2003 ENGINES

2.4L 4 Cylinder - Sonata

GENERAL

SPECIFICATIONS

GENERAL SPECIFICATIONS

Description	Specification	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinders	4	
Bore	86.5 mm (3.41 in.)	
Stroke	100 mm (3.94 in.)	
Total displacement	2351 cc (143.5 cu. in.)	
Compression ratio	10 : 1	
Firing order	1-3-4-2	
Valve timing		
Intake valve		
Open (BTDC)	18°	
Close (ABDC)	54°	
Exhaust valve		
Open (BBDC)	56°	
Close (ATDC)	8°	
Cylinder head		
Flatness of gasket surface	Max. 0.03 mm (0.0012 in.)	0.2 mm (0.008 in.)
Flatness of manifold mounting surface	0.15 mm (0.0059 in.)	0.3 mm (0.012 in.)
Dimensions for reworking oversize valve seat hole		
Intake		
0.3 mm (0.012 in.) O.S.	35.3-35.325 mm (1.39-1.3907 in.)	
0.6 mm (0.024 in.) O.S.	35.6-35.625 mm (1.40-1.4026 in.)	
Exhaust		
0.3 mm (0.012 in.) O.S.	33.3-33.325 mm (1.31-1.3120 in)	
0.6 mm (0.024 in.) O.S.	33.6-33.625 mm (1.32-1.3238 in.)	
Dimensions for reworking oversize valve guide hole (both intake and exhaust)		
0.05 mm (0.002 in.) O.S.	12.05-12.068 mm (0.4751 in.)	
0.25 mm (0.010 in.) O.S.	12.25-12.268 mm (0.4830 in.)	
0.50 mm (0.020 in.) O.S.	12.50-12.518 mm (0.4928 in.)	

Camshaft		
Cam height		
Intake	35.493 mm (1.3974 in.)	34.993 mm (1.3776 in.)
Exhaust	35.204 mm (1.3860 in.)	34.704 mm (1.3663 in.)
Journal O.D.	26 mm (1.02 in.)	
Bearing oil clearance	0.040 - 0.076 mm (0.0020 - 0.0030 in.)	
End play	0.1 - 0.15 mm (0.004 - 0.006 in.)	
Valve		
Valve length		
Intake	109.5 mm (4.311 in)	
Exhaust	109.7 mm (4.319 in.)	
Stem O.D.		
Intake	6.565-6.580 mm (0.2585-0.2591 in.)	
Exhaust	6.530-6.550 mm (0.2571-0.2579 in.)	
Face angle	45° - 45°5'	
Thickness of valve head (margin)		
Intake	1.0 mm (0.039 in.)	0.7 mm (0.028 in.)
Exhaust	1.5 mm (0.059 in.)	1.0 mm (0.039 in.)
Valve stem to valve guide clearance		
Intake	0.020-0.047 mm (0.0008-0.0019 in.)	0.1 mm (0.0039 in.)
Exhaust	0.050-0.085 mm (0.0020-0.0033 in.)	0.15 mm (0.0059 in.)
Valve guide		
Length		
Intake	45.5 mm (1.791 in.)	
Exhaust	50.5 mm (1.988 in.)	
Service over size	0.05, 0.25, 0.50 mm	
	(0.002, 0.010, 0.020 in.)	
Valve seat		
Width of seat contact	0.9 - 1.3 mm (0.035 - 0.051 in.)	
Seat angle	44° - 44°. 5'	
Service size	0.3 mm (0.012 in.),	
	0.6 mm (0.024 in.) oversize	
Valve sprin		
Free length	48.3 mm (1.901 in.)	
Load	30 kg / 40 mm (66.14 lb /1.57 in.) at installed height	
Out - of - square	Less than 1.5°	
Cylinder block		

Cylinder bore	86.5+0.03 mm (3.406+0.0012 in.)	
Out-of-round and taper of cylinder bore	Less than 0.01 mm (0 0004 in.)	
Flatness of gasket surface	Less than 0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)
Piston		
O.D.	86.47 - 86.5 mm (3.404 - 3.406 in.)	
Piston - to - cylinder clearance	0.02 - 0.04 mm (0.0008 - 0.0016 in.)	
Ring groove width		
No. 1	1.22 - 1.24 mm (0.048 - 0.049 in.)	
No. 2	1.51 - 1.53 mm (0.059 - 0.060 in.)	
Oil	2.81 - 2.83 mm (0.111 - 0.1114 in.)	
Service size	0.5 mm (0.020 in.) oversize	
Piston ring		
Side clearance		
No. 1	0.03 - 0.07 mm (0.0012 - 0.0028 in.)	
No. 2	0.02 - 0.06 mm (0.0008 - 0.0024 in.)	0.1 mm (0.0039 in.)
Oil ring	0.06 - 0.15 mm (0.0024 - 0.0059 in.)	
End gap		
No. 1	0.25 - 0.35 mm (0.0098 - 0.0138 in.)	0.8 mm (0.031 in.)
No. 2	0.40 - 0.55 mm (0.0157 - 0 0216 in.)	0.8 mm (0.031 in.)
Oil ring side rail	0.10 - 0 40 mm (0.0039 - 0.0157 in.)	1.0 mm (0.039 in.)
Connecting rod		
Bend	0.05 mm (0.0020 in.)	
Twist	0.1 mm (0 004 in.)	
Connecting rod big end to crankshaft side clearance	0.10 - 0.25 mm (0.0040 - 0.0098 in.)	0.4 mm (0.0157 in.)
Piston pin installation force	1250 ± 500 kg (2756 ± 1100 lb.f)	
Connecting rod pin O.D	48 - 48.015 mm (1.890 - 1 8903 in.)	
Connecting rod bearing oil clearance	0.015 - 0.048 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Crankshaft main bearing oil clearance		
No. 1,2,4,5 journal	0.018 - 0.036 mm (0.0007 - 0.0014 in.)	0.1 mm (0.0039 in.)
No. 3 journal	0.024 - 0.042 mm (0.0009 -	

	0.0016 in.)	
Crankshaft		
Journal O.D.	56.982 - 57.000 mm (2.2434 - 2.2441 in.)	
Out - of - round of journal and pin	Less than 0.015 mm (0.0006 in.)	
Taper of journal and pin	Less than 0.005 (0.0002 in.)	
End play	0.05 - 0.25 mm (0.0020 - 0.0098 in.)	0.25 mm (0.0098 in.)
Flywheel		
Runout		0.13 mm (0.0051 in.)
Oil pressure at idle [Oil temperature is 75-90°C (167-194° F)]	80 kPa (11.6 psi)	
Oil pump		
Tip clearance		
Drive gear	0.16 - 0.21 mm (0.0063 - 0.0083 in.)	0.25 mm(0.0098 in.)
Driven gear	0.18 - 0.21 mm (0.0071 - 0.0083 in.)	0.25 mm(0.0098 in.)
Side clearance		
Drive gear	0.08 - 0.14 mm (0.0031 - 0.0055 in.)	0.25 mm (0.0098 in.)
Driven gear	0.06 - 0.12 mm (0.0024 - 0.0047 in.)	0.25 mm (0.0098 in.)
Relief spring		
Free length	46.6 mm (1.835 in.)	
Load [61 N (13.5 lb)]	40.1 mm (1.579 in.)	
Right silent shaft		
Front journal diameter	18.467 - 18.480 mm (0.7270 - 0.7276 in.)	
Rear journal diameter	40.951 - 40.967 mm (1.6516 - 1.6129 in.)	
Oil clearance		
Front	0.020 - 0.061 mm (0.0008 - 0.0024 in.)	
Rear	0.050 - 0.091 mm (0.0020 - 0.0036 in.)	
Left silent shaft		
Front journal diameter	18.467 - 18.480 mm (0.7270 - 0.7276 in.)	
Rear journal diameter	40.951 - 40.967 mm (1.6122 - 1.6130 in.)	
Oil clearance		
Front	0.020 - 0.054 mm (0.0008 -	

Rear	0.0021 in.) 0.042 - 0.083 mm (0.0017 - 0.0033 in.)	
Cooling method	Forced circulation with electric fan	
Cooling system quantity	7.0 lit (7.4 U.S.qts., 6.1 lmp.qts.) [For DOHC]	
Thermostat Type Normal opening temperature Opening temperature range Wide open temperature	 Wax pellet type with jiggle valve 88°C (190°F) 86.5°C - 89.5°C (187°F - 193°F) 100°C (212°F)	
Radiator cap Main valve opening pressure Main valve closing pressure Vacuum valve opening pressure	 107.9 ± 14.7 kPa (1.1 ± 0.15 kg/cm^2 , 15.64 ± 2.13 psi) 83.4 kPa (0.85 kg/cm^2 , 12.1 psi) -6.86 kPa (-0.07 kg/ cm^2 , -1.00 psi)	
Air cleaner Type Element Exhaust pipe Muffler Suspension system	 Dry type Unwoven cloth type Expansion resonance type Rubber hangers	
Coolant temperature sensor Type Resistance 20°C (68°F) 80°C (176°F)	 Thermister type 2.37 ± 0.24 kohms 0.29 ± 0.032 kohms	

SERVICE STANDARDS

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

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Fig. 1: Standard Value Table
Courtesy of HYUNDAI MOTOR CO.

LUBRICANT

Engine coolant	Ethylene glycol base for aluminum radiator

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Fig. 2: Engine Coolant Specification
Courtesy of HYUNDAI MOTOR CO.

SEALANT

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

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Fig. 3: Sealant Specification Table
Courtesy of HYUNDAI MOTOR CO.

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

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bracket Bolts	17-20 (23-27)
A/C Compressor-To-Bracket Bolts	26-33 (35-45)
Alternator Bracket Bolts	15-18 (20-25)
Auto Tensioner Bolts	14-20 (19-27)
Balance Shaft Bolts	25-30 (34-40)
Block Plug Caps	14-20 (19-27)
Camshaft Bearing Cap Bolts	14-15 (19-20)
Camshaft Sprocket Bolts	58-72 (78-98)
Coolant Pump Bolts	15-20 (20-27)
Coolant Temperature Sensor	15-30 (20-40)
Connecting Rod Cap Bolts	
Step 1	15 (20)
Step 2	Tighten An Additional 90 Degrees
Crankshaft Sprocket Bolt	81-96 (110-130)
Cylinder Head Bolts	
Using New Bolts (1)	
Step 1	46 (63)

Step 2	(2) Fully Loosen Bolts
Step 3	15 (20)
Step 4	Tighten An Additional 90 Degrees
Step 5	Tighten An Additional 90 Degrees
Using Original Bolts (1)	
Step 1	15 (20)
Step 2	Tighten An Additional 90 Degrees
Step 3	Tighten An Additional 90 Degrees
Damper Pulley-To-Crankshaft Sprocket	15-22 (20-30)
Driven Gear Bolts	25-30 (34-40)
Drive Plate Bolts	94-101 (127-137)
Engine Mounting Components	
Engine Hanger Bolts	
M8	18-22 (25-30)
M10	25-41 (35-55)
Engine Mounting Bracket Bolts & Nuts	44-59 (60-80)
Engine Mount Insulator Bolts	66-81 (90-110)
Engine Support Bracket Fasteners	41-48 (55-65)
Front Roll Stopper Bracket-To-Crossmember Bolts	30-41 (40-55)
Front Roll Stopper Insulator Fasteners	36-47 (50-60)
Rear Roll Stopper Bracket-To-Crossmember Bolts	36-47 (50-60)
Rear Roll Stopper Insulator Fasteners	37-44 (50-60)
Exhaust Components	
Center Exhaust Pipe-To-Catalytic Converter Nuts	22-29 (30-39)
Center Exhaust Pipe Bolts	22-29 (30-39)
Exhaust Manifold Cover Bolts	9-11 (12-15)
Exhaust Manifold Bolts	
M8 Nut	18-22 (25-30)
M10 Nut	25-40 (34-54)
Front Exhaust Pipe-To-Exhaust Manifold Bolts	22-30 (30-40)
Front Exhaust Pipe-To-Bracket Bolts	15-22 (20-30)
Front Exhaust Manifold Bolt-To-Cylinder Head	15-22 (20-30)
Flywheel-To-Crankshaft Bolts	96-103 (130-140)
Front Case Bolts	15-20 (20-27)
Front Case Plug Cap	15-20 (20-27)
Idler Pulley Bolts	22-30 (30-40)
Intake Manifold	

Bracket Bolts (Stay)	13-18 (15-25)
Mounting Bolts/Nuts	
Bolts	11-14 (15-19)
Nuts	22-30 (30-40)
Main Bearing Cap Bolts	
Step 1	18 (25)
Step 2	Tighten An Additional 90-94 Degrees
Oil Drain Plug	25-33 (34-45)
Oil Filter Bracket Bolts	15-20 (20-27)
Oil Pump	
Case Bolts	14-20 (19-27)
Cover Bolts	11-13 (15-18)
Driven Gear Bolt	25-29 (34-39)
Sprocket Nuts	36-43 (49-58)
Oil Screen Bolts	11-16 (15-22)
Oxygen Sensor	30-37 (40-50)
Power Steering Pump Bracket Bolts	26-33 (35-45)
Relief Plug	30-37 (40-50)
Starter Bolts	20-25 (27-34)
Stud Bolts	22-29 (30-40)
Tension Rod Bracket Bolt-To-Tension Rod	25-40 (35-55)
Tensioner Arm Assembly Bolts	12-19 (17-26)
Tensioner Pulley Bolts	31-40 (42-54)
Tensioner Pulley Bracket Bolts	17-20 (23-27)
Thermostat Housing Bolts/Nuts	11-15 (15-20)
Throttle Body Stay Bolts	11-16 (15-22)
Throttle Body-To-Intake Manifold Bolts	11-15 (15-20)
Timing Belt Cover	
Lower & Upper Cover Bolts	(3)
Rear Left Cover Bolts	
Lower	22-30 (30-40)
Upper	(4)
Right Rear Cover Bolts	(4)
Timing Belt Idler Bolts	22-30 (30-40)
Timing Belt Tensioner Bolts	31-40 (42-54)
Torque Converter-To-Drive Plate Bolts	33-39 (45-53)
Transaxle Mount	
Bracket Bolts	43-58 (58-79)
Insulator Bolts	65-80 (88-108)
Sub-Bracket Bolts	43-58 (58-79)

Water Pump Mounting Bolts	14-20 (19-27)
	INCH Lbs. (N.m)
Air Cleaner Body Bolts	71-89 (8-10)
Air Cleaner Bracket Bolts	106-133 (12-15)
Center Cover Bolts	35-44 (4-5)
Coolant Inlet Fitting	89-133 (10-15)
Coolant Pump Pulley Bolts	71-89 (8-10)
Crankshaft Position Sensor Bolts	89-115 (10-13)
Delivery Pipe-To-Cylinder Block Bolts	89-115 (10-13)
Heat Protector-To-Exhaust Manifold Bolts	106-133 (12-15)
Ignition Coil Bolts	71-106 (8-12)
Oil Level Gauge	106-133 (12-15)
Oil Pan Bolts	89-106 (10-12)
Oil Pressure Switch	71-106 (8-12)
Oil Seal Case Bolts	89-106 (10-12)
Power Transistor Bolts	89-106 (10-12)
Radiator Fan Motor Bolts	71-89 (8-10)
Rear Oil Seal Case Bolts	89-106 (10-12)
Resonator Mounting Bolts	71-89 (8-10)
Rocker Cover Bolts	71-89 (8-10)
Timing Belt Cover Bolts (Front)	71-89 (8-10)
Timing Belt Cover Bolts (Rear)	89-106 (10-12)
Valve Cover Bolts	71-89 (8-10)
Water Pump Pulley Bolts	71-89 (8-10)

(1) Fully loosen bolts in correct order. See **Fig. 4**.

(2) Tighten in sequence with engine cold. See **Fig. 5**.

(3) Tighten to 71-89 INCH lbs. (8-10 N.m).

(4) Tighten to 89-106 INCH lbs. (10-12 N.m)

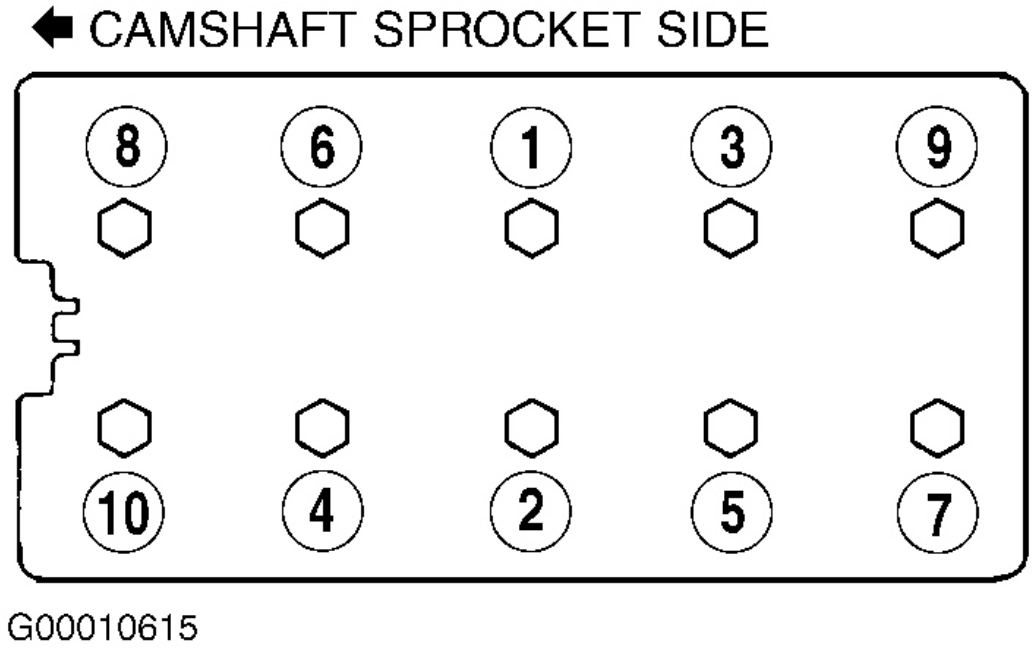


Fig. 4: Cylinder Head Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

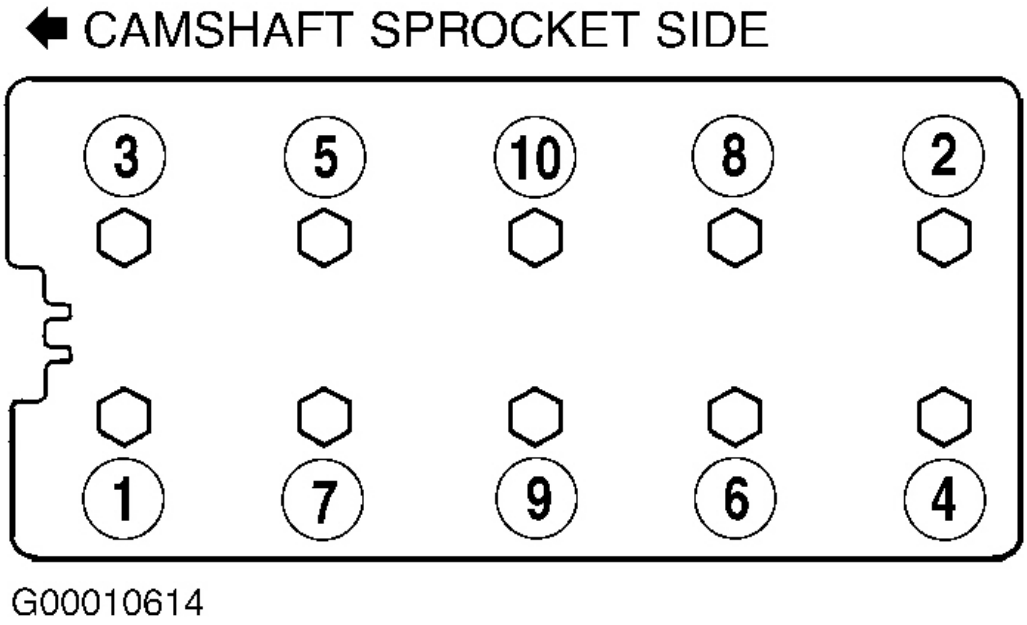


Fig. 5: Cylinder Head Bolt Removal Sequence
Courtesy of NISSAN MOTOR CO., U.S.A.

SPECIAL TOOLS

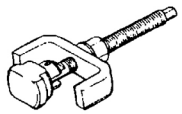
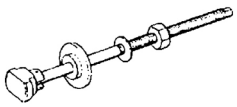
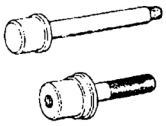
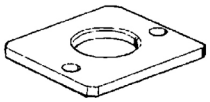
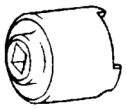
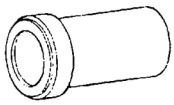
Tool (Number and name)	Illustration	Use
Counter balance shaft bearing puller (09212-32000)		Removal of counter balance shaft front bearing
Counter balance shaft bearing puller (09212-32100)		Removal of counter balance shaft rear bearing (use with 09212-32300)
Counter balance shaft bearing installer (09212-32200)		Installation of counter balance shaft front and rear bearing (use with 09212-32300)
Guide plate (09212-32300)		Removal and installation of counter balance shaft rear bearing (use with 09212-32100, 09212-32200)
Plug cap wrench (09213-33000)		Removal and installation of front case cap plug
Crankshaft front oil seal installer (09214-32000)		Installation of the crankshaft front oil seal (use with 09214-32100)

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Fig. 6: Identifying Special Tools (1 Of 3)
Courtesy of HYUNDAI MOTOR CO.

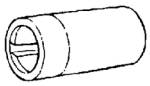
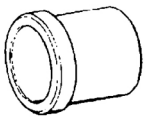
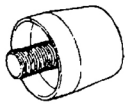
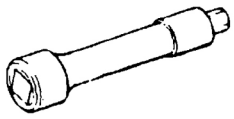
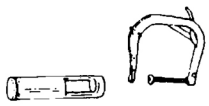
Tool (Number and name)	Illustration	Use
Crankshaft front oil seal guide (09214-32100)		Installation of the crankshaft front oil seal (use with 09214-32000)
Camshaft oil seal installer (09221-21000)		Installation of the camshaft oil seal (use with 09221-21100)
Camshaft oil seal guide (09221-21100)		1. Used as a guide when pressing in the camshaft oil seal (use with 09221-21000)
Cylinder head bolt socket (09221-32001)		Removal and installation of cylinder head bolts
Valve guide installer (09222-21200A, 09222-21200B)		Removal and installation of valve guides
Valve spring compressor (09222-28000) Valve spring compressor holder (09222-28100)		Removal and installation of inlet and exhaust valves
Valve stem oil seal install (09222-28200)		Installation of valve stem oil seals

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Fig. 7: Identifying Special Tools (2 Of 3)
Courtesy of HYUNDAI MOTOR CO.

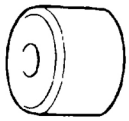
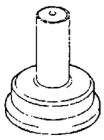
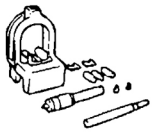
Tool (Number and name)	Illustration	Use
Valve guide installer adapter (09222-28400)		Installation of valve guides
Crankshaft rear oil seal installer (09231-21000)		1. Installation of the engine rear oil seal 2. Installation of the crankshaft real oil seal
Piston pin remover and installer kit (09234-33001)		Removal and installation of piston pins
Insert (09234-33002)		Removal and installation of piston pins (use with 09234-33001)
Cross member stud bolt socket (09624-38100)		Removal and installation of the cross member stud bolt

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Fig. 8: Identifying Special Tools (3 Of 3)
Courtesy of HYUNDAI MOTOR CO.

TROUBLESHOOTING

Symptom	Probable cause	Remedy
Low compression	Damaged cylinder head gasket	Replace gasket
	Worn or damaged piston rings	Replace rings
	Worn piston or cylinder	Repair or replace piston and/or cylinder block
	Worn or damaged valve seat	Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level	Check engine oil level
	Faulty oil pressure switch	Replace
	Clogged oil filter	Replace
	Worn oil pump gears or cover	Replace
	Thin or diluted engine oil	Change and find out cause
	Oil relief valve stuck (open)	Repair
	Excessive bearing clearance	Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine vibration	Loose engine roll stopper (front, rear)	Re-tighten
	Loose transaxle mount bracket	Re-tighten
	Loose engine mount bracket	Re-tighten
	Loose center member	Re-tighten
	Broken transaxle mount insulator	Replace
	Broken engine mount insulator	Replace
	Broken engine roll stopper insulator	Replace
Noisy valves	Thin or diluted engine oil (low oil pressure)	Change
	Worn or damaged valve stem or valve guide	Replace
Connecting rod and/main beaing noise	Insufficient oil supply	Check engine oil level
	Thin or diluted engine oil	Change and find out cause
	Excessive bearing clearance	Replace
Timing belt noise	Incorrect belt tension (alternator tensioner, timing belt)	Adjust belt tension
Low coolant level	Leakage of coolant	
	Damaged radiator core joint	Replace
	Corroded or cracked hoses (radiator hose, heater hose, etc)	Replace
	Faulty radiator cap valve or setting of spring	Replace
	Faulty thermostat	Replace
	Faulty engine coolant pump	Replace
Clogged radiator	Foreign material in coolant	Replace

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

Symptom	Probable cause	Remedy
Abnormally high coolant temperature	Faulty thermostat	Replace
	Faulty radiator cap	Replace
	Restricted of flow in cooling system	Replace
	Loose or missing drive belt	Adjust or replace
	Faulty engine coolant pump	Replace
	Faulty temperature sensor wiring	Repair or replace
	Faulty electric fan	Repair or replace
	Faulty thermo-sensor on radiator	Replace
	Insufficient coolant	Refill coolant
Abnormally low coolant temperature	Faulty thermostat	Replace
	Faulty temperature sensor wiring	Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection	Retighten
	Blocked or collapsed hose and pipe	Replace
Inoperative electrical cooling fan	Damaged, fuse	Replace or repair
Exhaust gas leakage	Loose connections	Retighten
	Broken pipe or muffler	Repair or replace
Abnormal noise	Detached baffle plate in muffler	Replace
	Broken rubber hanger	Replace
	Pipe or muffler contacting vehicle body	Correct
	Broken pipe or muffler	Repair or replace

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

CHECKING ENGINE OIL

1. Position a vehicle on a level surface.
2. Turn off the engine.

NOTE: If a vehicle that has not been used for a prolonged period, run the engine for several minutes.

Turn off the engine and wait for 5 minutes at least, and then check the oil level.

3. 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.

NOTE: When refilling, use the proper grade of engine oil.

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.

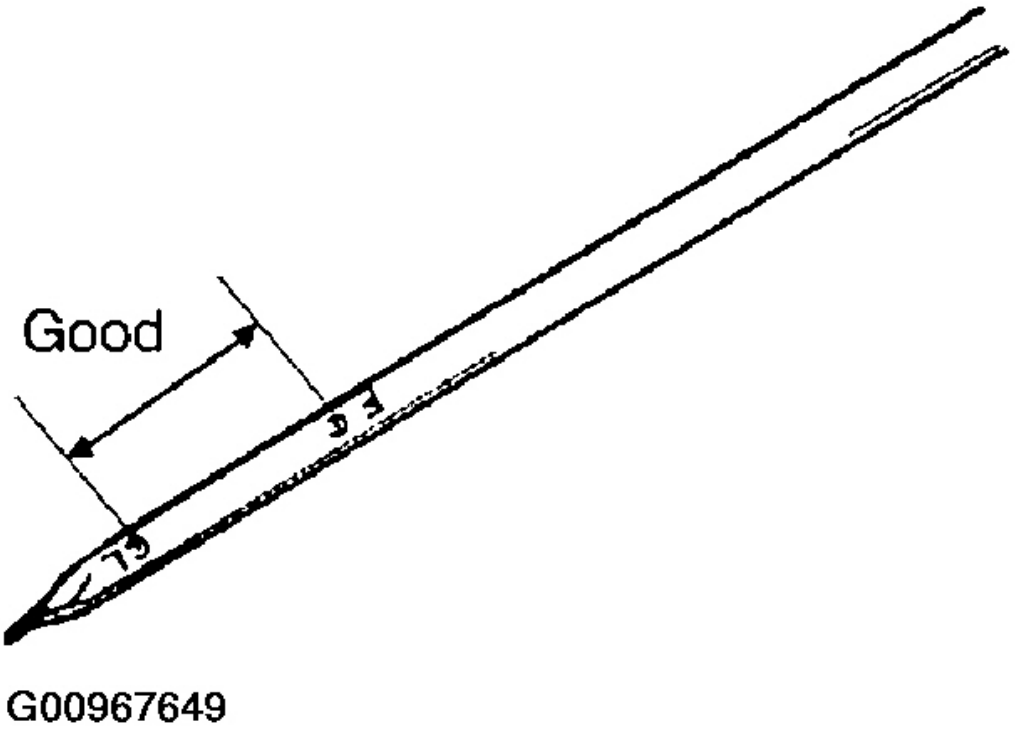
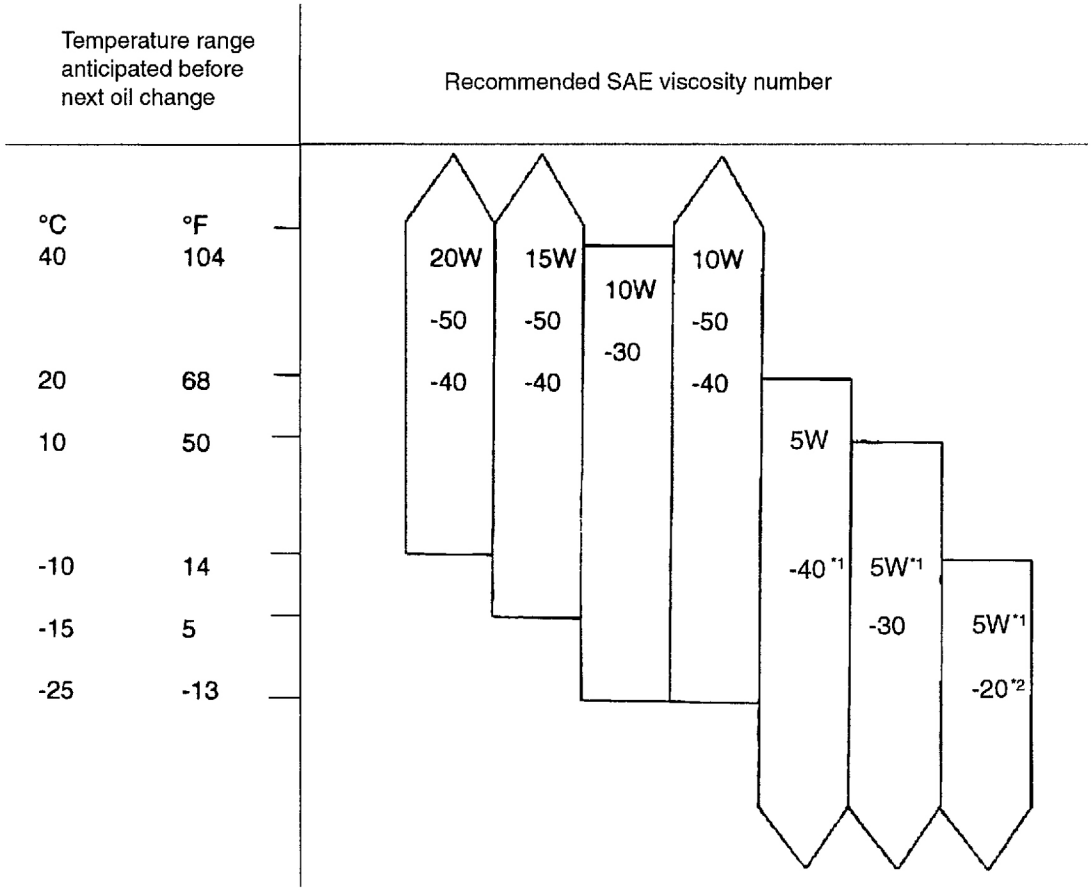


Fig. 11: Identifying Good Oil Level
Courtesy of HYUNDAI MOTOR CO.

SELECTION OF ENGINE OIL

Recommended API classification: SH OR ABOVE



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

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Fig. 12: 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:

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

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

CHANGING ENGINE OIL

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. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque

Oil pan drain plug: 35-45 N.m (350-450 kg.cm, 25-33 lb.ft)

NOTE: Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

Capacity

Drain and refill: 4.3 liters (4.53 U.S. qts., 3.78 Imp.qts.)

NOTE: Do not overfill. This will cause oil aeration and loss of oil pressure.

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.

REPLACING THE OIL FILTER

All Hyundai Motor Company engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of aftermarket replacement filters is considerably diverse.

High quality replacement 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 a new filter.

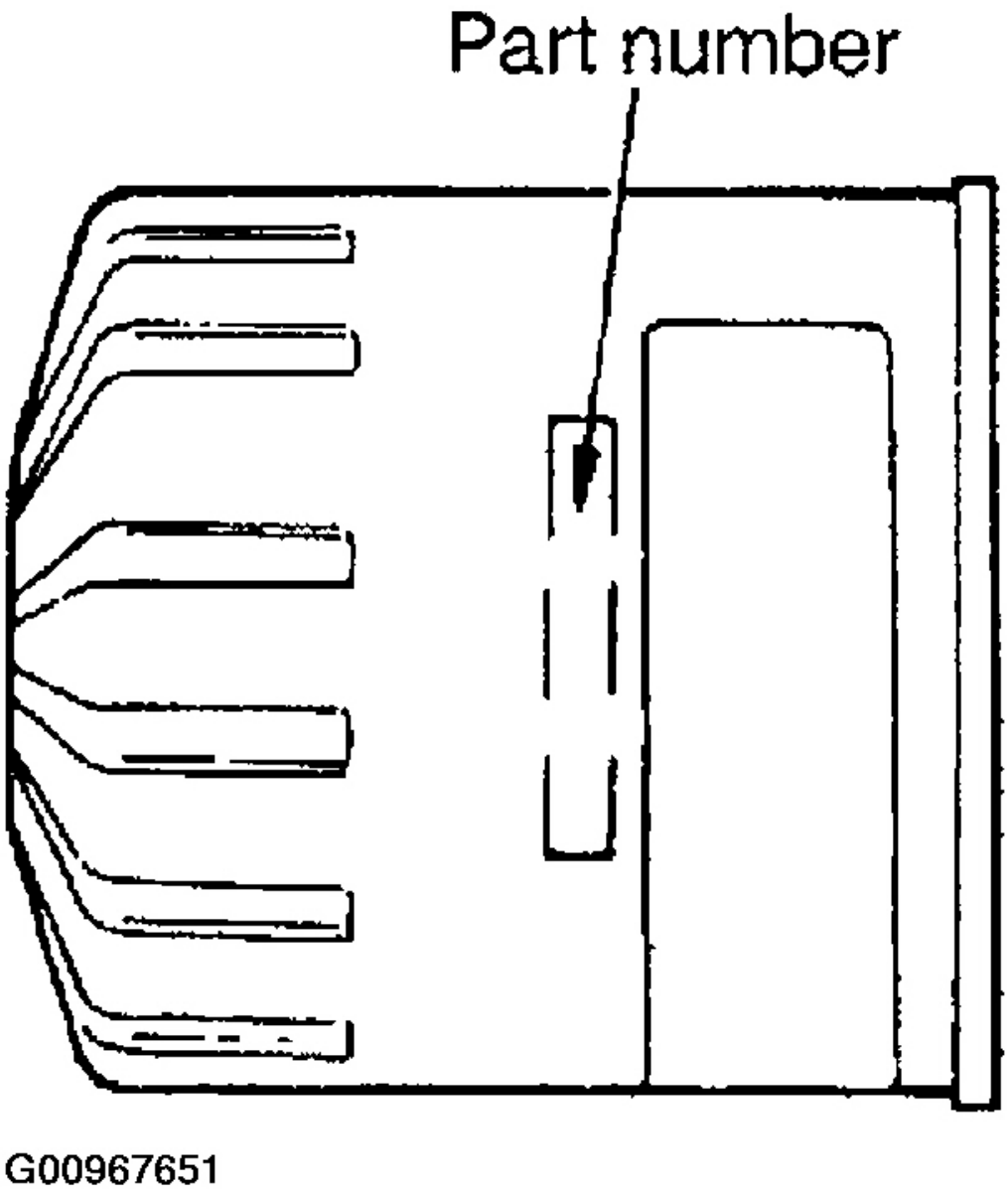

Fig. 13: Identifying Oil Filter Part Number
Courtesy of HYUNDAI MOTOR CO.

PROCEDURE FOR REPLACING THE OIL FILTER

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

3. Tighten the oil filter to the specified torque.

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

4. Start and run the engine and check for engine oil leak.
5. After turning off the engine, check the oil level and add oil as necessary.

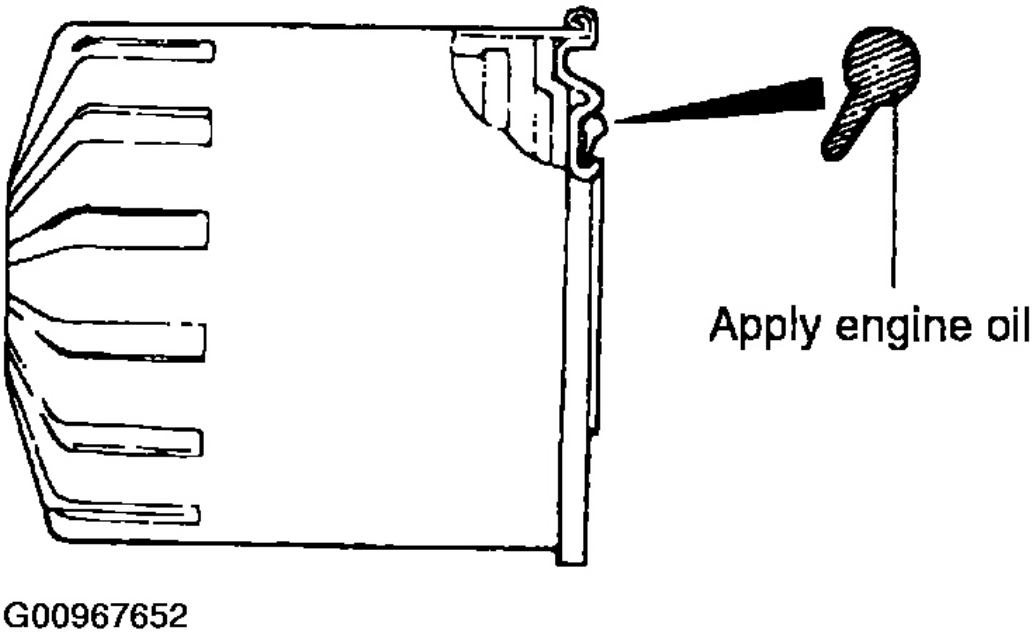

Fig. 14: Applying Engine Oil To Oil Filter Rubber Gasket
Courtesy of HYUNDAI MOTOR CO.

CHECKING COOLANT LEAK

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 kPa (21 psi, 1.53 kg/cm^2) 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. **When the tester is removed, be careful not to spill any coolant from**

it.

3. **Be sure to clean away completely any from the area.**
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.

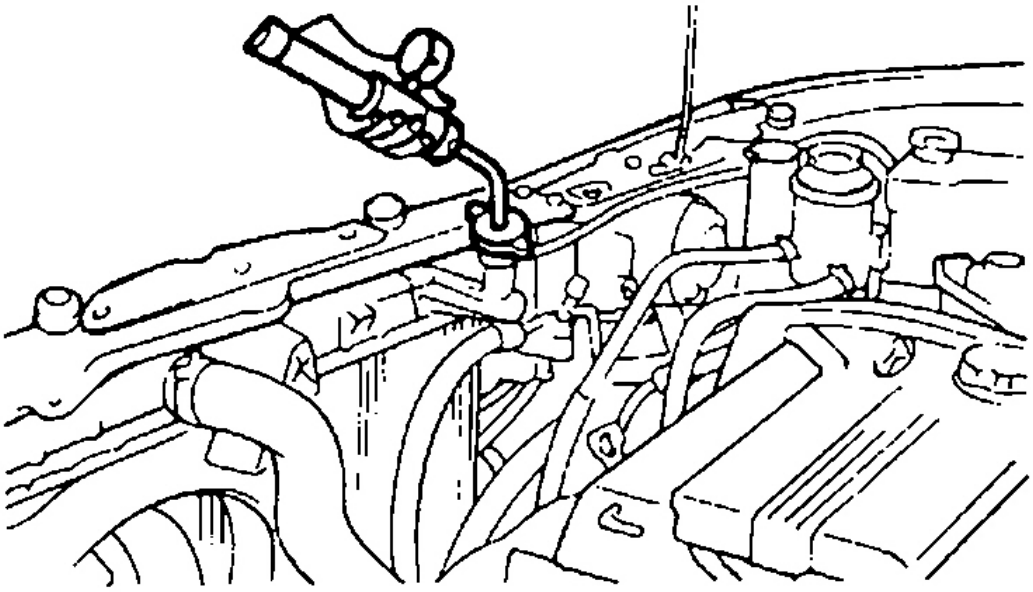

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Fig. 15: Pressure Testing Cooling System
Courtesy of HYUNDAI MOTOR CO.

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:107.9 kPa +/- 14.7 kPa (1.1 +/- 0.15 kg/cm^2 , 15.64 +/- 2.13)

   Main valve closing pressure:83.4 kPa (0.85 kg/cm^2 , 12.1 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.

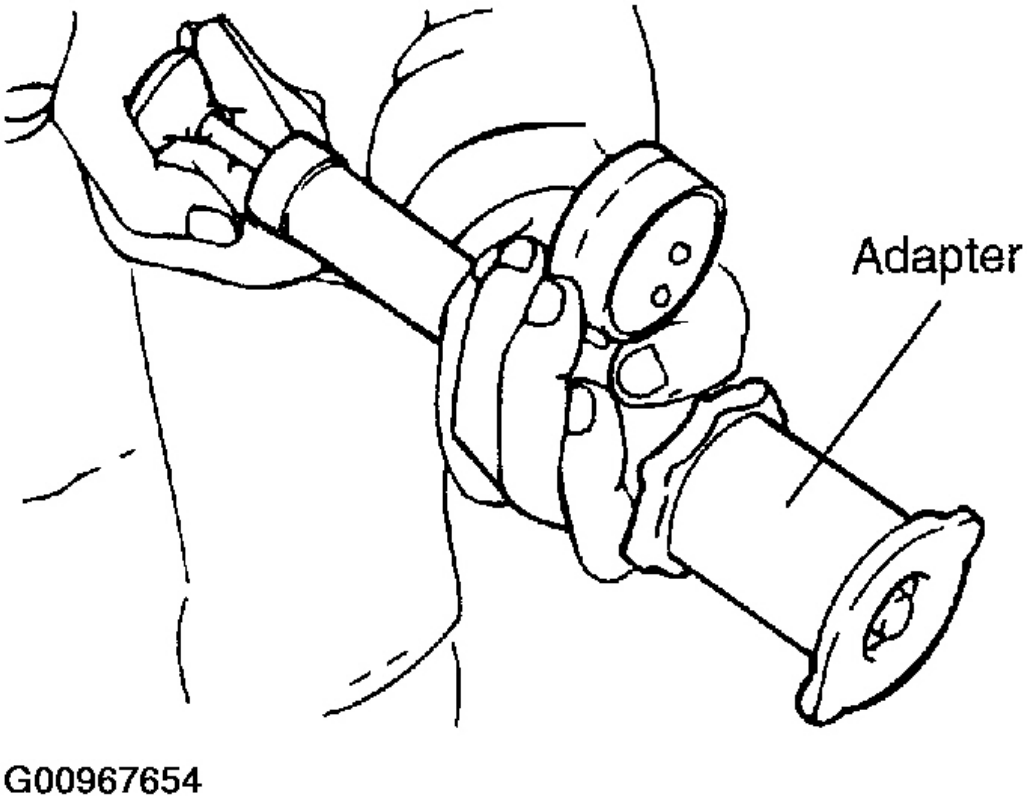

Fig. 16: Pressure Testing Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

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 the following table for reference.

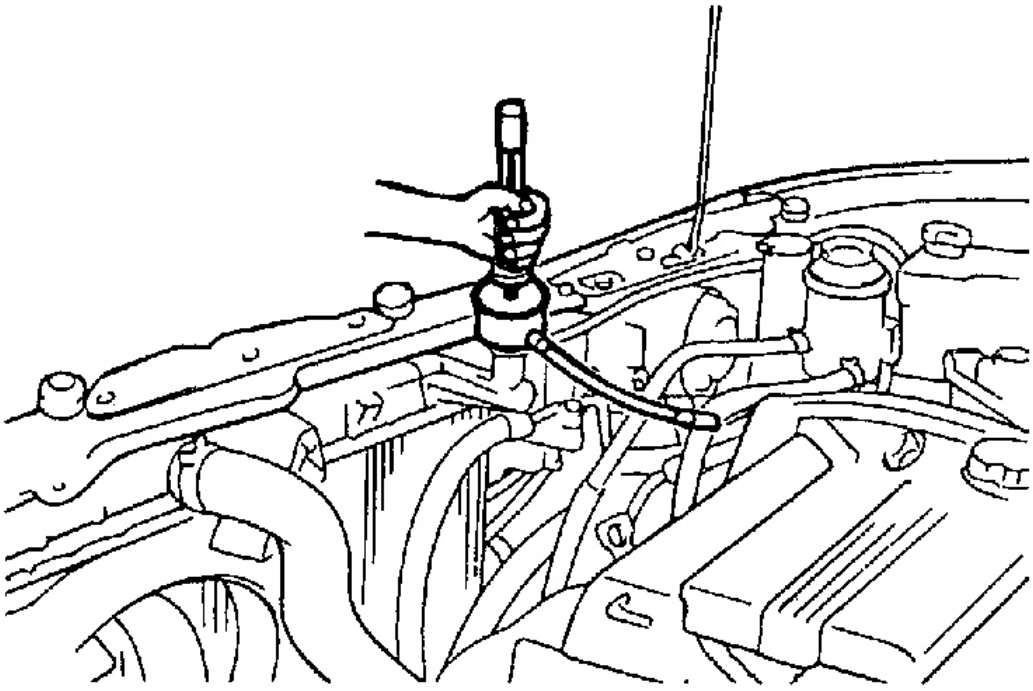

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Fig. 17: Checking Coolant With Hydrometer
Courtesy of HYUNDAI MOTOR CO.

RELATION BETWEEN COOLANT CONCENTRATION & SPECIFIC GRAVITY

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. 18: Coolant Concentration Table
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 mix types of anti-freeze.**

RECOMMENDED COOLANT

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. 19: 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 the engine coolant temperature reaches 80-95°C (176-205°F).
3. Turn off the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
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: 1200 kPa (12.2 kg/cm^2 , 170 psi)

   Limit: 12.0 kg/cm^2 (1.18 MPa, 171 psi)

9. Repeat steps 6 to 8 for all cylinders, ensuring that the pressure difference 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 causes 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 N.m (200-300 kg.cm, 14-22 lb.ft)

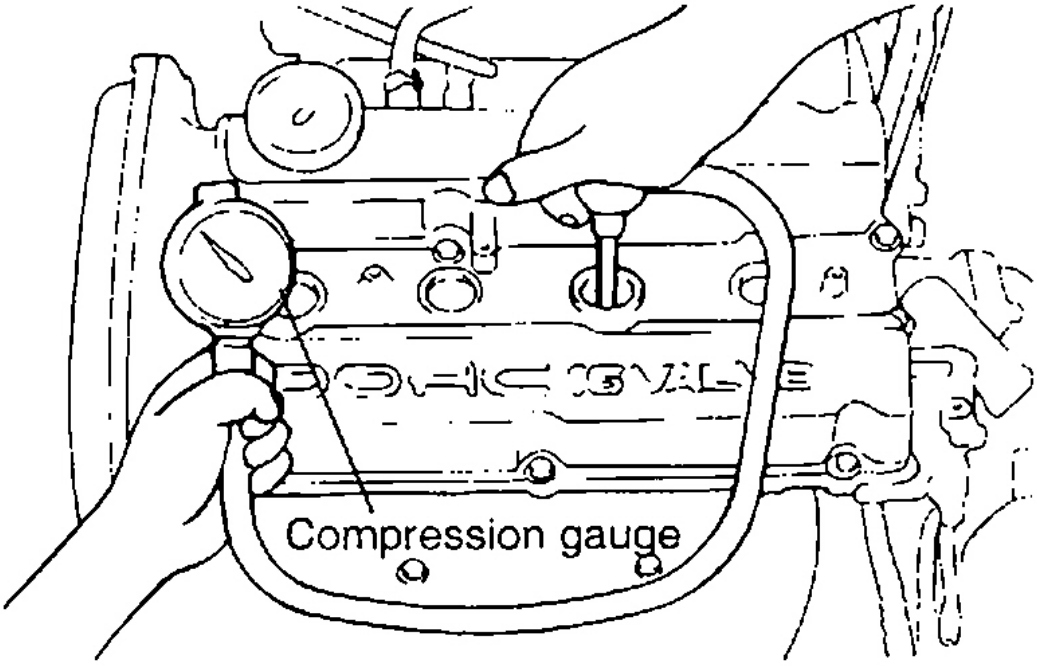

Fig. 20: Reading Compression Gauge
Courtesy of HYUNDAI MOTOR CO.

ADJUSTING DRIVE BELT TENSION

1. Check that the belts are not damaged and are properly placed 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 and measure the amount of deflection with a tension gauge.

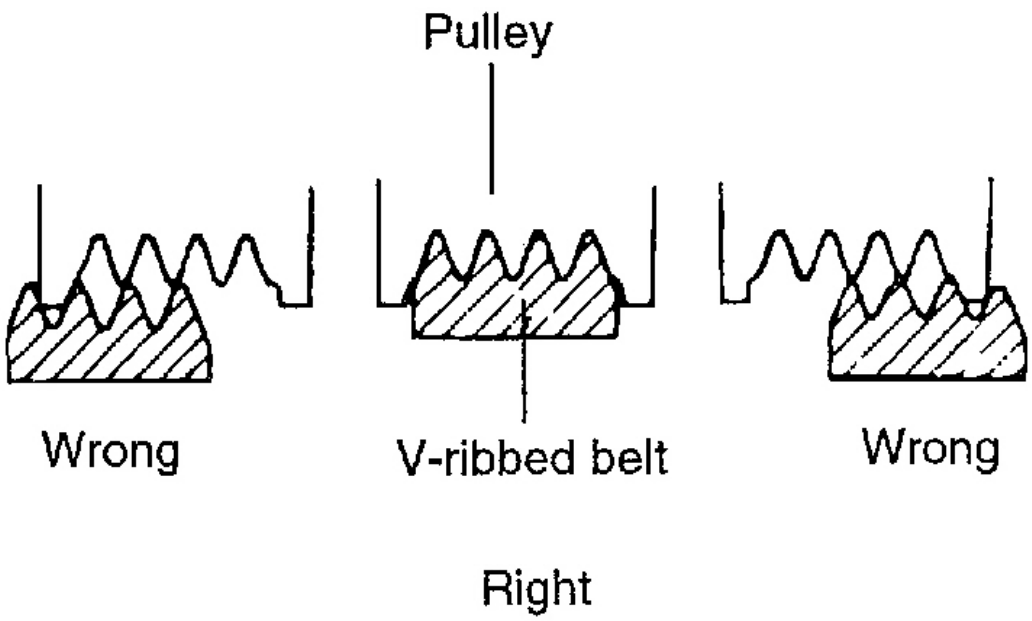

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Fig. 21: Locating Belt On Pulley
Courtesy of HYUNDAI MOTOR CO.

CAUTION:

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

Items		Inspection	Adjustment	
			New	Used
For alternator	Deflection mm (in.)	9.0-10.4 (0.35-0.41)	7.5-9.0 (0.30-0.35)	10 (0.40)
	Tension N (lb)	350-500 (79-112)	600-700 (135-157)	400 (90)
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. 22: 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 a belt installed newly after 5 minutes or more of operation, refer to Fig. 22 indicated under "Used" in the above table.**
4. **Refer to Fig. 22 indicated under "Inspection" for periodic inspections.**

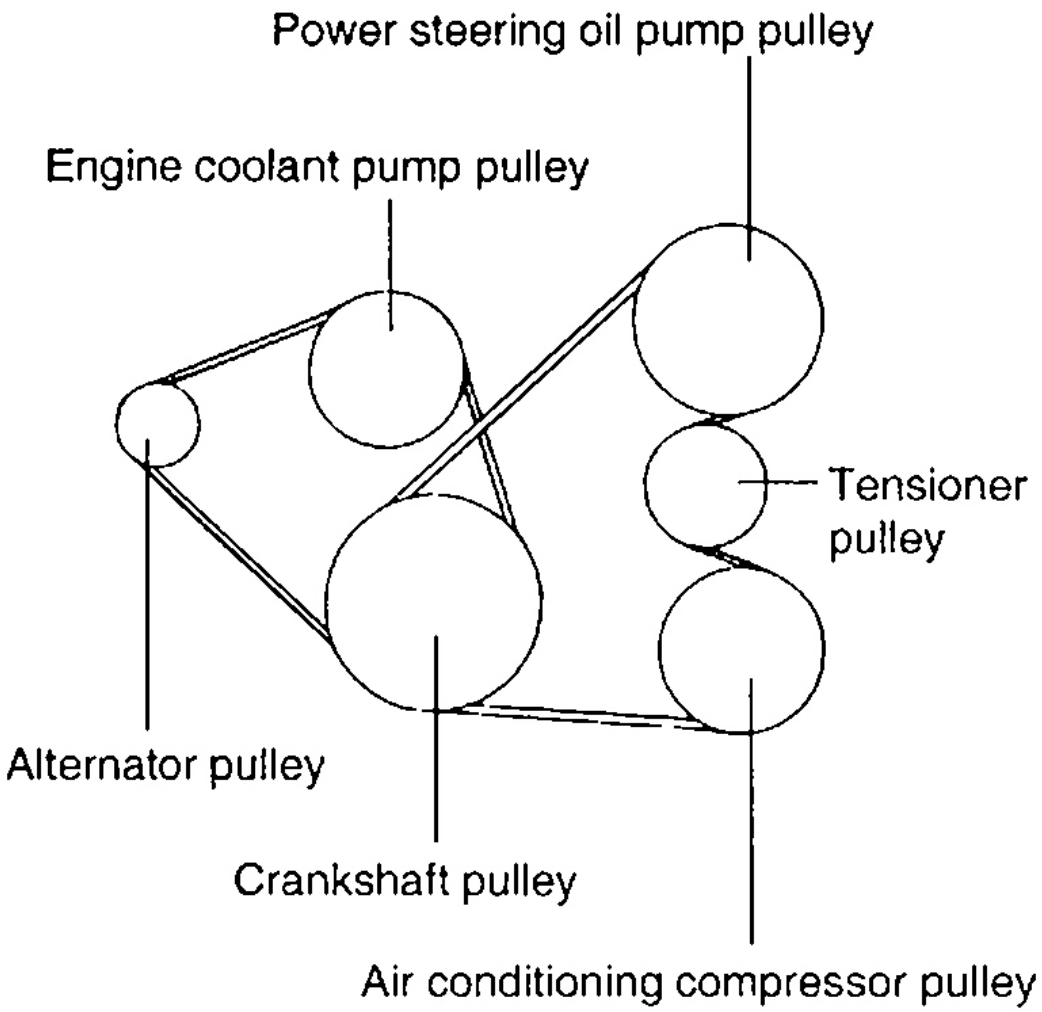

Fig. 23: Identifying Belts & Pulleys
Courtesy of HYUNDAI MOTOR CO.

TYPE A TENSION GAUGE

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

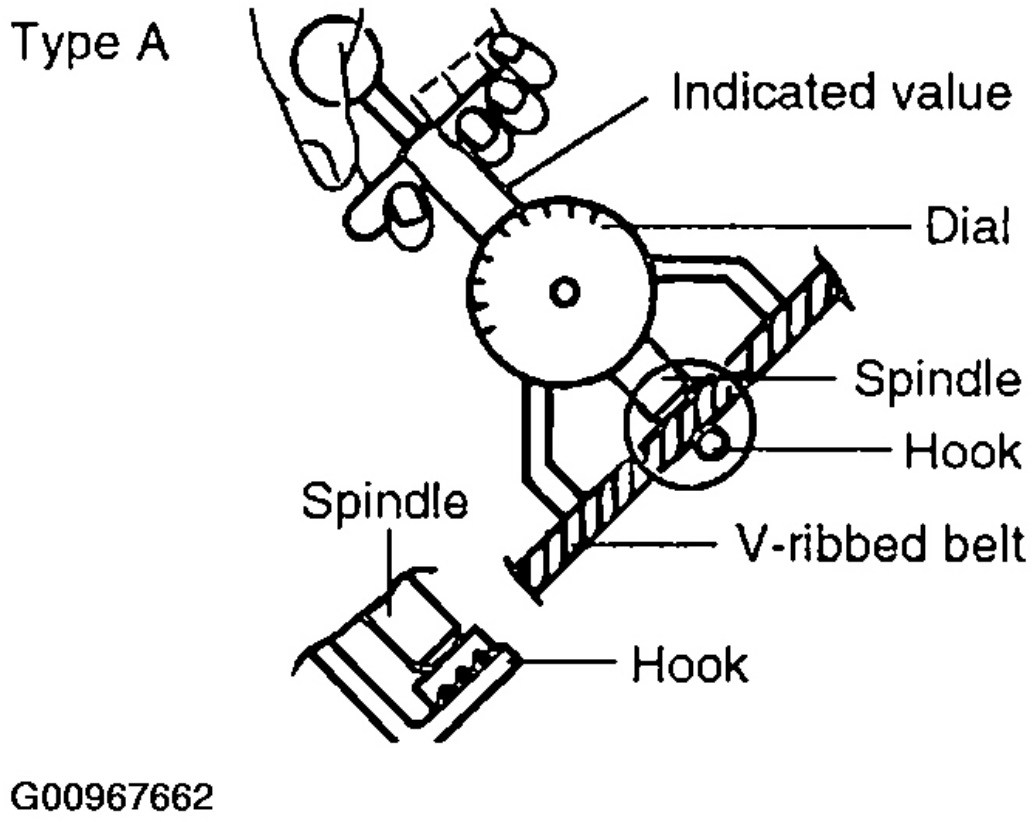

Fig. 24: Identifying Type A Tension Gauge
Courtesy of HYUNDAI MOTOR CO.

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.

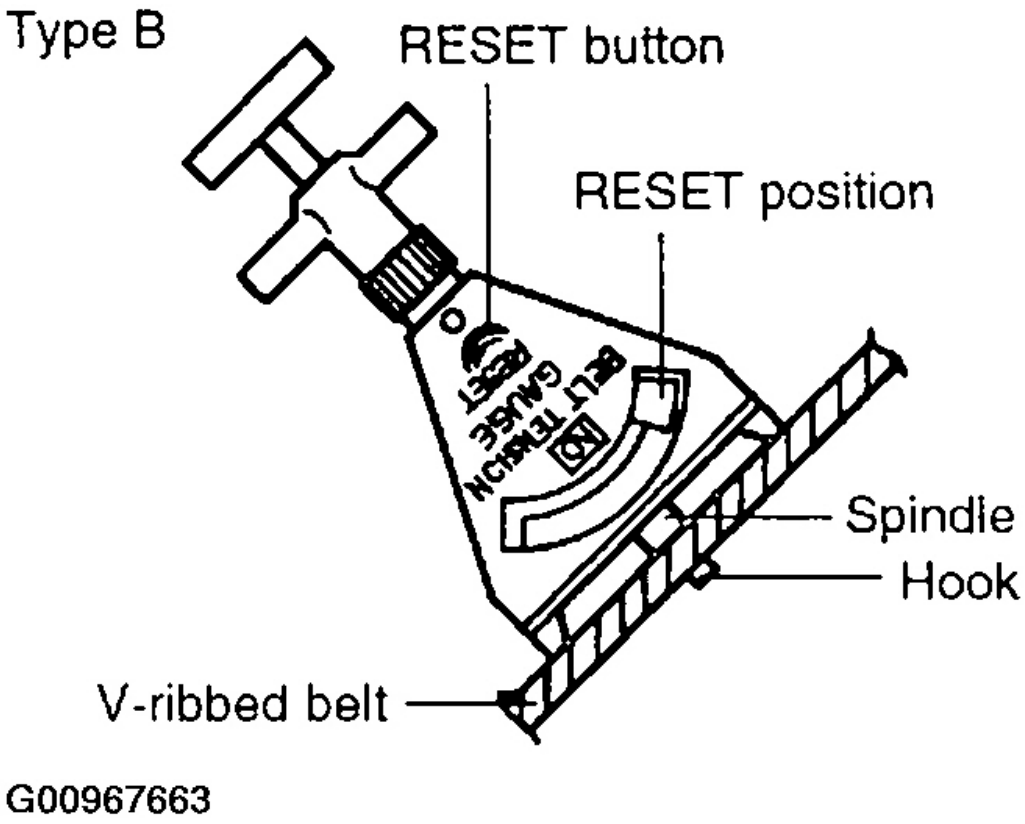

Fig. 25: Identifying Type B Tension Gauge
Courtesy of HYUNDAI MOTOR CO.

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 be 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, and read-just if necessary.

Tightening torque

Alternator nut A: 35-55 N.m (350-550 kg.cm, 25-40 lb.ft)
Adjuster lock bolt B: 20-25 N.m (200-250 kg.cm, 14-18 lb.ft)
Tension adjuster bolt: 8-12 N.m (80-120 kg.cm, 6-9 lb.ft)

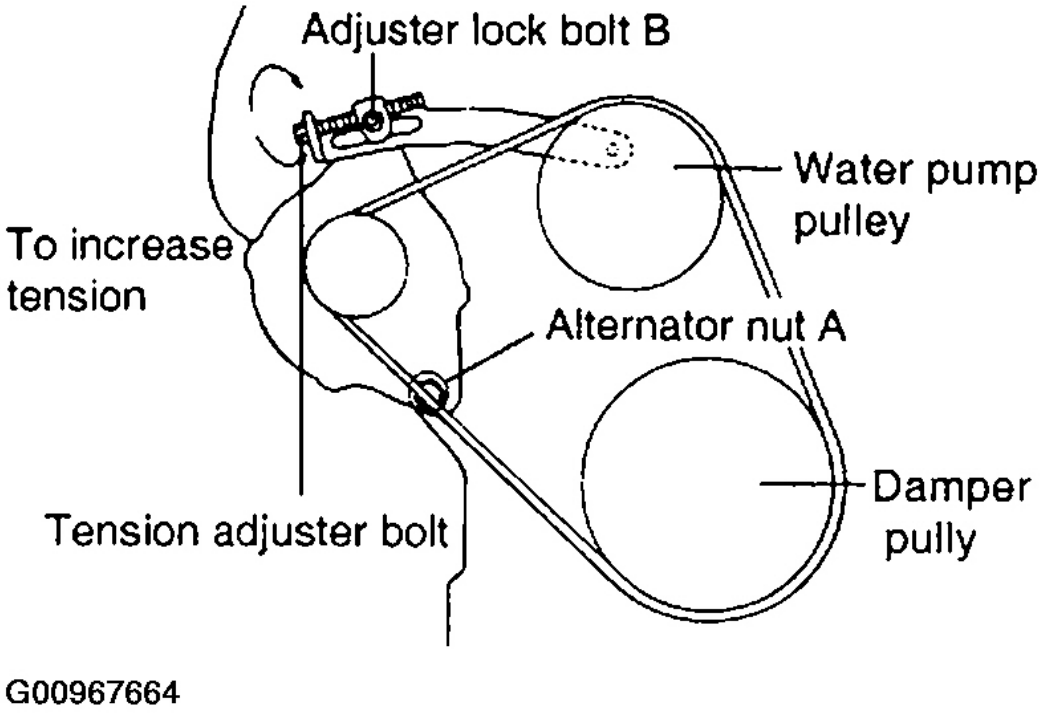

Fig. 26: Identifying Alternator Belt Tensioner Bolt
Courtesy of HYUNDAI MOTOR CO.

ADJUSTING POWER STEERING & AIR CONDITIONER BELTS

1. Loosen the tension pulley adjustment bolt A.
2. Adjust the belt deflection with adjustment bolt B.
3. Tighten bolt A.
4. Recheck the belt deflection and readjust, if necessary.

NOTE: Before rechecking, crank the engine one more revolution.

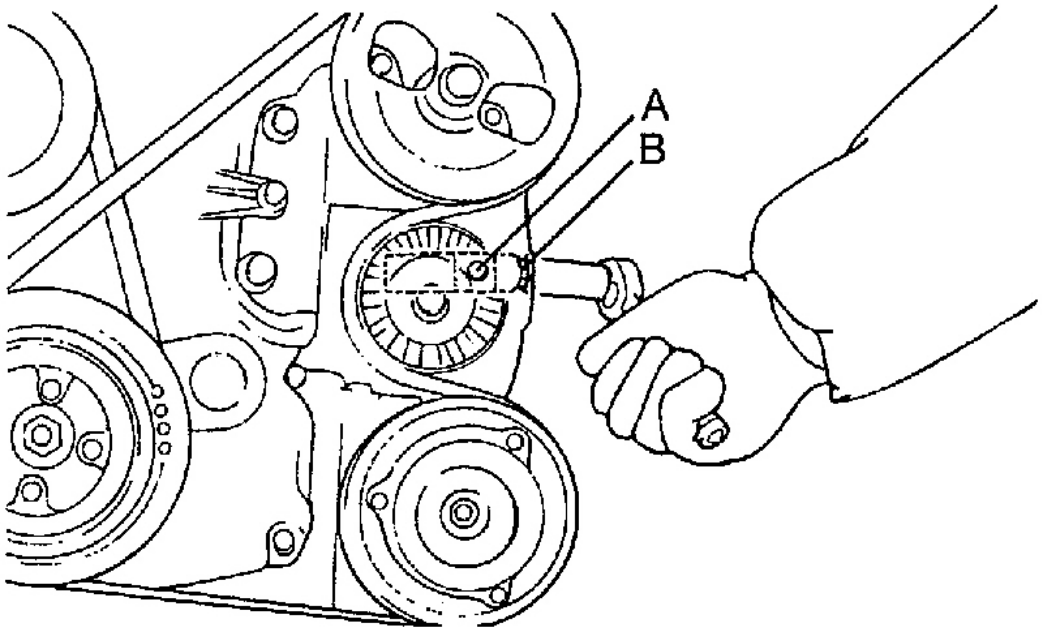

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Fig. 27: Identifying Power Steering & Air Conditioner Belt Tensioner
Courtesy of HYUNDAI MOTOR CO.

ENGINE BLOCK

COMPONENTS

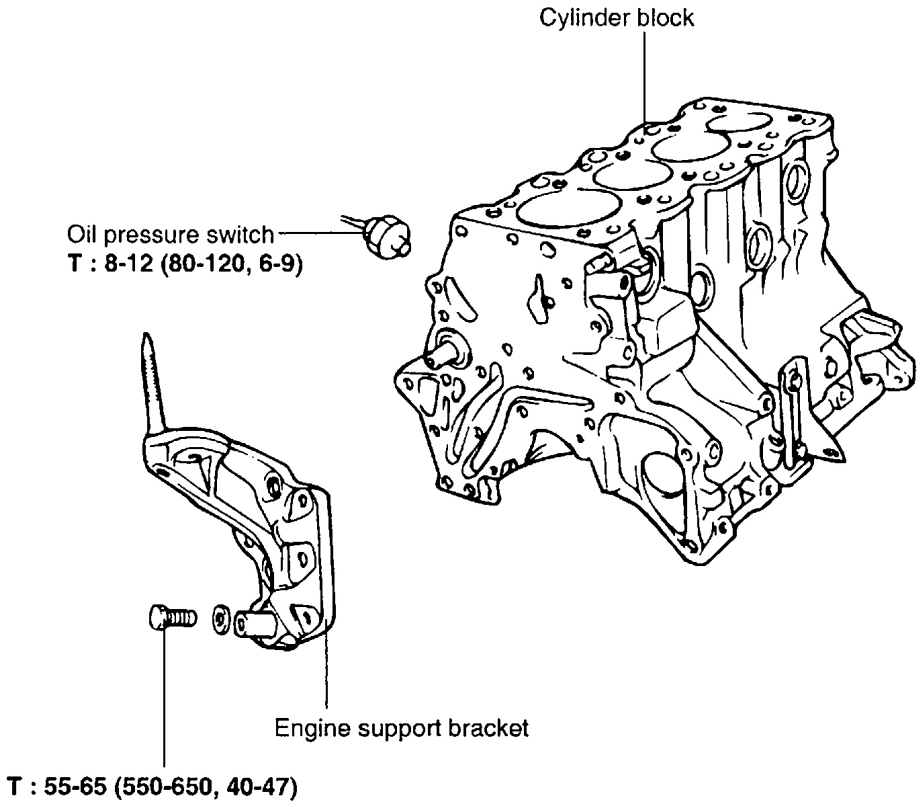

Fig. 28: Engine Block Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

Remove the following:

- Cylinder head. See **CYLINDER HEAD**.
- Timing belt. See **TIMING BELT**.
- Front case. See **FRONT CASE**.
- Flywheel.
- Pistons. See **CONNECTING ROD**.
- Crankshaft. See **CRANK SHAFT**.

INSPECTION

1. Check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects.

Replace the block if defective.

2. Measure the cylinder bore with a cylinder gauge at the three levels indicated and in the directions of A and B.

   Level 1: No. 1 piston ring position at TDC

   Level 2: Center of cylinder

   Level 3: Bottom of cylinder

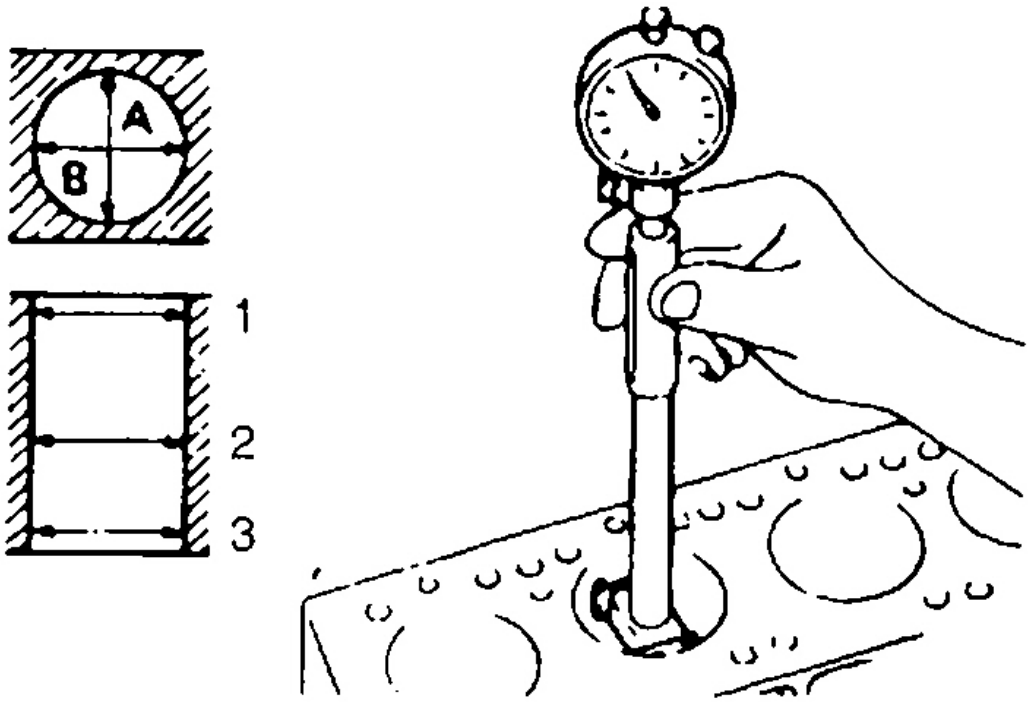

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Fig. 29: Measuring Cylinder Bore
Courtesy of HYUNDAI MOTOR CO.

3. If the cylinder bores show more than specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. New oversize piston and rings should be installed.

   Standard value

   Cylinder bore: 86.5 + 0.03 mm (3.41 + 0.0012 in.)

   Out-of-round and taper of cylinder bore: Max. 0.01 mm (0.0004 in.)

4. If a ridge exists at the top of the cylinder, cut it away with a ridge reamer.

PISTON SERVICE SIZE & MARK MM (IN.)

Identification Mark: 0.50

Size: 0.50 (0.020) O.S.

5. To rebore the cylinder bore to oversize, maintain the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of the same oversize. The standard measurement of the piston outside diameter is taken at a level 12 mm (0.47 in.) above the bottom of the piston skirt and across the thrust faces.

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

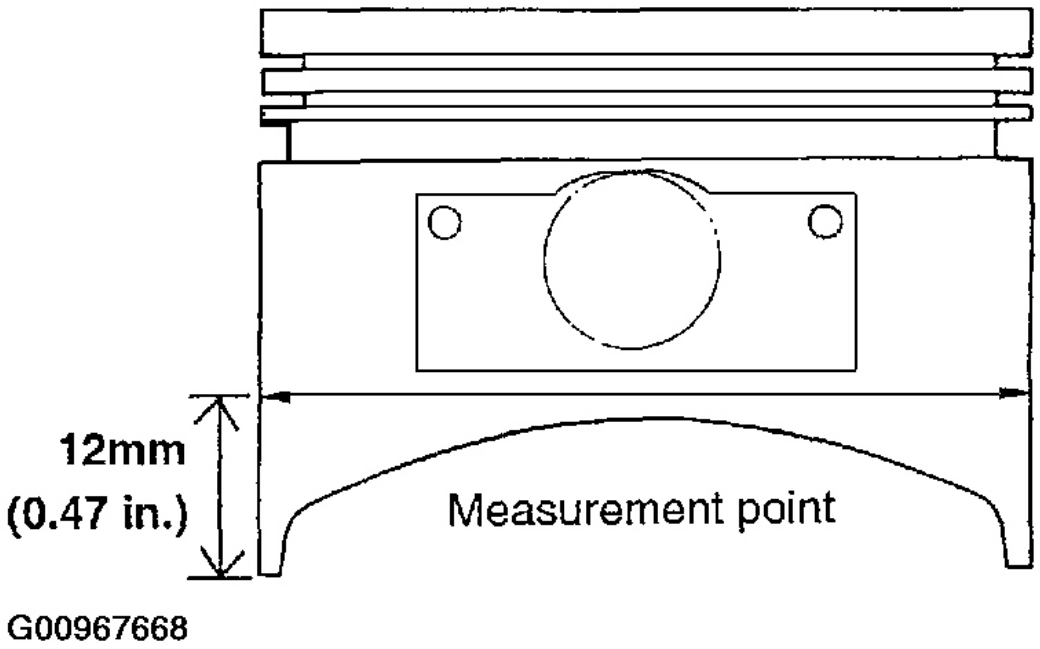

Fig. 30: Measuring Point On Piston Skirt
Courtesy of HYUNDAI MOTOR CO.

6. Check for damage and cracks.
7. Check the top surface of the cylinder block for flatness. If the top surface exceeds limits, surface to minimum limit or replace.

   Standard value

   Flatness of cylinder block: Max. 0.05 mm (0.0020 in.)

Service limit

Flatness of cylinder block: 0.1 mm (0.0039 in.)

NOTE: When the cylinder head is assembled, grinding less than 0.2 mm (0.008 in.) is permissible.

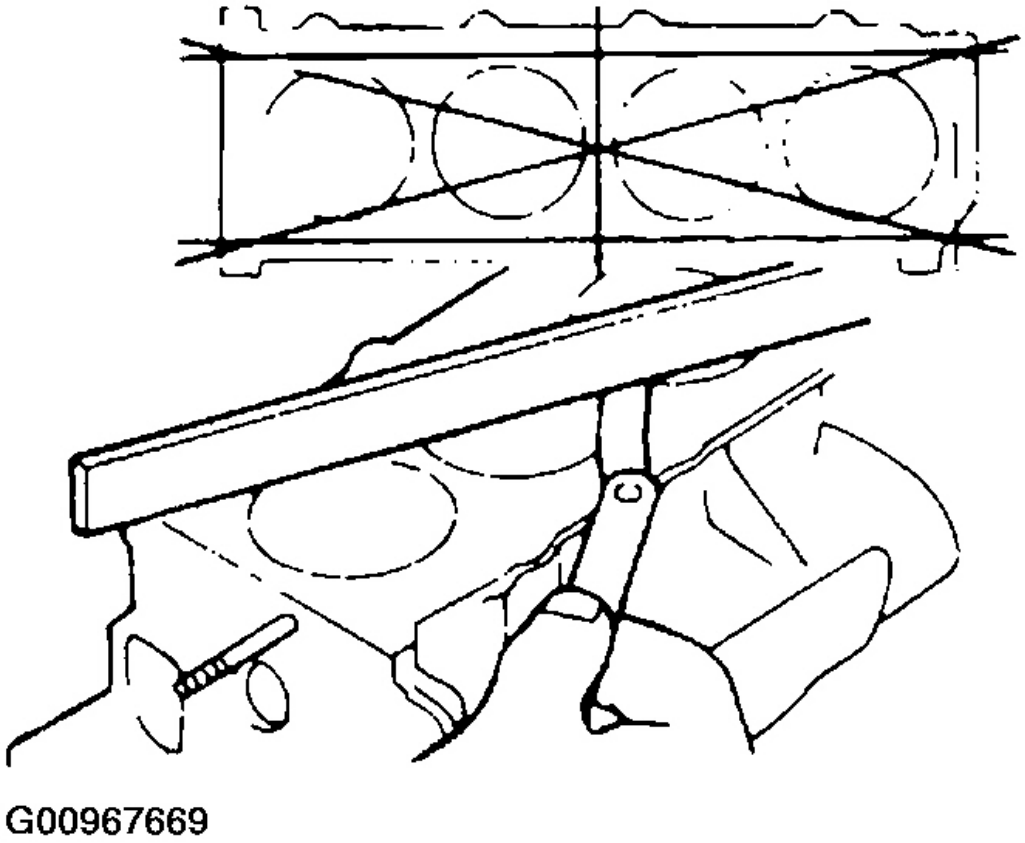

Fig. 31: Checking Top Surface Of Cylinder Block
Courtesy of HYUNDAI MOTOR CO.

BORING CYLINDER

1. Oversize pistons should be selected on the basis of the largest cylinder bore.

   Identification Mark: 0.50

   Size: 0.50 mm (0.020 in.) O.S.

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

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

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

4. Bore each of cylinders to the calculated size.

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

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

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

REASSEMBLY

Install the following parts by referring to their respective paragraphs.

1. Crankshaft
2. Flywheel
3. Piston
4. Cylinder head
5. Timing belt train
6. Front case

ENGINE MOUNTS

COMPONENTS

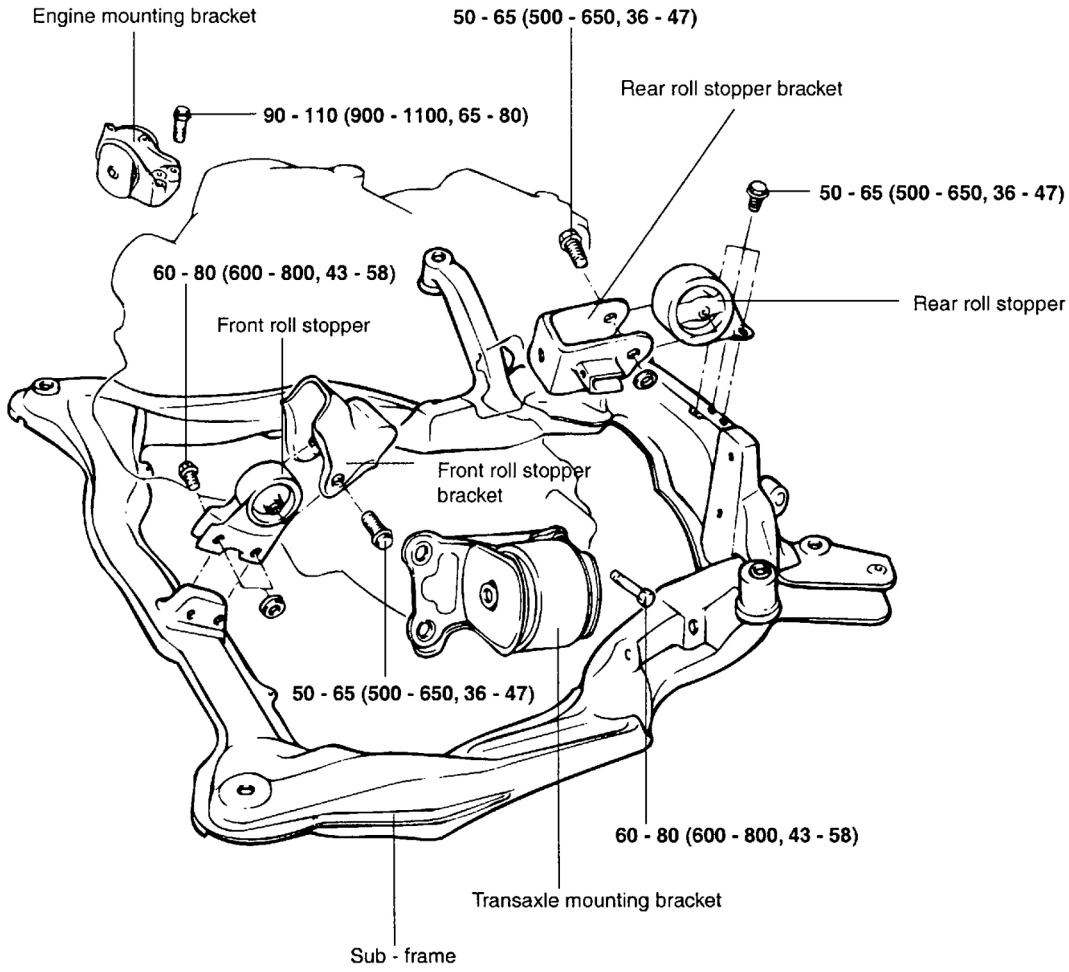

Fig. 32: Engine Mount Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

Attach a chain or cable to the engine hooks and lift enough so that there is no pressure on the motor mounts.

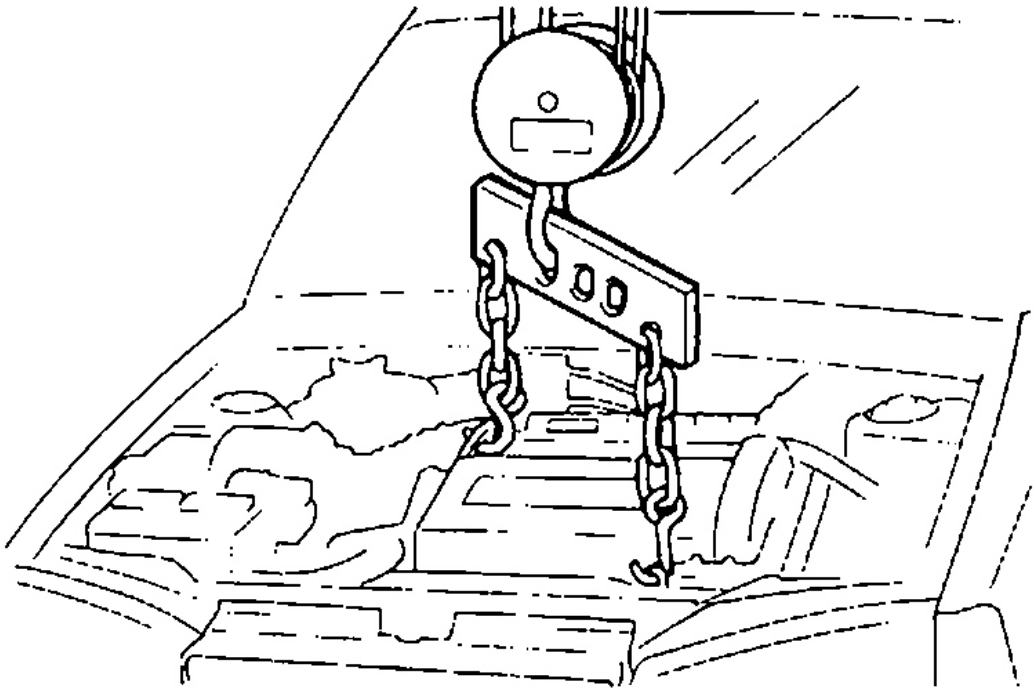

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Fig. 33: Lifting Engine
Courtesy of HYUNDAI MOTOR CO.

ENGINE MOUNTING

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

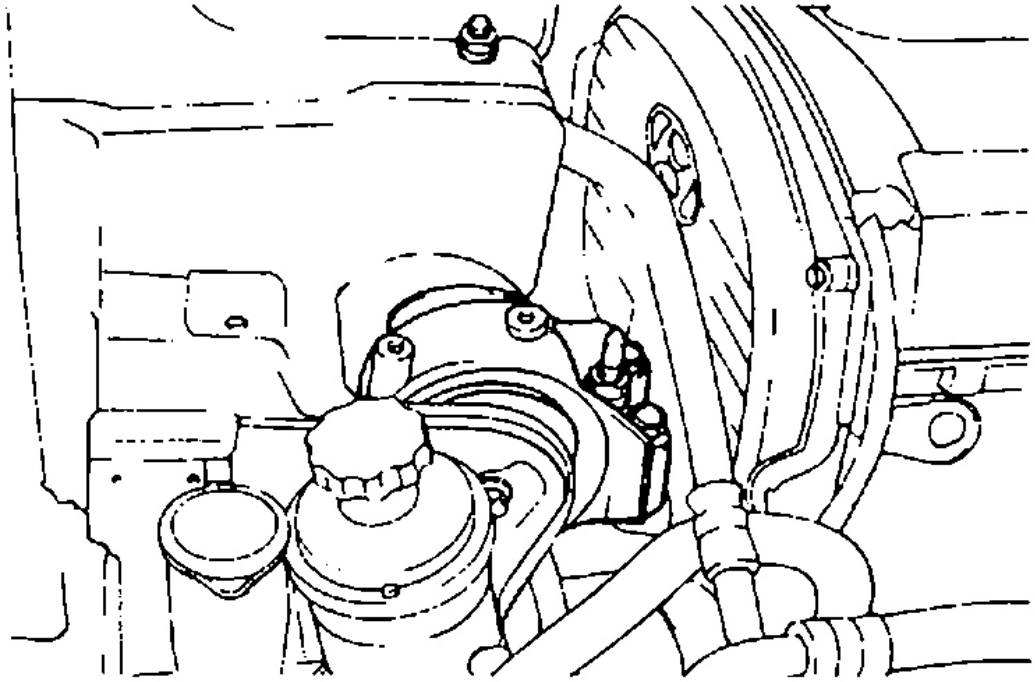

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Fig. 34: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

TRANSAXLE MOUNTING

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

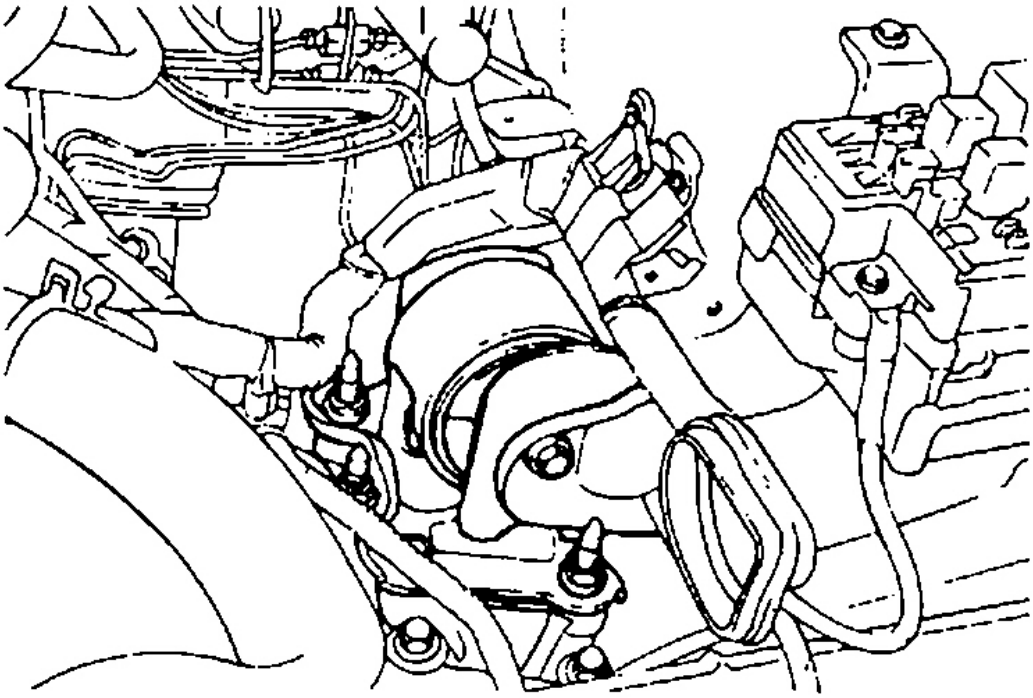

Fig. 35: Identifying Transaxle Bracket
Courtesy of HYUNDAI MOTOR CO.

FRONT ROLL STOPPER

Remove the front roll stopper bracket from the sub-frame.

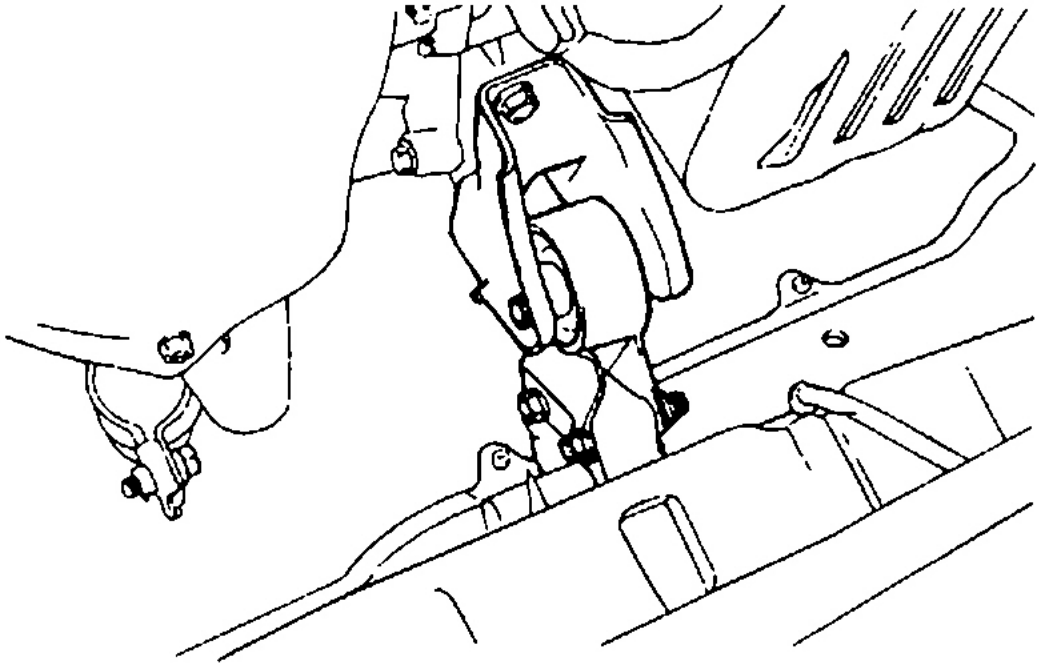

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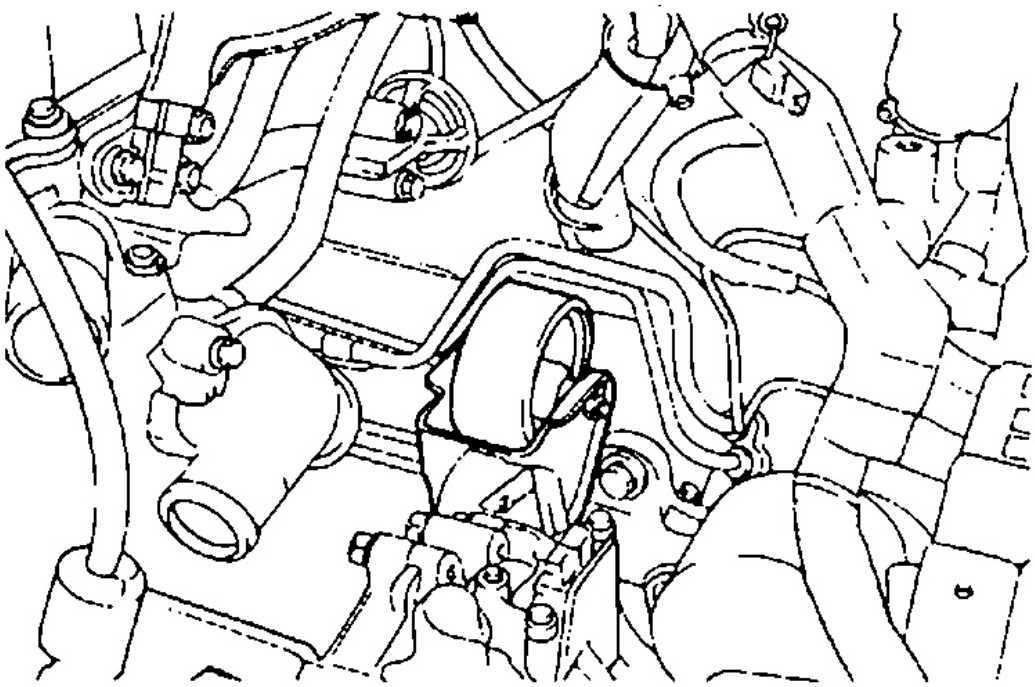
Fig. 36: Identifying Front Roller Stopper Bracket
Courtesy of HYUNDAI MOTOR CO.

REAR ROLL STOPPER

1. Remove the bolt from the rear roll stopper.
2. Remove the rear roll stopper from the subframe.



G00967675

Fig. 37: Identifying Rear Roller Stopper Bracket
Courtesy of HYUNDAI MOTOR CO.

INSPECTION ITEMS

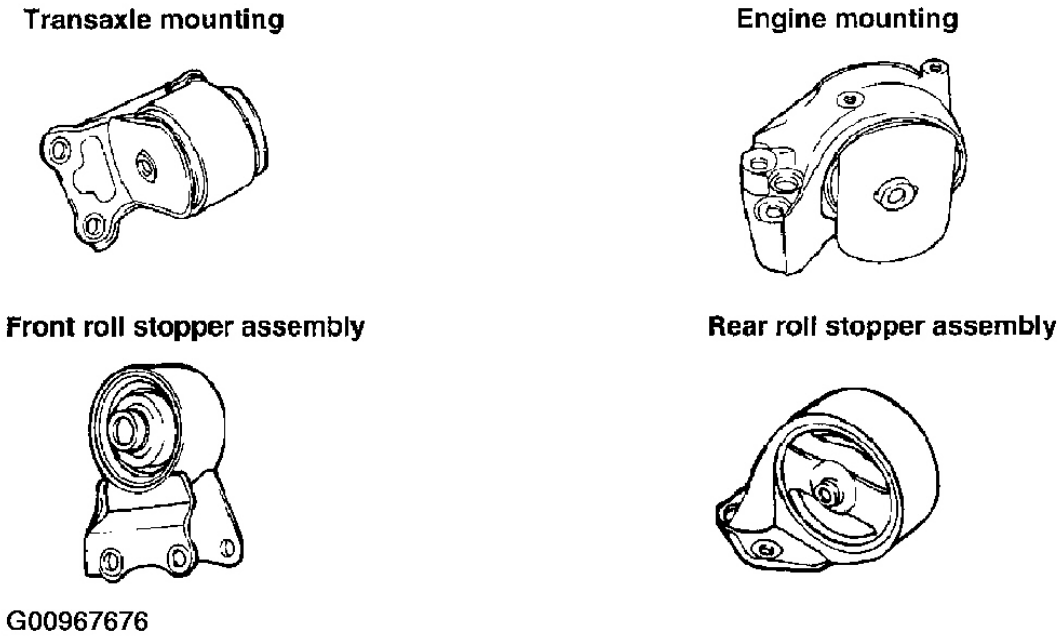


Fig. 38: View Of Inspection Items
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

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

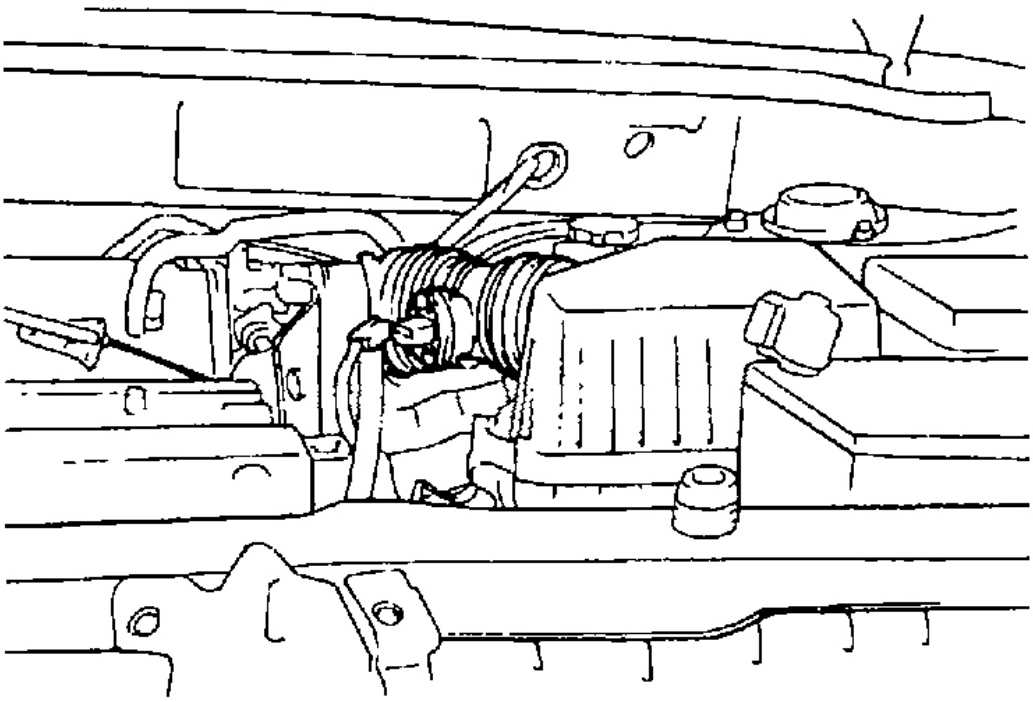
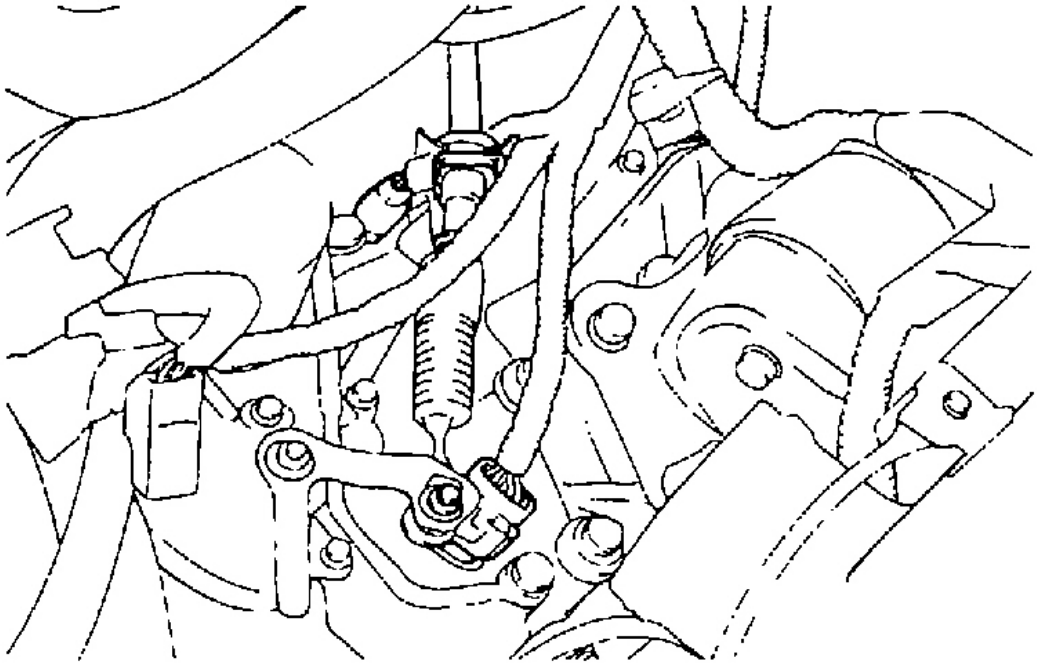


Fig. 39: View Of Air Cleaner
Courtesy of HYUNDAI MOTOR CO.

3. Disconnect the engine harness connectors.
    1. Engine wiring connectors (alternator, starter, etc.)
    2. TPS connector
    3. Power steering switch connector, oil pressure gauge connector.
    4. Back up lamp switch connector.
    5. A/T solenoid, inhibitor switch connector.
    6. Coolant temperature sensor.
    7. Ignition coil, power TR connector.
    8. Idle speed control valve (ISC) connector.
    9. MAP and ATS connectors.
    10. Oxygen sensor connector.



G00967678

Fig. 40: View Transmission Range Sensor
Courtesy of HYUNDAI MOTOR CO.

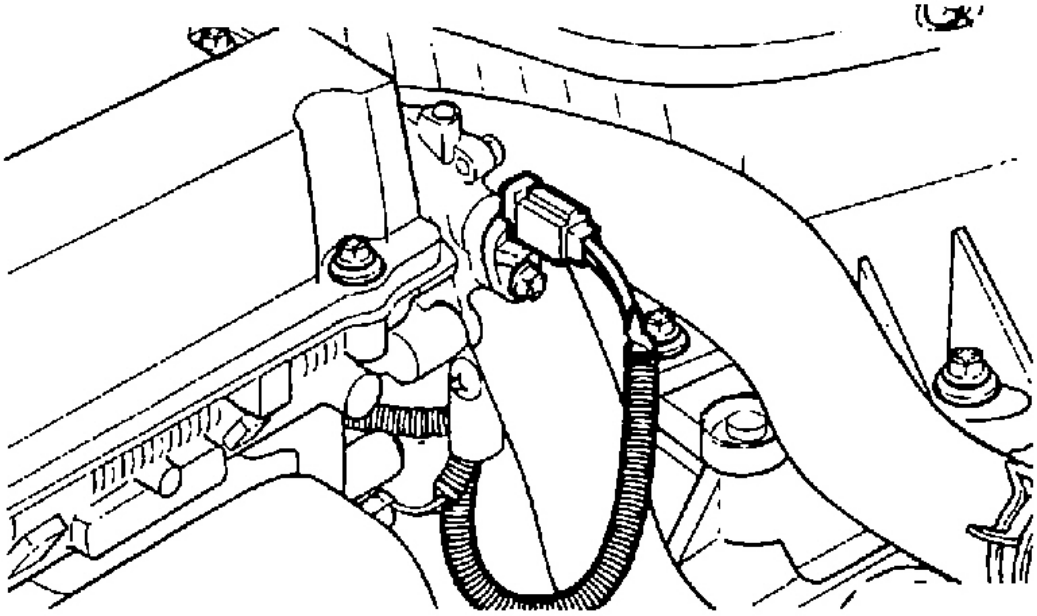


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Fig. 41: View Engine Coolant Temperature Sensor
Courtesy of HYUNDAI MOTOR CO.

4. Drain the engine coolant.
5. For a vehicle with automatic transaxles, disconnect the transaxle oil cooler hoses.

NOTE:

- **When disconnecting hoses, make identification marks to avoid making any mistake when installing them again.**

CAUTION:

- **Be careful not to spill any of oil or fluid out of the hoses. Plug the openings to prevent the entry of foreign material.**

6. Disconnect the radiator upper and lower hoses on the engine side then remove the radiator assembly.

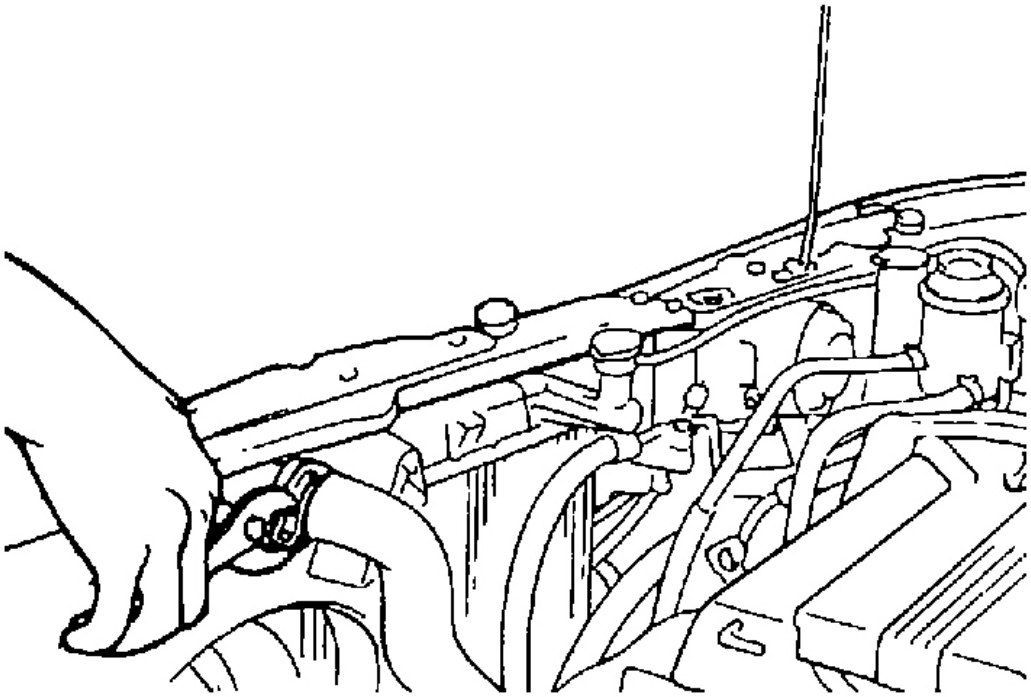
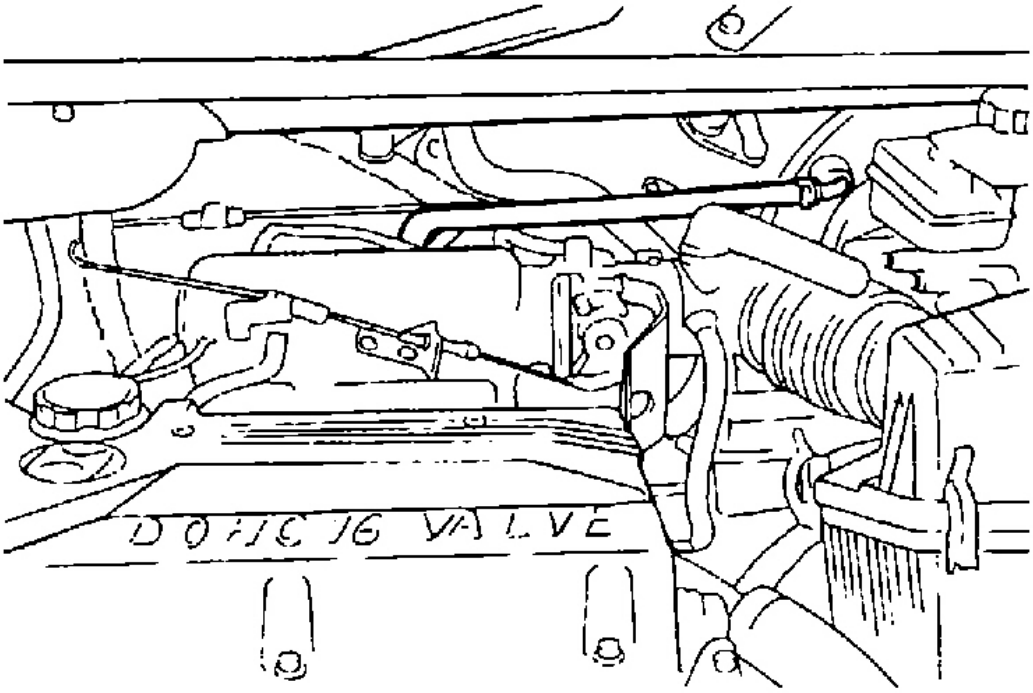


Fig. 42: Removing Upper Radiator Hose
Courtesy of HYUNDAI MOTOR CO.

7. Disconnect the engine ground.
8. Disconnect the brake booster vacuum hose.



G00967681

Fig. 43: Identifying Brake Booster Vacuum Hose
Courtesy of HYUNDAI MOTOR CO.

9. Disconnect the heater hoses (inlet and outlet) on the engine side.
10. Disconnect the accelerator cable at the engine side.

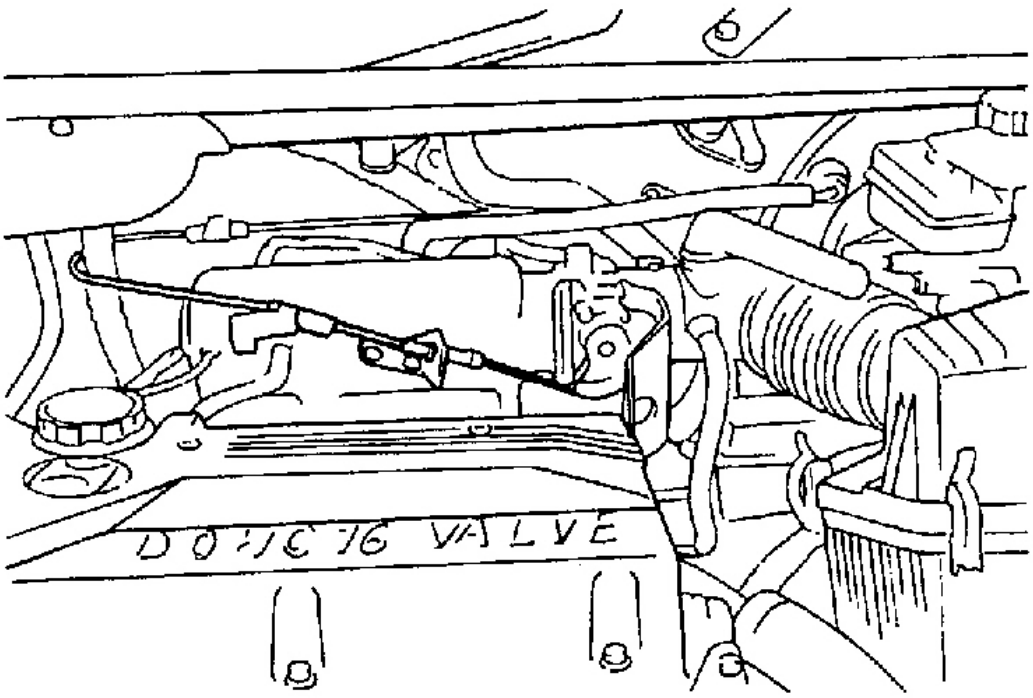


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Fig. 44: Identifying Accelerator Cable
Courtesy of HYUNDAI MOTOR CO.

11. Using a special tool, remove the main fuel line at the delivery pipe (supply/return).
12. Disconnect the speedometer cable from the transaxle.
13. Disconnect the clutch cable or control cable from the transaxle.

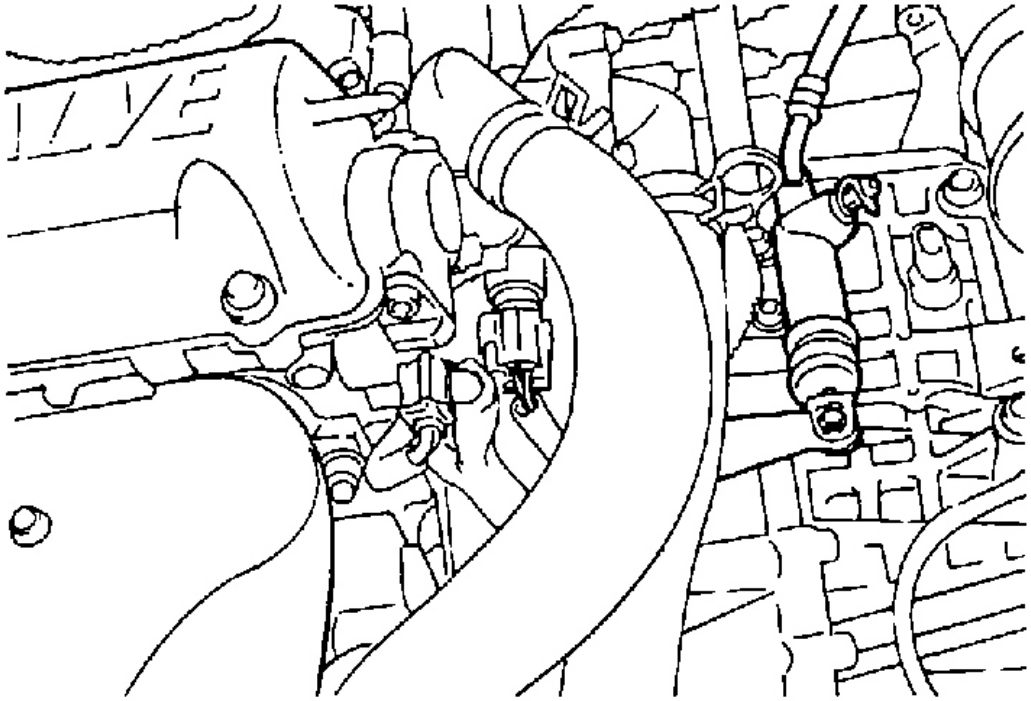

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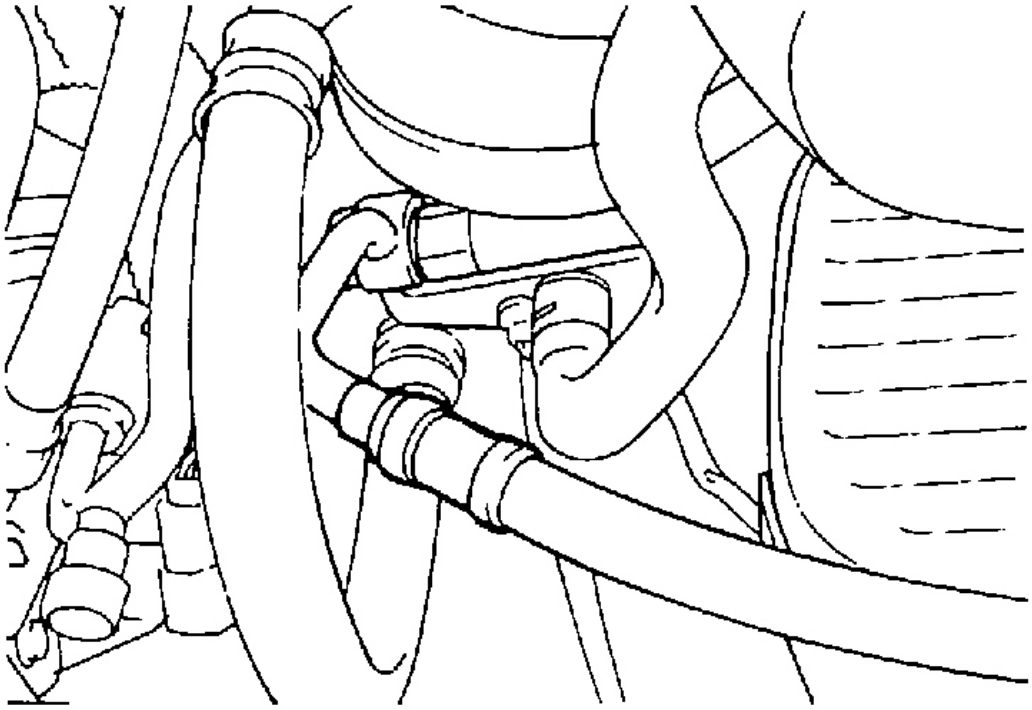
Fig. 45: Identifying Clutch Cable Or Control Cable
Courtesy of HYUNDAI MOTOR CO.

14. Disconnect the power steering suction hose and return hose from the pump.



G00967684

Fig. 46: Identifying Power Steering Hoses
Courtesy of HYUNDAI MOTOR CO.

15. Detach the steering dust cover in the engine compartment and then disconnect the gear box universal joint bolt.

NOTE: Make sure to make identification marks between the universal joint and the gear box for reassembly.

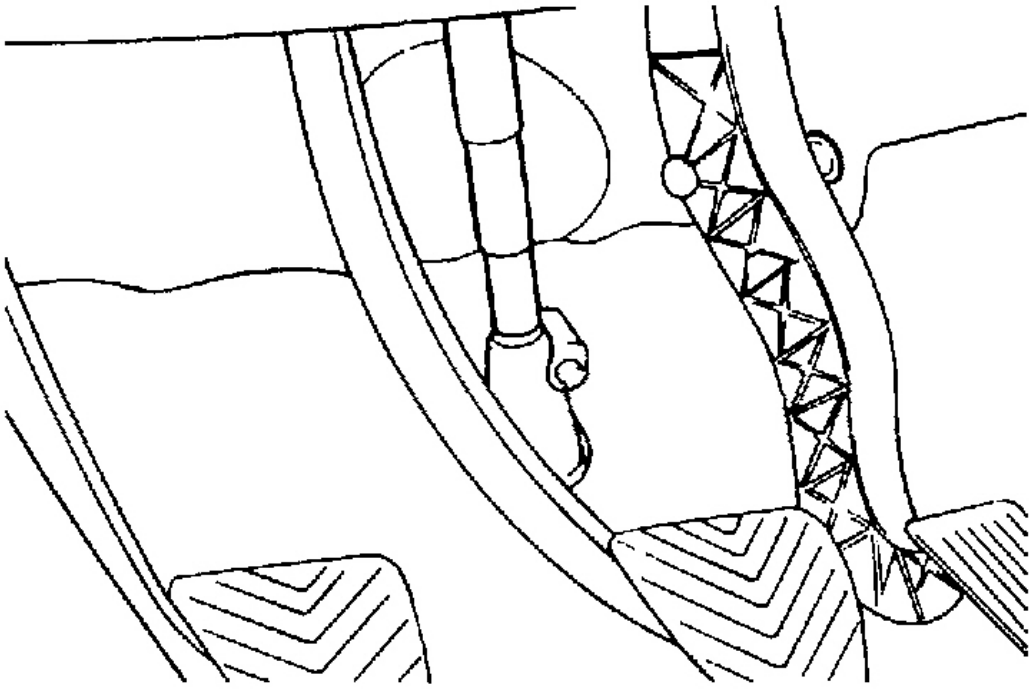


Fig. 47: Identifying Steering Column Through Floor Board Location
Courtesy of HYUNDAI MOTOR CO.

16. Raise the vehicle and then remove the front tire.
17. Attaching the wheel speed sensor and caliper to the body, disconnect the lower arm and the fork, and then separate the upper arm and knuckle.

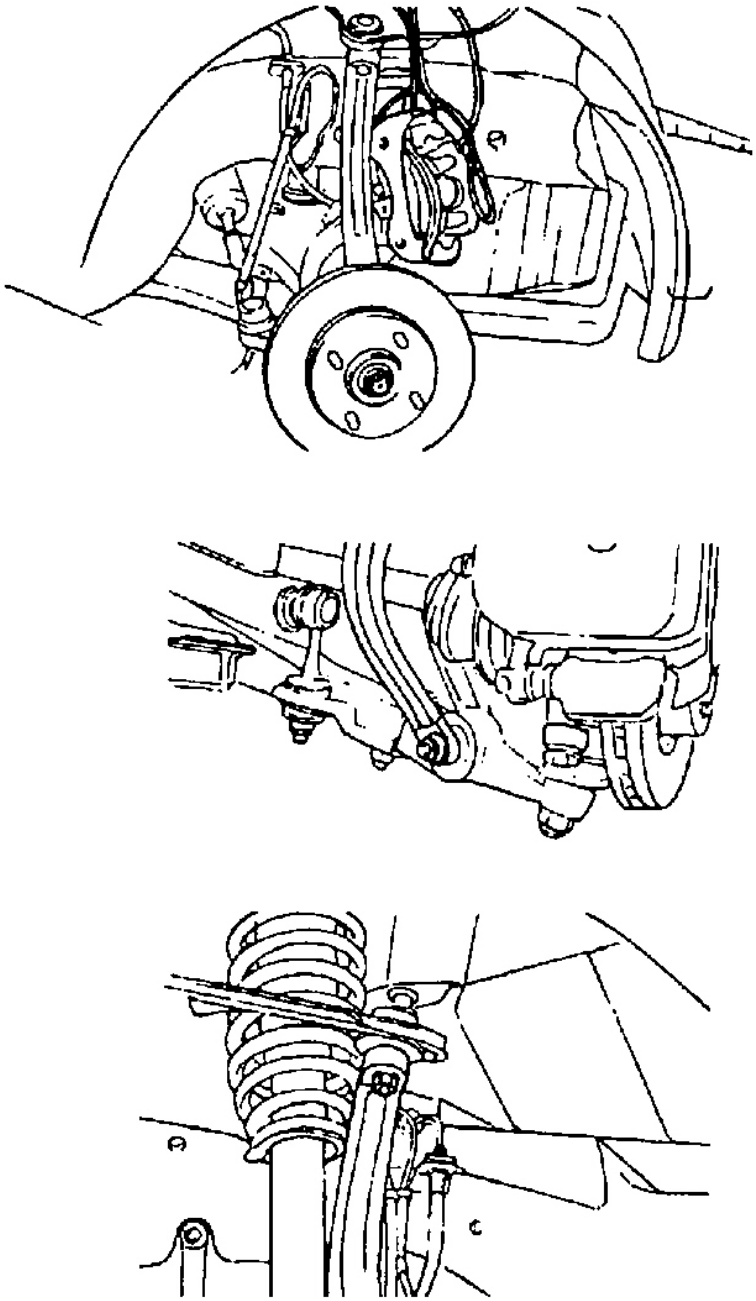


Fig. 48: Supporting Caliper & Identifying Upper & Lower Arm-To-Knuckle Bolts
Courtesy of HYUNDAI MOTOR CO.

18. Drain the transaxle oil.

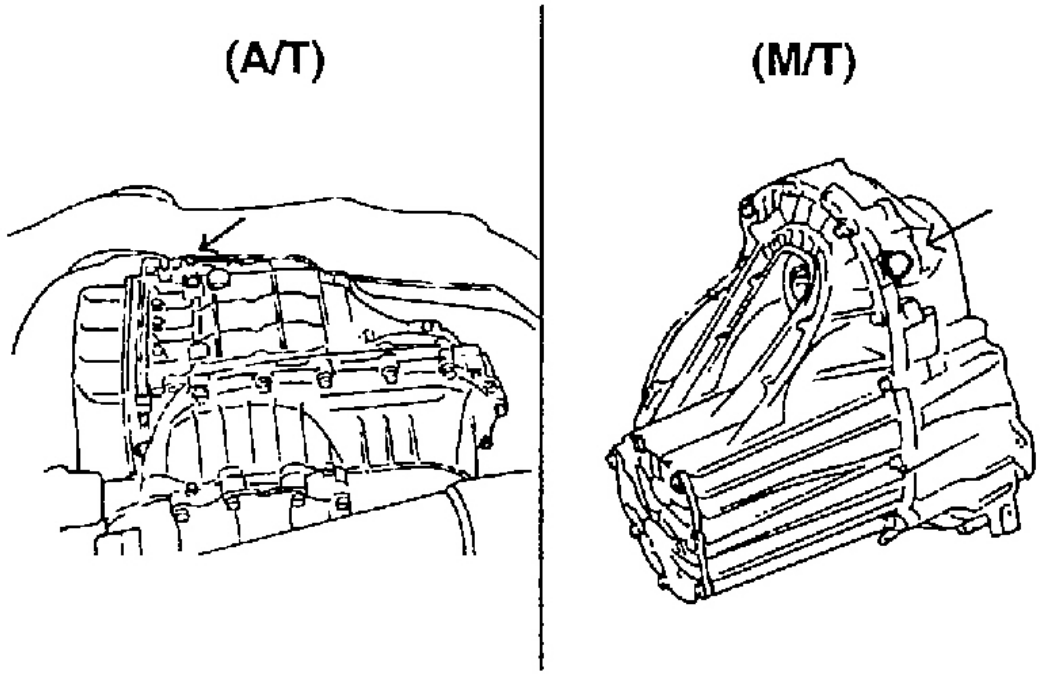


Fig. 49: Identifying Drain Plug Bolt
Courtesy of HYUNDAI MOTOR CO.

19. Remove the front muffler bolts.
20. Remove the transaxle control rod and extension rod (M/T only).

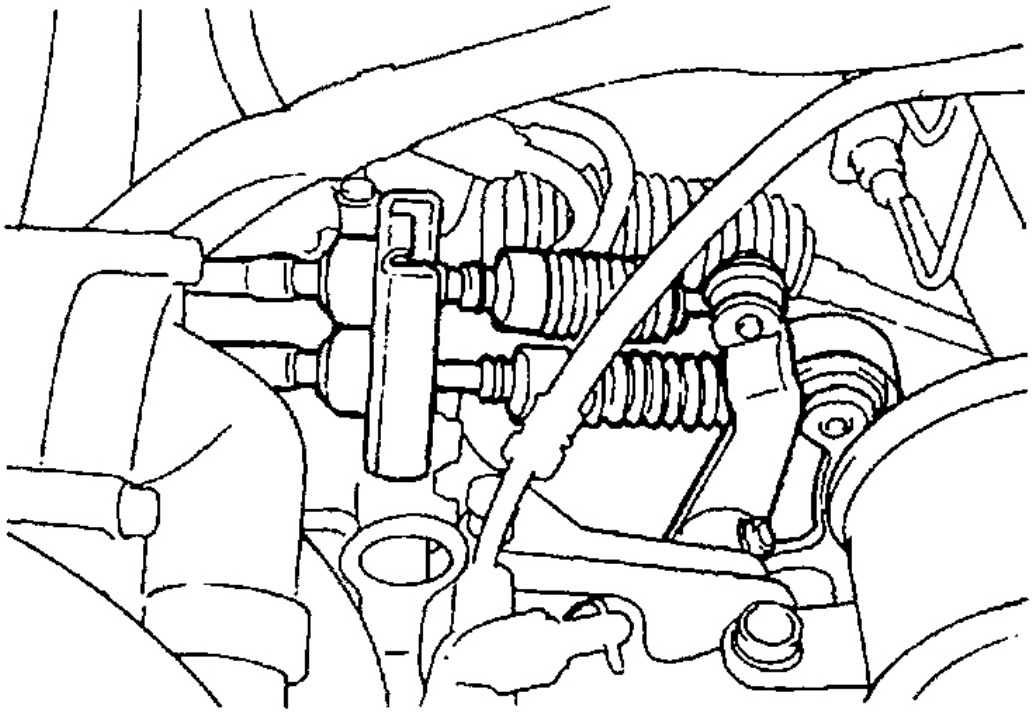


Fig. 50: Identifying Transaxle Control Rod & Extension Rod
Courtesy of HYUNDAI MOTOR CO.

21. Put the special fixture on the T/M jack and then adjust it to the sub-frame.

NOTE: Check that all the cables, harness connector and hose are disconnected from the engine and transaxle assembly.

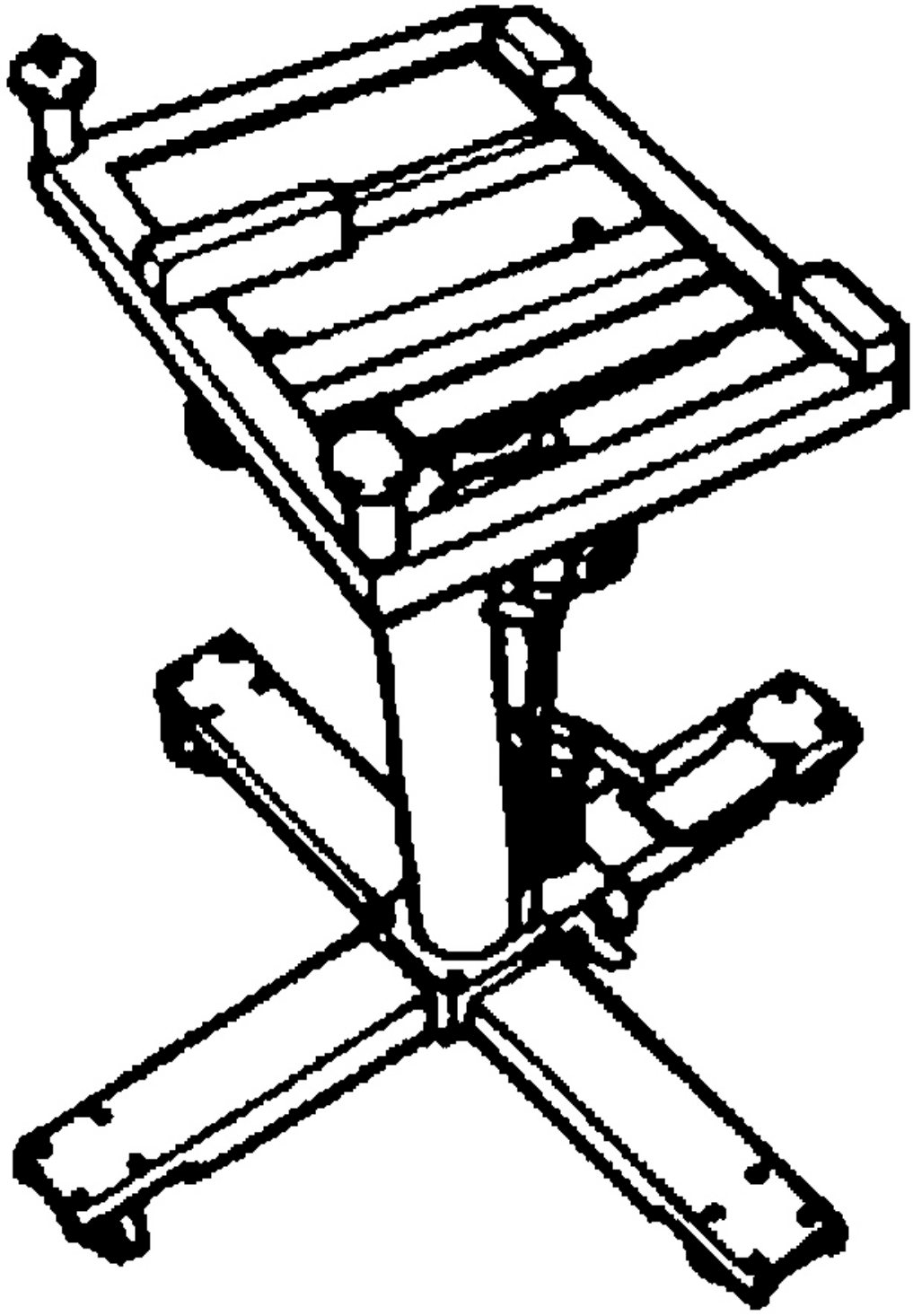


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Fig. 51: Identifying T/M Jack
Courtesy of HYUNDAI MOTOR CO.

22. Remove the engine mounting bracket and the transaxle mounting bracket.

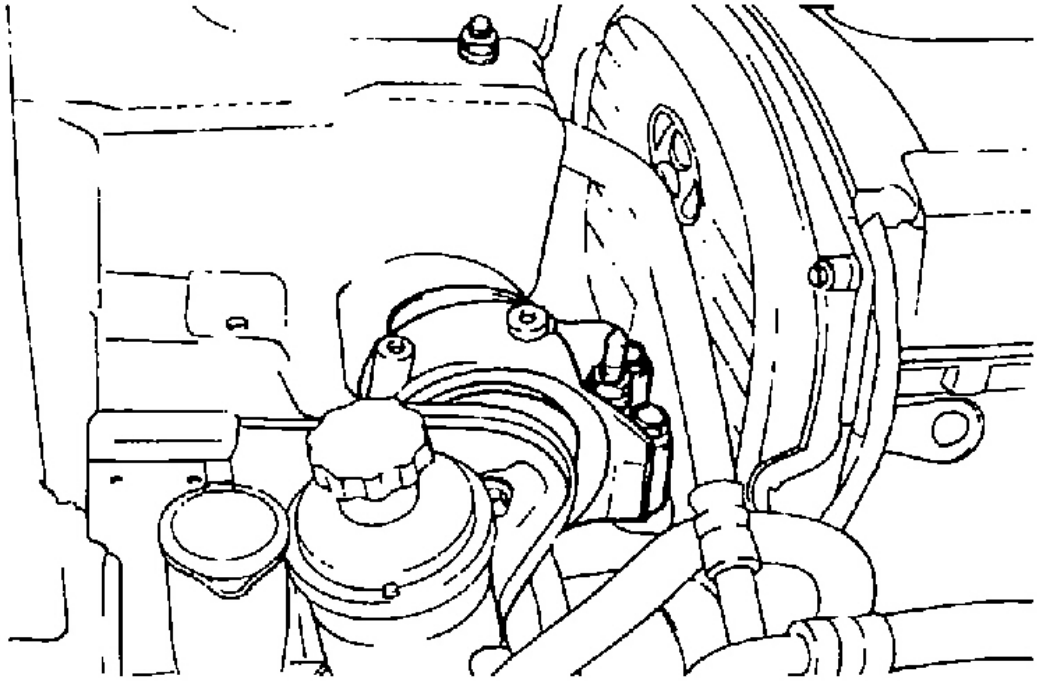

Fig. 52: Identifying Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

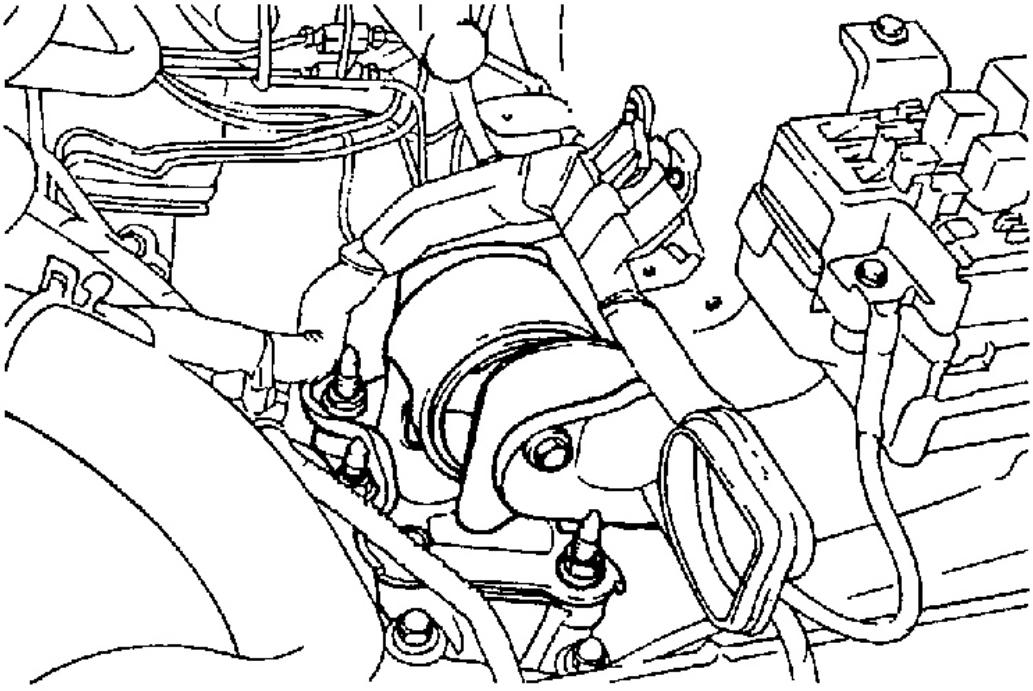

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Fig. 53: Identifying Transaxle Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

23. Remove the sub-frame installation bolts.

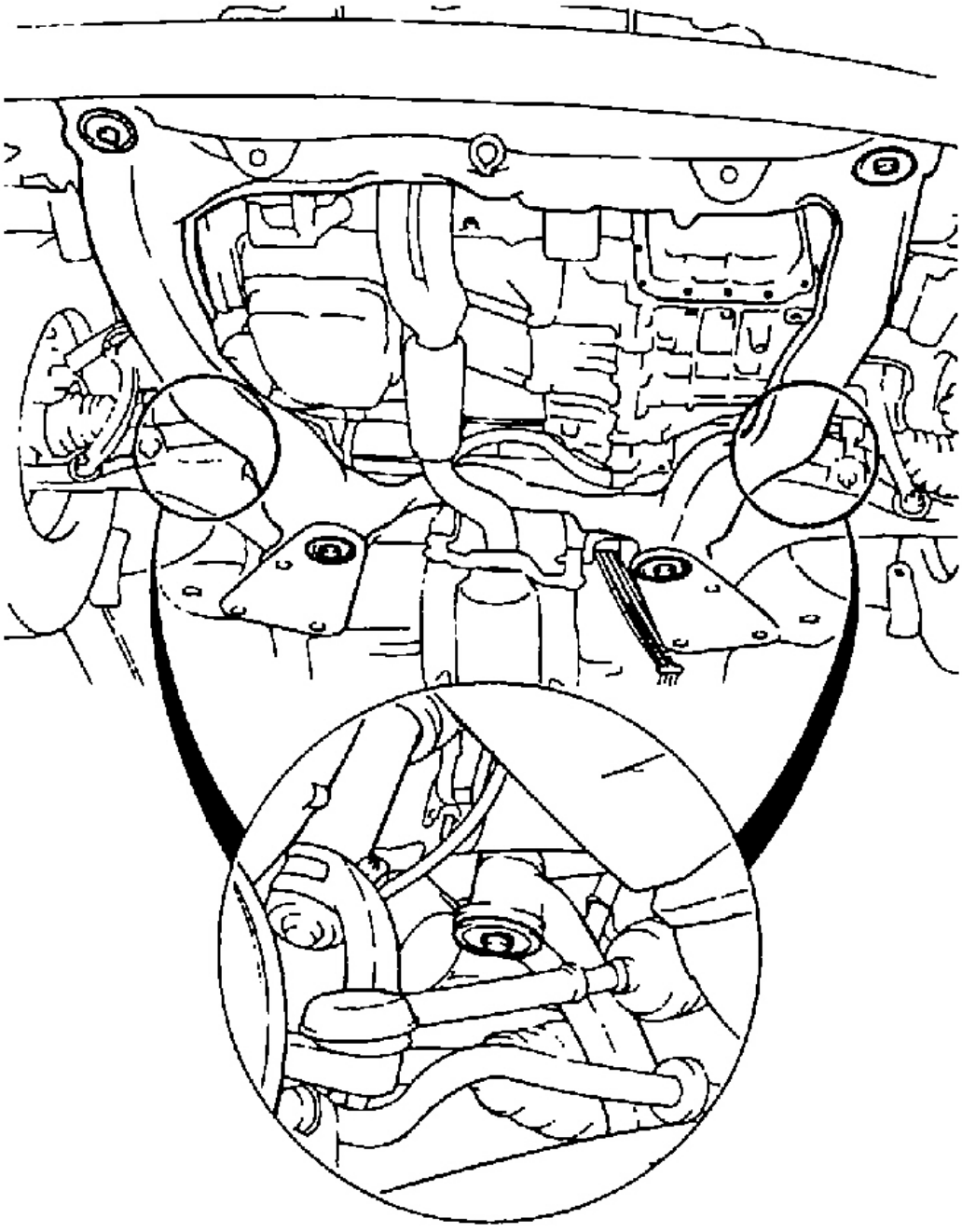

Fig. 54: Identifying Sub-Frame Installation Bolts
Courtesy of HYUNDAI MOTOR CO.

24. Using the special tool 09624-38100, remove the cross member stub bolt.

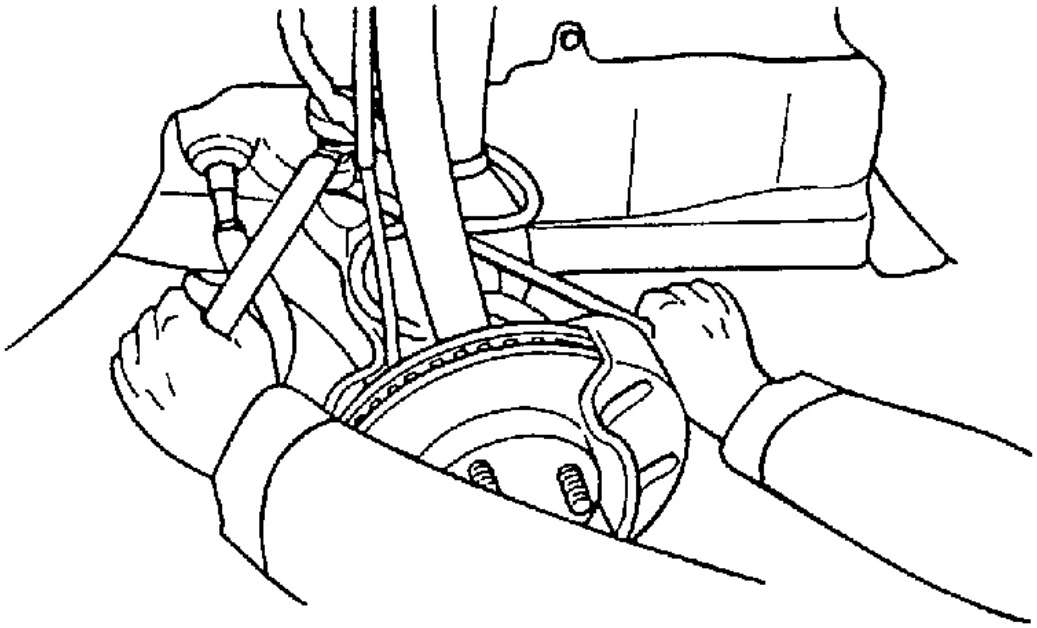

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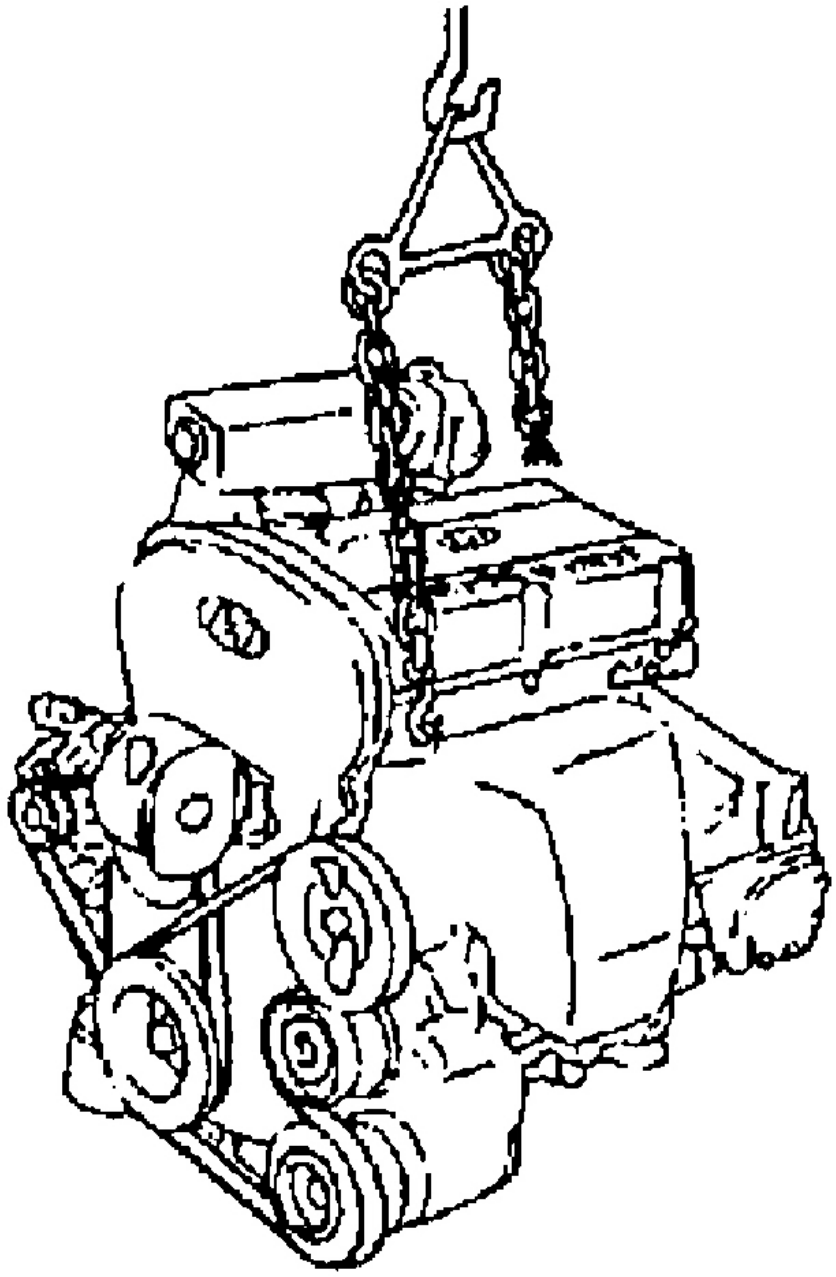
Fig. 55: Removing Cross Member Stud Bolt
Courtesy of HYUNDAI MOTOR CO.

With holding the stud bolt using a special tool in order not to loosen the stud bolt, remove the lock nut using a ring wrench.

25. After removing the drive shaft, lower the engine and transaxle assembly on the jack then, remove the front roll stopper and the rear roll stopper.



G00967694

Fig. 56: Removing Engine
Courtesy of HYUNDAI MOTOR CO.

26. Remove the engine and transaxle assembly as a unit.

INSTALLATION

1. When installing the engine and transaxle, check the connections of harnesses, pipes, hoses, etc. make sure that none of them are caught, damaged, etc.
2. Install the front roll stopper to the bracket roughly.

   Tightening torque

   Service standard: 50-65 N.m (500-650 kg.cm, 36-47 lb.ft)

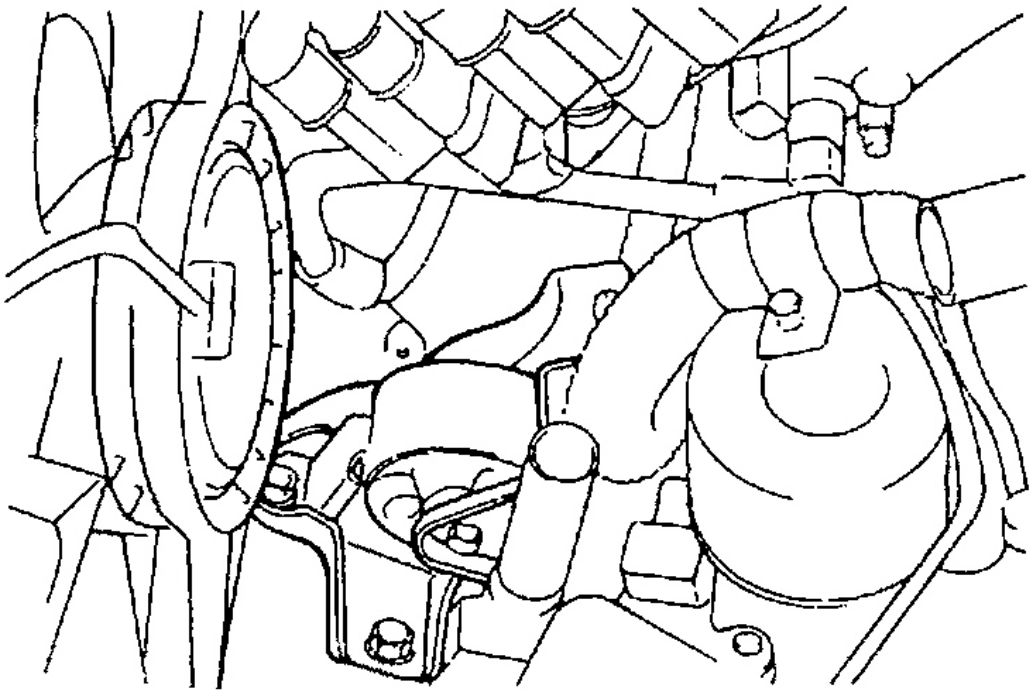


Fig. 57: Installing Front Roll Stopper
Courtesy of HYUNDAI MOTOR CO.

3. Install the rear roll stopper to the bracket.

   Tightening torque

   Service standard: 50-65 N.m (500-650 kg.cm, 36-47 lb.ft)

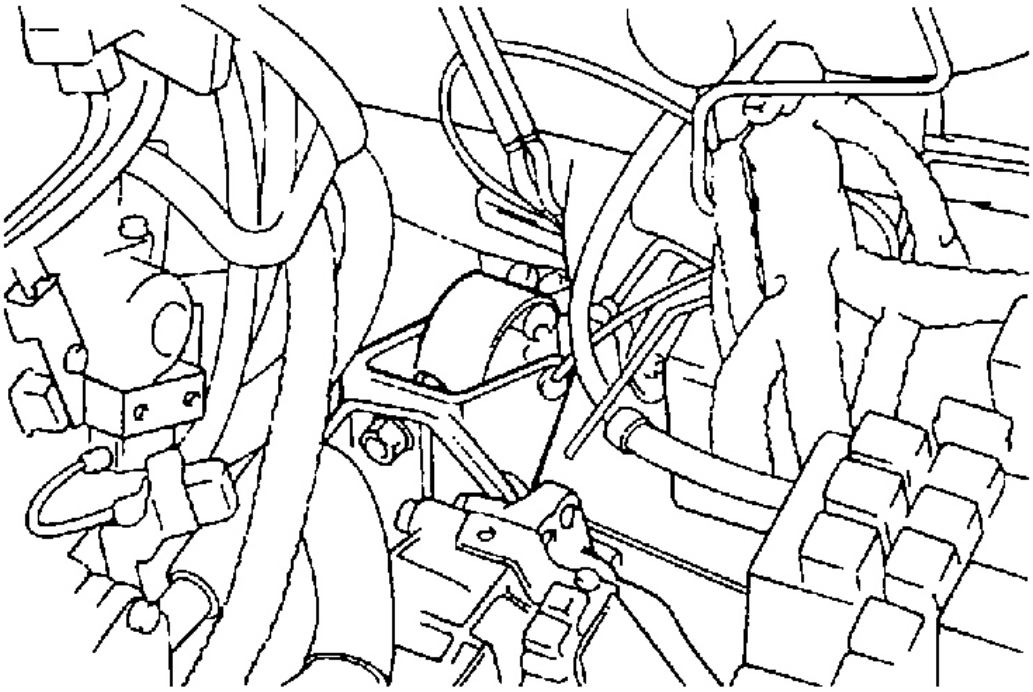


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Fig. 58: Installing Rear Roll Stopper
Courtesy of HYUNDAI MOTOR CO.

4. Install the engine/transaxle to the sub-frame assembly. Use the T/M jack to raise the assembly slowly adjust it to the vehicle body.
5. Install the transaxle mounting bracket.

Tightening torque

Service standard: 90-110 N.m (900-1100 kg.cm, 65-80 lb.ft)

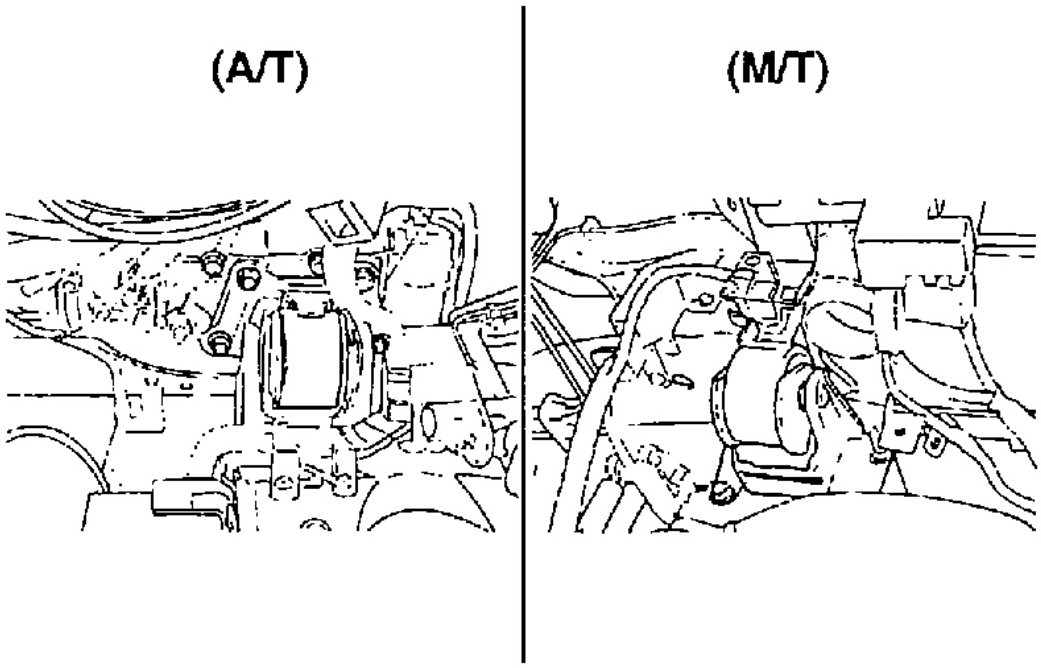


Fig. 59: Identifying Transaxle Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

6. Install the engine bracket (right side).

Tightening torque

Service standard: 60-80 N.m (600-800 kg.cm, 43-58 lb.ft)

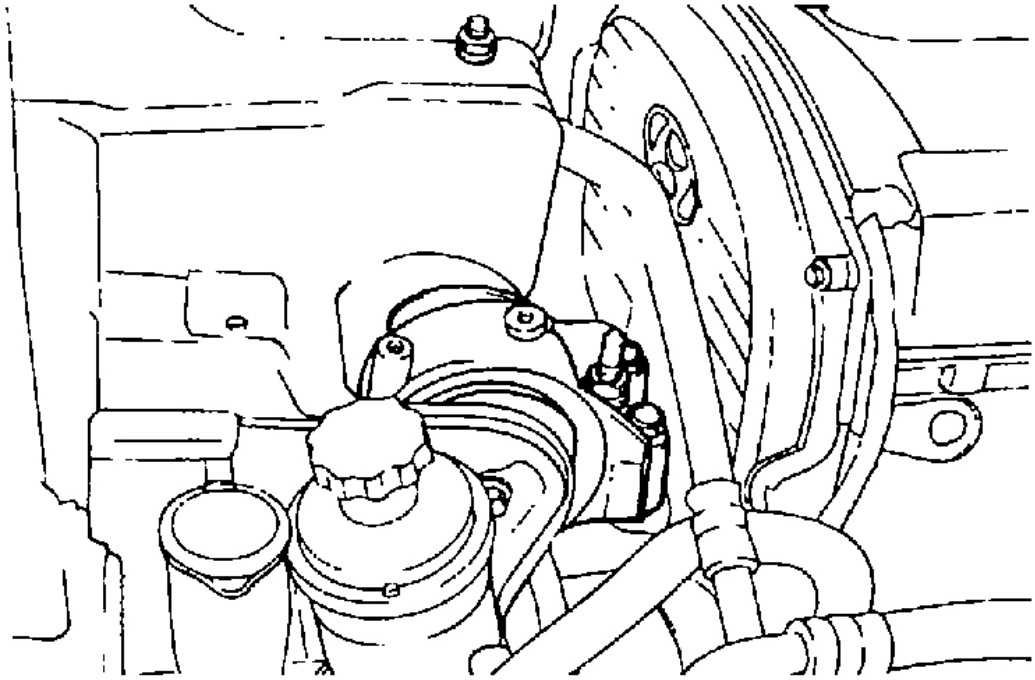


Fig. 60: Identifying Engine Bracket
Courtesy of HYUNDAI MOTOR CO.

7. To install all of parts, follow the removal procedures in the reverse order.
8. Refill the coolant and then check for leaks.
9. Refill the transaxle oil and check for leaks, then test its operation.
10. Check the operation of the transaxle control cable and accelerator cable.
11. Check the proper operation of each gauge.

FRONT CASE

COMPONENTS

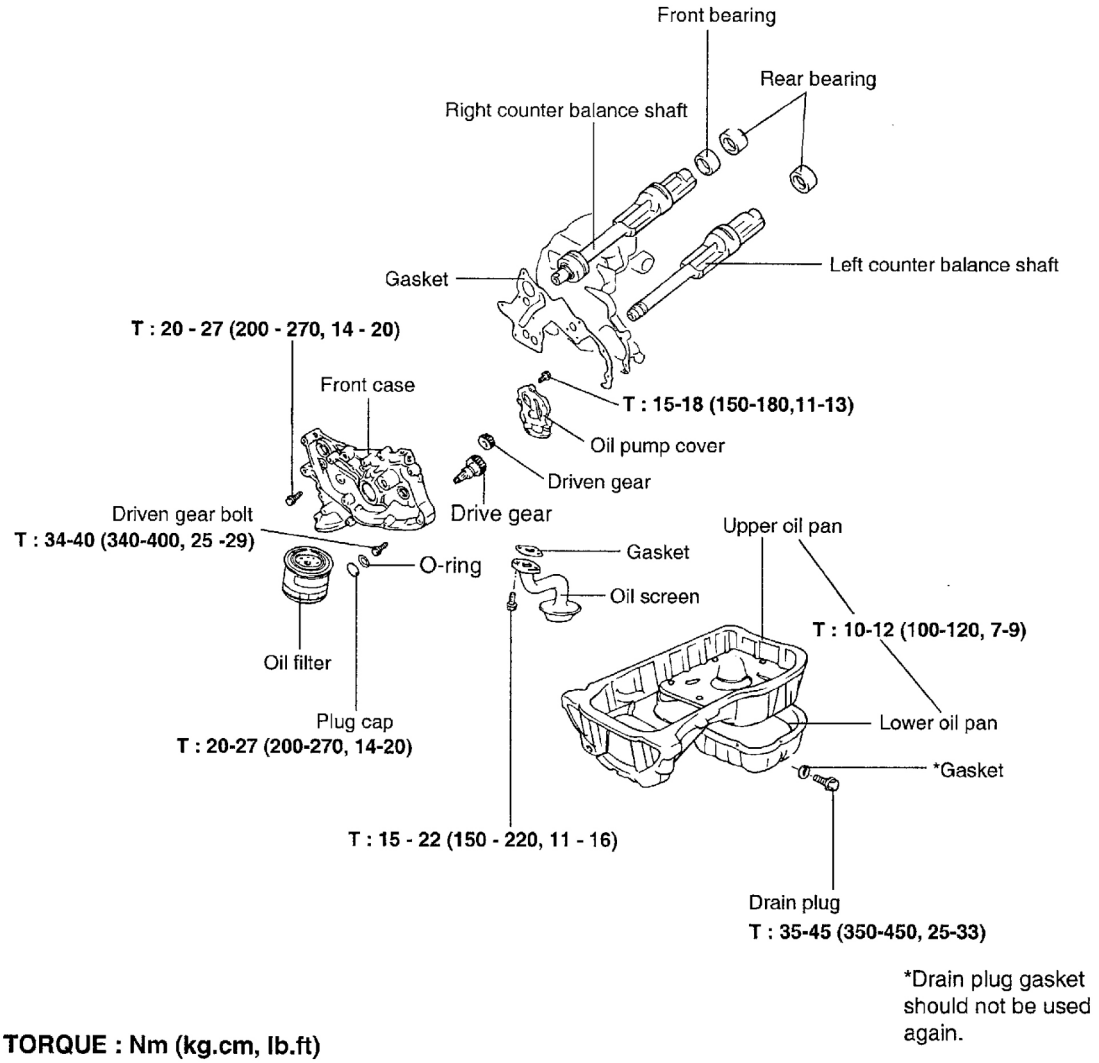


Fig. 61: Front Case Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the timing belt. Refer to **TIMING BELT**.
2. Remove all the oil pan bolts.
3. Tap the oil pan with a rubber hammer and remove the pan. (upper and lower parts)
4. Remove the oil screen and gasket.
5. Remove the front case assembly.
6. Remove the oil pressure switch.

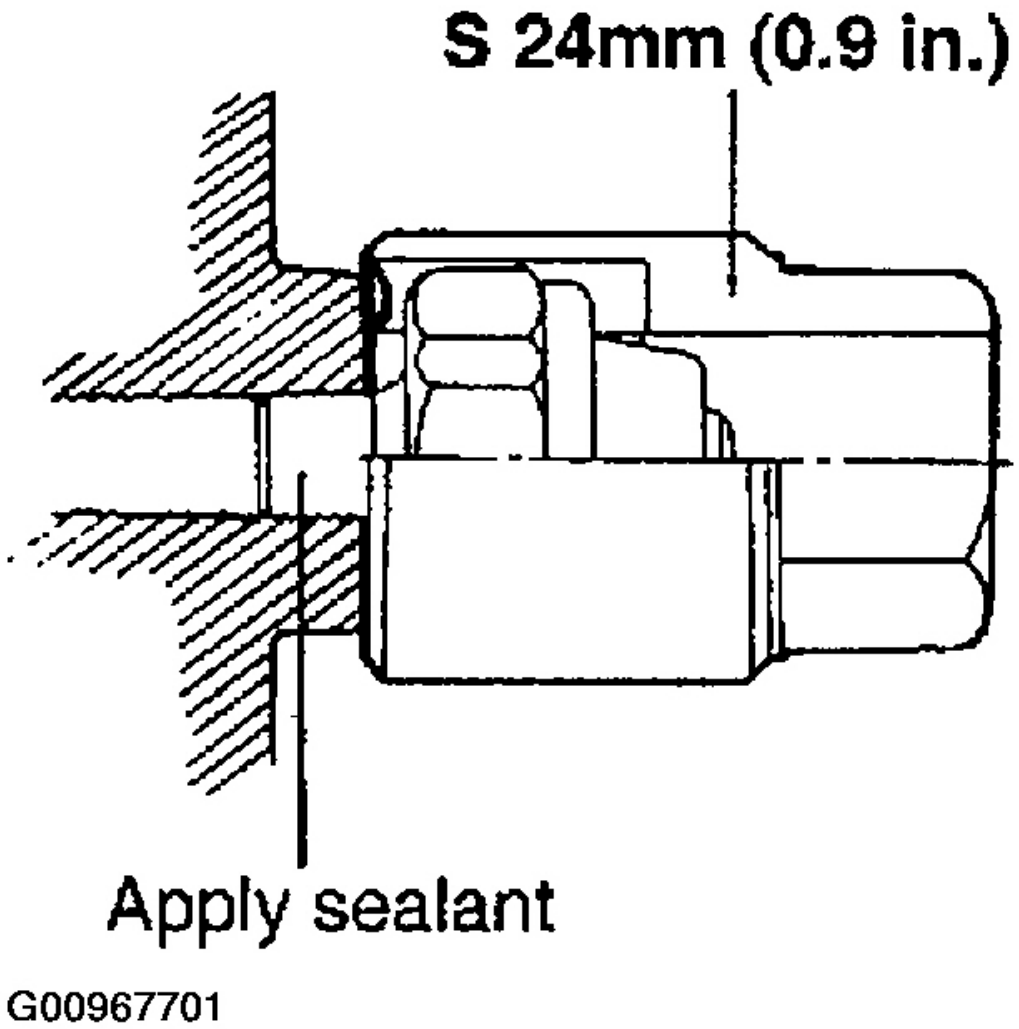


Fig. 62: Removing Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

7. Remove the oil filter bracket and gasket.
8. Using the special tool (09213-33000) remove the plug cap from the oil pump portion of the front case.

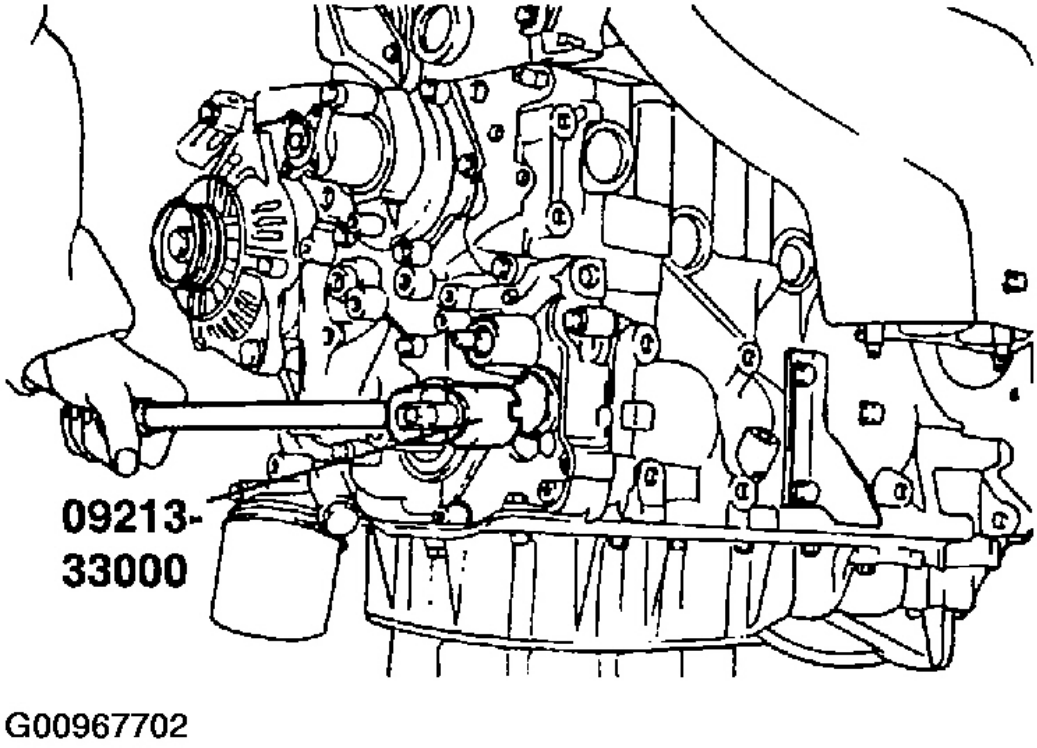
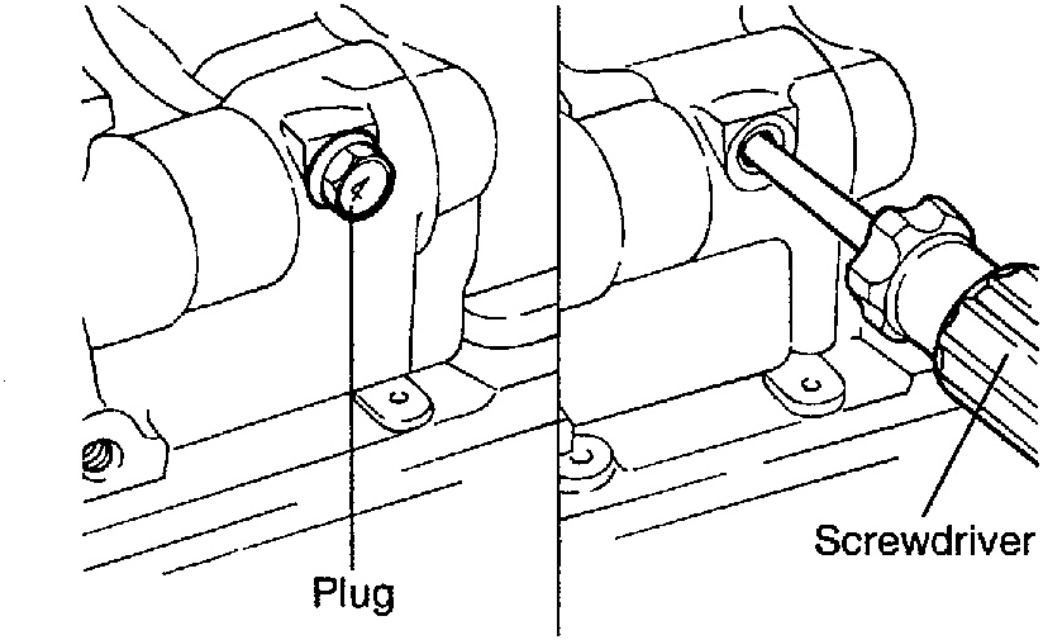


Fig. 63: Removing Plug Cap
Courtesy of HYUNDAI MOTOR CO.

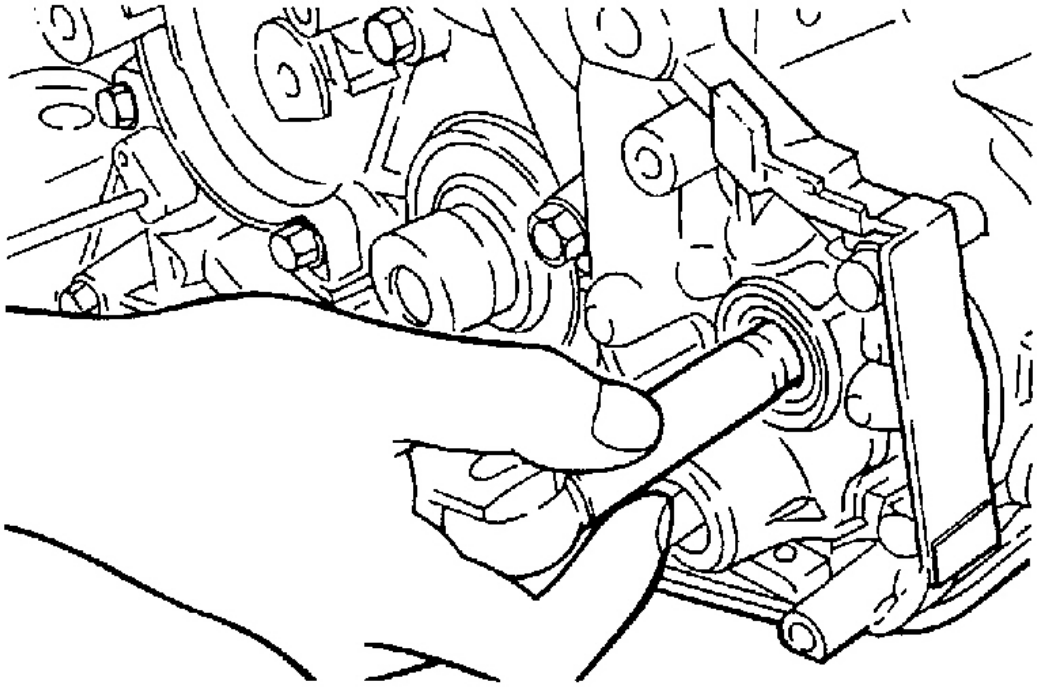
9. Remove the plug on the left side of the cylinder block and insert a screw driver with an 8 mm (0.32 in.) diameter into the plug hole. The screwdriver must be inserted more than 60 mm (2.4 in.)



G00967703

Fig. 64: Identifying Plug On Left Side Of Motor
Courtesy of HYUNDAI MOTOR CO.

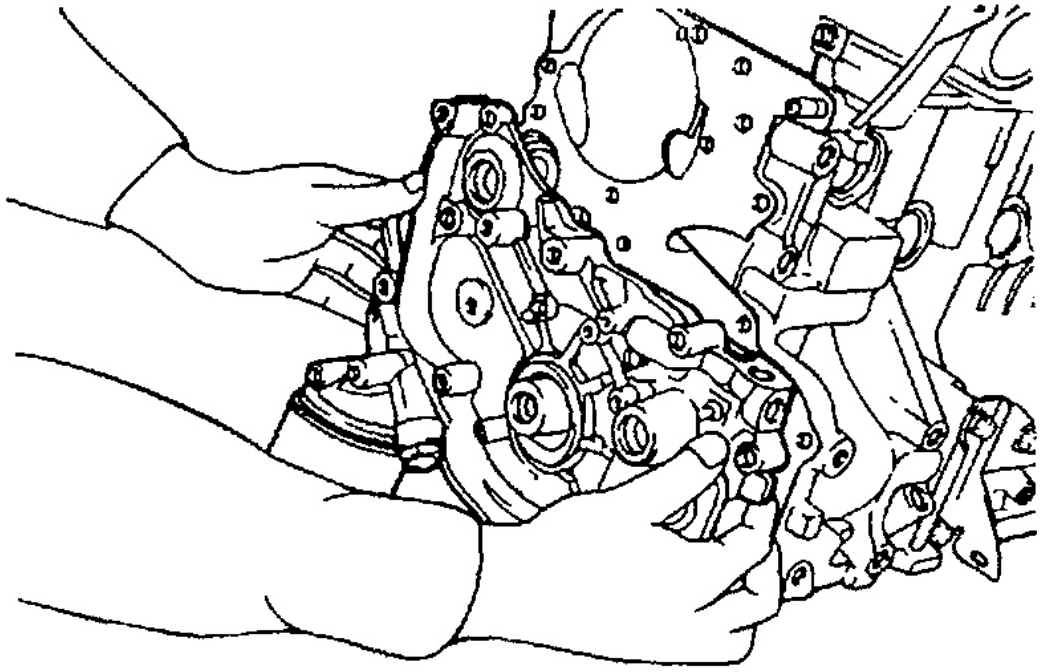
10. Remove the oil pump driven gear and the left counter balance shaft retaining bolt.



G00967704

Fig. 65: Removing Counter Balance Shaft Retaining Bolt
Courtesy of HYUNDAI MOTOR CO.

11. Remove the front case mounting bolts and remove the front case assembly and gasket and then remove the two counter balance shafts from the cylinder block.



G00967705

Fig. 66: Removing Front Case
Courtesy of HYUNDAI MOTOR CO.

12. Remove the oil pump cover from the front case.
13. Remove the oil pump gears from the front case.

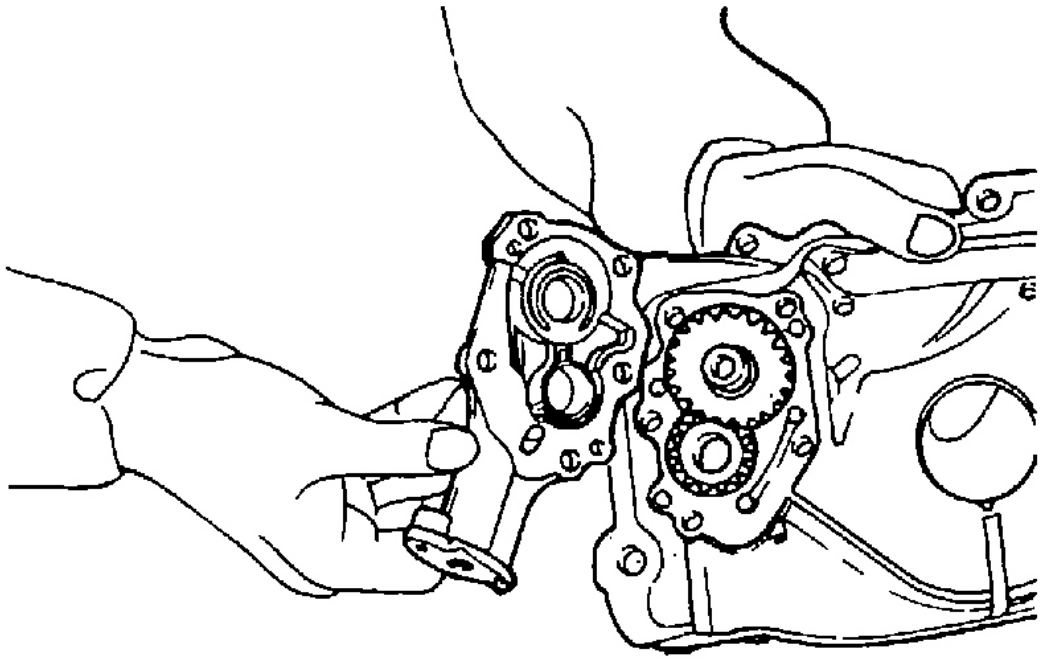


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Fig. 67: Identifying Oil Pump Gears
Courtesy of HYUNDAI MOTOR CO.

14. Remove the screw driver (Step 9).

INSPECTION

FRONT CASE

1. Check all oil holes for clogging. Clean the holes if necessary.
2. Check the counter balance shaft front bearing for wear, damage and seizure. If there is anything wrong with the bearing, replace the front case.
3. Check the front case for cracks and other damage.
4. Replace a cracked or damaged front case.

COUNTER BALANCE SHAFT

1. Check the journals for wear or seizure.
2. If excessive wear or seizure is evident, check the bearing carefully.
3. If necessary, replace the counter balance shaft bearing or the shaft itself.

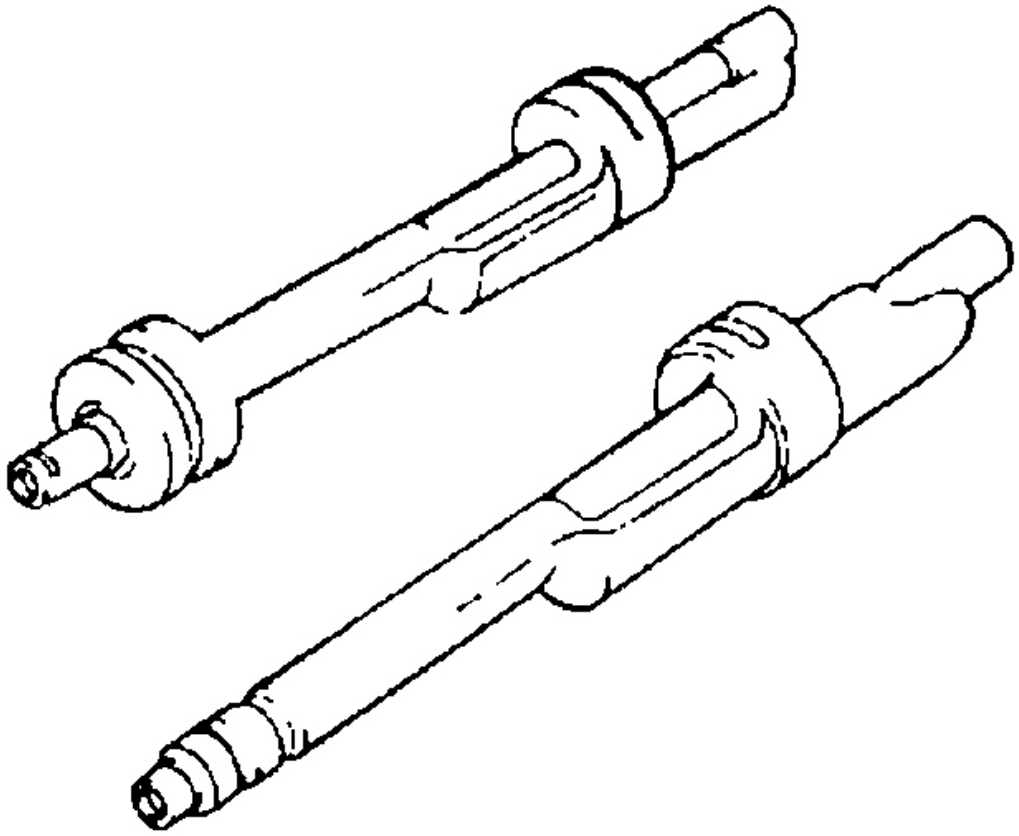


Fig. 68: Identifying Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

OIL SEAL

1. Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
2. Check the oil seal lip for deterioration. Replace the oil seal if necessary.

OIL PRESSURE SWITCH

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

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

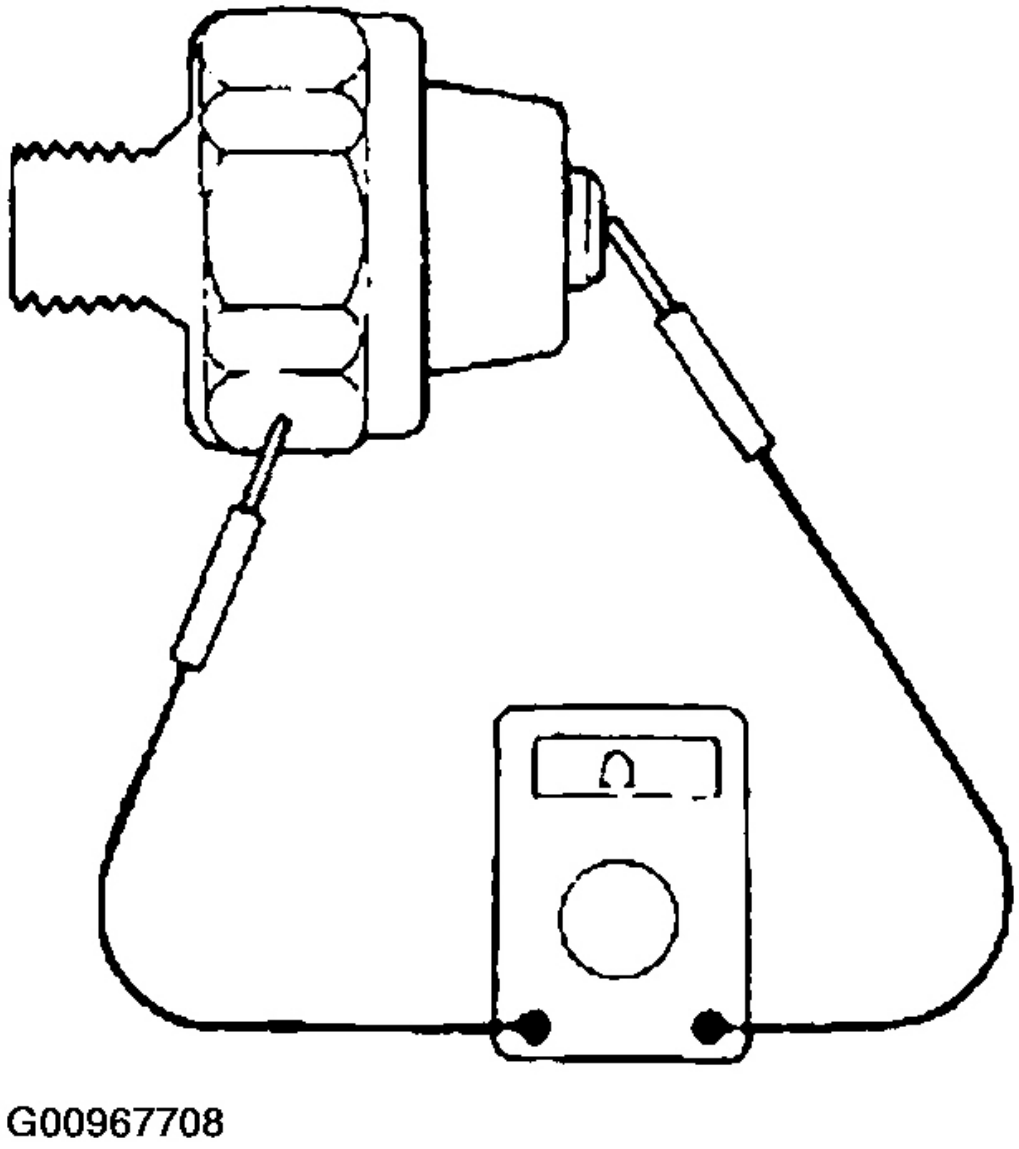


Fig. 69: Checking Oil Pressure Switch Continuity
Courtesy of HYUNDAI MOTOR CO.

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 an air leak. If air leaks, the diaphragm is broken. Replace the switch.

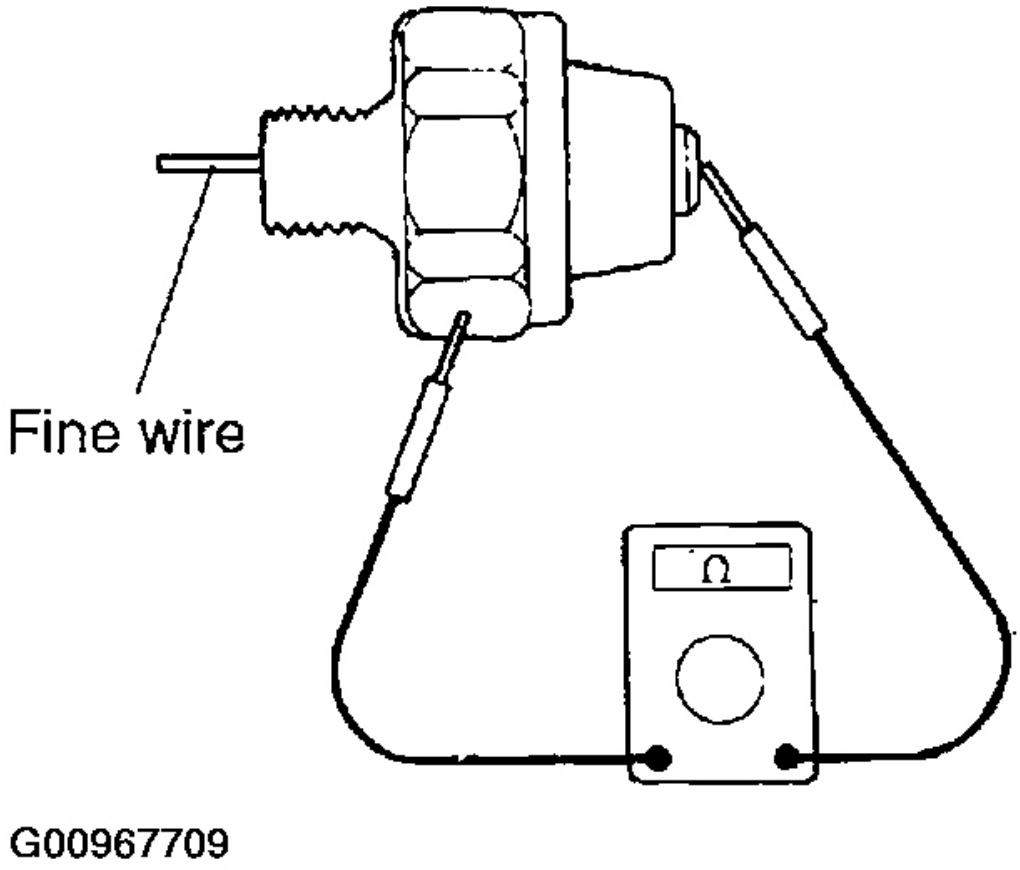


Fig. 70: Checking Oil Pressure Switch Continuity With Fine Wire
Courtesy of HYUNDAI MOTOR CO.

OIL PUMP

1. Assemble the oil pump gear to the front case and rotate it to verify smooth rotation with no looseness.
2. Make sure that there is no ridge wear on the contact surface between the front case and the gear surface of the oil pump cover.
3. Install the drive and driven gears to the front case. Measure the tip clearance of the gears.

   [Standard value]

   Drive gear: 0.16-0.21 mm (0.0063-0.0083 in.)

   Driven gear: 0.18-0.21 mm (0.0071-0.0083 in.)

[Limit]

Drive gear: 0.25 mm (0.0098 in)

Driven gear: 0.25 mm (0.0098 in.)

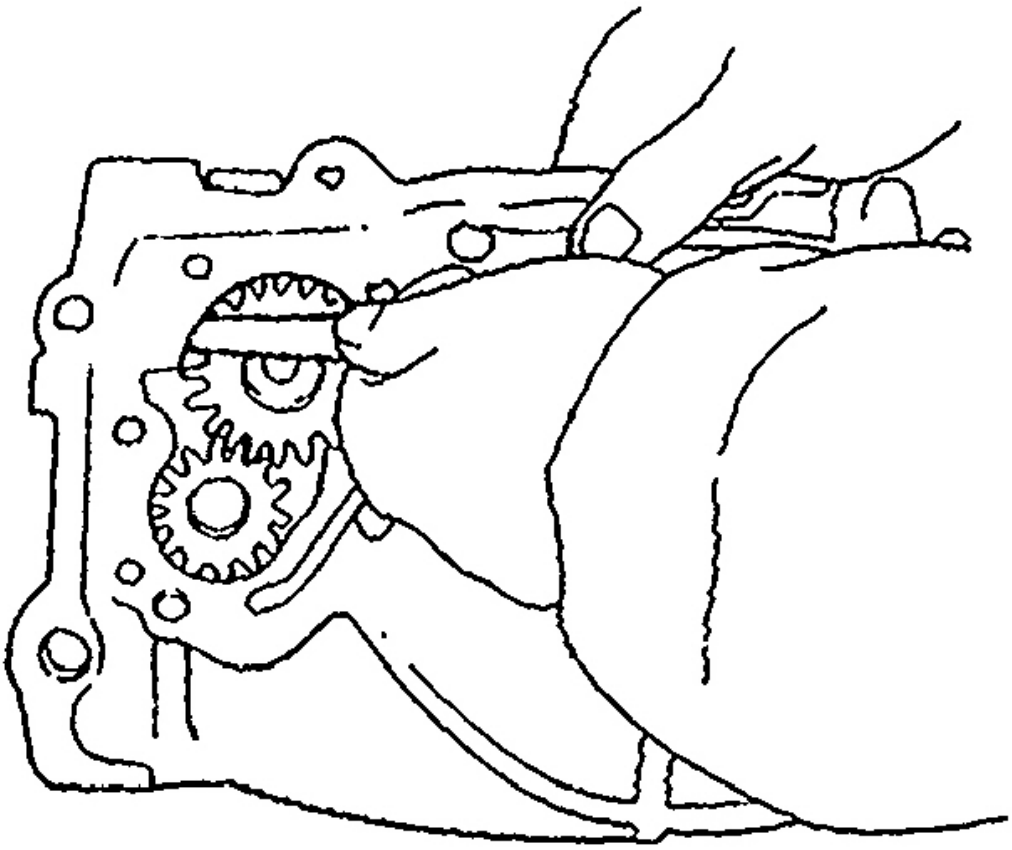


Fig. 71: Measuring Tip Clearance Of Drive & Driven Gears
Courtesy of HYUNDAI MOTOR CO.

4. Check the side clearance.

[Standard value]

Drive gear: 0.08-0.14 mm (0.0031-0.0055 in.)

Driven gear: 0.06-0.12 mm (0.0024-0.0047 in.)

[Limit]

Drive gear: 0.25 mm (0.0098 in)

Driven gear: 0.25 mm (0.0098 in.)

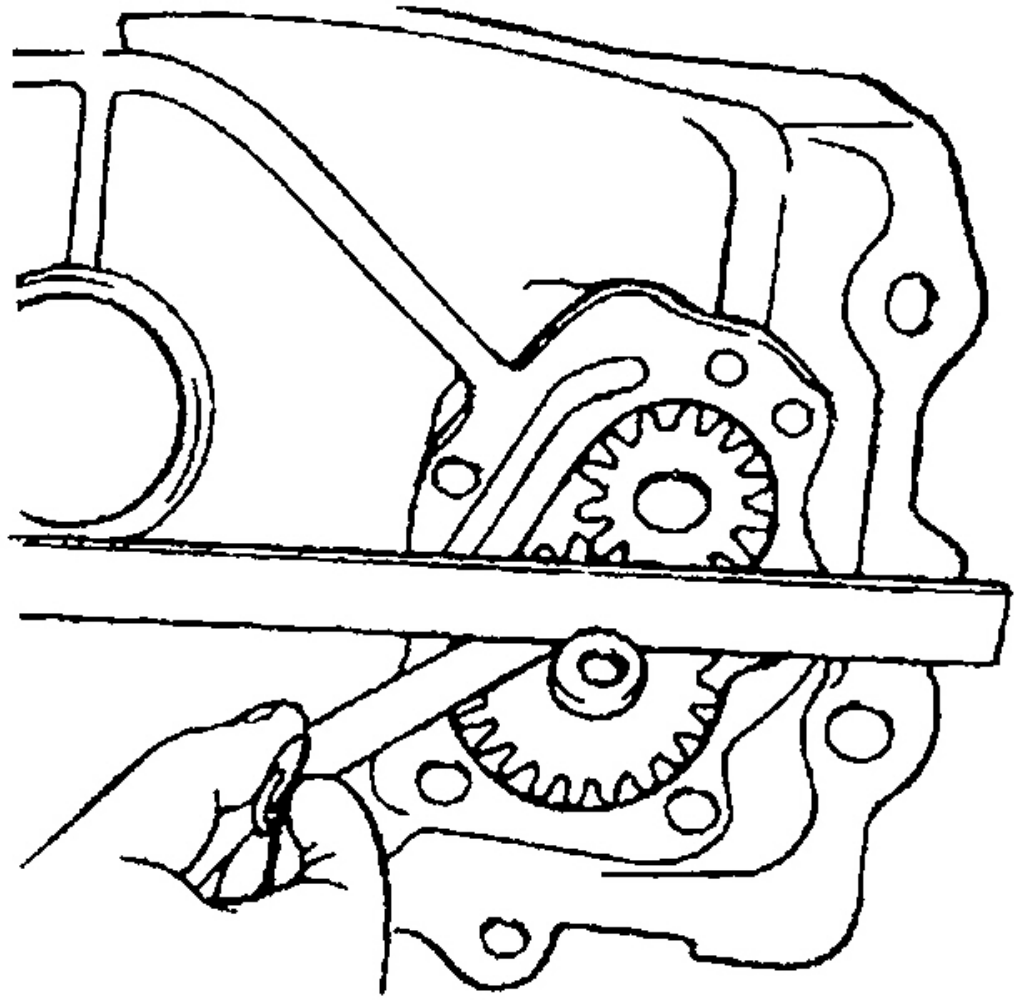


Fig. 72: Checking Side Clearance
Courtesy of HYUNDAI MOTOR CO.

COUNTER BALANCE SHAFT BEARING

REPLACEMENT

1. Using a special tool, remove the front bearing of the right counter balance shaft from the cylinder block.

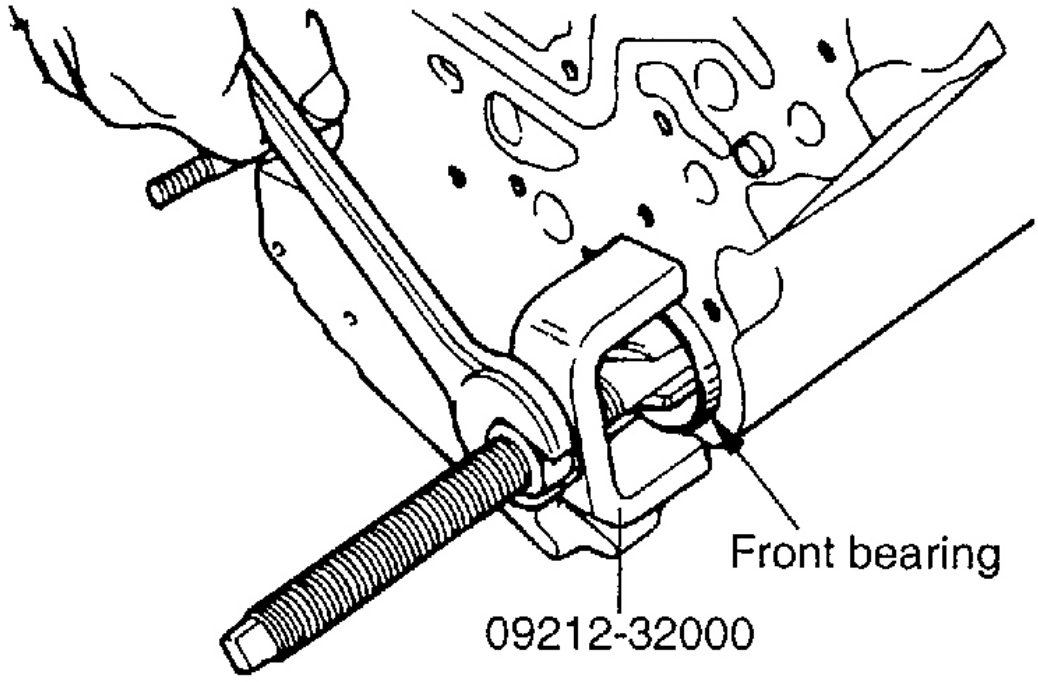


Fig. 73: Removing Front Bearing Of Right Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

2. Using a special tool, remove the rear bearing of the right counter balance shaft from the cylinder block.

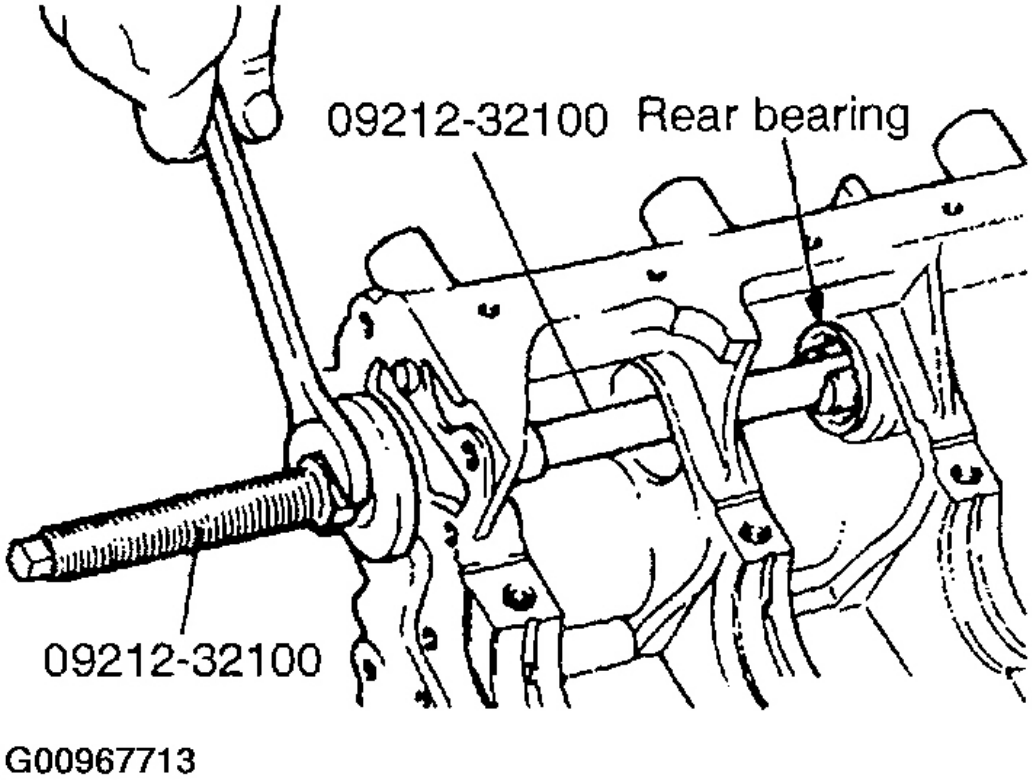


Fig. 74: Removing Rear Bearing Of Right Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

3. Using a special tool, remove the rear bearing of the left counter balance shaft from the cylinder block. At this time, install a special tool on the front surface of cylinder block to hold the bearing puller.

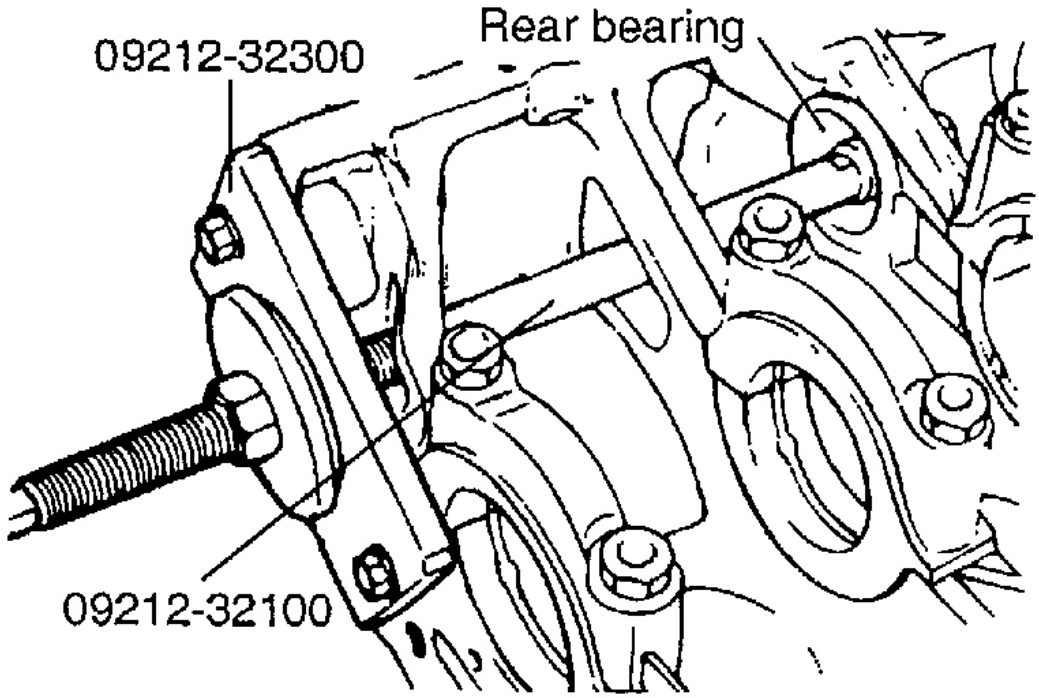


Fig. 75: Removing Rear Bearing Of Left Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

4. Using a special tool, install the rear bearing of the left counter balance shaft to the cylinder block.

NOTE:

1. **Apply engine oil to the outside of rear bearing and bearing hole in cylinder block.**
2. **The left rear bearing has no oil holes.**

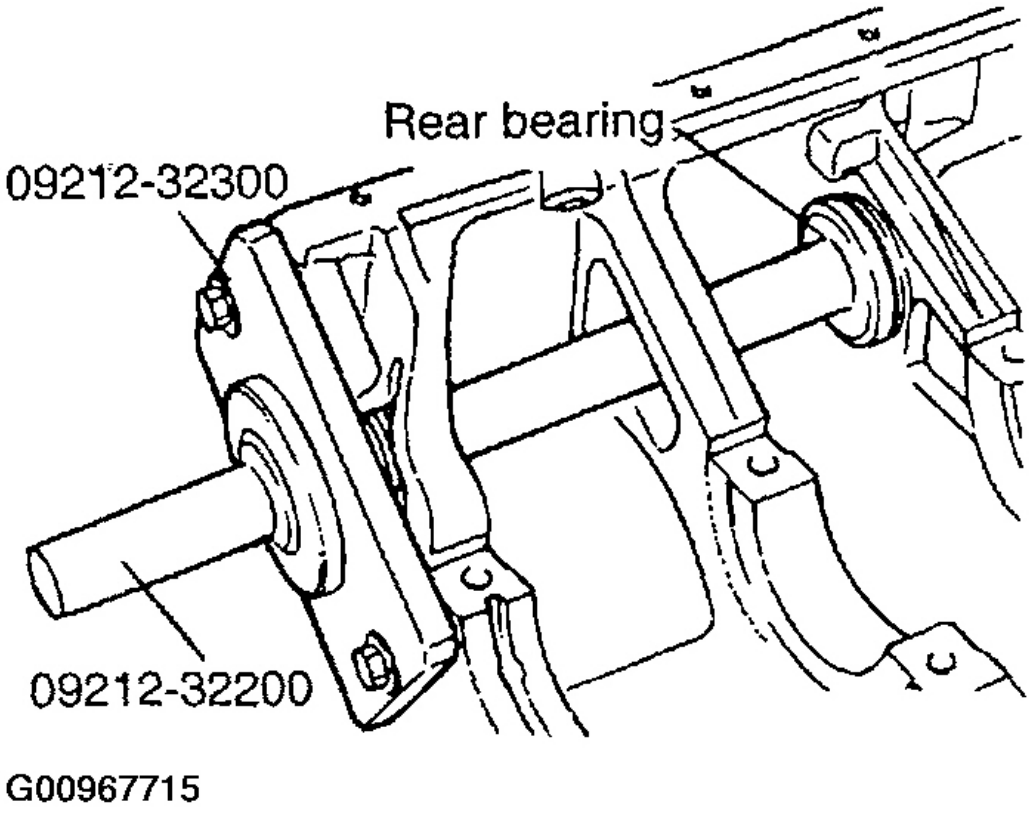


Fig. 76: Installing Rear Bearing Of Left Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

5. Using a special tool, install the rear bearing of the right counter balance shaft to the cylinder block.

NOTE:

1. **Apply engine oil to the outside surface of the bearing.**
2. **Make sure that the bearing oil hole is aligned with the oil hole of cylinder block.**

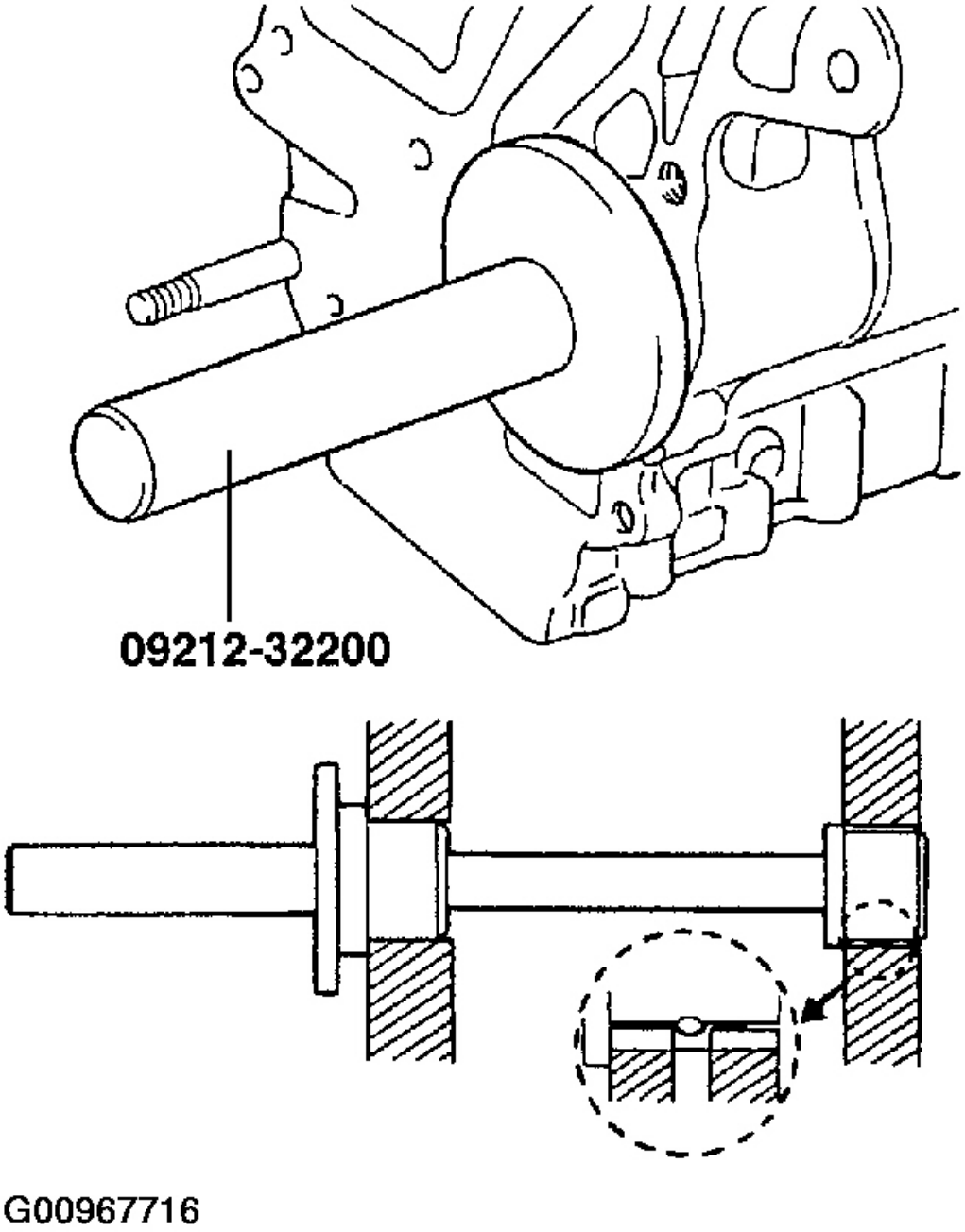
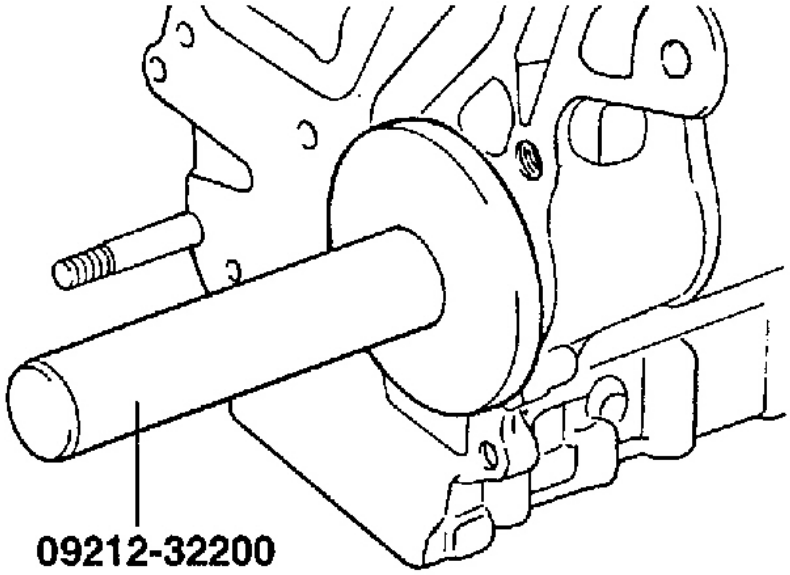


Fig. 77: Installing Rear Bearing Of Right Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

6. Using a special tool, install the front bearing of the right counter balance shaft to the cylinder block.



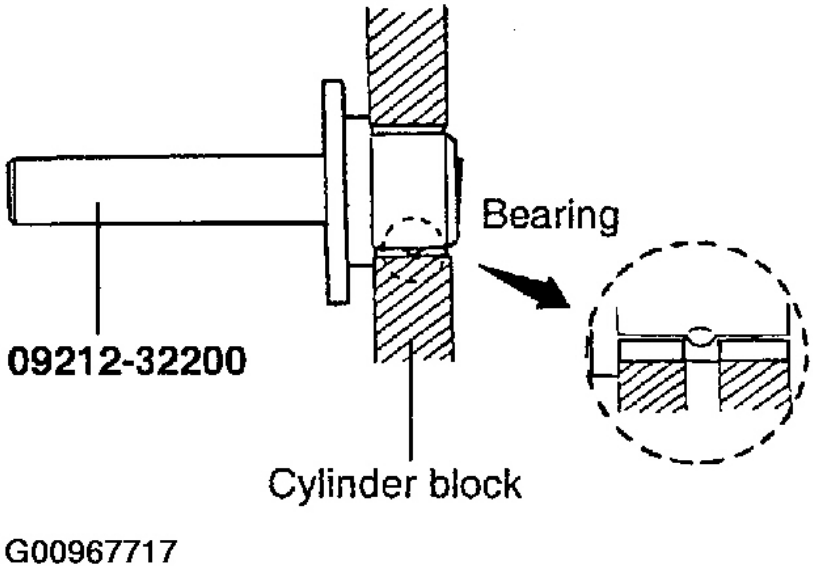


Fig. 78: Installing Front Bearing Of Right Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

NOTE: Make sure that the bearing oil hole is aligned with the oil hole cylinder

block.

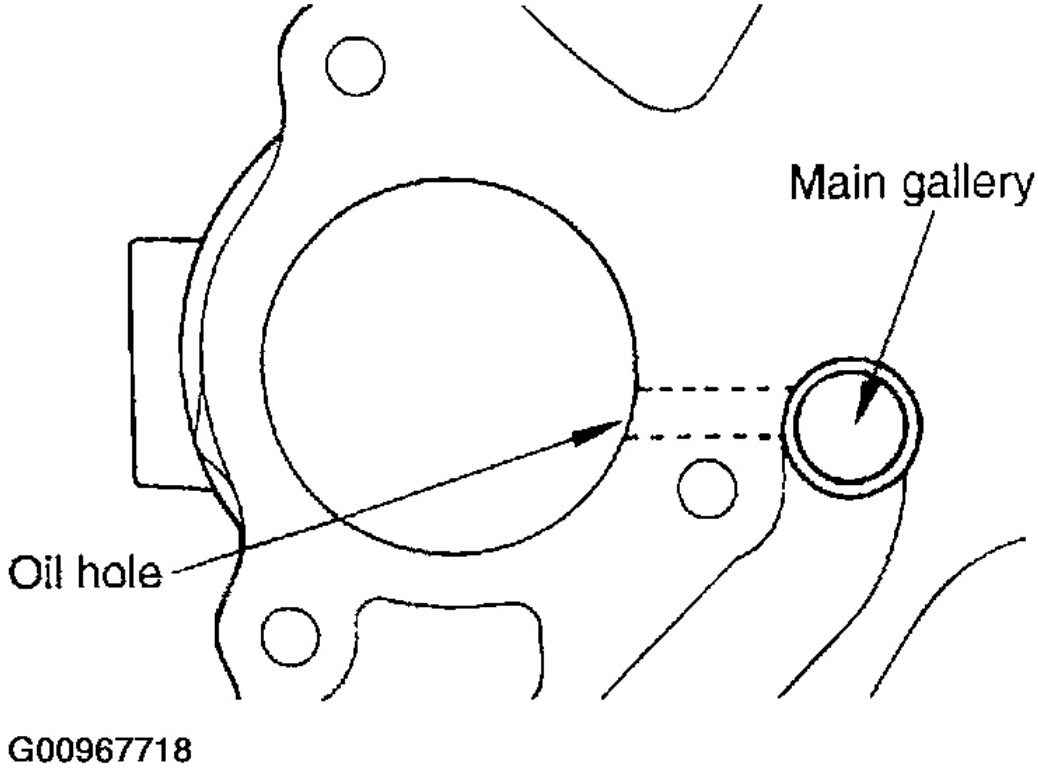


Fig. 79: Identifying Oil Hole
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Apply engine oil to the gear and align the two timing marks.

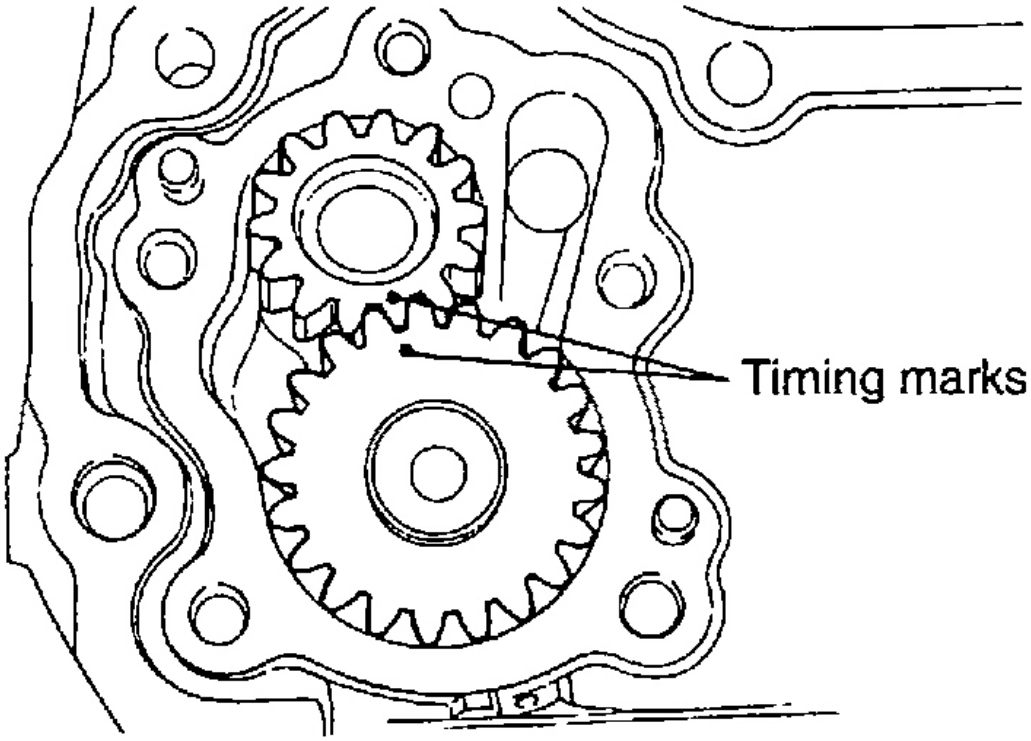


Fig. 80: Identifying Timing Marks
Courtesy of HYUNDAI MOTOR CO.

2. Using the special tool, the crankshaft front oil seal installer (09214-32000), install the crankshaft front oil seal into the front case.

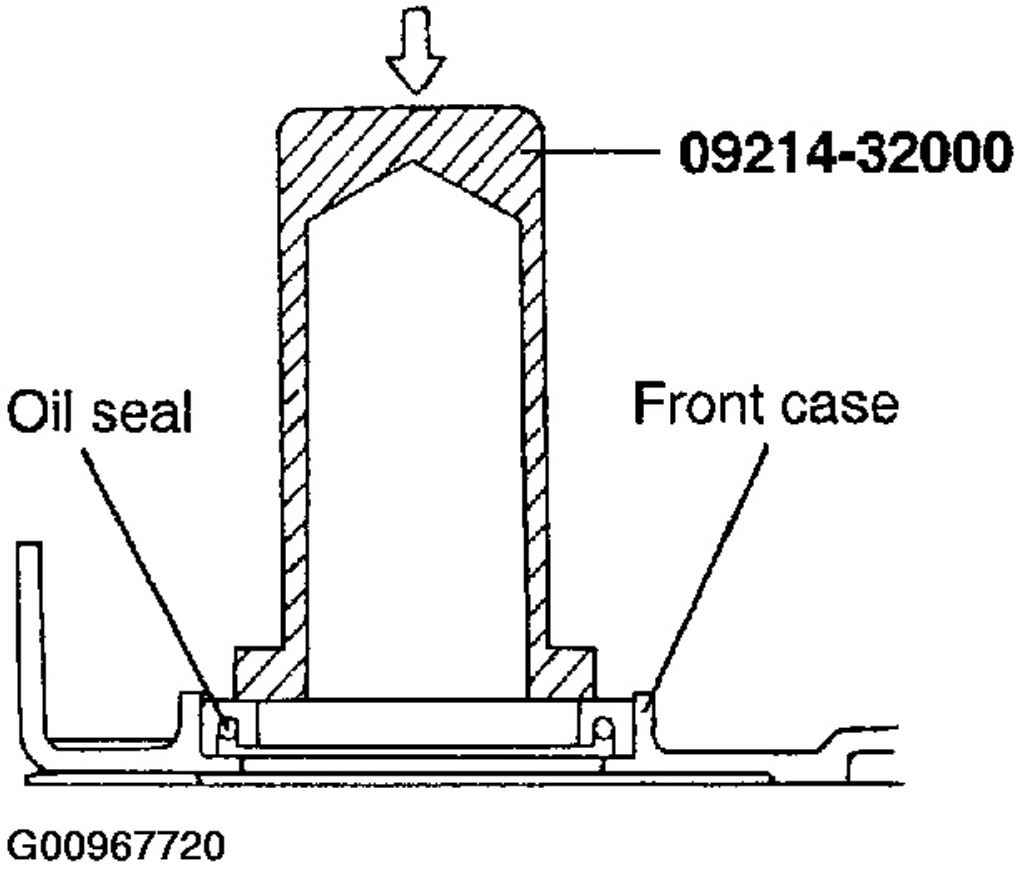


Fig. 81: Installing Front Crankshaft Oil Seal
Courtesy of HYUNDAI MOTOR CO.

3. Set the special tool (09214-32100) on the front end of the crankshaft and apply a thin coat of engine oil to the outer circumference of the special tool to install the front case.

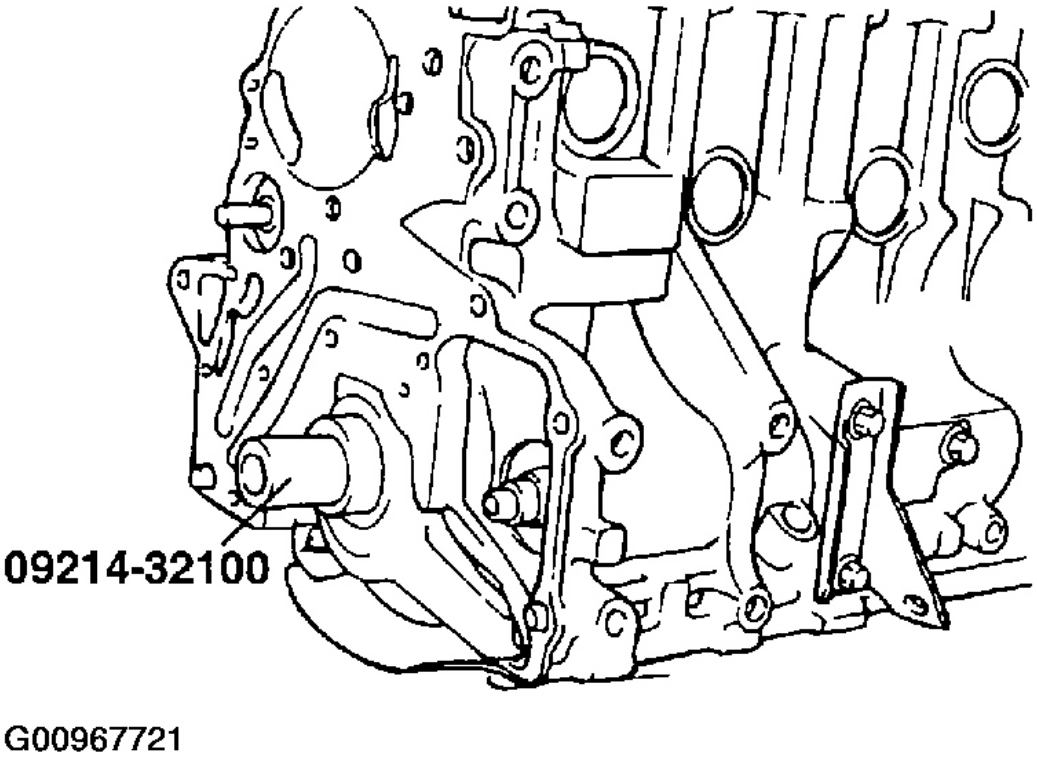


Fig. 82: Identifying Special Tool
Courtesy of HYUNDAI MOTOR CO.

4. Install a new front case gasket to the front case assembly and tighten the flange bolts temporarily.

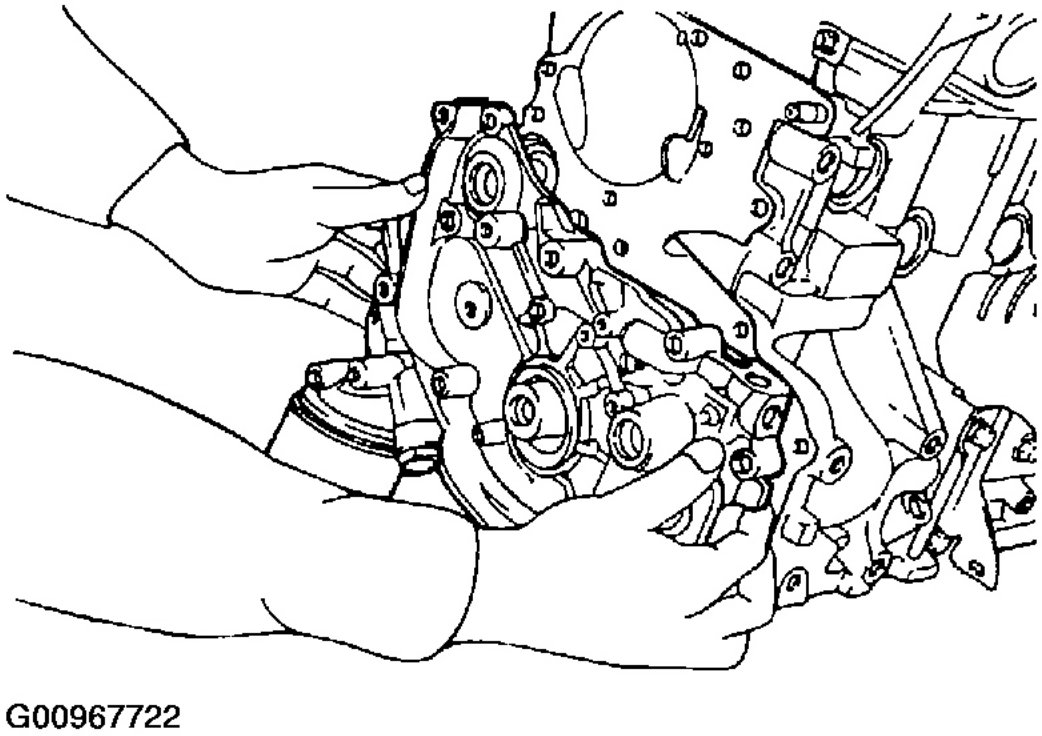


Fig. 83: Installing Front Case
Courtesy of HYUNDAI MOTOR CO.

5. Install the front case assembly with a new gasket. Tighten bolts to the specified torque.

   Front case assembly

   Tightening torque: 20-27 N.m (200-270 kg.cm, 14-20 lb.ft)

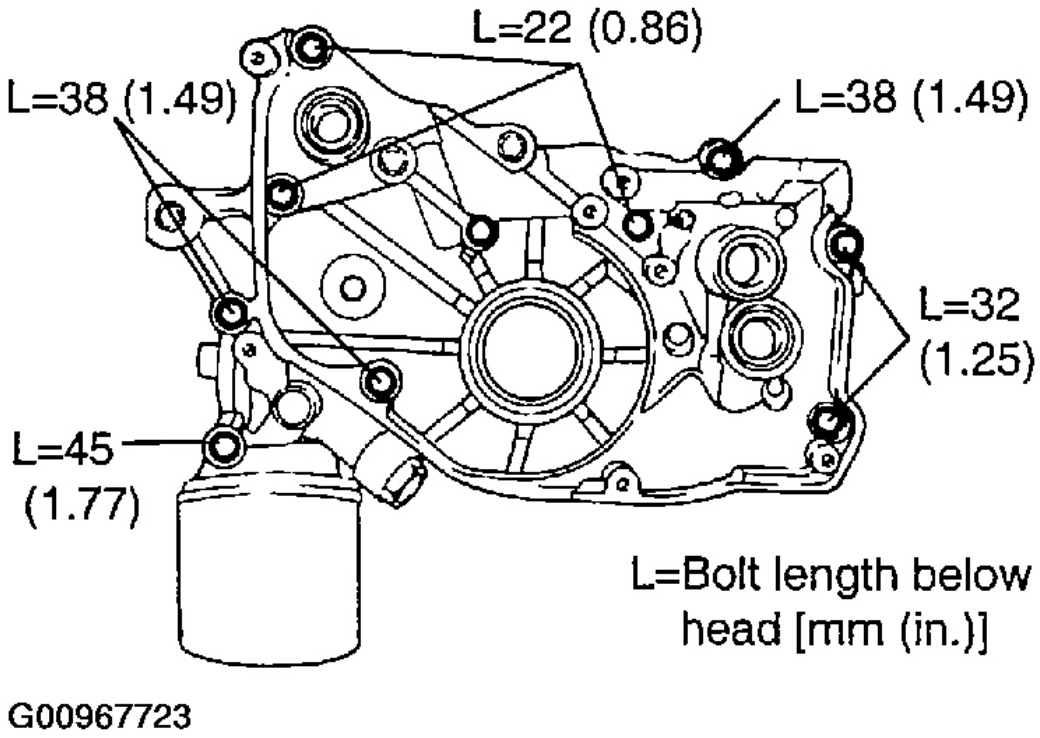


Fig. 84: Identifying Front Case Bolts
Courtesy of HYUNDAI MOTOR CO.

6. Insert a screwdriver into the plug hole in left side of cylinder block. After verifying that the shaft is in the proper position, replace the bolt and tighten it.

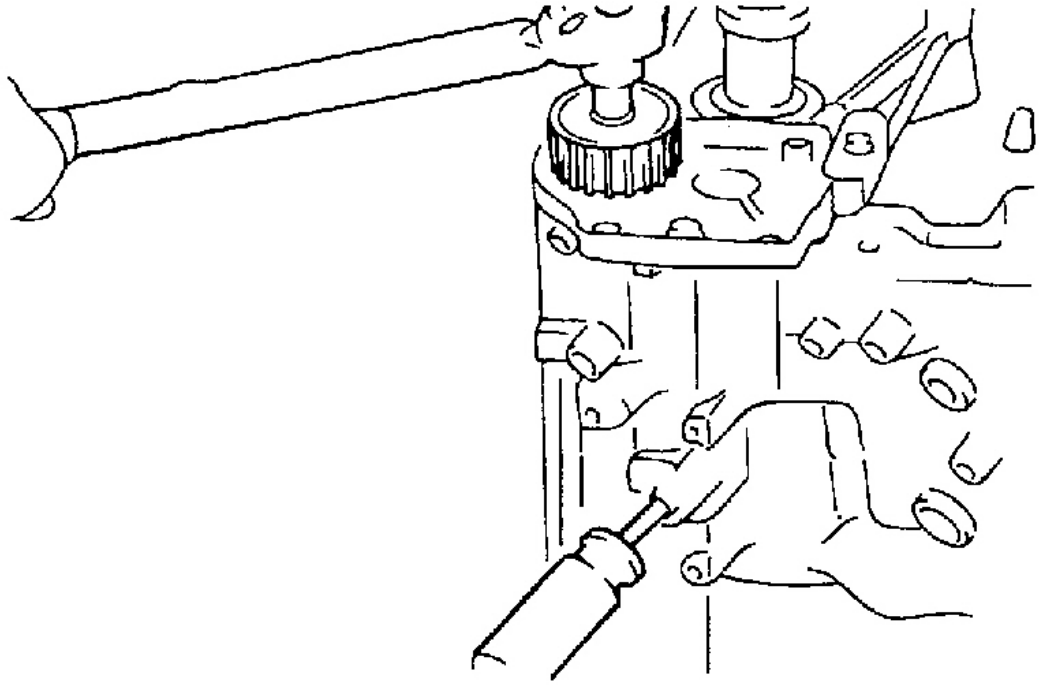


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Fig. 85: Verifying Shaft Position
Courtesy of HYUNDAI MOTOR CO.

7. Install a new O-ring to the groove of the front case.
8. Using a special tool, install the plug case and tighten it to the specified torque.

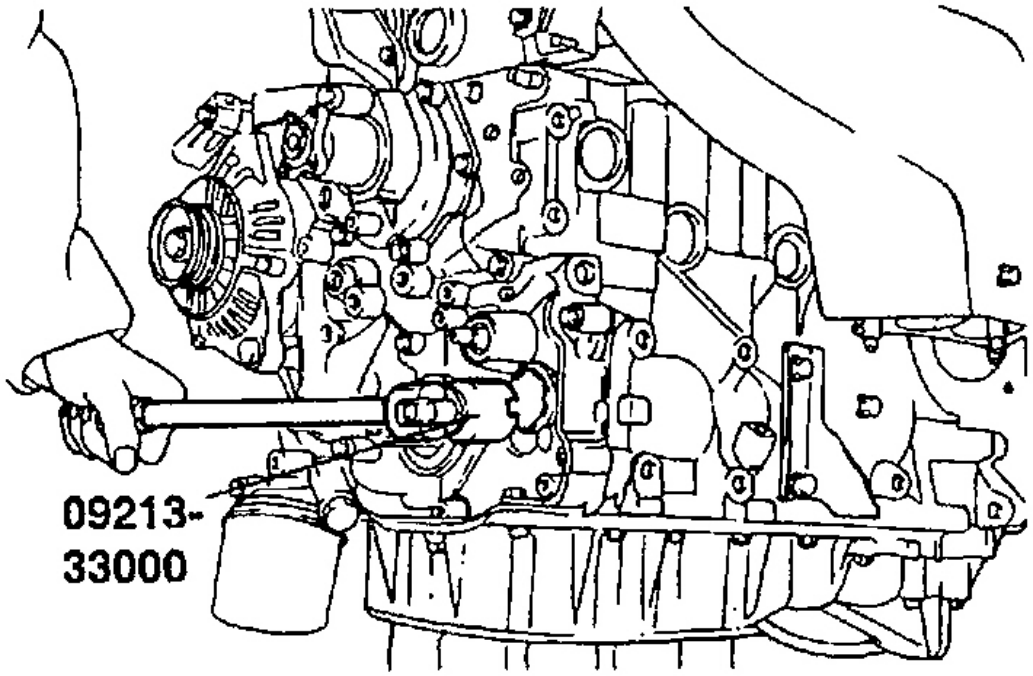

Fig. 86: Installing Plug Case
Courtesy of HYUNDAI MOTOR CO.

Plug cap

Tightening torque: 20-27 N.m (200-270 kg.cm, 14-20 lb.ft)

9. Apply sealant to the groove of the pan flange as shown.

NOTE:

1. **Apply sealant approximately 4 mm (0.16 in.) in thickness.**
2. **After the application of the sealant, install the oil pan within 15 minutes.**

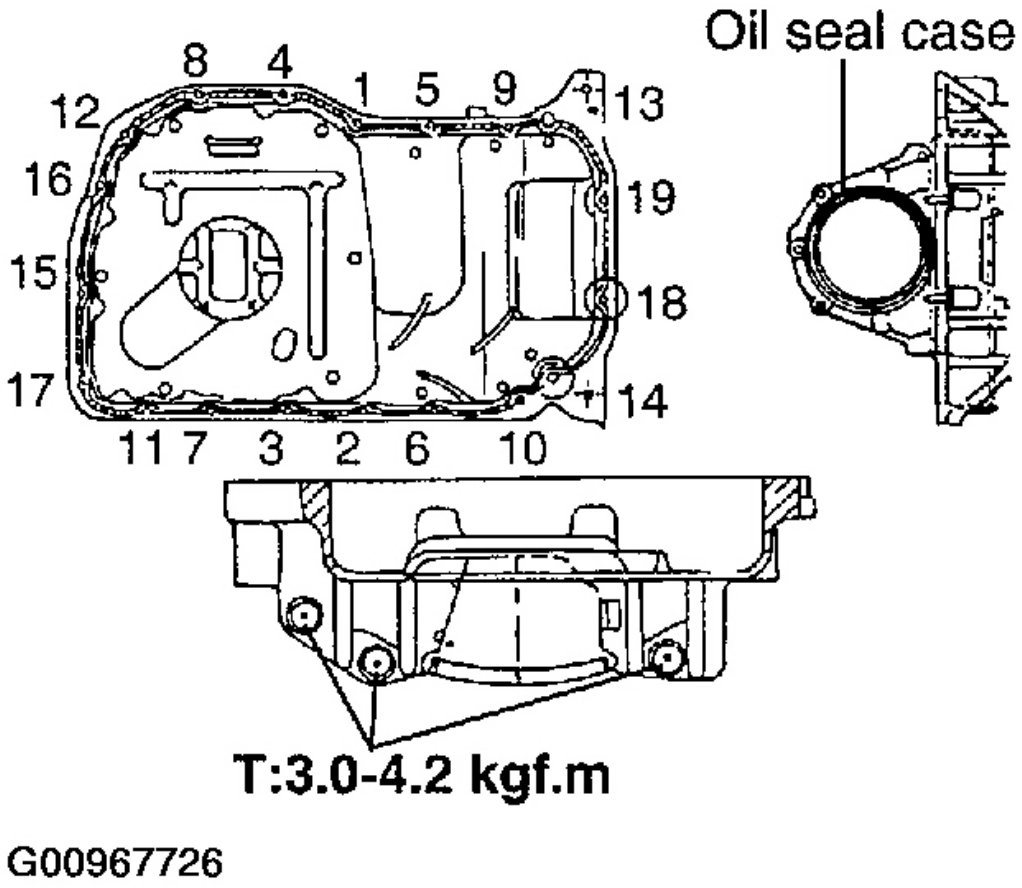

Fig. 87: Oil Pan Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

10. Note the difference in bolt lengths at the locations shown.

    Install the upper and lower oil pans and tighten the bolts to the specified torque.

    Tightening torque

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

11. Using a 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area.

    Sealant: Threebond 1104 or equivalent

    NOTE: Do not torque the oil pressure switch excessively.

Tightening torque

Oil pressure switch: 8-12 N.m (80-120 kg.cm, 6-9 lb.ft)

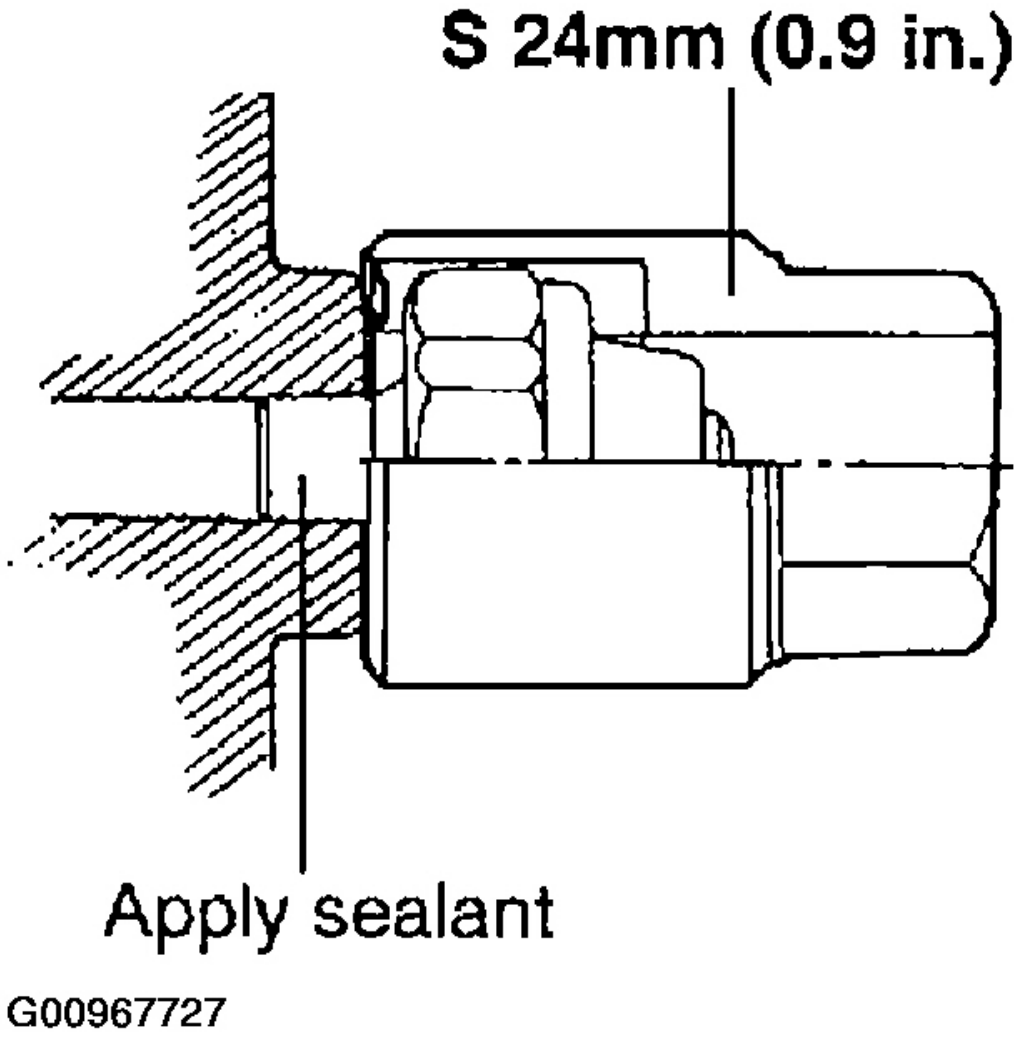

Fig. 88: Installing Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

MAIN MOVING SYSTEM

CAMSHAFT

COMPONENTS

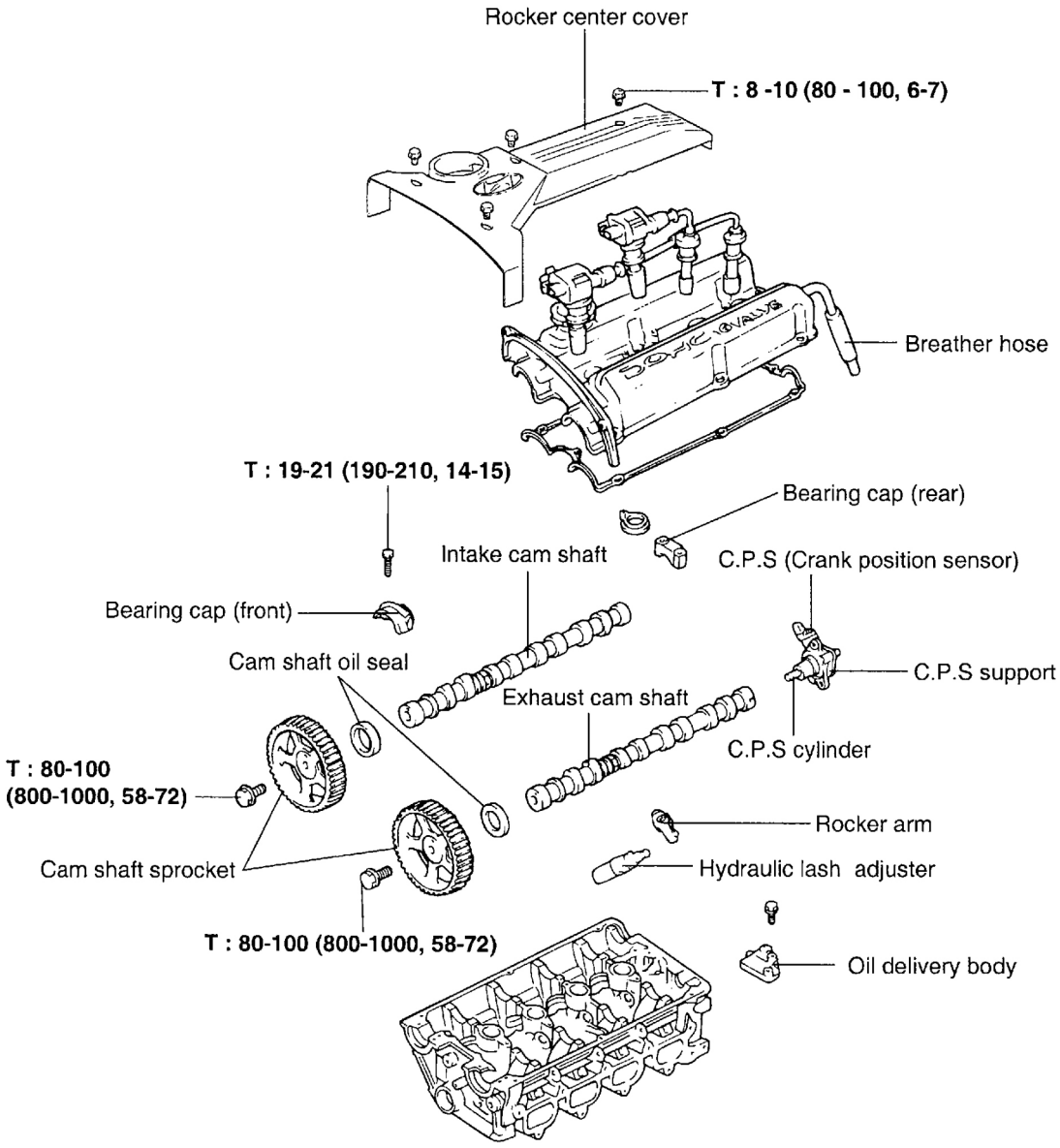

Fig. 89: Camshaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Disconnect the negative terminal from the battery.
2. Drain the engine coolant.
3. Remove the breather hose between the air cleaner and the rocker cover.
4. Remove the air cleaner.

5. Remove the timing belt cover.
6. Remove the rocker cover and crank shaft position sensor.
7. Loosen the camshaft sprocket bolts then remove the camshaft sprockets.
8. Loosen the camshaft bearing cap bolts and remove the bearing caps, camshafts, rocker arms and lash adjusters.

CAUTION: Loosen the cap bolts in increments to avoid bending the camshafts.

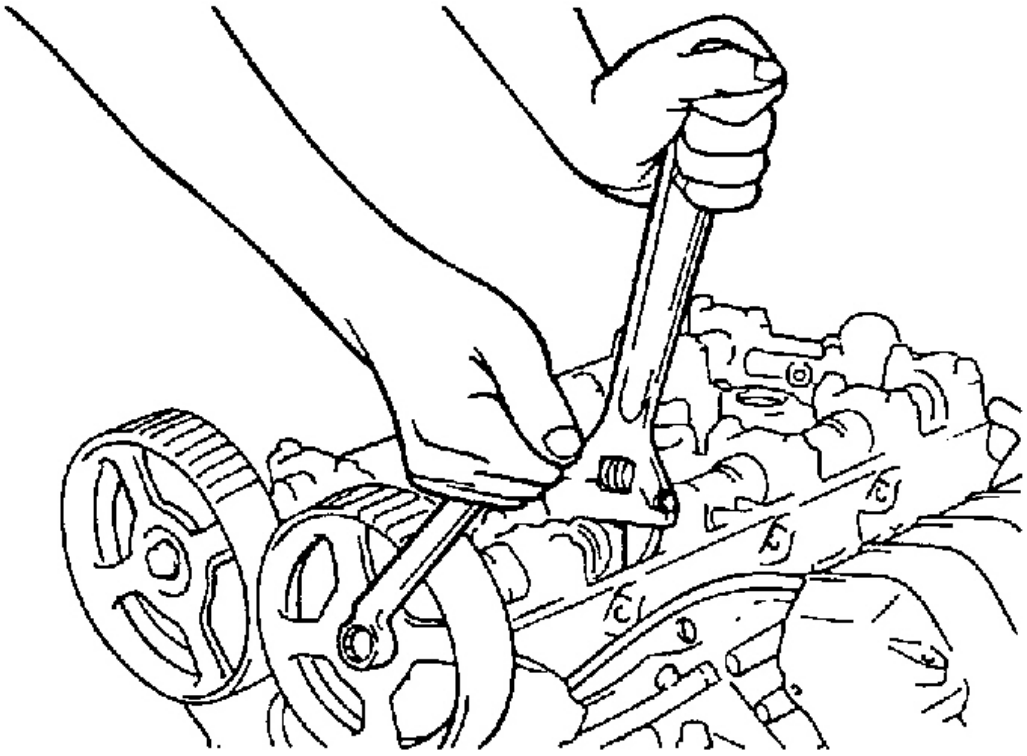

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Fig. 90: Loosening Camshaft Sprocket Bolt
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

ROCKER ARMS

1. Check rotation of the roller. If they do not rotate smoothly or are loose, replace them.

2. Check the roller surface. Replace if there is any dent, damage or evidence to seizure.
3. Check the valve contact surface for possible damage or evidence of seizure. Replace if necessary.

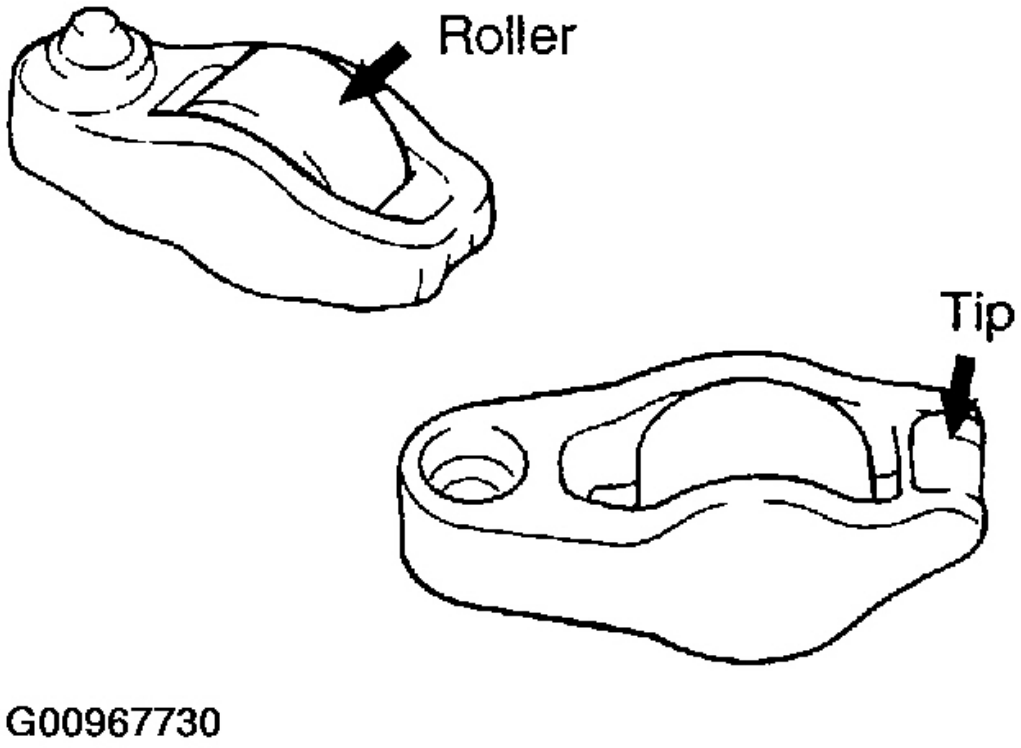

Fig. 91: Identifying Rocker Arms
Courtesy of HYUNDAI MOTOR CO.

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.

Cam height

[Standard]

Intake: 35.493 mm (1.3974 in.)

Exhaust: 35.204 mm (1.3860 in.)

[Limit]

Intake : 34.993 mm (1.3776 in.)

Exhaust: 34.704 mm (1.3663 in.)

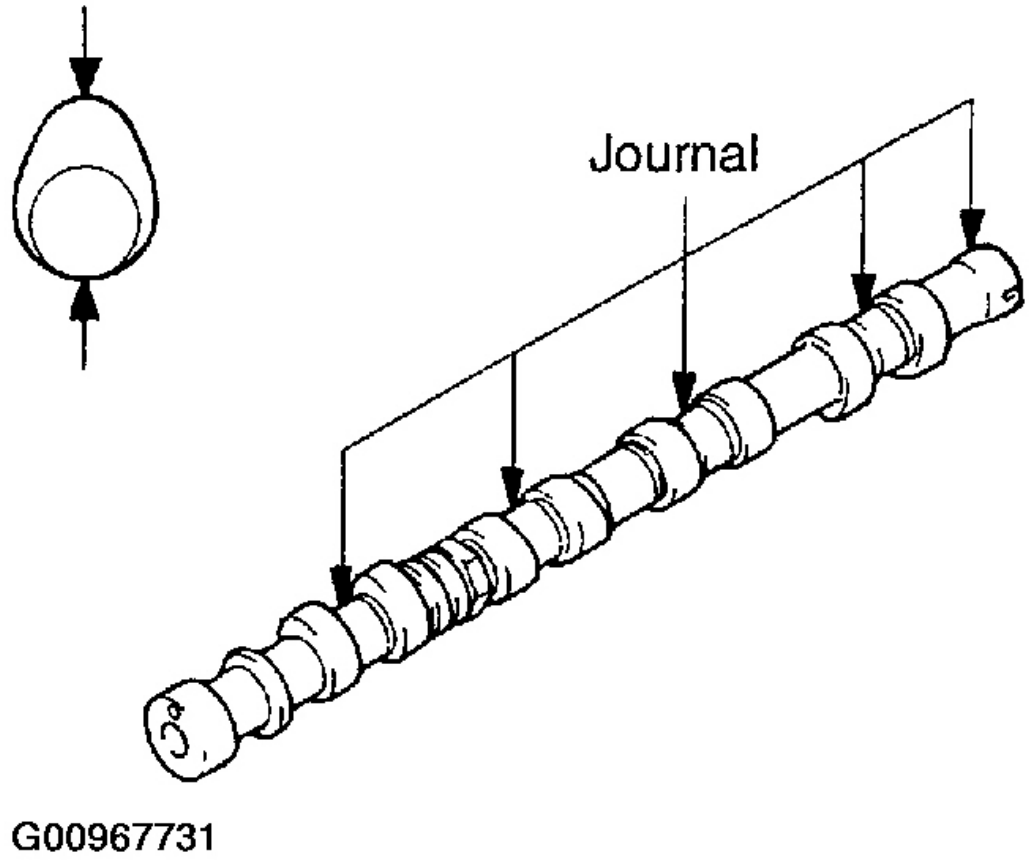

Fig. 92: Identifying Camshaft Journals & Lobes
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Install the camshafts on the cylinder head. Do not install the rocker arms yet.

NOTE:

1. **Apply engine oil to journals and cams of the camshafts.**
2. **The exhaust camshaft has a slit on its rear end for the crankshaft position sensor.**

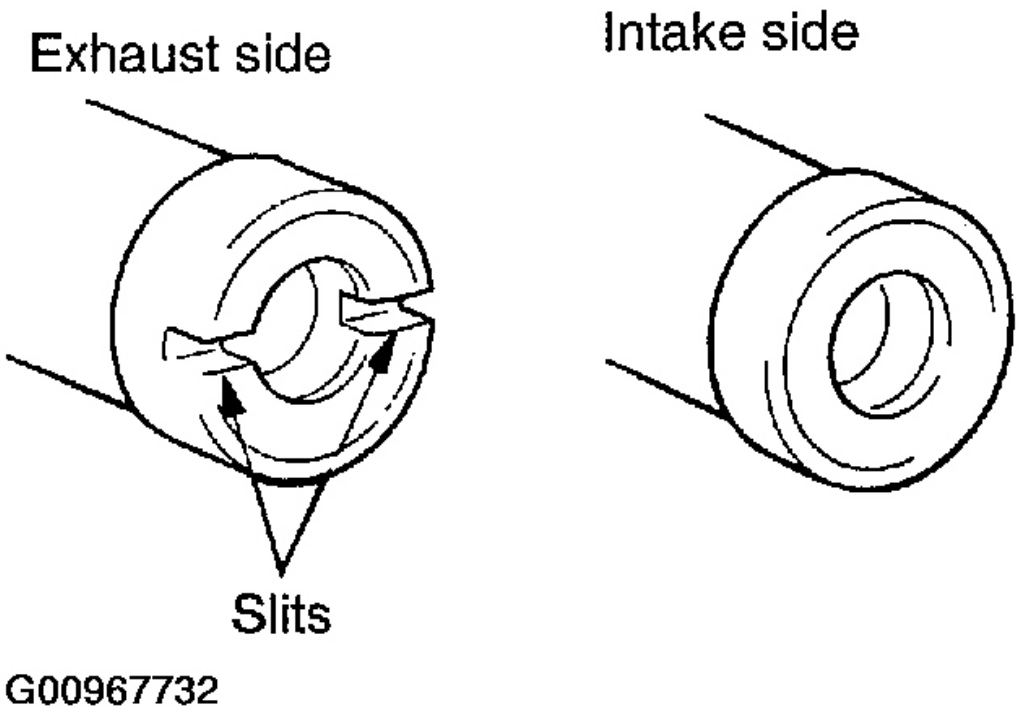

Fig. 93: Identifying Camshafts
Courtesy of HYUNDAI MOTOR CO.

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

   I: Intake camshaft. E: Exhaust camshaft

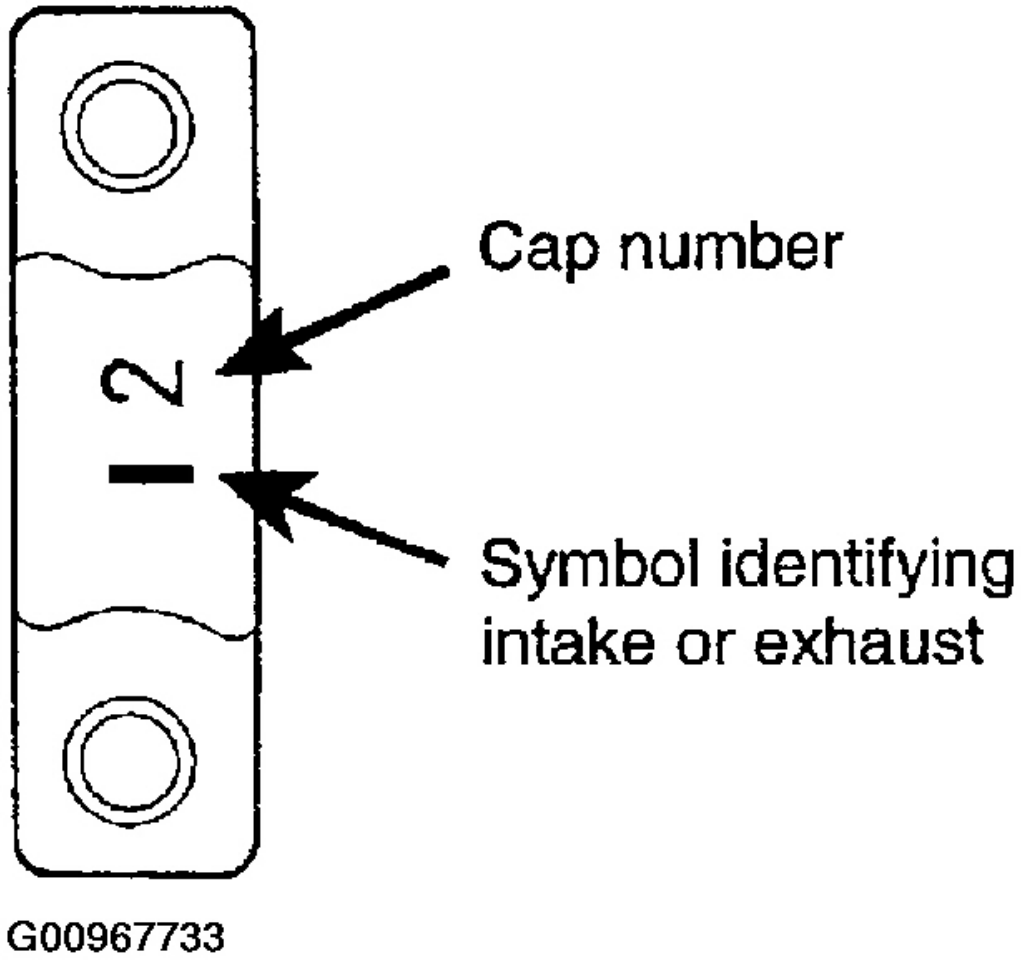

Fig. 94: Identifying Camshafts Bearing Cap
Courtesy of HYUNDAI MOTOR CO.

3. Check that the camshaft can be easily turned by hand. After checking, remove the bearing caps and the camshafts, and then install the rocker arms.

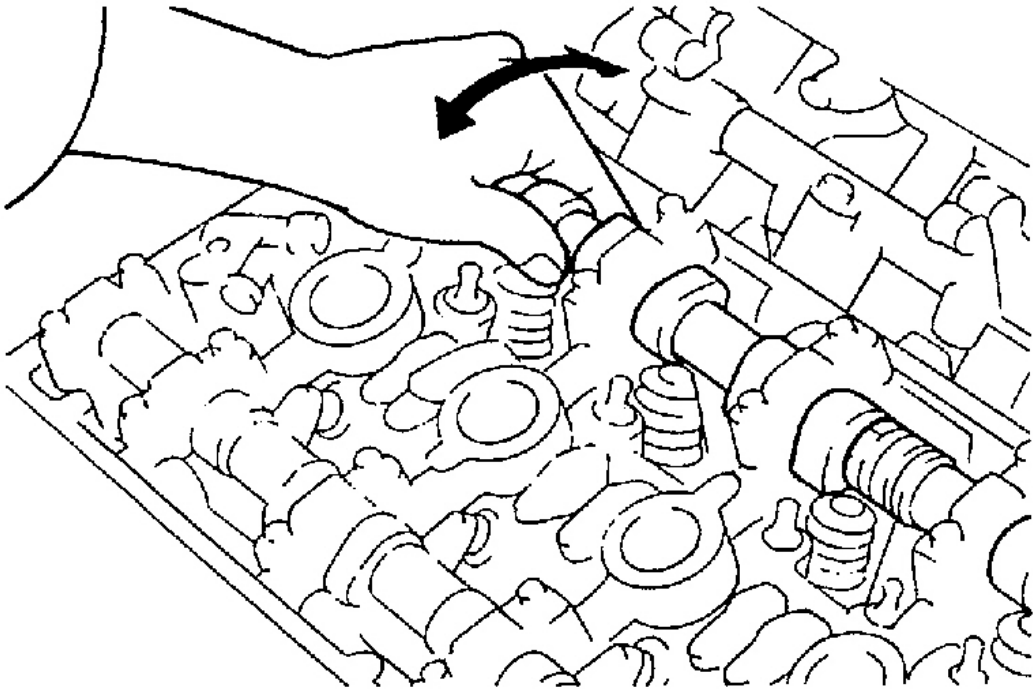

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Fig. 95: Checking Rotational Force Of Camshaft
Courtesy of HYUNDAI MOTOR CO.

4. Make sure that the dowel pins on the camshaft sprocket ends are located on the top.

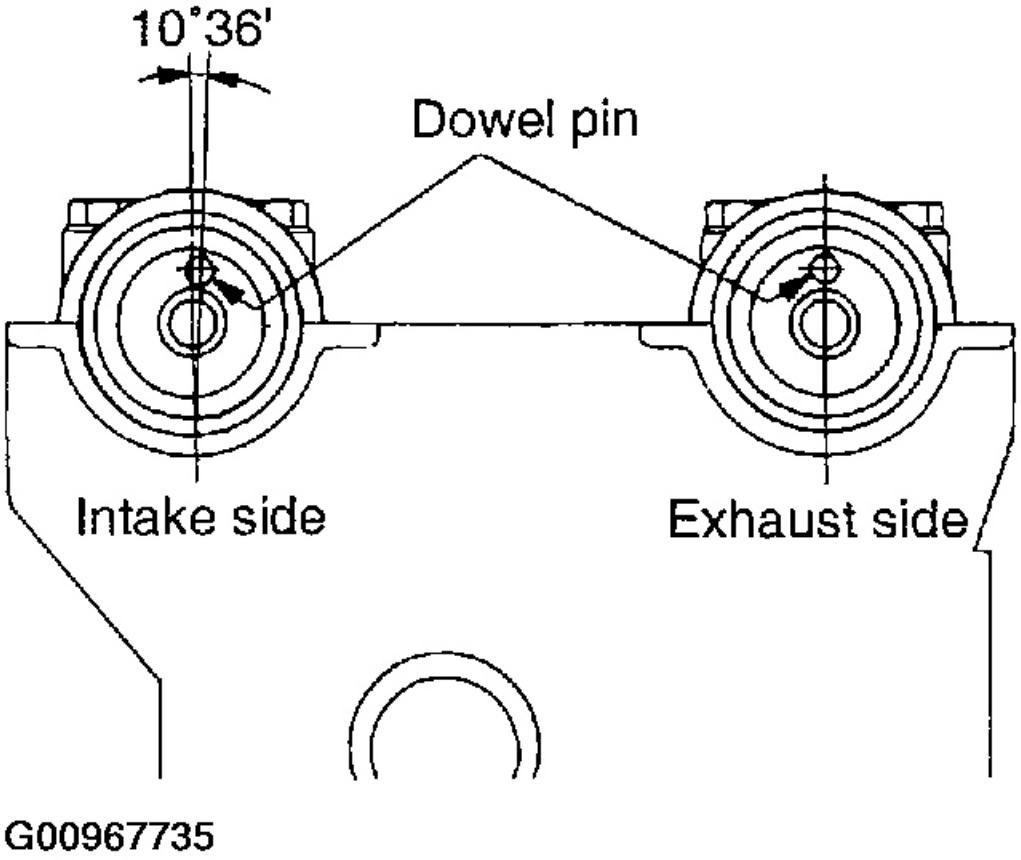

Fig. 96: Identifying Dowel Pins
Courtesy of HYUNDAI MOTOR CO.

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

NOTE: Tighten the rocker arms uniformly.

Tightening torque

Bearing cap bolts: 19-21 N.m (190-210 kg.cm, 14-15 lb.ft)

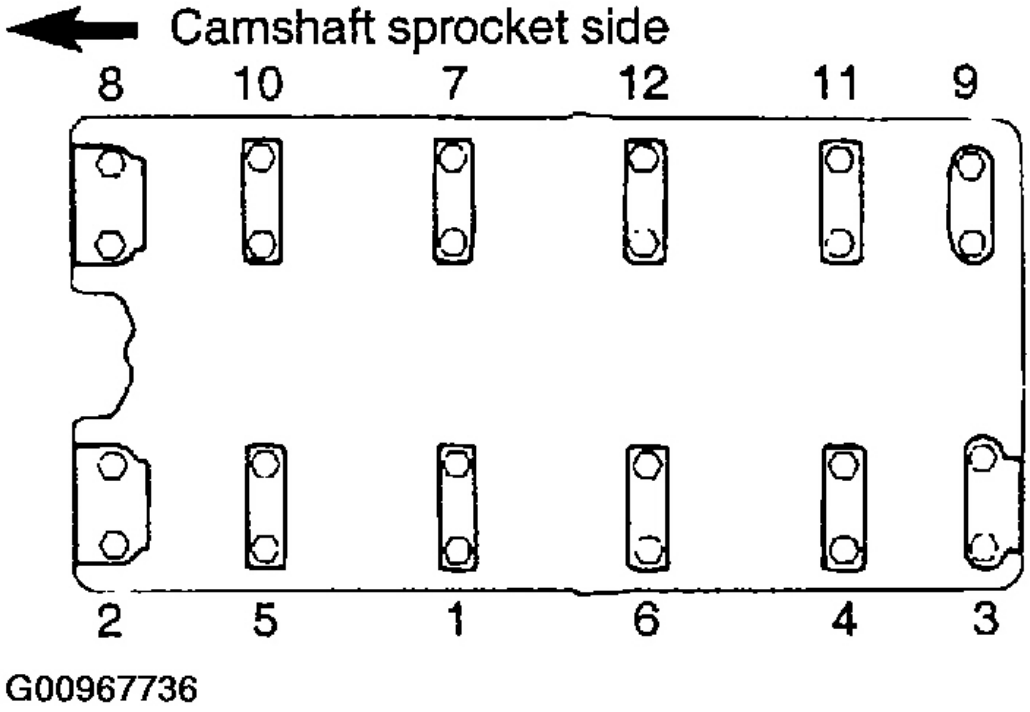

Fig. 97: Identifying Camshaft Bearing Cap Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

6. Using the special tools, camshaft oil seal Installer and guide (09221-21000, 09221-21100). Be sure to apply engine oil to the external surface of the oil seal. Insert the oil seal along the camshaft front end and install it by driving the installer with a hammer until the oil seal is fully seated.

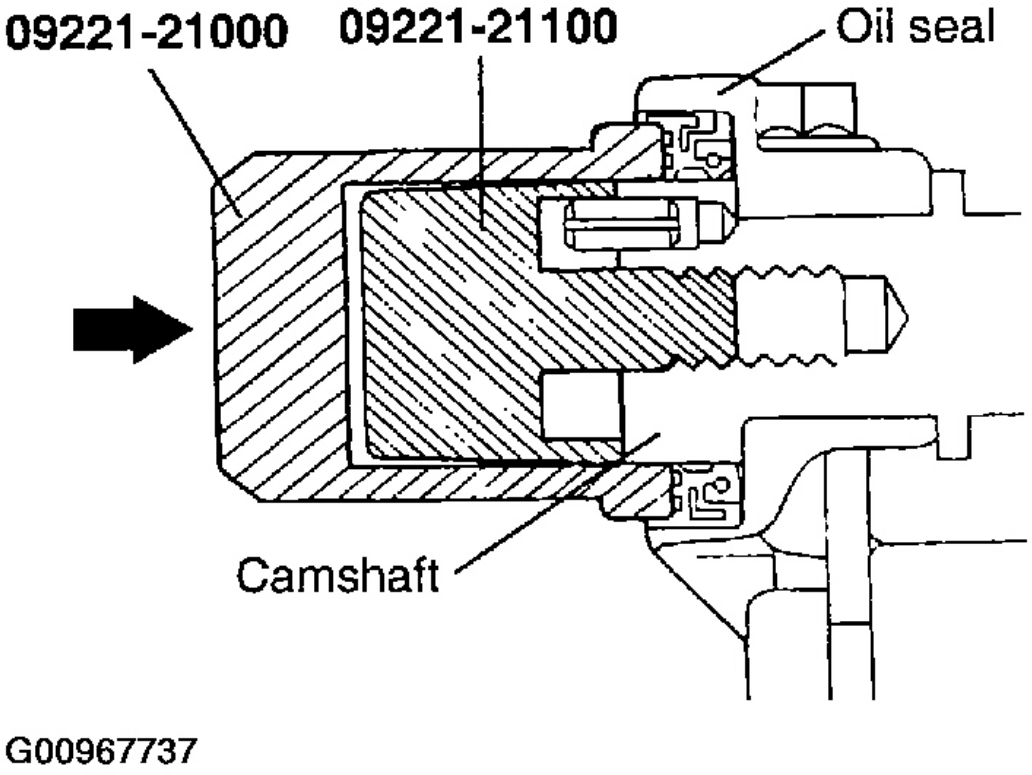

Fig. 98: Installing Camshaft Oil Seal
Courtesy of HYUNDAI MOTOR CO.

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

   Tightening torque

   Camshaft sprocket bolts: 80-100 N.m (800-1000 kg.cm, 58-72 lb.ft)

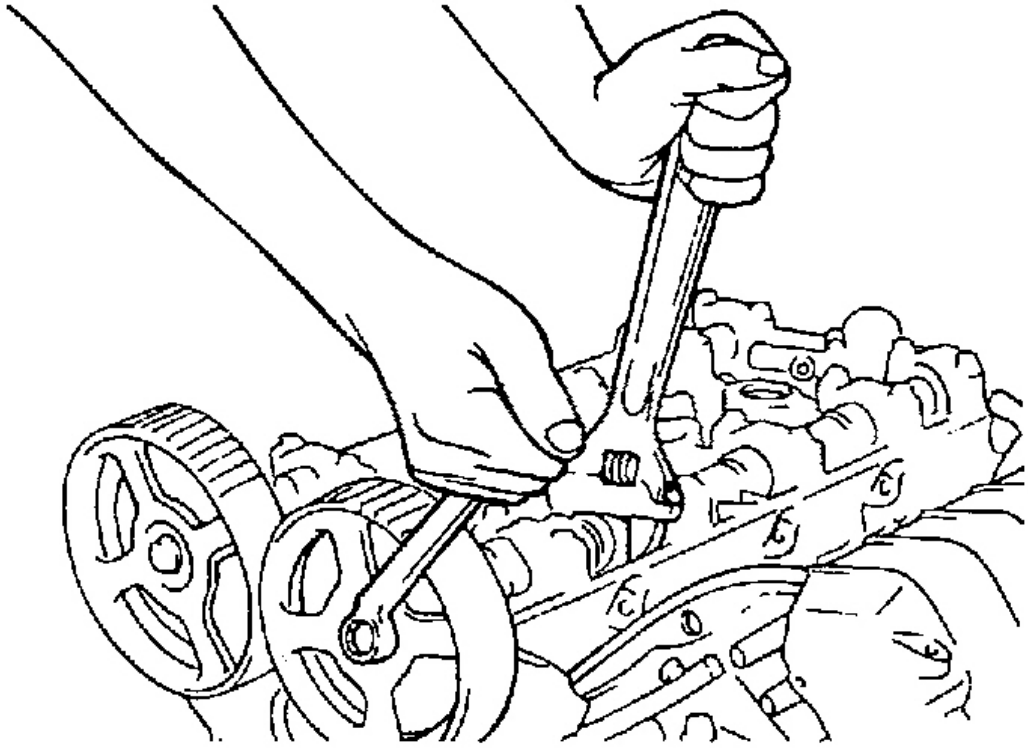

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Fig. 99: Tightening Camshaft Sprocket Bolt
Courtesy of HYUNDAI MOTOR CO.

8. Install the rocker cover. Apply sealant as shown.

   Tightening torque

   Rocker cover bolts: 8-10 N.m (80-100 kg.cm, 6-7 lb.ft)

   Center cover bolts: 4-5 N.m (40-50 kg.cm, 3-4 lb.ft)

   Sealant

   A Portion : Threebond No. 10 or equivalent

   B Portion : Threebond No. 1212D or equivalent

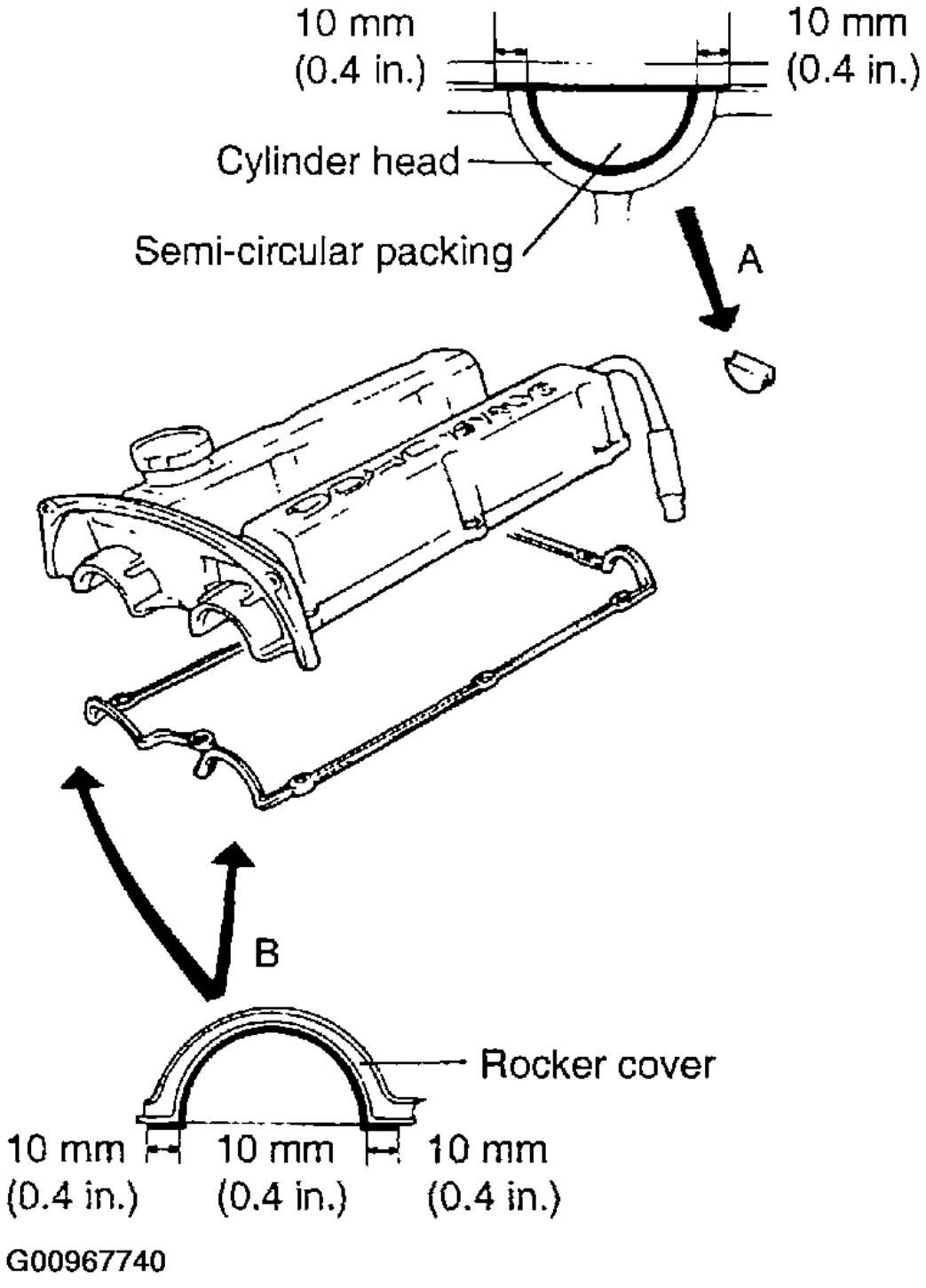

Fig. 100: Identifying Rocker Cover
Courtesy of HYUNDAI MOTOR CO.

Bolt

A : 13EA (Rocker cover bolts)

B : 4EA (Center cover bolts)

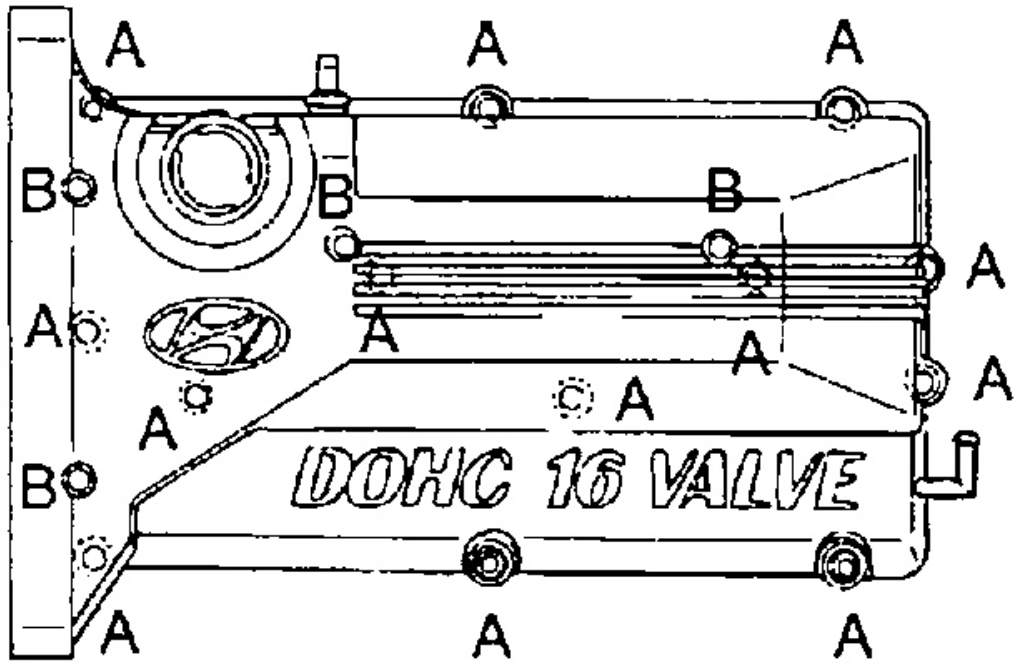

Fig. 101: Identifying Rocker Cover Bolts
Courtesy of HYUNDAI MOTOR CO.

9. Install the spark plugs, and ignition coils. Connect the secondary wires and then install the center cover.

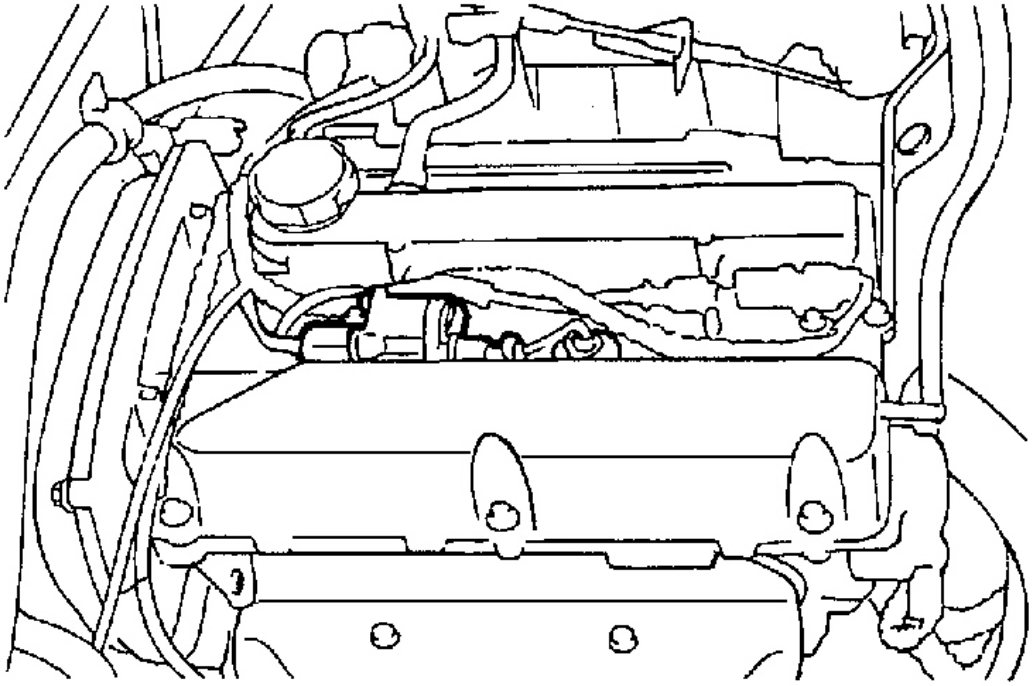

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Fig. 102: View Of Ignition Coil & Spark Plugs
Courtesy of HYUNDAI MOTOR CO.

10. Install the dowel pin on the sprocket side of the intake cam shaft.

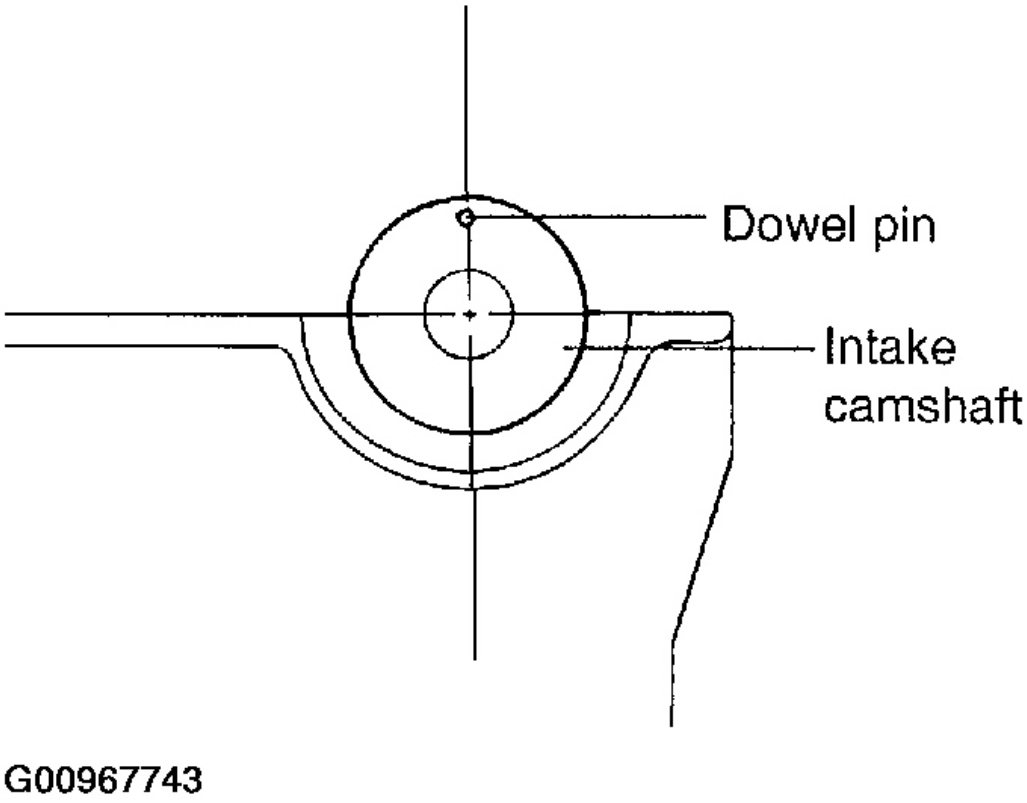

Fig. 103: Identifying Dowel Pin
Courtesy of HYUNDAI MOTOR CO.

11. Install the camshaft position sensor support assembly after installing the camshaft position sensor cylinder on the exhaust camshaft.

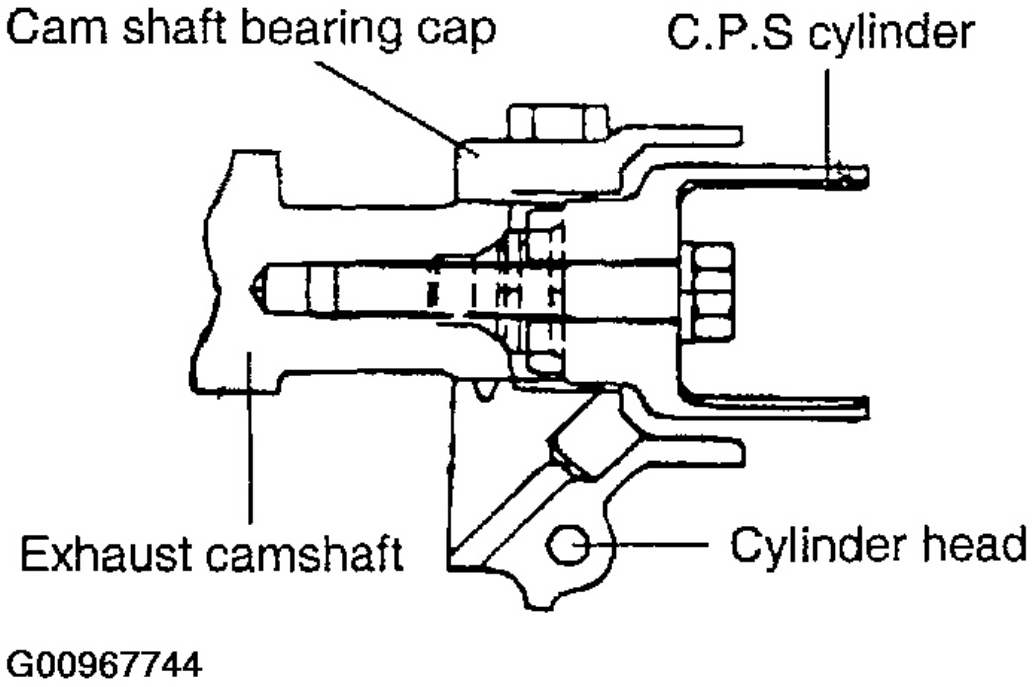

Fig. 104: View Of Cam Position Sensor Cylinder
Courtesy of HYUNDAI MOTOR CO.

CONNECTING ROD

COMPONENTS

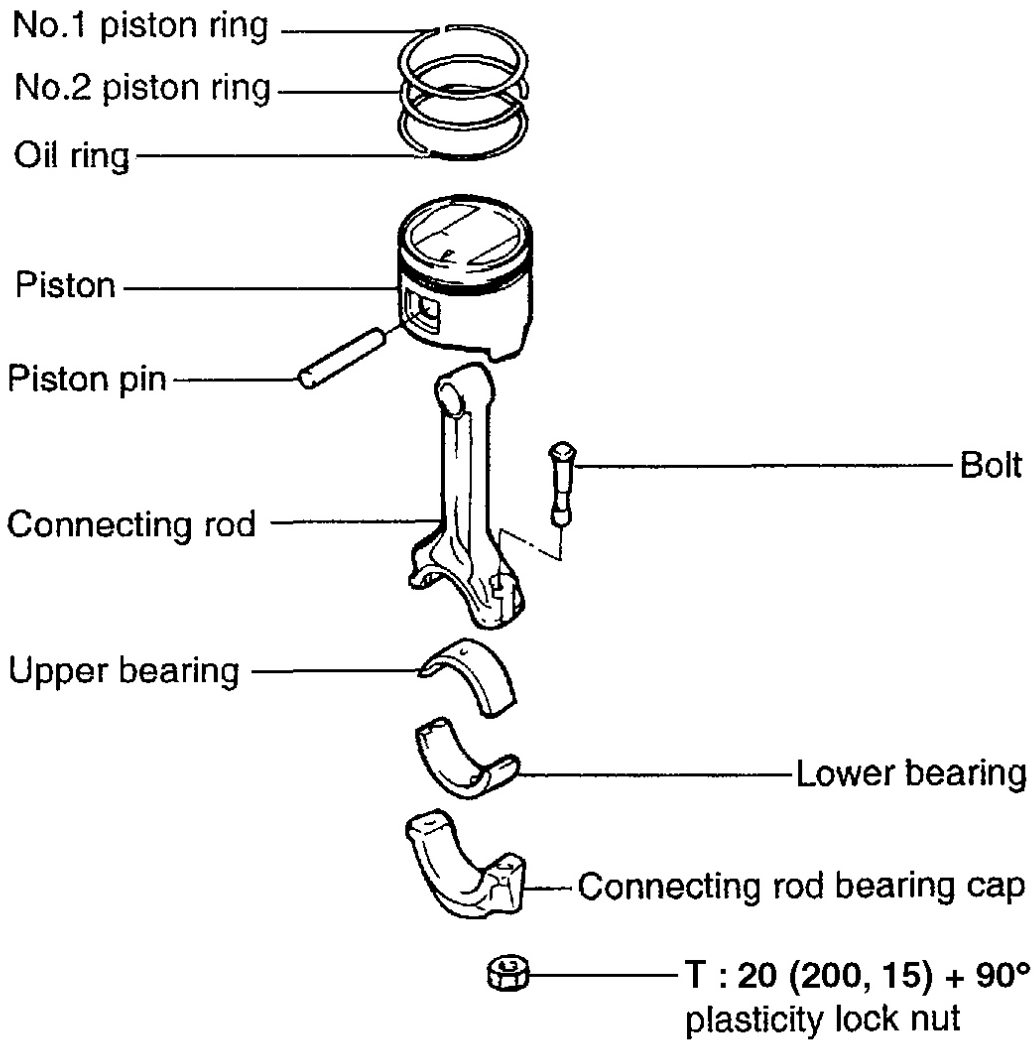

Fig. 105: Piston Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

CONNECTING ROD CAP

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

1. Remove the connecting rod cap nuts and then remove the caps and the big end lower bearing. Mark for reassembly.

2. Push each piston-connecting rod assembly toward the top of the cylinder.

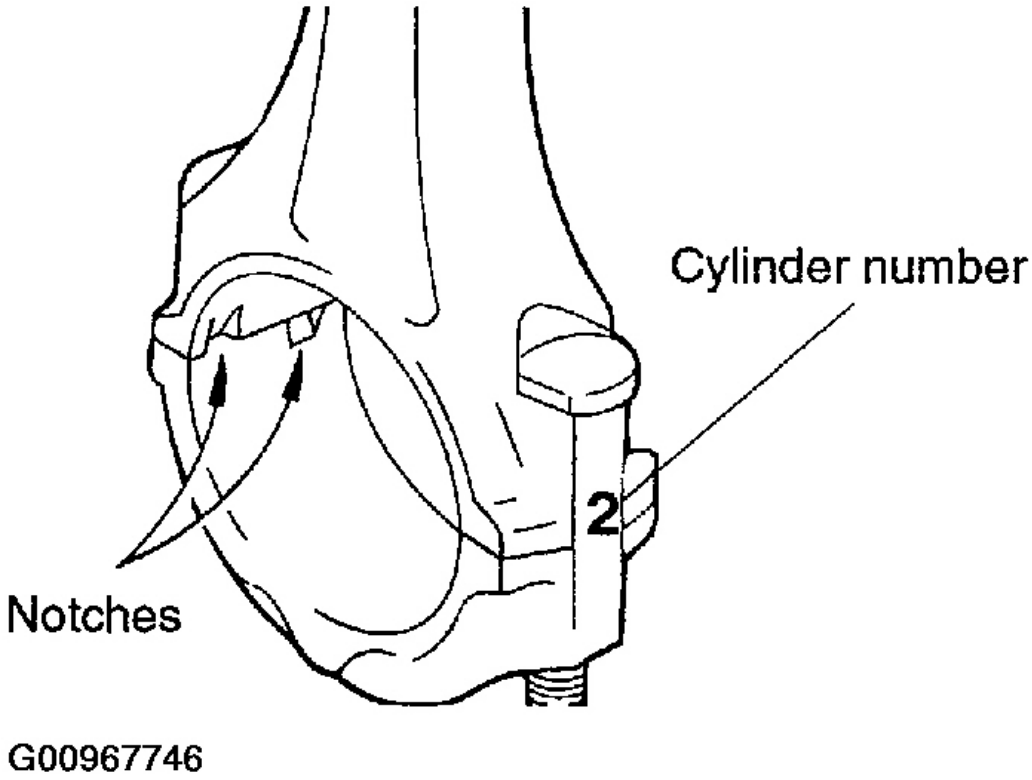

Fig. 106: Identifying Connecting Rod Bearing Notches
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY & REASSEMBLY OF PISTON PIN

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

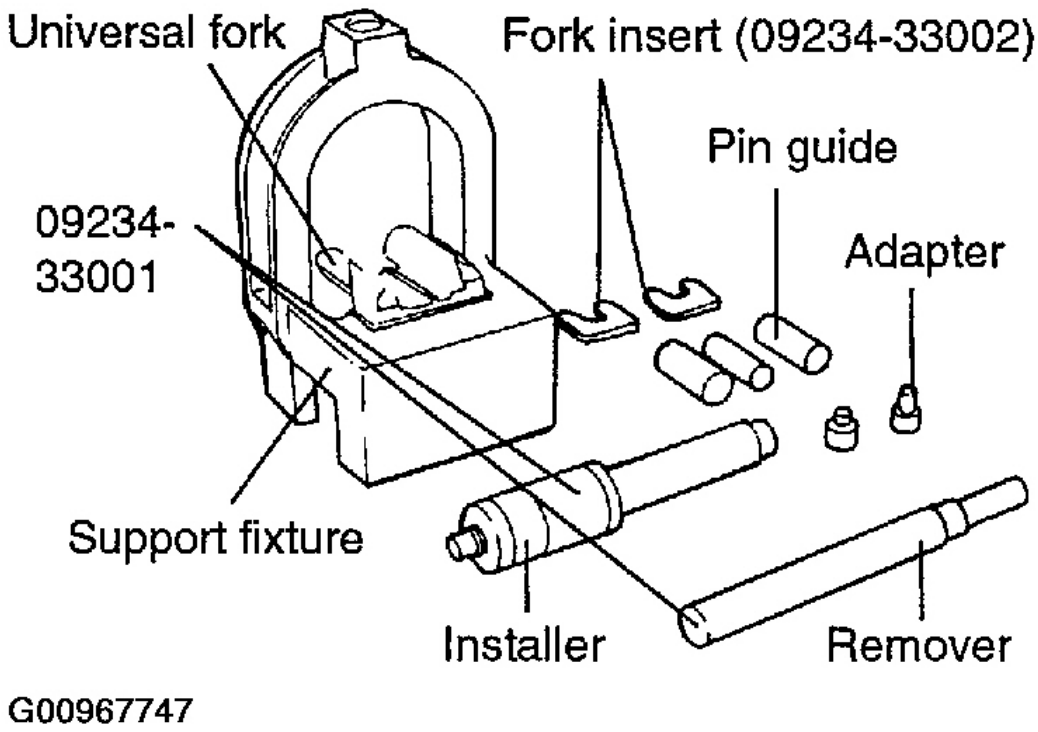

Fig. 107: Identifying Special Tools
Courtesy of HYUNDAI MOTOR CO.

2. The piston pin is a press fit in 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 while the rod resting on the fork inserts. Pass the remover tool through the top of the support fixture and use it to press out the pin.

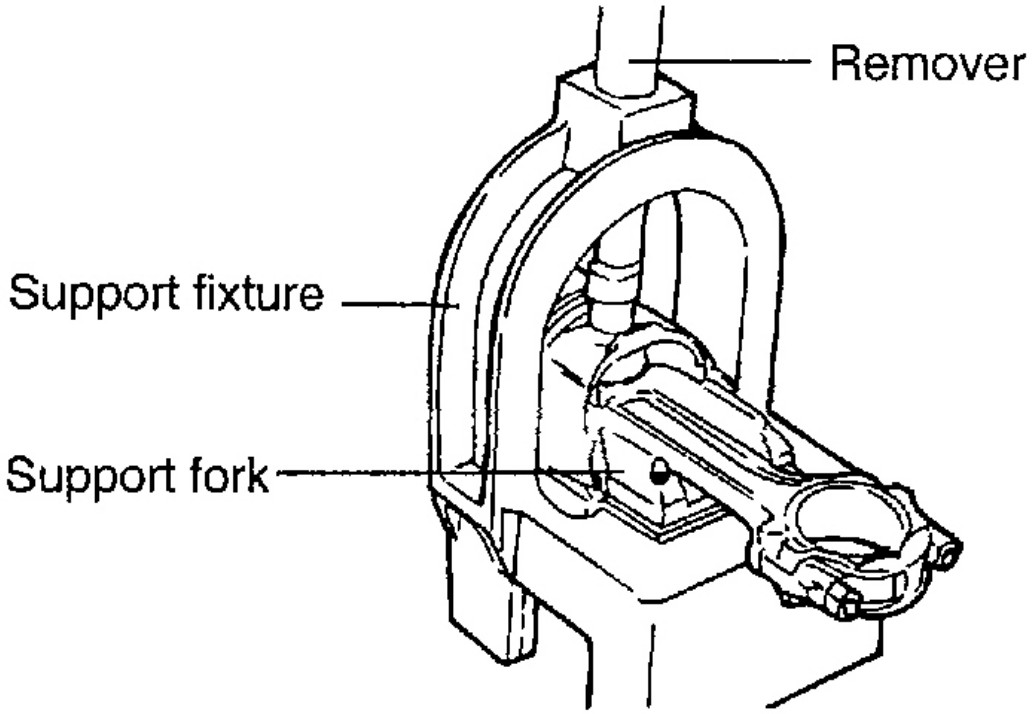

Fig. 108: Removing Piston Pin
Courtesy of HYUNDAI MOTOR CO.

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 on 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 though 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 fort inserts. If the wrong size pin guide is used, the piston and pin will not line up with the support fixture.

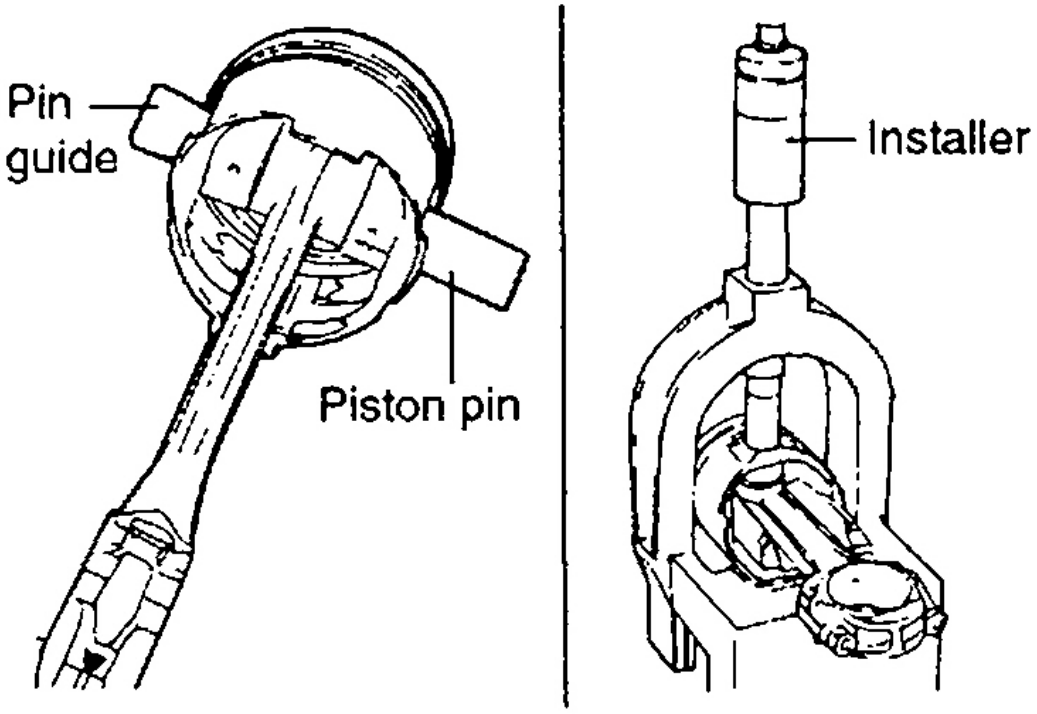

Fig. 109: Installing Piston Pin
Courtesy of HYUNDAI MOTOR CO.

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 (2756 +/- 1102 lb.) of force when stopping the installing arbor sleeve against the arch.

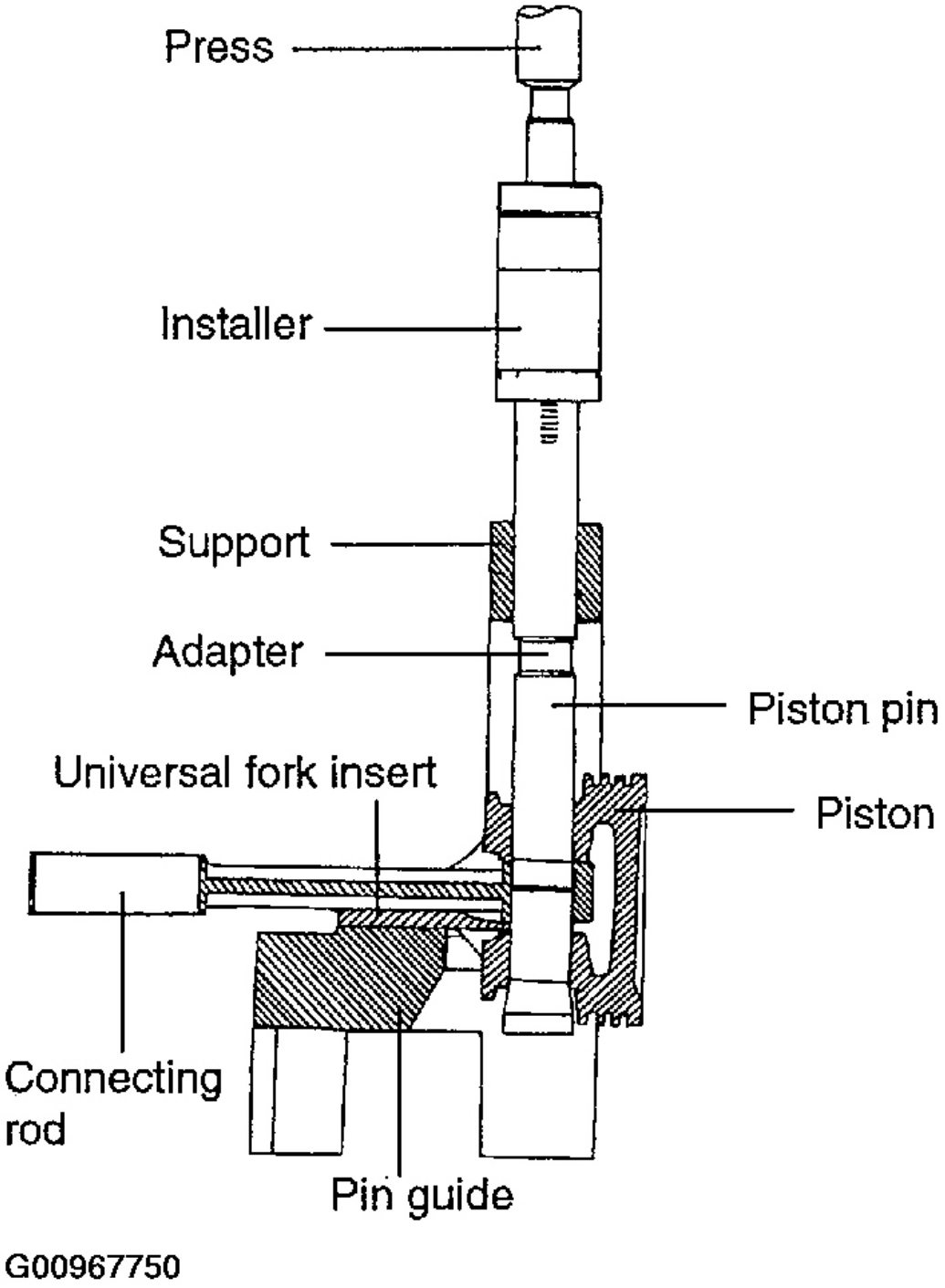

Fig. 110: Installing Piston Pin
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

PISTON & 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).

PISTON RINGS

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in a 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 only the piston ring only.

   Standard value

   Piston ring side clearance:

   No. 1 : 0.03-0.07 mm (0.0012-0.0028 in.)

   No. 2 : 0.02-0.06 mm (0.0008-0.0024 in.)

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

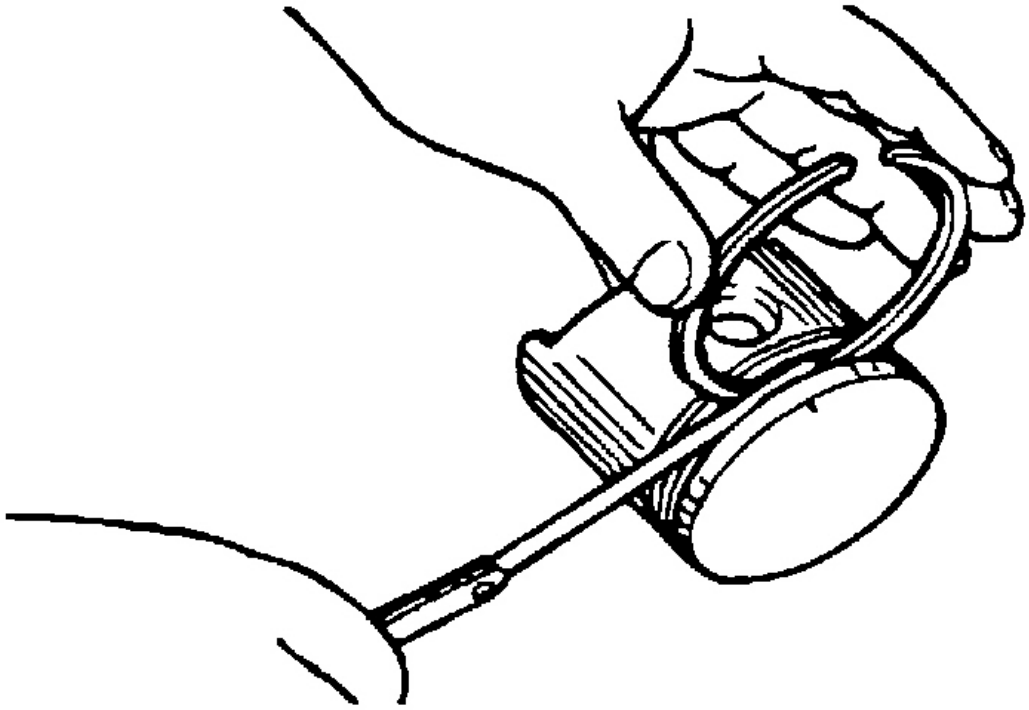

Fig. 111: Measuring Piston Ring Side Clearance
Courtesy of HYUNDAI MOTOR CO.

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

   Piston ring end gap

   [Standard dimensions]

   No. 1: 0.25-0.35 mm (0.0098-0.0138 in.)

   No. 2: 0.40-0.55 mm (0.0157-0.0216 in.)

   Oil ring side rail : 0.10-0.40 mm (0.0039-0.0157 in.)

   [Limit]

   No. 1, No. 2: 0.8 mm (0.031 in.)

Oil ring side rail: 1.0 mm (0.039 in.)

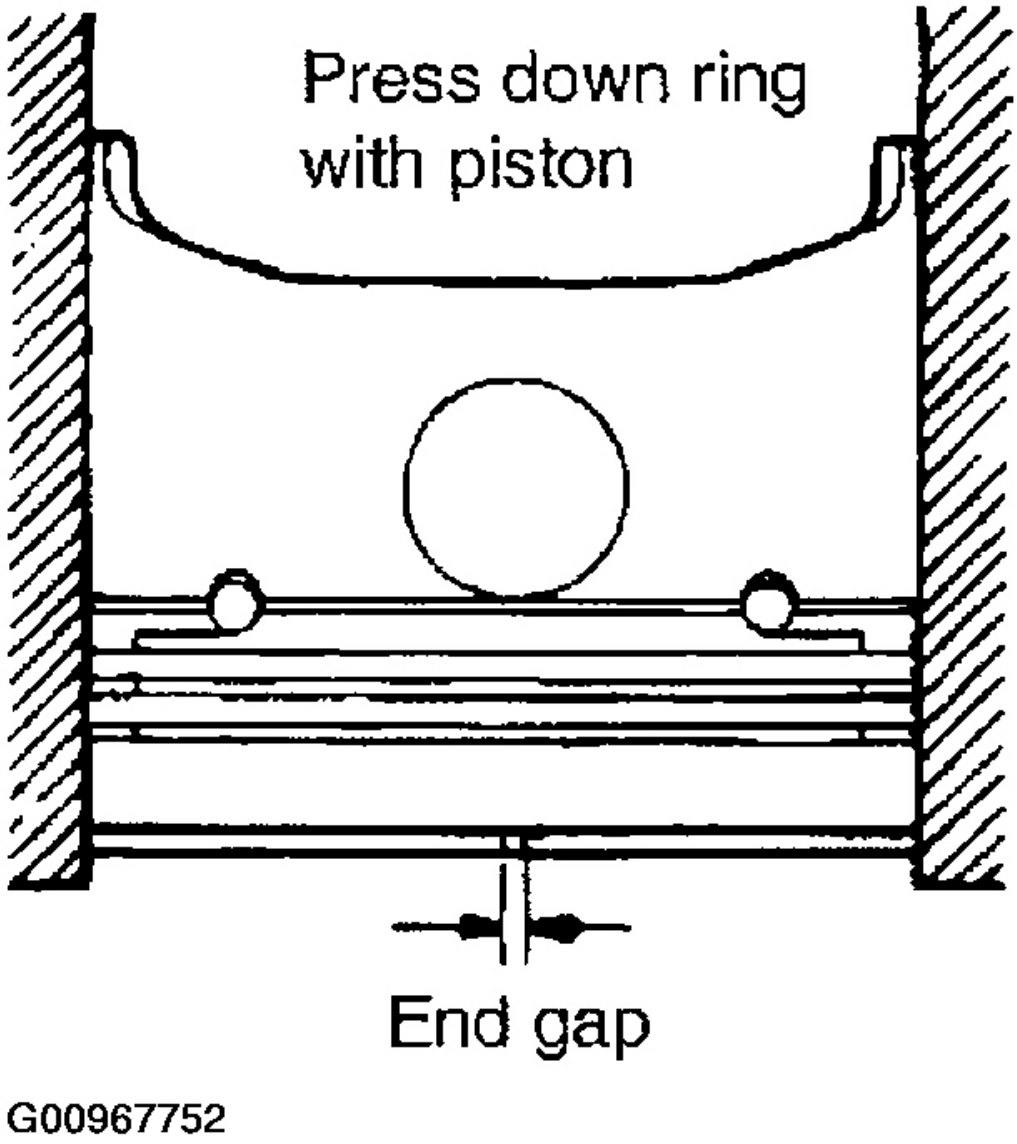

Fig. 112: Identifying Piston Ring End Gap
Courtesy of HYUNDAI MOTOR CO.

CONNECTING RODS

1. When the connecting rod cap is installed, make sure that cylinder numbers, marked on the rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches for holding the

bearing in place are on the same side.

2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has stratified wear in, or if the surface of, the inside diameter of the small end is severely rough, replace the rod.

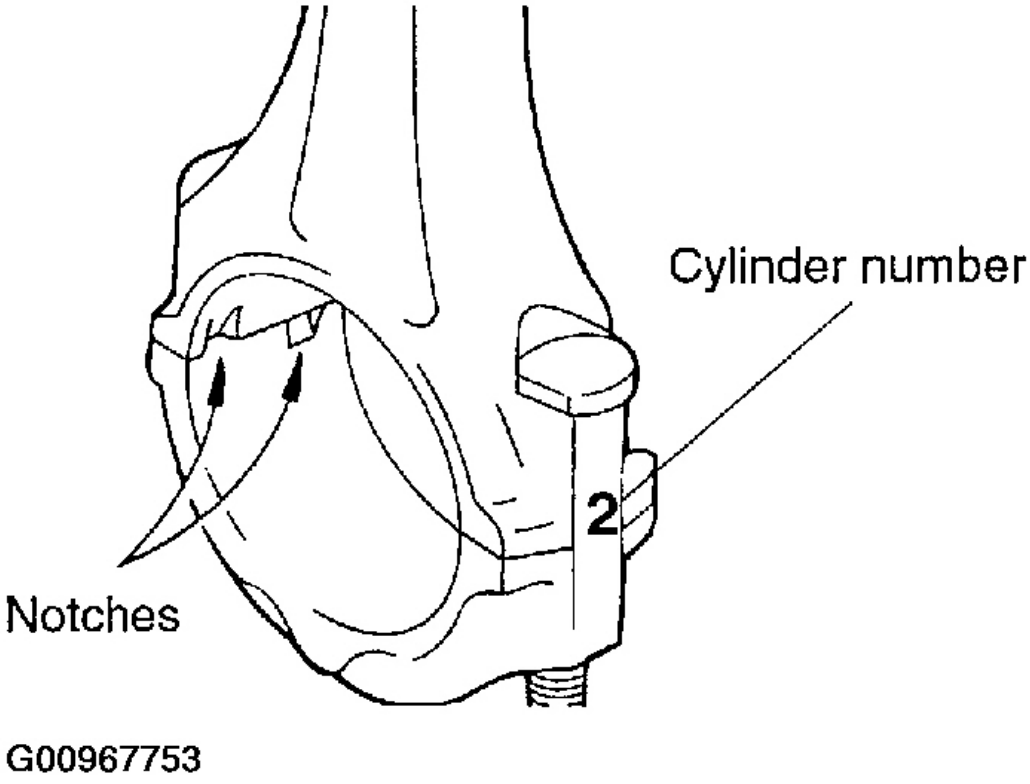

Fig. 113: Identifying Connecting Rod Bearing Notches
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

1. Install the spacer.

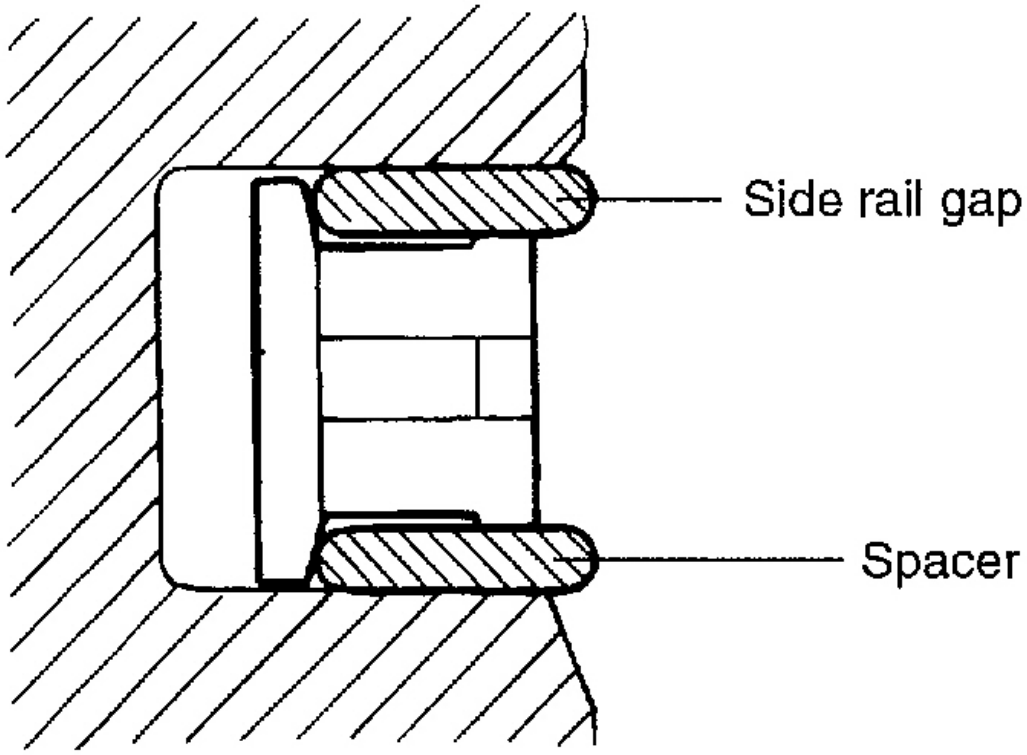

Fig. 114: Identifying Spacer Installation (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

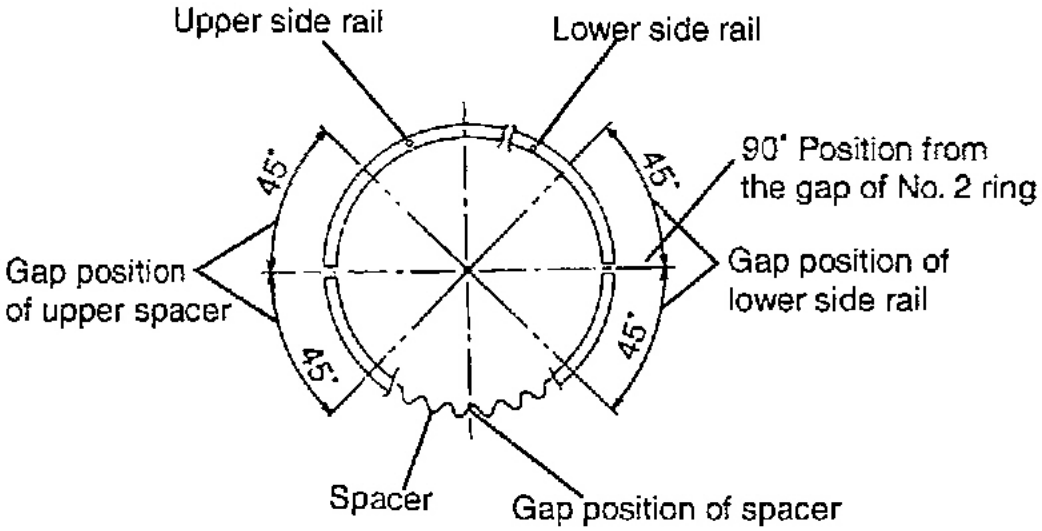

Fig. 115: Identifying Spacer Installation (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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, then press down with your finger the portion to be inserted into groove as illustrated.

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

3. Install the lower side rail by the same procedure as described in Step No. 2.

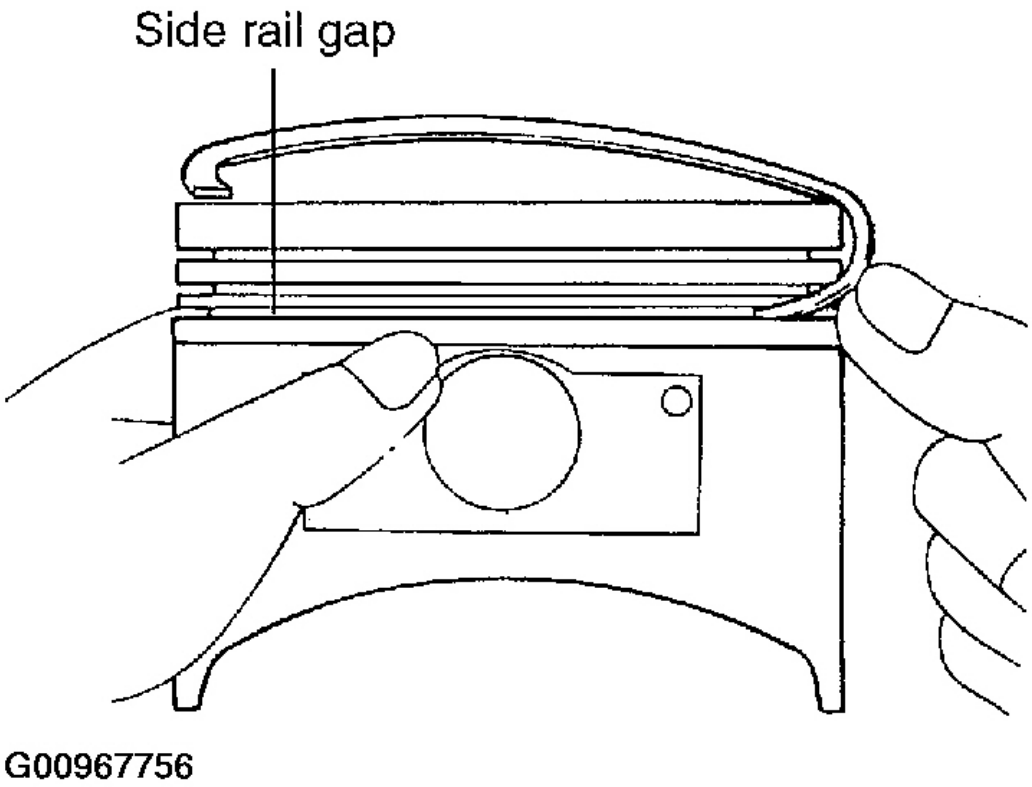

Fig. 116: Installing Side Rail
Courtesy of HYUNDAI MOTOR CO.

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

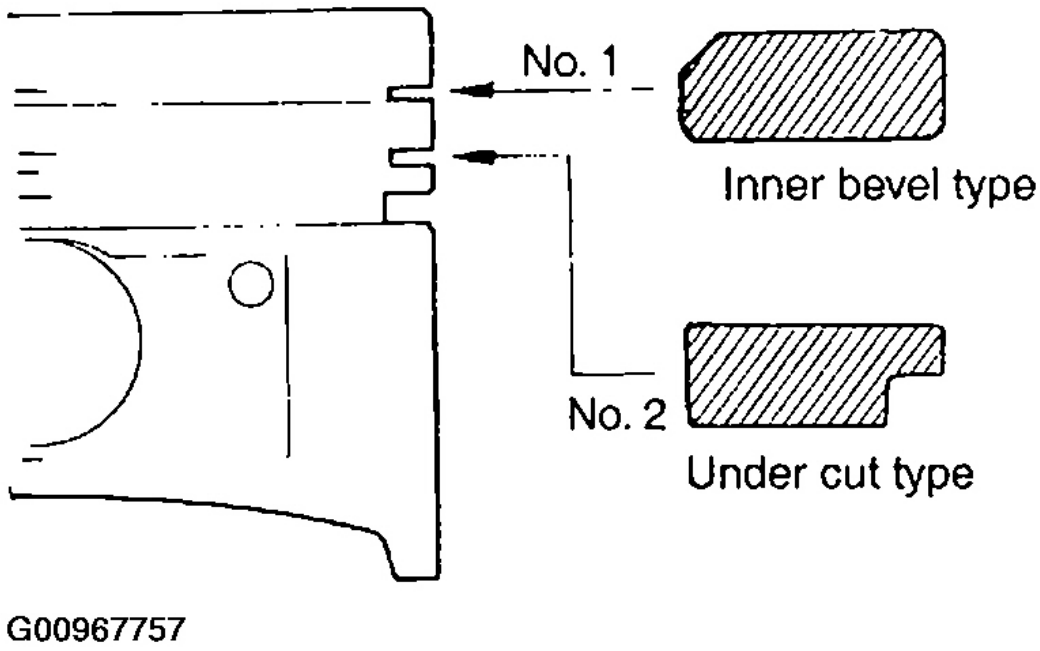

Fig. 117: Identifying Piston Rings
Courtesy of HYUNDAI MOTOR CO.

7. Place each piston ring end gap as far apart from its neighboring gaps as possible. Make sure that 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.

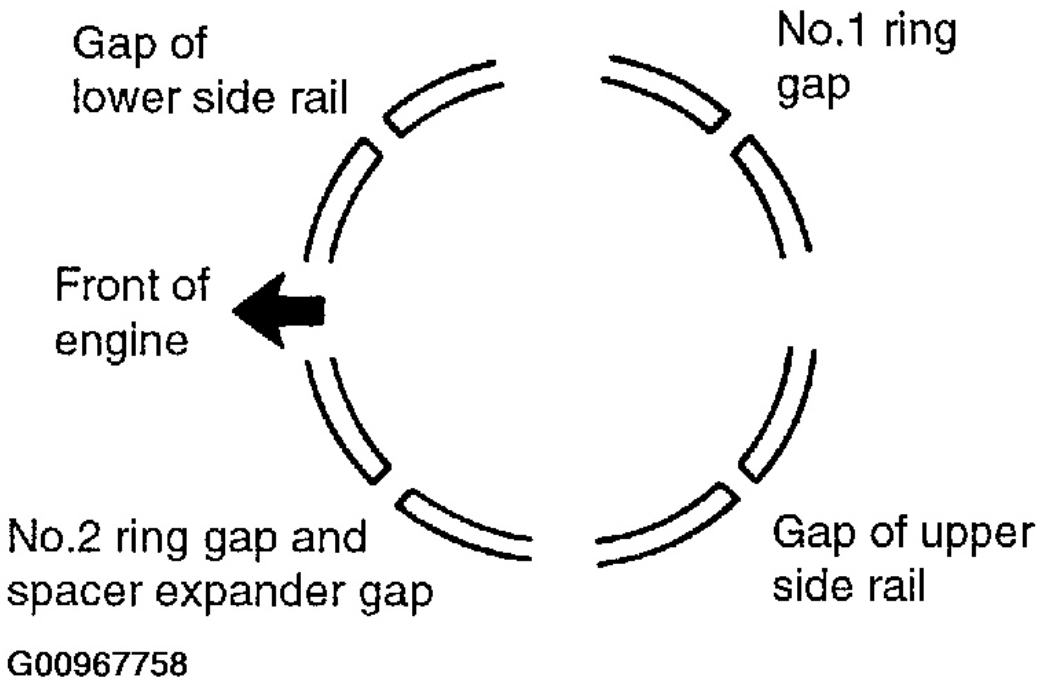

Fig. 118: Identifying Piston Installation
Courtesy of HYUNDAI MOTOR CO.

9. 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.
10. When the connecting rod cap is installed, make sure that the cylinder numbers put on the rod and cap at disassembly match.
11. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
12. Tighten the connecting rod cap nuts.

Tightening torque

Connecting rod cap nuts: 20 N.m (200 kg.cm, 14 lb.ft) + 90°

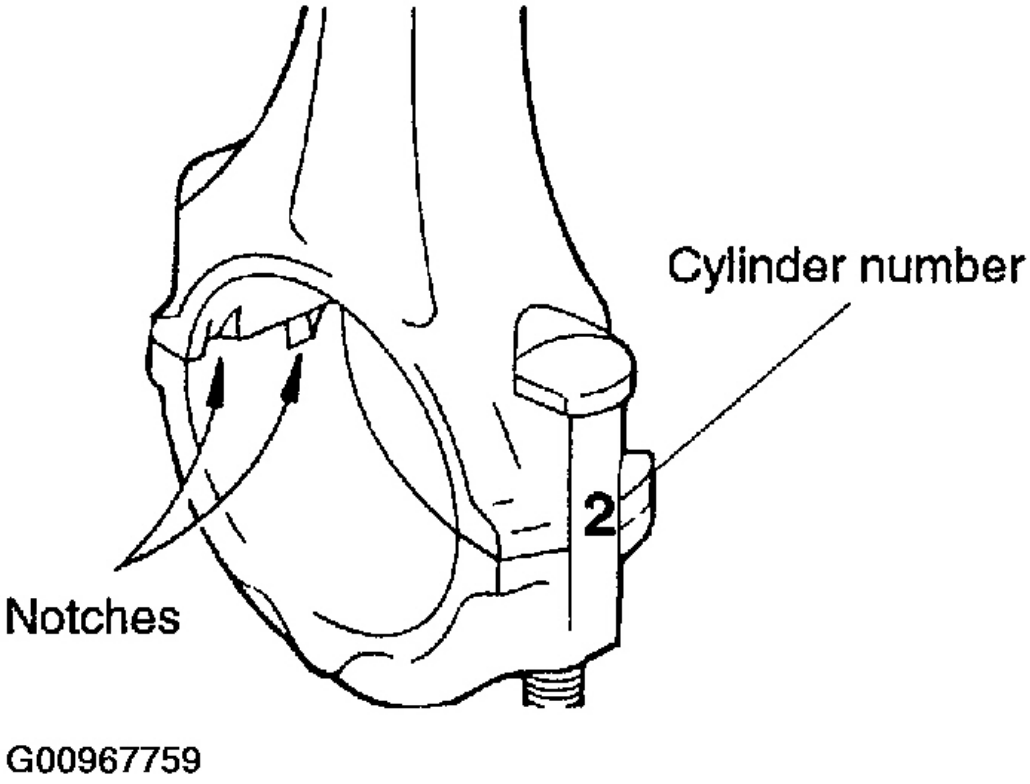

Fig. 119: Identifying Connecting Rod Bearing Notches
Courtesy of HYUNDAI MOTOR CO.

13. Check the connecting rod side clearance.

    Connecting rod side clearance

    Standard : 0.10-0.25 mm (0.004-0.0098 in.)

    Limit : 0.4 mm (0.0157 in.)

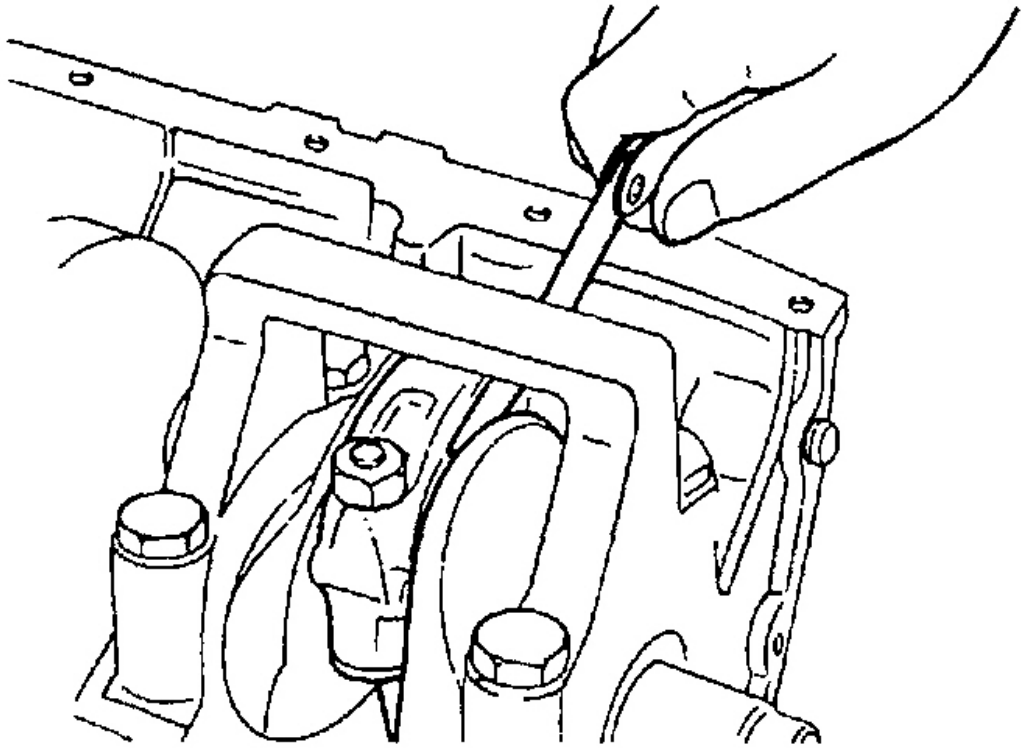

Fig. 120: Measuring Connecting Rod Side Clearance
Courtesy of HYUNDAI MOTOR CO.

CRANKSHAFT

COMPONENTS

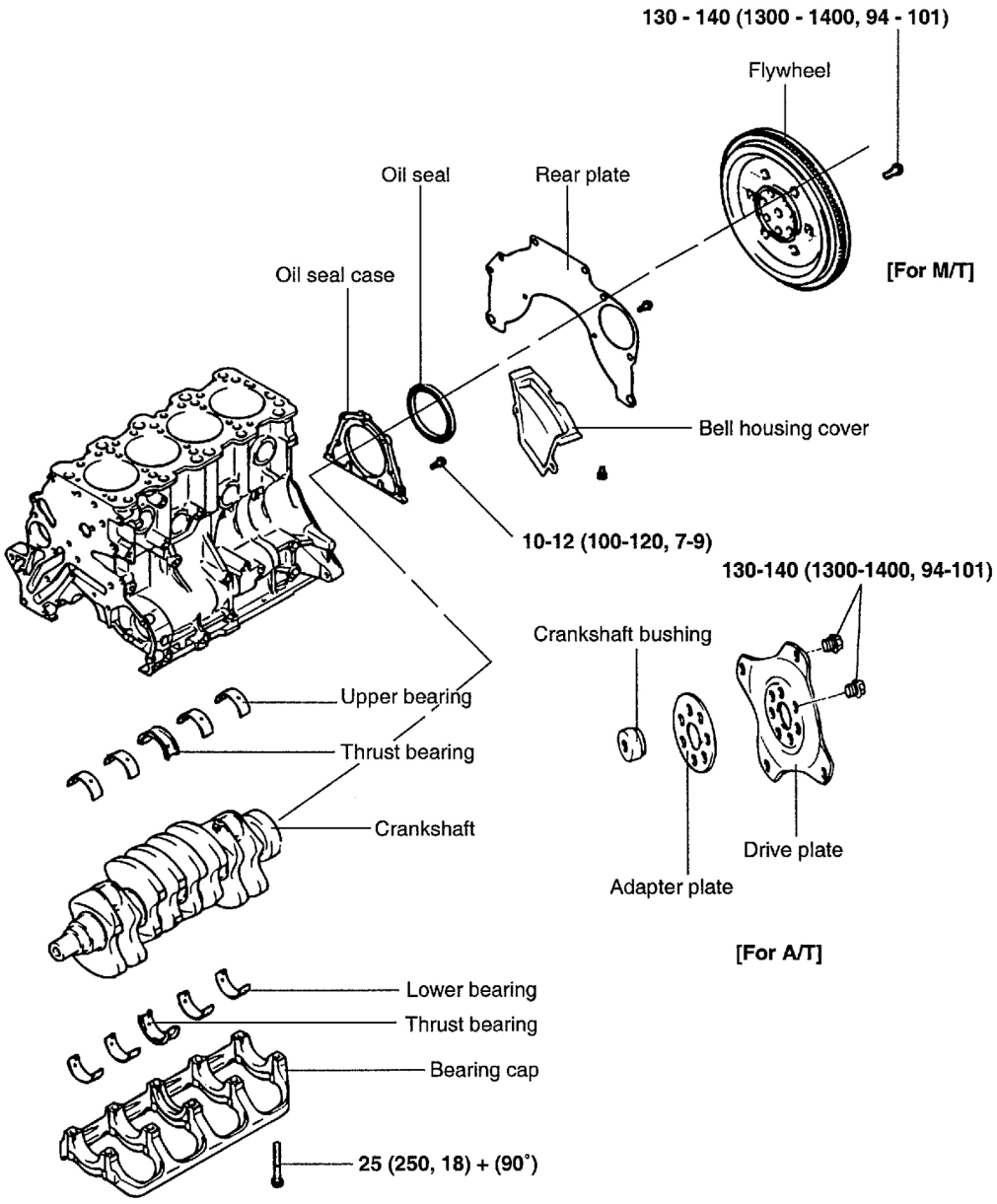

Fig. 121: Crankshaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the assembly and oil pan.
    - Timing belt. See **TIMING BELT**.
    - Front case. See **FRONT CASE**.

- Flywheel.
- Cylinder head. See **CYLINDER HEAD**.

2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

NOTE: Mark the main bearing caps to be able to reassemble in the original position and direction.

4. Remove the main bearing caps and the crankshaft. Keep the bearings in order according to the cap number.

INSPECTION

CRANKSHAFT

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

Standard value

Crankshaft journal O.D: 56.982-57.000 mm (2.2434-2.2441 in.)

Crankshaft pin O.D: 44.980-45.000 mm (1.7709-1.7717 in.)

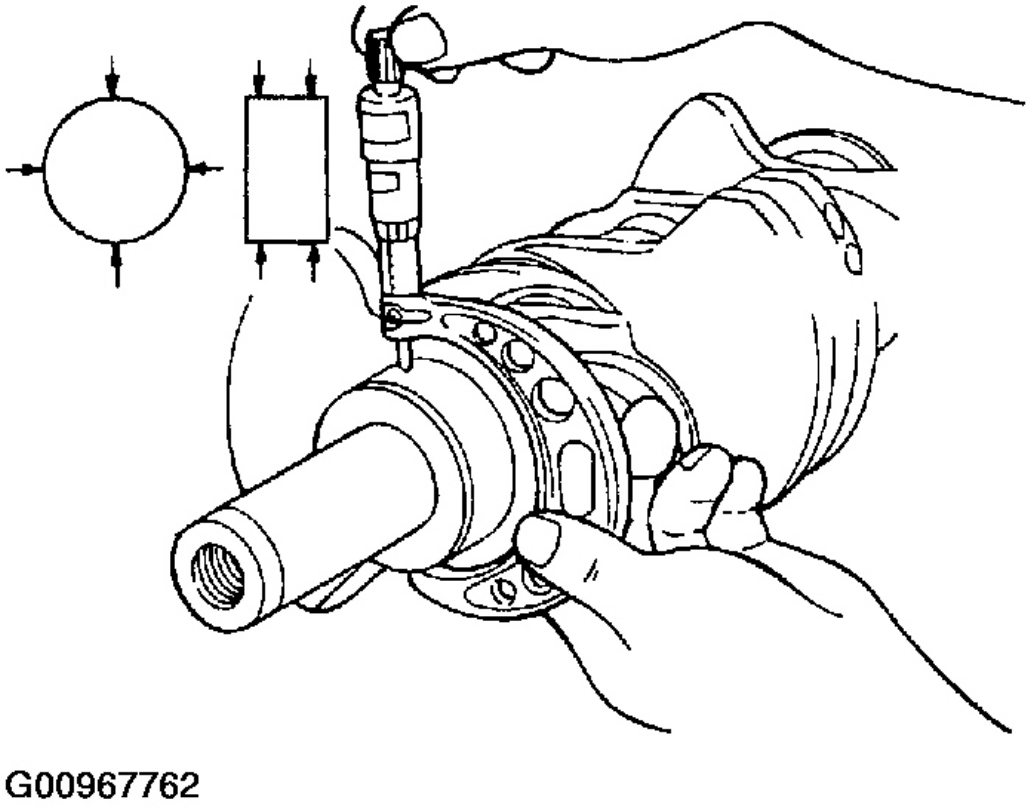

Fig. 122: Checking Crankshaft Journal
Courtesy of HYUNDAI MOTOR CO.

MAIN BEARINGS & CONNECTING ROD BEARINGS

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

MEASURING OIL CLEARANCE

Check the oil clearance by measuring the outside diameter of the crankshaft journal as well as the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured diameters.

Standard value

Oil clearance

Crankshaft main bearing

No. 1, 2, 4, 5: 0.018-0.036 mm (0.0007-0.0014 in.)
No. 3: 0.024-0.042 mm (0.0009-0.0017 in.)
Connecting rod bearing: 0.015-0.048 mm (0.0006-0.0019 in.)
Limit: 0.1 mm (0.0039 in.)

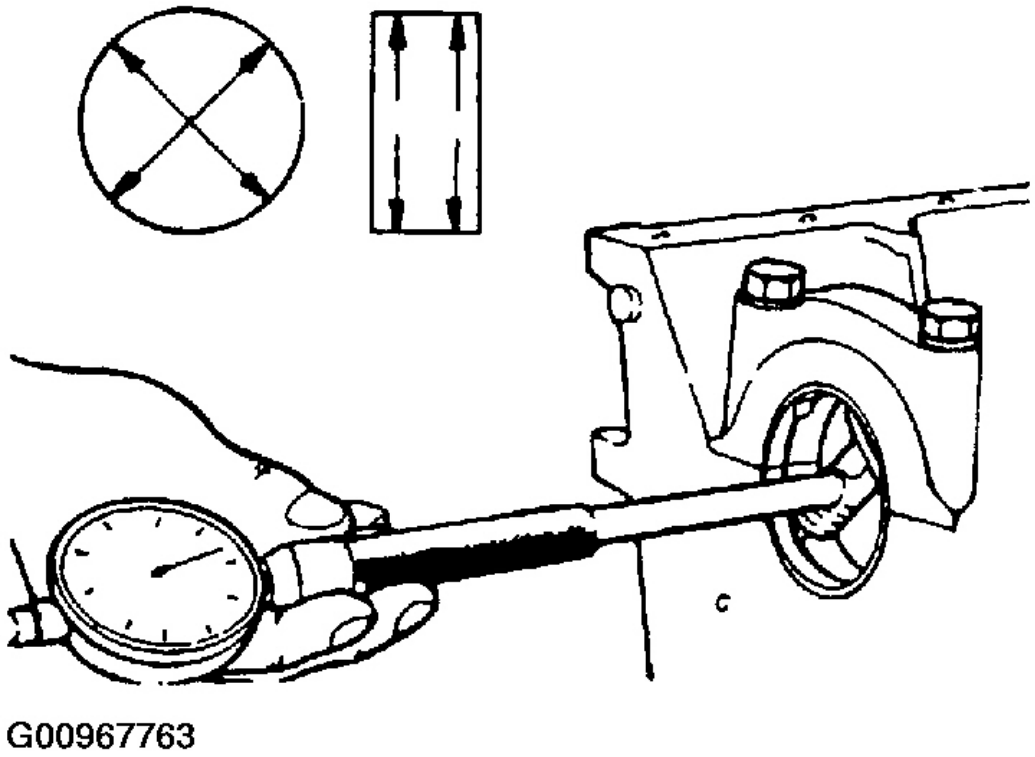

Fig. 123: Measuring Outside Diameter Of Crankshaft Journal
Courtesy of HYUNDAI MOTOR CO.

HOW TO USE PLASTIC GAUGE

Plastigage may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plastigage to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastigage at the widest part by using the scale printed on the gauge package. If the clearance exceeds the service limit, the bearing should be replaced or an undersize bearing should be used. When installing a new crankshaft, be sure to use

standard size bearings. If the standard clearance can not be obtained even after replacing the bearing, the journal and pin should be ground to the undersize and a bearing of the corresponding size should be installed.

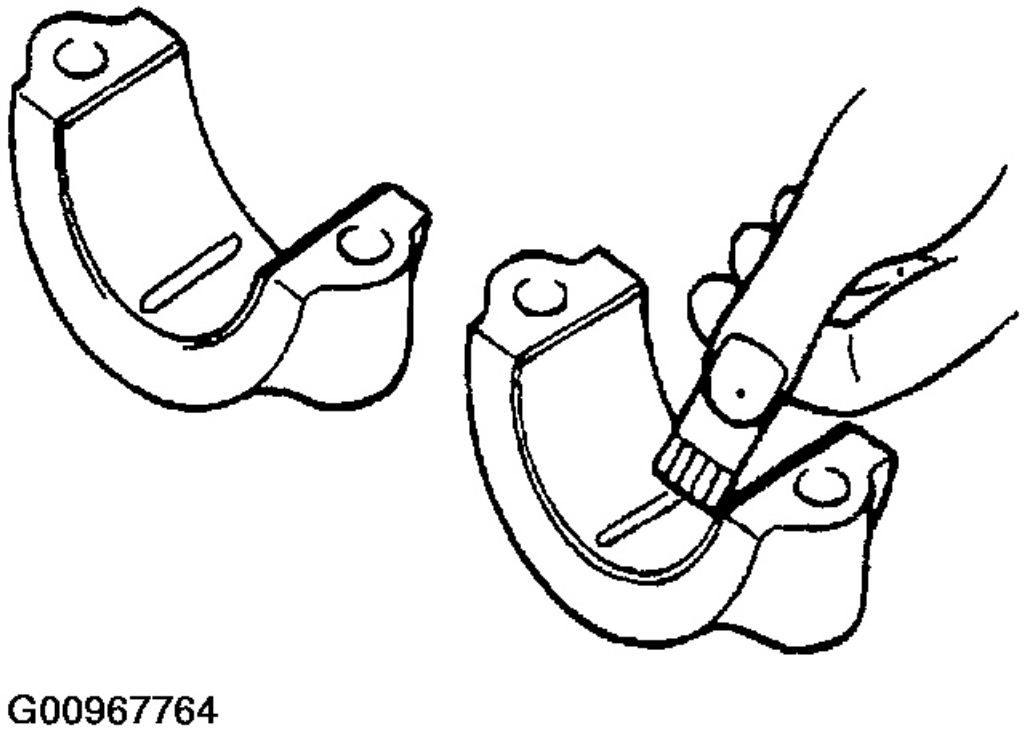

Fig. 124: Identifying & Measuring Plastic Gauge
Courtesy of HYUNDAI MOTOR CO.

OIL SEAL

Check the front and rear oil seals for damage or worn surface. Replace any seat that is defective.

BEARING CAPS

After installing the bearing caps, make sure the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace the crankshaft bearings.

Standard value: 0.05-0.25 mm (0.0020-0.0098in.)

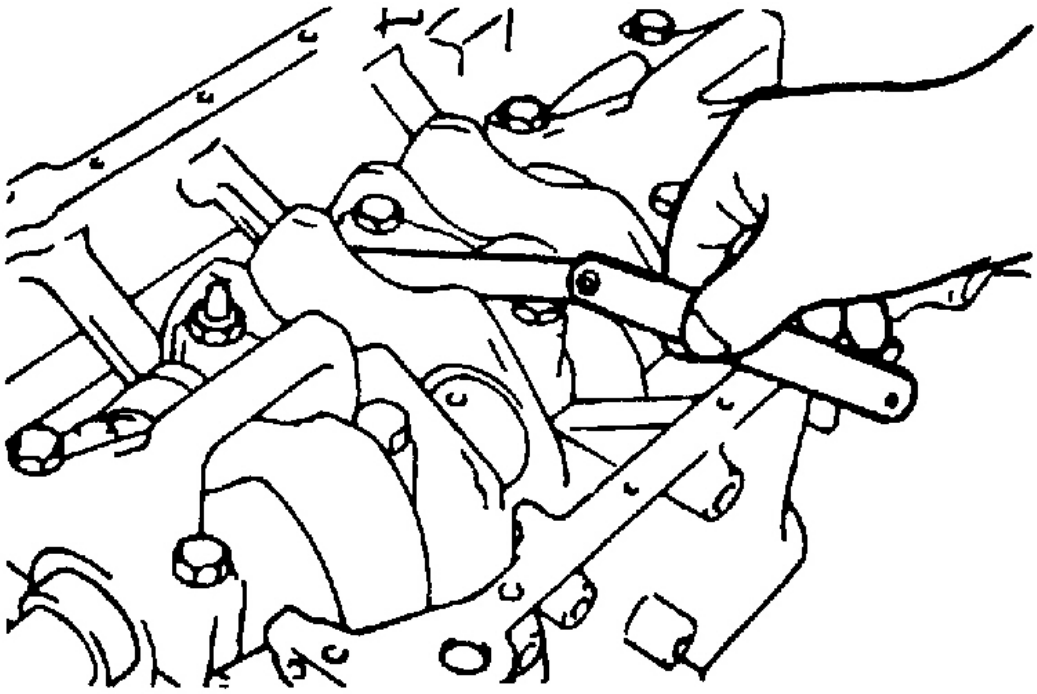

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Fig. 125: Measuring Crankshaft End Play
Courtesy of HYUNDAI MOTOR CO.

DRIVE PLATE (A/T)

Replace distorted, damaged, or cracked drive plates.

FLYWHEEL (M/T)

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 run-out

   Limit

   Flywheel runout: 0.13 mm (0.0051 in.)

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

REASSEMBLY

1. Install a grooved main bearing (upper bearing) on the cylinder block side.
2. Install a grooveless main bearing (lower bearing) on the main bearing cap side.
3. Both upper and lower center thrust bearings are grooveless.

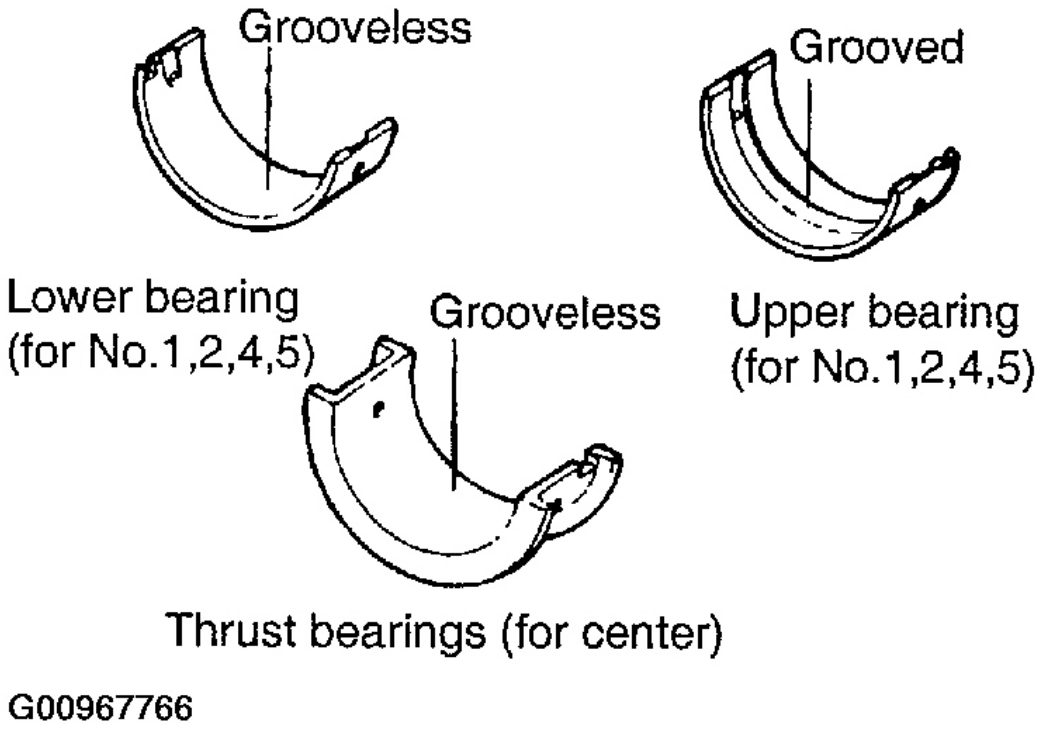

Fig. 126: Identifying Bearings
Courtesy of HYUNDAI MOTOR CO.

4. Apply engine oil to journals and pins. Install the crankshaft.
5. Install the bearing caps with the arrow mark directed toward the front of the engine. The cap number must be correct.
6. Tighten the cap bolts to the specified torque.

   Tightening torque

   Main bearing cap bolts: 25 N.m (250, 18lb.ft) + (90°)
7. Cap bolts should be tightened evenly in 4 to 5 increments before they are tightened to the specified torque.
8. Make sure that the crankshaft turns freely and check the end play of the crankshaft.
9. Using a special tool (09231-21000), Install the oil seal in the oil seal case. A new oil seal should be used.

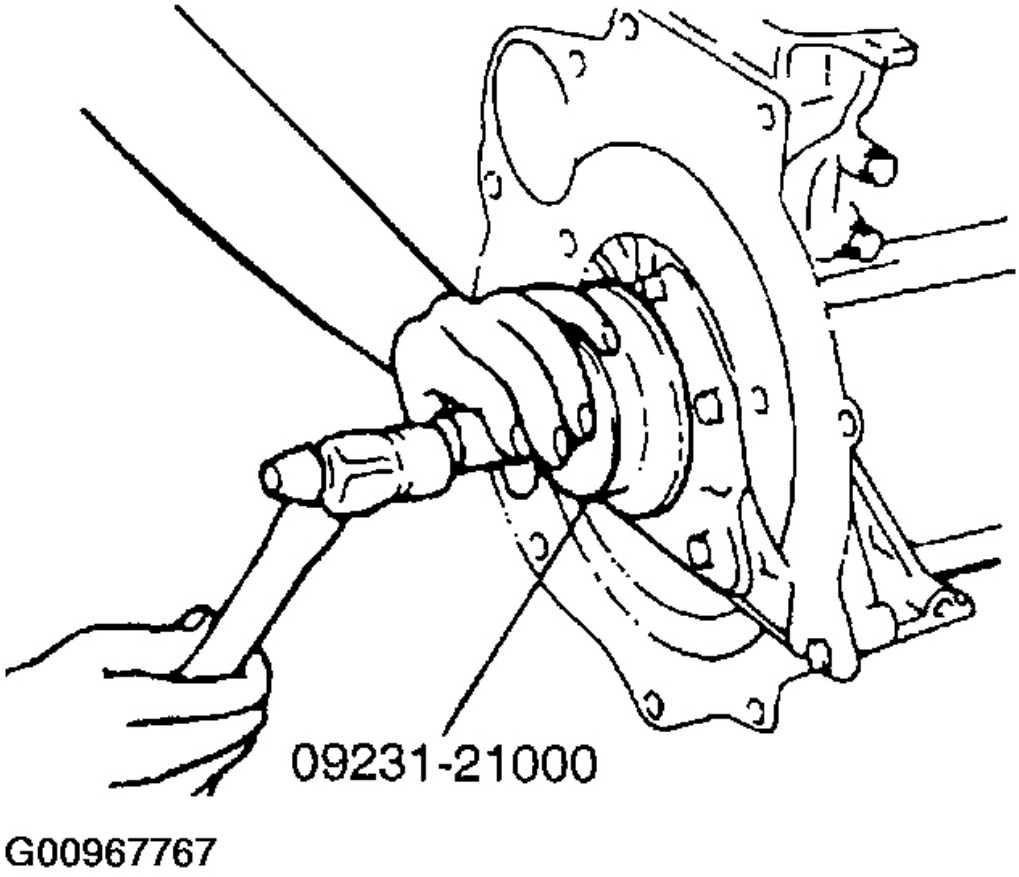

Fig. 127: Installing Oil Seal Into Oil Seal Case
Courtesy of HYUNDAI MOTOR CO.

10. Install the oil seal into the oil seal case so that the oil hole in the separator may be directed downward (arrow in illustration)

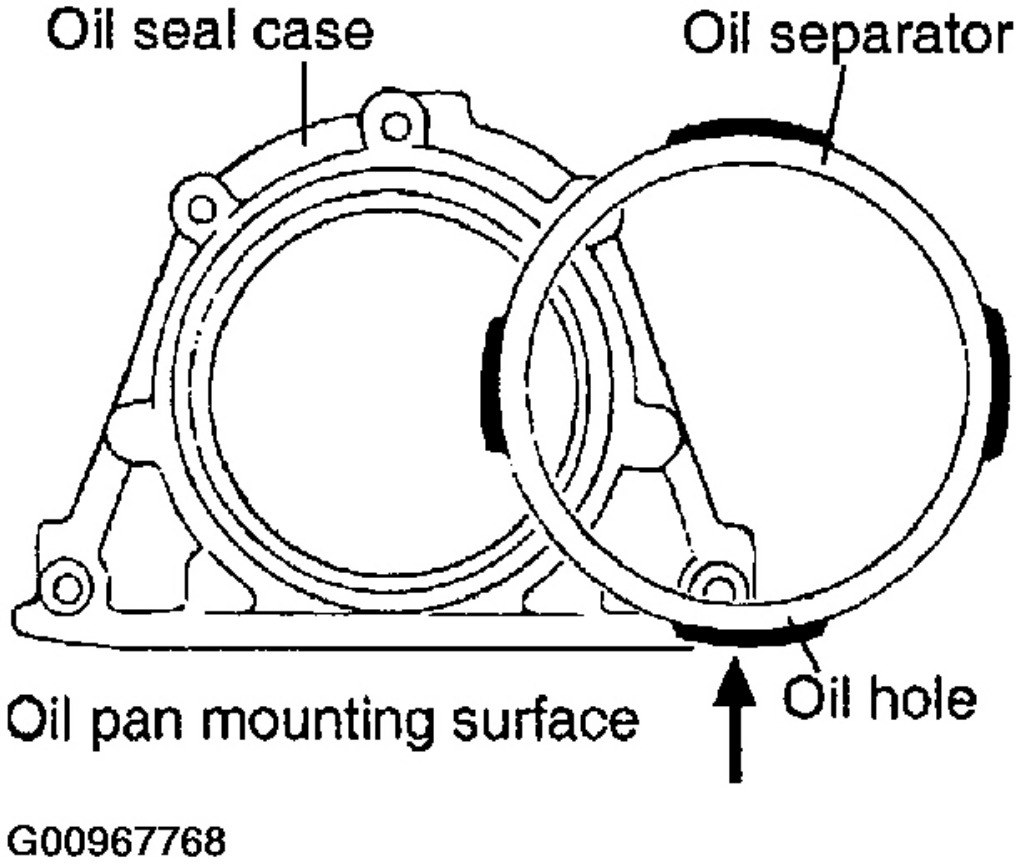

Fig. 128: Identifying Oil Separator
Courtesy of HYUNDAI MOTOR CO.

11. Install the new oil seal case gasket and oil seal case assembly.

    Tightening torque

    Oil seal case: 10-12 N.m (100-120 kg.cm, (7-9 lb.ft)

    < For M/T >

12. Install the rear plate to the cylinder block.
13. Install the flywheel assembly and tighten the bolts to the specified torque.

    Tightening torque

Flywheel bolt: 130-140 N.m (1300-1400 kg.cm, 94-101 lb.ft)

< For A/T >

14. Install the adapter plate to the cylinder block.
15. Install the drive plate and tighten the bolts to the specified torque.

Tightening torque

Drive plate:130-140 N.m (1300-1400 kg.cm, 94-101 lb.ft)

COOLING SYSTEM

ENGINE COOLANT HOSE/PIPES

COMPONENTS

[DOHC ENGINE]

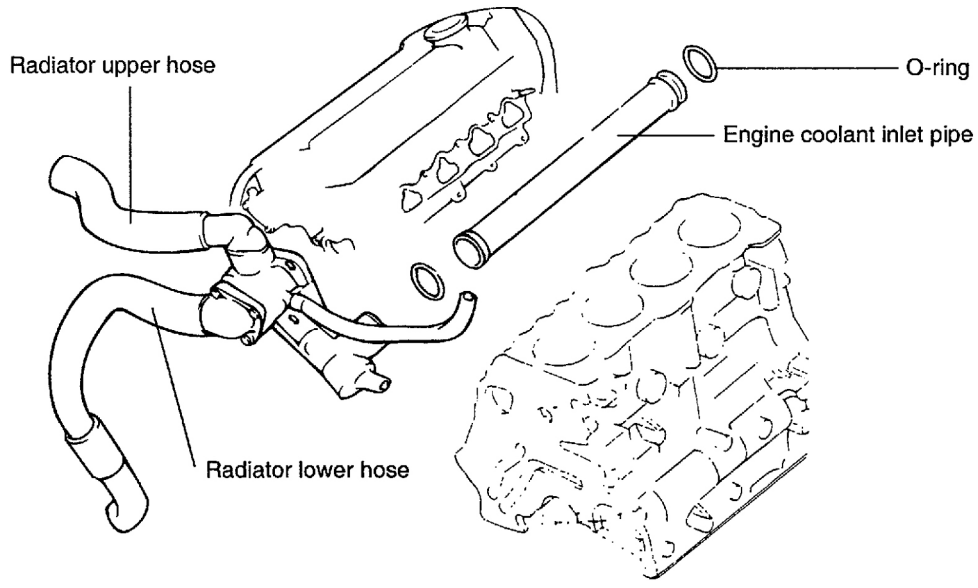

Fig. 129: Engine Coolant Hose/Pipes Components
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

Check the engine coolant pipe and hose for cracks, damage and restrictions. Replace if necessary.

REASSEMBLY

Fit an O-ring in the groove provided at the engine coolant inlet pipe end. Wet the periphery of the O-ring with water and insert the engine coolant inlet pipe.

NOTE:

1. **Do not apply oil or grease to engine coolant pipe O-ring.**
2. **Keep the engine coolant pipe connections free of sand, dust, etc.**
3. **Insert the engine coolant pipe into the end of the engine coolant pump inlet.**
4. **Whenever installing the engine coolant inlet pipe, always replace the O-ring with a new one.**

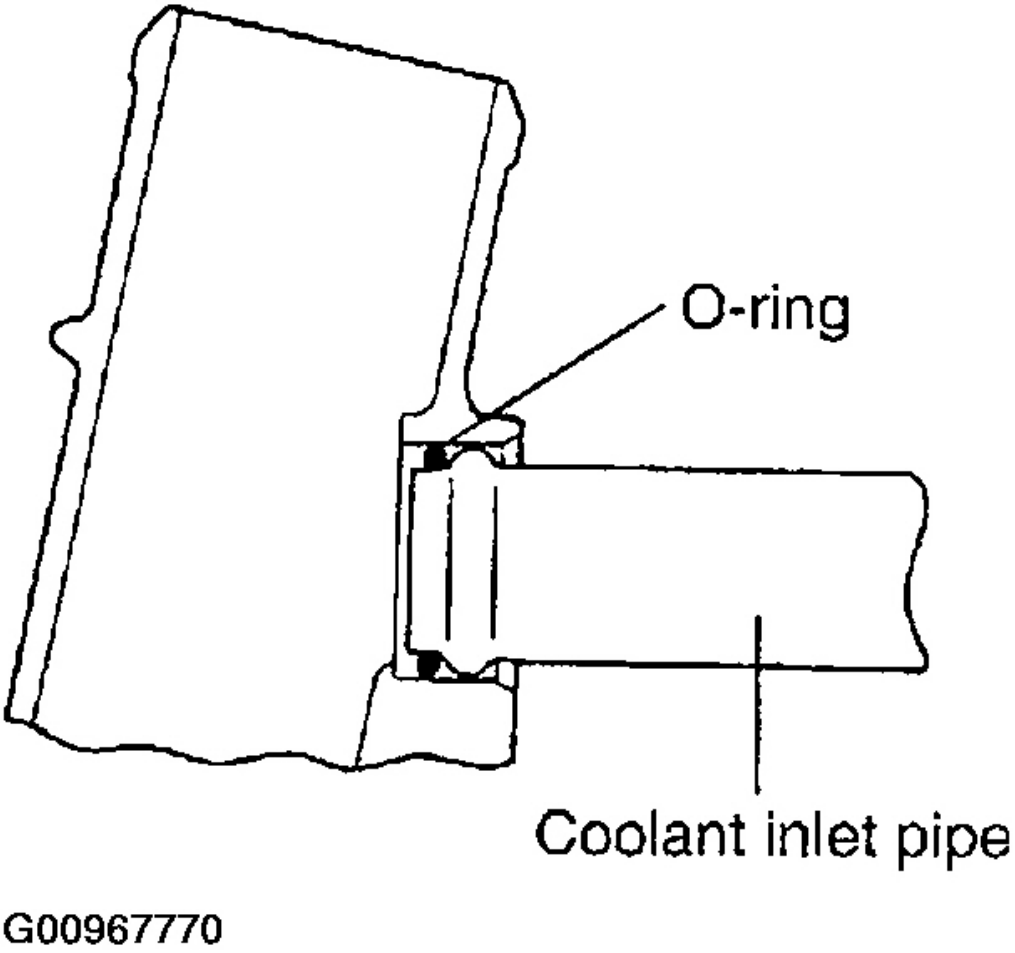

Fig. 130: Identifying Inlet Pipe O-Ring
Courtesy of HYUNDAI MOTOR CO.

COOLANT TEMPERATURE SENSOR

REMOVAL

1. Drain the coolant to a level below the bottom of the sensor.
2. Disconnect the ground cable from the battery and then remove the sensor connector.
3. Remove the coolant sensor.

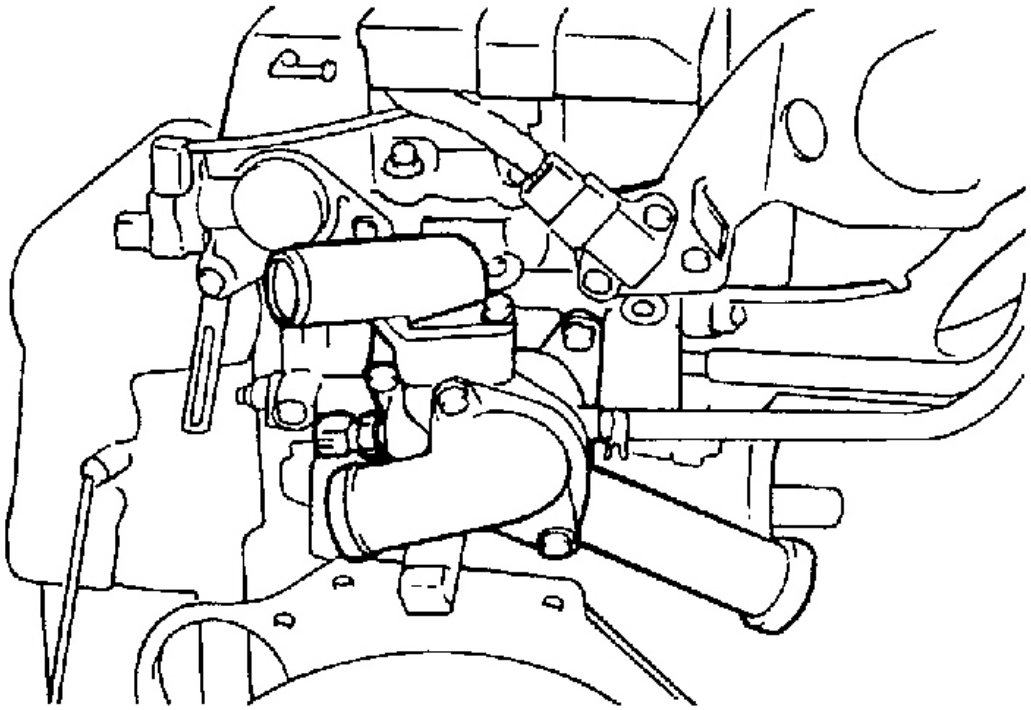

Fig. 131: Identifying Coolant Temperature Sensor
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Tighten the coolant temperature sensor to the specified torque after applying the sealant to the screw area.
   Recommended sealant: Threebond No. 1324N or LOCTITE 262

   Tightening torque

   The coolant temperature sensor: 20-40 N.m (200-400 kg.cm, 14-29 lb.ft)
2. Connect the sensor to the harness.
3. Connect the ground cable to the battery.
4. Refill the engine coolant.

ENGINE COOLANT PUMP

COMPONENTS

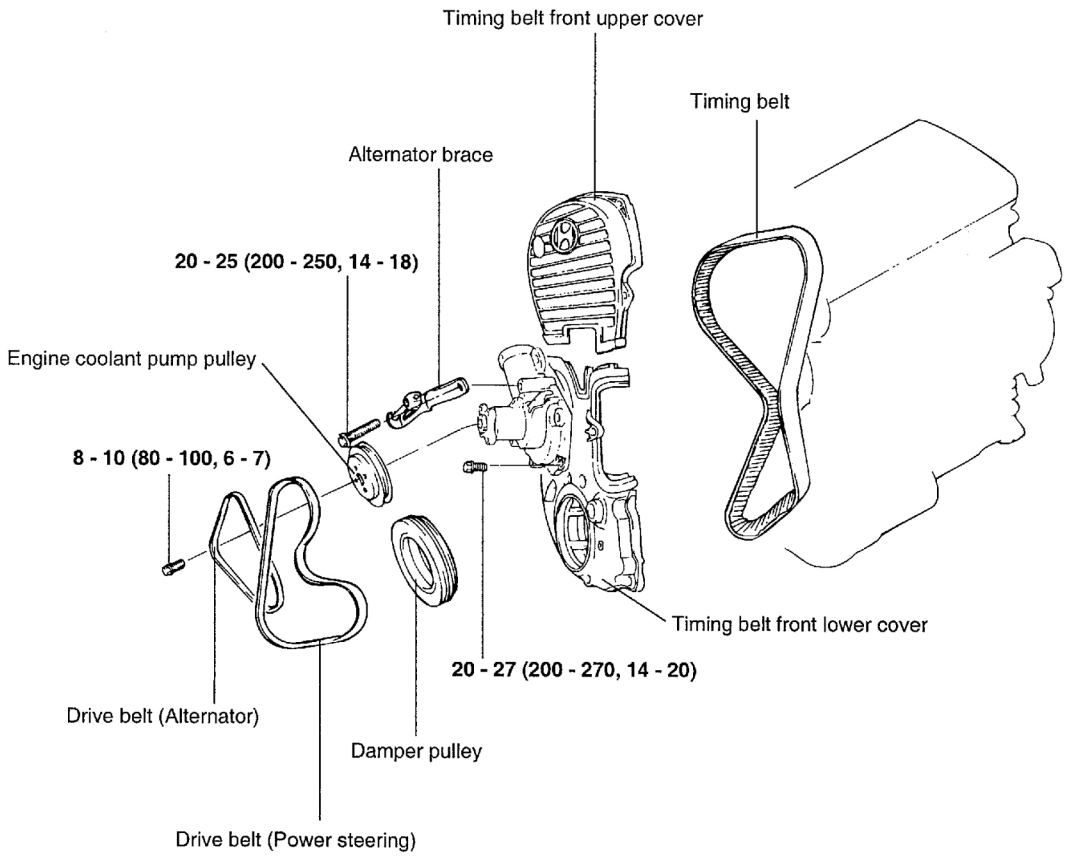

Fig. 132: Engine Coolant Pump Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

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

INSPECTION

1. Check the pump for cracks, damage or wear. Replace the pump assembly if necessary.
2. Check the bearing for damage, abnormal noise, and sluggish rotation. Replace the pump assembly if necessary.
3. Check the seal for leaks. Replace the pump assembly if necessary.

4. Check for engine coolant leakage. If the engine coolant leaks, the seal is defective. Replace the engine coolant pump assembly.

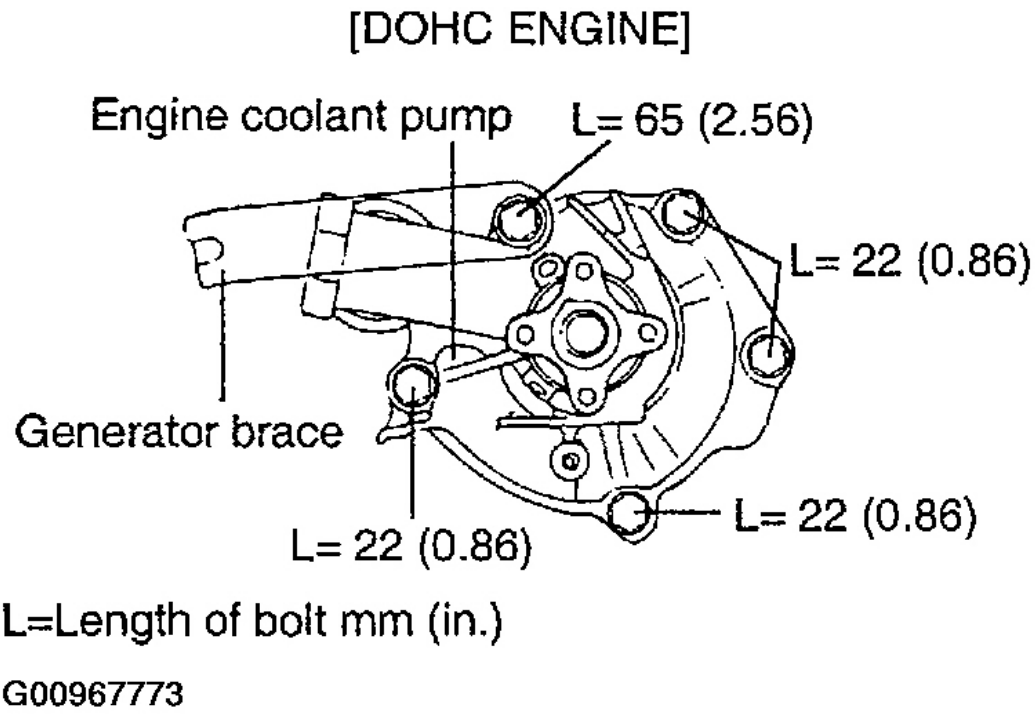

Fig. 133: Identifying Engine Coolant Pump Bolts
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.
2. Install the new O-ring onto the groove on the front end of the engine coolant pipe, then wet the O-ring with water. Do not apply oil or grease.

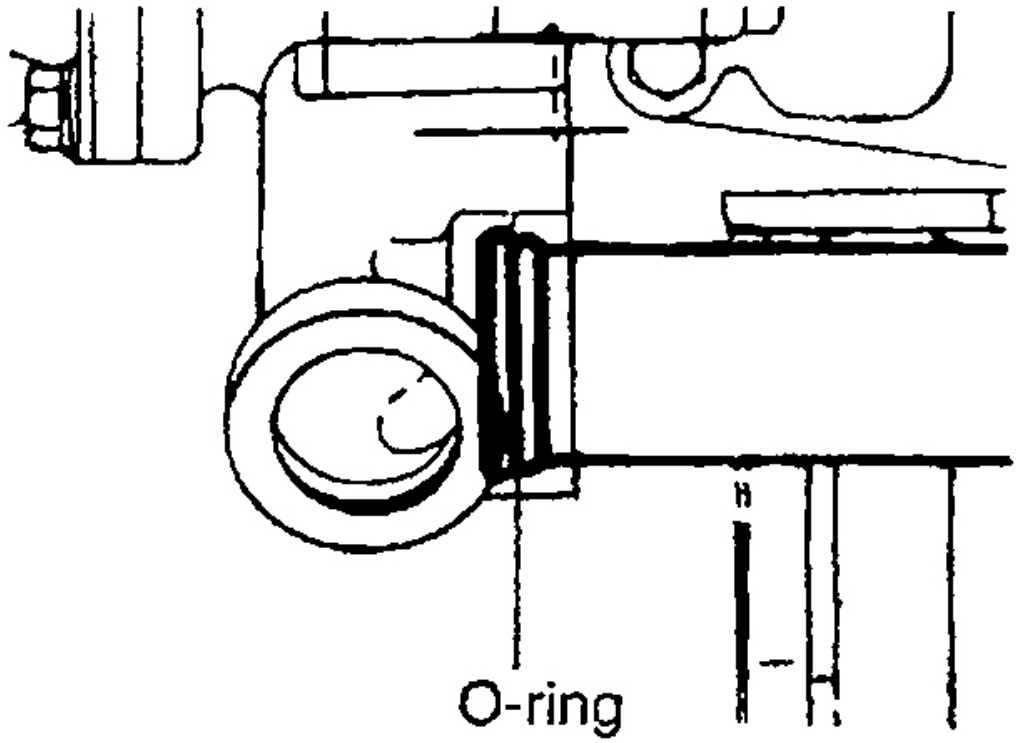

Fig. 134: Identifying Engine Coolant Pipe O-ring
Courtesy of HYUNDAI MOTOR CO.

3. Install a new engine coolant pump gasket and engine coolant pump assembly. Tighten the bolts to the specified torque.

   Tightening torque

   Engine coolant pump bolt: 20-27 N.m (200-270 kg.cm, 14-20 lb.ft)
4. Install the timing belt tensioner and timing belt. Adjust the timing belt tension, then install the timing belt covers.
5. Install the engine coolant pump pulley and drive belt, then adjust the belt tension.
6. Refill the coolant.
7. Run the engine and check for leaks.

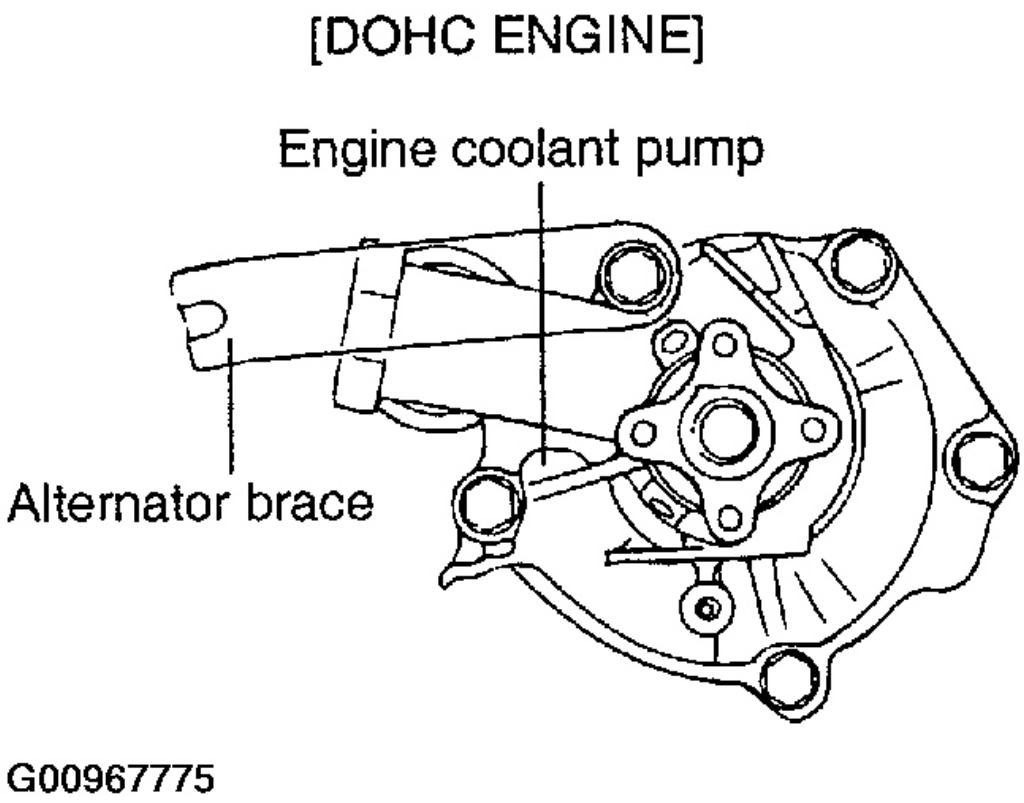

Fig. 135: Identifying Alternator Brace
Courtesy of HYUNDAI MOTOR CO.

RADIATOR

COMPONENTS

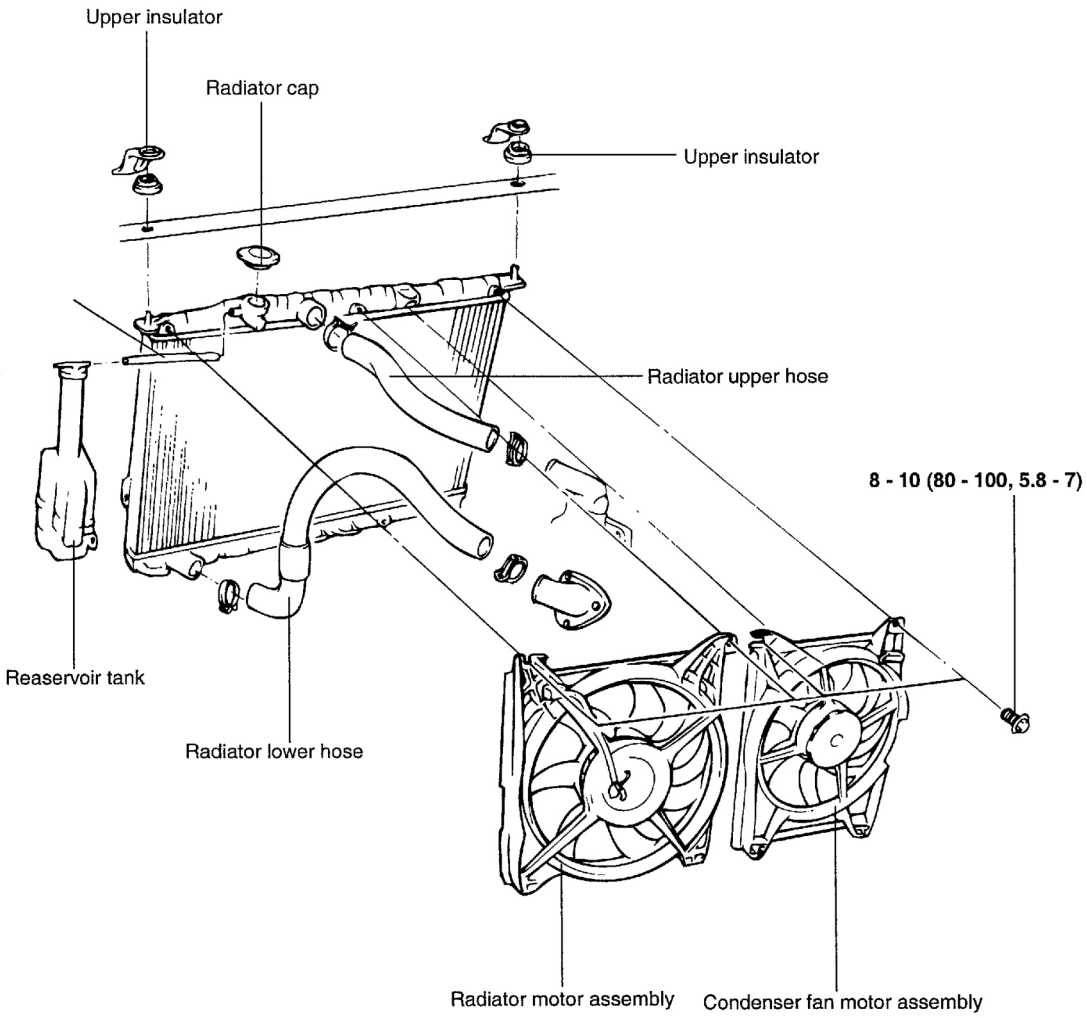

Fig. 136: Identifying Radiator Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Disconnect the ground cable from the battery terminal.
2. Disconnect the fan motor connector.
3. Loosen the radiator drain plug to drain the coolant.
4. Disconnect the upper and lower hoses and overflow tube after making marks on the radiator hose and the hose clamp.

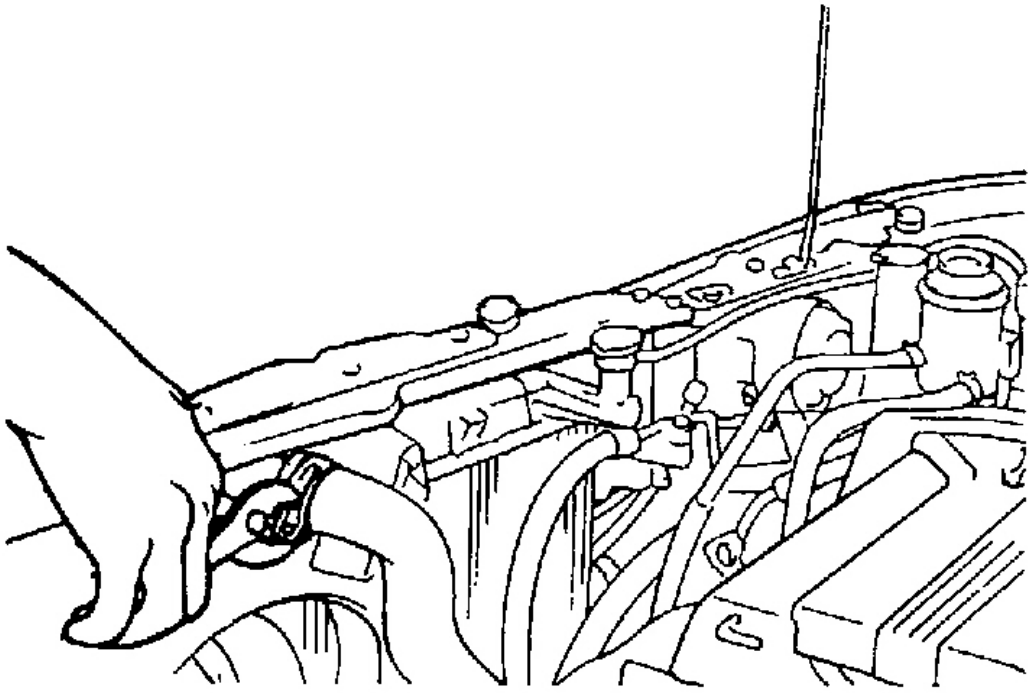

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Fig. 137: Removing Upper Radiator Hose
Courtesy of HYUNDAI MOTOR CO.

5. For vehicles with automatic transaxles, disconnect the oil cooler hoses from the automatic transaxle.

CAUTION: Cover or plug the hose and inlets of the radiator so that dust and other foreign materials can not enter after the hose is disconnected from the radiator.

6. Remove the radiator upper mounting bolt.

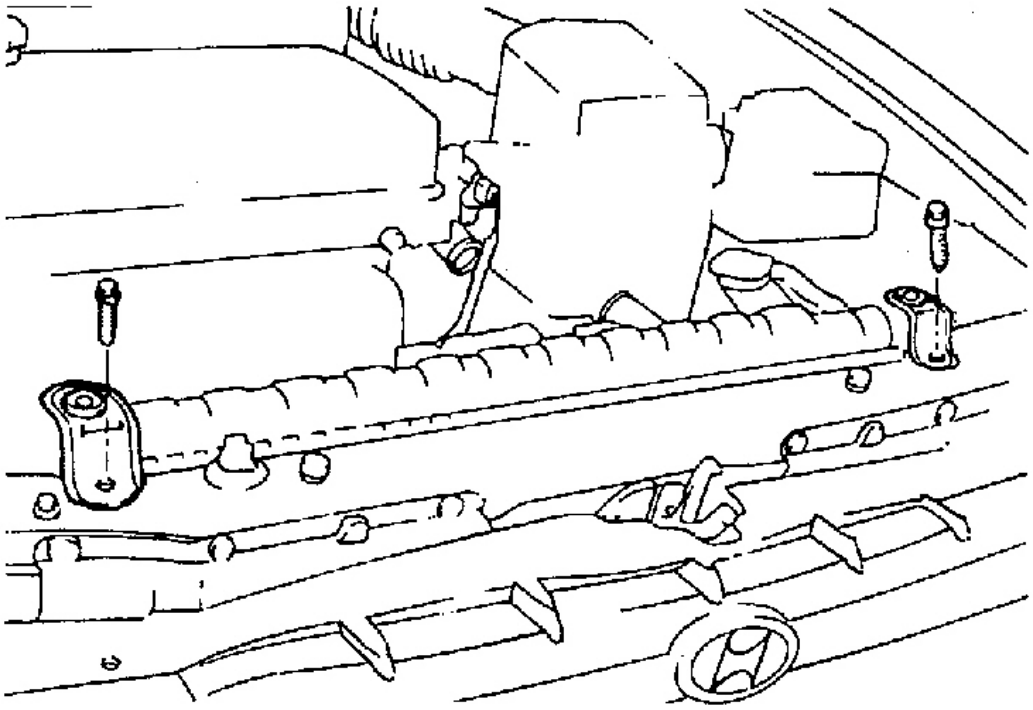


Fig. 138: Identifying Radiator Upper Mount & Bolts
Courtesy of HYUNDAI MOTOR CO.

7. Remove the radiator together with the fan motor.
8. Remove the radiator fan motor and condenser fan motor from the radiator.

INSPECTION

1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the automatic transaxle oil cooler hoses for cracking, damage or deterioration (only A/T).

INSTALLATION

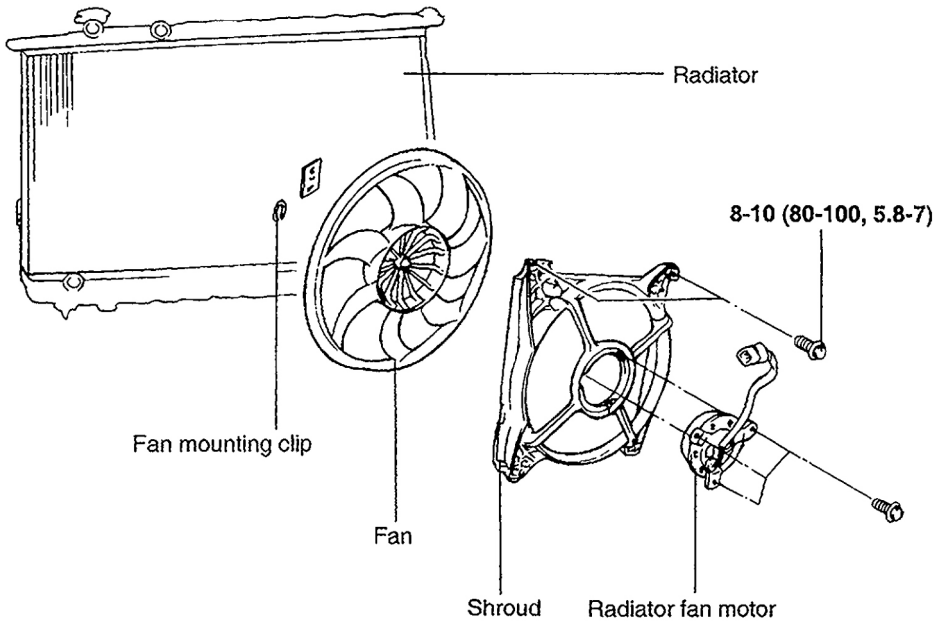
1. Fill the radiator and reservoir tank with clean coolant mixture.
2. Run the engine until the coolant has warmed up enough so that the thermostat valve is open. Then, stop

the engine.

3. Remove the radiator cap and pour the coolant into the filler neck of the radiator. Fill the reservoir tank with the coolant to the upper level. Replace the radiator cap.
4. Check that there are no leaks from the radiator, hoses or connections.

RADIATOR FAN MOTOR

COMPONENTS



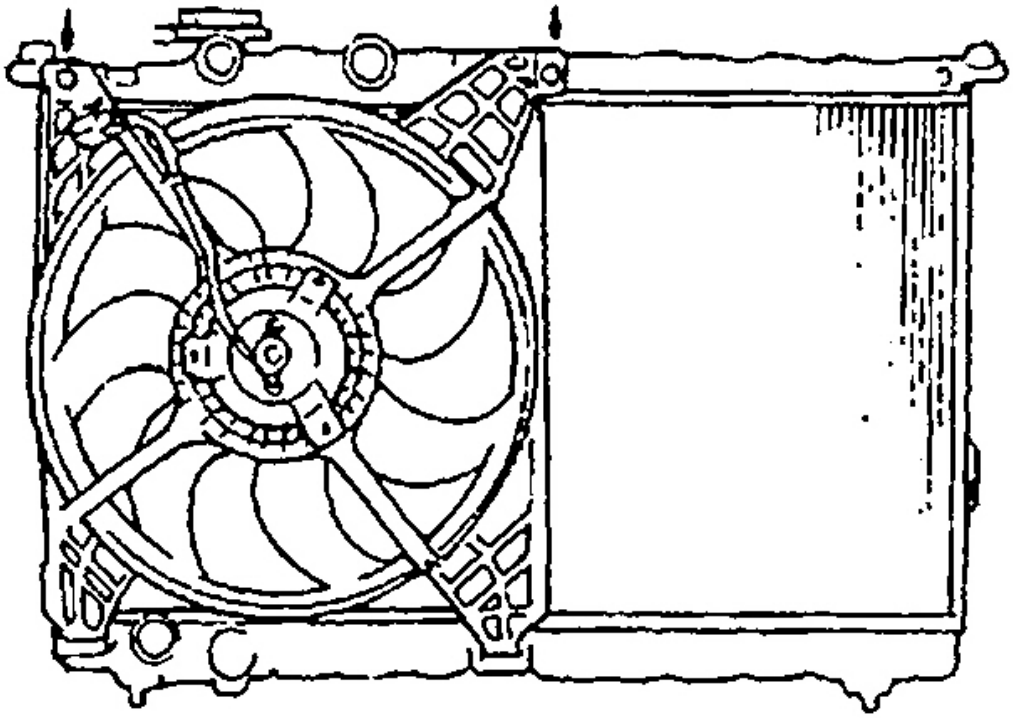
TORQUE : Nm (kg·cm, lb· ft)

G00967779

Fig. 139: Radiator Fan Motor Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Disconnect the ground cable from the battery cable.



G00967780

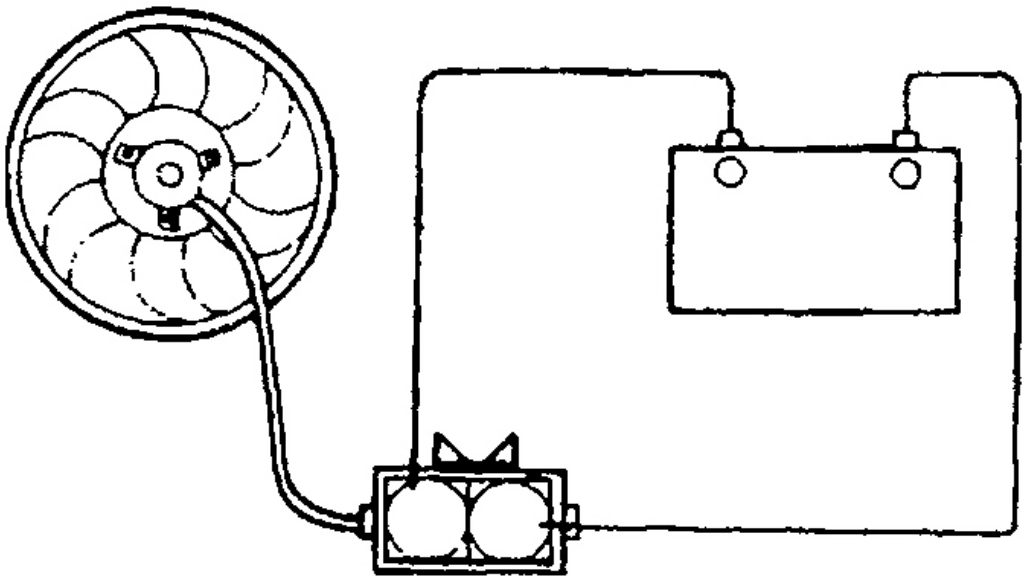
Fig. 140: Radiator Fan
Courtesy of HYUNDAI MOTOR CO.

2. Disconnect the connectors from the fan motor and the harness from the shroud.
3. For vehicles with automatic transaxles, remove the oil cooler hose from the shroud.
4. Remove the four bolts holding the shroud.
5. Remove the shroud with the fan motor.
6. Remove the fan mounting clip and detach the fan from the fan motor.
7. Remove the three screws and detach the fan motor.

INSPECTION

Radiator Fan Motor

1. Check that the radiator fan rotates when battery voltage is applied between the terminals (as shown in the table below).
2. Check that abnormal noise is not produced while the motor is turning.

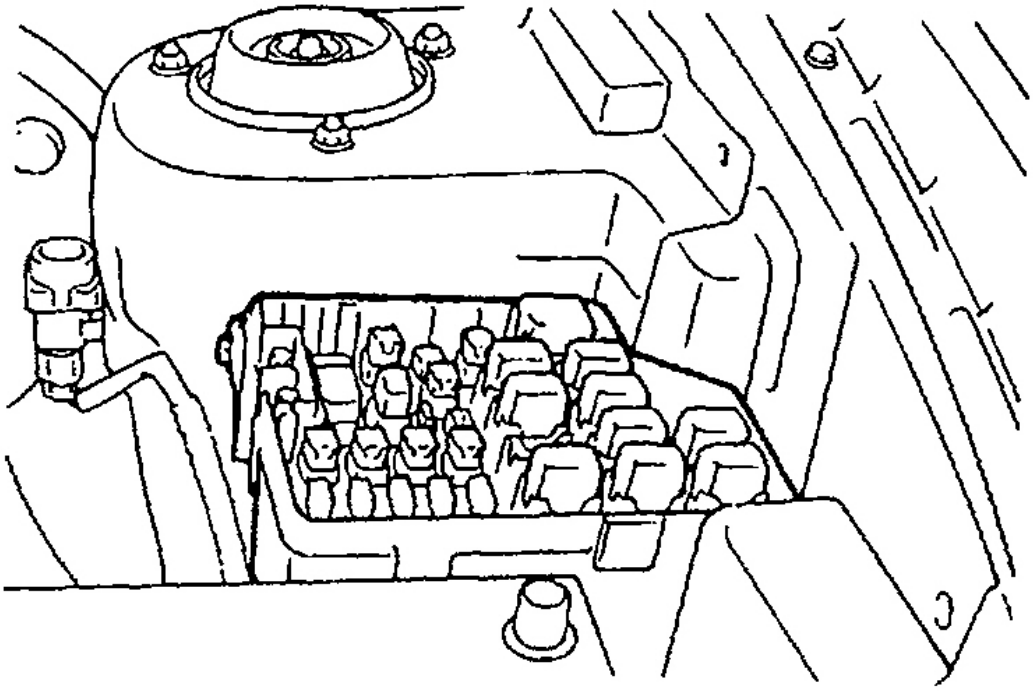


G00967781

Fig. 141: Checking Fan Motor
Courtesy of HYUNDAI MOTOR CO.

RADIATOR FAN MOTOR RELAY

1. Remove the radiator fan motor relay (High and Low) from the relay box in the engine bay.



G00967782

Fig. 142: Identifying Relay Box
Courtesy of HYUNDAI MOTOR CO.

2. Check the continuity of the terminals "2" and "4" with an ohmmeter.

Item	Terminal No.	Yes or No
ON	Terminal 1-3	Continuity
OFF	Terminal 1-3	Non continuity
	Terminal 2-4	Continuity

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Fig. 143: Fan Relay Continuity Table
Courtesy of HYUNDAI MOTOR CO.

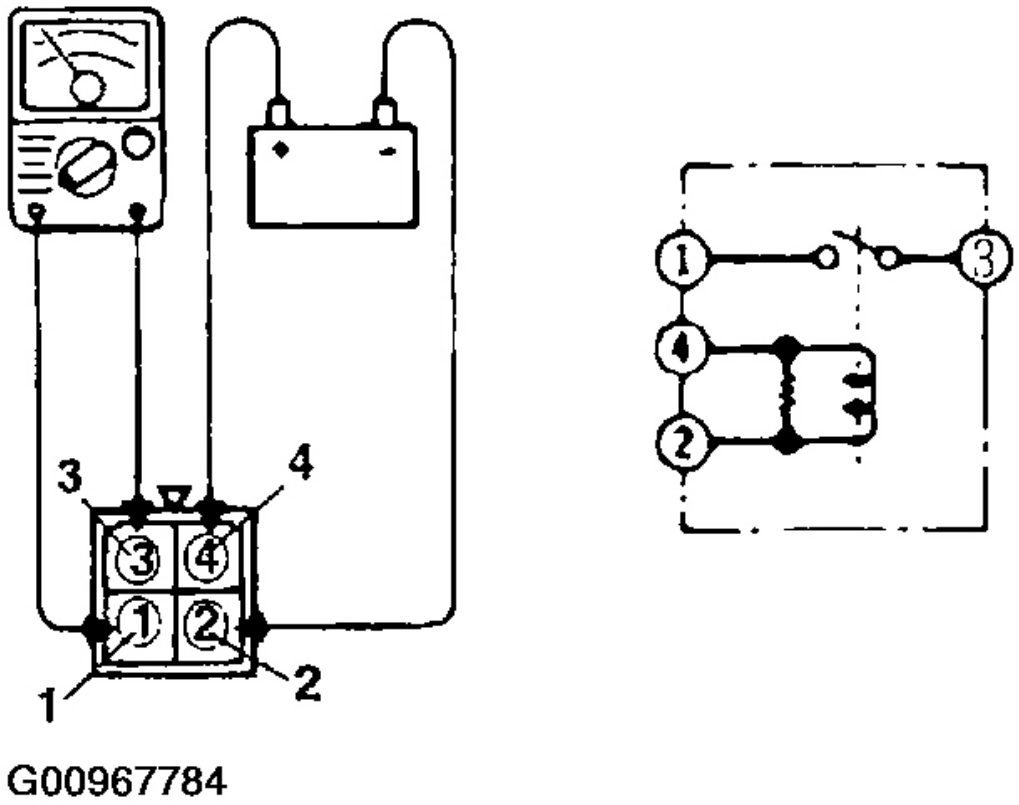


Fig. 144: Checking Fan Relay
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

Installation is in the reverse order of removal procedures.

NOTE:

- **Make sure the cooling fan does not come into contact with the shroud when installed.**
- **After installation, make sure there is no unusual noise or vibration when the fan is rotating.**

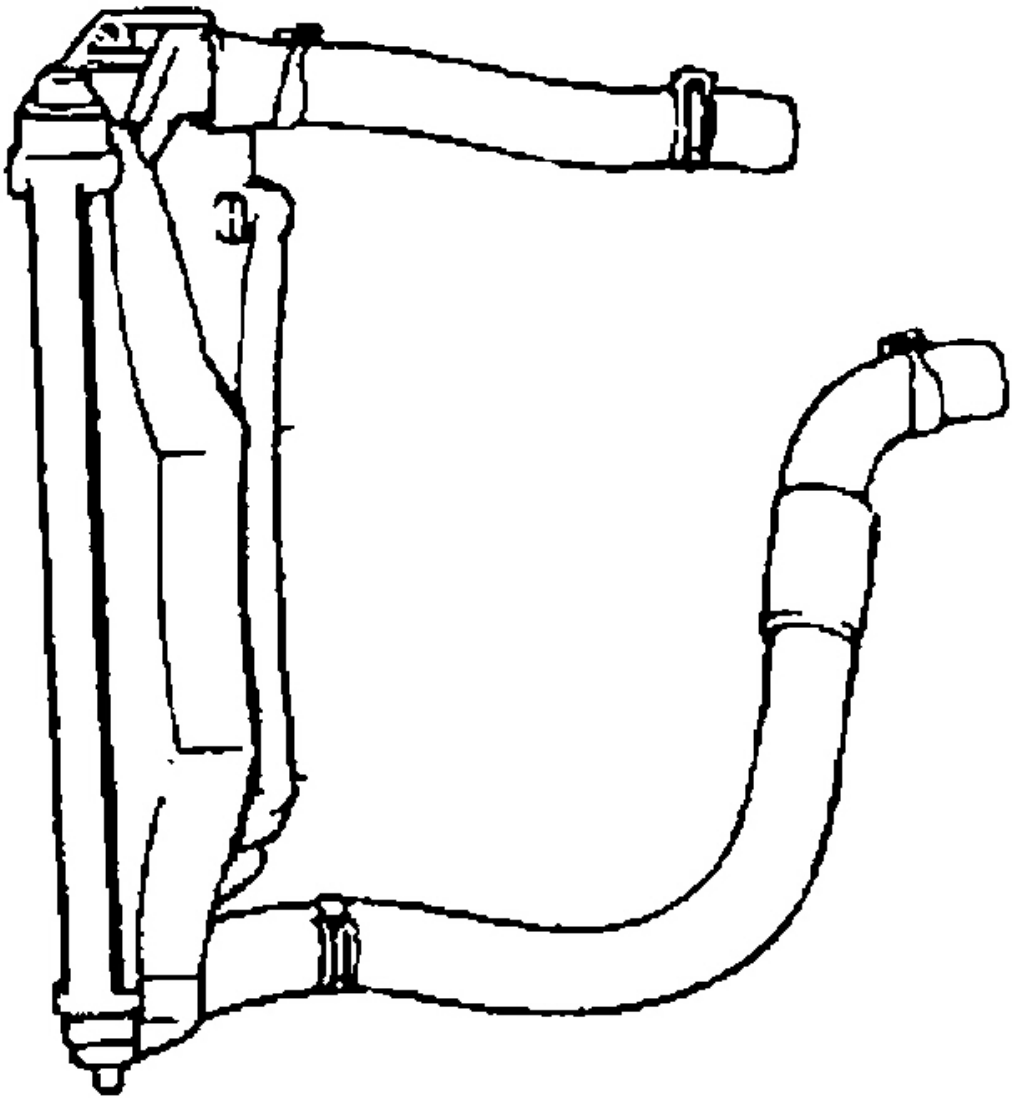


Fig. 145: View Of Fan Motor Assembly & Radiator Hoses
Courtesy of HYUNDAI MOTOR CO.

RADIATOR CAP

COMPONENTS

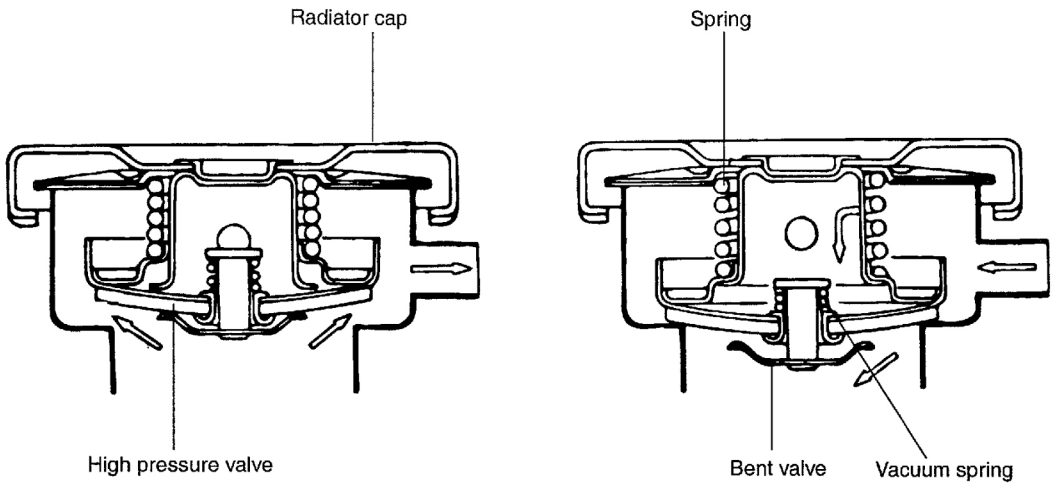


Fig. 146: Radiator Cap Components
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

1. Check the radiator cap for damage, cracks or weakening.

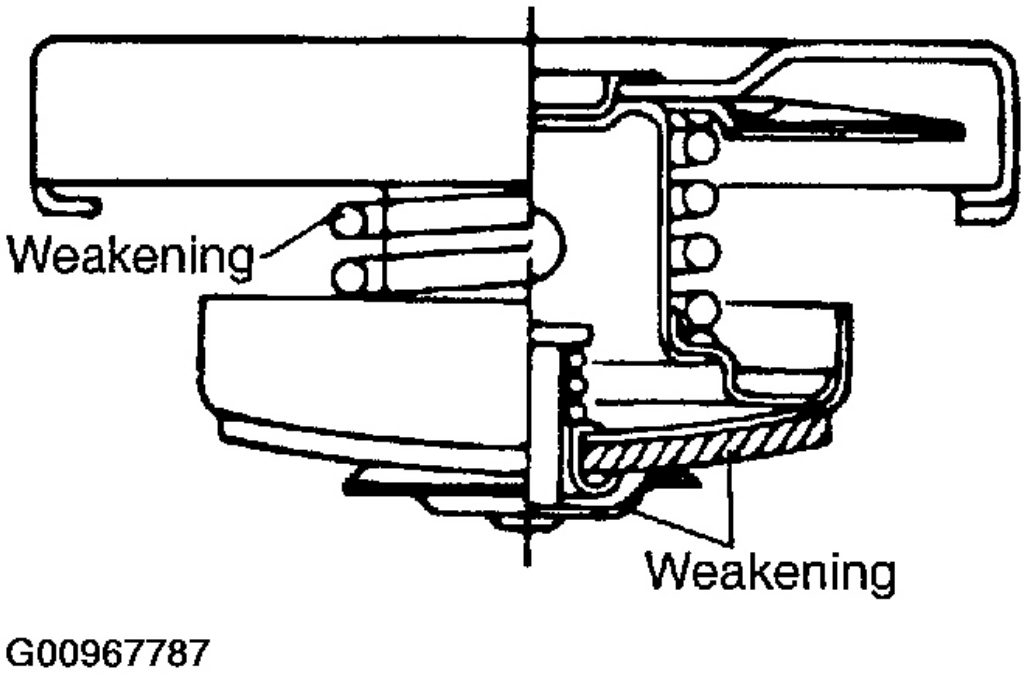


Fig. 147: Inspecting Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

2. Connect the tester to the radiator cap.
3. Increase the pressure until the indicator stops moving.
4. Replace the radiator cap if the reading does not hold steady for about 10 seconds.

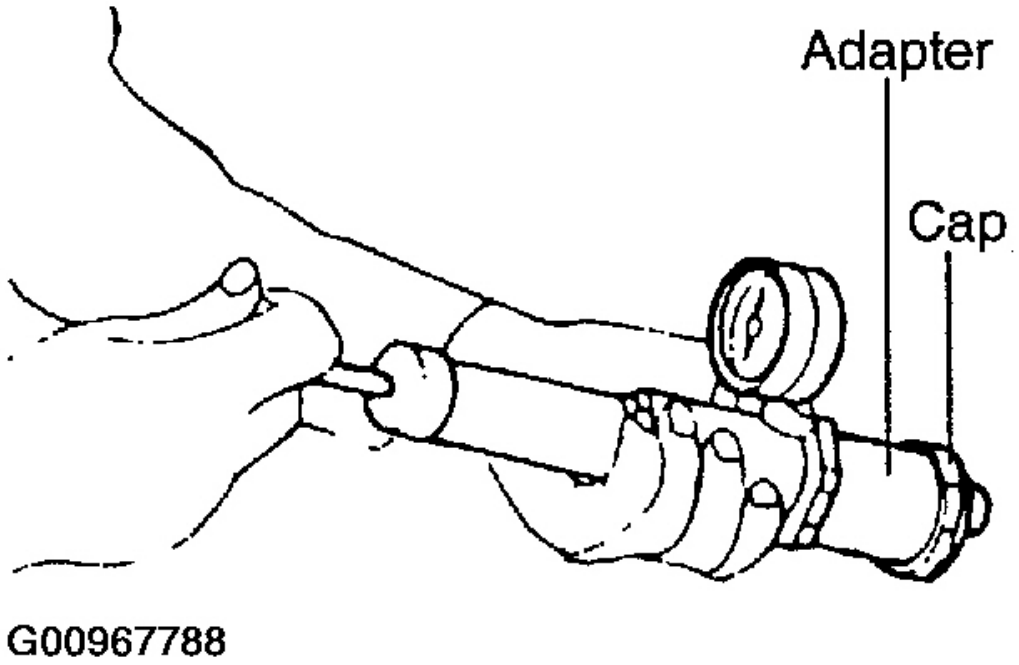


Fig. 148: Pressure Testing Radiator Cap
Courtesy of HYUNDAI MOTOR CO.

THERMOSTAT

COMPONENTS

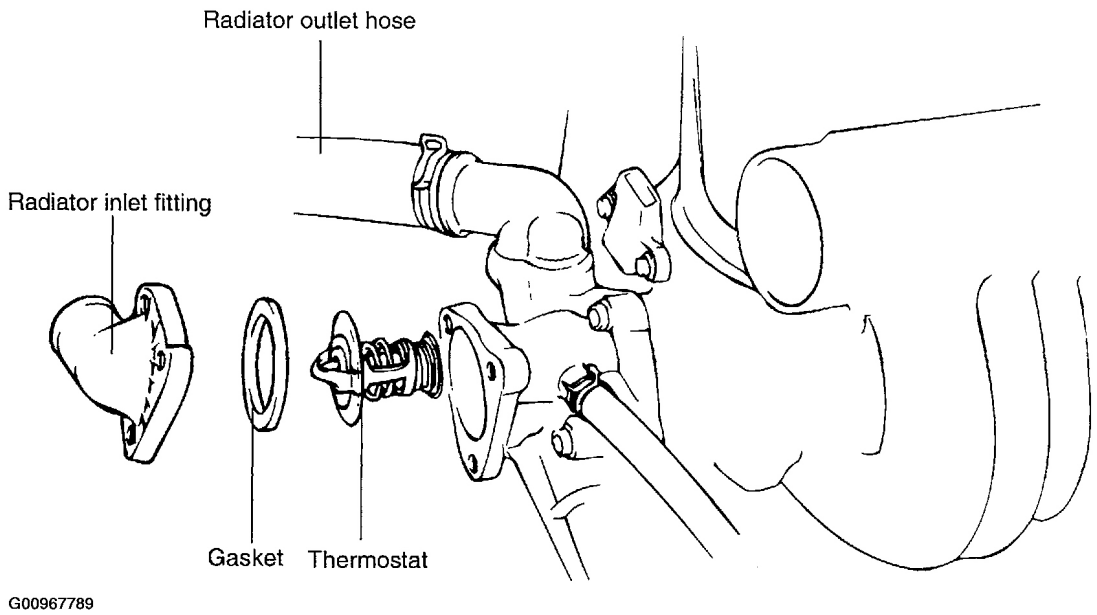


Fig. 149: Thermostat & Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Drain the coolant so its level is below the thermostat.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.

INSPECTION

1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Verify the temperature at which the valve begins to open.

   Valve opening temperature: 80-84°C (176-183.2°F)

   Full opening temperature: 95°C (203°F)

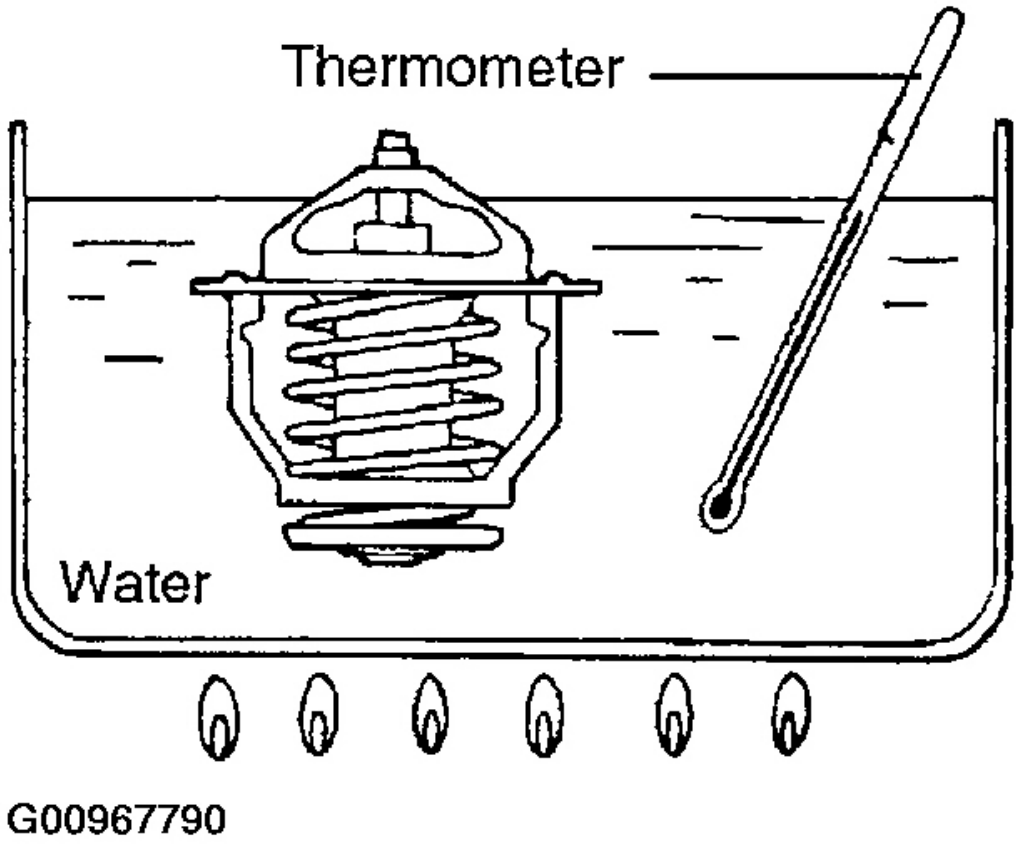
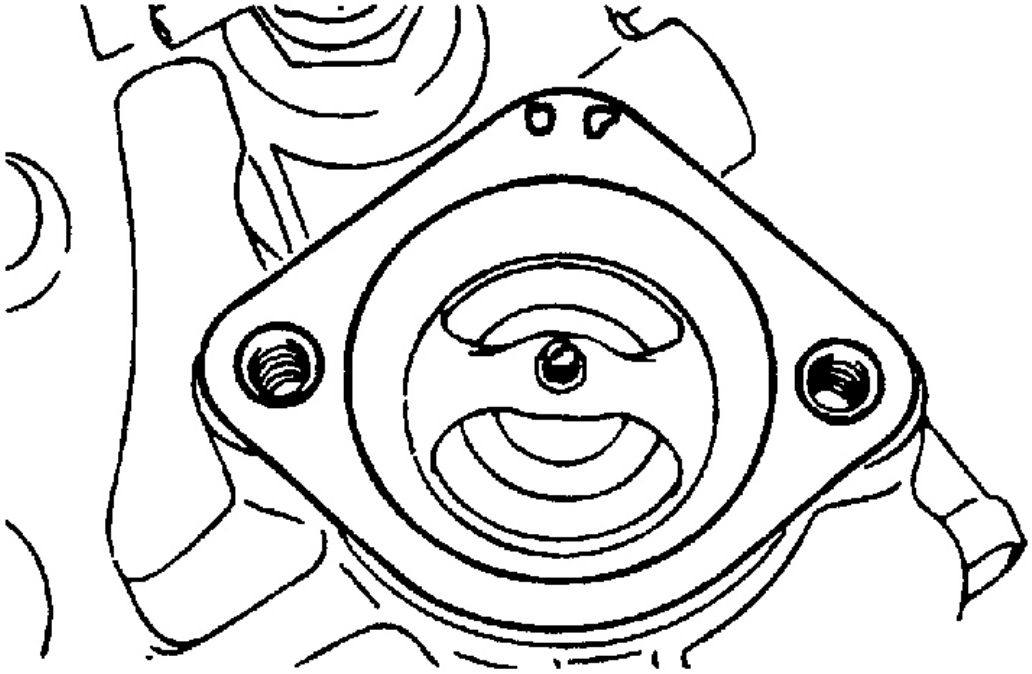


Fig. 150: Checking Thermostat Opening Temperature
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install the inlet fitting.



G00967791

Fig. 151: Identifying Thermostat Installation
Courtesy of HYUNDAI MOTOR CO.

Tightening torque

Engine coolant inlet fitting bolt: 10-15 N.m (100-150 kg.cm, 7-11 lb.ft)

3. Refill the coolant.

INTAKE & EXHAUST SYSTEM

EXHAUST PIPE

COMPONENTS

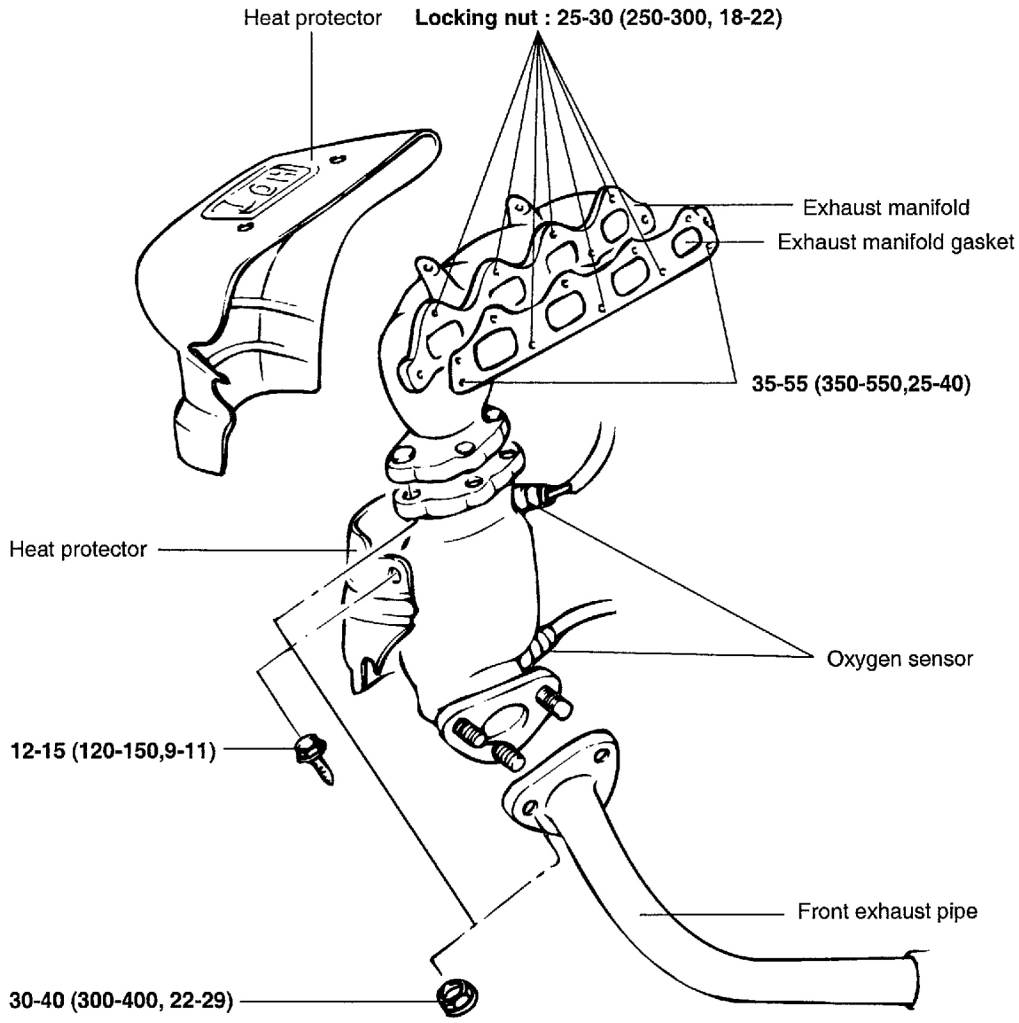
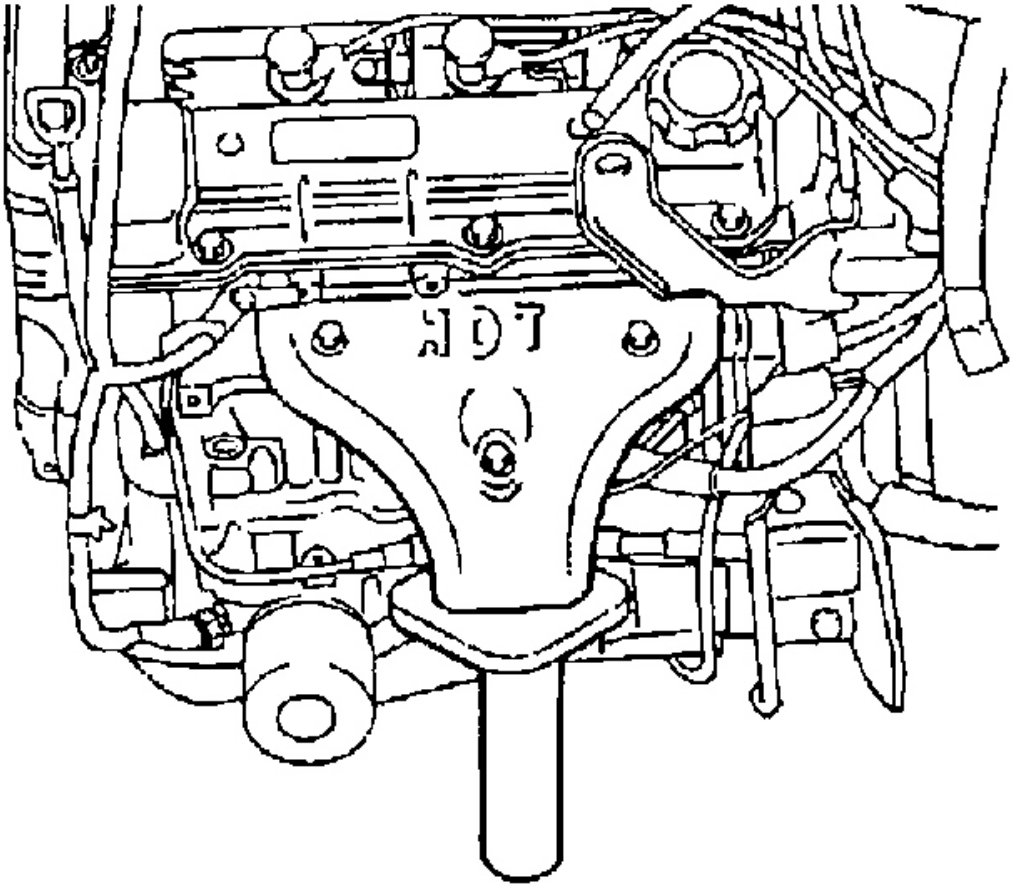


Fig. 152: Exhaust Manifold Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

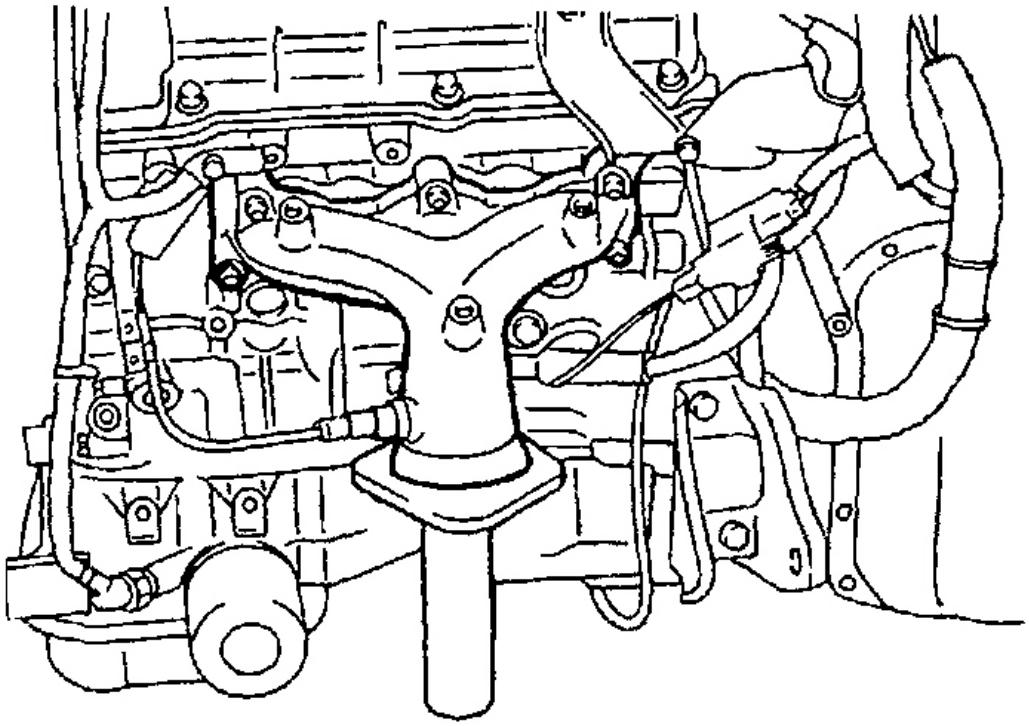
1. Remove the heat protector.



G00967793

Fig. 153: Identifying Heat Protector
Courtesy of HYUNDAI MOTOR CO.

2. Remove the exhaust manifold.



G00967794

Fig. 154: Identifying Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

3. Remove the exhaust manifold gasket.

INSPECTION

1. Check for damage or cracking.
2. Using a straight edge and feeler gauge, check for distortion on the cylinder head matching surface.

   Standard value: 0.15 mm (0.006 in.)

   Service limit: 0.3 mm (0.012 in.)

3. Check the exhaust manifold for damage and cracking.

INSTALLATION

1. Install the exhaust manifold with its gasket.

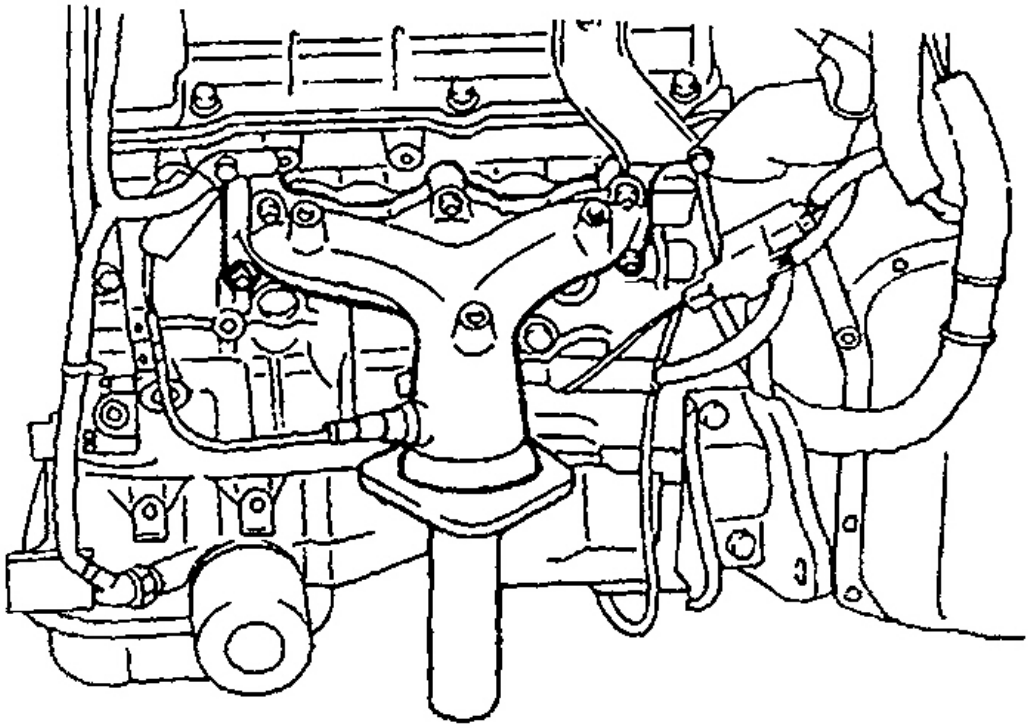
Tightening torque

Exhaust manifold

M8: 25-30 N.m (250-300 kg.cm, 18-22 lb.ft)

M10: 35-55 N.m (350-550 kg.cm, 25-40 lb.ft)

NOTE: Do not use the used exhaust manifold gasket.



G00967795

Fig. 155: Identifying Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

2. Install the heat protector.

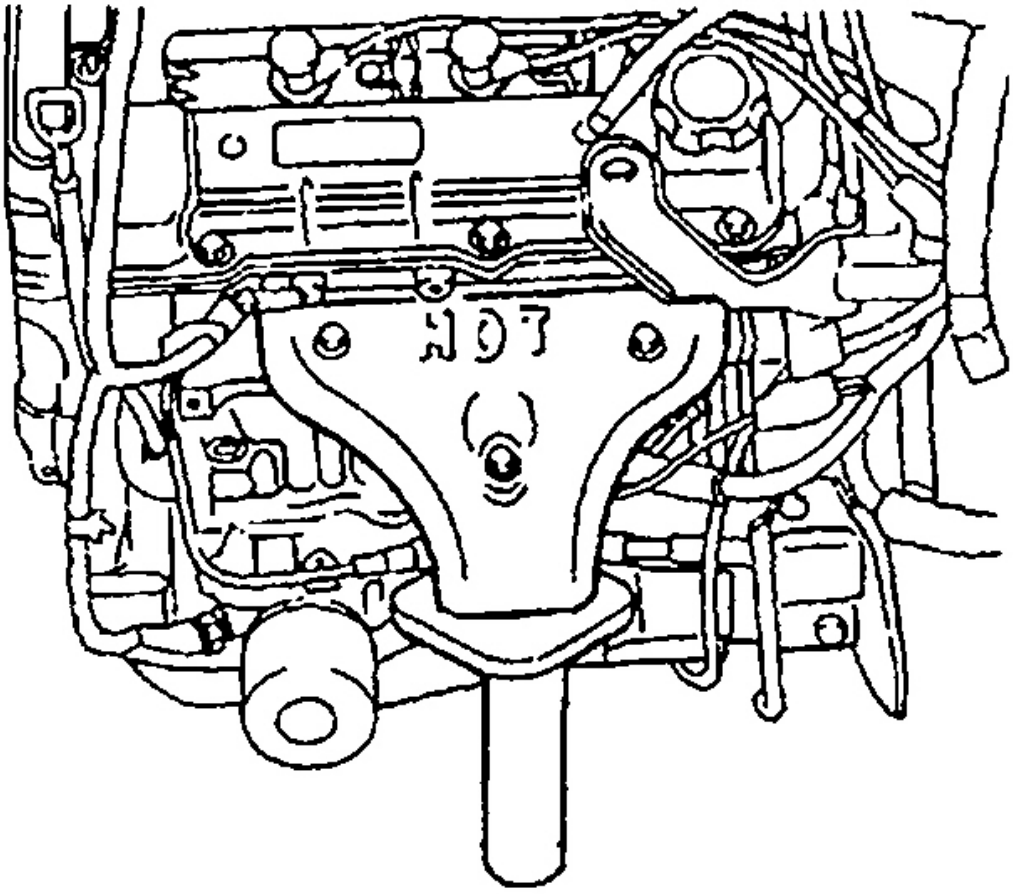


Fig. 156: Identifying Heat Protector
Courtesy of HYUNDAI MOTOR CO.

INTAKE MANIFOLD

COMPONENTS

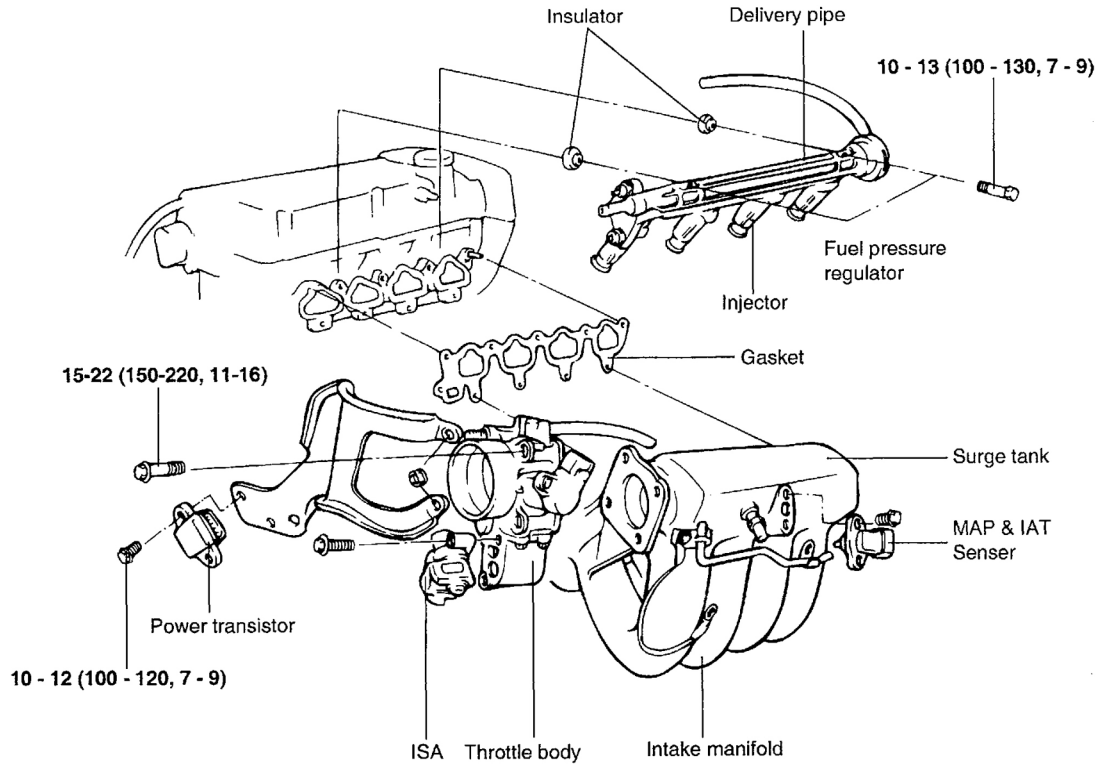


Fig. 157: Intake Manifold Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Remove the air breather hose connected to the throttle body.

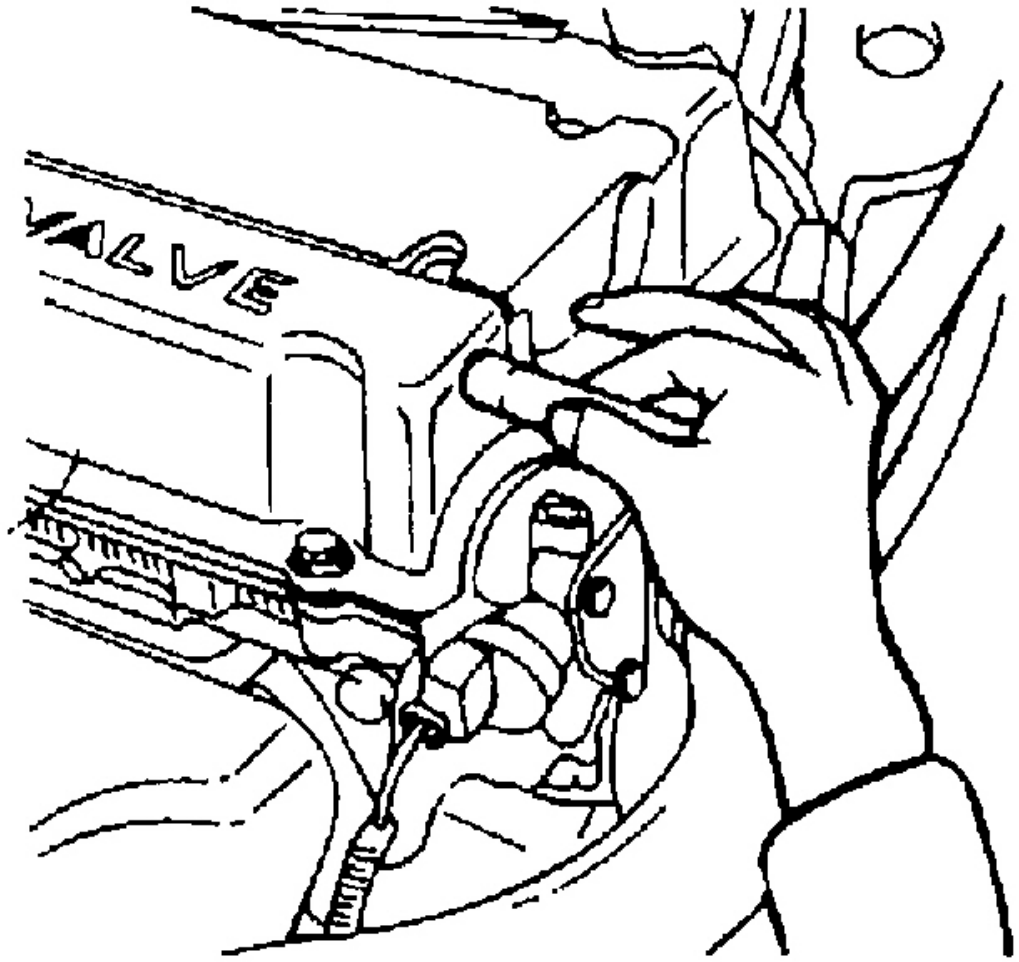
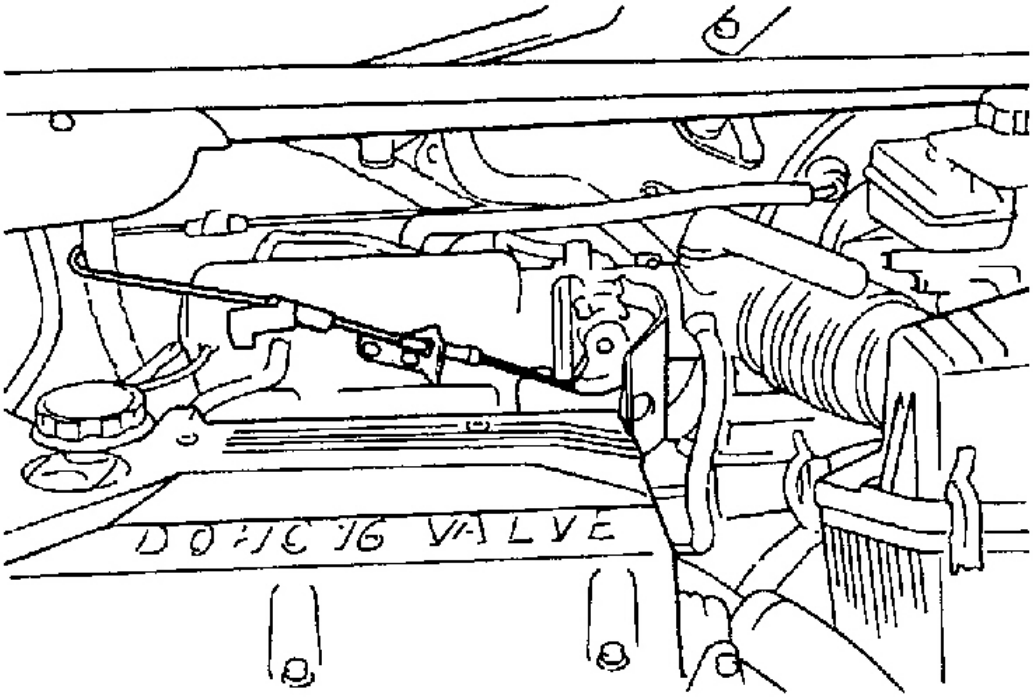


Fig. 158: Removing Air Breather Hose
Courtesy of HYUNDAI MOTOR CO.

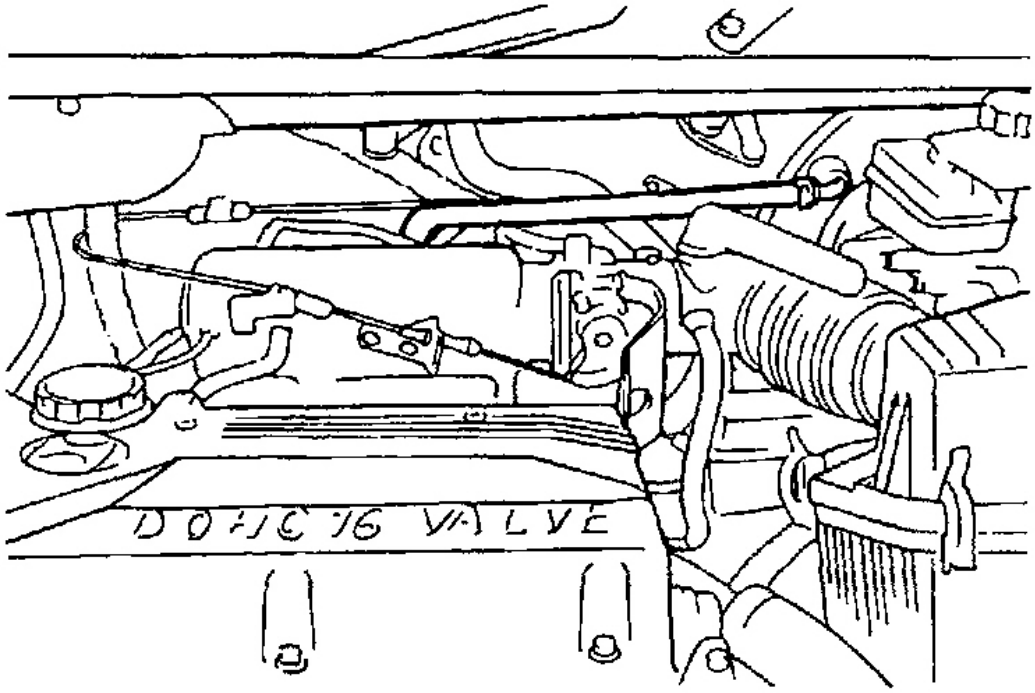
2. Remove the accelerator cable.



G00967799

Fig. 159: Identifying Accelerator Cable
Courtesy of HYUNDAI MOTOR CO.

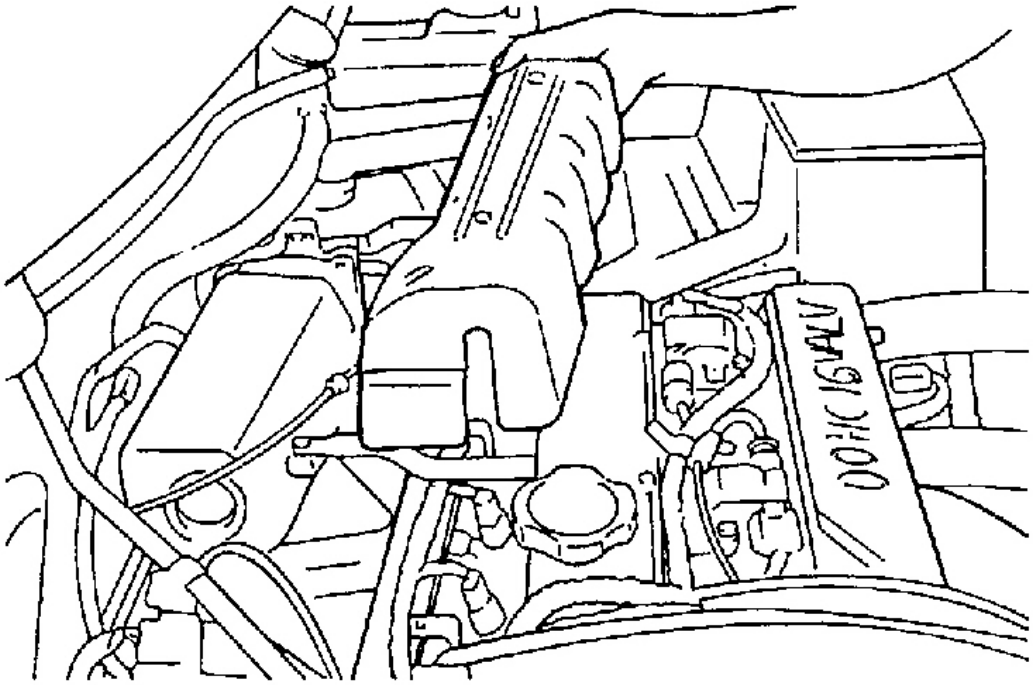
3. Remove the engine coolant hose and throttle body.
4. Remove the P.C.V. valve and brake boost vacuum hose.



G00967800

Fig. 160: Identifying Brake Booster Vacuum Hose
Courtesy of HYUNDAI MOTOR CO.

5. Disconnect the vacuum hose connector.
6. Remove the injector cover.



G00967801

Fig. 161: Removing Injector Cover
Courtesy of HYUNDAI MOTOR CO.

7. Bleed off pressure in the fuel pipe line to prevent fuel from spilling and then disconnect the high pressure hose.
8. Disconnect the fuel injector harness connector.

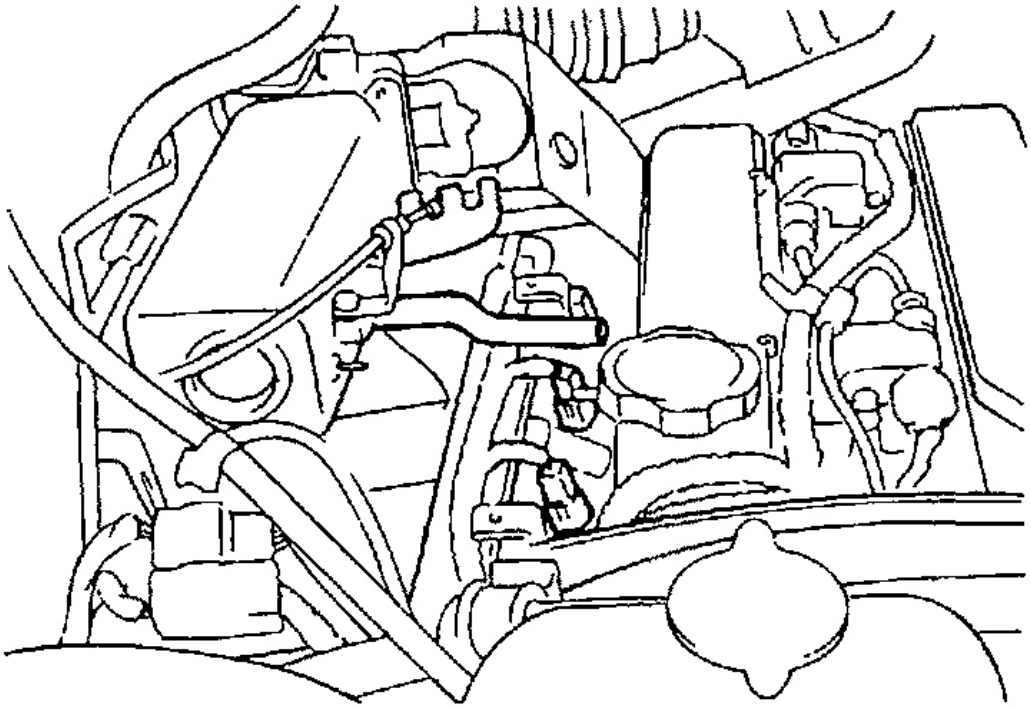
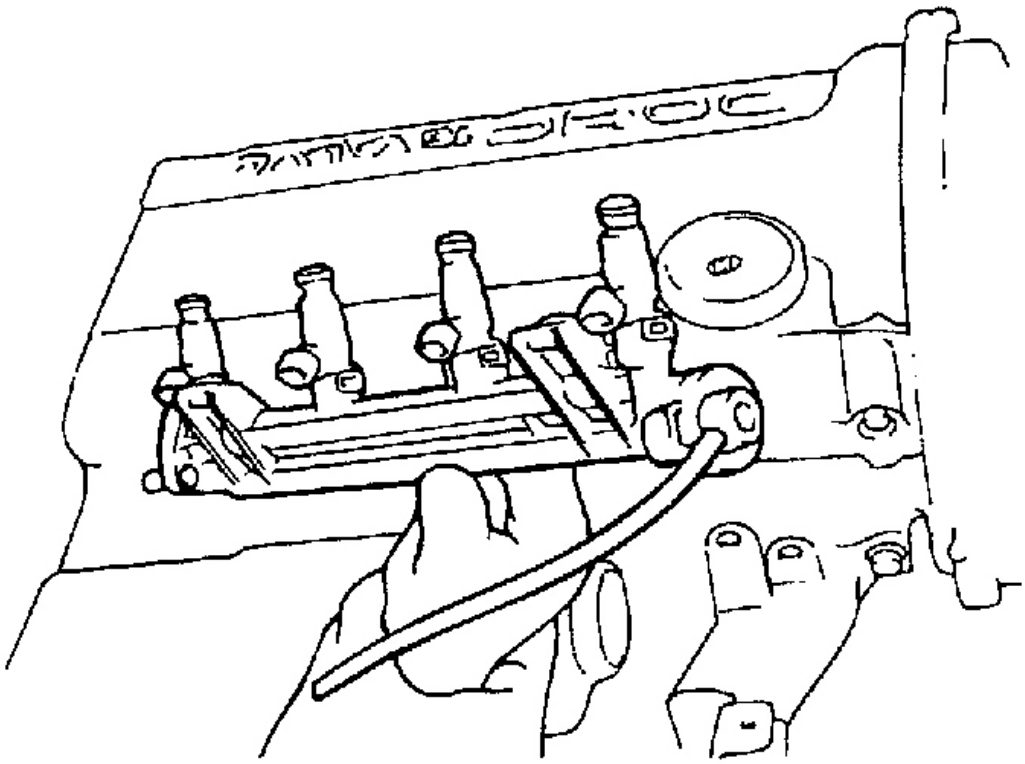


Fig. 162: View Of Injector Harness Connector
Courtesy of HYUNDAI MOTOR CO.

9. Remove the delivery pipe with fuel injectors and the pressure regulator.

NOTE: When the delivery pipe is removed, do not drop the injectors.



G00967803

Fig. 163: Removing Fuel Delivery Pipe
Courtesy of HYUNDAI MOTOR CO.

10. Remove the intake manifold stay.

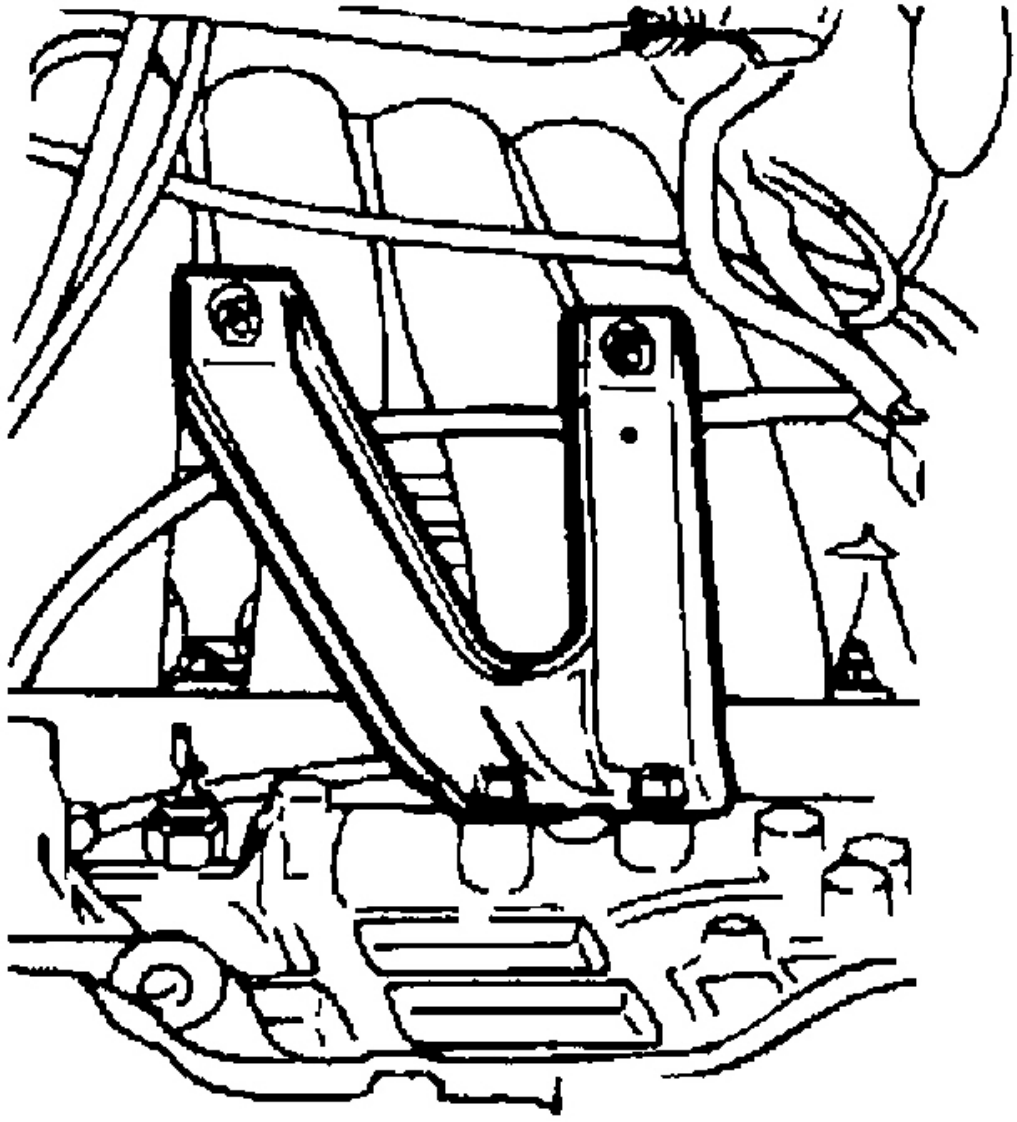


Fig. 164: Identifying Intake Manifold Stay
Courtesy of HYUNDAI MOTOR CO.

11. Remove the intake manifold.

INSPECTION

INTAKE MANIFOLD & SURGE TANK

1. Check the parts for damage or cracking.
2. Check for restrictions in the vacuum outlet port, water or gas passages.
3. Check for flatness using a straight edge and feeler gauge.

   Standard value: 0.15 mm (0.06 in.) or less

   Service limit: 0.2 mm (0.0078 in.)

INSTALLATION

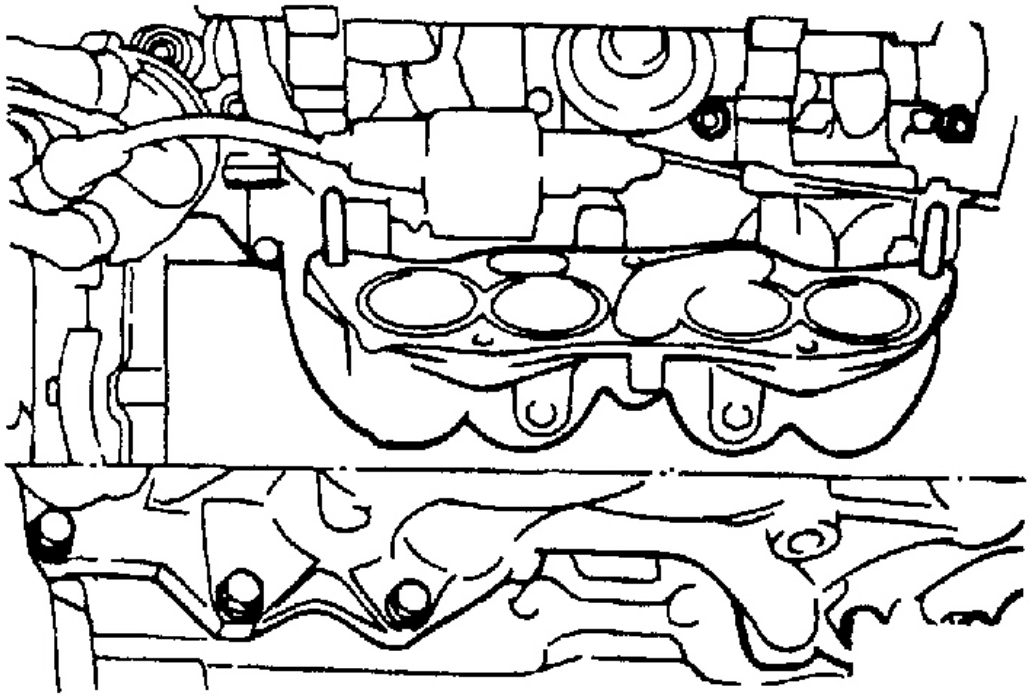
1. Install the intake manifold and new gasket to the specified torque.

   Tightening torque

   intake manifold

   Bolt: 15-20 N.m (150-120 kg.cm, 11-14 lb.ft)

   Nut: 30-42 N.m (300-420 kg.cm, 22-30 lb.ft)

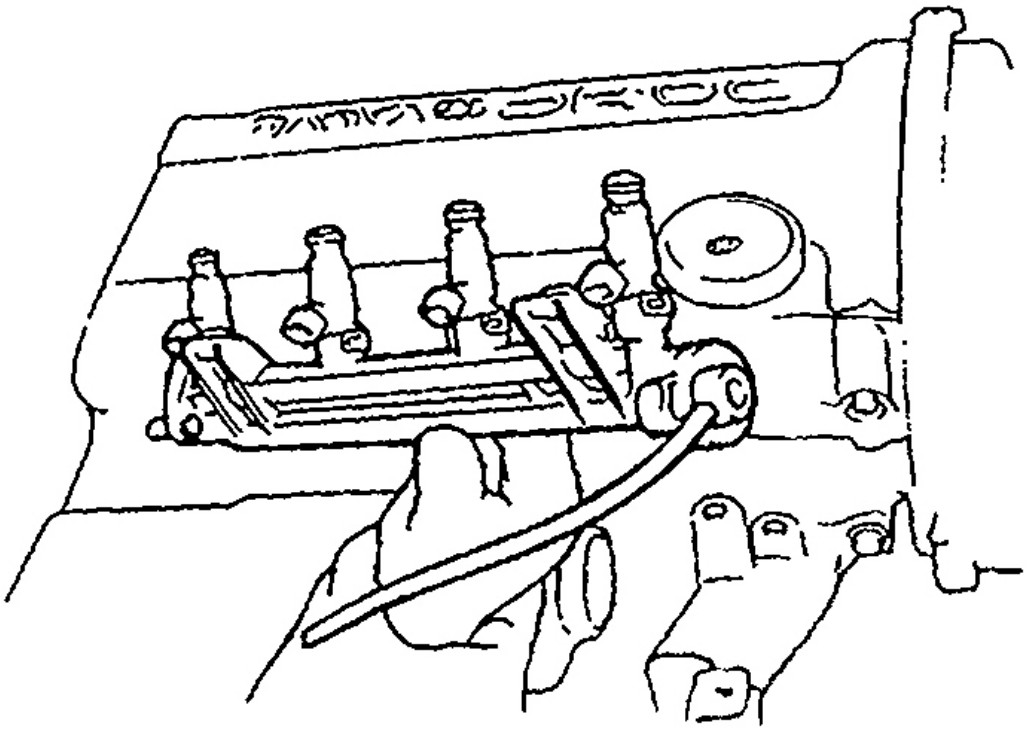


G00967806

Fig. 165: View Of Intake Manifold
Courtesy of HYUNDAI MOTOR CO.

2. Install the delivery pipe and injector assembly to the intake manifold.

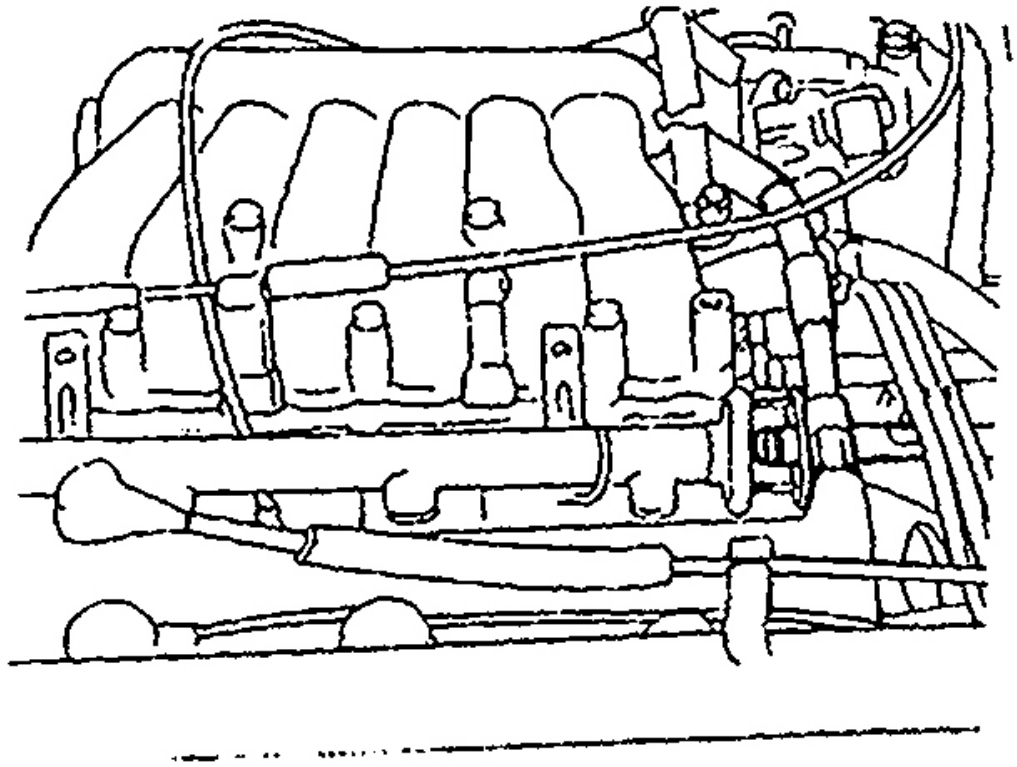
NOTE: Make certain that there is no interference between the injectors and injector ports on the intake manifold.



G00967807

Fig. 166: Installing Fuel Delivery Pipe
Courtesy of HYUNDAI MOTOR CO.

3. Install the surge tank stay.
4. Connect the fuel injector connector and wiring harness and then install the cover.
5. Connect the high pressure hoses.



G00967808

Fig. 167: Identifying High Pressure Hose
Courtesy of HYUNDAI MOTOR CO.

6. Connect the vacuum hoses.

Tightening torque

Intake manifold stay and cylinder block: 18-25 N.m (180-250 kg.cm, 13-18 lb.ft)

7. Connect the PCV valve and brake boost hoses.
8. Install the air breather hose.
9. Install the accelerator cable.

MUFFLER

COMPONENTS

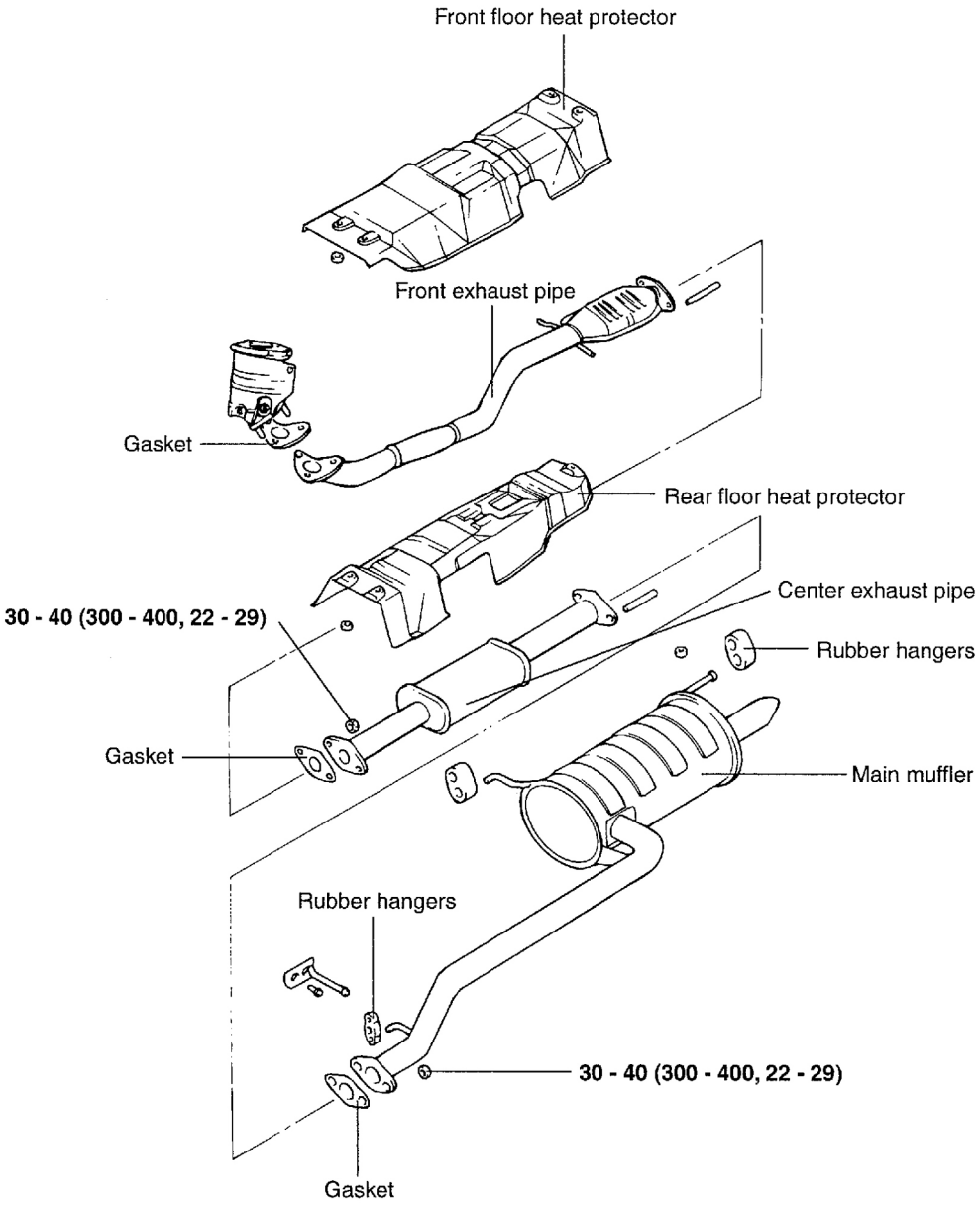


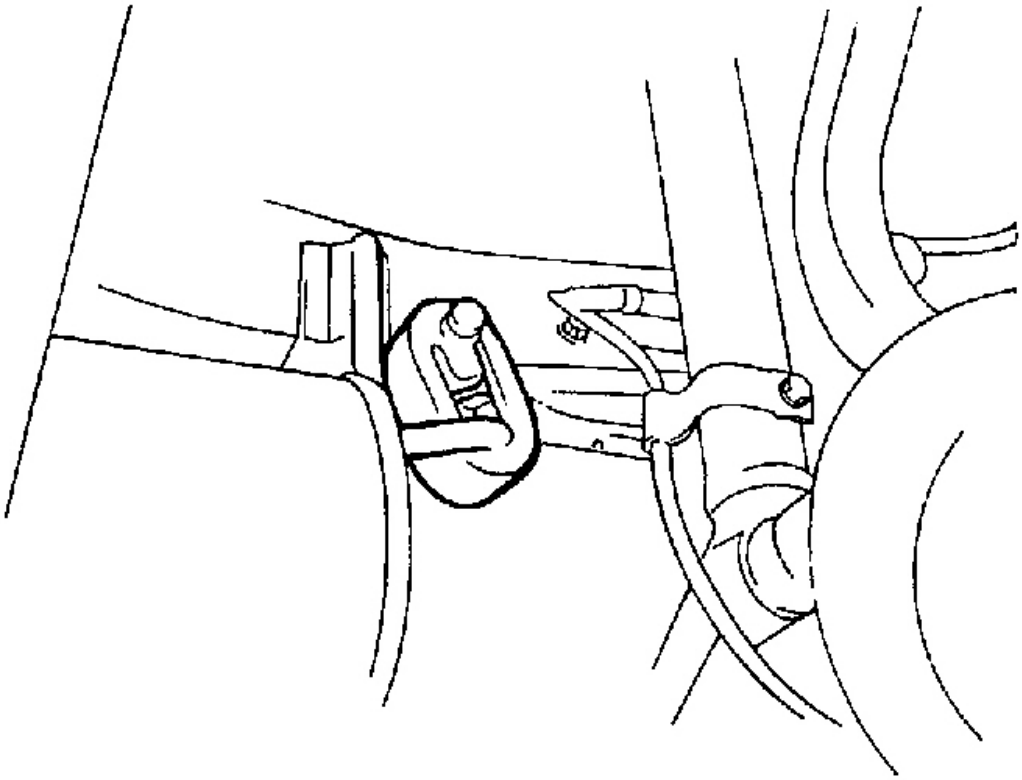
Fig. 168: Muffler Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

MAIN MUFFLER

CAUTION: Before removing or inspecting the exhaust system, ensure that the exhaust system is cool.

1. Disconnect the main muffler from the center exhaust pipe.
2. Remove the rubber hangers and remove the main muffler.



G00967810

Fig. 169: Identifying Muffler Main Hanger (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

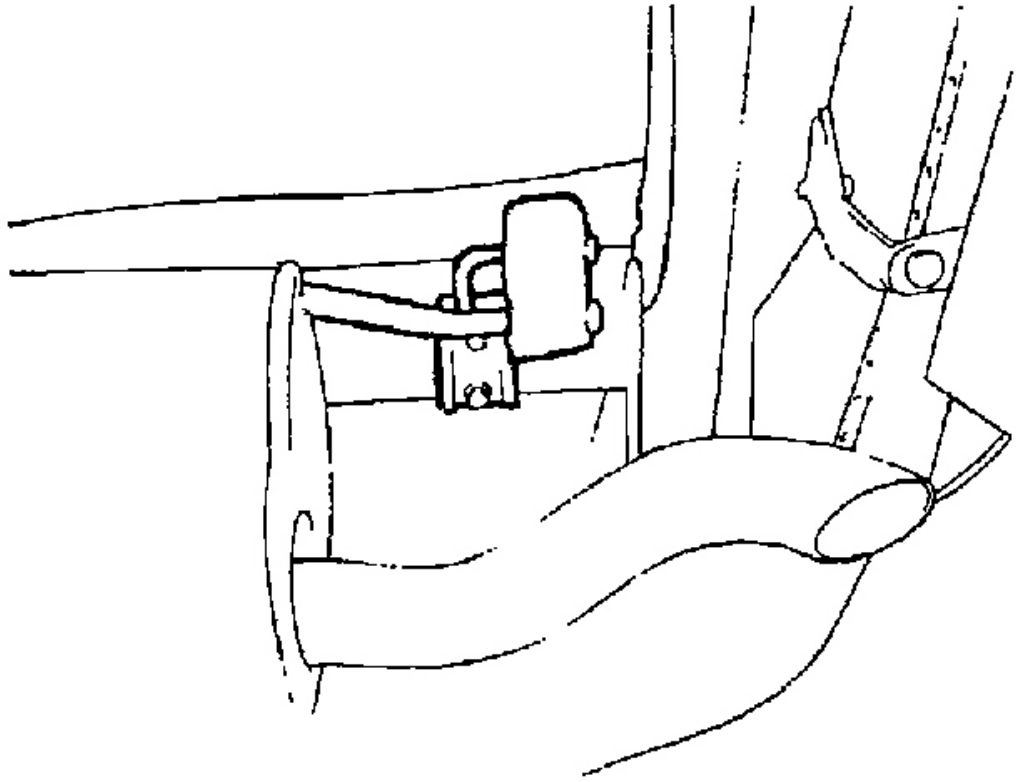
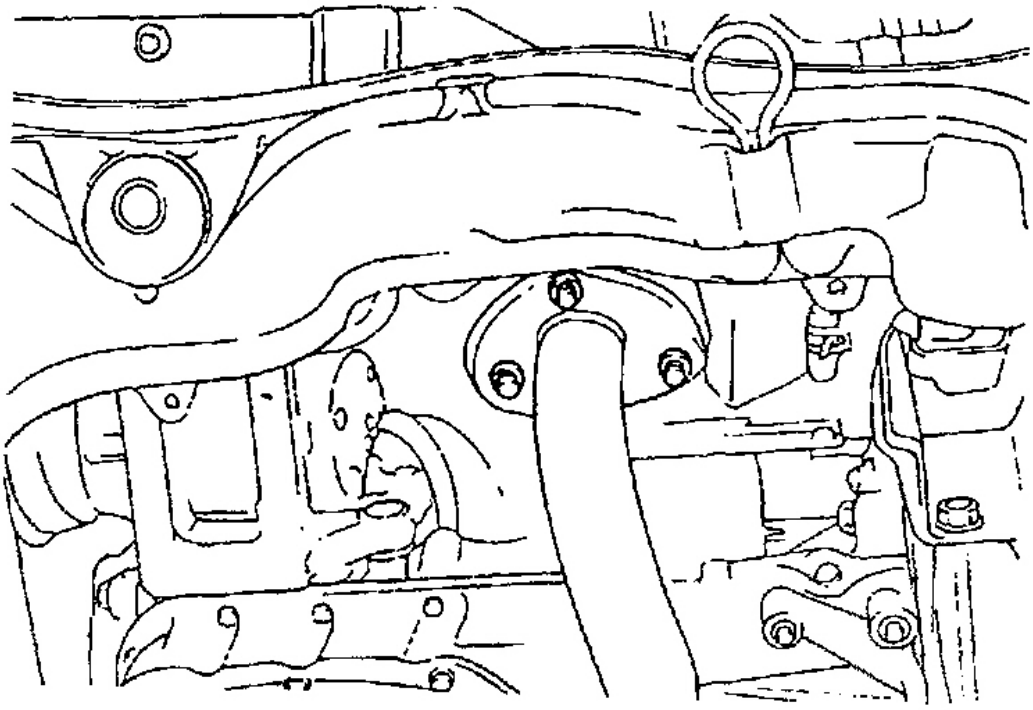


Fig. 170: Identifying Muffler Main Hanger (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)

1. Remove the front exhaust pipe from the center exhaust pipe.
2. Remove the front exhaust pipe bolts and exhaust manifold pipe mounting nuts.



G00967812

Fig. 171: Identifying Exhaust Pipe-To-Manifold Bolts
Courtesy of HYUNDAI MOTOR CO.

3. Remove the front exhaust pipe from the rubber hanger.

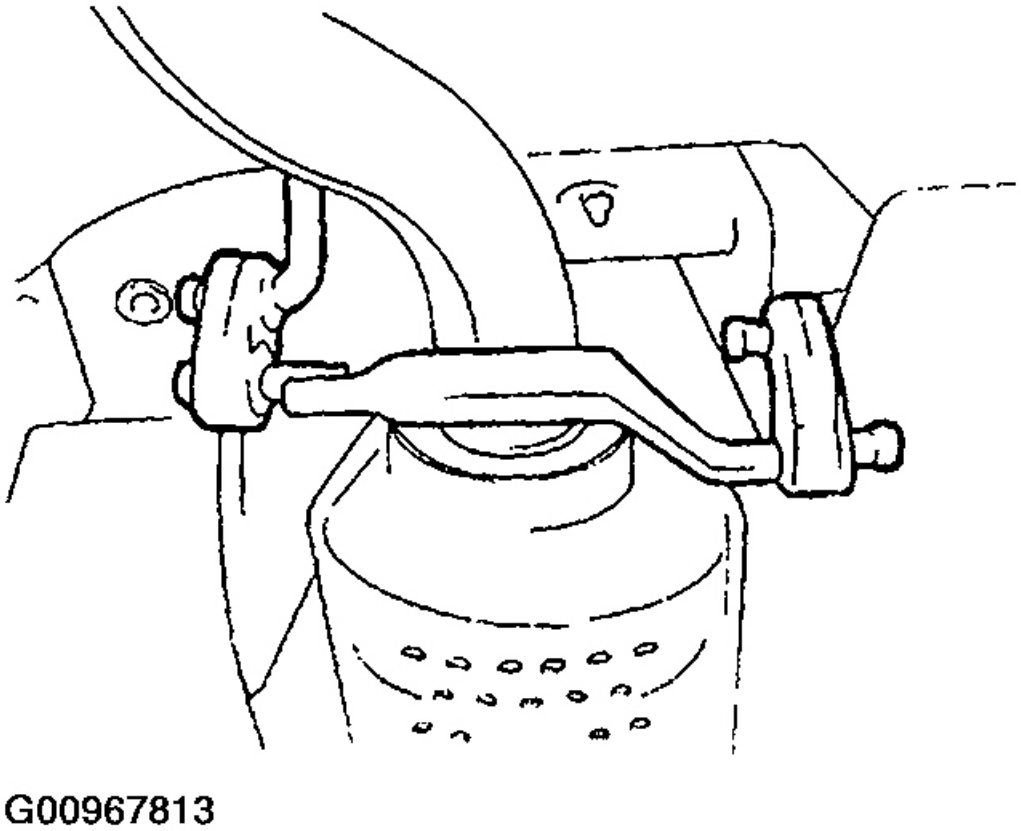


Fig. 172: Identifying Front Muffler Hangers
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

1. Check the mufflers and pipes for leaks, corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

INSTALLATION

1. Temporarily install the front exhaust pipe (catalytic converter assembly), the center exhaust pipe and the main muffler in this order.
2. Install the rubber hangers so that they hang equally (left and right).
3. Tighten the parts securely and then confirm that there is no interference with any of components.

AIR CLEANER (ACL)

COMPONENTS

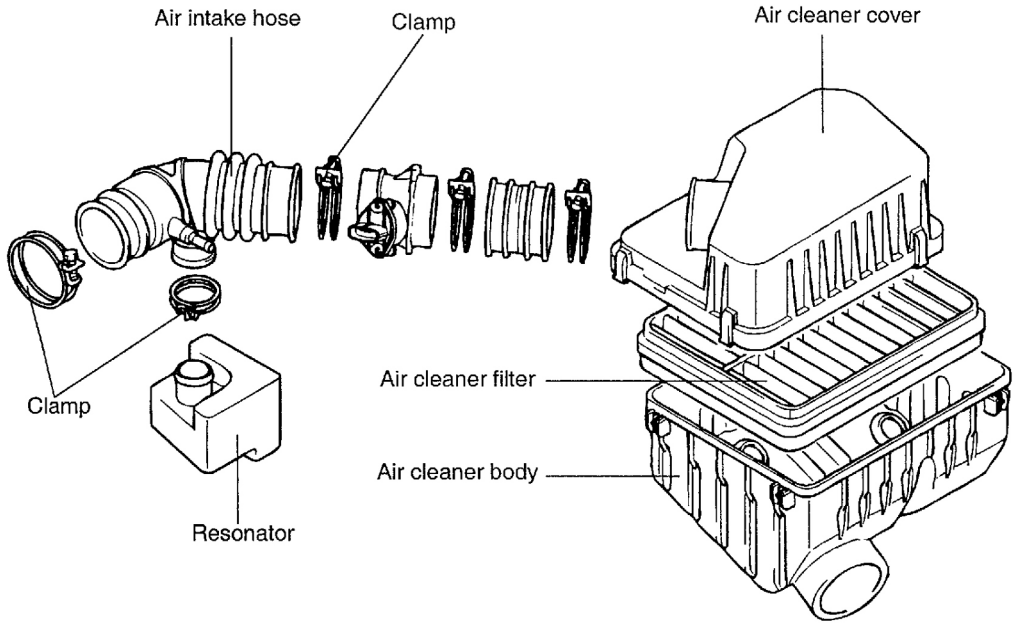


Fig. 173: Air Cleaner Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Disconnect the air flow sensor connector.
2. Remove the air intake hose at the air cleaner and the resonator.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Detach the air cleaner.

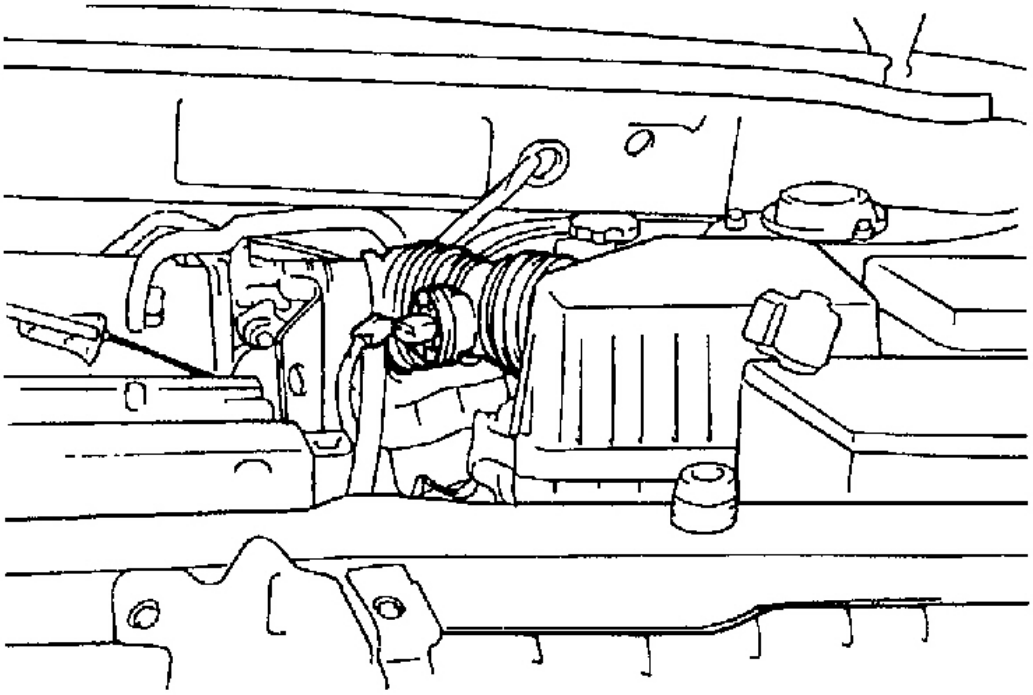


Fig. 174: View Of Air Cleaner
Courtesy of HYUNDAI MOTOR CO.

5. Remove the air flow sensor from the air intake hose.

CAUTION: Do not pull on the air flow sensor wires.

INSPECTION

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

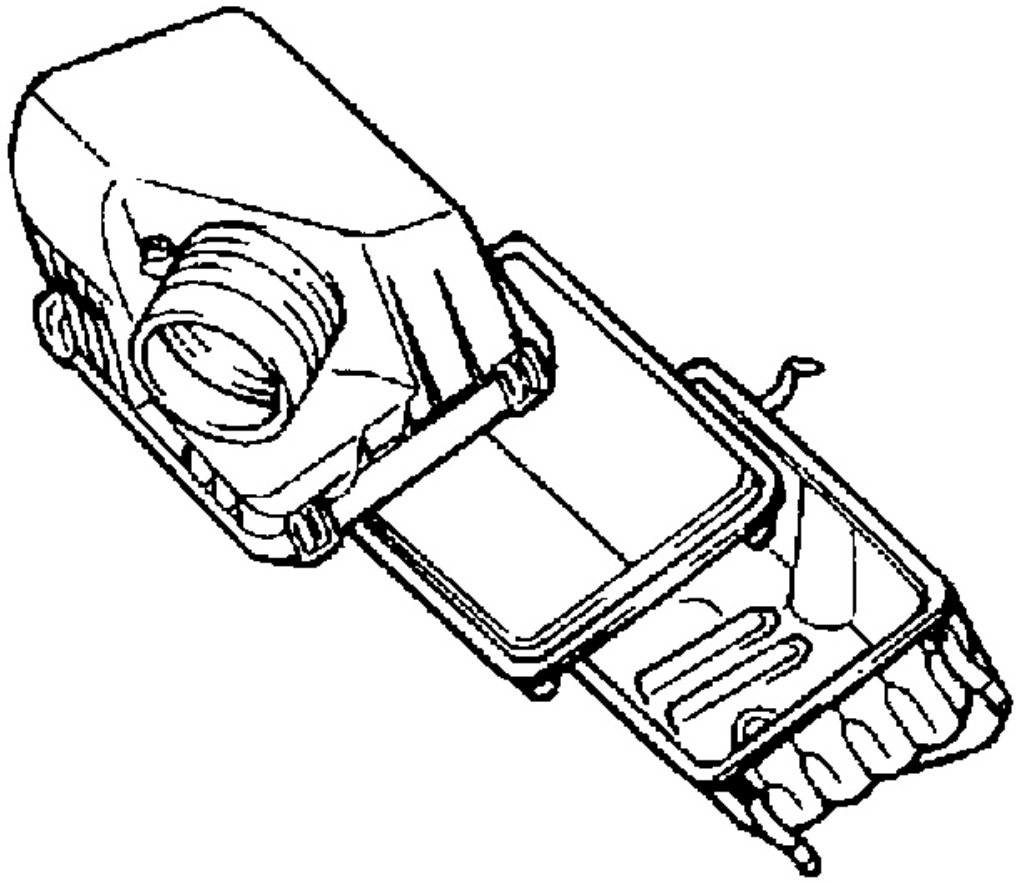


Fig. 175: Identifying Air Cleaner Cover Assembly
Courtesy of HYUNDAI MOTOR CO.

3. Check the air cleaner element for restriction, contamination or damage. If the element is slightly restricted, remove the dust and debris by blowing compressed air from the inside of the element.

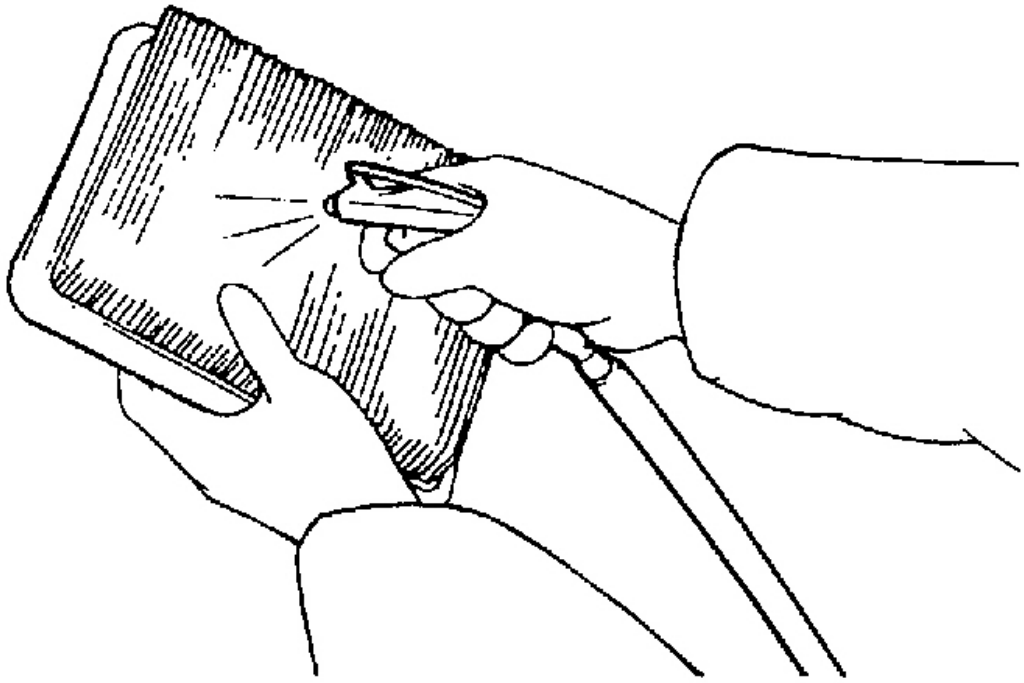


Fig. 176: Cleaning Air Filter
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

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

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS

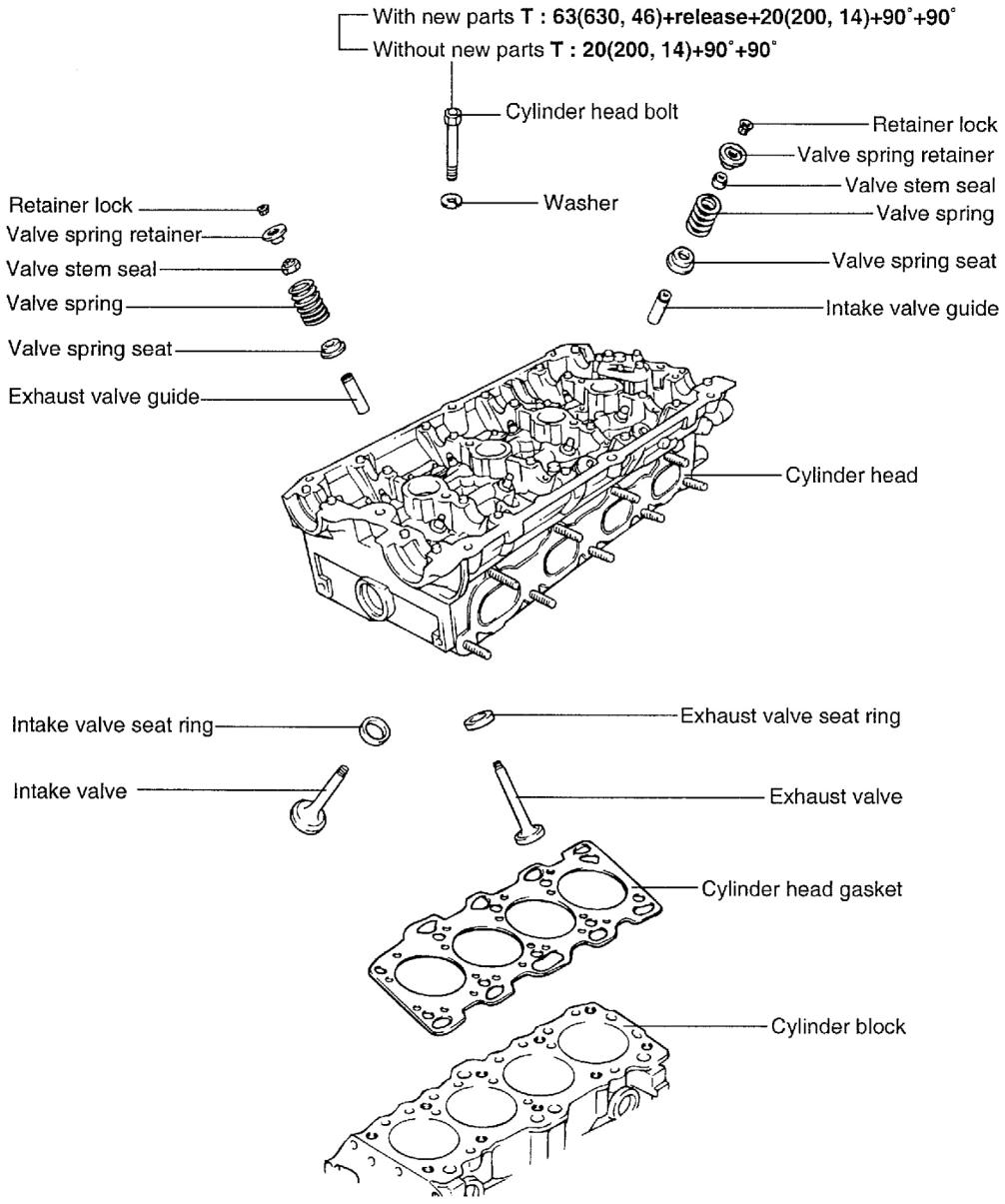
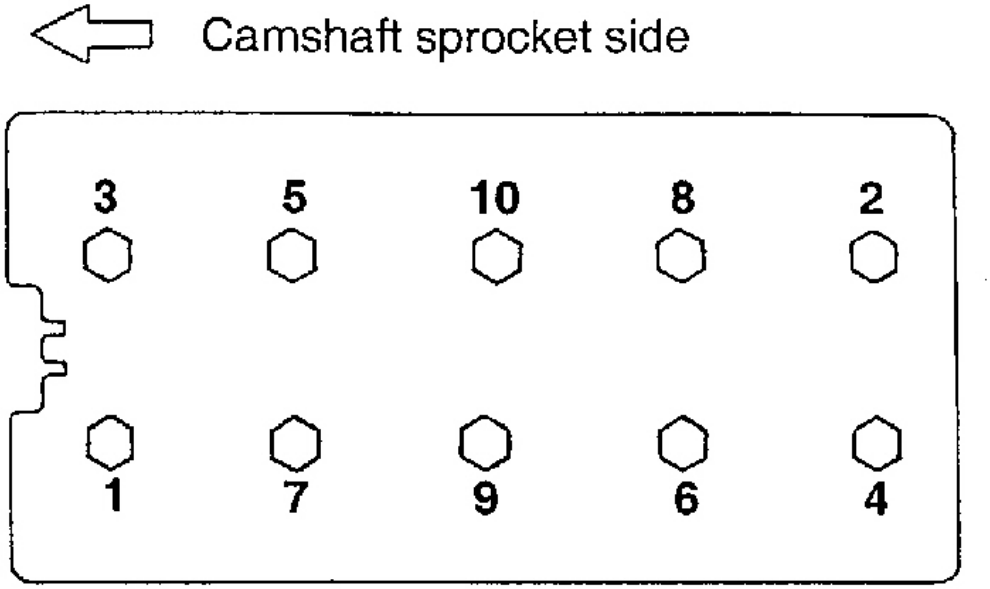


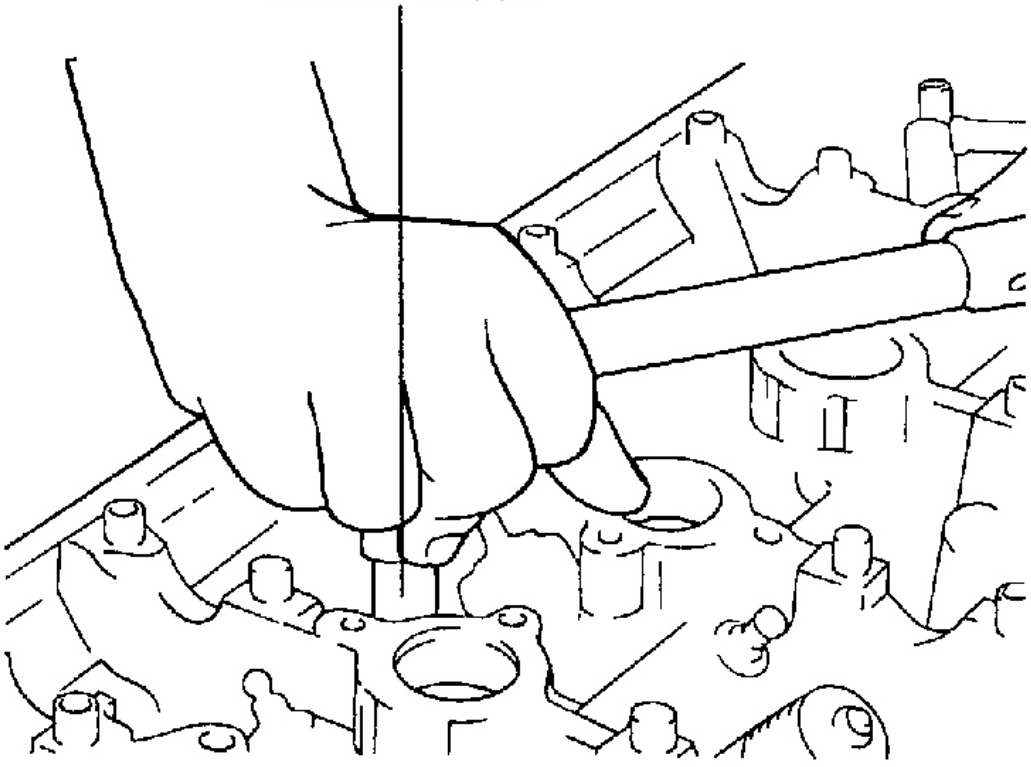
Fig. 177: Cylinder Head Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

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



09221-32001



G00967819

Fig. 178: Cylinder Head Bolt Removal Sequence
Courtesy of HYUNDAI MOTOR CO.

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

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

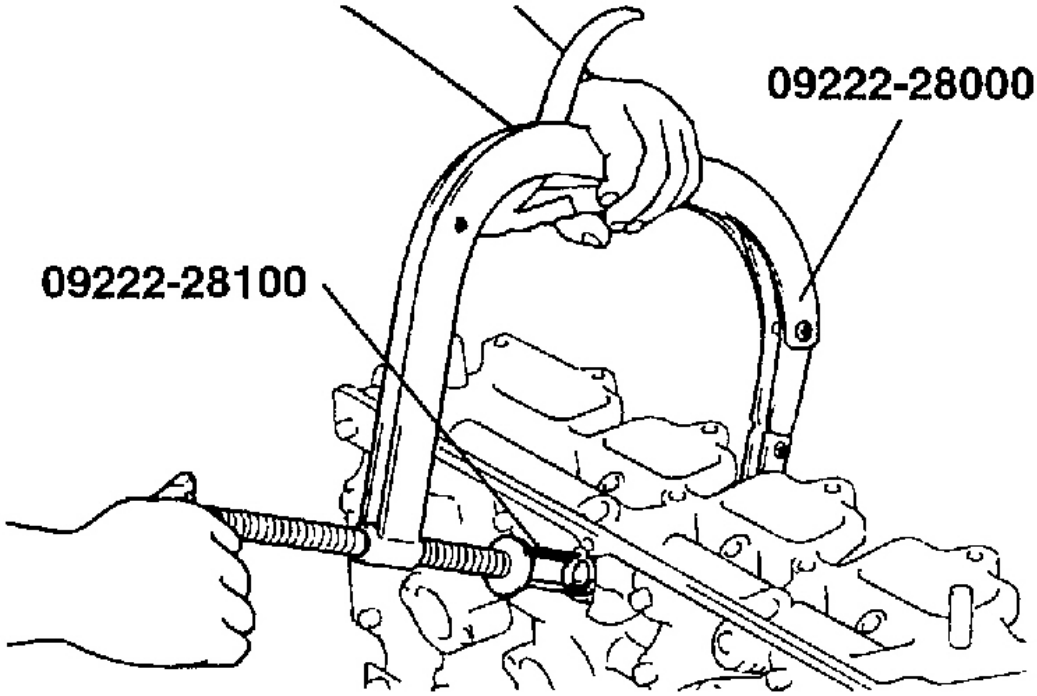
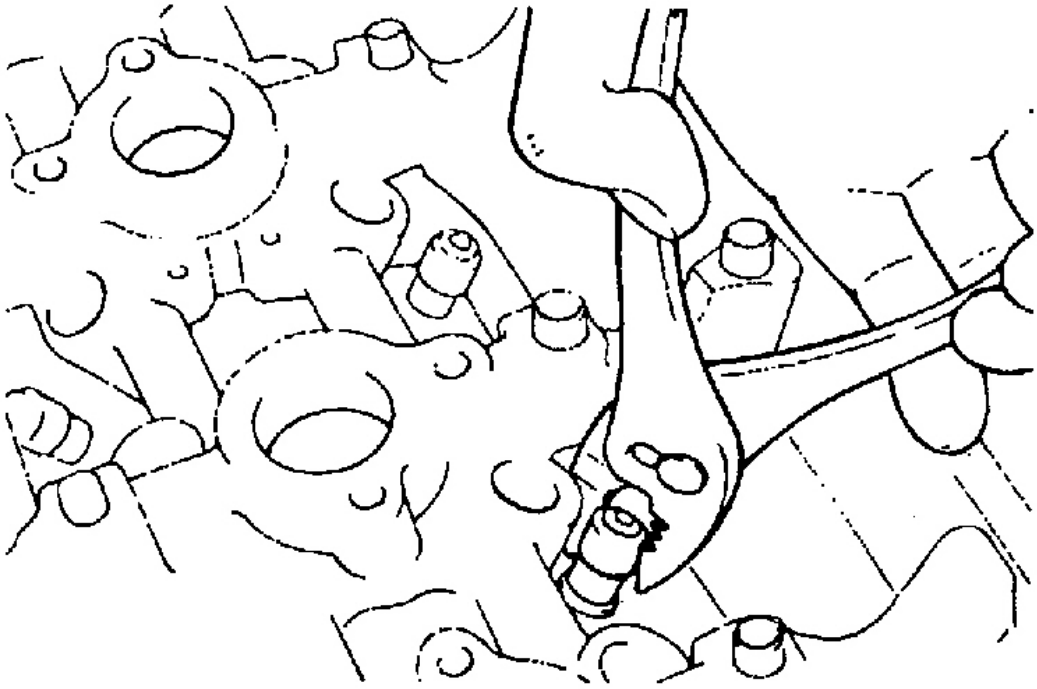


Fig. 179: Removing Valve Spring Retainer Locks
Courtesy of HYUNDAI MOTOR CO.

3. Remove the valve stem seals with pliers.

NOTE: Do not reuse the valve stem seals.



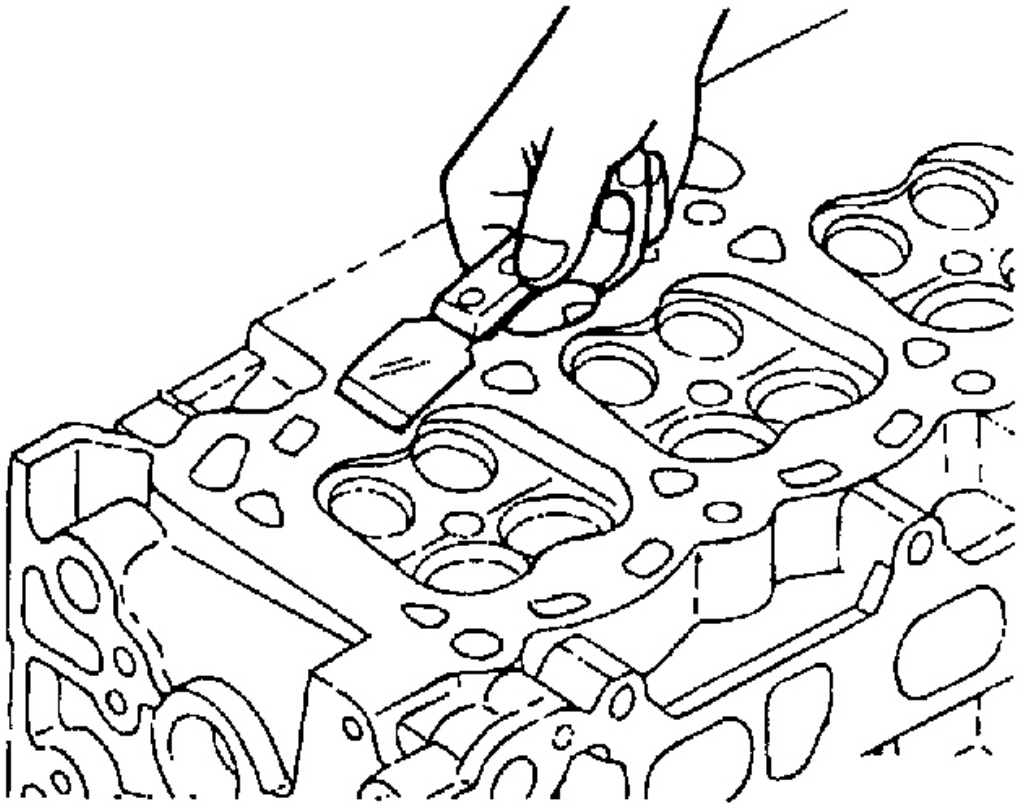
G00967821

Fig. 180: 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.



G00967822

Fig. 181: Cleaning Cylinder Head Surface
Courtesy of HYUNDAI MOTOR CO.

3. Check the cylinder head surface for flatness in the direction as shown in the illustration. If flatness exceeds 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 0.03 mm (0.0012 in.)

    Limit: 0.2 mm (0.008 in.)

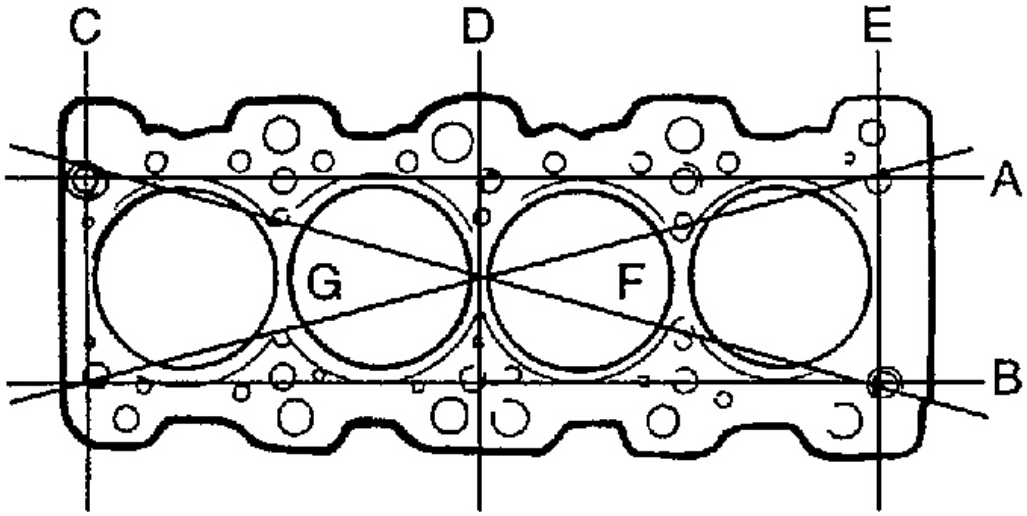


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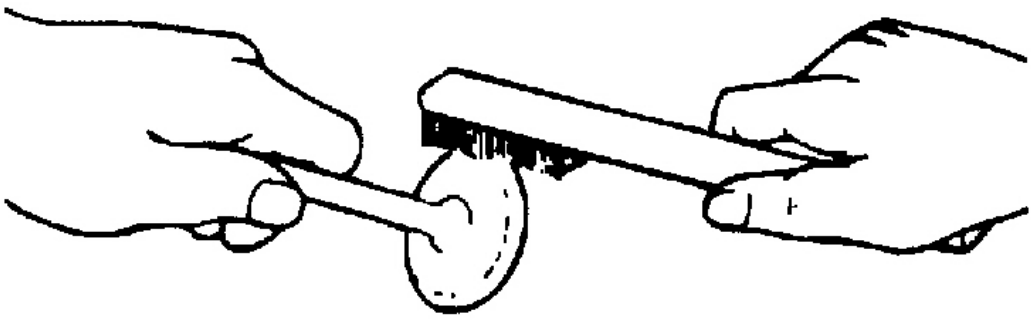
Fig. 182: Checking Cylinder Head Flatness
Courtesy of HYUNDAI MOTOR CO.

VALVES

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



G00967824

Fig. 183: 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: 1.0 mm (0.040 in.)
   Exhaust: 1.5 mm (0.059 in.)
   [Limit]
   Intake: 0.7 mm (0.028 in.)
   Exhaust: 1.0 mm (0.040 in.)

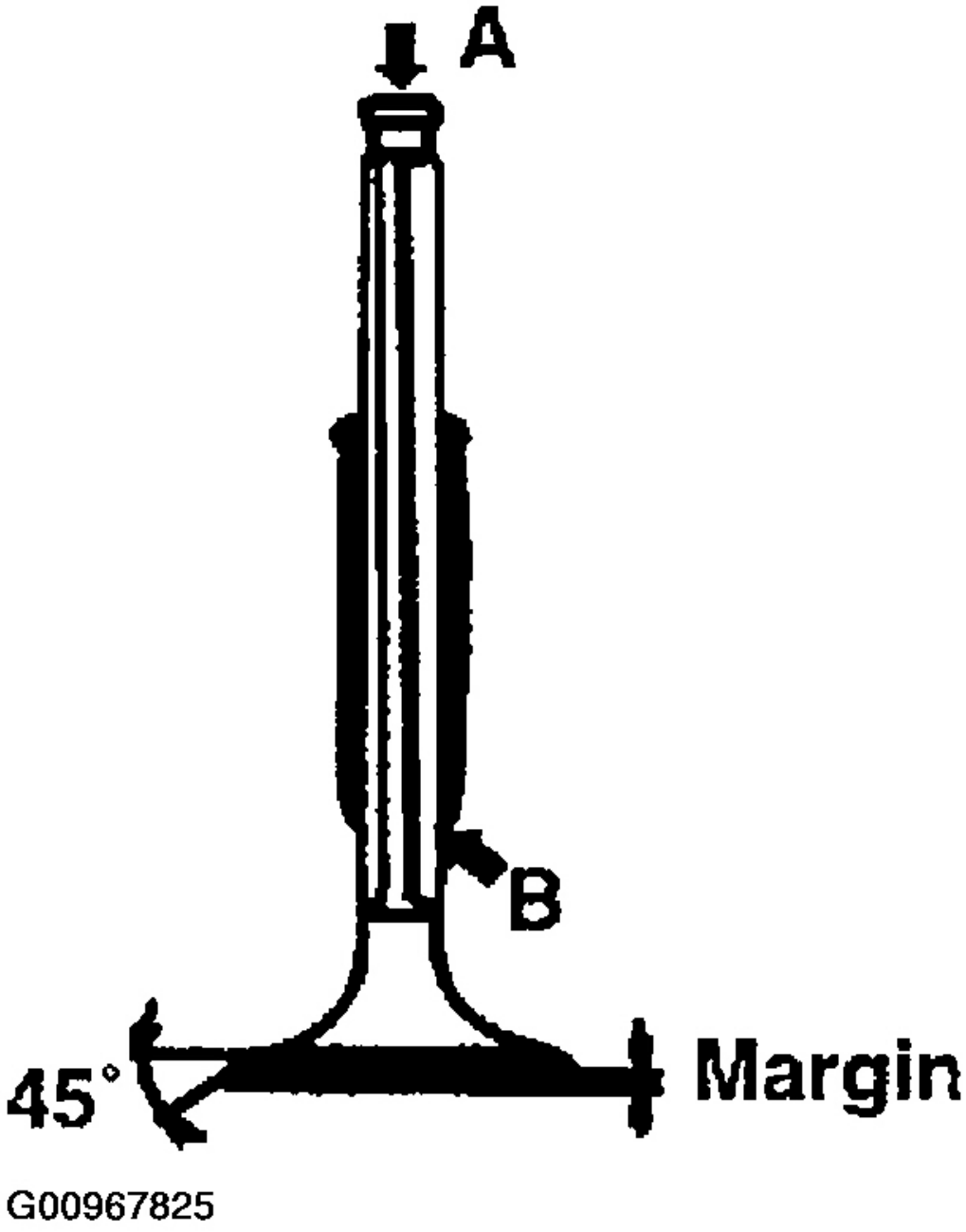


Fig. 184: Identifying Valve Margin
Courtesy of HYUNDAI MOTOR CO.

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: 45.82 mm (1.804 in.)
Load: 25.3 kg / 40 mm (55.8 lb / 1.57 in.)
Out of square: 1.5° or less
[Limit]
Free height: 44.82 mm (1.7646 in.)
Out of square: 4°

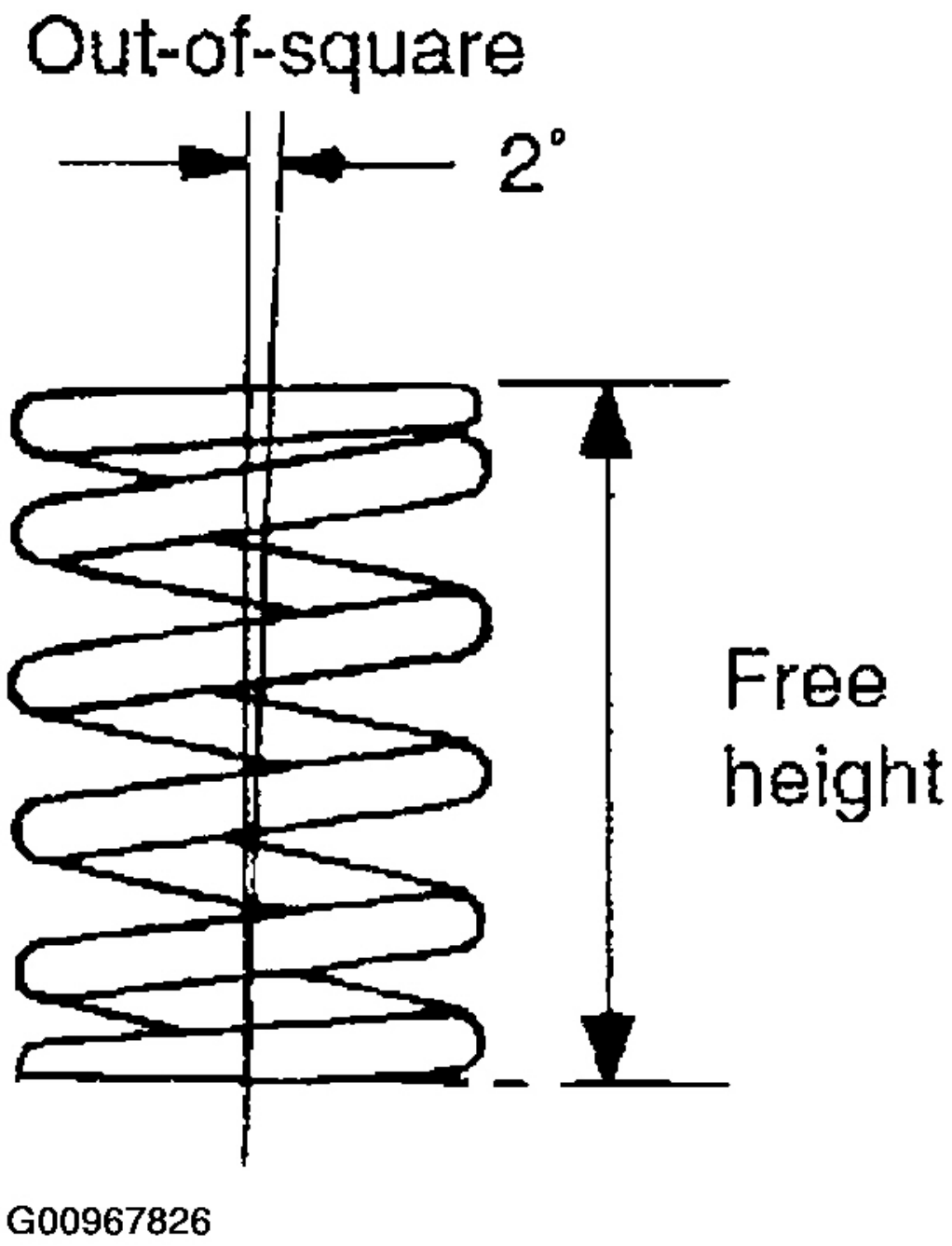


Fig. 185: Checking Valve Spring
Courtesy of HYUNDAI MOTOR CO.

VALVE GUIDES

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: 0.020-0.047 mm (0.0008-0.0020 in.)

Exhaust: 0.050-0.085 mm (0.0020-0.0033 in.)

[Limit]

Intake: 0.1 mm (0.0040 in)

Exhaust: 0.15 mm (0.0059 in.)

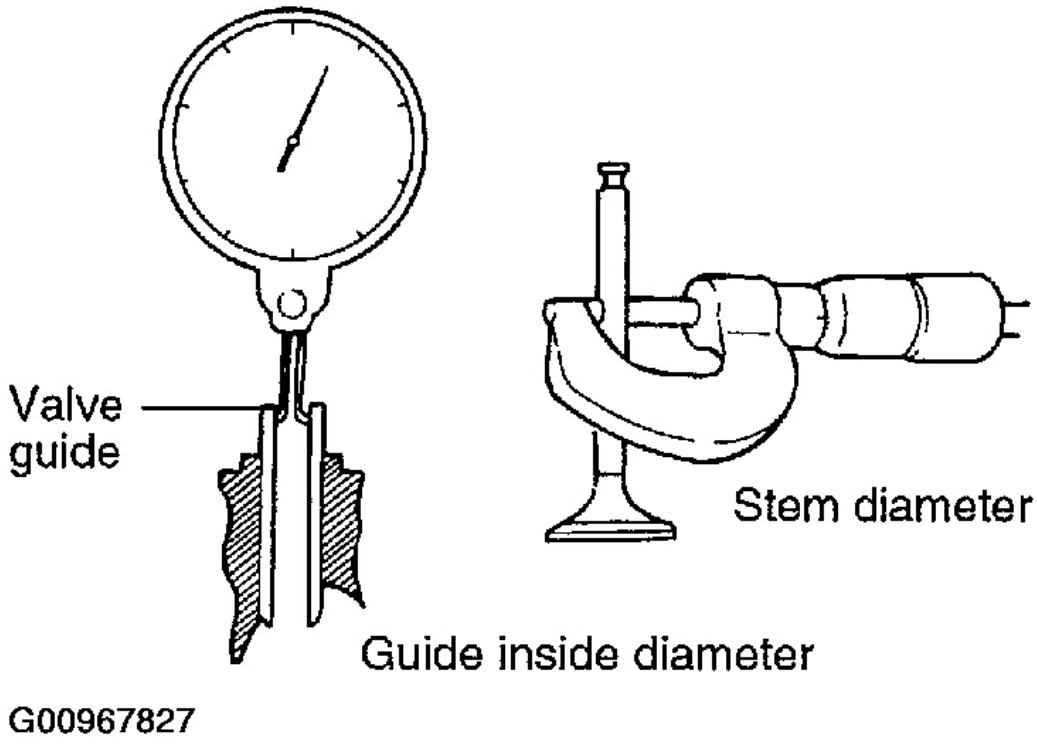


Fig. 186: Measuring Valve Stem-To-Guide Clearance
Courtesy of HYUNDAI MOTOR CO.

RECONDITIONING VALVE SEAT

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

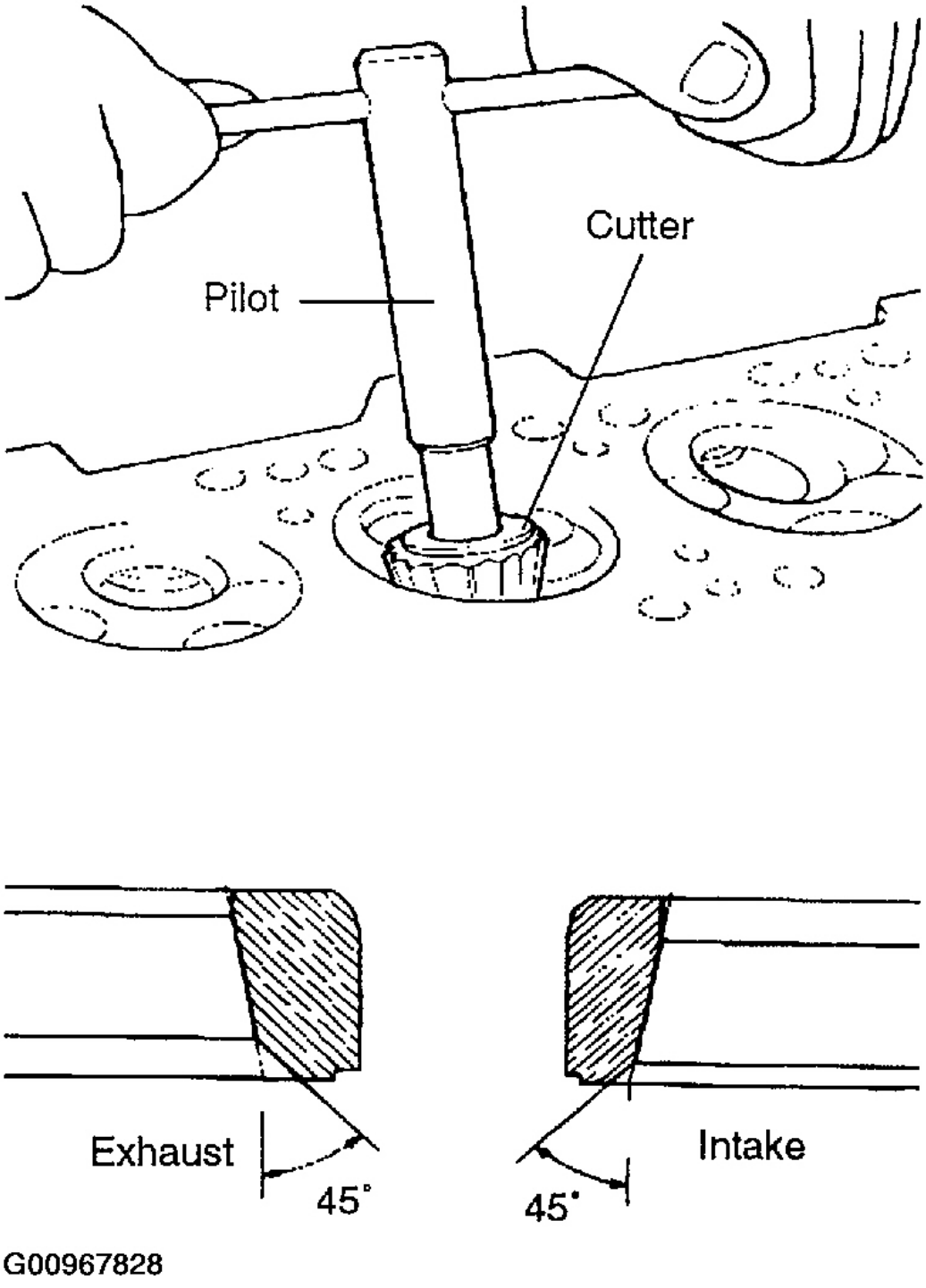


Fig. 187: Reconditioning Valve Seat
Courtesy of HYUNDAI MOTOR CO.

REPLACING THE VALVE SEAT RING

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

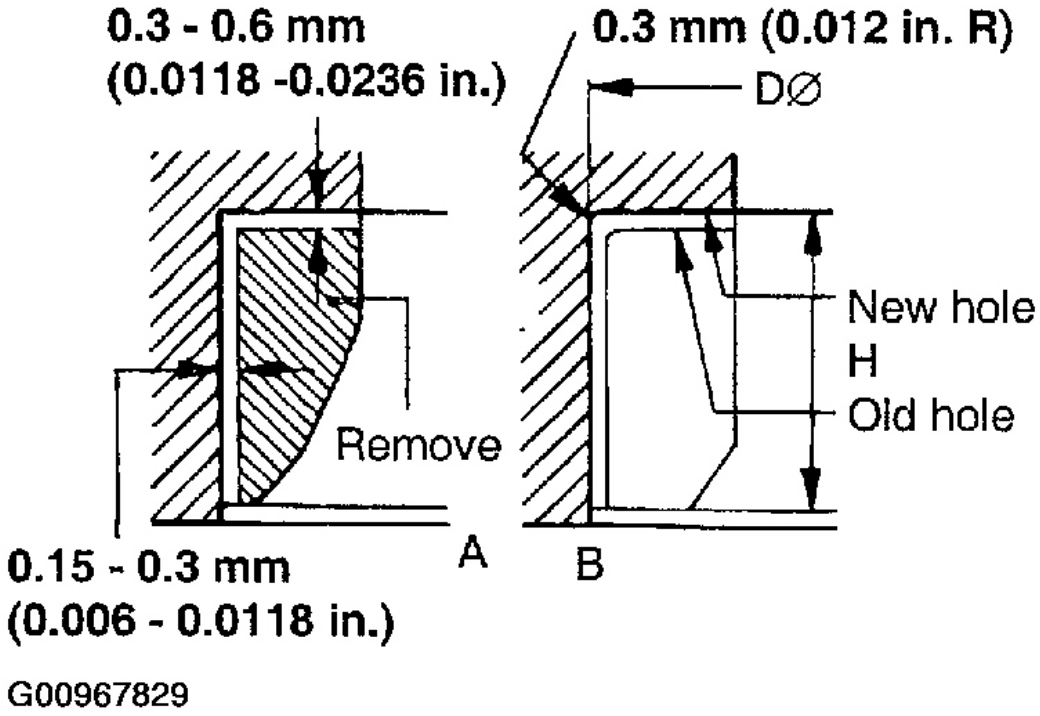


Fig. 188: Cutting Inner Face Of Valve Seat
Courtesy of HYUNDAI MOTOR CO.

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: 0.9-1.3 mm (0.035-0.051 in.)

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 Seat ring	0.3(0.012) O.S. 0.6(0.024) O.S.	30 60	7.9-8.1 (0.311-0.319) 8.2-8.4 (0.323-0.331)	35.300-35.325 (1.3898-1.3907) 35.600-35.625 (1.4016-1.4026)
Exhaust valve Seat ring	0.3(0.012) O.S. 0.6(0.024) O.S	30 60	7.9-8.1 (0.311-0.319) 8.2-8.4 (0.323-0.331)	33.300-33.325 (1.3110-1.3120) 33.600-33.625 (1.3228-1.3238)

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Fig. 189: Valve Seat Insert Oversize Table
Courtesy of HYUNDAI MOTOR CO.

REPLACING VALVE GUIDE

1. Using the special tool (09222-21200A), withdraw the old valve guide toward the bottom of cylinder head.

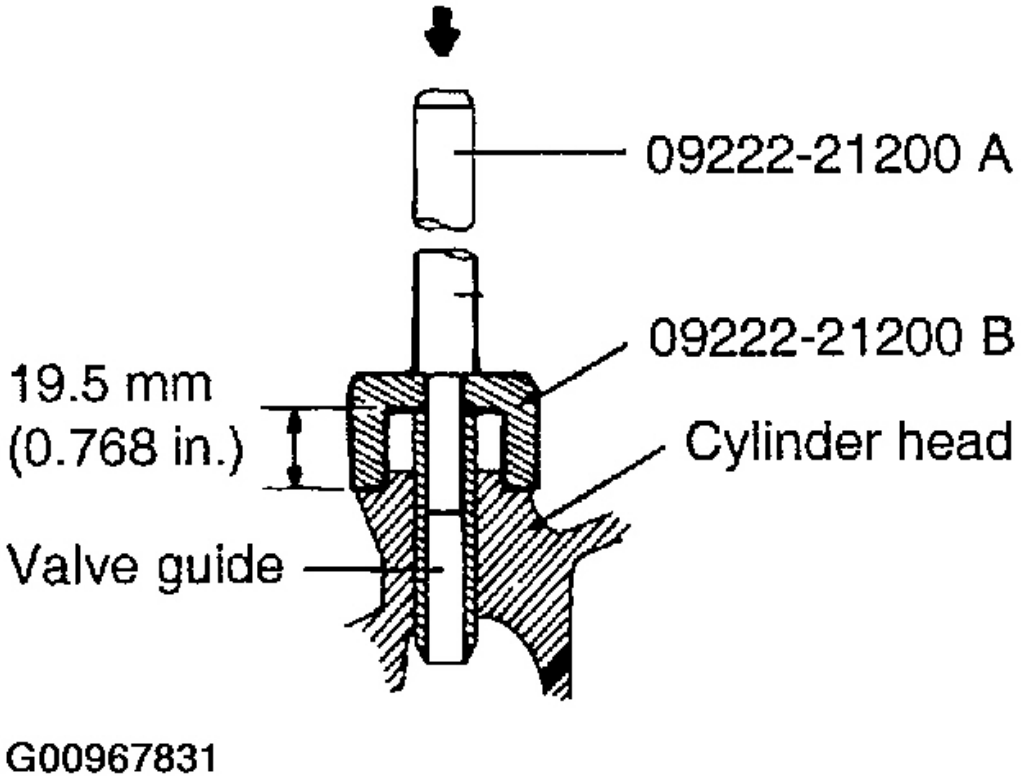

Fig. 190: Removing Old Valve Guide
Courtesy of HYUNDAI MOTOR CO.

2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.

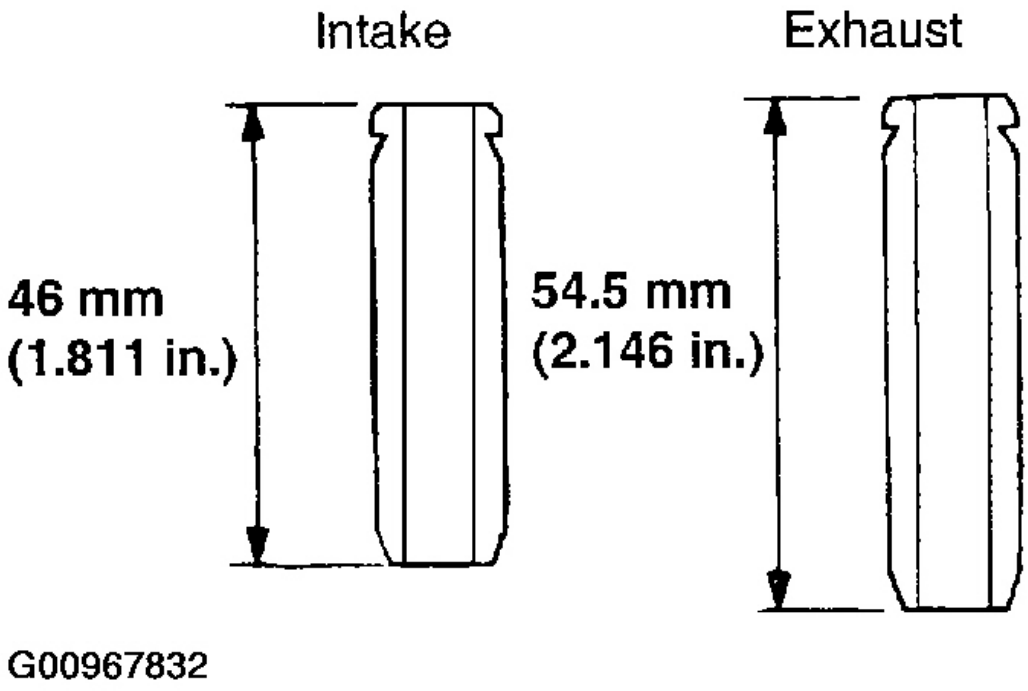

Fig. 191: Checking If Valve Is Fully Seated
Courtesy of HYUNDAI MOTOR CO.

3. Using the special tool (09222-21200 A, B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

NOTE: Do not install a valve guide unless it is oversize.

Over size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05(0.002)	5	12.050 - 12.068 (0.4744 - 0.4751)
0.25 (0.010)	25	12.250 - 12.268 (0.4823 - 0.4830)
0.50 (0.020)	50	12.500 - 12.518 (0.4921 - 0.4928)

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Fig. 192: Valve Guide Oversizes
Courtesy of HYUNDAI MOTOR CO.

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

REASSEMBLY

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

1. Install the spring seats.
2. Using a special tool (09222-28200), 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.**

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

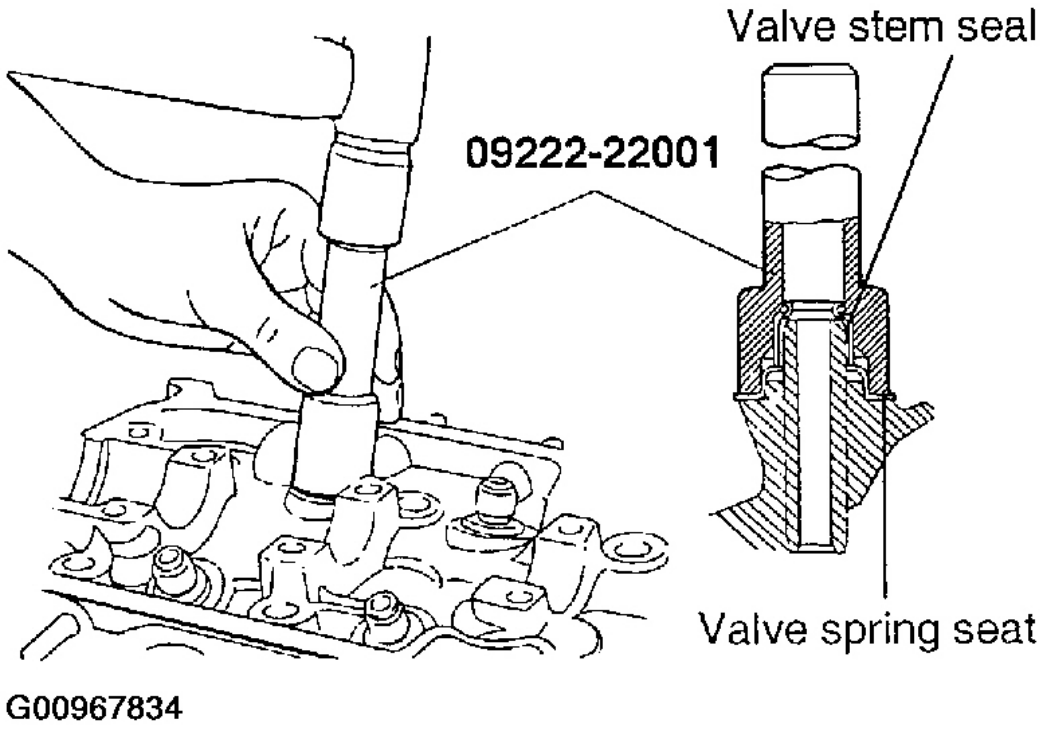

Fig. 193: Installing Valve Stem Seals
Courtesy of HYUNDAI MOTOR CO.

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

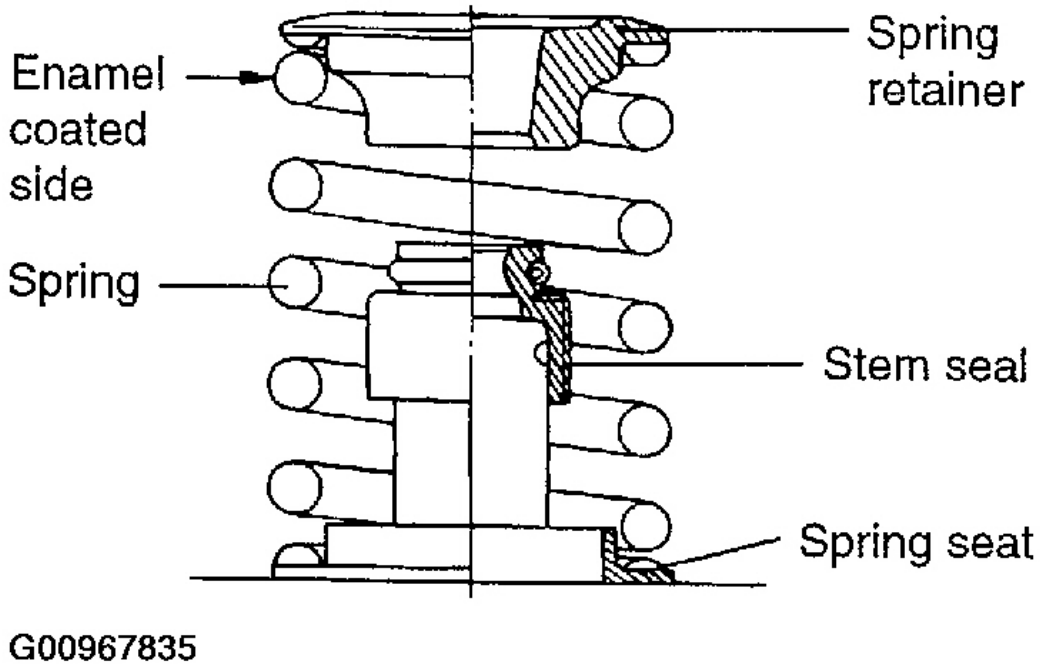

Fig. 194: Identifying Valve Spring Installation
Courtesy of HYUNDAI MOTOR CO.

5. 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.

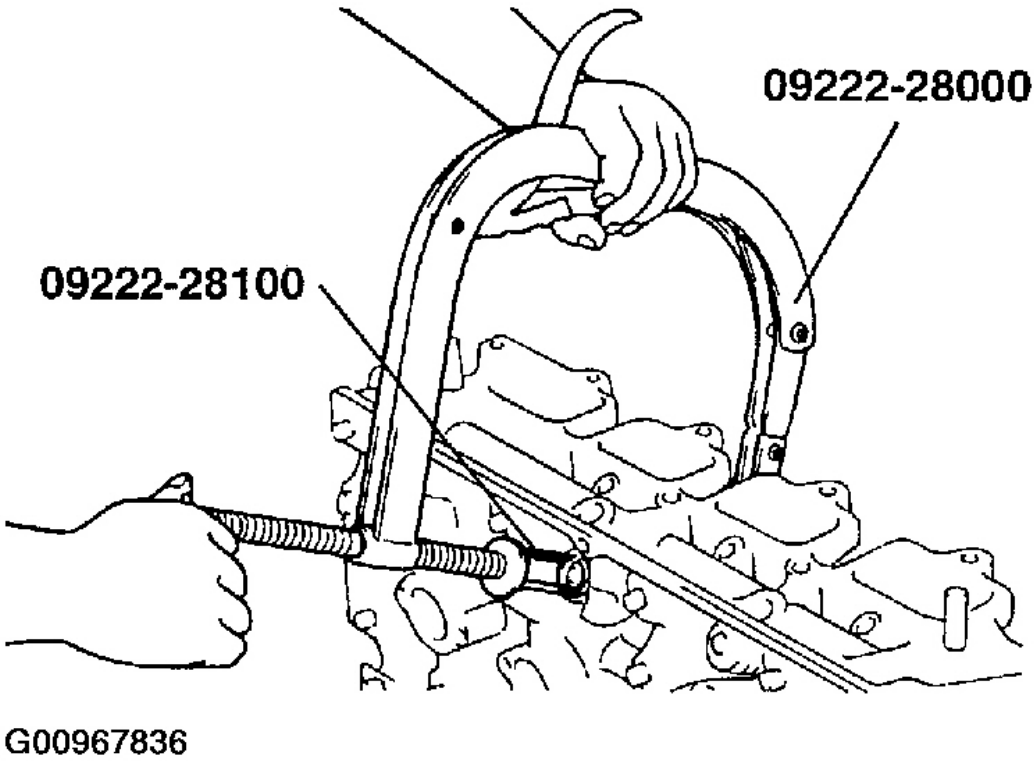

Fig. 195: Installing Valve Spring Retainer Locks
Courtesy of HYUNDAI MOTOR CO.

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

6. Clean both gasket surfaces of the cylinder block and cylinder head.
7. Verify the identification marks on the cylinder head gasket.
8. Install the gasket so that the surface with the identification mark faces toward the cylinder head.

NOTE: Check and measure the length of each head bolt. Maximum length: 99.4 mm (3.9 in.)

9. Tighten the bolts to the specified torque.

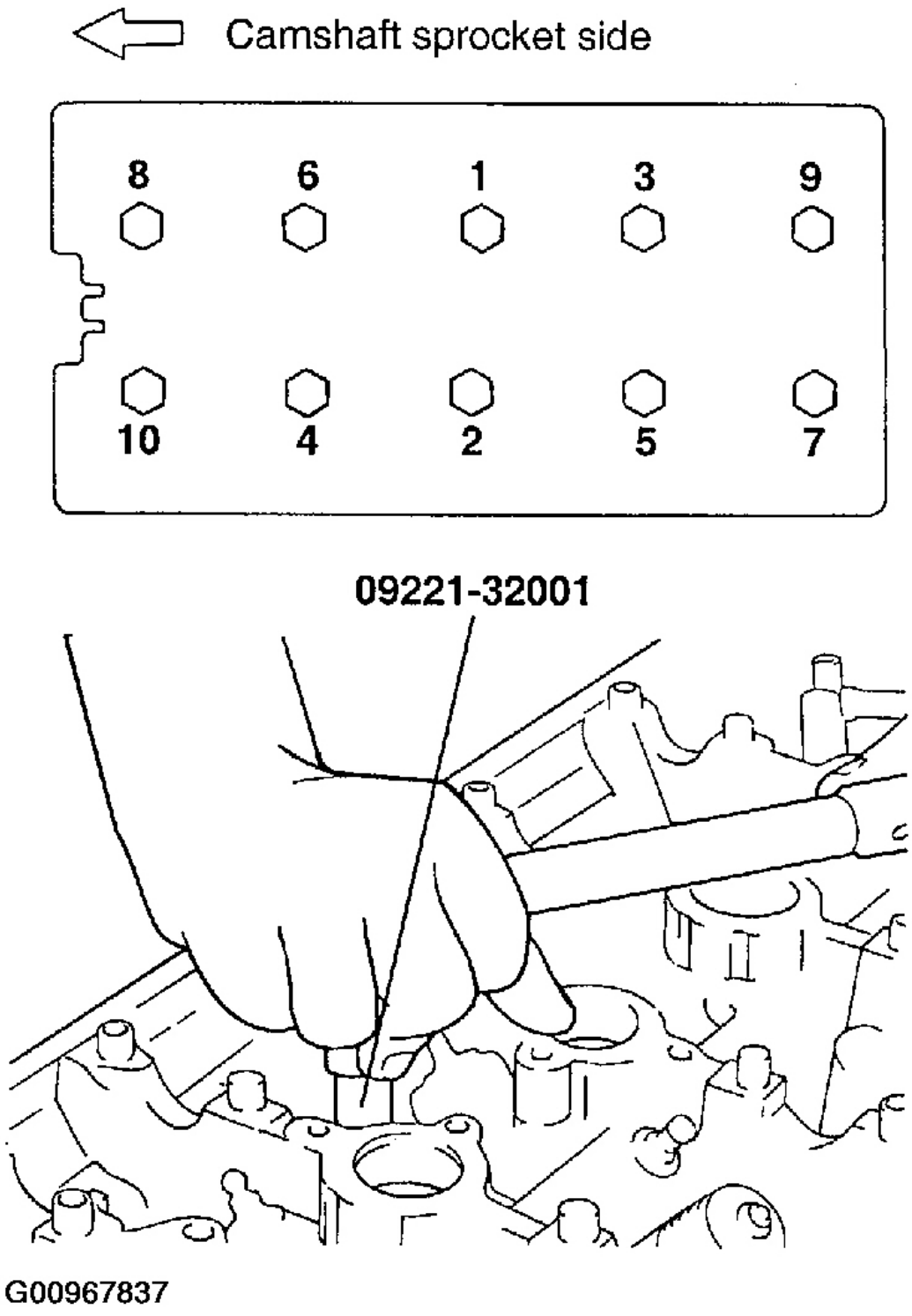

Fig. 196: Cylinder Head Bolt Tightening Sequence

Courtesy of HYUNDAI MOTOR CO.

Tightening torque

With used parts (head bolt, cylinder head, cylinder block):
20 N.m (200 kg.cm, 14 lb.ft) + 90° + 90°
With new parts (even if only one thing is replaced):
64 N.m (640 kg.cm, 46 lb.ft) + release + 20Nm (200 kg.cm, 14 lb.ft) + 90° + 90°

TIMING SYSTEM

TIMING BELT

COMPONENTS

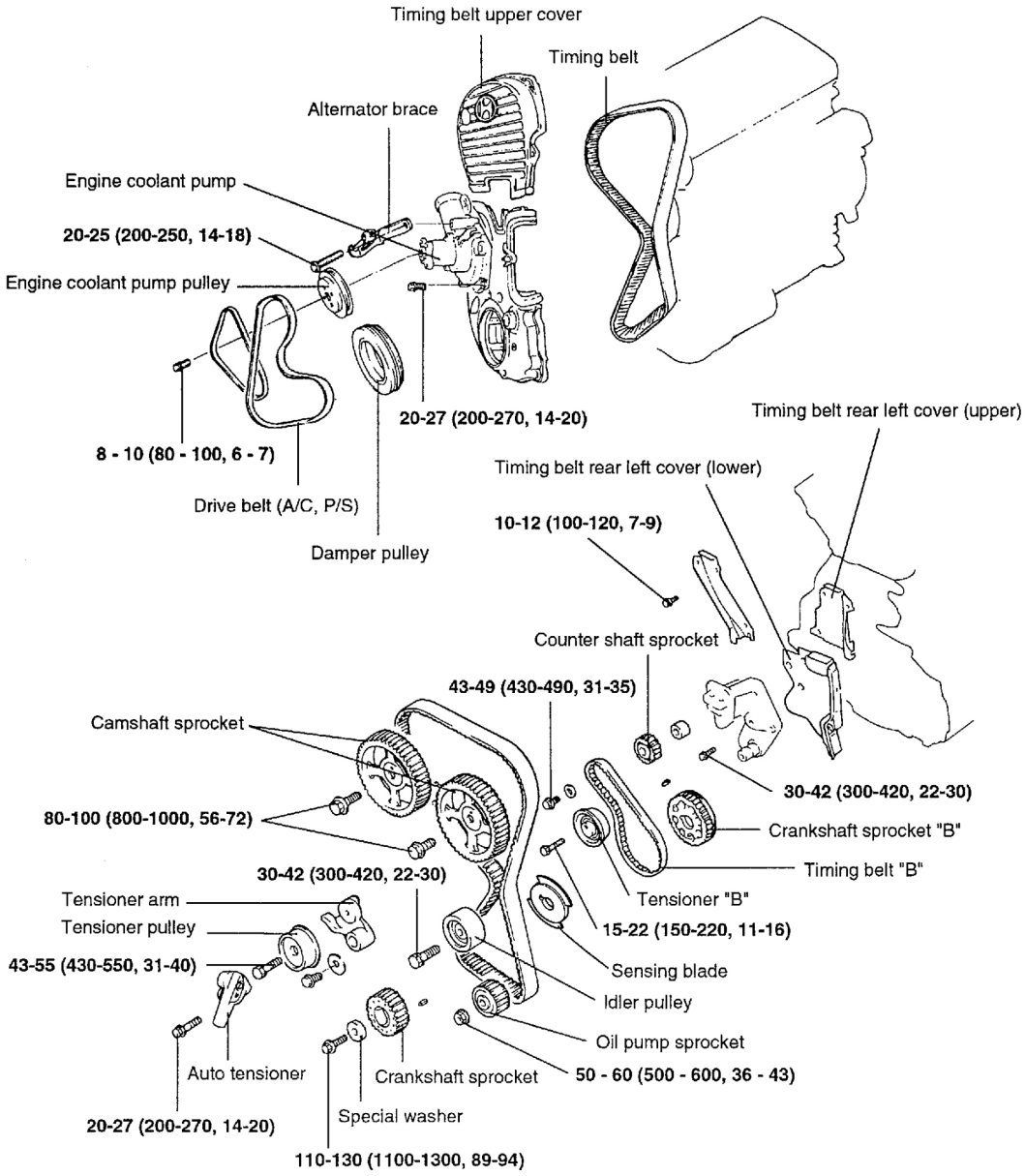

Fig. 197: Timing Belt Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

CAUTION: Rotate the crankshaft clockwise and align the timing marks to set the No. 1 cylinder's piston to TDC.

At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with

eachother and the dowel pin of the camshaft sprocket should be at the upper side.

1. Remove the crankshaft pulley, engine coolant pump pulley and drive belt.
2. Remove the timing belt cover.
3. Remove the auto tensioner.

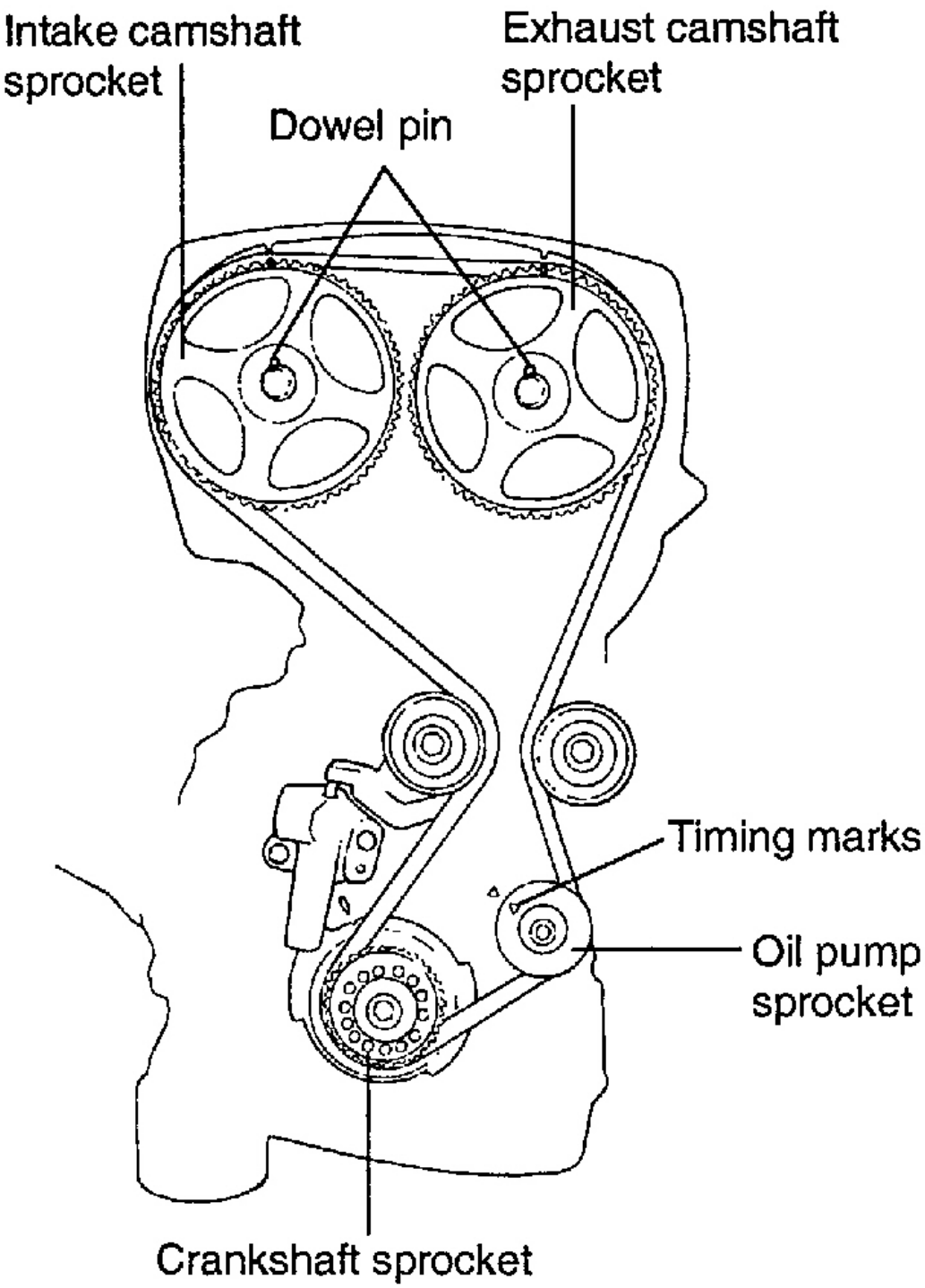

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Fig. 198: Identifying Timing Belt & Pulleys
Courtesy of HYUNDAI MOTOR CO.

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

In this case the timing marks on the camshaft sprocket and on the locker cover should be aligned and the dowel pins on the camshaft sprockets should be positioned upward.

4. Remove the timing belt.

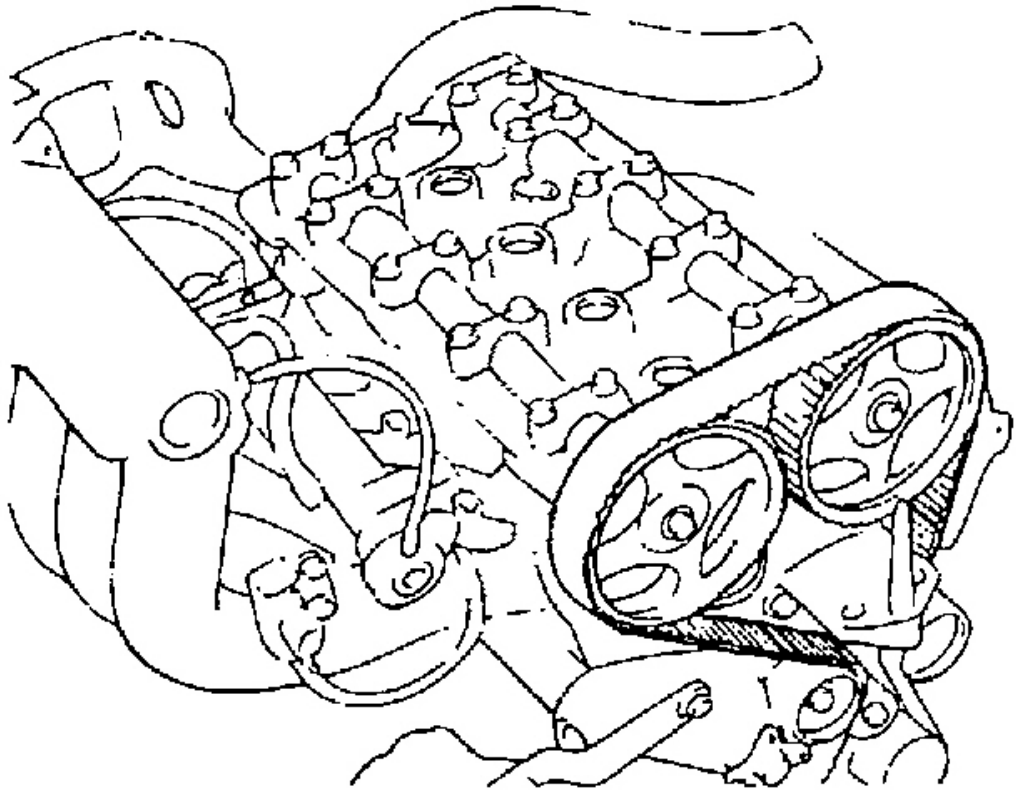

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Fig. 199: View Of Timing Belt
Courtesy of HYUNDAI MOTOR CO.

5. Remove the camshaft sprockets.

NOTE: Be careful not to damage the cylinder head and camshaft sprocket with the wrench.

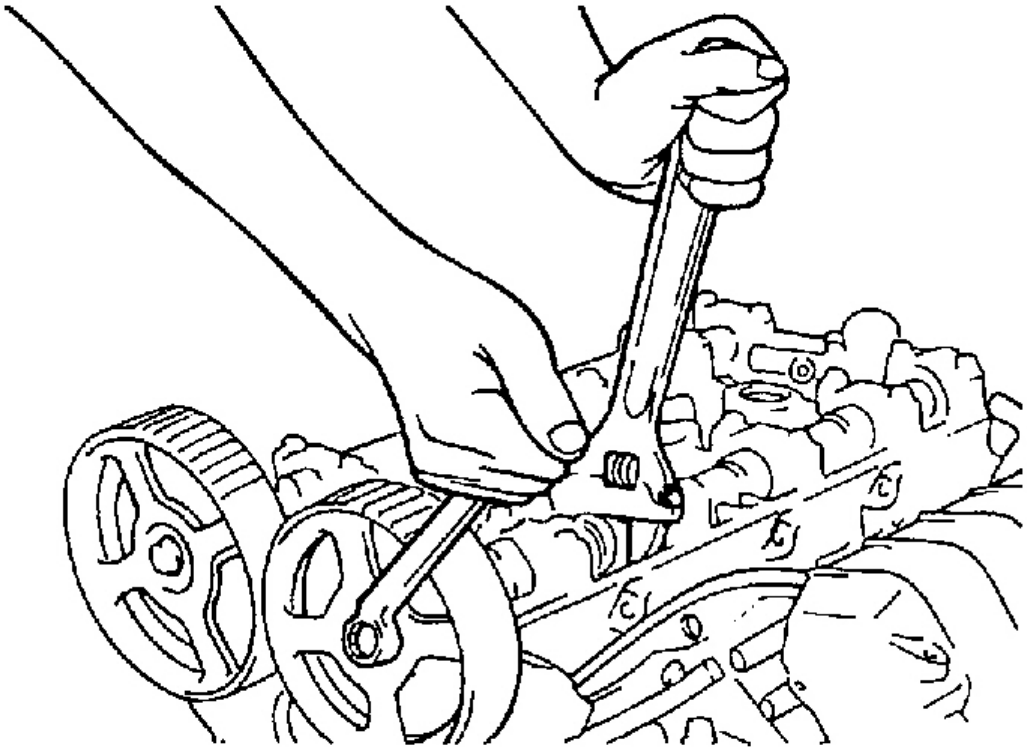

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Fig. 200: Removing Camshaft Sprockets
Courtesy of HYUNDAI MOTOR CO.

6. When the oil pump sprocket nut is removed, first remove the plug at the left side of the cylinder block and insert a screwdriver to keep the left counter balance shaft in position. Use a screwdriver with a shaft measuring 8 mm (0.3in.) in diameter which can be inserted by more than 60 mm (2.36 in.)
7. Remove the oil pump sprocket retaining nut and the oil pump sprocket.

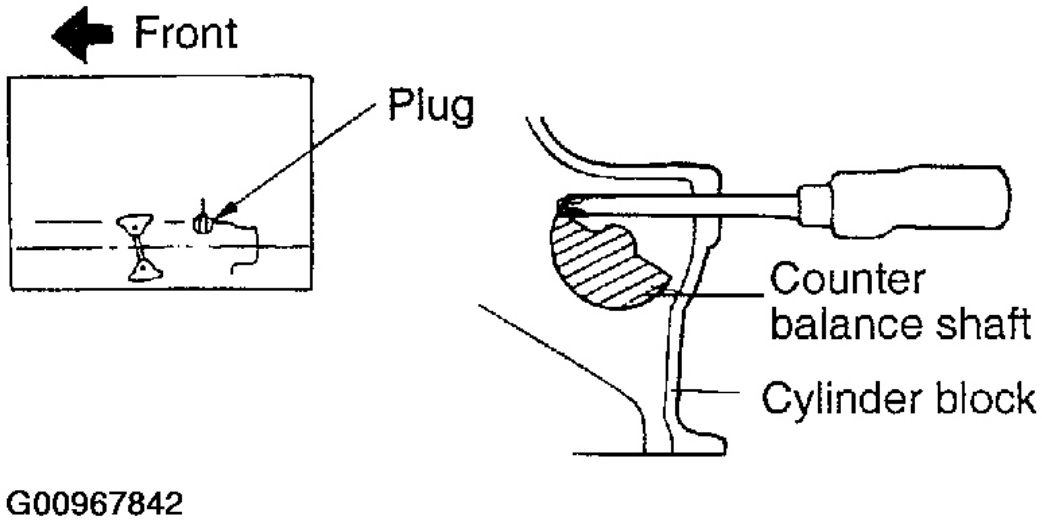


Fig. 201: Securing Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

8. Loosen the right counter balance shaft sprocket mounting bolt until it can be loosened by hand.
9. Next, remove the tensioner "B" and then the timing belt "B".

CAUTION: After the timing belt "B" is removed, do not attempt to loosen bolts while holding the sprocket with pliers or any other tool.

10. Remove the crankshaft sprocket "B" from the crankshaft.

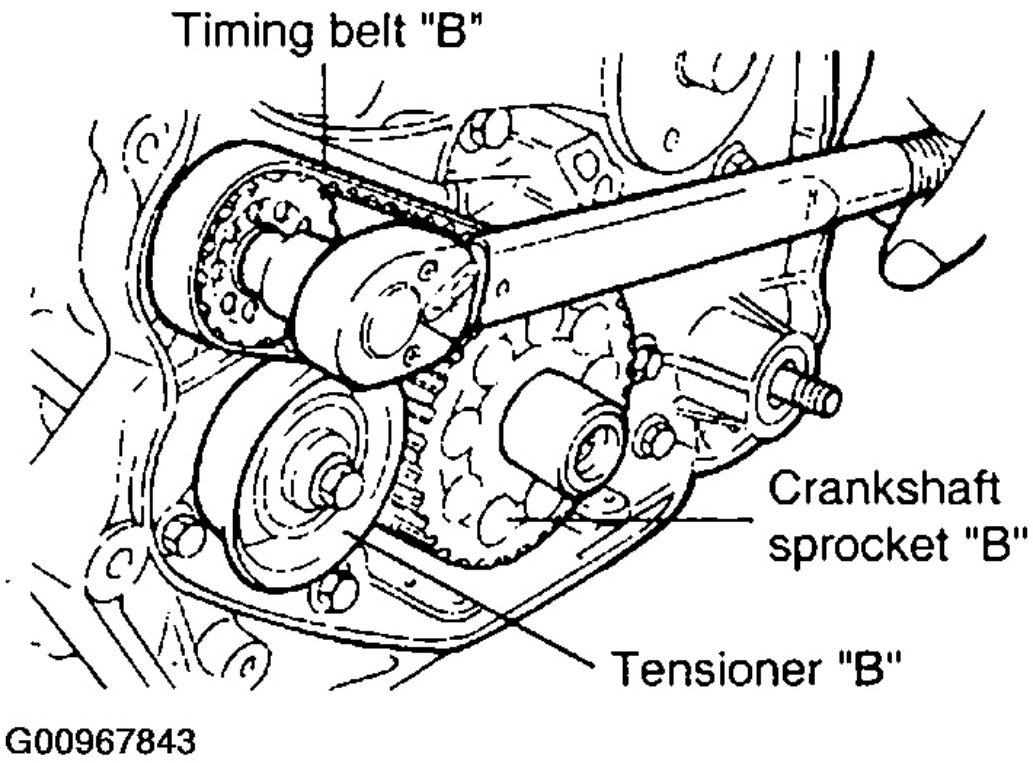


Fig. 202: Removing Crankshaft Sprocket "B"
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

SPROCKETS, TENSIONER PULLEY & IDLER PULLEY

1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley and idler pulley for abnormal wear, cracks or damage. Replace if necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace if necessary.
3. Replace the pulley if there is a grease leak from its bearing.

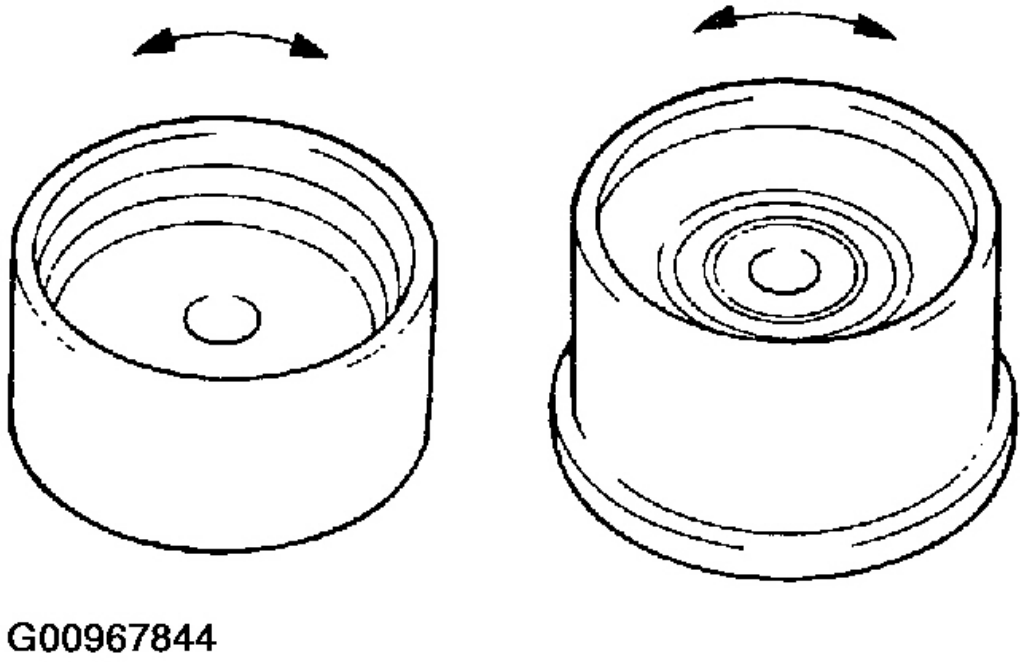


Fig. 203: Checking Pulley For Smooth Rotation
Courtesy of HYUNDAI MOTOR CO.

AUTO TENSIONER

1. Check the auto tensioner for leaking and replace if necessary.
2. Check the rod end for wear or damage and replace if necessary.

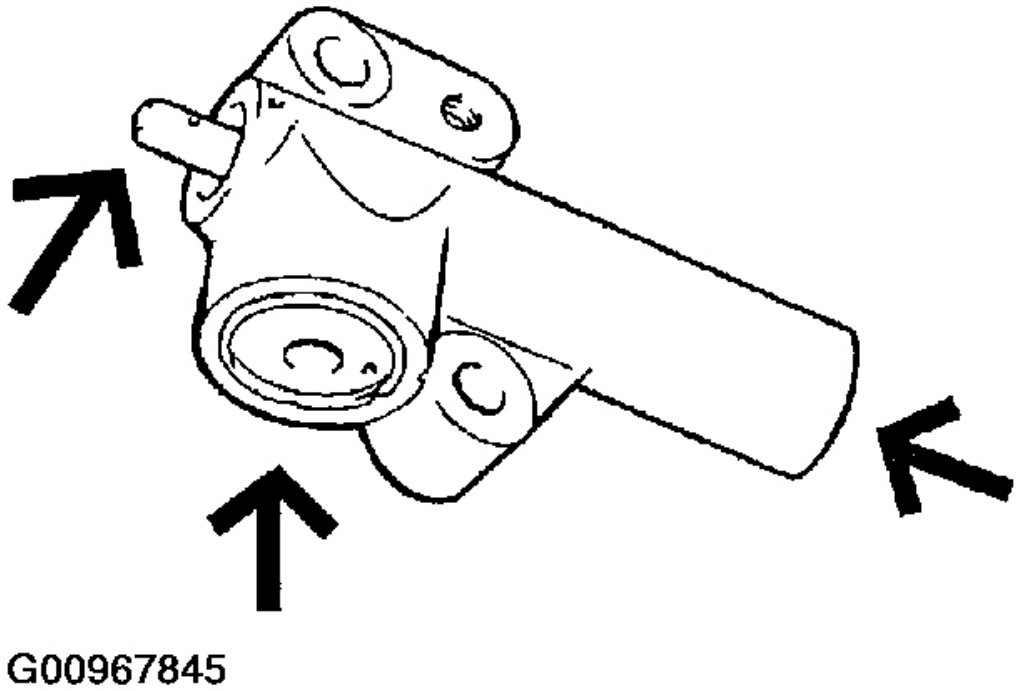


Fig. 204: Identifying Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

3. Measure the rod protrusion. If it is out of specification, replace the auto tensioner.

   Standard value: 14.5 mm (0.57 in)

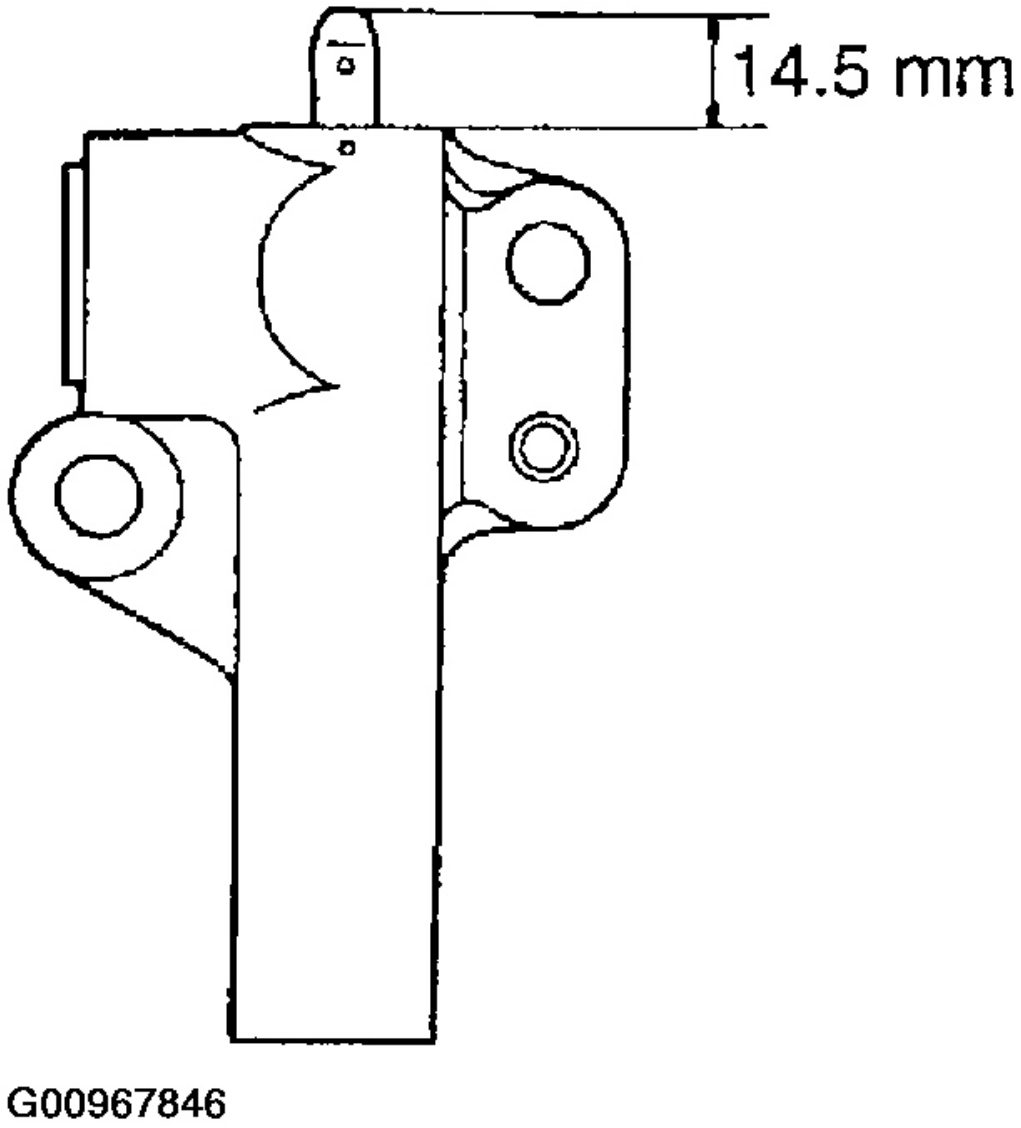


Fig. 205: Measuring Rod Protrusion
Courtesy of HYUNDAI MOTOR CO.

4. Using a soft jaw vise, compress the auto tensioner rod. slowly. If the rod can be easily retracted, replace the auto tensioner. You should feel extensive resistance when pushing the rod in. And it must be compressed in several steps.

NOTE: Clamp the auto tensioner in the vise so that it is level. Use soft jaws in the vise to avoid damaging the auto tensioner.

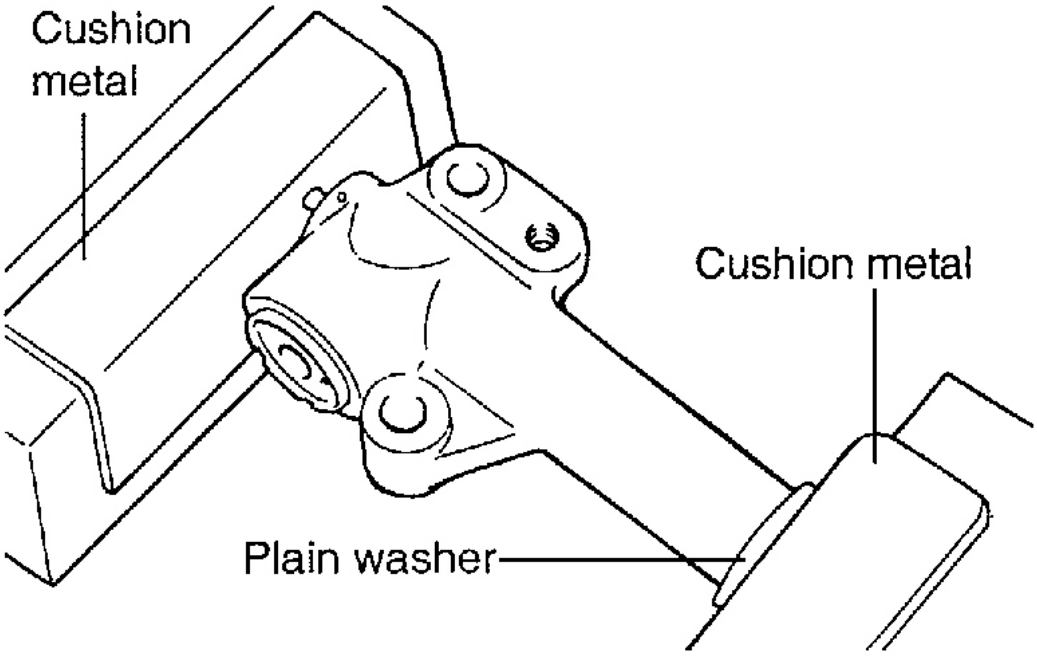


Fig. 206: Compressing Auto Tensioner Rod
Courtesy of HYUNDAI MOTOR CO.

TIMING BELT

1. Check the belt for oil or dust deposit. 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 is adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt with a new one.

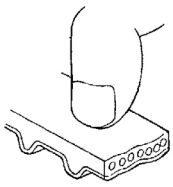
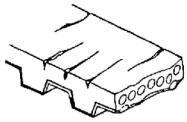
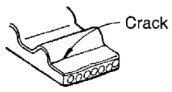
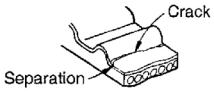
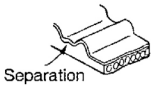
Description	Flaw conditions
1. Hardened back surface of rubber	Back surface is glossy, Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced. 
2. Cracked back surface of rubber	
3. Cracked or separating canvas	  
4. Badly worn out teeth (initial stage)	Tooth flank shows canvas on the load side (Fluffy canvas fibers, rubber changed into white color and unclear canvas texture)

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Fig. 207: Identifying Belt Flaw Conditions (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

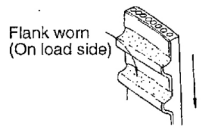
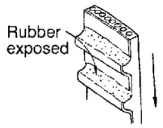
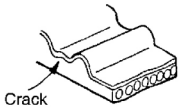
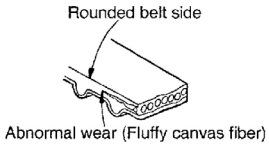
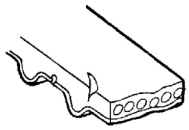
Description	Flaw conditions
	
5. Badly worn out teeth (last stage)	Tooth flank worn and rubber exposed on load side (tooth width reduced) 
6. Cracked tooth bottom	
7. Missing tooth	
8. Badly worn side of belt	
9. Cracked side of belt	

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Fig. 208: Identifying Belt Flaw Conditions (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Install the crankshaft sprocket "B" into the crankshaft.

CAUTION: Pay attention to the direction of the flange. If it is installed in the wrong direction, a broken belt could result.

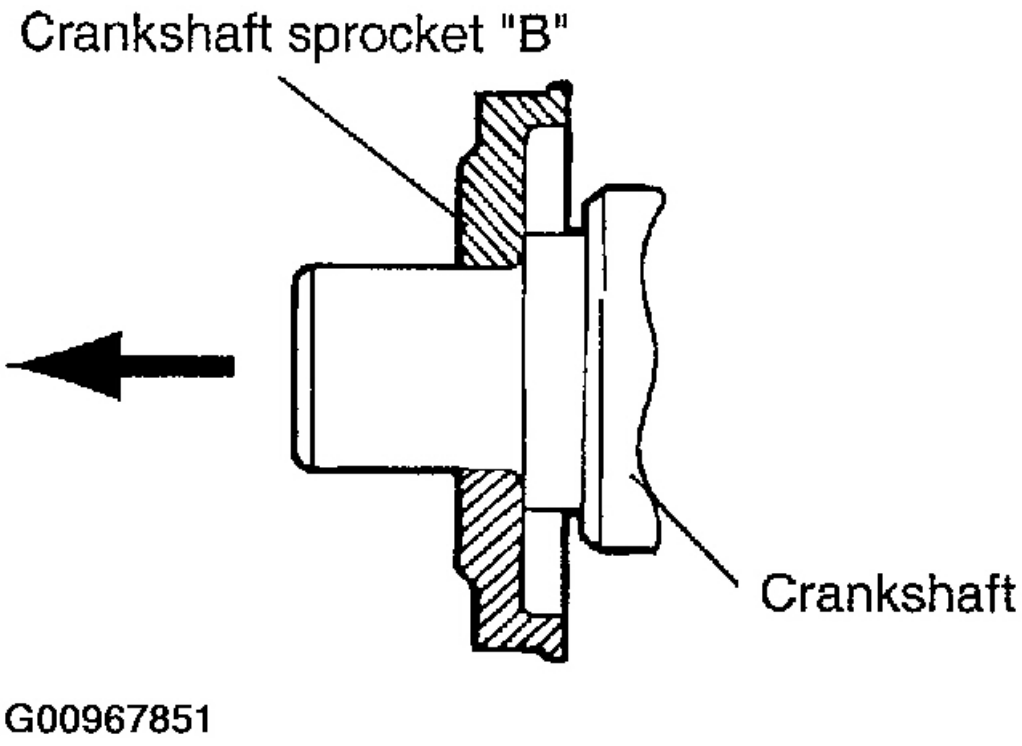

Fig. 209: Identifying Crankshaft Sprocket "B"
Courtesy of HYUNDAI MOTOR CO.

2. Apply engine oil to the outer surface of the spacer lightly and then install the spacer to the right counter balance shaft. Be sure to install in the direction shown in the illustration.
3. Install the counter balance shaft sprocket onto the right counterbalance shaft and then tighten its flange bolt by hand tightly.

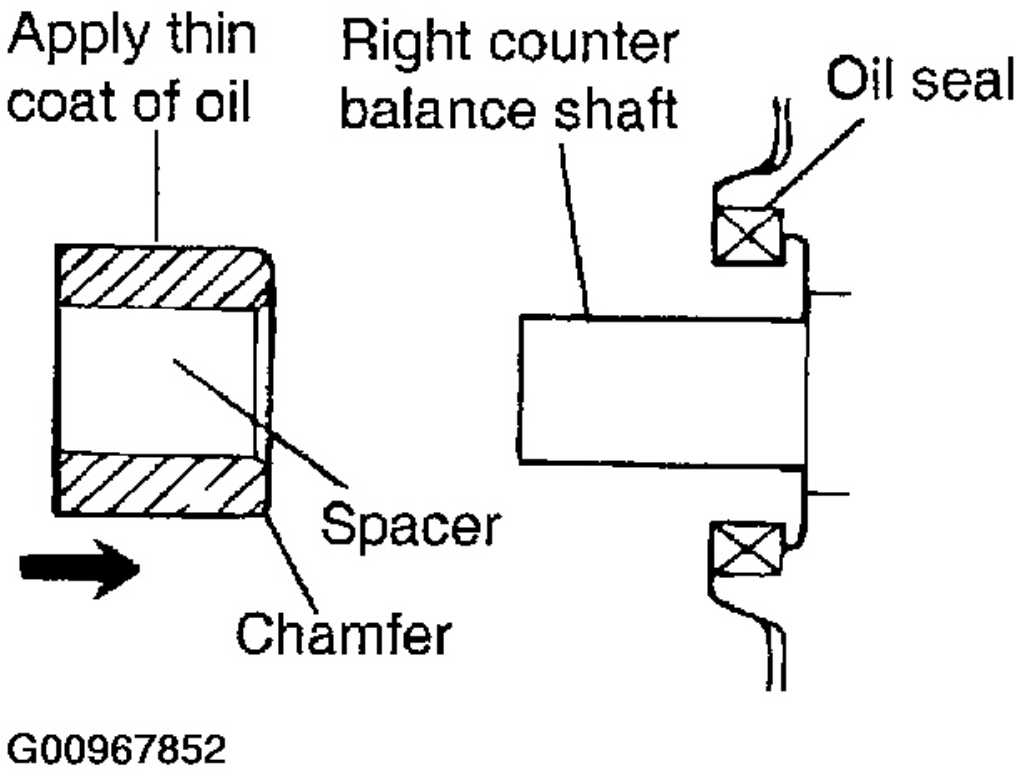

Fig. 210: Installing Counter Balance Shaft
Courtesy of HYUNDAI MOTOR CO.

4. Align the timing mark on each sprocket with the corresponding timing mark on the front case.

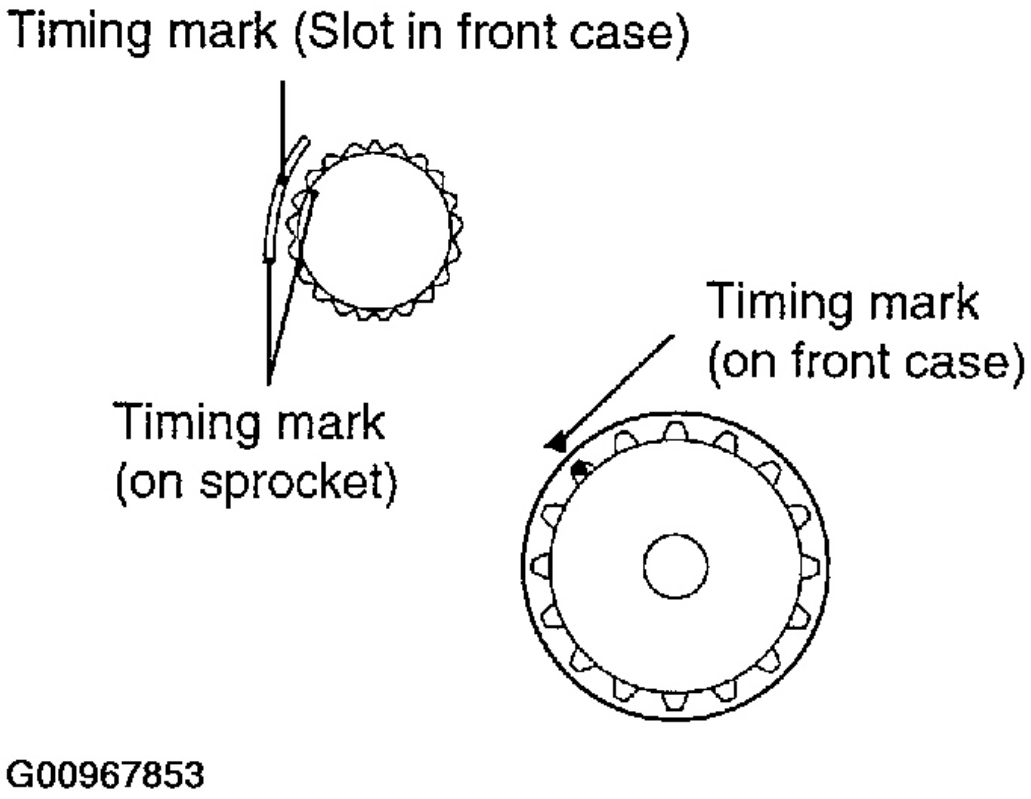

Fig. 211: Identifying Timing Marks
Courtesy of HYUNDAI MOTOR CO.

5. When the timing belt "B" is installed, make certain that its tension side has no slack.

   Install the tensioner "B" so the center of the pulley is located on the left side of the mounting bolt and in the pulley flange faces the front of the engine.

   Align the timing mark on the right counter balance shaft sprocket with the timing mark on the front case.

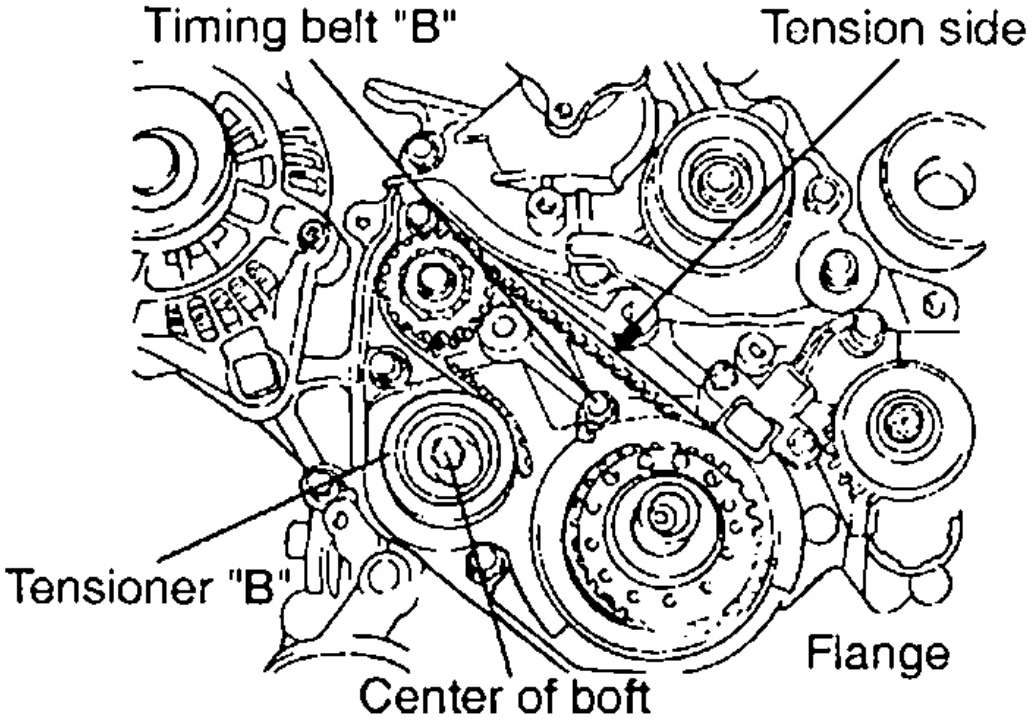

Fig. 212: Installing Timing Belt "B"
Courtesy of HYUNDAI MOTOR CO.

6. Lift the tensioner "B" to tighten the timing belt "B" so that its tension side is pulled tight. In this condition, tighten the bolt to secure tensioner "B". As the bolt is tightened, be careful to prevent the shaft from turning. If the shaft is turned, the belt will be tightened excessively.

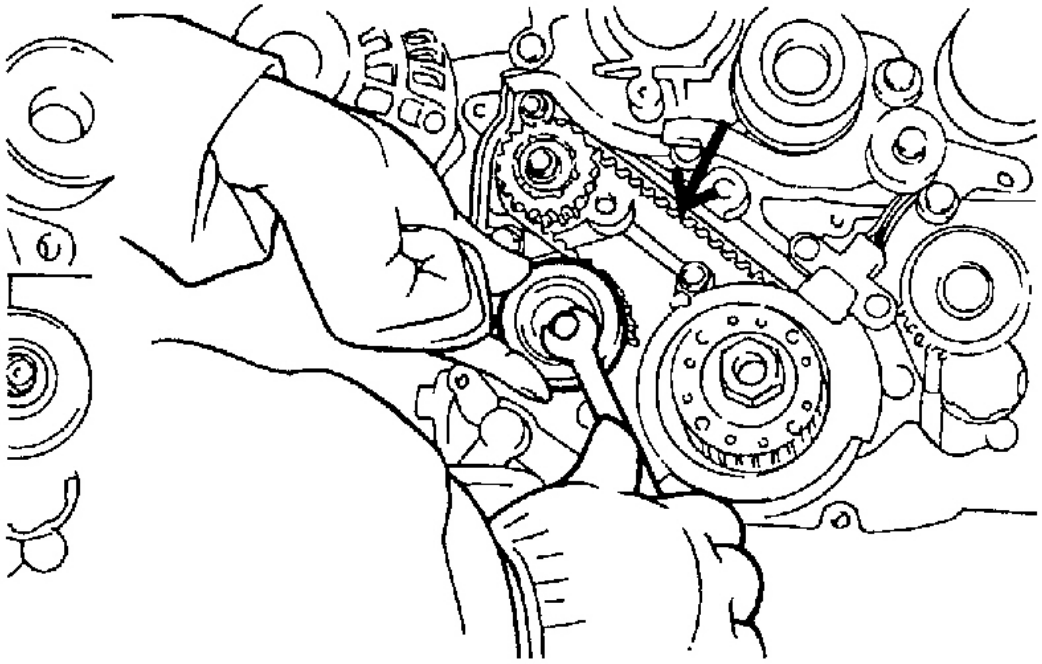

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Fig. 213: Tightening Tensioner "B"
Courtesy of HYUNDAI MOTOR CO.

7. Check to ensure that the timing marks are in alignment.
8. Verify the tension of the timing belt.

Method 1 : Verify that, when the center of the span on the tension side is depressed with an index finger in the direction of arrow, the deflection of the belt is within specification.

Belt deflection: 5-7 mm (0.20-0.28 in)

Method 2: Measure the tension of the timing belt by using a tension gauge.

Timing Belt Tension Table

Span length	Pressure	Torque
139 mm (5.47 in.)	0.42 kg/cm^2 (42 kPa)	50-100 N.m (500-1000 kg.cm, 36-72 lb.ft)

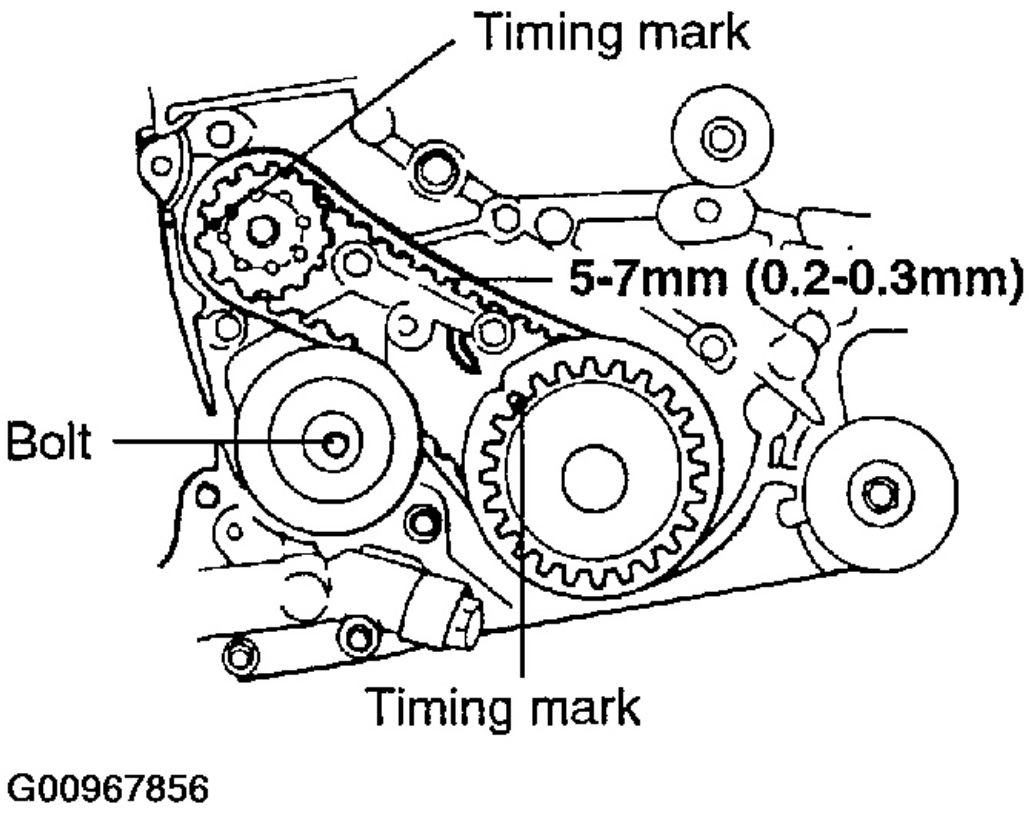

Fig. 214: View Of Timing Belt & Alignment Marks
Courtesy of HYUNDAI MOTOR CO.

9. Install the flange and crankshaft sprocket onto the crankshaft. Be sure to install the as shown in the illustration.

CAUTION: Pay attention to the direction of the flange. If it is installed in the wrong direction, a broken belt could result.

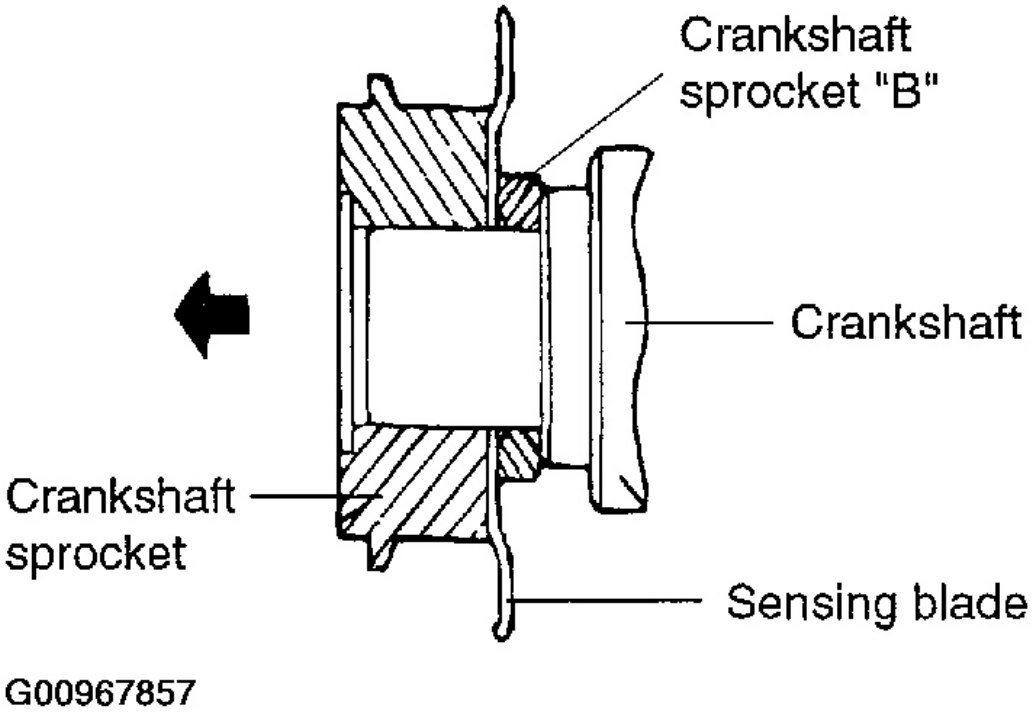

Fig. 215: Installing Crankshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

10. Install the special washer and sprocket bolt to the crankshaft and then tighten the sprocket bolt.

Tightening torque

Crankshaft sprocket bolt:
110-130 N.m (1100-1300 kg.cm, 80-94 lb.ft)

11. Insert a screwdriver through the plug hole in the left side of the cylinder block to keep the shaft in position.

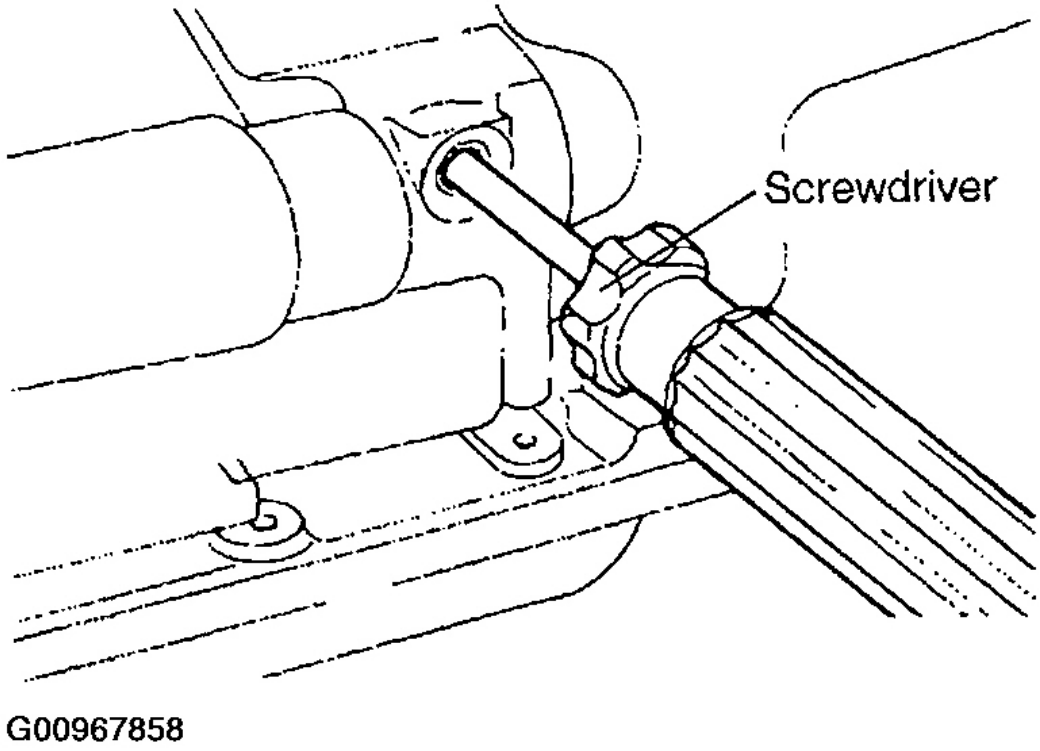

Fig. 216: Identifying Screw Driver In Plug Hold
Courtesy of HYUNDAI MOTOR CO.

12. Install the oil pump sprocket and tighten the nut to the specified torque.

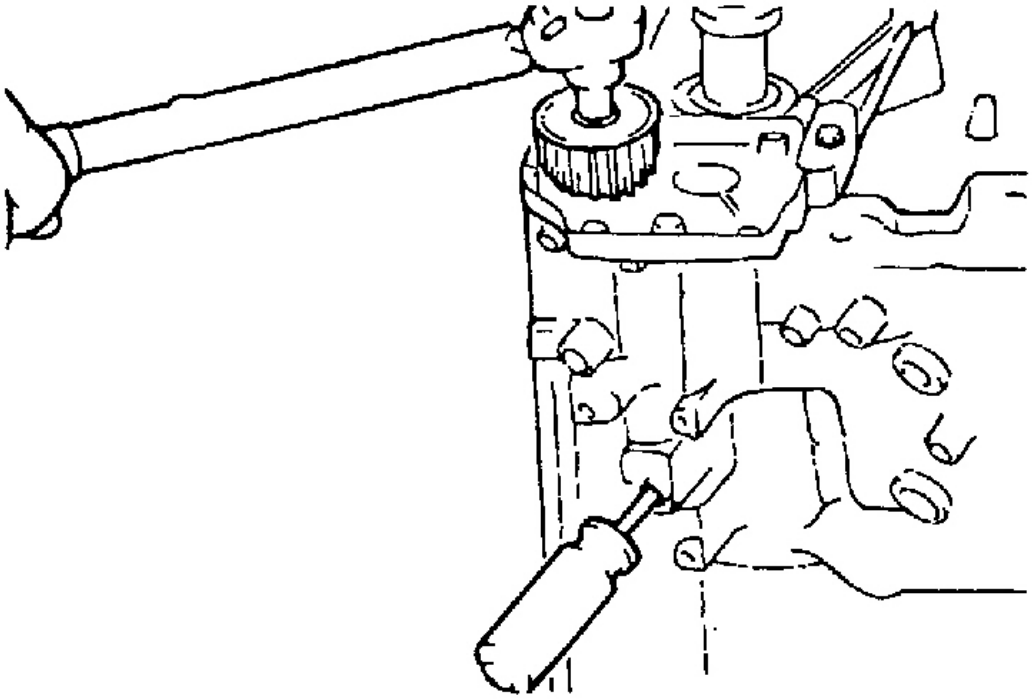

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Fig. 217: Tightening Oil Pump Sprocket
Courtesy of HYUNDAI MOTOR CO.

Tightening torque

Oil pump sprocket: 50-60 N.m (500-600 kg.cm, 36-43 lb.ft)

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

Tightening torque

Camshaft sprocket bolt: 80-100 N.m (800-1000 kg.cm, 58-72 lb.ft)

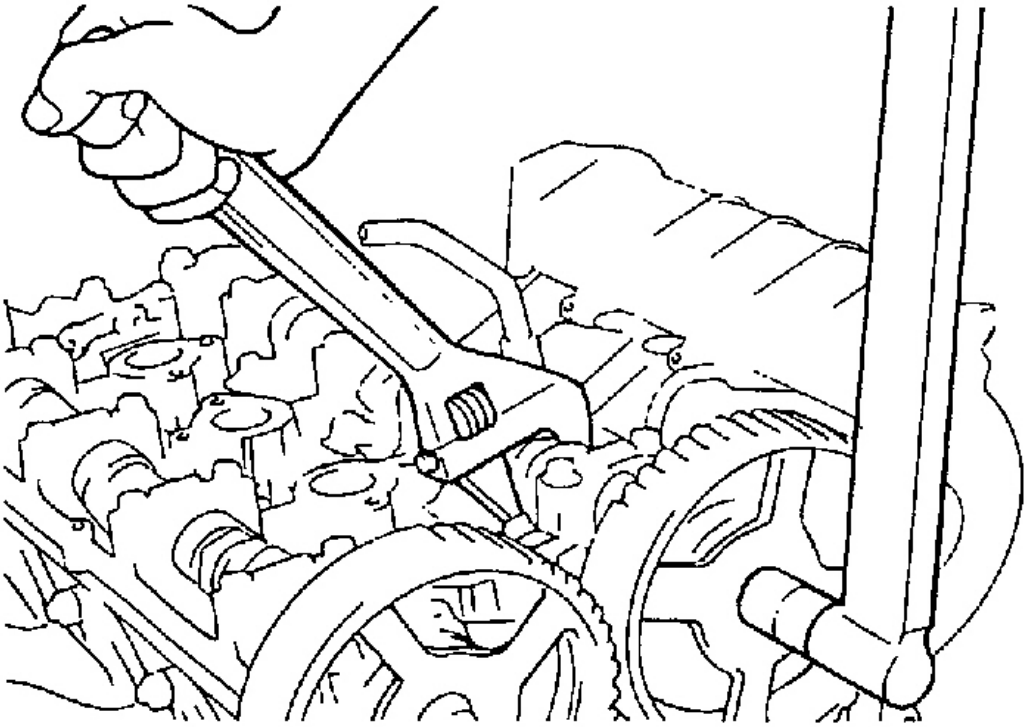

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Fig. 218: Installing Camshaft Sprocket
Courtesy of HYUNDAI MOTOR CO.

14. Install the auto tensioner.

CAUTION: Leave the set pin installed in the auto tensioner.

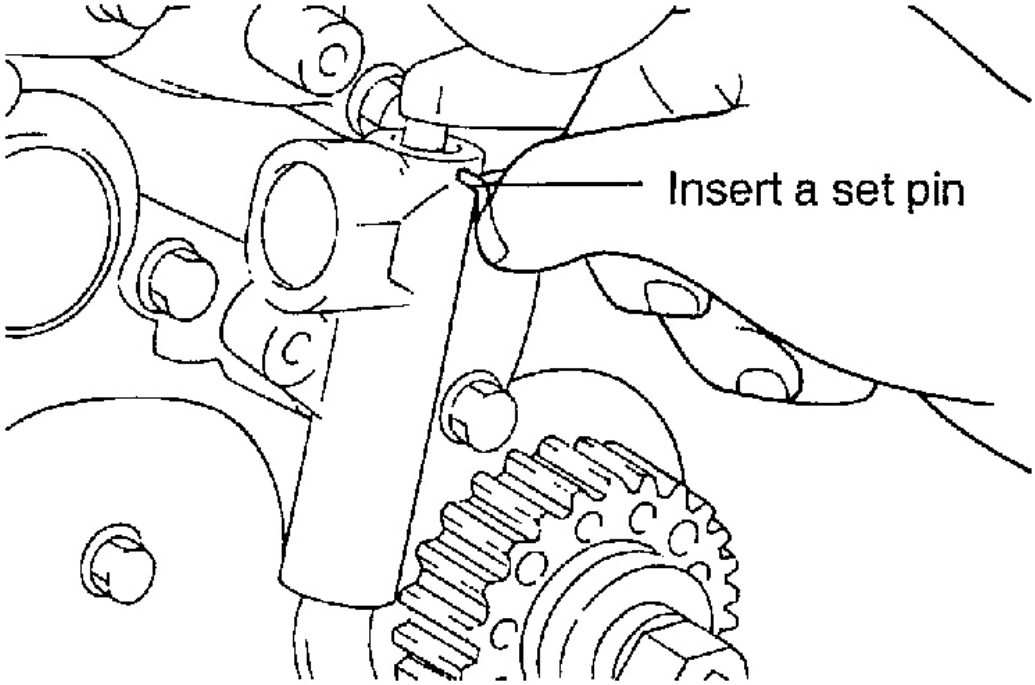

Fig. 219: Installing Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

NOTE: If the auto tensioner rod is in its fully extended position, reset it as follows.

1. Clamp it in a vise equipped with soft jaws, in a level position. Use a plain washer if there is a plug at the bottom of the auto tensioner.
2. Compress the rod slowly with the vise until the set hole in the rod is aligned with set hole in the cylinder.

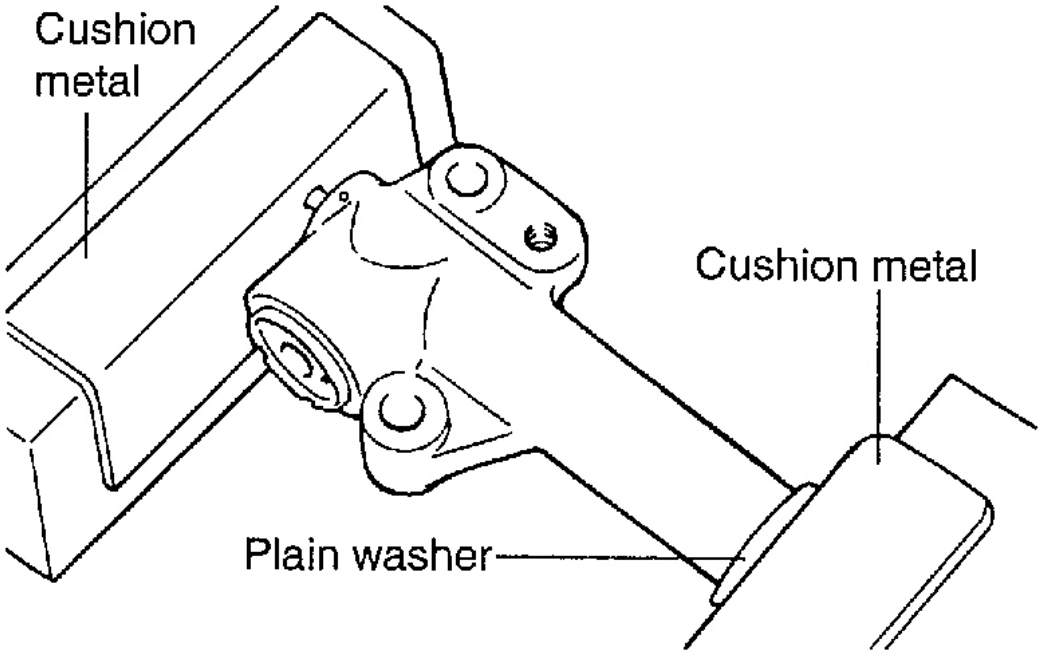

Fig. 220: Resetting Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

3. Insert a set pin through the auto tensioner body and rod.

CAUTION: Leave the set pin installed in the auto tensioner.

15. Install the tensioner pulley onto the tensioner arm.

Tightening torque

Tensioner pulley :
43-55 N.m (430-550 kg.cm, 31-40 lb.ft)

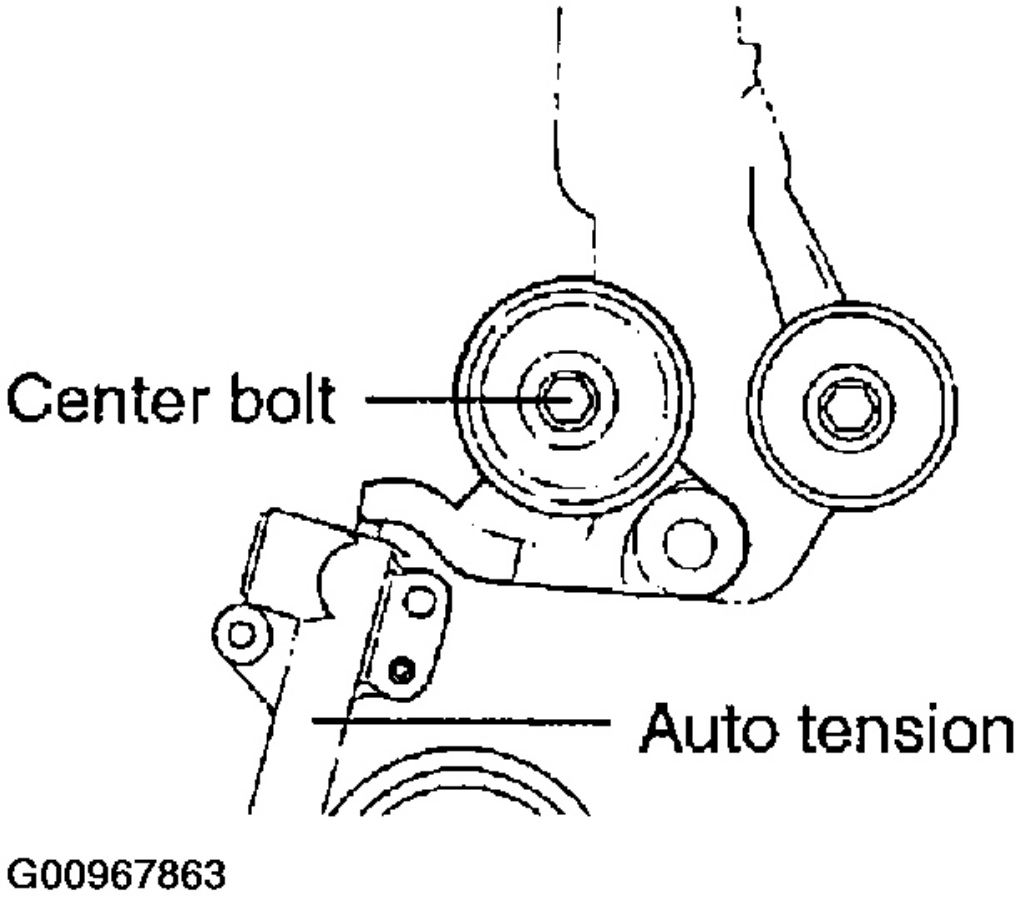

Fig. 221: Identifying Tensioner Pulley
Courtesy of HYUNDAI MOTOR CO.

16. Rotate the camshaft sprockets so that the dowel pin of the camshaft sprocket is at the upper side. Set the timing mark of sprocket correctly

NOTE:

1. **Before installing the timing belt, if the timing mark of the camshaft sprocket doesn't coincide with that of the rocker cover, do not rotate the cam sprocket more than 2 teeth of the sprocket in any direction. Rotating the sprocket more than 2 teeth may make the valve and piston touch each other.**
2. **If it is necessary to rotate the cam sprocket more than 2 teeth, rotate the crank sprocket counter clock wise first based on the timing mark.**

After the camshaft sprocket is properly timed return the crankshaft to

TDC.

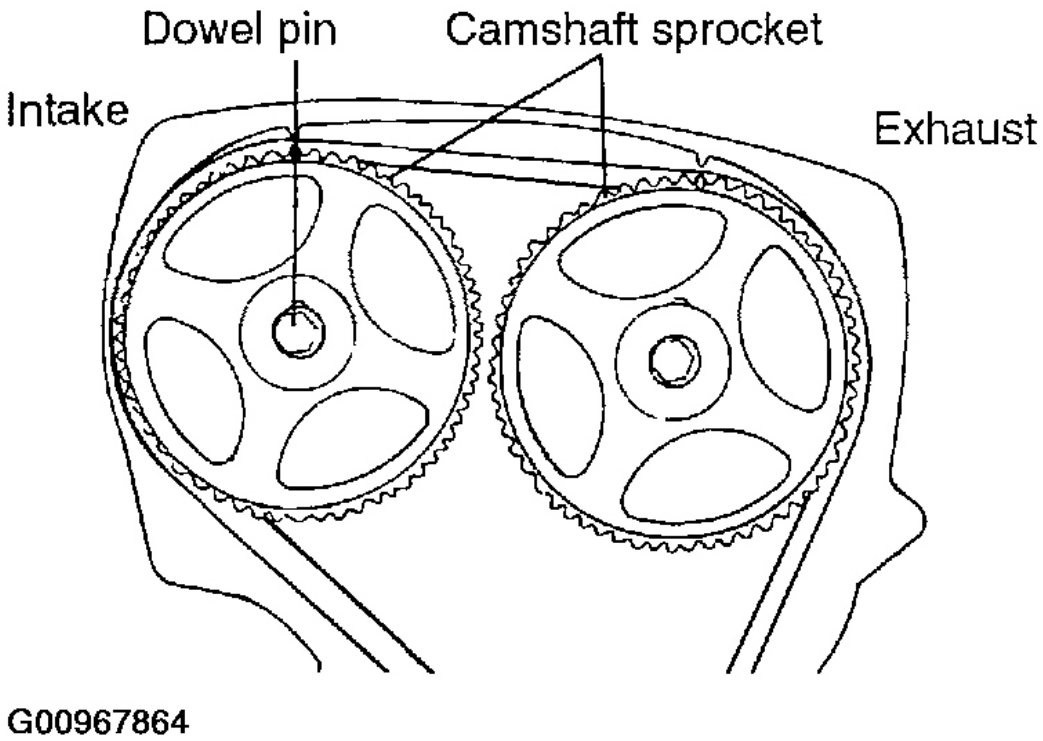

Fig. 222: Identifying Dowel Pin & Camshaft Timing Marks
Courtesy of HYUNDAI MOTOR CO.

NOTE: When exhaust and intake camshaft sprocket is used and install it after checking I.D. mark depending on the engine displacement.

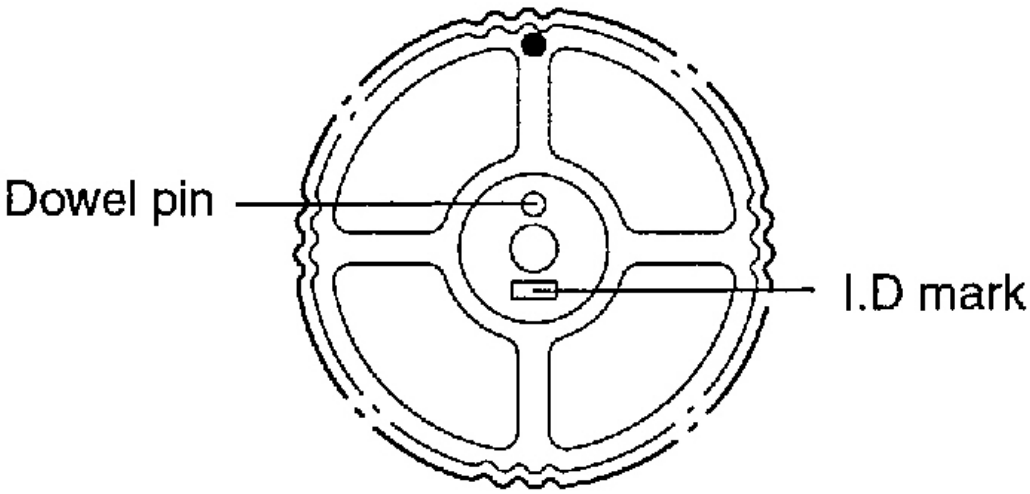

Fig. 223: Identifying Camshaft Sprocket I.D. Mark
Courtesy of HYUNDAI MOTOR CO.

17. Align the timing mark on each sprocket with the corresponding timing mark and install the belt as the following order.

    Crankshaft sprocket-Oil pump sprocket-Idler pulley-Exhaust camshaft sprocket-Intake camshaft sprocket-Tensioner pulley

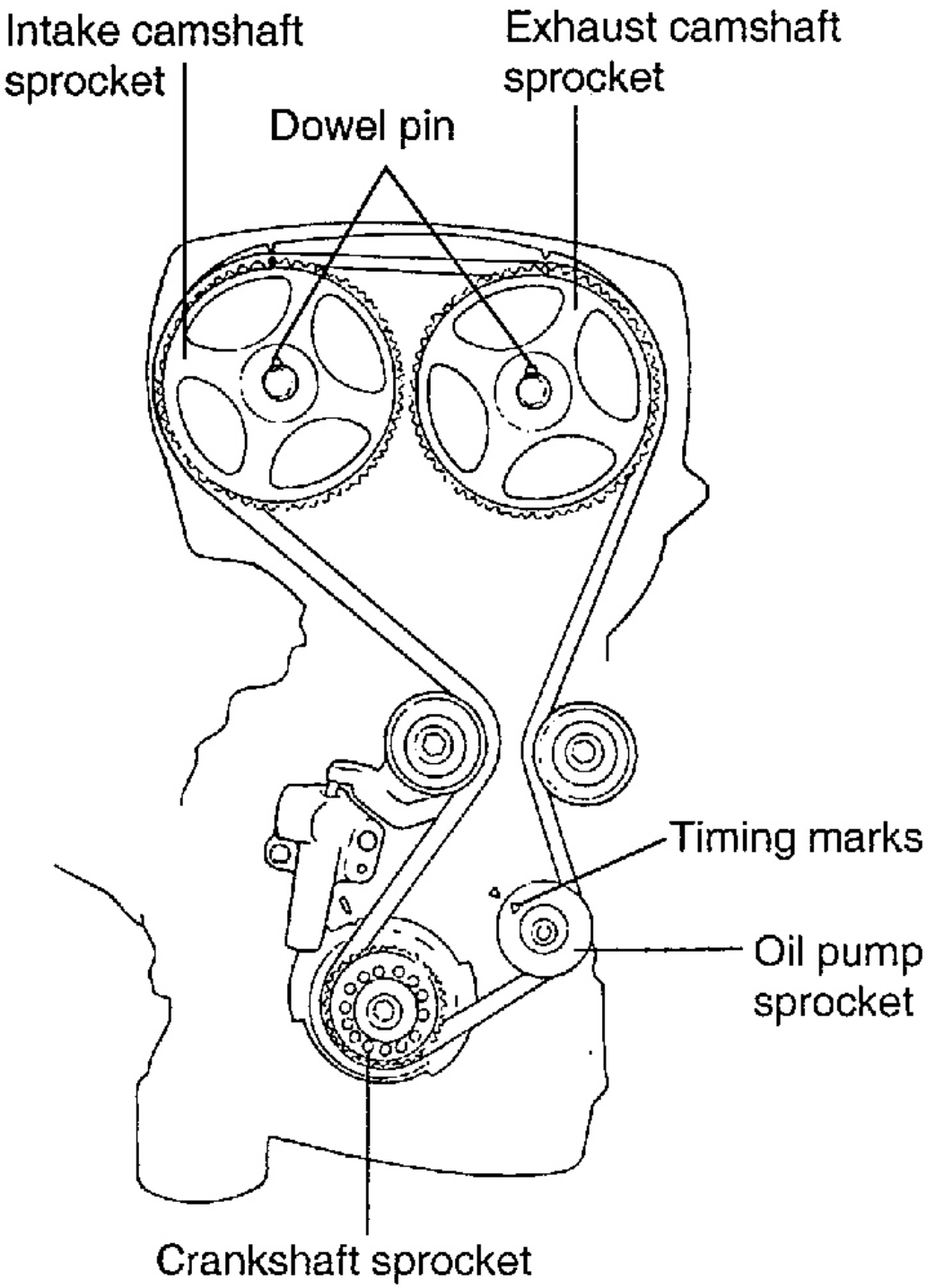

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Fig. 224: Identifying Timing Belt & Pulleys
Courtesy of HYUNDAI MOTOR CO.

NOTE:

1. **Be sure that the piston of No. 1 cylinder is located in TDC position (Compression stroke).**
2. **When aligning the timing mark on oil pump sprocket, remove the left plug of cylinder block, and then check that the count balance shaft is in the specified position by inserting the screwdriver (Diameter: 8mm, inserting length: 60 mm or more)**

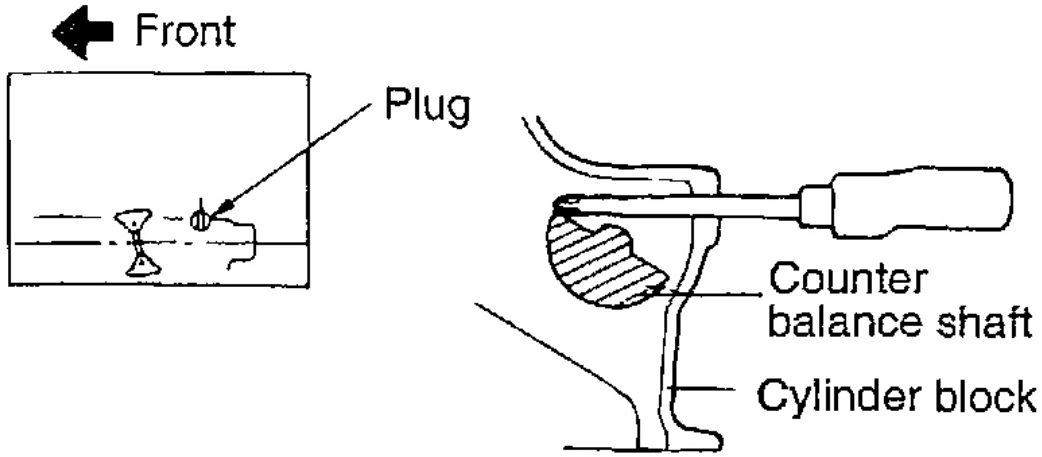

Fig. 225: Checking Counter Balance Shaft Position
Courtesy of HYUNDAI MOTOR CO.

18. After checking the timing mark, install the lift plug of cylinder block.
    Tightening torque: 2.7-3.4 kgf.m
    (Apply the liquid gasket: THREE BOND NO.1212B or equivalent)
19. Pull out the set pin.
20. Rotate the crankshaft two turns clockwise and leave it for about 5 minutes. Then, measure the auto tensioner protrusion "A" (Distance between the tensioner arm and auto tensioner body) to ensure that it is within the specification.

    Standard value: 5.5-9 mm (0.22-0.35 in)

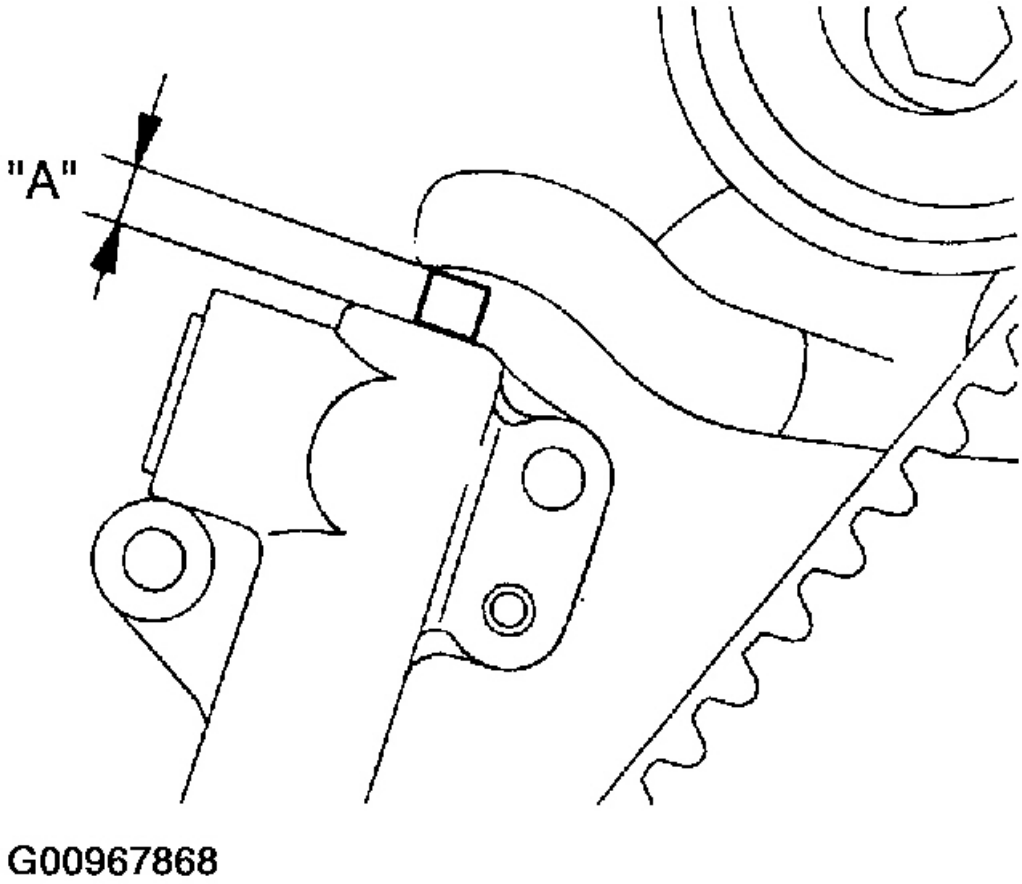

Fig. 226: Measuring Auto Tensioner Protrusion
Courtesy of HYUNDAI MOTOR CO.

21. Install the timing belt lower cover and the timing belt upper cover.

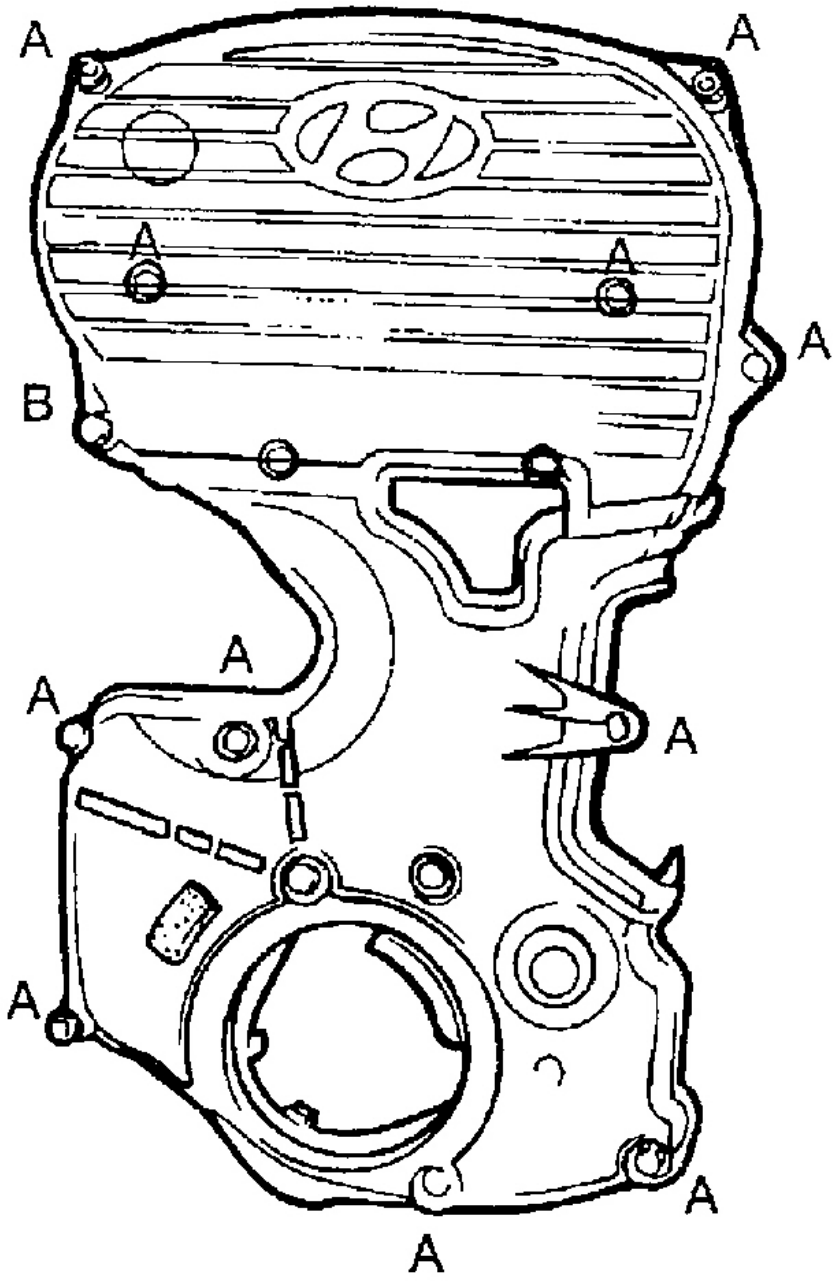

Fig. 227: Identifying Timing Belt Cover Bolts
Courtesy of HYUNDAI MOTOR CO.

