2002 ENGINE

Engine Mechanical System (DOHC 1.6L) - Accent

GENERAL

SPECIFICATION

Description	Specification	Limit
General		
Type	In-line, Double Over Head Camshaft	
Number of cylinders	4	
Bore	76.5 mm (3.0118 in)	
Stroke	87 mm (3.4252 in)	
Total displacement	1599 cc (97.54 cu.in)	
Compression ratio	10	
Firing order	1 - 3 - 4 - 2	
Idle R.P.M.	750± 100	
Igniton timing at idling speed	BTDC 9° ±5°/800 rpm	
Valve timing		
Intake valve		
Opens (BTDC)	5°	
Closes (ABDC)	35°	
Exhaust valve		
Opens (BBDC)	43°	
Closes (ATDC)	5°	
Valve overlap	10°	
Cylinder head		
Flatness of cylinder head surface	Max. 0.03mm (0.0012 in.)	0.1 mm (0.0039 in.)
Flatness of mainfold mounting surface	0.15mm (0.0059 in.)	0.2 mm (0.008in.)
Oversize rework dimension of valve seat hole		
Intake		
0.3mm (0.012 in.) O.S.		
0.6mm (0.024 in.) O.S.	30.7 - 30.721 mm (1.2087 - 1.2095 in.)	
Exhaust	40.0 - 40.021 mm (1.5748 - 1.5756 in.)	
0.3mm (0.012 in.) O.S.		
0.6mm (0.024 in.) O.S	27.3 - 27.321 mm (1.0748 - 1.0756 in.)	
	27.6 - 27.621 mm (1.0866 - 1.0874 in.)	
Oversize rework dimensions of valve		
Guide hole		
0.05mm (0.002 in.) O.S.	11.05 - 11.068 mm (0.435 - 0.4357 in.)	
0.25mm (0.010 in.) O.S.	11.25 - 11.268 mm (0.443 - 0.4436 in.)	
0.50mm (0.020 in.) O.S.	11.50 - 11.518 mm (0.453 - 0.4535 in.)	
Camshaft		
Camlobe height		
Intake	43.4484 mm (1.7106 in.)	42.9484mm(1.6909 in.)
Exhaust	43.8489 mm (1.7263 in.)	43.3489mm(1.7.66 in.)
Joumal O.D	ø27 mm (1.0630 in.)	
Bearing oil clearance	0.035 - 0.072 mm (0.0014 - 0.0028 in.)	
End play	0.1 - 0.2 mm (0.004- 0.008 in.)	

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Fig. 1: Specification Table (1 Of 4)
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Description	Specification	Limit
Valve		
Valve length		
Intake	91.7 mm (3.6102 in.)	
Exhaust	92.3 mm (3.6339 in.)	
Stem O.D.		
Intake	5.955 - 5.97 mm (0.2344 - 0.2350 in.)	
Exhaust	5.935 - 5.95 mm (0.2337 - 0.2343 in.)	
Face angle thickness of valve head (Margin)		
Intake	1.1 mm (0.0433 in.)	0.8 mm (0.031 in.)
Exhaust	1.3 mm (0.0512 in.)	1.0 mm (0.039 in.)
Valve stem to valve guide clearance		
Intake	0.03 - 0.06 mm (0.0012 - 0.0024 in.)	0.10 mm (0.0039 in.)
Exhaust	0.05 - 0.08mm (0.0020 - 0.0031 in.)	0.15 mm (0.0059 in.)
Valve guide		
Installed dimension O.D.		
Intake	12.8 mm (0.504 in.)	
Exhaust	12.8 mm (0.504 in.)	
Service size	0.05, 0.25, 0.50mm (0.002, 0.010, 0.020 in.) oversize	
Valve seat		
Width of seat contact		
Intake	0.8 - 1.2 mm (0.031- 0.047 in.)	
Exhaust	1.3 - 1.7 mm (0.051- 0.066 in.)	
Seat angle	45°	
Oversize	0.3, 0.6 mm (0.012, 0.024 in.) oversize	
Valve spring		
Free length	44.00 mm (1.7323 in.)	
Load	21.6kg/ 35 mm (47.6lb/1.3780 in.) 45.1kg/ 27.2 mm (99.4lb/1.709 in.)	
Squareness	1.5° or less	
Cylinder block		
Cylinder bore	76.50 - 76.53 mm (3.0118 - 3.0130 in.)	
Out- of- round and taper of cylinder bore	Less than 0.01 mm (0.0004 in.)	
Clearance with piston	0.025 - 0.045 mm (0.0009 - 0.0017 in.)	
Piston		
O.D.	76.465 - 76.495 mm (3.010 - 3.012 in.)	
Service size	0.25, 0.50, 0.75, 1.00 mm (0.010, 0.020, 0.030, 0.039 in.) oversize	
Piston ring		
Side clearance		
No. 1	0.04 - 0.085 mm (0.0015 - 0.0033 in.)	0.1mm (0.004 in.)
No. 2	0.04 - 0.085 mm (0.0015 - 0.0033 in.)	0.1mm (0.004 in.)
Endgap		
No. 1	0.20 - 0.35 mm (0.0079 - 0.0138 in.)	1.0mm (0.039 in.)
No. 2	0.30 - 0.45 mm (0.0118 - 0.0177 in.)	1.0mm (0.039 in.)
Oil ring side rail	0.2 - 0.7 mm (0.0078 - 0.0275 in.)	1.0mm (0.039 in.)
Service size	0.25, 0.50, 0.75, 1.00 mm (0.010, 0.020, 0,030, 0.039 in.) noversize	

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Fig. 2: Specification Table (2 Of 4)
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Description	Specification	Limit
Connecting rod		
Bend	0.05mm (0.0020 in.) or less	
Twist	0.1mm (0.0039 in.) or less	
Connecting rod big end to crankshaft side clearance	0.100 - 0.250mm (0.0039 - 0.0098 in.)	0.4mm (0.0157 in.)
Connecting rod bearing oil clearance	0.018 - 0.036mm (0.0007 - 0.0014 in.)	
Undersize	0.25, 0.50, 0.75mm (0.010, 0.020, 0.030 in.)	
Crankshaft		
Pin O.D.	45 mm (1.77 in.)	
Journal O.D.	50 mm (1.97 in.)	
Bend	0.03 mm (0.0012 in.) or less	
Out- of- round, taper of journal and pin	0.005 mm (0.0002 in.) or less	
End play	0.05 - 0.175 mm (0.0019 - 0.0068 in.)	
Undersize rework dimension of pin		
0.25mm (0.010 in.)	44.725- 44.74mm (1.7608- 1.7614 in.)	
0.50mm (0.20 in.)	44.475-44.49mm (1.7509- 1.7516 in.)	
0.75mm (0.030 in.)	44.225-44.24mm (1.7411- 1.7417 in.)	
Undersize rework dimension of journal		
0.25mm (0.010 in.)	49.727 - 49.742 mm (1.9577 - 1.9583 in.)	
0.50mm (0.20 in.)	49.477 - 49.492 mm (1.9479 - 1.9485 in.)	
0.75mm (0.030 in.)	49.227 - 49.242 mm (1.9380 - 1.9386 in.)	
Flywheel		
Runout	0.1mm (0.0039 in.)	0.13mm (0.0051 in.)
Oil pump		
Clearance between outer circumference and front case (body clearance)	0.12 - 0.18 mm (0.0047- 0.0070 in.)	
Front case tip clearance	0.025 - 0.069 mm (0.001- 0.0027 in.)	
Side clearance		
Inner gear	0.04 - 0.085 mm (0.0016 - 0.0033 in.)	
Outer gear	0.06 - 0.11 mm (0.0024 - 0.0043 in.)	
Engine oil pressure		
Engine at idle [Oil temperature is 90 to 100°C (194 to 215°F)]	147KPa (1.5 kg/ cm², 21.33psi)	
Relief spring		
Free height	46.6mm (1.8346 in.)	
Load	6.1kg at 40.1mm (13.42lb/ 1.578 in.)	
Cooling method	Water-cooled, pressurized, forced circulation with electrical fan	
Coolant		
Quantity	6 liter	
Radiator		
Type	Pressurized corrugated fin type	
Radiator cap		
Main valve opening pressure	81.4-108 kpa (11.8-15.6 psi.,0.83-1.1kg/cm²)	
Vacuum valve opening pressure	-6.86 kpa (-1.00 psi, -0.07 kg/cm² or less	
Coolant pump	Centrifugal type impeller	

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Fig. 3: Specification Table (3 Of 4)
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Description	Specification	Limit
Thermostat		
Type	Wax pellet type with jiggle valve	
Valve opening temperature	82°C (180°F)	
Full-opening temperature	95°C (203°F)	
Engine coolant temperature sensor		
Type	Heat-sensitive thermistor type	
Resistance	2.31-2.59k Ω at 20°C(68°F)	
	146.9-147.3 Ω at 110°C(230°F)	
Air cleaner		
Type	Dry type	
Element	Un woven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

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Fig. 4: Specification Table (4 Of 4)
Courtesy of HYUNDAI MOTOR CO.

NOTE: **O.D. = Outer Diameter**
I.D. = Inner Diameter
O.S. = Oversize Diameter
U.S. = Undersize Diameter

TIGHTENING TORQUE

WARNING: **For updated reuse guidelines and tightening procedures of cylinder head, connecting rod and main bearing bolts, refer to TSB 02-20-002 CYLINDER HEAD/CONNECTING ROD/MAIN BEARING BOLT REUSE GUIDELINES & TORQUE SPECS .**

TORQUE SPECIFICATIONS

Application	Ft Lbs. (N.m)
Alternator Brace Bolt	15-20 (20-27)
Alternator Support Fasteners	15-18 (20-25)
Camshaft Sprocket Bolt	59-74 (80-100)
Connecting Rod Cap Nut	24-26 (32-35)
Coolant Inlet Fitting Bolt	13-14 (17-20)
Coolant Temperature Sensor	18-22 (25-30)
Crankshaft Bearing Cap Bolt	41-44 (55-60)
Crankshaft Pulley Bolt	103-111 (140-150)
Cylinder Head Bolts (1)	
Step 1	26 (35)
Step 2	Tighten An Additional 90 Degrees
Step 3	Loosen All Bolts
Step 4	26 (35)

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Step 5	Tighten An Additional 90 Degrees
Driveplate/Flywheel Bolts	
Automatic Transmission	89-96 (120-130)
Manual Transmission	89-96 (120-130)
Engine Mounts	
Front Engine Support Bracket Fasteners	33-41 (45-55)
Front Engine Support Bracket Stay Bolt	33-41 (45-55)
Front Roll Stopper Bracket-To-Sub Frame	30-36 (40-50)
Front Roll Stopper Insulator Nut	36-48 (50-60)
Rear Roll Stopper Bracket Subframe Bolts	30-36 (40-50)
Rear Roll Stopper Insulator Nut	37-48 (50-65)
Right Mounting Bracket-To-Engine Fasteners	37-48 (50-65)
Right Mounting Insulator Nut (Large)	66-81 (90-110)
Right Mounting Insulator Nut (Small)	33-41 (45-60)
Transmission Insulator Bracket-To-Side Member Nut	30-37 (40-50)
Transmission Mount Insulator Nut	66-81 (90-110)
Exhaust Manifold Cover-To-Exhaust Manifold Bolts	11-15 (15-20)
Exhaust Manifold Nut	18-22 (25-30)
Exhaust Pipe (Front) Bracket Bolt	22-30 (30-40)
Exhaust Pipe-To-Catalytic Converter	30-40 (40-60)
Exhaust Pipe-To-Exhaust Manifold Nut	22-30 (30-40)
Front Case Bolt	15-20 (20-27)
Intake Manifold Bolts & Nuts	11-15 (15-20)
Oil Filter	9-12 (12-16)
Oil Pan Drain Plug	25-33 (35-45)
Oil Screen Bolts	11-16 (15-22)
Oxygen Sensor	37-44 (50-60)
Rear Plate Bolt	24-26 (32-35)
Surge Tank Stay-To-Cylinder Block Bolt	13-18 (18-25)
Thermostat Housing Bolt	11-14 (15-20)
Throttle Body-To-Surge Tank Bolts	11-14 (15-20)
Timing Belt Idler Bolt	32-41 (43-55)
Timing Belt Tensioner Bolt	15-20 (20-27)
	INCH Lbs. (N.m)
Air Cleaner Body Mounting Bolts	71-89 (8-10)
Alternator Lock Bolt	106-133 (12-15)
Camshaft Bearing Nut	106-124 (12-14)
Coolant Pump Pulley Bolt	71-89 (8-10)
Cylinder Head Cover Bolts	71-89 (8-10)
Coolant Pump Bolt	106-133 (12-15)

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Oil Pan Bolts	89-106 (10-12)
Oil Pressure Switch	10-11 (13-45)
Resonator Mounting Bolt	27-35 (4-6)
Timing Belt Cover Bolt	71-89 (8-10)
(1) Tighten cylinder head bolts in sequence. See **Fig. 5**.	

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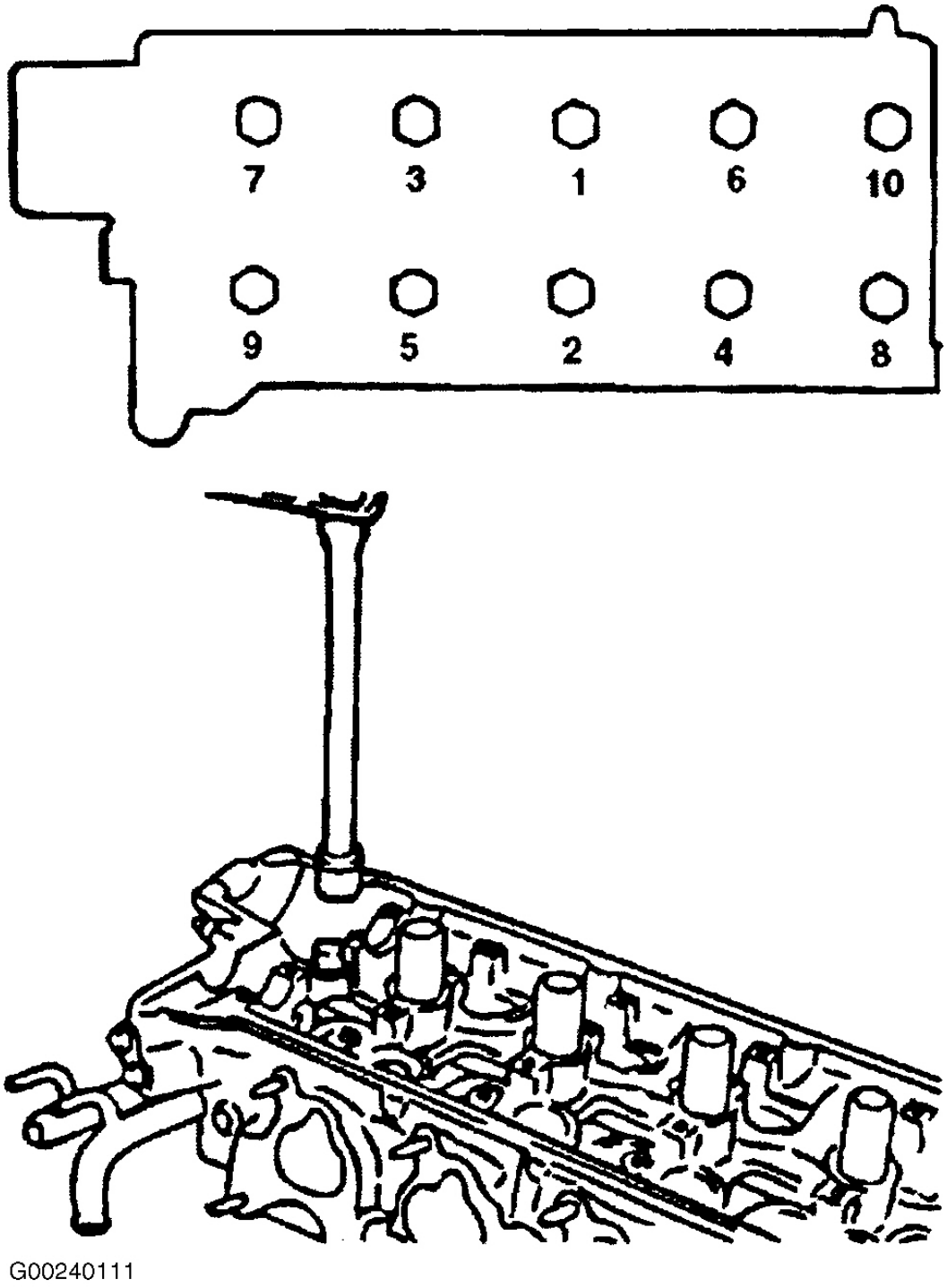

Fig. 5: Identifying Cylinder Head Tightening Sequence
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SERVICE STANDARD

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

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Fig. 6: Service Standard
Courtesy of HYUNDAI MOTOR CO.

SPECIAL TOOLS

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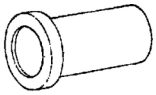
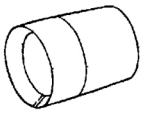
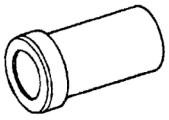
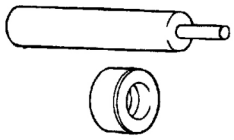
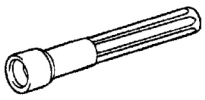
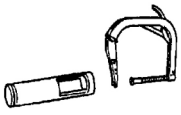
Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-21000)		Installation of the front oil seal
Crankshaft front oil seal guide (09214-21100)		Guide of oil seal
Camshaft oil seal installer (09221-21000)		Installation of the camshaft oil seal
Valve guide installer (09221-22000)		Removal and installation of valve guides
Valve stem oil seal installer (09222-22001)		Installation of valve stem oil seals
Valve spring compressor (09222-28000) Valve spring compressor holder (09222-28000)		Removal and installation of intake and exhaust valves

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Fig. 7: Identifying Special Tools (1 Of 2)
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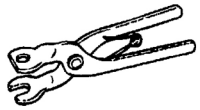
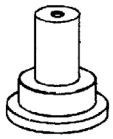
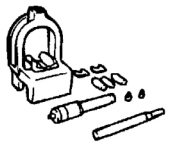
Tool (Number and name)	Illustration	Use
Valve stem seal remover 09222-29000		Removal of valve stem seal
Crankshaft rear oil seal installer (09231-21000)		Installation of engine real oil seal and crankshaft rear oil seal
Piston pin remover and installer kit (09234-33001)		Removal and installation of piston pin (Use with 09234-33003)
Piston pin setting tool insert (09234-33002)		Removal and installation of piston pin (Use with 09234-33001)

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Fig. 8: Identifying Special Tools (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

TROUBLESHOOTING

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Symptom	Probable cause	Remedy
Low compression	Blown cylinder head gasket Worn or damaged piston rings Worn piston or cylinder Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Low oil pressure	Low engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and determine cause Repair Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine vibration	Loose engine roll stopper (front, rear) Loose transaxle mount bracket Loose engine mount bracket Loose center member Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Re-tighten Re-tighten Re-tighten Re-tighten Replace Replace Replace
Noisy valves	Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide HLA abnormal operation	Change Replace Speed the engine up (for venting) or Replace the HLA
Connecting rod and/or main bearing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and determine cause Replace
Timing belt noise	Incorrect belt tension	Adjust belt tension
Low coolant level	Leakage of coolant 1. Heater or radiator hose 2. Faulty radiator cap 3. Thermostat housing 4. Radiator 5. Engine coolant pump	 Repair or replace parts Tighten or replace clamps Replace gasket or housing Repair or replace Replace parts
Clogged radiator	Foreign material in coolant	Replace coolant
Abnormally high coolant temperature	Faulty thermostat Faulty radiator cap Restricted flow in cooling system Loose or missing drive belt Faulty water pump Faulty electric fan Insufficient coolant	Replace parts Replace parts Clear restriction or replace parts Adjust or replace Replace Repair or replace Refill coolant
Abnormally low coolant temperature	Faulty thermostat Faulty temperature sensor wiring	Replace Repair or replace
Inoperative electrical cooling fan	Damaged thermo sensor, electrical motor, radiator fan relay and wiring, fuse	Replace or repair

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Fig. 9: Troubleshooting Table (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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Symptom	Probable cause	Remedy
Exhaust gas leakage	Loose connections Broken pipe or muffler	Retighten Repair or replace
Abnormal noise	Detached baffle plate in muffler Broken rubber hanger Pipe or muffler contacting vehicle body Broken pipe or muffler	Replace Replace Correct Repair or replace

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Fig. 10: Troubleshooting Table (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

MAINTNENCE

CHECKING ENGINE OIL

1. Position the vehicle on a level surface.
2. Warm up the engine.

NOTE: If a vehicle has been out of service for a prolonged period of time, warm up the engine for approximately 20 minutes.

3. Turn off the engine, and wait 2 or 3 minutes, then check the oil level.
4. Check that the engine oil level is within the level range indicated on the oil dipstick If the oil level is found to have fallen to the lower limit (the L mark), refill to the "F" mark.

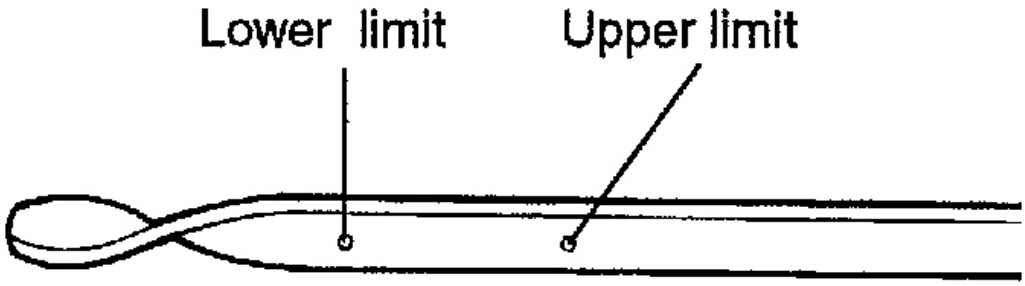

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Fig. 11: Locating Dipstick Level Range Indication
Courtesy of HYUNDAI MOTOR CO.

NOTE: When refilling, use the same type of engine oil.

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5. Check that the oil is not dirty or contaminated with coolant or gasoline, and that it has the proper viscosity.

CHANGING ENGINE OIL

CAUTION: Be careful not to burn yourself, as the engine oil is hot.

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine
3. Remove the oil filler cap and the drain plug (on the oil pan). Drain the engine oil.

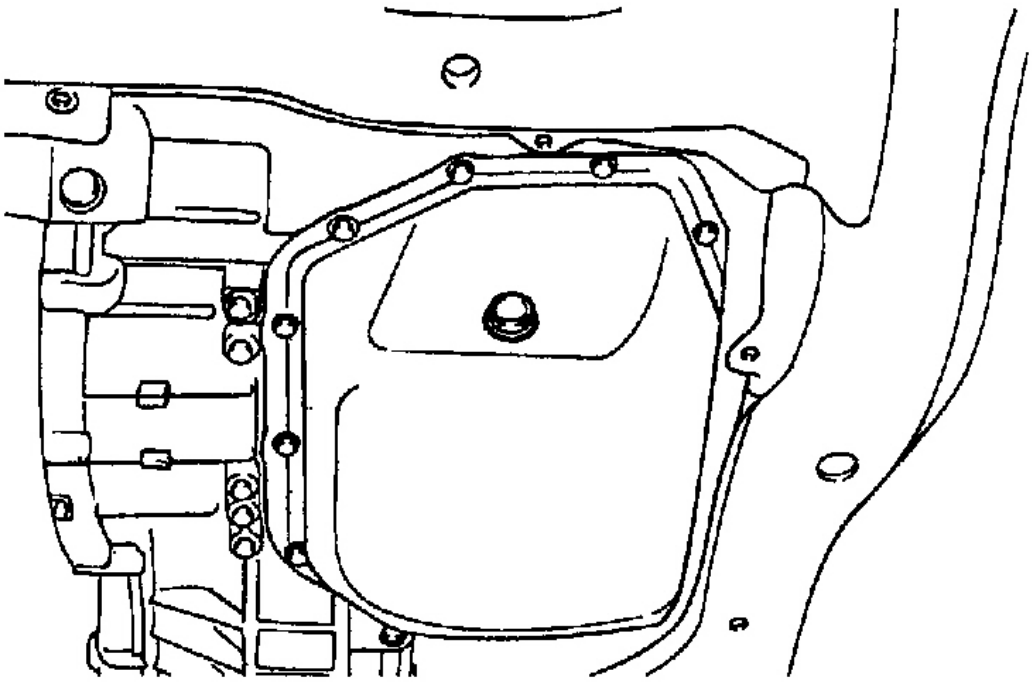

Fig. 12: Identifying Drain Plug
Courtesy of HYUNDAI MOTOR CO.

4. Install and tighten the drain plug to the specified torque.

Tightening torque

Drain plug: 35-45Nm (350-450 kg.cm, 24-33 lb.ft)

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5. Fill the crankcase with fresh engine oil through the oil filler cap opening.

   Drain and Refill Without oil filter:

   3.0liter (3.17U.S.qts, 2.64 Imp.qts.)

   Drain and Refill With oil filter:

   3.3liter (3.48 U.S.qts., 2.90 Imp.qts.)

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

FILTER SELECTION

All Hyundai engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter on all vehicles. The quality of replacement filters varies considerably. Only high quality filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing the new filter.

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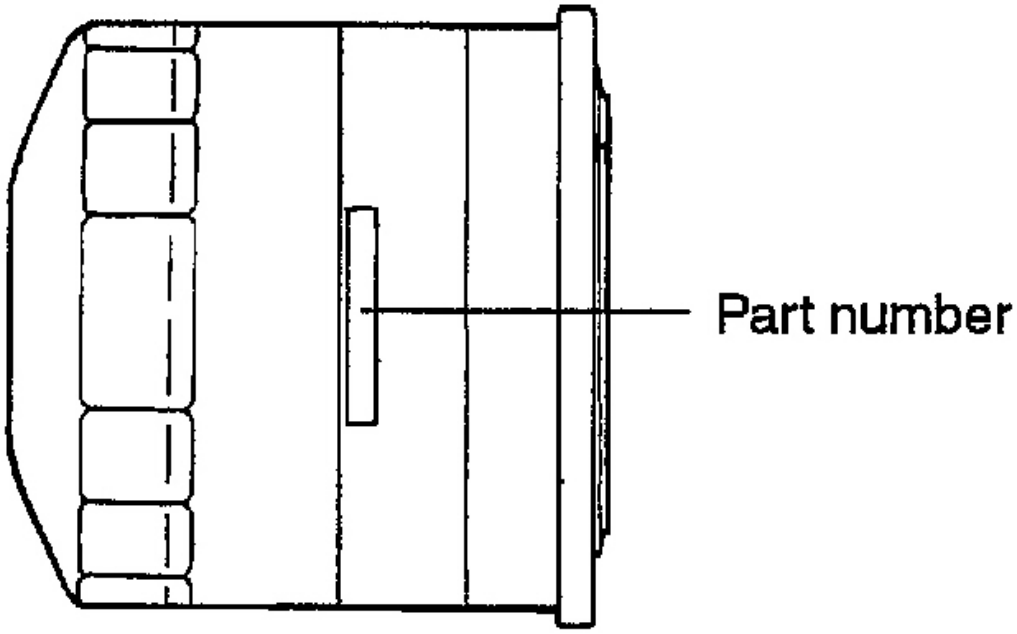

Fig. 13: Locating Oil Filter Part Number
Courtesy of HYUNDAI MOTOR CO.

PROCEDURE FOR REPLACING THE OIL FILTER

CAUTION: Be careful not to burn yourself, as the engine and engine oil are hot.

1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.

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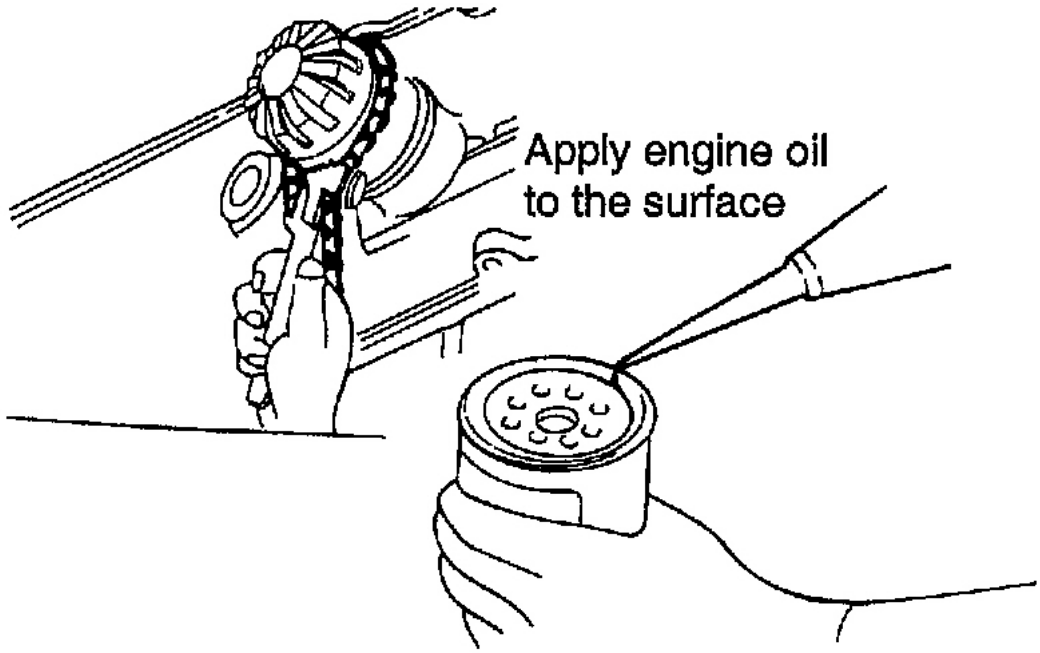

Fig. 14: Installing Oil Filter
Courtesy of HYUNDAI MOTOR CO.

3. Tighten the oil filter to the specified torque.

   Tightening torque

   Oil filter: 12 - 16 Nm (120 - 160 kg.cm, 9 - 12 lb.ft)

4. Run the engine to check for engine oil leaks.
5. After turning off the engine, check the oil level and add oil as necessary.

SELECTION OF ENGINE OIL

Recommended API classification: SG OR ABOVE [For EC.]

Recommended SAE viscosity grades:

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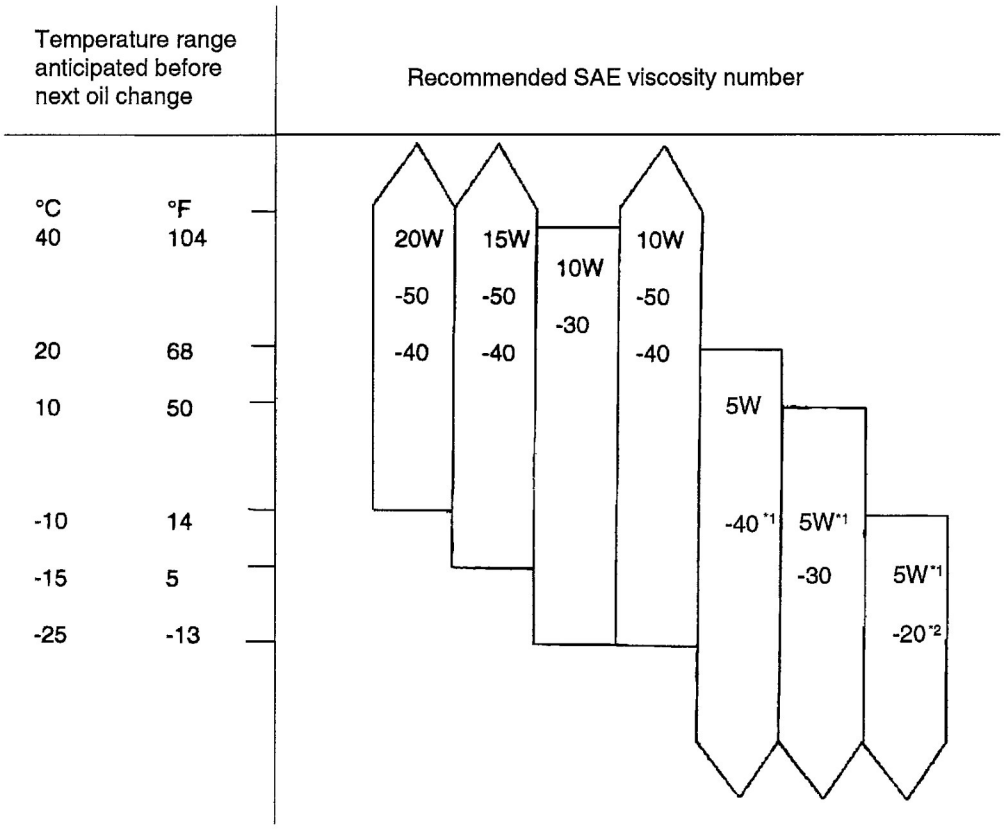

***1 Restricted by driving condition and environment.**
***2 Not recommended for sustained high speed vehicle operation**

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Fig. 15: Recommended SAE Viscosity Grades
Courtesy of HYUNDAI MOTOR CO.

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

NOTE:

1. **Satisfy the requirements of the API classification.**
2. **Have proper SAE grade number for expected ambient temperature range.**

NOTE: Lubricant that does not have both an SAE grade number and an API service classification on the container should not be used.

CHECKING COOLANT LEAK

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.

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3. Install a radiator cap tester to the radiator filler neck and apply 140 KPa (1.4 kg/cm^2 , 20psi) pressure. Hold it for two minutes in that condition, while checking for leakage from the radiator, hoses or connections.

NOTE:

1. **Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.**
2. **Be sure to clean away any moisture from the places checked completely.**
3. **When the tester is removed, be careful not to spill any coolant from it.**
4. **Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.**

4. If there is leakage, repair or replace with the appropriate part.

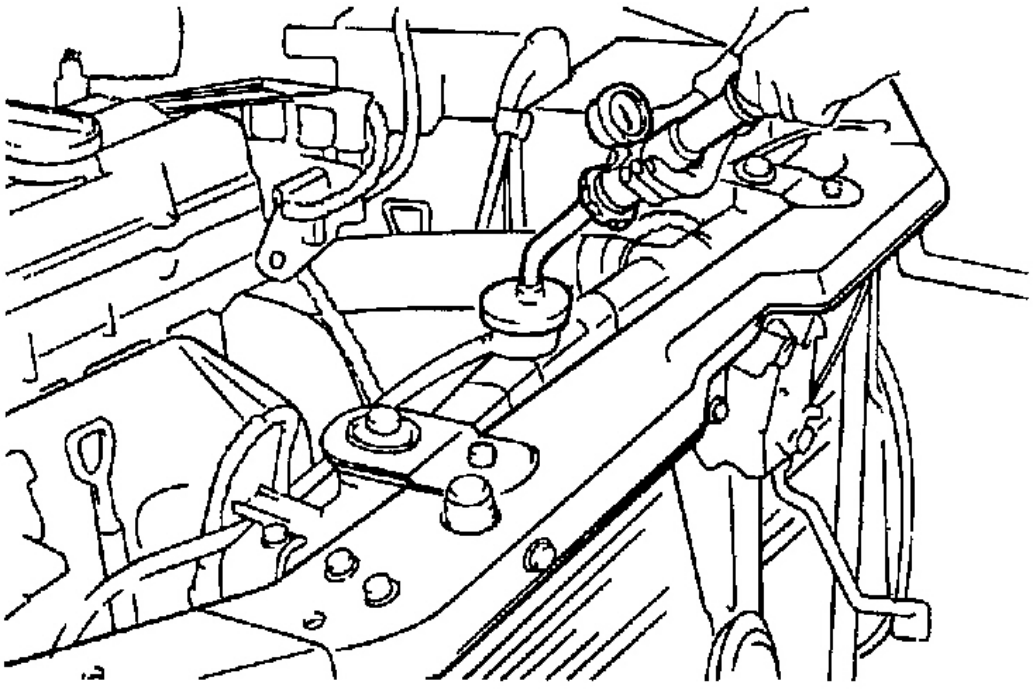

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Fig. 16: Pressure Testing Cooling System
Courtesy of HYUNDAI MOTOR CO.

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RADIATOR CAP PRESSURE TEST

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

   Main valve opening pressure:

   83-110 kPa (0.83-1.1 kg/cm^2 , 12-16psi)

   Vacuum valve opening pressure:

   -7 kPa (-0.07 kg/cm^2 , -1.0 psi)

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

NOTE: Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.

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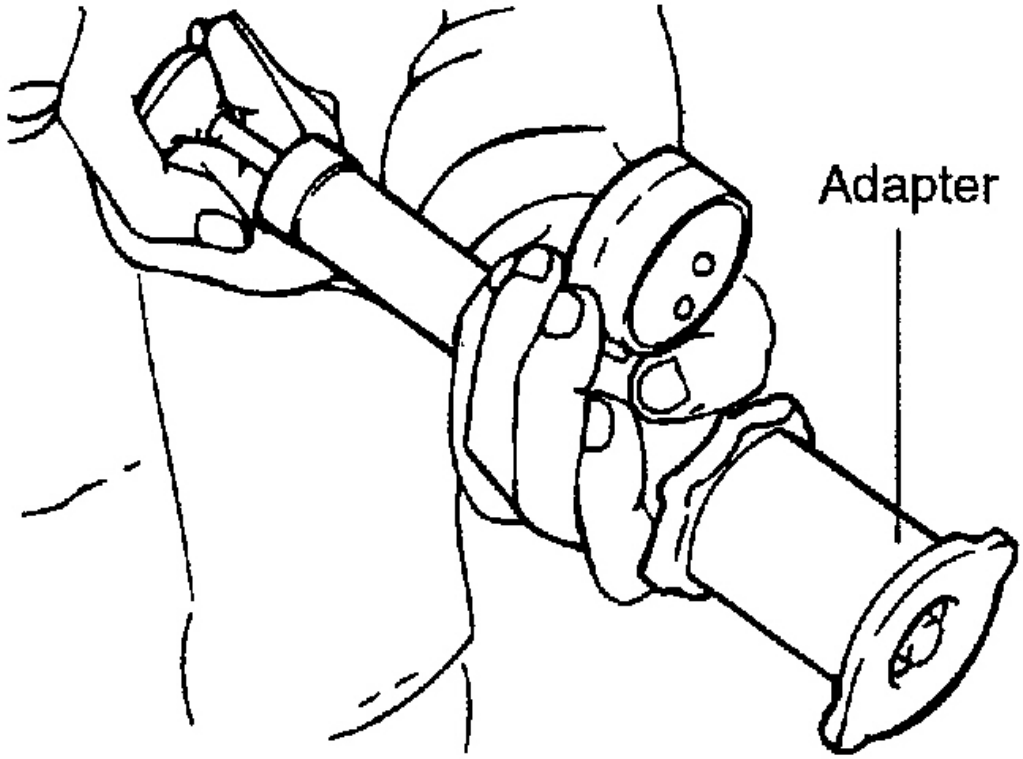

Fig. 17: Pressure Testing Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

SPECIFIC GRAVITY TEST

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using **Fig. 19** for reference.

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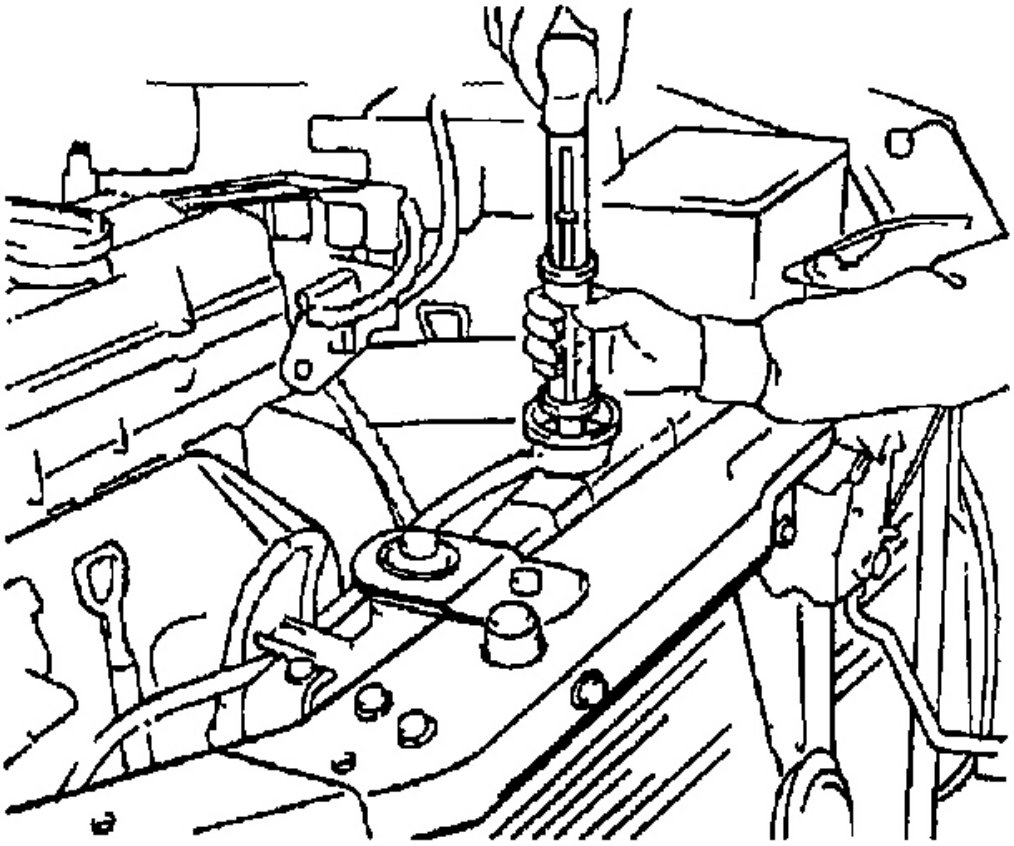

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Fig. 18: Inspecting Coolant Specific Gravity
Courtesy of HYUNDAI MOTOR CO.

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

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Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

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Fig. 19: Relation Between Coolant Concentration & Specific Gravity
Courtesy of HYUNDAI MOTOR CO.

Example

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

CAUTION:

- **If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.**
- **If the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.**
- **Do not use together with another brand's product.**

Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

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Fig. 20: Recommended Coolant
Courtesy of HYUNDAI MOTOR CO.

CHECKING COMPRESSION PRESSURE

1. Before checking engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until engine coolant temperature reaches 80-95°C (176-205°F).
3. Turn off engine and disconnect the spark plug cables.
4. Remove the spark plugs.

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5. Crank the engine to remove any foreign material in the cylinders.
6. Insert the compression gauge into the spark plug hole.
7. Depress the accelerator pedal to open the throttle fully.
8. Crank the engine and read the gauge.

   Standard value: 1500kpa (15Kg/cm^2 , 218 psi)

   Limit: 1400kpa (14Kg/cm^2 , 203 psi)

9. Repeat steps 6 to 8 over all cylinders, ensuring that the pressure differential for each of the cylinders is within the specified limit.

   Limit Max. 100 kpa (1.0 kg/cm^2 , 14 psi): between cylinders

10. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the spark plug hole, and repeat steps 6 to 9.

1. If the addition of oil makes the compression to rise, it is likely that there may be wear between the piston ring and cylinder wall
2. If compression remains the same, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

Tightening torque

Spark plug: 20-30 Nm (200-300 kg.cm, 14-22 lb.ft)

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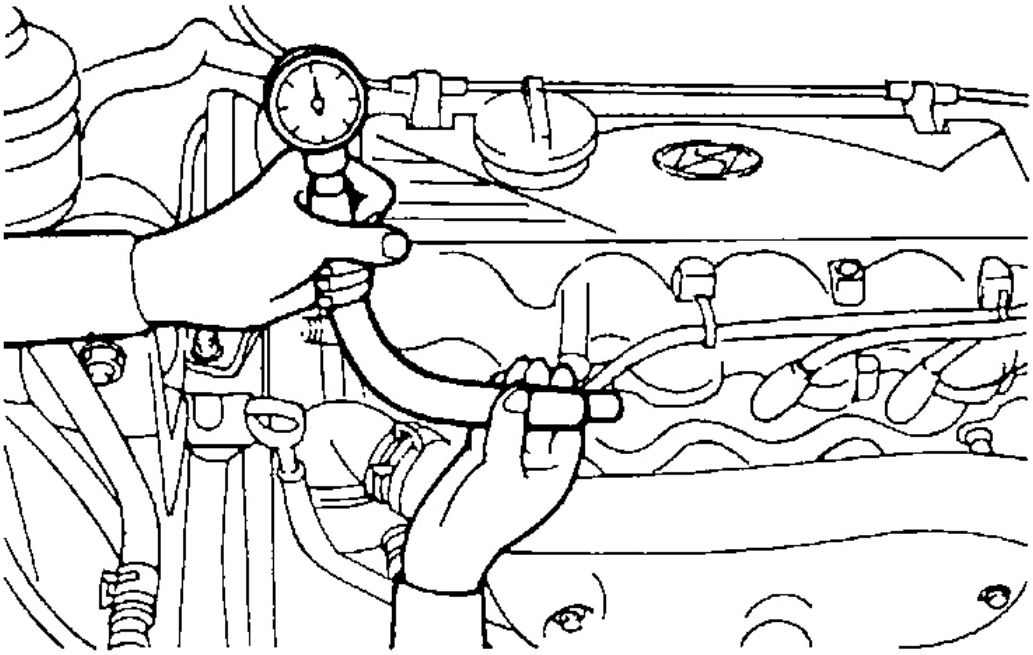

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Fig. 21: Checking Compression
Courtesy of HYUNDAI MOTOR CO.

ADJUSTING TIMING BELT TENSION

1. Lift the vehicle by using of jack.
2. Rotate the steering wheel counter-clockwise thoroughly.

NOTE: Do watch not to over load.

3. Remove the engine support bracket.

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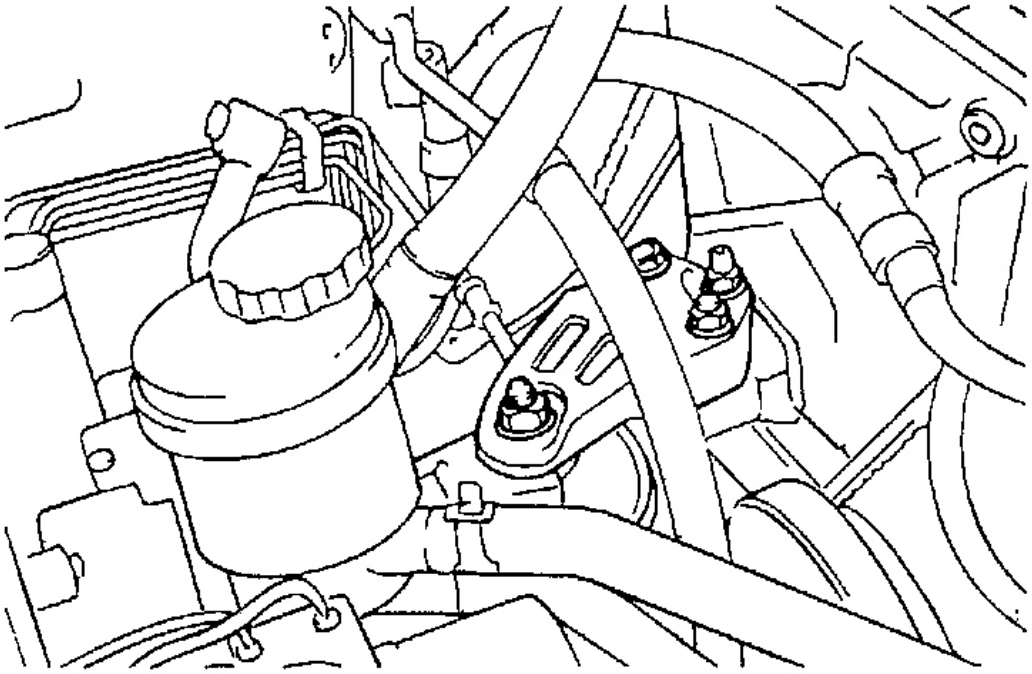

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Fig. 22: Identifying Engine Support Bracket
Courtesy of HYUNDAI MOTOR CO.

4. Remove the water pump pulley.
5. Remove the timing belt upper cover.

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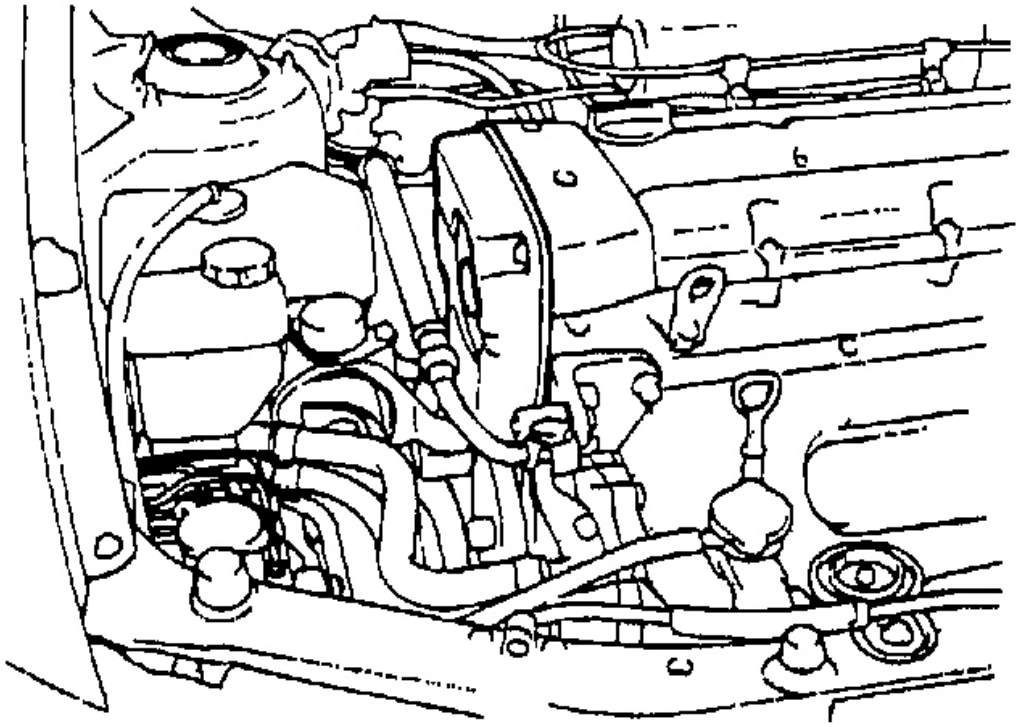

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Fig. 23: Identifying Timing Belt Upper Cover
Courtesy of HYUNDAI MOTOR CO.

6. Remove the spark plug.
7. Place the piston of No.1 cylinder to TDC of the compression stroke by rotating the crankshaft clockwise.

NOTE: Crankshaft is to be rotated clockwise otherwise, the tension is inadequately adjusted.

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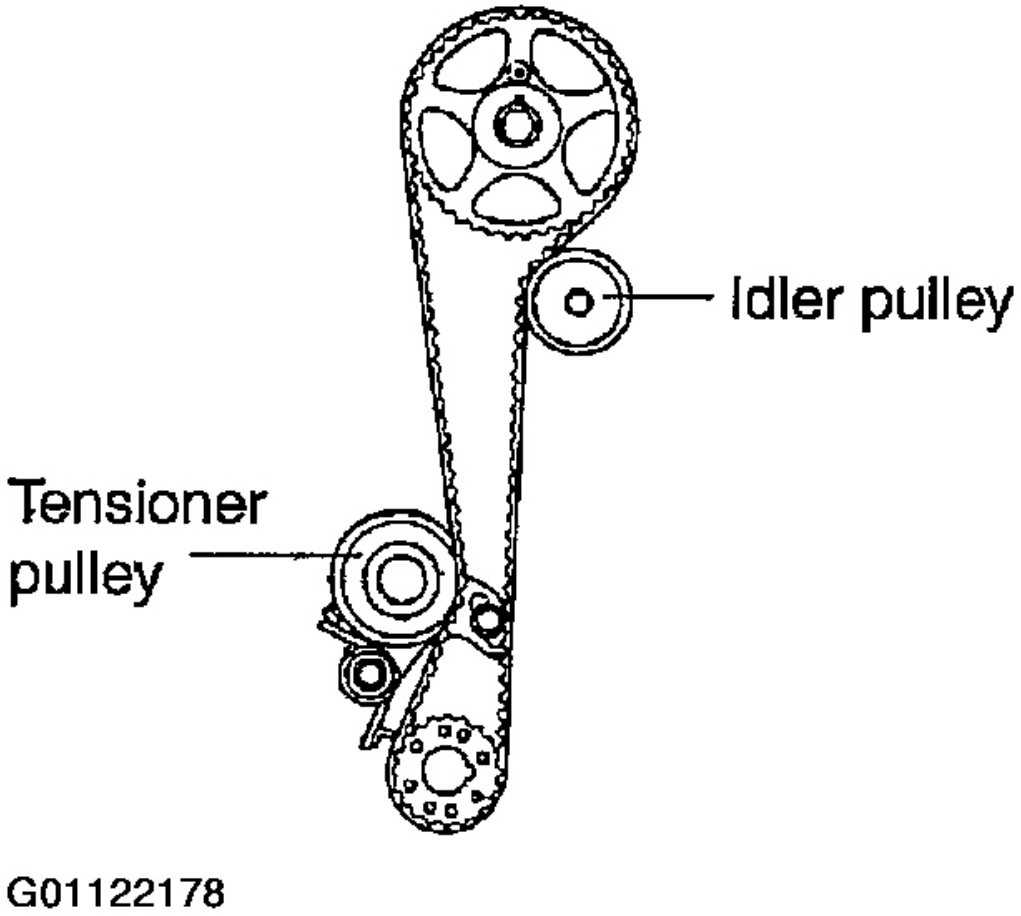

Fig. 24: Locating Idler & Tensioner Pulley
Courtesy of HYUNDAI MOTOR CO.

8. Loosen the tensioner bolt of pivot side and slot side.
9. Rotate the crankshaft clockwise as many as 2 teeth of sprocket.

NOTE: Set the exhaust valve rocker arm to upper position of cam in order to be the specified tension.

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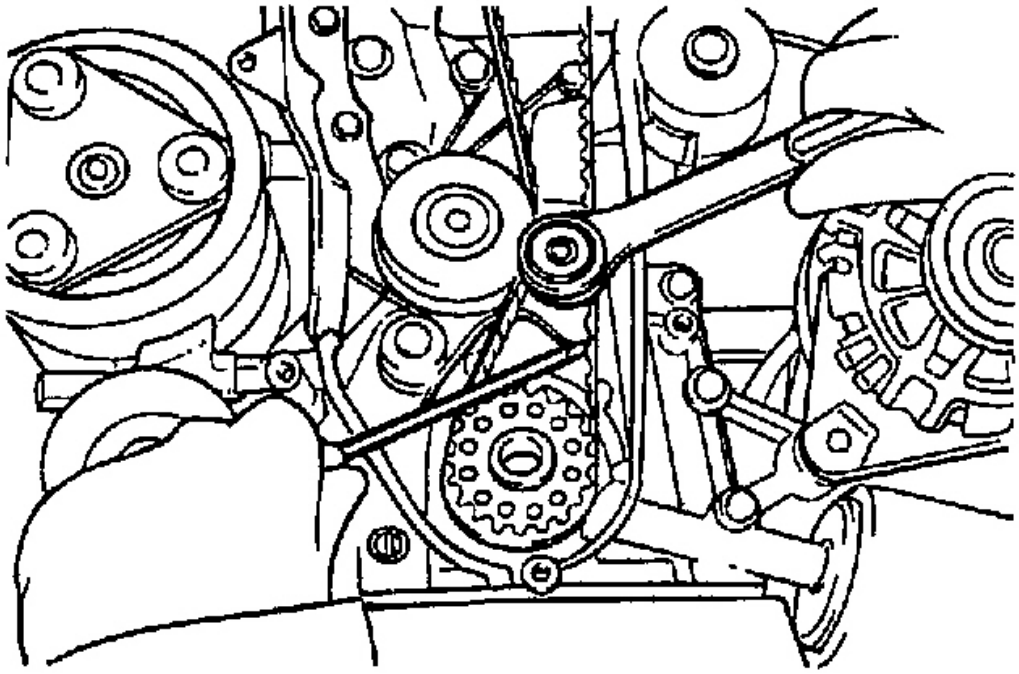

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Fig. 25: Tightening Bolt
Courtesy of HYUNDAI MOTOR CO.

10. Check that the teeth of sprocket and belt coincide with each other.
11. Tighten the bolt of slot side of first and then tighten the bolt of pivot side.
12. Install the timing belt tension.
13. Install the spark plug.
14. Install the timing belt upper cover.
15. Install the water pump pulley and engine support bracket.

ADJUSTING DRIVE BELT TENSION

1. Check that the belts are not damaged and are properly fit for the pulley grooves.
2. Apply 100 N (22 lbs.) force to the back and midway portion of the belt between the pulleys as shown in the illustration, measure the amount of deflection with a tension gauge.

CAUTION: **1. When installing the V-ribbed belt, check that the V-ribs are properly aligned.**

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2. **If noise or slippage is detected, check the belt for wear, damage, or breakage on the pulley contact surface, and check the pulley for scoring. Also check the amount that the belt is deflected.**

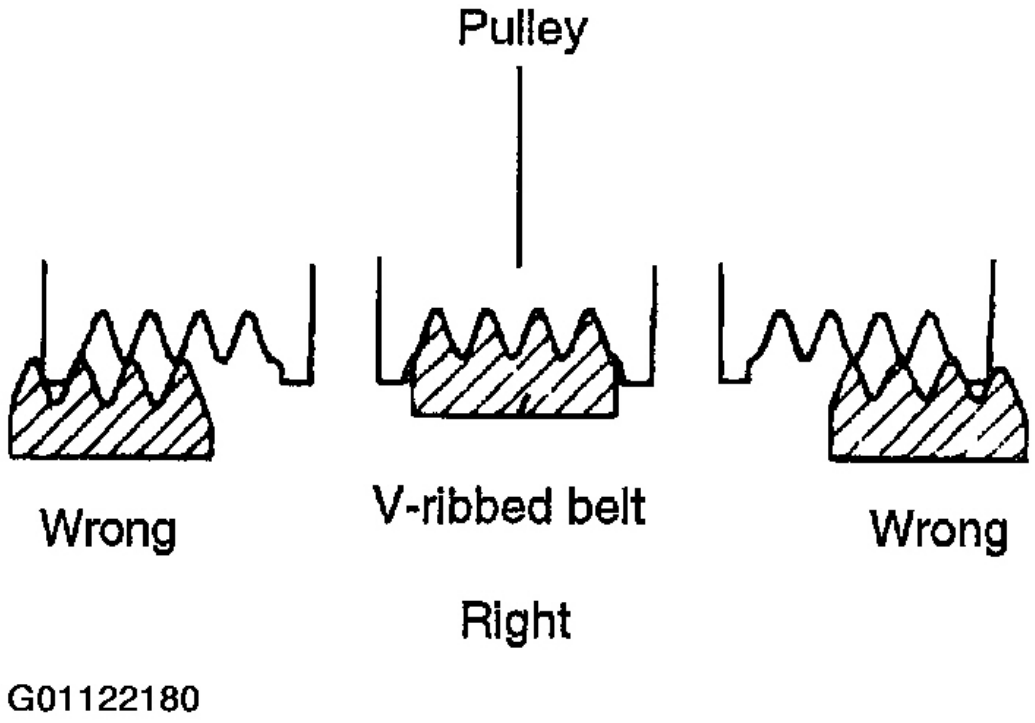

Fig. 26: Verifying Belt Installation
Courtesy of HYUNDAI MOTOR CO.

STANDARD VALUE:

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Items		Inspection	Adjustment	
			New	Used
For alternator	Deflection mm (in.)	5.1-6.0 (0.200-0.236)	4.0-4.4 (0.157-0.173)	5.1-5.7 (0.200-0.224)
	Tension N (lb)	350-500 (79-112)	650-750 (143-165)	400-500 (88-110)
For air conditioner	Deflection mm (in.)	8 (0.31)	5.0-5.5 (0.20-0.22)	6.0-7.0 (0.24-0.28)
	Tension N (lb)	250-500 (56-112)	470-570 (106-128)	320-400 (72-90)
For power steering	Deflection mm (in.)	6.0-9.0 (0.24-0.35)	-	-

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Fig. 27: Standard Value Table
Courtesy of HYUNDAI MOTOR CO.

NOTE:

1. **The belt tension must be measured half - way between the specified pulleys.**
2. **When a new belt is installed, adjust the tension to the central value of the standard range indicated under "New" in the above table. Let the engine idle for 5 minutes or more, and check the standard value indicated under "Inspection."**
3. **When adjusting a belt which has been used, or newly installed, after 5 minutes or more of operation, refer to the standard value indicated under "Used" in Fig. 27.**
4. **Refer to the standard value indicated under "inspection" for periodic inspections.**

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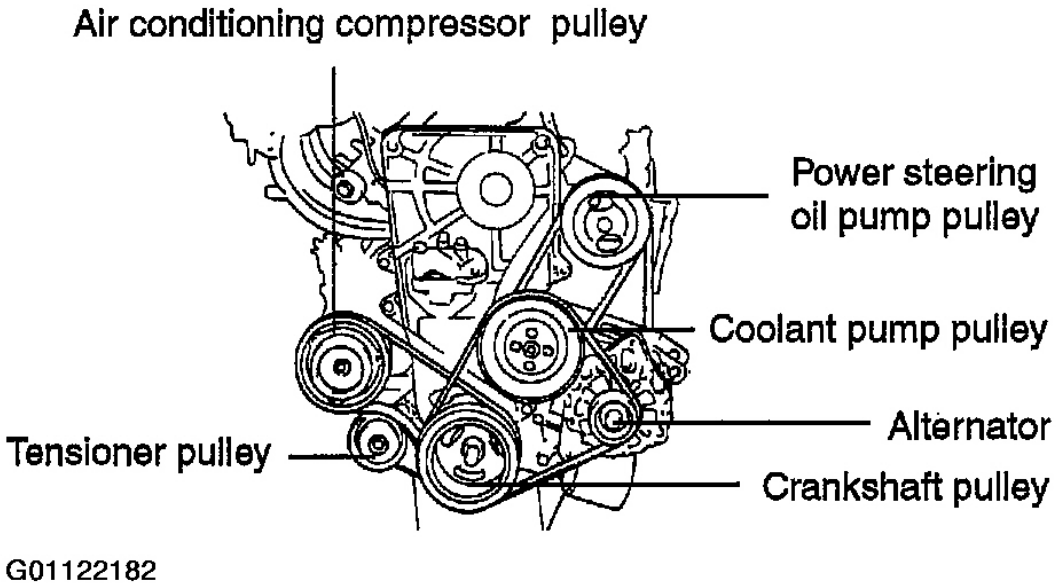

Fig. 28: Locating Engine Pulleys
Courtesy of HYUNDAI MOTOR CO.

TYPE A TENSION GAUGE

Do not let the dial section of the tension gauge contact other objects during measurement.

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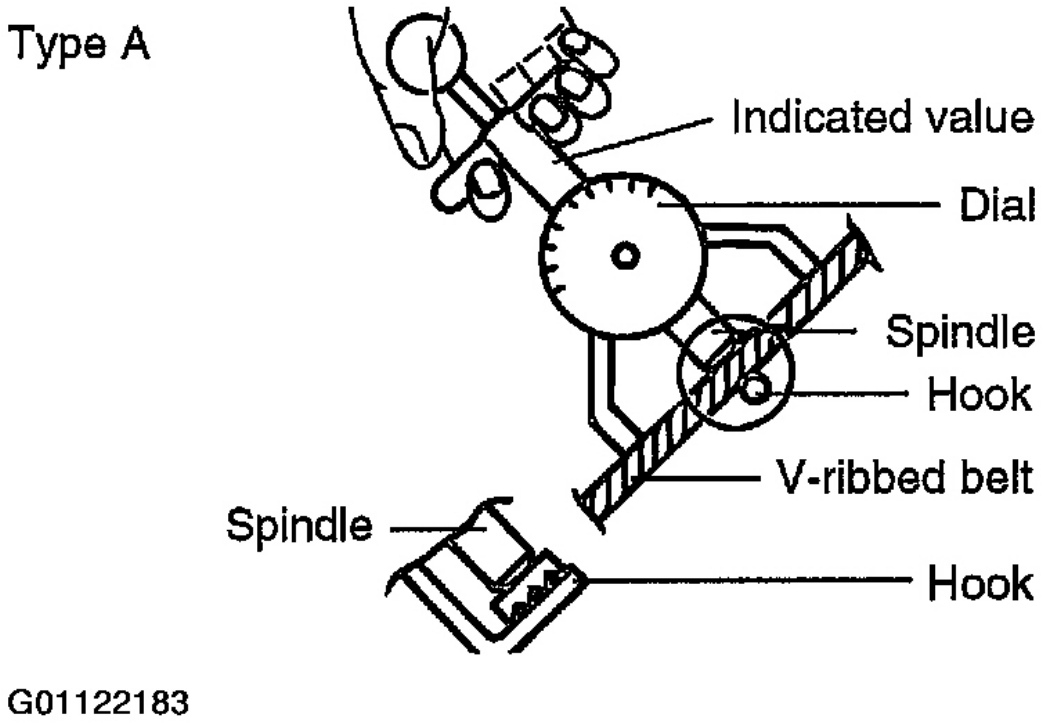

Fig. 29: Identifying Type A Tension Gauge
Courtesy of HYUNDAI MOTOR CO.

TYPE B TENSION GAUGE

1. When measuring, turn the reset button in the direction of the arrow and set the gauge needle to the RESET position.
2. If the tension gauge is removed from the belt, the needle will still indicate the tension. Read the tension value after removing the gauge.

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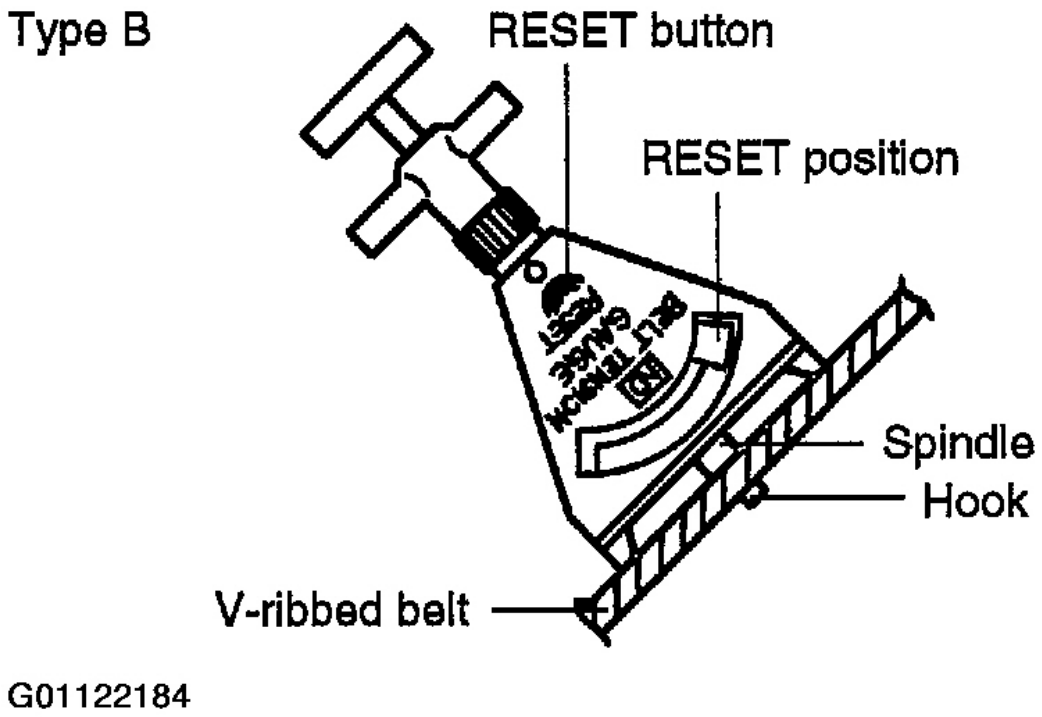

Fig. 30: Identifying Type B Tension Gauge
Courtesy of HYUNDAI MOTOR CO.

ADJUSTING THE ALTERNATOR BELT

CAUTION: If the belt is too loose, it will cause noise or sudden wear. If the belt is too tight, the engine coolant pump bearing or the alternator can get damaged.

1. Loosen the alternator nut "A" and the tension adjuster lock bolt "B".
2. Using the tension adjuster bolt, adjust the belt tension to the specification.
3. Tighten the adjuster lock bolt "B".
4. Tighten the alternator nut "A".
5. Check the tension or the deflection of belt, readjust if necessary.

Tightening torque

Alternator support bolt and nut:

20-25 Nm (200-250 kg.cm, 14-18 lb.ft)

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Alternator lock bolt B:

12-15 Nm (120-150 kg.cm, 9-11 lb.ft)

Alternator brace mounting bolt:

20-27 Nm (200-270 kg.cm, 15-20 lb.ft)

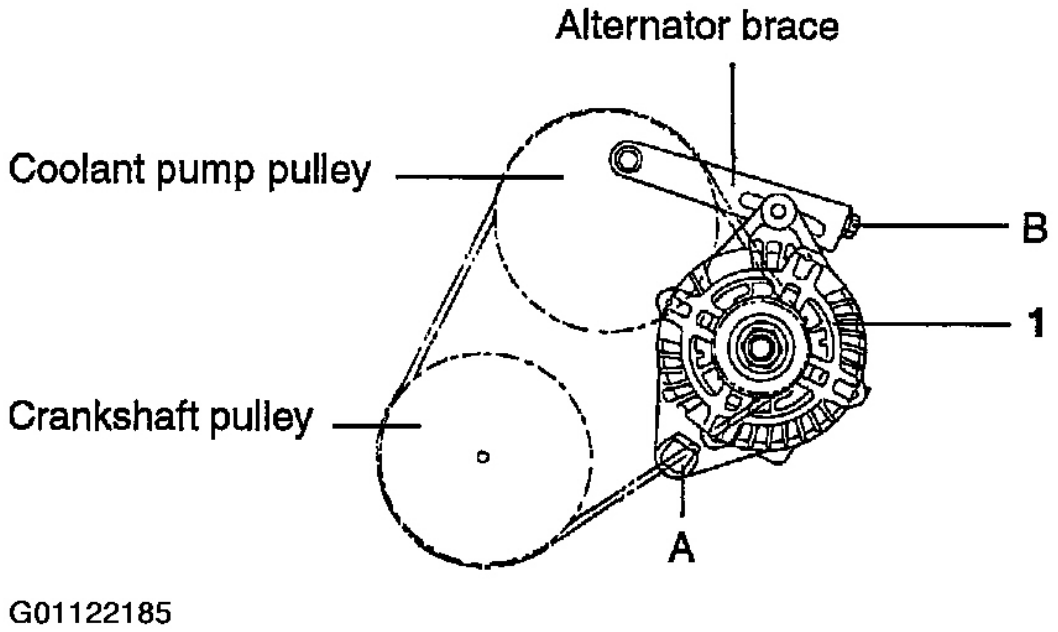

Fig. 31: Adjusting Alternator Belt
Courtesy of HYUNDAI MOTOR CO.

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS

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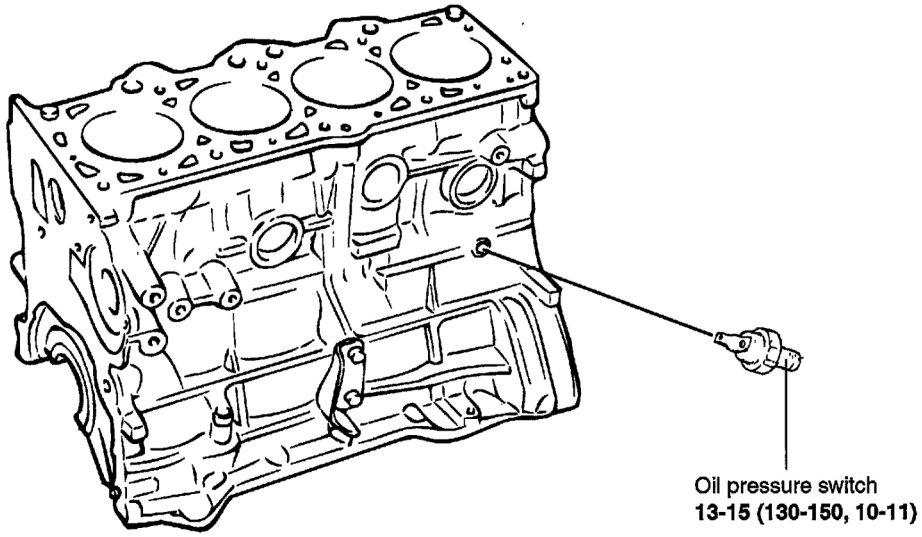

TORQUE : Nm (kg.cm, lb.ft)

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Fig. 32: Engine Block Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the cylinder head, timing belt, front case, flywheel, pistons and crankshaft.
2. Remove the oil pressure switch.

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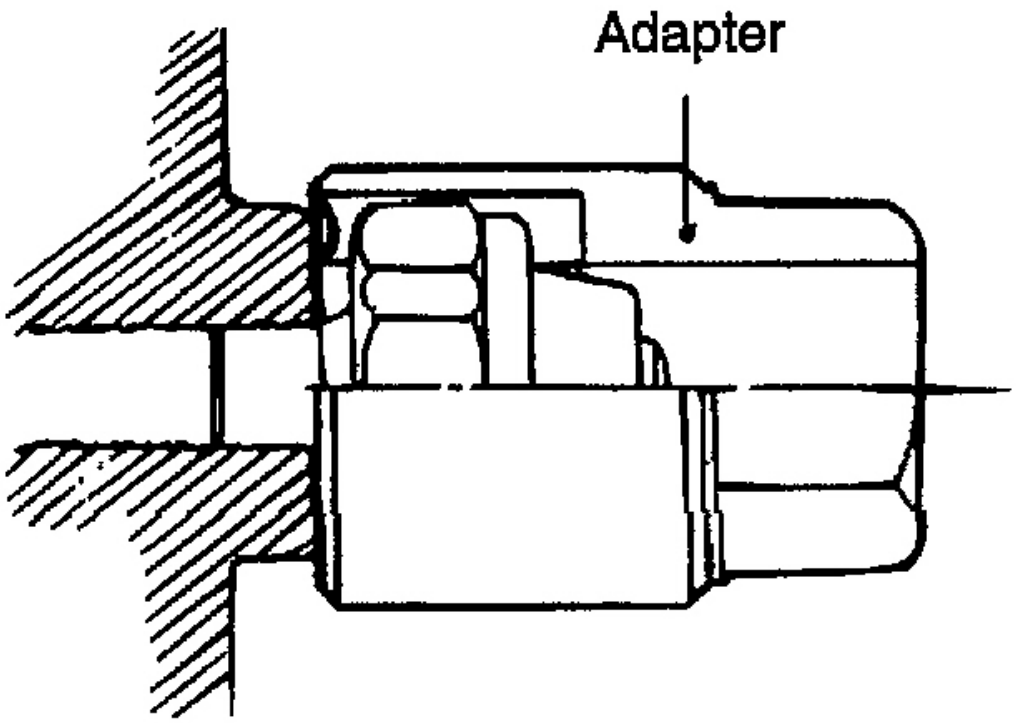

Fig. 33: Removing Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

CYLINDER BLOCK

1. Check the engine block for scores, rust and corrosion. Also check for cracks or any other defects. Replace the block if defective.
2. Using a straight edge and feeler gauge, check the top surface of the block for warpage. Make sure that the surface is free from gasket chips or other foreign material.

   Standard: 0.03 mm (0.0012 in.) or less

   Limit: 0.15 mm (0.0059 in.) or less

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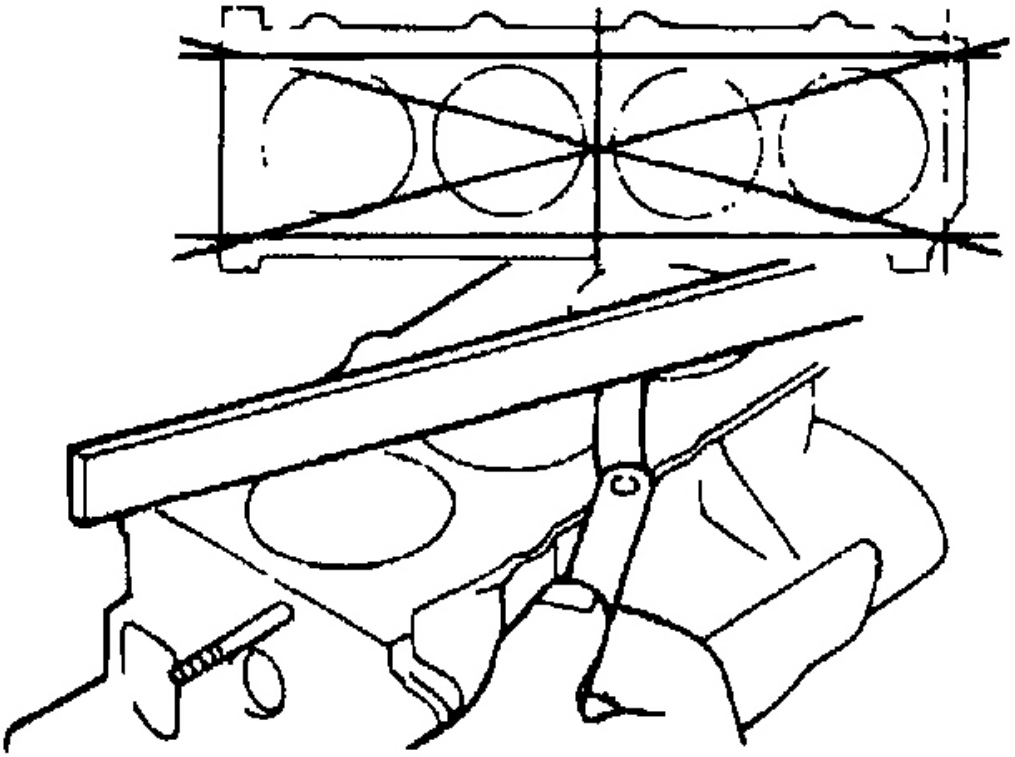

Fig. 34: Checking Top Surface Of Block For Warpage
Courtesy of HYUNDAI MOTOR CO.

3. Measure the cylinder bore with a cylinder gauge at three levels in the direction of A and B. If the cylinder bores show more than the specified out-of-round or taper or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. Oversize pistons and rings must be fitted.

   Cylinder I.D: 76.5 - 76.53 mm (3.0118 - 3.0130 in.)

   Cylinder I.D taper: 0.01 mm (0.0004 in.) or less

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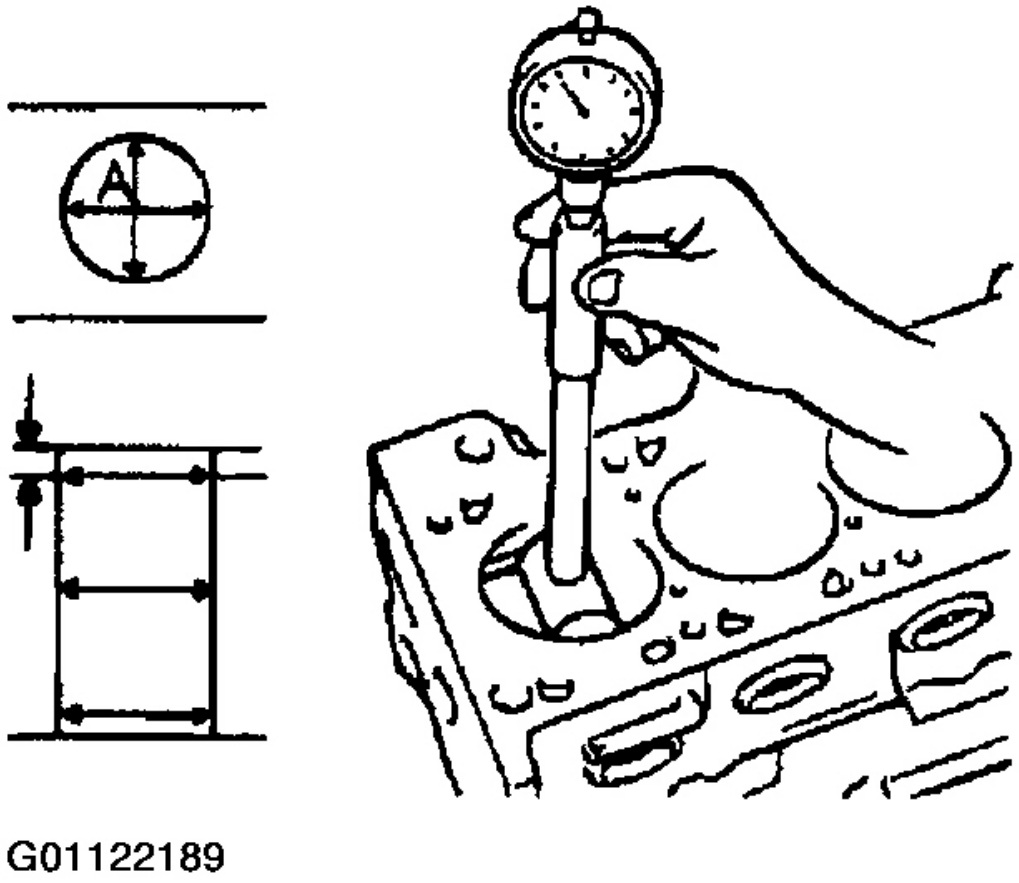

Fig. 35: Measuring Cylinder Bore Diameter
Courtesy of HYUNDAI MOTOR CO.

4. If a cylinder ridge exists, cut away with a ridge reamer.
5. Oversize pistons are available in four sizes.

Piston service size and mark mm (in.)

0.25 (0.010) O.S.: 0.25

0.50 (0.020) O.S.: 0.50

0.75 (0.030) O.S.: 0.75

1.00 (0.039) O.S.: 1.00

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6. When boring the cylinder to the oversize, maintain the specified clearance between the oversize piston and the bore, and make sure that all pistons used are the same oversize.

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

Piston - to - cylinder clearance:

0.025 - 0.045 mm (0.0010 - 0.0018 in.)

ENGINE MOUNTS

COMPONENTS

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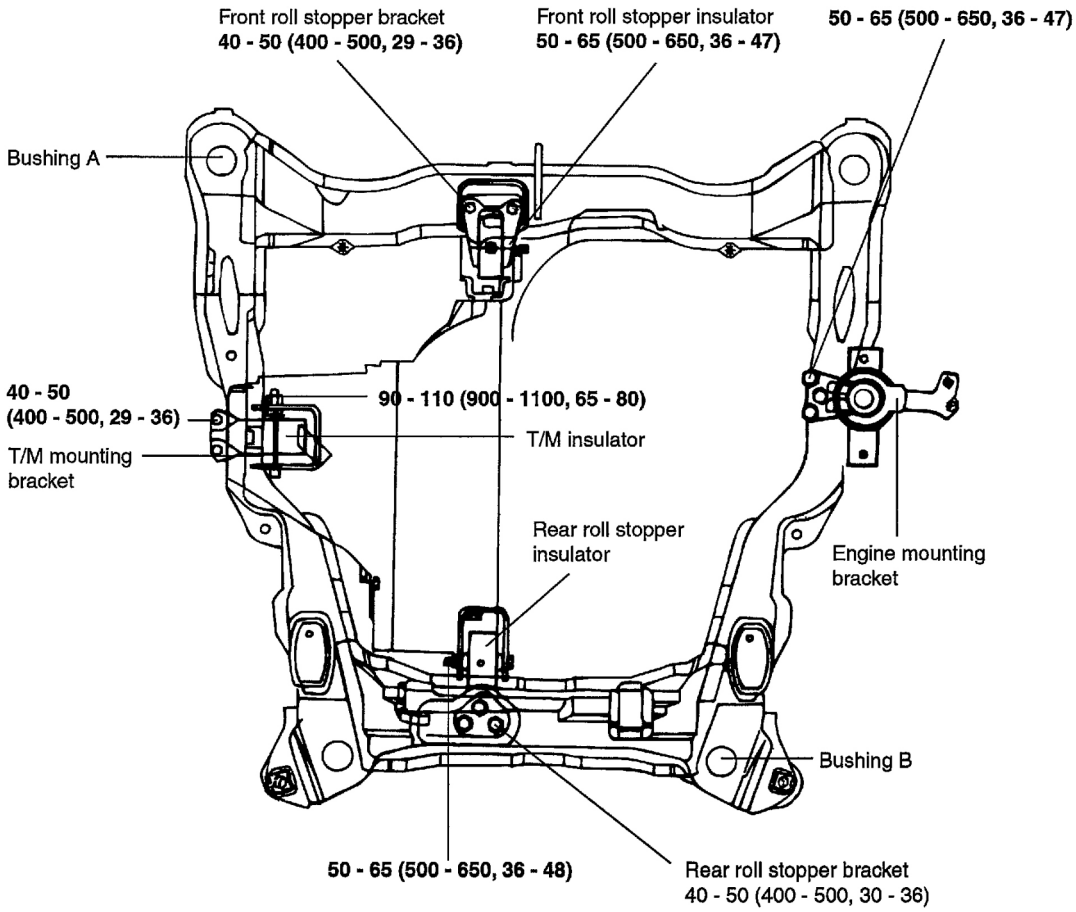

Fig. 36: Engine Mounts Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Attach an engine hoist to the engine hooks, and raise the engine just enough so that there is no pressure on the insulators.

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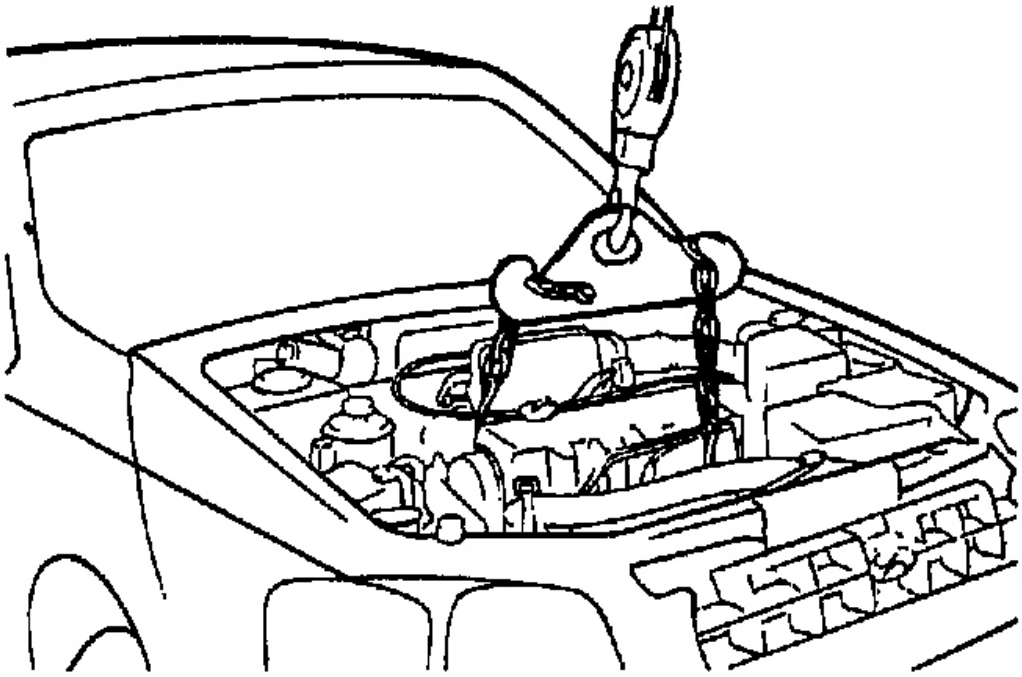

Fig. 37: Attaching Engine Hoist To Engine Hooks
Courtesy of HYUNDAI MOTOR CO.

ENGINE MOUNTING

1. Remove the engine mounting insulator bolts.
2. Remove the engine mounting bracket from the engine.

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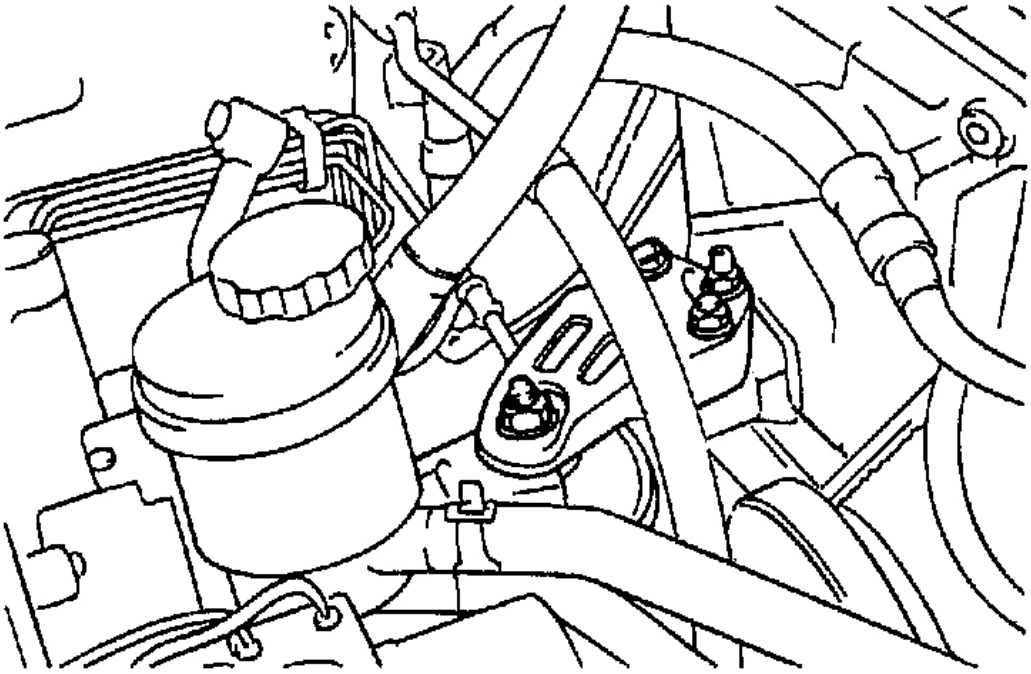

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Fig. 38: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

TRANSMISSION MOUNTING

1. For vehicles with a 5-speed manual transmission, remove the select control valve.
2. Remove the transmission mounting bolt.

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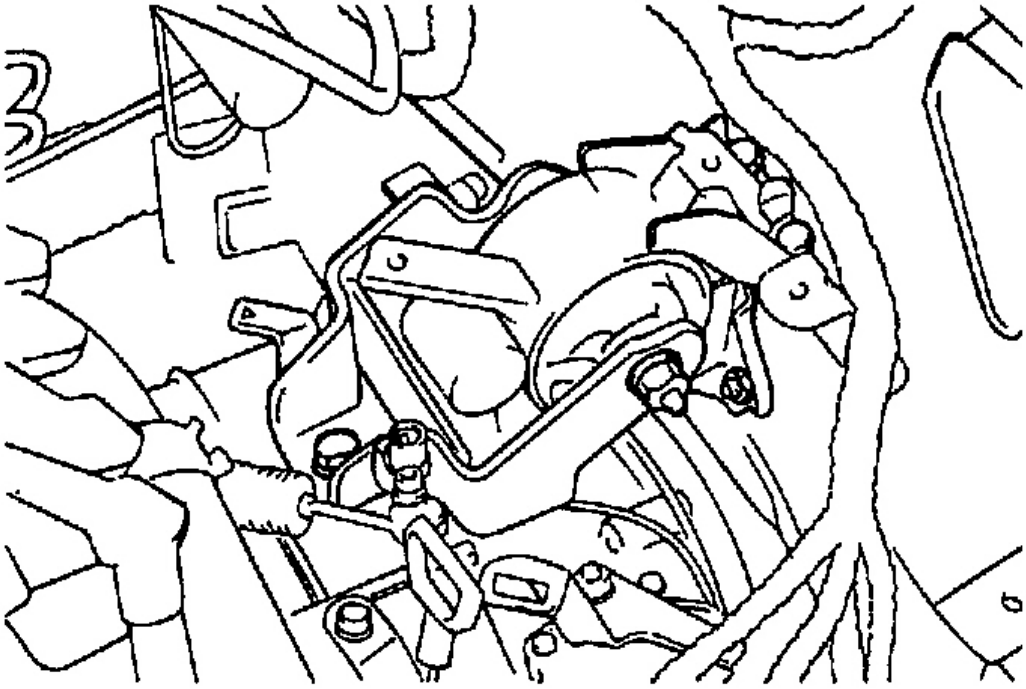

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Fig. 39: Identifying Transmission Mounting Bolt
Courtesy of HYUNDAI MOTOR CO.

3. Detach the cap from inside the right fender shield. Remove the transmission mounting bolts.
4. Remove the transmission bracket.

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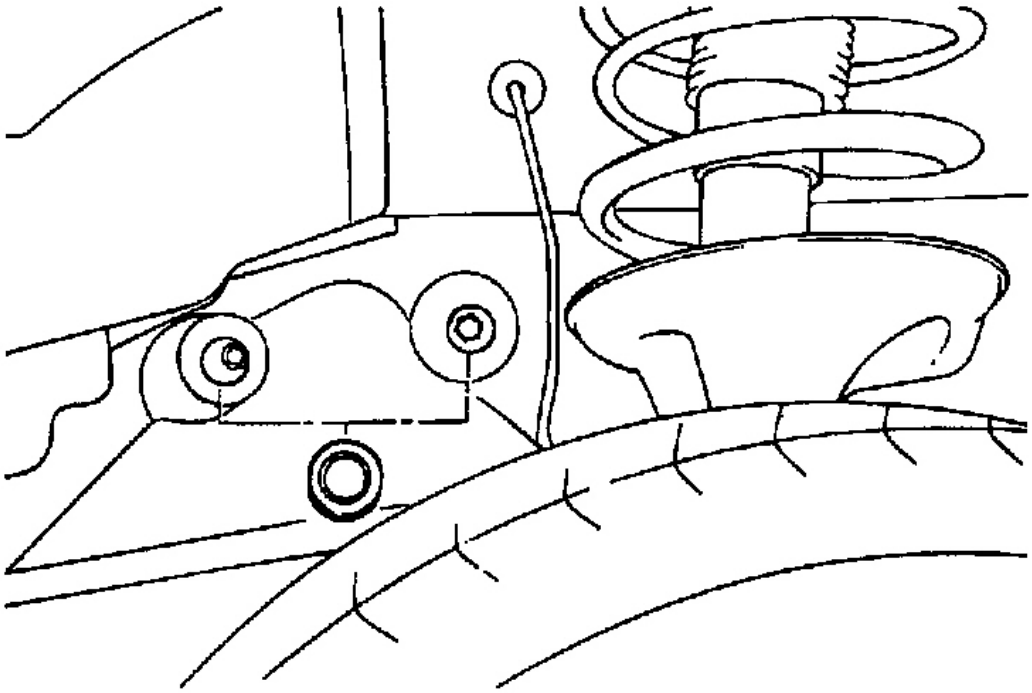

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Fig. 40: Detaching Cap From Inside Right Fender Shield
Courtesy of HYUNDAI MOTOR CO.

FRONT ROLL STOPPER

1. Remove the front roll stopper bracket from the subframe.

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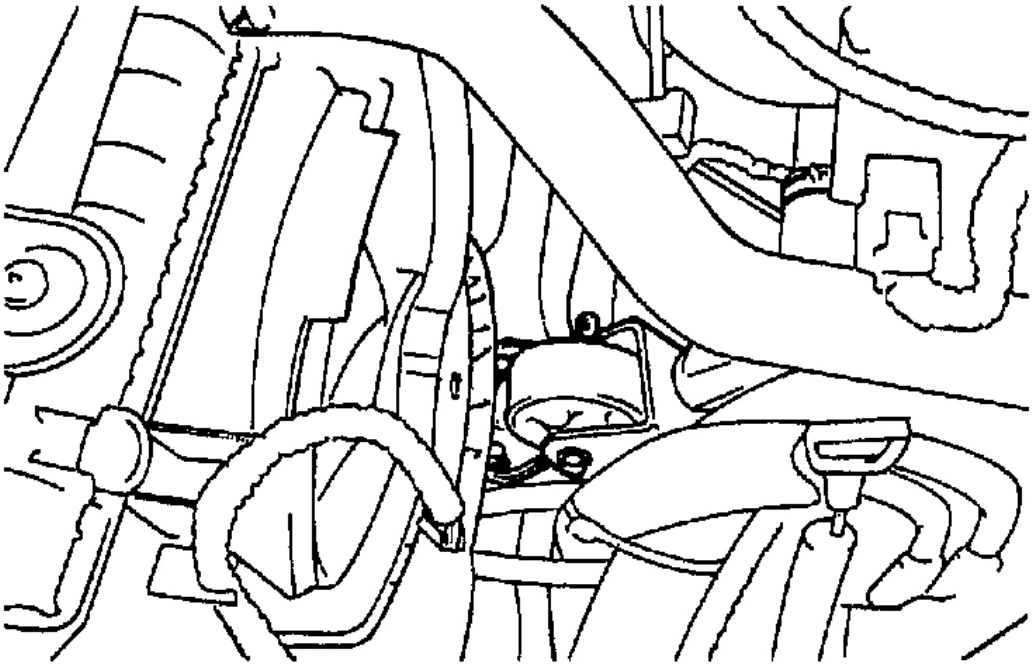

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Fig. 41: Identifying Front Roll Stopper Bracket
Courtesy of HYUNDAI MOTOR CO.

REAR ROLL STOPPER

1. Remove the rear roll stopper from the subframe.

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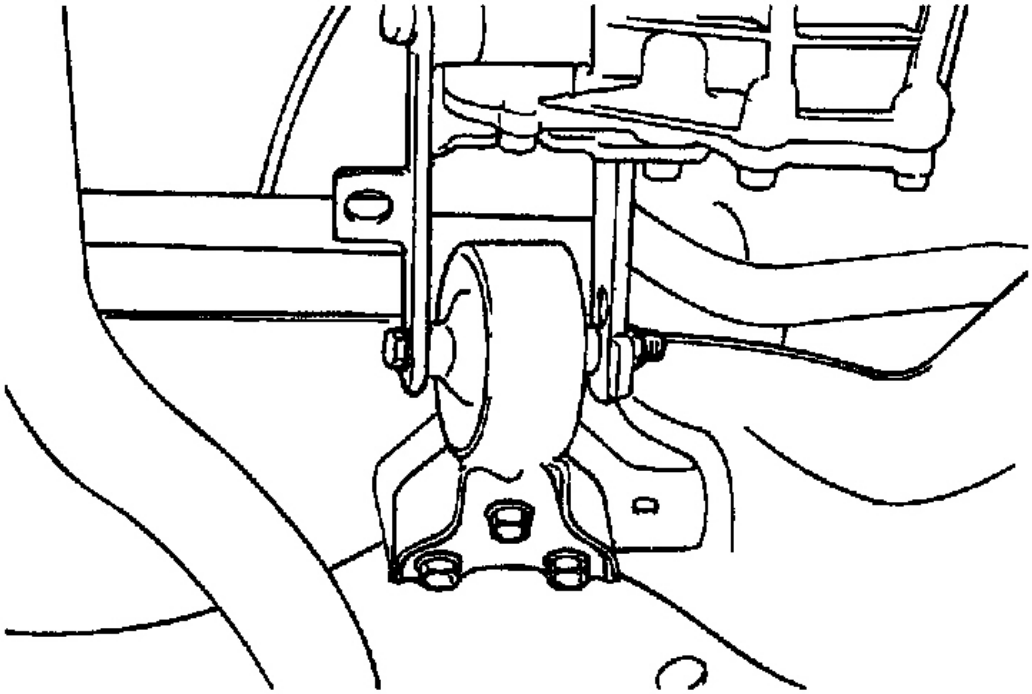

Fig. 42: Identifying Rear Roll Stopper
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

TRANSMISSION MOUNTING

1. Verify that the stopper is correctly inserted into the inner pipe in order not to move.
2. Install the stopper after making sure it is positioned correctly.

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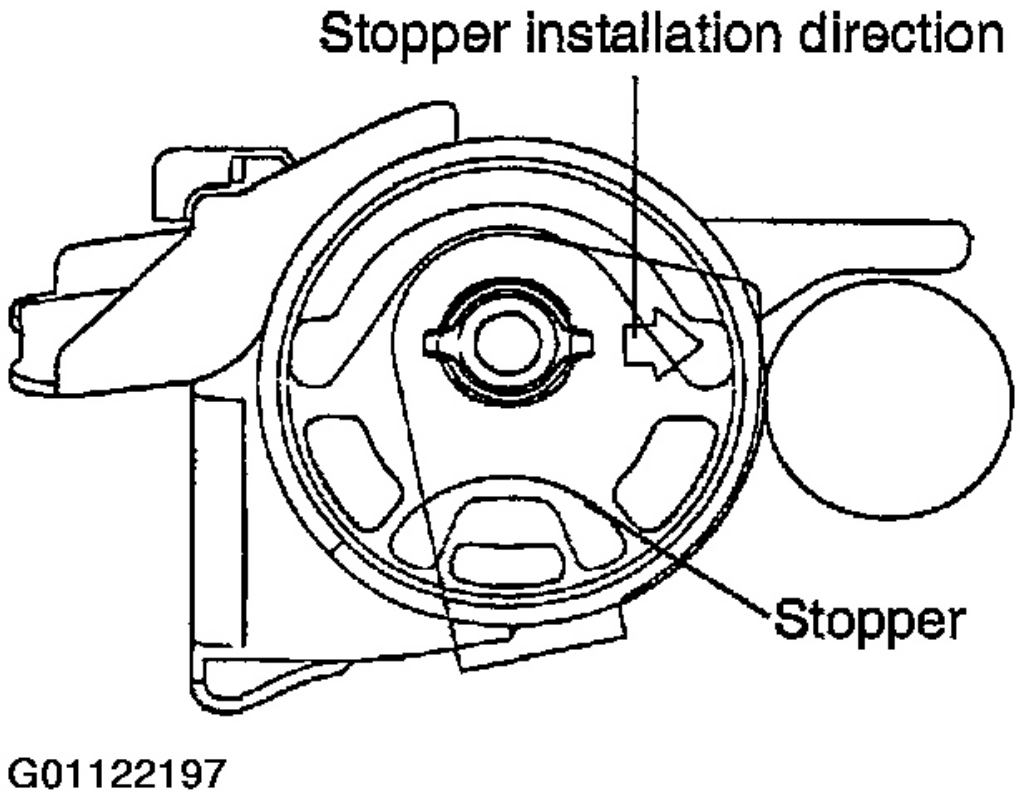

Fig. 43: Installing Stopper
Courtesy of HYUNDAI MOTOR CO.

FRONT ROLL STOPPER

1. Install the insulator in the correct angle.

A/T: 30 +/- 3°

M/T: 14 +/- 3°

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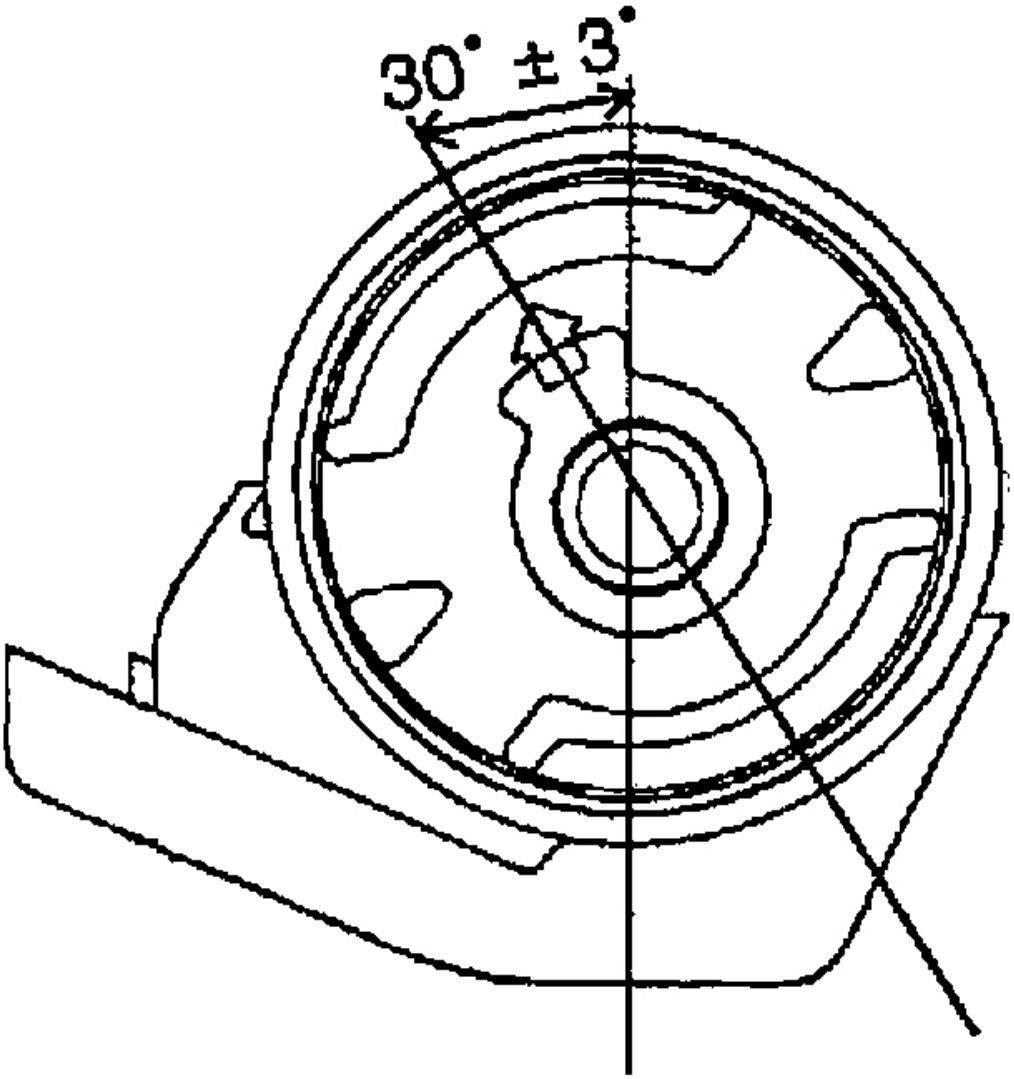

Fig. 44: Installing Insulator In Correct Angle - Front
Courtesy of HYUNDAI MOTOR CO.

REAR ROLL STOPPER

1. Install the insulator in the correct angle.

A/T: 33 +/- 3°

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M/T: 20 +/- 3°

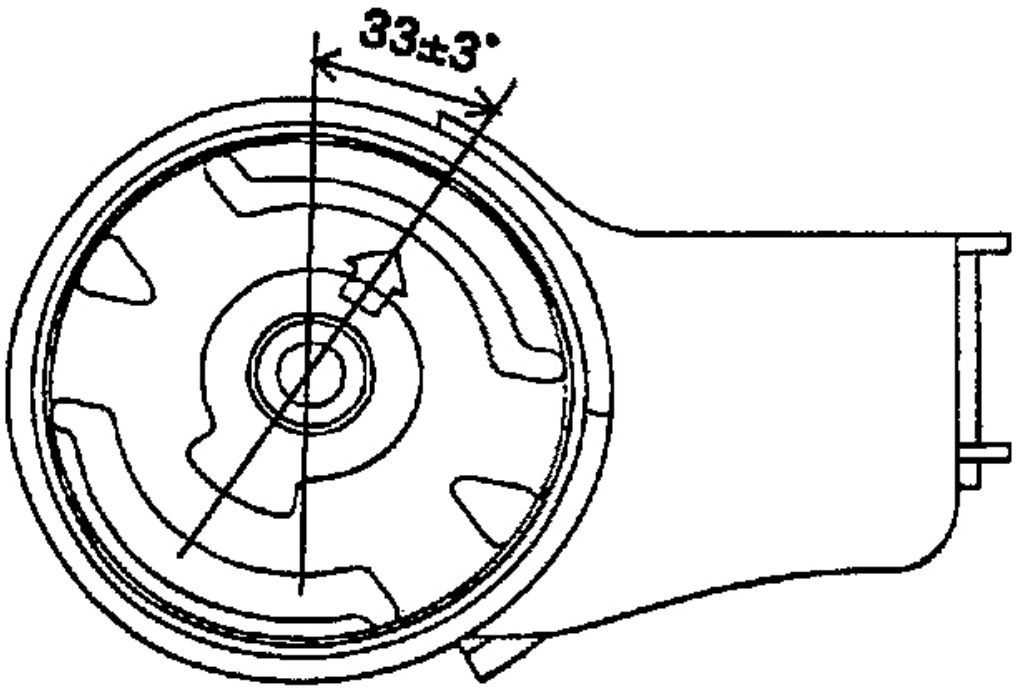

Fig. 45: Installing Insulator In Correct Angle - Rear
Courtesy of HYUNDAI MOTOR CO.

MOUNTING BUSHING

NOTE:

- **The front and rear cross member mounting bushings are directional.**
- **Be sure to install the bushings in the correct direction.**

1. There are 2 arrow marks on the upper side of the front and rear cross member mounting bushings.
2. When installing the bushings into the cross member inner pipe, align the arrow marks on the bushing with the lateral direction of the lateral member.

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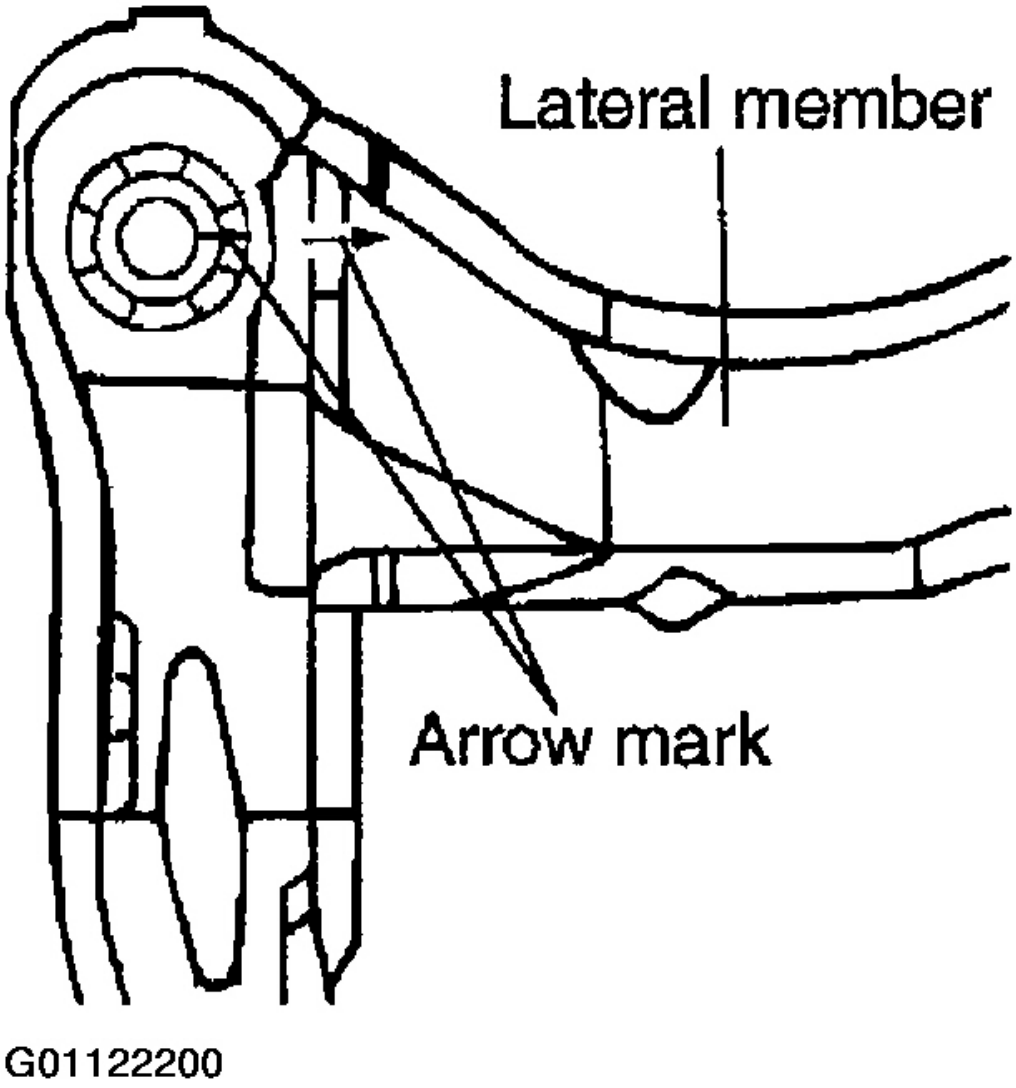

Fig. 46: Locating Lateral Member Arrow Mark (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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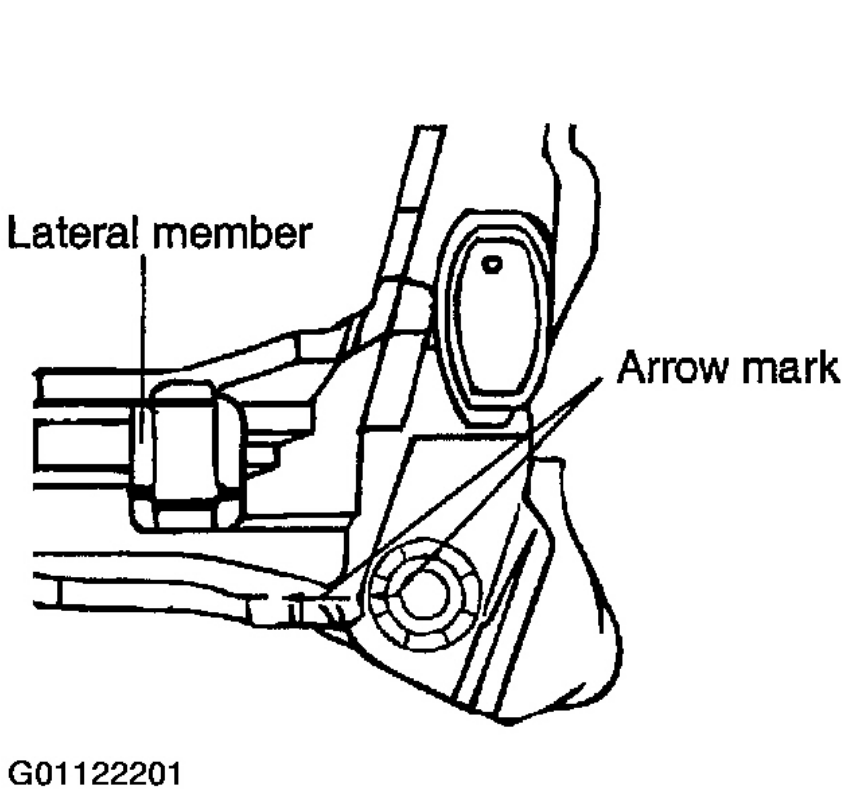

Fig. 47: Locating Lateral Member Arrow Mark (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

NOTE: Make sure the bushings are positioned parallel to the lateral member of the cross member. Be sure that the installation direction of the bushings do not deviate +/- 3° from the lateral direction of the lateral member when they are installed to the member.

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

1. Remove the battery.
2. Detach the air cleaner.

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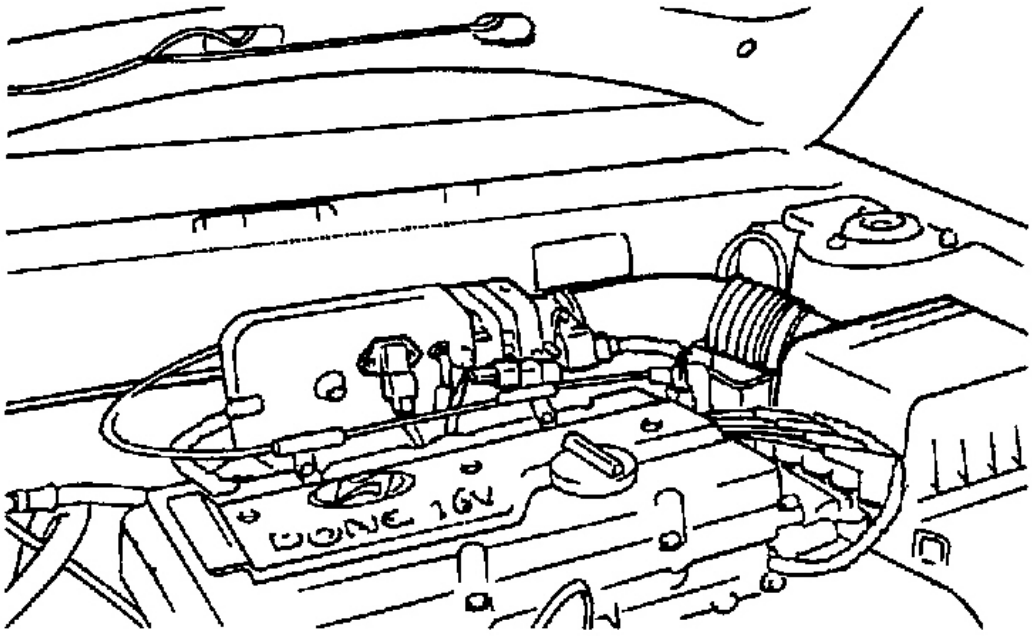

Fig. 48: Identifying Air Cleaner
Courtesy of HYUNDAI MOTOR CO.

3. Disconnect the connectors for the backup lamp switch and engine harness.
4. For vehicles with a 5-speed manual transmission, disconnect the select control valve connector.
5. Disconnect the connectors for the alternator harness and the oil pressure gauge wiring.
6. Drain the engine coolant.

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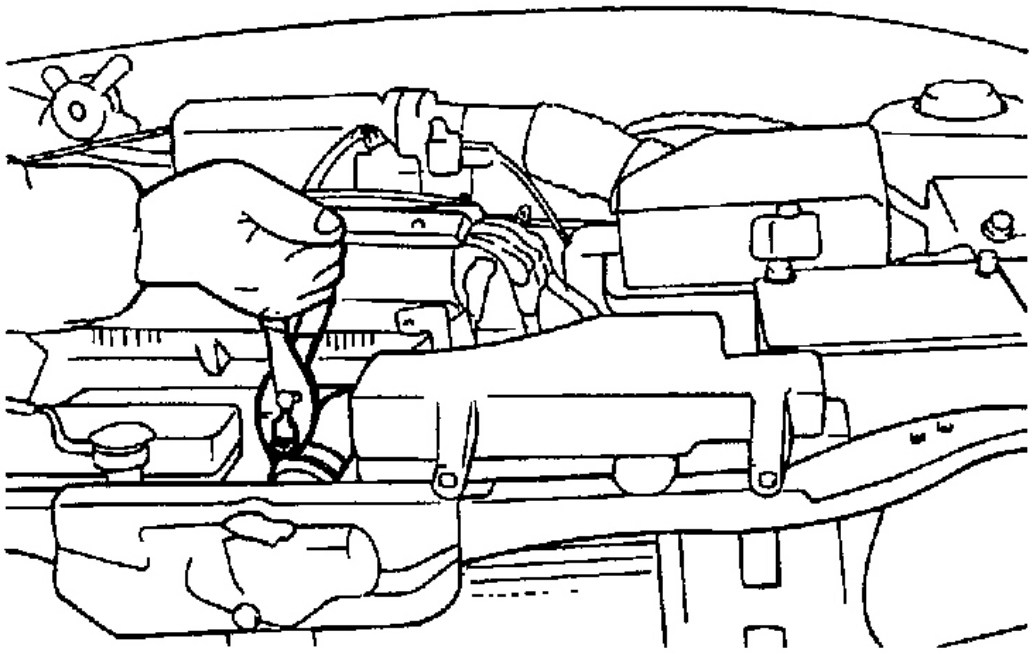

G01122203

Fig. 49: Removing Hose Clamp
Courtesy of HYUNDAI MOTOR CO.

NOTE: When disconnecting hoses, make identification marks to ensure they are reconnected correctly.

CAUTION: Be careful not to spill oil or fluid from hoses. Plug the openings to prevent foreign material from entering.

7. Disconnect the radiator upper and lower hoses on the engine side, then remove the radiator assembly.
8. Disconnect the engine ground.
9. Disconnect the brake booster vacuum hose.
10. Remove the main fuel line, the return and vapor hoses from the engine side.
11. Disconnect the heater hoses (inlet and outlet) on the engine side.
12. Disconnect the accelerator cable at the engine side.
13. For vehicles with manual transmission, remove the control cable from the transmission.
14. For vehicles with automatic transmission, remove the control cable from the transmission.
15. Disconnect the speedometer cable from the transmission.

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16. Disconnect the air conditioner compressor from the mounting bracket.

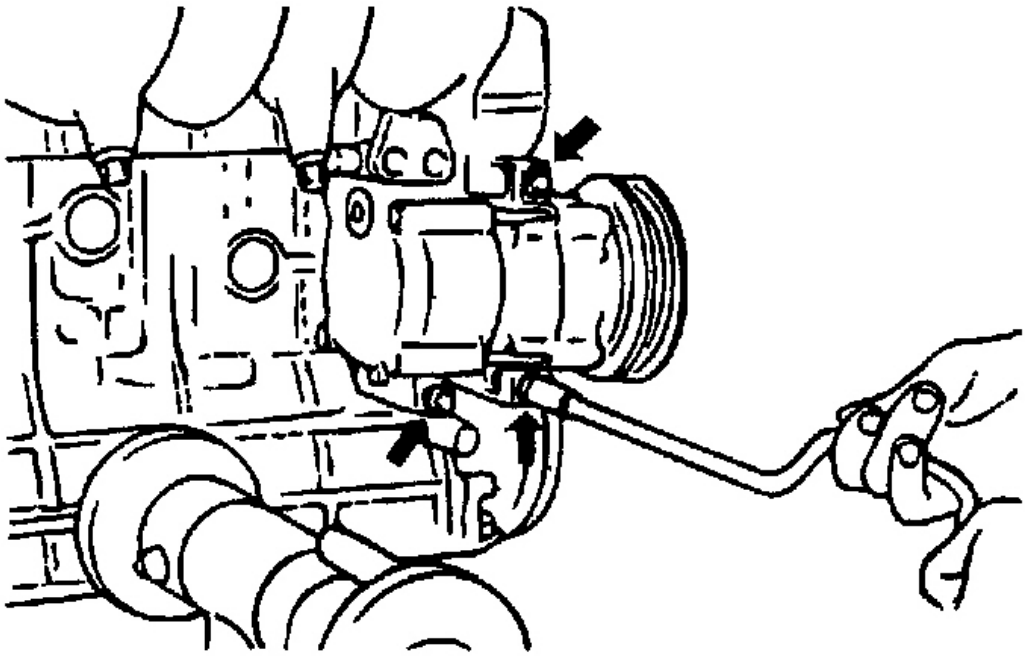

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Fig. 50: Removing Air Conditioner Compressor
Courtesy of HYUNDAI MOTOR CO.

17. Jack up the vehicle.
18. Drain the transmission oil (or fluid).

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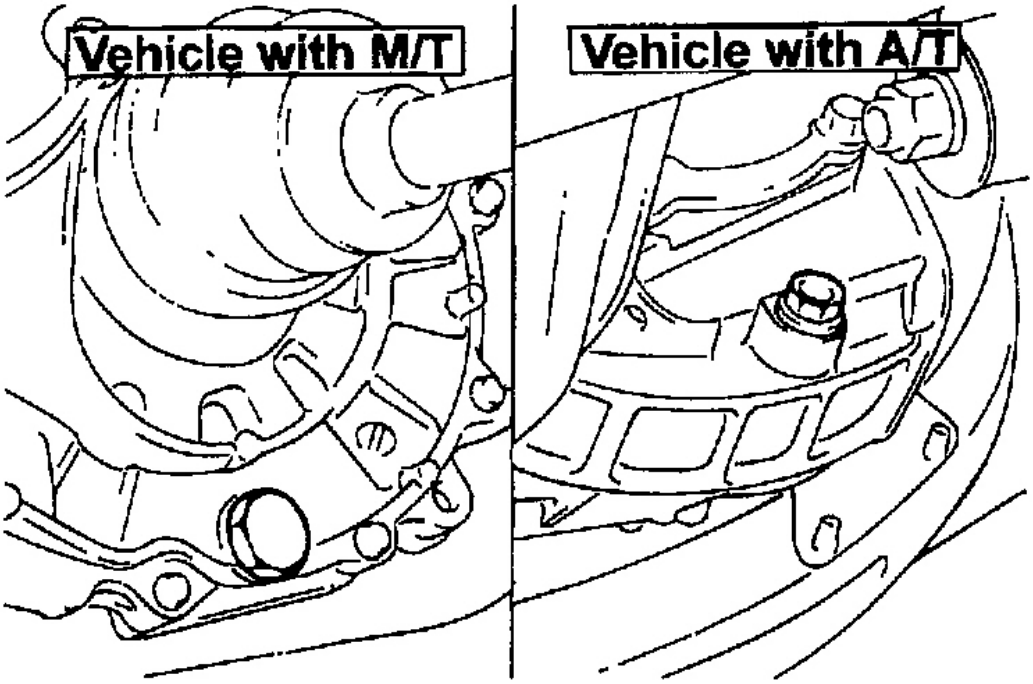

Fig. 51: Locating Transmission Oil Drain Plug
Courtesy of HYUNDAI MOTOR CO.

19. Disconnect the front exhaust pipe from the manifold.

NOTE: Use wire to suspend the exhaust pipe from the bottom of the vehicle.

20. For vehicles with manual transmission, remove the shift control rod and extension rod.
21. Remove the lower arm ball joint bolts and the stabilizer bar at the point where it is mounted to the lower arm.
22. Remove the drive shafts from the transmission case.

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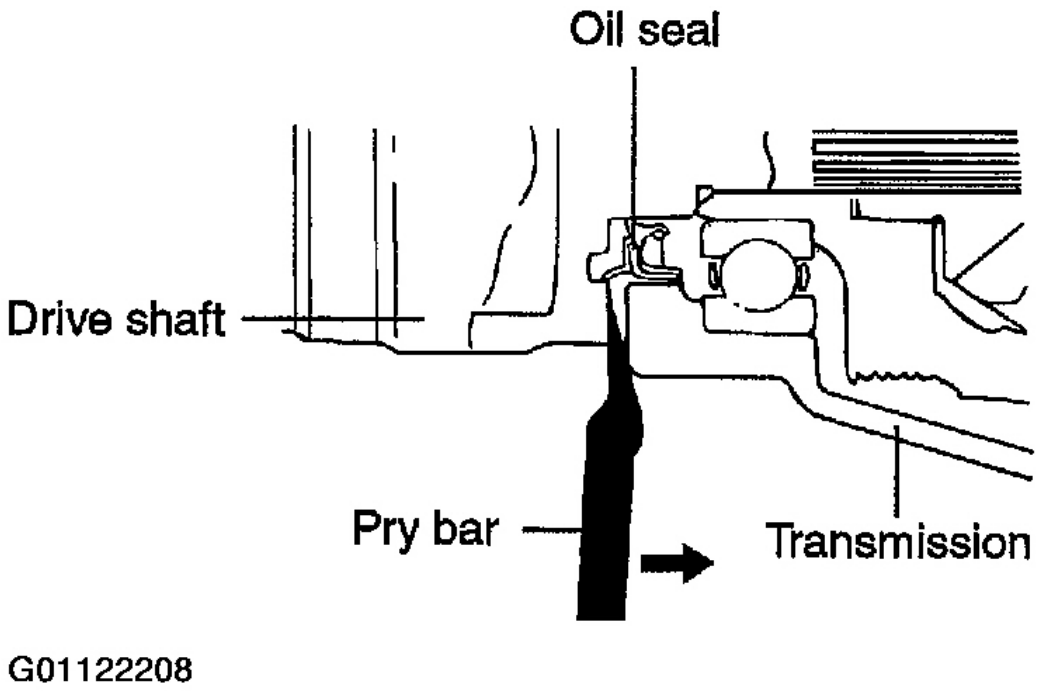

Fig. 52: Locating Drive Shaft Oil Seal
Courtesy of HYUNDAI MOTOR CO.

CAUTION:
- **Plug the axle holes of the transmission case to prevent entry of foreign material.**
- **Install new circlips on the drive shafts when reassembling.**

23. Hang the lower arm and drive shaft from the body with wire.
24. Attach a chains or cables to the engine. Use an engine hoist or a chain hoist to slightly raise the engine (enough to support the engine's weight while processing with the following steps).
25. Remove the front roll stopper.

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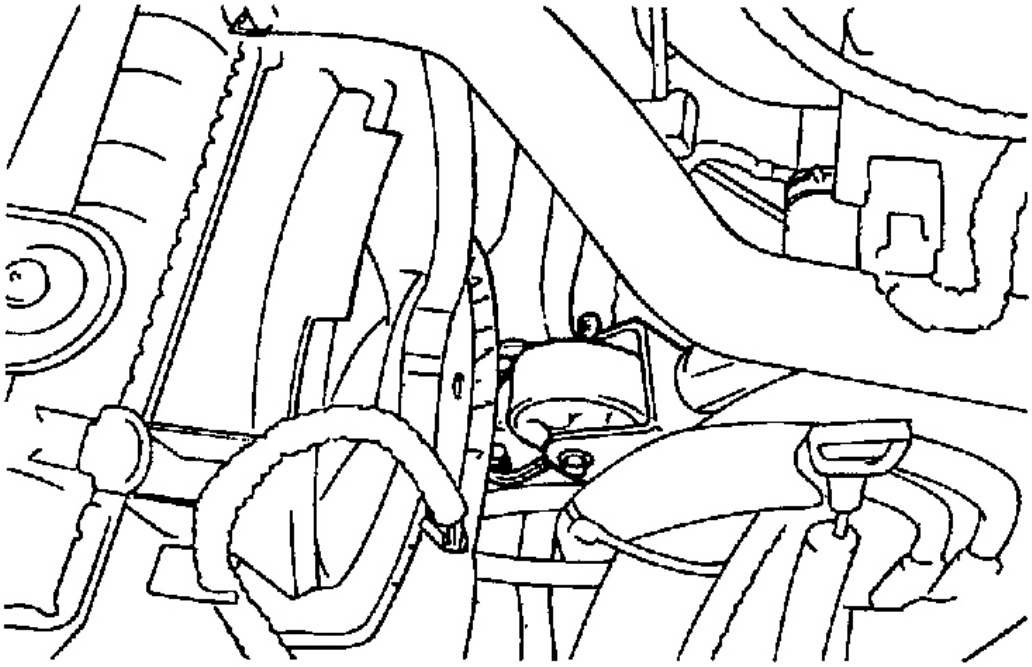

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Fig. 53: Identifying Front Roll Stopper
Courtesy of HYUNDAI MOTOR CO.

26. Separate the rear roll stopper.

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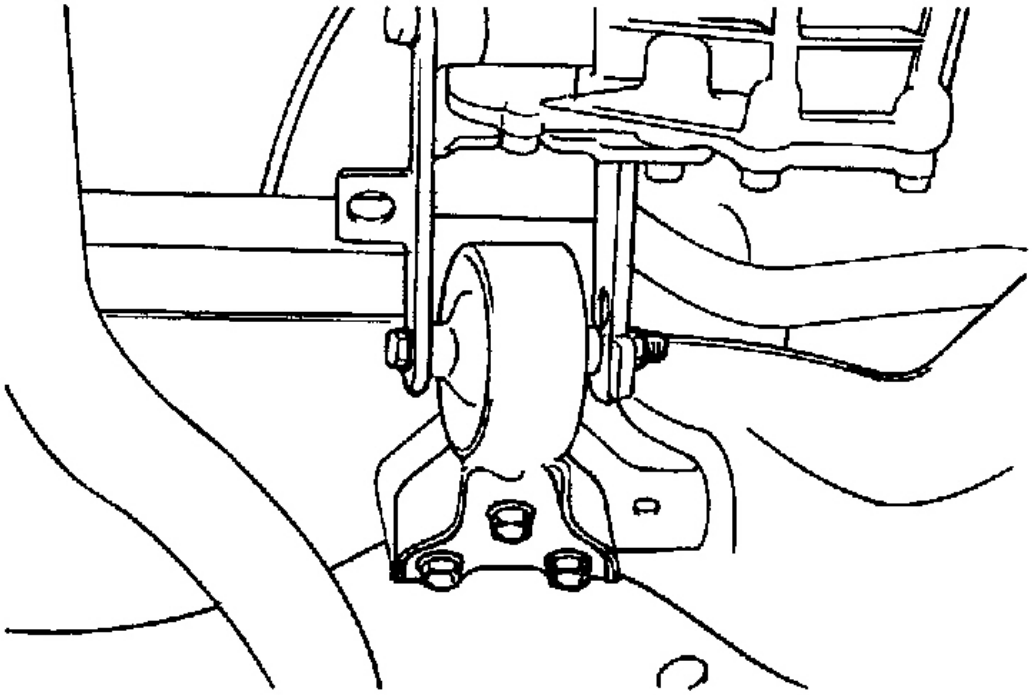

Fig. 54: Identifying Rear Roll Stopper
Courtesy of HYUNDAI MOTOR CO.

27. Remove the engine mounting insulator bolts.
28. Remove the engine mounting bracket from the engine.

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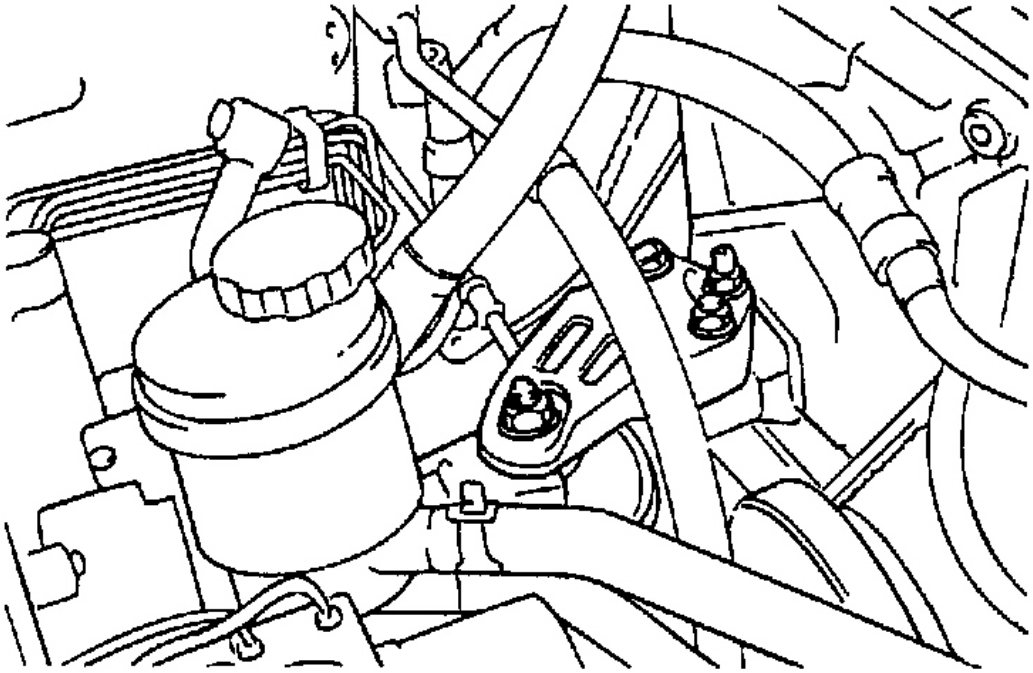

G01122211

Fig. 55: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

29. Slowly raise the engine (to the extent that the weight of the engine and transmission assembly is not applied to the mounting portions) and temporarily hold it in the raised position.

CAUTION: Check that all cables, hoses, harnesses, connectors etc. are disconnected from the engine.

30. Remove the caps from the inside of the right fender shield and remove the transaxle mount bracket bolts.

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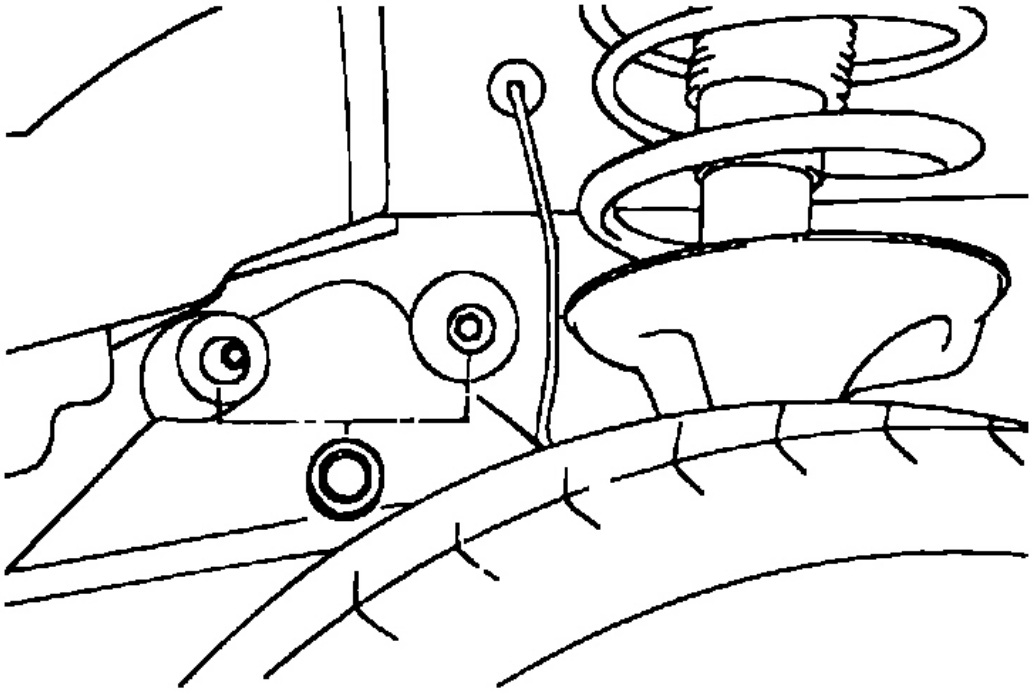

Fig. 56: Removing Caps From Inside Of Right Fender Shield
Courtesy of HYUNDAI MOTOR CO.

31. While directing the transmission side downward, lift the engine and transmission assembly up and out of the vehicles.

MAIN MOVING SYSTEM

CAM SHAFT

COMPONENTS

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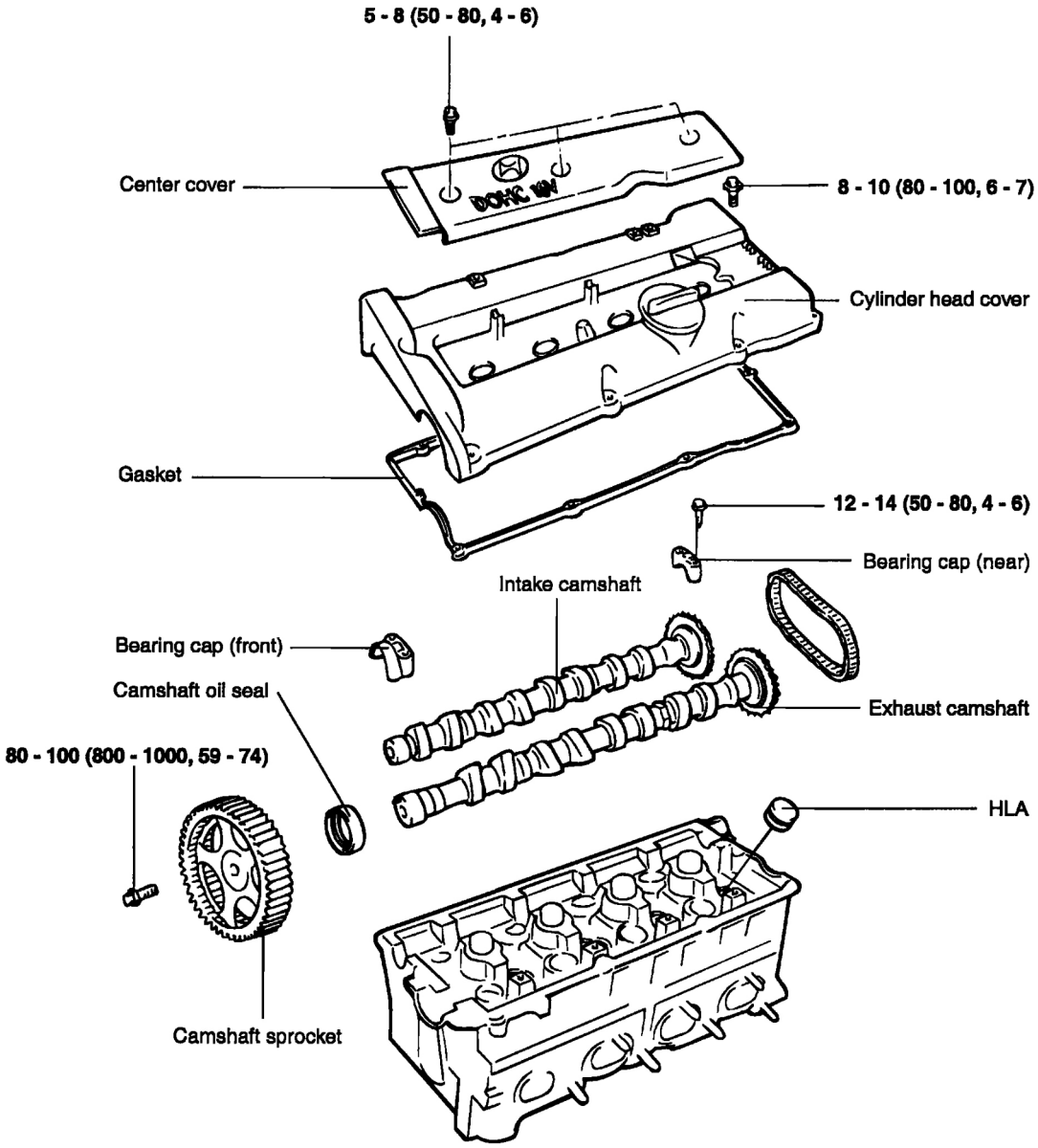

Fig. 57: Cam Shaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Disconnect the breather hose and the PCV hose.
2. Remove the coolant pump pulley and crankshaft pulley.

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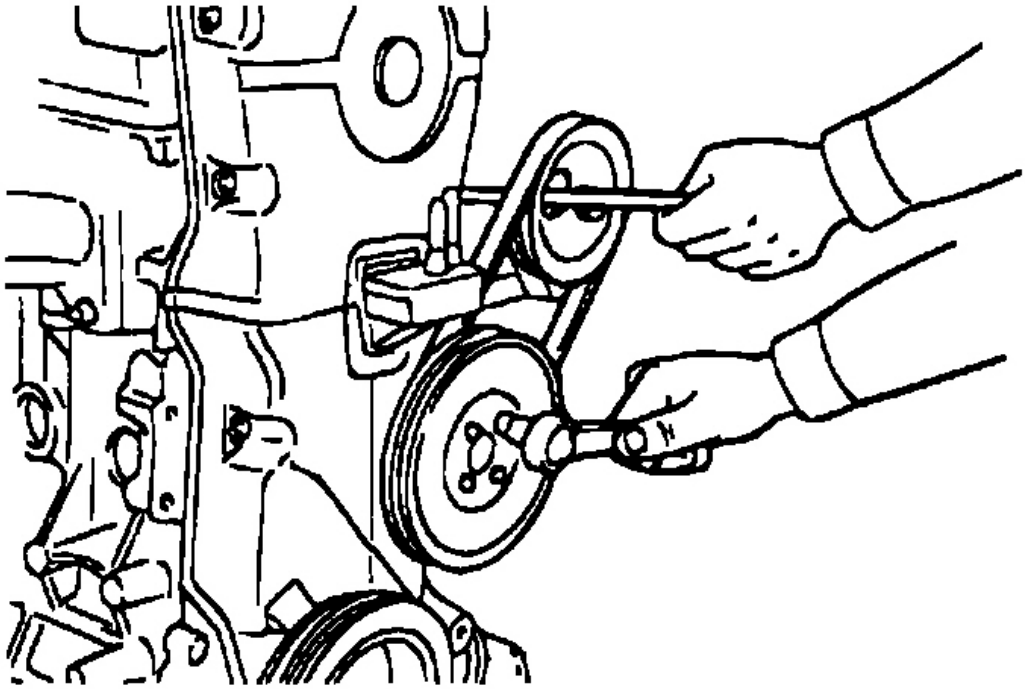

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Fig. 58: Removing Coolant Pump Pulley & Crankshaft Pulley
Courtesy of HYUNDAI MOTOR CO.

3. Remove the timing belt cover.
4. Loosen the timing belt tensioner pulley and temporarily secure it.
5. Remove the timing belt from the camshaft sprocket.
6. Loosen the center cover bolts and remove the center cover.
7. Remove the ignition coil assembly.
8. Loosen the cylinder head cover bolts and remove the cylinder head cover.

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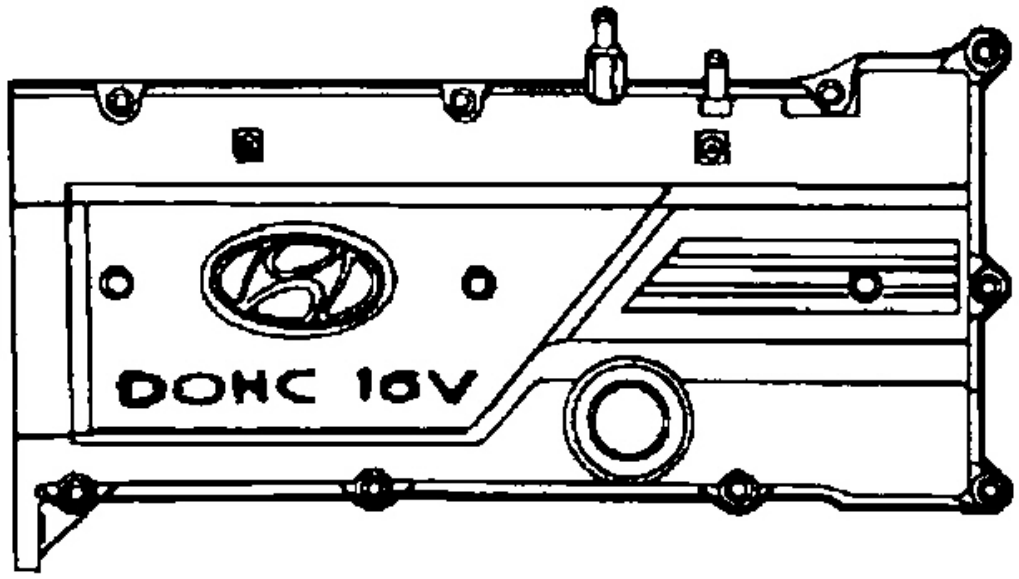

Fig. 59: Identifying Cylinder Head Cover
Courtesy of HYUNDAI MOTOR CO.

9. Remove the camshaft sprocket.
10. Remove the camshaft bearing caps and timing chain.

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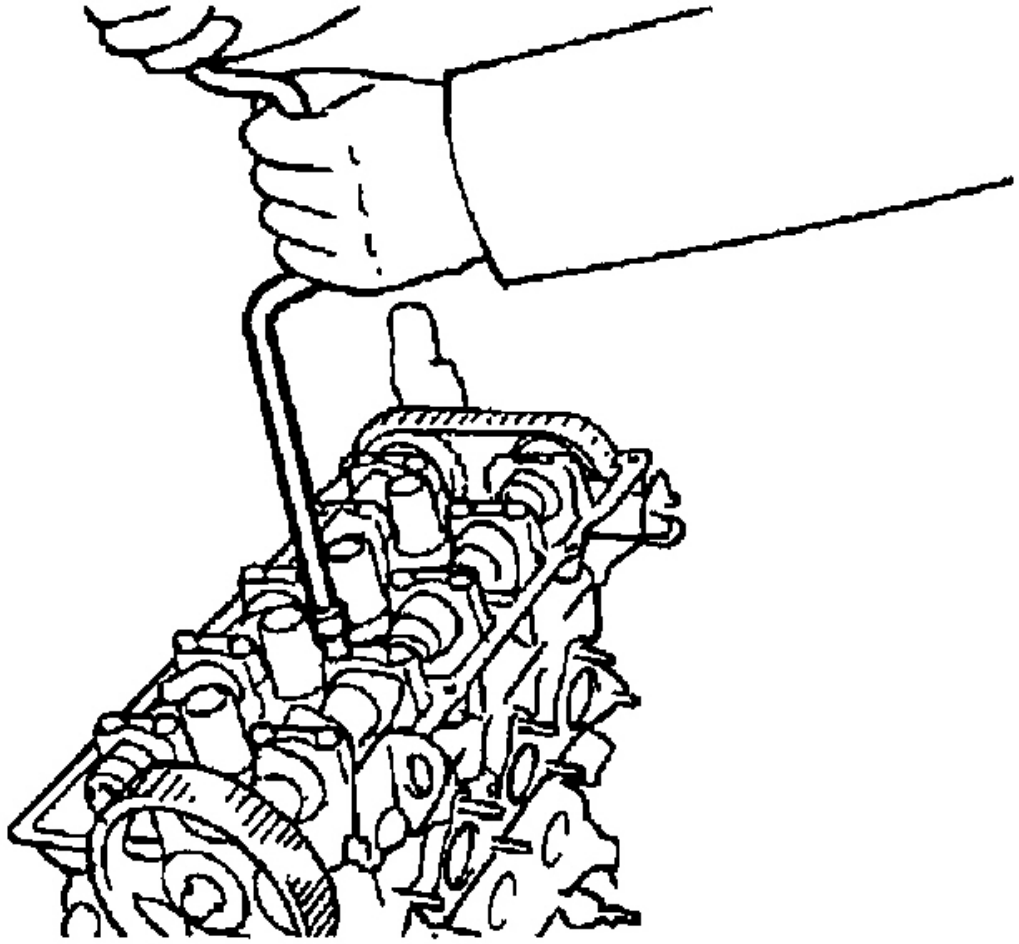

Fig. 60: Removing Camshaft
Courtesy of HYUNDAI MOTOR CO.

11. Remove the camshaft.
12. Remove the HLA. (Hydraulic lash adjuster)

INSPECTION

CAMSHAFTS

1. Check the camshaft journals for wear. If the journals are badly worn, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or worn excessively, replace the camshaft.

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Standard value

Intake: 43.4484 mm (1.7106 in.)

Exhaust: 43.8489 mm (1.7263 in.)

Limit

Intake: 42.9484 mm (1.6909 in.)

Exhaust: 43.3489 mm (1.7066 in.)

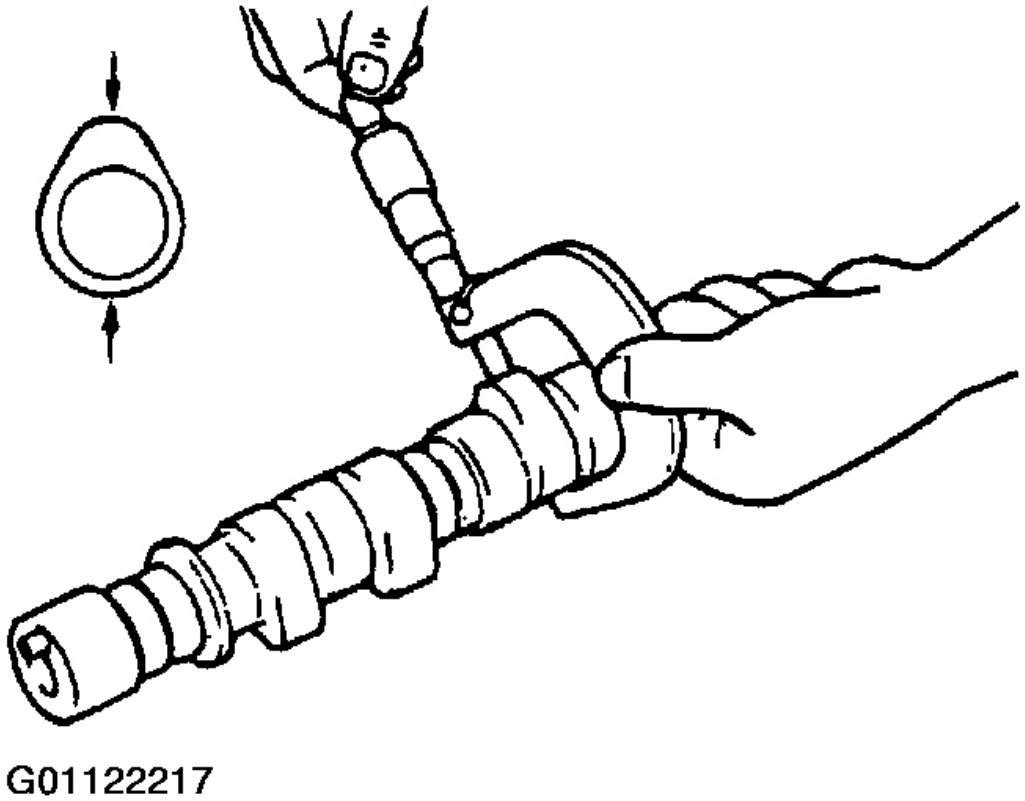

Fig. 61: Checking Cam Lobes For Damage
Courtesy of HYUNDAI MOTOR CO.

3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly or camshaft bearing cap, as necessary.

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Camshaft end play: 0.1-0.15 mm (0.0039-0.0059 in.)

OIL SEAL

1. Check the lips for wear. If the lip threads are worn, replace.
2. Check the oil seal lip contacting surface of the camshaft. If it is worn, replace the camshaft.

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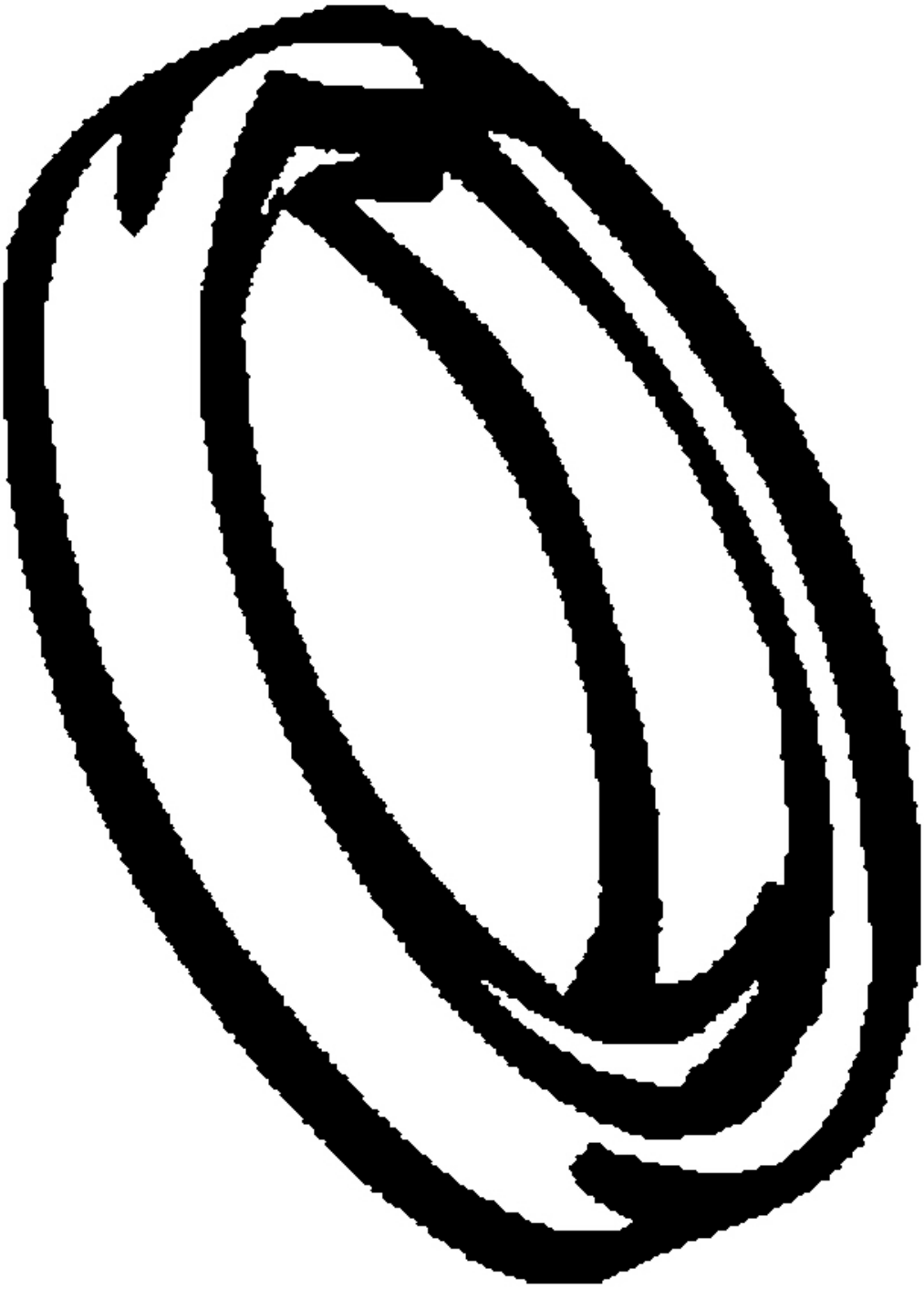

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Fig. 62: Identifying Oil Seal
Courtesy of HYUNDAI MOTOR CO.

HLA (HYDRAULIC LASH ADJUSTER)

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.

For other specific troubleshooting regarding HLA, refer to **Fig. 64**.

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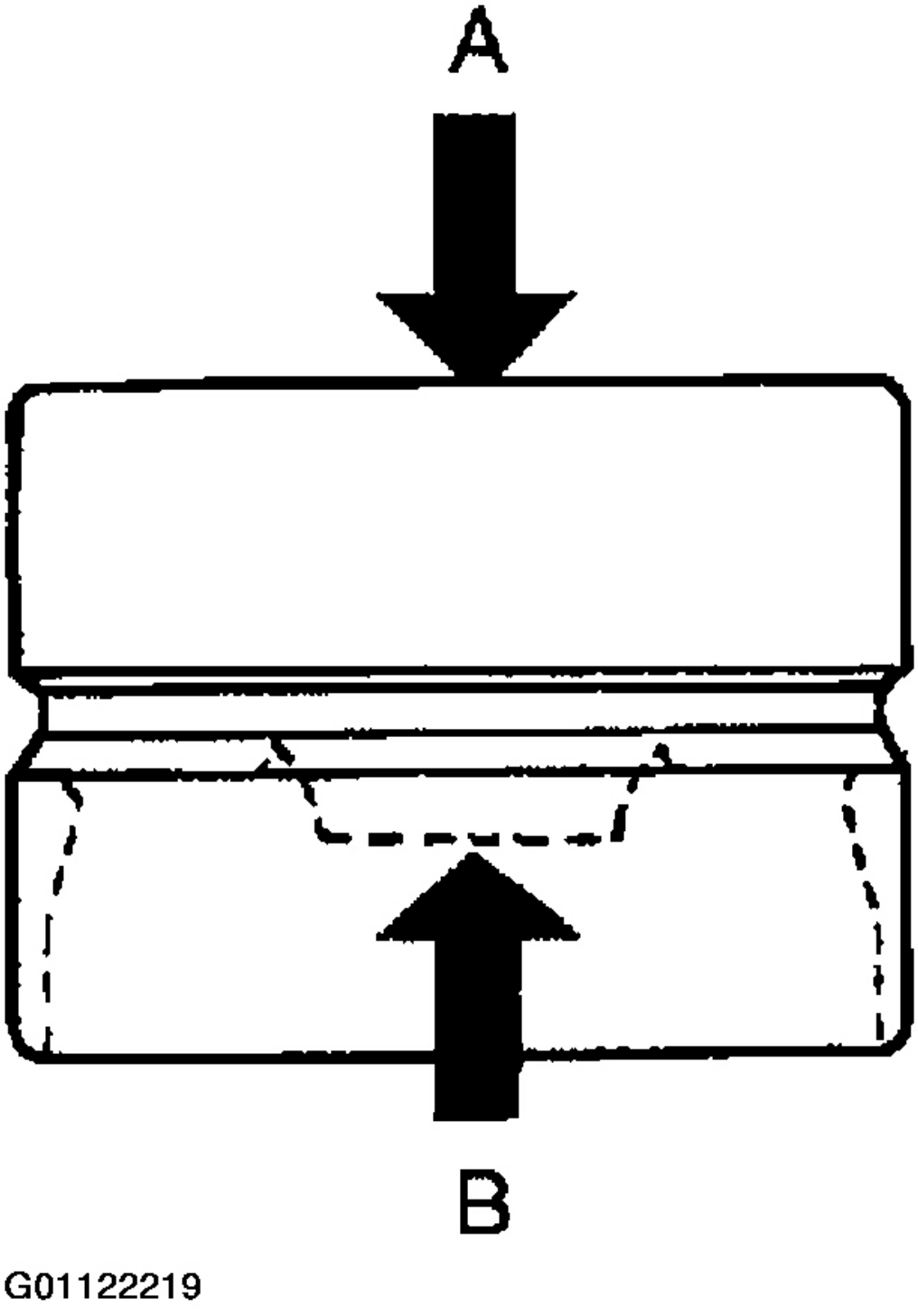

Fig. 63: Checking HLA (Hydraulic Lash Adjuster)

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Courtesy of HYUNDAI MOTOR CO.

Problem	Possible cause	Action
Temporary noise on starting a cold engine	Normal	This noise will disappear after the oil in the engine has reached normal pressure.
Continuous noise when engine is running after sitting more than 48 hours.	Oil leakage of the high pressure chamber on HLA,allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm If it doesn't disappear,refer to item 7 below
Continuous noise when engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
Continuous noise when engine is running after excessive cranking.	Oil drain out of the high-pressure chamber in HLA, allowing air to get in. Insufficient oil in HLA,	
Continuous noise when engine is running after changing HLA.		⚠ ***CAUTION*** ***Do not run engine at a speed higher than 3000 rpm as this may damage HLA.***
Continuous noise during idle after high speed running.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system
	Deteriorated oil	Check oil quality. If deteriorated, replace with specified type and amount of oil.
Noise continuous for more than 15 minutes.	Low oil pressure	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press down on the HLA by hand. If it moves, replace HLA. ⚠ ***CAUTION*** ***Be careful of hot HLA.***

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Fig. 64: Troubleshooting Table
Courtesy of HYUNDAI MOTOR CO.

TIMING CHAIN

Check the bushing and plate of timing chain for wear. Replace if wear is severe.

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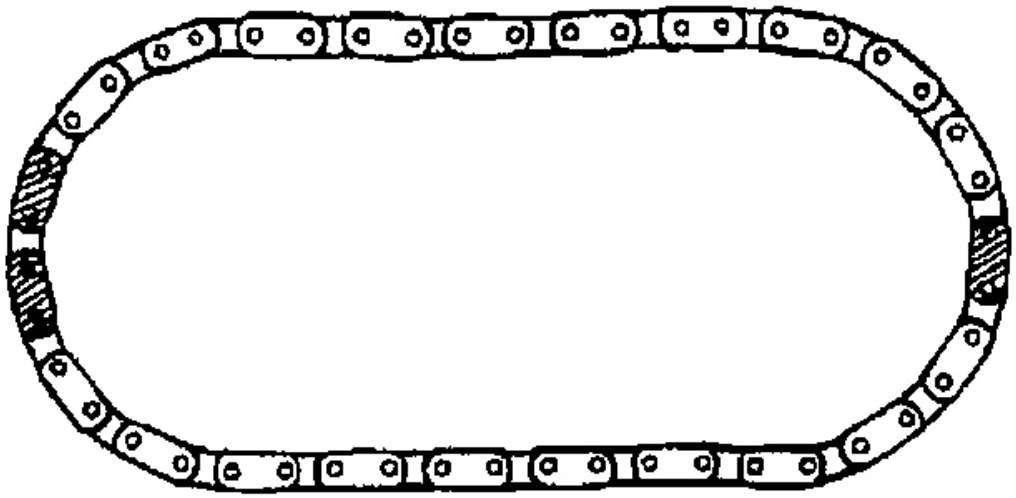

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Fig. 65: Identifying Timing Chain
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

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

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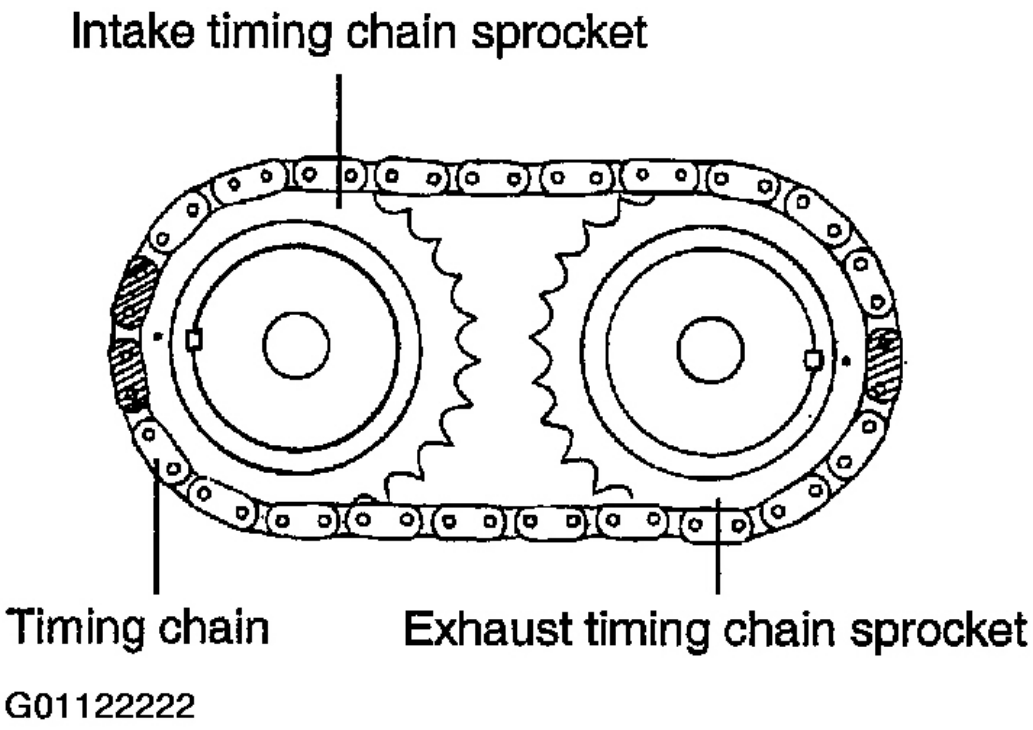

Fig. 66: Identifying Timing Chain Sprockets
Courtesy of HYUNDAI MOTOR CO.

3. Install the camshaft after lubricating the camshaft journals with engine oil.

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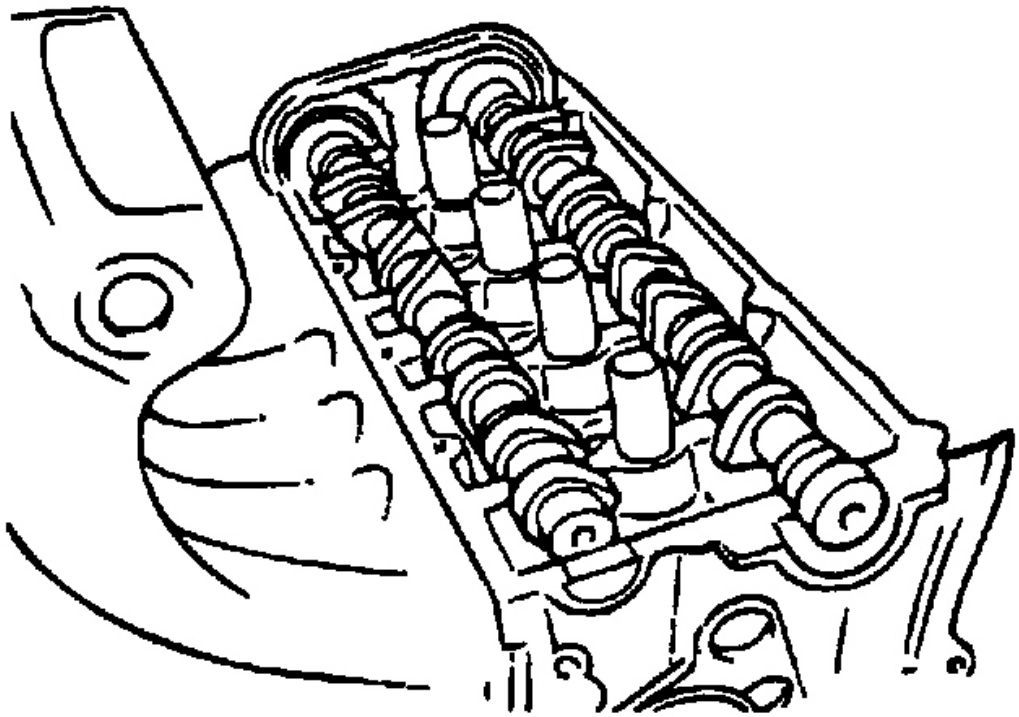

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Fig. 67: Installing Camshaft
Courtesy of HYUNDAI MOTOR CO.

4. Install the bearing caps. The markings on the caps are for intake/exhaust identification.

   I: Intake camshaft

   E: Exhaust camshaft

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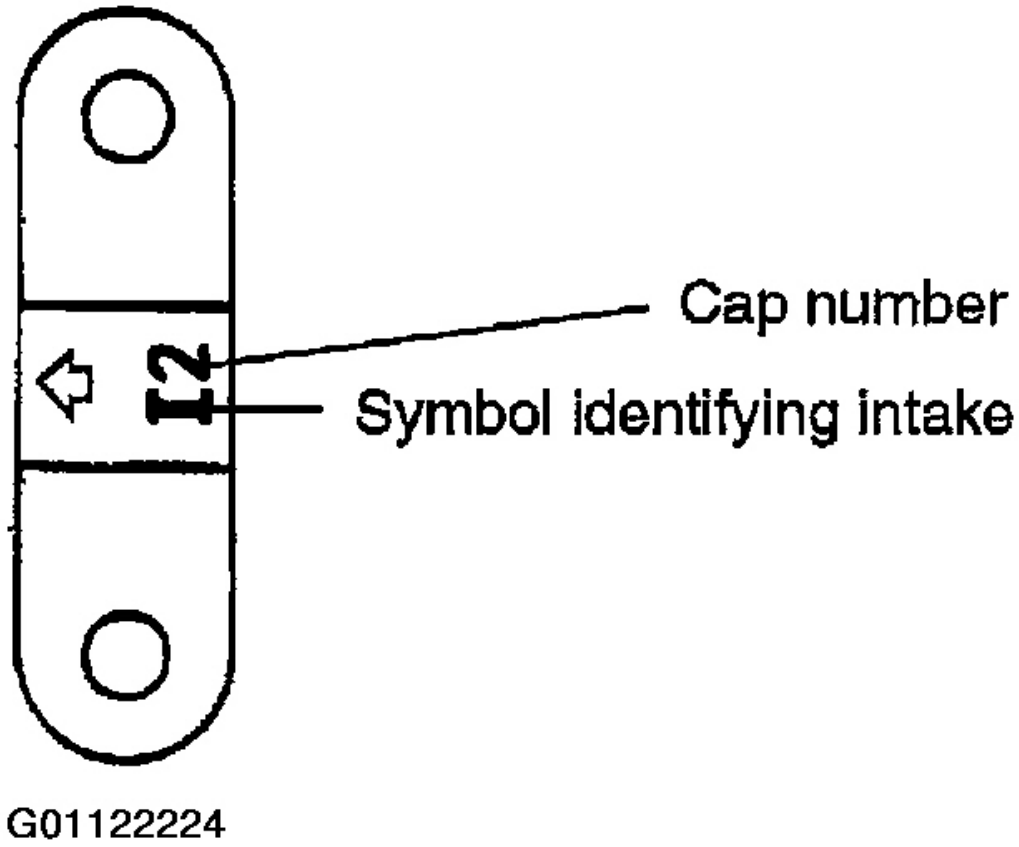

Fig. 68: Identifying Bearing Cap Number
Courtesy of HYUNDAI MOTOR CO.

5. Tighten the bearing caps to the specified torque in two or three steps as shown.

Tightening torque

Bearing cap bolt.: 12 - 14 Nm (120 - 140 kg.cm, 9 - 10 lb.ft)

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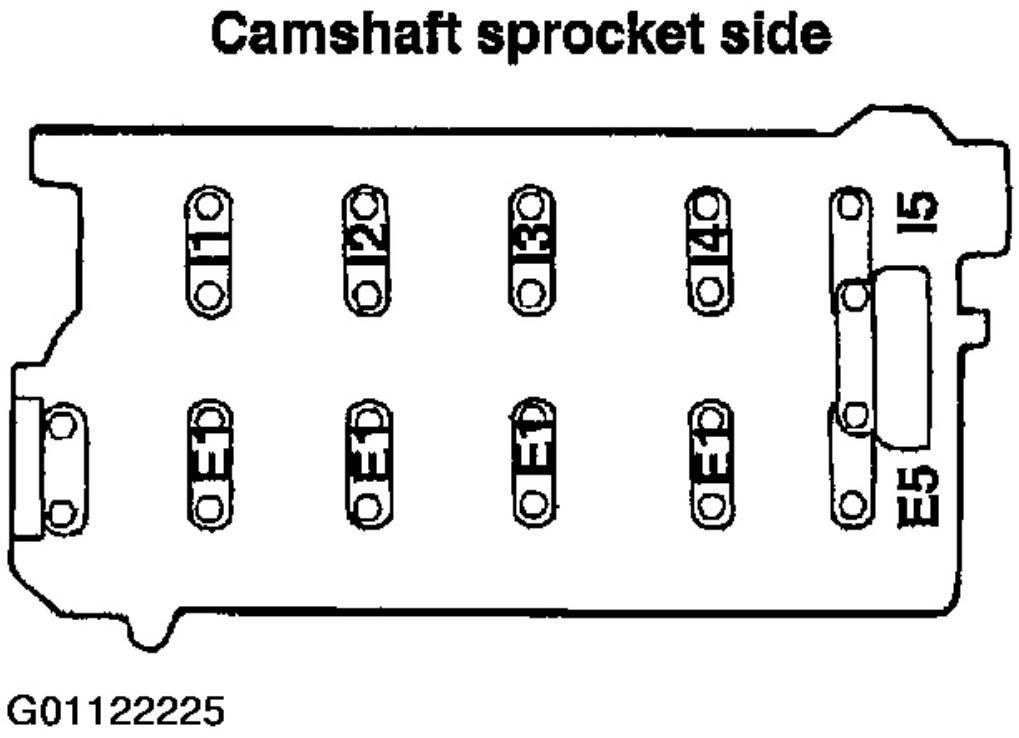

Fig. 69: Bearing Cap Installation
Courtesy of HYUNDAI MOTOR CO.

6. Using the special tool, camshaft oil seal installer (09221-21000), press fit the camshaft oil seal. Be sure to apply engine oil to the oil seal lip. Insert the oil seal along the camshaft front end and install by driving the installer with a hammer until the oil seal is fully seated.

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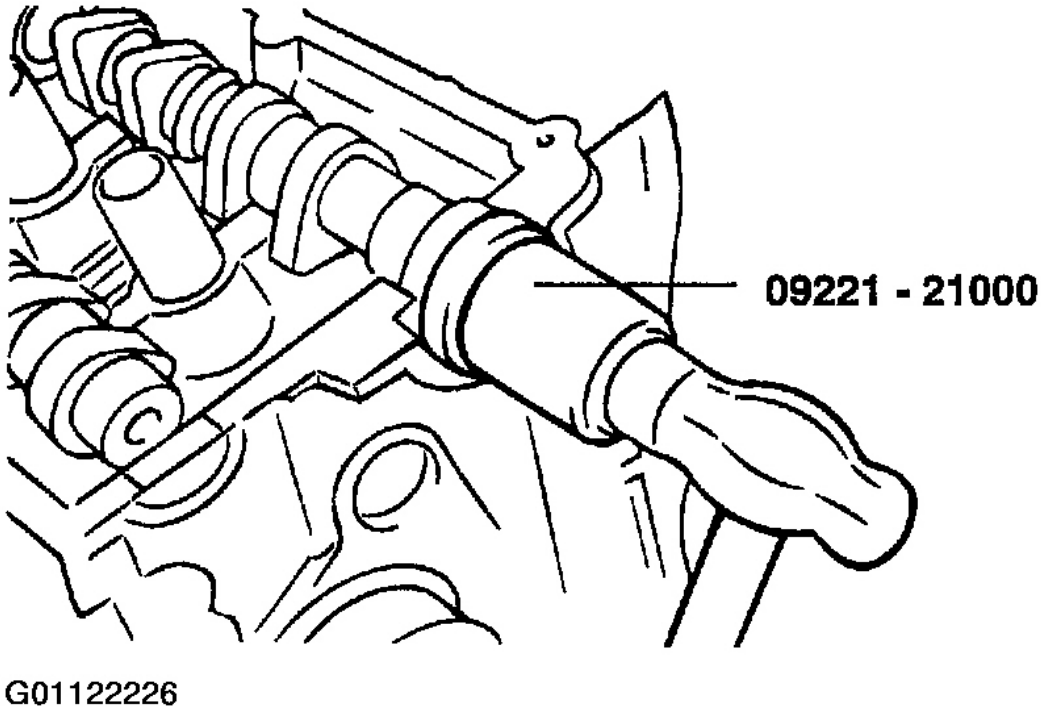

Fig. 70: Installing Camshaft Oil Seal
Courtesy of HYUNDAI MOTOR CO.

7. Install the camshaft sprocket bolts to the specified torque.

Tightening torque

Camshaft sprocket bolt:

80 - 100 Nm (800 - 1000 kg.cm, 59 - 74 lb.ft)

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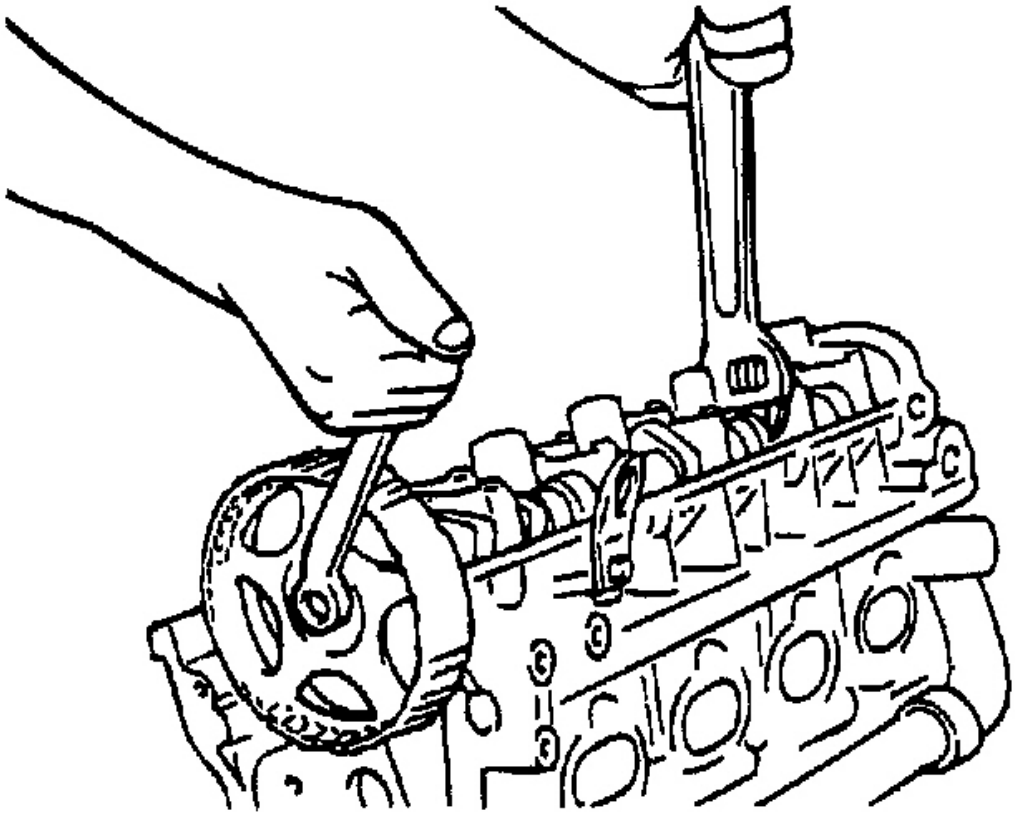

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Fig. 71: Installing Camshaft Sprocket Bolts
Courtesy of HYUNDAI MOTOR CO.

8. Align the camshaft sprocket and crankshaft sprocket timing marks. Place the piston in the No.1 cylinder to top dead center on the compression stroke.
9. Install the cylinder head cover.

Tightening torque

Cylinder head cover bolts: 8 - 10 Nm (80 - 100 kg.cm, 6 - 7 lb.ft)

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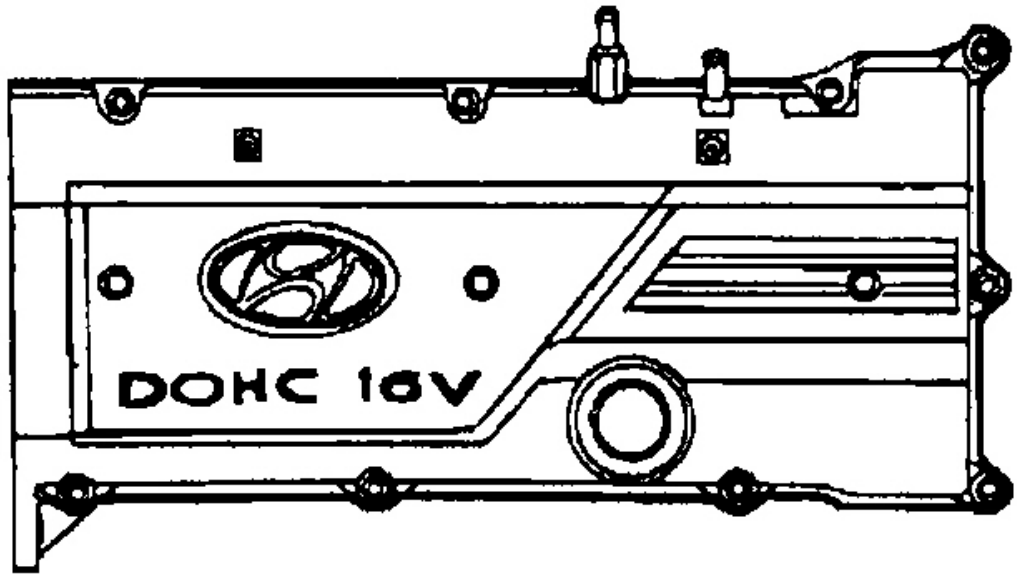

Fig. 72: Identifying Cylinder Head Cover
Courtesy of HYUNDAI MOTOR CO.

10. Install the spark plug cables, ignition coil assembly and cylinder head center cover.

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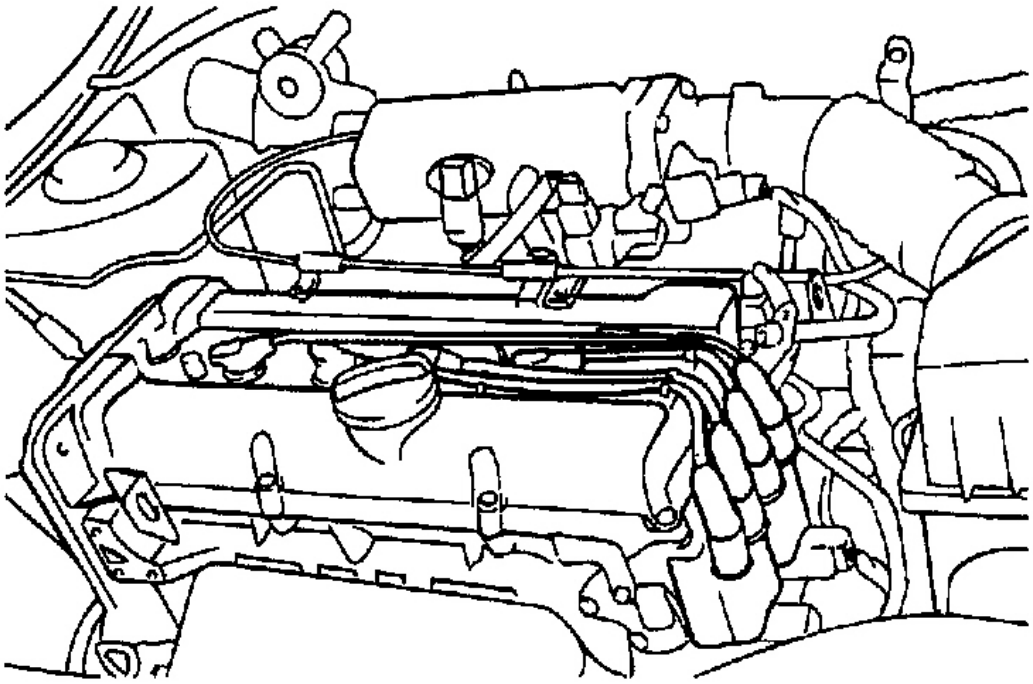

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Fig. 73: Identifying Spark Plug Cables, Ignition Coil Assembly & Cylinder Head Center Cover
Courtesy of HYUNDAI MOTOR CO.

11. Install the timing belt and then tighten the timing belt tensioner pulley.
12. Install the timing belt cover.

Tightening torque

Timing belt cover: 8 - 10 Nm (80 - 100kg.cm, 6-7 lb.ft)

13. Install the coolant pump pulley and crankshaft pulley

CRANK SHAFT

COMPONENTS

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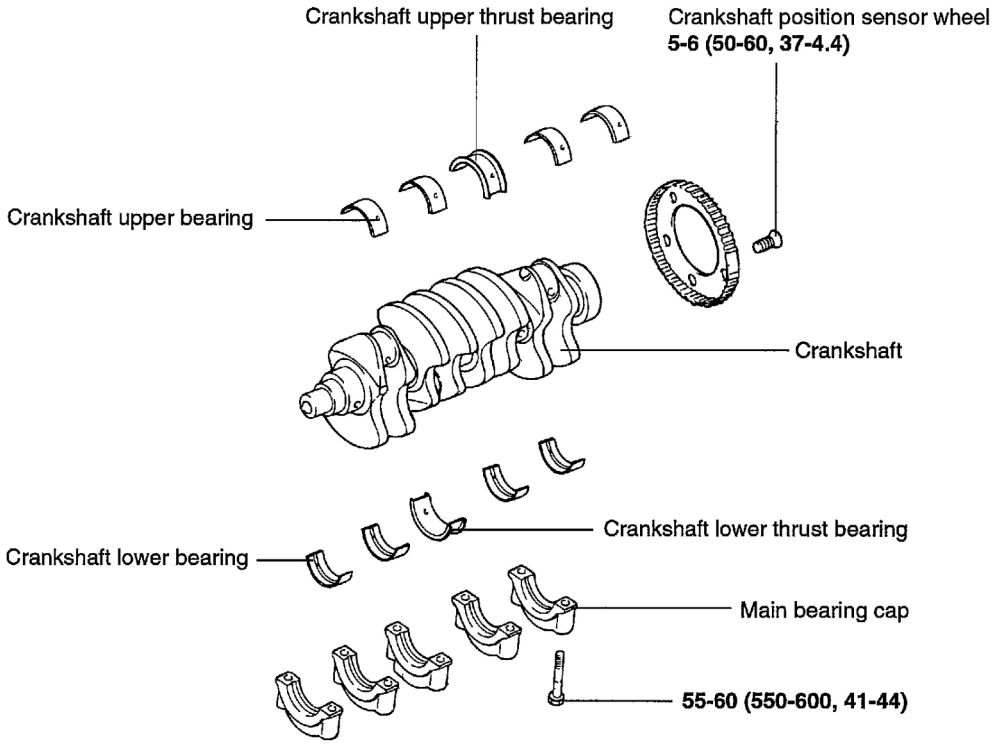

Fig. 74: Crank Shaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the timing belt, front case, flywheel, cylinder head assembly and oil pan.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.
4. Remove the main bearing caps and remove the crank-shaft.
5. Remove the crankshaft position sensor wheel.

CAUTION: Mark the main bearing caps to permit reassembly in the original position and direction.

INSPECTION

CRANKSHAFT

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1. Check the crankshaft journals and pins for damage, uneven wear, and cracks. Also check oil holes for clogging. Correct or replace any defective part.
2. Inspect the crankshaft journal for taper and out - of - round.

Standard value

Crankshaft journal O.D.: 50 mm (1.9685 in.)

Crankshaft pin O.D: 45 mm (1.7717 in.)

Crankshaft journal, pin out-of-roundness and taper: 0.005 mm (0.0002 in.) or less

MAIN BEARINGS AND CONNECTING ROD BEARINGS

1. Visually inspect each bearing for peeling, melting, seizure, and improper contact. Replace the defective bearings.

OIL CLEARANCE MEASUREMENT

1. Measure the diameter of the crankshaft journal and pin.
2. Measure the diameter of the crankshaft bore and connecting rod bore.
3. Measure the thickness of the crankshaft bearing and connecting rod bearing.
4. Measure the clearance by the value that subtract the diameter of journal and pin and the thickness of bearing from the diameter of bore.

Connecting rod bearing oil clearance: 0.018 - 0.036 mm (0.0007 - 0.0014 in.)

Crankshaft main bearing oil clearance

NO.1, 2, 4, 5: 0.022 - 0.040 mm (0.0009-0.0018 in.)

NO. 3: 0.028-0.046 mm (0.0011-0.0018 in.)

OIL SEAL

1. Check front and rear oil seals for damage or wear. Replace any seal that is defective.

CRANKSHAFT SENSOR WHEEL

1. Remove the sensor wheel
2. Check the sensor wheel for damage, cracks and wear, and replace if necessary.
3. Check the clearance between the sensor wheel and the crank position sensor with a depth gage.

Standard value

Clearance between sensor wheel and crank position sensor: 0.5 - 1.1 mm (0.020 - 0.043 in.)

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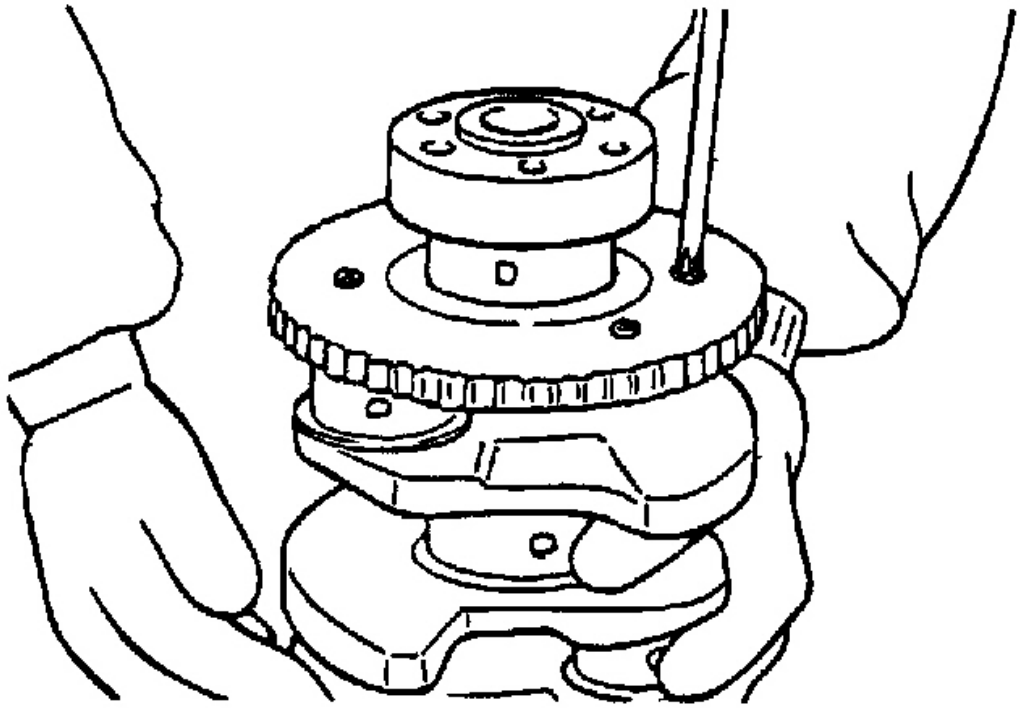

Fig. 75: Checking Clearance Between Sensor Wheel & Crank Position Sensor
Courtesy of HYUNDAI MOTOR CO.

NOTE:

1. **Measure the depth of the top of sensor wheel tooth and the cylinder block mounting block.**
2. **Measure the difference between sensor length and depth.**
3. **Sensor length is the distance between the end of the sensor and the inner point of the contacting face.**

REASSEMBLY

1. Install the upper main bearing inserts in the cylinder block.

   When reusing the main bearings, remember to install them by referring to the location marks made at the time of disassembly.

2. Install the crankshaft. Apply engine oil to the journals.
3. Install bearing caps and tighten cap bolts to the specified torque in the following sequence; center, No.2,

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No.4, front, and rear caps.

Cap bolts should be tightened evenly in 2 to 3 stages before they are tightened to the specified torque.

The caps should be installed with the arrow mark directed toward the crank pulley side of engine. Cap numbers must be correct.

Tightening torque

Main bearing cap bolt:

55-6Nm (550-600kg.cm, 41-44lb.ft)

Connecting rod cap bolt:

32-35Nm (320-350 kg.cm, 24-26lb.ft)

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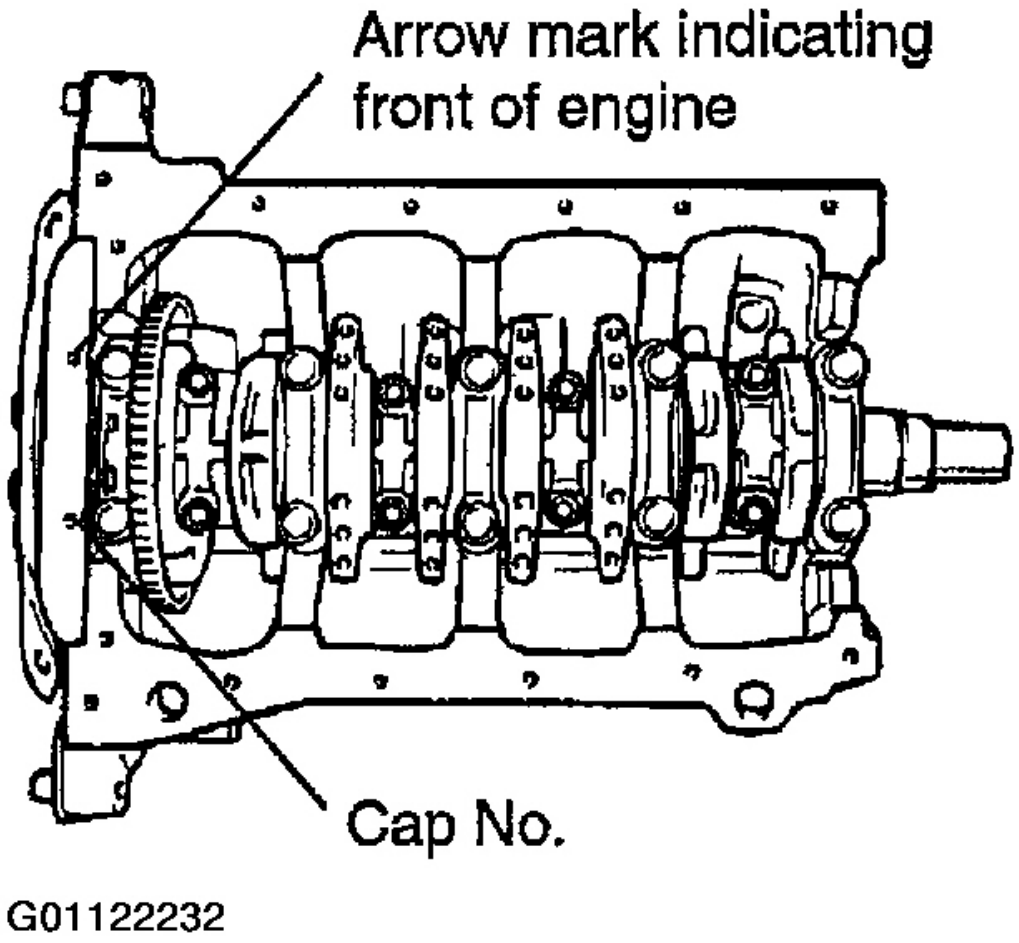

Fig. 76: Identifying Arrow Mark Indicating Front Of Engine
Courtesy of HYUNDAI MOTOR CO.

4. Make certain that the crankshaft turns freely and has the proper clearance between the center main bearing thrust flange and the connecting rod big end bearing.

   Standard value

   Crankshaft end play:

   0.05-0.175 mm (0.0019-0.0068 in.)

5. Install the oil seal in the crankshaft rear oil seal case. Use the Special Tool, Crankshaft Rear Oil Seal Installer (09231-21000) as shown. Press fit the oil seal all the way in, being careful not to misalign it.

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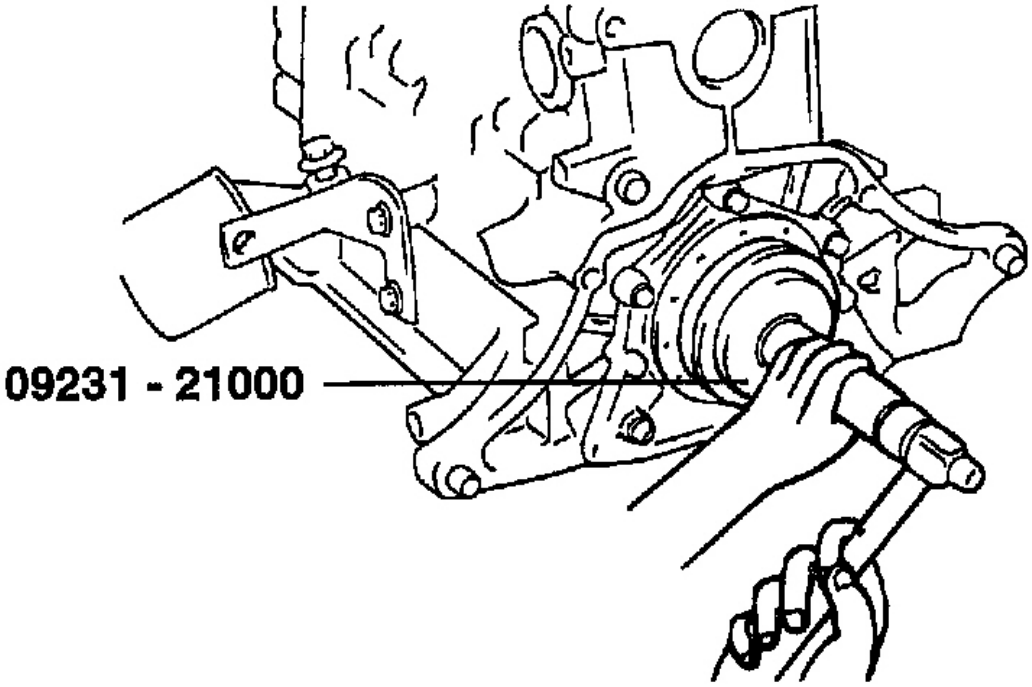

Fig. 77: Installing Oil Seal In Crankshaft Rear Oil Seal Case
Courtesy of HYUNDAI MOTOR CO.

6. Install the rear plate and tighten the bolts.
7. Install the connecting rod caps.
8. Install the flywheel, front case, oil pan and timing belt.

FLY WHEEL

COMPONENTS

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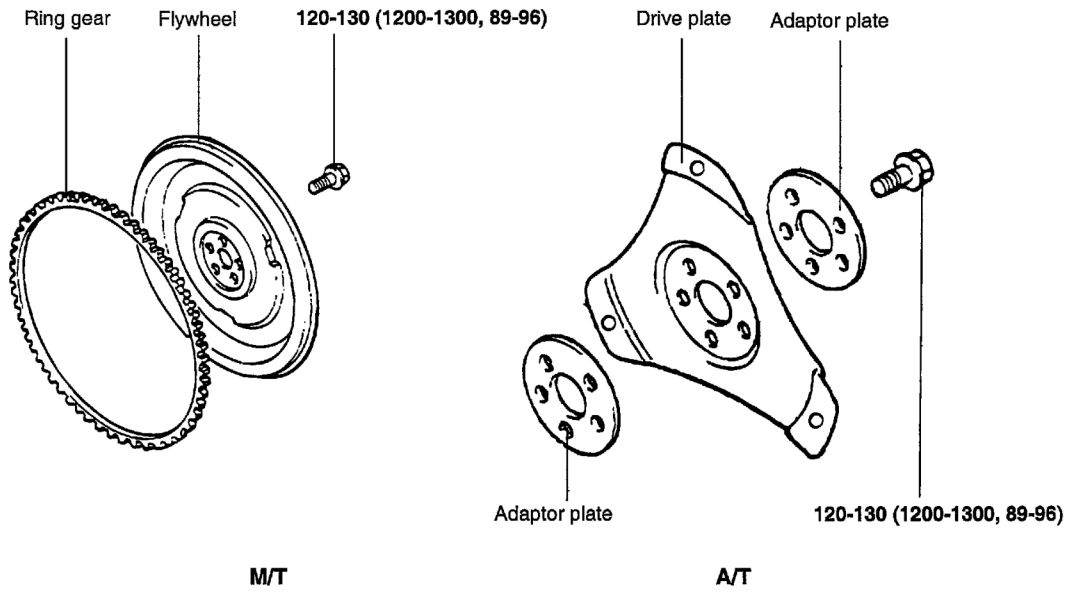

Fig. 78: Fly Wheel Components
Courtesy of HYUNDAI MOTOR CO.

M/T: Manual Transmission Vehicles

A/T: Automatic Transmission Vehicles

DISASSEMBLY

1. Remove the Transmission and clutch.
2. Remove the flywheel.

INSPECTION

1. Check the clutch disc contacting surface of the flywheel for damage and wear. Replace the flywheel if excessively damaged or worn.
2. Check the clutch disc contacting surface of the flywheel for runout.

   Standard value

   Flywheel run-out: 0.1 mm (0.0039 in.)

3. Check the ring gear for damage, cracks, and wear, and replace if necessary.

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REASSEMBLY

1. Install the flywheel assembly and tighten the bolts to the specified torque.

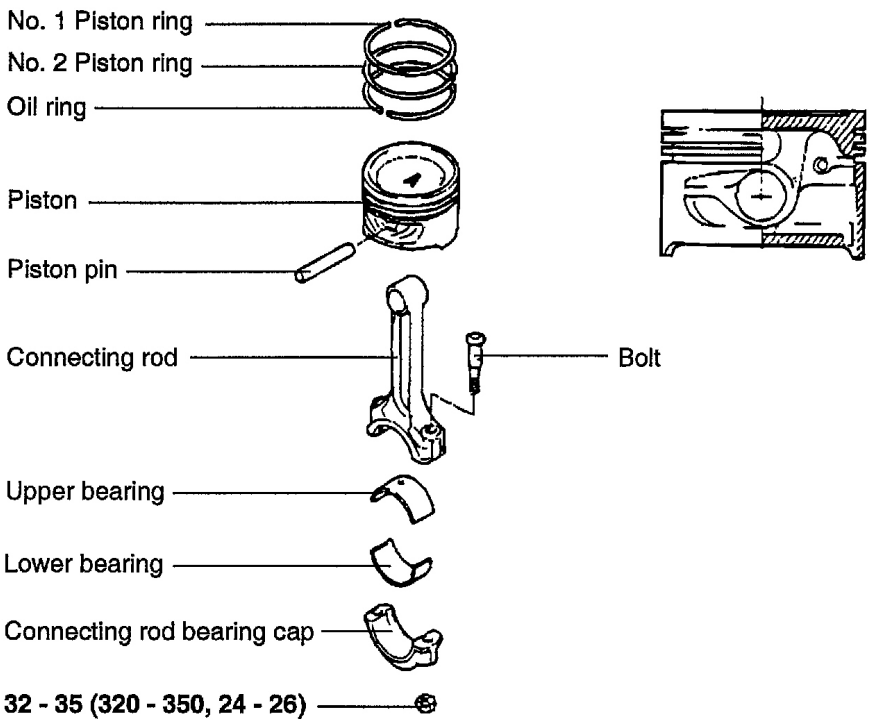
   Tightening torque

   Flywheel bolt:

   120-130Nm (1200-1300kg.cm, 89-96lb.ft)

PISTON

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

G01122235

Fig. 79: Piston Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

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CONNECTING ROD CAP

CAUTION: Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing.
2. Push each piston connecting rod assembly toward the top of the cylinder.

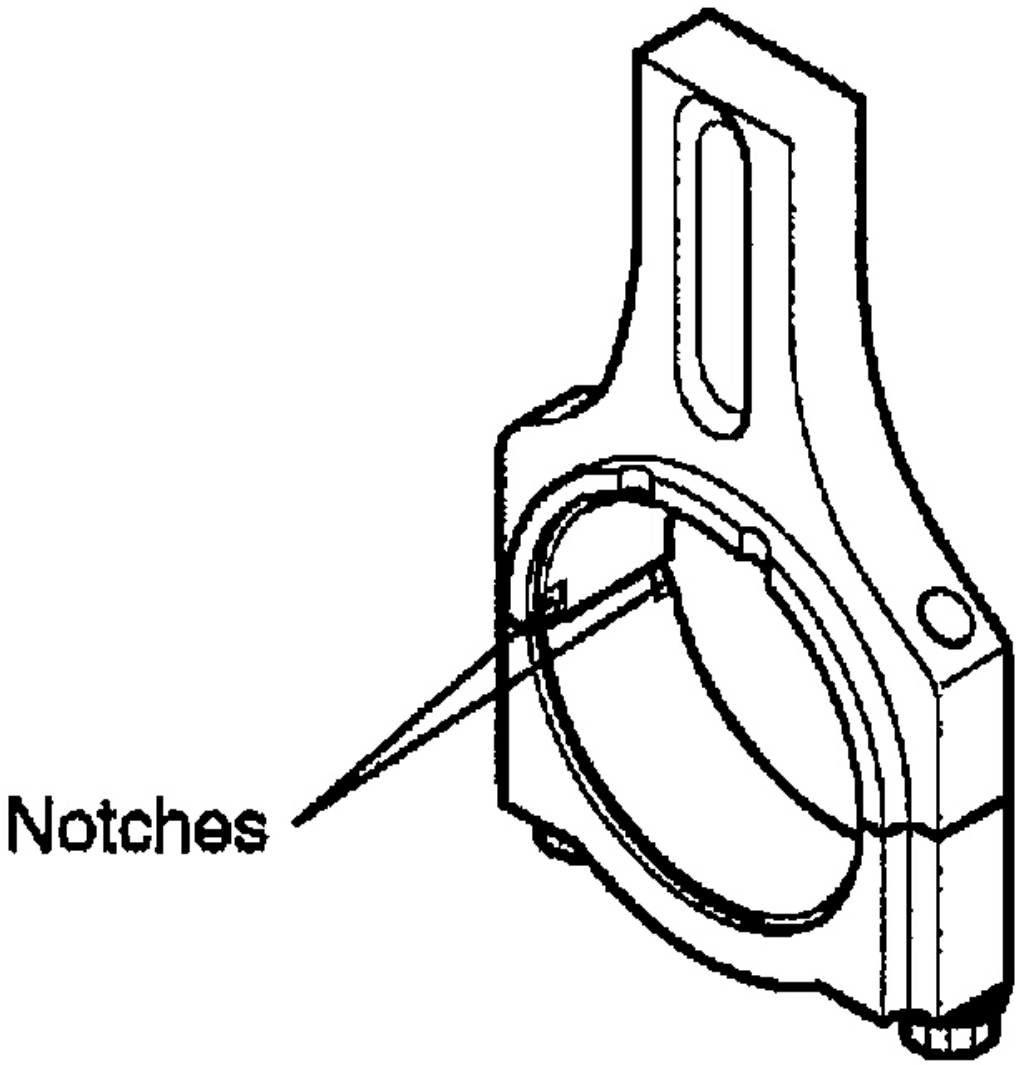

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Fig. 80: Identifying Connecting Rod Notches
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY AND REASSEMBLY OF THE PISTON PIN

1. Using the special tools (09234-33001) and (09234-33002), disassemble and reassemble the piston and connecting rod.

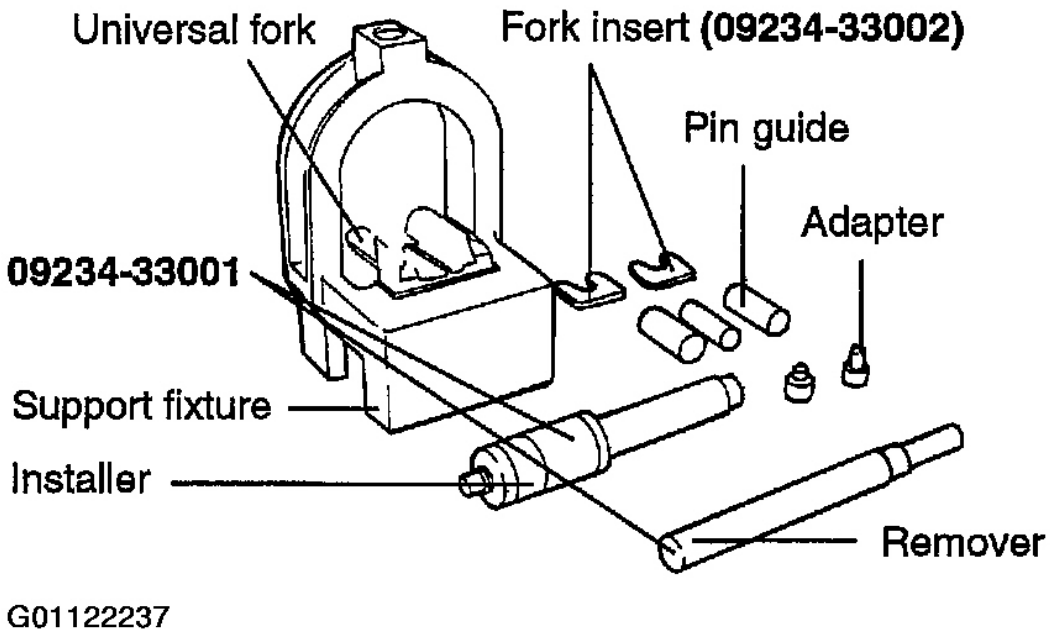

Fig. 81: Identifying Special Tools For Piston & Connecting Rod Disassembly & Reassembly
Courtesy of HYUNDAI MOTOR CO.

2. The piston pin is press fit into the rod little end, and the piston floats on the pin.
3. The tool consists of a support fixture with fork inserts, guides, adapters, an installer and a remover. The piston is supported in the support fixture while the pin is being installed or removed. Guides help position the pin as it is installed or removed, while the rod is supported by fork inserts.
4. To remove the pin from the piston, place the piston in the support fixture with the rod resting on the fork inserts. Pass the remove tool through the top of the support fixture and use it to press out the pin.

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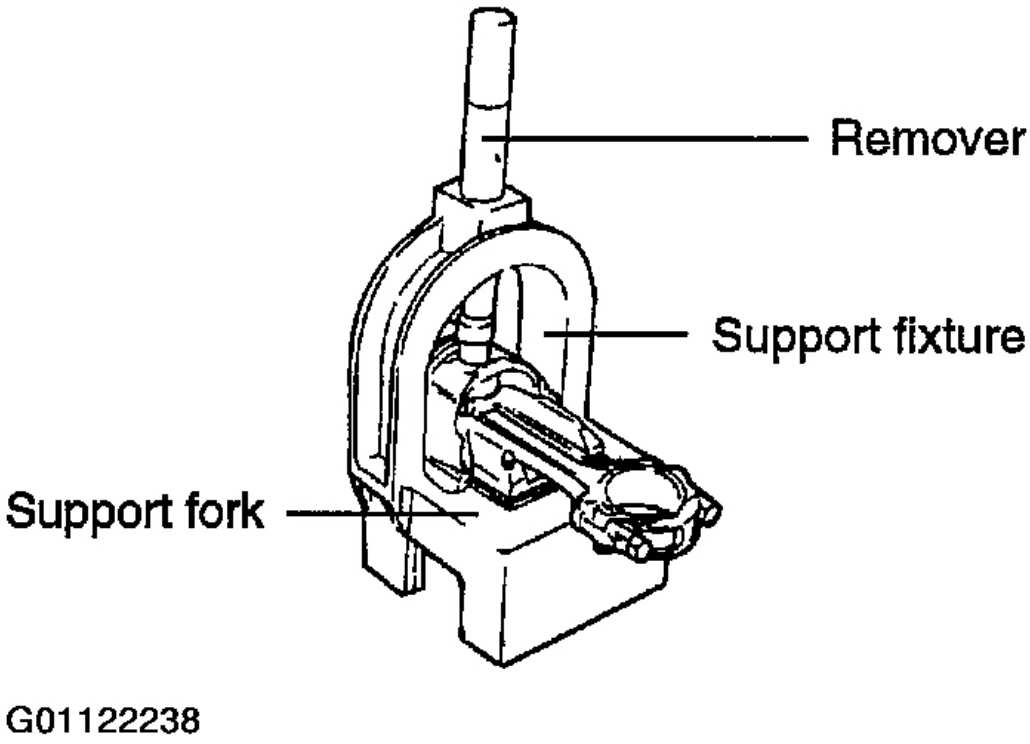

Fig. 82: Placing Piston In Support Fixture
Courtesy of HYUNDAI MOTOR CO.

5. To install a new pin, the proper fork inserts must be in place to support the rod.
6. Position the rod inside the piston. Insert the proper pin guide through one side of the piston and through the rod. Hand tap the pin guide so it is held by the piston. Insert the new pin into the piston from the other side and set the assembly into the support fixture with the pin guide facing down.

NOTE: The pin guide should be centered on the connecting rod through the piston. If assembled correctly, the pin guide will sit exactly under the center of the hole in the tool's arch, and rest evenly on the fork inserts. If the wrong size pin guide is used, the piston and pin will not line up with the support fixture.

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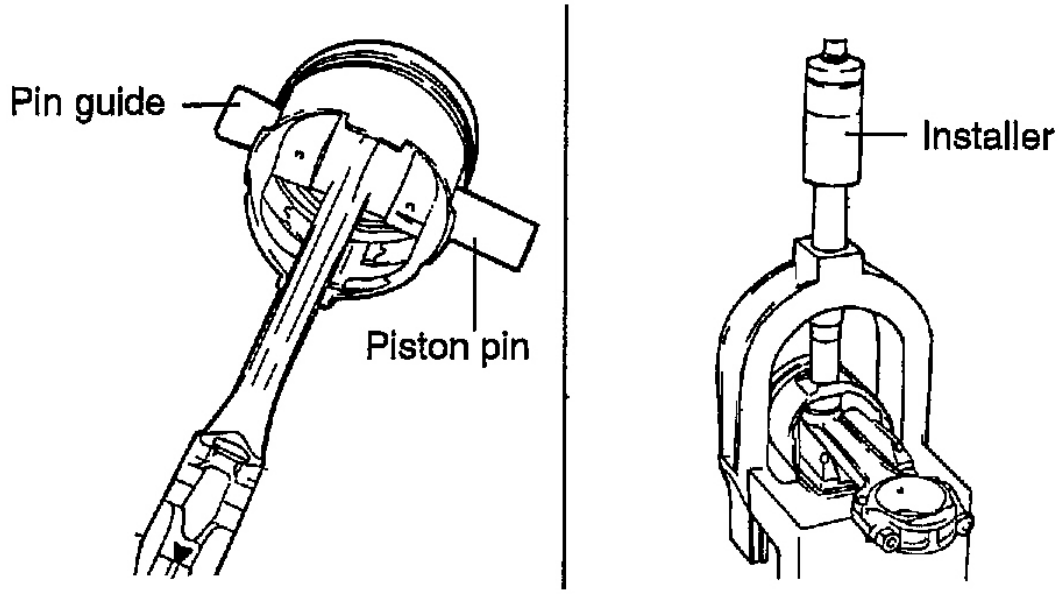

Fig. 83: Installing Piston Pin
Courtesy of HYUNDAI MOTOR CO.

7. Insert the installer tool through the hole in the arch of the support fixture and use an hydraulic press to force the piston pin through the rod little end. Continue pressing until the pin guide falls free and the installer tool seats against the top of the arch.

CAUTION: Do not exceed 1250 +/- 500 kg (2765 +/- 1102 lb) of force when the installing tool seats against the top of the arch.

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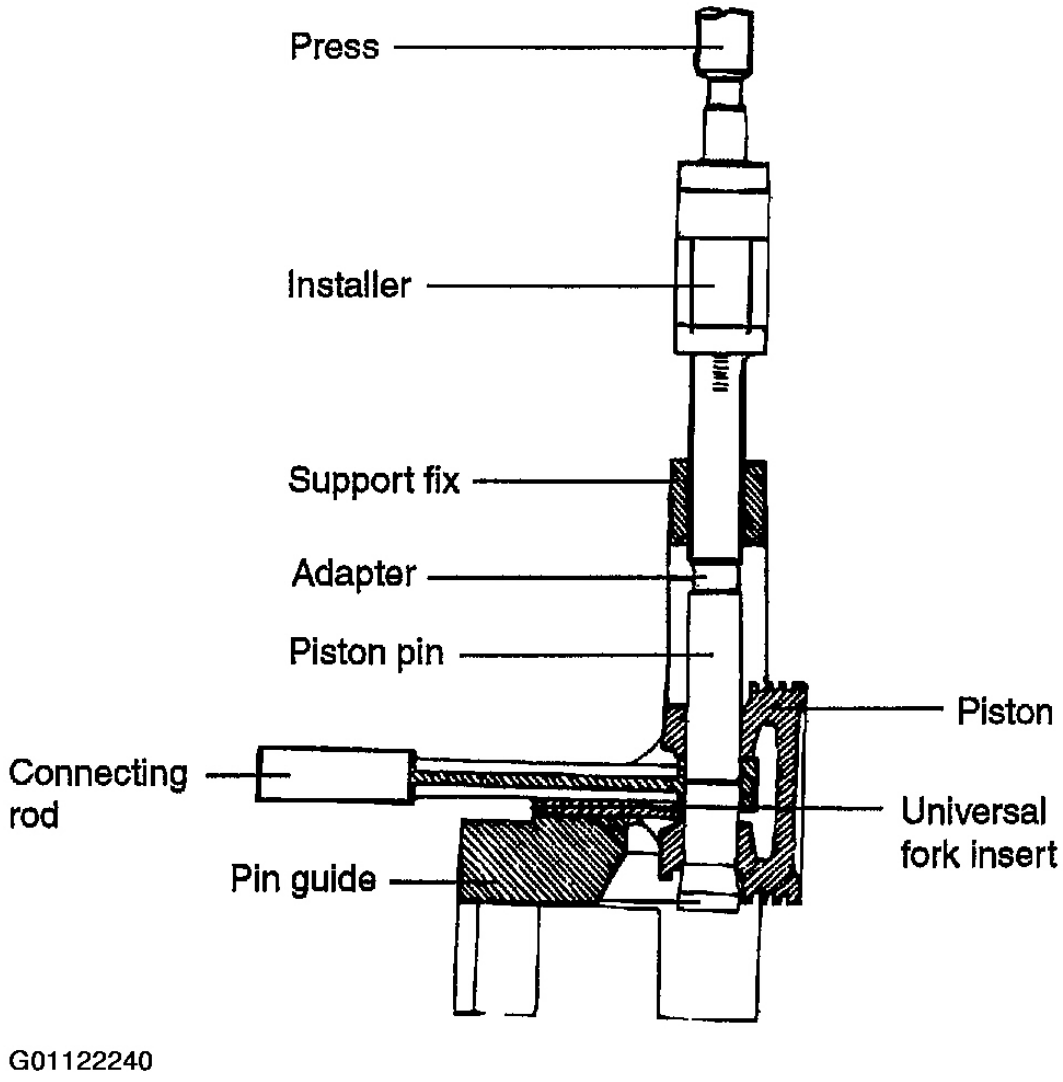

Fig. 84: Inserting Piston Pin Through Rod Little End
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

PISTONS AND PISTON PINS

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature).

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PISTON RINGS

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in the ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace the piston rings only.

   Piston ring side clearance

   No.1: 0.04-0.085 mm (0.0016-0.0033 in.)

   No.2: 0.04-0.085 mm (0.0016-0.0033 in.)

   [Limit]

   No.1: 0.1 mm (0.004 in.)

   No.2: 0.1 mm (0.004 in.)

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

   Piston ring end gap

   [Standard dimensions]

   No.1: 0.20-0.35 mm (0.0079 - 0.0138 in.)

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

   Oil ring side rail: 0.2-0.7 mm (0.0079-0.0276)

   [Limit]

   No.1, No.2: 1.0 mm (0.039 in.)

   Oil ring side rail: 1.0 mm (0.039 in)

   When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the low part of cylinder that is less worn out.

   Piston ring service size and mark

   standard None

   0.25mm (0.010 in.) O.S 25

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0.50mm (0.020 in.) O.S 50

0.75mm (0.030 in.) O.S 75

1.00mm (0.039 in.) O.S 100

NOTE: The mark can be found on the upper side of the ring next to the end.

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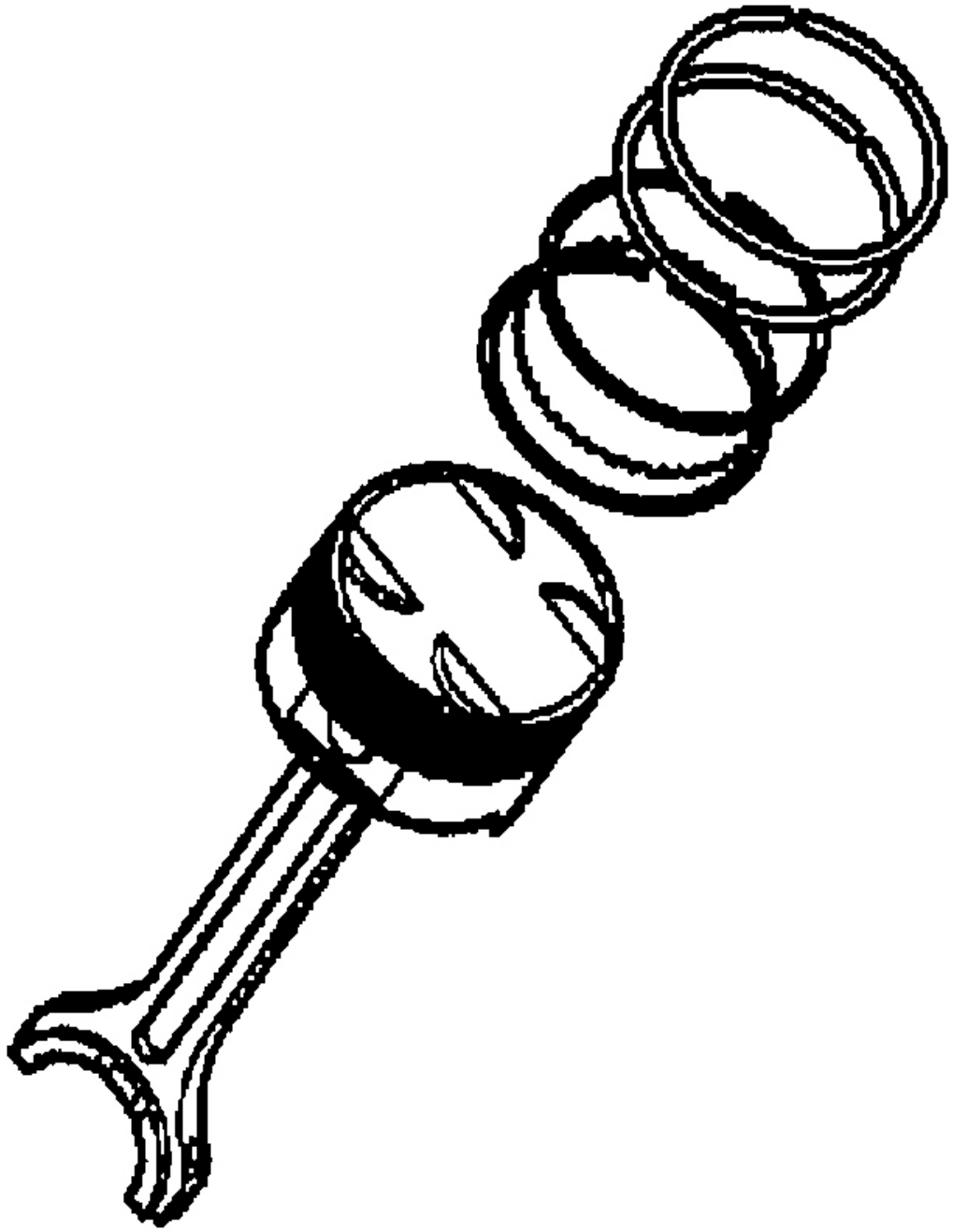

Fig. 85: Installing Piston Rings
Courtesy of HYUNDAI MOTOR CO.

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CONNECTING RODS

1. When the connecting rod cap is installed, make sure that the cylinder numbers, marked on rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has a stratified wear in, or if the surface of the inside diameter of the small end is severely rough, replace the rod.

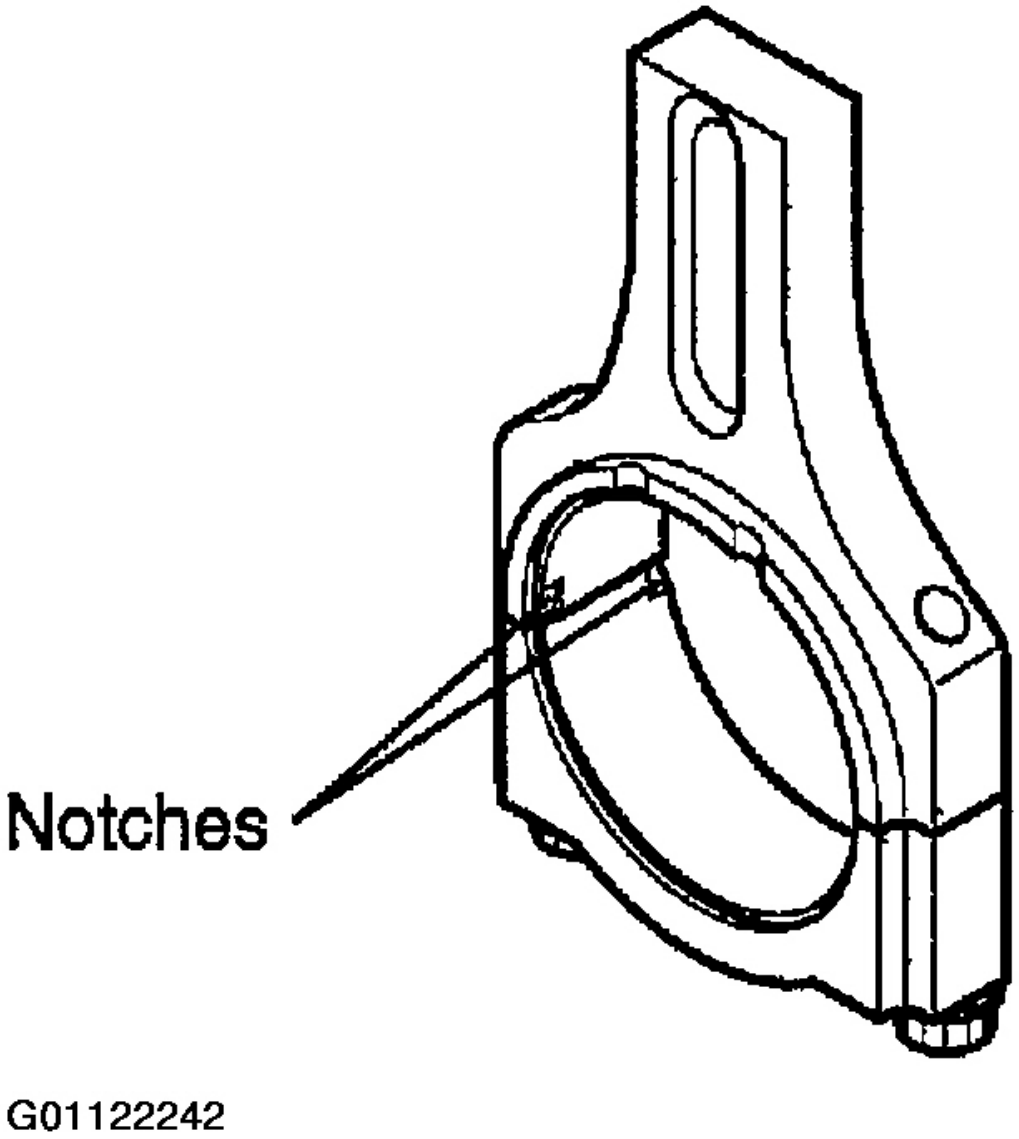

Fig. 86: Locating Connecting Rod Notches

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Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Install the spacer.

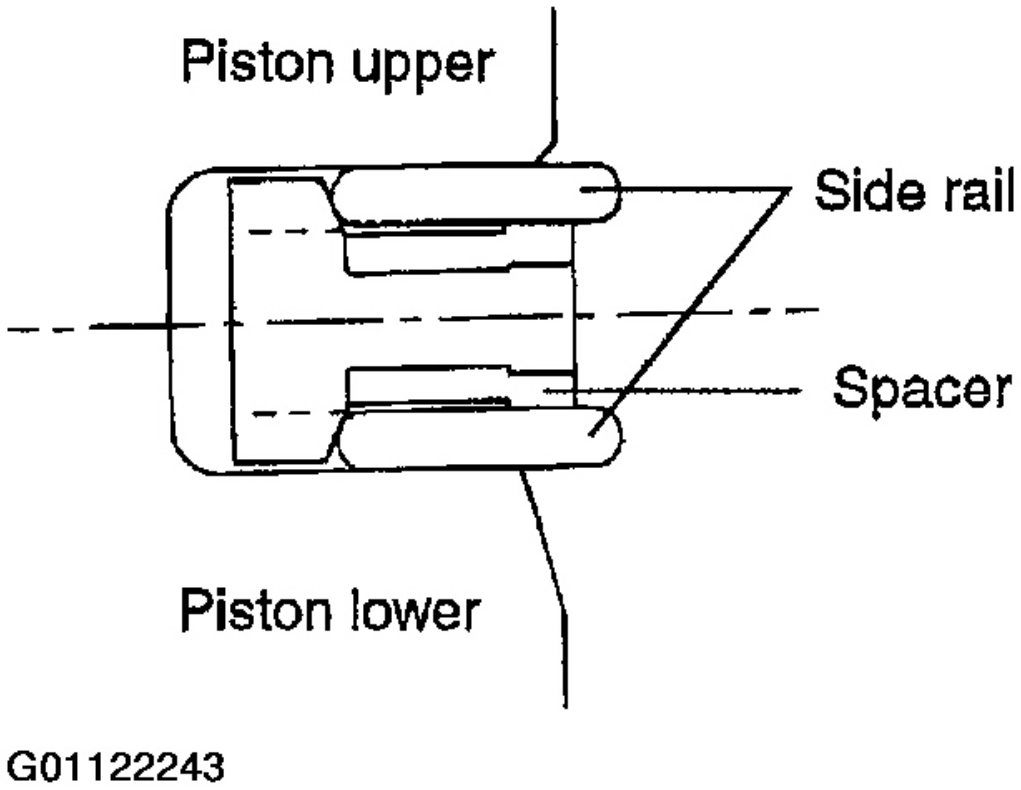

Fig. 87: Installing Spacer
Courtesy of HYUNDAI MOTOR CO.

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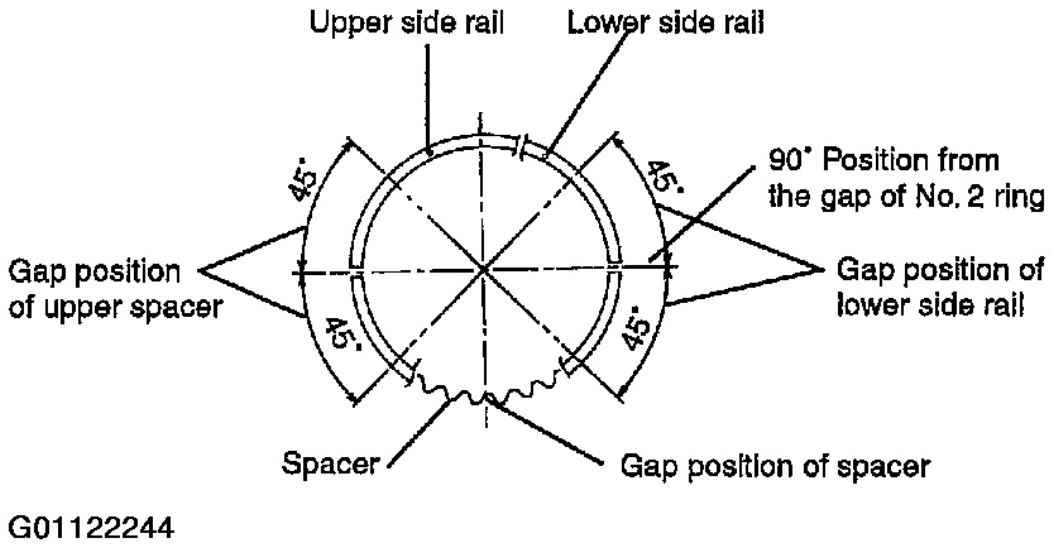

Fig. 88: Positioning Spacer
Courtesy of HYUNDAI MOTOR CO.

2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, and press down with a finger on the portion to be inserted into the groove (as illustrated).

CAUTION: Do not use a piston ring expander when installing side rail.

3. Install the lower side rail by the same procedure described in Step 2.

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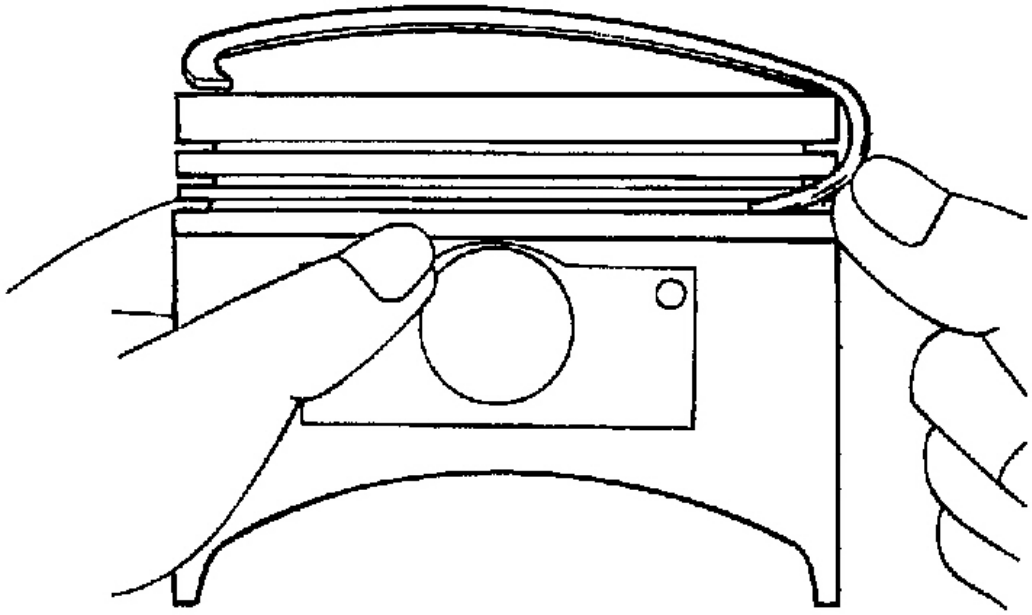

Fig. 89: Installing Piston Lower Side Rail
Courtesy of HYUNDAI MOTOR CO.

4. Apply engine oil around the piston and piston grooves.
5. Using a piston ring expander, install the No.2 piston ring.
6. Install the No. 1 piston ring.

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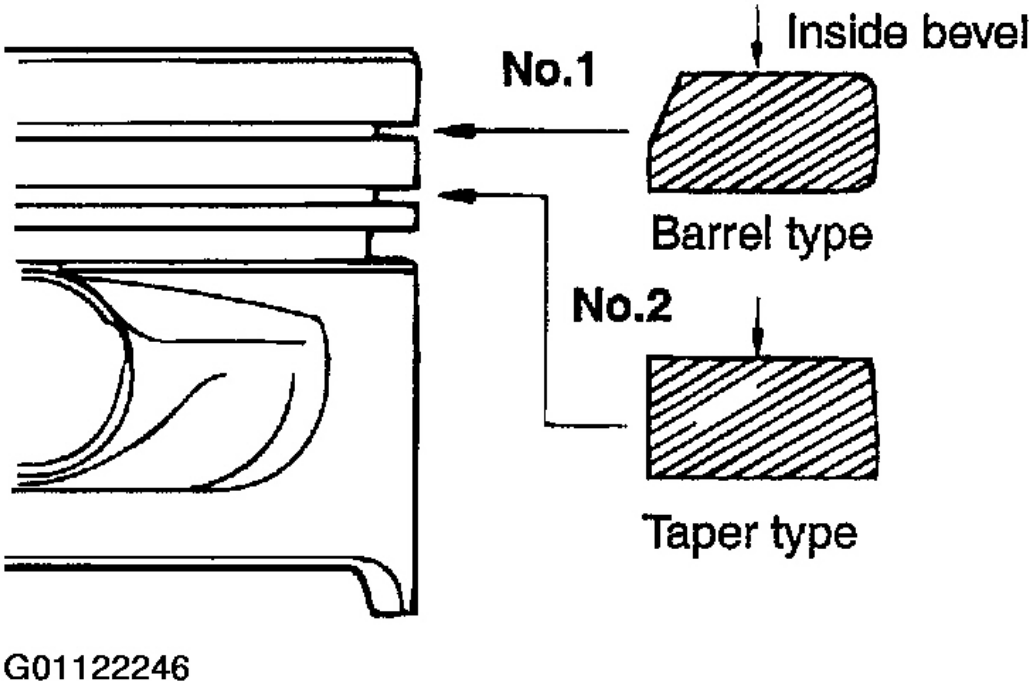

Fig. 90: Locating No. 1 & No. 2 Piston Rings
Courtesy of HYUNDAI MOTOR CO.

7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.
8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.

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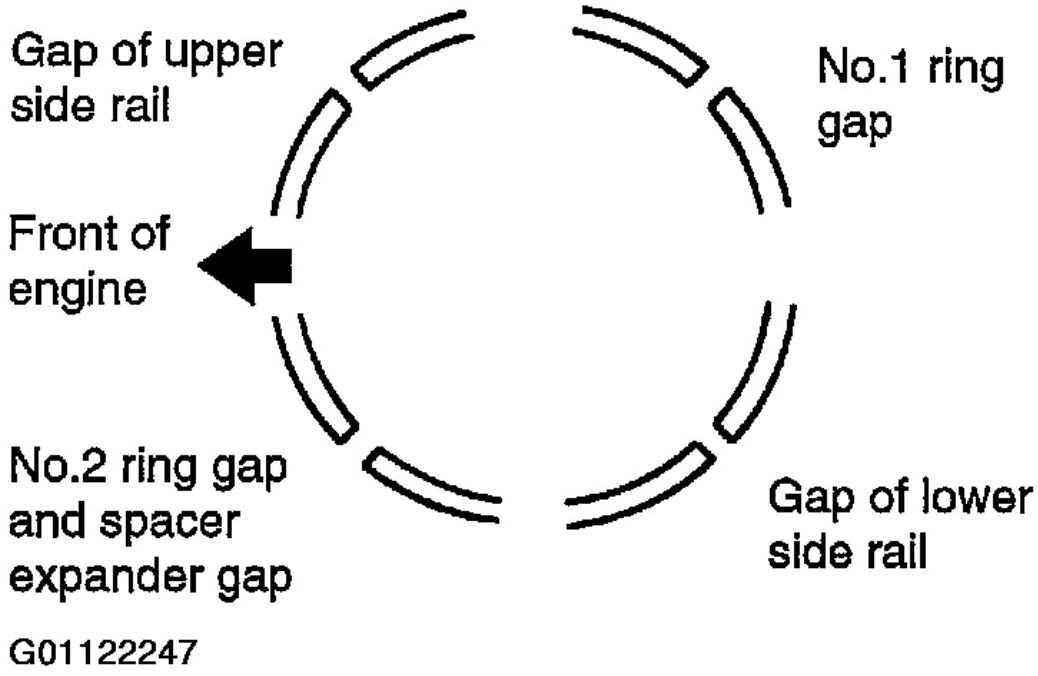

Fig. 91: Positioning Piston Ring End Gaps
Courtesy of HYUNDAI MOTOR CO.

9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.
11. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
12. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
13. When assembling, bolts should be fastened by the angle - torque controlled method as the following.
    1. Apply oil to the thread of nuts and spot areas.
    2. Tighten the connecting rod bolt.

       Tightening torque

       Connecting rod cap nut:

       32-35 Nm (320-350 kg.cm, 24-26 lb.ft)

CAUTION: After removing the connecting rod bolt, do not use if again. When using a new bolt, do not tighten the bolt more than 3

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times.

14. Check the connecting rod side clearance.

    Connecting rod side clearance

    Standard: 0.10-0.25 mm (0.0039-0.0098 in.)

    Limit: 0.4 mm (0.0157 in.)

15. Install the oil screen.
16. Install the oil pan
17. Install the cylinder head.

COOLING SYSTEM

ENGINE COOLANT HOSE/PIPES

COOLING SYSTEM

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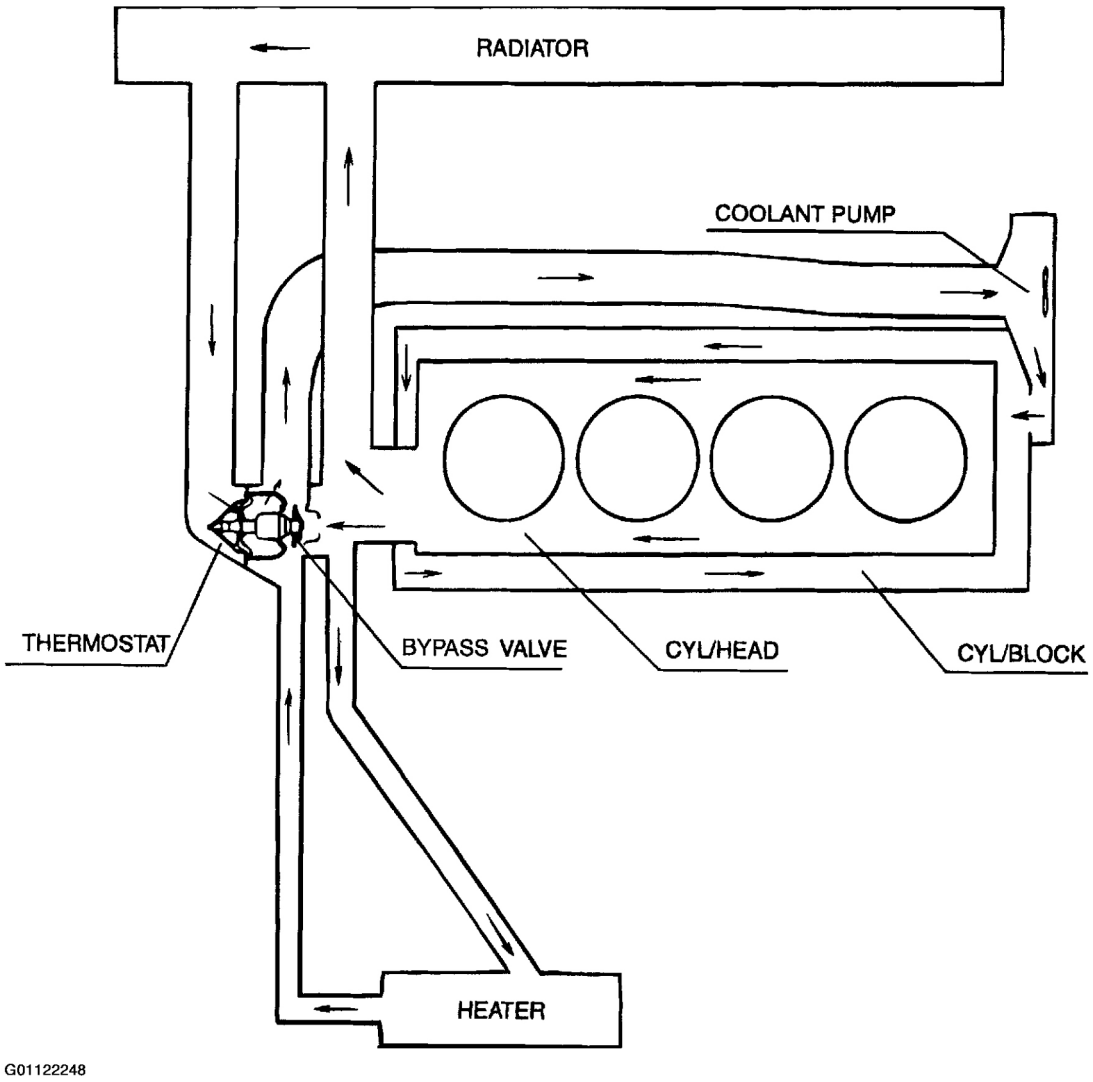

Fig. 92: Engine Coolant Hose/Pipes
Courtesy of HYUNDAI MOTOR CO.

COMPONENTS

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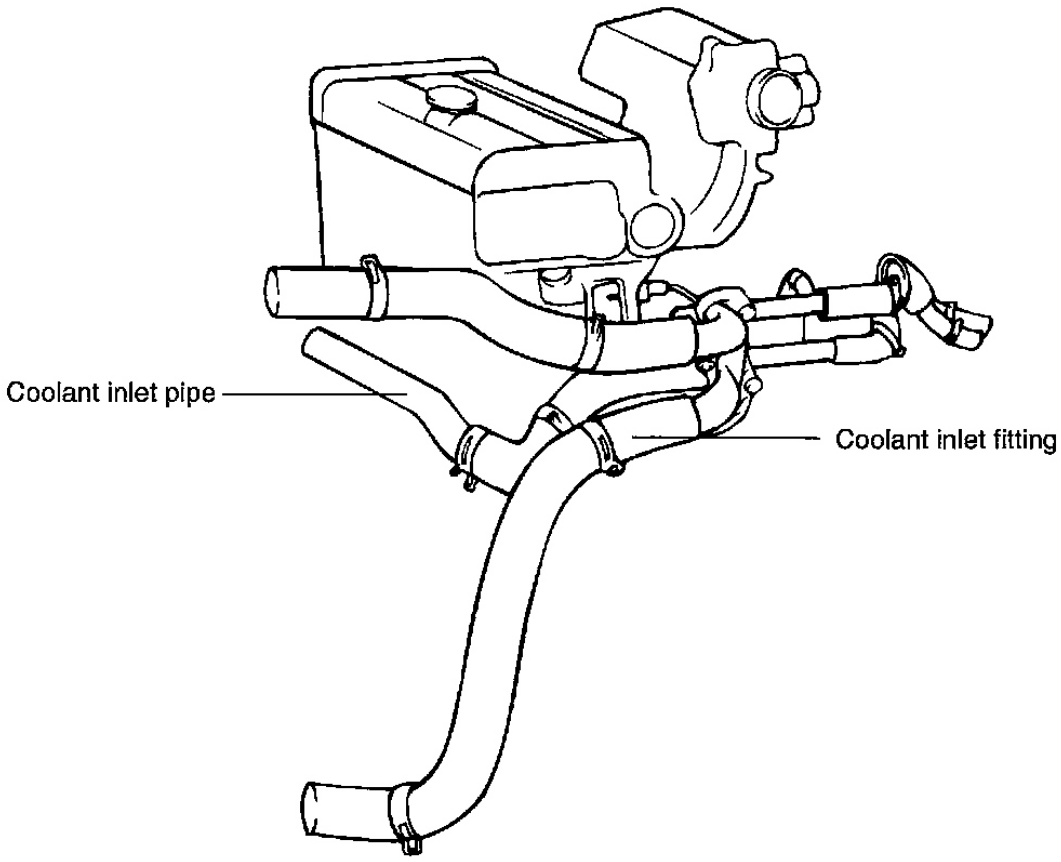

Fig. 93: Cooling System Components
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

Check the coolant pipe and hoses for cracks, damage, or restrictions.

Replace if necessary.

REASSEMBLY

1. Fit on O-ring in the groove provided at the coolant inlet pipe end, wet the O-ring with coolant and insert the coolant inlet pipe.

NOTE:
1. **Do not apply oil or grease to the coolant pipe O-ring.**
2. **Keep the coolant pipe connections free of sand, dust, etc.**
3. **Insert the coolant pipe fully into the cylinder block.**

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4. **Do not reuse the O-ring. Replace it with a new part.**

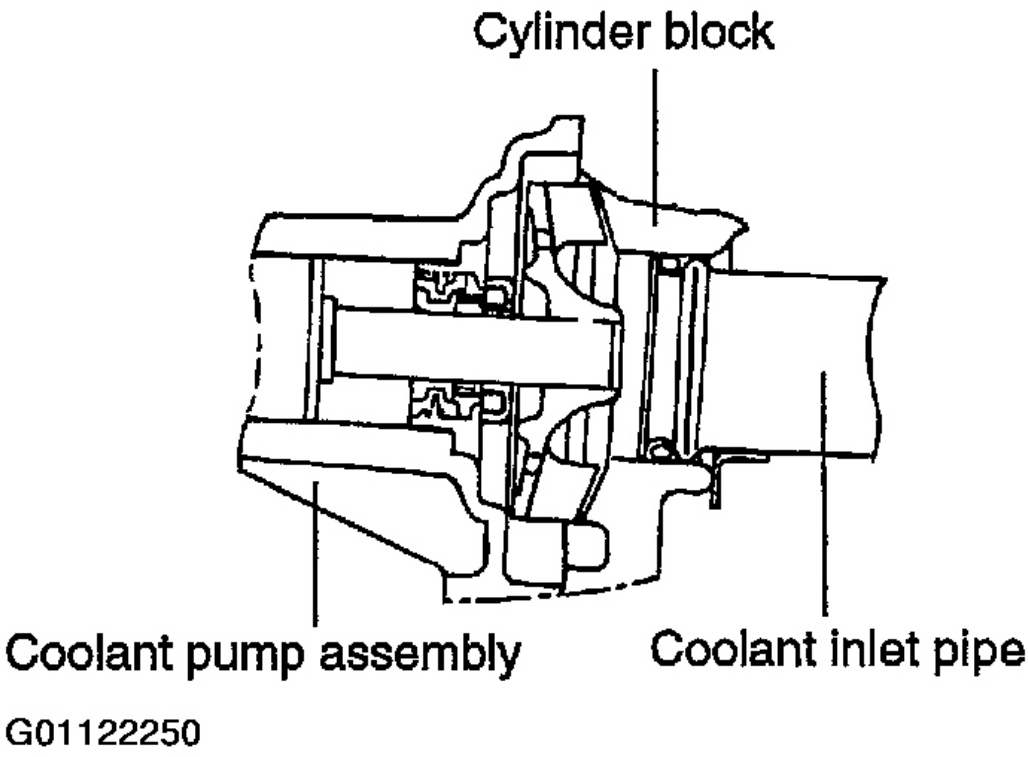

Fig. 94: Identifying Coolant Pump & Inlet Pipe
Courtesy of HYUNDAI MOTOR CO.

ENGINE COOLANT PUMP

COMPONENTS

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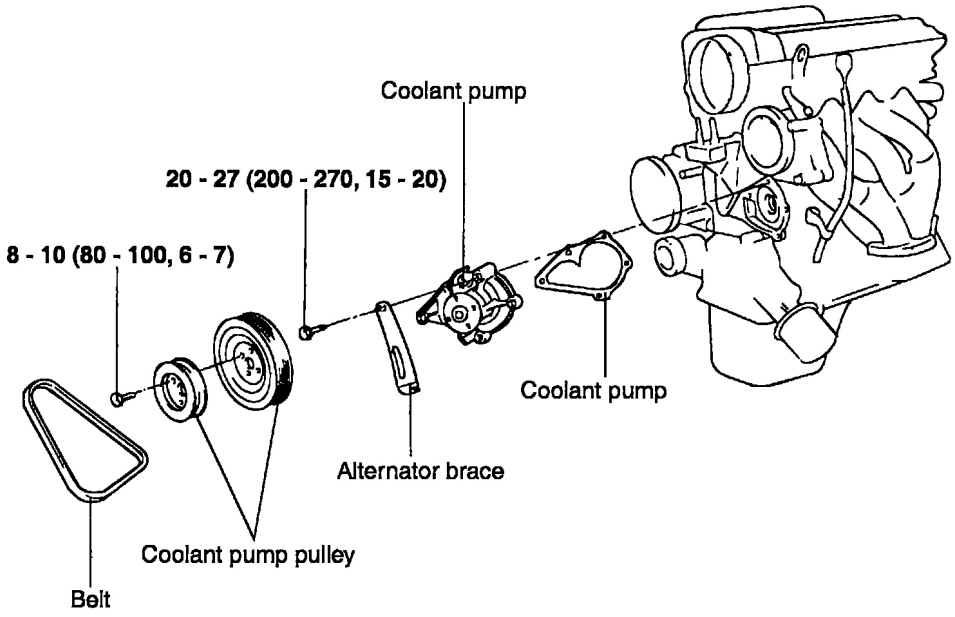

TORQUE : Nm (kg.cm, lb.ft)

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Fig. 95: Engine Coolant Pump Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Drain the coolant and disconnect the coolant inlet pipe connection hose from the coolant pump.
2. Remove the drive belt and engine coolant pump pulley.
3. Remove the timing belt covers and the timing belt idler.
4. Remove the coolant pump mounting bolts, then remove the alternator brace.
5. Remove the coolant pump assembly from the cylinder block.

INSPECTION

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 then the seal is defective. Replace the coolant pump assembly.

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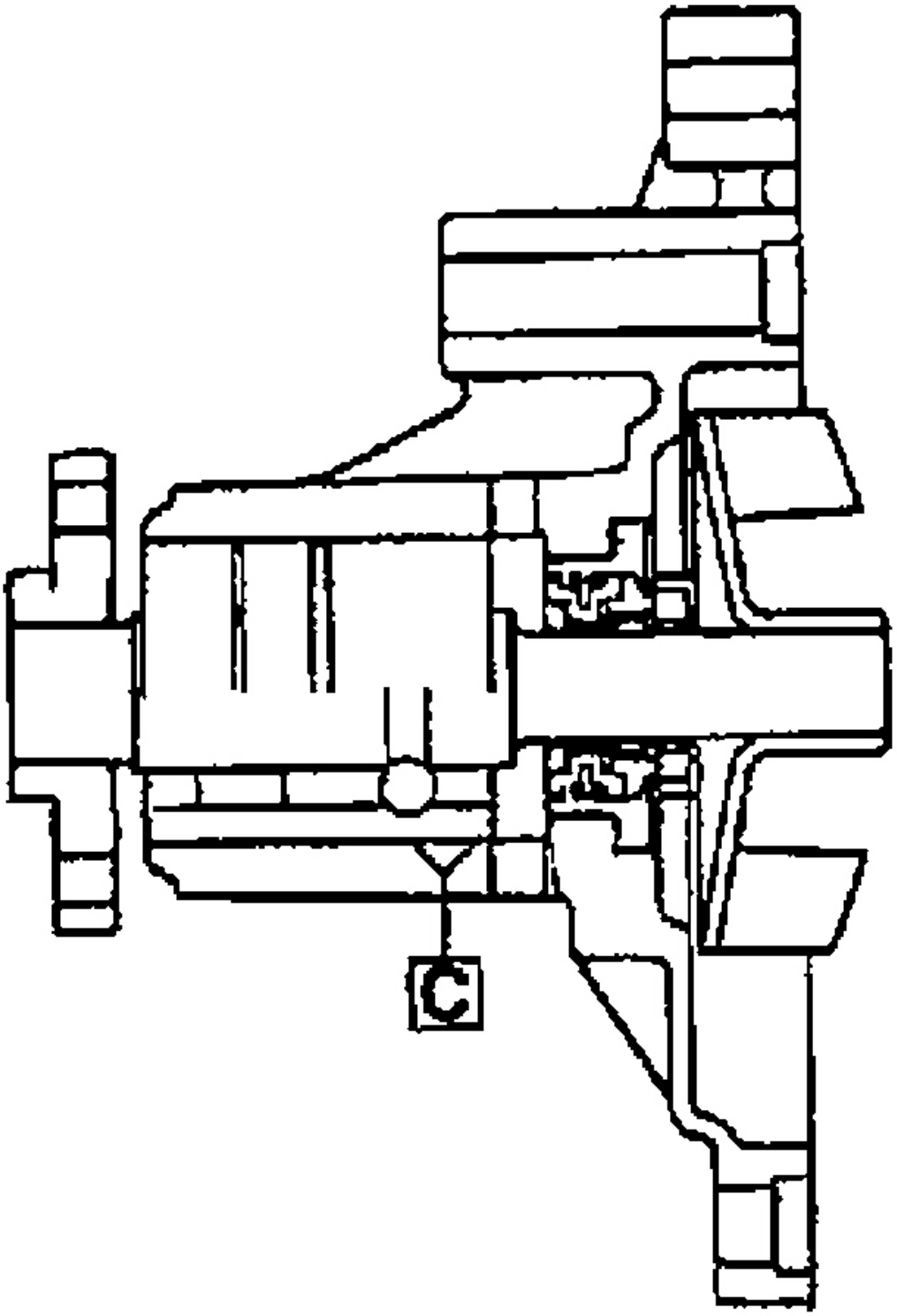

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Fig. 96: Identifying Engine Coolant Pump
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Clean the gasket surfaces of the coolant pump body and the cylinder block.
2. Install a new coolant pump gasket to the coolant pump and tighten the bolts to the specified torque.

   Tightening torque

   Coolant pump to cylinder block:

   A: 12-15Nm (120-150kg.cm, 9-11lb.ft)

   B: 20-27Nm (200-270kg.cm, 15-20 lb.ft)

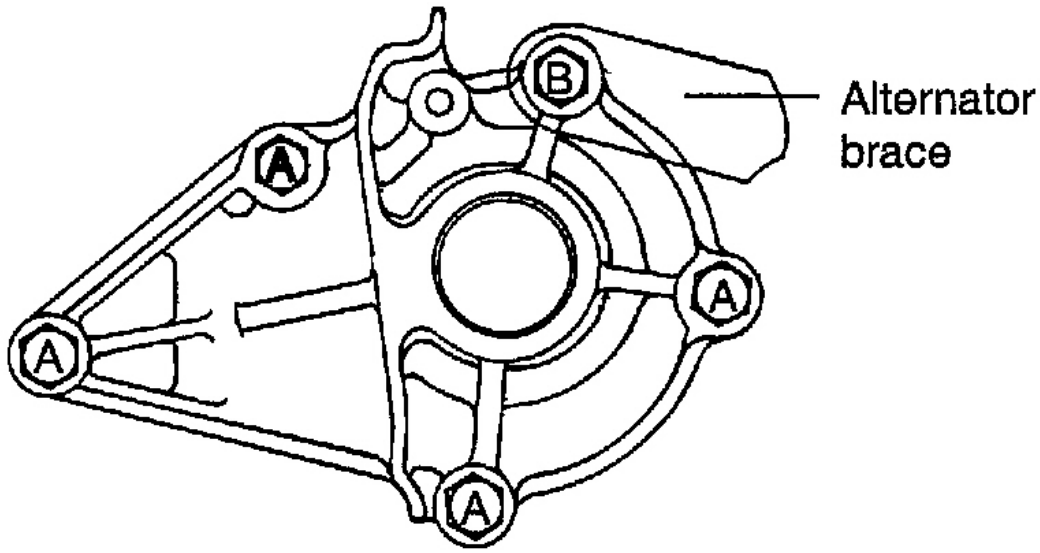

Fig. 97: Locating Coolant Pump Bolts
Courtesy of HYUNDAI MOTOR CO.

3. Install the timing tensioner and timing belt. Adjust the timing belt tension.
4. Install the timing belt covers.
5. Install the coolant pump pulley and drive belt, and then adjust the belt tension.
6. Refill the system with clean coolant.
7. Run the engine and check for leaks.

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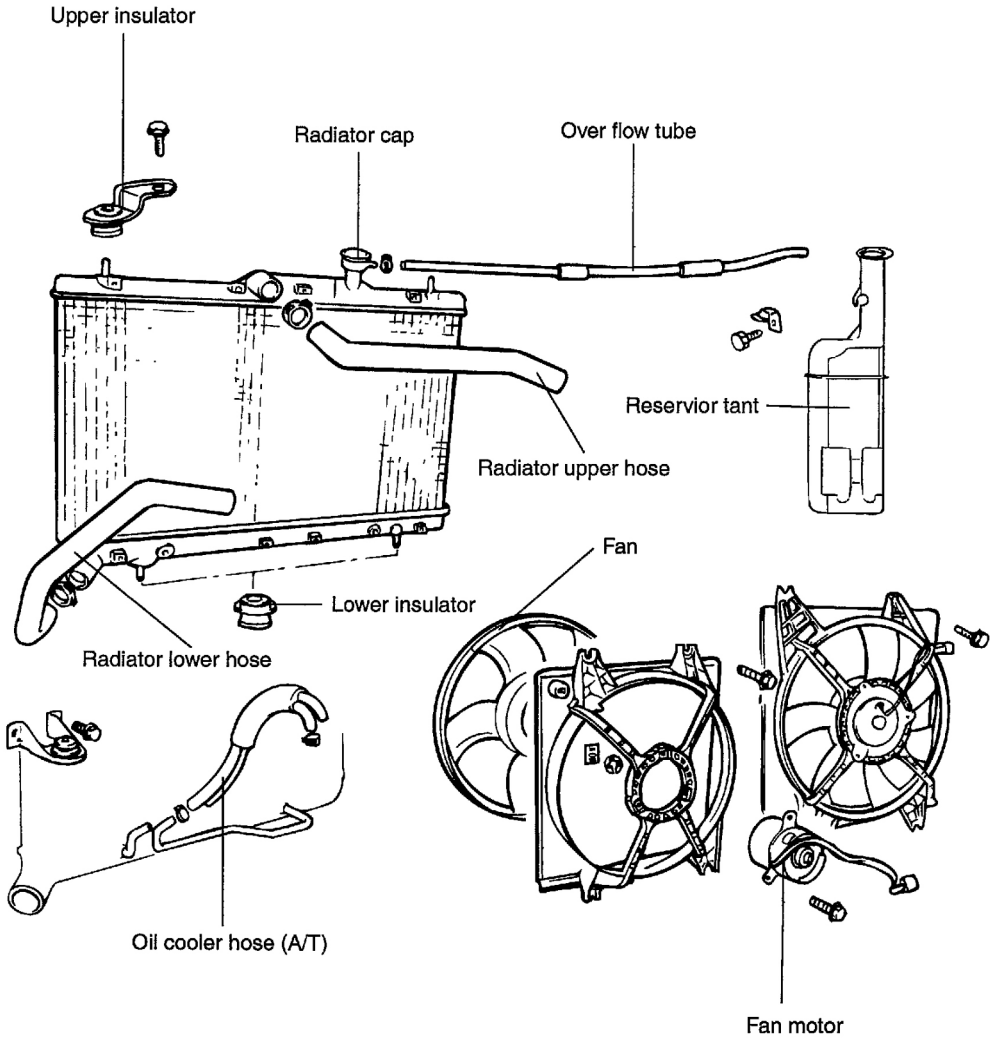
RADIATOR

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

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Fig. 98: Radiator Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Disconnect the radiator fan motor connector.

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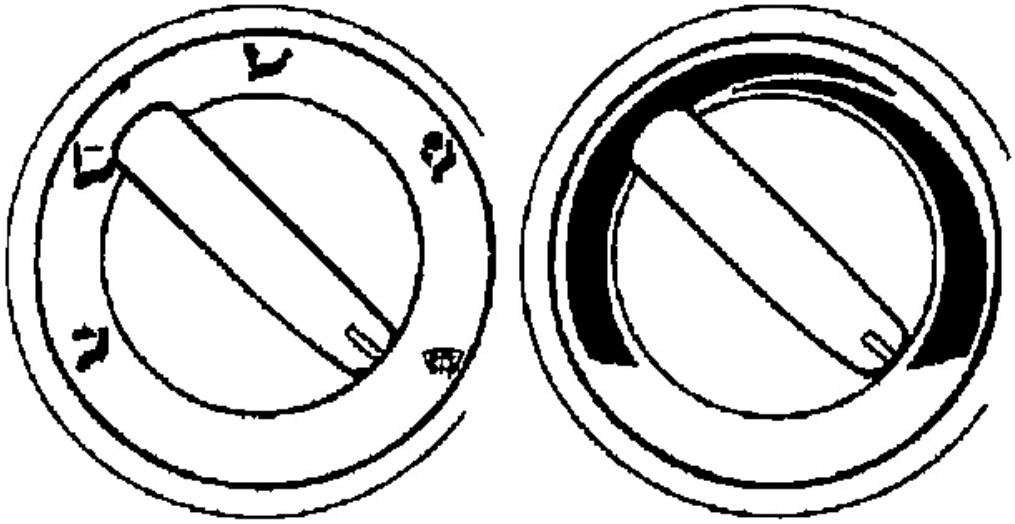
2. Set the temperature of the heater control to the hot position.



G01122255

Fig. 99: Identifying Heater Control Knob
Courtesy of HYUNDAI MOTOR CO.

3. Loosen the radiator drain plug to drain coolant.
4. Disconnect the upper and lower hose and overflow tube.
5. For vehicles with automatic transmission, disconnect the oil cooler hoses from the automatic transmission.

CAUTION: Plug the ends of the oil cooler hoses and the automatic transmission fittings to prevent transmission fluid from spilling out and foreign material from entering.

6. Remove the radiator mounting bolts.
7. Remove the radiator together with the fan motor.
8. Remove the fan motor from the radiator.

INSPECTION

1. Check the radiator for bent, broken or plugged fins.
2. Check the radiator for corrosion, damage, rust or scale.

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3. Check the radiator hoses for cracks, damage or deterioration.
4. Check the reservoir tank for damage.
5. Check the radiator cap spring for damage.
6. Test the pressure of the cap using a cooling system checker.
7. Check the radiator cap seal for cracks or damage.

RADIATOR FAN MOTOR

1. Check that the radiator fan rotates when the battery voltage is applied to the terminals.

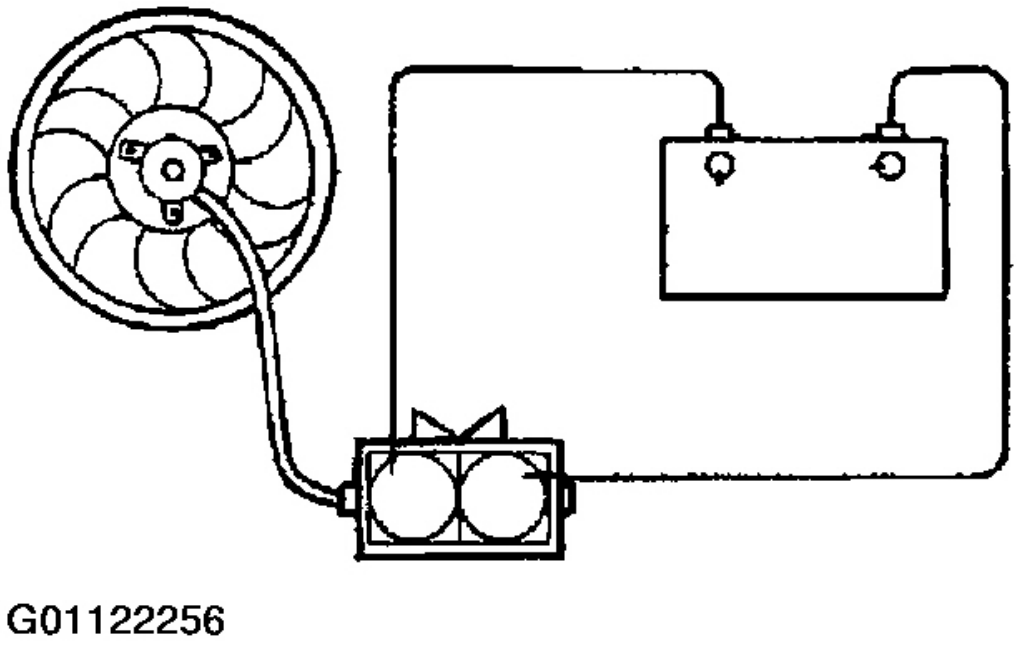

Fig. 100: Checking Radiator Fan Operation
Courtesy of HYUNDAI MOTOR CO.

2. Check that abnormal noises are not produced while the motor is turning.

REASSEMBLY

1. Fill the radiator and reservoir tank with clean coolant mixture.
2. Run the engine until the thermostat opens, and then stop the engine.
3. Remove the radiator cap, and add coolant up to the filler neck of the radiator, and then fill the reservoir tank to the upper level. Replace the radiator cap.

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4. Check that there are no leaks from the radiator, hoses or connections.

RADIATOR CAP

COMPONENTS

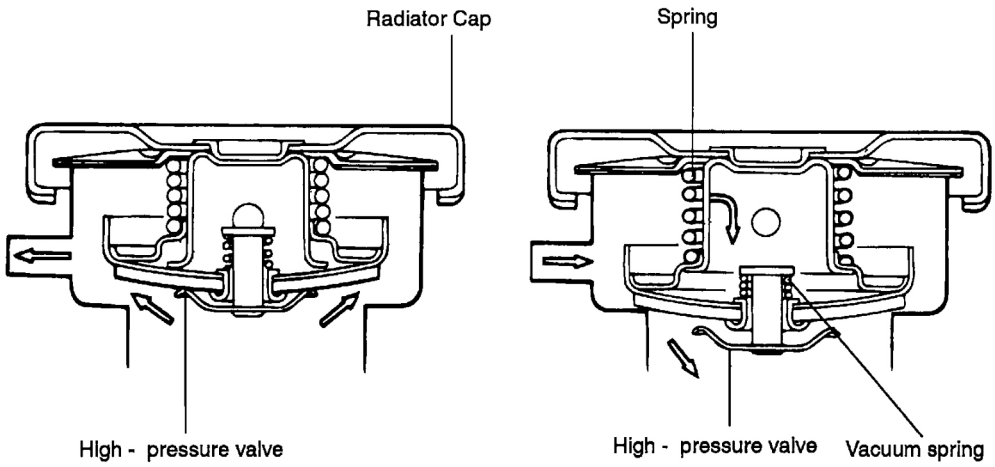

Fig. 101: Radiator Cap Components
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

1. Check the radiator cap for damage, cracks and deterioration.

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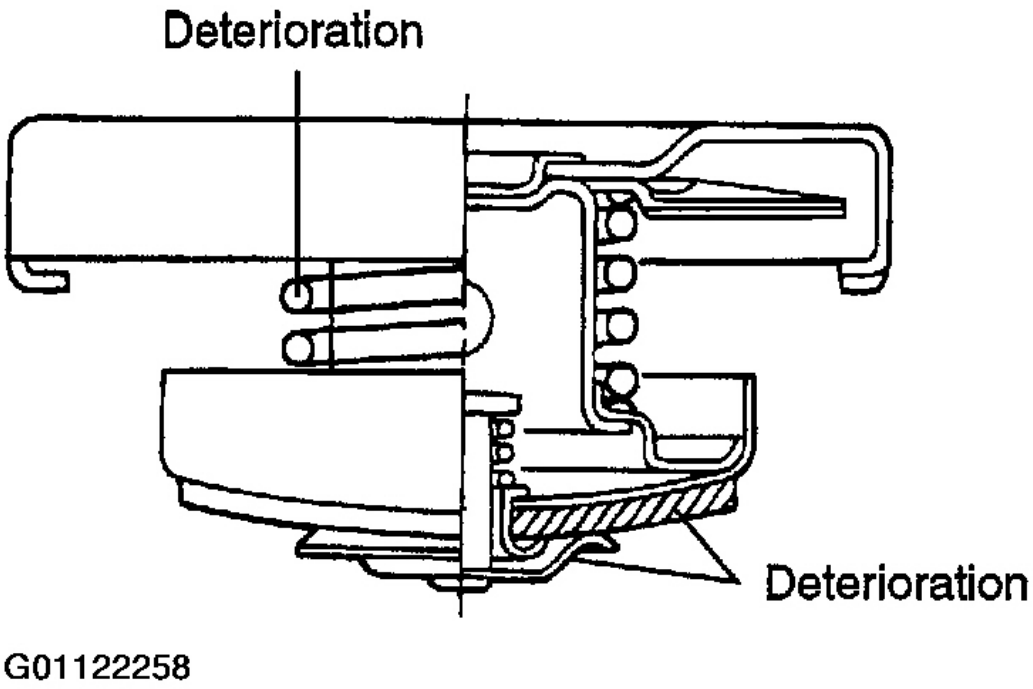

Fig. 102: Checking Radiator Cap For Deterioration
Courtesy of HYUNDAI MOTOR CO.

2. Attach a radiator cap tester to the radiator.
3. Pump the tester until the pointer stabilizes.
4. If the pointer stays constant for 10 seconds at a point exceeding the service limit, the radiator cap is good.

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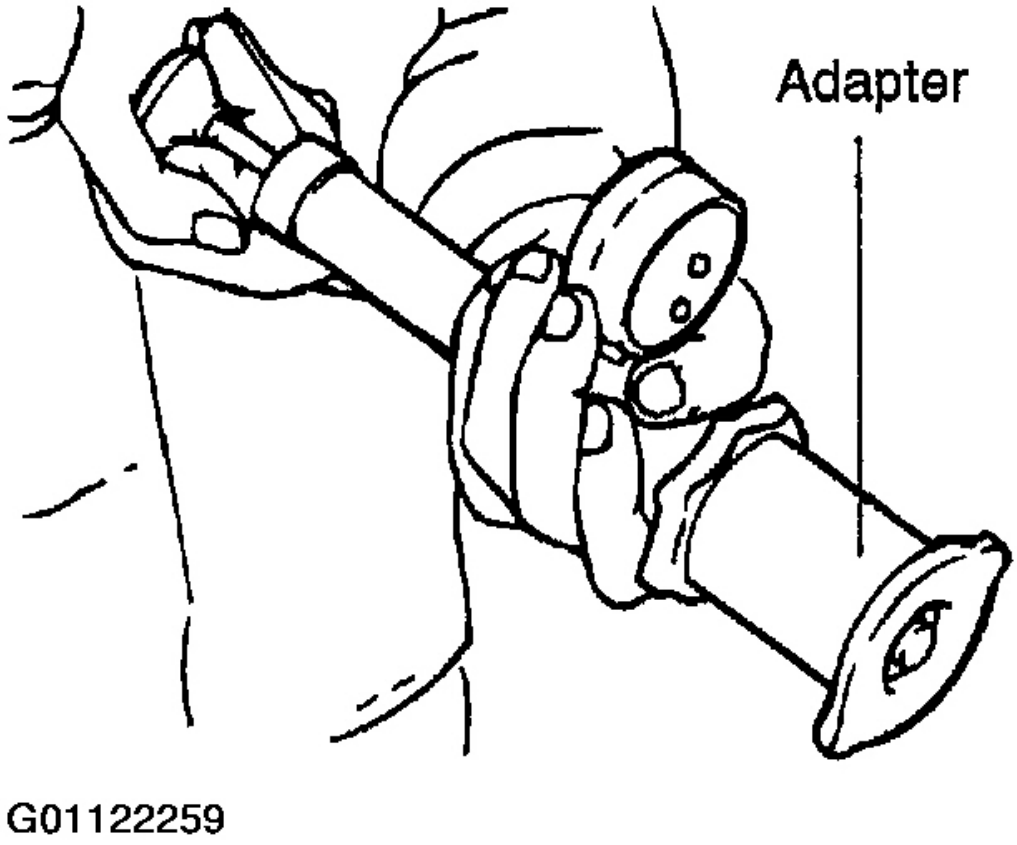

Fig. 103: Attaching Radiator Cap Tester To Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

THERMOSTAT

COMPONENTS

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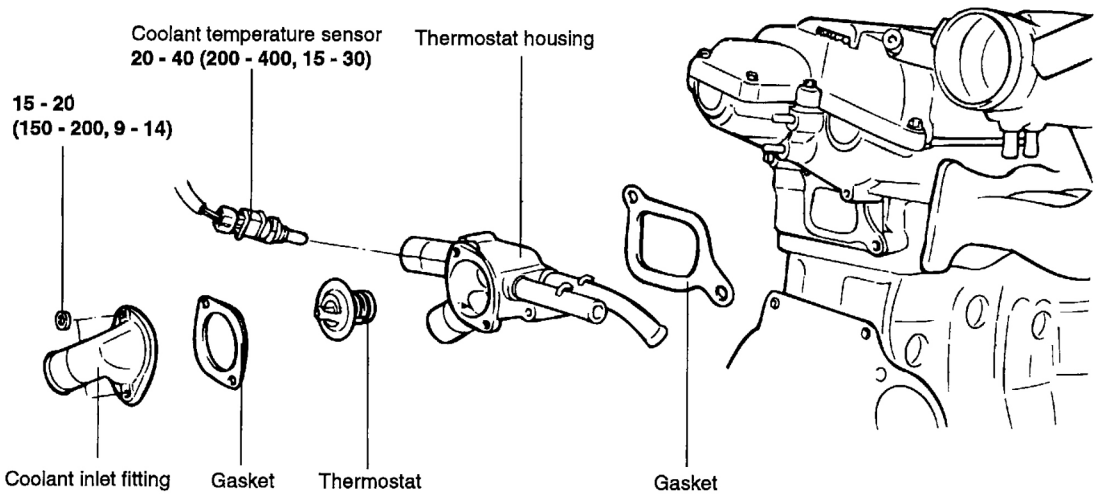

TORQUE : Nm (kg.cm, lb.ft)

G01122260

Fig. 104: Thermostat Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY AND INSPECTION

1. Drain the coolant so its level is below thermostat.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.
4. Immerse thermostat in hot coolant to check proper valve opening temperature. Replace if necessary.

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

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

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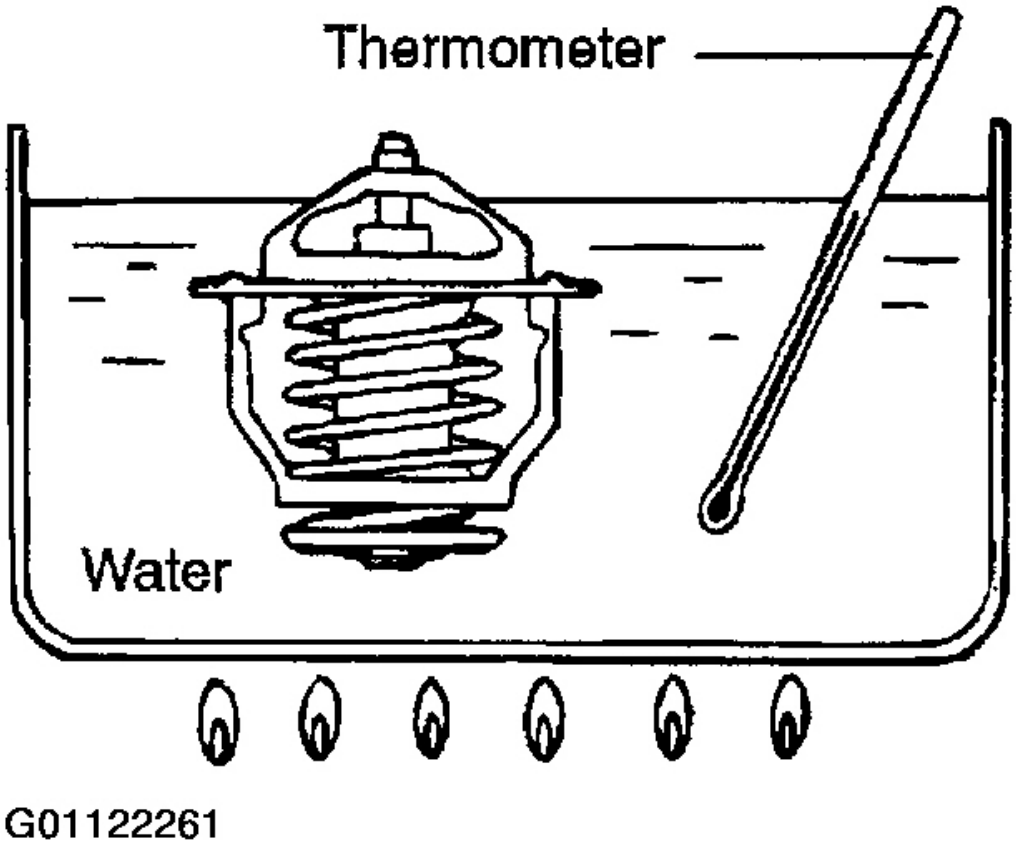

Fig. 105: Checking Thermostat Valve Opening Temperature
Courtesy of HYUNDAI MOTOR CO.

COOLANT TEMPERATURE SENSOR

1. Heat the sensor by submerging it in hot engine coolant.
2. Check that the resistance is within the specified range.

Resistance

At: 20 °C(68 °F): 2.31 - 2.59 kg

REASSEMBLY

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install a new gasket and the coolant inlet fitting.
3. Refill the system with clean coolant.

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Tightening torque

Coolant temperature sensor:

20 - 40 Nm (200 - 400 kg.cm, 15 - 30 lb.ft)

LUBRICATION SYSTEM

OIL PUMP

COMPONENTS

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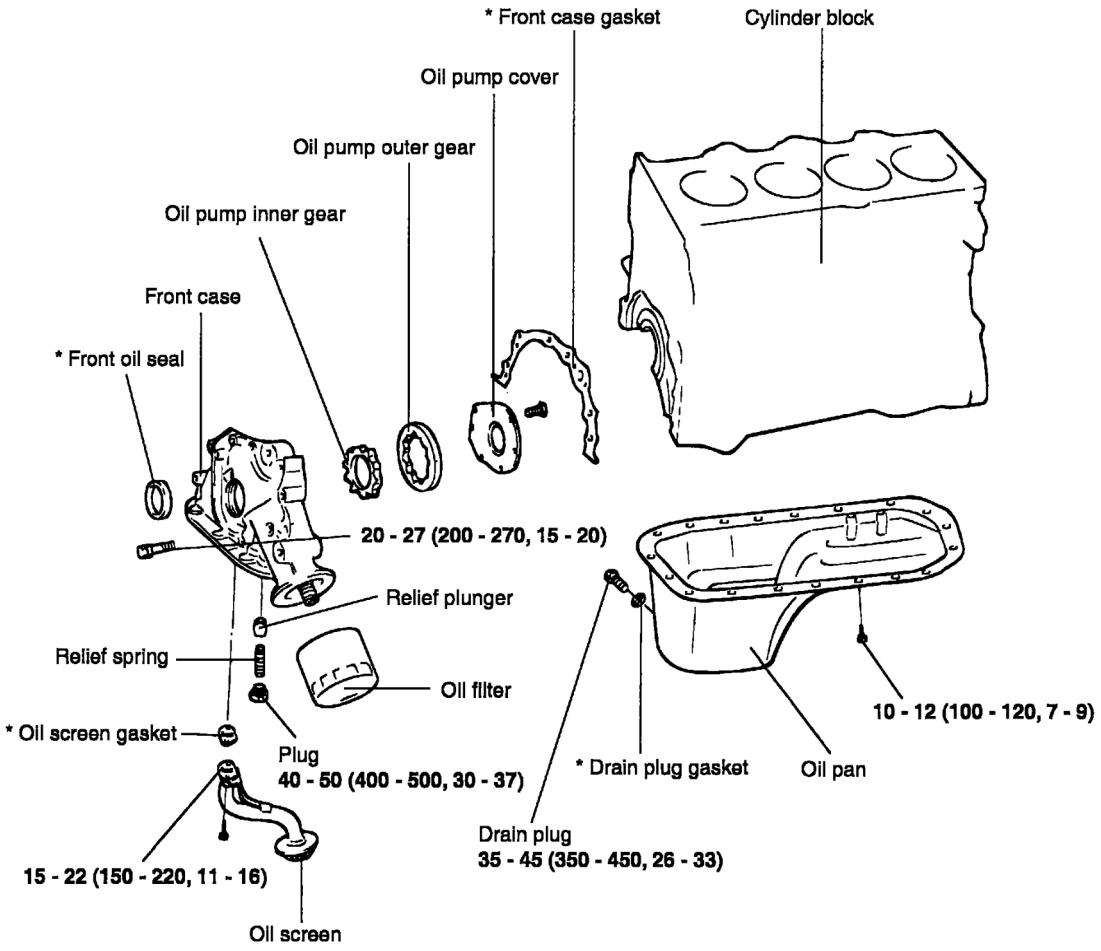

*** Replace the gasket and seal with new ones after removal.**

TORQUE : Nm (kg.cm, lb.ft)

G01122262

Fig. 106: Oil Pump Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the timing belt.
2. Remove all the oil pan bolts.
3. Remove the oil pan.
4. Remove the oil screen.
5. Remove the front case assembly.

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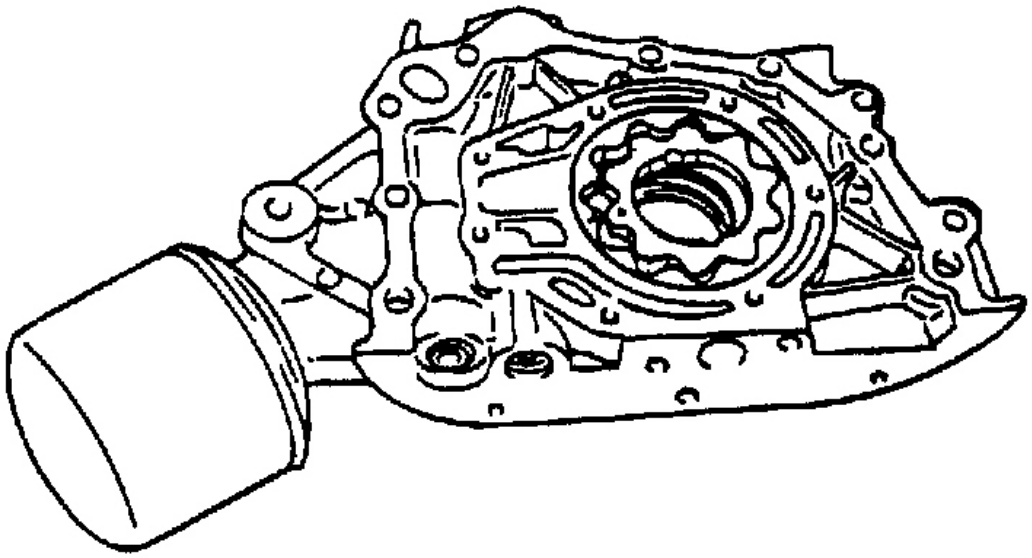

Fig. 107: Removing Front Case Assembly
Courtesy of HYUNDAI MOTOR CO.

6. Remove the oil pump cover.
7. Remove the inner and outer gears from the front case. The matching marks on the inner and outer gears indicate the direction of installation.
8. Remove all the oil pan bolts.

INSPECTION

FRONT CASE

1. Check the front case for cracks or damage. Replace as necessary.
2. Check the front oil seal for worn or damaged lips. Replace if defective.

OIL PAN AND OIL SCREEN

1. Check the oil pan for failure, damage or cracks. Replace if defective.
2. Check the oil screen for failure, damage and cracks and replace if defective.

FRONT CASE AND OIL PUMP COVER

Check the surfaces contacting the gears for damage or wear.

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OIL PUMP GEARS

1. Check the gear tooth surfaces for wear or damage.
2. Measure the clearance between outer gear and front case.

   Body clearance: 0.12 - 0.185 mm (0.0047 - 0.0073 in.)

   Tip clearance: 0.025 - 0.069 mm (0.0010 - 0.0027 in.)

   Side clearance

   Outer gear: 0.04 - 0.09 mm (0.0016 - 0.0035 in.)

   Inner gear: 0.04 - 0.085 mm (0.0016 - 0.0033 in.)

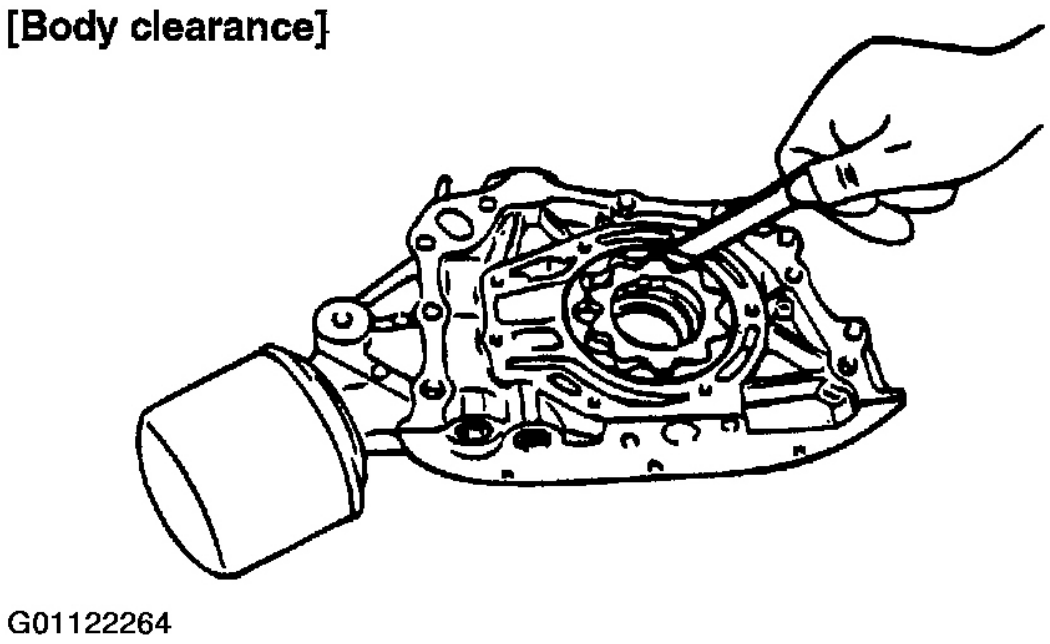

Fig. 108: Measuring Clearance Between Outer Gear & Front Case
Courtesy of HYUNDAI MOTOR CO.

3. Check the tip clearance on the pump rotor.

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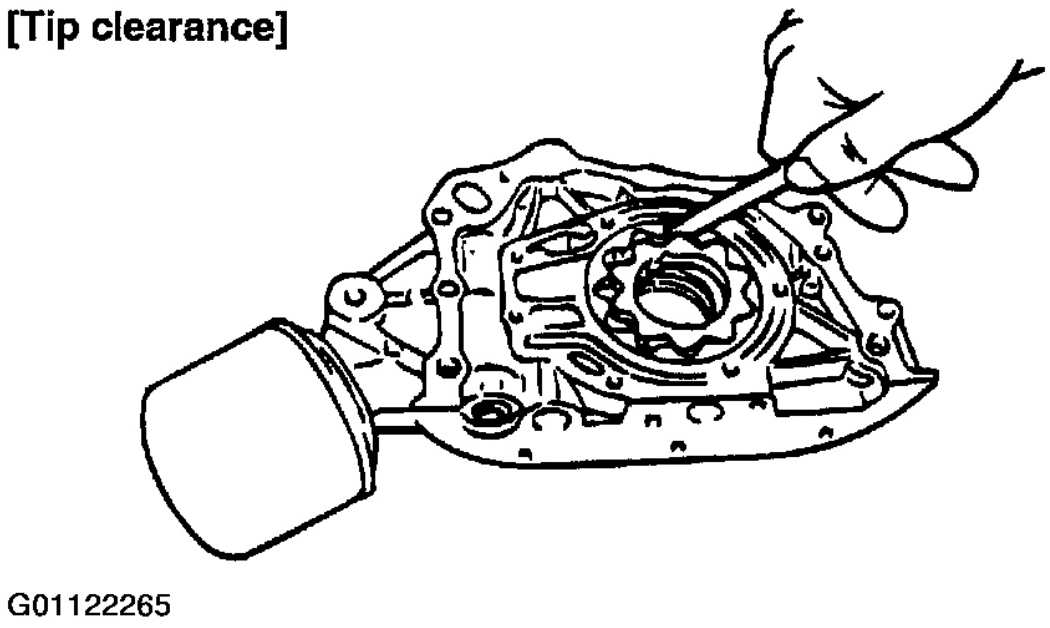

Fig. 109: Checking Tip Clearance On Pump Rotor
Courtesy of HYUNDAI MOTOR CO.

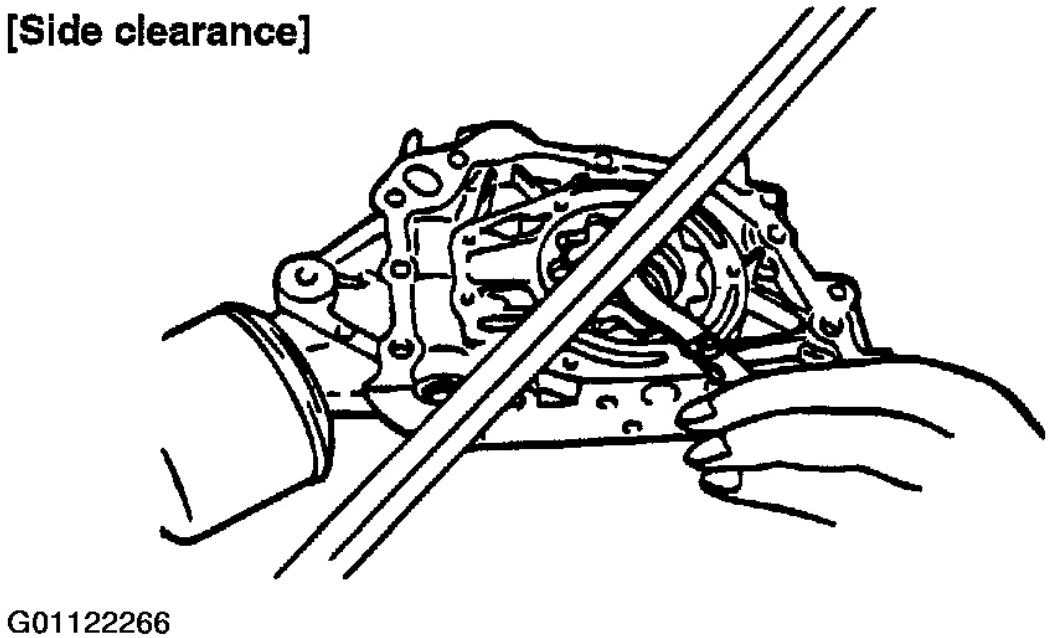

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Fig. 110: Checking Side Clearance On Pump Rotor
Courtesy of HYUNDAI MOTOR CO.

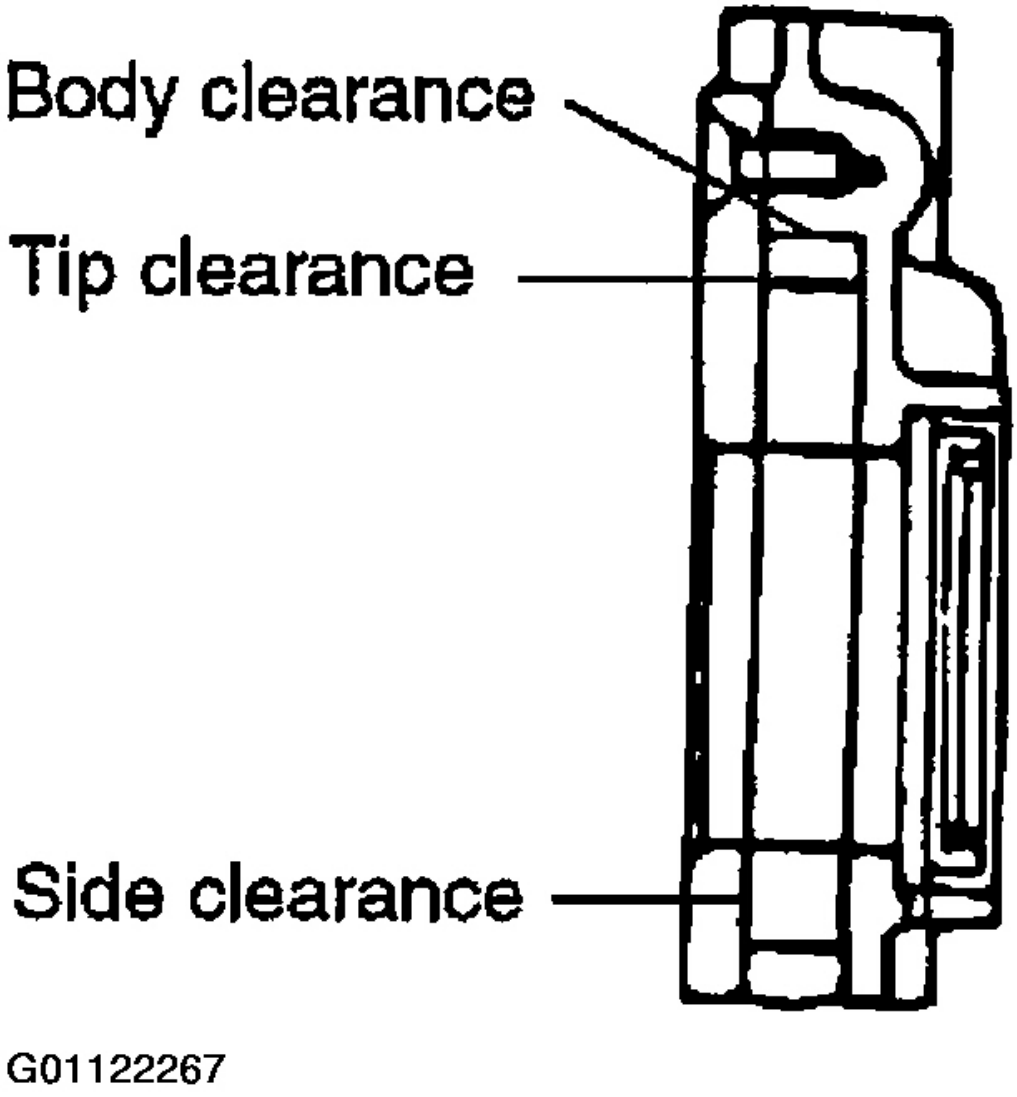

Fig. 111: Checking Body Clearance
Courtesy of HYUNDAI MOTOR CO.

RELIEF VALVE AND SPRING

1. Check sliding condition of the relief valve inserted in the front case.
2. Inspect for distorted or broken relief valve spring.

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Standard value

Free height: 46.6 mm (1.8346 in.)

Load: 6.1 kg/40.1 mm (13.42 lb/1.578 in.)

OIL PRESSURE SWITCH

1. Use an ohmmeter to check the continuity between the terminal and the body. If there is no continuity, replace the oil pressure switch.

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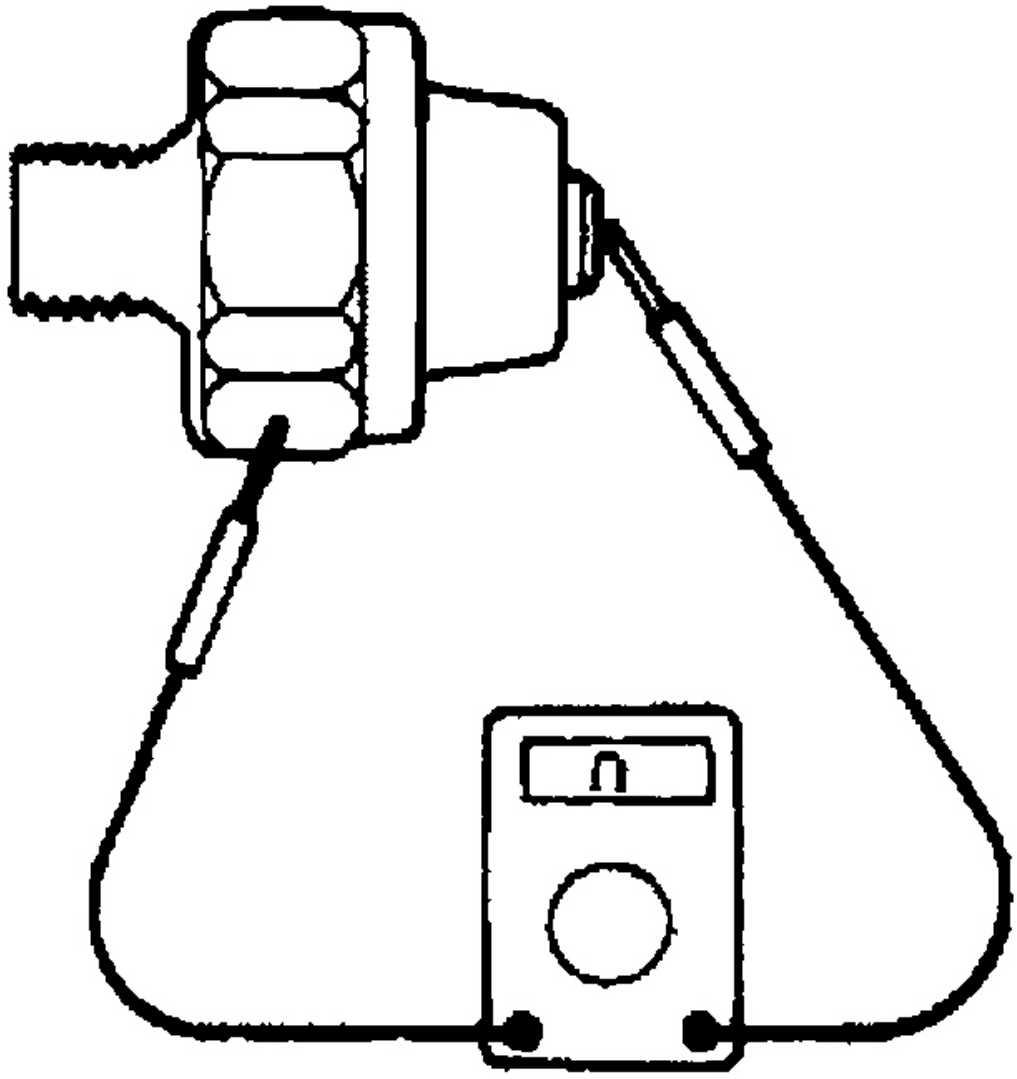

Fig. 112: Checking Continuity Between Oil Pressure Switch Terminal & Body
Courtesy of HYUNDAI MOTOR CO.

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

   Check for air leaks. If air does leak, the diaphragm is broken. Replace the switch.

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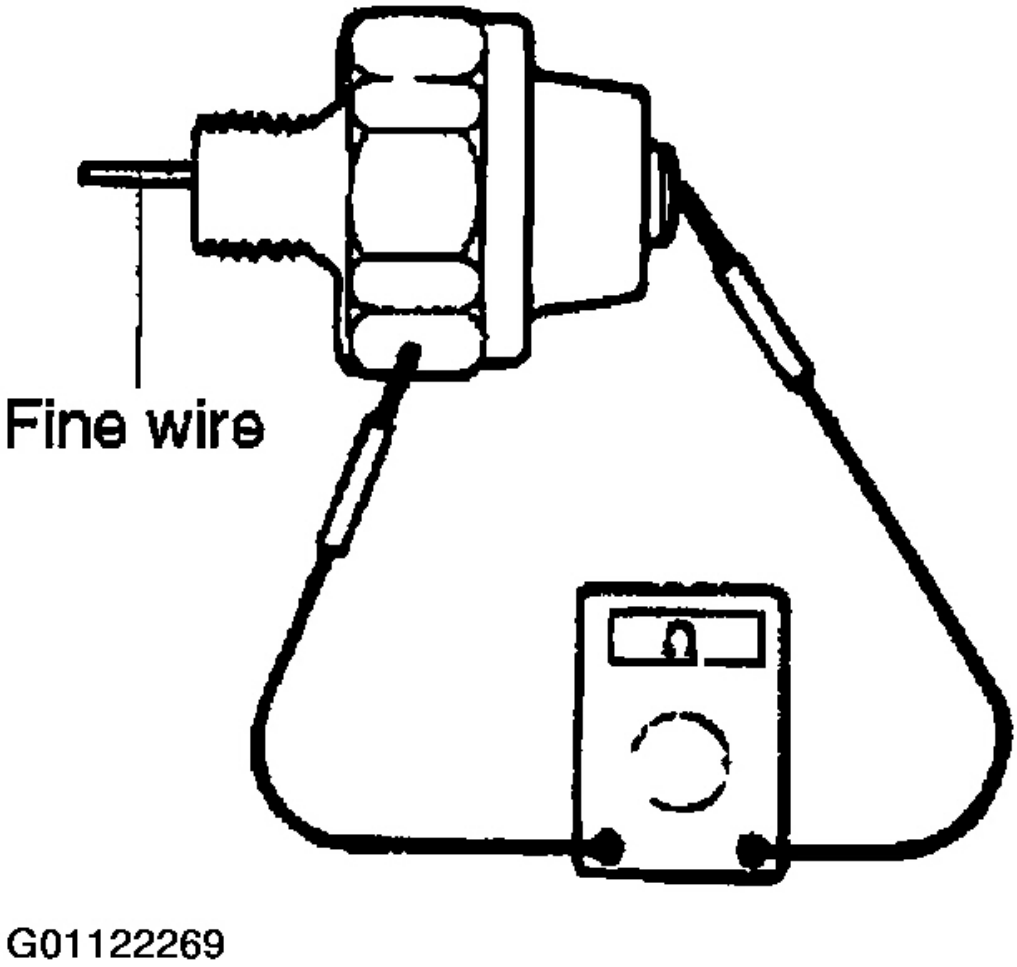

Fig. 113: Checking Continuity Between Oil Pressure Switch Terminal & Body - Fine Wire Pushed
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

OIL PUMP

1. Install the outer and inner gears into the front case. Make sure that the inner and outer gears are installed in the same direction as shown.
2. Install the oil pump cover and tighten the bolts to the specified torque. After the bolts have been tightened, check to ensure that the gear turns smoothly.

Tightening torque

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Oil pump cover bolt: 8-12 Nm (80-120 kg.cm, 6-9 lb.ft)

3. Install the relief valve and spring. Tighten the plug to the specified torque. Apply engine oil to the relief valve.

   Relief valve plug: 40-50 Nm (400-500 kg.cm, 30-37 lb.ft)

   [Body clearance]

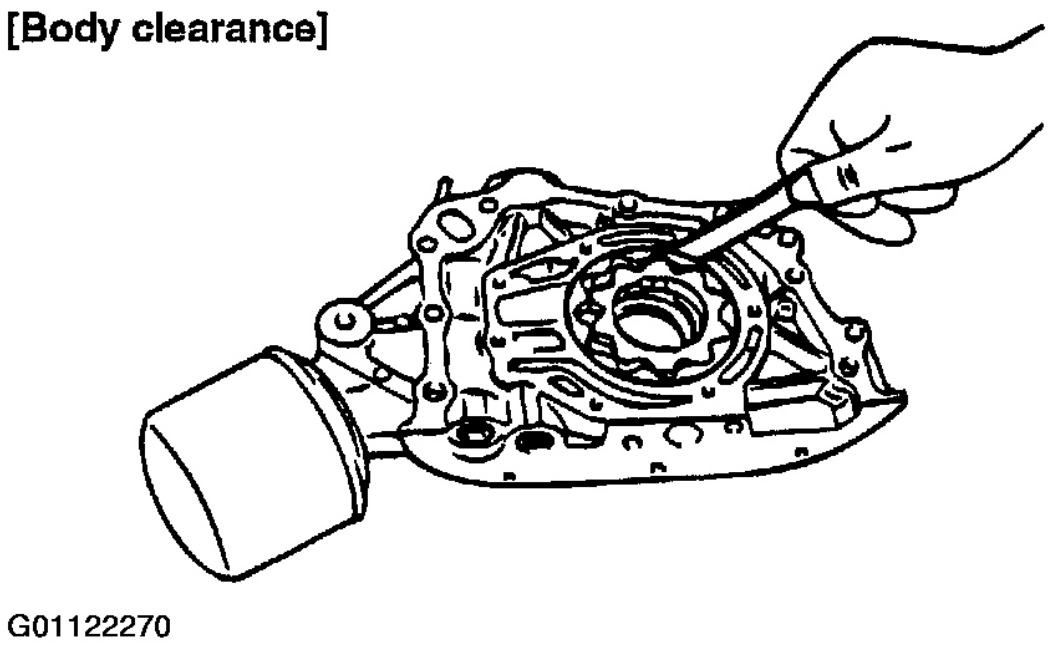

Fig. 114: Inspecting Oil Pump Body Clearance
Courtesy of HYUNDAI MOTOR CO.

FRONT CASE

1. Install the front case assembly with a new gasket, and tighten the bolts to the specified torque.

   Tightening torque:

   20 - 27 N.m (200 - 270 kg.cm, 15 - 20 lb.ft)

   Length

   A: 30 mm (1.18 in.)

   B: 45 mm (1.77 in.)

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C: 60 mm (2.36 in.)

D: 22 mm (0.89 in.)

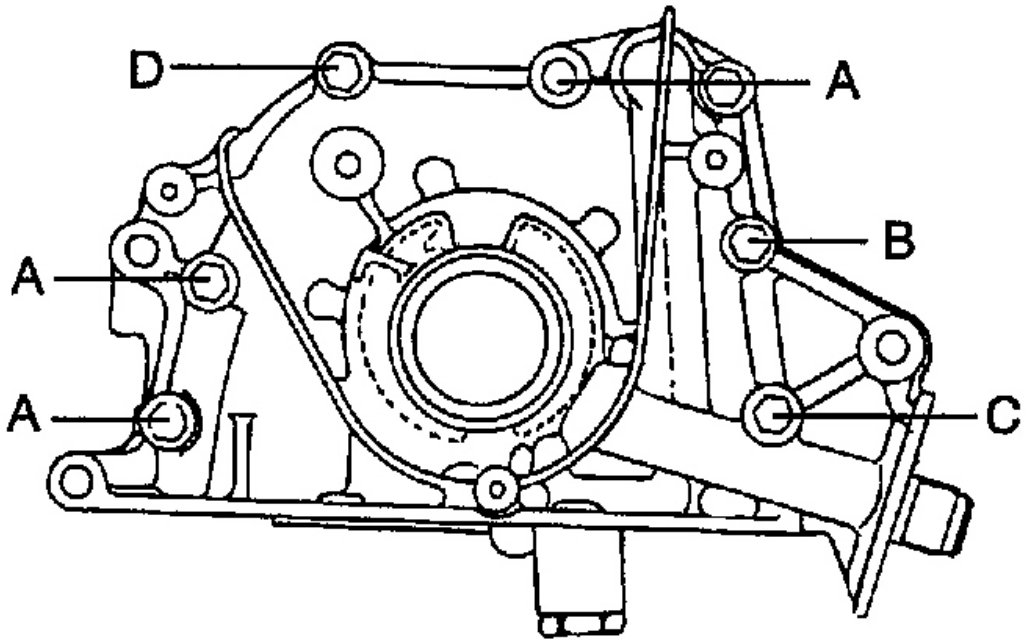

Fig. 115: Locating Front Case Assembly Bolts
Courtesy of HYUNDAI MOTOR CO.

OIL SEAL

1. Using the special tool, Crankshaft oil seal guide (09214 - 21100), install the oil seal.

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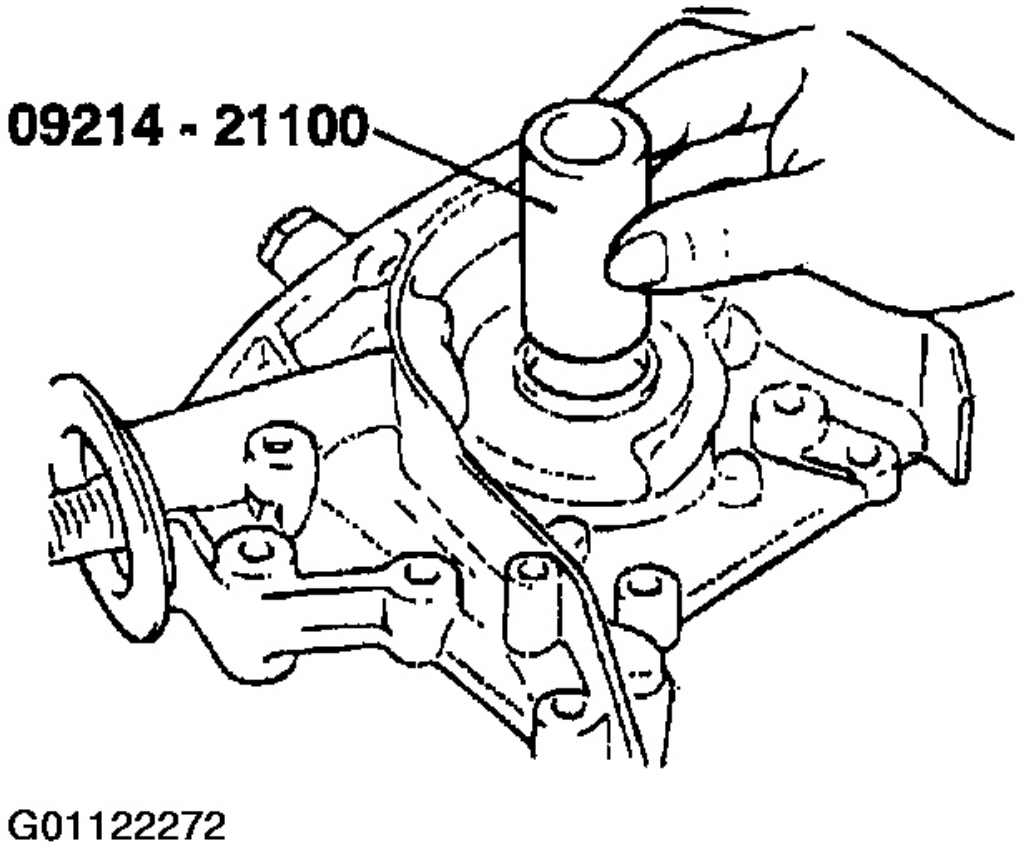

Fig. 116: Installing Oil Seal Using Crankshaft Oil Seal Guide
Courtesy of HYUNDAI MOTOR CO.

2. Using the special tool, Crankshaft front oil seal installer (09214-21000), install the oil seal.

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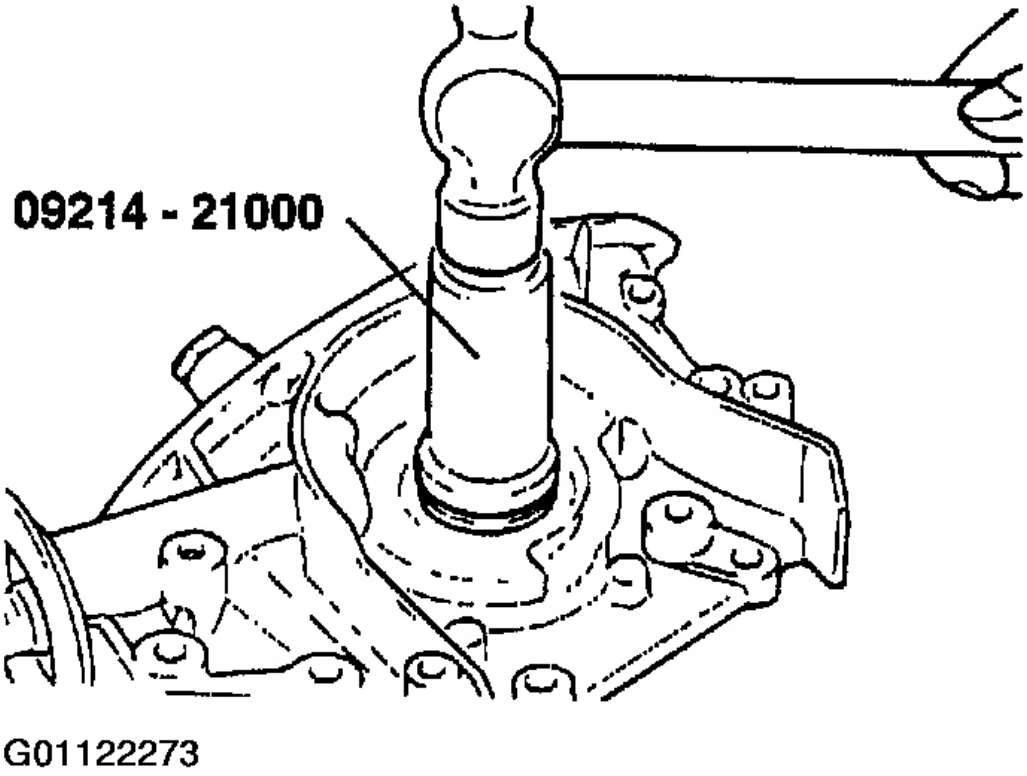

Fig. 117: Installing Oil Seal Using Crankshaft Front Oil Seal Installer
Courtesy of HYUNDAI MOTOR CO.

3. Install the oil screen.
4. Clean both gasket surfaces of the oil pan and the cylinder block.
5. Apply sealant into the groove of the oil pan flange as shown.

CAUTION:
- **Apply sealant approx. 4mm (0.16 in.) in thickness.**
- **After application of sealant, do not exceed 15 minutes before inst the oil pan.**

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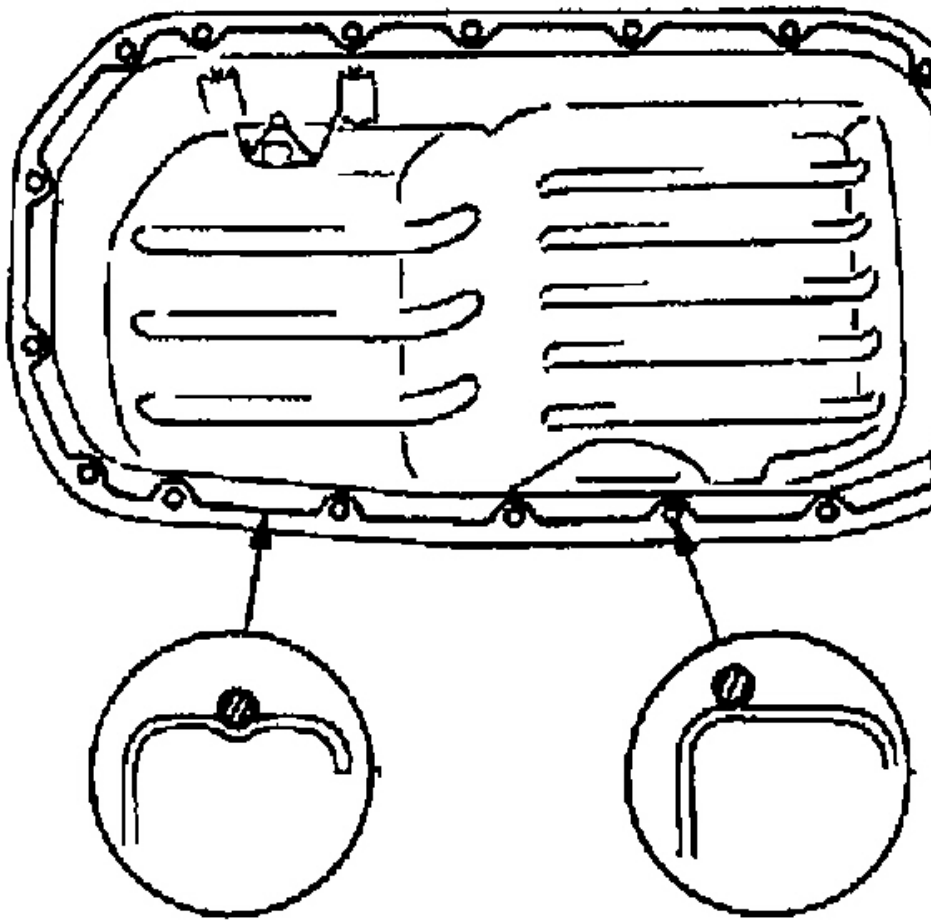

Fig. 118: Applying Sealant Into Groove Of Oil Pan Flange
Courtesy of HYUNDAI MOTOR CO.

6. Install the oil pan and tighten the bolts to the specified torque.

   Tightening torque

   Oil pan bolt: 10-12 Nm (100 - 120 kg.cm, 7-9 lb.ft)

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

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COMPONENTS

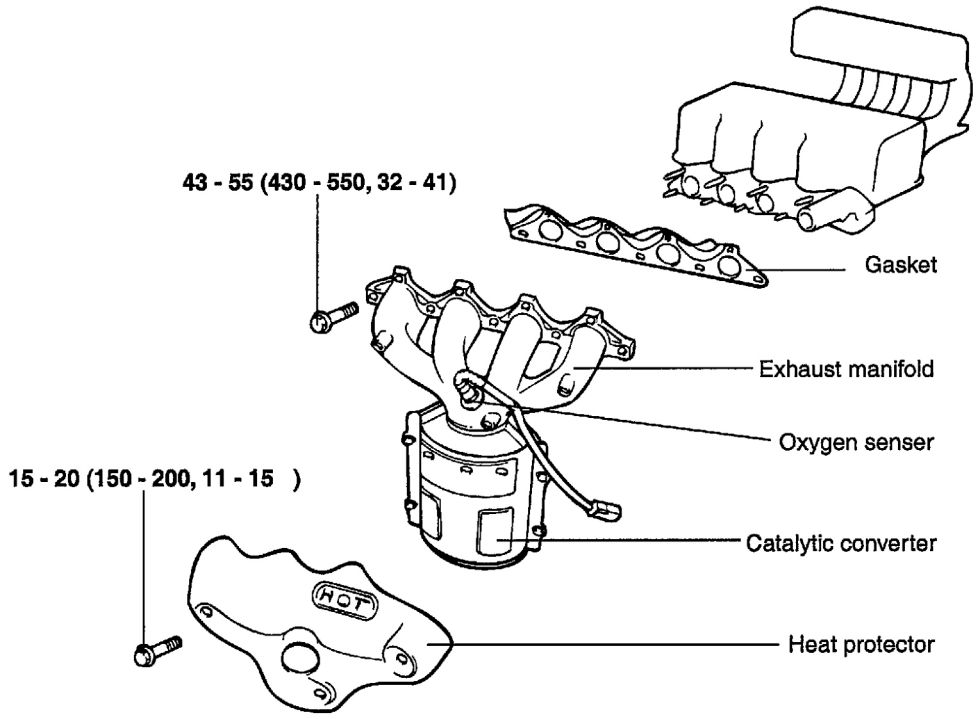

Fig. 119: Exhaust Manifold Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the exhaust manifold heat protector.
2. Remove the exhaust manifold assembly from the cylinder head.
3. Remove the exhaust manifold gasket.

INSPECTION

EXHAUST MANIFOLD

1. Check for damage or cracking.
2. Check for damage or cracking of welding between exhaust manifold and converter.

REASSEMBLY

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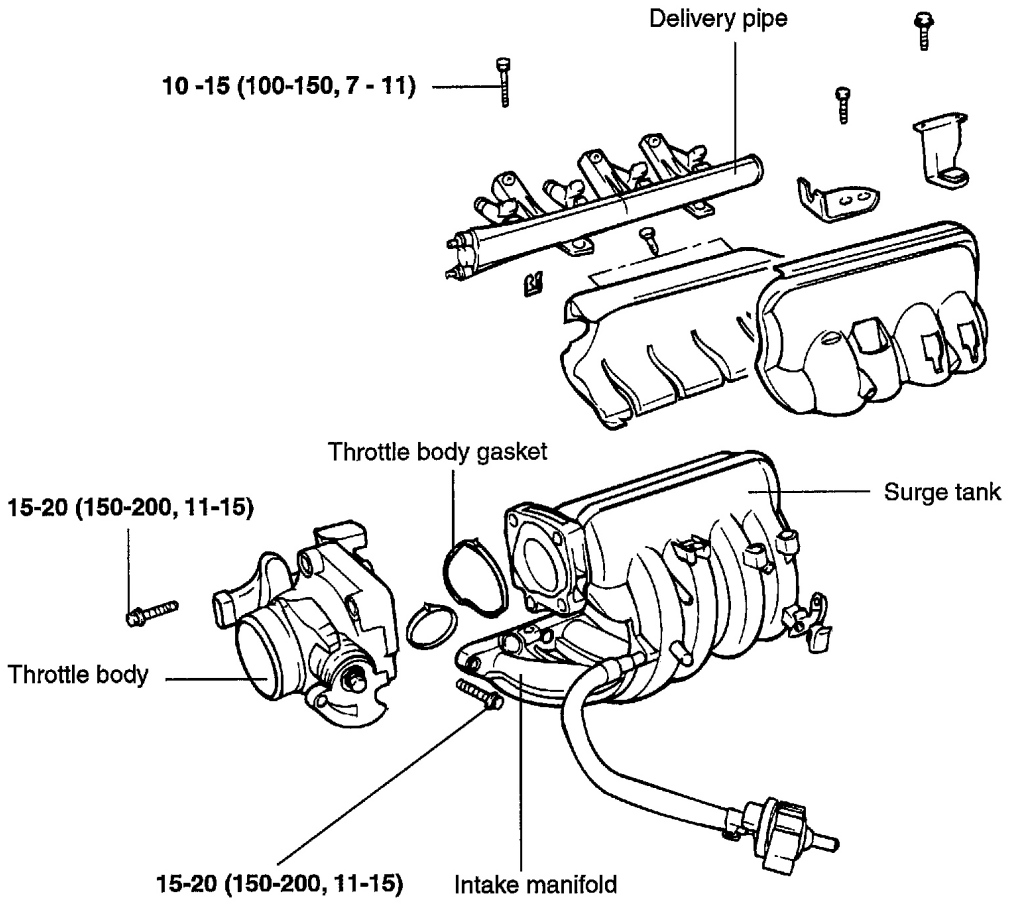
Install the exhaust manifold in the reverse order of removal.

CAUTION: Replace the exhaust manifold gasket and lock nut when reassembling.

INTAKE MANIFOLD

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

G01122276

Fig. 120: Intake Manifold Components
Courtesy of HYUNDAI MOTOR CO.

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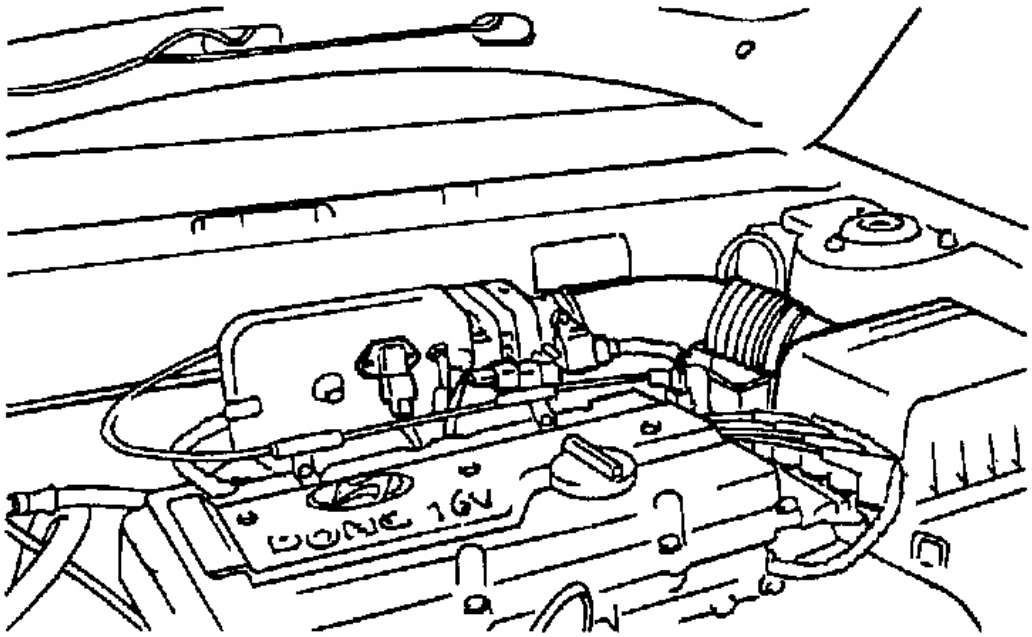
REMOVAL

1. Remove the engine cover.



G01122277

Fig. 121: Removing Engine Cover
Courtesy of HYUNDAI MOTOR CO.

2. Remove the intake air hose connected to the throttle body.
3. Remove the accelerator cable.
4. Remove the P.C.V. hose and brake booster vacuum hoses.
5. Disconnect the vacuum hose connections, ISA and TPS connector.

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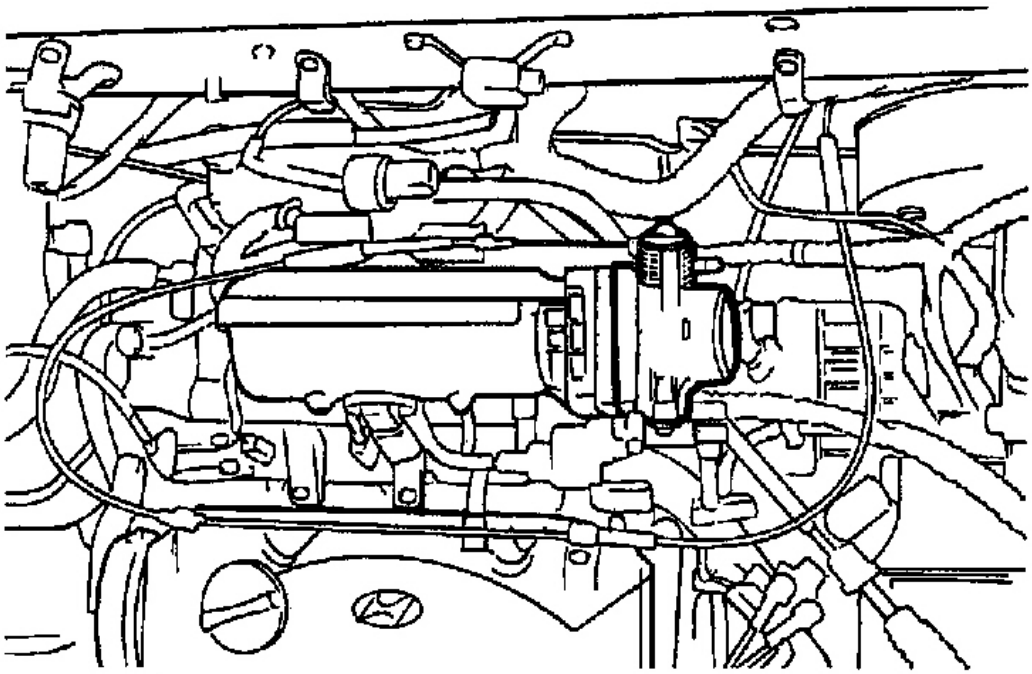

G01122278

Fig. 122: Disconnecting Vacuum Hose Connections
Courtesy of HYUNDAI MOTOR CO.

6. Disconnect the high pressure fuel hose connection after relieving pressure in the fuel rail to prevent fuel from spilling.
7. Remove the intake manifold.
8. Remove the intake manifold assembly and gasket.
9. Disconnect the fuel injector harness connector.
10. Remove the delivery pipe with the fuel injectors.

CAUTION: Be careful not to drop the injectors when removing the delivery pipe.

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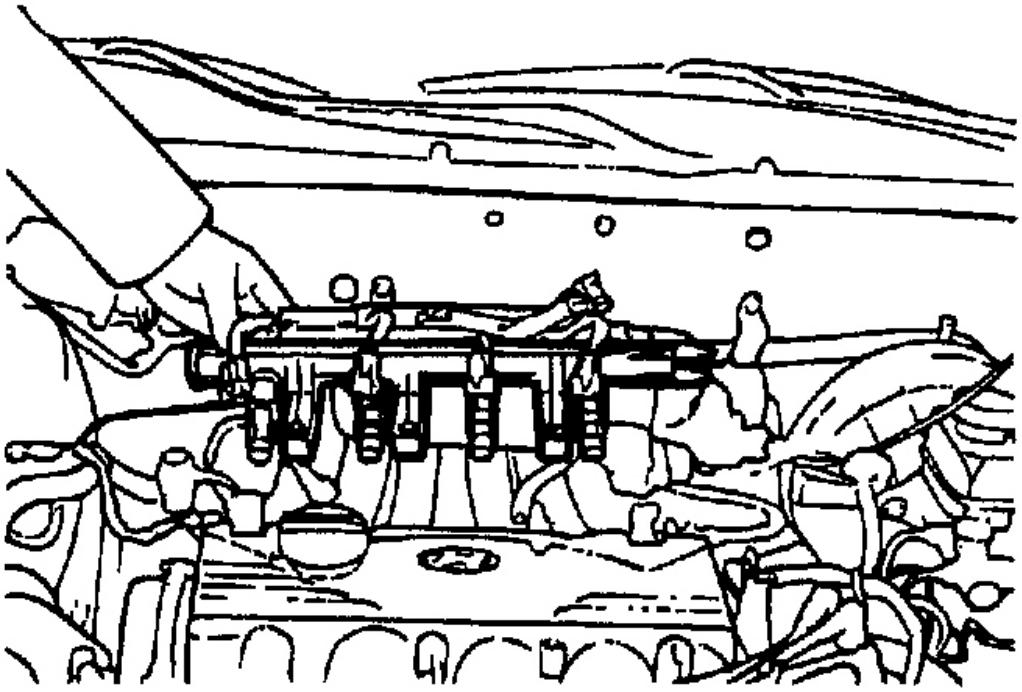

Fig. 123: Removing Delivery Pipe With Fuel Injectors
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

INTAKE MANIFOLD

Check the parts for damage or cracking.

AIR HOSE

Check for damage or cracking of any part.

INSTALLATION

1. Replace the intake manifold gasket and install the intake manifold.

CAUTION: Be careful not to drop the injectors when removing the delivery pipe.

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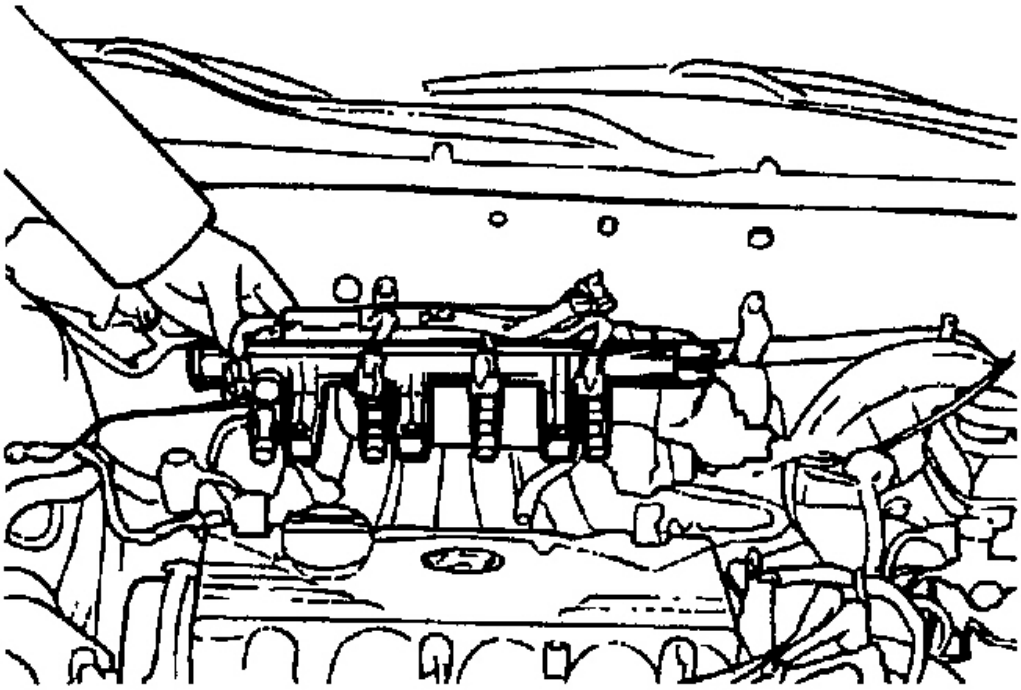

G01122280

Fig. 124: Installing Delivery Pipe With Fuel Injectors
Courtesy of HYUNDAI MOTOR CO.

2. Install the delivery pipe with the fuel injectors.
3. Connect the fuel injector harness connector.
4. Install the intake manifold stay.
5. Connect the high pressure fuel hose connection.
6. Install the P.C.V hose and brake booster vacuum hose.
7. Install the intake air hose to the throttle body.
8. Install the accelerator cable.
9. Connect the ISA and TPS wire harness connector.

MUFFLER

COMPONENTS

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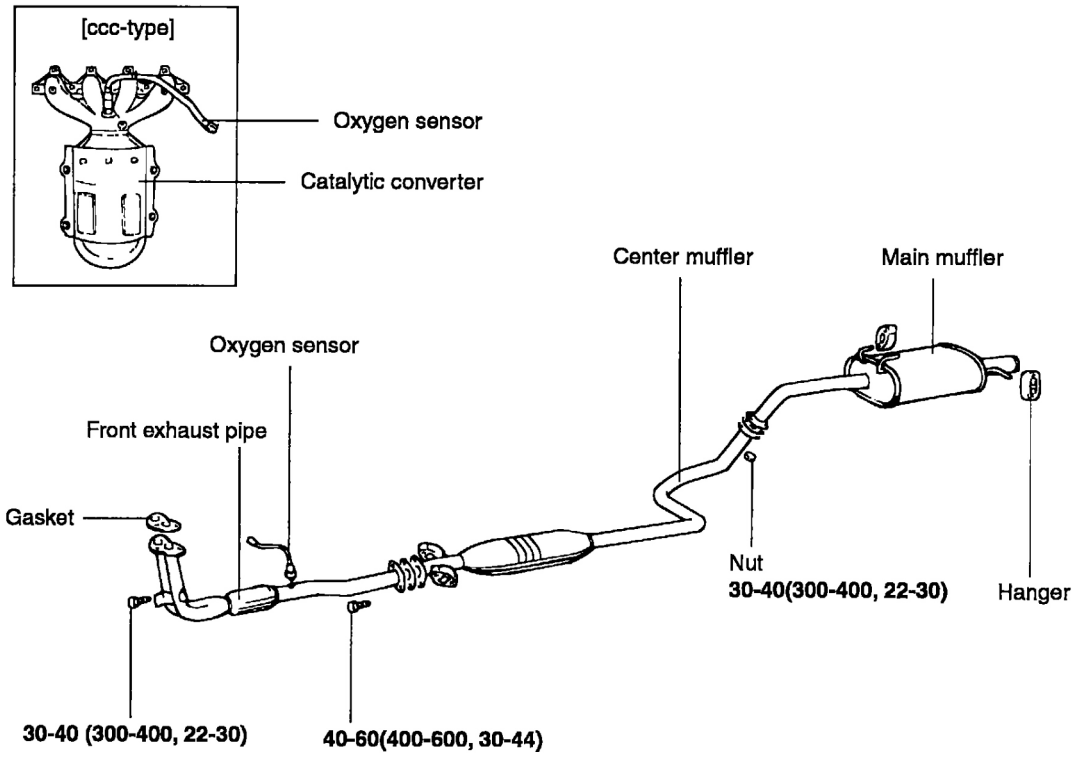

TORQUE : Nm (kg.cm, lb.ft)

G01122281

Fig. 125: Muffler Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

MAIN MUFFLER

CAUTION: Before removing or inspecting the exhaust system, ensure that the exhaust system has cooled sufficiently.

1. Disconnect the main muffler from the center muffler.

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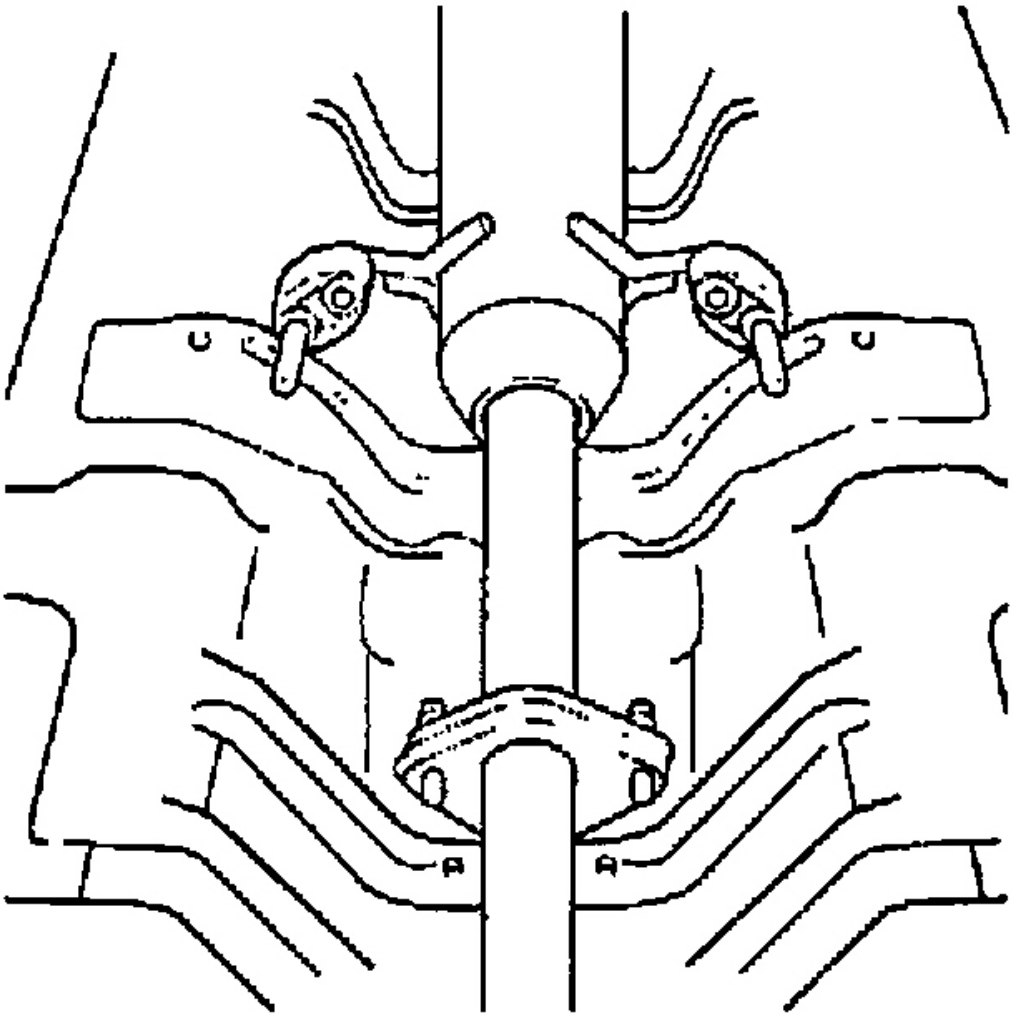

Fig. 126: Disconnecting Main Muffler From Center Muffler
Courtesy of HYUNDAI MOTOR CO.

2. Remove the rubber hangers and remove the main muffler.

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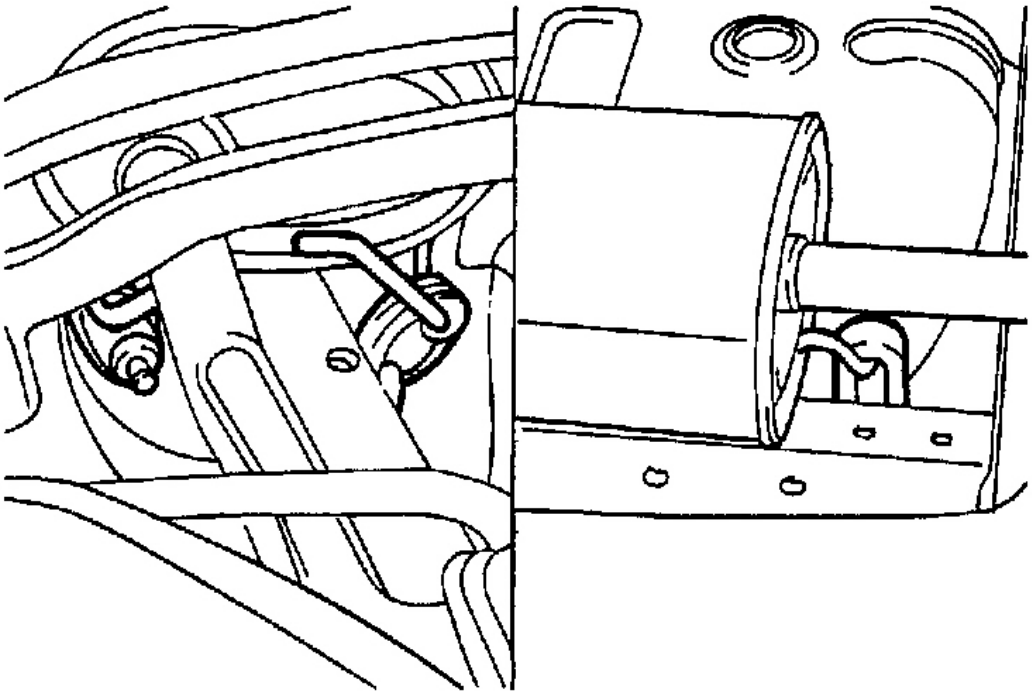

Fig. 127: Removing Rubber Hangers & Removing Main Muffler
Courtesy of HYUNDAI MOTOR CO.

CENTER MUFFLER

1. Remove the center muffler assembly from the main muffler and front exhaust pipe.

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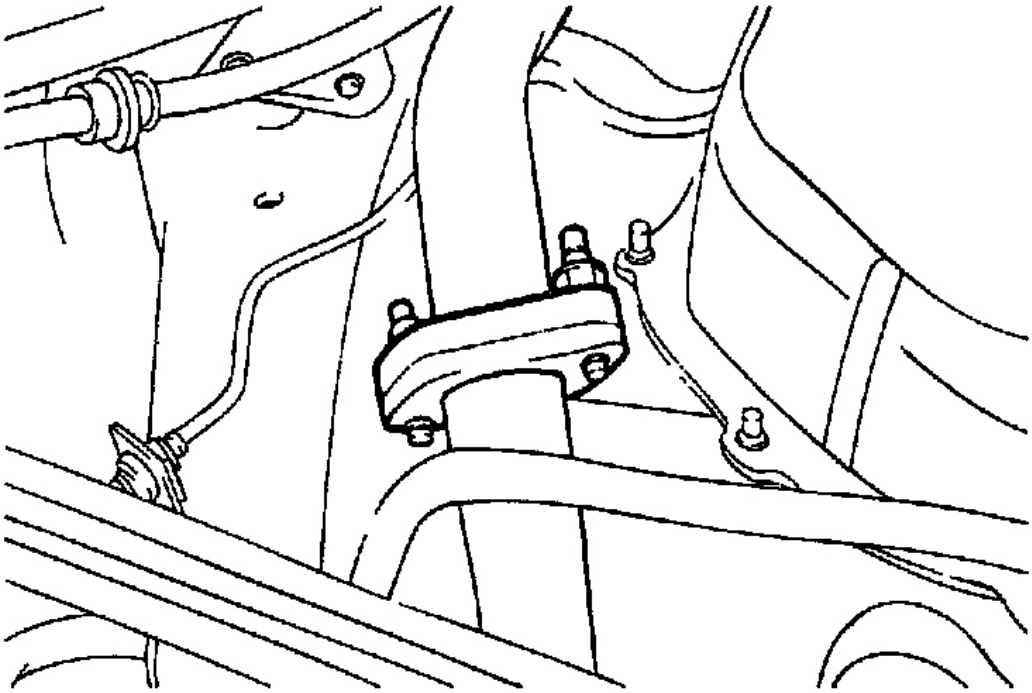

Fig. 128: Removing Center Muffler Assembly From Main Muffler
Courtesy of HYUNDAI MOTOR CO.

2. Remove the rubber hanger, then remove the center muffler.

FRONT EXHAUST PIPE

1. Remove the front exhaust pipe clamp bolts and remove the front exhaust pipe nuts from the catalytic converter.
2. Remove the front exhaust pipe and center muffler bolt.

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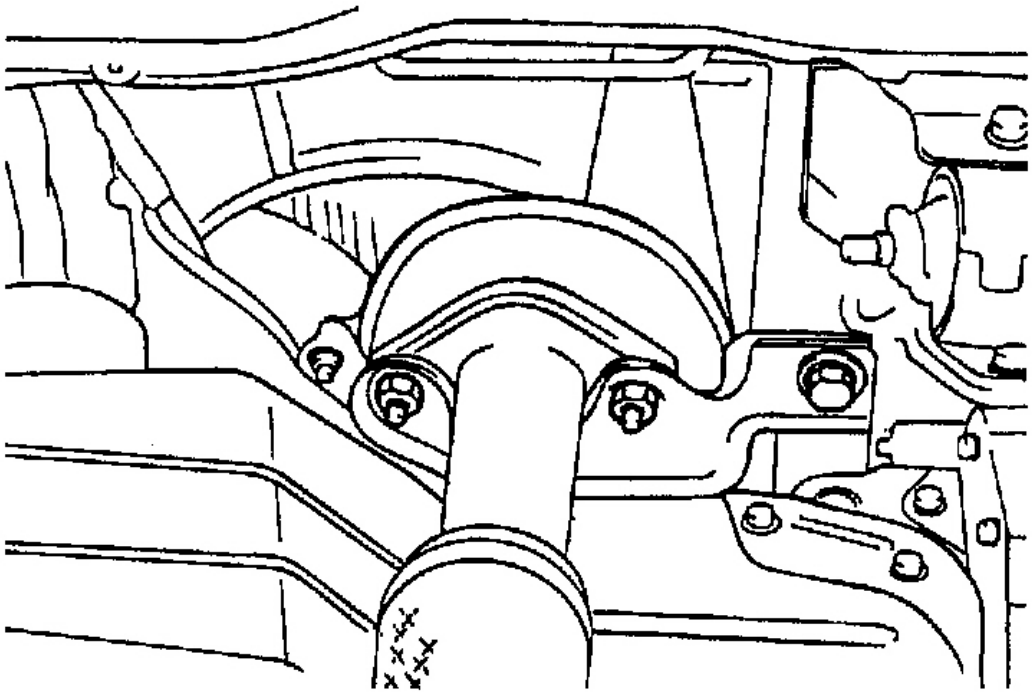

Fig. 129: Removing Front Exhaust Pipe & Center Muffler Bolt
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Temporarily install the front exhaust pipe, the center exhaust pipe, and the main muffler, in that order.
2. Tighten the parts securely. Make sure there is no interference with any body components.

AIR CLEANER (ACL)

COMPONENTS

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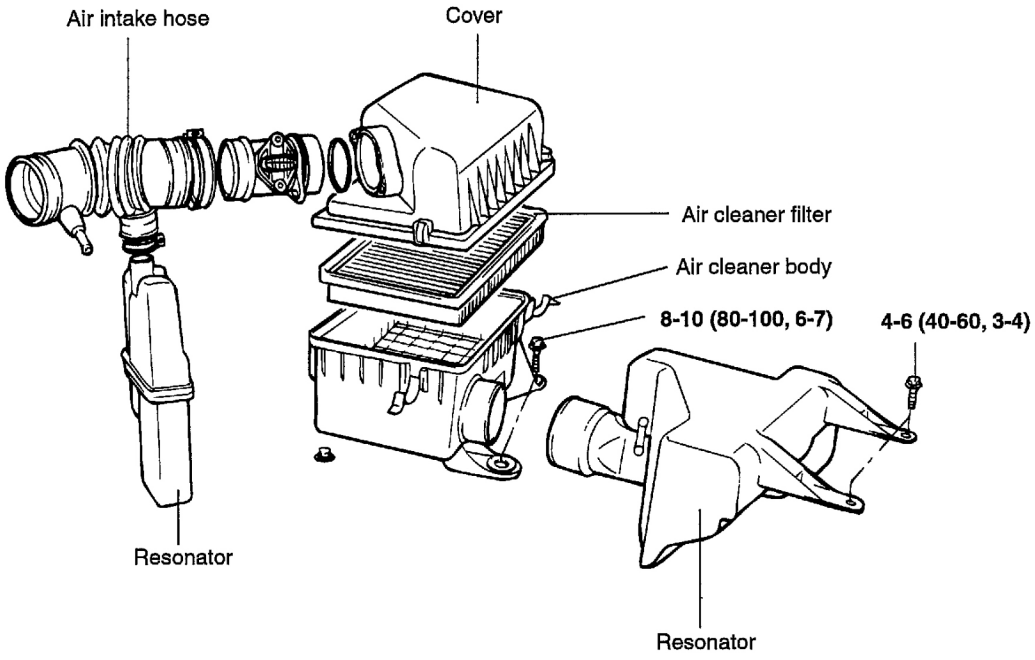

TORQUE : Nm (kg.cm, lb.ft)

G01122286

Fig. 130: Air Cleaner Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Remove the air duct connected to the air cleaner.
2. Disconnect the intake air temperature sensor harness.
3. Remove the air intake hose at the air cleaner side.
4. Remove the air cleaner cover and filter.
5. Remove the air cleaner mounting bolts and remove the air cleaner.

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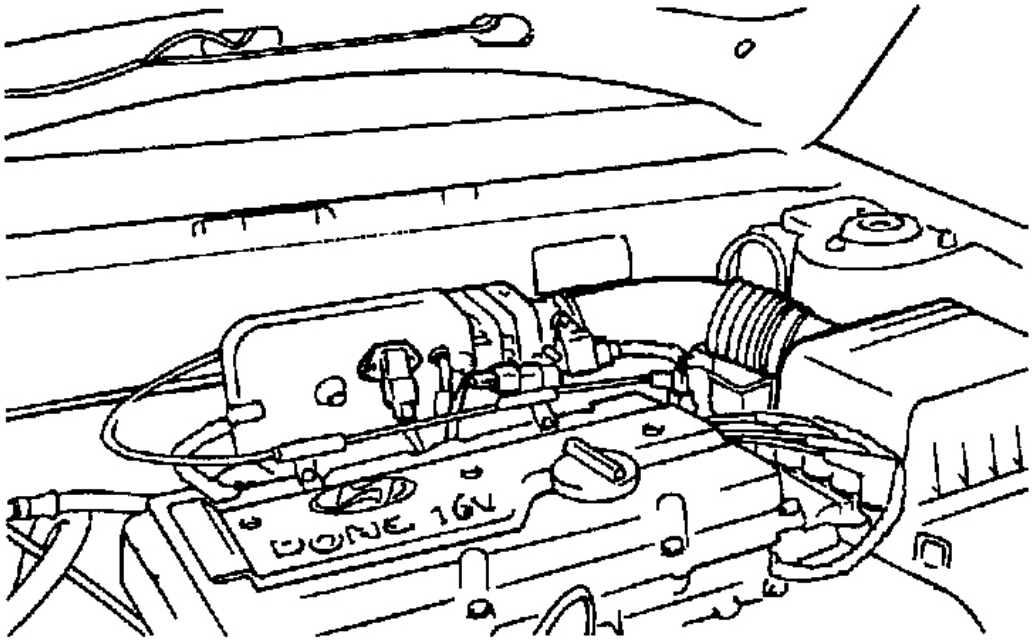

G01122287

Fig. 131: Identifying Air Cleaner
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

1. Check the air cleaner body, cover, or filter for distortion, corrosion or damage.
2. Check the air duct for damage.
3. Check the resonator for distortion or damage.

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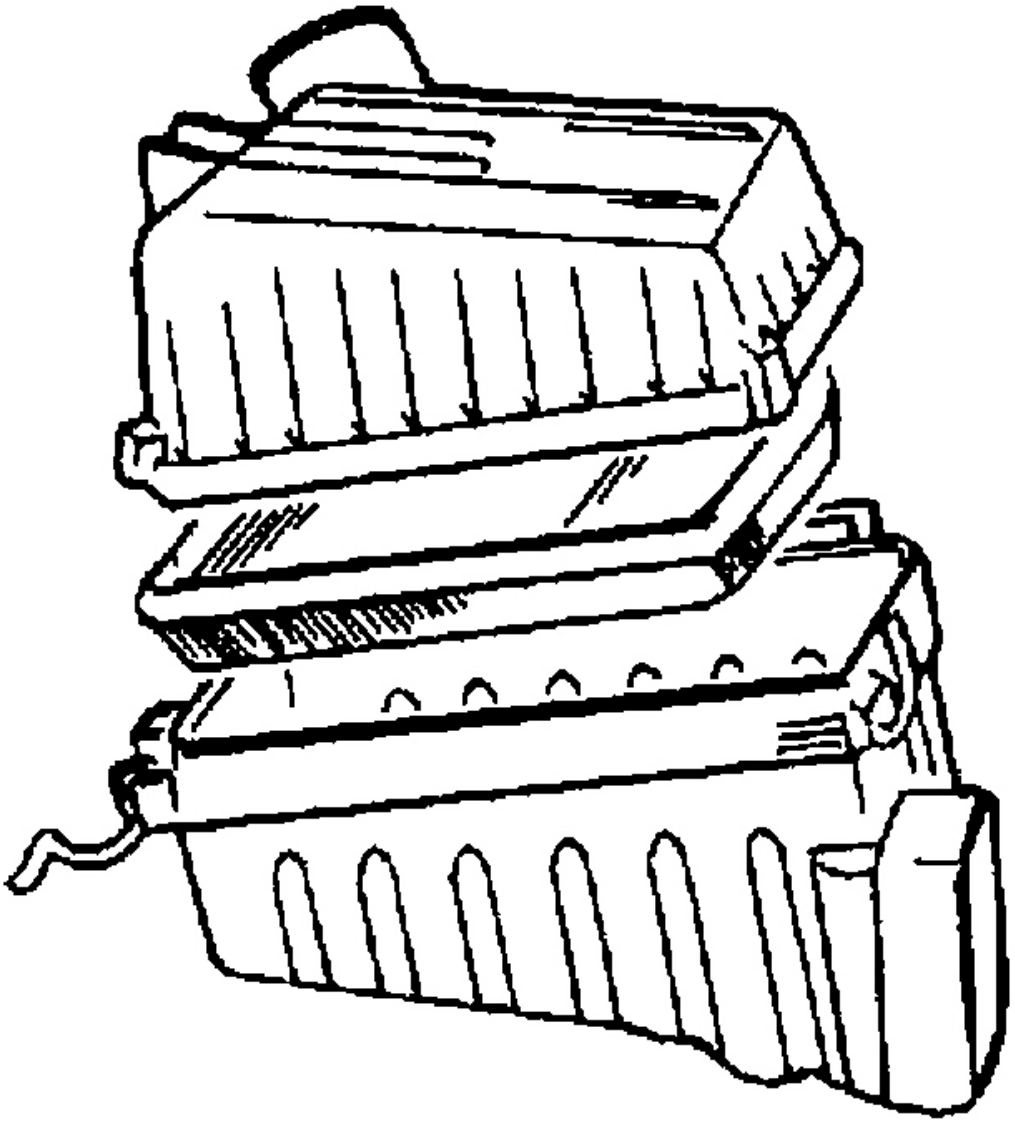

Fig. 132: Checking Resonator For Distortion Or Damage
Courtesy of HYUNDAI MOTOR CO.

4. Check the air cleaner filter for restriction, contamination or damage. If the filter is slightly restricted, remove the dust and other contaminants by blowing compressed air from the upper side through the filter.

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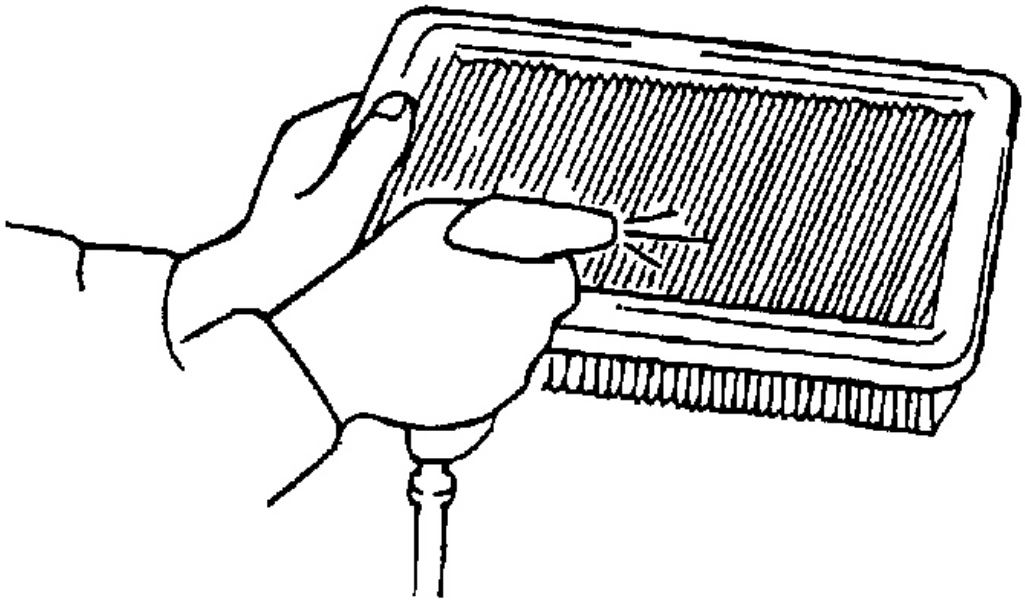

Fig. 133: Cleaning Air Filter
Courtesy of HYUNDAI MOTOR CO.

5. Check the air cleaner housing for restrictions, contamination or damage.

INSTALLATION

Install the air cleaner assembly following the reverse order of removal.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS

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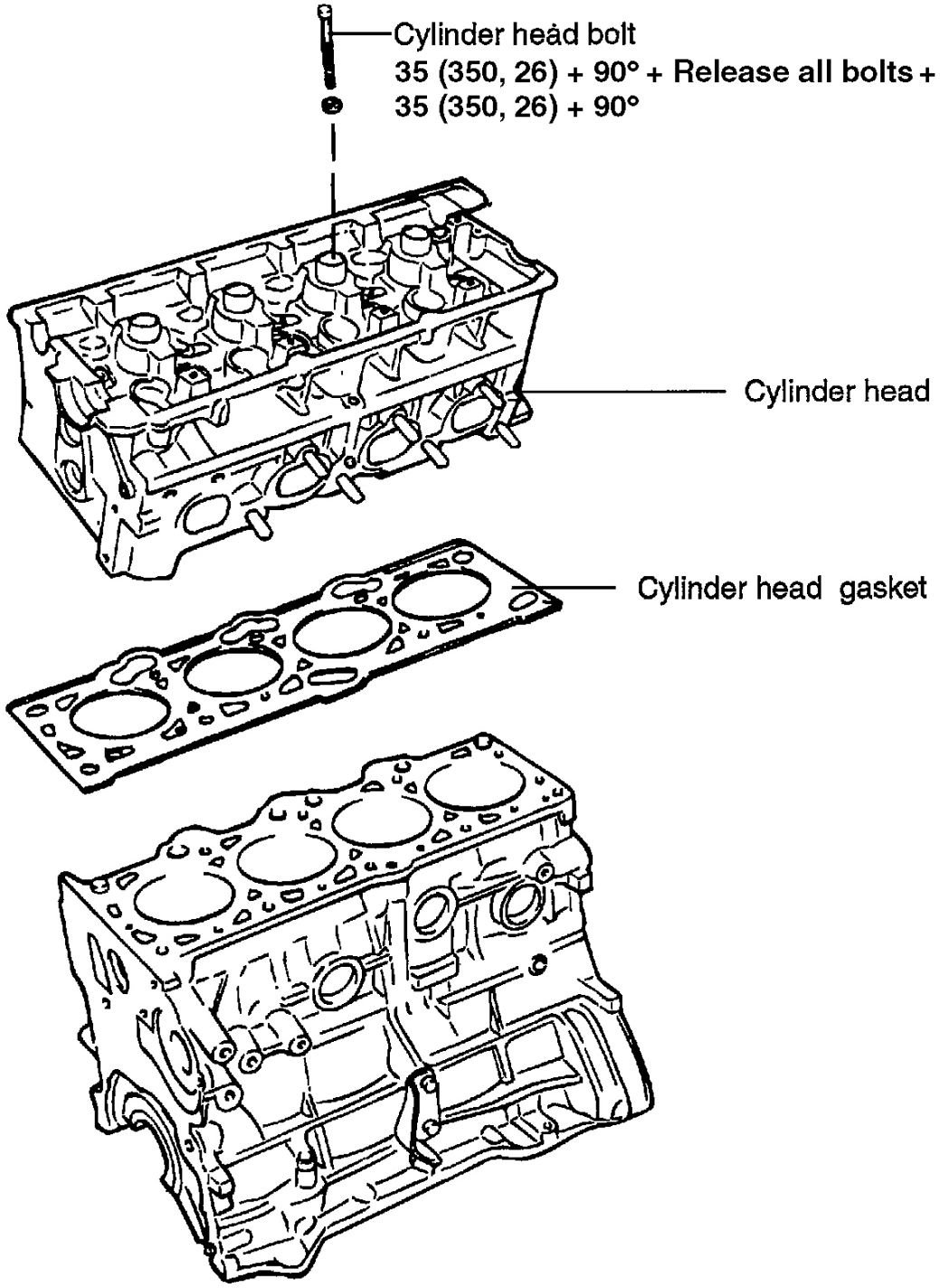

Fig. 134: Cylinder Head Components

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Courtesy of HYUNDAI MOTOR CO.

VALVES

COMPONENTS

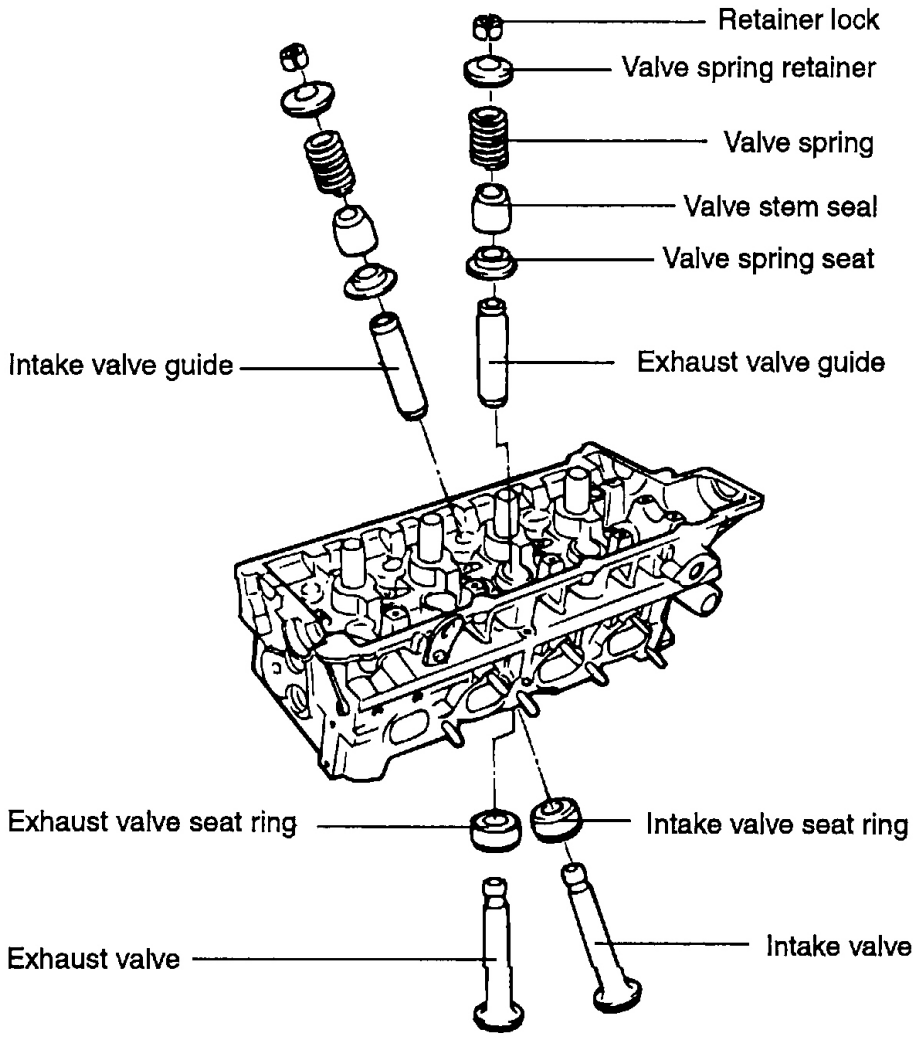

Fig. 135: Valves & Components
Courtesy of HYUNDAI MOTOR CO.

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DISASSEMBLY

1. Using a special tool (09221-32001), remove the cylinder head bolts in the order shown in the illustration.

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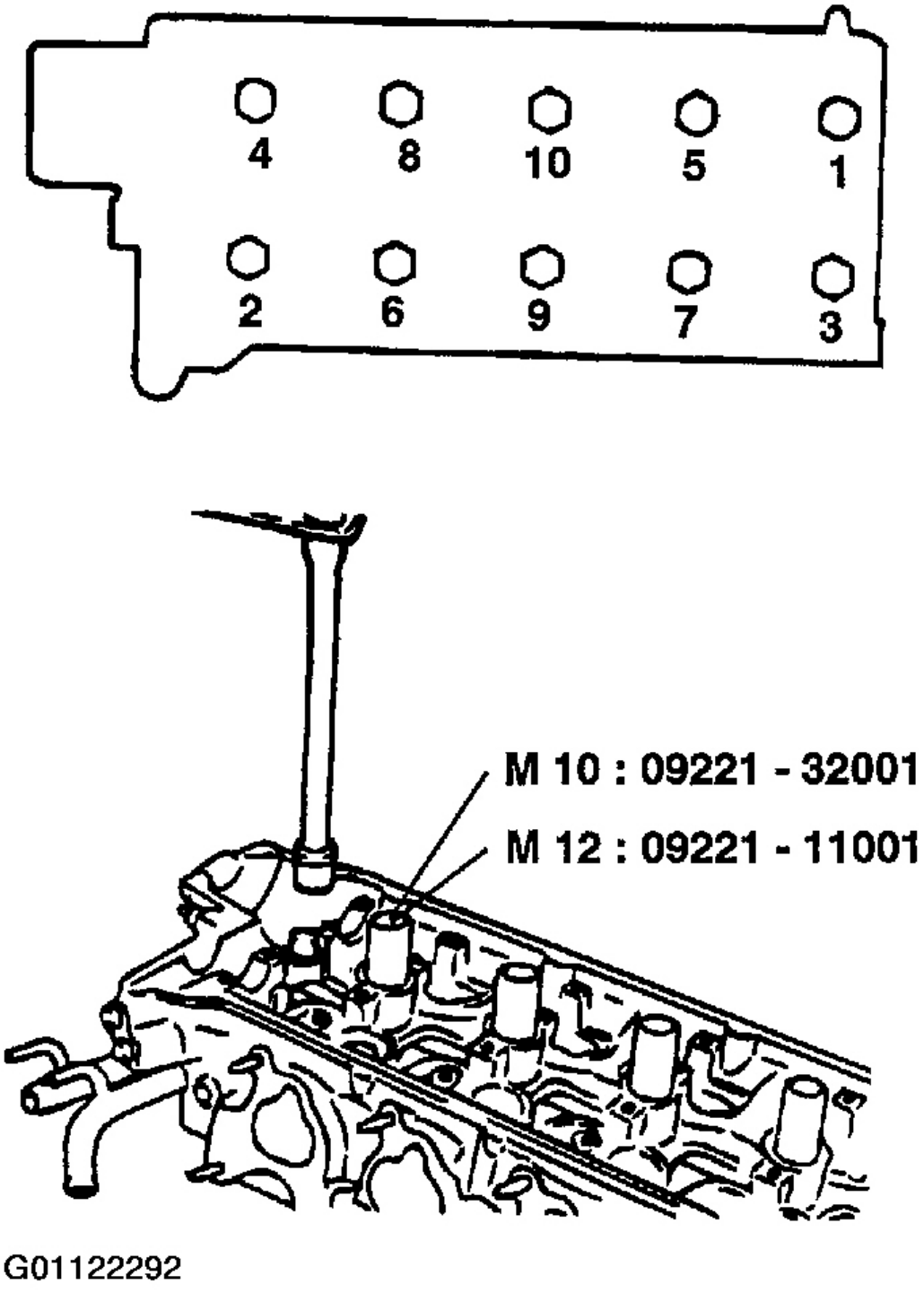

Fig. 136: Removal Order Of Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.

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2. Using the special tool (09222-28000, 09222-28100), remove the valve retainer lock. Next remove the spring retainer, valve spring, spring seat and valve.

NOTE: Arrange these parts so that they can be reinstalled in their original positions.

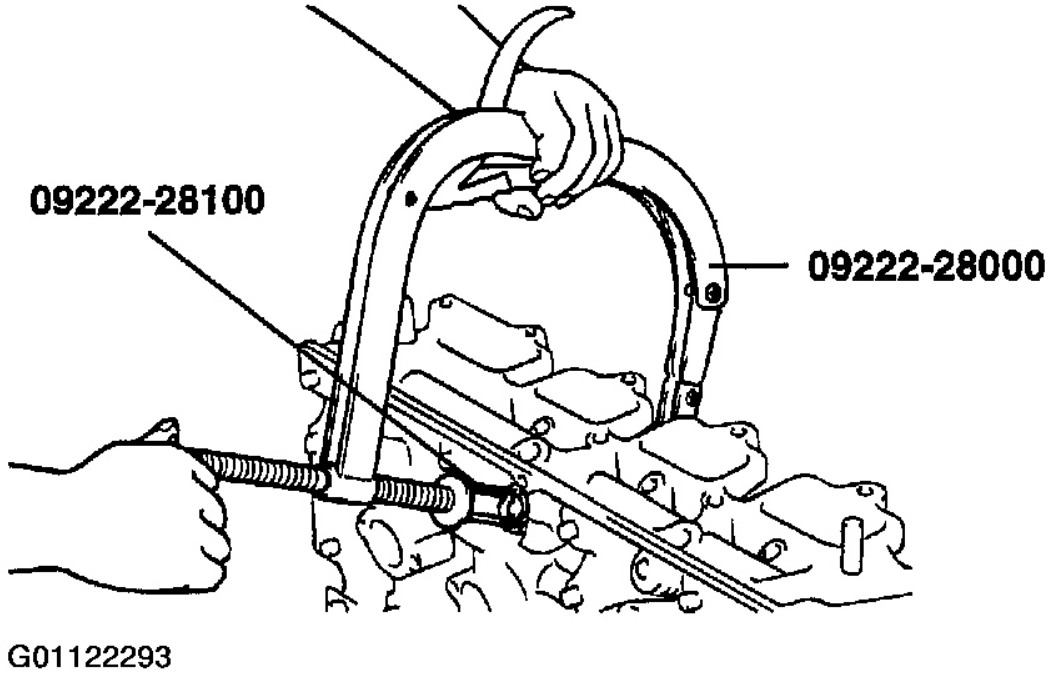

Fig. 137: Removing Valve Retainer Lock
Courtesy of HYUNDAI MOTOR CO.

3. Remove the valve stem seals with pliers.

NOTE: Do not reuse the valve stem seals.

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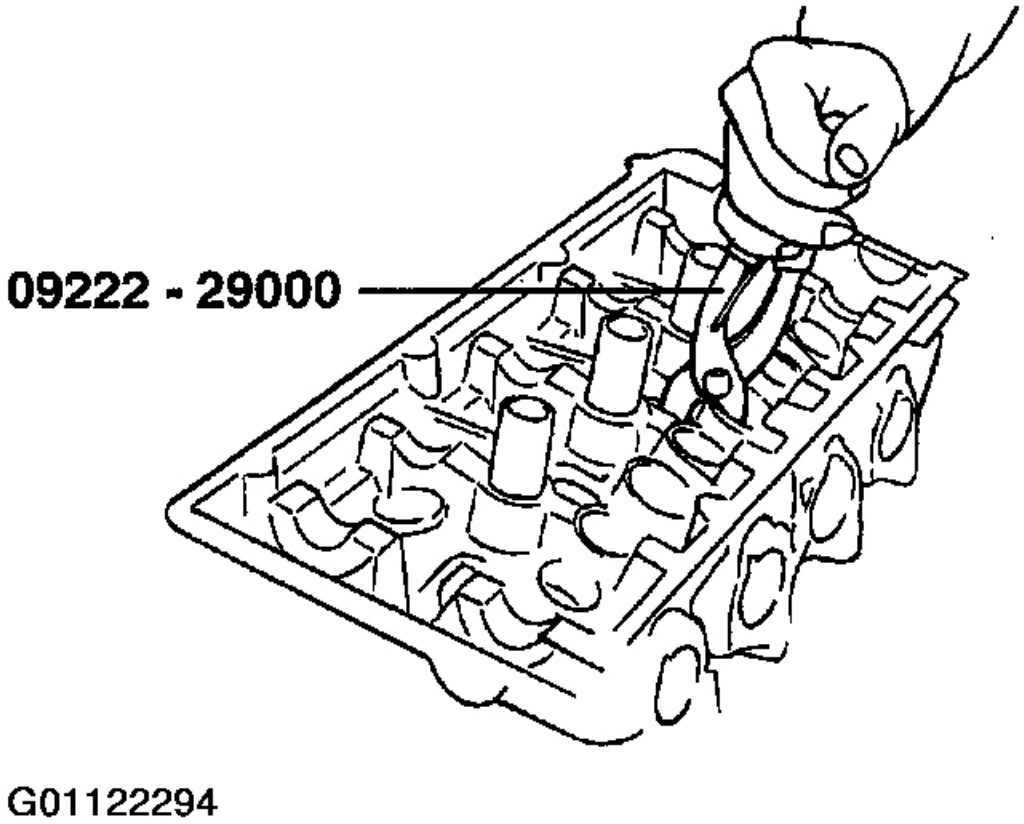

Fig. 138: Removing Valve Stem Seals
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

CYLINDER HEAD

1. Check the cylinder head for cracks, damage and coolant leakage. If cracked, replace the cylinder head.
2. Remove scale, sealing compound and carbon deposits completely. After cleaning the oil passages, apply compressed air to verify that the passages are not clogged.

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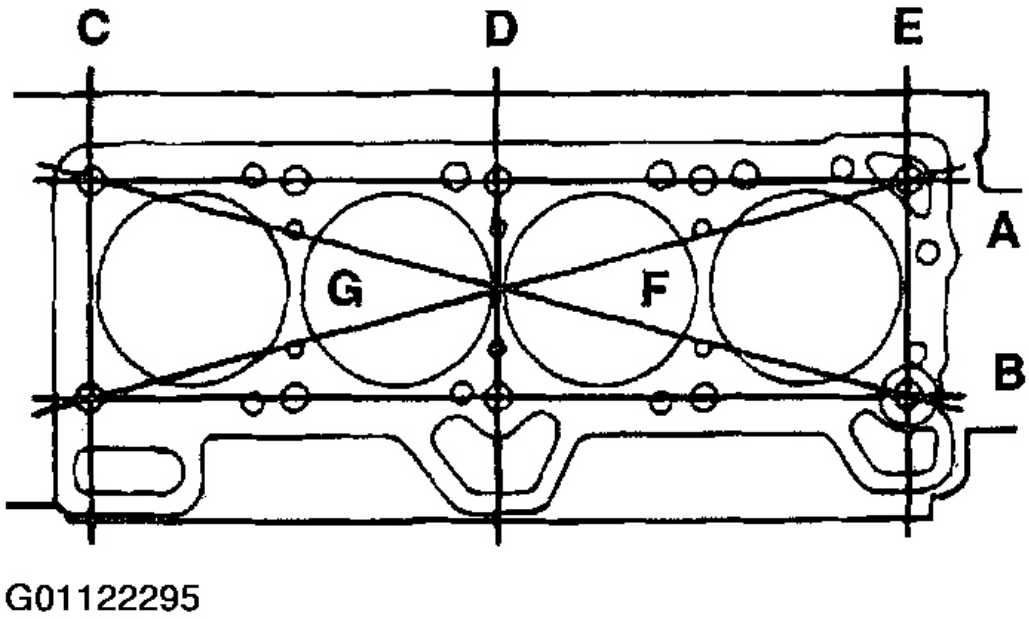

Fig. 139: Checking Cylinder Head Flatness
Courtesy of HYUNDAI MOTOR CO.

3. Check the cylinder head surface for flatness in the direction as shown in the illustration. If flatness exceeds the service limit in any direction, either replace the cylinder head or machine the cylinder head matching surface lightly.

Flatness of cylinder head gasket surface

Standard: Less than 0.03mm (0.0012 in.)

Limit: 0.2 mm (0.008 in.)

VALVES

1. Using a wire brush, clean the valve thoroughly.

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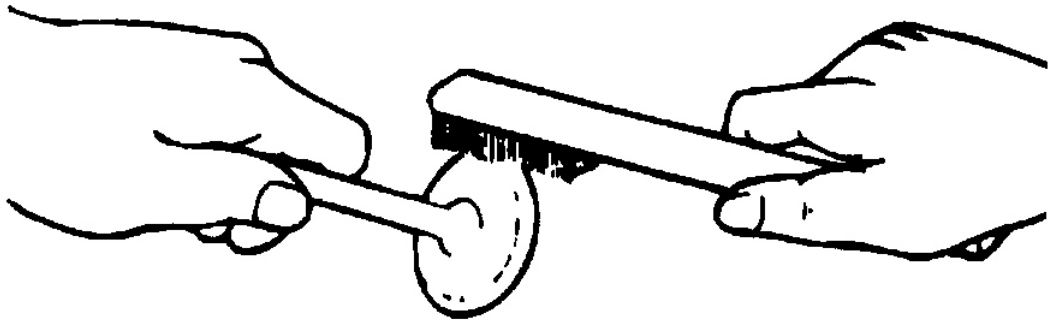

Fig. 140: Cleaning Valve
Courtesy of HYUNDAI MOTOR CO.

2. Check each valve for wear, damage and distortion of the head and the stem at B position. Replace, if necessary. If stem end, A, is hollowed out or worn, resurface as necessary. This correction must be limited to a minimum. Also resurface the valve face. Replace the valve if the margin has decreased to less than the service limit.

   Margin

   [Standard]

   Intake: 1.1 mm (0.043 in.)

   Exhaust: 1.3 mm (0.051 in.)

   [Limit]

   Intake: 0.8 mm (0.028 in.)

   Exhaust: 1.0 mm (0.040 in.)

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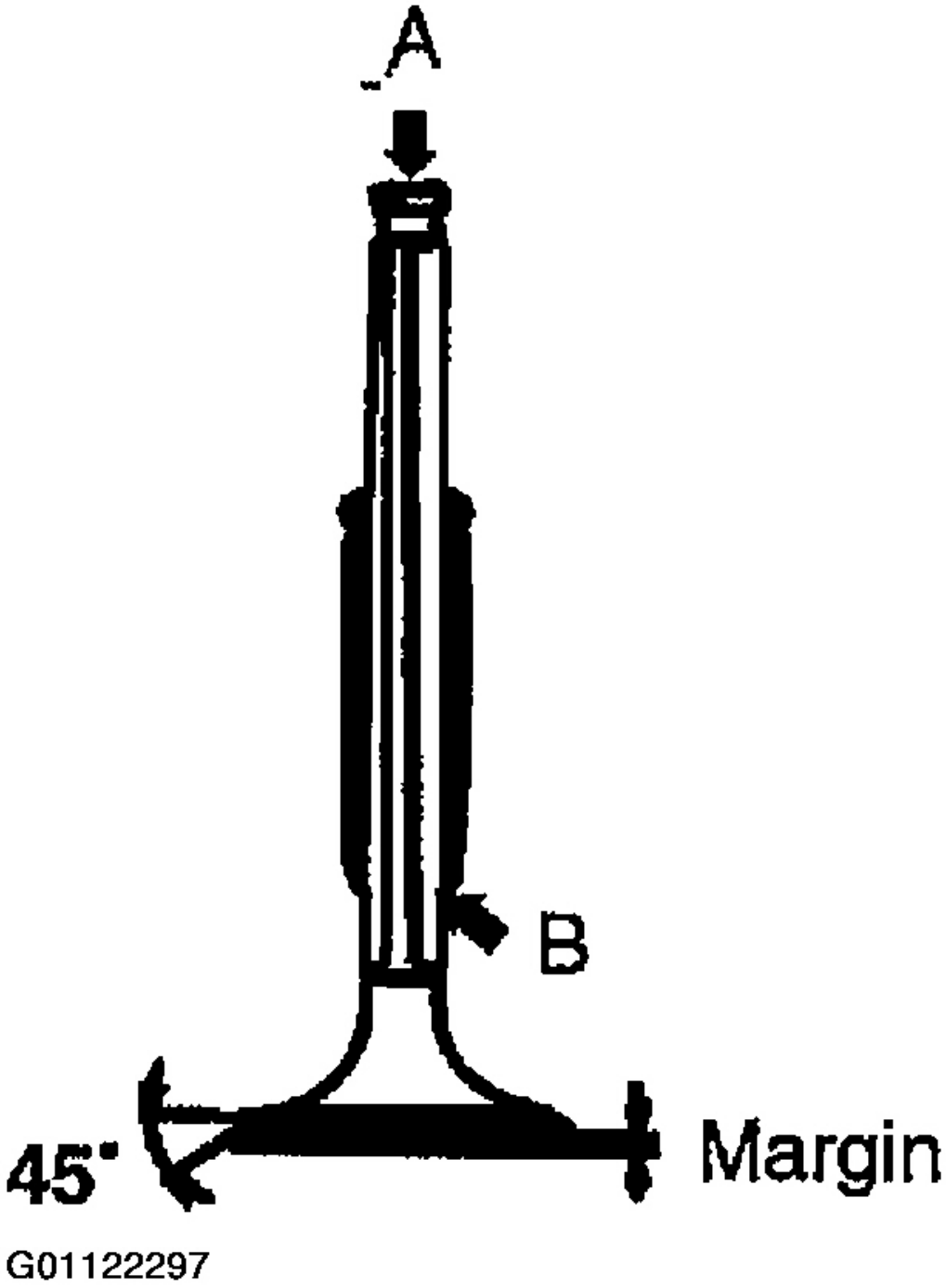

Fig. 141: Checking Valve Head For Distortion
Courtesy of HYUNDAI MOTOR CO.

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VALVE SPRINGS

1. Check the free height of each valve spring. If they exceed the service limit, replace the springs.
2. Using a square, test the squareness of each spring. If a spring is excessively out-of-square, replace it.

Valve spring

[Standard]

Free height: 44 mm (1.7323 in.)

Load:

21.6kg/35 mm (47.6 lb/1.0709 in.)

45.1 kg/27.2 mm (16 lb/1.0709 in.)

Out of square: 1.5° or less 100

[Limit]

Free height: - 1.0 mm (-0.039 in.)

Out of square: 4°

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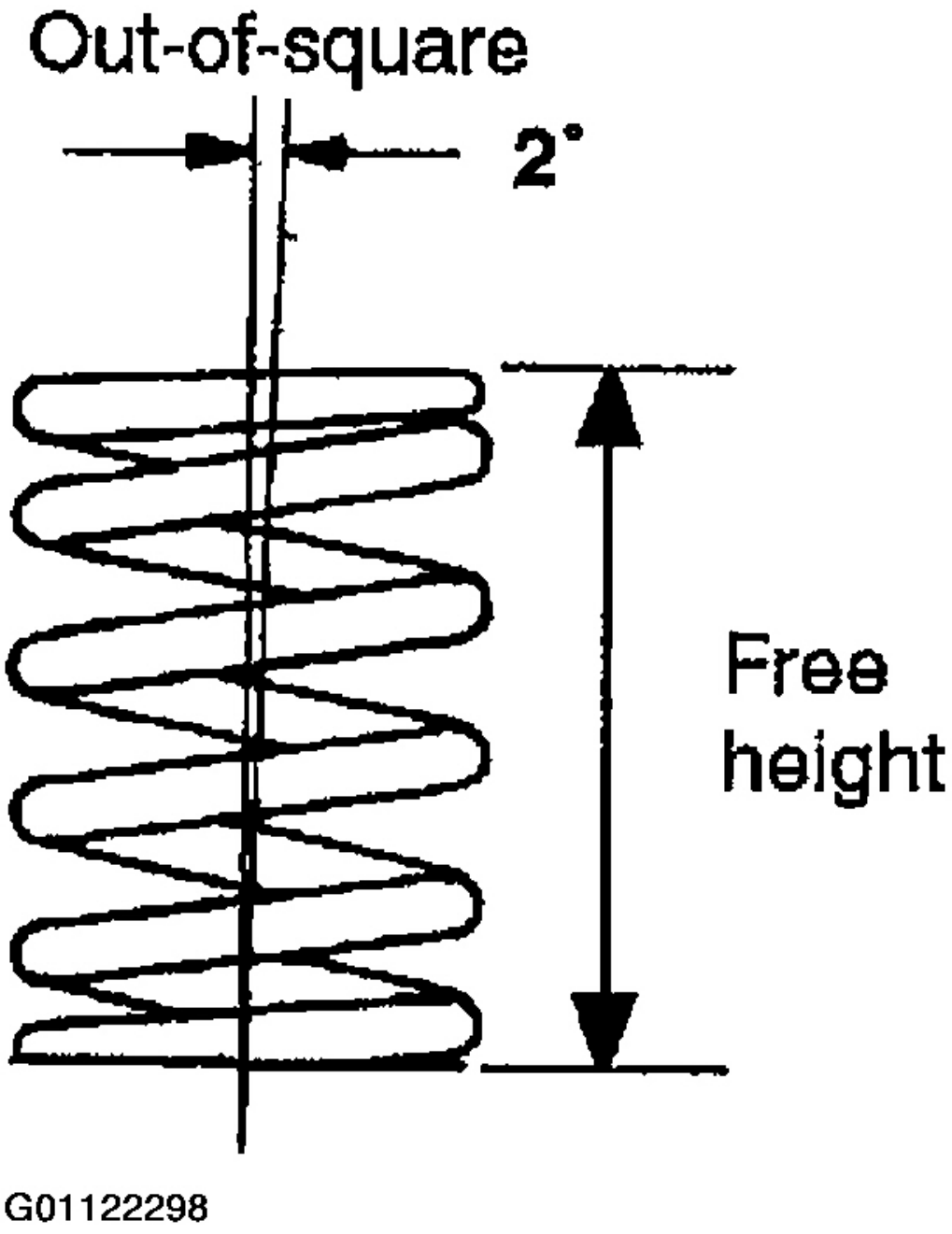

Fig. 142: Identifying Valve Spring Free Height & Squareness
Courtesy of HYUNDAI MOTOR CO.

VALVE GUIDES

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Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with the next oversize part.

Valve stem-to-guide clearance

[Standard]

Intake: 0.03-0.06 mm (0.0012-0.0024 in.)

Exhaust: 0.05-0.08 mm (0.0020-0.0031 in.)

[Limit]

Intake: 0.1mm(0.0040 in)

Exhaust: 0.15mm(0.0059 in.)

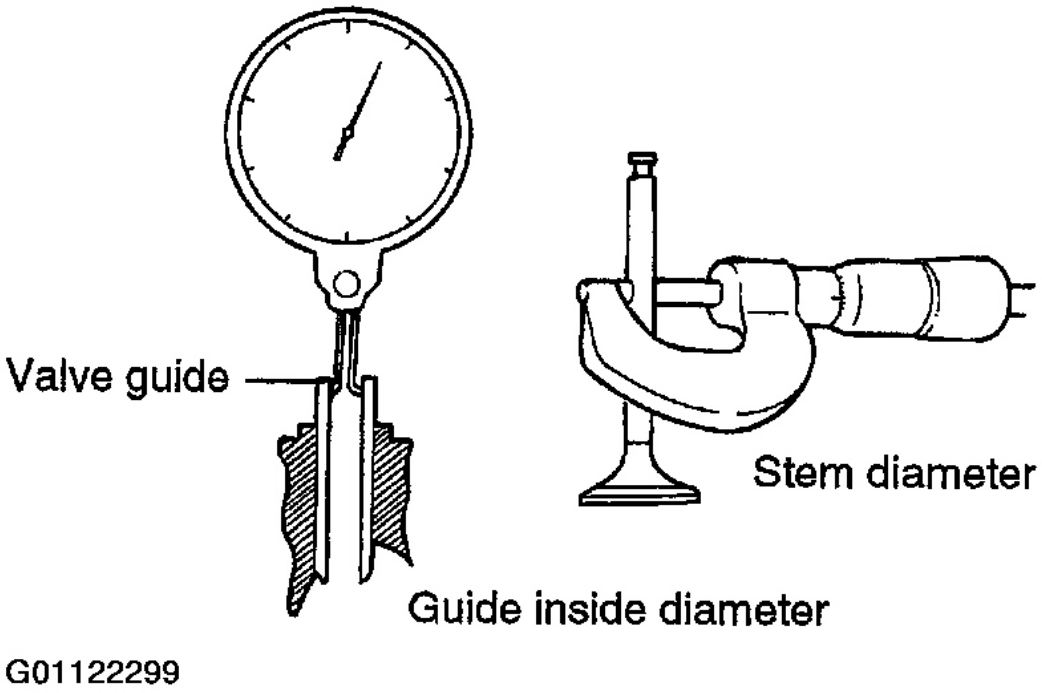

Fig. 143: Checking Valve Stem-To-Guide Clearance
Courtesy of HYUNDAI MOTOR CO.

RECONDITIONING VALVE SEAT

Check the valve seat for overheating and unequal contact with the valve face. Recondition or replace the seat if

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necessary. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it and 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. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.

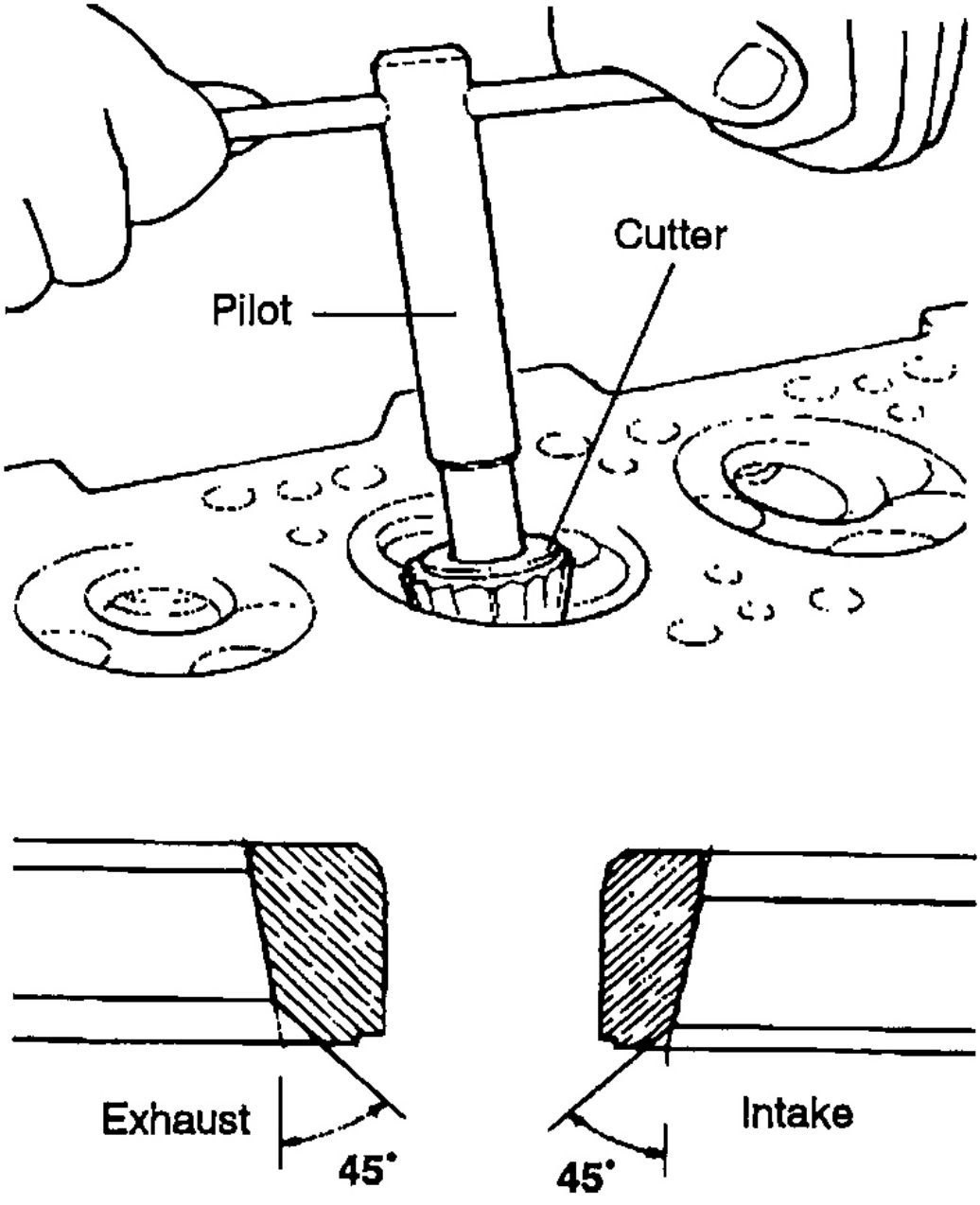

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Fig. 144: Reconditioning Valve Seat
Courtesy of HYUNDAI MOTOR CO.

REPLACING THE VALVE SEAT RING

1. Cut away the inner face of the valve seat to reduce the wall thickness.

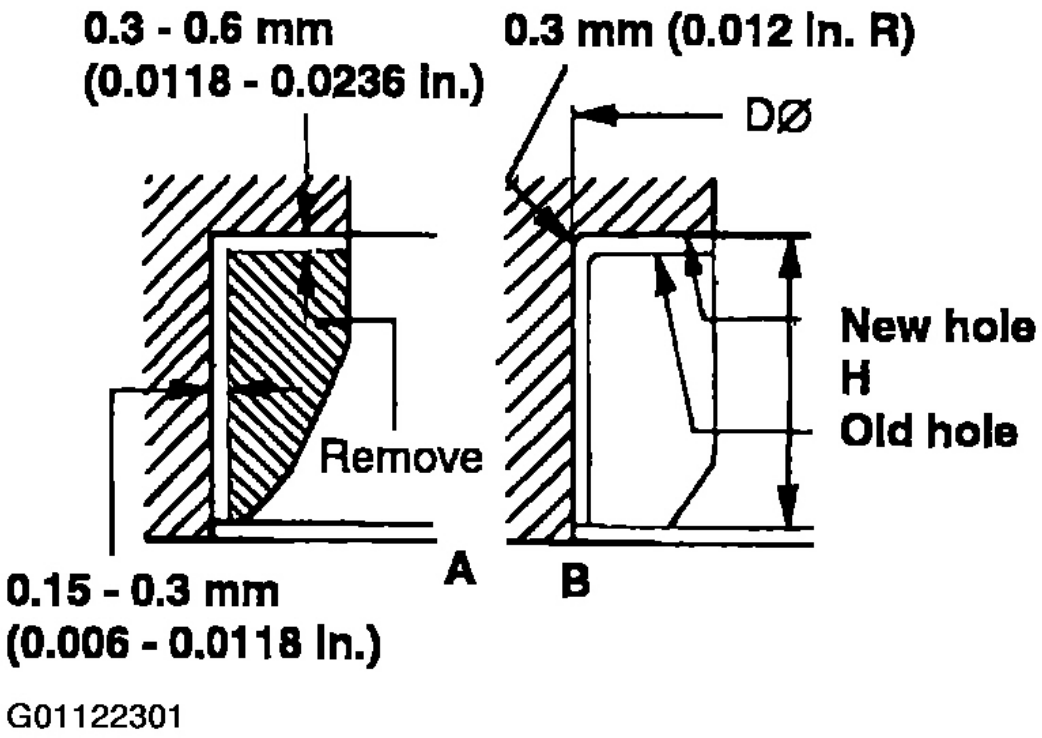

Fig. 145: Cutting Away Inner Face Of Valve Seat
Courtesy of HYUNDAI MOTOR CO.

2. Enlarge the diameter of the valve seat so that it matches the specified oversize hole diameter of the new valve seat ring.
3. Heat the cylinder head to about 250°C (480°F) and press - fit an oversize seat ring for the bore in the cylinder head.
4. Using lapping compound, lap the valve to the new seat.

Valve seat contact width

Intake: 0.8 - 1.2 mm (0.0315 - 0.0472 in.)

Exhaust: 1.3 - 1.7 mm (0.0512 - 0.0670 in.)

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VALVE SEAT INSERT OVERSIZE

Description	Size mm (in.)	Size mark	Seat ring height H mm(in.)	Oversize hole diameter I.D. mm(in.)
Intake valve	0.3 (0.012) O.S.	30	5.1-5.3 (0.2008-0.2087)	30.7-30.721 (1.2087-1.2095)
Seat ring	0.6 (0.024) O.S.	60	5.4-5.6 (0.2126-0.2205)	31.0-31.021 (1.2205-1.2213)
Exhaust valve	0.3 (0.012) O.S.	30	6.2-6.4 (0.2441-0.2520)	27.3-27.321 (1.0748-1.0756)
Seat ring	0.6 (0.024) O.S	60	6.5-6.7 (0.2560-0.2638)	27.6-27.621 (1.0866-1.0874)

G01122302

Fig. 146: Valve Seat Insert Overissues
Courtesy of HYUNDAI MOTOR CO.

REPLACING VALVE GUIDE

1. Using the special tool (09221-22000 A/B), withdraw the old valve guide toward the bottom of cylinder head.
2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.

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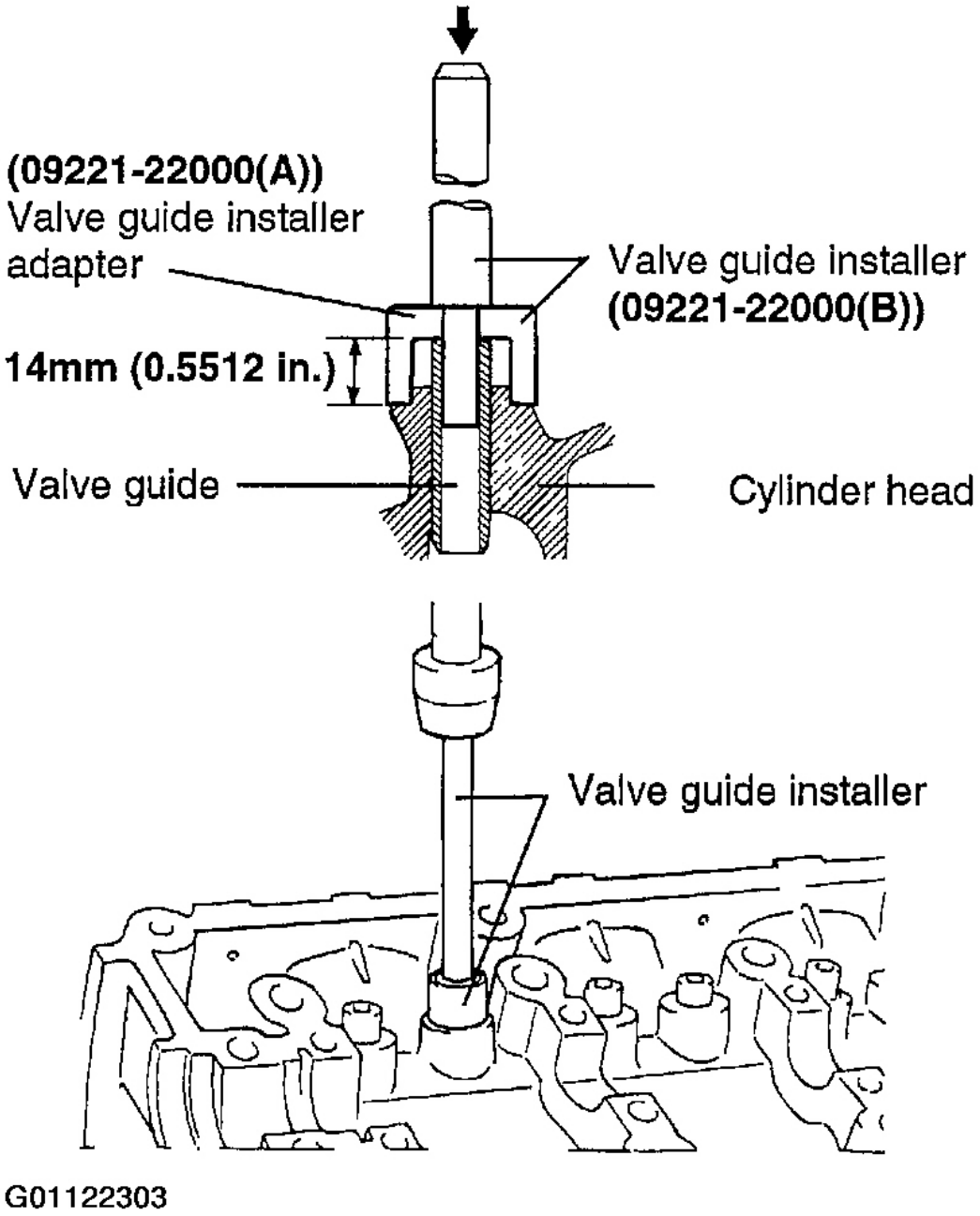

Fig. 147: Replacing Valve Guide
Courtesy of HYUNDAI MOTOR CO.

3. Using the special tool (09221-22000 A/B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head.
4. After the valve guide is press-fitted, insert a new valve and check for proper the clearance.

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

VALVE GUIDE OVERISSUES

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)

G01122304

Fig. 148: Valve Guide Oversize Table
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

NOTE:
1. **Clean each part before assembly.**
2. **Apply engine oil to the sliding and rotating parts.**

1. Install the spring seats.

   Using a special tool (09222-22001), tap the seal in position lightly.

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

2. Apply engine oil to each valve. Insert the valve into the valve guide. Avoid pushing the valve into the seal by force. After inserting the valve, check that it moves smoothly.

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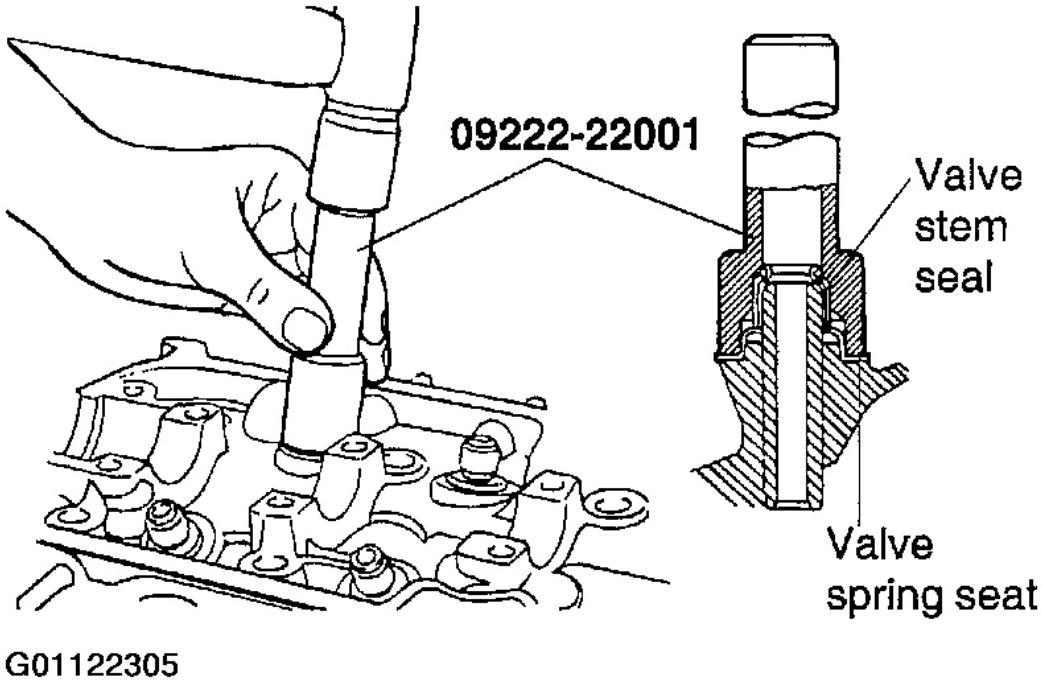

Fig. 149: Inserting Valve Into Valve Guide
Courtesy of HYUNDAI MOTOR CO.

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

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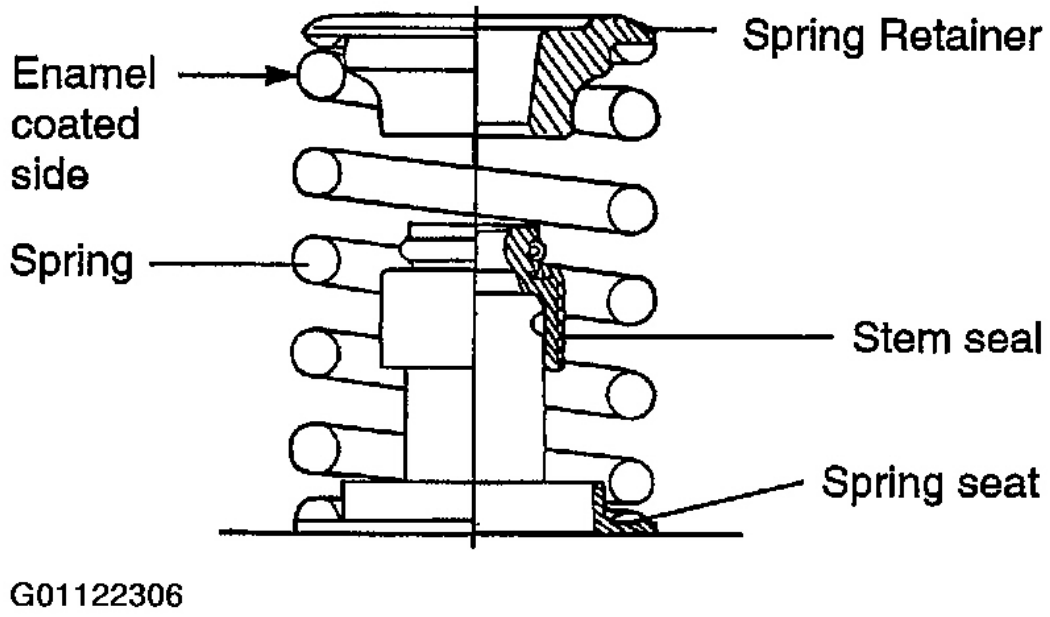

Fig. 150: Installing Retainer
Courtesy of HYUNDAI MOTOR CO.

4. Using the special tool (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.

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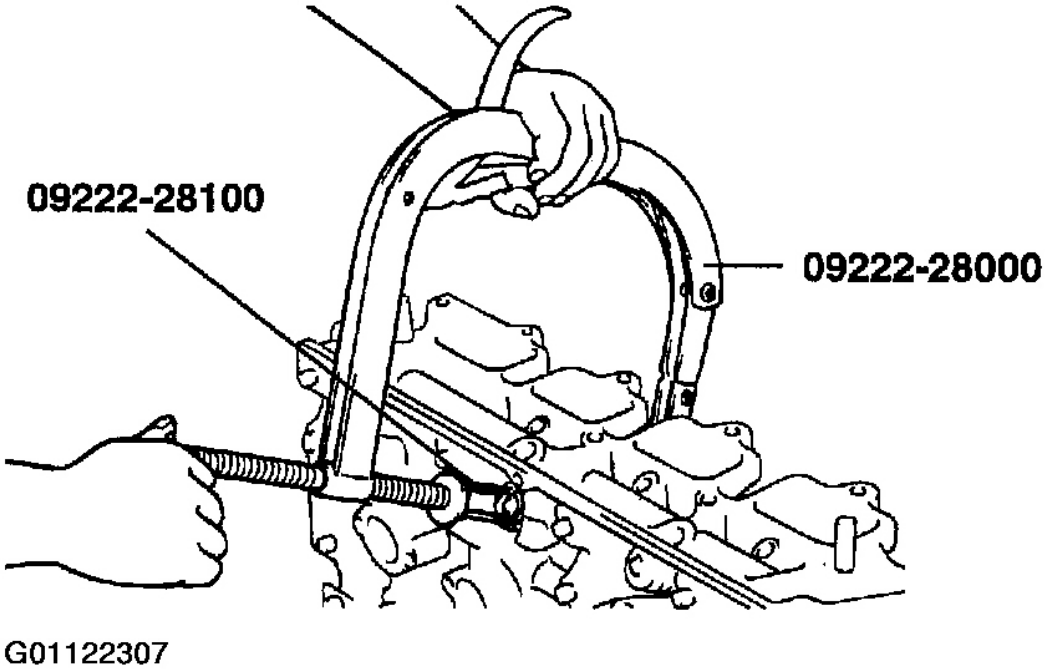

Fig. 151: Installing Retainer Locks
Courtesy of HYUNDAI MOTOR CO.

NOTE: When the spring is compressed, Check that the valve stem seal is not pressed against the bottom of the retainer.

5. Clean both gasket surfaces of the cylinder block and cylinder head.
6. Verify the identification marks on the cylinder head gasket.
7. Install the gasket so that the surface with the identification mark faces toward the cylinder head.
8. Tighten the bolts to the specified torque in the sequence shown.

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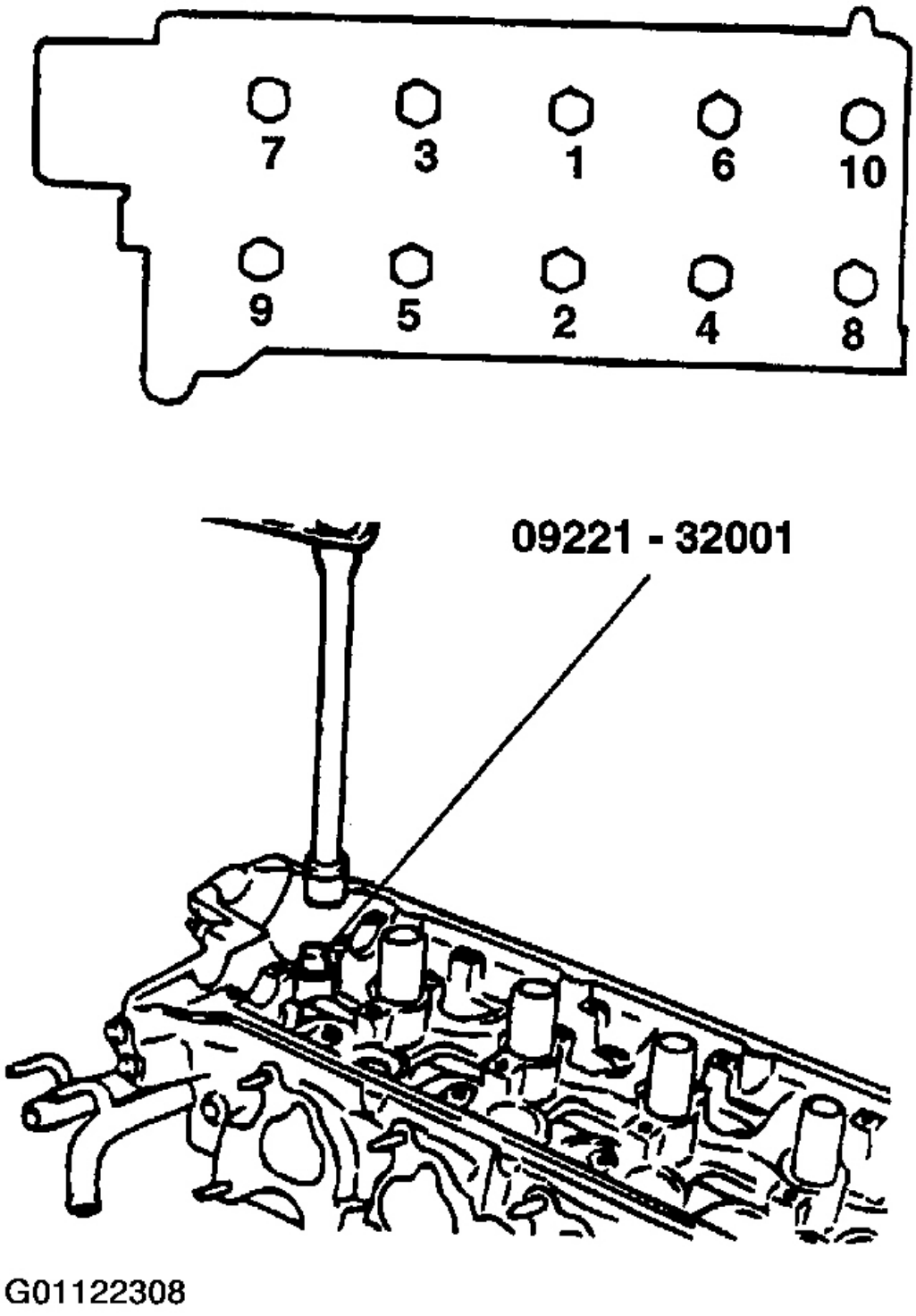

Fig. 152: Tightening Cylinder Head Bolts

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Courtesy of HYUNDAI MOTOR CO.

Cylinder head bolt: 35 Nm (26 lb.ft) + 90° + Release all bolt + 35 Nm (26 lb.ft) + 90°

TIMING SYSTEM

TIMING BELT

COMPONENTS

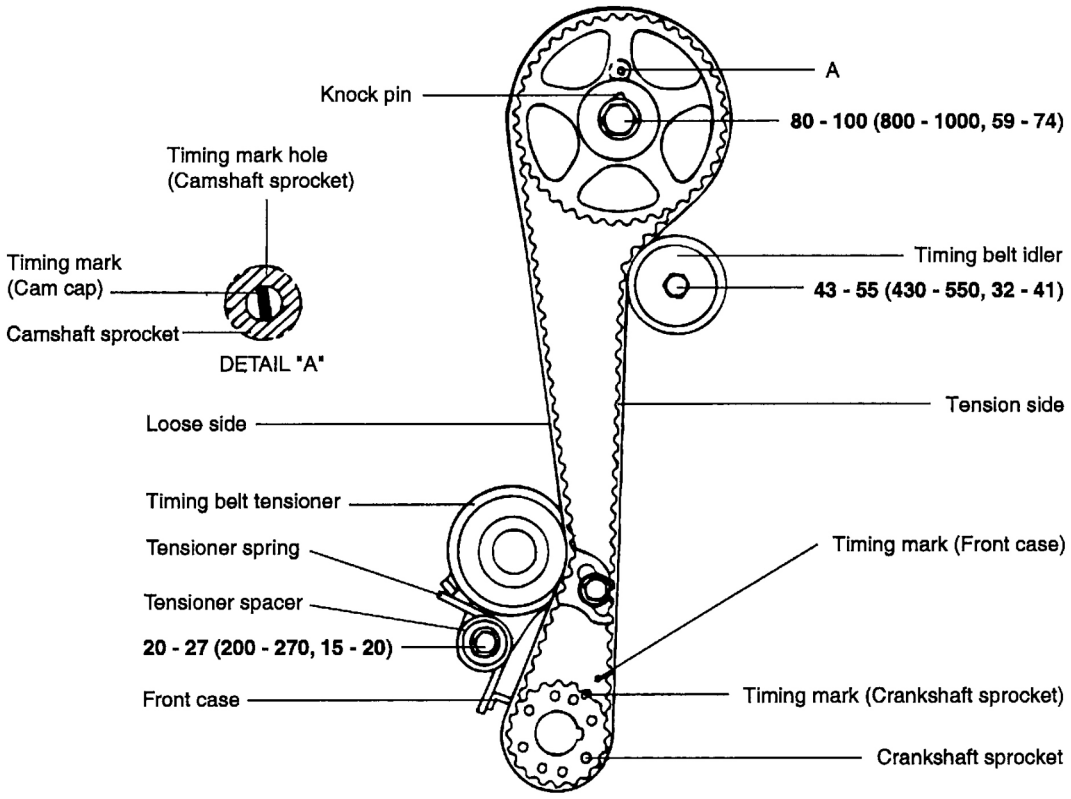

Fig. 153: Timing Belt Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Loosen the coolant pump pulley bolt.
2. Loosen the alternator bolt.
3. Remove the coolant pump pulley and belt.
4. Remove the crankshaft pulley.

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5. Remove the timing belt cover.

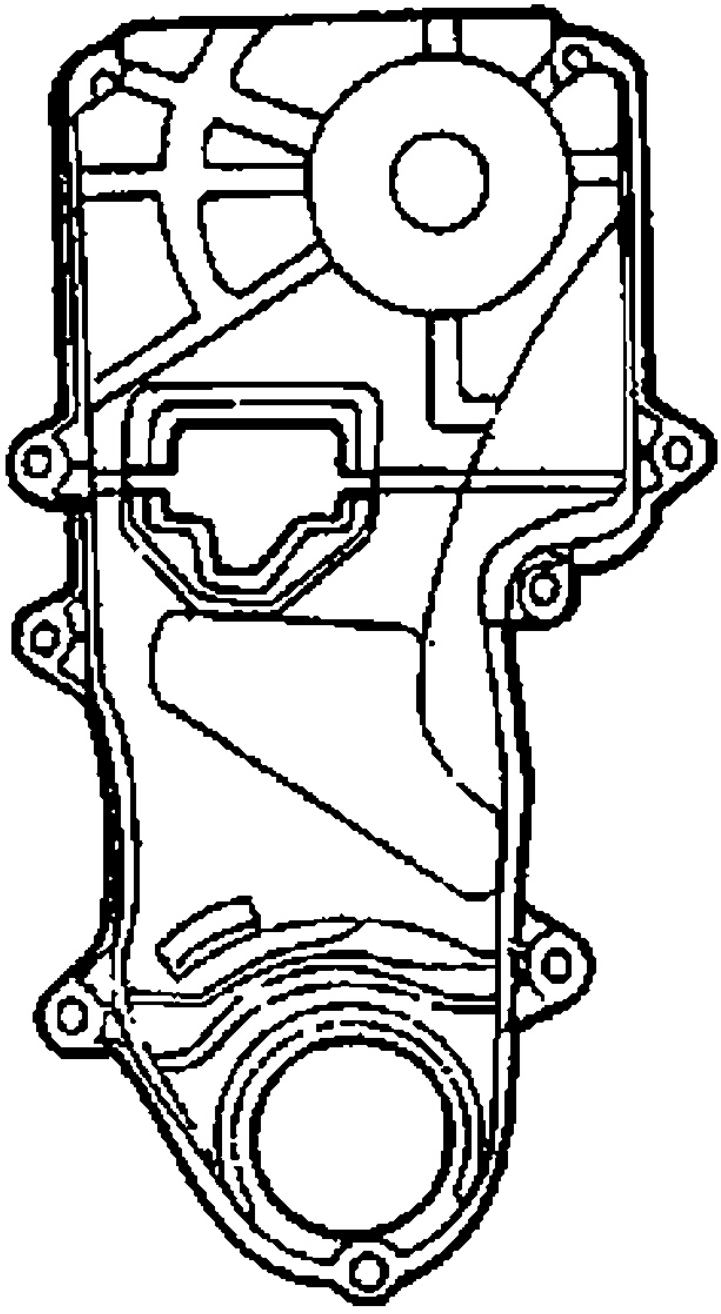

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Fig. 154: Removing Timing Belt Cover
Courtesy of HYUNDAI MOTOR CO.

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6. Move the timing belt tensioner pulley toward the coolant pump and temporarily secure it.
7. Remove the camshaft from the camshaft sprocket.
8. Remove the camshaft sprocket.
9. Remove the timing belt.

NOTE: If the timing belt is reused, mark with an arrow to indicate direction of rotation (on the front of the engine) to make sure that the belt is reinstalled in the same direction as before.

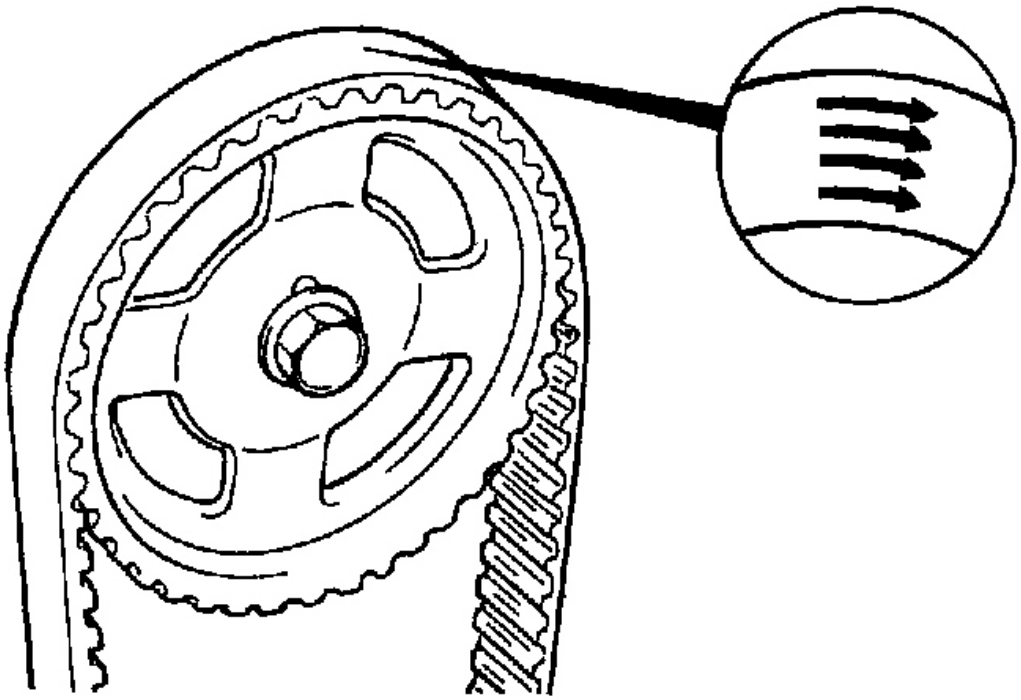

Fig. 155: Referencing Timing Belt Direction
Courtesy of HYUNDAI MOTOR CO.

10. Remove the crankshaft sprocket bolts. Remove the crankshaft sprocket and flange.
11. Remove the timing belt tensioner.

INSPECTION

SPROCKETS TENSIONER PULLEY, AND IDLER PULLEY

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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.

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

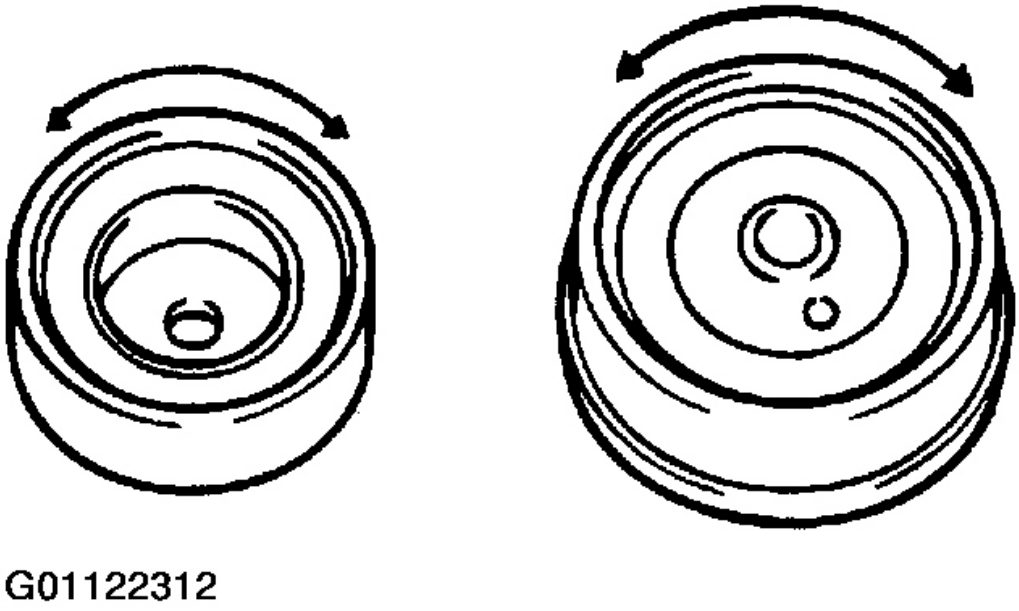

Fig. 156: Inspecting Tensioner Pulley & Idler Pulley Movement
Courtesy of HYUNDAI MOTOR CO.

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 with a new one.

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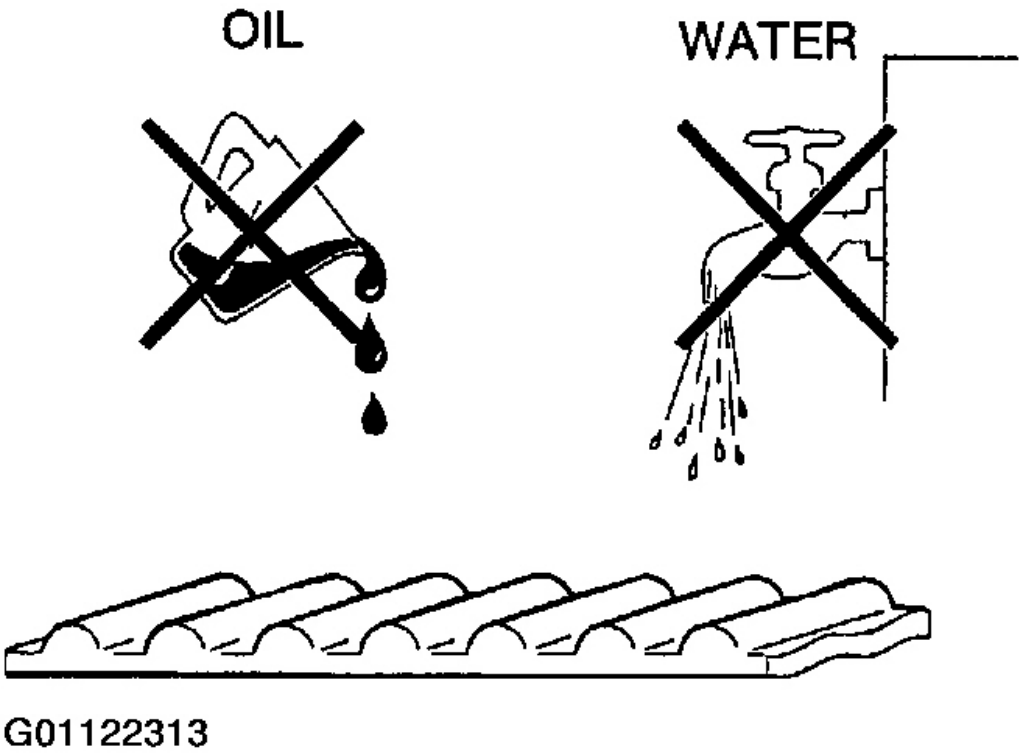

Fig. 157: Precautions For Timing Belt
Courtesy of HYUNDAI MOTOR CO.

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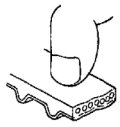
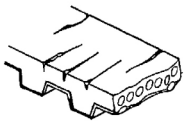
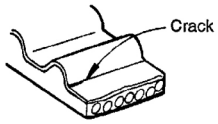
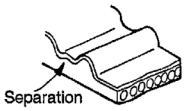
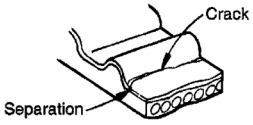
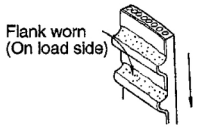
Description	Flaw conditions
1. Hardened back surface • Back surface is glossy, non-elastic and so hard that when your fingernail is pressed into it, no mark is produced.	
2. Cracked back surface rubber	
3. Cracked or separating canvas	  
4. Badly worn teeth (initial stages) • Canvas on load side of tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture)	
5. Badly worn teeth (last stage)	

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Fig. 158: Timing Belt Flaw Conditions (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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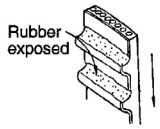
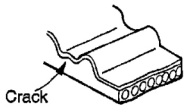
Description	Flaw conditions
• Canvas on load side of tooth flank worn down and rubber exposed (tooth width reduced)	
6. Cracked tooth bottom	
7. Missing tooth	
8. Side of belt badly worn **NOTE** *Normal belt should have precisely cut sides as if cut by a sharp knife.*	
9. Side of belt cracked	

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Fig. 159: Timing Belt Flaw Conditions (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Install the flange and crankshaft sprocket as shown. Pay close attention to their mounting directions.

   Tightening torque

   Crankshaft sprocket bolt: 140-150Nm (1400-1500kg.cm, 103-111lb.ft)

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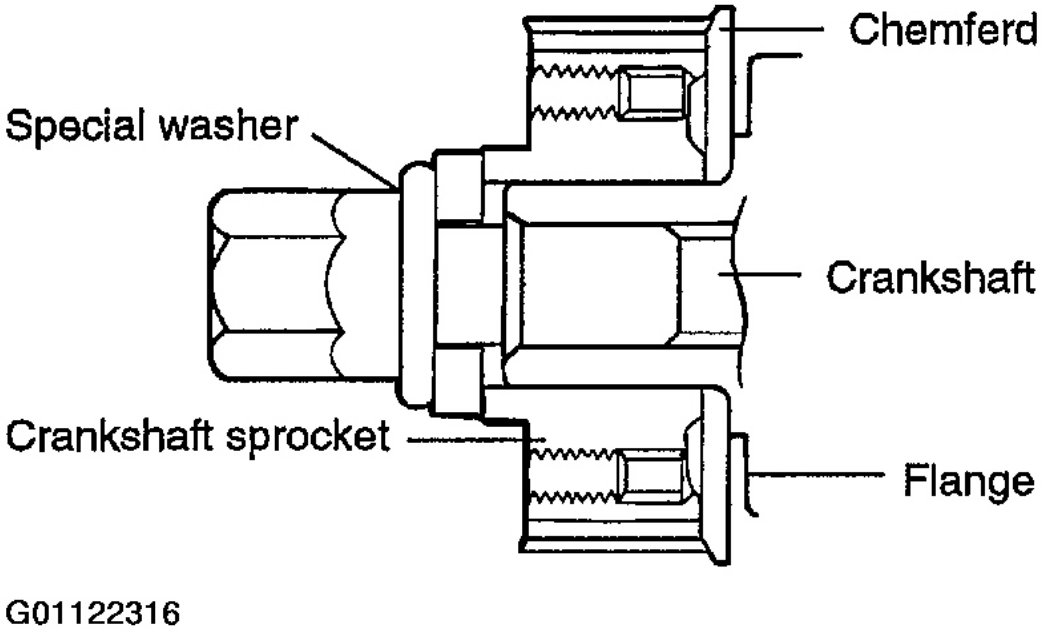

Fig. 160: Installing Flange & Crankshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

2. Install the camshaft sprocket and tighten the bolt to the specified torque.

   Tightening torque

   Camshaft sprocket bolt: 80-100Nm (800-1000kg.cm, 59-74lb.ft)

3. Install the idler and tighten the idler bolt to the specified torque.

   Tightening torque

   Idler bolt: 43-55Nm (430-550kg.cm, 32-41lb.ft)

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

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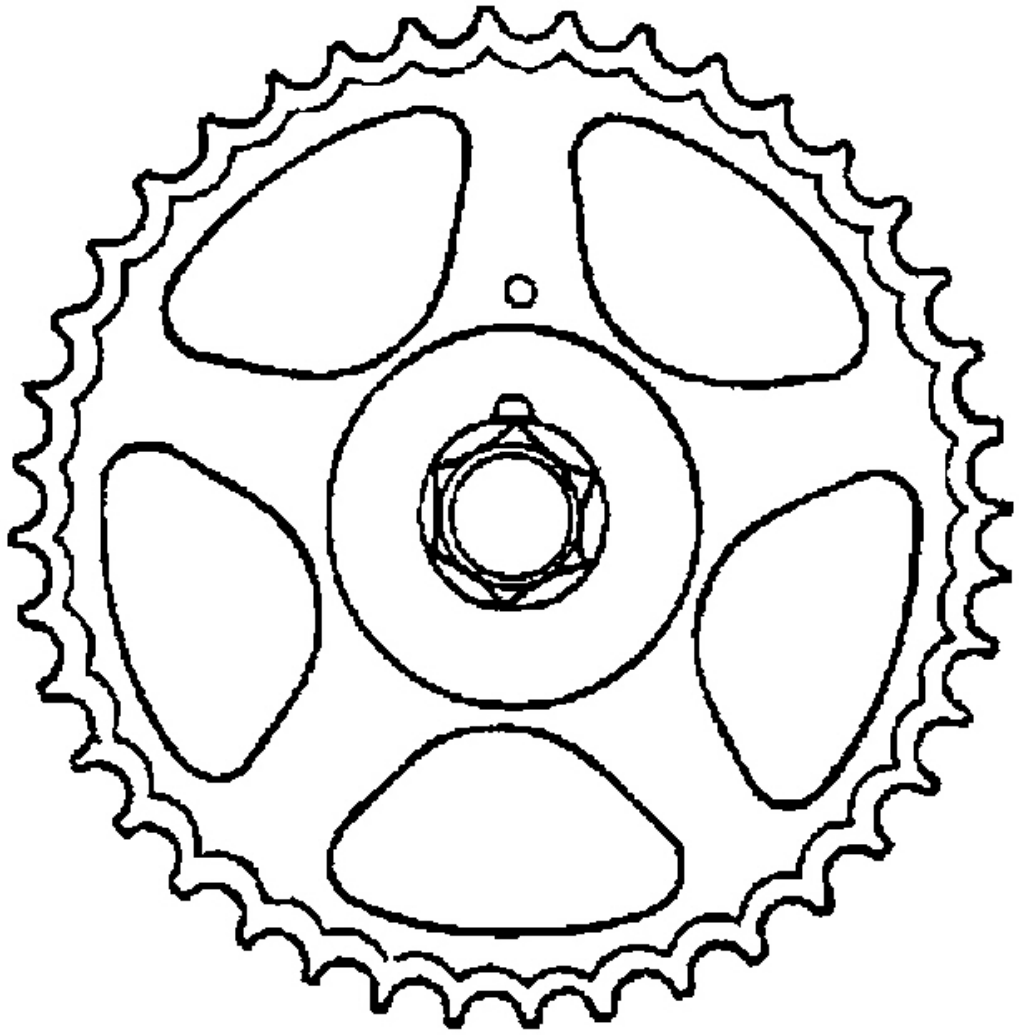

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Fig. 161: Identifying Camshaft Sprockets
Courtesy of HYUNDAI MOTOR CO.

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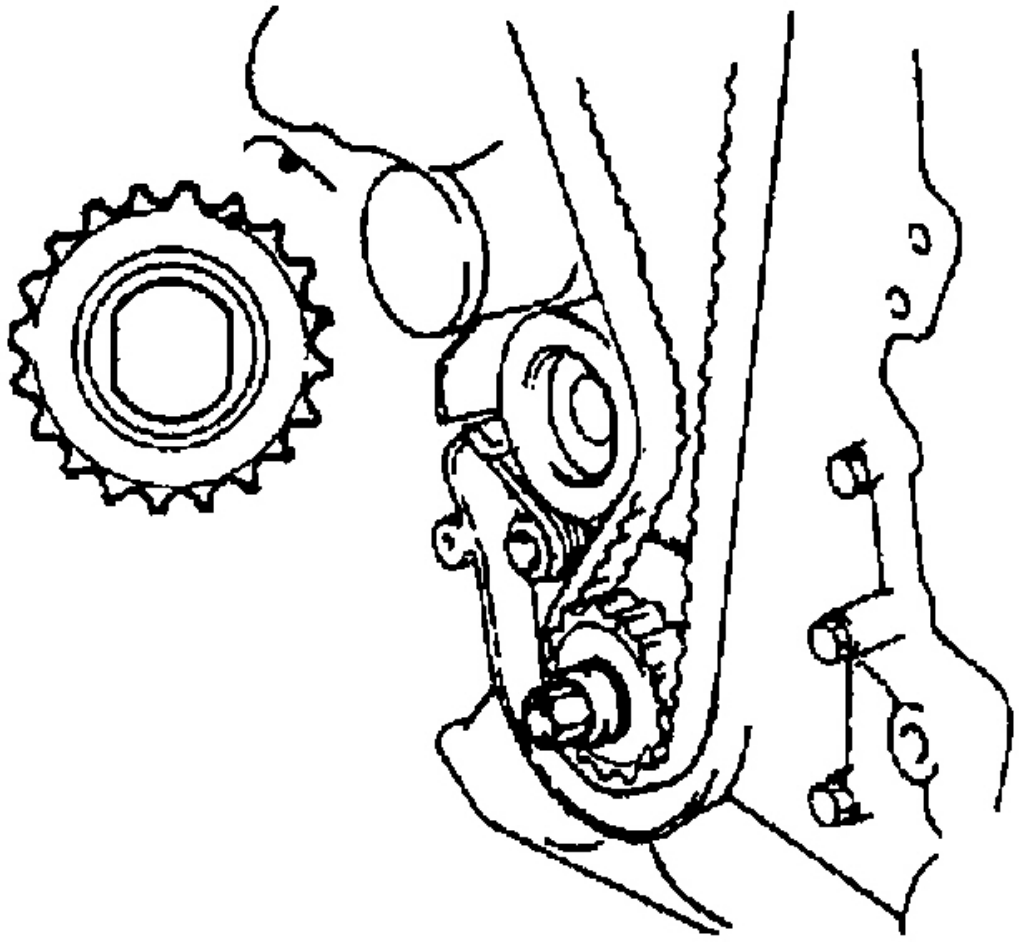

Fig. 162: Installing Camshaft Sprockets
Courtesy of HYUNDAI MOTOR CO.

5. To install the timing belt tensioner, first mount the tensioner, spring, and spacer. Temporarily tighten the bolts. Next, temporarily tighten the tensioner long hole side washer and bolts. Install the bottom end of the spring against the front case as shown in the illustration.

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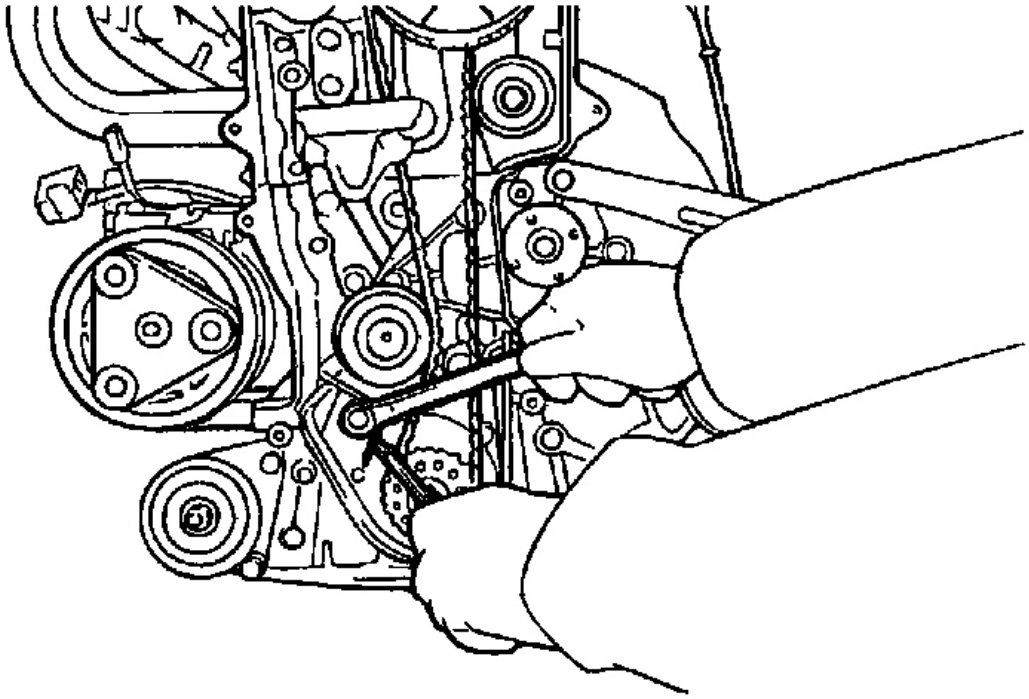

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Fig. 163: Installing Timing Belt Tensioner
Courtesy of HYUNDAI MOTOR CO.

6. Secure the tensioner, positioned towards the water pump.
7. Install the timing belt on the crankshaft sprocket.
8. Install the timing belt on the camshaft sprocket. When the timing belt is installed on the camshaft sprocket, make sure that the tension side is tight. Then, check to ensure that when the tension side is tightened by turning the camshaft sprocket in a reverse direction and all timing marks are in line.

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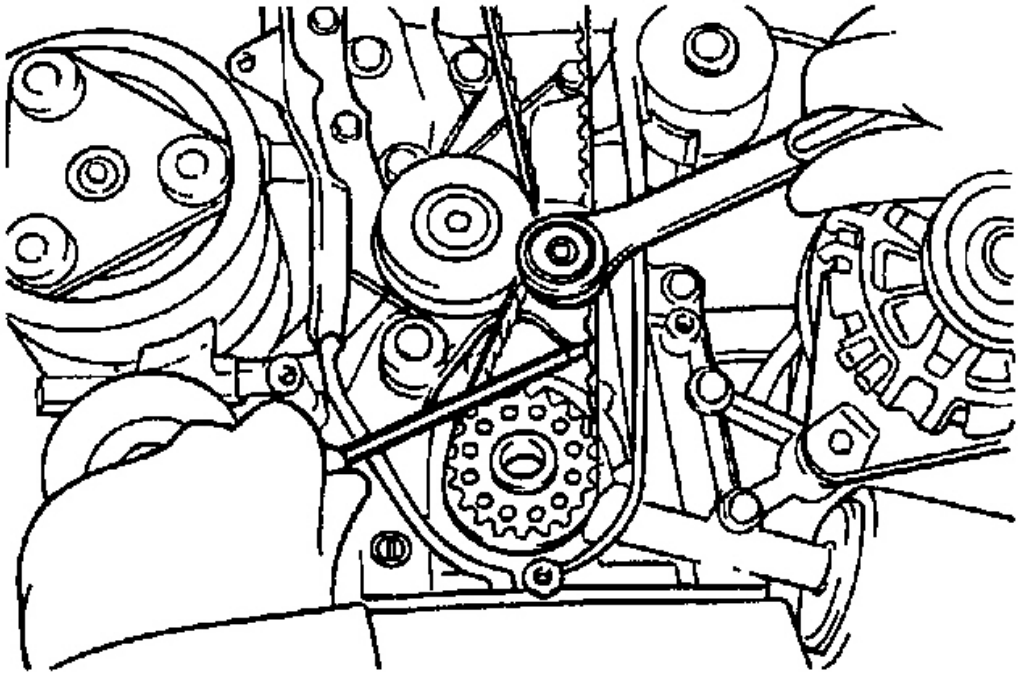

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Fig. 164: Tightening Tensioner Bolts
Courtesy of HYUNDAI MOTOR CO.

9. Tighten the tensioner bolts.
10. Give the crankshaft one turn in its operating direction (clock-wise) and realign the crankshaft sprocket timing mark with the top dead center position.

Tightening torque

Tensioner attaching bolt: 20-27Nm (200-270kg.cm, 15-20lb.ft)

11. Then recheck the belt tension. Verify that when the tensioner and the tension side of the timing belt are pushed in horizontally with a moderate force [approx. 49N (11lb)], the timing belt cog end is aprox. 1/2 of the tensioner mounting bolt head radius (across flats) away from the bolt head center.

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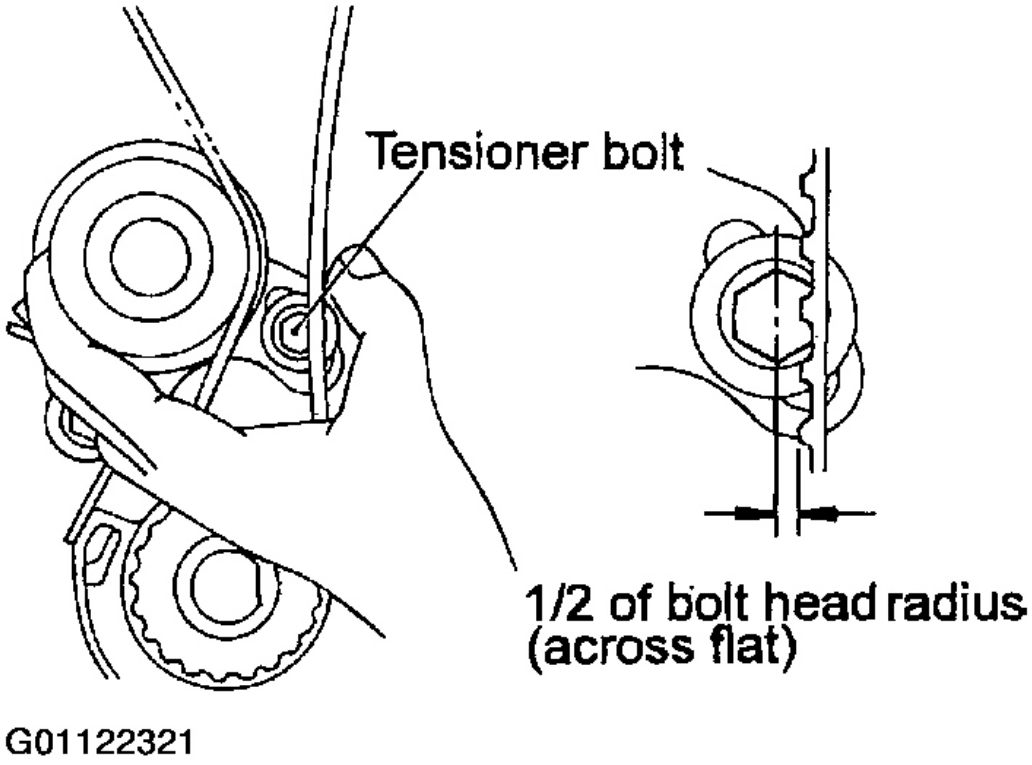

Fig. 165: Checking Timing Belt Tension
Courtesy of HYUNDAI MOTOR CO.

12. Install the timing belt cover.

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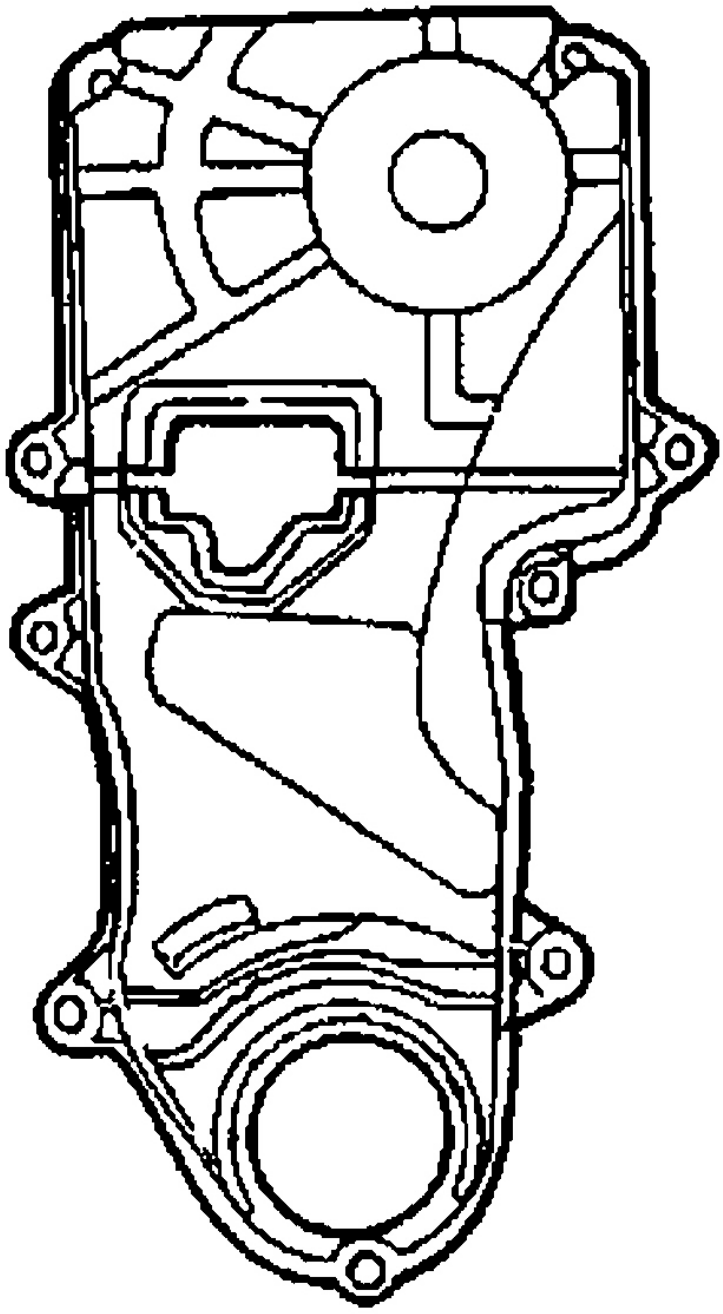

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Fig. 166: Installing Timing Belt Cover
Courtesy of HYUNDAI MOTOR CO.

Tightening torque

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Timing belt cover bolt: 8-10Nm (80-100kg.cm, 6-7 lb.ft)

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

    Tightening torque

    Crankshaft pulley bolt: 140-150 Nm (1400-1500kg.cm, 103-111lb.ft)

14. Install the fan belt and adjust the belt tension.
15. Install the water pump pulley.
16. Install V-belt and adjust the belt tension.

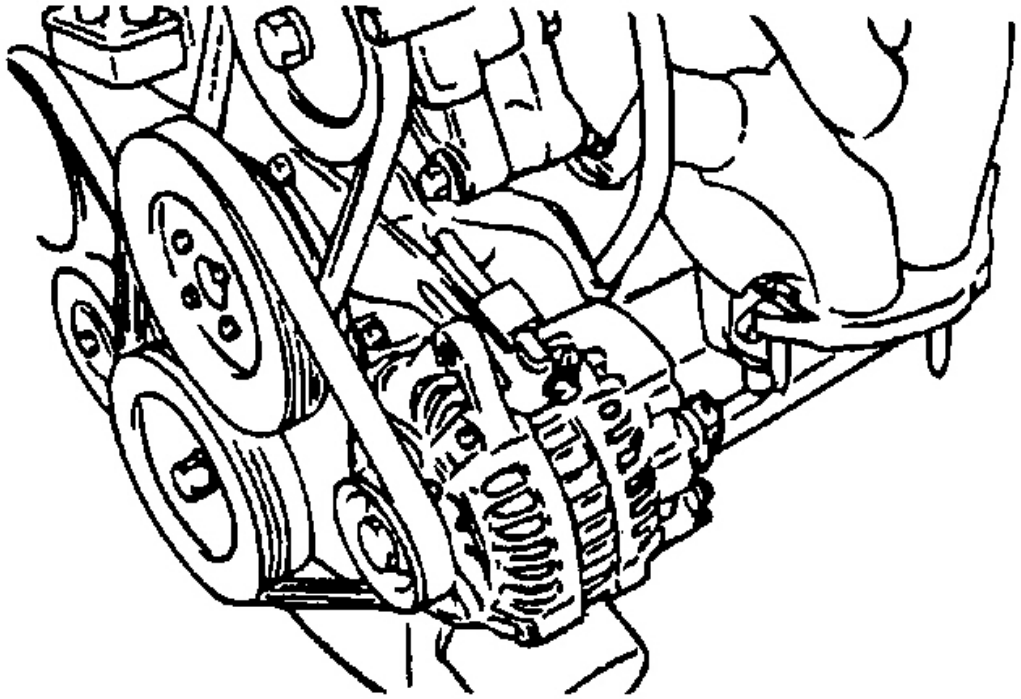

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Fig. 167: Installing V-Belt
Courtesy of HYUNDAI MOTOR CO.

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