

2008 ENGINE**Engine Mechanical System (G6BA-GSL 2.7) - Tiburon****GENERAL****SPECIFICATIONS****GENERAL SPECIFICATIONS**

Description	Specifications	Limit
General		
Type		
Number of cylinder	V-type, DOHC	
Bore	6	
Stroke	86.7mm (3.4133in.)	
Total displacement	75mm (2.9528in.)	
Compression ratio	2,656cc	
Firing order	10:1	
Valve timing	1-2-3-4-5-6	
Intake valve		
Opens (BTDC)	6°	
Closes (ABDC)	46°	
Exhaust valve		
Opens (BBDC)	44°	
Closes (ATDC)	8	
Camshaft		
Drive mechanism	Cogged type belt	
Cam height		
Intake	43.95-44.15mm (1.7303-1.7382in.)	43.45mm (1.7106in.)
Exhaust	43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)	43.45mm (1.7106in.)
Journal diameter	25.964 ~ 25.980mm (1.0222 ~ 1.0228in.)	25.914mm (1.0202in.)
Bearing oil clearance	0.02 ~ 0.057mm (0.0007 ~ 0.0021 in.)	0.1mm (0.0039in.)
End play	0.1 ~ 0.2mm (0.0039 ~ 0.0079in.)	
Cylinder head		
Flatness of cylinder head surface	Max. 0.03mm (0.0012in.)	0.05mm (0.0020in.)
Flatness of manifold mounting surface		
Intake	Max. 0.15mm (0.0059in.)	0.15mm (0.0059in.)
Exhaust	Max. 0.15mm (0.0059in.)	0.15mm (0.0059in.)

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Valve guides hole diameter		
0.05 (0.002) O.S.	11.05 ~ 11.068mm (0.435 ~ 0.436in.)	
0.25 (0.010) O.S.	11.25 ~ 11.268mm (0.443 ~ 0.444in.)	
0.50 (0.020) O.S.	11.50 ~ 11.518mm (0.453 ~ 0.453in.)	
Intake valve seat ring hole diameter 0.3 (0.012) O.S.	33.300 ~ 33.325mm (1.311 ~ 1.312in.)	
Exhaust valve seat ring hole diameter 0.3 (0.012) O.S.	28.600 ~ 28.621mm (1.126 ~ 1.127in.)	
Valve		
Overall length		
Intake	96.1mm (3.783in.)	
Exhaust	97.15mm (3.825in.)	
Stem diameter		
Intake	5.965 ~ 5.98mm (0.235 ~ 0.2354in.)	
Exhaust	5.95 ~ 5.965mm (0.234 ~ 0.235in.)	
Face angle	45° ~ 45.5°	
Margin		
Intake	1.0mm (0.0394in.)	0.5mm (0.0197in.)
Exhaust	1.3mm (0.0512in.)	0.8mm (0.0315in.)
Clearance (Stem-to-guide)		
Intake	0.02 ~ 0.05mm (0.008 ~ 0.0020in.)	0.10mm (0.0039in.)
Exhaust	0.035 ~ 0.065mm (0.0014 ~ 0.0026in.)	0.13mm (0.0051 in.)
Valve spring		
Free length	42.5mm (1.6732in.)	41.5mm (1.6339in.)
Load	21.9kg/35mm (48.3lb/1.3780in.)	21.9kg/34mm (48.4lb/1.3386in.)
Out of squareness	Max. 1.5°	Max. 3°
Piston		
Diameter (Standard)	86.67 ~ 86.70mm (3.412 ~ 3.4134in.)	
Clearance (Piston-to-cylinder)	0.02 ~ 0.04mm (0.0008 ~ 0.0016in.)	
Ring groove width		
No.1	1.230 ~ 1.250mm (0.0484 ~ 0.0492in.)	
No.2	1.220 ~ 1.240mm (0.0480 ~ 0.0488in.)	

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Oil	2.015 ~ 2.035mm (0.0793 ~ 0.0801 in.)	
Piston for service	0.25mm (0.010in.), 0.50mm (0.020in.)	
Piston ring		
Number of rings per piston	3	
Compression ring	2	
Oil ring	1	
Compression ring type		
No.1	Inner bevel type	
No.2	Taper type	
Oil ring type	3-piece type	
Ring end gap		
No.1	0.15 ~ 0.30mm (0.0059 ~ 0.0118in.)	0.8mm (0.031 in.)
No.2	0.30 ~ 0.45mm (0.0118 ~ 0.0177in.)	0.8mm (0.031 in.)
Oil ring side rail	0.2 ~ 0.7mm (0.0079 ~ 0.0276in.)	1.0mm (0.039in.)
Ring side clearance		
No.1	0.04 ~ 0.08mm (0.0016 ~ 0.0031 in.)	0.1mm (0.004in.)
No.2	0.03 ~ 0.07mm (0.0012 ~ 0.0028in.)	0.1mm (0.004in.)
Rings for service	0.25mm (0.010in.), 0.50mm (0.020in.)	
Connecting rod		
Piston pin installation force	2,450 ~ 12.225N (250 ~ 1,250kg, 551 ~ 2,755lb)	0.4mm (0.016in.)
Side clearance (big end)	0.10 ~ 0.25mm (0.0039 ~ 0.0098in.)	
Bend	0.05mm or less/100mm. (0.0020in. or less/3.937in.)	
Bearing oil clearance	0.018 ~ 0.036mm (0.0007 ~ 0.0014in.)	0.1mm (0.004in.)
Crankshaft		
Journal O.D.	61.982 ~ 62.000mm (2.4402 ~ 2.4409in.)	
Pin O.D.	47.982 ~ 48.000mm (1.8891 ~ 1.8898in.)	
Out-of-round, taper of journal and pin	Max. 0.003mm (0.0012in.)	
Taper of journal and pin	Max. 0.003mm (0.0001 in.)	
End play	0.070 ~ 0.250mm (0.0028 ~	0.4mm (0.016in.)

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	0.0098in.)	
Main bearing of clearance	0.004 ~ 0.022mm (0.0002 ~ 0.0009in.)	0.1mm (0.004in.)
Cylinder block		
Cylinder bore	86.7mm (3.4134in.)	
Flatness of gasket surface	Max. 0.03mm (0.0012in.)	0.05mm (0.002in.)
Out-of-round of cylinder bore	Max. 0.02mm (0.0008in.)	
Engine oil	5W - 20 Above GF3 & SL	
Oil quantity(Total)	4.8L(5.07US qt, 4.22 lmp qt)	When replacing a short engine or a block assembly
Oil quantity(Excluding oil filter)	4.2L(4.76US qt, 3.96 lmp qt)	When replacing an oil pan only
Oil quantity(Drain and refill including oil filter)	4.5L(4.44US qt, 3.90 lmp qt)	
Oil pump		
Body clearance	0.100 ~ 0.181mm (0.0039 ~ 0.0071 in.)	
Side clearance	0.040 ~ 0.095mm (0.0016 ~ 0.0037in.)	
Relief spring		
Free height	43.8mm (1.724in.)	
Load	4.6kg/39.3mm (10lb/1.548in.)	
Oil filter		
Type	Cartridge, full flow	
Engine oil pressure	50kPa (7.3psi) or more [Conditions: Oil temperature is 75 to 90°C (167 to 194°F)]	
Cooling method	Engine coolant cooling, forced circulation with electric fan	
Cooling system quantity	8.0L (8.45U.S.qts., 7.04lmp.qts)	
Thermostat		
Type	Wax pellet type with jiggle valve	
Normal opening temperature	82 ± 2.0°C (179.6 ± 3.6°F)	
Opening temperature range	80 ~ 84°C (176 ~ 183.2°F)	
Wide open temperature	95°C (203°F)	
Radiator cap		
Main valve opening pressure	107.9 ± 14.7kPa (1.1 ± 0.15kg/cm ² , 15.65 ± 2.13psi)	
Main valve closing pressure	83.4kPa (0.85kg/cm ² , 12.1psi)	
Vacuum valve opening pressure	-6.86kPa (-0.07kg/cm ² , -1.00psi)	
Air cleaner		
Type	Dry	
Element	Paper type	

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Exhaust pipe

Muffler	Expansion resonance type	
Suspend system	Rubber hangers	

SERVICE STANDARDS**SERVICE STANDARDS SPECIFICATIONS**

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

COOLANT**COOLANT SPECIFICATIONS**

Engine coolant	Ethlylen glycol base for aluminum radiator
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SEALANT**SEALANT SPECIFICATIONS**

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

TIGHTENING TORQUES**TIGHTENING TORQUES SPECIFICATIONS**

Item	Nm	kgf.m	lbf.ft
Camshaft sprocket bolt	88.3 ~ 107.7	9.0-11	65.1 ~ 79.6
Cylinder head cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Main bearing cap bolt			
M10	26.5~32.4+90°~95°	2.7~3.0+ 90°~95°	19.5~23.9+ 90°~95°
M8	12.7~18.6+90°~95°	1.3~1.9+ 90°~95°	9.4~13.7+ 90°~95°
Connecting rod bolt	15.7~19.6 + (90°~94°)	1.6~2.0 + (90°~94°)	11.6~14.5 + (90°~94°)
Cylinder head bolt (Cold engine)	24.5 + (58°~62°) + (43°~47°)	2.5 + (58°~62°) + (43°~47°)	18.1 + (58°~62°) + (43°~47°)
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Lower oil pan bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Upper oil pan bolt			
[10 x 38mm (0.937 x 1.4961 in.)]	39.2 ~ 46.1	4.0 ~ 4.7	28.9 ~ 34.0
[8 x 22mm (0.3150 x 0.8661 in.)]	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4.

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[163.5mm (6.4370in.)]	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
[154.5mm (6.0827in.)]	4.9 ~ 6.9	0.5 ~ 0.7	3.6 ~ 5.1
Oil screen bolt	14.7 ~ 21.6	1.5 ~ 2.2	10.8~15.9
Oil pump case bolt	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil relief valve plug	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2.
Oil pressure switch	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil pressure cover screw	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Drive plate and adapter	71.6 ~ 75.5	7.3 ~ 7.7	52.8 ~ 55.7
Air cleaner body installation bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Surge tank stay	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Air intake surge tank to intake manifold (bolt)	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Air intake surge tank to intake manifold (nut)	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold to cylinder head	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Heat protector exhaust manifold	16.7 ~ 21.6	1.7 ~ 2.2	12.3 ~ 15.9
Exhaust manifold to cylinder head (Self-locking nut)	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Oil level gauge guide to engine	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water outlet fitting bolt	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Power steering oil pump bracket to cylinder head	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Crank position sensor wheel screw	10.8 ~ 11.8	1.1 ~ 1.2	8.0 ~ 8.7
Engine mounting insulator nut(large)	58.8 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.9
Engine mounting bracket bolts	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Engine support bracket nuts & bolt	58.8 ~ 78.5	6.0 ~ 8.0	43.4 ~ 57.9
Transmission insulator nut	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Transmission insulator bracket to side member bolt	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Rear roll insulator nut	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll insulator bracket bolts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Front roll insulator nut	49.0 ~ 63.4	5.0 ~ 6.5	36.2 ~ 47.0
Front roll insulator bracket bolts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Transaxle mounting bracket bolt	49.0 ~ 58.8	5.0 ~ 6.5	36.2 ~ 43.4
Transaxle mounting insulator bolt	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Fuel hose clamp to rear cylinder head assembly	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Transaxle mounting plate	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Rear plate	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil seal case	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Crankshaft pulley bolt	166.7 ~ 176.5	17.0 ~ 18.0	123.0 ~ 130.2

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Timing belt cover bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Engine hanger bracket to engine	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Alternator mounting bracket to engine	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
Alternator mounting nut (Engine front case side)	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
Alternator mounting bolt (Alternator mounting bracket side)	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
Starter to transmission(nut)	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
Starter to transmission(bolt)	26.5 ~ 33.3	2.7 ~ 3.4	19.5 ~ 24.6
Drive belt pulley bolt	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Drive belt tensioner bolt	24.5 ~ 27.5	2.5 ~ 2.8	18.1 ~ 20.3
Engine coolant pump to cylinder block bolt (Head mark "8" mark)	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Engine coolant temperature sensor	19.6 ~ 39.2	2.0 ~ 4.0	14.5 ~ 28.9
Engine coolant inlet fitting attaching bolt	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.5
Throttle body to surge tank bolt	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Oxygen sensor to exhaust manifold	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Front exhaust pipe to exhaust manifold nut	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front exhaust pipe to catalytic. converter bolt	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Catalytic converter to center exhaust pipe nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Center exhaust pipe to main muffler nut	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.3
Main muffler hanger support bracket bolt	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Delivery pipe installation bolt	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Timing belt tensioner pulley bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Timing belt idler pulley bolt	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Timing belt tensioner arm fixed bolt	34.3 ~ 53.9	3.5 ~ 5.5	25.3 ~ 39.8
Auto tensioner fixed bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Accelerator cable bracket	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Spark plug	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7

INSPECTION

COMPRESSION PRESSURE

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

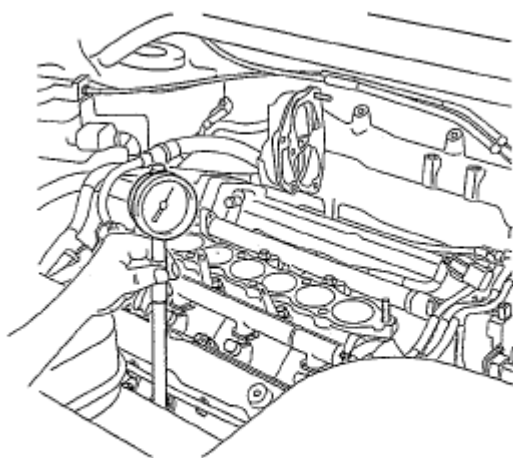
1. Warm up and stop engine

Allow the engine to warm up to normal operating temperature.

2. Remove ignition coils. (Refer to **IGNITION SYSTEM**).
3. Remove spark plugs.

Using a 16mm plug wrench, remove the 6 spark plugs.

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



EDQF165A

Fig. 1: Checking Cylinder Compression Pressure

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

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

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

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

Compression pressure:

1,420kPa (14.5kgf/cm² , 206psi)

Minimum pressure:

1,270kPa (13kgf/cm² , 184psi)

Difference between each cylinder:

100kPa (1.0kgf/cm² , 15psi) or less

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

TROUBLESHOOTING

TROUBLESHOOTING CHART

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required
	Excessive worn or mis-aligned timing chain	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption	• Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. • Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem, oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	• Inspect the cylinder for a loss of compression. • Repair or replace as required.
	Incorrect oil viscosity	• Drain the oil.

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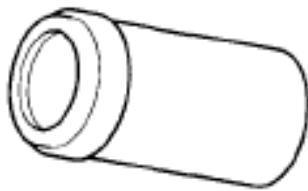
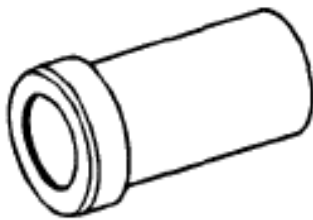
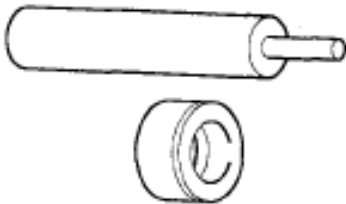
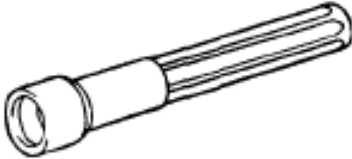
Engine noise on start-up, but only lasting a few seconds.		• Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	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.
Lower engine noise, regardless of engine speed	Low oil pressure.	Repair or required.
	Loose or damaged flywheel.	Repair or replace the flywheel
	Damaged oil pan, contacting the oil pump screen.	• Inspect the oil pan. • Inspect the oil pump screen. • Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	• Inspect the oil pump screen. • Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	• Inspect the piston, piston pin and cylinder bore. • Repair as required.
	Excessive piston pin-to-connecting rod 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. • The crankshaft journal.
		Inspect the following components, and repair as required.

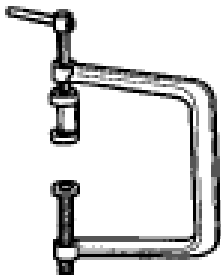
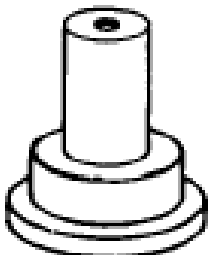
	Excessive crankshaft bearing clearance	• The crankshaft bearing. • The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required: • The connecting rod bearings. • The connecting rods. • The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft journals. • The cylinder block crankshaft
Engine will not crank-crankshaft will not rotate	Hydraulically locked cylinder • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bend or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft.

2. Repair as required.

SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS DESCRIPTION

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 EDKA010A	Installation of the front oil seal
Camshaft oil seal installer (09214-21000)	 EDDA005B	Installation of the camshaft oil seal
Valve guide installer (09221-3F100 A/B)	 ECKA010B	Remove and installation of the valve guide
Valve stem oil seal installer (09222-22001)	 ECKA010A	Installation of the valve stem oil seal

Valve spring compressor & adaptor (09222-28000, 09222-28100)	 EDDA005C	Removal and installation of the intake or exhaust valve
Crankshaft rear oil seal installer (09231-33000)	 EDDA005F	1. Installation of the engine rear oil seal 2. Installation of the crankshaft rear oil seal
Oil filter wrench (09263-2E000)	 ACIE008A	Removal and installation of oil filter

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

CAUTION:

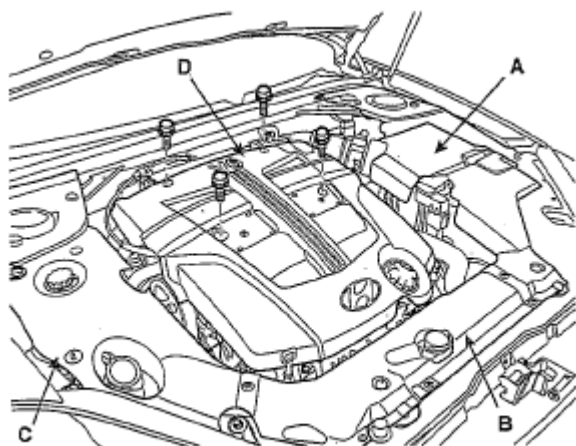
- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

- Mark all wiring and hoses to avoid misconnection.
- Inspection the timing belt before removing the cylinder head.

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

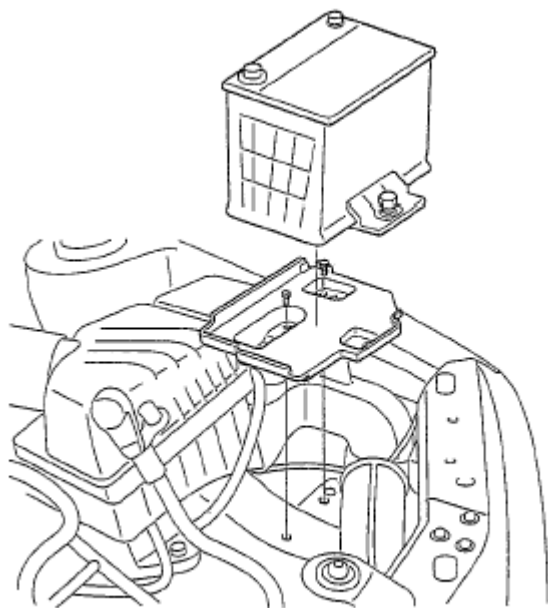
1. Remove the side cover(D) and the engine cover(A, B, C).



SGKM17001N

Fig. 2: Identifying Side Cover And Engine Cover

2. Disconnect the battery terminal and the battery.

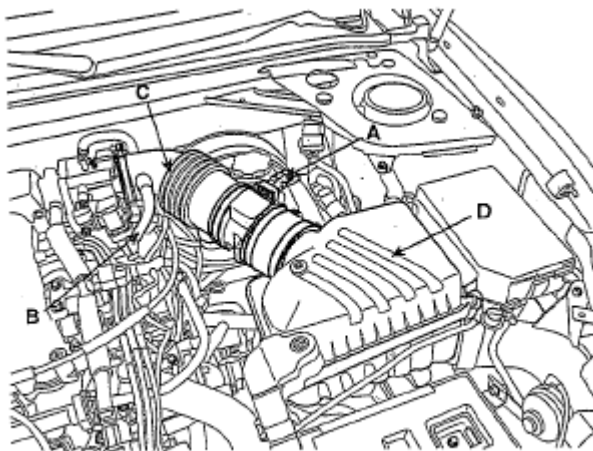


ECKD201B

Fig. 3: Identifying Battery Terminal

3. Remove the radiator cap to speed draining.
4. Remove the radiator drain plug and drain engine coolant.
5. Remove the air cleaner assembly.

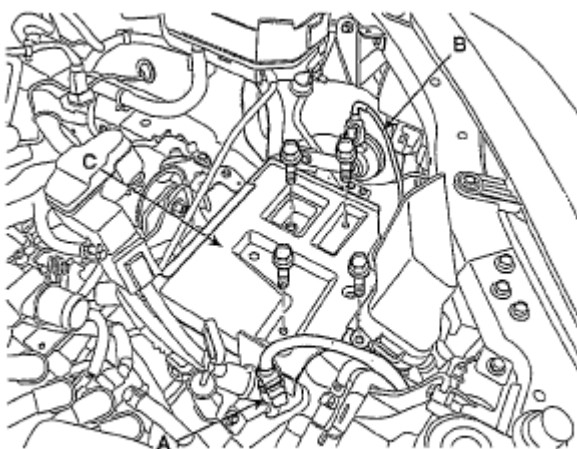
1. Disconnect the air flow sensor (AFS) connector (A).
2. Remove the breather hose (B) from intake hose(C).
3. Remove the intake hose (C) and air cleaner upper cover (D).
4. Remove the air cleaner lower cover (A).



SGKM17002N

Fig. 4: Identifying Air Flow Sensor Connector, Breather Hose, Intake Hose And Air Cleaner Upper Cover

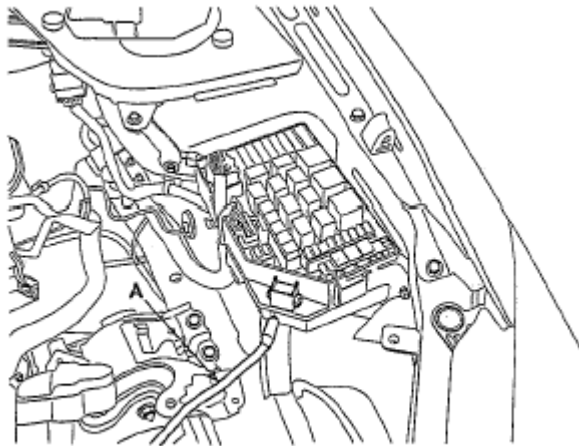
6. Disconnect the front connector (A) and horn connector(B).
7. Remove the battery try (C).



SGKM17003N

Fig. 5: Identifying Front Connector, Horn Connector And Battery Try

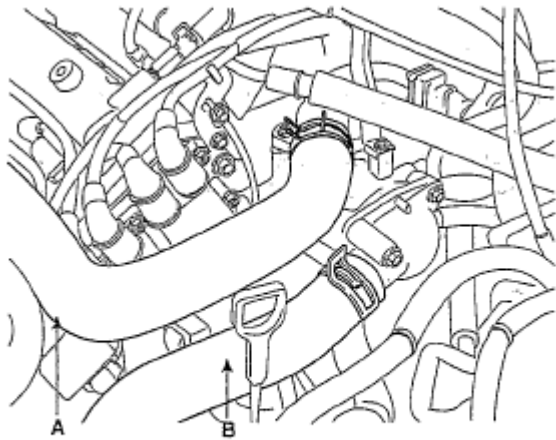
8. Remove the fuse box cover.
9. Disconnect the terminals(A) from the fuse box.



SGKM17009N

Fig. 6: Identifying Fuse Box Terminals

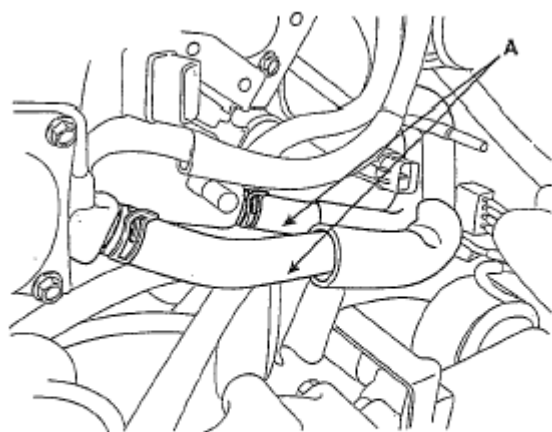
10. Remove the upper radiator hose(A) and lower radiator hose(B).



EDQF037A

Fig. 7: Identifying Upper And Lower Radiator Hose

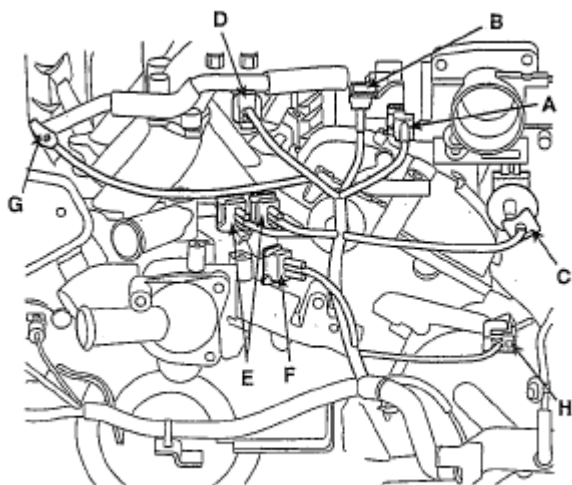
11. Remove the heater hoses(A).



EDQF019A

Fig. 8: Identifying Heater Hoses

12. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
 1. Throttle position sensor (TPS) connector(A).
 2. Idle speed actuator (ISA) connector(B).
 3. Purge control solenoid valve(PCSV) connector(C).
 4. Injector connector(E).
 5. Knock sensor connector(F).
 6. Camshaft position sensor(CPS) connector(G).
 7. Engine ground line (F).
 8. Heated oxygen sensor (Bank 2, Sensor 1) connector (H).

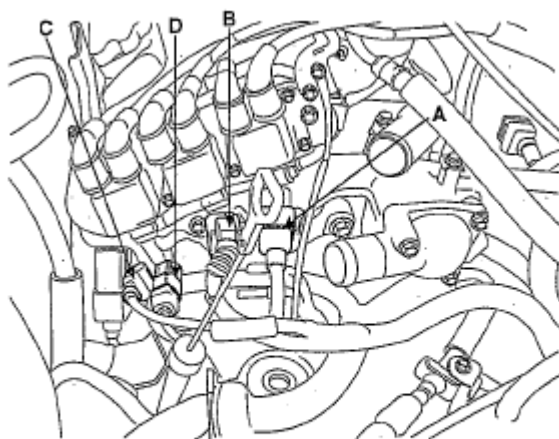


SGKM17004N

Fig. 9: Identifying TPS Connector, ISA Connector, PCSV Connector, Injector Connector

And CPS Connector

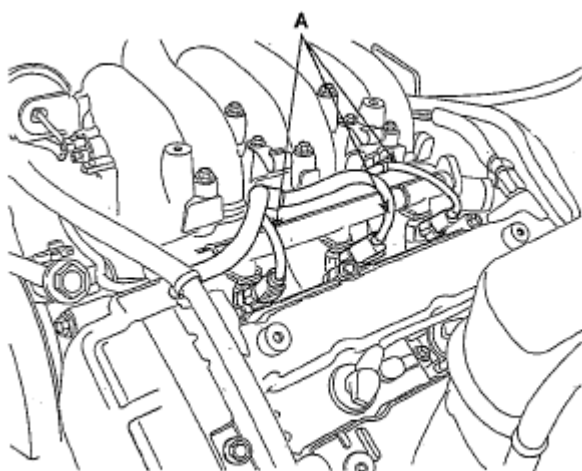
9. Engine temperature coolant sensor connector(A).
10. Ignition coil connector (B).
11. Crankshaft position sensor connector (C).
12. Heated oxygen sensor (Bank 1, Sensor 2) connector (D).



EDQF033A

Fig. 10: Identifying Engine Temperature Coolant Sensor Connector, Heated Oxygen Sensor Connector And Ignition Coil Connector

13. Three fuel injector connectors(A).

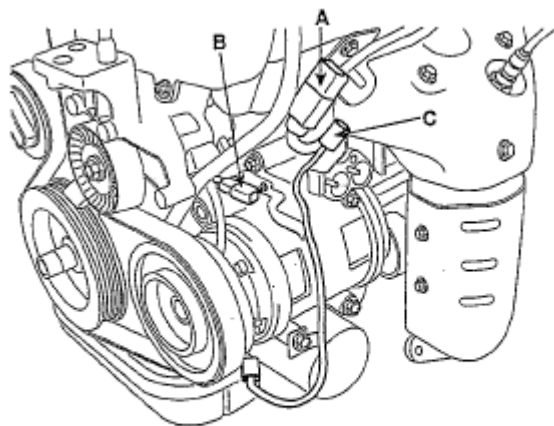


SGKM17401N

Fig. 11: Identifying Fuel Injector Connectors

13. Disconnect heated oxygen sensor (bank 1, sensor 1) connector(A), air compressor switch connector(B)

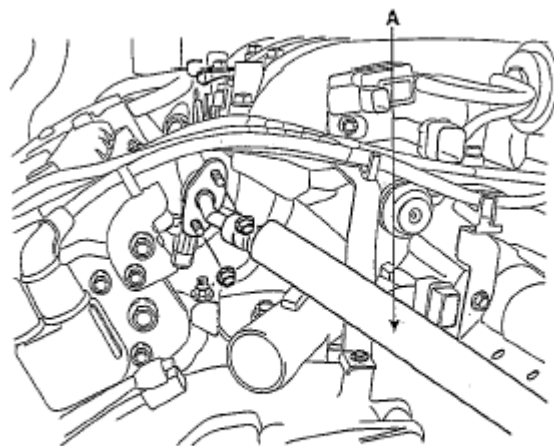
and oil pressure sensor connector(C).



EDQF009A

Fig. 12: Identifying Heated Oxygen Sensor Connector, Air Compressor Switch Connector And Oil Pressure Sensor Connector

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



EDQF025A

Fig. 13: Identifying Delivery Pipe

15. Disconnect the purge control solenoid valve (PCSV) hose (A).

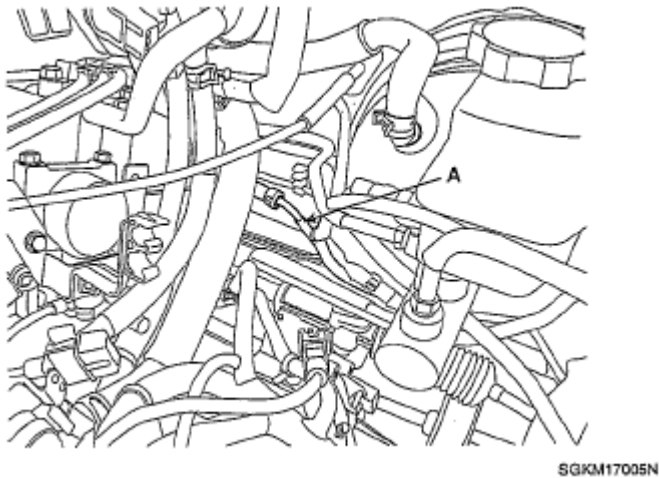


Fig. 14: Identifying Purge Control Solenoid Valve Hose

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

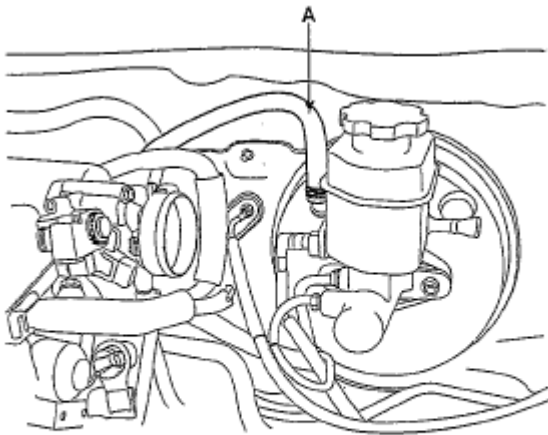


Fig. 15: Identifying Brake Booster Vacuum Hose

17. Remove the accelerator cable by loosening the lock-nut, then slip the cable end out of the throttle linkage.
18. Remove the auto-cruise connector (A) and the auto-cruise cable (B).

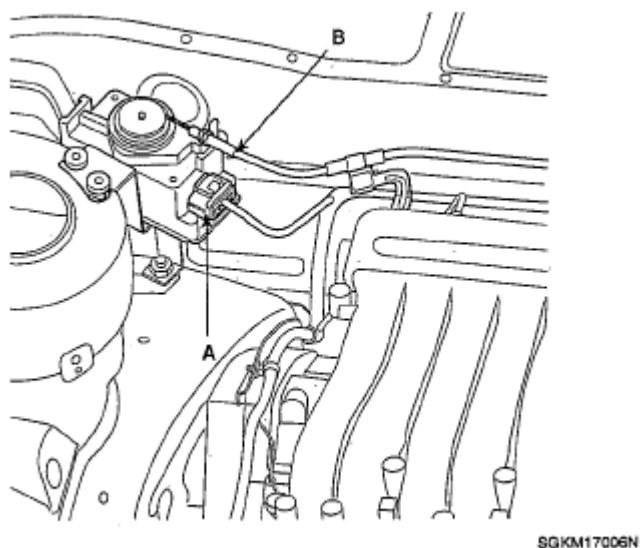


Fig. 16: Identifying Auto-Cruise Connector And Auto-Cruise Cable

19. Disconnect the air temperature sensor (ATS) connector (A) and heated oxygen sensor (Bank 2, Sensor 2) connector (B).

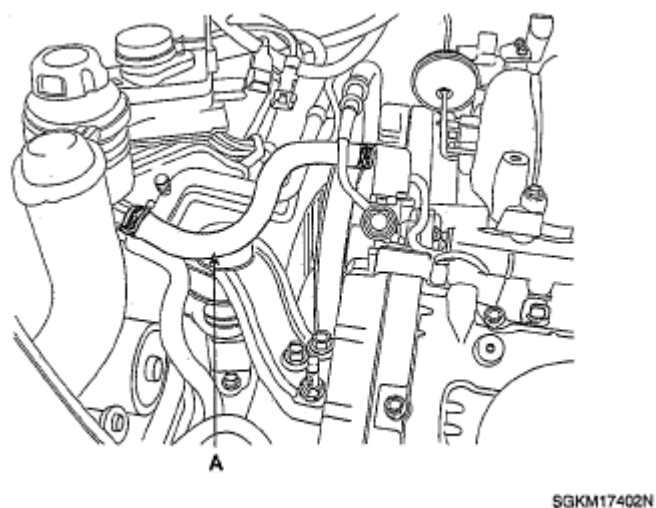
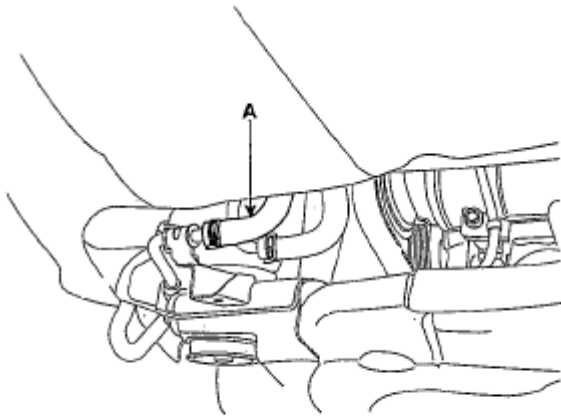


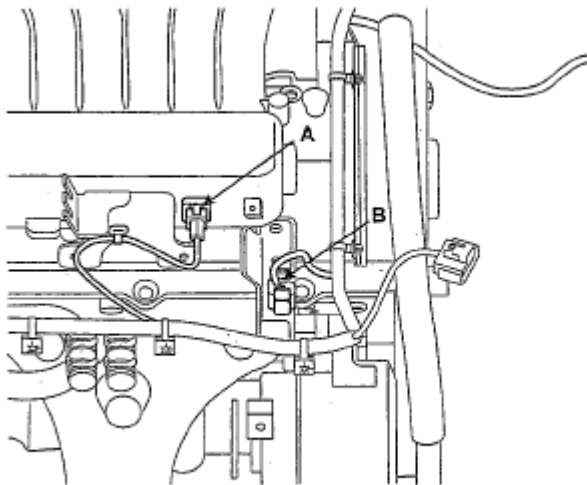
Fig. 17: Identifying Air Temperature Sensor Connector



EDQF021A

Fig. 18: Identifying Air Temperature Sensor Connector

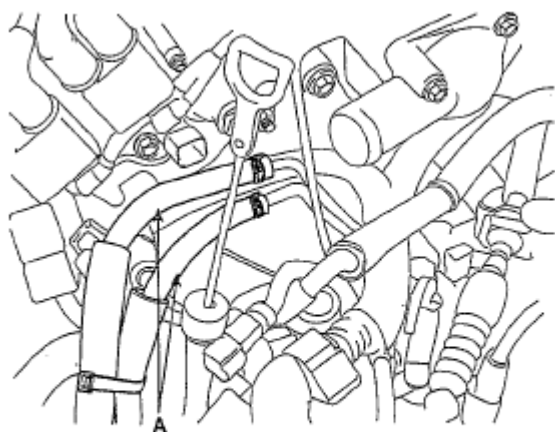
20. Disconnect the air temperature sensor (ATS) connector (A) and heated oxygen sensor (Bank 2, Sensor 2) connector (B).



SGKM17007N

Fig. 19: Identifying Air Temperature Sensor Connector And Heated Oxygen Sensor Connector

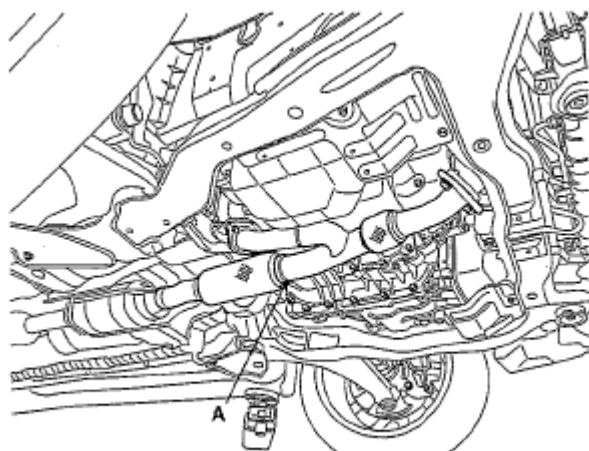
21. Remove the auto transaxle fluid hoses (A).



EDQF034A

Fig. 20: Identifying Auto Transaxle Fluid Hoses

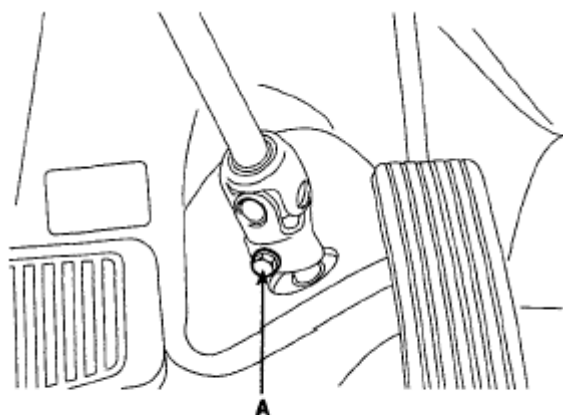
22. Disconnect the transaxle wire harness connector. (Refer to **AUTOMATIC TRANSAXLE (F4A42)** or **MANUAL TRANSAXLE**).
23. Remove the front exhaust pipe(A).



SGKM17006N

Fig. 21: Identifying Front Exhaust Pipe

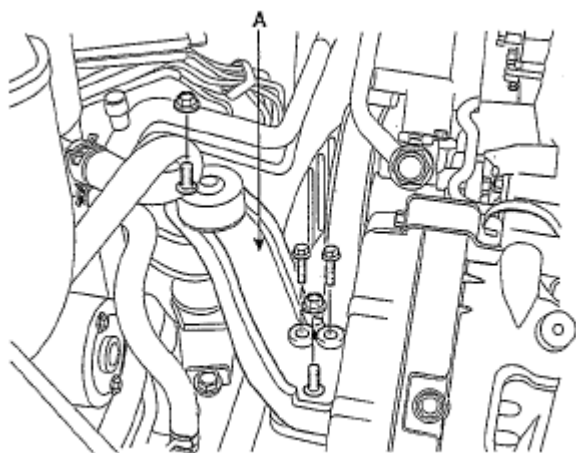
24. Recover refrigerant and remove the high & low pressure pipe. (Refer to **AIR CONDITIONING SYSTEM**).
25. Remove the steering column mounting bolt(A), (Refer to **STEERING COLUMN AND SHAFT**).



ECKD616A

Fig. 22: Identifying Steering Column Mounting Bolt

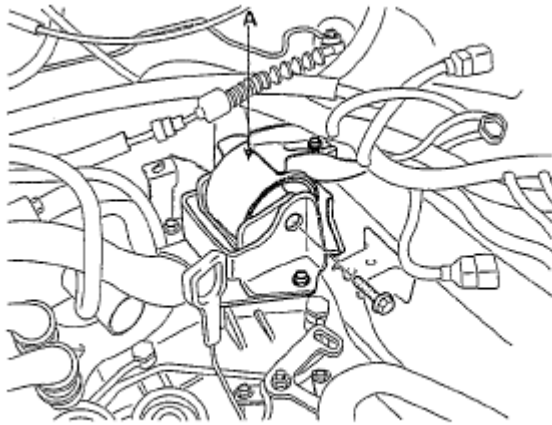
26. Remove the front wheels and tires.
27. Disconnect the stabilizer bar link and remove the mounting bolts from the lower arm and the front axles.
28. Support the engine and transaxle assembly.
29. Remove the engine mounting support bracket(A) and the ground line(B).



SGKM17403N

Fig. 23: Identifying Engine Mounting Support Bracket

30. Remove the transaxle mounting bracket(A).



EDQF016A

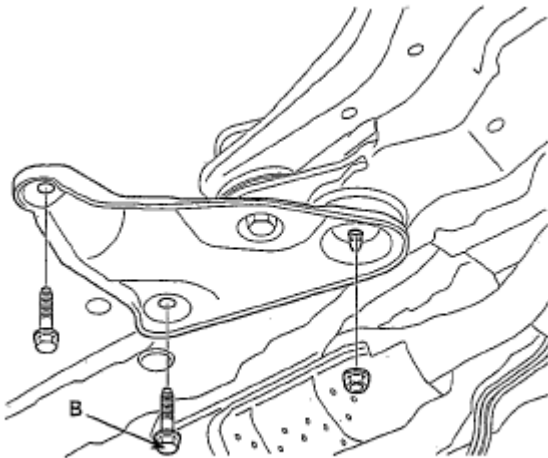
Fig. 24: Identifying Transaxle Mounting Bracket

31. Remove the sub frame mounting bolts (A, B) and nut.

Tightening torque

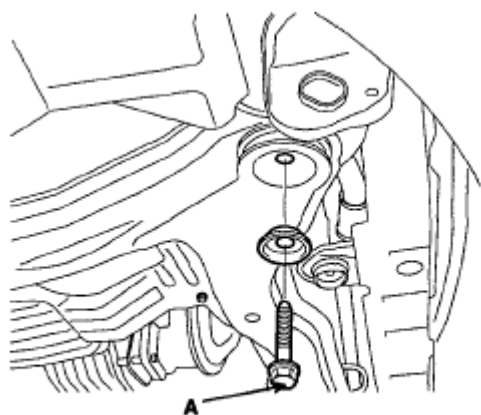
A: 160 ~ 180Nm (16 ~ 18kgf.m, 118 ~ 133lb-ft)

B: 70 ~ 90Nm (7.0 ~ 9.0kgf.m, 52 ~ 66lb-ft)



ECOF002A

Fig. 25: Identifying Sub Frame Mounting Bolts And Nut (1 Of 2)



ECKD618A

Fig. 26: Identifying Sub Frame Mounting Bolts And Nut (2 Of 2)

INSTALLATION

Installation is in the reverse order of removal.

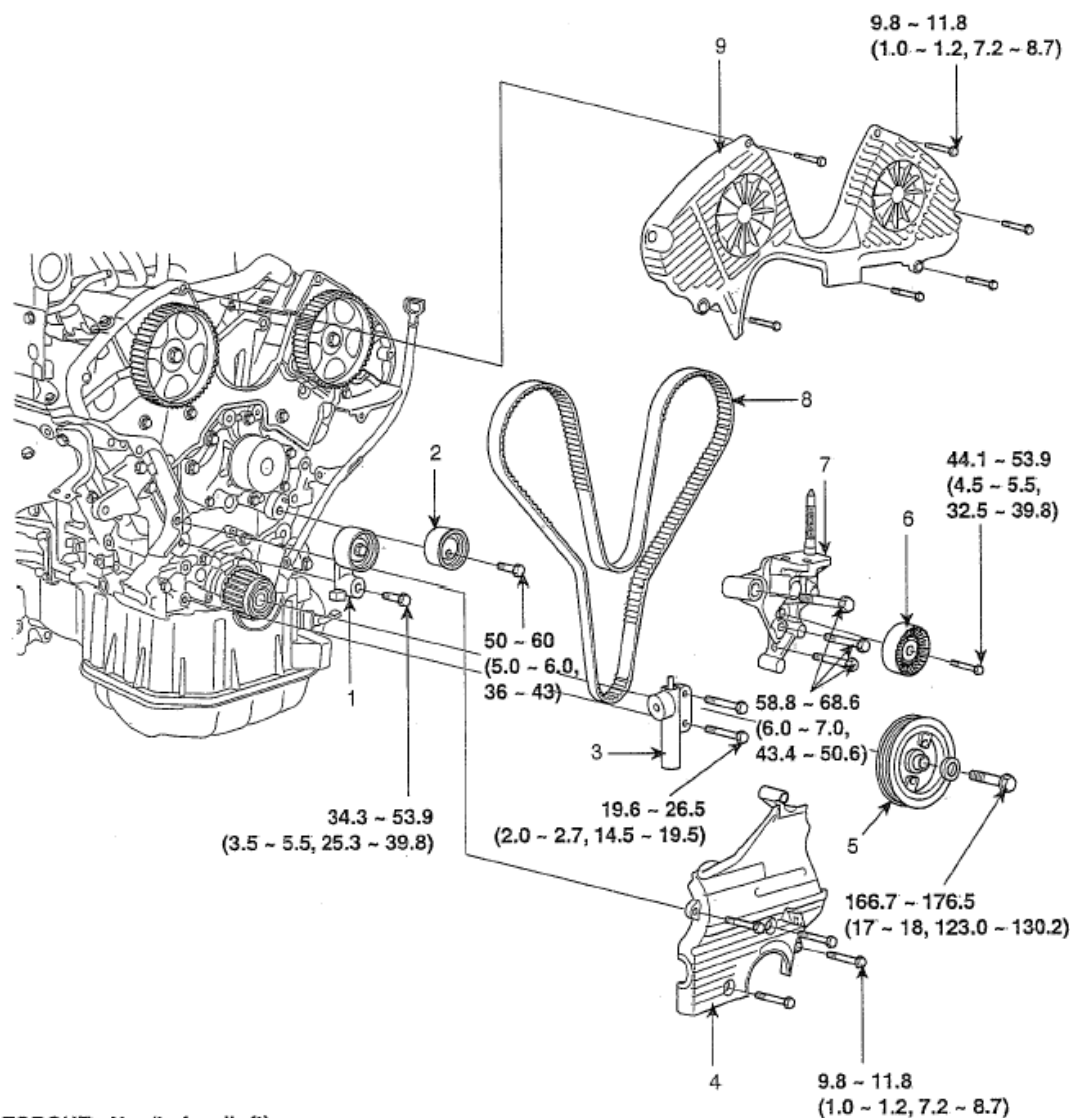
Perform the following:

- Adjust the shift cable.
- Adjust the throttle cable.
- Refill the engine with engine oil.
- Refill the transaxle with fluid.
- Refill the radiator and reservoir tank with engine coolant.
- Place the heater control knob on "HOT" position.
- 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 engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.
 - Put the radiator cap on tightly, then run engine again and check for leaks.
- Clean the battery posts and cable terminals with sandpaper, assemble them and then apply grease to prevent corrosion.
- Inspect for fuel leakage.
 - After assembling fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump could run for approximately two seconds and fuel line could be pressurized.
 - Repeat this operation two or three times and check for fuel leakage at any point in the fuel line.

TIMING SYSTEM

TIMING BELT

COMPONENTS



SGKM17404N

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

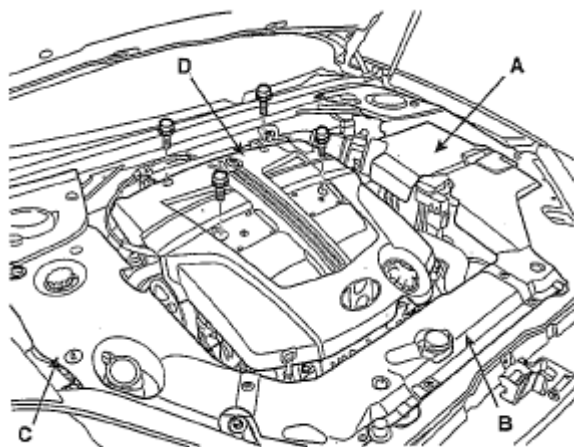
1. Tensioner arm assembly
2. Idler pulley
3. Auto tensioner
4. Timing belt lower cover
5. Crankshaft pulley
6. Drive belt idler pulley
7. Engine support bracket
8. Timing belt
9. Timing belt upper cover

Fig. 27: Identifying Timing System Components With Torque Specifications

REMOVAL

Engine removal is not required for this procedure.

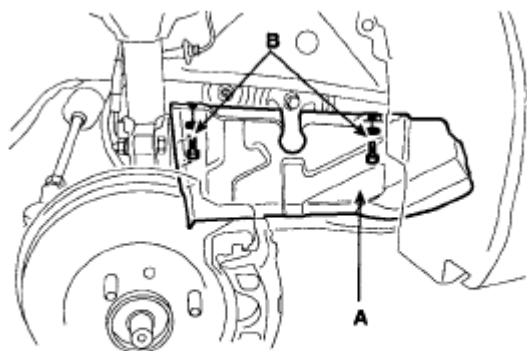
1. Remove the RH side cover(C) and the engine cover(D).



SGKM17001N

Fig. 28: Identifying Side Cover And Engine Cover

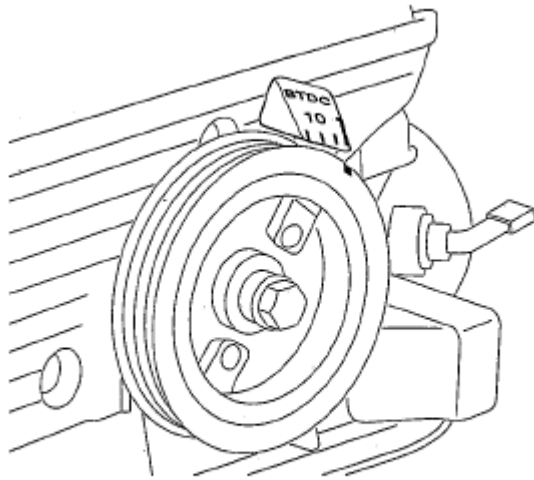
2. Remove RH front wheel.
3. Remove 2 bolts(B) and RH side cover(A).



KXDSE16A

Fig. 29: Identifying RH Side Cover Bolts

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

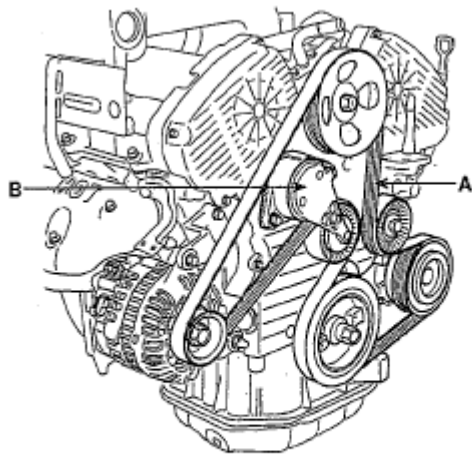


EDQF102A

Fig. 30: Identifying Timing Mark Of Timing Belt Cover

NOTE: Always turn the crankshaft clockwise.

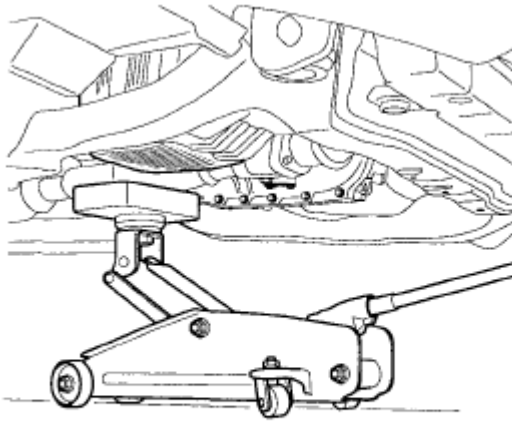
5. Remove the auto-tensioner(B) and the drive belt(A).



EDQF100A

Fig. 31: Identifying Auto-Tensioner And Drive Belt

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

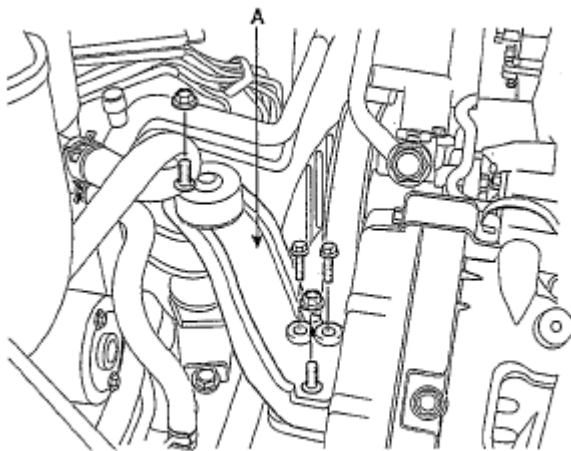


ECKD102A

Fig. 32: Supporting Engine Oil Pan With Jack

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

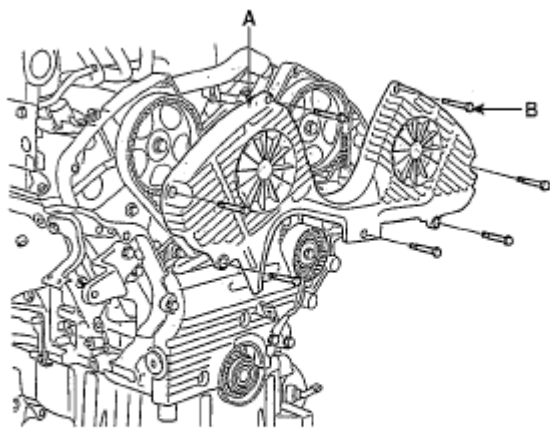
2. Remove the 2 bolts, 2 nuts and engine mount bracket(A).



SGKM17403N

Fig. 33: Identifying Engine Mounting Support Bracket

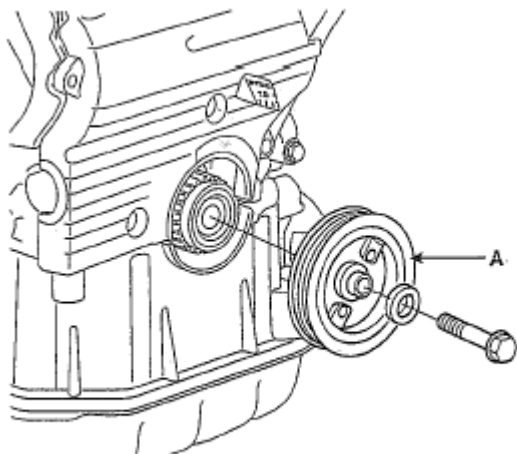
7. Remove the power steering pump. (Refer to **MECHANICAL POWER STEERING SYSTEM**).
8. Remove the 7 bolts(B) and timing belt upper cover(A).



EDCF103A

Fig. 34: Identifying Timing Belt Upper Cover Bolts

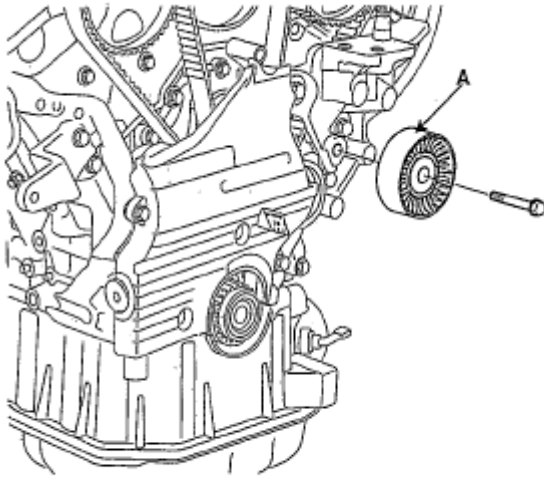
9. Remove the crankshaft pulley bolt and crankshaft pulley(A).



SGKM17405N

Fig. 35: Identifying Crankshaft Pulley Bolt And Crankshaft Pulley

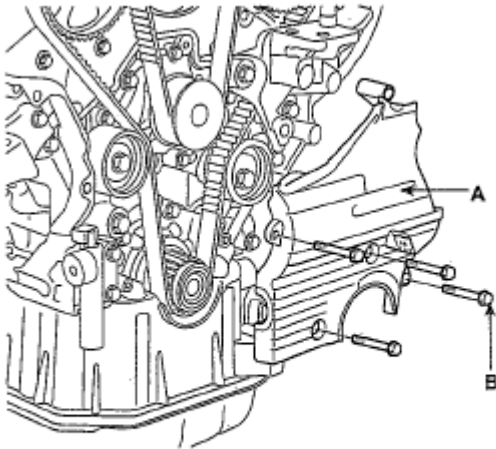
10. Remove the drive belt idler pulley(A).



EDQF105A

Fig. 36: Identifying Drive Belt Idler Pulley

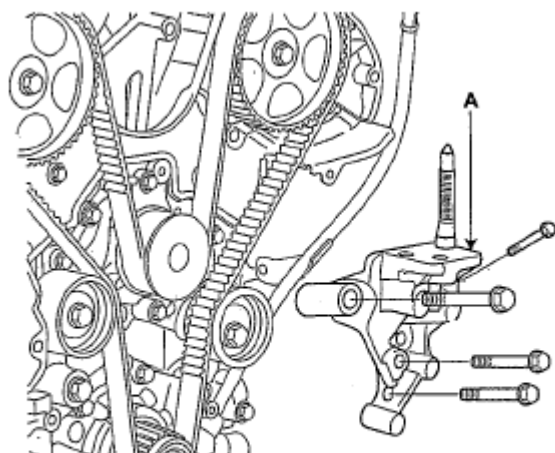
11. Remove the 4 bolts(B) and timing belt lower cover(A).



EDQF105B

Fig. 37: Identifying Timing Belt Lower Cover Bolts

12. Remove the engine support bracket(A).



EDQF106A

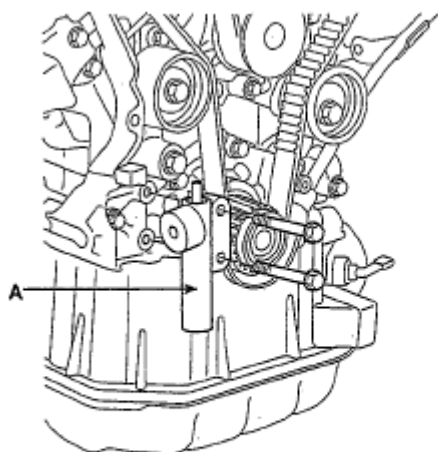
Fig. 38: Identifying Engine Support Bracket

13. Check that timing marks of the camshaft timing pulleys and cylinder head covers are aligned.

If not, turn the crankshaft 1 revolution (360°).

14. Remove timing belt tensioner.

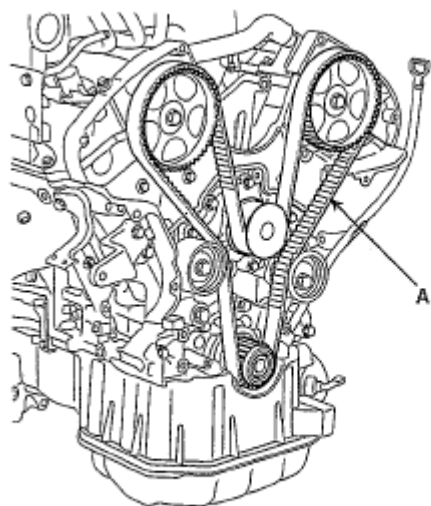
Alternately loosen the 2 bolts, and remove the tensioner(A).



EDQF107A

Fig. 39: Identifying Timing Belt Tensioner

15. Remove the timing belt(A).

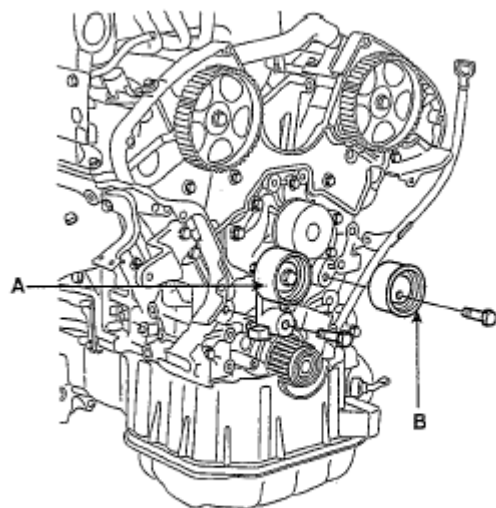


EDQF108A

Fig. 40: Identifying Timing Belt

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

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



EDQF110A

Fig. 41: Identifying Tensioner Arm Assembly And Timing Belt Idler Pulley

17. Remove the crankshaft sprocket.
18. Remove camshaft sprockets.

Hold the hexagonal head wrench portion of the camshaft with a wrench and remove the bolt and camshaft

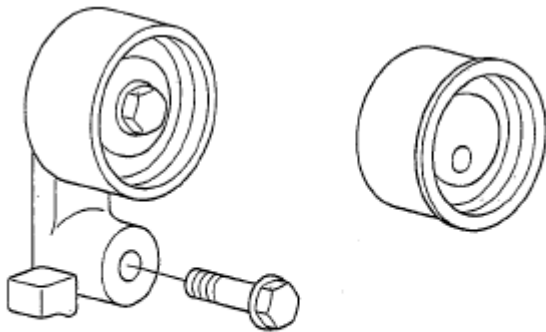
sprocket.

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

INSPECTION

SPROCKETS, TENSIONER, IDLER

1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley, and idler pulley for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner pulley, and the idler pulley for easy and smooth rotation and check for play or noise. Replace as necessary.



EDQF111A

Fig. 42: Identifying Belt Adjuster

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

TIMING BELT

1. Check the belt for oil or dust deposits.

Replace, if necessary.

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

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

NOTE:

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

INSTALLATION

1. Install the crankshaft sprocket.

Align the pulley set key with the key groove the crankshaft sprocket and slide on the crankshaft sprocket.

2. Install the camshaft sprockets and tighten the bolts to the specified torque.
 1. Temporarily install the camshaft sprocket bolts.
 2. Hold the hexagonal head wrench portion of the camshaft with a wrench, and tighten the camshaft sprocket bolts.

Tightening torque

Camshaft sprocket bolt

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

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

Tightening torque

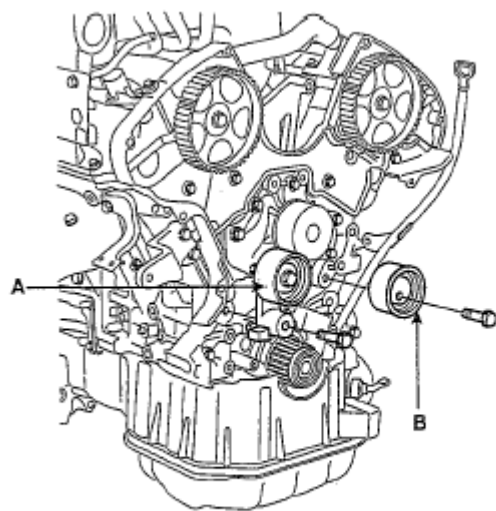
Idler pulley bolt

49.0 ~ 58.8Nm (5.0 ~ 6.0kgf.m, 36.2 ~ 43.4lb-ft)

Tensioner arm fixed bolt

34.3 ~ 53.9Nm (3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)

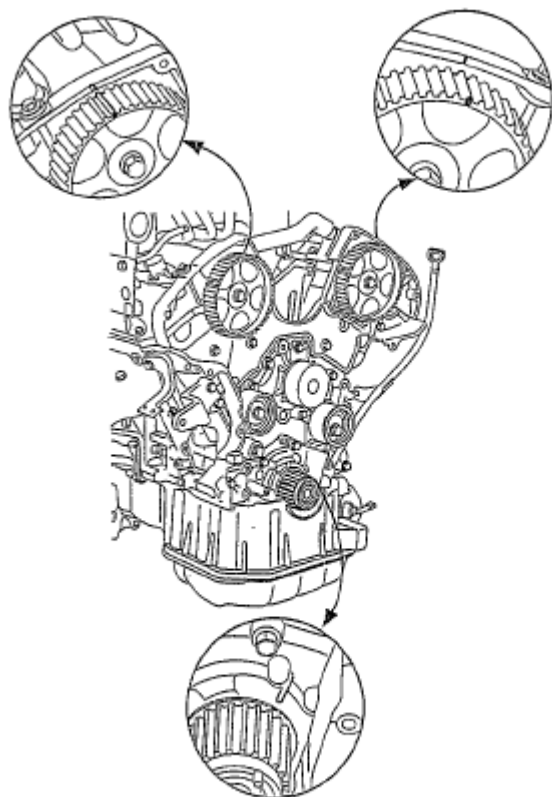
NOTE: **Insert and install the idler pulley to the roll pin that is pressed in the water pump boss.**



EDQF110A

Fig. 43: Identifying Idler Pulley And Tensioner Pulley

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



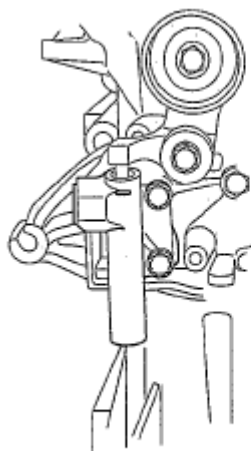
EDQF109A

Fig. 44: Identifying Timing Marks Of Camshaft Sprocket And Crankshaft Sprocket

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

Tightening torque

19.6 ~ 26.5Nm (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

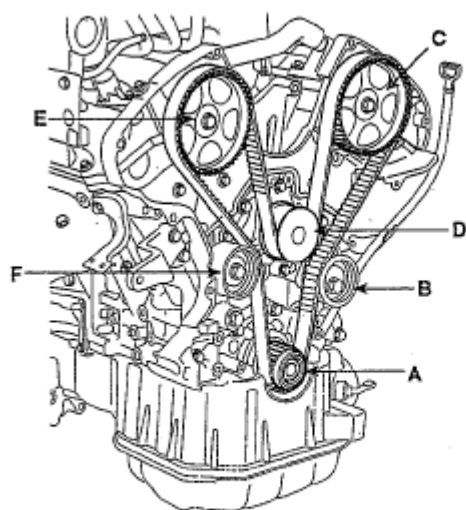


EDQF161A

Fig. 45: Identifying Timing Belt Tensioner Bolts

7. Install the timing belt.
 1. Remove any oil or water on the sprockets, and keep them clean.
 2. Install the timing belt in this order.

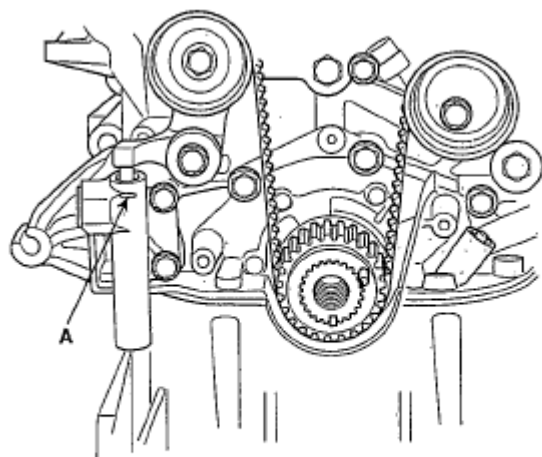
Crankshaft sprocket(A) --> Idler pulley(B) --> Camshaft sprocket LH side(C) --> Water pump pulley(D) --> Camshaft sprocket RH side(E) --> Tensioner pulley(F).



EDQF106B

Fig. 46: Identifying Idler Pulley, Camshaft Sprocket And Water Pump Pulley

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

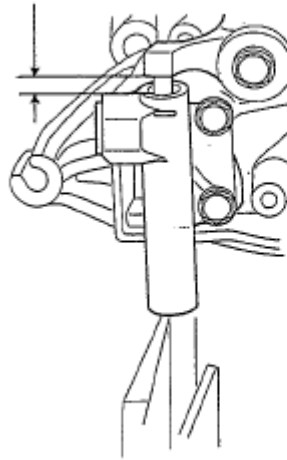


EDQF162A

Fig. 47: Identifying Set Pin

9. Timing belt tensioner checking.
 1. Rotate the crankshaft 2 turns clockwise and measure the projected length of the auto tensioner at TDC(#1 compression stroke) after 5 minutes.
 2. The projected length should be 7 ~ 9mm. (0.27 ~ 0.31 in.)

6 ~ 8 (0.2362 ~ 0.3150in)



SGKM17406N

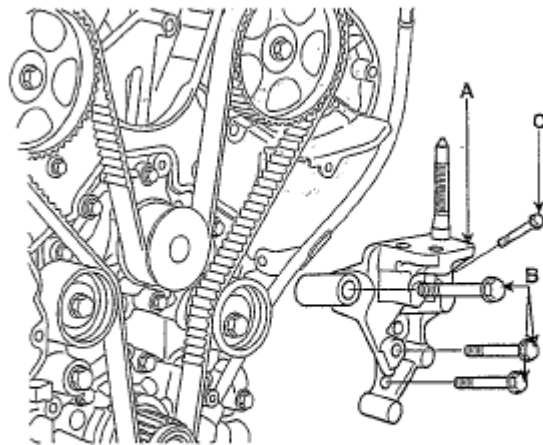
Fig. 48: Identifying Projected Length Of Auto Tensioner

10. Install the engine support bracket(A).

Tightening torque

B: 58.8 ~ 68.6Nm (6.0 ~ 7.0kgf.m, 43.4 ~ 50.6lb-ft)

C: 14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



EDQF106B

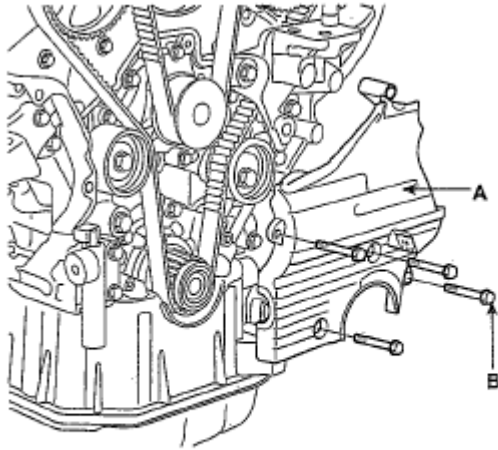
Fig. 49: Identifying Engine Support Bracket

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

Tightening torque

Timing belt cover bolt

9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



EDQF105B

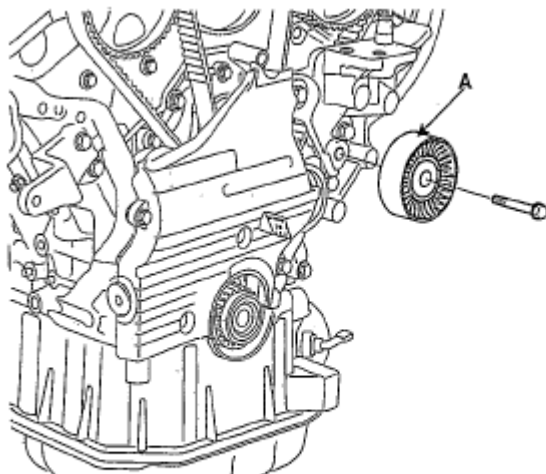
Fig. 50: Identifying Timing Belt Lower Cover Bolts

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

Tightening torque

Idler pulley bolt

44.1 ~ 53.9Nm (4.5 ~ 5.5kgf.m, 32.5 ~ 39.8lb-ft)



EDQF105A

Fig. 51: Identifying Drive Belt Idler Pulley

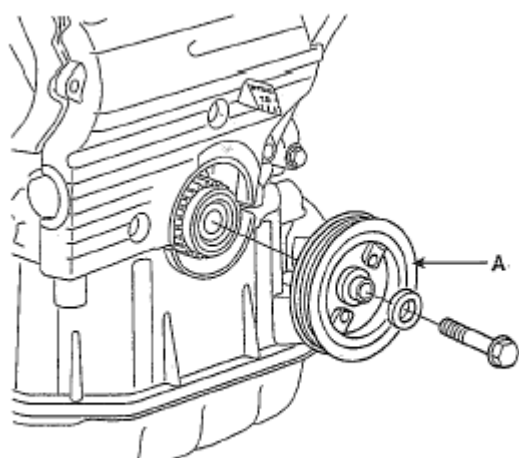
13. Install the crankshaft pulley(A).

Make sure that crankshaft sprocket pin fits the small hole in the pulley.

Tightening torque

Crankshaft pulley bolt

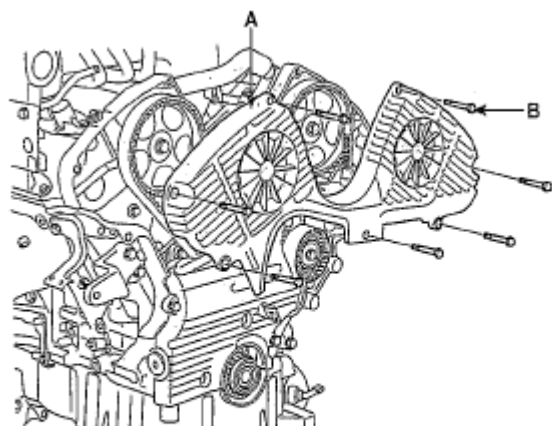
166.7 ~ 176.5Nm (17.0 ~ 18.0kgf.m, 123.0 ~ 130.2lb-ft)



SGKM17405N

Fig. 52: Identifying Crankshaft Pulley

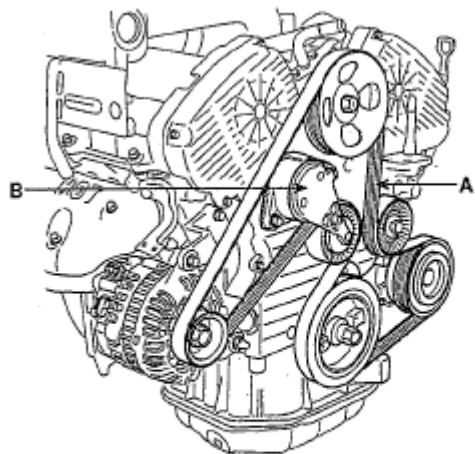
14. Install the timing belt upper cover(A) with 7 bolts(B).



EDQF103A

Fig. 53: Identifying Timing Belt Upper Cover Bolts

15. Install the power steering pump. (Refer to **POWER STEERING OIL PUMP**).
16. Install the drive belt tensioner(B) and drive belt(A).



EDCF100A

Fig. 54: Identifying Drive Belt Tensioner And Drive Belt

NOTE: V- ribbed-belt & tensioner installation procedure

1. Install the drive belt to the tensioner pulley and the install the tensioner as shown below, tightening torque:

24.5 ~ 27.5 N.m (2.5 ~ 2.8 krf.m, 18.1 ~ 20.3lb-ft)

2. Install the drive belt following order:

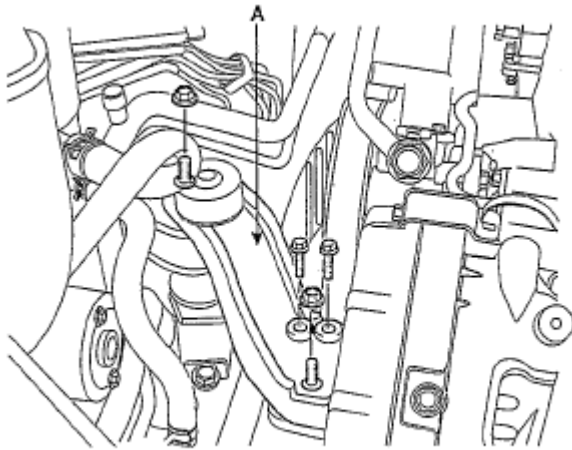
Alternator --> power steering --> crankshaft pulley (--> aircon pulley), install the drive belt to the arrow direction of the idle by rotate the tensioner arm (about 14°) the clockwise using a wrench and return is slowly to the original position.

17. Install the engine mount bracket.

Install engine mount bracket with 2 nuts and 2 bolt.

Tightening torque

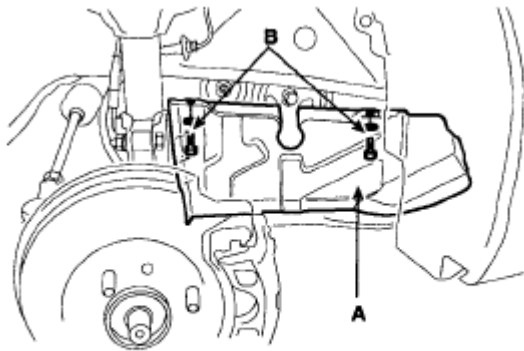
58.8 ~ 78.5Nm (6.0 ~ 8.0kgf.m, 43.4 ~ 57.9lb-ft)



SGKM17403N

Fig. 55: Identifying Engine Mounting Support Bracket

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



KXDSE16A

Fig. 56: Identifying RH Side Cover Bolts

19. Install RH front wheel.
20. Install the RH side cover(C) and the engine cover(D).

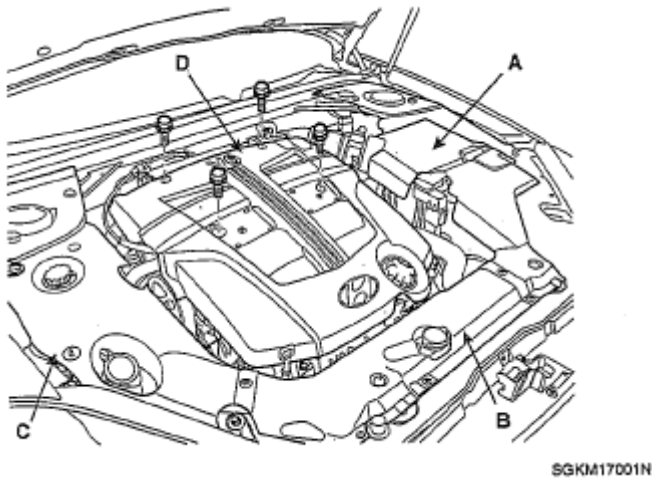
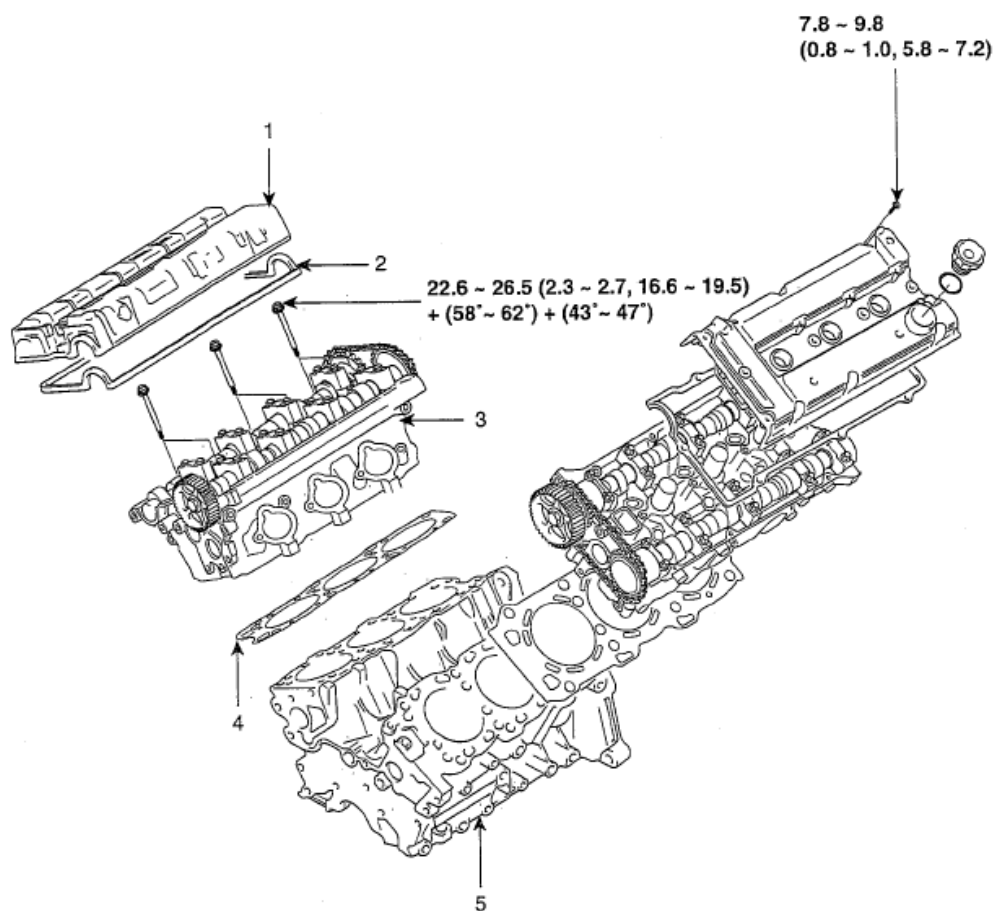


Fig. 57: Identifying Side Cover And Engine Cover

CYLINDER HEAD ASSEMBLY

COMPONENTS

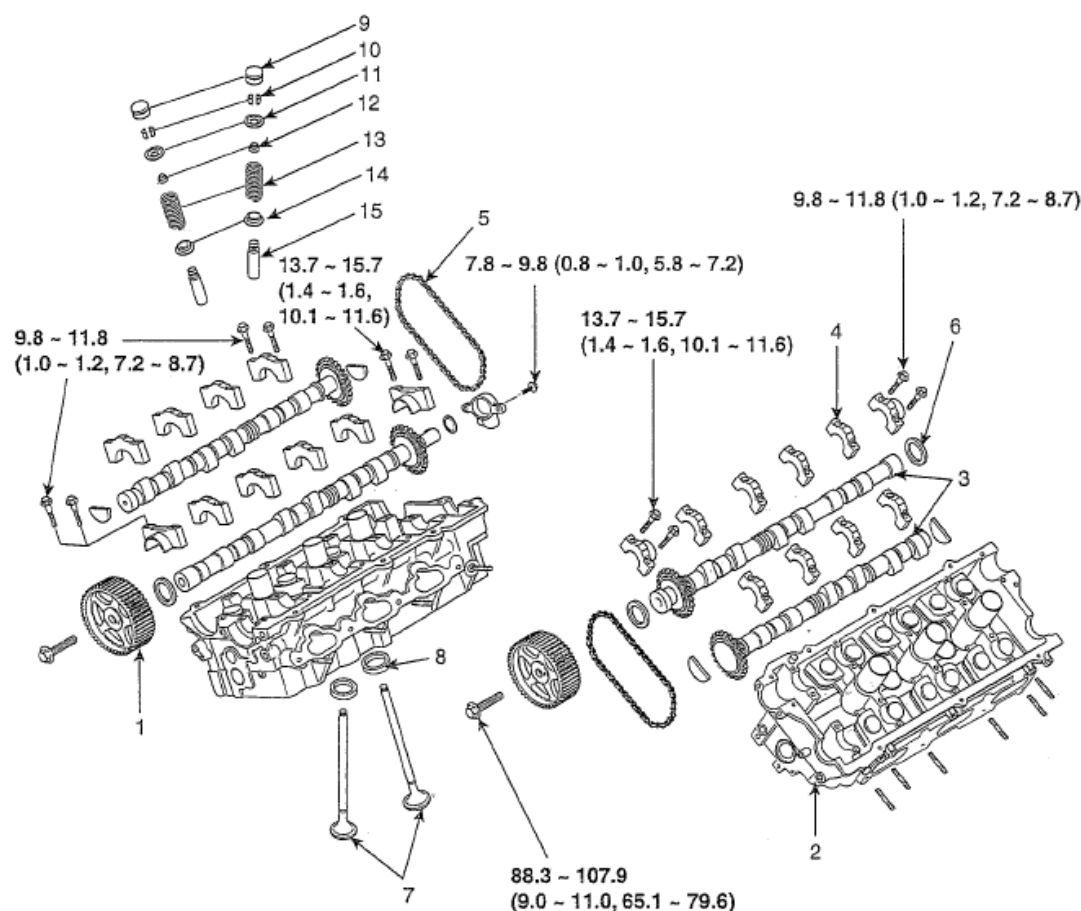


TORQUE : Nm (kgf.m, lb-ft)

- 1. Cylinder head cover
- 2. Gasket
- 3. Cylinder head

- 4. Cylinder head gasket
- 5. Cylinder block

Fig. 58: Identifying Cylinder Head Assembly Components With Torque Specifications (1 Of 2)



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

- | | |
|-------------------------|--------------------------------|
| 1. Camshaft sprocket | 9. HLA |
| 2. Cylinder head | 10. Valve spring retainer lock |
| 3. Camshaft | 11. Valve spring retainer |
| 4. Camshaft bearing cap | 12. Valve stem seal |
| 5. Timing chain | 13. Valve spring |
| 6. Oil seal | 14. Valve spring seat |
| 7. Valve | 15. Valve guide |
| 8. Valve seat | |

SGHM17409N

Fig. 59: Identifying Cylinder Head Assembly Components With Torque Specifications (2 Of 2)

REMOVAL

Engine removal is not required for this procedure.

CAUTION:

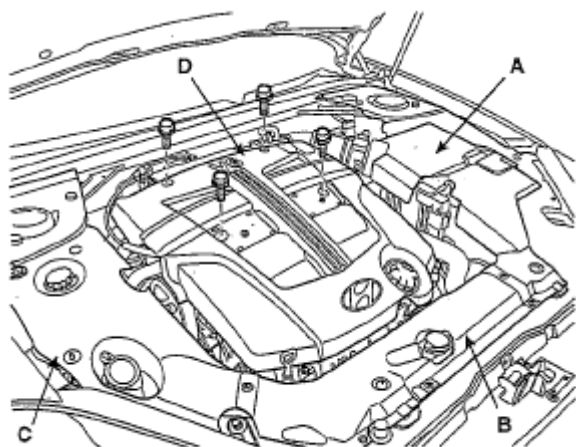
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.

- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE:

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

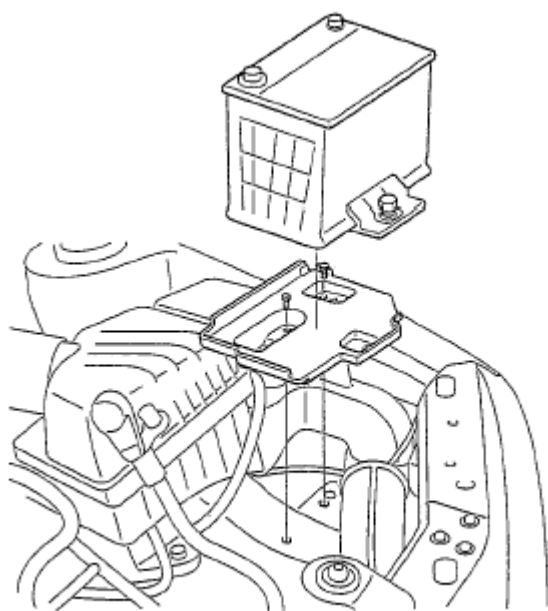
1. Remove the side cover(A, B, C) and the engine cover(D).



SGKM17001N

Fig. 60: Identifying Side Cover And Engine Cover

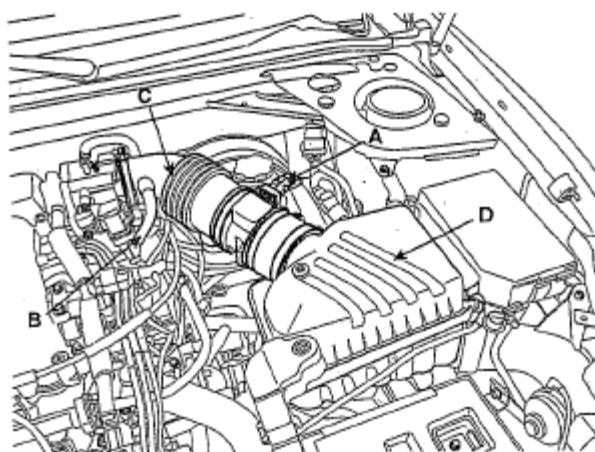
2. Disconnect the battery terminal and the battery.



ECKD201B

Fig. 61: Identifying Battery Terminal

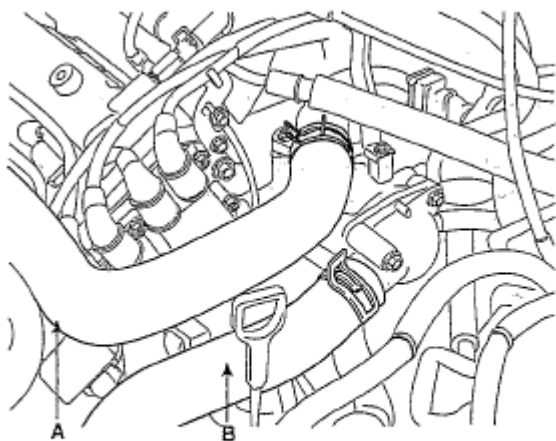
3. Remove the radiator cap to speed draining.
4. Remove the radiator drain plug and drain engine coolant.
5. Remove the air cleaner assembly.
 1. Disconnect the air flow sensor (AFS) connector (A).
 2. Remove the breather hose (B) from intake hose(C).
 3. Remove the intake hose (C) and air cleaner upper cover (D).
 4. Remove the air cleaner lower cover (A).



SGIKM17002N

Fig. 62: Identifying Air Flow Sensor Connector, Breather Hose, Intake Hose And Air Cleaner Upper Cover

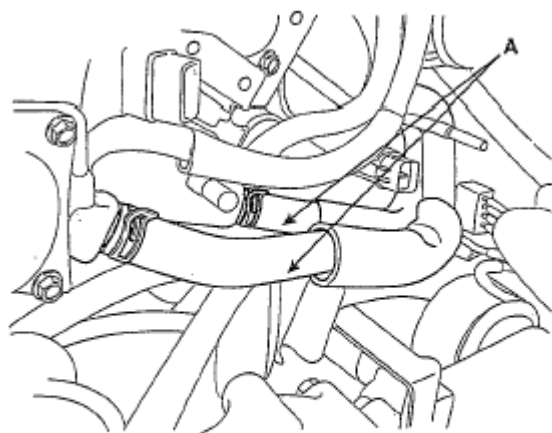
6. Remove the upper radiator hose(A) and lower radiator hose(B).



EDQF037A

Fig. 63: Identifying Upper And Lower Radiator Hose

7. Remove the heater hoses(A).



EDQF019A

Fig. 64: Identifying Heater Hoses

8. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
 1. Throttle position sensor (TPS) connector(A).
 2. Idle speed actuator (ISA) connector(B).
 3. Purge control solenoid valve(PCSV) connector(C).
 4. Injector connector(E).
 5. Knock sensor connector(F).
 6. Camshaft position sensor(CPS) connector(G).
 7. Engine ground line (F).
 8. Heated oxygen sensor (Bank 2, Sensor 1) connector (H).

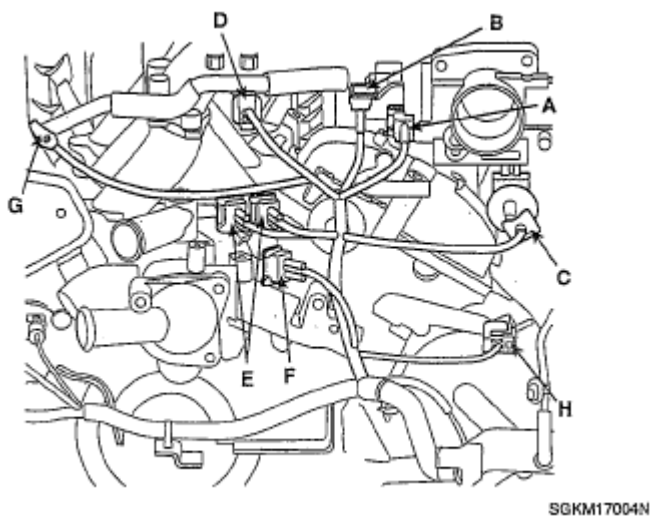


Fig. 65: Identifying TPS Connector, ISA Connector, PCSV Connector, Injector Connector And CPS Connector

9. Engine temperature coolant sensor connector(A).
10. Ignition coil connector (B).
11. Crankshaft position sensor connector (C).
12. Heated oxygen sensor (Bank 1, Sensor 2) connector (D).

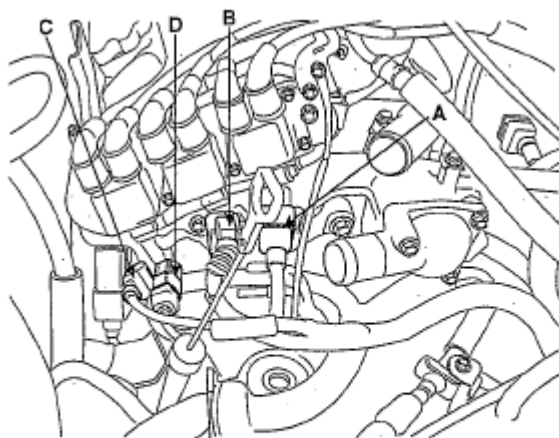
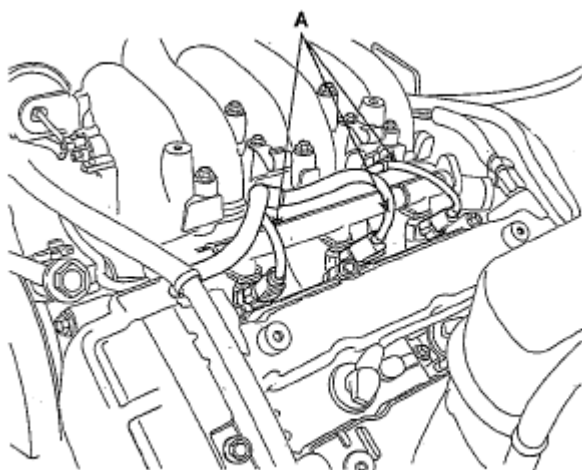


Fig. 66: Identifying Engine Temperature Coolant Sensor Connector, Heated Oxygen Sensor Connector And Ignition Coil Connector

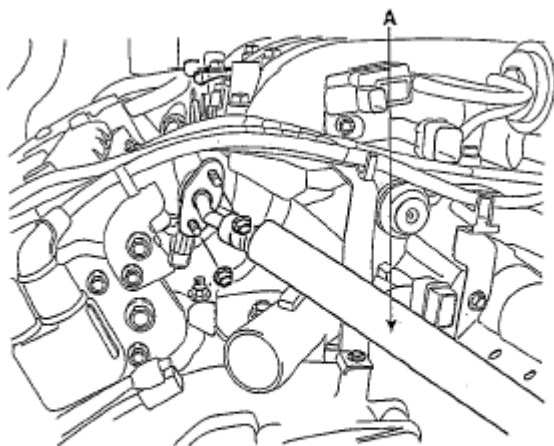
13. Three fuel injector connectors(A).



SGKM17401N

Fig. 67: Identifying Fuel Injector Connectors

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



EDQF025A

Fig. 68: Identifying Delivery Pipe

10. Disconnect the purge control solenoid valve (PCSV) hose (A).

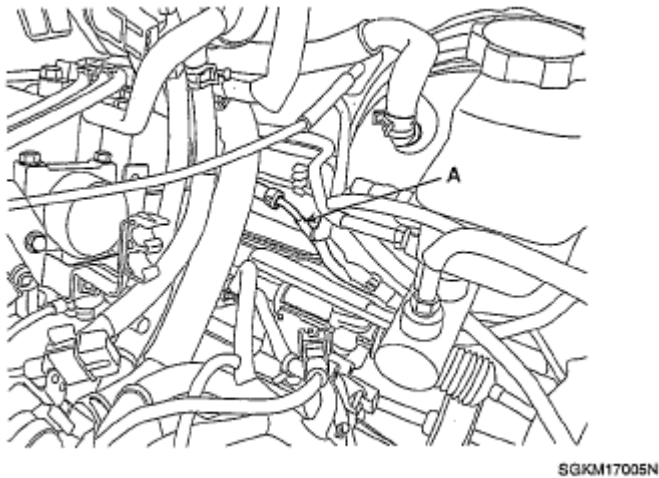


Fig. 69: Identifying Purge Control Solenoid Valve Hose

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

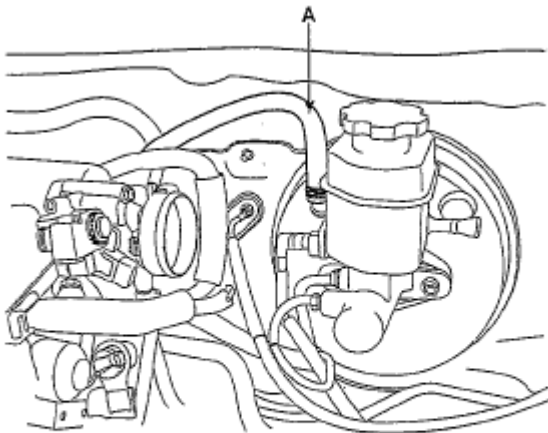


Fig. 70: Identifying Brake Booster Vacuum Hose

12. Remove the accelerator cable by loosening the lock-nut, then slip the cable end out of the throttle linkage.
13. Remove the auto-cruise connector (A) and the auto-cruise cable (B).

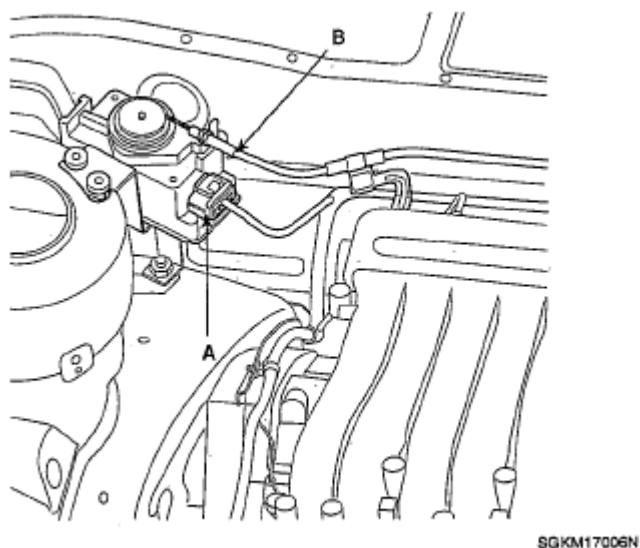


Fig. 71: Identifying Auto-Cruise Connector And Auto-Cruise Cable

14. Remove the PCV hose(A).

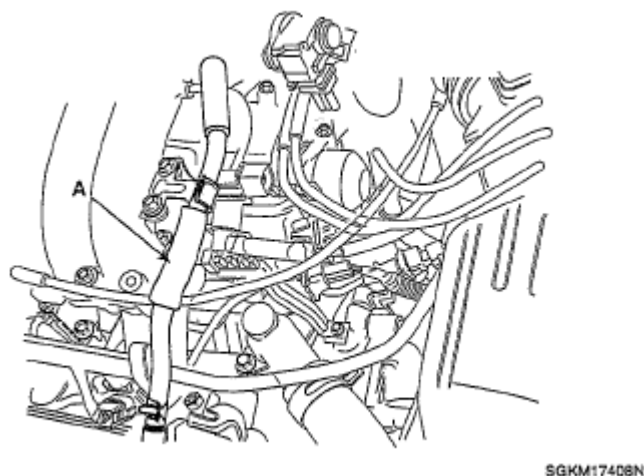
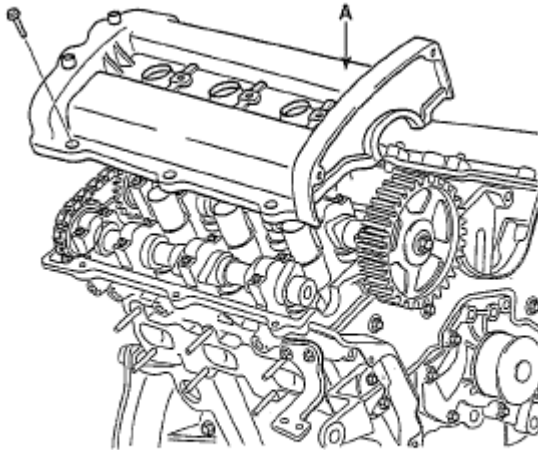


Fig. 72: Identifying PCV Hose

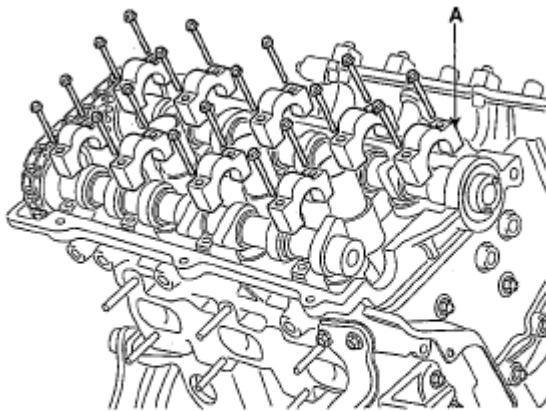
15. Remove the intake manifold. (Refer to **INTAKE MANIFOLD**).
16. Remove the power steering pump. (Refer to **POWER STEERING OIL PUMP**).
17. Remove the exhaust manifold. (Refer to **EXHAUST MANIFOLD**).
18. Remove the timing belt. (Refer to **TIMING BELT**)
19. Remove the spark plug cable. (Refer to **IGNITION SYSTEM**).
20. Remove the cylinder head covers(A).



EDQF050A

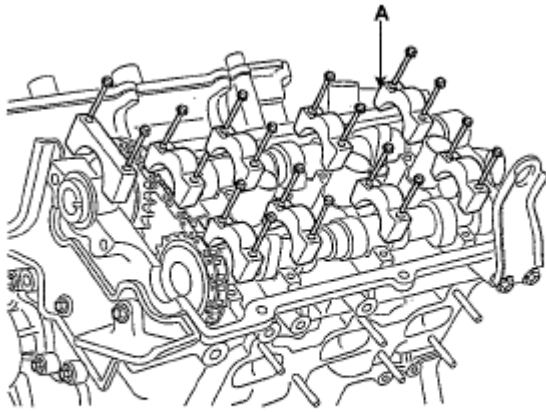
Fig. 73: Identifying Cylinder Head Cover

21. Remove the camshaft sprocket.
22. Remove the camshaft bearing caps(A).



EDQF053A

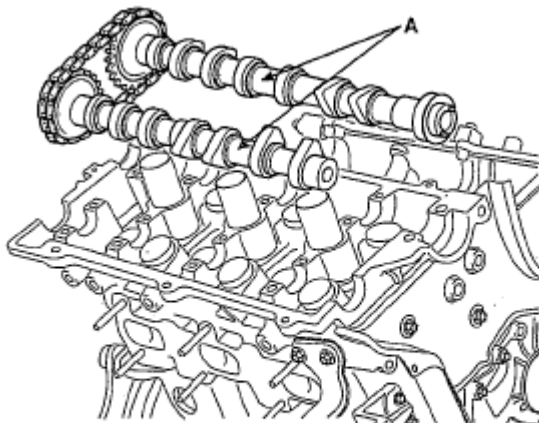
Fig. 74: Identifying Camshaft Bearing Caps (1 Of 2)



EDQF055A

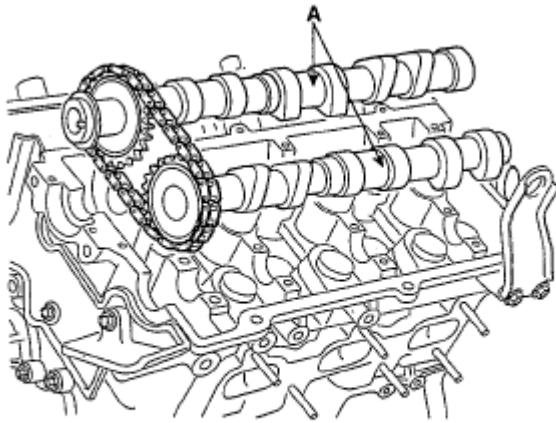
Fig. 75: Identifying Camshaft Bearing Caps (2 Of 2)

23. Remove the camshafts(A).



EDQF054A

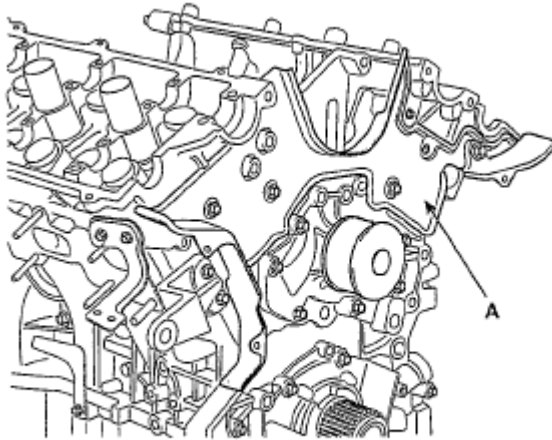
Fig. 76: Identifying Camshafts (1 Of 2)



EDQF056A

Fig. 77: Identifying Camshafts (2 Of 2)

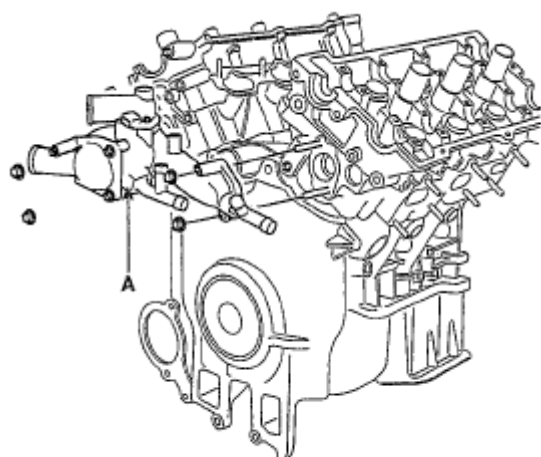
24. Remove the timing belt rear cover(A).



EDQF057A

Fig. 78: Identifying Timing Belt Rear Cover

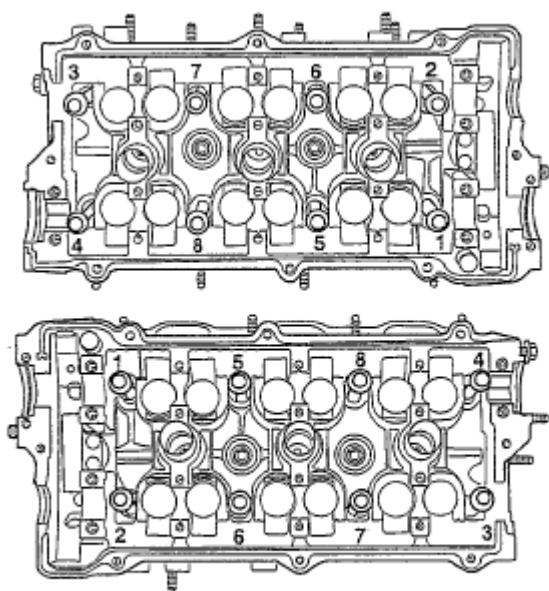
25. Remove the water temperature control assembly(A) and water pipe.



EDQF058A

Fig. 79: Identifying Water Temperature Control Assembly

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



EDQF166A

Fig. 80: Identifying Removal Sequence Of Cylinder Head Bolts

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

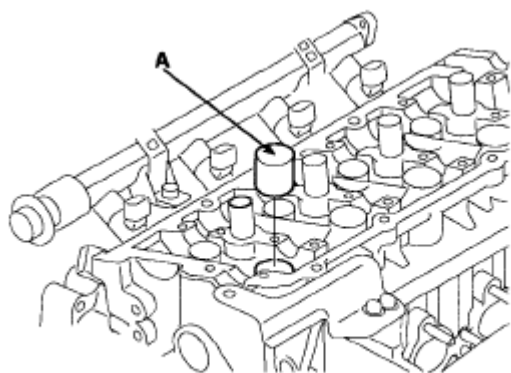
2. Lift the cylinder head from the dowels on the cylinder block and place the cylinder head on wooden blocks on a bench.

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

DISASSEMBLY

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

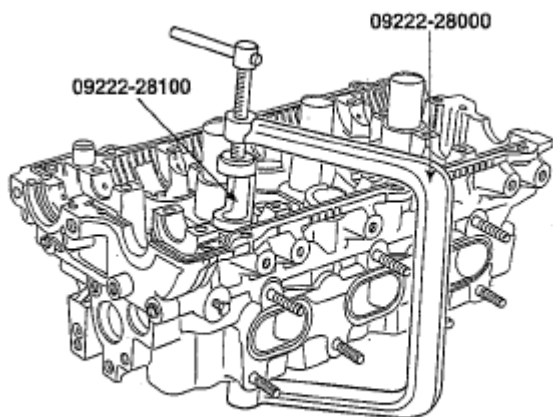
1. Remove HLAs(A).



ECKD217A

Fig. 81: Identifying Hydraulic Lash Adjuster

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



EDQF169A

Fig. 82: Compressing Valve Spring And Removing/Installing Retainer Lock

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

INSPECTION

CLEANING

1. Clean top surfaces of pistons and cylinder block.
 1. Turn the crankshaft, and bring each piston to top dead center(TDC).

Using a gasket scraper, remove all the carbon from the piston top surface.

2. Using a gasket scraper, remove all the gasket material from the cylinder block surface.
 3. Using compressed air, blow, carbon and oil from the bolt holes.
2. Remove gasket material.

Using a gasket scraper, remove all the gasket material from the cylinder block contact/surface.

CAUTION: Be careful not to scratch the cylinder block contact surface.

3. Clean combustion chambers.

Using a wire brush, remove all the carbon from the combustion chambers.

CAUTION: Be careful not to scratch the cylinder block contact surface.

4. Clean cylinder heads.

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

5. Clean valves.
 1. Using a gasket scraper, chip off any carbon from the valve head.
 2. Using a wire brush thoroughly clean the valve.

CYLINDER HEAD

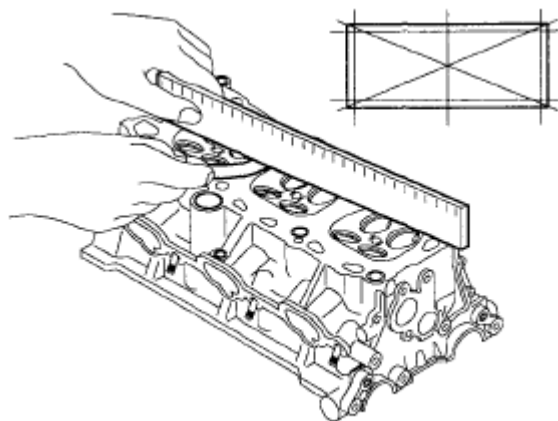
1. Inspect for flatness.

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

Flatness of cylinder head gasket surface

Standard: Less than 0.03mm(0.0012 in.)

Limit: 0.05 mm (0.0020 in.)



EDQF160A

Fig. 83: Checking Flatness Of Cylinder Head Gasket Surface

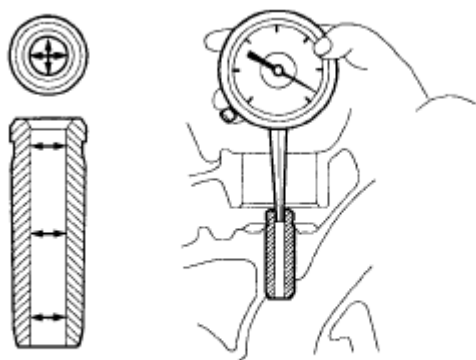
2. Inspect for cracks.

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

VALVE AND VALVE SPRING

1. Inspect valve stems and valve guides.

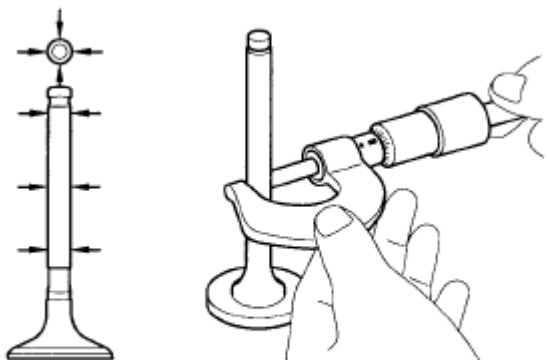
1. Using a caliper gauge, measure the inside diameter of the valve guide. Valve guide inside.



ECKD219A

Fig. 84: Measuring Inside Diameter Or Valve Guide

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



ECKD220A

Fig. 85: Measuring Diameter Of Valve Stem

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

Valve stem-to-guide clearance

[Standard]

Intake: 0.02 ~ 0.05mm (0.0008 ~ 0.0020in.)

Exhaust: 0.035 ~ 0.065mm (0.0014 ~ 0.0026in.)

[Limit]

Intake: 0.1mm (0.0040in.)

Exhaust: 0.13mm (0.0051 in.)

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

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

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

Margin

[Standard]

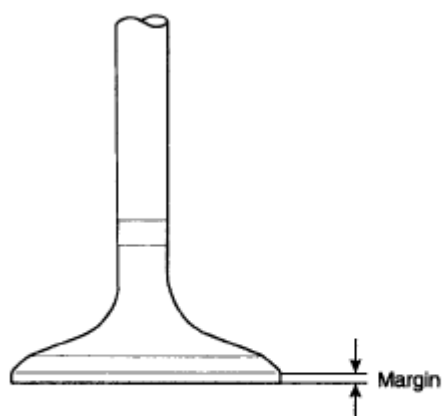
Intake: 1.0mm (0.0394in.)

Exhaust: 1.3mm (0.0512in.)

[Limit]

Intake: 0.5mm (0.0197in.)

Exhaust: 0.8mm (0.0315in.)



ECKD221A

Fig. 86: Identifying Valve Head Margin Thickness

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

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

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

Valve spring

[Standard]

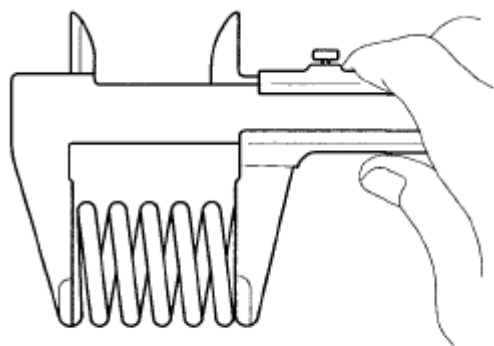
Free height: 42.5mm (1.6732in.)

Load: 21.9kg/35mm (48.3kg/1.378mm)

[Limit]

Free height: -1.0mm (-0.0394 in.)

Out-of-square: 3°



ECKD222A

Fig. 87: Measuring Free Length Of Valve Spring

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

CAMSHAFT

1. Inspect cam lobes.

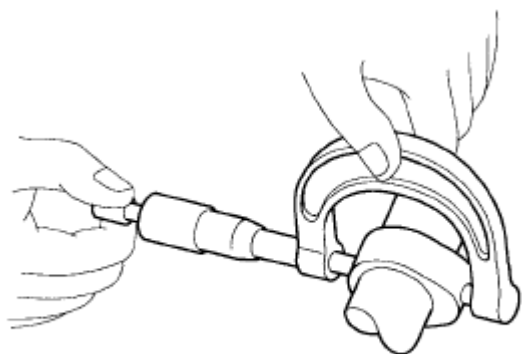
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake: 43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)

Exhaust: 43.95 ~ 44.15mm (1.7303 ~ 1.7382in.)



ECKD223A

Fig. 88: Measuring Cam Lobe Height

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

2. Inspect cam journals.

Using a micrometer, measure the journal diameter.

Journal diameter

Standard value

25.964 ~ 25.980mm (1.0222 ~ 1.0228in.)

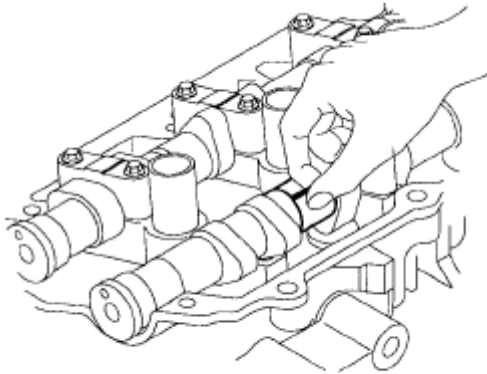
If the journal diameter is not as specified, check the oil clearance.

3. Inspect camshaft bearings.

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

4. Inspect camshaft journal oil clearance.

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



ECKD224A

Fig. 89: Measuring Journal Diameter

4. Install the bearing caps.

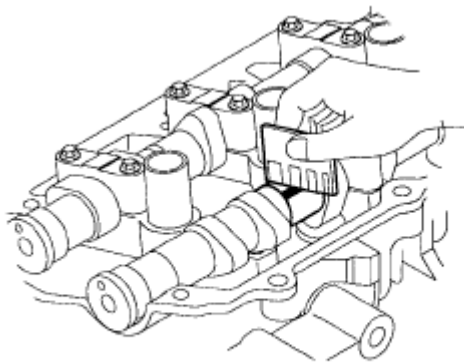
CAUTION: Do not turn the camshaft.

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

Bearing oil clearance

Standard value: 0.02 ~ 0.057mm (0.0008 ~ 0.0022in.)

Limit: 0.1mm (0.0039in.)



ECKD225A

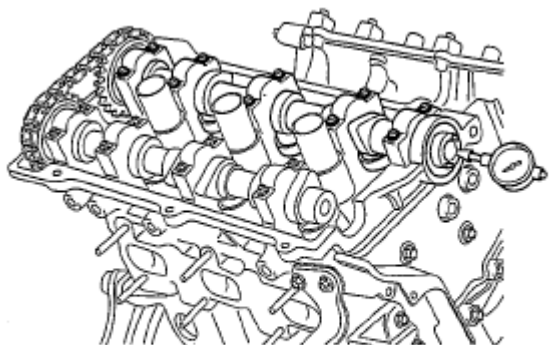
Fig. 90: Measuring Plastigage

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

7. Completely remove the plastigage.
8. Remove the camshafts.
5. Inspect camshaft end play.
 1. Install the camshafts.
 2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

Standard value: 0.1 ~ 0.2mm (0.004 ~ 0.0079in.)



EDGF063B

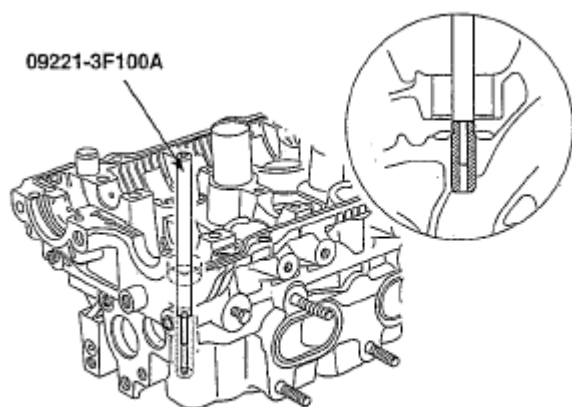
Fig. 91: Checking Camshaft End Play

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

3. Remove the camshafts.

REPLACEMENT**VALVE GUIDE**

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



SGKM17410N

Fig. 92: Removing Valve Guide

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

VALVE GUIDE SPECIFICATION

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

Valve guide length

Intake: 39mm (1.535in.)

Exhaust: 41.5mm (1.6339in.)

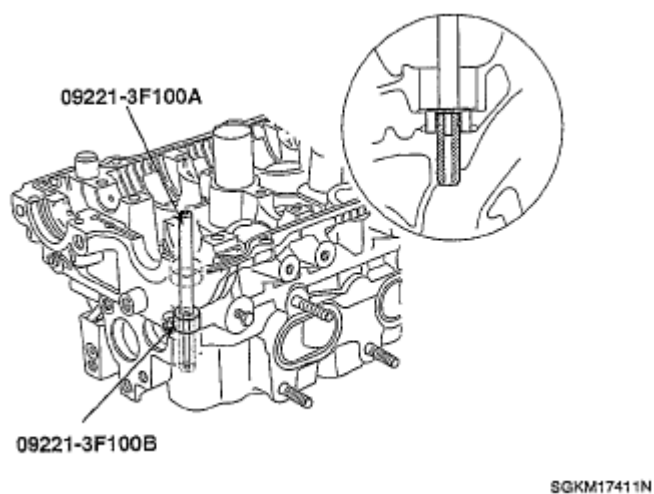


Fig. 93: Installing Valve Guide

4. After the valve guide is press-fitted, insert a new valve and check for proper stem-to-guide clearance.
5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

REASSEMBLY

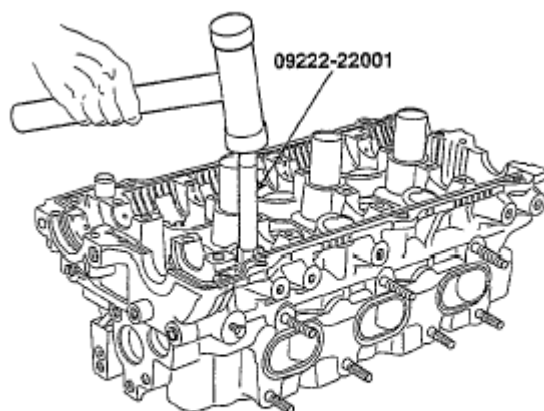
NOTE: Thoroughly clean all parts to be assembled.

Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.

Replace oil seals with new ones.

1. Install valves.
 1. Install the spring seats.
 2. Using SST(0922-2-22001), push in a new oil seal.

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



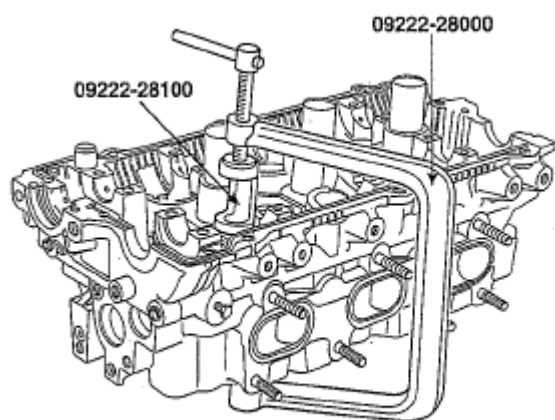
EDQF167A

Fig. 94: Installing Oil Seal

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

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

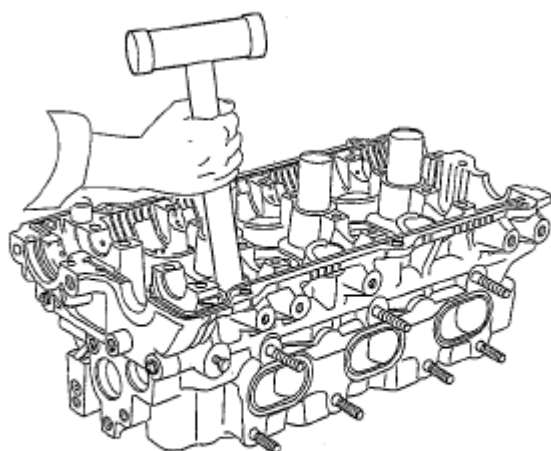
4. Using the SST(09222-28000, 09222-28100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



EDQF169A

Fig. 95: Compressing Valve Spring And Removing/Installing Retainer Lock

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

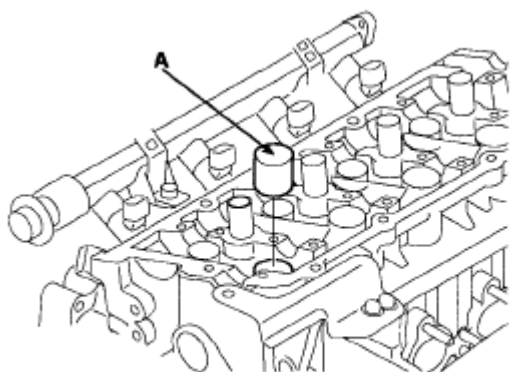


EDQF168A

Fig. 96: Tapping End Of Valve Stem

2. Install HLAs.

Check that the HLA rotates smoothly by hand.



ECKD217A

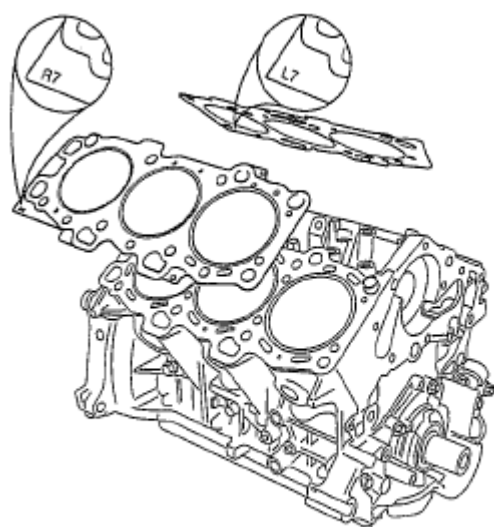
Fig. 97: Identifying Hydraulic Lash Adjuster

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 gaskets on the cylinder block.



EDQF170A

Fig. 98: Identifying Cylinder Head Gaskets

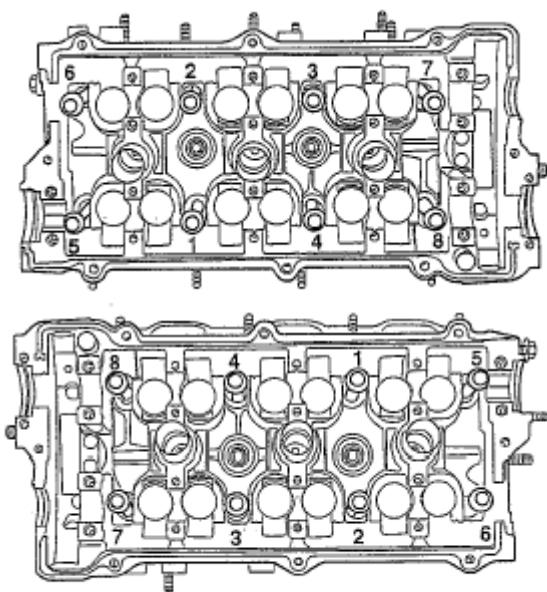
NOTE: Be careful of the installation direction.

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

Tightening torque

24.5Nm (2.5kgf.m, 18.1 lb-ft) + 60° + 45°

1. Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
2. Install the plate washer to the cylinder head bolt.
3. Install and uniformly tighten the cylinder head bolts on each cylinder head in several passes and in the sequence shown, then repeat for the other side, as shown.

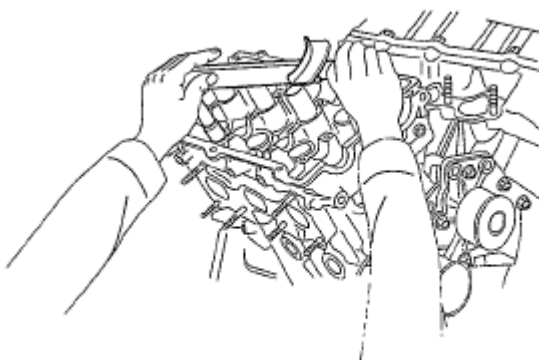


EDQF166B

Fig. 99: Identifying Tightening Sequence Of Cylinder Head Bolts

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

Torque: 24.5Nm (2.5kgf.m, 18.1lb-ft)



EDQF156A

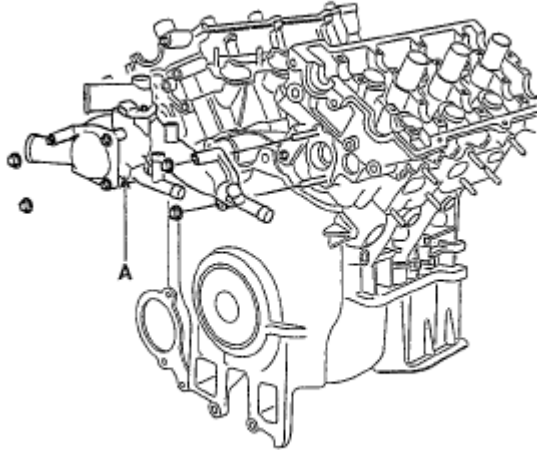
Fig. 100: Tightening Cylinder Head Bolts

4. Retighten the cylinder head bolts by 60° in the numerical order shown.
5. Retighten the cylinder head bolts by 45° in the numerical order shown.
4. Install the water pipe and water temperature control assembly(A).

Tightening torque

Water temperature control

14.7 ~ 19.6Nm (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)



EDQF058A

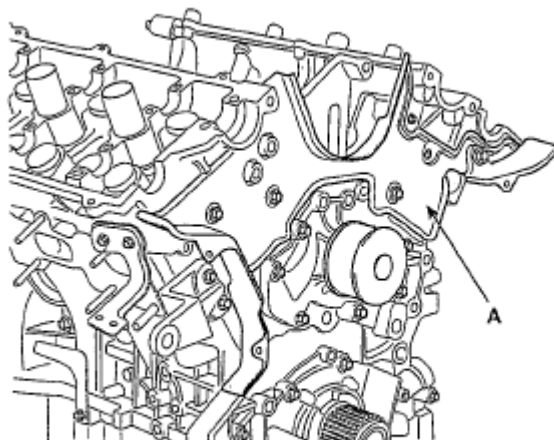
Fig. 101: Identifying Water Temperature Control Assembly

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

Tightening torque

Timing belt rear cover

9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

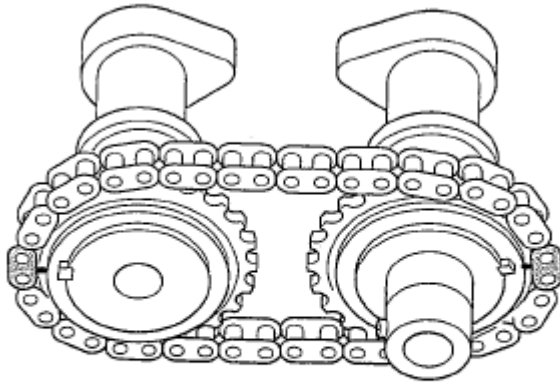


EDQF057A

Fig. 102: Identifying Timing Belt Rear Cover

6. Install the camshafts.

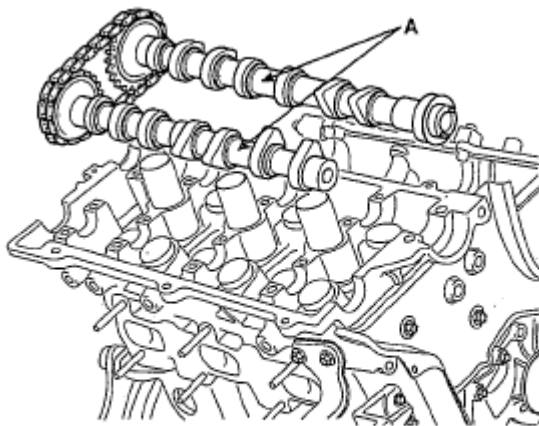
1. Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown.



EDQF165A

Fig. 103: Identifying Camshaft Timing Chain And Timing Chain Sprocket

2. Install the camshaft(A).



EDQF054A

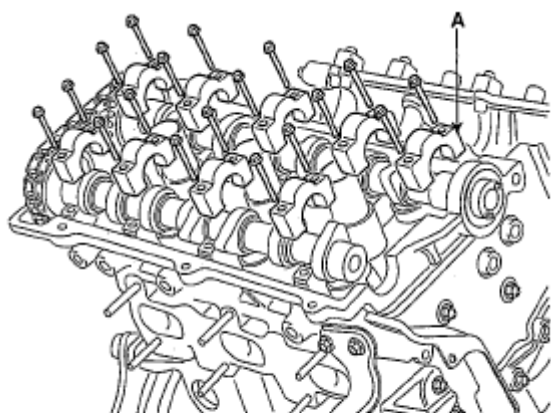
Fig. 104: Identifying Camshaft

3. Install the camshaft bearing caps(A).

Tightening torque

M6(38mm): 9.8 ~ 12.7Nm (1.0 ~ 1.3kgf.m, 7.2 ~ 9.4lb-ft)

M6(50mm): 14.7 ~ 16.7Nm (1.5 ~ 1.7kgf.m, 10.8 ~ 12.3lb-ft)



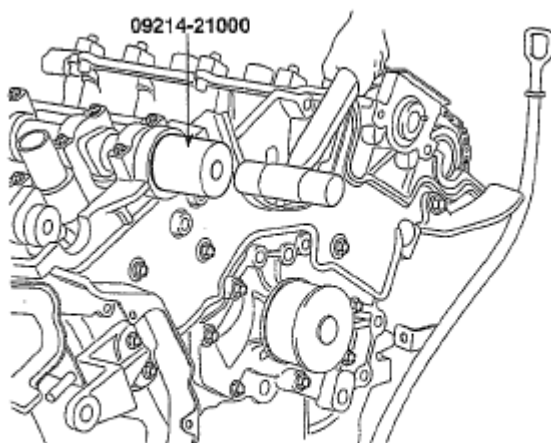
EDQF053A

Fig. 105: Identifying Camshaft Bearing Caps

NOTE:

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

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



EDQF052A

Fig. 106: Installing Camshaft Bearing Oil Seal

8. Install the camshaft sprocket.
1. Temporarily install the camshaft sprocket bolts.
 2. Hold the hexagonal head wrench portion of the camshaft with a wrench, and tighten the camshaft

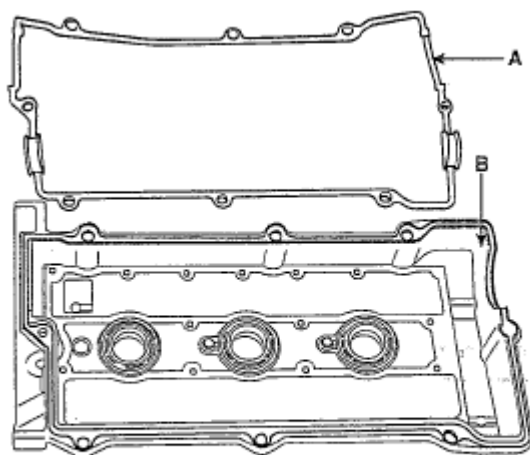
sprocket bolts.

Tightening torque

Camshaft sprocket bolt

88.3 ~ 107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79: 6lb-ft)

9. Install semi-circular packing.
10. Install the cylinder head cover.
 1. Install the cylinder head cover gasket(A) in the groove of the cylinder head cover(B).



EDQF171A

Fig. 107: Identifying Cylinder Head Cover Gasket And Cylinder Head Cover

NOTE:

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

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

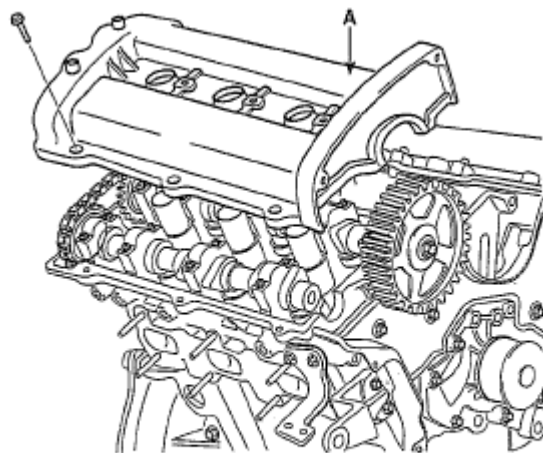
NOTE:

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

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

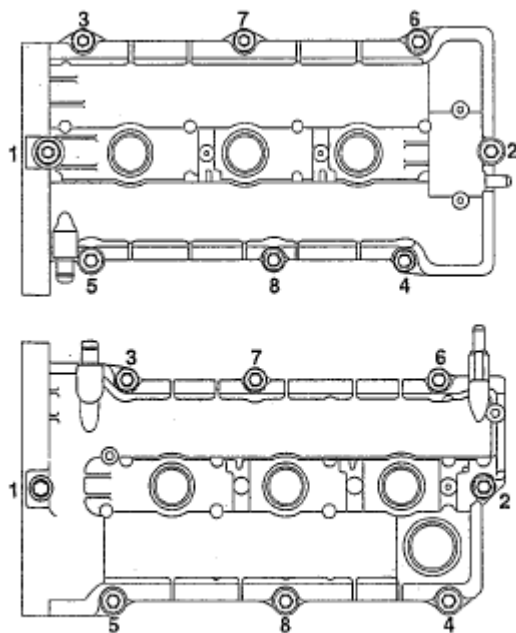
Tightening torque

7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



EDQF050A

Fig. 108: Identifying Cylinder Head Cover

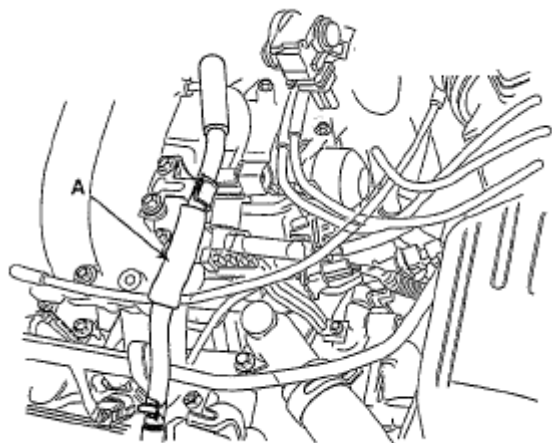


EDQF172A

Fig. 109: Identifying Tightening Sequence Of Cylinder Head Cover Bolts

11. Install the spark plug cable. (Refer to **IGNITION SYSTEM**).
12. Install the timing belt. (Refer to **TIMING SYSTEM**).

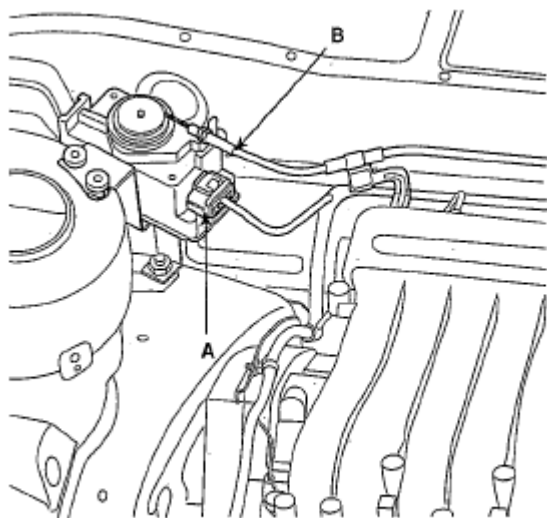
13. Install the exhaust manifold. (Refer to **EXHAUST MANIFOLD**).
14. Install the power steering pump. (Refer to **POWER STEERING OIL PUMP**).
15. Install the intake manifold. (Refer to **INTAKE MANIFOLD**).
16. Install the PCV hose(A).



SGKM17406N

Fig. 110: Identifying PCV Hose

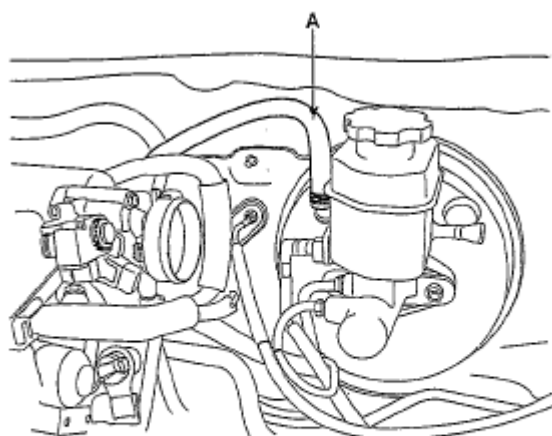
17. Connect the auto-cruise connector (A) and the auto-cruise cable (B).



SGKM17006N

Fig. 111: Identifying Auto-Cruise Connector And Auto-Cruise Cable

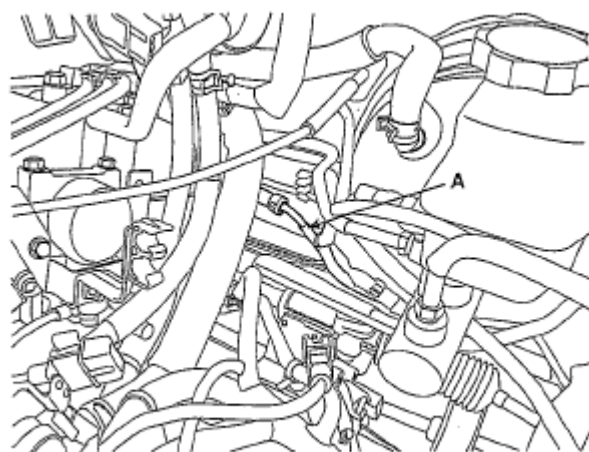
18. Install the accelerator cable by loosening the locknut, then slip the cable end out of the throttle linkage.
19. Remove the brake booster vacuum hose(A).



EDQF026A

Fig. 112: Identifying Brake Booster Vacuum Hose

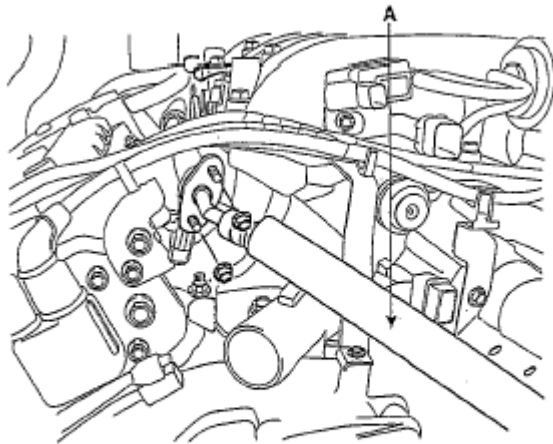
20. Disconnect the purge control solenoid valve (PCSV) hose (A).



SGKM17005N

Fig. 113: Identifying Purge Control Solenoid Valve Hose

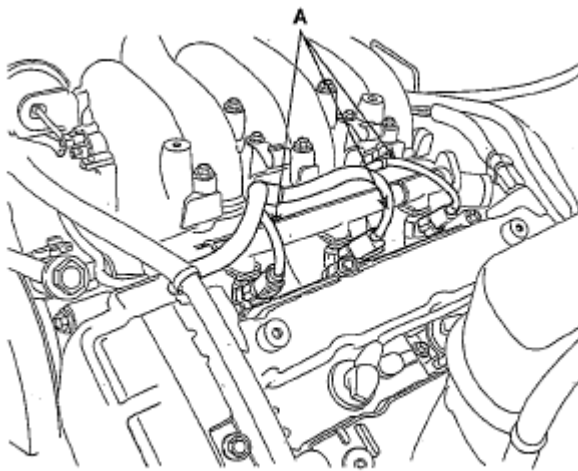
21. Remove the fuel inlet from delivery pipe(A).



EDQF025A

Fig. 114: Identifying Delivery Pipe

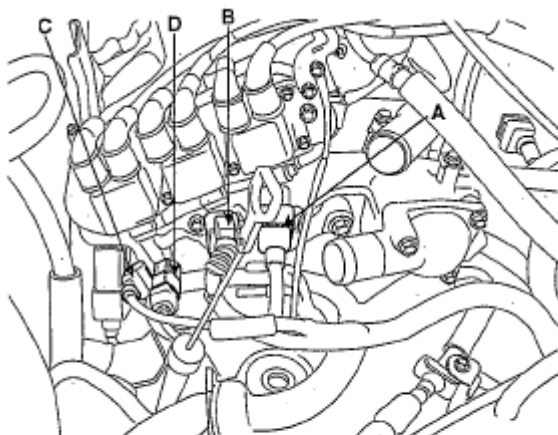
1. Three fuel injector connectors(A).



SGKM17401N

Fig. 115: Identifying Fuel Injector Connectors

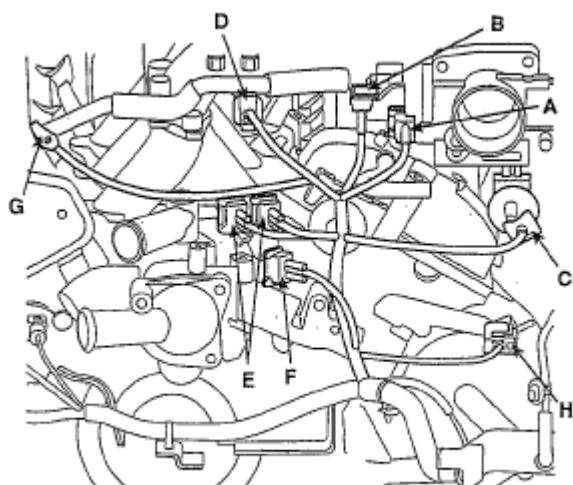
2. Heated oxygen sensor (Bank 1, Sensor 2) connector (D).
3. Crankshaft position sensor connector (C).
4. Ignition coil connector (B).
5. Engine temperature coolant sensor connector(A).



EDQF033A

Fig. 116: Identifying Engine Temperature Coolant Sensor Connector, Heated Oxygen Sensor Connector And Ignition Coil Connector

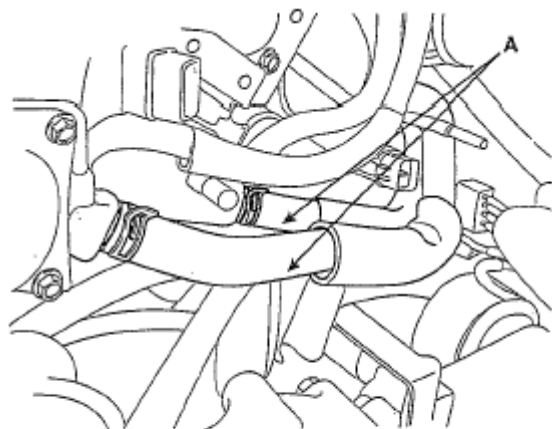
6. Heated oxygen sensor (Bank 2, Sensor 1) connector (H).
7. Engine ground line (F).
8. Camshaft position sensor(CPS) connector(G).
9. Knock sensor connector(F).
10. Injector connector(E).
11. Purge control solenoid valve(PCSV) connector(C).
12. Idle speed actuator (ISA) connector(B).
13. Throttle position sensor (TPS) connector(A).
22. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.



SGKM17004N

Fig. 117: Identifying TPS Connector, ISA Connector, PCSV Connector, Injector Connector And CPS Connector

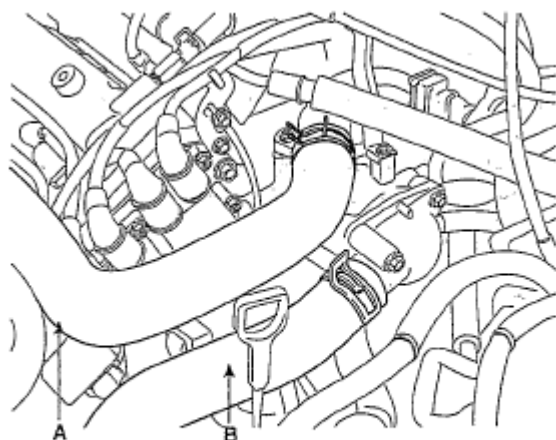
23. Remove the heater hoses(A).



EDQF019A

Fig. 118: Identifying Heater Hoses

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

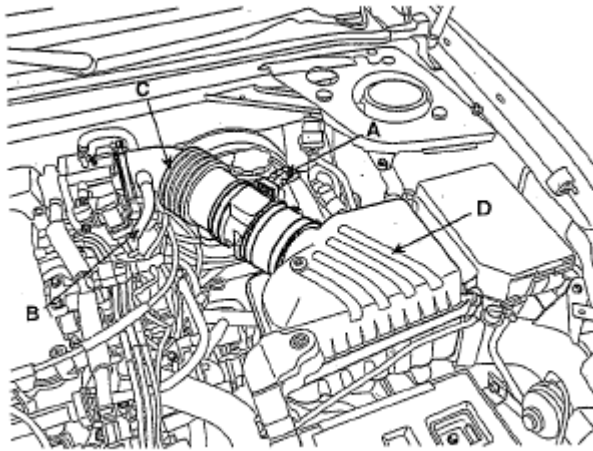


EDQF037A

Fig. 119: Identifying Upper And Lower Radiator Hose

25. Remove the air cleaner assembly.
1. Remove the air cleaner lower cover (A).
 2. Remove the intake hose (C) and air cleaner upper cover (D).
 3. Remove the breather hose (B) from intake hose(C).

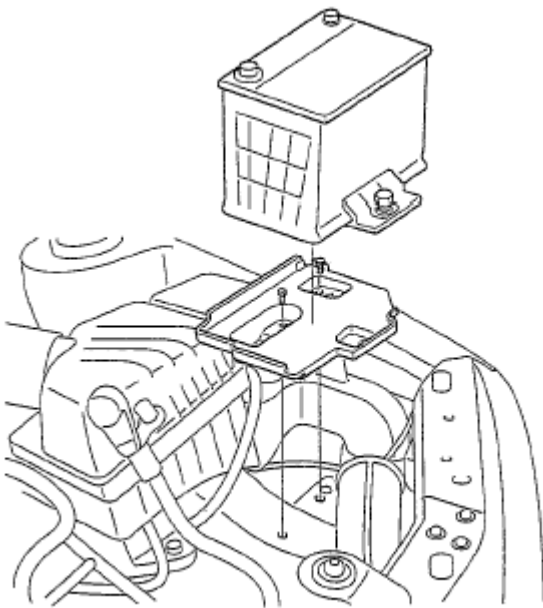
4. Disconnect the air flow sensor (AFS) connector (A).



SGKM17002N

Fig. 120: Identifying Air Flow Sensor Connector, Breather Hose, Intake Hose And Air Cleaner Upper Cover

26. Disconnect the battery terminal and the battery.



ECKD201B

Fig. 121: Identifying Battery Terminal

27. Remove the side cover(A, B, C) and the engine cover(D).

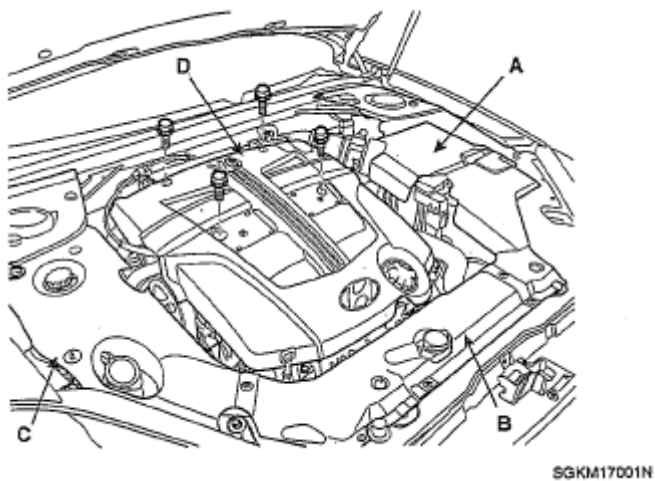
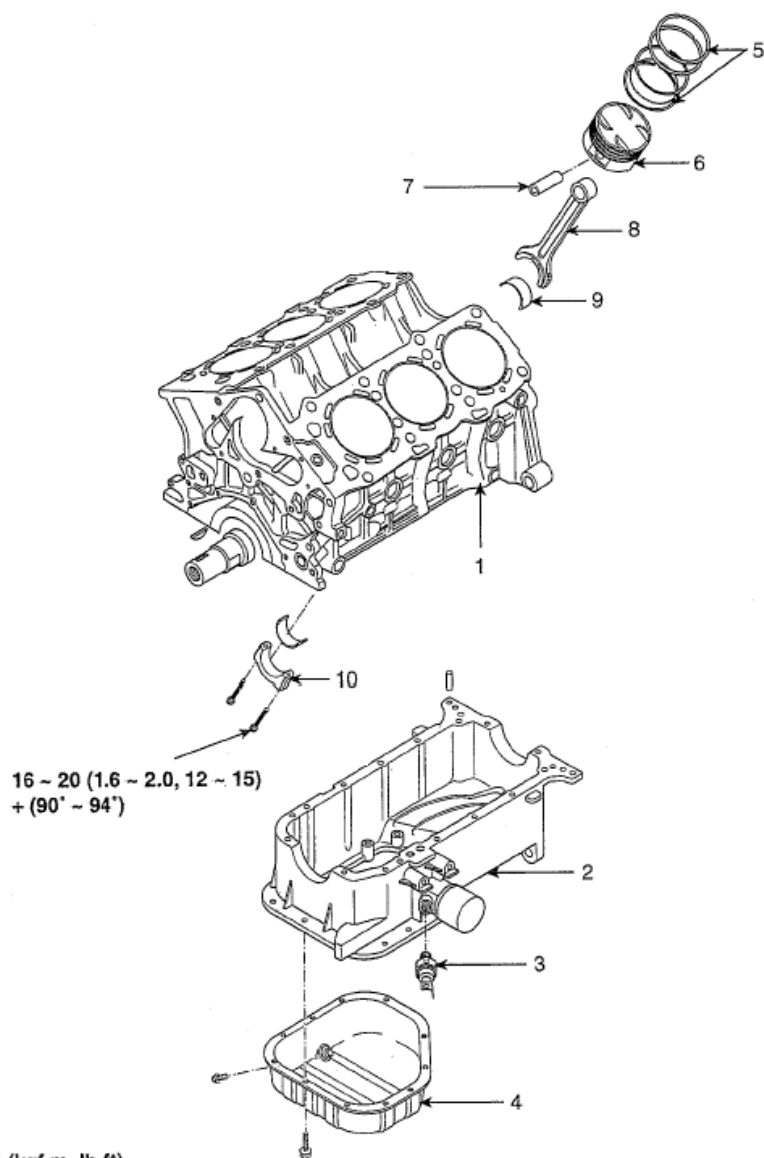


Fig. 122: Identifying Side Cover And Engine Cover

ENGINE BLOCK

COMPONENTS



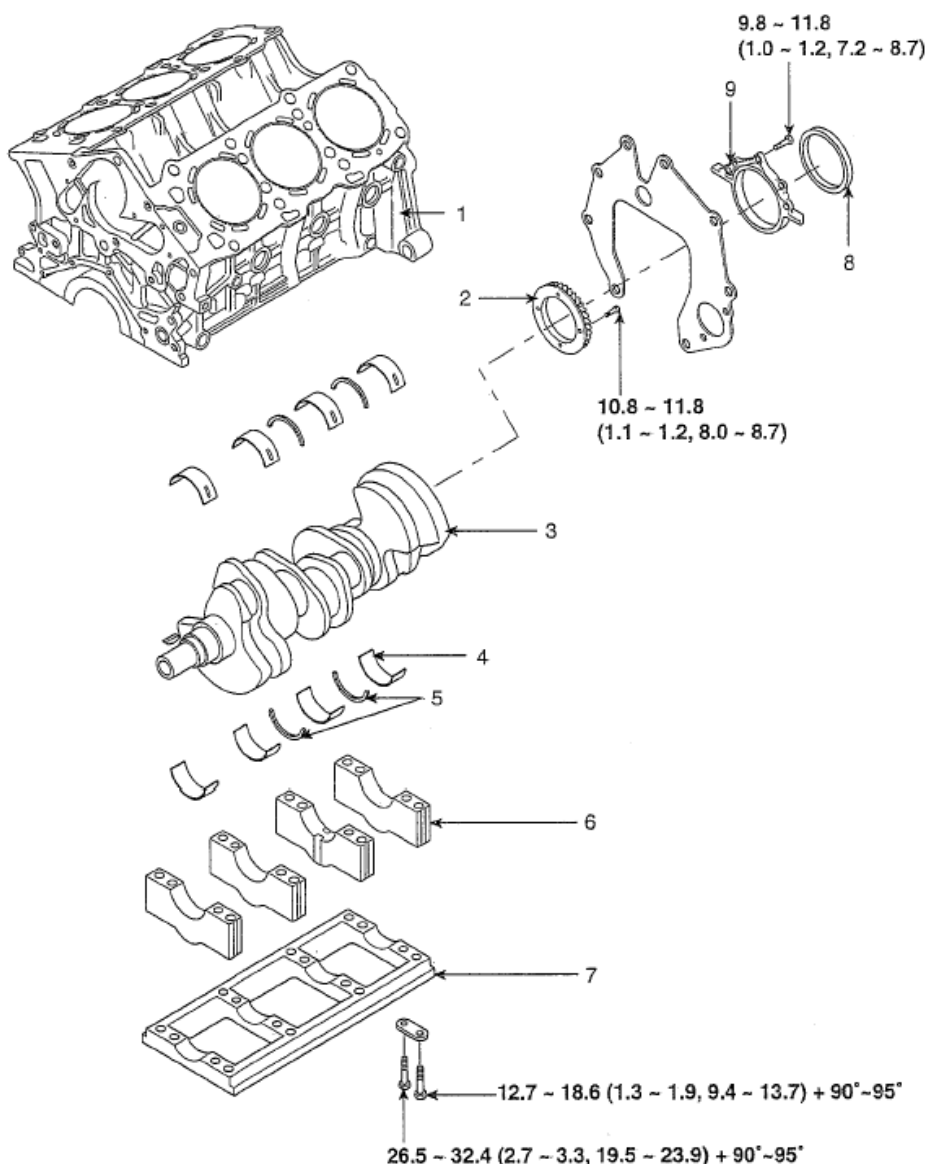
TORQUE : Nm (kgf.m, lb-ft)

- 1. Cylinder block
- 2. Upper oil pan
- 3. Oil pressure switch
- 4. Lower oil pan
- 5. Piston ring

- 6. Piston
- 7. Piston pin
- 8. Connecting rod
- 9. Connecting rod bearing
- 10. Bearing cap

SJMEM7004N

Fig. 123: Identifying Engine Block Components With Torque Specifications (1 Of 2)



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

1. Cylinder block
2. Crankshaft position sensor wheel
3. Crankshaft

4. Main bearing
5. Thrust bearing
6. Main bearing cap

7. Bearing cap bridge
8. Oil seal
9. Oil seal case

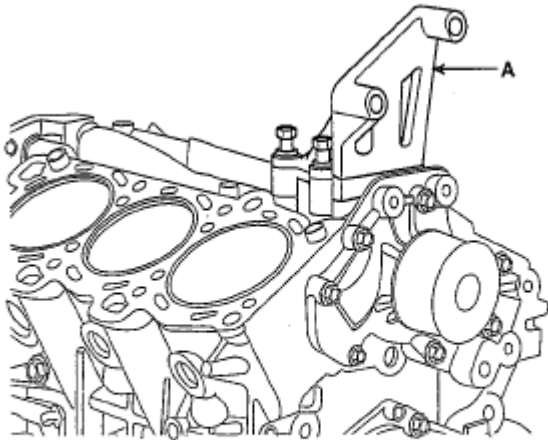
SGKM17412N

Fig. 124: Identifying Engine Block Components With Torque Specifications (2 Of 2)

DISASSEMBLY

1. A/T: remove drive plate.
2. Install engine to engine stand for disassembly(A).
3. Remove timing belt.
4. Remove cylinder head.
5. Remove oil level gauge assembly.

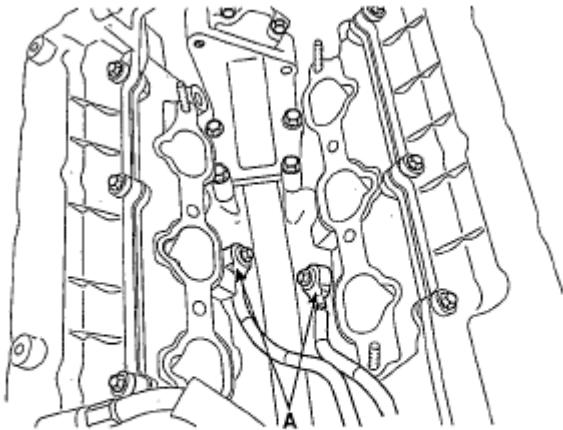
6. Remove the alternator.
7. Remove the air compressor.
8. Remove the power steering pump bracket(A).



EDQF061A

Fig. 125: Identifying Power Steering Pump Bracket

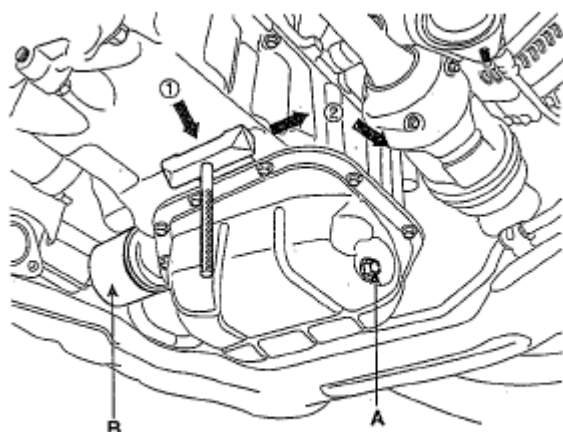
9. Remove water pump.
10. Remove knock sensors(A).



EDQF181A

Fig. 126: Identifying Knock Sensors

11. Remove the lower oil pan(A).



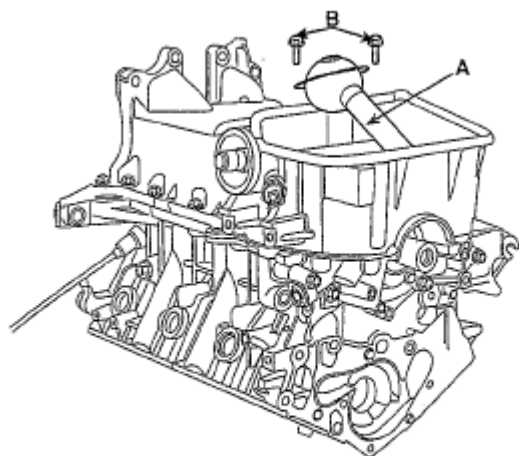
SGKM17416N

Fig. 127: Removing Lower Oil Pan**CAUTION:**

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of 1 arrow.
- After tapping the SST with a plastic hammer along the direction of 2 arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST abruptly without tapping. It is result in damage of the SST.

12. Remove oil screen.

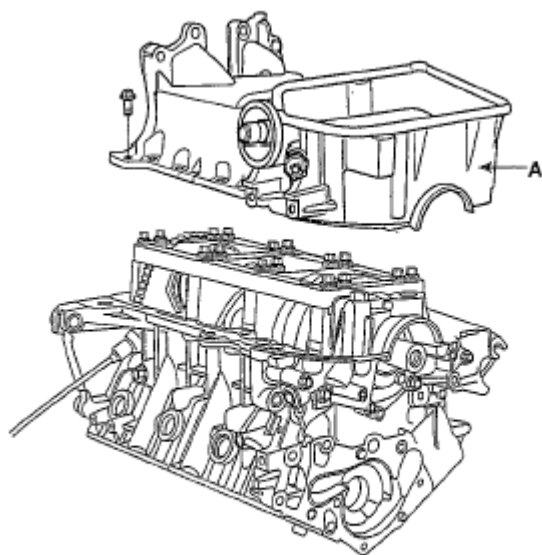
Remove the 2 bolts(B), oil screen(A) and gasket.



EDQFD66A

Fig. 128: Identifying Oil Screen Bolts

13. Remove the upper oil pan(A).



EDQF067A

Fig. 129: Identifying Upper Oil Pan

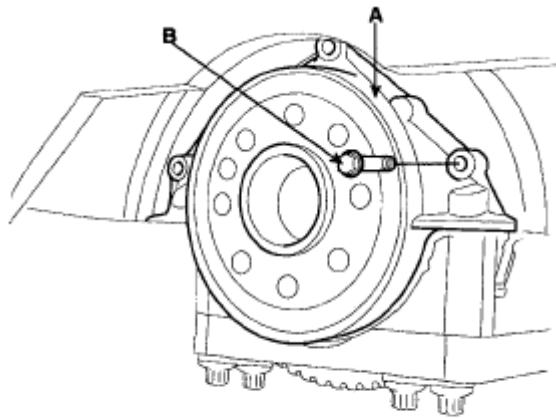
14. Check the connecting rod end play.
15. Remove the connecting rod caps and check oil clearance.
16. Remove piston and connecting rod assemblies.
1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTE:

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

17. Remove front case.
18. Remove oil seal case.

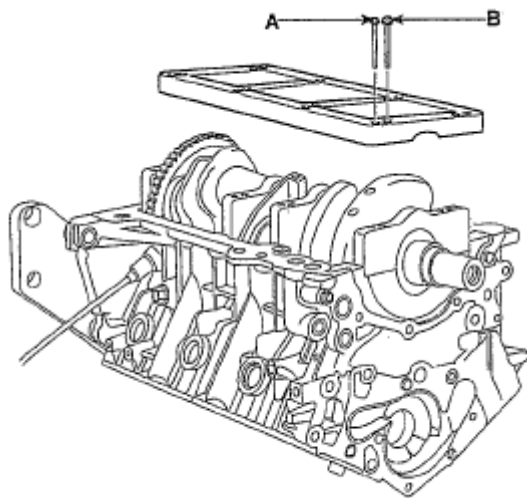
Remove the 3 bolts(B) and oil seal case(A).



EDQF174B

Fig. 130: Identifying Oil Seal Case Bolts

19. Check the crankshaft end play.
20. Remove crankshaft bearing cap and check oil clearance.

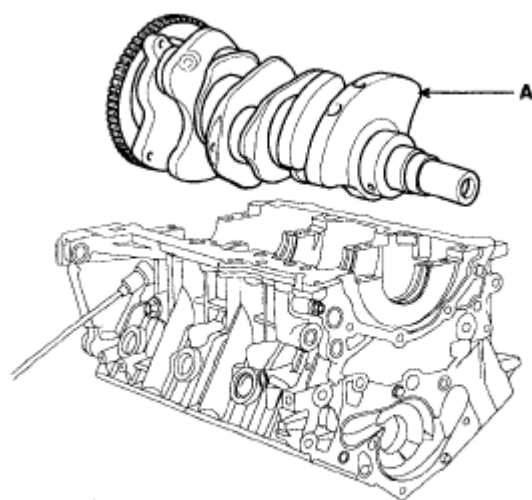


EDQF072A

Fig. 131: Identifying Crankshaft Bearing Cap Bolts

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

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



EDQF074A

Fig. 132: Identifying Crankshaft

22. Check fit between piston and piston pin.

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

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

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

24. Disconnect connecting rod from piston.

INSPECTION

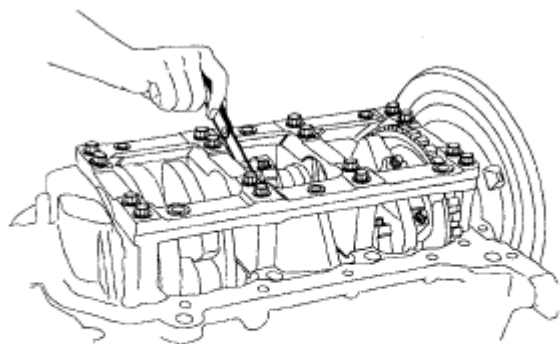
CONNECTING ROD AND CRANKSHAFT

1. Check the connecting rod end play.

Using a dial indicator, measure the end play while moving the connecting rod back and forth.

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

Maximum end play: 0.4mm(0.016in.)



EDQF159A

Fig. 133: Checking Connecting Rod End Play

- If out-of-tolerance, replace the connecting rod assembly.
 - 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 the 2 connecting rod cap bolts.
 3. Remove the connecting rod cap and bearing half.
 4. Clean the crank pin and bearing.
 5. Place plastigage across the crank pin.
 6. Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

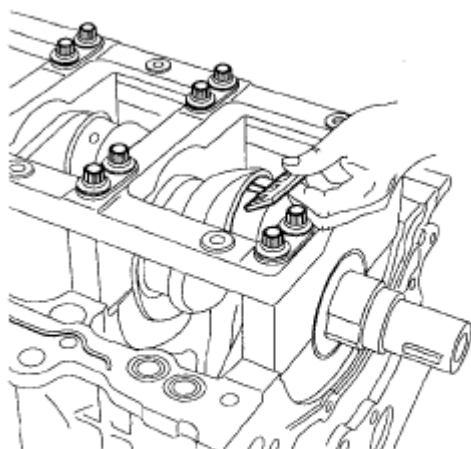
15.7 ~ 19.6Nm (1.6 ~ 2.0kgf.m, 11.6 ~ 14.5lb-ft) + 90°

NOTE: Do not turn the crankshaft.

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

Standard oil clearance

0.018 ~ 0.036mm(0.0007 ~ 0.0014in.)



EDQF175A

Fig. 134: Measuring Plastigage

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

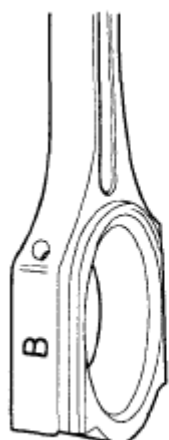
CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

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

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

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

CONNECTING ROD MARK LOCATION



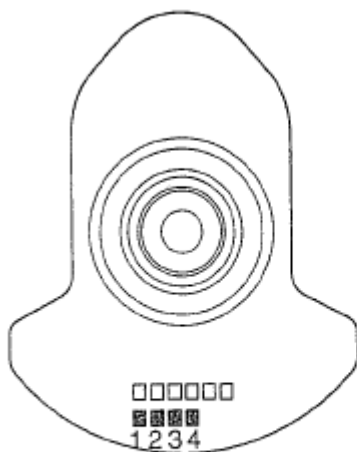
EDQF196A

Fig. 135: Identifying Connecting Rod Mark Location

DISCRIMINATION OF CONNECTING ROD

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

CRANKSHAFT PIN MARK LOCATION



SGKM17418N

Fig. 136: Identifying Crankshaft Pin Mark Location

DISCRIMINATION OF CRANKSHAFT

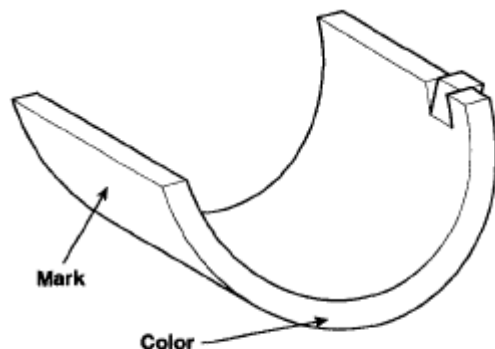
CLASS	MARK	OUTSIDE DIAMETER OF PIN
I	A	47.994 ~ 48.000mm (1.8895 ~ 1.8898in.)
II	B	47.988 ~ 47.994mm (1.8893 ~ 1.8895in.)

III

C

47.982 ~ 47.988mm (1.8890 ~ 1.8893in.)

PLACE OF IDENTIFICATION MARK (CONNECTING ROD BEARING)



ECKD313A

Fig. 137: Identifying Place Of Identification Mark (Connecting Rod Bearing)

DISCRIMINATION OF CONNECTING ROD BEARING

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

Selection

CONNECTING ROD IDENTIFICATION MARK REFERENCE

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

Check the crankshaft bearing oil clearance.

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

Tightening torque

M8

13 ~ 19Nm (1.3 ~ 1.9kgf.m, 10 ~ 14lb-ft) + 90°

M10

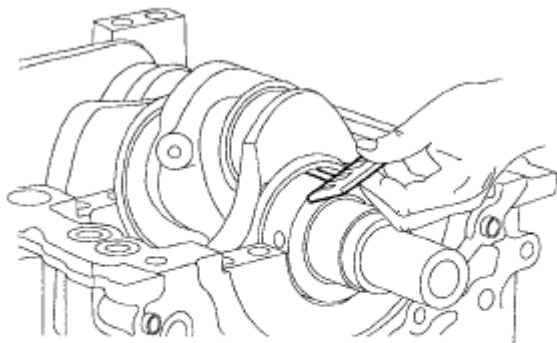
27 ~ 33Nm (2.7 ~ 3.3kgf.m, 19.5 ~ 24lb-ft) + 90°

NOTE: **Do not turn the crankshaft.**

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

Standard oil clearance

0.004 ~ 0.022mm (0.00016 ~ 0.00087in.)



EQQF075A

Fig. 138: Measuring Widest Part Of Plastigage

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

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

clearance.

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

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

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

CONNECTING RODS

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

Allowable bend of connecting rod

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

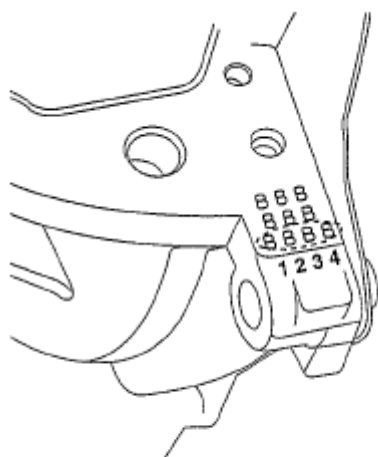
Allowable twist of connecting rod

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

Crankshaft bore mark location

Letters have been stamped on the end of the block as a mark for the size of each of the 4 main journal bores.

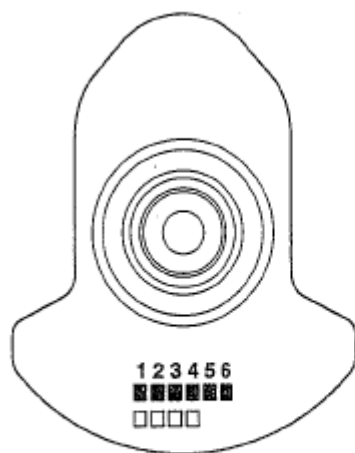
Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.



SGKM17100N

Fig. 139: Identifying Crankshaft Bore Mark Location**DISCRIMINATION OF CYLINDER BLOCK**

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

CRANKSHAFT JOURNAL MARK LOCATION

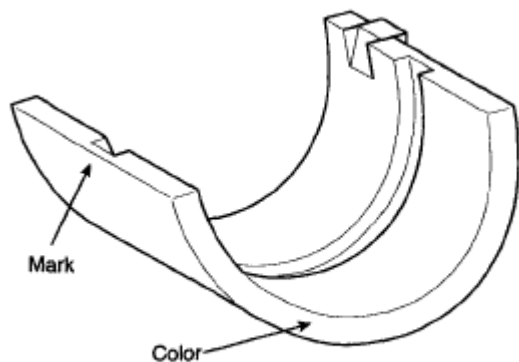
SGKM17101N

Fig. 140: Identifying Crankshaft Journal Mark Location**DISCRIMINATION OF CRANKSHAFT**

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

PLACE OF IDENTIFICATION MARK (CRANKSHAFT BEARING)



ECKD316A

Fig. 141: Identifying Place Of Identification Mark (Crankshaft Bearing)

DISCRIMINATION OF CRANKSHAFT BEARING

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

SELECTION

CRANKSHAFT BORE IDENTIFICATION MARK REFERENCE

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

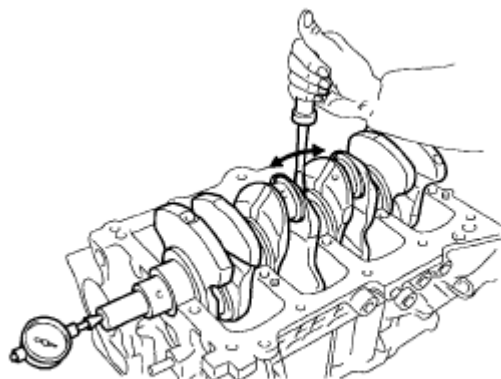
Check crankshaft end play.

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

Standard end play

0.07 ~ 0.25mm (0.0027 ~ 0.0098in.)

Limit: 0.30mm (0.0118in.)



ECKD001B

Fig. 142: Checking Crankshaft End Play

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

Thrust bearing thickness

1.925 ~ 1.965mm (0.076 ~ 0.077in.)

Inspect main journals and crank pins

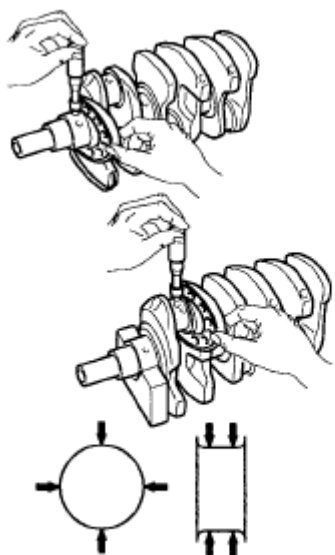
Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter

61.982 ~ 62.000mm (2.4402 ~ 2.4409in.)

Crank pin diameter

47.982 ~ 48.000mm (1.8890 ~ 1.8898in.)



ECKD001E

Fig. 143: Measuring Diameter Of Main Journal And Crank Pin

CYLINDER BLOCK

1. Remove gasket material.

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

2. Clean cylinder block

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

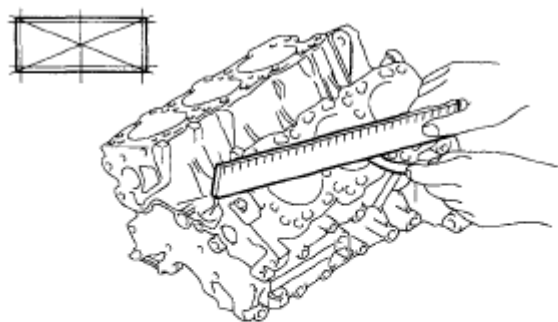
3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard: Less than 0.03mm(0.0012 in.)

Limit: 0.05 mm (0.0020 in.)



EDQF154A

Fig. 144: Checking Flatness Of Cylinder Block Gasket Surface

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratches.

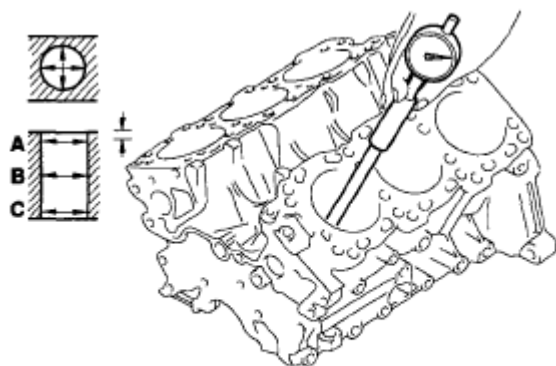
If deep scratches are present, replace the cylinder liner.

5. Inspect cylinder bore diameter

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

Standard diameter

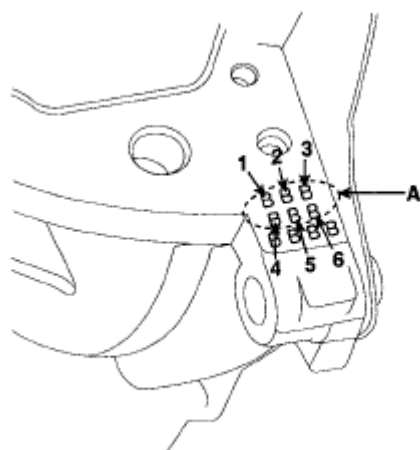
86.70 ~ 86.73mm (3.4134 ~ 3.4145in.)



EDQF153A

Fig. 145: Measuring Cylinder Bore Diameter

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



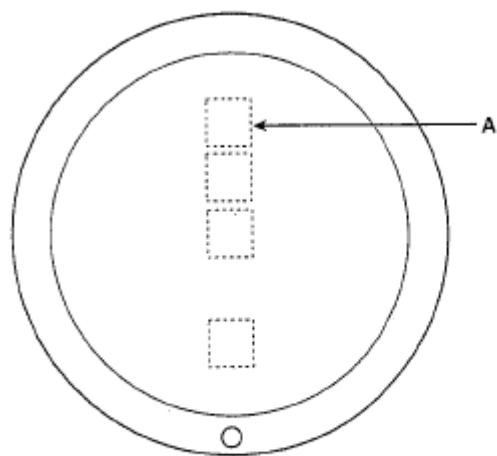
SCMEM6315D

Fig. 146: Identifying Cylinder Bore Size Code On Cylinder Block Bottom Face

CYLINDER BORE INNER DIAMETER SPECIFICATION

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

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



SGKM17102N

Fig. 147: Identifying Piston Size Code On Piston Top Face

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

PISTON DIAMETER SPECIFICATION

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

8. Select the piston related to cylinder bore class.

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

BORING CYLINDER

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

PISTON SIZE SPECIFICATION

Identification Mark	Size
0.25	0.25mm (0.010in.)
0.50	0.50mm (0.0250in.)

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

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

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

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

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

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

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

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

PISTON AND RINGS

1. Clean piston
 1. Using a gasket scraper, remove the carbon from the piston top.

2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

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

Standard diameter

86.67 ~ 86.70mm (3.4122 ~ 3.4134in.)

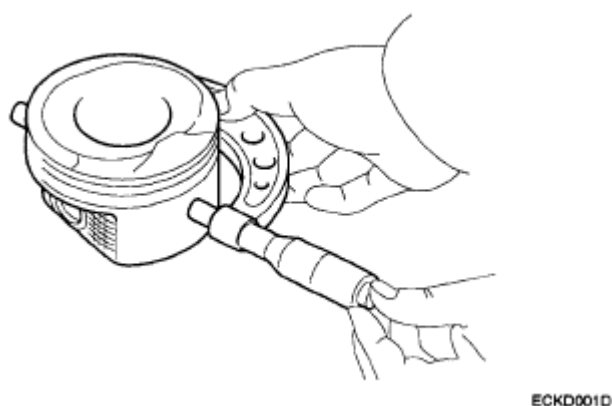


Fig. 148: Measuring Piston Outside Diameter

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

Piston-to-cylinder clearance

0.02 - 0.04mm(0.0008 ~ 0.0016in.)

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

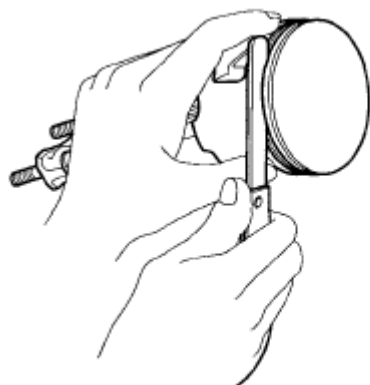
No. 1: 0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in.)

No. 2: 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)

Limit

No. 1: 0.1mm (0.004in.)

No. 2: 0.1mm (0.004in.)



ECKD001G

Fig. 149: Measuring Clearance Between Piston Ring And Wall Of Ring Groove

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. If the bore is over the service limit, the cylinder block must be rebored.

Piston ring end gap

Standard

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

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

Limit

Oil ring: 0.2 ~ 0.7mm (0.0079 ~ 0.0276in.)

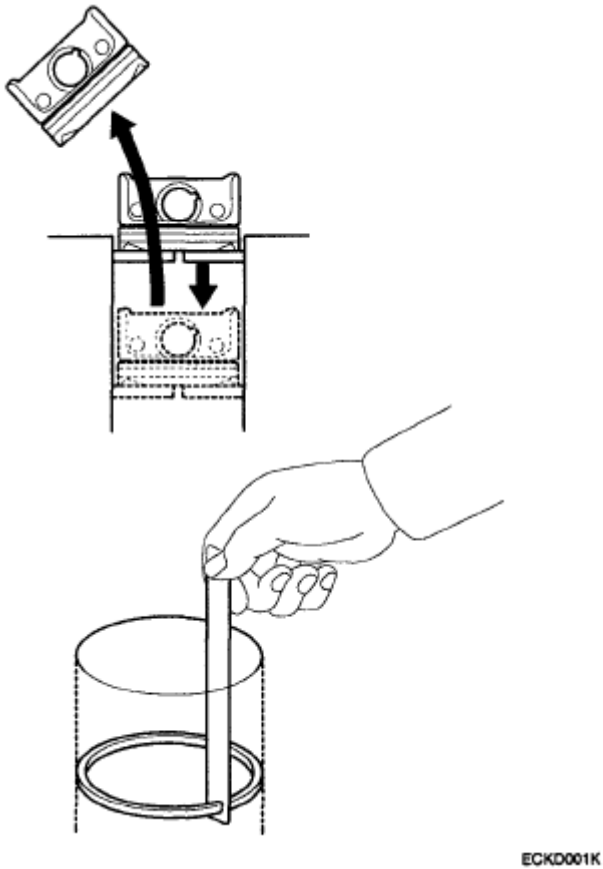


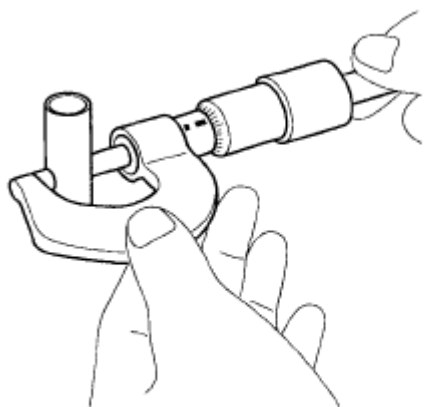
Fig. 150: Measuring Piston Ring End Gap

PISTON PINS

1. Measure the diameter of the piston pin.

Piston pin diameter

21.001 ~ 21.007mm (0.8268 ~ 0.8270in.)



ECKD001Z

Fig. 151: Measuring Diameter Of Piston Pin

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

Piston pin-to-piston clearance

0.011 ~ 0.018mm (0.00043 ~ 0.00071in.)

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

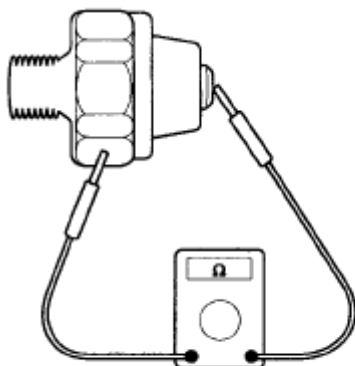
Piston pin-to-connecting rod interference

0.016 ~ 0.033mm (0.00063 ~ 0.00130in.)

OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter.

If there is no continuity, replace the oil pressure switch.

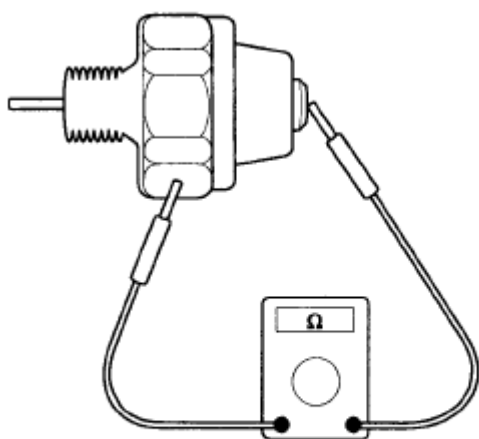


ECKD001W

Fig. 152: Checking Continuity Between Terminal And Body

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50kpa (7psi) vacuum is applied through the oil hole, the switch is operating properly.

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



ECKD001Y

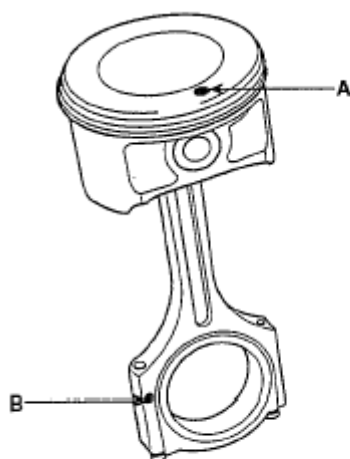
Fig. 153: Checking Continuity Between Terminal And Body

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.

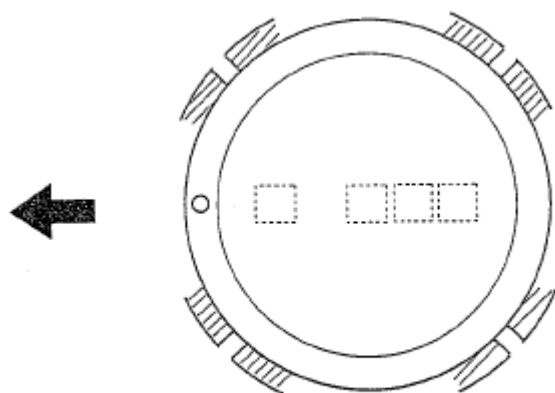
1. Assemble piston and connecting rod.
 1. Use a hydraulic press for installation.
 2. The piston front mark(A) and the connecting rod front mark(B) must face the timing belt side of the engine.



EDQF077A

Fig. 154: Identifying Piston Front Mark And Connecting Rod Front Mark

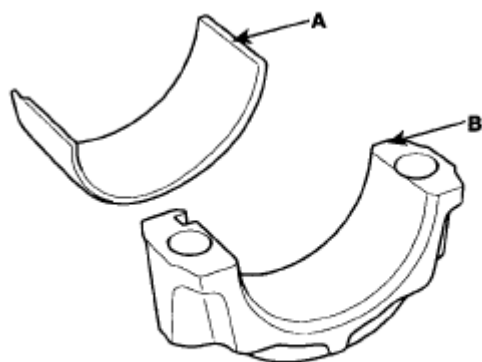
2. Install piston rings.
 1. Install the oil ring expander and 2 side rails by hand.
 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
 3. Position the piston rings so that the ring ends are as shown.



SGKM17413N

Fig. 155: Identifying Piston Rings Ends

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



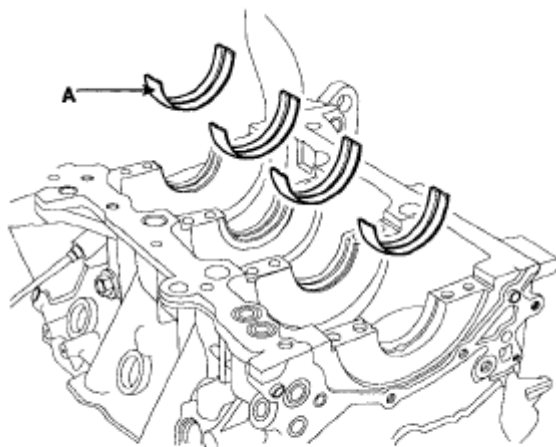
ECKD322A

Fig. 156: Identifying Connecting Rod Cap And Bearing

4. Install main bearings.

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

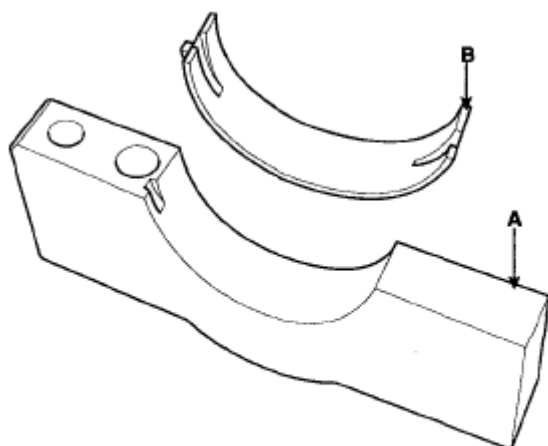
1. Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings(A).



EDQF076A

Fig. 157: Identifying Upper Bearings

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



EDQF079A

Fig. 158: Identifying Main Bearing Cap And Lower Bearing

5. Install thrust bearings.

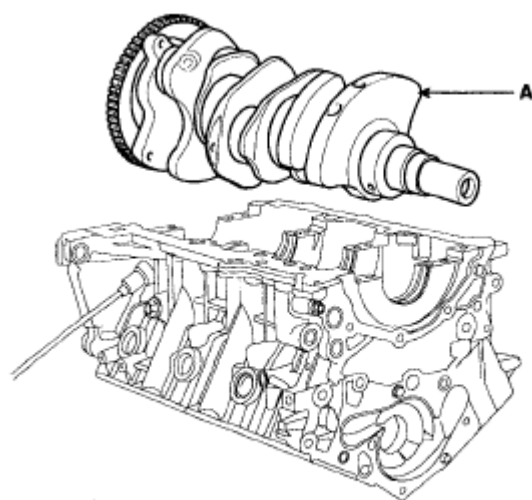
Install the 2 thrust bearings (A) under the No.3 journal position of the cylinder block with the oil grooves facing outward.



ECKD324A

Fig. 159: Identifying Thrust Bearings

6. Place crankshaft(A) on the cylinder block.



EDQF074A

Fig. 160: Identifying Crankshaft

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

NOTE:

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

Tightening torque

Main bearing cap bolt

M8

12.7 ~ 18.6Nm (1.3 ~ 1.9kgf.m, 9.4 ~ 13.7lb-ft) + 90° ~ 95°

M10

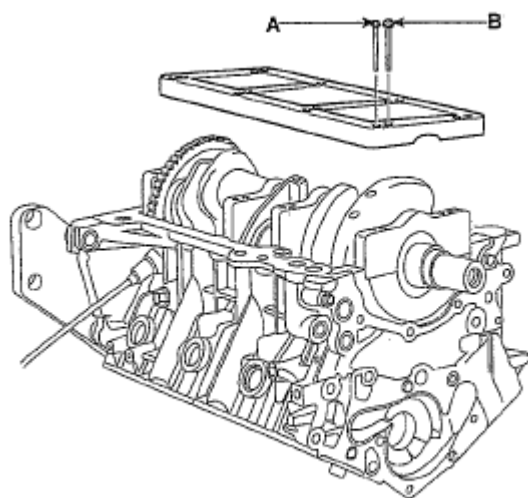
26.5 ~ 32.4Nm (2.7 ~ 3.3kgf.m, 19.5 ~ 23.9lb-ft) + 90° ~ 95°

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 16 bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

M8(A): 12.7 ~ 18.6Nm (1.3 ~ 1.9kgf.m, 9.4 ~ 13.7lb-ft)

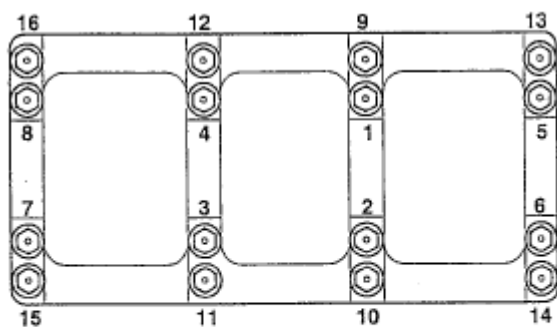
M10(B): 26.5 ~ 32.4Nm (2.7 ~ 3.3kgf.m, 19.5 ~ 23.9lb-ft)



EDQF072A

Fig. 161: Identifying Bearing Cap Bolts

3. Retighten the bearing cap bolts by $90^{\circ} \sim 95^{\circ}$ in the numerical order shown.



EDQF186A

Fig. 162: Identifying Tightening Sequence Of Bearing Cap Bolts

4. 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. Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
2. Install the ring compressor, check that the bearing is securely in place, then position the piston in

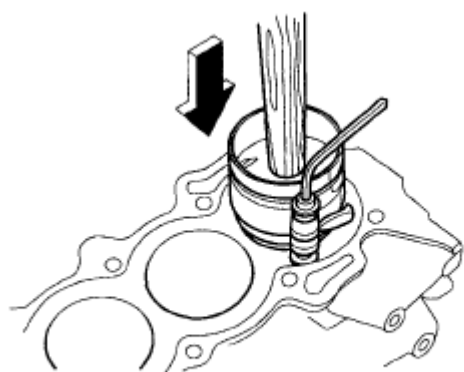
the cylinder, and tap it in using the wooden handle of a hammer.

3. Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
4. Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the bolts.

Tightening torque

15.7 ~ 19.6Nm (1.6 ~ 2.0kgf.m, 11.6 ~ 14.5lb-ft) + 90° ~ 94°

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



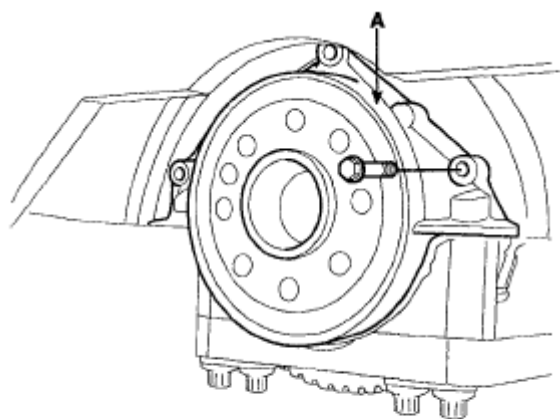
ECKD001F

Fig. 163: Installing Piston And Connecting Rod Assemblies

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

Tightening torque

9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



EDQF174A

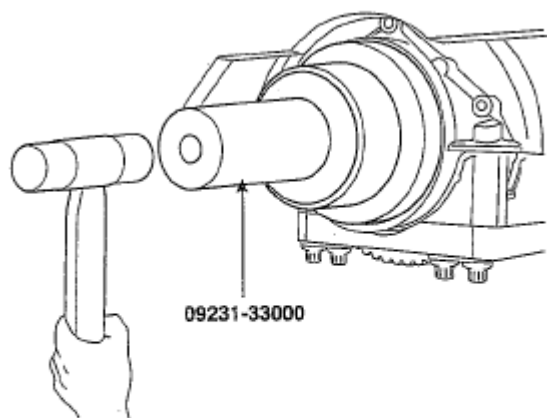
Fig. 164: Identifying Oil Seal Case

NOTE:

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

12. Install rear oil seal.

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



EDQF179A

Fig. 165: Installing Rear Oil Seal

13. Install front case.
14. Install the upper oil pan.

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

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

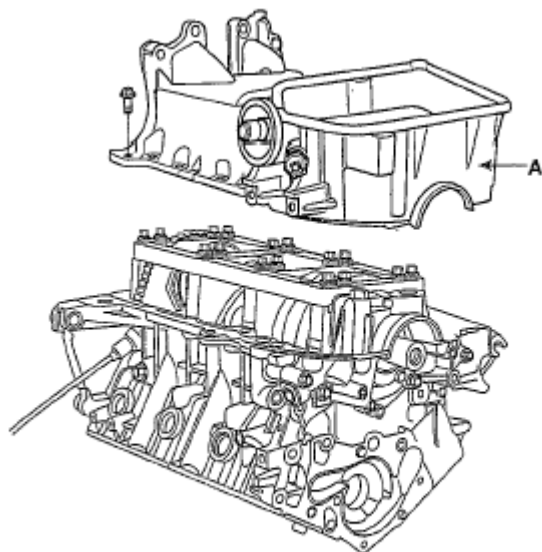
2. Install the oil pan(A) with the 17 bolts.

Uniformly tighten the bolts in several passes.

Tightening torque

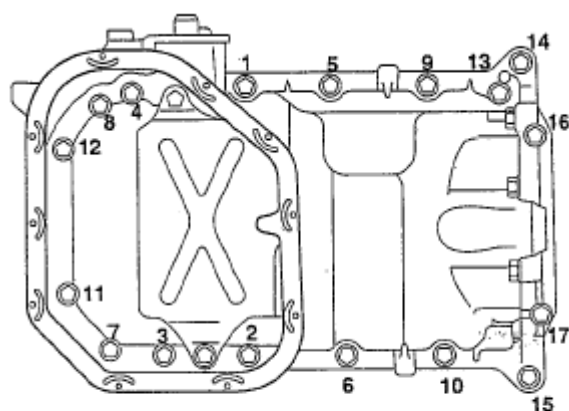
18.6 ~ 23.5Nm (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft): (1 ~ 15)

4.9 ~ 6.9Nm (0.5 ~ 0.7kgf.m, 3.6 ~ 5.1lb-ft): (16,17)



EDQF067A

Fig. 166: Identifying Oil Pan



EDQF151A

Fig. 167: Identifying Tightening Sequence Of Oil Pan Bolts

NOTE:

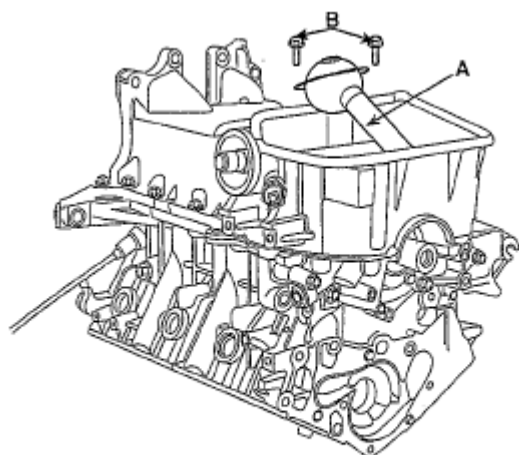
- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
- Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.
- After assembly, wait at least 30 minutes before filling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

15. Install oil screen.

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

Tightening torque

14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



EDQFD66A

Fig. 168: Identifying Oil Screen Bolts

16. Install the lower oil pan.

1. Apply liquid gasket as an even bead, centered between the edges of the mating surface.

Use liquid gasket MS 721-40A or equivalent.

NOTE:

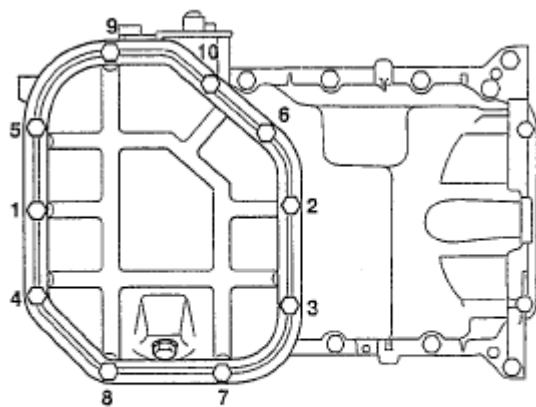
- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
- Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.
- After assembly, wait at least 30 minutes before filling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

2. Install the lower oil pan 10 bolts.

Uniformly tighten the bolts several passes

Tightening torque

9.8 ~ 11.8Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



EDQF152A

Fig. 169: Identifying Tightening Sequence Of Lower Oil Pan Bolts

17. Install oil pressure sensor.

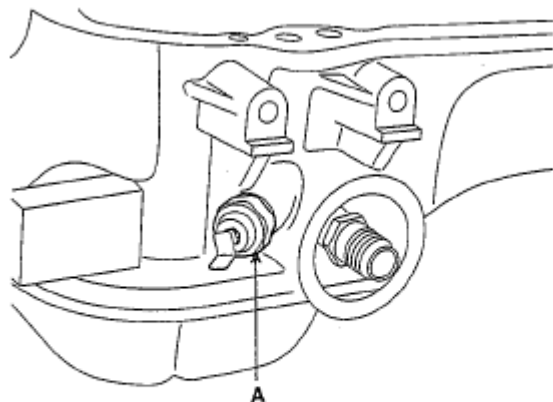
1. Apply adhesive to 2 or 3 threads.

Adhesive: THREE BOND TB2403 or equivalent.

2. Install the oil pressure sensor(A).

Tightening torque

14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



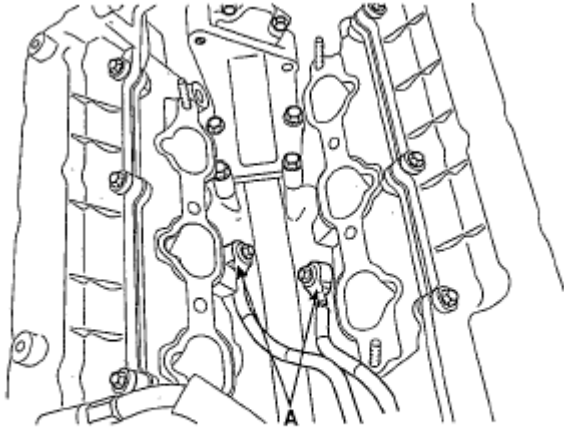
EDQF180A

Fig. 170: Identifying Oil Pressure Sensor

18. Install knock sensor(A).

Tightening torque

16.7 ~ 25.5Nm (1.7 ~ 2.6kgf.m, 12.3 ~ 18.8lb-ft)



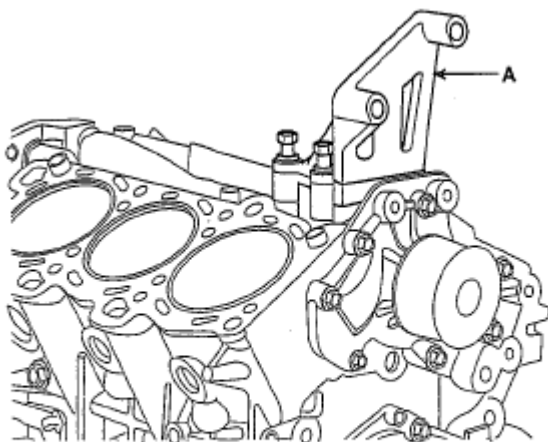
EDQF181A

Fig. 171: Identifying Knock Sensor

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

Tightening torque

34.3 ~ 53.9Nm (3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)



EDQF061A

Fig. 172: Identifying Power Steering Pump Bracket

21. Install the air compressor. (Refer to **COMPRESSOR**)
22. Install the alternator. (Refer to **ALTERNATOR**)
23. Install oil level gauge assembly.
 1. Install a new O-ring on the oil level gauge.
 2. Apply engine oil on the O-ring.
 3. Install the oil level gauge assembly (A) with the bolt.

Tightening torque

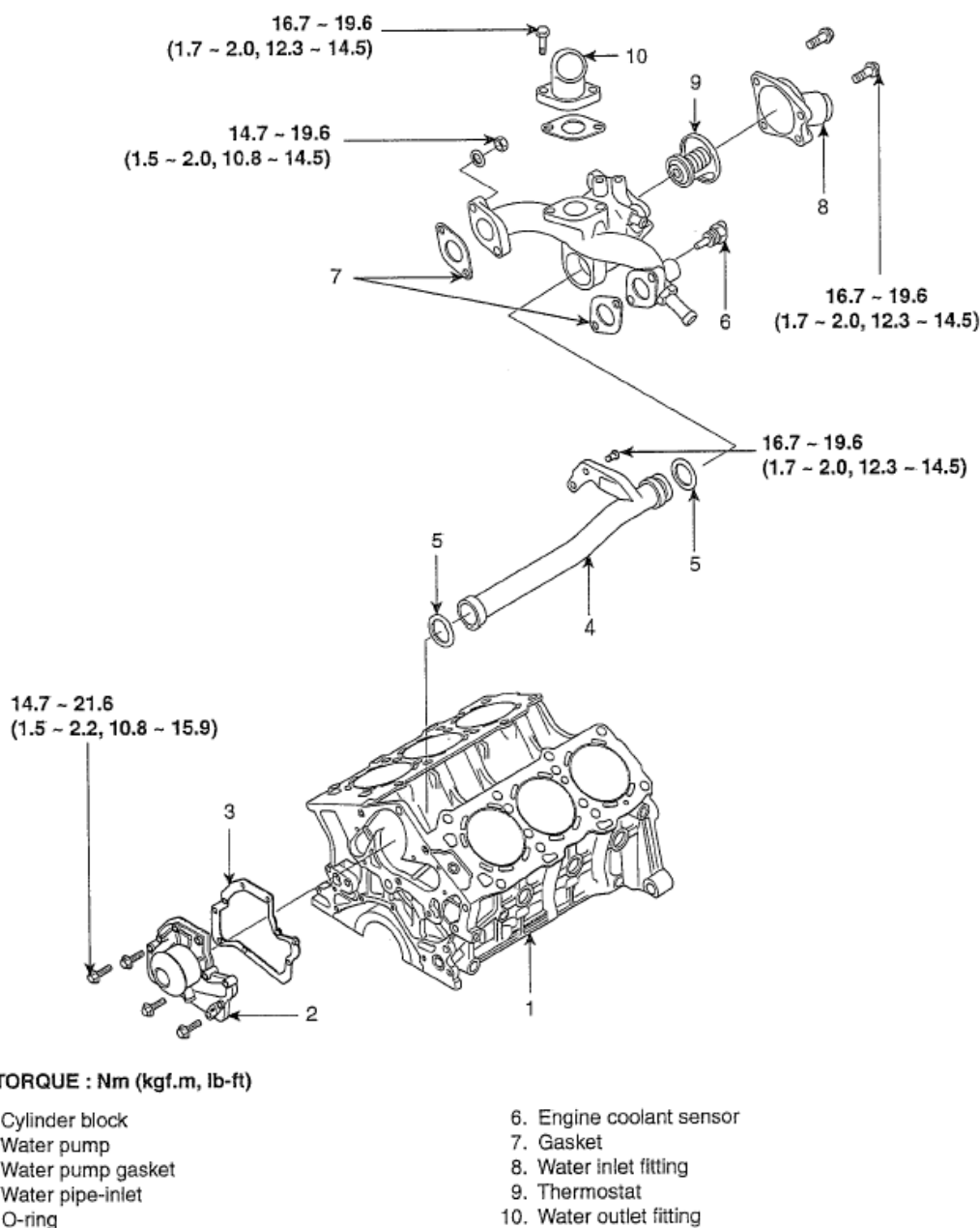
11.8 ~ 14.7Nm (1.2 ~ 1.5kgf.m, 8.7 ~ 10.8lb-ft)

24. Install cylinder head. (Refer to **CYLINDER HEAD ASSEMBLY**).
25. Install timing belt. (Refer to **TIMING SYSTEM**).
26. Remove engine stand.
27. Install drive plate.

Tightening torque

71.6 ~ 75.5Nm (7.3 ~ 7.7kgf.m, 52.8 ~ 55.7lb-ft)

COOLING SYSTEM**COMPONENTS**



SGKM17414N

Fig. 173: Identifying Cooling System Components With Torque Specifications

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. Slide the heater temperature control lever to maximum heat. Make sure the engine and radiator are cool to the touch.
2. Remove radiator cap.
3. Loosen the drain plug, and drain the coolant.
4. Tighten the radiator drain plug securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
6. Fill fluid mixture with coolant and water slowly through the radiator cap. Gently squeeze the upper/lower hoses of the radiator so as bleed air easily.

NOTE:

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

CAUTION:

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

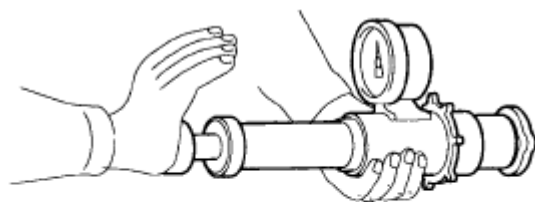
7. Start the engine and allow coolant to circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
8. Repeat 7 until the cooling fan 3 ~ 5 times and bleed air sufficiently out of the cooling system.
9. Install the radiator cap and fill the reservoir tank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

NOTE:

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

CAP TESTING

1. Remove the radiator cap, wet its seal with engine coolant, then install it on the pressure tester.



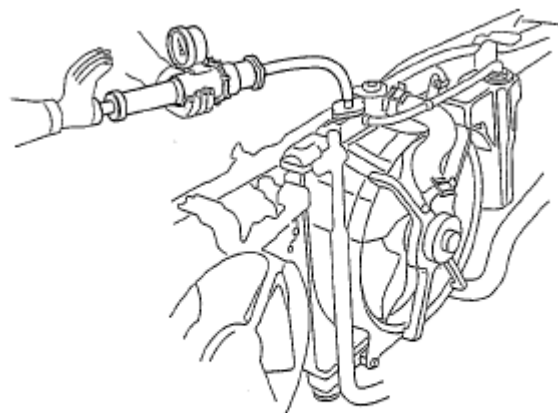
ECKD501X

Fig. 174: Checking Radiator Cap

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

TESTING

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
2. Apply a pressure tester to the radiator and apply a pressure of 93 ~ 123kPa (0.95 ~ 1.25kgf/cm² 14 ~ 19psi).



ECKD501Y

Fig. 175: Checking Radiator Cap

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

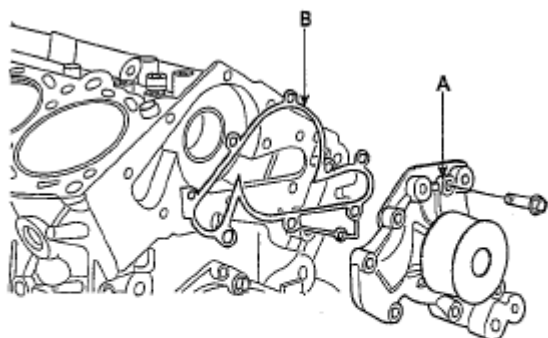
WATER PUMP

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 belts.
3. Remove the timing belt.
4. Remove the timing belt idler.
5. Remove the water pump.

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



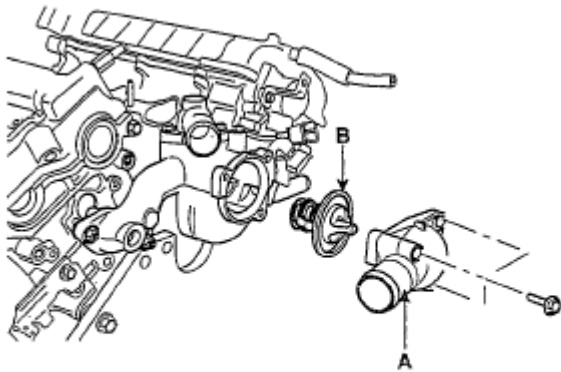
EDQF062A

Fig. 176: Identifying Water Pump And Gasket

THERMOSTAT

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

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

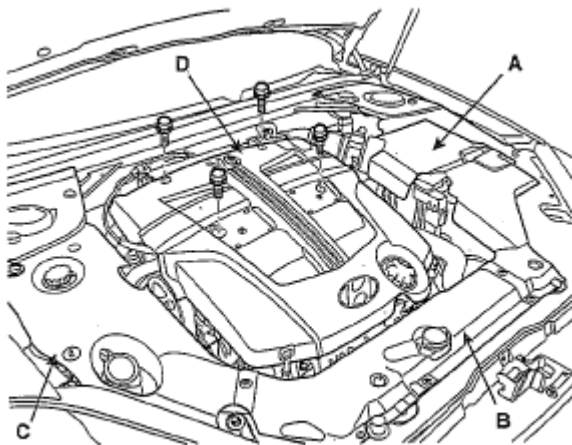


EDQF183A

Fig. 177: Identifying Water Inlet And Thermostat

RADIATOR

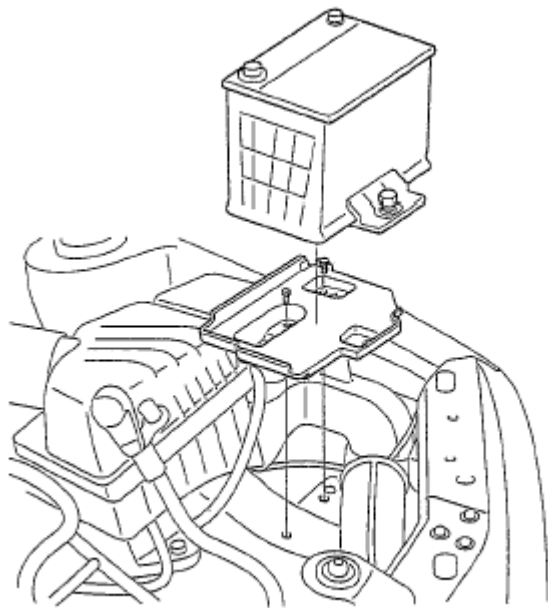
1. Remove the side cover(A, B, C) and the engine cover(D).



SGKM17001N

Fig. 178: Identifying Side Cover And Engine Cover

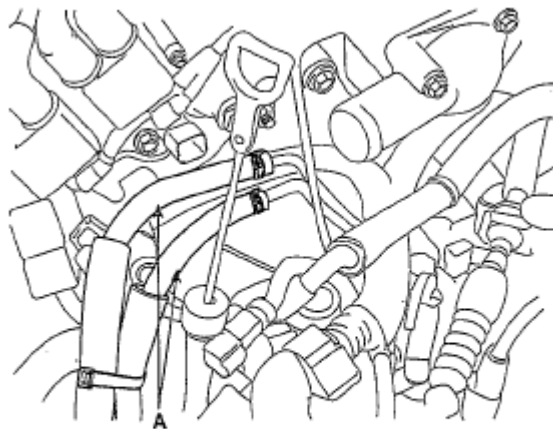
2. Disconnect the battery terminal and the battery.



ECKD201B

Fig. 179: Identifying Battery Terminal

3. Remove the radiator cap to speed draining.
4. Remove the radiator drain plug and drain engine coolant.
5. Remove the auto transaxle fluid hoses (A).

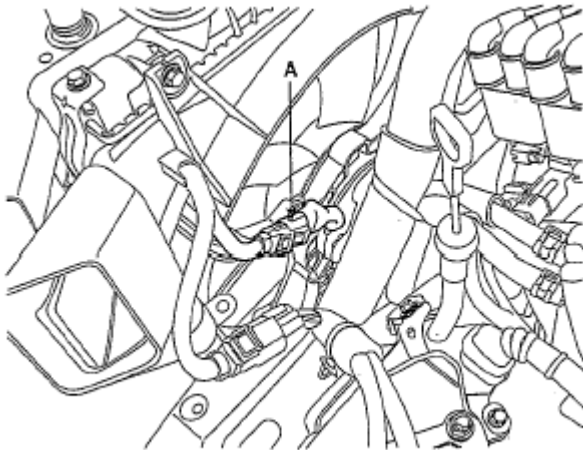


EDQF034A

Fig. 180: Identifying Auto Transaxle Fluid Hoses

6. Remove the auto transaxle fluid hoses (A).

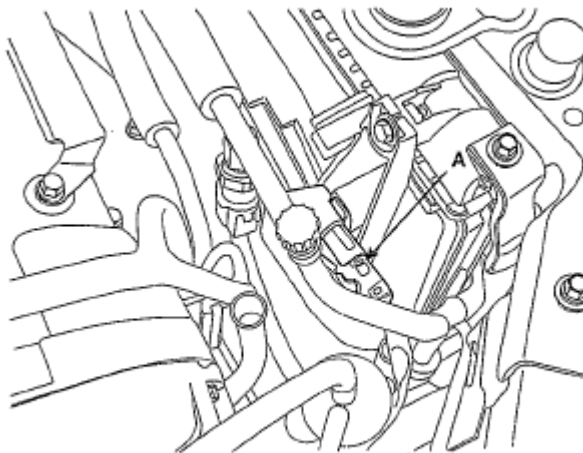
[LH]



SGKM17010N

Fig. 181: Identifying Auto Transaxle Fluid Hoses (LH)

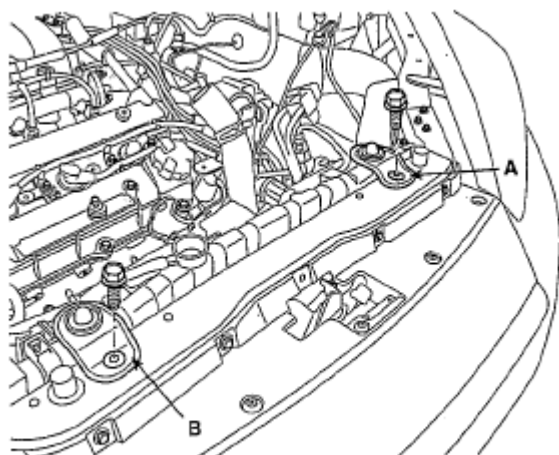
[RH]



SGKM17011N

Fig. 182: Identifying Auto Transaxle Fluid Hoses (RH)

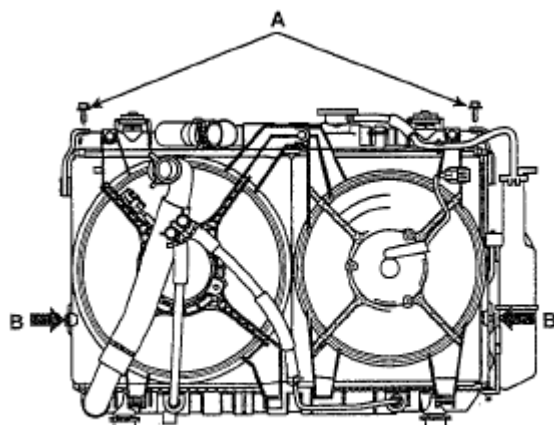
7. Remove the radiator mounting bracket (A,B).



SGKM17012N

Fig. 183: Identifying Radiator Mounting Bracket

8. Remove the, radiator mounting bracket (A,B).



SGKM17013N

Fig. 184: Identifying Radiator Mounting Bracket

9. Remove the radiator assembly from engine room.
10. To install, reverse the removal procedure.

INSPECTION

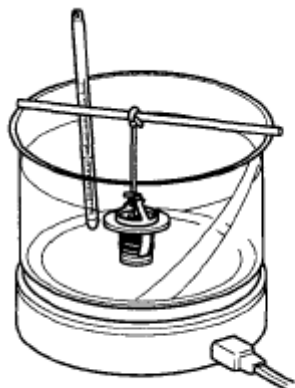
WATER PUMP

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

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

THERMOSTAT

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



ECKD503B

Fig. 185: Checking Thermostat Valve Opening Temperature

2. Check the valve opening temperature.

Valve opening temperature: 82°C (177°F)

Full opening temperature: 95°C (205°F)

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

3. Check the valve lift.

Valve lift: 10mm(0.4in.) or more at 95°C (205°F)

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

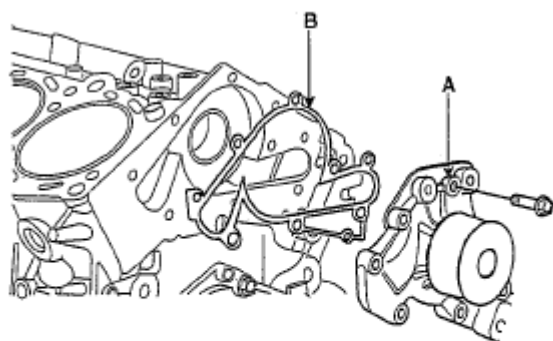
INSTALLATION

WATER PUMP

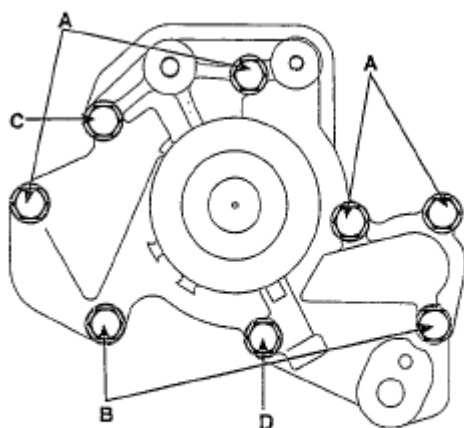
1. Install the water pump(A) and a new gasket(B) with the 8 bolts.

Tightening torque

14.7 ~ 21.6Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



EDQF062A

Fig. 186: Identifying Water Pump And Gasket


EDQF190A

Fig. 187: Identifying Water Pump Bolts
BOLTS SIZE AND NUMBER REFERENCE

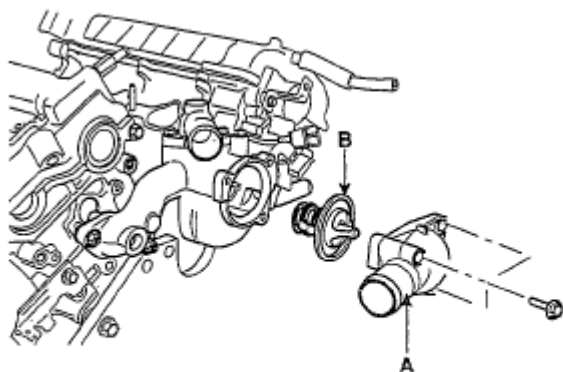
Bolt	Size	Number
A	8 x 25	4
B	8 x 20	2
C	8 x 32	1
D	8 x 40	1

2. Install the timing belt idler.
3. Install the timing belt.
4. Install drive belt.
5. Fill with engine coolant.

6. Start engine and check for leaks.
7. Recheck engine coolant level.

THERMOSTAT

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



EDQF183A

Fig. 188: Identifying Thermostat And Water Inlet

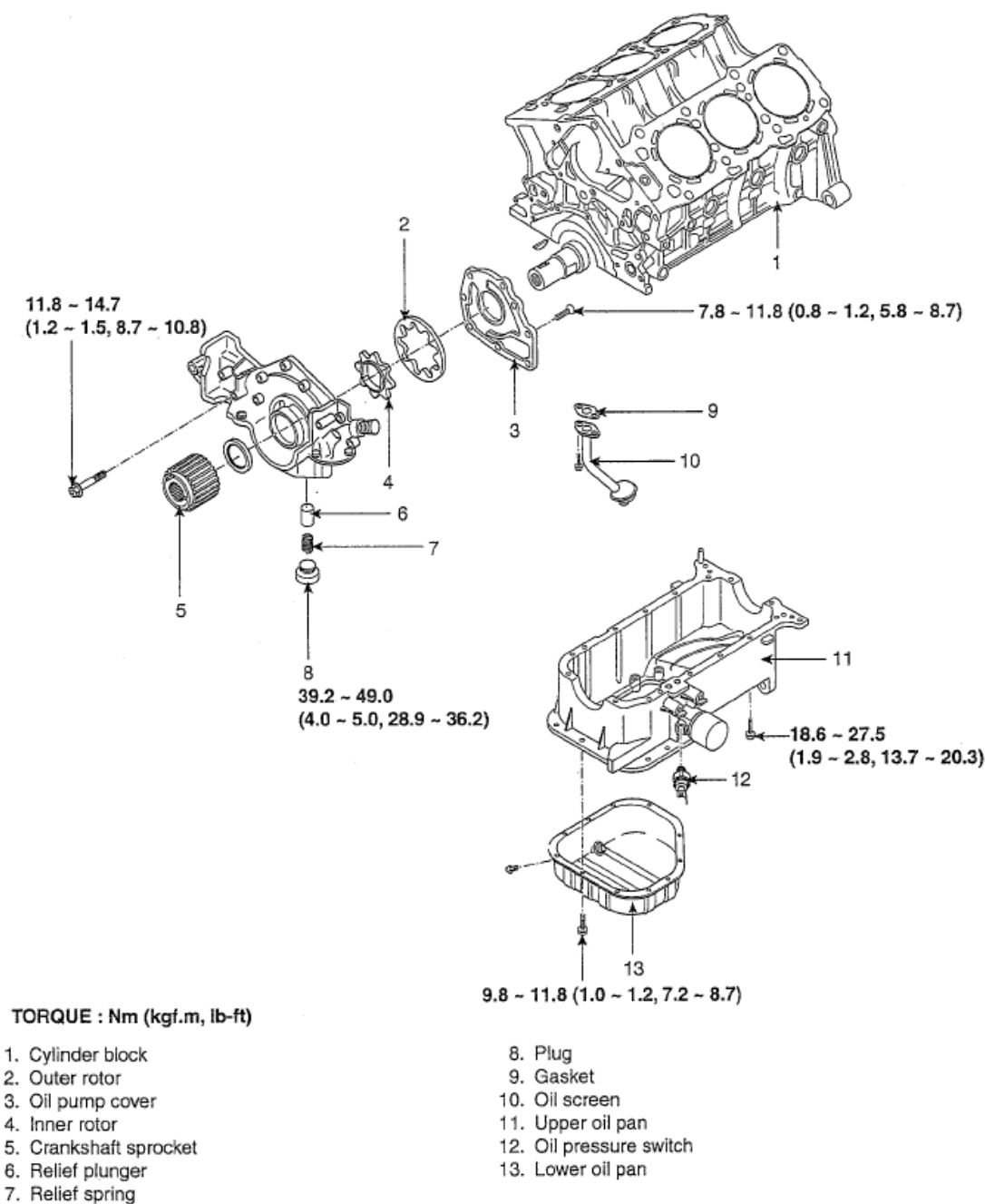
2. Install water inlet(A).

Tightening torque

16.7 ~ 19.6Nm (1.7 ~ 2.0kgf.m, 12.3 ~ 14.5lb-ft)

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

LUBRICATION SYSTEM**COMPONENTS**



SGKM17415N

Fig. 189: Identifying Lubrication System Components With Torque Specifications

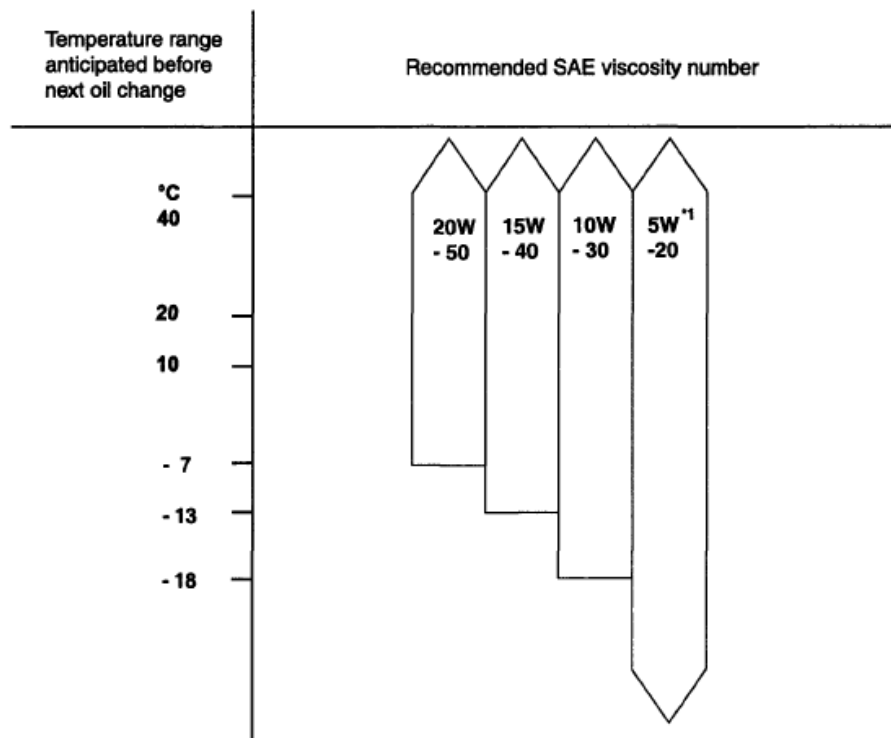
INSPECTION

SELECTION OF ENGINE OIL

Recommended ILSAC classification: GF3 OR ABOVE

Recommended API classification: SJ/SL OR ABOVE

Recommended SAE viscosity grades:



*1 : Recommended regardless of environment.

If not available, refer to the recommended SAE viscosity numbers.

LC8F002A

Fig. 190: Identifying SAE Viscosity Grades

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

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

ENGINE OIL

1. Check engine oil quality

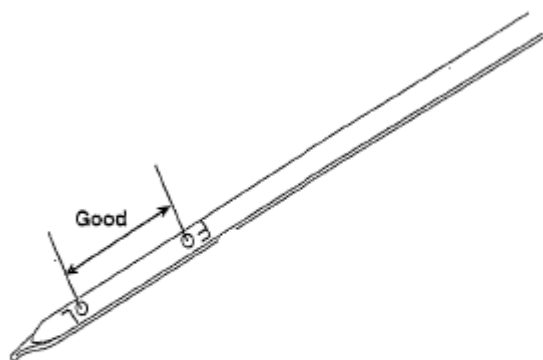
Check the oil for deterioration, entry of water, discoloring or thinning.

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.



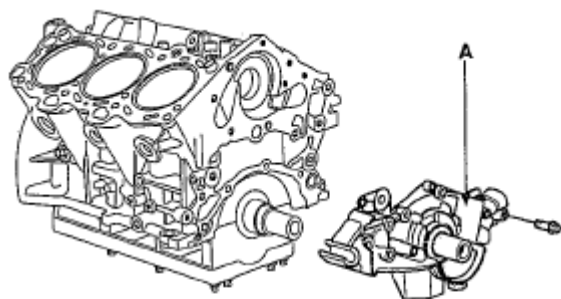
SBLEM6027L

Fig. 191: Identifying Engine Oil Level

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

REMOVAL

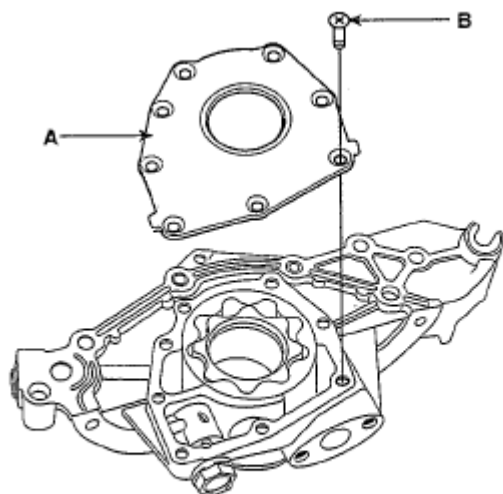
1. Drain engine oil.
2. Remove RH front wheel.
3. Remove RH side cover.
4. Remove the front exhaust pipe.
5. Remove the alternator from engine. (Refer to **ALTERNATOR**)
6. Remove the drive belt.
7. Turn the crankshaft and align the white groove on the crankshaft pulley with the pointer on the lower cover.
8. Remove the timing belt. (Refer to **TIMING SYSTEM** .)
9. Remove the oil pan and oil screen.
10. Remove the oil pump case(A).



EDQF068A

Fig. 192: Identifying Oil Pump Case

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



EDQF070A

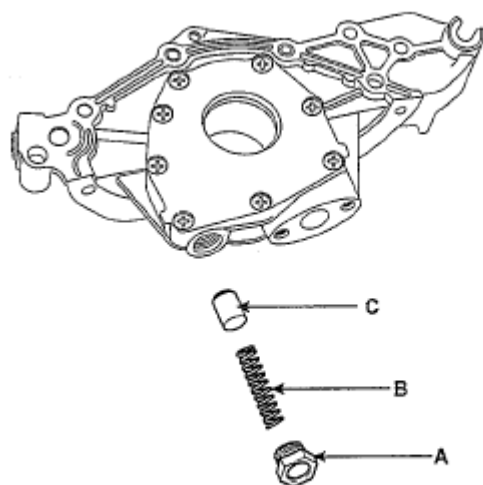
Fig. 193: Identifying Oil Pump Cover Screws

2. Remove the inner and outer rotors.

DISASSEMBLY

1. Remove the relief plunger.

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



EDQF069A

Fig. 194: Identifying Plug, Spring And Relief Plunger

INSPECTION

1. Inspect relief plunger.

Coat the valve with engine oil and check that it falls smoothly into the plunger hole by its own weight.

If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect relief valve spring.

Inspect for distorted or broken relief valve spring.

Standard value

Free height: 43.8mm (91.724in.)

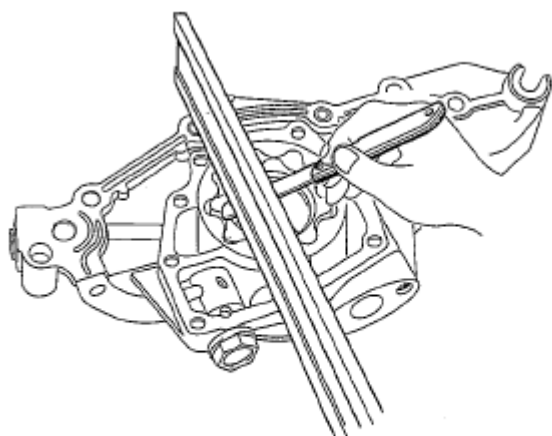
Load: 4.5kg/39.1mm (10lb/1.547in.)

3. Inspect rotor side clearance.

Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Side clearance

0.04 ~ 0.095mm (0.0016 ~ 0.0037in.)



EDQF184A

Fig. 195: Measuring Clearance Between Rotors And Precision Straight Edge

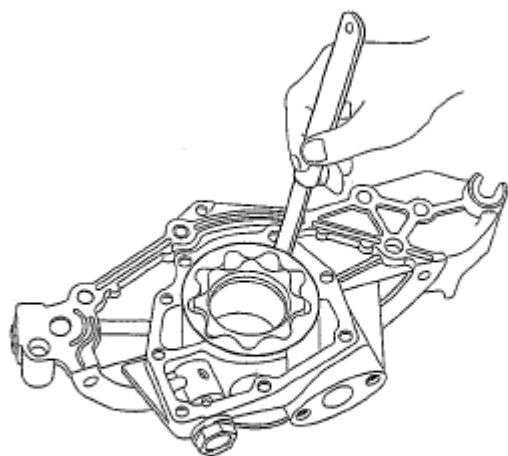
If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the front case.

4. If the tip clearance is greater than maximum, replace the rotor as a set.
5. Inspect rotor body clearance.

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

Body clearance

0.100 ~ 0.181mm (0.0039 ~ 0.0017in.)



EDQF186A

Fig. 196: Measuring Clearance Between Outer Rotor And Body

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

REPLACEMENT

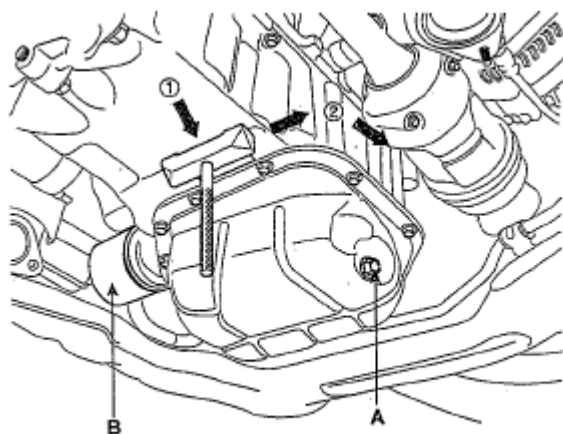
ENGINE OIL AND FILTER REPLACEMENT

CAUTION:

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

1. Drain engine oil.

1. Remove the oil filler cap.
2. Remove the oil drain plug(A), and drain the oil into a container.



SGKM17418N

Fig. 197: Removing Lower Oil Pan

CAUTION:

- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of 1 arrow.
- After tapping the SST with a plastic hammer along the direction of 2 arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.

- **Do not turn over the SST abruptly without tapping. It is result in damage of the SST.**

2. Replace oil filter.
 1. Remove the oil filter(B).
 2. Check and clean the oil filter installation surface.
 3. Check the part number of the new oil filter is as same as old one.
 4. Apply clean engine oil to the gasket of a new oil filter.
 5. Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
 6. Tighten it an additional 3/4 turn.
3. Refill with engine oil filter.
 - Clean and install the oil drain plug with a new gasket.

Tightening torque

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

- Fill with fresh engine oil

Capacity

Total: 4.8L (5.07 US qts, 4.22 Imp qts)

Oil pan: 4.2 L (4.44 US qts, 3.70 Imp qts)

Drain and refill including oil filter:

4.5 L (4.76 US qts, 3.96 Imp qts)

Oil quality: Above API SJ/SL or SAE 5W-20

- Install the oil filler cap.
4. Start engine and check for oil leaks.
 5. Recheck engine oil level.

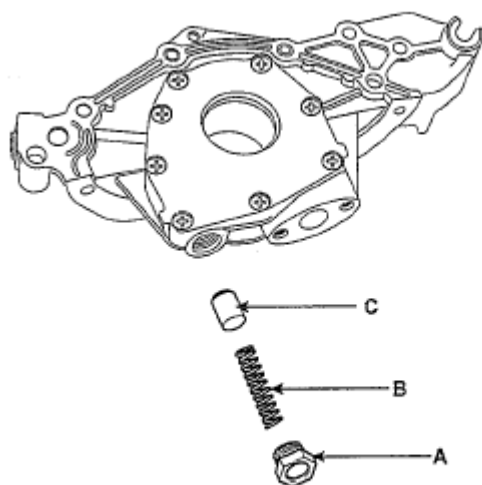
REASSEMBLY

1. Install relief plunger.

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

Tightening torque

39.2 ~ 49.0Nm (4.0 ~ 5.0kgf.m, 28.9 ~ 36.2lb-ft)



EDQF069A

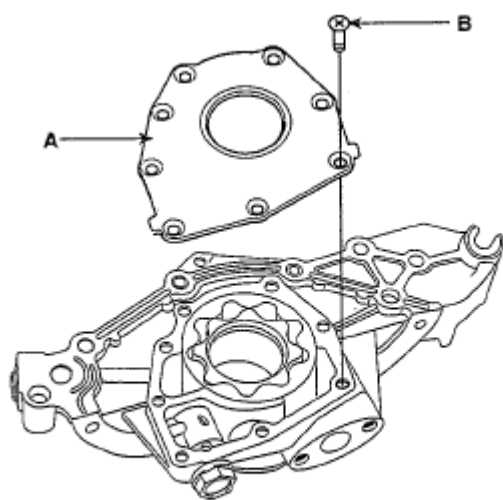
Fig. 198: Identifying Relief Plunger, Spring And Plug

INSTALLATION

1. Install oil pump.
 1. Place the inner and outer rotors into front case with the marks facing the oil pump cover side.
 2. Install the oil pump cover(A) to front case with the 8 screws(B).

Tightening torque

7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

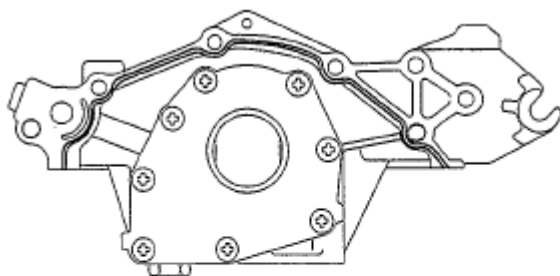


EDQF070A

Fig. 199: Identifying Oil Pump Cover Screws

2. Check that the oil pump turns freely.
3. Install the oil pump on the cylinder block.
 1. Remove any old liquid gasket and be careful not to drop any oil on the contact surfaces of the oil pump and cylinder block.
 - Using a razor blade and gasket scraper, remove all the old liquid gasket from the gasket surfaces and sealing grooves.
 - Using a non-residue solvent, clean both sealing surfaces.
 2. Apply liquid gasket to the oil pump as shown in the illustration.

Use liquid gasket MS 721-40A.



EDQP157A

Fig. 200: Identifying Liquid Gasket Applying Area Of Oil Pump

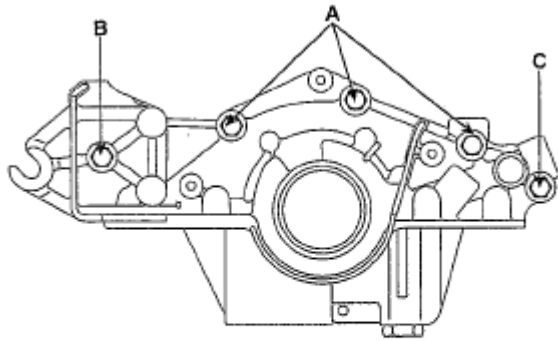
NOTE:

- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
 - Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.
 - After assembly, wait at least 30 minutes before filling the engine with oil.
3. Place a new O-ring on the cylinder block.
 4. Engage the spline teeth of the oil pump drive gear with large teeth of the crankshaft, and slide the oil pump on the crankshaft.
 5. Install the oil pump with 5 bolts.

Uniformly tighten the bolts in several passes.

Tightening torque

11.8 ~ 14.7Nm (1.2 ~ 1.5kgf.m, 8.7 ~ 10.8lbf.ft)



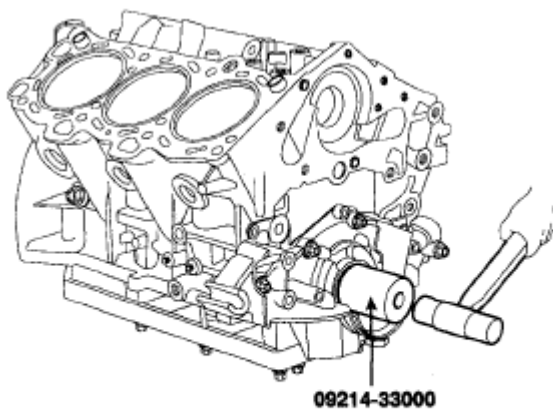
EDQF188A

Fig. 201: Identifying Oil Pump Bolts

BOLTS SIZE AND NUMBER REFERENCE

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

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



EDQF188A

Fig. 202: Installing Oil Seal

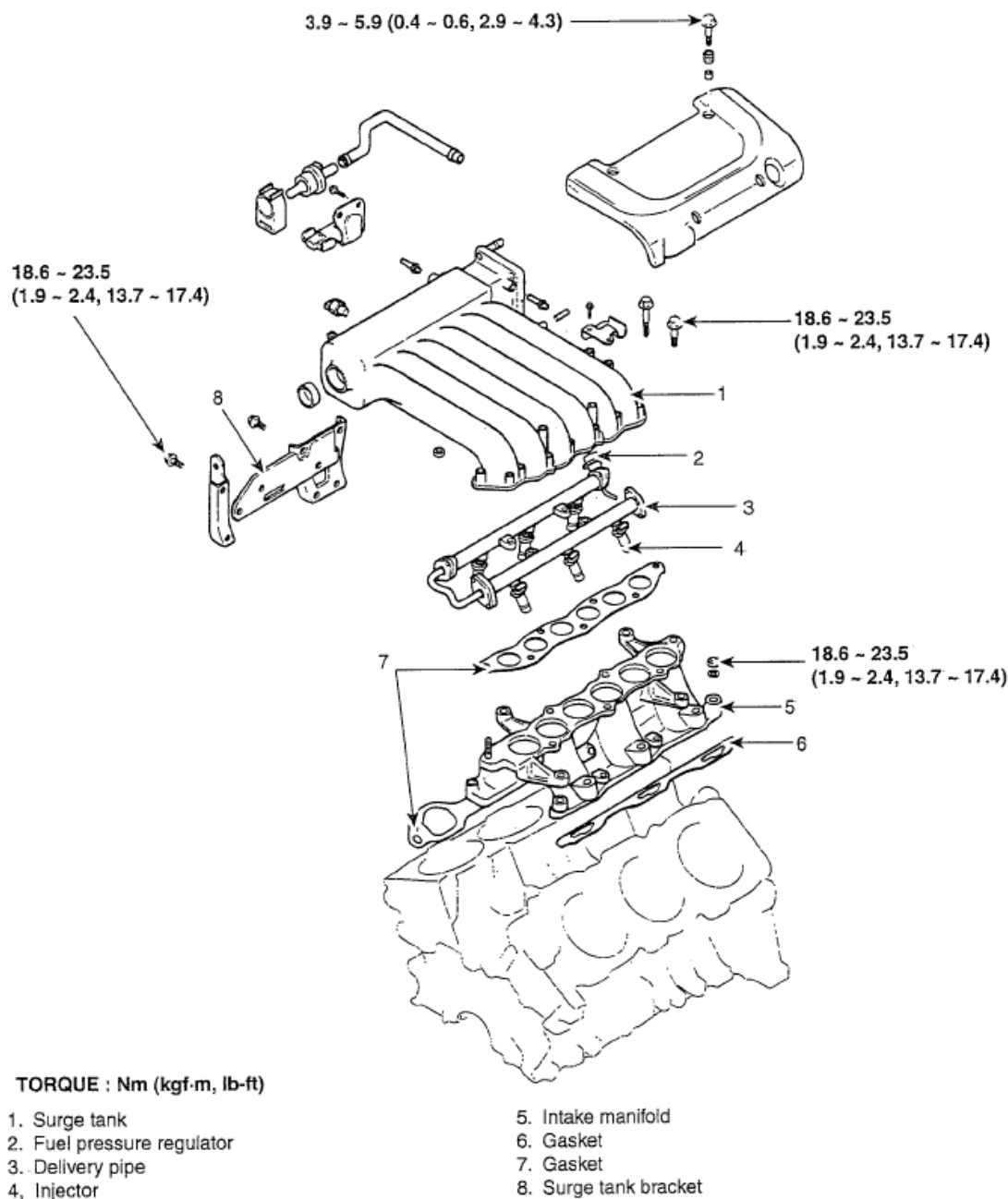
6. Install the oil pan and oil screen.
7. Install the timing belt. (Refer to **TIMING SYSTEM** .)

8. Install the drive belt.
9. Install the alternator. (Refer to **ALTERNATOR**)
10. Install the front exhaust pipe.
11. Install the RH front wheel.
12. Fill engine with oil.
13. Start engine and check for leaks.
14. Recheck engine oil level.

INTAKE AND EXHAUST SYSTEM

INTAKE MANIFOLD

COMPONENTS



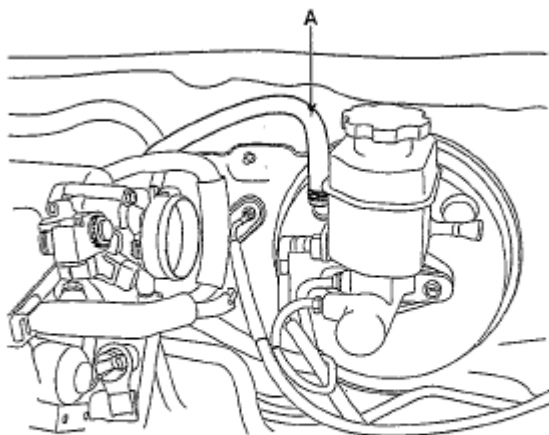
SGKM17103N

Fig. 203: Identifying Intake Manifold Components With Torque Specifications

REMOVAL

1. Remove the engine cover.
2. Remove air cleaner hose.
3. Remove surge tank assembly.
 1. Disconnect the accelerator cable.
 2. Disconnect the TPS connector.

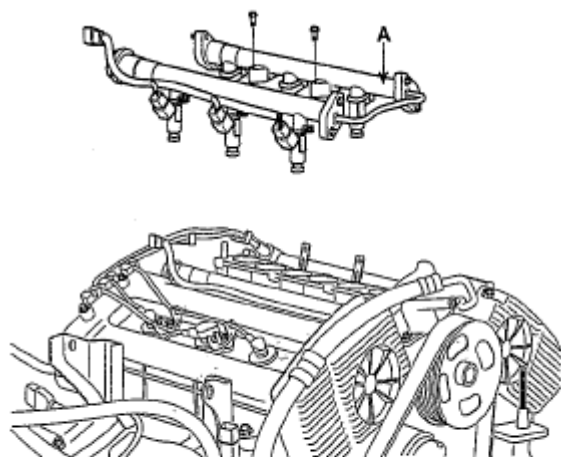
3. Disconnect the ISA connector.
4. Disconnect the injector connector.
5. Disconnect the PCSV connector.
6. Disconnect the PCSV hose.
7. Disconnect the brake booster vacuum hose.



EDQF020A

Fig. 204: Identifying Brake Booster Vacuum Hose

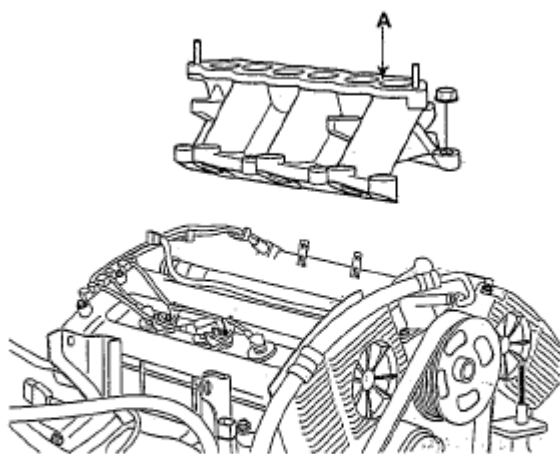
8. Disconnect the PCV hose.
9. Disconnect the IAT sensor connector.
10. Remove the surge tank stay.
11. Remove the surge tank assembly.
4. Remove the injector assembly(A).



EDQF007A

Fig. 205: Identifying Injector Assembly

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



EDQF063A

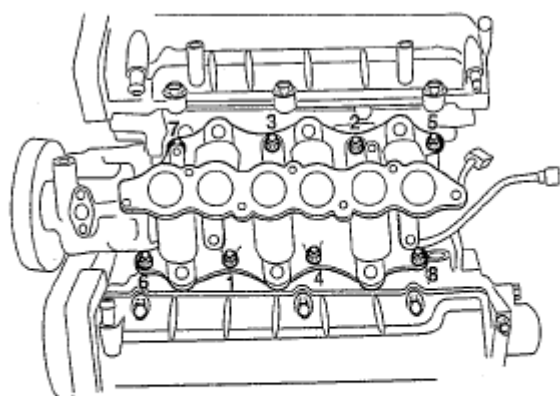
Fig. 206: Identifying Intake Manifold

INSTALLATION

1. Install the intake manifold and gasket.

Tightening torque

18.6 ~ 23.5Nm (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)



EDQF164A

Fig. 207: Identifying Intake Manifold

2. Install the injector assembly. (Refer to **FUEL SYSTEM (G6BA-GSL 2.7L)**).
3. Install the surge tank assembly.
 1. Install the surge tank assembly.

Tightening torque

18.6 ~ 23.5Nm (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)

2. Install the surge tank stay.

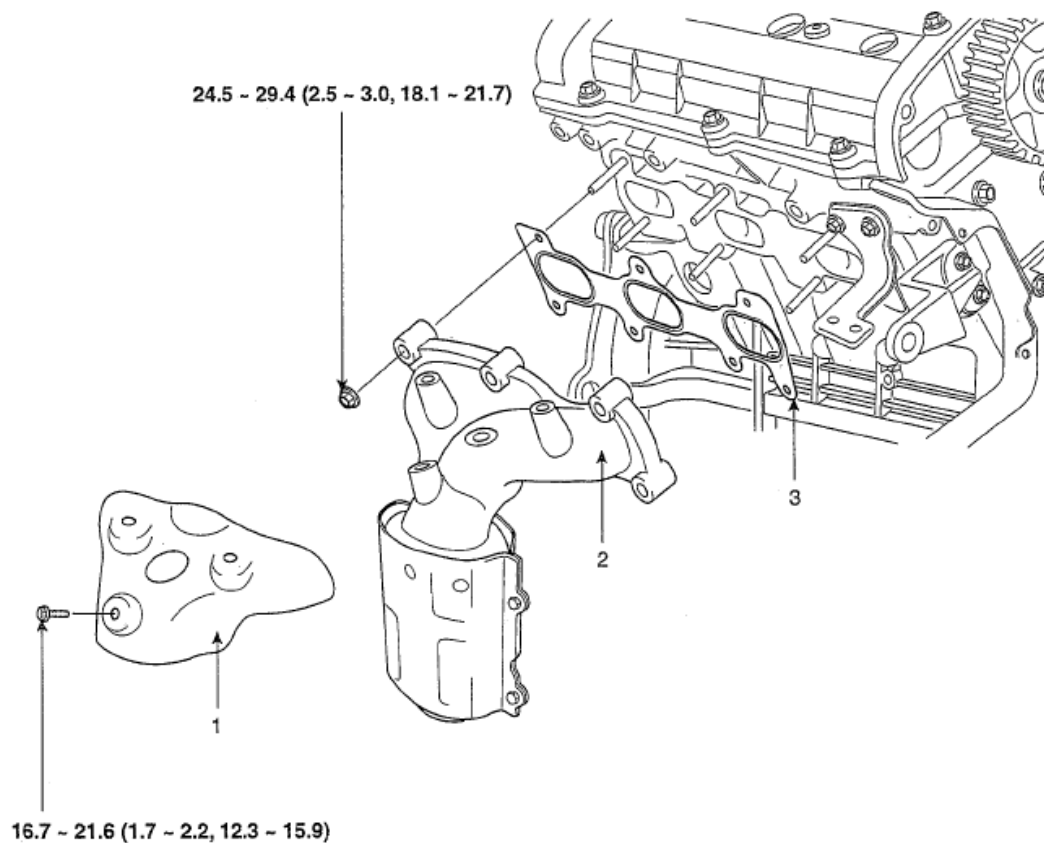
Tightening torque

18.6 ~ 23.5Nm (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)

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

EXHAUST MANIFOLD

COMPONENTS



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

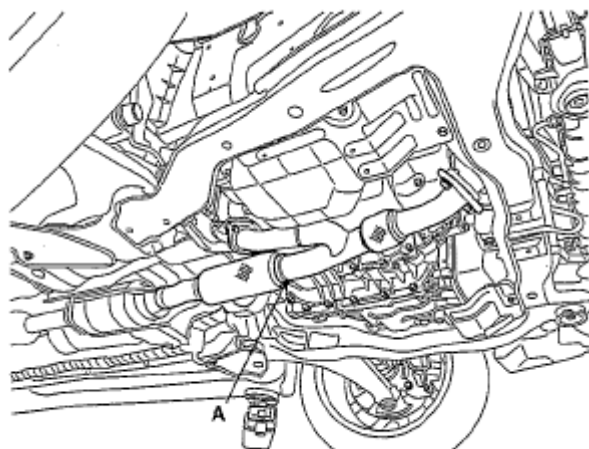
1. Heat protector
2. Exhaust manifold
3. Gasket

SGKM17417N

Fig. 208: Identifying Exhaust Manifold Components With Torque Specifications

REMOVAL

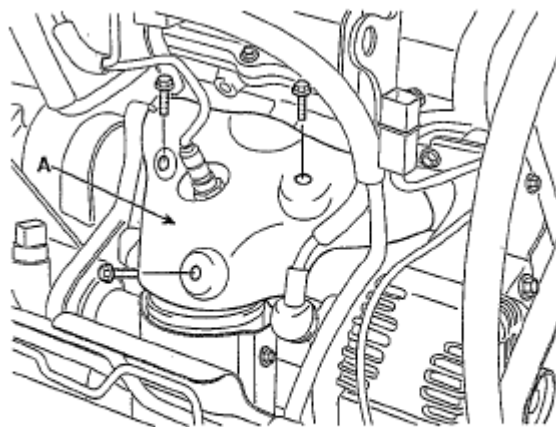
1. Remove the under coyer.
2. Remove the front muffler(A).



SGKM17006N

Fig. 209: Identifying Front Muffler

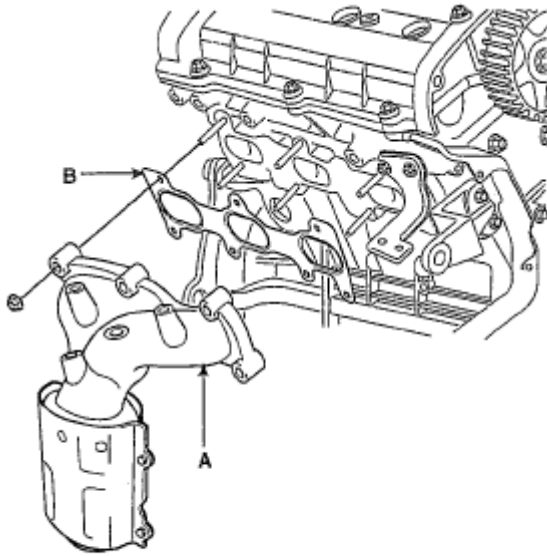
3. Disconnect the oxygen sensor connector.
4. Remove the heat protector(A).



EDQF003A

Fig. 210: Identifying Heat Protector

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



EDQF064A

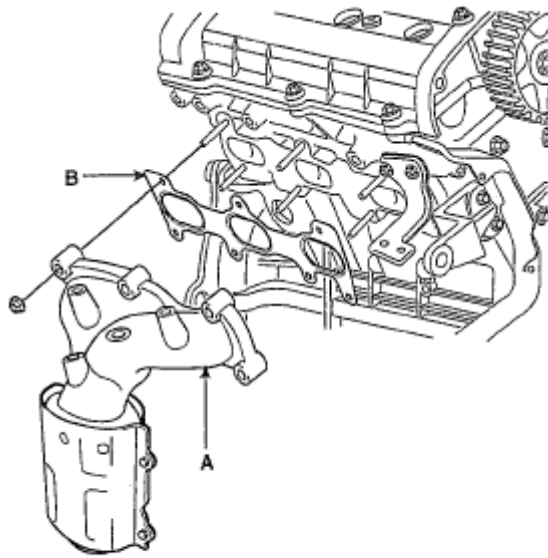
Fig. 211: Identifying Exhaust Manifold And Gasket

INSTALLATION

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

Tightening torque

24.5 ~ 29.4Nm (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)



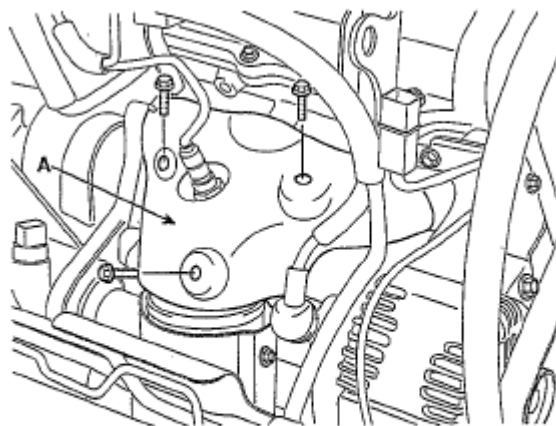
EDQF064A

Fig. 212: Identifying Exhaust Manifold And Gasket

2. Install the heat protector(A).

Tightening torque

16.7 ~ 21.6Nm (1.7 ~ 2.2kgf.m, 12.3 ~ 15.9lb-ft)



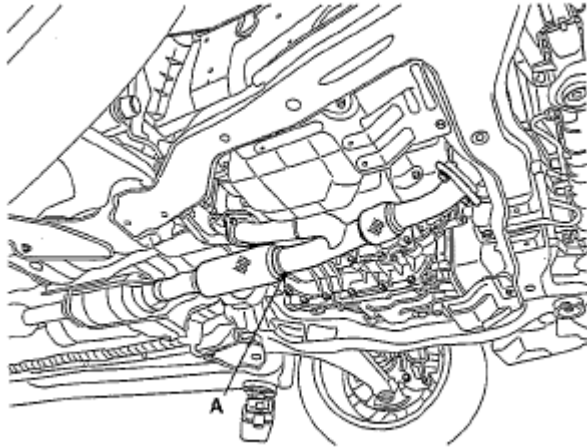
EDQF003A

Fig. 213: Identifying Heat Protector

3. Connect the oxygen sensor connector.
4. Install the front muffler(A).

Tightening torque

29.4 ~ 39.2Nm (3.0 ~ 4.0kgf.m, 21.7 ~ 28.9lb-ft)



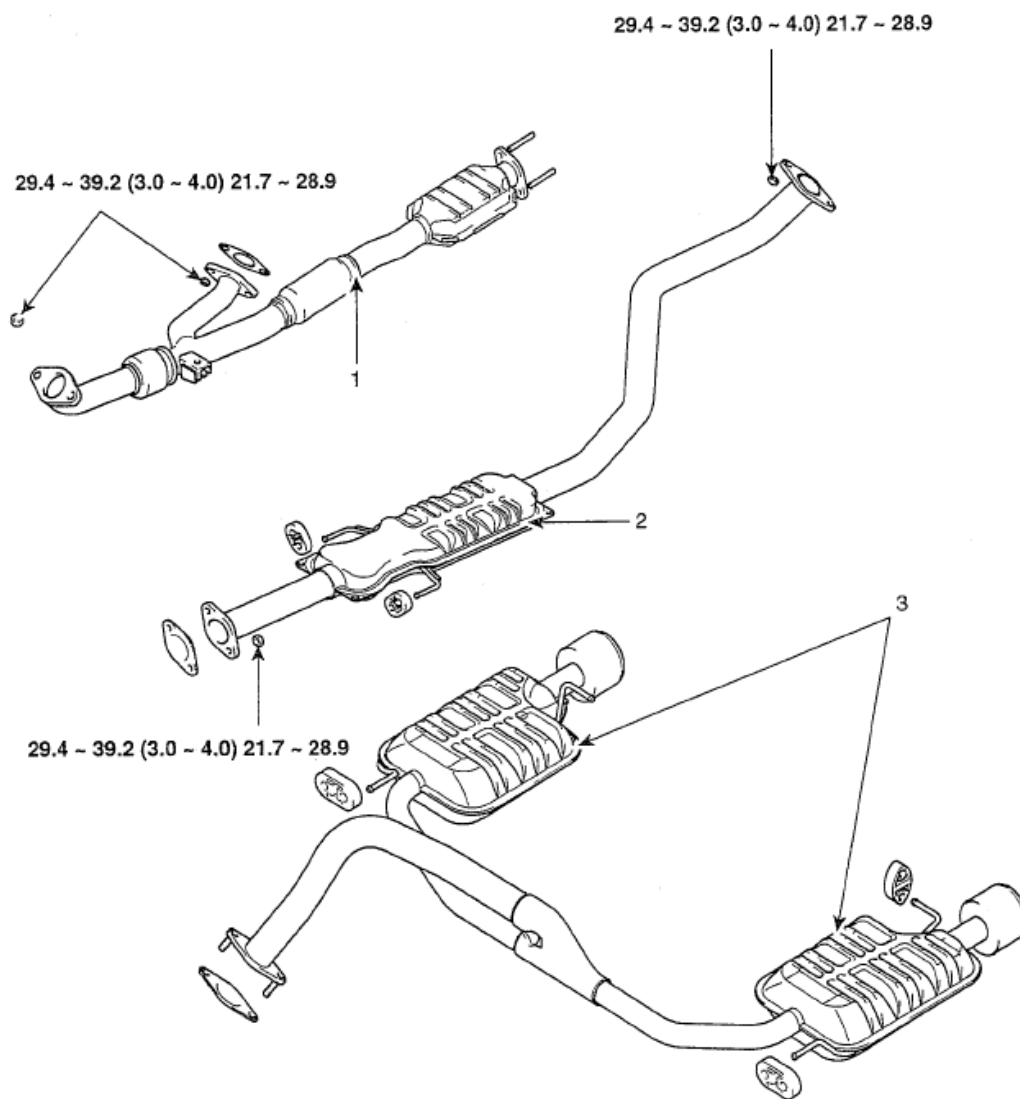
SGKM17008N

Fig. 214: Identifying Front Muffler

5. Install the under cover.

EXHAUST PIPE

COMPONENTS



TORQUE : Nm (kgf-m, lb-ft)

1. Front muffler
2. Center muffler
3. Main muffler

SGKM17301N

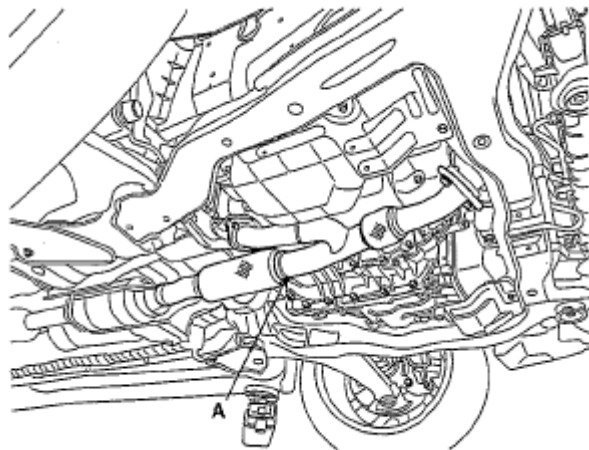
Fig. 215: Identifying Exhaust Pipe Components With Torque Specifications

REMOVAL

1. Remove the front muffler(A).

Tightening torque

29.4 ~ 39.2Nm (3.0 ~ 4.0kgf.m, 21.7 ~ 28.9lb-ft)



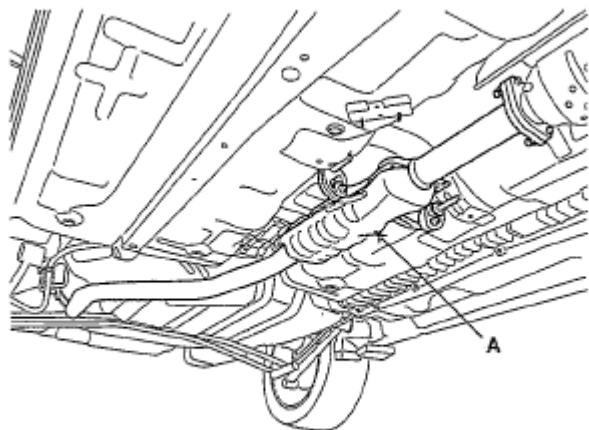
SGKM17006N

Fig. 216: Identifying Front Muffler

2. Remove the center muffler(A).

Tightening torque

29.4 ~ 39.2Nm (3.0 ~ 4.0kgf.m, 21.7 ~ 28.9lb-ft)



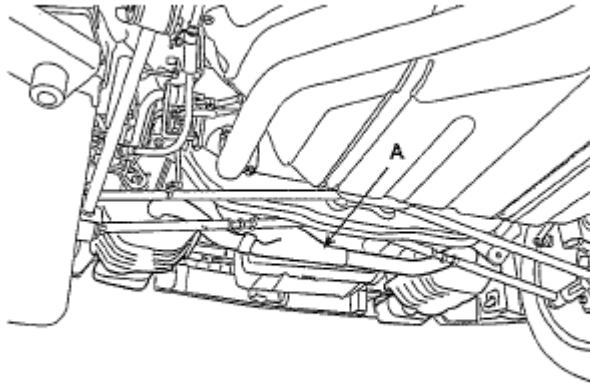
SGKM17014N

Fig. 217: Identifying Center Muffler

3. Remove the main muffler(A).

Tightening torque

29.4 ~ 39.2Nm (3.0 ~ 4.0kgf.m, 21.7 ~ 28.9lb-ft)



SGKM17015N

Fig. 218: Identifying Main Muffler

4. Install reverse the removal order with a new gasket.