

2006 Hyundai Sonata GL

2006 ENGINE Engine (G4KC-GSL 2.4) - Sonata

2006 ENGINE**Engine (G4KC-GSL 2.4) - Sonata****GENERAL****SPECIFICATIONS****GENERAL SPECIFICATIONS**

Description	Specifications	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinder	4	
Bore	88mm (3.464in.)	
Stroke	97mm (3.819in.)	
Total displacement	2359cc (143.90cu.in.)	
Compression ratio	10.5	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Opens (ATDC)	11°	
Closes (ABDC)	67°	
Exhaust		
Opens (BBDC)	34°	
Closes (ATDC)	10°	
Valve		
Valve length		
Intake	113.18mm (4.4559in.)	112.93mm (4.4460in.)
Exhaust	105.89mm (4.1689in.)	105.74mm (4.1629in.)
Stem O.D.		
Intake	5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)	
Exhaust	5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)	
Face angle	45.25° ~ 45.75°	
Margin		
Intake	1.02mm (0.0401 in.)	
Exhaust	1.09mm (0.0429in.)	
Valve stem to valve guide clearance		
Intake	0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)	0.07mm (0.00275in.)
Exhaust	0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)	0.09mm (0.00354in.)

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	0.00212in.)	
Valve guide		
Length		
Intake	43.8 ~ 44.2mm (1.7244 ~ 1.7401 in.)	
Exhaust	43.8 ~ 44.2mm (1.7244 ~ 1.7401 in.)	
Valve seat		
Width of seat contact		
Intake	1.16 ~ 1.46mm (0.0457 ~ 0.0575in.)	
Exhaust	1.35 ~ 1.65mm (0.0531 ~ 0.0649in.)	
Seat angle	44.75° ~ 45.10°	
Valve spring		
Free length	47.44mm (1.8677in.)	
Load	19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in.) 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.)	
Squareness	1.5° MAX.	
Valve clearance		
Cold (20°C[68°F])		
Intake	0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)	0.10 ~ 0.30mm (0.0039-0.0118in.)
Exhaust	0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)	0.20 ~ 0.40mm (0.0078-0.0157in.)
Cylinder head		
Flatness of gasket surface	Max. 0.05mm (0.0019in.)	
Flatness of manifold mounting surface	Max. 0.10mm (0.0039in.)	
Oversize rework dimensions of		
Cylinder block		
Cylinder bore	88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)	
Out-of-round and taper of cylinder bore	Less than 0.05mm (0.0019in.)	
Clearance with piston	0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)	
(To set limits to new parts)		
Piston		
O.D (To set limits to new parts)	87.97 ~ 88.00mm (3.4634 ~ 3.4645in.)	
Ring groove width		

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No.1	1.22 ~ 1.24mm (0.0480 ~ 0.0488in.)	1.26mm (0.0496in.)
No.2	1.22 ~ 1.24mm (0.0480 ~ 0.0488in.)	1.26mm (0.0496in.)
Oil ring	2.01 ~ 2.03mm (0.0791 ~ 0.0799in.)	2.05mm (0.0807in.)
Service oversize	0.25, 0.50mm (0.010, 0.020in.) oversize	
Piston ring		
Side clearance		
No.1	0.03 ~ 0.07mm (0.0012 ~ 0.0027in.)	0.1mm (0.004in.)
No.2	0.03 ~ 0.07mm (0.0012 ~ 0.0027in.)	0.1mm (0.004in.)
Oil ring	0.06 ~ 0.15mm (0.0024 ~ 0.0059in.)	0.2mm (0.008in.)
End gap		
No.1	0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)	0.6mm (0.0236in.)
No.2	0.30 ~ 0.45mm (0.0118 ~ 0.0177in.)	0.7mm (0.0275in.)
Oil ring side rail	0.20 ~ 0.70mm (0.0078 ~ 0.0275in.)	0.8mm (0.0315in.)
Service oversize	0.25, 0.50mm(0.010, 0.020in.) oversize	
Connecting rod		
Bend		
Twist		
Connecting rod big end to crankshaft side clearance		
	0.05mm (0.0020in.) 0.05mm (0.0020in.) or less 0.1mm (0.004in.) or less 0.100 ~ 0.250mm (0.0039 ~ 0.010in.)	0.35mm (0.0138in.)
Connecting rod bearing		
Oil clearance (To seat limits to new parts)	0.028 ~ 0.046mm (0.0011 ~ 0.0018in.)	0.05mm (0.0019in.)
Camshaft		
Cam height		
Intake		
Exhaust		
Journal O.D.		
Intake		
Exhaust		

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Bearing oil clearance		
Intake	No.1: 0.020 ~ 0.057mm (0.00078 ~ 0.00224in.)	0.09mm (0.0035in.)
	No.2,3,4,5: 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)	0.12mm (0.0047in.)
Exhaust	No.1,2,3,4,5: 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)	0.12mm (0.0047in.)
End play	0.1 ~ 0.22mm (0.0039 ~ 0.0086in.)	0.24mm (0.0094in.)
Crankshaft		
Pin O.D.	47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)	
Journal O.D.	51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)	
End play	0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)	
Crankshaft bearing		
Oil clearance	0.026 ~ 0.048mm (0.0010 ~ 0.0019in.)	
Cooling method	Water-cooled, pressurized. Forced circulation with electrical fan	
Radiator		
Type	Pressurized corrugated fin type	
Radiator cap		
Main valve opening pressure	83 ~ 110kpa (12 ~ 16psi, 0.83 ~ 1.1 kg/cm ²)	
Vacuum valve opening pressure	-7kpa (-100psi, -0.07kg/cm ²) 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 ~ 2.59Kohms at 20°C (68°F)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	

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Suspension system

Rubber hangers

SERVICE STANDARDS**SERVICE STANDARDS****Standard value**

Antifreeze

Mixture ratio of anti-freeze in coolant

ETHYLENE GLYCOL BASE FOR ALUMINUM

50%

TIGHTENING TORQUE**TIGHTENING TORQUE SPECIFICATION**

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

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Tensioner & idler bracket bolt	7	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Water temp, control bolt	2	14.7 ~ 21.56	1.5 ~ 2.2	10.84 ~ 15.90
Water temp, control nut	1	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52
Water inlet pipe bolt	2	19.6 ~ 26.46	2.0 ~ 2.7	14.46 ~ 19.52
Oil level gauge assembly bolt	1	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Ignition coil bolt	4	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Intake manifold bolt	3	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Intake manifold nut	2	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Intake manifold stay bolt	4	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Exhaust manifold heat protector bolt	4	18.62 ~ 27.44	1.9 ~ 2.8	13.73 ~ 20.24
Exhaust manifold nut	7	39.2 ~ 44.1	4.0 ~ 4.5	28.92 ~ 32.53
Exhaust manifold stay bolt (M8)	2	18.62 ~ 27.44	1.9 ~ 2.8	13.74 ~ 20.24
Exhaust manifold stay bolt (M10)	1	51.94 ~ 57.82	5.4 ~ 5.9	38.3 ~ 42.6
Front muffler bolt	2	39.2 ~ 58.8	4.0 ~ 6.0	28.92 ~ 43.37
Engine cover nut	2	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Engine cover mounting bracket bolt	2	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Crankshaft position sensor bolt	1	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Oxygen sensor	1	34.3 ~ 44.1	3.5 ~ 4.5	25.30 ~ 32.53
Knock sensor	1	16.66 ~ 25.48	1.7 ~ 2.6	12.29 ~ 18.79
Oil temperature sensor	1	19.6 ~ 39.2	2.0 ~ 4.0	14.46 ~ 28.92
Camshaft position sensor	1	3.92 ~ 5.88	0.4 ~ 0.6	2.89 ~ 4.34
Oil pressure switch	1	7.84 ~ 11.76	0.8 ~ 1.2	5.78 ~ 8.67
Main bearing cap bolt	10	26.46 + 45°	2.7 + 45°	19.52 + 45°
Oil filter	1	11.76 ~ 15.68	1.2 ~ 1.6	8.67 ~ 11.57
Connecting rod bearing cap bolt	8	19.6 + 90°	2.0 + 90°	14.46 + 90°

COMPRESSION

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

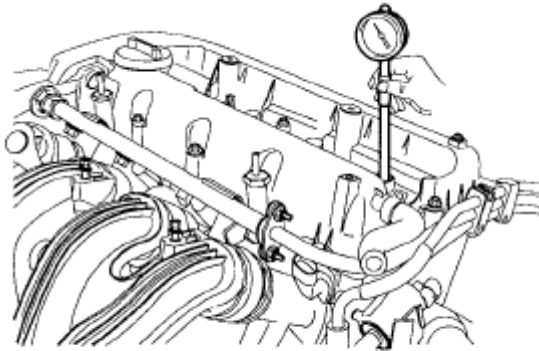
1. Warm up and stop engine.

Allow the engine to warm up to normal operating temperature.

2. Remove ignition coils. (See **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.



KCRF134B

Fig. 1: Inserting Compression Gauge Into Spark Plug Hole
Courtesy of HYUNDAI MOTOR CO.

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

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

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

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

Compression pressure:

1,283kPa (13.0kgf/cm² , 185psi)

Minimum pressure:

1,135kPa (11.5kgf/cm² , 164psi)

Difference between each cylinder:

100kPa (1.0kgf/cm² , 15psi) or less

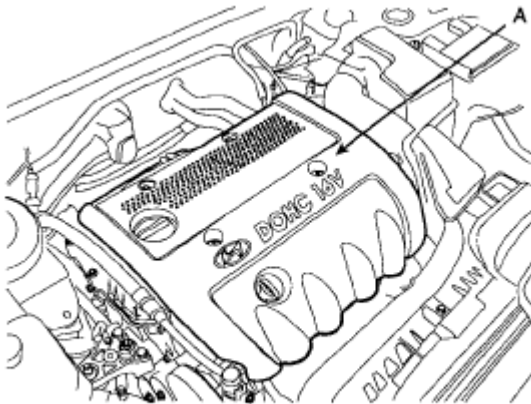
- e. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for cylinders with low compression.
 - If adding oil helps the compression, it is likely that the piston rings and/or cylinder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

5. Reinstall spark plugs.
6. Install ignition coils. (See **IGNITION**)

VALVE CLEARANCE INSPECTION AND ADJUSTMENT

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

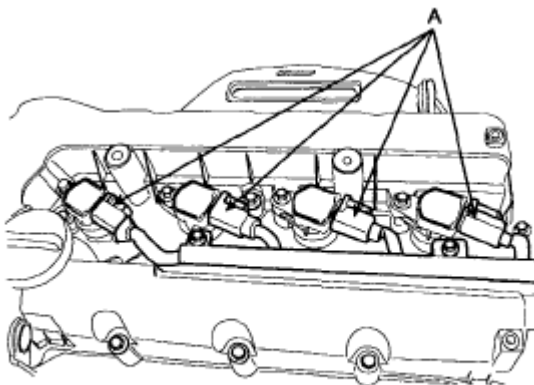
1. Remove the engine cover (A).



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Fig. 2: Identifying Engine Cover
Courtesy of HYUNDAI MOTOR CO.

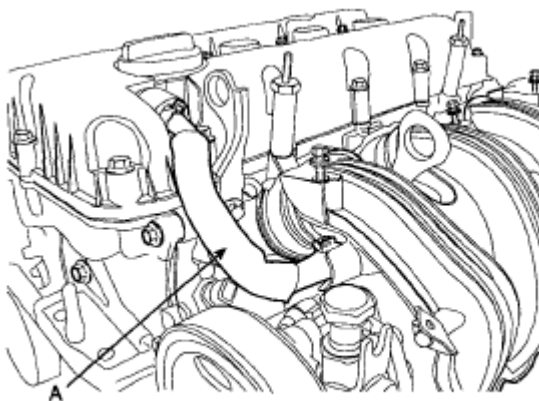
2. Remove the cylinder head cover.
 - a. Disconnect the ignition coil connect (A) and remove the ignition coil.



KCRF131A

Fig. 3: Identifying Ignition Coil Connect
Courtesy of HYUNDAI MOTOR CO.

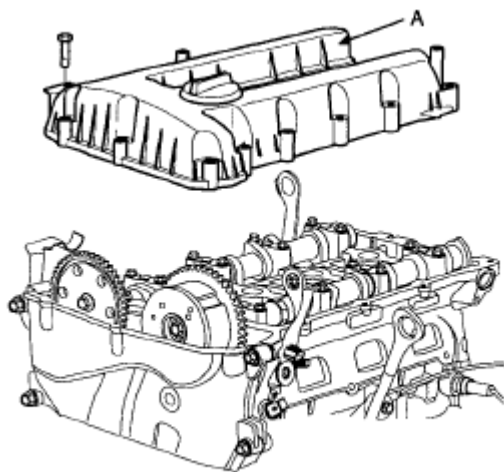
- b. Disconnect the P.C.V hose (A) and the breather hose from the cylinder head cover.



KCRF141E

Fig. 4: Identifying P.C.V Hose
Courtesy of HYUNDAI MOTOR CO.

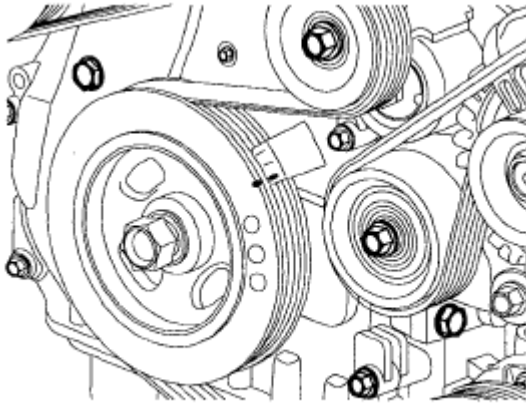
- c. Loosen the cylinder head cover bolts and then remove the cover (A) and gasket.



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Fig. 5: Identifying Cylinder Head Cover
Courtesy of HYUNDAI MOTOR CO.

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

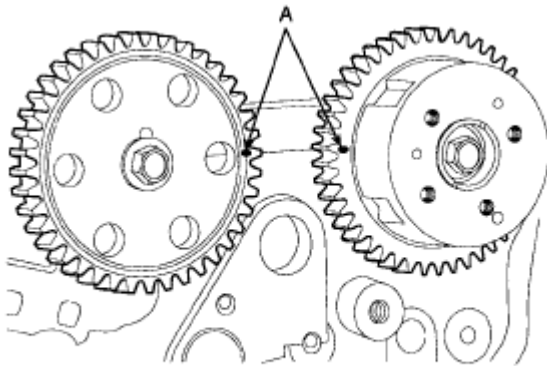


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Fig. 6: Aligning Groove With Timing Mark "T" Of Lower Timing Chain Cover
Courtesy of HYUNDAI MOTOR CO.

- b. Check that the mark (A) of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration.

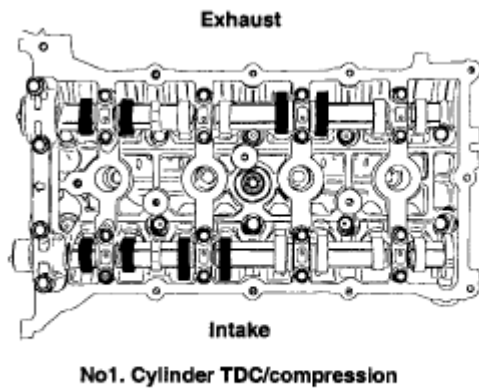
If not, turn the crankshaft one revolution (360°)



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Fig. 7: Aligning Mark Of Camshaft Timing Sprockets On Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

4. 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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Fig. 8: Inspecting Valve Clearance (No. 1 Cylinder)
Courtesy of HYUNDAI MOTOR CO.

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

Valve clearance

Specification

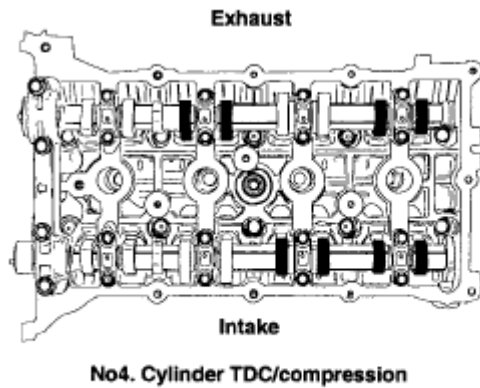
Engine coolant temperature: 20°C [68°F]

Limit

Intake: 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)

Exhaust: 0.20 ~ 0.40mm (0.0079 ~ 0.0157in.)

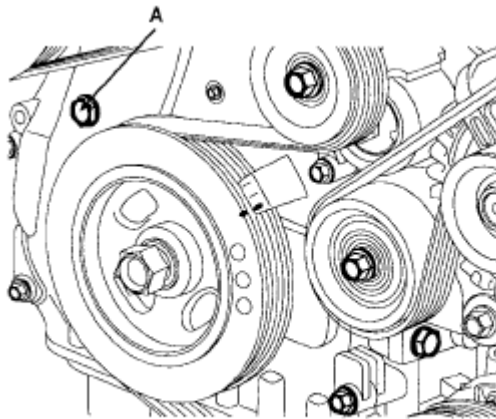
- Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.
- Check only valves indicated as shown. [NO. 4 cylinder: TDC/compression]. Measure the valve clearance.



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Fig. 9: Inspecting Valve Clearance (No. 2 Cylinder)
Courtesy of HYUNDAI MOTOR CO.

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

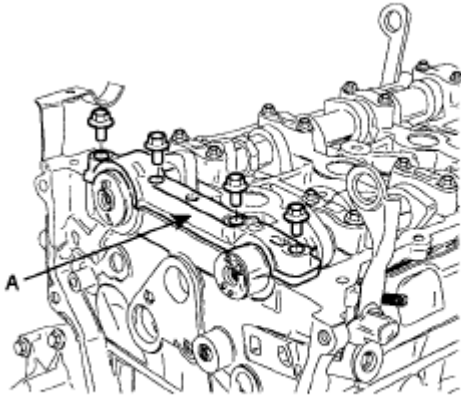


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Fig. 10: Aligning Marks On Timing Chain And Camshaft Timing Sprockets
Courtesy of HYUNDAI MOTOR CO.

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

- d. Insert a thin rod in the service hole of the timing chain cover and release the ratchet.
 - e. Remove the front camshaft bearing cap (A).



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Fig. 11: Identifying Front Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

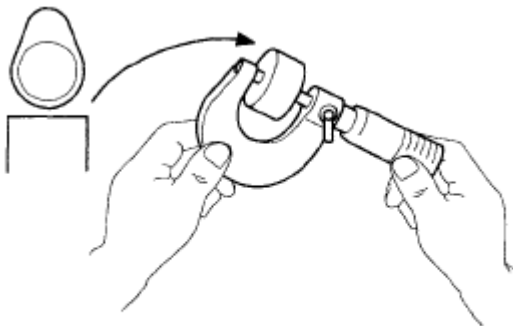
- f. Remove the exhaust camshaft sprocket.
- g. Remove the exhaust camshaft bearing cap and exhaust camshaft. (See **REMOVAL**)
- h. Remove the intake camshaft bearing cap and intake camshaft. (See **REMOVAL**)

CAUTION: When disconnecting the timing chain from the camshaft timing sprocket, hold the timing chain.

- i. Tie a timing chain with a string.

CAUTION: Be careful not to drop anything inside timing chain cover.

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



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Fig. 12: Measuring Thickness Of Tappet
Courtesy of HYUNDAI MOTOR CO.

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

Valve clearance (Engine coolant temperature: 20°C)

T: Thickness of removed tappet

A: Measured valve clearance

N: Thickness of new tappet

Intake: $N = T + [A - 0.20\text{mm} (0.0079\text{in.})]$

Exhaust: $N = T + [A - 0.30\text{mm} (0.0118\text{in.})]$

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

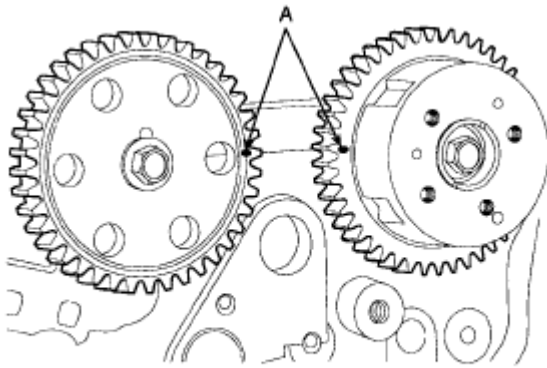
NOTE: Shims are available in 47 size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.690mm (0.1452in.)

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

Tightening torque

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

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



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Fig. 13: Aligning Mark Of Camshaft Timing Sprockets On Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

- t. Recheck the valve clearance.

Valve clearance (Engine coolant temperature: 20°C)

[Specification]

Intake: 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)

Exhaust: 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)

TROUBLESHOOTING

TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings Loose or improperly engine flywheel	Replace the crankshaft and bearings as required. Repair or replace the flywheel 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.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup 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	Faulty cylinder head gasket	Inspect the cylinder head

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consumption	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.	and engine block for damage to the coolant passages and/or a faulty head gasket. Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	- Inspect the cylinder for a loss of compression. - Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity	- Drain the oil. - Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	- Inspect the thrust bearing and crankshaft. - Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	- Inspect the camshaft lobes. - Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required
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

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2006 ENGINE Engine (G4KC-GSL 2.4) - Sonata

		required.
	Oil pump screen loose, damaged or restricted.	- Inspect the oil pump screen. - Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	- Inspect the piston, piston pin and cylinder bore. - Repair as required.
	Excessive piston pin-to-piston clearance	- Inspect the piston, piston pin and the connecting rod. - Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. - The connecting rod bearings. - The connecting rods. - The crankshaft pin journals.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. - The crankshaft bearings. - The crankshaft main journals. - The cylinder block
Engine noise under load	Incorrect piston, piston pin and connecting rod installation	- Verify the piston pins and connecting rods are installed correctly. - Repair as required.
	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

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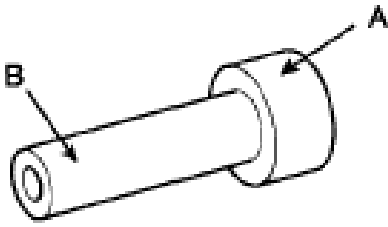
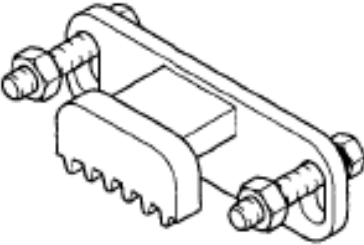
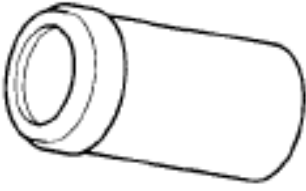
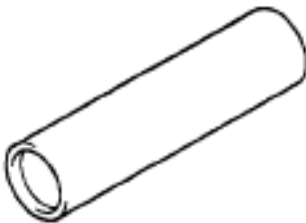
		journals. • The cylinder block.
Engine will not crank- crankshaft will not rotate	Hydraulically locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or 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 or replace 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 connecting rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

SPECIAL TOOLS**SPECIAL TOOLS REFERENCE**

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-3K000) (09231-H1100)		Installation of the front oil seal A: 09214-3K000 B: 09231-H1100

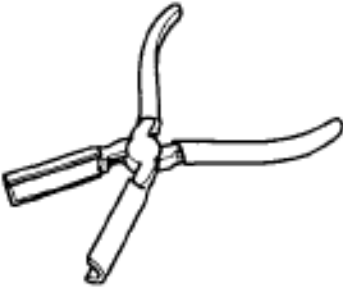
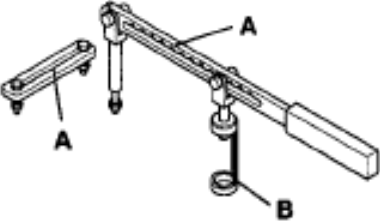
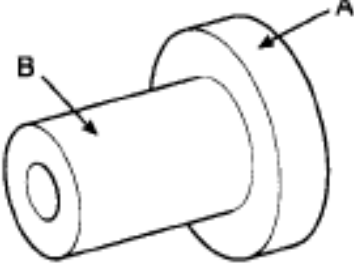
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	 ACRF002A	
Flywheel stopper (09231-3K000)	 KCRF030D	Removal and installation of the flywheel and crankshaft pulley.
Torque angle adapter (09221-4A000)	 EDKA010A	Installation of bolts & nuts needing an angular method
Valve stem seal installer (09222-4A000)	 LCAC030D	Installation of the valve stem seal
Valve stem seal installer		Removal of the valve stem seal

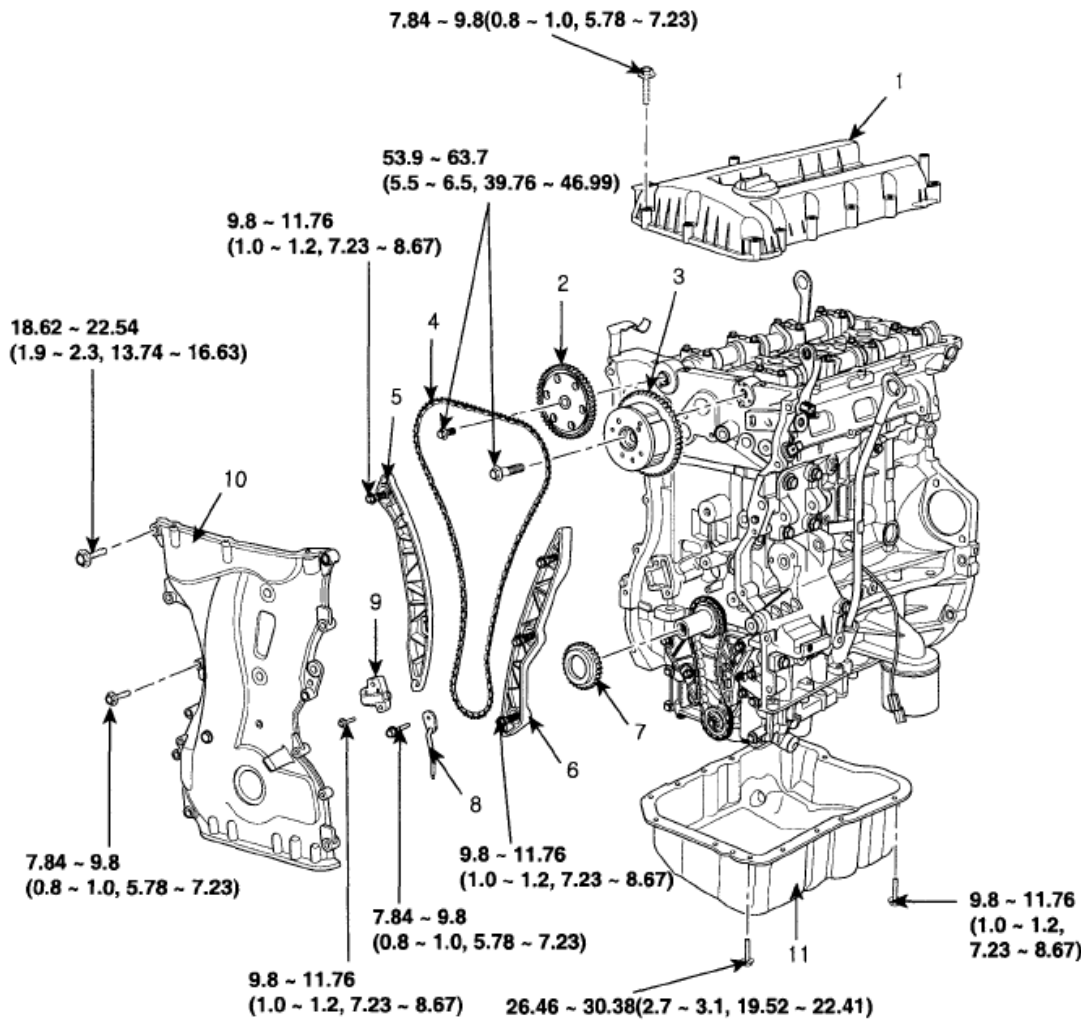
2006 Hyundai Sonata GL

2006 ENGINE Engine (G4KC-GSL 2.4) - Sonata

(09222-29000)	 KDRF232A	
Valve spring compressor & holder (09222-3K000) (09222-3K100)	 ECRF003A	Removal and installation of the intake or exhaust valve A: 09222-3K000 B: 09222-3K100 (holder)
Crankshaft rear oil seal installer (09214-3K100) (09231-H1100)	 ACRIF003A	Installation of the crankshaft rear oil seal A: 09214-3K100 B: 09231-H1100

TIMING SYSTEM

COMPONENT

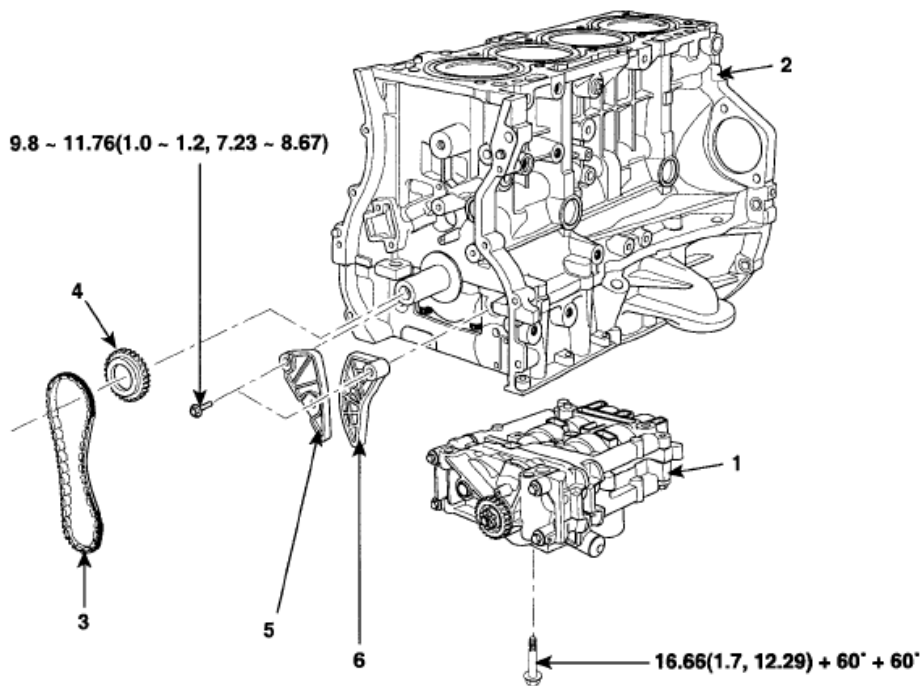


TORQUE : N.m (kgf.m, lbf.ft)

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

EGRF004A

Fig. 14: Exploded View Of Timing System Components With Torque Specifications (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



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

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

ECRF005A

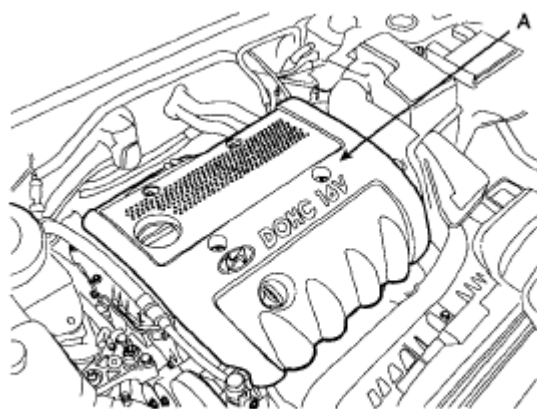
Fig. 15: Exploded View Of Timing System Components With Torque Specifications (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

Engine removal is not required for this procedure.

TIMING CHAIN

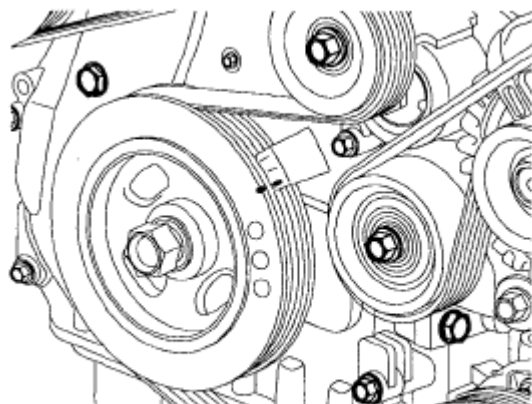
1. Remove the engine cover (A).



KCRF146A

Fig. 16: Identifying Engine Cover
Courtesy of HYUNDAI MOTOR CO.

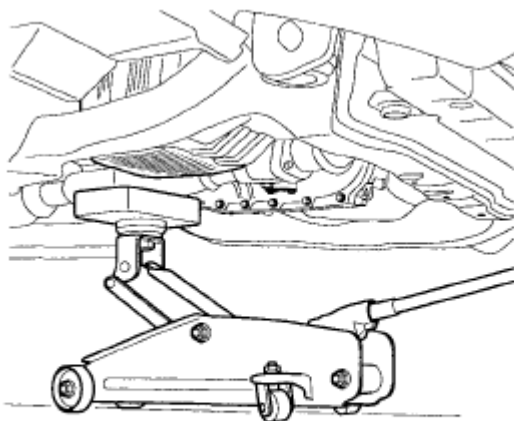
2. Remove RH front wheel.
3. Remove RH side cover.
4. Set No.1 cylinder to TDC/compression



KCRF107A

Fig. 17: Aligning No.1 Cylinder To TDC/Compression Position
Courtesy of HYUNDAI MOTOR CO.

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

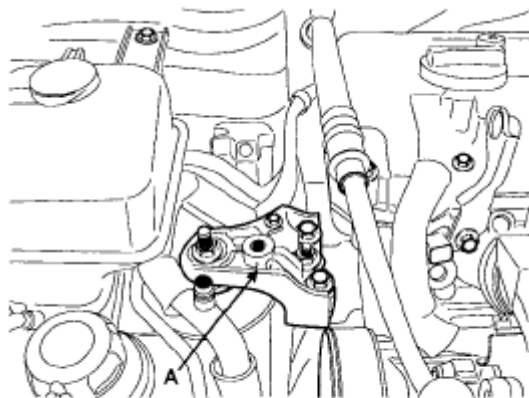


ECKD102A

Fig. 18: Lifting Vehicle
Courtesy of HYUNDAI MOTOR CO.

NOTE: Place wooden block between the jack and engine oil pan.

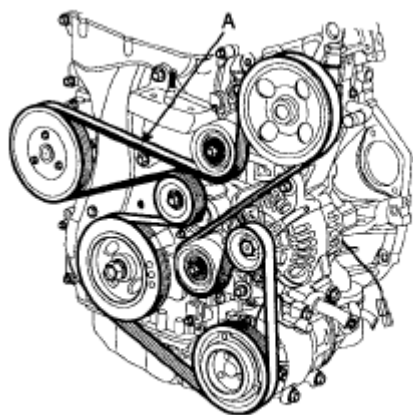
2. Remove the 2bolts, 2nuts and engine mount bracket (A).



KCRF137A

Fig. 19: Identifying Engine Mount Bracket
Courtesy of HYUNDAI MOTOR CO.

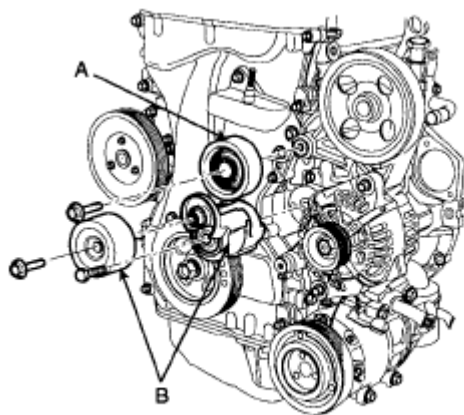
6. Temporarily loosen the water pump pulley bolts.
7. Remove drive belt (A).



KCRF108A

Fig. 20: Identifying Drive Belt Routing
Courtesy of HYUNDAI MOTOR CO.

8. Remove the idler pulley (A).



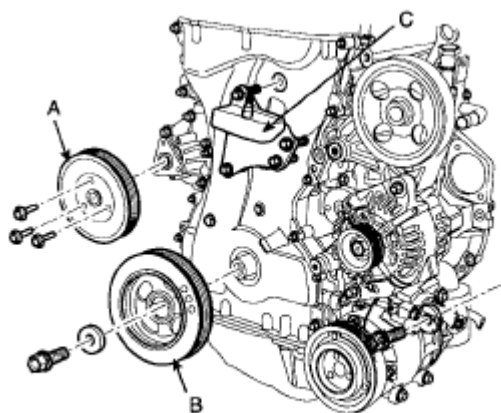
KCRF109A

Fig. 21: Identifying Idler Pulley With Bolts
Courtesy of HYUNDAI MOTOR CO.

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

NOTE: Tensioner pulley bolt is left-handed screw.

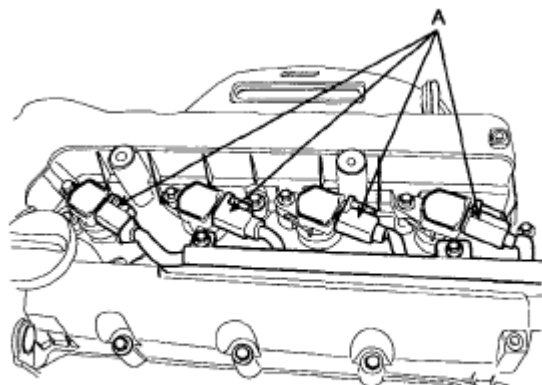
10. Remove the water pump pulley (A).



KCRF110A

Fig. 22: Identifying Water Pump Pulley And Crankshaft Pulley
Courtesy of HYUNDAI MOTOR CO.

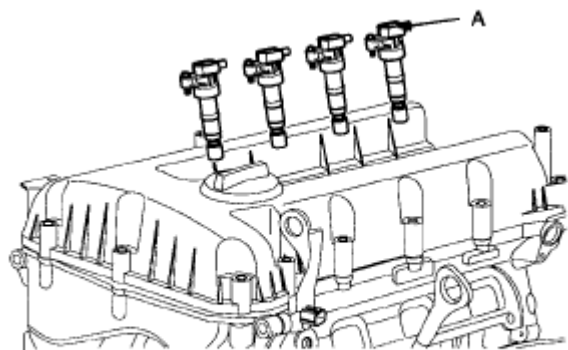
11. Remove the crankshaft pulley (B).
12. Remove the engine support bracket (C).
13. Disconnect the ignition coil connector (A).



KCRF131A

Fig. 23: Identifying Ignition Coil Connector
Courtesy of HYUNDAI MOTOR CO.

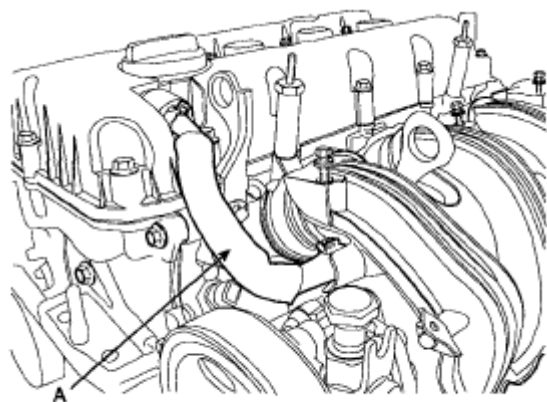
14. Remove the ignition coil (A).



KCRF111A

Fig. 24: Identifying Ignition Coil
Courtesy of HYUNDAI MOTOR CO.

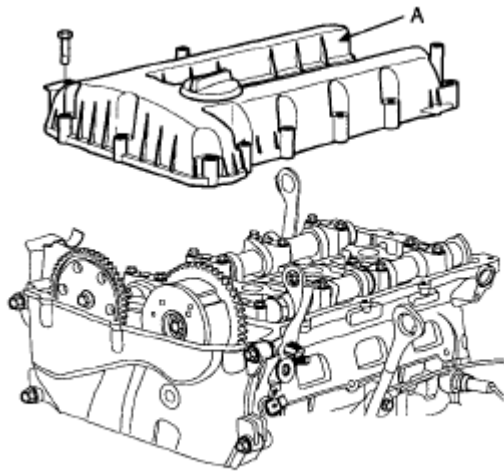
15. Remove the PCV hose (A) and breather hose from the cylinder head cover.



KCRF141E

Fig. 25: Identifying PCV Hose
Courtesy of HYUNDAI MOTOR CO.

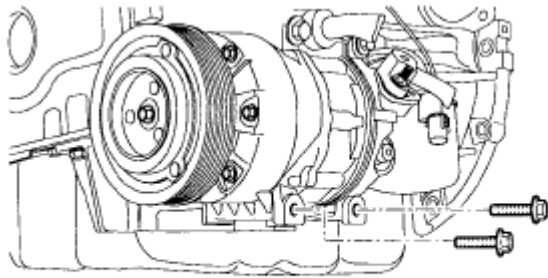
16. Loosen the cylinder head cover bolts and then remove the cylinder head cover (A) and gasket.



KCRF115A

Fig. 26: Identifying Cylinder Head Cover
Courtesy of HYUNDAI MOTOR CO.

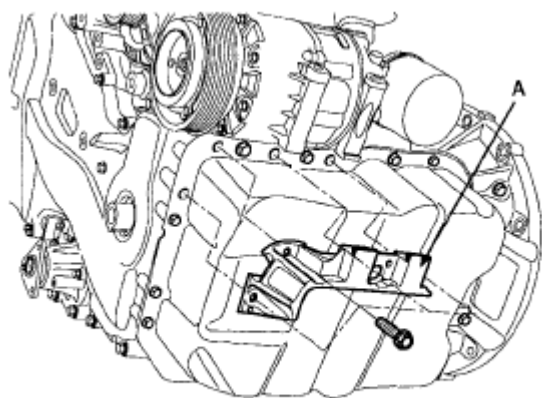
17. Remove the compressor lower bolts.



KCRF112A

Fig. 27: Identifying Compressor Lower Bolts
Courtesy of HYUNDAI MOTOR CO.

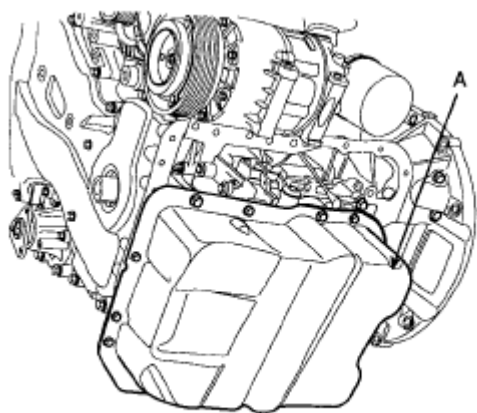
18. Remove the compressor bracket (A).



KCRF113A

Fig. 28: Identifying Compressor Bracket
Courtesy of HYUNDAI MOTOR CO.

19. Drain the engine oil.
20. Remove the oil pan.

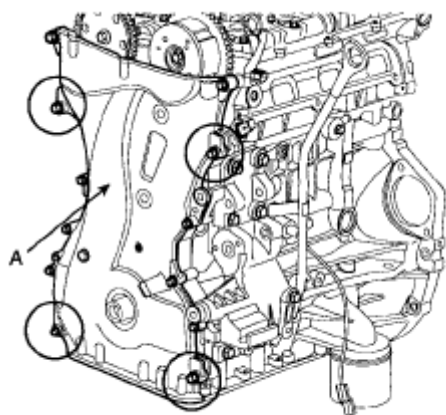


KCRF114A

Fig. 29: Identifying Oil Pan
Courtesy of HYUNDAI MOTOR CO.

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

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



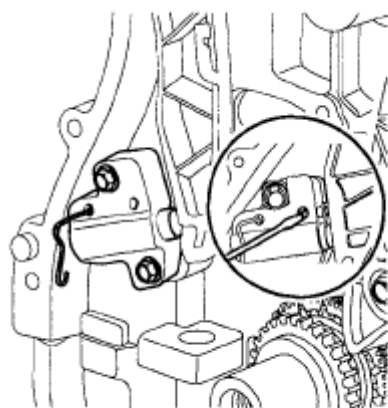
KCRF106A

Fig. 30: Identifying Timing Chain Cover

Courtesy of HYUNDAI MOTOR CO.

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

22. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
23. Install a set pin after compressing the timing chain tensioner.

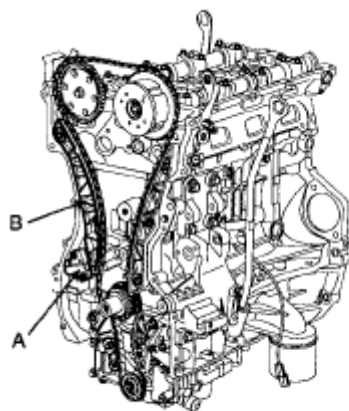


KCRF105A

Fig. 31: Compressing Timing Chain Tensioner

Courtesy of HYUNDAI MOTOR CO.

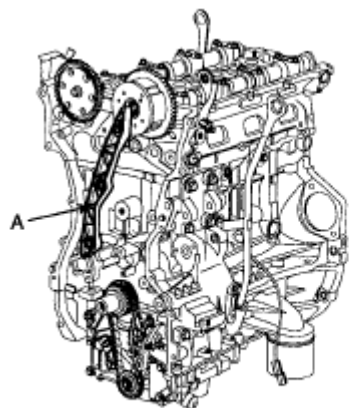
24. Remove the timing chain tensioner (A).



KCRF104A

Fig. 32: Identifying Timing Chain Tensioner With Timing Chain Tensioner Arm
Courtesy of HYUNDAI MOTOR CO.

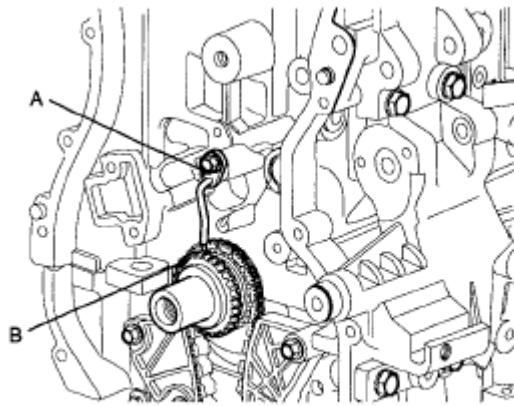
25. Remove the timing chain tensioner arm (B).
26. Remove the timing chain.
27. Remove the timing chain guide (A).



KCRF103A

Fig. 33: Identifying Timing Chain Guide
Courtesy of HYUNDAI MOTOR CO.

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



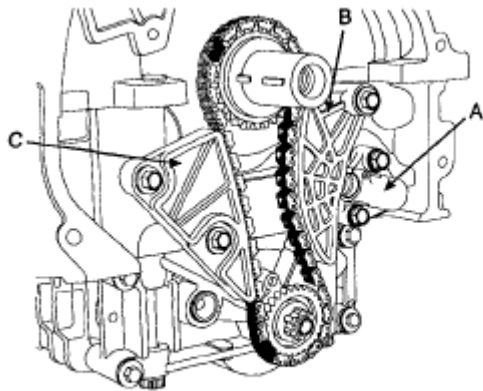
KCRF101A

Fig. 34: Identifying Timing Chain Oil Jet And Crankshaft Chain Sprocket
Courtesy of HYUNDAI MOTOR CO.

29. Remove the crankshaft chain sprocket (B).

BALANCE SHAFT CHAIN

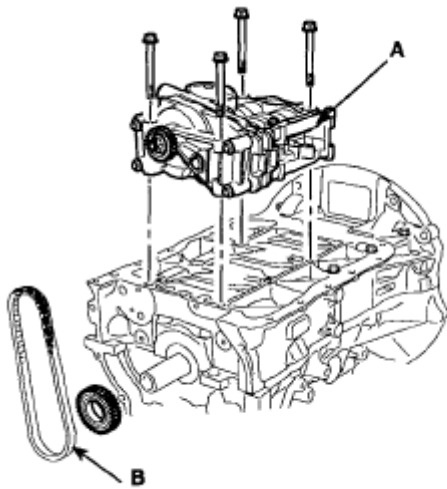
1. Remove the timing chain.
2. Install a set pin after compressing the balance shaft chain tensioner.
3. Remove the balance shaft chain tensioner (A).



KCRF117A

Fig. 35: Identifying Balance Shaft Chain Tensioner And Balance Shaft Chain Tensioner Arm
Courtesy of HYUNDAI MOTOR CO.

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



KCRF165A

Fig. 36: Identifying Balance Shaft Module And Balance Shaft Chain
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

SPROCKETS, CHAIN TENSIONER, CHAIN GUIDE, CHAIN TENSIONER ARM

1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage.

Replace as necessary.

3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

BELT, IDLER, BELT TENSIONER, PULLEY

1. Check the belt for oil or dust deposits.

Replace, if necessary.

Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt.

NOTE:

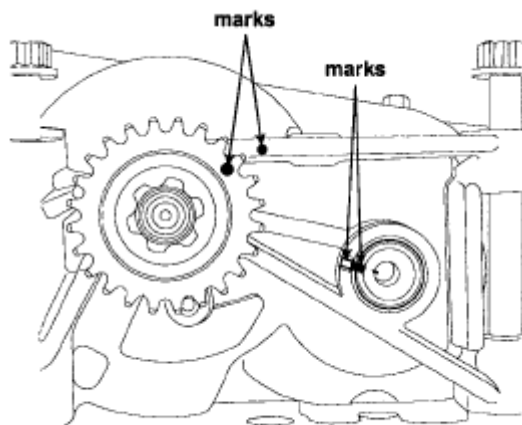
- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water and steam.

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

INSTALLATION

BALANCE SHAFT CHAIN

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
2. Confirm the balance shaft module timing mark. Timing marks to be visually aligned with centers of adjacent cast timing notches.



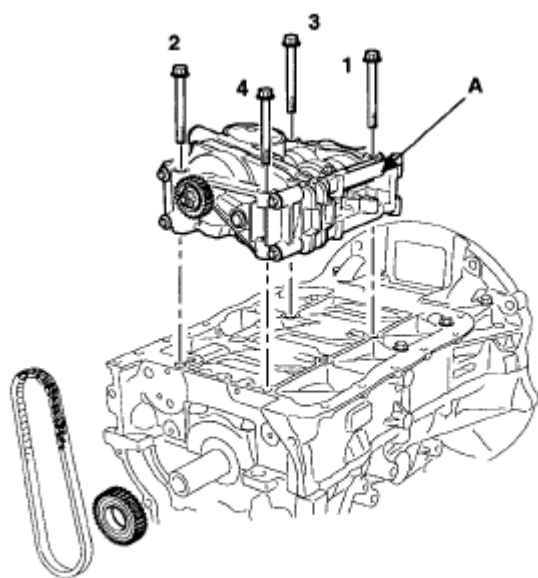
ECRF006A

Fig. 37: Aligning Timing Mark Of Balance Shaft Module With Sprocket
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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



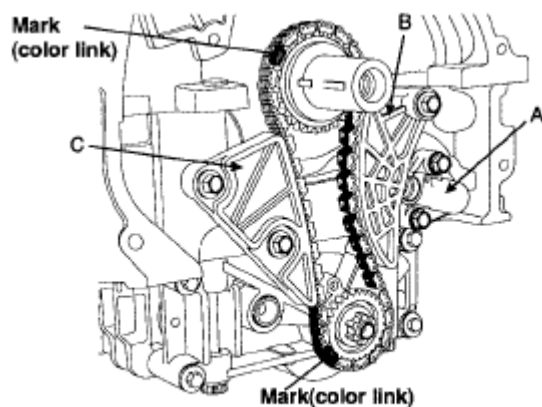
KCRF165B

Fig. 38: Identifying Balance Shaft Module And Balance Shaft Chain
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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



ECRF007A

Fig. 39: Identifying Balance Shaft Chain Guide And Balance Shaft Tensioner Arm
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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

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

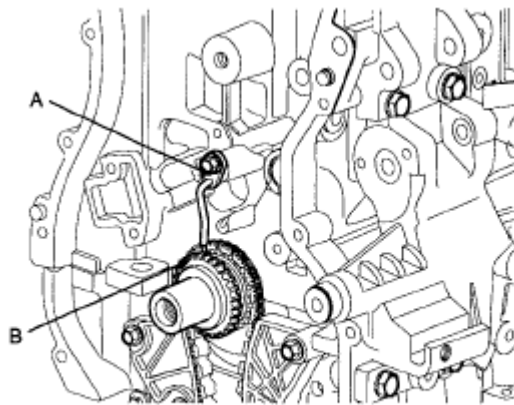
Tightening torque

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

7. Confirm the timing marks.

TIMING CHAIN

1. Install crankshaft chain sprocket (B).



KCRF101A

Fig. 40: Identifying Timing Chain Oil Jet And Crankshaft Chain Sprocket
Courtesy of HYUNDAI MOTOR CO.

2. Install timing chain oil jet (A).

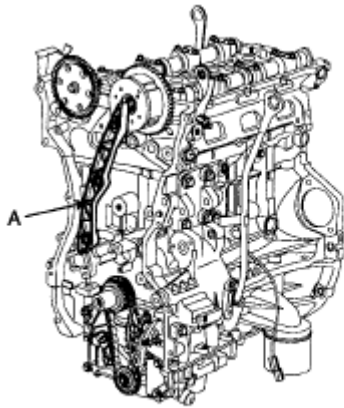
Tightening torque

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

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

Tightening torque

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



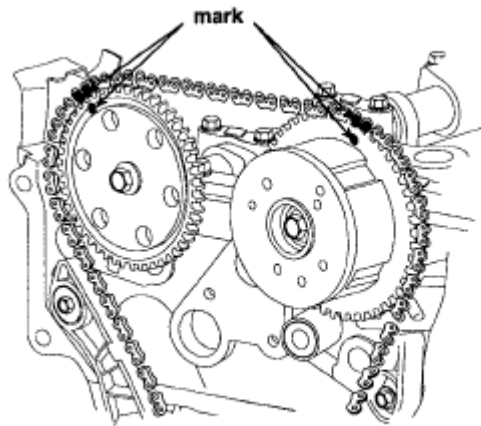
KCRF103A

Fig. 41: Identifying Timing Chain Guide
Courtesy of HYUNDAI MOTOR CO.

5. Install timing chain.

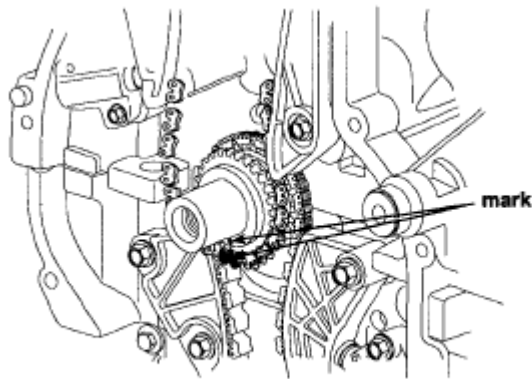
To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure. Crankshaft sprocket (A) -> Timing chain guide (B) -> Intake camshaft sprocket (C) -> Exhaust camshaft sprocket (D).

The timing mark of each sprockets should be matched with timing mark (color link) of timing chain at installing timing chain.



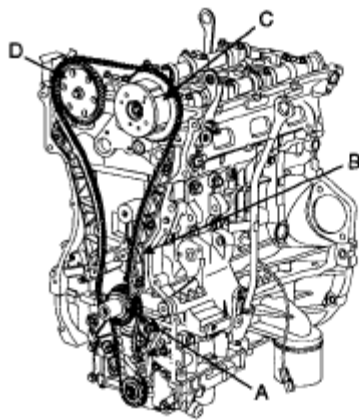
ECRF030A

Fig. 42: Aligning Mark Of Timing Chain With Crankshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.



ECRF031A

Fig. 43: Identifying Mark Of Crankshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.



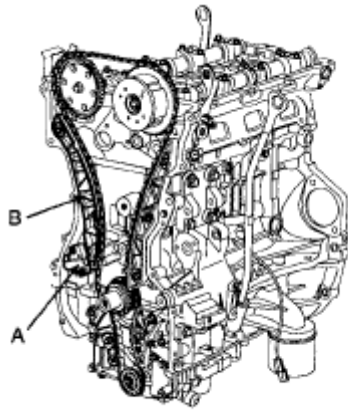
KCRF104B

Fig. 44: Identifying Crankshaft Sprocket, Timing Chain Guide And Intake Camshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

6. Install timing chain tensioner arm (B).

Tightening torque

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



KCRF104A

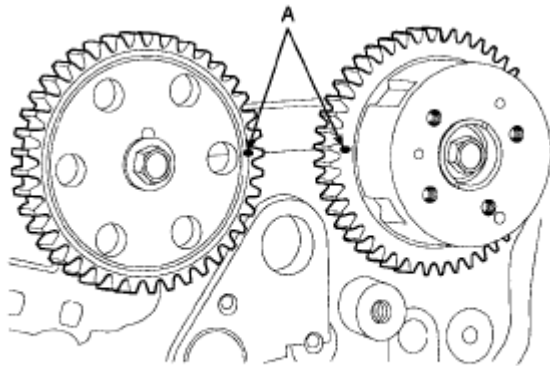
Fig. 45: Identifying Timing Chain Tensioner Arm Timing Chain Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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

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



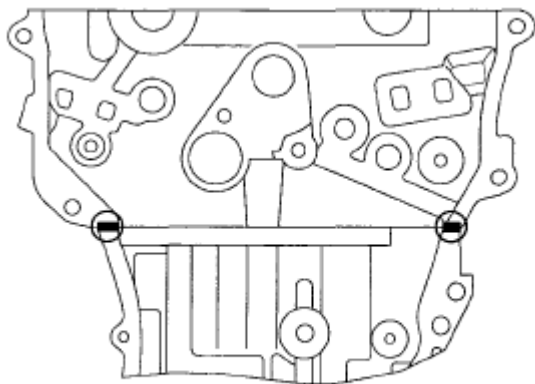
ACRF007A

Fig. 46: Aligning Timing Mark
Courtesy of HYUNDAI MOTOR CO.

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

sealant was applied.

Bead width: 2.5mm (0.1in.)



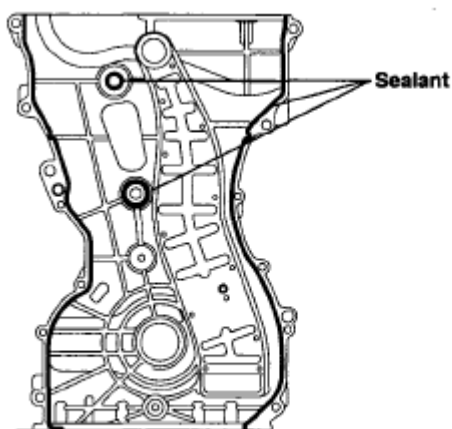
ECRF008A

Fig. 47: Applying Liquid Sealant On Timing Chain Cover
Courtesy of HYUNDAI MOTOR CO.

- c. After applying liquid sealant Loctite 5900 on timing chain cover.

The part must be assembled within 5 minutes after sealant was applied. Sealant should be applied without discontinuity.

Bead width: 2.5mm (0.1in.)



ECRF009A

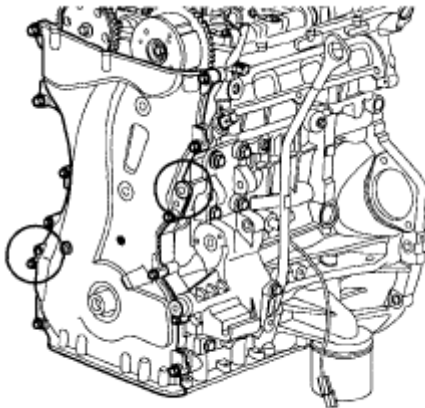
Fig. 48: Applying Liquid Sealant On Timing Chain Cover
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

M6: 7.84 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.78 ~ 7.23 lbf.ft)

M8: 18.62 ~ 22.54 N.m (1.9 ~ 2.3 kgf.m, 13.74 ~ 16.63 lbf.ft)



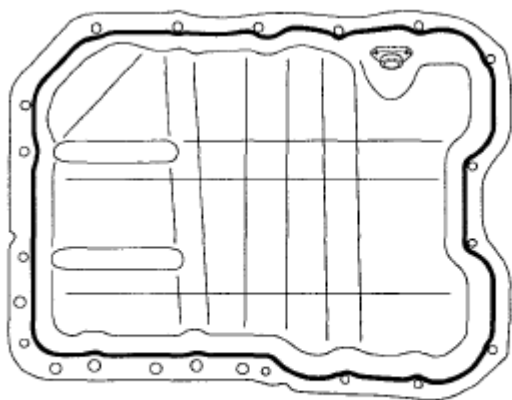
ECRF010A

Fig. 49: Identifying Timing Chain Cover Bolts
Courtesy of HYUNDAI MOTOR CO.

- e. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.
- 10. Install timing chain cover oil seal
 - 1. Apply engine oil to a new oil seal lip.
 - 2. Using SST (09214-3K000, 09231-H1100) and a hammer, tap in the oil seal.
- 11. Install oil pan.
 - a. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 - b. Before assembling the oil pan, the liquid sealant Loctite 5900 should be applied on oil pan.

The part must be assembled within 5 minutes after the sealant was applied.

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



KCRF179A

Fig. 50: Applying Liquid Sealant On Oil Pan
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

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

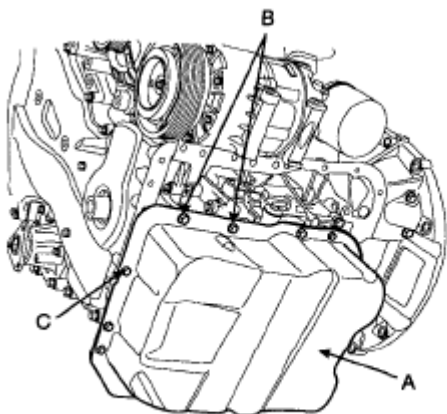
c. Install oil pan (A).

Uniformly tighten the bolts in several passes.

Tightening torque

M8 (B): 26.46 ~ 30.38 N.m (2.7 ~ 3.1 kgf.m, 19.52 ~ 22.41 lbf.ft)

M6 (C): 9.8 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.67 lbf.ft)



KCRF114B

Fig. 51: Identifying Oil Pan With Bolts

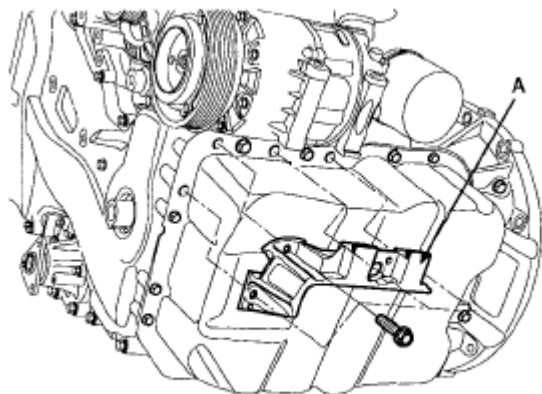
Courtesy of HYUNDAI MOTOR CO.

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

12. Install air compressor bracket (A).

Tightening torque

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



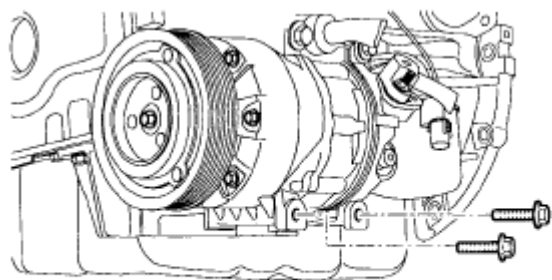
KCRF113A

Fig. 52: Identifying Air Compressor Bracket
Courtesy of HYUNDAI MOTOR CO.

13. Install air compressor bolt

Tightening torque

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



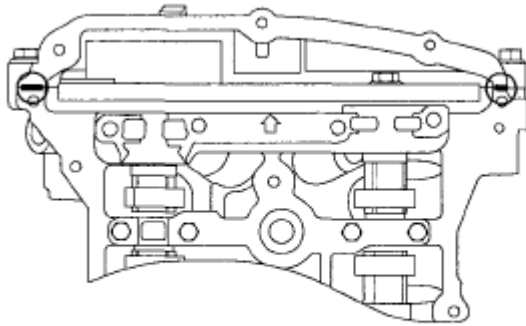
KCRF112A

Fig. 53: Identifying Air Compressor Bolt
Courtesy of HYUNDAI MOTOR CO.

14. Install cylinder head cover.

- a. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- b. After applying sealant, it should be assembled within 5 minutes.

Bead width: 2.5mm (0.1in.)



ECRF011A

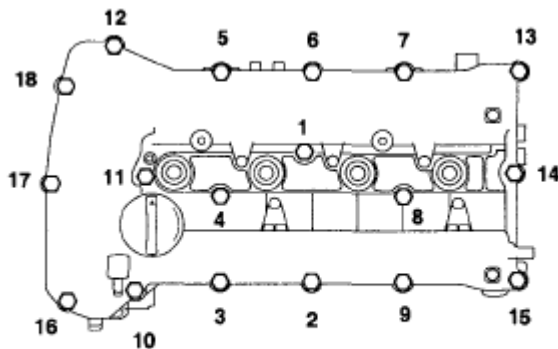
Fig. 54: Applying Sealant Upper Area Between Timing Chain Cover And Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

- c. The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.
- d. Install the cylinder head cover bolts as following method.

Tightening torque

1st step: 3.92 ~ 5.88 N.m (0.4 ~ 0.6 kgf.m, 2.89 ~ 4.34 lbf.ft)

2nd step: 7.84 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.78 ~ 7.23 lbf.ft)

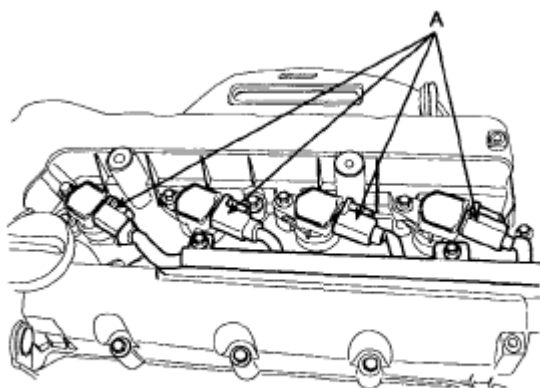


KGRF180A

Fig. 55: Identifying Tightening Sequence For Cylinder Head Cover Bolts
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Do not reuse cylinder head cover gasket.

15. Install ignition coil (See **IGNITION**)
16. Connect ignition coil connector (A).



KCRF131A

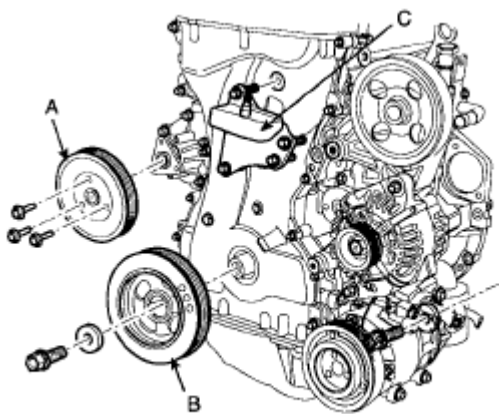
Fig. 56: Identifying Ignition Coil Connector
Courtesy of HYUNDAI MOTOR CO.

17. Install engine support bracket (C).

Tightening torque

M10: 39.2 ~ 44.1 N.m (4.0 ~ 4.5 kgf.m, 28.92 ~ 32.53 lbf.ft)

M8: 19.6 ~ 24.5 N.m (2.0 ~ 2.5 kgf.m, 14.46 ~ 18.07 lbf.ft)



KCRF110A

Fig. 57: Identifying Water Pump Pulley And Crankshaft Pulley
Courtesy of HYUNDAI MOTOR CO.

18. Using SST (09231-3K000), install crankshaft pulley (B).

Tightening torque

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

19. Install water pump pulley (A).

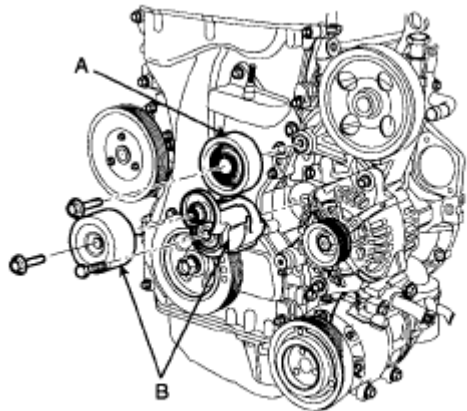
Tightening torque

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

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

Tightening torque

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



KCRF109A

Fig. 58: Identifying Drive Belt Tensioner And Tensioner Pulley
Courtesy of HYUNDAI MOTOR CO.

NOTE: Tensioner pulley bolt is left-handed screw.

21. Install idler pulley (A)

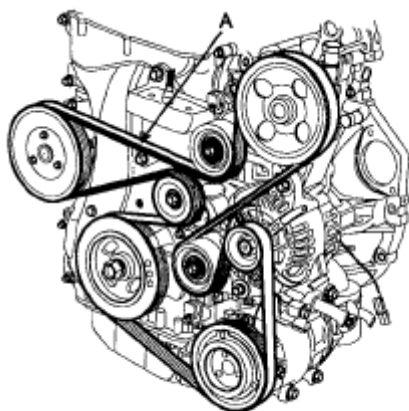
Tightening torque

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

22. Install drive belt (A)

Crankshaft pulley -> A/C pulley -> alternator pulley -> idler pulley -> P/C pump pulley -> idler pulley -> water pump pulley -> tensioner pulley. Rotate auto tensioner arm in the counter-clockwise moving auto

tensioner pulley bolt with wrench. After putting belt on auto tensioner pulley, release the auto tensioner pulley slowly.



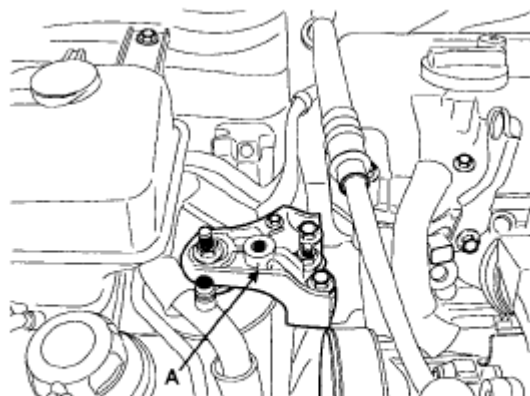
ECRF012A

Fig. 59: Identifying Drive Belt Routing
Courtesy of HYUNDAI MOTOR CO.

23. Install engine mounting bracket (A).

Tightening torque

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



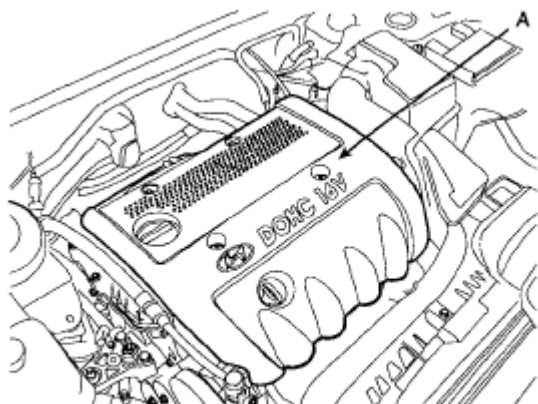
KCRF137A

Fig. 60: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

24. Install RH side cover.
25. Install RH front wheel.
26. Install engine cover (A).

Tightening torque

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



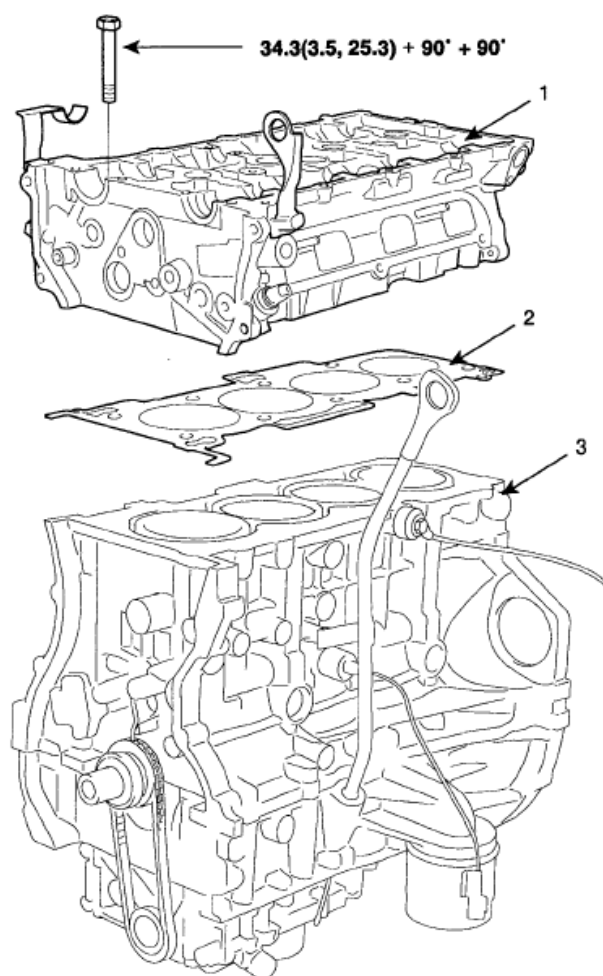
KCRF146A

Fig. 61: Identifying Engine Cover

Courtesy of HYUNDAI MOTOR CO.

CYLINDER HEAD ASSEMBLY

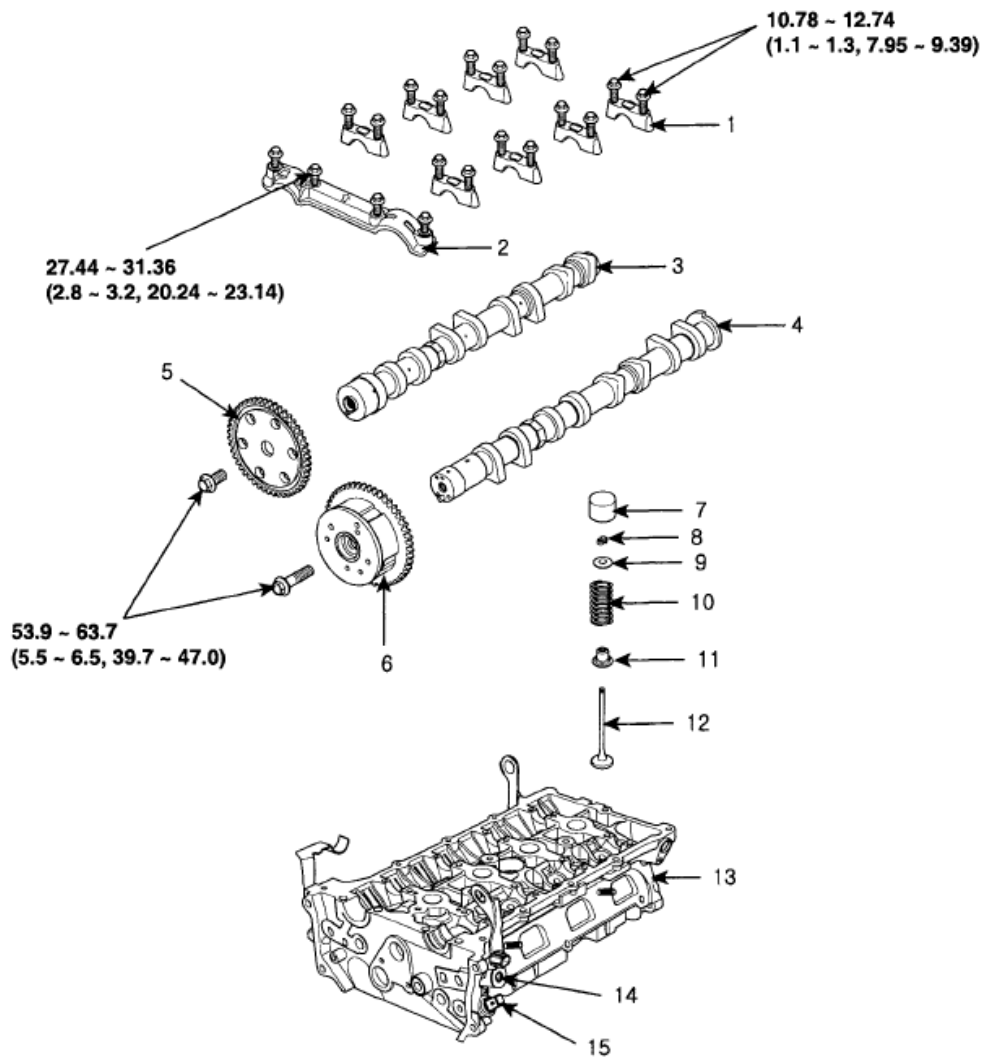
COMPONENTS

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

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

ECRF013A

Fig. 62: Exploded View Of Cylinder Head Assembly Components With Torque Specifications (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



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

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

ECRF014A

Fig. 63: Exploded View Of Cylinder Head Assembly Components With Torque Specifications (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

Engine removal is not required for this procedure.

CAUTION:

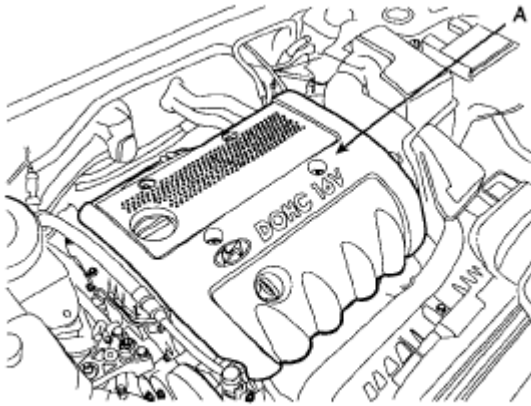
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.

- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center. (See VALVE CLEARANCE INSPECTION AND ADJUSTMENT)

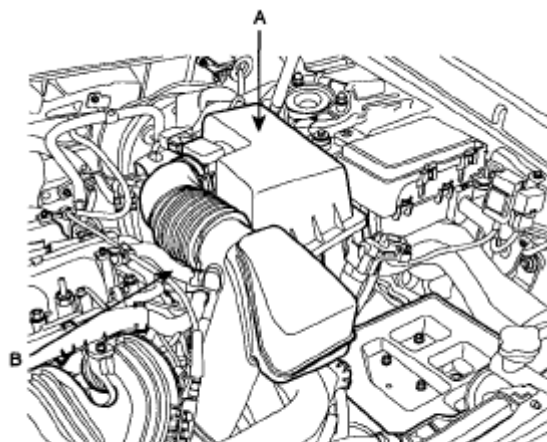
1. Disconnect the negative terminal from the battery.
2. Remove engine cover (A).



KCRF146A

Fig. 64: Identifying Engine Cover
Courtesy of HYUNDAI MOTOR CO.

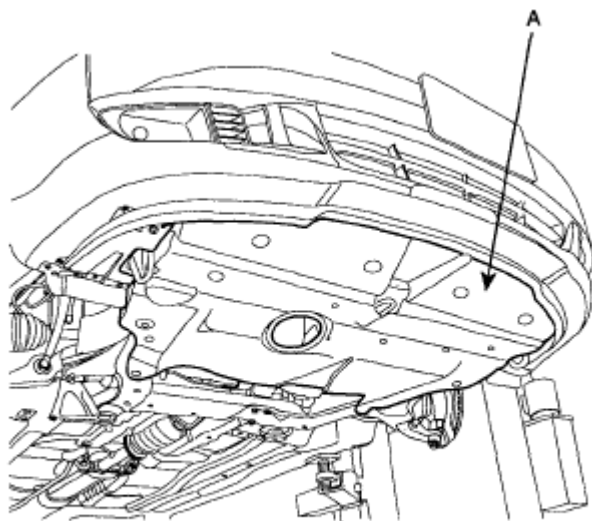
3. Remove air duct.
4. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the AFS connector.
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Disconnect the ECM connector. (See ENGINE CONTROL MODULE)
 4. Remove the intake air hose and air cleaner assembly (A).



ACRF011A

Fig. 65: Identifying Intake Air Hose And Air Cleaner Assembly
Courtesy of HYUNDAI MOTOR CO.

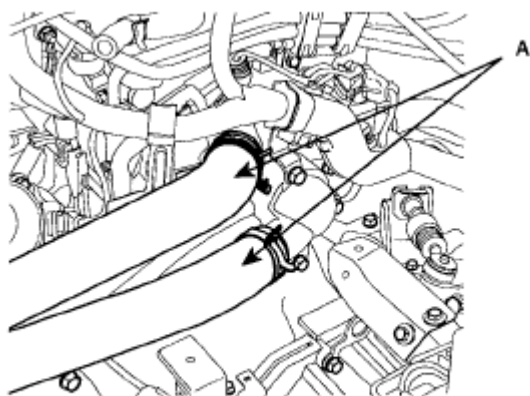
5. Remove front wheels.
6. Remove under cover (A).



KMRE009H

Fig. 66: Identifying Under Cover
Courtesy of HYUNDAI MOTOR CO.

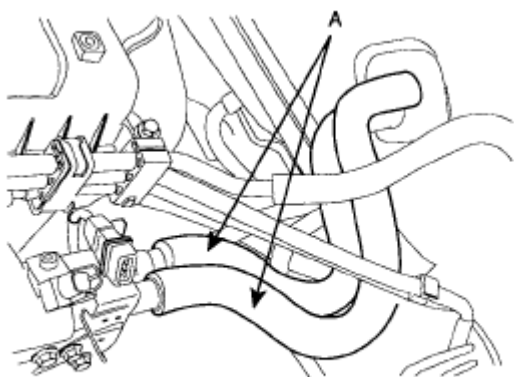
7. Drain the engine coolant.
Remove the radiator cap to speed draining.
8. Remove the upper and lower radiator hose (A).



KCRF124A

Fig. 67: Identifying Upper And Lower Radiator Hose
Courtesy of HYUNDAI MOTOR CO.

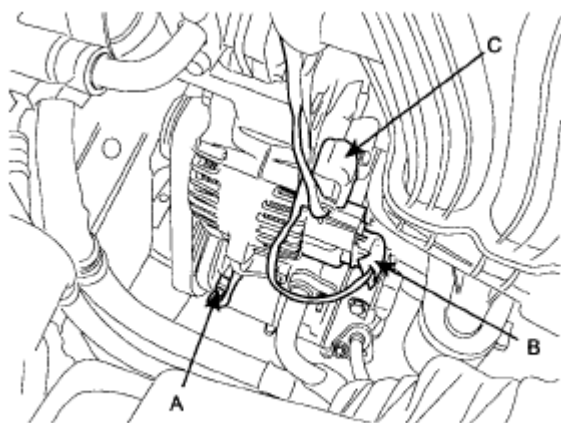
9. Remove the heater hoses (A).



KCRF133A

Fig. 68: Identifying Heater Hoses
Courtesy of HYUNDAI MOTOR CO.

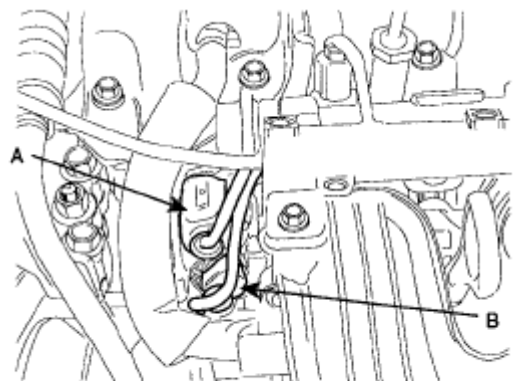
10. Disconnect A/C switch (A), alternator connector (B), and oil pressure switch (C).



KCRF126A

Fig. 69: Identifying A/C Switch, Alternator Connector, And Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

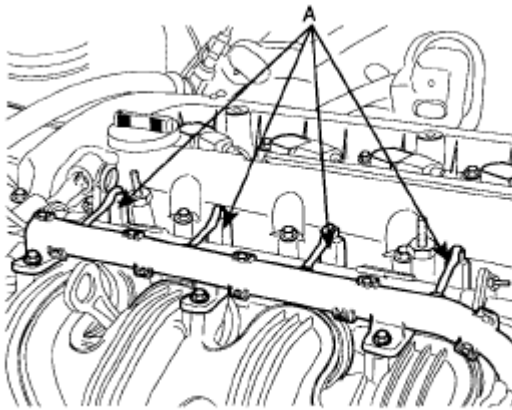
11. Disconnect OCV connector (A) and OTS connector (B).



KCRF127A

Fig. 70: Identifying OCV Connector And OTS Connector
Courtesy of HYUNDAI MOTOR CO.

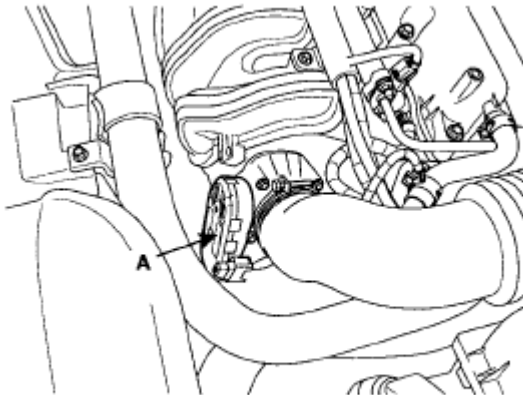
12. Disconnect injector connectors (A).



KCRF128A

Fig. 71: Identifying Injector Connectors
Courtesy of HYUNDAI MOTOR CO.

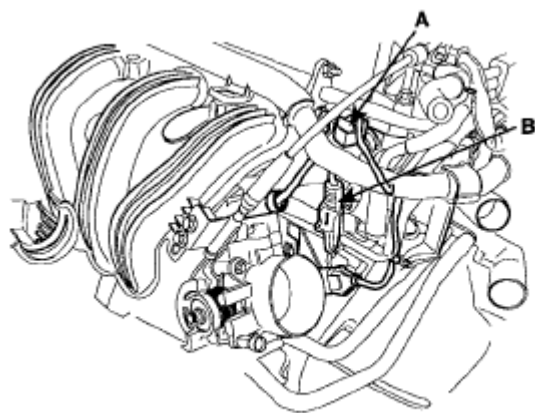
13. Disconnect ETS connector (A)



EGRF032A

Fig. 72: Identifying ETS Connector
Courtesy of HYUNDAI MOTOR CO.

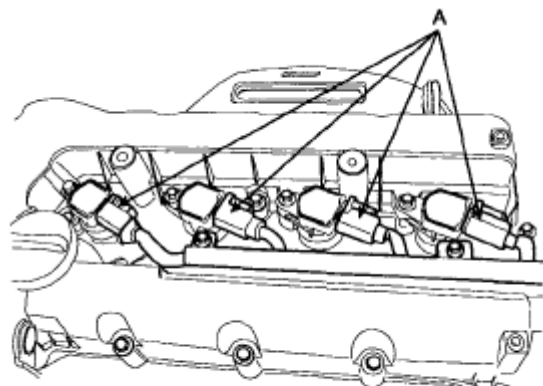
14. Disconnect CMP connector (A), and knock sensor connector (B).



ECRF029A

Fig. 73: Identifying CMP Connector And Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

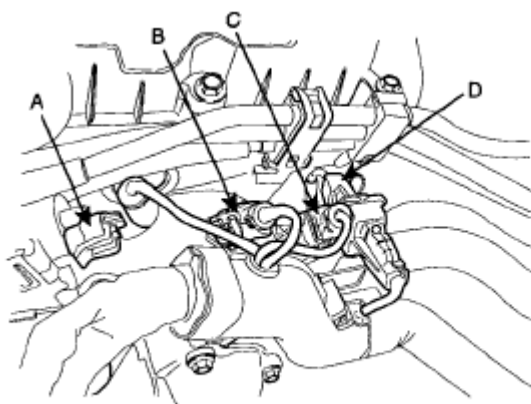
15. Disconnect ignition coil connectors (A).



KCRF131A

Fig. 74: Identifying Ignition Coil Connectors
Courtesy of HYUNDAI MOTOR CO.

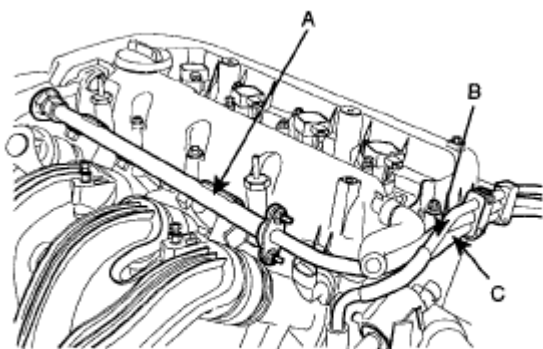
16. Disconnect PCSV connector (A), WTS connector (B), condenser connector (C), and CKP sensor connector (D).



KCRF132A

Fig. 75: Identifying PCSV Connector, WTS Connector, Condenser Connector, And CKP Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

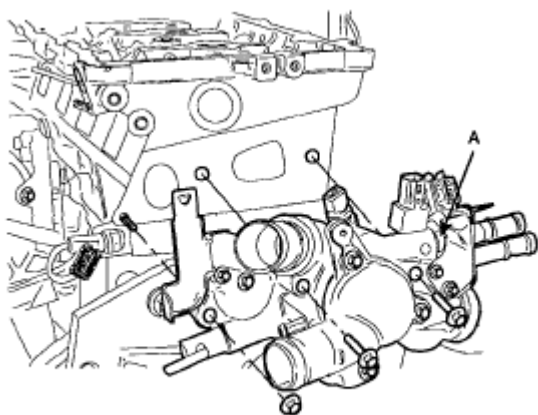
17. Remove delivery pipe (A), brake vacuum hose (B), and PCSV hose (C).



KCRF134A

Fig. 76: Identifying Delivery Pipe, Brake Vacuum Hose And PCSV Hose
Courtesy of HYUNDAI MOTOR CO.

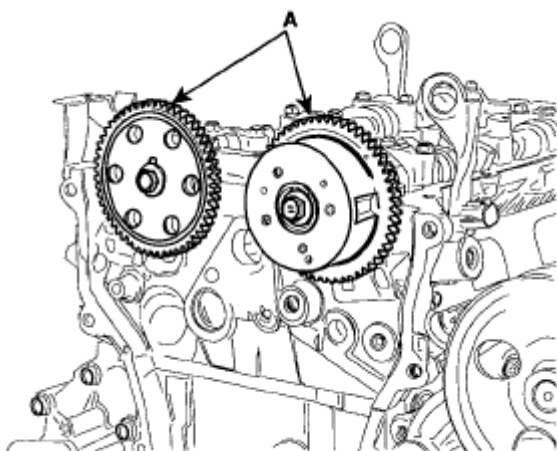
18. Remove water temp control assembly (A).



ACRF012A

Fig. 77: Identifying Water Temp Control Assembly
Courtesy of HYUNDAI MOTOR CO.

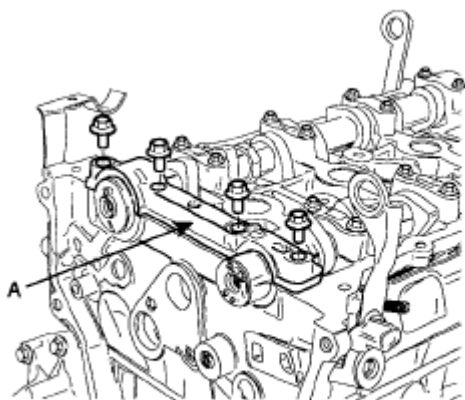
19. Remove intake manifold. (See **REMOVAL**)
20. Remove exhaust manifold. (See **EXHAUST MANIFOLD**)
21. Remove timing chain. (See **VALVE CLEARANCE INSPECTION AND ADJUSTMENT**)
22. Remove CVVT assembly and camshaft sprocket (A).



KCRF151A

Fig. 78: Identifying CVVT Assembly And Camshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

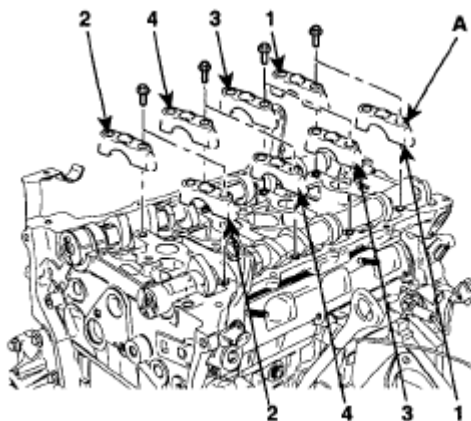
23. Remove camshaft.
 1. Remove front camshaft bearing cap (A).



KCRF153A

Fig. 79: Identifying Front Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

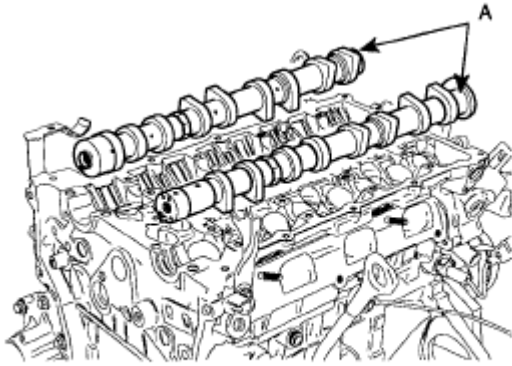
2. Remove camshaft bearing cap (A), in the sequence shown.



ACRF020A

Fig. 80: Identifying Removal Sequence Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

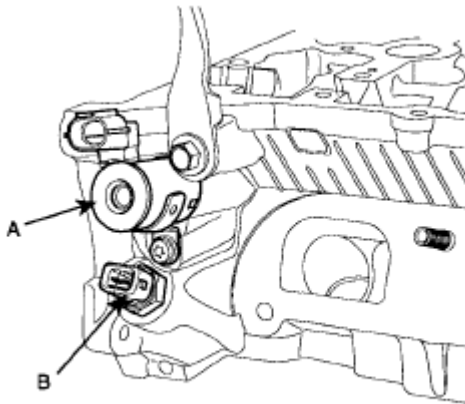
3. Remove camshafts (A)



KCRF155A

Fig. 81: Identifying Camshafts
Courtesy of HYUNDAI MOTOR CO.

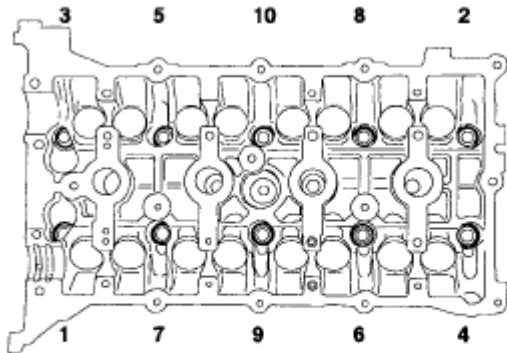
24. Remove OCV (A) and OTS (B).



KCRF119A

Fig. 82: Identifying OCV And OTS
Courtesy of HYUNDAI MOTOR CO.

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



KCRF162A

Fig. 83: Removal Sequence Of Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.

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

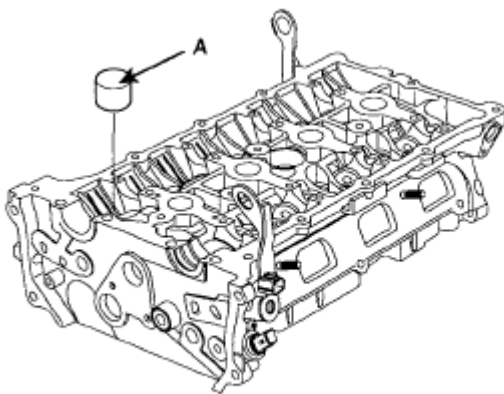
2. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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

DISASSEMBLY

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

1. Remove MLAs (A).



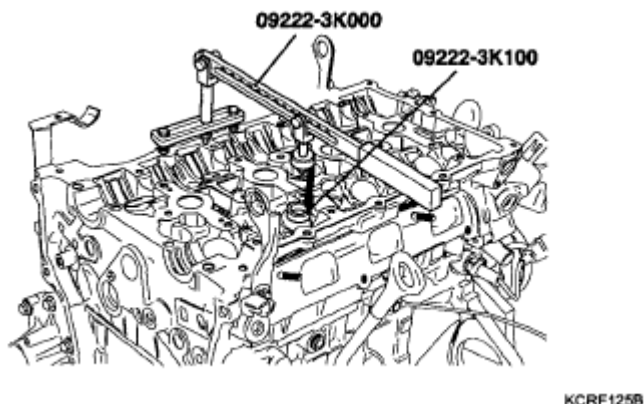
KCRF125A

Fig. 84: Identifying MLAs

Courtesy of HYUNDAI MOTOR CO.

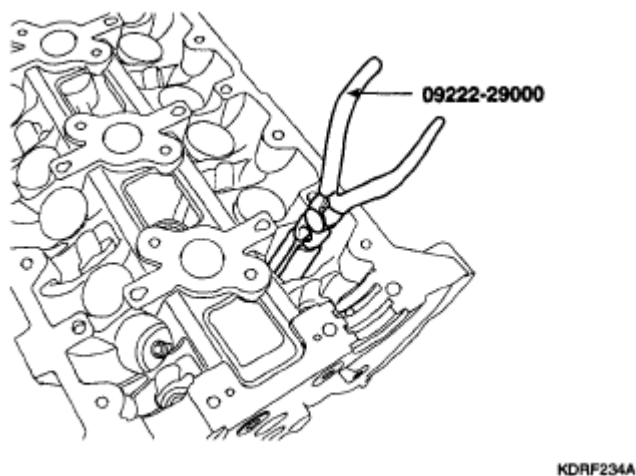
2. Remove valves.

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

**Fig. 85: Compressing Valve Spring Using SST**

Courtesy of HYUNDAI MOTOR CO.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Using SST (09222-29000) remove the valve stem seal.

**Fig. 86: Removing Valve Stem Seal Using SST**

Courtesy of HYUNDAI MOTOR CO.

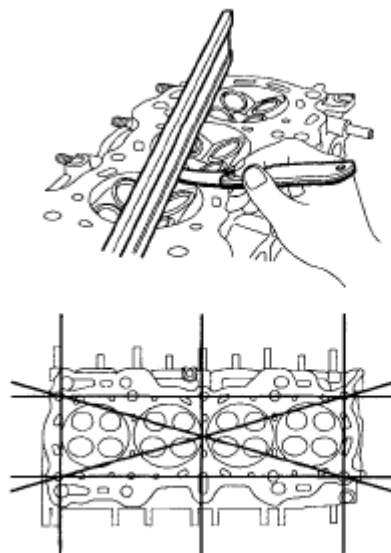
INSPECTION**CYLINDER HEAD**

1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard: Less than 0.05mm (0.002in.)



ECKD001H

Fig. 87: Measuring Flatness Of Cylinder Head Gasket Surface
Courtesy of HYUNDAI MOTOR CO.

2. Inspect for cracks.

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

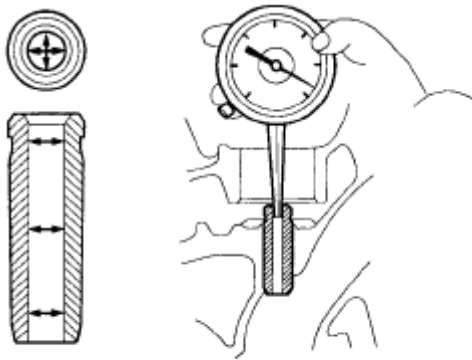
VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

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

Valve guide I.D.

Intake / Exhaust: 5.500 ~ 5.512mm (0.216 ~ 0.217in.)



ECKD219A

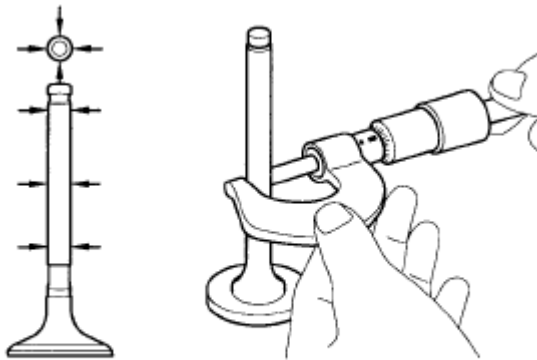
Fig. 88: Measuring Inside Diameter Of Valve Guide
Courtesy of HYUNDAI MOTOR CO.

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

Valve stem O.D.

Intake: 5.465 ~ 5.480mm (0.2151 ~ 0.2157in.)

Exhaust: 5.458 ~ 5.470mm (0.2149 ~ 0.2153in.)



ECKD220A

Fig. 89: Measuring Diameter Of Valve Stem
Courtesy of HYUNDAI MOTOR CO.

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

Valve stem-to-guide clearance

[Standard]

Intake: 0.020 ~ 0.047mm (0.0008 ~ 0.0018in.)

Exhaust: 0.030 ~ 0.054mm (0.0012 ~ 0.0021 in.)

[Limit]

Intake: 0.07mm (0.0027in.)

Exhaust: 0.09mm (0.0035in.)

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

2. Inspect valves.

1. Check the valve is ground to the correct valve face angle.
2. Check that the surface of the valve for wear. If the valve face is worn, replace the valve.
3. Check the valve head margin thickness.

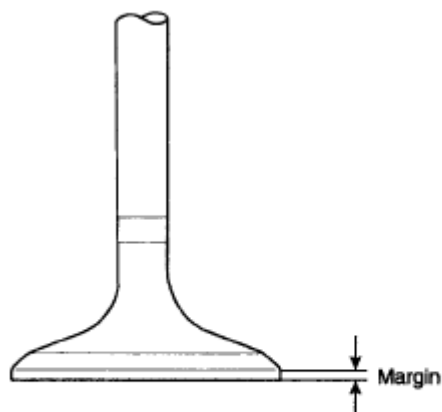
If the margin thickness is less than minimum, replace the valve.

Margin

[Standard]

Intake: 1.02mm (0.0401in.)

Exhaust: 1.09mm (0.0429in.)



ECKD221A

Fig. 90: Identifying Valve Head Margin Thickness
Courtesy of HYUNDAI MOTOR CO.

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

Check the valve seat for evidence of overheating and improper contact with the valve face.

Replace the seat if necessary.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

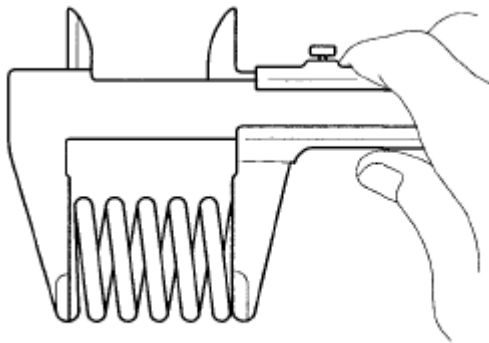
4. Inspect valve springs.
 1. Using a steel square, measure the out-of-square of the valve spring.
 2. Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 47.44mm (1.8677in.)

Out-of-square: 1.5°



ECKD222A

Fig. 91: Measuring Free Length Of Valve Spring
Courtesy of HYUNDAI MOTOR CO.

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

MLA

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

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

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

Tappet bore I.D.

Intake/Exhaust: 32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)

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

MLA to tappet bore clearance

[Standard]

Intake/Exhaust: 0.020 ~ 0.061 mm (0.0008 ~ 0.0024in.)

[Limit]

Intake/Exhaust: 0.07mm (0.0027in.)

- Inspect cam lobes.

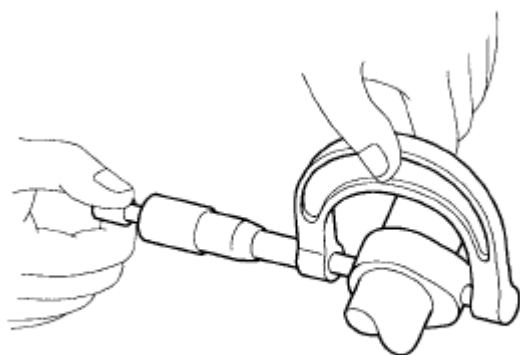
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 43.70 ~ 43.90mm (1.7204 ~ 1.7283in.)

Exhaust: 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)

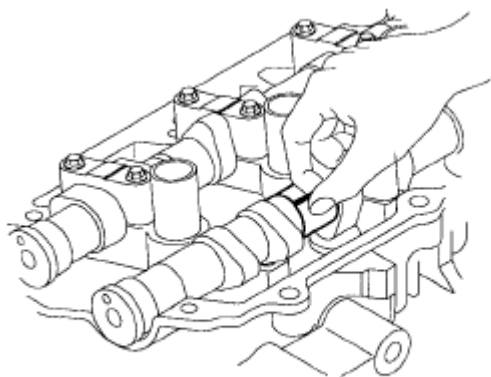


ECKD223A

Fig. 92: Measuring Cam Lobe Height
Courtesy of HYUNDAI MOTOR CO.

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

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



ECKD224A

Fig. 93: Laying Strip Of Plastigage Of Camshaft Journal
Courtesy of HYUNDAI MOTOR CO.

4. Install the bearing caps. (See **INSTALLATION**)

CAUTION: Do not turn the camshaft.

5. Remove the bearing caps.
6. Measure the plastigage at its widest point.

Bearing oil clearance

[Standard value]

Intake

No.1 journal: 0.02 ~ 0.057mm (0.0008 ~ 0.0022in.)

No.2,3,4,5, journal: 0.045 ~ 0.082mm

(0.0018 ~ 0.0032in.)

Exhaust: 0.045 ~ 0.082mm (0.0018 ~ 0.0032in.)

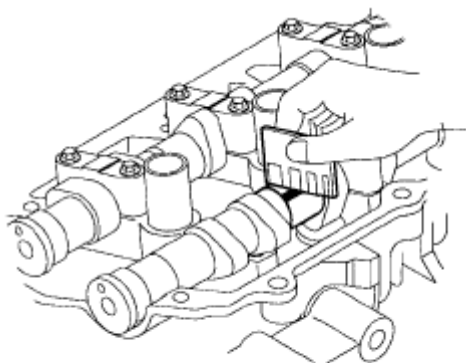
[Limit]:

Intake

No.1 journal: 0.09mm (0.0035in.)

No.2,3,4,5 journal: 0.12mm (0.0047in.)

Exhaust: 0.12mm (0.0047in.)



ECKD225A

Fig. 94: Measuring Plastigage Widest Point
Courtesy of HYUNDAI MOTOR CO.

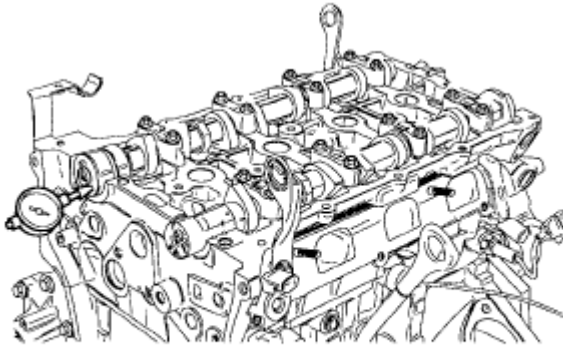
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

7. Completely remove the plastigage.
8. Remove the camshafts.
3. Inspect camshaft end play.
 1. Install the camshafts. (See **INSTALLATION**)
 2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value]: 0.10 ~ 0.22mm (0.004 ~ 0.0087in.)

[Limit]: 0.24mm (0.0094in.)



KCRF151B

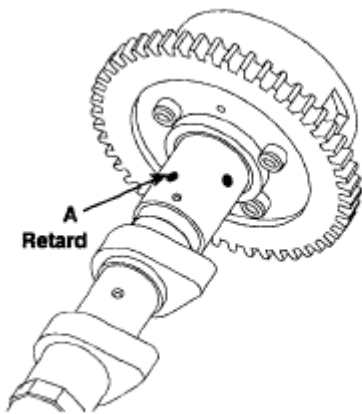
Fig. 95: Measuring Camshaft End Play
Courtesy of HYUNDAI MOTOR CO.

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

3. Remove the camshafts.

CVVT ASSEMBLY

1. Inspect CVVT assembly.
 1. Check that the CVVT assembly will not turn.
 2. Apply vinyl tape to the retard hole except the one indicated by the arrow in the illustration.



ECRF015A

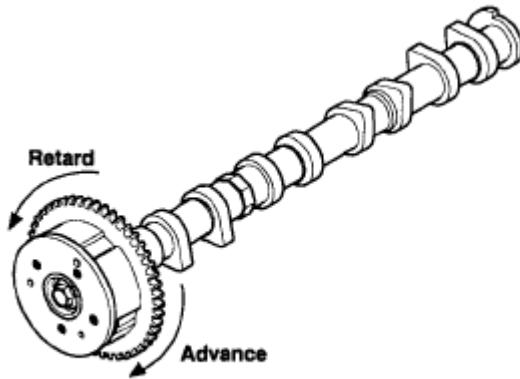
Fig. 96: Identifying Retard Hole
Courtesy of HYUNDAI MOTOR CO.

3. Wind tape around the tip of the air gun and apply air of approx. 150kpa (1.5kgf/cm² , 21psi) to the port of the camshaft.

(Perform this order to release the lock pin for the maximum delay angle locking.)

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

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



ECRF016A

Fig. 97: Identifying Camshaft Advance And Retard Directions
Courtesy of HYUNDAI MOTOR CO.

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

Standard: Movable smoothly in the range about 22.5°

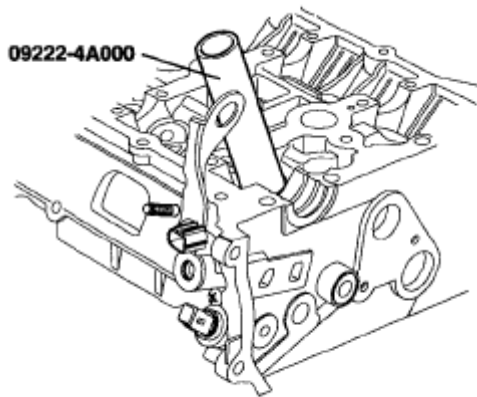
6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (counter clockwise).

REASSEMBLY

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

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

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



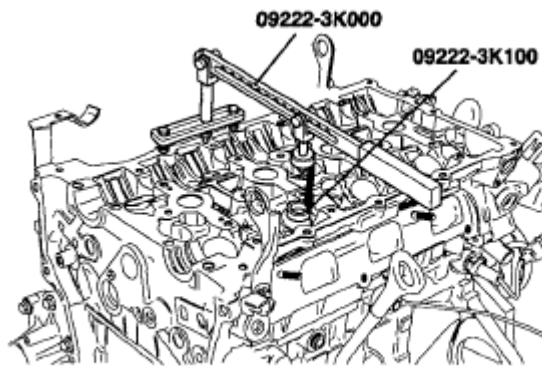
KCRF120C

Fig. 98: Identifying SST (09222-4A000)
Courtesy of HYUNDAI MOTOR CO.

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

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

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



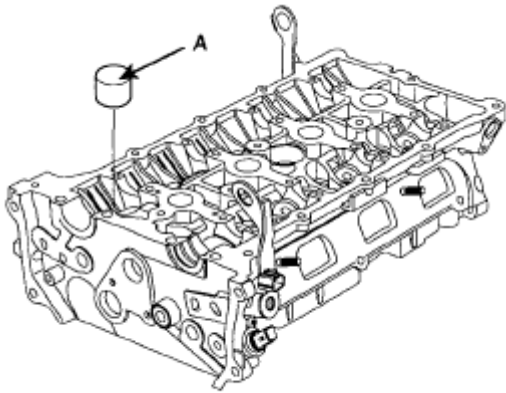
KCRF125B

Fig. 99: Compressing Valve Spring Using SST (09222-3K000, 09222-3K100)
Courtesy of HYUNDAI MOTOR CO.

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

2. Install MLAs.

Check that the MLA rotates smoothly by hand.



KCRF125A

Fig. 100: Identifying MLAs

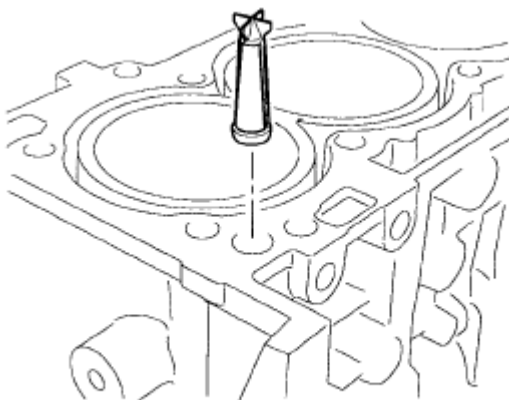
Courtesy of HYUNDAI MOTOR CO.

NOTE: MLA can be reinstalled in its original position.

INSTALLATION

- 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 VALVE CLEARANCE INSPECTION AND ADJUSTMENT)

1. Install OCV filter.



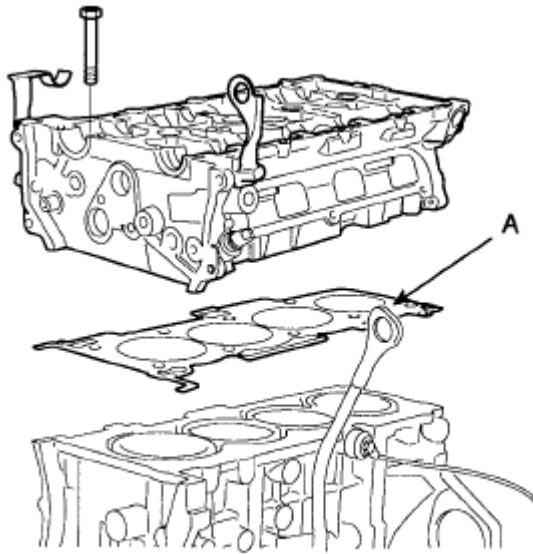
KCRF176A

Fig. 101: Identifying OCV Filter

Courtesy of HYUNDAI MOTOR CO.

NOTE: Keep clean the OCV filter.

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



KCRF163A

Fig. 102: Identifying Cylinder Head Gasket On Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

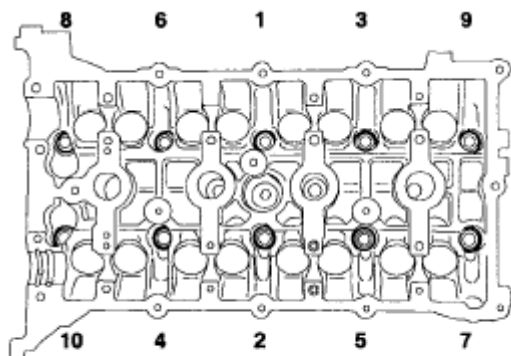
NOTE: Be careful of the installation direction.

3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
4. Install cylinder head bolts.
 1. Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
 2. Using wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque

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

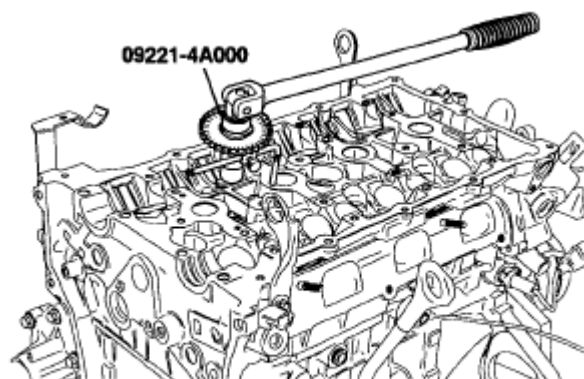
NOTE: Always use new cylinder head bolt.



KCRF162B

Fig. 103: Identifying Tightening Sequence Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.

Using SST (09221-4A000), install cylinder head bolts.



ECRF040A

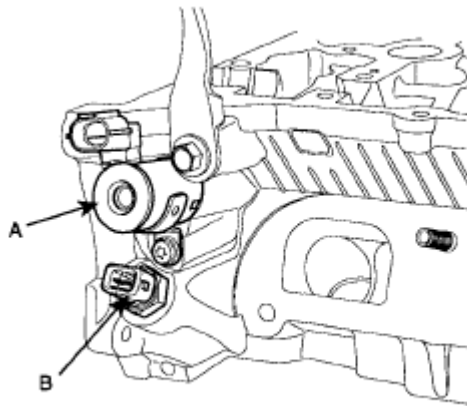
Fig. 104: Tightening Cylinder Head Bolts Using SST
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

OCV: 9.8 ~ 11.76 Nm (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.67 lbf.ft)

OTS: 19.6 ~ 23.52 Nm (2.0 ~ 2.4 kgf.m, 14.46 ~ 17.35 lbf.ft)



KCRF119A

Fig. 105: Identifying OCV And OTS
Courtesy of HYUNDAI MOTOR CO.

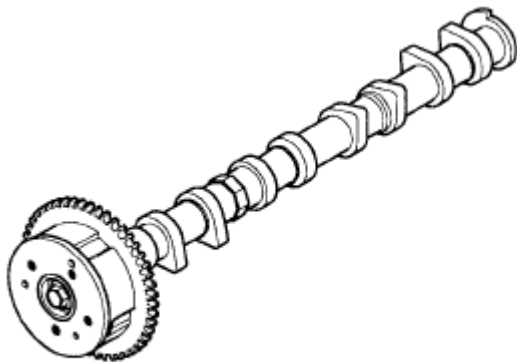
CAUTION:

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

6. Install the CVVT and camshaft sprocket.

Tightening torque

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



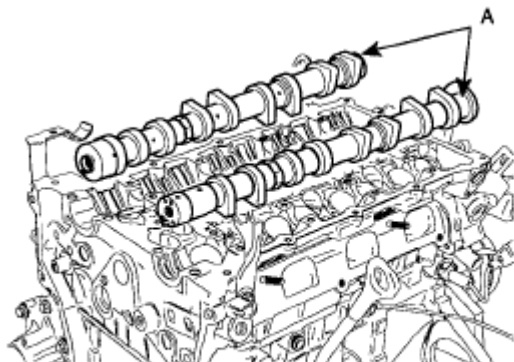
KCRF122A

Fig. 106: Identifying Camshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

NOTE: Hold the hexagonal head wrench portion of the camshaft with a vise, and

install the bolt and CVVT assembly.

7. Install camshafts (A).



KCRF155A

Fig. 107: Identifying Camshafts
Courtesy of HYUNDAI MOTOR CO.

NOTE: Apply a light coat of engine oil on camshaft journals.

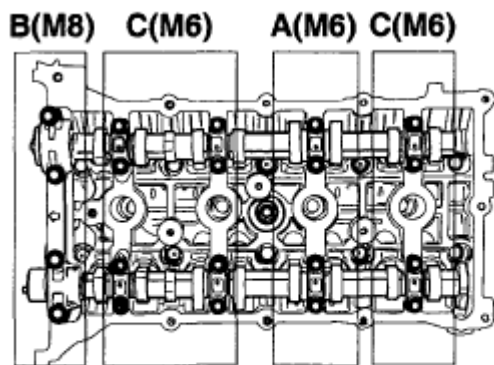
8. Install camshaft bearing caps in their proper locations. Tightening order.

Group A --> Group B --> Group C.

Tightening torque

M6: 10.78 ~ 12.74 Nm (1.1 ~ 1.3 kgf.m, 7.95 ~ 9.39 lbf.ft)

M8: 27.44 ~ 31.36 Nm (2.8 ~ 3.2 kgf.m, 20.24 ~ 23.14 lbf.ft)



ECRF017A

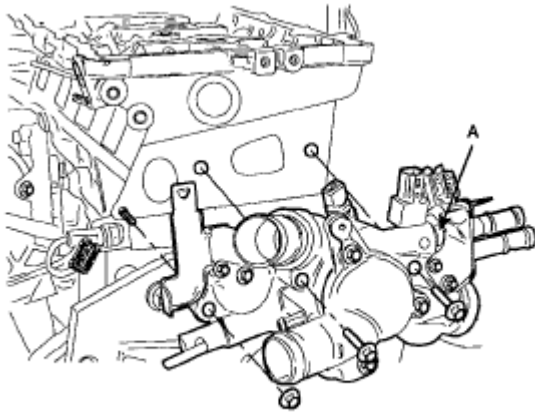
Fig. 108: Identifying Tightening Sequence Camshaft Bearing Caps Bolts
Courtesy of HYUNDAI MOTOR CO.

9. Install timing chain. (See **INSTALLATION**)
10. Check and adjust valve clearance. (See **VALVE CLEARANCE INSPECTION AND ADJUSTMENT**)
11. Install the exhaust manifold. (See **EXHAUST MANIFOLD**)
12. Install the intake manifold. (See **INSTALLATION**)
13. Install water temp control assembly (A).

Tightening torque

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

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



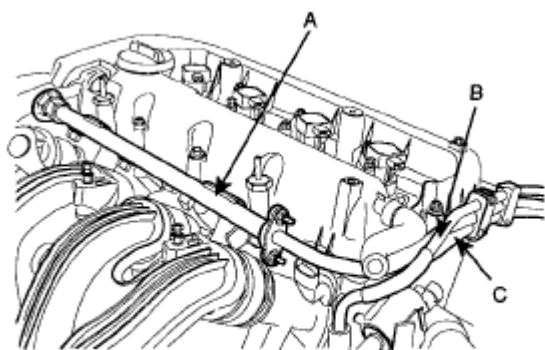
ACRF012A

Fig. 109: Identifying Water Temp Control Assembly
Courtesy of HYUNDAI MOTOR CO.

NOTE:

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

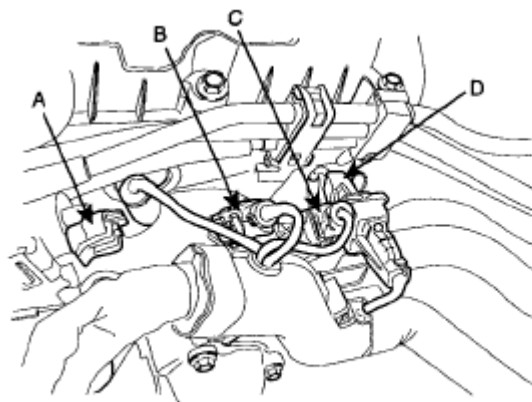
14. Install delivery pipe (A), brake hose (B), and PCSV hose (C).



KCRF134A

Fig. 110: Identifying Delivery Pipe, Brake Hose, And PCSV Hose
Courtesy of HYUNDAI MOTOR CO.

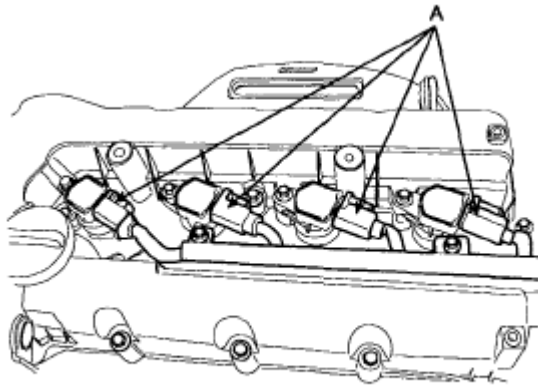
15. Connect PCSV connector (A), WTS connector (B), condenser connector (C), and CKP sensor connector (D).



KCRF132A

Fig. 111: Identifying PCSV Connector, WTS Connector, Condenser Connector, And CKP Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

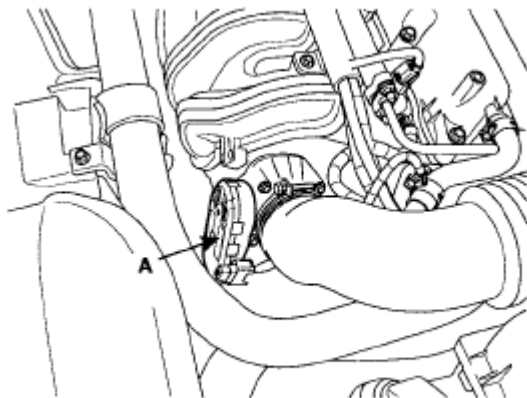
16. Install ignition coil connector (A).



KCRF131A

Fig. 112: Identifying Ignition Coil Connector
Courtesy of HYUNDAI MOTOR CO.

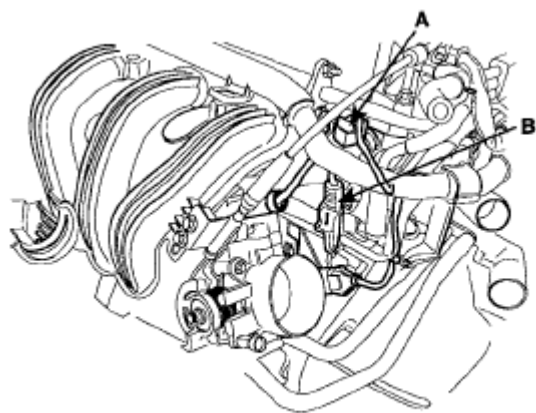
17. Connect ETS connector (A)



EGRF032A

Fig. 113: Identifying ETS Connector
Courtesy of HYUNDAI MOTOR CO.

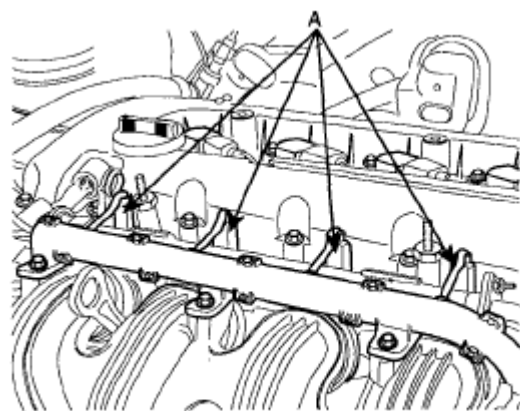
18. Connect CMP connector (A), and knock sensor connector (B).



ECRF029A

Fig. 114: Identifying CMP Connector And Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

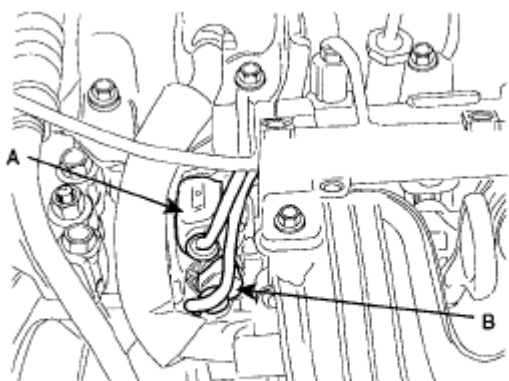
19. Connect injector connectors (A).



KCRF128A

Fig. 115: Identifying Injector Connectors
Courtesy of HYUNDAI MOTOR CO.

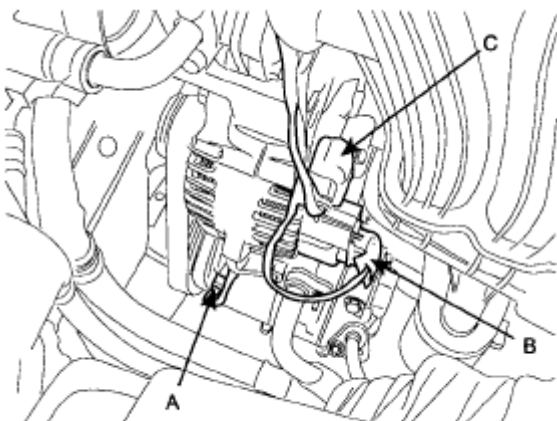
20. Connect OCV connector (A) and OTS connector (B).



KCRF127A

Fig. 116: Identifying OCV Connector And OTS Connector
Courtesy of HYUNDAI MOTOR CO.

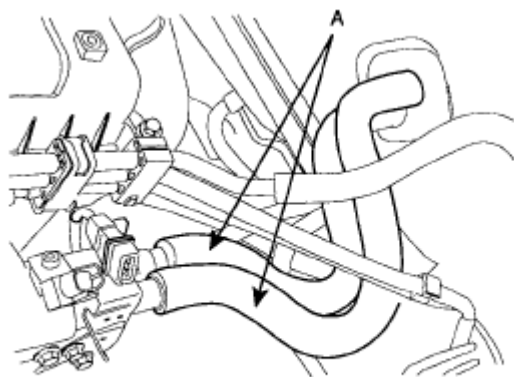
21. Connect A/C switch (A), alternator connect (B), and oil pressure switch (C).



KCRF128A

Fig. 117: Identifying A/C Switch, Alternator Connect And Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

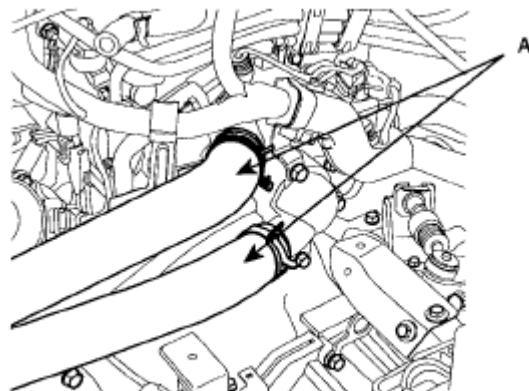
22. Install heater hoses (A).



KCRF133A

Fig. 118: Identifying Heater Hoses
Courtesy of HYUNDAI MOTOR CO.

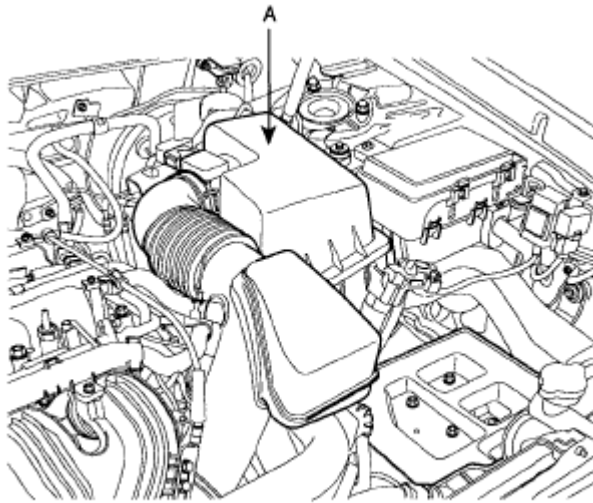
23. Install the upper radiator hose and lower radiator hose (A).



KCRF124A

Fig. 119: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of HYUNDAI MOTOR CO.

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



KMRE009A

Fig. 120: Identifying Intake Air Hose And Air Cleaner Assembly
Courtesy of HYUNDAI MOTOR CO.

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

ENGINE AND TRANSAXLE ASSEMBLY

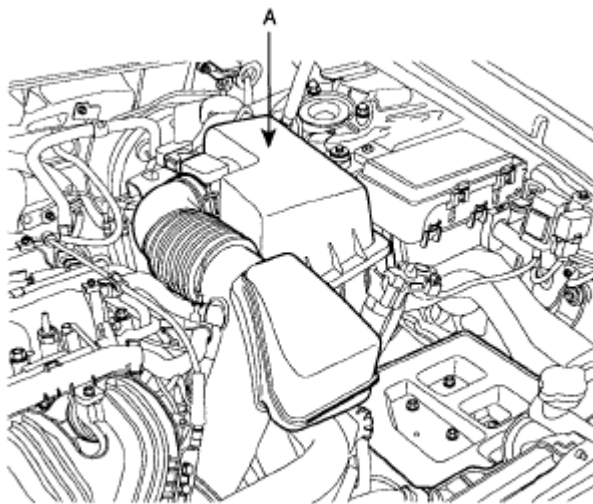
REMOVAL

- 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.
 - 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 VALVE CLEARANCE INSPECTION AND ADJUSTMENT)

1. Disconnect the negative terminal from the battery.
2. Remove the engine cover.
3. Remove the air duct.
4. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the AFS connector.

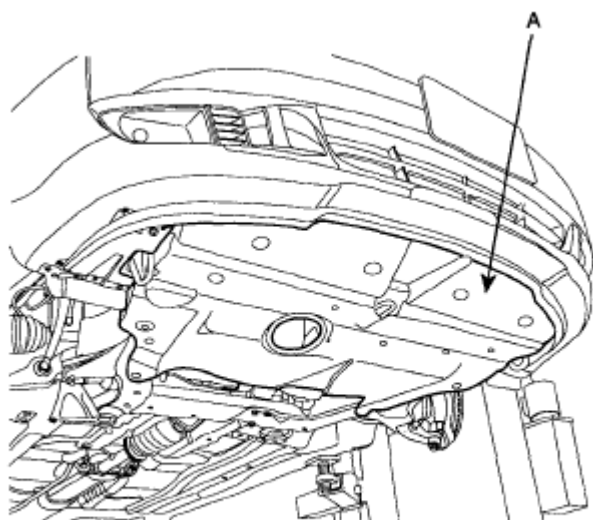
2. Disconnect the breather hose from air cleaner hose.
3. Disconnect the ECM connector. (See **ENGINE CONTROL MODULE**)
4. Remove the intake air hose and air cleaner (A).



KMRE009A

Fig. 121: Identifying Intake Air Hose And Air Cleaner Assembly
Courtesy of HYUNDAI MOTOR CO.

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



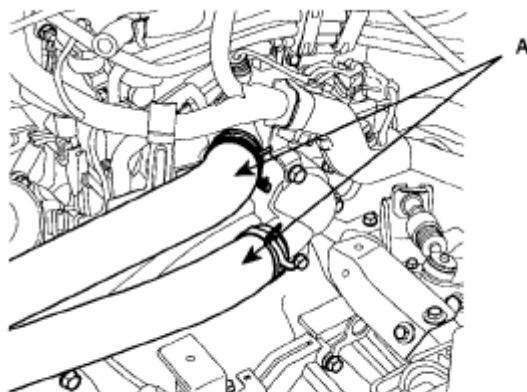
KMRE009H

Fig. 122: Identifying Under Cover
Courtesy of HYUNDAI MOTOR CO.

7. Drain the engine coolant.

Remove the radiator cap to speed draining.

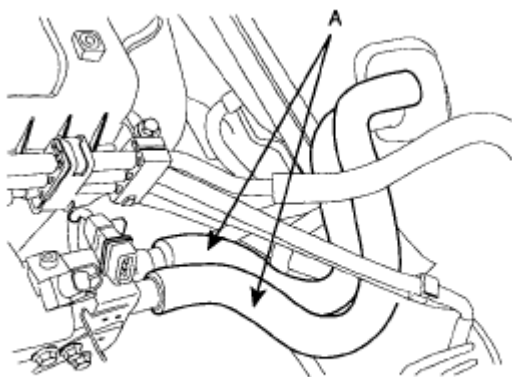
8. Remove the upper radiator hose and lower radiator hose (A).



KCRF124A

Fig. 123: Identifying Upper Radiator Hose And Lower Radiator Hose
Courtesy of HYUNDAI MOTOR CO.

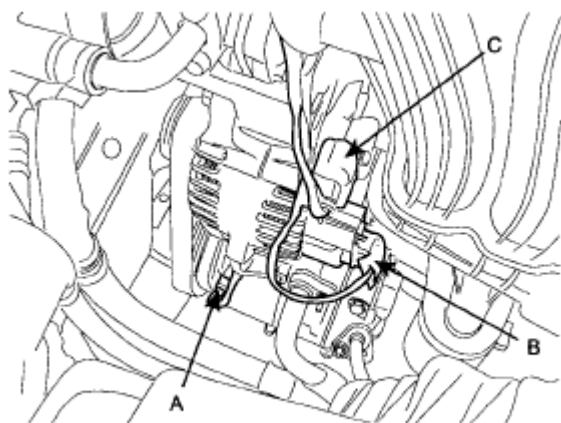
9. Remove the heater hoses (A).



KCRF133A

Fig. 124: Identifying Heater Hoses
Courtesy of HYUNDAI MOTOR CO.

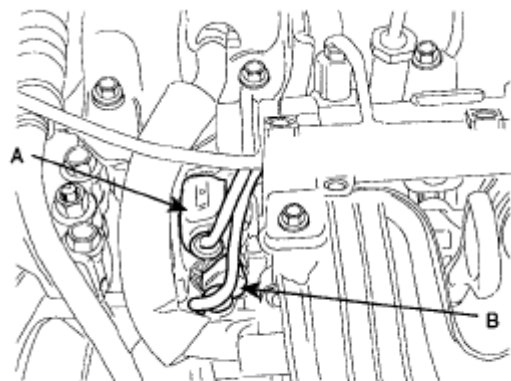
10. Disconnect A/C switch (A), alternator connector (B) and pressure switch (C).



KCRF126A

Fig. 125: Identifying A/C Switch, Alternator Connector And Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

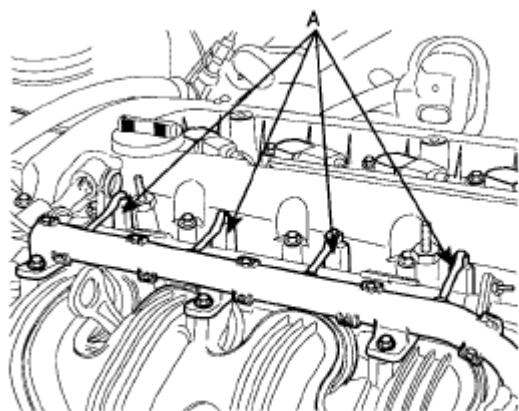
11. Disconnect OCV connector (A) and OTS connector (B).



KCRF127A

Fig. 126: Identifying OCV Connector And OTS Connector
Courtesy of HYUNDAI MOTOR CO.

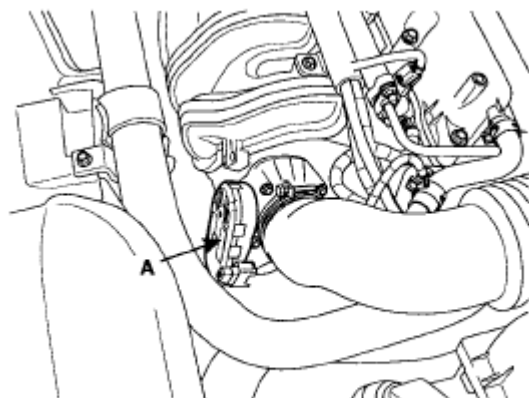
12. Disconnect injector connectors (A).



KCRF128A

Fig. 127: Identifying Injector Connectors
Courtesy of HYUNDAI MOTOR CO.

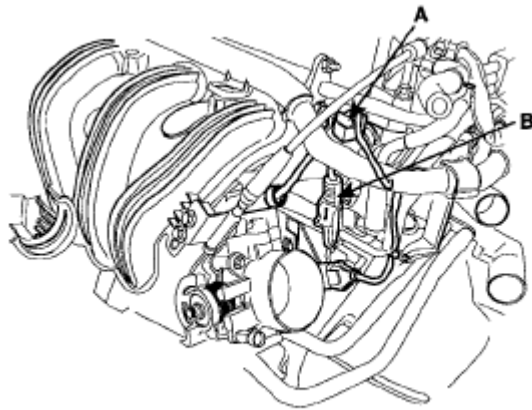
13. Disconnect ETS connector (A)



EGRF032A

Fig. 128: Identifying ETS Connector
Courtesy of HYUNDAI MOTOR CO.

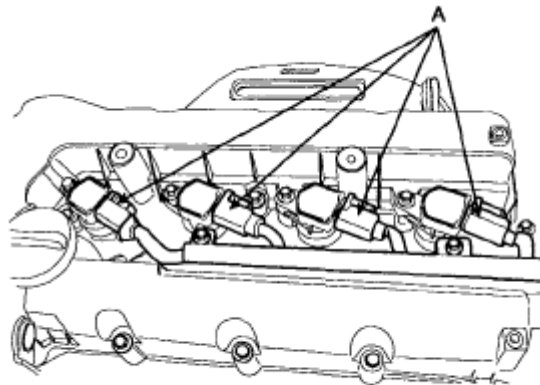
14. Disconnect CMP connector (A), and knock sensor connector (B).



ECRF029A

Fig. 129: Identifying CMP Connector And Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

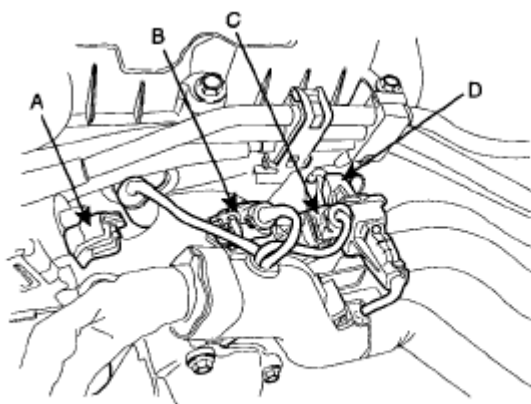
15. Disconnect ignition coil connectors (A).



KCRF131A

Fig. 130: Identifying Ignition Coil Connectors
Courtesy of HYUNDAI MOTOR CO.

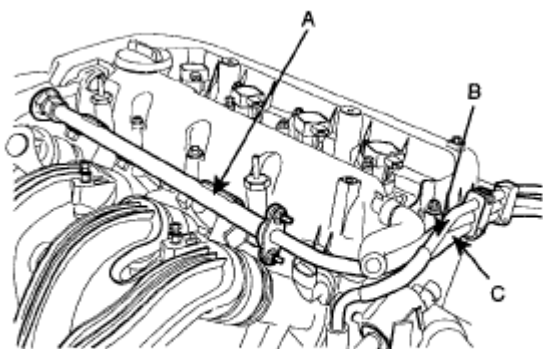
16. Disconnect PCSV connector (A), WTS connector (B), condenser connector (C), and CKP sensor connector (D).



KCRF132A

Fig. 131: Identifying PCSV Connector, WTS Connector, Condenser Connector And CKP Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

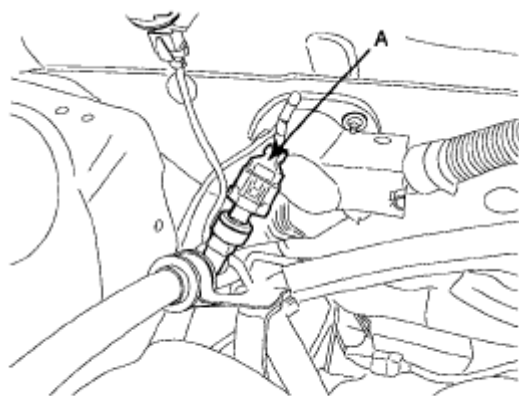
17. Remove delivery pipe (A), brake vacuum hose (B), and PCSV hose (C).



KCRF134A

Fig. 132: Identifying Delivery Pipe, Brake Vacuum Hose And PCSV Hose
Courtesy of HYUNDAI MOTOR CO.

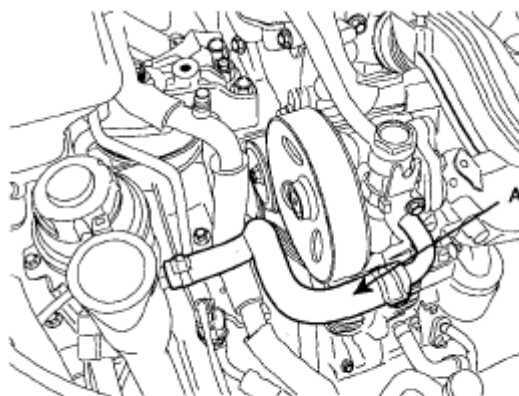
18. Disconnect P/S pump oil pressure switch connector (B).



KCRF135A

Fig. 133: Identifying P/S Pump Oil Pressure Switch Connector
Courtesy of HYUNDAI MOTOR CO.

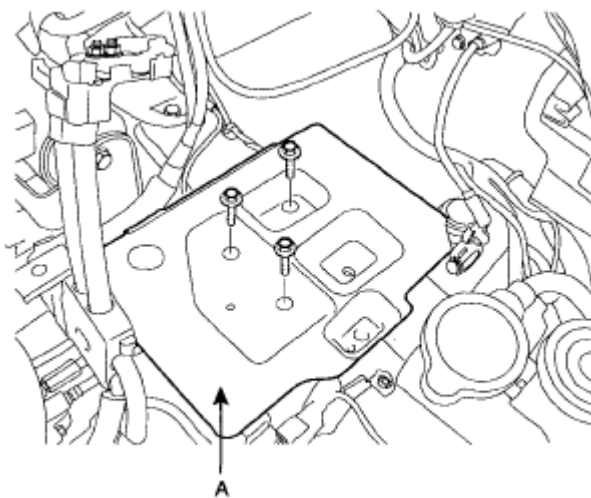
19. Remove P/S pump hose (A).



KCRF136A

Fig. 134: Identifying P/S Pump Hose
Courtesy of HYUNDAI MOTOR CO.

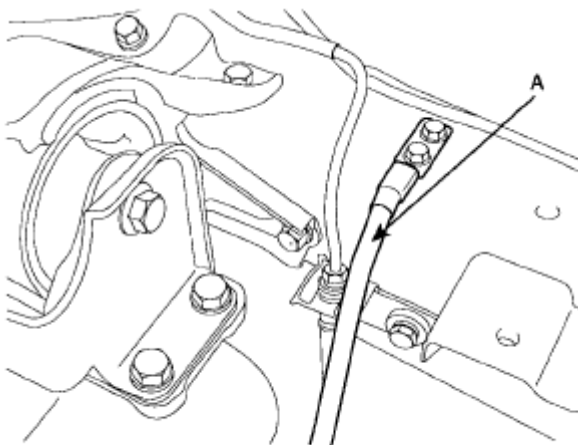
20. Remove the battery body bracket. (A).



KMRE008B

Fig. 135: Identifying Battery Body Bracket
Courtesy of HYUNDAI MOTOR CO.

21. Disconnect the ground cable from the transaxle.

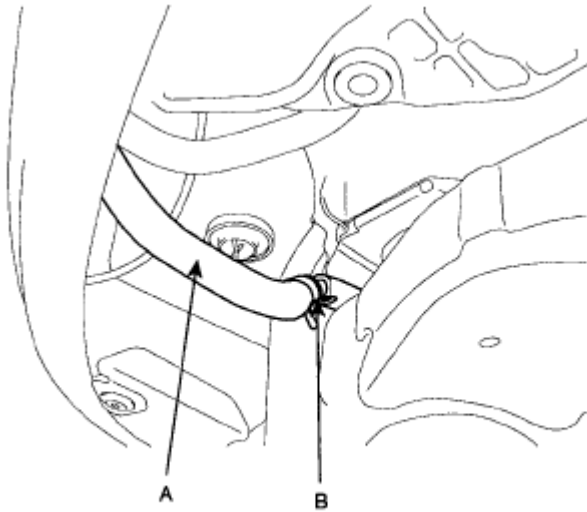


KMRE009C

Fig. 136: Identifying Transaxle Ground Cable
Courtesy of HYUNDAI MOTOR CO.

22. Disconnect the transaxle wire harness connector. (ATT).
- Disconnect the inhibitor switch connector.
 - Disconnect the transaxle range connector.
 - Disconnect the input shaft speed connector.
 - Disconnect the output shaft speed connector.
 - Disconnect the vehicle speed sensor connector.
 - Remove control cable transaxle range switch.

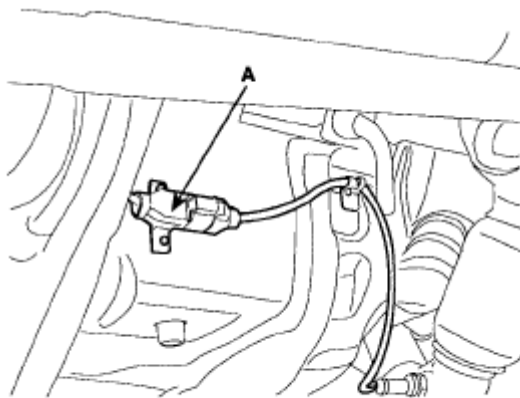
23. Drain transaxle oil.
24. Disconnect EPS connector, if equipped.
25. Remove lower arm ball joint. (See **FRONT LOWER ARM**)
26. Remove tie rod end ball joint. (See **FRONT SUSPENSION SYSTEM**)
27. Remove stabilizer link. (See **FRONT STABILIZER BAR**)
28. Remove power steering return hose (A) and drain power steering oil.



KMRE009J

Fig. 137: Identifying Power Steering Return Hose And Drain Power Steering Oil
Courtesy of HYUNDAI MOTOR CO.

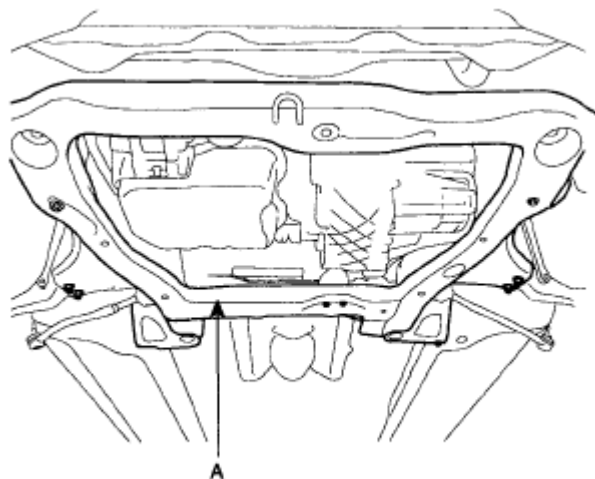
29. Remove front roll stopper mounting bolt.
30. Remove rear roll stopper mounting bolt.
31. Remove steering u-joint mounting (See **STEERING COLUMN / SHAFT**)
32. Disconnect oxygen sensor connector (A).



ECRF018A

Fig. 138: Identifying Oxygen Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

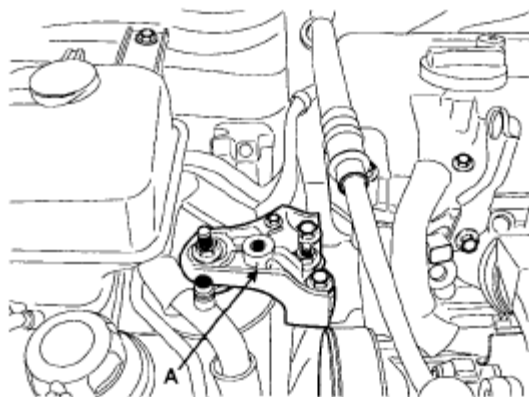
33. Remove front exhaust pipe.
34. Install jack and remove sub-frame (A).



KMRE009R

Fig. 139: Identifying Sub-Frame
Courtesy of HYUNDAI MOTOR CO.

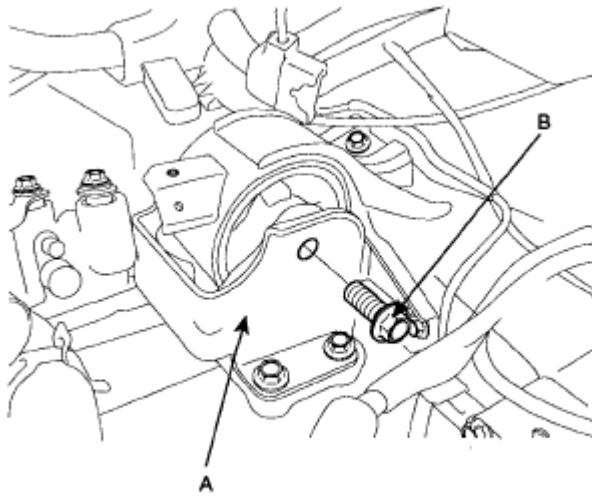
35. Remove drive shaft from transaxle.
36. Install jack for supporting engine and transaxle assembly.
37. Remove the engine mounting bracket (A).



KCRF137A

Fig. 140: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

38. Remove the transaxle mounting bracket (A).



KMRE009T

Fig. 141: Identifying Transaxle Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

39. Jack up the vehicle.

INSTALLATION

Installation is in the reverse order of removal.

Perform the following:

- Adjust the shift 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 pressurizes.

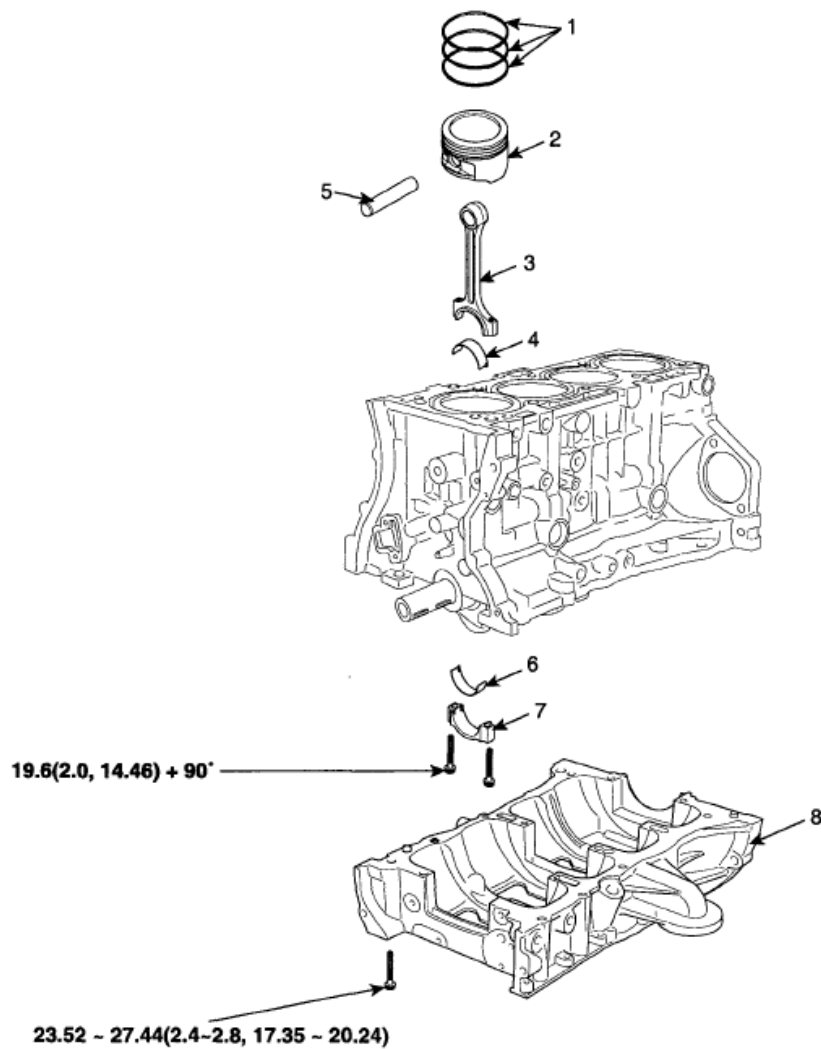
Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

ENGINE BLOCK

COMPONENTS

2006 Hyundai Sonata GL

2006 ENGINE Engine (G4KC-GSL 2.4) - Sonata

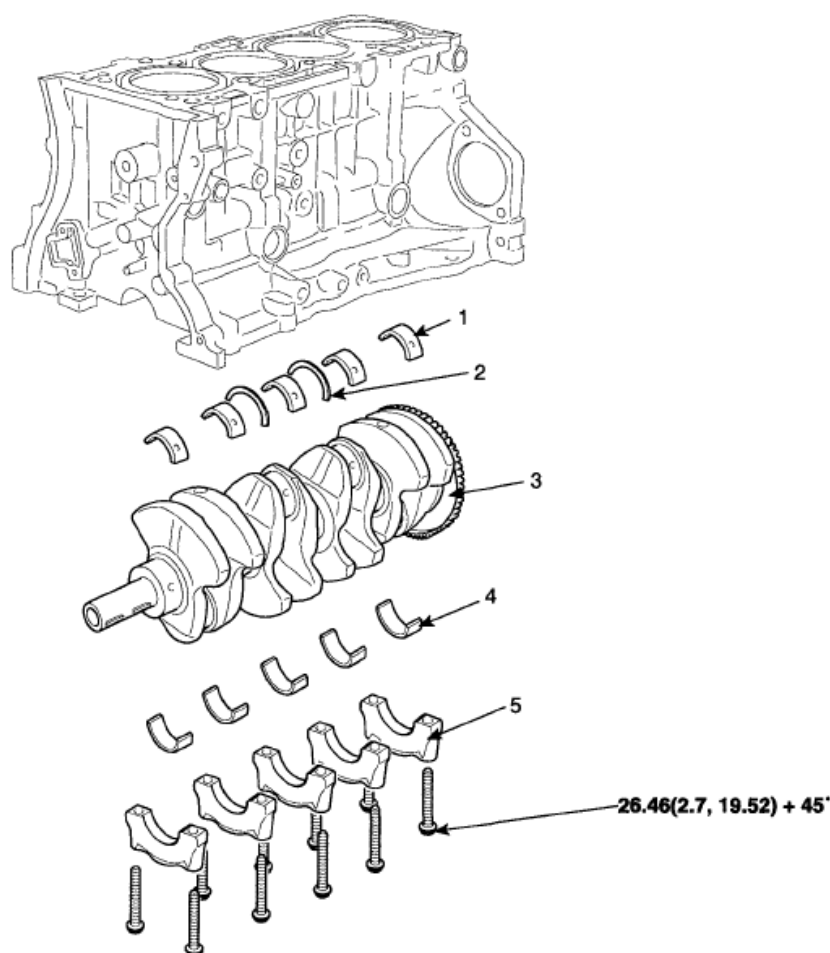


TORQUE : N.m (kgf.m, lbf.ft)

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

ECRF019A

Fig. 142: Exploded View Of Engine Block Components With Torque Specifications (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



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

1. Crankshaft upper bearing
2. Thrust bearing
3. Crankshaft

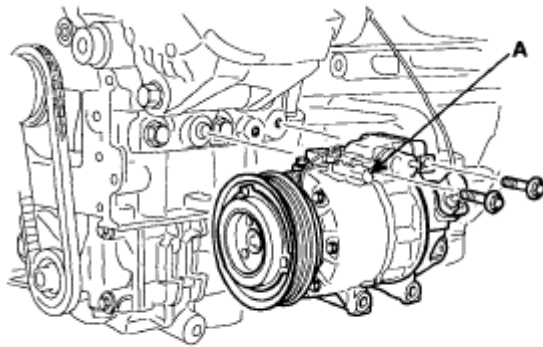
4. Crankshaft lower bearing
5. Main bearing cap

ECRF020A

Fig. 143: Exploded View Of Engine Block Components With Torque Specifications (2 Of 2)
 Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

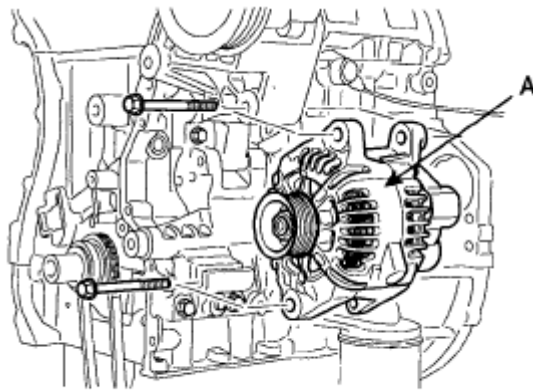
1. M/T: remove flywheel.
2. A/T: remove drive plate.
3. Install engine to engine stand for disassembly.
4. Remove timing chain. (See **REMOVAL**)
5. Remove cylinder head. (See **REMOVAL**)
6. Remove A/C compressor (A) from engine. (See **A/C COMPRESSOR CONTROLS (MANUAL)**)



KCRF158A

Fig. 144: Identifying A/C Compressor With Bolts
Courtesy of HYUNDAI MOTOR CO.

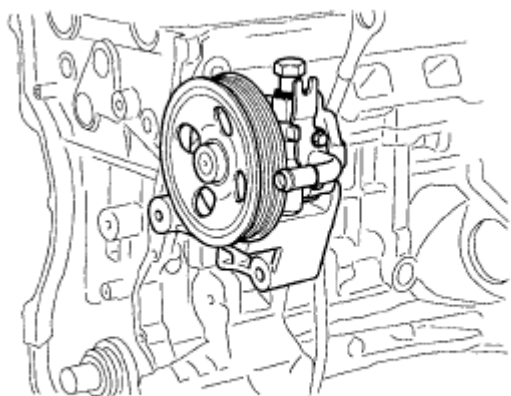
7. Remove alternator (A) from engine. (See ALTERNATOR)



KCRF158A

Fig. 145: Identifying Alternator
Courtesy of HYUNDAI MOTOR CO.

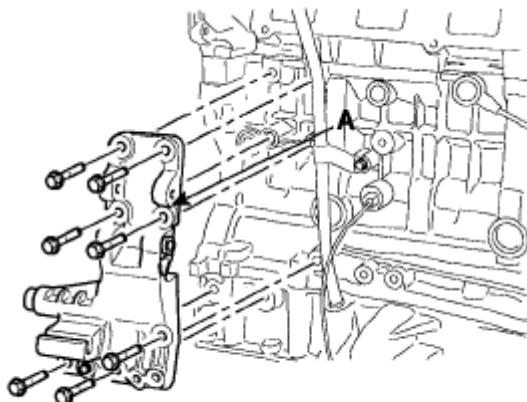
8. Remove power steering pump and bracket. (See MECHANICAL POWER STEERING SYSTEM)



KCRF160A

Fig. 146: Identifying Power Steering Pump And Bracket
Courtesy of HYUNDAI MOTOR CO.

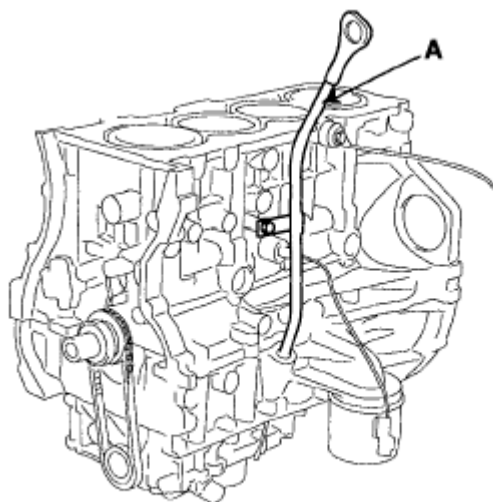
9. Remove tensioner assembly integrated bracket (A).



KCRF161A

Fig. 147: Identifying Tensioner Assembly Integrated Bracket
Courtesy of HYUNDAI MOTOR CO.

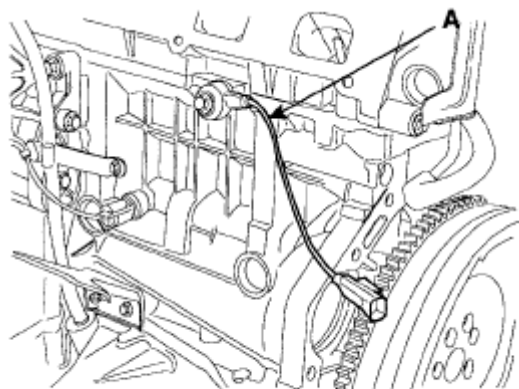
10. Remove oil level gauge assembly (A).



KCRF163B

Fig. 148: Identifying Oil Level Gauge Assembly
Courtesy of HYUNDAI MOTOR CO.

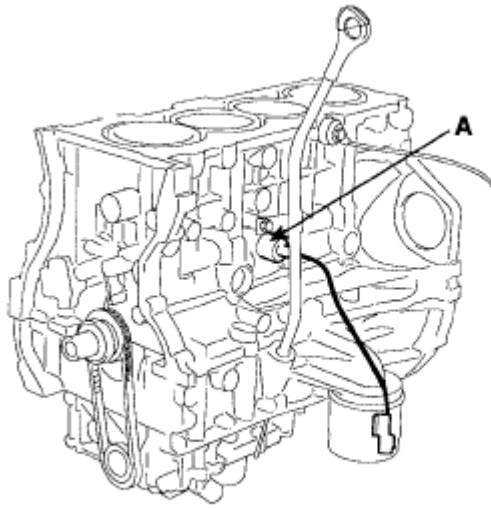
11. Remove knock sensor (A).



KCRF143A

Fig. 149: Identifying Knock Sensor
Courtesy of HYUNDAI MOTOR CO.

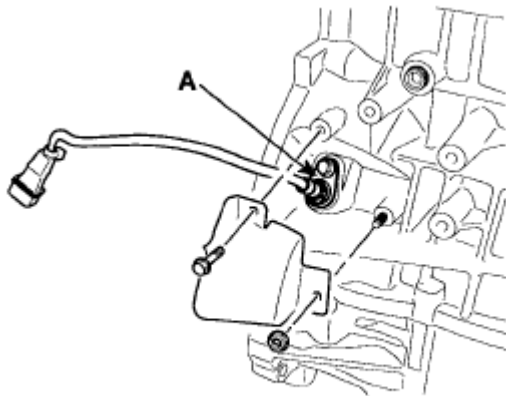
12. Remove oil pressure sensor (A).



KCRF163C

Fig. 150: Identifying Oil Pressure Sensor
Courtesy of HYUNDAI MOTOR CO.

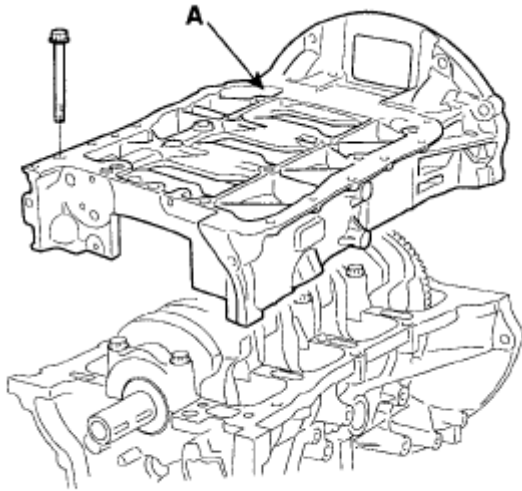
13. Remove CKP sensor (A).



KCRF164A

Fig. 151: Identifying CKP Sensor
Courtesy of HYUNDAI MOTOR CO.

14. Remove water pump. (See **REMOVAL**)
15. Remove balance shaft module. (See **REMOVAL**)
16. Remove ladder frame (A).



KCRF167A

Fig. 152: Identifying Ladder Frame
Courtesy of HYUNDAI MOTOR CO.

17. Check the connecting rod end play. (See CONNECTING ROD AND CRANKSHAFT)
18. Remove the connecting rod caps and check oil clearance. (See CONNECTING ROD AND CRANKSHAFT)
19. Remove piston and connecting rod assemblies.
 1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

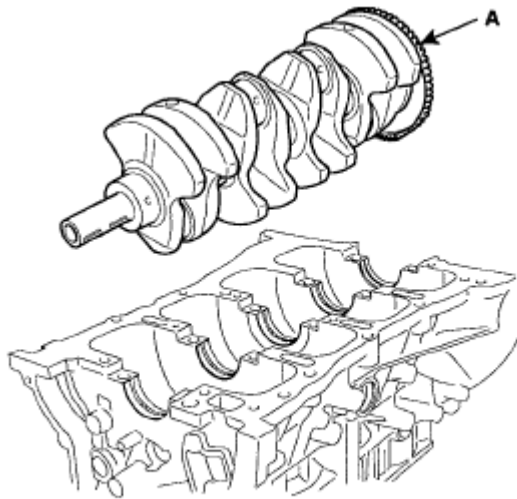
NOTE:

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

20. Remove crankshaft bearing cap and check oil clearance. (See CONNECTING RODS)
21. Check the crankshaft end play. (See CONNECTING RODS)
22. Lift the crankshaft (A) out of the engine, being careful not to damage journals.

NOTE:

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



KCRF172A

Fig. 153: Lifting Crankshaft
Courtesy of HYUNDAI MOTOR CO.

23. Check fit between piston and piston pin.

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

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

NOTE: **Arrange the piston rings in the correct order only.**

25. Disconnect connecting rod from piston.

INSPECTION

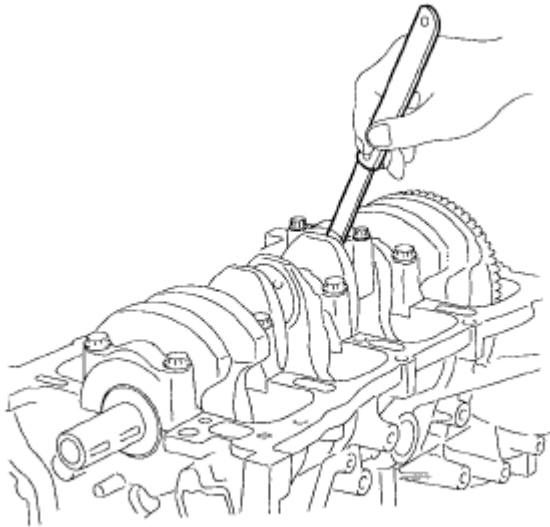
CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.

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

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

Maximum end play: 0.35mm (0.0138in.)



KCRF109B

Fig. 154: Measuring Connecting Rod And Crankshaft End Play
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

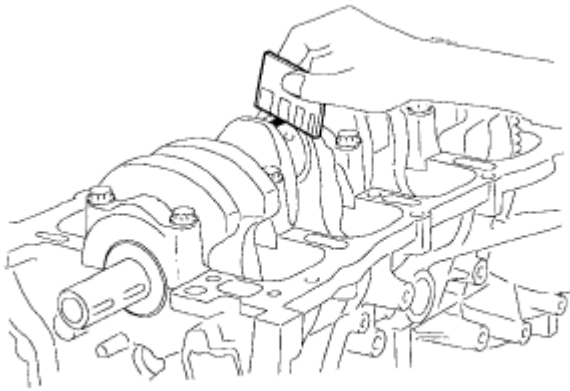
19.6 Nm (2.0 kgf.m, 14.46 lbf.ft) + 90°

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.028 ~ 0.046mm (0.0011 ~ 0.0018in.)



KCRF169A

Fig. 155: Measuring Plastigage Widest Point
Courtesy of HYUNDAI MOTOR CO.

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

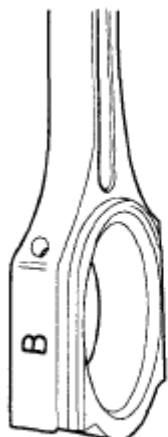
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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

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

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

CONNECTING ROD MARK LOCATION



EDQF196A

Fig. 156: Identifying Connecting Rod Mark Location
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CONNECTING ROD

CONNECTING ROD INSIDE DIAMETER SPECIFICATION

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

CRANKSHAFT PIN MARK LOCATION DISCRIMINATION OF CRANKSHAFT



ACGE063Z

Fig. 157: Identifying Crankshaft Pin Mark Location
Courtesy of HYUNDAI MOTOR CO.

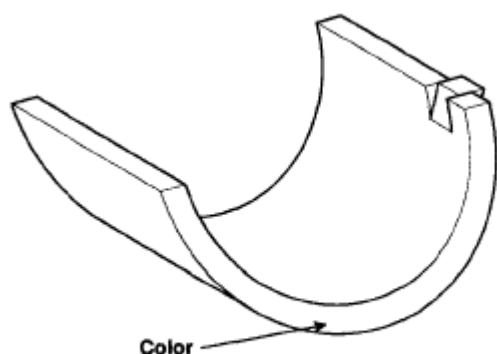
DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT OUTSIDE DIAMETER SPECIFICATION

CLASS	MARK	OUTSIDE DIAMETER OF PIN
-------	------	-------------------------

I	1	47.966 ~ 47.972mm (1.8884 ~ 1.8886in.)
II	2	47.960 ~ 47.966mm (1.8881 ~ 1.8884in.)
III	3	47.954 ~ 47.960mm (1.8879 ~ 1.8881 in.)

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



ECRF021A

Fig. 158: Identifying Mark On Connecting Rod Bearing
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CONNECTING ROD BEARING

CONNECTING ROD BEARING THICKNESS DIAMETER SPECIFICATION

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 IDENTIFICATION MARK REFERENCE

CRANKSHAFT IDENTIFICATION MARK	CONNECTING ROD IDENTIFICATION MARK	ASSEMBLING CLASSIFICATION OF BEARING
I(1)	a (A)	D (YELLOW)
	b(B)	C (GREEN)
	c(C)	B (NONE)
II (2)	a (A)	C (GREEN)
	b(B)	B (NONE)
	c(C)	A (BLACK)

III (3)	a (A)	B (NONE)
	b(B)	A (BLACK)
	c(C)	AA (BLUE)

3. Check the crankshaft bearing oil clearance.

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

Tightening torque

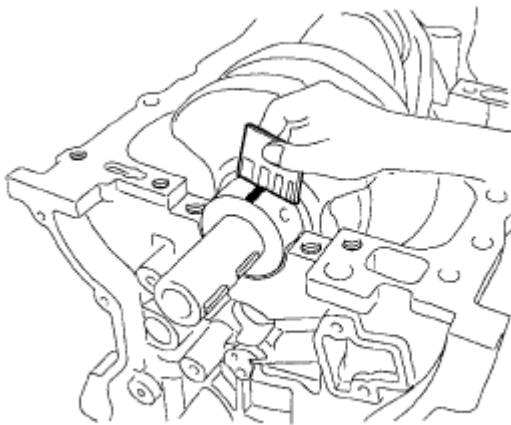
26.46 Nm (2.7 kgf.m, 19.52 lbf.ft) + 45°

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.026 ~ 0.048mm (0.0010 ~ 0.0019in.)



KCRF170A

Fig. 159: Measuring Widest Part Of Plastigage
Courtesy of HYUNDAI MOTOR CO.

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

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

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

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

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

CONNECTING RODS

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

Allowable bend of connecting rod:

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

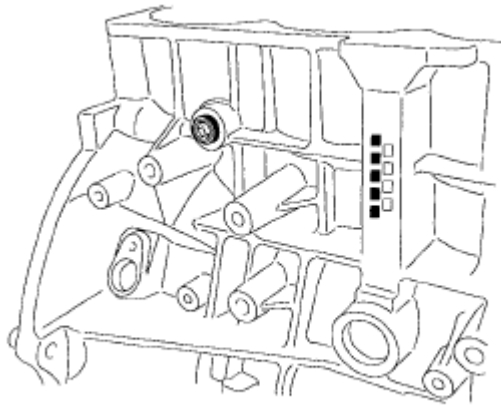
Allowable twist of connecting rod:

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

Crankshaft bore mark location

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

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



KCRF175C

Fig. 160: Identifying Crankshaft Bore Mark Location
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CYLINDER BLOCK

CYLINDER BLOCK INSIDE DIAMETER SPECIFICATION

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

CRANKSHAFT JOURNAL MARK LOCATION DISCRIMINATION OF CRANKSHAFT



ACGE084Z

Fig. 161: Identifying Crankshaft Journal Mark Location
Courtesy of HYUNDAI MOTOR CO.

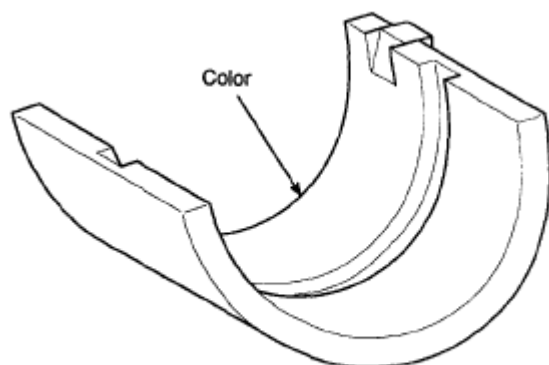
DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT OUTSIDE DIAMETER SPECIFICATION

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
-------	------	-----------------------------

I	1	51.954 ~ 51.960mm (2.0454 ~ 2.0456in.)
II	2	51.948 ~ 51.954mm (2.0452 ~ 2.0454.)
III	3	51.942 ~ 51.948mm (2.0449 ~ 2.0452in.)

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



ECRF022A

Fig. 162: Identifying Mark On Crankshaft Bearing
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CRANKSHAFT BEARING

CRANKSHAFT BEARING THICKNESS SPECIFICATION

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

SELECTION

CRANKSHAFT IDENTIFICATION MARK REFERENCE

CRANKSHAFT IDENTIFICATION MARK	CRANKSHAFT BORE IDENTIFICATION MARK	ASSEMBLING CLASSIFICATION OF BEARING
I (1)	a (A)	D (YELLOW)
	b(B)	C (GREEN)
	c(C)	B (NONE)
II (2)	a (A)	C (GREEN)
	b(B)	B (NONE)
	c(C)	A (BLACK)

III (3)	a (A)	B (NONE)
	b(B)	A (BLACK)
	c(C)	AA (BLUE)

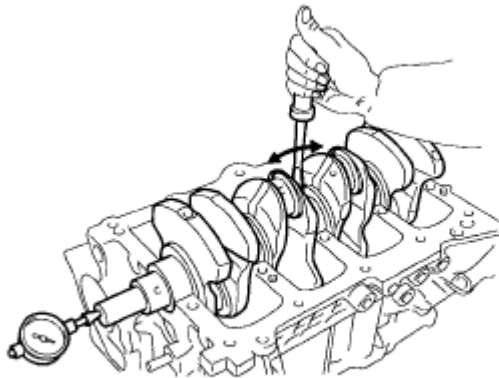
4. Check crankshaft end play.

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

Standard end play

0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)

Limit: 0.30mm (0.0118in.)



ECKD001B

Fig. 163: Measuring Crankshaft Thrust Clearance (End Play)
 Courtesy of HYUNDAI MOTOR CO.

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

Thrust bearing thickness

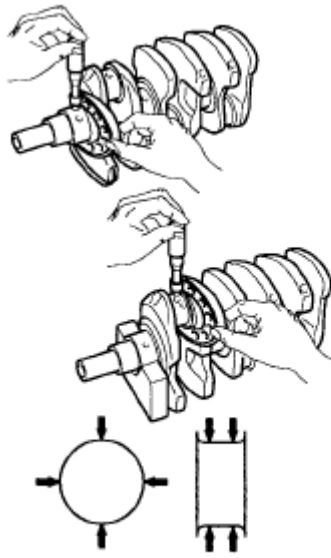
1.925 ~ 1.965mm (0.0758 ~ 0.07736in.)

5. Inspect main journals and crank pins

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

Main journal diameter: 51.942 ~ 51.960mm (2.0449 ~ 2.0456in.)

Crank pin diameter: 47.954 ~ 47.972mm (1.8879 ~ 1.8886in.)



ECKD001E

Fig. 164: Measuring Diameter Of Main Journal And Crank Pin
 Courtesy of HYUNDAI MOTOR CO.

CYLINDER BLOCK

1. Remove gasket material.

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

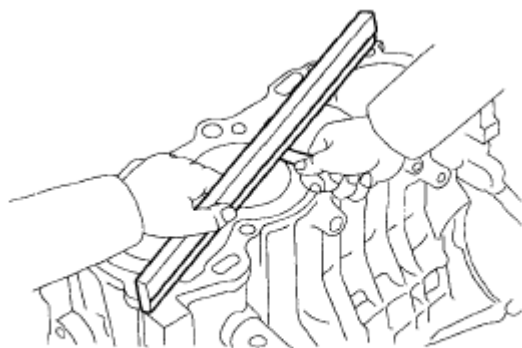
2. Clean cylinder block

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

3. Inspect top surface of cylinder block for flatness. Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Flatness of cylinder block gasket surface

Standard: Less than 0.05mm (0.0020 in.)



ECKD001L

Fig. 165: Measuring Cylinder Block Gasket Surface Flatness
Courtesy of HYUNDAI MOTOR CO.

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

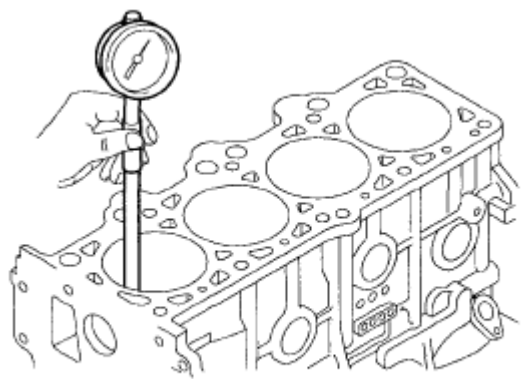
If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

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

Standard diameter

88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)

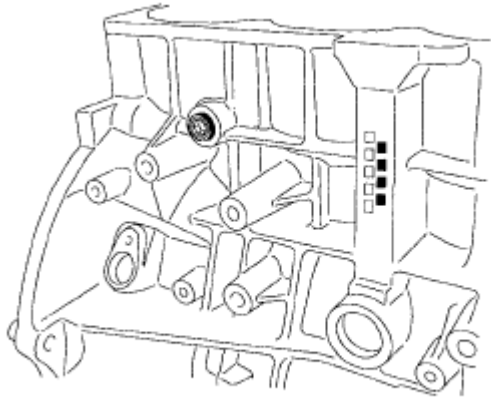


ECKD318A

Fig. 166: Measuring Cylinder Bore Diameter
Courtesy of HYUNDAI MOTOR CO.

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

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



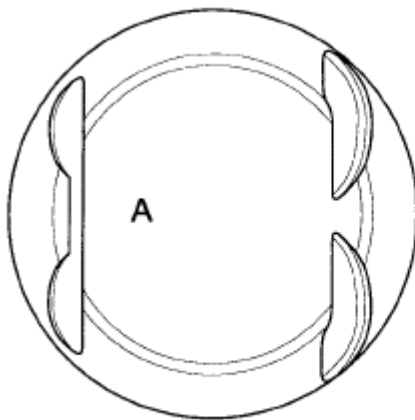
KCRF175B

Fig. 167: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

CYLINDER BORE INNER DIAMETER SPECIFICATION

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

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



ECKE320B

Fig. 168: Identifying Piston Size Code
Courtesy of HYUNDAI MOTOR CO.

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

PISTON OUTER DIAMETER SPECIFICATION

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

8. Select the piston related to cylinder bore class.

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

PISTON AND RINGS

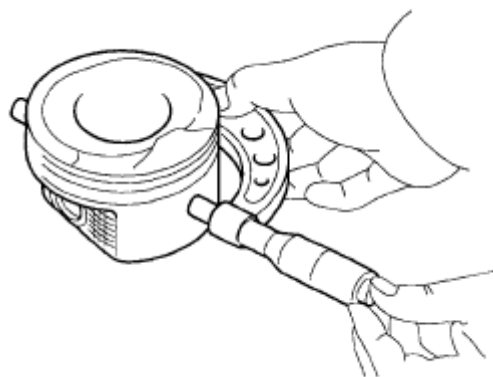
1. Clean piston
 1. Using a gasket scraper, remove the carbon from the piston top.
 2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
 3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

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

Standard diameter

87.97 ~ 88.00mm (3.4633 ~ 3.4645in.)



ECKD001D

Fig. 169: Measuring Piston Outside Diameter
Courtesy of HYUNDAI MOTOR CO.

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

Piston-to-cylinder clearance

0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

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

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

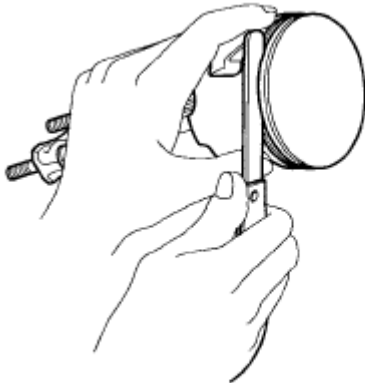
Oil ring: 0.06 ~ 0.15mm (0.0024 ~ 0.0059in.)

Limit

No.1: 0.1mm (0.004in.)

No.2: 0.1mm (0.004in.)

Oil ring: 0.2mm (0.008in.)



ECKD001G

Fig. 170: Measuring Clearance Between Piston Ring And Wall Of Ring Groove
Courtesy of HYUNDAI MOTOR CO.

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

5. Inspect piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right

angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits on page EM-64. If the bore is over the service limit, the cylinder block must be replaced.

Piston ring end gap**Standard**

No.1: 0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)

No.2: 0.30 ~ 0.45mm (0.0118 ~ 0.0177in.)

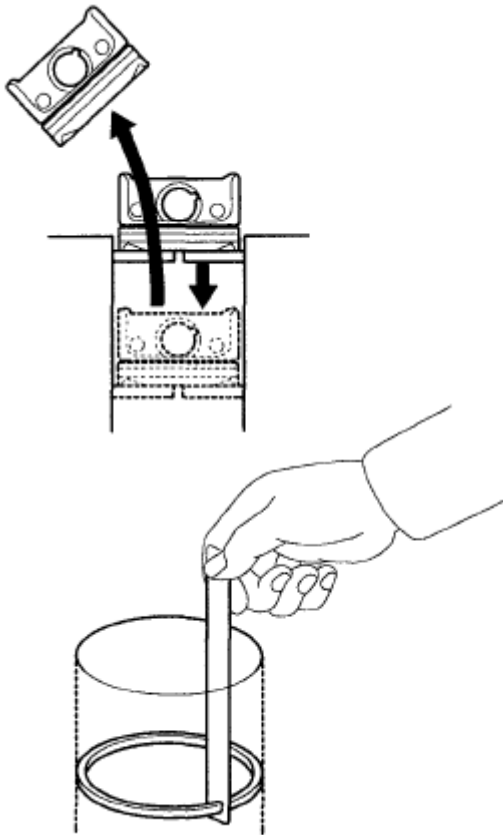
Oil ring: 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)

Limit

No.1: 0.6mm (0.0236in.)

No.2: 0.7mm (0.0275in.)

Oil ring: 0.8mm (0.0315in.)



ECKD001K

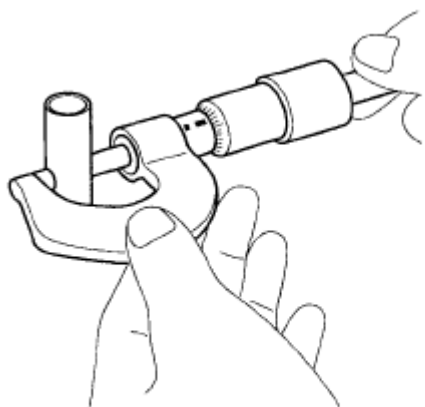
Fig. 171: Measuring Piston Ring End Gap
Courtesy of HYUNDAI MOTOR CO.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

21.001 ~ 21.006mm (0.8268 ~ 0.8270in.)



ECKD001Z

Fig. 172: Measuring Diameter Of Piston Pin
Courtesy of HYUNDAI MOTOR CO.

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.

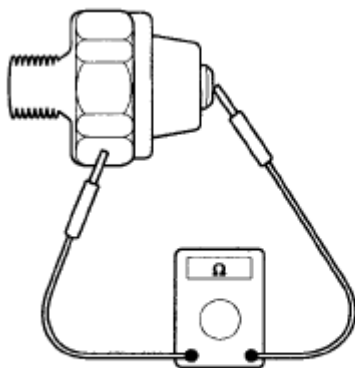
Piston pin-to-connecting rod interference

0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)

OIL 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.

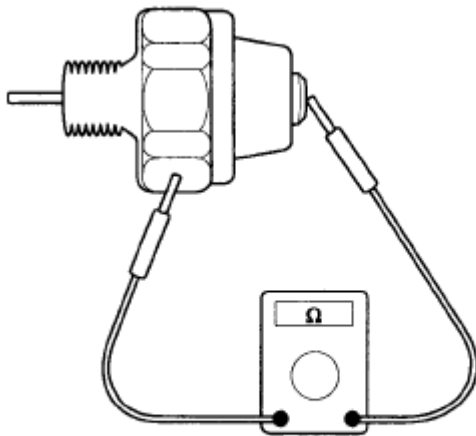


ECKD001W

Fig. 173: Checking Continuity Between OIP Pressure Switch Terminal And Body
Courtesy of HYUNDAI MOTOR CO.

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 through the oil hole, the switch is operating properly.

Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



ECKD001Y

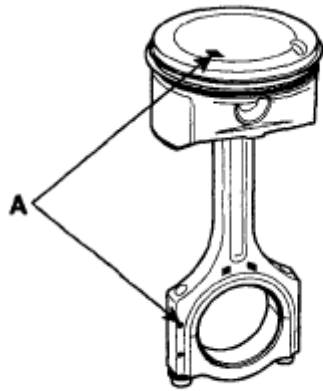
Fig. 174: Checking Continuity Between Terminal And Body With Fine Wire Pushed In
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

NOTE:

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

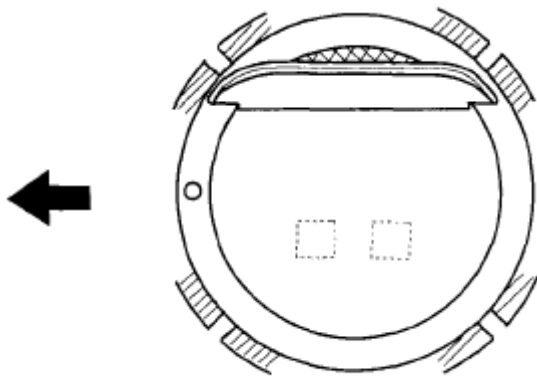
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



KCRF168A

Fig. 175: Aligning Piston Mark With Connecting Rod
Courtesy of HYUNDAI MOTOR CO.

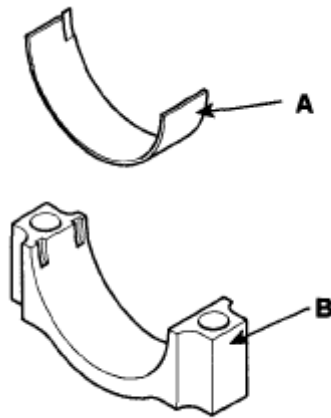
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown.



ECKD321A

Fig. 176: Identifying Piston Ring Installation Positions
Courtesy of HYUNDAI MOTOR CO.

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).



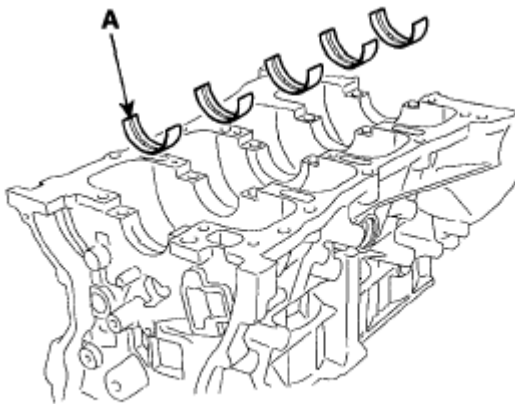
KCRF116B

Fig. 177: Identifying Bearings With Connecting Rod Cap
Courtesy of HYUNDAI MOTOR CO.

4. Install main bearings.

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

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



KCRF173A

Fig. 178: Aligning Bearing Claw With Claw Groove Of Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

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

Fig. 179: Identifying Thrust Bearings
Courtesy of HYUNDAI MOTOR CO.

6. Place crankshaft on the cylinder block.
7. Place main bearing caps on cylinder block.
8. Install main bearing cap bolts.

Tightening torque

Main bearing cap bolt

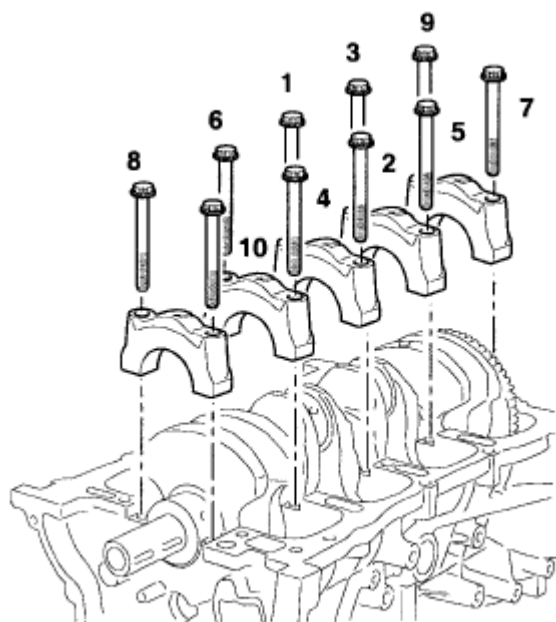
26.46 Nm (2.7 kgf.m, 19.52lb.ft) + 45°

NOTE:

- The main bearing cap bolts are tightened in 2 progressive steps.
- If any of the bearing cap bolts is broken or deformed, replace it.
- Always use new main bearing cap bolt.

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 10 bearing cap bolts (A), in several passes, in the sequence shown.

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

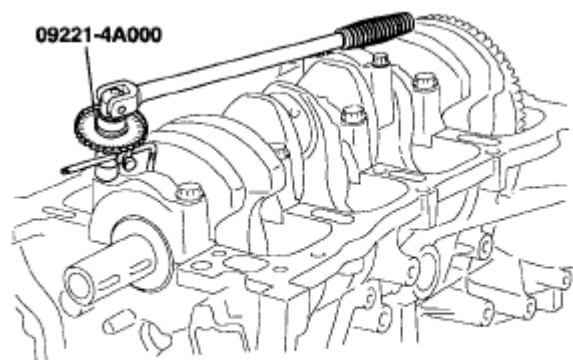


KGRF171A

Fig. 180: Identifying Installation Sequence Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

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

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



ECRF041A

Fig. 181: Retightening Bearing Cap Bolts Using Special Tool By 45°
Courtesy of HYUNDAI MOTOR CO.

4. Check that the crankshaft turns smoothly.
9. Check crankshaft end play. (See **CONNECTING RODS**)
10. Install piston and connecting rod assemblies.

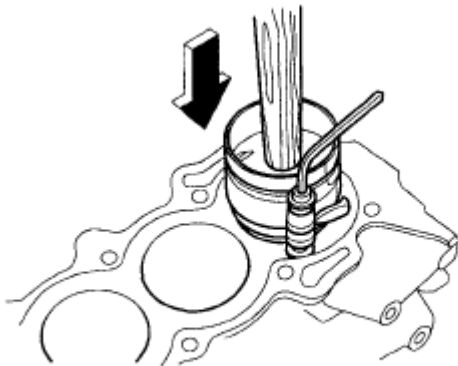
NOTE: Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

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

Tightening torque

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

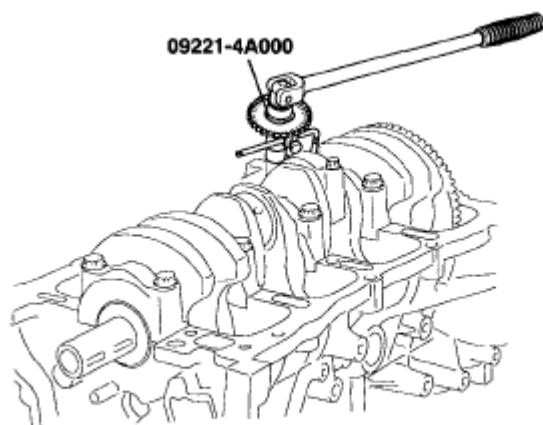
NOTE: Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



ECKD001F

Fig. 182: Installing Piston Into Cylinder Bores
Courtesy of HYUNDAI MOTOR CO.

5. Using SST (09221-4A000), install connecting rod bolts.



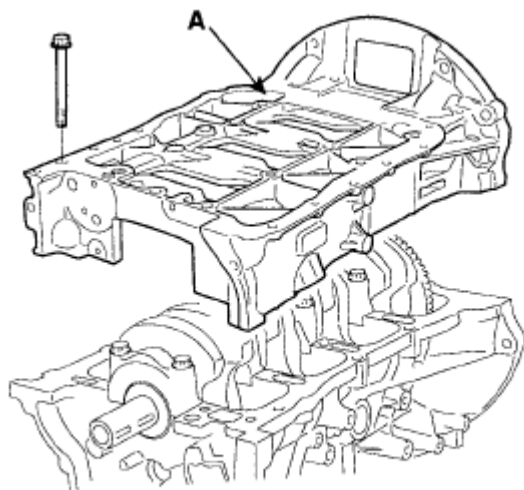
ECRF042A

Fig. 183: Tightening Connecting Rod Bolts Using SST
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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



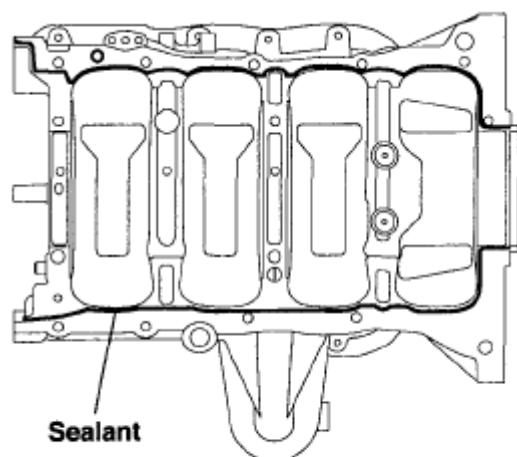
KCRF167A

Fig. 184: Identifying Ladder Frame With Bolts
Courtesy of HYUNDAI MOTOR CO.

NOTE:

- Be assembling ladder frame, the liquid sealant Loctite 5900 should be applied ladder frame.
- The part must be assembled within 5 minutes after sealant was applied.

- Apply sealant to the inner threads of the bolt holes.



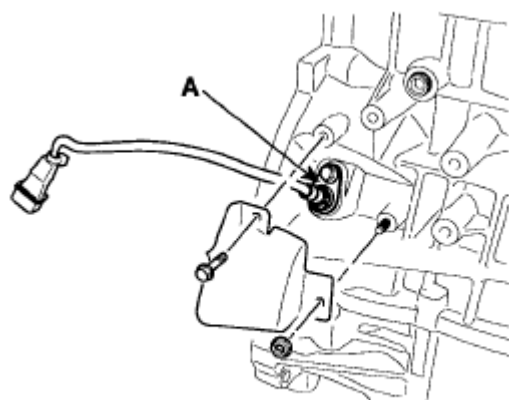
ECRF023A

Fig. 185: Applying Sealant To Inner Threads Of Bolt Holes
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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



KCRF164A

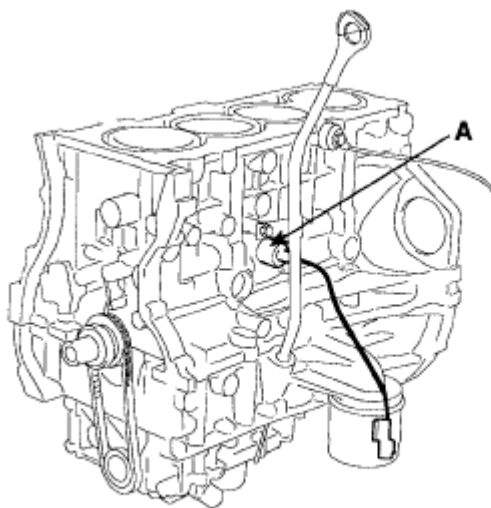
Fig. 186: Identifying CKP Sensor
Courtesy of HYUNDAI MOTOR CO.

16. Install oil pressure sensor.
 1. Apply adhesive to 2 or 3 threads.

Adhesive: MS 721-39 (B) or equivalent.
 2. Install the oil pressure sensor (A).

Tightening torque

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



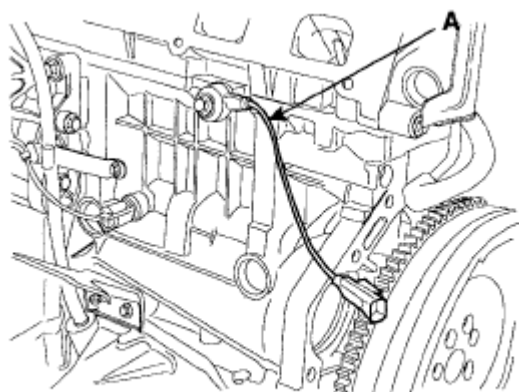
KCRF163C

Fig. 187: Identifying Oil Pressure Sensor
Courtesy of HYUNDAI MOTOR CO.

17. Install knock sensor (A).

Tightening torque

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



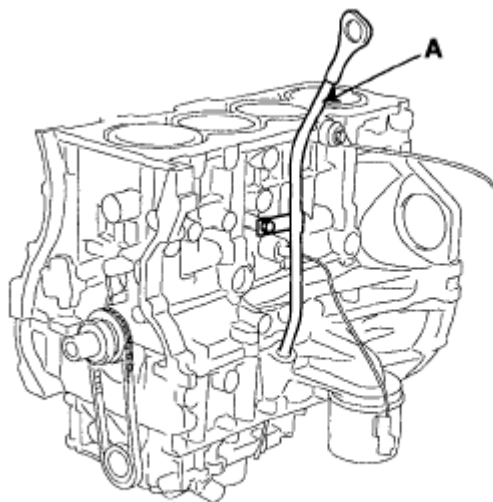
KCRF143A

Fig. 188: Identifying Knock Sensor
Courtesy of HYUNDAI MOTOR CO.

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

Tightening torque

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



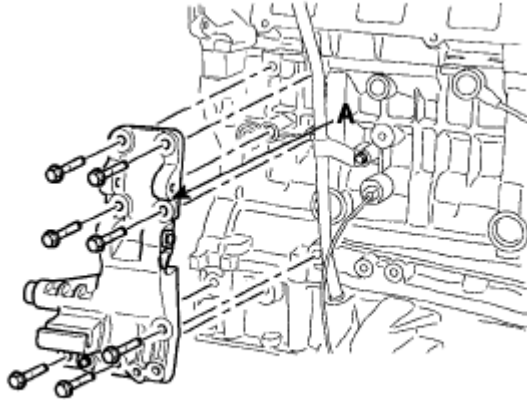
KCRF163B

Fig. 189: Identifying Oil Level Gauge Assembly
Courtesy of HYUNDAI MOTOR CO.

19. Install tensioner assembly integrated bracket (A).

Tightening torque

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



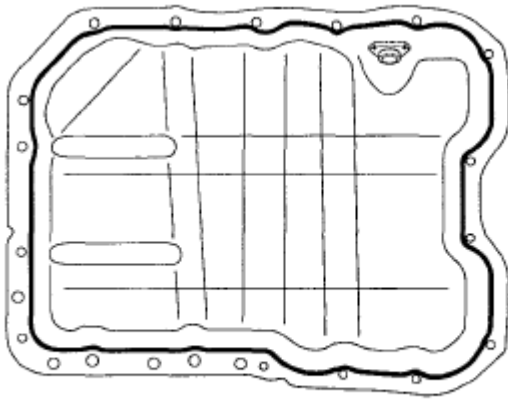
KCRF161A

Fig. 190: Identifying Tensioner Assembly Integrated Bracket
Courtesy of HYUNDAI MOTOR CO.

20. Install power steering pump bracket and power steering pump. (See **MECHANICAL POWER STEERING SYSTEM**)
21. Install alternator. (See **ALTERNATOR**)
22. Install A/C compressor. (See **A/C COMPRESSOR CONTROLS (MANUAL)**)
23. Install cylinder head. (See **INSTALLATION**)
24. Install timing chain. (See **INSTALLATION**)
25. Install oil pan.
 1. Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

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

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



KCRF179A

Fig. 191: Applying Liquid Gasket On Oil Pan
Courtesy of HYUNDAI MOTOR CO.

NOTE:

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

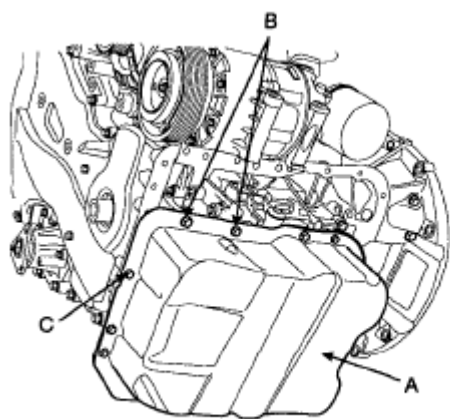
3. Install the oil pan (A).

Uniformly tighten the bolts in several passes.

Tightening torque

M8 (B): 26.46 ~ 30.38 Nm (2.7 ~ 3.1 kgf.m, 19.52 ~ 22.41 lbf.ft)

M6 (C): 9.8 ~ 11.76 Nm (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.67 lbf.ft)



KCRF114B

Fig. 192: Identifying Oil Pan With Bolts
Courtesy of HYUNDAI MOTOR CO.

26. Remove engine stand.
27. A/T: Install drive plate.

Tightening torque

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

28. M/T: Install flywheel

Tightening torque

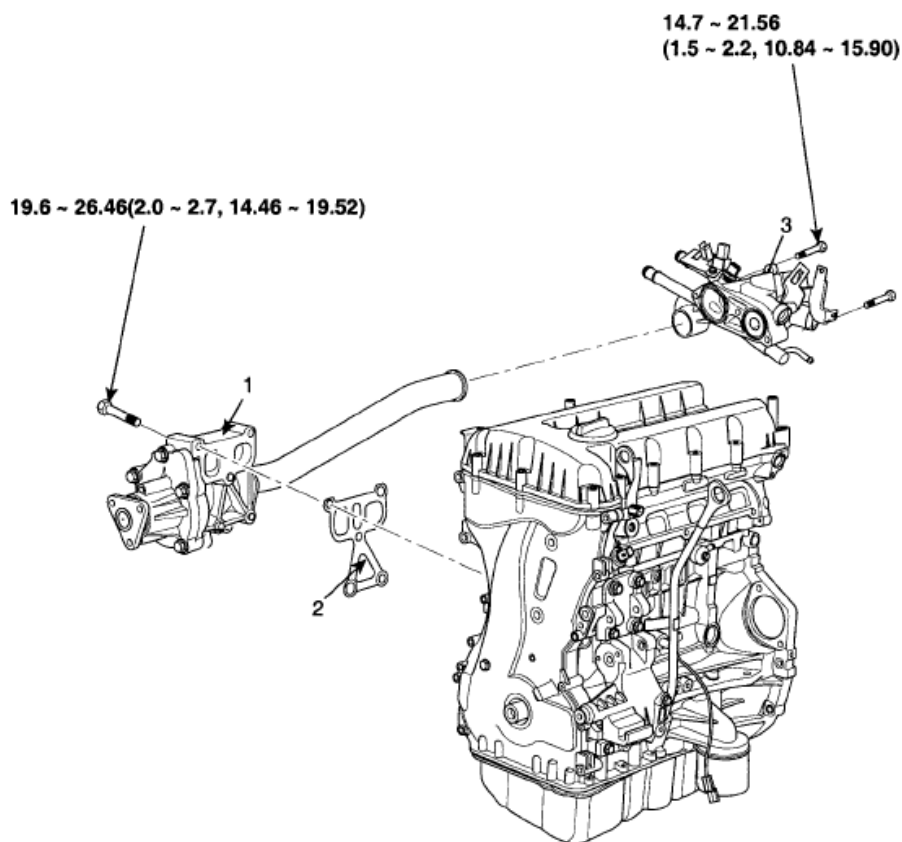
117.6 ~ 127.4 Nm (12 ~ 13 kgf.m, 86.75 ~ 93.98 lbf.ft)

NOTE:

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

COOLING SYSTEM

COMPONENT



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

- 1. Water pump
- 2. Water pump gasket

- 3. Water temp control assembly

ECRF024A

Fig. 193: Identifying Cooling System Components With Torque Specifications
Courtesy of HYUNDAI MOTOR CO.

ENGINE COOLANT REFILLING AND BLEEDING

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

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

1. Make sure the engine and radiator are cool to the touch.

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

NOTE:

- **Use only genuine antifreeze/coolant.**
- **For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum. Coolant concentrations less than 50% may not provide sufficient protection against corrosion or freezing.**
- **Coolant concentrations greater than 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 anti-rust products; they may not be compatible with the coolant.**

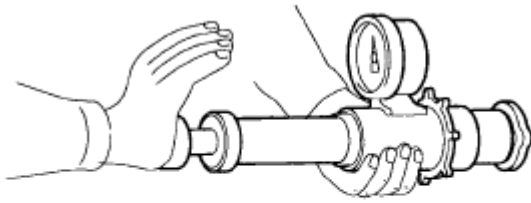
7. Start the engine and run coolant circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to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

NOTE:

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

CAP TESTING

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



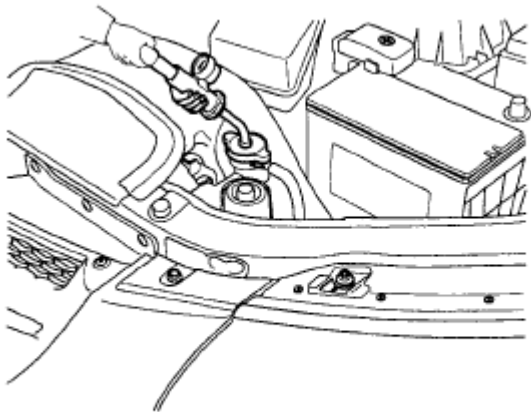
ECKD501X

Fig. 194: Applying Pressure To Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

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

TESTING

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



KCRF184A

Fig. 195: Applying Pressure To Radiator
Courtesy of HYUNDAI MOTOR CO.

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.

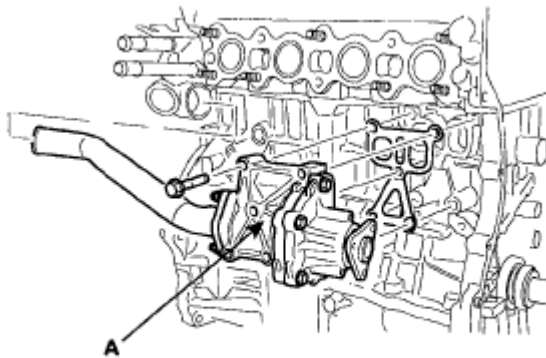
NOTE: Check for engine oil in the coolant and/or coolant in the engine oil.

REMOVAL**WATER PUMP**

1. Drain the engine coolant.

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

2. Remove drive belt.
3. Remove exhaust manifold. (See **EXHAUST MANIFOLD**)
4. Remove the water pump.
 1. Remove the 4 bolts and pump pulley.
 2. Remove the water pump (B) and gasket.



KCRF157A

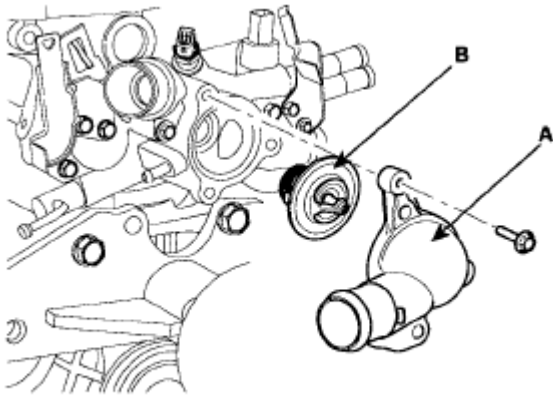
Fig. 196: Identifying Water Pump
Courtesy of HYUNDAI MOTOR CO.

5. Remove water inlet pipe nut.

THERMOSTAT

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

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



KCRF123A

Fig. 197: Identifying Water Inlet And Thermostat
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

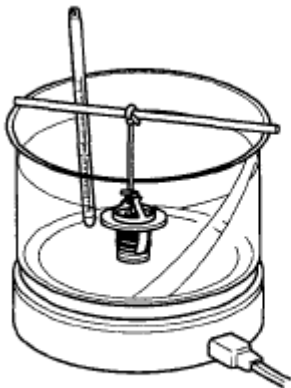
WATER PUMP

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

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

THERMOSTAT

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



ECKD503B

Fig. 198: Heating Valve Opening Temperature

Courtesy of HYUNDAI MOTOR CO.

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)

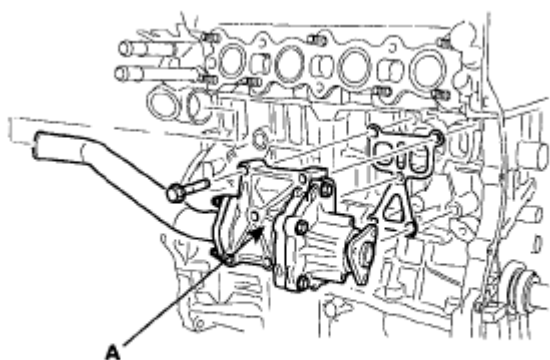
If the valve lift is not as specified, replace the thermostat.

INSTALLATION**WATER PUMP**

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

Tightening torque

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



KCRF157A

Fig. 199: Identifying Water Pump With Bolts
Courtesy of HYUNDAI MOTOR CO.

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

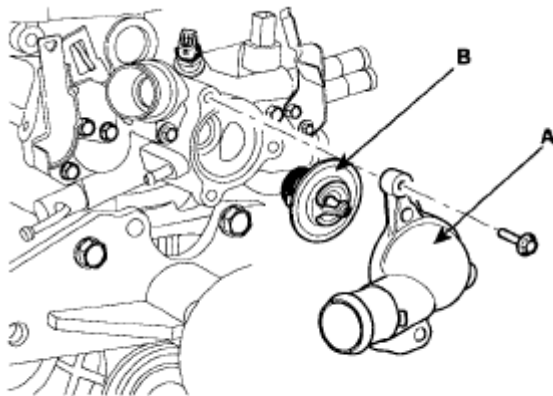
Tightening torque

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

3. Install exhaust manifold. (See **EXHAUST MANIFOLD**)
4. Install drive belt.
5. Fill with engine coolant.
6. Start engine and check for leaks.
7. Recheck engine coolant level.

THERMOSTAT

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



KCRF123A

Fig. 200: Identifying Water Inlet And Thermostat
Courtesy of HYUNDAI MOTOR CO.

2. Install water inlet (A).

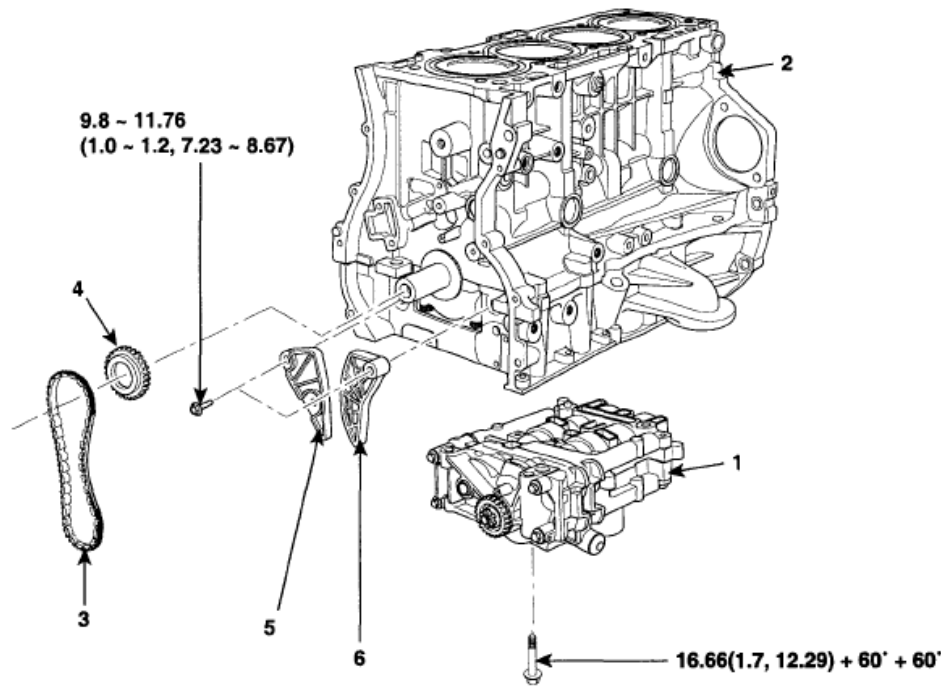
Tightening torque

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

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

LUBRICATION SYSTEM

COMPONENT



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

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

ECRF025A

Fig. 201: Identifying Lubrication System Components With Torque Specifications
Courtesy of HYUNDAI MOTOR CO.

OIL AND FILTER

CAUTION:

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

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

Tightening torque

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

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

Tightening torque

39.2 ~ 44.1 Nm (4.0 ~ 4.5 kgf.m, 28.9 ~ 32.5 lbf.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.

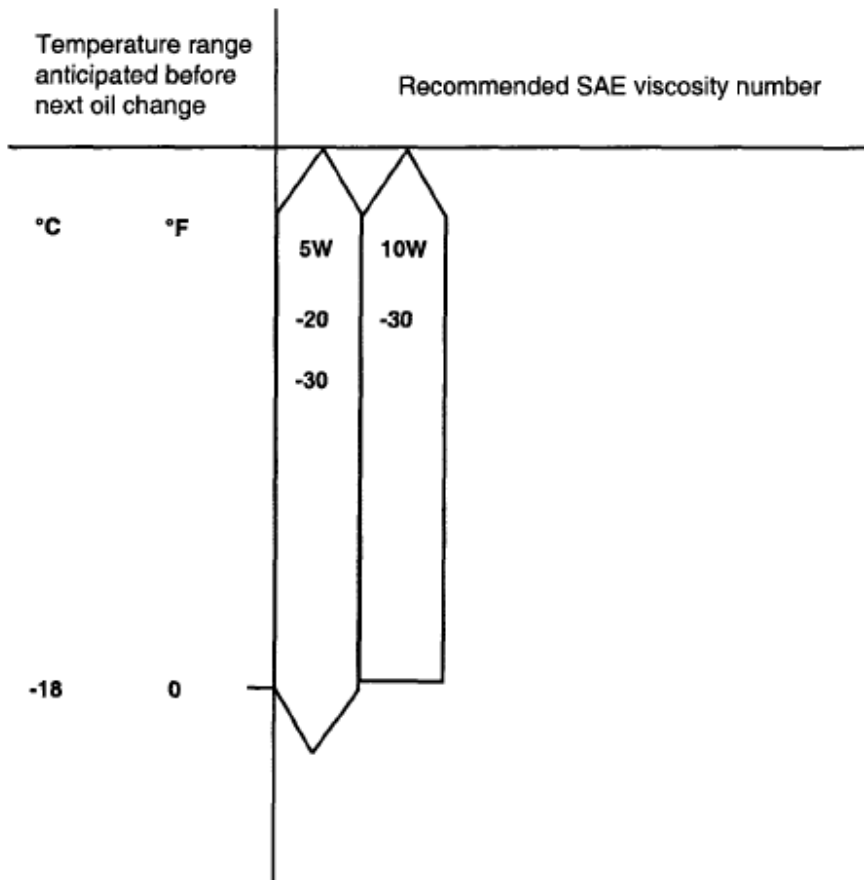
NOTE: Do not fill with engine oil above the "F" mark.

SELECTION OF ENGINE OIL

Recommended API classification: SJ OR ABOVE

Recommended SAE viscosity grades: 5W-20

If 5W-20 engine oil is not available, secondary recommended engine oil can be used for corresponding temperature range.



EARF012A

Fig. 202: Engine Oil Viscosity Chart
Courtesy of HYUNDAI MOTOR CO.

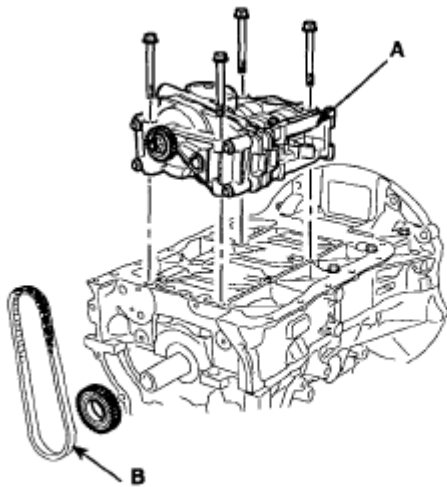
NOTE: For best performance and maximum protection of all types of operation, select only those lubricants which:

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

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

REMOVAL

1. Drain engine oil.
2. Remove the drive belt.
3. Turn the crankshaft and align the white groove on the crankshaft pulley with the pointer on the lower cover. (See **VALVE CLEARANCE INSPECTION AND ADJUSTMENT**)
4. Remove the oil pan. (See **TIMING CHAIN**)
5. Remove the timing chain. (See **REMOVAL**)
6. Remove balance shaft chain (B) and balance shaft module (A).



KCRF165A

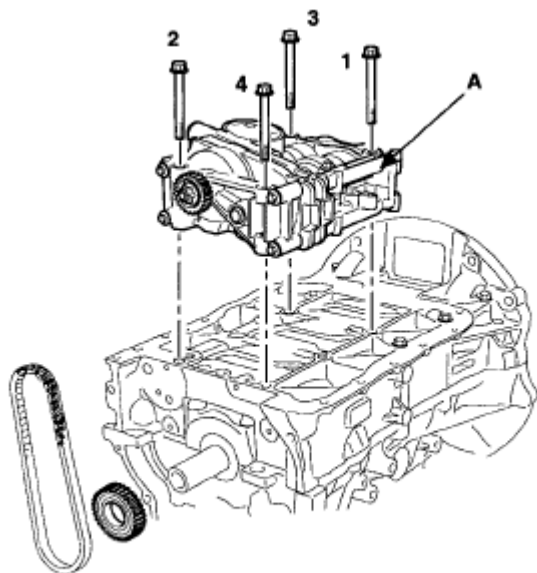
Fig. 203: Identifying Balance Shaft Chain And Balance Shaft Module
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

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

Tightening torque

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

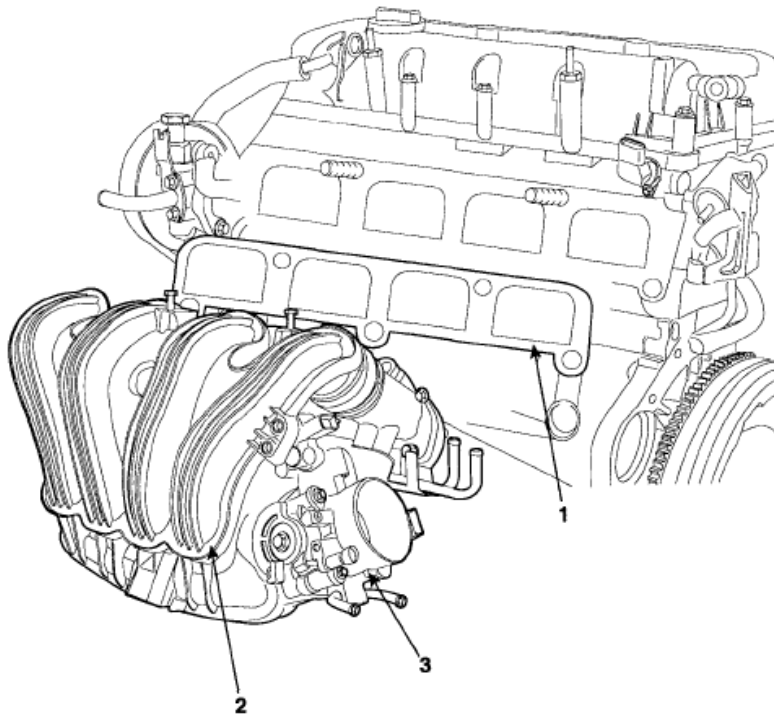


KCRF165B

Fig. 204: Identifying Balance Shaft Module Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

4. Install timing chain. (See **TIMING CHAIN**)
5. Install oil pan. (See **TIMING CHAIN**)
6. Fill with engine oil.
7. Start engine and check for leaks.

INTAKE AND EXHAUST SYSTEM**COMPONENT****INTAKE MANIFOLD**

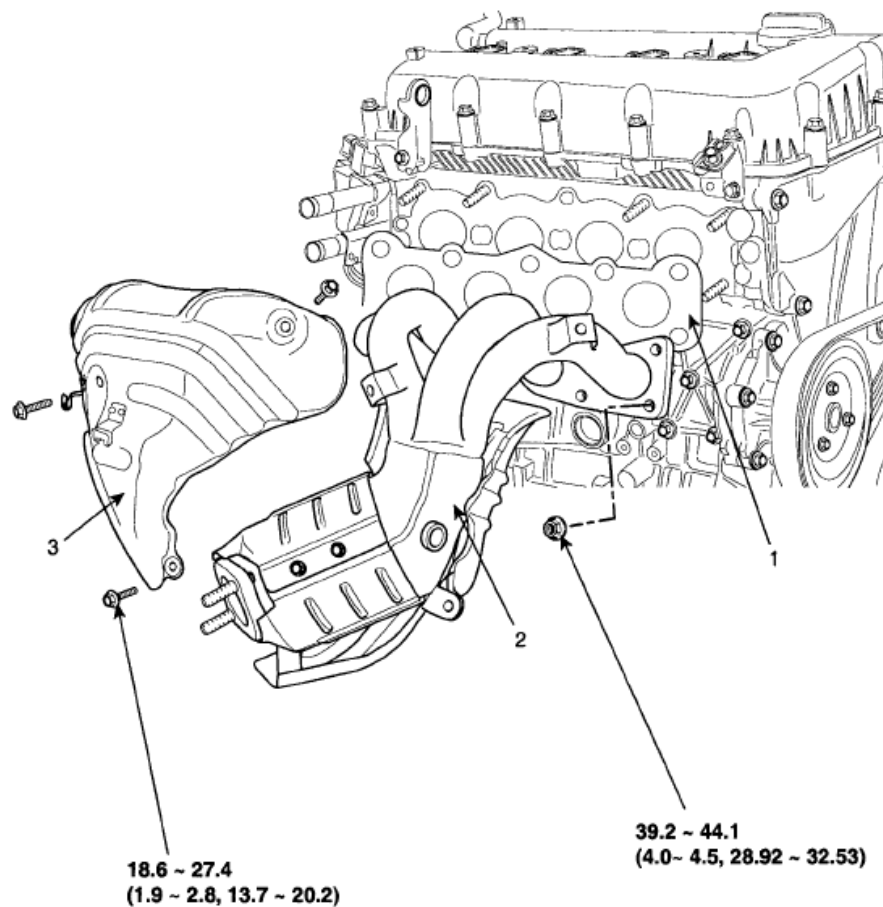


- 1. Intake manifold gasket
- 2. Intake manifold assembly
- 3. Throttle body

ECRF026A

Fig. 205: Identifying Intake Manifold Components
Courtesy of HYUNDAI MOTOR CO.

EXHAUST MANIFOLD

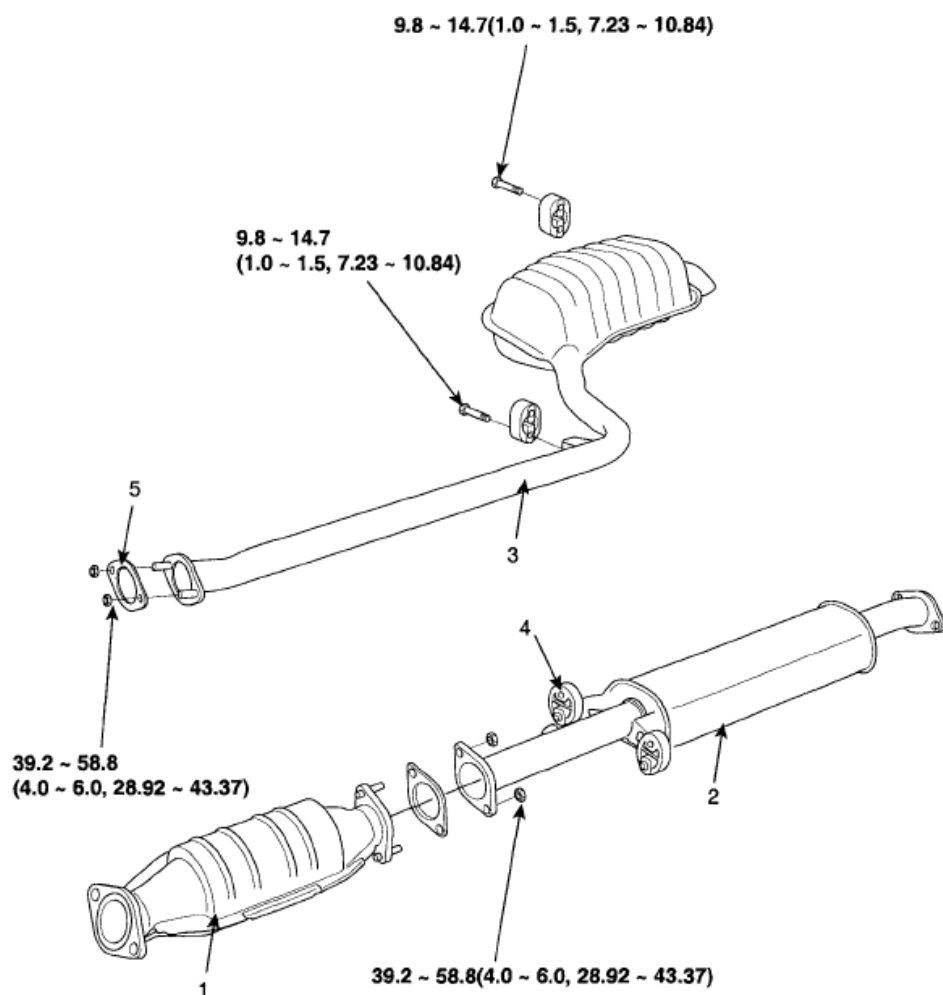
**TORQUE : Nm (kgf.m, lbf.ft)**

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

ECRF007C

Fig. 206: Identifying Exhaust Manifold Components With Torque Specifications
Courtesy of HYUNDAI MOTOR CO.

MUFFLER



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

- 1. Catalytic converter
- 2. Center muffler
- 3. Main muffler

- 4. Rubber hanger
- 5. Gasket

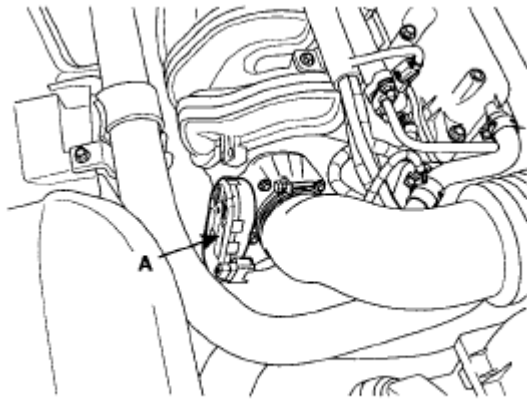
ECRF028A

Fig. 207: Identifying Muffler Components With Torque Specifications
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

INTAKE MANIFOLD

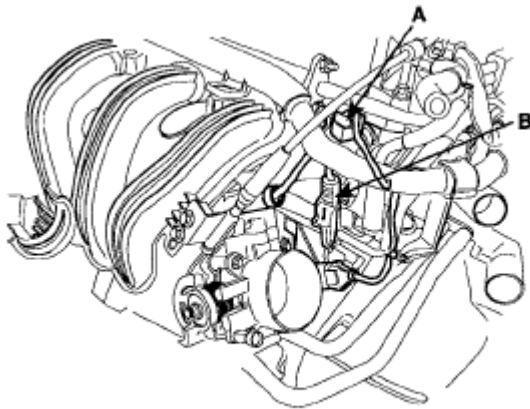
1. Remove the engine cover. (See **REMOVAL**)
2. Disconnect ETS connector (A)



ECRF032A

Fig. 208: Identifying ETS Connector
Courtesy of HYUNDAI MOTOR CO.

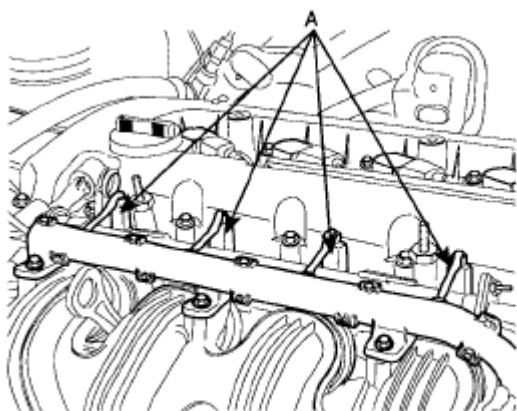
3. Disconnect CMP connector (A), and knock sensor connector (B).



ECRF029A

Fig. 209: Identifying CMP Connector And Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

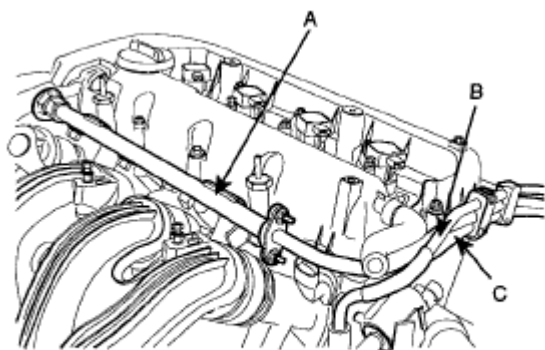
4. Disconnect injector connector (A).



KCRF128A

Fig. 210: Identifying Injector Connector
Courtesy of HYUNDAI MOTOR CO.

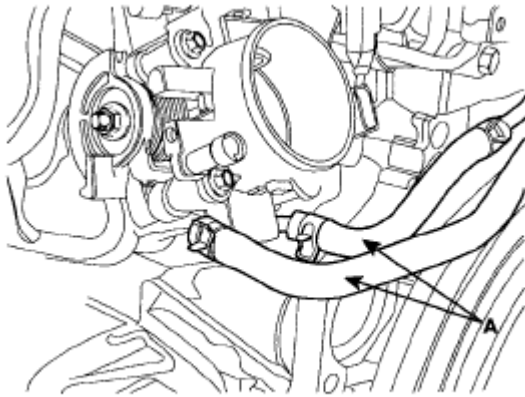
5. Remove the delivery pipe (A), brake vacuum hose (B), and PCSV hose (C).



KCRF134A

Fig. 211: Identifying Delivery Pipe, Brake Vacuum Hose And PCSV Hose
Courtesy of HYUNDAI MOTOR CO.

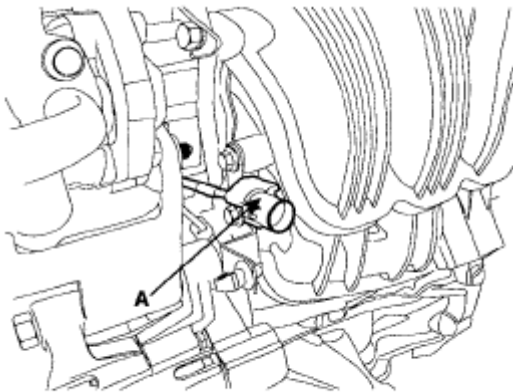
6. Remove coolant hose (A) from throttle body.



KCRF141B

Fig. 212: Identifying Coolant Hose
Courtesy of HYUNDAI MOTOR CO.

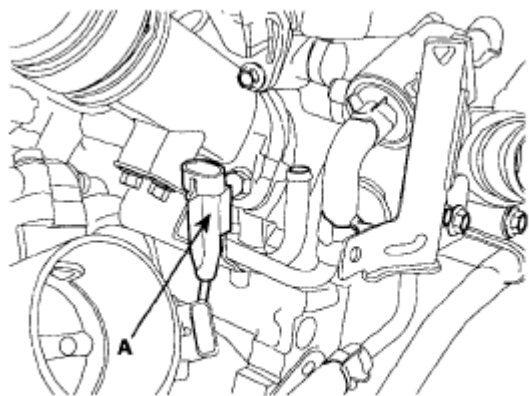
7. Remove oil pressure switch connector (A) from bracket.



KCRF141A

Fig. 213: Identifying Oil Pressure Switch Connector
Courtesy of HYUNDAI MOTOR CO.

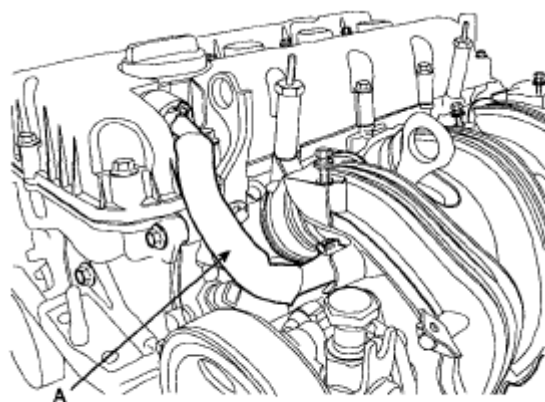
8. Remove knock sensor connector (A) from bracket.



KCRF141C

Fig. 214: Identifying Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

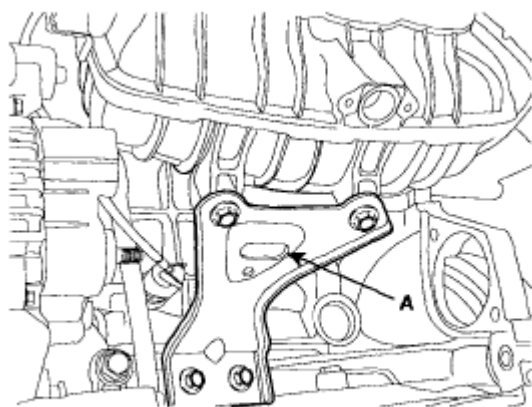
9. Remove PCV hose (A).



KCRF141E

Fig. 215: Identifying PCV Hose
Courtesy of HYUNDAI MOTOR CO.

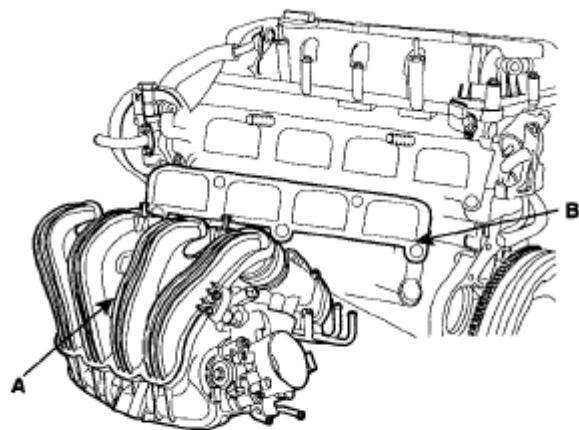
10. Remove oil level gauge.
11. Remove intake manifold stay (A).



KCRF141D

Fig. 216: Identifying Intake Manifold Stay
Courtesy of HYUNDAI MOTOR CO.

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

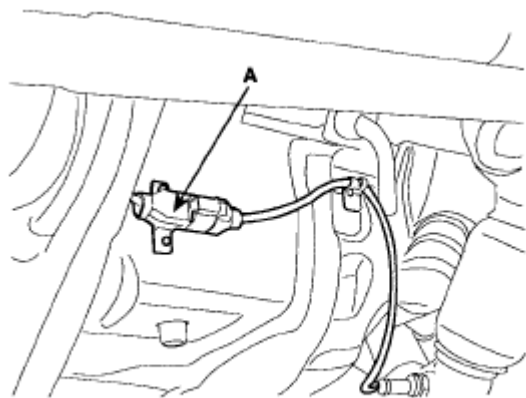


KCRF142A

Fig. 217: Identifying Intake Manifold And Gasket
Courtesy of HYUNDAI MOTOR CO.

EXHAUST MANIFOLD

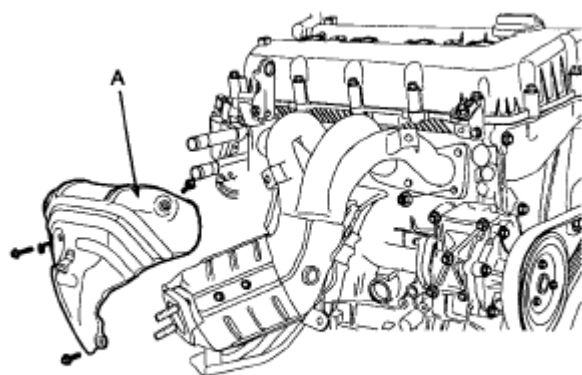
1. Remove the oxygen sensor connector.



ECRF018A

Fig. 218: Identifying Oxygen Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

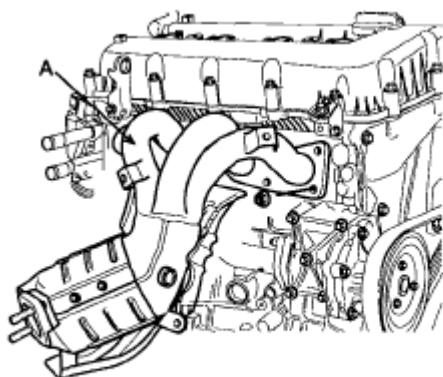
2. Remove the front muffler.
3. Remove the heat protector (A).



KCRF138B

Fig. 219: Identifying Heat Protector
Courtesy of HYUNDAI MOTOR CO.

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



KCRF140B

Fig. 220: Identifying Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

EXHAUST MANIFOLD

1. Install new gasket and exhaust manifold.

Tightening torque

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

2. Install exhaust manifold stay bolt.

Tightening torque

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

3. Install heat protector.

Tightening torque

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

4. Install front muffler.

Tightening torque

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

5. Connect oxygen sensor connector.

INTAKE MANIFOLD

1. Install intake manifold.

Tightening torque

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

2. Install intake manifold stay.

Tightening torque

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

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