

2008 Hyundai Entourage GLS

2008 ENGINE Engine (G6DA - GSA 3.8L) - Entourage

2008 ENGINE**Engine (G6DA - GSA 3.8L) - Entourage****GENERAL****SPECIFICATION****SPECIFICATION**

Description		Specifications	Limit
General			
Type		V-type, DOHC	
Number of cylinders		6	
Bore		96mm (3.7795 in.)	
Stroke		87.0mm (3.4252 in.)	
Total displacement		3.778cc (230.55cu. in.)	
Compression ratio		10.4	
Firing order		1-2-3-4-5-6	
Valve timing			
Intake	Opens (ATDC)	10°	
	Closes (ABDC)	62°	
Exhaust	Opens (BBDC)	42°	
	Closes (ATDC)	6°	
Cylinder head			
Flatness of gasket surface		Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.)/150 x 150]	
Flatness of manifold mounting	Intake	Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.)/110 x 110]	
	Exhaust	Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.)/110 x 110]	
Camshaft			
Cam height	LH Camshaft	Intake	46.8 mm (1.8425 in.)
		Exhaust	45.8 mm (1.8031 in.)
	RH Camshaft	Intake	46.8 mm (1.8425 in.)
		Exhaust	45.8 mm (1.8031 in.)
Journal outer diameter	LH, RH camshaft	Intake	No. 1: 27.964~27.980 mm (1.1009~1.1016 in.) No. 2,3,4: 23.954~23.970 mm (0.9430~0.9437 in.)
		Exhaust	No. 1: 27.964~27.980 mm (1.1009~1.1016 in.) No. 2,3,4: 23.954~23.970 mm (0.9430~0.9437 in.)
		Intake	No. 1: 0.020~0.057 mm (0.0008~0.0022 in.) No. 2,3,4: 0.030~0.067 mm

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Bearing oil clearance	LH, RH camshaft		(0.0012~0.0026 in.)	
		Exhaust	No. 1: 0.020~0.057 mm (0.0008~0.0022 in.) No. 2,3,4: 0.030~0.067 mm (0.0012~0.0026 in.)	
End play			0.02~0.18 mm (0.0008~0.0071 in.)	
Valve				
Valve length	Intake		105.27 mm (4.1445 in.)	
	Exhaust		105.50 mm (4.1535 in.)	
Stem outer diameter	Intake		5.465~5.480 mm (0.2151~0.2157 in.)	
	Exhaust		5.458~5.470 mm (0.2149~0.2153 in.)	
Face angle			45.25°~45.75°	
Thickness of valve head (margin)	Intake		1.56~1.86 mm (0.06142~0.07323 in.)	
	Exhaust		1.73~2.03 mm (0.06811~0.07992 in.)	
Valve stem to valve guide clearance	Intake		0.020~0.047 mm (0.00078~0.00185 in.)	0.07mm (0.00275 in.)
	Exhaust		0.030~0.054 mm (0.00118~0.00212 in.)	0.09 mm (0.00354 in.)
Valve guide				
Inner diameter	Intake		5.500~5.512 mm (0.2165~0.2170 in.)	
	Exhaust		5.500~5.512 mm (0.2165~0.2170 in.)	
Length	Intake		41.8~42.2 mm (1.6457~1.6614 in.)	
	Exhaust		41.8~42.2 mm (1.6457~1.6614 in.)	
Valve seat				
Width of seat contact	Intake		1.15~1.45 mm (0.05118~0.05709 in.)	
	Exhaust		1.35~1.65 mm (0.05315~0.06496 in.)	
Seat angle	Intake		44.75°~45.20°	
	Exhaust		44.75°~45.20°	
Valve spring				
Free length			43.86 mm (1.7267 in.)	
Load	19.3 ± 0.8kg/34.0 mm (42.7 ± 1.8 lb/1.3386 in.)			
	42.3 ± 1.3kg/24.2 mm (93.3 ± 2.9 lb/0.9527 in.)			
Out of squareness			Less than 1.5°	
MLA				
MLA outer diameter	Intake		34.964~34.980 mm (1.3765~1.3772 in.)	
	Exhaust		34.964~34.980 mm (1.3765~1.3772 in.)	
Cylinder head tappet bore inner diameter	Intake		35.000~35.025 mm (1.3779~1.3789 in.)	
	Exhaust		35.000~35.025 mm (1.3779~1.3789 in.)	
MLA to tappet bore clearance	Intake		0.020~0.061 mm (0.0008~0.0024 in.)	0.07 mm (0.0027 in.)
	Exhaust		0.020~0.061 mm (0.0008~0.0024 in.)	0.07 mm (0.0027 in.)

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Valve clearance

Intake	0.17~0.23 mm (0.0067~0.0090 in.)	0.10~0.30 mm (0.0039~0.0118 in.)
Exhaust	0.27~0.33 mm (0.0106~0.0129 in.)	0.20~0.40 mm (0.0078~0.0157 in.)

Cylinder block

Cylinder bore	96.00~96.03 mm (3.7795~3.7807 in.)	
Flatness of gasket surface	Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.)/150 x 150]	

Piston

Piston outer diameter	95.96~95.99 mm (3.7779~3.7791 in.)	
Piston to cylinder clearance	0.03~0.05 mm (0.0012~0.0020 in.)	
Ring groove width	No. 1 ring groove	1.22~1.24 mm (0.0480~0.0488 in.)
	No. 2 ring groove	1.22~1.24 mm (0.0480~0.0488 in.)
	Oil ring groove	2.01~2.03 mm (0.0791~0.0799 in.)

Piston ring

Side clearance	No. 1 ring	0.03~0.07 mm (0.0012~0.0027 in.)	0.1 mm (0.004 in.)
	No. 2 ring	0.03~0.07 mm (0.0012~0.0027 in.)	0.1 mm (0.004 in.)
	Oil ring	0.06~0.15 mm (0.0024~0.0059 in.)	0.2mm (0.008 in.)
End gap	No. 1 ring	0.17~0.32 mm (0.0067~0.0126 in.)	0.6 mm (0.0236 in.)
	No. 2 ring	0.32~0.47 mm (0.0126~0.0185 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.20~0.70 mm (0.0078~0.0275 in.)	0.8 mm (0.0315 in.)

Piston pin

Piston pin outer diameter	23.001~23.006 mm (0.9055~0.9057 in.)	
Piston pin hole inner diameter	23.016~23.021 mm (0.9061~0.9063 in.)	
Piston pin hole clearance	0.01~0.02 mm (0.0039~0.0078 in.)	
Connecting rod small end inner diameter	22.974~22.985 mm (0.9045~0.9049 in.)	
Connecting rod small end hole clearance	-0.032~-0.016 mm (-0.0012~0.0006 in.)	

Connecting rod

Connecting rod big end inner diameter	58.000~58.018 mm (2.2834~2.2842 in.)	
Connecting rod bearing oil clearance	0.038~0.056 mm (0.0015~0.0022 in.)	
Side clearance	0.1~0.25 mm (0.0039~0.0098 in.)	

Crankshaft

Main journal outer diameter	68.942~68.960 mm (2.7142~2.7149 in.)	
Pin journal outer diameter	54.954~54.972 mm (2.1635~2.1642 in.)	
Main bearing oil clearance	0.022~0.040 mm (0.0008~0.0016 in.)	
End play	0.10~0.28 mm (0.0039~0.0110 in.)	

Oil pump

Relief valve opening pressure	450~550 kPa (4.59~5.61 kgf/cm ² , 65.28~79.79psi)	
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Engine oil

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Oil quantity (Total)		6.4L (6.76 U.S.qts, 5.63 Imp.qts)	
Oil quantity (Oil pan)		5.5L (5.81 U.S.qts, 4.84 Imp.qts)	
Oil quantity (Oil filter)		0.4L (0.42 U.S.qts, 0.35 Imp.qts)	
Oil quantity (Drain and refill)		5.2L (5.49 U.S.qts, 4.58 Imp.qts)	
Oil quality		Above SJ or SL	
Oil pressure		130 kPa (1.32 kgf/cm ² , 18.77 psi) [at 1000 rpm, 110°C (230°F)]	
Cooling system			
Cooling method		Forced circulation with electrical fan	
Coolant quantity		8.6L (9.09 U.S.qts, 7.57 Imp.qts)	
Thermostat	Type	Wax pellet type	
	Opening temperature	82 ± 2°C (179.6 ± 35.6°F)	
	Fully open temperature	95°C (203°F)	
	Full lift	More than 10 mm (0.3937 in.)	
Radiator cap	Main valve opening pressure	93.16~122.58 kPa (0.95~1.25 kg/cm ² , 13.51~17.78 psi)	
	Vacuum valve opening pressure	0.98~4.90 kPa (0.01~0.05 kg/cm ² , 0.14~0.71 psi)	
Water temperature sensor			
Type		Thermister type	
Resistance	20°C (68°F)	2.31~2.59 Kohms	
	80°C (176°F)	0.3222 Kohms	

TIGHTENING TORQUE

TIGHTENING TORQUE

Item	Quantity	Nm	kgf.m	lb-ft
Crankshaft pulley bolt	1	284.2~303.8	29.0~31.0	209.76~224.22
Timing chain cover bolt B	17	18.62~21.56	1.9~2.2	13.74~15.91
Timing chain cover bolt C	4	9.80~11.76	1.0~1.2	7.23~8.68
Timing chain cover bolt D	1	58.80~68.80	6.0~7.0	43.40~50.63
Timing chain cover bolt E	1	58.80~68.80	6.0~7.0	43.40~50.63
Timing chain cover bolt F	2	24.50~26.46	2.5~2.7	18.08~19.53
Timing chain cover bolt G	4	21.56~23.52	2.2~2.4	15.91~17.36
Timing chain cover bolt H	1	9.80~11.76	1.0~1.2	7.23~8.68
Timing chain cover bolt I	1	9.80~11.76	1.0~1.2	7.23~8.68
Timing chain cover bolt J	1	9.80~11.76	1.0~1.2	7.23~8.68
Cam to cam guide bolt	4	9.80~11.76	1.0~1.2	7.23~8.68
Timing chain auto tensioner bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Timing chain auto tensioner nut	2	9.80~11.76	1.0~1.2	7.23~8.68

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Timing chain guide bolt	4	19.60~24.50	2.0~2.5	14.17~18.08
Oil pump chain cover bolt	3	9.80~11.76	1.0~1.2	7.23~8.68
Oil pump chain tensioner bolt	1	9.80~11.76	1.0~1.2	7.23~8.68
Oil pump chain guide bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Oil pump chain sprocket bolt	1	18.62~21.56	1.9~2.2	13.74~15.91
Lower oil pan bolt	13	9.80~11.76	1.0~1.2	7.23~8.68
Drive belt auto tensioner bolt (M12)	1	96.04~99.96	9.8~10.2	70.88~73.78
Drive belt auto tensioner bolt (M8)	1	17.64~21.56	1.8~2.2	13.02~15.91
Drive belt idler bolt	1	53.90~57.82	5.5~5.9	39.78~42.67
OCV (oil control valve) bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Cylinder head bolt	16	39.2 + 120° + 90°	4.0 + 120° + 90°	28.93 + 120° + 90°
Cylinder head bolt	1	18.62~23.52	1.9~2.4	13.74~17.36
CVVT & exhaust cam sprocket bolt	4	64.68~76.44	6.6~7.8	47.74~56.42
Camshaft bearing cap bolt	32	9.80~11.76	1.0~1.2	7.23~8.68
Cylinder head cover bolt	38	9.80~11.76	1.0~1.2	7.23~8.68
Connecting rod bearing bolt	12	19.60 + 90°	2.0 + 90°	14.46 + 90°
Main bearing cap inner bolt (M11)	8	49.00 + 90°	5.0 + 90°	36.16 + 90°
Main bearing cap outer bolt (M8)	8	19.60 + 120°	2.0 + 120°	14.46 + 120°
Main bearing cap side bolt (M8)	6	29.40~31.36	3.0~3.2	21.70~23.14
Oil drain cover bolt	6	9.80~11.76	1.0~1.2	7.23~8.68
Rear oil seal case bolt	6	9.80~11.76	1.0~1.2	7.23~8.68
Baffle plate bolt	12	9.80~11.76	1.0~1.2	7.23~8.68
Upper oil pan bolt	16	9.80~11.76	1.0~1.2	7.23~8.68
Knock sensor bolt	2	15.68~23.52	1.6~2.4	11.57~17.36
Drive plate bolt	8	71.54~75.46	7.3~7.7	52.80~55.69
Oil filter cap		24.50	2.5	18.08
Oil drain bolt	1	34.30~44.10	3.5~4.5	25.31~32.55
Oil pump bolt	3	19.6~23.5	2.0~2.4	14.5~17.4
Oil filter body bolt	10	9.80~11.76	1.0~1.2	7.23~8.68
Oil filter body cover bolt	11	9.80~11.76	1.0~1.2	7.23~8.68
Water vent hose bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Water pump bolt (Timing chain cover bolt L)	1	21.56~26.46	2.2~2.7	15.91~19.53
Water pump bolt (Timing chain cover bolt K)	4	9.80~11.76	1.0~1.2	7.23~8.68
Water pump pulley bolt	4	7.84~9.80	0.8~1.0	5.78~7.23
Water temp, control nut	4	18.62~23.52	1.9~2.4	13.74~17.36
Water temp, control bolt	2	18.62~23.52	1.9~2.4	13.74~17.36
Water inlet fitting bolt	3	16.66~19.60	1.7~2.0	12.30~14.47
Water vent pipe bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Intake manifold bolt	6	18.62~23.52	1.9~2.4	13.74~17.36

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Intake manifold nut	2	18.62~23.52	1.9~2.4	13.74~17.36
Surge tank bolt (M8 x 25)	3	18.62~23.52	1.9~2.4	13.74~17.36
Surge tank bolt (M6 x 106)	2	9.80~11.76	1.0~1.2	7.23~8.68
Surge tank nut	1	18.62~23.52	1.9~2.4	13.74~17.36
Breather pipe bolt	2	9.80~11.76	1.0~1.2	7.23~8.68
Surge tank bracket bolt rear (M10 x 18)	2	27.44~31.36	2.8~3.2	20.25~23.14
Surge tank bracket bolt front (M8 x 16)	2	18.62~23.52	1.9~2.4	13.74~17.36
ETC bracket bolt	2	15.68~25.48	1.6~2.6	11.57~18.80
Exhaust manifold nut	16	39.20~44.10	4.0~4.5	28.93~32.55
Heat protector bolt	8	3.9~5.9	0.4~0.6	2.89~4.34
Front muffler	2	39.20~58.80	4.0~6.0	28.93~43.40

COMPRESSION

NOTE: If 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 the surge tank.
3. Remove the ignition coil connectors (A) and ignition coils (B).

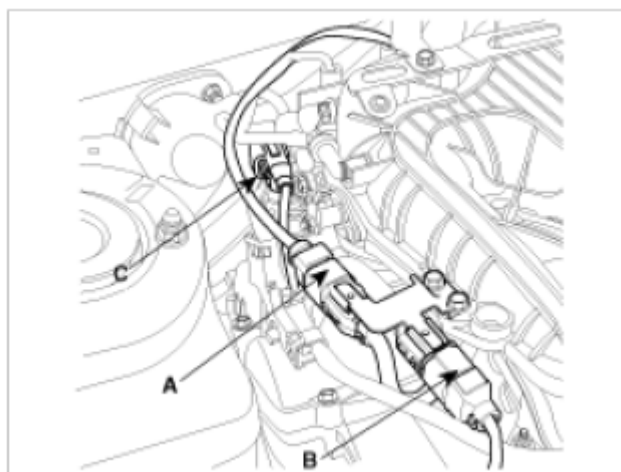


Fig. 1: Locating Ignition Coil Connectors (A) And Ignition Coils (B)
Courtesy of HYUNDAI MOTOR CO.

4. Remove all 6 spark plugs using a 16mm spark plug socket.
5. Check cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole.

2. Fully open the throttle.
3. After 7 times of cranking the engine, measure the compression pressure.

NOTE: Always use a fully charged battery to obtain engine speed of 250 RPM or more.

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

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

Compression pressure: 1,225 kPa (12.5 kgf/cm² , 177 psi) - 200~250 rpm

Minimum pressure: 1,078 kPa (11.0 kgf/cm² , 156 psi)

5. 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 (1) through (3) 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.
6. Reinstall the spark plugs.
7. Install the ignition coil and ignition coil connectors.
8. Install the surge tank.

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.
2. Remove air cleaner assembly.
3. Remove the surge tank.
4. Remove the cylinder head cover.
 1. Disconnect the ignition coil connector and remove the ignition coil.
 2. Disconnect the breather pipe assembly (A) from the cylinder head cover.

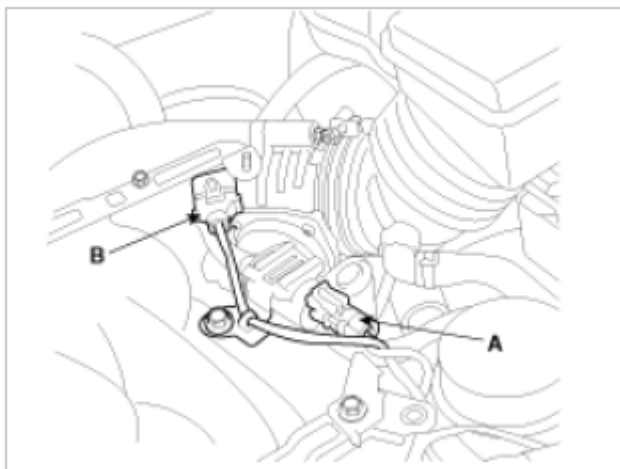


Fig. 2: Locating Breather Pipe Assembly
Courtesy of HYUNDAI MOTOR CO.

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

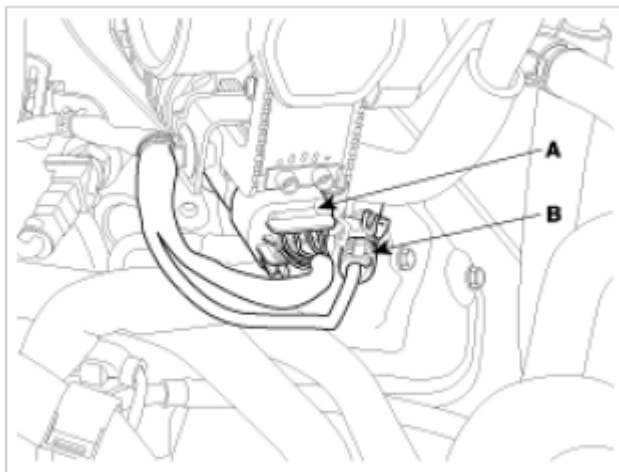


Fig. 3: Locating Cylinder Head Cover
Courtesy of HYUNDAI MOTOR CO.

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

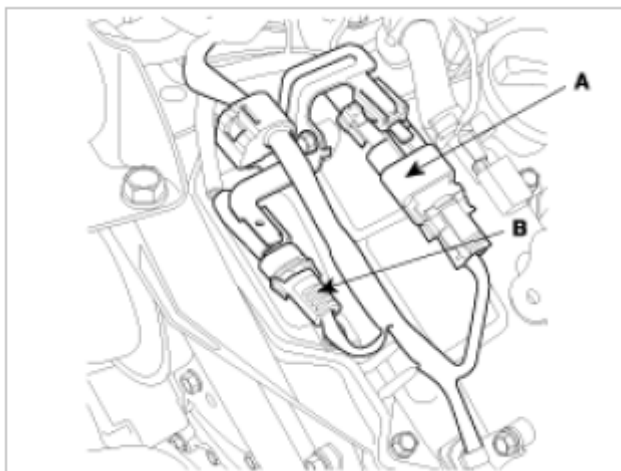


Fig. 4: Identifying Timing Mark "T" Of Lower Timing Chain Cover
Courtesy of HYUNDAI MOTOR CO.

2. 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°)

NOTE: Do not rotate engine counterclockwise

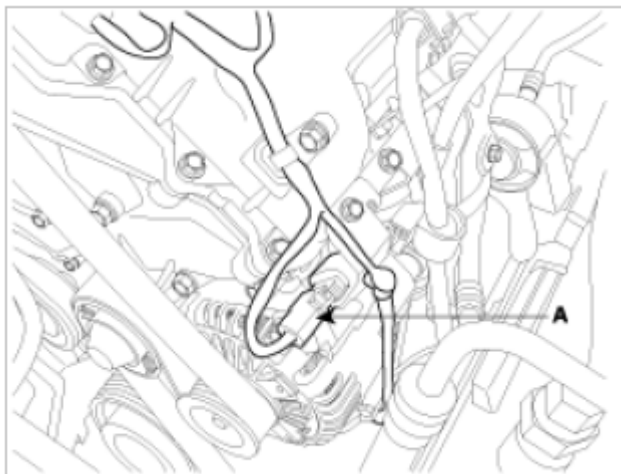


Fig. 5: Identifying Mark Of Camshaft Timing Sprockets
Courtesy of HYUNDAI MOTOR CO.

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

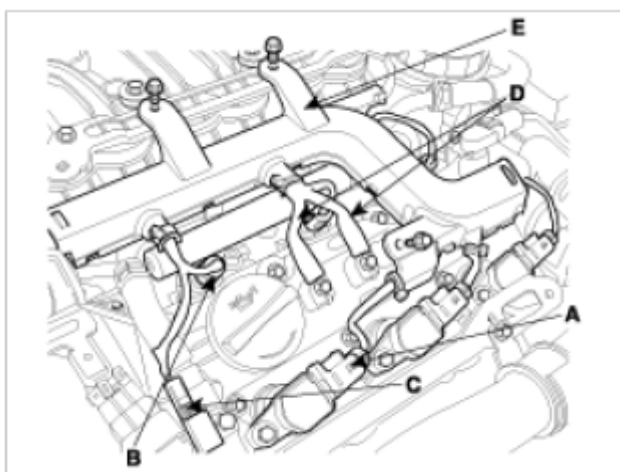


Fig. 6: Inspecting Valve Clearance
 Courtesy of HYUNDAI MOTOR CO.

Measurement method.

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

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

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

NOTE: Do not rotate engine counterclockwise

3. Check only valves indicated as shown. [NO. 4 cylinder: TDC/compression]. Measure the valve clearance. (Refer to procedure step 1).

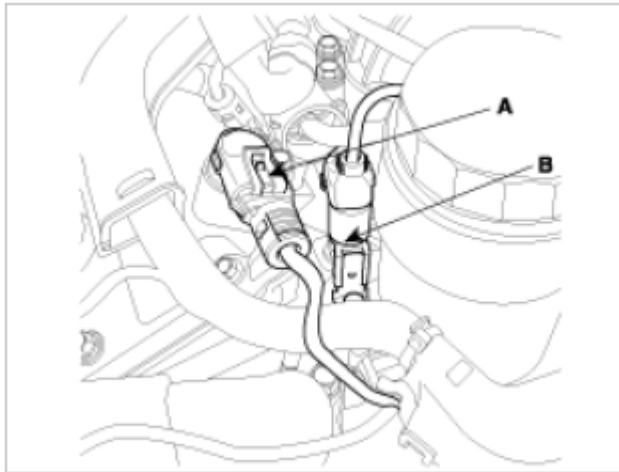


Fig. 7: Inspecting Valve Clearance
Courtesy of HYUNDAI MOTOR CO.

7. Adjust the intake and exhaust valve clearance.
 1. Set the No. 1 cylinder to the TDC/compression.
 2. Remove the timing chain.

NOTE: Before removing the timing chain, mark the RH/LH timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.

3. Remove the camshaft bearing caps (A).

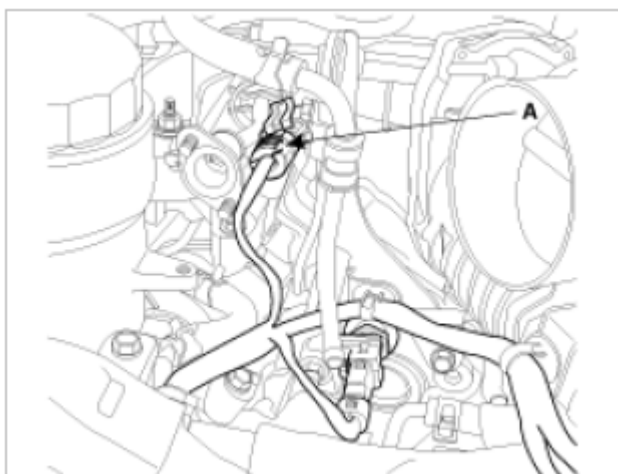


Fig. 8: Identifying Camshaft Bearing Caps
Courtesy of HYUNDAI MOTOR CO.

4. Remove the camshaft assembly (A).

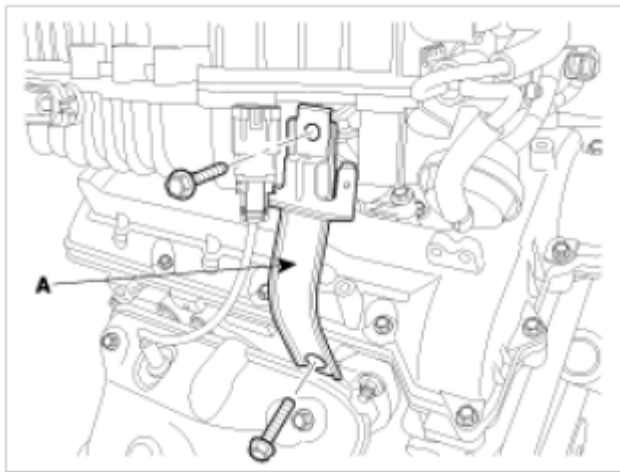


Fig. 9: Identifying Camshaft Assembly
Courtesy of HYUNDAI MOTOR CO.

5. Remove MLAs.
6. Measure the thickness of the removed tappet using a micrometer.

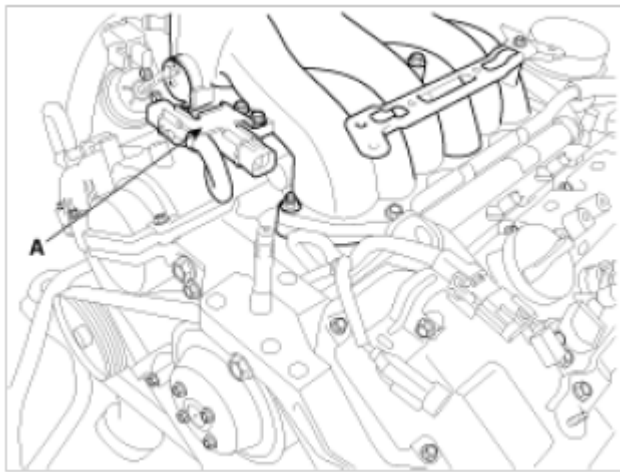


Fig. 10: Measuring Thickness Of Removed Tappet
Courtesy of HYUNDAI MOTOR CO.

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

Valve clearance (Engine coolant temperature: 20°C [68°F])

T: Thickness of removed tappet

A: Measured valve clearance

N: Thickness of new tappet

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

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

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

NOTE: Shims are available in 41 size increments of 0.015 mm (0.0006 in.) from 3.00 mm (0.1 W in.) to 3.600 mm (0.1417 in.)

9. Place a new tappet on the cylinder head.

NOTE: Applying engine oil at the selected tappet on the periphery and top surface.

10. Install the intake and exhaust camshaft.
11. Install camshaft bearing caps (A).

Assemble camshaft bearing caps as the order below.

Tightening torque 5.9 Nm (0.6 kgf.m, 4.3 lb-ft) - 1st step 9.80~11.76 Nm (1.0~1.2 kgf.m, 7.23~8.68 lb-ft) - 2nd step

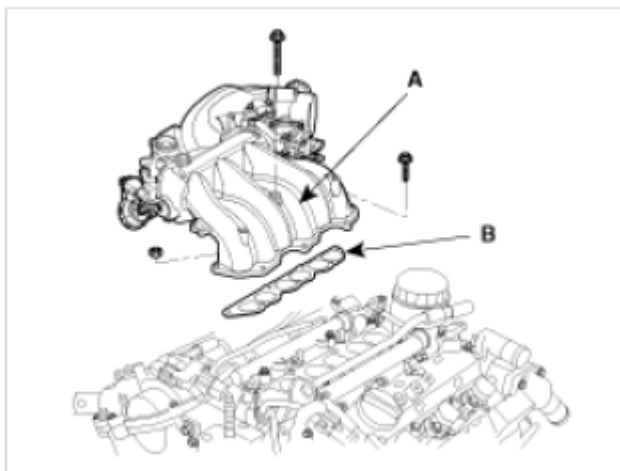


Fig. 11: Identifying Camshaft Bearing Caps
Courtesy of HYUNDAI MOTOR CO.

12. Install the timing chain.
13. Turn the crankshaft two turns in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks (A).

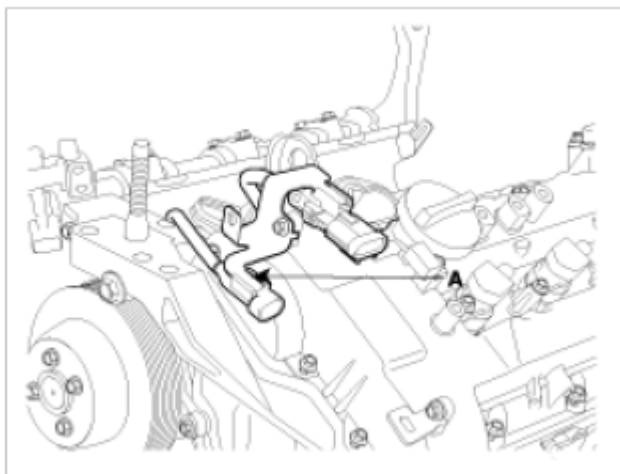


Fig. 12: Identifying Camshaft Sprocket Timing Marks
Courtesy of HYUNDAI MOTOR CO.

14. Recheck the valve clearance.

Valve clearance (Engine coolant temperature: 20°C [68°F])

[Specification]

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

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

TROUBLESHOOTING

TROUBLESHOOTING

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or improperly installed engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate 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.
	Malfunctioning cylinder head gasket	

2008 Hyundai Entourage GLS

2008 ENGINE Engine (G6DA - GSA 3.8L) - Entourage

Engine misfire with coolant 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.	- Inspect the cylinder head and engine block for damage to the coolant passages and/or a malfunctioning 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.
	Low oil pressure.	Repair or required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	- Inspect the oil pan. - Inspect the oil pump screen. - Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	- Inspect the oil pump screen. - Repair or replace as required.
	Excessive piston-to-cylinder bore	Inspect the piston, piston pin and

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

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Engine will not crank—crankshaft will not rotate.	Broken timing chain and/or timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft.	1. Inspect crankshaft. 2. Repair as required.

SPECIAL TOOLS

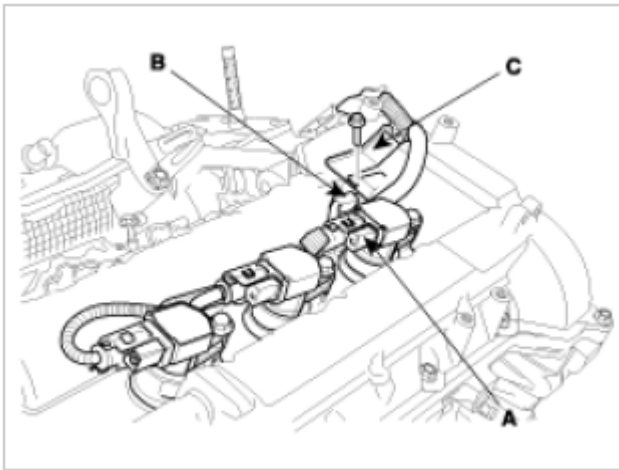


Fig. 13: Special Tools Chart (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

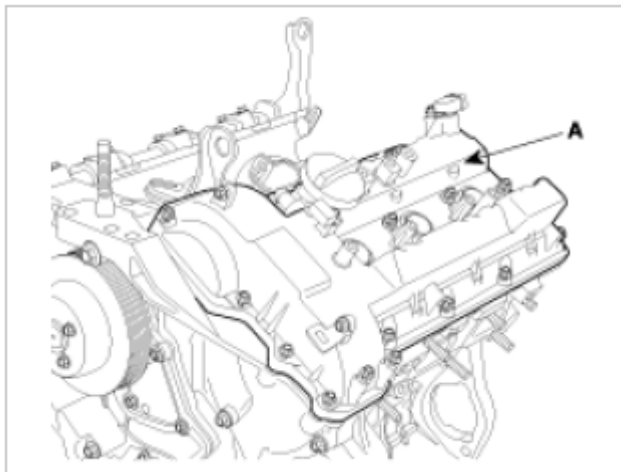


Fig. 14: Special Tools Chart (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

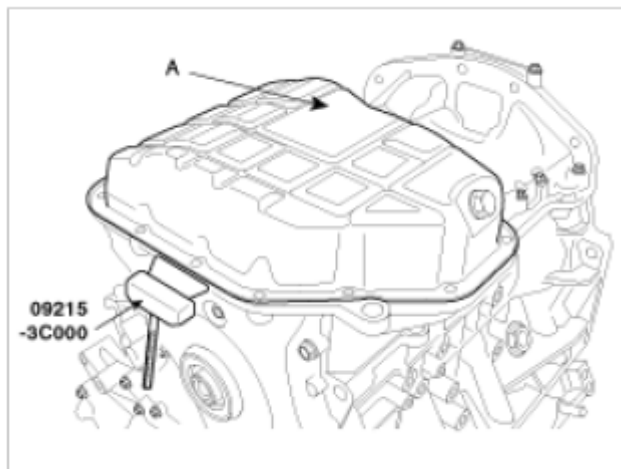
ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

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

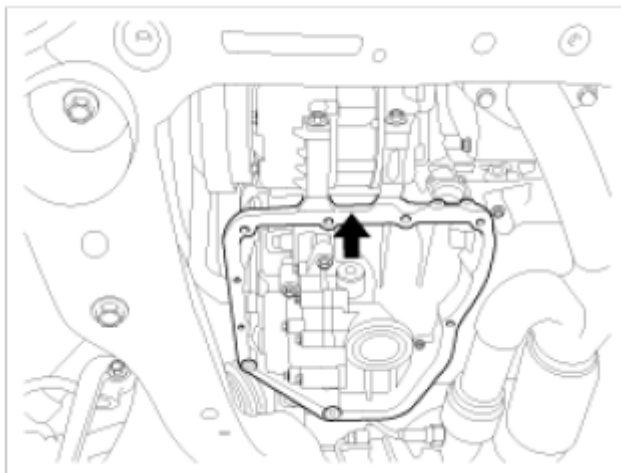
- NOTE:**
- Mark all wiring and hoses to avoid mis-connection.

1. Remove the engine cover.
2. Recover refrigerant, opening the high & low pressure pipe caps and connecting the refrigerant station (Refer to **REFRIGERANT SYSTEM SERVICE BASICS**).
3. Disconnect the negative terminal from the battery and remove the battery (A).

**Fig. 15: Identifying Battery**

Courtesy of HYUNDAI MOTOR CO.

4. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Remove the intake air hose and air cleaner assembly (C).

**Fig. 16: Identifying Intake Air Hose And Air Cleaner Assembly**

Courtesy of HYUNDAI MOTOR CO.

5. Remove the battery tray (A).

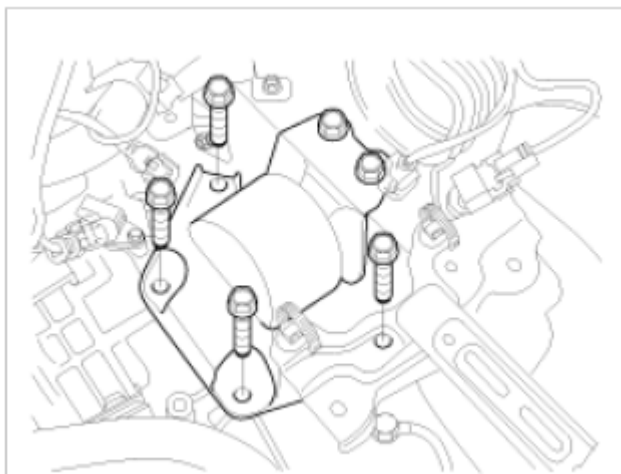


Fig. 17: Identifying Battery Tray
Courtesy of HYUNDAI MOTOR CO.

6. Remove the radiator grille upper cover (A).

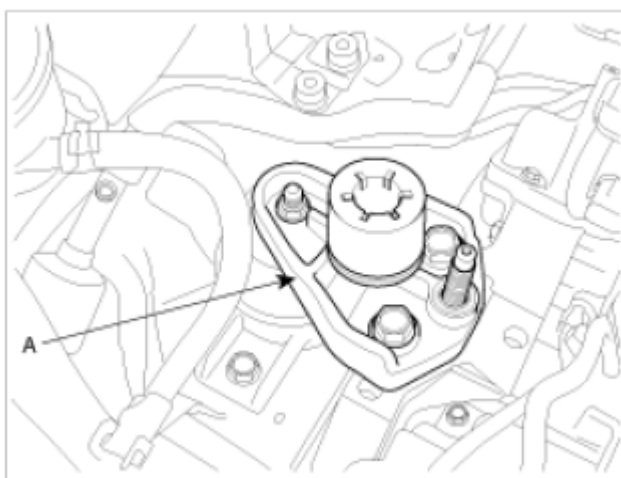


Fig. 18: Identifying Radiator Grille Upper Cover
Courtesy of HYUNDAI MOTOR CO.

7. Disconnect the RH and LH oxygen sensor connectors (A, B).

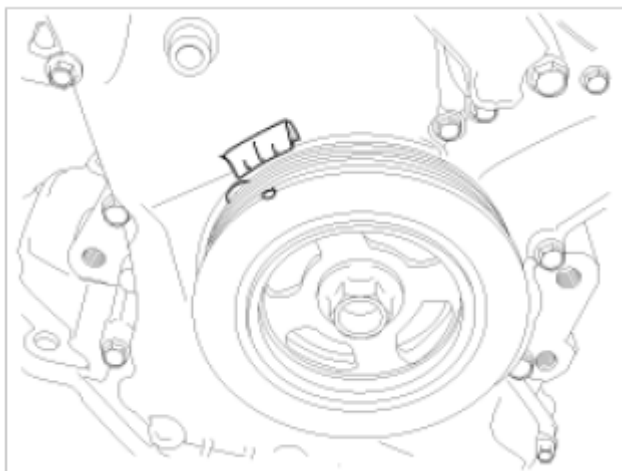


Fig. 19: Identifying RH Oxygen Sensor Connectors
Courtesy of HYUNDAI MOTOR CO.

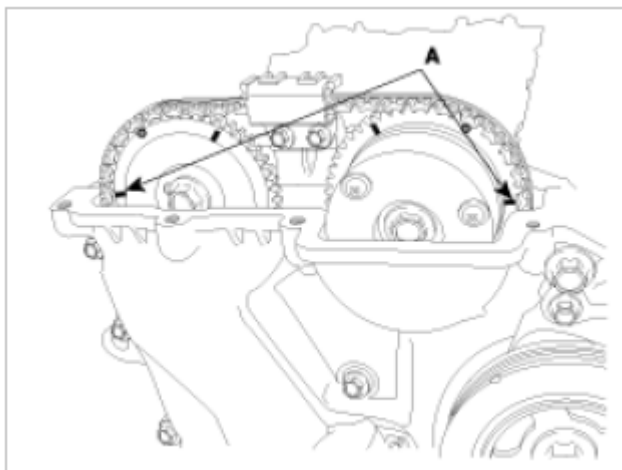


Fig. 20: Identifying LH Oxygen Sensor Connectors
Courtesy of HYUNDAI MOTOR CO.

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

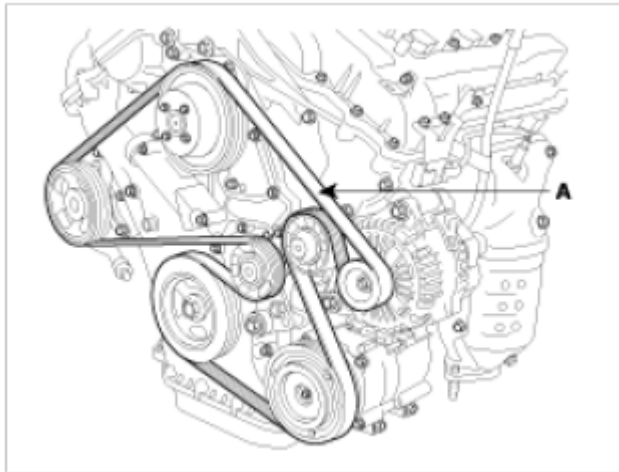


Fig. 21: Identifying Radiator Upper And Lower Hoses
Courtesy of HYUNDAI MOTOR CO.

9. Disconnect the automatic transaxle fluid cooler hoses (A).

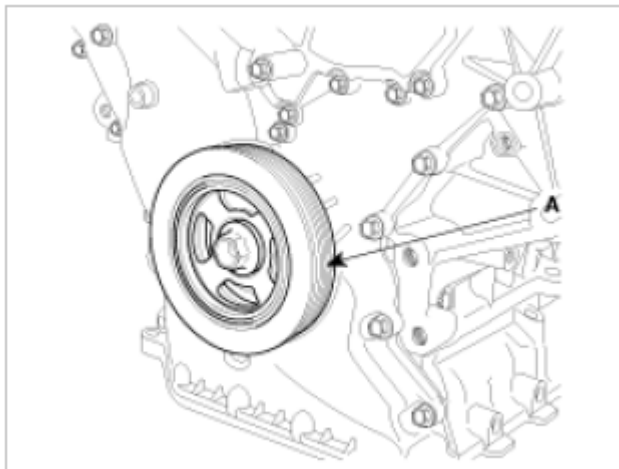


Fig. 22: Identifying Automatic Transaxle Fluid Cooler Hoses
Courtesy of HYUNDAI MOTOR CO.

10. Disconnect the high and low pressure pipes from the radiator or the compressor.
11. Disconnect engine wiring.
 1. Remove the engine room fuse and relay box cover (A).
 2. Disconnect the PCM connectors (B).
 3. Disconnect the FAM connectors (C) (Refer to **HEATING, VENTILATION & AIR CONDITIONING -- ENTOURAGE**).

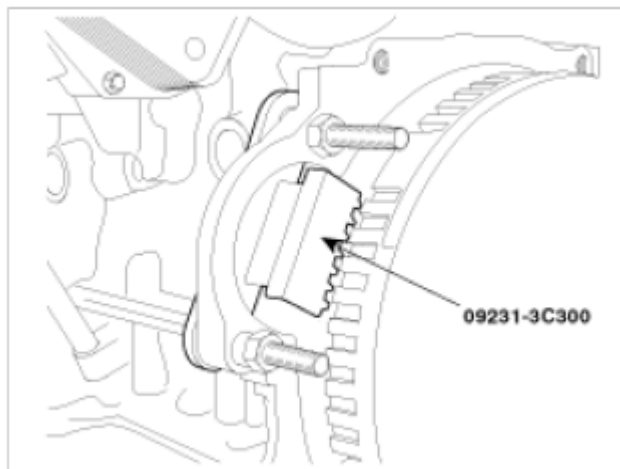


Fig. 23: Identifying FAM Connectors
Courtesy of HYUNDAI MOTOR CO.

4. Unscrew the FAM mounting bolts (D-3EA) and take the FAM (E) out of the splash shield (F).
5. Disconnect the connector (G) from the splash shield (B).

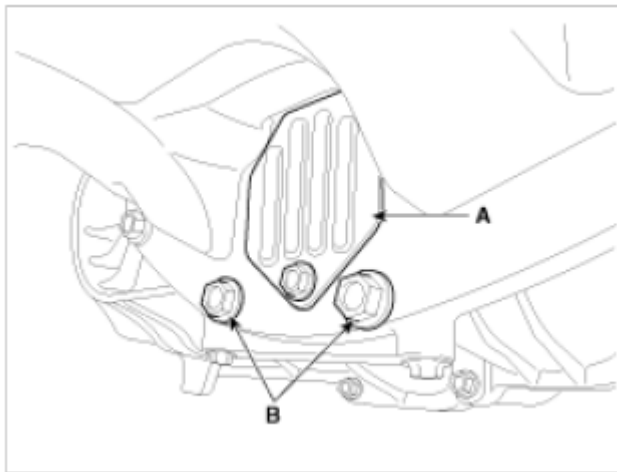


Fig. 24: Identifying Splash Shield Connector
Courtesy of HYUNDAI MOTOR CO.

12. Disconnect the transaxle wire harness connector and remove the transaxle control cable (Refer to **AUTOMATIC TRANSAXLE (A5HF1) -- ENTOURAGE**).
13. Remove heater hose (A).

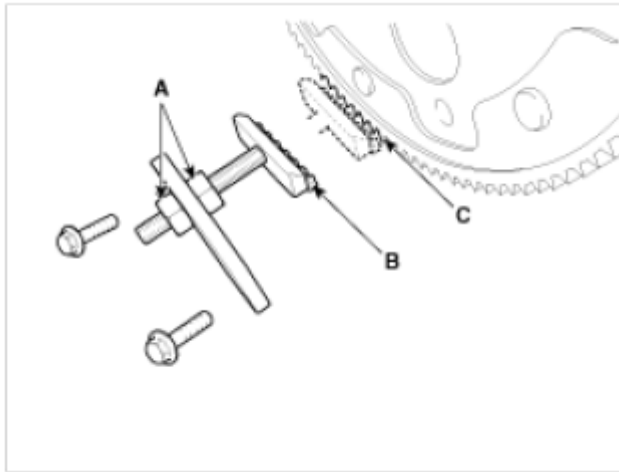


Fig. 25: Identifying Heater Hose
Courtesy of HYUNDAI MOTOR CO.

14. Remove the brake vacuum hose (A).

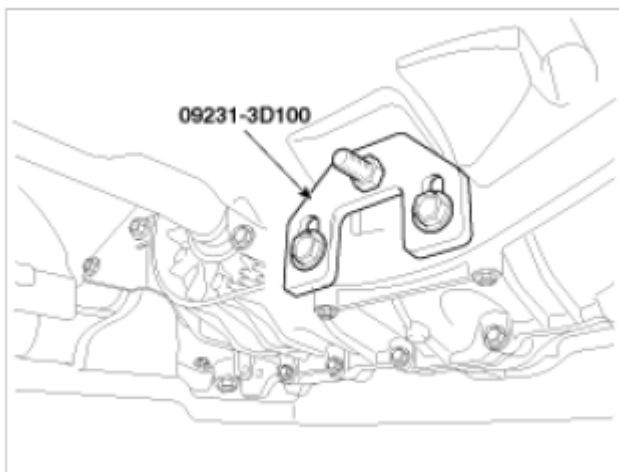


Fig. 26: Identifying Brake Vacuum Hose
Courtesy of HYUNDAI MOTOR CO.

15. Remove power steering pump hose (Refer to **POWER STEERING HOSES**).
16. Remove front wheels (Refer to step 1 under **REMOVAL**).
17. Remove the radiator grille upper cover (A) for convenience sake.

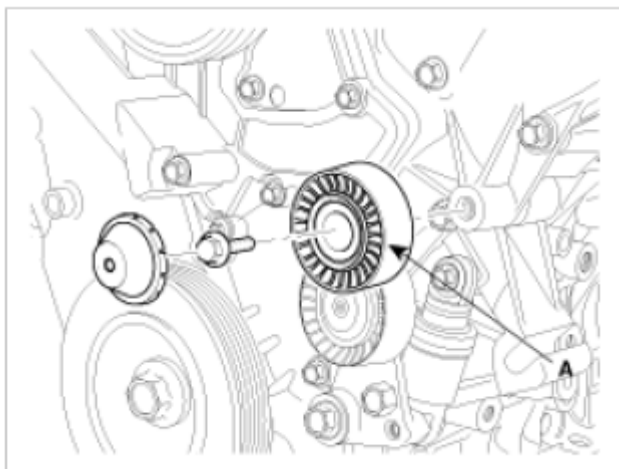


Fig. 27: Identifying Radiator Grille Upper Cover
Courtesy of HYUNDAI MOTOR CO.

18. Disconnect the power steering return hose (A).

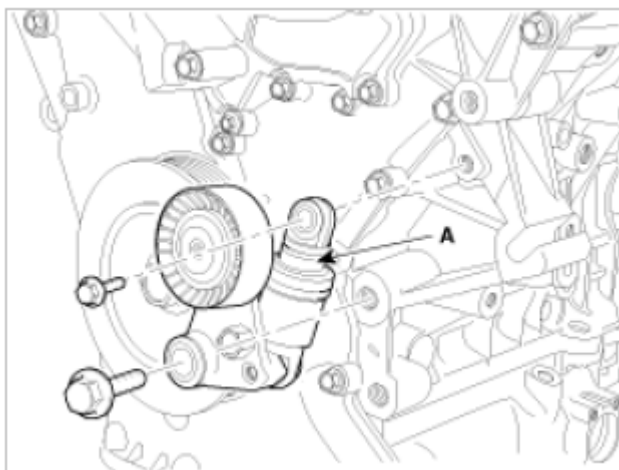


Fig. 28: Identifying Power Steering Return Hose
Courtesy of HYUNDAI MOTOR CO.

19. Remove the radiator support upper member assembly (C) for convenience sake.

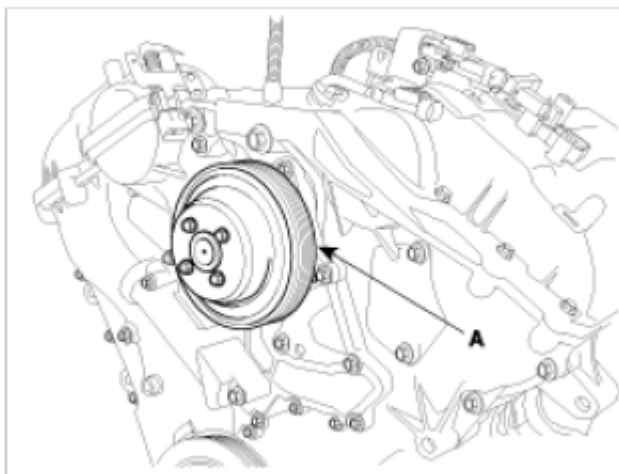


Fig. 29: Identifying Radiator Support Upper Member Assembly
Courtesy of HYUNDAI MOTOR CO.

NOTE: The bottom side bolt (A) which can be seen after removing the under cover should be loosened for removal of the radiator support upper member assembly.

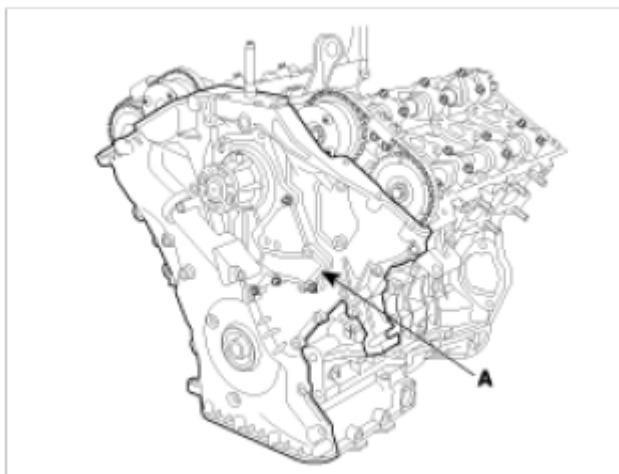


Fig. 30: Identifying Bottom Side Bolt
Courtesy of HYUNDAI MOTOR CO.

20. Remove the under cover (A).

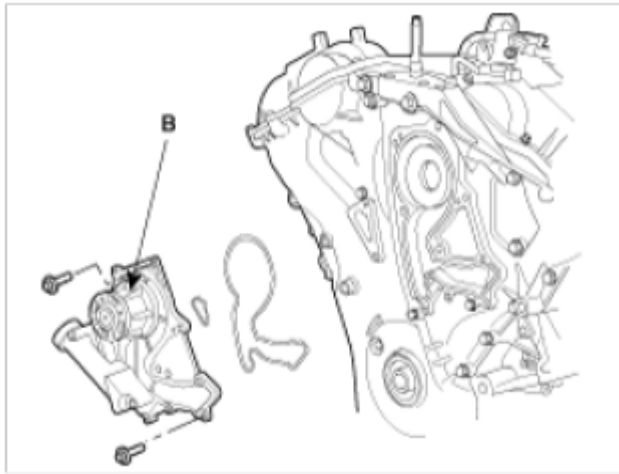


Fig. 31: Identifying Under Cover
Courtesy of HYUNDAI MOTOR CO.

21. Drain engine oil.
22. Coolant should be drained before heater hose removal.
23. Remove front exhaust pipe (A).

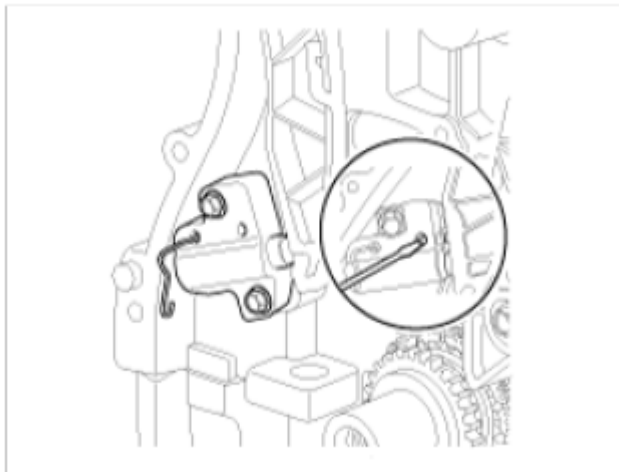


Fig. 32: Identifying Front Exhaust Pipe
Courtesy of HYUNDAI MOTOR CO.

24. Disconnect the wheel speed sensor and the stabilizer bar link (Refer to step 4 and 5 under **REMOVAL**).
25. Remove the caliper assembly and suspend it with a wire (Refer to step 6 under **REMOVAL**).
26. Supporting the engine and transaxle assembly with sub frame, remove the engine mounting bracket (A).

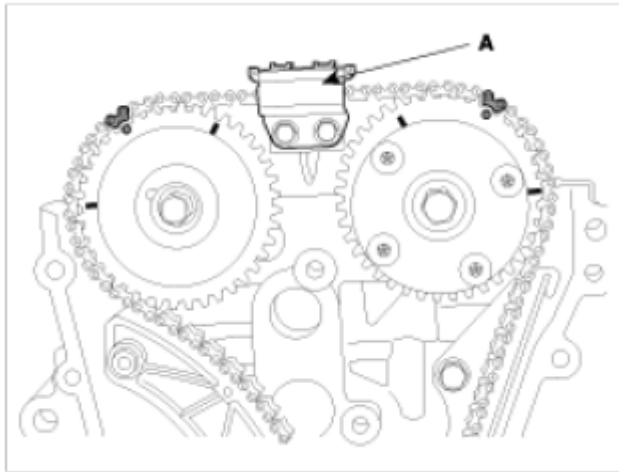


Fig. 33: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

27. Remove the transaxle insulator mounting bolt (A).

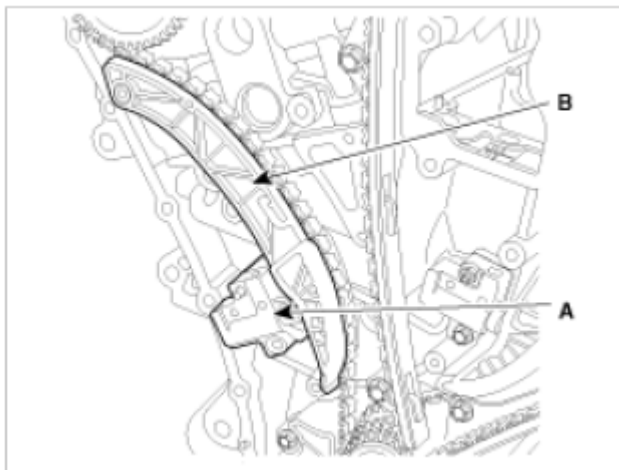


Fig. 34: Identifying Transaxle Insulator Mounting Bolt
Courtesy of HYUNDAI MOTOR CO.

28. Supporting the engine and transaxle assembly with a jack, remove the sub frame with the engine and transaxle assembly.

NOTE: When removing the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

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.

TIMING SYSTEM

TIMING CHAIN

Components and Components Location

COMPONENT

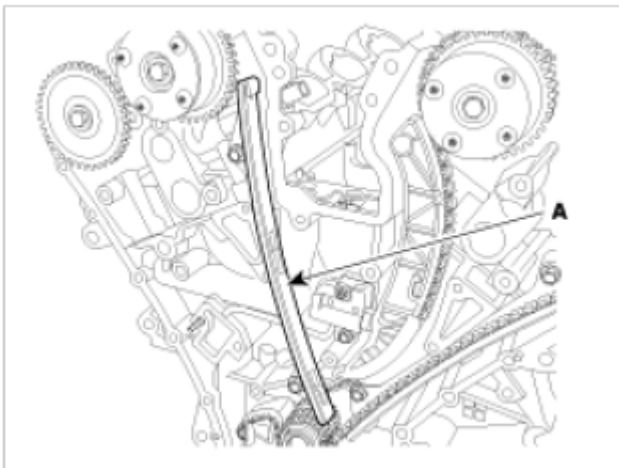
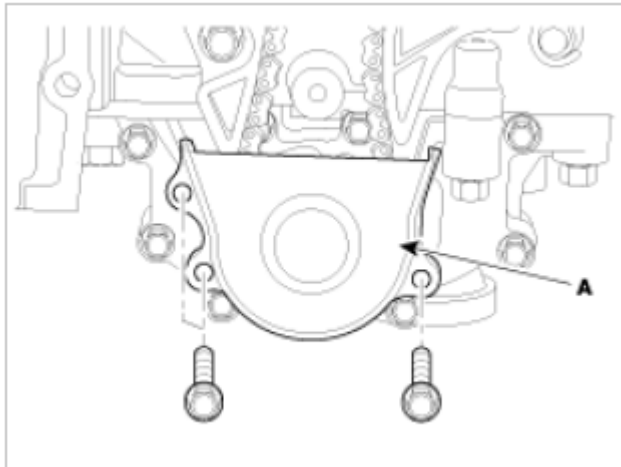


Fig. 35: Identifying Timing Chain Components (1 Of 2)

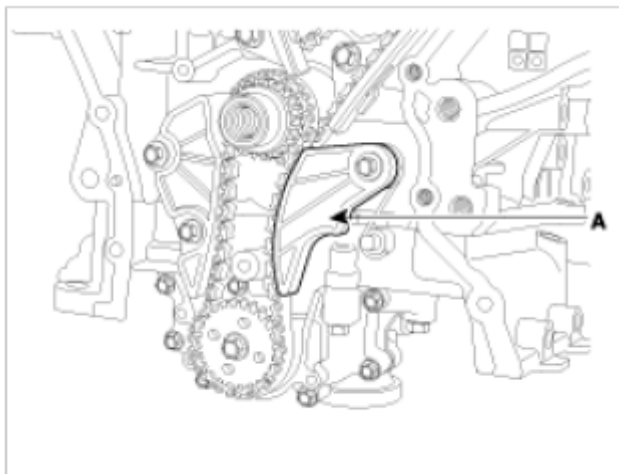
**Fig. 36: Identifying Timing Chain Components (2 Of 2)****Repair procedures****REMOVAL****CAUTION:**

- 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.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Disconnect the battery negative cable (A).

**Fig. 37: Locating Battery Negative Cable**

2. Remove the engine cover (A).

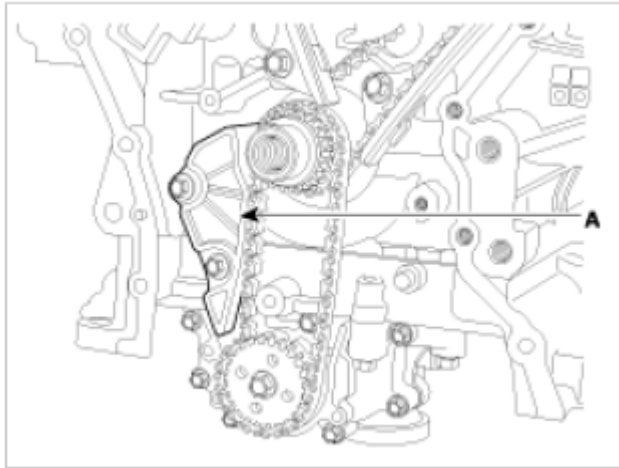


Fig. 38: Locating Engine Cover

3. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF sensor connector (A).
 2. Disconnect the breather hose (B) from air intake hose.
 3. Remove the intake air hose and air cleaner assembly (C).

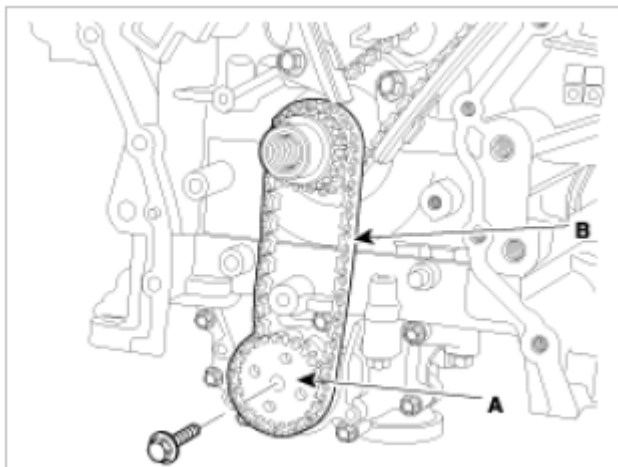
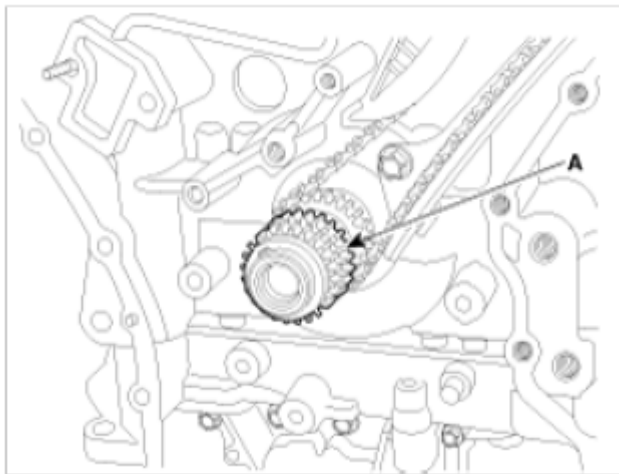
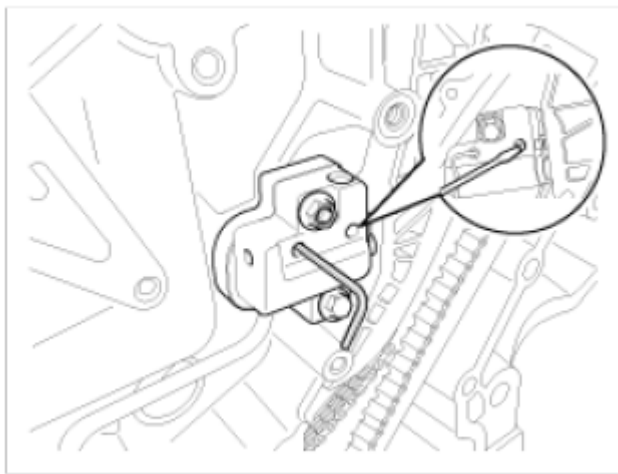


Fig. 39: Locating MAF Sensor Connector, Breather Hose And Air Cleaner Assembly

4. Remove the RH front wheel.
5. Remove the under cover (A).

**Fig. 40: Locating Under Cover**

6. Remove the side cover.
7. Loosen the drain plug and drain the engine coolant.
8. Drain the engine oil.
9. Remove the surge tank.
 1. Disconnect the RH oxygen sensor connector (A) and loosen the power steering hose mounting bolts (B).

**Fig. 41: Locating RH Oxygen Sensor Connector And Power Steering Hose Mounting Bolts**

2. Disconnect the RH injector connector (A) and ignition coil connector (B).

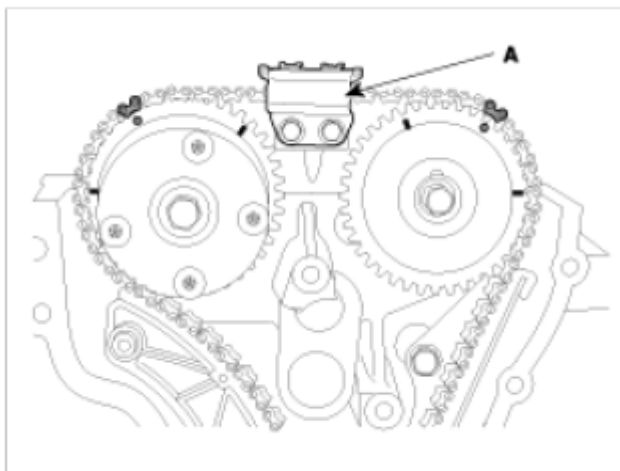


Fig. 42: Locating RH Injector Connector And Ignition Coil Connector

3. Disconnect the PCSV connector (A), MAP sensor connector (B) and PCSV hose.

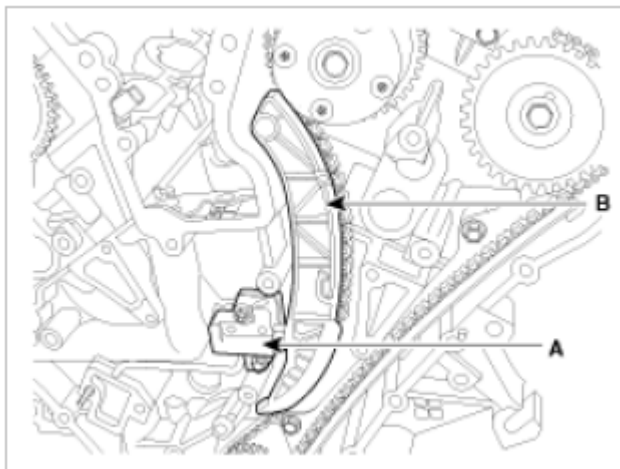


Fig. 43: Locating PCSV Connector, MAP Sensor Connector And PCSV Hose

4. Disconnect the ETC connector (A) and knock sensor connector (B).

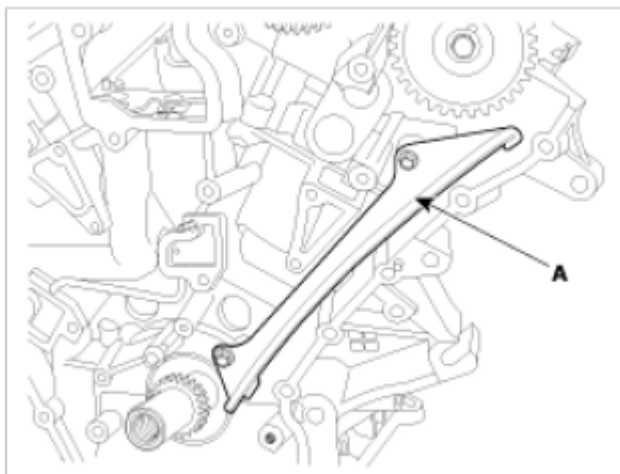


Fig. 44: Locating ETC Connector And Knock Sensor Connector

5. Disconnect the OCV connector (A) and knock sensor connector (B).

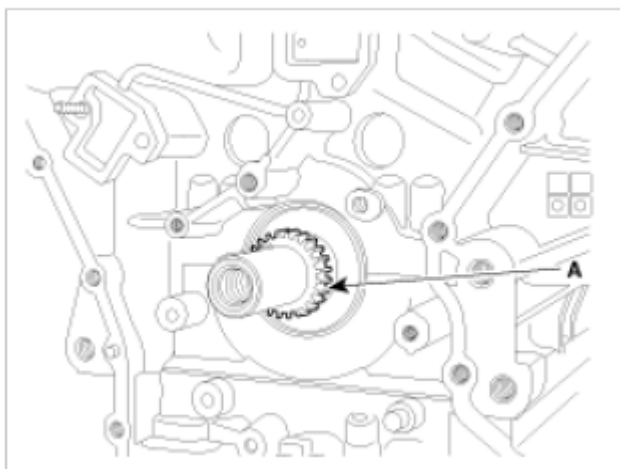


Fig. 45: Locating OCV Connector And Knock Sensor Connector

6. Disconnect the LH front oxygen sensor connector (A).

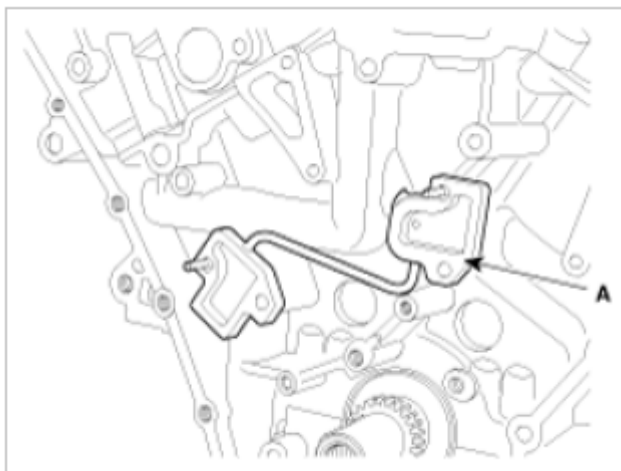


Fig. 46: Locating LH Front Oxygen Sensor Connector

7. Disconnect the LH ignition coil connector (A), injector connector (B), condenser connector (C) and ground (D), and remove the wiring harness protector (E).

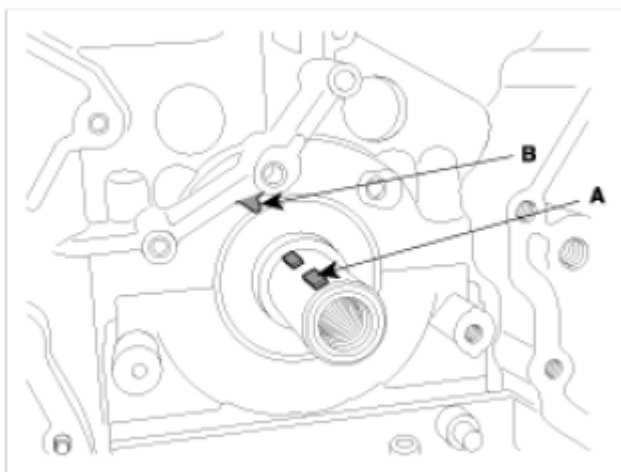


Fig. 47: Locating LH Ignition Coil Connector, Injector Connector, Condenser Connector, Ground And Wiring Harness Protector

8. Disconnect the LH CMPS (A) and oil pressure switch connector (B).

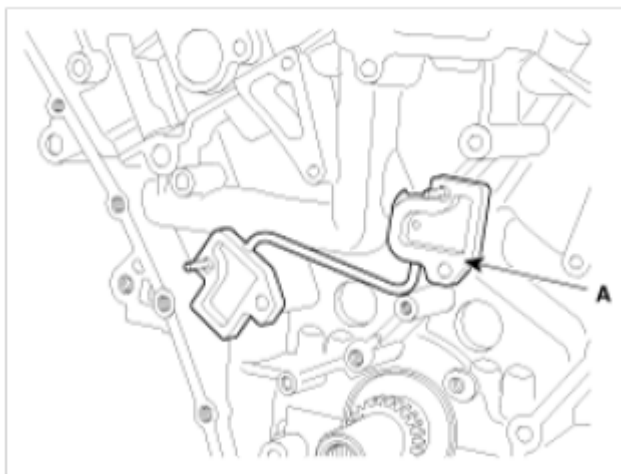


Fig. 48: Locating LH CMPS And Oil Pressure Switch Connector

9. Remove the ETC bracket (A).
10. Disconnect the water hoses (B) from ETC.
11. Disconnect the PCV hose (C).

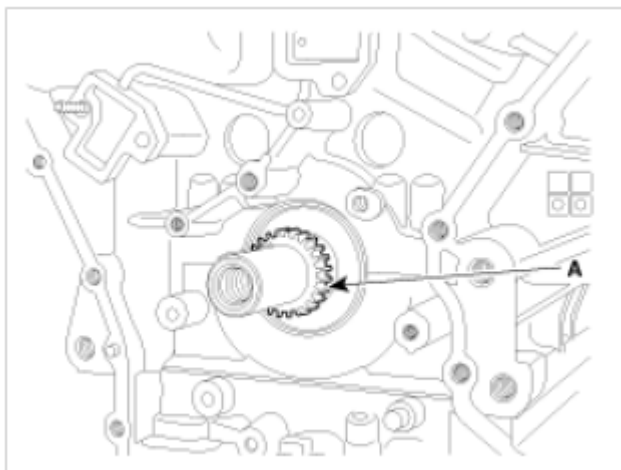


Fig. 49: Locating ETC Bracket, Water Hoses And PCV Hose

12. Disconnect the brake vacuum hose.
13. Remove the surge tank stay (A).

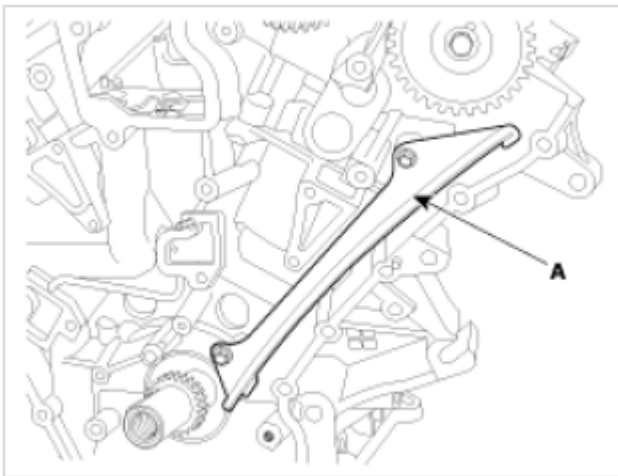


Fig. 50: Locating Surge Tank Stay

14. Remove the connector bracket (A) from surge tank.

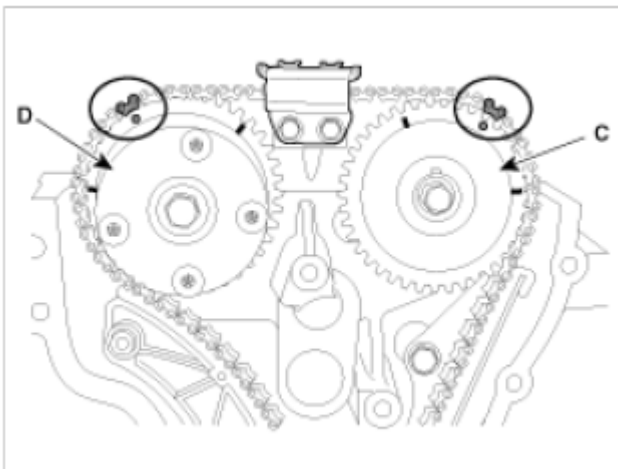


Fig. 51: Locating Surge Tank Connector Bracket

15. Remove the surge tank (A).

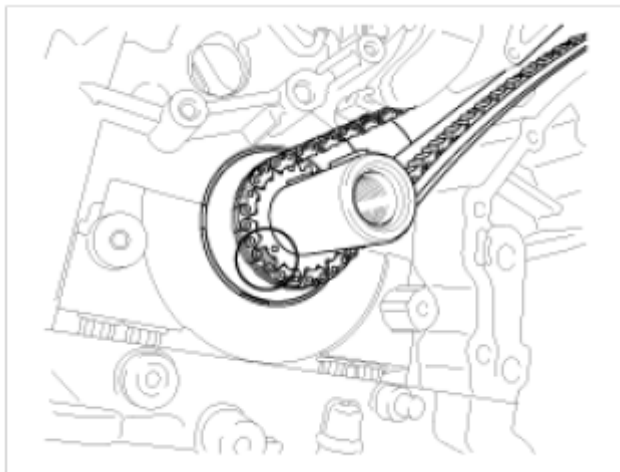


Fig. 52: Locating Surge Tank

NOTE: Cover the inlet of intake manifold with a clean woven stuff or vinyl cover to prevent foreign materials from entering.

10. Remove the cylinder head cover.
 1. Remove the connector bracket (A) from LH cylinder head cover.

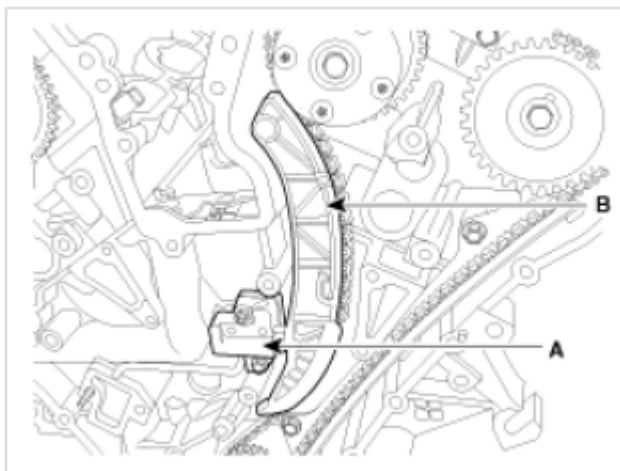


Fig. 53: Locating LH Cylinder Head Cover Connector Bracket

2. Disconnect the RH ignition coil connector (A), condenser connector (B) and remove the wiring bracket (C).

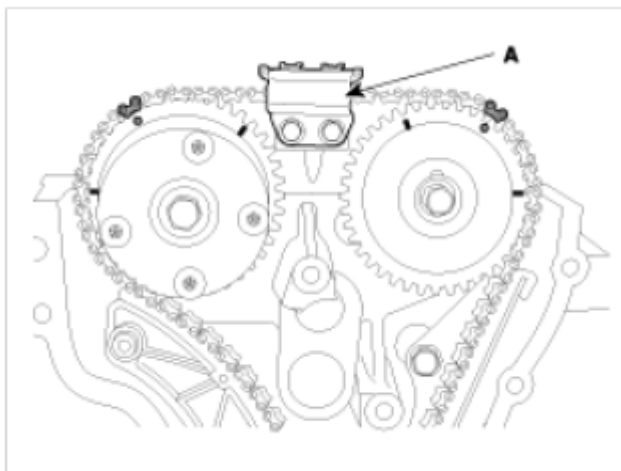


Fig. 54: Locating RH Ignition Coil Connector, Condenser Connector And Wiring Bracket

3. Remove the LH, RH ignition coil.
4. Remove the LH, RH cylinder head cover (A).

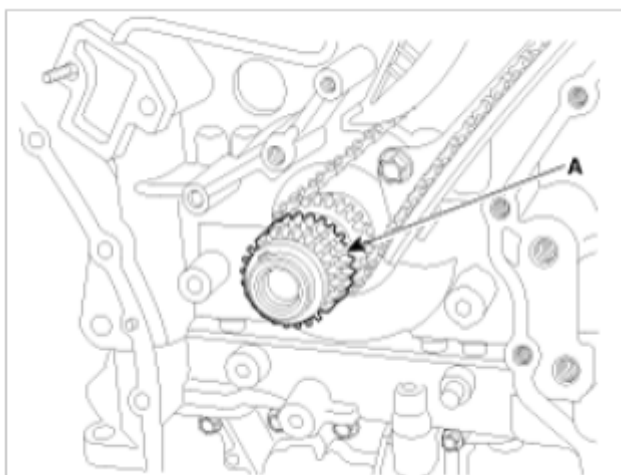


Fig. 55: Locating RH Cylinder Head Cover

11. Using SST (09215-3C000) remove lower oil pan (A).

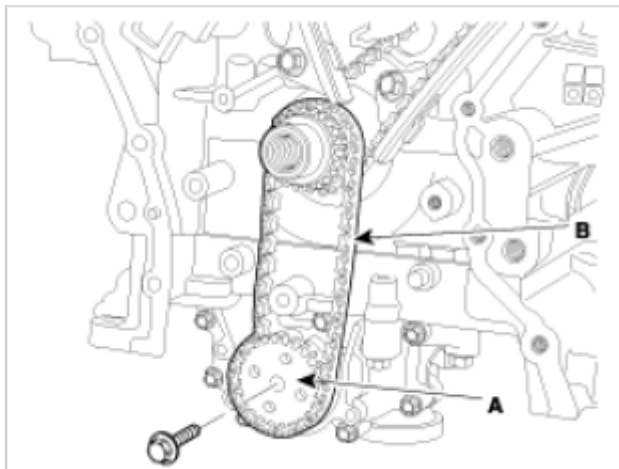


Fig. 56: Removing Lower Oil Pan Using SST (09215-3C000)

NOTE: Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

12. Set a jack to the upper oil pan.

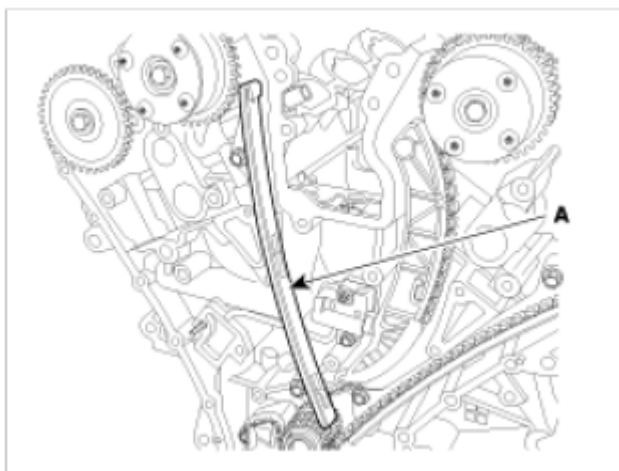


Fig. 57: Locating Upper Oil Pan

13. Remove the coolant reservoir tank.
14. Remove the engine mounting bracket (A).

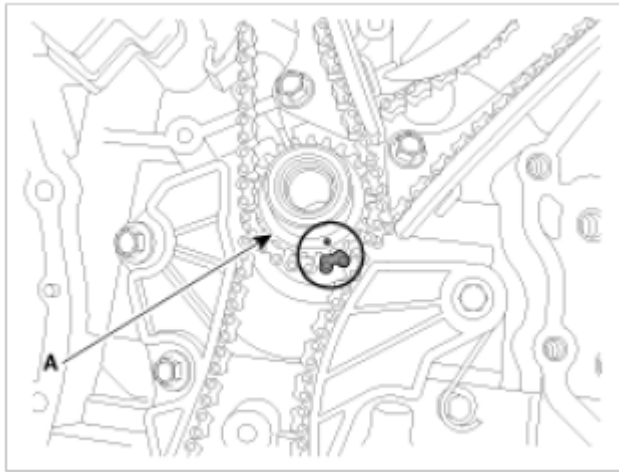


Fig. 58: Locating Engine Mounting Bracket

15. Set No.1 cylinder to TDC/compression.

1. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.

NOTE: Do not rotate engine counterclockwise.

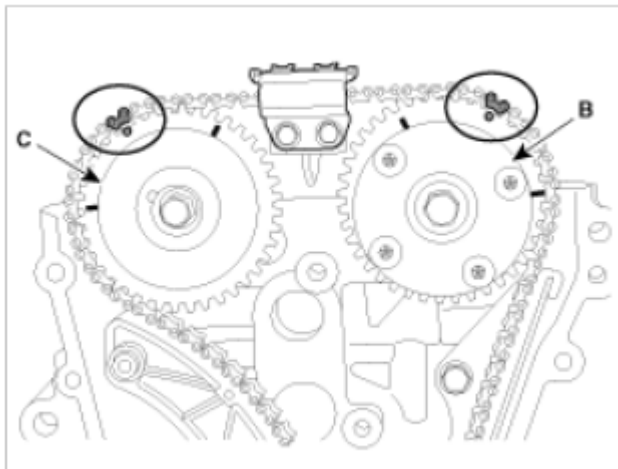


Fig. 59: Aligning Crankshaft Pulley Groove With Timing Mark "T" Of Lower Timing Chain Cover

2. 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°).

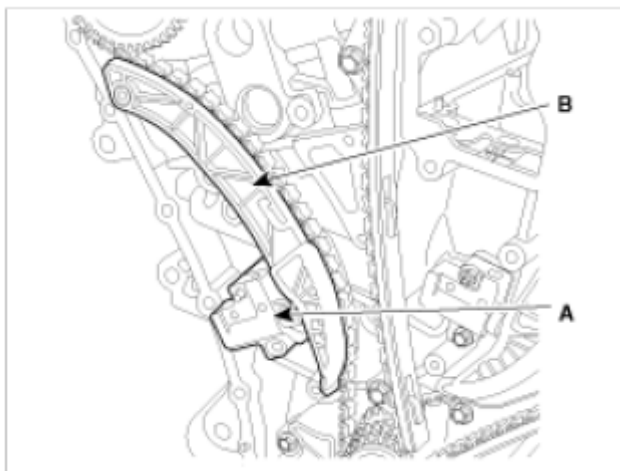


Fig. 60: Checking Mark Of Camshaft Timing Sprockets Are In Straight Line On Cylinder Head Surface

NOTE: Do not rotate engine counterclockwise.

16. Remove the drive belt (A).

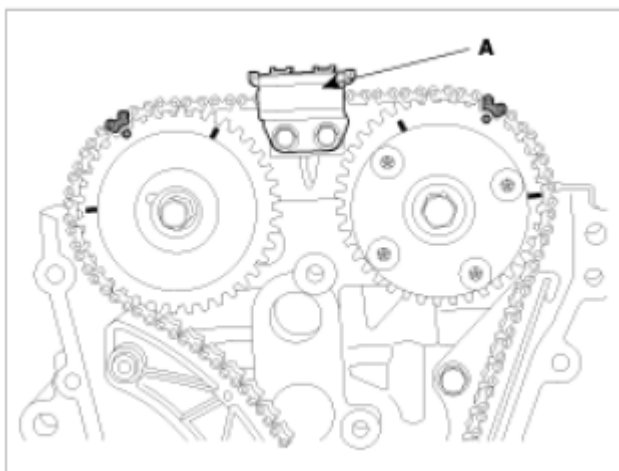


Fig. 61: Locating Drive Belt

17. Using SST (09231-3C300) remove the crankshaft damper pulley (A).

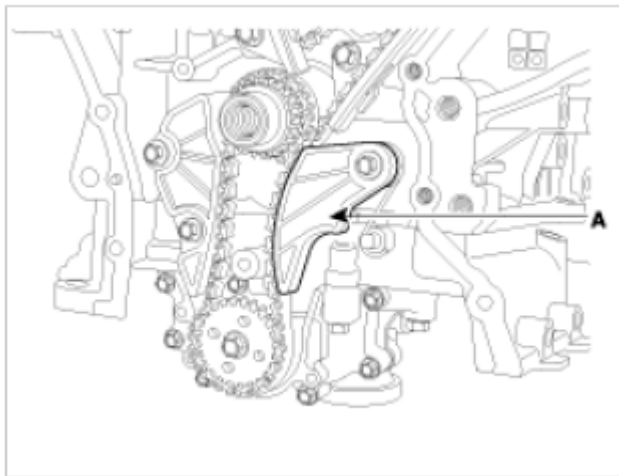


Fig. 62: Locating Crankshaft Damper Pulley

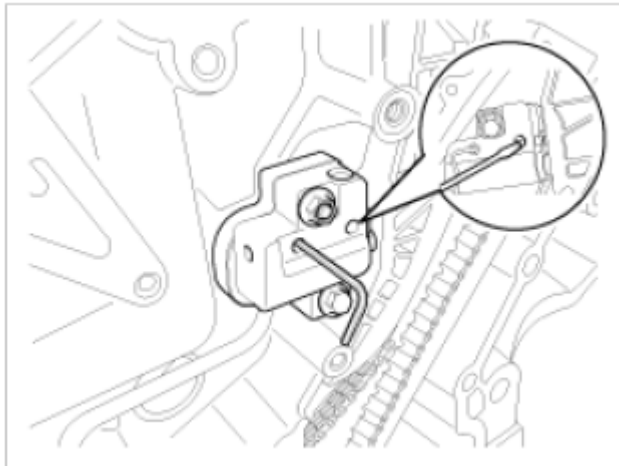


Fig. 63: Removing Crankshaft Damper Pulley Using SST (09231-3C300)

18. Lift up the engine assembly to using the jack.
19. Remove the drive belt idler (A).

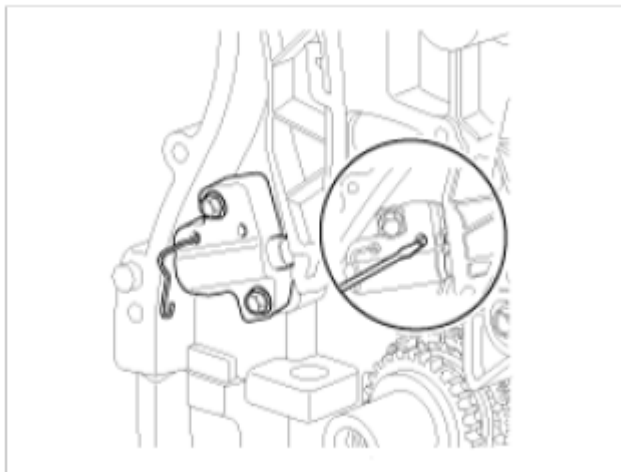


Fig. 64: Locating Drive Belt Idler

20. Remove the drive belt auto tensioner (A).

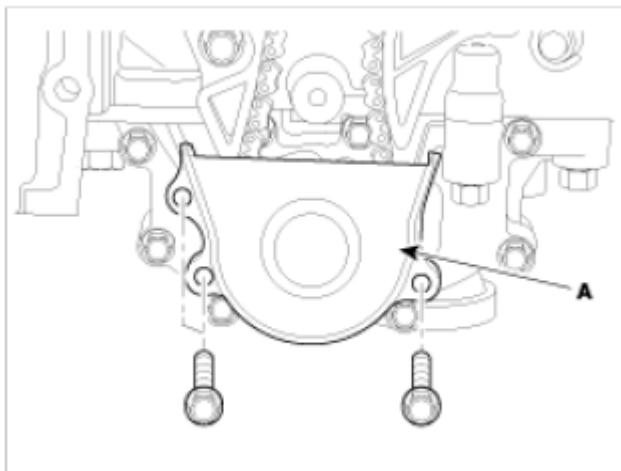


Fig. 65: Locating Drive Belt Auto Tensioner

21. Remove the water pump pulley (A).

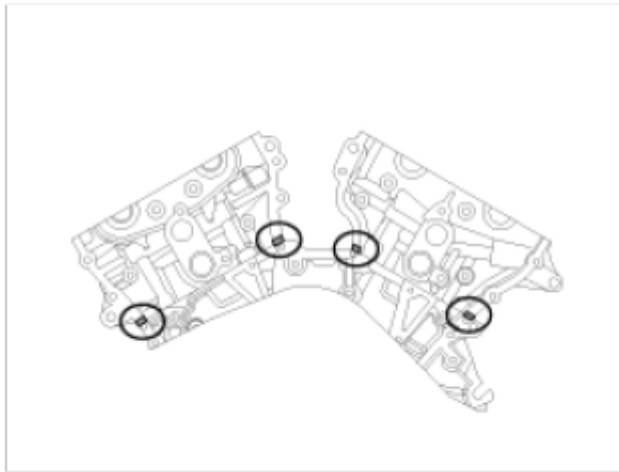


Fig. 66: Locating Water Pump Pulley

22. Remove the timing chain cover (A).

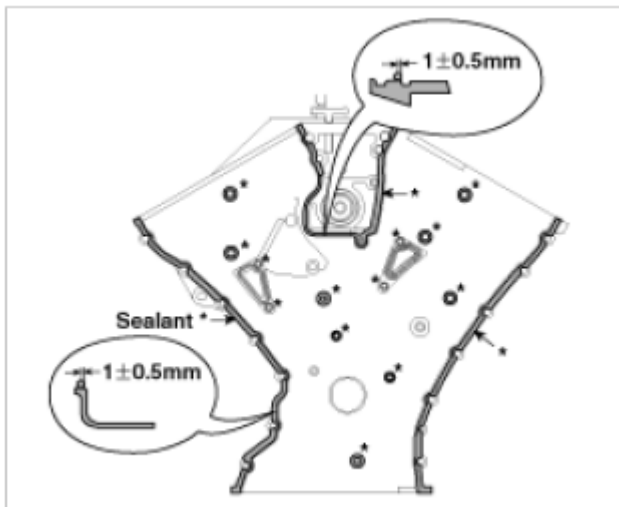


Fig. 67: Locating Timing Chain Cover

NOTE: Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover. Before removing the timing chain, mark the RH/LH timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.

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

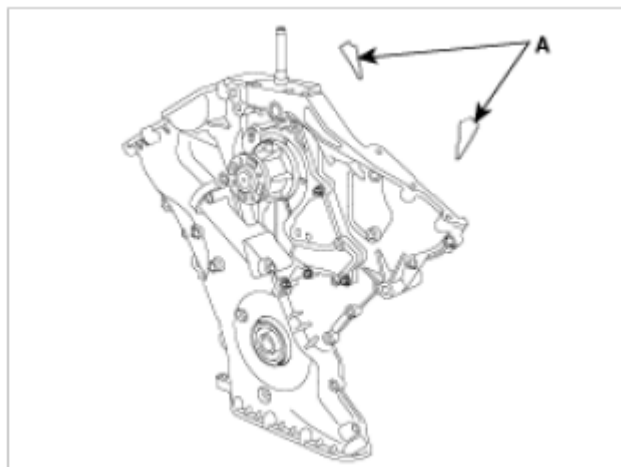


Fig. 68: Installing Set Pin After Compressing Timing Chain Tensioner

24. Remove the RH cam-to-cam guide (A).

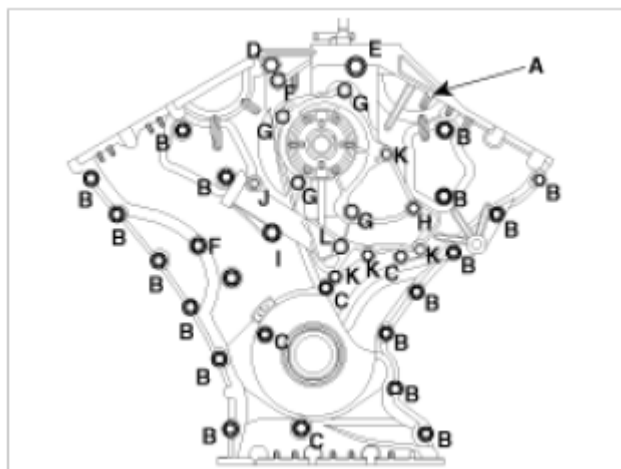


Fig. 69: Locating RH Cam-To-Cam Guide

25. Remove the RH timing chain auto tensioner (A) and RH timing chain tensioner arm (B).

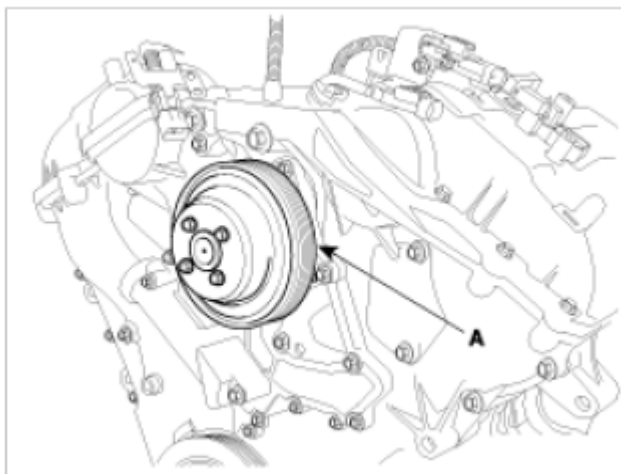


Fig. 70: Locating RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

26. Remove the RH timing chain.
27. Remove the RH timing chain guide (A).

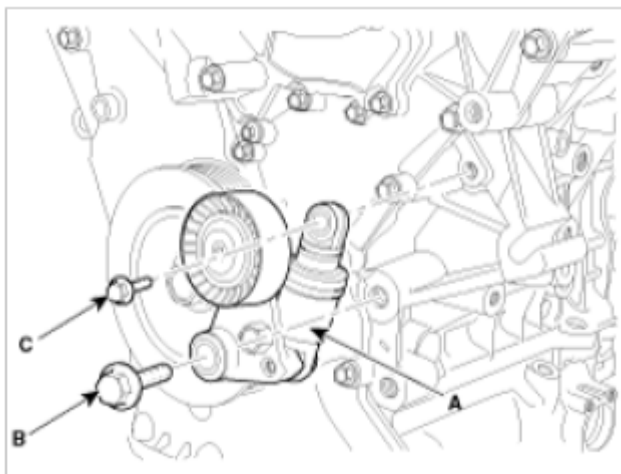


Fig. 71: Locating RH Timing Chain Guide

28. Remove the oil pump chain cover (A).

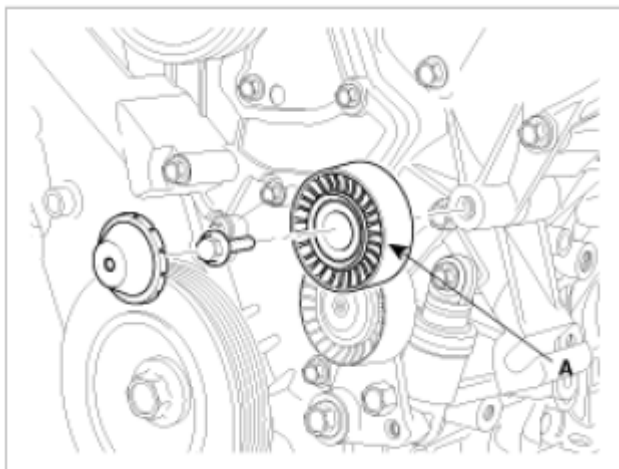


Fig. 72: Locating Oil Pump Chain Cover

29. Remove the oil pump chain tensioner assembly (A).

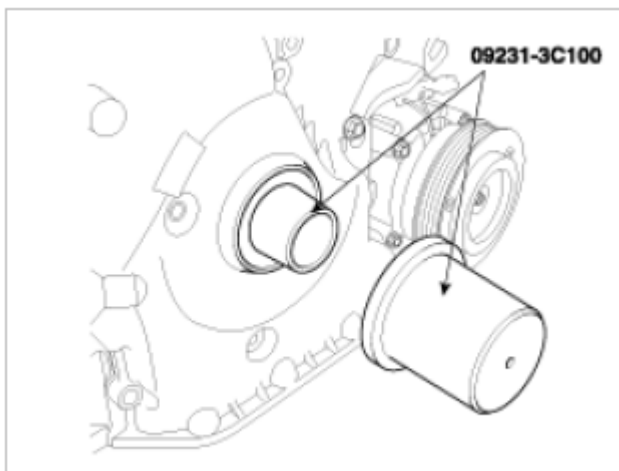


Fig. 73: Locating Oil Pump Chain Tensioner Assembly

30. Remove the oil pump chain guide (A).

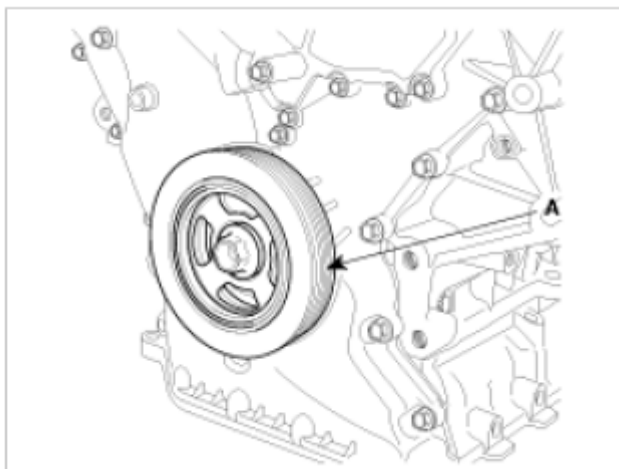


Fig. 74: Locating Oil Pump Chain Guide

31. Remove the oil pump chain sprocket (A) and oil pump chain (B).

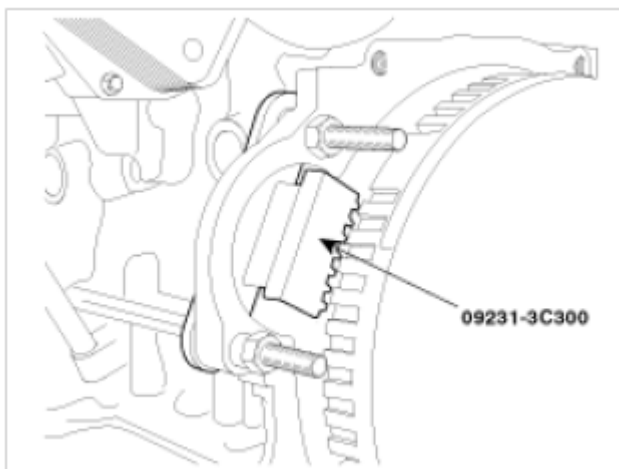


Fig. 75: Locating Oil Pump Chain Sprocket And Oil Pump Chain

32. Remove the crankshaft sprocket (A) (Oil pump & RH camshaft drive).

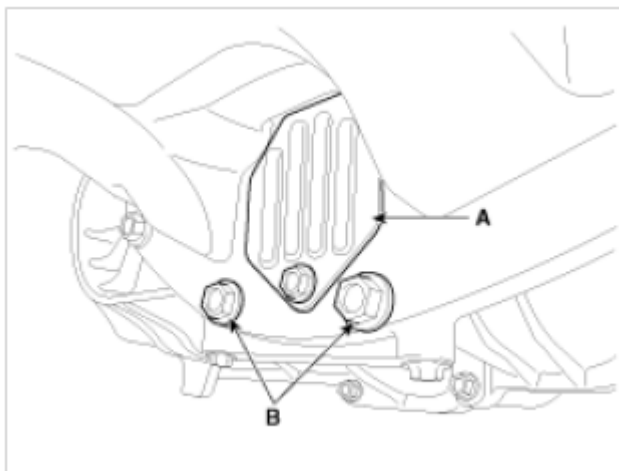


Fig. 76: Locating Crankshaft Sprocket (Oil Pump & RH Camshaft Drive)

33. Install a set pin after compressing the LH timing chain tensioner.

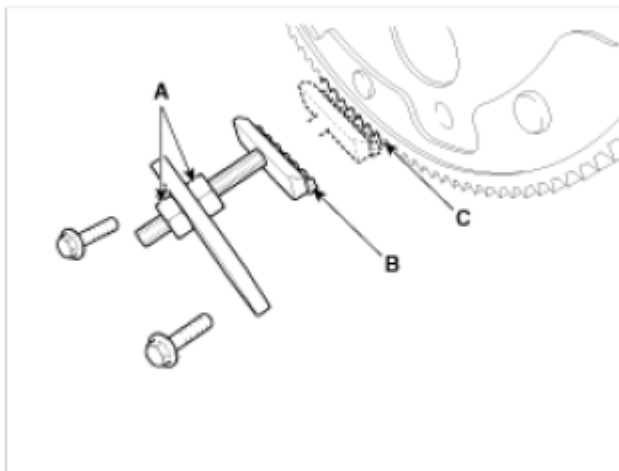


Fig. 77: Installing Set Pin After Compressing LH Timing Chain Tensioner

34. Remove the LH cam-to-cam guide (A).

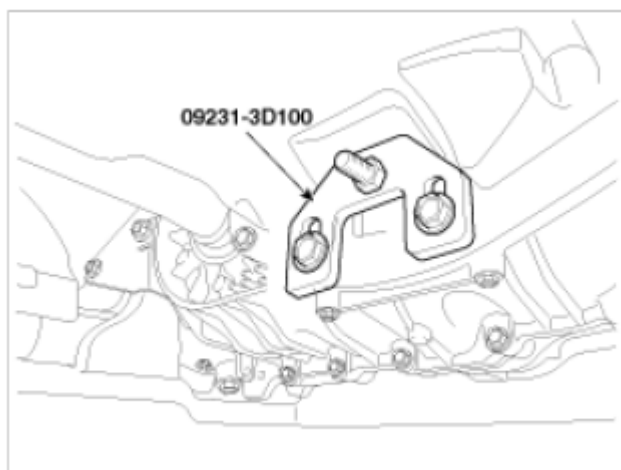


Fig. 78: Locating LH Cam-To-Cam Guide

35. Remove the LH timing chain auto tensioner (A) and LH timing chain tensioner arm (B).

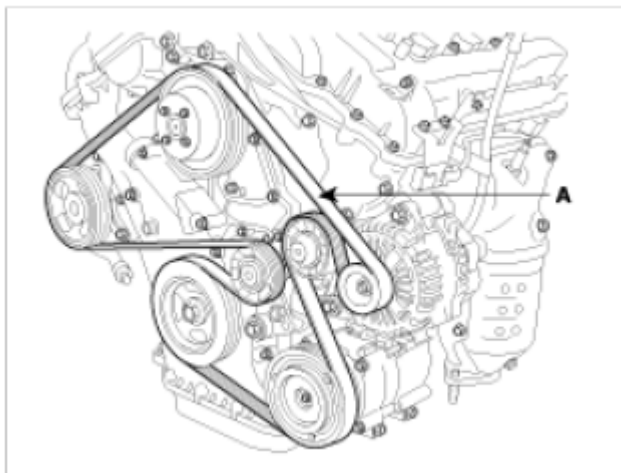


Fig. 79: Locating LH Timing Chain Auto Tensioner And LH Timing Chain Tensioner Arm

36. Remove the LH timing chain.
37. Remove the LH timing chain guide (A).

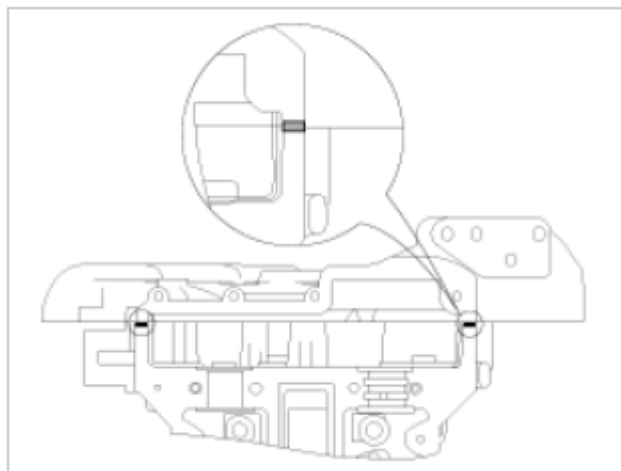


Fig. 80: Locating LH Timing Chain Guide

38. Remove the crankshaft sprocket (A) (LH camshaft drive).

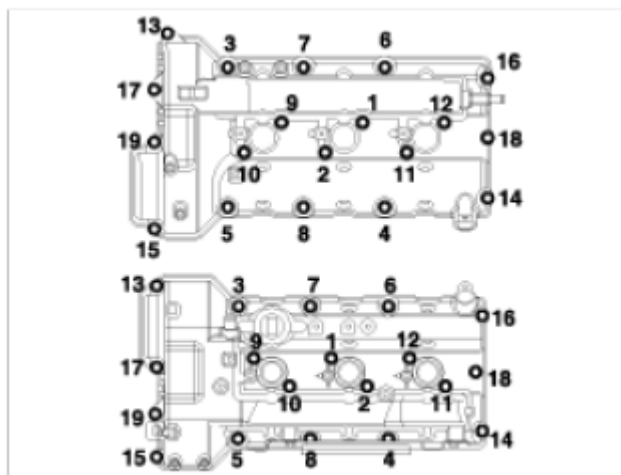


Fig. 81: Locating Crankshaft Sprocket (LH Camshaft Drive)

39. Remove the tensioner adapter assembly (A).

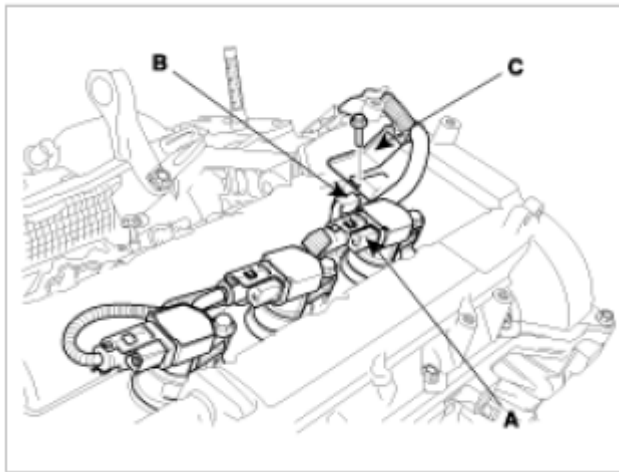


Fig. 82: Locating Tensioner Adapter Assembly

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.

INSTALLATION

1. Install the jack to the upper oil pan.
2. The key (A) of crankshaft should be aligned with the timing mark (B) of timing chain cover. As a result of this, the piston of No. 1 cylinder is placed at the top dead center on compression stroke.

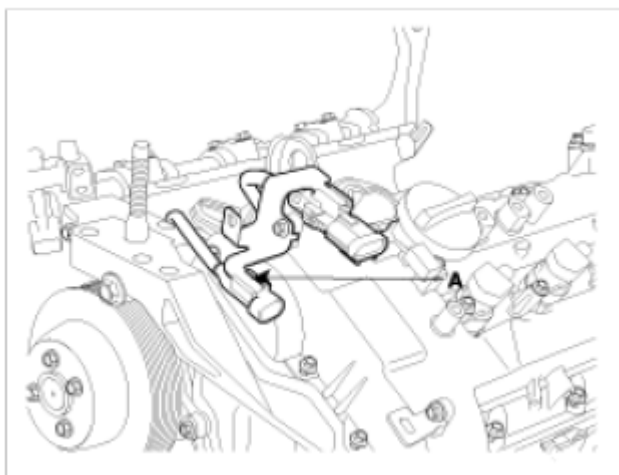


Fig. 83: Aligning Crankshaft Key With Timing Mark Of Timing Chain Cover

3. Install the tensioner adapter assembly (A).

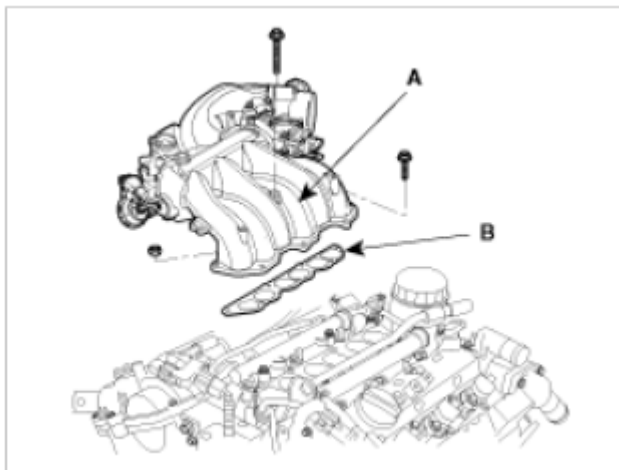


Fig. 84: Locating Tensioner Adapter Assembly

4. Install the crankshaft sprocket (A) (LH camshaft drive).

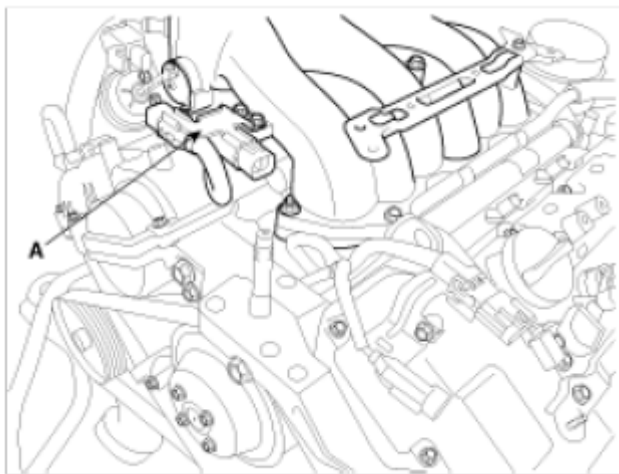


Fig. 85: Locating Crankshaft Sprocket (LH Camshaft Drive)

5. Install the LH timing chain guide (A).

Tightening torque:

19.60 ~ 24.50 N.m (2.0 ~ 2.5 kgf.m, 14.17 ~ 18.08 lb-ft)

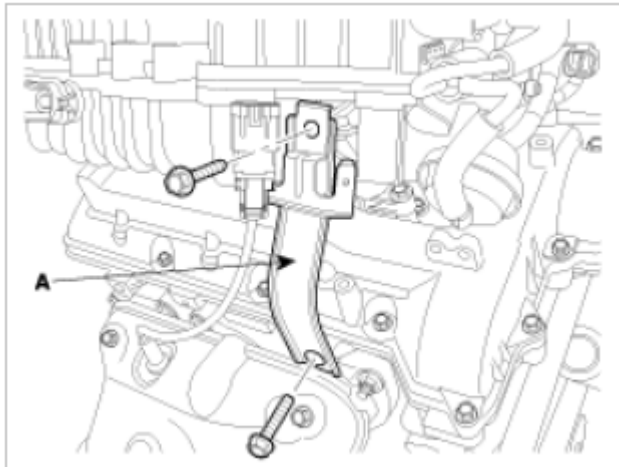


Fig. 86: Locating LH Timing Chain Guide

6. Install LH timing chain.

To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below.

Crankshaft sprocket --> Timing chain guide --> Exhaust camshaft sprocket (C) --> Intake camshaft sprocket (D).

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

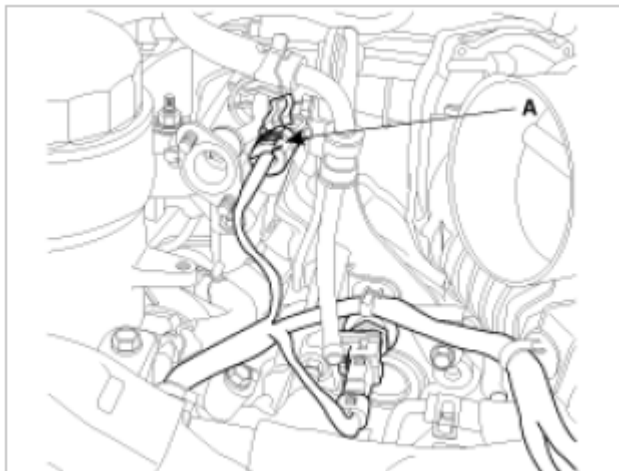


Fig. 87: Identifying Timing Mark Of Camshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

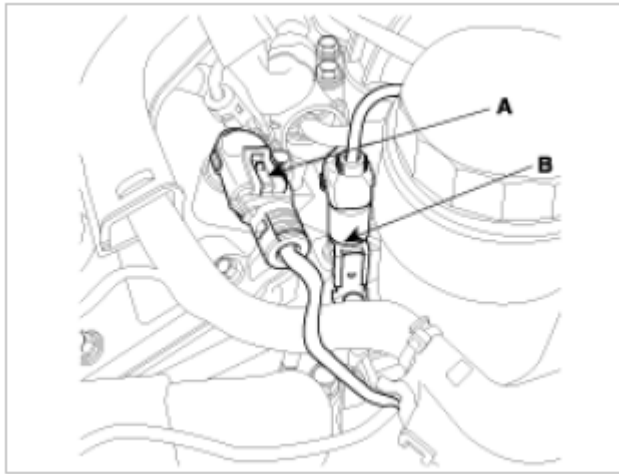


Fig. 88: Identifying Timing Mark Of Crankshaft Sprocket Matched With Timing Mark Of Timing Chain

7. Install the LH timing chain tensioner arm(B).

Tightening torque:

18.62 ~ 21.56 N.m (1.9 ~ 2.2 kgf.m, 13.74 ~ 15.91 lb-ft)

8. Install the LH chain tensioner (A).

Tightening torque:

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

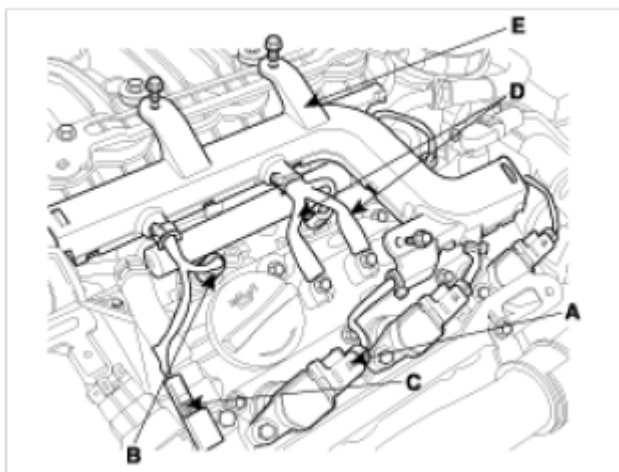


Fig. 89: Locating LH Chain Tensioner And LH Timing Chain Tensioner Arm

9. Install the LH cam-to-cam guide (A).

Tightening torque:

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

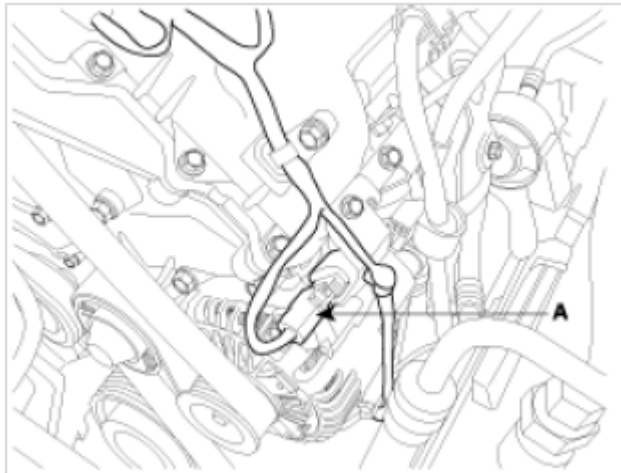


Fig. 90: Locating LH Cam-To-Cam Guide

10. Install the crankshaft sprocket (A) (Oil pump & RH camshaft drive).

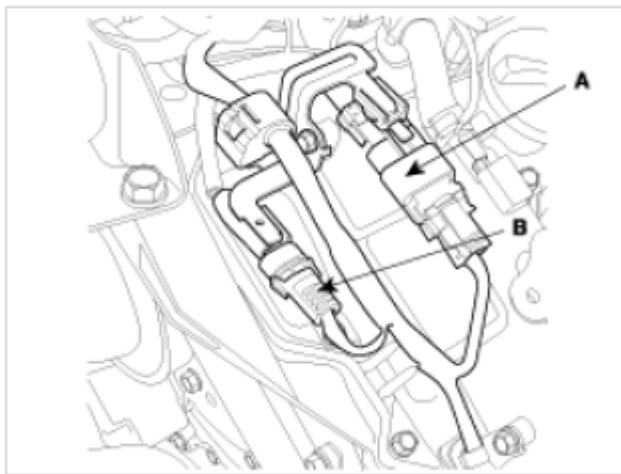


Fig. 91: Locating Crankshaft Sprocket (Oil Pump & RH Camshaft Drive)

11. Install the oil pump chain (B) and oil pump sprocket (A).

Tightening torque:

18.62 ~ 21.56 N.m (1.9 ~ 2.2 kgf.m, 13.74 ~ 15.91 lb-ft)

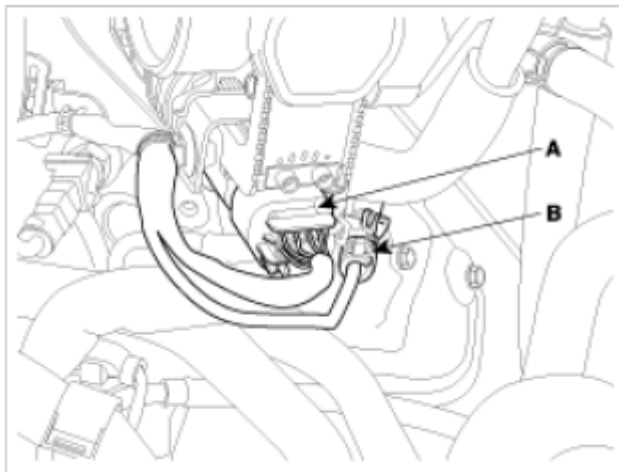


Fig. 92: Locating Oil Pump Chain And Oil Pump Sprocket

12. Install the RH timing chain guide (A).

Tightening torque:

19.60 ~ 24.50 N.m (2.0 ~ 2.5 kgf.m, 14.17 ~ 18.08 lb-ft)

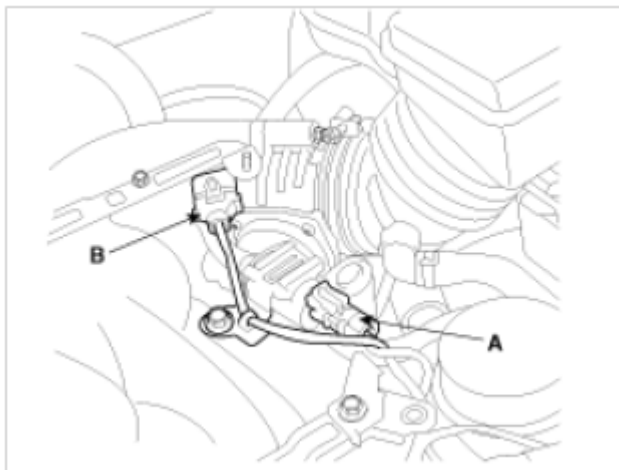


Fig. 93: Locating RH Timing Chain Guide

13. Install the RH timing chain.

To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below.

Crankshaft sprocket (A) --> Intake camshaft sprocket (B) --> Exhaust camshaft sprocket (C).

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

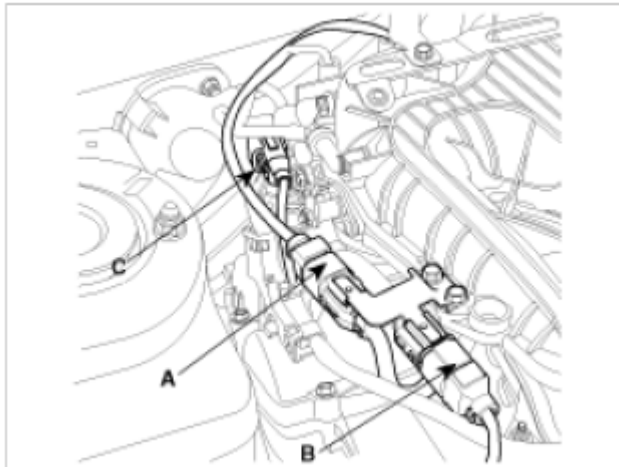


Fig. 94: Identifying Timing Mark Of Crankshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

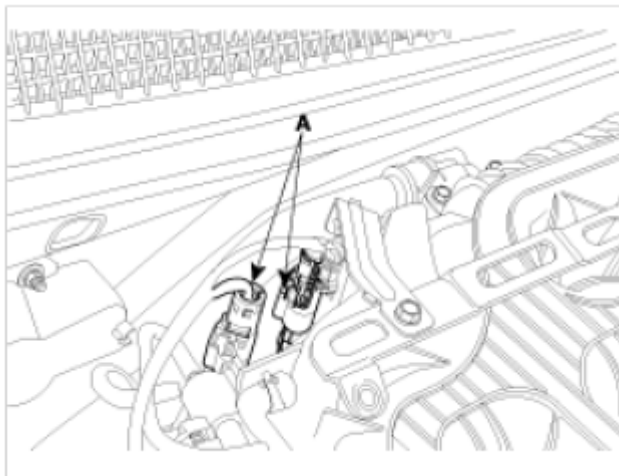


Fig. 95: Identifying Timing Mark Of Camshaft Sprocket Matched With Timing Mark (Color Link) Of Timing Chain

14. Install the RH timing chain tensioner arm (B).

Tightening torque:

18.62 ~ 21.56 N.m (1.9 ~ 2.2 kgf.m, 13.74 ~ 15.91 lb-ft)

15. Install the RH timing chain auto tensioner (A).

Tightening torque:

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

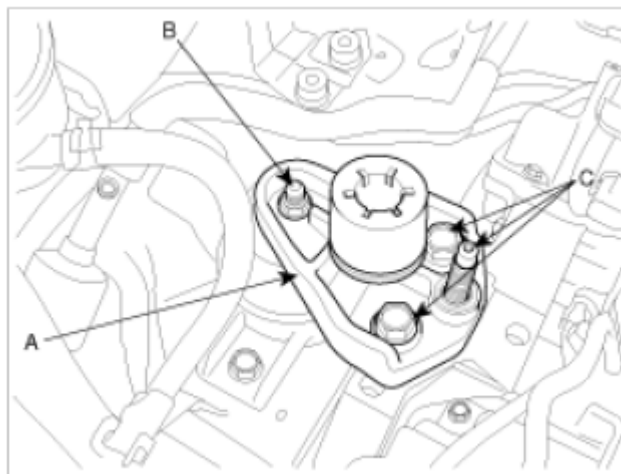


Fig. 96: Locating RH Timing Chain Auto Tensioner And RH Timing Chain Tensioner Arm

16. Install the RH cam-to-cam guide (A).

Tightening torque:

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



Fig. 97: Locating RH Cam-To-Cam Guide

17. Install the oil pump chain guide (A).

Tightening torque:

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

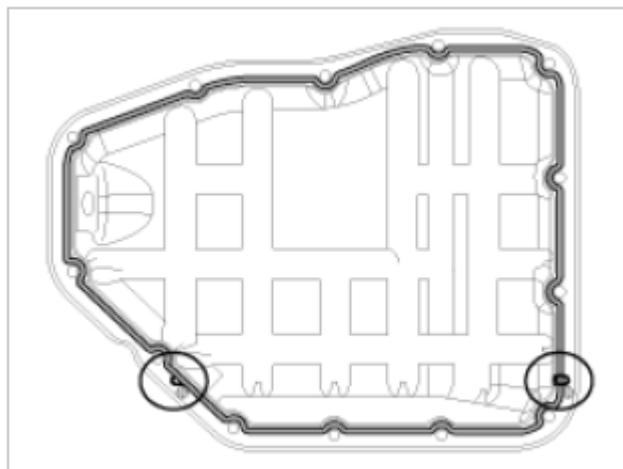


Fig. 98: Locating Oil Pump Chain Guide

18. Install the oil pump chain tensioner assembly (A).

Tightening torque:

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

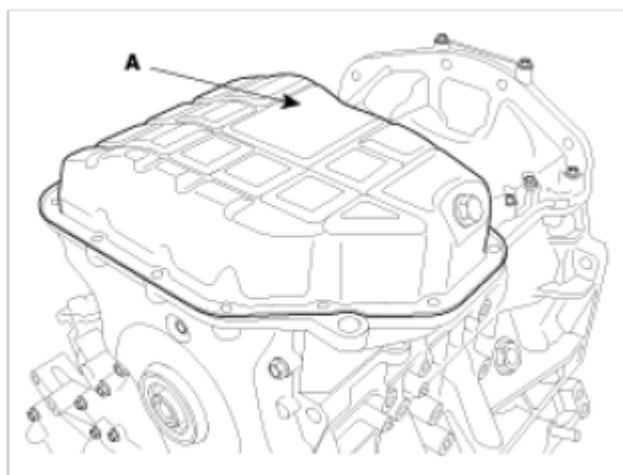


Fig. 99: Locating Oil Pump Chain Tensioner Assembly

19. Pull out the pins of hydraulic tensioners (LH & RH).

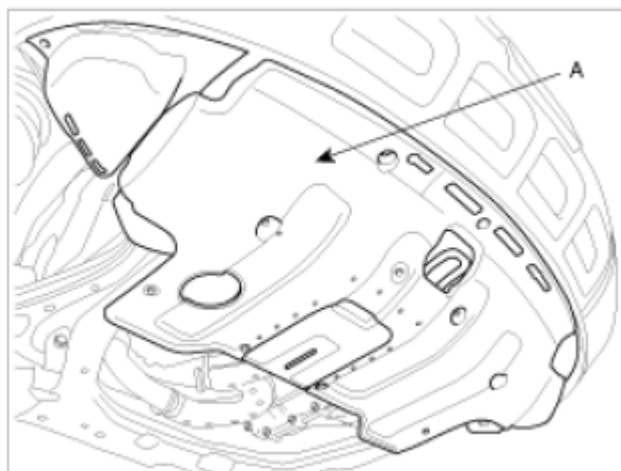


Fig. 100: Pulling Out Pins Of Hydraulic Tensioners (LH)

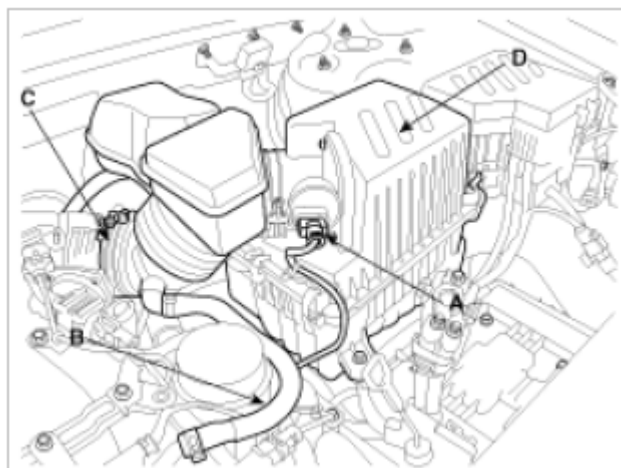


Fig. 101: Pulling Out Pins Of Hydraulic Tensioners (RH)

20. Install the oil pump chain cover (A).

Tightening torque:

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

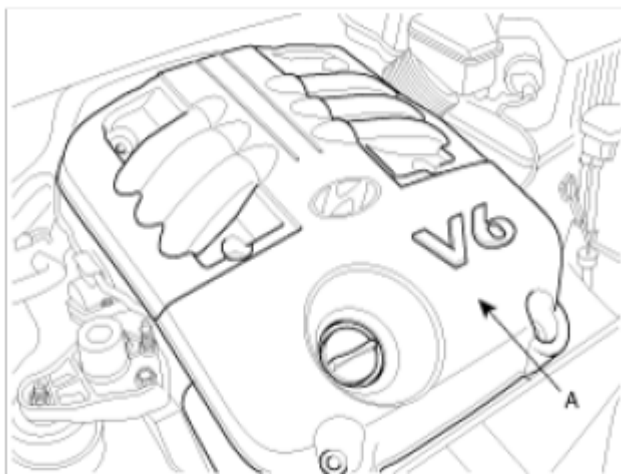


Fig. 102: Locating Oil Pump Chain Cover

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

NOTE: Always turn the crankshaft clockwise.

22. Install the timing chain cover.
1. The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and lower oil pan) must be free of engine oil and ETC.
 2. Before assembling the timing chain cover, the liquid sealant TB1217H 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: 2.5 mm (0.1 in.)

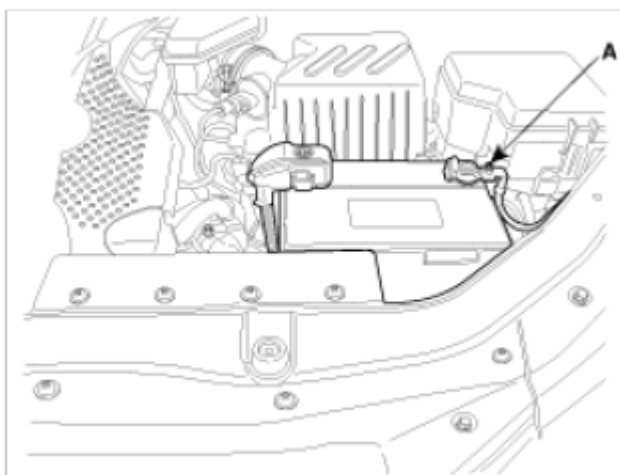


Fig. 103: Identifying Sealant Locations On Chain Cover

3. After applying liquid sealant TB1217H on the timing chain cover.

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

Sealant should be applied without discontinuity.

Bead width: 2.5 mm (0.1 in.)

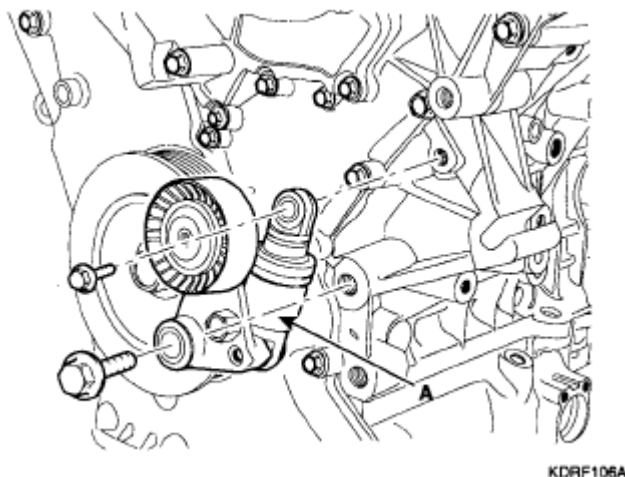


Fig. 104: Identifying Timing Chain Cover Liquid Sealant TB1217H Applying Specifications

4. Install the new gasket (A) to the timing chain cover.

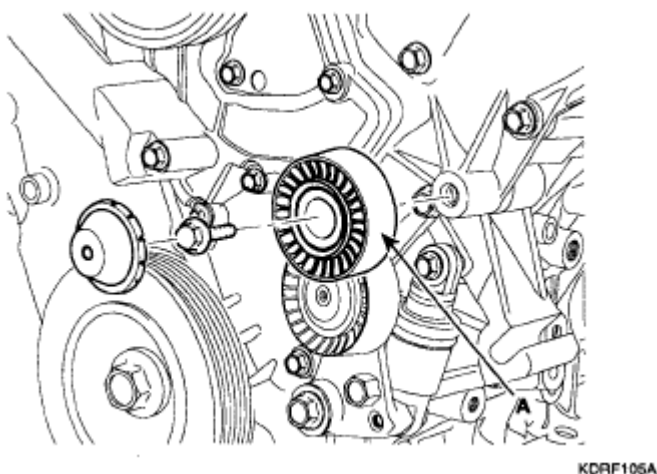


Fig. 105: Locating Timing Chain Cover Gasket

NOTE: During timing cover installation, care not to take off applied sealant on the timing cover by contact with other parts.

5. 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:

B(17): 18.62 ~ 21.56 N.m (1.9 ~ 2.2 kgf.m, 13.74 ~ 15.91 lb-ft)

C(4): 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

D(1): 58.80 ~ 68.80 N.m (6.0 ~ 7.0 kgf.m, 43.40 ~ 50.63 lb-ft)

E(1): 58.80 ~ 68.80 N.m (6.0 ~ 7.0 kgf.m, 43.40 ~ 50.63 lb-ft)

F(2): 24.50 ~ 26.46 N.m (2.5 ~ 2.7 kgf.m, 18.08 ~ 19.53 lb-ft)

G(4): 21.56 ~ 23.52 N.m (2.2 ~ 2.4 kgf.m, 15.91 ~ 17.36 lb-ft)

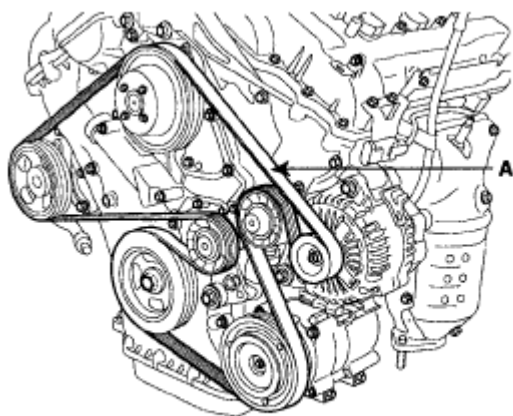
H(1): 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

I(1): 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

J(1): 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

K(4): 9.80 ~ 11.76 N.m (1.0 ~ 1.2 kgf.m, 7.23 ~ 8.68 lb-ft)

L(1): 21.56 ~ 26.46 N.m (2.2 ~ 2.7 kgf.m, 15.91 ~ 19.53 lb-ft) - New bolt



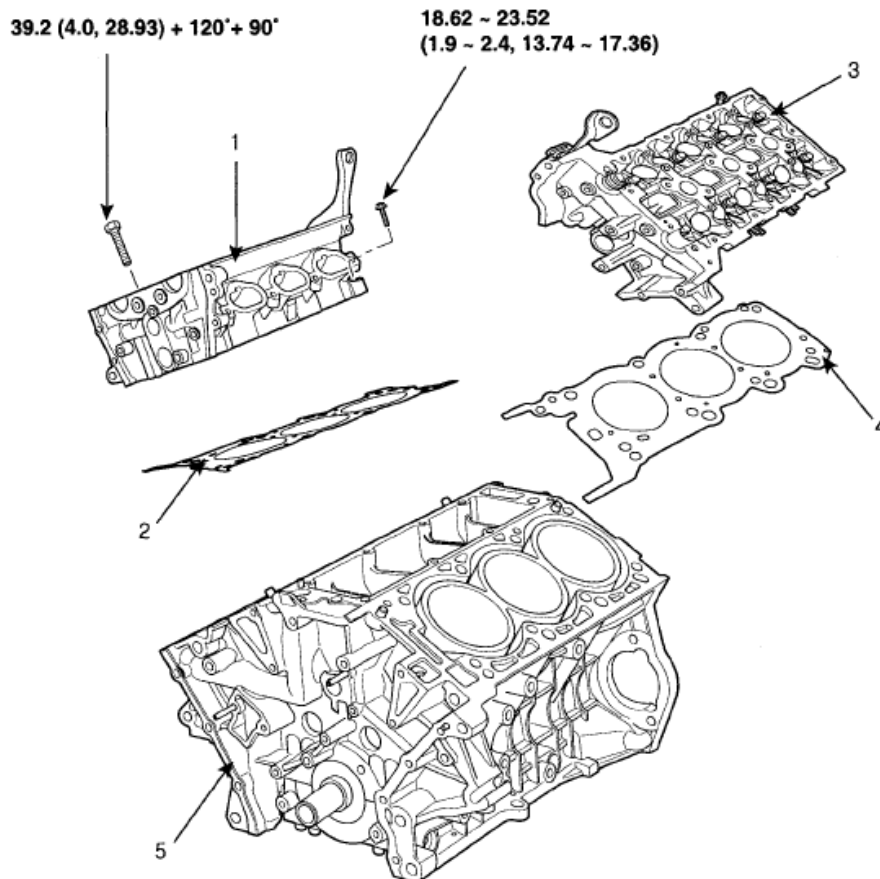
KDRF101A

Fig. 106: Identifying Timing Chain Cover Bolts Tightening Torque

6. The firing and/or blow out test should not be performed within 30 minutes after the timing chain cover was assembled.
23. Install the water pump pulley (A).

Tightening torque:

7.84 ~ 9.80 N.m (0.8 ~ 1.0 kgf.m, 5.78 ~ 7.23 lb-ft)



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

- 1. RH cylinder head
- 2. RH cylinder head gasket
- 3. LH cylinder head

- 4. LH cylinder head gasket
- 5. Cylinder block

EDRF003A

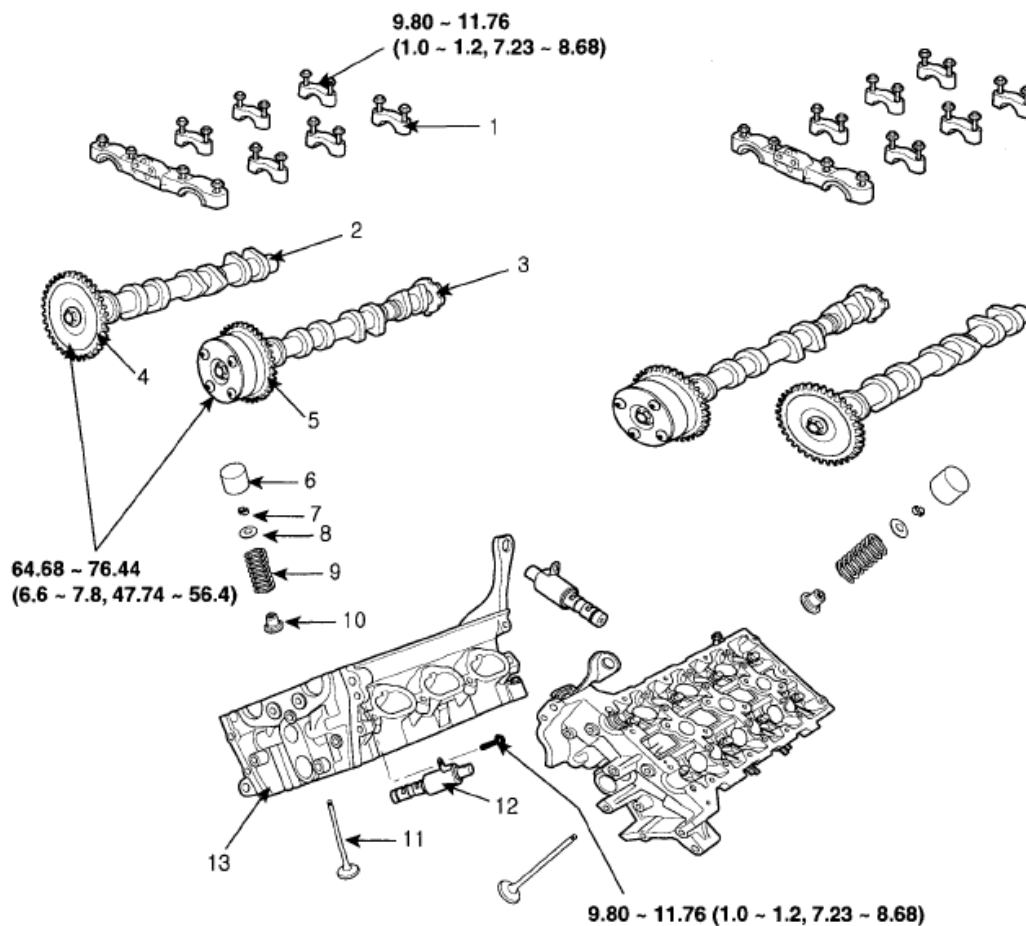
Fig. 107: Locating Water Pump Pulley

24. Install the drive belt auto tensioner (A).

Tightening torque:

Bolt(B): 81.39 ~ 85.32 N.m (8.3 ~ 8.7 kgf.m, 60.03 ~ 62.93 lb-ft)

Bolt(C): 17.64 ~ 21.56 N.m (1.8 ~ 2.2 kgf.m, 13.02 ~ 15.91 lb-ft)



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

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

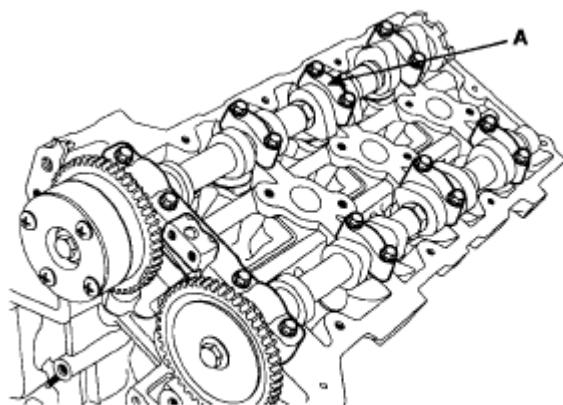
EDRF004A

Fig. 108: Locating Drive Belt Auto Tensioner

25. Install the drive belt idler (A).

Tightening torque:

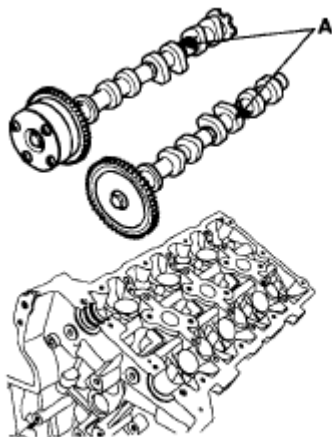
52.92 ~ 57.82 N.m (5.4 ~ 5.9 kgf.m, 39.06 ~ 42.67 lb-ft)



KDRF196A

Fig. 109: Locating Drive Belt Idler

26. Lower the engine assembly by using the jack.
27. Using SST (09231-3C100), install timing chain cover oil seal.



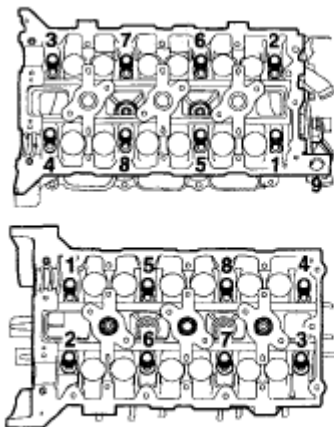
KDRF197A

Fig. 110: Installing Timing Chain Cover Oil Seal Using SST (09231-3C100)

28. Using SST (09231-3C300) install the crankshaft damper pulley (A).

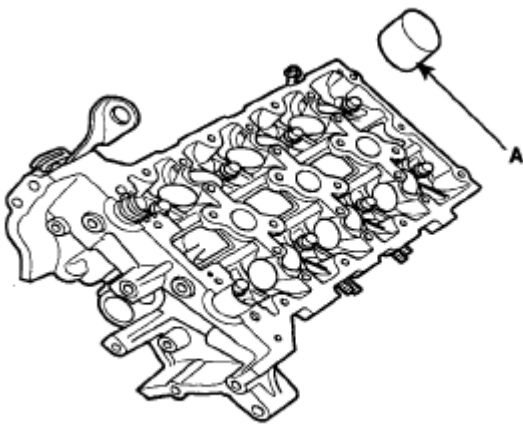
Tightening torque:

284.2~303.8 N.m (29.0~31.0 kgf.m, 209.76~224.22 lb-ft)



SEPEM6004N

Fig. 111: Locating Crankshaft Damper Pulley



KDRF200A

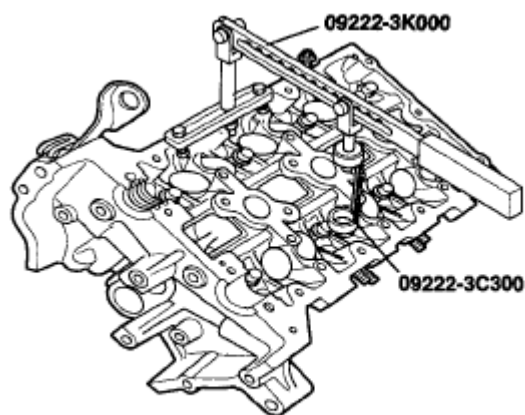
Fig. 112: Installing Crankshaft Damper Pulley Using SST (09231-3C300)

29. Install the drive belt (A).

Crankshaft pulley --> A/C pulley --> idler pulley --> alternator pulley --> water pump pulley --> P/S pump pulley --> tensioner pulley.

Rotate auto tensioner arm in the counterclockwise moving auto tensioner pulley bolt with wrench.

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



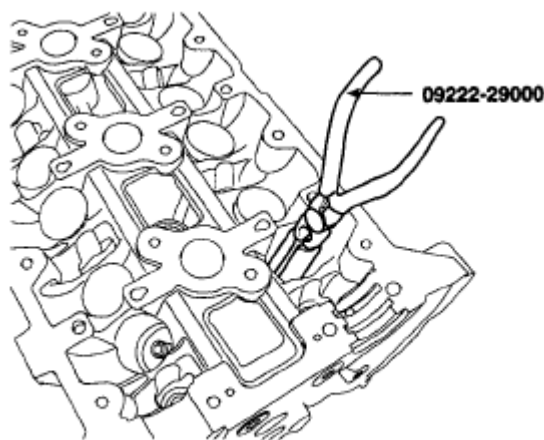
KDRF201A

Fig. 113: Locating Drive Belt

30. Install the cylinder head cover.

1. The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
2. After applying sealant (TB1217H), it should be assembled within 5 minutes.

Bead width: 2.5 mm (0.1 in.)



KDRF234A

Fig. 114: Identifying Hardening Sealant Located On Upper Area Between Timing Chain Cover And Cylinder Head

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

Tightening torque:

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

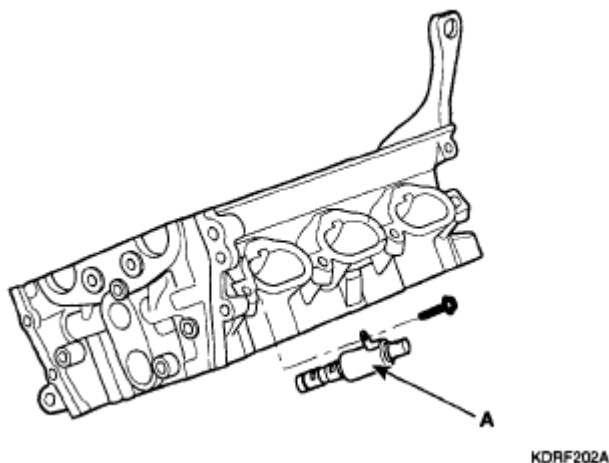


Fig. 115: Identifying Cylinder Head Cover Bolts Tightening Sequence (LH And RH)

CAUTION: Do not reuse cylinder head cover gasket.

5. Install the ignition coil.
6. Connect the RH ignition coil connector (A), the condenser connector (B) and install the wiring bracket (C).

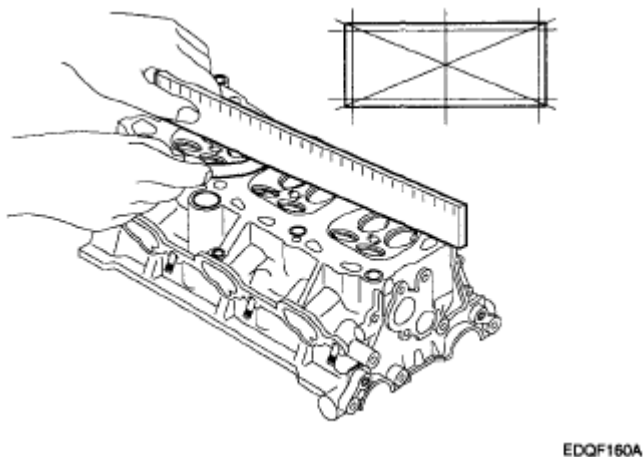
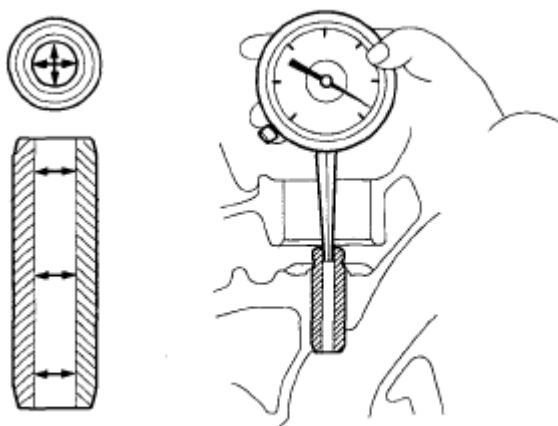


Fig. 116: Locating RH Ignition Coil Connector, Condenser Connector And Wiring Bracket

7. Install the connector bracket (A) to the LH cylinder head cover.



ECBF034A

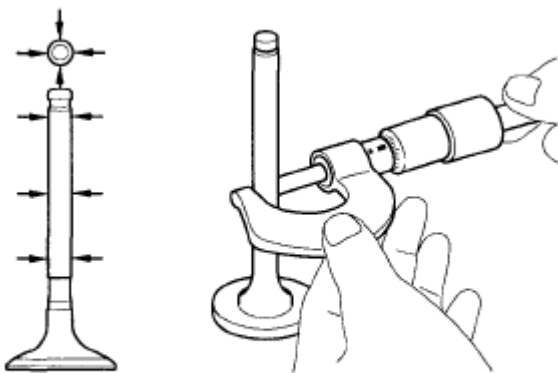
Fig. 117: Locating LH Cylinder Head Cover Connector Bracket

31. Install the surge tank and wiring connectors.

1. Install the surge tank (A).

Tightening torque:

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



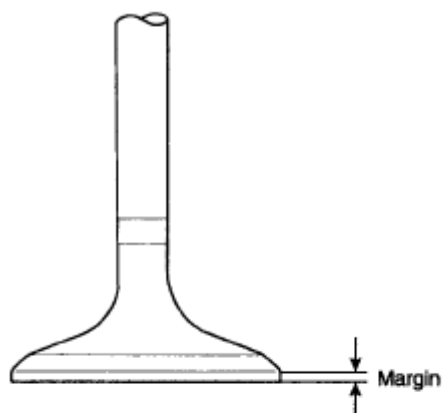
KCRF227A

Fig. 118: Locating Surge Tank

2. Install the connector bracket (A) to the surge tank.

Tightening torque:

6.86 ~ 10.78 N.m (0.7 ~ 1.1 kgf.m, 5.06 ~ 7.96 lb-ft)



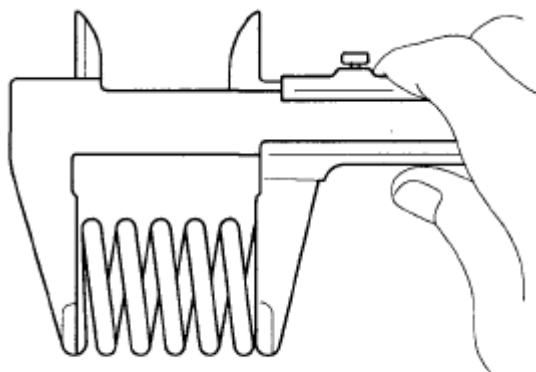
ECKD221A

Fig. 119: Locating Surge Tank Connector Bracket

3. Install the surge tank stay.

Tightening torque:

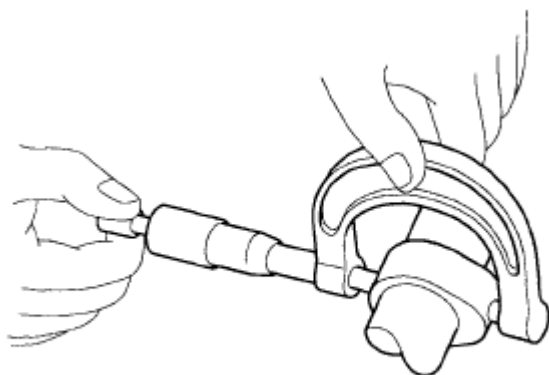
27.44 ~ 31.36 N.m (2.8 ~ 3.2 kgf.m, 20.25 ~ 23.14 lb-ft)



KCRF205A

Fig. 120: Locating Surge Tank Stay

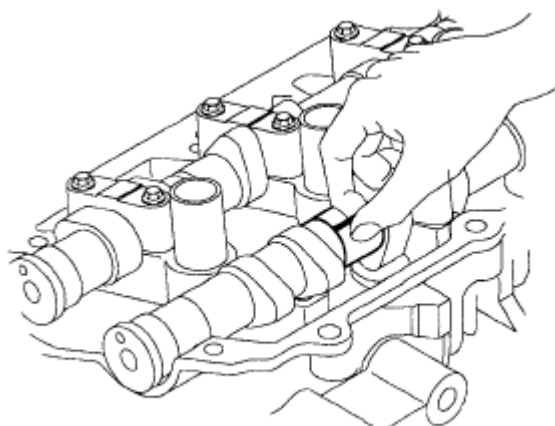
4. Connect the brake vacuum hose.
5. Connect the PCV hose (C).
6. Connect the water hoses (B) to the ETC.
7. Install the ETC bracket (A).



KCRF206A

Fig. 121: Locating ETC Bracket, Water Hoses And PCV Hose

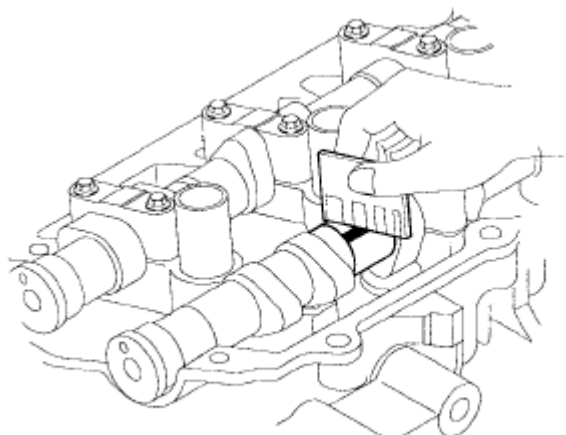
8. Connect the LH CMPS connector (A) and oil pressure switch connector (B).



KCRF207A

Fig. 122: Locating LH CMPS Connector And Oil Pressure Switch Connector

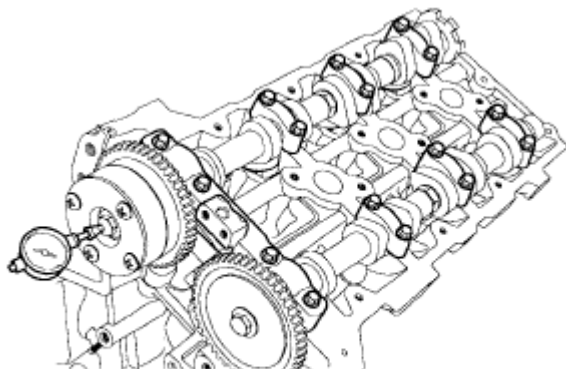
9. Install the wiring harness protector (E) and connect the LH ignition coil connector (A), injector connector (B), condenser connector (C) and ground (D).



KCRF208A

Fig. 123: Locating Wiring Harness Protector, LH Ignition Coil Connector, Injector Connector, Condenser Connector And Ground

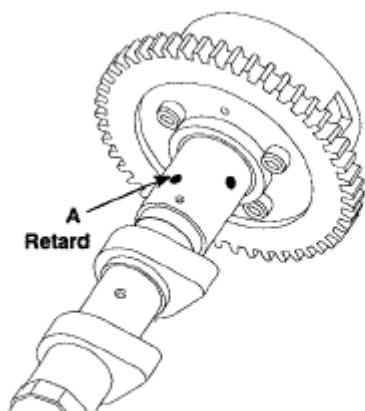
10. Connect the LH front oxygen sensor connector (A).



KDRF196B

Fig. 124: Locating LH Front Oxygen Sensor Connector

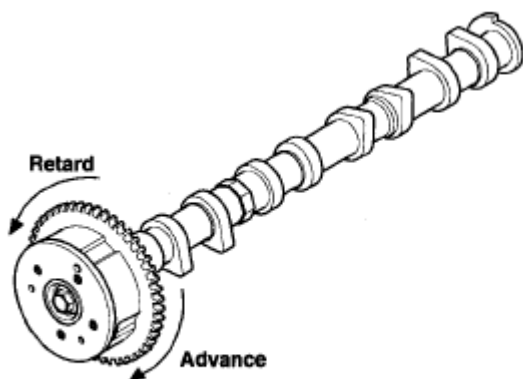
11. Connect the OCV connector (A) and knock sensor connector (B).



ECRF015A

Fig. 125: Locating OCV Connector And Knock Sensor Connector

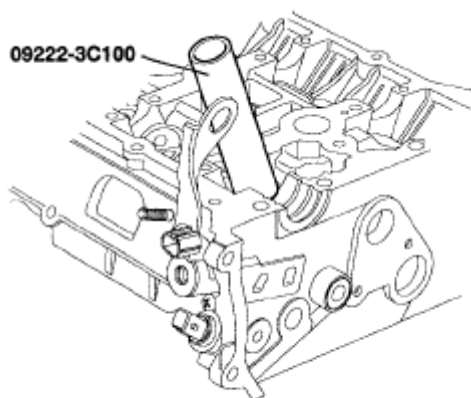
12. Connect the ETC connector (A) and knock sensor connector (B).



ECRF016A

Fig. 126: Locating ETC Connector And Knock Sensor Connector

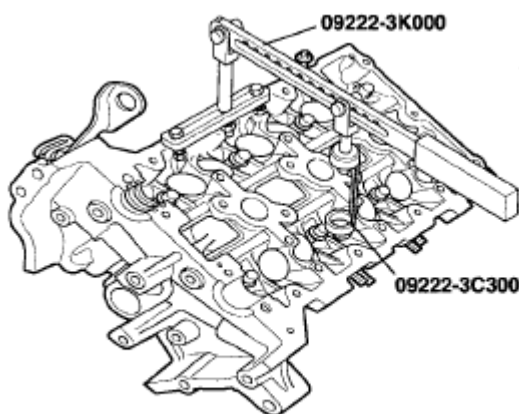
13. Connect the PCSV connector (A), MAP sensor connector (B) and PCSV hose.



KCRF120B

Fig. 127: Locating PCSV Connector And MAP Sensor Connector

14. Connect the RH injector connector (A) and ignition coil connector (B).



KDRF201A

Fig. 128: Locating RH Injector Connector And Ignition Coil Connector

15. Connect the RH oxygen sensor connector (A) and tighten the power steering hose mounting bolts (B).

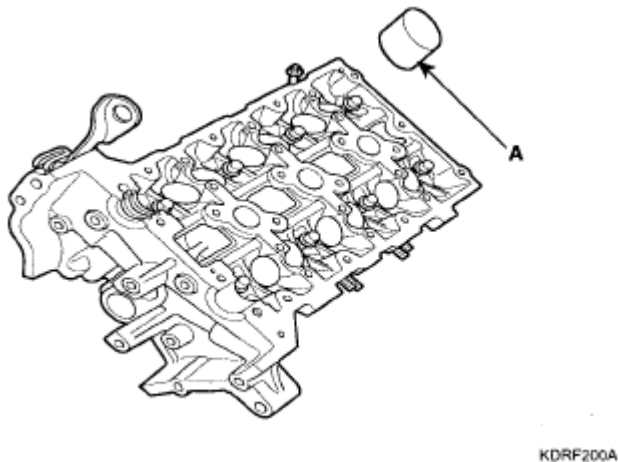


Fig. 129: Locating RH Oxygen Sensor Connector And Power Steering Hose Mounting Bolts

32. Install the engine mounting bracket (A).

Tightening torque:

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

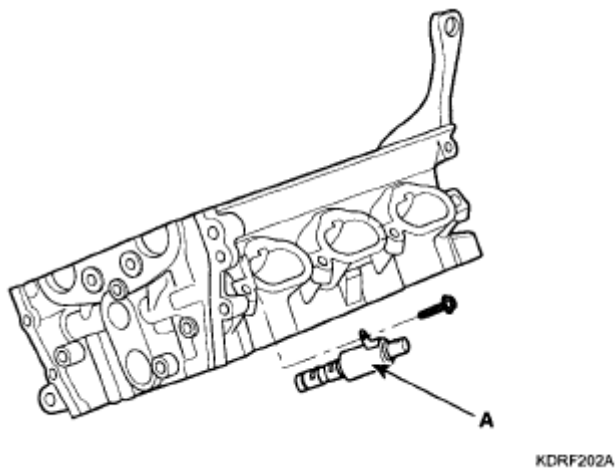


Fig. 130: Locating Engine Mounting Bracket

33. Install the coolant reservoir tank.
34. Remove the jack from the upper oil pan.
35. Install lower oil pan.
1. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
 2. Before assembling the oil pan, the liquid sealant TB1217H should be applied on oil pan.

Bead width: 2.5 mm (0.1 in.).

But marked area (*) to be 5.0 mm (0.2 in.)

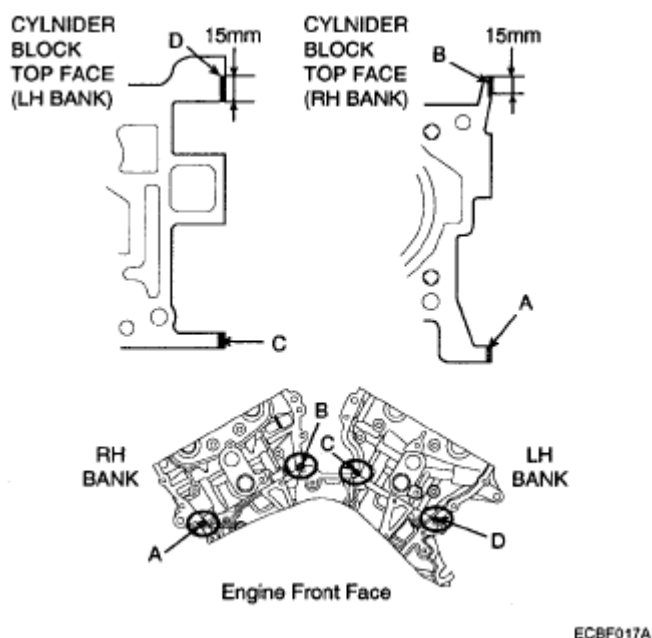


Fig. 131: Identifying Liquid Sealant TB1217H On Oil Pan

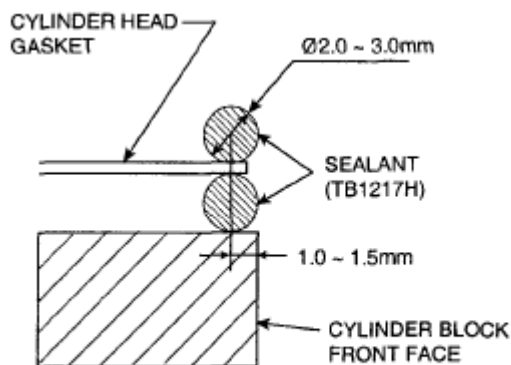
CAUTION:

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

3. Install the lower oil pan (A).

Tightening torque:

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



ECBF018A

Fig. 132: Locating Lower Oil Pan

36. Install the side cover.

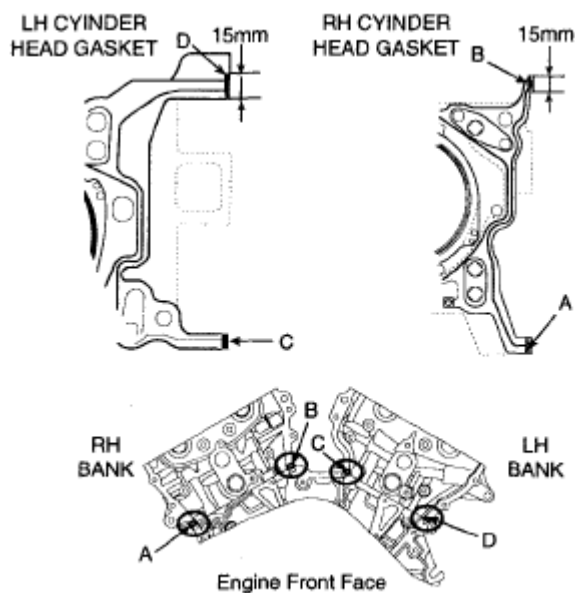
Tightening torque:

8.8 ~ 10.8 N.m (0.9 ~ 1.1 kgf.m, 6.5 ~ 7.9 lb-ft)

37. Install the under cover (A).

Tightening torque:

8.8 ~ 10.8 N.m (0.9 ~ 1.1 kgf.m, 6.5 ~ 7.9 lb-ft)



ECBF019A

Fig. 133: Locating Under Cover

38. Install the RH front wheel.

Tightening torque:

88.3 ~ 107.9 N.m (9.0 ~ 11.0 kgf.m, 65.1 ~ 79.6 lb-ft)

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

1. Install the intake air hose and air cleaner assembly (C).
2. Connect the breather hose (B) to the air intake hose.
3. Connect the MAF sensor connector (A).

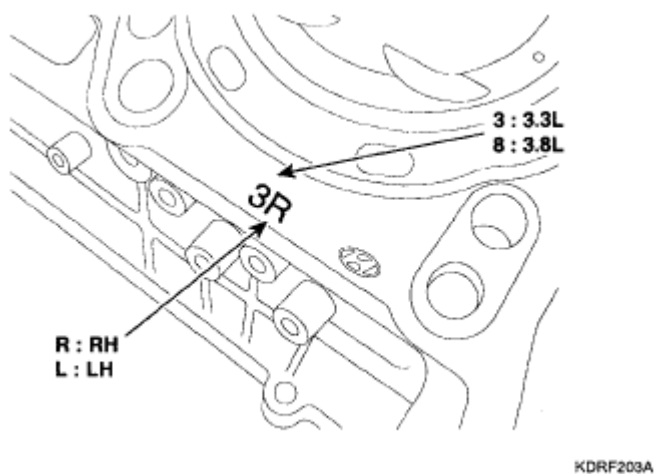


Fig. 134: Locating MAF Sensor Connector, Air Cleaner Assembly And Breather Hose

40. Install the engine cover (A).

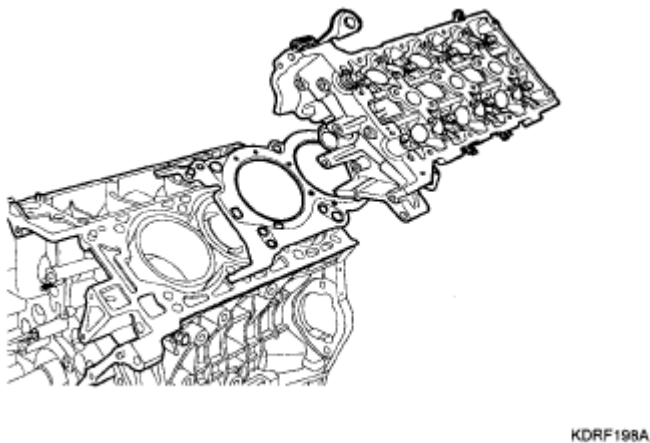
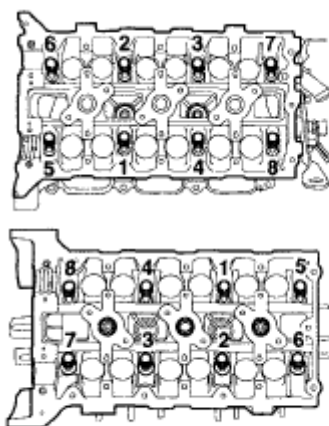


Fig. 135: Locating Engine Cover

41. Connect the battery negative cable (A).



KDRF199B

Fig. 136: Locating Battery Negative Cable

NOTE:

- Refill engine with engine oil.
- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.
 - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
 - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
 - Put radiator cap on tightly, then run the engine again and check for leaks.

ACCESSORY DRIVE BELT

INSPECTION

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.

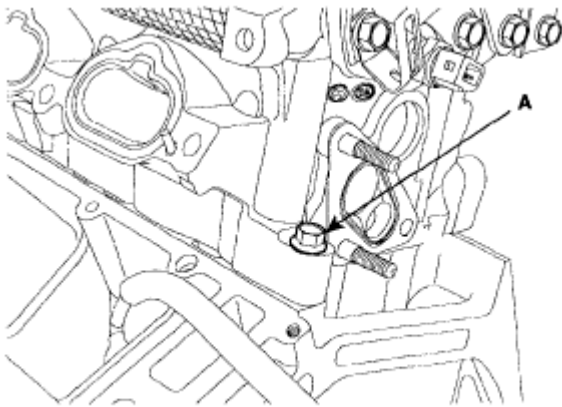
INSTALLATION

1. Install drive belt auto tensioner (A).

Tightening torque

96.04~99.96 Nm (9.8~10.2 kgf.m, 70.85~73.74 lb-ft)

17.64~21.56 Nm (1.8~2.2 kgf.m, 13.02~15.91 lb-ft)



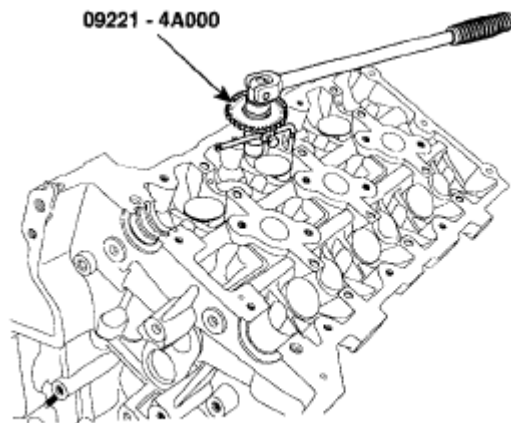
ECBF035A

Fig. 137: Identifying Drive Belt Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

2. Install drive belt idler (A).

Tightening torque

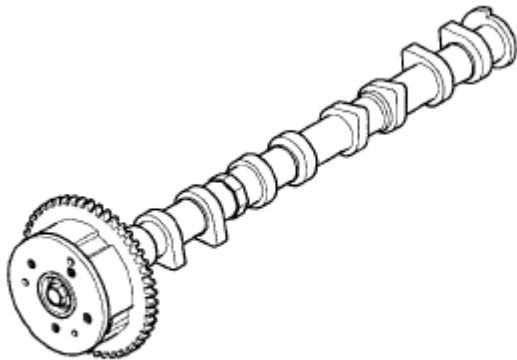
52.92~57.82 Nm (5.4~5.9 kgf.m, 39.06~42.67 lb-ft)



KDRF223A

Fig. 138: Identifying Drive Belt Idler
Courtesy of HYUNDAI MOTOR CO.

3. Install generator (A).



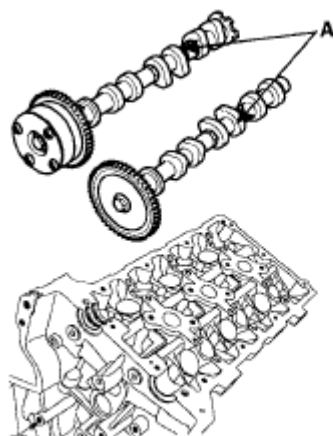
KCRF122A

Fig. 139: Identifying Generator
Courtesy of HYUNDAI MOTOR CO.

4. Install drive belt (A).

Crankshaft pulley --> A/C pulley --> idler pulley --> generator pulley --> water pump pulley --> P/S 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.

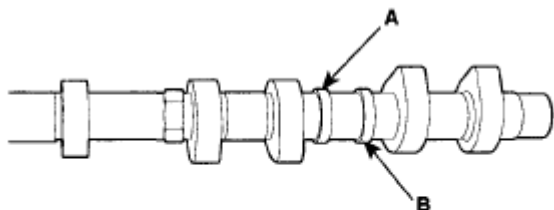


KDRF197A

Fig. 140: Identifying Drive Belt
Courtesy of HYUNDAI MOTOR CO.

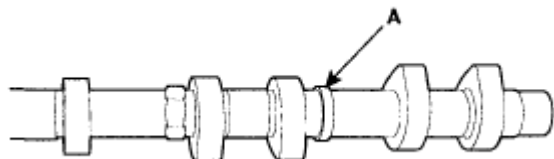
CYLINDER HEAD ASSEMBLY

COMPONENTS



KDRF226A

Fig. 141: Identifying Cylinder Head Assembly Components And Tightening Torque (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



KDRF227A

Fig. 142: Identifying Cylinder Head Assembly Components And Tightening Torque (2 Of 2)

Courtesy of HYUNDAI MOTOR CO.

REMOVAL

CAUTION:

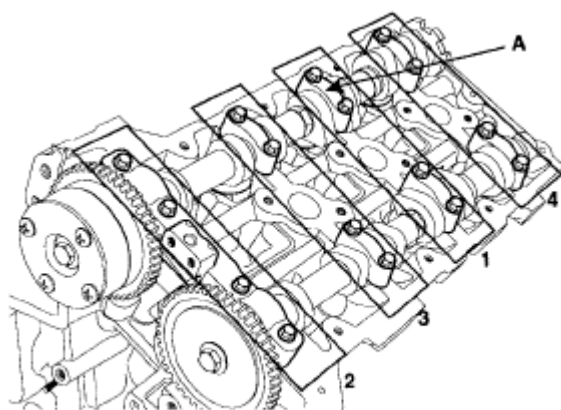
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal operating temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket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

NOTE:

- Mark all wiring and hoses to avoid mis-connection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

Engine removal is required for this procedure.

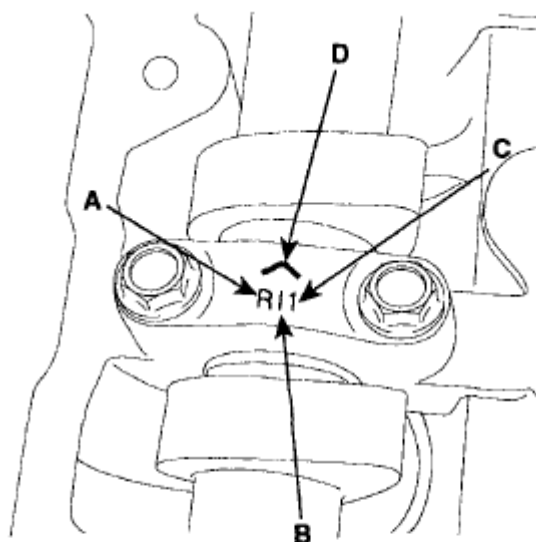
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove camshaft bearing cap (A).



UCBF008A

Fig. 143: Identifying Camshaft Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

6. Remove camshaft assembly (A).

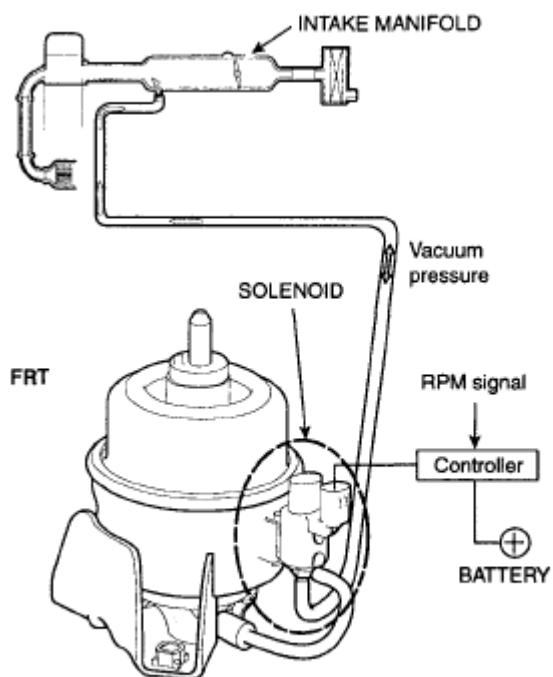


ECBF036A

A : L(LH),R(RH)
B : I(Intake),None(Exhaust)
C : Journal number
D : Front mark

Fig. 144: Identifying Camshaft Assembly
Courtesy of HYUNDAI MOTOR CO.

7. Remove cylinder head bolts, then remove cylinder head.
 1. Uniformly loosen and remove the 16 cylinder head bolts, in several passes, in the sequence shown. Remove the 16 cylinder head bolts and plate washers.



SCMM16200N

Fig. 145: Identifying Cylinder Head Bolts Loosening Sequence
Courtesy of HYUNDAI MOTOR CO.

2. In the case of RH head, Remove support bolt (M8).

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

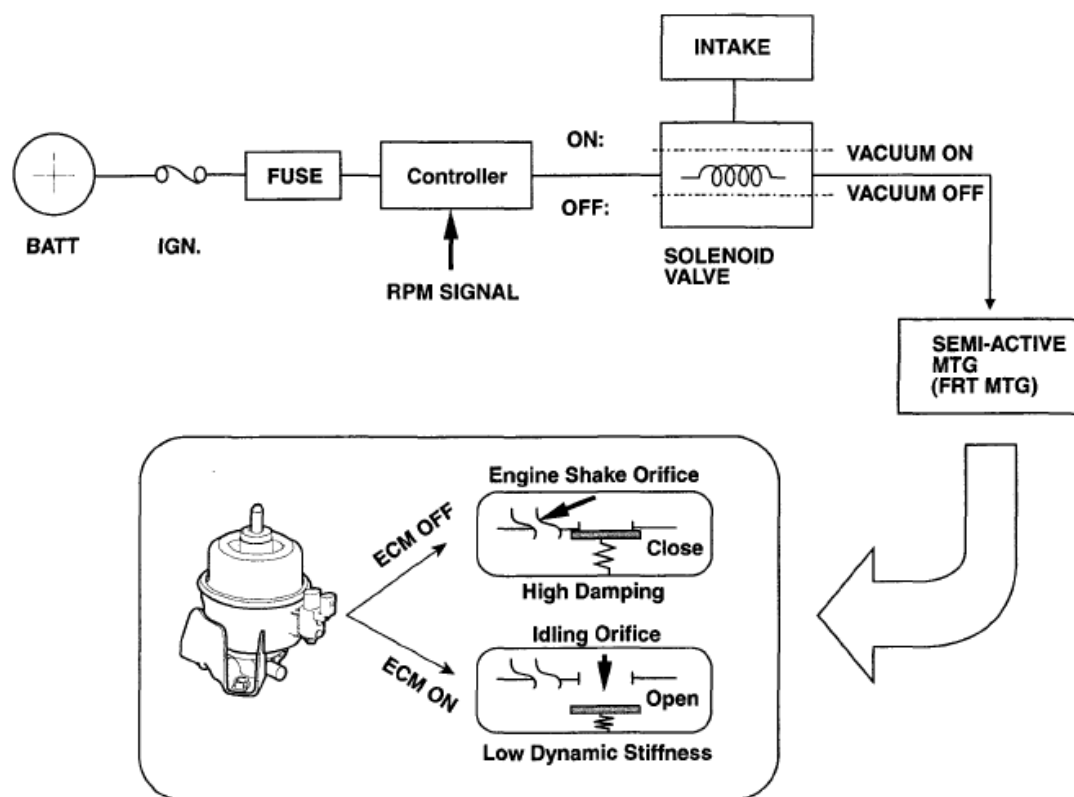
3. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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

DISASSEMBLY

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

1. Remove MLAs (A).

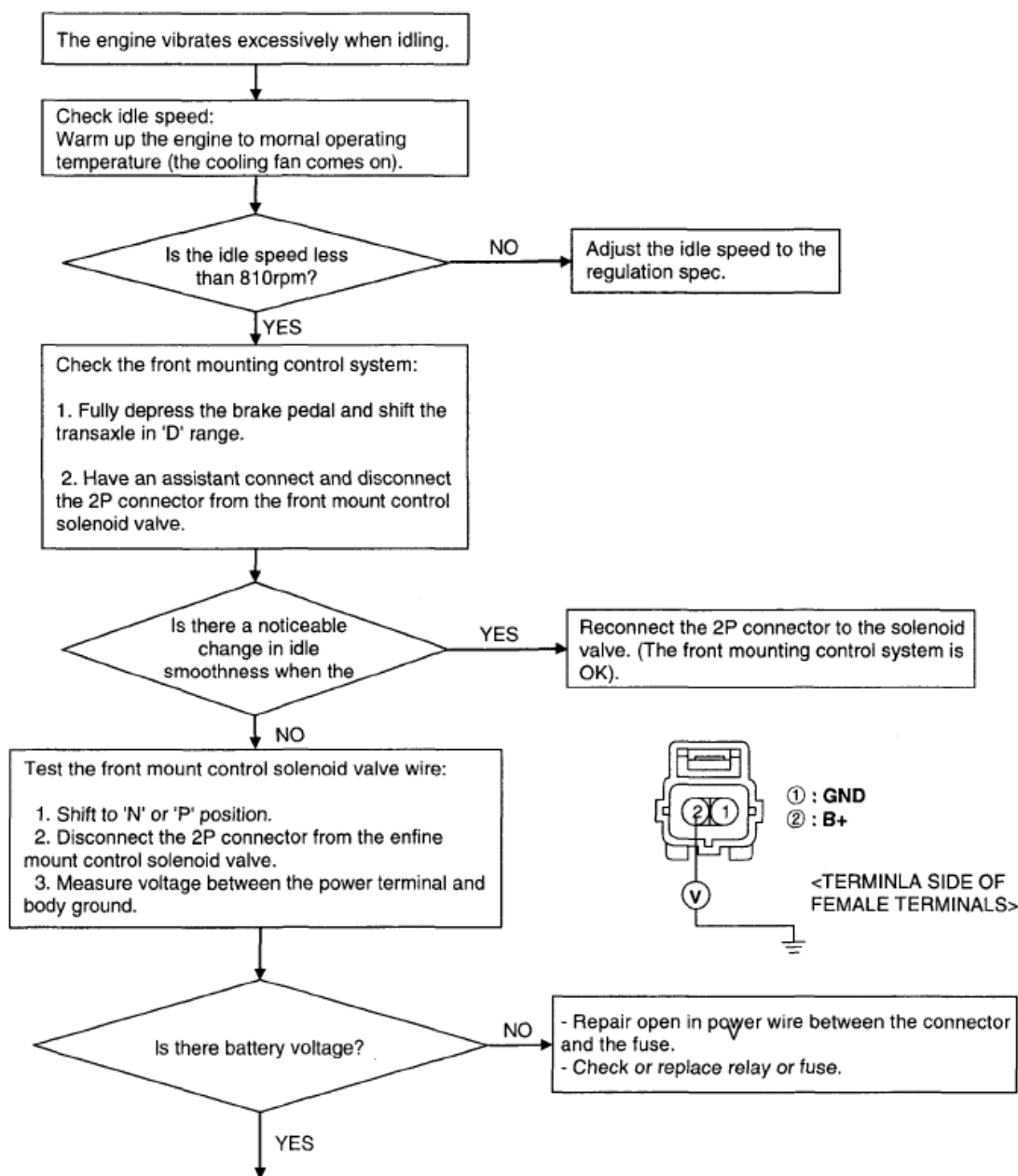


SCMM16201N

Fig. 146: Identifying MLAs

Courtesy of HYUNDAI MOTOR CO.

2. Remove valves.
 1. Using SST (09222-3K000, 09222-3C300), compress the valve spring and remove retainer lock.

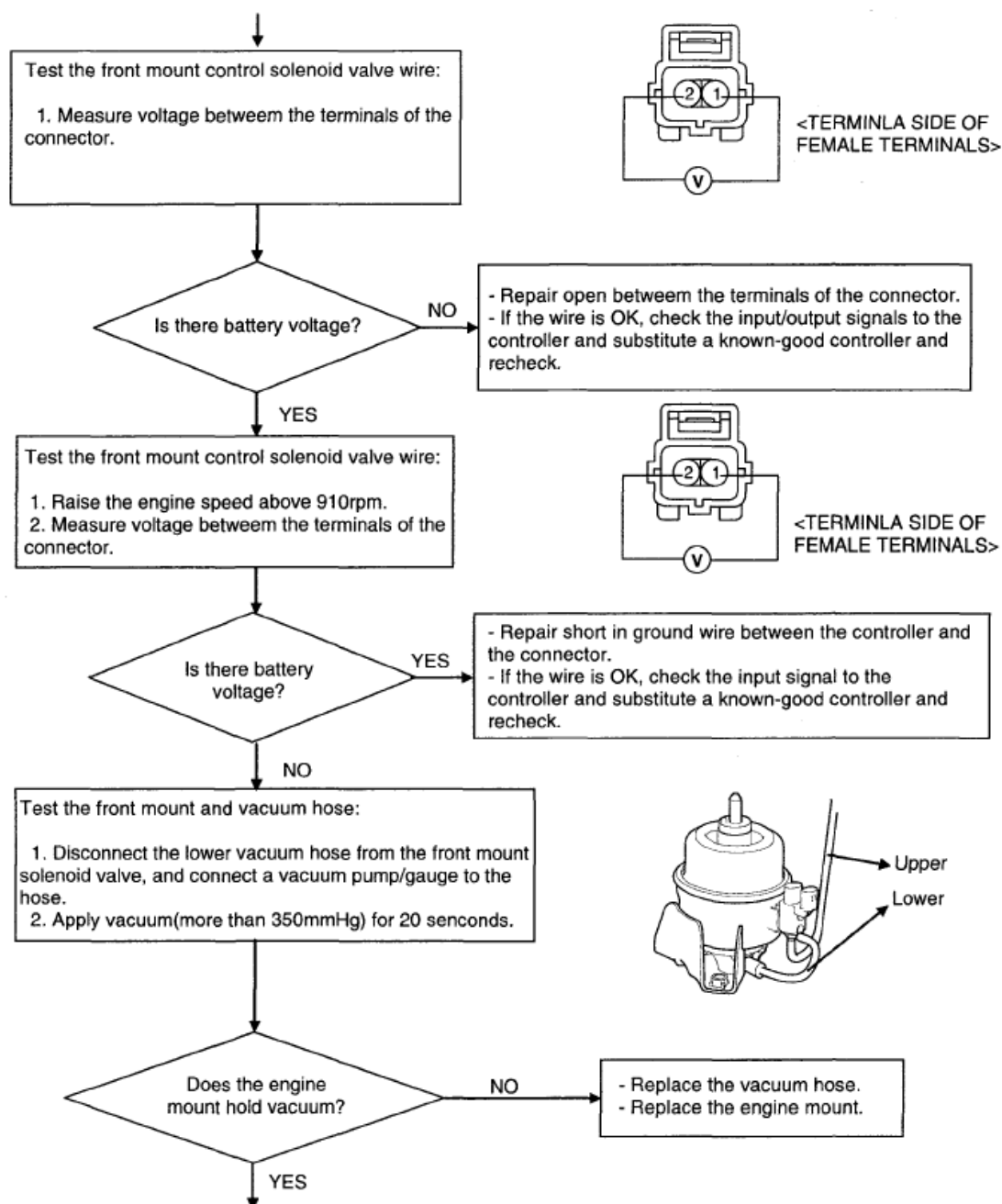


SCMM16202N

Fig. 147: Identifying SST (09222-3K000, 09222-3C300)

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.

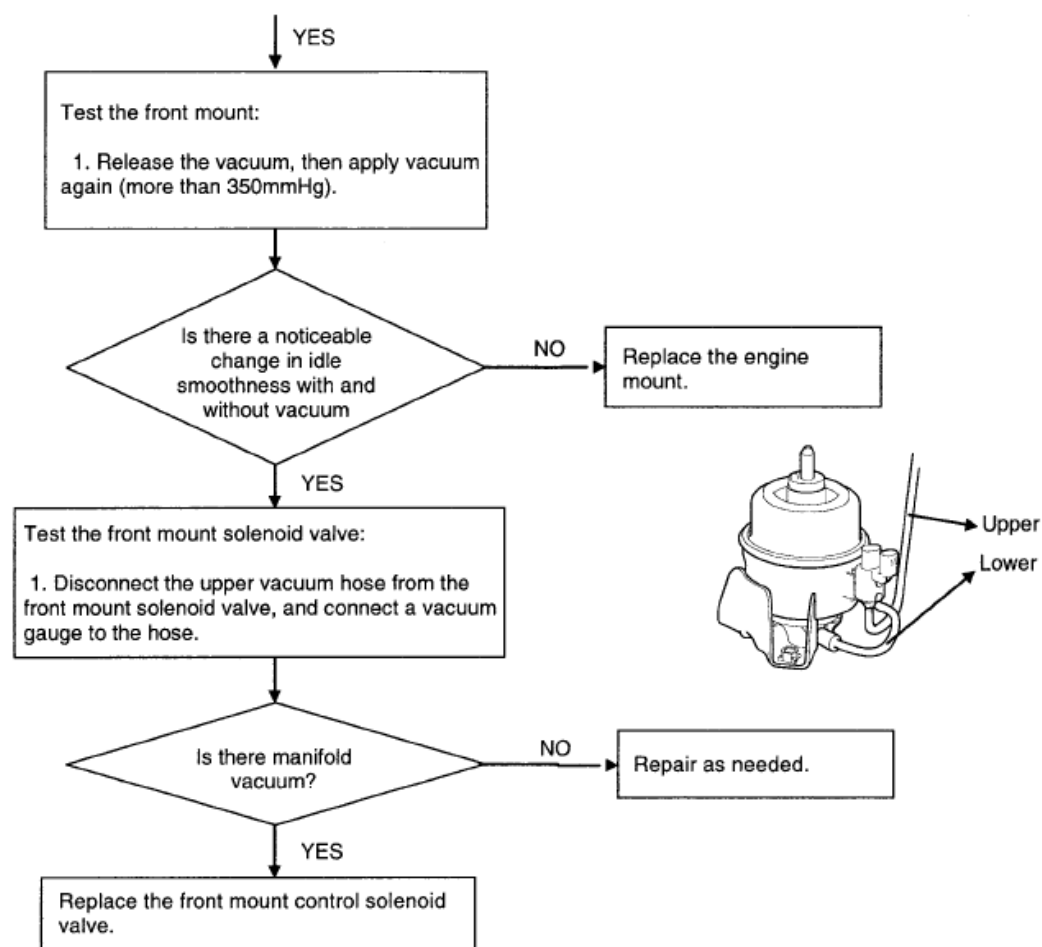


SCMM16203N

Fig. 148: Identifying SST (09222-29000)
Courtesy of HYUNDAI MOTOR CO.

NOTE: Do not reuse old valve stem seals.

3. Remove OCV (A).



SCMM16204N

Fig. 149: Identifying OCV
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

CYLINDER HEAD

1. Inspect for flatness.

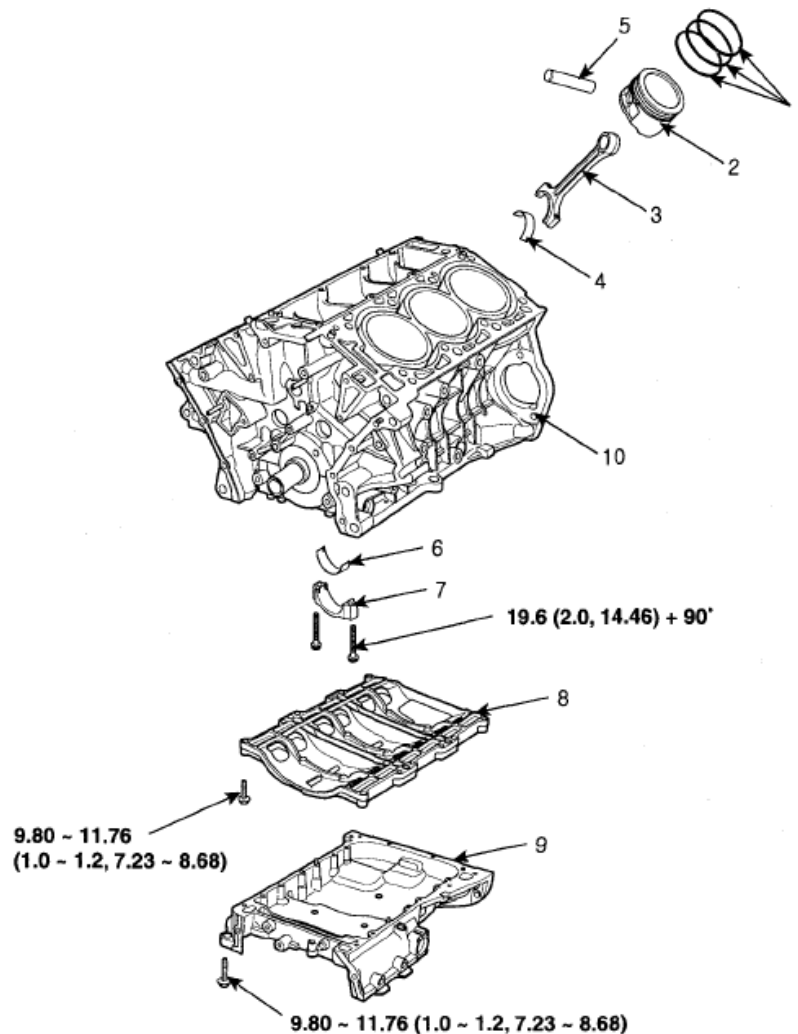
Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface

Standard: Less than 0.05 mm (0.002 in.) [Less than 0.02 mm (0.0008 in.)/150 x 150]

Flatness of manifold gasket surface

Standard: Less than 0.1 mm (0.0039 in.) [Less than 0.03 (0.001 in.)/(110 x 110)]



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

1. Piston ring
2. Piston
3. Connecting rod
4. Connecting rod upper bearing
5. Piston pin

6. Connecting rod lower bearing
7. Connecting rod bearing cap
8. Baffle plate
9. Upper oil pan
10. Cylinder block

EDRF005A

Fig. 150: Measuring Surface Contacting Cylinder Block And Manifolds For Warpage
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.

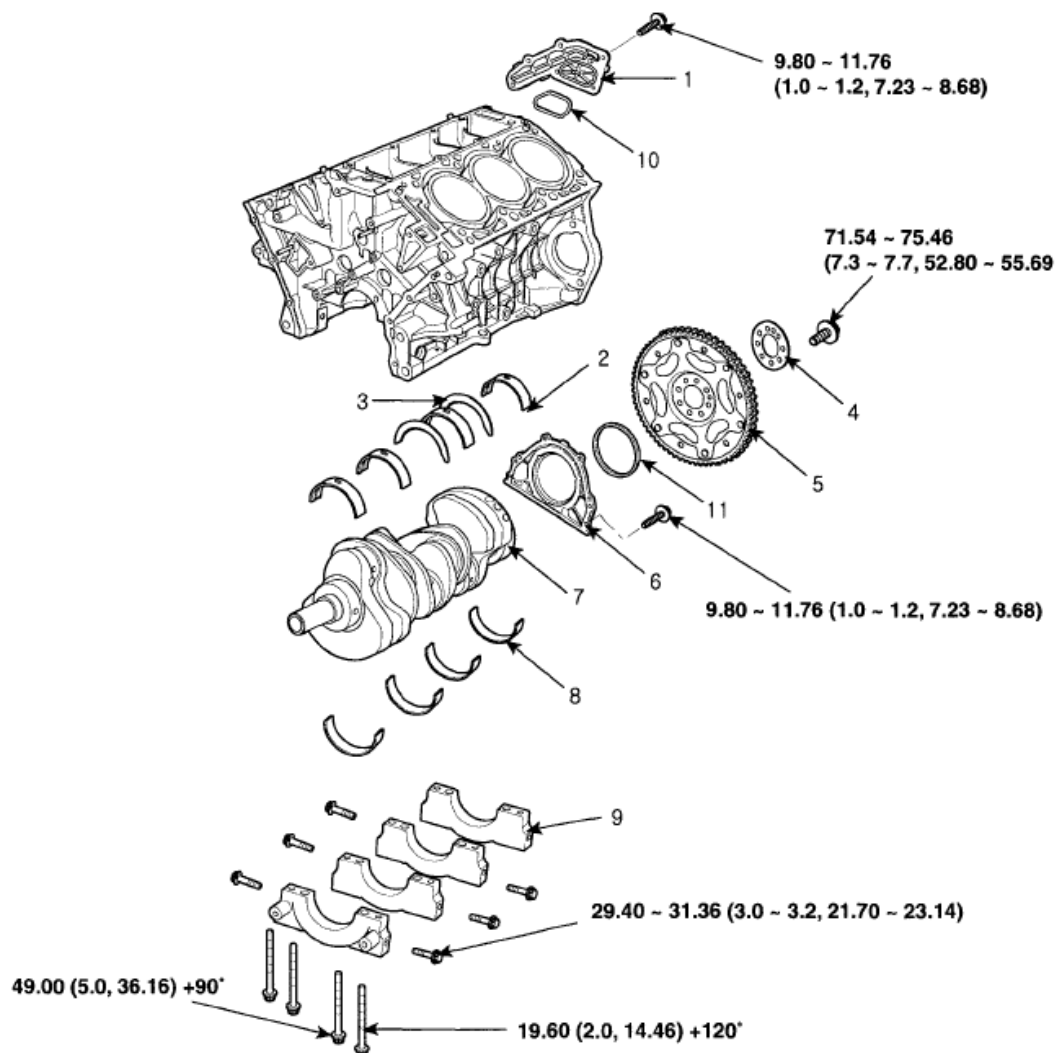
VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

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

Valve guide I.D.

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



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

- | | |
|-----------------------------|-----------------------------|
| 1. Oil drain cover | 6. Rear oil seal case |
| 2. Crankshaft upper bearing | 7. Crankshaft |
| 3. Thrust bearing | 8. Crankshaft lower bearing |
| 4. Plate adapter | 9. Main bearing cap |
| 5. Drive plate | 10. Oil drain cover gasket |
| | 11. Rear oil seal |

SCMM16100N

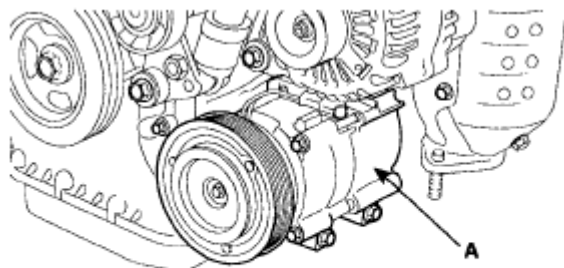
Fig. 151: Measuring Inside Diameter Of Valve Guide
 Courtesy of HYUNDAI MOTOR CO.

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

Valve stem O.D.

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

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



KDRF103A

Fig. 152: 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: 0.020~0.047 mm (0.0008~0.0018 in.)

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

[Limit]

Intake : 0.07 mm (0.0027 in.)

Exhaust: 0.09 mm (0.0035 in.)

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.

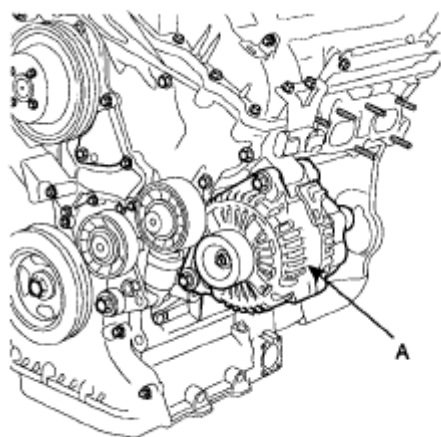
If the margin thickness is less than minimum, replace the valve.

Margin

[Standard]

Intake: 1.56~1.86 mm (0.06142~0.07323 in.)

Exhaust: 1.73~2.03 mm (0.06811~0.07992 in.)



KDRF104A

Fig. 153: Identifying Valve Head Margin Thickness
Courtesy of HYUNDAI MOTOR CO.

4. Check the valve length.

Length

Intake: 105.27 mm (4.1445 in.)

Exhaust: 105.50 mm (4.1535 in.)

5. 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.

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. 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.

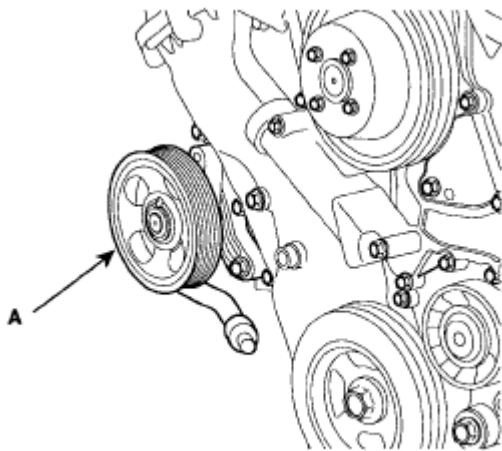
2. Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height: 43.86 mm (1.7267 in.)

Out-of-square: 1.5°



KDRF102A

Fig. 154: Measuring Free Length Of Valve Spring
Courtesy of HYUNDAI MOTOR CO.

MLA

1. Inspect MLA.

Using a micrometer, measure the MLA outside diameter.

MLA O.D.

Intake/Exhaust: 34.964~34.980 mm (1.3765~1.3771 in.)

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

Tappet bore I.D.

Intake/Exhaust: 35.000~35.025 mm (1.3779~1.3789 in.)

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

MLA to tappet bore clearance

[Standard]

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

[Limit]

Intake/Exhaust: 0.07 mm (0.0027 in.)

CAMSHAFT

1. Inspect cam lobes.

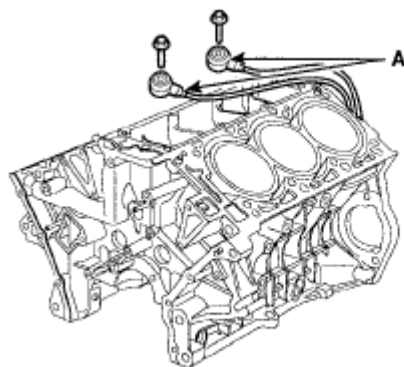
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 46.8 mm (1.8425 in.)

Exhaust: 45.8 mm (1.8031 in.)

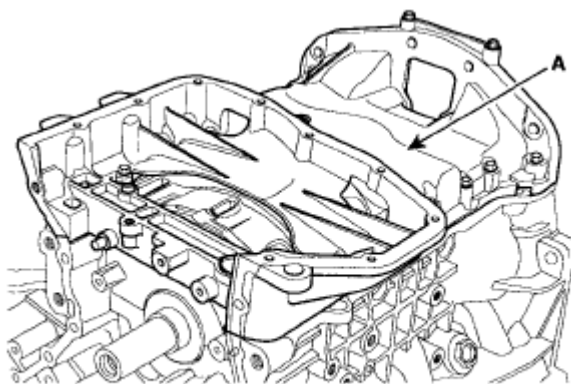


KDRF205A

Fig. 155: 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.



KDRF206A

Fig. 156: Laying Strip Of Plastigage Across Of Camshaft Journal
Courtesy of HYUNDAI MOTOR CO.

4. Install the bearing caps.

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

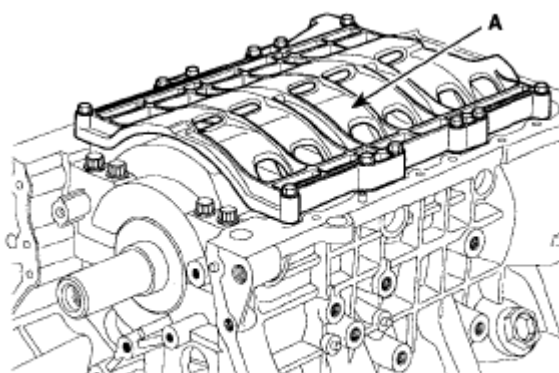
No. 1 journal: 0.020~0.057 mm (0.0008~0.0022 in.)

No. 2,3,4 journal : 0.030~0.067 mm (0.0012~0.0026 in.)

Exhaust

No. 1 journal: 0.020~0.057 mm (0.0008~0.0022 in.)

No. 2,3,4 journal : 0.030~0.067 mm (0.0012~0.0026 in.)



KDRF207A

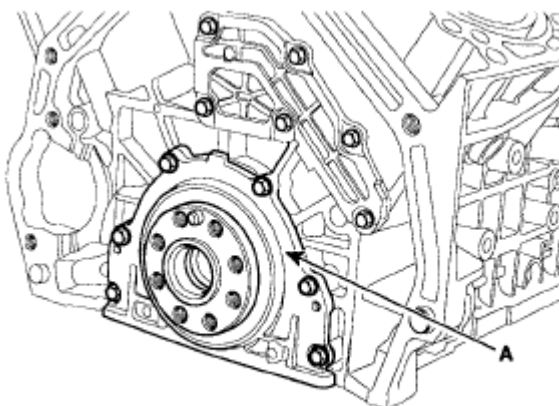
Fig. 157: Measuring Plastigage At Its Widest Point
Courtesy of HYUNDAI MOTOR CO.

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

Camshaft end play

[Standard value]: 0.02~0.18 mm (0.0008~0.0071 in.)



KDRF208A

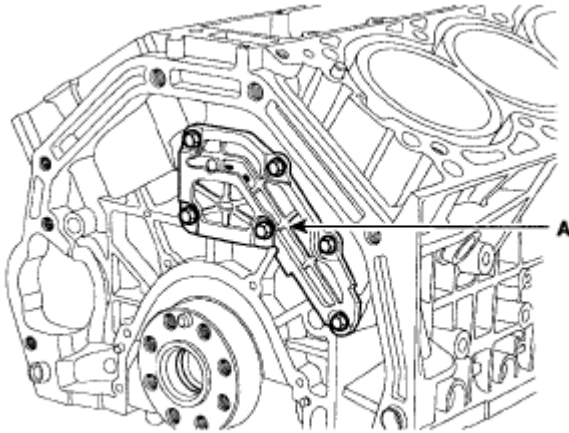
Fig. 158: Measuring End Play While Moving Camshaft Back And Forth
Courtesy of HYUNDAI MOTOR CO.

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.



KDRF209A

Fig. 159: Identifying Retard Hole
Courtesy of HYUNDAI MOTOR CO.

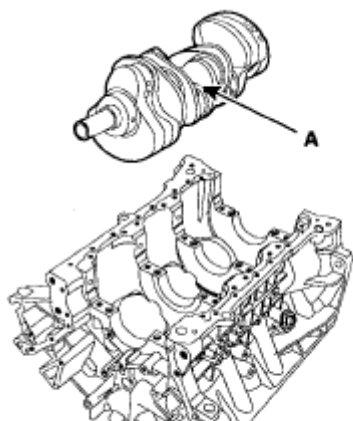
3. Wind tape around the tip of the air gun and apply air of approx. 150 kpa (1.5 kgf/cm², 21 psi) to the port of the camshaft.

(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.**

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, If excessive air leaks from the port, the lock pin may not be fully released.



KDRF210A

Fig. 160: Identifying CVVT Assembly Retard And Advance Direction
 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 resistance to movement.

Standard: Movable smoothly in the range about 22.5°

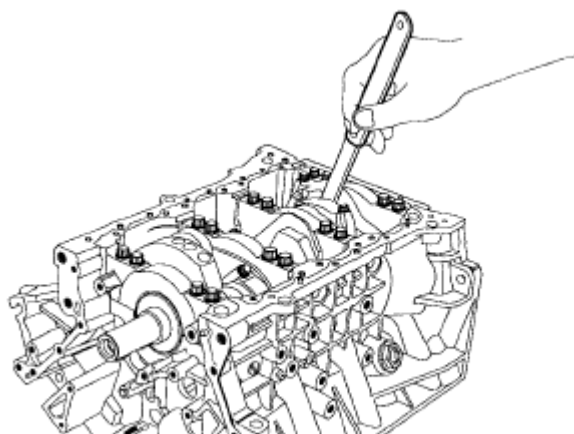
6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position (counter clockwise).

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 (09222-3C100), 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.



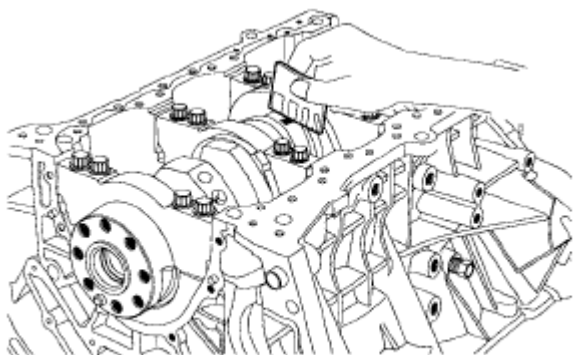
KDRF211A

Fig. 161: Identifying SST (09222-3C100)
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, 09222-3C300), 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.

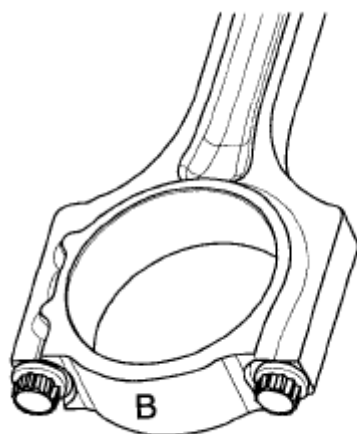


KDRF212A

Fig. 162: Identifying SST (09222 - 3K000, 09222-3C300)
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.



SCMM16101N

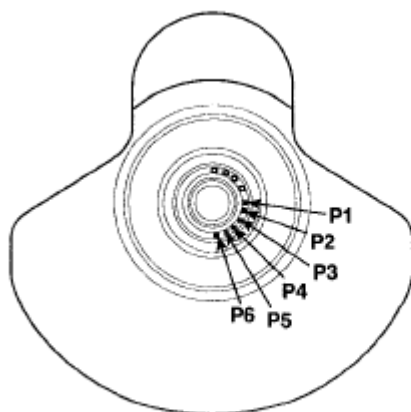
Fig. 163: Identifying MLA
Courtesy of HYUNDAI MOTOR CO.

NOTE: MLA can be reinstalled in its original position.

3. Install OCV (A).

Tightening torque

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



EC8F037A

Fig. 164: Identifying OCV
Courtesy of HYUNDAI MOTOR CO.

NOTE:

- To install OCV with gray colored connector into RH bank.
- To install OCV with black colored connector into LH bank.

CAUTION:

- Do not reuse the OCV when dropped.

- Keep the OCV assembly clean.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine by holding the OCV yoke.

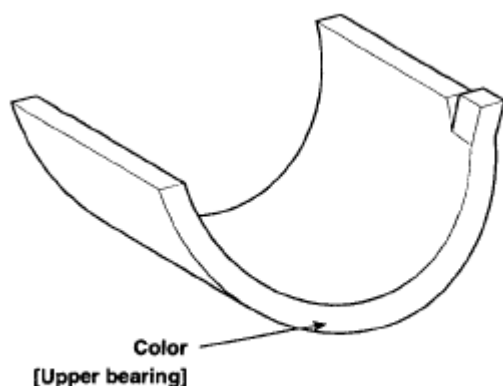
INSTALLATION

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.

1. Install the cylinder head.
 - a. The sealant locations on cylinder head and cylinder block must be free from contamination.
 - b. Apply sealant on cylinder block top face before assembling cylinder head gaskets.

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



SCMM16102N

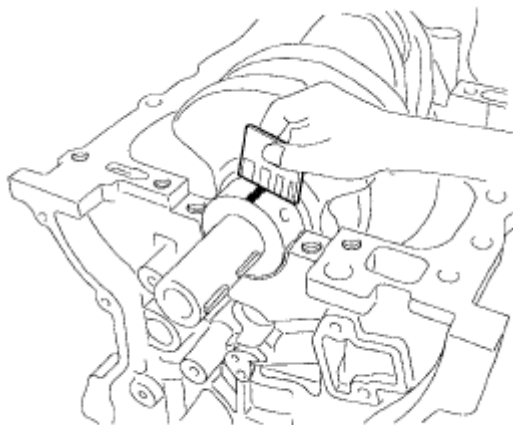
Fig. 165: Identifying Sealant On Cylinder Block Top Face
Courtesy of HYUNDAI MOTOR CO.

NOTE: Refer to below illustration to apply the sealant. See Fig. 166.

Bead width: 2.0~3.0 mm

Sealant locations: 1.0~1.5mm from block surface

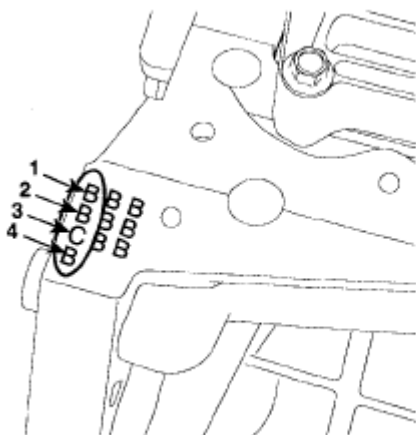
Recommended sealant: Liquid sealant TB1217H



KCRF170A

Fig. 166: Identifying Bead Width And Sealant Locations
Courtesy of HYUNDAI MOTOR CO.

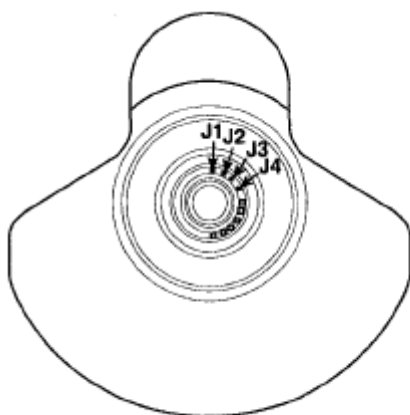
- c. Apply sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block. The part must be assembled within 5 minutes after sealant was applied.



ECBF038A

Fig. 167: Identifying Sealant On Cylinder Head Gaskets
Courtesy of HYUNDAI MOTOR CO.

NOTE: Be careful of the installation direction.

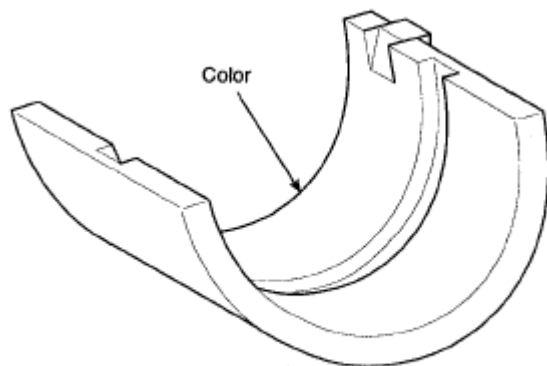


ECBF039A

Fig. 168: Identifying Cylinder Installation Direction
Courtesy of HYUNDAI MOTOR CO.

- d. Install the cylinder head.

NOTE: Remove the extruded sealant after assembling cylinder heads.



ECRF022A

Fig. 169: Identifying Cylinder Head
Courtesy of HYUNDAI MOTOR CO.

2. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
 1. Do not apply engine oil on the threads and under the heads of the cylinder head bolts.
 2. Using SST (09221 -4A000), install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque

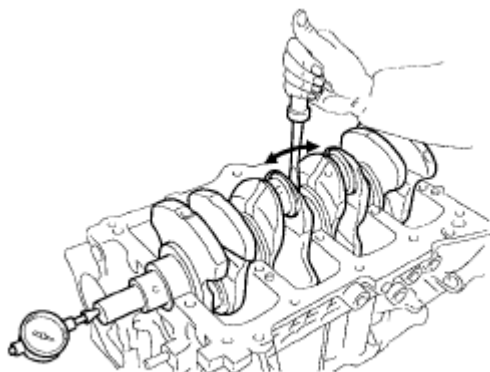
1st step: 37.3~41.2 Nm (3.8~4.2 kgf.m, 27.5~30.4 lbf.ft)

2nd step: $120^{\circ} \pm 2^{\circ}$

3rd step: $90^{\circ} \pm 2^{\circ}$

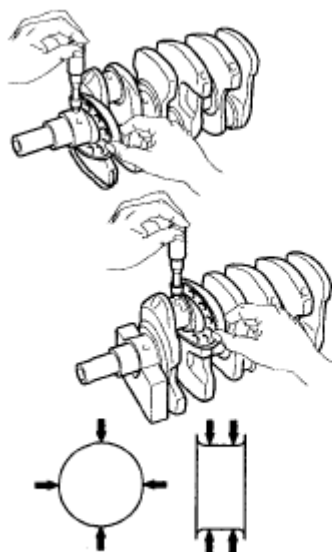
18.62~23.52 Nm (1.9~2.4 kgf.m, 13.74~17.36 lb-ft) (A)

NOTE: Always use new cylinder head bolt.



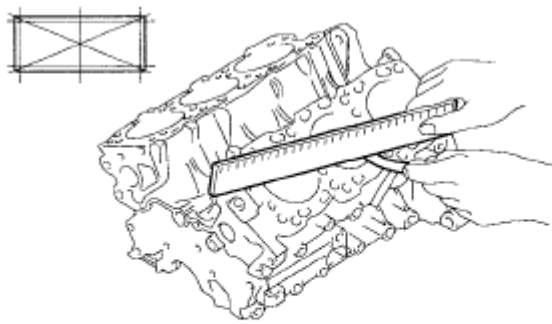
ECKD001B

Fig. 170: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.



ECKD001E

Fig. 171: Identifying Cylinder Head Bolt
Courtesy of HYUNDAI MOTOR CO.



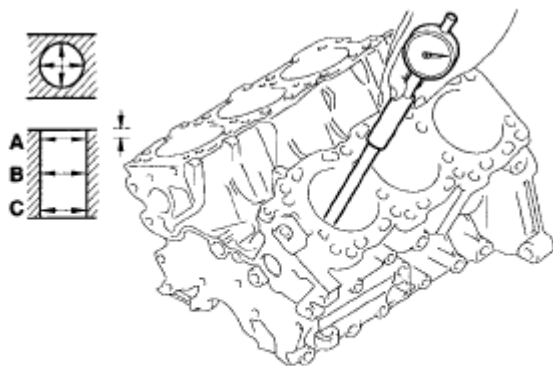
EDQF154A

Fig. 172: Tightening Cylinder Head Bolt
Courtesy of HYUNDAI MOTOR CO.

4. Install the CVVT and camshaft sprocket.

Tightening torque

64.68~76.44 Nm (6.6~7.8 kgf.m, 47.74~56.4 lb-ft)



EDQF153A

Fig. 173: Identifying CVVT
Courtesy of HYUNDAI MOTOR CO.

NOTE:

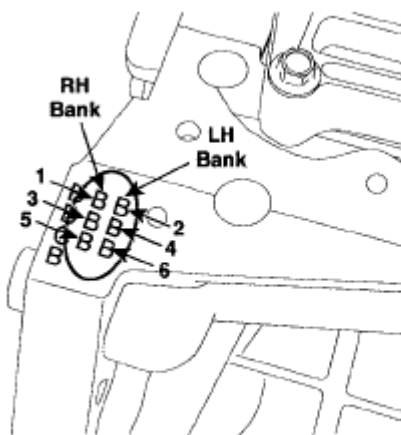
- Install camshaft-inlet to dowel pin of CVVT assembly.
- Ensure that the camshaft oil inlet is not obstructed.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.

- Do not rotate CVVT assembly when camshaft is installed to dowel pin of CVVT assembly.

5. Install camshafts (A).

NOTE:

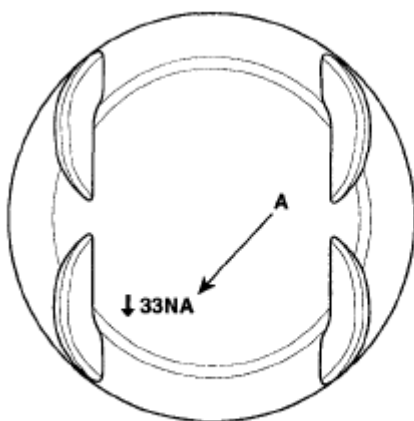
- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.
- Ensure that the camshaft components are installed in the correct locations.



ECBF002A

Fig. 174: Identifying Camshafts
Courtesy of HYUNDAI MOTOR CO.

INTAKE CAMSHAFT

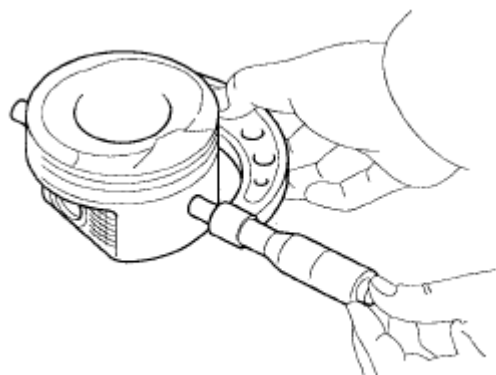


UDRF001A

Fig. 175: Identifying Intake Camshaft
Courtesy of HYUNDAI MOTOR CO.

INTAKE CAMSHAFT REFERENCE

LH	RH
A: 30 mm (1.1811 in.)	A: 27 mm (1.0630 in.)
B: 27 mm (1.0630 in.)	B: 30 mm (1.1811 in.)

EXHAUST CAMSHAFT

ECKD001D

Fig. 176: Identifying Exhaust Camshaft
Courtesy of HYUNDAI MOTOR CO.

EXHAUST CAMSHAFT REFERENCE

LH	RH
A: 27 mm (1.0630 in.)	A: 30 mm (1.1811 in.)

6. Install camshaft bearing caps (A).

Assemble camshaft bearing caps as the order below.

Tightening torque

5.9 Nm (0.6 kgf.m, 4.3 lb-ft) - 1st step

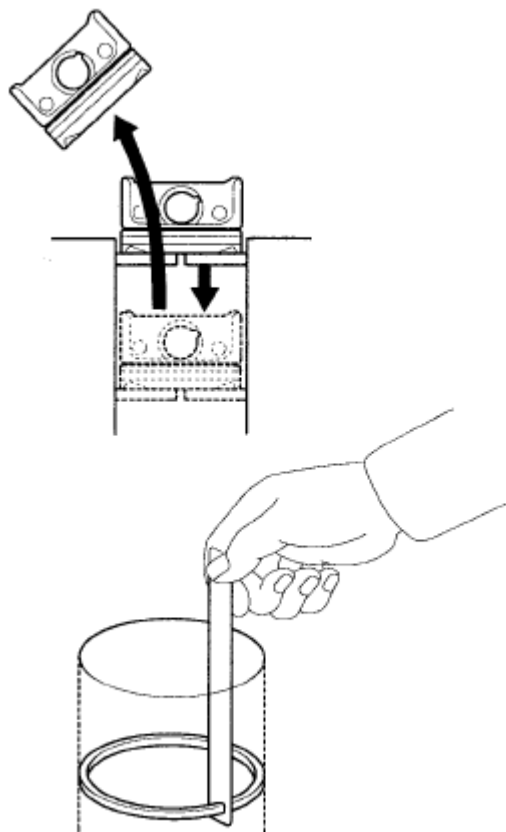
9.80~11.76 Nm (1.0~1.2 kgf.m, 7.23~8.68 lb-ft) - 2nd step



ECKD001G

Fig. 177: Identifying Camshaft Bearing Caps
Courtesy of HYUNDAI MOTOR CO.

NOTE: Ensure that the cam bearing caps are installed in the correct location and direction. Refer to the table below.



ECKD001K

Fig. 178: Identifying Cam Bearing Caps Install Correct Location And Direction
Courtesy of HYUNDAI MOTOR CO.

A: L (LH), R (RH)

B: I (Intake), None (Exhaust)

C: Journal number

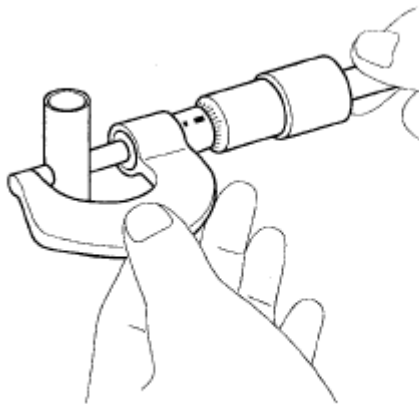
D: Front mark

CAUTION: Rotate the crankshaft to position the pistons 10mm (0.3937 in.) from the top of the cylinder block.

7. Install water temperature control assembly.
8. Install timing chain.
9. Check and adjust valve clearance.
10. Install the exhaust manifold.
11. Install the intake manifold.

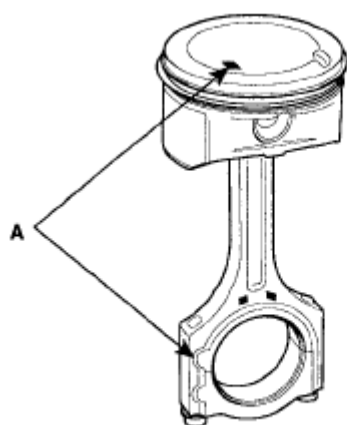
ENGINE BLOCK

COMPONENTS



ECKD001Z

Fig. 179: Identifying Engine Block Components And Tightening Torque (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



SCMM16103N

Fig. 180: Identifying Engine Block Components And Tightening Torque (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

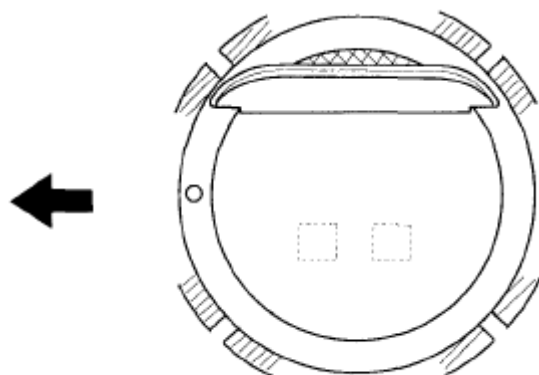
CAUTION:

- 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 mis-connection.
- Inspection the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- Engine removal is required for this procedure.

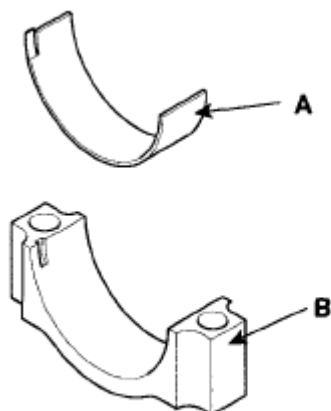
1. Remove exhaust manifold.
2. Remove intake manifold.
3. Remove timing chain.
4. Remove water temperature control assembly.
5. Remove cylinder head.
6. Remove oil pump.
7. Remove oil filter assembly.
8. Remove A/C compressor (A) from engine.



ECKD321A

Fig. 181: Identifying A/C Compressor
Courtesy of HYUNDAI MOTOR CO.

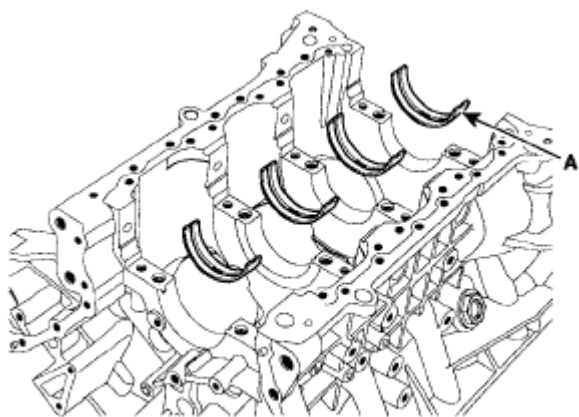
9. Remove generator (A) from engine.



SCMM16104N

Fig. 182: Identifying Generator
Courtesy of HYUNDAI MOTOR CO.

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

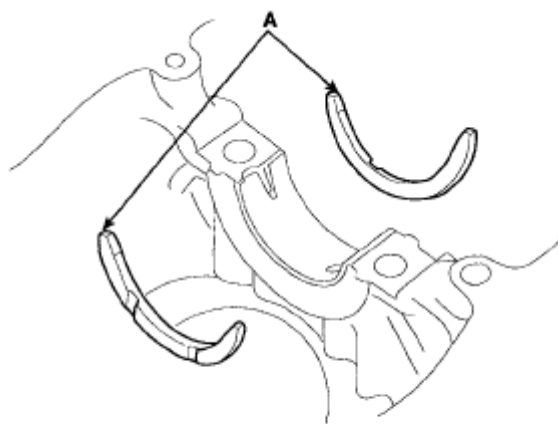


KDRF216A

Fig. 183: Identifying Power Steering Pump
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

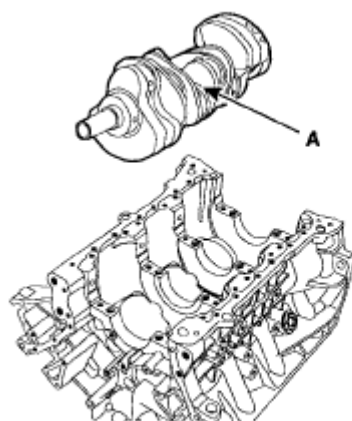
1. Remove drive plate.
2. Remove knock sensor (A).



ECKD324A

Fig. 184: Identifying Knock Sensor
Courtesy of HYUNDAI MOTOR CO.

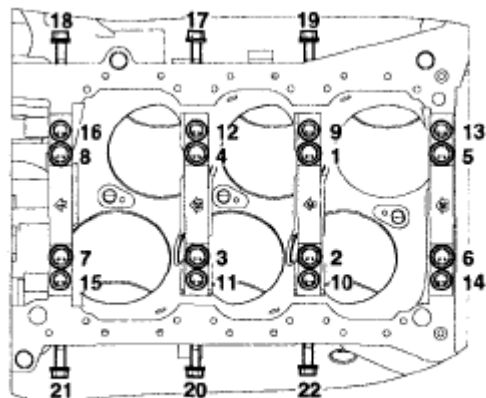
3. Remove upper oil pan (A).



KDRF210A

Fig. 185: Identifying Upper Oil Pan
Courtesy of HYUNDAI MOTOR CO.

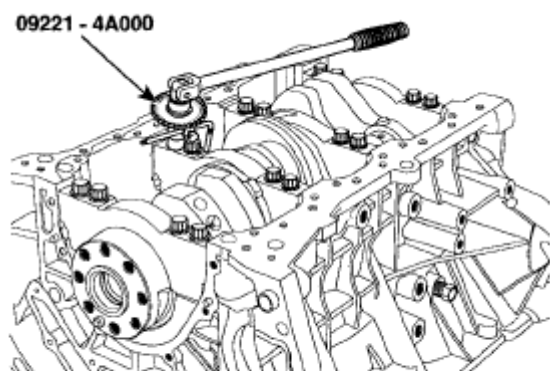
4. Remove baffle plate (A).



KDRF140A

Fig. 186: Identifying Baffle Plate
Courtesy of HYUNDAI MOTOR CO.

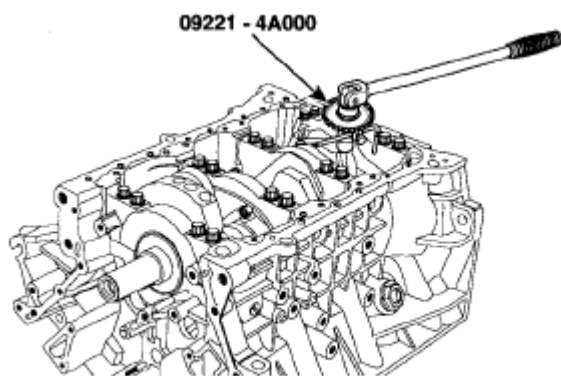
5. Remove rear oil seal case (A).



KDRF224A

Fig. 187: Identifying Rear Oil Seal Case
Courtesy of HYUNDAI MOTOR CO.

6. Remove oil drain cover (A).



KDRF225A

Fig. 188: Identifying Oil Drain Cover
Courtesy of HYUNDAI MOTOR CO.

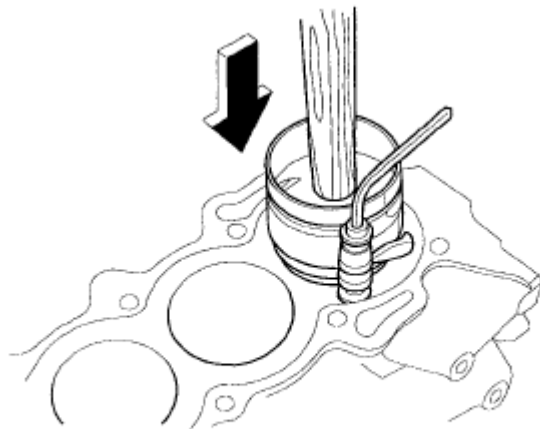
7. Check the connecting rod end play.
8. Check the connecting rod cap oil clearance.
9. Remove piston and connecting rod assemblies.
 1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE:

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

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

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



ECKD001F

Fig. 189: Identifying Crankshaft
Courtesy of HYUNDAI MOTOR CO.

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

13. Check fit between piston and piston pin.

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

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

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

15. Disconnect connecting rod from piston.

Using a press, remove the piston pin from piston. (Press-in load: 800~1400 kg (1764~3086 lb))

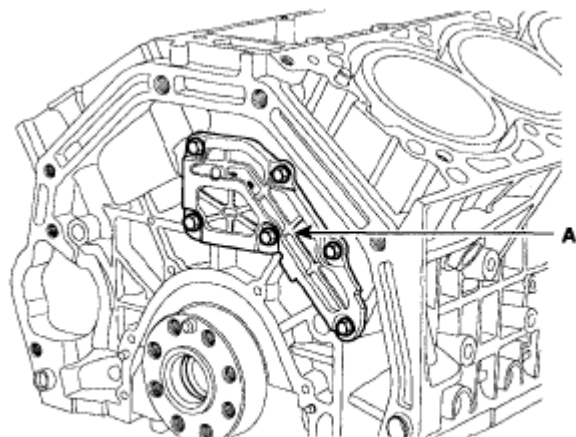
INSPECTION

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: 0.1~0.25 mm (0.004~0.010 in.)



KDRF209A

Fig. 190: Measuring End Play While Moving Connecting Rod Back And Forth
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

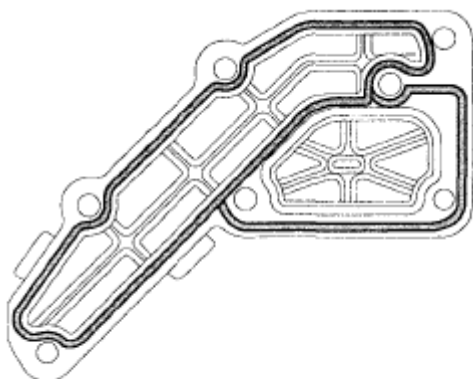
19.6 Nm (2.0 kgf.m, 14.46 lb-ft) + 90°

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

0.038~0.056 mm (0.0015~0.0022 in.)



ECBF003A

Fig. 191: Measuring Plastigage At Its 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.

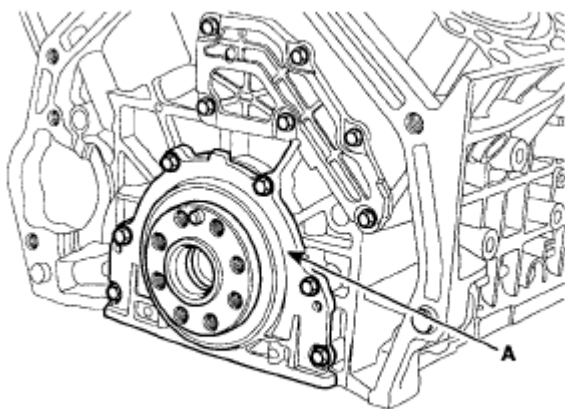
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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



KDRF208A

Fig. 192: Identifying Connecting Rod Mark Location
Courtesy of HYUNDAI MOTOR CO.

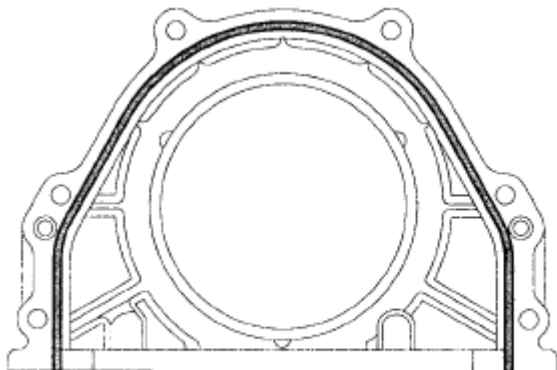
DISCRIMINATION OF CONNECTING ROD

CONNECTING ROD DISCRIMINATION

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

CRANKSHAFT PIN MARK LOCATION

DISCRIMINATION OF CRANKSHAFT



KDRF218A

Fig. 193: Identifying Discrimination Of Crankshaft

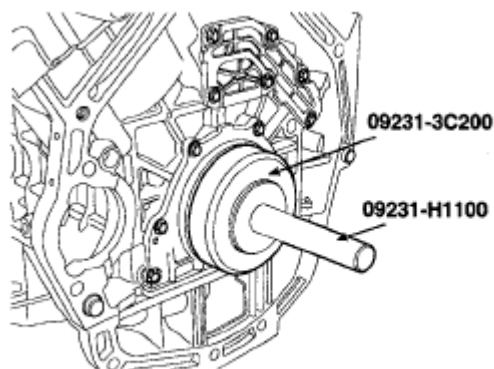
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT DISCRIMINATION

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

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



KDRF237A

Fig. 194: Identifying Place Of Identification Mark (Connecting Rod Bearing)
Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CONNECTING ROD BEARING

CONNECTING ROD BEARING DISCRIMINATION

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

(0.0591~0.0593 in.)

11. Selection

CONNECTING ROD IDENTIFICATION MARK REFERENCE

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

3. Check the crankshaft bearing oil clearance.

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

Tightening torque

49.00 Nm (5.0 kgf.m, 36.16 lb-ft) + 90°

19.60 Nm (2.0 kgf.m, 14.46 lb-ft) + 120°

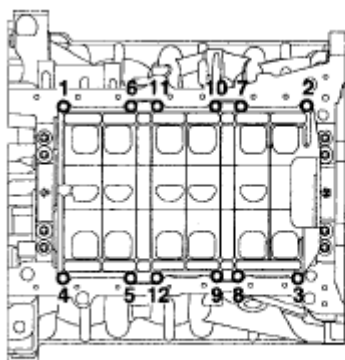
29.40~31.36 Nm (3.0~3.2 kgf.m, 21.70~23.14 lb-ft)

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.022~0.040 mm (0.0009~0.0016 in.)



KDRF135A

Fig. 195: 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.

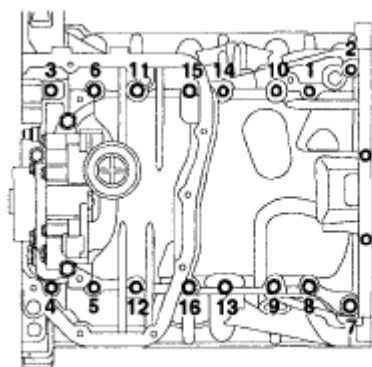
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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.

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.



KDRF131A

Fig. 196: Identifying Crankshaft Bore Mark Location
 Courtesy of HYUNDAI MOTOR CO.

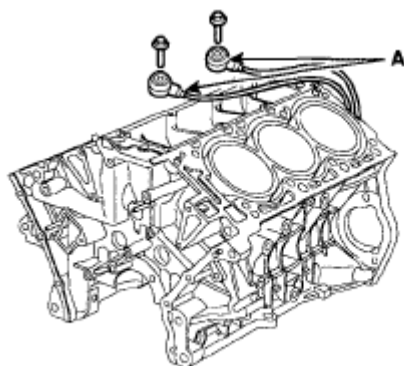
DISCRIMINATION OF CYLINDER BLOCK

CYLINDER BLOCK DISCRIMINATION

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

CRANKSHAFT JOURNAL MARK LOCATION

DISCRIMINATION OF CRANKSHAFT



KDRF205A

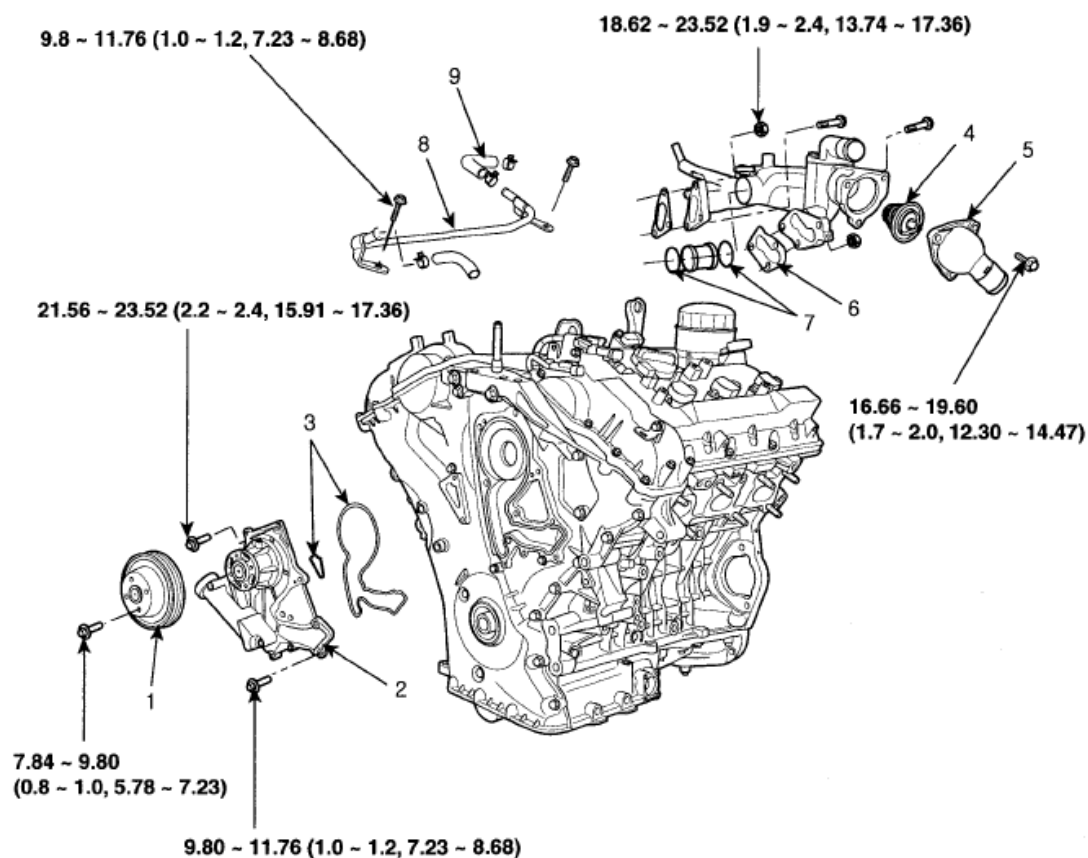
Fig. 197: Identifying Discrimination Of Crankshaft
 Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CRANKSHAFT

CRANKSHAFT DISCRIMINATION

CLASS	MARK	OUTSIDE DIAMETER OF JOURNAL
I	1 or A	68.954~68.960 mm (2.7147~2.7150 in.)
II	2 or B	68.948~68.954 mm (2.7145~2.7147 in.)
III	3 or C	68.942~68.948 mm (2.7142~2.7145 in.)

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



SCMM16105N

Fig. 198: Identifying Place Of Identification Mark (Crankshaft Bearing)
 Courtesy of HYUNDAI MOTOR CO.

DISCRIMINATION OF CRANKSHAFT BEARING**CRANKSHAFT BEARING DISCRIMINATION**

CLASS	MARK	THICKNESS OF BEARING
E	BLUE	2.277~2.280 mm (0.0896~0.0897 in.)
D	BLACK	2.274~2.277 mm (0.0895~0.0896 in.)
C	BROWN	2.271~2.274 mm (0.0894~0.0895 in.)
B	GREEN	2.268~2.271 mm (0.0893~0.0894 in.)
A	YELLOW	2.265~2.268 mm (0.0892~0.0893 in.)

SELECTION**CRANKSHAFT BORE IDENTIFICATION MARK REFERENCE**

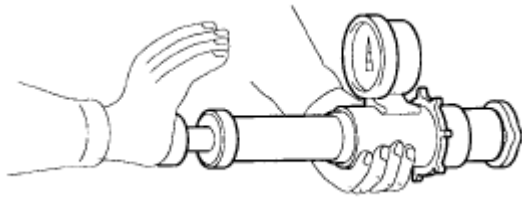
		CRANKSHAFT BORE IDENTIFICATION MARK		
		a (A)	b (B)	c (C)
CRANKSHAFT IDENTIFICATION MARK	1 or A	A (YELLOW)	B (GREEN)	C (BROWN)
	2 or B	B (GREEN)	C (BROWN)	D (BLACK)
	3 or C	C (BROWN)	D (BLACK)	E (BLUE)

4. Check crankshaft end play.

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

Standard end play

0.10~0.28 mm (0.0039~0.0110 in.)



ECKD501X

Fig. 199: Measuring Thrust Clearance While Prying Crankshaft Back And Forth With Screwdriver

Courtesy of HYUNDAI MOTOR CO.

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

Thrust bearing thickness

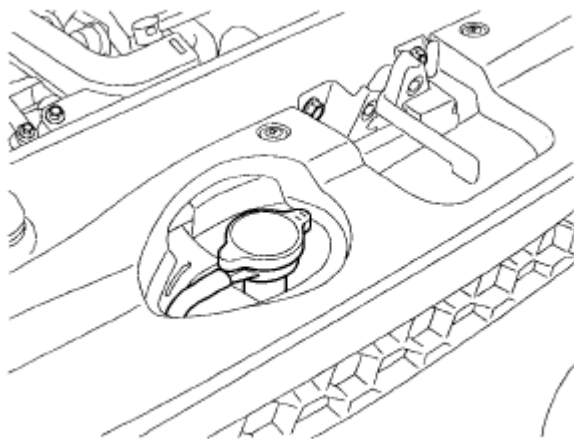
2.41~2.45 mm (0.0949~0.0964 in.)

5. Inspect main journals and crank pins

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

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

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



SCMM16018N

Fig. 200: Measuring Diameter Of Main Journal And Crank Pin

Courtesy of HYUNDAI MOTOR CO.

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

Allowable twist of connecting rod: 0.1 mm/100 mm (0.0039 in./3.94 in.) or less

CYLINDER BLOCK

1. Remove gasket material.

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

2. Clean cylinder block

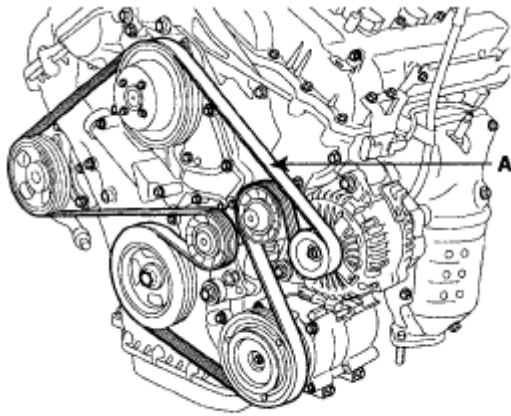
Using a soft brush and solvent, thoroughly clean the cylinder block.

3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

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



KDRF101A

Fig. 201: Measuring Surface Contacting Cylinder Head Gasket For Warp
Courtesy of HYUNDAI MOTOR CO.

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

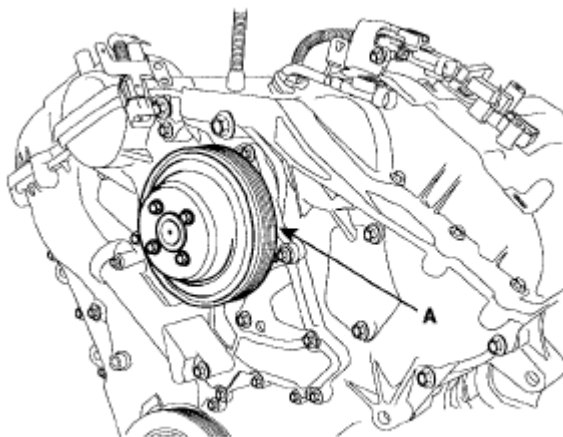
If deep scratches are present, replace the cylinder block.

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

96.00~96.03 mm (3.7795~3.7807 in.)

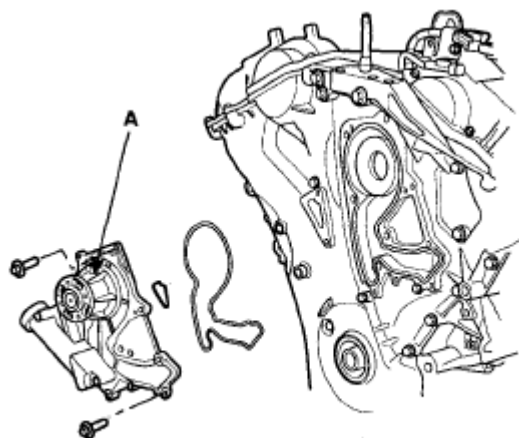


KDRF107A

Fig. 202: Measuring Cylinder Bore Diameter At Position In Thrust And Axial Directions

Courtesy of HYUNDAI MOTOR CO.

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



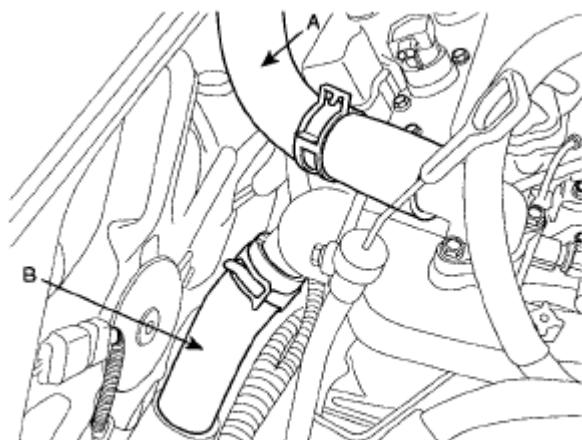
KDRF221A

Fig. 203: Identifying Cylinder Bore Size Code On Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

CYLINDER BORE INNER DIAMETER REFERENCE

Class	Size code	Cylinder bore inner diameter
A	A	96.00~96.01 mm (3.7795~3.7799 in.)
B	B	96.01~96.02 mm (3.7799~3.7803 in.)
C	C	96.02~96.03 mm (3.7803~3.7807 in.)

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



SCMM1604N

Fig. 204: Identifying Piston Size Code On Piston Top Face
 Courtesy of HYUNDAI MOTOR CO.

PISTON OUTER DIAMETER REFERENCE

Class	Size code	Piston outer diameter
A	A	95.96~95.97 mm (3.7779~3.7783 in.)
B	B	95.97~95.98 mm (3.7783~3.7787 in.)
C	C	95.98~95.99 mm (3.7787~3.7791 in.)

8. Select the piston related to cylinder bore class.

Clearance: 0.03~0.05 mm (0.0012~0.0020 in.)

PISTON AND RINGS

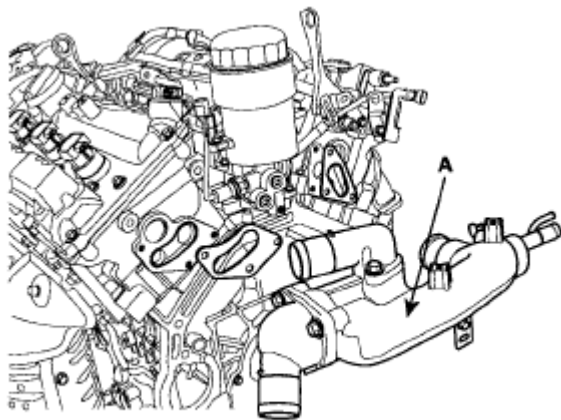
1. Clean piston
 1. Using a gasket scraper, remove the carbon from the piston top.
 2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
 3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

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

Standard diameter

95.96~95.99 mm (3.7779~3.7791 in.)



KDRF194A

Fig. 205: 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

0.03~0.05 mm (0.0012~0.0020 in.)

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: 0.03~0.07 mm (0.0012~0.0027 in.)

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

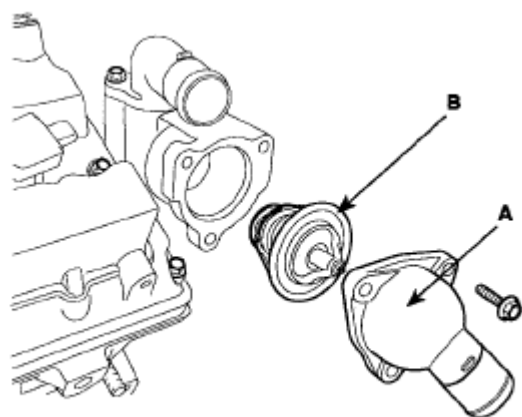
Oil ring: 0.06~0.15 mm (0.0024~0.0059 in.)

Limit

No. 1: 0.1 mm (0.004 in.)

No. 2: 0.1 mm (0.004 in.)

Oil ring: 0.2 mm (0.008 in.)



KDRF195A

Fig. 206: 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 **PISTON AND RINGS**. If the bore is over the service limit, the cylinder block must be replaced. (Refer to **PISTON AND RINGS**).

Piston ring end gap

Standard

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

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

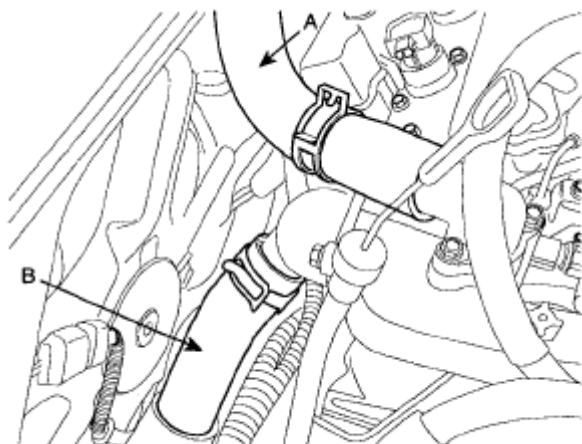
Oil ring : 0.20~0.70 mm (0.0079~0.0275 in.)

Limit

No. 1: 0.6 mm (0.0236 in.)

No. 2: 0.7 mm (0.0275 in.)

Oil ring: 0.8 mm (0.0315 in.)



SCMM16004N

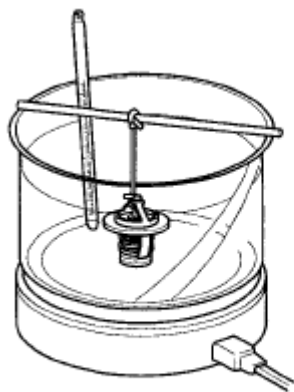
Fig. 207: Inspecting Piston Ring End Gap
Courtesy of HYUNDAI MOTOR CO.

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

23.001~23.006 mm (0.9055~0.9057 in.)



ECKD5038

Fig. 208: Measuring Diameter Of Piston Pin
Courtesy of HYUNDAI MOTOR CO.

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

Piston pin-to-piston clearance

0.01~0.02 mm (0.0004~0.0008 in.)

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

Piston pin-to-connecting rod interference

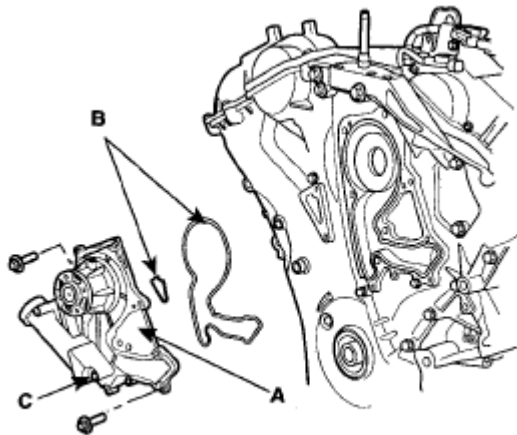
-0.032~-0.016 mm (-0.00126~-0.00063 in.)

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.

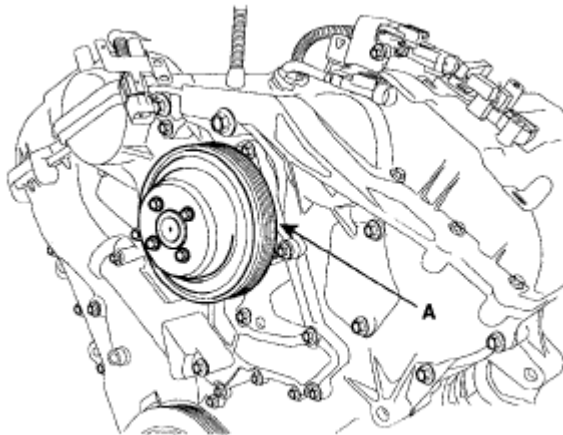
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



SCMM16106N

Fig. 209: Identifying Piston Front Mark And Connecting Rod Front Mark
 Courtesy of HYUNDAI MOTOR CO.

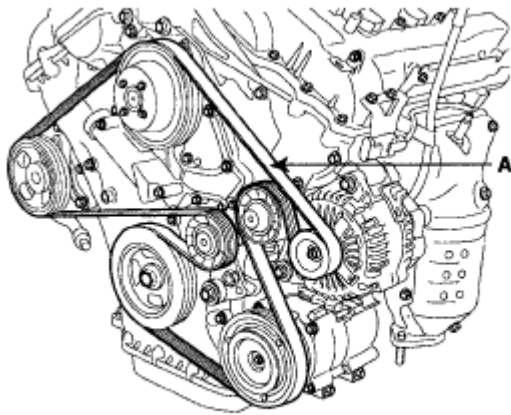
2. Install piston rings.
 1. Install the oil ring spacer and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown.



KDRF107A

Fig. 210: Positioning Piston Rings
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).



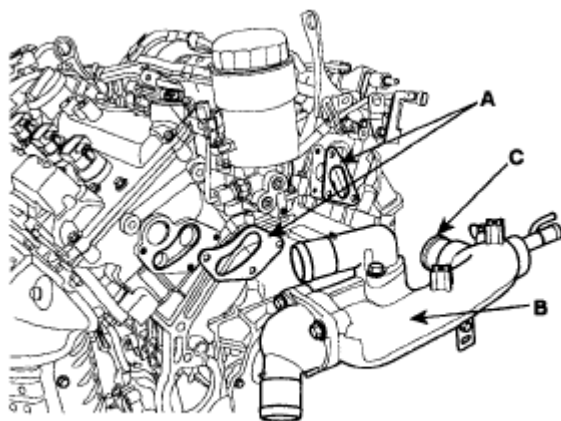
KDRF101A

Fig. 211: Identifying Connecting Rod Bearing And 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 4 upper bearings.
2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings (A).

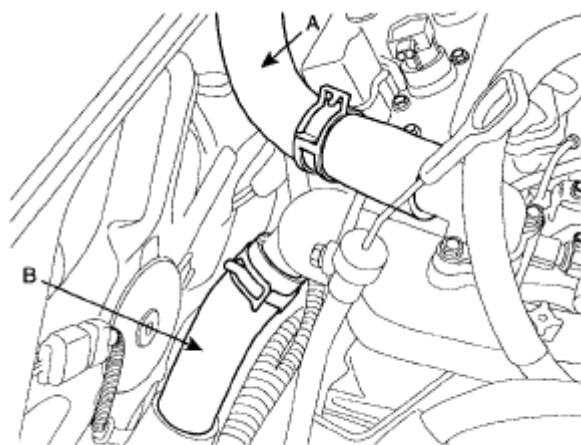


KDRF194B

Fig. 212: Identifying Lower Bearings
Courtesy of HYUNDAI MOTOR CO.

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.



SCMM16004N

Fig. 213: Identifying Thrust Bearings
Courtesy of HYUNDAI MOTOR CO.

6. Place crankshaft on the cylinder block.

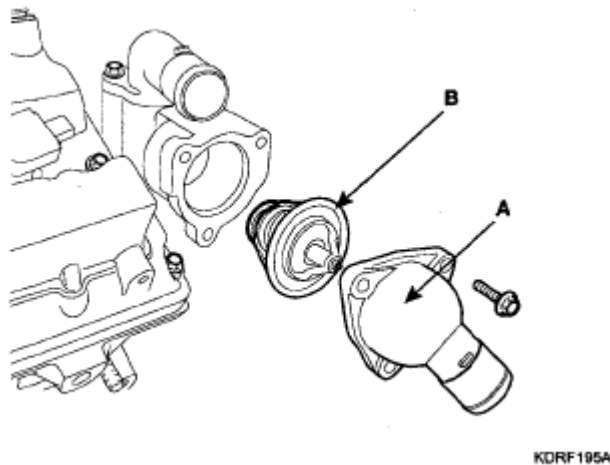


Fig. 214: Identifying Crankshaft
Courtesy of HYUNDAI MOTOR CO.

7. Place main bearing caps on cylinder block.
8. Install main bearing cap bolts.
 1. Install and uniformly tighten the bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

Main bearing cap bolt

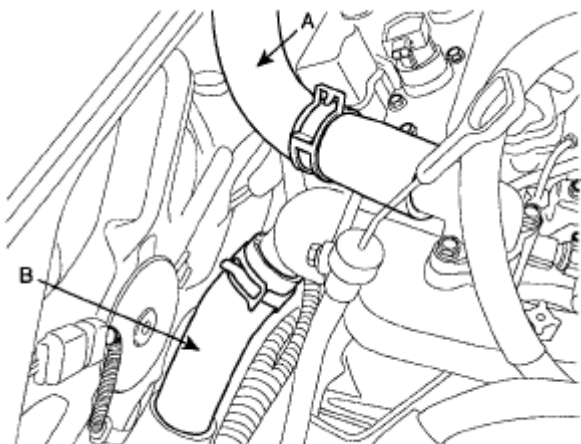
49.00 Nm (5.0 kgf.m, 36.16 lb-ft) + 90° (1~8)

19.60 Nm (2.0 kgf.m, 14.46 lb-ft) + 120° (9~16)

29.40~31.36 Nm (3.0~3.2 kgf.m, 21.70~23.14 lb-ft) (17~22)

NOTE:

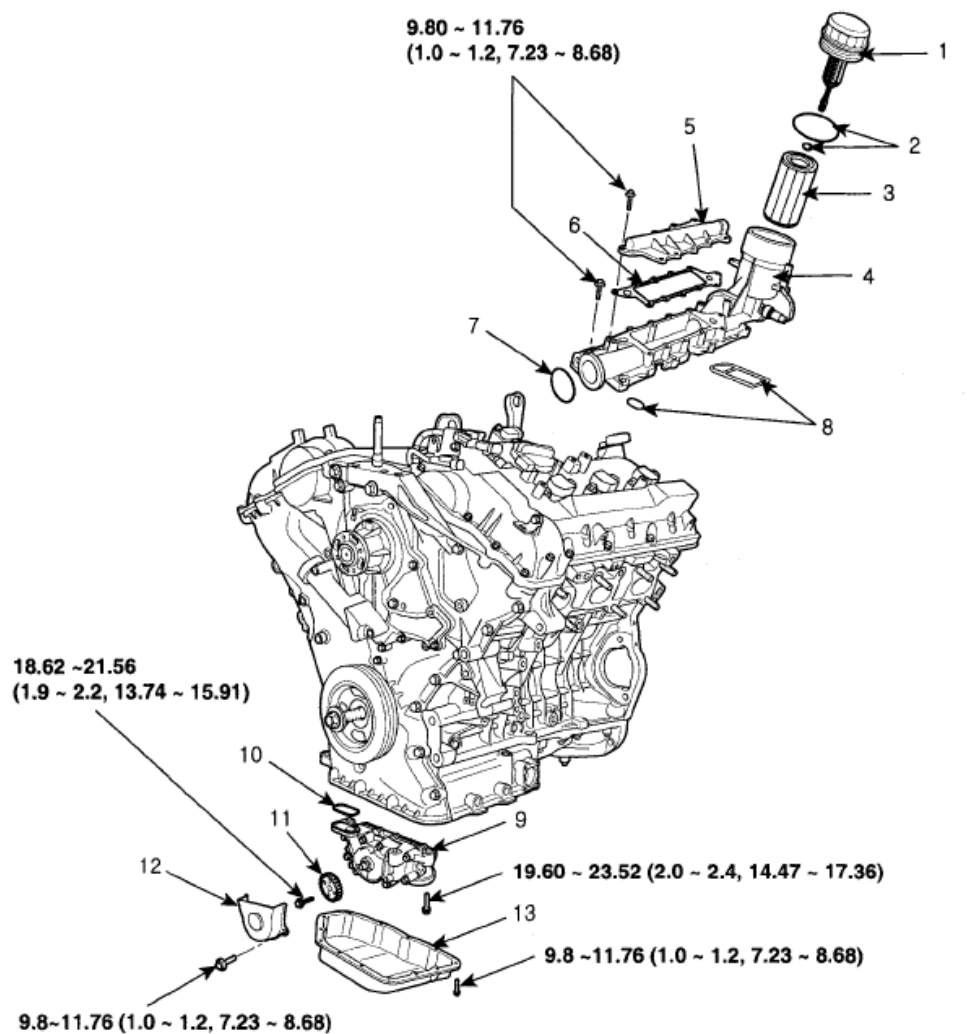
- Always use new main bearing cap bolt.
- If any of the bearing cap bolts in broken or deformed, replace it.



SCMM16004N

Fig. 215: Identifying Main Bearing Cap Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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



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

- | | | |
|--------------------------|-------------|--------------------------|
| 1. Oil filter cap | 6. Gasket | 11. Oil pump sprocket |
| 2. O - ring | 7. O - ring | 12. Oil pump chain cover |
| 3. Oil filter element | 8. Gasket | 13. Lower oil pan |
| 4. Oil filter body | 9. Oil pump | |
| 5. Oil filter body cover | 10. Gasket | |

EDRF008A

Fig. 216: Identifying SST (09221-4A000)
Courtesy of HYUNDAI MOTOR CO.

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

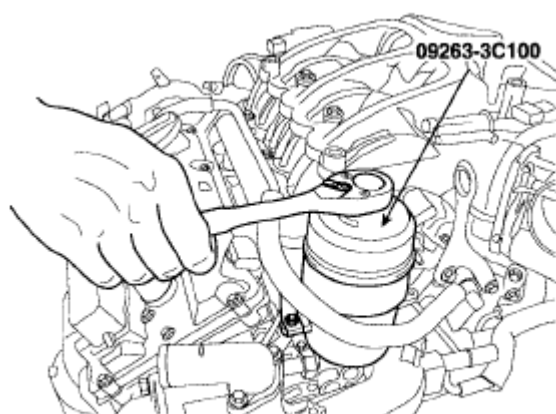
NOTE: Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

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

Tightening torque

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

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

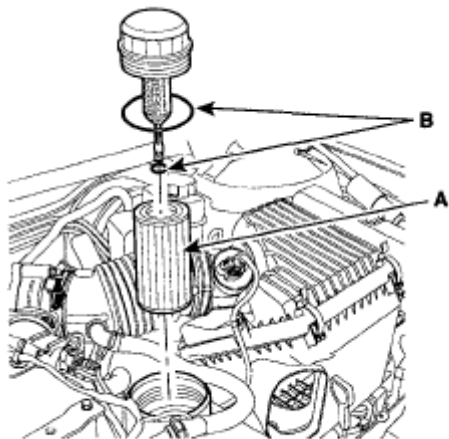


ECRF051A

Fig. 217: Identifying SST (09221-4A000)
Courtesy of HYUNDAI MOTOR CO.

NOTE:

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



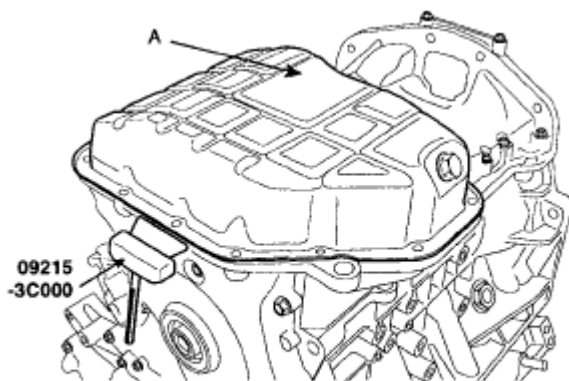
KDRF168A

Fig. 218: Installing Piston And Connecting Rod
Courtesy of HYUNDAI MOTOR CO.

11. Check the connecting rod end play.
12. Install oil drain cover.

Tightening torque

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



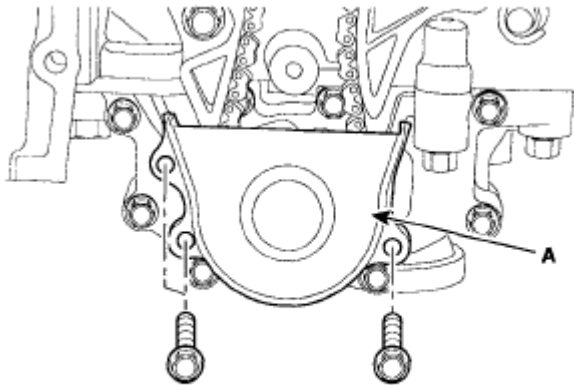
ECRF060A

Fig. 219: Identifying Oil Drain Cover
Courtesy of HYUNDAI MOTOR CO.

NOTE:

- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- Be assembling oil drain cover, the liquid sealant TB1217H should be applied oil drain cover.

- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.



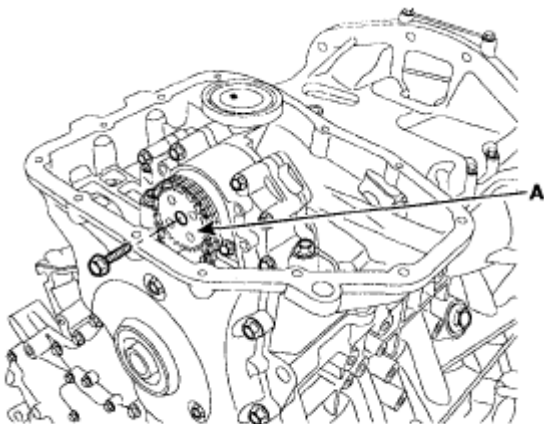
KDRF185A

Fig. 220: Identifying Oil Drain Cover Sealant Apply Area
Courtesy of HYUNDAI MOTOR CO.

13. Install rear oil seal case.

Tightening torque

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



KDRF189A

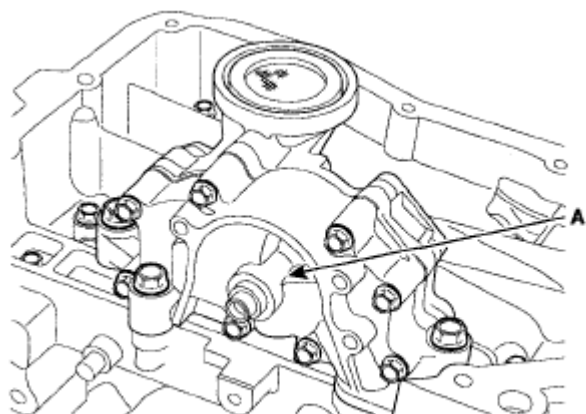
Fig. 221: Identifying Rear Oil Seal Case
Courtesy of HYUNDAI MOTOR CO.

NOTE:

- Clean the sealing surface before assembling the two parts.
- Remove harmful foreign matters on the sealing face before applying

sealant

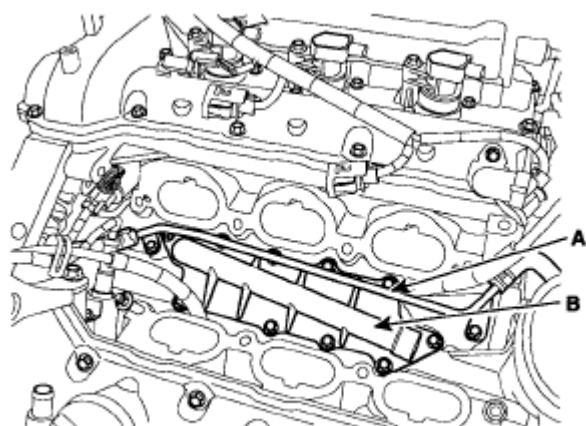
- Be assembling rear oil seal case, the liquid sealant TB1217H should be applied rear oil seal case.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.



KDRF190A

Fig. 222: Identifying Rear Oil Seal Case Sealant Apply Area
Courtesy of HYUNDAI MOTOR CO.

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



KDRF191A

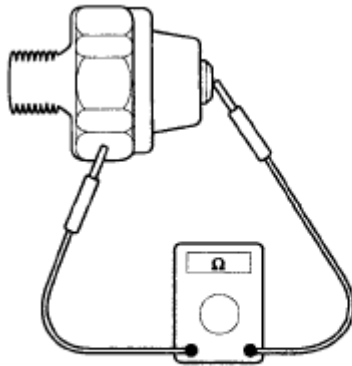
Fig. 223: Identifying SST (09231-3C200, 09231-H1100)
Courtesy of HYUNDAI MOTOR CO.

- Install baffle plate.

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

Tightening torque

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

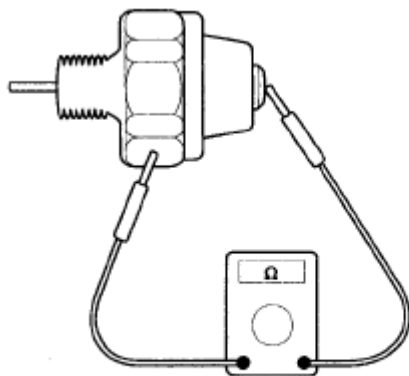


ECKD001W

Fig. 224: Identifying Baffle Plate Bolts Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

16. Install upper 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 TB1217H should be applied on upper oil pan. The part must be assembled within 5 minutes after the sealant was applied.

Bead width: 2.5 mm (0.1 in.)



ECKD001Y

Fig. 225: Identifying Upper Oil Pan Sealant
Courtesy of HYUNDAI MOTOR CO.

NOTE:

- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant

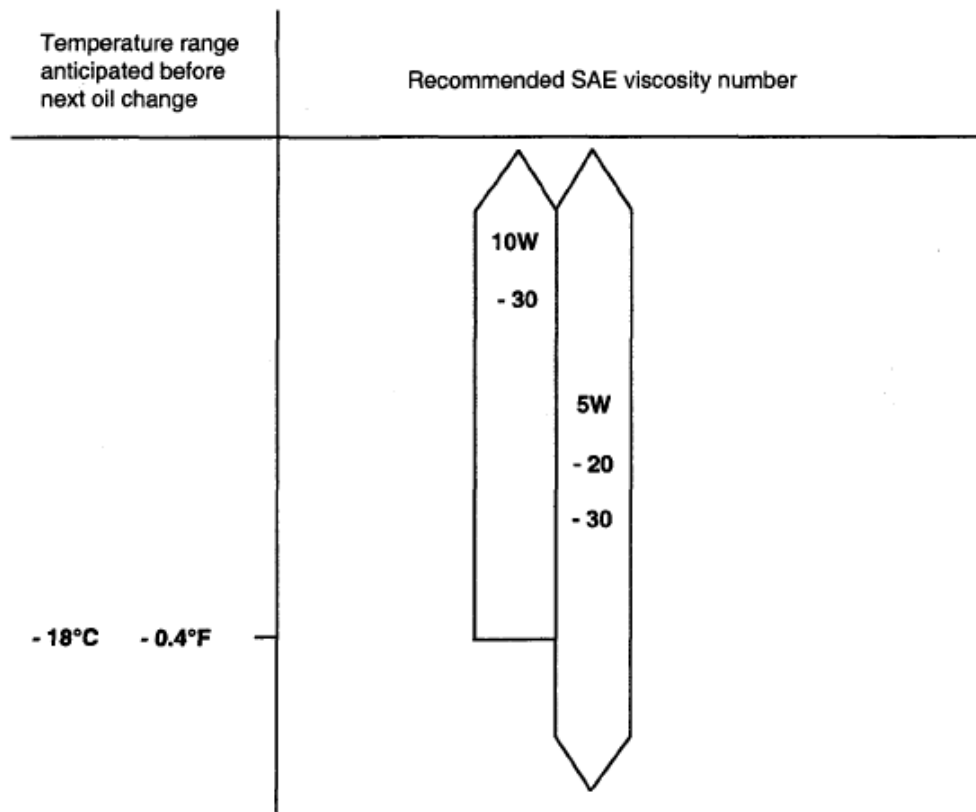
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket of the inner threads of the bolt holes.

Install upper oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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



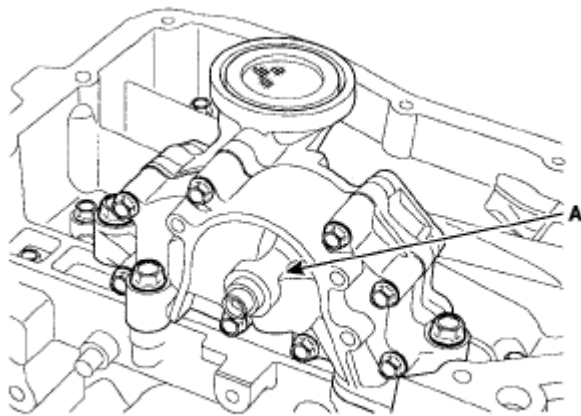
EDRF020A

Fig. 226: Identifying Upper Oil Pan Bolts Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

17. Install knock sensor.

Tightening torque

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



KDRF180A

Fig. 227: Identifying Knock Sensor
Courtesy of HYUNDAI MOTOR CO.

18. Install drive plate.

Tightening torque

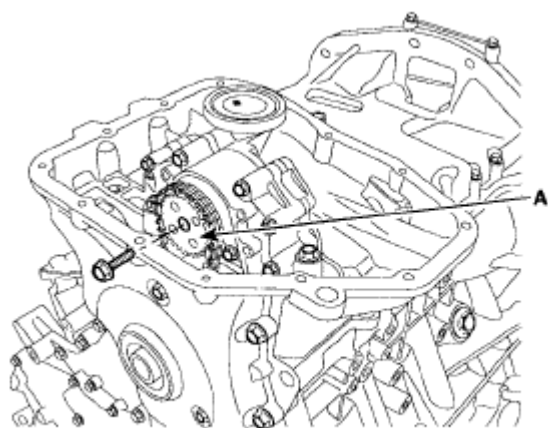
71.54~75.46 Nm (7.3~7.7 kgf.m, 52.80~55.69 lb-ft)

INSTALLATION

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

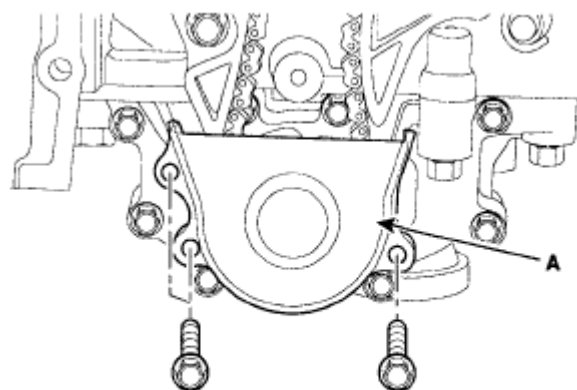
COOLING SYSTEM

COMPONENT



KDRF189A

Fig. 228: Identifying Cooling System Component And Tightening Torque (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



KDRF185A

Fig. 229: Identifying Cooling System Component And Tightening Torque (2 Of 2)
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 "F" mark with water, then up to the "F" 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 to ensure proper air bleeding.

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 antirust products; they may not be compatible with the coolant.**

7. Start the engine.

When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.

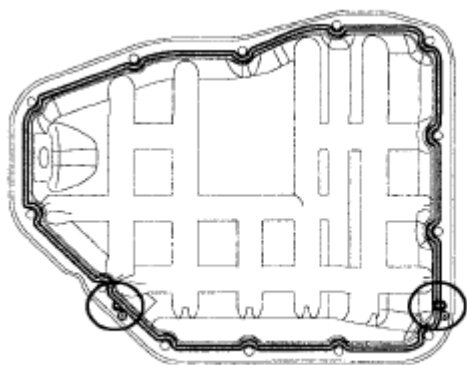
8. Repeat 7 until the cooling fan cycles 3~5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank to the "MAX" line with coolant.
10. Run the vehicle under idle until the cooling fan operates 2~3 times.
11. Stop the engine and wait until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

NOTE:

Proper cooling system operation depends on the absence of trapped air within the system. It is essential that the cooling system be properly filled and bled before returning the vehicle to service.

CAP TESTING

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



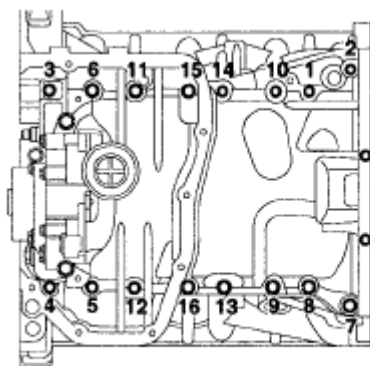
KDRF136A

Fig. 230: Testing Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

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

RADIATOR 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.



KDRF131A

Fig. 231: Inspecting For Engine Coolant Leaks And Drop In Pressure
Courtesy of HYUNDAI MOTOR CO.

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

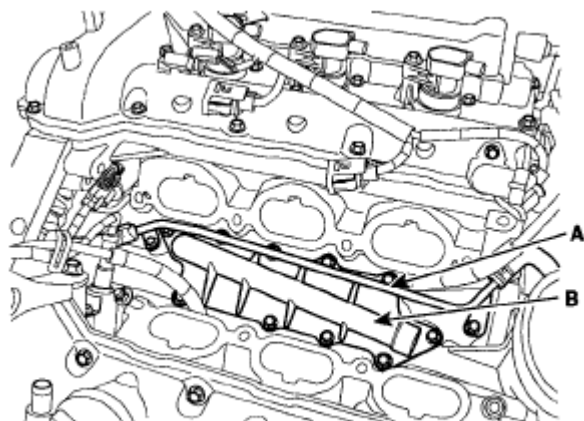
REMOVAL

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.

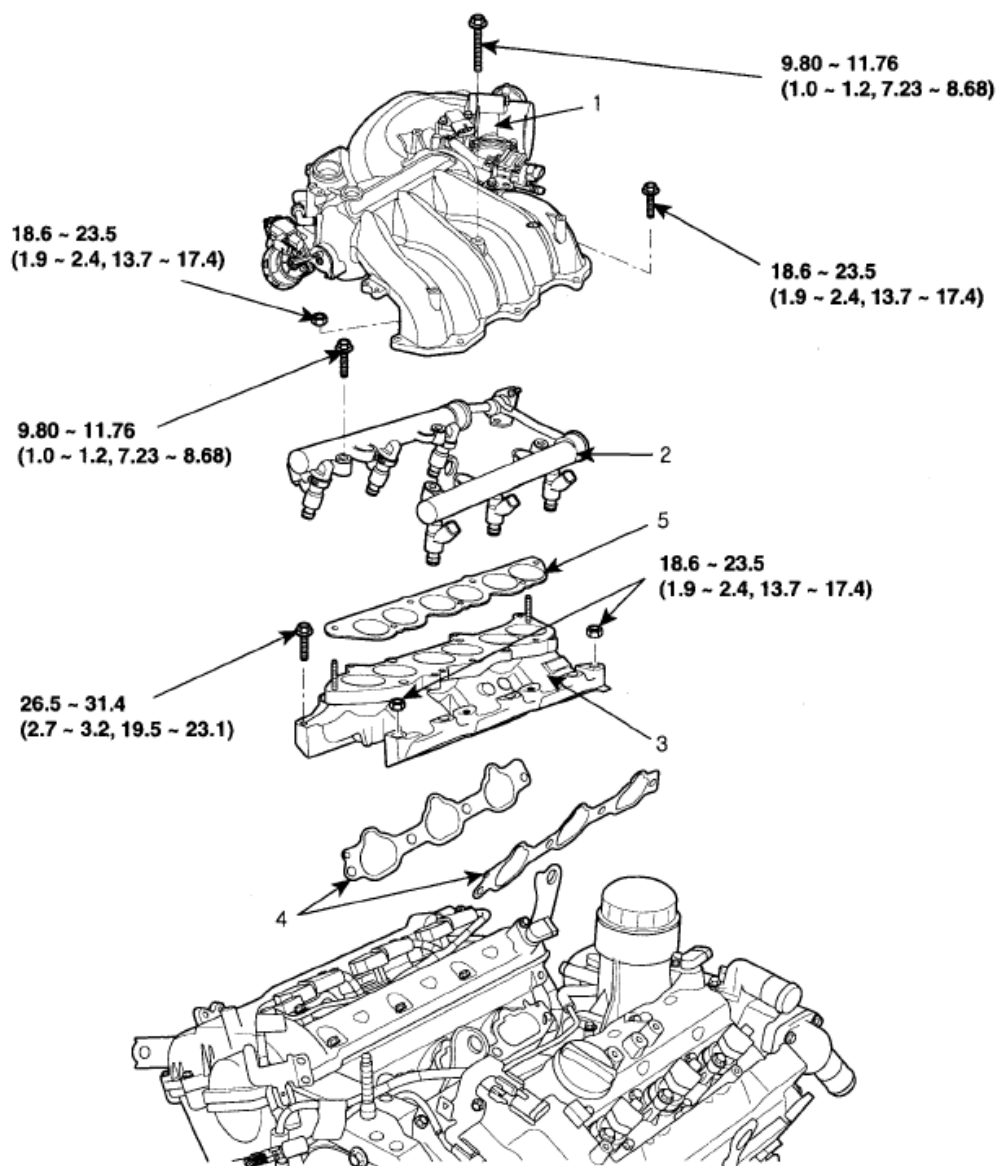
2. Remove drive belt (A).



KDRF191A

Fig. 232: Identifying Drive Belt
Courtesy of HYUNDAI MOTOR CO.

3. Remove the 4 bolts and pump pulley (A).



TORQUE : N.m (kgf.m, lb-ft)

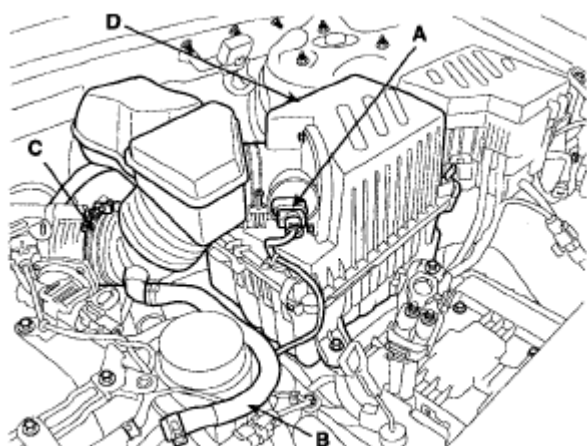
- 1. Surge tank
- 2. Delivery pipe
- 3. Surge tank gasket

- 4. Intake manifold
- 5. Intake manifold gasket

SCMM16107N

Fig. 233: Identifying Pump Pulley
Courtesy of HYUNDAI MOTOR CO.

4. Remove the water pump (A) and gasket.

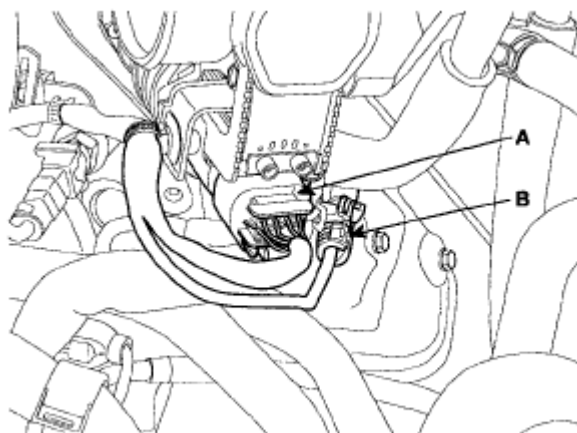


SCMM16205N

Fig. 234: Identifying Water Pump And Gasket
Courtesy of HYUNDAI MOTOR CO.

WATER TEMPERATURE CONTROL ASSEMBLY

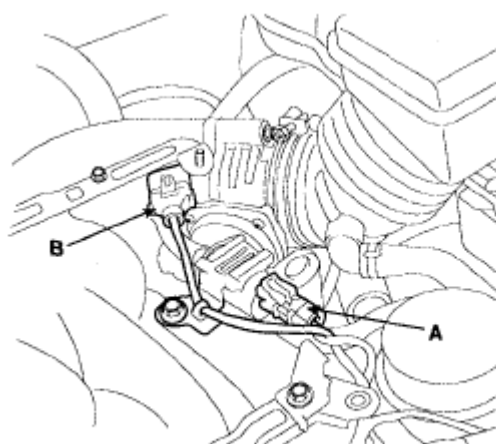
1. Drain the engine coolant.
2. Remove air cleaner assembly.
3. Disconnect radiator upper and lower hose (A).



KDRF162A

Fig. 235: Identifying Radiator Upper And Lower Hose
Courtesy of HYUNDAI MOTOR CO.

4. Disconnect ECT connector.
5. Disconnect heater hose, water vent hose and water hose from water temperature control assembly.
6. Remove wiring protector.
7. Remove water temperature control assembly (A).



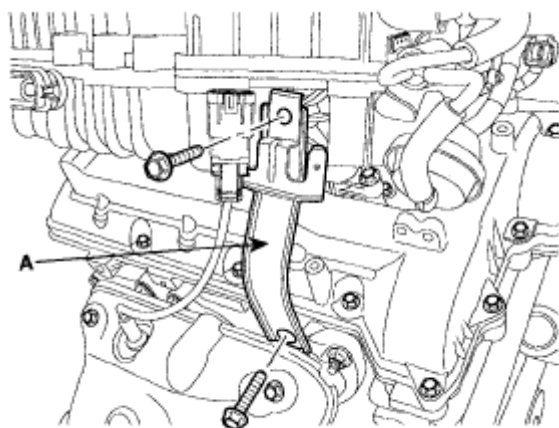
SCMM16019N

Fig. 236: Identifying Water Temperature Control Assembly
Courtesy of HYUNDAI MOTOR CO.

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).

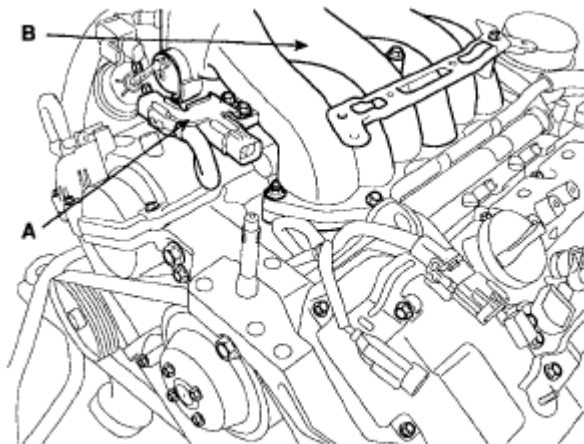


KDRF177A

Fig. 237: Identifying Water Inlet And Thermostat
Courtesy of HYUNDAI MOTOR CO.

RADIATOR

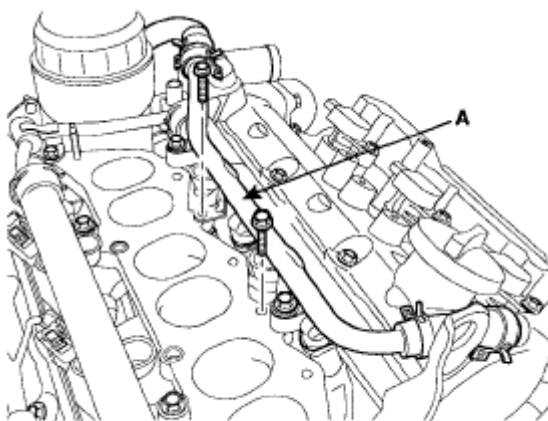
1. Drain the engine coolant.
2. Remove the radiator grille upper cover (A).



SCMM16017N

Fig. 238: Identifying Radiator Grille Upper Cover
Courtesy of HYUNDAI MOTOR CO.

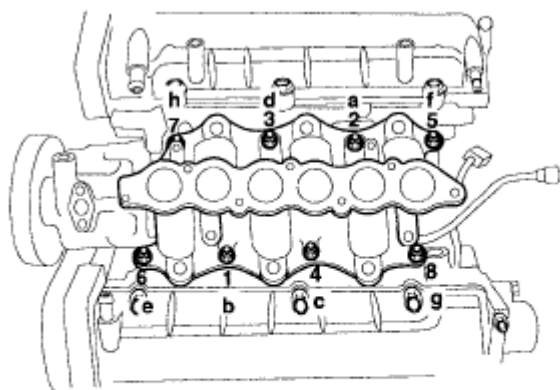
3. Remove the radiator support upper member assembly (A) for convenience sake.



ECBF031A

Fig. 239: Identifying Radiator Support Upper Member Assembly
Courtesy of HYUNDAI MOTOR CO.

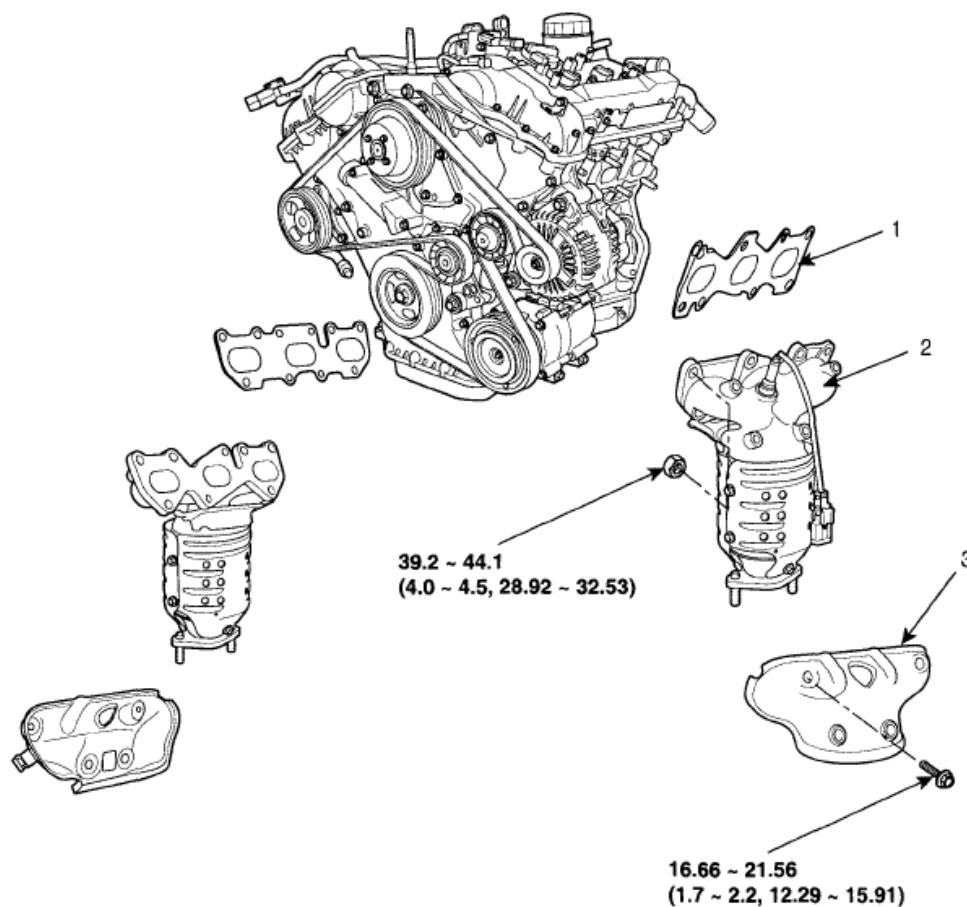
NOTE: The bottom side bolt (A) which can be seen after removing the under cover should be loosened for removal of the radiator support upper member assembly.



UCBF019A

Fig. 240: Identifying Bottom Side Bolt
Courtesy of HYUNDAI MOTOR CO.

4. Disconnect radiator upper and lower hoses (A).



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

1. Gasket

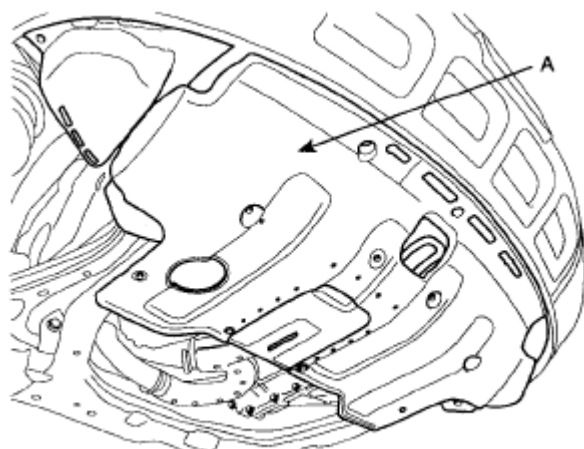
2. Exhaust manifold

3. Heat protector

EDRF010A

Fig. 241: Identifying Radiator Upper And Lower Hoses
Courtesy of HYUNDAI MOTOR CO.

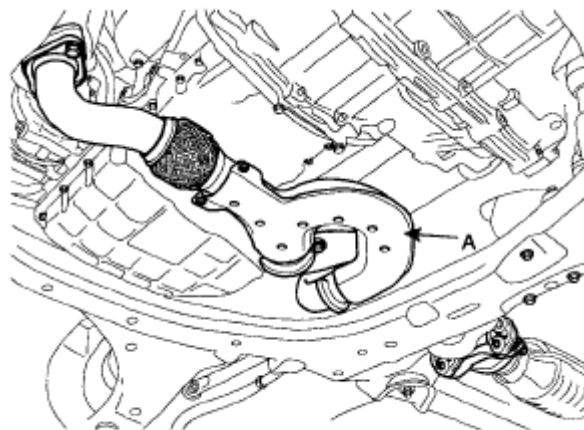
5. Disconnect transaxle oil cooler hoses (A). (Refer to **AUTOMATIC TRANSAXLE (A5HF1) -- ENTOURAGE**).



SCMM16008N

Fig. 242: Identifying Transaxle Oil Cooler Hoses
Courtesy of HYUNDAI MOTOR CO.

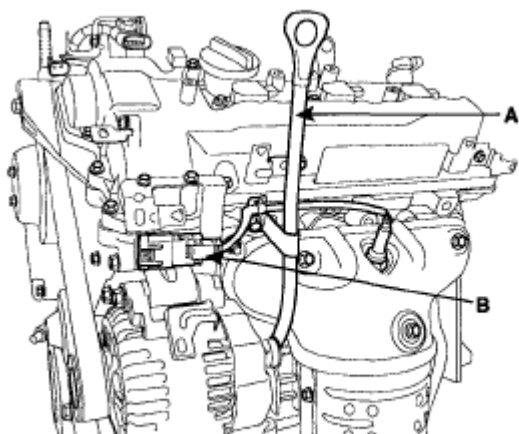
6. Disconnect the radiator fan connectors (A).



SCMM16008N

Fig. 243: Identifying Radiator Fan Connectors
Courtesy of HYUNDAI MOTOR CO.

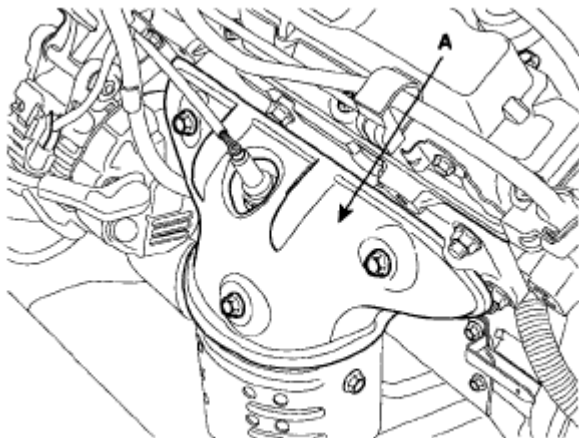
7. Disconnect the pressure lines (A) from the radiator assembly (B).



KDRF183A

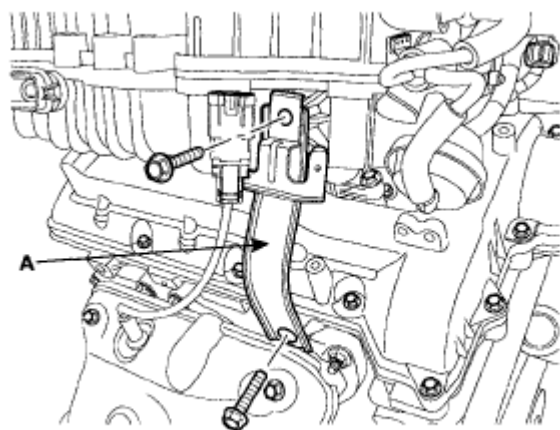
Fig. 244: Identifying Pressure Lines And Radiator Assembly
Courtesy of HYUNDAI MOTOR CO.

8. Separate the condenser (A) from the radiator assembly (B) by removing the bolts (C).



KDRF184A

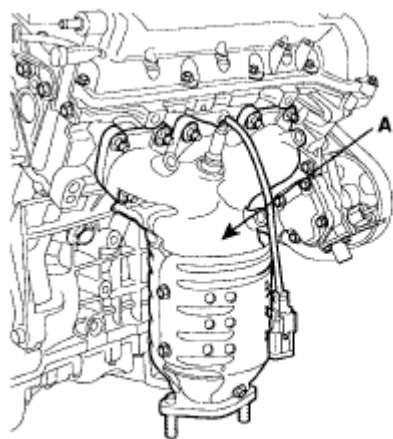
Fig. 245: Identifying Condenser, Radiator Assembly And Bolts (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



KDRF177A

Fig. 246: Identifying Condenser, Radiator Assembly And Bolts (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

9. Remove the radiator bracket.
10. Remove the radiator assembly.
11. Remove the radiator cooling fan (A).



KDRF187A

Fig. 247: Identifying Radiator Cooling Fan
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

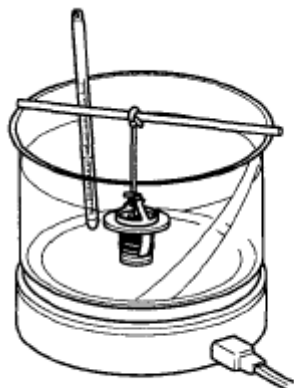
WATER PUMP

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 malfunctioning. 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. 248: Checking 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: Min. 10 mm (0.4 in.) at 95°C (205°F)

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

INSTALLATION

WATER PUMP

1. Install the water pump (A) and a new gasket (B) with 12 bolts.

Tightening torque

21.56~23.52 Nm (2.2~2.4 kgf.m, 15.91~17.36 lb-ft)

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

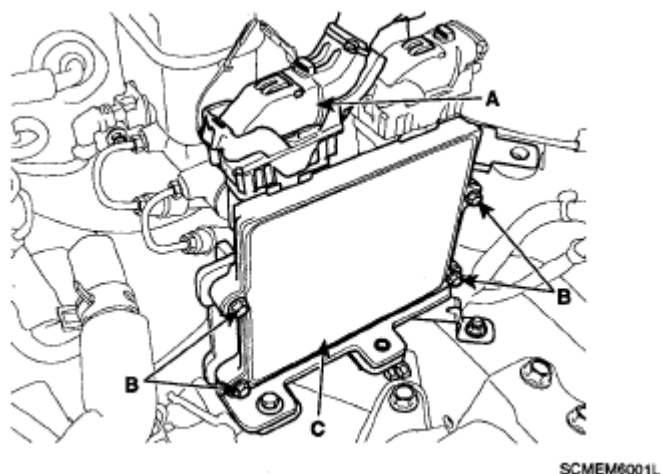


Fig. 249: Identifying Water Pump And Gasket
Courtesy of HYUNDAI MOTOR CO.

NOTE: Make clean the contact face before assembly.

2. Install the 4 bolts and pump pulley (A).

Tightening torque

7.84~9.80 Nm (0.8~1.0 kgf.m, 5.78~7.23 lb-ft)

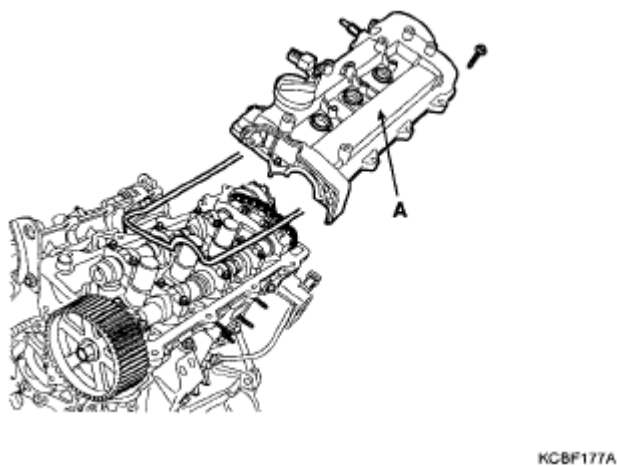
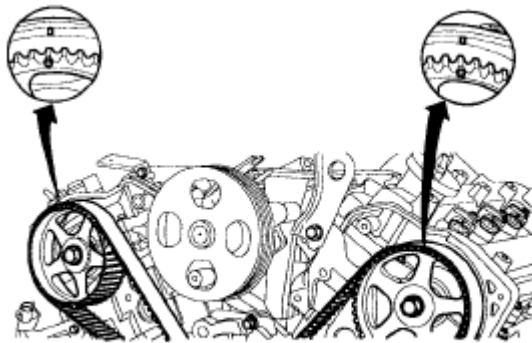


Fig. 250: Identifying Pump Pulley
Courtesy of HYUNDAI MOTOR CO.

3. Install drive belt (A).



KCBF119B

Fig. 251: Identifying Drive Belt
Courtesy of HYUNDAI MOTOR CO.

4. Fill with engine coolant.
5. Start engine and check for leaks.
6. Recheck engine coolant level.

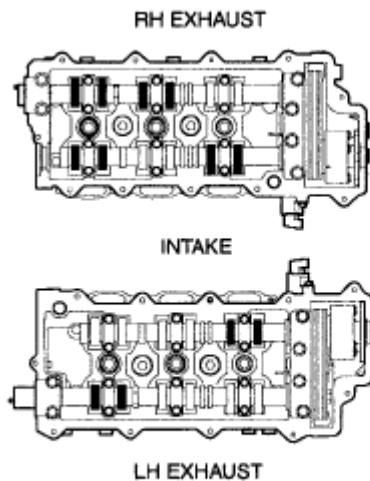
WATER TEMPERATURE CONTROL ASSEMBLY

NOTE: Clean the contact surface before assembly.

1. Install water temperature control assembly (B) and new gasket (A).

Tightening torque

18.62~23.52 Nm (1.9~2.4 kgf.m, 13.74~17.36 lb-ft)

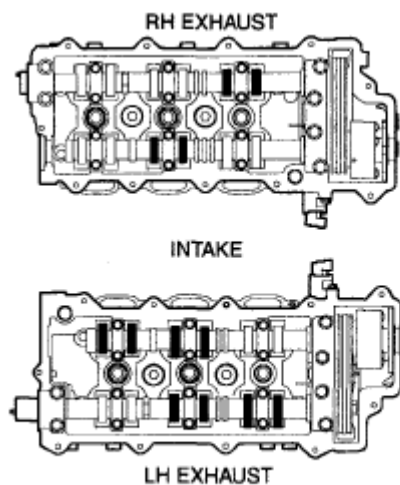


LDLG030A

Fig. 252: Identifying Water Temperature Control Assembly And Gasket
Courtesy of HYUNDAI MOTOR CO.

NOTE: Use new O-rings (C) when reassembling.

2. Connect water hoses to the water temperature control assembly.
3. Install wiring protector.
4. Connect ECT connector.
5. Connect radiator upper and lower hose (A).



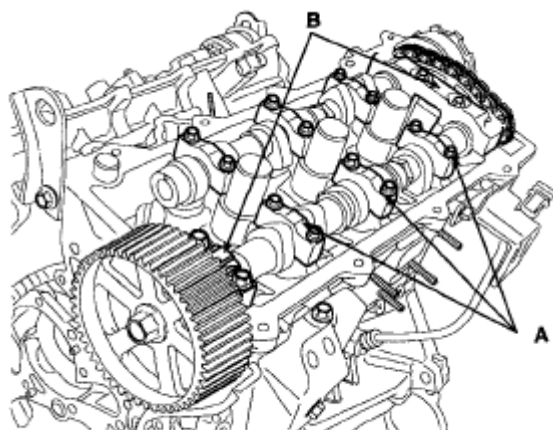
LDLG031A

Fig. 253: Identifying Radiator Upper And Lower Hose
Courtesy of HYUNDAI MOTOR CO.

6. Install air cleaner assembly.
7. Fill with engine coolant.
8. Start engine and check for leaks.
9. 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).



KCBF169A

Fig. 254: Identifying Thermostat
Courtesy of HYUNDAI MOTOR CO.

2. Install water inlet (A).

Tightening torque

16.66~19.60 Nm (1.7~2.0 kgf.m, 12.30~14.47 lb-ft)

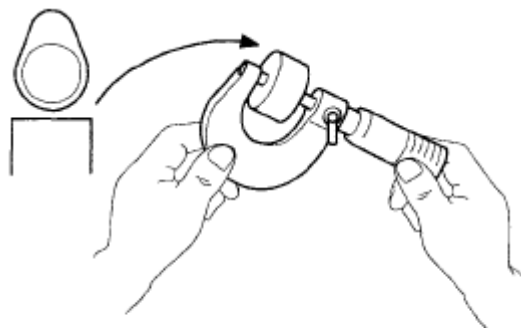
3. Fill with engine coolant.
4. Start engine and check for leaks.

RADIATOR

1. Install the radiator fan (A) to the radiator.

Tightening torque

4.9~7.8 Nm (0.5~0.8 kgf.m, 3.6~5.8 lb-ft)



EDKE899D

Fig. 255: Identifying Radiator Fan

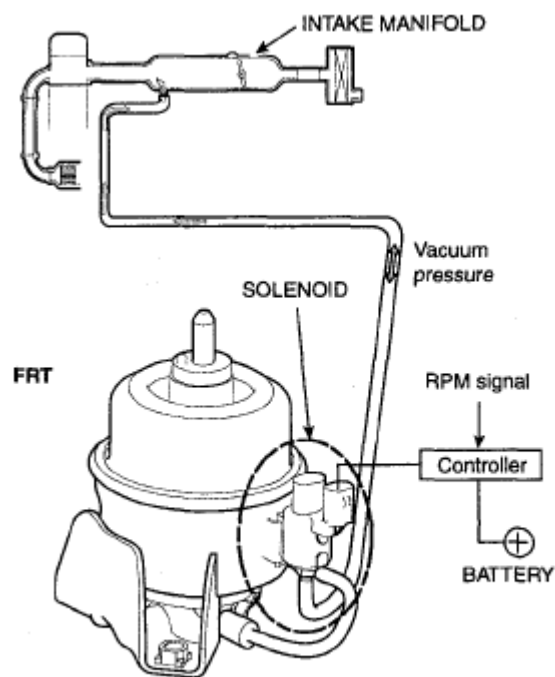
Courtesy of HYUNDAI MOTOR CO.

2. Install the radiator assembly to the vehicle.
3. Install the radiator bracket.
4. Fix the condenser with the radiator assembly.

Tightening torque

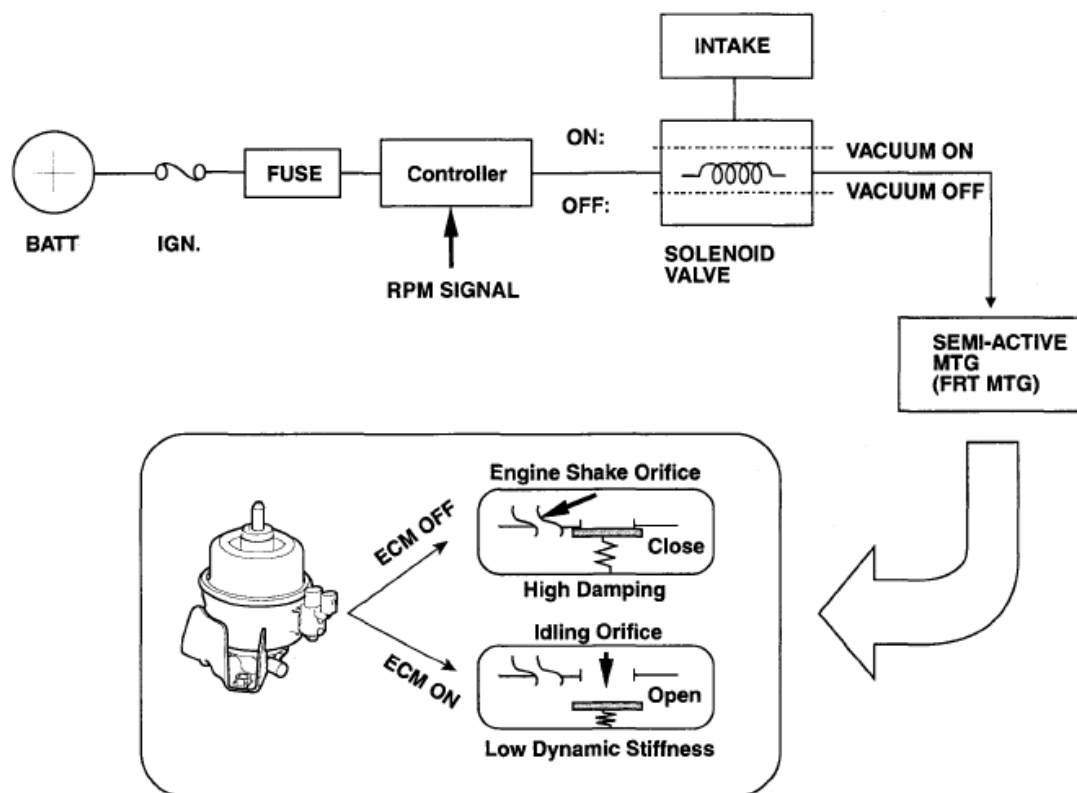
4.9~7.8 Nm (0.5~0.8 kgf.m, 3.6~5.8 lb-ft) - D

6.9~9.8 Nm (0.7~1.0 kgf.m, 5.1~7.2 lb-ft) - C



SCMM16200N

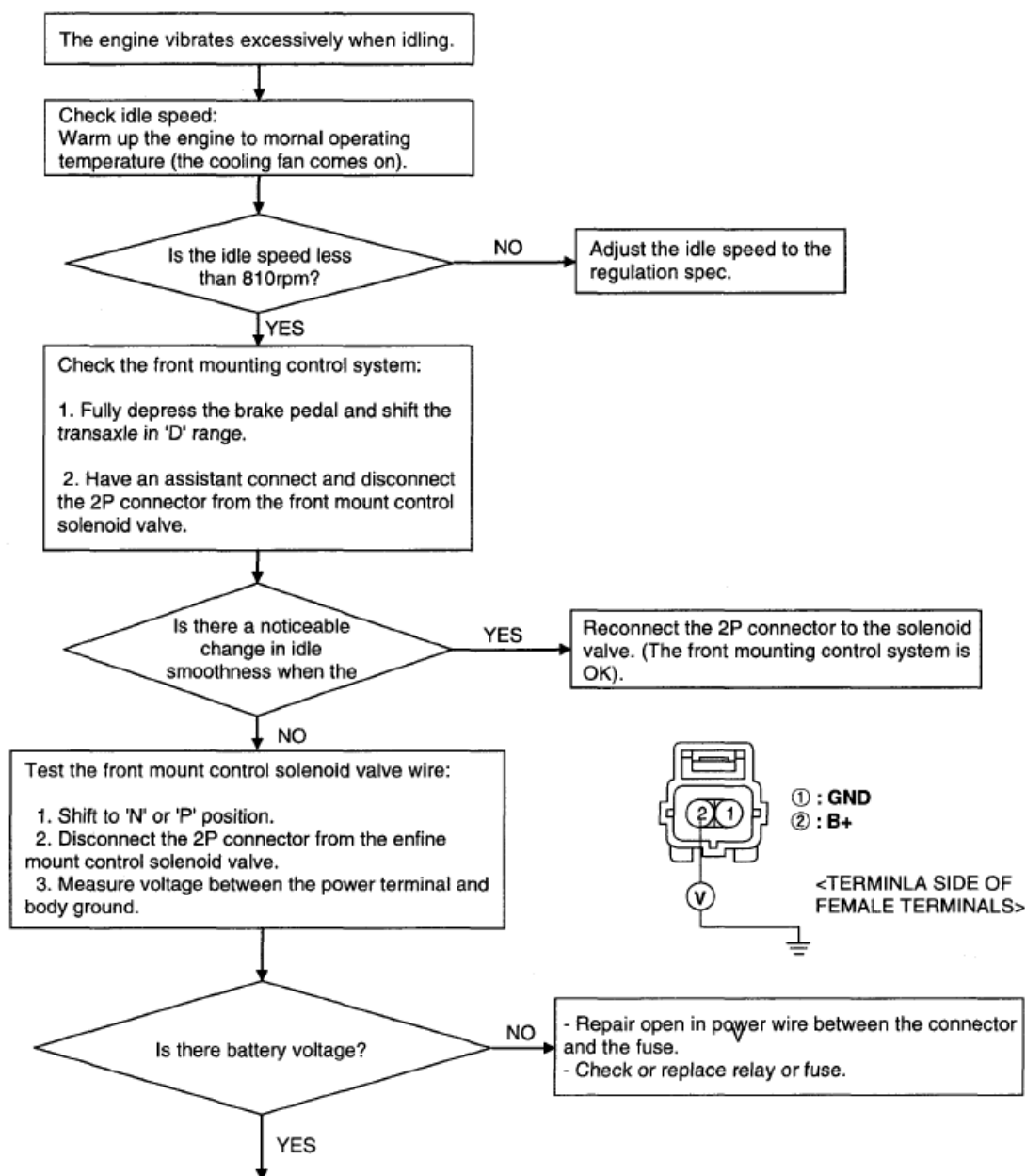
Fig. 256: Identifying Condenser, Radiator Assembly And Bolts (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.



SCMM16201N

Fig. 257: Identifying Condenser, Radiator Assembly And Bolts (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

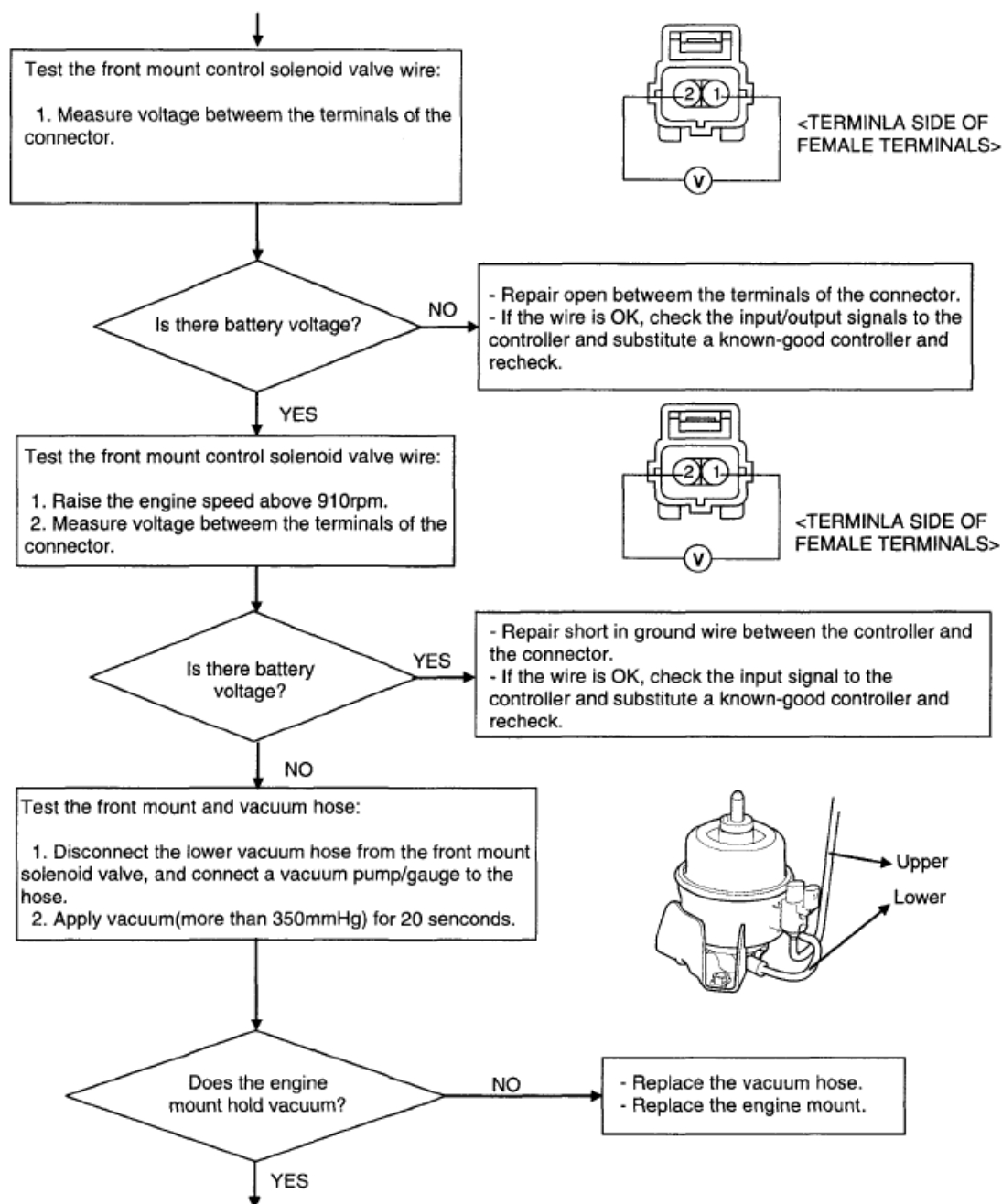
5. Connect the radiator fan connectors (A).



SCMM16202N

Fig. 258: Identifying Radiator Fan Connectors
Courtesy of HYUNDAI MOTOR CO.

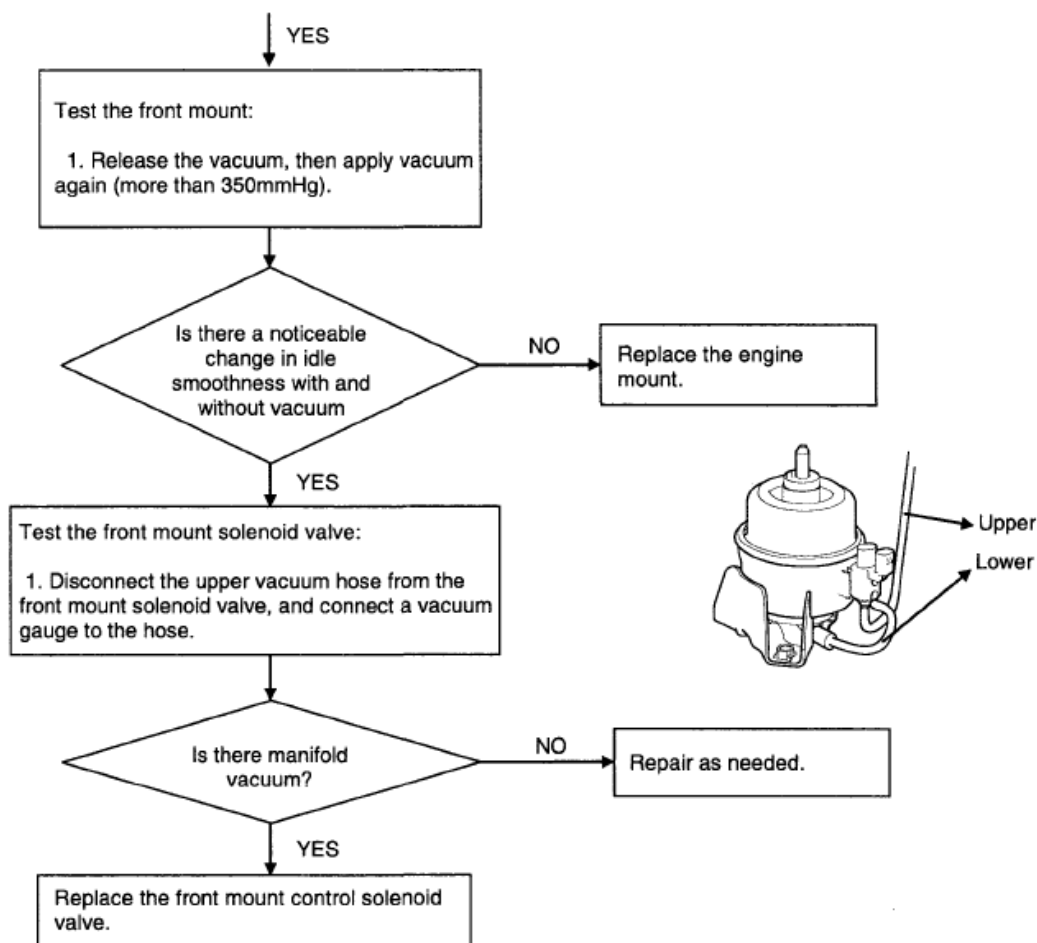
6. Connect the pressure lines (A) to the radiator assembly (B).



SCMM16203N

Fig. 259: Identifying Pressure Lines And Radiator Assembly
Courtesy of HYUNDAI MOTOR CO.

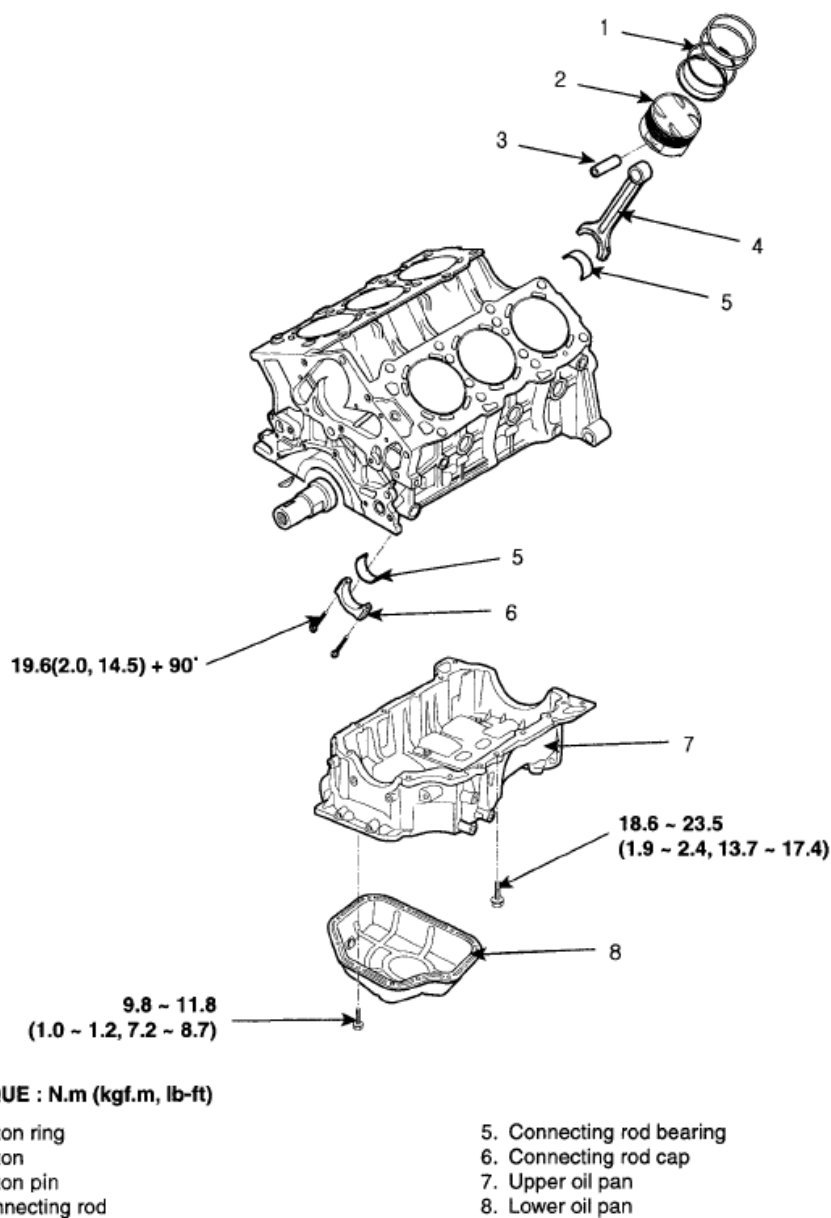
7. Connect transaxle oil cooler hoses (A). (Refer to **AUTOMATIC TRANSAXLE (A5HF1) -- ENTOURAGE**).



SCMM16204N

Fig. 260: Identifying Transaxle Oil Cooler Hoses
Courtesy of HYUNDAI MOTOR CO.

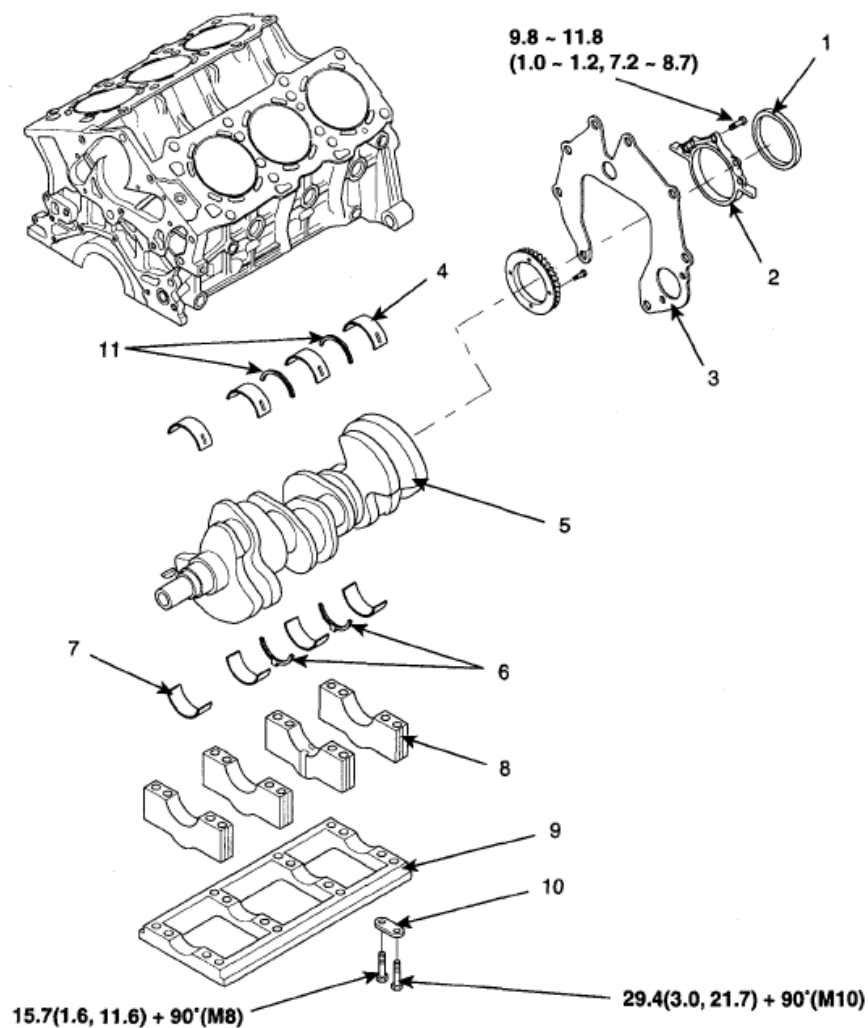
8. Connect radiator upper and lower hoses (A).



LDLG042A

Fig. 261: Identifying Radiator Upper And Lower Hoses
Courtesy of HYUNDAI MOTOR CO.

9. Install the radiator support upper member assembly (A).



TORQUE : N.m (kgf.m, lb-ft)

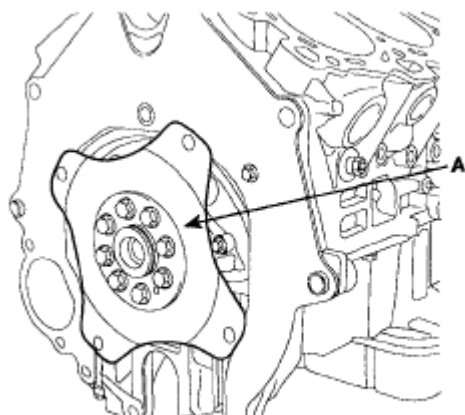
1. Rear oil seal
2. Rear oil seal case
3. Rear plate
4. Crankshaft upper bearing
5. Crankshaft
6. Lower thrust bearing

7. Crankshaft lower bearing
8. Main bearing cap
9. Bearing cap bridge
10. Bearing cap bolt washer
11. Upper thrust bearing

LDLG643A

Fig. 262: Identifying Radiator Support Upper Member Assembly
Courtesy of HYUNDAI MOTOR CO.

10. Install the radiator grille upper cover (A).



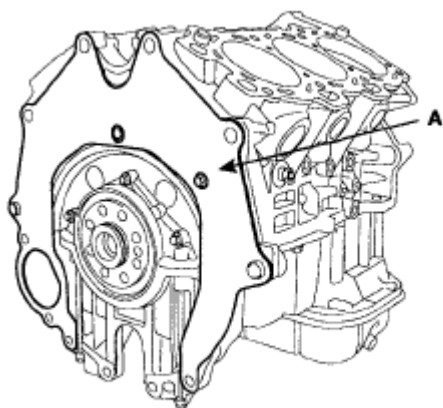
KCBF120A

Fig. 263: Identifying Radiator Grille Upper Cover
Courtesy of HYUNDAI MOTOR CO.

11. Fill with engine coolant.
12. Start engine and check for leaks.
13. Recheck engine coolant level.

LUBRICATION SYSTEM

COMPONENT



KCBF121A

Fig. 264: Identifying Lubrication System Component And Tightening Torque
Courtesy of HYUNDAI MOTOR CO.

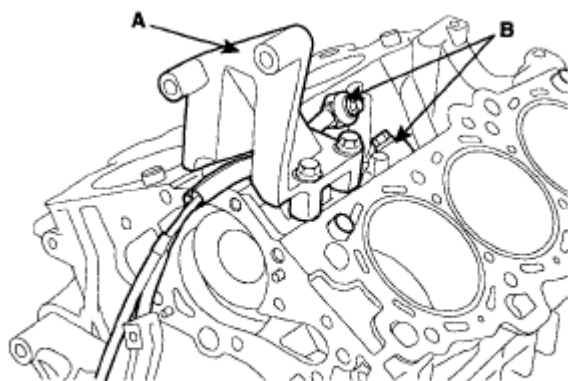
OIL AND FILTER

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.**

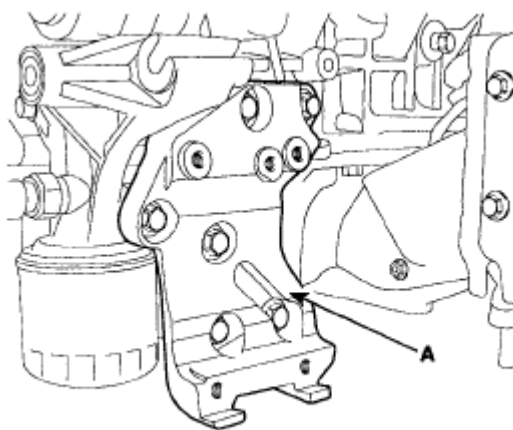
1. Park the car on level ground. Start the engine and let it warm up.
2. Turn the engine off and open the hood. Remove the engine cover.
3. Loosen the oil filter cap by turning it clockwise with SST (09263-3C100). Allow 5 minutes for the oil in the filter assembly to drain.



KCBF122A

Fig. 265: Loosening Oil Filter Cap
Courtesy of HYUNDAI MOTOR CO.

4. Drain the engine oil.
 - a. Remove the oil filler cap.
 - b. After lifting the car, remove the oil drain plug and drain the oil into a container.
5. Replace oil filter.
 - a. Disconnect the oil filter cap from oil filter body.
 - b. Remove the oil filter element.
 - c. Check and clean the oil filter installation surface.
 - d. Check the part number of the new oil filter is as same as old one.
 - e. Install new oil filter element (A) and two new O-rings (B).



KCBF136A

Fig. 266: Identifying Oil Filter Element And O-Rings
Courtesy of HYUNDAI MOTOR CO.

- f. Apply clean engine oil to the new O-rings. Lightly screw the oil filter cap into place, and tighten it until the O-ring contacts the seat.
- g. Finally tighten it again by specified tightening torque.

Tightening torque

24.50 Nm (2.5 kgf.m, 18.08 lb-ft)

- 6. Refill with engine oil.
 - a. Install the oil drain plug with a new gasket.

Tightening torque

34.3~44.1 Nm (3.5~4.5 kgf.m, 25.3~32.5 lb-ft)

- b. Fill with fresh engine oil, after removing the engine oil level gauge.

Capacity

Total: 6.4L (6.76 U.S.qts, 5.63 Imp.qts)

Oil pan: 5.5L (5.81 U.S.qts, 4.84 Imp.qts)

Oil filter: 0.4L (0.42 U.S.qts, 0.35 Imp.qts)

Drain and refill: 5.2L (5.49 U.S.qts, 4.58 Imp.qts)

- c. Install the oil filler cap and oil level gauge.
- 7. Start the engine and check to be sure no oil is leaking from the drain plug or oil filter.

8. 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.

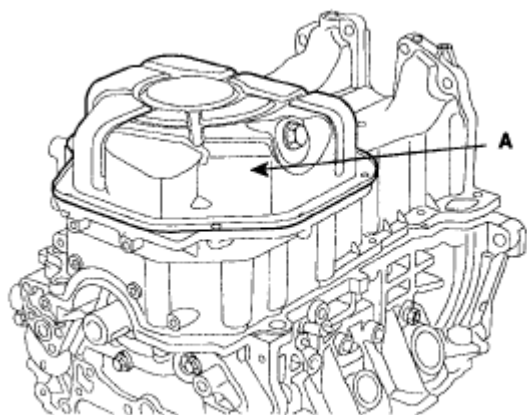
NOTE: Do not fill with engine oil above the "F" mark.

SELECTION OF ENGINE OIL

Recommended API classification : Above SJ or SL

Recommended SAE viscosity grades: 5W-20

If 5W-20 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.



KCBF123A

Fig. 267: Recommended SAE Viscosity Grades Chart
Courtesy of HYUNDAI MOTOR CO.

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

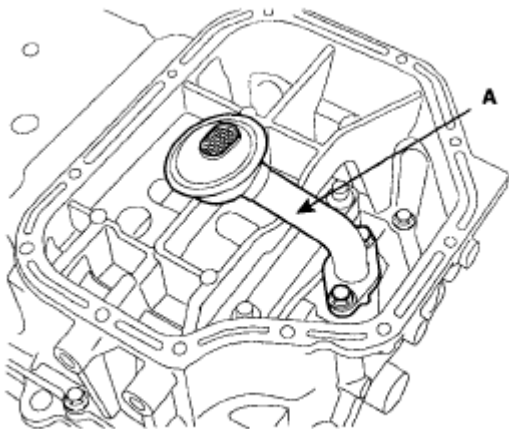
- Satisfy the requirement of the API classification.
- Have proper SAE grade number for expected ambient temperature range.

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

REMOVAL

OIL PUMP

1. Drain engine oil.
2. Using SST (09215-3C000) remove lower oil pan (A).

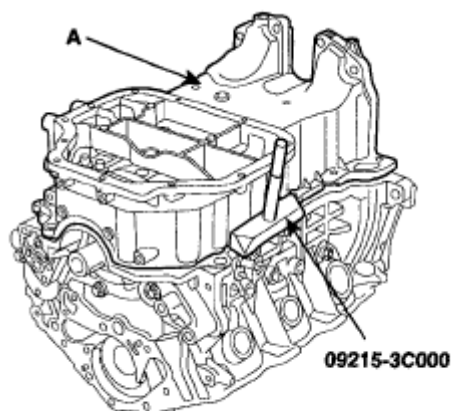


KCBF124A

Fig. 268: Identifying Lower Oil Pan
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

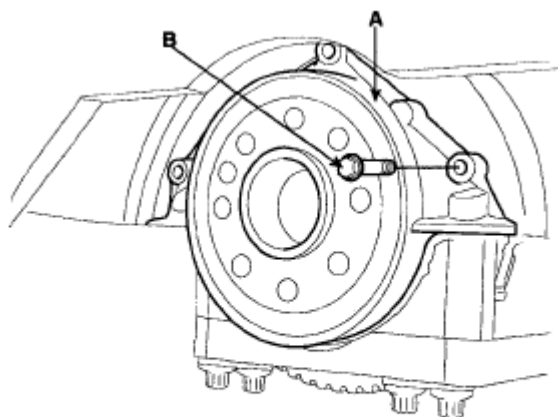
3. Remove oil pump chain cover (A).



KCBF125B

Fig. 269: Identifying Oil Pump Chain Cover
Courtesy of HYUNDAI MOTOR CO.

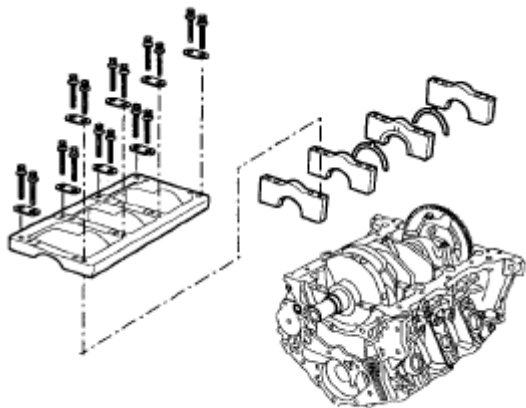
4. Remove oil pump chain sprocket (A).



EDQF174B

Fig. 270: Identifying Oil Pump Chain Sprocket
Courtesy of HYUNDAI MOTOR CO.

5. Remove oil pump (A).

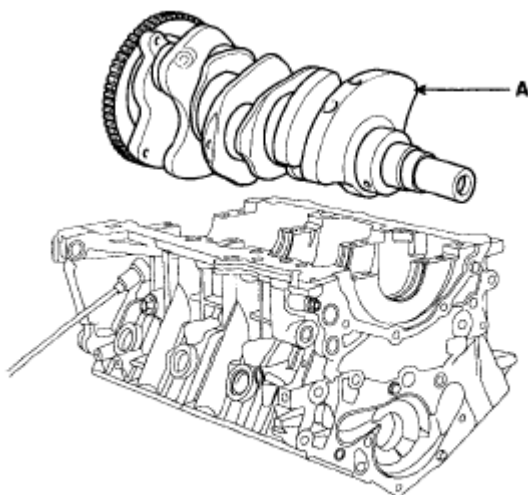


KCBF126A

Fig. 271: Identifying Oil Pump
Courtesy of HYUNDAI MOTOR CO.

OIL FILTER ASSEMBLY

1. Loosen the oil filter cap by turning it counter clockwise with SST (09263-3C100). Allow 5 minutes for the oil in the filter assembly to drain.
2. Remove surge tank and intake manifold.
3. Disconnect oil pressure switch connector.
4. Drain the engine coolant.
5. Disconnect water hoses from ETC.
6. Remove water temperature control assembly.
7. Disconnect water vent hose (A).
8. Remove oil filter body cover (B).



EDQF074A

Fig. 272: Identifying Oil Filter Body Cover
Courtesy of HYUNDAI MOTOR CO.

9. Remove oil filter body.

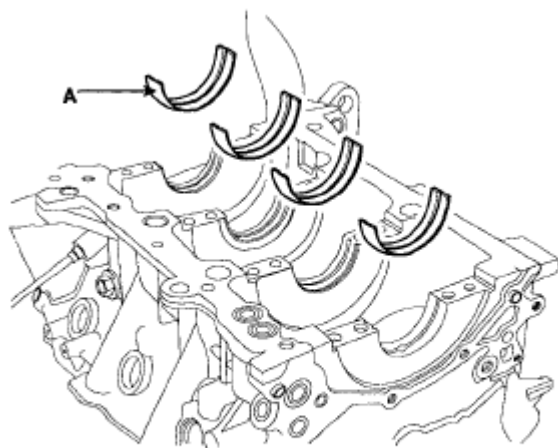
NOTE: Be careful of the knock sensor connector.

INSPECTION

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.

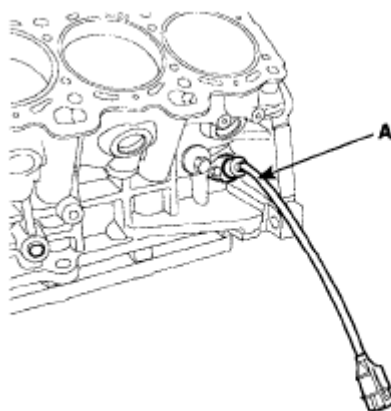


EDQF076A

Fig. 273: Checking Continuity Between Terminal And Body With An Ohmmeter
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 50 kpa (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.



KCBF128A

Fig. 274: Checking Continuity Between Terminal And Body When Fine Wire Is Pushed
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

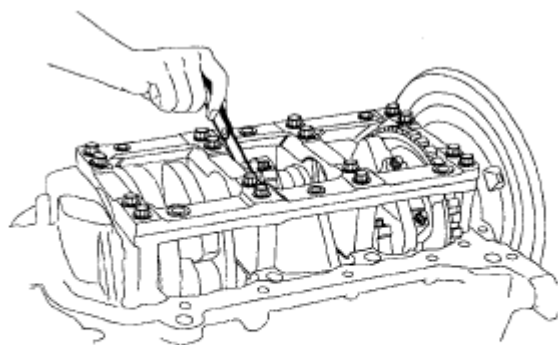
OIL PUMP

1. Install oil pump (A).

Tightening torque

19.6~23.5 Nm (2.0~2.4 kgf.m, 14.5~17.4 lb-ft)

NOTE: Always use a new O-ring (B).



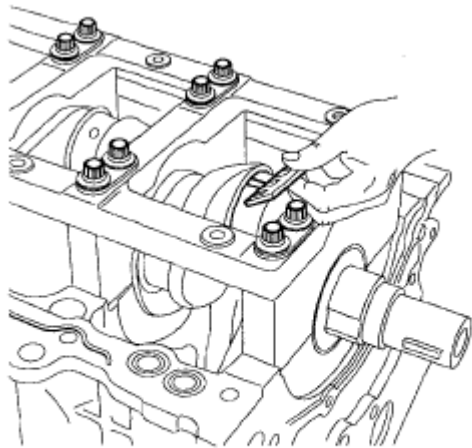
EDQF159A

Fig. 275: Identifying Oil Pump
Courtesy of HYUNDAI MOTOR CO.

2. Install oil pump sprocket (A) and oil pump chain on the oil pump.

Tightening torque

18.62~21.56 Nm (1.9~2.2 kgf.m, 13.74~15.91 lb-ft)



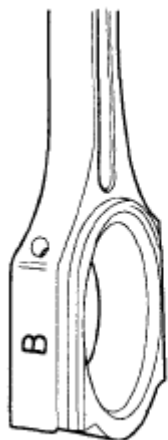
EDQF175A

Fig. 276: Identifying Oil Pump Sprocket And Oil Pump Chain
Courtesy of HYUNDAI MOTOR CO.

3. Install oil pump chain cover (A).

Tightening torque

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



EDQF196A

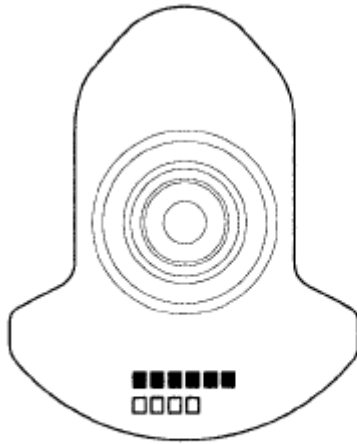
Fig. 277: Identifying Oil Pump Chain Cover
Courtesy of HYUNDAI MOTOR CO.

4. Install lower 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 TB1217H should be applied on upper oil pan. The part must be assembled within 5 minutes after the sealant was applied.

Bead width: 2.5 mm (0.1 in.)

But marked area (*) to be 5.0 mm (0.2 in.)



EDQF176B

Fig. 278: Identifying Sealant Bead Width
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

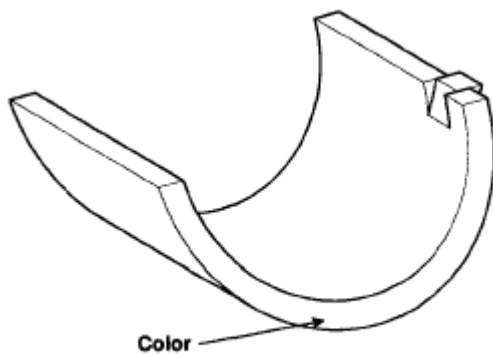
- Ensure the sealing face is clean before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant
- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket of the inner threads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

Install lower oil pan.

Uniformly tighten the bolts in several passes.

Tightening torque

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



ECRF021A

Fig. 279: Identifying Lower Oil Pan
Courtesy of HYUNDAI MOTOR CO.

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

OIL FILTER ASSEMBLY

1. Install oil filter body and new O-rings.

Tightening torque

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

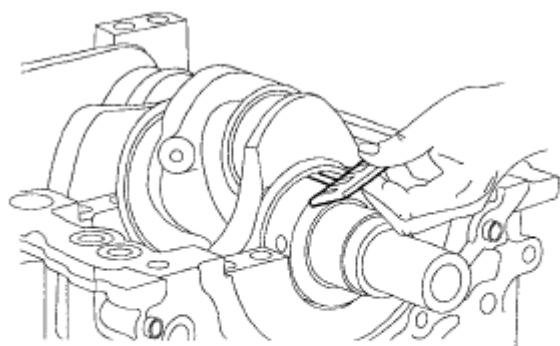
NOTE:

- All rubber gasket must be no damaged by assembling parts.
- Be careful of the knock sensor connector.
- Always use a new O-ring

2. Install oil filter body cover (B) and new gasket on the oil filter body.

Tightening torque

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



EDQF075A

Fig. 280: Identifying Oil Filter Body Cover
Courtesy of HYUNDAI MOTOR CO.

3. Connect water vent hose (A)

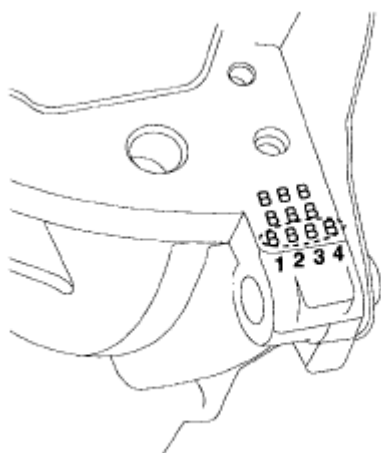
Tightening torque

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

4. Install water temperature control assembly.
5. Connect water hoses on the ETC.
6. Connect oil pressure switch connector.
7. Install intake manifold and surge tank.
8. Fill with engine coolant.
9. Start engine and check for leaks.
10. Recheck engine coolant level.

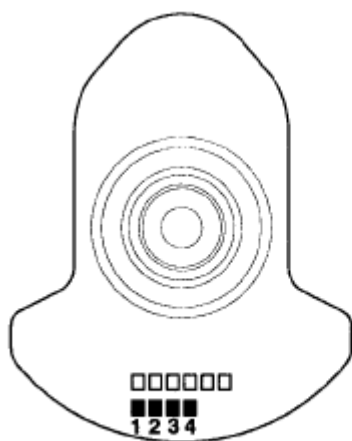
INTAKE AND EXHAUST SYSTEM

COMPONENT



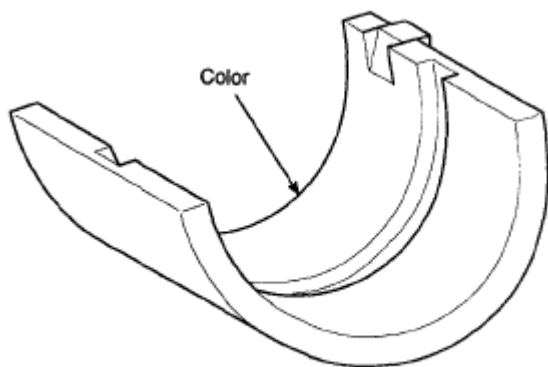
SCMEM6313D

Fig. 281: Identifying Intake And Exhaust System Component And Tightening Torque (1 Of 3)
 Courtesy of HYUNDAI MOTOR CO.



SCMEM6314D

Fig. 282: Identifying Intake And Exhaust System Component And Tightening Torque (2 Of 3)
 Courtesy of HYUNDAI MOTOR CO.



ECRF022A

Fig. 283: Identifying Intake And Exhaust System Component And Tightening Torque (3 Of 3)
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

INTAKE MANIFOLD

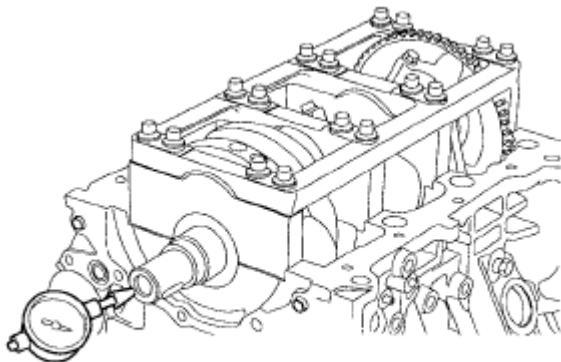
CAUTION:

- 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.

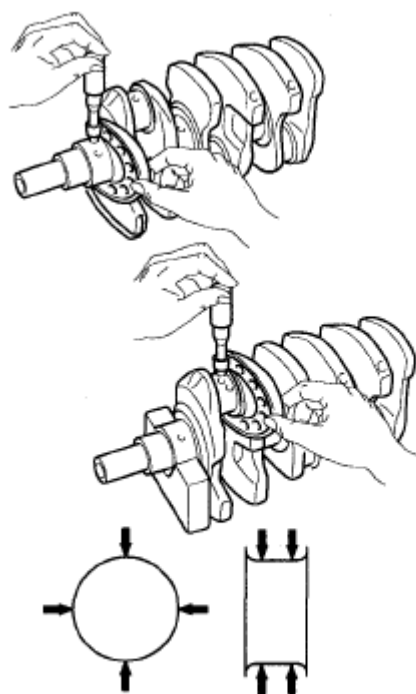
1. Remove the engine cover.
2. Remove the intake air hose and air cleaner assembly.
 1. Disconnect the MAF connector (A).
 2. Disconnect the breather hose (B) from air cleaner hose.
 3. Remove the intake air hose and air cleaner assembly (C).



KCBF127A

Fig. 284: Identifying Intake Air Hose And Air Cleaner Assembly
Courtesy of HYUNDAI MOTOR CO.

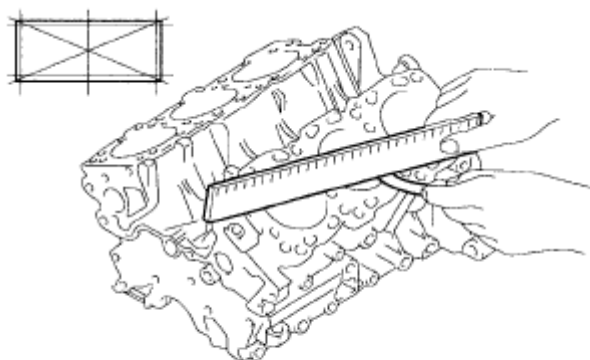
3. Disconnect RH oxygen sensor connector (A).



KCRF212A

Fig. 285: Identifying RH Oxygen Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

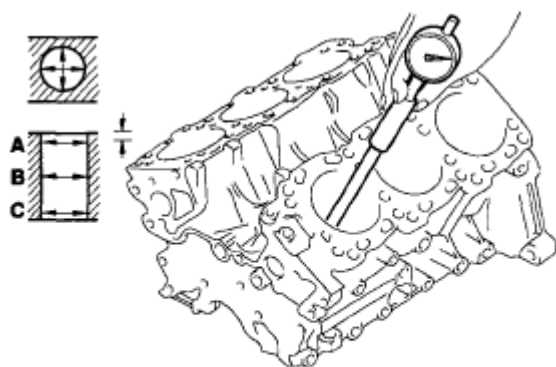
4. Disconnect RH injector connector (A) and ignition coil connector (B).



LDLG044A

Fig. 286: Identifying RH Injector Connector And Ignition Coil Connector
Courtesy of HYUNDAI MOTOR CO.

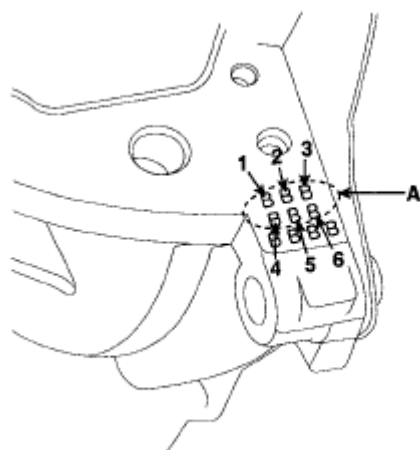
5. Disconnect PCSV connector (A), MAP sensor connector (B) and PCSV hose.



EDQF153A

Fig. 287: Disconnect PCSV Connector, Map Sensor Connector And PCSV Hose
Courtesy of HYUNDAI MOTOR CO.

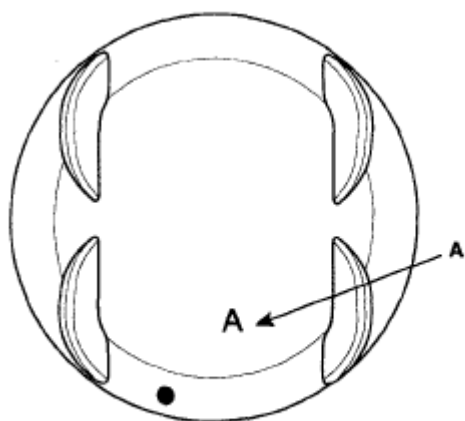
6. Disconnect ETC connector (A) and knock sensor connector (B).



SCMEM6315D

Fig. 288: Identifying ETC Connector And Knock Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

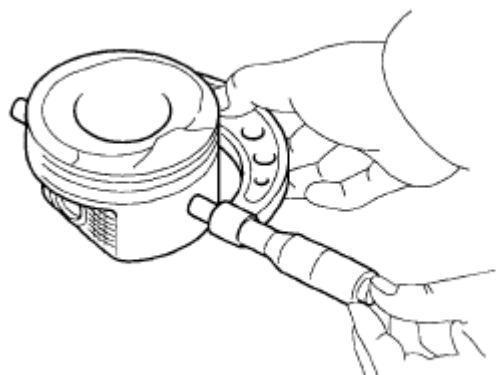
7. Remove ETC bracket (A).
8. Disconnect water hoses (B) from ETC.
9. Disconnect PCV (C) hose.



SCMEM6316D

Fig. 289: Identifying PCV Hose
Courtesy of HYUNDAI MOTOR CO.

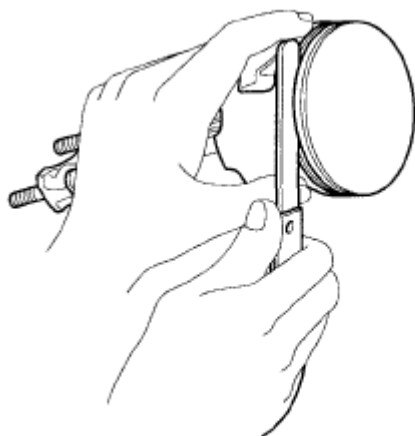
10. Disconnect brake vacuum hose.
11. Remove surge tank stay.
12. Remove connector bracket (A) from surge tank.



ECKD001D

Fig. 290: Identifying Connector Bracket
Courtesy of HYUNDAI MOTOR CO.

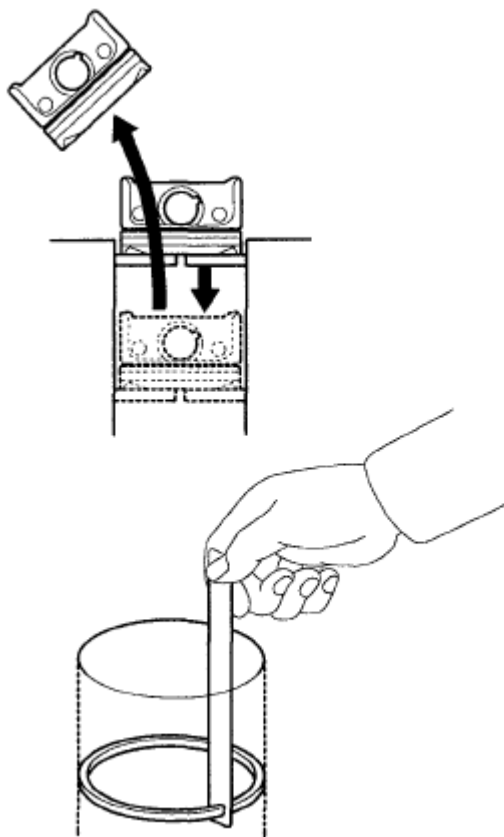
13. Remove surge tank (A).



LDLG045A

Fig. 291: Identifying Surge Tank
Courtesy of HYUNDAI MOTOR CO.

14. Disconnect breather Pipe assembly (A).



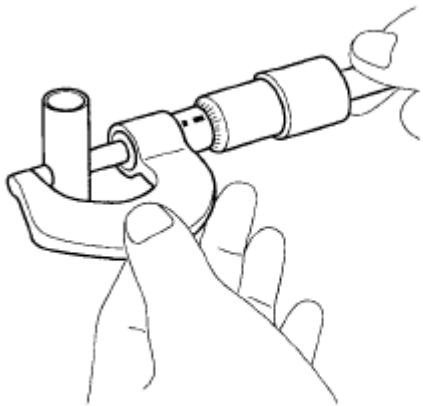
ECKD001K

Fig. 292: Identifying Breather Pipe Assembly
Courtesy of HYUNDAI MOTOR CO.

15. Disconnect LH injector connector.
16. Remove the delivery pipe and intake manifold together.

EXHAUST MANIFOLD

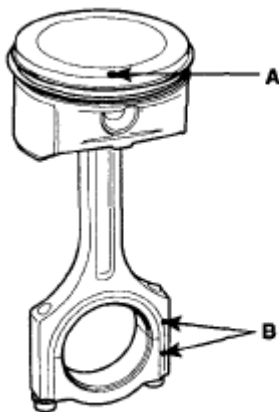
1. Remove under cover (A).



ECKD001Z

Fig. 293: Identifying Under Cover
Courtesy of HYUNDAI MOTOR CO.

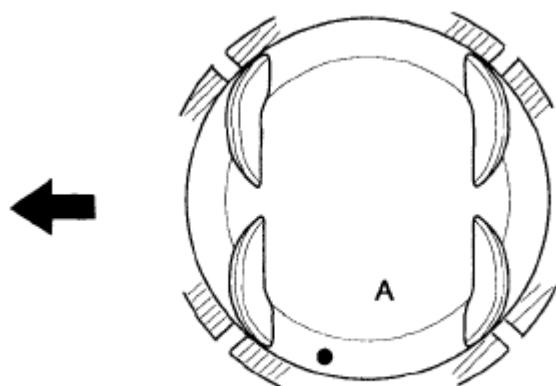
2. Disconnect LH, RH rear oxygen sensor connector from bracket.
3. Remove front muffler (A).



SCMEM6310D

Fig. 294: Identifying Front Muffler
Courtesy of HYUNDAI MOTOR CO.

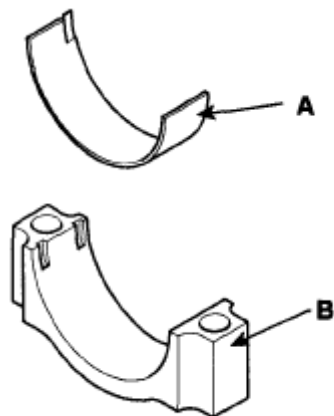
4. Remove oil level gauge (A).
5. Disconnect LH front oxygen sensor connector (B) from bracket.



SCMEM6311D

Fig. 295: Identifying LH Front Oxygen Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

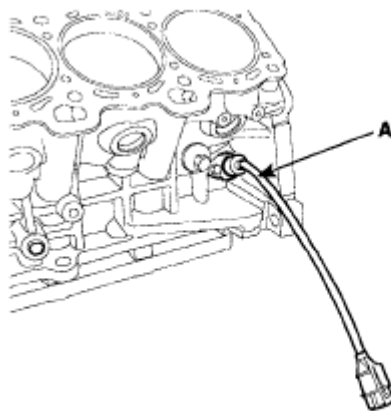
6. Remove LH heat protector (A).



KCRF116B

Fig. 296: Identifying LH Heat Protector
Courtesy of HYUNDAI MOTOR CO.

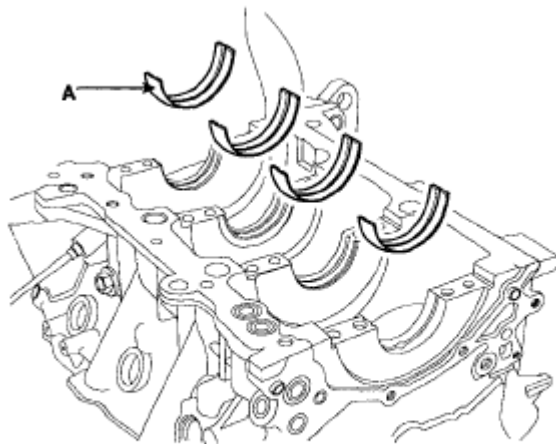
7. Remove LH exhaust manifold.
8. Disconnect RH front oxygen sensor connector from bracket.



KCBF128A

Fig. 297: Identifying RH Front Oxygen Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

9. Remove RH heat protector.
10. Remove RH exhaust manifold.



EDQF076A

Fig. 298: Identifying RH Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

INTAKE MANIFOLD

1. Install intake manifold and new gasket on the cylinder head.

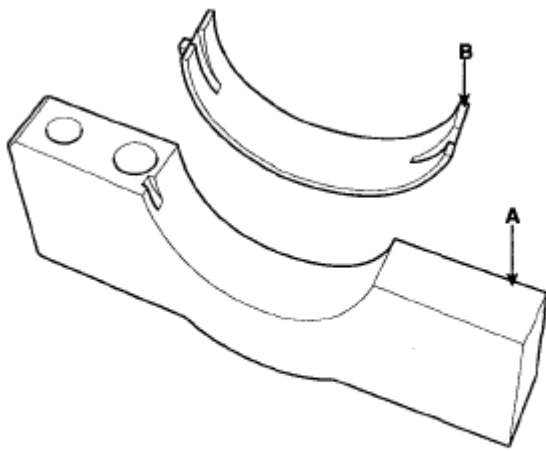
Tightening torque

1st: 3.9~5.9 Nm (0.4~0.6 kgf.m, 2.9~4.3 lb-ft)

2st: 18.62~23.52 Nm (1.9~2.4 kgf.m, 13.74~17.36 lb-ft)

3st: Repeat 2nd step twice or move.

NOTE: Be careful of the installation direction.
a - h: 1st step order
1~8: 2nd step order



EDQF079A

Fig. 299: Identifying Intake Manifold Bolts Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

2. Install delivery pipe. (Refer to **FUEL DELIVERY SYSTEM**).
3. Connect LH injector connector.
4. Connect breather pipe assembly.

Tightening torque

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

5. Install surge tank.

Tightening torque

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

6. Install connector bracket on the surge tank.

Tightening torque

6.86~10.78 Nm (0.7~1.1 kgf.m, 5.06~7.96 lb-ft)

7. Install surge tank stay.

Tightening torque

27.44~31.36 Nm (2.8~3.2 kgf.m, 20.25~23.14 lb-ft)

8. Connect brake vacuum hose.
9. Connect PCV hose.
10. Connect water hoses to ETC.
11. Install ETC bracket.

Tightening torque

15.68~25.48 Nm (1.6~2.6 kgf.m, 11.57~18.80 lb-ft)

12. Connect ETC connector and knock sensor connector.
13. Connect PCSV connector, MAP sensor connector and PCSV hose.
14. Connect RH injector connector and ignition coil connector.
15. Connect RH oxygen sensor connector.
16. Install air cleaner upper cover and intake hose.
17. Connect MAF (A) and breather hose.

EXHAUST MANIFOLD

1. Install new gasket and exhaust manifold.

Tightening torque

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

2. Install heat protector.

Tightening torque

3.9~5.9 Nm (0.4~0.6 kgf.m, 2.89~4.34 lb-ft)

3. Install front muffler.

Tightening torque

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

4. Connect oxygen sensor connector.

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5. Install under cover.