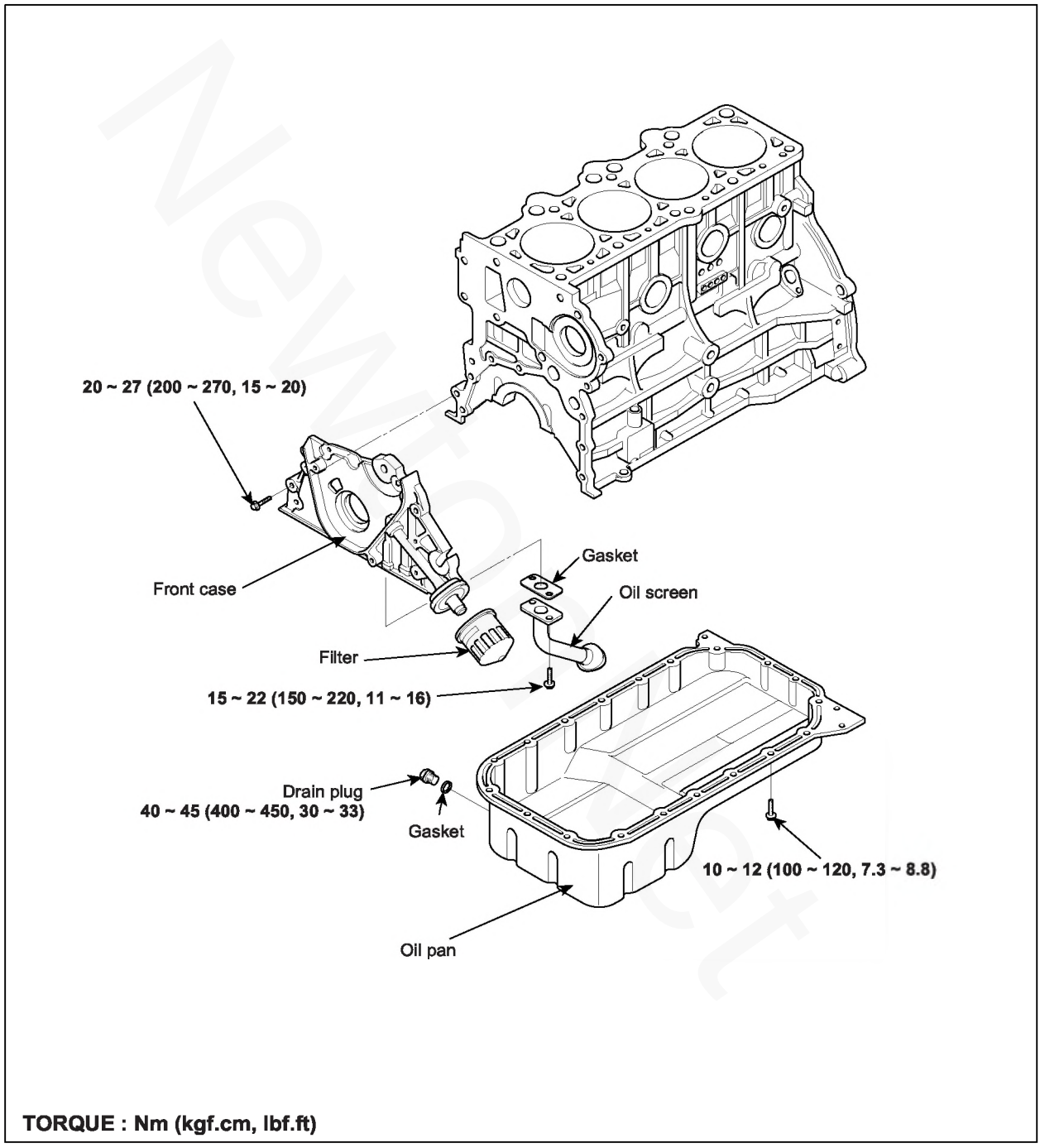


ECKD501B

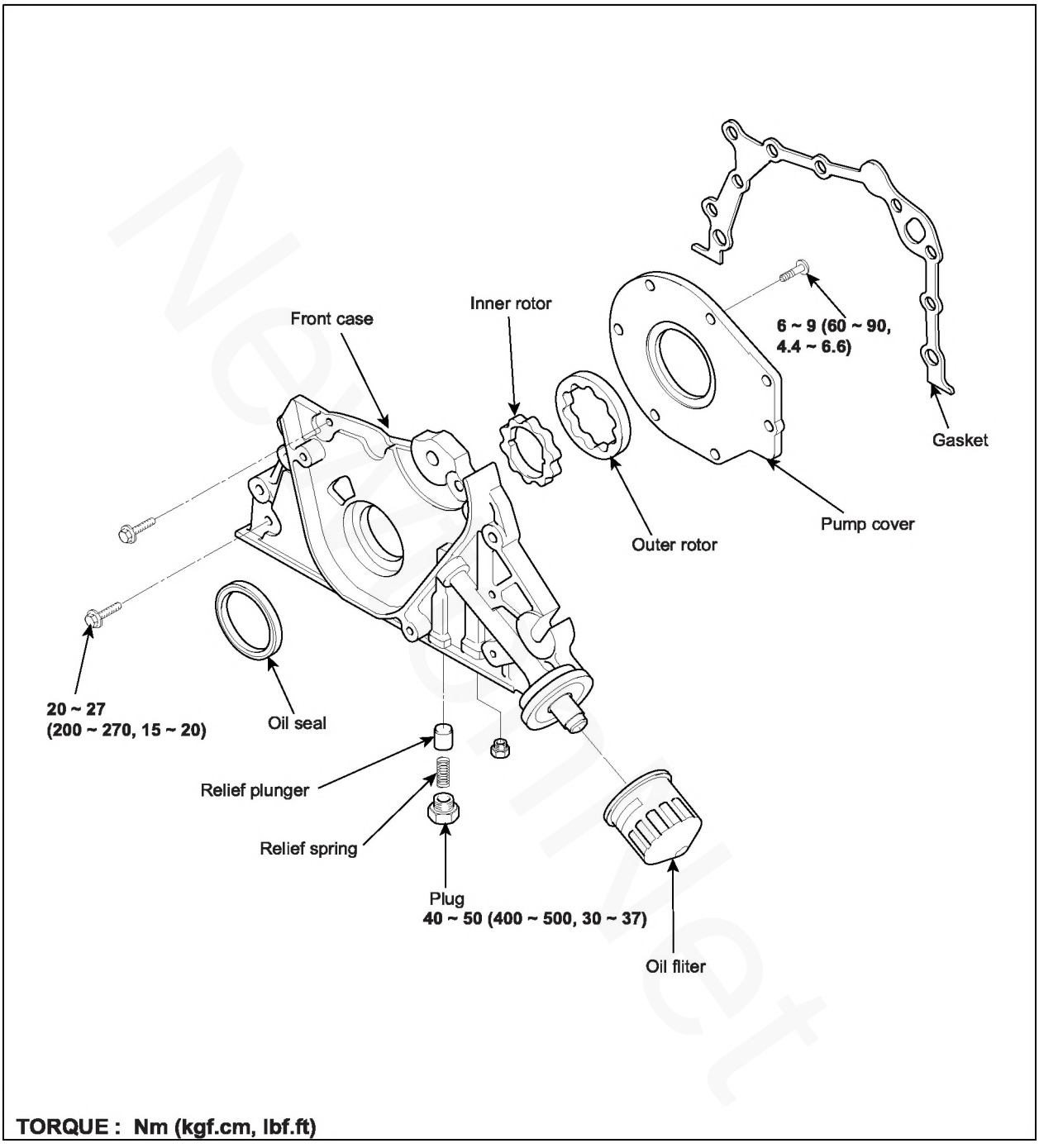
3. Fill with engine coolant.
4. Start engine and check for leaks.

LUBRICATION SYSTEM

COMPONENT E2A4EA3F



ECKD006A


Front case
Inner rotor
6 ~ 9 (60 ~ 90, 4.4 ~ 6.6)
Gasket
Pump cover
Outer rotor
20 ~ 27 (200 ~ 270, 15 ~ 20)
Oil seal
Relief plunger
Relief spring
Plug
40 ~ 50 (400 ~ 500, 30 ~ 37)
Oil fliter
TORQUE : Nm (kgf.cm, lbf.ft)

ECKD007A

OIL AND FILTER ECF1A5FC

CAUTION

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

1. Drain engine oil.
   a. Remove the oil filter cap.
   b. Remove the oil drain plug, and drain the oil into a container.

2. Replace oil filter.
   a. Remove the oil filter.
   b. Check and clean the oil filter installation surface.
   c. Check the part number of the new oil filter is as same as old one.
   d. Apply clean engine oil to the gasket of a new oil filter.
   e. Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
   f. Tighten it an additional 3/4 turn.

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

Tightening torque
40 ~ 45Nm (400 ~ 450kgf.cm, 30 ~ 33lbf.ft)

   b. Fill with fresh engine oil

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

   c. Install the oil filter cap.

4. Start engine and check for oil leaks.

5. Recheck engine oil level.

INSPECTION

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

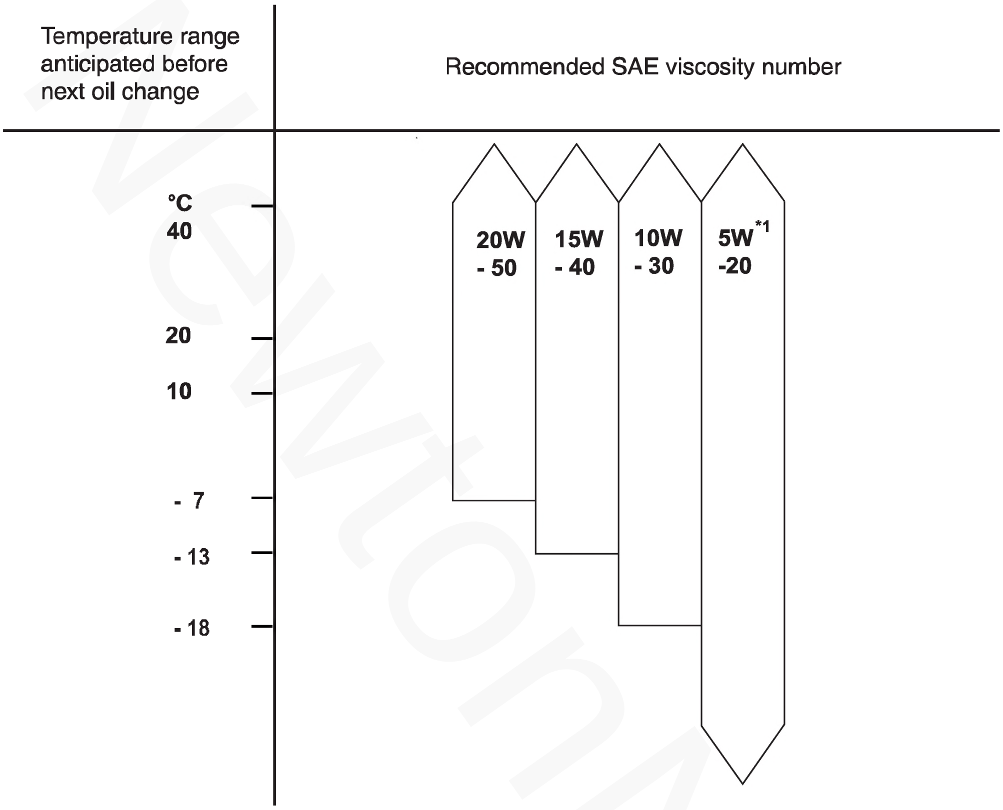
2. Check engine oil level.
   After warming up the engine and then 5 minutes after the engine stop, oil level should be between the "L" and "F" marks on the dipstick.
   If low, check for leakage and add oil up to the "F" mark.

NOTE

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

SELECTION OF ENGINE OIL

Recommended 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

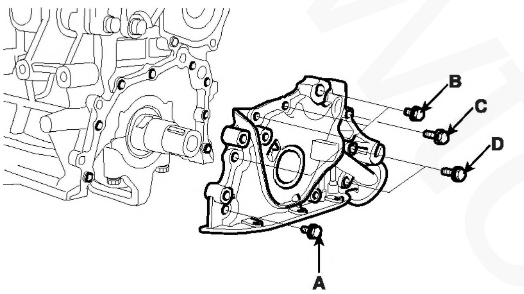
NOTE

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.*

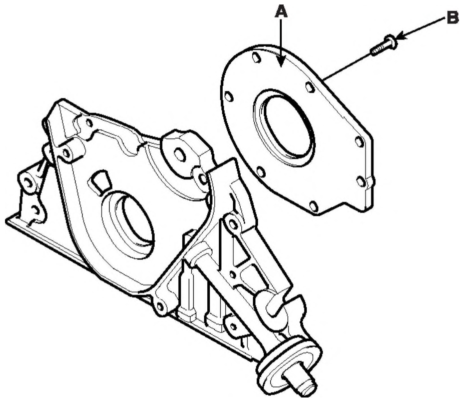
REMOVAL E8BDE9D1

1. Drain engine oil.
2. Remove the drive belts.
3. Turn the crankshaft and align the white groove on the crankshaft pulley with the pointer on the lower cover. (See page EM - 9)
4. Remove the timing belt. (See page EM - 23)
5. Remove the oil pan and oil screen. (See page EM - 64, 65)
6. Remove the front case.



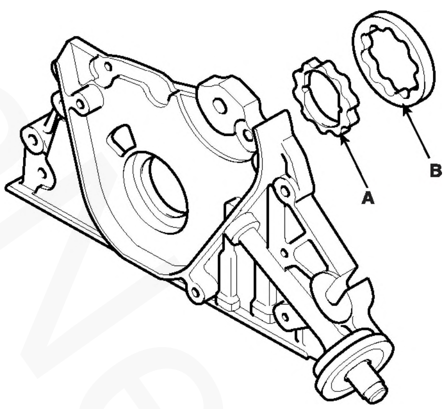
ECKD411A

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



ECKD401A

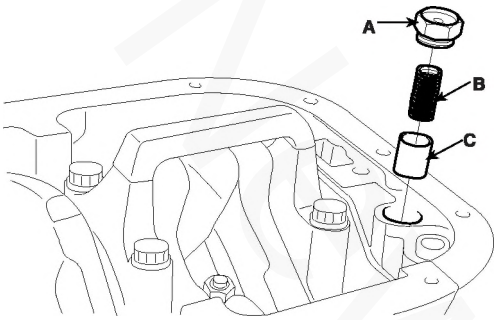
2) Remove the inner(A) and outer(B) rotors.



ECKD402A

DISASSEMBLY E65B43FC

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



ECKD403A

INSPECTION EDACC2F5

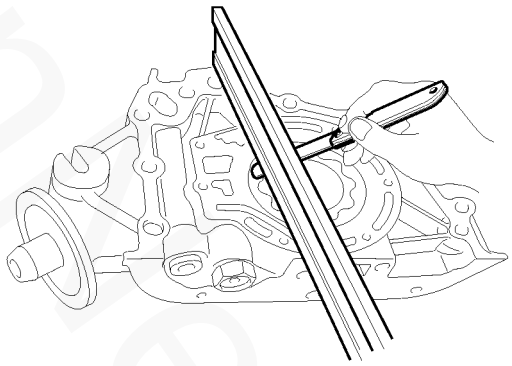
1. Inspect relief plunger.
   Coat the valve with engine oil and check that it falls smoothly into the plunger hole by its own weight.
   If it does not, replace the relief plunger. If necessary, replace the front case.

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

Standard value
Free height : 43.8mm (1.724 in.)
Load : 3.7±0.4kg/40.1mm (8.14±0.88lb/1.579 in.)

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	Outer gear	0.04 ~ 0.09mm (0.0016 ~ 0.0035in.)
	Inner gear	0.04 ~ 0.085mm (0.0016 ~ 0.0033in.)

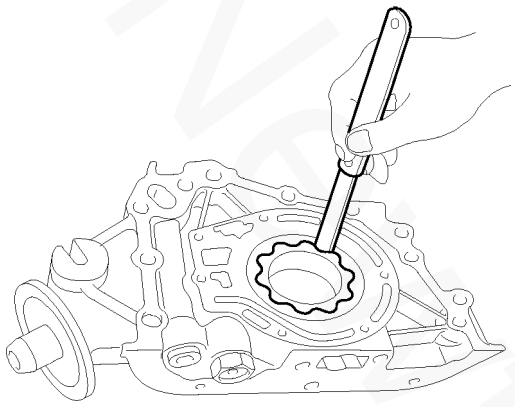


ECKD404A

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

4. Inspect rotor tip clearance.
   Using a feeler gauge, measure the tip clearance between the inner and outer rotor tips.

Tip clearance
0.025 ~ 0.069 mm(0.0010 ~ 0.0027 in.)

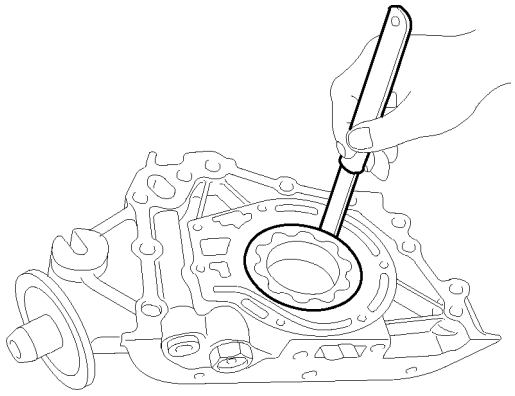


ECKD405A

If the tip clearance is greater than maximum, replace the rotor as a set.

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

Body clearance
0.12 ~ 0.185 mm(0.0047 ~ 0.0073 in.)



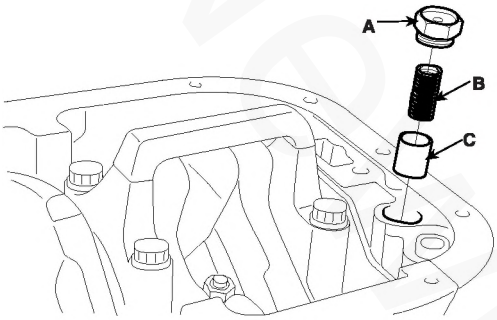
ECKD406A

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

REASSEMBLY E158FA78

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

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

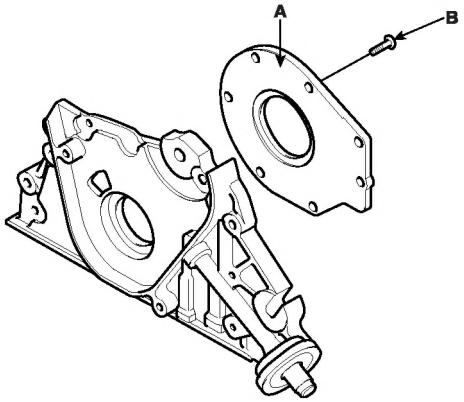


ECKD403A

INSTALLATION EC494CD5

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 7 screws(B).

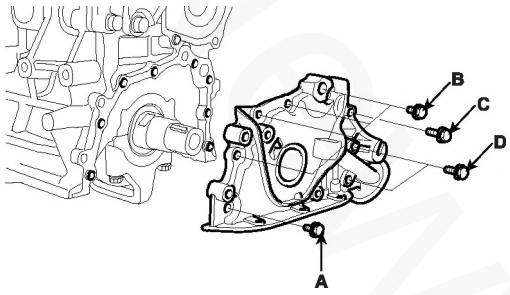
Tightenig torque
6 ~ 9Nm (60 ~ 90kgf.cm, 4.4 ~ 6.6lbf.ft)



ECKD401A

2. Check that the oil pump turns freely.

3. Install the oil pump on the cylinder block.
   Place a new front case gasket on the cylinder block. Apply engine oil to the lip of the oil pump seal. Then, install the oil pump onto the crankshaft. When the pump is in place, clean any excess grease off the crankshaft and check that the oil seal lip is not distorted.



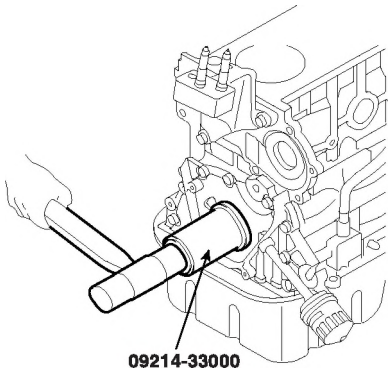
ECKD411A

Body length
(A) : 25mm (0.98in)
(B) : 20mm (0.787in)
(C) : 38mm (1.496in)
(D) : 45mm (1.771in)

Tighttening torque
20 ~ 27Nm (200 ~ 270kg.cm, 14.5 ~ 19.8lb.ft)

4. Apply a light coat of oil to the seal lip.

5. Using the SST(09214-33000), install the oil seal.



ECHE600C

6. Install the oil screen. (See page EM - 80)

7. Install the oil pan. (See page EM - 81)

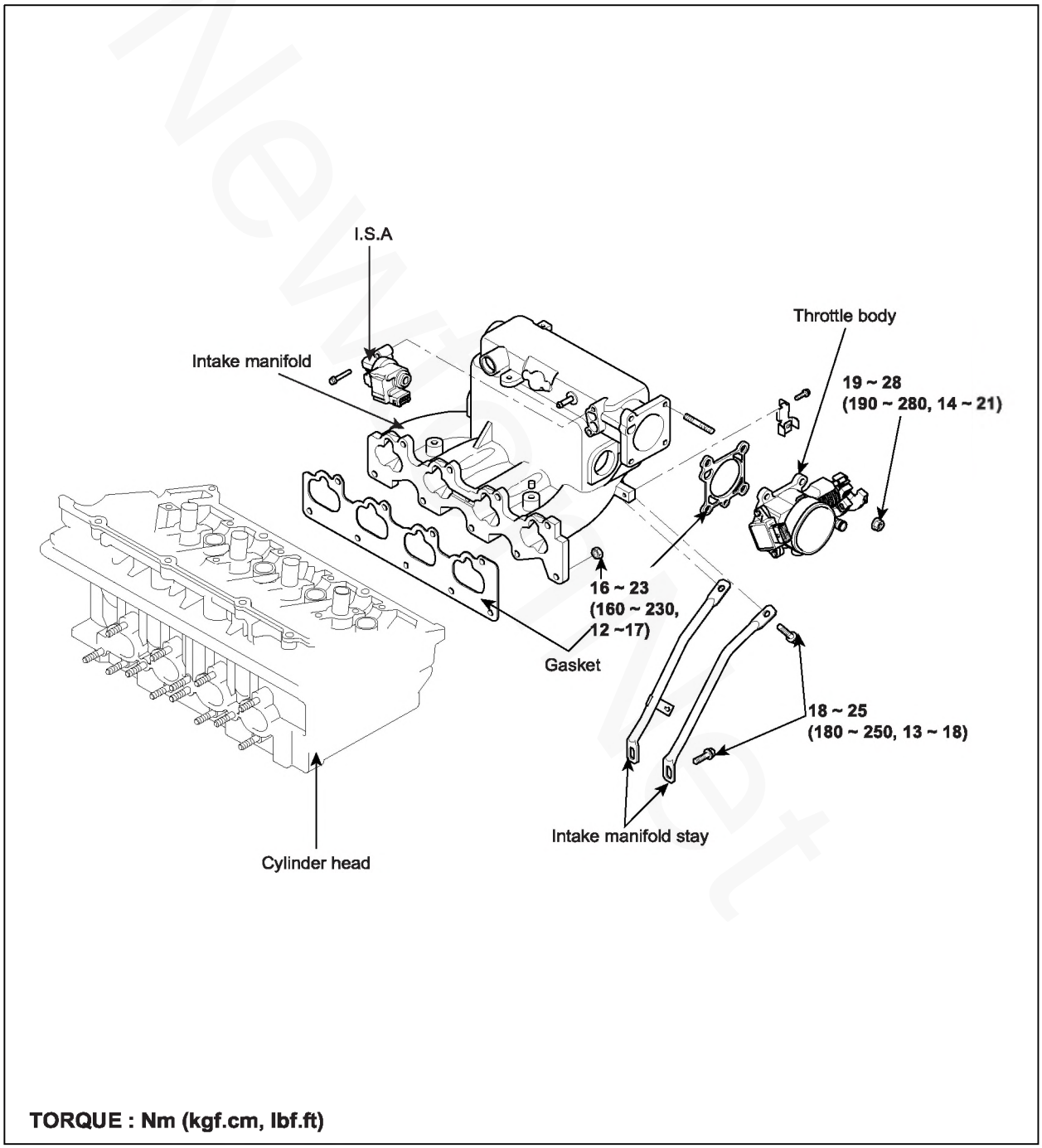
NOTE

Clean the oil pan gasket mating surfaces.

INTAKE AND EXHAUST SYSTEM

COMPONENT E26D8E3D

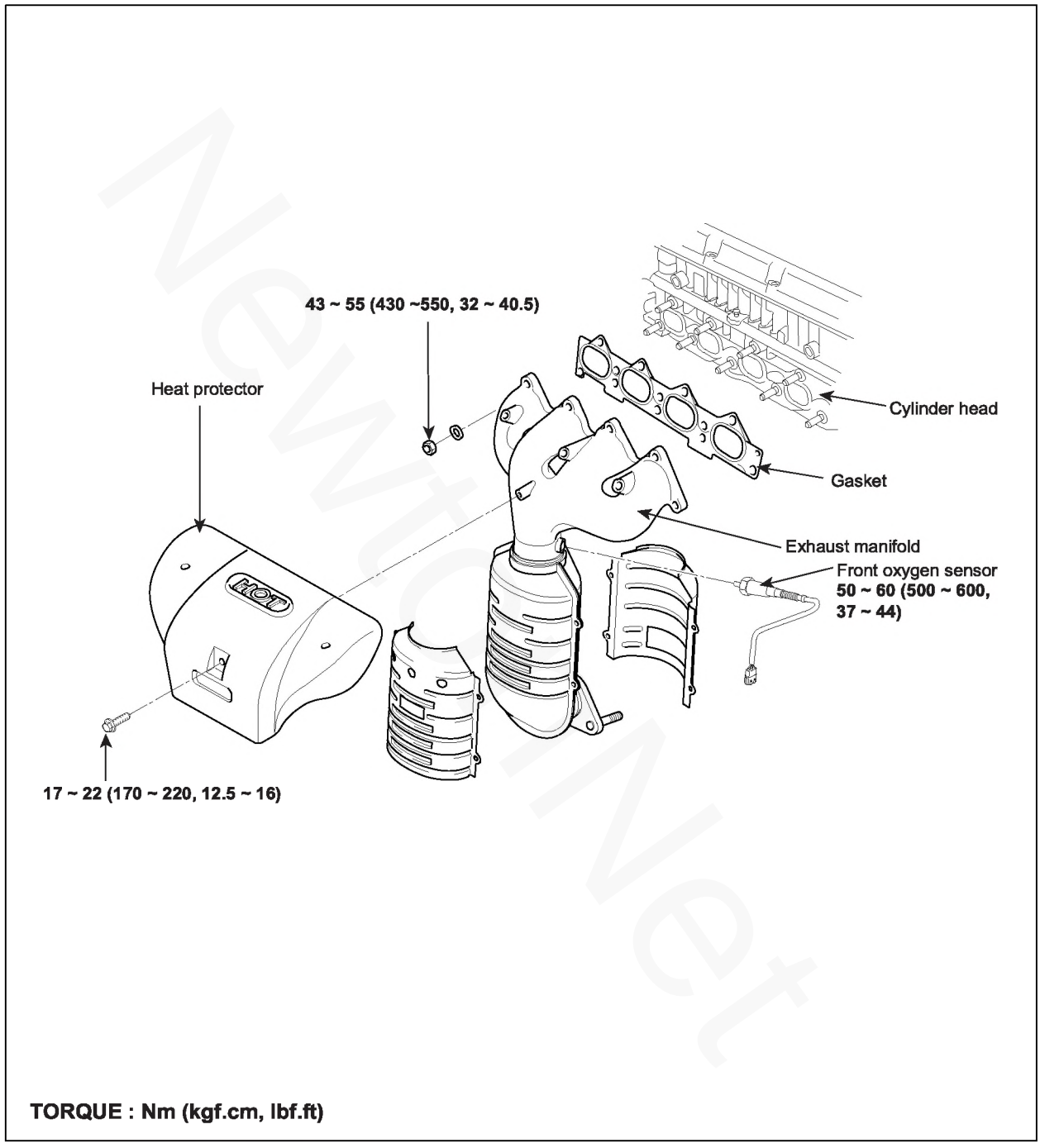
INTAKE MANIFOLD



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

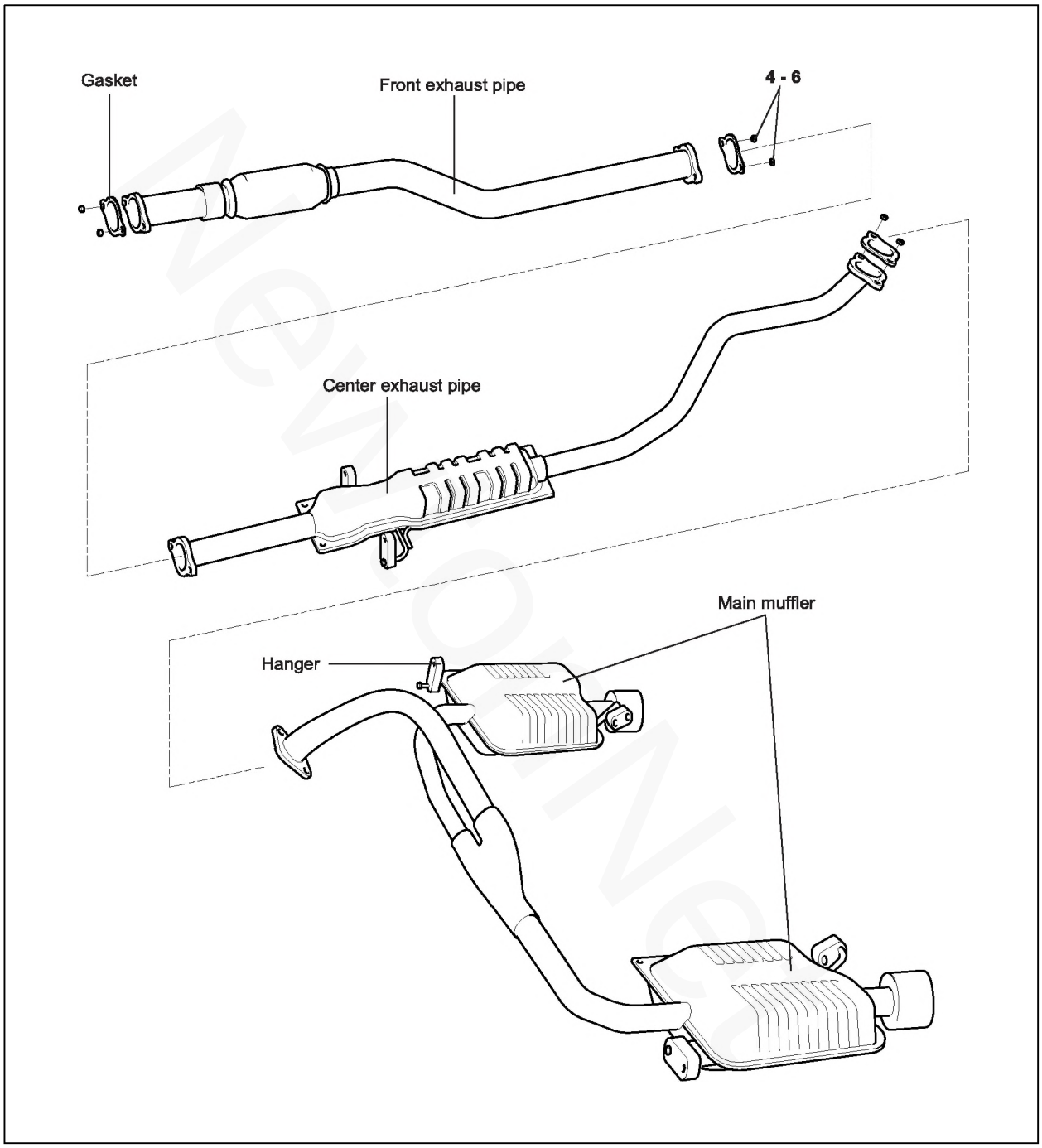
ECKD008A

EXHAUST MANIFOLD



ECKD009A

MUFFLER

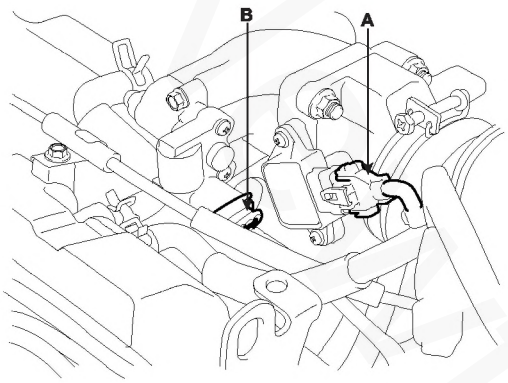


ECOC170A

REMOVAL EC8D02FD

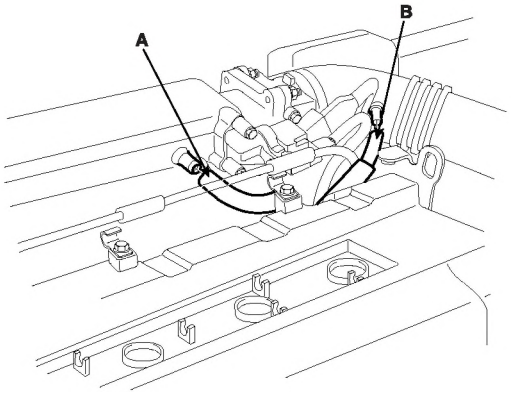
INTAKE MANIFOLD

1. Remove the engine cover. (See page EM - 8)
2. Disconnect the TPS connector(A) and ISA connector(B).



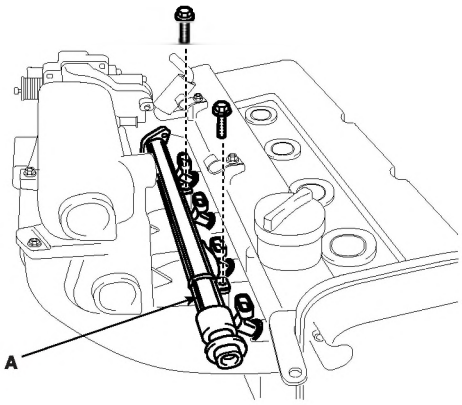
EDQF197A

3. Remove the PCV hose(A) and breather hose(B).



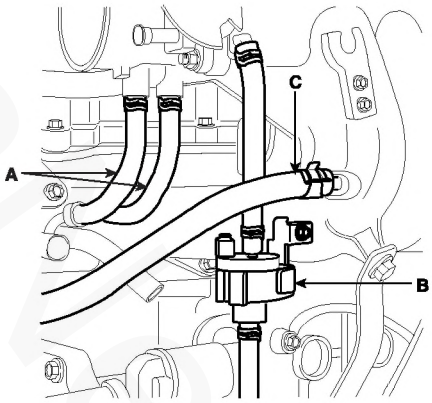
ECKD112A

4. Remove the accelerator cable by loosening the locknut, then slip the cable end out of the throttle linkage.
5. Remove the delivery pipe(A).



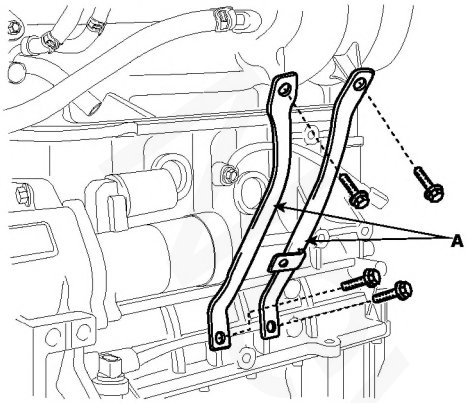
ACGE030A

6. Remove the heater hoses(A), PCSV(B), and brake vacuum hose(C).



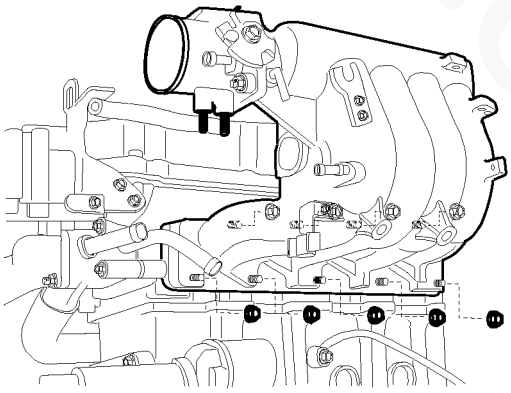
ACGE031A

7. Remove the intake manifold stay(A).



ACGE032A

8. Remove the intake manifold.

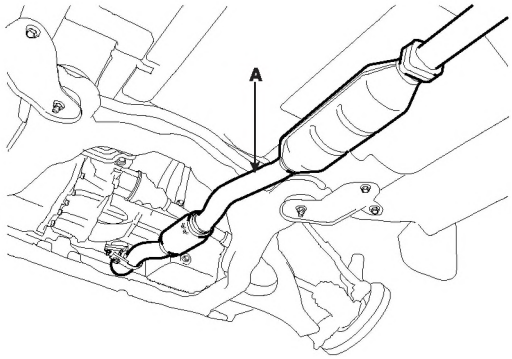


ACGE033A

9. Installation is in the reverse order of removal.

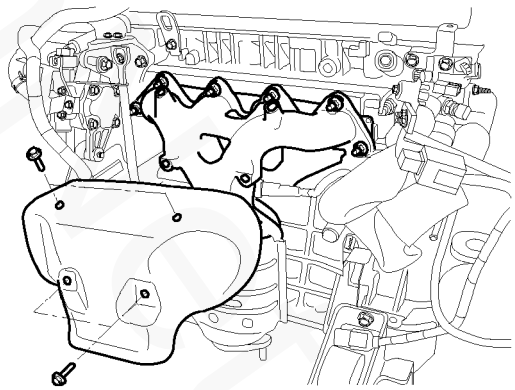
EXHAUST MANIFOLD

1. Remove the engine cover. (See page EM - 8)
2. Remove the front oxygen sensor connector.
3. Remove the front muffler(A).



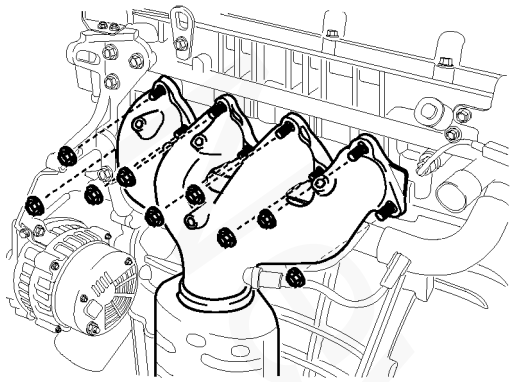
EDQF192A

4. Remove the heat protector.



EDQF195A

5. Remove the exhaust manifold.



ACGE035A