SECTION 1

ENGINE

SECTION 1A

GENERAL ENGINE INFORMATION

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DIAGNOSIS

COMPRESSION TEST

Important: Disconnect the Crankshaft Position Sensor (CPS) connector to disable the fuel and the ignition systems.

Test the compression pressure for each cylinder. Low compression pressure may be the fault of the valves or the pistons. The following conditions should be considered when you check the cylinder compression:

- The engine should be at normal operating temperature.
- The throttle must be wide open.
- All the spark plugs should be removed.
- The battery must be at or near full charge.

1. Place approximately three squirts of oil from a plunger type oiler into each spark plug port.
2. Insert the engine compression gauge into each spark plug port.
3. Crank test each cylinder with four to five compression strokes using the starter motor.
4. The lowest reading should not be less than 70% of the highest reading. The compression gauge reading should not be less than 689 kPa (100 psi) for any of the cylinders.
5. Examine the gauge readings obtained after the four “puffs” per cylinder are obtained from cranking the starter motor. The readings are explained in the following descriptions:

- Normal Condition - Compression builds up quickly and evenly to specified compression on each cylinder.
- Piston Rings Faulty - Compression is low on the first stroke and tends to build up on following strokes, but the compression pressure does not reach normal. The compression pressure improves considerably with the addition of oil into the cylinder.
- Valves Faulty - Low compression pressure on the first stroke. The compression pressure does not tend to build up on the following strokes. The compression pressure does not improve much with the addition of oil into the cylinder.

OIL PRESSURE TEST

Step	Action	Value(s)	Yes	No
1	Is low or no oil pressure indicated?	-	Go to Step 2	System OK
2	Check the oil level in the crankcase. Is the level low?	-	Go to Step 3	Go to Step 4
3	Add oil so that the oil level is up to the full mark on the indicator. Is the repair complete?	-	Go to Step 1	-
4	Check the idle speed. Is the idle speed below the value specified?	825 rpm	Go to Step 5	Go to Step 6
5	Increase the idle speed. Is the speed increased?	-	Go to Step 1	-
6	Inspect the oil pressure switch. Is the oil pressure switch incorrect or malfunctioning?	-	Go to Step 7	Go to Step 8
7	Install a new oil pressure switch. Is the repair complete?	-	Go to Step 1	-
8	Inspect the oil pressure gauge. Is the oil pressure gauge incorrect or malfunctioning?	-	Go to Step 9	Go to Step 10
9	Install a new oil pressure gauge. Is the repair complete?	-	Go to Step 1	-
10	Inspect the engine oil. Is the engine oil in the crankcase diluted or of the improper viscosity?	-	Go to Step 11	Go to Step 12
11	Install new engine oil of the proper viscosity for the expected temperatures. Is the repair complete?	-	Go to Step 1	-
12	Inspect the oil pump. Is the pump worn or dirty?	-	Go to Step 13	Go to Step 14
13	Replace the oil pump. Is the repair complete?	-	Go to Step 1	-
14	Inspect the oil filter. Is the oil filter plugged?	-	Go to Step 15	Go to Step 16
15	Install a new oil filter. Is the repair complete?	-	Go to Step 1	-
16	Inspect the oil pickup screen. Is the oil pickup screen loose or plugged?	-	Go to Step 17	Go to Step 18
17	Tighten or replace the oil pickup screen as necessary. Is the repair complete?	-	Go to Step 1	-
18	Inspect the oil pickup tube. Are there any holes in the oil pickup tube?	-	Go to Step 19	Go to Step 20
19	Replace the oil pickup tube. Is the repair complete?	-	Go to Step 1	-

OIL PRESSURE TEST (CONT'D)

Step	Action	Value(s)	Yes	No
20	Inspect the bearing clearances. Are the bearing clearances more than the values specified?	Crankshaft 0.005 mm (0.002 in.) Connecting Rod 0.019 X 0.070 mm (0.0007 X 0.0027 in.)	Go to Step 21	Go to Step 22
21	Replace the bearing if necessary. Is the repair complete?	-	Go to Step 1	-
22	Inspect the oil galleries. Are the oil galleries cracked, porous or plugged?	-	Go to Step 23	Go to Step 24
23	Repair or replace the engine block. Is the repair complete?	-	Go to Step 1	-
24	Inspect the gallery plugs. Are any of the gallery plugs missing or not installed properly?	-	Go to Step 25	Go to Step 26
25	Install plugs or repair as necessary. Is the repair complete?	-	Go to Step 1	-
26	Inspect the camshaft. Is the camshaft worn or is there evidence of poor machining?	-	Go to Step 27	System OK
27	Replace the camshaft. Is the repair complete?	-	Go to Step 1	-

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1. After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2. Wait a few minutes.
   - 2.3. You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1. Clean the area well.
   - 4.2. Dry the area.
   - 4.3. Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4. After operating the vehicle, visually check the suspected component.
   - 4.5. If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks. Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle under normal operating conditions as directed in the kit.

3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

Gaskets

- D The fluid level/pressure is too high.
- D The crankcase ventilation system is malfunctioning.
- D The fasteners are tightened improperly or the threads are dirty or damaged.
- D The flanges or the sealing surface is warped.
- D There are scratches, burrs or other damage to the sealing surface.
- D The gasket is damaged or worn.
- D There is cracking or porosity of the component.
- D An improper seal was used (where applicable).

Seals

- D The fluid level/pressure is too high.
- D The crankcase ventilation system is malfunctioning.
- D The seal bore is damaged (scratched, burred or nicked).
- D The seal is damaged or worn.
- D Improper installation is evident.
- D There are cracks in the component.
- D The shaft surface is scratched, nicked or damaged.
- D A loose or worn bearing is causing excess seal wear.

KNOCK DIAGNOSIS

Definition for Knock

Engine knock refers to various types of engine noise. Heavy knock is usually very loud and the result of broken or excessively worn internal engine components. Light knock is a noticeable noise, but not as loud. Light knock can be caused by worn internal engine components. Loose or broken external engine components can also cause heavy or light knock.

Engine Knocks Cold and Continues for Two-Three Minutes and/or Knock Increases with Engine Torque

Step	Action	Value(s)	Yes	No
1	Does the engine knock when it is cold and continue for two to three minutes or does the knock increase with torque?	-	Go to Step 2	System OK
2	Inspect the flywheel. Is the flywheel contacting the splash shield?	-	Go to Step 3	Go to Step 4
3	Reposition the splash shield. Is the repair complete?	-	Go to Step 1	-
4	Inspect the balancer and the drive pulleys. Is either the balancer or the drive pulleys loose or broken?	-	Go to Step 5	Go to Step 6
5	Tighten or replace the balancer or the drive pulleys. Is the repair complete?	-	Go to Step 1	-
6	Inspect the piston-to-bore clearance. Is the clearance more than the value specified?	0.030 mm (0.001 in.)	Go to Step 7	Go to Step 8
7	1. Rebore the cylinder and hone to size. 2. Replace the piston. Is the repair complete?*	-	Go to Step 1	-
8	Inspect the connecting rod. Is the connecting rod bent?	-	Go to Step 9	System OK
9	Replace the connecting rod. Is the repair complete?	-	Go to Step 1	-

* Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock, which disappears in about 1.5 minutes, is considered acceptable.

Heavy Knock Hot with Torque Applied

Step	Action	Value(s)	Yes	No
1	Is there a heavy knock when the engine is hot and torque is applied?	-	Go to Step 2	System OK
2	Inspect the balancer and pulley hub. Is the balancer or pulley hub broken?	-	Go to Step 3	Go to Step 4
3	Replace the broken balancer or pulley hub. Is the repair complete?	-	Go to Step 1	-
4	Inspect the torque converter bolts. Are the bolts tightened to the value specified?	45 NSm (33 lb ft)	Go to Step 5	Go to Step 6
5	Tighten the torque converter bolts. Is the repair complete?	-	Go to Step 1	-
6	Inspect the accessory belts. Are the belts too tight or nicked?	-	Go to Step 7	Go to Step 8
7	Replace and/or tension the belts to specifications as necessary. Is the repair complete?	-	Go to Step 1	-
8	Inspect the exhaust system. Is the system grounded?	-	Go to Step 9	Go to Step 10
9	Reposition the system as necessary. Is the repair complete?	-	Go to Step 1	-
10	Inspect the flywheel. Is the flywheel cracked?	-	Go to Step 11	Go to Step 12
11	Replace the flywheel. Is the repair complete?	-	Go to Step 1	-
12	Inspect the main bearing clearance. Is the clearance more than the value specified?	0.050 mm (0.002 in.)	Go to Step 13	Go to Step 14
13	Replace the main bearings as necessary. Is the repair complete?	-	Go to Step 1	-
14	Inspect the rod bearing clearance. Is the clearance more than the value specified?	0.019 X 0.070 mm (0.0007 X 0.0028 in.)	Go to Step 15	System OK
15	Replace the rod bearings as necessary. Is the repair complete?	-	Go to Step 1	-

Light Knock Hot

Step	Action	Value(s)	Yes	No
1	Is there a light knock when the engine is hot?	-	Go to Step 2	System OK
2	Is detonation or spark knock evident?	-	Go to Step 3	Go to Step 4
3	Check the engine timing and the fuel quality. Was the problem found?	-	Go to Step 1	-
4	Inspect the torque converter bolts. Are the bolts tightened to the value specified?	45 NSm (33 lb ft)	Go to Step 5	Go to Step 6
5	Tighten the torque converter bolts. Is the repair complete?	-	Go to Step 1	-
6	Inspect the manifold. Is there an exhaust leak at the manifold?	-	Go to Step 7	Go to Step 8
7	Tighten the bolts or replace the gasket. Is the repair complete?	-	Go to Step 1	-
8	Check the rod bearing clearance. Is the clearance within the value specified?	0.019 X 0.070 mm (0.0007 X 0.0028 in.)	Go to Step 9	System OK
9	Replace the rod bearings as necessary. Is the repair complete?	-	Go to Step 1	-

Knocks During Initial Start-Up But Lasts Only a Few Seconds

Step	Action	Value(s)	Yes	No
1	Does the engine knock during initial start-up but last only a few seconds?	-	Go to Step 2	System OK
2	Check the engine oil. Is the proper viscosity oil used in the crankcase?	-	Go to Step 4	Go to Step 3
3	Install oil of the proper viscosity for the expected seasonal temperatures. Is the repair complete?	-	Go to Step 1	-
4	Inspect the hydraulic lifters. Is there evidence of hydraulic lifter bleed-down?	-	Go to Step 5	Go to Step 6
5	Clean, test and replace the lifters as necessary. Is the repair complete?*	-	Go to Step 1	-
6	Inspect the crankshaft end clearance. Is the clearance more than value specified?	0.1 mm (0.0039 in.)	Go to Step 7	Go to Step 8
7	Replace the crankshaft thrust bearing. Is the repair complete?	-	Go to Step 1	-
8	Inspect the front main bearing clearance. Is the clearance more than the value specified?	0.005 mm (0.0001 in.)	Go to Step 9	System OK
9	Replace the worn parts of the front main bearing. Is the repair complete?	-	Go to Step 1	-

* When the engine is stopped, some valves will be open. Spring pressure against the lifters will tend to bleed lifter down. Attempts to repair this should be made only if the problem is consistent.

An engine that is operated for only short periods between start-ups may have lifter noise that lasts for a few minutes. This is a normal condition.

Knocks at Idle Hot

Step	Action	Value(s)	Yes	No
1	Does the engine knock at idle when hot?	-	Go to Step 2	System OK
2	Inspect the drive belts. Are the belts loose or worn?	-	Go to Step 3	Go to Step 4
3	Tension or replace the belts as necessary. Is the repair complete?	-	Go to Step 1	-
4	Inspect the A/C compressor and the generator. Is either the compressor or the generator faulty?	-	Go to Step 5	Go to Step 6
5	Replace the faulty A/C compressor or the generator. Is the repair complete?	-	Go to Step 1	-
6	Inspect the valve train. Are valve train components faulty?	-	Go to Step 7	Go to Step 8
7	Replace faulty valve train components. Is the repair complete?	-	Go to Step 1	-
8	Check the engine oil. Is the proper viscosity oil used in the crankcase?	-	Go to Step 10	Go to Step 9
9	Install oil of the proper viscosity for the expected seasonal temperatures. Is the repair complete?	-	Go to Step 1	-
10	Inspect the piston pin clearance. Is the clearance more than the value specified?	0.020 mm (0.0008 in.)	Go to Step 11	Go to Step 12
11	Replace the piston and the pin. Is the repair complete?	-	Go to Step 1	-
12	Check the connecting rod alignment. Is the alignment faulty?	-	Go to Step 13	Go to Step 14
13	Check and replace rods as necessary. Is the repair complete?	-	Go to Step 1	-
14	Inspect the piston-to-bore clearance. Is the clearance within the value specified?	0.030 mm (0.0012 in.)	Go to Step 16	Go to Step 15
15	Hone the bore and fit a new piston. Is the repair complete?	-	Go to Step 1	-
16	Inspect the crankshaft balancer. Is the balancer loose?	-	Go to Step 17	Go to Step 18
17	Torque or replace worn parts. Is the repair complete?	-	Go to Step 1	-
18	Check the piston pin offset. Is the offset at the value specified?	0.5 X 0.7 mm (0.020 X 0.028 in.) Toward Thrust Side	Go to Step 19	System OK
19	Install the correct piston. Is the repair complete?	-	Go to Step 1	-

NOISE DIAGNOSIS

Main Bearing Noise

Step	Action	Value(s)	Yes	No
1	Are dull thuds or knocks heard with every engine revolution?	-	Go to Step 2	System OK
2	Check the oil pump pressure. Is the oil pump pressure low?	-	Go to Oil Pressure Test	Go to Step 3
3	Inspect the crankshaft end play. Does the crankshaft end play exceed the value specified?	0.1 mm (0.0039 in.)	Go to Crankshaft Replacement Procedure	Go to Step 4
4	Inspect the crankshaft journals. Are the crankshaft journals out-of-round?	0.004 mm (0.0002 in.) max.	Go to Crankshaft Replacement Procedure	Go to Step 5
5	Inspect the belt tension. Does the belt tension exceed the value specified?	-	Go to Timing Belt Replacement Procedure	Go to Step 6
6	Inspect the crankshaft pulley. Is the crankshaft pulley loose?	-	Go to Crankshaft Replacement Procedure	System OK

Connecting Rod Bearing Noise Symptom

Step	Action	Value(s)	Yes	No
1	Is a knock noise heard under all engine speeds?	-	Go to Step 2	System OK
2	Inspect the crankshaft connecting rod journal. Is the crankshaft connecting rod journal worn?	-	Go to Crankshaft Replacement Procedure	Go to Step 3
3	Check the oil pump pressure. Is the oil pump pressure low?	-	Go to Oil Pressure Test	Go to Step 4
4	Inspect the crankshaft connecting rod journals. Are the journals out of round?	-	Go to Crankshaft Replacement Procedure	Go to Step 5
5	Inspect the connecting rods. Is there a misaligned connecting rod?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 6
6	Inspect the connecting rod bolts. Are the connecting rod bolts torqued properly?	-	System OK	Go to Pistons and Rods Replacement Procedure

Piston Noises

Step	Action	Value(s)	Yes	No
1	Are any of the following noises heard: a sharp double knock when the engine is idling, a light ticking with no load on the engine or a “slapping” noise when the engine is cold?	-	Go to Step 2	System OK
2	Inspect the piston pin and bushing. Is the piston pin or the bushing worn or loose?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 3
3	Inspect the piston. Is the piston broken or cracked?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 4
4	Inspect the connecting rods. Is there a misaligned connecting rod?	-	Go to Pistons and Rods Replacement Procedure	Go to Step 5
5	Inspect the piston position. Is the piston 180_ out of position?	-	Go to Pistons and Rods Replacement Procedure	System OK

Valve Mechanism or Valve Train Noises

Step	Action	Value(s)	Yes	No
1	Is a light tapping sound heard from the engine?	-	Go to Step 2	System OK
2	Inspect the valve springs. Are the springs weak or broken?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 3
3	Inspect the valves. Are the valves sticking or warped?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 4
4	Inspect the valve lifters. Are the valve lifters dirty, stuck or worn?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 5
5	Inspect the camshaft lobes. Are the camshaft lobes damaged or improperly machined?	-	Go to Camshaft Replacement Procedure	Go to Step 6
6	Check the oil supply to the valve train. Is the oil supply insufficient or poor?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 7
7	Inspect the valve guides. Are the valve guides worn?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	Go to Step 8
8	Inspect the valve spring seat. Is the valve spring seat incorrect?	-	Go to Cylinder Head and Valve Train Components Replacement Procedure	System OK

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

SECTION 1B

SOHC ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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SPECIFICATIONS

ENGINE SPECIFICATIONS

Application	Description (Manual and Automatic)
General Data:	
Engine Type	4 Cylinder (In-Line)
Displacement: 1.3 SOHC	1 349 cm^3 (82.30 in^3)
1.5 SOHC	1 498 cm^3 (91.44 in^3)
Bore Stroke: 1.3 SOHC	76.5 x 73.4 mm (3.01 in. x 2.89 in.)
1.5 SOHC	76.5 X 81.5 mm (3.01 in. X 3.21 in.)
Compression Ratio	9.5 $ 0.2:1
Firing Order	1-3-4-2
Cylinder Bore:	
Diameter	76.5 mm (3.01 in.)
Out of Round (Maximum)	0.0065 mm (0.00025 in.)
Taper (Maximum): 1.3 SOHC	0
1.5 SOHC	0.0065 mm (0.00025 in.)
Piston:	
Diameter	76.470 mm (3.01 in.)
Clearance to Bore	0.030 mm (0.0012 in.)
Piston Rings:	
Ring, End Gap: Top Compression	0.3 mm (0.019 in.)
2nd Compression	0.3 mm (0.019 in.)
Groove Clearance: Top Impression	0.02 mm (0.0008 in)
2nd Impression	0.02 mm (0.0008 in.)
Piston Pin:	
Diameter	18.000 mm (0.708 in.)
Pin Off-Set	0.5X 0.7 mm (0.019X 0.027 in.)
Camshaft:	
Lift Intake: 1.3 SOHC	5.61 mm (0.220 in.)
1.5 SOHC	6.12 mm (0.240 in.)
Lift Exhaust	6.12 mm (0.240 in.)
End Play	0.09X 0.21 mm (0.0035X 0.0082 in.)
Journal OD: No. 1	39.445 mm (1.552 in.)
No. 2	39.700 mm (1.562 in.)
No. 3	39.945 mm (1.572 in.)
No. 4	40.200 mm (1.582 in.)
No. 5	40.445 mm (1.592 in.)

ENGINE SPECIFICATIONS (Cont'd)

Application	Description (Manual and Automatic)
Bearing OD:	
No. 1	39.500 mm (1.555 in.)
No. 2	39.750 mm (1.564 in.)
No. 3	40.000 mm (1.574 in.)
No. 4	40.250 mm (1.584 in.)
No. 5	40.500 mm (1.594 in.)
Crankshaft:	
Main Journal:	
Diameter (All)	54.982X 54.994 mm (2.164X 2.165 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Main Bearing Clearance (All)	0.005 mm (0.0001 in.)
Crankshaft End Play	0.1 mm (0.003 in.)
Connecting Rod Journal:	
Diameter (All)	42.971X 42.987 mm (1.691X 1.692 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Rod Bearing Clearance (All)	0.019X 0.070 mm (0.0007X 0.0027 in.)
Rod Side Clearance	0.070X 0.242 mm (0.0027X 0.009 in.)
Valve System:	
Valve Lash Compensators	Hydraulic
Face Angle (All)	46_
Seat Angle (All)	46_
Seat Runout (Maximum, All)	0.03 mm (0.019 in.)
Face Runout (Maximum, All)	0.03 mm (0.019 in.)
Seat Width:	
Intake	1.3X 1.5 mm (0.051X 0.059 in.)
Exhaust	1.6X 1.8 mm (0.063X 0.071 in.)
Valve Guide Inside Diameter (All)	7.030X 7.050 mm (0.276X 0.277 in.)
Valve Stem Diameter (All)	7 mm (0.275 in.)
Valve Diameter (All):	
Intake	38.0" 0.15 mm (1.49" 0.0059 in.)
Exhaust	31.0" 0.15 mm (1.22" 0.0059 in.)
Valve Spring Loads:	
Valve Open	625" 25 N (461" 18 lbs) @ 21.5 mm (0.846 in.)
Valve Closed	275" 15 N (202" 11 lbs) @ 31.5 mm (1.240 in.)
Oil Pump:	
Gap Between Oil Pump Body and Out Rotor	0.400X 0.484 mm (0.0157X 0.0191 in.)
Out Rotor Side Clearance	0.045X 0.100 mm (0.0018X 0.0039 in.)
Inner Rotor Side Clearance	0.035X 0.085 mm (0.0014X 0.0033 in.)
Relief Valve Spring Free Length	81 mm (3.2 in.)

FASTENER TIGHTENING SPECIFICATIONS

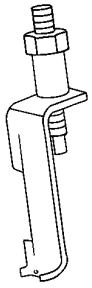
Application	NSm	Lb-Ft	Lb-In
A/C Compressor Hose Assembly Retaining Bolt	33	24	-
A/C Compressor Mounting Bolts	27	20	-
A/C Compressor Mounting Bracket Bolts	50	36	-
Air Filter Housing Bolts	12	-	106
Alternator Adjusting Bolt	20	15	-
Alternator Adjusting Bracket Retaining Bolt	20	15	-
Camshaft Gear Bolt	45	33	-
Camshaft Pressure Plate Bolts	10	-	89
Connecting Rod Bearing Cap Bolts	25 +30_ +15_	18 +30_ +15_	-
Coolant Pump Retaining Bolts	10	-	89
Coolant Temperature Sensor	20	15	-
Crankshaft Bearing Cap Bolts	50 +45_ +15_	37 +45_ +15_	-
Crankshaft Pulley Bolt	95 +30_ +15_	70 +30_ +15_	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Cylinder Head Bolts (Camshaft Support Housing & Cylinder Head Mounting Bolts)	25 +60_ +60_ +60_+10_	18 +60_ +60_ +60_+10_	-
DIS Ignition Coil Mounting Bolts	10	-	89
DIS Ignition Coil Mounting Plate Bolts	10	-	89
Engine Lift Bracket Bolt	25	18	-
Engine Mount Attaching Nuts	40	30	-
Engine Mount Bracket Retaining Bolts	60	44	-
Engine Mount Bracket-to-Engine Mount Retaining Bolts	60	44	-
Exhaust Flex Pipe Bracket Bolts	40	30	-
Exhaust Flex Pipe-to-Catalytic Converter or Connecting Pipe Retaining Nuts	30	22	-
Exhaust Flex Pipe-to-Exhaust Manifold Retaining Nuts	40	30	-
Exhaust Manifold Heat Shield Bolts	15	11	-
Exhaust Manifold Nuts	25	18	-
Flexible Plate Bolts	60	44	-
Flexible Plate Inspection Cover Bolts	10	-	89
Flywheel Bolts	35 +30_ +15_	25 +30_ +15_	-
Flywheel Inspection Cover Bolts	12	-	106
Fuel Rail Retaining Bolts	25	18	-
Intake Manifold Retaining Nuts	25	18	-
Intake Manifold Support Bracket Retaining Bolts	22	16	-
Lower Timing Belt Cover Bolts	10	-	89

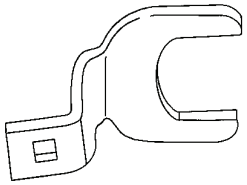
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application	NSm	Lb-Ft	Lb-In
Oil Pan Retaining Bolts	10	-	89
Oil Pan Drain Plug	55	41	-
Oil Pressure Switch	40	30	-
Oil Pump Retaining Bolts	10	-	89
Oil Pump/Pickup Tube and Support Bracket Bolts	10	-	89
Oil Pump Safety Relief Valve	30	22	-
Oil Pump Rear Cover Bolts	6	-	53
Power Steering Pump Mounting Bolts	25	18	-
Power Steering Pump Pulley Bolts	25	18	-
Rear Timing Belt Cover Bolts	10	-	89
Right Transaxle Brace Bolts	60	45	-
Spark Plugs	25	18	-
Thermostat Housing Mounting Bolts	20	15	-
Throttle Cable Bracket Bolts	8	-	71
Timing Belt Automatic Tensioner Bolt	20	15	-
Transaxle Bell Housing Bolts	75	55	-
Transaxle Torque Converter Bolts	45	33	-
Upper Timing Belt Cover Bolts	10	-	89
Valve Cover Bolts	10	-	89

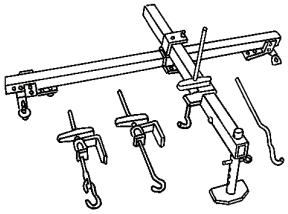
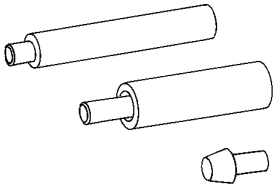
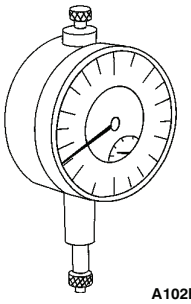
SPECIAL TOOLS

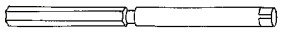
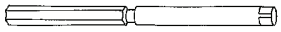
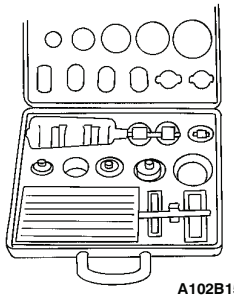
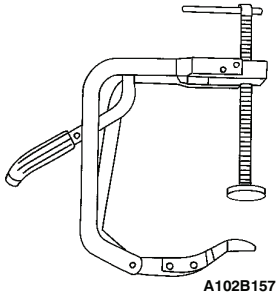
SPECIAL TOOLS TABLE

 A102B150	KM-565-A Valve Spring Compressor

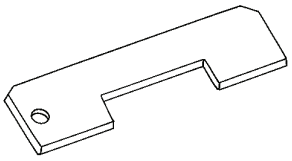
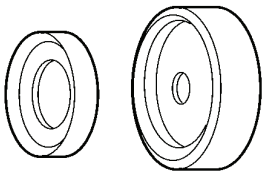
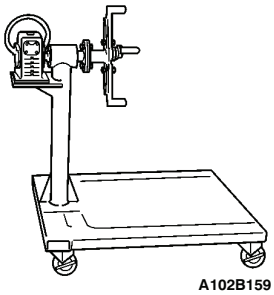
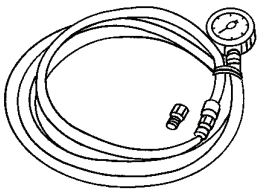
 A102B151	J-42492 Timing Belt Adjuster

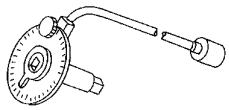
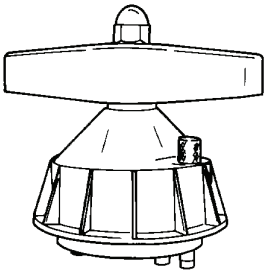
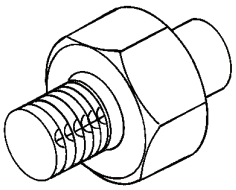
SPECIAL TOOLS TABLE (Cont'd)

 A102B152	**J-28467-B Engine Assembly Support Fixture**
 A102B153	**KM-427 Piston Pin Service Set**
 A102B154	**MKM-571-B Gauge**
 A102B155	**KM-253 Valve Guide Reamer**

 A102B155	**KM-254 Valve Guide Reamer**
 A102B155	**KM-255 Valve Guide Reamer**
 A102B156	**KM-340-0 Cutter Set** Includes: **KM-340-7** **KM-340-13** **KM-340-26**
 A102B157	**KM-348 Valve Spring Compressor**

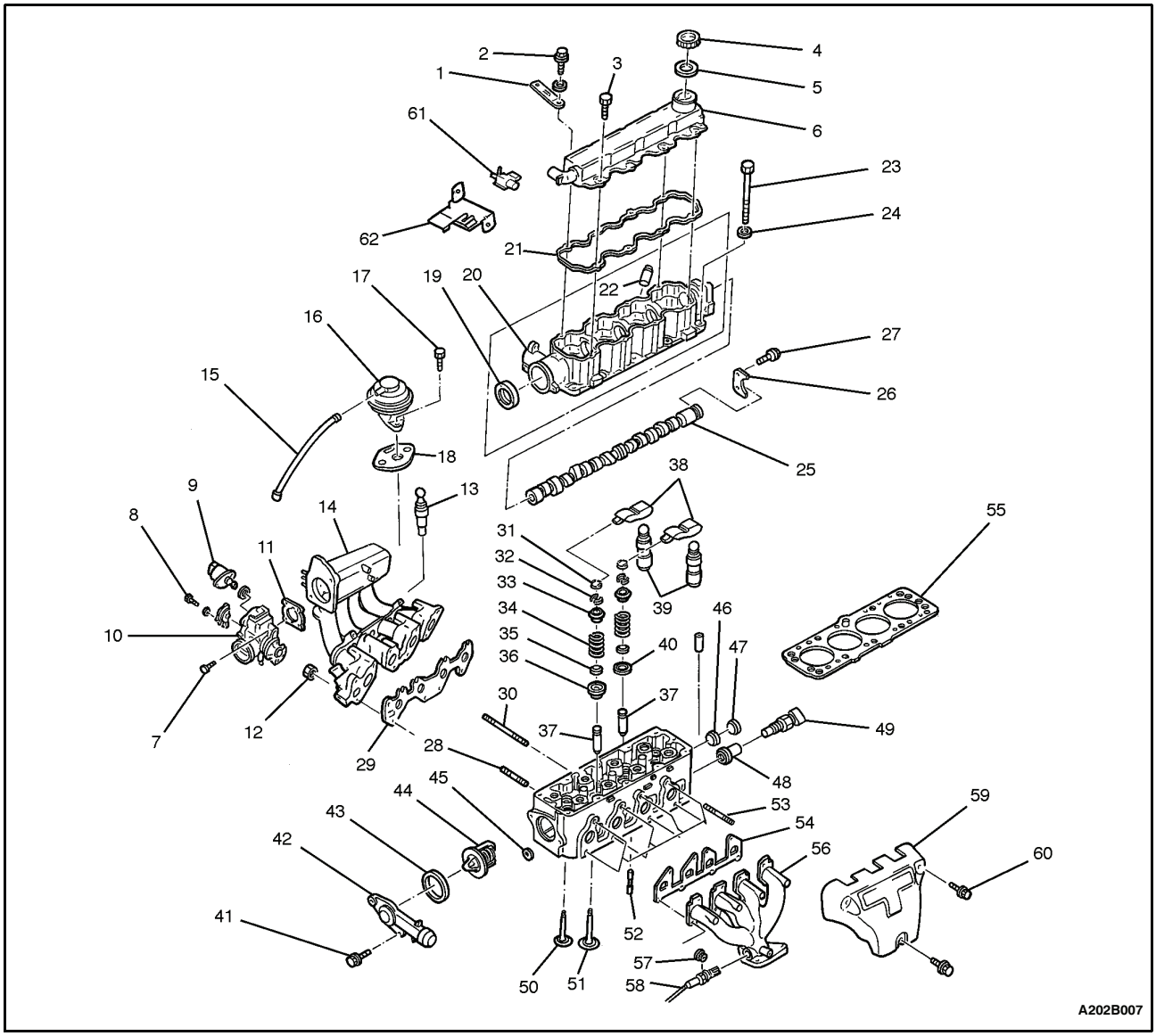
SPECIAL TOOLS TABLE (Cont'd)

 A102B158	**KM-419 Distance Gauge**
 A102B160	**KM-635 Crankshaft Rear Oil Seal Installer**
 A102B159	**MKM-412 Engine Overhaul Stand**
 A202B005	**KM-498-B Pressure Gauge**

 A102B161	**KM-470-B Angular Torque Gauge**
 A102C155	**J-36972 Crankshaft Rear Oil Seal Installer**
 B102C044	**KM-135 Adapter**

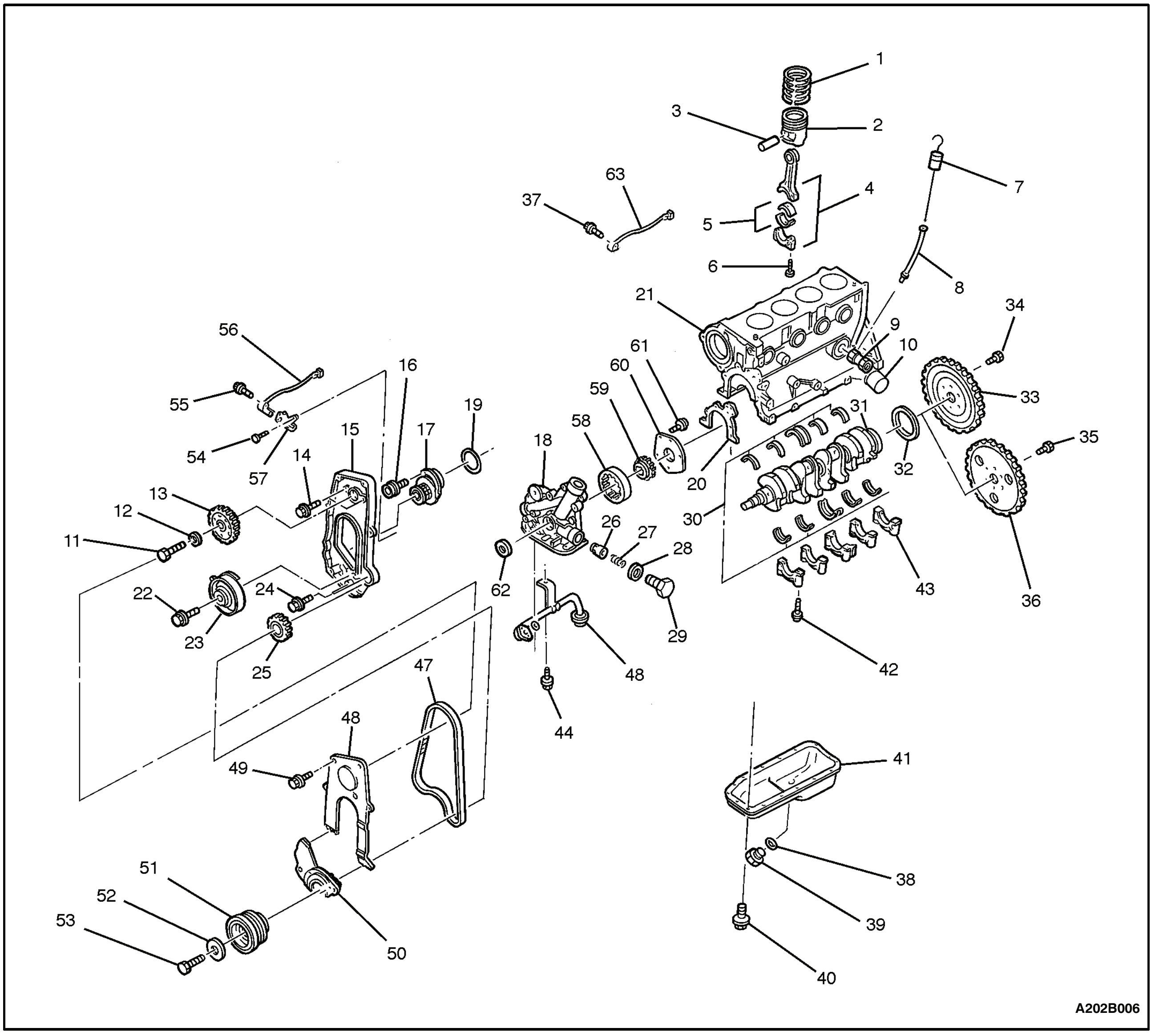
COMPONENT LOCATOR

UPPER END



1 Wiring Bracket
2 Bolt
3 Bolt
4 Cap, Bayonet Joint
5 Seal, Bayonet Cap
6 Valve Cover
7 Bolt
8 Throttle Position Sensor
9 Idle Air Control Valve
10 Throttle Body
11 Throttle Body Gasket
12 Nut
13 Engine Coolant Temperature Sensor
14 Intake Manifold
15 Vacuum Tube
16 EGR Valve
17 Bolt
18 EGR Gasket
19 Shaft Seal Ring
20 Camshaft Support
21 Valve Cover Gasket
22 Tube
23 Cylinder Head Bolt
24 Washer
25 Camshaft
26 Camshaft Pressure Plate
27 Bolt
28 Bolt-Stud
29 Intake Manifold Gasket
30 Bolt-Stud
31 Valve Thrust Piece
32 Valve Key
33 Valve Spring Plate
34 Valve Spring
35 Valve Stem Seal
36 Exhaust Valve Spring Seat
37 Valve Guide
38 Cam Follower
39 Cam Follower Lifter
40 Intake Valve Spring Seat
41 Bolt
42 Thermostat Housing
43 Thermostat Housing Seal Ring
44 Thermostat
45 Screw Plug
46 Oil Duct Cap
47 Oil Duct Cap
48 Adapter
49 Coolant Temperature Sensor
50 Exhaust Valve
51 Intake Valve
52 Cylinder Head Oil Duct Sleeve
53 Bolt-Stud
54 Exhaust Manifold Gasket
55 Cylinder Head Gasket
56 Exhaust Manifold
57 Nut
58 Exhaust Oxygen Sensor
59 Exhaust Manifold Heat Shield
60 Bolt
61 EGR Solenoid
62 Bracket

LOWER END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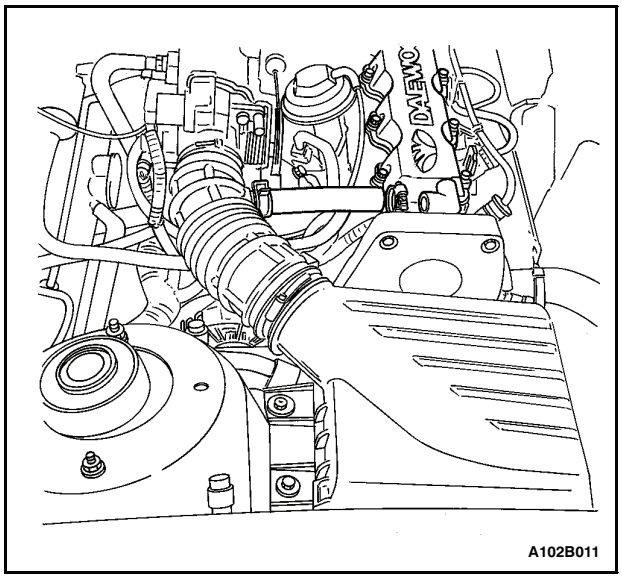
A202B006

1 Piston Ring Seat
2 Piston
3 Piston Pin
4 Connecting Rod
5 Connecting Rod Bearing Set
6 Connecting Rod Bolt
7 Oil Level Gauge Stick
8 Gauge Stick Tube
9 Connecting Piece
10 Oil Filter
11 Camshaft Pulley Bolt
12 Washer
13 Camshaft Gear
14 Rear Cover Bolt
15 Rear Timing Belt Cover
16 Bolt
17 Coolant Pump
18 Oil Pump
19 Seal Ring
20 Oil Pump Body Gasket
21 Engine Block
22 Bolt
23 Auto Tensioner
24 Bolt
25 Crankshaft Gear
26 Pressure Relief Valve Plunger
27 Spring
28 Oil Pump Seal Ring
29 Bolt Plug
30 Crankshaft Bearing Set
31 Crankshaft
32 Shaft Seal Ring
33 Flywheel (Manual Transaxle)
34 Bolt (Manual Transaxle)
35 Bolt (Automatic Transaxle)
36 Flex Plate (Automatic Transaxle)
37 Bolt
38 Threaded Ring
39 Drain Plug
40 Bolt
41 Oil Pan
42 Main Bearing Cap Bolt
43 Main Bearing
44 Bolt
45 Bracket
46 Oil Pickup Tube
47 Timing Belt
48 Upper Timing Belt Front Cover
49 Bolt
50 Lower Timing Belt Front Cover
51 Crankshaft Pulley
52 Washer
53 Bolt
54 Bolt
55 Bolt
56 Crankshaft Position Sensor
57 Bracket
58 Gear
59 Gear
60 Cover
61 Bolt
62 Seal
63 Knock Sensor



A102B011

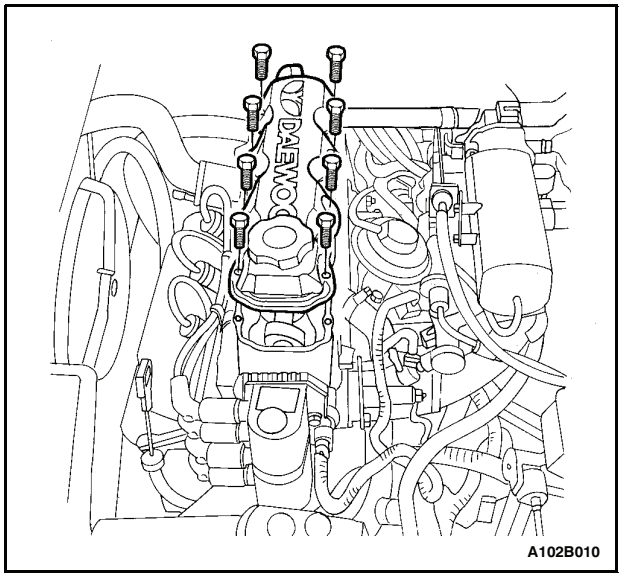
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

VALVE COVER

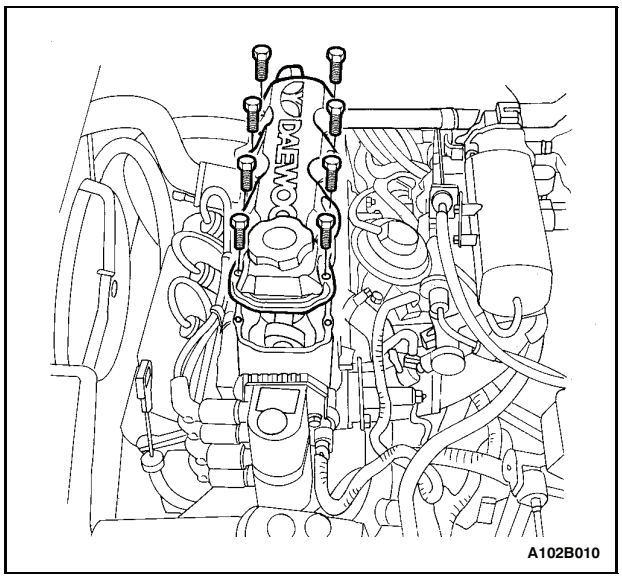
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the breather tube from the valve cover.



A102B010

3. Remove the eight bolts from the valve cover.
4. Remove the valve cover.
5. Remove the valve cover gasket.
6. Clean the sealing surfaces of the valve cover and the camshaft housing.



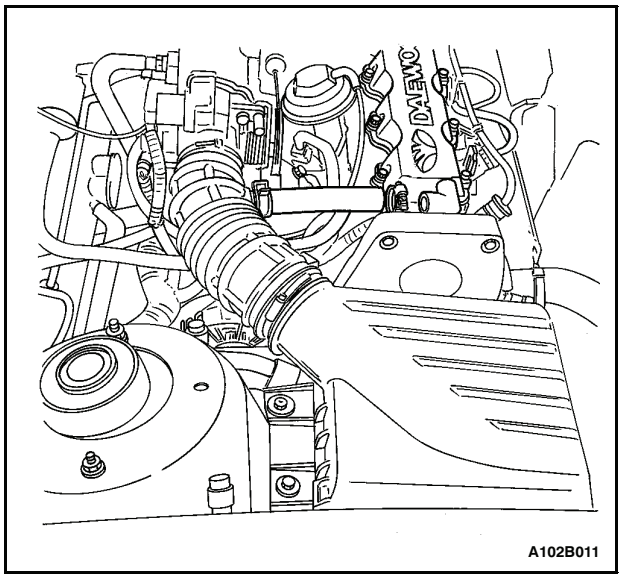
A102B010

Installation Procedure

1. Install the new valve cover gasket and the valve cover.
2. Install the eight bolts to the valve cover.

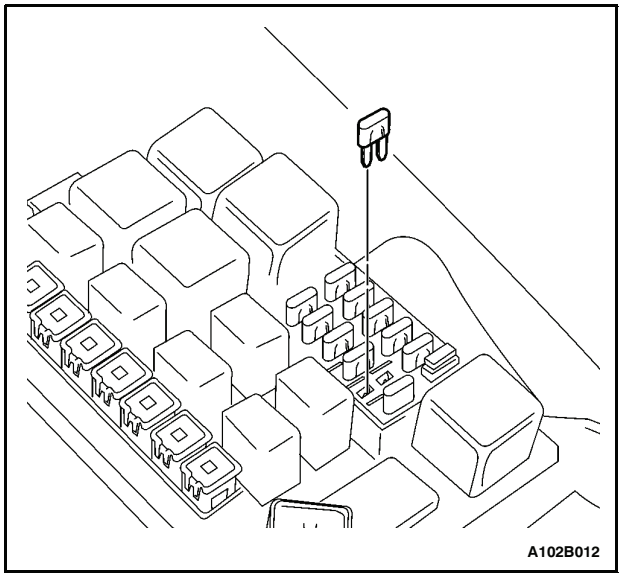
Tighten

Tighten the valve cover bolts to 10 NSm (89 lb-in).



A102B011

3. Connect the breather tube to the valve cover.
4. Connect the negative battery cable.


A102B012

CYLINDER HEAD AND GASKET

(Left-Hand Drive Shown, Right Hand Drive Similar)

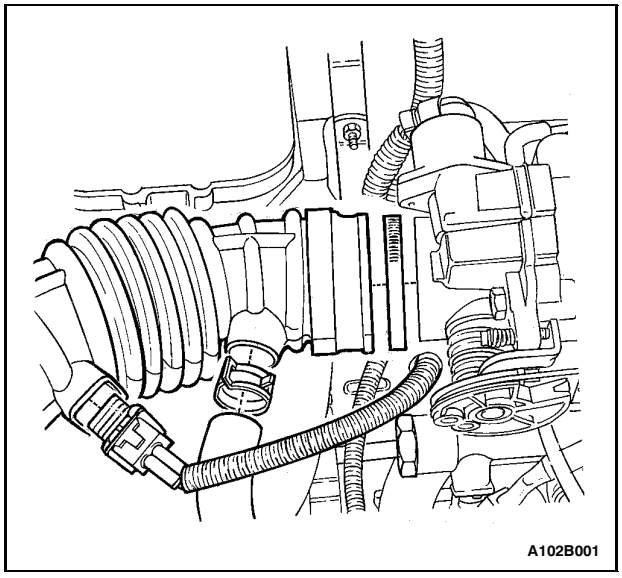
Tools Required

J-42492 Timing Belt Adjuster

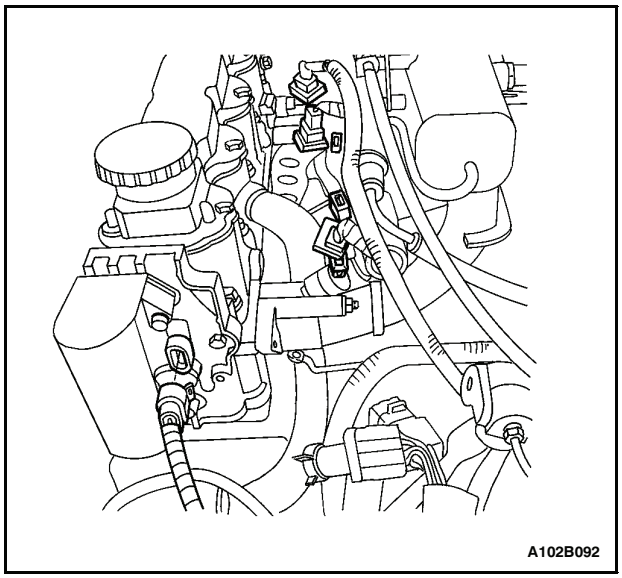
KM-470-B Angular Torque Gauge

Removal Procedure

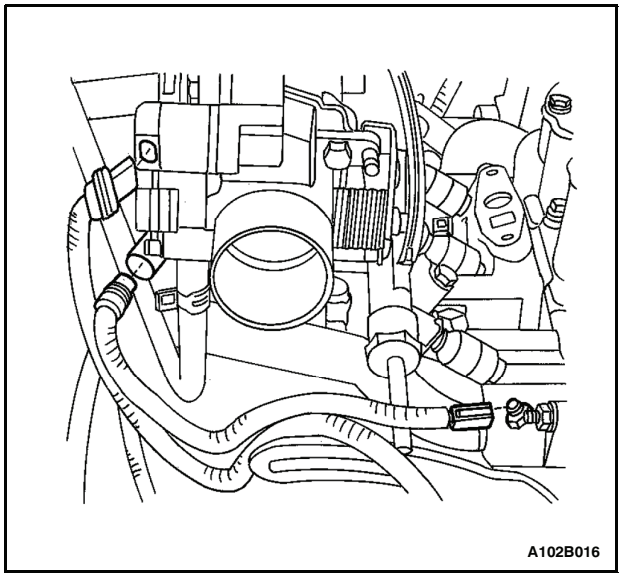
1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the electronic control module (ECM) ground terminal from the intake manifold.


A102B001

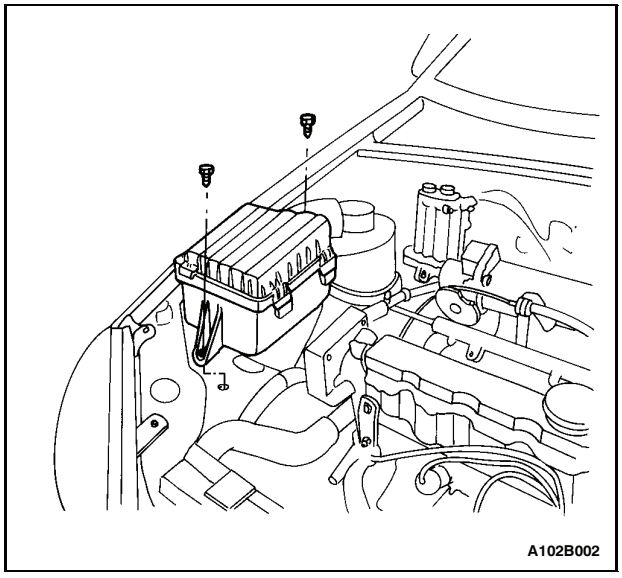
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the breather tube from the valve cover.
8. Disconnect the air intake tube from the throttle body.


A102B092

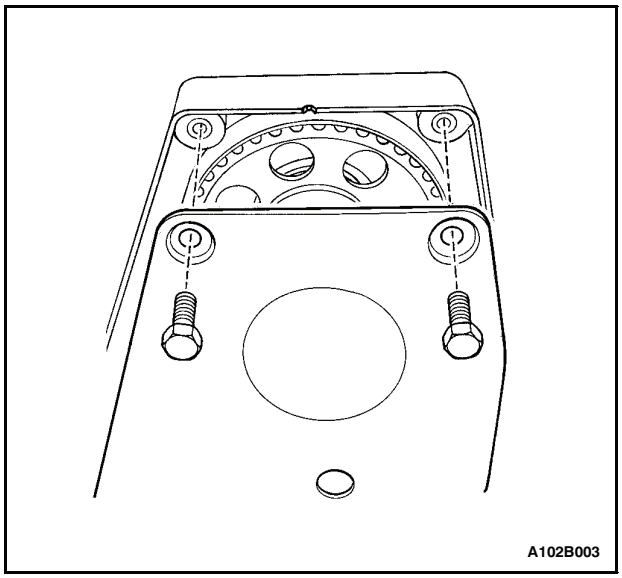
9. Disconnect the direct ignition system (DIS) ignition coil connector.
10. Disconnect the oxygen sensor connector.
11. Disconnect the fuel injector harness connectors.


A102B016

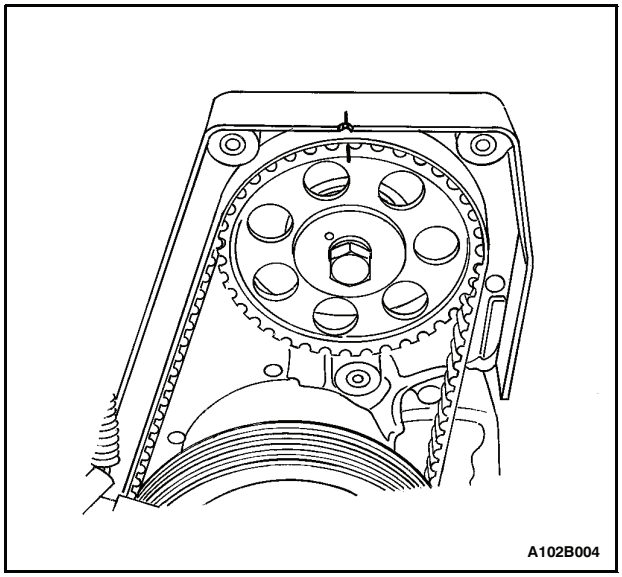
12. Disconnect the idle air control valve connector.
13. Disconnect the throttle position sensor connector.
14. Disconnect the engine coolant temperature sensor connector.
15. Disconnect the coolant temperature sensor connector.


A102B002

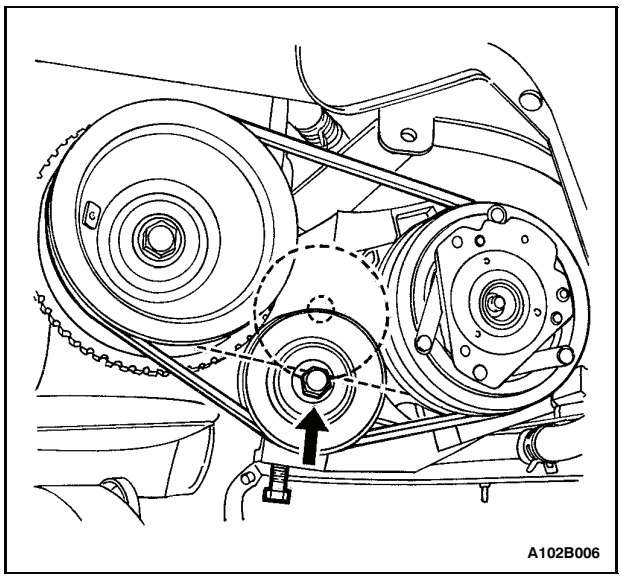
16. Remove the air cleaner housing bolts.
17. Remove the air cleaner housing.



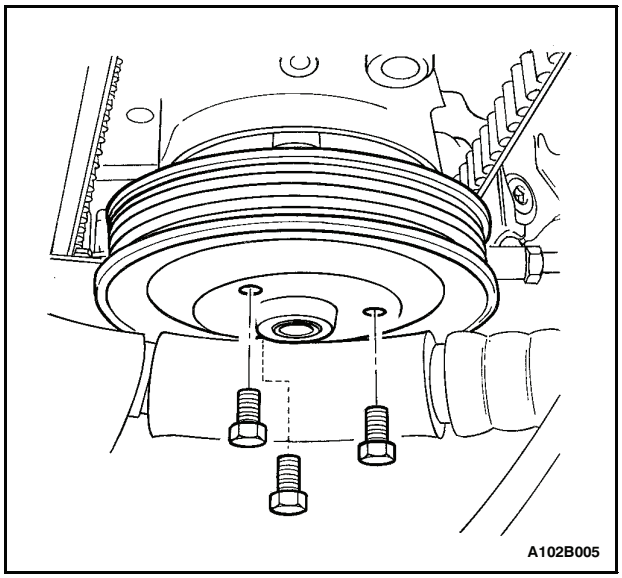
18. Remove the upper timing belt cover bolts.
19. Remove the upper timing belt cover.



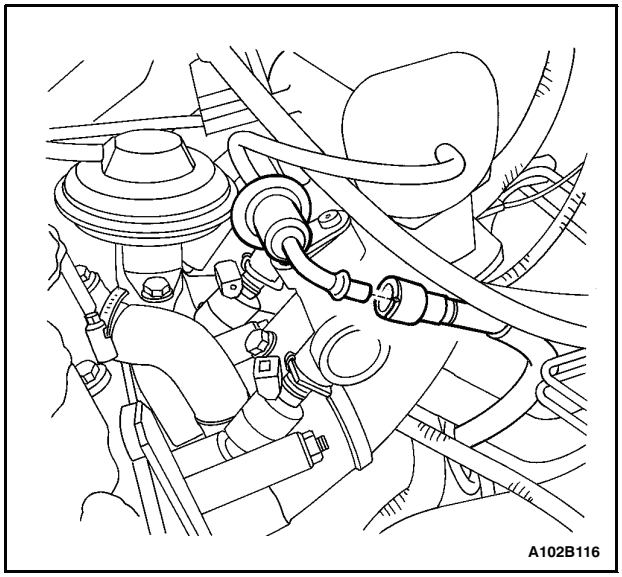
20. Align the camshaft gear timing mark to the notch in the rear timing belt cover.



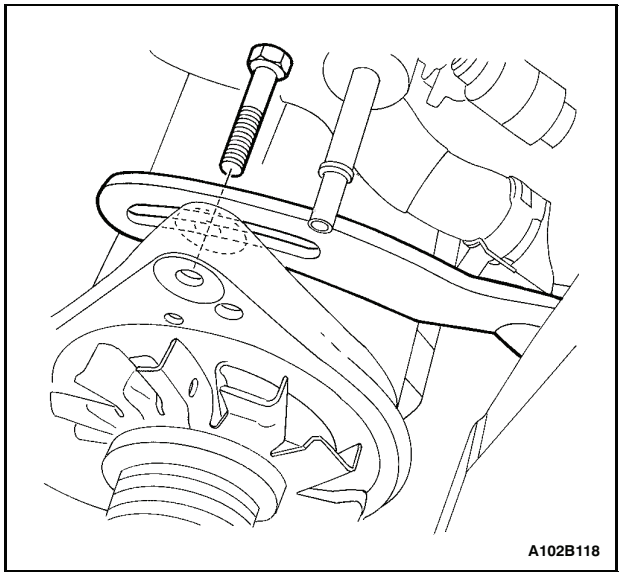
21. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
22. Remove the right front wheel well splash shield.
23. Remove the A/C compressor drive belt, if equipped.


A102B005

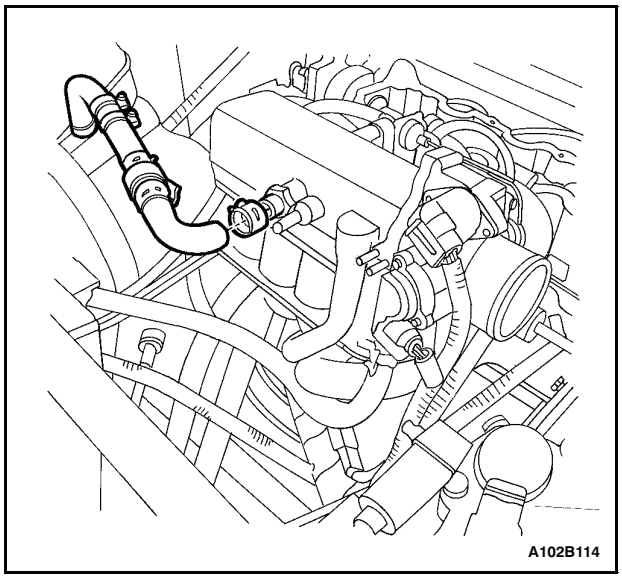
24. Remove the alternator drive belt.
25. Remove the power steering pump pulley bolts, if equipped.
26. Remove the power steering pump pulley, if equipped.


A102B116

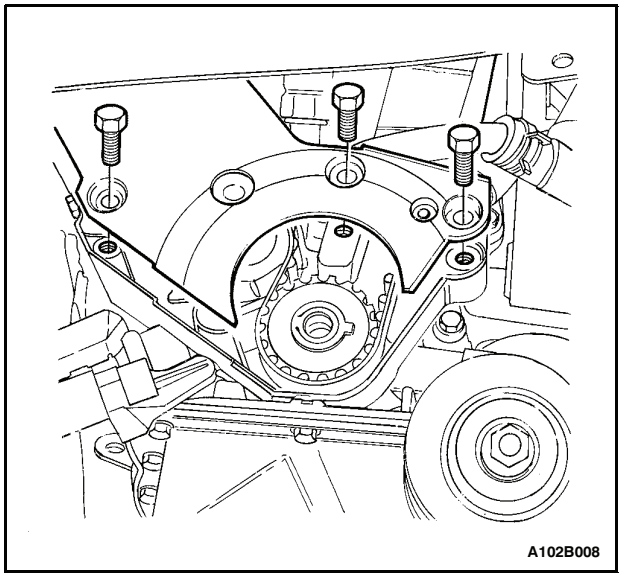
27. Disconnect the fuel return line at the fuel pressure regulator.
28. Disconnect the fuel feed line at the fuel rail.


A102B118

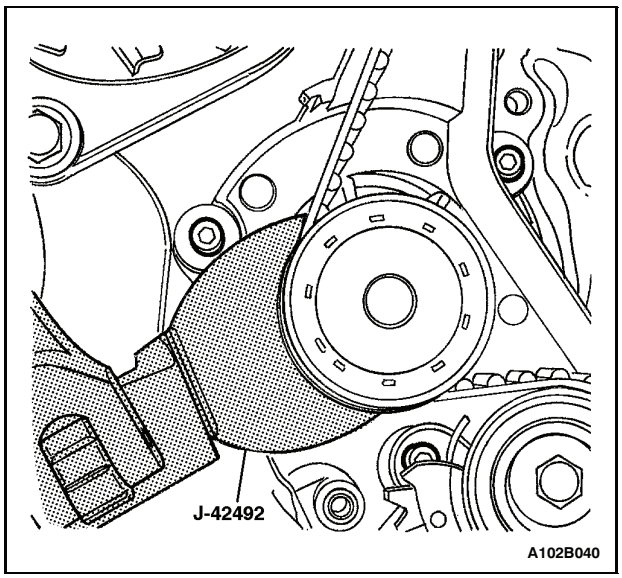
29. Remove the alternator adjusting bolt.
30. Remove the alternator adjusting bracket retaining bolt.
31. Remove the alternator adjusting bracket.


A102B114

32. Disconnect the upper radiator hose at the thermostat housing.
33. Disconnect the brake booster vacuum hose at the intake manifold.
34. Disconnect all of the necessary vacuum hoses.

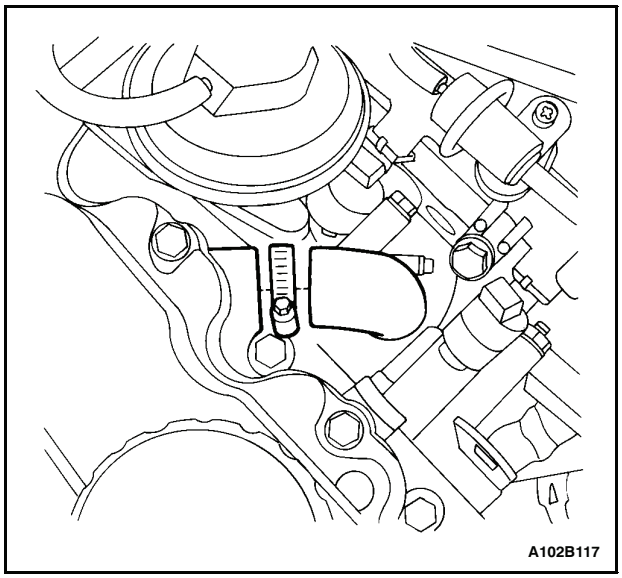

A102B008

35. Remove the crankshaft pulley bolt.
36. Remove the crankshaft pulley.
37. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
38. Install the engine mount bracket-to-engine mount retaining bolts and tighten the bolts to secure the engine, if the power steering pump was removed.
39. Remove the lower timing belt cover bolts.
40. Remove the lower timing belt cover.

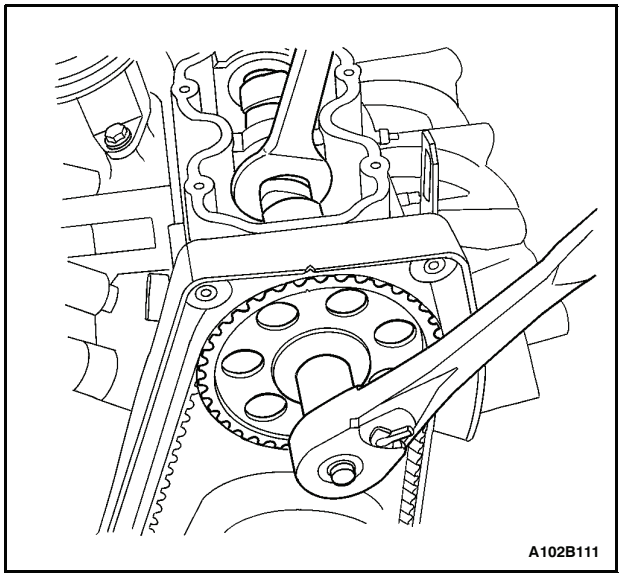


A102B040

41. Slightly loosen the coolant pump retaining bolts.
42. Rotate the coolant pump counterclockwise using the timing belt adjuster J-42492 to relieve the timing belt tension.
43. Remove the timing belt. Refer to "Timing Belt" in this section.


A102B117

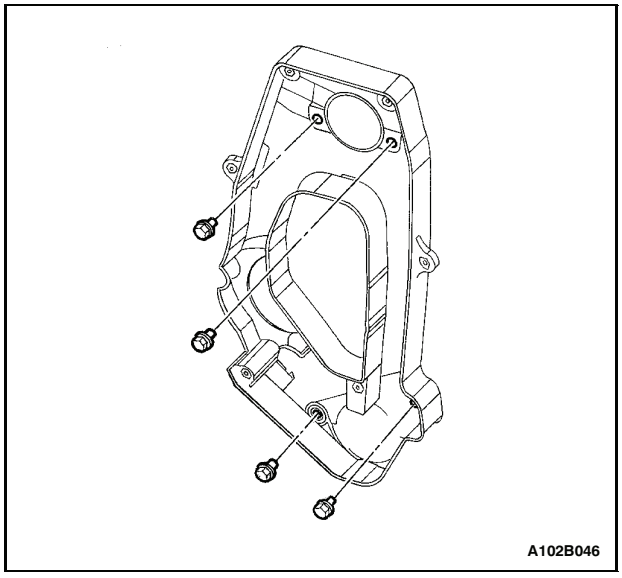
44. Disconnect the crankcase ventilation tube at the camshaft housing and the electrical connector at the exhaust gas recirculation (EGR) solenoid.


A102B111

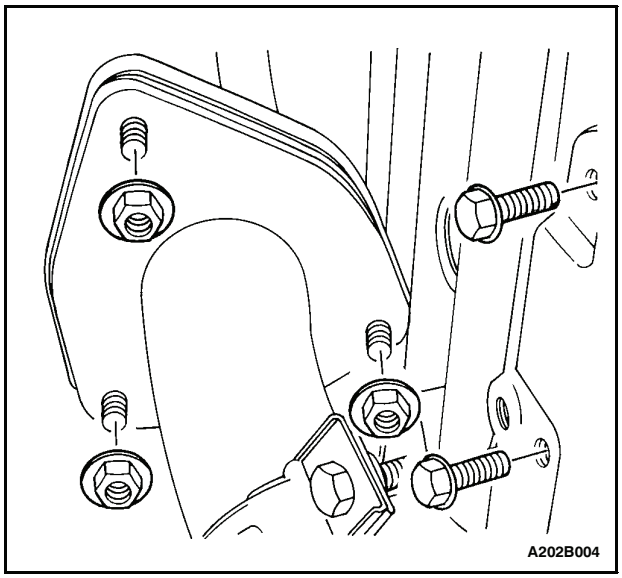
45. Remove the valve cover bolts.
46. Remove the valve cover and the valve cover gasket.

Notice: Take care to prevent any scratches, nicks or damage to the camshaft.

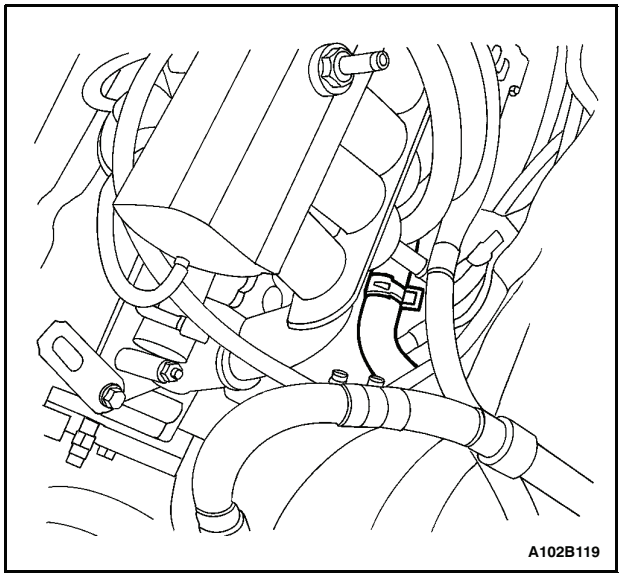
47. While holding the camshaft firmly in place, remove the camshaft gear bolt.
48. Remove the camshaft gear.


A102B046

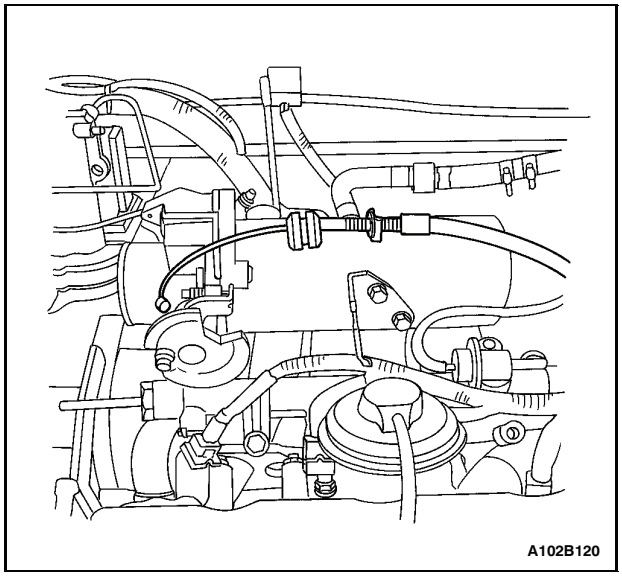
49. Remove the timing belt automatic tensioner bolt.
50. Remove the timing belt automatic tensioner.
51. Remove the rear timing belt cover bolts.
52. Remove the rear timing belt cover.



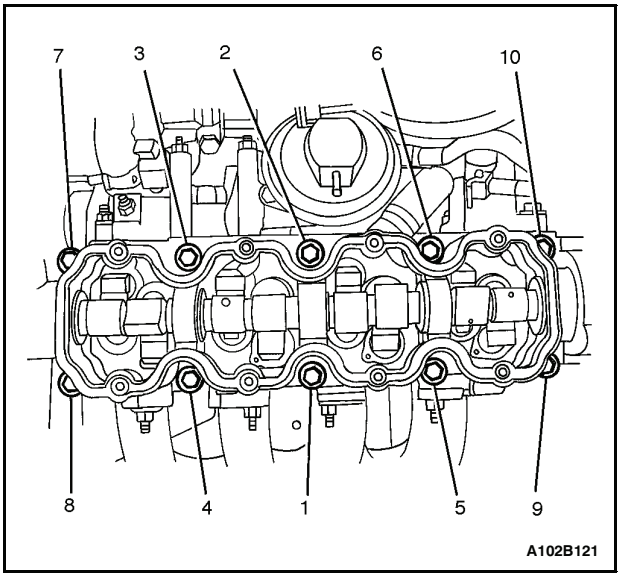
53. Disconnect the ignition wires at the spark plugs.
54. Remove the retaining nuts from the exhaust flex pipe at the exhaust manifold flange and the bolts at the bracket.



55. Disconnect the heater inlet hose at the coolant distributor.
56. Disconnect the surge tank coolant hose at the throttle body.



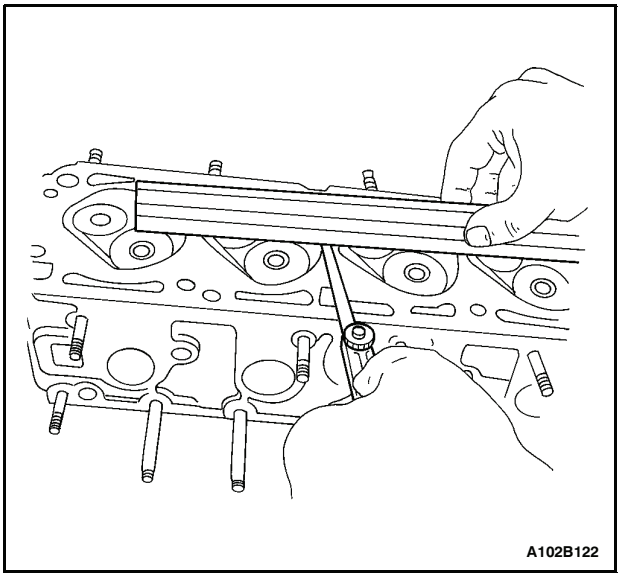
57. Remove the intake manifold support bracket retaining bolts from the coolant distributor.
58. Disconnect the throttle cable at the throttle body and the intake manifold.



59. Gradually loosen all of the cylinder head bolts in the sequence shown.
60. Remove the cylinder head bolts.
61. Remove the camshaft carrier assembly.

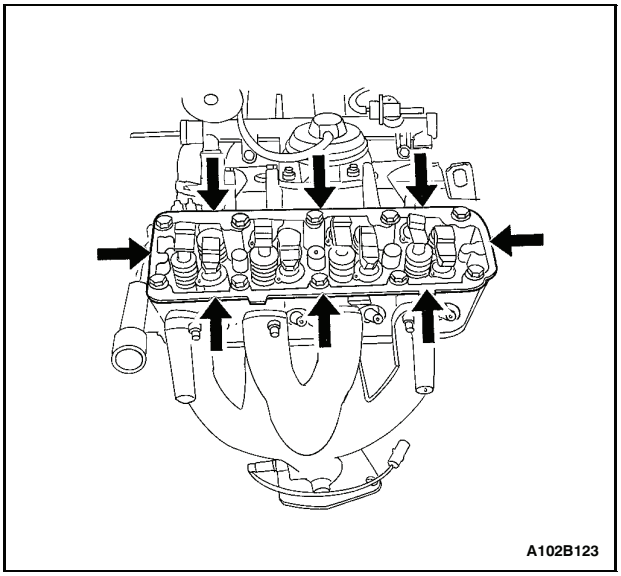
Notice: Prevent any engine oil or coolant from entering the cylinders when removing the cylinder head. Damage to the engine could result.

62. Remove the cylinder head with the intake manifold and the exhaust manifold attached.
63. Remove the cylinder head gasket.



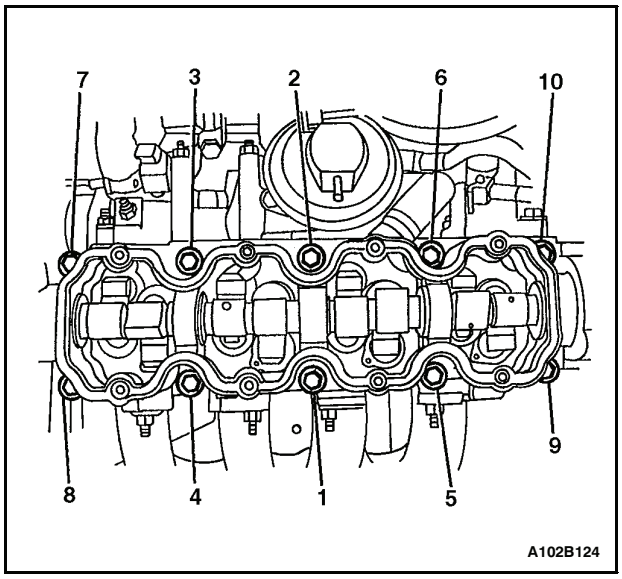
Cleaning Procedure

1. Clean the gasket surfaces of the cylinder head and the engine block.
2. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
3. Clean the cylinder head bolts.
4. Inspect the cylinder head for warpage. Refer to "Cylinder Head and Valve Train Components" in this section.

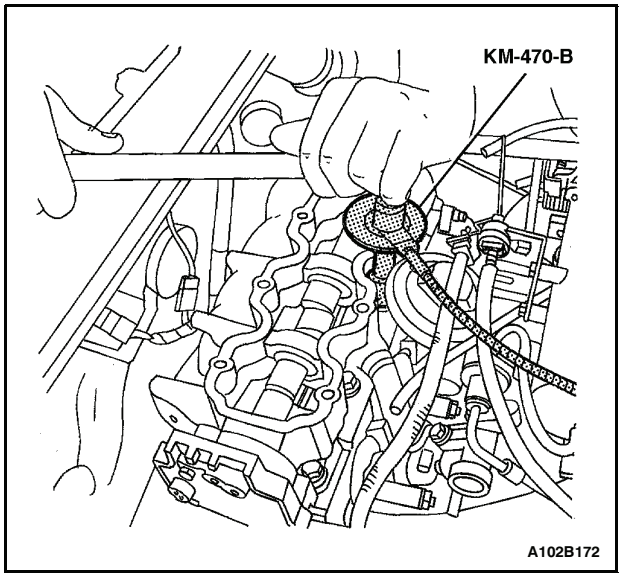


Installation Procedure

1. Apply a continuous 3 mm (0.12 inch) bead of gasket maker to the sealing surface of the camshaft carrier.
2. Install the cylinder head gasket.
3. Install the cylinder head with the intake manifold and the exhaust manifold attached.
4. Install the camshaft carrier assembly.

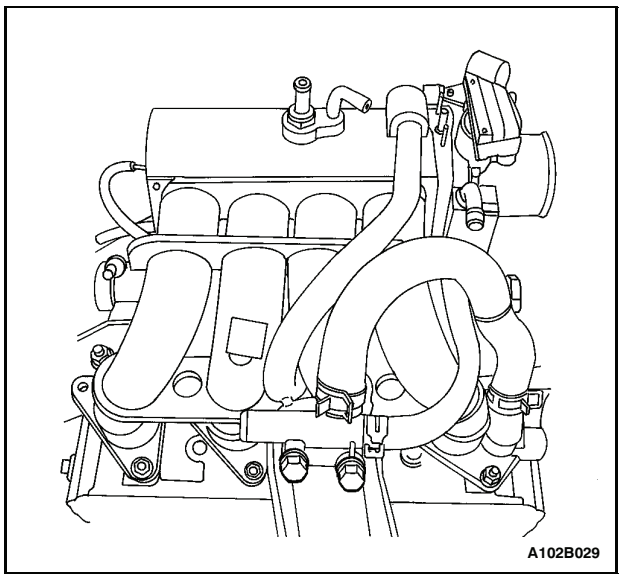


5. Install the cylinder head bolts in the sequence shown.



Tighten

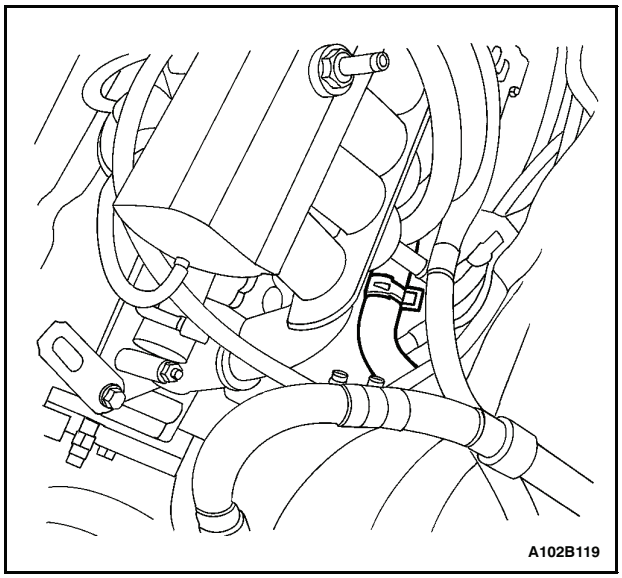
Tighten the cylinder head bolts in the sequence previously shown to 25 NSm (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the cylinder head bolts another 60 degrees plus 60 degrees plus 60 degrees plue 10 degrees.



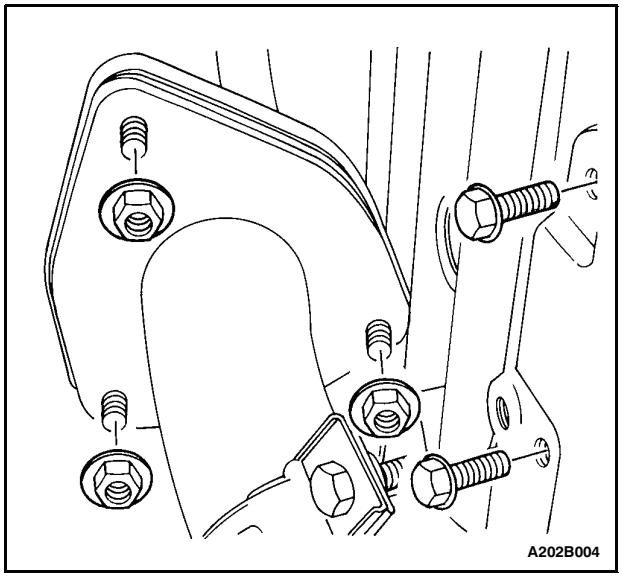
6. Connect the throttle cable at the throttle body and at the intake manifold.
7. Install the intake manifold support bracket retaining bolt to the coolant distributor.

Tighten

Tighten the intake manifold support bracket retaining bolts to 22 NSm (16 lb-ft).


A102B119

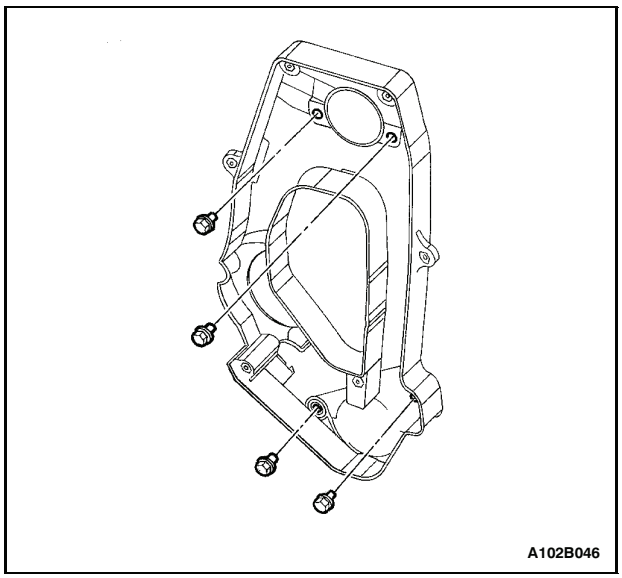
8. Connect the surge tank coolant hose at the throttle body.
9. Connect the heater inlet hose to the coolant distributor.


A202B004

10. Install the exhaust flex pipe retaining nuts at the exhaust manifold flange and the bolts to the bracket.

Tighten

Tighten the exhaust flex pipe-to-exhaust manifold retaining nuts and bracket bolts to 40 NSm (30 lb-ft).


A102B046

11. Connect the ignition wires at the spark plugs.
12. Install the rear timing belt cover.
13. Install the rear timing belt cover bolts.

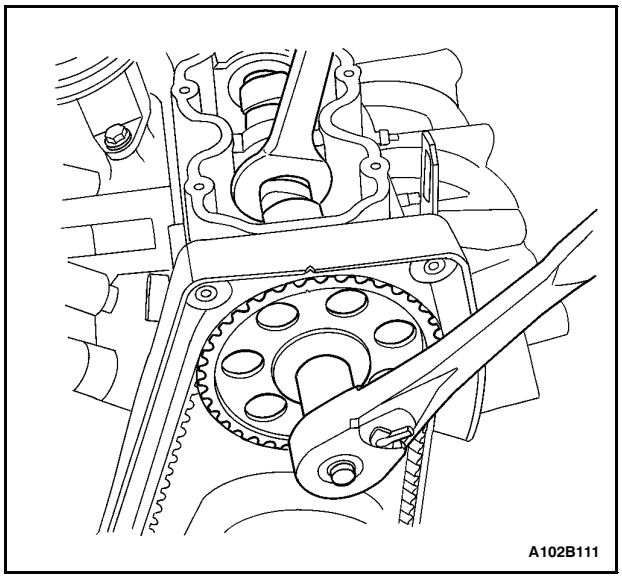
Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).

14. Install the timing belt automatic tensioner.
15. Install the timing belt automatic tensioner bolt.

Tighten

Tighten the timing belt automatic tensioner bolt to 20 NSm (15 lb-ft).

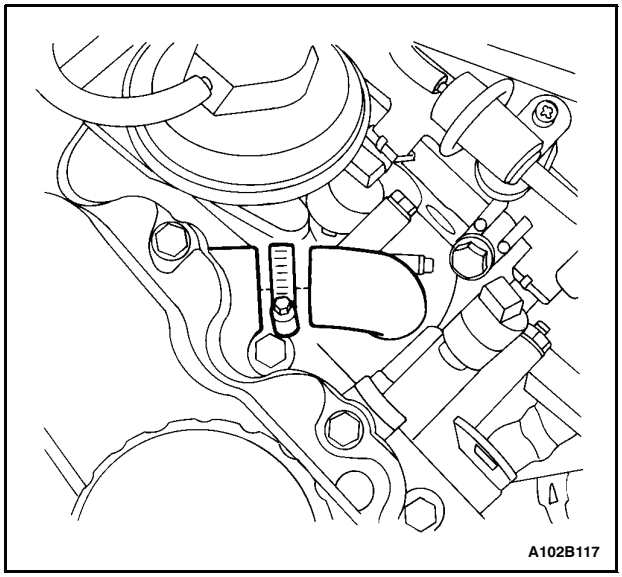

A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

16. **Install the camshaft gear.**
17. **While holding the camshaft firmly in place, install the camshaft gear bolt.**

Tighten

Tighten the camshaft gear bolt to 45 NSm (33 lb-ft).

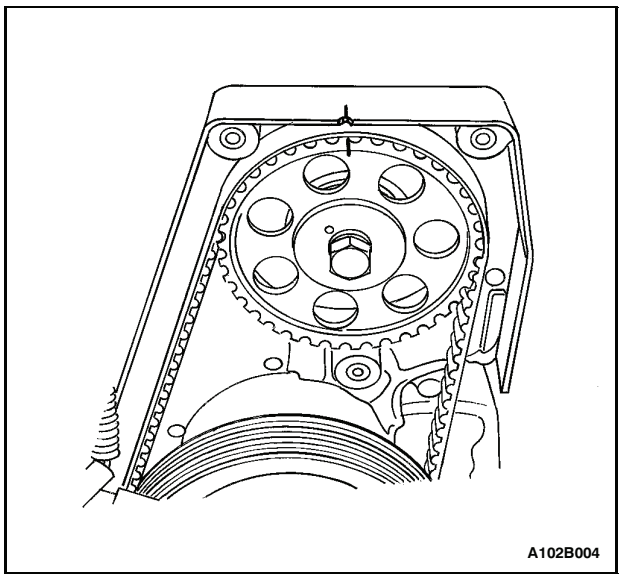

A102B117

18. **Install the valve cover and the valve cover gasket.**
19. **Install the valve cover bolts.**

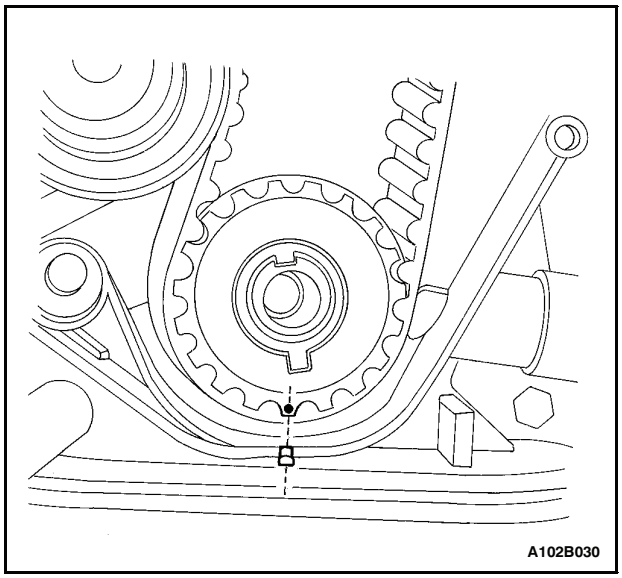
Tighten

Tighten the valve cover bolts to 10 NSm (89 lb-in).

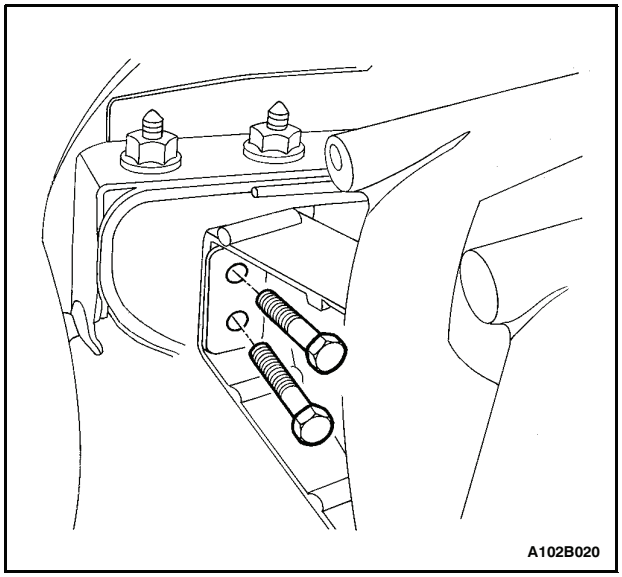
20. **Connect the crankcase ventilation tube to the camshaft housing and connect the EGR solenoid connector.**


A102B004

21. **Align the mark on the camshaft gear to the notch at the top of the rear timing belt cover.**


A102B030

22. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.


A102B020

23. Install the timing belt. Refer to "Timing Belt" in this section.
24. Check the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
25. Install the lower timing belt cover.
26. Install the lower timing belt cover bolts.

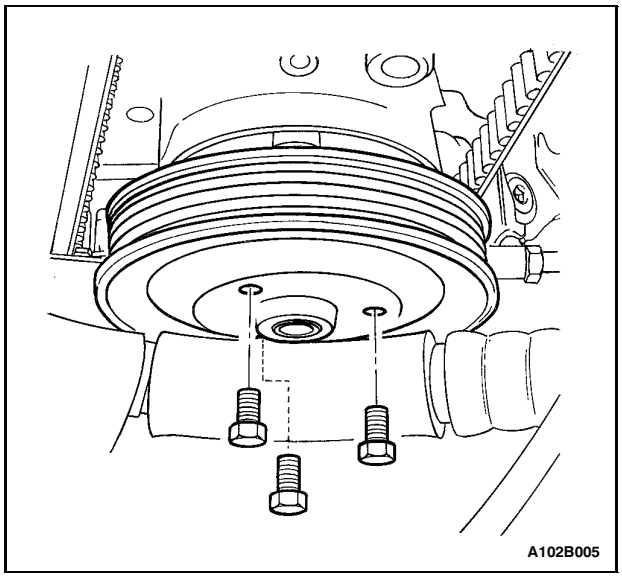
Tighten

Tighten the lower timing belt cover bolts to 10 NSm (89 lb-in).

27. Install the power steering pump and the bolts, if equipped. Refer to Section 6B, Power Steering Pump.
28. Install the engine mount bracket-to-engine mount retaining bolts if the power steering pump was installed.

Tighten

Tighten the engine mount bracket-to-engine mount retaining bolts to 60 NSm (44 lb-ft).


A102B005

29. Install the crankshaft pulley.
30. Install the crankshaft pulley bolt.

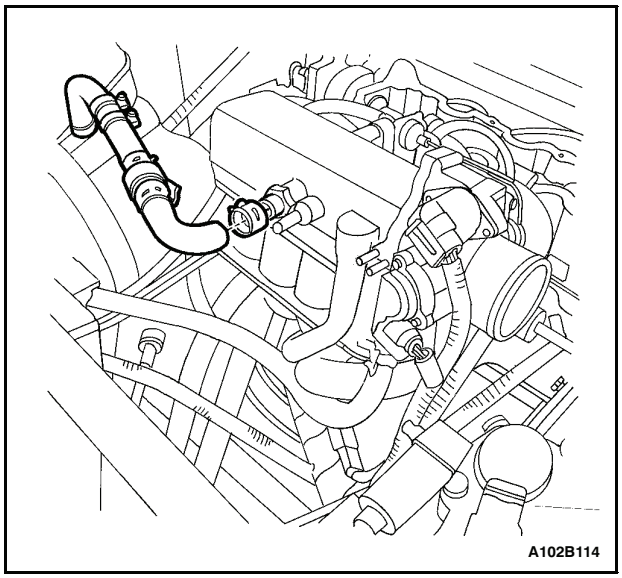
Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.

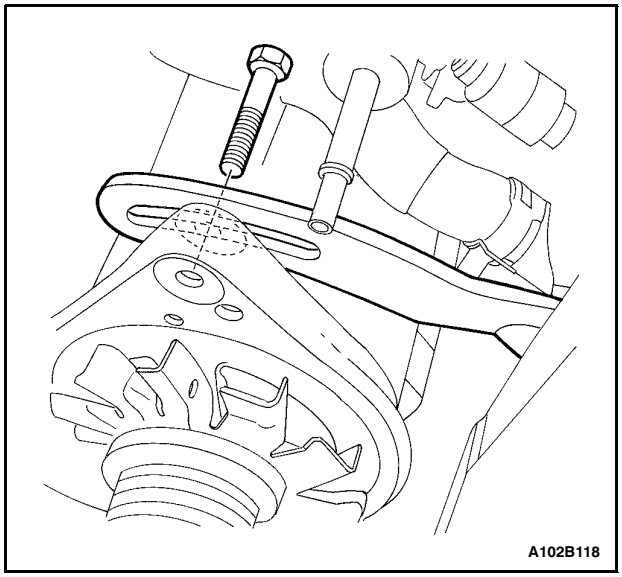
31. Install the power steering pump pulley, if equipped.
32. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).


A102B114

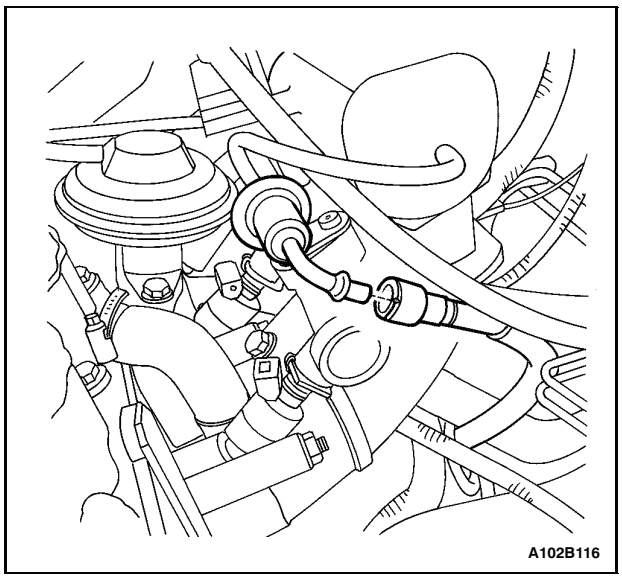
33. Connect all of the vacuum hoses.
34. Connect the brake booster hose at the intake manifold.
35. Connect the upper radiator hose at the thermostat housing.


A102B118

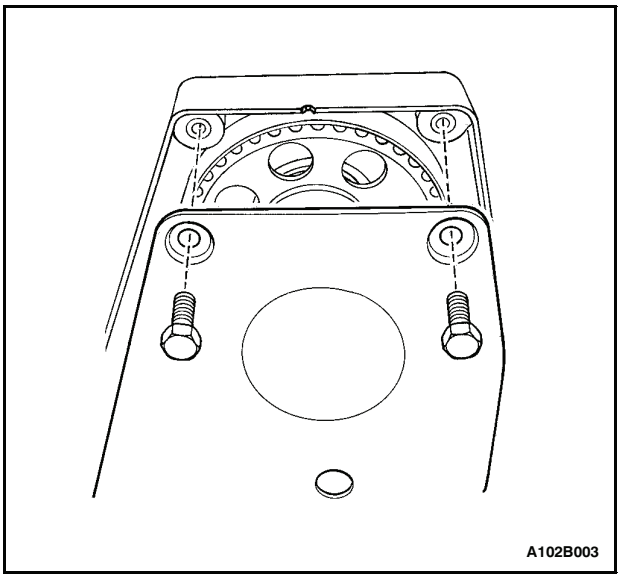
36. Install the alternator adjusting bracket.
37. Install the alternator adjusting bracket retaining bolt.

    Tighten

    Tighten the alternator adjusting bracket retaining bolt to 20 NSm (15 lb-ft).
38. Install the alternator adjusting bolt. Do not tighten.


A102B116

39. Connect the fuel feed line at the fuel rail.
40. Connect the fuel return line at the fuel pressure regulator.


A102B003

41. Install the alternator drive belt.

Tighten

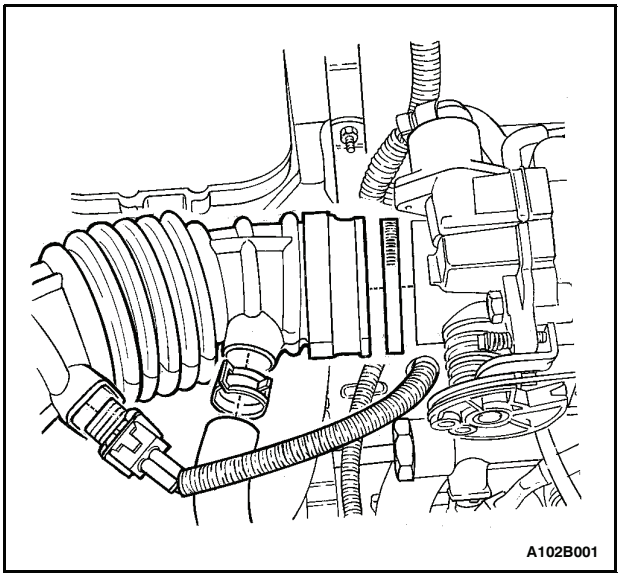
Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

42. Install the upper timing belt cover.
43. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).

44. Install the A/C compressor drive belt, as necessary.
45. Install the right front wheel well splash shield.
46. Install the right front wheel. Refer to Section 2E, Tires and Wheels.

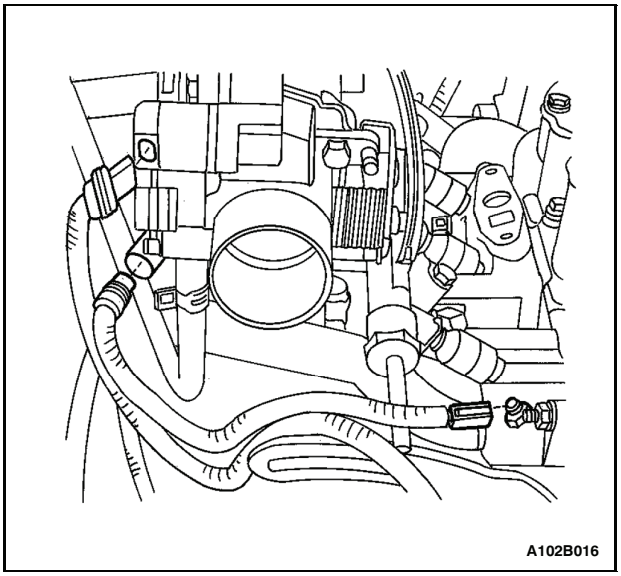

A102B001

47. Install the air filter housing.
48. Install the air filter housing bolts.

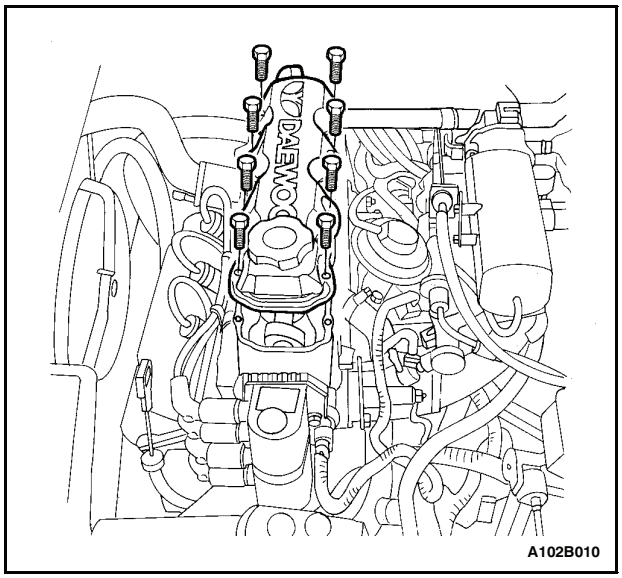
Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).

49. Connect the air intake tube to the throttle body.
50. Connect the breather tube to the valve cover.
51. Connect the manifold air temperature sensor connector.


A102B016

52. Connect the coolant temperature sensor connector.
53. Connect the engine coolant temperature sensor connector.
54. Connect the idle air control valve connector.
55. Connect the throttle position sensor connector.
56. Connect the DIS ignition coil connector.
57. Connect the fuel injector harness connectors.
58. Connect the oxygen sensor connector.
59. Connect the ECM ground terminal at the intake manifold.
60. Connect the negative battery cable.
61. Install the fuel pump fuse.
62. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.



A102B010

CAMSHAFT

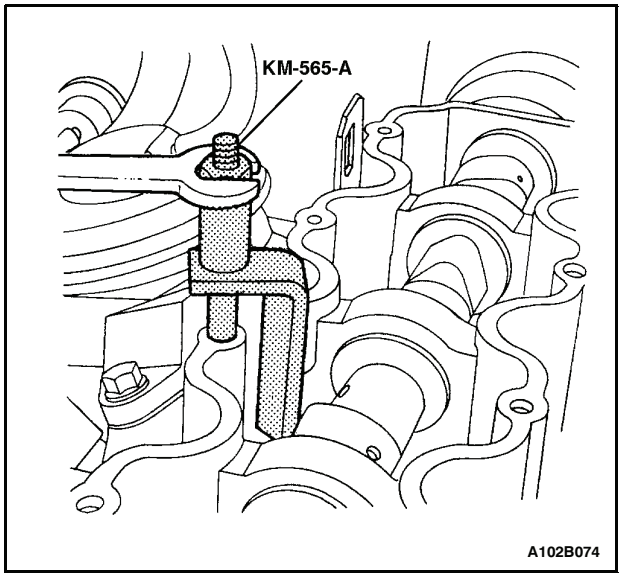
(Left-Hand Drive Shown, Right Hand Drive Similar)

Tools Required

KM-565-A Valve Spring Compressor

Removal Procedure

1. Remove the timing belt. Refer to "Timing Belt" in this section.
2. Disconnect the air breather tube at the valve cover.
3. Remove the valve cover bolts.
4. Remove the valve cover.
5. Remove the valve cover gasket.

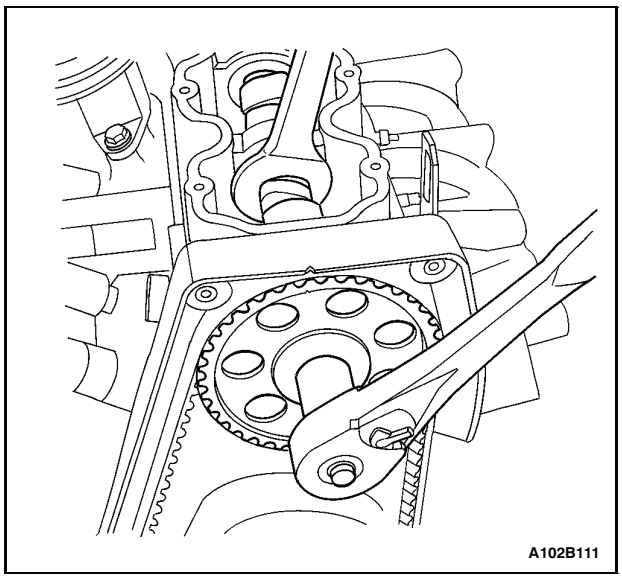


A102B074

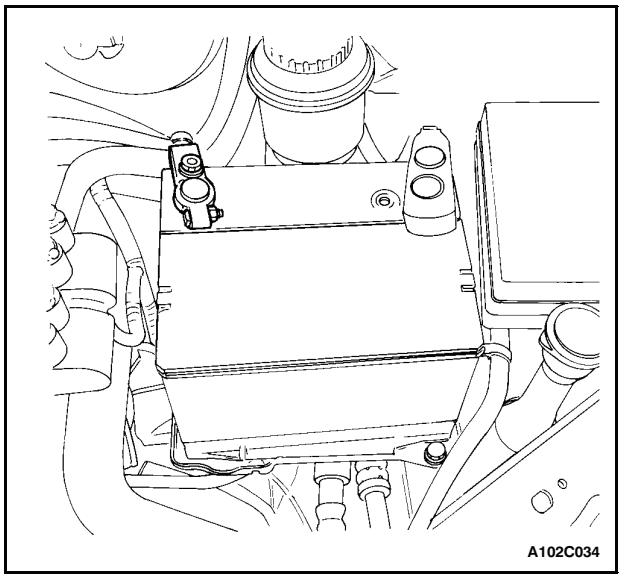
6. Install the valve spring compressor KM-565-A.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

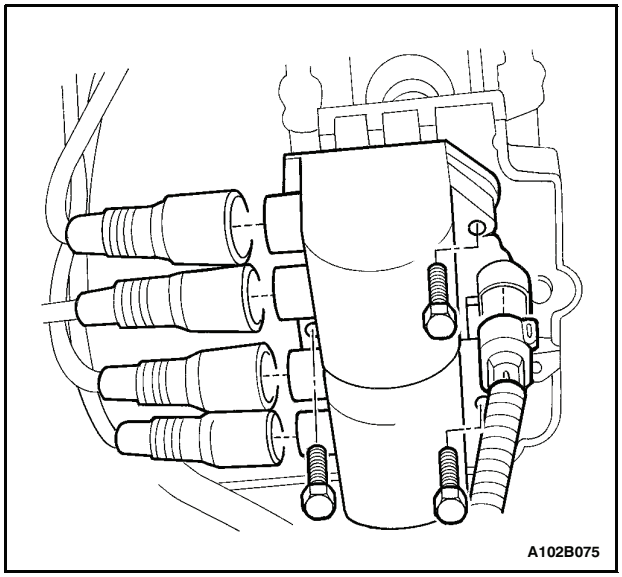
7. Remove the camshaft followers using the valve spring compressor KM-565-A.


A102B111

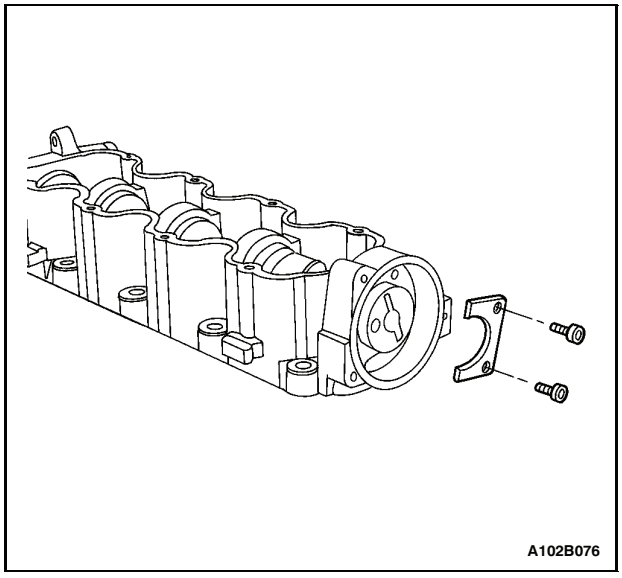
8. While holding the camshaft firmly in place, remove the camshaft gear bolt.
9. Remove the camshaft gear.


A102C034

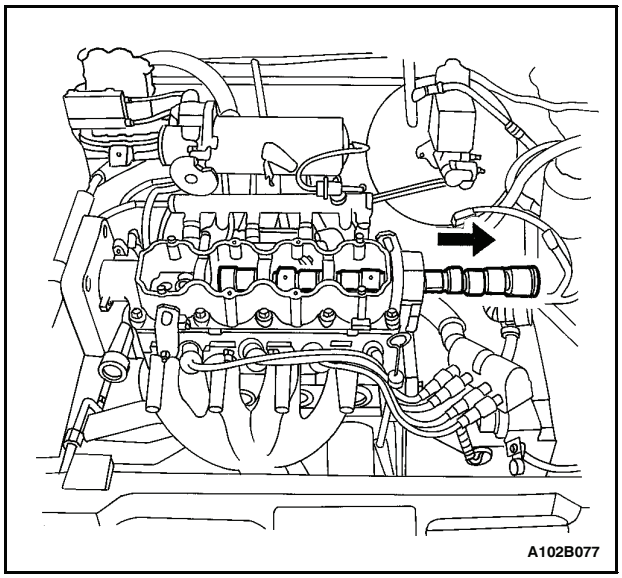
10. Disconnect the positive battery cable from the battery.
11. Remove the battery and the battery tray. Refer to Section 1E, Engine Electrical.


A102B075

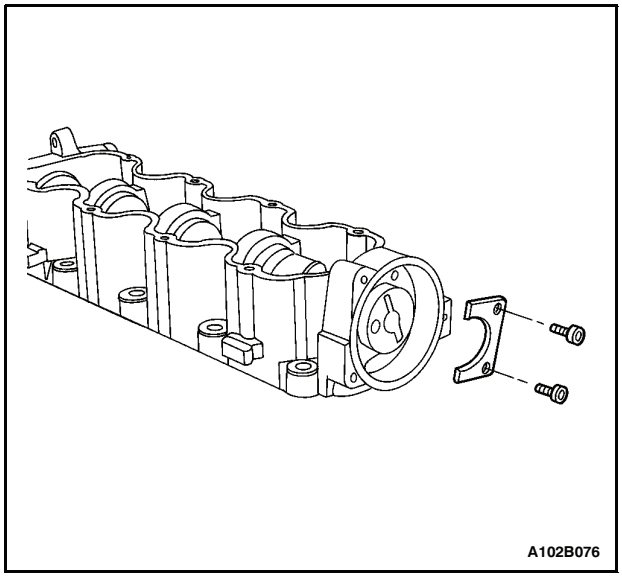
12. Disconnect the direct ignition system (DIS) ignition coil connector.
13. Disconnect the DIS ignition wires at the ignition coil.
14. Remove the DIS ignition coil mounting bolts.
15. Remove the DIS ignition coil.


A102B076

16. Remove the DIS ignition coil mounting plate bolts.
17. Remove the DIS ignition coil mounting plate.
18. Remove the camshaft pressure plate bolts.
19. Remove the camshaft pressure plate.


A102B077

20. Remove the camshaft.

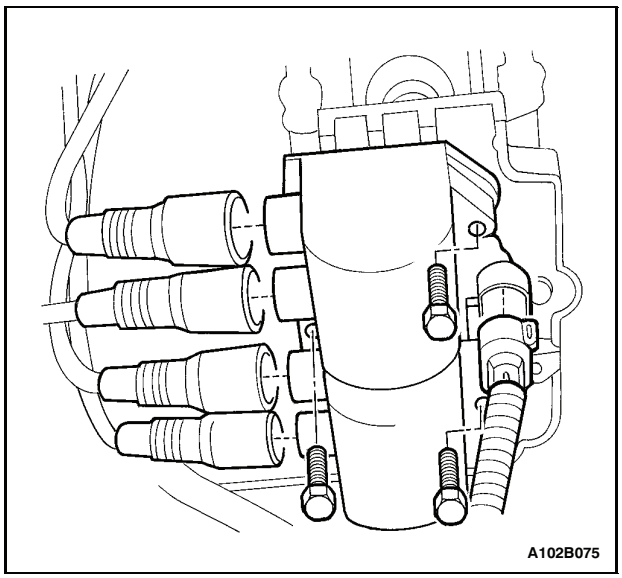

A102B076

Installation Procedure

1. Install the camshaft.
2. Install the camshaft pressure plate.
3. Install the camshaft pressure plate bolts.

Tighten

Tighten the camshaft pressure plate bolts to 10 NSm (89 lb-in).


A102B075

4. Measure camshaft end play. Camshaft end play should be 0.04 to 0.16 mm (.016 to 0.64 inch).
5. Install the DIS ignition coil mounting plate.
6. Install the DIS ignition coil mounting plate bolts.

Tighten

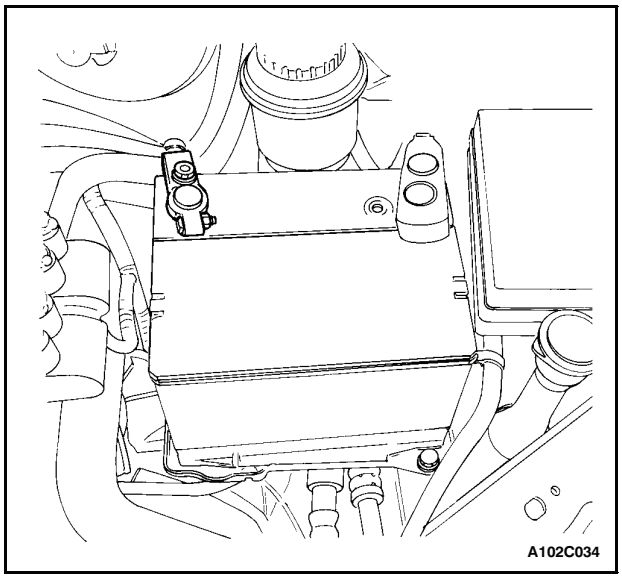
Tighten the DIS ignition coil mounting plate bolts to 10 NSm (89 lb-in).

7. Install the DIS ignition coil.
8. Install the DIS ignition coil mounting bolts.

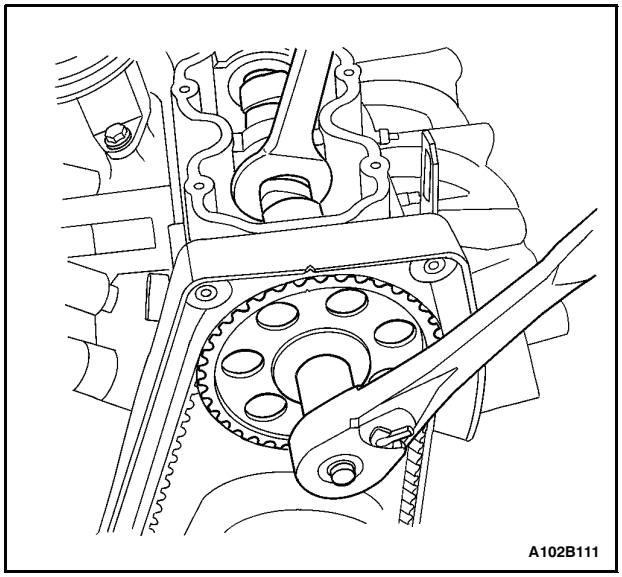
Tighten

Tighten the DIS ignition coil mounting bolts to 10 NSm (89 lb-in).

9. Connect the ignition wires at the DIS ignition coil.
10. Connect the DIS ignition coil connector.


A102C034

11. Install the battery and the battery tray. Refer to Section 1E, Engine Electrical.
12. Connect the positive battery cable to the battery.

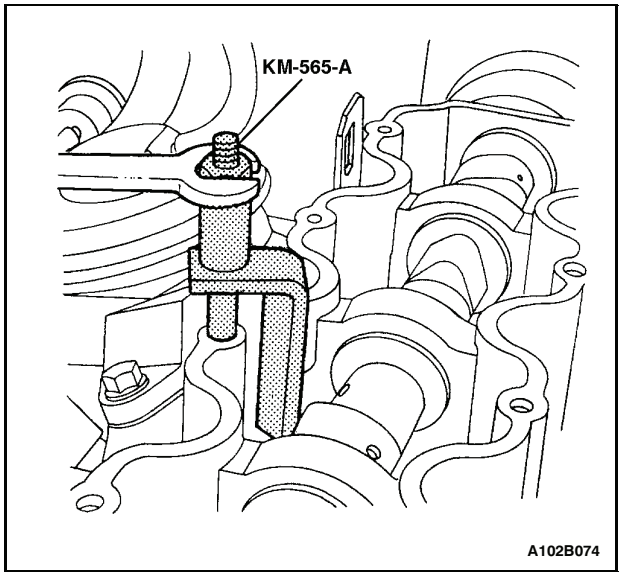

A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

13. Install the camshaft gear.
14. While holding the camshaft firmly in place, install the camshaft gear bolt.

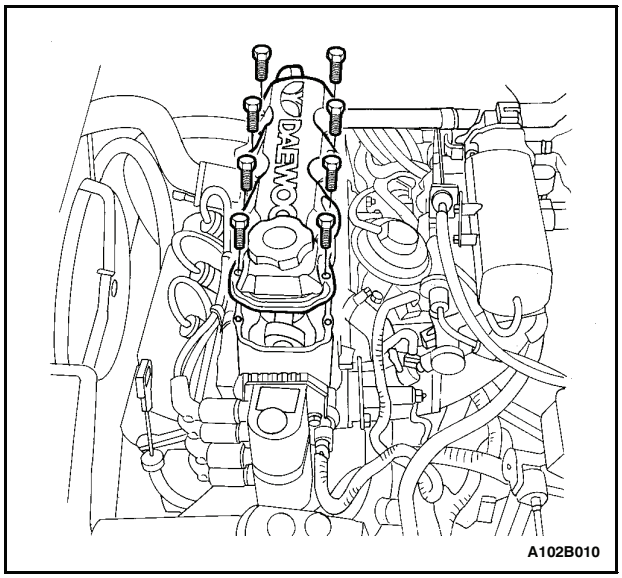
Tighten

Tighten the camshaft gear bolt to 45 NSm (33 lb-ft).



A102B074

15. Install the camshaft followers using the valve spring compressor KM-565-A.
16. Remove the tool KM-565-A.

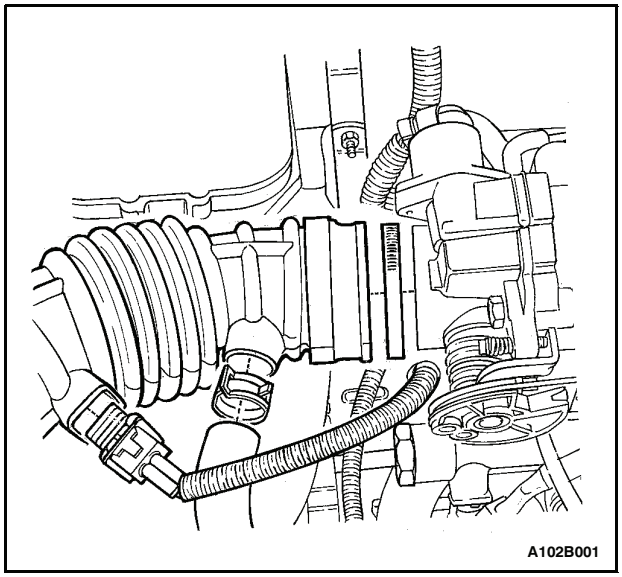


17. Install the valve cover gasket.
18. Install the valve cover.
19. Install the valve cover bolts.

Tighten

Tighten the valve cover bolts to 10 NSm (89 lb-in).

20. Connect the air breather tube to the valve cover.
21. Install the timing belt. Refer to "Timing Belt" in this section.



TIMING BELT CHECK AND ADJUST

(Left-Hand Drive Shown, Right Hand Drive Similar)

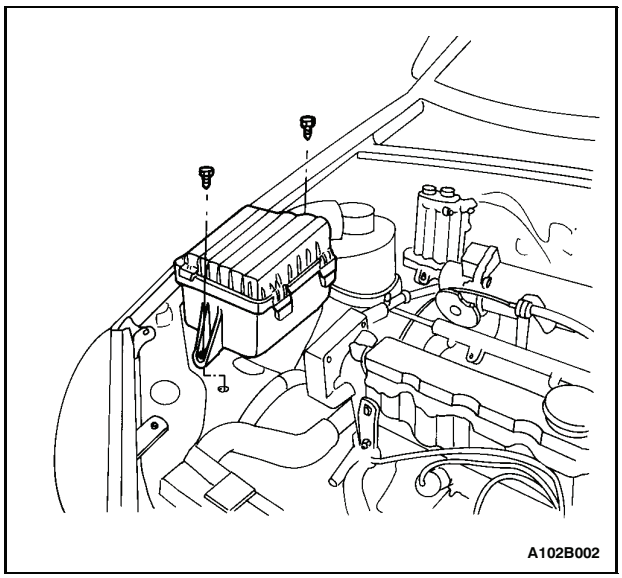
Tools Required

J-42492 Timing Belt Adjuster

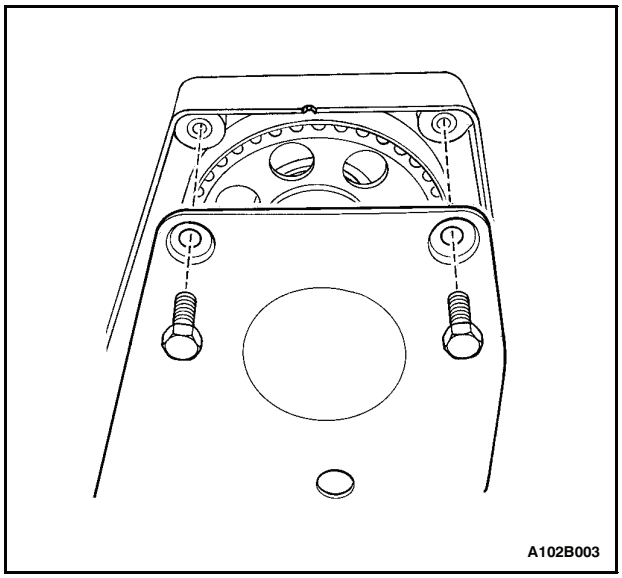
KM-470-B Angular Torque Gauge

Adjustment Procedure

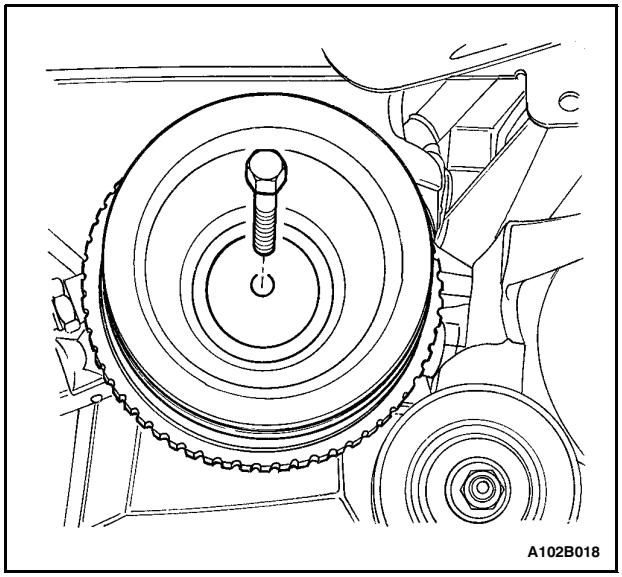
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.



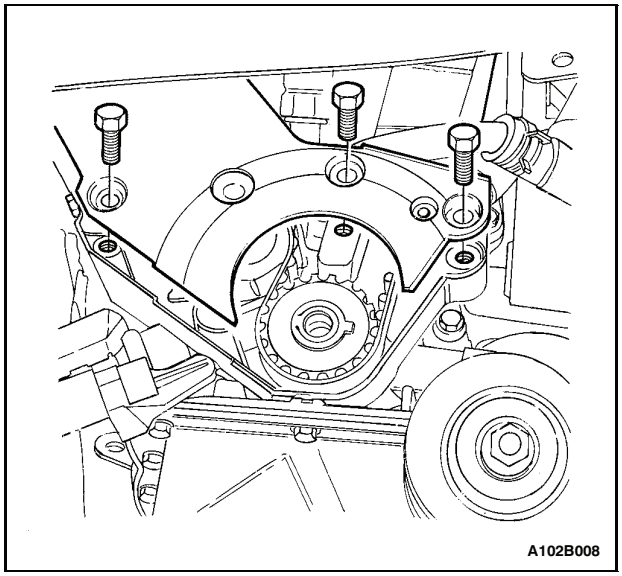
5. Remove the air cleaner housing bolts.
6. Remove the air cleaner housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front wheel well splash shield.



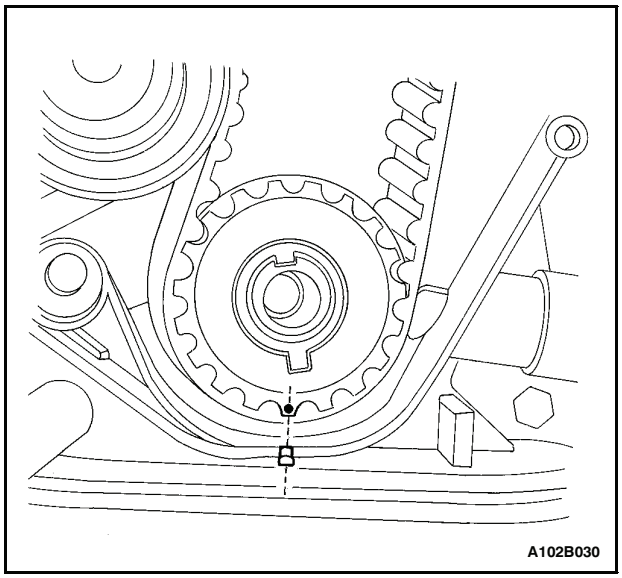
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.
12. Remove the power steering pump pulley, if equipped.
13. Remove the power steering pump mounting bolts, if equipped.
14. Remove the upper timing belt cover bolts.
15. Remove the upper timing belt cover.



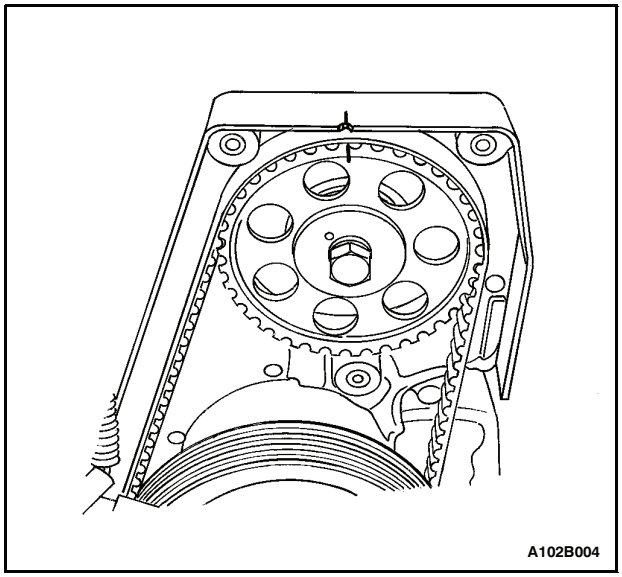
16. Remove the crankshaft pulley bolt.
17. Remove the crankshaft pulley.



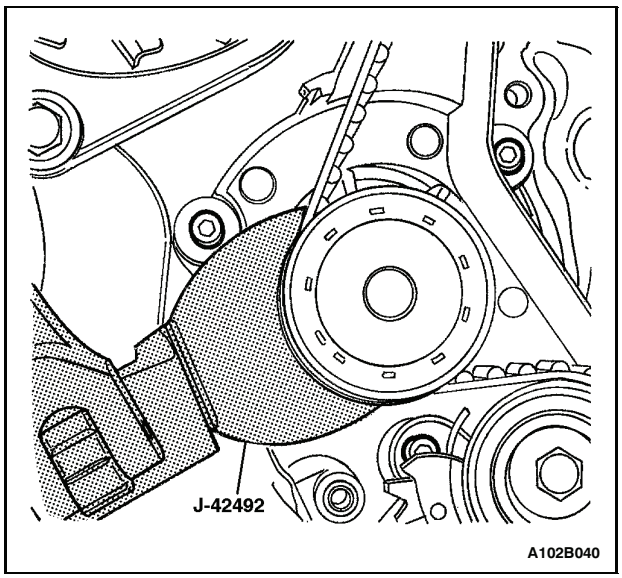
18. Remove the lower timing belt cover bolts.
19. Remove the lower timing belt cover.



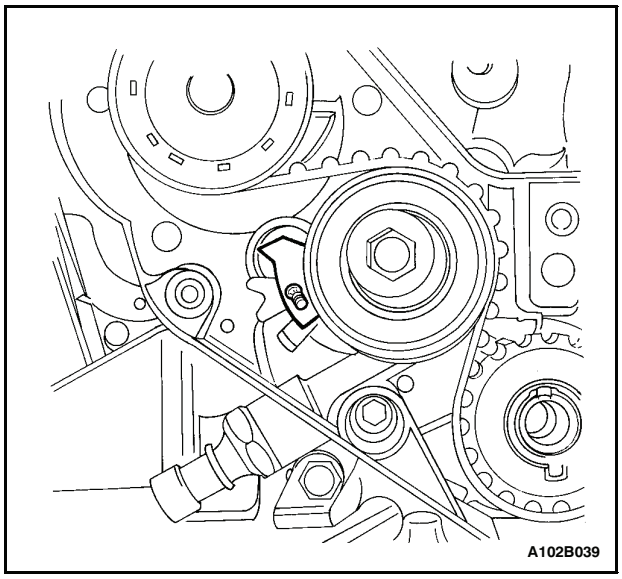
20. Install the crankshaft pulley bolt.
21. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
22. Align the dot on the crankshaft gear to the notch at the bottom of the rear timing belt cover.



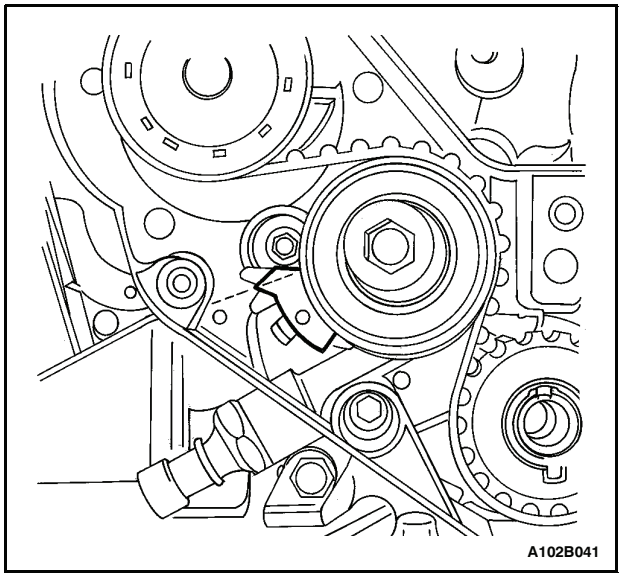
23. Align the camshaft gear timing mark to the notch at the top of the rear timing belt cover.



24. Slightly loosen the three coolant pump retaining bolts.
25. Using the timing belt adjuster J-42492, rotate the coolant pump clockwise to add the highest tension to the timing belt.
26. Tighten the coolant pump retaining bolts.


A102B039

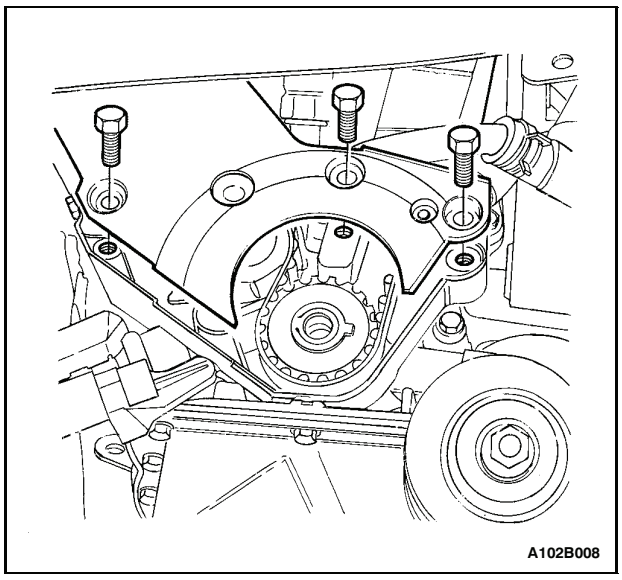
27. Align the adjust arm hole of the timing belt automatic tensioner to the hole in the timing belt automatic tensioner bracket.
28. Insert a 4.5 mm driver through the adjust arm hole and the tensioner bracket hole.
29. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
30. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
31. Remove the driver from the timing belt automatic tensioner.
32. Loosen the coolant pump retaining bolts.


A102B041

33. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.
34. Tighten the coolant pump retaining bolts.

Tighten

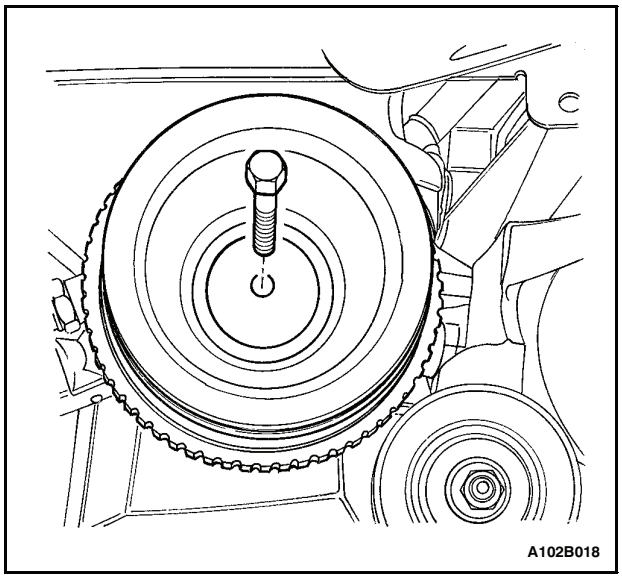
Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).


A102B008

35. Remove the crankshaft pulley bolt.
36. Install the lower timing belt cover.
37. Install the lower timing belt cover bolts.

Tighten

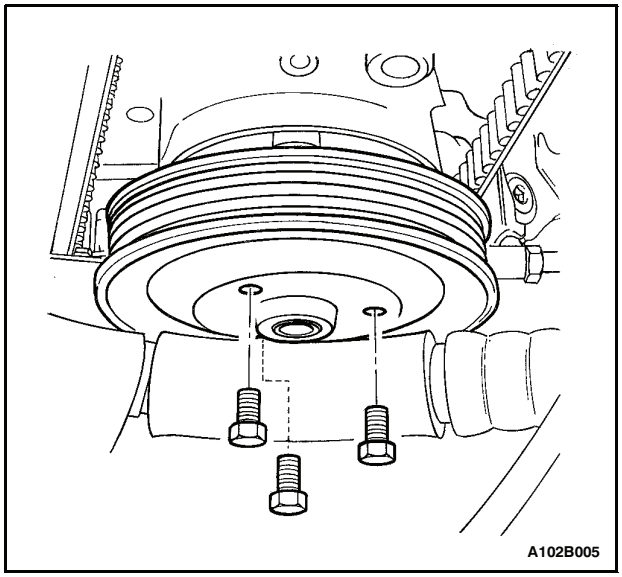
Tighten the lower timing belt cover bolts to 10 NSm (89 lb-in).


A102B018

38. Install the crankshaft pulley.
39. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.


A102B005

40. Install the upper timing belt cover.
41. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).

42. Install the power steering pump mounting bolts, if equipped.

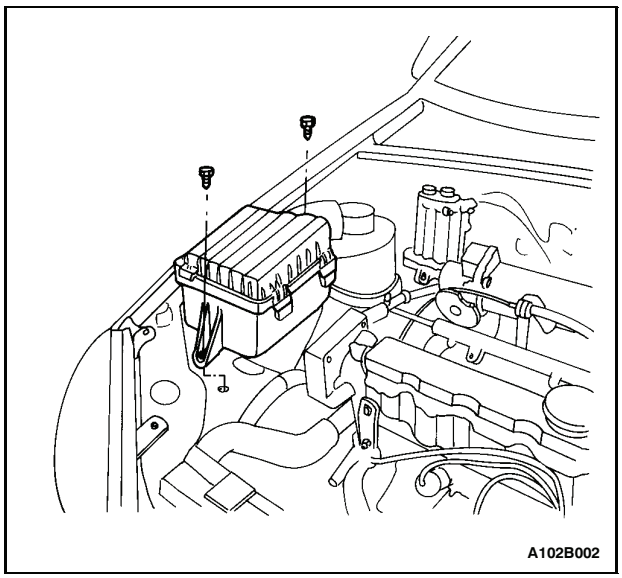
Tighten

Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).

43. Install the power steering pump pulley, if equipped.
44. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).


A102B002

45. Install the alternator drive belt.

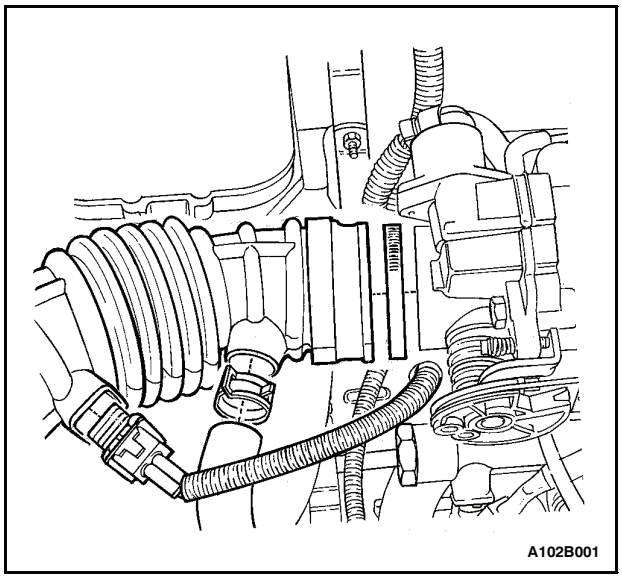
Tighten

Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

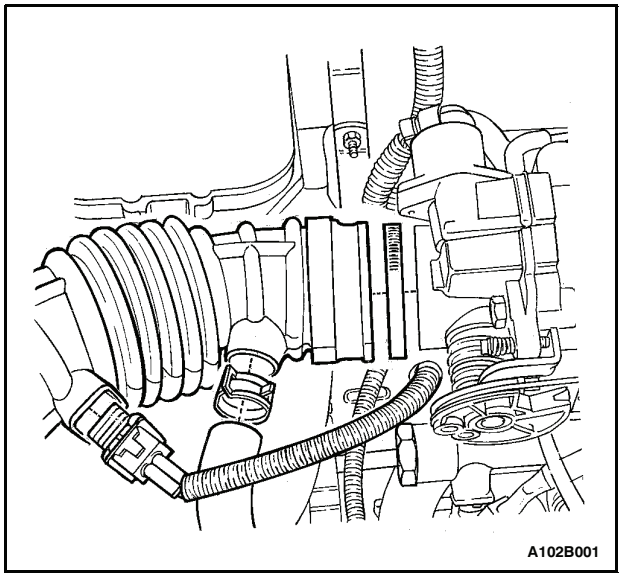
46. Install the A/C compressor drive belt, if equipped.
47. Install the right front wheel well splash shield.
48. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
49. Install the air cleaner housing.
50. Install the air cleaner housing bolts.

Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).


A102B001

51. Connect the air intake tube to the throttle body.
52. Connect the breather tube to the valve cover.
53. Connect the manifold air temperature sensor connector.
54. Connect the negative battery cable.


A102B001

TIMING BELT

(Left-Hand Drive Shown, Right Hand Drive Similar)

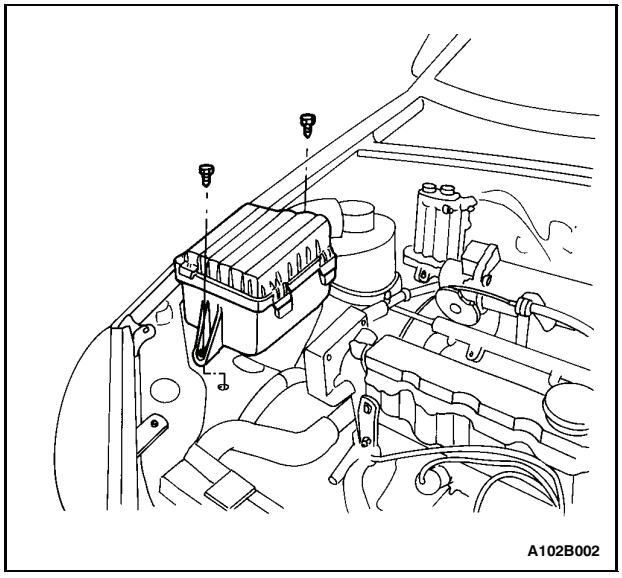
Tools Required

J-42492 Timing Belt Adjuster

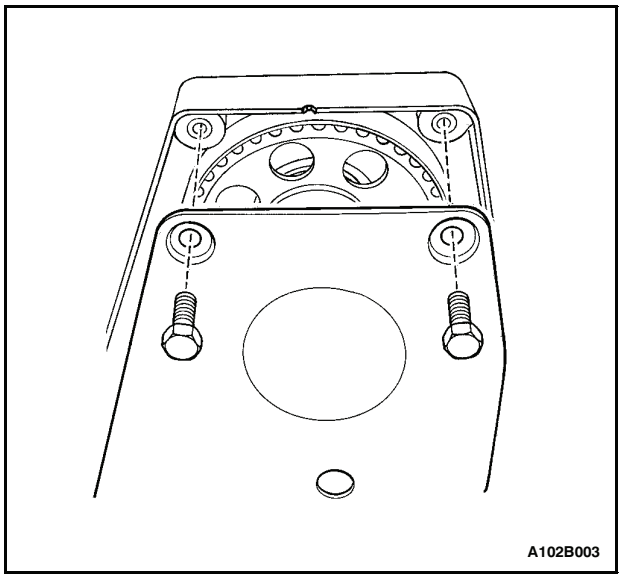
KM-470-B Angular Torque Gauge

Removal Procedure

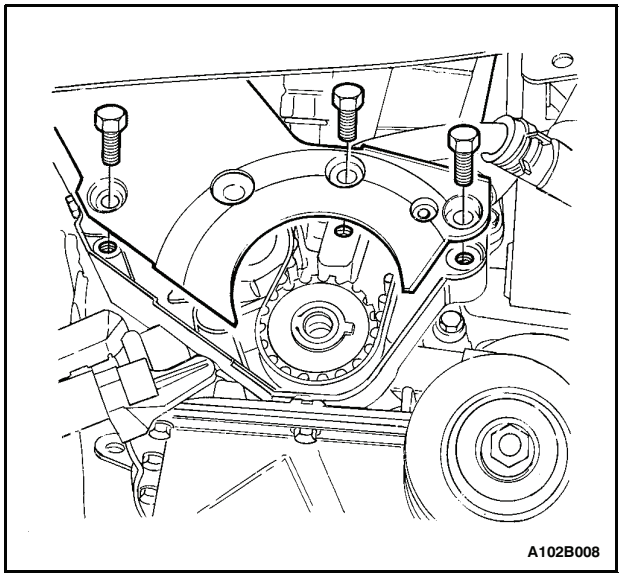
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.


A102B002

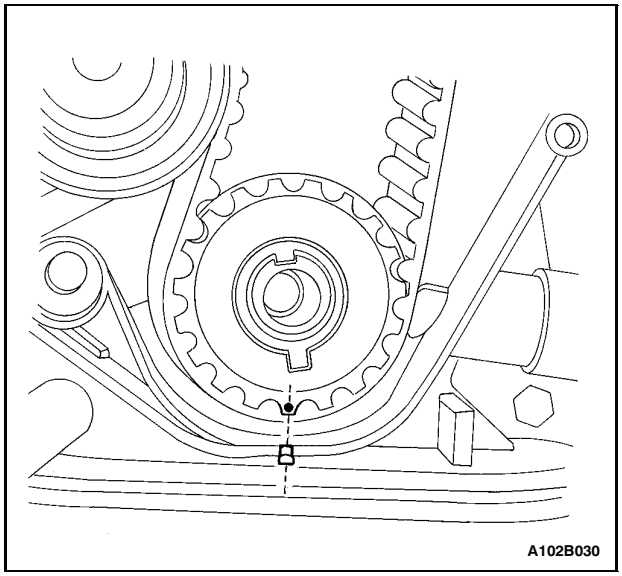
5. Remove the air cleaner housing bolts.
6. Remove the air cleaner housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front wheel well splash shield.


A102B003

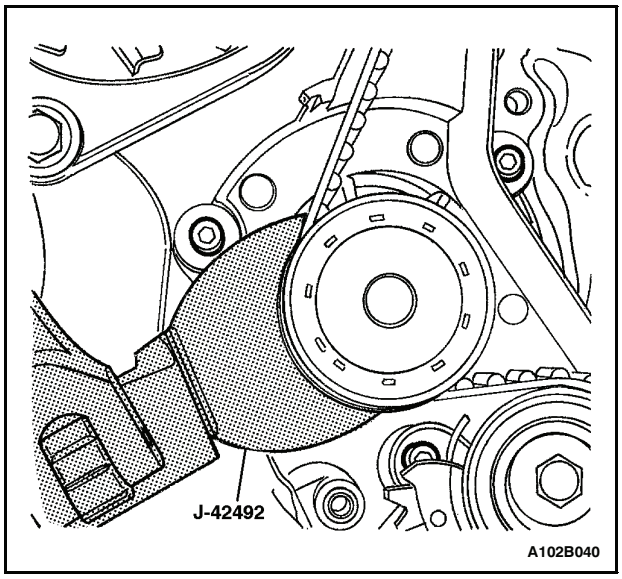
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
12. Remove the upper timing belt cover bolts.
13. Remove the upper timing belt cover.


A102B008

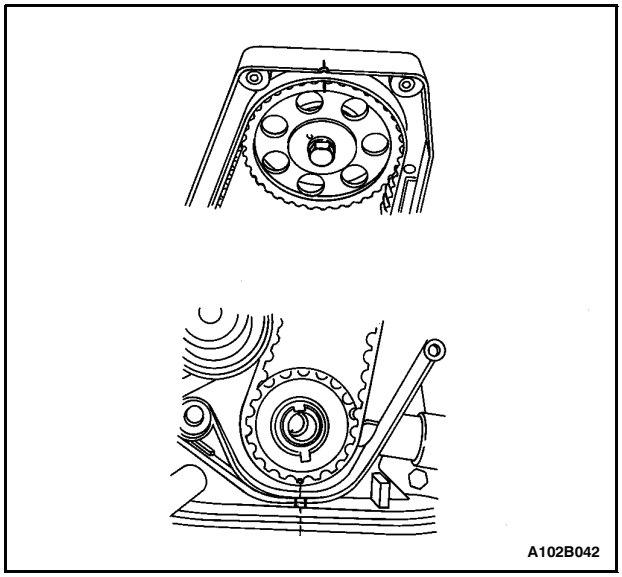
14. Remove the crankshaft pulley bolt.
15. Remove the crankshaft pulley.
16. Remove the lower timing belt cover bolts.
17. Remove the lower timing belt cover.


A102B030

18. Install the crankshaft pulley bolt.
19. Using the crankshaft pulley bolt, rotate the crankshaft clockwise until the mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.

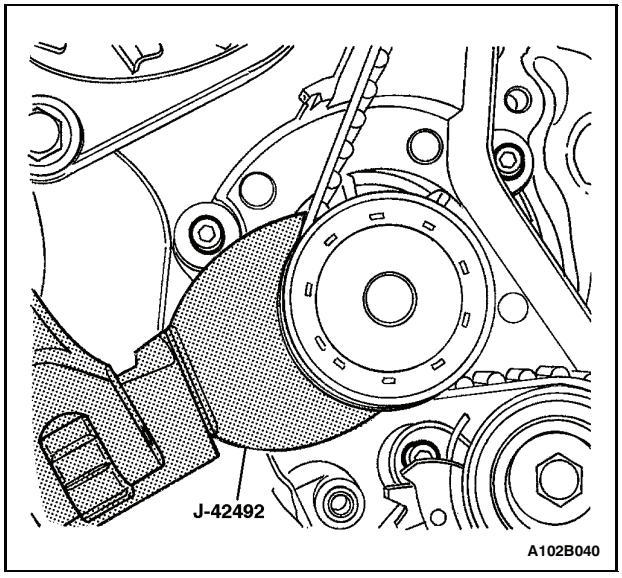


20. Slightly loosen the coolant pump retaining bolts.
21. Using the timing belt adjuster J-42492, rotate the coolant pump counterclockwise to release the tension on the timing belt.
22. Remove the timing belt.

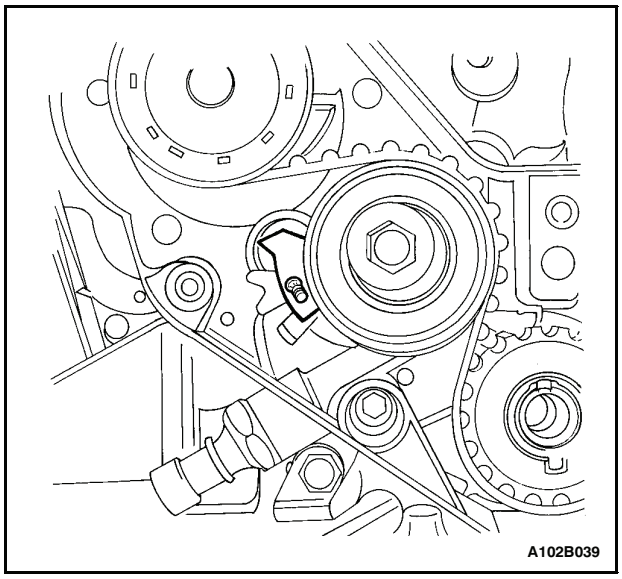


Installation Procedure

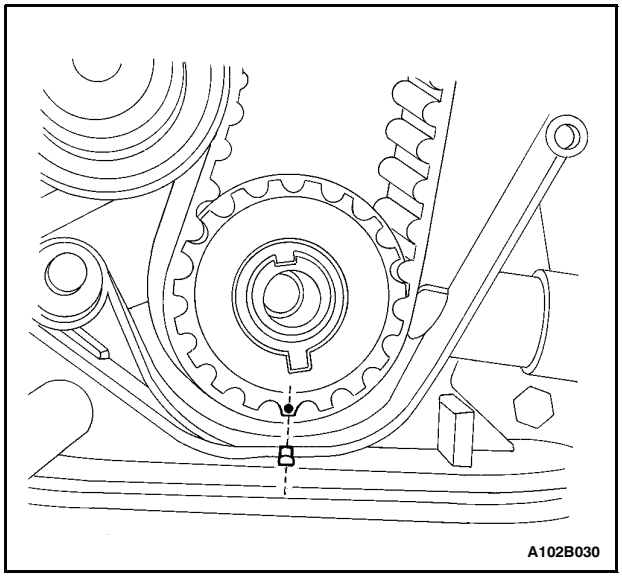
1. Align the mark on the crankshaft gear to the notch on the bottom of the rear timing belt cover.
2. Align the mark on the camshaft gear to the notch on the top of the rear timing belt cover.
3. Install the timing belt.



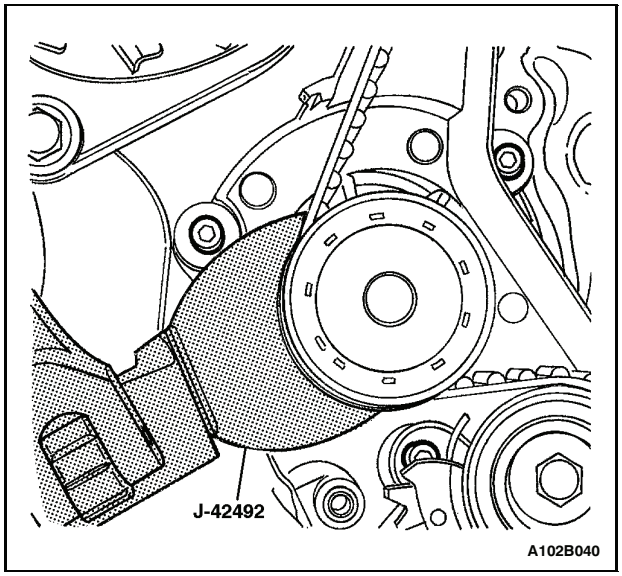
4. Using the timing belt adjuster J-42492, rotate the coolant pump clockwise to add the highest tension to the timing belt.
5. Tighten the coolant pump retaining bolts.


A102B039

6. Align the adjust arm hole of the timing belt automatic tensioner to the hole in the timing belt automatic tensioner bracket.
7. Insert a 4.5 mm driver through the adjust arm hole and the tensioner bracket hole.

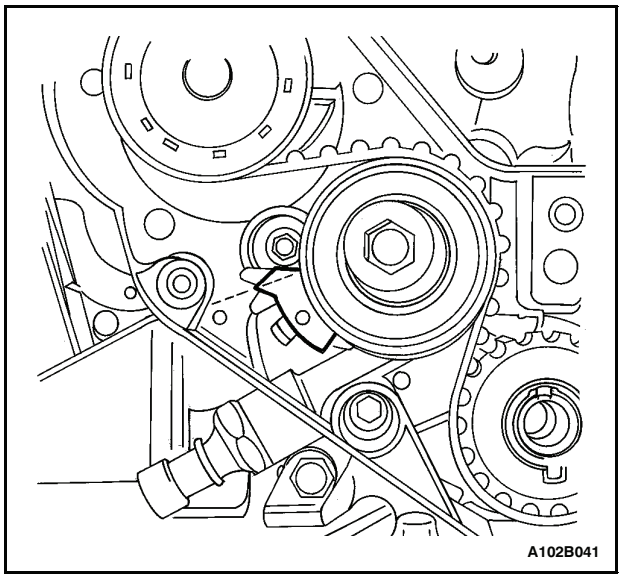

A102B030

8. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
9. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.



A102B040

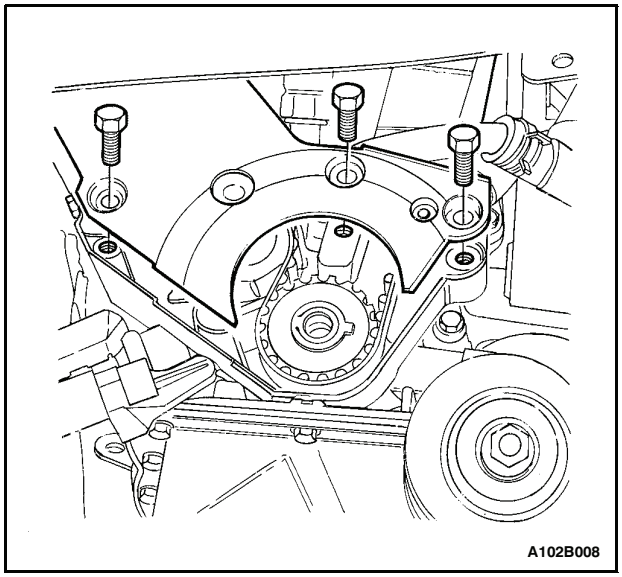
10. Remove the driver from the timing belt automatic tensioner.
11. Slightly loosen the three coolant pump retaining bolts.
12. Using the timing belt adjuster J-42492, rotate the coolant pump.


A102B041

13. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.
14. Tighten the coolant pump retaining bolts.

Tighten

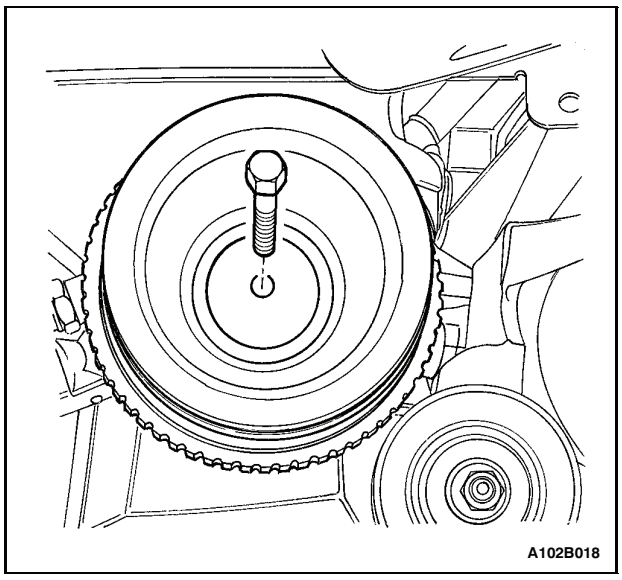
Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).


A102B008

15. Remove the crankshaft pulley bolt.
16. Install the lower timing belt cover.
17. Install the lower timing belt cover bolts.

Tighten

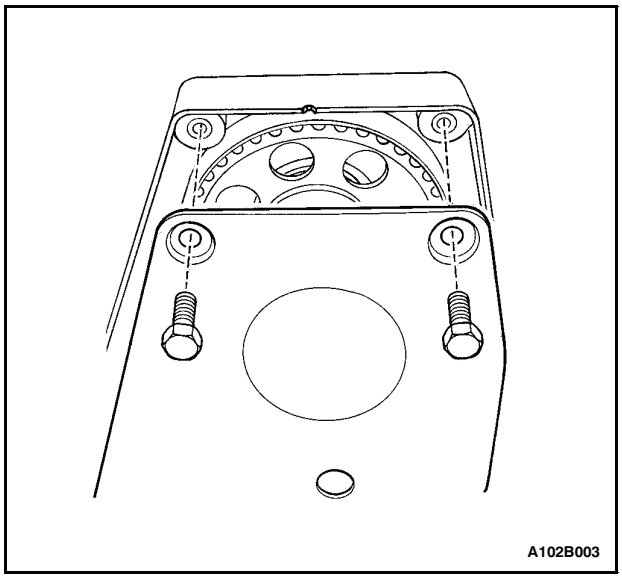
Tighten the lower timing belt cover bolts to 10 NSm (89 lb-in).


A102B018

18. Install the crankshaft pulley.
19. Install the crankshaft pulley bolt.

Tighten

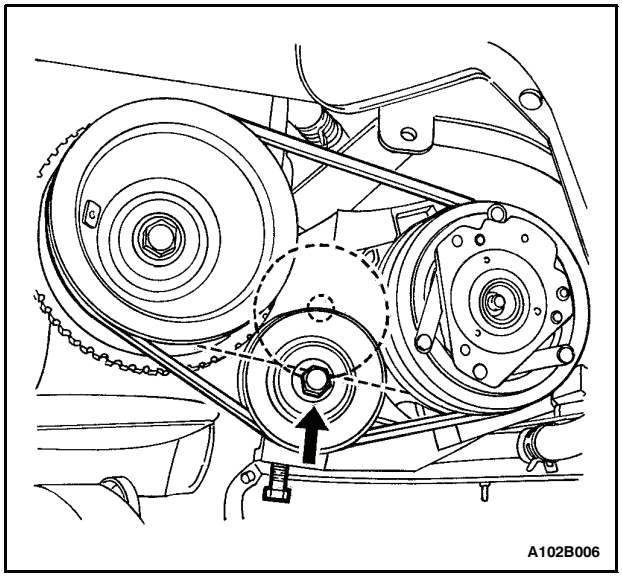
Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.



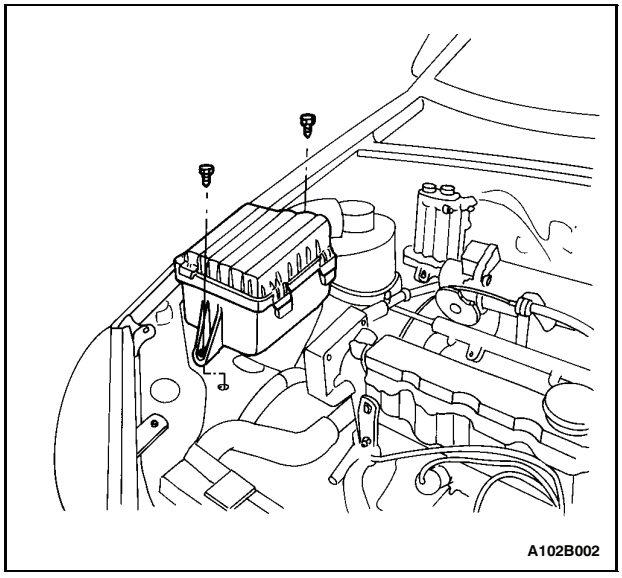
20. Install the upper timing belt cover.
21. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).



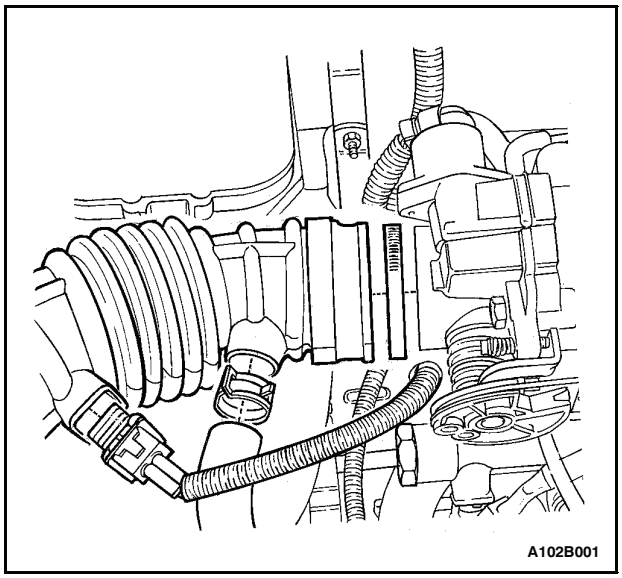
22. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
23. Install the alternator drive belt.
24. Install the A/C compressor drive belt, if equipped.



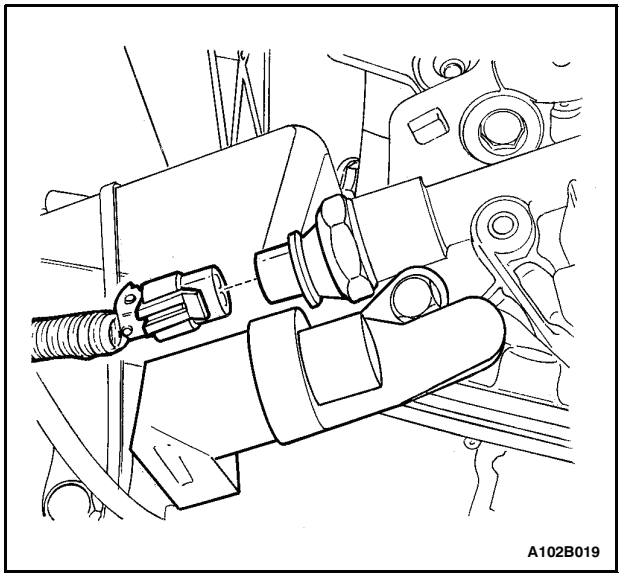
25. Install the right front wheel well splash shield.
26. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
27. Install the air filter housing.
28. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).


A102B001

29. Connect the air intake tube to the throttle body.
30. Connect the breather tube to the valve cover.
31. Connect the manifold air temperature sensor connector.
32. Connect the negative battery cable.


A102B019

OIL PUMP

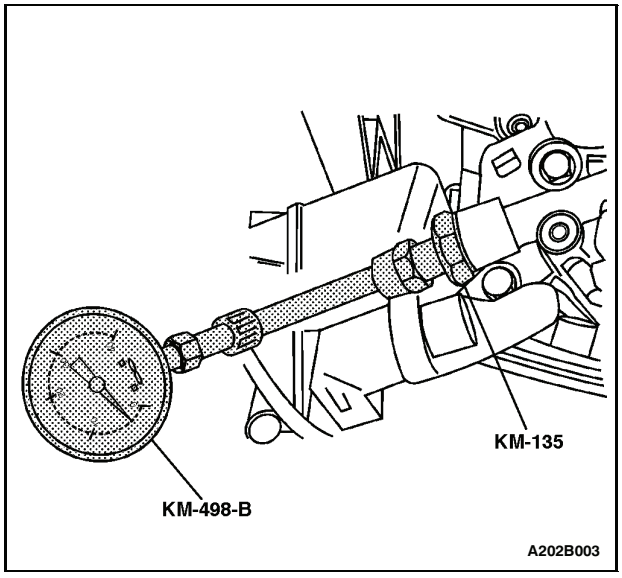
Tools Required

KM-498-B Pressure Gauge

KM-135 Adapter

Engine Oil Pressure Inspection Procedure

1. Remove the right-hand (RH) wheel well splash shield.
2. Remove the oil pressure switch connector.

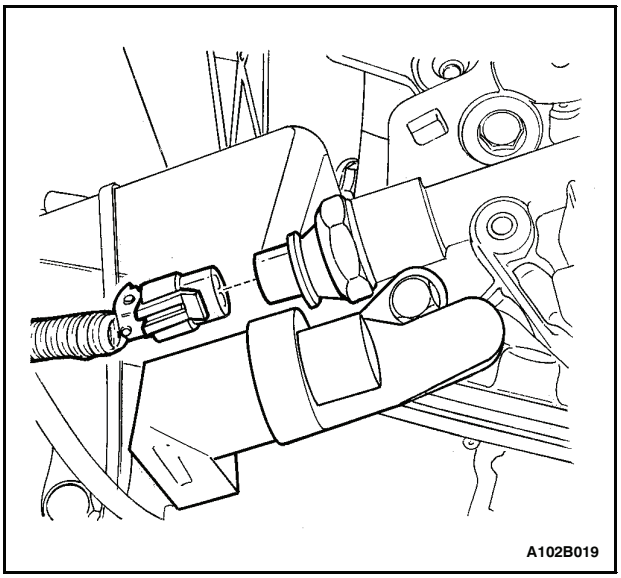


A202B003

3. Install the adapter KM-135 in place of the oil pressure switch.
4. Connect the pressure gauge KM-498-B to the adapter.
5. Start the engine and check the oil pressure at idle speed and an engine temperature of 80_C (176_ F).

Important: The minimum oil pressure should be 30 kPa (8.88 psi).

6. Stop the engine and remove the oil pressure gauge and the adapter.

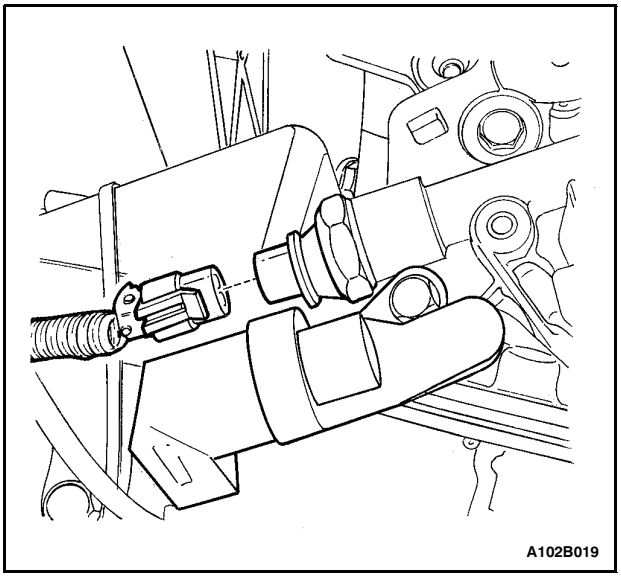

A102B019

7. Install the oil pressure switch.

Tighten

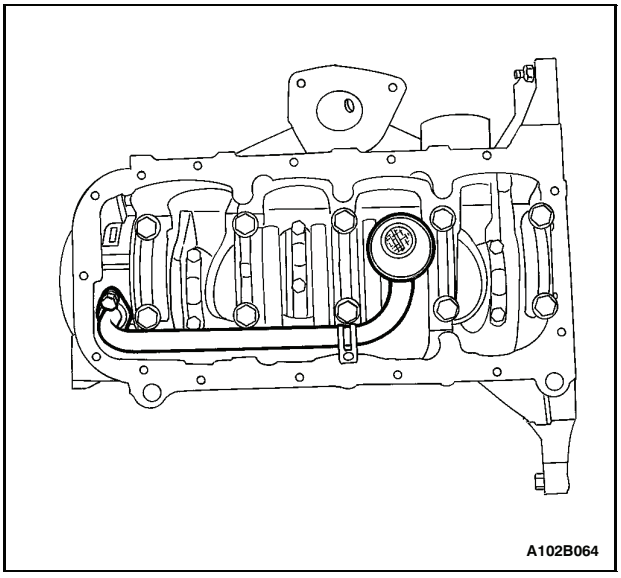
Tighten the oil pressure switch to 40 NSm (30 lb-ft).

8. Connect the electrical connector to the oil pressure switch.
9. Install the RH wheel well splash shield.
10. Check the oil level and fill the oil to the FULL mark.

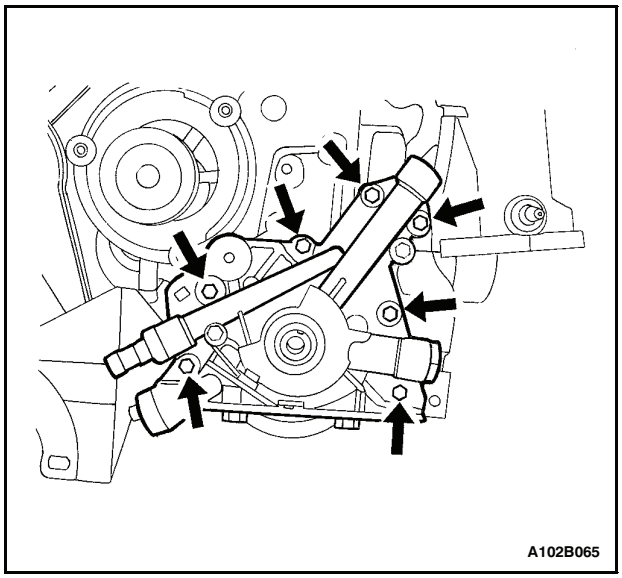

A102B019

Removal Procedure

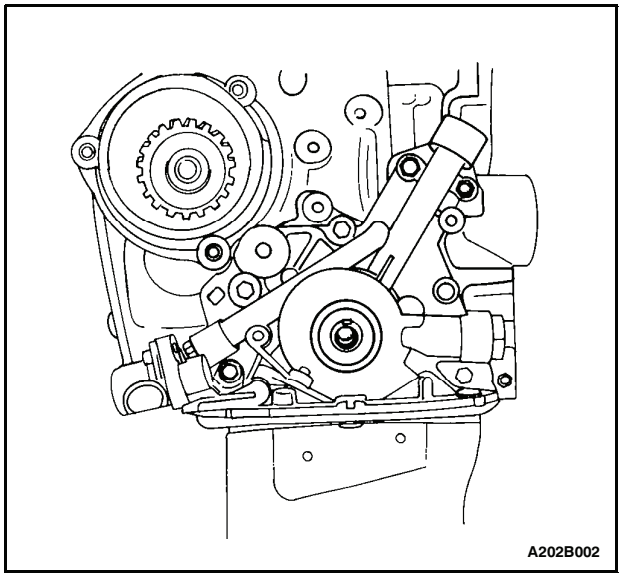
1. Disconnect the negative battery cable.
2. Remove the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
3. Remove the timing belt. Refer to "Timing Belt" in this section.
4. Remove the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
5. Disconnect the oil pressure switch connector.


A102B064

6. Remove the crankshaft position sensor bolt.
7. Remove the crankshaft position sensor.
8. Remove the oil pan. Refer to "Oil Pan" in this section.
9. Remove the oil pump pickup tube and the support bracket bolts.
10. Remove the oil pump pickup tube.

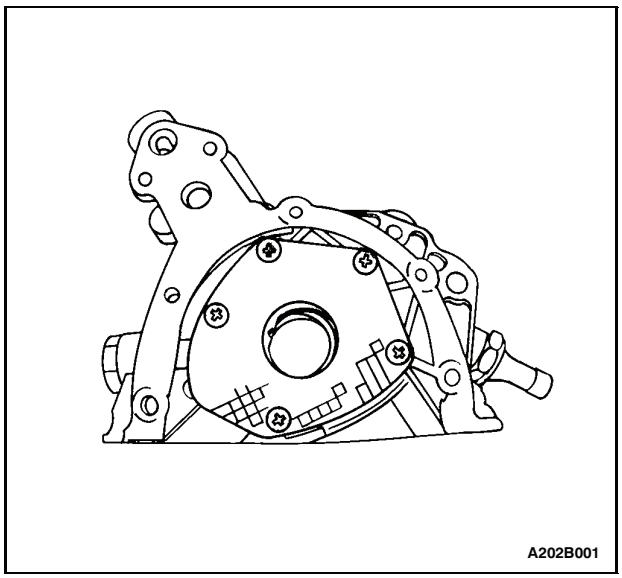

A102B065

11. Remove the oil pump retaining bolts.
12. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
13. Remove the oil pump.

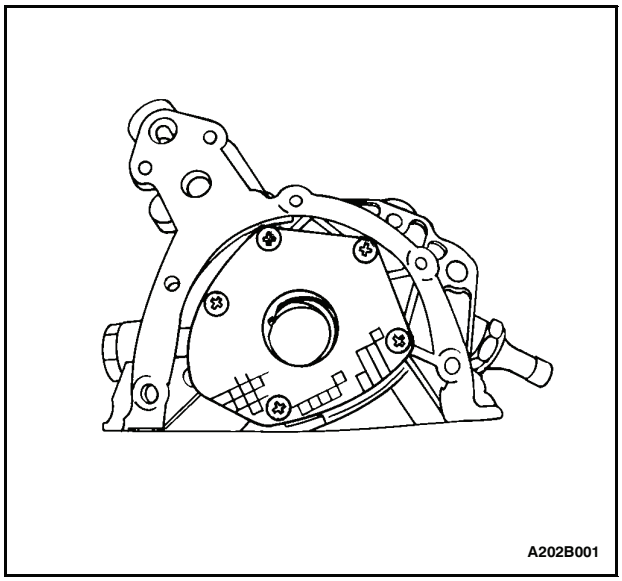

A202B002

Inspection Procedure

1. Clean the oil pump and the engine block gasket mating surfaces.
2. Remove the safety relief valve bolt.
3. Remove the safety relief valve and the spring.
4. Remove the oil pump-to-crankshaft seal.


A202B001

5. Remove the oil pump rear cover bolts.
6. Remove the rear cover.



A202B001

7. Clean the oil pump housing and all of the parts.
8. Inspect all of the parts for signs of wear. Refer to "Engine Specifications" in this section.
9. Coat all of the oil pump parts with clean engine oil.
10. Reinstall all of the oil pump parts.

Notice: Pack the oil pump gear cavity with petroleum jelly to ensure an oil pump prime. Failure to do this can damage the engine.

11. Install the oil pump rear cover and the bolts.

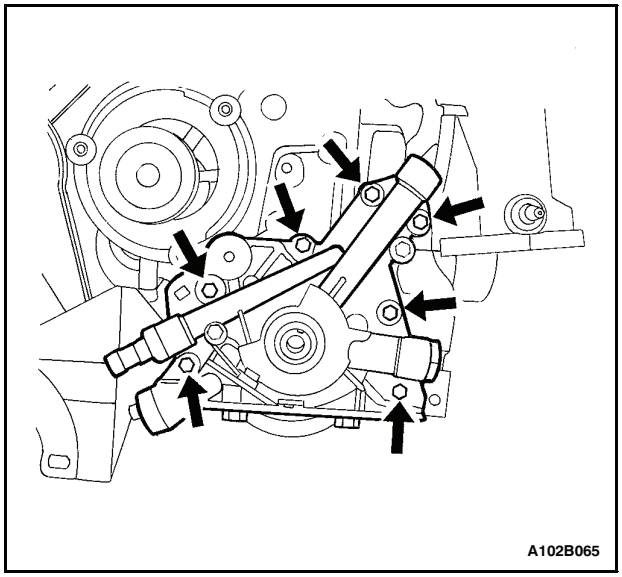
Tighten

Tighten the oil pump rear cover bolts to 6 NSm (53 lb-in).

12. Install the safety relief valve, the spring, the washer, and the bolt.

Tighten

Tighten the oil pump safety relief valve bolt to 30 NSm (22 lb-ft).



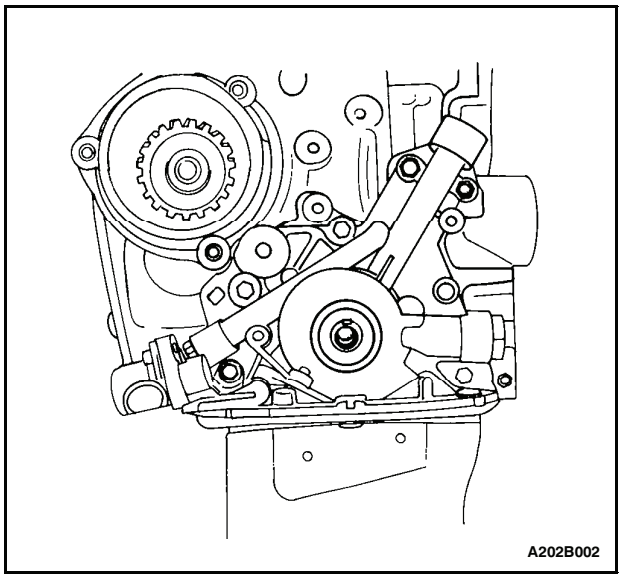
A102B065

Installation Procedure

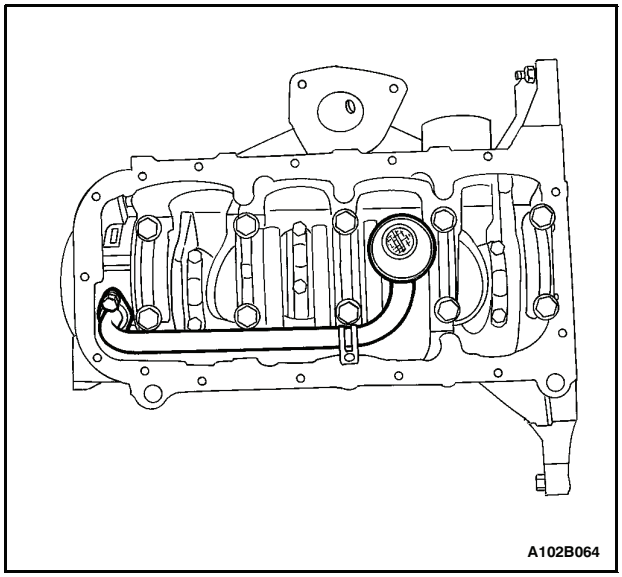
1. Apply a bead of room temperature vulcanizing (RTV) sealer to the oil pump gasket.
2. Install a new oil pump gasket to the oil pump.
3. Coat the threads of the oil pump bolts with Loctite[573.
4. Install the oil pump to the engine block with the bolts.

Tighten

Tighten the oil pump retaining bolts to 10 NSm (89 lb-in).


A202B002

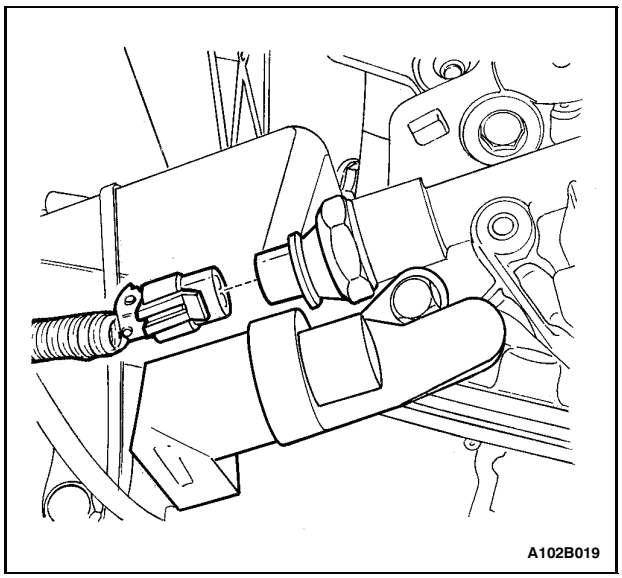
5. Install a new oil pump to the crankshaft shaft seal.
6. Coat the lip of the seal with a thin coat of grease.


A102B064

7. Coat the threads of the oil pump pickup tube and the support bracket bolts with Loctite[573.
8. Install the oil pump pickup tube and the bolts.

Tighten

Tighten the oil pump pickup tube and the support bracket bolts to 10 NSm (89 lb-in).

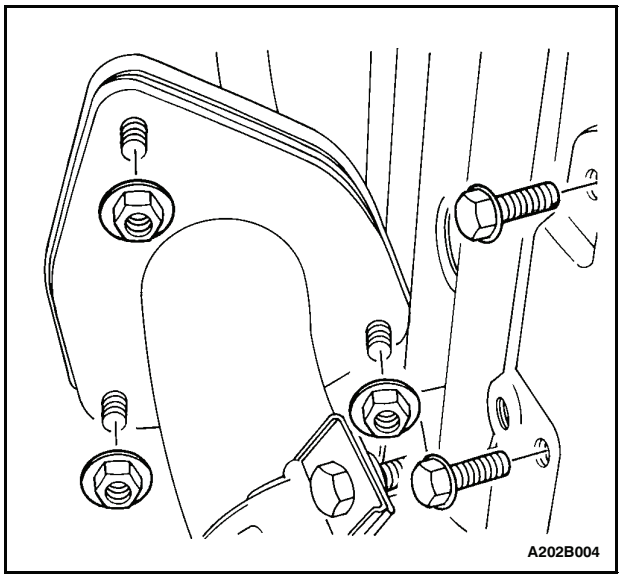

A102B019

9. Install the oil pan. Refer to "Oil Pan" in this section.
10. Install the crankshaft position sensor and the bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 NSm (89 lb-in).

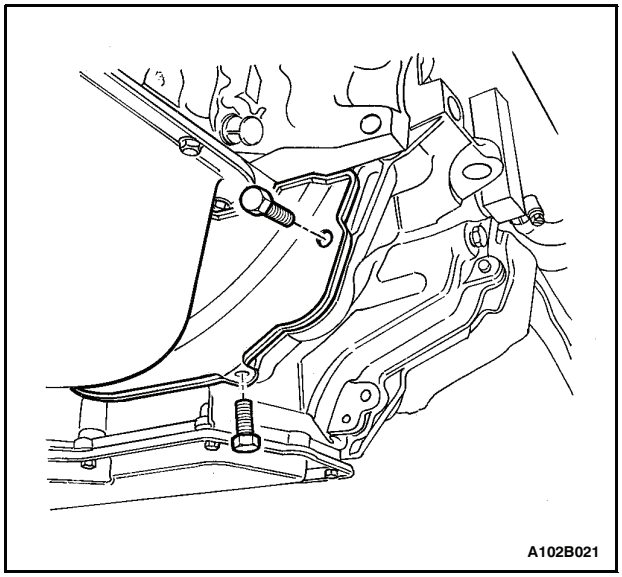
11. Connect the oil pressure switch connector.
12. Install the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
13. Install the timing belt. Refer to "Timing Belt" In this section.
14. Install the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
15. Connect the negative battery cable.



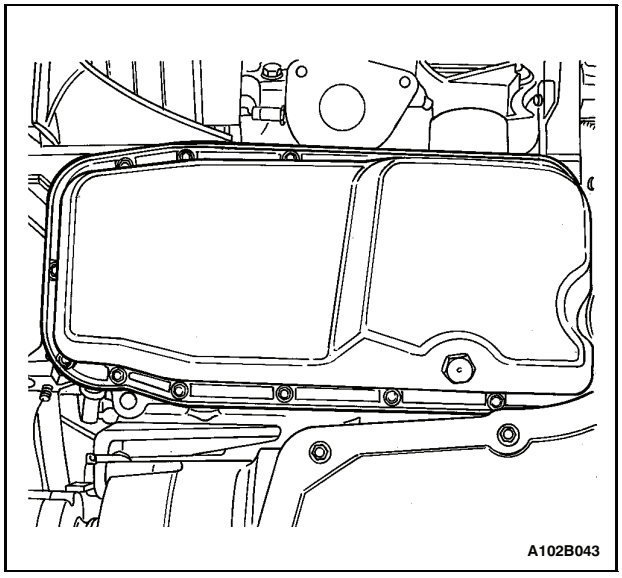
OIL PAN

Removal Procedure

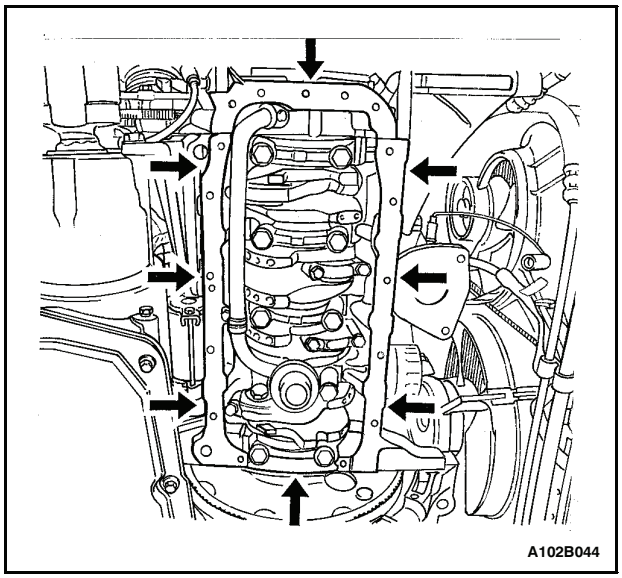
1. Disconnect the negative battery cable.
2. Drain the engine oil from the engine crankcase.
3. Remove the exhaust flex pipe retaining nuts from the exhaust manifold and the bolts from the bracket.
4. Remove the exhaust flex pipe retaining nuts from the catalytic converter or connecting pipe.
5. Remove the exhaust flex pipe.



6. Remove the flywheel or flexible plate inspection cover bolts.
7. Remove the flywheel or flexible plate inspection cover.

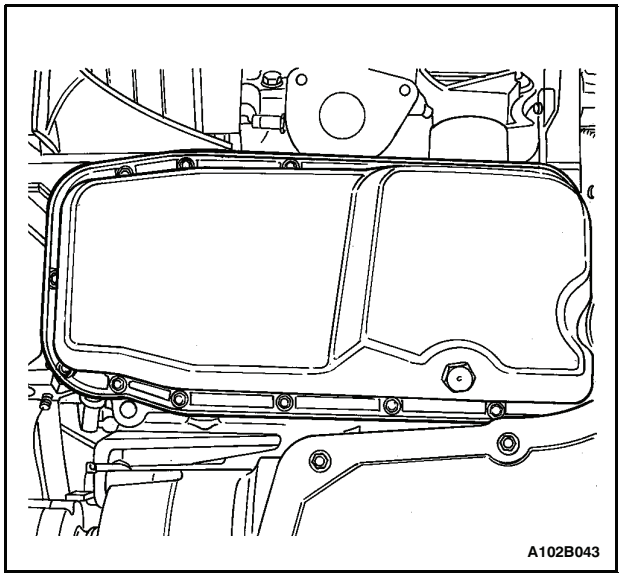


8. Remove the oil pan retaining bolts.
9. Remove the oil pan from the engine block.


A102B044

Cleaning Procedure

1. Clean the oil pan sealing surface.
2. Clean the engine block sealing surface.
3. Clean the oil pan retaining bolts.
4. Clean the oil pan retaining bolt holes in the engine block.


A102B043

Installation Procedure

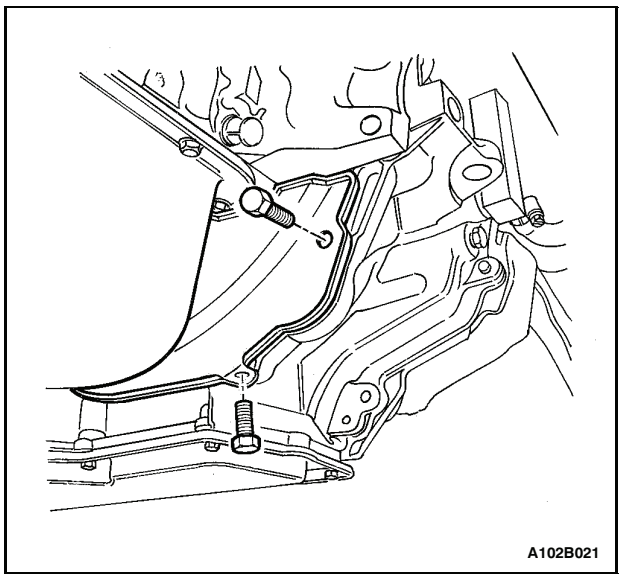
1. Install the oil pan gasket to the oil pan.
2. Install the oil pan to the engine block.

Important: Install the oil pan within 5 minutes after applying liquid gasket to the oil pan.

3. Install the oil pan retaining bolts.

Tighten

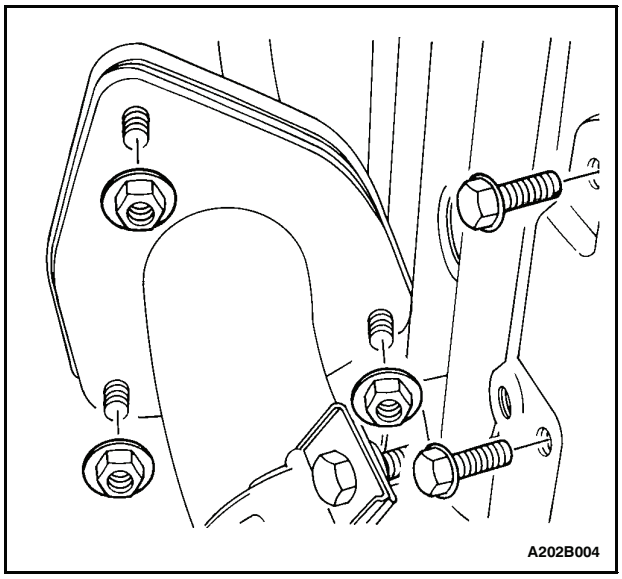
Tighten the oil pan retaining bolts to 10 NSm (89 lb-in).


A102B021

4. Install the flywheel or flexible plate inspection cover.
5. Install the flywheel or flexible plate inspection cover bolts.

Tighten

Tighten the flywheel inspection cover bolts to 12 NSm (106 lb-in) or the flexible plate inspection cover bolts to 10 NSm (89 lb-in).


A202B004

6. Install the exhaust flex pipe.
7. Install the exhaust flex pipe to the exhaust manifold retaining nuts and the bracket bolts.

Tighten

Tighten the exhaust flex pipe-to-exhaust manifold retaining nuts and bracket bolts to 40 NSm (30 lb-ft).

8. Install the exhaust flex pipe retaining nuts to the catalytic converter or connecting pipe.

Tighten

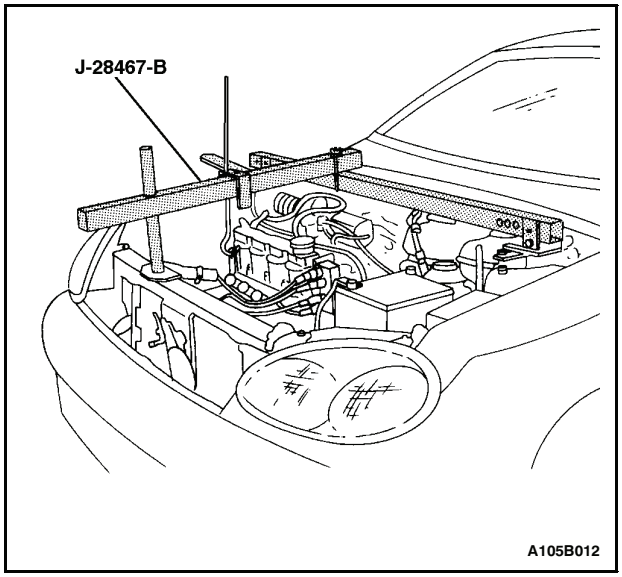
Tighten the exhaust flex pipe-to-catalytic converter or connecting pipe retaining nuts to 30 NSm (22 lb-ft).

9. Connect the negative battery cable.
10. Install the oil pan drain plug.

Tighten

Tighten the oil pan drain plug to 55 NSm (41 lb-ft).

11. Refill the engine crankcase with engine oil.



A105B012

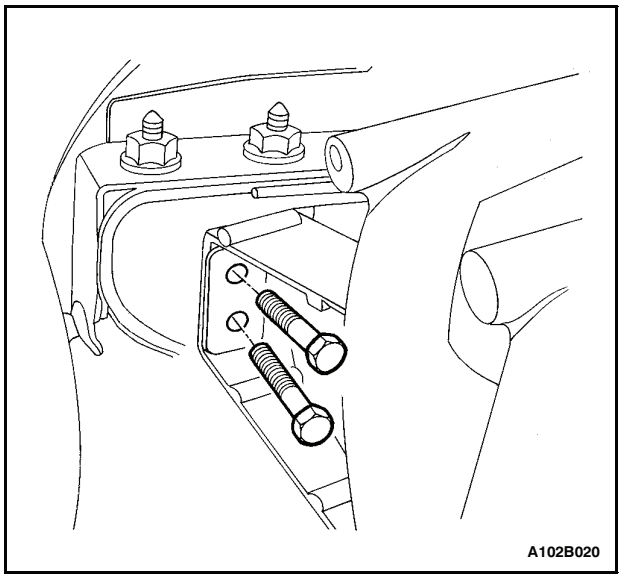
ENGINE MOUNT

Tools Required

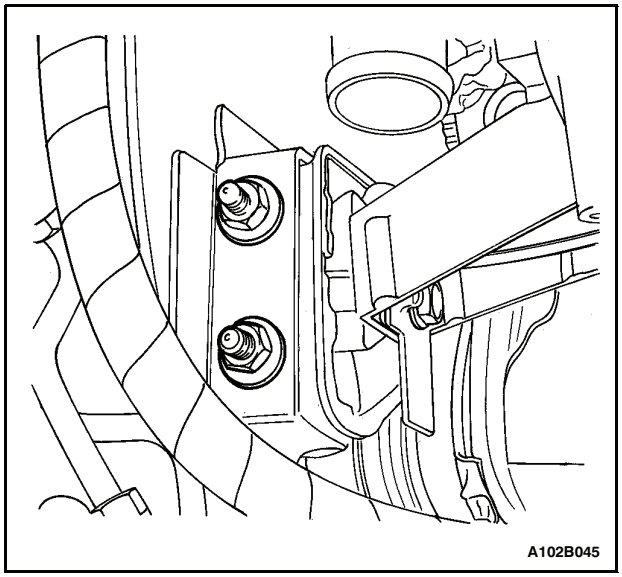
J-28467-B Engine Assembly Support Fixture

Removal Procedure

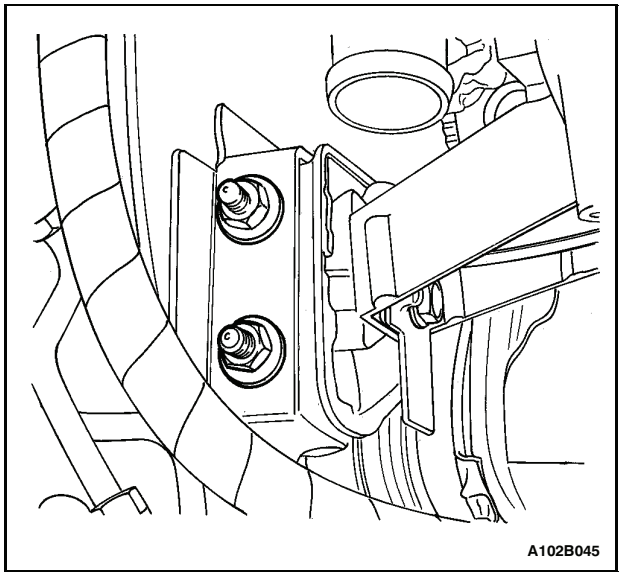
1. Disconnect the negative battery cable.
2. Support the engine assembly using the engine assembly support fixture J-28467-B.



3. Remove the engine mount bracket retaining bolts.



4. Remove the engine mount attaching nuts.
5. Remove the engine mount.

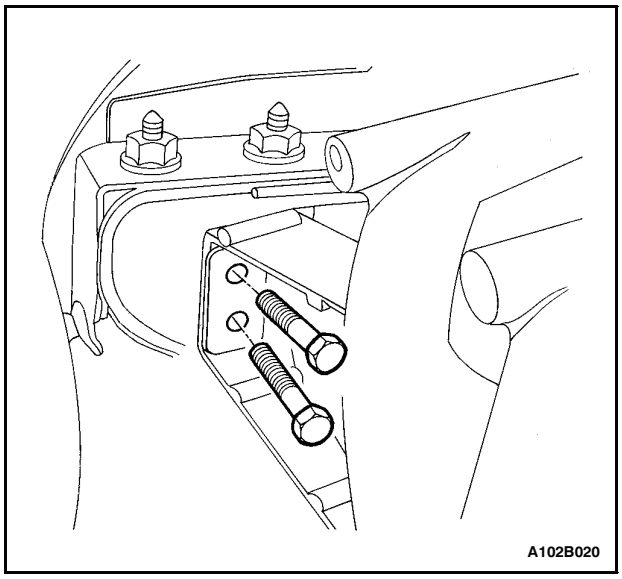


Installation Procedure

1. Install the engine mount.
2. Install the engine mount attaching nuts.

Tighten

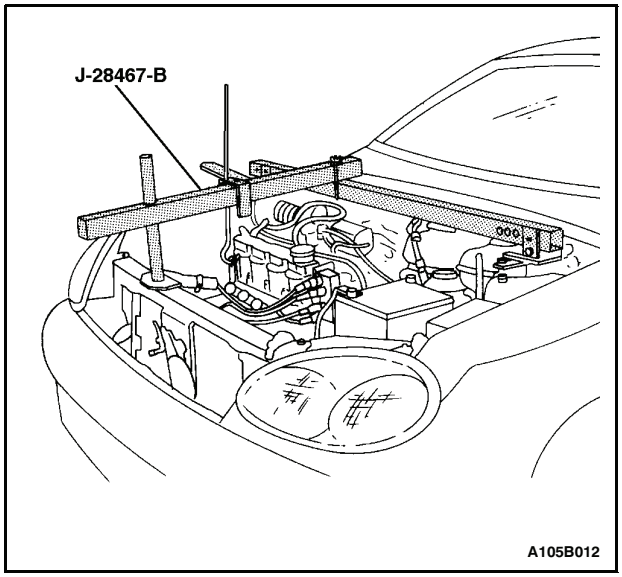
Tighten the engine mount attaching nuts to 40 NSm (30 lb-ft).


A102B020

3. Install the engine mount bracket retaining bolts.

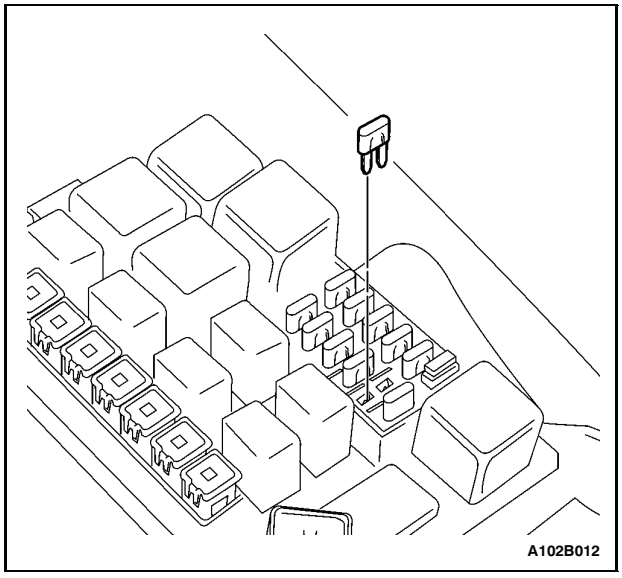
Tighten

Tighten the engine mount bracket retaining bolts to 60 NSm (44 lb-ft).



A105B012

4. Remove the engine assembly support fixture J-28467-B.
5. Connect the negative battery cable.

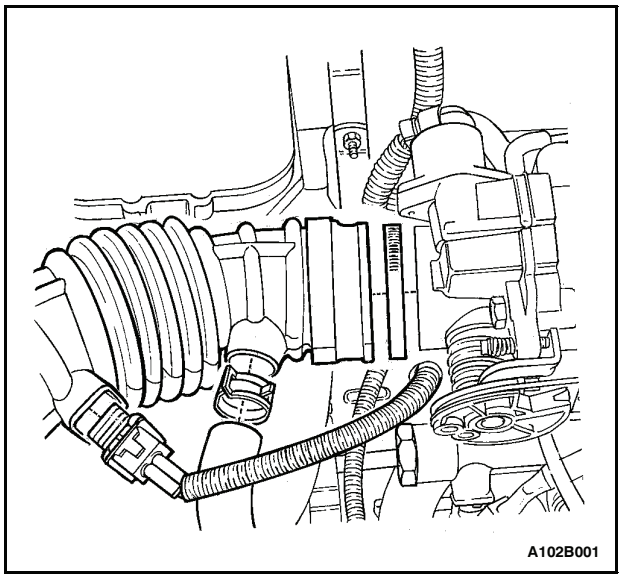

A102B012

INTAKE MANIFOLD

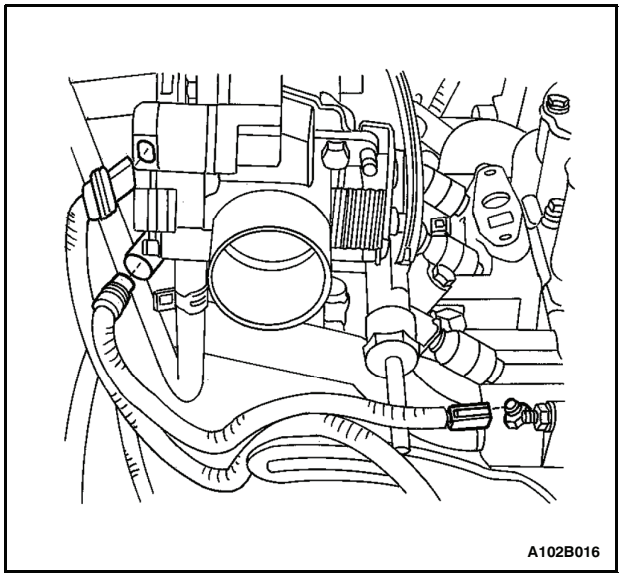
(Left-Hand Drive Shown, Right Hand Drive Similar)

Removal Procedure

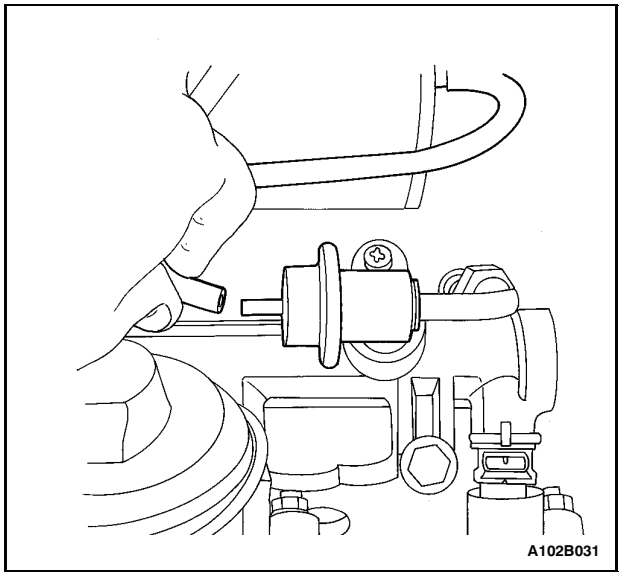
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the electronic control module (ECM) ground terminal from the intake manifold.


A102B001

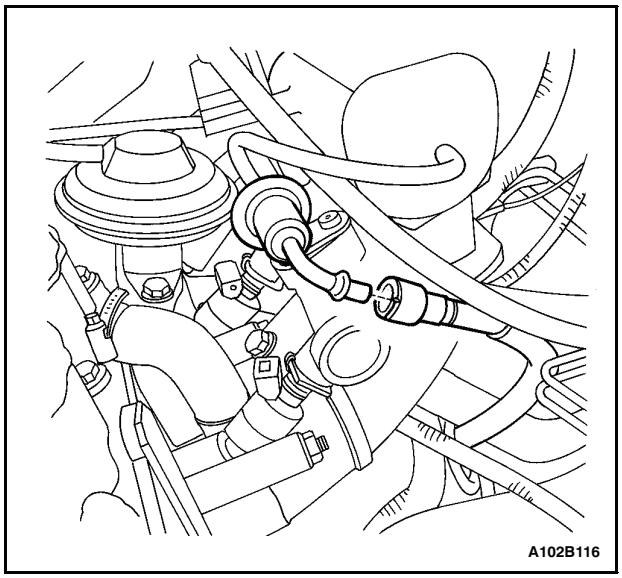
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the air intake tube from the throttle body.


A102B016

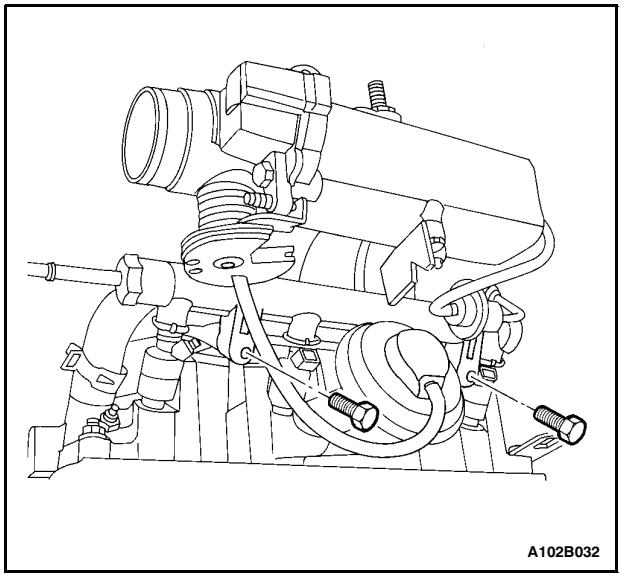
8. Disconnect the idle air control valve connector.
9. Disconnect the throttle position sensor connector.
10. Disconnect the engine coolant temperature sensor connector.


A102B031

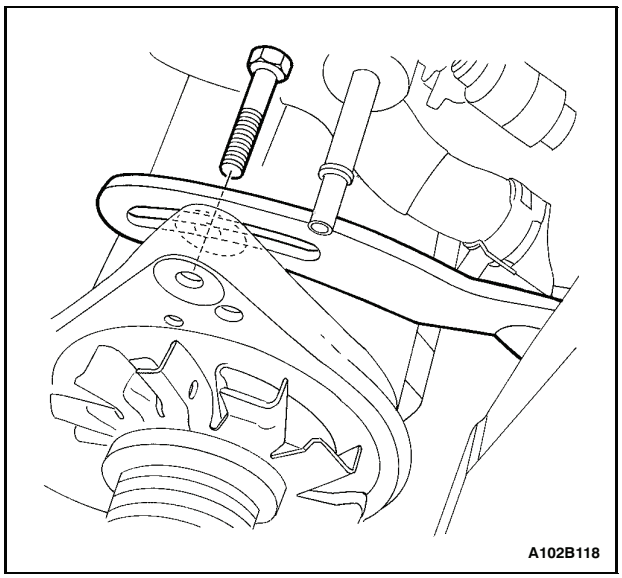
11. Disconnect the heater inlet hose from the coolant distributor beneath the intake manifold.
12. Disconnect the surge tank coolant hose at the throttle body.
13. Disconnect all of the necessary vacuum hoses, including the vacuum hose at the fuel pressure regulator and the brake booster vacuum hose at the intake manifold.


A102B116

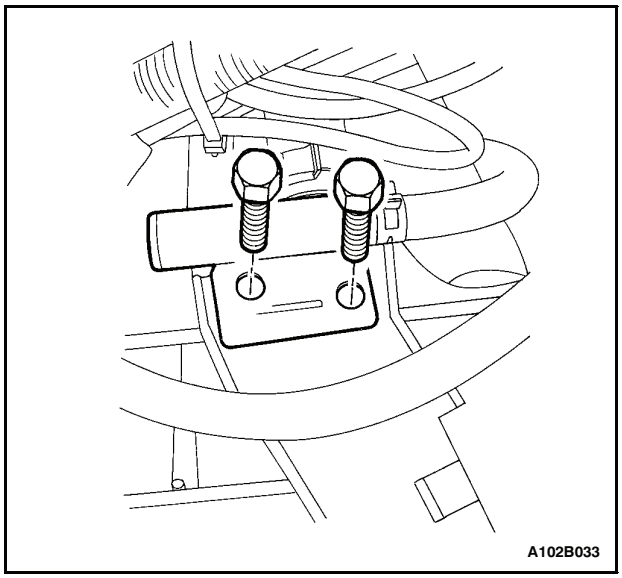
14. Disconnect the throttle cable from the throttle body and the intake manifold.
15. Remove the two throttle cable bracket bolts and the throttle cable bracket.
16. Disconnect the fuel return line from the fuel pressure regulator.
17. Disconnect the fuel feed line from the fuel rail.


A102B032

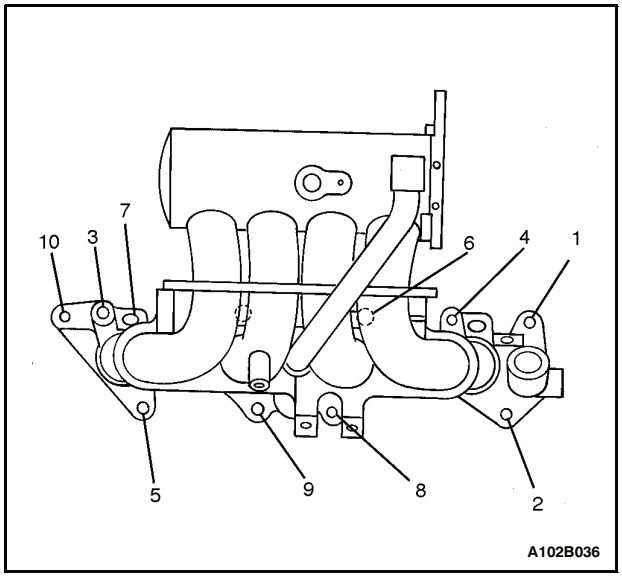
18. Disconnect the fuel injector connectors from the fuel injectors.
19. Remove the two retaining bolts from the fuel injector rail.
20. Remove the fuel injector rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.


A102B118

21. Remove the alternator drive belt.
22. Remove the alternator adjusting bracket and the bolts.

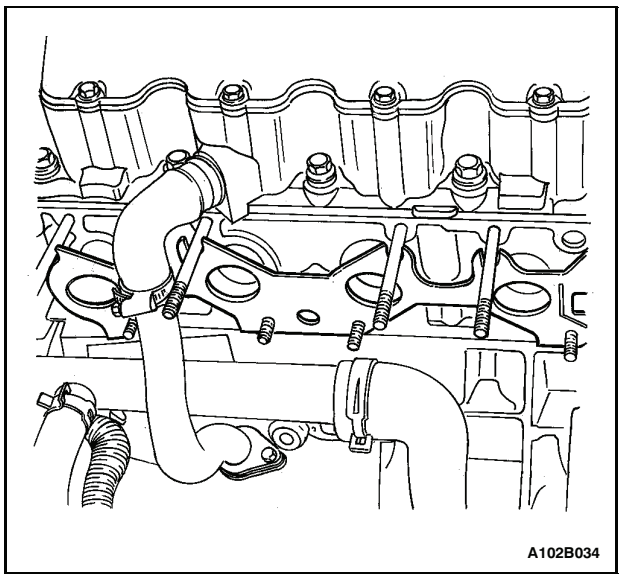

A102B033

23. Remove the three intake manifold support bracket retaining bolts from the coolant distributor and the engine block.
24. Remove the intake manifold support bracket.

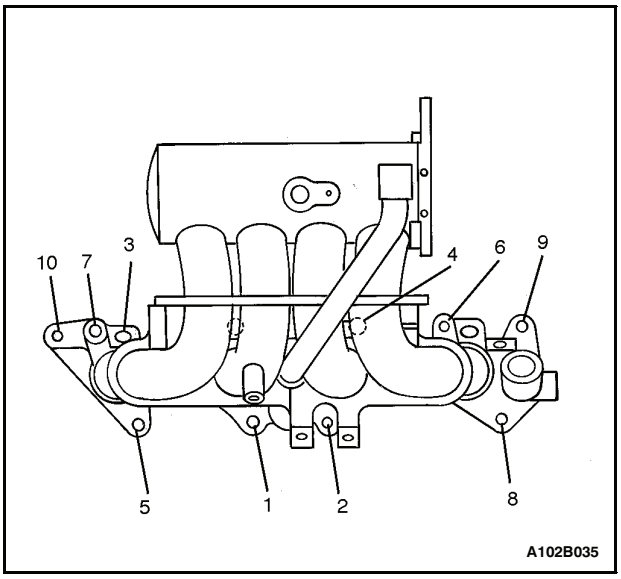


A102B036

25. Remove the intake manifold retaining nuts and the engine lift bracket bolt in the sequence shown.


A102B034

26. Remove the intake manifold.
27. Remove the intake manifold gasket.
28. Clean the sealing surfaces of the intake manifold and the cylinder head.



A102B035

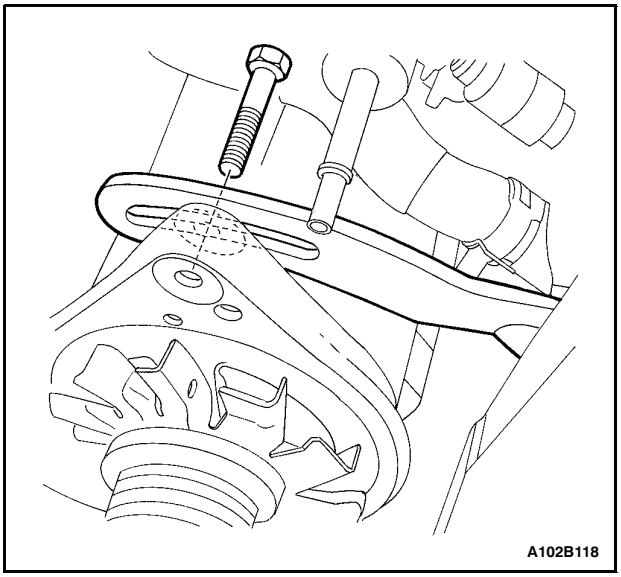
Installation Procedure

1. Install the intake manifold gasket.
2. Install the intake manifold.
3. Install the intake manifold retaining nuts and the engine lift bracket bolt in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts in the sequence shown to 25 NSm (18 lb-ft).

Tighten the engine lift bracket bolt to 25 NSm (18 lb-ft).


A102B118

4. Install the intake manifold support bracket.
5. Install the intake manifold support bracket retaining bolts.

Tighten

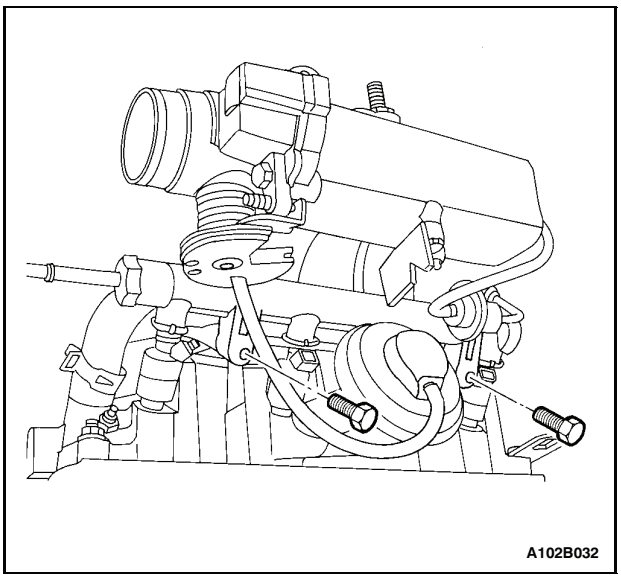
Tighten the intake manifold support bracket retaining bolts to 22 NSm (16 lb-ft).

6. Install the alternator adjusting bracket and the bolts.

Tighten

Tighten the alternator adjusting bracket retaining bolts to 20 NSm (15 lb-ft).

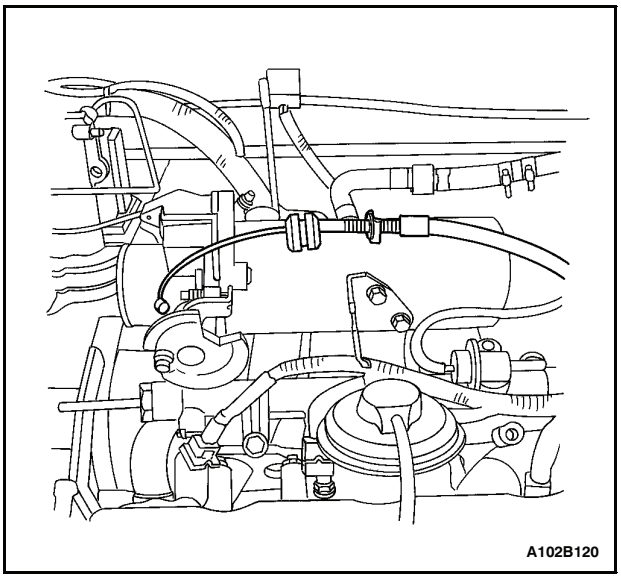
7. Install the alternator drive belt.


A102B032

8. Install the fuel rail and the fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
9. Install the fuel rail retaining bolts.

Tighten

Tighten the fuel rail retaining bolts to 25 NSm (18 lb-ft).

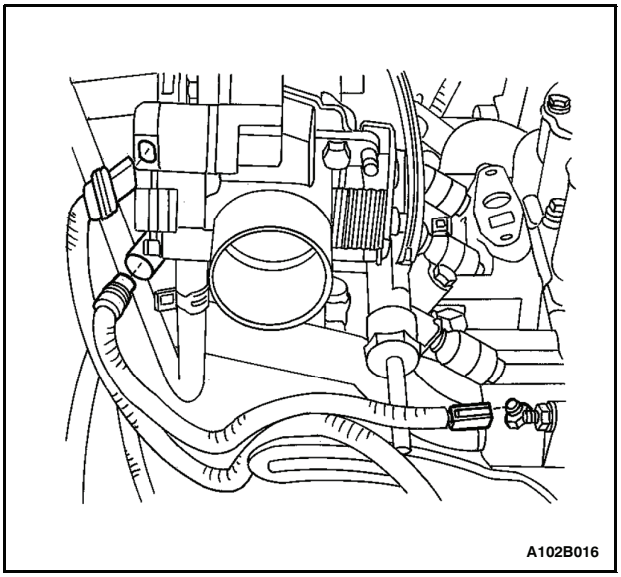

A102B120

10. Connect the fuel return line to the fuel pressure regulator.
11. Connect the fuel feed line to the fuel rail.
12. Install the throttle cable bracket and the two throttle cable bracket bolts.

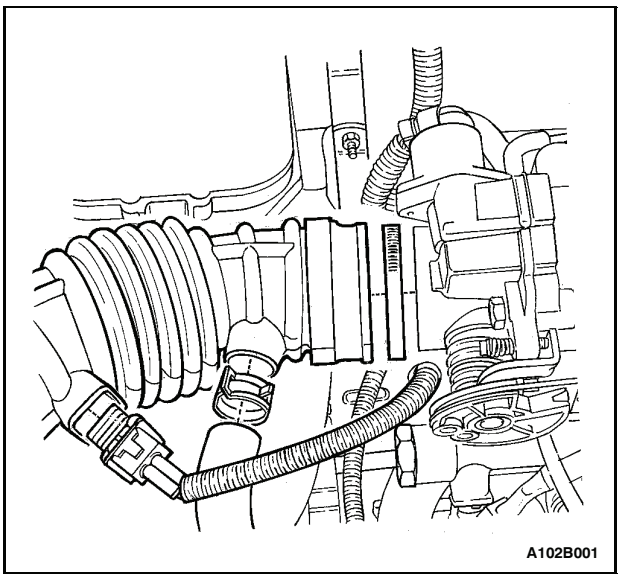
Tighten

Tighten the throttle cable bracket bolts to 8 NSm (71 lb-in).

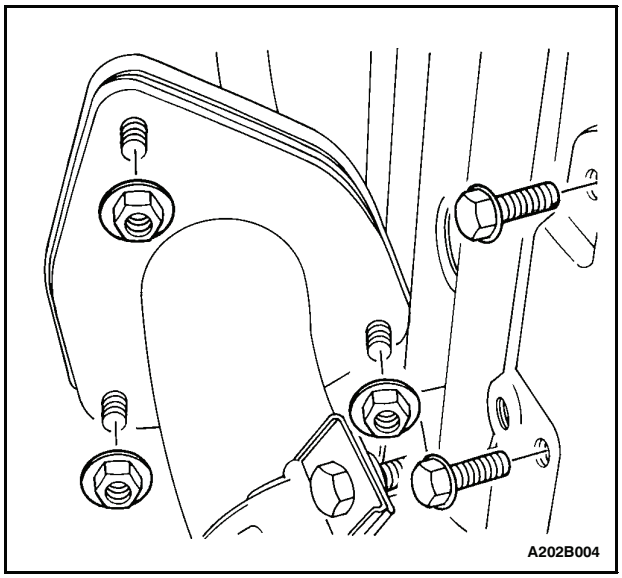
13. Connect the throttle cable to the intake manifold and the throttle body.


A102B016

14. Connect the fuel injector connectors to the fuel injectors.
15. Connect all of the vacuum lines that were previously disconnected.
16. Connect the heater inlet hose to the coolant distributor beneath the intake manifold.
17. Connect the surge tank coolant hose to the throttle body.
18. Connect the engine coolant temperature sensor connector.
19. Connect the idle air control valve connector.
20. Connect the throttle position sensor connector.


A102B001

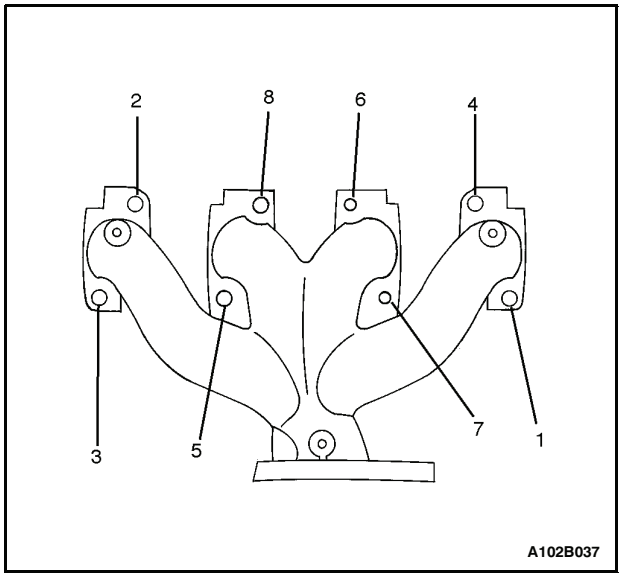
21. Connect the air intake tube to the throttle body.
22. Connect the manifold air temperature sensor connector.
23. Connect the ECM ground terminal to the intake manifold.
24. Connect the negative battery cable.
25. Install the fuel pump fuse.
26. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.


A202B004

EXHAUST MANIFOLD

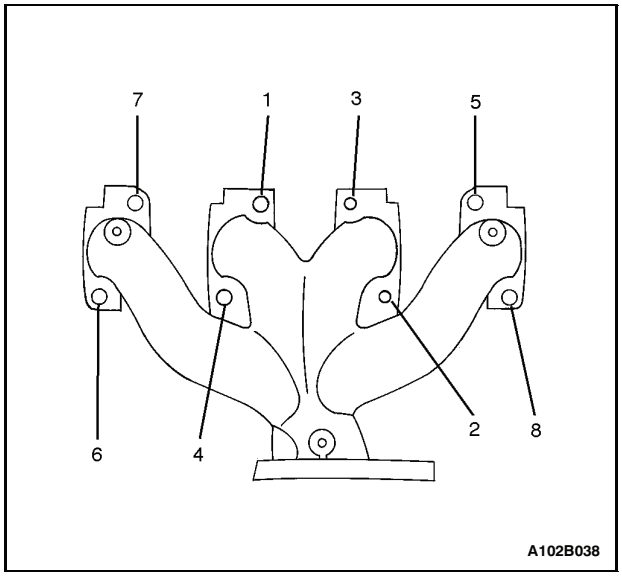
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition wires from the spark plugs.
3. Disconnect the oxygen sensor.
4. Remove the exhaust manifold heat shield bolts.
5. Remove the exhaust manifold heat shield.
6. Remove the nuts from the exhaust flex pipe flange and the bracket bolts.



A102B037

7. Remove the eight exhaust manifold nuts in the sequence shown.
8. Remove the exhaust manifold.
9. Remove the exhaust manifold gasket.
10. Clean the sealing surfaces of the exhaust manifold and the cylinder head.



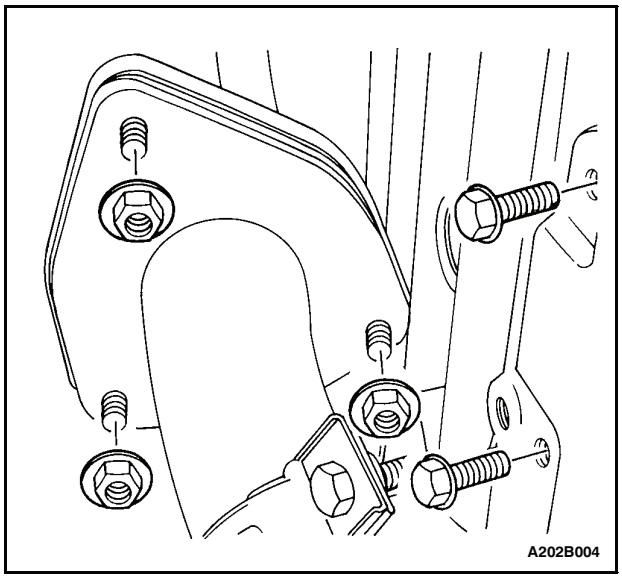
A102B038

Installation Procedure

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.
3. Install the eight exhaust manifold nuts and torque in the sequence shown.

Tighten

Tighten the exhaust manifold nuts 25 NSm (18 lb-ft).


A202B004

4. Install the exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts.

Tighten

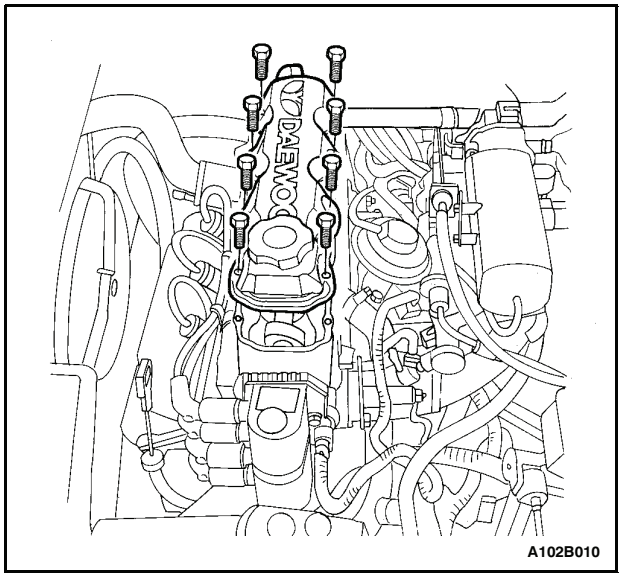
Tighten the three exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts to 40 NSm (30 lb-ft).

5. Install the manifold heat shield.
6. Install the exhaust manifold heat shield bolts.

Tighten

Tighten the exhaust manifold heat shield bolts to 15 NSm (11 lb-ft).

7. Connect the oxygen sensor.
8. Connect the ignition wires to the spark plugs.
9. Connect the negative battery cable.

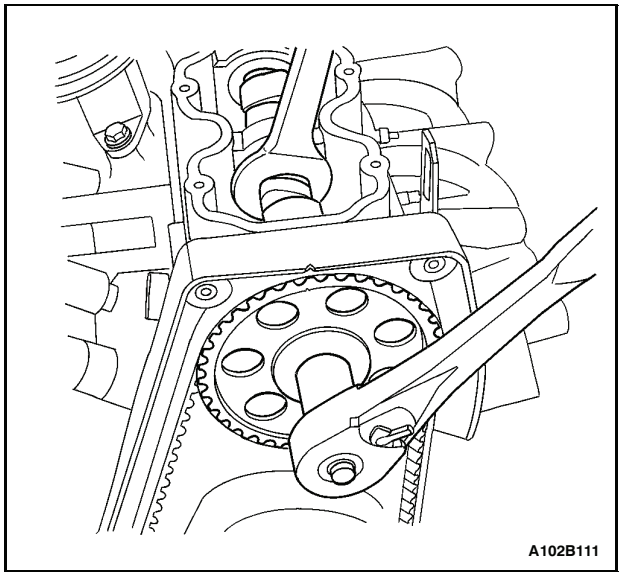


A102B010

CAMSHAFT GEAR

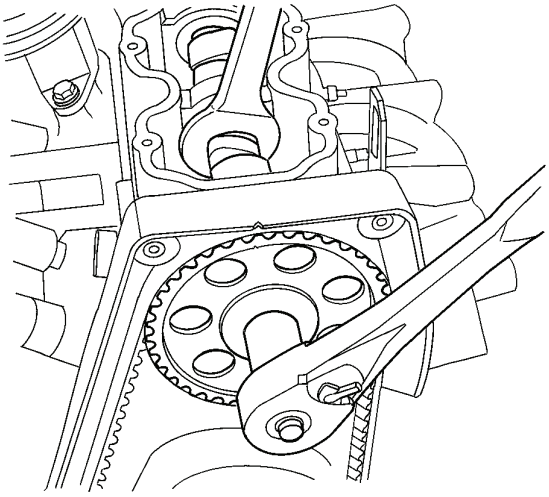
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.
3. Remove the valve cover bolts.
4. Remove the valve cover.


A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

5. While holding the camshaft firmly in place, remove the camshaft gear bolt.
6. Remove the camshaft gear.


A102B111

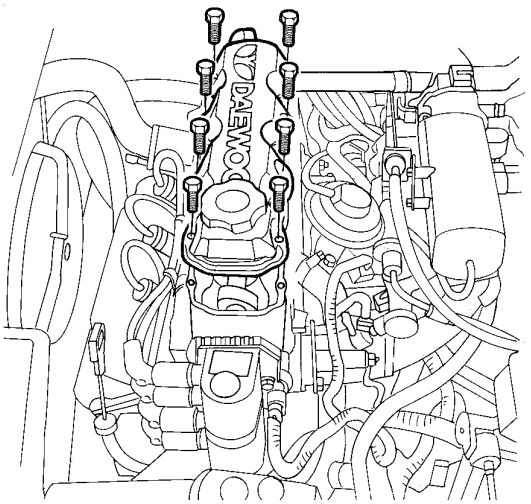
Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

1. Install the camshaft gear.
2. While holding the camshaft firmly in place, install the camshaft gear bolt.

Tighten

Tighten the camshaft gear bolt to 45 NSm (33 lb-ft).



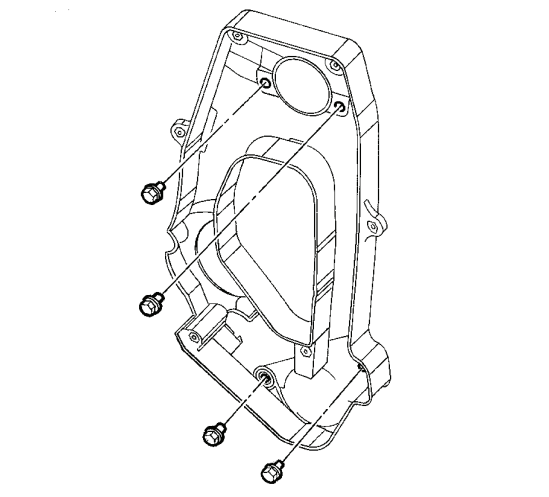
A102B010

3. Install the valve cover.
4. Install the valve cover bolts.

Tighten

Tighten the valve cover bolts to 10 NSm (89 lb-in).

5. Install the timing belt. Refer to "Timing Belt" in this section.
6. Connect the negative battery cable.


A102B046

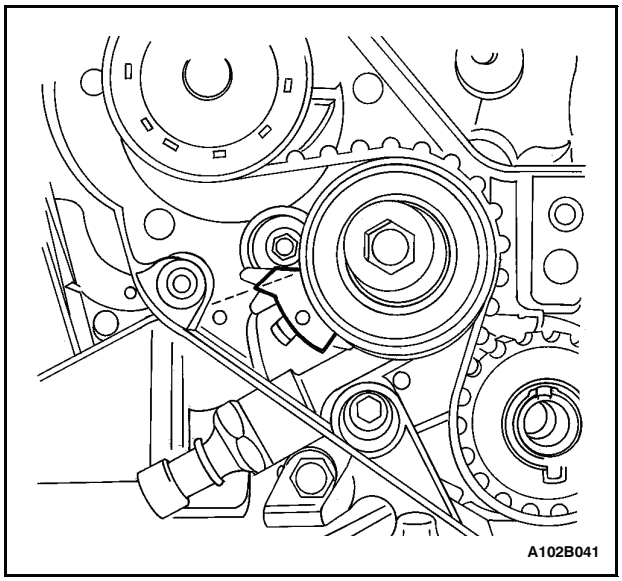
REAR TIMING BELT COVER

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

3. Remove the camshaft gear. Refer to "Camshaft Gear" in this section.
4. Remove the timing belt automatic tensioner bolt.
5. Remove the timing belt automatic tensioner.
6. Remove the rear timing belt cover bolts.
7. Remove the rear timing belt cover.



Installation Procedure

1. Install the rear timing belt cover.
2. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).

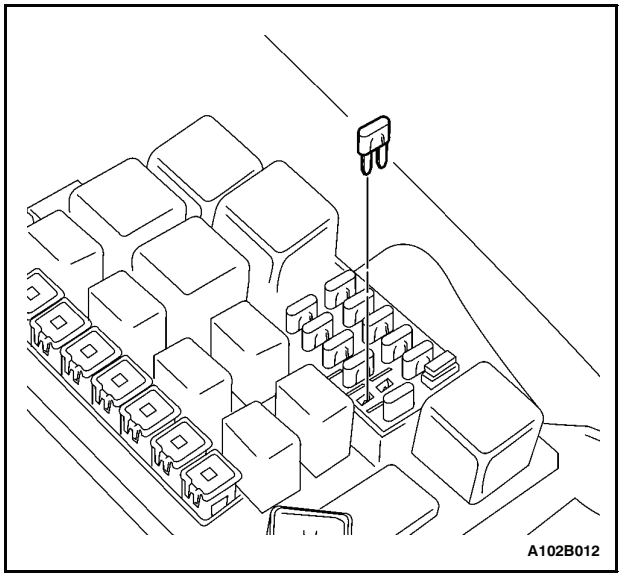
3. Install the timing belt automatic tensioner.
4. Install the timing belt automatic tensioner bolt.

Tighten

Tighten the timing belt automatic tensioner bolt to 20 NSm (15 lb-ft).

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

5. Install the camshaft gear. Refer to "Camshaft Gear" in this section.
6. Install the timing belt. Refer to "Timing Belt" in this section.
7. Connect the negative battery cable.



ENGINE

(Left-Hand Drive Shown, Right Hand Drive Similar)

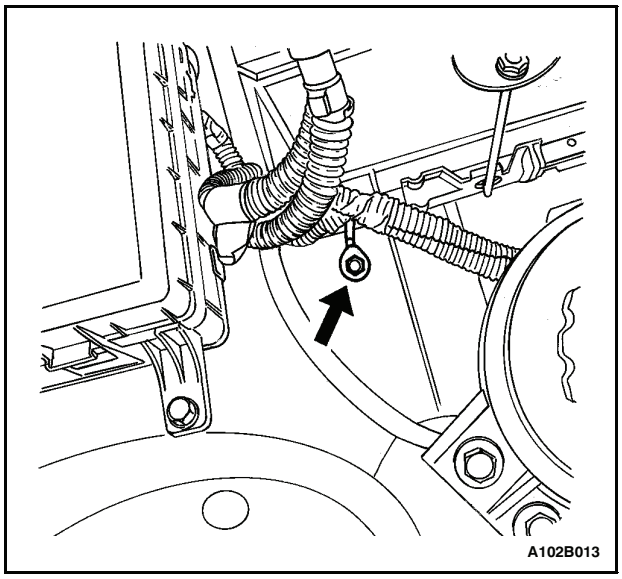
Tools Required

KM-470-B Angular Torque Gauge

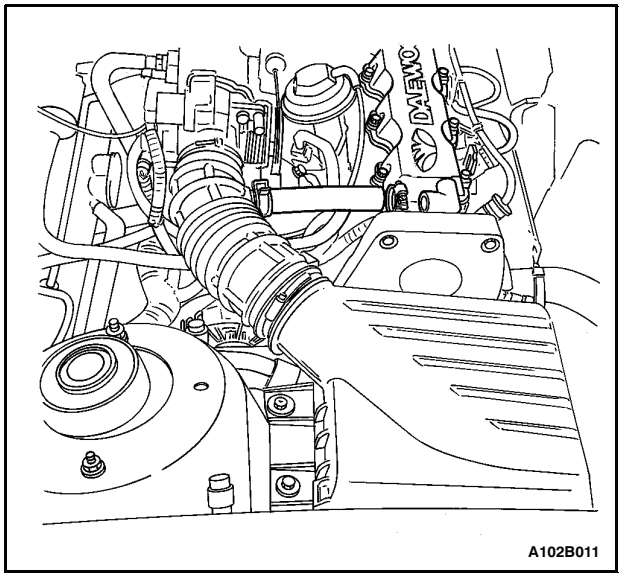
Removal Procedure

Important: On vehicles equipped with a manual transaxle, the manual transaxle must be removed before engine removal. Refer to Section 5B, Five-Speed Manual Transaxle.

1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Remove the hood. Refer to Section 9R, Body Front End.
4. Drain the engine oil.

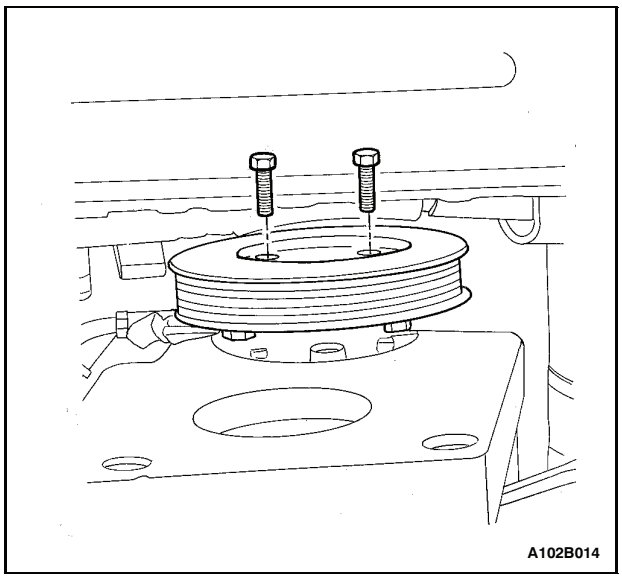

A102B013

5. Disconnect the negative battery cable.
6. Disconnect and separate the battery positive cable.
7. Disconnect the negative battery cable from the vehicle frame.

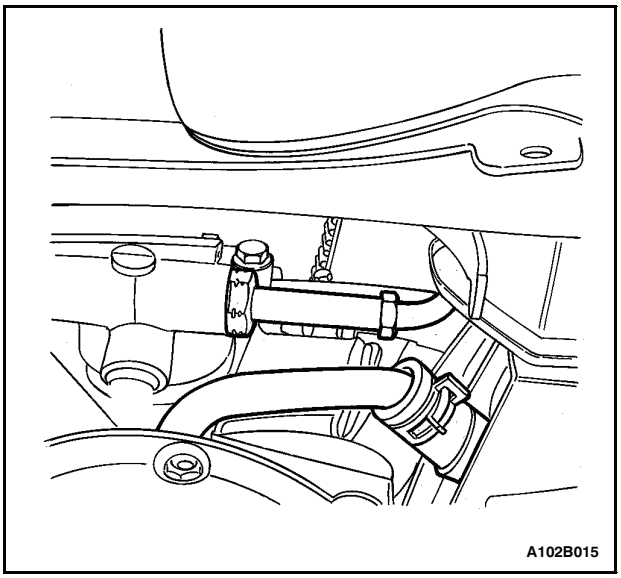


A102B011

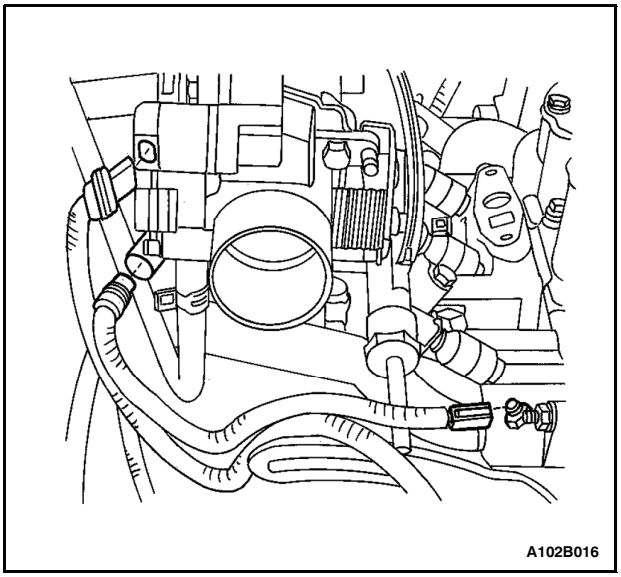
8. Discharge the air conditioning (A/C) system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
9. Disconnect the manifold air temperature sensor connector.
10. Remove the air intake tube from the throttle body and the air filter housing.
11. Disconnect the breather tube from the valve cover.


A102B014

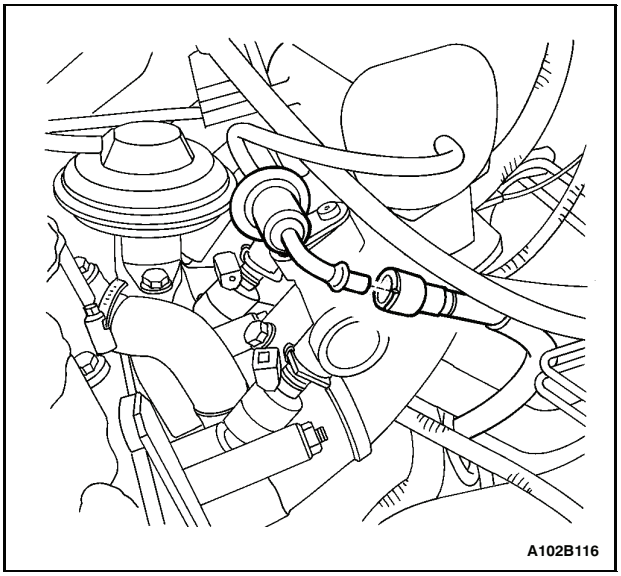
12. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
13. Remove the right front wheel well splash shield.
14. Remove the A/C compressor drive belt, if equipped.
15. Remove the alternator drive belt.
16. Remove the power steering pump pulley bolts.
17. Remove the power steering pump pulley.


A102B015

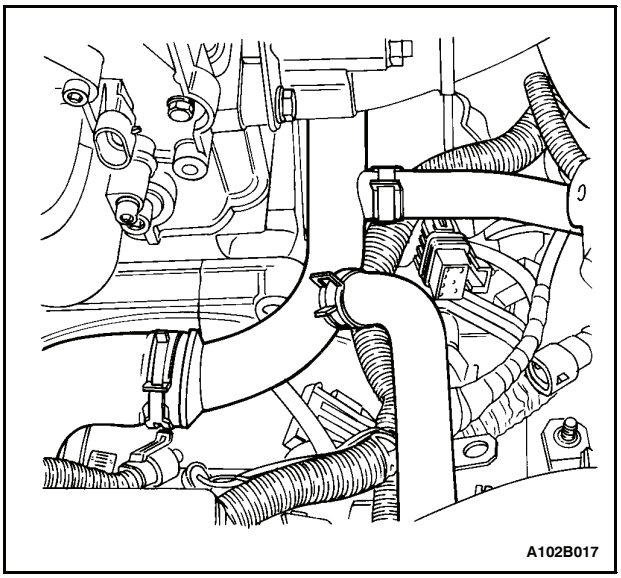
18. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
19. Remove the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
20. Disconnect the upper radiator hose from the thermostat housing.
21. Disconnect the coolant surge tank hose from the radiator.
22. Disconnect the power steering return hose from the power steering pump, if equipped.
23. Drain the power steering system, if equipped.
24. Disconnect the power steering pressure hose from the power steering pump, if equipped.


A102B016

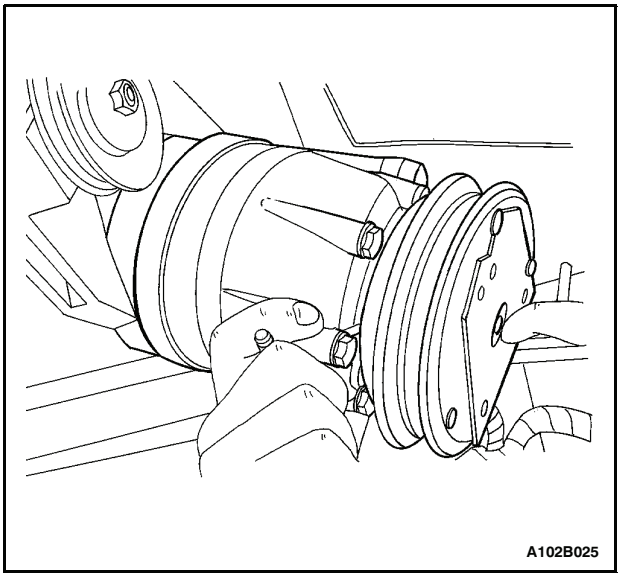
25. Disconnect the electrical connector at the direct ignition system (DIS) ignition coil, and the engine control module (ECM) ground terminal at the intake manifold and at the starter motor.
26. Disconnect the oxygen sensor connector.
27. Disconnect the electrical connectors at the fuel injectors.
28. Disconnect the idle air control valve connector.
29. Disconnect the throttle position sensor connector.
30. Disconnect the engine coolant temperature sensor connector.
31. Disconnect the coolant temperature sensor connector and the knock sensor, if equipped.


A102B116

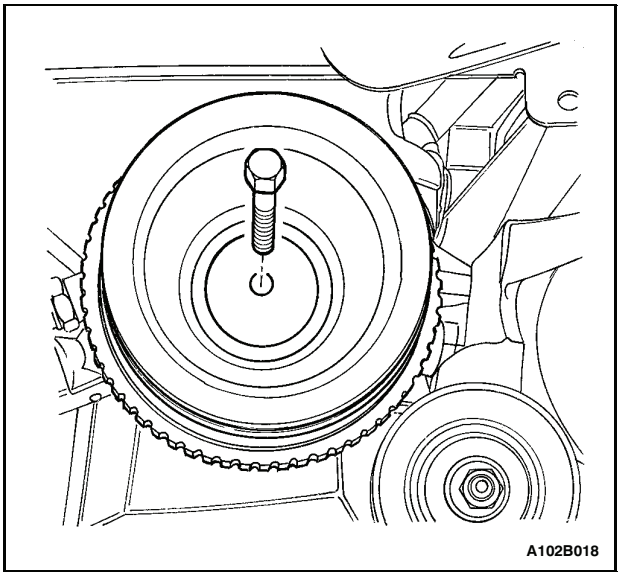
32. Disconnect the alternator voltage regulator connector.
33. Disconnect all of the necessary vacuum lines, including the brake booster vacuum hose.
34. Disconnect the fuel return line at the fuel pressure regulator.
35. Disconnect the fuel feed line at the fuel rail.
36. Disconnect the throttle cable from the throttle body and the intake manifold bracket.


A102B017

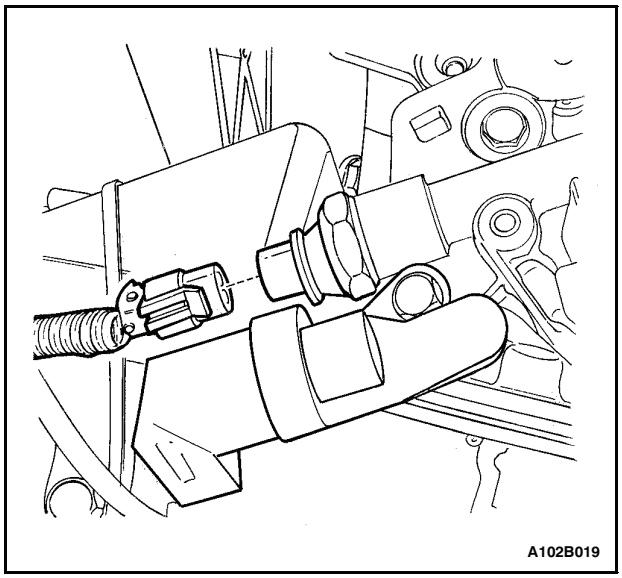
37. Disconnect the surge tank coolant hose at the throttle body.
38. Disconnect the heater inlet hose from the coolant distributor.
39. Disconnect the heater outlet hose at the coolant pipe.
40. Disconnect the surge tank coolant hose from the coolant pipe.
41. Disconnect the lower radiator hose at the coolant pipe.


A102B025

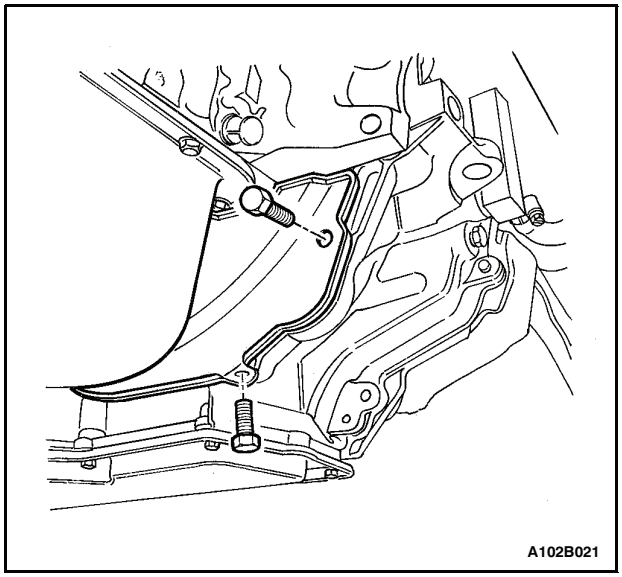
42. Disconnect the starter solenoid "S" terminal wire.
43. Remove the A/C compressor hose assembly retaining bolt.
44. Disconnect the A/C compressor hose assembly from the compressor.
45. Disconnect the A/C compressor coil connector.
46. Remove the A/C compressor mounting bolts.
47. Remove the A/C compressor.
48. Remove the A/C compressor mounting bracket bolts.
49. Remove the A/C compressor mounting bracket from the engine block.


A102B018

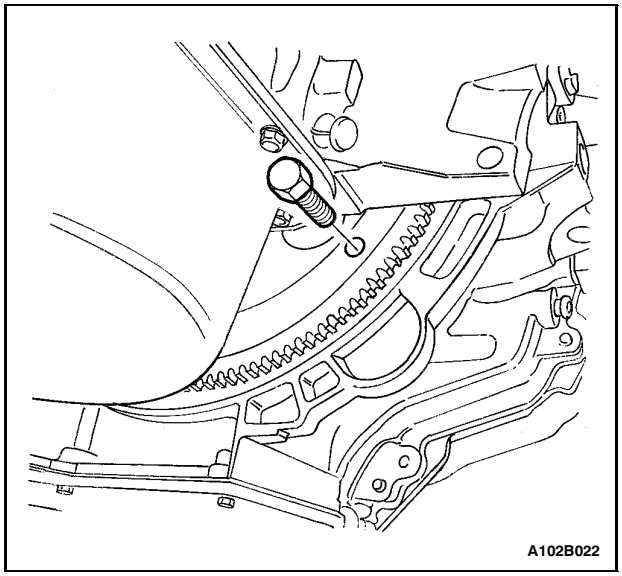
50. Remove the exhaust flex pipe retaining nuts from the exhaust manifold.
51. Remove the exhaust flex pipe retaining nuts from the catalytic converter or connecting pipe.
52. Remove the exhaust flex pipe.
53. Remove the engine crankshaft pulley bolt.
54. Remove the engine crankshaft pulley.


A102B019

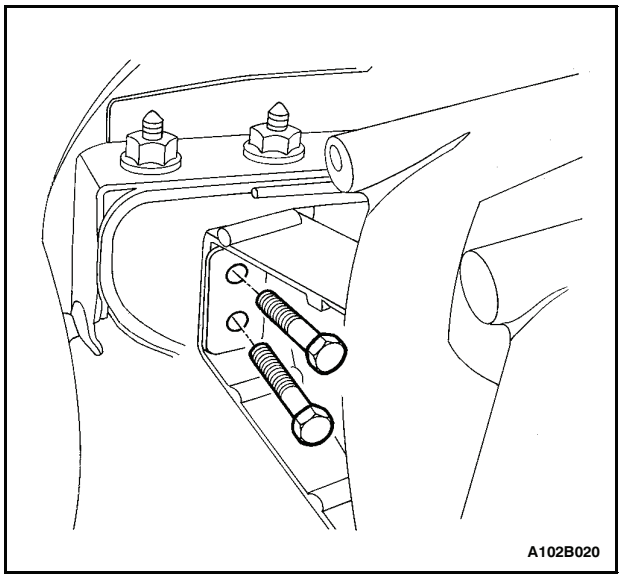
55. Disconnect the vacuum lines at the charcoal canister purge and exhaust gas recirculation (EGR) solenoid.
56. Disconnect the electrical connector at the charcoal canister purge solenoid and the knock sensor.
57. Disconnect the electrical connector at the oil pressure switch.
58. Disconnect the crankshaft position sensor connector.
59. Remove the crankshaft position sensor retaining bolt.
60. Remove the crankshaft position sensor.
61. Remove the right transaxle brace bolts from the transmission.


A102B021

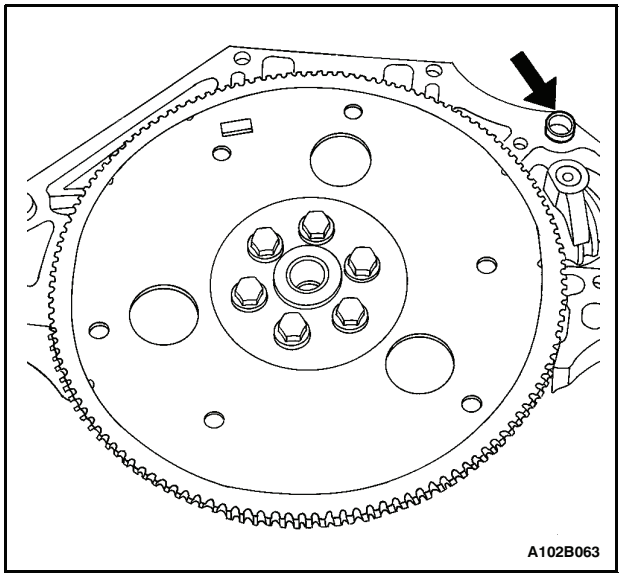
62. Remove the flywheel or the flexible plate inspection cover bolts.
63. Remove the flywheel or the flexible plate inspection cover.


A102B022

64. Remove the transaxle torque converter bolts on vehicles with an automatic transaxle.



65. Remove the transaxle bell housing bolts.
66. Support the transaxle with a floor jack.
67. Install the engine lifting device.
68. Disconnect the right engine mount bracket from the rubber engine mount by removing the two retaining bolts.
69. Remove the right engine mount bracket from the engine block.
70. Separate the engine block from the transaxle.
71. Remove the engine.
72. Transfer any necessary parts.

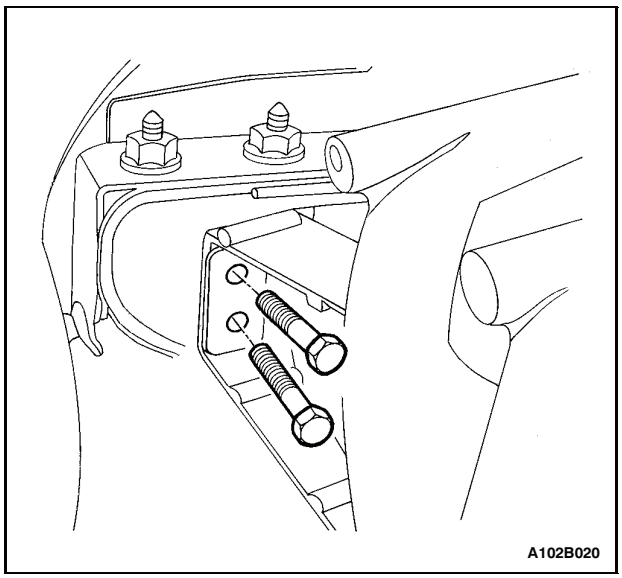


Installation Procedure

1. Install the engine into engine compartment.
2. Align the transaxle alignment pins to the transaxle.
3. Install the transaxle bell housing bolts.

Tighten

Tighten the transaxle bell housing bolts to 75 NSm (55 lb-ft).



4. Install the right engine mount bracket to the engine block.
5. Install the right engine mount bracket retaining bolts to the engine block.

Tighten

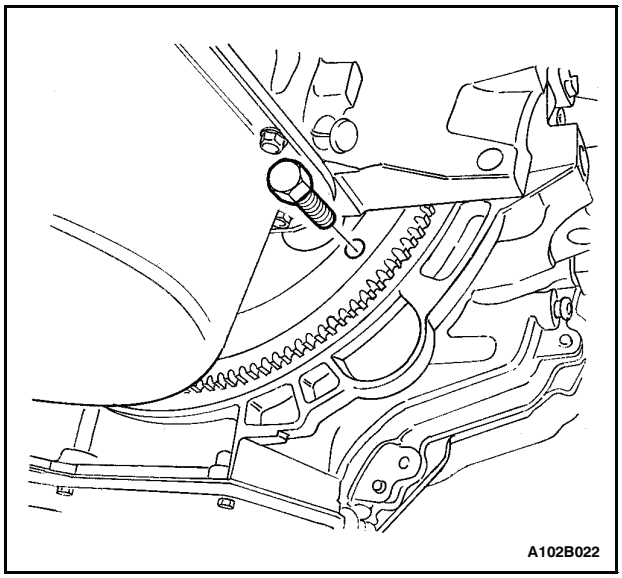
Tighten the engine mount bracket retaining bolts to 60 NSm (44 lb-ft).

6. Install the engine mount-to-bracket retaining bolts.

Tighten

Tighten the engine mount bracket-to-engine mount retaining bolts to 60 NSm (44 lb-ft).

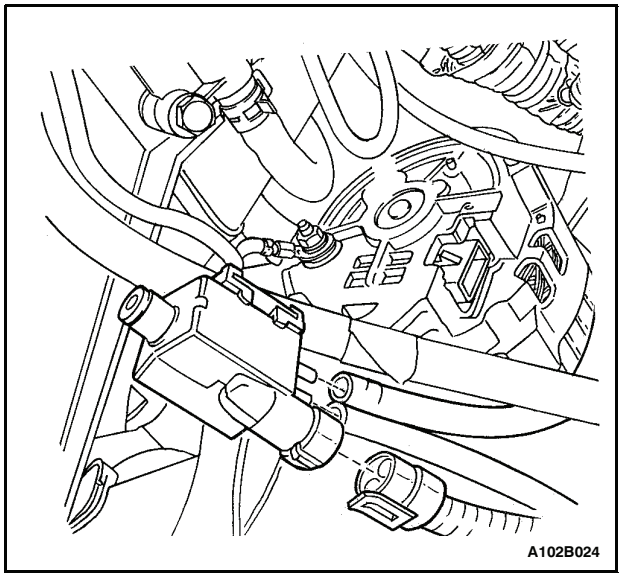
7. Remove the floor jack used for support of the transaxle.
8. Remove the engine lifting device.


A102B022

9. Install the transaxle torque converter bolts, if the vehicle has an automatic transaxle.

Tighten

Tighten the transaxle torque converter bolts to 45 NSm (33 lb-ft).


A102B024

10. Install the flywheel or the flexible plate inspection cover.
11. Install the flywheel or the flexible plate inspection cover bolts.

Tighten

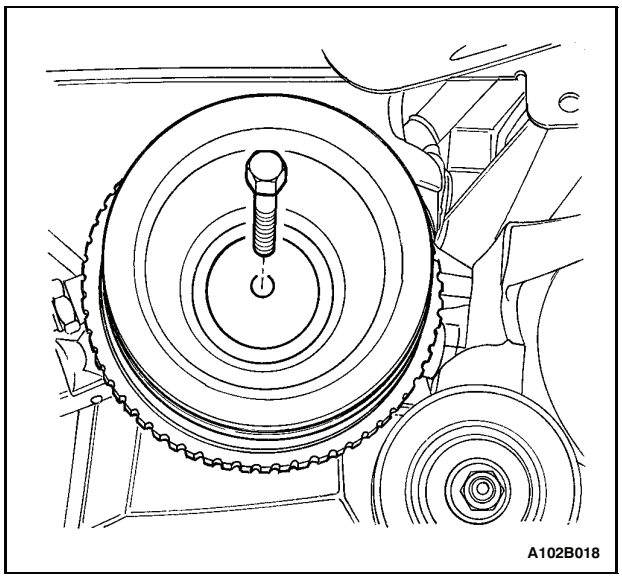
Tighten the flywheel inspection cover bolts to 12 NSm (106 lb-in) or the flexible plate inspection cover bolts to 10 NSm (89 lb-in).

12. Install the right transaxle brace bolts to the transaxle.

Tighten

Tighten the right transaxle brace bolts to 60 NSm (45 lb-ft).

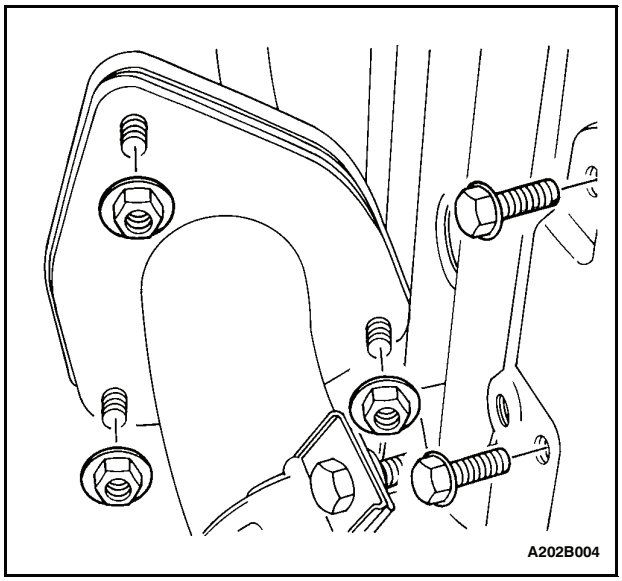
13. Connect the vacuum lines at the charcoal canister purge and EGR solenoid.
14. Connect the electrical connectors at the charcoal canister purge and EGR solenoids.


A102B018

15. Connect the oil pressure switch connector.
16. Install the crankshaft pulley.
17. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt another 30 degrees plus 15 degrees.


A202B004

18. Install the crankshaft position sensor and the crankshaft position sensor retaining bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 NSm (89 lb-in).

19. Connect the crankshaft position sensor connector.
20. Install the exhaust flex pipe.
21. Install the exhaust flex pipe-to-catalytic converter retaining nuts.

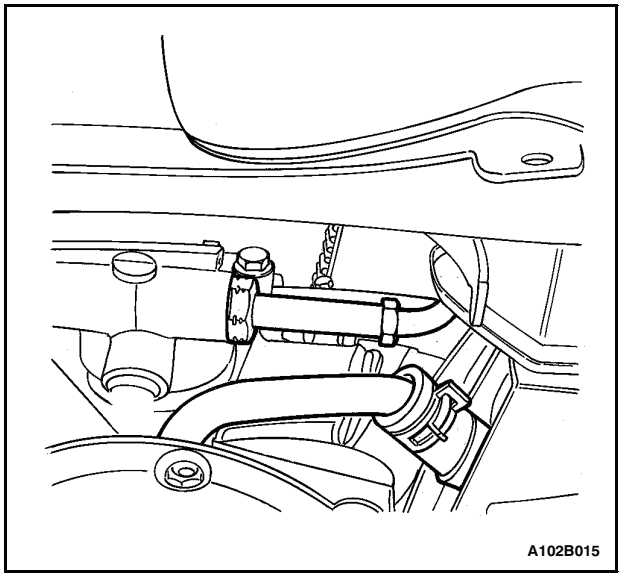
Tighten

Tighten the exhaust flex pipe-to-catalytic converter or connecting pipe retaining nuts to 30 NSm (22 lb-ft).

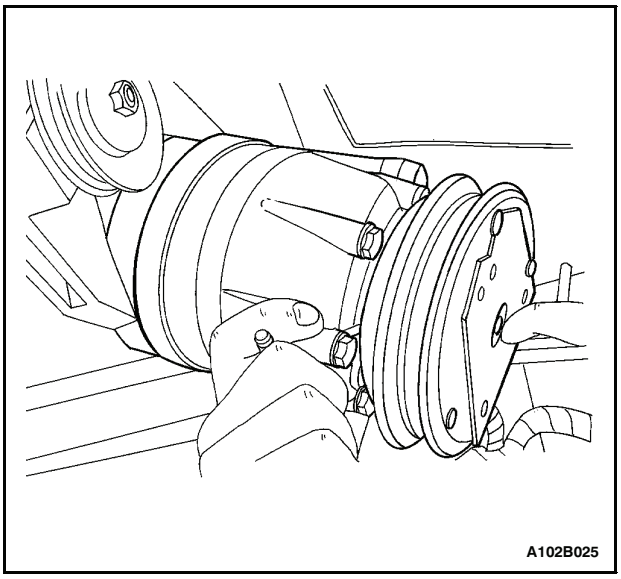
22. Install the exhaust flex pipe-to-exhaust manifold retaining nuts and the bracket bolts.

Tighten

Tighten the exhaust flex pipe to exhaust manifold retaining nuts and the bracket bolts to 40 NSm (30 lb-ft).


A102B015

23. Connect the power steering pressure hose, if equipped.
24. Connect the power steering return hose, if equipped.


A102B025

25. Install the A/C compressor mounting bracket, if equipped.
26. Install the A/C compressor mounting bracket bolts, if equipped.

Tighten

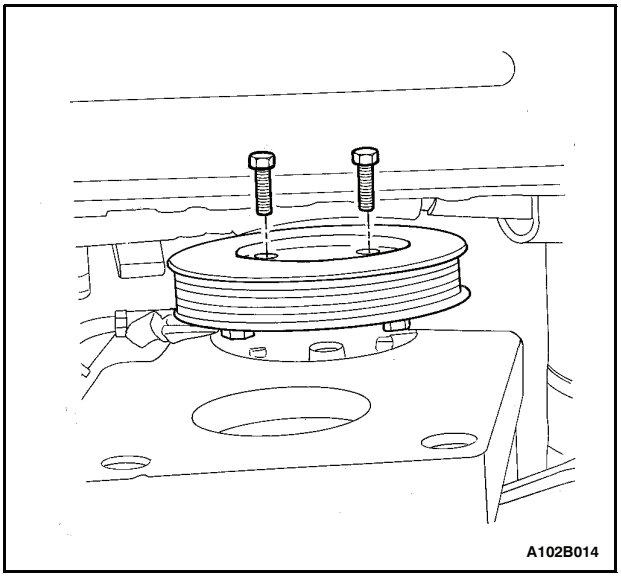
Tighten the A/C compressor mounting bracket bolts to 50 NSm (36 lb-ft).

27. Install the A/C compressor, if equipped.
28. Install the A/C compressor mounting bolts, if equipped.

Tighten

Tighten the A/C compressor mounting bolts to 27 NSm (20 lb-ft).

29. Connect the A/C compressor coil connector.
30. Install the alternator drive belt.
31. Install the A/C compressor drive belt, if equipped.


A102B014

32. Connect the A/C compressor hose assembly and the A/C compressor hose assembly retaining bolt, if equipped.

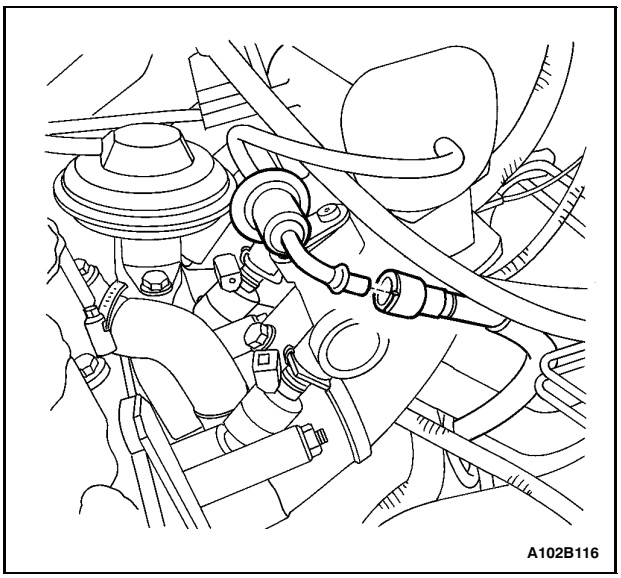
Tighten

Tighten the A/C compressor hose assembly retaining bolt to 33 NSm (24 lb-ft).

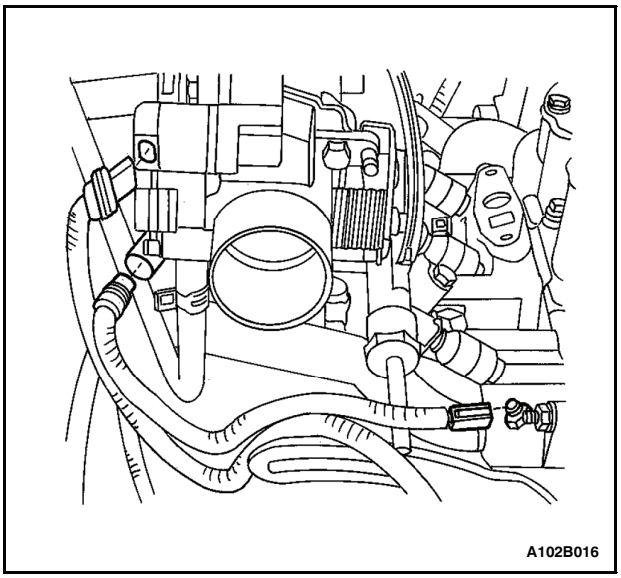
33. Install the power steering pump pulley, if equipped.
34. Install the power steering pump pulley bolts, if equipped.

Tighten

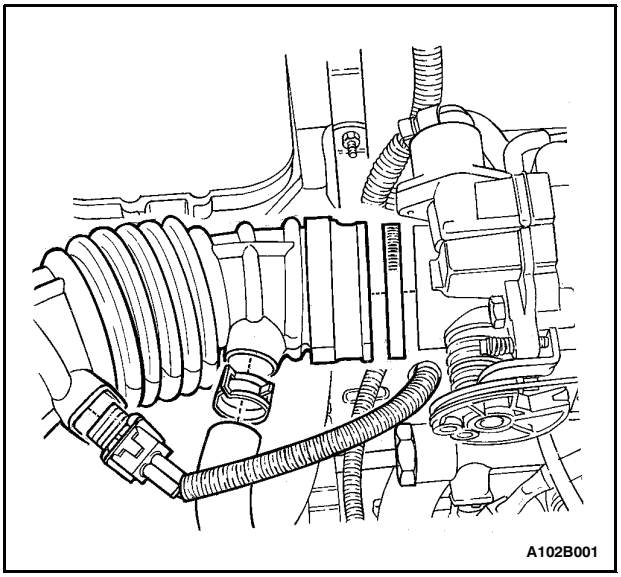
Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).


A102B116

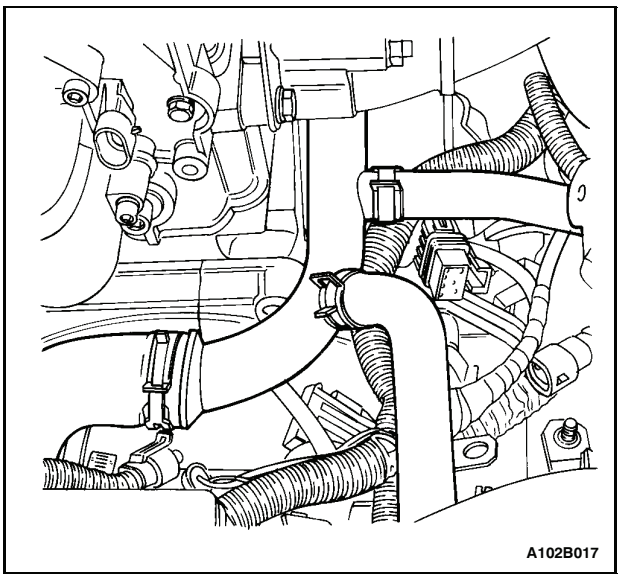
35. Install the right front wheel well splash shield.
36. Install the right front wheel. Refer to Section 2E, Tires and Wheels
37. Connect the fuel feed line to the fuel rail.
38. Connect the fuel return line to the fuel pressure regulator.
39. Connect all of the necessary vacuum lines, including the brake booster vacuum hose.


A102B016

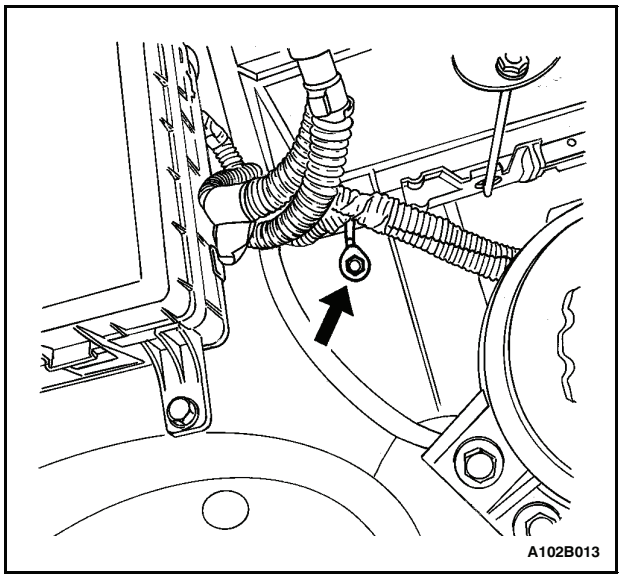
40. Connect the oxygen sensor connector.
41. Connect the starter solenoid "S" terminal wire.
42. Connect the alternator voltage regulator connector.
43. Connect the coolant temperature sensor connector.
44. Connect the engine coolant temperature sensor connector and the knock sensor connector, if equipped.
45. Connect the throttle position sensor connector.
46. Connect the idle air control valve connector.


A102B001

47. Connect the electrical connectors at the fuel injectors.
48. Connect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold.
49. Install the air intake tube between the throttle body and the air filter housing.
50. Connect the breather tube to the valve cover.
51. Connect the manifold air temperature sensor connector.


A102B017

52. Install the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
53. Connect the lower radiator hose to the coolant pipe.
54. Connect the upper radiator hose to the thermostat housing.
55. Connect the coolant surge tank hose to the radiator.
56. Connect the heater outlet hose to the coolant pipe.
57. Connect the heater inlet hose to the coolant distributor.
58. Connect the coolant surge tank hose to the coolant pipe.
59. Connect the surge tank coolant hose to the throttle body.


A102B013

60. Connect the throttle cable to the throttle body and the intake manifold bracket.
61. Install the fuel pump fuse.
62. Connect the negative battery cable to the vehicle frame.
63. Connect the negative battery cable to the battery.
64. Connect and assemble the battery positive cable.
65. Refill the engine crankcase with engine oil.
66. Refill the engine coolant system. Refer to Section 1D, Engine Cooling.
67. Bleed the power steering system as necessary. Refer to Section 6A, Power Steering System.
68. Refill the A/C refrigerant system as necessary. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
69. Install the hood. Refer to Section 9R, Body Front End.

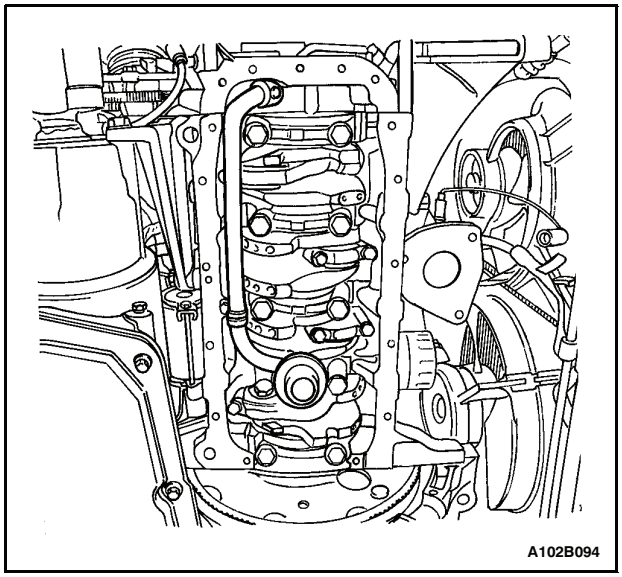
PISTONS AND RODS

Tools Required

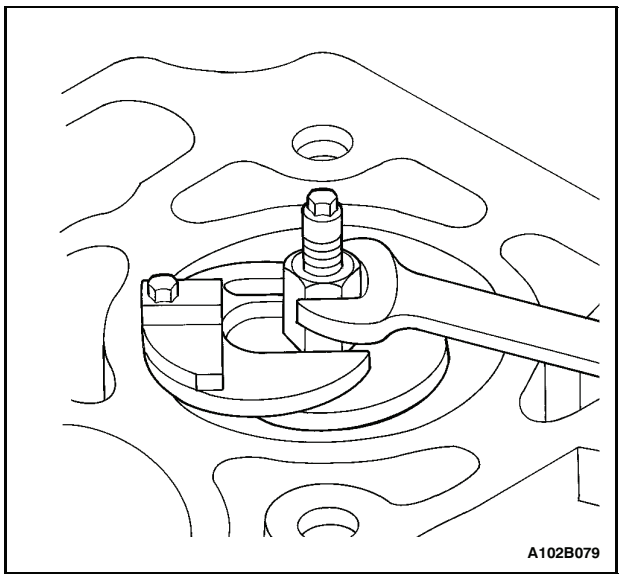
KM-427 Piston Pin Service Set

KM 470-B Angular Torque Gauge

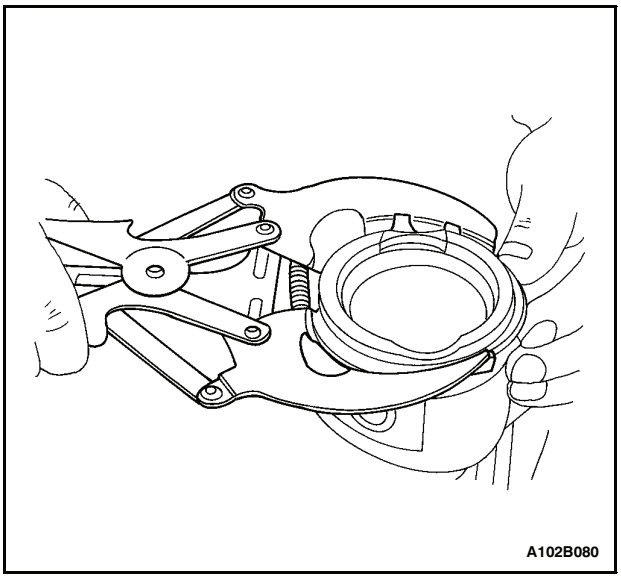
Removal Procedure


A102B094

1. Remove the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the oil pan. Refer to "Oil Pan" in this section.
3. Remove the oil pump/pickup tube bolts.
4. Remove the oil pump/pickup tube.

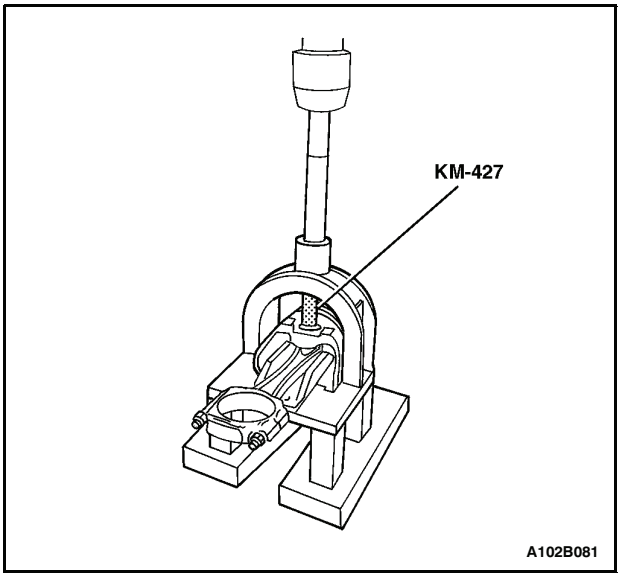

A102B079

5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.


A102B080

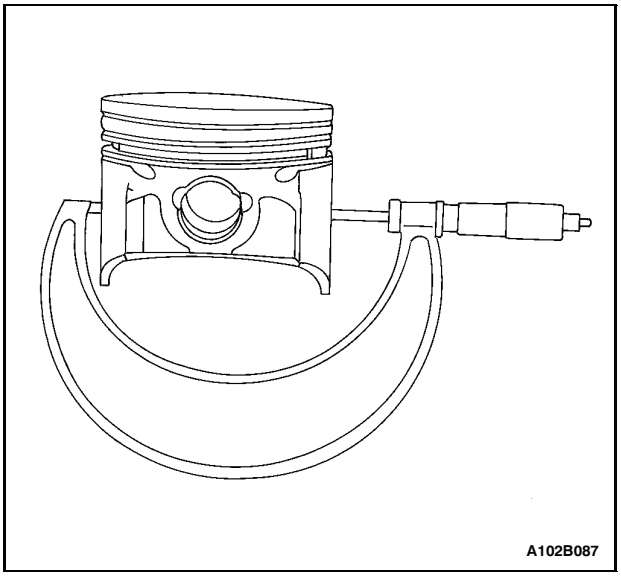
Caution: Use care when handling the piston. Worn piston rings are sharp and may cause injury.

11. Remove the piston.
12. Use a piston ring expander tool to expand the piston rings.
13. Remove the piston rings.



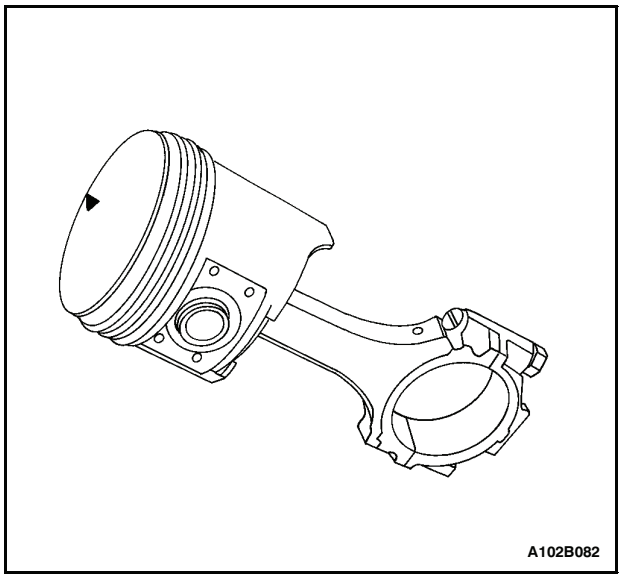
A102B081

14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.

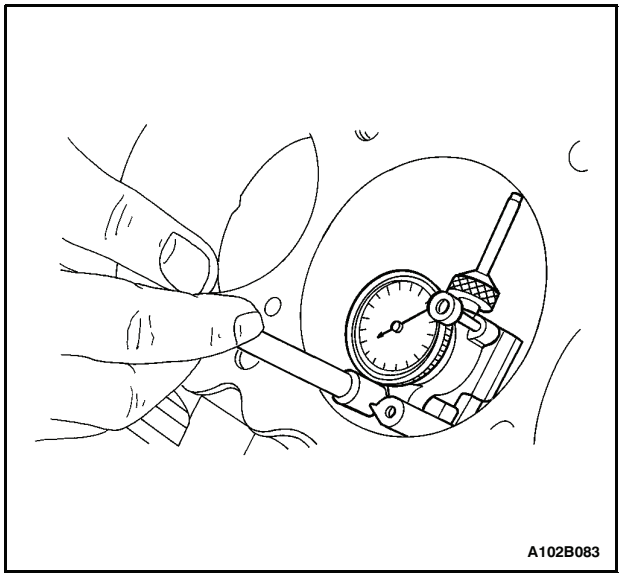

A102B087

Inspection Procedure

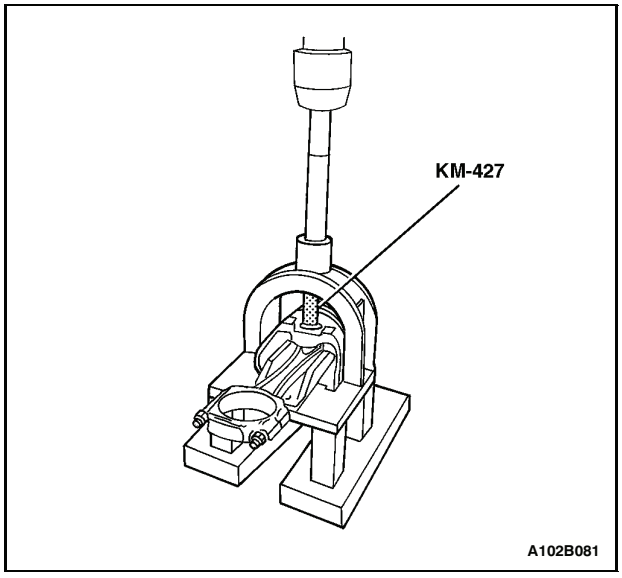
1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the piston for scoring, cracks and wear.
6. Inspect the piston for taper using a micrometer.


A102B082

7. Inspect the piston for fit to the connecting rod.


A102B083

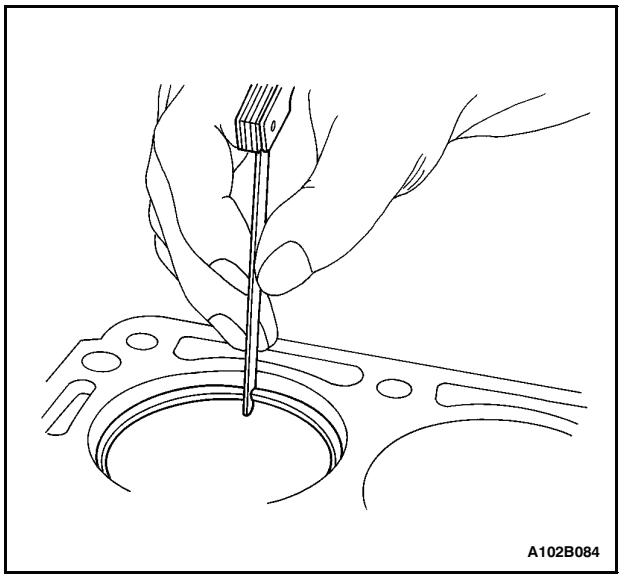
8. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to "Engine Specifications" in this section.
9. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to "Engine Specifications" in this section. If beyond specifications, replace the engine block.
10. Inspect the engine block cylinder bore for wear, run-out, ridging and taper using a bore gauge. Refer to "Engine Specifications" in this section.
11. Inspect the engine block cylinder bore for glazing. Lightly hone the cylinder bore as necessary.



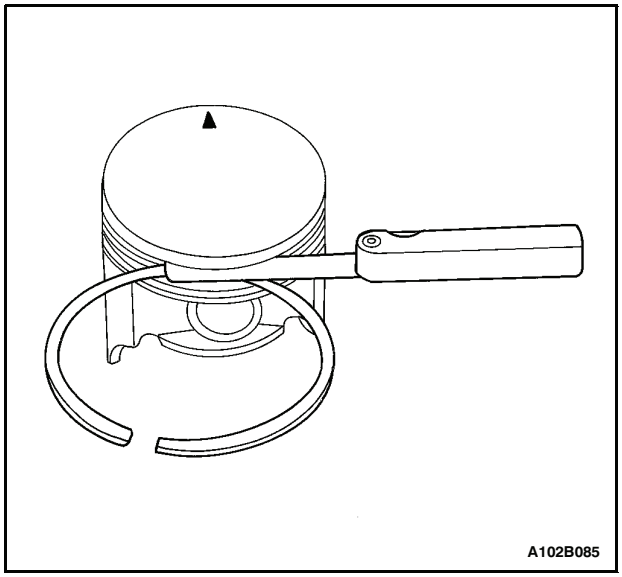
A102B081

Installation Procedure

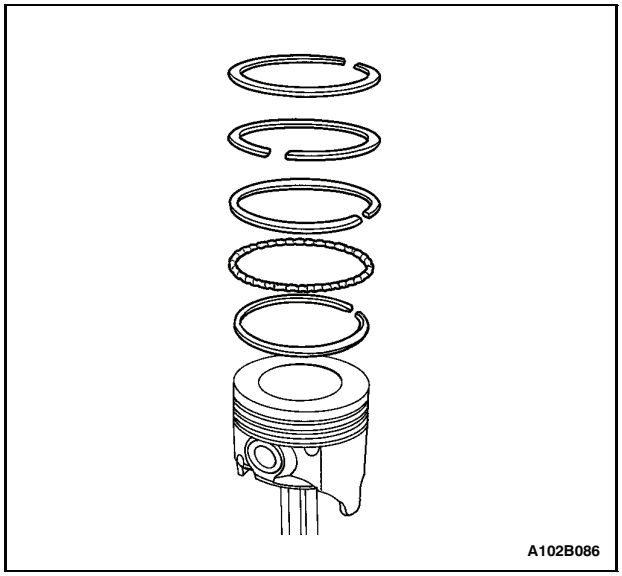
1. Align the notch on the piston and connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.
5. Install the piston pin into the piston and connecting rod assembly using the piston pin service set KM-427.


A102B084

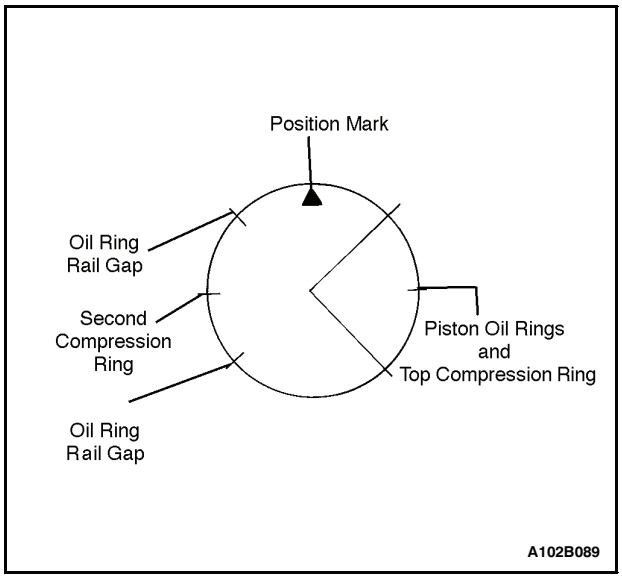
6. Select a set of new piston rings.
7. Measure the piston ring gap using a feeler gauge. Refer to "Engine Specifications" in this section.
8. Increase the piston ring gap by carefully filing off excess material if the piston ring gap is below specifications.


A102B085

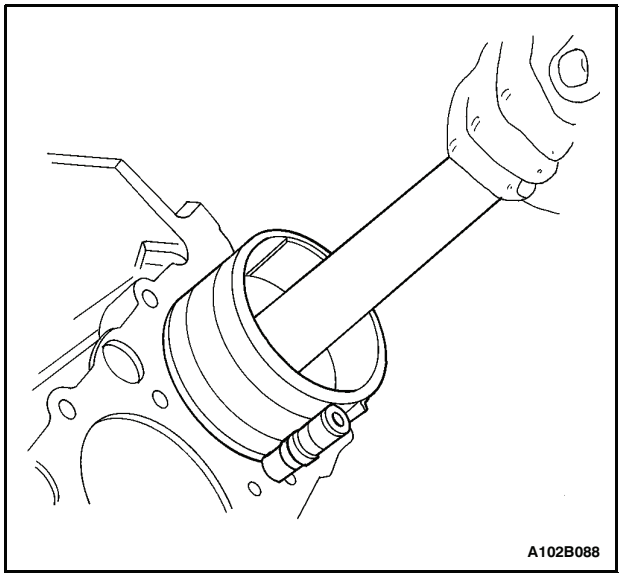
9. Measure the piston ring side clearance using a feeler gauge. Refer to "Engine Specifications" in this section.
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed on a sheet of glass.


A102B086

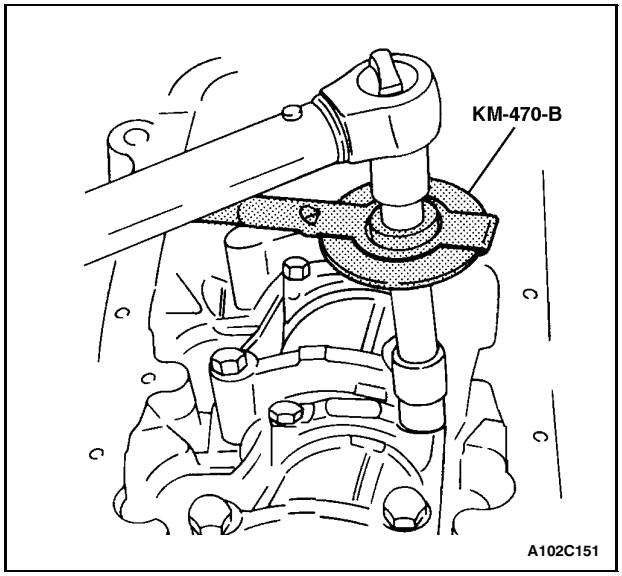
12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.



15. Use a piston ring expander to install the piston rings. Do not expand the piston rings beyond the expansion necessary for installation.
16. Stagger the piston oil rings, the oil ring rail gaps, the second compression ring, and the top compression ring in relation to the notch on the top of the piston.



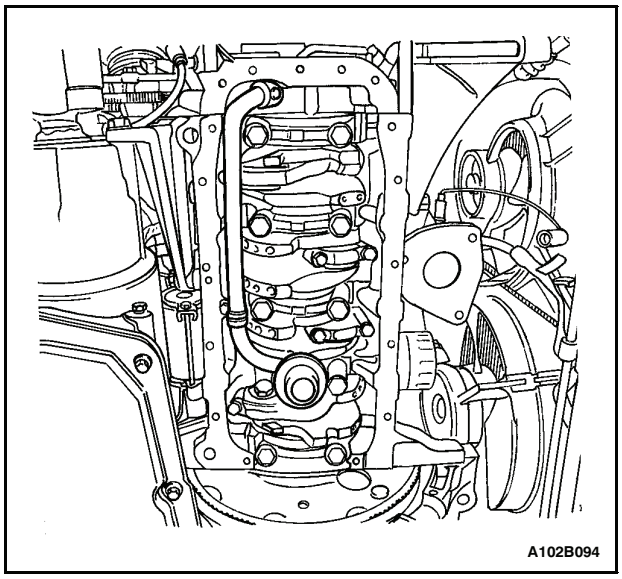
17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using a ring compressor and a wood handle. Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and the bearings. Refer to "Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic" in this section.



20. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM-470-B, tighten one turn of 30 degrees plus one turn of 15 degrees.

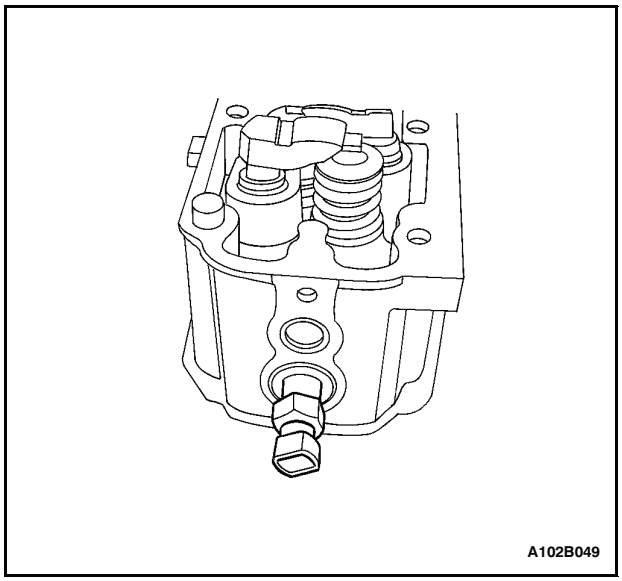

A102B094

21. Install the oil pump/pickup tube.
22. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 NSm (89 lb-in).

23. Install the oil pan. Refer to "Oil Pan" in this section.
24. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.


A102B049

UNIT REPAIR

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

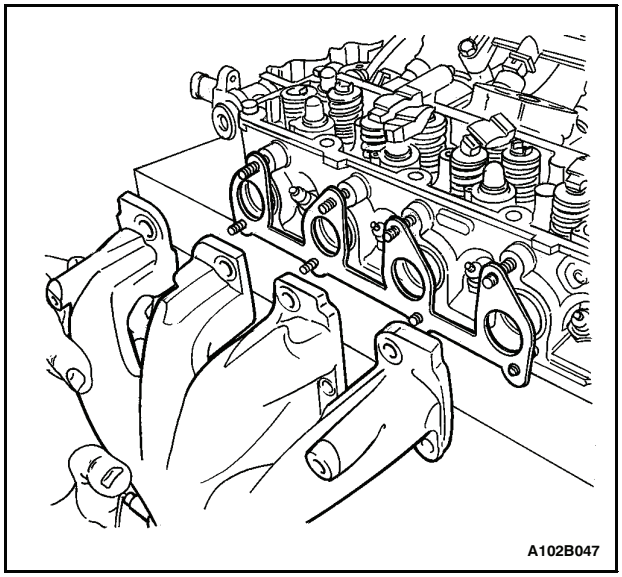
Tools Required

MKM-571-B Gauge
KM-253 Valve Guide Reamer
KM-254 Valve Guide Reamer
KM-255 Valve Guide Reamer
KM-340-0 Cutter Set
- **KM-340-7 Guide Drift**
- **KM-340-13 Cutter**
- **KM-340-26 Cutter**

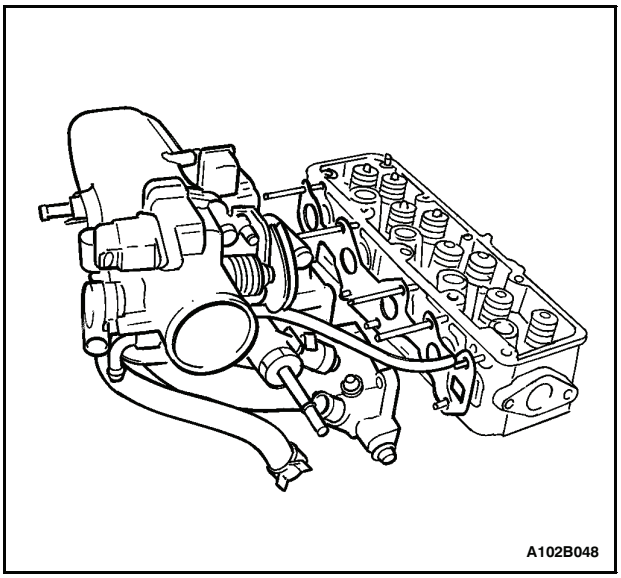
KM-348 Valve Spring Compressor
KM-419 Distance Gauge

Disassembly Procedure

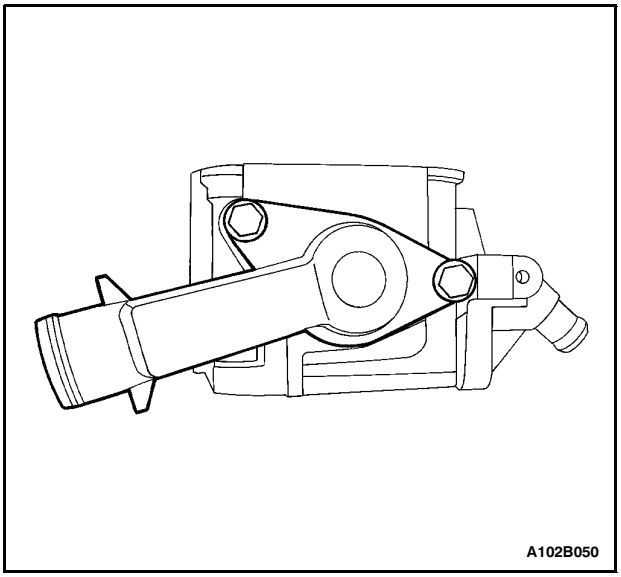
1. **Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.**
2. **Remove the coolant temperature sensor.**


A102B047

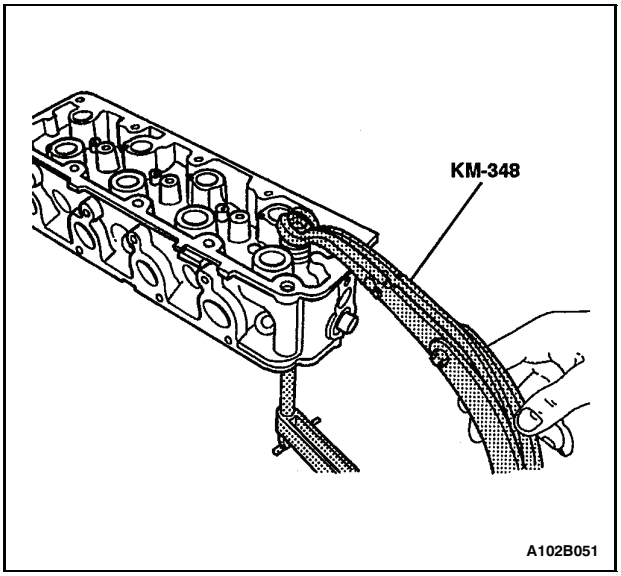
3. **Remove the exhaust manifold heat shield bolts.**
4. **Remove the exhaust manifold heat shield.**
5. **Remove the exhaust manifold nuts.**
6. **Remove the exhaust manifold.**
7. **Remove the exhaust manifold gasket.**
8. **Remove the exhaust manifold studs.**
9. **Remove the spark plugs.**


A102B048

10. Remove the intake manifold retaining nuts.
11. Remove the intake manifold.
12. Remove the intake manifold gasket.
13. Remove the intake manifold studs.

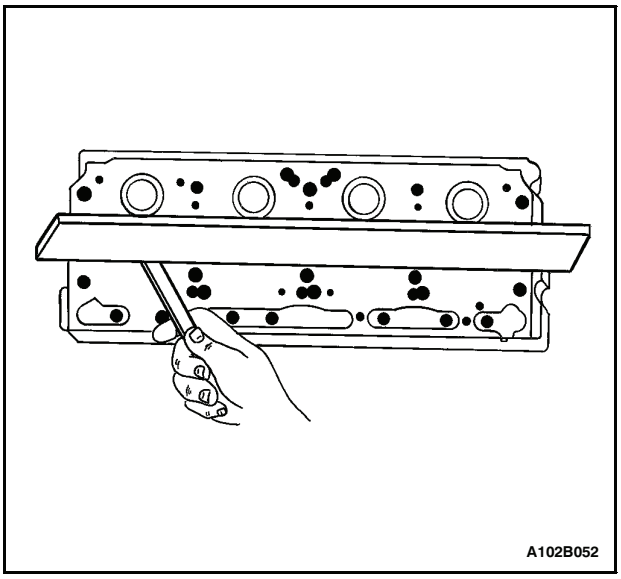

A102B050

14. Remove the thermostat housing mounting bolts.
15. Remove the thermostat housing.
16. Remove the thermostat and thermostat gasket.



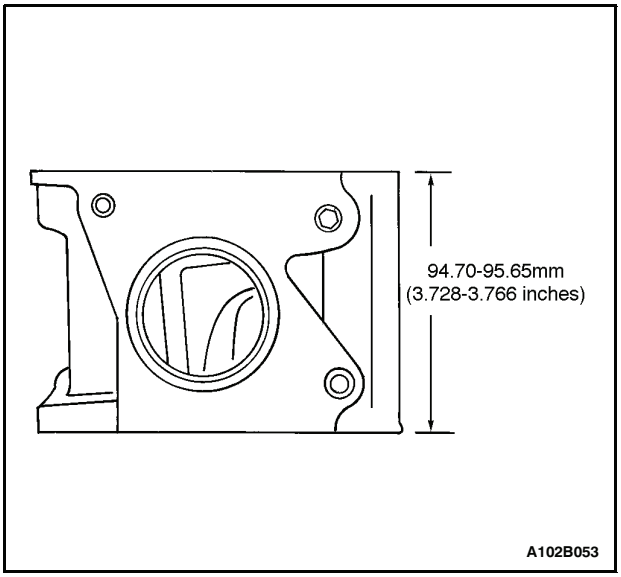
A102B051

17. Using the valve spring compressor KM-348, compress the valve springs.
18. Remove the valve keepers.
19. Remove the valve spring cap.
20. Remove the valve springs.
21. Remove the valves.
22. Remove the valve stem oil seals.
23. Remove camshaft carrier alignment pins.


A102B052

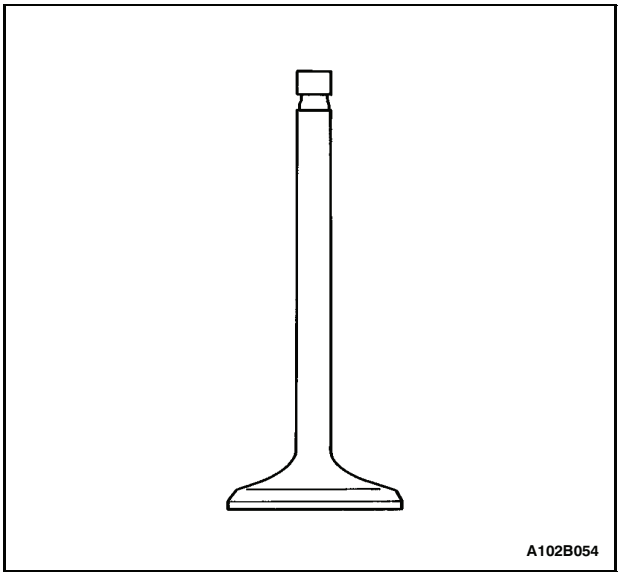
Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and the mating surfaces for leaks, corrosion, and blowby.
3. Inspect the cylinder head for cracks.
4. Inspect the length and the width of the cylinder head using a feeler gauge and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within .025 mm (.001 inch) maximum.



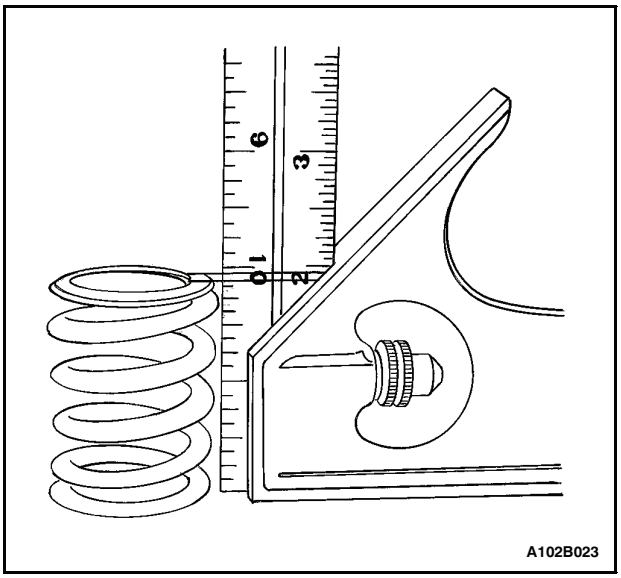
A102B053

6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 94.70 to 95.65 mm (3.728 to 3.766 inches). If the cylinder head height is less than 94.70 mm (3.728 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect the valve seats for excessive wear and burned spots.

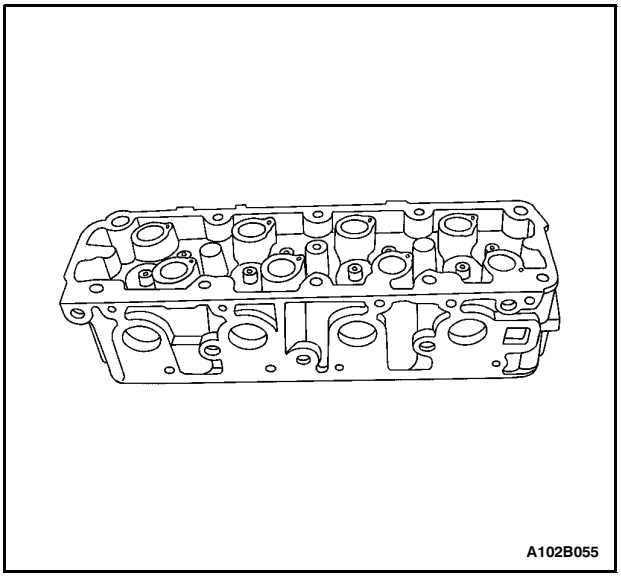

A102B054

Valve Inspection

1. Inspect valve stem tip wear.
2. Inspect the valve keeper grooves and oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.
4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep the refacing would result in a sharp edge, replace the valve.

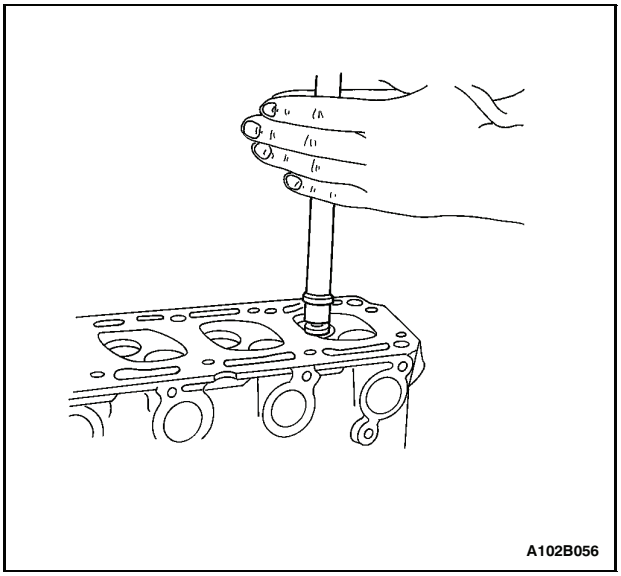


7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to "Engine Specifications" in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.



Cleaning Procedure

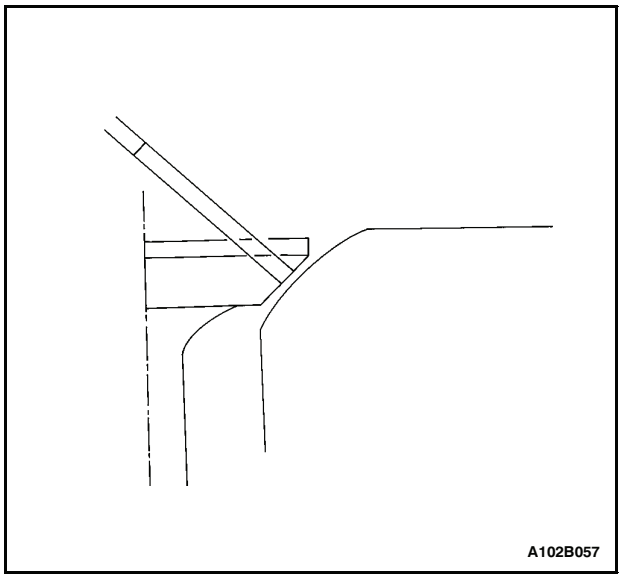
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil and varnish.



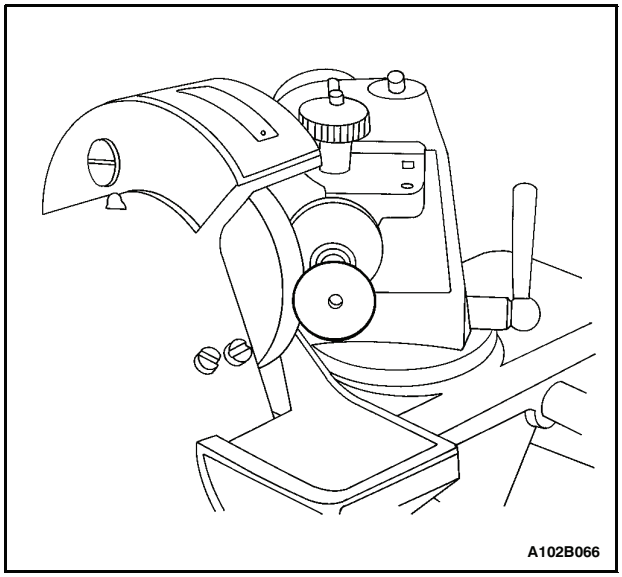
Cylinder Head Overhaul

Valve Grind-in

1. Lubricate the valve stem using a fine-grained paste.
2. Lift the valve rhythmically from the seat with a commercially available valve grinding tool in order to distribute the paste.

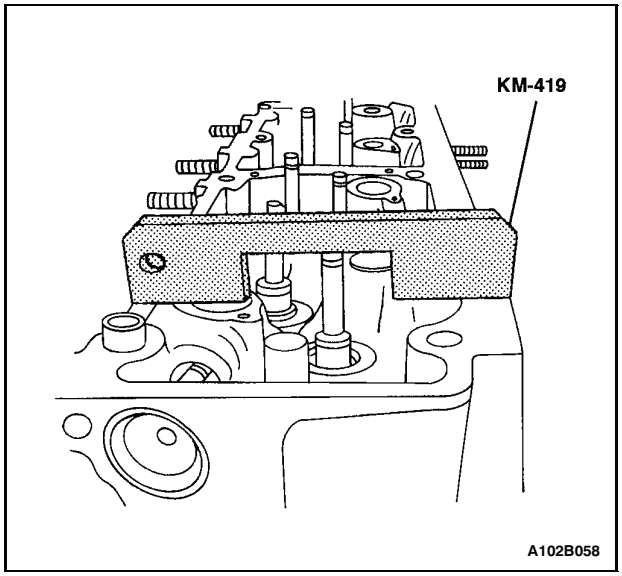

A102B057

3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.


A102B066

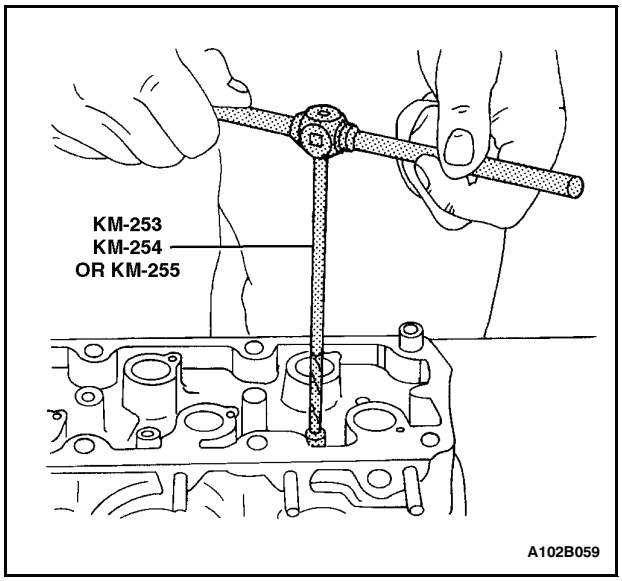
Valve Grind

1. Ensure that there are no crater line burns on the valve cone.
2. The valve may be reground only two times. Do not grind the valve stem end.
3. The angle at the valve face angle is 46 degrees.



A102B058

4. Check the valve stem projection using the distance gauge KM-419.



Valve Guide Ream

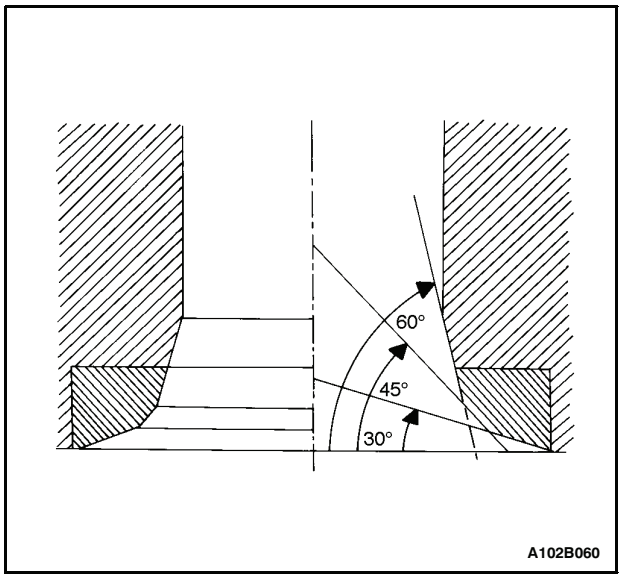
1. Measure the diameter of the valve guide using the gauge MKM-571-B and a commercially available inside micrometer.

Important: Valve oversizes may already have been fitted in production.

2. An oversize code is on the valve guide and the valve stem end. The following table gives the correct size, reamer, and production code for each service code.

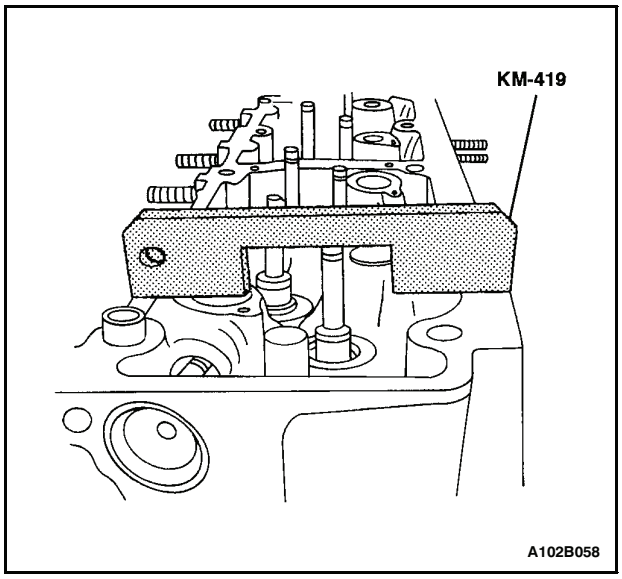
Size	Reamer	Production Code	Service Code
Normal	—	—	K
0.075	KM-253	1	K1
0.150	KM-254	2	K2
0.250	KM-255	—	A

3. Ream the valve guide from the upper side of the cylinder head to the next oversize. After reaming, cross out the code and emboss the valve guide with the new code.

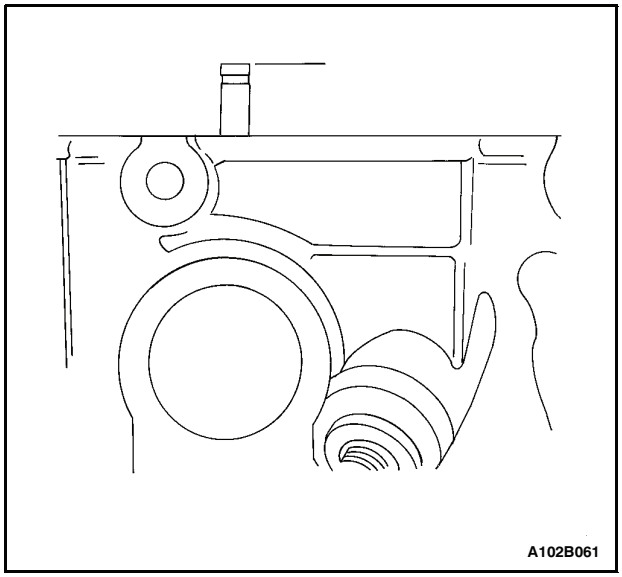


Valve Seat — Cut

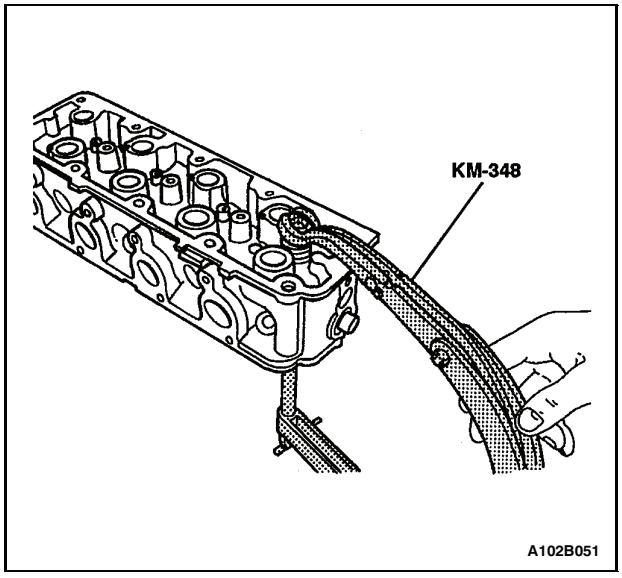
1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the guide drift KM-340-7 as follows:
   - Valve seat: a 45-degree side using the cutter KM-340-13.
   - Upper correction angle: a 30-degree side using the cutter KM-340-13.
   - Lower correction angle: a 60-degree side using the cutter KM-340-26.



3. Clean the chippings from the cylinder head.
4. Inspect the dimension for the proper valve seat width.
   - Intake: 1.3 to 1.5 mm (0.051 to 0.059 inch)
   - Exhaust: 1.6 to 1.8 mm (0.063 to 0.071 inch)
5. Inspect the valve stem projection using the distance gauge KM-419.

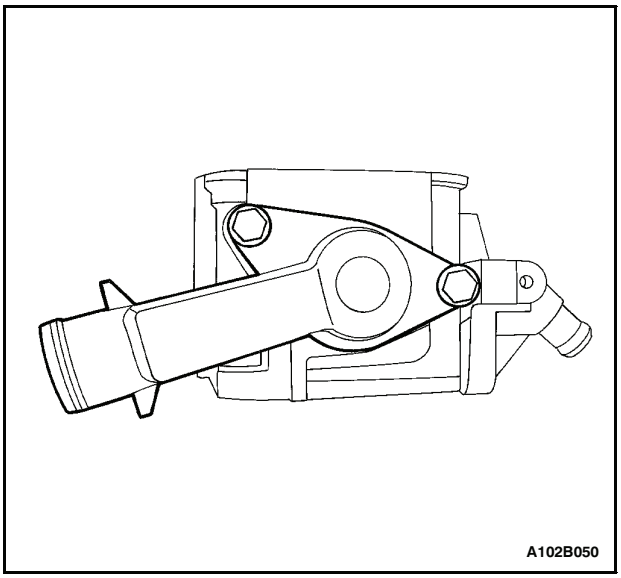


6. If the dimension is exceeded, install new valves and then check the valve stem projection again. Refer to "Valve Grind" and "Valve Grind-In" in this section.
7. If the valve stem projection is still too large despite replacing the valves, replace the cylinder head.



Assembly Procedure

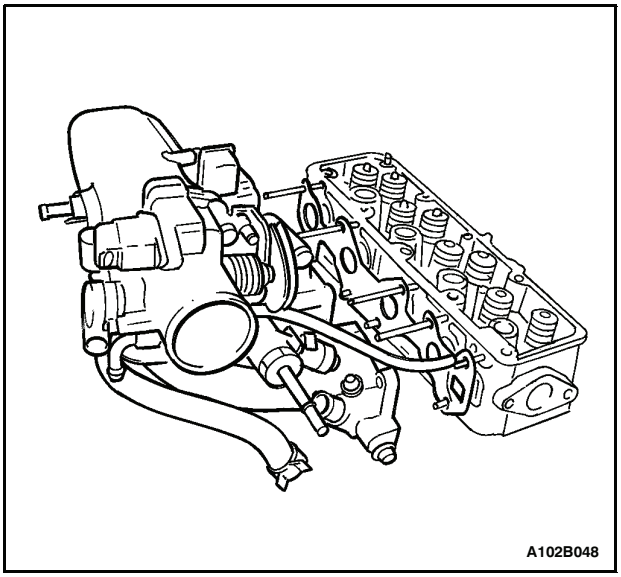
1. Install the camshaft carrier alignment pins.
2. Install the valve stem oil seals.
3. Coat the valves with engine oil.
4. Install the valves.
5. Install the valve springs.
6. Using the valve spring compressor KM-348, compress the valve springs.
7. Install the valve keeper.
8. Install the valve spring cap.


A102B050

9. Install the thermostat and the gasket.
10. Install the thermostat housing.
11. Install the thermostat housing mounting bolts.

Tighten

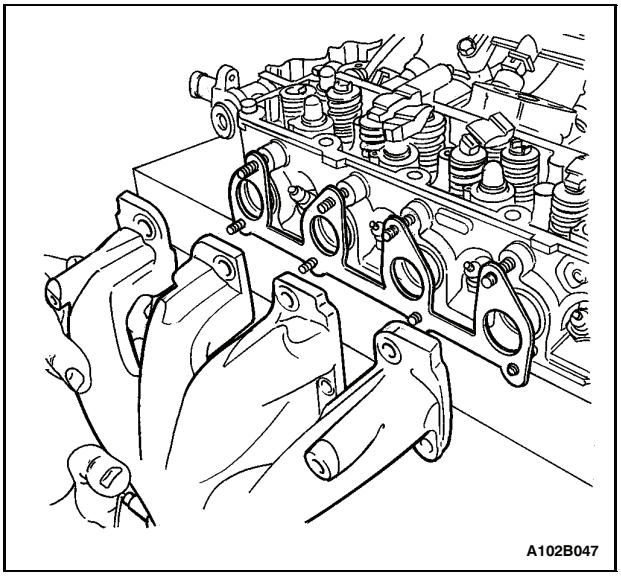
Tighten the thermostat housing mounting bolts to 20 NSm (15 lb-ft).


A102B048

12. Install the intake manifold studs.
13. Install the intake manifold gasket.
14. Install the intake manifold.
15. Install the intake manifold retaining nuts.

Tighten

Tighten the intake manifold retaining nuts to 25 NSm (18 lb-ft).


A102B047

16. Install the spark plugs.

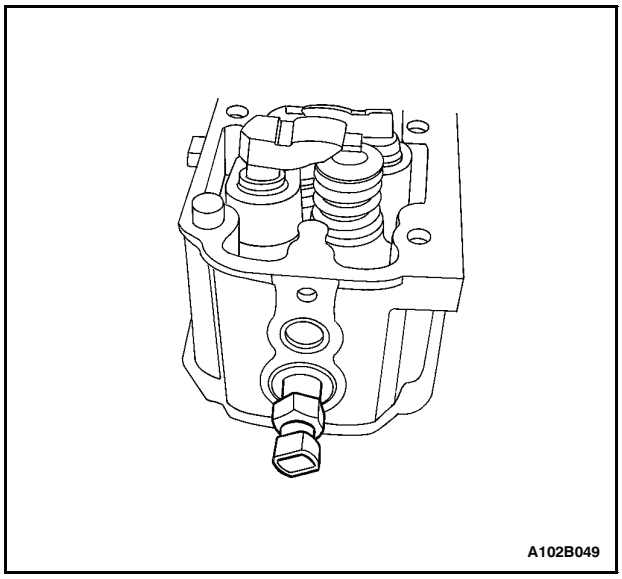
Tighten

Tighten the spark plugs to 25 NSm (18 lb-ft).

17. Install the exhaust manifold studs.
18. Install the exhaust manifold gasket.
19. Install the exhaust manifold.
20. Install the exhaust manifold nuts.

Tighten

Tighten the exhaust manifold nuts to 25 NSm (18 lb-ft).


A102B049

21. Install the exhaust manifold heat shield.
22. Install the exhaust manifold heat shield bolts.

Tighten

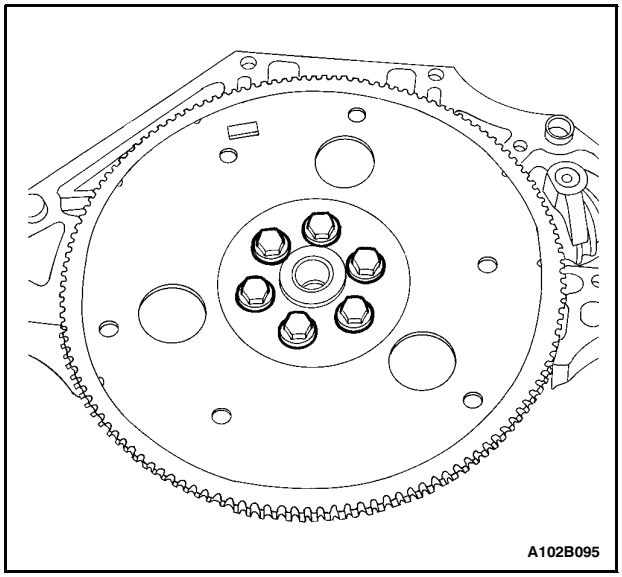
Tighten the exhaust manifold heat shield bolts to 15 NSm (11 lb-ft).

23. Install the coolant temperature sensor.

Tighten

Tighten the coolant temperature sensor to 20 NSm (15 lb-ft).

24. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.


A102B095

CRANKSHAFT

Tools Required

MKM-412 Engine Overhaul Stand

J-42492 Timing Belt Adjuster

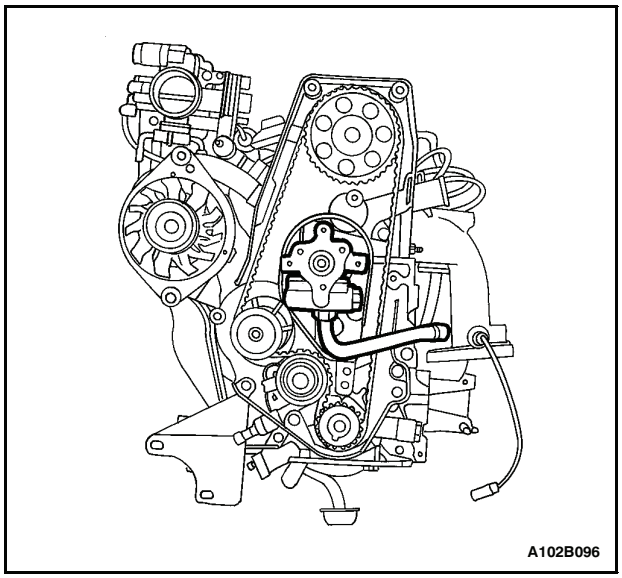
KM-470-B Angular Torque Gauge

J-36792 or KM-635 Crankshaft Rear Oil Seal Installer

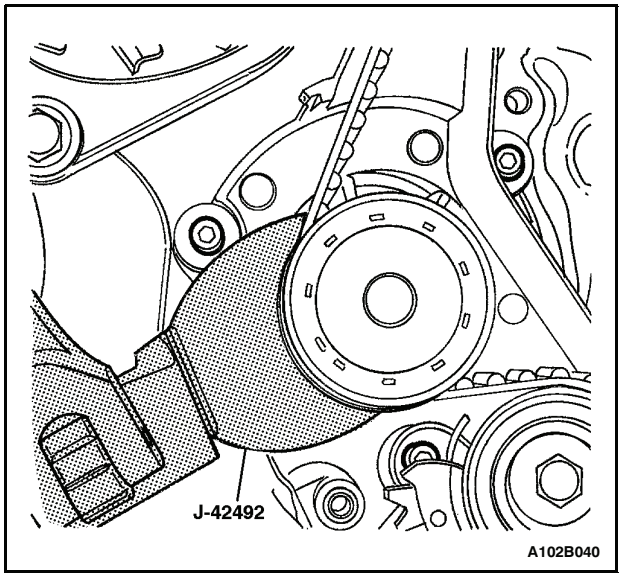
Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

Disassembly Procedure

1. Remove the engine. Refer to "Engine" in this section.
2. Remove the flywheel bolts.
3. Remove the flywheel.
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand MKM-412.

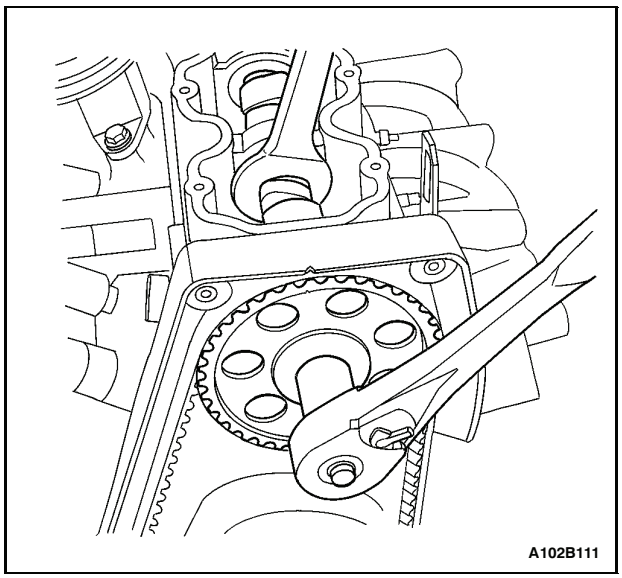

A102B096

6. Remove the upper timing belt cover bolts.
7. Remove the upper timing belt cover.
8. Remove the power steering pump mounting bolts.
9. Remove the power steering pump.
10. Remove the lower timing belt cover bolts.
11. Remove the lower timing belt cover.



A102B040

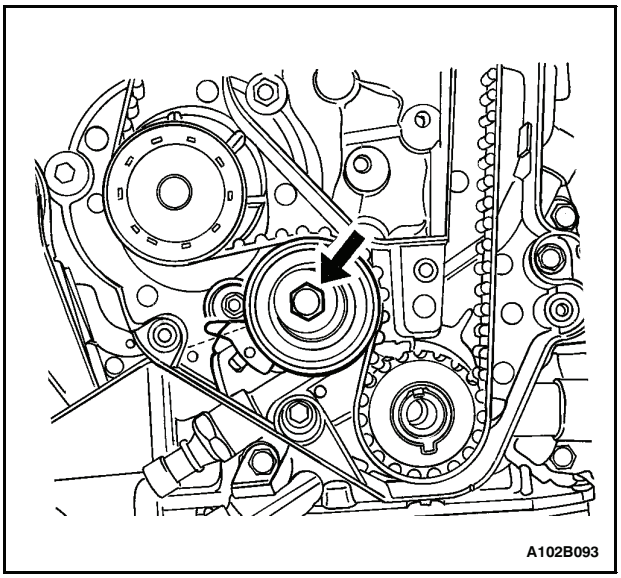
12. Slightly loosen the three coolant pump retaining bolts.
13. Rotate the coolant pump using timing belt adjuster J-42492 to remove the tension from the timing belt.
14. Remove the timing belt.


A102B111

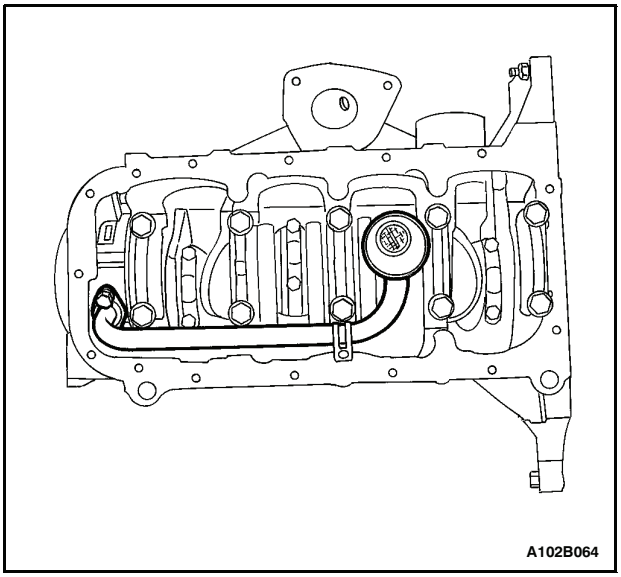
15. Remove the valve cover bolts.
16. Remove the valve cover and the valve cover gasket.

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

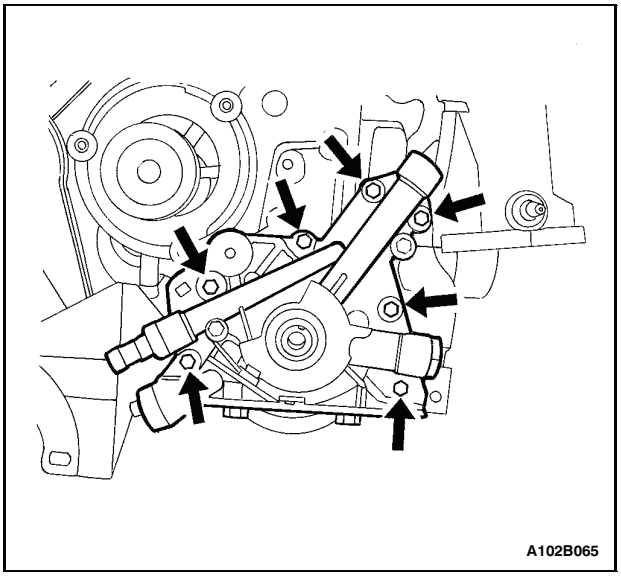
17. While holding the camshaft firmly in place, remove the camshaft gear bolt.
18. Remove the camshaft gear.


A102B093

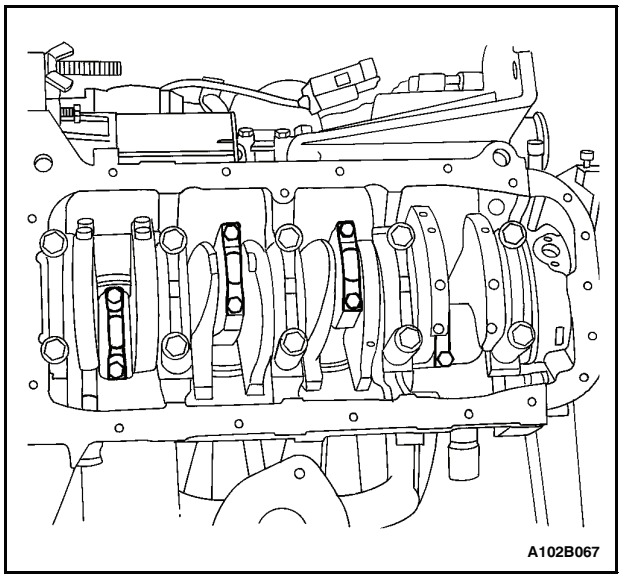
19. Remove the timing belt automatic tensioner bolt.
20. Remove the timing belt automatic tensioner.
21. Remove the rear timing belt cover bolts.
22. Remove the rear timing belt cover.
23. Remove the crankshaft timing belt gear.


A102B064

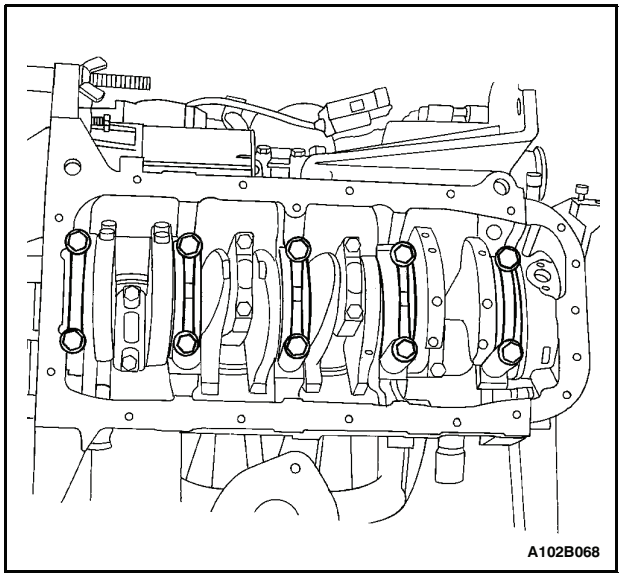
24. Rotate the engine on the engine overhaul stand MKM-412.
25. Remove the oil pan retaining bolts.
26. Remove the oil pan.
27. Remove the oil pickup tube bolts.
28. Remove the oil pump pickup tube.


A102B065

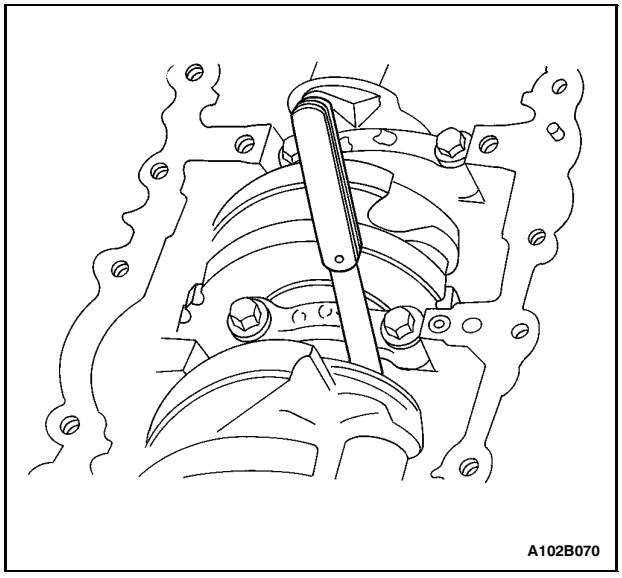
29. Remove the oil pump retaining bolts.
30. Remove the oil pump.


A102B067

31. Mark the order of the rod bearing caps.
32. Remove the connecting rod cap bolts for all of the pistons.
33. Remove the connecting rod bearing caps and the lower connecting rod bearings.
34. Remove the upper connecting rod bearings.

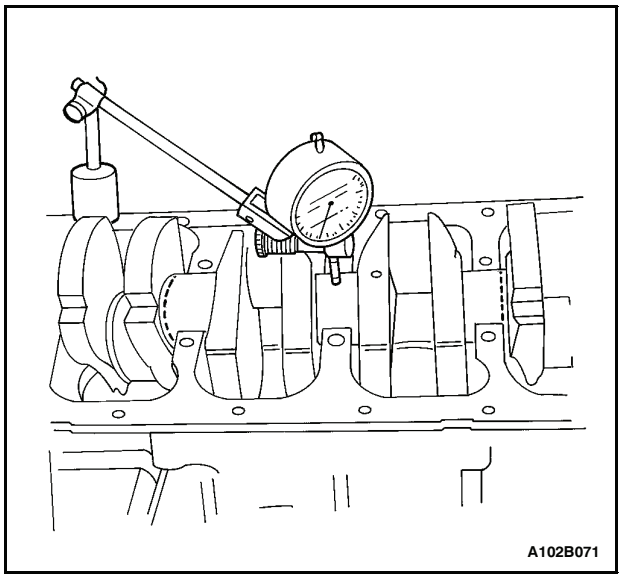

A102B068

35. Mark the order of the crankshaft bearing caps.
36. Remove the crankshaft bearing cap bolts.
37. Remove the crankshaft bearing caps.
38. Remove the crankshaft bearings from the crankshaft bearing caps.
39. Remove the crankshaft.
40. Remove the crankshaft bearings from the engine block.
41. Clean the parts, as necessary.

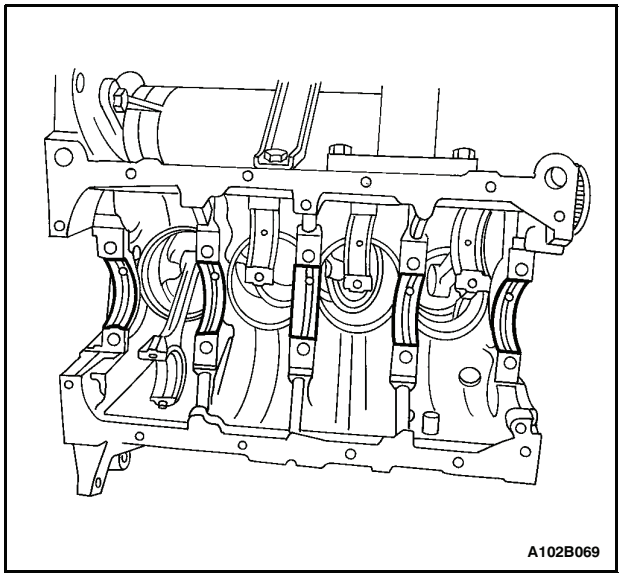

A102B070

Assembly Procedure

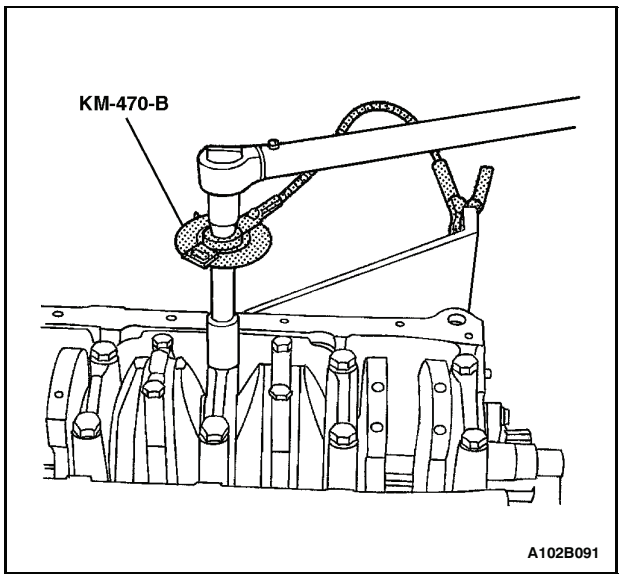
1. With crankshaft and bearings in place, plastic gauge all bearing clearances. Refer to “Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic” in this section.
2. Inspect the crankshaft end play with the crankshaft bearings installed.
3. Check for permissible crankshaft end play. Refer to “Engine Specifications” in this section.


A102B071

4. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.


A102B069

5. Coat the crankshaft bearings with engine oil.
6. Apply a bead of adhesive sealing compound to the grooves of the rear crankshaft bearing cap.
7. Install the crankshaft bearings in the engine block.
8. Install the crankshaft.



A102B091

9. Install the crankshaft bearings to the crankshaft bearing caps.
10. Install the crankshaft bearing caps.

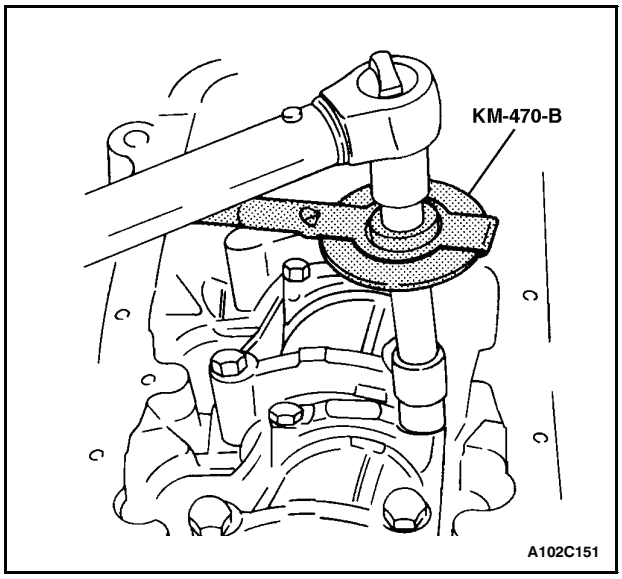
Notice: Do not reuse the old crankshaft bearing cap bolts. Damage to the engine could result.

11. Install new crankshaft bearing cap bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts another 45 degrees plus 15 degrees.

12. Install the upper connecting rod bearings to the connecting rods.
13. Install the lower connecting rod bearings to the connecting rod bearing caps



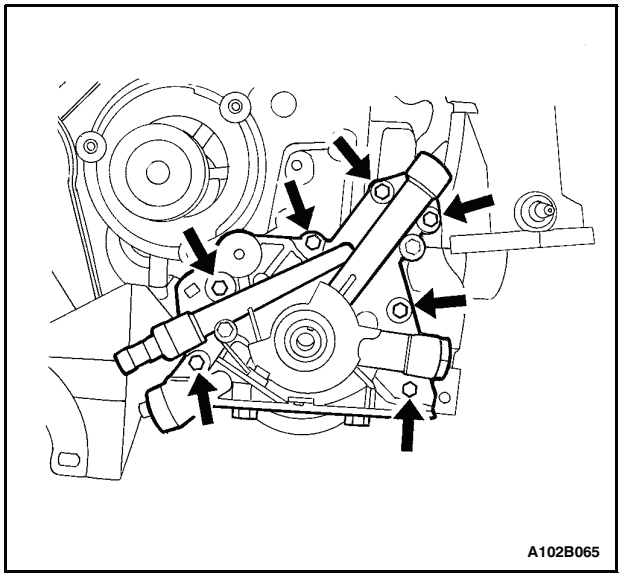
14. Install the connecting rod bearing caps to the connecting rods.

Notice: Do not reuse the old connecting rod bearing cap bolts. Damage to the engine could result.

15. Install new connecting rod bearing cap bolts.

Tighten

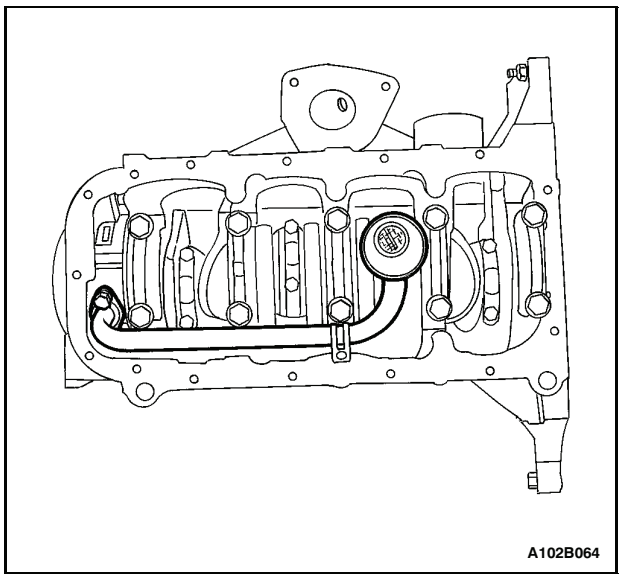
Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the connecting rod bearing cap bolts another 30 degrees plus 15 degrees.



16. Install the oil pump.
17. Install the oil pump retaining bolts.

Tighten

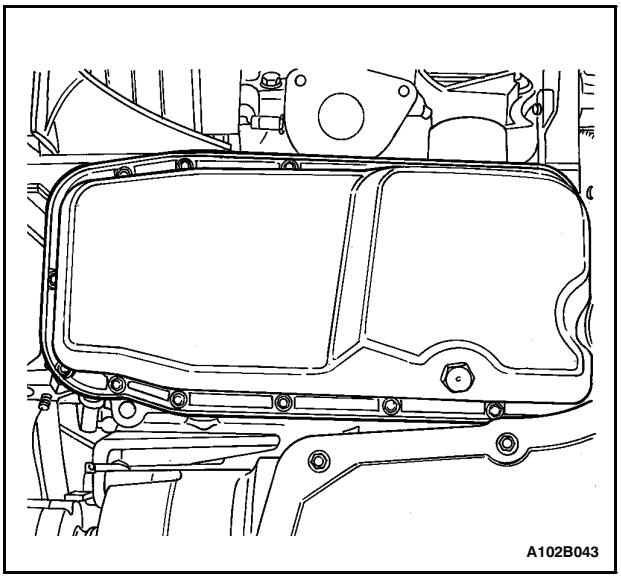
Tighten the oil pump retaining bolts to 10 NSm (89 lb-in).



18. Install the oil pump/pickup tube.
19. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 NSm (89 lb-in).


A102B043

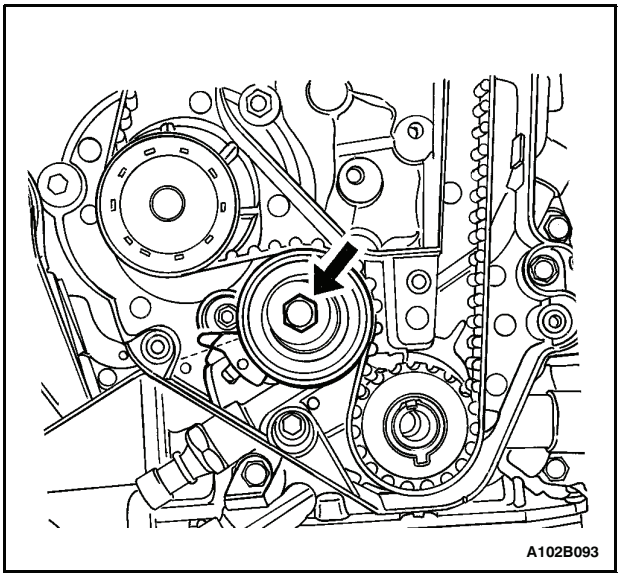
20. Install the oil pan gasket to the oil pan.
21. Install the oil pan.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

22. Install the oil pan retaining bolts.

Tighten

Tighten the oil pan retaining bolts to 10 NSm (89 lb-in).


A102B093

23. Install the crankshaft timing belt gear.
24. Install the rear timing belt cover.
25. Install the rear timing belt cover bolts.

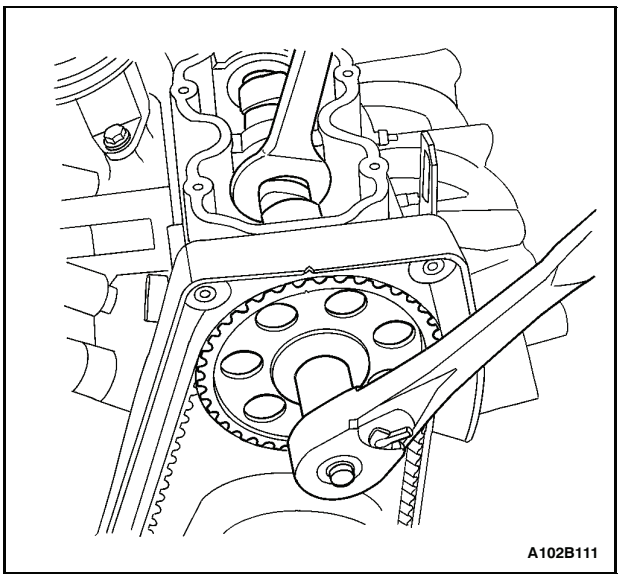
Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).

26. Install the timing belt automatic tensioner.
27. Install the timing belt automatic tensioner bolt.

Tighten

Tighten the timing belt automatic tensioner bolt to 20 NSm (15 lb-ft).

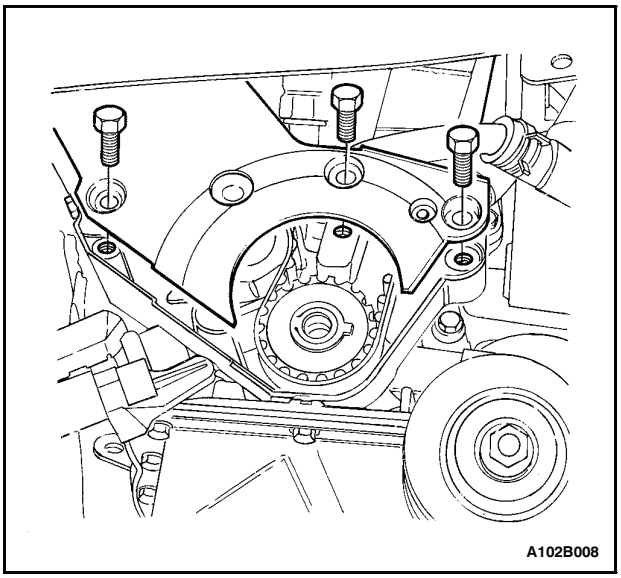

A102B111

Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

28. Install the camshaft gear.
29. Install the camshaft gear bolt while holding the camshaft firmly in place.

Tighten

Tighten the camshaft gear bolt to 45 NSm (33 lb-ft).


A102B008

30. Install the timing belt.
31. Adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
32. Install the valve cover gasket and the valve cover.
33. Install the valve cover bolts.

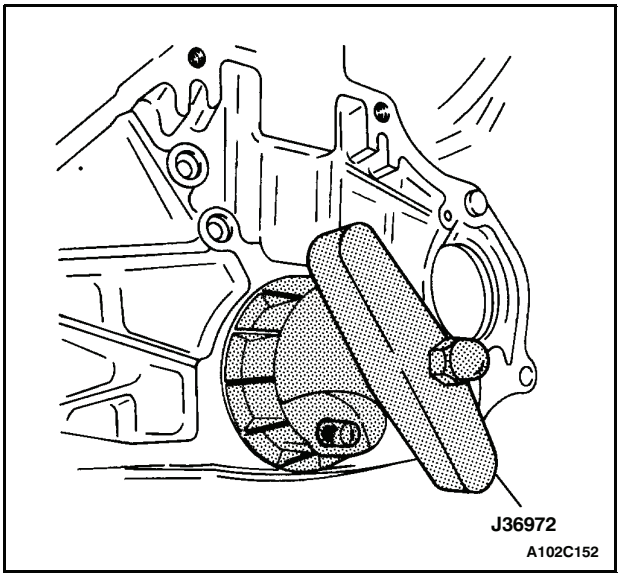
Tighten

Tighten the valve cover bolts to 10 NSm (89 lb-in).

34. Install the lower timing belt cover.
35. Install the lower timing belt cover bolts.

Tighten

Tighten the lower timing belt cover bolts to 10 NSm (89 lb-in).



A102C152

36. Install the power steering pump.
37. Install the power steering pump mounting bolts.

Tighten

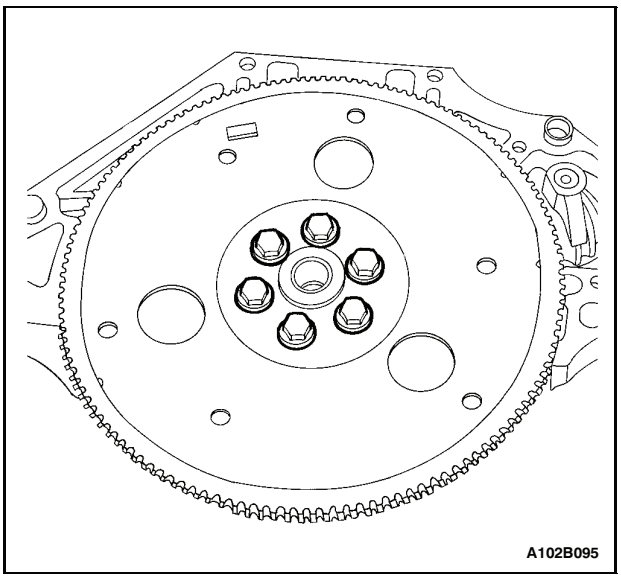
Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).

38. Install the upper timing belt cover.
39. Install the upper timing belt cover bolts.

Tighten

Tighten the upper timing belt cover bolts to 10 NSm (89 lb-in).

40. Install the engine lifting device.
41. Dismount the engine from the engine overhaul stand MKM-412.
42. Install the crankshaft rear oil seal using installer J-36972 or KM-635.

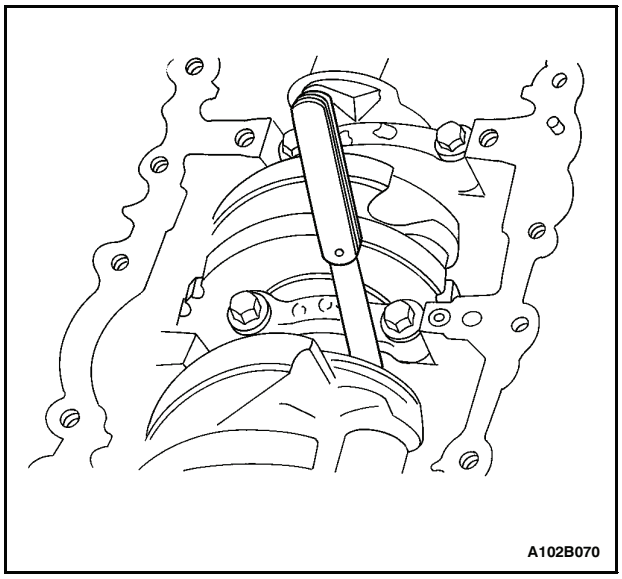

A102B095

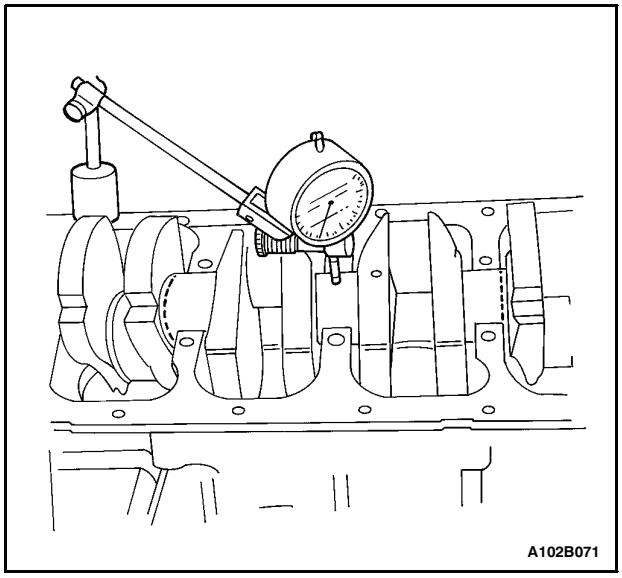
43. Install the flywheel.
44. Install the flywheel bolts.

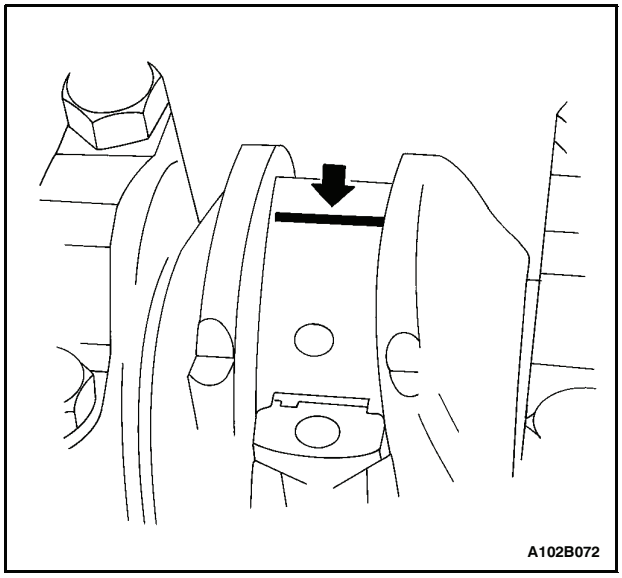
Tighten

Tighten the flywheel bolts to 35 NSm (25 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the flywheel bolts another 30 degrees plus 15 degrees.

45. Install the engine. Refer to "Engine" in this section.


A102B070


A102B071


A102B072

CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS — GAUGING PLASTIC

Tools Required

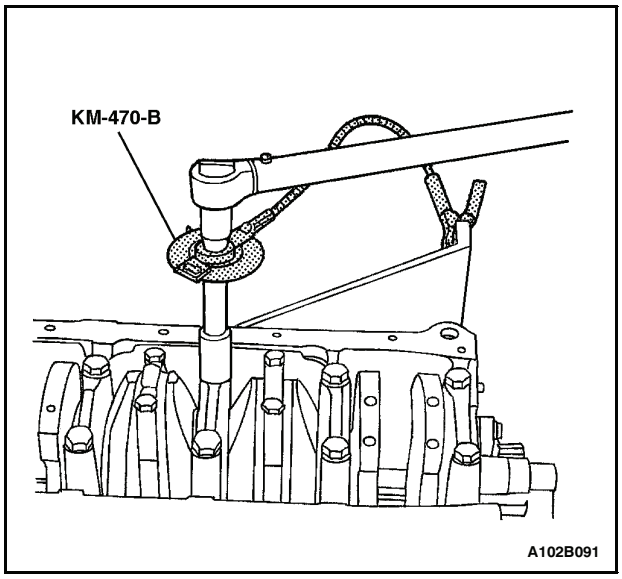
KM-470-B Angular Torque Gauge

Inspection Procedure - Crankshaft

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.
4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.
7. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.

Important: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

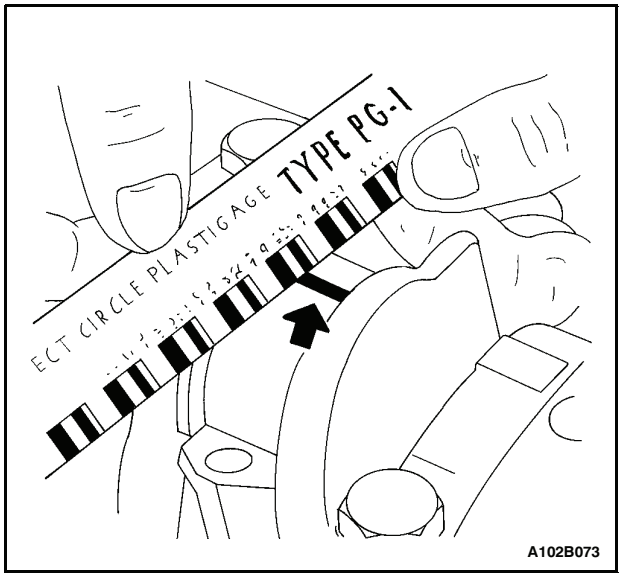
8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.



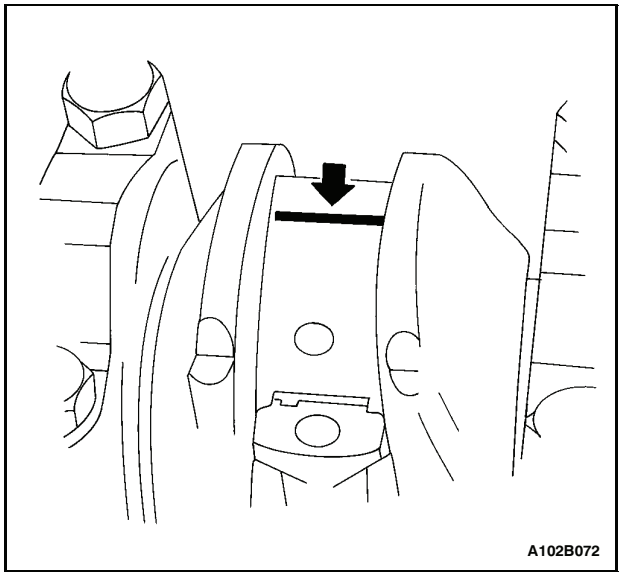
10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts another 45 degrees plus 15 degrees.



12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
14. Inspect the bearing clearances for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

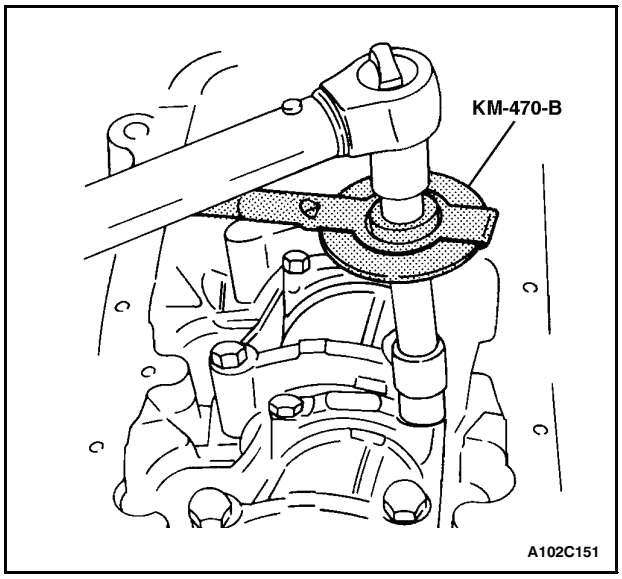


Inspection Procedure - Connecting Rods

1. Coat the connecting rod bearings with engine oil.

Important: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

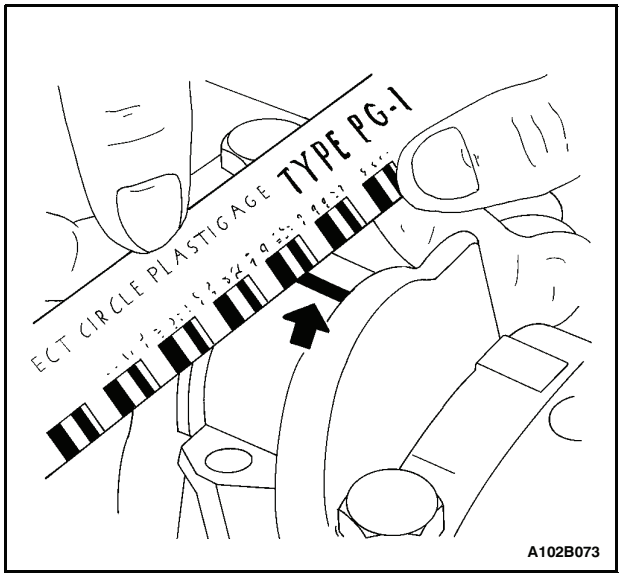
2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.
4. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).



5. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
6. Install the connecting rod bearing caps.
7. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft cap bolts another 30 degrees plus 15 degrees.



8. Remove the connecting rod bearing caps.
9. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
10. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

CYLINDER HEAD AND GASKET

The cylinder head is made of an aluminum alloy. The cylinder head uses crossflow intake and exhaust ports. A spark plug is located in the center of each of the combustion chambers.

CRANKSHAFT

The crankshaft is supported by the five main bearings. The number three bearing is the end thrust bearing. The main bearings are lubricated from the oil holes which intersect the main oil gallery on the left side of the engine block.

TIMING BELT

The timing belt coordinates the crankshaft and the camshaft and keeps them synchronized. The timing belt also turns the coolant pump. The timing belt and the pulleys are toothed so that there is no slippage between them. There is a tension pulley that maintains the correct timing belt tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine drive belt. The timing belt requires no lubrication.

OIL PUMP

The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or the other engine components. When the drive gear rotates, the driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows.

At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages. During normal oil supply, a coil spring and a valve keep the bypass closed, directing all of the oil pumped to the engine. When the amount of oil being pumped increases, the pressure becomes high enough to overcome the force of the spring. This opens the valve of the oil pressure regulator, allowing the excess oil to flow through the valve and drain back to the oil pan.

OIL PAN

The oil pan is mounted to the bottom of the cylinder block. The oil pan houses the crankcase and is made of pressed sheet metal.

Engine oil is pumped from the oil pan by the oil pump. After the oil passes through the oil filter, the oil is fed through two paths to lubricate the cylinder block and the cylinder head. In one path, the oil is pumped through the oil passages in the crankshaft to the connecting rods, then to the pistons and the cylinders in the cylinder block. The oil then drains back into the oil pan. In the second path, the oil is pumped through the oil passages to the camshaft. The oil passes through the internal passageways in the camshafts to lubricate the valve assemblies in the cylinder head before draining back into the oil pan.

EXHAUST MANIFOLD

A single four-port, rear-takedown exhaust manifold is used with this engine. The exhaust manifold is designed to direct the escaping exhaust gases out of the combustion chambers with a minimum of backpressure.

INTAKE MANIFOLD

The intake manifold is made of aluminum. The intake manifold is heated by the engine coolant. An air/fuel mixture is transferred through the intake manifold to the engine cylinders for combustion.

CAMSHAFT

The cast-iron camshaft is supported by the five bearing surfaces in an aluminum camshaft carrier located on the top of the cylinder head. The camshaft gear is power driven by the crankshaft, using the timing belt.

EXHAUST GAS RECIRCULATION VALVE

The exhaust gas recirculation (EGR) system is used to lower oxides of nitrogen (NOX) emission levels caused by high combustion temperatures. The main element of the system is the EGR valve which is operated by vacuum.

The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease the combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

SECTION 1C

DOHC ENGINE MECHANICAL

TABLE OF CONTENTS

SPECIFICATIONS

ENGINE SPECIFICATIONS

Application	Description (1.6L DOHC)
General Data:	
Engine Type	4 Cylinder (In-line)
Displacement	1 598 cm^3 (97.51 in^3)
Bore Stroke	79.0 X 81.5 mm (3.11 in. X 3.21 in.)
Compression Ratio	9.5$ 0.02:1
Firing Order	1-3-4-2
Cylinder Bore:	
Diameter	79.0 mm (3.11 in.)
Out of Round (Maximum)	0.0065 mm (0.00025 in.)
Taper (Maximum)	0.0065 mm (0.00025 in.)
Piston:	
Diameter	78.970 mm (3.1090 in.)
Clearance to Bore	0.030 mm (0.0012 in.)
Piston Rings:	
Ring, End Gap: Top Compression	0.3 mm (0.019 in.)
2nd Compression	0.3 mm (0.019 in.)
Groove Clearance: Top Impression	0.02 mm (0.0008 in.)
2nd Impression	0.02 mm (0.0008 in.)
Piston Pin:	
Diameter	18.00 mm (0.708 in.)
Pin Off-Set	0.6X 0.8 mm (0.02X 0.03 in.)
Camshaft:	
Lift Intake	8.75 mm (0.344 in.)
Lift Exhaust	8.75 mm (0.344 in.)
End Play	0.10X 0.25 mm (0.003X 0.009 in.)
Journal OD: No. 1	30 mm (1.18 in.)
No. 2	27 mm (1.06 in.)
No. 3	27 mm (1.06 in.)
No. 4	27 mm (1.06 in.)
No. 5	27 mm (1.06 in.)
Crankshaft:	
Main Journal: Diameter (All)	54.982X 54.994 mm (2.164X 2.165 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Main Bearing Clearance (All)	0.005 mm (0.0001 in.)

ENGINE SPECIFICATIONS (Cont'd)

Application	Description (1.6L DOHC)
Crankshaft End Play	0.01 mm (0.003 in.)
Connecting Rod Journal: Diameter (All)	42.971X 42.987 mm (1.691X 1.692 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)
Rod Bearing Clearance (All)	0.019X 0.070 mm (0.0007X 0.0027 in.)
Rod Side Clearance	0.070X 0.242 mm (0.0027X 0.009 in.)
Valve System:	
Valve Lash Compensators	Hydraulic
Face Angle (All)	46_
Seat Angle (All)	46_
Seat Runout (Maximum, All)	0.03 mm (0.019 in.)
Face Runout (Maximum, All)	0.03 mm (0.019 in.)
Seat Width: Intake	1.17X 1.57 mm (0.046X 0.062 in.)
Exhaust	1.07X 1.47 mm (0.042X 0.058 in.)
Valve Guide Inside Diameter (All)	6.00X 6.02 mm (0.236X 0.237 in.)
Valve Stem Diameter (All)	6 mm (0.236 in.)
Valve Diameter (All): Intake	30.3" 0.12 mm (1.19" 0.0047 in.)
Exhaust	26.0" 0.14 mm (1.02" 0.0055 in.)
Valve Spring Loads: Valve Open	580" 26 N (428" 19 lbs) @ 23.0 mm (0.90 in.)
Valve Closed	260" 13 N (192" 9 lbs) @ 32.0 mm (1.25 in.)
Valve Spring Free Length	-
Cylinder Head:	
Overall Height	138.18 mm (5.440 in.)
Minimum Height after machining	138.13 mm (5.438 in.)
Distortion	0.1 mm (0.002 in.)
Oil Pump:	
Gap Between Oil Pump Body and Out Rotor	0.4X 0.484 mm (0.016X 0.019 in.)
Out Rotor Side Clearance	0.45X 0.100 mm (0.017X 0.003 in.)
Inner Rotor Side Clearance	0.035X 0.085 mm (0.001X 0.003 in.)
Relief Valve Spring Free Length	81 mm (3.188 in.)
Sealants and Adhesives:	
Rear Main Bearing Cap	GE p/n RTV 159
Camshaft Carrier to Cylinder Head	HN 1581 (Loctite® 515)
Oil Pan Bolts	HN 1256 (Loctite® 242)
Oil Pump Bolts	HN 1256 (Loctite® 242)
Oil Pan Pickup Tube Bolts	HN 1256 (Loctite® 242)
Oil Gallery Plug	HN 1256 (Loctite® 242)
Coolant Jacket Caps and Plugs (Freeze Plugs)	HN 1756 (Loctite® 176)
Exhaust Manifold Studs/Nuts	Anti-seize Compound (HMC Spec HN1325)

FASTENER TIGHTENING SPECIFICATIONS

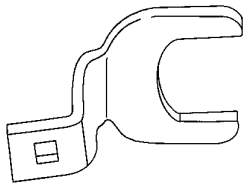
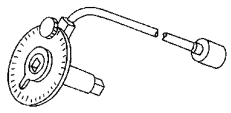
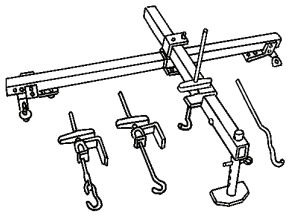
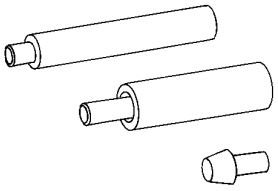
Application	NSm	Lb-Ft	Lb-In
A/C Compressor Hose Assembly Retaining Bolt	33	24	-
A/C Compressor Mounting Bolts	27	20	-
A/C Compressor Mounting Bracket Bolts	50	37	-
Air Filter Housing Bolts	12	-	106
Alternator Adjusting Bolt	20	15	-
Alternator Adjusting Bracket Retaining Bolt	20	15	-
Camshaft Cap Bolts	16	12	-
Camshaft Gear Bolt, Intake & Exhaust	67.5	49	-
Connecting Rod Cap Bolts	25 +30_+15_	18 +30_+15_	-
Coolant Pump Retaining Bolts	10	-	89
Coolant Temperature Sensor	20	15	-
Crankshaft Bearing Cap Bolts	50 +45_+15_	37 +45_+15_	-
Crankshaft Pulley Bolt	95 +30_+15_	70 +30_+15_	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Cylinder Head Bolts (Camshaft Support Housing & Cylinder Head Mounting Bolts)	25 +60_+60_ +60_+10_	18 +60_+60_ +60_+10_	-
DIS Ignition Coil Mounting Bracket Bolts	10	-	89
DIS Ignition Coil Mounting Bolts	10	-	89
Engine Mount Bracket Retaining Bolts	60	44	-
Engine Mount Retaining Nuts	40	30	-
Engine-Mount-to-Engine-Mount-Bracket Retaining Bolts	60	44	-
Exhaust Flexible Pipe Bracket Bolts	40	30	-
Exhaust Flex Pipe-to-Catalytic Converter or Connecting Pipe Retaining Nuts	30	22	-
Exhaust Flex Pipe-to-Exhaust Manifold Retaining Nuts	40	30	-
Exhaust Gas Recirculation Valve Adapter Bolts	25	18	-
Exhaust Manifold Heat Shield Bolts	15	11	-
Exhaust Manifold Retaining Nuts	25	18	-
Flexible Plate Bolts	60	44	-
Flexible Plate Inspection Cover Bolts	10	-	89
Flywheel Bolts	35 +30_+15_	25 +30_+15_	-
Flywheel Inspection Cover Bolts	12	-	106
Front Timing Belt Cover Bolts, Upper and Lower	10	-	89
Fuel Rail Retaining Bolts	25	18	-
Intake Manifold Retaining Nuts/Bolts	25	18	-
Intake Manifold Support Bracket Bolts, Upper	25	18	-

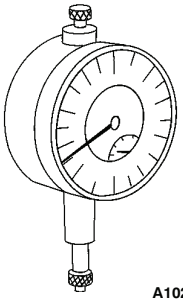
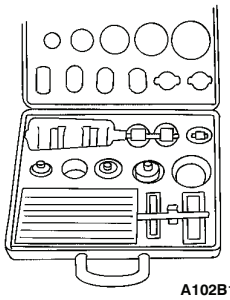
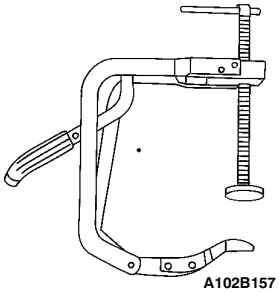
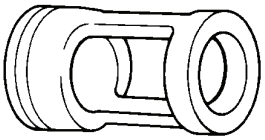
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application	NSm	Lb-Ft	Lb-In
Oil Pan Retaining Bolts	10	-	89
Oil Pressure Switch	40	30	-
Oil Pump Rear Cover Bolts	6	-	53
Oil Pump Retaining Bolts	10	-	89
Oil Pump Safety Relief Valve	30	22	-
Oil Pump/Pickup Tube Bolts	10	-	89
Power Steering Pump Mounting Bolts	25	18	-
Power Steering Pump Pulley Bolts	25	18	-
Rear Timing Belt Cover Bolts	10	-	89
Right Transaxle Brace Bolts	40	30	-
Spark Plug Cover Bolts	3	-	27
Spark Plugs	25	18	-
Support Bracket Bolt	10	-	89
Thermostat Housing Mounting Bolts	20	15	-
Throttle Cable Bracket Bolts	8	-	71
Timing Belt Automatic Tensioner Bolts	25	18	-
Timing Belt Idler Pulley Bolt	40	30	-
Transaxle Torque Converter Bolts	65	48	-
Transmission/Transaxle Bell Housing Bolts	75	55	-
Valve Cover Nuts	10	-	89

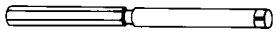
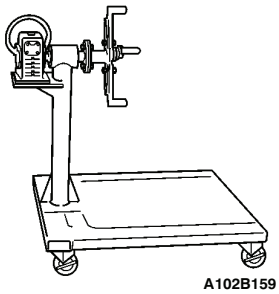
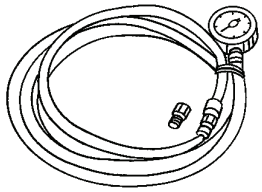
SPECIAL TOOLS

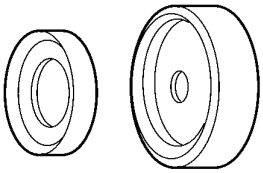
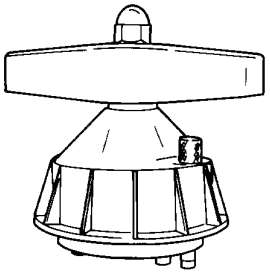
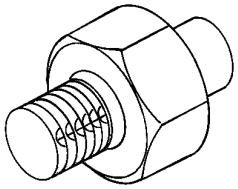
SPECIAL TOOLS TABLE

 A102B151	**J-42492 Timing Belt Adjuster**
 A102B161	**KM-470-B Angular Torque Gauge**
 A102B152	**J-28467-B Engine Assembly Support Fixture**
 A102B153	**KM-427 Piston Pin Service Set**

 A102B154	**MKM-571-B Gauge**
 A102B156	**KM-340-0 Cutter Set** Includes: **KM-340-7** **KM-340-13** **KM-340-26**
 A102B157	**KM-348 Valve Spring Compressor**
 A102C153	**KM-653 Adapter**

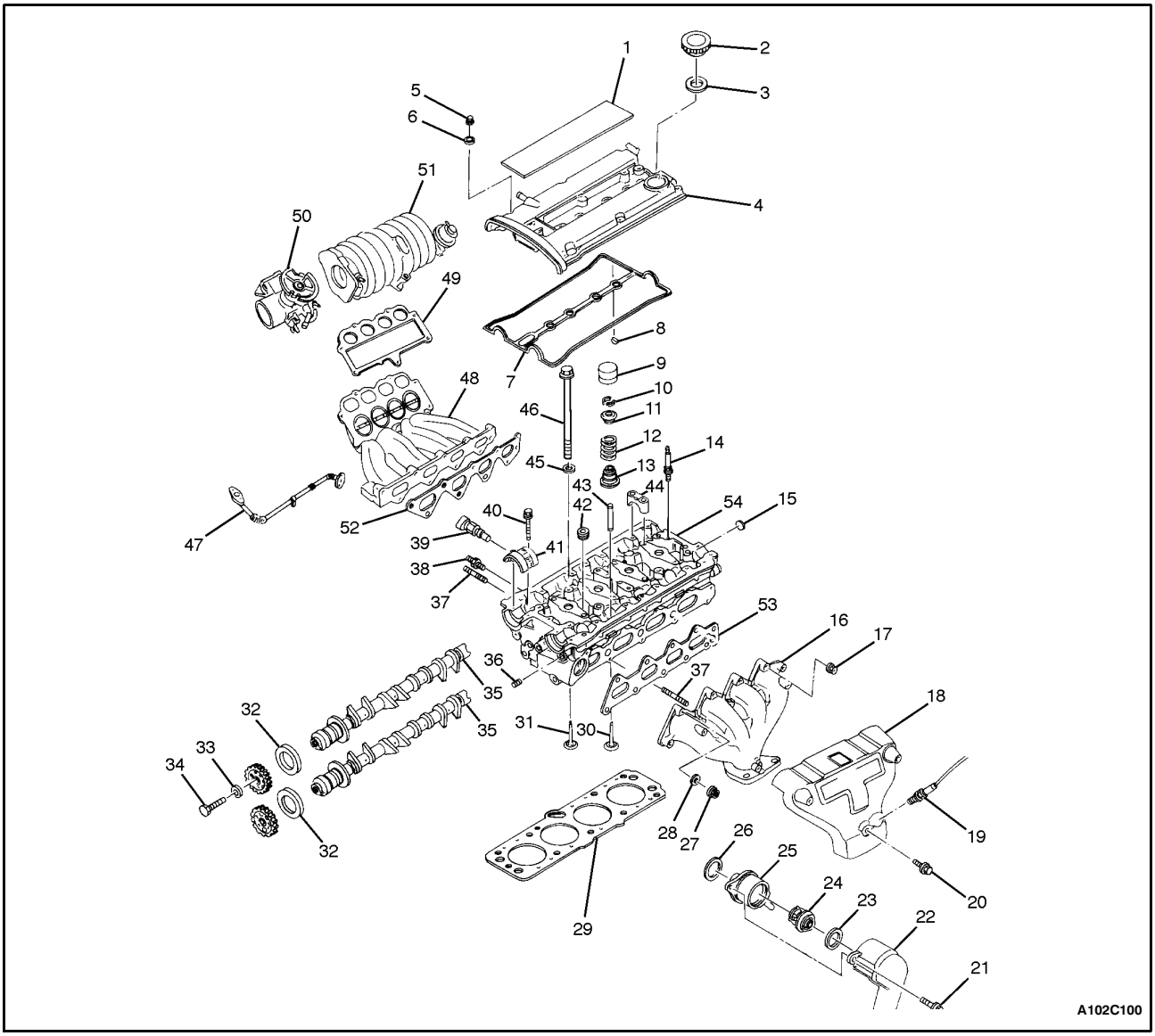
SPECIAL TOOLS TABLE (Cont'd)

 A102C154	**KM-805 Valve Guide Reamer**
 A102B159	**KM-412 Engine Overhaul Stand**
 A202B005	**KM-498-B Pressure Gauge**

 A102B160	**KM-635 Crankshaft Rear Oil Seal Installer**
 A102C155	**J-36972 Crankshaft Rear Oil Seal Installer**
 B102C044	**KM-135 Adapter**

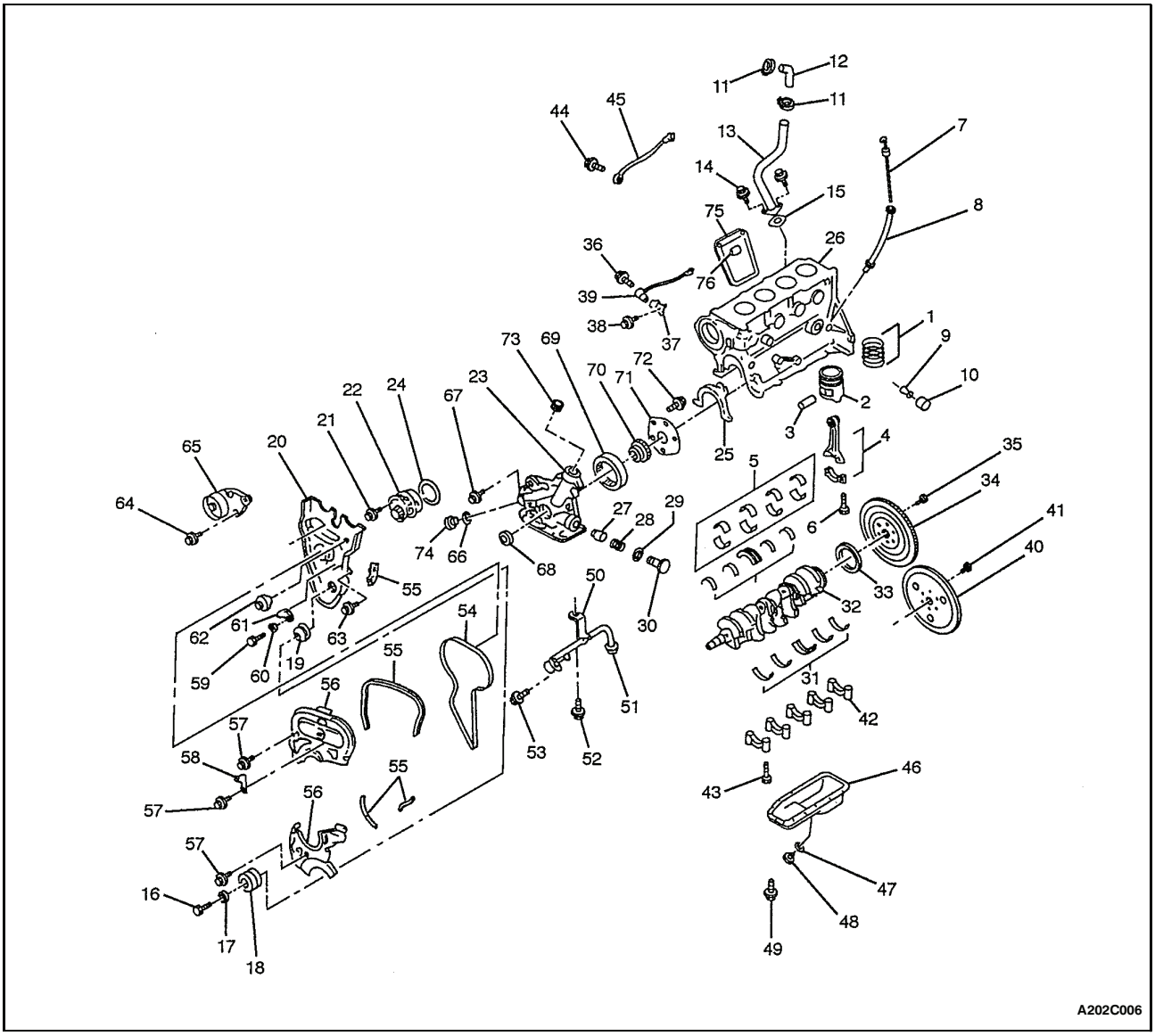
COMPONENT LOCATOR

UPPER END

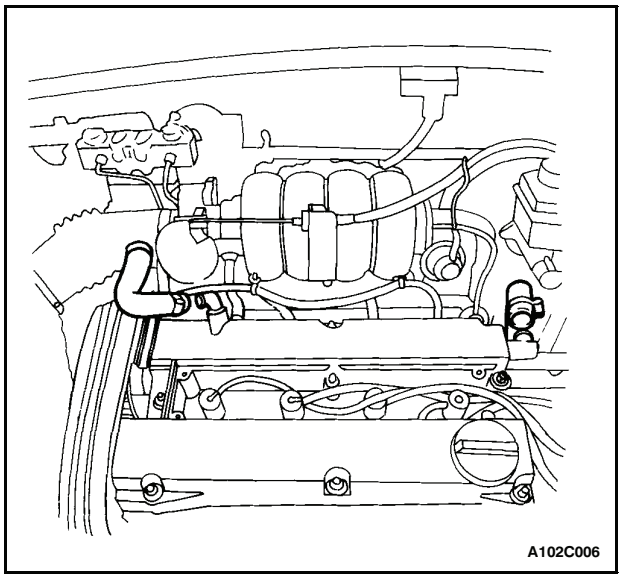


1 Spark Plug Cover
2 Oil Cap
3 Oil Cap Seal
4 Valve Cover
5 Valve Cover Nut
6 Valve Cover Washer
7 Valve Cover Gasket
8 Seal
9 Hydraulic Valve Lash Adjuster
10 Valve Key
11 Valve Spring Retainer
12 Valve Spring
13 Valve Stem Oil Seal
14 Valve Cover Stud
15 Freeze Plug
16 Exhaust Manifold
17 Nut
18 Exhaust Manifold Heat Shield
19 Oxygen Sensor
20 Bolt
21 Bolt
22 Thermostat Housing
23 Thermostat Housing Seal
24 Thermostat
25 Thermostat Adapter
26 Thermostat Adapter Seal
27 Nut
28 Washer
29 Cylinder Head Gasket
30 Exhaust Valve
31 Intake Valve
32 Camshaft Seal
33 Washer
34 Camshaft Gear Bolt
35 Camshaft
36 Plug
37 Stud
38 Engine Coolant Temperature Sensor
39 Coolant Temperature Sensor
40 Bolt
41 Front Camshaft Cap
42 Plug
43 Valve Guide
44 Intermediate Camshaft Cap
45 Washer
46 Head Bolt
47 Exhaust Gas Recirculation Pipe
48 Intake Manifold
49 Plenum Gasket
50 Throttle Body
51 Plenum
52 Intake Manifold Gasket
53 Exhaust Manifold Gasket
54 Cylinder Head

LOWER END



1 Piston Ring Set
2 Piston
3 Piston Pin
4 Connecting Rod
5 Connecting Rod Bearing Set
6 Connecting Rod Bolt
7 Oil Level Gauge Stick
8 Gauge Stick Tube
9 Connecting Piece
10 Oil Filter
11 Hose Clamp
12 Engine Ventilation Hose
13 Engine Ventilation Pipe
14 Bolt
15 Oil Separator Gasket
16 Crankshaft Pulley Bolt
17 Washer
18 Crankshaft Pulley
19 Crankshaft Gear
20 Rear Timing Belt Cover
21 Bolt
22 Coolant Pump
23 Oil Pump
24 Engine Block Seal Ring
25 Oil Pump Body Gasket
26 Engine Block
27 Pressure Relief Valve Plunger
28 Spring
29 Oil Pump Seal Ring
30 Bolt Plug
31 Crankshaft Bearing Set
32 Crankshaft
33 Shaft Seal Ring
34 Flywheel (Manual Transmission)
35 Bolt (Manual Transmission)
36 Bolt
37 Bracket
38 Bolt
39 Crankshaft Position Sensor
40 Flexible Plate (Automatic Transmission)
41 Bolt (Automatic Transmission)
42 Crankshaft Main Bearing Cap
43 Bolt
44 Bolt
45 Knock Sensor
46 Oil Pan
47 Threaded Ring
48 Bolt
49 Bolt
50 Bracket
51 Oil Pickup Tube
52 Bolt
53 Bolt
54 Timing Belt
55 Cover Seal
56 Cover
57 Bolt
58 Clamp
59 Bolt
60 Washer
61 Cover Bracket
62 Idler Pulley
63 Rear Cover Bolt
64 Bolt
65 Auto Tensioner
66 Seal
67 Bolt
68 Seal
69 Gear
70 Gear
71 Cover
72 Bolt
73 Plug
74 Oil Pressure Sensor
75 Intake Manifold Support Bracket
76 EGR Solenoid


A102C006

MAINTENANCE AND REPAIR

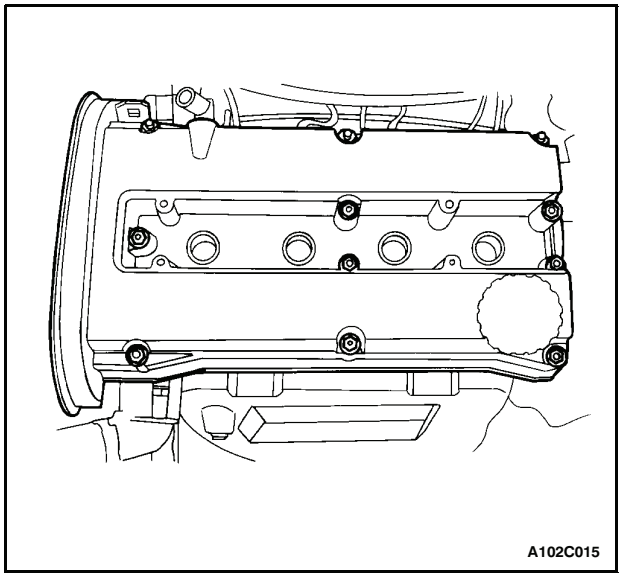
ON-VEHICLE SERVICE

VALVE COVER

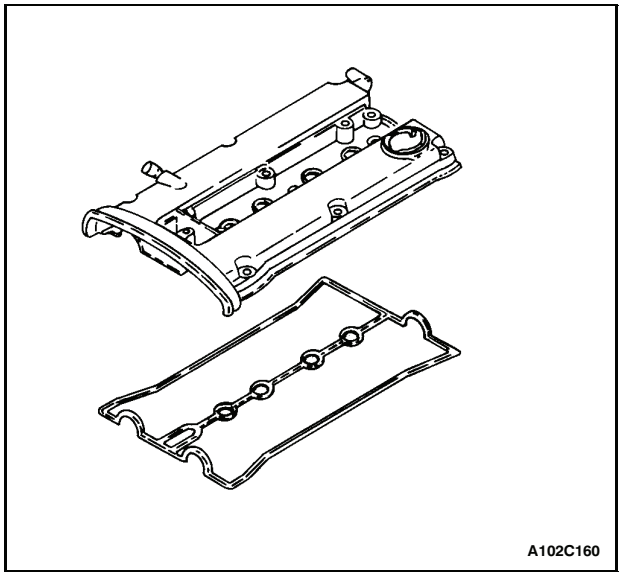
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

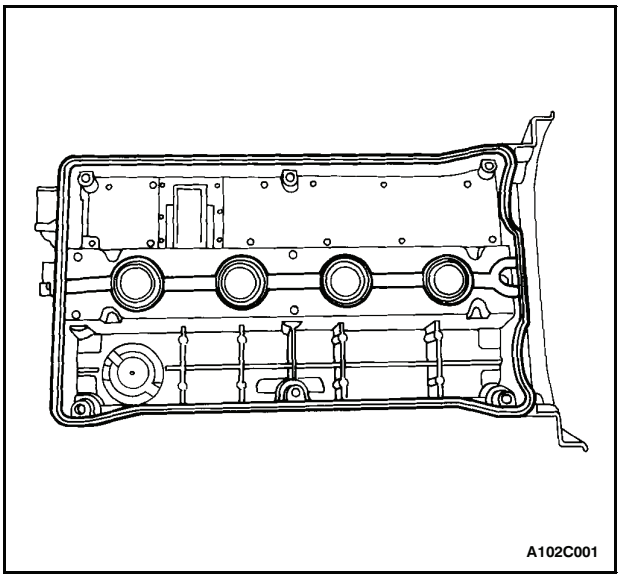
1. Disconnect the negative battery cable.
2. Remove the spark plug cover bolts and cover.
3. Disconnect the breather tube from the valve cover.
4. Disconnect the crankcase ventilation tube from the valve cover.


A102C015

5. Disconnect all of the necessary vacuum lines.
6. Disconnect the ignition wires from the spark plugs.
7. Remove the valve cover nuts.
8. Remove the valve cover washers.

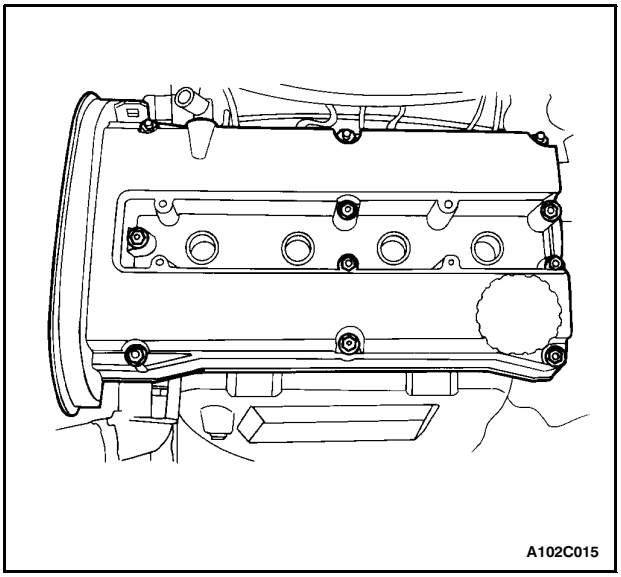

A102C160

9. Remove the valve cover.
10. Remove the valve cover gasket from the valve cover.


A102C001

Installation Procedure

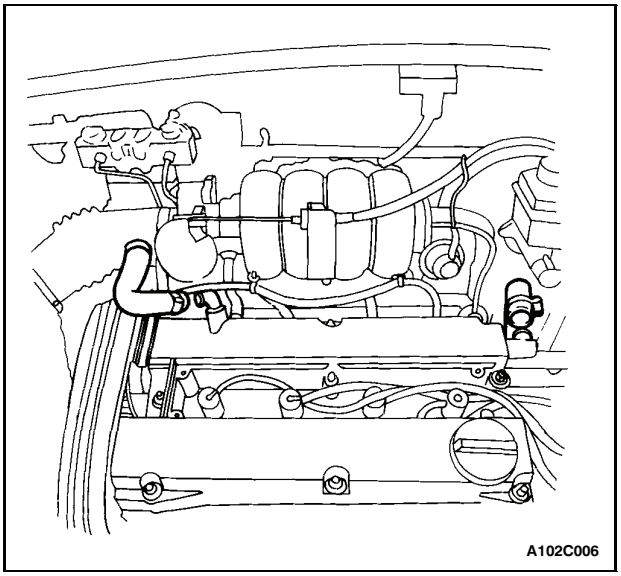
1. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.
2. Install the new valve cover gasket to the valve cover.
3. Install the valve cover.


A102C015

4. Install the valve cover washers.
5. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).

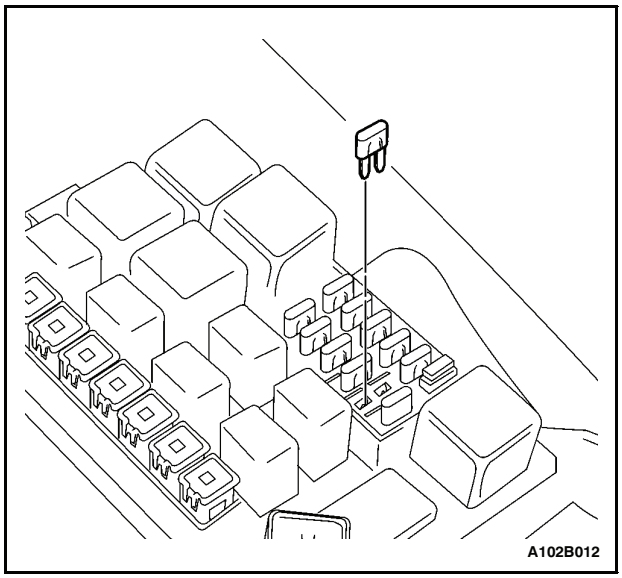

A102C006

6. Connect the ignition wires to the spark plugs.
7. Install the spark plug cover.
8. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

9. Connect all of the necessary vacuum lines.
10. Connect the crankcase ventilation tube to the valve cover.
11. Connect the breather tube to the valve cover.
12. Connect the negative battery cable.


A102B012

CYLINDER HEAD AND GASKET

(Left-Hand Drive Shown, Right-Hand Drive Similar)

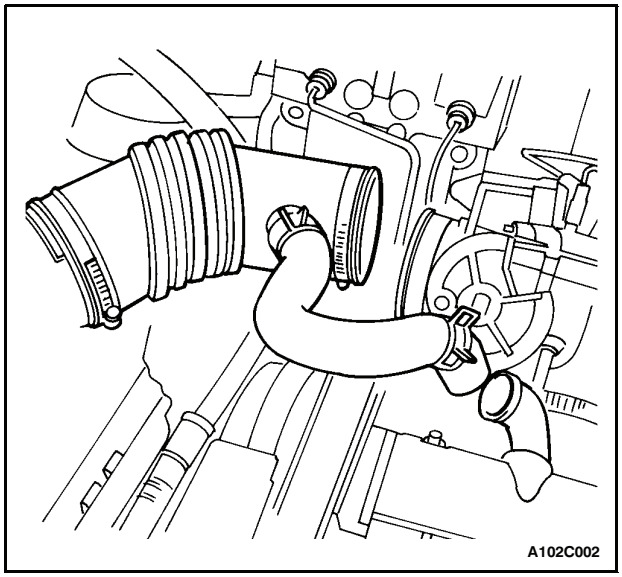
Tools Required

J-42472 Timing Belt Adjuster

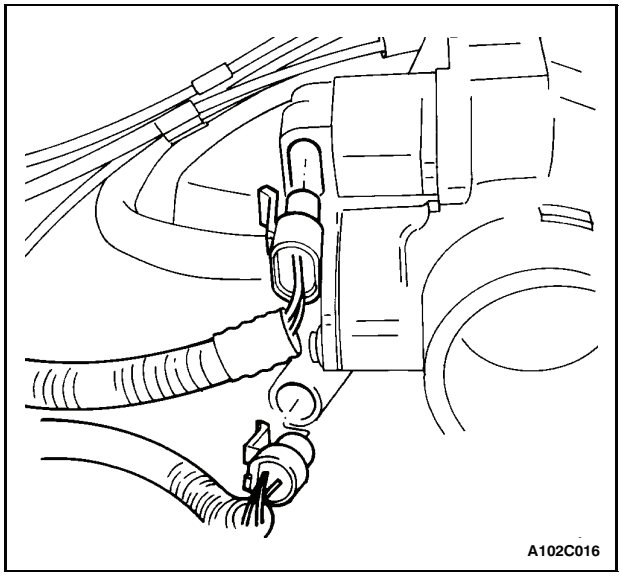
KM-470-B Angular Torque Gauge

Removal Procedure

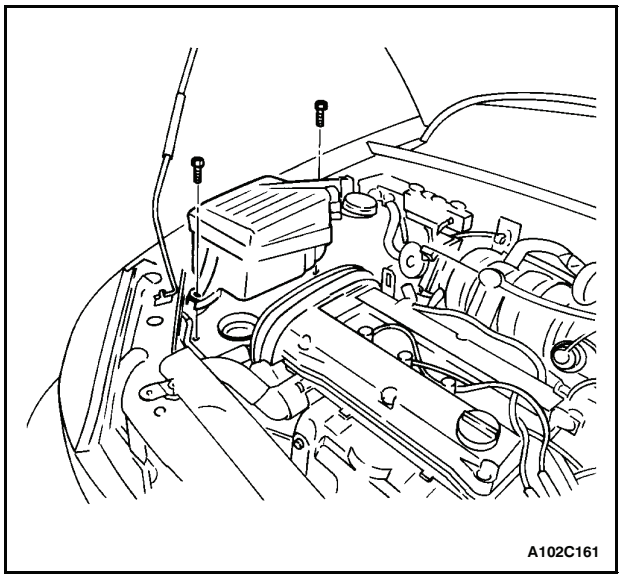
1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the ECM ground terminal from the intake manifold.
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.


A102C002

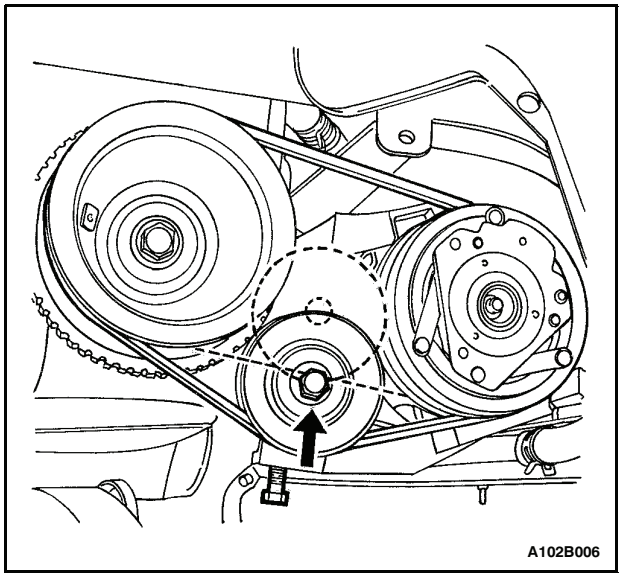
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the breather tube from the valve cover.
8. Disconnect the air intake tube from the throttle body.


A102C016

9. Disconnect the DIS ignition coil connector.
10. Disconnect the oxygen sensor connector.
11. Disconnect the fuel injector harness connectors.
12. Disconnect the idle air control valve connector.
13. Disconnect the throttle position sensor connector.
14. Disconnect the engine coolant temperature sensor connector.
15. Disconnect the coolant temperature sensor connector.


A102C161

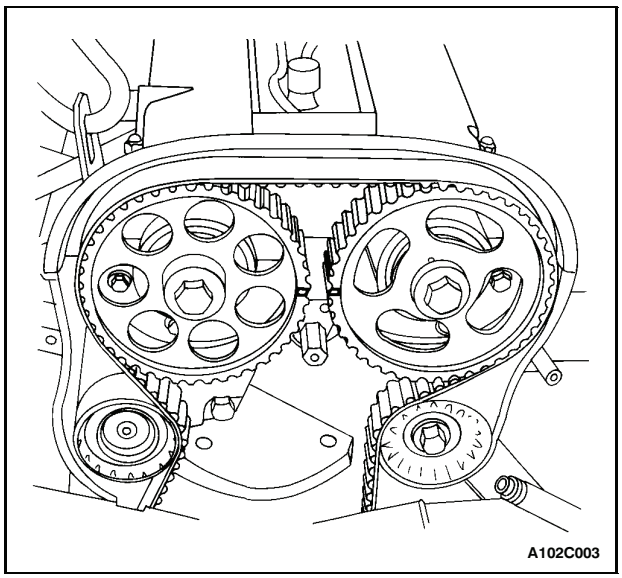
16. Remove the air filter housing bolts.
17. Remove the air filter housing.
18. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
19. Remove the right front splash shield.


A102B006

20. Disconnect the upper radiator hose at the thermostat housing.
21. Remove the A/C compressor drive belt, if equipped.
22. Remove the alternator adjusting bolt and the alternator drive belt.
23. Remove the power steering pump pulley bolts, if equipped.

Important: Push the engine assembly toward the battery to remove the power steering pump pulley.

24. Remove the power steering pump pulley, if equipped.
25. Remove the crankshaft pulley bolt.
26. Remove the crankshaft pulley.

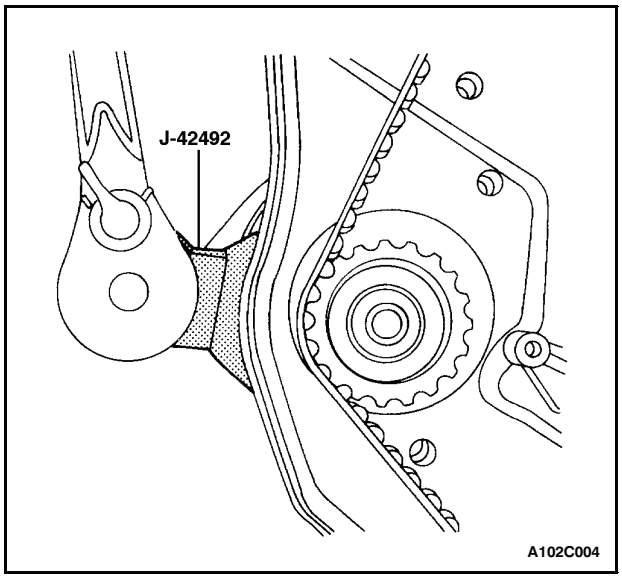

A102C003

27. Remove the upper front timing belt cover bolts.
28. Remove the upper front timing belt cover.
29. Remove the lower front timing belt cover bolts.
30. Remove the lower front timing belt cover.
31. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
32. Install the engine-mount-to-engine-mount-bracket retaining bolts and tighten the bolts to secure the engine if the power steering was removed.

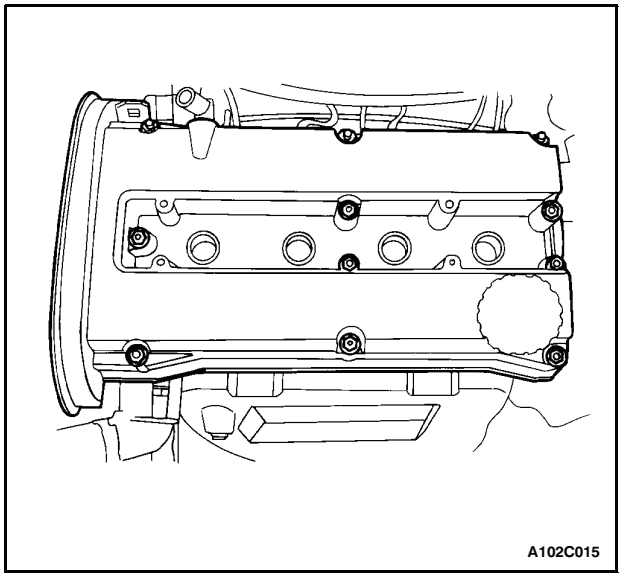
Tighten

Tighten the engine-mount-to-engine-mount-bracket retaining bolts to 60 NSm (44 lb-ft).

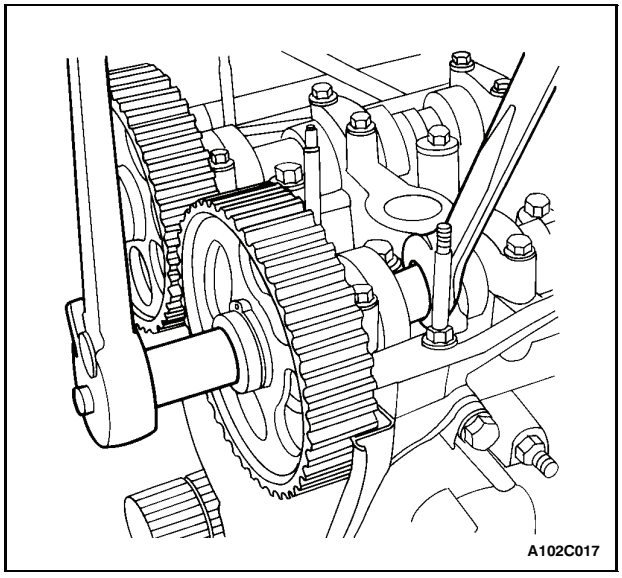
33. Align the camshaft gear timing marks.



34. Slightly loosen the coolant pump retaining bolts.
35. Rotate the coolant pump counterclockwise using the timing belt adjuster J-42492 to relieve the timing belt tension.
36. Remove the timing belt. Refer to "Timing Belt" in this section.

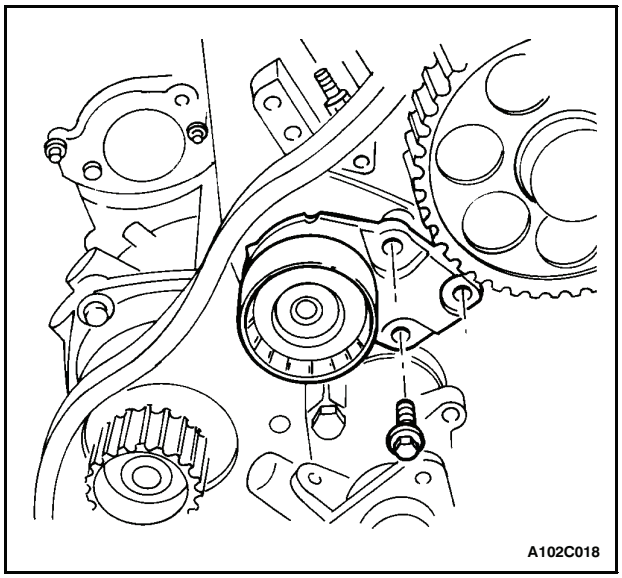


37. Disconnect the crankcase ventilation tube at the valve cover.
38. Remove the spark plug cover bolts.
39. Remove the spark plug cover.
40. Disconnect the ignition wires from the spark plugs.
41. Remove the valve cover nuts.
42. Remove the valve cover washers.
43. Remove the valve cover and the valve cover gasket.

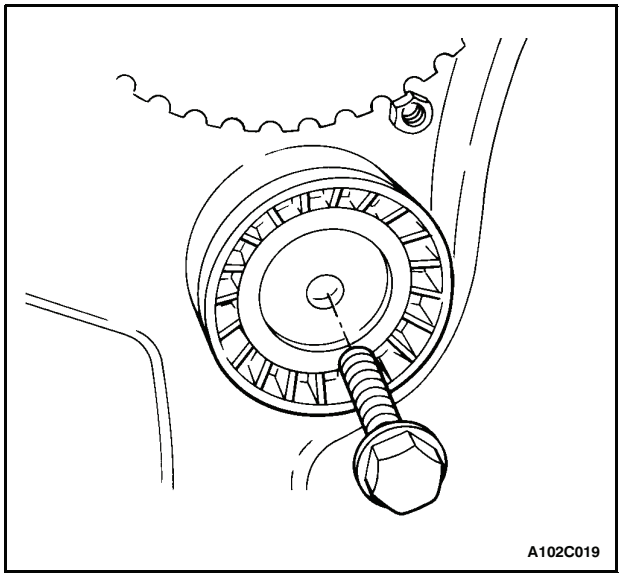


Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

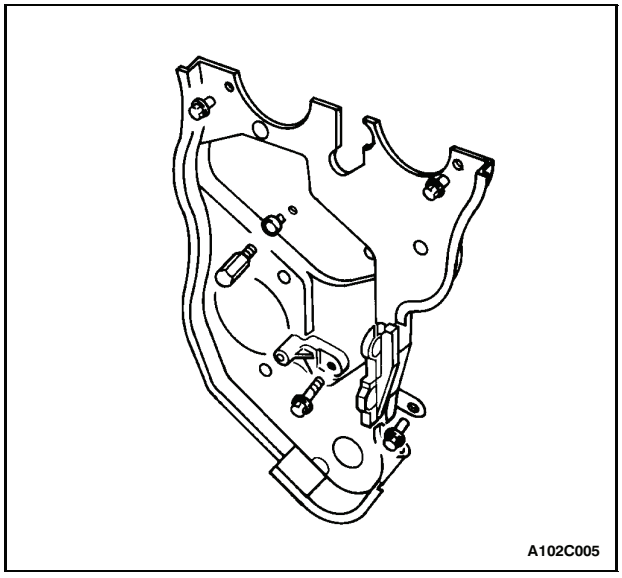
44. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
45. Remove the intake camshaft gear.
46. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
47. Remove the exhaust camshaft gear.



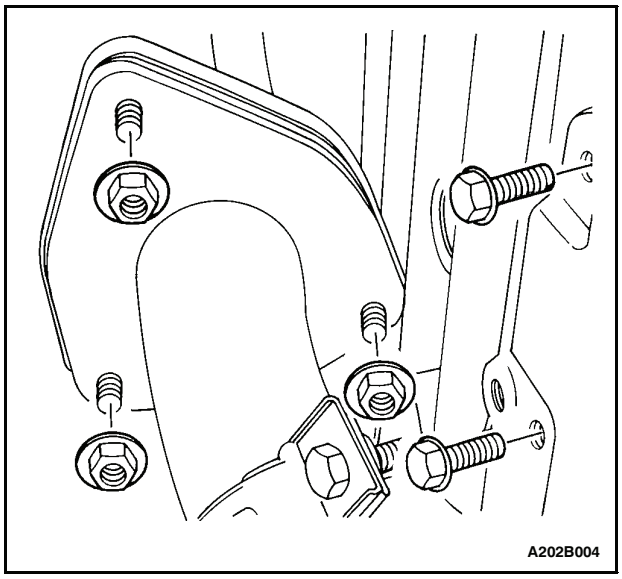
48. Remove the timing belt automatic tensioner bolts.
49. Remove the timing belt automatic tensioner.



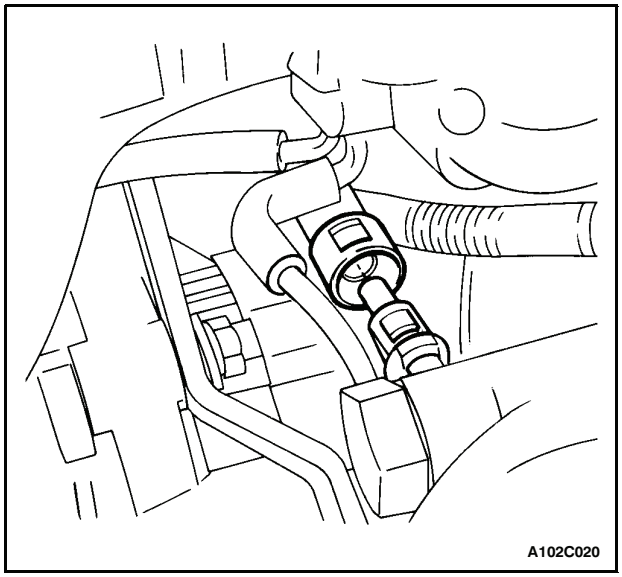
50. Remove the timing belt idler pulley bolt.
51. Remove the timing belt idler pulley.



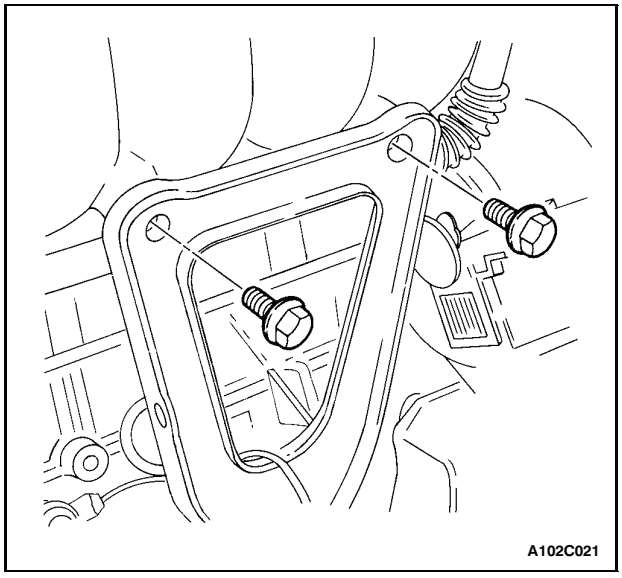
52. Remove the rear timing belt cover bolts.
53. Remove the rear timing belt cover.



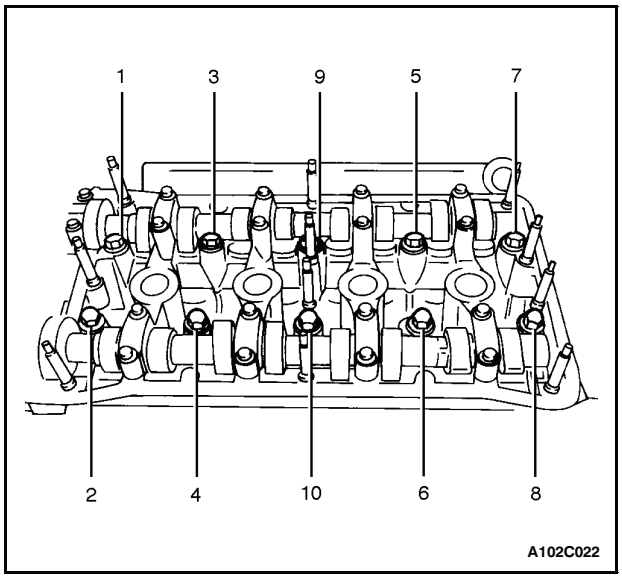
54. Remove the exhaust flex pipe retaining nuts at the exhaust manifold studs and the bolts at the bracket.
55. Disconnect all of the necessary vacuum hoses.



56. Disconnect the fuel return line at the fuel pressure regulator.
57. Disconnect the fuel feed line at the fuel rail.
58. Remove the alternator adjusting bracket retaining bolt and the bracket.
59. Disconnect the heater inlet hose at the cylinder head.
60. Disconnect the surge tank coolant hose at the throttle body.



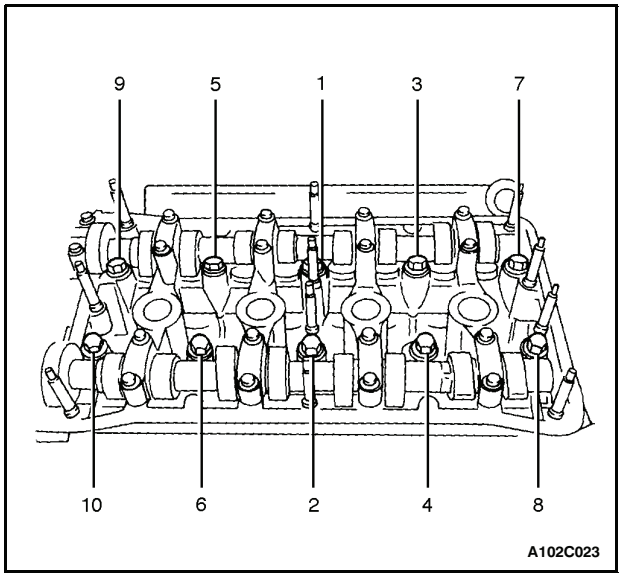
61. Remove the upper intake manifold support bracket bolts.



62. Disconnect the throttle cable at the throttle body and the intake manifold.
63. Loosen all of the cylinder head bolts gradually and in the sequence shown.
64. Remove the cylinder head bolts.
65. Remove the cylinder head with the intake manifold and the exhaust manifold attached.

Notice: Prevent any engine oil or coolant from entering the cylinders when removing the cylinder heads.

66. Remove the cylinder head gasket.



Cleaning Procedure

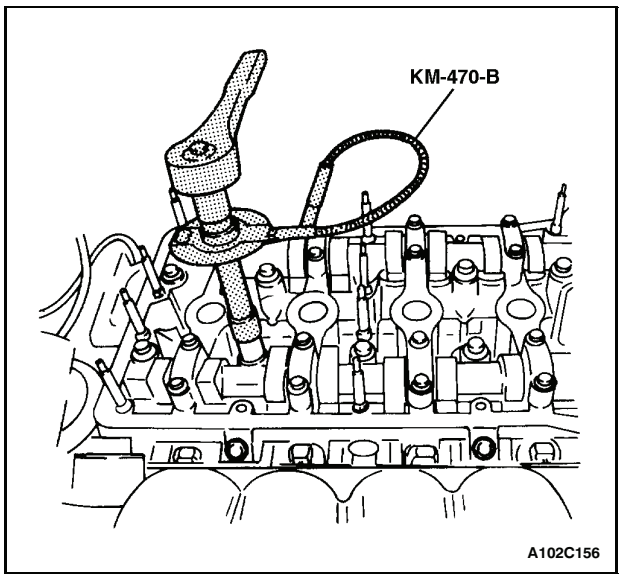
1. Clean the gasket surfaces of the cylinder head and the engine block.
2. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
3. Clean the cylinder head bolts.
4. Inspect the cylinder head for warpage. Refer to "Cylinder Head and Valve Train Components" in this section.

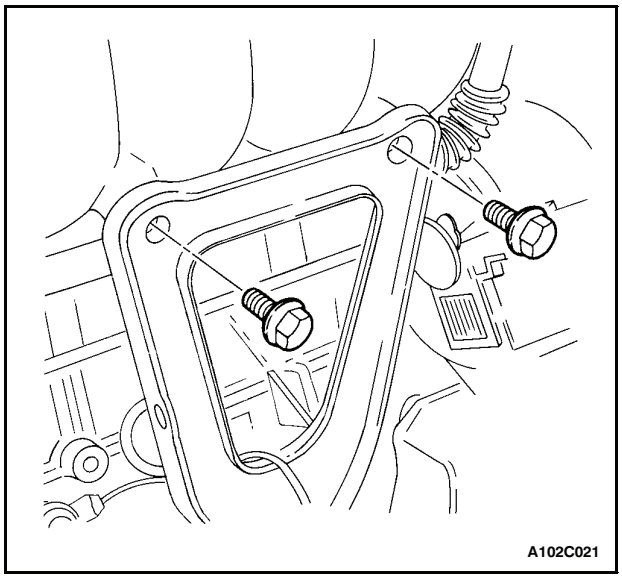
Installation Procedure

1. Install the cylinder head gasket.
2. Install the cylinder head with the intake manifold and the exhaust manifold attached.
3. Install the cylinder head bolts.
4. Tighten the cylinder head bolts gradually and in the sequence shown.

Tighten

Tighten the cylinder head bolts to 25 NSm (18 lb-ft). Adjust the bolts to 60 degrees + 60 degrees + 60 degrees + 10 degrees using the angular torque gauge KM-470-B.



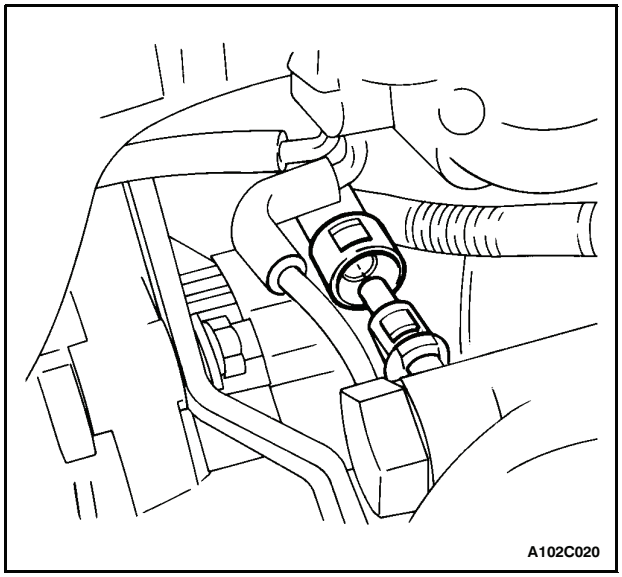

A102C021

5. Connect the throttle cable at the throttle body and the intake manifold.
6. Install the intake manifold support bracket upper bolts to the intake manifold.

Tighten

Tighten the intake manifold support bracket upper bolts to the intake manifold to 25 NSm (18 lb-ft).

7. Connect the surge tank coolant hose at the throttle body.
8. Connect the heater inlet hose to the cylinder head.

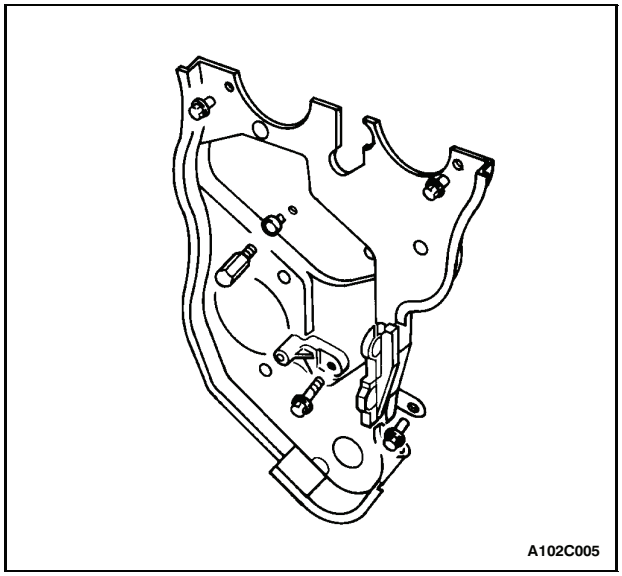

A102C020

9. Install the alternator adjusting bracket with the bolt.

Tighten

Tighten the alternator adjusting bracket retaining bolt to 20 NSm (15 lb-ft).

10. Connect the fuel feed line at the fuel rail.
11. Connect the fuel return line at the fuel rail.
12. Connect all of the necessary vacuum hoses.


A102C005

13. Install the exhaust flex pipe retaining nuts at the exhaust manifold flange and the bolts at the bracket.

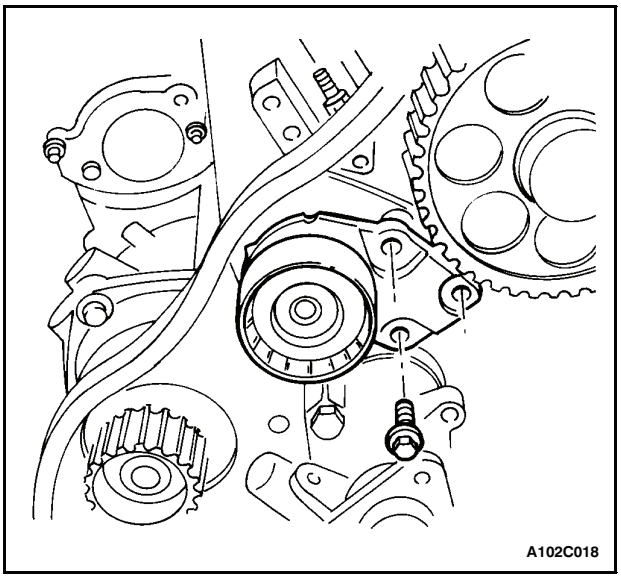
Tighten

Tighten the exhaust flex pipe retaining nuts and bracket bolts to 40 NSm (30 lb-ft).

14. Install the rear timing belt cover.
15. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).


A102C018

16. Install the timing belt automatic tensioner.
17. Install the timing belt automatic tensioner bolts.

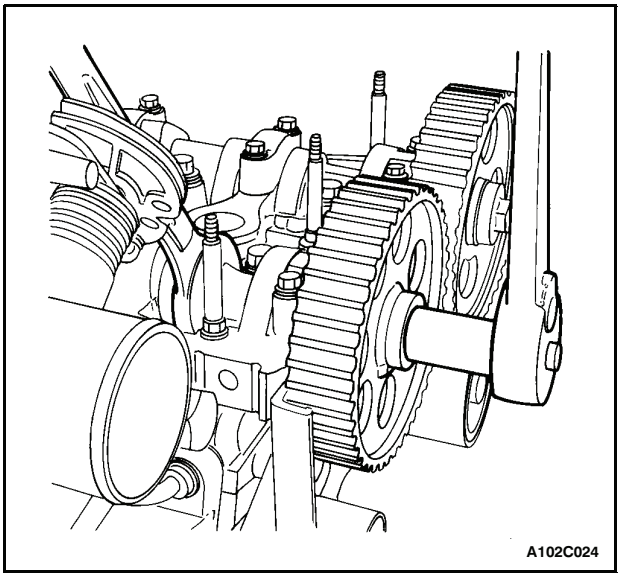
Tighten

Tighten the timing belt automatic tensioner bolts to 25 NSm (18 lb-ft).

18. Install the timing belt idler pulley.
19. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 NSm (30 lb-ft).

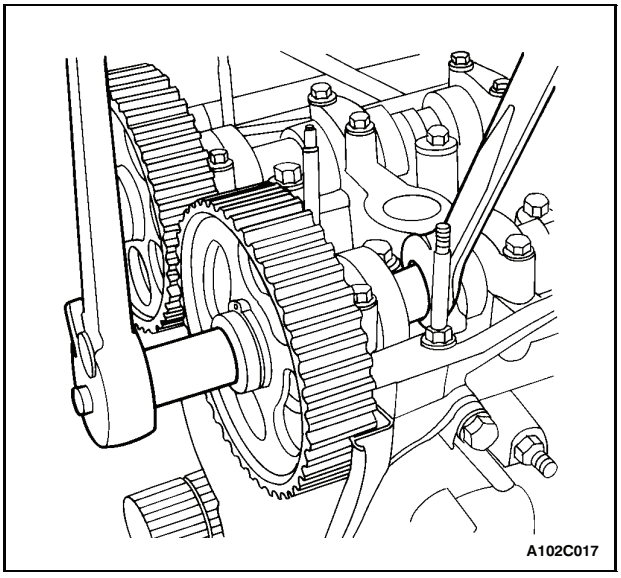

A102C024

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

20. Install the intake camshaft gear.
21. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten

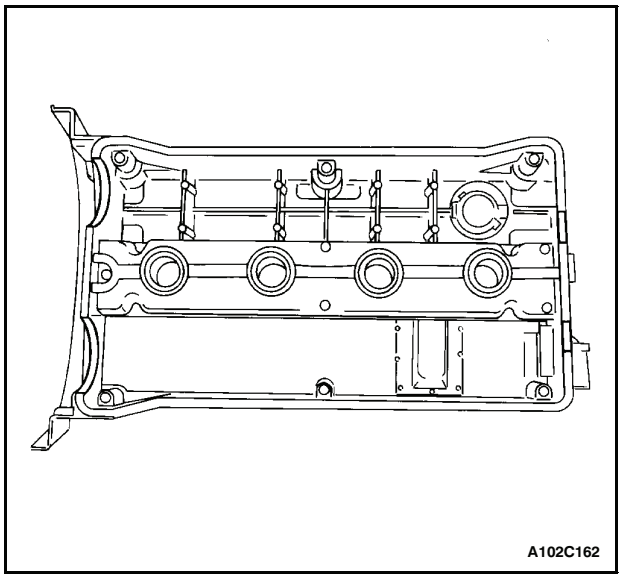
Tighten the intake camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C017

22. Install the exhaust camshaft gear.
23. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten

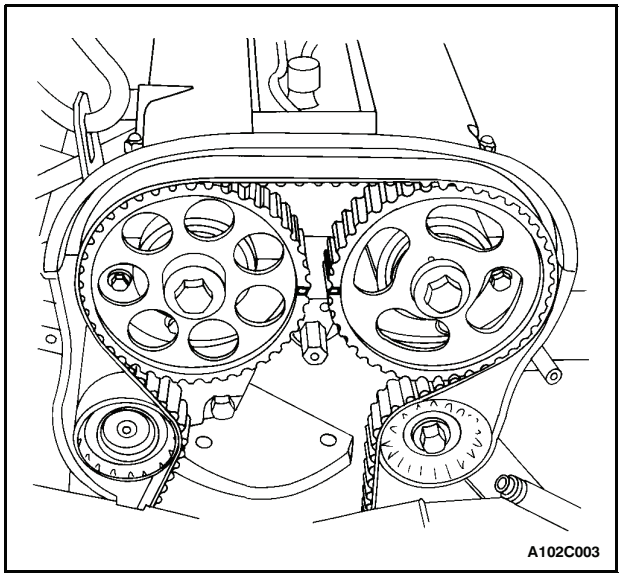
Tighten the exhaust camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C162

24. Apply a small amount of gasket sealant to the corners of the front camshaft caps, and the top of the rear valve cover to cylinder head seal.
25. Install the valve cover and the valve cover gasket.
26. Install the valve cover washers.
27. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).

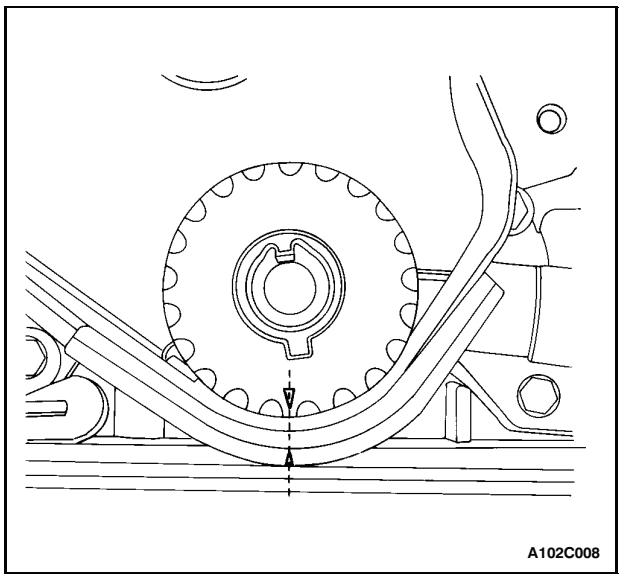

A102C003

28. Connect the ignition wires to the spark plugs.
29. Install the spark plug cover.
30. Install the spark plug cover bolts.

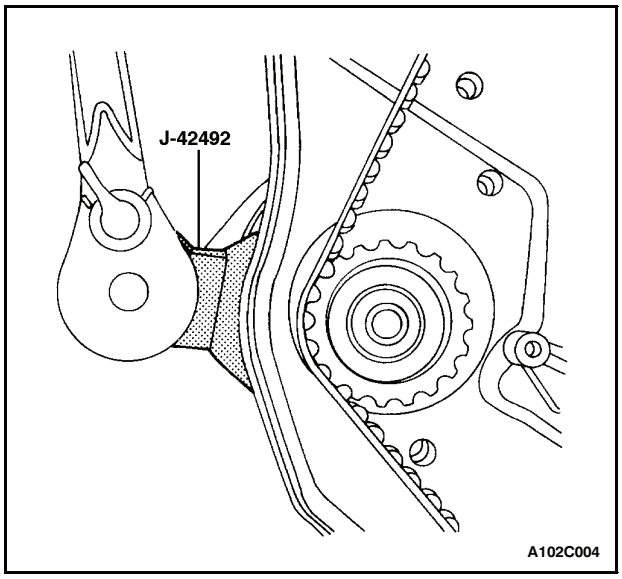
Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

31. Connect the crankcase ventilation tube to the valve cover.
32. Align the timing marks on the camshaft gears.


A102C008

33. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.

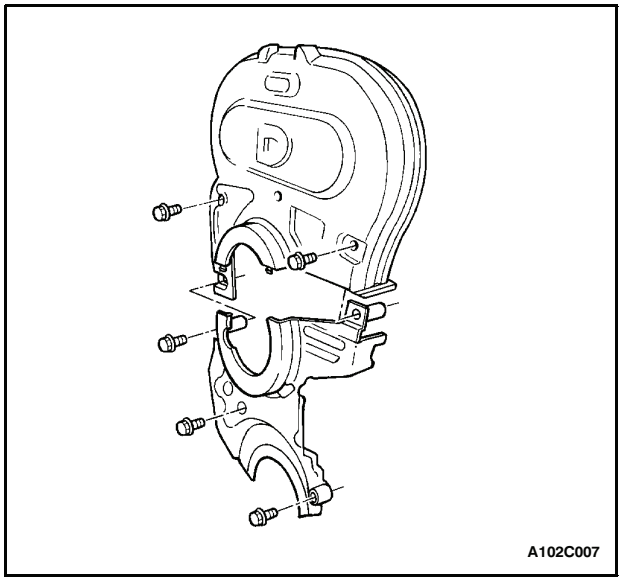


34. Install the timing belt.
35. Rotate the coolant pump clockwise using the timing belt adjuster J-42492 to apply tension to the timing belt.

Tighten

Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).

36. Check and adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.



37. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
38. Install the engine-mount-bracket-to-engine-mount retaining bolts if the power steering pump was installed.

Tighten

Tighten the engine-mount-bracket-to-engine-mount retaining bolts to 60 NSm (44 lb-ft).

39. Install the upper and lower front timing belt cover.
40. Install the upper and lower front timing belt cover bolts.

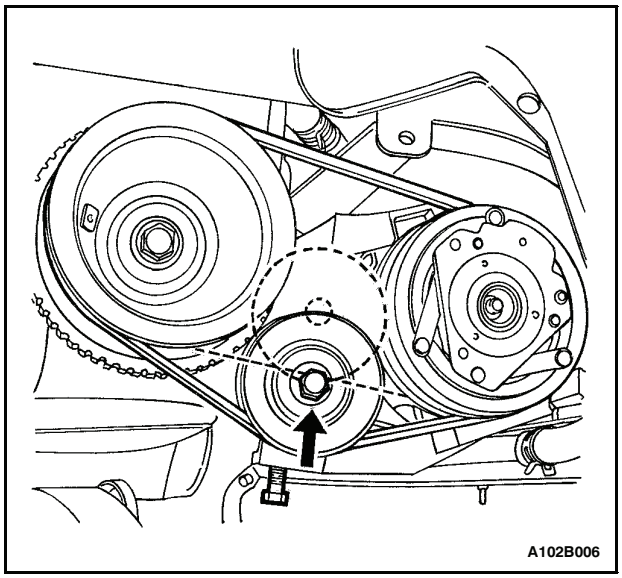
Tighten

Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).

41. Install the crankshaft pulley.
42. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.


A102B006

43. Install the power steering pump pulley, if equipped.
44. Install the power steering pump pulley bolts, if equipped.

Tighten

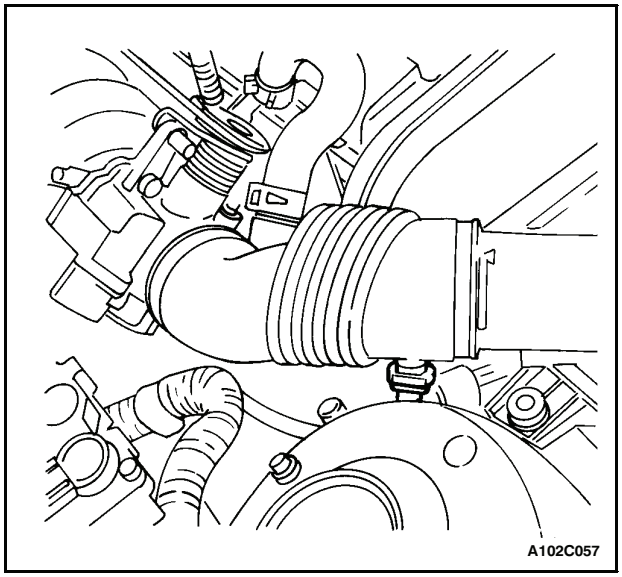
Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

45. Install the alternator drive belt.
46. Install the alternator adjusting bolt.

Tighten

Tighten the alternator adjusting bolt to 20 NSm (15 lb-ft).

47. Install the A/C compressor drive belt, if equipped.
48. Connect the upper radiator hose to the thermostat housing.
49. Install the right front splash shield.
50. Install the right front wheel. Refer to Section 2E, Tires and Wheels.

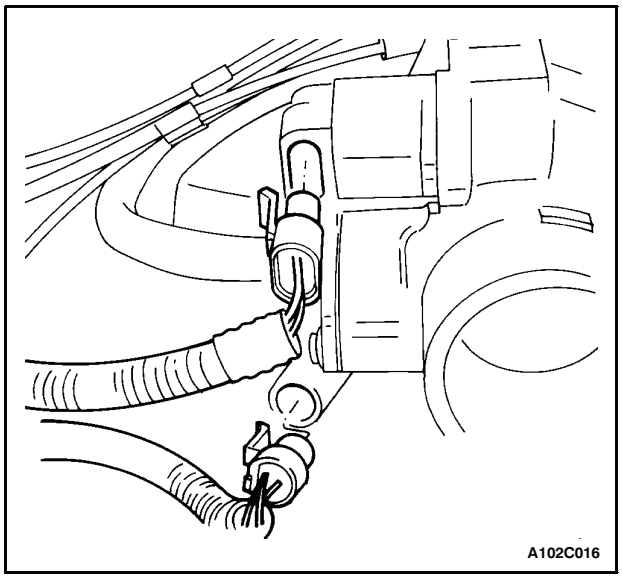

A102C057

51. Install the air filter housing.
52. Install the air filter housing bolts.

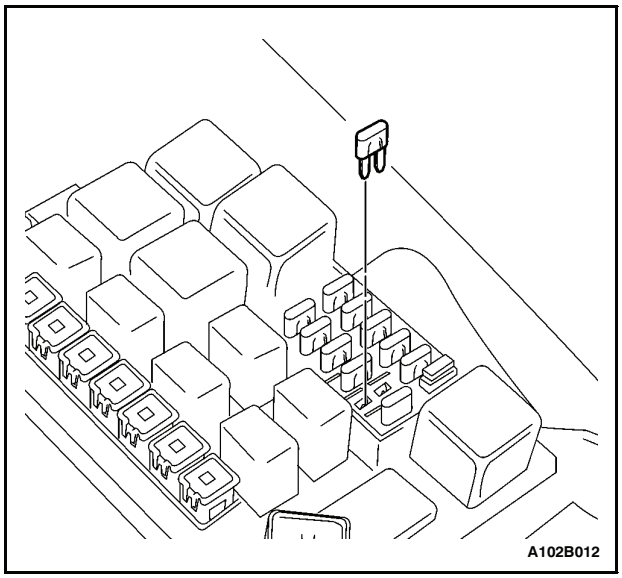
Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).

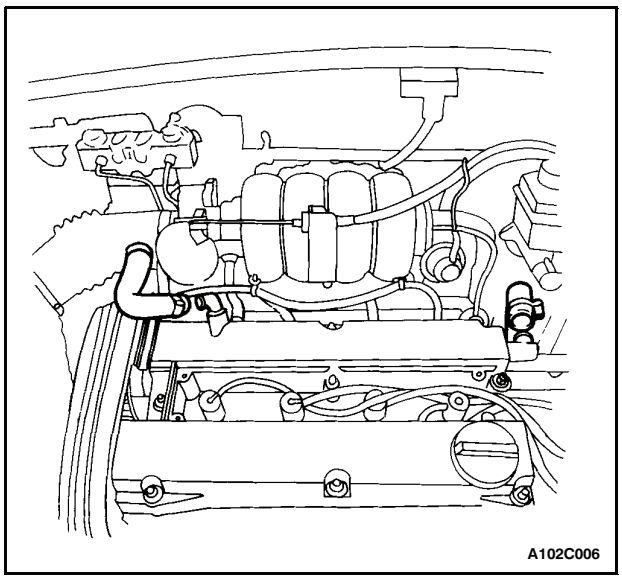
53. Connect the air intake tube to the throttle body.
54. Connect the breather tube to the valve cover.
55. Connect the manifold air temperature sensor connector.


A102C016

56. Connect the coolant temperature sensor connector.
57. Connect the engine coolant temperature sensor connector.
58. Connect the idle air control valve connector.
59. Connect the throttle position sensor connector.


A102B012

60. Connect the DIS ignition coil connector.
61. Connect the fuel injector harness connectors.
62. Connect the oxygen sensor connector.
63. Connect the ECM ground terminal at the intake manifold.
64. Install the fuel pump fuse.
65. Connect the negative battery ground cable.
66. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.

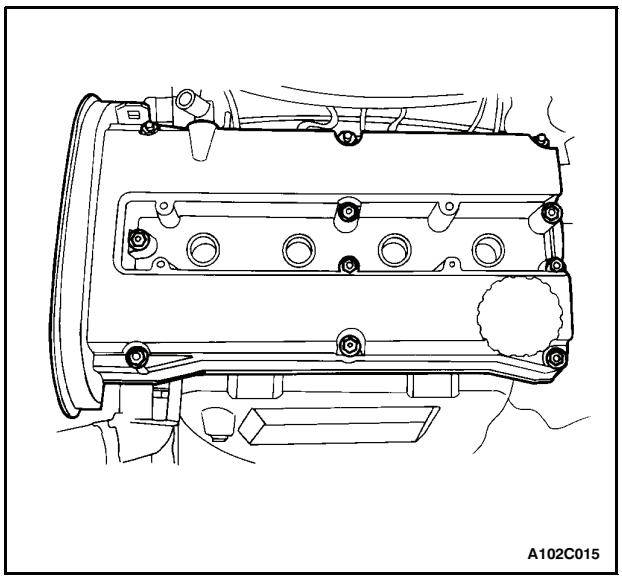

A102C006

CAMSHAFTS

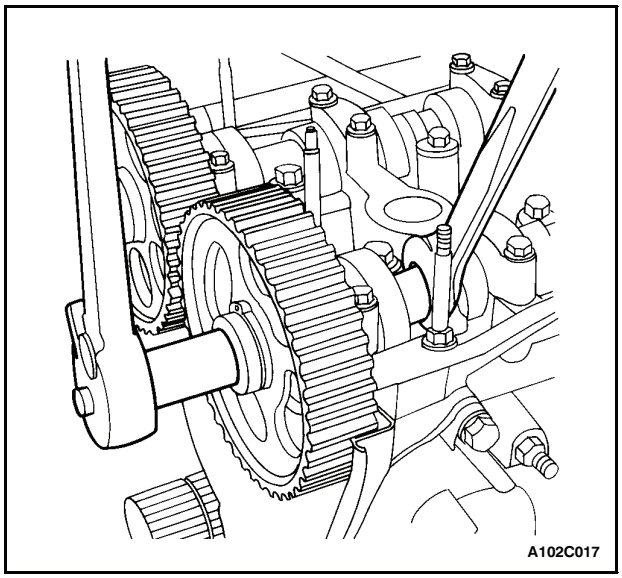
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Remove the timing belt. Refer to "Timing Belt" in this section.
2. Disconnect the air breather tube at the valve cover.
3. Disconnect the crankcase ventilation tube at the valve cover.
4. Remove the spark plug cover bolts.
5. Remove the spark plug cover.

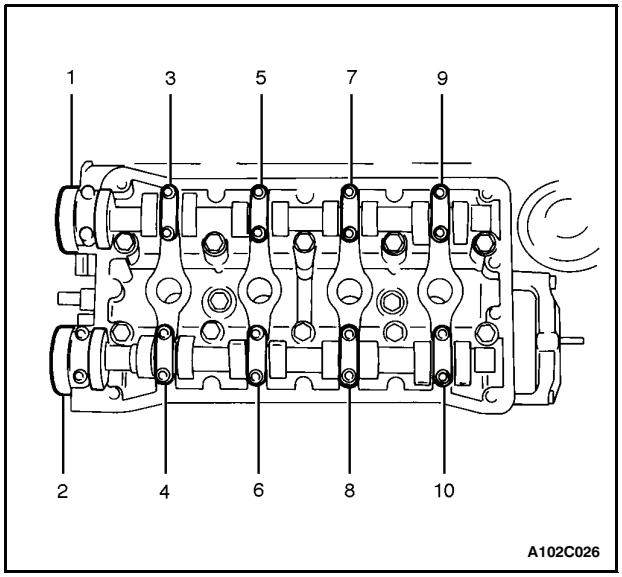

A102C015

6. Disconnect the ignition wires from the spark plugs.
7. Remove the valve cover nuts.
8. Remove the valve cover washers.
9. Remove the valve cover and the valve cover gasket.


A102C017

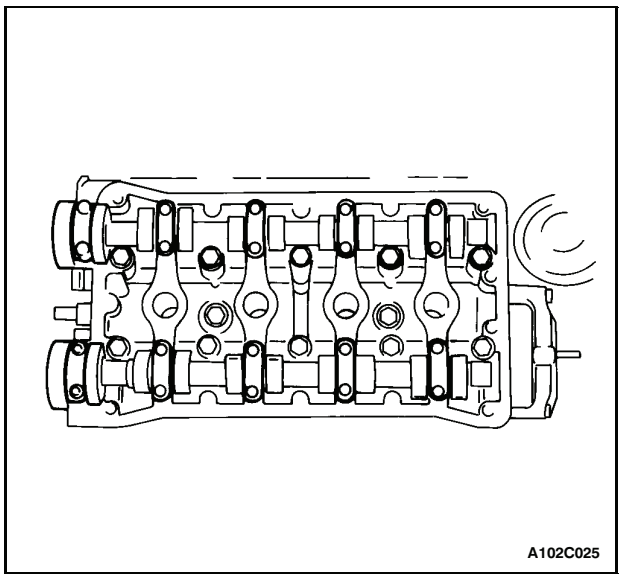
Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

10. **While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.**
11. **Remove the intake camshaft gear.**
12. **While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.**
13. **Remove the exhaust camshaft gear.**

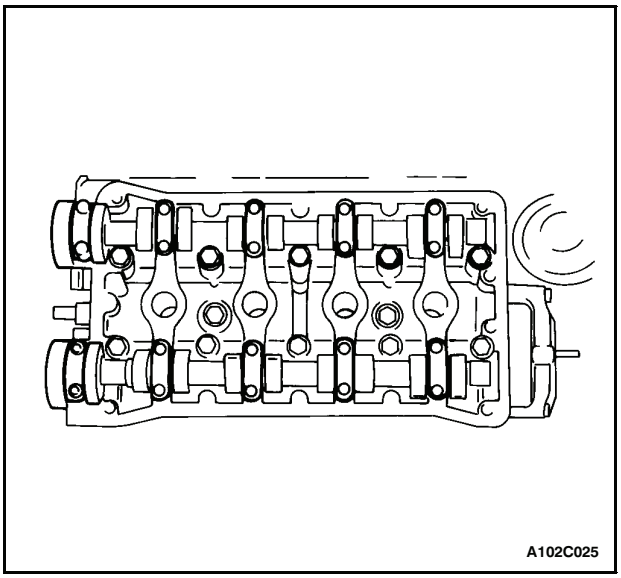


A102C026

14. **Remove the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.**


A102C025

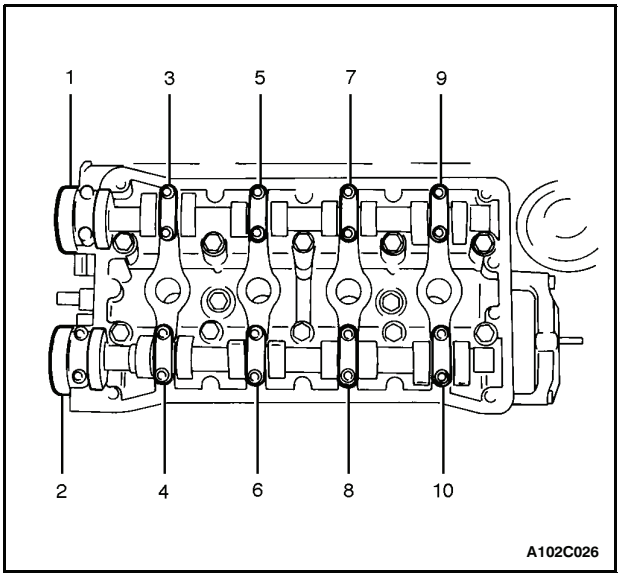
15. **Remove the intake camshaft caps. Maintain the correct positions for installation.**
16. **Remove the intake camshaft.**
17. **Remove the exhaust camshaft caps. Maintain the correct positions for installation.**
18. **Remove the exhaust camshaft.**


A102C025

Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

1. Lubricate the camshaft journals and the camshaft caps with engine oil.
2. Install the intake camshaft.
3. Install the intake camshaft caps in their original positions.
4. Install the intake camshaft cap bolts.
5. Install the exhaust camshaft.
6. Install the exhaust camshaft caps in their original positions.
7. Install the exhaust camshaft cap bolts.

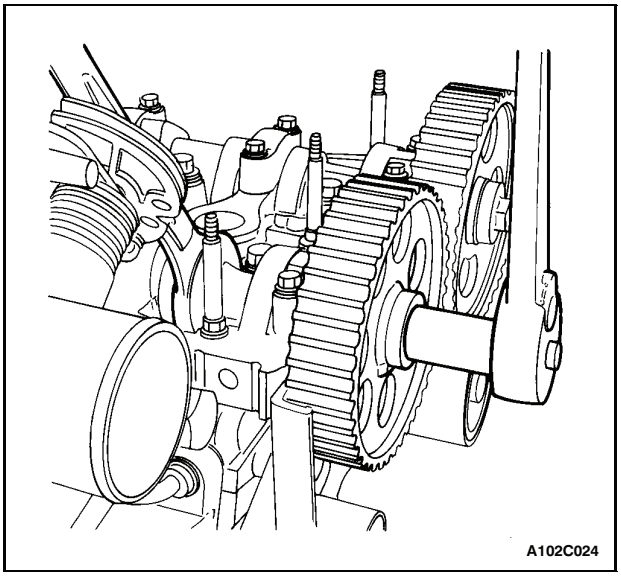


A102C026

8. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

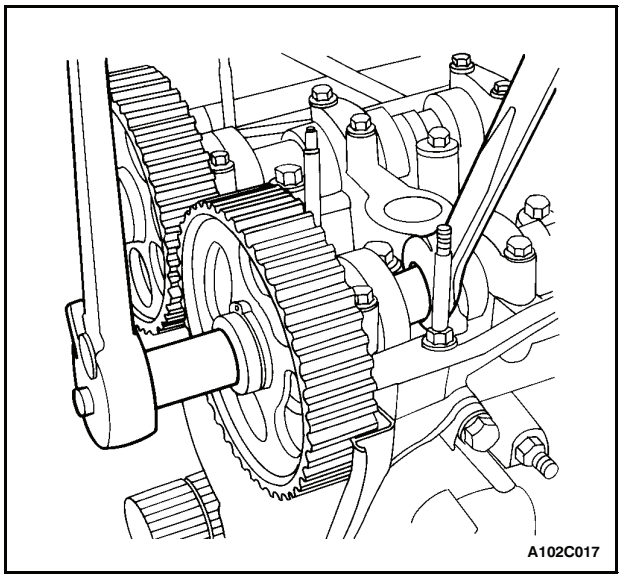
Tighten the camshaft cap bolts to 16 NSm (12 lb-ft).


A102C024

9. Measure the intake camshaft end play and the exhaust camshaft end play. Refer to "Engine Specifications" in this section.
10. Install the intake camshaft gear.
11. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten

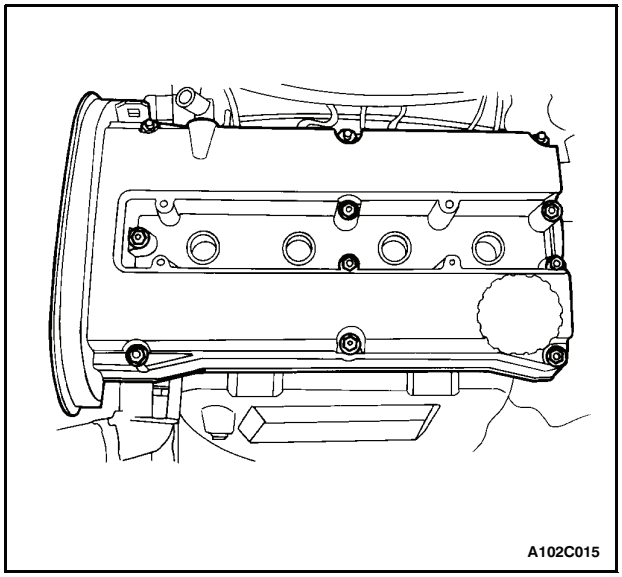
Tighten the intake camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C017

12. Install the exhaust camshaft gear.
13. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten

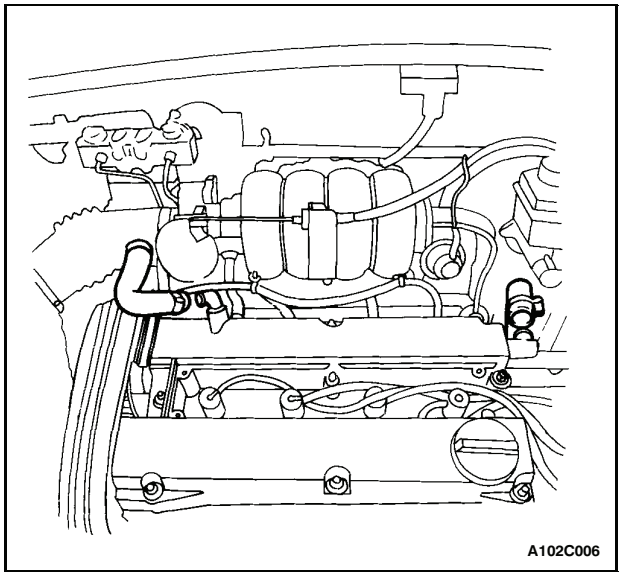
Tighten the exhaust camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C015

14. Install the valve cover and the valve cover gasket.
15. Install the valve cover washers.
16. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).

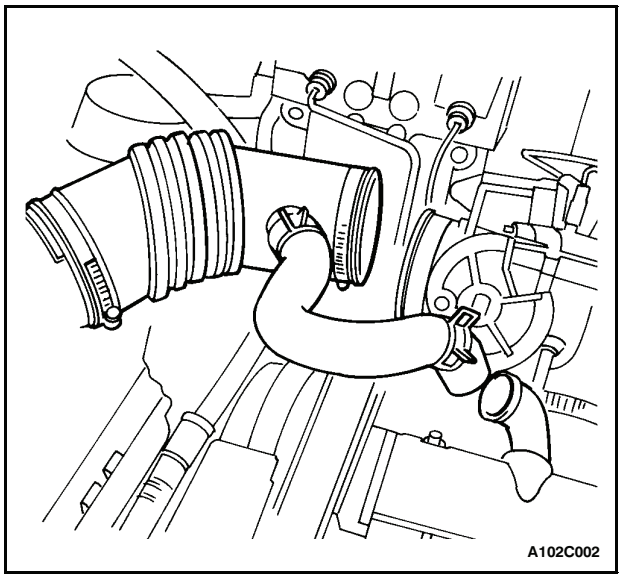

A102C006

17. Connect the ignition wires to the spark plugs.
18. Install the spark plug cover.
19. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

20. Connect the air breather tube to the valve cover.
21. Connect the crankcase ventilation tube to the valve cover.
22. Install the timing belt. Refer to “Timing Belt” in this section.


A102C002

TIMING BELT CHECK AND ADJUST

(Left-Hand Drive Shown, Right-Hand Drive Similar)

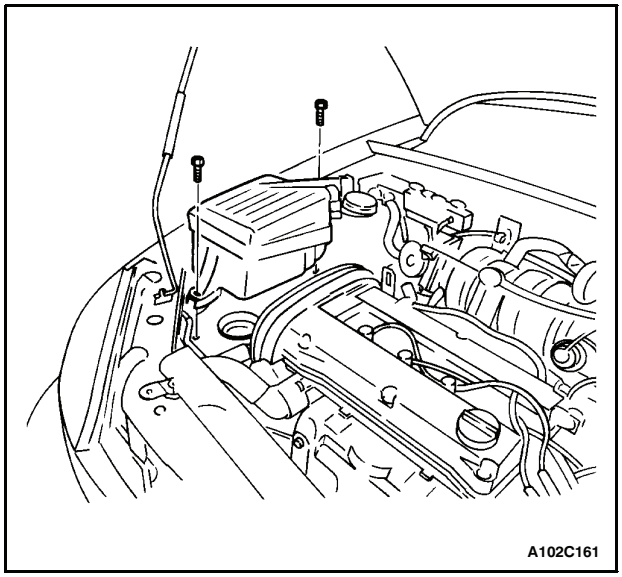
Tools Required

J-42492 Timing Belt Adjuster

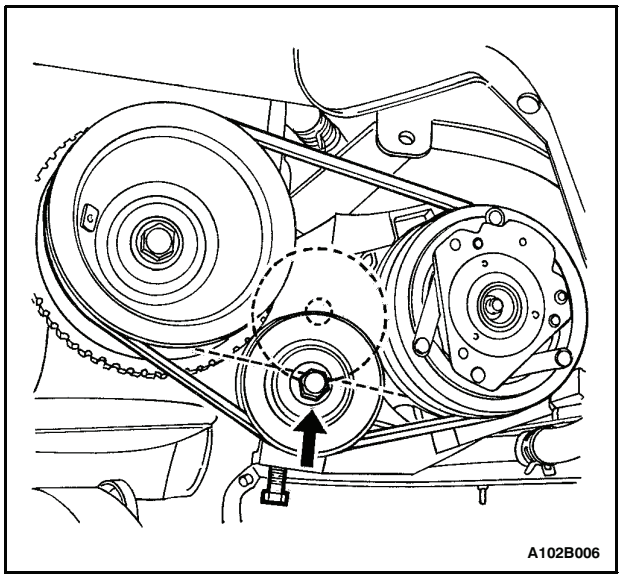
KM-470-B Angular Torque Gauge

Adjustment Procedure

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Remove the air intake tube from the throttle body.
4. Remove the breather tube from the valve cover.


A102C161

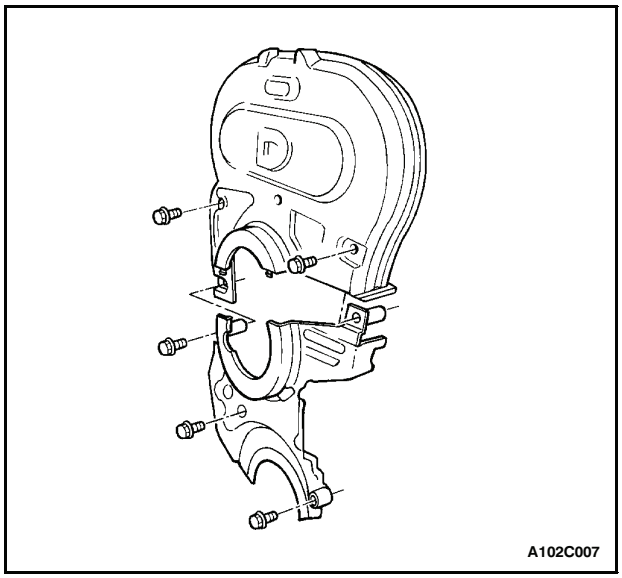
5. Remove the air filter housing bolts.
6. Remove the air filter housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front splash shield.


A102B006

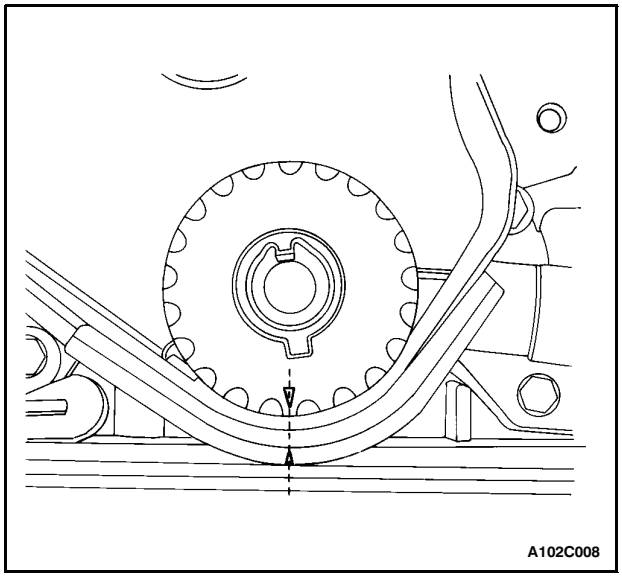
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.

Important: Push the engine assembly toward the battery to remove the power steering pump pulley.

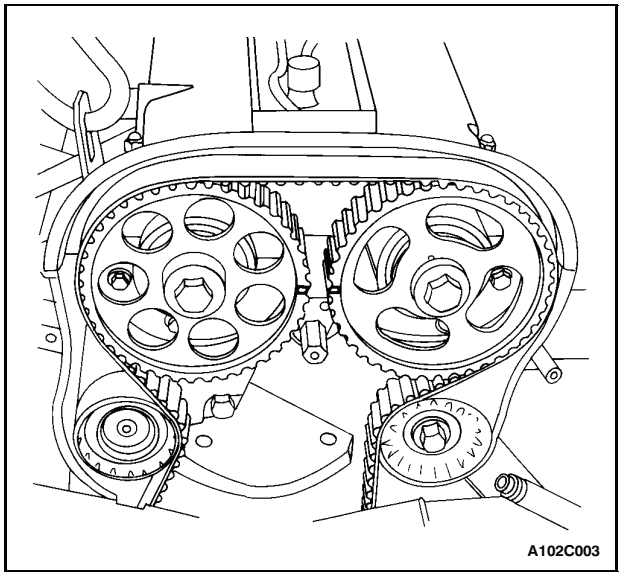
12. Remove the power steering pump pulley, if equipped.
13. Remove the crankshaft pulley bolt.
14. Remove the crankshaft pulley.


A102C007

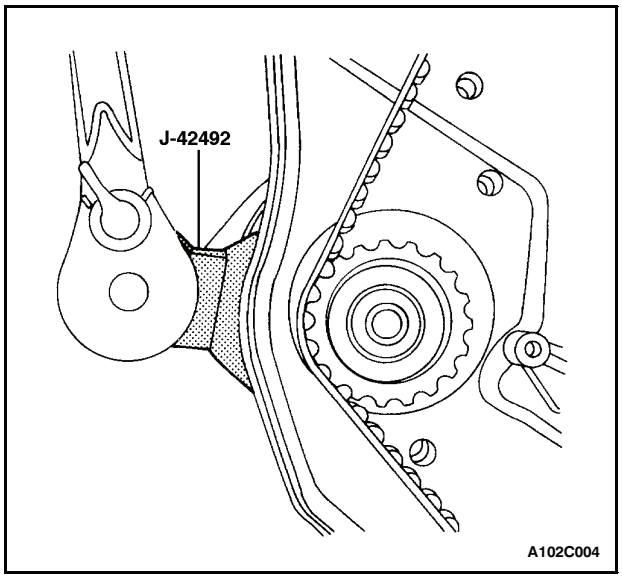
15. Remove the upper front timing belt cover bolts.
16. Remove the upper front timing belt cover.
17. Remove the lower front timing belt cover bolts.
18. Remove the lower front timing belt cover.
19. Remove the power steering pump mounting bolts, if equipped.
20. Install the crankshaft pulley bolt.


A102C008

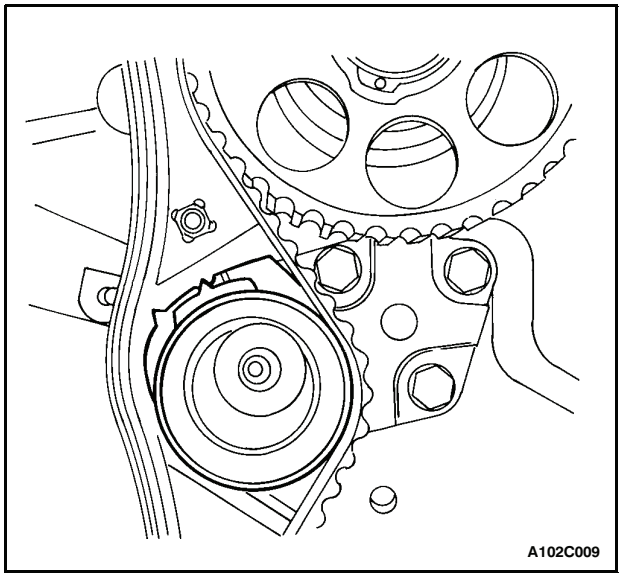
21. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
22. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.


A102C003

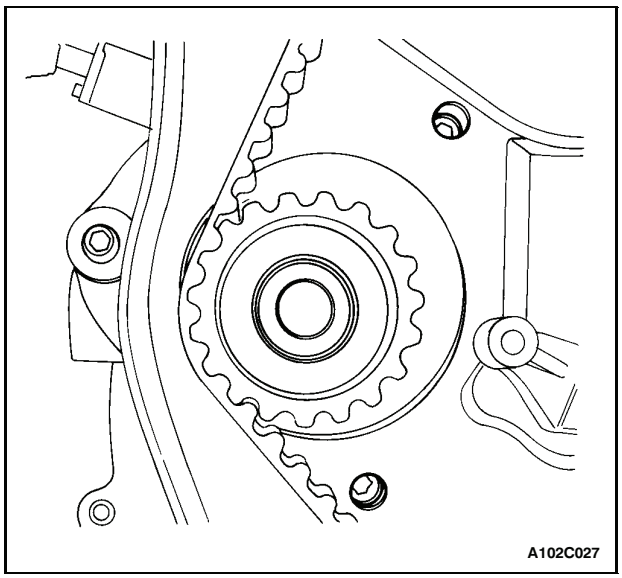
23. Align the camshaft gear timing marks.



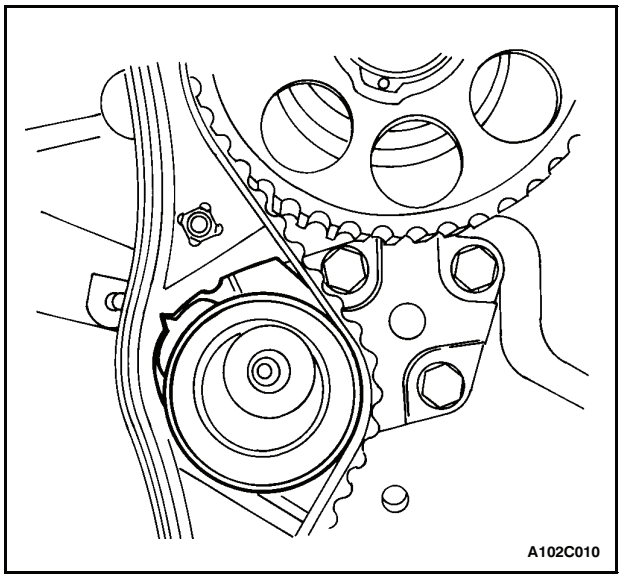
24. Slightly loosen the coolant pump retaining bolts.
25. Rotate the coolant pump clockwise using the timing belt adjuster J-42492.



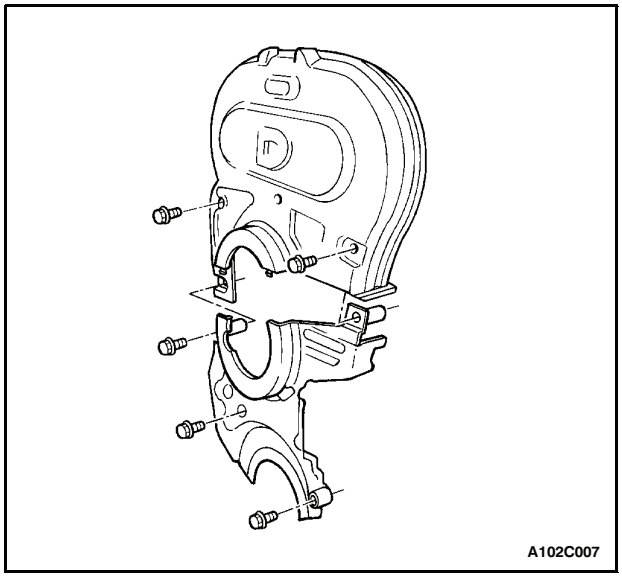
26. Rotate the coolant pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned to the notch in the timing belt automatic tensioner bracket.



27. Tighten the coolant pump retaining bolts.
28. Rotate the crankshaft two full turns clockwise using the crankshaft pulley.
29. Loosen the coolant pump retaining bolts.


A102C010

30. Using the timing belt adjuster J-42492, rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the pointer on the timing belt automatic tensioner bracket.


A102C007

31. Tighten the coolant pump retaining bolts.

Tighten

Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).

32. Remove the crankshaft pulley bolt.
33. Install the power steering pump mounting bolts, if equipped.

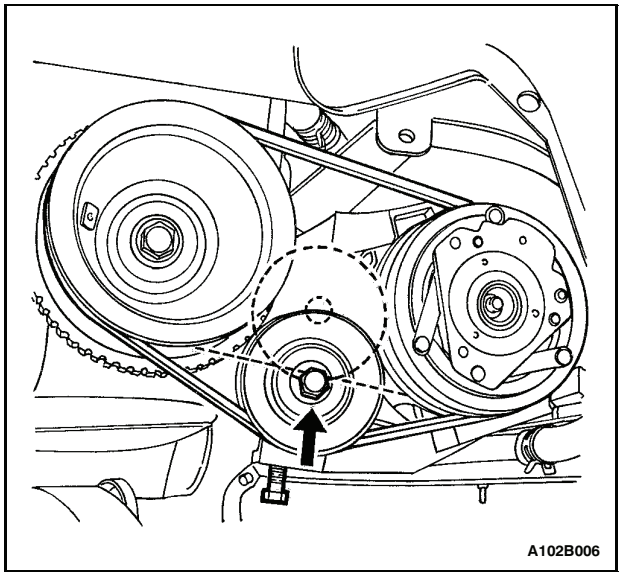
Tighten

Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).

34. Install the upper and lower front timing belt cover.
35. Install the upper and lower front timing belt cover bolts.

Tighten

Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).


A102B006

36. Install the crankshaft pulley.
37. Install the crankshaft pulley bolt.

Tighten

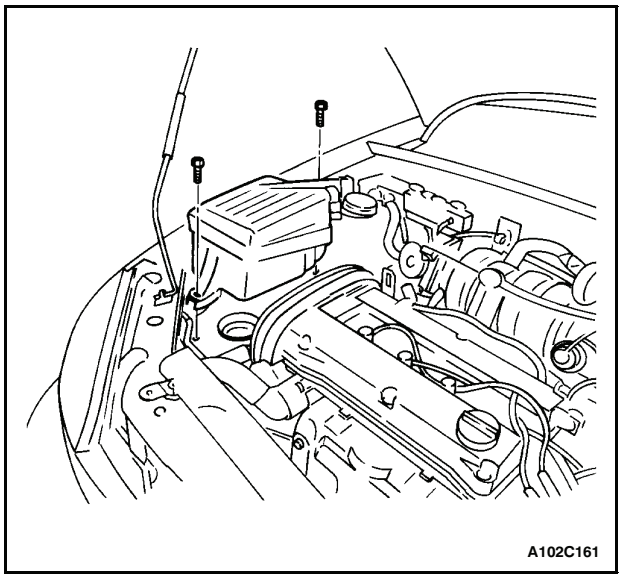
Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.

38. Install the power steering pump pulley, if equipped.
39. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

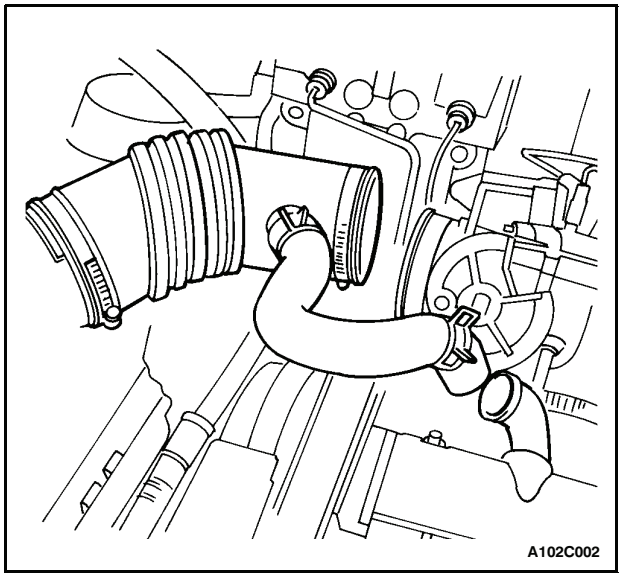
40. Install the alternator drive belt.
41. Install the A/C compressor drive belt, if equipped.


A102C161

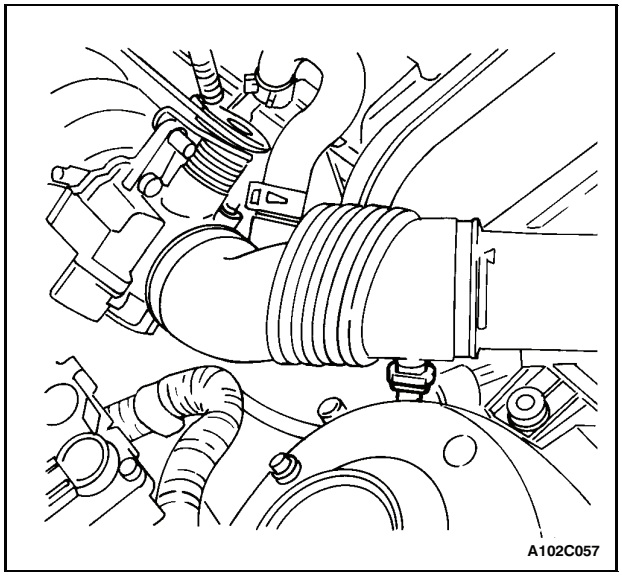
42. Install the right front splash shield.
43. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
44. Install the air filter housing.
45. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).


A102C002

46. Connect the air intake tube to the throttle body.
47. Connect the breather tube to the valve cover.
48. Connect the manifold air temperature sensor connector.
49. Connect the negative battery cable.


A102C057

TIMING BELT

(Left-Hand Drive Shown, Right-Hand Drive Similar)

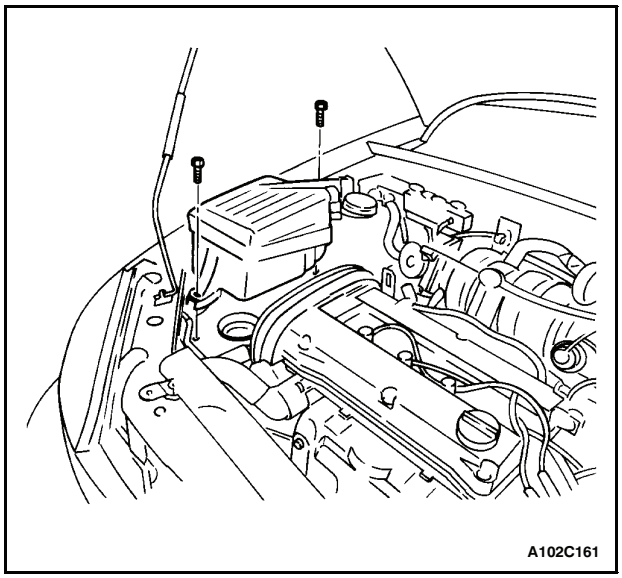
Tools Required

J-42492 Timing Belt Adjuster

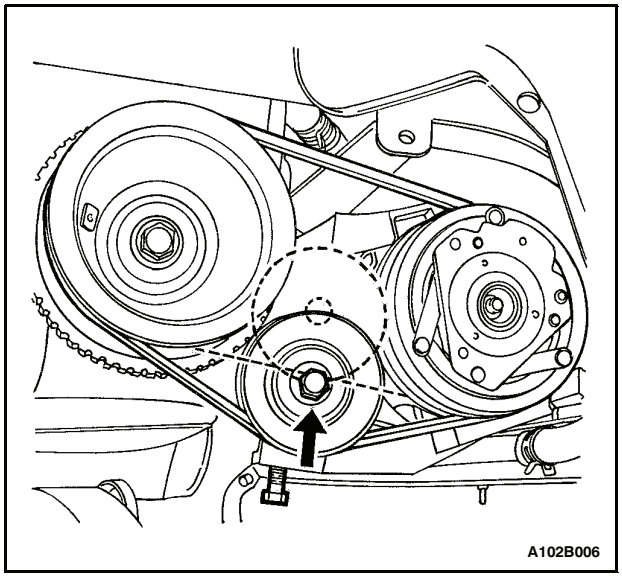
KM-470-B Angular Torque Gauge

Removal Procedure

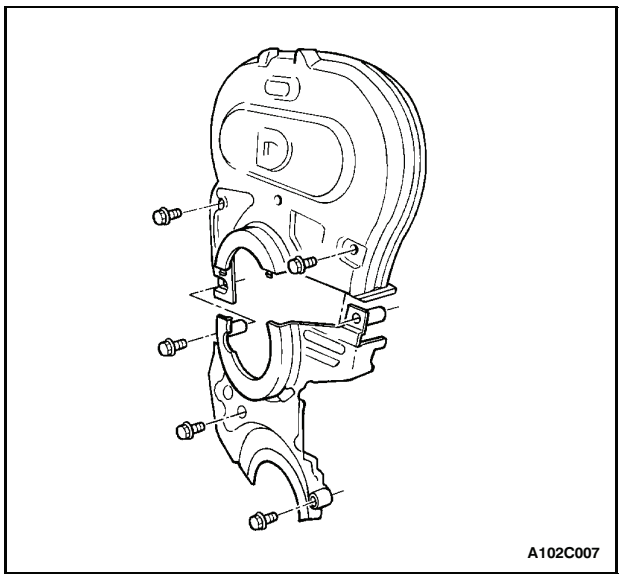
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor connector.
3. Disconnect the air intake tube from the throttle body.
4. Disconnect the breather tube from the valve cover.


A102C161

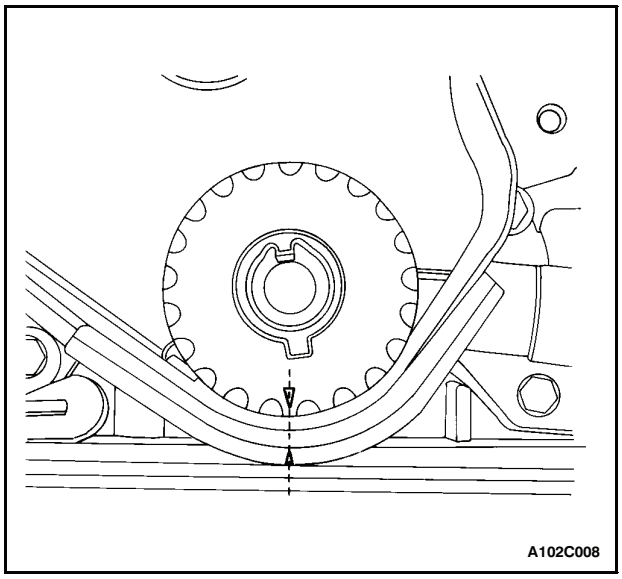
5. Remove the air filter housing bolts.
6. Remove the air filter housing.
7. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
8. Remove the right front splash shield.


A102B006

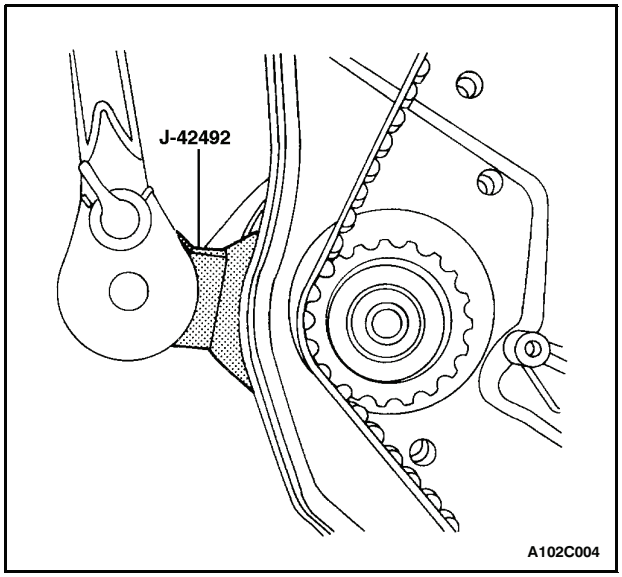
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump pulley bolts, if equipped.
12. Remove the power steering pump pulley, if equipped.
13. Remove the crankshaft pulley bolt.
14. Remove the crankshaft pulley.


A102C007

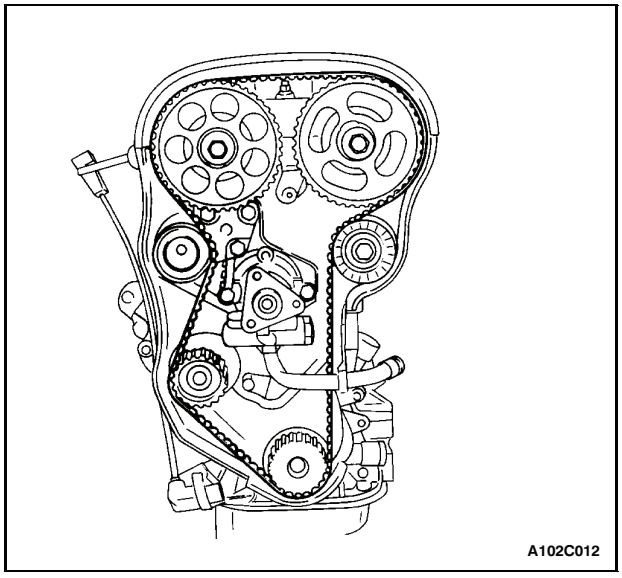
15. Remove the upper front timing belt cover bolts.
16. Remove the upper front timing belt cover.
17. Remove the lower front timing belt cover bolts.
18. Remove the lower front timing belt cover.
19. Remove the power steering pump mounting bolts, if equipped.
20. Install the crankshaft pulley bolt.



21. Using the crankshaft pulley bolt, rotate the crankshaft clockwise until the timing mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.

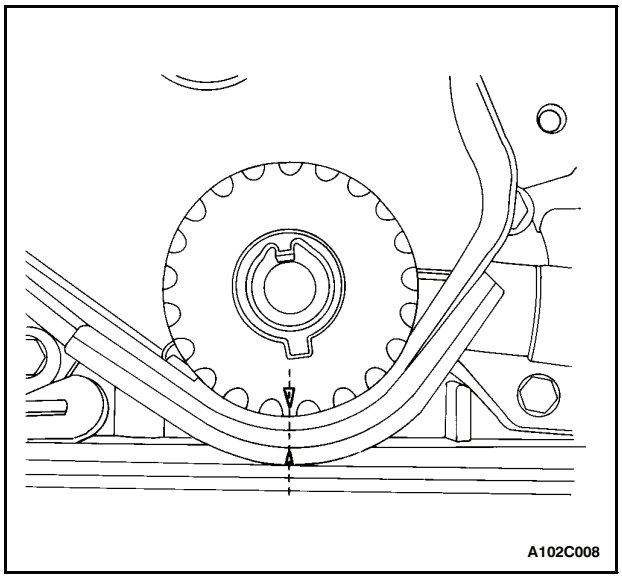


22. Slightly loosen the coolant pump retaining bolts.
23. Using the timing belt adjuster J-42492, rotate the coolant pump counterclockwise to release the tension on the timing belt.



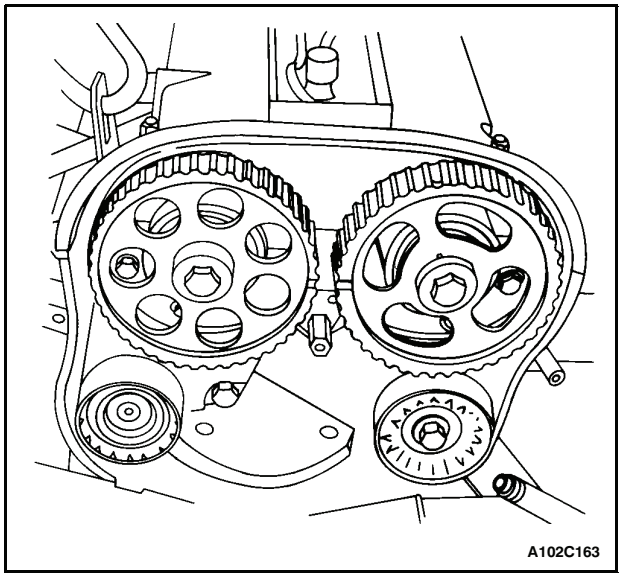
Important: Remove the timing belt behind the power steering pump.

24. Remove the timing belt.

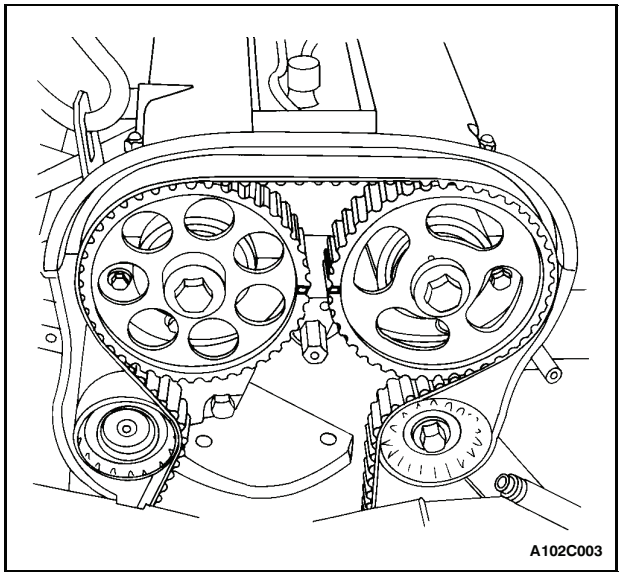

A102C008

Installation Procedure

1. Align the timing mark on the crankshaft gear to the notch on the bottom of the rear timing belt cover.

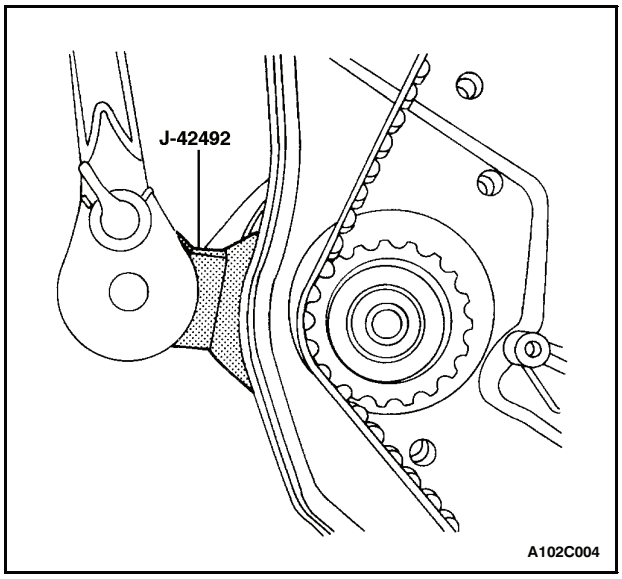

A102C163

2. Align the timing marks on the camshaft gears.

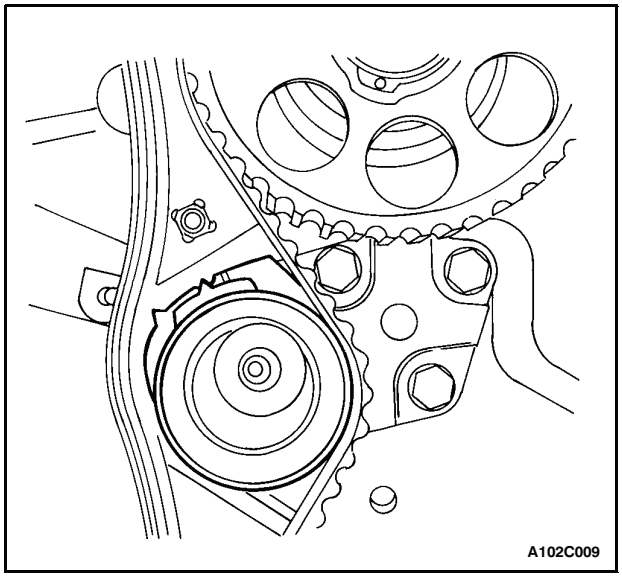

A102C003

Important: Insert the timing belt behind the power steering pump.

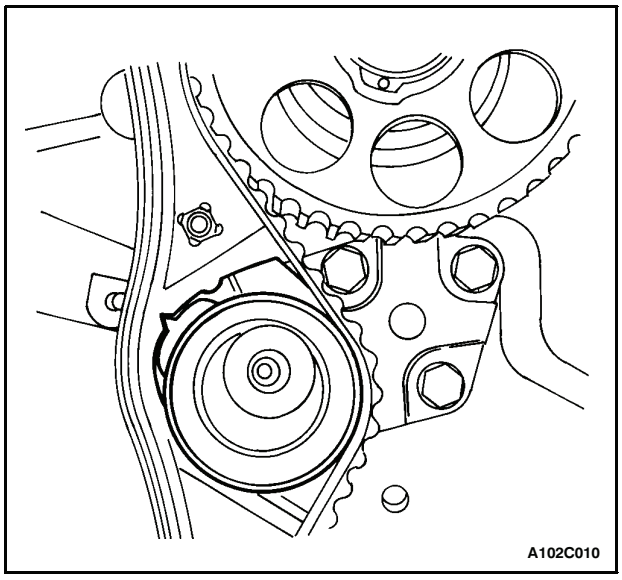
3. Install the timing belt.



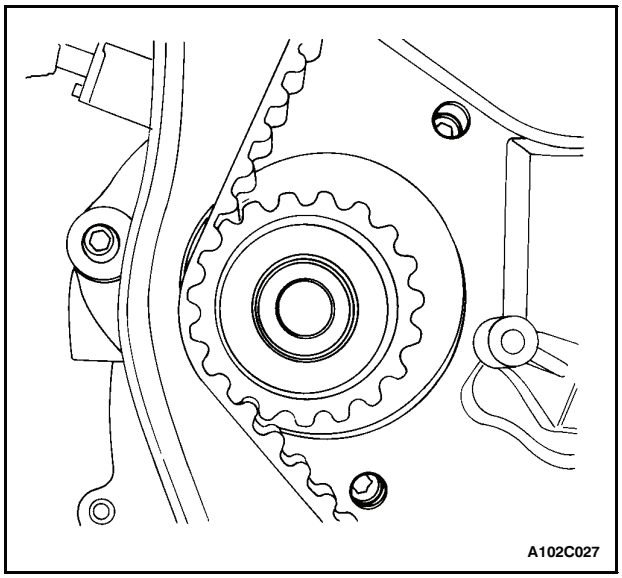
4. Rotate the coolant pump clockwise using the timing belt adjuster J-42492.



5. Rotate the coolant pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned to the notch in the timing belt automatic tensioner bracket.



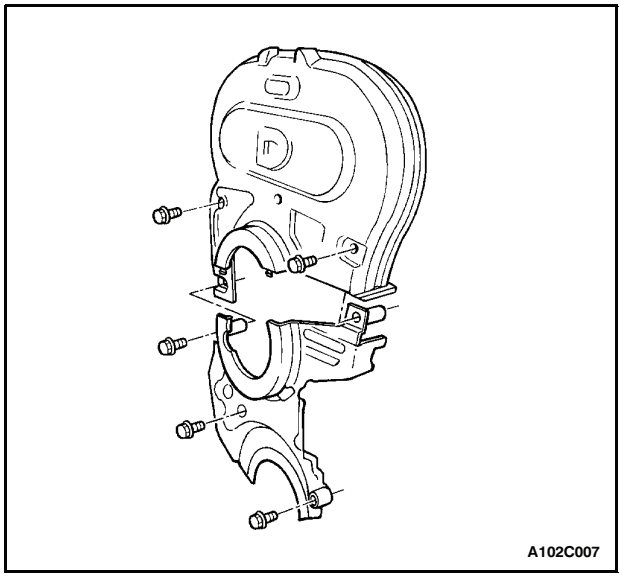
6. Tighten the coolant pump retaining bolts.
7. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
8. Loosen the coolant pump retaining bolts.
9. Rotate the coolant pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the pointer on the timing belt automatic tensioner bracket.


A102C027

10. Tighten the coolant pump retaining bolts.

Tighten

Tighten the coolant pump retaining bolts to 10 NSm (89 lb-in).


A102C007

11. Remove the crankshaft pulley bolt.
12. Install the power steering pump mounting bolts, if equipped.

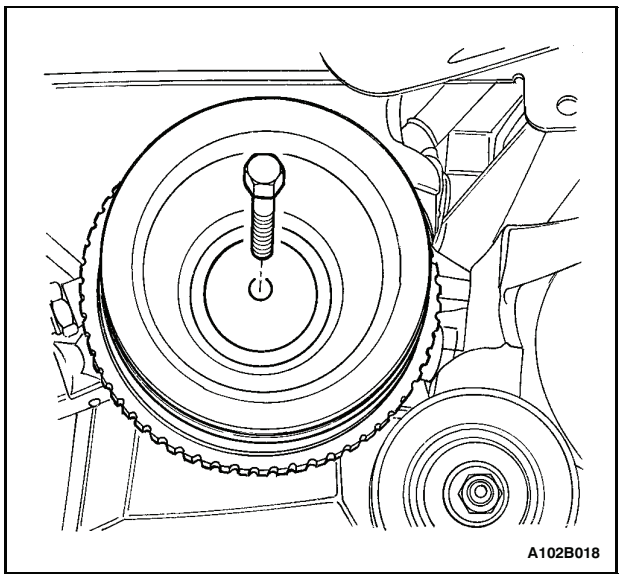
Tighten

Tighten the power steering mounting bolts to 25 NSm (18 lb-ft).

13. Install the upper and lower front timing belt cover.
14. Install the upper and lower front timing belt cover bolts.

Tighten

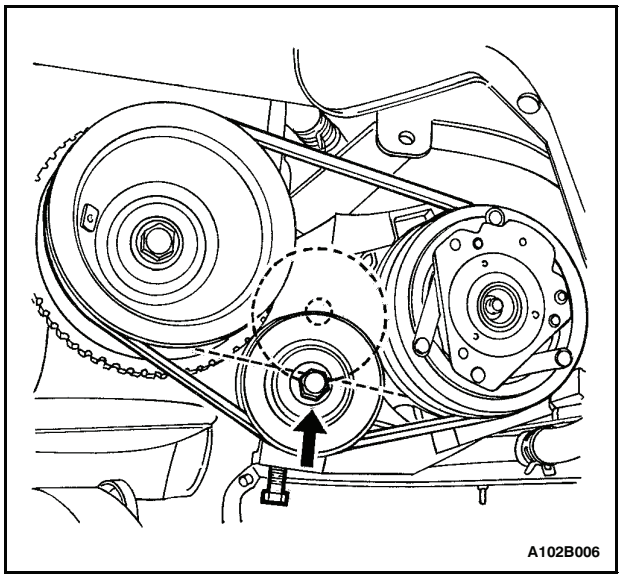
Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).


A102B018

15. Install the crankshaft pulley.
16. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.

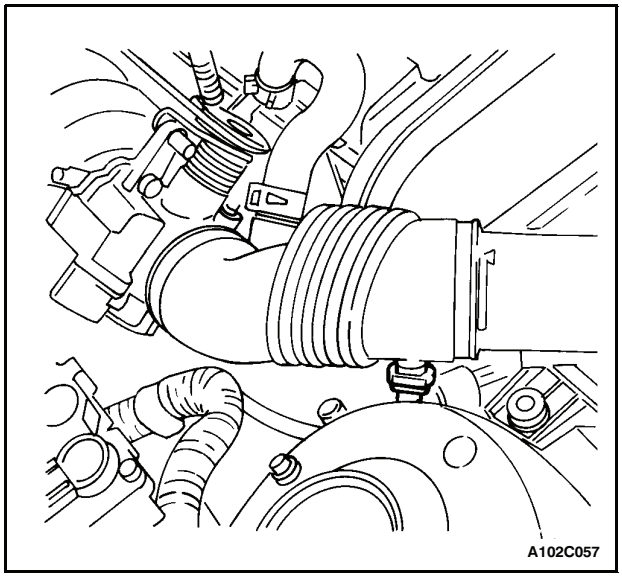

A102B006

17. Install the power steering pump pulley, if equipped.
18. Install the power steering pump pulley bolts, if equipped.

Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

19. Install the alternator drive belt.
20. Install the A/C compressor drive belt, if equipped.
21. Install the right front splash shield.
22. Install the right front wheel. Refer to Section 2E, Tires and Wheels.

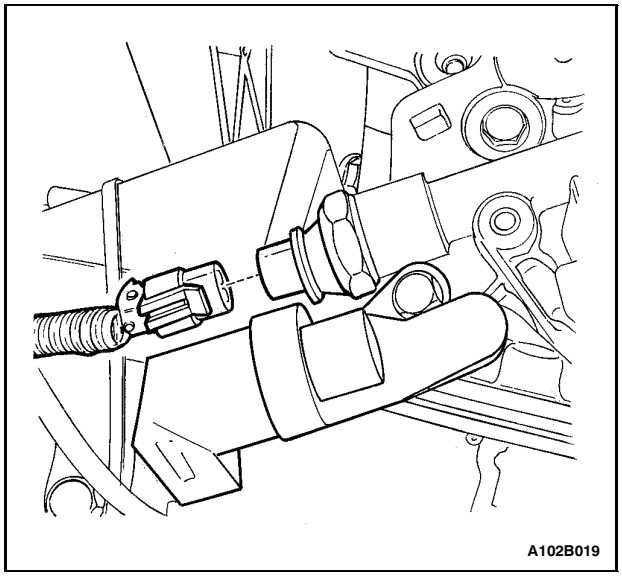

A102C057

24. Install the air filter housing.
25. Install the air filter housing bolts.

Tighten

Tighten the air filter housing bolts to 12 NSm (106 lb-in).

26. Connect the air intake tube to the throttle body.
27. Connect the breather tube to the valve cover.
28. Connect the manifold air temperature sensor connector.
29. Connect the negative battery cable.


A102B019

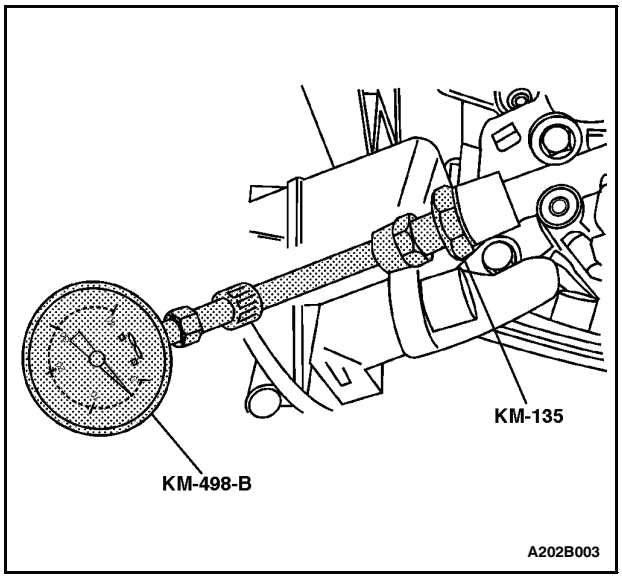
ENGINE OIL PRESSURE INSPECTION PROCEDURE

Tools Required

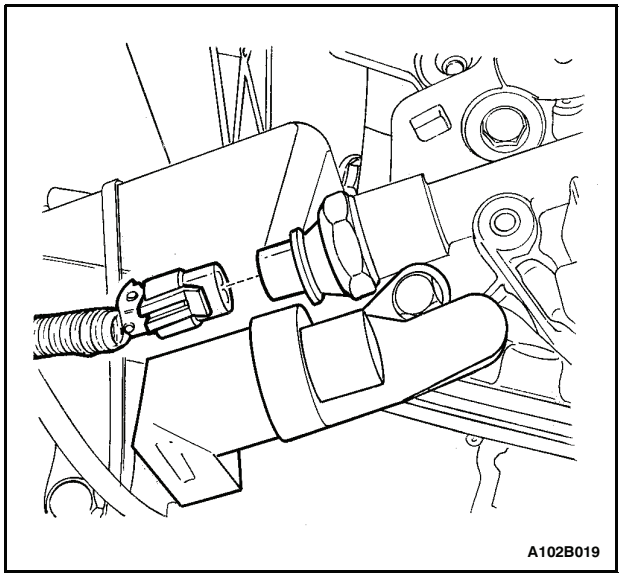
KM-498-B Pressure Gauge

KM-135 Adapter

1. Remove the front, right-hand wheel well splash shield.
2. Disconnect the oil pressure switch connector.



3. Install the adapter KM-135 in place of the oil pressure switch.
4. Connect the pressure gauge KM-498-B to the adapter.
5. Start the engine and check the oil pressure at idle speed and engine temperature of 80_C (176_F). The minimum oil pressure should be 30 kPa (8.88 psi).
6. Turn the engine OFF and remove the oil pressure gauge and adapter.

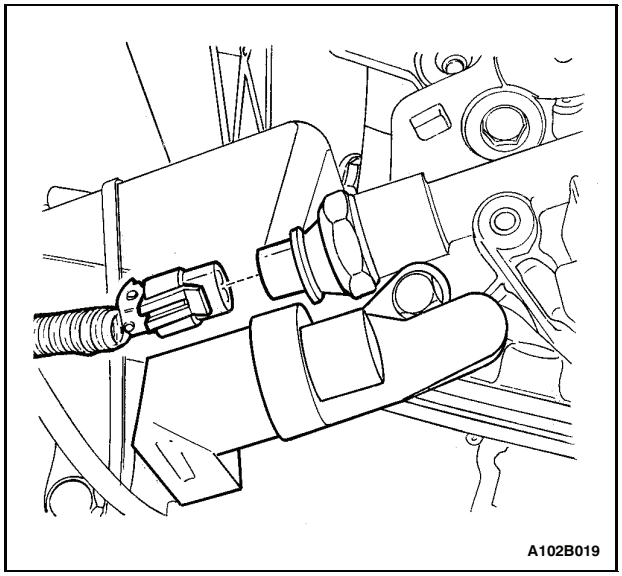


7. Install the oil pressure switch.

Tighten

Tighten the oil pressure switch to 40 NSm (30 lb-ft).

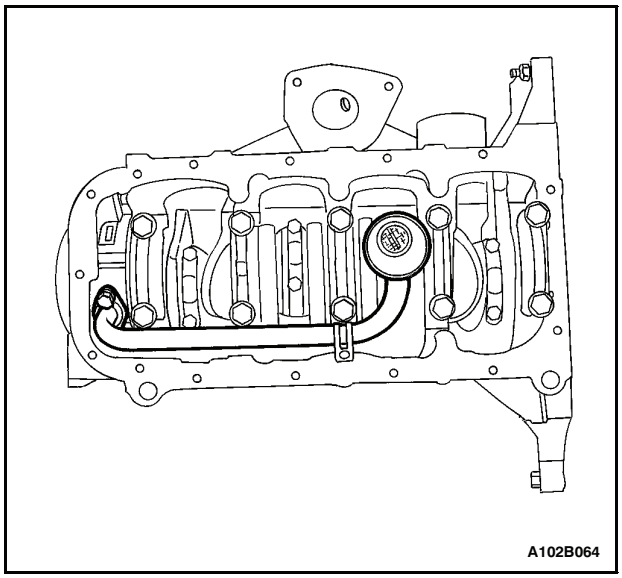
8. Connect the oil pressure switch connector.
9. Install the lower front, right-hand wheel well splash shield.
10. Check the oil level and fill to the full mark.



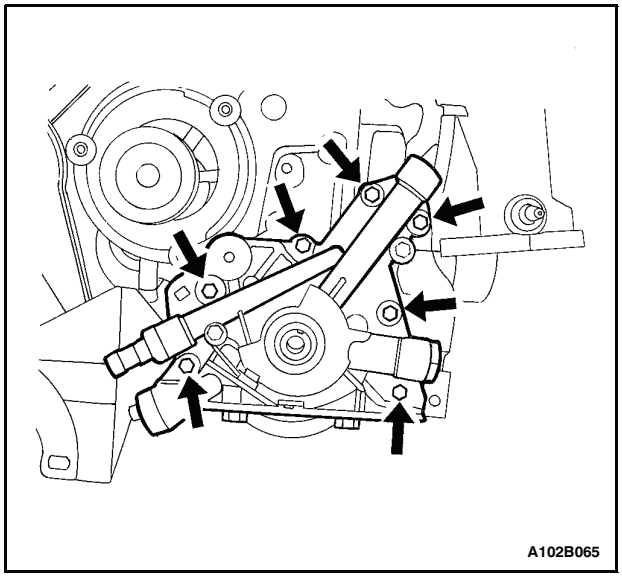
OIL PUMP

Removal Procedure

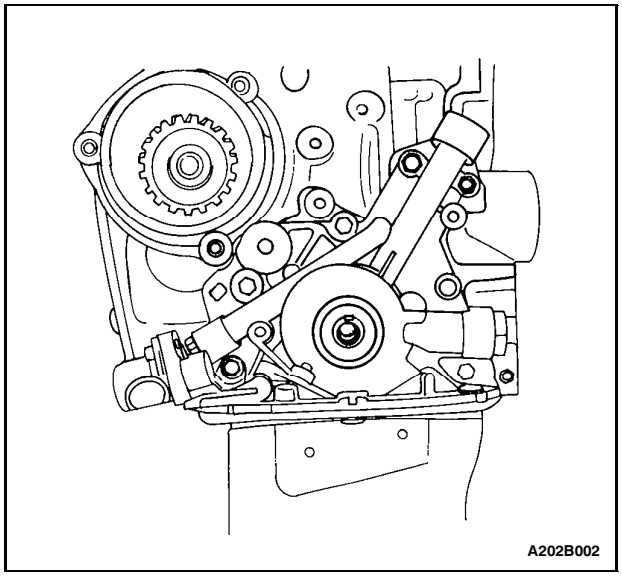
1. Disconnect the negative battery cable.
2. Remove the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
3. Remove the timing belt. Refer to "Timing Belt" in this section.
4. Remove the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
5. Disconnect the oil pressure switch connector.


A102B064

6. Remove the crankshaft position sensor bolt.
7. Remove the crankshaft position sensor.
8. Remove the oil pan. Refer to "Oil Pan" in this section.
9. Remove the oil pump pickup tube and the support bracket bolts.
10. Remove the oil pump pickup tube.

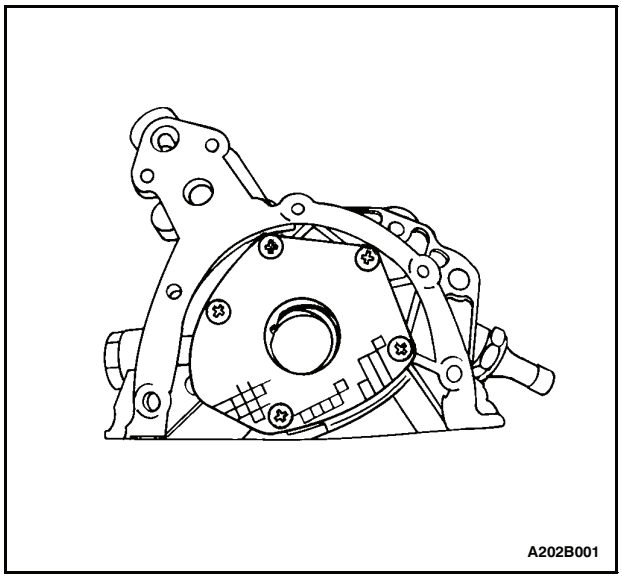

A102B065

11. Remove the oil pump retaining bolts.
12. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
13. Remove the oil pump.

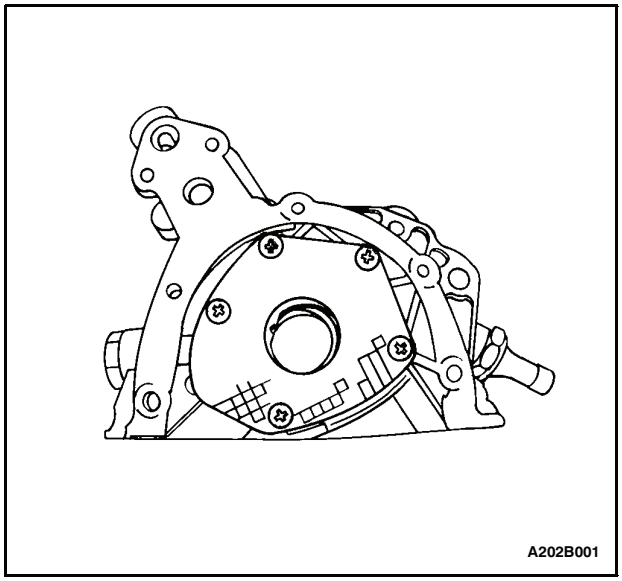

A202B002

Inspection Procedure

1. Clean the oil pump and the engine block gasket mating surfaces.
2. Remove the safety relief valve bolt.
3. Remove the safety relief valve and the spring.
4. Remove the oil pump-to-crankshaft seal.


A202B001

5. Remove the oil pump rear cover bolts.
6. Remove the rear cover.


A202B001

7. Clean the oil pump housing and all of the parts of the oil pump housing.
8. Inspect all of the parts for signs of wear. Refer to "Engine Specifications" in this section.
9. Coat all of the oil pump parts with clean engine oil and reinstall them.

Notice: Pack the oil pump gear cavity with petroleum jelly to ensure an oil pump prime, or engine damage could result.

10. Apply Loctite® 242 to the rear cover bolts and install the rear oil pump cover with the bolts.

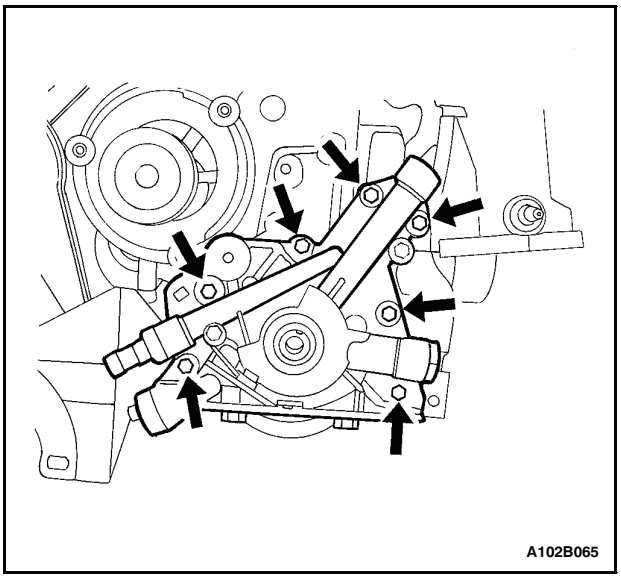
Tighten

Tighten the rear cover bolts to 6 NSm (53 lb-in).

11. Install the safety relief valve, the spring, the washer, and the bolt.

Tighten

Tighten the safety relief valve bolt to 30 NSm (22 lb-ft).

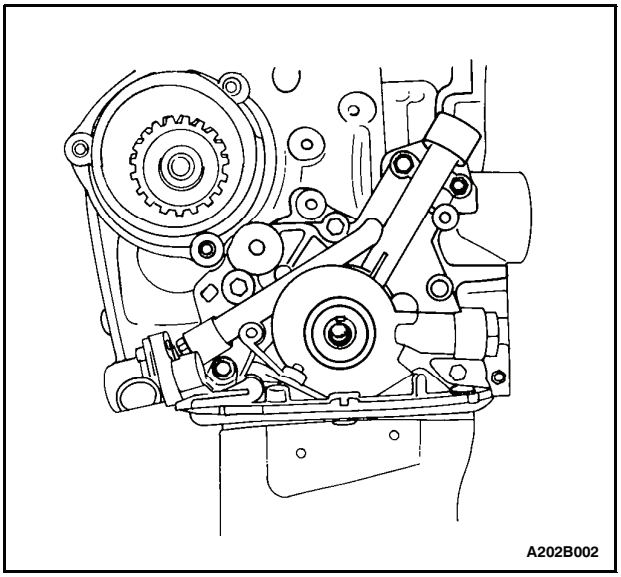

A102B065

Installation Procedure

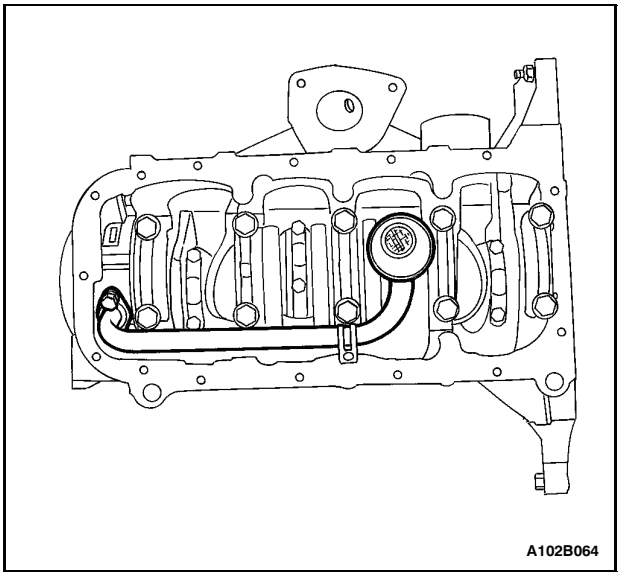
1. Apply Loctite[242 to the oil pump bolts and room temperature vulcanizing (RTV) (sealer) sealant to the new oil pump gasket.
2. Install the gasket to the oil pump and install the oil pump to the engine block with the retaining bolts.

Tighten

Tighten the oil pump retaining bolts to 10 NSm (89 lb-in).


A202B002

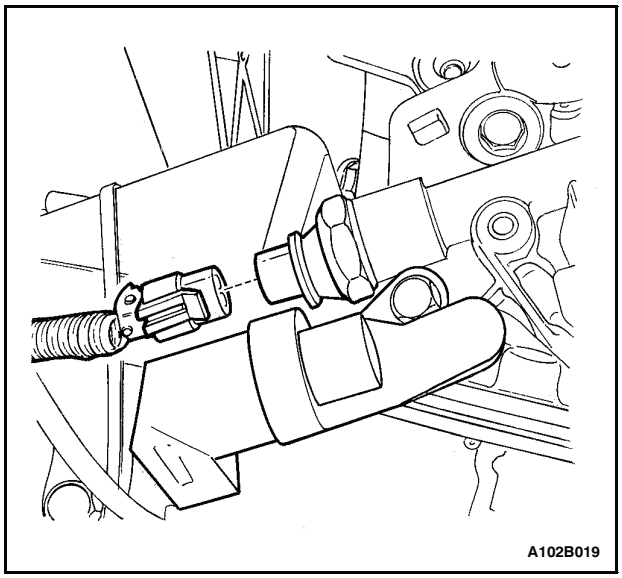
3. Install a new oil pump-to-crankshaft seal. Coat the lip of the seal with a thin coat of grease.


A102B064

4. Coat the threads of the oil pump pickup tube and support bracket bolts with Loctite^{R} 242.
5. Install the oil pump pickup tube and bolts.

Tighten

Tighten the oil pump pickup tube and the support bracket bolts to 10 NSm (89 lb-in).

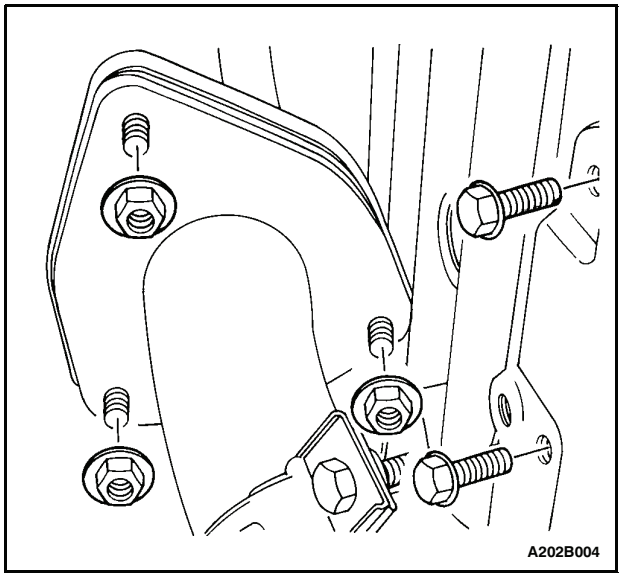

A102B019

6. Install the oil pan. Refer to "Oil Pan" in this section.
7. Install the crankshaft position sensor and the bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 NSm (89 lb-in).

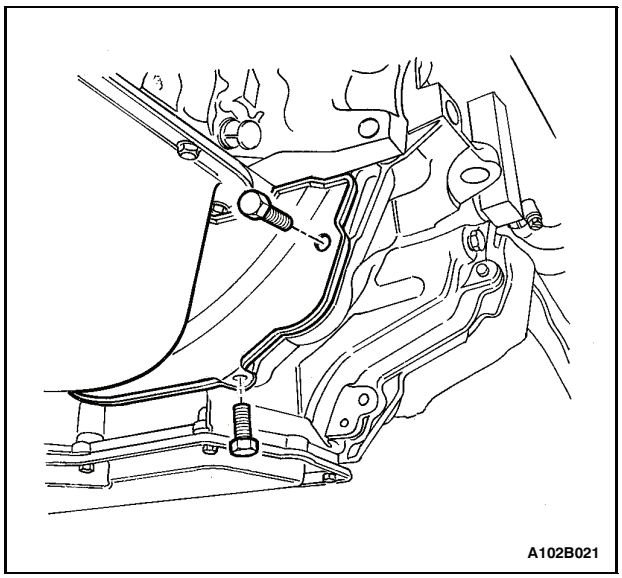
8. Connect the oil pressure switch connector.
9. Install the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
10. Install the power steering pump, if equipped. Refer to Section 6B, Power Steering Pump.
11. Install the timing belt. Refer to "Timing Belt" In this section.
12. Connect the negative battery cable.


A202B004

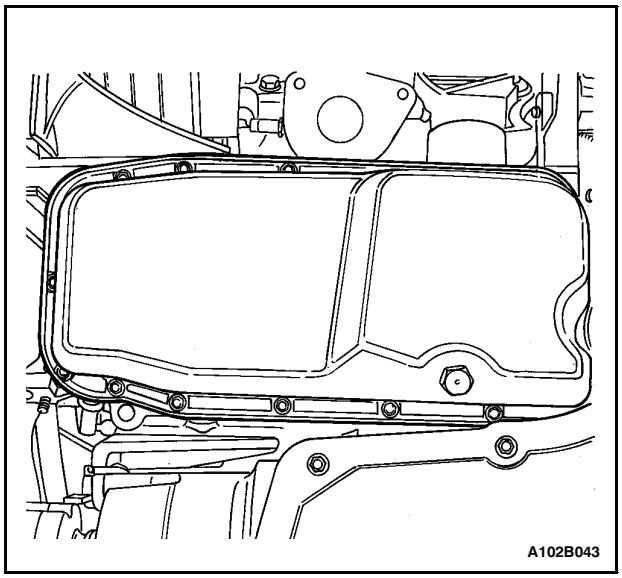
OIL PAN

Removal Procedure

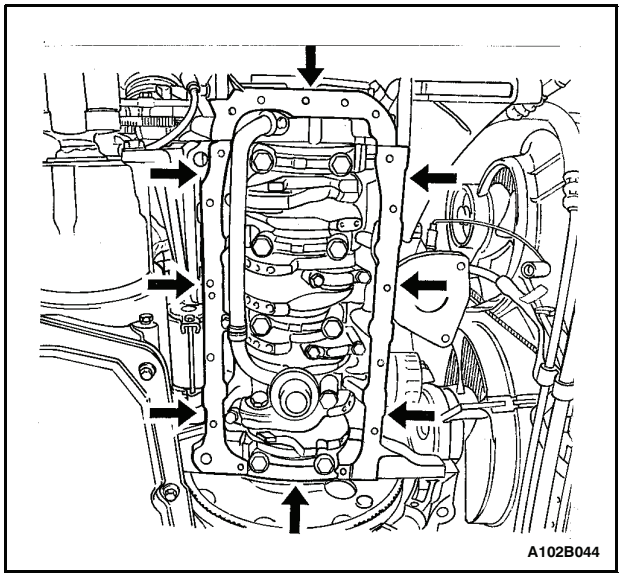
1. Disconnect the negative battery cable.
2. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
3. Remove the right front splash shield.
4. Drain the engine oil from the engine crankcase.
5. Remove the exhaust flex pipe retaining nuts from the exhaust manifold and the bolts at the bracket.
6. Remove the exhaust flex pipe retaining nuts from the catalytic converter or the connecting pipe.
7. Remove the exhaust flex pipe.


A102B021

8. Remove the flywheel or flexible plate inspection cover bolts.
9. Remove the flywheel or flexible plate inspection cover.

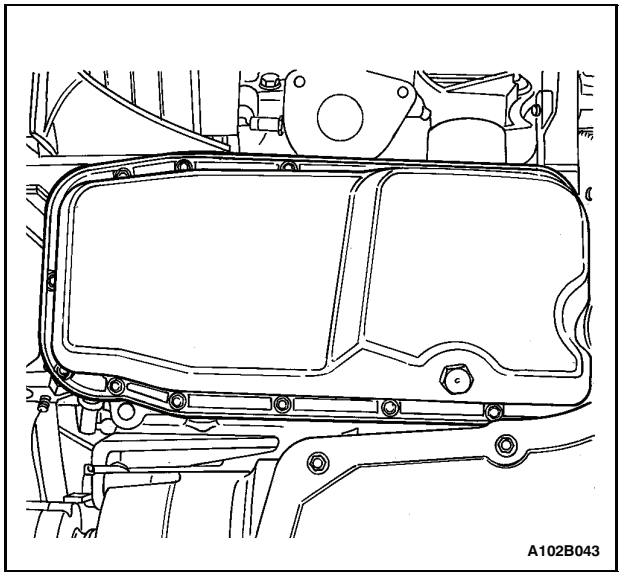


10. Remove the oil pan retaining bolts.
11. Remove the oil pan from the engine block.
12. Remove the oil pan gasket from the oil pan.



Cleaning Procedure

1. Clean the oil pan sealing surface.
2. Clean the engine block sealing surface.
3. Clean the oil pan retaining bolts.
4. Clean the oil pan attaching bolt holes in the engine block.



Installation Procedure

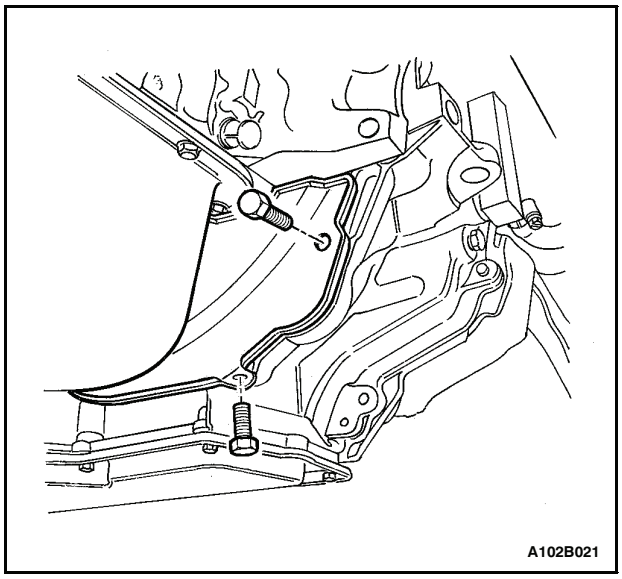
1. Install the oil pan gasket to the oil pan.
2. Install the oil pan to the engine block.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

3. Install the oil pan retaining bolts.

Tighten

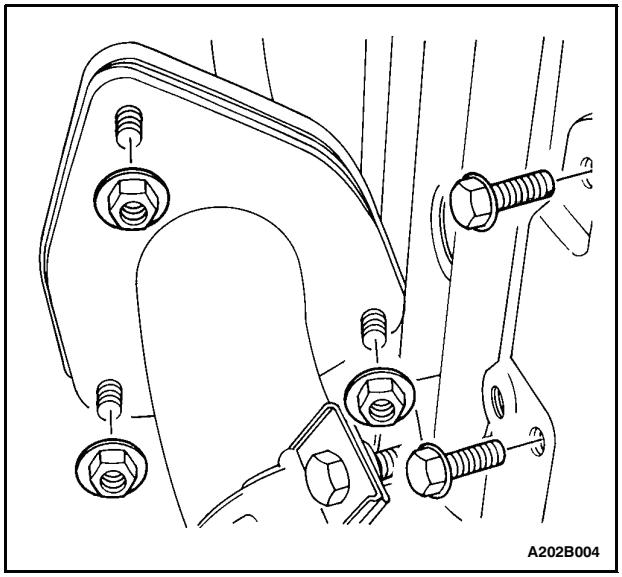
Tighten the oil pan retaining bolts to 10 NSm (89 lb-in).


A102B021

4. Install the flywheel or flexible plate inspection cover.
5. Install the flywheel or flexible plate inspection cover bolts.

Tighten

Tighten the flywheel inspection cover bolts to 12 NSm (106 lb-in) or the flexible plate inspection cover bolts to 10 NSm (89 lb-in).


A202B004

6. Install the exhaust flex pipe.
7. Install the exhaust flex pipe retaining nuts to the exhaust manifold and the exhaust pipe bracket bolts.

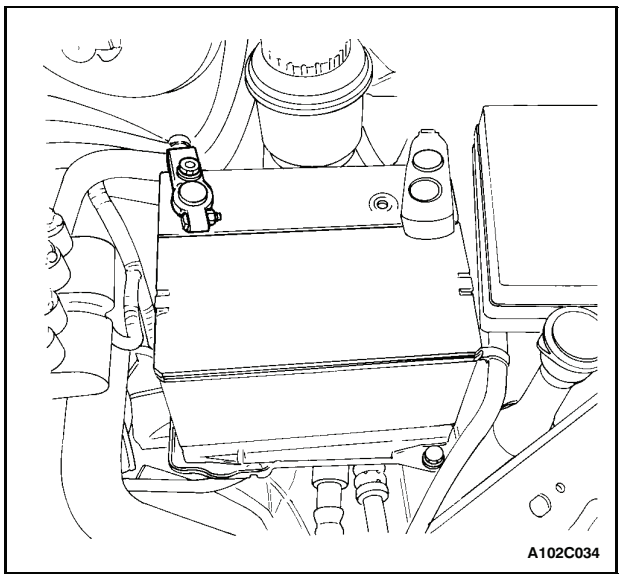
Tighten

Tighten the exhaust flex pipe retaining nuts to the exhaust manifold and the exhaust pipe bracket bolts to 40 NSm (30 lb-ft).

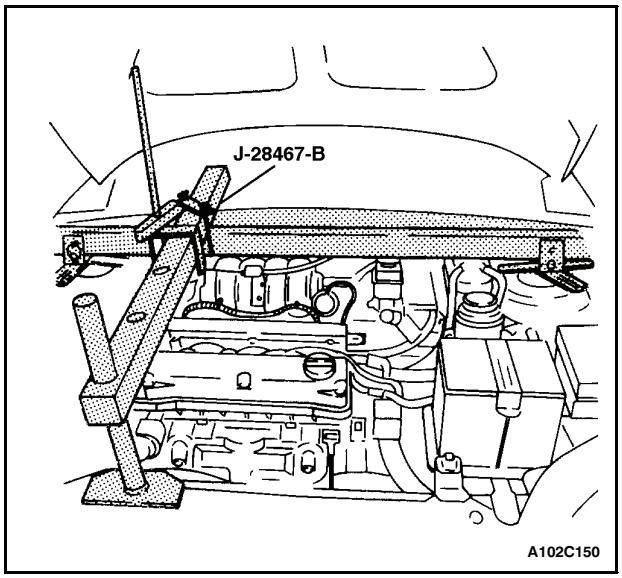
8. Install the exhaust flex pipe retaining nuts to the catalytic converter or the connecting pipe.

Tighten

Tighten the exhaust flex pipe retaining nuts to the catalytic converter or the connecting pipe to 30 NSm (22 lb-ft).


A102C034

9. Install the right front splash shield.
10. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
11. Connect the negative battery cable.
12. Refill the engine crankcase with engine oil.



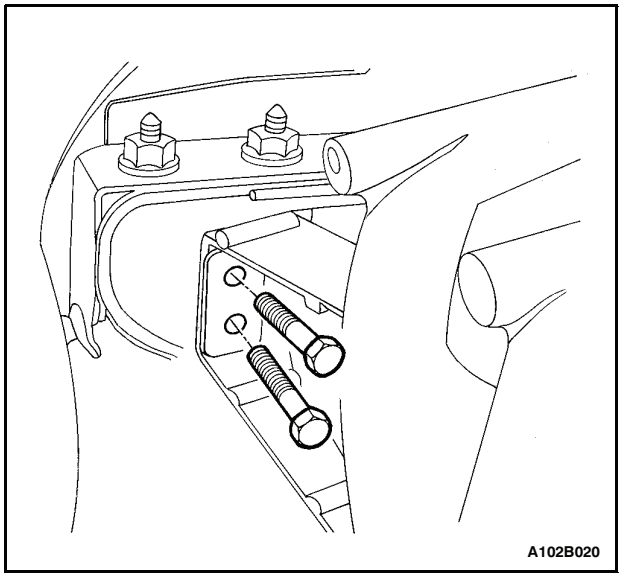
ENGINE MOUNT

Tools Required

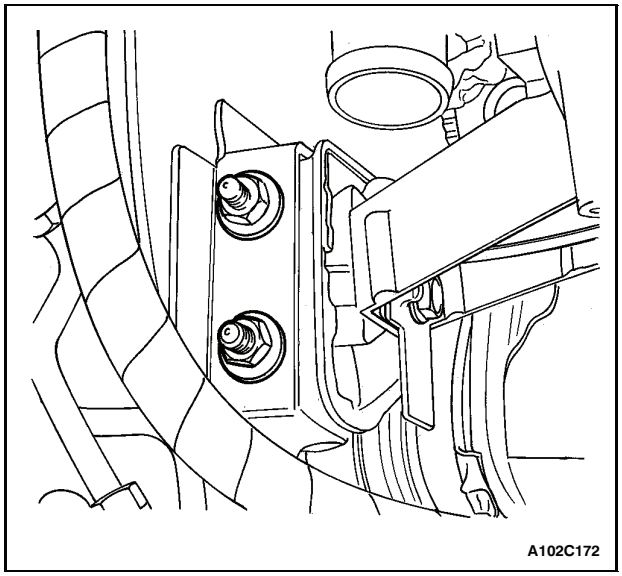
J-28467-B Engine Assembly Lift Support

Removal Procedure

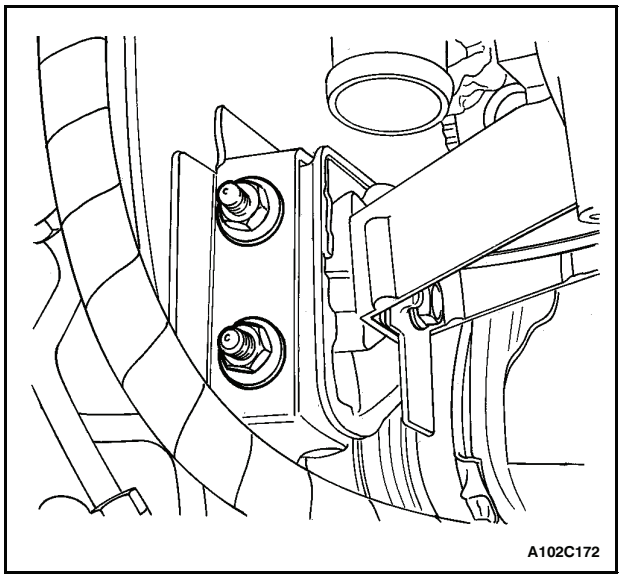
1. **Disconnect the negative battery cable.**
2. **Remove the upper radiator cover.**
3. **Remove the right front splash shield.**
4. **Support the engine assembly using the engine assembly lift support J-28467-B.**



5. **Remove the engine mount bracket retaining bolts.**



6. **Remove the engine mount retaining nuts.**
7. **Lower the engine.**
8. **Remove the engine mount.**

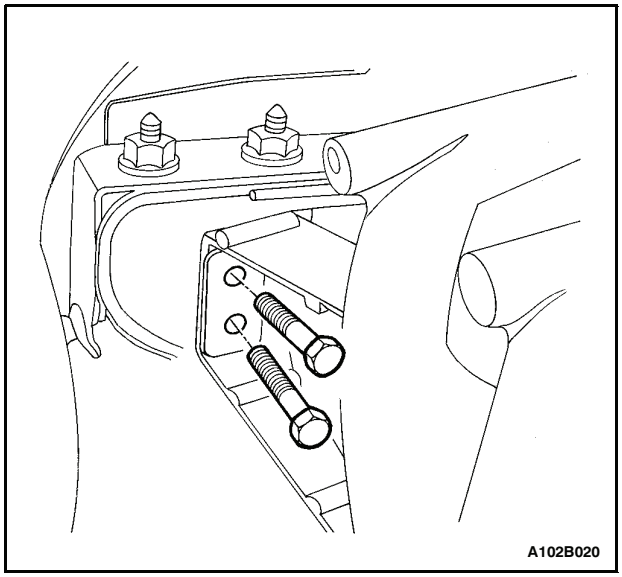

A102C172

Installation Procedure

1. Install the engine mount.
2. Raise the engine.
3. Install the engine mount retaining nuts.

Tighten

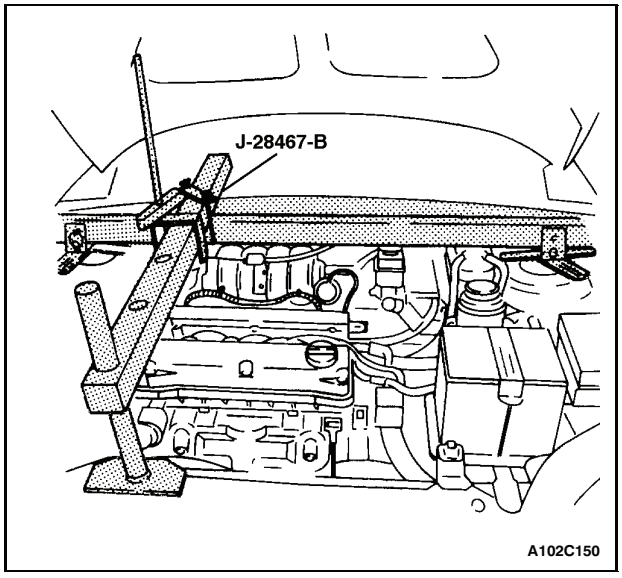
Tighten the engine mount retaining nuts to 40 NSm (30 lb-ft).


A102B020

4. Install the engine mount bracket retaining bolts.

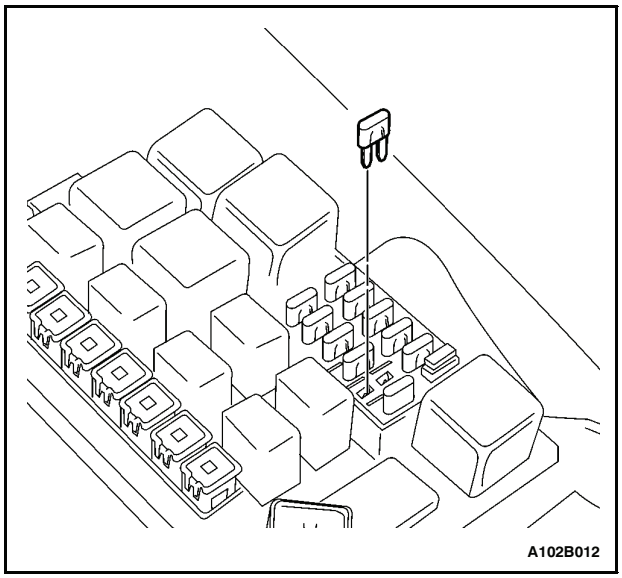
Tighten

Tighten the engine mount bracket retaining bolts to 60 NSm (44 lb-ft).



A102C150

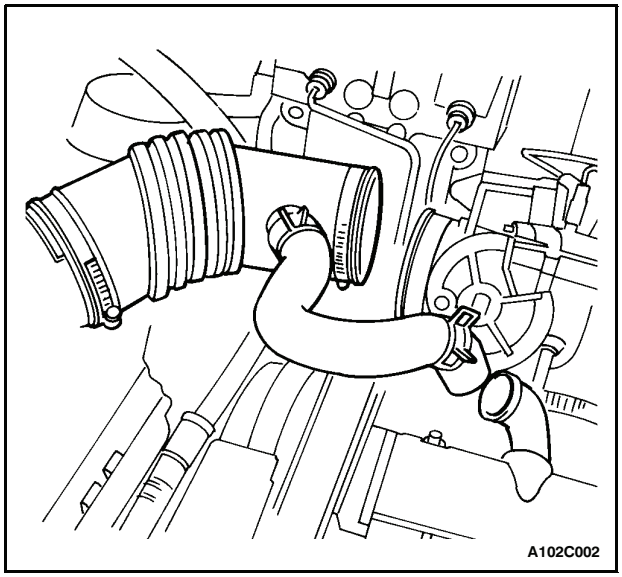
5. Remove engine assembly lift support J-28467-B.
6. Install the right front splash shield.
7. Install the upper radiator cover.
8. Connect the negative battery cable.


A102B012

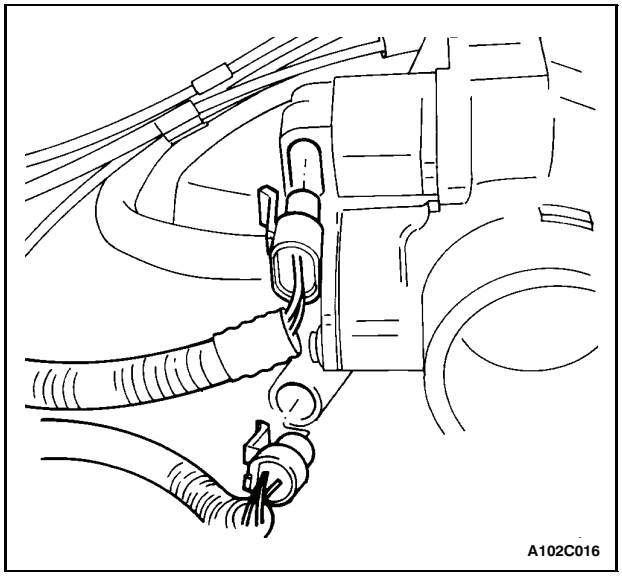
INTAKE MANIFOLD

Removal Procedure

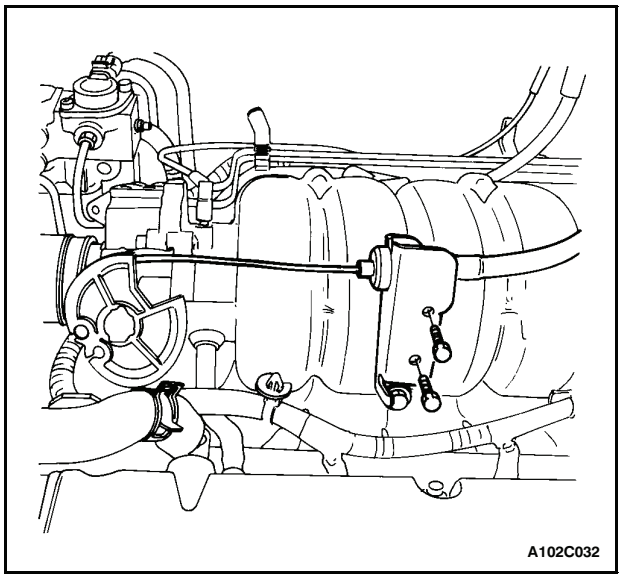
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the ECM ground terminal from the intake manifold.
5. Drain the engine coolant. Refer to Section 1D, Engine Cooling.


A102C002

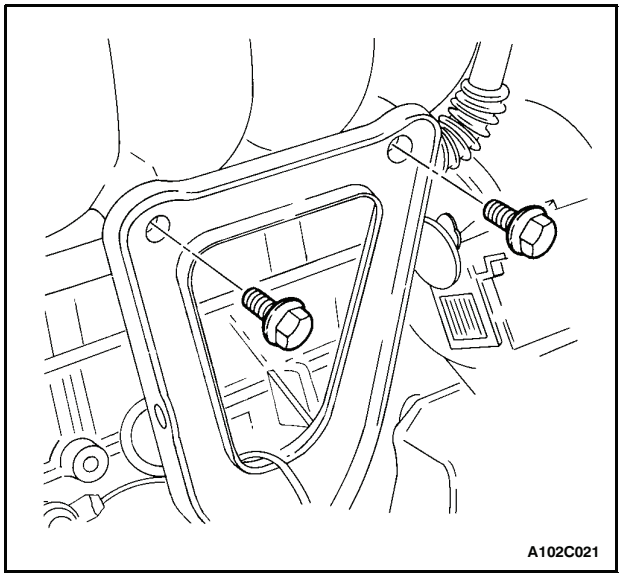
6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the air intake tube from the throttle body.


A102C016

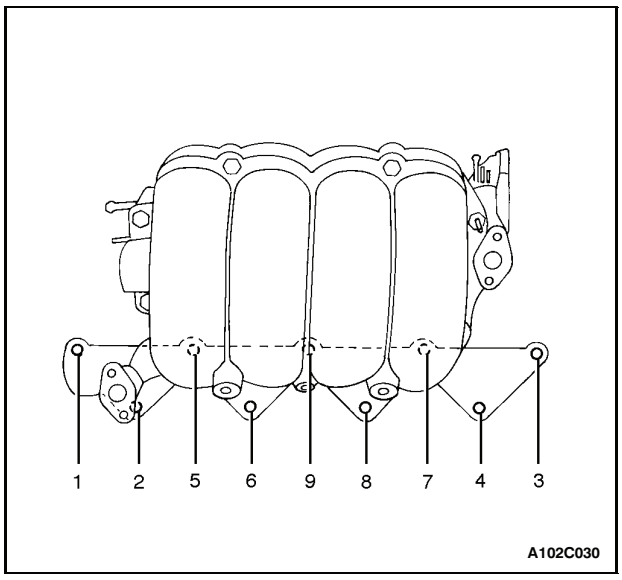
8. Disconnect the idle air control valve connector.
9. Disconnect the throttle position sensor connector.
10. Disconnect the coolant temperature sensor connector.
11. Disconnect the engine coolant temperature sensor connector.
12. Disconnect the heater inlet hose from the cylinder head.
13. Disconnect the surge tank coolant hose at the throttle body.



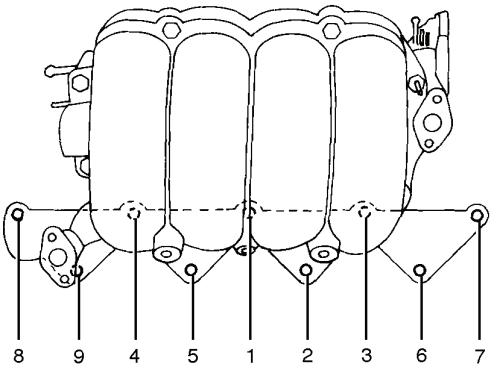
14. Disconnect all of the necessary vacuum hoses, including the vacuum hose at the fuel pressure regulator and the brake booster vacuum hose at the intake manifold.
15. Disconnect the throttle cable from the throttle body and the intake manifold.
16. Remove the throttle cable bracket bolts from the intake manifold.
17. Remove the throttle cable bracket.



18. Remove the fuel injector rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
19. Remove the alternator. Refer to Section 1E, Engine Electrical.
20. Remove the intake manifold support bracket bolts.
21. Remove the intake manifold support bracket.



22. Remove the intake manifold retaining bolts/nuts in the sequence shown.
23. Remove the intake manifold.
24. Remove the intake manifold gasket.
25. Clean the sealing surfaces of the intake manifold and the cylinder head.



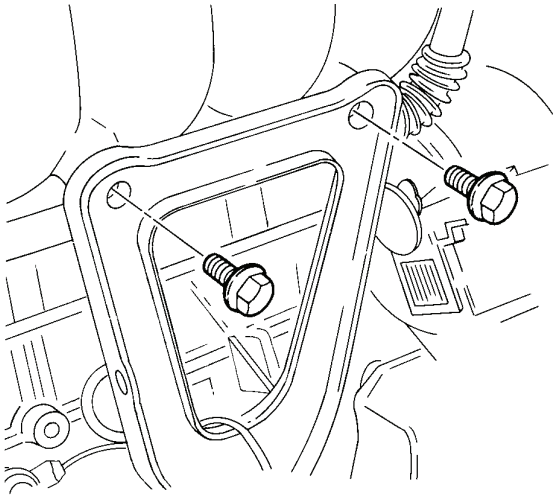
A102C031

Installation Procedure

1. Install the intake manifold gasket.
2. Install the intake manifold.
3. Install the intake manifold retaining bolts/nuts in the sequence shown.

Tighten

Tighten the intake manifold retaining bolts to 25 NSm (18 lb-ft).



A102C021

4. Install the intake manifold support bracket.
5. Install the intake manifold support bracket upper bolts to the intake manifold.

Tighten

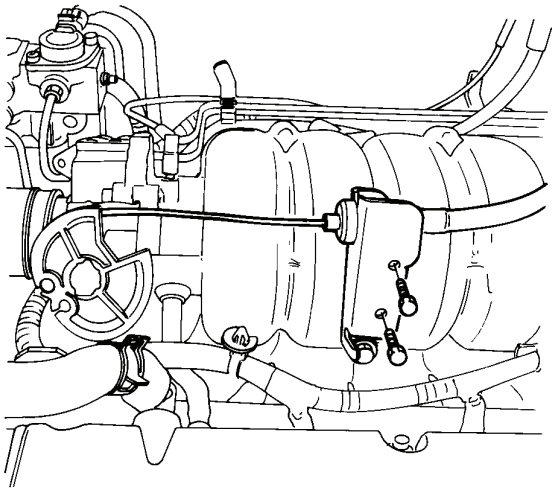
Tighten the intake manifold support bracket bolts to 25 NSm (18 lb-ft).

6. Install the intake manifold support bracket lower bolt to the engine block.

Tighten

Tighten the intake manifold support bracket lower bolt to the engine block to 40 NSm (30 lb-ft).

7. Install the alternator. Refer to Section 1E, Engine Electrical.



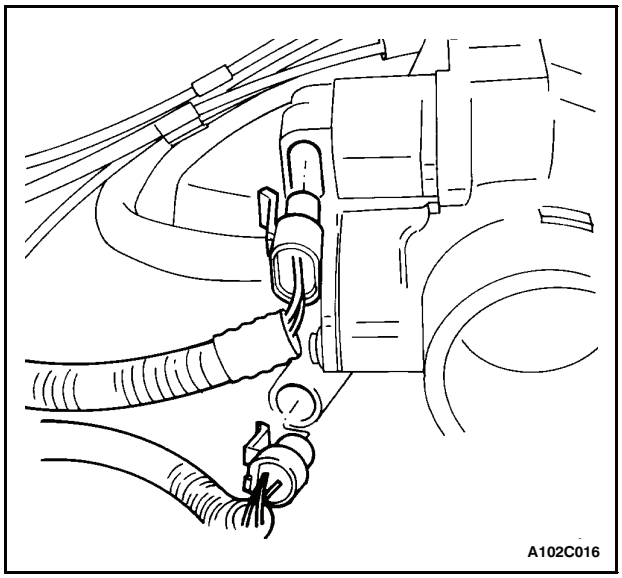
A102C032

8. Install the fuel rail and fuel injectors as an assembly. Refer to Section 1F, Engine Controls.
9. Install the throttle cable bracket.
10. Install the throttle cable bracket bolts.

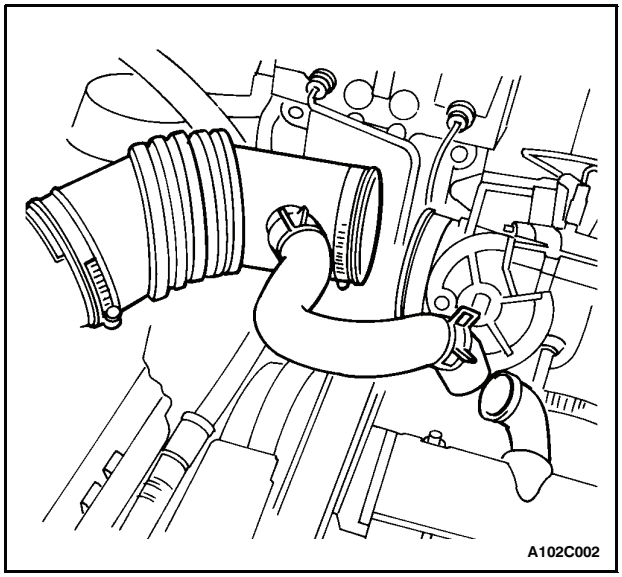
Tighten

Tighten the throttle cable bracket bolts to 8 NSm (71 lb-in).

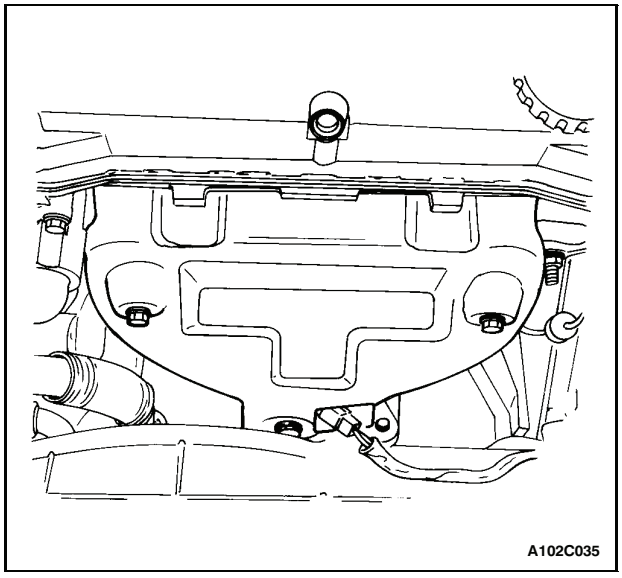
11. Connect the throttle cable to the intake manifold and the throttle body.
12. Connect all of the necessary vacuum lines that were previously disconnected.


A102C016

13. Connect the heater inlet hose to the cylinder head.
14. Connect the surge tank coolant hose to the throttle body.
15. Connect the coolant temperature sensor connector.
16. Connect the engine coolant temperature sensor connector.
17. Connect the idle air control valve connector.
18. Connect the throttle position sensor connector.


A102C002

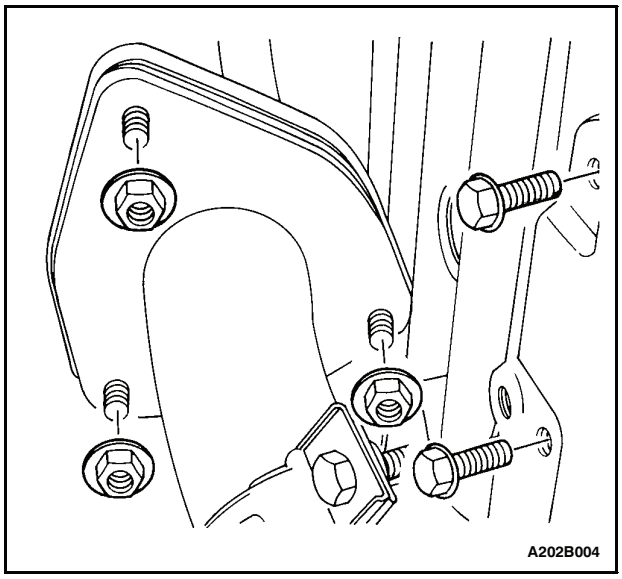
19. Connect the air intake tube to the throttle body.
20. Connect the manifold air temperature sensor connector.
21. Connect the ECM ground terminal to the intake manifold.
22. Install the fuel pump fuse.
23. Connect the negative battery cable.
24. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.


A102C035

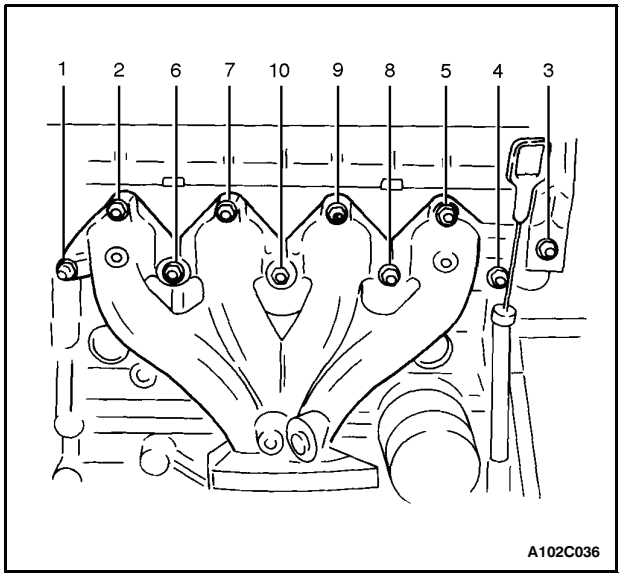
EXHAUST MANIFOLD

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the oxygen sensor connector.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.

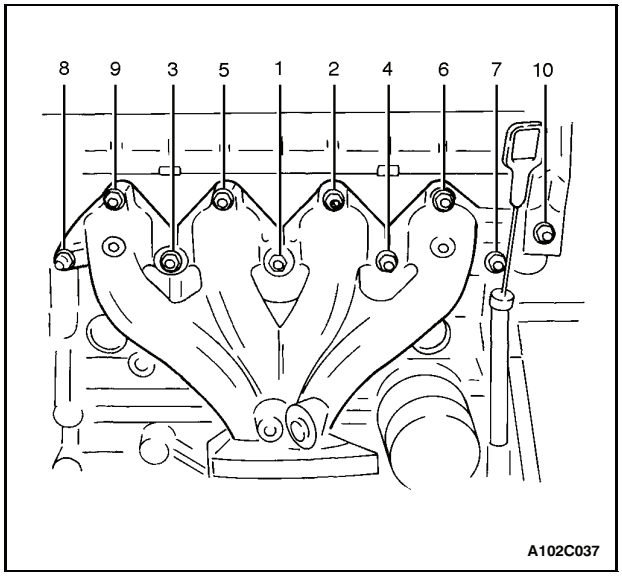

A202B004

5. Remove the exhaust flex pipe retaining nuts from the exhaust manifold studs.



A102C036

6. Remove the exhaust manifold retaining nuts in the sequence shown.
7. Remove the exhaust manifold.
8. Remove the exhaust manifold gasket.
9. Clean the sealing surfaces of the exhaust manifold and the cylinder head.



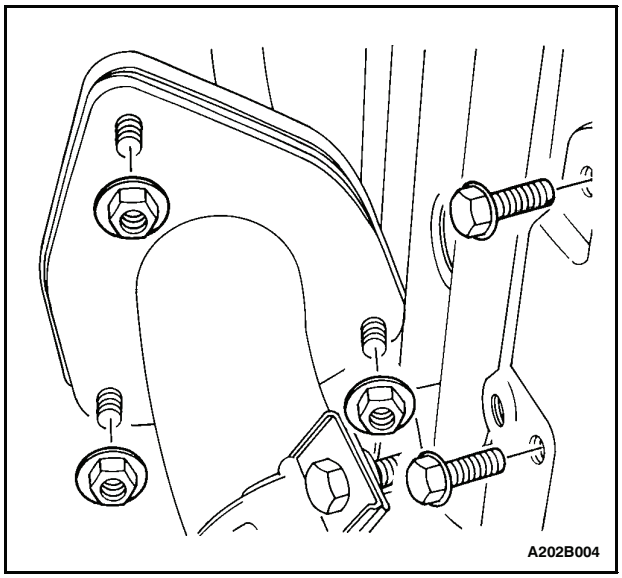
A102C037

Installation Procedure

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.
3. Install the exhaust manifold retaining nuts and tighten in the sequence shown.

Tighten

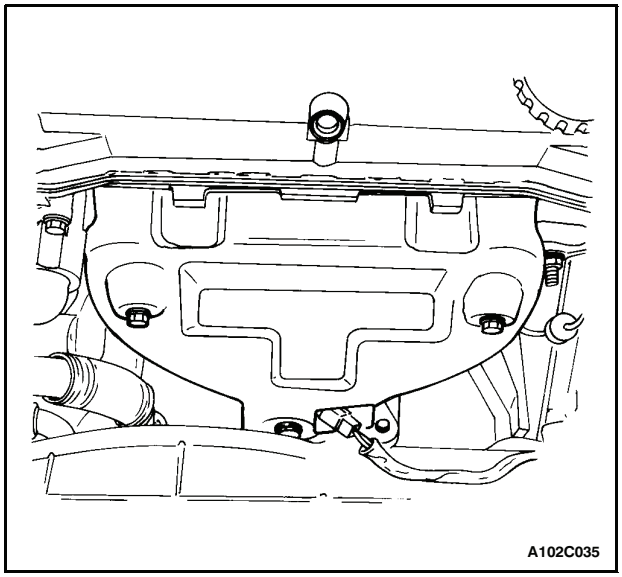
Tighten the exhaust manifold retaining nuts 25 NSm (18 lb-ft).


A202B004

4. Install the exhaust flex pipe retaining nuts to the exhaust manifold studs.

Tighten

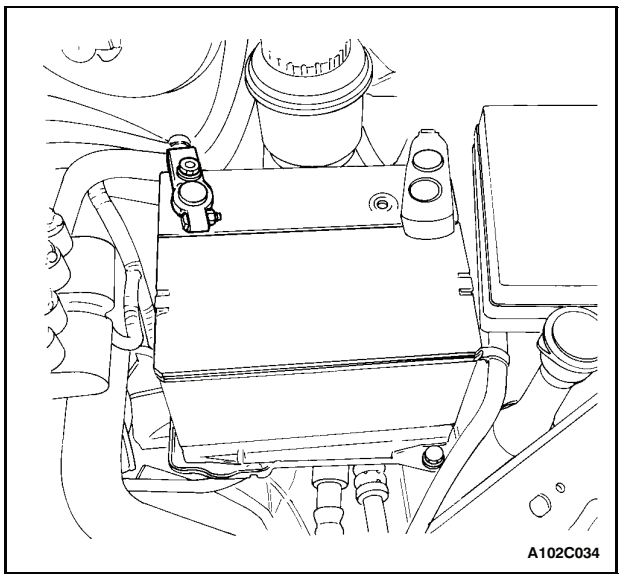
Tighten the exhaust flex pipe retaining nuts to 40 NSm (30 lb-ft).


A102C035

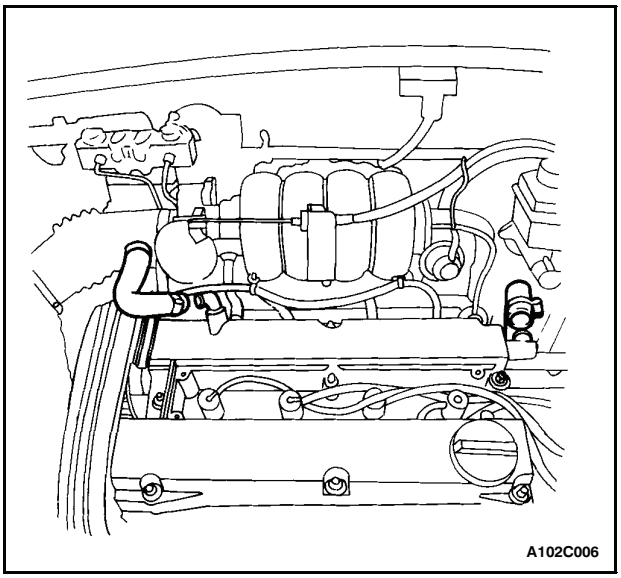
5. Install the exhaust manifold heat shield.
6. Install the exhaust manifold heat shield bolts.

Tighten

Tighten the exhaust manifold heat shield bolts to 15 NSm (11 lb-ft).


A102C034

7. Connect the oxygen sensor connector.
8. Connect the negative battery cable.

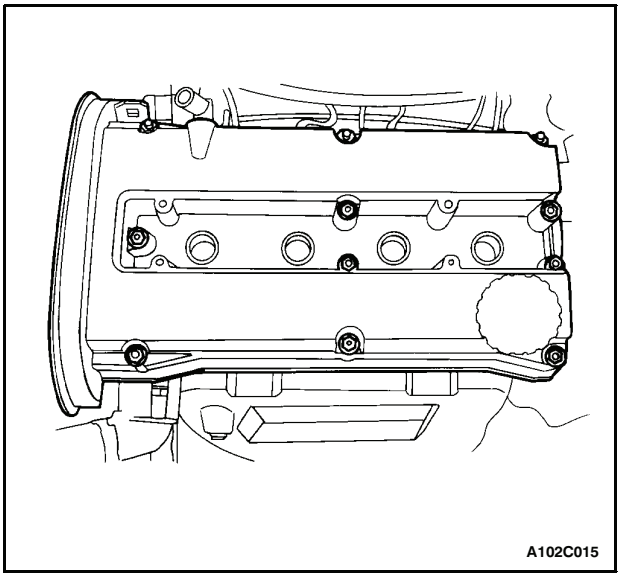

A102C006

CAMSHAFT GEARS

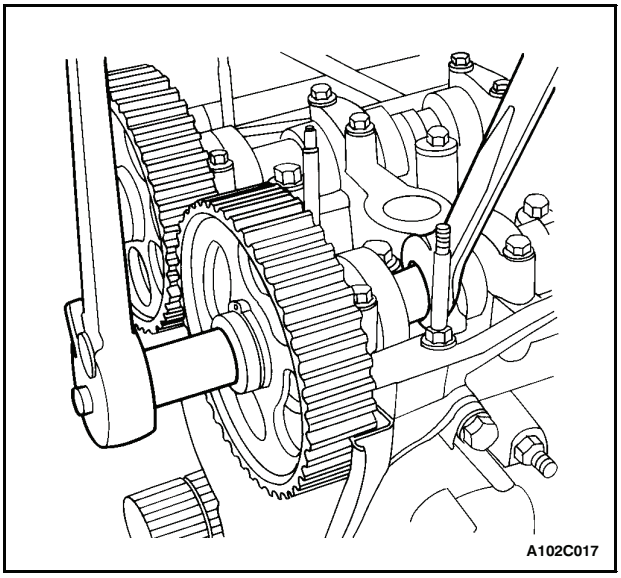
(Left-Hand Drive Shown, Right-Hand Drive Similar)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to "Timing Belt" in this section.
3. Remove the spark plug cover bolts.
4. Remove the spark plug cover.
5. Disconnect the ignition wires from the spark plugs.
6. Disconnect the crankcase ventilation tubes from the valve cover.

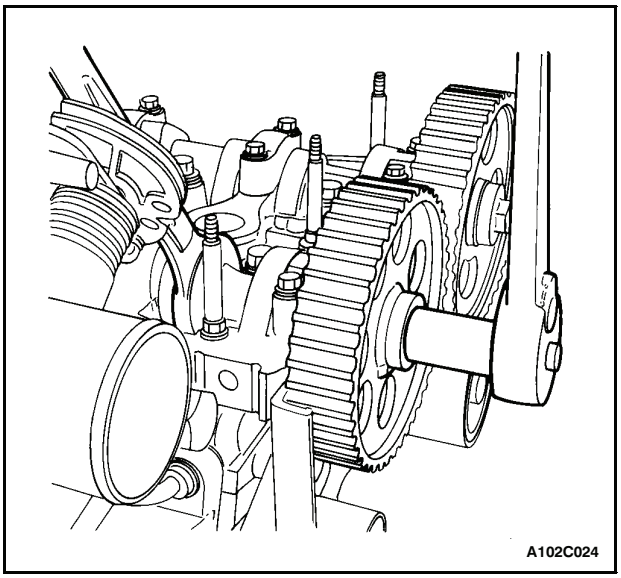

A102C015

7. Remove the valve cover nuts.
8. Remove the valve cover washers.
9. Remove the valve cover and the valve cover gasket.


A102C017

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

10. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
11. Remove the intake camshaft gear.
12. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
13. Remove the exhaust camshaft gear.


A102C024

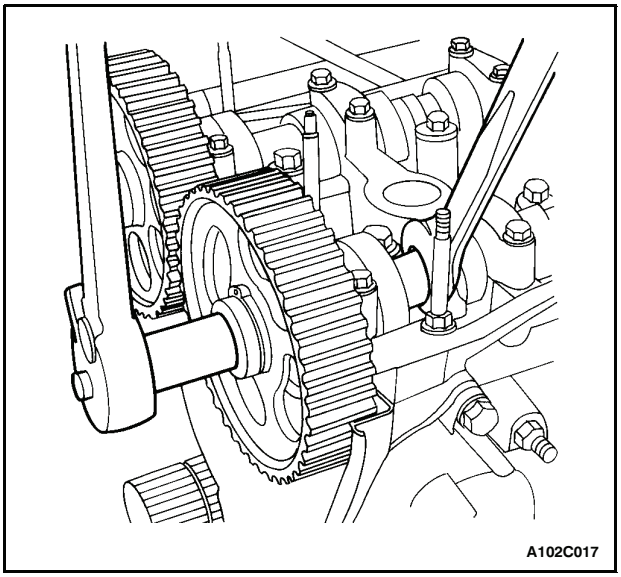
Installation Procedure

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

1. Install the intake camshaft gear.
2. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten

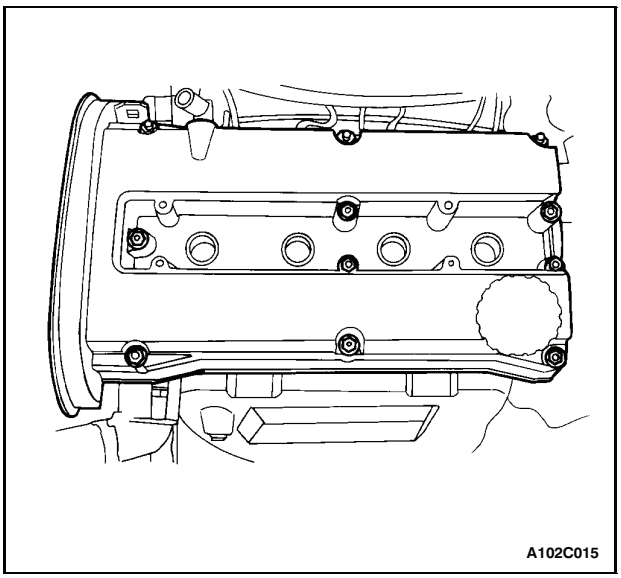
Tighten the intake camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C017

3. Install the exhaust camshaft gear.
4. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten

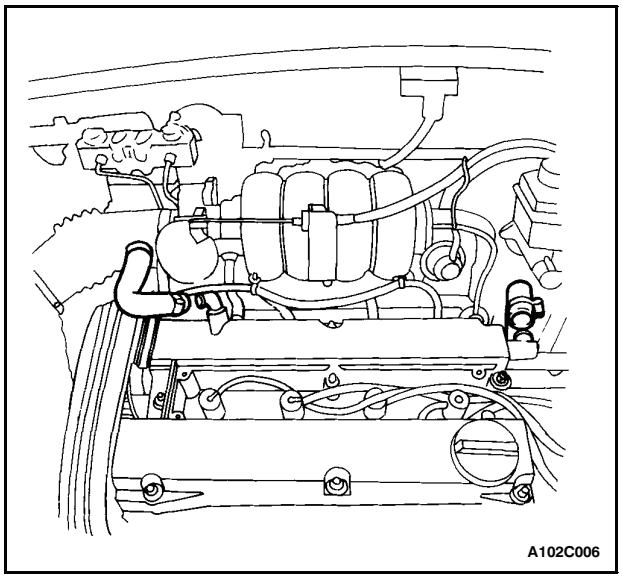
Tighten the exhaust camshaft gear bolt to 67.5 NSm (49 lb-ft).


A102C015

5. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.
6. Install the valve cover and the valve cover gasket.
7. Install the valve cover washers.
8. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).

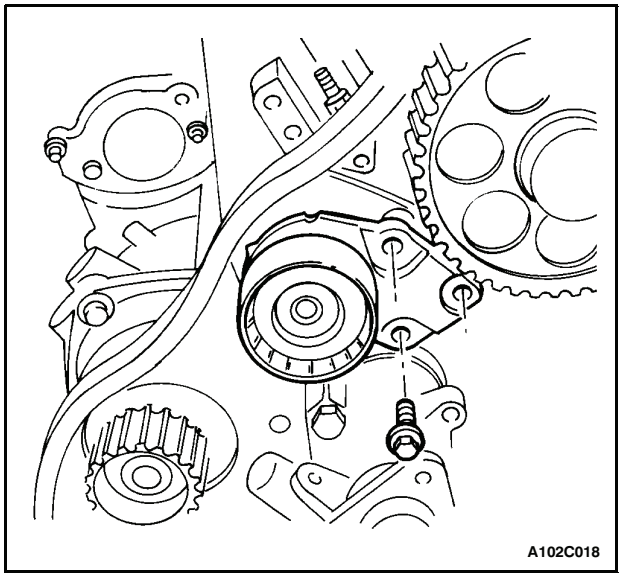

A102C006

9. Connect the crankcase ventilation tubes to the valve cover.
10. Connect the ignition wires to the spark plugs.
11. Install the spark plug cover.
12. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

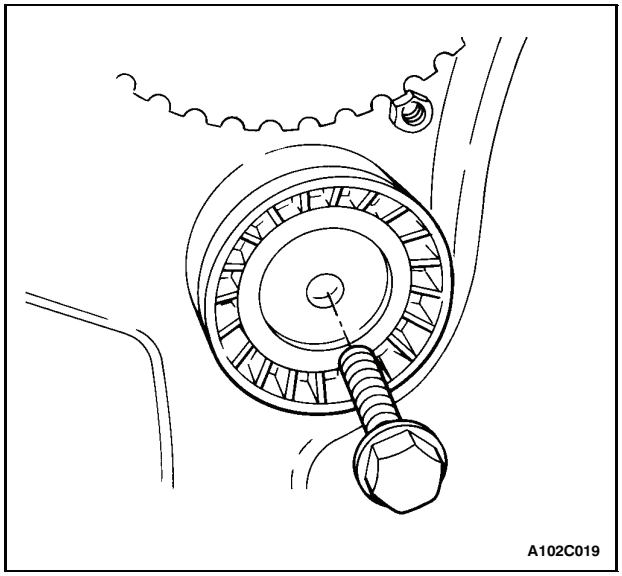
13. Install the timing belt. Refer to "Timing Belt" in this section.
14. Connect the negative battery cable.


A102C018

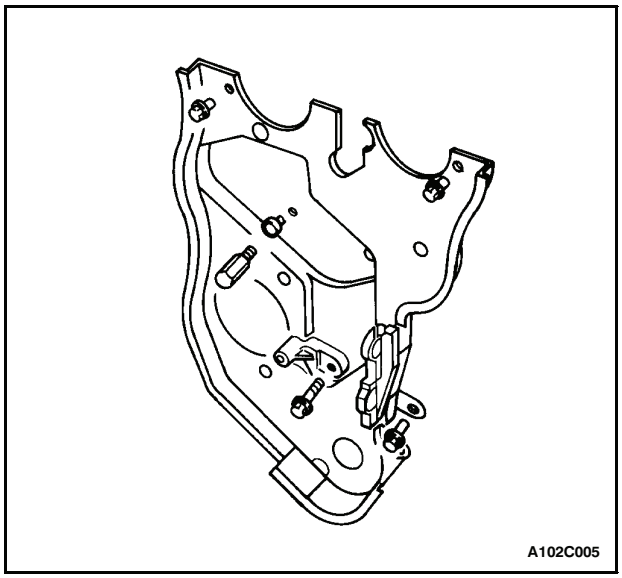
REAR TIMING BELT COVER

Removal Procedure

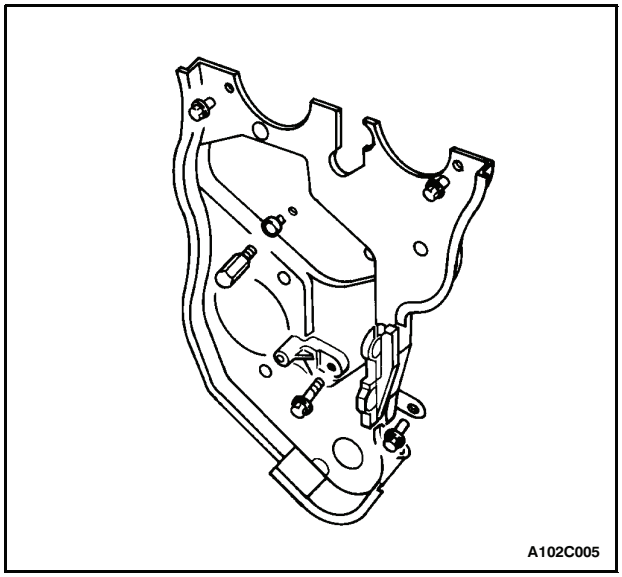
1. Remove the timing belt and the timing belt cover. Refer to "Timing Belt" in this section.
2. Remove the camshaft gears. Refer to "Camshaft Gears" in this section.
3. Remove the crankshaft gear.
4. Remove the timing belt automatic tensioner bolts.
5. Remove the timing belt automatic tensioner.


A102C019

6. Remove the timing belt idler pulley bolt.
7. Remove the timing belt idler pulley.


A102C005

8. Remove the rear timing belt cover bolts.
9. Remove the rear timing belt cover.

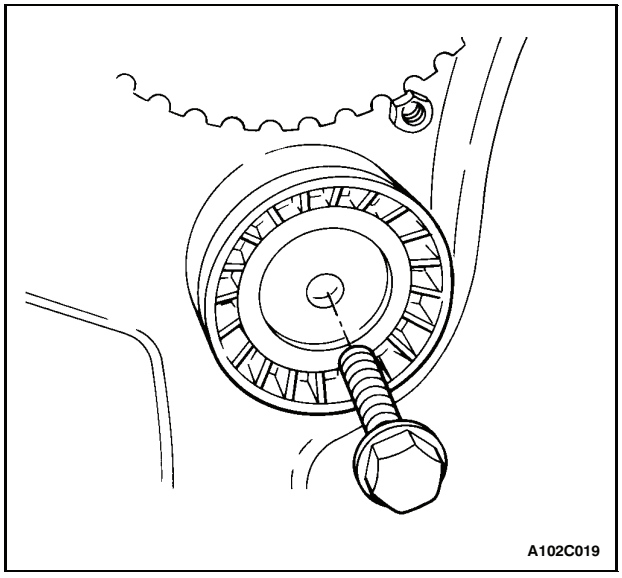

A102C005

Installation Procedure

1. Install the rear timing belt cover.
2. Install the rear timing belt cover bolts.

Tighten

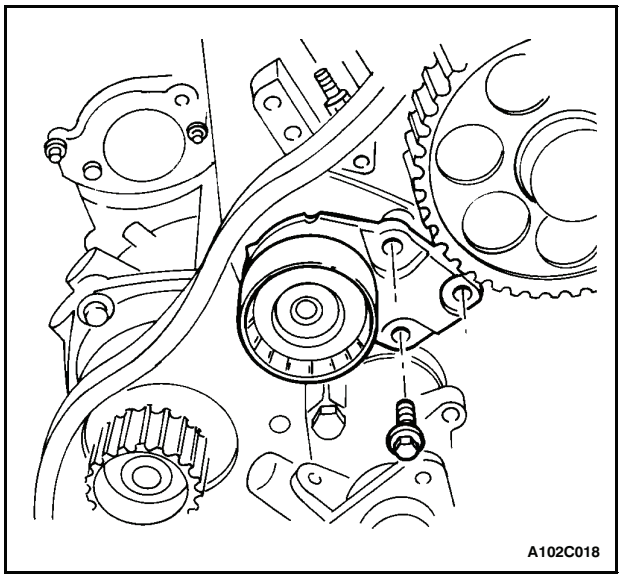
Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).


A102C019

3. Install the timing belt idler pulley.
4. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 NSm (30 lb-ft).

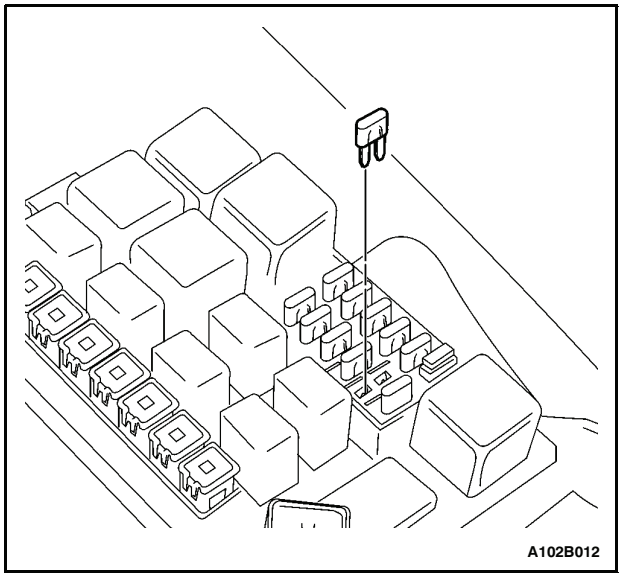

A102C018

5. Install the timing belt automatic tensioner.
6. Install the timing belt automatic tensioner bolts.

Tighten

Tighten the timing belt automatic tensioner bolts to 25 NSm (18 lb-ft).

7. Install the crankshaft gear.
8. Install the camshaft gears. Refer to "Camshaft Gears" in this section.
9. Install the timing belt and timing belt cover. Refer to "Timing Belt" in this section.


A102B012

ENGINE

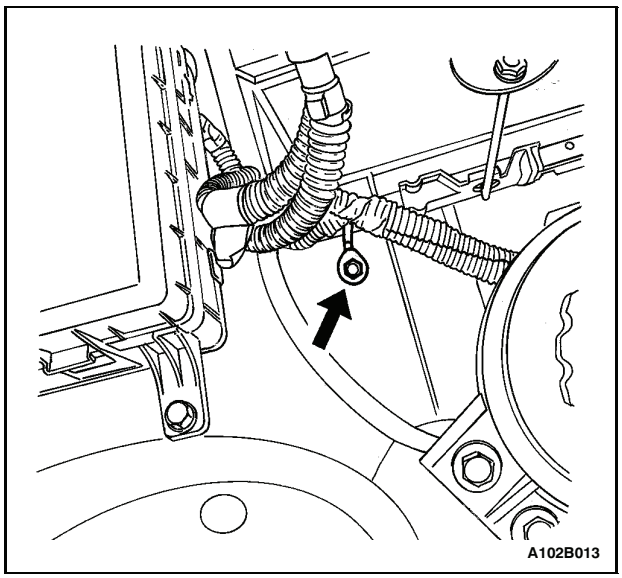
Tools Required

KM-470-B Angular Torque Gauge

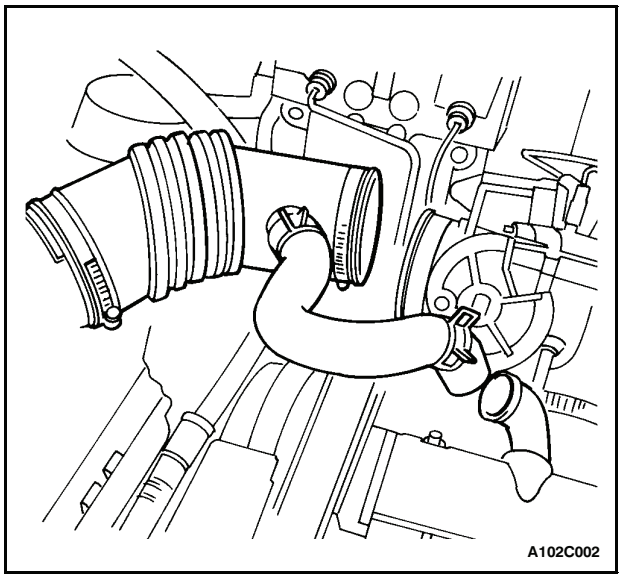
Removal Procedure

Important: On vehicles equipped with manual transaxle, the manual transaxle must be removed before the engine is removed. Refer to Section 5B, Manual Transaxle.

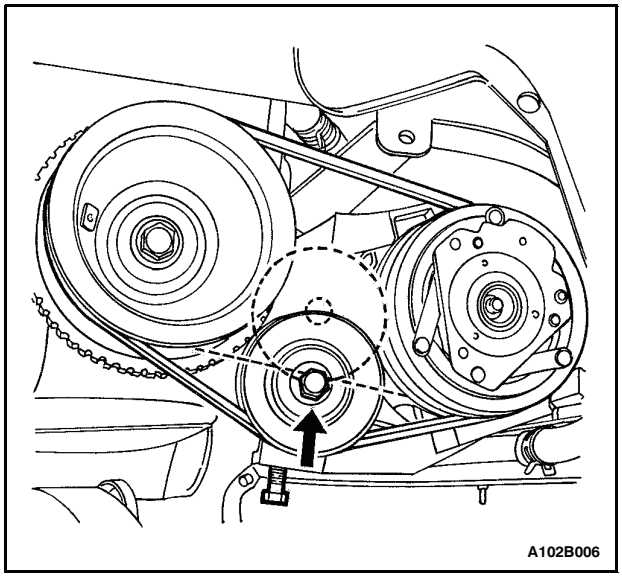
1. Remove the fuel pump fuse.
2. Start the engine. Crank the engine after it stalls for 10 seconds to rid the fuel system of fuel pressure.
3. Remove the hood. Refer to Section 9R, Body Front End.
4. Drain the engine oil.


A102B013

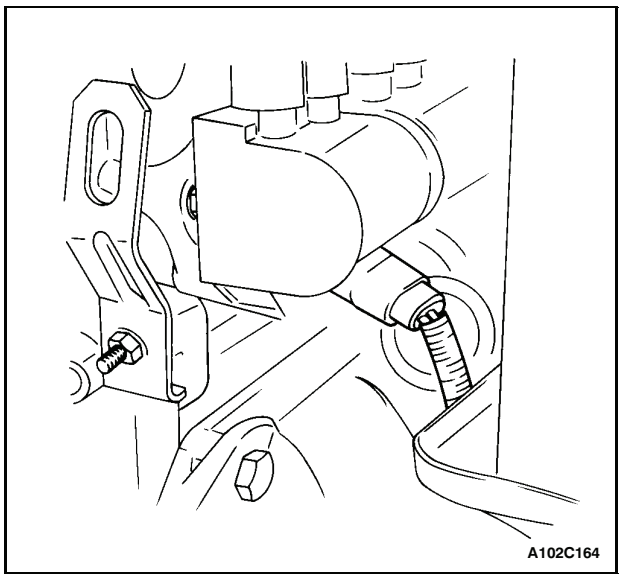
5. Disconnect the negative battery cable.
6. Disconnect and separate the positive battery cable.
7. Disconnect the negative battery cable from the vehicle frame.


A102C002

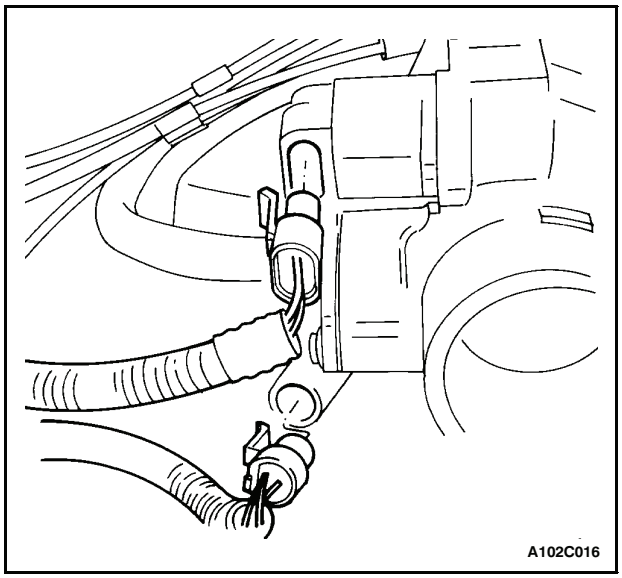
8. Discharge the air conditioning system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
9. Disconnect the manifold air temperature sensor connector.
10. Remove the air intake tube from the throttle body and air filter housing.
11. Disconnect the breather tubes from the valve cover.


A102B006

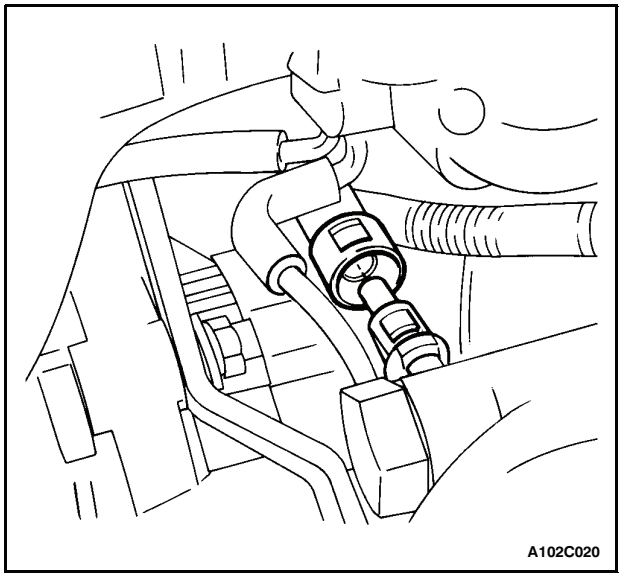
12. Remove the right front wheel. Refer to Section 2E, Tires and Wheels.
13. Remove the right front splash shield.
14. Remove the A/C compressor drive belt, if equipped.
15. Remove the alternator drive belt.
16. Remove the power steering pump pulley bolts.
17. Remove the power steering pump pulley.


A102C164

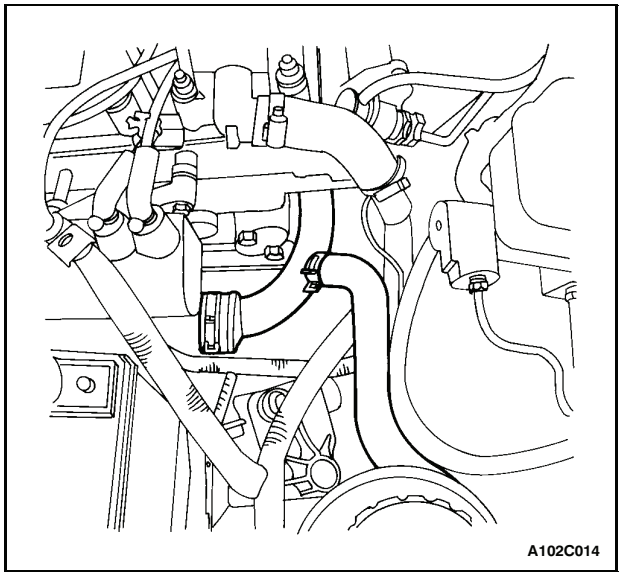
18. Drain the engine coolant. Refer to Section 1D, Engine Cooling.
19. Remove the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.
20. Disconnect the upper radiator hose from the thermostat housing.
21. Disconnect the power steering return hose from the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
22. Disconnect the power steering pressure hose from the power steering pump, if equipped. Refer to Section 6A, Power Steering System.
23. Disconnect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold and at the starter motor.



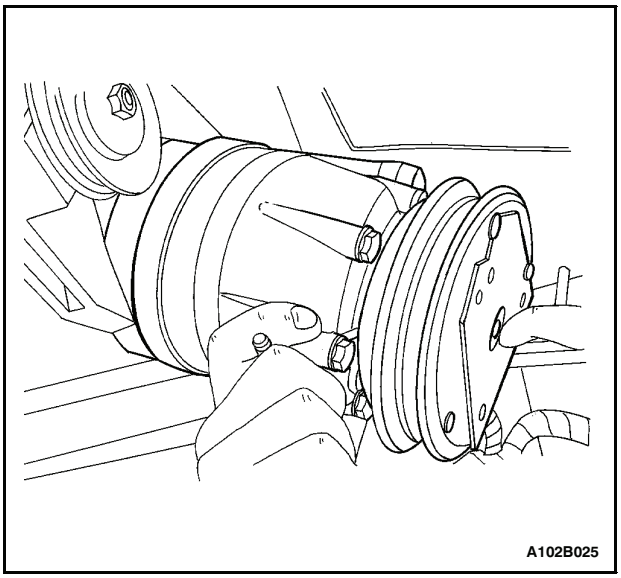
24. Disconnect the oxygen sensor connector.
25. Disconnect the fuel injector harness connectors.
26. Disconnect the idle air control valve connector.
27. Disconnect the throttle position sensor connector.
28. Disconnect the engine coolant temperature sensor connector.
29. Disconnect the coolant temperature sensor connector.
30. Disconnect the alternator voltage regulator connector.



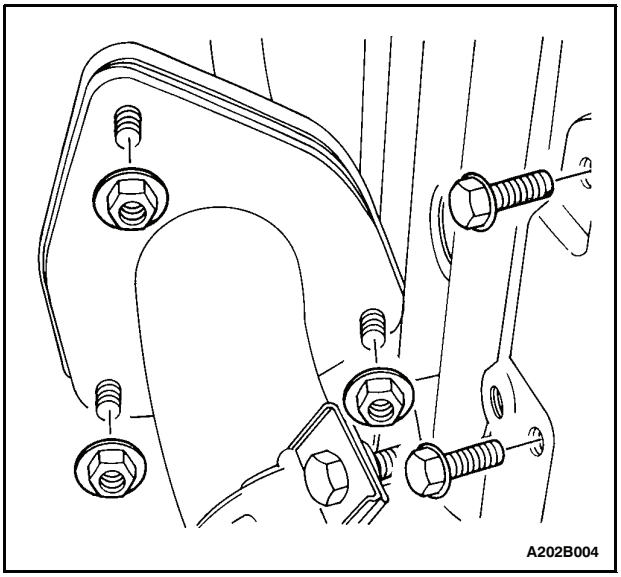
31. Disconnect all of the necessary vacuum lines including the brake booster vacuum hose.
32. Disconnect the fuel return line at the fuel pressure regulator.
33. Disconnect the fuel feed line at the fuel rail.



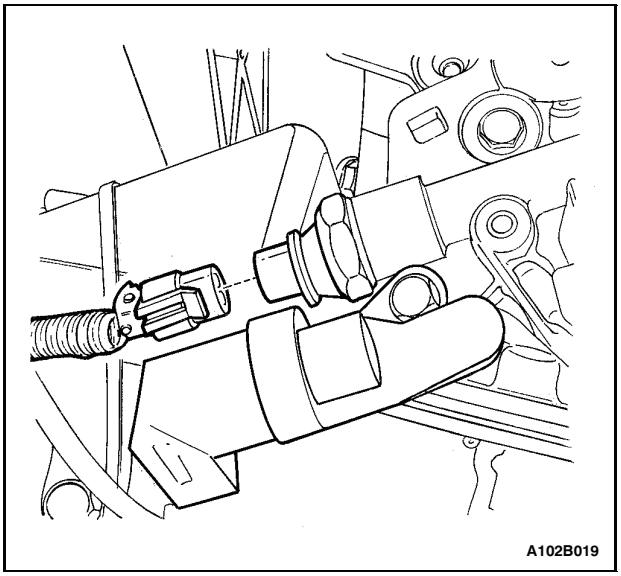
34. Disconnect the throttle cable from the throttle body and the intake manifold bracket.
35. Disconnect the surge tank coolant hose at the throttle body.
36. Disconnect the heater outlet hose at the coolant pipe.
37. Disconnect the heater inlet hose from the cylinder head.
38. Disconnect the surge tank coolant hose from the coolant pipe.
39. Disconnect the lower radiator hose from the coolant pipe.


A102B025

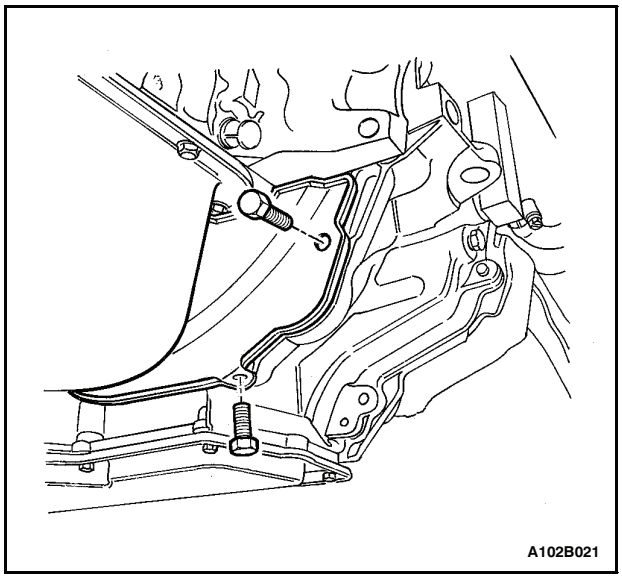
40. Disconnect the starter solenoid "S" terminal wire.
41. Remove the A/C compressor hose assembly retaining bolt.
42. Disconnect the A/C compressor hose assembly from the compressor.
43. Disconnect the electrical connector at the A/C compressor coil.
44. Remove the A/C compressor mounting bolts.
45. Remove the A/C compressor.
46. Remove the A/C compressor mounting bracket bolts from the engine block.
47. Remove the A/C compressor mounting bracket.


A202B004

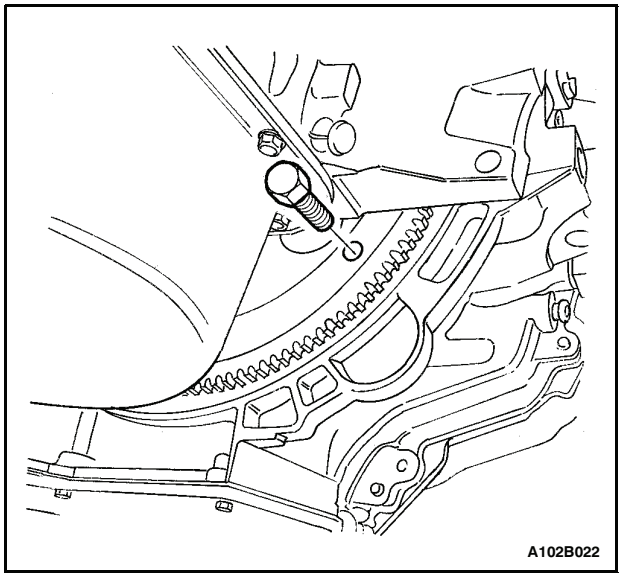
48. Remove the exhaust flex pipe retaining nuts from the exhaust manifold studs and the bolts at the bracket.
49. Remove the exhaust flex pipe retaining nuts from the catalytic converter or the connecting pipe.
50. Remove the exhaust flex pipe.


A102B019

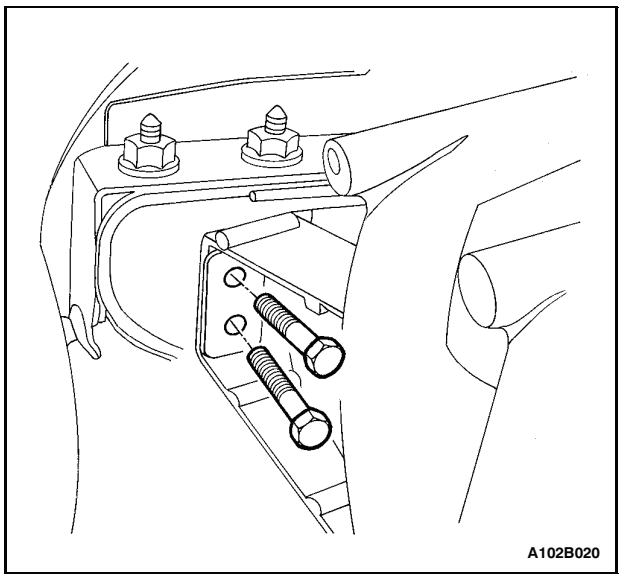
51. Remove the crankshaft pulley bolt.
52. Remove the crankshaft pulley.
53. Disconnect the vacuum lines at the charcoal canister purge and exhaust gas recirculation (EGR) solenoid.
54. Disconnect the electrical connector at the charcoal canister purge and EGR solenoid.
55. Disconnect the electrical connector at the oil pressure switch.
56. Disconnect the crankshaft position sensor and the knock sensor connectors.
57. Remove the crankshaft position sensor retaining bolt.
58. Remove the crankshaft position sensor.


A102B021

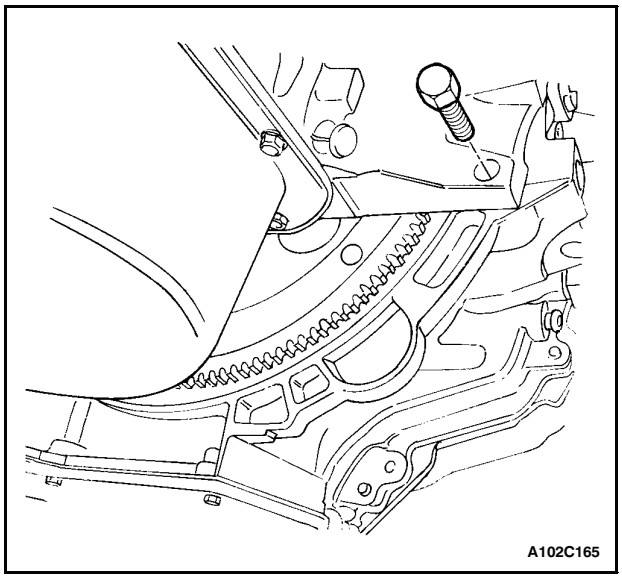
59. Remove the right transaxle brace bolts from the transmission.
60. Remove the flywheel or flexible plate inspection cover bolts.
61. Remove the flywheel or flexible plate inspection cover.


A102B022

62. Remove the transaxle torque converter bolts, if automatic transaxle equipped.
63. Remove the transmission/transaxle bell housing bolts.
64. Support the transmission with a floor jack.
65. Install the engine lifting device.


A102B020

66. Disconnect the right engine mount bracket from the engine mount by removing the retaining bolts.
67. Remove the right engine mount bracket from the engine block.
68. Separate the engine block from the transmission.
69. Remove the engine.

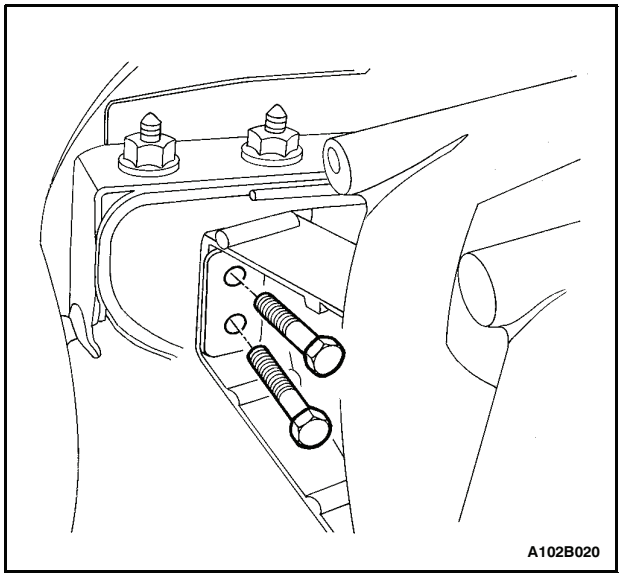

A102C165

Installation Procedure

1. Install the engine into the engine compartment.
2. Align the engine alignment pins to the transmission.
3. Install the transmission/transaxle bell housing bolts.

Tighten

Tighten the transmission/transaxle bell housing bolts to 75 NSm (55 lb-ft).


A102B020

4. Install the right engine mount bracket to the engine block.
5. Install the right engine mount bracket retaining bolts.

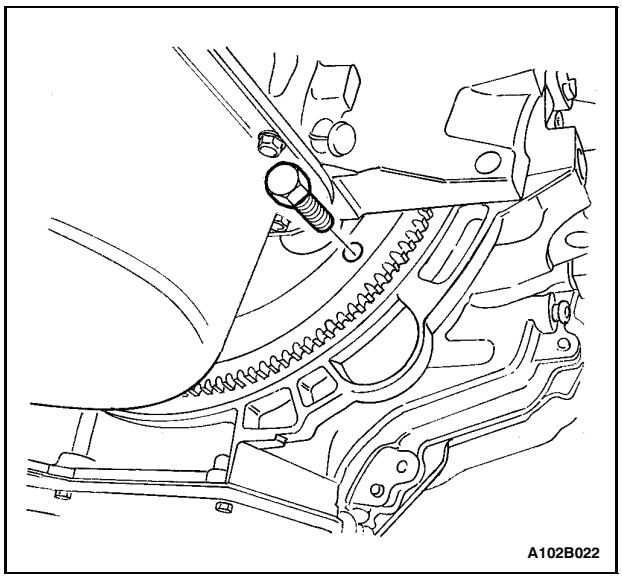
Tighten

Tighten the right engine mount bracket retaining bolts to 60 NSm (44 lb-ft).

6. Connect the right engine mount bracket to the engine mount by installing the two retaining bolts.

Tighten

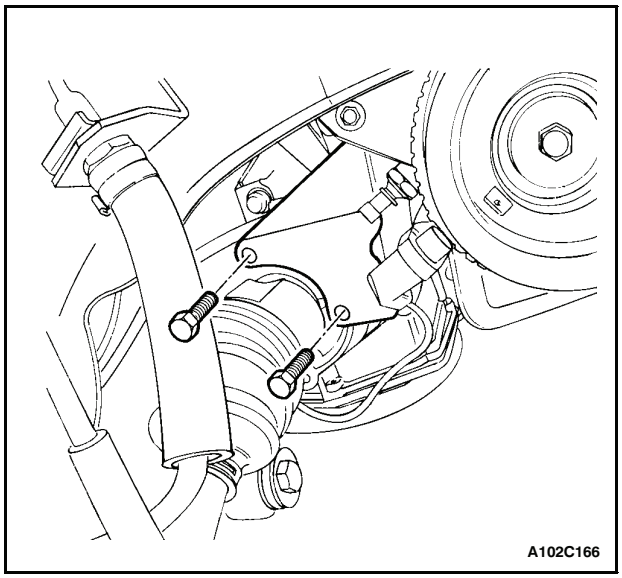
Tighten the right engine mount-to-engine mount bracket retaining bolts to 60 NSm (44 lb-ft).


A102B022

7. Remove the floor jack used for support of the transmission.
8. Remove the engine lifting device.
9. Install the transaxle torque converter bolts, if automatic transaxle equipped.

Tighten

Tighten the transaxle torque converter bolts to 65 NSm (48 lb-ft).


A102C166

10. Install the flywheel or flexible plate inspection cover.
11. Install the flywheel or flexible plate inspection cover bolts.

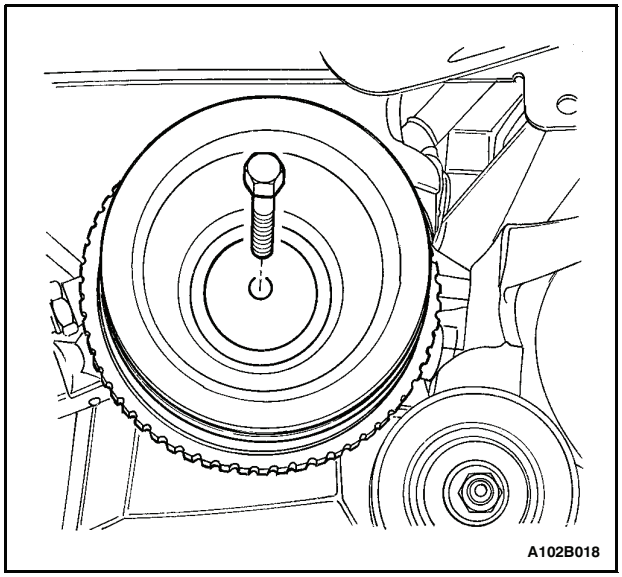
Tighten

Tighten the flywheel inspection cover bolts to 12 NSm (106 lb-in) or the flexible plate inspection cover bolts to 10 NSm (89 lb-in).

12. Install the right transaxle brace bolts to the transmission.

Tighten

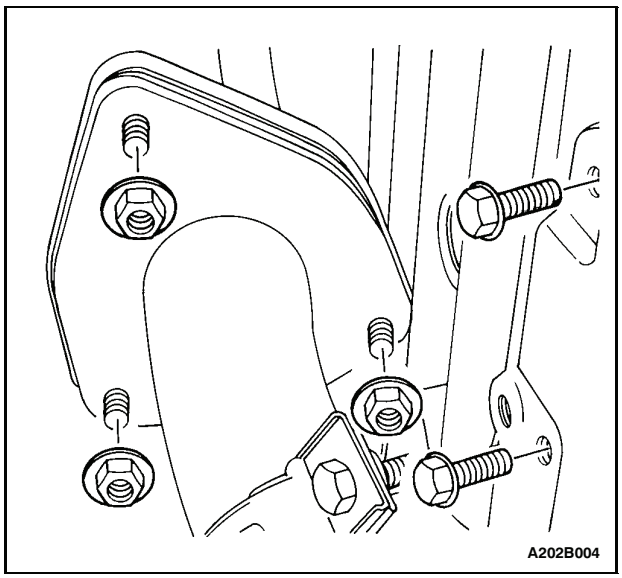
Tighten the right transaxle brace bolts to 40 NSm (30 lb-ft).


A102B018

13. Connect the vacuum lines at the charcoal canister purge and EGR solenoid.
14. Connect the electrical connector charcoal canister purge and EGR solenoid.
15. Connect the oil pressure switch connector.
16. Install the crankshaft pulley.
17. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 NSm (70 lb-ft) using a torque wrench. Using the angular torque gauge KM-470-B, tighten the crankshaft pulley bolt to 30 degrees + 15 degrees.


A202B004

18. Install the crankshaft position sensor and the crankshaft position sensor retaining bolt.

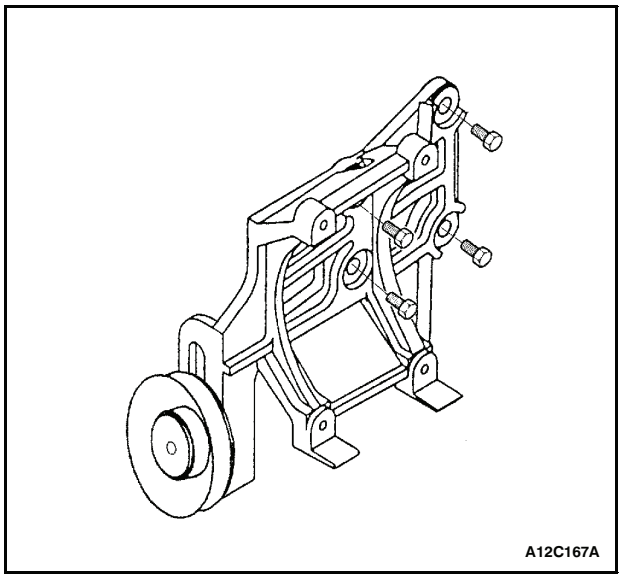
Tighten

Tighten the crankshaft position sensor retaining bolt to 10 NSm (89 lb-in).

19. Connect the crankshaft position sensor and the knock sensor connectors.
20. Install the exhaust flex pipe.
21. Install the exhaust flex pipe retaining nuts to the exhaust manifold studs and the bolts at the bracket.

Tighten

Tighten the exhaust flex pipe retaining nuts and the bolts at the bracket to 40 NSm (30 lb-ft).


A12C167A

22. Install the exhaust flex pipe retaining nuts to the catalytic converter.

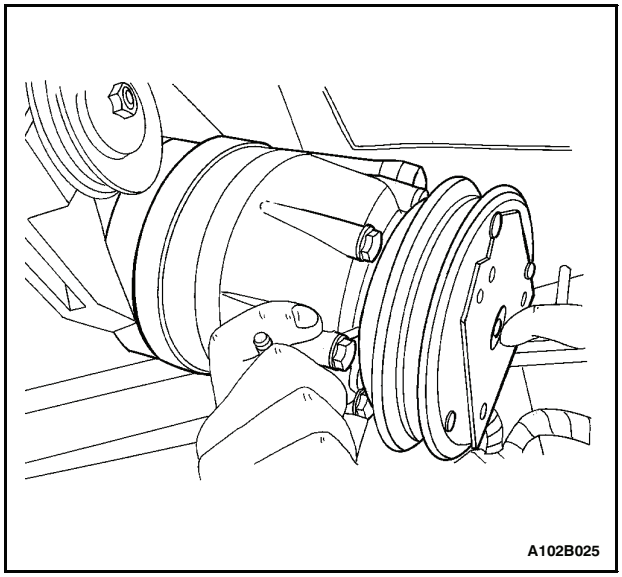
Tighten

Tighten the exhaust flex pipe retaining nuts to the catalytic converter on the connecting pipe or the connecting pipe to 30 NSm (22 lb-ft).

23. Connect the power steering pressure hose, if equipped. Refer to Section 6A, Power Steering System.
24. Connect the power steering return hose, if equipped. Refer to Section 6A, Power Steering System.
25. Install the A/C compressor mounting bracket, if equipped.
26. Install the A/C compressor mounting bracket bolts, if equipped.

Tighten

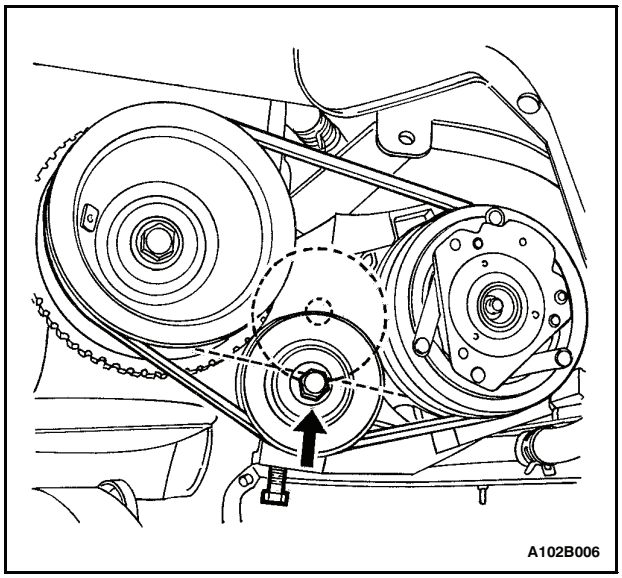
Tighten the A/C compressor mounting brackets bolts to 50 NSm (37 lb-ft).


A102B025

27. Install the A/C compressor, if equipped.
28. Install the A/C compressor mounting bolts, if equipped.

Tighten

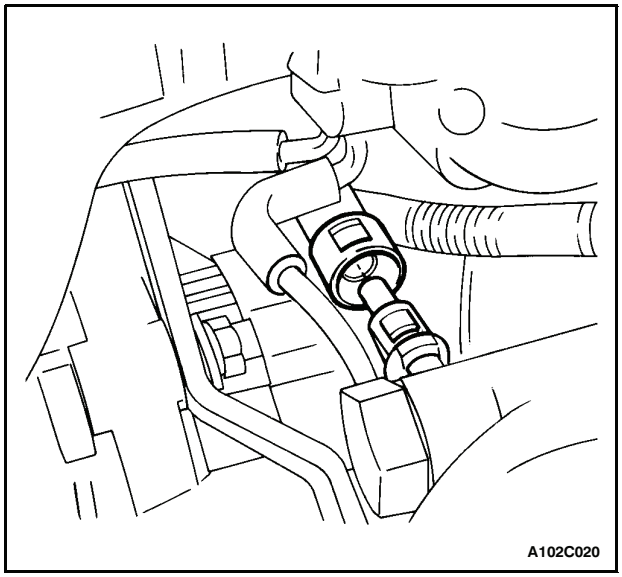
Tighten the A/C compressor mounting bolts to 27 NSm (20 lb-ft).


A102B006

29. Connect the A/C compressor coil connector, if equipped.
30. Install the alternator drive belt.
31. Install the A/C compressor drive belt, if equipped.
32. Connect the A/C compressor hose assembly and the A/C compressor hose assembly retaining bolt, if equipped.

Tighten

Tighten the A/C compressor hose assembly retaining bolt to 33 NSm (24 lb-ft).

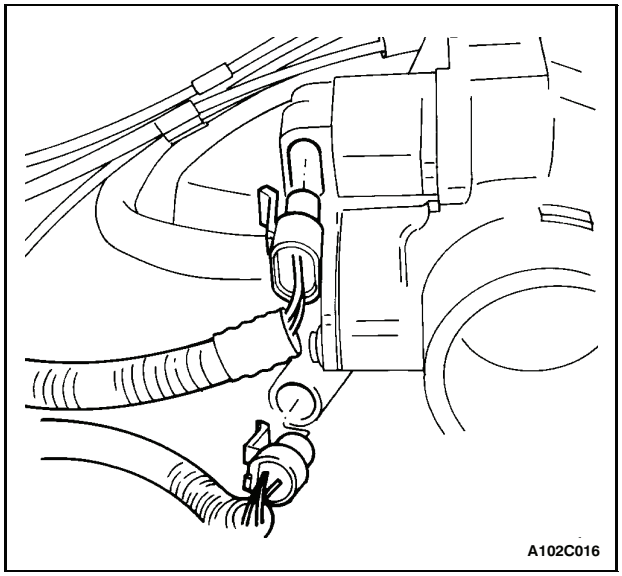

A102C020

33. Install the power steering pump pulley, if equipped.
34. Install the power steering pump pulley bolts, if equipped.

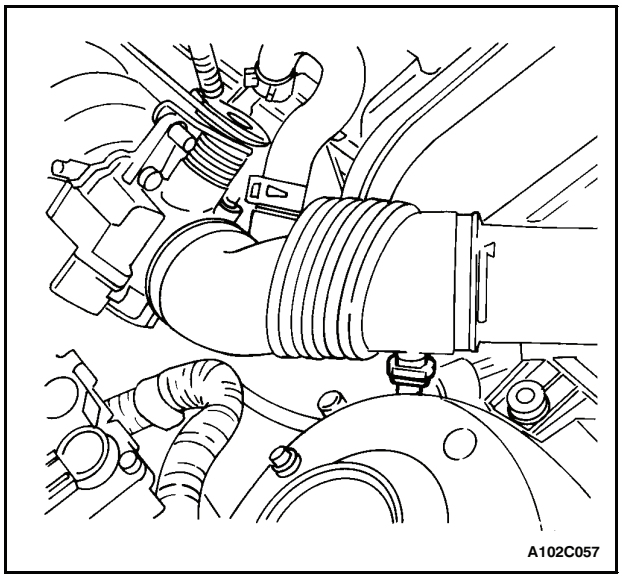
Tighten

Tighten the power steering pump pulley bolts to 25 NSm (18 lb-ft).

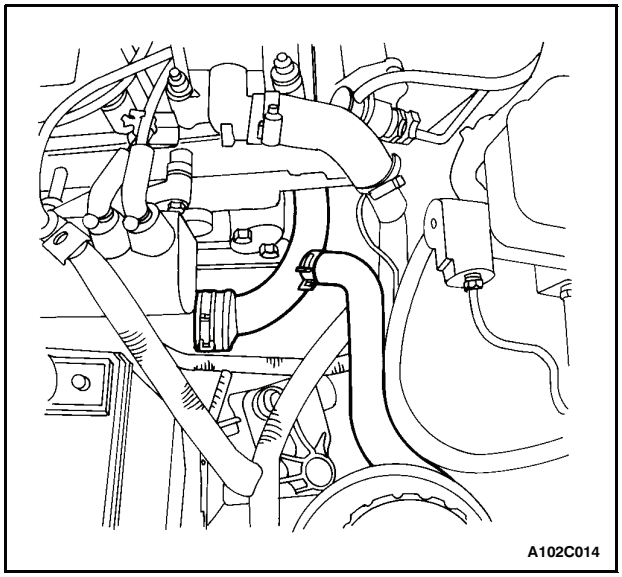
35. Install the right front splash shield.
36. Install the right front wheel. Refer to Section 2E, Tires and Wheels.
37. Connect the fuel feed line to the fuel rail.
38. Connect the fuel return line to the fuel pressure regulator.


A102C016

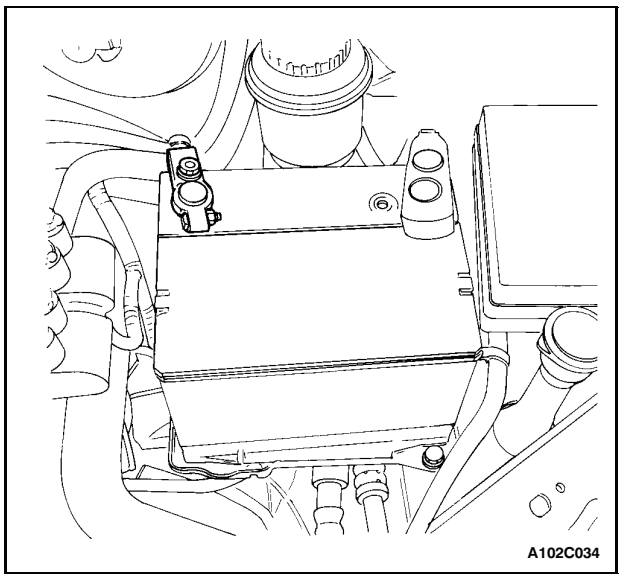
39. Connect all of the necessary vacuum lines including the brake booster vacuum hose.
40. Connect the oxygen sensor connector.
41. Connect the starter solenoid "S" terminal wire.
42. Connect the alternator voltage regulator connector.
43. Connect the coolant temperature sensor connector.
44. Connect the engine coolant temperature sensor connector.
45. Connect the throttle position sensor connector.
46. Connect the idle air control valve connector.


A102C057

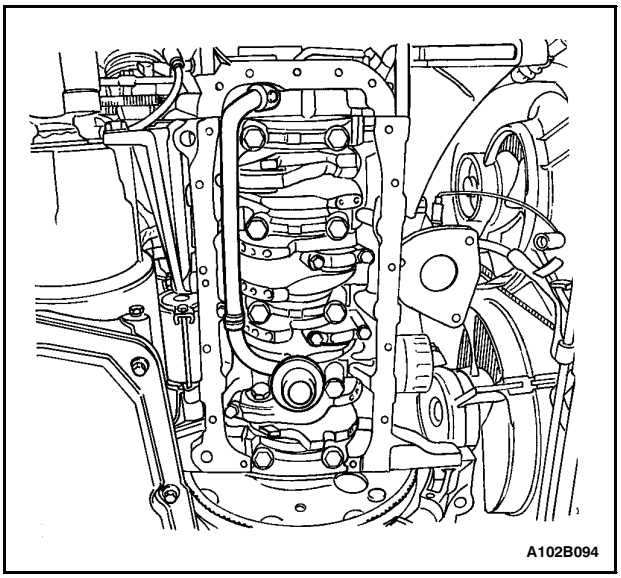
47. Connect the fuel injector harness connectors.
48. Connect the electrical connector at the DIS ignition coil and the ECM ground terminal at the intake manifold and the starter motor.
49. Install the air intake tube between the throttle body and the air filter housing.
50. Connect the breather tubes to the valve cover.
51. Connect the manifold air temperature sensor connector.
52. Install the cooling system radiator and the engine cooling fans. Refer to Section 1D, Engine Cooling.


A102C014

53. Connect the lower radiator hose to the coolant pipe.
54. Connect the upper radiator hose to the thermostat housing.
55. Connect the heater inlet hose to the cylinder head.
56. Connect the heater outlet hose to the coolant pipe.
57. Connect the coolant surge tank hose to the coolant pipe.
58. Connect the surge tank coolant hose to the throttle body.


A102C034

59. Connect the throttle cable to the throttle body and the intake manifold bracket.
60. Install the fuel pump fuse.
61. Connect the negative battery cable to the vehicle frame.
62. Connect the negative battery cable.
63. Connect and assemble the positive battery cable.
64. Refill the engine crankcase with engine oil.
65. Refill the engine coolant system. Refer to Section 1D, Engine Cooling.
66. Bleed the power steering system, if equipped. Refer to Section 6A, Power Steering System.
67. Refill the A/C refrigerant system, if equipped. Refer to Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.
68. Install the hood. Refer to Section 9R, Body Front End.


A102B094

PISTONS AND RODS

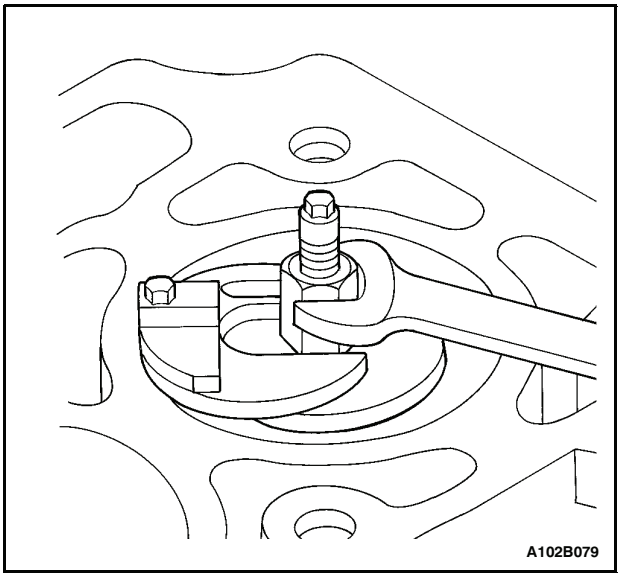
Tools Required

KM-427 Piston Pin Service Set

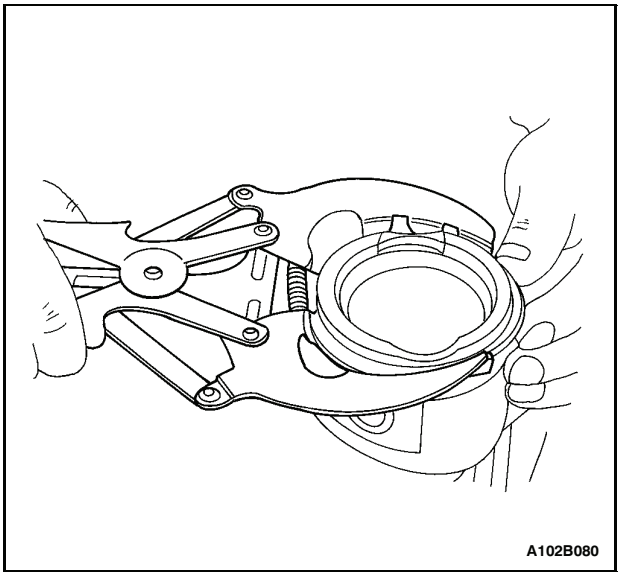
KM 470-B Angular Torque Gauge

Removal Procedure

1. Remove the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the oil pan. Refer to "Oil Pan" in this section.
3. Remove the oil pump/pickup tube bolts.
4. Remove the oil pump/pickup tube.

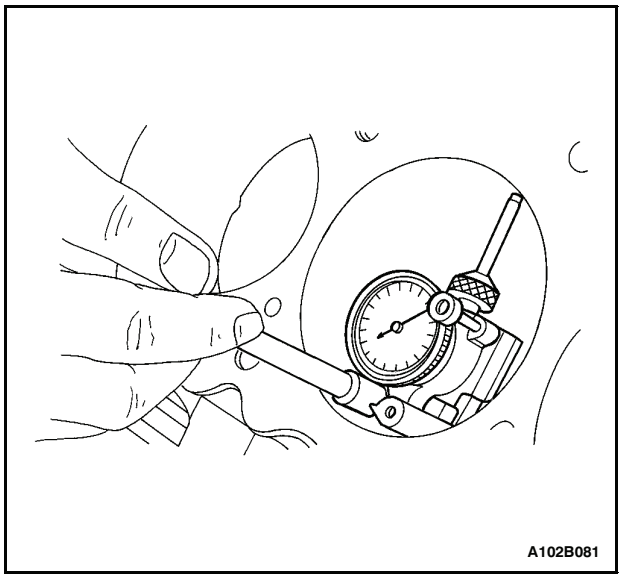

A102B079

5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap for position.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.


A102B080

Caution: Use care when handling the piston. Worn piston rings are sharp and may cause injury.

11. Remove the piston.
12. Use a piston ring expander tool to expand the piston rings.
13. Remove the piston rings.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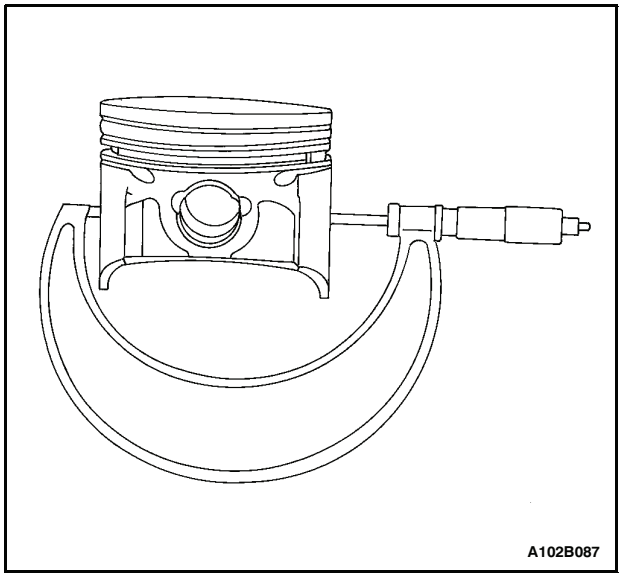
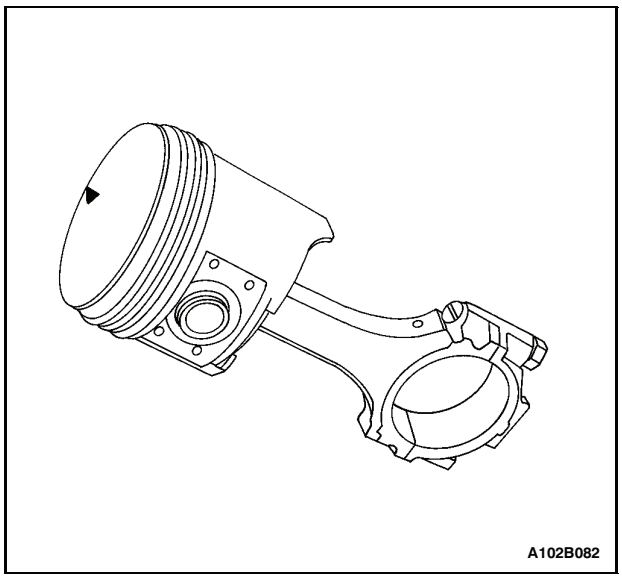
14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.

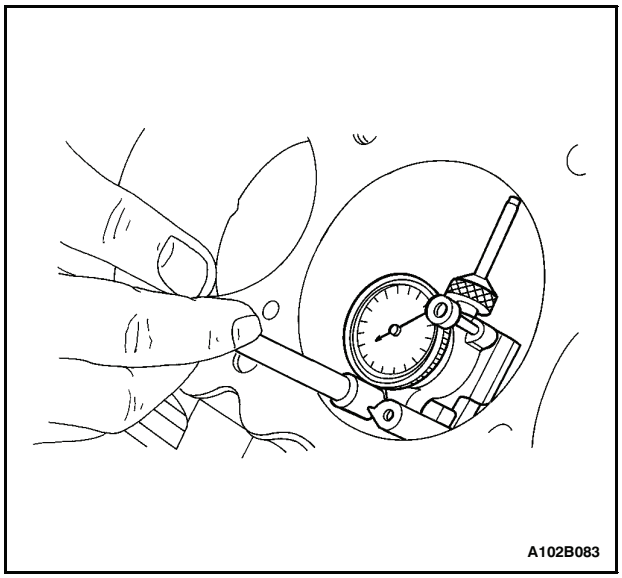

A102B087

Inspection Procedure

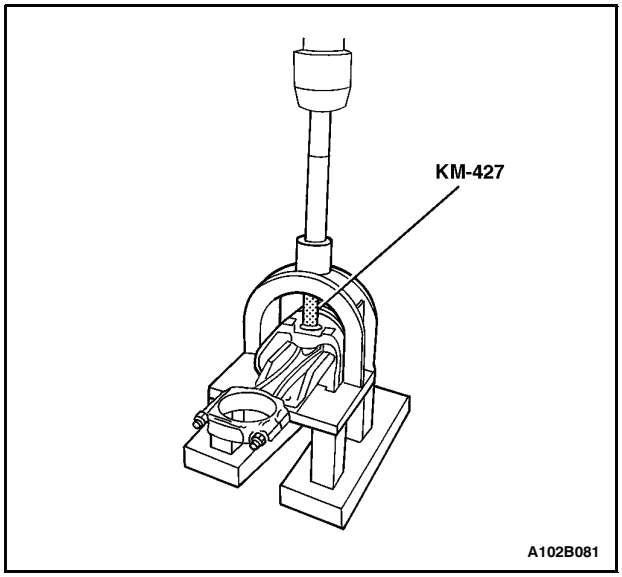
1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the crankshaft rod bearing journal for wear. Refer to "Engine Specifications" in this section.
6. Inspect the piston for scoring, cracks, and wear.
7. Inspect the piston for taper using a micrometer.


A102B082

8. Inspect the piston for fit to the connecting rod.


A102B083

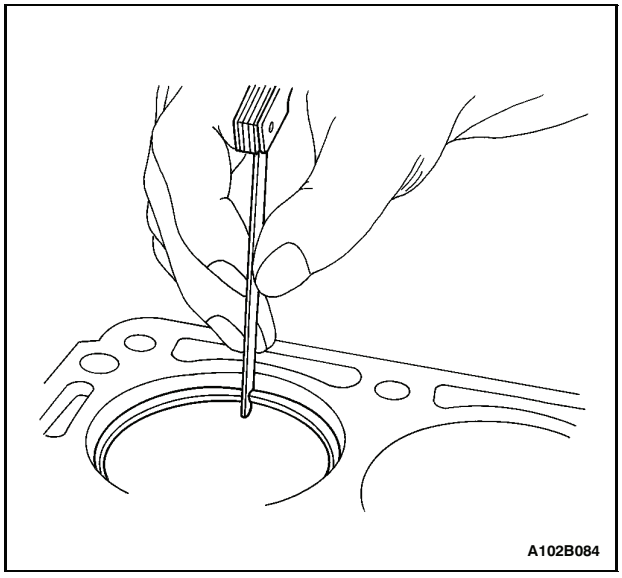
9. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to "Engine Specifications" in this section.
10. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to "Engine Specifications" in this section. If the bearing bore is beyond specifications, replace the engine block.
11. Inspect the engine block cylinder bore for wear, runout, ridging and taper using a bore gauge. Refer to "Engine Specifications" in this section.
12. Inspect the engine block cylinder bore for glazing. Lightly hone the cylinder bore as necessary.



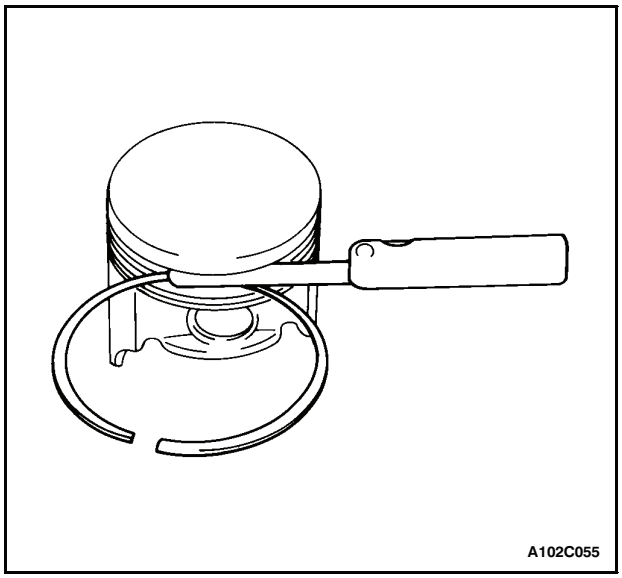
A102B081

Installation Procedure

1. Align the notch on the piston and connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.
5. Install the piston pin into the piston and connecting rod assembly using the piston pin service set KM-427.

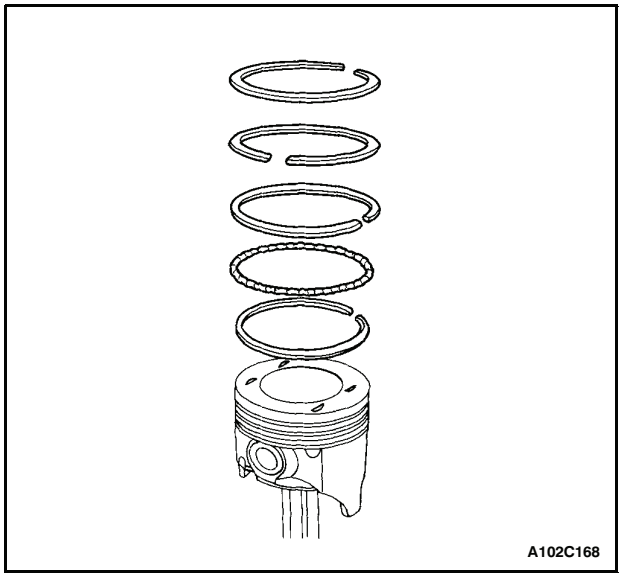

A102B084

6. Select a set of new piston rings.
7. Measure the piston ring gap using a feeler gauge. Refer to "Engine Specifications" in this section.
8. Increase the piston ring gap by carefully filing off excess material if the piston ring gap is below specifications.



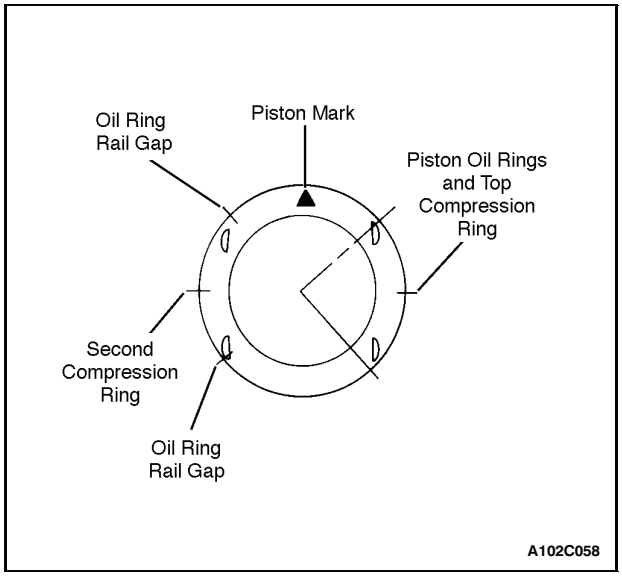
A102C055

9. Measure the piston ring side clearance using a feeler gauge. Refer to "Engine Specifications" in this section.
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed on a sheet of glass.



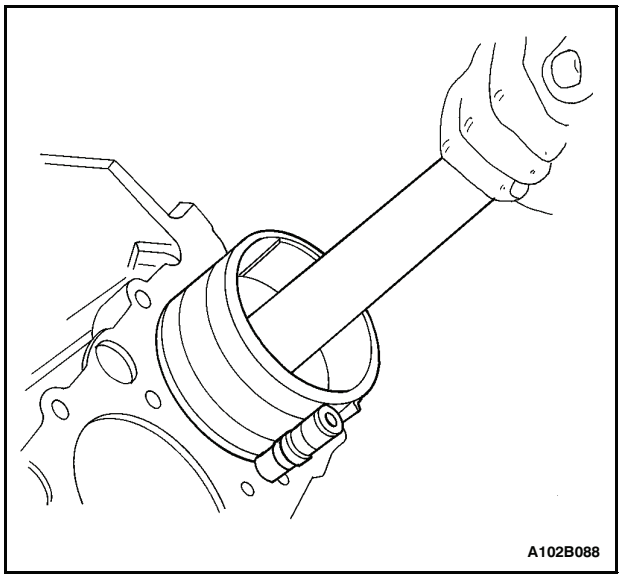
A102C168

12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.

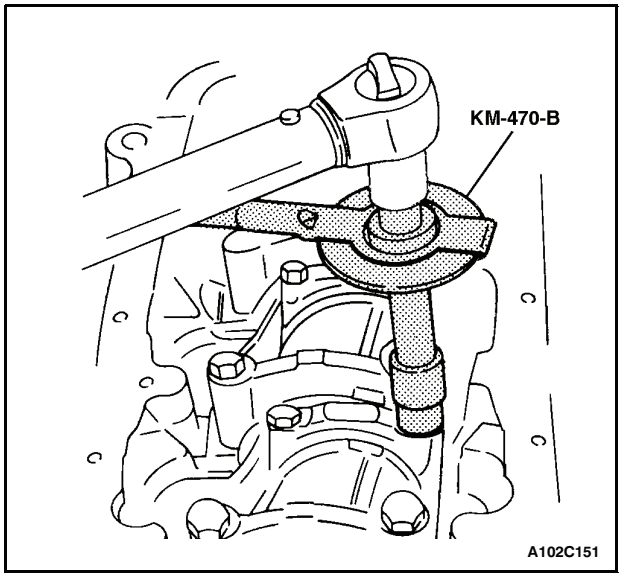


A102C058

15. Use a piston ring expander to install the piston rings. Do not expand the piston rings beyond the expansion necessary for installation.
16. Stagger the piston oil rings, the oil ring rail gaps, the second compression ring, and the top compression ring in relation to the notch on the top of the piston.


A102B088

17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using a ring compressor and a wood handle. Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and bearings. Refer to "Crankshaft Bearings and Connecting Rod Bearings - Gauging Plastic" in this section.

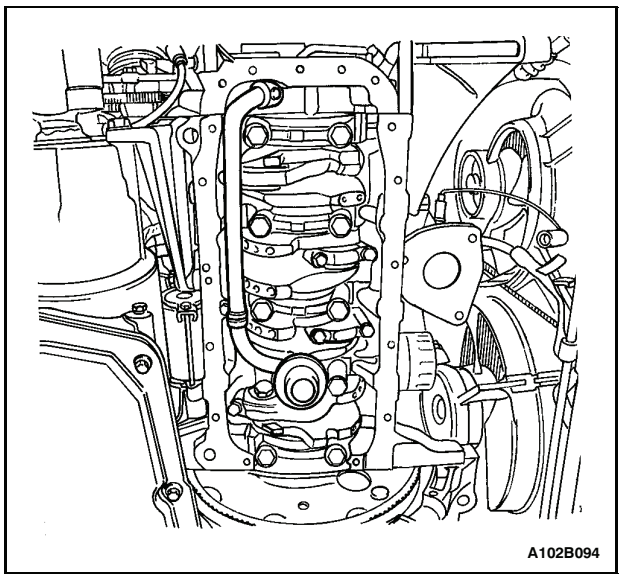


A102C151

20. Install the connecting rod cap bolts.

Tighten

Tighten the connecting rod cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM 470-B, tighten the bolts one turn of 30 degrees plus one turn of 15 degrees.

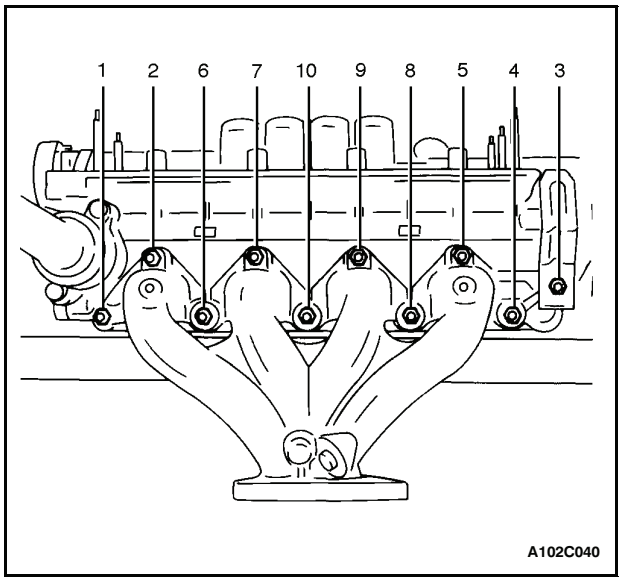

A102B094

21. Install the oil pump/pickup tube.
22. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pickup tube bolts to 10 NSm (89 lb-in).

23. Install the oil pan. Refer to "Oil Pan" in this section.
24. Install the cylinder head with the intake manifold and exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.



UNIT REPAIR

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

Tools Required

MKM-571-B Gauge

KM-340-0 Cutter Set

- **KM-340-7 Guide Drift**
- **KM-340-13 Cutters**
- **KM-340-26 Cutters**

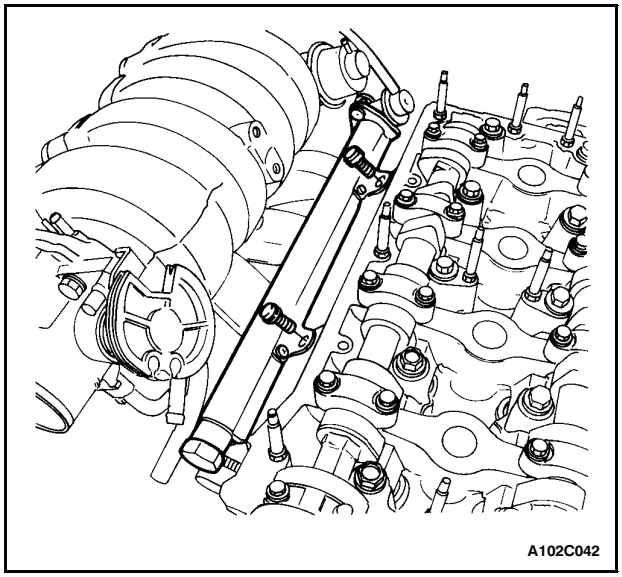
KM-348 Valve Spring Compressor

KM-653 Adapter

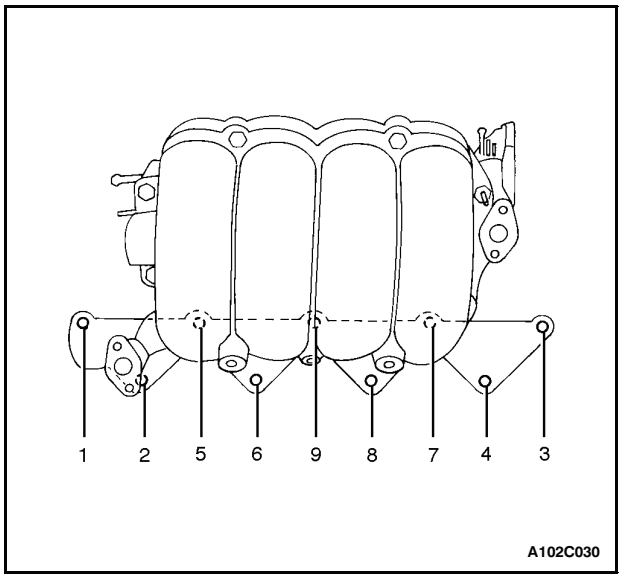
KM-805 Reamer

Disassembly Procedure

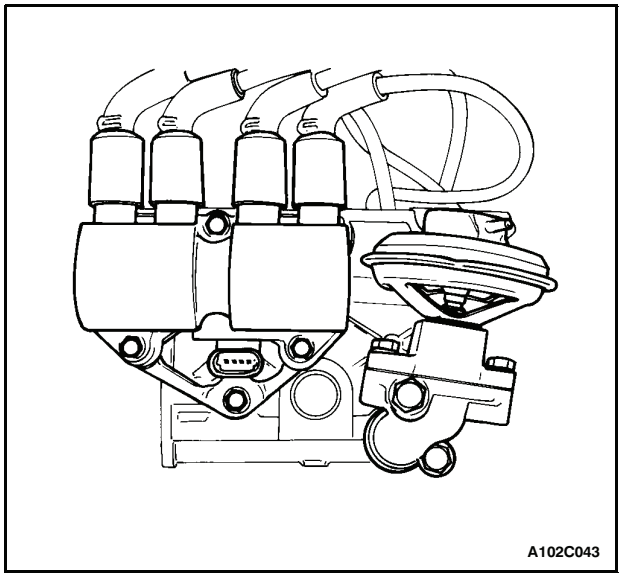
1. **Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.**
2. **Remove the coolant temperature sensor.**
3. **Remove the exhaust manifold heat shield bolts.**
4. **Remove the exhaust manifold heat shield.**
5. **Remove the exhaust manifold retaining nuts in the sequence shown.**
6. **Remove the exhaust manifold.**
7. **Remove the exhaust manifold gasket.**
8. **Remove the exhaust manifold studs.**



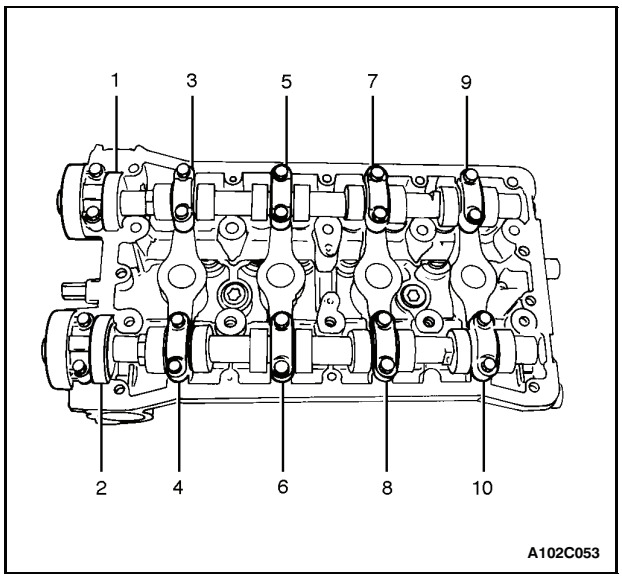
9. **Remove the thermostat housing mounting bolts.**
10. **Remove the thermostat housing assembly.**
11. **Remove the fuel rail retaining bolts and the fuel rail assembly.**



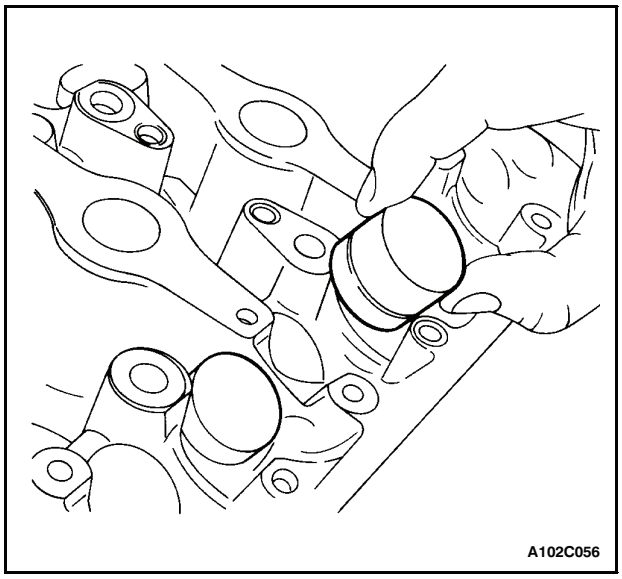
12. Remove the intake manifold retaining nuts and retaining bolts in the sequence shown.
13. Remove the intake manifold.
14. Remove the intake manifold gasket.
15. Remove the intake manifold studs.



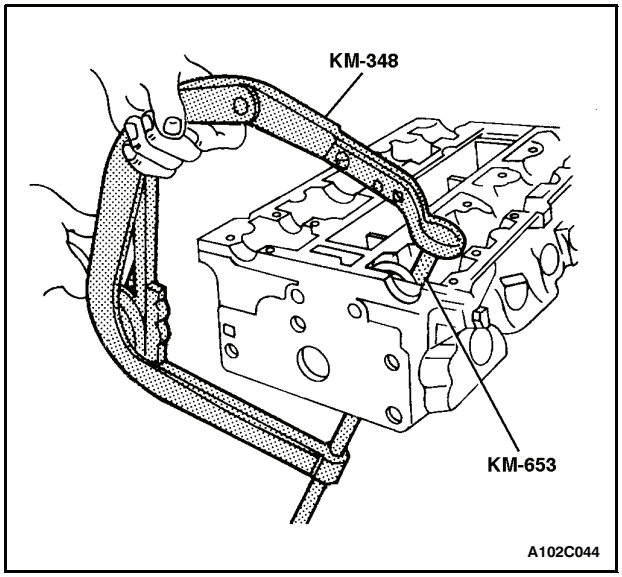
16. Remove the DIS ignition coil mounting bolts.
17. Remove the DIS ignition coil with the ignition wires attached.
18. Remove the DIS ignition coil mounting bracket bolts.
19. Remove the DIS ignition coil mounting bracket.
20. Remove the exhaust gas recirculation valve adapter bolts.
21. Remove the exhaust gas recirculation valve adapter.
22. Remove the exhaust gas recirculation valve adapter gasket.
23. Remove the spark plugs.



24. Remove the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

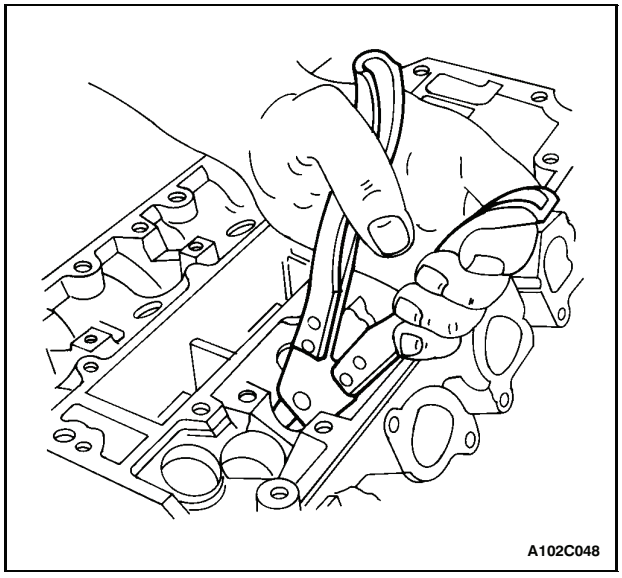

A102C056

25. Remove the intake camshaft caps. Maintain the correct positions for installation.
26. Remove the intake camshaft.
27. Remove the intake valve lash adjusters.
28. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
29. Remove the exhaust camshaft.
30. Remove the exhaust valve lash adjusters.

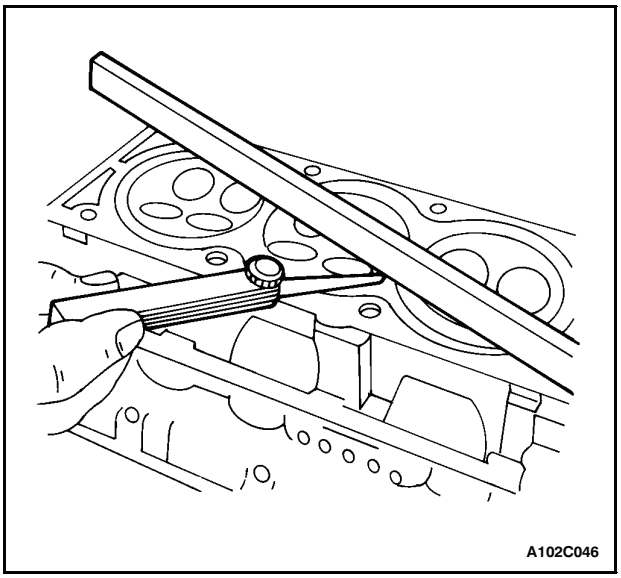


A102C044

31. Compress the valve springs with the valve spring compressor KM-348 and the adapter KM-653.
32. Remove the valve retainers.
33. Remove the valve spring compressor KM-348 and the adapter KM-653.
34. Remove the valve spring caps.
35. Remove the valve springs. Maintain the original position of the valves springs for installation.

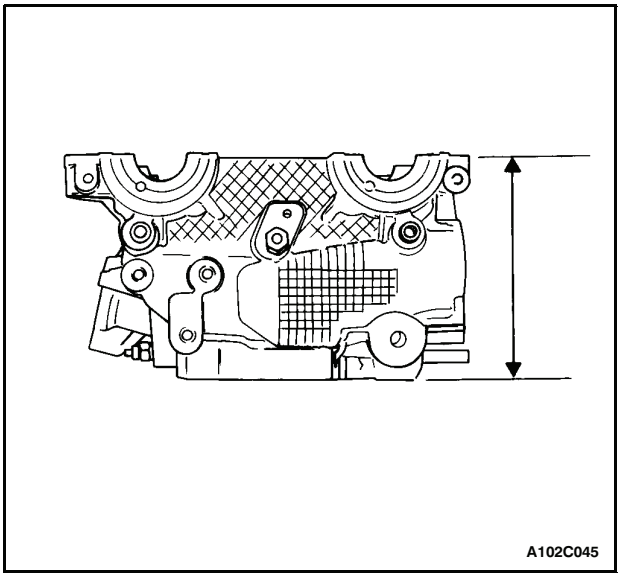

A102C048

36. Remove the valves. Maintain the original position of the valves for installation.
37. Remove the valve stem seals.

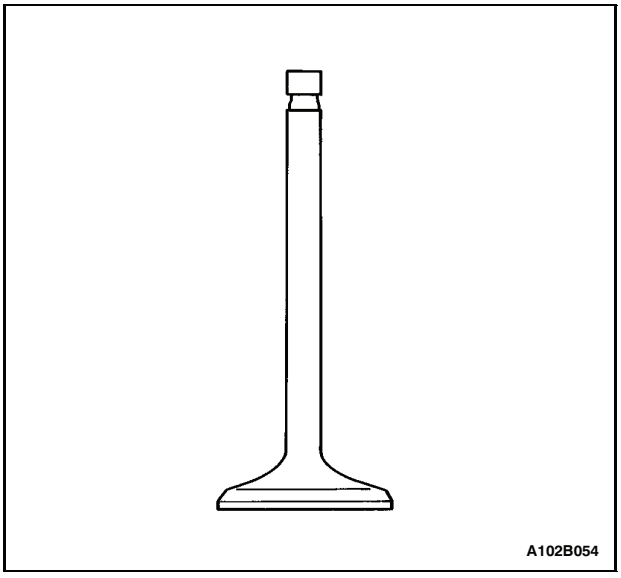


Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by.
3. Inspect the cylinder head for cracks.
4. Inspect the length and width of the cylinder head using a feeler gauge and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within 0.050 mm (0.002 inch) maximum.

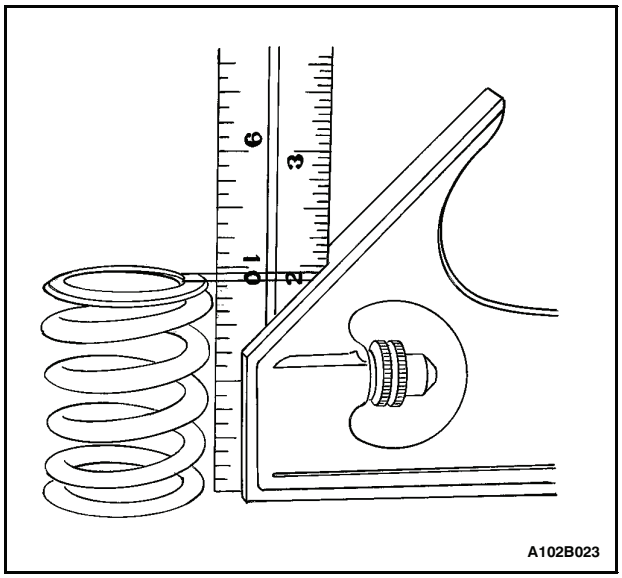


6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 138.13 to 138.18 mm (5.438 to 5.440 inches). If the cylinder head height is less than 138.13 mm (5.438 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Valve seats for excessive wear and burned spots.

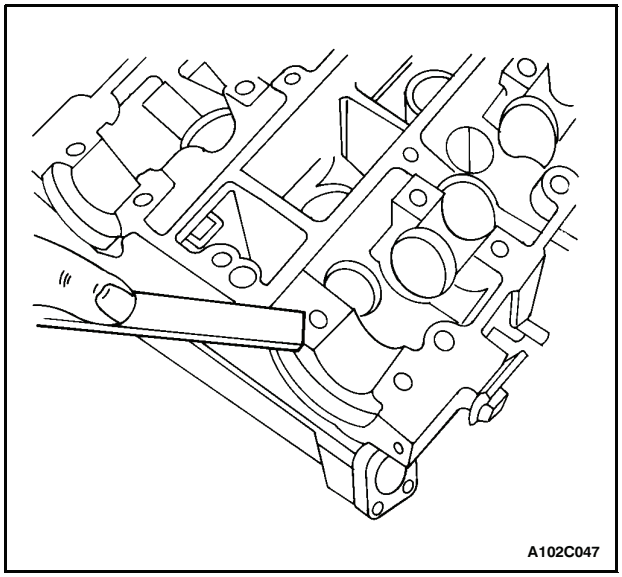


Valve Inspection

1. Inspect the valve stem tip for wear.
2. Inspect the valve retainer grooves and the oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.
4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep that refacing the valve would result in a sharp edge, replace the valve.

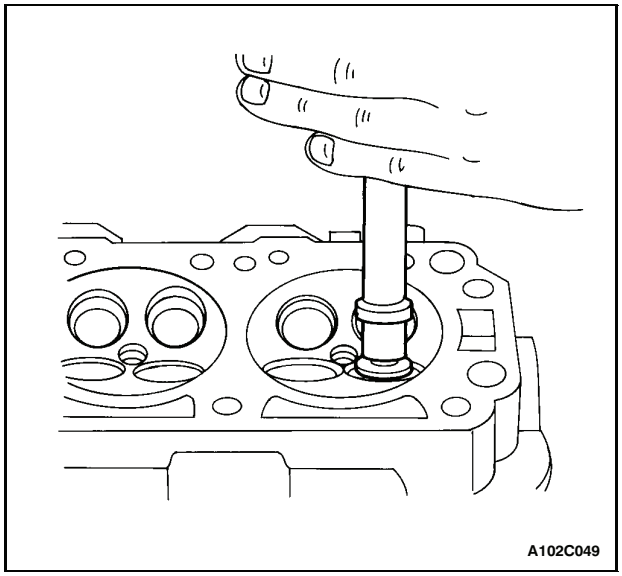


7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to "Engine Specifications" in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.



Cleaning Procedure

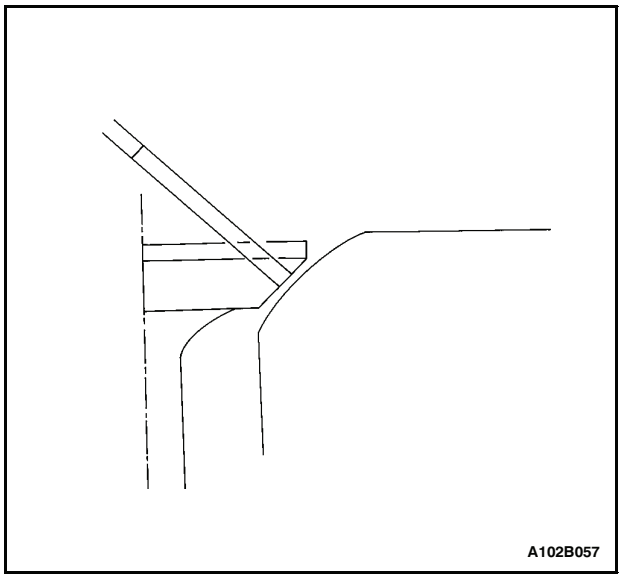
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil and varnish.



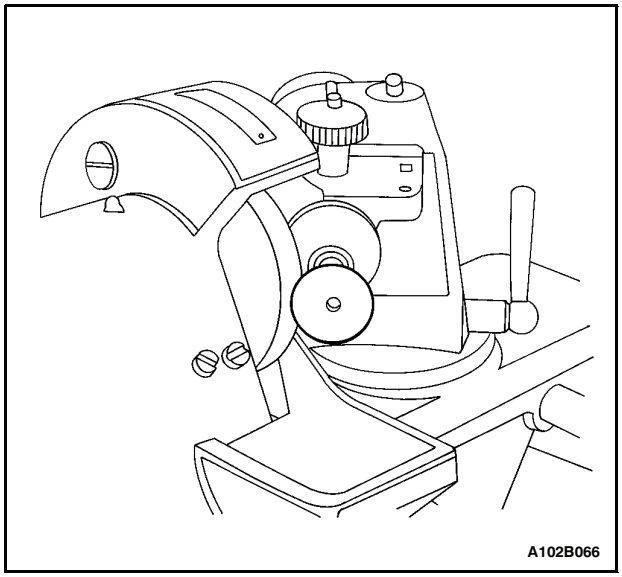
Cylinder Head Overhaul

Valve Grind-in

1. Lubricate the valve stem using a fine-grained paste.
2. Lift the valve rhythmically from the seat with a commercially-available valve grinding tool in order to distribute the paste.

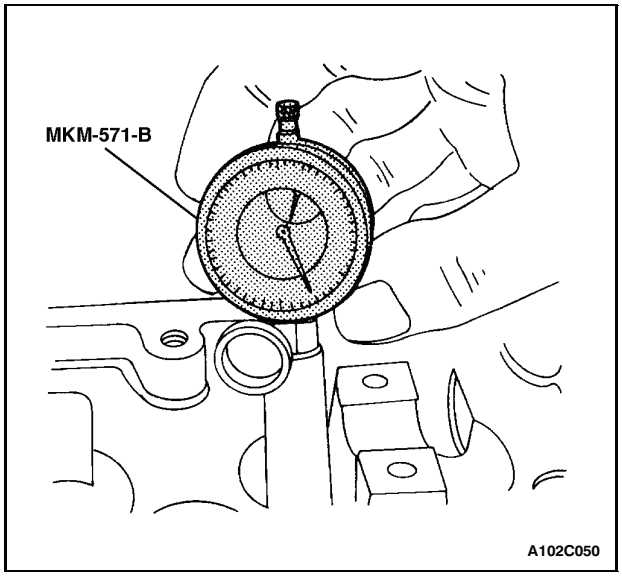

A102B057

3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.


A102B066

Valve Grind

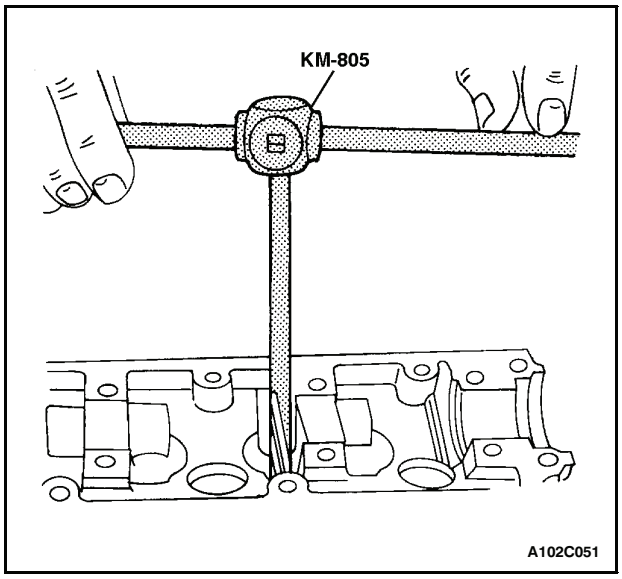
1. Ensure that there are no crater line burns on the valve cone.
2. The valve may be reground only two times. Do not grind the valve stem end.
3. The angle at the valve face is 45 degrees.
4. Inspect the assembly height of the intake valves and the exhaust valves.

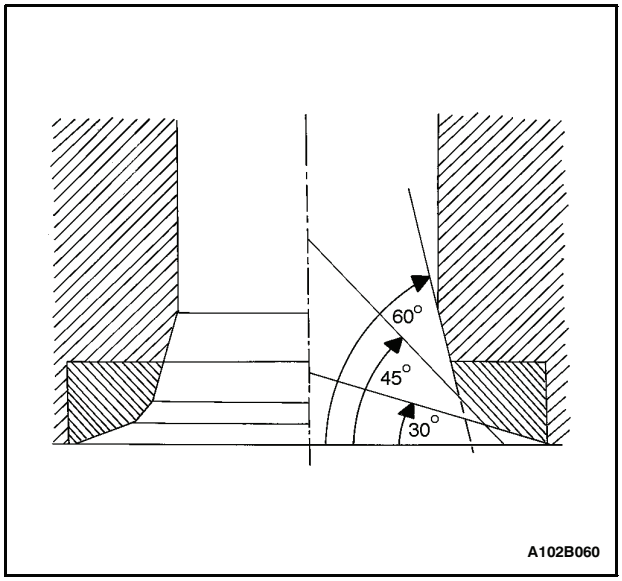


A102C050

Valve Guide - Ream

1. Measure the diameter of the valve guide using gauge MKM-571-B and a commercially-available inside micrometer.





Important: Valve oversizes may already have been fitted in production.

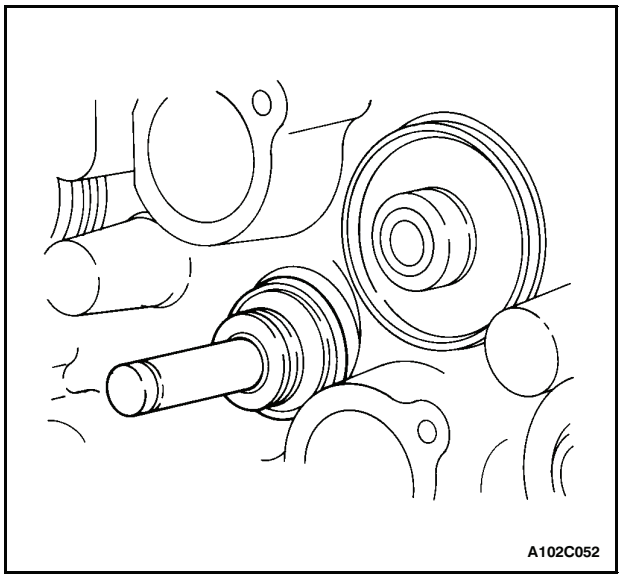
2. **An oversize service code is on the valve guide and the valve stem end. The following table gives the correct size, reamer, and production code for each service.**

Size	Reamer	Production Code	Service Code
Normal	—	—	K
0.075	KM-805	1	K1
0.150		2	K2

3. **Ream the valve guide from the upper side of the cylinder head to the next oversize.**
4. **After reaming, cross out the code and emboss the valve guide with the new code.**

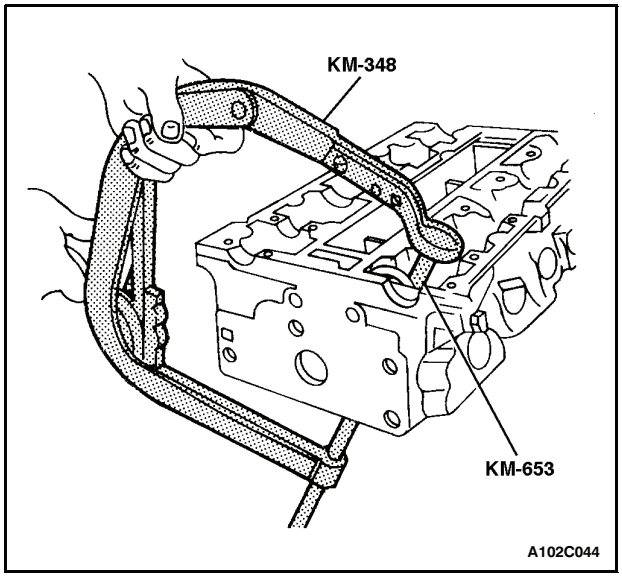
Valve Seat - Cut

1. **Place the cylinder head on wooden blocks.**
2. **Cut the intake and the exhaust valve seats using the guide drift KM-340-7 as follows:**
   - **Valve seat: * 45 degrees side using the cutter KM-340-13.**
   - **Upper correction angle: * 30 degrees side using the cutter KM-340-13.**
   - **Lower Correction Angle: * 60 degrees using cutter KM-340-26.**
3. **Clean the chippings from the cylinder head.**
4. **Inspect the dimension for the valve seat width.**
   - **Intake: 1.17 to 1.57 mm (0.046 to 0.062 inch).**
   - **Exhaust: 1.07 to 1.47 mm (0.042 to 0.058 inch).**
5. **Inspect the assembly height of the intake valves and the exhaust valves.**
6. **If the dimension is exceeded, install new valves. Inspect the assembly height of the intake valves and the exhaust valves again.**
7. **If the valve assembly height is still too large despite replacing the valves, replace the cylinder head.**


A102C052

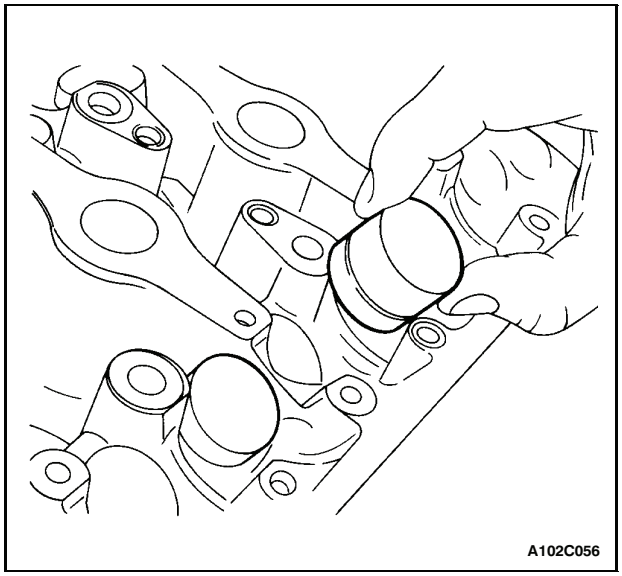
Assembly Procedure

1. Install the valve stem seals.
2. Lubricate the valve stems with engine oil.
3. Carefully install the valves in their original positions. Do not damage the valve stem seals.
4. Install the valve springs in their original positions.
5. Install the valve spring caps.

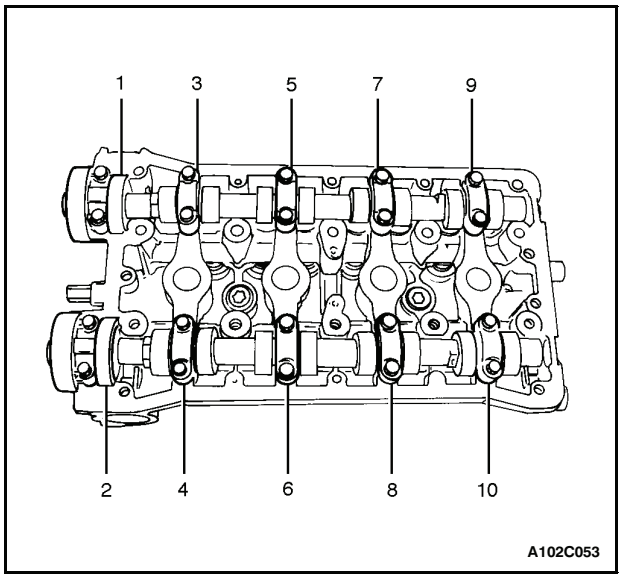


A102C044

6. Compress the valve springs with the valve spring compressor KM-348 and adapter KM-653.
7. Install the valve retainers.
8. Remove the valve spring compressor KM-348 and adapter KM-653.


A102C056

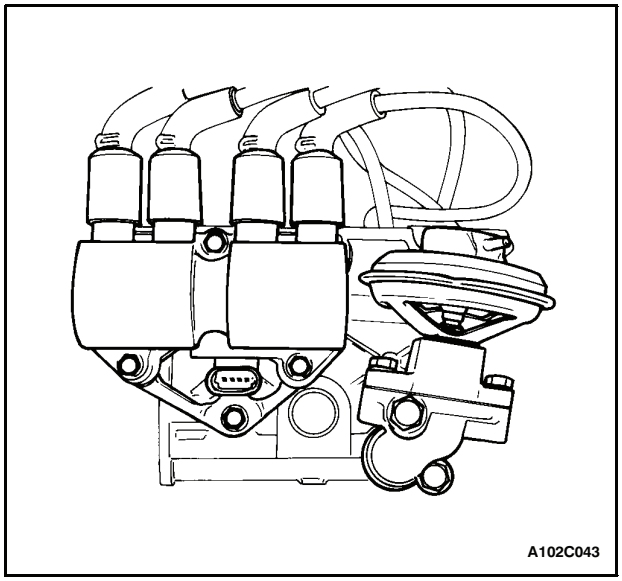
9. Lubricate the valve lash adjusters with engine oil.
10. Install the valve lash adjusters.



11. Install the intake camshaft.
12. Install the intake camshaft caps in their original positions.
13. Install the exhaust camshaft.
14. Install the exhaust camshaft caps in their original positions.
15. Install the camshaft cap bolts.
16. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

Tighten the camshaft cap bolts to 16 NSm (12 lb-ft).



17. Install the spark plugs.

Tighten

Tighten the spark plugs to 25 NSm (18 lb-ft).

18. Install the exhaust gas recirculation valve adapter gasket.
19. Install the exhaust gas recirculation valve adapter.
20. Install the exhaust gas recirculation valve adapter bolts.

Tighten

Tighten the exhaust gas recirculation valve adapter bolts to 25 NSm (18 lb-ft).

21. Install the DIS ignition coil mounting bracket.
22. Install the DIS ignition coil mounting bracket bolts.

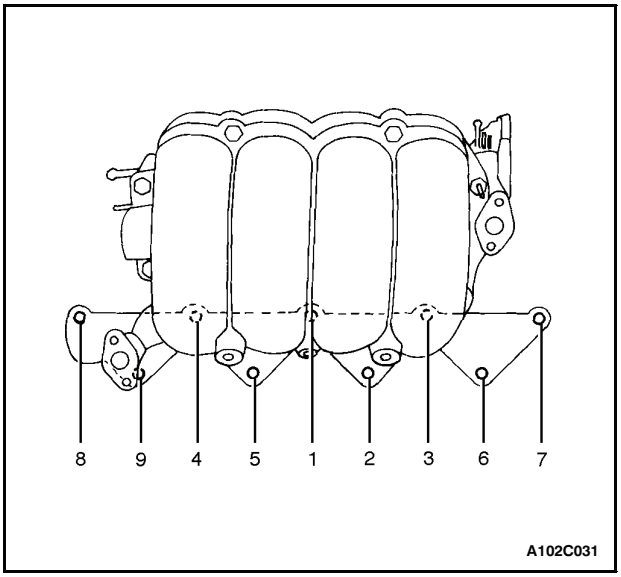
Tighten

Tighten the DIS ignition coil mounting bracket bolts to 10 NSm (89 lb-in).

23. Install the DIS ignition coil with the ignition wires attached.
24. Install the DIS ignition coil mounting bolts.

Tighten

Tighten the DIS ignition coil mounting bolts to 10 NSm (89 lb-in).

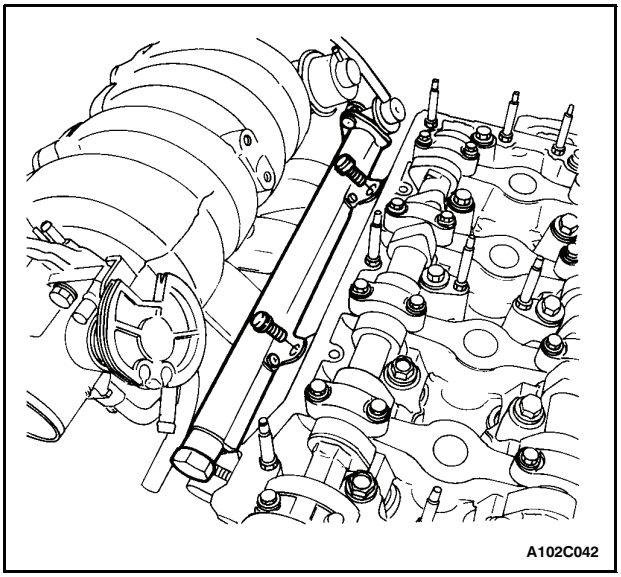


A102C031

25. Install the intake manifold studs.
26. Install the intake manifold gasket.
27. Install the intake manifold.
28. Install the intake manifold retaining nuts and retaining bolts in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts and retaining bolts to 25 NSm (18 lb-ft).


A102C042

29. Install the fuel rail assembly with the bolts.

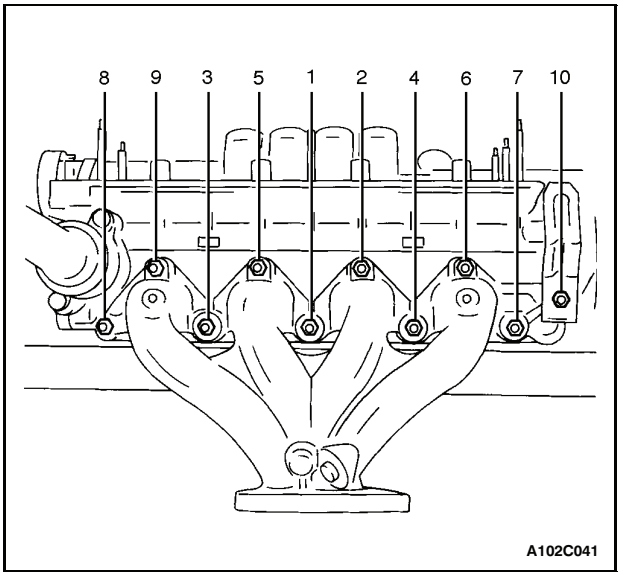
Tighten

Tighten the fuel rail retaining bolts to 25 NSm (18 lb-ft).

30. Install the thermostat housing assembly.
31. Install the thermostat housing mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 NSm (15 lb-ft).



A102C041

32. Install the exhaust manifold studs.
33. Install the exhaust manifold gasket.
34. Install the exhaust manifold.
35. Install the exhaust manifold retaining nuts in the sequence shown.

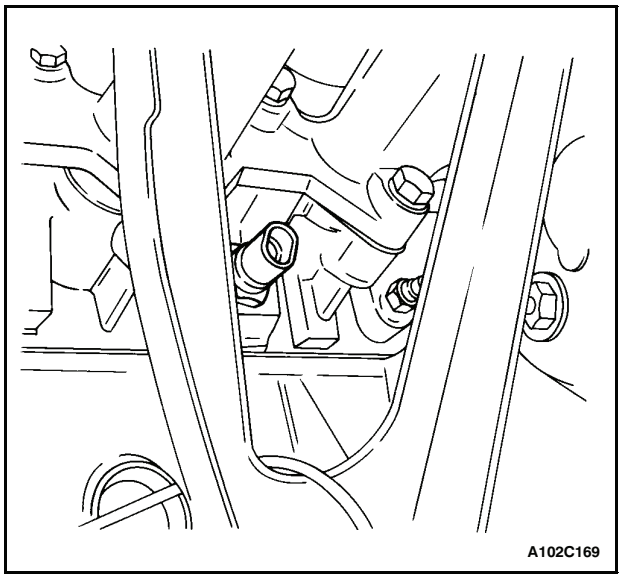
Tighten

Tighten the exhaust manifold retaining nuts to 25 NSm (18 lb-ft).

36. Install the exhaust manifold heat shield.
37. Install the exhaust manifold heat shield bolts.

Tighten

Tighten the exhaust manifold heat shield bolts to 15 NSm (11 lb-ft).

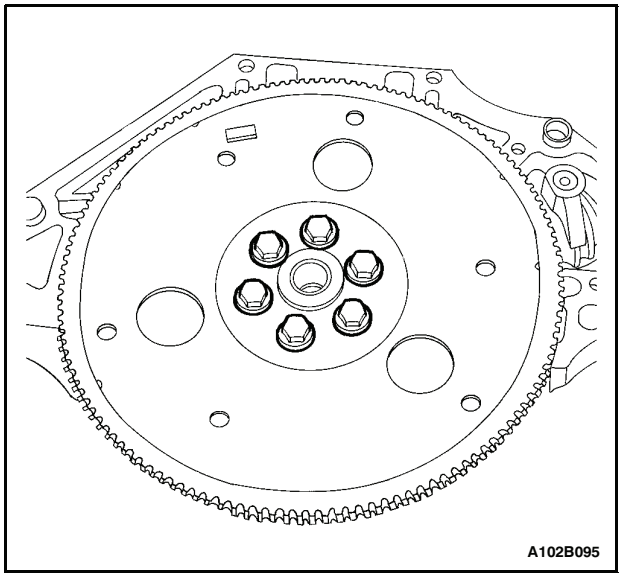

A102C169

38. Install the coolant temperature sensor.

Tighten

Tighten the coolant temperature sensor to 20 NSm (15 lb-ft).

39. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.


A102B095

CRANKSHAFT

Tools Required

KM-412 Engine Overhaul Stand

J-42492 Timing Belt Adjuster

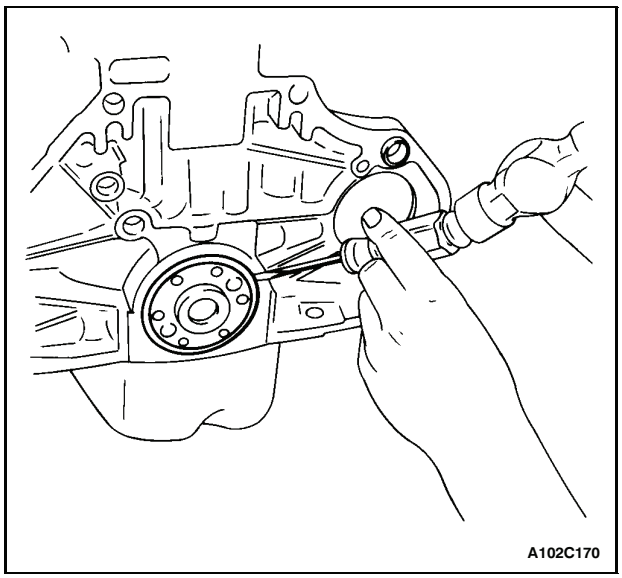
KM-470-B Angular Torque Gauge

J-36792 Crankshaft Rear Oil Seal Installer (or KM-635)

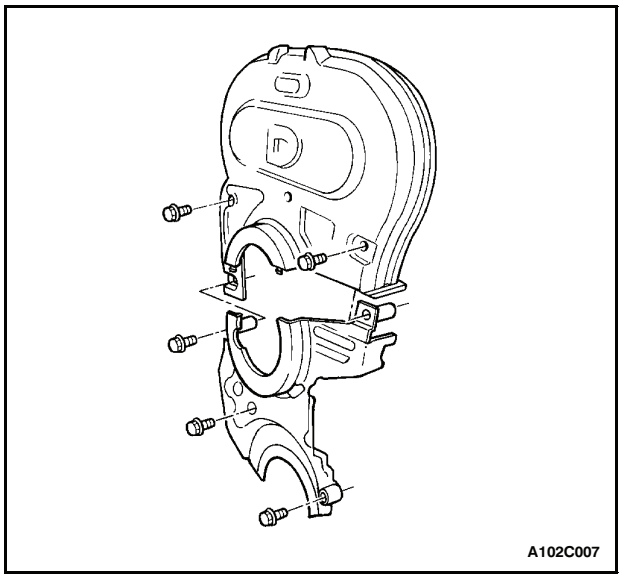
Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshafts.

Disassembly Procedure

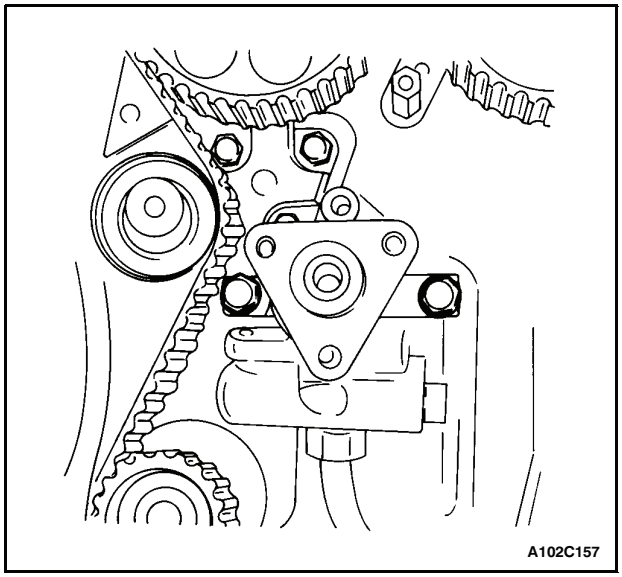
1. Remove the engine. Refer to "Engine" in this section.
2. Remove the flywheel or flexible plate bolts.
3. Remove the flywheel or the flexible plate.


A102C170

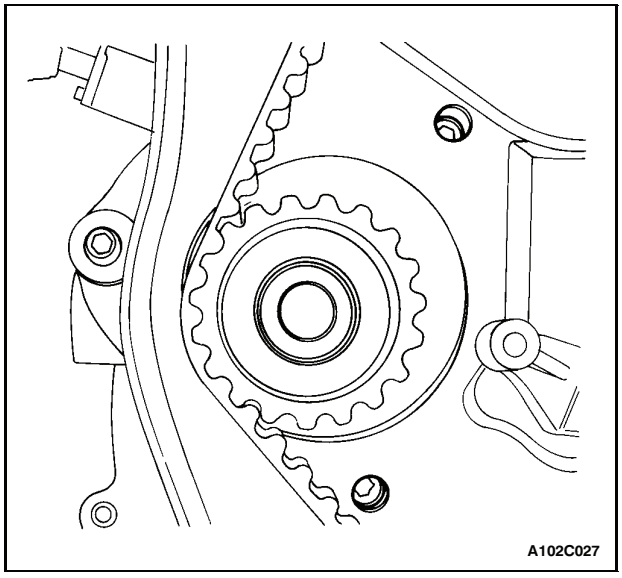
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand KM-412.


A102C007

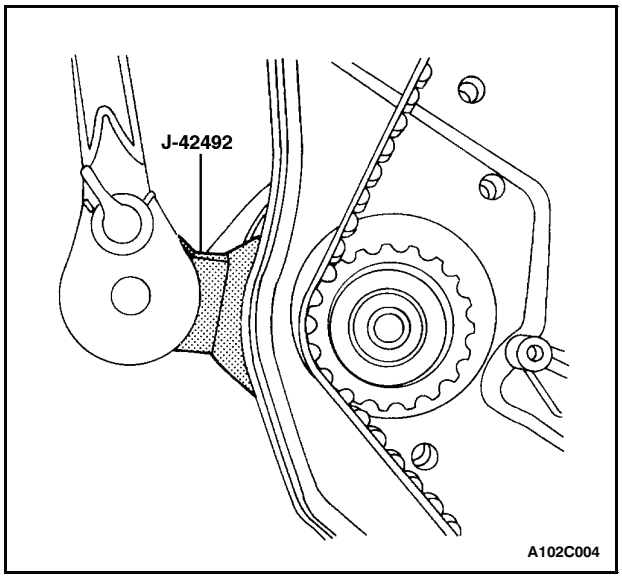
6. Remove the upper and lower front timing belt cover bolts.
7. Remove the upper and lower front timing belt cover.


A102C157

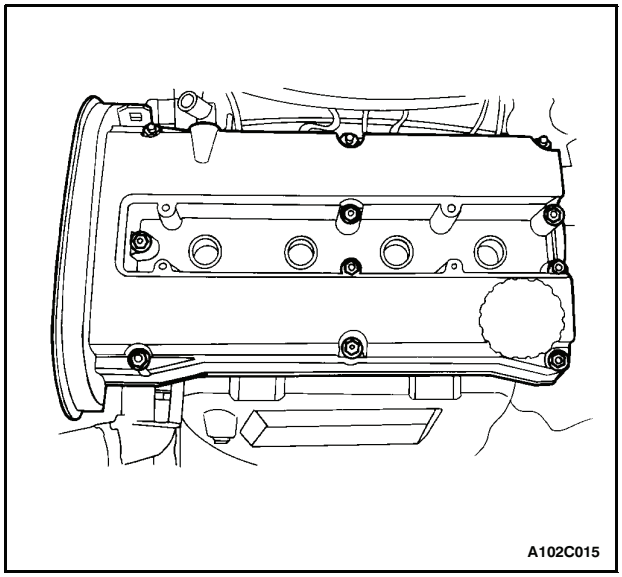
8. Remove the power steering pump mounting bolts, if equipped.
9. Remove the power steering pump, if equipped.


A102C027

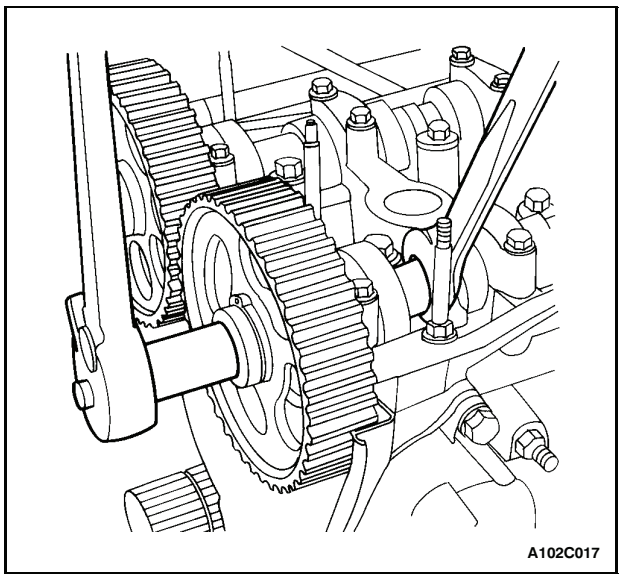
10. Slightly loosen the coolant pump retaining bolts.



11. Rotate the coolant pump using the timing belt adjuster J-42942 to remove the tension from the timing belt.
12. Remove the timing belt.

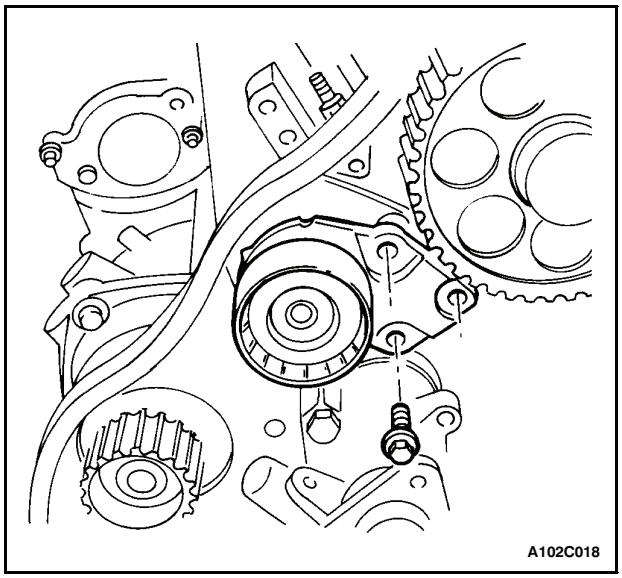


13. Disconnect the crankcase ventilation tubes from the valve cover.
14. Remove the spark plug cover bolts.
15. Remove the spark plug cover.
16. Disconnect the ignition wires from the spark plugs.
17. Remove the valve cover nuts.
18. Remove the valve cover washers.
19. Remove the valve cover and the valve cover gasket.

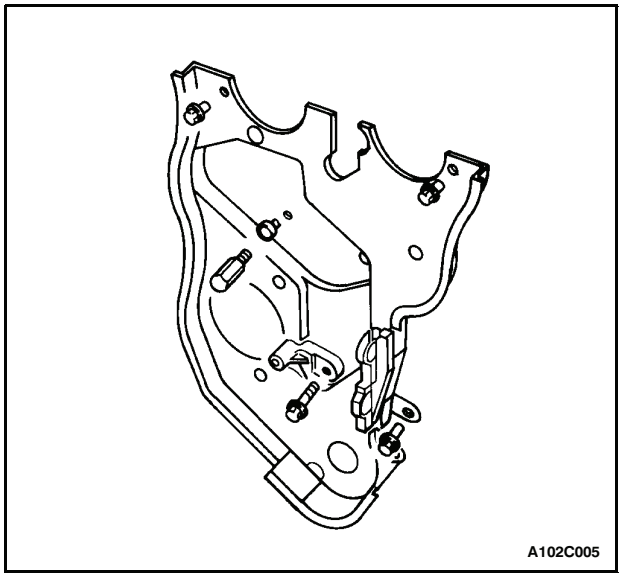


Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

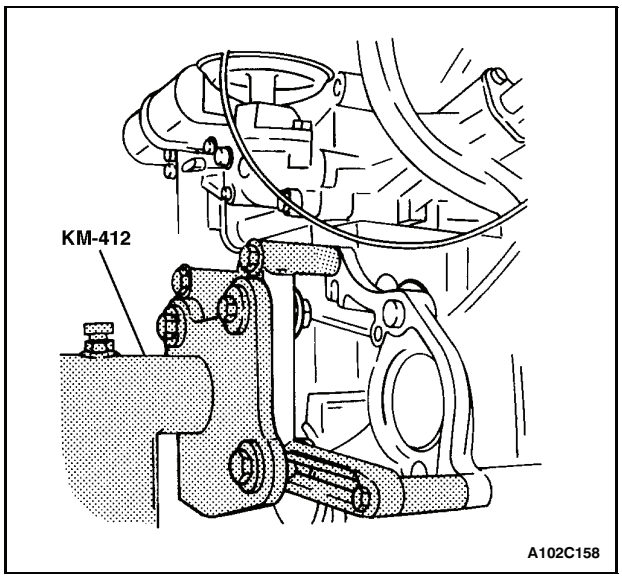
20. While holding the intake camshaft firmly in place, remove the intake camshaft bolt.
21. Remove the intake camshaft gear.
22. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft bolt.
23. Remove the exhaust camshaft gear.



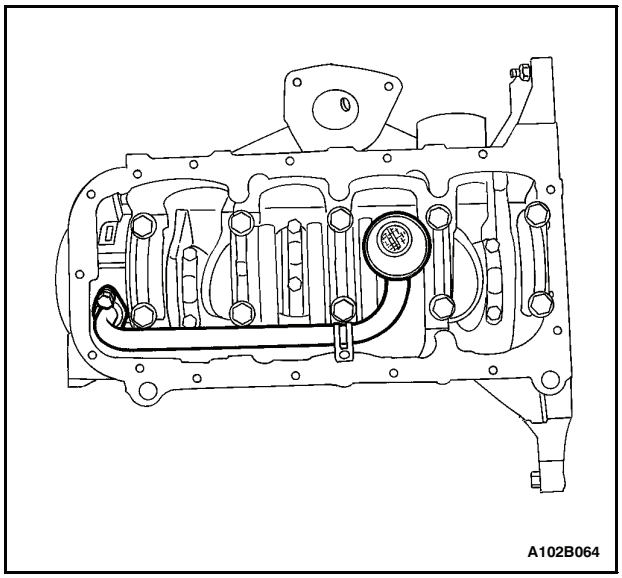
24. Remove the timing belt automatic tensioner bolts.
25. Remove the timing belt automatic tensioner.
26. Remove the timing belt idler pulley bolt.
27. Remove the timing belt idler pulley.



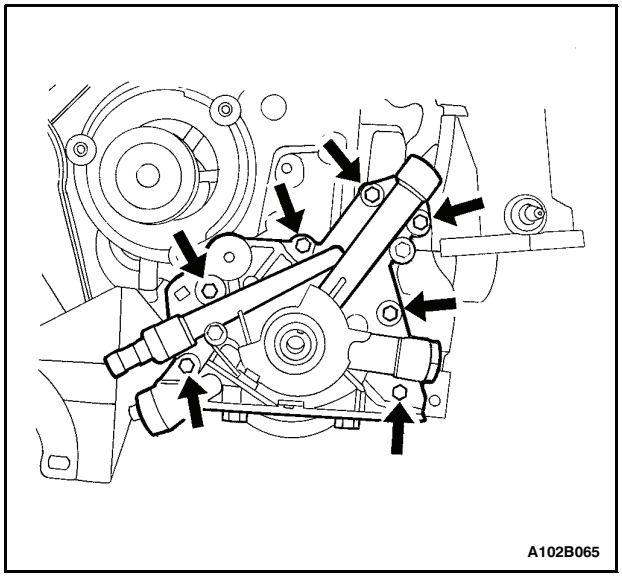
28. Remove the crankshaft timing belt gear.
29. Remove the rear timing belt cover bolts.
30. Remove the rear timing belt cover.



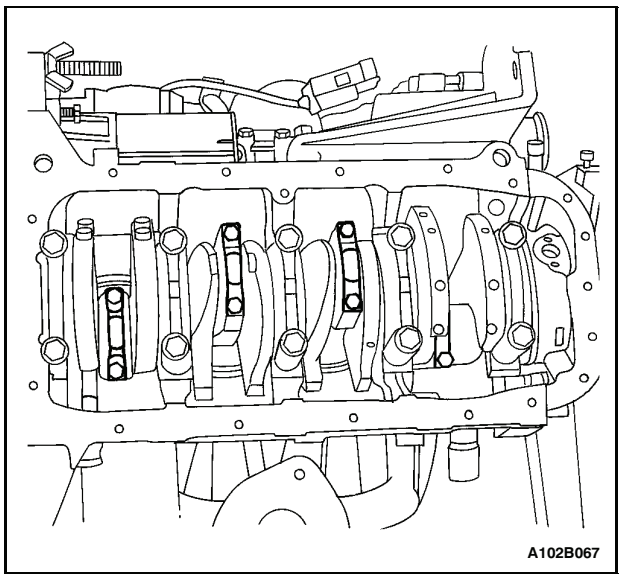
31. Rotate the engine on the engine overhaul stand KM-412.


A102B064

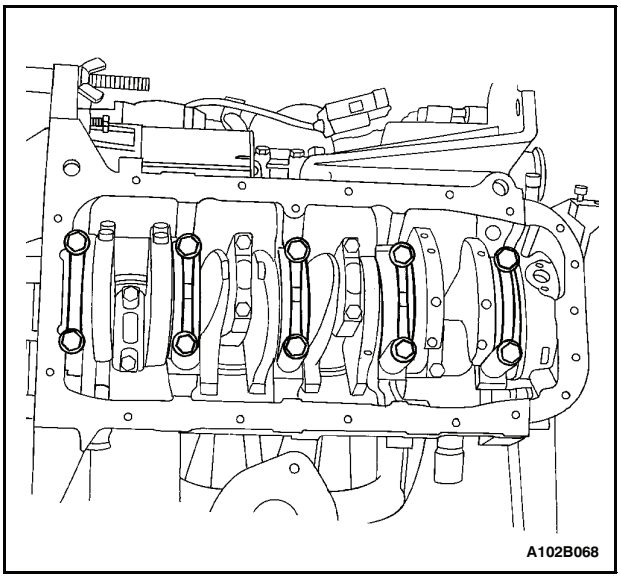
32. Remove the oil pan retaining bolts.
33. Remove the oil pan.
34. Remove the oil pickup tube bolts.
35. Remove the oil pickup tube.


A102B065

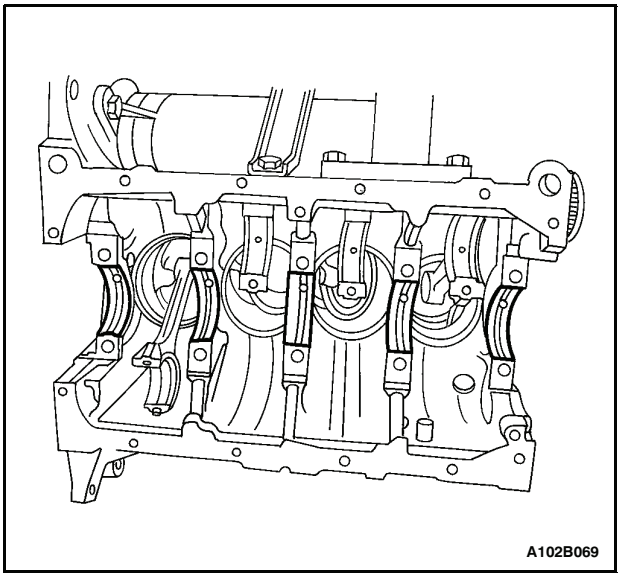
36. Remove the oil pump retaining bolts.
37. Remove the oil pump.


A102B067

38. Mark the order of the connecting rod bearing caps.
39. Remove the connecting rod bearing cap bolts for all of the pistons.
40. Remove the connecting rod bearing caps and the lower connecting rod bearings.
41. Remove the upper connecting rod bearings.

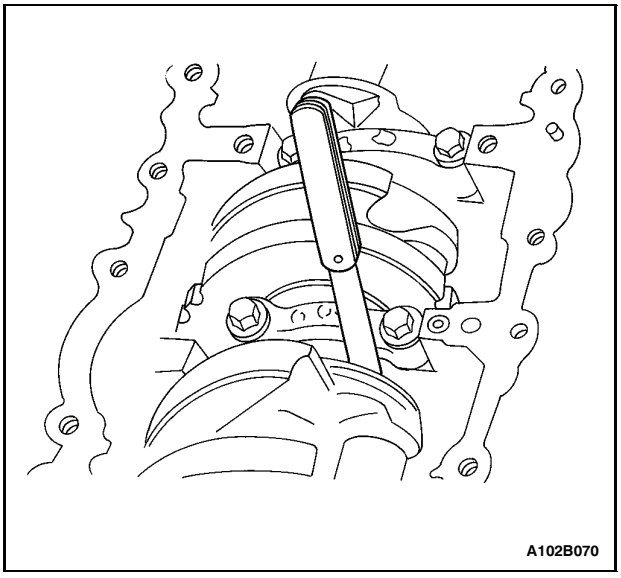

A102B068

42. Mark the order of the crankshaft bearing caps.
43. Remove the crankshaft bearing cap bolts.
44. Remove the crankshaft bearing caps and the lower crankshaft bearings.
45. Remove the crankshaft.
46. Remove the upper crankshaft bearings.
47. Clean any necessary parts.

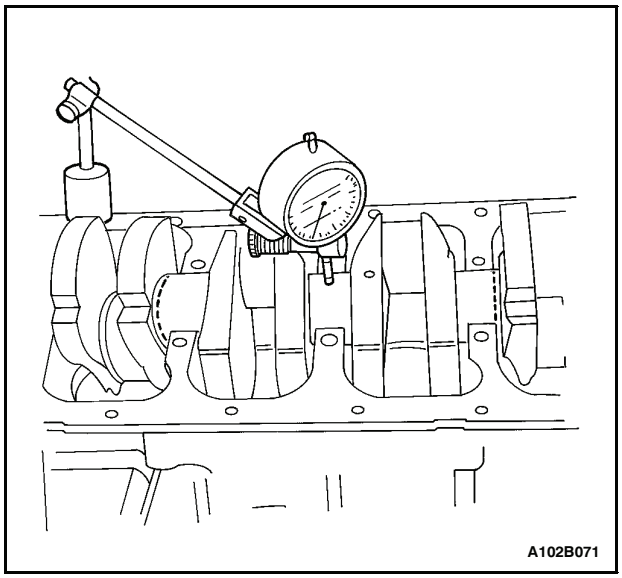

A102B069

Assembly Procedure

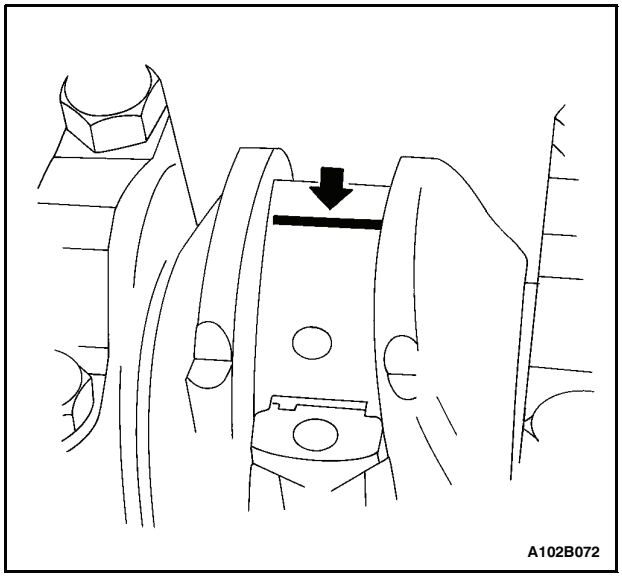
1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings in the engine block.


A102B070

3. Install the crankshaft.
4. Install the lower crankshaft bearings in the bearing caps.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.


A102B071

7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.

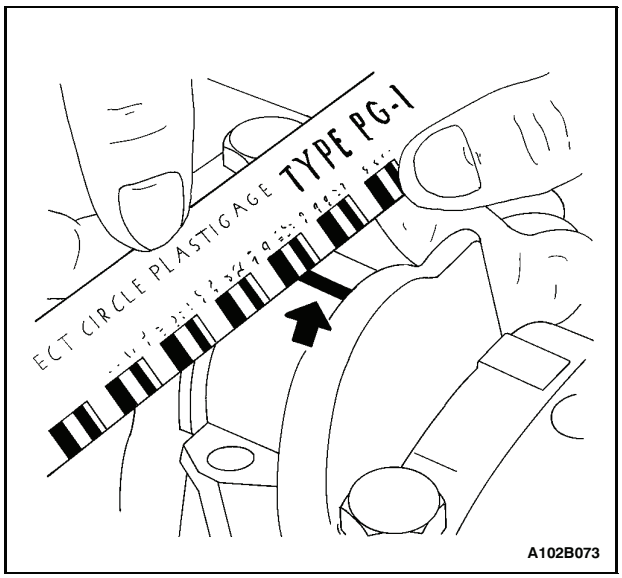

A102B072

Important: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.
10. Install the crankshaft bearing caps and the bolts.

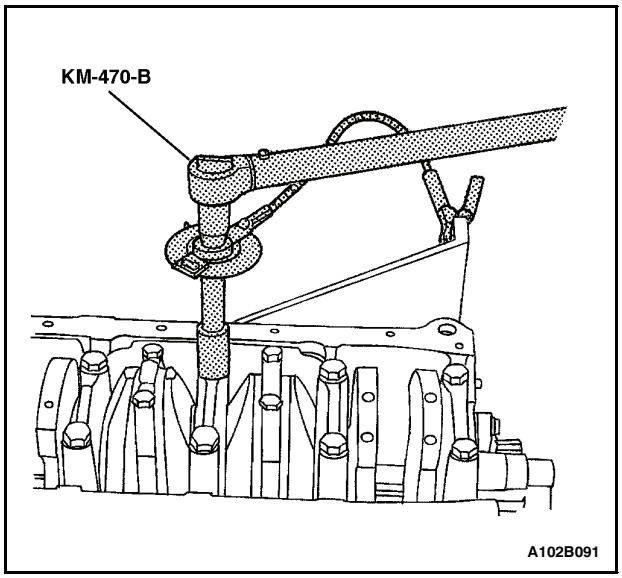
Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft) 45 degrees +15 degrees.



A102B073

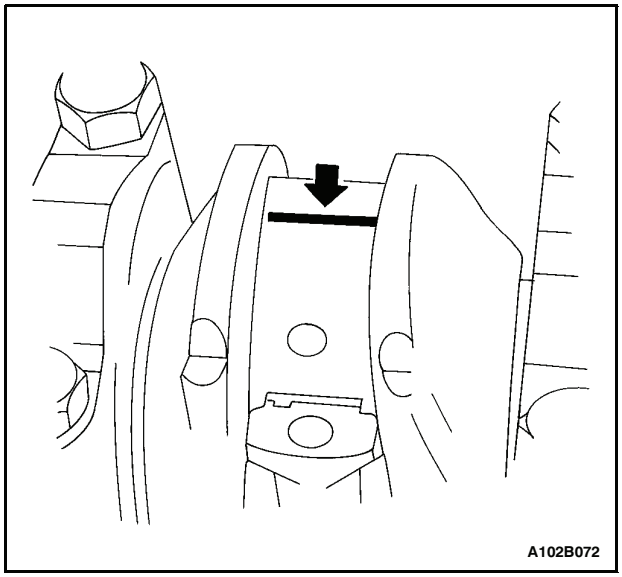
11. Remove the crankshaft bearing cap bolts and the caps.
12. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
13. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.



14. Apply a bead of adhesive sealing compound to the grooves of the crankshaft bearing caps.
15. Install the crankshaft bearing caps to the engine block.
16. Tighten the crankshaft bearing caps using new bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft bearings 45 degrees +15 degrees.

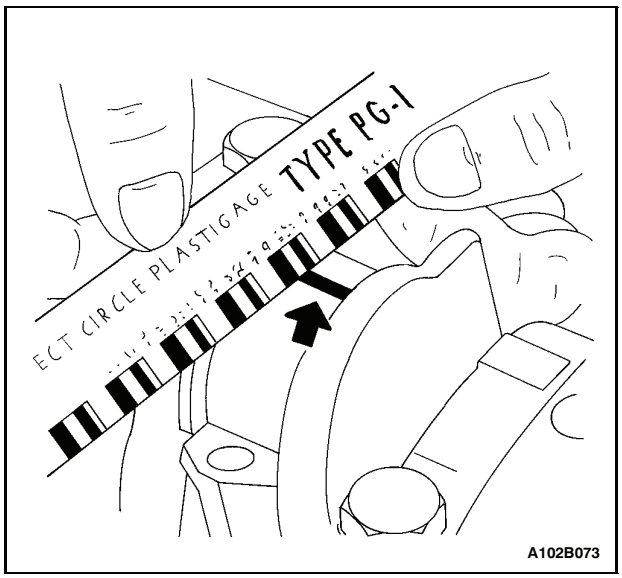


Important: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

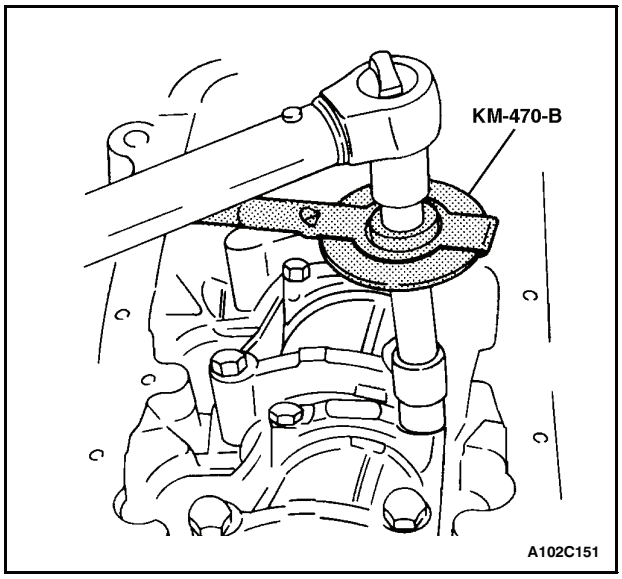
17. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).
18. Cut the plastic gauging threads to the length of the connecting rod bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
19. Install the connecting rod bearing caps.

Tighten

Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod bearing cap bolts to 30 degrees +15 degrees.



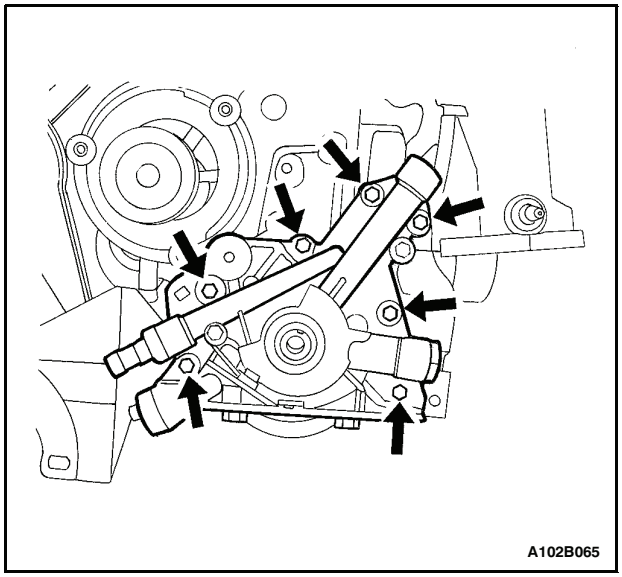
20. Remove the connecting rod bearing caps.
21. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
22. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.



23. Install the connecting rod bearing caps to the connecting rods.
24. Tighten the connecting rod bearing caps using new bolts.

Tighten

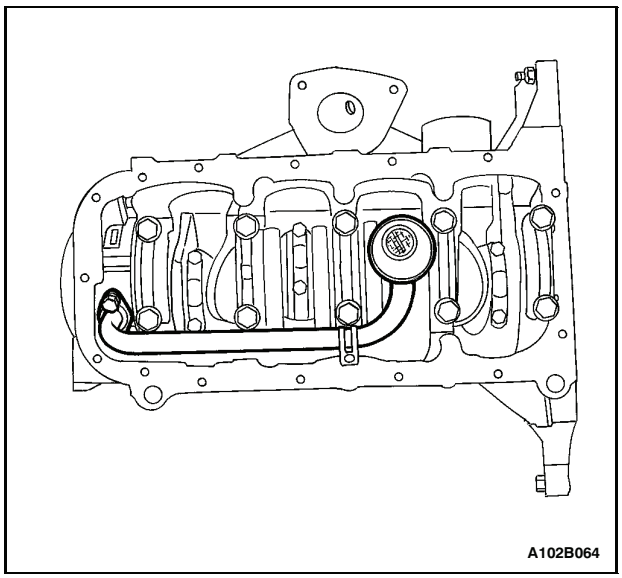
Tighten the connecting rod bearing cap bolts to 25 NSm (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod cap bolts to 30 degrees + 15 degrees.



25. Install the oil pump.
26. Install the oil pump retaining bolts.

Tighten

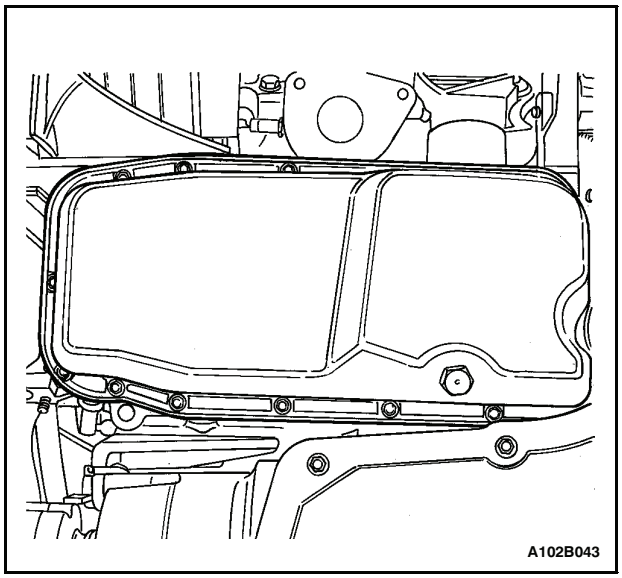
Tighten the oil pump retaining bolts to 10 NSm (89 lb-in).



27. Install the oil pump/pickup tube.
28. Install the oil pump/pickup tube bolts.

Tighten

Tighten the oil pump/pickup tube bolts to 10 NSm (89 lb-in).


A102B043

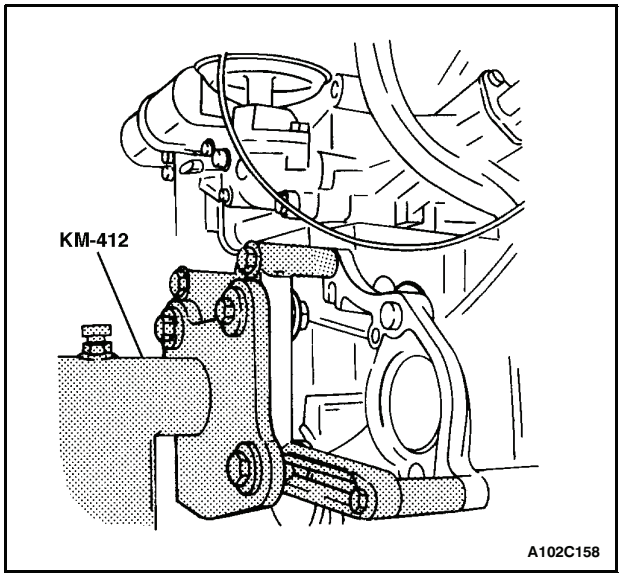
29. Install the oil pan gasket to the oil pan.
30. Install the oil pan.

Important: Install the oil pan within 5 minutes after applying the liquid gasket to the oil pan.

31. Install the oil pan retaining bolts.

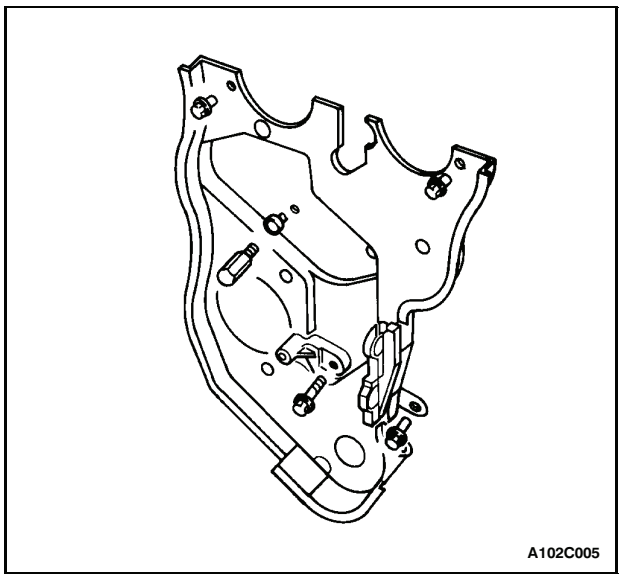
Tighten

Tighten the oil pan retaining bolts to 10 NSm (89 lb-in).



A102C158

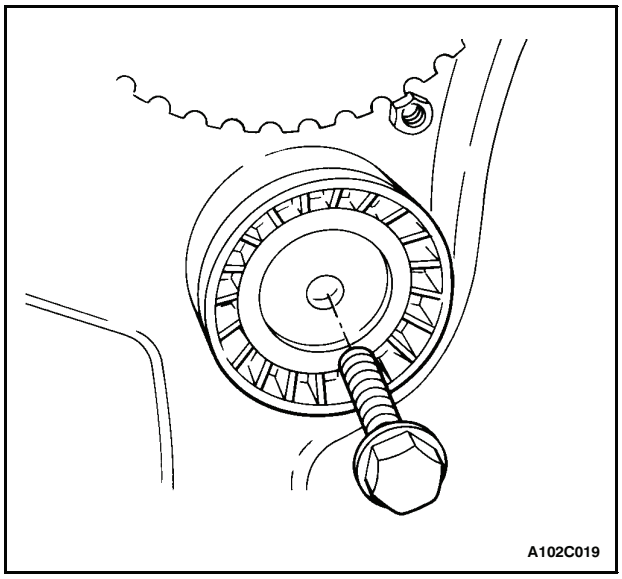
32. Rotate the engine on the engine assembly stand KM-412.


A102C005

33. Install the rear timing belt cover.
34. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 10 NSm (89 lb-in).


A102C019

35. Install the crankshaft timing belt gear.
36. Install the timing belt automatic tensioner.
37. Install the timing belt automatic tensioner bolts.

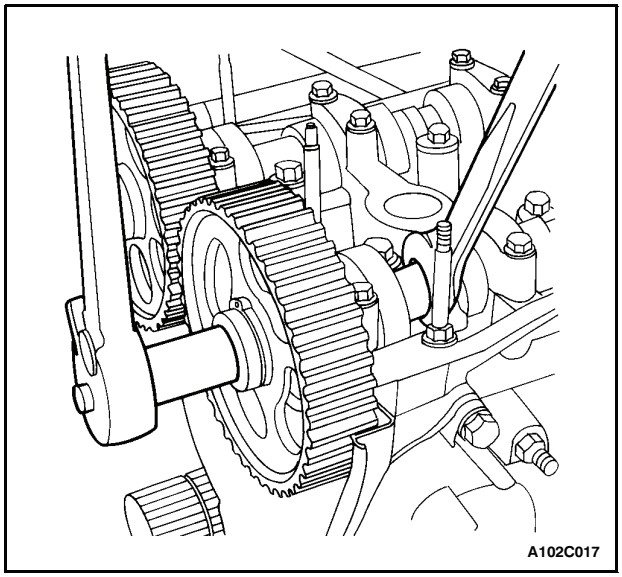
Tighten

Tighten the timing belt automatic tensioner bolts to 25 NSm (18 lb-ft).

38. Install the timing belt idler pulley.
39. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 NSm (30 lb-ft).


A102C017

Notice: Take extreme care to prevent any scratches, nicks or damage to the camshafts.

40. Install the intake camshaft gear.
41. Install the intake camshaft gear bolt while holding the intake camshaft firmly in place.

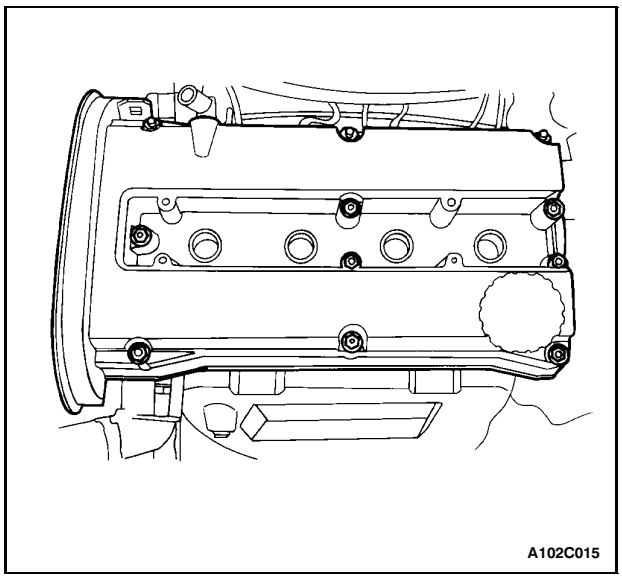
Tighten

Tighten the intake camshaft gear bolt to 67.5 NSm (49 lb-ft).

42. Install the exhaust camshaft gear.
43. Install the exhaust camshaft gear bolt while holding the exhaust camshaft firmly in place.

Tighten

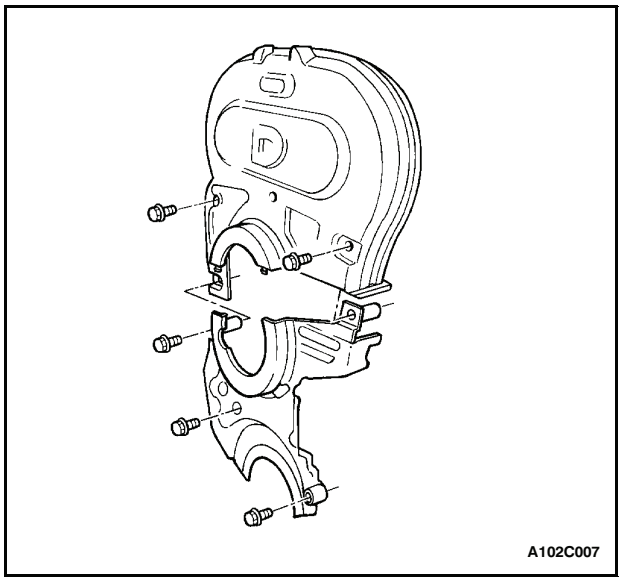
Tighten the exhaust camshaft bolt to 67.5 NSm (49 lb-ft).


A102C015

44. Install the timing belt. Refer to "Timing Belt" in this section.
45. Adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
46. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover to cylinder head seal.
47. Install the valve cover and the valve cover gasket.
48. Install the valve cover washers.
49. Install the valve cover nuts.

Tighten

Tighten the valve cover nuts to 10 NSm (89 lb-in).


A102C007

50. Connect the ignition wires to the spark plugs.
51. Install the spark plug cover.
52. Install the spark plug cover bolts.

Tighten

Tighten the spark plug cover bolts to 3 NSm (27 lb-in).

53. Connect the crankcase ventilation tube to the valve cover.
54. Install the upper and lower front timing belt cover.
55. Install the upper and lower front timing belt cover bolts.

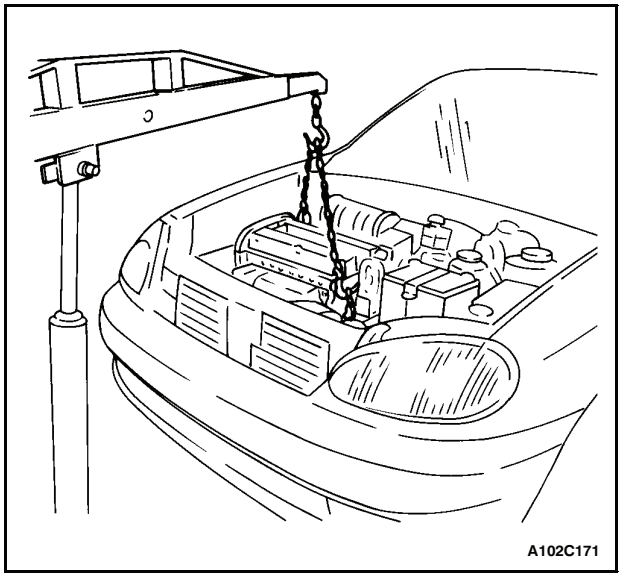
Tighten

Tighten the upper and lower front timing belt cover bolts to 10 NSm (89 lb-in).

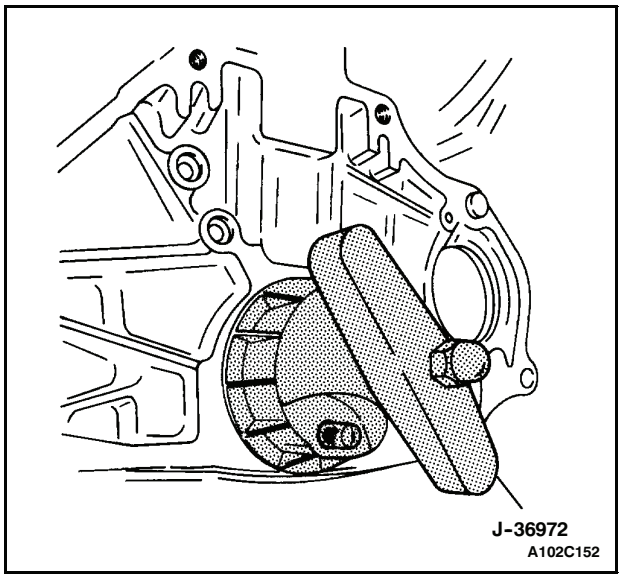
56. Install the power steering pump, if equipped.
57. Install the power steering pump mounting bolts.

Tighten

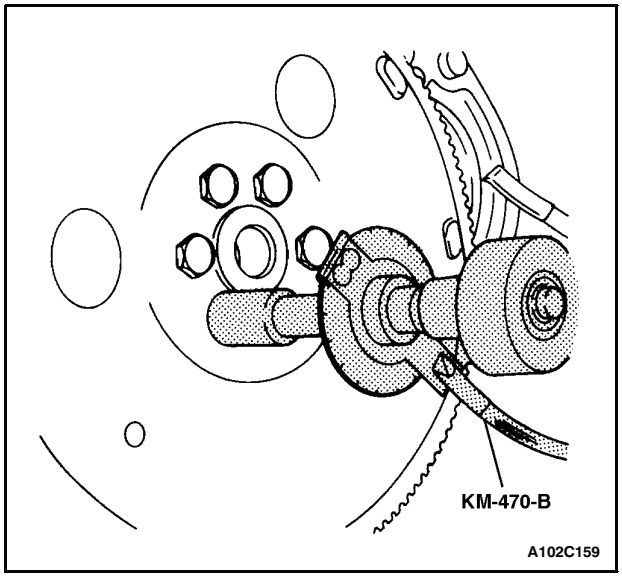
Tighten the power steering pump mounting bolts to 25 NSm (18 lb-ft).


A102C171

58. Install the engine lifting device.
59. Remove the engine from the engine assembly stand KM-412.



60. Install a new crankshaft rear oil seal using installer J-36972 (or KM-635).

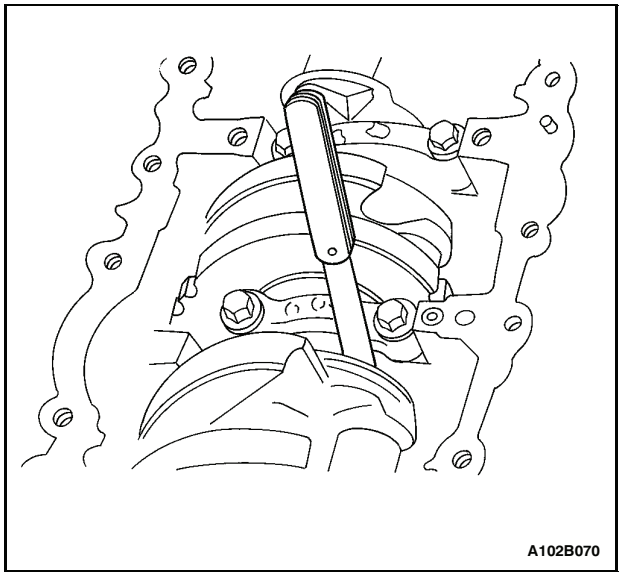


61. Install the flywheel or flexible plate.
62. Install the flywheel or the flexible plate bolts.

Tighten

Tighten the flywheel bolts to 35 NSm (25 lb-ft). Use the angular torque gauge KM-470-B to tighten the flywheel bolts to 30 degrees + 15 degrees. For the manual transmission, tighten the flexible plate bolts to 60 NSm (44 lb-ft).

63. Install the engine. Refer to "Engine" in this section.



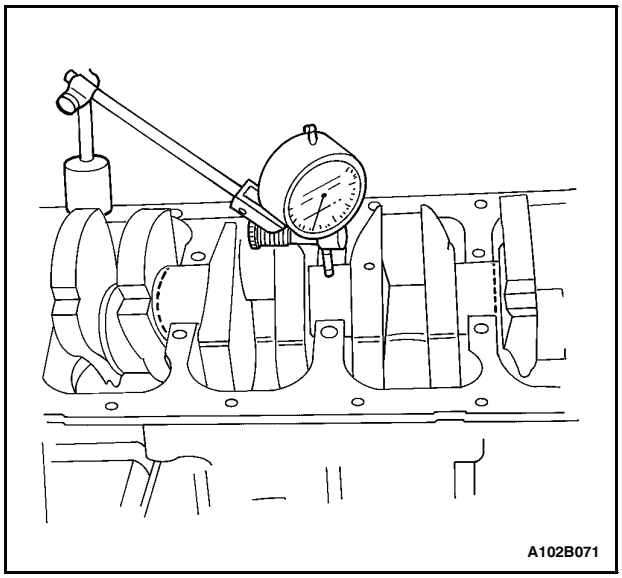
CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS — GAUGING PLASTIC

Tools Required

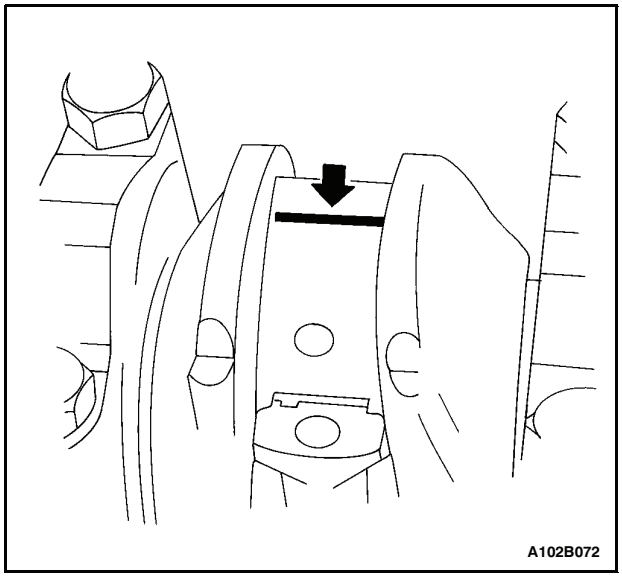
KM-470-B Angular Torque Gauge

Inspection Procedure - Crankshaft

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.
4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.

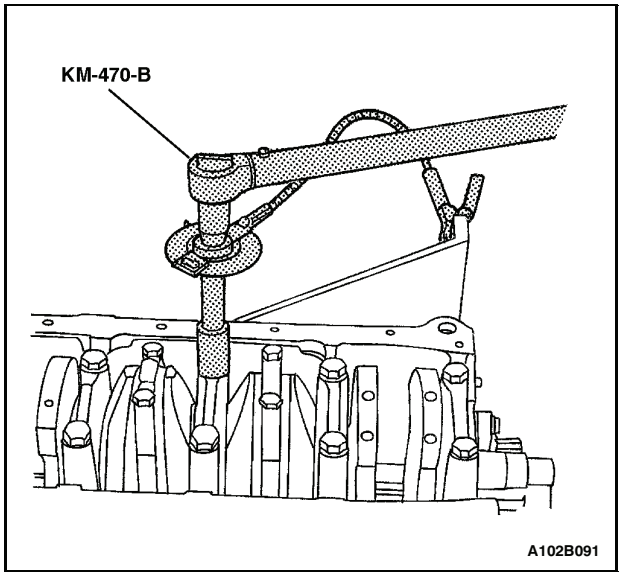

A102B071

7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.


A102B072

Notice: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.

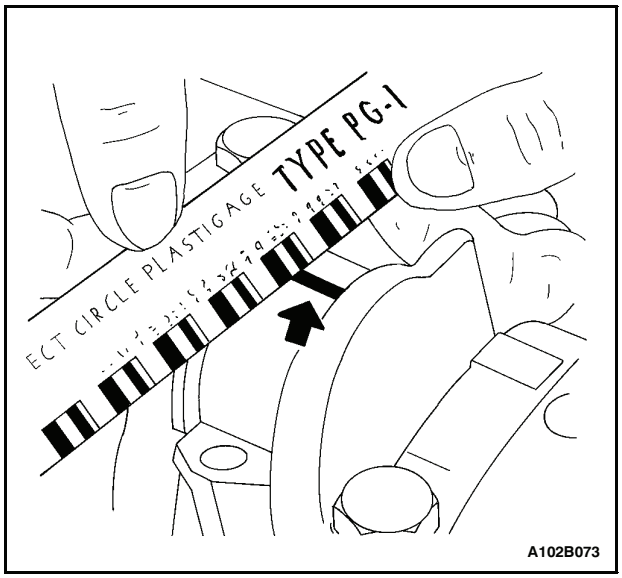


A102B091

10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

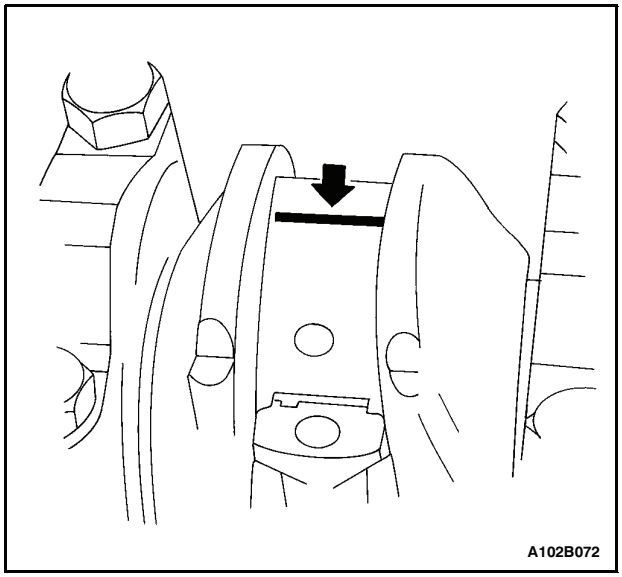
Tighten

Tighten the crankshaft bearing cap bolts to 50 NSm (37 lb-ft). Using the angular torque gauge KM-470-B, tighten the crankshaft bearing cap bolts to 45 degrees +15 degrees.



A102B073

12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
14. Inspect the bearing clearances for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

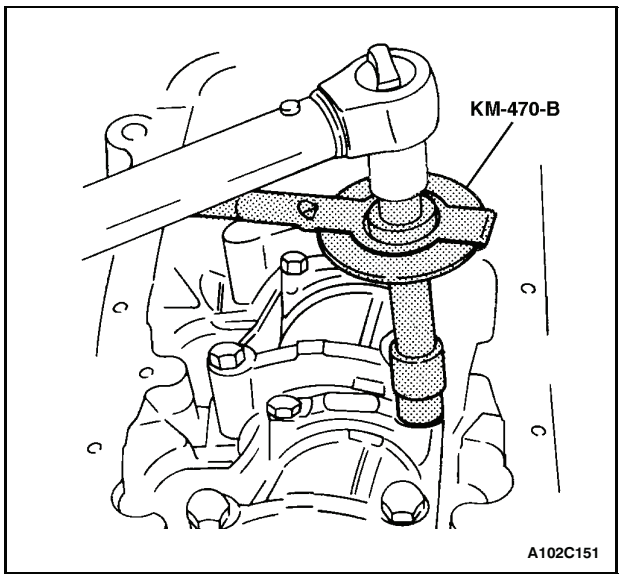

A102B072

Inspection Procedure - Connecting Rods

1. Coat the connecting rod bearings with engine oil.
2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.

Notice: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

4. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).

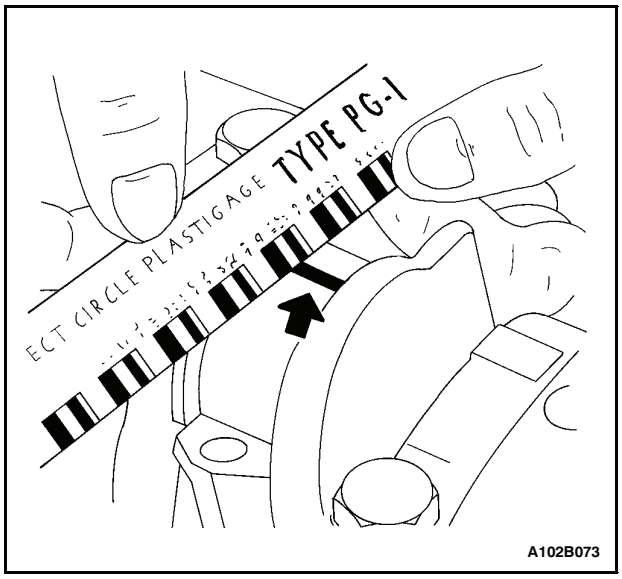


A102C151

5. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
6. Install the connecting rod bearing caps.
7. Install the connecting rod bearing cap bolts.

Tighten

Tighten the connecting rod cap bolts to 25 NSm (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the connecting rod cap bolts to 30 degrees +15 degrees.



8. Remove the connecting rod bearing caps.
9. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
10. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

CYLINDER HEAD AND GASKET

The cylinder head is made of an aluminum alloy. The cylinder head uses crossflow intake and exhaust ports. A spark plug is located in the center of each combustion chamber. The cylinder head houses the dual camshafts.

CRANKSHAFT

The crankshaft has eight integral weights which are cast with it for balancing. Oil holes run through the center of the crankshaft to supply oil to the connecting rods, the bearings, the pistons, and the other components. The end thrust load is taken by the thrust washers installed at the center journal.

TIMING BELT

The timing belt coordinates the crankshaft and the dual overhead camshafts and keeps them synchronized. The timing belt also turns the coolant pump. The timing belt and the pulleys are toothed so that there is no slippage between them. There are two idler pulleys. An automatic tensioner pulley maintains the timing belt's correct tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine drive belt. The timing belt requires no lubrication.

OIL PUMP

The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or other engine components. When the drive gear rotates, the driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows.

At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages. During normal oil supply, a coil spring and valve keeps the bypass closed, directing all of the oil pumped to the engine. When the amount of oil being pumped increases, the pressure becomes high enough to overcome the force of the spring. This opens the valve of the oil pressure regulator, allowing the excess oil to flow through the valve and drain back to the oil pan.

OIL PAN

The engine oil pan is mounted to the bottom of the cylinder block. The engine oil pan houses the crankcase and is made of pressed sheet metal.

Engine oil is pumped from the oil pan by the oil pump. After it passes through the oil filter, it is fed through two paths to lubricate the cylinder block and cylinder head. In one path, the oil is pumped through oil passages in the crankshaft to the connecting rods, then to the pistons and cylinders. It then drains back to the oil pan. In the second path, the oil is pumped through passages to the camshaft. The oil passes through the internal passageways in the camshafts to lubricate the valve assemblies before draining back to the oil pan.

EXHAUST MANIFOLD

A single four-port, rear-takedown manifold is used with this engine. The manifold is designed to direct escaping exhaust gases out of the combustion chambers with a minimum of backpressure. The oxygen sensor is mounted to the exhaust manifold.

INTAKE MANIFOLD

The intake manifold has four independent long ports and utilizes an inertial supercharging effect to improve engine torque at low and moderate speeds. The plenum is attached to the intake manifold.

CAMSHAFTS

This engine is a dual over head camshaft (DOHC) type, which means there are two camshafts. One camshaft operates the intake valves, and the other camshaft operates the exhaust valves. The camshafts sit in journals on the top of the engine (in the cylinder head) and are held in place by camshaft caps. The camshaft journals of the cylinder head are drilled for oil passages. Engine oil travels to the camshafts under pressure where it lubricates each camshaft journal. The oil returns to the oil pan through drain holes in the cylinder head. The camshaft lobes are machined into the solid camshaft to precisely open and close the intake and the exhaust valves the correct amount at the correct time. The camshaft lobes are oiled by splash action from pressurized oil escaping the camshaft journals.

EXHAUST GAS RECIRCULATION VALVE

The exhaust gas recirculation (EGR) system is used to lower oxides of nitrogen (NOX) emission levels caused by high combustion temperatures. The main element of the system is the EGR valve which is operated by vacuum.

The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease the combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters, combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

SECTION 1D

ENGINE COOLING

TABLE OF CONTENTS

SPECIFICATIONS

CAPACITY

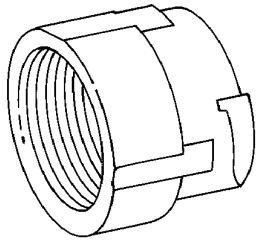
Application	Description
Coolant in the Cooling System (SOHC MPFI System)	7.0L (1.85 gal) for automatic transaxle 7.0L (1.85 gal) for manual transaxle
Coolant in the Cooling System (DOHC MPFI System)	7.1L (1.88 gal) for automatic transaxle 7.2L (1.90 gal) for manual transaxle

FASTENER TIGHTENING SPECIFICATIONS

Application	NSm	Lb-Ft	Lb-In
Coolant Pump Mounting Bolts	10	-	89
Electric Cooling Fan (Auxiliary) Motor Retaining Nuts	3.2	-	28
Electric Cooling Fan (Auxiliary) Retaining Nut	4	-	35
Electric Cooling Fan (Main) Motor Nut	3.2	-	28
Electric Cooling Fan (Main) Motor Retaining Screws	4	-	35
Electric Cooling Fan Assembly (Auxiliary) Mounting Bolts	4	-	35
Electric Cooling Fan Assembly (Main) Mounting Bolts	4	-	35
Engine Coolant Temperature Sensor (DOHC)	20	15	-
Engine Coolant Temperature Sensor (SOHC)	20	15	-
Negative Battery Terminal Retainer Bolt	15	11	-
Radiator Retaining Bolt (Upper Left)	4	-	35
Radiator Retaining Bolt (Upper Right)	4	-	35
Surge Tank Attaching Nuts	4	-	35
Thermostat Housing Mounting Bolts (DOHC)	20	15	-
Thermostat Housing Mounting Bolts (SOHC)	20	15	-
Transmission Cooler Pipe Bolt (Lower)	12	-	106
Transmission Cooler Pipe Bolt (Upper)	12	-	106

SPECIAL TOOLS

SPECIAL TOOLS TABLE

 A102D020	KM-471 Adapter

DIAGNOSIS

THERMOSTAT TEST

1. Remove the thermostat from the vehicle. Refer to "Thermostat" in this section.
2. Make sure the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.
3. Suspend the thermostat and a thermometer in a pan of 50/50 mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan because the uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
4. Heat the pan on a burner.
5. Use the thermometer to measure the temperature of the heated solution.
6. The thermostat should begin to open at 87_C (189_F) and it should be fully open at 102_C (226_F). If it does not open at these temperatures, replace the thermostat.

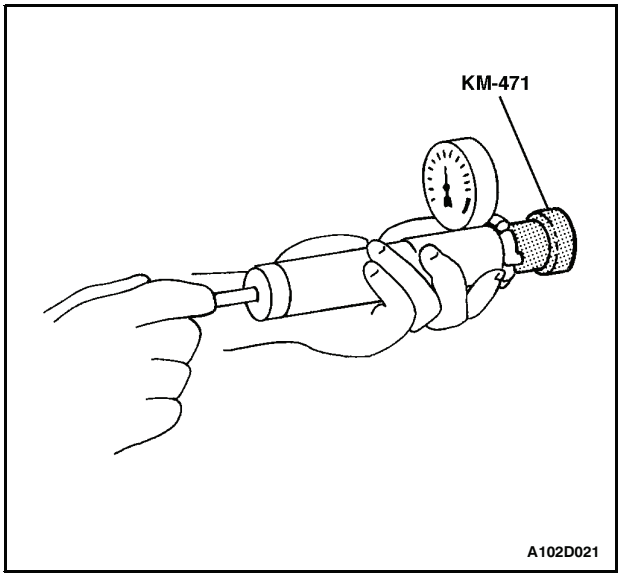
SURGE TANK CAP TEST

SPECIAL TOOLS

KM-471 Adapter

The surge tank cap maintains proper pressure, protects the system from high-pressure by opening a pressure-valve, and protects the coolant hoses from collapsing because of a vacuum.

1. Wash any sludge from the surge tank cap and the valve seat of the vacuum pressure valve for the surge tank cap.
2. Check for any damage or deformity to the vacuum pressure valve for the surge tank cap. If any damage or deformity is found, replace the cap.
3. Install a suitable cooling system pressure tester to the cap using the KM-471 Adapter.
4. Pull the vacuum pressure valve to the open position. If the surge tank cap does not seal properly, replace the surge tank cap.
5. Pressurize the cap to 90 to 120 kPa (13 to 17 psi).
6. Wait 10 seconds and check the pressure held by the tank cap tester.



7. If the pressure held by the cooling system pressure tester falls below 80 kPa (11.6 psi) replace the surge tank cap.

COOLING SYSTEM DIAGNOSIS

Engine Overheats

Checks	Action
Check for a loss of the coolant.	Add the coolant.
Check for a weak coolant solution.	Confirm that the coolant solution is a 50/50 mixture of ethylene glycol and water.
Check the front of the radiator for any dirt, any leaves, or any insects.	Clean the front of the radiator.
Check for leakage from the hoses, the coolant pump, the heater, the thermostat housing, the radiator, the core plugs, or the head gasket.	Replace any damaged components.
Check for a faulty thermostat.	Replace a damaged thermostat.
Check for retarded ignition timing.	Perform an ECM code diagnosis. Confirm the integrity of the timing belt.
Check for an improperly operating electric cooling fan.	Replace the electric cooling fan.
Check for radiator hoses that are plugged or rotted.	Replace any damaged radiator hoses.
Check for a faulty water pump.	Replace a faulty water pump.
Check for a faulty surge tank cap.	Replace a faulty surge tank cap.
Check for a cylinder head or an engine block that is cracked or plugged.	Repair the damaged cylinder head or the damaged engine block.

Loss of Coolant

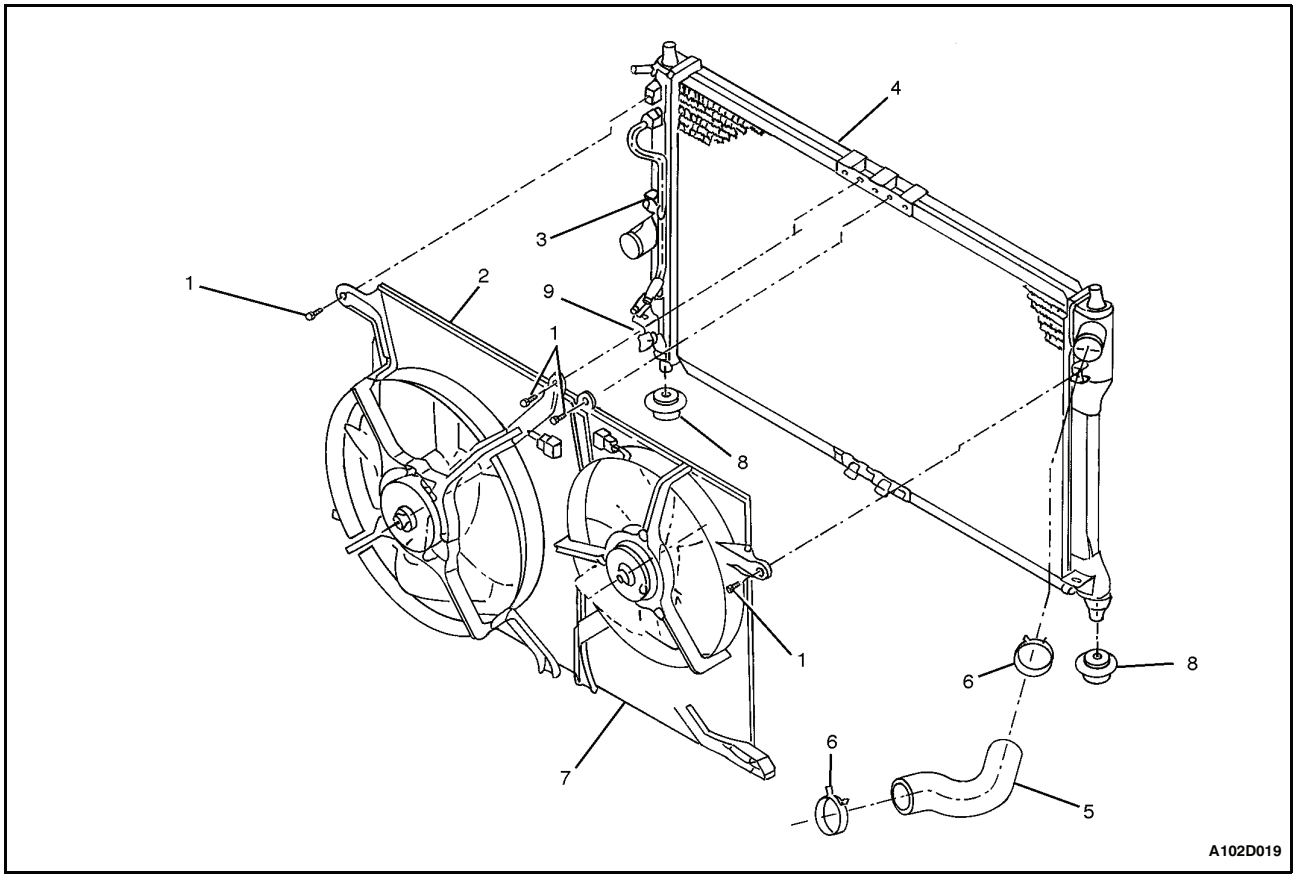
Checks	Action
Check for a leak in the radiator.	Replace a damaged radiator.
Check for a leak in the D Surge tank. D Hose.	Replace the D Surge tank. D Hose.
Check for loose or damaged D Radiator hoses. D Heater hoses. D Connections.	Reseat the hoses. Replace the hoses or the clamps.
Check for leaks in the coolant pump seal.	Replace the coolant pump seal.
Check for leaks in the coolant pump gasket.	Replace the coolant pump gasket.
Check for an improper cylinder head torque.	Tighten the cylinder head bolts to specifications. Replace the cylinder head gasket, if needed.
Check for leaks in the D Intake manifold. D Cylinder head gasket. D Cylinder block plug. D Heater core. D Radiator drain plug.	Repair or replace any components, as needed to correct the leak.

Engine Fails to Reach Normal Operating Temperature
or
Cool Air from the Heater

Checks	Action
Check to determine if the thermostat is D Stuck open. D The wrong type of thermostat.	Install a new thermostat of the correct type and heat range.
Check the coolant level to determine if it is below the MIN mark on the surge tank.	Add sufficient coolant to raise the fluid to the specified mark on the surge tank.

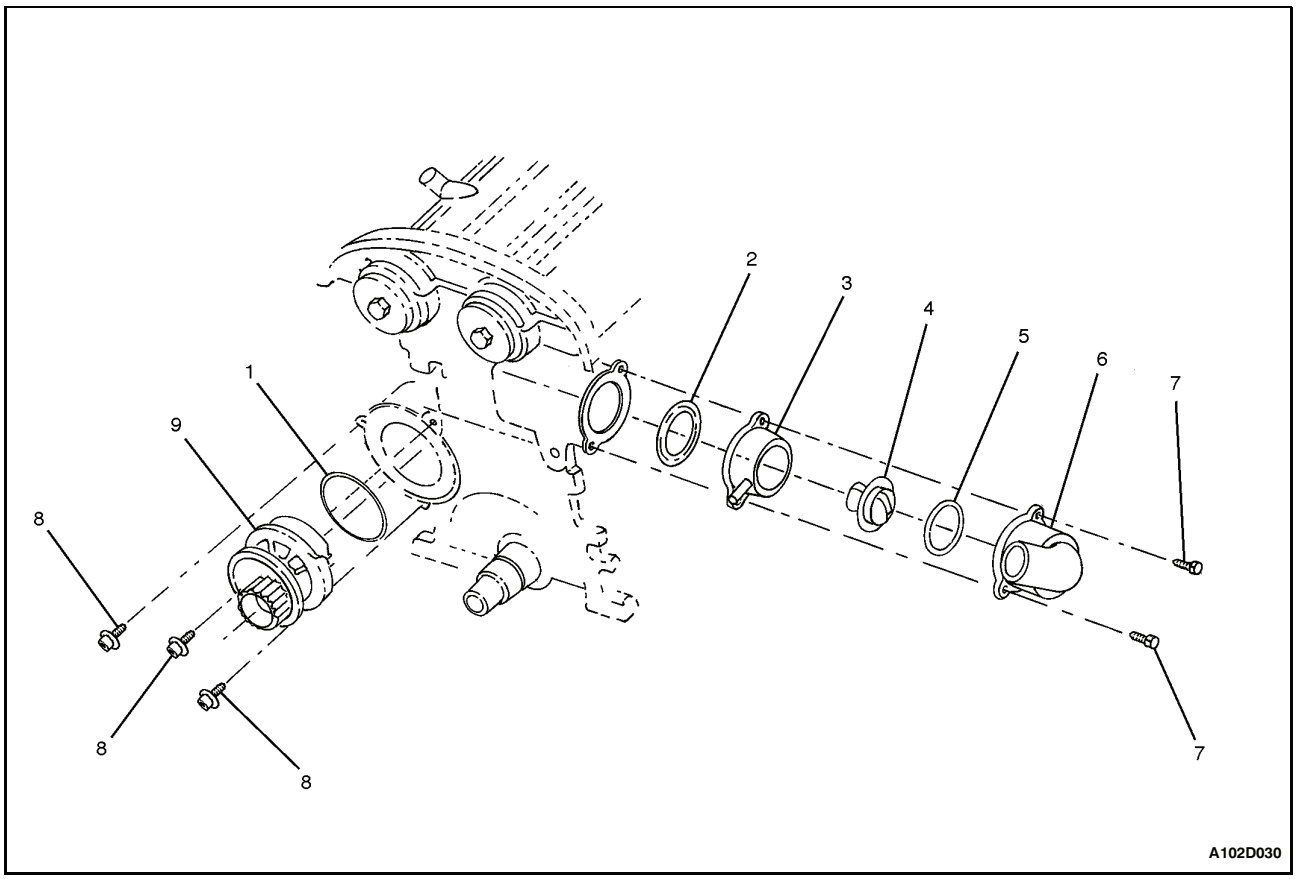
COMPONENT LOCATOR

RADIATOR/FAN



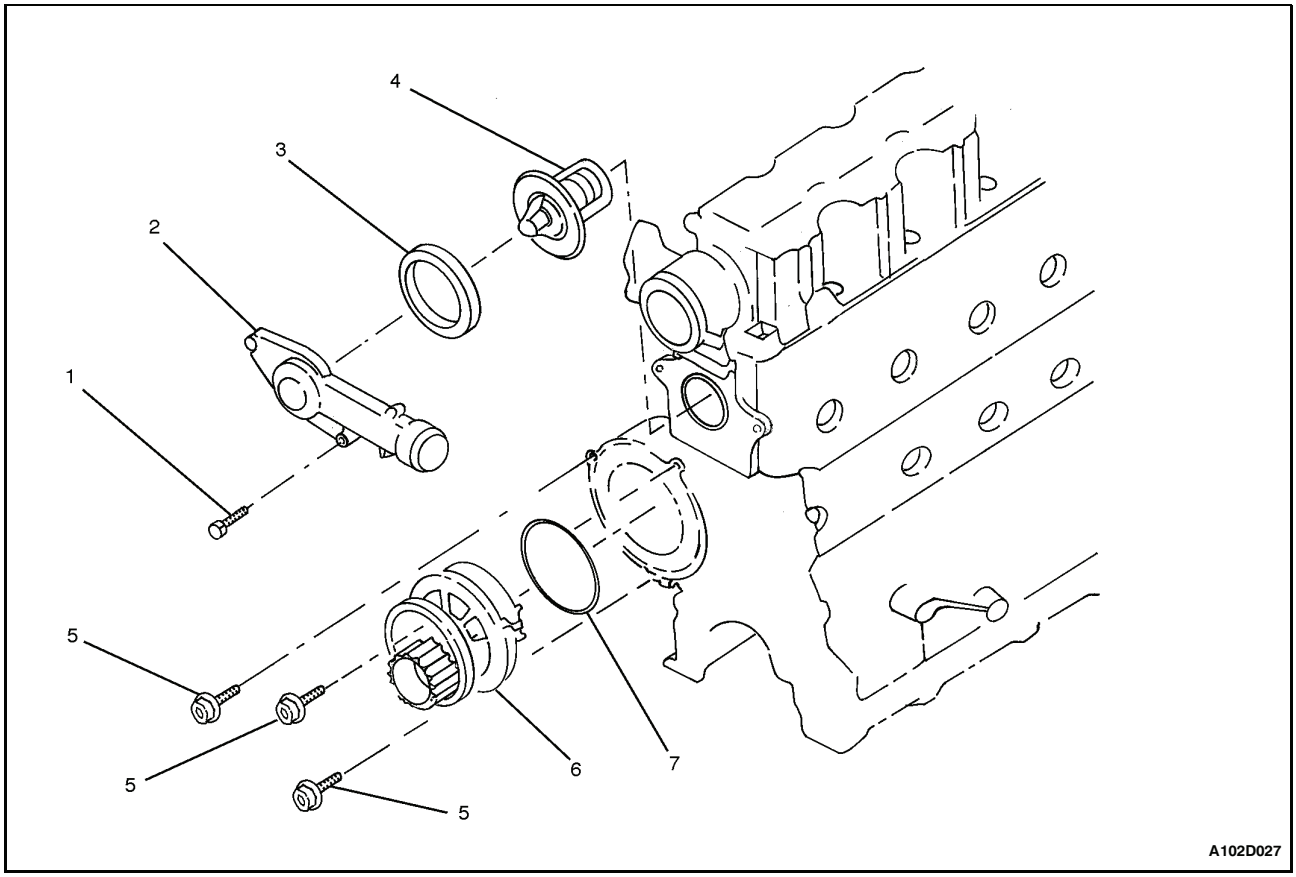
1 Bolt
2 Main Cooling Fan
3 Holder Transmission Fluid Pipe (Automatic Transmission Only)
4 Radiator
5 Upper Radiator Hose
6 Spring Clamp
7 Auxiliary Cooling Fan (Air Conditioning Only)
8 Radiator Bumper
9 Drain Cock

COOLANT PUMP/THERMOSTAT (DOHC)

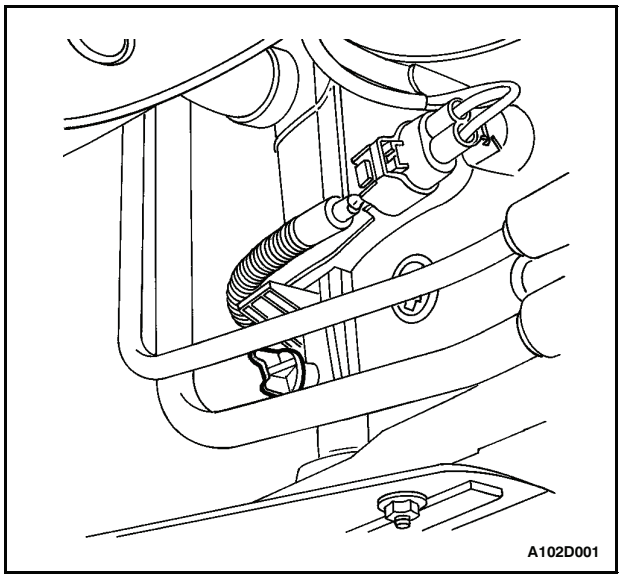


1 Cylinder Block Seal Ring
2 Seal Ring
3 Thermostat Adapter
4 Thermostat
6 Seal Ring
6 Thermostat Housing
7 Bolt
8 Bolt
9 Water Pump

COOLANT PUMP/THERMOSTAT (SOHC)



1 Thermostat Housing Bolt
2 Thermostat Housing
3 Seal Ring
4 Thermostat
5 Water Pump Mounting Bolts
6 Water Pump
7 O-Ring


A102D001

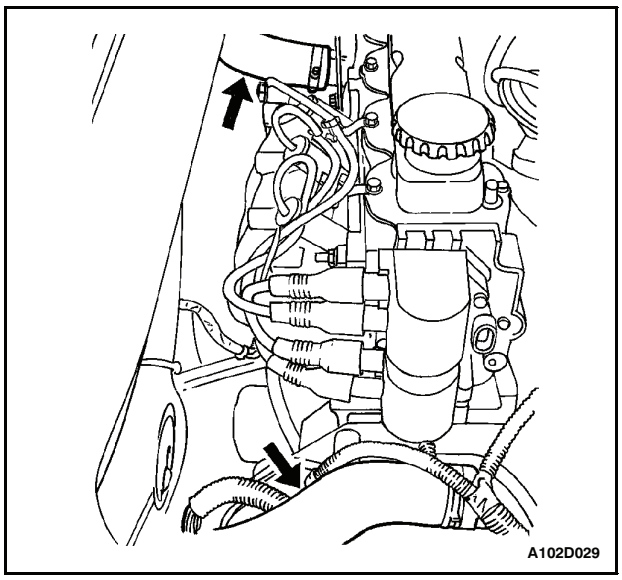
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

DRAINING AND REFILLING THE COOLING SYSTEM

Caution: Do not remove the surge tank cap while the engine and the radiator are hot. Scalding fluid and steam may be blown out under pressure.

1. Place a pan below the vehicle to catch the draining coolant.
2. Remove the surge tank cap.
3. Unplug the drain cock.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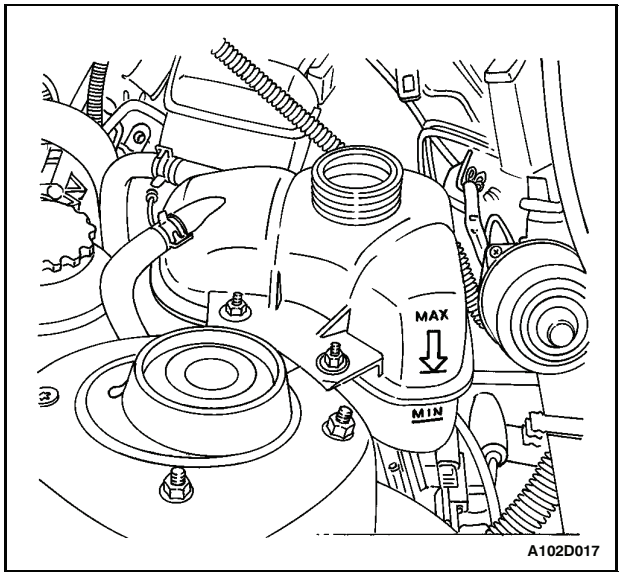
Caution: Dispose of the used coolant to a used coolant holding tank to be picked up with the used oil for disposal. Never pour the used coolant down the drain. Ethylene glycol antifreeze is an extremely toxic chemical. Disposing of it into the sewer system or the ground water can contaminate the local environment.

4. Catch the escaping fluid in a drain pan.
5. Remove all sludge and dirt from inside the surge tank. Refer to "Surge Tank" in this section.
6. Plug the drain cock.
7. Add the clean water to the surge tank.
8. Fill the tank slowly so that the upper reservoir hose remains above the water line. This allows the air inside the cooling system to escape.
9. Start the engine.
10. Run the engine until the thermostat opens. You can tell the thermostat is open when both radiator hoses are hot to the touch.

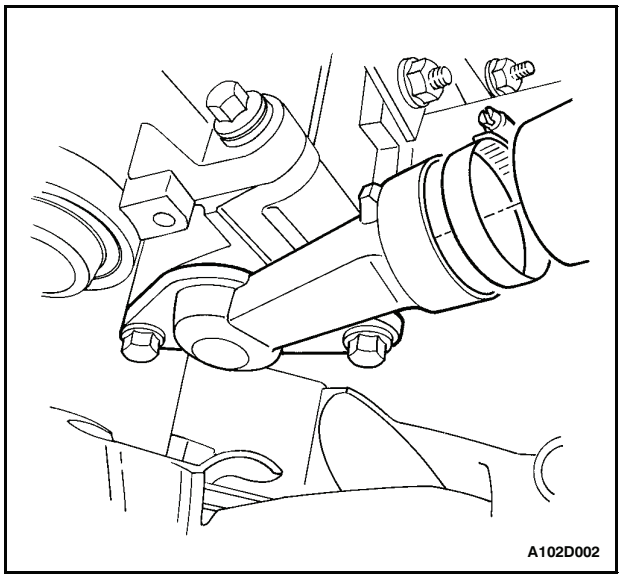


A102D017

11. Stop the engine.
12. Repeat steps 1 through 9 until the drained water is clear and free of coolant and rust.

Notice: Never use an antifreeze mixture more concentrated than 60 percent antifreeze to 40 percent water. The solution freezing point increases above this concentration.

13. Fill the cooling system through the surge tank with a mixture of ethylene glycol antifreeze and water. The mixture must be at least 50 percent antifreeze, but not more than 60 percent antifreeze for cold weather operation.
14. Fill the surge tank to the specified MAX fill mark on the outside of the tank.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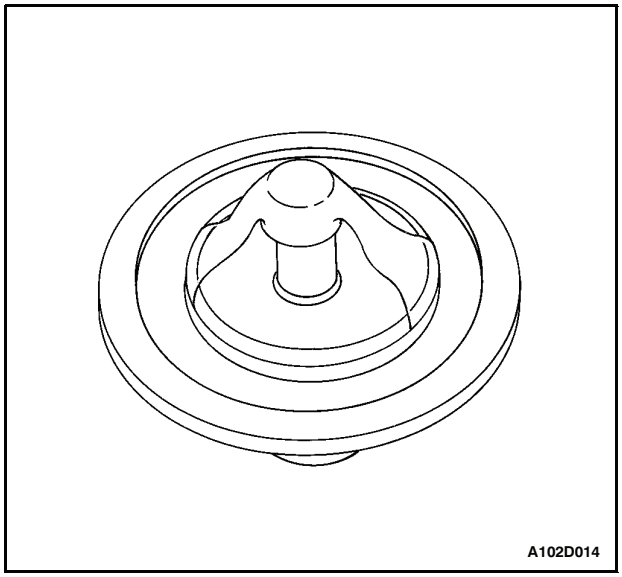
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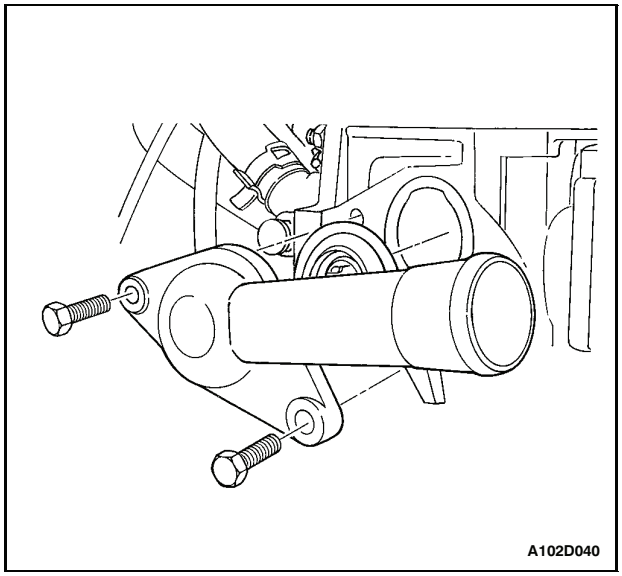

A102D040

THERMOSTAT

Single Overhead Cam Engine

Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the coolant. Refer to "Draining and Refilling the Cooling System" in this section.
2. Remove the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical.
3. Loosen the hose clamp on the upper radiator hose at the thermostat housing.
4. Disconnect the upper radiator hose from the thermostat housing.
5. Remove the mounting bolts that hold the thermostat housing to the cylinder head.
6. Remove the thermostat housing from the head.
7. Remove the thermostat from its recess in the cylinder head.
8. Inspect the valve seat for foreign matter that could prevent the valve from seating properly.
9. Inspect the thermostat for proper operation. Refer to "Thermostat Test" in this section.
10. Clean the thermostat housing and the cylinder head mating surfaces.

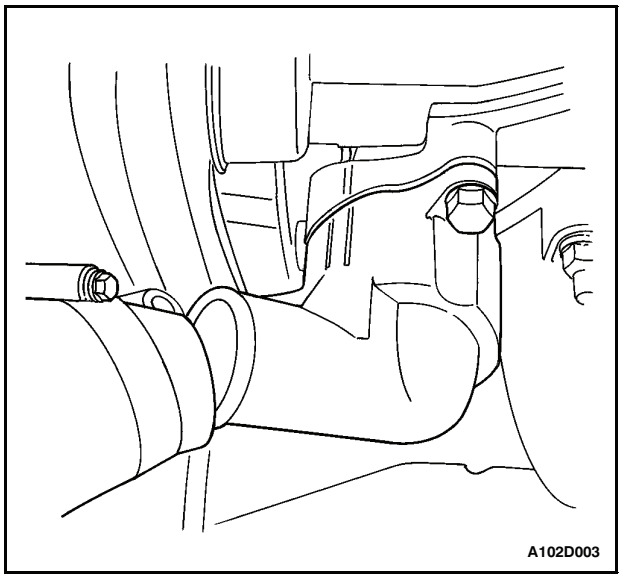
Installation Procedure

1. Install the thermostat into the cylinder head recess.
2. Install the thermostat housing.
3. Secure the thermostat housing to the cylinder head with the mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 NSm (15 lb-ft).

4. Connect the upper radiator hose to the thermostat housing.
5. Secure the upper radiator hose to the thermostat housing with a hose clamp.
6. Install the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical.
7. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.

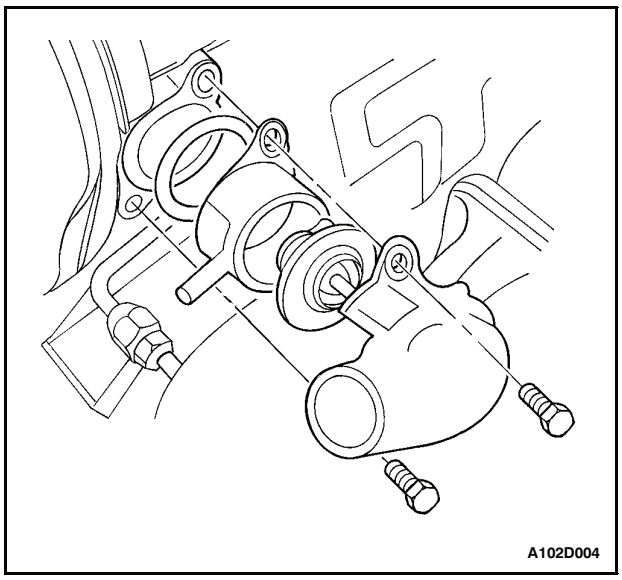

A102D003

Dual Overhead Cam Engine

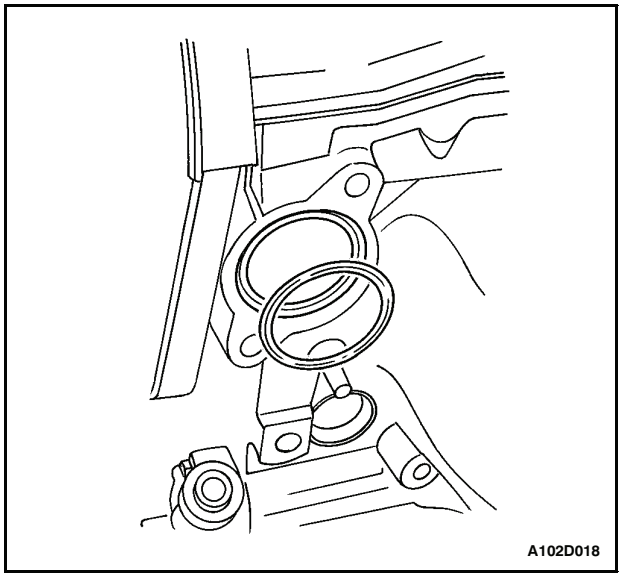
Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are still hot because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the coolant. Refer to "Draining and Refilling the Cooling System" in this section.
2. Loosen the hose clamp on the upper radiator hose at the thermostat housing.
3. Disconnect the upper radiator hose from the thermostat housing.

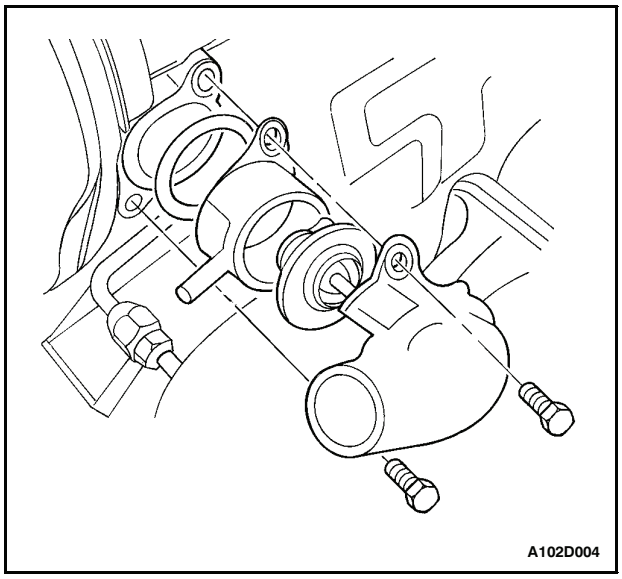

A102D004

4. Loosen the clamp on the bypass hose.
5. Disconnect the bypass hose from the thermostat adapter.
6. Remove the mounting bolts holding the thermostat housing to the cylinder head.
7. Remove the thermostat housing from the head.
8. Remove the O-ring seal from the head.
9. Separate the thermostat cover from the thermostat adapter.
10. Remove the thermostat from its recess in the thermostat adapter.
11. Check the valve seat for foreign matter that could prevent the valve from seating properly.
12. Check the thermostat for proper operation. Refer to "Thermostat Test" in this section.
13. Clean the thermostat housing and cylinder head mating surfaces.


A102D018

Installation Procedure

1. Install the thermostat into the thermostat adapter recess.
2. Assemble the thermostat cover over the thermostat adapter.
3. Coat the sealing surface of a new O-ring seal with Lubriplate.

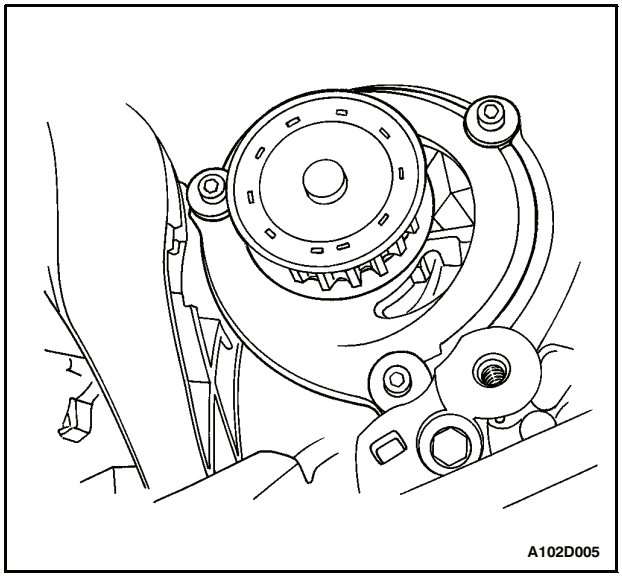

A102D004

4. Install a new O-ring seal into the recess in the cylinder head.
5. Secure the thermostat housing to the cylinder head with the mounting bolts.

Tighten

Tighten the thermostat housing mounting bolts to 20 NSm (15 lb-ft).

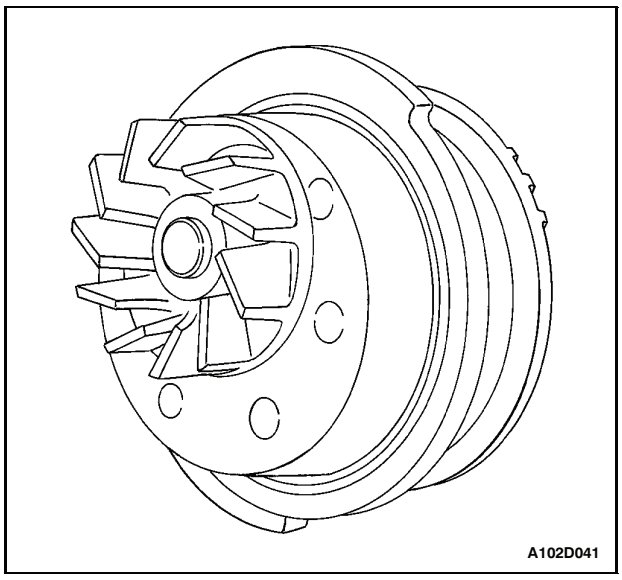
6. Connect the bypass hose to the thermostat adapter.
7. Secure the bypass hose with a hose clamp.
8. Connect the upper radiator hose to the thermostat housing.
9. Secure the upper radiator hose to the thermostat housing with a hose clamp.
10. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.


A102D005

COOLANT PUMP

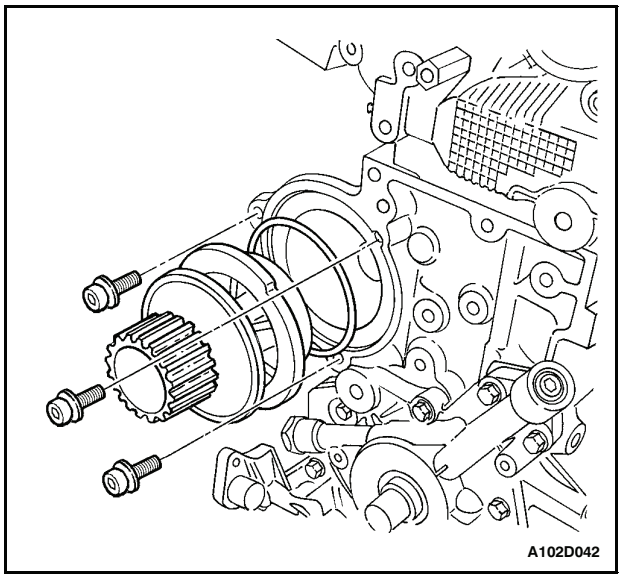
Removal Procedure

1. Drain the engine cooling system to a level below the thermostat housing. Refer to "Draining and Refilling the Cooling System" in this section.
2. Remove the rear timing belt cover. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
3. Remove the coolant pump mounting bolts.
4. Remove the coolant pump from the cylinder block.
5. Remove the ring seal from coolant pump.


A102D041

Inspection and Cleaning Procedure

1. Inspect the coolant pump body for cracks and leaks.
2. Inspect the coolant pump bearing for play or abnormal noise.
3. Inspect the coolant pump pulley for excessive wear. If the coolant pump is defective, replace the coolant pump as a unit.
4. Clean the mating surfaces of the coolant pump and cylinder block.



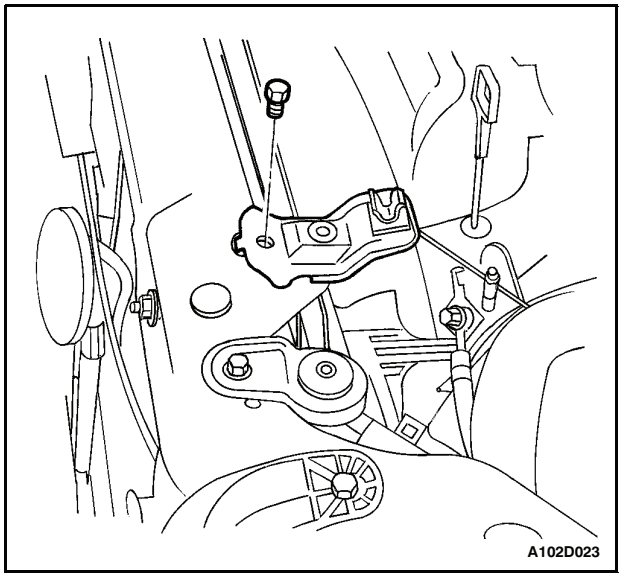
Installation Procedure

1. Install a new ring seal to the coolant pump.
2. Coat the sealing surface of the ring seal with Lubriplate.
3. Install the coolant pump to the engine block.
4. Secure the coolant pump to the engine block with the mounting bolts.

Tighten

Tighten the coolant pump mounting bolts to 10 NSm (89 lb-in).

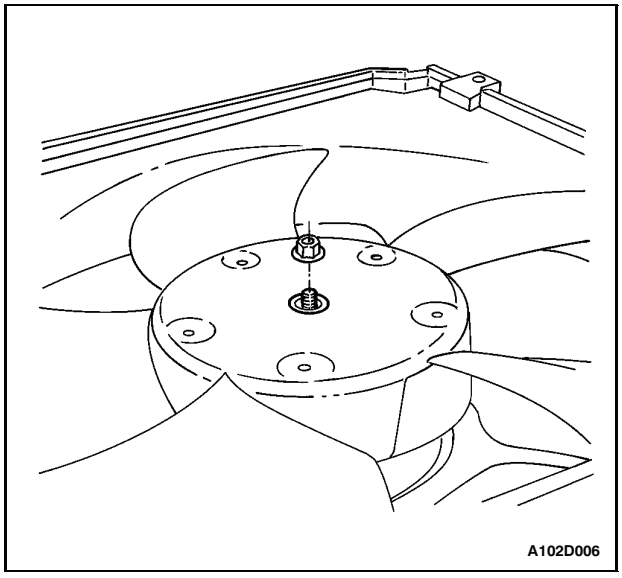
5. Install the rear timing belt cover. Refer to Section 1B, DOHC Engine Mechanical.
6. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.



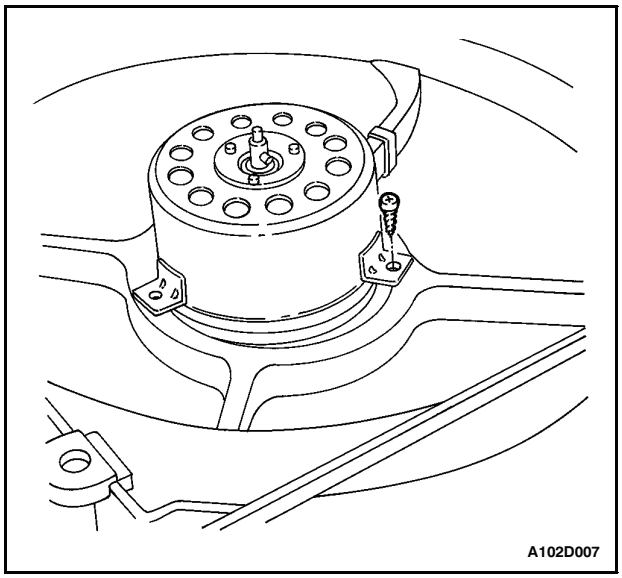
ELECTRIC COOLING FAN - MAIN

Removal Procedure

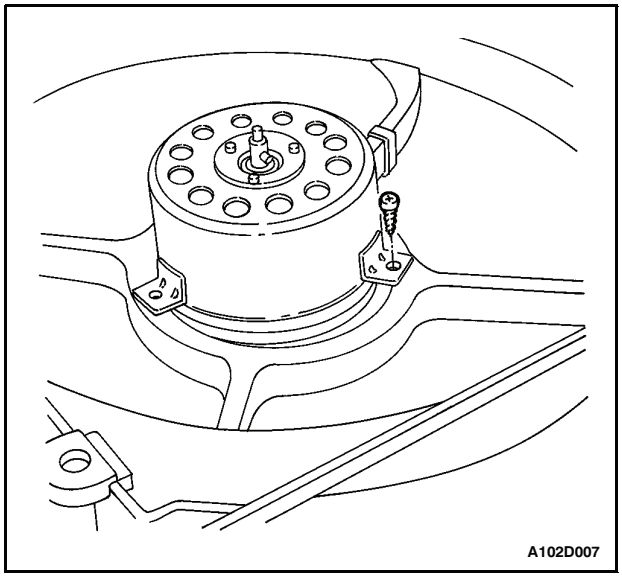
1. Disconnect the negative battery cable.
2. Remove the hood support rod bracket.



3. Disconnect the cooling fan electrical connector.
4. Remove the fan shroud mounting bolts.
5. Lift the fan shroud assembly upward, and remove the fan shroud assembly from the vehicle.
6. Remove the fan blade from the fan motor by removing the nut at the center of the fan hub.



7. Remove the fan motor retaining screws.
8. Remove the fan motor from the shroud.



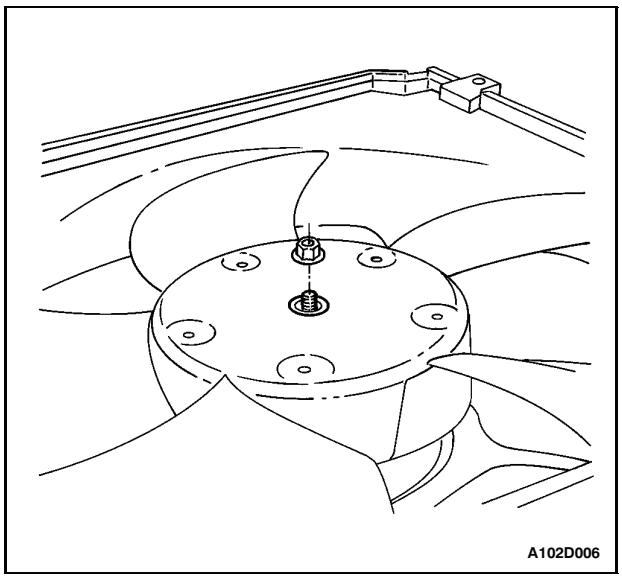
Installation Procedure

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly must be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance. A fan assembly that is not in proper balance can fail and fly apart during use, creating extreme danger. Proper balance cannot be assured on a fan assembly that has been bent or damaged.

1. Install the fan motor to the shroud.
2. Secure the motor to the shroud with the retaining screws.

Tighten

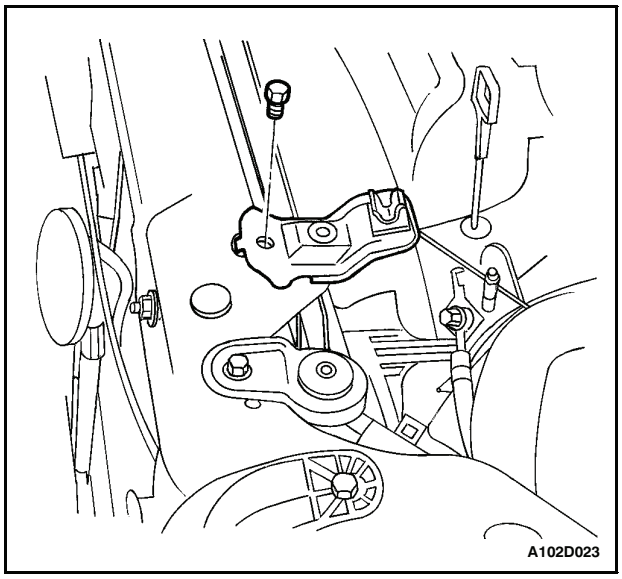
Tighten the fan motor retaining screws to 4 NSm (35 lb-in).



3. Install the fan to the motor with the single nut in the center of the fan hub.

Tighten

Tighten the fan motor nut to 3.2 NSm (28 lb-in).


A102D023

4. Install the electric cooling fan shroud assembly to the radiator.

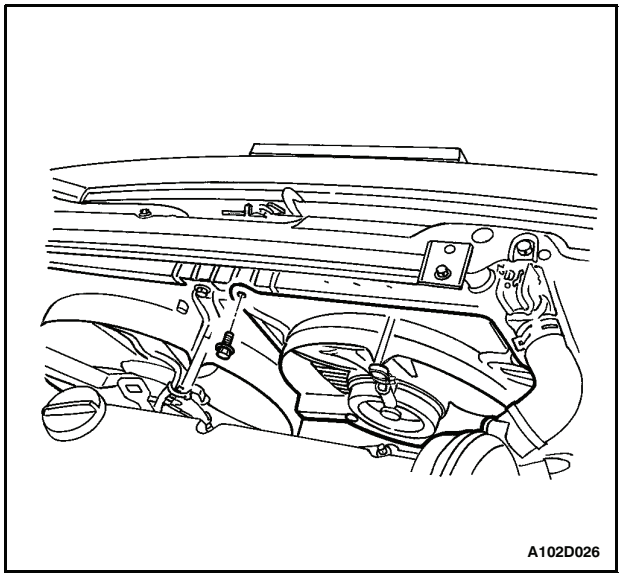
Important: Be careful to seat the mounting post on the fan shroud into the socket at the radiator left tank. Be sure to slip the tab at the bottom edge of the shroud into the retaining clip near the center of the radiator.

5. Secure the shroud to the top of the radiator with the mounting bolts.

Tighten

Tighten the electric cooling fan assembly mounting bolts to 4 NSm (35 lb-in).

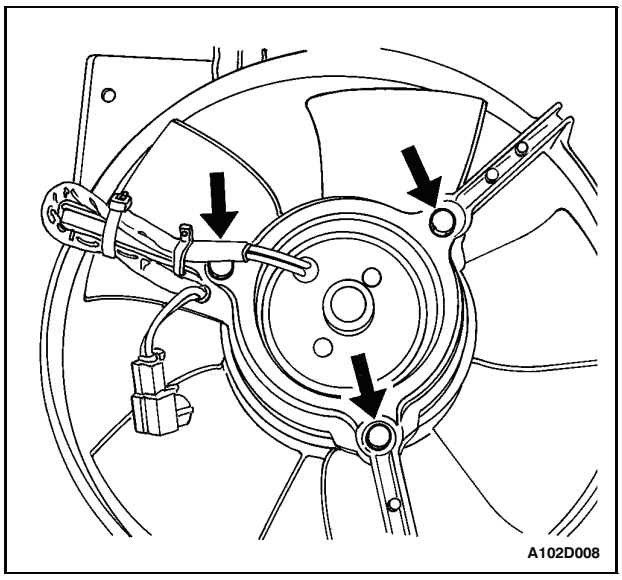
6. Install the electrical connector to the cooling fan.
7. Install the hood support rod bracket.
8. Connect the negative battery cable.


A102D026

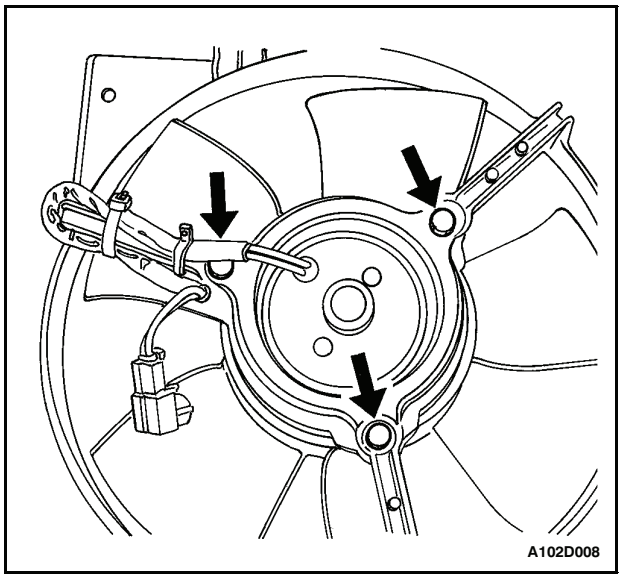
ELECTRIC COOLING FAN - AUXILIARY

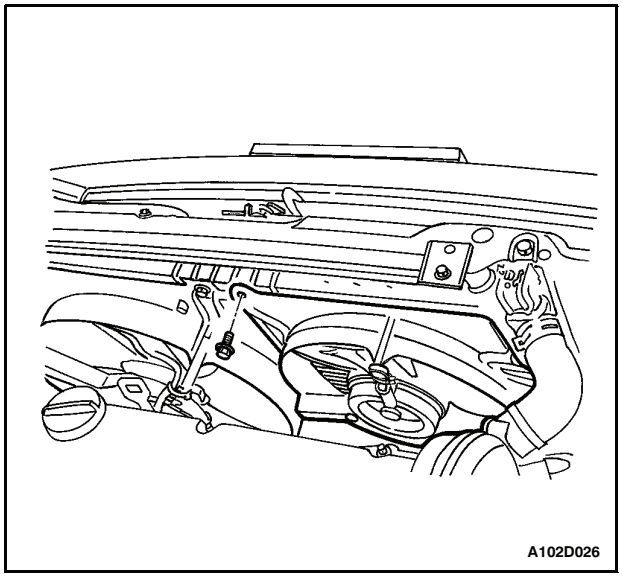
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the cooling fan electrical connector.
3. Remove the fan shroud mounting bolts.
4. Lift the fan shroud assembly upward, and remove the fan shroud assembly from the vehicle.
5. Remove the fan motor nuts that secure the fan motor to the shroud.


A102D008

6. Remove the fan motor from the shroud.
7. Remove the fan retaining nut which secures the fan to the motor.


A102D008


A102D026

Installation Procedure

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly must be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance. A fan assembly that is not in proper balance can fail and fly apart during use, creating an extremely dangerous condition. Proper balance cannot be assured on a fan assembly that has been bent or damaged.

1. Install the fan to the motor.
2. Attach the fan retaining nut.

Tighten

Tighten the fan retaining nut to 4 NSm (35 lb-in).

3. Attach the fan motor to the shroud.
4. Secure the fan motor to the shroud with the retaining nuts.

Tighten

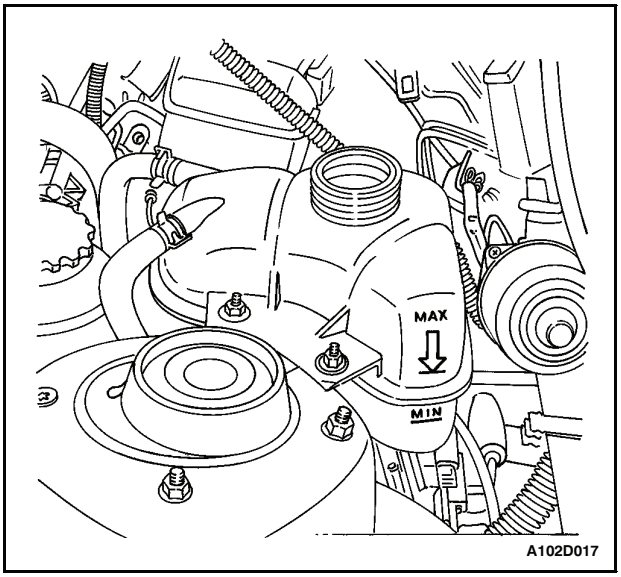
Tighten the fan motor retaining nuts to 3.2 NSm (28 lb-in).

5. Install the electric cooling fan assembly to the radiator.
6. Be careful to seat the mounting post on the fan shroud into the socket at the radiator right tank.
7. Also be sure to slip the bottom edge of the shroud into the retaining clip near the center of the radiator.
8. Secure the shroud to the top of the radiator with the mounting bolts.

Tighten

Tighten the electric cooling fan assembly mounting bolts to 4 NSm (35 lb-in).

9. Install the electrical connector to the cooling fan.
10. Connect the negative battery cable.



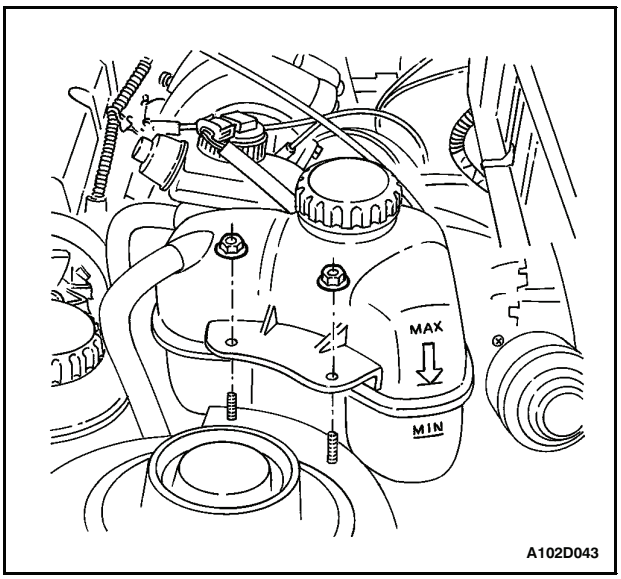
A102D017

SURGE TANK

Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot, because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

1. Drain the engine coolant to below the level of the surge tank.
2. Loosen the overflow hose clamps and disconnect the overflow hoses from the surge tank.
3. Remove the tank attaching nuts.
4. Remove the tank from the vehicle.
5. Clean the inside and the outside of the surge tank and the surge tank cap with soap and water.
6. Rinse the surge tank and the cap thoroughly.



A102D043

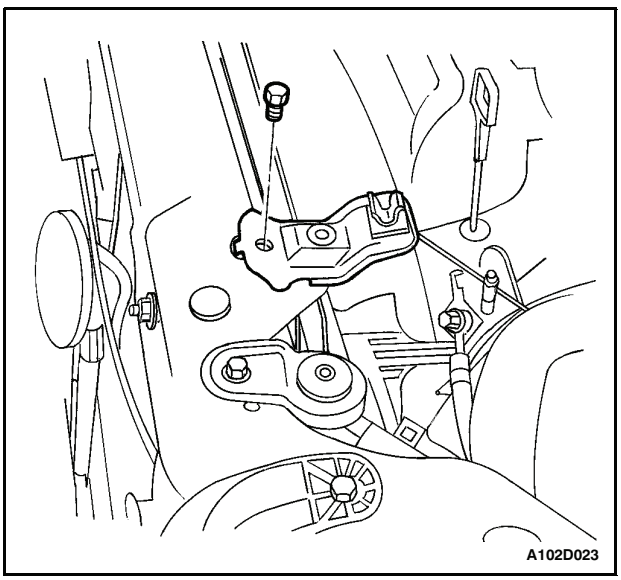
Installation Procedure

1. Install the surge tank to the vehicle.
2. Secure the surge tank with the attaching nuts.

Tighten

Tighten the surge tank attaching nuts to 4 NSm (35 lb-in).

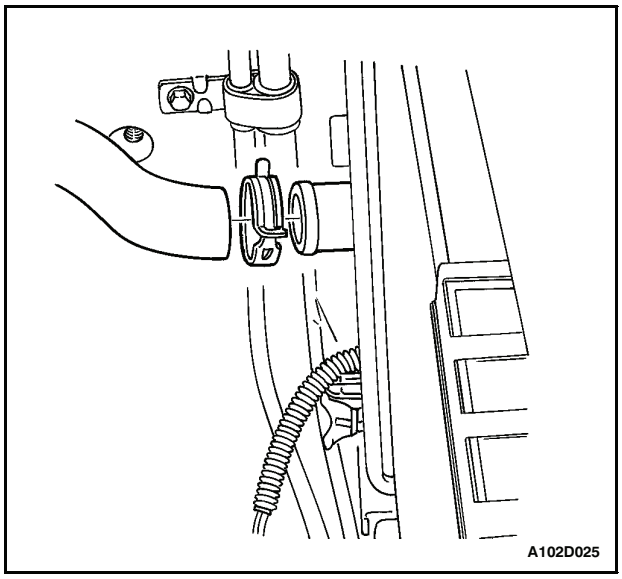
3. Connect the overflow hoses to the surge tank.
4. Secure the overflow hoses to the surge tank with the hose clamps.
5. Fill the surge tank with the coolant to the center ridge, or the MAX mark.


A102D023

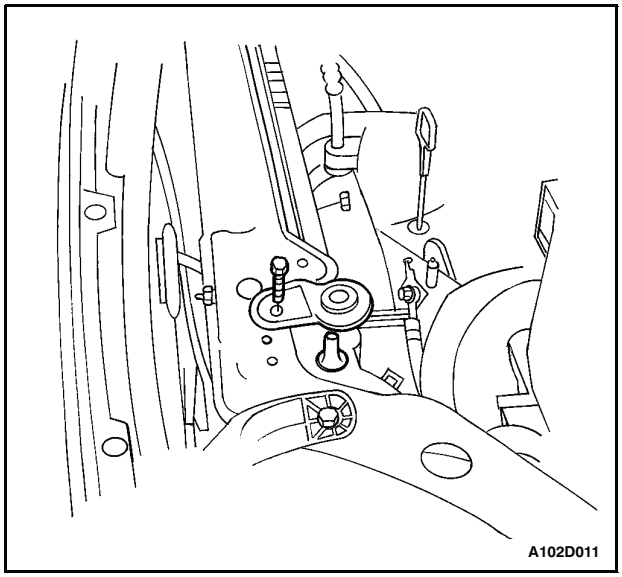
RADIATOR

Removal Procedure

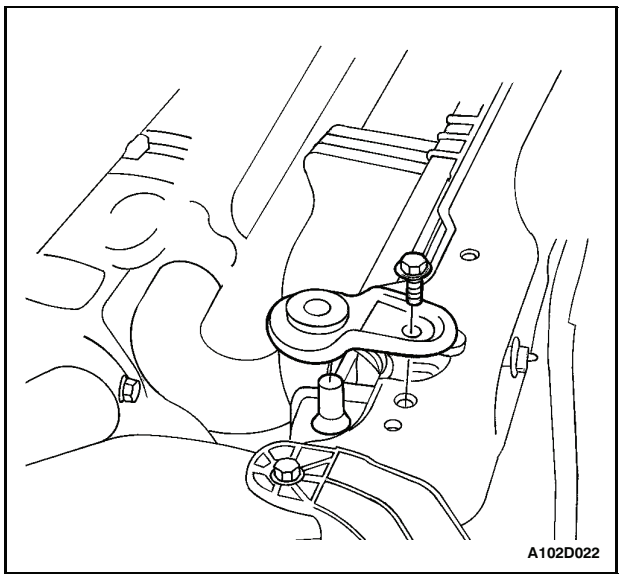
1. Disconnect the negative battery cable.
2. Drain the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
3. Remove the hood support rod bracket.



4. Remove the main cooling fan. Refer to "Electric Cooling Fan - Main" in this section.
5. Remove the auxiliary cooling fan, if equipped. Refer to "Electric Cooling Fan - Auxiliary" in this section.
6. Remove the lower radiator hose clamp.
7. Disconnect the lower radiator hose from the radiator.
8. Remove the upper radiator hose clamp.
9. Disconnect the upper radiator hose from the radiator.

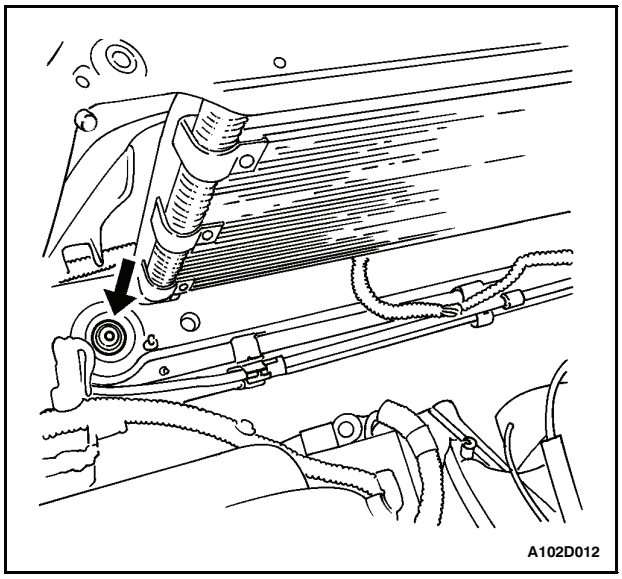


10. Remove the hose clamp from the surge tank hose at the radiator.
11. Disconnect the surge tank hose from the radiator.
12. Disconnect the upper and lower transmission cooler hoses from the pipes at the left radiator tank, if equipped.
13. Remove the left upper radiator retaining bolt.
14. Remove the left upper radiator retaining bracket.



15. Remove the right upper radiator retaining bolt.
16. Remove the right upper radiator retaining bracket.
17. Remove the radiator from the vehicle.

Important: The radiator still contains a substantial amount of coolant. Drain the remainder of the coolant from the radiator into a drain pan.


A102D012

Installation Procedure

1. If installing a new radiator, remove the transmission cooler pipes from the old radiator and install them onto the left tank of the new radiator.
2. Install the upper transmission cooler pipe to the radiator and secure the pipe with a pipe bolt.

Tighten

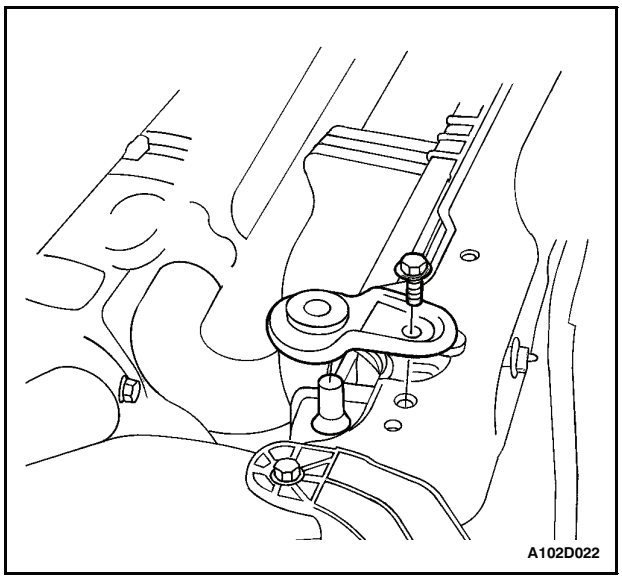
Tighten the upper transmission cooler pipe bolt to 12 NSm (106 lb-in).

3. Install the pipe holder as it was in the old radiator.
4. Install the lower transmission cooler pipe to the radiator and secure the pipe with a pipe bolt.

Tighten

Tighten the lower transmission cooler pipe bolt to 12 NSm (106 lb-in).

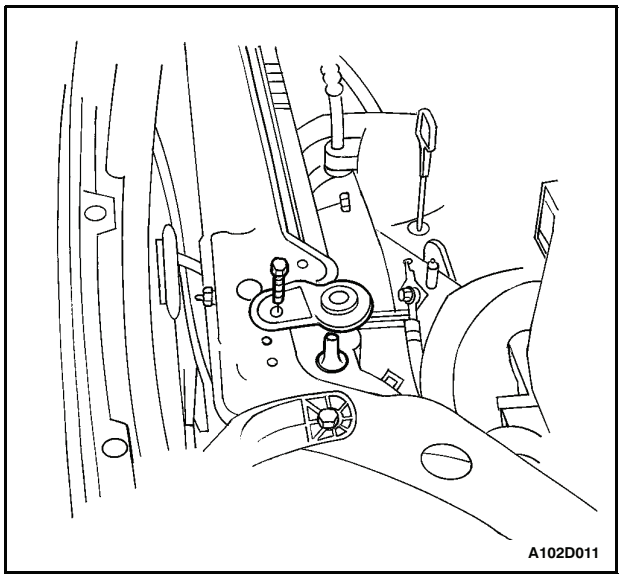
5. Set the radiator into place in the vehicle with the radiator bottom posts in the rubber shock bumpers.


A102D022

6. Position the radiator retainers in place.
7. Install the right upper radiator retainer bracket.
8. Install the right upper radiator retaining bolt.

Tighten

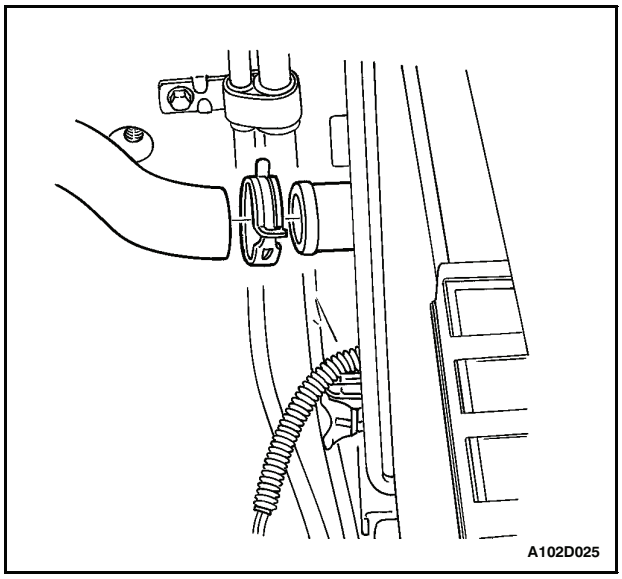
Tighten the right upper radiator retaining bolt to 4 NSm (35 lb-in).


A102D011

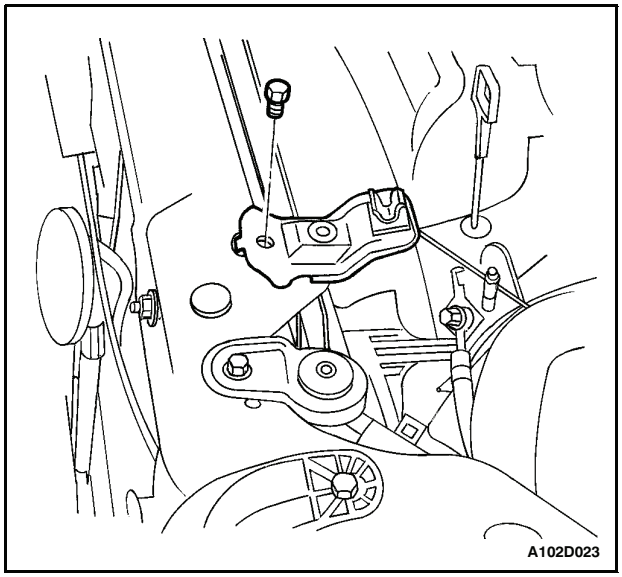
9. Install the left upper radiator retainer bracket.
10. Install the left upper radiator retaining bolt.

Tighten

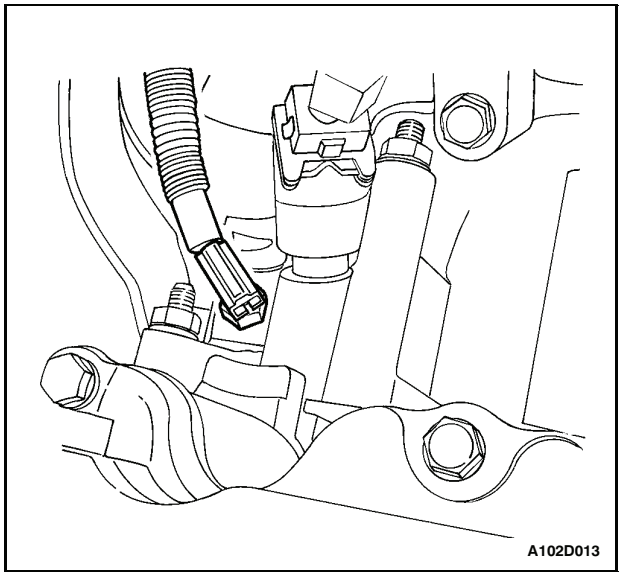
Tighten the left upper radiator retaining bolt to 4 NSm (35 lb-in).


A102D025

11. Connect the transmission cooler hoses to the pipes, if equipped.
12. Connect the surge tank hose to the radiator.
13. Secure the surge tank hose with a hose clamp.
14. Connect the upper radiator hose and the lower radiator hose to the radiator.


A102D023

15. Secure each hose with a hose clamp.
16. Install the main cooling fan. Refer to "Electric Cooling Fan - Main" in this section.
17. Install the auxiliary cooling fan, if equipped. Refer to "Electric Cooling Fan - Auxiliary" in this section.
18. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
19. Install the hood support bracket.
20. Connect the negative battery cable.

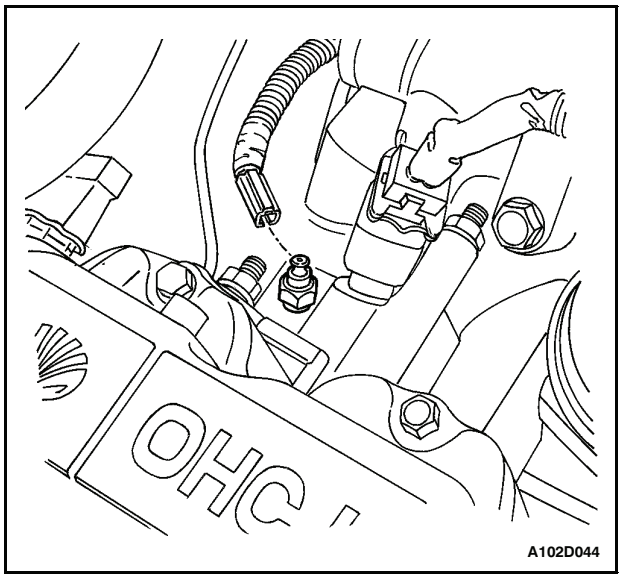

A102D013

ENGINE COOLANT TEMPERATURE SENSOR

Single Overhead Cam Engine

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain the coolant below the engine coolant temperature sensor level.
3. Disconnect the electrical connector from the engine coolant temperature sensor.
4. Remove the temperature sensor from the intake manifold.



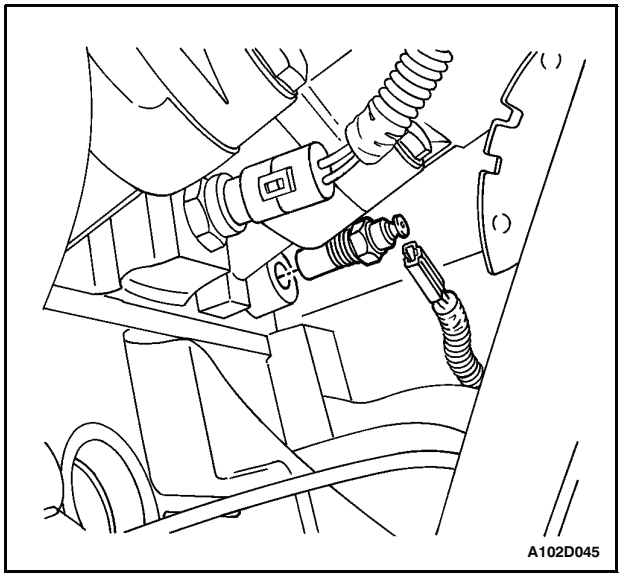
Installation Procedure

1. Install the engine coolant temperature sensor into the threaded hole in the intake manifold.

Tighten

Tighten the engine coolant temperature sensor to 20 NSm (15 lb-ft).

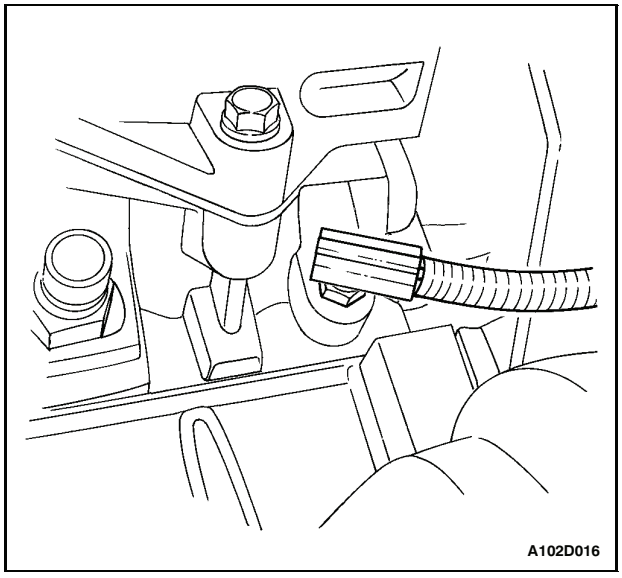
2. Connect the electrical connector to the engine coolant temperature sensor.
3. Refill the coolant system. Refer to "Draining and Refilling the Cooling System" in this section.
4. Connect the negative battery cable.



Dual Overhead Cam Engine

Removal Procedure

1. Disconnect the negative battery table.
2. Drain the coolant below the engine coolant temperature sensor level.
3. Disconnect the electrical connector from the engine coolant temperature sensor.
4. Remove the temperature sensor from the cylinder head.



Installation Procedure

1. Install the engine coolant temperature sensor into the threaded hole in the cylinder head.

Tighten

Tighten the engine coolant temperature sensor to 20 NSm (15 lb-ft).

2. Connect the electrical connector to the engine coolant temperature sensor.
3. Refill the coolant system. Refer to "Draining and Refilling the Cooling System" in this section.
4. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL DESCRIPTION

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. When the engine is cold the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly.

The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, a coolant pump, and a coolant pump drive belt. The timing belt drives the coolant pump.

All components must function properly in order for the cooling system to operate. The coolant pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools.

This system directs some coolant through the hoses to the heater core. This provides for heating and defrosting. The surge tank is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The surge tank maintains the correct coolant level.

The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the surge tank.

RADIATOR

This vehicle has a lightweight tube-and-fin aluminum radiator. Plastic tanks are mounted on the right and the left sides of the radiator core.

On vehicles equipped with automatic transaxles, the transaxle fluid cooler lines run through the left radiator tank. A radiator drain cock is on this radiator.

To drain the cooling system, open the drain cock.

SURGE TANK

The surge tank is a transparent plastic reservoir, similar to the windshield washer reservoir.

The surge tank is connected to the radiator by a hose and to the engine cooling system by another hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the surge tank. The air trapped in the radiator and the engine is degassed into the surge tank.

When the engine is stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency.

Maintain the coolant level between the MIN and the MAX marks on the surge tank when the system is cold.

COOLANT PUMP

The belt-driven centrifugal coolant pump consists of an impeller, a drive shaft, and a belt pulley. The coolant pump is mounted on the front of the transverse-mounted engine, and is driven by the timing belt.

The impeller is supported by a completely sealed bearing.

The coolant pump is serviced as an assembly and, therefore, cannot be disassembled.

THERMOSTAT

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the front of the cylinder head.

The thermostat stops the flow of the engine coolant from the engine to the radiator in order to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator, where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine.

As the wax pellet cools, the contraction allows a spring to close the valve.

The thermostat begins to open at 87_C (189_F) and is fully open at 102_C (226_F). The thermostat closes at 86_C (187_F).

ELECTRIC COOLING FAN

Caution: Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn ON whether or not the engine is running.

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one.

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioner (A/C)-equipped vehicles. This helps to speed cooling when the vehicle is at idle or moving at low speeds.

The main fan size is 320 mm (12.6 inches) in diameter with five blades to aid the air flow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan.

A/C models have two fans - the main fan, and the auxiliary fan. The auxiliary fan is 250 mm (9.8 inches) in diameter. Non-A/C models have only the main fan.

A/C OFF or Non-A/C Model

- The cooling fan(s) are actuated by the electronic control module (ECM) using a low speed cooling fan relay and a high speed cooling fan relay. On A/C equipped vehicles, a series/parallel cooling fan relay is also used.
- The ECM will turn the cooling fan(s) on at low speed when the coolant temperature reaches 93_C (199_F) and high speed at 97_C (207_F).
- The ECM will change the cooling fan(ls) from high speed to low speed at 94_C (201_F) and turn the cooling fans off at 90_C (194_F).

A/C ON

- The ECM will turn the cooling fans on at low speed when the A/C system is on. The ECM will change to high speed when the coolant temperature reaches 97_C (207_F) or highside A/C pressure reaches 1 882 kPa (273 psi).

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor controls the instrument panel temperature indicator. The engine coolant temperature sensor is located on the intake manifold near the throttle body on an SOHC engine, and on the cylinder head, under the intake manifold on a DOHC engine.

ENGINE BLOCK HEATER

The vehicle is designed to accept an engine block heater. The engine block heater helps warm the engine for improved cold weather starting. It can also help reduce fuel consumption when a cold engine is warming up.

The engine block heater utilizes an existing expansion plug for installation and is located under the intake manifold.

Contact your Daewoo dealer for further information or installation.

SECTION 1E

ENGINE ELECTRICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

SPECIFICATIONS

STARTER SPECIFICATIONS

Application	Description
Starter 0.8 Kilowatts No Load Test @ 10 volts Drive Pinion Speed at:	 Minimum 60 - Maximum 98 amps 6,000-12,000 rpm
Solenoid Hold-in Windings @ 10 volts Pull-in Windings @ 10 volts	 13-19 amps 59-79 amps
Starter 1.4 Kilowatts No Load Test @ 12.2 volts Drive Pinion Speed at:	 Minimum 40 - Maximum 90 amps 3,200-4,800 rpm
Solenoid Hold-in Windings @ 10 volts Pull-in Windings @ 10 volts	 13-19 amps 59-79 amps

GENERATOR SPECIFICATIONS

Application	Description
Types	CS-121D CS-128D

BATTERY SPECIFICATIONS

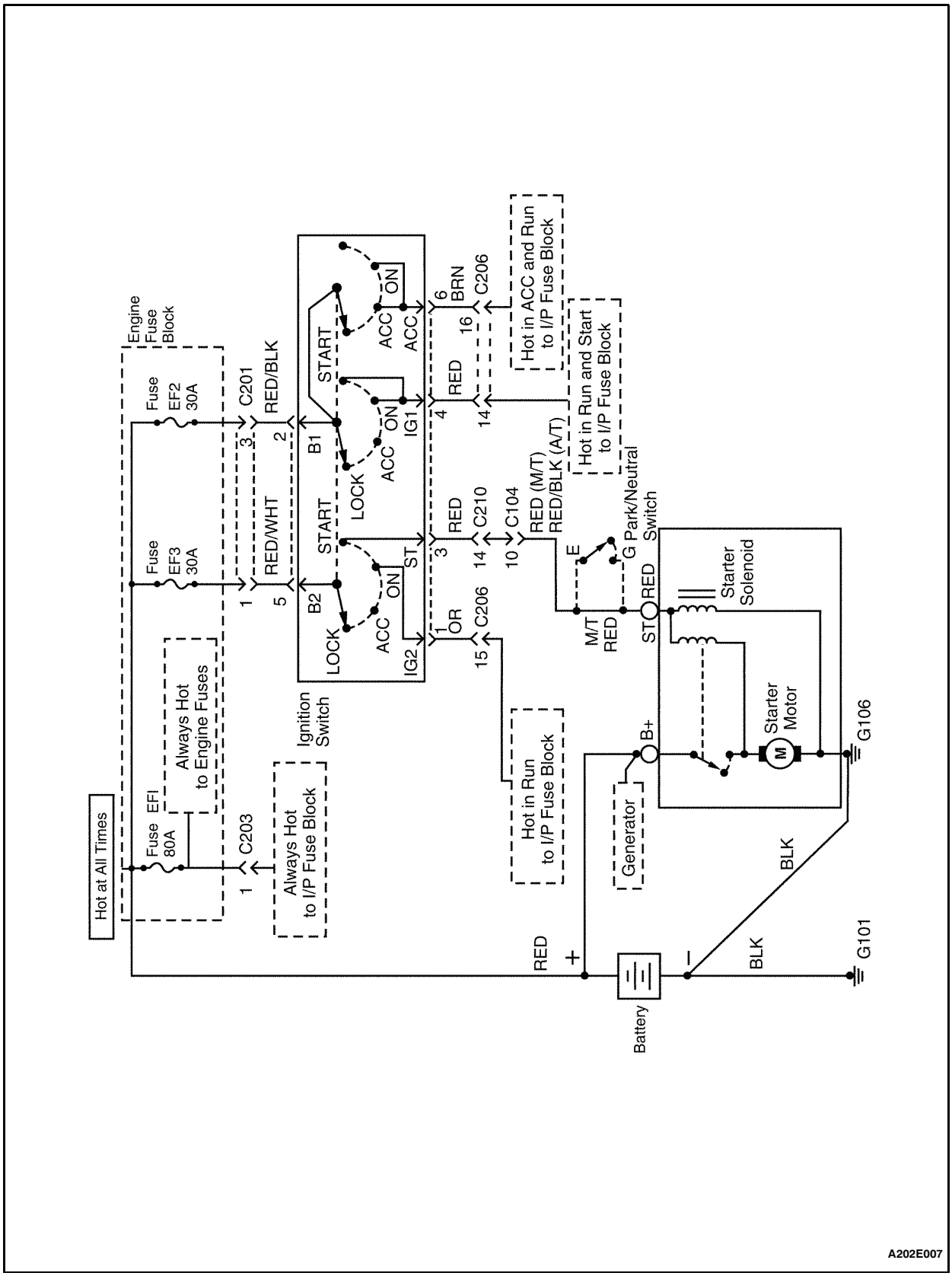
Application	Description
L4 Engine	
Cold Cranking Amps	550 amps
RC (Minimum)	90 minutes
Load Test	270 amps
Replacement	85B-60
Minimum Voltage: 9.6 9.4 9.1 8.8 8.5 8.0	Estimated Temperature: 21_C (70_F) 20_C (68_F) 0_C (32_F) * 10_C (14_F) * 18_C (0.4_F) Below * 18_C (Below 0_F)

FASTENER TIGHTENING SPECIFICATIONS

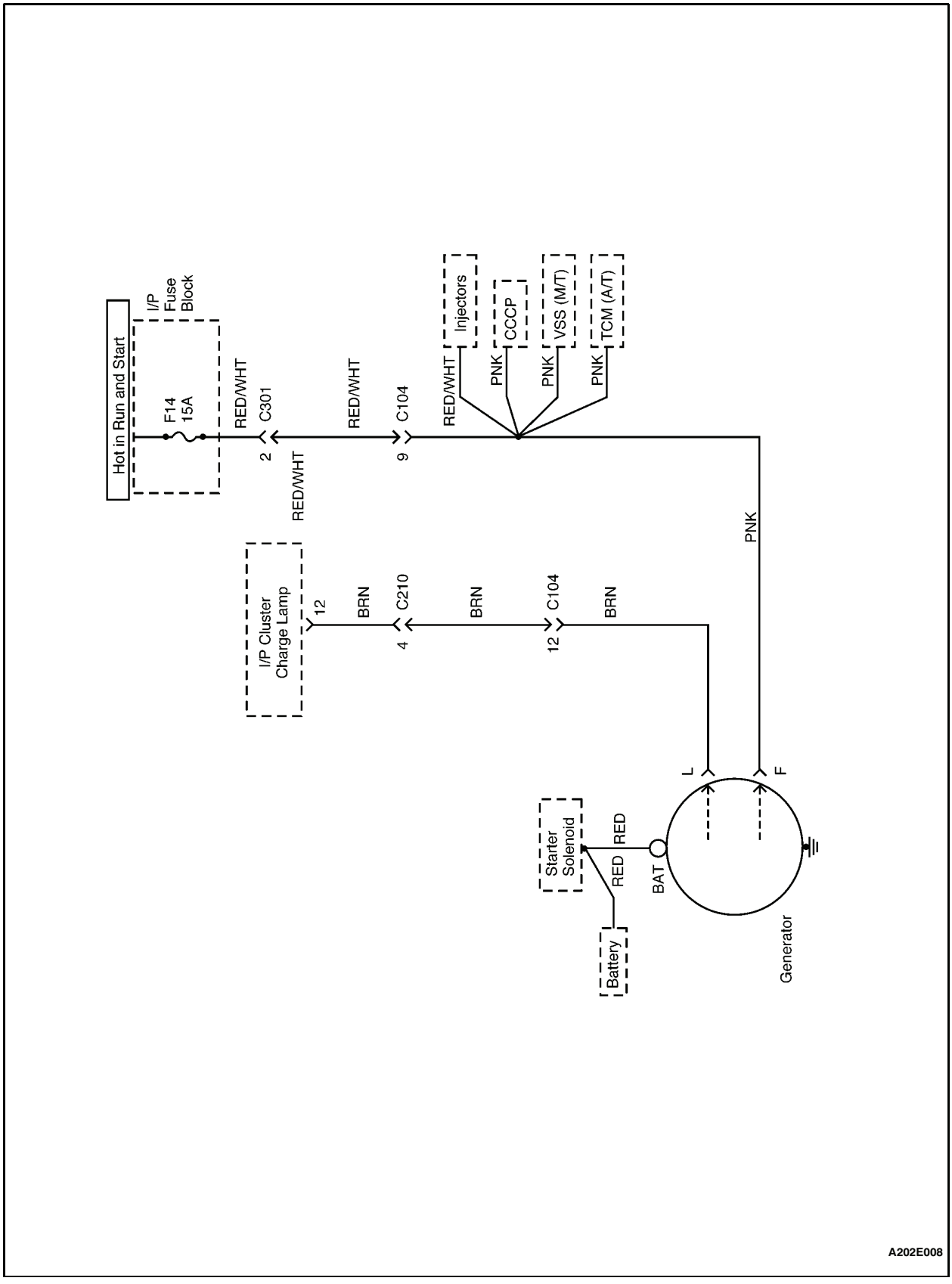
Application	NSm	Lb-Ft	Lb-In
Battery Cable Nuts	15	11	-
Battery Carrier Tray Lower Bolts	20	15	-
Battery Carrier Tray Upper Bolts	20	15	-
Battery Retainer Clamp-to-Battery Rod Nuts	5	-	44
Fuel Rail Retaining Bolts	20	15	-
Generator Battery Lead Connector Nut	15	11	-
Generator Drive End Bearing Nut (CS-121D)	81	60	-
Generator Drive End Nut (CS-128D)	100	74	-
Generator Lower Bracket-to-Generator	20	15	-
Generator Shackle Bracket Bolt	20	15	-
Generator Through-Bolts (CS-121D)	10	-	89
Generator Through-Bolts (C5-128D)	25	18	-
Starter End Frame-to-Brush Holder Assembly Bolts (0.8 Kilowatts)	3	-	27
Starter Field Connector Nut	8	-	71
Starter Mounting Studs	43	32	-
Starter Solenoid Assembly Screws	8	-	71
Starter Solenoid-to-Ignition Terminal Nut	6	-	53
Starter Through-Bolts	6	-	53
Starter Solenoid Terminal-to-Battery Cable Nut	7	-	62

SCHEMATIC AND ROUTING DIAGRAMS

STARTING SYSTEM



CHARGING SYSTEM



DIAGNOSIS

NO CRANK

Step	Action	Value(s)	Yes	No
1	1. Turn the headlamps ON. 2. Turn the dome lamps ON. 3. Turn the key to START. Do the lights dim or go out?	-	Go to Step 2	Go to Step 8
2	Check the battery state of charge. Is the green eye showing from the built-in hydrometer?	-	Go to Step 3	Go to "Charging Procedure"
3	1. Connect the voltmeter positive lead to the positive battery terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Turn the ignition to START. Does the voltmeter indicate the value specified?	< 9.6 v	Go to "Charging Procedure"	Go to Step 4
4	1. Connect the voltmeter negative lead to the negative battery terminal. 2. Connect the voltmeter positive lead to the engine block. 3. Place the ignition in the START position. Does the voltmeter indicate the value specified?	> 0.5 v	Go to Step 5	Go to Step 6
5	1. Clean and tighten the negative battery cable connections both at the battery end and at the ground end. 2. Replace the cable if needed. Is the repair complete?	-	System OK	-
6	1. Connect the voltmeter positive lead to the starter "B" terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Check the cranking voltage. Does the voltmeter indicate the value specified?	< 9 v	Go to Step 7	Go to Step 13
7	Clean, tighten, or replace the positive battery cable. Is the repair complete?	-	System OK	-
8	Check system fuse EF3 in the engine fuse block. Is fuse EF3 blown?	-	Go to Step 9	Go to Step 10
9	Replace system fuse EF3. Is the repair complete?	-	System OK	-
10	Check the connection at the starter "S" terminal. Is the connection in good condition?	-	Go to Step 12	Go to Step 11
11	Repair the starter "S" terminal. Is the repair complete?	-	System OK	-
12	1. Connect the voltmeter positive lead to the starter "S" terminal. 2. Connect the voltmeter negative lead to the negative battery terminal. 3. Place the ignition in the START position. 4. Read the voltage present at the "S" terminal. Does the voltmeter indicate the specified value?	> 7 v	Go to Step 13	Go to Step 14

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
13	Repair or replace the starter. Is the repair complete?	-	System OK	-
14	Turn on the heater blower. Does the blower operate?	-	Go to Step 24	Go to Step 15
15	1. Disconnect connector C201. 2. Connect the voltmeter positive lead to terminal 1 of connector C201. 3. Connect the voltmeter negative terminal to ground. Does the voltmeter indicate the specified value?	12 v	Go to Step 17	Go to Step 16
16	Repair the open in the RED/WHT wire from fuse EF3 to Connector C201. Is the repair complete?	-	System OK	-
17	Check the contacts of terminal 1 on connector C201. Are the contacts OK?	-	Go to Step 19	Go to Step 18
18	Repair the faulty contact of connector C201. Is the repair complete?	-	System OK	-
19	1. Reconnect connector C201. 2. Disconnect the ignition switch connector. 3. Connect the voltmeter positive lead to terminal 5 of the ignition switch connector. 4. Connect the voltmeter negative terminal to ground. Does the voltmeter indicate the specified value?	11-14 v	Go to Step 21	Go to Step 20
20	Repair the open in the RED/WHT wire from terminal 1 of connector C201 to terminal 5 of the ignition switch connector. Is the repair complete?	-	System OK	-
21	Check the contacts of terminal 5 of the ignition switch connector. Are the contacts OK?	-	Go to Step 23	Go to Step 22
22	Repair the faulty contact of the ignition switch connector. Is the repair complete?	-	System OK	-
23	Replace the ignition switch. Is the repair complete?	-	System OK	-
24	Does the vehicle have an automatic transmission?	-	Go to Step 25	Go to Step 35
25	1. Disconnect the Park/Neutral switch connector. 2. Connect the voltmeter positive lead to the Park/Neutral switch connector terminal E, connected to the RED/BLK wire. 3. Connect the voltmeter negative lead to the negative battery terminal. 4. Place the ignition in the START position. Does the voltmeter indicate the value specified?	< 7 v	Go to Step 26	Go to Step 31
26	Check continuity between the Park/Neutral switch connector terminal G, connected to the RED wire, and the Park/Neutral switch connector terminal E, connected to the RED/BLK wire. Does the ohmmeter indicate the specified value?	0 W	Go to Step 27	Go to Step 30

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
27	Check the condition of terminals E and G on both the Park/Neutral switch connector and on the Park/Neutral switch. Are any of these terminals faulty?	-	Go to Step 28	Go to Step 29
28	Repair the faulty terminal. Is the repair complete?	-	System OK	-
29	Repair the open in the RED wire between terminal G of the Park/Neutral switch connector and the starter "S" terminal. Is the repair complete?	-	System OK	-
30	Replace the Park/Neutral switch. Is the repair complete?	-	System OK	-
31	1. Reconnect the Park/Neutral switch. 2. Disconnect connector C104. 3. Connect the voltmeter positive lead to terminal 10 of connector C104 on the ECM/ABS harness. 4. Connect the voltmeter negative lead to ground. 5. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 32	Go to Step 39
32	Check terminal 10 on both sides of connector C104. Is one of them faulty?	-	Go to Step 33	Go to Step 34
33	Repair the faulty terminal. Is the repair complete?	-	System OK	-
34	Repair the open in the RED/BLK wire from terminal 10 of connector C104 to terminal E of the Park/Neutral switch. Is the repair complete?	-	System OK	-
35	1. Disconnect connector C104. 2. Connect the voltmeter positive lead to terminal 10 of connector C104 on the ECM/ABS harness. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 36	Go to Step 39
36	Check terminal 10 on both sides of connector C104. Is one of them faulty?	-	Go to Step 37	Go to Step 38
37	Repair the faulty terminal. Is the repair complete?	-	System OK	-
38	Repair the open in the RED wire from terminal 10 of connector C104 to the starter "S" terminal. Is the repair complete?	-	System OK	-
39	1. Disconnect connector C210. 2. Connect the voltmeter positive lead to terminal 14 of connector C210 on the I/P harness. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 40	Go to Step 43
40	Check terminal 14 on both sides of connector C210. Is one of them faulty?	-	Go to Step 41	Go to Step 42
41	Repair the faulty terminal. Is the repair complete?	-	System OK	-

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
42	Repair the open in the RED wire from terminal 14 of connector C210 to terminal 10 of connector C104. Is the repair complete?	-	System OK	-
43	1. Disconnect the ignition switch connector. 2. Connect the voltmeter positive lead to terminal ST of the ignition switch. 3. Connect the voltmeter negative lead to ground. 4. Turn the ignition switch to START. Does the voltmeter indicate the specified value?	12 v	Go to Step 45	Go to Step 44
44	Replace the ignition switch. Is the repair complete?	-	System OK	-
45	Check terminal ST on the ignition switch and terminal 3 of the ignition switch connector. Are the terminals in good condition?	-	Go to Step 46	Go to Step 47
46	Repair the open in RED wire between terminal 3 of the ignition switch connector and terminal 14 of connector C210. Is the repair complete?	-	System OK	-
47	Repair the faulty terminal. Is the repair complete?	-	System OK	-

STARTER MOTOR NOISE

To correct starter motor noise during starting, use the following procedure:

Checks	Action
Check for a high-pitched whine during cranking, before the engine fires. The engine cranks and fires properly.	The distance is too great between the starter pinion and the flywheel. Shimming the starter toward the flywheel is required.
Check for a high-pitched whine after the engine fires, as the key is being released. The engine cranks and fires properly. This intermittent complaint is often diagnosed as "starter hang-in" or "solenoid weak."	The distance is too small between the starter pinion and the flywheel. Shimming the starter away from the flywheel is required.
Check for a loud "whoop" after the engine fires but while the starter is still held engaged. The sound is like a siren if the engine is revved while the starter is engaged.	The most probable cause is a defective clutch. A new clutch will often correct this problem.
Check for a "rumble," a "growl," or, in severe cases, a "knock" as the starter is coasting down to a stop after starting the engine.	The most probable cause is a bent or an unbalanced starter armature. A new armature will often correct this problem.

If the complaint is noise, correction can be achieved by proper shimming as follows:

1. Check for a bent or a worn flywheel.
2. Start the engine and carefully touch the outside diameter of the rotating flywheel ring gear with chalk or a crayon to show the high point of the tooth runout. Turn the engine OFF and rotate the flywheel so that the marked teeth are in the area of the starter pinion gear.
3. Disconnect the negative battery cable to prevent the cranking of the engine.
4. Check the pinion-to-flywheel clearance by using a wire gauge of 0.5 mm (0.02 inch) minimum thickness or diameter. Center a pinion tooth between two flywheel teeth and the gauge. Do not gauge in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.
5. If the clearance approaches 1.5 mm (0.06 inch) or more, shimming the starter toward the flywheel is required. This condition is generally the cause of broken flywheel teeth or a broken starter housing. Shim the starter toward the flywheel by shimming only the outboard starter mounting pad. A shim of 0.40 mm (0.016 inch) thickness at this location will decrease the clearance by approximately 0.30 mm (0.012 inch). If normal starter shims are not available, plain washers or other suitable material may be used as shims.

BATTERY LOAD TEST

1. Check the battery for obvious damage, such as a cracked or broken case or cover, which could permit the loss of electrolyte. If damage is obvious, replace the battery.

Caution: Do not charge the battery if the hydrometer is clear or light yellow. Instead, replace the battery. If the battery feels hot or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce the charging rate to avoid injury.

2. Check the hydrometer. If the green dot is visible, go to the load test procedure. If the indicator is dark but green is not visible, charge the battery. For charging a battery removed from the vehicle, refer to "Charging a Completely Discharged Battery (Off the Vehicle)" in this section.
3. Connect a voltmeter and a battery load tester across the battery terminals.
4. Apply a 300-ampere load for 15 seconds to remove any surface charge from the battery.
5. Remove the load.
6. Wait 15 seconds to let the battery recover, and apply a 270-ampere load.

Important: The battery temperature must be estimated by touch and by the temperature condition the battery has been exposed to for the preceding few hours.

7. If the voltage does not drop below the minimum listed, the battery is good and should be reinstalled. If the voltage is less than the minimum listed, replace the battery. Refer to "Battery Specifications" in this section.

GENERATOR OUTPUT TEST

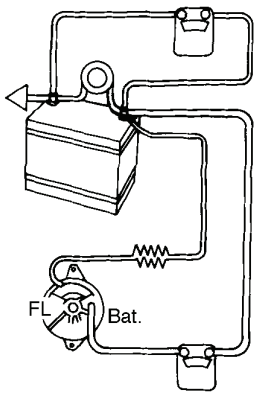
1. Perform the generator system test. Refer to "Generator System Check" in this section.
2. Replace the generator if it fails that test. Refer to "Generator" in the On-Vehicle Service section. If it passes the test, perform the on-vehicle output check which follows.

Important: Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator.

3. Attach a digital multimeter, an ammeter, and a carbon pile load to the vehicle.

Important: Be sure the vehicle battery is fully charged, and the carbon pile load is turned off.

4. With the ignition switch in the OFF position, check and record the battery voltage.
5. Remove the harness connector from the generator.
6. Turn the ignition switch to the RUN position with the engine not running. Use a digital multimeter to check for voltage in the harness connector "L" terminal.
7. The reading should be near the specified battery voltage of 12 volts. If the voltage is too low, check the indicator "L" terminal circuits for open and grounded circuits causing voltage loss. Correct any open wires, terminal connections, etc., as necessary. Refer to "Charging System" in this section.
8. Attach the generator harness connector.
9. Run the engine at a moderate idle, and measure the voltage across the battery terminals. The reading should be above that recorded in Step 14 but less than 16 volts. If the reading is over 16 volts or below the previous reading, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
10. Run the engine at a moderate idle, and measure the generator amperage output.
11. Turn on the carbon pile, and adjust it to obtain the maximum amps while maintaining the battery voltage above 13 volts.
12. If the reading is within 15 amps of the generator's rating noted on the generator, the generator is good. If not, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
13. With the generator operating at the maximum output, measure the voltage between the generator housing and the battery negative terminal. The voltage drop should be 0.5 volt or less. If the voltage drop is more than 0.5 volt, check the ground path from the generator housing to the negative battery cable.
14. Check, clean, tighten, and recheck all of the ground connections.



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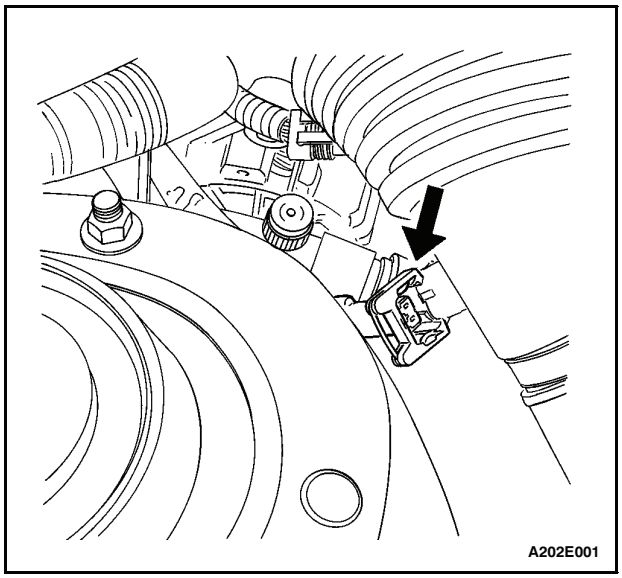
GENERATOR SYSTEM CHECK

When operating normally, the generator indicator lamp will come on when the ignition switch is in the RUN position and go out when the engine starts. If the lamp operates abnormally or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight or by a defective switch that allows a lamp, such as a trunk or glove box lamp, to stay on.

Diagnose the generator with the following procedure:

1. Visually check the belt and wiring.
2. With the ignition switch in the ON position and the engine stopped, the charge indicator lamp should be on. If not, detach the harness at the generator and ground the "L" terminal in the harness with a fused, 5-ampere jumper lead.
   - If the lamp lights, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
   - If the lamp does not light, locate the open circuit between the ignition switch and the harness connector. The indicator lamp bulb may be burned out.
3. With the ignition switch in the ON position and the engine running at moderate speed, the charge indicator lamp should be off. If not, detach the wiring harness at the generator.
   - If the lamp goes off, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
   - If the lamp stays on, check for a short to ground in the harness between the connector and the indicator lamp.

Important: Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator. Refer to "Generator" in the Unit Repair section.


A202E001

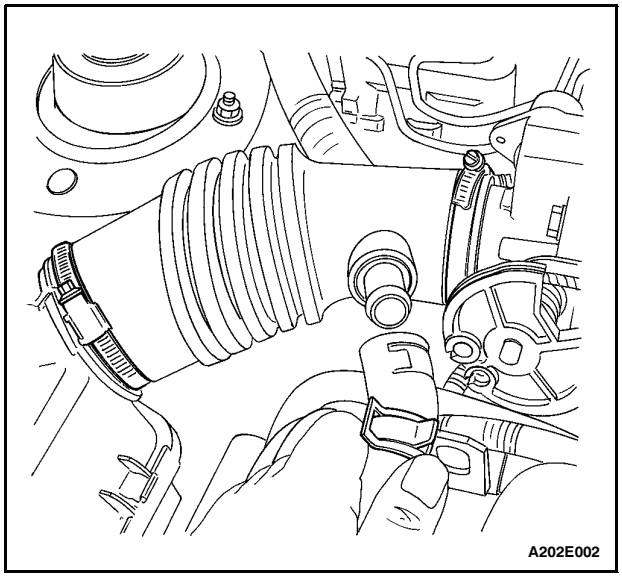
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

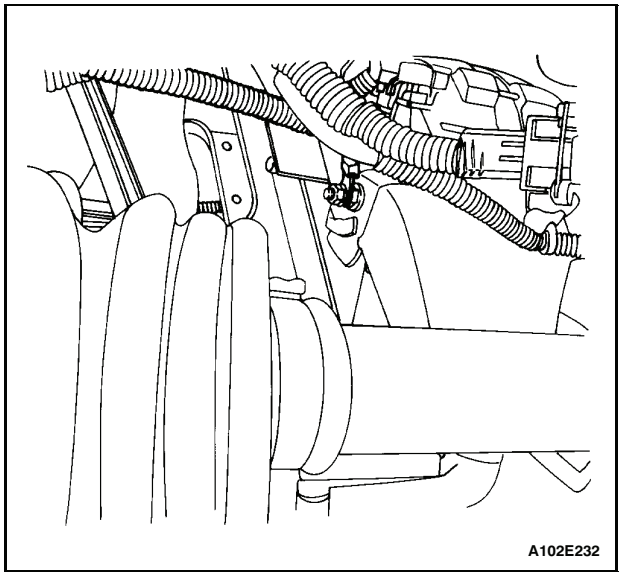
GENERATOR

Removal Procedure

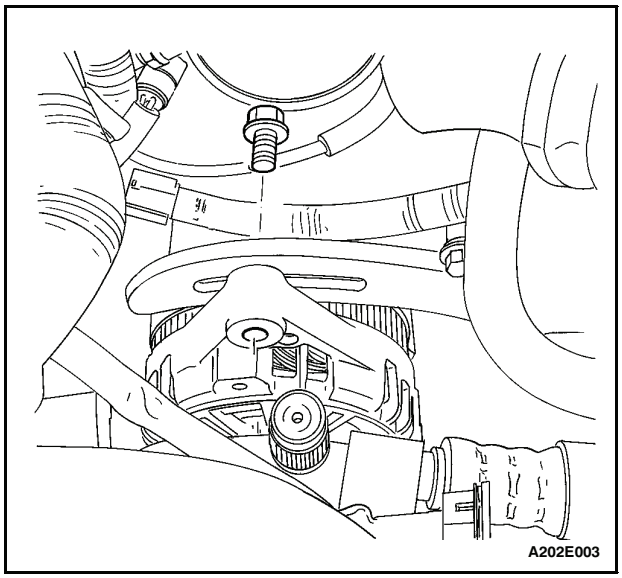
1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature (MAT) sensor electrical connector from the air intake tube.


A202E002

3. Remove the breather tube clamp and all other clamps to remove the air intake tube.


A102E232

4. Remove the battery harness connector nut from the generator.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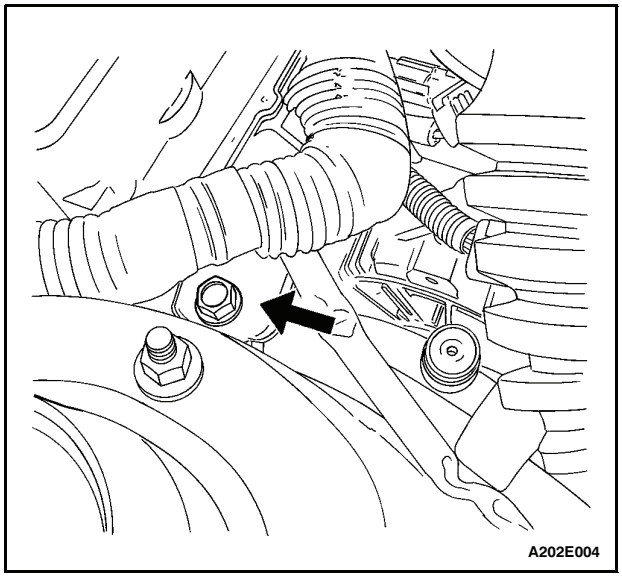
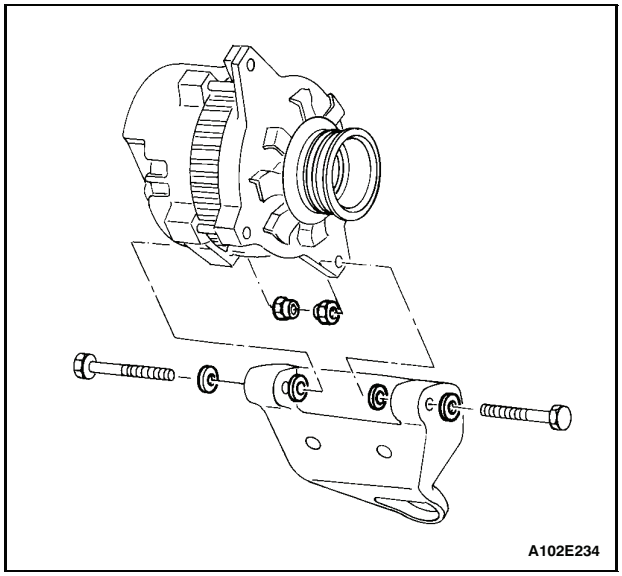
5. Remove the generator shackle bracket bolt and the washer.
6. Remove the serpentine accessory drive belt. For vehicles equipped with power steering and air conditioning, refer to Section 6B, Power Steering Pump for belt removal.


A202E004

7. Remove the bolt and the retaining clamp of the harness.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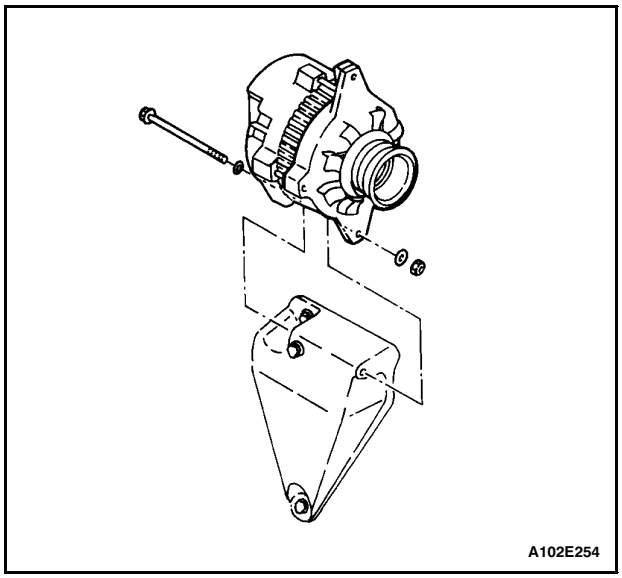
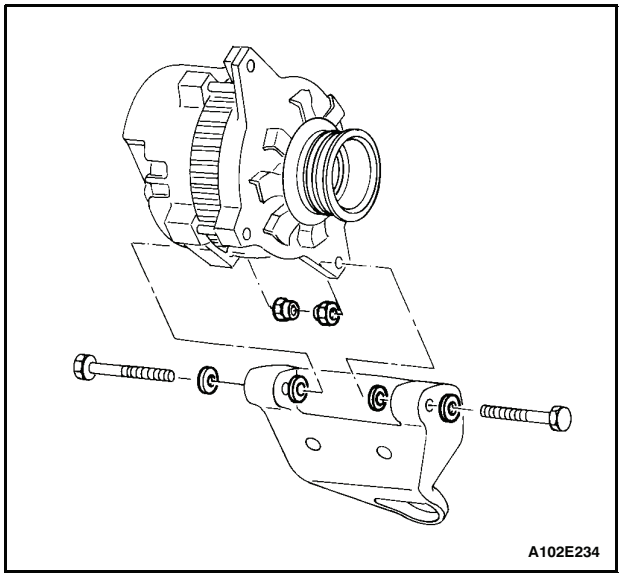
8. For vehicles with the SOHC engine, remove the nuts and the washers which hold the generator lower bracket-to-generator bolts.


A102E254

9. For vehicles with the DOHC engine, remove the throttle body. Refer to Section 1F, Engine Controls.
10. Remove the fuel rail mounting bolts.

Notice: Take extreme care not to damage the fuel injector O-rings to prevent fuel leaks when the fuel rail is reseated.

11. Unseat the fuel rails from the cylinder head, and slightly push the fuel rail assembly clear of the cylinder head in the direction of the master cylinder.
12. Remove the nut and the washers which hold the generator lower bracket-to-generator bolt.
13. Carefully remove the generator.

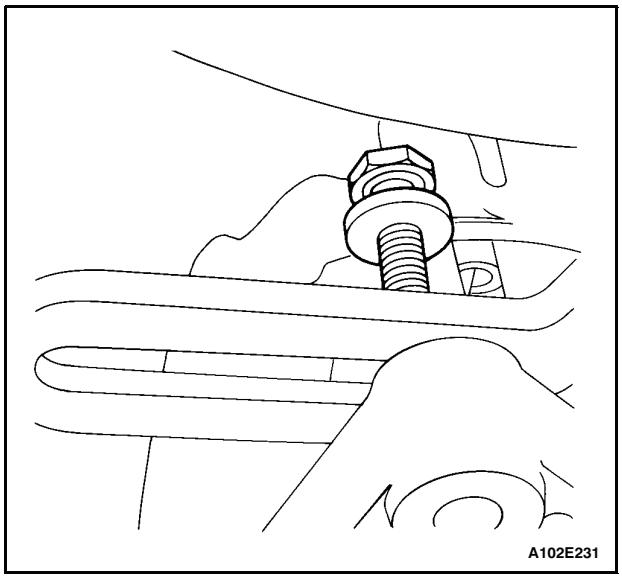

A102E234

Installation Procedure

1. Install the generator at the generator lower bracket and insert the generator bolts.
2. Install the nuts and the washers on the generator lower bracket-to-generator bolts (SOHC engine is shown).

Tighten

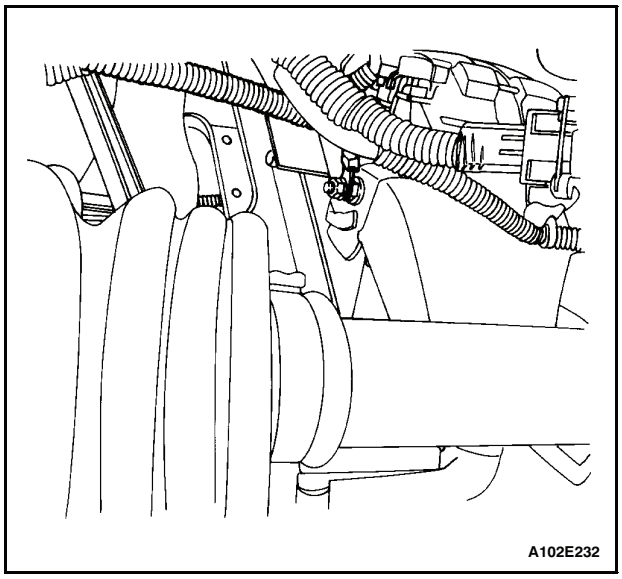
Tighten the generator lower bracket-to-generator nuts to 20 NSm (15 lb-ft).


A102E231

3. Install the serpentine accessory drive belt on vehicles not equipped with power steering and air conditioning.
4. Secure the generator to the shackle bracket with the bolt (SOHC engine is shown). For vehicles equipped with power steering and air conditioning, refer to SecĆ tion 6B, Power Steering Pump.

Tighten

Tighten the generator shackle bracket bolt to 20 NSm (15 lb-ft).


A102E232

5. Connect the harness connector to the back of the generator.
6. Install the generator lead to the battery and fasten the lead with the nut.

Tighten

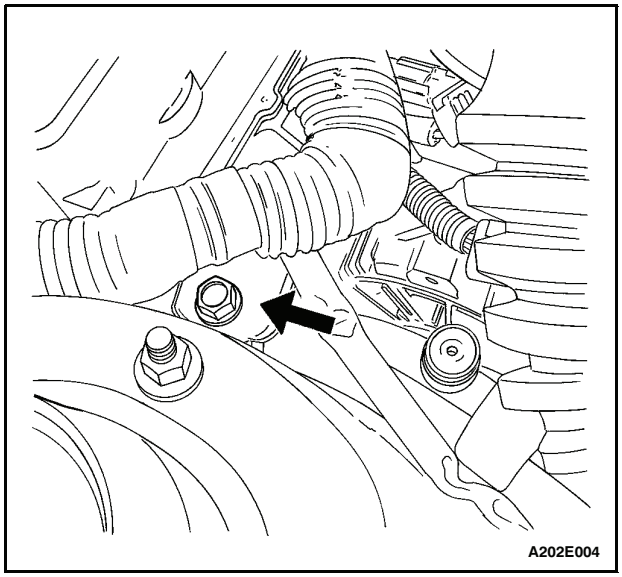
Tighten the generator battery lead connector nut to 15 NSm (11 lb-ft).

7. Lubricate the injector O-rings on the DOHC engine with engine oil.
8. Install the fuel rail assembly.

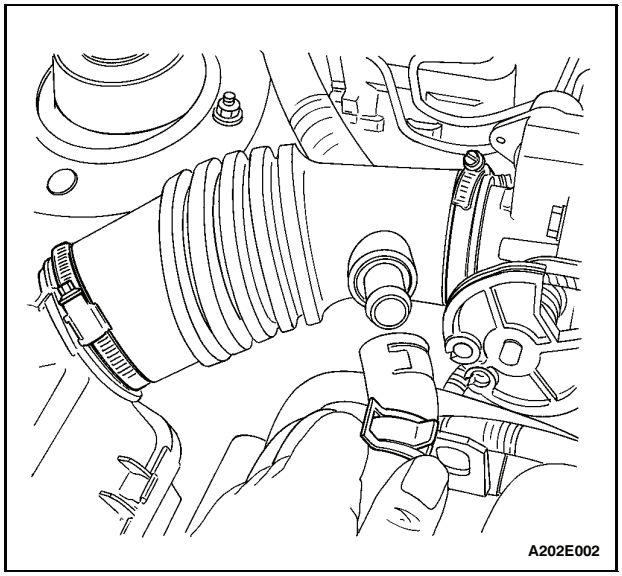
Tighten

Tighten the fuel rail retaining bolts to 20 NSm (15 lb-ft).

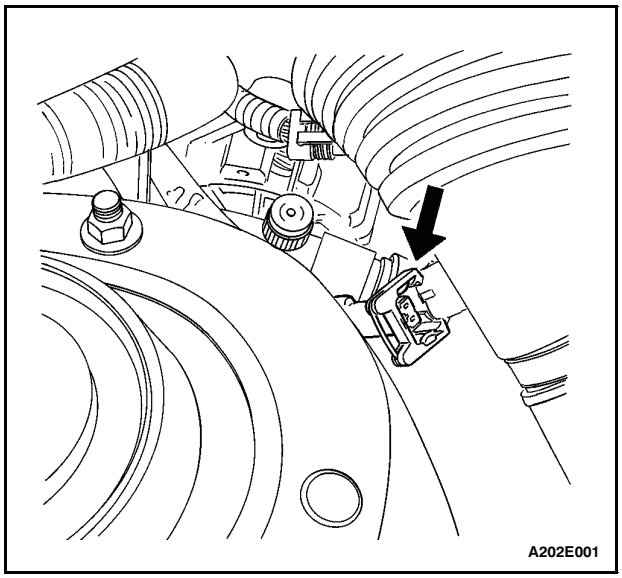
9. Install the throttle body. Refer to Section 1F, Engine Controls.


A202E004

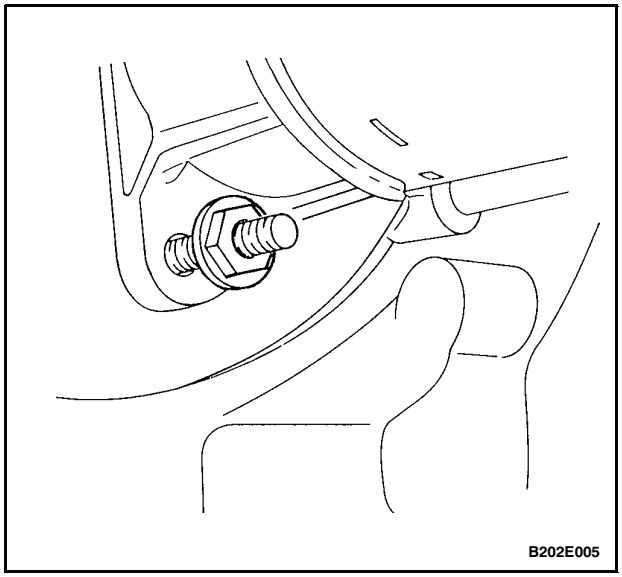
10. Install the harness retaining clamp bolt.


A202E002

11. Install the air intake tube and the connector.



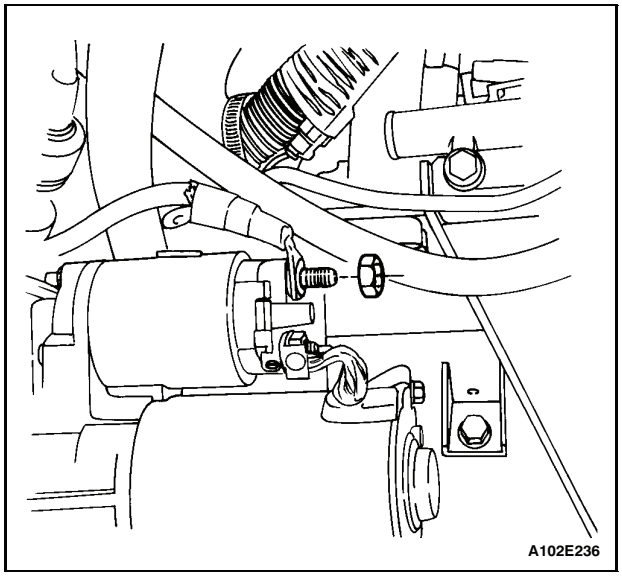
12. Install the MAT electrical connector to the air intake tube.
13. Connect the negative battery cable.



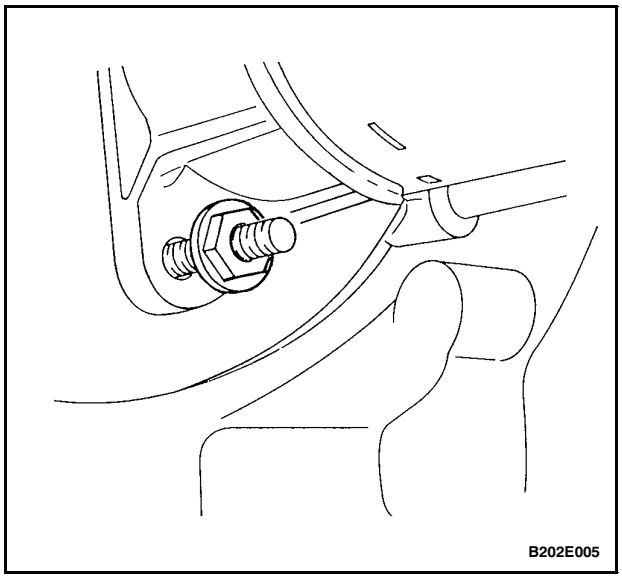
STARTER

Removal Procedure

1. Remove the nut that secures the starter ground wire to the mounting stud.
2. Remove the ground wire.
3. Remove the lower and then the upper starter stud/weld nut assemblies. (The lower stud/weld nut assembly is shown.)



4. Remove the starter solenoid nuts to disconnect the electrical cables.
5. Remove the starter assembly.

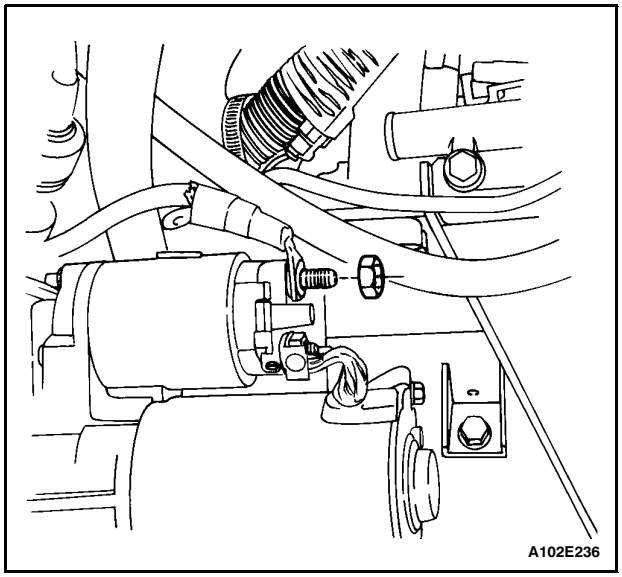

B202E005

Installation Procedure

1. Place the starter assembly in position using an assistant to prop up the starter to aid in fastening the upper mounting stud with the weld nut.
2. Install the upper and the lower starter mounting studs with the weld nuts.

Tighten

Tighten the starter mounting studs to 43 NSm (32 lb-ft).


A102E236

3. Position the starter electrical wires on the solenoid terminals.
4. Position the ground wire on the lower stud.
5. Install the starter solenoid nuts.

Tighten

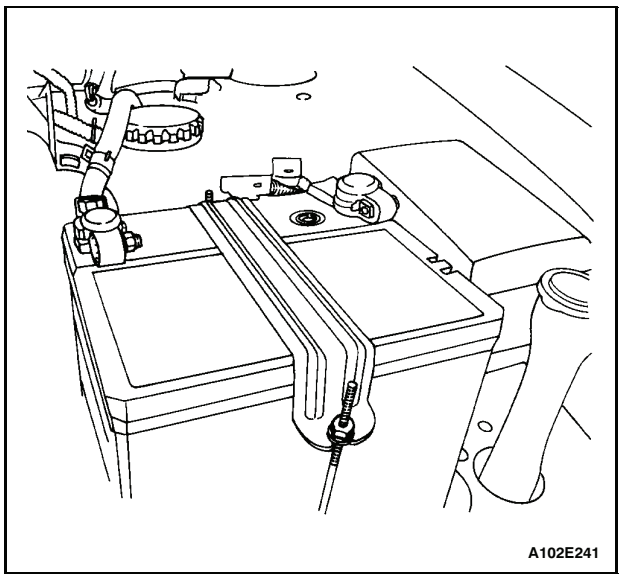
Tighten the starter solenoid terminal-to-battery cable terminal nut to 7 NSm (62 lb-in).

Tighten the starter solenoid terminal-to-ignition terminal nut to 6 NSm (53 lb-in).

6. Install the ground wire nut.

Tighten

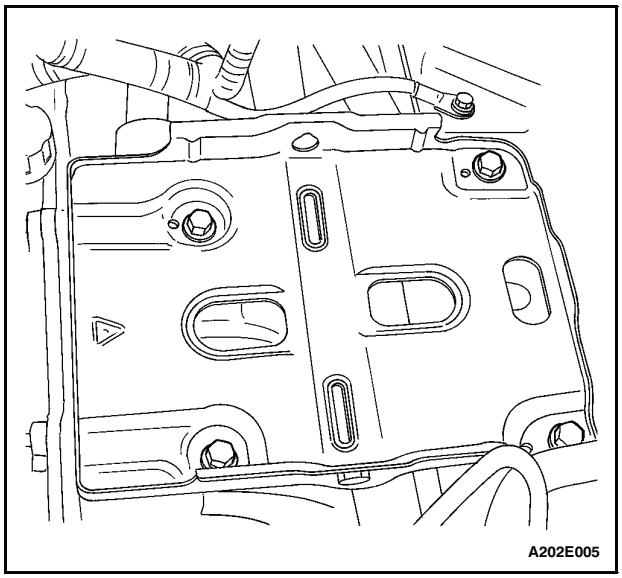
Tighten the ground wire terminal to the point at which it meets the nut. Then tighten the ground wire terminal an additional quarter turn.


A102E241

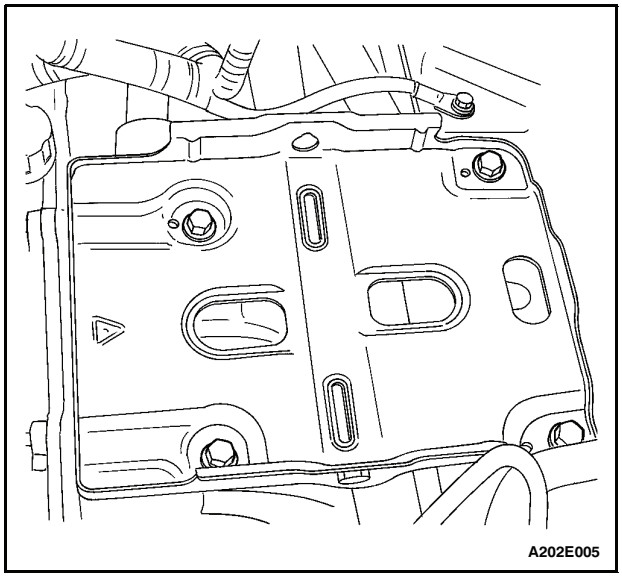
BATTERY/BATTERY TRAY

Removal Procedure

1. Disconnect the negative battery cable and then disconnect the positive battery cable.
2. Remove the nuts from the battery rods that fasten the battery hold-down bar clamp.


A202E005

3. Check the battery carrier tray for obvious cracks or damage. Detach the carrier tray if necessary by removing the upper and the lower bolts.

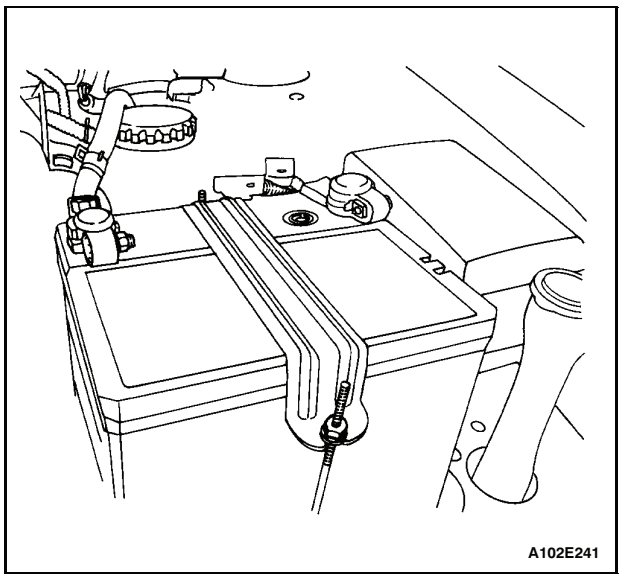

A202E005

Installation Procedure

1. Install the battery carrier by fastening the carrier tray upper and lower bolts.

Tighten

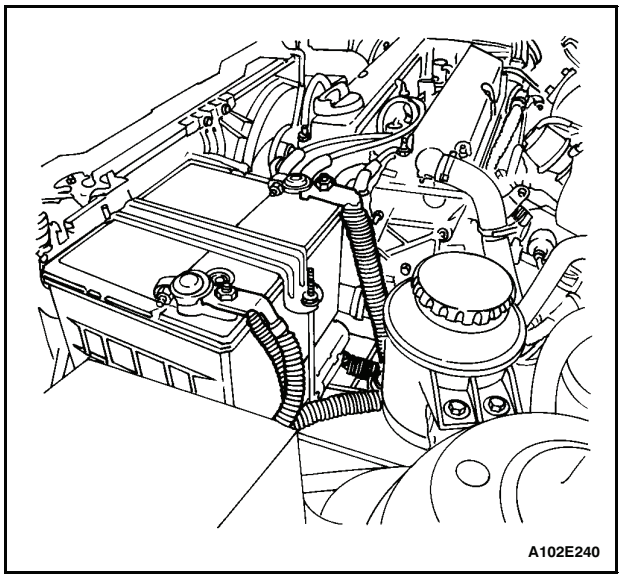
Tighten the battery carrier tray upper and lower bolts to 20 NSm (15 lb-ft).


A102E241

2. Install the battery into the tray.
3. Fasten the bar clamp to the battery by loosely attaching the battery rods from the battery tray cutouts through the bar clamp holes, and loosely tightening the nuts.

Tighten

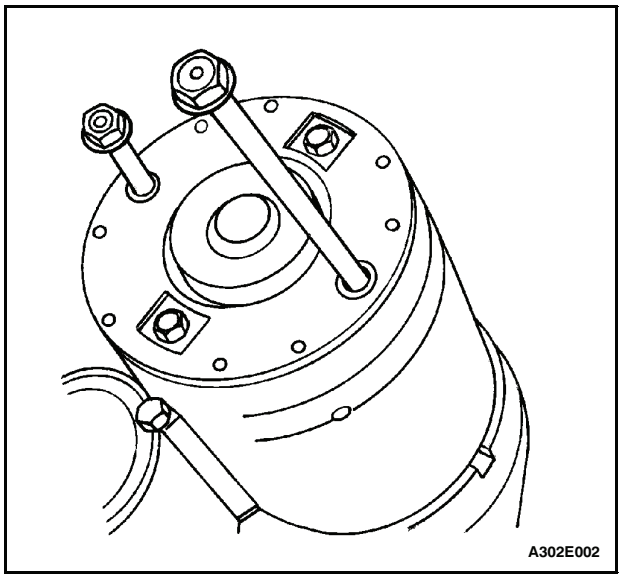
Tighten the battery retainer clamp-to-battery rod nuts to 5 NSm (44 lb-in).


A102E240

4. **Connect the negative and the positive battery cables.**

   Tighten

   Tighten the battery cable nuts to 15 NSm (11 lb-ft).

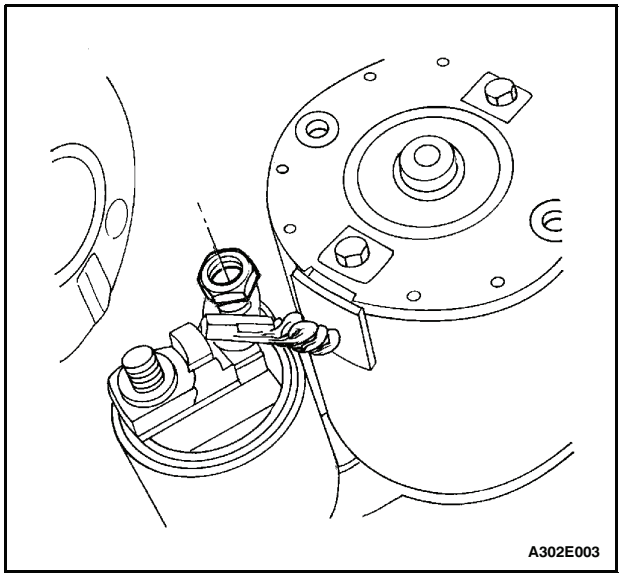

A302E002

UNIT REPAIR

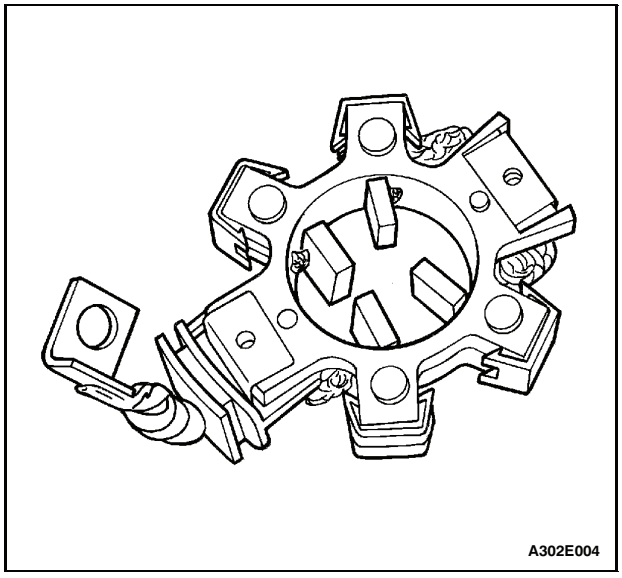
STARTER MOTOR (0.8 KILOWATTS)

Disassembly Procedure

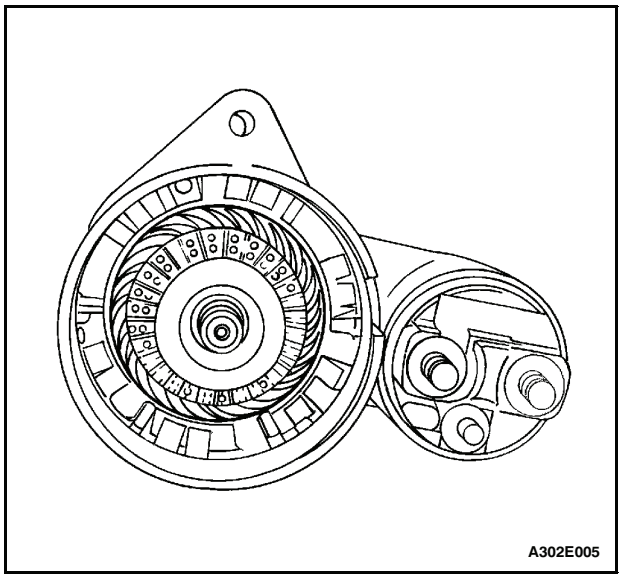
1. Remove the starter. Refer to "Starter" in this section.
2. Remove the starter through-bolts.


A302E003

3. Remove the field connector nut. Disconnect the field connector.

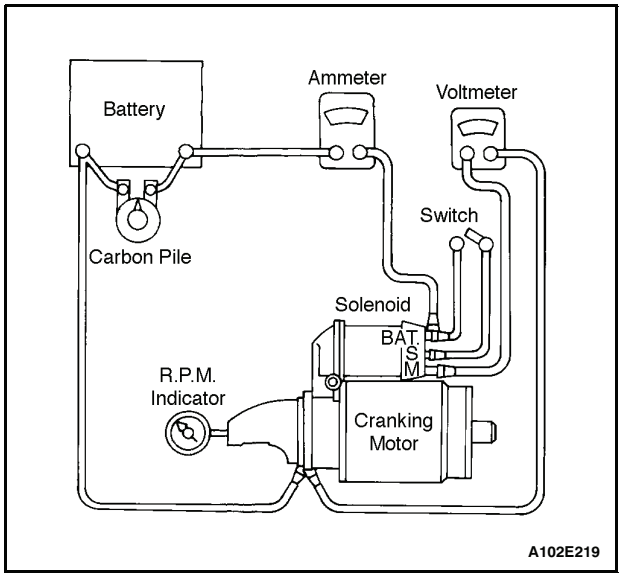

A302E004

4. Pry off the commutator end frame/brush/brush holder assembly from the field frame.
5. Remove the bolts that secure the end frame to the brush/brush holder assembly.
6. Inspect the brushes, the pop-out springs, and the plastic spring retainers for wear and damage. Replace the parts, if necessary.



A302E005

7. Check the armature to see if it turns freely. If the armature does not turn freely, break down the assembly beginning with Step 9. Otherwise, give the armature a no-load test.

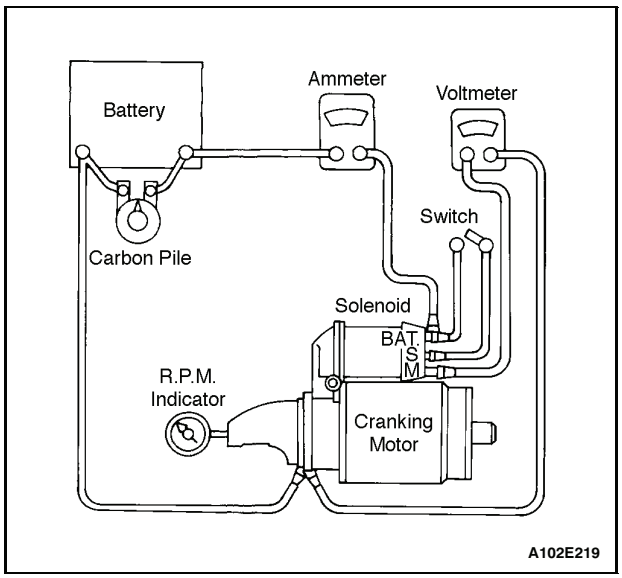


A102E219

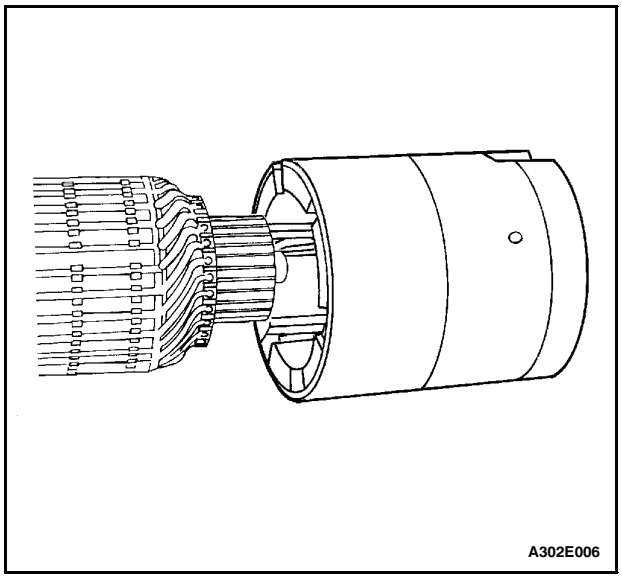
Important: If the specified current draw does not include the solenoid, deduct from the armature reading the specified current draw of the solenoid hold-in winding.

Notice: Complete the testing in a minimum amount of time to prevent overheating and damaging the solenoid.

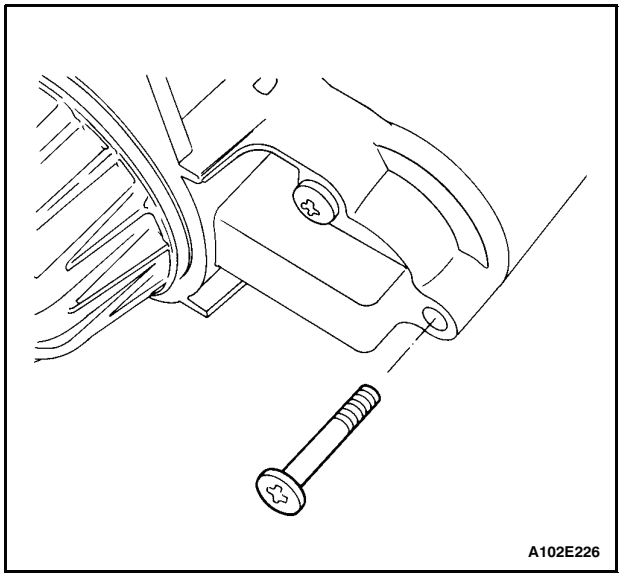
8. To begin the no-load test, close the switch and compare the rpm, the current, and the voltage readings with the specifications. Refer to "Starter Specifications" in this section. Make disconnections only with the switch open. Use the test results as follows:
   - 8.1. Rated current draw and no-load speed indicate a normal condition for the starter motor.
   - 8.2. Low free speed and high current draw indicate too much friction (tight, dirty, or worn bearings, or a bent armature shaft), a shorted armature, or a shorted armature and fields.
   - 8.3. Failure to operate with high current draw indicates a direct ground in the terminal or fields, or "frozen" bearings.
   - 8.4. Failure to operate with no current draw indicates an open field circuit, open armature coils, broken brush springs, worn brushes, high insulation between the commutator bars, or other causes which will prevent good contact between the brushes and the commutator.
   - 8.5. Low no-load speed and low current indicate high internal resistance and high current draw, which usually means shorted fields.



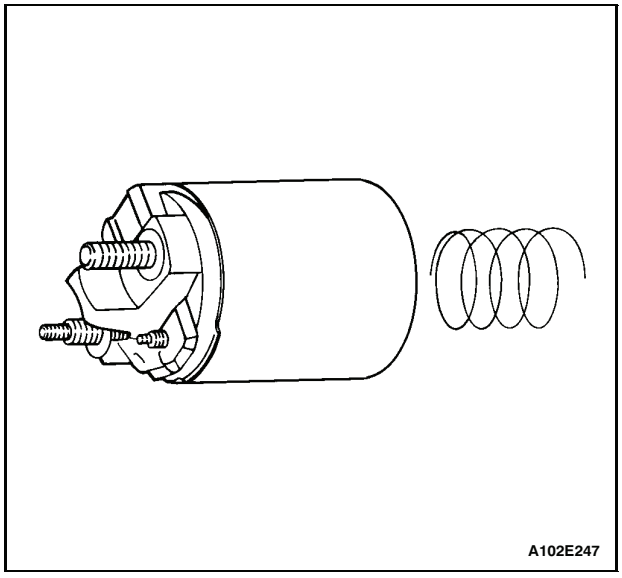
A102E219


A302E006

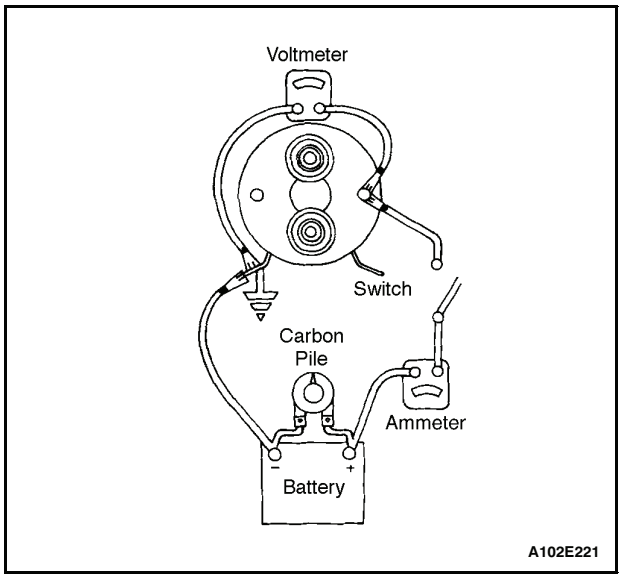
9. Separate the field frame from the armature assembly.


A102E226

10. Remove the solenoid assembly screws.


A102E247

11. Rotate the solenoid and remove it along with the plunger return spring.



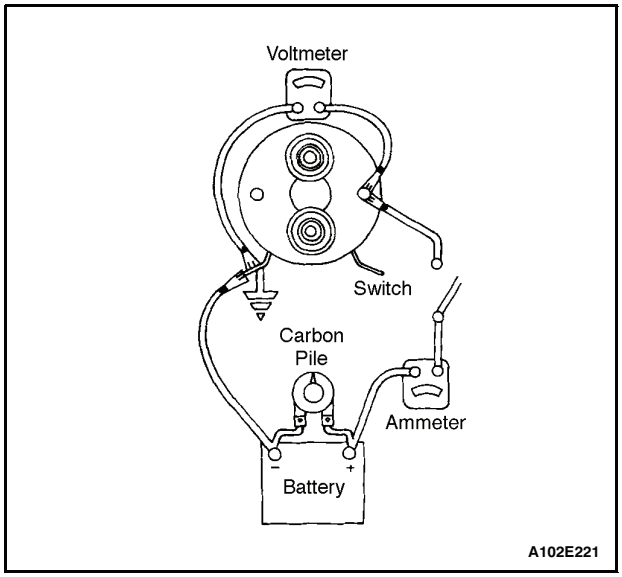
Important: If the solenoid is not removed from the starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests.

12. Test the solenoid windings by checking the current draw.

12.1. Check the hold-in windings by connecting an ammeter in series with a 12-volt battery, the switch terminal, and to ground.

12.2. Connect the carbon pile across the battery.

12.3. Adjust the voltage to 10 volts. The ammeter reading should be 13 to 19 amperes.



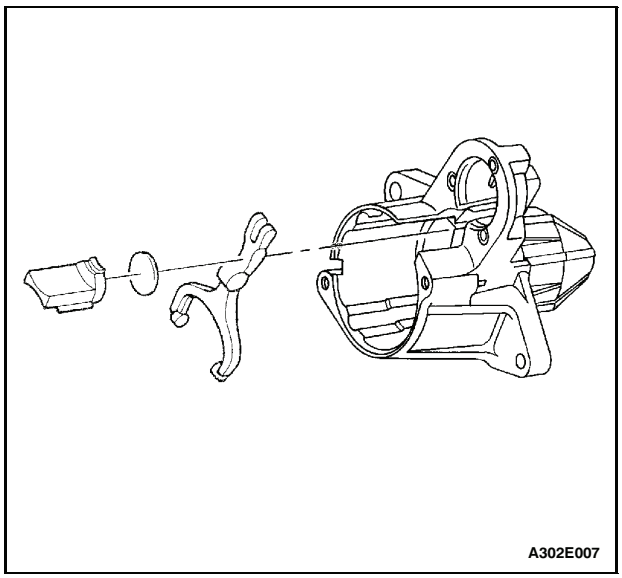
Important: Current will decrease as the windings heat up. Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid Both conditions require replacement of the solenoid. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit.

13. Check both windings, connecting them as in the preceding test.

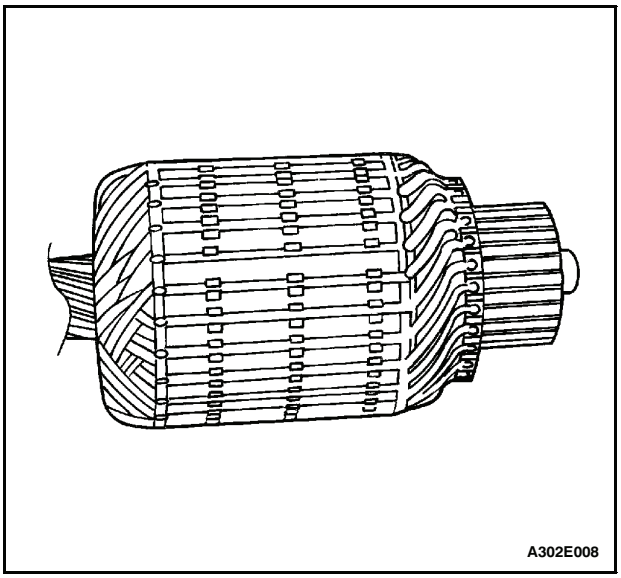
13.1. Ground the solenoid motor terminal.

13.2. Adjust the voltage to 10 volts. The ammeter reading should be 59 to 79 amperes.

13.3. Check the connections and replace the solenoid, if needed.

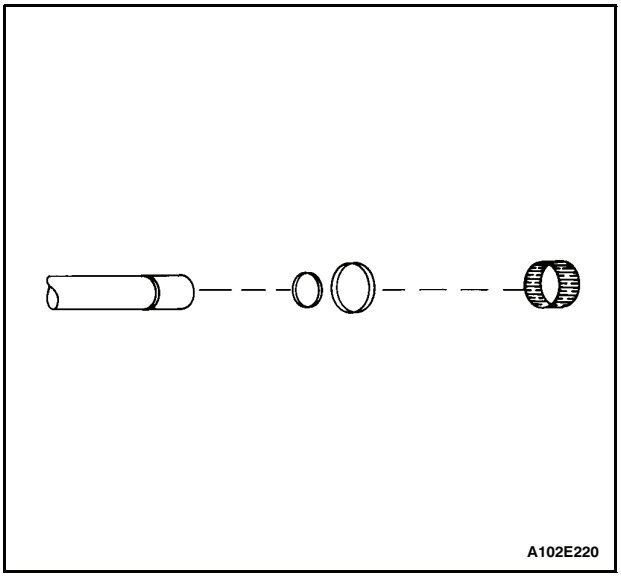


14. Remove the plunger with the boot and the shift lever assembly.



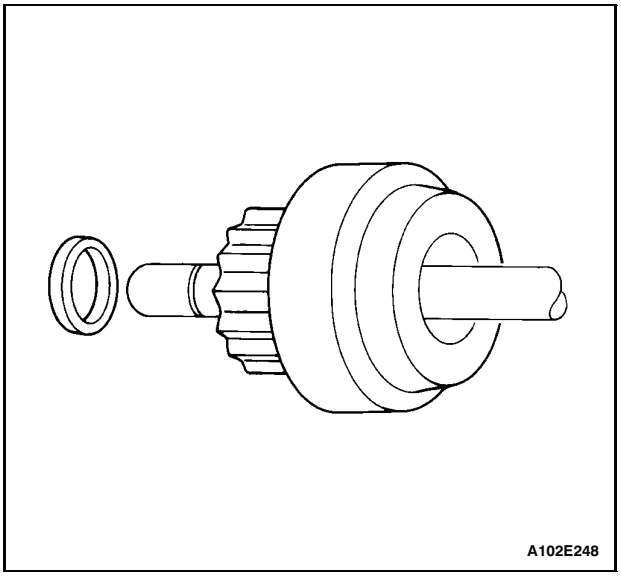
A302E008

15. Remove the armature assembly from the starter housing.



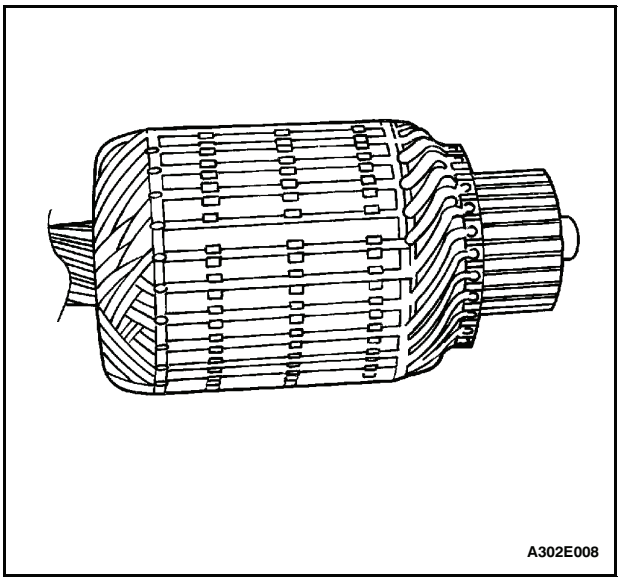
A102E220

16. Disassemble the shaft assembly by separating the bushing from the shaft.
17. Remove the collar and the locking ring from the groove on the shaft.



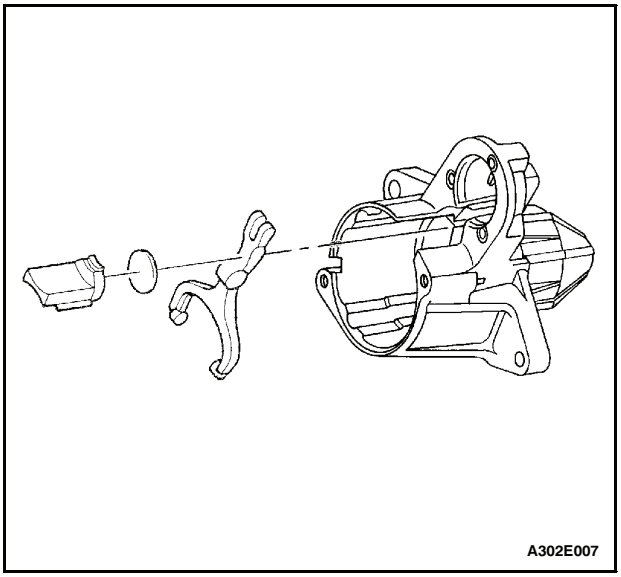
A102E248

18. Remove the pinion stop and the drive from the shaft.



A302E008

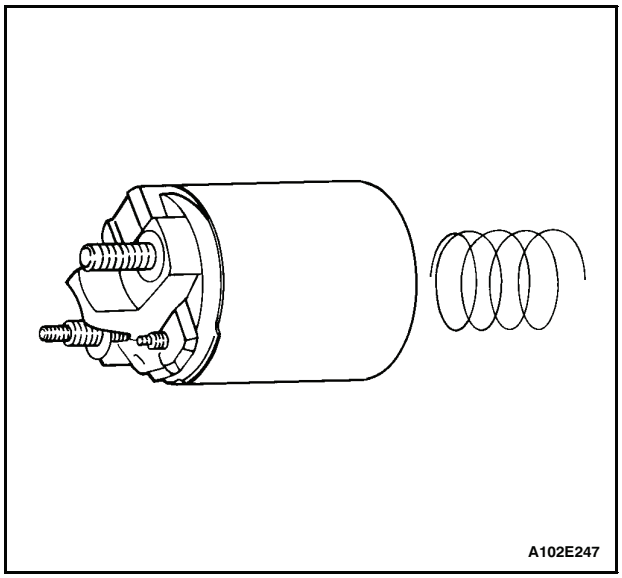
19. Inspect the armature shaft, the collar, and the pinion for discoloration, damage, or wear. Replace the parts, as needed.
20. Inspect the armature commutator. If the commutator is rough, it should be turned down. The outside diameter of the commutator must measure at least 41.91 mm (1.650 inches) after it is undercut or turned. Do not turn out-of-round commutators.
21. Inspect the points where the armature conductors join the commutator bars. Make sure the armature conductors and the commutator bars have a good connection. A burned commutator bar is usually evidence of a poor connection.
22. If test equipment is available, check the armature for short circuits by placing it on a growler and holding a saw blade over the armature core while the armature is rotated. If the saw blade vibrates, replace the armature.
23. Recheck the armature after cleaning between the commutator bars. If the saw blade vibrates, replace the armature.



A302E007

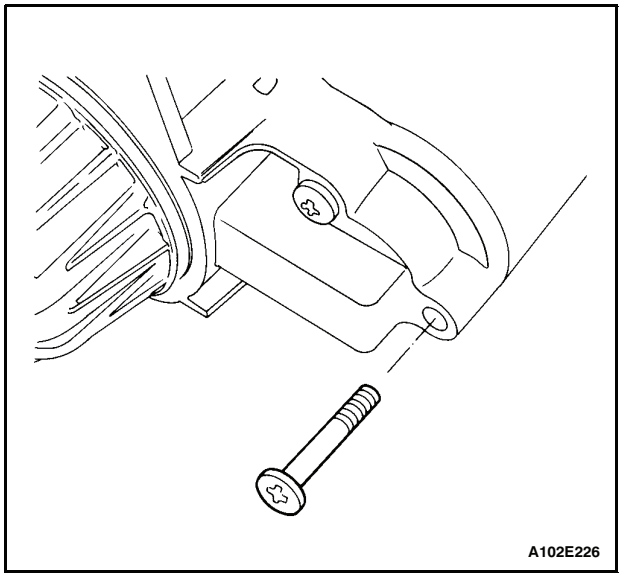
Assembly Procedure

1. Clean all of the starter motor parts, but do not use grease-dissolving solvents for cleaning the armature and the field coils.
2. Lubricate the drive and the bushings.
3. If proceeding with just the reassembly of the solenoid, perform Steps 4 and 5.
4. If the starter and the solenoid were fully disassembled, begin reassembly by installing the shift lever assembly with the plunger and the boot.



A102E247

5. Position the solenoid assembly and the return spring against the plunger, applying the sealer to the solenoid flange.

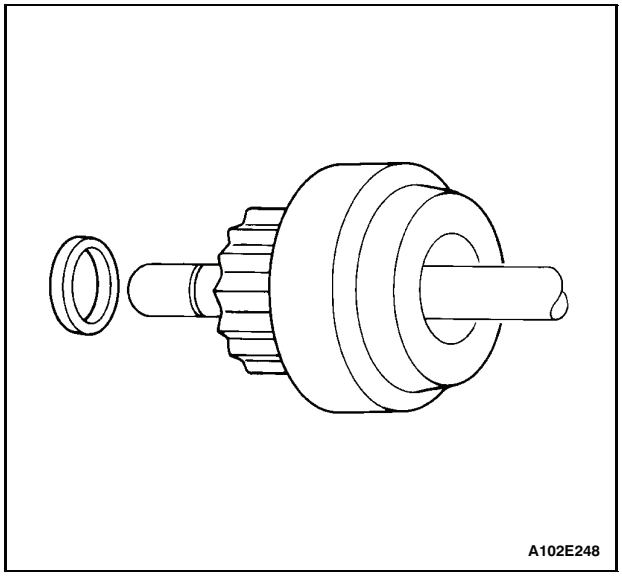


A102E226

6. Fasten the solenoid assembly with the screws.

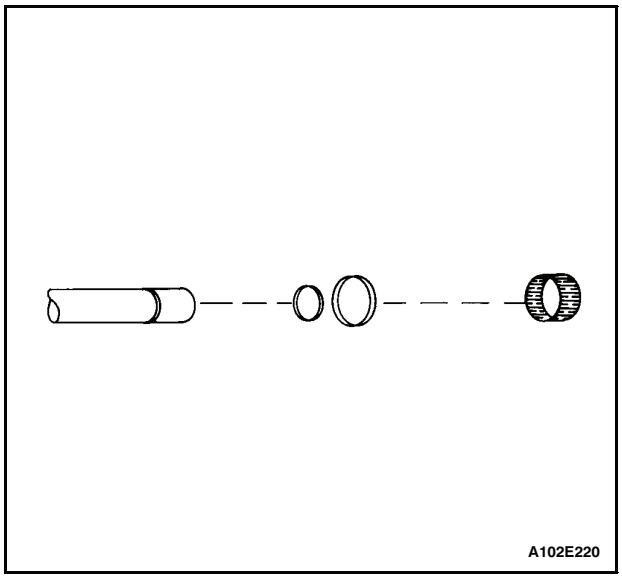
Tighten

Tighten the starter solenoid assembly screws to 8 NSm (71 lb-in).

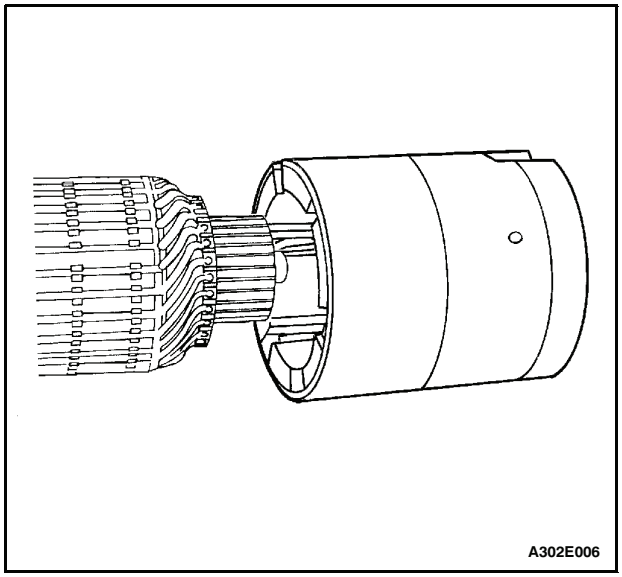


A102E248

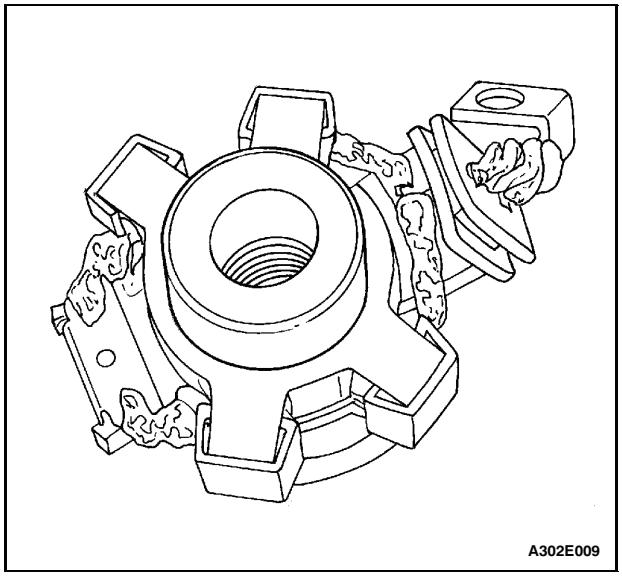
7. Install the drive and the pinion stop on the armature shaft.


A102E220

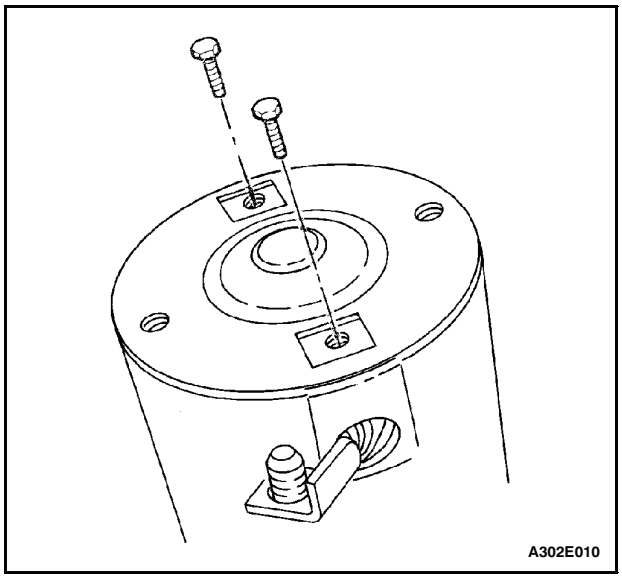
8. Install the lock ring into the groove on the armature shaft.
9. Insert the collar.


A302E006

10. Install the field frame.


A302E009

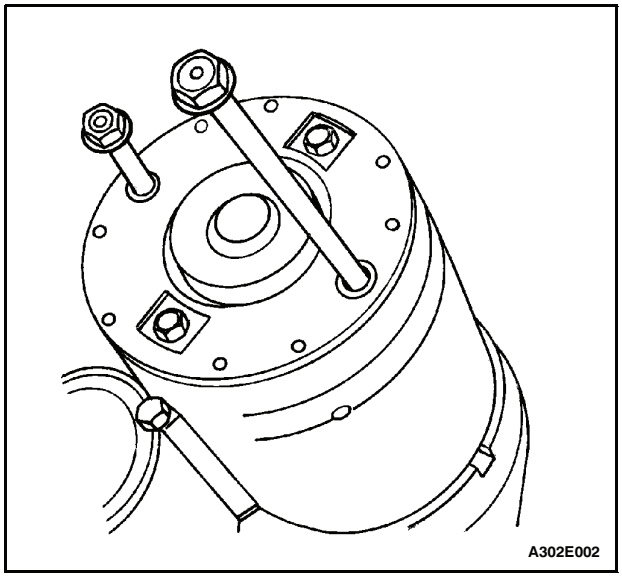
11. With new brushes positioned in the brush holder assembly, measure the inside diameter of the brush holder assembly.
12. Insert the brush holder assembly on a plastic, steel, or wooden dowel about the same diameter as the inside diameter of the brush holder assembly.


A302E010

13. Position the end of the dowel with the armature commutator end. Slide the brush holder assembly onto the armature.
14. Install the end frame on the brush holder assembly with the bolts.

Tighten

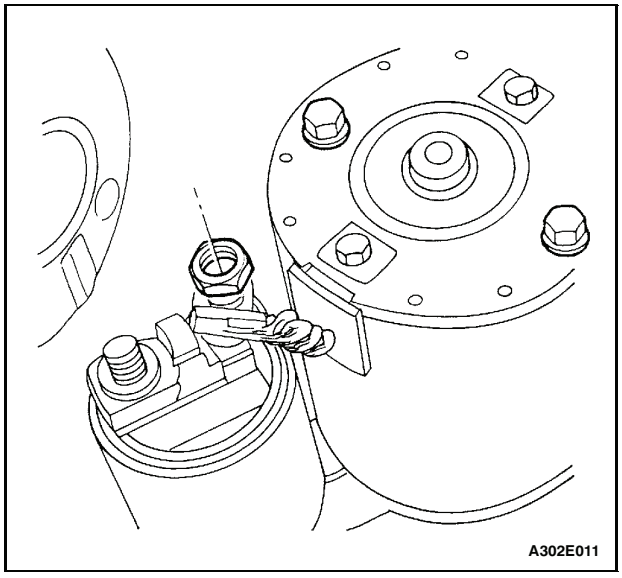
Tighten the starter end frame-to-brush holder assembly bolts to 3 NSm (27 lb-in).


A302E002

15. Install the starter through-bolts.

Tighten

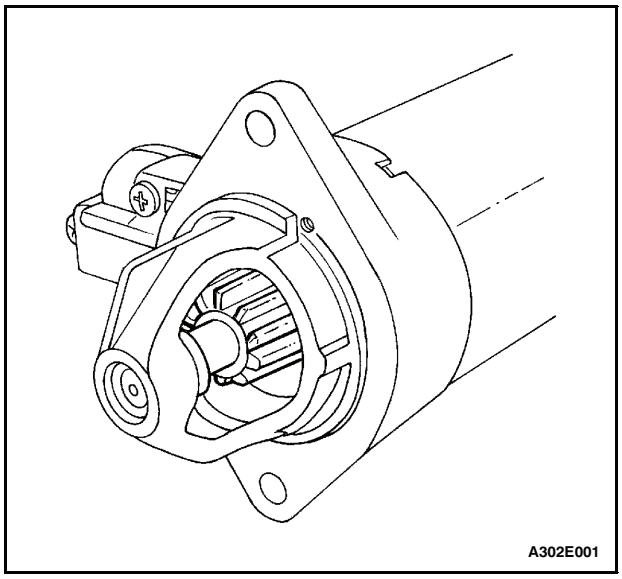
Tighten the starter through-bolts to 6 NSm (53 lb-in).


A302E011

16. Install the starter field coil connection to the starter terminal and fasten it with the nut.

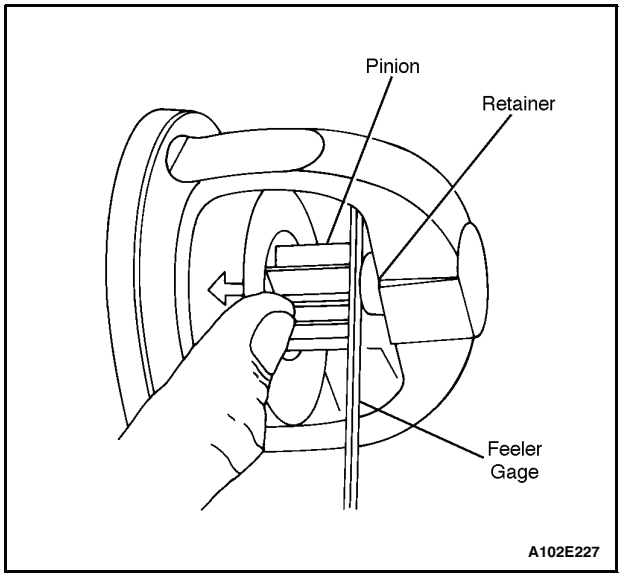
Tighten

Tighten the starter field connector nut to 8 NSm (71 lb-in).


A302E001

Important: The pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

17. **When the solenoid is replaced, it is necessary to check the pinion clearance.**

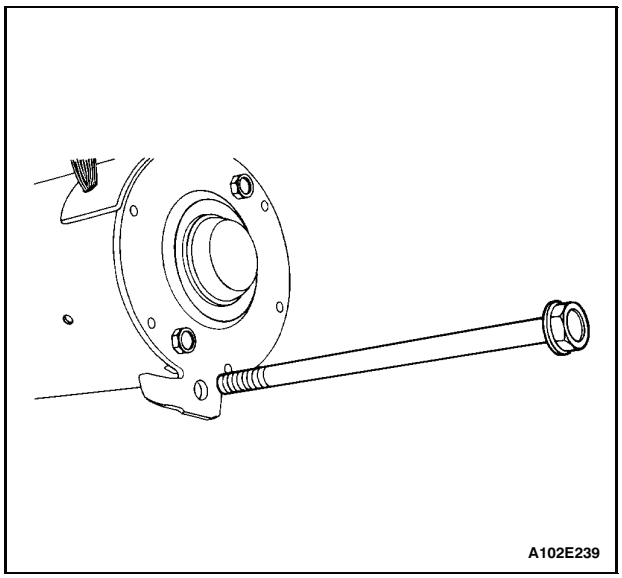


A102E227

18. **Disconnect the motor field coil connector from the solenoid motor terminal and carefully insulate the connector.**
19. **Connect one 12-volt battery lead to the solenoid switch terminal and the other to the starter frame.**
20. **Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame, allowing the pinion to shift in the cranking position, where it will remain until the battery is disconnected.**

Important: A means for adjusting the pinion clearance is not provided on the starter motor. If the clearance does not fall within the limits, check for improper installation and replace all worn parts.

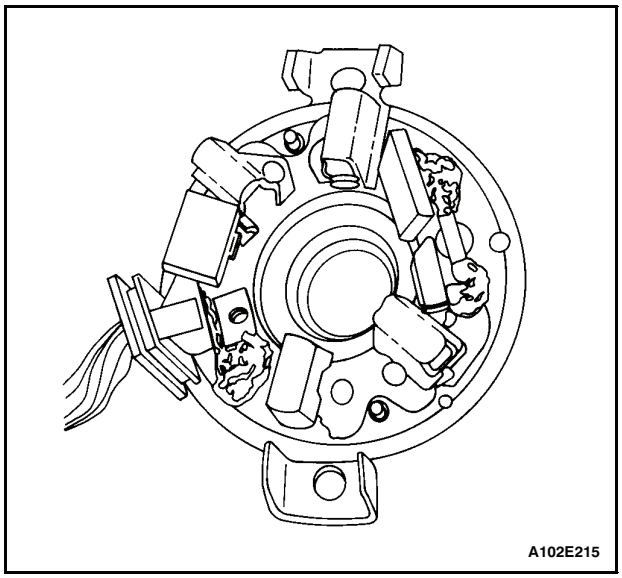
21. **Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge. The clearance should be 0.25 to 3.56 mm (0.01 to 0.14 inch).**


A102E239

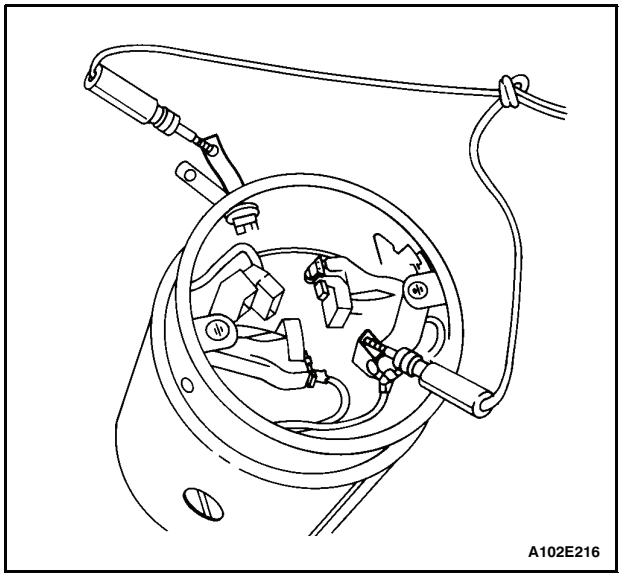
STARTER MOTOR (1.4 KILOWATTS)

Disassembly Procedure

1. **Remove the starter. Refer to "Starter," in this section.**
2. **Remove the starter through-bolts.**

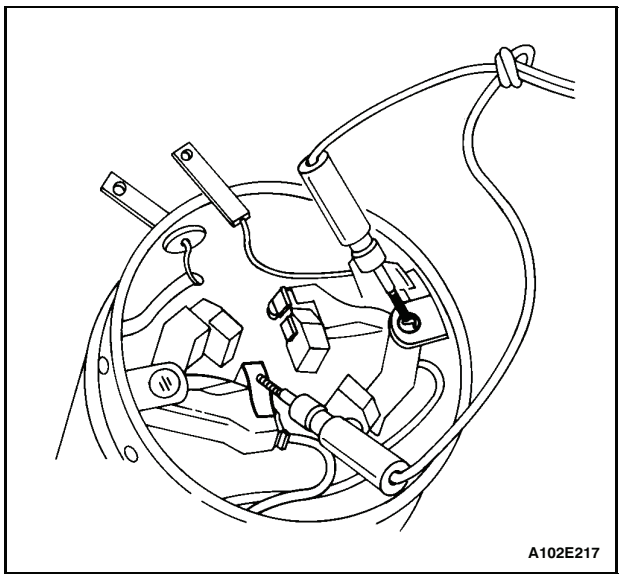

A102E215

3. Remove the commutator end frame/brush holder assembly.
4. Inspect the brushes, the pop-out springs, and the brush holders for wear and damage. Replace the assembly, if necessary.

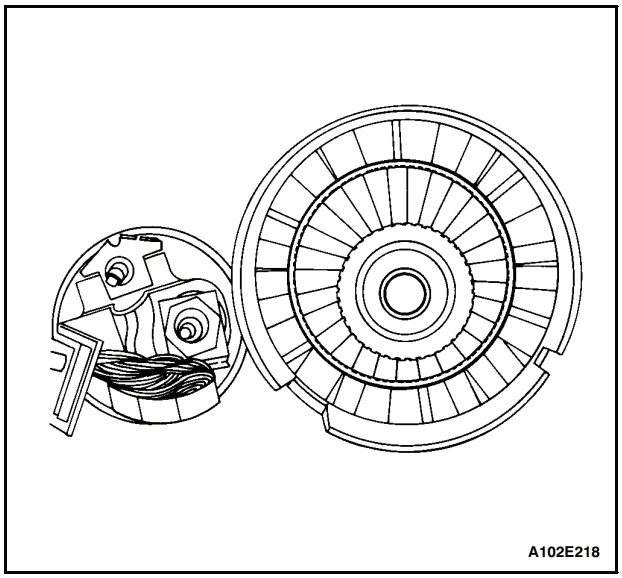

A102E216

Important: This test should be made for each ground or insulated brush to ensure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

5. For only those starters having a shunt coil connection, use a test lamp, placing one lead on the shunt coil terminal while connecting the other lead to a ground brush or an insulated brush.

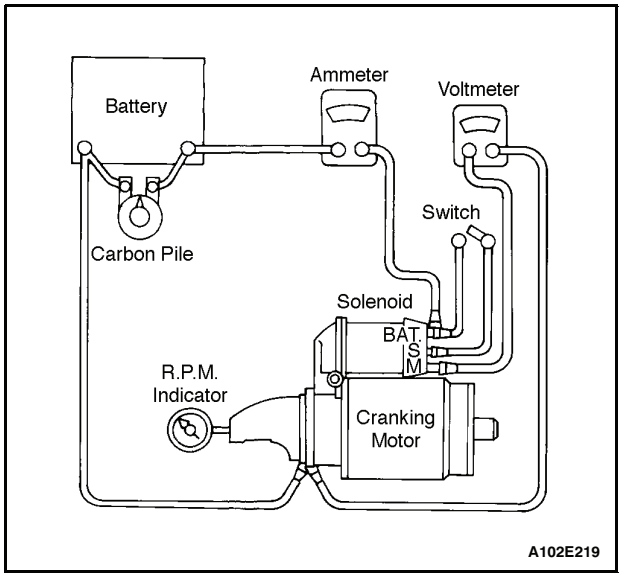

A102E217

6. When testing a series coil for ground, separate the series and the shunt coil strap terminals during the test.
   - 6.1 With the strap terminals not touching the case or the other ground, using a test lamp, placing one lead on the grounded brush holder and the other lead on either insulated brush.
   - 6.2 If the lamp is lit, a grounded series coil is indicated and must be repaired or replaced.
   - 6.3 Test for an open circuit on each insulated brush by placing one lead on the series coil terminal and the other lead on the insulated brush.
   - 6.4 If the test lamp is not lit, the series coil is open and will require repair or replacement.



A102E218

7. Check the armature to see if it turns freely. If the armature does not turn freely, break down the assembly immediately, starting with Step 14. Otherwise, give the armature a no-load test.

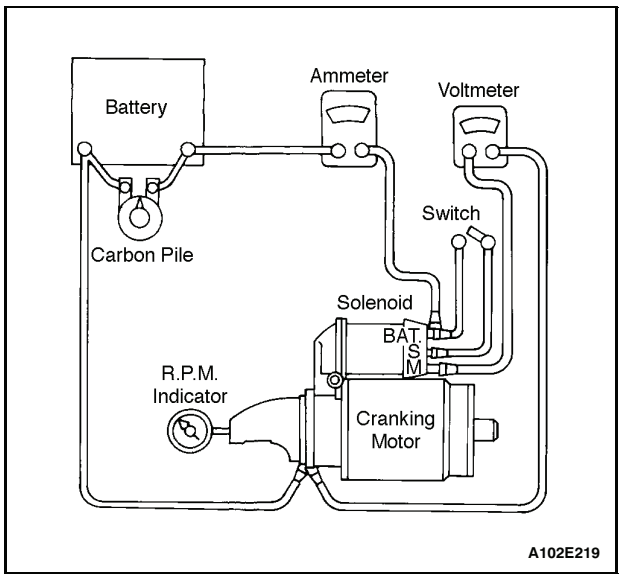


A102E219

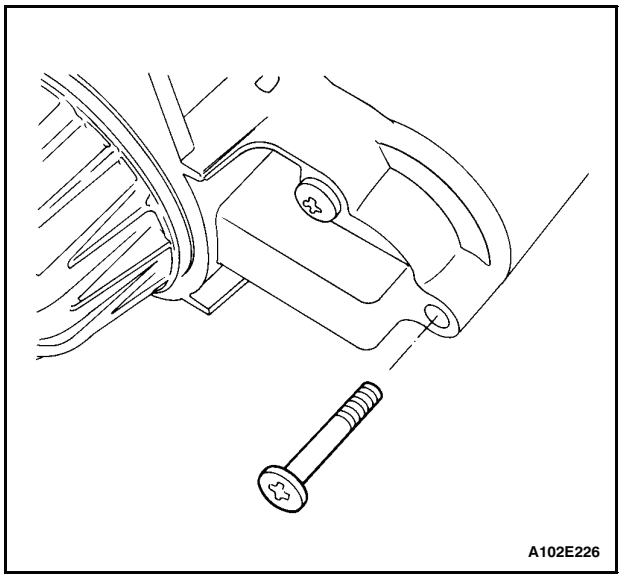
Notice: Complete the testing in a minimum amount of time to prevent overheating and damaging the solenoid.

Important: If the specified current draw does not include the solenoid, deduct from the armature reading the specified current draw of the solenoid hold-in winding.

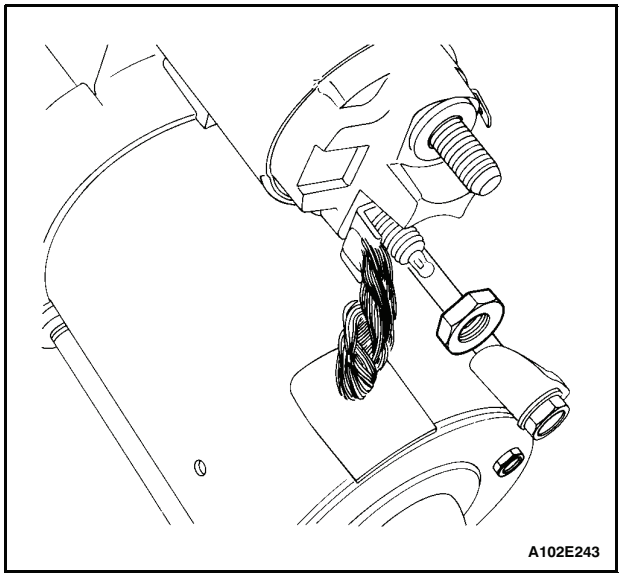
8. To begin the no-load test, close the switch and compare the rpm, the current, and the voltage readings with the specifications. Refer to "Starter Specifications" in this section. Make disconnections only with the switch open. Use the test results as follows:
   - 8.1 Rated current draw and no-load speed indicate a normal condition for the starter motor.
   - 8.2 Low free speed and high current draw indicate too much friction from tight, dirty, or worn bearings, or a bent armature shaft, a shorted armature, or a shorted armature or fields.
   - 8.3 Failure to operate with high current draw indicates a direct ground in the terminal or fields, or "frozen" bearings.
   - 8.4 Failure to operate with no current draw indicates an open field circuit, open armature coils, broken brush springs, worn brushes, high insulation between the commutator bars, or other causes which would prevent good contact between the brushes and the commutator.
   - 8.5 Low no-load speed and low current indicate high internal resistance and high current draw, which usually mean shorted fields.



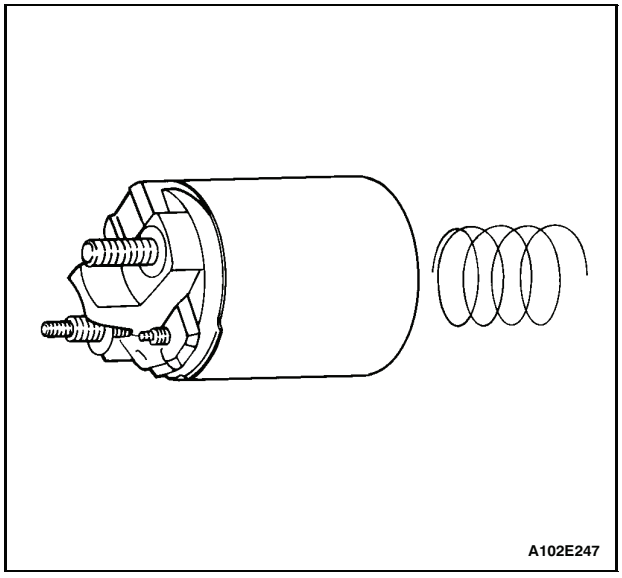
A102E219


A102E226

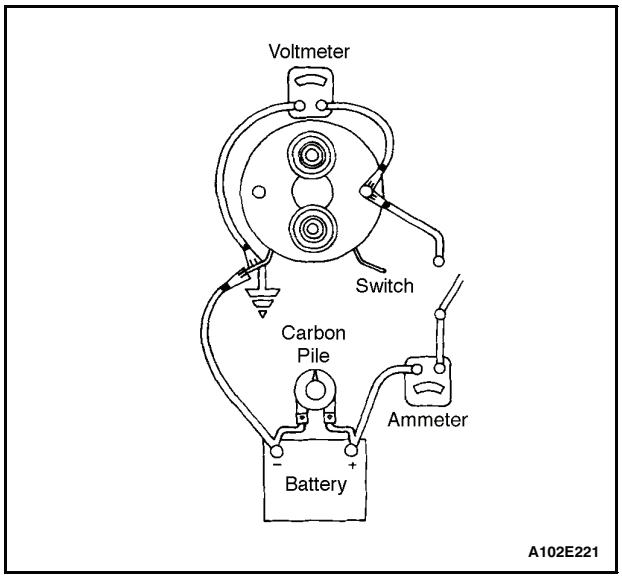
9. Remove the solenoid assembly screws.


A102E243

10. Remove the field connector nut. Disconnect the field connector.


A102E247

11. Rotate the solenoid 90 degrees and remove it along with the plunger return spring.



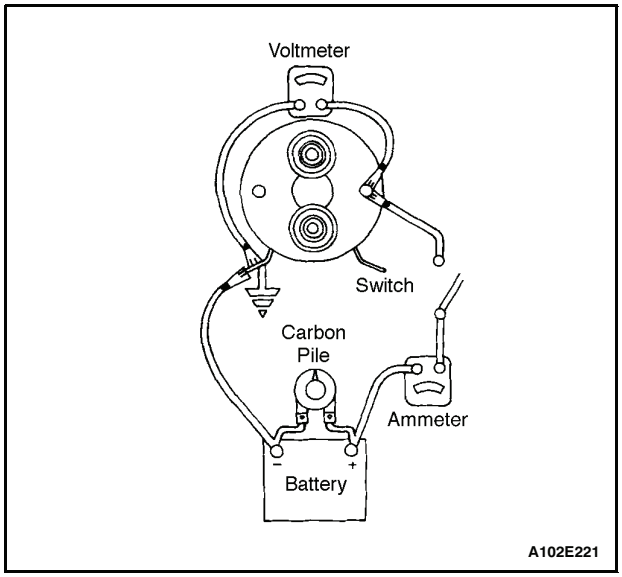
Important: If the solenoid is not removed from the starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests.

12. Test the solenoid windings by checking the current draw.

12.1 Check the hold-in windings by connecting an ammeter in series with a 12-volt battery, the switch terminal, and to ground.

12.2 Connect the carbon pile across the battery.

12.3 Adjust the voltage to 12.2 volts. The ammeter reading should be 12 to 21 amperes.



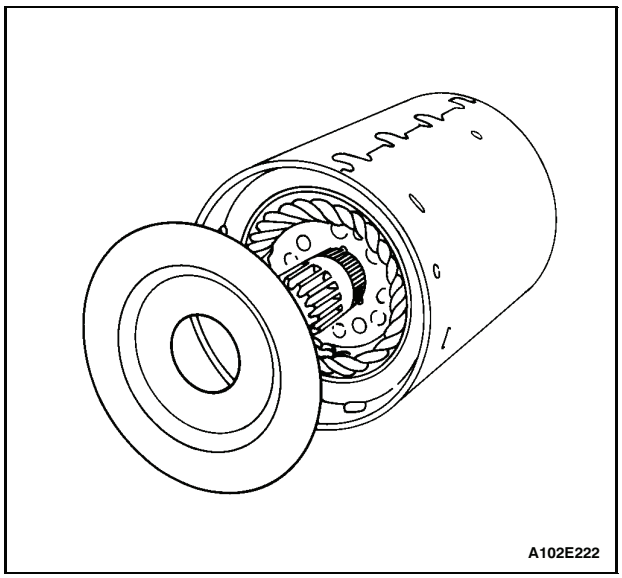
Important: Current will decrease as the windings heat up. Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid. Both conditions require replacement of the solenoid. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit.

13. Check both windings, connecting them according to the preceding test.

13.1 Ground the solenoid motor terminal.

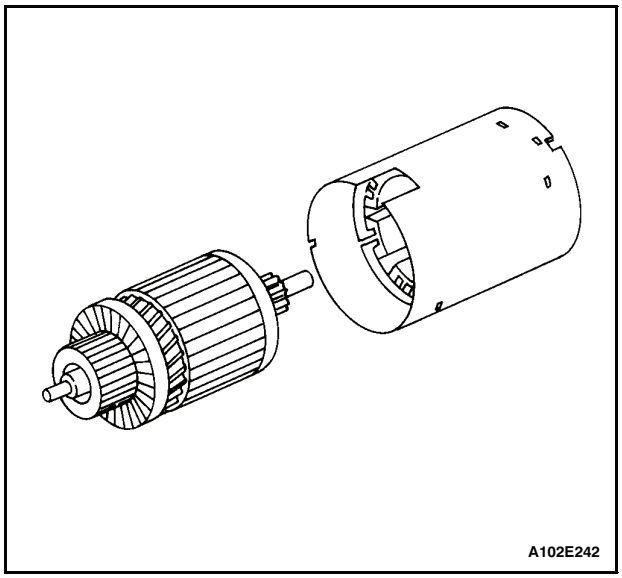
13.2 Adjust the voltage to 12.2 volts. The ammeter reading should be 60 to 90 amperes.

13.3 Check the connections and replace the solenoid, if necessary.

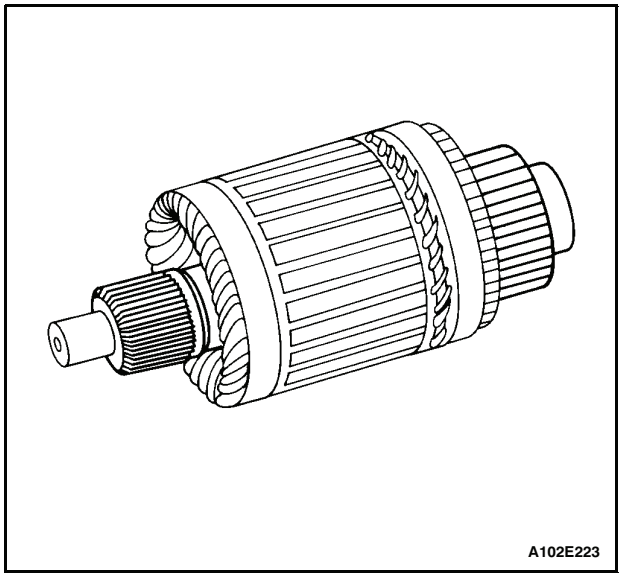


14. Slide the field frame with the enclosed armature assembly away from the starter assembly.

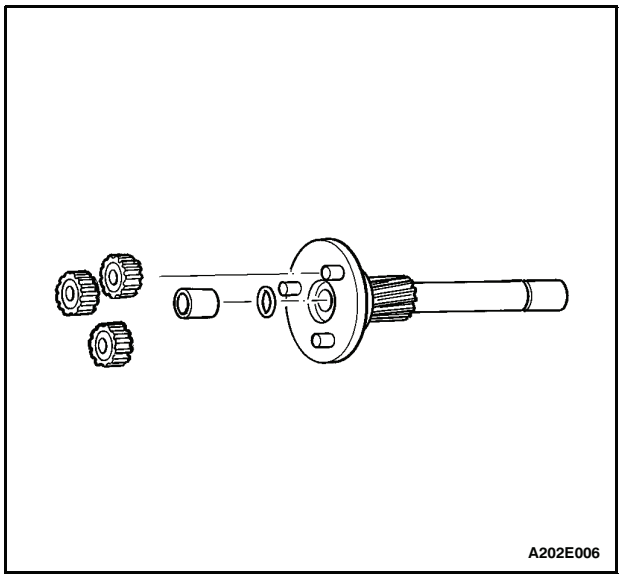
15. Remove the shield.


A102E242

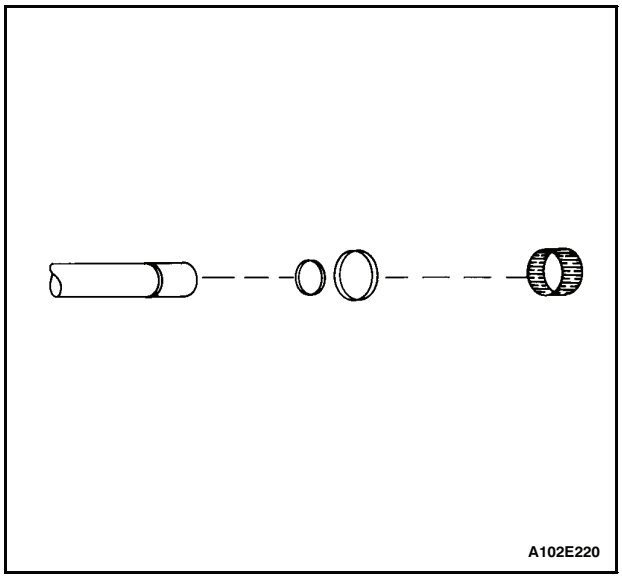
16. Separate the field frame from the armature.


A102E223

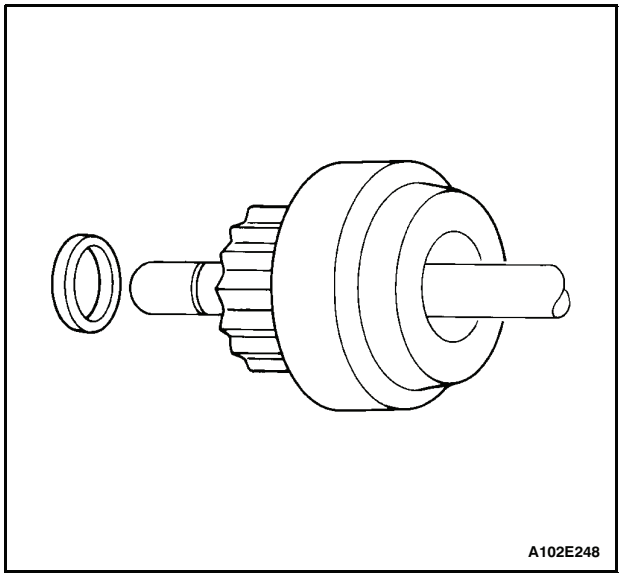
17. Inspect the shaft, the bearing, and the pinion for discoloration, damage, or wear. Replace, if necessary.
18. Inspect the armature commutator. If the commutator is rough, it should be turned down. The outside diameter of the commutator must measure at least 41.91 mm (1.650 inches) after it is undercut or turned. Do not turn out-of-round commutators.
19. Inspect the points where the armature conductors join the commutator bars. Make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.
20. If test equipment is available, check the armature for short circuits by placing it on a growler, and holding back a saw blade over the armature core while the armature is rotated. If the saw blade vibrates, replace the armature.
21. Recheck the armature after cleaning between the commutator bars. If the saw blade vibrates, replace the armature.


A202E006

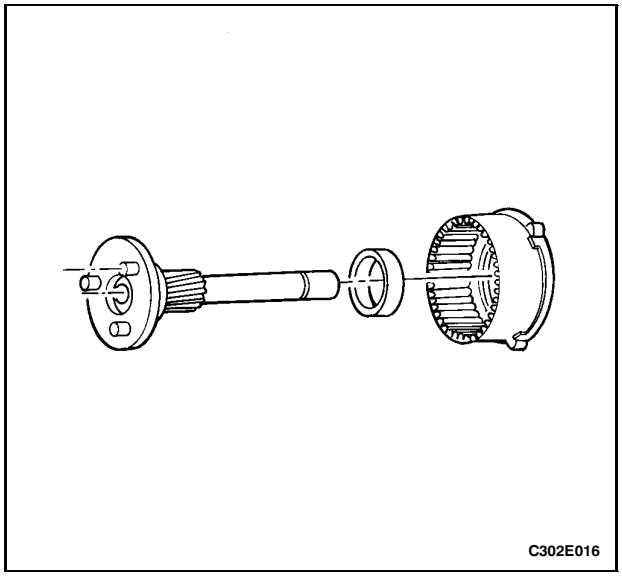
22. Remove the gears, the bushings, and the washer.
23. Remove the cushion and the driveshaft assembly from the starter housing.


A102E220

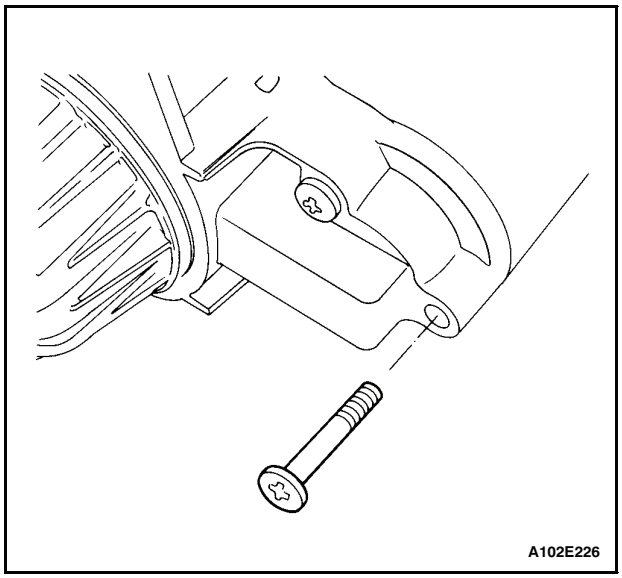
24. Disassemble the driveshaft assembly by first separating the needle bearing from the driveshaft.
25. Remove the collar and the locking ring from the groove in the driveshaft.


A102E248

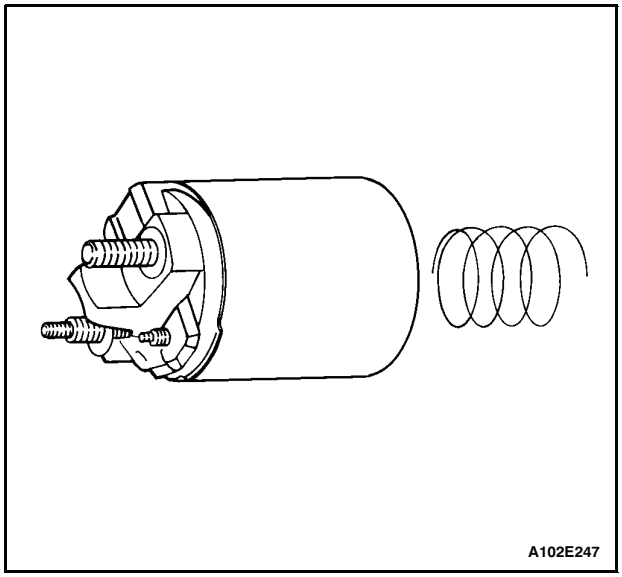
26. Remove the pinion stop and the drive from the driveshaft.


C302E016

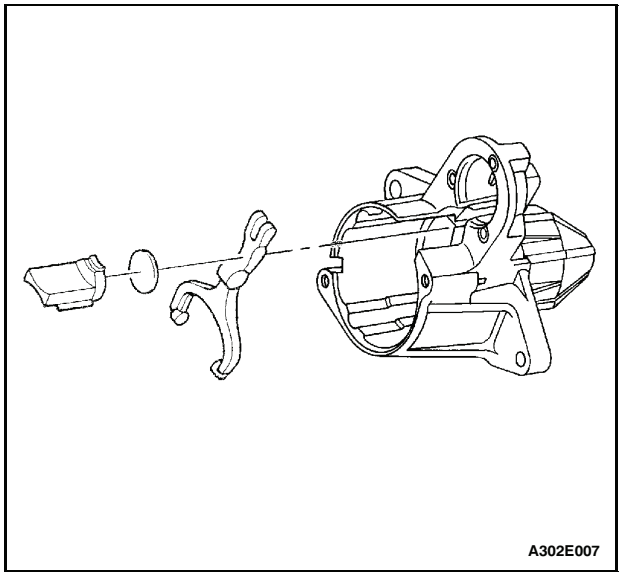
27. Remove the gear support and the collar from the driveshaft.


A102E226

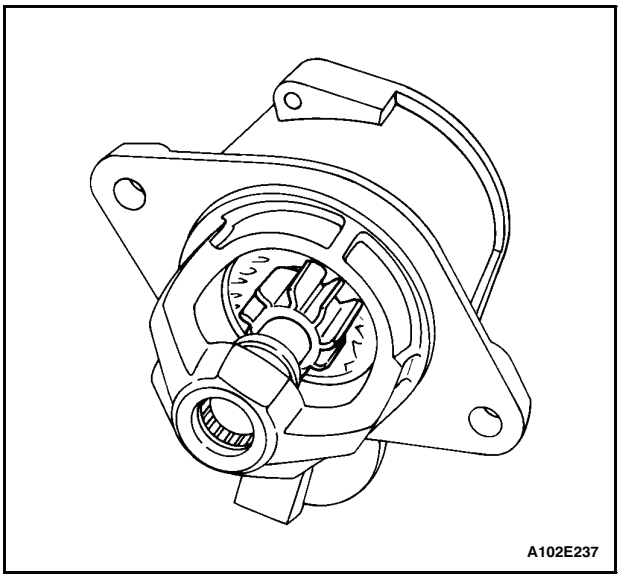
28. If not done in the previous steps, remove the screws that hold the solenoid assembly into the housing, and remove the nut from the field coil connector.


A102E247

29. Rotate the solenoid 90 degrees and remove it along with the return spring.

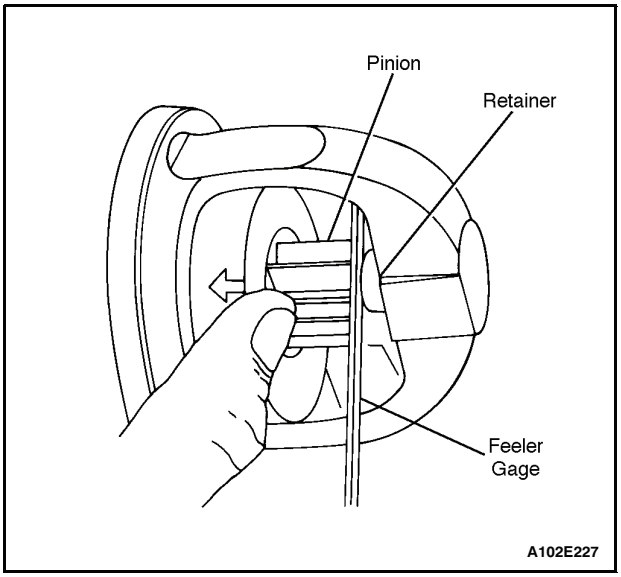

A302E007

30. Remove the plunger with the boot and the shift lever assembly. Test the solenoid windings, if not done in Step 12.


A102E237

Important: The pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during the cranking.

31. **When the starter motor is disassembled and the solenoid is replaced, it is necessary to check the pinion clearance when the starter is reassembled.**

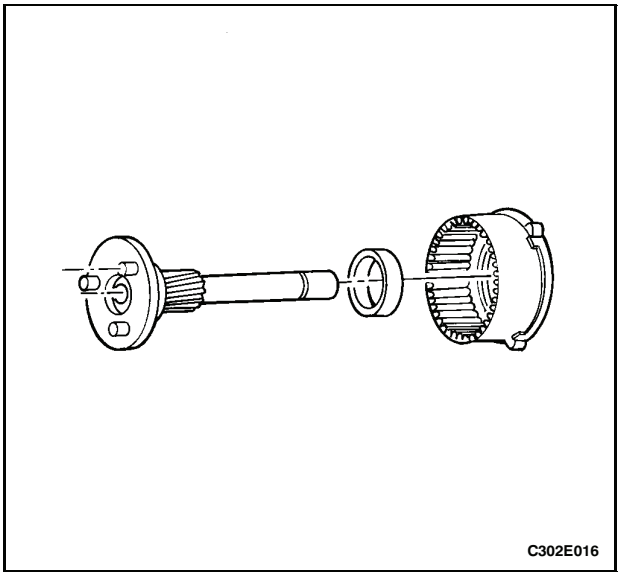


A102E227

32. **Disconnect the motor field coil connector from the solenoid motor terminal and carefully insulate the connector.**
33. **Connect one 12-volt battery lead to the solenoid switch terminal and the other to the starter frame.**
34. **Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame, allowing shifting of the pinion in the cranking position, where it will remain until the battery is disconnected.**

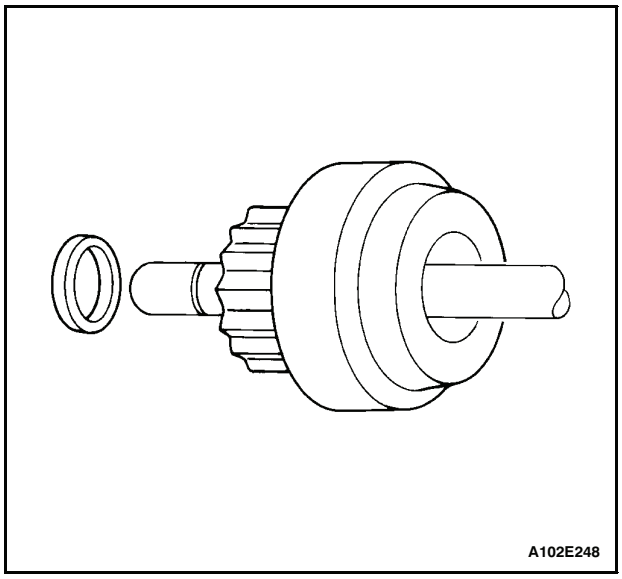
Important: A means for adjusting the pinion clearance is not provided on the starter motor. If the clearance does not fall within the limits, check for improper installation and replace all worn parts.

35. **Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge. The clearance should be 0.25 to 3.56 mm (0.01 to 0.14 inch).**

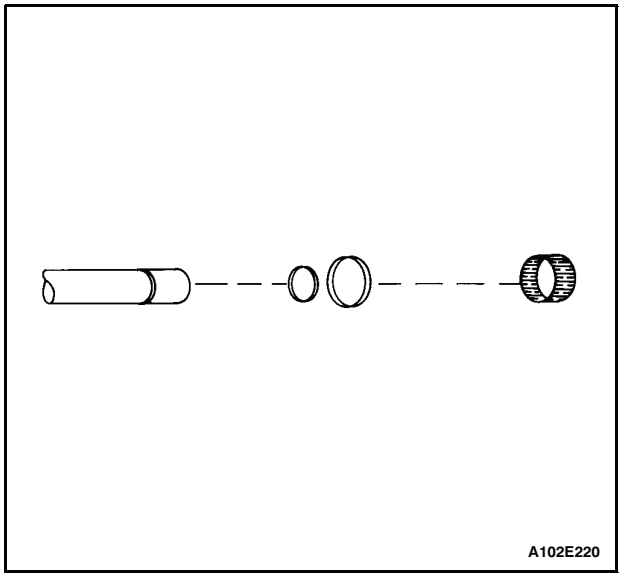

C302E016

Assembly Procedure

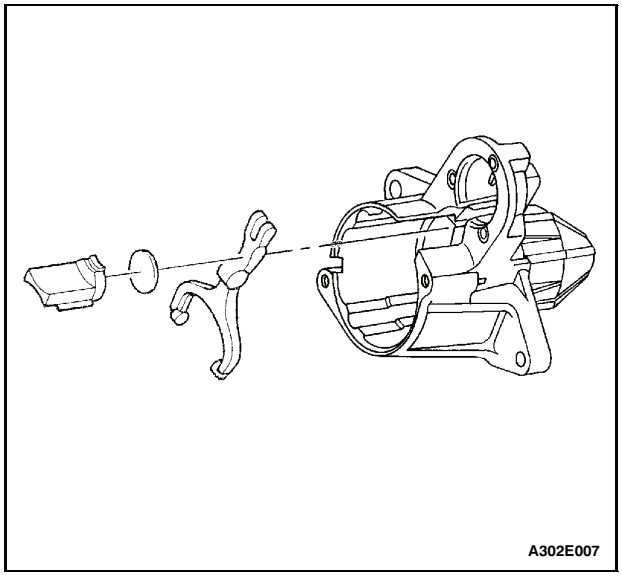
1. **Clean all of the starter motor parts, but do not use grease-dissolving solvents for cleaning the armature and the field coils.**
2. **Lubricate the gears with lubricant. (Begin at Step 7 if proceeding with just the reassembly of the solenoid.)**
3. **If full disassembly of the starter and the solenoid was performed, begin reassembly by placing the gear support and the collar on the driveshaft assembly.**


A102E248

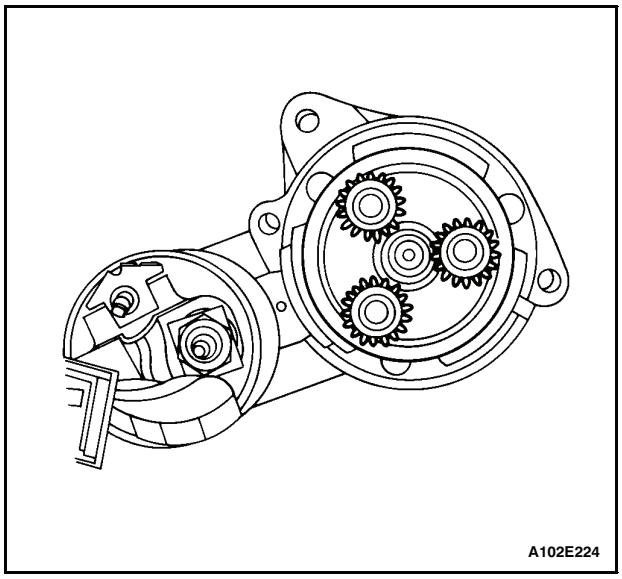
4. Install the drive and the pinion stop on the driveshaft.


A102E220

5. Install the lock ring into the groove on the driveshaft and insert the collar.
6. Install the needle bearing.

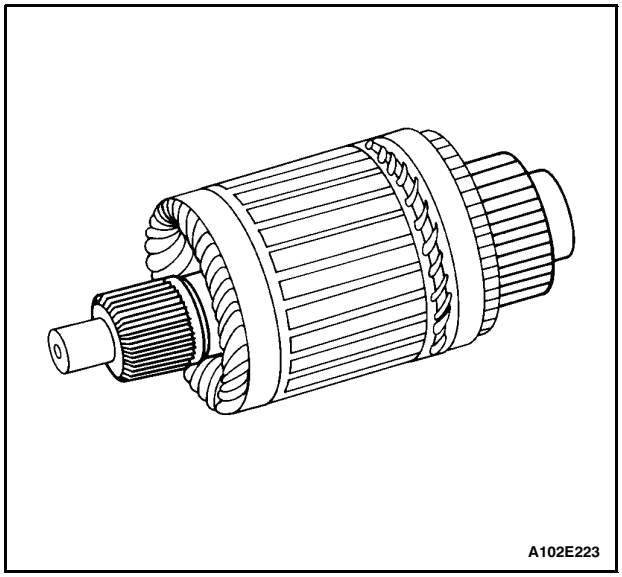

A302E007

7. Install the shift lever assembly with the plunger and the boot.



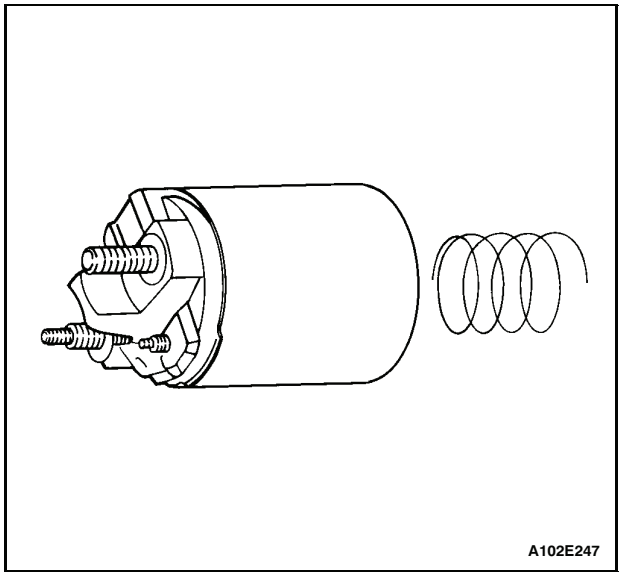
A102E224

8. Lubricate the gears with lubricant and install the driveshaft assembly with the bushing and the washer on the gear end.
9. Install the cushion and the gears.



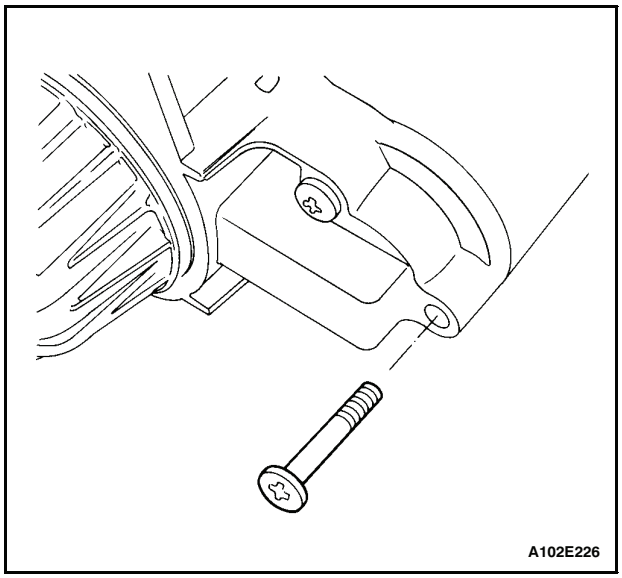
A102E223

10. Lubricate the drive end of the armature shaft with lubricant and install the new gear and the bearing, if necessary.



A102E247

11. Position the solenoid assembly and the return spring against the plunger, applying sealer to the solenoid flange.


A102E226

12. Fasten the solenoid assembly with the screws.

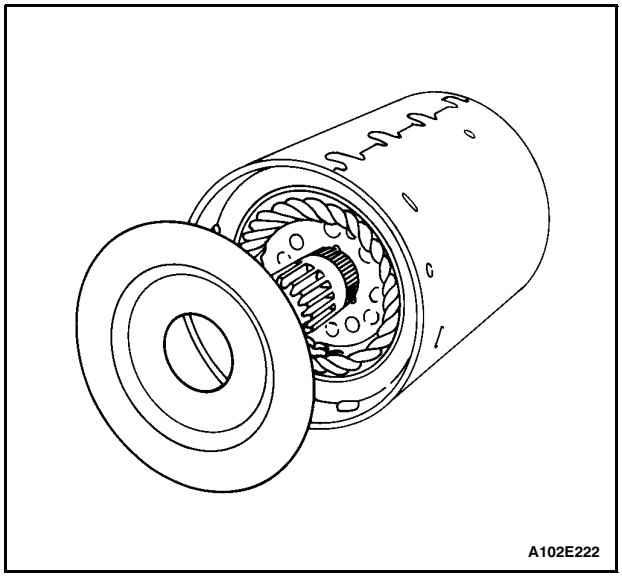
Tighten

Tighten the starter solenoid assembly screws to 8 NSm (71 lb-in).

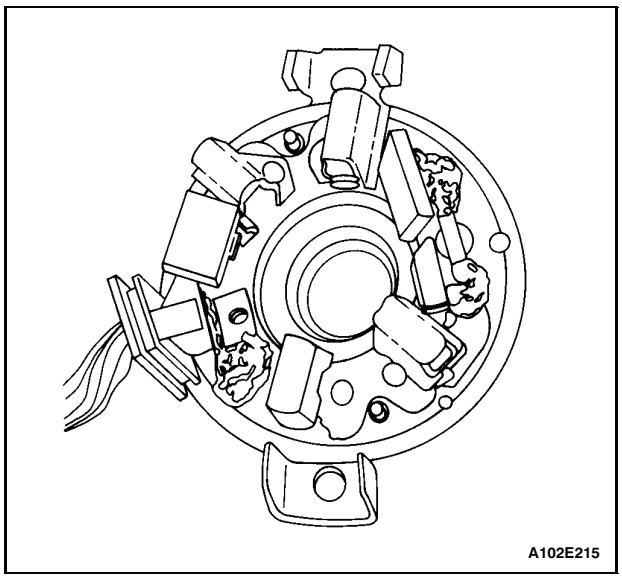
13. Install the field coil connection to the starter terminal. Install the nut.

Tighten

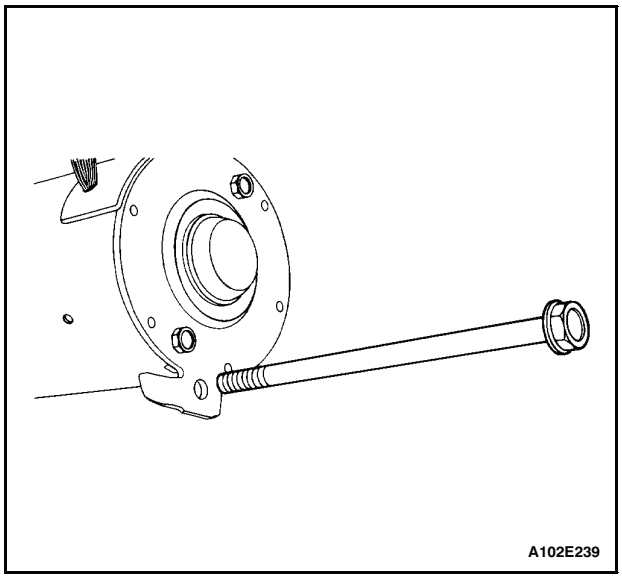
Tighten the starter field connector nut to 8 NSm (71 lb-in).


A102E222

14. Position the armature assembly into the field frame.
15. Place the shield on the armature and the field frame assembly.
16. Install the armature and the field frame assembly with the shield into the starter housing.


A102E215

17. Position the commutator end frame/brush holder assembly, lining up the end frame holes with the through-bolt holes in the housing.



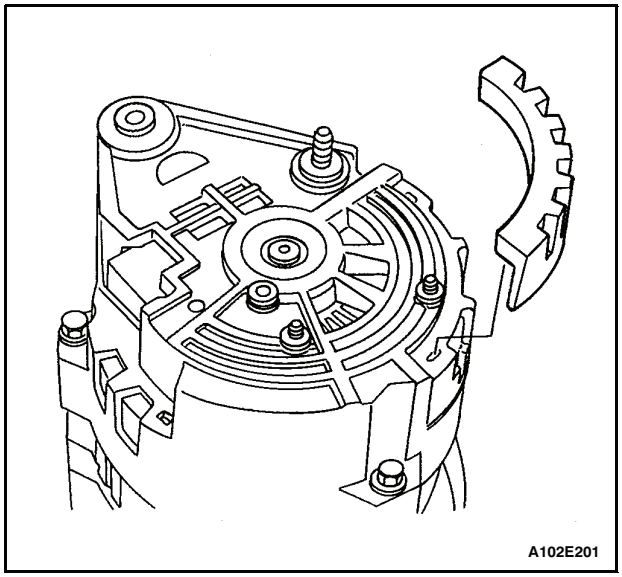
A102E239

18. Install the starter through-bolts.
19. Install the starter. Refer to "Starter" in this section.

Tighten

Tighten the starter through-bolts to 6 NSm (53 lb-in).

20. Refer to "Starter" in this section.

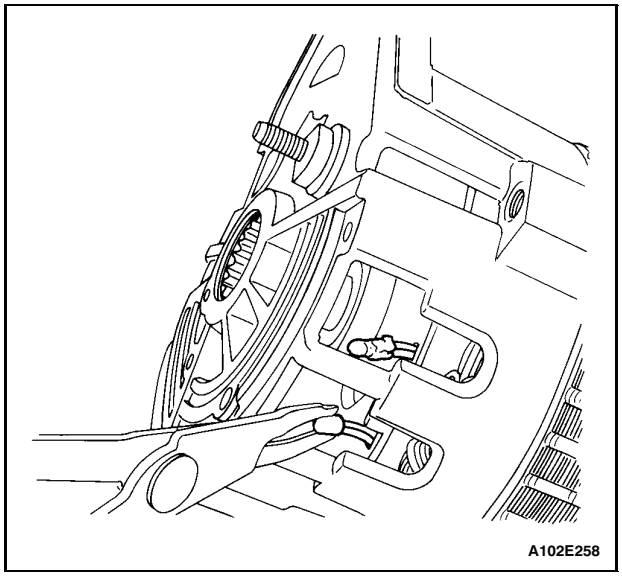


A102E201

GENERATOR (C5-121D)

Disassembly Procedure

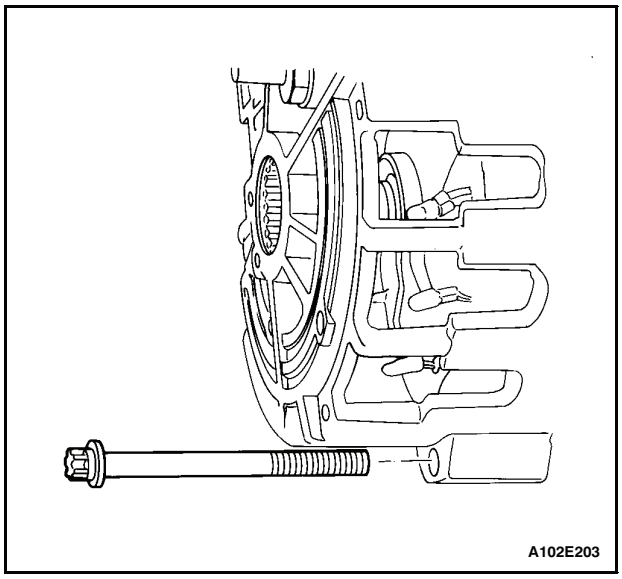
1. Remove the generator. Refer to "Generator" in the On-Vehicle Service section.
2. Mark a match line that cannot easily be removed on the end frame to make assembly easier.
3. Pry off the plastic cover to expose the stator connections.



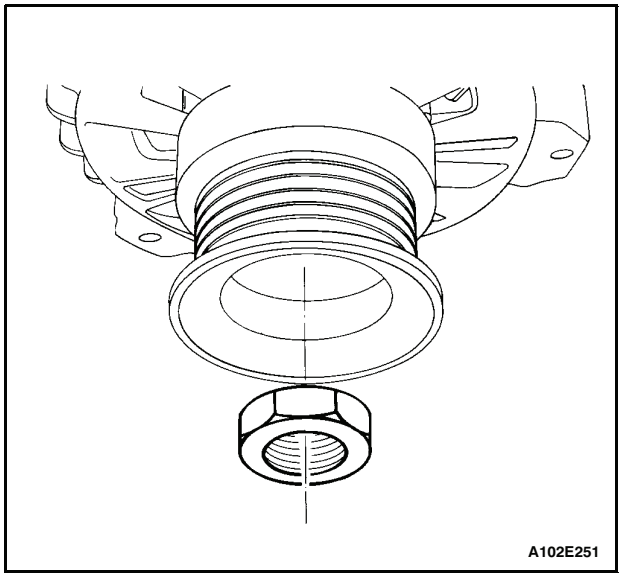
A102E258

Notice: If the stator connections are not welded, melt the lead. Avoid excessive heating, as it can damage the diodes in the rectifier bridge.

4. Remove the stator connections from the rectifier bridge terminals by unsoldering or cutting the wires.

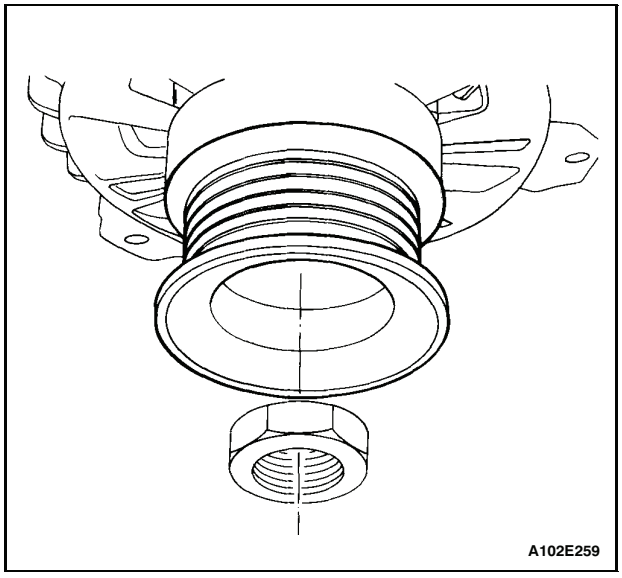

A102E203

5. Remove the generator through-bolts.

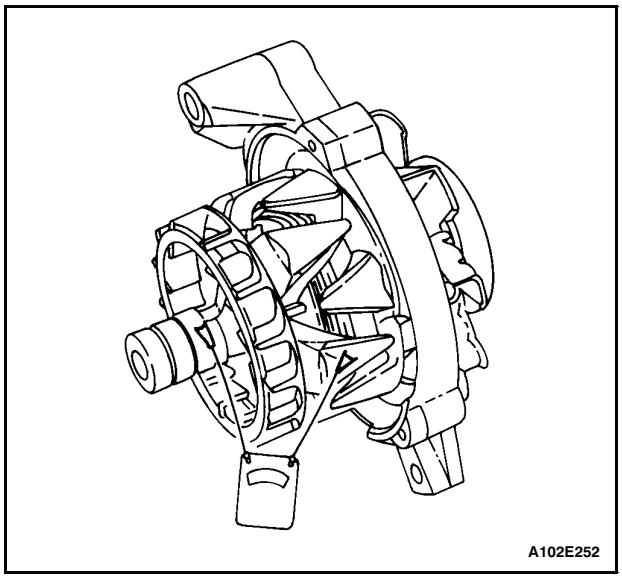

A102E251

Important: The fastening torque of this nut is 81 NSm (60 lb-ft) and may not normally be unfastened using hand strength.

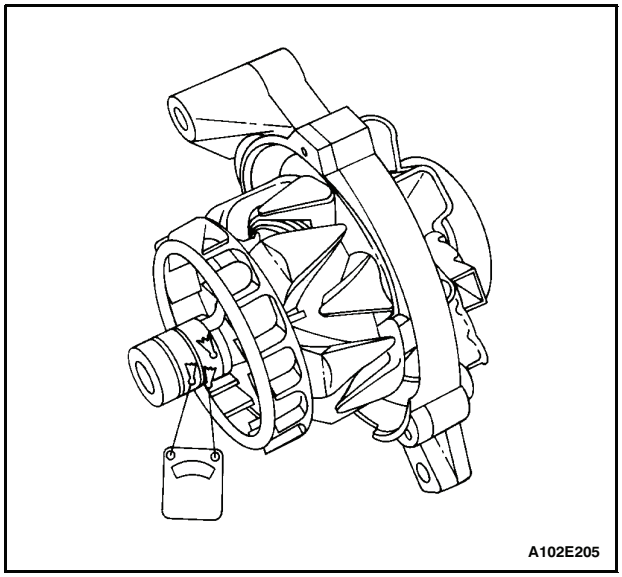
6. Move to the drive end of the generator and remove the drive end bearing nut.


A102E259

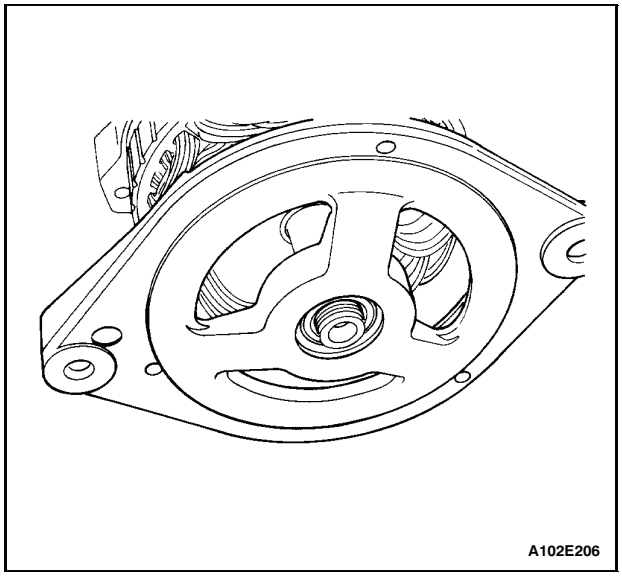
7. Remove the pulley and the collars.


A102E252

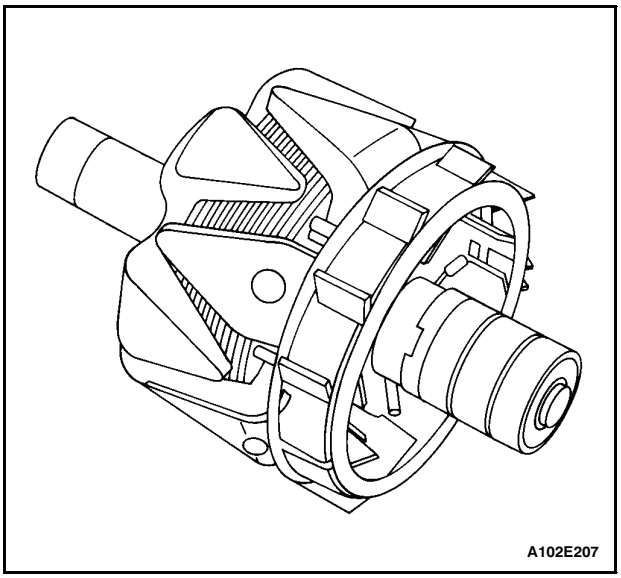
8. Test the rotor for an open circuit by using the ohmmeter with the drive end frame assembled. The reading should be sufficiently high, or the rotor must be replaced.


A102E205

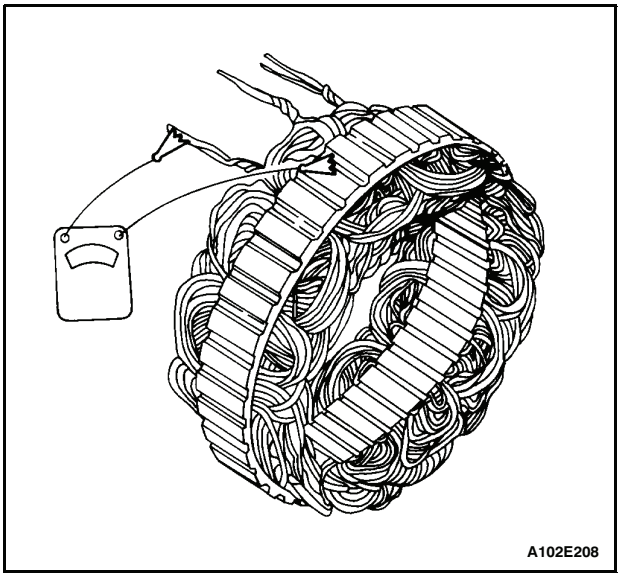
9. Test the rotor for open and short circuits. The reading should be 1.7 to 2.3 ohms, or the rotor should be replaced.


A102E206

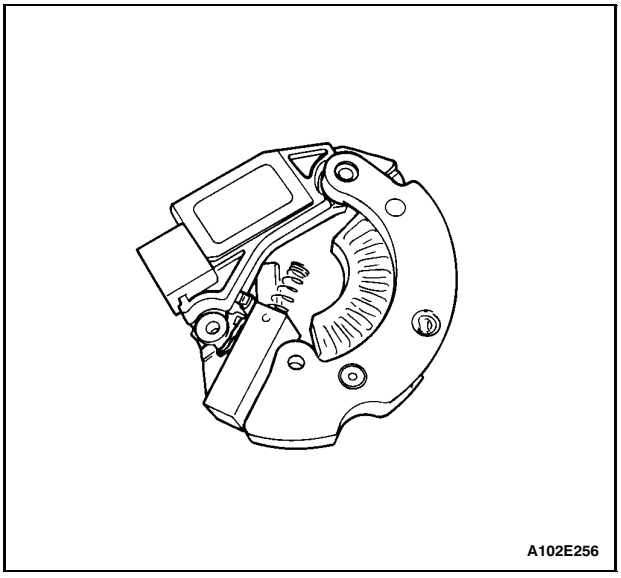
10. Remove the drive end frame from the shaft.
11. For vehicles with an internal generator fan, remove the drive end frame and the fan.


A102E207

12. Remove the rotor assembly.

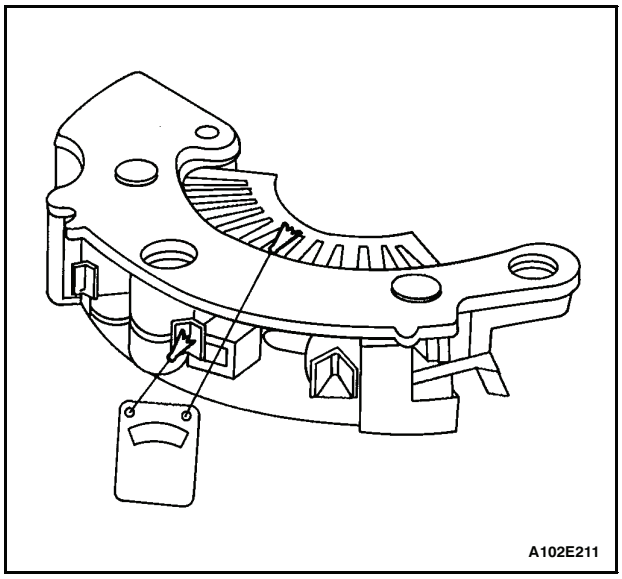

A102E208

13. Remove the stator.
14. Test the stator for an open circuit using the ohmmeter.

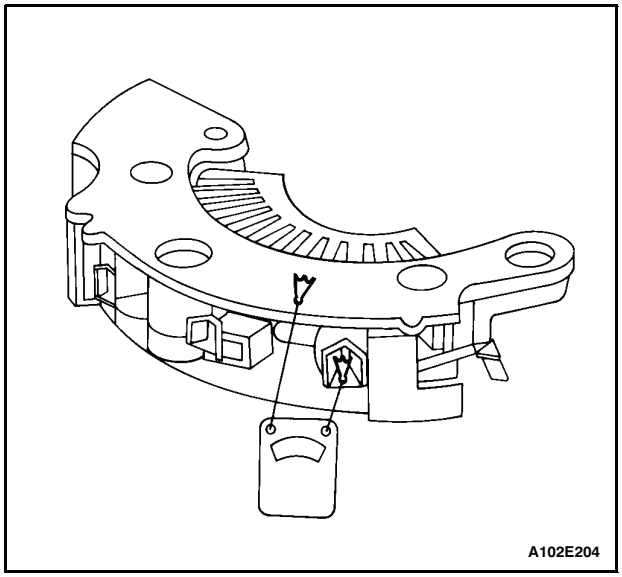

A102E256

15. Pry off the baffle.
16. Remove the rectifier/regulator/brush holder assembly screws.
17. Remove the brush holder assembly and the regulator, cutting the terminal between the regulator and the rectifier bridge.

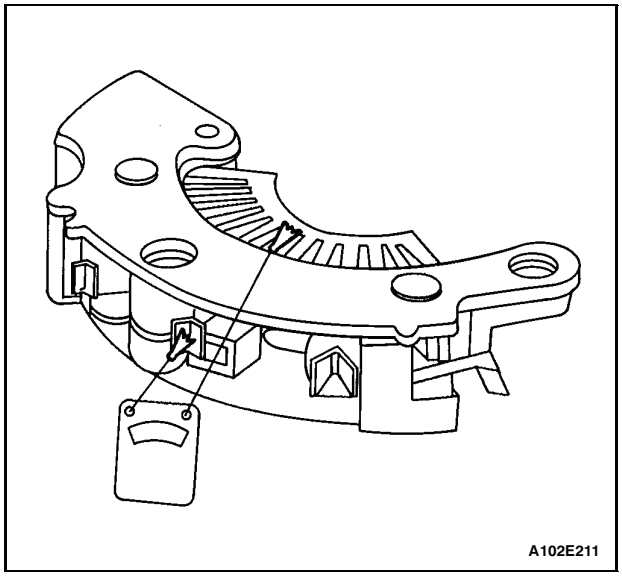
Important: If the brush can be reused, reassemble the brush to the holder with the retaining pin, after cleaning the brush with a soft, clean cloth.



18. Test the rectifier bridge by connecting the ohmmeter terminals to the bridge and the heat sink.



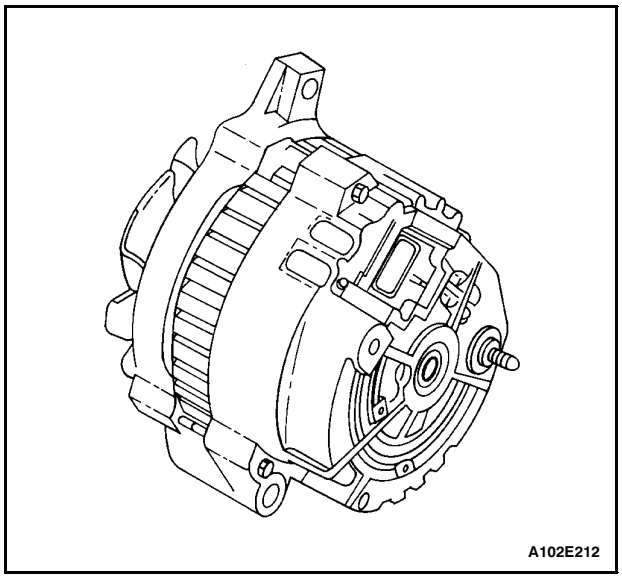
19. Retest by connecting the ohmmeter terminals in reverse.



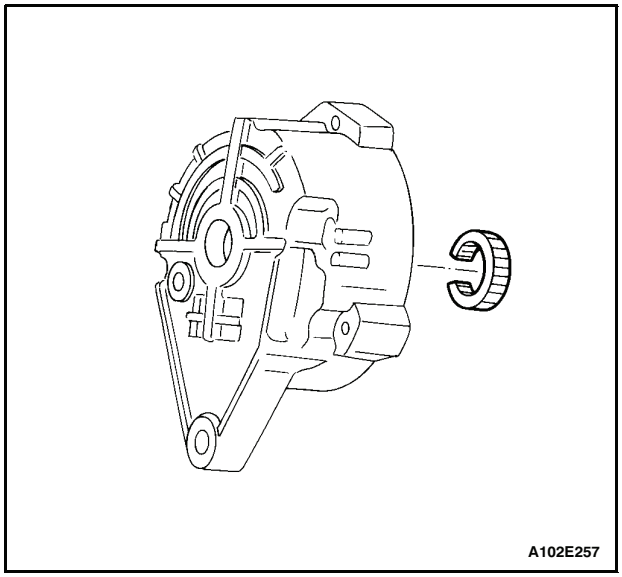
20. Replace the rectifier bridge, if each reading is the same.
21. Test the remaining two diodes after the above procedure.

Notice: Some kinds of digital ohmmeters are not suited for the test of the bridge diode. In this case, consult the manufacturer regarding the test capacity.

22. Test the diodes by connecting the ohmmeter terminals to the bridge terminal and the base plate. If the reading is the same, the rectifier bridge should be replaced.

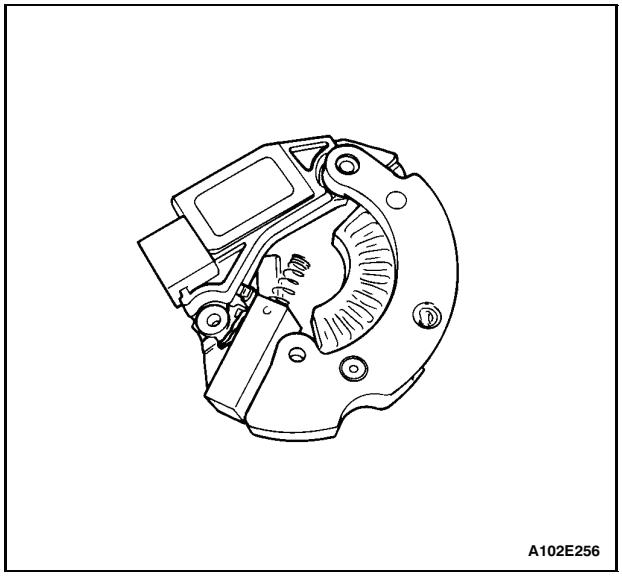

A102E212

23. Remove the ring in the slip ring end frame.

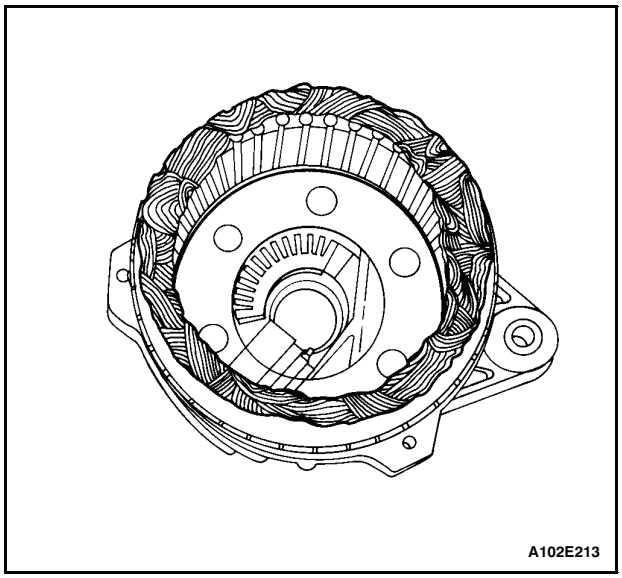

A102E257

Assembly Procedure

1. Install the new ring in the slip ring end frame.
2. Push the new bearing outer lace into the bottom of the end frame casting.

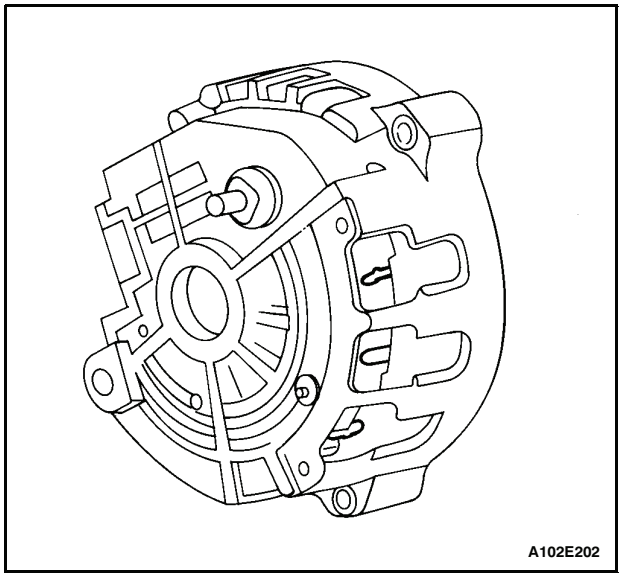

A102E256

3. Solder the brush holder terminal to the regulator terminal, if removed.
4. Fix the brush holder with the retainer pin, and solder the regulator/brush holder assembled terminal to the rectifier terminal.
5. Apply silicone grease between the bridge and the end frame for radiation purposes.
6. Fasten the screws holding the rectifier regulator/ brush holder assembly to the end frame.
7. Punch the new baffle with the pin into the brush.



A102E213

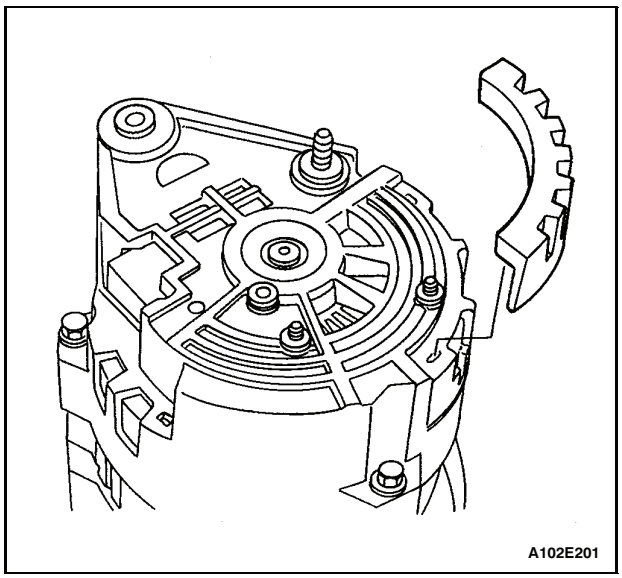
8. Install the stator.



A102E202

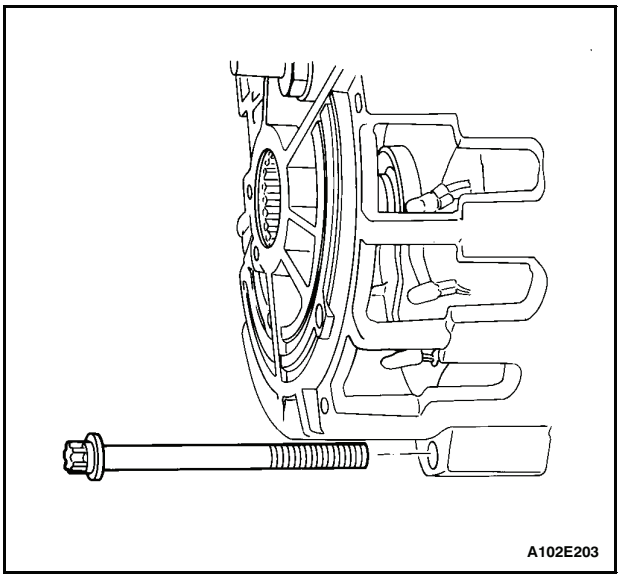
Notice: Take care to prevent damage to the vehicle by protecting the diode in the rectifier bridge from excessive heat while soldering or welding.

9. Solder or weld the connectors of the rectifier bridge.



A102E201

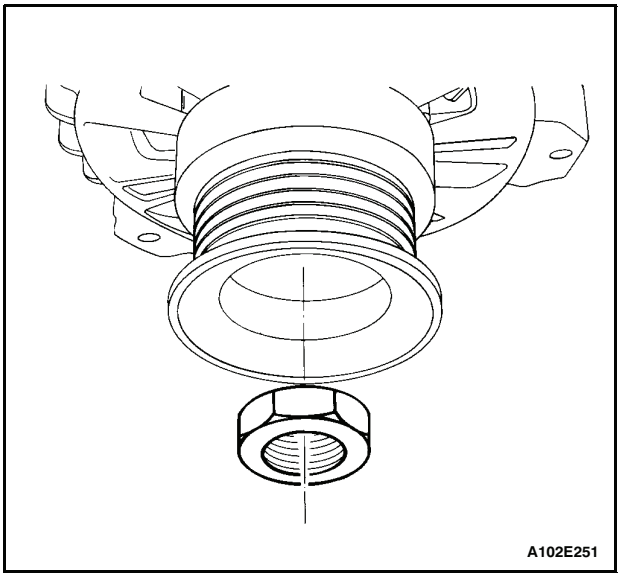
10. Install the outside cover.


A102E203

11. Position the rotor assembly shaft with the drive end frame in the slip ring end assembly until the gap between the outer lace and the end frame casting is 1.9 mm (0.075 inch).
12. Install the generator through-bolts.

Tighten

Tighten the generator through-bolts to 10 NSm (89 lb-in).

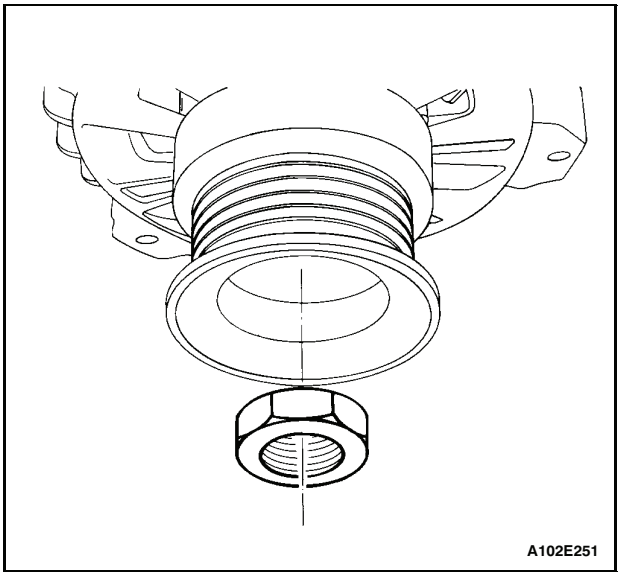

A102E251

13. Position the fan, the collars, and the pulley on the rotor shaft and secure with the nut.

Tighten

Tighten the generator drive end bearing nut to 81 NSm (60 lb-ft).

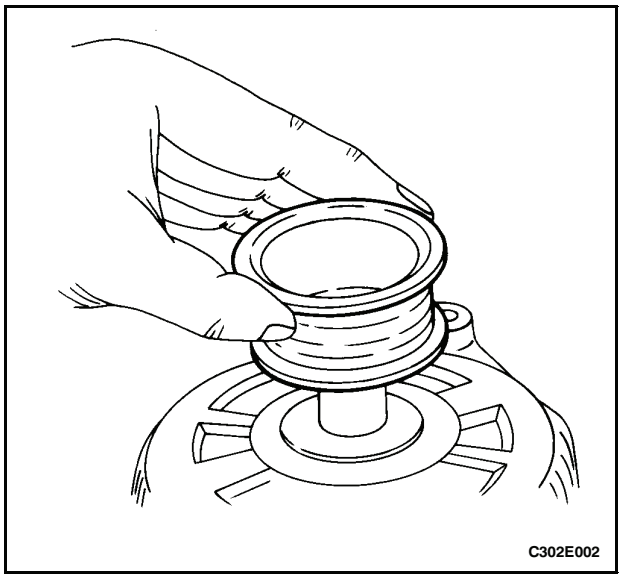
14. Install the generator. Refer to "Generator" in the On-Vehicle Service section.


A102E251

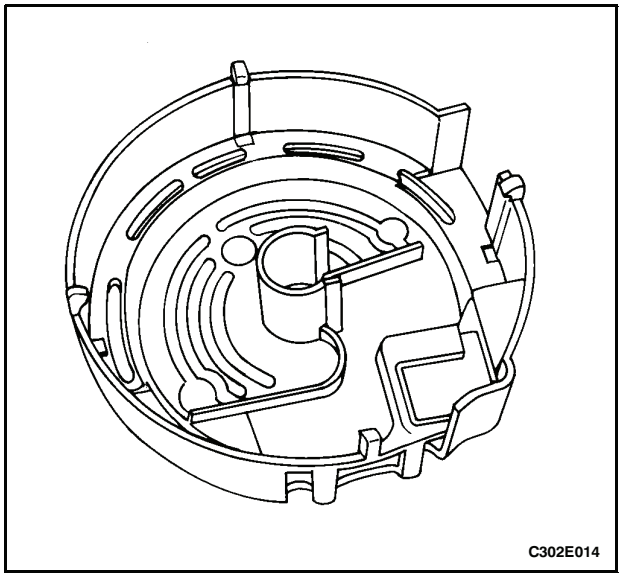
GENERATOR (CS-128D)

Disassembly Procedure

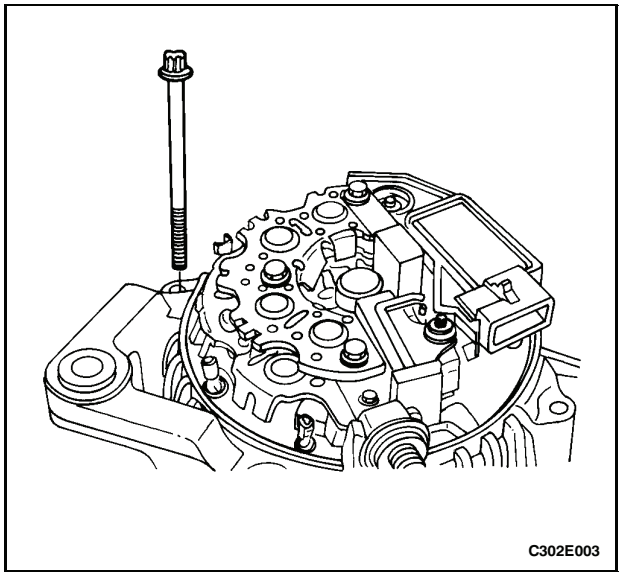
1. Remove the generator. Refer to "Generator" in this section.
2. Remove the driveshaft nut.


C302E002

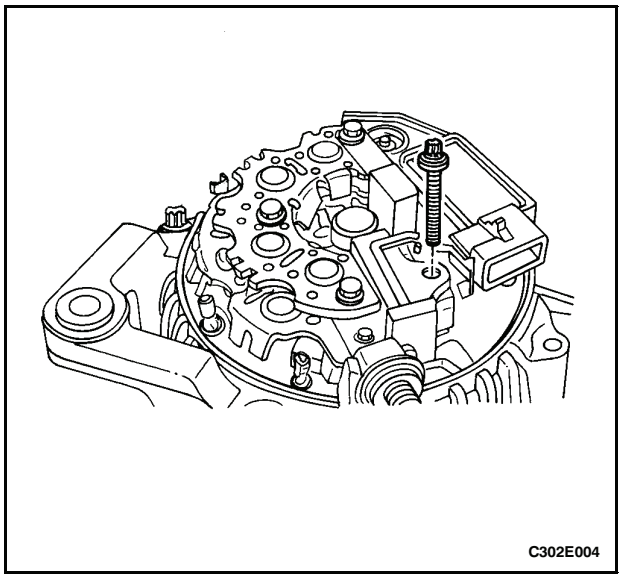
3. Remove the pulley and the collar from the driveshaft.


C302E014

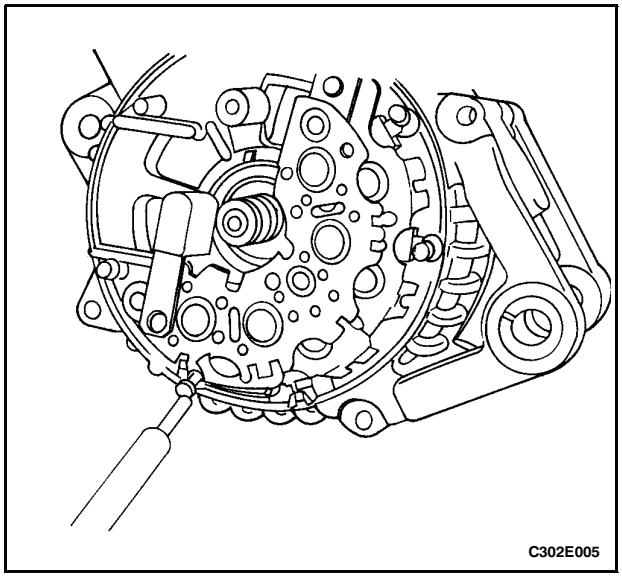
4. Pry off the plastic cover that encloses the rectifier and the regulator/brush holder assemblies.
5. Inspect the cover for damage.


C302E003

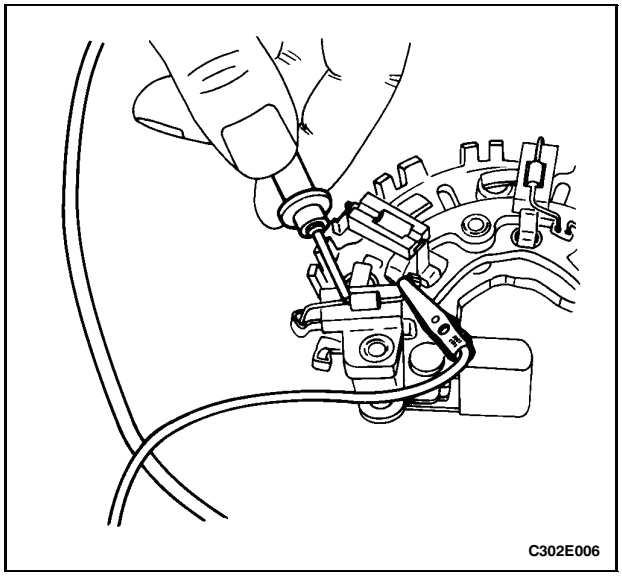
6. Remove the generator through-bolts.


C302E004

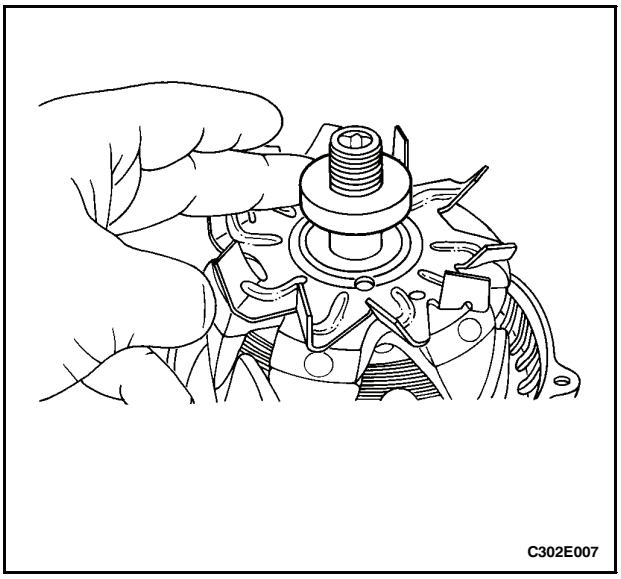
7. Remove the bolts that fasten the rectifier assembly and the regulator assembly to the slip ring end frame.


C302E005

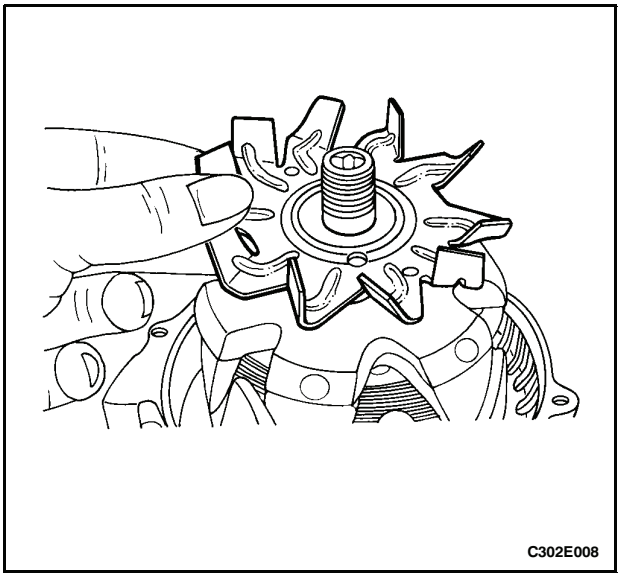
8. To remove the regulator/brush holder and the rectifier assemblies, first melt the solder of the lead that connects the regulator/brush holder assembly to the rectifier assembly. Then melt the lead to the stator, followed by the other rectifier assembly leads to the stator (as shown).


C302E006

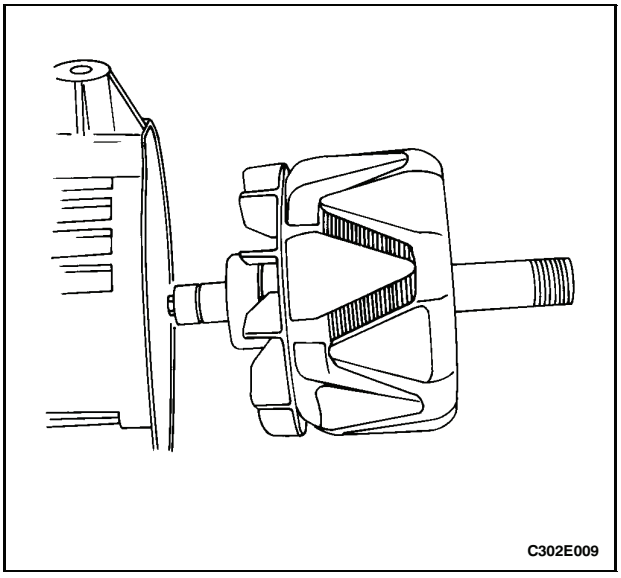
9. Test each of the three diodes of the rectifier assembly for continuity. Connect the ohmmeter probes on each side of the diode. Retest by connecting the ohmmeter probes in reverse. If the readings are the same, replace the rectifier.


C302E007

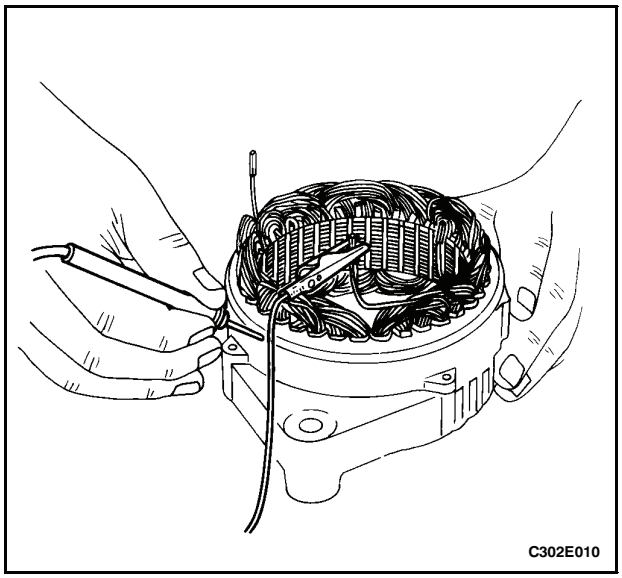
10. Mark a line perpendicular to the crack between the case of the drive end frame and that of the slip ring end frame.
11. Pry open the drive end frame from the slip ring end frame.
12. Remove the collar.


C302E008

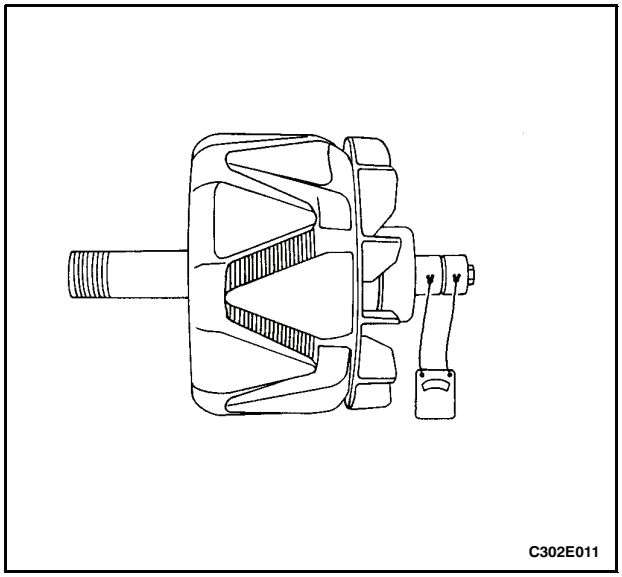
13. Remove the fan.


C302E009

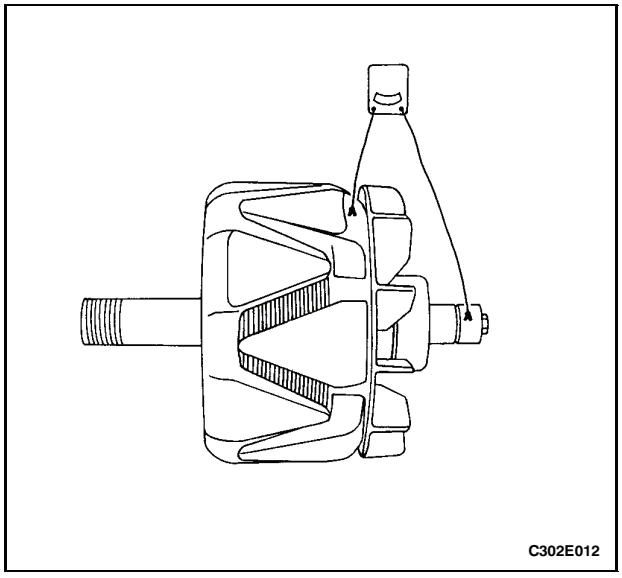
14. Separate the rotor from the slip ring end frame.


C302E010

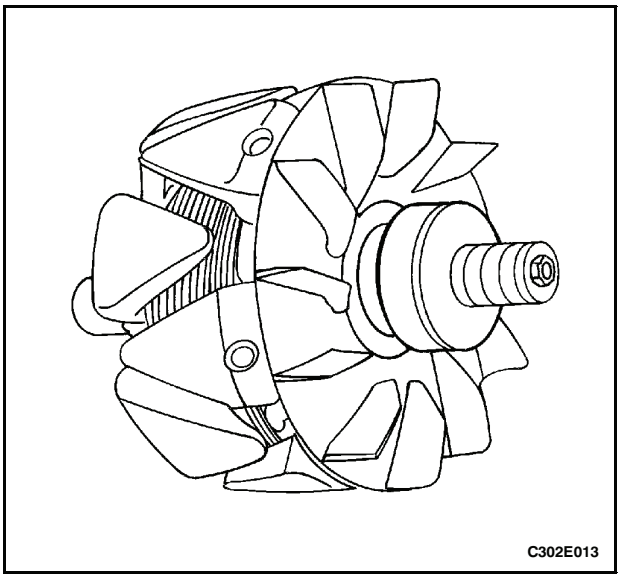
15. Using an ohmmeter, test the stator for ground. If the reading is low, replace the stator.
16. Check the stator for an open circuit by placing the probes on two terminals. If the reading is high (infinite), replace the stator.


C302E011

17. Using an ohmmeter, test the rotor for an open circuit. Check for continuity between the slip rings. Standard resistance (cold) is 2.8 to 3.0 ohms. If there is no continuity, replace the rotor.

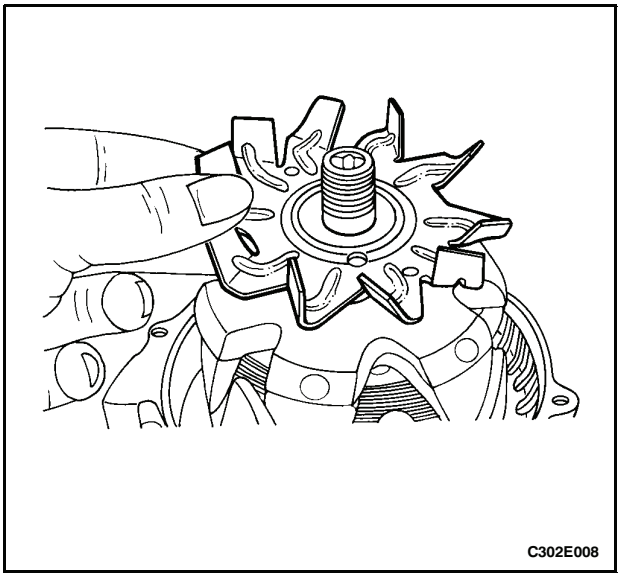

C302E012

18. Using an ohmmeter, inspect the rotor for ground. Check for continuity between the rotor and the slip ring. If there is no continuity between the rotor and the slip ring, replace the rotor.

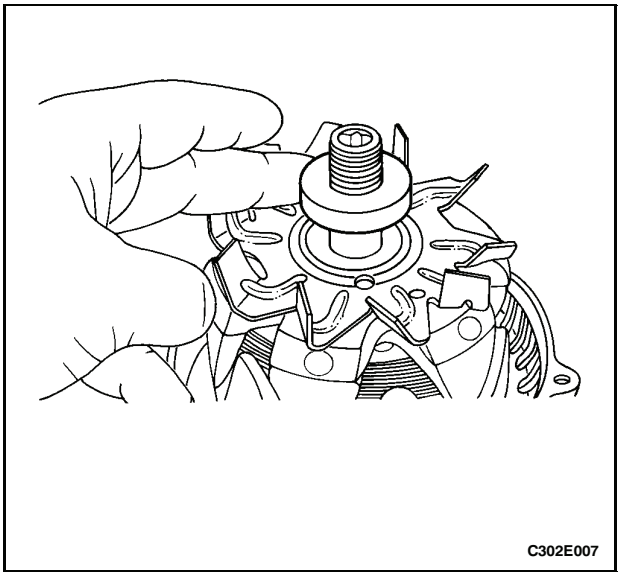

C302E013

Assembly Procedure

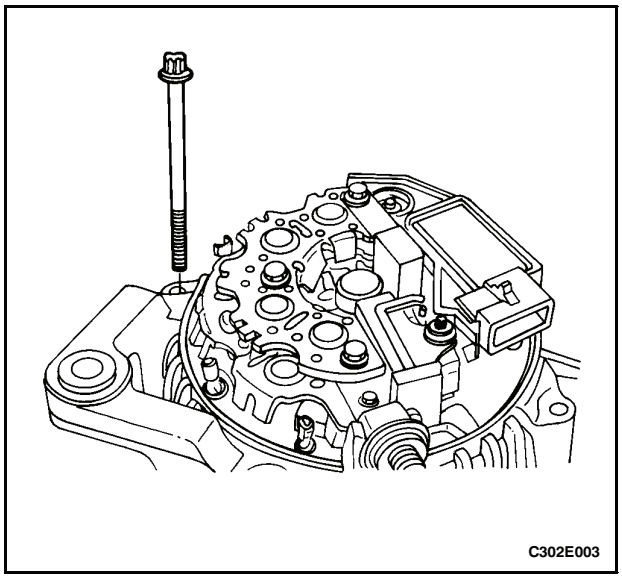
1. Check the bearing on the fan side of the rotor assembly. Replace the bearing if it is rough or worn, especially if the generator is diagnosed as having a noisy bearing with the vehicle running.
2. If required, install a new bearing and insert the bearing retainer on the rotor assembly shaft.


C302E008

3. Press the rotor assembly onto the end frame.
4. Install the fan on the rotor shaft.


C302E007

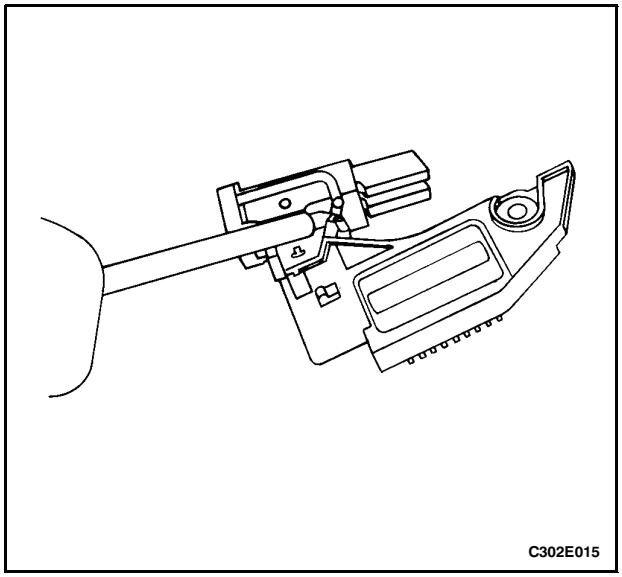
5. Install the collar.


C302E003

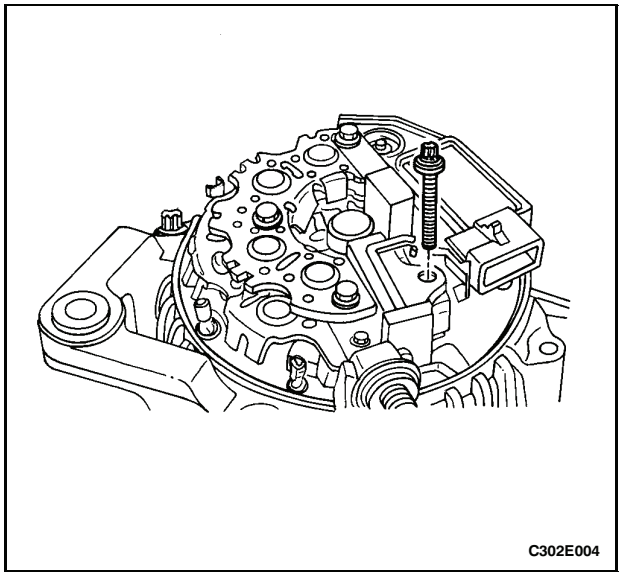
6. Install the slip ring end frame assembly by lining up the terminal ends of the stator with the end frame cover holes, and then lining up the marks that were made on the drive end frame case and the slip ring end frame case before the two cases were separated.
7. Install the generator through-bolts.

Tighten

Tighten the generator through-bolts to 25 NSm (18 lb-ft).


C302E015

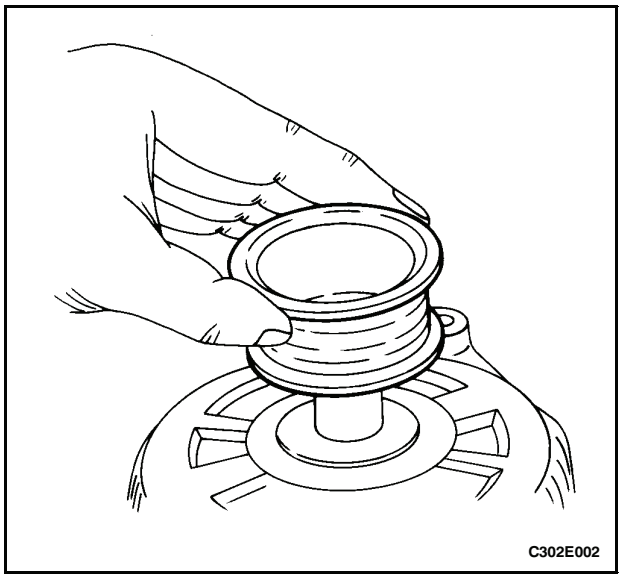
8. Install the rectifier assembly by first soldering its terminals to the stator terminal ends.
9. If the brushes are worn, solder the terminal of the new brush holder assembly to the regulator assembly.


C302E004

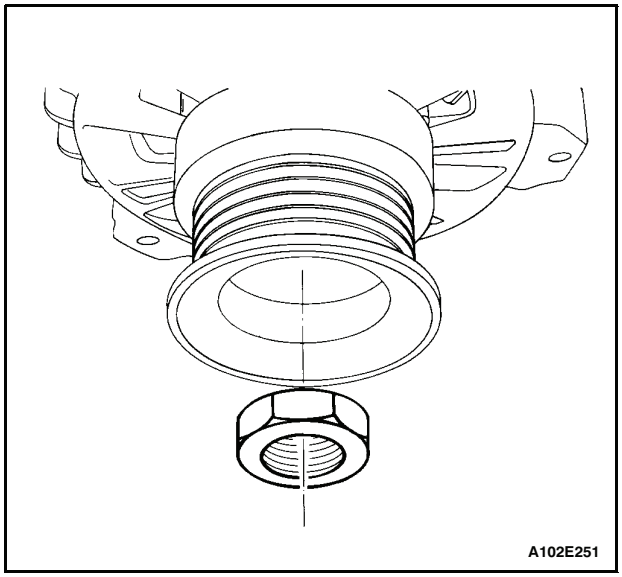
10. Solder the terminal of the regulator/brush holder assembly to the rectifier assembly.
11. Fasten the rectifier and the regulator/brush holder assemblies to the slip ring end frame with the bolts.

Tighten

Tighten the rectifier and the regulator/brush holder assembly bolts to the point at which they are touching their respective mounting plates. Then tighten the bolts with an additional quarter turn.


C302E002

12. Snap in the cover.
13. Install the collar and the pulley on the drive end shaft.


A102E251

14. Install the drive end nut.

Tighten

Tighten the generator drive end nut to 100 NSm (74 lb-ft).

15. Install the generator in the vehicle. Refer to "Generator" in this section.

GENERAL DESCRIPTION AND SYSTEM OPERATION

BATTERY

The battery has three major functions in the electrical system. First, the battery provides a source of energy for cranking the engine. Second, the battery acts as a voltage stabilizer for the electrical system. Finally, the battery can, for a limited time, provide energy when the electrical demand exceeds the output of the generator.

The sealed battery is standard on all cars. There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The sealed battery has the following advantages over conventional batteries:

- No water need be added for the life of the battery.
- It is protected against overcharge. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.
- It is not as liable to self-discharge as a conventional battery. This is particularly important when a battery is left standing for long periods of time.
- It has more power available in a lighter and a smaller case.

RATINGS

A battery has two ratings: (1) A reserve capacity rating designated at 27_C (81_F), which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; (2) A cold cranking amp rating determined under testing at -18_C (0_F), which indicates the cranking load capacity.

RESERVE CAPACITY

The reserve capacity is the maximum length of time it is possible to travel at night with the minimum electrical load and no generator output. Expressed in minutes, reserve capacity (or RC rating) is the time required for a fully charged battery, at a temperature of 27_C (81_F) and being discharged at a current of 25 amperes, to reach a terminal voltage of 10.5 volts.

COLD CRANKING AMPERAGE

The cold cranking amperage test is expressed at a battery temperature of -18_C (0_F). The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely. However, with proper care, the battery will provide many years of service.

If the battery tests well, but fails to perform satisfactorily in service for no apparent reason, the following factors may point to the cause of the trouble:

- Vehicle accessories left on overnight.
- Slow average driving speeds used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- Defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- Battery abuse, including failure to keep the battery cable terminals clean and tight, or a loose battery hold-down.
- Mechanical problems such as shorted or pinched wires in the electrical system.

BUILT-IN HYDROMETER

The sealed battery has a built-in, temperature-compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure:

1. When observing the hydrometer, make sure that the battery has a clean top.
2. Under normal operation, two indications can be observed:
   - GREEN DOT VISIBLE - Any green appearance is interpreted as a "green dot," meaning the battery is ready for testing.
   - DARK GREEN DOT IS NOT VISIBLE - If there is a cranking complaint, the battery should be tested. The charging and electrical systems should also be checked at this time.
3. Occasionally, a third condition may appear:
   - CLEAR OR BRIGHT YELLOW - This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping, or normal battery wear. Finding a battery in this condition may indicate high charging by a faulty charging system. Therefore, the charging and the electrical systems may need to be checked if a cranking complaint exists. If the cranking complaint is caused by the battery, replace the battery.

CHARGING PROCEDURE

1. Batteries with the green dot showing do not require charging unless they have just been discharged, such as in cranking a vehicle.
2. When charging sealed-terminal batteries out of the vehicle, install the adapter kit. Make sure all the char-

ger connections are clean and tight. For best results, batteries should be charged while the electrolyte and the plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting the charger.

3. Charge the battery until the green dot appears. The battery should be checked every half-hour while charging. Tipping or shaking the battery may be necessary to make the green dot appear.
4. After charging, the battery should be load tested. Refer to "Starter Motor" in this section.

CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

- D Size of Battery - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- D Temperature - A longer time will be needed to charge any battery at -18_C (0_F) than at 27_C (81_F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher current rate as the battery warms.
- D Charger Capacity - A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.
- D State-of-Charge - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

CHARGING A COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced.

The following procedure should be used to recharge a completely discharged battery:

1. Measure the voltage at the battery terminals with an accurate voltmeter. If the reading is below 10 volts, the charge current will be very low, and it could take some time before the battery accepts the current in excess of a few milliamperes. Refer to "Charging Time Required" in this section, which focuses on the factors affecting both the charging time required and the rough estimates in the table below. Such low current may not be detectable on ammeters available in the field.
2. Set the battery charger on the high setting.

Important: Some chargers feature polarity protection circuitry, which prevents charging unless the charger leads are correctly connected to the battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction for bypassing or overriding the circuitry so that the charger will turn on and charge a low-voltage battery.

3. Battery chargers vary in the amount of voltage and current provided. The time required for the battery to accept a measurable charge current at various voltages may be as follows:

Voltage	Hours
16.0 or more	Up to 4 hours
14.0-15.9	Up to 8 hours
13.9 or less	Up to 16 hours

- D If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- D If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

Important: It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore the battery to a usable state. As a general rule, using the reserve capacity rating (RC) as the number of ampere hours of charge usually brings the green dot into view.

- D If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.
- D If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

JUMP STARTING PROCEDURE

1. Position the vehicle with the good (charged) battery so that the jumper cables will reach from one battery to the other.
2. Turn off the ignition, all the lights, and all the electrical loads in both vehicles. Leave the hazard flasher on if there may be other traffic and any other lights needed for the work area.
3. In both vehicles, apply the parking brake firmly.

Notice: Make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine starts, damaging the parts.

4. Shift an automatic transaxle to Park (P), or a manual transaxle to Neutral (N).

Caution: Do not use cables that have loose or missing insulation, or injury could result.

5. Clamp one end of the first jumper cable to the positive terminal on the battery. Make sure it does not touch any other metal parts. Clamp the other end of the same cable to the positive terminal on the other battery. Never connect the other end to the negative terminal of the discharged battery.

Caution: Do not attach the cable directly to the negative terminal of the discharged battery. Doing so could cause sparks and a possible battery explosion, possibly resulting in personal injury.

6. Clamp one end of the second cable to the negative terminal of the booster battery. Make the final connection to a solid engine ground, such as the engine lift bracket, at least 450 millimeters (18 inches) from the discharged battery.
7. Start the engine of the vehicle with the good battery. Run the engine at a moderate speed for several minutes. Then start the engine of the vehicle which has the discharged battery.
8. Remove the jumper cables by reversing the above sequence exactly. Remove the negative cable from the vehicle with the discharged battery first. While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

GENERATOR

The Delco-Remy CS charging system has several models available, including the CS-121D and the CS-128D. The number denotes the outer diameter in millimeters of the stator lamination.

CS generators are equipped with internal regulators. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and a fan are used. There is no test hole.

Unlike three-wire generators, the CS-121D and the CS-128D may be used with only two connections: battery positive and an “L” terminal to the charge indicator lamp.

As with other charging systems, the charge indicator lamp lights when the ignition switch is turned to ON, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. This indicator light will glow at full brilliance for several kinds of defects, as well as when the system voltage is too high or too low.

The regulator voltage setting varies with the temperature and limits the system voltage by controlling the rotor field current. The regulator switches rotor field current on and off at a fixed frequency of about 400 hertz. By varying the on-/off-time time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, the on-time may be 90 percent and the off-time 10 percent.

CHARGING SYSTEM

The Delco-Remy CS charging system has several models available, including the CS-121D and the CS-128D. The number denotes the outer diameter in millimeters of the stator laminations.

CS generators use a new type of regulator that incorporates a diode trio. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and a fan are used. There is no test hole.

STARTER

Wound field starter motors have pole pieces, arranged around the armature, which are energized by wound field coils.

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icy conditions, and splashes.

In the basic circuit, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear. The solenoid main contacts close. Cranking then takes place.

When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be released immediately after the engine starts.

STARTING SYSTEM

The engine electrical system includes the battery, the ignition, the starter, the generator, and all the related wiring. Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual.

The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring. All of these components are connected electrically.

SECTION 1F

ENGINE CONTROLS

TABLE OF CONTENTS

SPECIFICATIONS

SCAN TOOL DATA TABLE

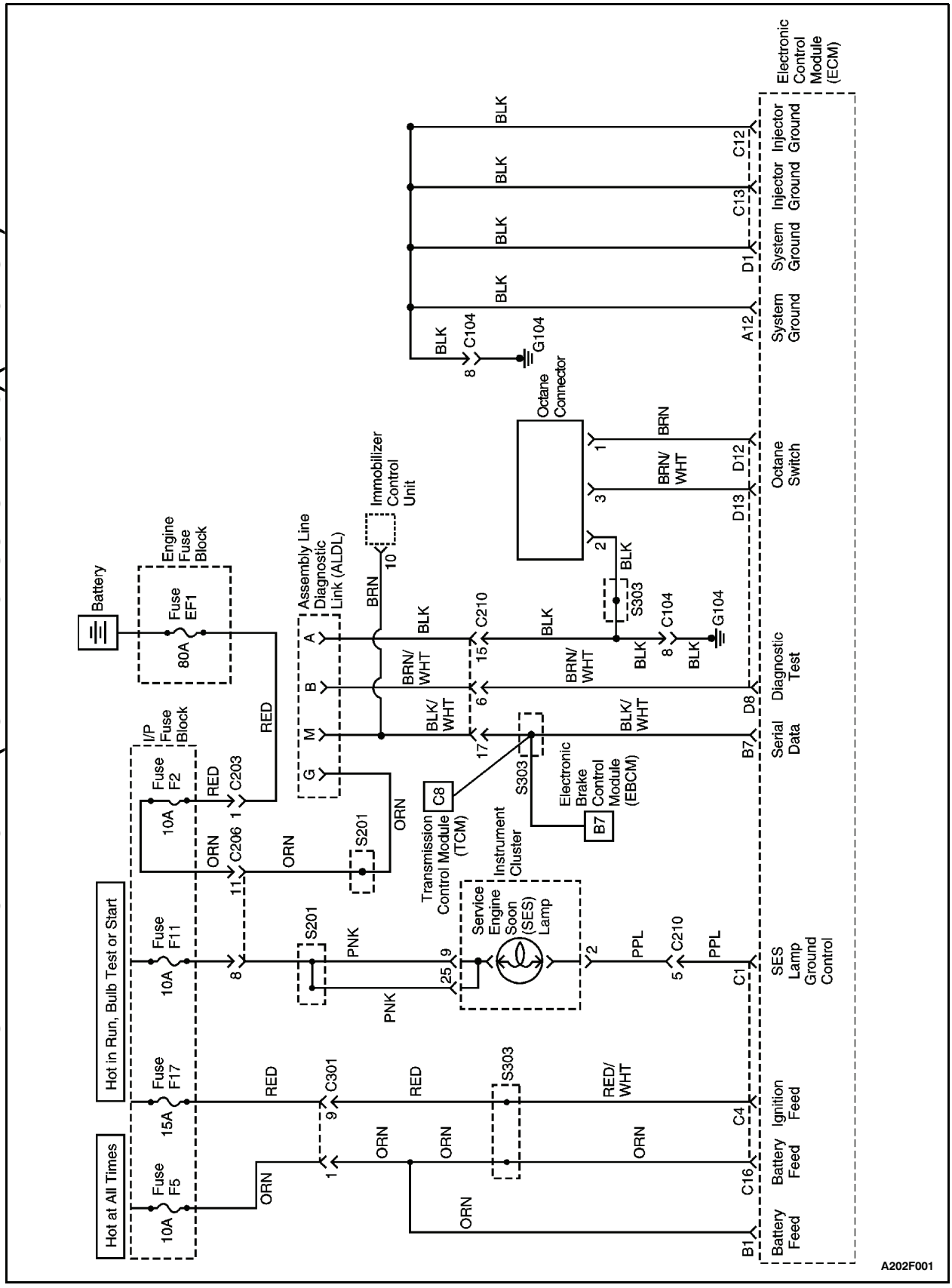
Parameter	Units Displayed	Typical Data Value
Engine Speed	rpm	$ 50 rpm from desired rpm in drive (A/T) $ 50 rpm from desired rpm in neutral (M/T)
Desired Idle	rpm	ECM idle command (varies with temperature)
Engine Coolant Temperature	degrees Celsius	85-105°C
MAT/Internal Air Temperature	degrees Celsius	10-90°C
MAP	kPa/volts	29-48 kPa/1-2 volts (varies with manifold and barometric pressure)
Barometric Pressure	kPa/volts	varies with altitude
Fueling Mode	open/closed	"Closed Loop" (may enter "Open Loop" at extended idle)
Throttle Position	volts	0.3-1.0 v
Air/Fuel Ratio	-	-
Oxygen Sensor Signal	millivolts	1-1000 mv (varies continuously)
Injector-Pulse Width	milliseconds	0.8-2.5 ms
Spark Advance	degrees	varies
Fuel Integrator	counts	110 X 145
Block Lever	counts	115 X 138
Idle Air Control	counts	1-50
P/N Switch (A/T Only)	P-N and R-D-L	Park/Neutral (P/N)
Vehicle Speed	kph, mph	0
A/C Pressure	kPa	varies
Ignition/Battery Voltage	volts	13.5-14.8 v
Cooling Fan Relay	on/off	on/off
A/C Request	yes/no	no
A/C Clutch	on/off	off
Low Fan Request	on/off	on/off
Prom ID	0-9999	PROM ID number varies
Canister Purge Solenoid	on/off	off
CO Adjust (Leaded Fuel)	count	128
High-Speed Fan	on/off	off

FASTENER TIGHTENING SPECIFICATIONS

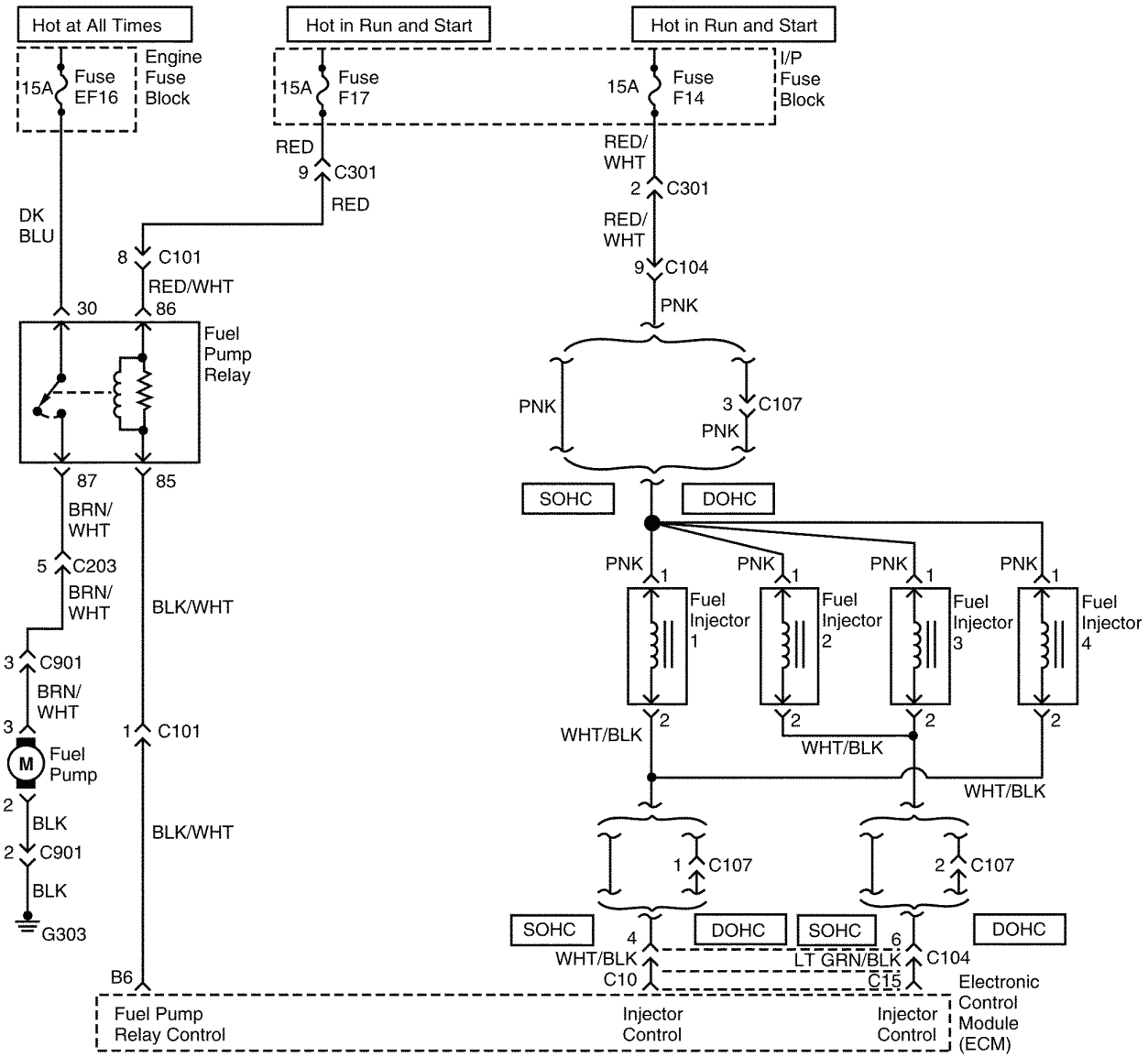
Application	N•m	Lb-Ft	Lb-In
Coolant Temperature Sensor	20	15	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Direct Ignition System Ignition Coil Retaining Bolts	10	-	89
Evaporative Emission Canister Flange Bolt	20	15	-
Exhaust Gas Recirculation Valve Retaining Bolts	20	15	-
Fuel Pressure Regulator Retaining Bolt - SOHC	12	-	106
Fuel Pressure Regulator Retaining Screw	12	-	106
Fuel Tank Retaining Bolts	20	15	-
Idle Air Control Valve Retaining Bolts	3	-	27
Knock Sensor Bolt	20	15	-
Manifold Absolute Pressure Sensor Mounting Bracket Bolt	10	-	89
Manifold Absolute Pressure Sensor Retaining Bolts and Nuts	8	-	71
Oxygen Sensor	41	30	-
Parking Brake Cable Retainer Clamps	10	-	89
Throttle Body Retaining Bolts	15	11	-
Throttle Position Sensor Retaining Bolts	2	-	18
Variable Geometry Induction System Vacuum Actuator Assembly Mounting Bracket Bolt	16	12	-

SCHEMATIC AND ROUTING DIAGRAMS

ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 1 OF 5) (IEFI-6 ECM)

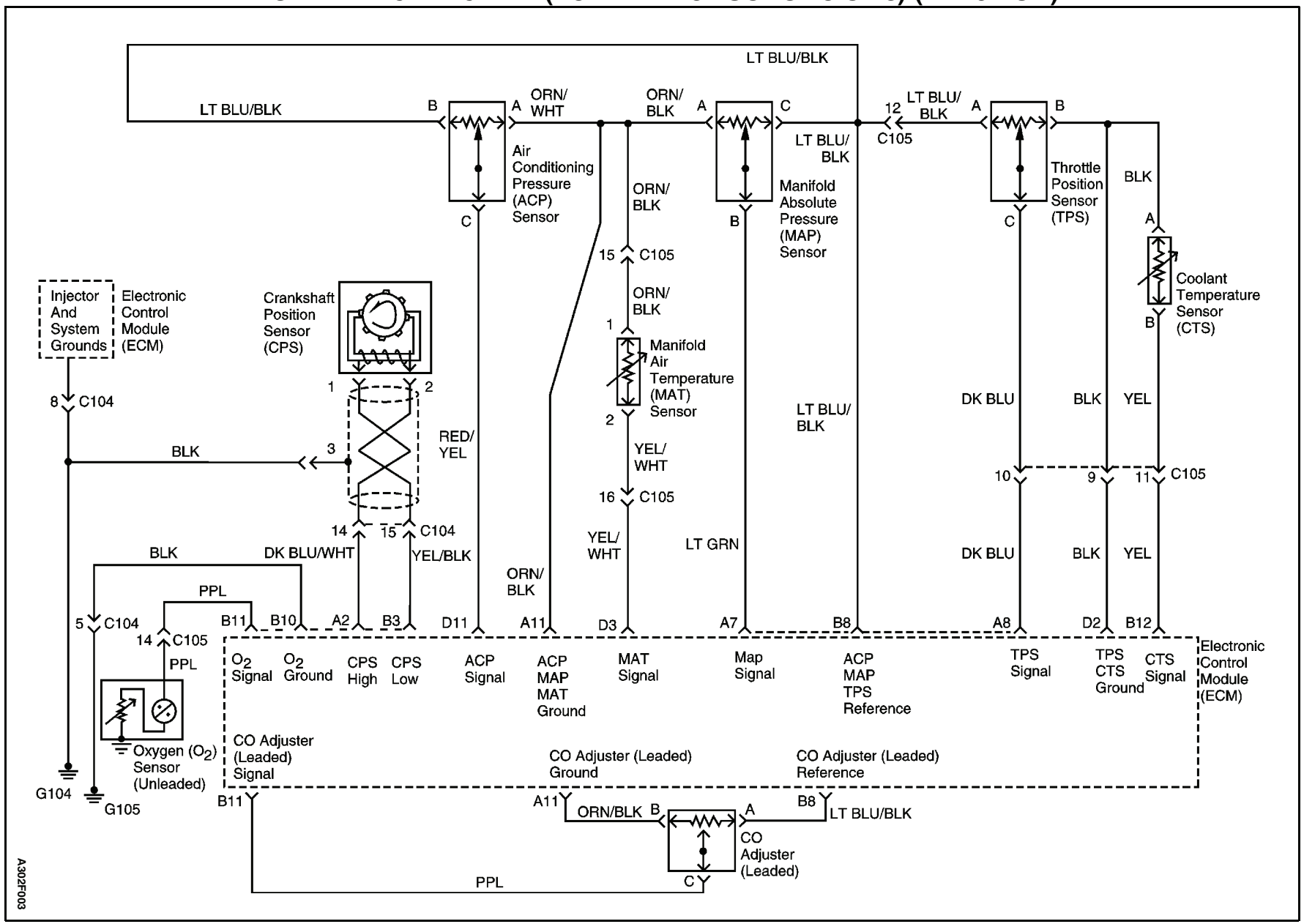


ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 2 OF 5) (IEFI-6 ECM)



A22F002A

ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 3 OF 5) (IEFI-6 ECM)



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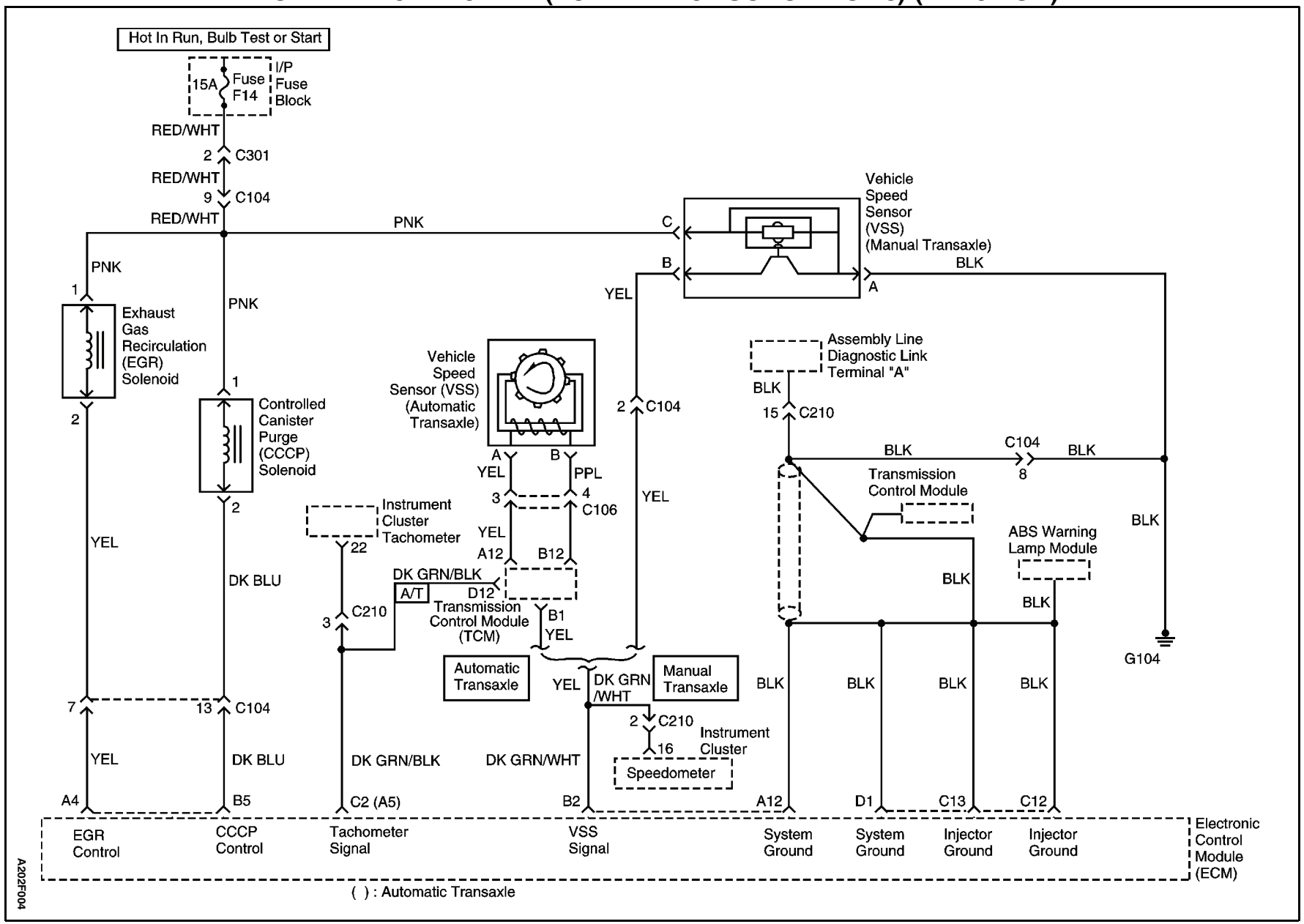
ECM WIRING DIAGRAM (1.3L AND 1.5L SOHC - 4 OF 5) (IEFI-6 ECM)



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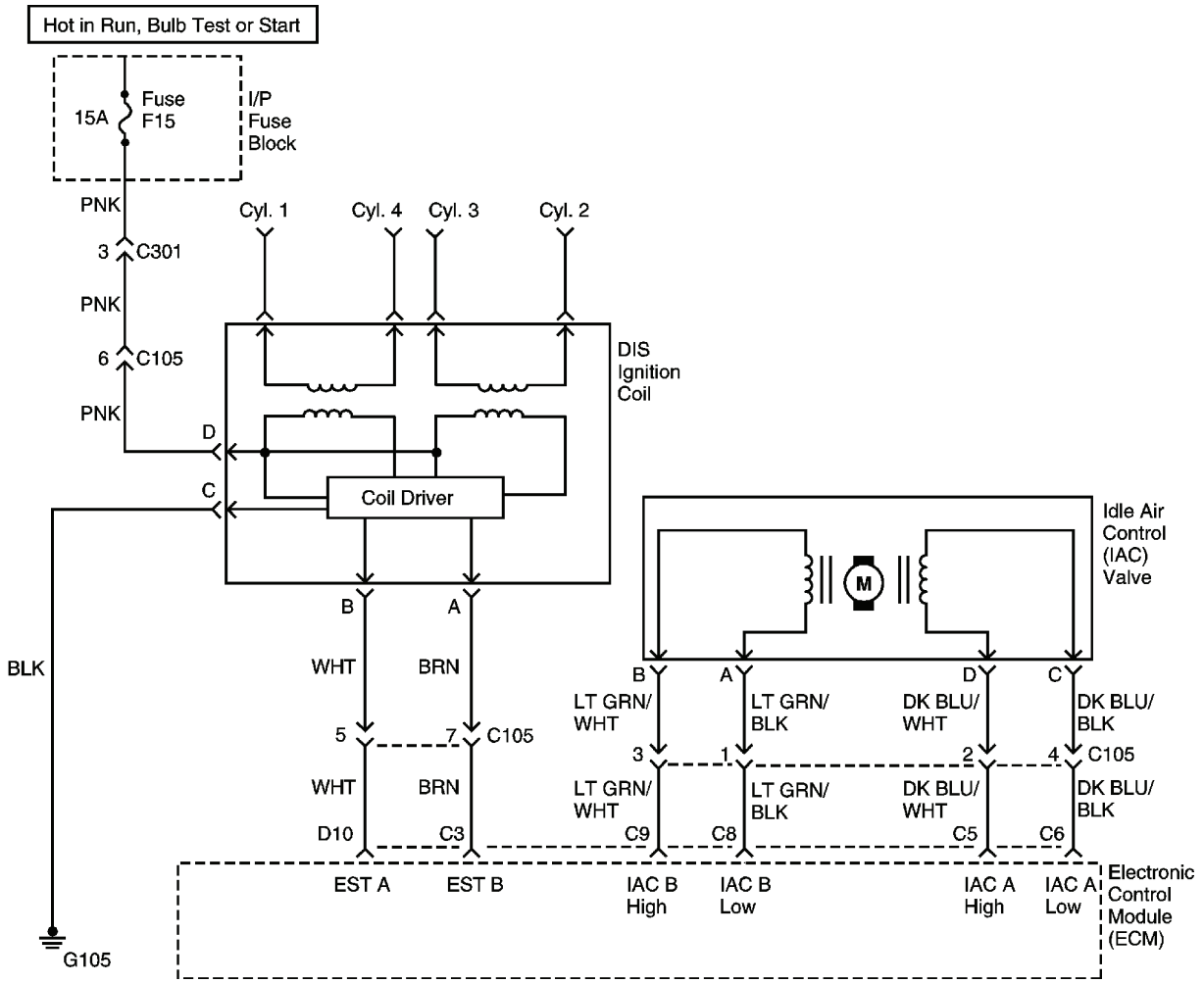

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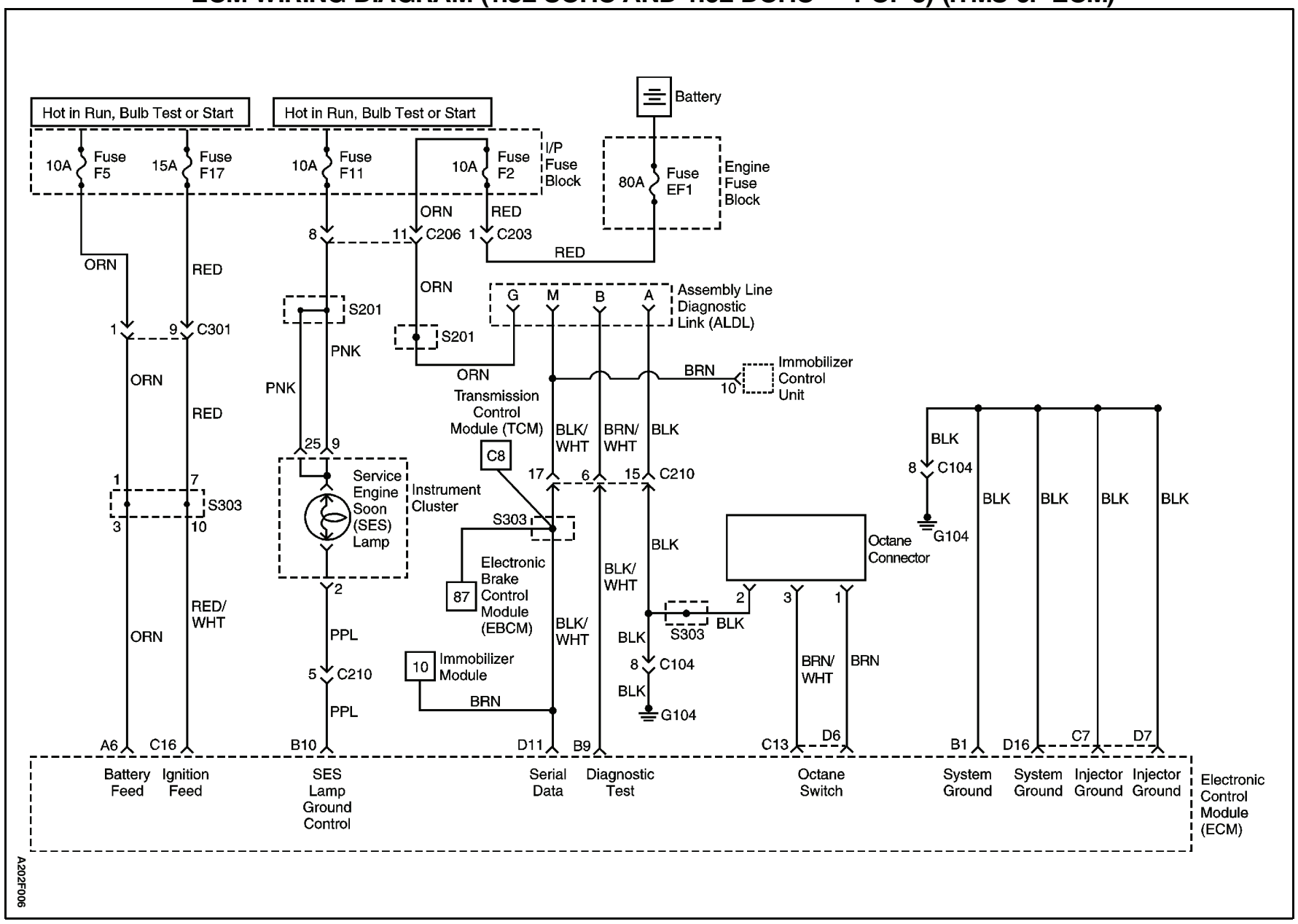
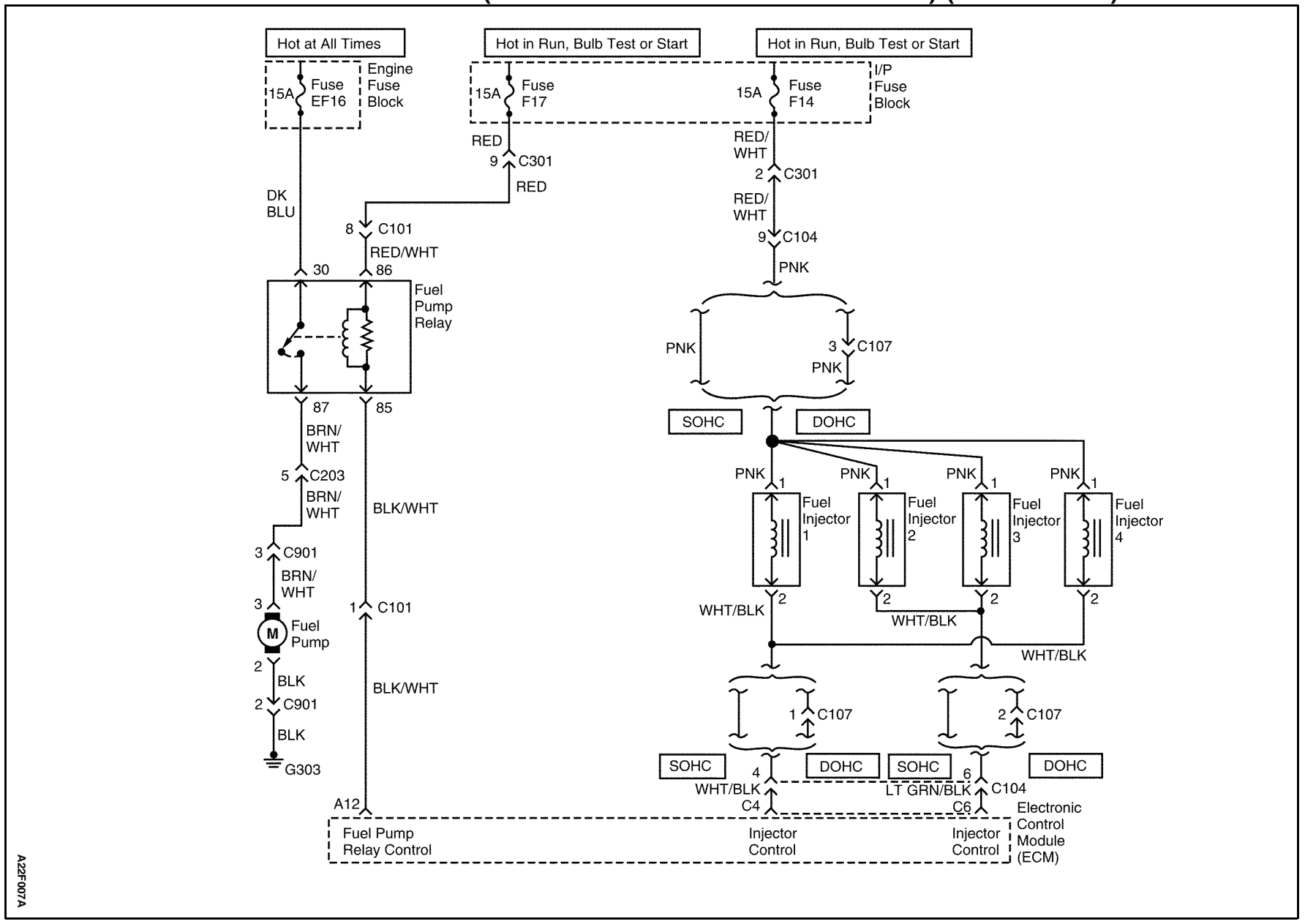
ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 1 OF 5) (ITMS-6F ECM)



ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 2 OF 5) (ITMS-6F ECM)



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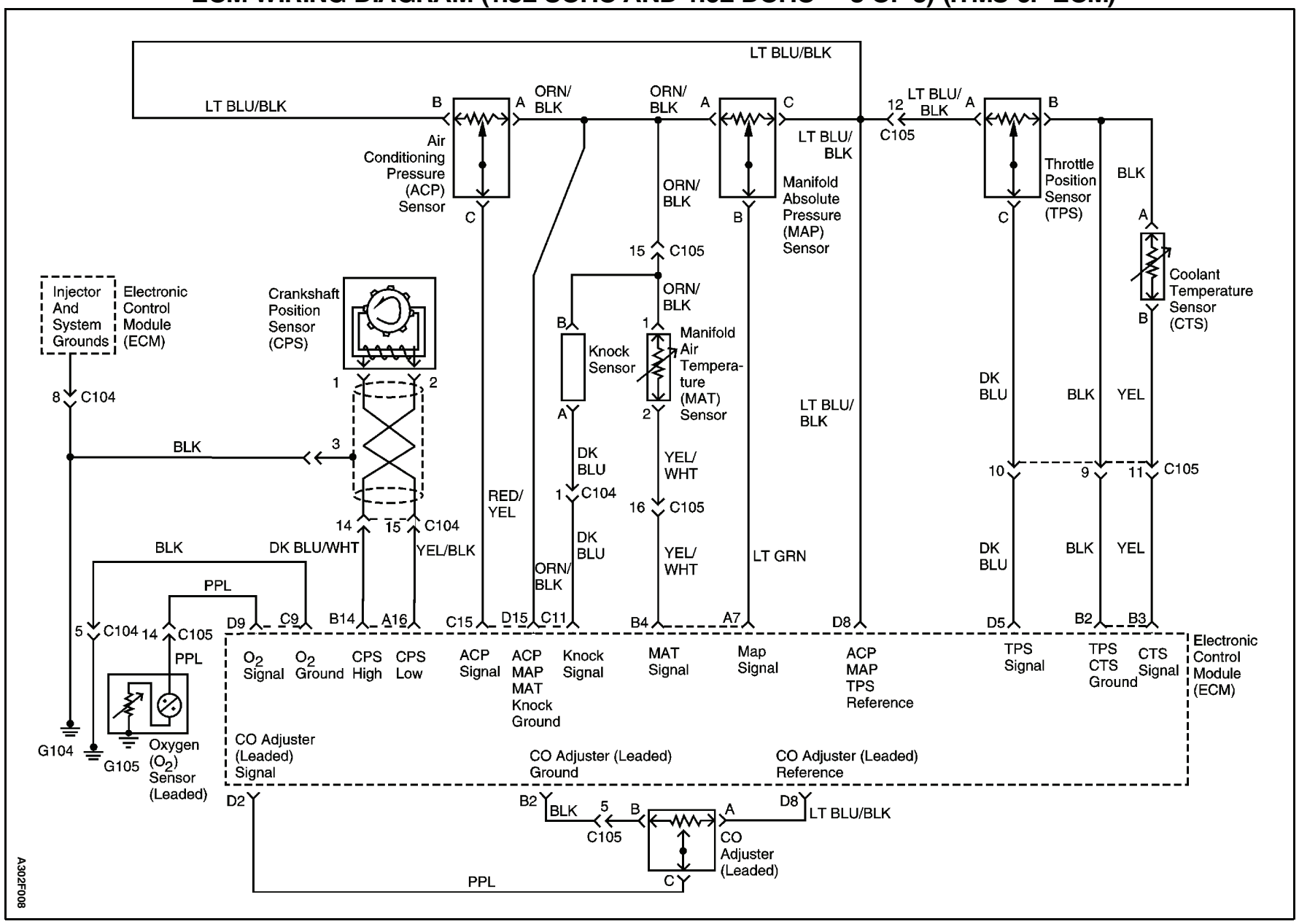
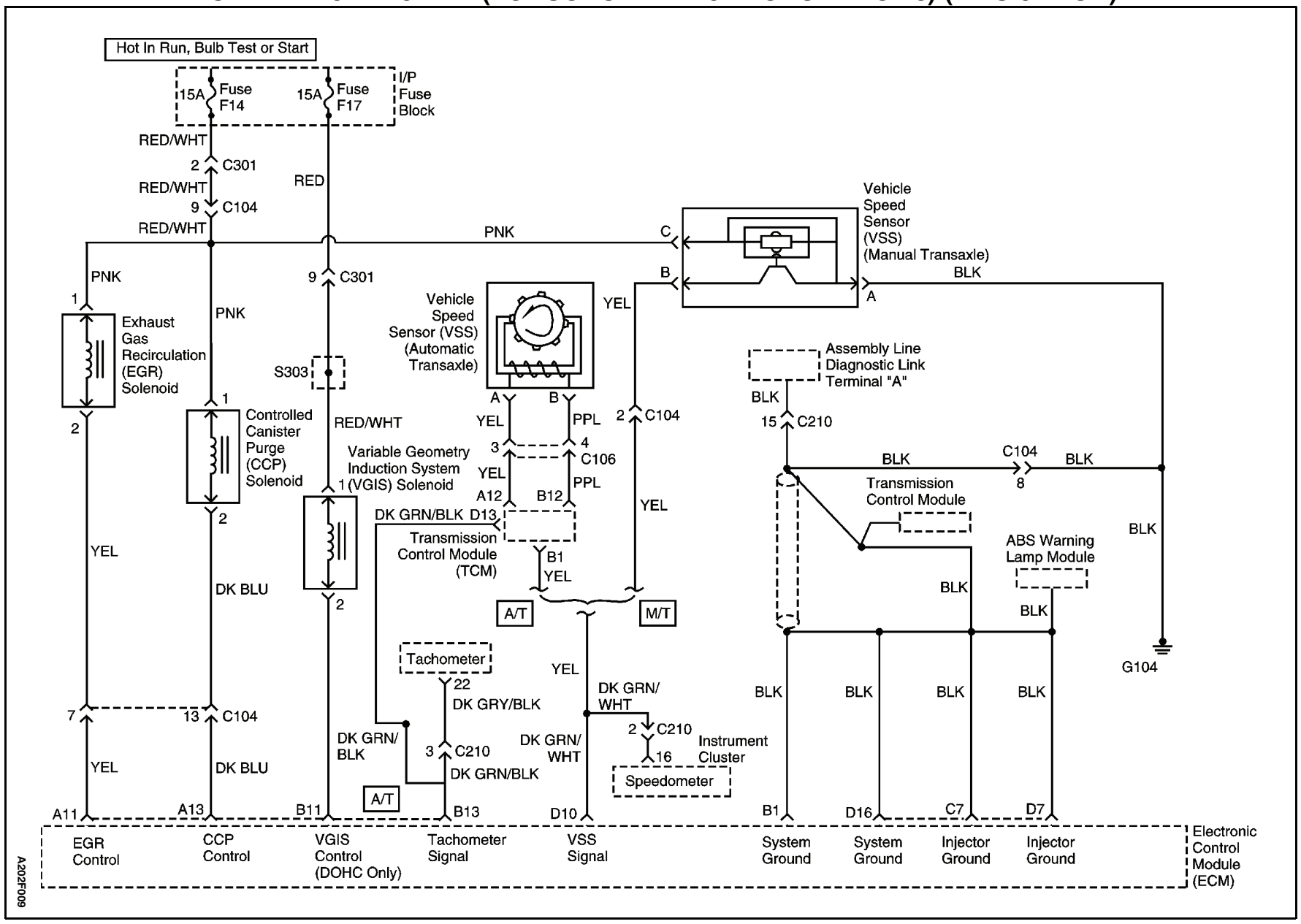
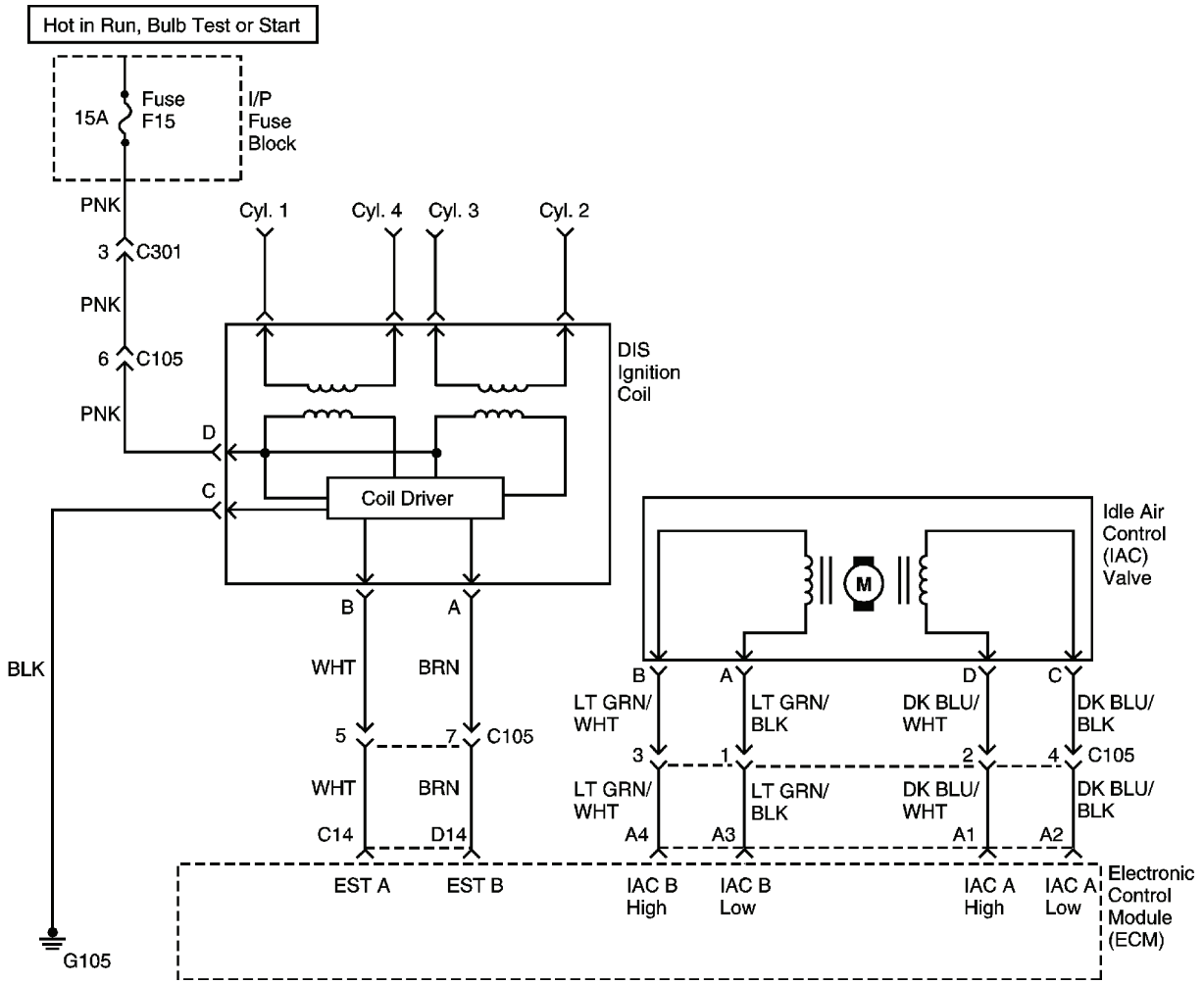
ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 3 OF 5) (ITMS-6F ECM)



ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 4 OF 5) (ITMS-6F ECM)

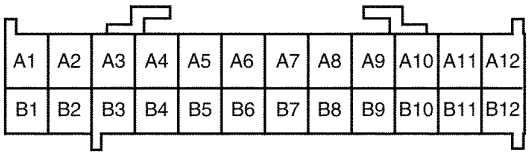


ECM WIRING DIAGRAM (1.3L SOHC AND 1.6L DOHC - 5 OF 5) (ITMS-6F ECM)



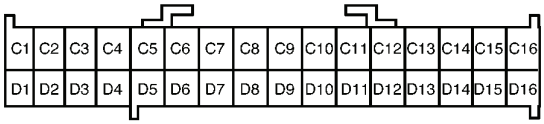
A202F010

CONNECTOR END VIEW



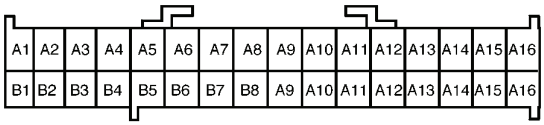
Electronic Control
Module (ECM) 24-Pin
Connector
(1.3L and 1.5L SOHC)

A302F065



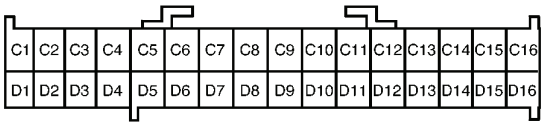
Electronic Control
Module (ECM) 32-Pin
Connector
(1.3L and 1.5L SOHC)

A302F066



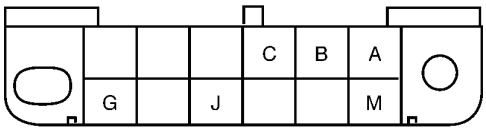
Electronic Control
Module (ECM) J2 (Red)
Connector
(1.3L SOHC and 1.6L DOHC)

A202F067



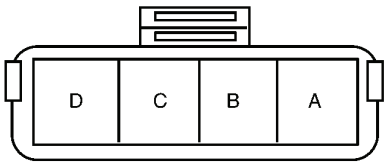
Electronic Control
Module (ECM) J1 (White)
Connector
(1.3L SOHC and 1.6L DOHC)

A202F068



Assembly Line
Diagnostic Link
(ALDL)

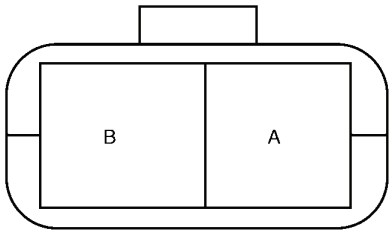
A302F091



Direct Ignition System (DIS)
Ignition Coil
Connector

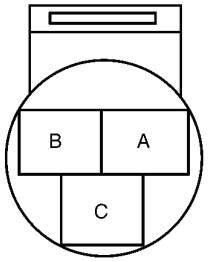
A102F080

CONNECTOR END VIEW (Cont'd)



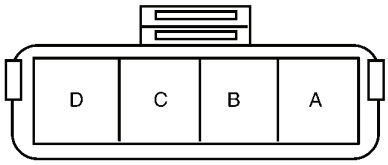
Coolant Temperature
Sensor (CTS) Connector

A102F085



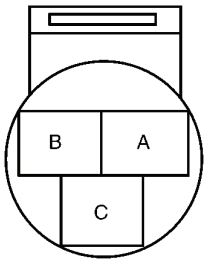
Air Conditioning
Pressure (ACP) Sensor
Connector

A102F088



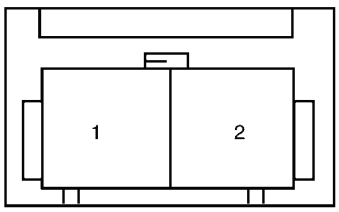
Idle Air Control (IAC) Valve
Connector

A102F076



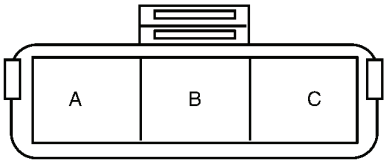
Throttle Position
Sensor (TPS) Connector

A102F074



Manifold Air
Temperature (MAT) Sensor
Connector

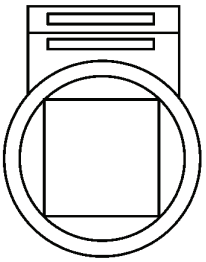
A102F077



Vehicle Speed
Sensor (VSS) (M/T)
Connector

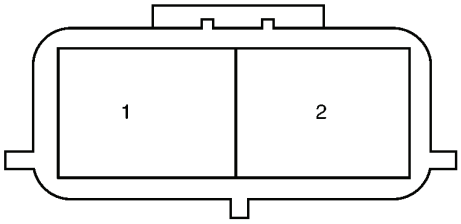
A102F086

CONNECTOR END VIEW (Cont'd)



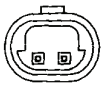
Oxygen (O_2) Sensor
Connector

A102F081



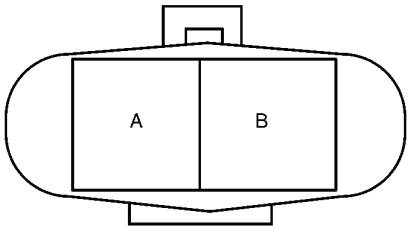
Controlled Canister
Purge (CCP) Solenoid
Connector

A102F078



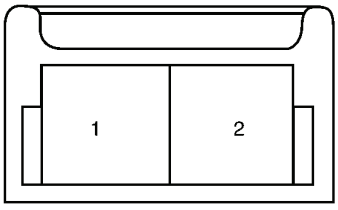
Knock Sensor Connector

A202F069



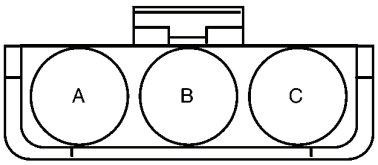
Cooling Fan
Connector

A102F089



Fuel Injector
Connector

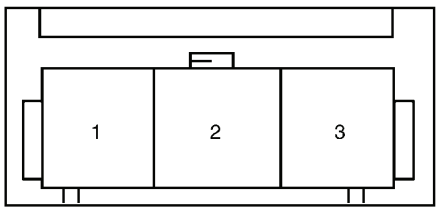
A102F082



Manifold Absolute
Pressure (MAP) Sensor
Connector

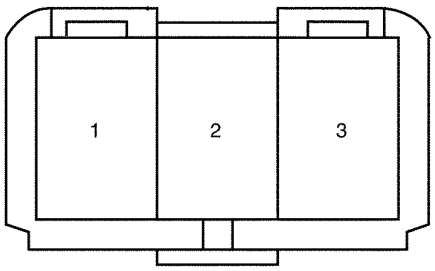
A102F075

CONNECTOR END VIEW (Cont'd)



Crankshaft Position
Sensor (CPS) Connector

A102F084

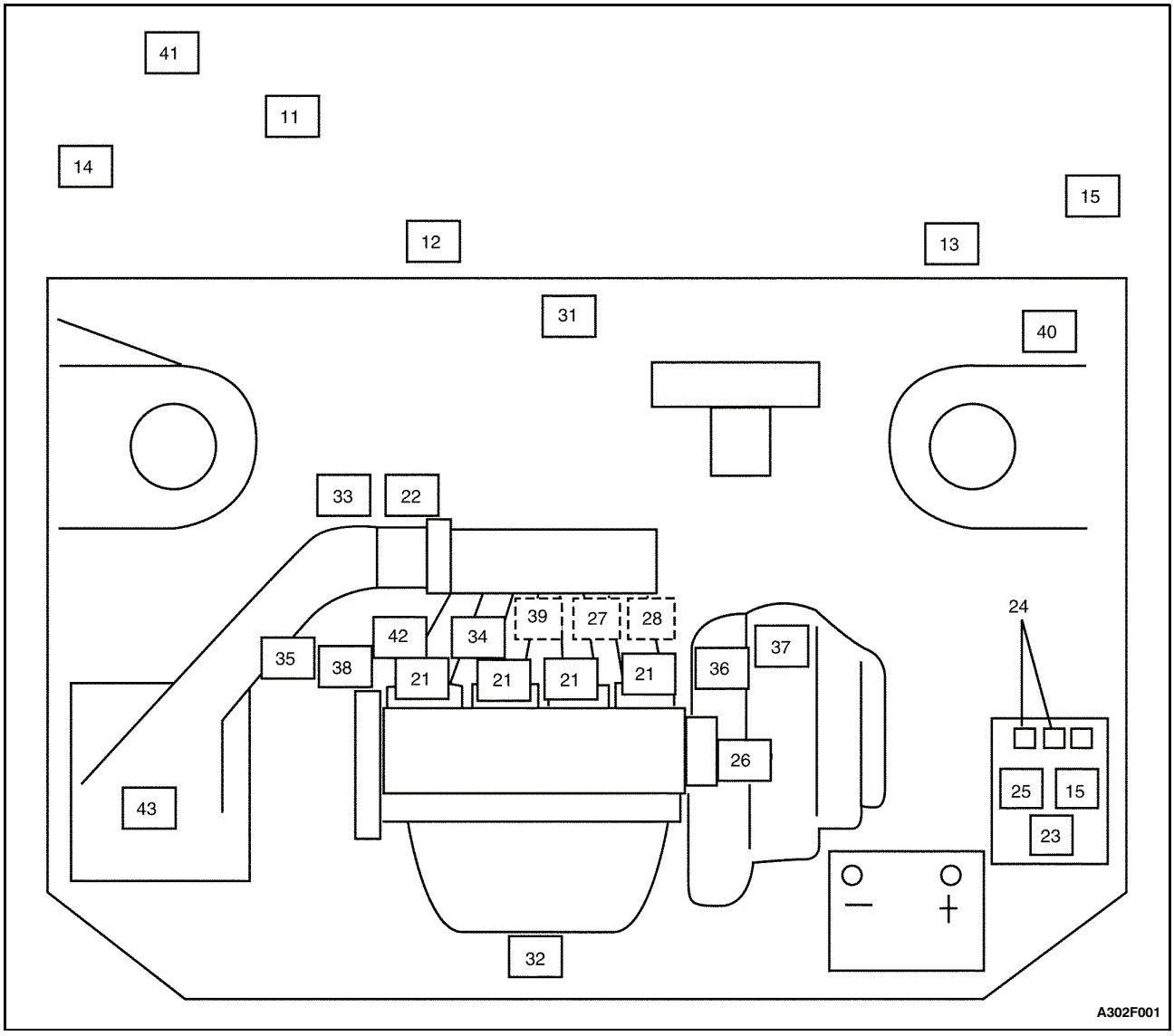


CO Potentiometer Connector

B302F150

COMPONENT LOCATOR

COMPONENT LOCATOR - SOHC



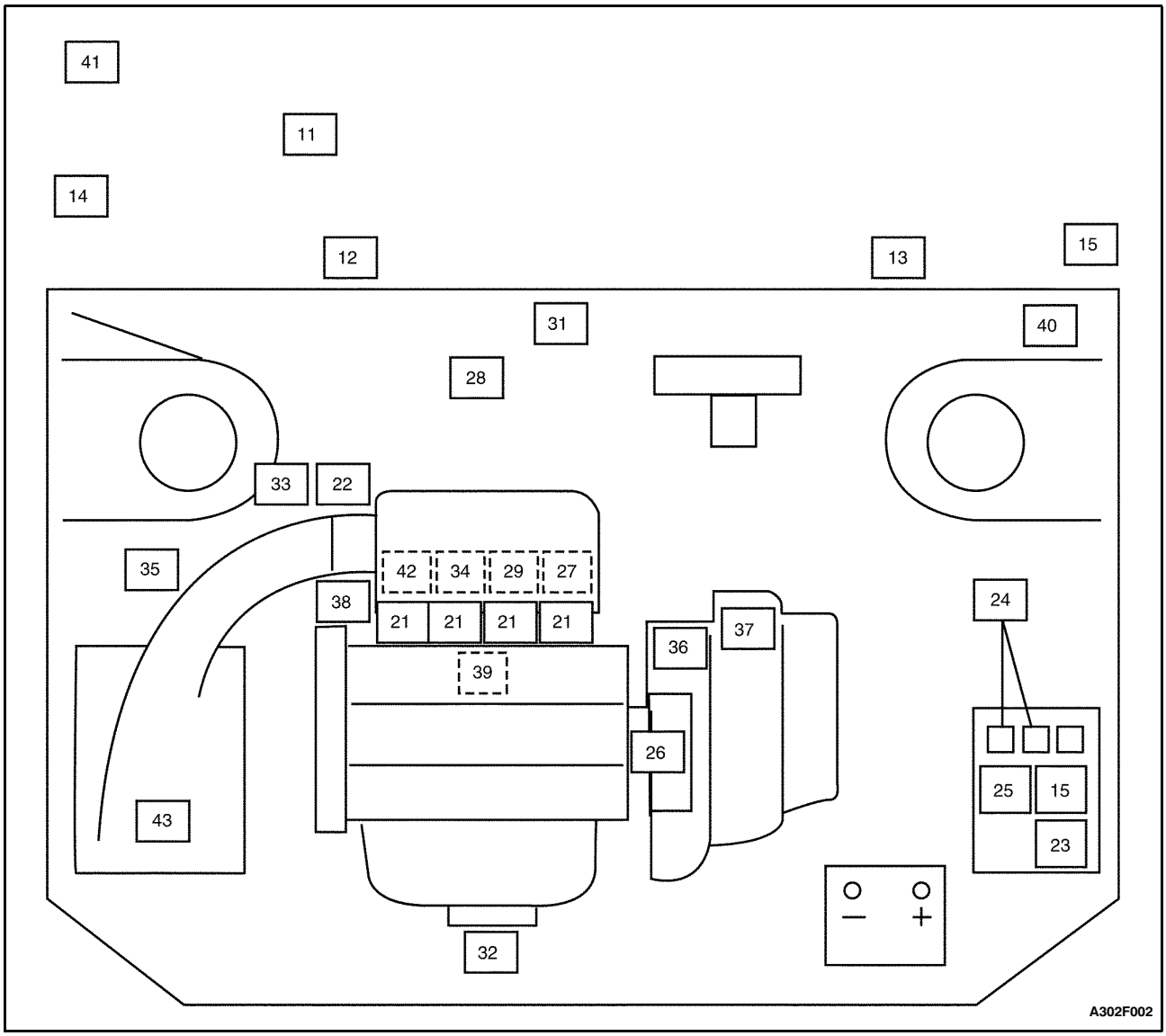
Components on ECM Harness
- 11 Electronic Control Module (ECM)
- 12 Assembly Line Diagnostic Link (ALDL) Diagnostic Connector
- 13 Malfunction Indicator Lamp
- 14 ECM/ABS Harness Ground
- 15 Fuse Panel (2)

ECM-Controlled Devices
- 21 Fuel Injector (4)
- 22 Idle Air Control (IAC) Valve
- 23 Fuel Pump Relay
- 24 Engine Fan Relays
- 25 A/C Compressor Relay
- 26 Direct Ignition System (DIS) Ignition Coil
- 27 Controlled Canister Purge (CCP) Solenoid
- 28 Exhaust Gas Recirculation (EGR) Solenoid

Information Sensors
- 31 Manifold Absolute Pressure (MAP) Sensor
- 32 Oxygen (O_2) Sensor
- 33 Throttle Position Sensor (TPS)
- 34 Coolant Temperature Sensor (CTS)
- 35 Manifold Air Temperature (MAT) Sensor
- 36 Vehicle Speed Sensor (VSS) (Manual Transaxle Only)
- 37 P/N Switch (Automatic Transaxle only)
- 38 Crankshaft Position Sensor (CPS)
- 39 Knock Sensor
- 40 CO Potentiometer

Not ECM-Connected
- 41 Evaporative Emission Canister (under vehicle, behind right rear wheel)
- 42 Oil Pressure Switch
- 43 Air Cleaner

COMPONENT LOCATOR - DOHC



Components on ECM Harness
- 11 Electronic Control Module (ECM)
- 12 Assembly Line Diagnostic Link (ALDL) Diagnostic Connector
- 13 Malfunction Indicator Lamp
- 14 ECM/ABS Harness Ground
- 15 Fuse Panel (2)

ECM-Controlled Devices
- 21 Fuel Injector (4)
- 22 Idle Air Control (IAC) Valve
- 23 Fuel Pump Relay
- 24 Engine Fan Relays
- 25 A/C Compressor Relay
- 26 Direct Ignition System (DIS) Ignition Coil
- 27 Controlled Canister Purge (CCP) Solenoid
- 28 Variable Geometry Induction System (VGIS)
- 29 Exhaust Gas Recirculation (EGR) Solenoid

Information Sensors
- 31 Manifold Absolute Pressure (MAP) Sensor
- 32 Oxygen (O_2) Sensor
- 33 Throttle Position Sensor (TPS)
- 34 Coolant Temperature Sensor (CTS)
- 35 Manifold Air Temperature (MAT) sensor
- 36 Vehicle Speed Sensor (VSS) (Manual Transaxle Only)
- 37 P/N Switch (Automatic Transaxle Only)
- 38 Crankshaft Position Sensor (CPS)
- 39 Knock Sensor
- 40 CO Potentiometer

Not ECM-Connected
- 41 Evaporative Emission Canister (under vehicle, behind right rear wheel)
- 42 Oil Pressure Switch
- 43 Air Cleaner

DIAGNOSIS

TROUBLE CODE DIAGNOSIS

CLEARING TROUBLE CODES

Notice: To prevent electronic control module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, electronic control module pigtail connector, electronic control module fuse, jumper cables, etc.).

When the ECM sets a diagnostic trouble code (DTC), the service engine soon (SES) lamp will be turned on and a DTC will be stored in the ECM's memory. If the problem is intermittent, the light will go out after 10 seconds if the fault is no longer present. The DTC will stay in the ECM's memory until the battery voltage to the ECM is removed. Removing battery voltage for 10 seconds will clear all stored DTCs.

DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart. This allows the ECM to set the DTC while going through the chart, which will help to find the cause of the problem more quickly.

IDLE LEARN PROCEDURE

Whenever the battery cables, the electronic control module (ECM), or the ECM fuse is disconnected or replaced, the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 5 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in P/N (park/neutral).
5. Allow the engine run until the engine coolant is above 85°C (185°F).
6. Turn the air conditioning (A/C) ON for 10 seconds, if equipped.
7. Turn the A/C OFF for 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).
9. Turn the A/C ON for 10 seconds, if equipped.
10. Turn the A/C OFF for 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

DIAGNOSTIC SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Check for proper operation of the service engine soon (SES) lamp. When the ignition is ON and the engine is OFF, the SES lamp should come on and remain on steadily.
2. No SES at this point indicates that there is a problem with the SES circuit or the electronic control module (ECM) control of that circuit.
3. This step checks the ability of the ECM to control the SES lamp. With the assembly line diagnostic link (ALDL) terminal grounded, the SES lamp should flash a Code 12 three times, followed by any diagnostic trouble code (DTC) stored in memory. Depending upon the type of ECM, an ECM error may result in the inability to flash Code 12.
4. Most procedures use a scan tool to aid diagnosis; therefore, serial data must be available. If an ECM error is present, the ECM may be able to illuminate the SES lamp, but not enable serial data.
5. Although the ECM is powered up, an "Engine Cranks But Will Not Start" symptom could exist because of an ECM or system problem.
6. This step will isolate if the customer complaint is an SES or a driveability problem with no SES. Refer to the DTC in this section for a list of valid DTCs. An invalid DTC may be the result of a faulty scan tool or a faulty ECM.
7. Comparison of actual control system data with the typical values is a quick check to determine if any parameter is not within limits. Keep in mind that a basic engine problem (such as incorrect valve timing or a vacuum leak) may substantially alter sensor values.
8. Installation of a scan tool will provide a good ground path for the ECM and may hide a driveability complaint due to poor ECM grounds.
9. If the actual data is not within the typical values established, refer to the tables in "Symptom Diagnosis" to provide a functional check of the suspect component or system.

Diagnostic System Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Verify the customer complaint(s). Are the customer's complaint(s) verified?	-	Go to Step 2	-
2	Turn the ignition ON. Is the service engine soon (SES) lamp on steadily?	-	Go to Step 4	Go to Step 3
3	Jumper the assembly line diagnostic link (ALDL) terminals A and B. Does the SES flash Code 12?	-	Go to Step 4	Go to "Will Not Flash SES"
4	1. Connect the scan tool to the ALDL. 2. Turn the ignition ON. Does the scan tool display serial data?	-	Go to Step 5	Go to Step 12
5	Start the engine. Does the engine start?	-	Go to Step 6	Go to "Engine Cranks But Will Not Start"
6	1. Turn the ignition OFF. 2. Connect the scan tool to the ALDL. 3. Turn the ignition ON. Are any diagnostic trouble codes (DTCs) displayed?	-	Go to Step 8	Go to Step 7
7	1. Start the engine. 2. Compare the scan tool data with typical values. Are the values normal or within the normal range?	-	Go to Step 9	Go to Step 10
8	Refer to the applicable DTC table. Start with the DTC with the lowest numerical value and move up. Are the DTC(s) identified as valid trouble code(s)?	-	Go to the applicable DTC table	Go to Step 6
9	Are there any symptoms that have been identified?	-	Go to the applicable symptom table	Go to Step 11
10	Identify the component that has a serial data value outside the normal range. Has the component been identified?	-	Go to "Diagnostic Aids"	-
11	1. Clear any DTC(s) from the electronic control module (ECM) memory. 2. Verify that the DTC(s) have been cleared. 3. Road test the vehicle. 4. Recheck for the presence of any DTC(s). Is the repair complete?	-	System OK	Go to Step 1
12	1. Attach the scan tool to another vehicle. 2. Turn the ignition ON. Does the scan tool read serial data?	-	Go to Step 13	Go to Step 16
13	Check for an open or short in the wire between ECM terminal B7 and ALDL connector M. Is the problem found?	-	Go to Step 14	Go to Step 15
14	1. Repair the open or short as necessary. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	System OK	Go to Step 15

Diagnostic System Check (1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Replace the ECM. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	Go to Step 6	-
16	1. Replace the scan tool. 2. Connect the scan tool to the ALDL. 3. Ignition ON. Does the scan tool read serial data?	-	Go to Step 5	-

DIAGNOSTIC SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis because it directs the technician to the next logical step in diagnosing the complaint. Understanding the table and using it correctly will reduce diagnostic time and prevent the unnecessary replacement of parts.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. Check for proper operation of the service engine soon (SES) lamp. When the ignition is ON and the engine is OFF, the SES lamp should come on and remain on steadily.
2. No SES at this point indicates that there is a problem with the SES circuit or the electronic control module (ECM) control of that circuit.
3. This step checks the ability of the ECM to control the SES lamp. With the assembly line diagnostic link (ALDL) terminal grounded, the SES lamp should flash a Code 12 three times, followed by any diagnostic trouble code (DTC) stored in memory. Depending upon the type of ECM, an ECM error may result in the inability to flash Code 12.
4. Most procedures use a scan tool to aid diagnosis; therefore, serial data must be available. If an ECM error is present, the ECM may be able to illuminate the SES lamp, but not enable serial data.
5. Although the ECM is powered up, an "Engine Cranks But Will Not Start" symptom could exist because of an ECM or system problem.
6. This step will isolate if the customer complaint is an SES or a driveability problem with no SES. Refer to the DTC in this section for a list of valid DTCs. An invalid DTC may be the result of a faulty scan tool or a faulty ECM.
7. Comparison of actual control system data with the typical values is a quick check to determine if any parameter is not within limits. Keep in mind that a basic engine problem (such as incorrect valve timing or a vacuum leak) may substantially alter sensor values.
8. Installation of a scan tool will provide a good ground path for the ECM and may hide a driveability complaint due to poor ECM grounds.
9. If the actual data is not within the typical values established, refer to the tables in "Symptom Diagnosis" to provide a functional check of the suspect component or system.

Diagnostic System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Verify the customer complaint(s). Are the customer's complaint(s) verified?	-	Go to Step 2	-
2	Turn the ignition ON. Is the service engine soon (SES) lamp on steadily?	-	Go to Step 4	Go to Step 3
3	Jumper the assembly line diagnostic link (ALDL) terminals A and B. Does the SES flash Code 12?	-	Go to Step 4	Go to "Will Not Flash SES"
4	1. Connect the scan tool to the ALDL. 2. Turn the ignition ON. Does the scan tool display serial data?	-	Go to Step 5	Go to Step 12
5	Start the engine. Does the engine start?	-	Go to Step 6	Go to "Engine Cranks But Will Not Start"
6	1. Turn the ignition OFF. 2. Connect the scan tool to the ALDL. 3. Turn the ignition ON. Are any diagnostic trouble codes (DTCs) displayed?	-	Go to Step 8	Go to Step 7
7	1. Start the engine. 2. Compare the scan tool data with typical values. Are the values normal or within the normal range?	-	Go to Step 9	Go to Step 10
8	Refer to the applicable DTC table. Start with the DTC with the lowest numerical value and move up. Are the DTC(s) identified as valid trouble code(s)?	-	Go to the applicable DTC table	Go to Step 6
9	Are there any symptoms that have been identified?	-	Go to the applicable symptom table	Go to Step 11
10	Identify the component that has a serial data value outside the normal range. Has the component been identified?	-	Go to "Diagnostic Aids"	-
11	1. Clear any DTC(s) from the electronic control module (ECM) memory. 2. Verify that the DTC(s) have been cleared. 3. Road test the vehicle. 4. Recheck for the presence of any DTC(s). Is the repair complete?	-	System OK	Go to Step 1
12	1. Attach the scan tool to another vehicle. 2. Turn the ignition ON. Does the scan tool read serial data?	-	Go to Step 13	Go to Step 16
13	Check for an open or short in the wire between ECM terminal D11 and ALDL connector M. Is the problem found?	-	Go to Step 14	Go to Step 15
14	1. Repair the open or short as necessary. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	System OK	Go to Step 15

Diagnostic System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Replace the ECM. 2. Connect the scan tool to the ALDL. 3. Start the engine. Does the scan tool display serial data?	-	Go to Step 6	-
16	1. Replace the scan tool. 2. Connect the scan tool to the ALDL. 3. Ignition ON. Does the scan tool read serial data?	-	Go to Step 5	-

DIAGNOSTIC AIDS

If an intermittent problem is evident, follow the guidelines below.

Preliminary Checks

Before using this section you should have already performed the "Diagnostic System Check."

Perform a thorough visual inspection. This inspection can often lead to correcting a problem without further checks and can save valuable time. Inspect for the following conditions:

- Electronic control module (ECM) grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks, or collapsing and improper connections as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- Air leaks at the throttle body mounting area and the intake manifold sealing surfaces.
- Ignition wires for cracks, hardness, improper routing, and carbon tracking.
- Wiring for improper connections.
- Wiring for pinches or cuts.

Diagnostic Trouble Code Tables

Do not use the diagnostic trouble code (DTC) tables to try to correct an intermittent fault. The fault must be present to locate the problem.

Incorrect use of the DTC tables may result in the unnecessary replacement of parts.

Faulty Electrical Connections or Wiring

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful inspection of suspect circuits for the following:

- Poor mating of the connector halves.
- Terminals not fully seated in the connector body.
- Improperly formed or damaged terminals. All connector terminals in a problem circuit should be carefully inspected, reformed, or replaced to insure contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body.

Road Test

If a visual inspection does not find the cause of the problem, the vehicle can be driven with a voltmeter or a scan tool connected to a suspected circuit. An abnormal voltage or scan tool reading will indicate that the problem is in that circuit.

If there are no wiring or connector problems found and a DTC was stored for a circuit having a sensor, except for DTC 44 and DTC 45, replace the sensor.

Intermittent Service Engine Soon (SES) Lamp

An intermittent service engine soon (SES) lamp with no DTC present may be caused by the following:

- Electrical system interference caused by a defective relay, ECM-driven solenoid, or switch.
- Improper installation of electrical options such as lights, two-way radios, sound systems, or security systems.
- Ignition control wires not routed away from ignition wires, ignition system components, and the generator.
- Ignition secondary wires shorted to ground.
- SES lamp driver wire or diagnostic test terminal intermittently shorted to ground.
- Intermittent loss of ECM ground connections.

Fuel System

Some intermittent driveability problems can be attributed to poor fuel quality. If a vehicle is occasionally running rough, stalling, or otherwise performing badly, ask the customer about the following fuel buying habits:

- Do they always buy from the same source? If so, fuel quality problems can usually be discounted.
- Do they buy their fuel from whichever fuel station is advertising the lowest price? If so, check the fuel tank for signs of debris, water, or other contamination.

ENGINE CRANKS BUT WILL NOT START (1.3L AND 1.5L SOHC IEFI-6)

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **By performing a compression test, it can be determined if the engine has the mechanical ability to run.**
9. **It is important to check for the presence of spark from all of the ignition wires. If spark is present from one to three of the ignition coil terminals, the crankshaft position sensor (CPS) is OK.**
19. **In checking the electronic control module (ECM) outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.**
35. **This step checks for proper operation of the ECM's control of the fuel pump circuit.**
59. **This step checks for a ground signal being supplied by the ECM to operate the fuel injectors. If there is no ground present during the cranking of the engine, and the fuel injector wiring is OK, the ECM is at fault.**

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Crank the engine. Does the engine start and continue to run?	-	System OK	Go to Step 3
3	Perform a cylinder compression test. Is the cylinder compression for all of the cylinders at or above the value specified?	689 kPa (100 psi)	Go to Step 7	Go to Step 4
4	Inspect the timing belt alignment. Is the timing belt in alignment?	-	Go to Step 6	Go to Step 5
5	Align or replace the timing belt as needed. Is the repair complete?	-	Go to Step 2	-
6	Repair the internal engine damage as needed. Is the repair complete?	-	Go to Step 2	-
7	Inspect the fuel pump fuse. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the fuse. Is the repair complete?	-	Go to Step 2	-
9	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	Go to Step 34	Go to Step 10
10	1. Measure the resistance of the ignition wires. 2. Replace any of the ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	Go to Step 2	Go to Step 11

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Turn the ignition ON. 4. Measure the voltage between the CPS connector terminals 1 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 12	Go to Step 13
12	Measure the voltage between the CPS connector terminals 2 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 19	Go to Step 14
13	Measure the voltage between the CPS connector terminals 1 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 16
14	Measure the voltage between the CPS connector terminals 2 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 17
15	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 18	Go to Step 33
16	Check for an open or short in the wire between the CPS connector terminal 1 and the electronic control module (ECM) connector terminal A2. Is the problem found?	-	Go to Step 18	Go to Step 33
17	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the problem found?	-	Go to Step 18	Go to Step 33
18	Repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
19	1. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at the ECM connector terminal A2 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 20	Go to Step 21
20	Measure the voltage at the ECM connector terminal B3 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 22	Go to Step 21
21	Replace the CPS. Is the repair complete?	-	Go to Step 2	-
22	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the DIS ignition coil. 3. Connect a test light between terminal D of the DIS ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 23	Go to Step 24
23	Connect a test light between terminal C of the DIS ignition coil connector and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 25

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
24	Check for an open in the wiring between the ignition switch and the DIS ignition coil connector terminal D. Is the problem found?	-	Go to Step 26	-
25	Check for an open in the wire from the DIS ignition coil to ground. Is the problem found?	-	Go to Step 26	-
26	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 27
27	1. Turn the ignition OFF. 2. Disconnect the DIS ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 28	Go to Step 29
28	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 32	Go to Step 30
29	Check for an open in the wire from the DIS ignition coil connector terminal B to the ECM connector terminal D10. Is the problem found?	-	Go to Step 31	Go to Step 33
30	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal C3. Is the problem found?	-	Go to Step 31	Go to Step 33
31	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 32
32	Replace the DIS ignition coil. Is the repair complete?	-	Go to Step 2	-
33	Replace the ECM. Is the repair complete?	-	Go to Step 2	-
34	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	-	Go to Step 37	Go to Step 35
35	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminals 3 and 2. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 36	Go to Step 46

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
36	Replace the fuel pump. Is the repair complete?	-	Go to Step 2	-
37	Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 41	Go to Step 38
38	1. Check the fuel filter for a restriction. 2. Inspect the fuel lines for kinks and restrictions. Is the problem found?	-	Go to Step 39	Go to Step 40
39	1. Replace the fuel filter and/or the fuel lines as needed. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 2	Go to Step 40
40	1. Disconnect the vacuum line from the fuel pressure regulator. 2. Inspect the vacuum line for the presence of fuel. 3. Inspect the fuel pressure regulator vacuum port for the presence of fuel. Is any fuel present?	-	Go to Step 43	Go to Step 44
41	Check the fuel for contamination. Is the fuel contaminated?	-	Go to Step 42	Go to Step 58
42	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	-	Go to Step 2	-
43	Replace the fuel pressure regulator. Is the repair complete?	-	Go to Step 2	-
44	1. Remove the fuel pump assembly from the fuel tank. 2. Inspect the fuel pump sender and the fuel coupling hoses for a restriction. 3. Inspect the in-tank fuel filter for a restriction. Is the problem found?	-	Go to Step 45	Go to Step 36
45	Replace the fuel pump sender, the in-tank fuel filter, and/or the fuel coupling hoses as needed. Is the repair complete?	-	Go to Step 2	-
46	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminal 3 and a known good ground. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 47	Go to Step 48
47	Repair the open wire between the fuel pump connector terminal 2 and ground. Is the repair complete?	-	Go to Step 2	-
48	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 49	Go to Step 54

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
49	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 50	Go to Step 55
50	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 51	Go to Step 57
51	1. Turn the ignition OFF. 2. Check the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3 for an open or short to ground. Is the problem found?	-	Go to Step 52	Go to Step 53
52	Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the repair complete?	-	Go to Step 2	-
53	Replace the fuel pump relay. Is the repair complete?	-	Go to Step 2	-
54	1. Inspect the I/P fuse block fuse F17. 2. Check for an open in the wiring between the ignition switch and the fuel pump relay connector terminal 86. Is the problem found?	-	Go to Step 65	-
55	Check the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6 for an open. Is the problem found?	-	Go to Step 56	Go to Step 33
56	Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6. Is the repair complete?	-	Go to Step 2	-
57	Repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. Is the repair complete?	-	Go to Step 2	-
58	1. Turn the ignition OFF. 2. Disconnect the fuel injector harness connectors from all of the fuel injectors. 3. Turn the ignition ON. 4. Connect a test light between the fuel injector harness connector 1 and ground. 5. Repeat step 4 for each of the remaining fuel injectors. Is the test light on at all of the fuel injectors?	-	Go to Step 59	Go to Step 62

Engine Cranks But Will Not Start (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
59	1. Turn the ignition OFF. 2. Connect a test light between the fuel injector harness connector terminal 2 and battery positive. 3. Crank the engine. 4. Repeat Steps 3 and 4 for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	-	Go to Step 60	Go to Step 63
60	Measure the resistance of each fuel injector. Is the resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 61
61	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	-	Go to Step 2	-
62	Repair the open wire(s) between the fuel injector harness connector(s) terminal 1 and the engine harness C104 terminal 9. Is the repair complete?	-	Go to Step 2	-
63	1. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C10 for the fuel injectors 1 and 4. 2. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C15 for the fuel injectors 2 and 3. Is the problem found?	-	Go to Step 64	Go to Step 66
64	Repair the open fuel injector harness wire(s). Is the repair complete?	-	Go to Step 2	-
65	Replace the fuse or repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
66	1. Inspect the I/P fuse F14. 2. Check for an open between the circuits from terminal 1 for each of the four fuel injectors and the ignition switch. Is the problem found?	-	Go to Step 65	-

ENGINE CRANKS BUT WILL NOT START (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **By performing a compression test, it can be determined if the engine has the mechanical ability to run.**
9. **It is important to check for the presence of spark from all of the ignition wires. If spark is present from one to three of the ignition coil terminals, the crankshaft position sensor (CPS) is OK.**
19. **In checking the electronic control module (ECM) outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.**
35. **This step checks for proper operation of the ECM's control of the fuel pump circuit.**
59. **This step checks for a ground signal being supplied by the ECM to operate the fuel injectors. If there is no ground present during the cranking of the engine, and the fuel injector wiring is OK, the ECM is at fault.**

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Crank the engine. Does the engine start and continue to run?	-	System OK	Go to Step 3
3	Perform a cylinder compression test. Is the cylinder compression for all of the cylinders at or above the value specified?	689 kPa (100 psi)	Go to Step 7	Go to Step 4
4	Inspect the timing belt alignment. Is the timing belt in alignment?	-	Go to Step 6	Go to Step 5
5	Align or replace the timing belt as needed. Is the repair complete?	-	Go to Step 2	-
6	Repair the internal engine damage as needed. Is the repair complete?	-	Go to Step 2	-
7	Inspect the fuel pump fuse. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the fuse. Is the repair complete?	-	Go to Step 2	-
9	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	Go to Step 34	Go to Step 10
10	1. Measure the resistance of the ignition wires. 2. Replace any of the ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 Ω	Go to Step 2	Go to Step 11

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Turn the ignition ON. 4. Measure the voltage between the CPS connector terminals 1 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 12	Go to Step 13
12	Measure the voltage between the CPS connector terminals 2 and 3. Does the voltage measure near the value specified?	1.08 v	Go to Step 19	Go to Step 14
13	Measure the voltage between the CPS connector terminal 1 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 16
14	Measure the voltage between the CPS connector terminals 2 and ground. Does the voltage measure near the value specified?	1.08 v	Go to Step 15	Go to Step 17
15	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 18	Go to Step 33
16	Check for an open or short in the wire between the CPS connector terminal 1 and the electronic control module (ECM) connector terminal B14. Is the problem found?	-	Go to Step 18	Go to Step 33
17	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the problem found?	-	Go to Step 18	Go to Step 33
18	Repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
19	1. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at the ECM connector terminal B14 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 20	Go to Step 21
20	Measure the voltage at the ECM connector terminal A16 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with ignition ON, 1.20 v during cranking	Go to Step 22	Go to Step 21
21	Replace the CPS. Is the repair complete?	-	Go to Step 2	-
22	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the DIS ignition coil. 3. Connect a test light between terminal D of the DIS ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 23	Go to Step 24
23	Connect a test light between terminal C of the DIS ignition coil connector and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 25

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
24	Check for an open in the wiring between the ignition switch and the DIS ignition coil connector terminal D. Is the problem found?	-	Go to Step 26	-
25	Check for an open in the wire from the DIS ignition coil to ground. Is the problem found?	-	Go to Step 26	-
26	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 27
27	1. Turn the ignition OFF. 2. Disconnect the DIS ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 28	Go to Step 29
28	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 32	Go to Step 30
29	Check for an open in the wire from the DIS ignition coil connector terminal B to the ECM connector terminal C14. Is the problem found?	-	Go to Step 31	Go to Step 33
30	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal D14. Is the problem found?	-	Go to Step 31	Go to Step 33
31	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	Go to Step 2	Go to Step 32
32	Replace the DIS ignition coil. Is the repair complete?	-	Go to Step 2	-
33	Replace the ECM. Is the repair complete?	-	Go to Step 2	-
34	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	-	Go to Step 37	Go to Step 35
35	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminals 3 and 2. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 36	Go to Step 46

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
36	Replace the fuel pump. Is the repair complete?	-	Go to Step 2	-
37	Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 41	Go to Step 38
38	1. Check the fuel filter for a restriction. 2. Inspect the fuel lines for kinks and restrictions. Is the problem found?	-	Go to Step 39	Go to Step 40
39	1. Replace the fuel filter and/or the fuel lines as needed. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to Step 2	Go to Step 40
40	1. Disconnect the vacuum line from the fuel pressure regulator. 2. Inspect the vacuum line for the presence of fuel. 3. Inspect the fuel pressure regulator vacuum port for the presence of fuel. Is any fuel present?	-	Go to Step 43	Go to Step 44
41	Check the fuel for contamination. Is the fuel contaminated?	-	Go to Step 42	Go to Step 58
42	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	-	Go to Step 2	-
43	Replace the fuel pressure regulator. Is the repair complete?	-	Go to Step 2	-
44	1. Remove the fuel pump assembly from the fuel tank. 2. Inspect the fuel pump sender and the fuel coupling hoses for a restriction. 3. Inspect the in-tank fuel filter for a restriction. Is the problem found?	-	Go to Step 45	Go to Step 36
45	Replace the fuel pump sender, the in-tank fuel filter, and/or the fuel coupling hoses as needed. Is the repair complete?	-	Go to Step 2	-
46	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the fuel pump. 3. Connect a test light between the fuel pump connector terminal 3 and a known good ground. 4. Turn the ignition ON. 5. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 47	Go to Step 48
47	Repair the open wire between the fuel pump connector terminal 2 and ground. Is the repair complete?	-	Go to Step 2	-

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
48	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 49	Go to Step 54
49	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 50	Go to Step 55
50	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 51	Go to Step 57
51	1. Turn the ignition OFF. 2. Check the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3 for an open or short to ground. Is the problem found?	-	Go to Step 52	Go to Step 53
52	Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the repair complete?	-	Go to Step 2	-
53	Replace the fuel pump relay. Is the repair complete?	-	Go to Step 2	-
54	1. Inspect the I/P fuse block fuse F17. 2. Check for an open in the wiring between the ignition switch and the fuel pump relay connector terminal 86. Is the problem found?	-	Go to Step 65	-
55	Check the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12 for an open. Is the problem found?	-	Go to Step 56	Go to Step 33
56	Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. Is the repair complete?	-	Go to Step 2	-
57	Repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. Is the repair complete?	-	Go to Step 2	-

Engine Cranks But Will Not Start (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
58	1. Turn the ignition OFF. 2. Disconnect the fuel injector harness connectors from all of the fuel injectors. 3. Turn the ignition ON. 4. Connect a test light between the fuel injector harness connector 1 and ground. 5. Repeat Step 4 for each of the remaining fuel injectors. Is the test light on at all of the fuel injectors?	-	Go to Step 59	Go to Step 62
59	1. Turn the ignition OFF. 2. Connect a test light between the fuel injector harness connector terminal 2 and battery positive. 3. Crank the engine. 4. Repeat Steps 3 and 4 for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	-	Go to Step 60	Go to Step 63
60	Measure the resistance of each fuel injector. Is the resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 61
61	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	-	Go to Step 2	-
62	Repair the open wire(s) between the fuel injector harness connector(s) terminal 1 and the engine harness connector C104 terminal 9. Is the repair complete?	-	Go to Step 2	-
63	1. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C4 for the fuel injectors 1 and 4. 2. Check for an open between the fuel injector harness connector terminal 2 and the ECM connector terminal C6 for the fuel injectors 2 and 3. Is the problem found?	-	Go to Step 64	Go to Step 66
64	Repair the open fuel injector harness wire(s). Is the repair complete?	-	Go to Step 2	-
65	Replace the fuse or repair the wiring as needed. Is the repair complete?	-	Go to Step 2	-
66	1. Inspect the I/P fuse F14. 2. Check for an open between the circuit from terminal 1 for each of the four fuel injectors and the ignition switch. Is the problem found?	-	Go to Step 65	-

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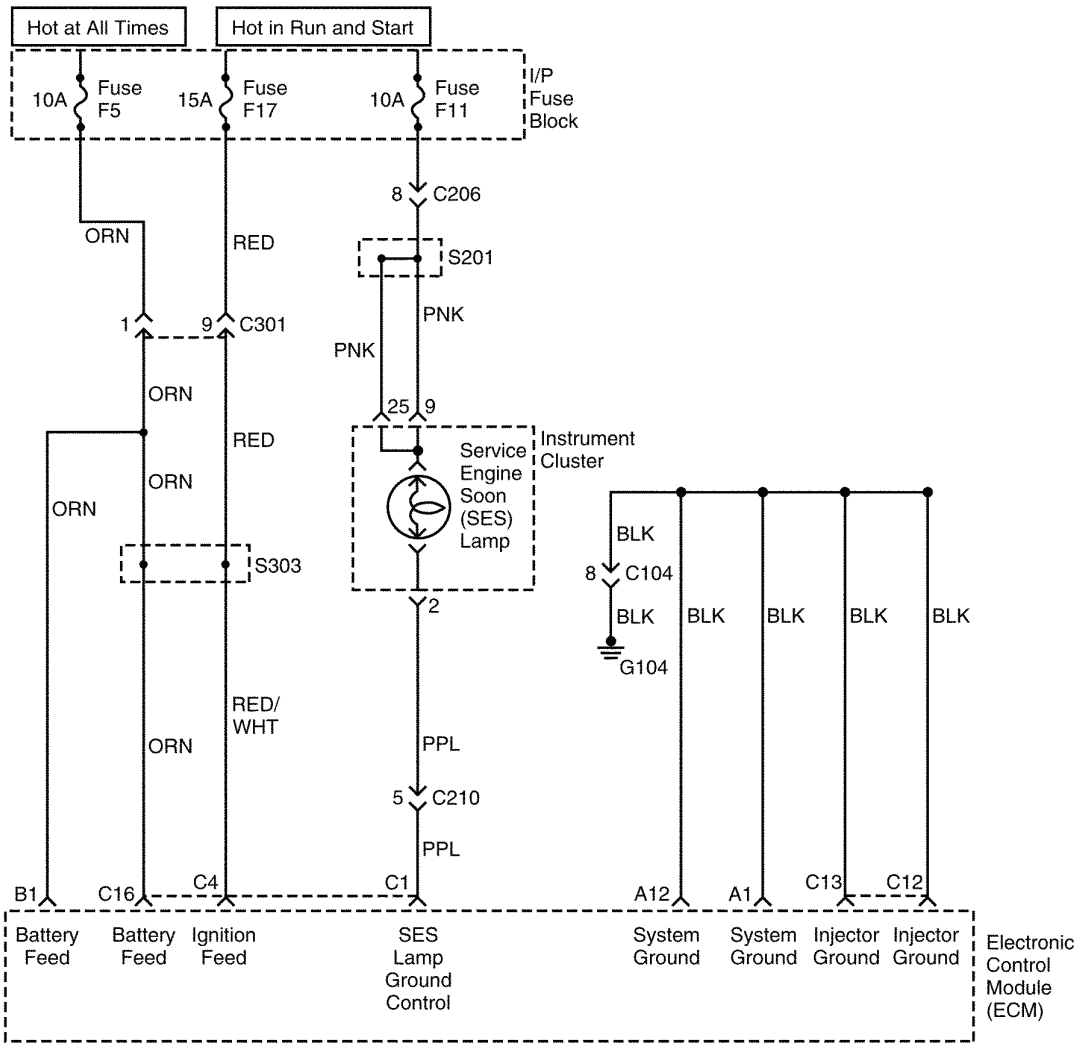

NO SERVICE ENGINE SOON LAMP (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine is stopped. Battery voltage is supplied directly to the SES bulb. The electronic control module (ECM) will control the SES lamp and turn it on by providing a ground path through the ECM connector terminal C1 wire to the SES lamp.

Diagnostic Aids

- **If the engine runs OK, inspect for a faulty malfunction indicator lamp bulb.**
- **If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **This step checks for battery voltage in the instrument panel SES lamp bulb socket.**
8. **This step, along with step 9, checks for battery feed to the ECM.**
10. **This step checks for ignition feed to the ECM.**
24. **At this point the SES lamp wiring is OK. The problem is a faulty ECM.**

No Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Start the engine. Does the engine start?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connectors. 3. Turn the ignition ON. 4. Connect a test light between the ECM connector terminal C1 and ground. Is the service engine soon (SES) lamp on?	-	Go to Step 14	Go to Step 3
3	Inspect the kick panel fuse F11. Is the fuse OK?	-	Go to Step 4	Go to Step 15
4	Check the ignition feed to the SES bulb using a voltmeter. Is the voltage within the value specified?	11-14 v	Go to Step 5	Go to Step 16
5	Inspect the SES bulb. Is the SES bulb OK?	-	Go to Step 6	Go to Step 17
6	Check for an open or short to voltage in the wire between the ECM connector terminal C1 and the SES bulb. Is the problem found?	-	Go to Step 18	Go to Step 13
7	Inspect the ECM fuse F5/F17. Is the problem found?	-	Go to Step 19	Go to Step 8
8	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light to ECM connector terminal B1 and ground. Is the test light on?	-	Go to Step 9	Go to Step 20
9	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light between the ECM connector terminal C16 and ground. Is the test light on?	-	Go to Step 10	Go to Step 21
10	1. Turn the ignition OFF. 2. Connect a test light between the ECM connector terminal C4 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 11	Go to Step 22
11	Inspect the ECM connector terminals B1, C16, and C4 for damage or poor mating. Is the problem found?	-	Go to Step 12	Go to Step 14
12	Repair the ECM connector terminal(s) as needed. Is the repair complete?	-	Go to "Diagnostic System Check"	-
13	Inspect for damage or poor mating at the ECM connector terminal C1. Is the problem found?	-	Go to Step 12	Go to Step 14
14	Check the ECM connector terminals A12 and D1 for ground. Are the grounds OK?	-	Go to Step 24	Go to Step 23

No Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Turn the ignition OFF. 2. Replace the fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 4
16	Repair the open in the ignition feed wire to the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
17	Replace the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
18	Repair the wire between the ECM connector terminal C1 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
19	1. Turn the ignition OFF. 2. Replace the ECM fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 1
20	Repair the wire between the ECM connector terminal B1 and the F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
21	Repair the wire between the ECM connector terminal C16 and the F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
22	Repair the wire between the ECM connector terminal C4 and fuse F17. Is the repair complete?	-	Go to "Diagnostic System Check"	-
23	Repair the open wire between the ECM connector terminals A12 and/or D1 and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
24	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

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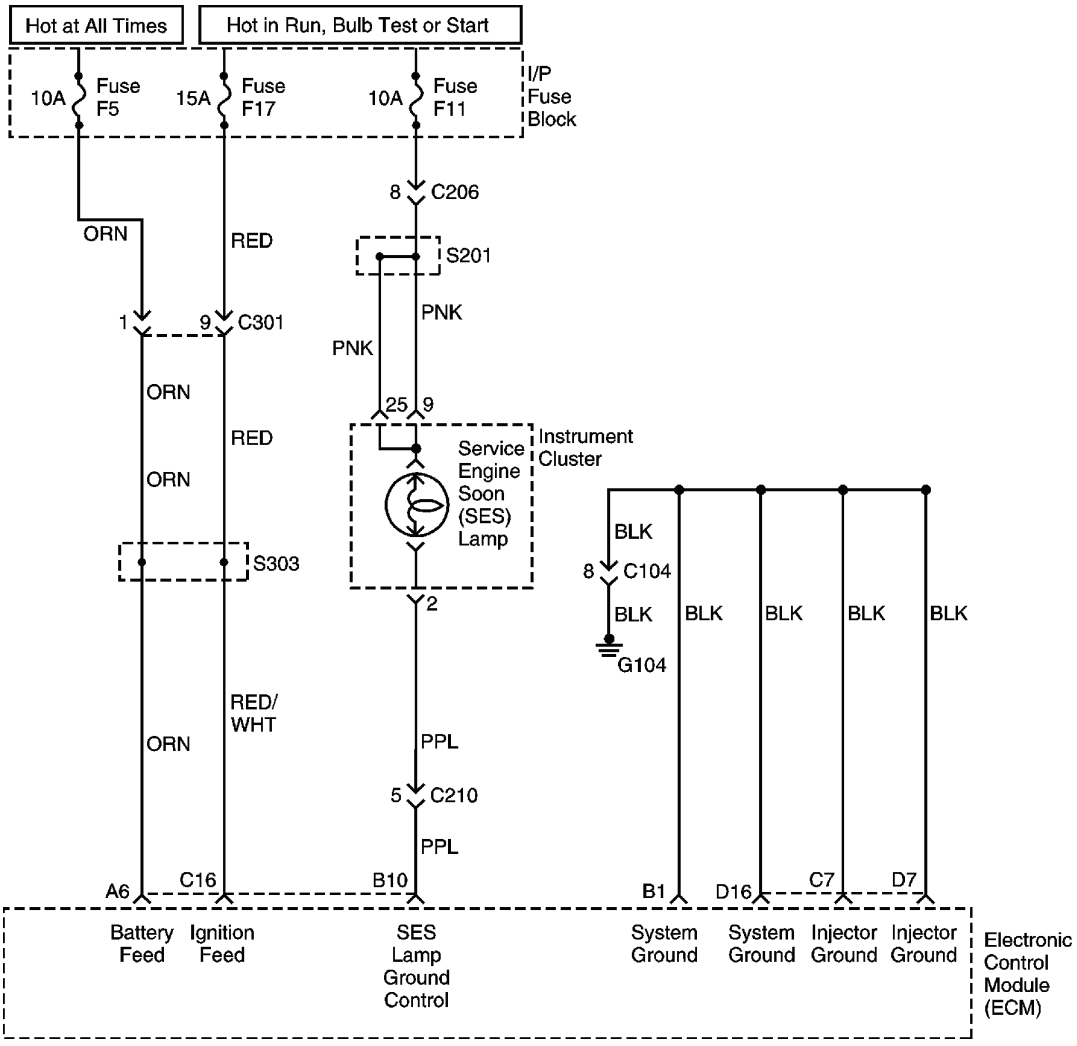

NO SERVICE ENGINE SOON LAMP (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine is stopped. Battery voltage is supplied directly to the SES bulb. The electronic control module (ECM) will control the SES lamp and turn it on by providing a ground path through the ECM connector terminal B10 wire to the SES lamp.

Diagnostic Aids

- **If the engine runs OK, inspect for a faulty malfunction indicator lamp bulb.**
- **If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for battery voltage in the instrument panel SES lamp bulb socket.

8. This step checks for battery feed to the ECM.

9. This step checks for ignition feed to the ECM.

22. At this point the SES lamp wiring is OK. The problem is a faulty ECM.

No Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Start the engine. Does the engine start?	-	Go to Step 2	Go to Step 7
2	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connectors. 3. Turn the ignition ON. 4. Connect a test light between the ECM connector terminal B10 and ground. Is the service engine soon (SES) lamp on?	-	Go to Step 13	Go to Step 3
3	Inspect the kick panel fuse F11. Is the fuse OK?	-	Go to Step 4	Go to Step 14
4	Check the ignition feed to the SES bulb using a voltmeter. Is the voltage within the value specified?	11-14 v	Go to Step 5	Go to Step 15
5	Inspect the SES bulb. Is the SES bulb OK?	-	Go to Step 6	Go to Step 16
6	Check for an open or short to voltage in the wire between the ECM connector terminal B10 and the SES bulb. Is the problem found?	-	Go to Step 17	Go to Step 12
7	Inspect the ECM fuse F5/F17. Is the problem found?	-	Go to Step 18	Go to Step 8
8	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Connect a test light to ECM connector terminal A6 and ground. Is the test light on?	-	Go to Step 9	Go to Step 19
9	1. Turn the ignition OFF. 2. Disconnect the ECM white connector. 3. Connect a test light between the ECM connector terminal C16 and ground. Is the test light on?	-	Go to Step 10	Go to Step 20
10	Inspect the ECM connector terminals A6 and C16 for damage or poor mating. Is the problem found?	-	Go to Step 11	Go to Step 13
11	Repair the ECM connector terminal(s) as needed. Is the repair complete?	-	Go to "Diagnostic System Check"	-
12	Inspect for damage or poor mating at the ECM connector terminal B10. Is the problem found?	-	Go to Step 11	Go to Step 13
13	Check the ECM connector terminals B1 and D16 for ground. Are the grounds OK?	-	Go to Step 22	Go to Step 21
14	1. Turn the ignition OFF. 2. Replace the fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 4

No Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair the open in the ignition feed wire to the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
16	Replace the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
17	Repair the wire between the ECM connector terminal B10 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
18	1. Turn the ignition OFF. 2. Replace the ECM fuse. 3. Turn the ignition ON. Is the SES lamp on?	-	Go to "Diagnostic System Check"	Go to Step 1
19	Repair the wire between the ECM connector terminal A6 and the fuse F5. Is the repair complete?	-	Go to "Diagnostic System Check"	-
20	Repair the wire between the ECM connector terminal C16 and the fuse F17. Is the repair complete?	-	Go to "Diagnostic System Check"	-
21	Repair the open wire between the ECM connector terminals B1 and/or D16 and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
22	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

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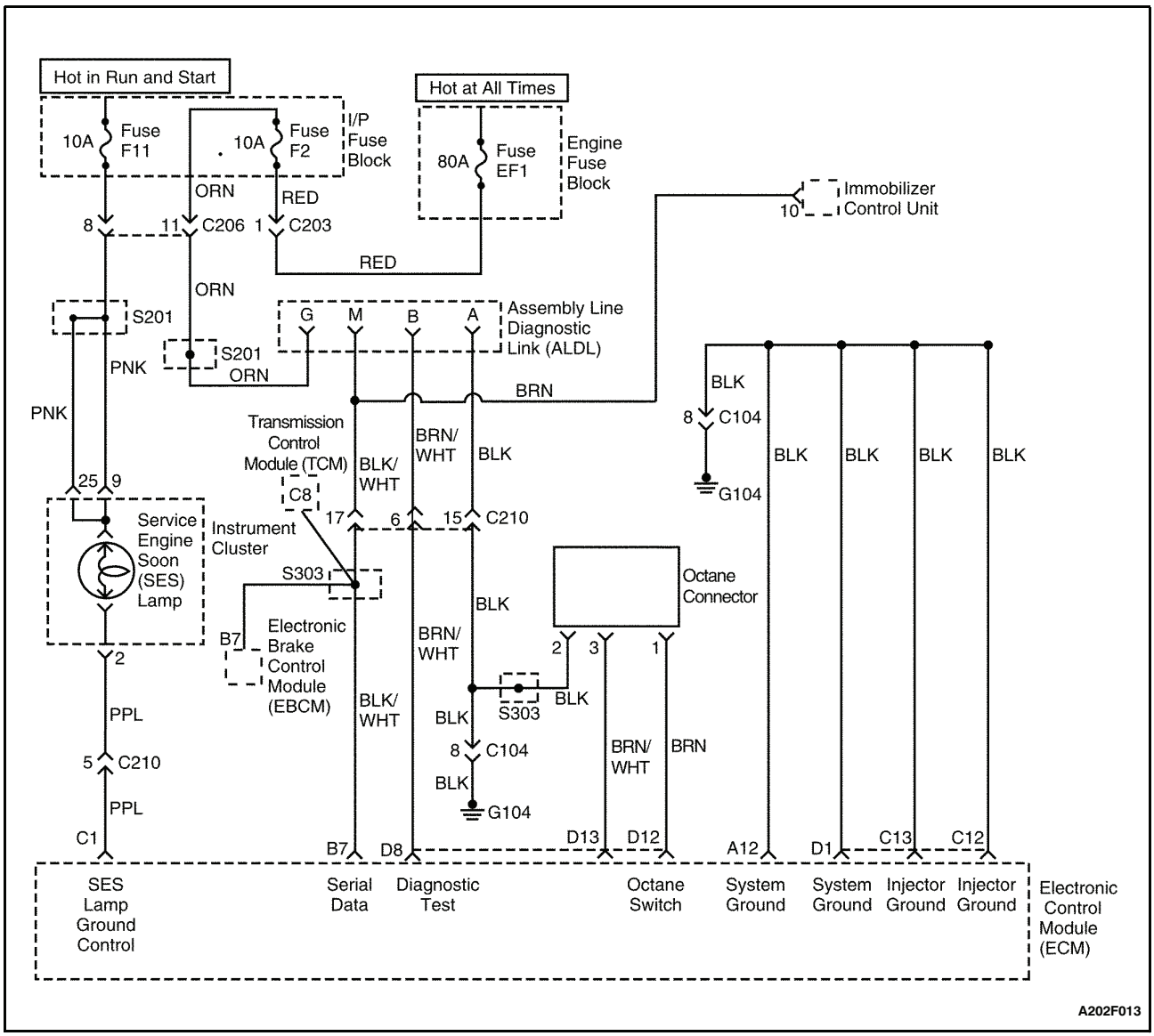


WILL NOT FLASH SERVICE ENGINE SOON LAMP (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine stopped. Battery ignition voltage is supplied directly to the SES bulb. The electronic control module (ECM) will turn the SES on by grounding the ECM connector terminal C1 wire. With the assembly line diagnostic link (ALDL) A and B terminals grounded, the SES lamp should flash a Code 12 followed by any diagnostic trouble codes (DTCs) stored in the ECM memory. A steady SES lamp suggests a short to ground in the ECM connector terminal C1 wire, or an open in the diagnostic test wire. A steady but dim light indicates a failed quad-driver. The table will confirm and suggest the cause.

Diagnostic Aids

- **If the engine runs OK, inspect for a faulty SES bulb.**
- **If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

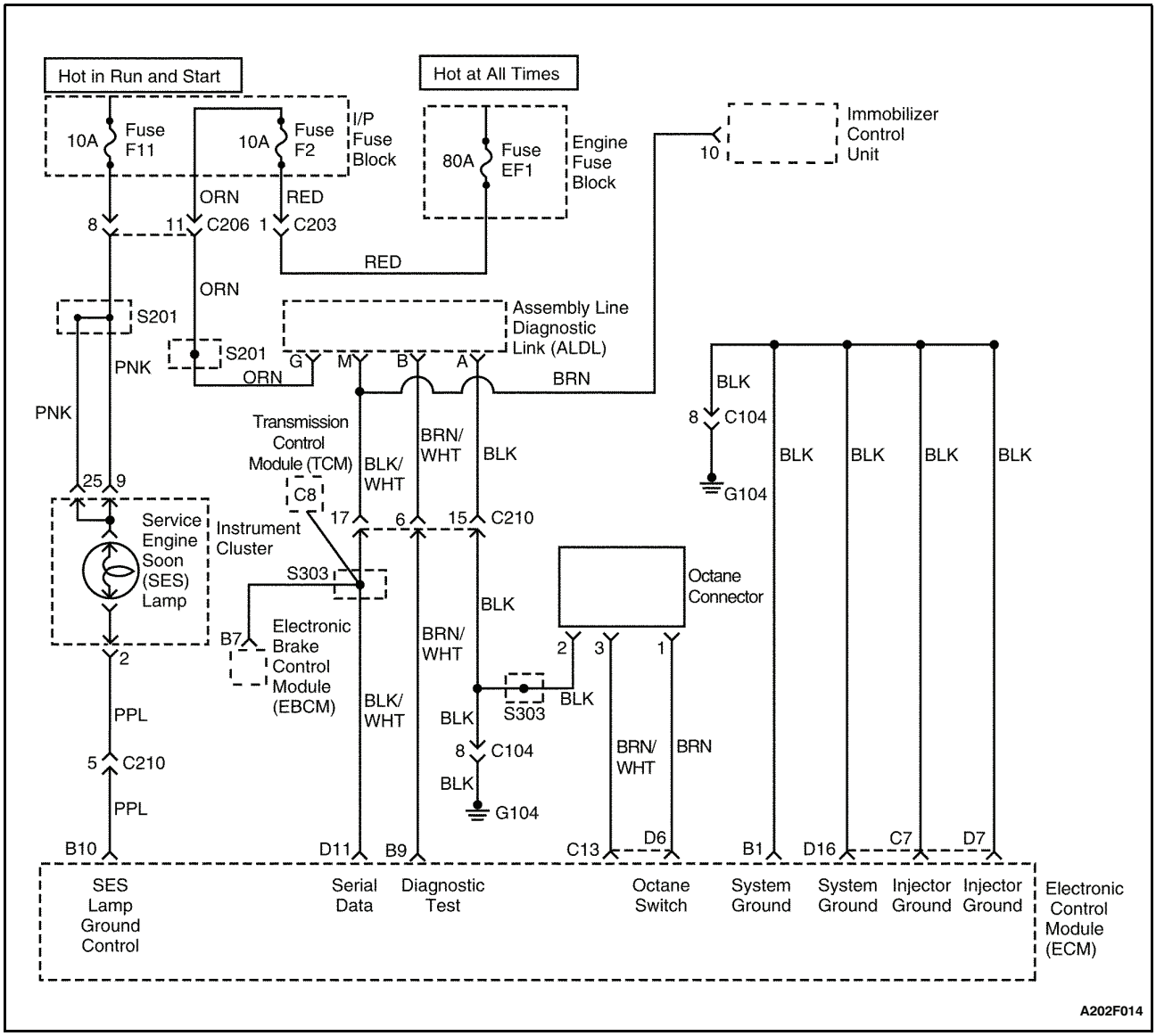
3. **If the SES lamp is on when the ECM white connector is disconnected, the wire to the ECM connector terminal C1 is shorted to ground.**

5. This step will check for an open diagnostic test wire.

11. At this point the SES wiring is OK. The problem is a faulty ECM.

Will Not Flash Service Engine Soon Lamp (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the service engine soon (SES) lamp on?	-	Go to Step 2	Go to "No Service Engine Soon Lamp"
2	1. Turn the ignition OFF. 2. Jumper the assembly line diagnostic link (ALDL) terminals A and B. 3. Turn the ignition ON. Does the SES lamp flash the diagnostic trouble code (DTC) 12?	-	Go to "Diagnostic System Check"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the ECM white connector. 3. Turn the ignition ON. Is the SES on?	-	Go to Step 4	Go to Step 5
4	Repair the short to ground in the wire between the electronic control module (ECM) connector terminal C1 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
5	1. Turn the ignition OFF. 2. Reconnect the ECM white connector. 3. Turn the ignition ON. 4. Backprobe the ECM connector terminal D8 with a test light connected to ground. Does the SES flash DTC 12?	-	Go to Step 6	Go to Step 8
6	Check for an open wire between the ECM connector terminal D8 and the ALDL terminal B. Is the problem found?	-	Go to Step 10	Go to Step 7
7	Repair the open wire between the ALDL terminal A and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Check for damage or poor mating at the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	Repair the ECM connector terminal D8. Is the repair complete?	-	Go to "Diagnostic System Check"	-
10	Repair the wire between the ECM connector terminal D8 and the ALDL terminal B. Is the repair complete?	-	Go to "Diagnostic System Check"	-
11	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-



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WILL NOT FLASH SERVICE ENGINE SOON LAMP (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

There should always be a steady service engine soon (SES) lamp when the ignition is ON and the engine stopped. Battery ignition voltage is supplied directly to the SES bulb. The electronic control module (ECM) will turn the SES on by grounding the ECM connector terminal B10 wire. With the assembly line diagnostic link (ALDL) A and B terminals grounded, the SES lamp should flash a Code 12 followed by any diagnostic trouble codes (DTCs) stored in the ECM memory. A steady SES lamp suggests a short to ground in the ECM connector terminal B10 wire, or an open in the diagnostic test wire. A steady but dim light indicates a failed quad-driver. The table will confirm and suggest the cause.

Diagnostic Aids

- **If the engine runs OK, inspect for a faulty SES bulb.**
- **If the engine cranks but will not start, check for open fuses and poor ECM connections. Particularly check for ECM ignition and battery feeds, including clean and tight ECM ground connections.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **If the SES lamp is on when the ECM red connector is disconnected, the wire to the ECM connector terminal B10 is shorted to ground.**

5. This step will check for an open diagnostic test wire.
11. At this point the SES wiring is OK. The problem is a faulty ECM.

Will Not Flash Service Engine Soon Lamp (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Is the service engine soon (SES) lamp on?	-	Go to Step 2	Go to "No Service Engine Soon Lamp"
2	1. Turn the ignition OFF. 2. Jumper the assembly line diagnostic link (ALDL) terminals A and B. 3. Turn the ignition ON. Does the SES lamp flash the diagnostic trouble code (DTC) 12?	-	Go to "Diagnostic System Check"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Turn the ignition ON. Is the SES on?	-	Go to Step 4	Go to Step 5
4	Repair the short to ground in the wire between the ECM connector terminal B10 and the SES bulb. Is the repair complete?	-	Go to "Diagnostic System Check"	-
5	1. Turn the ignition OFF. 2. Reconnect the ECM red connector. 3. Turn the ignition ON. 4. Backprobe the ECM connector terminal B9 with a test light connected to ground. Does the SES flash DTC 12?	-	Go to Step 6	Go to Step 8
6	Check for an open wire between the ECM connector terminal B9 and the ALDL terminal B. Is the problem found?	-	Go to Step 10	Go to Step 7
7	Repair the open wire between the ALDL terminal A and ground. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Check for damage or poor mating at the ECM connector terminal B9. Is the problem found?	-	Go to Step 9	Go to Step 11
9	Repair the ECM connector terminal B9. Is the repair complete?	-	Go to "Diagnostic System Check"	-
10	Repair the wire between the ECM connector terminal B9 and the ALDL terminal B. Is the repair complete?	-	Go to "Diagnostic System Check"	-
11	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-

FUEL SYSTEM PRESSURE TEST

Circuit Description

The fuel pump is an in-tank fuel pump mounted to a fuel sender assembly. The fuel pump will remain on as long as the engine is cranking or running and the electronic control module (ECM) is receiving reference pulses from the crankshaft position sensor (CPS). If there are no reference pulses, the ECM will turn off the fuel pump 2 seconds after the ignition switch is turned ON or 2 seconds after the engine stops running. The fuel pump delivers fuel to the fuel rail and the fuel injectors, where the fuel system pressure is controlled from 284 to 325 kPa (41 to 47 psi) by the fuel pressure regulator. The excess fuel is returned to the fuel tank.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. When the engine is idling, the intake manifold vacuum is high. This vacuum is applied to the fuel pressure regulator diaphragm, offsetting the spring pressure inside the fuel pressure regulator and lowering the fuel pressure.
10. If there is fuel bleeding back through the fuel return outlet, this is due to a faulty fuel pressure regulator.
14. Another symptom often present when the fuel injectors are leaking is hard starting. Leaking fuel injectors can cause a flooding condition.
23. Fuel leaking from the fuel pump inlet is due to a faulty one-way check valve in the fuel pump.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Fuel Pressure Relief Procedure

1. Remove the fuel cap.
2. Remove the fuel pump fuse EF18 from the engine fuse block.
3. Start the engine and allow the engine to stall.
4. Crank the engine for an additional 10 seconds.

Fuel System Pressure Test

Step	Action	Value(s)	Yes	No
1	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	Go to Step 2	Go to Step 5
2	1. Disconnect the fuel pressure regulator vacuum hose. 2. Start the engine. 3. Allow the engine to idle. 4. Connect the fuel pressure regulator vacuum hose. Does the fuel pressure decrease?	-	System OK	Go to Step 3
3	1. Allow the engine to idle. 2. Disconnect the vacuum hose from the fuel pressure regulator. 3. Connect a vacuum pump with a gauge to the fuel pressure regulator vacuum port. 4. Apply 41-47 kPa (12-14 in. Hg) of vacuum to the fuel pressure regulator. Does the fuel pressure decrease?	-	Go to Step 4	Go to Step 16
4	1. Locate and correct the cause of the vacuum restriction to the fuel pressure regulator. 2. Confirm the operation of the fuel pressure regulator. Is the repair complete?	-	System OK	-

Fuel System Pressure Test (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified but not holding steady?	284-325 kPa (41-47 psi)	Go to Step 6	Go to Step 17
6	Inspect the fuel lines for a leak. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Replace the fuel line(s) as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
8	1. Remove the fuel pump assembly. 2. With the fuel pump under pressure, inspect the fuel pump coupling hoses for leaking. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Tighten or replace the fuel pump coupling hoses as needed. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
10	With the fuel system under pressure, inspect the fuel return outlet for leaking. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Replace the fuel pressure regulator. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
12	With the fuel system under pressure, inspect the fuel inlet for leaking. Is the problem found?	-	Go to Step 13	Go to Step 14
13	1. Replace the fuel pump assembly. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-
14	1. Remove the fuel rail and the fuel injectors as an assembly. 2. With the fuel system under pressure, inspect all of the fuel injectors for leaking. Is the problem found?	-	Go to Step 15	-
15	1. Replace the leaking fuel injector(s). 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel pressure within the values specified and holding steady?	284-325 kPa (41-47 psi)	System OK	-

Fuel System Pressure Test (Cont'd)

Step	Action	Value(s)	Yes	No
16	1. Replace the fuel pressure regulator. 2. Disconnect the fuel pressure regulator vacuum hose. 3. Start the engine. 4. Allow the engine to idle. 5. Connect the fuel pressure regulator vacuum hose. Does the fuel pressure decrease?	-	System OK	-
17	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel system pressure below the values specified and holding steady?	284-325 kPa (41-47 psi)	Go to Step 13	Go to Step 18
18	1. Relieve the fuel system pressure. 2. Install a fuel pressure gauge. 3. Turn the ignition ON. Is the fuel system pressure below the values specified and not holding steady?	284-325 kPa (41-47 psi)	Go to Step 19	-
19	Inspect the fuel lines for leaks. Is the problem found?	-	Go to Step 7	Go to Step 20
20	1. Remove the fuel pump assembly. 2. With the fuel pump under pressure, inspect the fuel pump coupling hoses for leaking. Is the problem found?	-	Go to Step 9	Go to Step 21
21	1. Remove the fuel pump assembly. 2. With the fuel system under pressure, inspect the fuel return outlet for leaking. Is the problem found?	-	Go to Step 11	Go to Step 22
22	1. Remove the fuel pump assembly. 2. With the fuel system under pressure, inspect the fuel inlet for leaking. Is the problem found?	-	Go to Step 13	Go to Step 23
23	1. Remove the fuel rail and the fuel injectors as an assembly. 2. With the fuel system under pressure, inspect all of the fuel injectors for leaking. Is the problem found?	-	Go to Step 15	Go to Step 13

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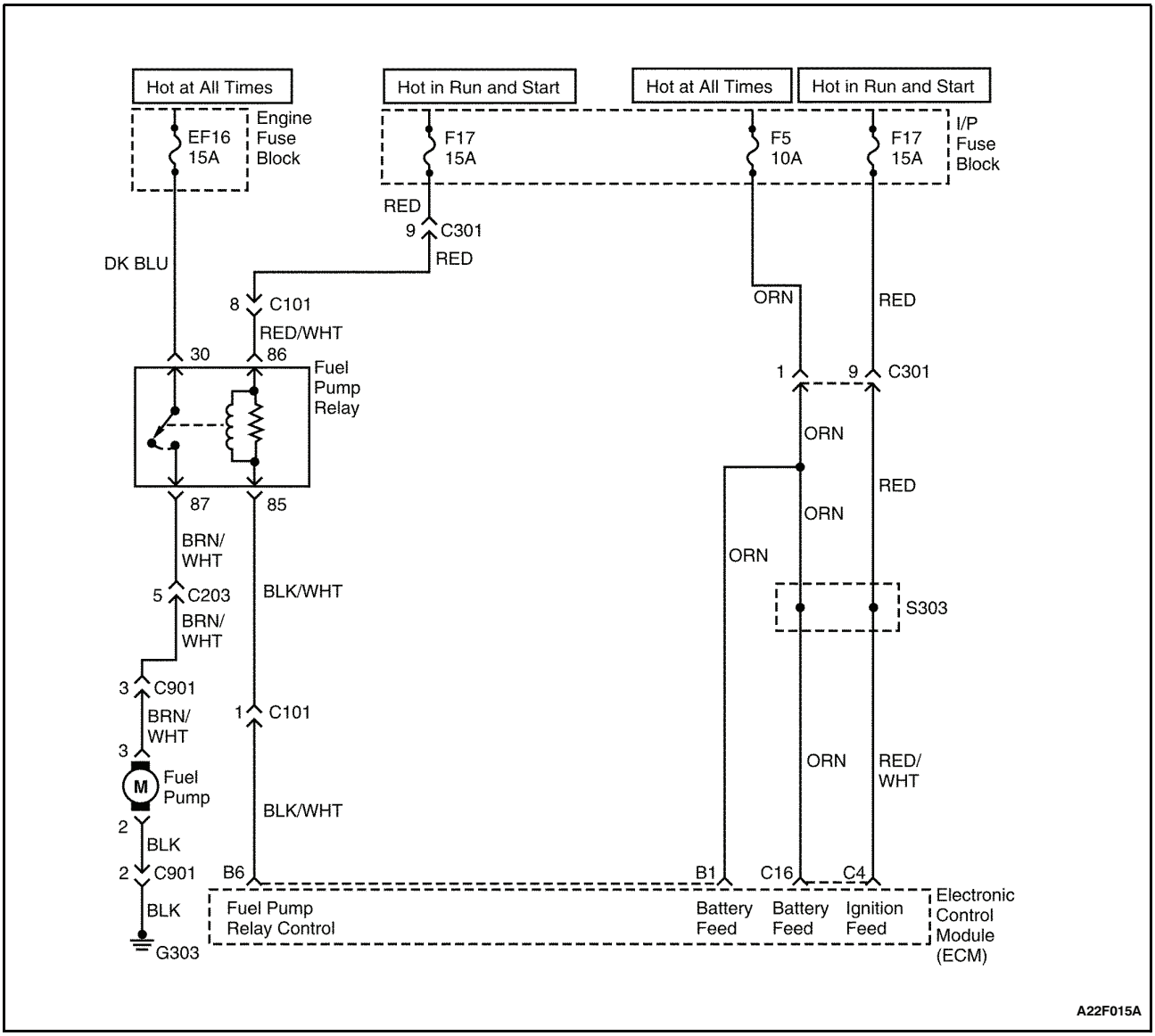

FUEL PUMP RELAY CIRCUIT CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

When the ignition switch is turned ON, the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for the ECM providing a ground for the operation of the fuel pump relay.

7. By confirming that the wiring is OK using Steps 2 through 6, it can be determined that the fuel pump relay is at fault.

8. If there is no voltage present at the fuel pump relay connector terminal 86, the problem is an open I/P fuse block fuse F17, or an open in the wiring between the fuel pump relay and the ignition switch.

9. After determining that there is no ground being provided by the ECM to the fuel pump relay, the fault is either the ECM or the wiring between the ECM and the fuel pump relay.

Fuel Pump Relay Circuit Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF for 10 seconds. 2. Turn the ignition ON. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate for the time specified?	2 sec	System OK	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 3	Go to Step 8
3	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 4	Go to Step 9
4	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 5	Go to Step 11
5	Check for an open or short to ground in the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the problem found?	-	Go to Step 6	Go to Step 7
6	1. Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
7	1. Replace the fuel pump relay. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
8	Check for an open wire between the fuel pump relay connector terminal 86 and the ignition switch. Is the problem found?	-	Go to Step 13	-
9	Check for an open wire between the fuel pump relay connector terminal 85 and the electronic control module (ECM) connector terminal B6. Is the problem found?	-	Go to Step 10	Go to Step 12

Fuel Pump Relay Circuit Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal B6. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
11	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 30 and the fuse EF16. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
12	1. Replace the ECM. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
13	1. Replace the fuse EF17 or repair the wire between the fuel pump relay connector terminal 86 and the ignition system. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-

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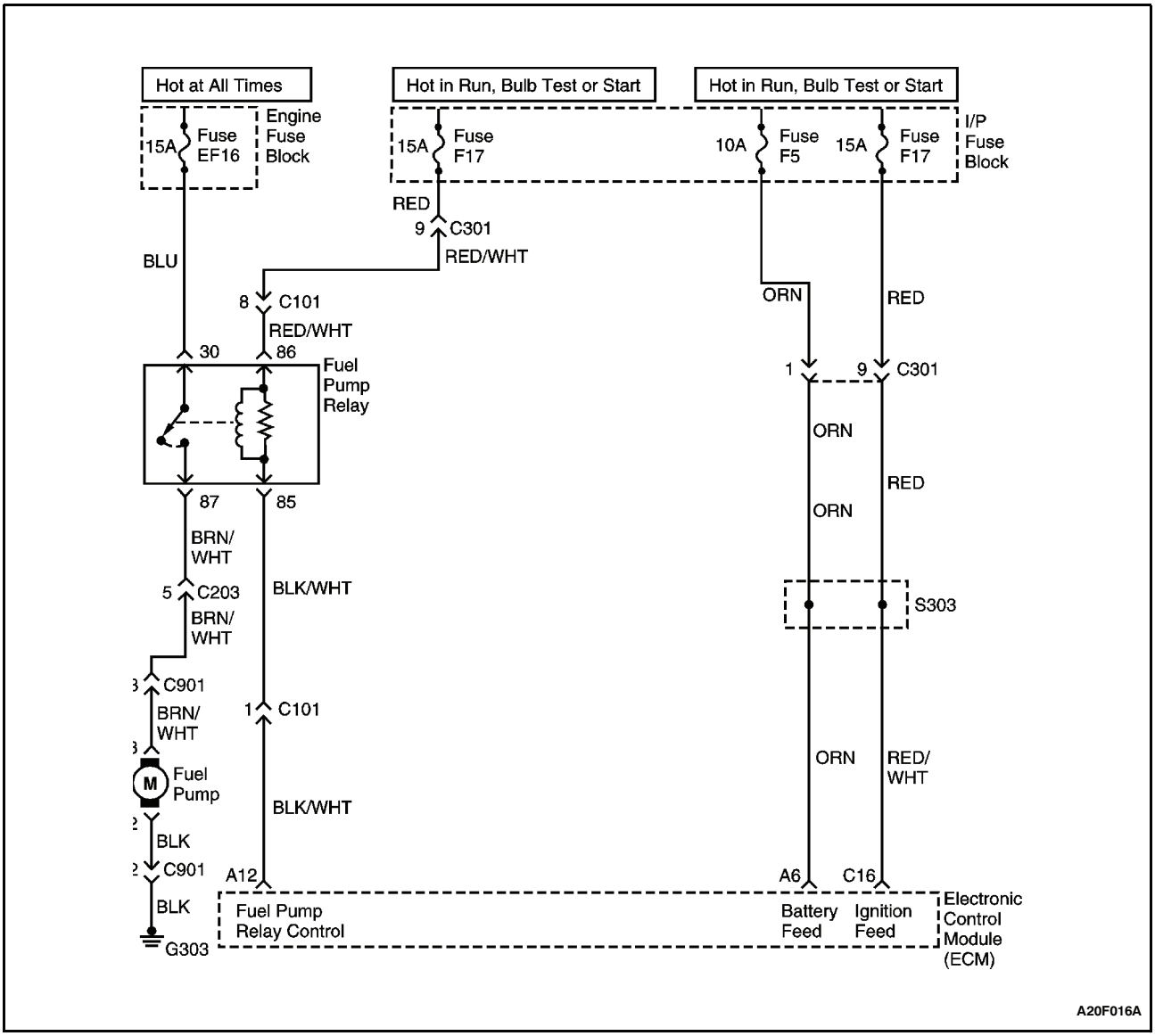

FUEL PUMP RELAY CIRCUIT CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition switch is turned ON, the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks for the ECM providing a ground for the operation of the fuel pump relay.

7. By confirming that the wiring is OK using Steps 2 through 6, it can be determined that the fuel pump relay is at fault.

8. If there is no voltage present at the fuel pump relay connector terminal 86, the problem is an open I/P fuse block fuse F17, or an open in the wiring between the fuel pump relay and the ignition switch.

9. After determining that there is no ground being provided by the ECM to the fuel pump relay, the fault is either the ECM or the wiring between the ECM and the fuel pump relay.

Fuel Pump Relay Circuit Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF for 10 seconds. 2. Turn the ignition ON. 3. Listen for in-tank fuel pump operation. Does the fuel pump operate for the time specified?	2 sec	System OK	Go to Step 2
2	1. Turn the ignition OFF. 2. Disconnect the fuel pump relay. 3. Connect a test light between the fuel pump relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 3	Go to Step 8
3	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. 3. Turn the ignition ON. 4. With the ignition ON, the test light should light for the time specified. Is the test light on?	2 sec	Go to Step 4	Go to Step 9
4	1. Turn the ignition OFF. 2. Connect a test light between the fuel pump relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 5	Go to Step 11
5	Check for an open or short to ground in the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. Is the problem found?	-	Go to Step 6	Go to Step 7
6	1. Repair the wire between the fuel pump relay connector terminal 87 and the fuel pump connector terminal 3. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
7	1. Replace the fuel pump relay. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
8	Check for an open wire between the fuel pump relay connector terminal 86 and the ignition switch. Is the problem found?	-	Go to Step 13	-
9	Check for an open wire between the fuel pump relay connector terminal 85 and the electronic control module (ECM) connector terminal A12. Is the problem found?	-	Go to Step 10	Go to Step 12

Fuel Pump Relay Circuit Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Repair the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
11	1. Replace the fuse EF16 or repair the wire between the fuel pump relay connector terminal 30 and the EF16. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
12	1. Replace the ECM. 2. Turn the ignition OFF for 10 seconds. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-
13	1. Replace the fuse EF17 or repair the wire between the fuel pump connector terminal 86 and the ignition switch. 2. Install the fuel pump relay. 3. Turn the ignition OFF for 10 seconds. 4. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	-

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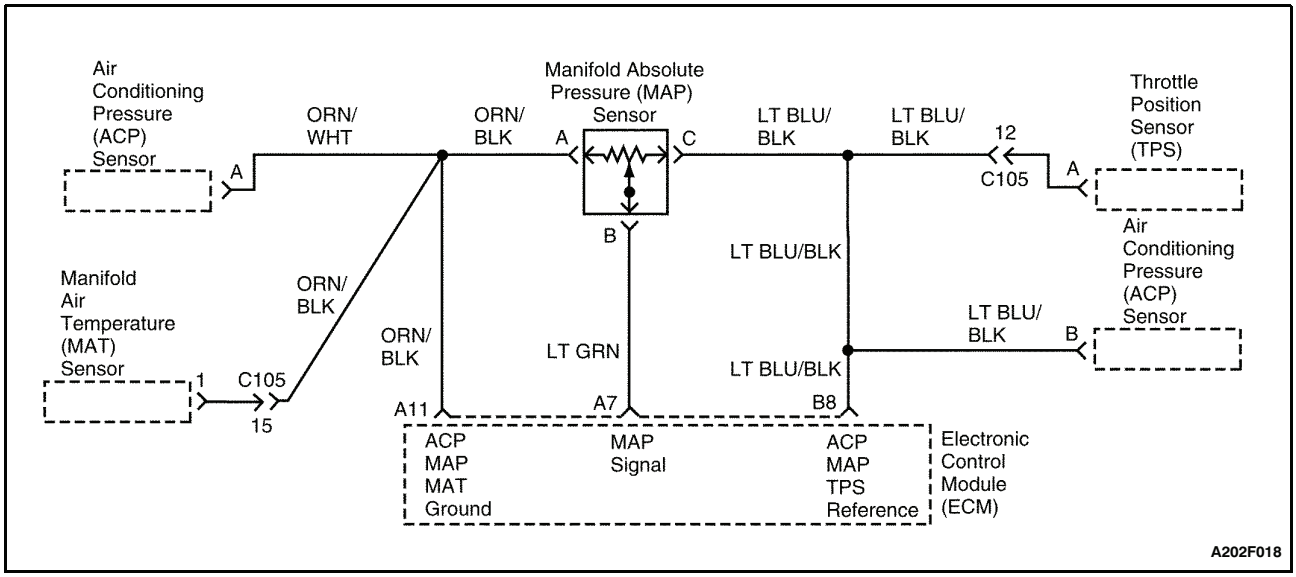


MANIFOLD ABSOLUTE PRESSURE CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load (intake manifold vacuum) and rpm changes. The MAP sensor converts these changes into a voltage output. The electronic control module (ECM) sends a 5-volt reference voltage to the MAP sensor. As the intake manifold pressure changes, the output voltage of the MAP sensor also changes. A low voltage (high vacuum) output of 1 to 2 volts is present at idle. A high voltage (low vacuum) output of 4.0 to 4.8 volts is present at wide open throttle. The MAP sensor is also used under certain conditions to measure barometric pressure. This allows the ECM to make adjustments for altitude changes. The ECM uses the MAP sensor for fuel delivery and ignition timing changes.

Test Description

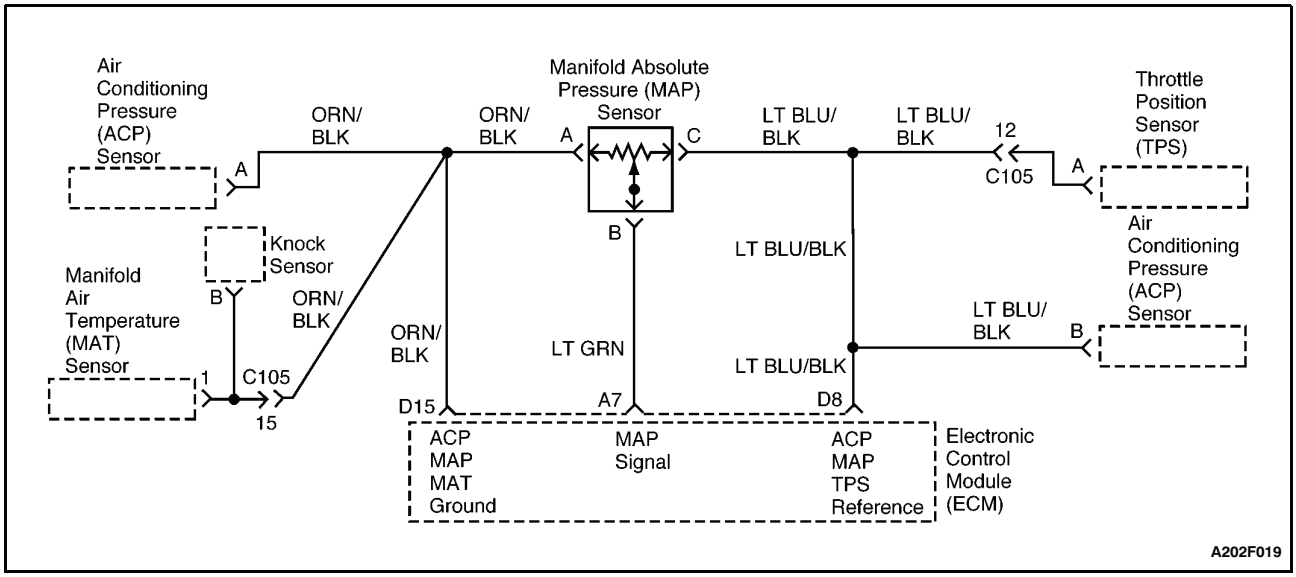
The number(s) below refer to step(s) on the diagnostic table.

2. Applying 34 kPa (10 inches Hg) of vacuum to the MAP sensor should cause the voltage to change. Subtract the second voltage reading from the first. That voltage value should be more than 1.5 volts. When applying vacuum to the MAP sensor, the change in the voltage should happen instantly. A slow voltage change indicates a faulty MAP sensor.

3. Disconnect the MAP sensor from the bracket and twist the MAP sensor. Output changes more than 0.1 volt indicate a faulty connector or connection.

Manifold Absolute Pressure Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the assembly line diagnostic link (ALDL). 3. Turn the ignition ON. 4. Compare the manifold absolute pressure (MAP) sensor voltage reading from the scanner with that from a known good vehicle. Is the difference in the two voltage readings less than the value specified?	0.4 v	Go to Step 2	Go to Step 5
2	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Disconnect the MAP sensor vacuum line. 4. Connect a hand vacuum pump to the MAP sensor. 5. Turn the ignition ON. 6. Note the MAP sensor voltage. 7. Apply 34 kPa (10 in. Hg) of vacuum to the MAP sensor and note the voltage change. Is the difference in voltage readings more than the value specified?	1.5 v	System OK	Go to Step 3
3	Inspect the MAP sensor connector terminals. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair the MAP sensor connector terminals as needed. Is the repair complete?	-	System OK	-
5	Replace the MAP sensor. Is the repair complete?	-	System OK	-



MANIFOLD ABSOLUTE PRESSURE CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load (intake manifold vacuum) and rpm changes. The MAP sensor converts these changes into a voltage output. The electronic control module (ECM) sends a 5-volt reference voltage to the MAP sensor. As the intake manifold pressure changes, the output voltage of the MAP sensor also changes. A low voltage (high vacuum) output of 1 to 2 volts is present at idle. A high voltage (low vacuum) output of 4.0 to 4.8 volts is present at wide open throttle. The MAP sensor is also used under certain conditions to measure barometric pressure. This allows the ECM to make adjustments for altitude changes. The ECM uses the MAP sensor for fuel delivery and ignition timing changes.

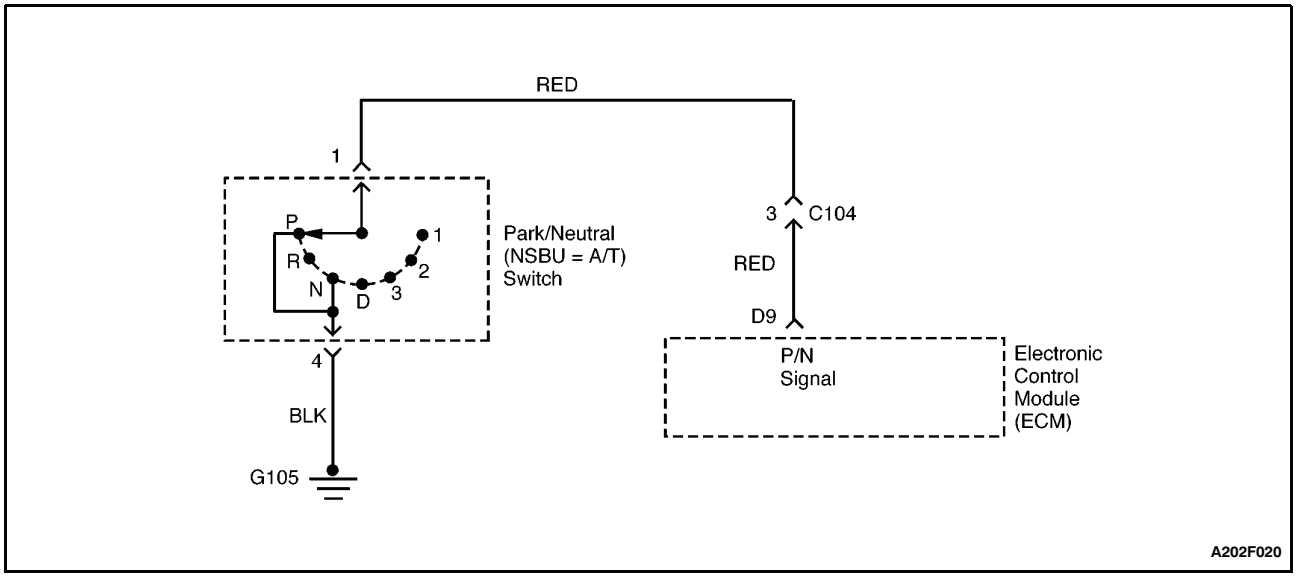
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **Applying 34 kPa (10 inches Hg) of vacuum to the MAP sensor should cause the voltage to change. Subtract the second voltage reading from the first. That voltage value should be more than 1.5 volts. When applying vacuum to the MAP sensor, the change in the voltage should happen instantly. A slow voltage change indicates a faulty MAP sensor.**
3. **Disconnect the MAP sensor from the bracket and twist the MAP sensor. Output changes more than 0.1 volt indicate a faulty connector or connection.**

Manifold Absolute Pressure Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the assembly line diagnostic link (ALDL). 3. Turn the ignition ON. 4. Compare the manifold absolute pressure (MAP) sensor voltage reading from the scanner with that from a known good vehicle. Is the difference in the two voltage readings less than the value specified?	0.4 v	Go to Step 2	Go to Step 5
2	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Disconnect the MAP sensor vacuum line. 4. Connect a hand vacuum pump to the MAP sensor. 5. Turn the ignition ON. 6. Note the MAP sensor voltage. 7. Apply 34 kPa (10 in. Hg) of vacuum to the MAP sensor and note the voltage change. Is the difference in voltage readings more than the value specified?	1.5 v	System OK	Go to Step 3
3	Inspect the MAP sensor connector terminals. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair the MAP sensor connector terminals as needed. Is the repair complete?	-	System OK	-
5	Replace the MAP sensor. Is the repair complete?	-	System OK	-



PARK/NEUTRAL SWITCH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The park/neutral (P/N) switch contacts are a part of the selector position switch. The contacts are closed to ground in park and neutral and open in the drive ranges.

The electronic control module (ECM) supplies ignition voltage through a current limiting resistor to the signal wire and senses a closed switch when the voltage on the signal wire drops to less than 1 volt. The ECM uses the P/N signal as one of the inputs to control idle air and spark timing.

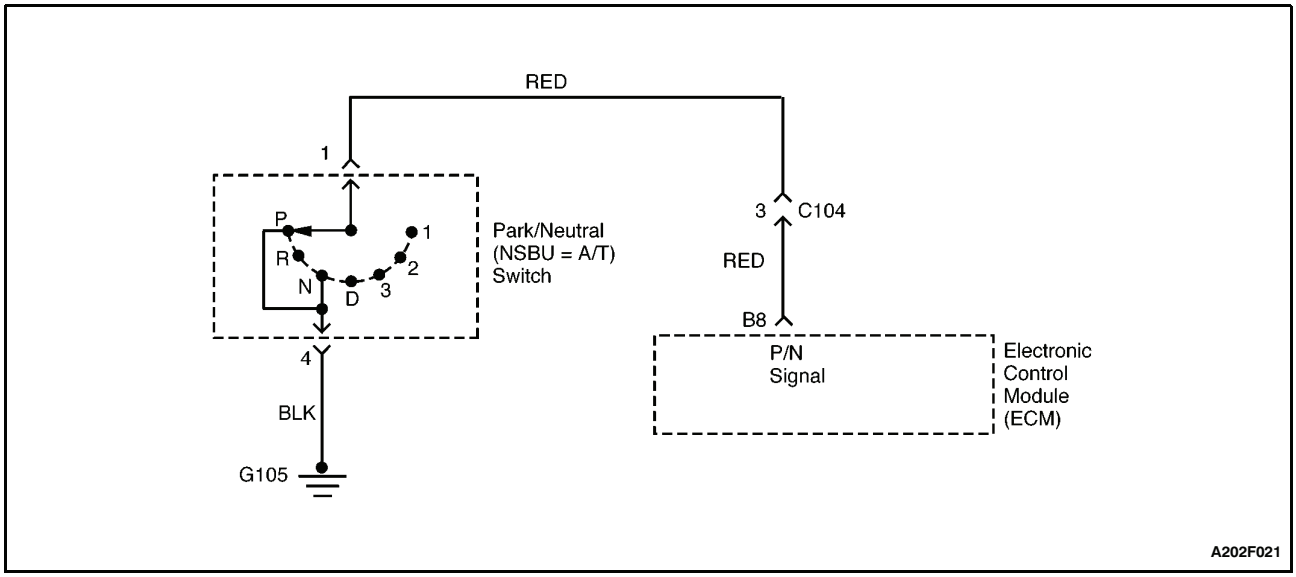
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. **This step checks for the P/N switch closed to ground in the park position. Different makes of scan tools will read P/N differently. Refer to the tool operations manual for the type of display used.**
2. **This step checks for an open P/N switch in the drive range.**

Park/Neutral Switch (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Place the transaxle in park (P). 3. Turn the ignition ON. Does the scan tool indicate park or neutral?	-	Go to Step 2	Go to Step 10
2	Place the transaxle in drive (D). Does the scan tool indicate drive?	-	System OK	Go to Step 3
3	Disconnect the park/neutral (P/N) switch. Does the scan tool indicate drive?	-	Go to Step 4	Go to Step 7
4	Check the P/N switch adjustment. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Adjust the P/N switch. Is the repair complete?	-	System OK	-
6	Replace the P/N switch. Is the repair complete?	-	System OK	-
7	Check for an open or short to ground in the wire between the P/N switch connector terminal 1 and the electronic control module (ECM) connector terminal D9. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair the open or short to ground in the wire between the P/N switch connector terminal 1 and the ECM connector terminal D9. Is the repair complete?	-	System OK	-
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	1. Disconnect the P/N switch. 2. Jumper the P/N switch connector terminals 1 and 4. 3. Turn the ignition ON. Does the scan tool indicate park?	-	Go to Step 4	Go to Step 11
11	Jumper the P/N switch connector terminal 1 to ground. Does the scan tool indicate park?	-	Go to Step 12	Go to Step 7
12	Repair the open wire between the P/N switch connector terminal 4 and ground. Is the repair complete?	-	System OK	-



PARK/NEUTRAL SWITCH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The park/neutral (P/N) switch contacts are a part of the selector position switch. The contacts are closed to ground in park and neutral and open in the drive ranges.

The electronic control module (ECM) supplies ignition voltage through a current limiting resistor to the signal wire and senses a closed switch when the voltage on the signal wire drops to less than 1 volt. The ECM uses the P/N signal as one of the inputs to control idle air and spark timing.

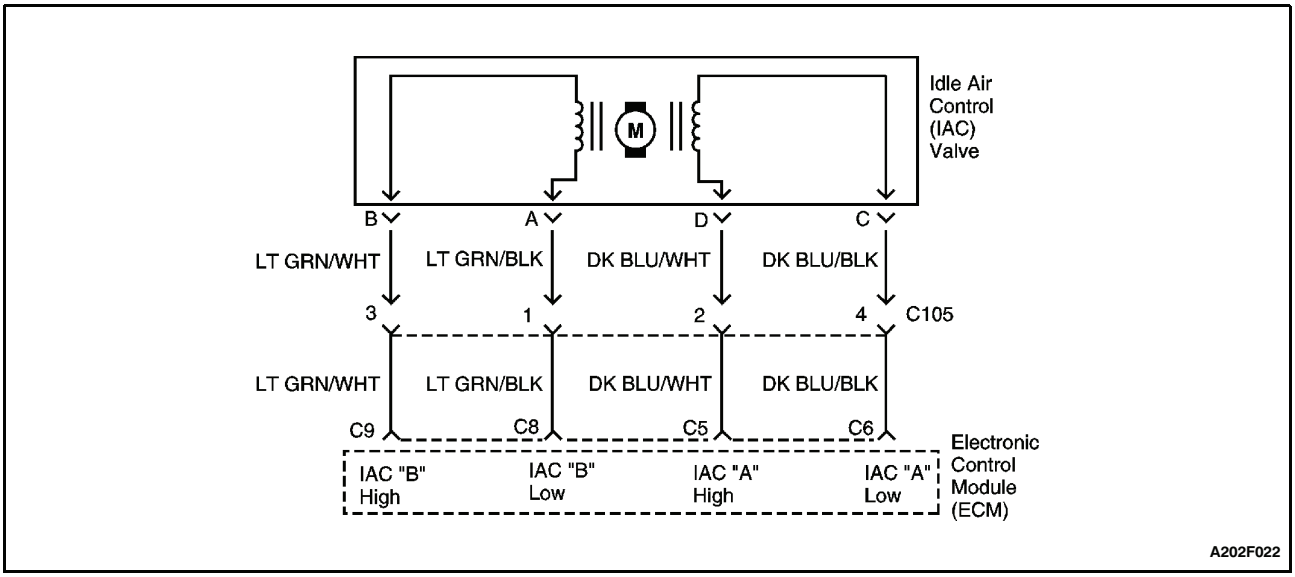
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. **This step checks for the P/N switch closed to ground in the park position. Different makes of scan tools will read P/N differently. Refer to the tool operations manual for the type of display used.**
2. **This step checks for an open P/N switch in the drive range.**

Park/Neutral Switch (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Place the transaxle in park (P). 3. Turn the ignition ON. Does the scan tool indicate park or neutral?	-	Go to Step 2	Go to Step 10
2	Place the transaxle in drive (D). Does the scan tool indicate drive?	-	System OK	Go to Step 3
3	Disconnect the park/neutral (P/N) switch. Does the scan tool indicate drive?	-	Go to Step 4	Go to Step 7
4	Check the P/N switch adjustment. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Adjust the P/N switch. Is the repair complete?	-	System OK	-
6	Replace the P/N switch. Is the repair complete?	-	System OK	-
7	Check for an open or short to ground in the wire between the P/N switch connector terminal 1 and the electronic control module (ECM) connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair the open or short to ground in the wire between the P/N switch connector terminal 1 and the ECM connector terminal B8. Is the repair complete?	-	System OK	-
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	1. Disconnect the P/N switch. 2. Jumper the P/N switch connector terminals 1 and 4. 3. Turn the ignition ON. Does the scan tool indicate park?	-	Go to Step 4	Go to Step 11
11	Jumper the P/N switch connector terminal 1 to ground. Does the scan tool indicate park?	-	Go to Step 12	Go to Step 7
12	Repair the open wire between the P/N switch connector terminal 4 and ground. Is the repair complete?	-	System OK	-



IDLE AIR CONTROL SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) controls the engine idle speed with the idle air control (IAC) valve. To increase the idle speed, the ECM pulls the IAC pintle away from its seat, allowing more air to pass by the throttle bore. To decrease the idle speed, it extends the IAC valve pintle toward its seat, reducing bypass air flow. A scan tool will read the ECM commands to the IAC valve in counts. The higher counts indicate more air bypass (higher idle). The lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

If the idle is too high, stop the engine. Fully extend the IAC valve with an IAC tester. Start the engine. If the idle speed is above 800 rpm, locate and repair the vacuum leak. Also, check for a binding throttle plate or throttle linkage, or an incorrect base idle setting.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The IAC valve is extended and retracted by the IAC driver. IAC valve movement is verified by an engine speed change. If no change in engine speed occurs, the valve can be removed from the throttle body and tested. Connect the IAC driver to the removed IAC valve and turn the ignition ON. Do not start the engine.

5. This step checks the quality of the IAC valve movement in Step 2. Fully extending the IAC valve may cause an engine stall. This may be normal.

6. Steps 2 and 5 verify proper IAC valve operation. This step checks the IAC circuit for a wiring or ECM fault.

Idle Air Control Valve Reset Procedure

Whenever the battery cable or the ECM connector or the ECM fuse EF31 is disconnected or replaced (more than 10 seconds), the following idle learn procedure must be performed:

1. **Turn the ignition ON for 5 seconds.**
2. **Turn the ignition OFF for 10 seconds.**
3. **Turn the ignition ON for 5 seconds.**
4. **Start the engine in park/neutral (P/N).**
5. **Allow the engine to run until the engine coolant is above 85°C (185°F).**
6. **Turn the air conditioning (A/C) ON over 10 seconds, if equipped.**
7. **Turn the A/C OFF over 10 seconds, if equipped.**
8. **If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).**
9. **Turn the A/C ON over 10 seconds, if equipped.**
10. **Turn the A/C OFF over 10 seconds, if equipped.**
11. **Turn the ignition OFF. The idle learn procedure is complete.**

Idle Air Control System Check (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the idle air control (IAC) driver to the IAC valve. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. With the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the engine rpm change?	-	Go to Step 5	Go to Step 3
3	1. Remove the IAC valve. 2. Inspect the IAC passages for restrictions. Is the problem found?	-	Go to Step 4	Go to Step 19
4	Clean the IAC passages. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Start the engine. 3. Using the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC driver to the IAC valve. 3. Install an IAC node light to the IAC valve connector. 4. Start the engine. 5. Cycle the IAC driver. 6. Watch the node lights of the IAC driver. Do both lights cycle red and green but never off as the rpm is changed?	-	Go to Step 7	Go to Step 9
7	1. Measure the resistance of the IAC valve between terminals A and B. 2. Measure the resistance of the IAC valve between terminals C and D. Does the resistance measure within the value specified?	40-80 W	Go to Step 8	Go to Step 19
8	1. Measure the resistance of the IAC valve between terminals B and C. 2. Measure the resistance of the IAC valve between terminals A and D. Does the ohmmeter show the specified value?	R	Go to "Diagnostic Aids"	Go to Step 19
9	Inspect the IAC connector terminals. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Repair or replace the IAC connector terminals as needed. Is the repair complete?	-	System OK	-

Idle Air Control System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open or short in the wire between the IAC connector terminal B and the electronic control module (ECM) connector terminal C9. Is the problem found?	-	Go to Step 15	Go to Step 12
12	Check for an open or short in the wire between the IAC connector terminal A and the ECM connector terminal C8. Is the problem found?	-	Go to Step 15	Go to Step 13
13	Check for an open or short in the wire between the IAC connector terminal D and the ECM connector terminal C5. Is the problem found?	-	Go to Step 15	Go to Step 14
14	Check for an open or short in the wire between the IAC connector terminal C and the ECM connector terminal C6. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair the wire as needed. Is the repair complete?	-	System OK	-
16	Inspect the ECM connector terminals. Is the problem found?	-	Go to Step 17	Go to Step 18
17	Repair the ECM connector terminals as needed. Is the repair complete?	-	System OK	-
18	Replace the ECM. Is the repair complete?	-	System OK	-
19	Replace the IAC valve. Is the repair complete?	-	System OK	-

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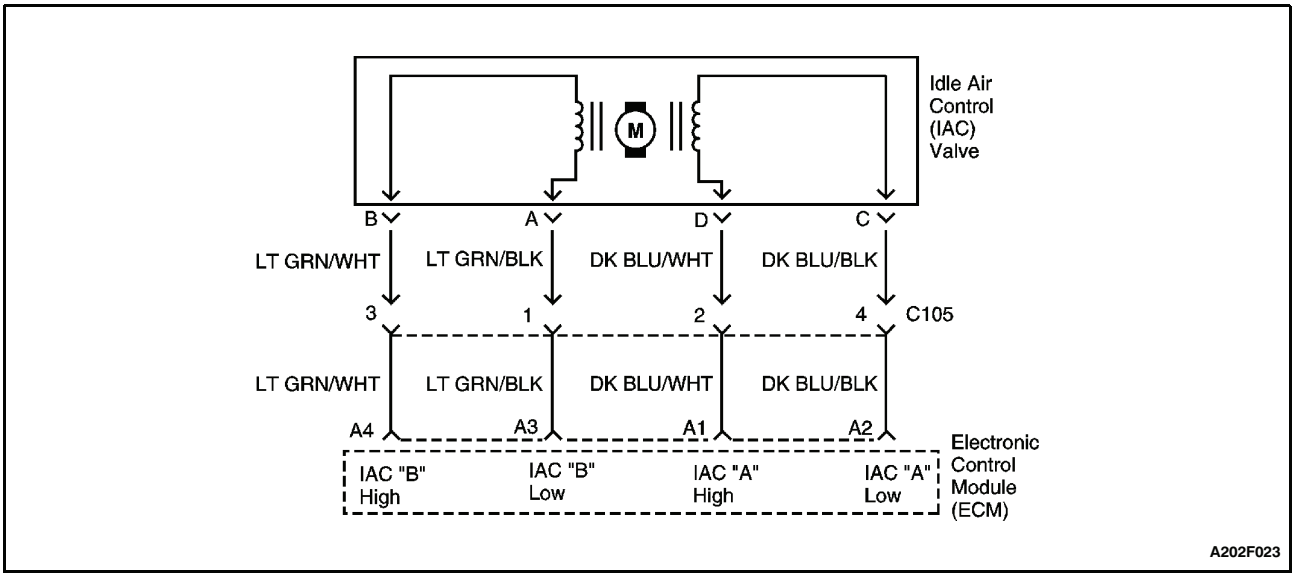

IDLE AIR CONTROL SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) controls the engine idle speed with the idle air control (IAC) valve. To increase the idle speed, the ECM pulls the IAC pintle away from its seat, allowing more air to pass by the throttle bore. To decrease the idle speed, it extends the IAC valve pintle toward its seat, reducing bypass air flow. A scan tool will read the ECM commands to the IAC valve in counts. The higher counts indicate more air bypass (higher idle). The lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

If the idle is too high, stop the engine. Fully extend the IAC valve with an IAC tester. Start the engine. If the idle speed is above 800 rpm, locate and repair the vacuum leak. Also, check for a binding throttle plate or throttle linkage, or an incorrect base idle setting.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The IAC valve is extended and retracted by the IAC driver. IAC valve movement is verified by an engine speed change. If no change in engine speed occurs, the valve can be removed from the throttle body and tested. Connect the IAC driver to the removed IAC valve and turn the ignition ON. Do not start the engine.
5. This step checks the quality of the IAC valve movement in Step 2. Fully extending the IAC valve may cause an engine stall. This may be normal.
6. Steps 2 and 5 verify proper IAC valve operation. This step checks the IAC circuit for a wiring or ECM fault.

Idle Air Control Valve Reset Procedure

Whenever the battery cable or the ECM connector or the ECM fuse EF31 is disconnected or replaced (more than 10 seconds), the following idle learn procedure must be performed:

1. Turn the ignition ON for 5 seconds.
2. Turn the ignition OFF for 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral (P/N).
5. Allow the engine to run until the engine coolant is above 85°C (185°F).
6. Turn the air conditioning (A/C) ON over 10 seconds, if equipped.
7. Turn the A/C OFF over 10 seconds, if equipped.
8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D).
9. Turn the A/C ON over 10 seconds, if equipped.
10. Turn the A/C OFF over 10 seconds, if equipped.
11. Turn the ignition OFF. The idle learn procedure is complete.

Idle Air Control System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the idle air control (IAC) driver to the IAC valve. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. With the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the engine rpm change?	-	Go to Step 5	Go to Step 3
3	1. Remove the IAC valve. 2. Inspect the IAC passages for restrictions. Is the problem found?	-	Go to Step 4	Go to Step 19
4	Clean the IAC passages. Is the repair complete?	-	System OK	-
5	1. Turn the ignition OFF. 2. Start the engine. 3. Using the IAC driver, extend and retract the IAC valve. Engine rpm should increase and decrease as the IAC valve is cycled. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC driver to the IAC valve. 3. Install an IAC node light to the IAC valve connector. 4. Start the engine. 5. Cycle the IAC driver. 6. Watch the node lights of the IAC driver. Do both lights cycle red and green but never off as the rpm is changed?	-	Go to Step 7	Go to Step 9
7	1. Measure the resistance of the IAC valve between terminals A and B. 2. Measure the resistance of the IAC valve between terminals C and D. Does the resistance measure within the value specified?	40-80 W	Go to Step 8	Go to Step 19
8	1. Measure the resistance of the IAC valve between terminals B and C. 2. Measure the resistance of the IAC valve between terminals A and D. Does the ohmmeter show the specified value?	R	Go to "Diagnostic Aids"	Go to Step 19
9	Inspect the IAC connector terminals. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Repair or replace the IAC connector terminals as needed. Is the repair complete?	-	System OK	-

Idle Air Control System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open or short in the wire between the IAC connector terminal B and the electronic control module (ECM) connector terminal A4. Is the problem found?	-	Go to Step 15	Go to Step 12
12	Check for an open or short in the wire between the IAC connector terminal A and the ECM connector terminal A3. Is the problem found?	-	Go to Step 15	Go to Step 13
13	Check for an open or short in the wire between the IAC connector terminal D and the ECM connector terminal A1. Is the problem found?	-	Go to Step 15	Go to Step 14
14	Check for an open or short in the wire between the IAC connector terminal C and the ECM connector terminal A2. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair the wire as needed. Is the repair complete?	-	System OK	-
16	Inspect the ECM connector terminals. Is the problem found?	-	Go to Step 17	Go to Step 18
17	Repair the ECM connector terminals as needed. Is the repair complete?	-	System OK	-
18	Replace the ECM. Is the repair complete?	-	System OK	-
19	Replace the IAC valve. Is the repair complete?	-	System OK	-

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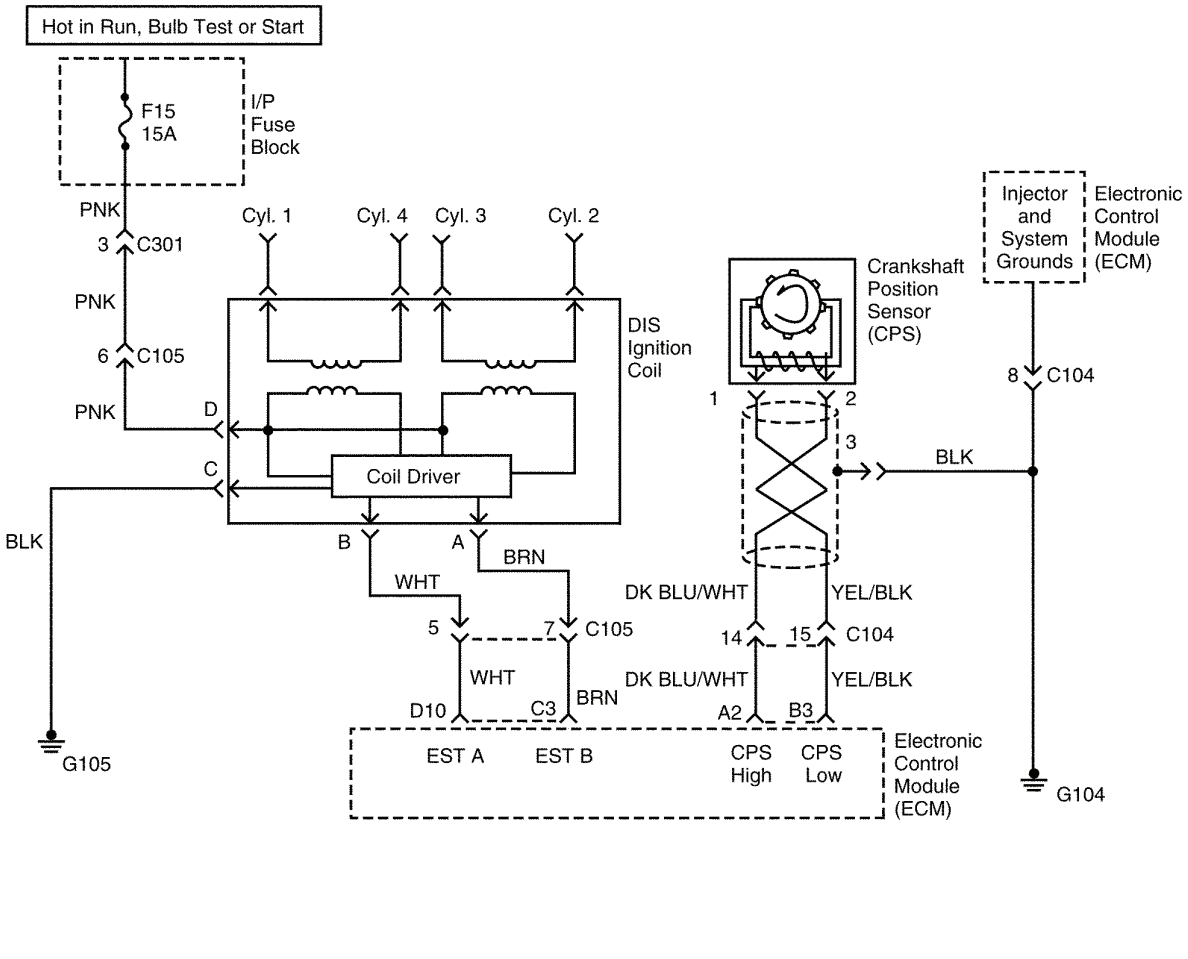


IGNITION SYSTEM CHECK (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) uses a waste spark method of spark distribution. In this type of DIS system, the crankshaft position sensor (CPS) is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CPS sends reference pulses to the electronic control module (ECM). The ECM then triggers the DIS ignition coil. Once the ECM triggers the DIS ignition coil, both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke. This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CPS is in a fixed position, timing adjustments are not possible or needed.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **It is important to check for the presence of spark to all of the cylinders to isolate the problem to either DIS ignition coil inputs or outputs.**
5. **In checking the ECM outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.**
6. **After confirming ECM inputs for the electronic spark timing to the DIS ignition coil are OK, it can be determined that a faulty DIS ignition coil is the problem.**

11. After confirming proper CPS inputs to the ECM and the lack of wiring problems, it can be determined that the ECM is at fault.
24. This step, along with Step 25, checks for battery voltage and a ground to the DIS ignition coil.

Ignition System Check (1.3L and 1.5L SOHC IEFI-6)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

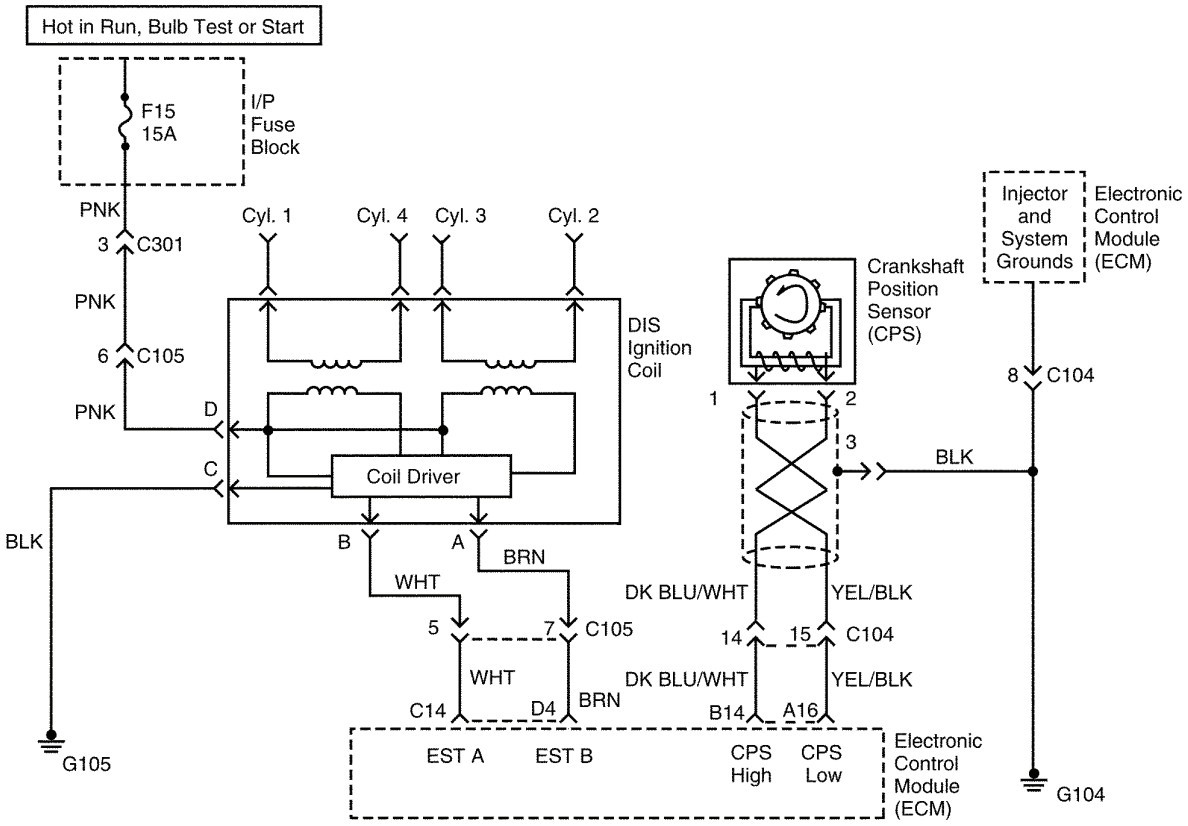
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	-	System OK	Go to Step 2
2	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	System OK	Go to Step 3
3	1. Measure the resistance of the ignition wires. 2. Replace any ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	System OK	Go to Step 4
4	Is spark present from at least one of the ignition wires, but not all of the ignition wires?	-	Go to Step 5	Go to Step 12
5	1. Turn the ignition OFF. 2. Disconnect the direct ignition system (DIS) ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 6	Go to Step 7
6	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 8
7	Check for an open in the wire from the DIS ignition coil connector terminal B to the electronic control module (ECM) connector terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-

Ignition System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the DIS ignition coil. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
11	1. Replace the ECM. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
12	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Measure the resistance between the CPS terminals 1 and 2. Is the resistance within the value specified?	400-600 W	Go to Step 13	Go to Step 28
13	1. Measure the resistance between the CPS terminals 1 and 3. 2. Measure the resistance between the CPS terminals 2 and 3. Is the resistance infinite (open circuit)?	R	Go to Step 14	Go to Step 28
14	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 1 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 20	Go to Step 15
15	Measure the voltage between the CPS connector terminal 1 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 16
16	Check the wire between the CPS connector terminal 1 and the ECM connector terminal A2 for an open or short. Is the problem found?	-	Go to Step 18	Go to Step 11
17	Check the wire between the CPS connector terminal 3 and ground for an open or short. Is the problem found?	-	Go to Step 19	Go to Step 11
18	Repair the wire between the CPS connector terminal 1 and the ECM connector terminal A2. Is the repair complete?	-	System OK	-
19	Repair the wire between the CPS connector terminal 3 and ground. Is the repair complete?	-	System OK	-
20	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 2 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 24	Go to Step 21
21	Measure the voltage between the CPS connector terminal 2 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 22

Ignition System Check (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
22	Check the wire between the CPS connector terminal 2 and the ECM connector terminal B3 for an open or short. Is the problem found?	-	Go to Step 23	Go to Step 11
23	Repair the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the repair complete?	-	System OK	-
24	1. Turn the ignition OFF. 2. Connect a test light between the DIS ignition coil connector terminal D and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 25	Go to Step 26
25	Connect a test light between the DIS ignition coil connector terminal C and battery positive. Is the test light on?	-	Go to Step 5	Go to Step 27
26	Check for an open or short to ground in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the problem found?	-	Go to Step 29	-
27	Repair the wire between the DIS ignition coil connector terminal C and ground. Is the repair complete?	-	System OK	-
28	Replace the CPS. Is the repair complete?	-	System OK	-
29	Replace the fuse F15 or repair the open in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the repair complete?	-	System OK	-



IGNITION SYSTEM CHECK (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) uses a waste spark method of spark distribution. In this type of DIS system, the crankshaft position sensor (CPS) is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CPS sends reference pulses to the electronic control module (ECM). The ECM then triggers the DIS ignition coil. Once the ECM triggers the DIS ignition coil, both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke. This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CPS is in a fixed position, timing adjustments are not possible or needed.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **It is important to check for the presence of spark to all of the cylinders to isolate the problem to either DIS ignition coil inputs or outputs.**
5. **In checking the ECM outputs for the electronic spark timing signal, it recommended to use an oscilloscope to view the varying voltage signals. In measuring these outputs with a voltmeter, intermittent errors may occur that cannot be seen by a voltmeter.**
6. **After confirming ECM inputs for the electronic spark timing to the DIS ignition coil are OK, it can be determined that a faulty DIS ignition coil is the problem.**

11. After confirming proper CPS inputs to the ECM and the lack of wiring problems, it can be determined that the ECM is at fault.
24. This step, along with Step 25, checks for battery voltage and a ground to the DIS ignition coil.

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F)

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

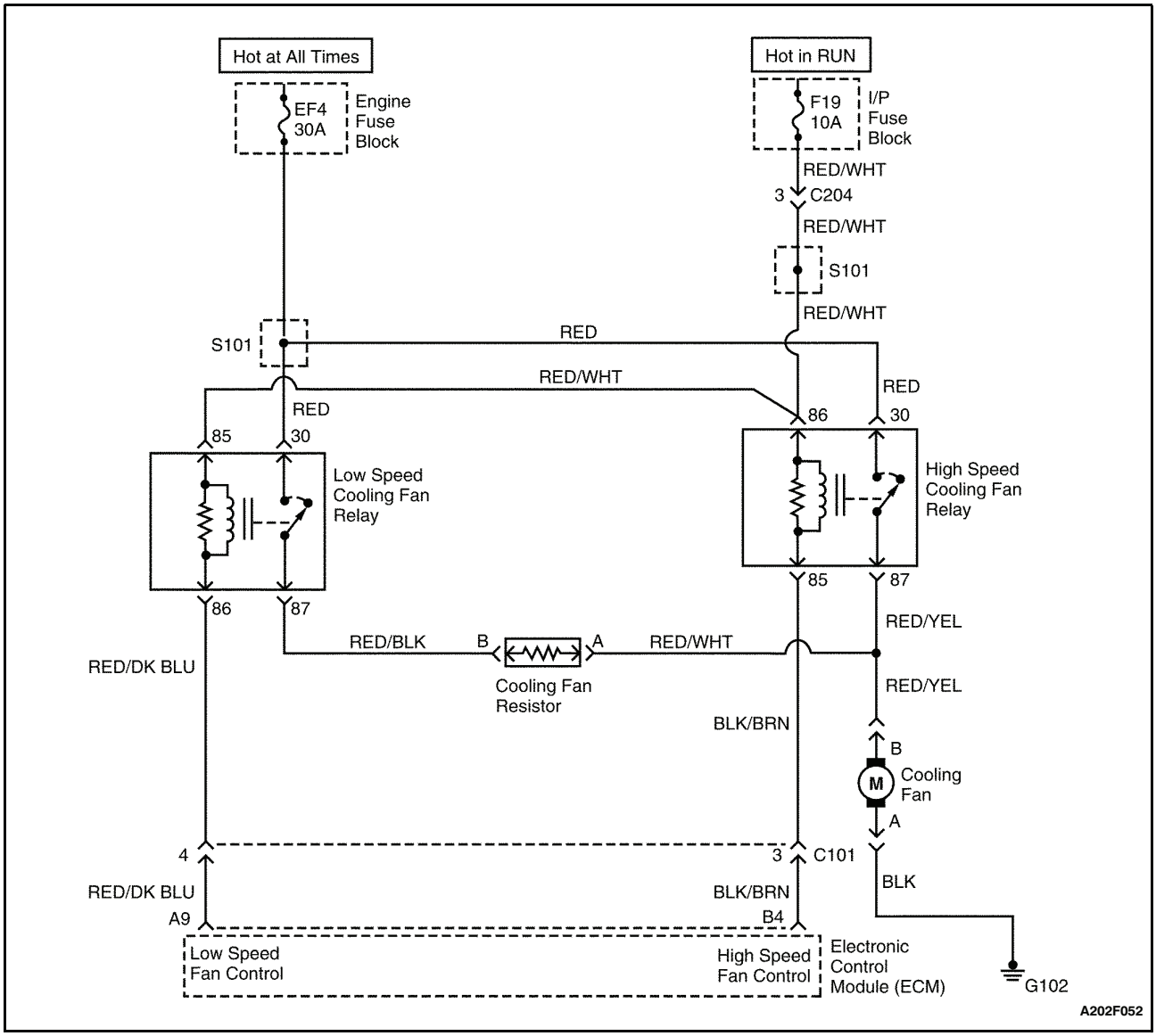
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	-	System OK	Go to Step 2
2	Check for the presence of spark from all of the ignition wires while cranking the engine. Is spark present from all of the ignition wires?	-	System OK	Go to Step 3
3	1. Measure the resistance of the ignition wires. 2. Replace any ignition wire(s) with a resistance above the value specified. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	30,000 W	System OK	Go to Step 4
4	Is spark present from at least one of the ignition wires, but not all of the ignition wires?	-	Go to Step 5	Go to Step 12
5	1. Turn the ignition OFF. 2. Disconnect the direct ignition system (DIS) ignition coil connector. 3. While cranking the engine, measure the voltage at the DIS ignition coil connector terminal B. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 6	Go to Step 7
6	While cranking the engine, measure the voltage at the DIS ignition coil connector terminal A. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 8
7	Check for an open in the wire from the DIS ignition coil connector terminal B to the electronic control module (ECM) connector terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for an open in the wire from the DIS ignition coil connector terminal A to the ECM connector terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wiring as needed. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Replace the DIS ignition coil. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
11	1. Replace the ECM. 2. Connect the DIS ignition coil connector. 3. Check for the presence of spark from all of the ignition wires. Is spark present from all of the ignition wires?	-	System OK	-
12	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Measure the resistance between the CPS terminals 1 and 2. Is the resistance within the value specified?	400-600 W	Go to Step 13	Go to Step 28
13	1. Measure the resistance between the CPS terminals 1 and 3. 2. Measure the resistance between the CPS terminals 2 and 3. Is the resistance infinite (open circuit)?	R	Go to Step 14	Go to Step 28
14	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 1 and 3 Is the voltage within the value specified?	0.95-1.10 v	Go to Step 20	Go to Step 15
15	Measure the voltage between the CPS connector terminal 1 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 16
16	Check the wire between the CPS connector terminal 1 and the ECM connector terminal B14 for an open or short. Is the problem found?	-	Go to Step 18	Go to Step 11
17	Check the wire between the CPS connector terminal 3 and ground for an open or short. Is the problem found?	-	Go to Step 19	Go to Step 11
18	Repair the wire between the CPS connector terminal 1 and the ECM connector terminal B14. Is the repair complete?	-	System OK	-
19	Repair the wire between the CPS connector terminal 3 and ground. Is the repair complete?	-	System OK	-
20	1. Turn the ignition ON. 2. Measure the voltage between the CPS connector terminals 2 and 3. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 24	Go to Step 21
21	Measure the voltage between the CPS connector terminal 2 and ground. Is the voltage within the value specified?	0.95-1.10 v	Go to Step 17	Go to Step 22

Ignition System Check (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
22	Check the wire between the CPS connector terminal 2 and the ECM connector terminal A16 for an open or short. Is the problem found?	-	Go to Step 23	Go to Step 11
23	Repair the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the repair complete?	-	System OK	-
24	1. Turn the ignition OFF. 2. Connect a test light between the DIS ignition coil connector terminal D and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 25	Go to Step 26
25	Connect a test light between the DIS ignition coil connector terminal C and battery positive. Is the test light on?	-	Go to Step 5	Go to Step 27
26	Check for an open or short to ground in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the problem found?	-	Go to Step 29	-
27	Repair the wire between the DIS ignition coil connector terminal C and ground. Is the repair complete?	-	System OK	-
28	Replace the CPS. Is the repair complete?	-	System OK	-
29	Replace the fuse F15 or repair the open in the wiring between the DIS ignition coil connector terminal D and the ignition switch. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK - WITHOUT A/C (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the electronic control module (ECM) based on input from the coolant temperature sensor (CTS). The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A9. This energizes the low-speed cooling fan relay and operates the cooling fan at low speed. The low-speed cooling fan operation is achieved by the cooling fan resistor causing a drop in the voltage supplied to the cooling fan. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal B4. This energizes the high-speed cooling fan relay, bypassing the radiator fan resistor. This results in high-speed cooling fan operation.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**
- **If the I/P fuse block fuse F19 or the engine fuse block fuse EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fan is to be turned on by the ECM, suspect a faulty cooling fan motor.**

- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM 24-pin connector and grounding the connector terminal A9. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A9 and B4 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with Step 5, checks for the ability of the ECM to operate the cooling fans.
22. By directly grounding the ECM connector terminals A9 and B4, the cooling fan should run at high speed.

Engine Cooling Fan Circuit Check - Without A/C (1.3L and 1.5L SOHC IEFI-6)

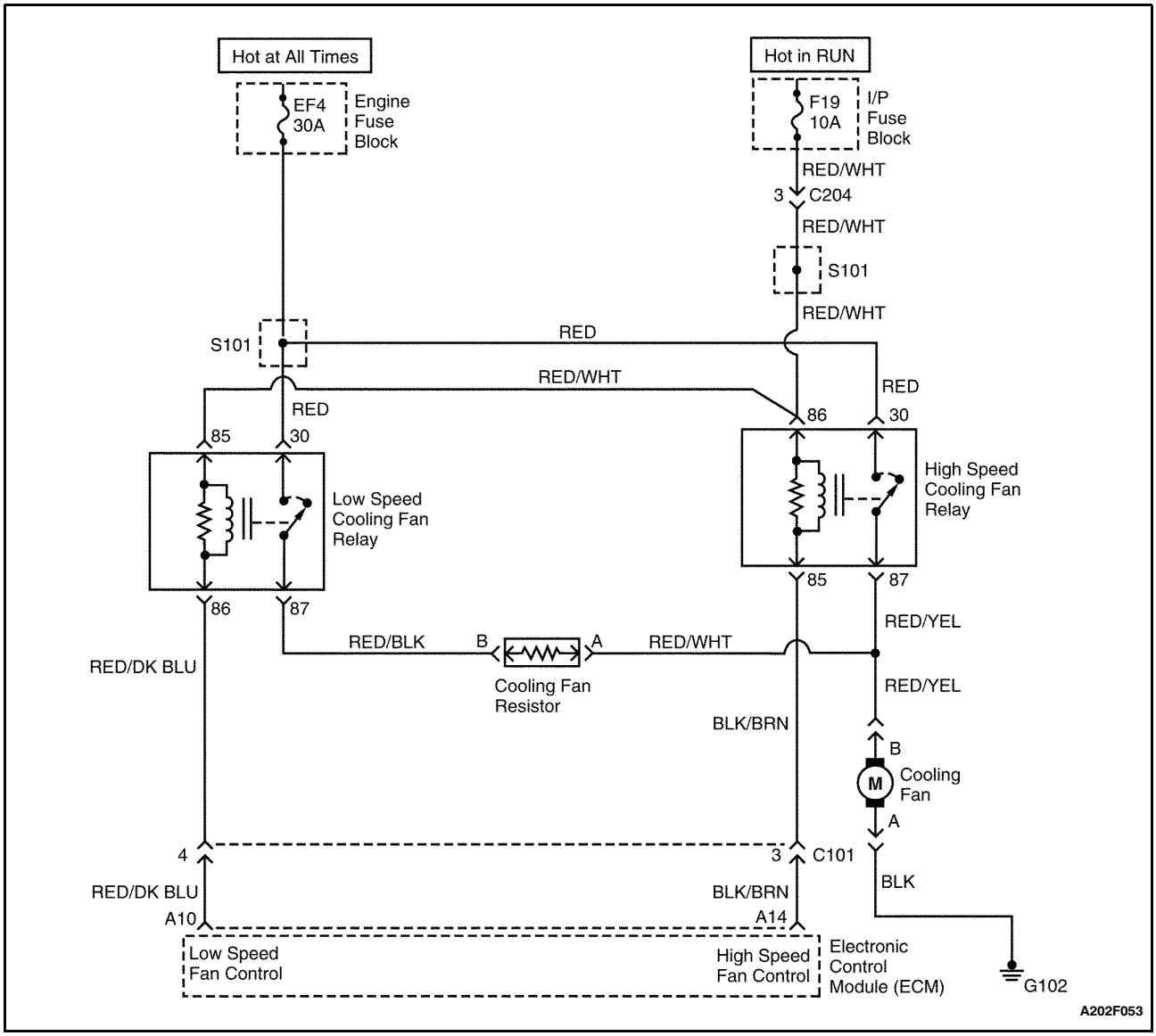
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the I/P fuse block fuse 19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Start the engine. 4. The cooling fan should run at low speed when the coolant temperature reaches 93°C (199°F). Does the cooling fan run at low speed?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Start the engine. 4. The cooling fan should run at high speed when the coolant temperature reaches 97°C (207°F). Does the cooling fan run at high speed?	-	System OK	Go to Step 22
6	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) 24-pin connector. 3. Connect a fused jumper between the ECM connector terminal A9 and ground. 4. Turn the ignition ON. Does the cooling fan run at low speed?	-	Go to Step 21	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A9 and ground. 3. Disconnect the cooling fan connector. 4. Connect a test light between the cooling fan connector terminal B and ground. 5. Turn the ignition ON. Is the test light on?	-	Go to Step 8	Go to Step 9

Engine Cooling Fan Circuit Check - Without A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Connect a test light between the cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 18	Go to Step 17
9	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 10	Go to Step 13
10	1. Turn the ignition OFF. 2. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 11	Go to Step 14
11	Connect a test light between the low-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 12	Go to Step 16
12	1. Connect a fused jumper between the ECM connector terminal A9 and ground. 2. Connect a test light between the low-speed cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 19	Go to Step 15
13	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
14	Repair the open wire between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
15	Repair the open wire between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A9. Is the repair complete?	-	System OK	-
16	Check for an open wire between the low-speed cooling fan connector terminal 87 and the cooling fan connector terminal B. Is the problem found?	-	Go to Step 20	Go to Step 17
17	Check for an open wire between the cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 20	Go to Step 18
18	Replace the cooling fan. Is the repair complete?	-	System OK	-
19	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
20	Repair the wire as needed. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check - Without A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the ECM. Is the repair complete?	-	System OK	-
22	1. Turn the ignition OFF. 2. Disconnect the ECM 24-pin connector. 3. Connect a fused jumper between the ECM connector terminal A9 and ground. 4. Connect a fused jumper between the ECM connector terminal B4 and ground. 5. Turn the ignition ON. Does the cooling fan run at high speed?	-	Go to Step 21	Go to Step 23
23	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 24	Go to Step 28
24	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 25	Go to Step 29
25	Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 26	Go to Step 30
26	1. Connect a fused jumper between the ECM connector terminal B4 and ground. 2. Connect a test light between the high-speed relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 31
27	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
28	Repair the open wire between the high-speed cooling fan connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
29	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
30	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the cooling fan connector terminal B. Is the repair complete?	-	System OK	-
31	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal B4. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK - WITHOUT A/C (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the electronic control module (ECM) based on input from the coolant temperature sensor (CTS). The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A10. This energizes the low-speed cooling fan relay and operates the cooling fan at low speed. The low-speed cooling fan operation is achieved by the cooling fan resistor causing a drop in the voltage supplied to the cooling fan. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A14. This energizes the high-speed cooling fan relay, bypassing the radiator fan resistor. This results in high-speed cooling fan operation.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**
- **If the I/P fuse block fuse F19 or the engine fuse block fuse EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fan is to be turned on by the ECM, suspect a faulty cooling fan motor.**

- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM connector and grounding the connector terminal A10. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A10 and A14 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with step 5, checks for the ability of the ECM to operate the cooling fans.
22. By directly grounding the ECM connector terminals A10 and A14, the cooling fan should run at high speed.

Engine Cooling Fan Circuit Check - Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F)

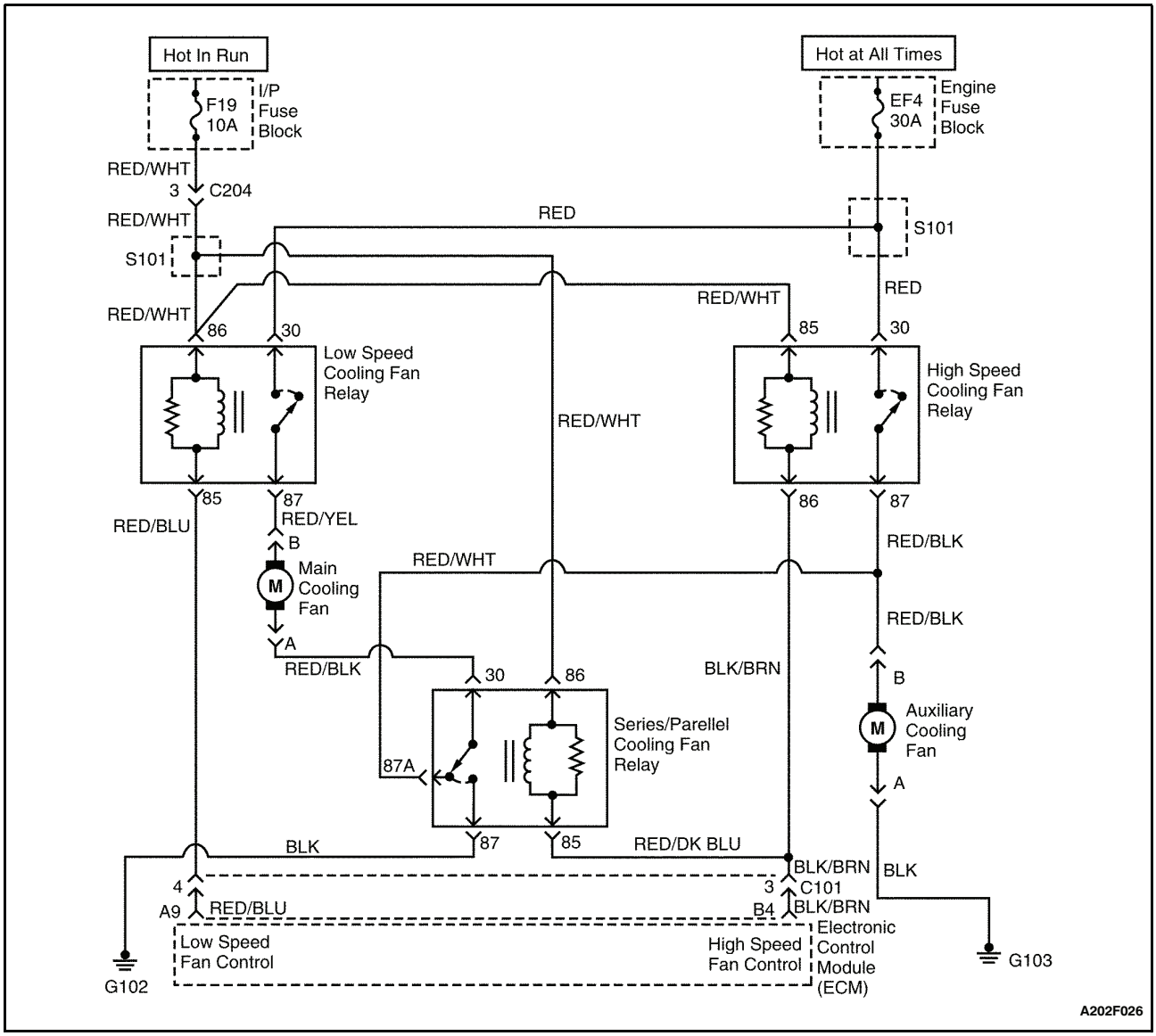
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the I/P fuse block fuse 19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Start the engine. 4. The cooling fan should run at low speed when the coolant temperature reaches 93°C (199°F). Does the cooling fan run at low speed?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. Start the engine. 4. The cooling fan should run at high speed when the coolant temperature reaches 97°C (207°F). Does the cooling fan run at high speed?	-	System OK	Go to Step 22
6	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) connector. 3. Connect a fused jumper between the ECM connector terminal A10 and ground. 4. Turn the ignition ON. Does the cooling fan run at low speed?	-	Go to Step 21	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A10 and ground. 3. Disconnect the cooling fan connector. 4. Connect a test light between the cooling fan connector terminal B and ground. 5. Turn the ignition ON. Is the test light on?	-	Go to Step 8	Go to Step 9

Engine Cooling Fan Circuit Check - Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Connect a test light between the cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 18	Go to Step 17
9	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 10	Go to Step 13
10	1. Turn the ignition OFF. 2. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 11	Go to Step 14
11	Connect a test light between the low-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 12	Go to Step 16
12	1. Connect a fused jumper between the ECM connector terminal A10 and ground. 2. Connect a test light between the low-speed cooling fan relay connector terminal 86 and battery positive. Is the test light on?	-	Go to Step 19	Go to Step 15
13	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
14	Repair the open wire between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
15	Repair the open wire between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A10. Is the repair complete?	-	System OK	-
16	Check for an open wire between the low-speed cooling fan connector terminal 87 and the cooling fan connector terminal B. Is the problem found?	-	Go to Step 20	Go to Step 17
17	Check for an open wire between the cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 20	Go to Step 18
18	Replace the cooling fan. Is the repair complete?	-	System OK	-
19	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
20	Repair the wire as needed. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check - Without A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace the ECM. Is the repair complete?	-	System OK	-
22	1. Turn the ignition OFF. 2. Disconnect the ECM connector. 3. Connect a fused jumper between the ECM connector terminal A10 and ground. 4. Connect a fused jumper between the ECM connector terminal A14 and ground. 5. Turn the ignition ON. Does the cooling fan run at high speed?	-	Go to Step 21	Go to Step 23
23	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 24	Go to Step 28
24	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 25	Go to Step 29
25	Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 26	Go to Step 30
26	1. Connect a fused jumper between the ECM connector terminal A14 and ground. 2. Connect a test light between the high-speed relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 27	Go to Step 31
27	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
28	Repair the open wire between the high-speed cooling fan connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
29	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
30	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the cooling fan connector terminal B. Is the repair complete?	-	System OK	-
31	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the repair complete?	-	System OK	-



ENGINE COOLING FAN CIRCUIT CHECK - WITH A/C (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The engine cooling fan circuit operates the main cooling fan and the auxiliary cooling fan. The cooling fans are controlled by the electronic control module (ECM) based on inputs from the coolant temperature sensor (CTS) and the air conditioning pressure (ACP) sensor. The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A9. This energizes the low-speed cooling fan relay and operates the main cooling fan and the auxiliary cooling fan at low speed as the cooling fans are connected in a series circuit. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A9 and the ECM connector terminal B4 at the same time. This energizes the low-speed cooling fan relay, the high-speed cooling fan relay, and the series/parallel cooling fan relay resulting in high-speed fan operation as the cooling fans are now connected in a parallel circuit.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**

- If the engine fuse block fuses EF4 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fans are to be turned on by the ECM, suspect a faulty cooling fan motor.
- The ECM will turn the cooling fans on at low speed when the coolant temperature is 97°C (207°F). The ECM will turn the cooling fans off when the coolant temperature is 94°C (201°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 101°C (214°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 98°C (208°F).
- The ECM will turn the cooling fans on at low speed when the air conditioning (A/C) system is on. The ECM will change the cooling fans from low speed to high speed when the high-side A/C pressure is 1 882 kPa (273 psi), then return to low speed when the high-side A/C pressure is 1 448 kPa (210 psi). When the A/C system is on, the ECM will change the cooling fans from low to high speed when the coolant temperature reaches 117°C (243°F) then return to low speed when the coolant temperature reaches 114°C (237°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM red connector and grounding the connector terminal A9. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A9 and B4 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with Step 5, checks for the ability of the ECM to operate the cooling fans.
8. This step, along with Step 9, checks for the ability of the ECM to operate the cooling fans in response to A/C pressure readings.
16. After confirming battery voltage and the ECM supplying a ground to the coil side of the low-speed cooling fan relay, jumper connector terminals 30 and 87 to determine if the relay is at fault or a wiring problem is present.
31. This step checks for the presence of battery voltage to the main cooling fan when the A/C is on. If battery voltage is present and the cooling fans are not operating, the problem is in the ground side of the cooling fan circuit.
37. By directly grounding the ECM connector terminals A9 and B4, the main and auxiliary cooling fans should run at high speed.

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the I/P fuse block fuse F19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Turn the air conditioning (A/C) switch OFF. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. The cooling fans should run at low speed when the coolant temperature reaches 97°C (207°F). Do the cooling fans run at low speed?	-	Go to Step 5	Go to Step 10

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Turn the A/C switch OFF. 3. Connect a scan tool to the ALDL. 4. Start the engine. 5. The cooling fans should run at high speed when the coolant temperature reaches 101°C (214°F). Do the cooling fans run at high speed?	-	Go to Step 6	Go to Step 33
6	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	Go to Step 7
7	1. Diagnose the A/C compressor clutch circuit. 2. Repair the A/C compressor clutch circuit as needed. 3. Start the engine. 4. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	-
8	Do the cooling fans run at low speed?	-	Go to Step 9	Go to Step 31
9	1. Turn the ignition OFF. 2. Connect the A/C pressure gauges. 3. Start the engine. 4. Turn the A/C switch ON. 5. The cooling fans should run at high speed when the high-side A/C pressure reaches 1 882 kPa (273 psi). Do the cooling fans run at high speed?	-	System OK	-
10	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 97°C (207°C). 4. Disconnect the main cooling fan connector. 5. Turn the ignition ON. 6. Connect a test light between the main cooling fan connector terminal B and ground. Is the test light on?	-	Go to Step 11	Go to Step 12
11	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 97°C (207°C). 4. Disconnect the main cooling fan connector. 5. Connect a test light between the main cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 28	Go to Step 17
12	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 13	Go to Step 24

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Disconnect the electronic control module (ECM) red connector. 4. Connect a fused jumper between the ECM connector terminal A9 and ground. 5. Turn the ignition ON. Do the cooling fans run at low speed?	-	Go to Step 30	Go to Step 14
14	Check for an open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A9. Is the problem found?	-	Go to Step 25	Go to Step 15
15	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 16	Go to Step 23
16	Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 26	Go to Step 17
17	1. Disconnect the series/parallel cooling fan relay. 2. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 3. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 27	Go to Step 18
18	Check the wire between the low-speed cooling fan relay connector terminal 87 to the main cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 19
19	Check the wire between the main cooling fan connector terminal A and the series/parallel cooling fan relay connector terminal 30 for an open. Is the problem found?	-	Go to Step 22	Go to Step 20
20	Check the wire between the series/parallel cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 21
21	Check for an open wire between the auxiliary cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 22	Go to Step 29
22	Repair the open wire as needed. Is the repair complete?	-	System OK	-
23	Repair the open between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
24	Repair the open between the low-speed cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A9. Is the repair complete?	-	System OK	-
26	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
27	Replace the series/parallel cooling fan relay. Is the repair complete?	-	System OK	-
28	Replace the main cooling fan. Is the repair complete?	-	System OK	-
29	Replace the auxiliary cooling fan. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-
31	1. Turn the ignition OFF. 2. Disconnect the main cooling fan connector. 3. Connect a test light between the main cooling fan connector terminal B and ground. 4. Turn the A/C switch ON. 5. Start the engine. Is the test light on?	-	Go to Step 32	Go to Step 12
32	1. Turn the ignition OFF. 2. Connect a test light between the main cooling fan connector terminal A and battery positive. 3. Turn the A/C switch ON. 4. Start the engine. Is the test light on?	-	Go to Step 28	Go to Step 17
33	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 34	Go to Step 44
34	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 35	Go to Step 45
35	1. Disconnect the series/parallel cooling fan relay. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 86 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 36	Go to Step 46
36	1. Turn the ignition OFF. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 37	Go to Step 47

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
37	1. Connect the main cooling fan connector. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Disconnect the ECM connector. 5. Connect a fused jumper between the ECM connector terminal A9 and ground. 6. Connect a fused jumper between the ECM connector terminal B4 and ground. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 30	Go to Step 38
38	1. Turn the ignition OFF. 2. Check for an open wire between the high-speed cooling fan relay connector terminal 86 and the ECM connector terminal B4. Is the problem found?	-	Go to Step 22	Go to Step 39
39	1. Disconnect the high-speed cooling fan relay. 2. Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 40	Go to Step 48
40	1. Disconnect the ECM connector. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a test light between the series/parallel cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 41	Go to Step 49
41	1. Connect the series/parallel cooling fan relay. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the high-speed cooling fan relay. 4. Connect a fused jumper between the high-speed cooling fan relay connector terminals 30 and 87. 5. Disconnect the low-speed cooling fan relay. 6. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 43	Go to Step 42
42	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal B4 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. 5. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 6. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 27	-

Engine Cooling Fan Circuit Check - With A/C (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
43	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
44	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
45	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the battery. Is the repair complete?	-	System OK	-
46	Repair the open wire between the series/parallel cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
47	Repair the open wire between the series/parallel cooling fan relay connector terminal 87 and ground. Is the repair complete?	-	System OK	-
48	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B. Is the repair complete?	-	System OK	-
49	Repair the open wire between the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal B4. Is the repair complete?	-	System OK	-

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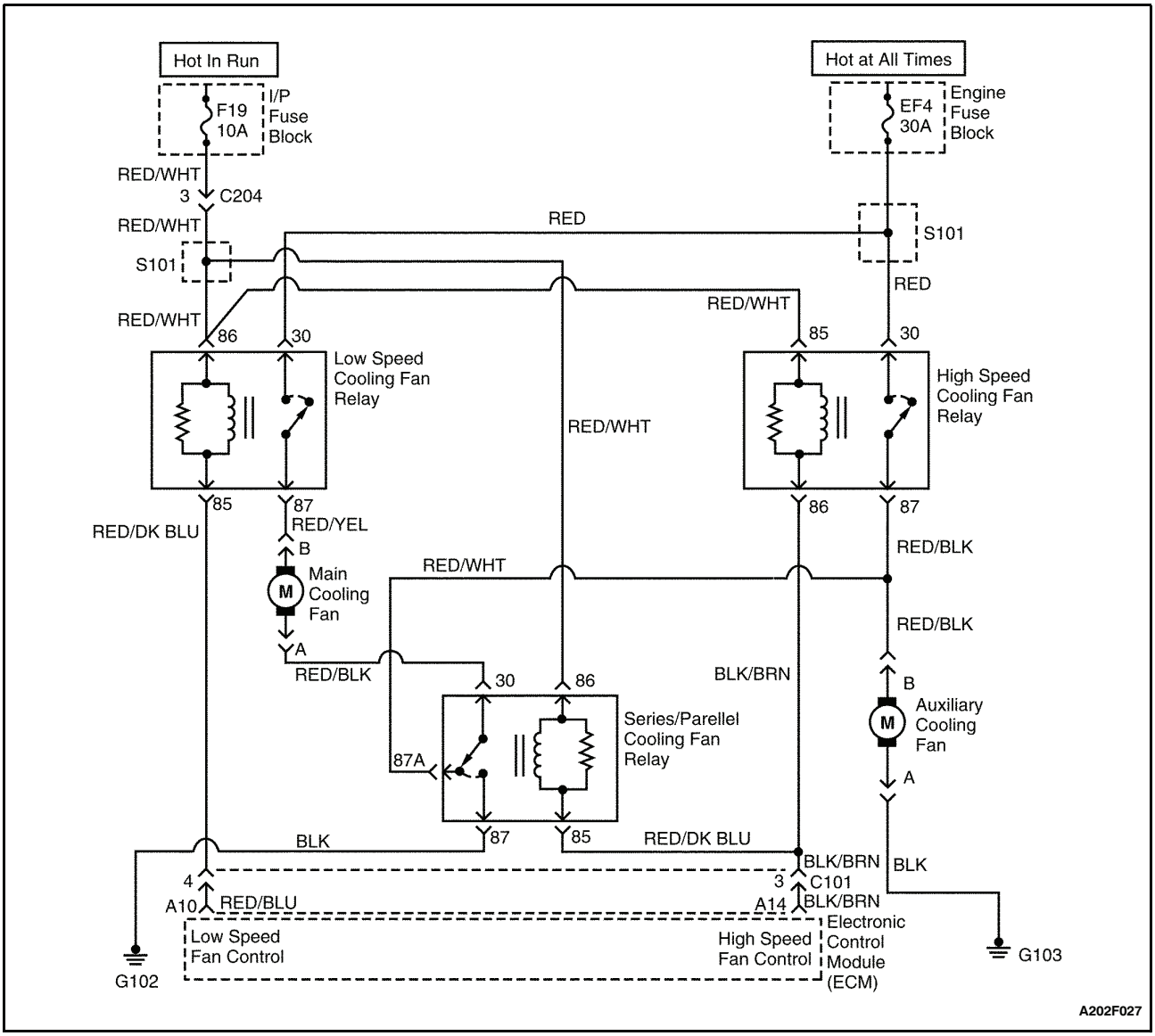


ENGINE COOLING FAN CIRCUIT CHECK - WITH A/C (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The engine cooling fan circuit operates the main cooling fan and the auxiliary cooling fan. The cooling fans are controlled by the electronic control module (ECM) based on inputs from the coolant temperature sensor (CTS) and the air conditioning pressure (ACP) sensor. The ECM controls the low-speed cooling fan operation by internally grounding the ECM connector terminal A10. This energizes the low-speed cooling fan relay and operates the main cooling fan and the auxiliary cooling fan at low speed as the cooling fans are connected in a series circuit. The ECM controls the high-speed cooling fan operation by internally grounding the ECM connector terminal A10 and the ECM connector terminal A14 at the same time. This energizes the low-speed cooling fan relay, the high-speed cooling fan relay, and the series/parallel cooling fan relay resulting in high-speed fan operation as the cooling fans are now connected in a parallel circuit.

Diagnostic Aids

- **If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the engine coolant temperature gauge indicated overheating. If the engine is overheating and the cooling fans are on, the cooling system should be checked.**

- If the engine fuse block fuses EF3 or EF8 become open (blown) immediately after installation, inspect for a short to ground in the wiring of the appropriate circuit. If the fuses become open (blown) when the cooling fans are to be turned on by the ECM, suspect a faulty cooling fan motor.
- The ECM will turn the cooling fans on at low speed when the coolant temperature is 93°C (199°F). The ECM will turn the cooling fans off when the coolant temperature is 90°C (194°F).
- The ECM will turn the cooling fans on at high speed when the coolant temperature is 97°C (207°F). The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94°C (201°F).
- The ECM will turn the cooling fans on at low speed when the air conditioning (A/C) system is on. The ECM will change the cooling fans from low speed to high speed when the high-side A/C pressure is 1 882 kPa (273 psi), then return to low speed when the high-side A/C pressure is 1 448 kPa (210 psi). When the A/C system is on, the ECM will change the cooling fans from low to high speed when the coolant temperature reaches 115°C (239°F) then return to low speed when the coolant temperature reaches 112°C (234°F).
- The cooling fan circuit can be checked quickly by disconnecting the ECM red connector and grounding the connector terminal A10. This should create low-speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals A10 and A14 and turning the ignition ON, high-speed cooling fan operation should be achieved.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step, along with step 5, checks for the ability of the ECM to operate the cooling fans.
8. This step, along with step 9, checks for the ability of the ECM to operate the cooling fans in response to A/C pressure readings.
16. After confirming battery voltage and the ECM supplying a ground to the coil side of the low-speed cooling fan relay, jumper connector terminals 30 and 87 to determine if the relay is at fault or a wiring problem is present.
31. This step checks for the presence of battery voltage to the main cooling fan when the A/C is on. If battery voltage is present and the cooling fans are not operating, the problem is in the ground side of the cooling fan circuit.
37. By directly grounding the ECM connector terminals A10 and A14, the main and auxiliary cooling fans should run at high speed.

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Check the engine fuse block fuse EF4. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Check the I/P fuse block fuse F19. 2. Replace the fuse as needed. Is the fuse OK?	-	Go to Step 4	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Turn the air conditioning (A/C) switch OFF. 3. Connect a scan tool to the assembly line diagnostic link (ALDL). 4. Start the engine. 5. The cooling fans should run at low speed when the coolant temperature reaches 93°C (199°F). Do the cooling fans run at low speed?	-	Go to Step 5	Go to Step 10

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Turn the A/C switch OFF. 3. Connect a scan tool to the ALDL. 4. Start the engine. 5. The cooling fans should run at high speed when the coolant temperature reaches 97°C (207°F). Do the cooling fans run at high speed?	-	Go to Step 6	Go to Step 33
6	1. Turn the ignition OFF. 2. Start the engine. 3. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	Go to Step 7
7	1. Diagnose the A/C compressor clutch circuit. 2. Repair the A/C compressor clutch circuit as needed. 3. Start the engine. 4. Turn the A/C switch ON. Does the A/C compressor clutch engage?	-	Go to Step 8	-
8	Do the cooling fans run at low speed?	-	Go to Step 9	Go to Step 31
9	1. Turn the ignition OFF. 2. Connect the A/C pressure gauges. 3. Start the engine. 4. Turn the A/C switch ON. 5. The cooling fans should run at high speed when the high-side A/C pressure reaches 1 882 kPa (273 psi). Do the cooling fans run at high speed?	-	System OK	-
10	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 93°C (199°C). 4. Disconnect the main cooling fan connector. 5. Turn the ignition ON. 6. Connect a test light between the main cooling fan connector terminal B and ground. Is the test light on?	-	Go to Step 11	Go to Step 12
11	1. Turn the ignition OFF. 2. Connect a scan tool to the ALDL. 3. The coolant temperature should be above 93°C (199°C). 4. Disconnect the main cooling fan connector. 5. Connect a test light between the main cooling fan connector terminal A and battery positive. Is the test light on?	-	Go to Step 28	Go to Step 17
12	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 85 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 13	Go to Step 24

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Disconnect the electronic control module (ECM) red connector. 4. Connect a fused jumper between the ECM connector terminal A10 and ground. 5. Turn the ignition ON. Do the cooling fans run at low speed?	-	Go to Step 30	Go to Step 14
14	Check for an open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the problem found?	-	Go to Step 25	Go to Step 15
15	1. Turn the ignition OFF. 2. Disconnect the low-speed cooling fan relay. 3. Connect a test light between the low-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 16	Go to Step 23
16	Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 26	Go to Step 17
17	1. Disconnect the series/parallel cooling fan relay. 2. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 3. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. Do the cooling fans run at low speed?	-	Go to Step 27	Go to Step 18
18	Check the wire between the low-speed cooling fan relay connector terminal 87 to the main cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 19
19	Check the wire between the main cooling fan connector terminal A and the series/parallel cooling fan relay connector terminal 30 for an open. Is the problem found?	-	Go to Step 22	Go to Step 20
20	Check the wire between the series/parallel cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B for an open. Is the problem found?	-	Go to Step 22	Go to Step 21
21	Check for an open wire between the auxiliary cooling fan connector terminal A and ground. Is the problem found?	-	Go to Step 22	Go to Step 29
22	Repair the open wire as needed. Is the repair complete?	-	System OK	-
23	Repair the open between the low-speed cooling fan relay connector terminal 30 and the fuse EF4. Is the repair complete?	-	System OK	-
24	Repair the open between the low-speed cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair the open wire between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the repair complete?	-	System OK	-
26	Replace the low-speed cooling fan relay. Is the repair complete?	-	System OK	-
27	Replace the series/parallel cooling fan relay. Is the repair complete?	-	System OK	-
28	Replace the main cooling fan. Is the repair complete?	-	System OK	-
29	Replace the auxiliary cooling fan. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-
31	1. Turn the ignition OFF. 2. Disconnect the main cooling fan connector. 3. Connect a test light between the main cooling fan connector terminal B and ground. 4. Turn the A/C switch ON. 5. Start the engine. Is the test light on?	-	Go to Step 32	Go to Step 12
32	1. Turn the ignition OFF. 2. Connect a test light between the main cooling fan connector terminal A and battery positive. 3. Turn the A/C switch ON. 4. Start the engine. Is the test light on?	-	Go to Step 28	Go to Step 17
33	1. Turn the ignition OFF. 2. Disconnect the high-speed cooling fan relay. 3. Connect a test light between the high-speed cooling fan relay connector terminal 86 and ground. 4. Turn the ignition ON. Is the test light on?	-	Go to Step 34	Go to Step 44
34	1. Turn the ignition OFF. 2. Connect a test light between the high-speed cooling fan relay connector terminal 30 and ground. Is the test light on?	-	Go to Step 35	Go to Step 45
35	1. Disconnect the series/parallel cooling fan relay. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 86 and ground. 3. Turn the ignition ON. Is the test light on?	-	Go to Step 36	Go to Step 46
36	1. Turn the ignition OFF. 2. Connect a test light between the series/parallel cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 37	Go to Step 47

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
37	1. Connect the main cooling fan connector. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Disconnect the ECM connector. 5. Connect a fused jumper between the ECM connector terminal A10 and ground. 6. Connect a fused jumper between the ECM connector terminal A14 and ground. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 30	Go to Step 38
38	1. Turn the ignition OFF. 2. Check for an open wire between the high-speed cooling fan relay connector terminal 86 and the ECM connector terminal A14. Is the problem found?	-	Go to Step 22	Go to Step 39
39	1. Disconnect the high-speed cooling fan relay. 2. Connect a test light between the high-speed cooling fan relay connector terminal 87 and battery positive. Is the test light on?	-	Go to Step 40	Go to Step 48
40	1. Disconnect the ECM connector. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a test light between the series/parallel cooling fan relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 41	Go to Step 49
41	1. Connect the series/parallel cooling fan relay. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the high-speed cooling fan relay. 4. Connect a fused jumper between the high-speed cooling fan relay connector terminals 30 and 87. 5. Disconnect the low-speed cooling fan relay. 6. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 7. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 43	Go to Step 42
42	1. Turn the ignition OFF. 2. Connect a fused jumper between the ECM connector terminal A14 and ground. 3. Disconnect the series/parallel cooling fan relay. 4. Connect a fused jumper between the series/parallel cooling fan relay connector terminals 30 and 87. 5. Connect a fused jumper between the low-speed cooling fan relay connector terminals 30 and 87. 6. Turn the ignition ON. Do the cooling fans run at high speed?	-	Go to Step 27	-

Engine Cooling Fan Circuit Check - With A/C (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
43	Replace the high-speed cooling fan relay. Is the repair complete?	-	System OK	-
44	Repair the open wire between the high-speed cooling fan relay connector terminal 85 and the ignition switch. Is the repair complete?	-	System OK	-
45	Repair the open wire between the high-speed cooling fan relay connector terminal 30 and the battery. Is the repair complete?	-	System OK	-
46	Repair the open wire between the series/parallel cooling fan relay connector terminal 86 and the ignition switch. Is the repair complete?	-	System OK	-
47	Repair the open wire between the series/parallel cooling fan relay connector terminal 87 and ground. Is the repair complete?	-	System OK	-
48	Repair the open wire between the high-speed cooling fan relay connector terminal 87 and the auxiliary cooling fan connector terminal B. Is the repair complete?	-	System OK	-
49	Repair the open wire between the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the repair complete?	-	System OK	-

FUEL INJECTOR BALANCE TEST

A fuel injector tester is used to energize the injector for a precise amount of time, thus spraying a measured amount of fuel into the intake manifold. This causes a drop in the fuel rail pressure that can be recorded and used to compare each of the fuel injectors. All of the fuel injectors should have the same pressure drop 10 kPa (1.5 psi).

Injector Balance Test Example

Cylinder	1	2	3	4
First Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
Second Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount Of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Faulty Injector - Too Much Pressure Drop	Injector OK	Faulty Injector - Too Little Pressure Drop

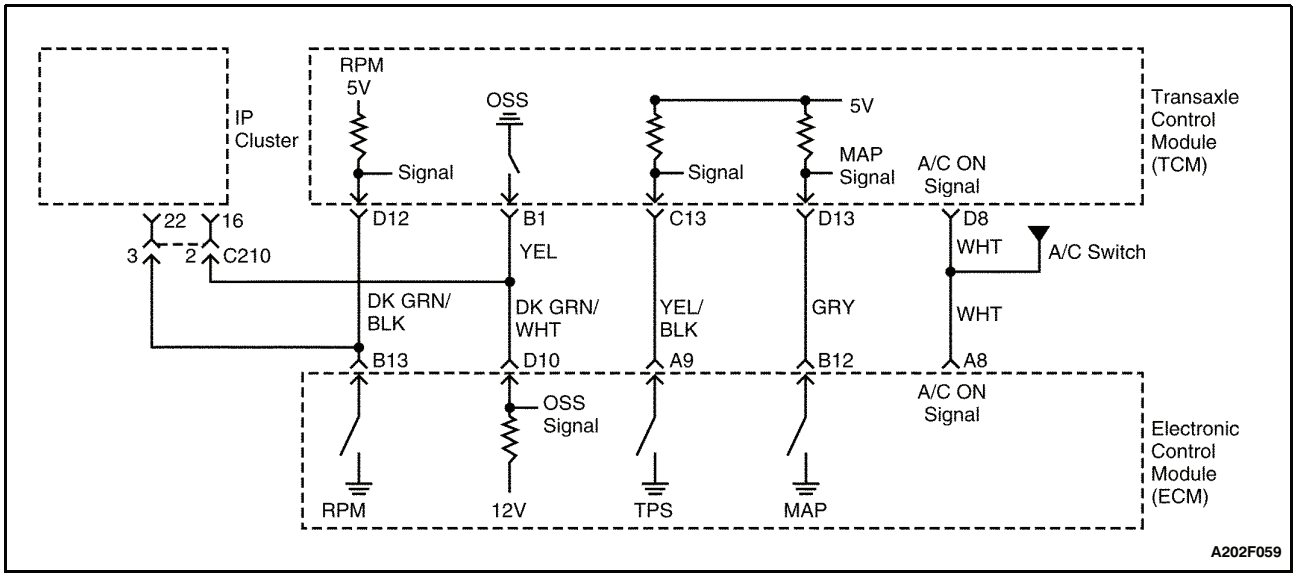
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

Caution: Do not pinch or restrict nylon fuel lines. Damage to the lines could cause a fuel leak, resulting in possible fire or personal injury.

Notice: In order to prevent flooding of the engine, do not perform the Injector Balance Test more than once (including any retest on faulty fuel injectors) without running the engine.

Test

1. An engine cool down period of 10 minutes is necessary in order to avoid irregular readings due to hot soak fuel boiling.
2. Connect the fuel pressure gauge carefully to avoid any fuel spillage.
3. The fuel pump should run about 2 seconds after the ignition is turned to the ON position.
4. Insert a clear tube attached to the vent valve of the fuel pressure gauge into a suitable container.
5. Bleed the air from the fuel pressure gauge and the hose until all of the air is bled from the fuel pressure gauge.
6. The ignition switch must be in the OFF position at least 10 seconds in order to complete the electronic control module (ECM) shutdown cycle.
7. Turn the ignition ON in order to get the fuel pressure to its maximum level.
8. Allow the fuel pressure to stabilize and then record this initial pressure reading. Wait until there is no movement of the needle on the fuel pressure gauge.
9. Follow the manufacturer's instructions for the use of the adapter harness. Energize the fuel injector tester once and note the fuel pressure drop at its lowest point. Record this second reading. Subtract it from the first reading to determine the amount of the fuel pressure drop.
10. Disconnect the fuel injector tester from the fuel injector.
11. After turning the ignition ON, in order to obtain maximum pressure once again, make a connection at the next fuel injector. Energize the fuel injector tester and record the fuel pressure reading. Repeat this procedure for all the injectors.
12. Retest any of the fuel injectors for which the pressure drop exceeds the 10 kPa (1.5 psi) specification.
13. Replace any of the fuel injectors that fail the retest.
14. If the pressure drop of all of the fuel injectors is within 10 kPa (1.5 psi), then the fuel injectors are flowing normally and no replacement should be necessary.
15. Reconnect the fuel injector harness and review the symptom diagnostic tables.



DIAGNOSTIC TROUBLE CODE (DTC) 1
TCMPWM LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position angle is computed by the transaxle control module (TCM) and the electronic control module (ECM) from the throttle position sensor (TPS) voltage input.

DTC 1 Will Set When

- **TCMPWM output short to ground (TPS: 0 - 5%) is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

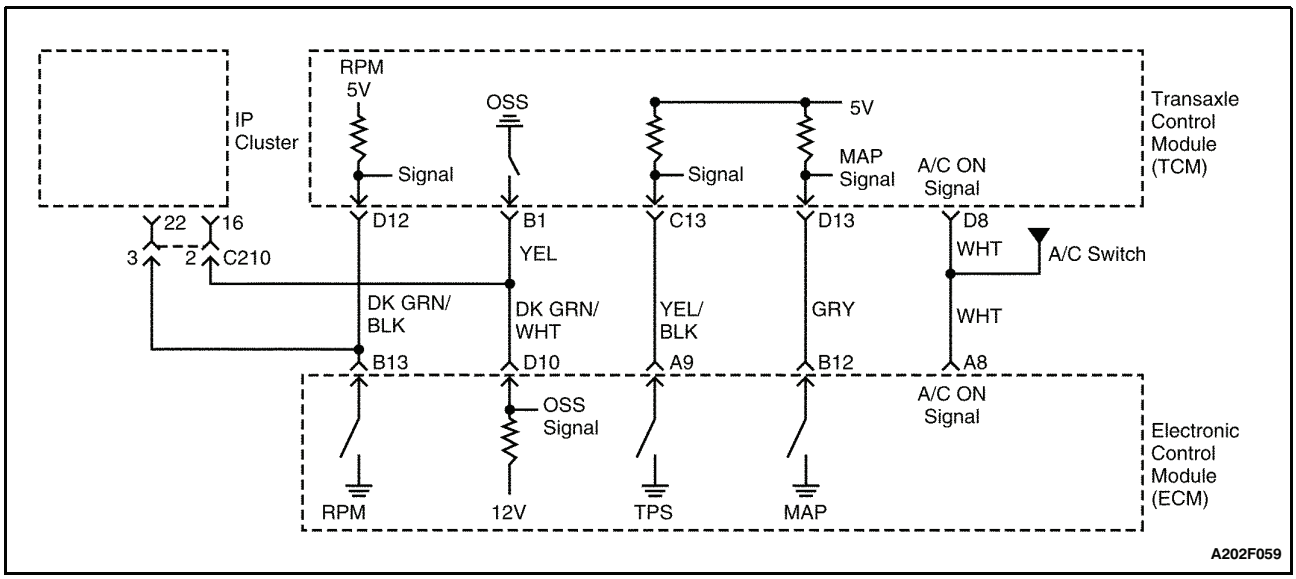
4. This step checks to see if the TCM is receiving TPS signal voltage.

DTC 1 - TCMPWM Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect a voltmeter to terminal C13 of the transaxle control module (TCM) and ground. 3. Turn the ignition ON. Does the voltmeter show the value specified?	6 v	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the repair complete?	-	System OK	-

DTC 1 - TCMPWM Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value	Yes	No
4	1. To determine if the TCM is receiving throttle position sensor (TPS) signal voltage, begin by turning the ignition OFF. 2. Disconnect the electrical connectors at the TCM. 3. Disconnect the electrical connectors at the electronic control module (ECM). 4. Check the wire from terminal C13 of the TCM to terminal A9 of the ECM for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground between terminal C13 of the TCM and terminal A9 of the ECM. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 2
TCMPWM HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position angle is computed by the transaxle control module (TCM) and the electronic control module (ECM) from the throttle position sensor (TPS) voltage input.

DTC 2 Will Set When

- **TCMPWM output short to battery voltage (TPS: 95 - 100%) is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

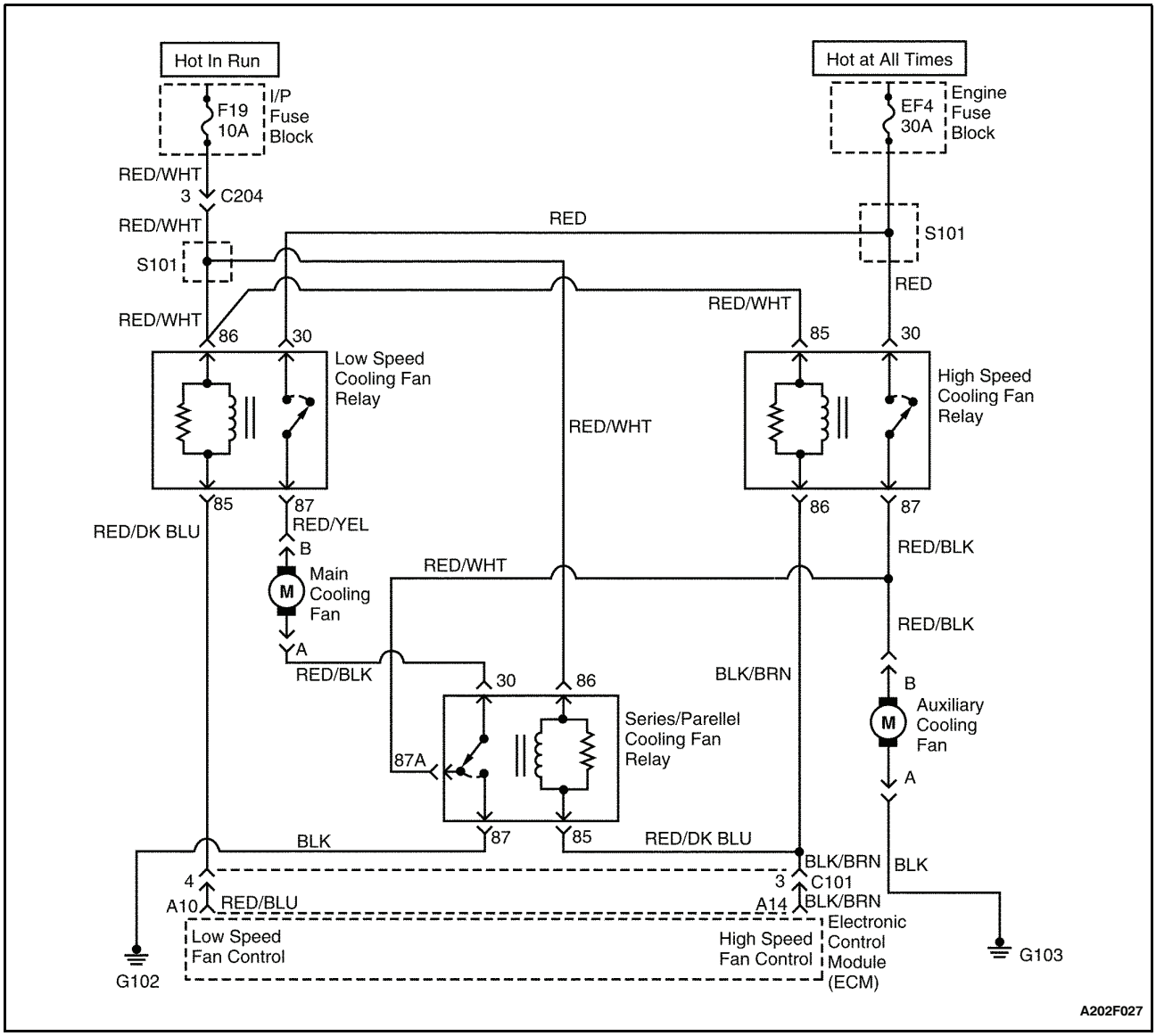
4. This step checks to see if the TCM is receiving TPS signal voltage.

DTC 2 - TCMPWM High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect a voltmeter to terminal C13 of the transaxle control module (TCM) and ground. 3. Turn the ignition ON. Does the voltmeter show the value specified?	6 v	Go to Step 3	Go to Step 4
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the repair complete?	-	System OK	-

DTC 2 - TCMPWM High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value	Yes	No
4	1. To determine if the TCM is receiving throttle position sensor (TPS) signal voltage, begin by turning the ignition OFF. 2. Disconnect the electrical connectors at the TCM. 3. Disconnect the electrical connectors at the electronic control module (ECM). 4. Check the wire from terminal C13 of the TCM to terminal A9 of the ECM for a short to battery voltage. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair the short to battery voltage between terminal C13 of the TCM and terminal A9 of the ECM. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 3
FAN NUMBER TWO LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The high-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the high-speed cooling fan relay, while also applying ground to the low-speed cooling fan relay, to achieve high-speed cooling fan operation. The ECM determines when to activate the high-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 3 Will Set When

- **An open or short to ground condition exists and this condition is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for an open or shorted relay.

6. This step checks for an open or shorted relay.

11. This step checks for the ability of the ECM to ground the fan circuits.

DTC 3 - Fan Number Two Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Inspect the fuse F19. Is the fuse in good condition?	-	Go to Step 4	Go to Step 3
3	1. Replace the fuse. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Disconnect the high-speed cooling fan relay. 2. Measure the resistance between the high-speed cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 5	Go to Step 6
5	1. Replace the high-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Disconnect the series/parallel cooling fan relay. 2. Measure the resistance between the series/parallel cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 7	Go to Step 8
7	1. Replace the series/parallel cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check for an open or short to ground in the wiring between the high-speed cooling fan relay connector terminal 85 and the ECM connector terminal A14. Is the problem found?	-	Go to Step 10	Go to Step 9
9	Check for an open or short to ground in the wiring between the series/parallel cooling fan relay connector terminal 85 and ECM connector terminal A14. Is the problem found?	-	Go to Step 10	Go to Step 11
10	1. Repair the open or short to ground in the wiring. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Connect the high-speed cooling fan relay. 3. Connect the series/parallel cooling fan relay. 4. Connect the ECM red connector. 5. Jumper terminals A and B of the assembly line diagnostic link (ALDL) connector. 6. Turn the ignition ON. 7. With a test light connected to battery voltage, backprobe the ECM connector terminal A14. Is the test light on?	-	Go to "Diagnostic Aids"	Go to Step 12

DTC 3 - Fan Number Two Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect for a poor connection at the ECM connector terminal A14. Is the problem found?	-	Go to Step 13	Go to Step 14
13	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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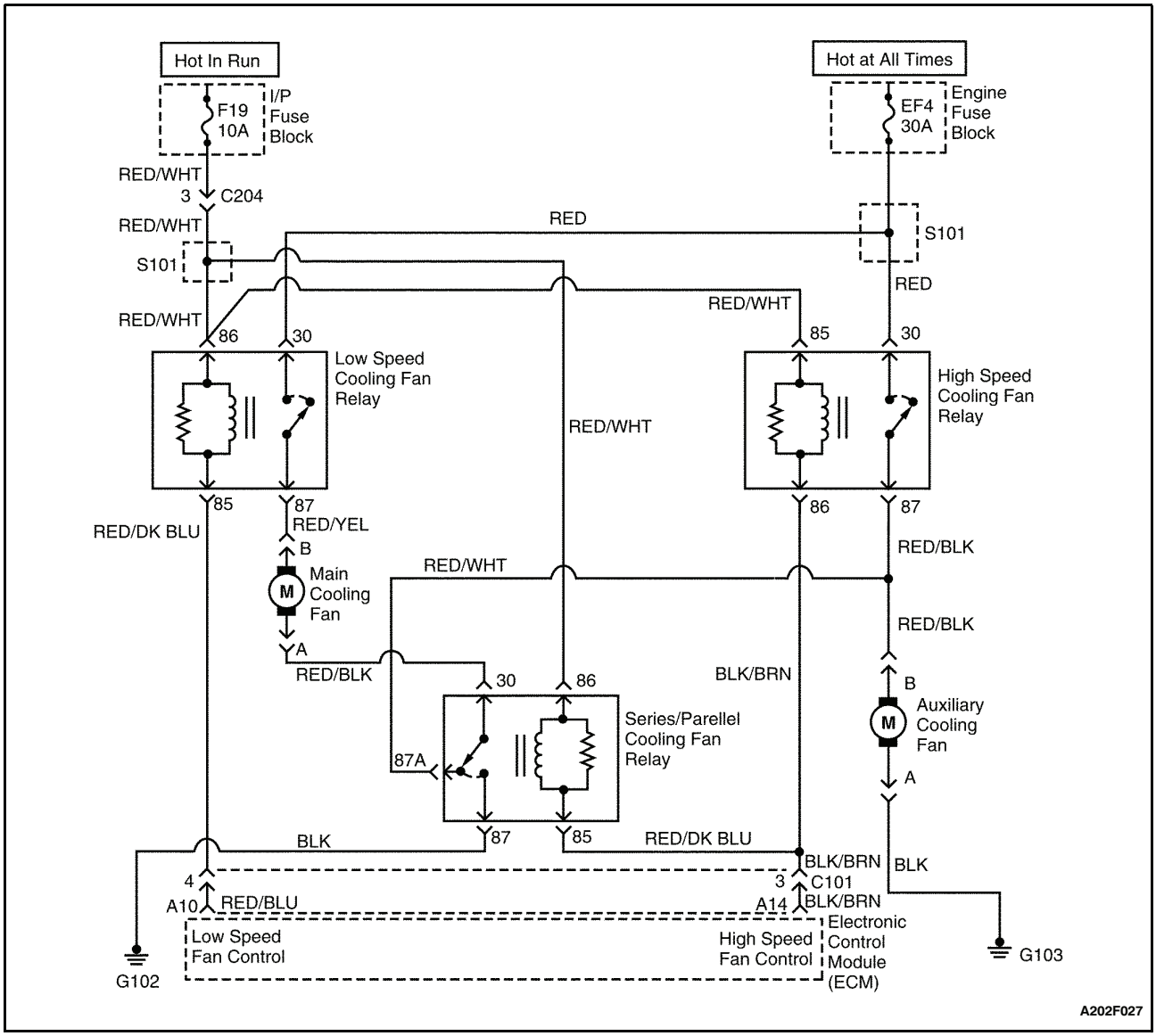


DIAGNOSTIC TROUBLE CODE (DTC) 4
FAN NUMBER TWO HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The high-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the high-speed cooling fan relay, while also applying ground to the low-speed cooling fan relay, to achieve high-speed cooling fan operation. The ECM determines when to activate the high-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 4 Will Set When

- **A short to battery voltage condition exists and this condition is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

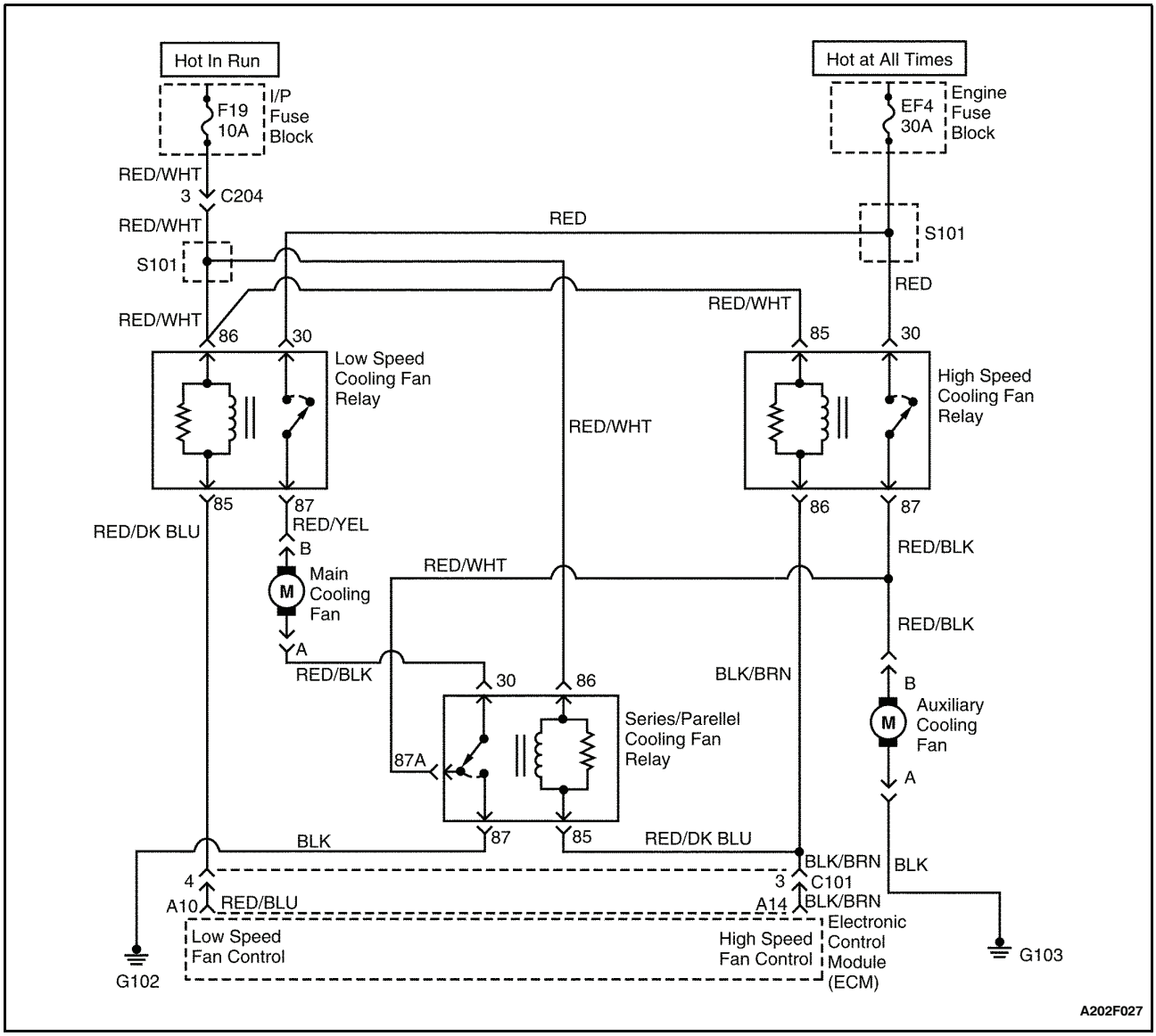
2. This step checks the wires for a short to battery voltage.

4. This step checks for a shorted relay.

6. This step checks for a shorted relay.

DTC 4 - Fan Number Two High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Disconnect the high-speed cooling fan relay and the series/parallel cooling fan relay. 3. Measure the voltage between the ECM connector terminal A14 and ground. Does the voltage measure within the value specified?	0 v	Go to Step 4	Go to Step 3
3	1. Repair the short to voltage between the high-speed cooling fan relay or the series/parallel cooling fan relay connector terminal 85 and the ECM connector terminal A14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	Measure the resistance between the high-speed cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 5	Go to Step 6
5	1. Replace the high-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the resistance between the series/parallel cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 7	Go to Step 8
7	1. Replace the series/parallel cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Inspect for a poor connection at the ECM connector terminal A14. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 5
FAN NUMBER ONE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The low-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the low-speed cooling fan relay to achieve low-speed cooling fan operation. The ECM determines when to activate the low-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 5 Will Set When

- **An open or short to ground condition exits and this condition is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

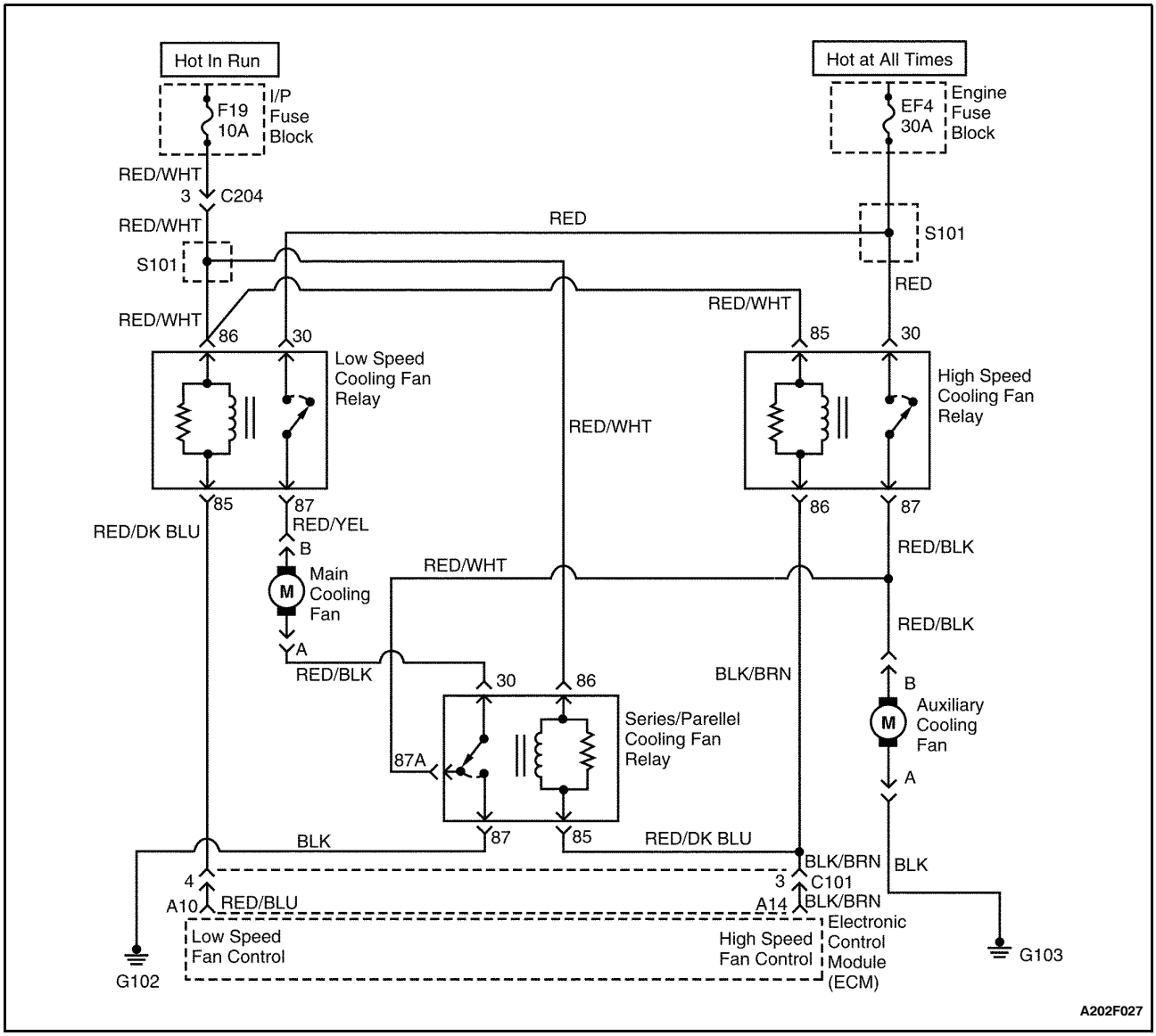
The number(s) below refer to step(s) on the diagnostic table.

4. This step checks for an open or shorted relay.

8. This step checks for the ability of the ECM to ground the fan circuits.

DTC 5 - Fan Number One Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Inspect the fuse F19. Is the fuse in good condition?	-	Go to Step 4	Go to Step 3
3	1. Replace the fuse. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Disconnect the low-speed cooling fan relay. 2. Measure the resistance between the low-speed cooling fan relay terminals 85 and 86. Is the circuit open or shorted to ground?	-	Go to Step 5	Go to Step 6
5	1. Replace the low-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Check for an open or short to ground in the wiring between the low-speed cooling fan relay connector terminal 85 and the ECM connector terminal A10. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground in the wiring. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Connect the low-speed cooling fan relay. 3. Connect the ECM red connector. 4. Jumper terminals A and B of the assembly line diagnostic link (ALDL) connector. 5. Turn the ignition ON. 6. With a test light connected to battery voltage, backprobe the ECM connector terminal A10. Is the test light on?	-	Go to "Diagnostic Aids"	Go to Step 9
9	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect for a poor connection at the ECM connector terminal A10. Is the problem found?	-	Go to Step 10	Go to Step 11
10	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 6
FAN NUMBER ONE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The low-speed cooling fan relay is controlled by the electronic control module (ECM). The ECM applies a ground to the low-speed cooling fan relay to achieve low-speed cooling fan operation. The ECM determines when to activate the low-speed cooling fan relay depending on the coolant temperature and the air conditioning (A/C) system high-side pressure.

DTC 6 Will Set When

- **A short to battery voltage condition exists and this condition is present for more than 2 seconds.**

Diagnostic Aids

- **An intermittent problem may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.**

Test Description

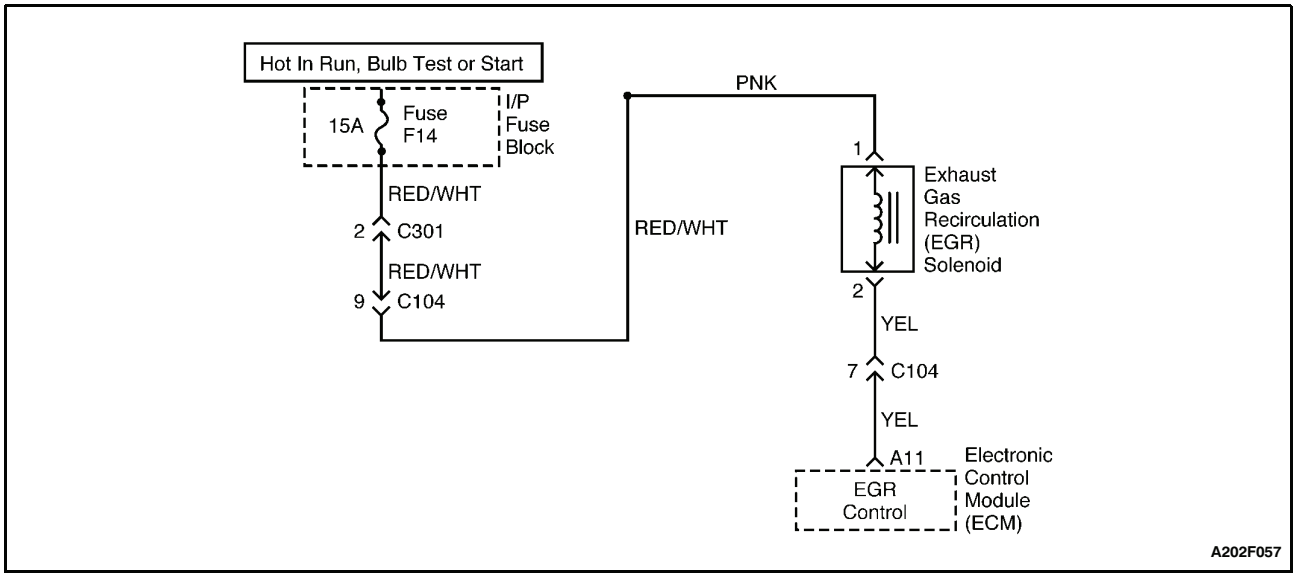
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the wires for a short to battery voltage.

4. This step checks for a shorted relay.

DTC 6 - Fan Number Two High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Disconnect the low-speed cooling fan relay. 3. Measure the voltage between the ECM connector terminal A10 and ground. Does the voltage measure within the value specified?	0 v	Go to Step 4	Go to Step 3
3	1. Repair the short to voltage between the low-speed cooling fan relay connector terminal 86 and the ECM connector terminal A10. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	Measure the resistance between the low-speed cooling fan relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 5	Go to Step 6
5	1. Replace the low-speed cooling fan relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Inspect for a poor connection at the ECM connector terminal A10. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair or replace the connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 7
EGR ON/OFF SOLENOID LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) operates a solenoid to control the back pressure (BP) exhaust gas recirculation (EGR) valve.

The solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid, which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR solenoid and shutting off vacuum to the EGR valve. With the EGR valve closed and the oxygen (O_2) sensor fluctuating normally, short-term fuel trim counts will be greater than they were during normal operation.

DTC 7 Will Set When

- **A short to ground condition exits.**
- **This condition is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the controlled canister purge (CCP) solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

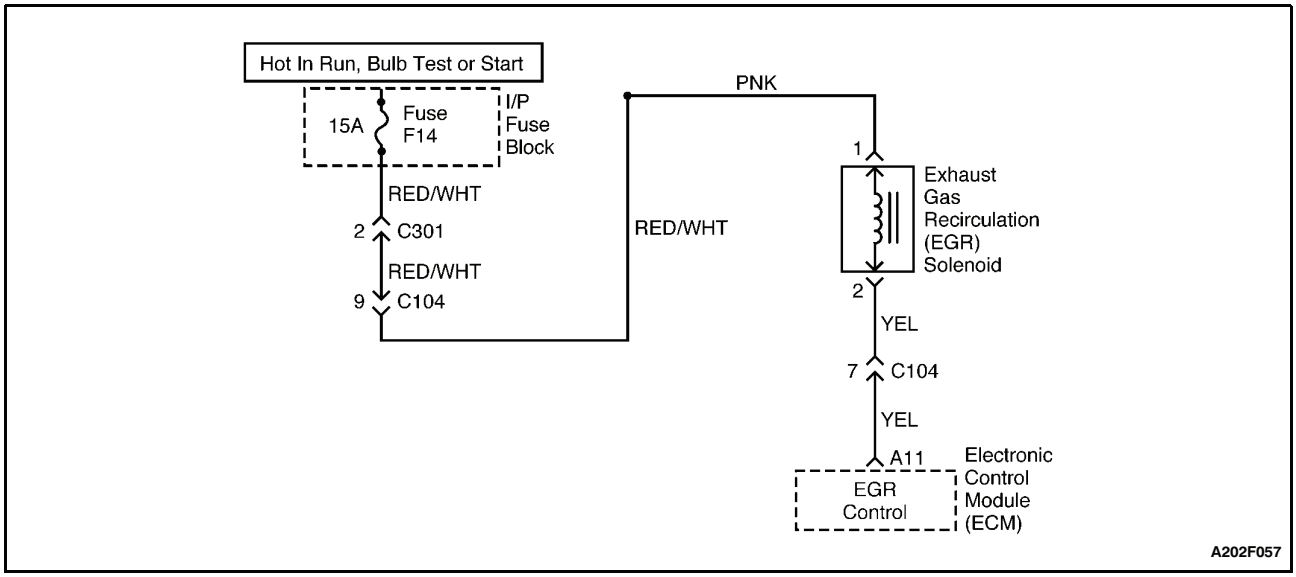
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **With the ignition OFF the ECM should not be applying ground to the EGR solenoid.**
3. **If the test light is still on after disconnecting the ECM red connector the wire between the EGR solenoid and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.**

DTC 7 - EGR On/Off Solenoid Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the exhaust gas recirculation (EGR) solenoid connector. 2. Connect a test light between the EGR solenoid connector terminal 2 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the ECM red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the EGR solenoid connector terminal 2 and the ECM connector terminal A11. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 8
EGR ON/OFF SOLENOID HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) operates a solenoid to control the back pressure (BP) exhaust gas recirculation (EGR) valve.

The solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid, which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR solenoid and shutting off vacuum to the EGR valve. With the EGR valve closed and the oxygen (O_2) sensor fluctuating normally, short-term fuel trim counts will be greater than they were during normal operation.

DTC 8 Will Set When

- **A short to battery voltage condition exits.**
- **This condition is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the controlled canister purge (CCP) solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and thd ECM is shorted to voltage. If the test light goes off, the ECM is at fault.**

DTC 8 - EGR On/Off Solenoid High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the exhaust gas recirculation (EGR) solenoid connector. 2. Measure the resistance of the EGR solenoid. Does the resistance measure near the value specified?	9 0 W	Go to Step 6	Go to Step 3
3	1. Disconnect the EGR solenoid connector. 2. Connect a test light between the EGR solenoid connector terminal 2 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the EGR solenoid connector terminal 2 and the ECM connector terminal A11. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the EGR solenoid. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 12
NO PULSE REFERENCE

Circuit Description

This is a normal code that the electronic control module (ECM) stores when the engine is not running and the ignition key is ON.

DTC 12 Will Set When

- The engine is not running and the ignition key is ON.

Diagnostic Aids

- This code indicates a normal condition with no malfunction noted.
- This code indicates that the ECM has the ability to store codes.

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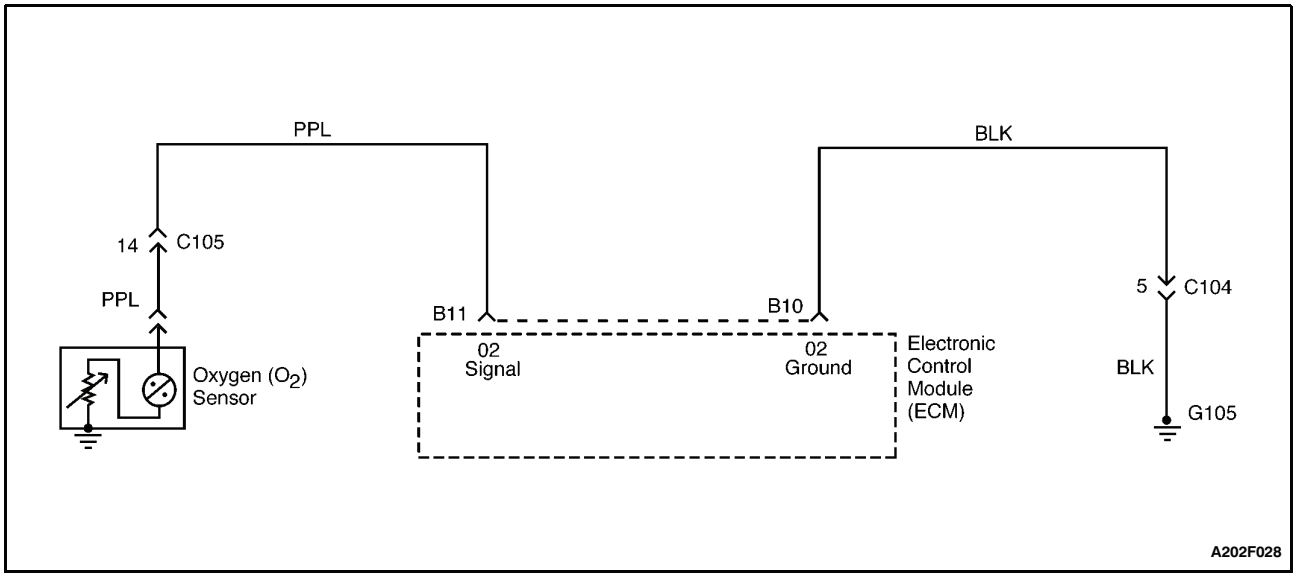

DIAGNOSTIC TROUBLE CODE (DTC) 13
OXYGEN SENSOR NOT TOGGLING (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 13 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The O_2 sensor is steady between 350 millivolts and 550 millivolts.
- These conditions are present for 30 seconds.

Diagnostic Aids

Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. If the conditions for DTC 13 are present, the engine controls system will not operate in closed loop.
5. By making a vacuum leak, a lean running condition should now be present. If the O_2 sensor toggles below 450 millivolts, the O_2 sensor is sensing the lean running condition.
6. By making a slight vacuum leak at the manifold absolute pressure (MAP) sensor, a rich running condition should now be present. If the O_2 sensor toggles above 550 millivolts, the O_2 sensor is sensing the rich running condition.
10. An open or short to ground in the O_2 sensor circuit will not allow the ECM to operate in closed loop.

DTC 13 - Oxygen Sensor Not Toggling (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Check for closed loop operation. Does the electronic control module (ECM) go into closed loop?	-	Go to Step 3	Go to Step 8
3	1. Run the engine until it reaches operating temperature. 2. Check the oxygen (O_2) sensor reading at different throttle settings. Does the scan tool read the O_2 sensor input toggling between the values specified?	100-900 mv	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Check the O_2 sensor pigtail lead at the sensor. Is the lead properly attached to the sensor?	-	Go to Step 5	Go to Step 9
5	1. Reconnect the O_2 sensor connector. 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Make a vacuum leak by disconnecting or partially disconnecting a vacuum hose. Do not disconnect the manifold absolute pressure (MAP) sensor. Does the O_2 sensor input stay fixed at or below the value specified?	300 mv	Go to Step 6	Go to Step 8
6	1. Run the engine until it reaches operating temperature. 2. Make a slight vacuum leak at the MAP sensor vacuum hose. Does the O_2 sensor input stay fixed at or above the value specified?	600 mv	Go to Step 7	Go to Step 8
7	1. Clear the intermittent diagnostic trouble code (DTC) 13 from the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Does DTC 13 reset in the ECM?	-	Go to Step 2	Go to "Diagnostic Aids"
8	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the O_2 sensor connector on the ECM side of the connector. Is the voltage within the value specified?	300-600 mv	Go to Step 9	Go to Step 10
9	1. Replace the O_2 sensor. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 13 - Oxygen Sensor Not Toggling (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for an open or short to ground between the O_2 sensor connector and the ECM connector terminal B11. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Repair the wire as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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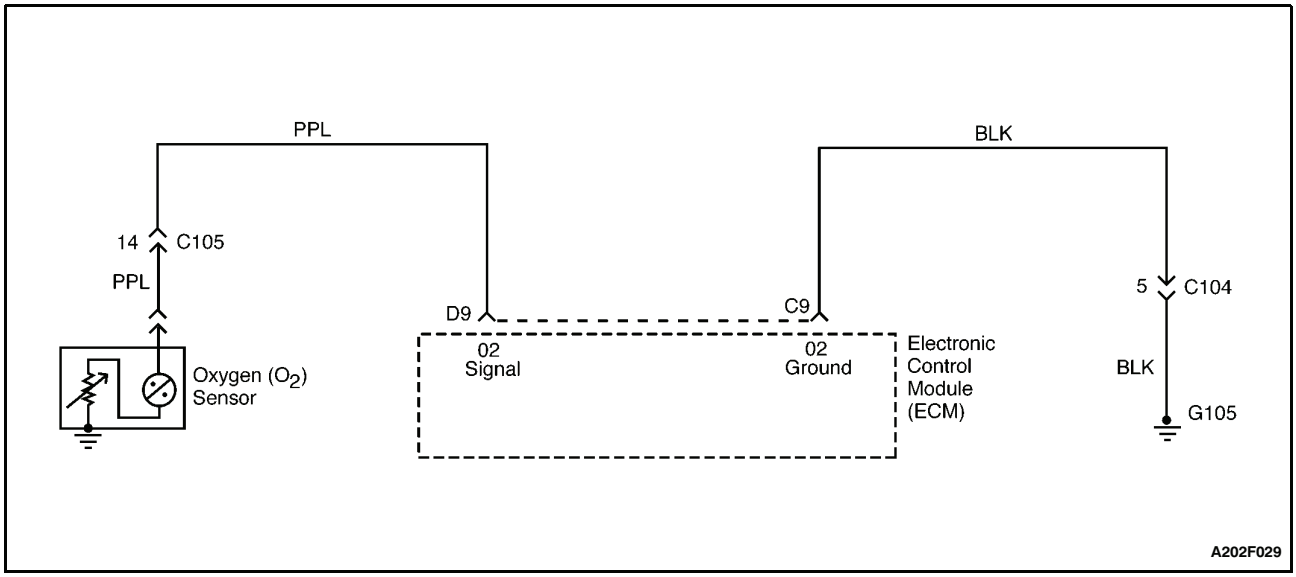

DIAGNOSTIC TROUBLE CODE (DTC) 13
OXYGEN SENSOR NOT TOGGLING (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 13 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The O_2 sensor is steady between 340 millivolts and 540 millivolts.
- These conditions are present for 20 seconds.

Diagnostic Aids

Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. If the conditions for DTC 13 are present, the engine controls system will not operate in closed loop.
5. By making a vacuum leak, a lean running condition should now be present. If the O_2 sensor toggles below 450 millivolts, the O_2 sensor is sensing the lean running condition.
6. By making a slight vacuum leak at the manifold absolute pressure (MAP) sensor, a rich running condition should now be present. If the O_2 sensor toggles above 550 millivolts, the O_2 sensor is sensing the rich running condition.
10. An open or short to ground in the O_2 sensor circuit will not allow the ECM to operate in closed loop.

DTC 13 - Oxygen Sensor Not Toggling (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Check for closed loop operation. Does the electronic control module (ECM) go into closed loop?	-	Go to Step 3	Go to Step 8
3	1. Run the engine until it reaches operating temperature. 2. Check the oxygen (O_2) sensor reading at different throttle settings. Does the scan tool read the O_2 sensor input toggling between the values specified?	100-900 mv	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Check the O_2 sensor pigtail lead at the sensor. Is the lead properly attached to the sensor?	-	Go to Step 5	Go to Step 9
5	1. Reconnect the O_2 sensor connector. 2. Start the engine. 3. Run the engine until it reaches operating temperature. 4. Make a vacuum leak by disconnecting or partially disconnecting a vacuum hose. Do not disconnect the manifold absolute pressure (MAP) sensor. Does the O_2 sensor input stay fixed at or below the value specified?	300 mv	Go to Step 6	Go to Step 8
6	1. Run the engine until it reaches operating temperature. 2. Make a slight vacuum leak at the MAP sensor vacuum hose. Does the O_2 sensor input stay fixed at or above the value specified?	600 mv	Go to Step 7	Go to Step 8
7	1. Clear the intermittent diagnostic trouble code (DTC) 13 from the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Does DTC 13 reset in the ECM?	-	Go to Step 2	Go to "Diagnostic Aids"
8	1. Turn the ignition OFF. 2. Disconnect the O_2 sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the O_2 sensor connector on the ECM side of the connector. Is the voltage within the value specified?	300-600 mv	Go to Step 9	Go to Step 10
9	1. Replace the O_2 sensor. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 13 - Oxygen Sensor Not Toggling (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for an open or short to ground between the O_2 sensor connector and the ECM connector terminal D9. Is the problem found?	-	Go to Step 11	Go to Step 12
11	1. Repair the wire as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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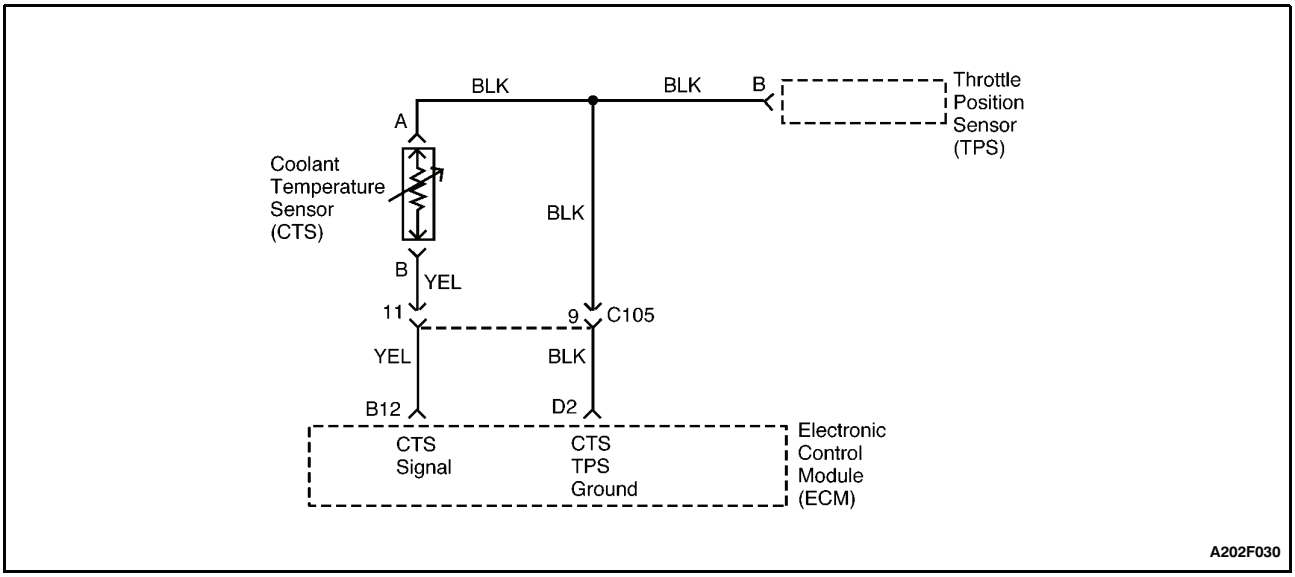

DIAGNOSTIC TROUBLE CODE (DTC) 14 COOLANT TEMPERATURE HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 14 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature above 145°C (293°F).

Diagnostic Aids

- If the connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 14. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.

6. This step checks for voltage reference from the ECM.

DTC 14 - Coolant Temperature High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display the engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Below * 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	1. Jumper terminals A and B of the CTS connector. 2. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Above 180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic controld module (ECM) white connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal D2 for a short to ECM reference voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the electronic control module. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 14 - Coolant Temperature High (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire for a short to ground between the CTS connector terminal B and the ECM connector terminal B12. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal D2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the short to ground in the wire between the CTS connector terminal B and the ECM connector terminal B12. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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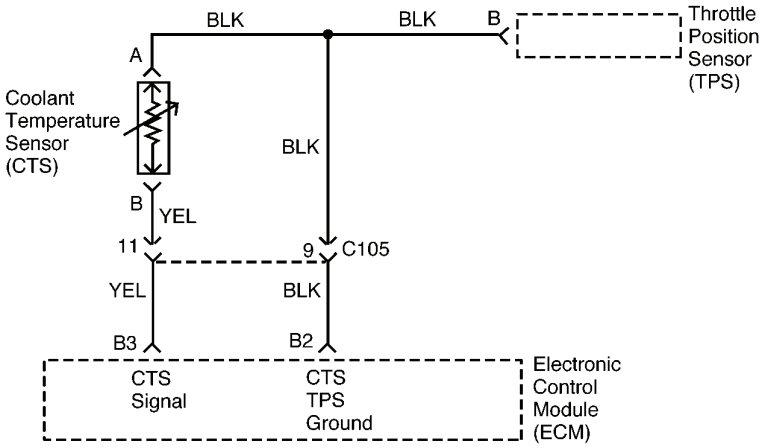

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DIAGNOSTIC TROUBLE CODE (DTC) 14 COOLANT TEMPERATURE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 14 Will Set When

- **The engine has been running for more than 2 seconds.**
- **The CTS signal voltage indicates a coolant temperature above 145°C (293°F).**

Diagnostic Aids

- **If the connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.**

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 14. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 14 - Coolant Temperature High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display the engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Below * 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	1. Jumper terminals A and B of the CTS connector. 2. Turn the ignition ON. Does the scan tool display the engine coolant temperature within the value specified?	Above 180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal B2 for a short to ECM reference voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 14 - Coolant Temperature High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire for a short to ground between the CTS connector terminal B and the ECM connector terminal B3. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal B2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the short to ground in the wire between the CTS connector terminal B and the ECM connector terminal B3. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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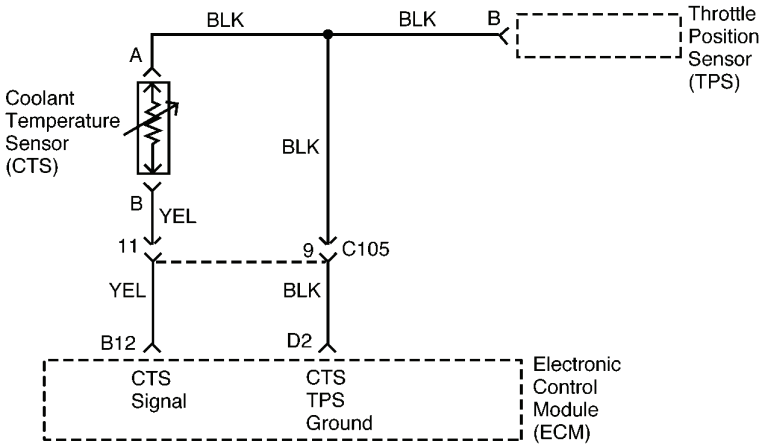

A202F030

DIAGNOSTIC TROUBLE CODE (DTC) 15 COOLANT TEMPERATURE LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 15 Will Set When

- The engine has been running for more than 2 seconds.
- The CTS signal voltage indicates a coolant temperature below * 35°C (* 31°F).

Diagnostic Aids

- If connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.
- The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 15. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 15 - Coolant Temperature Low (1.3L and 1.5L SOHC lEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display engine coolant temperature below the value specified?	* 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	Jumper terminals A and B of the CTS connector. Does the scan tool display engine coolant temperature above the value specified?	180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace damaged terminals as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal D2 for an open or short to battery voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 15 - Coolant Temperature Low (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire between the CTS connector terminal B and the ECM connector terminal B12 for an open or short battery voltage. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect ECM red connector. 3. Check the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the ECM connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the open or short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal D2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the open or short to voltage in the wire between the CTS connector terminal B and the ECM connector terminal B12. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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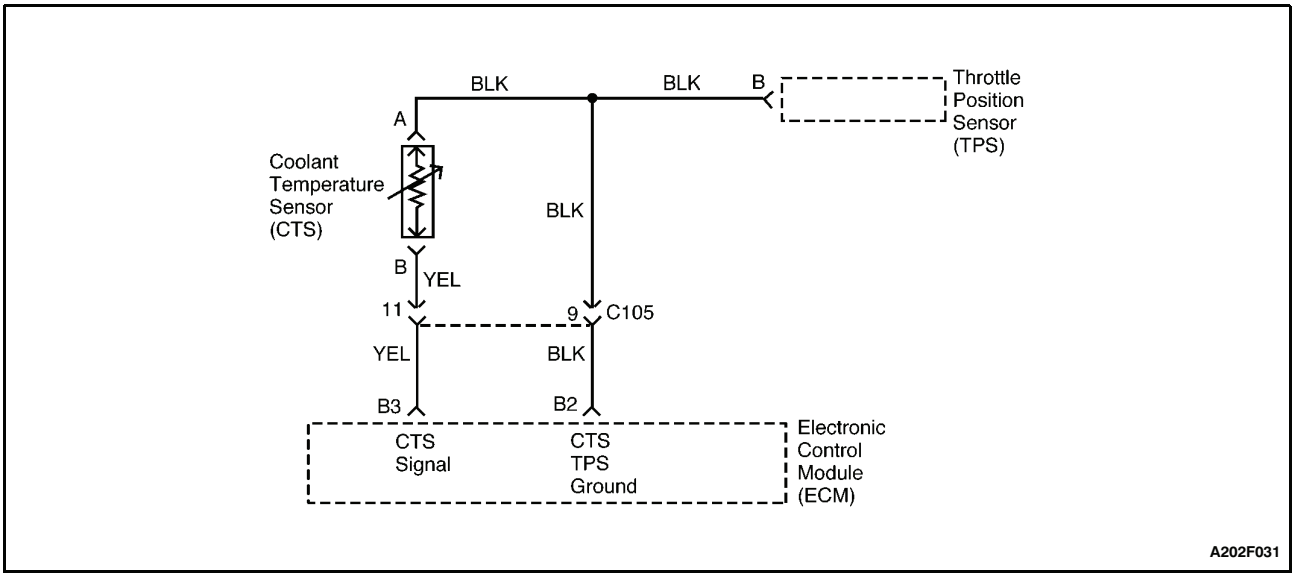

DIAGNOSTIC TROUBLE CODE (DTC) 15 COOLANT TEMPERATURE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The coolant temperature sensor (CTS) uses a thermistor to control the signal voltage to the electronic control module (ECM). The ECM applies a voltage to the CTS. When the engine is cold, the CTS resistance is high. Therefore, the ECM will see a high signal voltage. As the engine warms, the CTS resistance becomes less, and the voltage drops. At normal engine operating temperature the CTS signal will measure about 1.5 to 2.0 volts.

DTC 15 Will Set When

- **The engine has been running for more than 2 seconds.**
- **The CTS signal voltage indicates a coolant temperature below * 35°C (* 31°F).**

Diagnostic Aids

- **If connections are OK, monitor the coolant temperature while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **The "Temperature Vs. Resistance Values" scale may be used to test the coolant sensor at various temperatures to evaluate the possibility of a "shifted" or "mis-scaled" CTS which may result in driveability complaints.**

COOLANT TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
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5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. This test simulates the conditions for setting Diagnostic Trouble Code (DTC) 15. If the ECM recognizes the low signal voltage (high temperature) and the scan tool displays 180°C (356°F), the ECM wiring is OK.
6. This step checks for voltage reference from the ECM.

DTC 15 - Coolant Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool display engine coolant temperature within the value specified?	80-110°C (176-230°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the coolant temperature sensor (CTS) connector. 3. Turn the ignition ON. Does the scan tool display engine coolant temperature below the value specified?	* 30°C (* 22°F)	Go to Step 4	Go to Step 6
4	Jumper terminals A and B of the CTS connector. Does the scan tool display engine coolant temperature above the value specified?	180°C (356°F)	Go to Step 5	Go to Step 6
5	1. Replace the CTS. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Measure the voltage at the CTS connector terminal B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) red connector. 3. Inspect the ECM pins and the connector for bent or damaged terminals. Repair or replace damaged terminals as needed. 4. Check the wire between the CTS connector terminal A and the ECM connector terminal B2 for an open or short to battery voltage. Is the problem found?	-	Go to Step 12	Go to Step 8
8	1. Replace the ECM. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 15 - Coolant Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the wire between the CTS connector terminal B and the ECM connector terminal B3 for an open or short battery voltage. Is the problem found?	-	Go to Step 13	Go to Step 10
10	1. Turn the ignition OFF. 2. Disconnect ECM red connector. 3. Check the ECM pins and the connector for bent or damaged terminals or pins. Is the problem found?	-	Go to Step 11	Go to Step 8
11	1. Repair the ECM connector terminals and straighten the ECM pins as needed. 2. If the ECM pins are broken, the ECM must be replaced. Are the terminals and pins repaired?	-	Go to Step 6	-
12	1. Repair the open or short to voltage in the wire between the CTS connector terminal A and the ECM connector terminal B2. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Repair the open or short to voltage in the wire between the CTS connector terminal B and the ECM connector terminal B3. 2. Run the engine until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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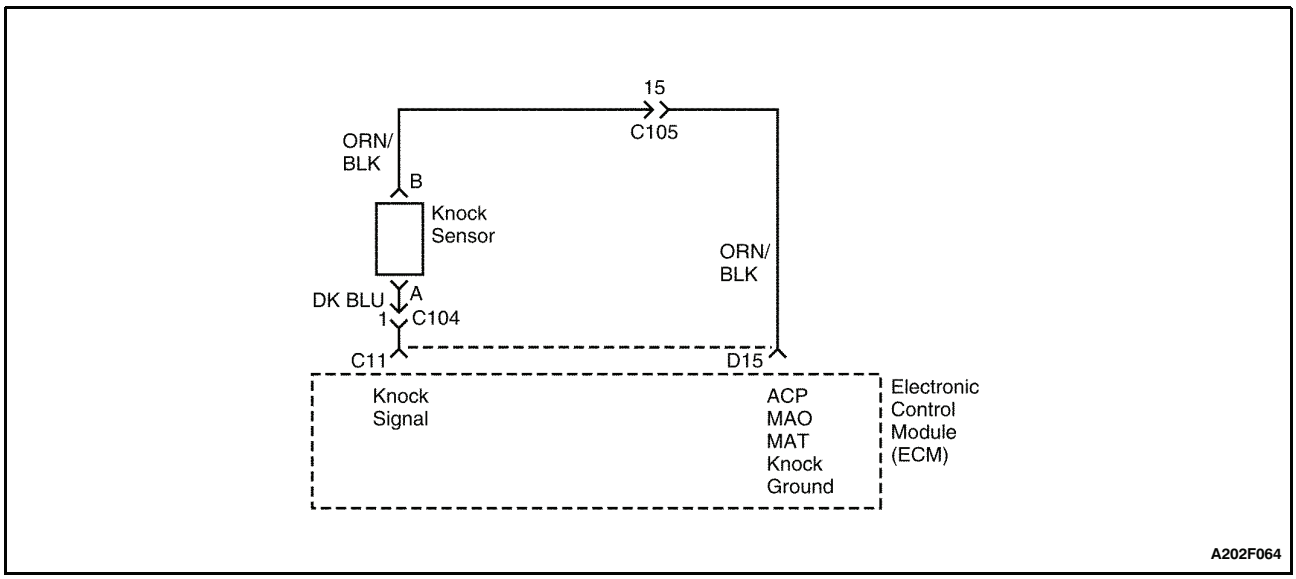


DIAGNOSTIC TROUBLE CODE (DTC) 16
KNOCK SENSOR FAILURE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

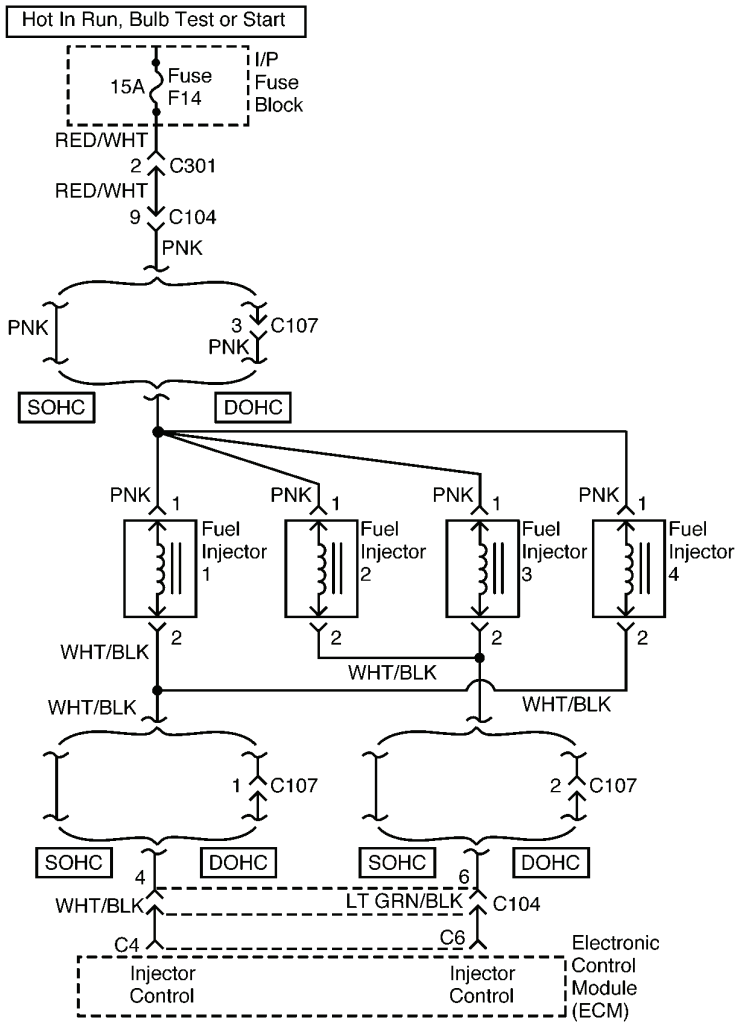
The knock sensor is used to detect engine detonation, allowing the electronic control module (ECM) to retard ignition control spark timing based on the knock sensor signal being received. The knock sensor produces an AC signal. The knock sensor signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM contains a non-replaceable knock filter module called a signal-to-noise enhancement filter (SNEF) module. This filter module in the ECM determines whether knock is occurring by comparing the signal level on the knock sensor circuit with the voltage level on the noise channel. The noise channel allows the ECM to reject any false knock signal by knowing the amount of normal engine mechanical noise present. Normal engine noise varies depending on engine speed and load. When the ECM determines that an abnormally low noise channel voltage level is being experienced, Diagnostic Trouble Code (DTC) 16 will set.

DTC 16 Will Set When

- **The engine speed is above 2,800 rpm.**
- **Maximum integrated value is above 192.**
- **Minimum integrated value is below 20.**
- **The setup time is more than 8 seconds.**

DTC 16 - Knock Sensor (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check was performed?	-	Go to Step 2	-
2	Replace the electronic control module (ECM). Is the repair complete?	-	Go to "Diagnostic System Check"	-



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DIAGNOSTIC TROUBLE CODE (DTC) 17 INJECTOR SHORTED TO GROUND/BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition switch is turned to ON or START, the electronic control module (ECM) will energize and de-energize the fuel injector solenoid coil. With the solenoid coil energized, a plunger is activated, which allows pressurized fuel to be sprayed through the fuel injector into the combustion chamber where it is mixed with air from the intake manifold. This creates the proper air/fuel mixture needed for combustion.

DTC 17 Will Set When

- **The fuel pump is running.**
- **Battery voltage is equal to or greater than 9 volts.**
- **A fuel injector fault has been detected more than three times in successive 1-second intervals.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **This step checks for the presence of battery voltage to the fuel injectors.**

3. If the fuel injector test light does not flash for one of the fuel injectors, there is an open fuel injector control wire to the ECM or the ECM is faulty.
13. An open coil in a fuel injector will prevent the fuel injector from operating.

DTC 17 - Injector Shorted to Ground/Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the fuel injector harness from all of the fuel injectors. 2. Turn the ignition ON. 3. Measure the voltage at all of the fuel injector harness terminals. Is battery voltage present only on terminal 1 of each connector?	-	Go to Step 3	Go to Step 8
3	Connect a fuel injector test light to each of the fuel injector harness connectosr while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 13	Go to Step 4
4	Does the fuel injector test light stay off for one or more of the fuel injector(s)?	-	Go to Step 6	Go to Step 5
5	Does the fuel injector test light stay on for one or more of the fuel injector(s)?	-	Go to Step 11	-
6	1. Check for a short to battery positive between the fuel injector harness connector terminal 2 and the electronic control module (ECM) connector terminal C4 for fuel injectors 1 and 4. 2. Check for a short to battery positive between the fuel injector harness connector terminal 2 and the ECM connector terminal C6 for fuel injectors 2 and 3. Is the problem found?	-	Go to Step 7	Go to Step 15
7	1. Repair the short to battery positive as needed. 2. Connect an injector test light to each injector harness connector while cranking the engine. Does the test light blink on all of the connectors?	-	Go to "Diagnostic System Check"	-
8	Is battery voltage not present at terminal 1 of any injector harness connector?	-	Go to Step 10	Go to Step 9
9	Is battery voltage present at terminal 2 of any injector harness connector?	-	Go to Step 6	-
10	1. Check for a short to ground in the fuel injector harness. 2. Check the fuel injector harness connectors for damaged terminals. 3. Perform repairs as needed. 4. Check for battery voltage at terminal 1 of all of the fuel injector harness connectors. Is battery voltage present only on terminal 1 of each connector?	-	Go to Step 3	-

DTC 17 - Injector Shorted to Ground/Battery (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Check for a short to ground between the fuel injector harness connector terminal 2 and ECM connector terminal C4 for injectors 1 and 4. 2. Check for a short to ground between the fuel injector harness connector terminal 2 and ECM connector terminal C6 for injectors 2 and 3. Is the problem found?	-	Go to Step 12	Go to Step 15
12	1. Repair the short to ground as needed. 2. Connect a fuel injector test light to each of the fuel injector harness connectors while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 13	Go to Step 4
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified?	11.6-12.4 W	System OK	Go to Step 14
14	1. Replace any of the fuel injectors with a resistance that is out of specification. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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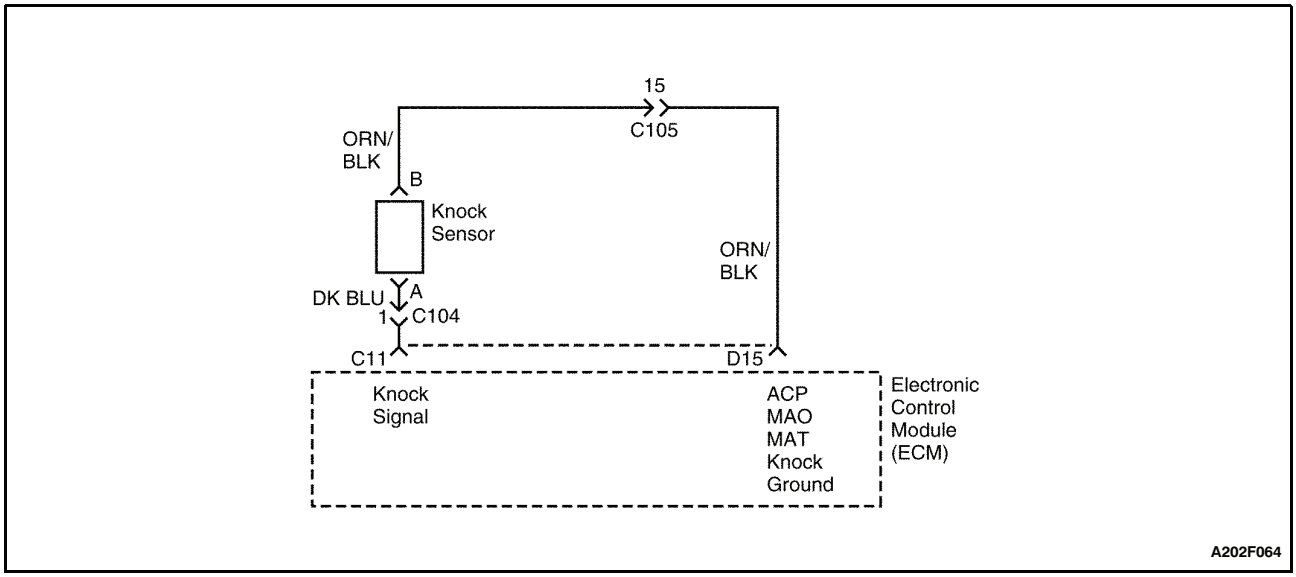


DIAGNOSTIC TROUBLE CODE (DTC) 18
DSNEF CONTROL ERROR FAILURE (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) uses the knock sensor to detect engine detonation, allowing the ECM to retard ignition control spark timing based on the knock sensor signal being received. The knock sensor produces an AC signal. The signal amplitude and frequency are dependent upon the amount of knock being experienced.

DTC 18 Will Set When

- **Knock detection is enabled.**
- **Diagnostic Trouble Code (DTC) 16 is not set.**
- **The engine speed is above 2,000 rpm.**
- **Maximum integrated value is above 110 for at least 2 seconds.**
- **Minimum integrated value is below 1 for at least 2 seconds.**
- **Noise value is above 32 counts for at least 4 seconds.**
- **Noise value is below 0 counts for at least 4 seconds.**

Diagnostic Aids

- **Repair any engine mechanical problem before proceeding with diagnostics.**
- **Make sure the correct fuel octane rating is used.**

Test Description

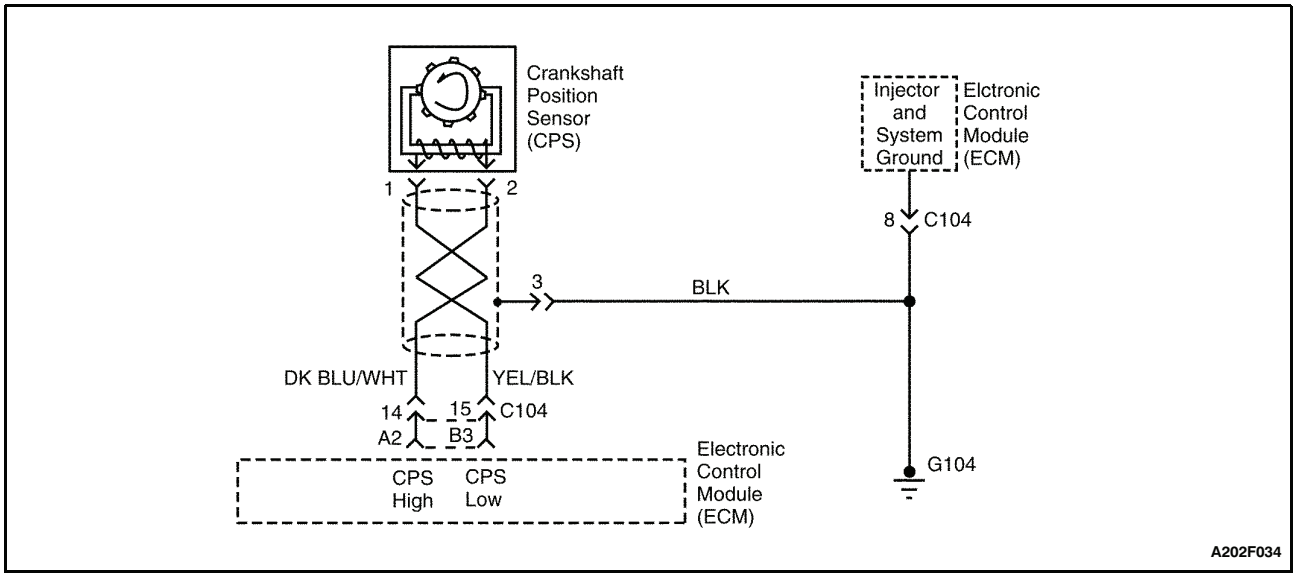
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks the signal circuit and not sensor voltage.

6. Check the ground side of the circuit for an open, a short to ground, or a short to battery.

DTC 18 - DSNEF Control Error Failure (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the electronic control module (ECM). 3. Connect a digital voltmeter (DVM) to monitor AC voltage between terminal C11 of the ECM connector and ground. 4. Tap on the engine with an extension near the knock sensor while observing the signal on the DVM. Is any signal indicated on the DVM while tapping on the engine?	-	Go to Step 3	Go to Step 4
3	1. Connect the electrical connector at the ECM. 2. Disconnect the electrical connector at the knock sensor. 3. Using a test light to battery positive, probe terminal B on the ECM side of the knock sensor. Did the test light illuminate?	-	Go to Step 6	Go to Step 8
4	Check the wire from terminal C11 on the ECM to terminal A on the ECM side of the knock sensor for an open, a short to ground, or a short to battery. Does the wire indicate an open, a short to ground, or a short to battery?	-	Go to Step 5	Go to Step 7
5	Repair the wire from terminal C11 of the ECM to terminal A on the ECM side of the knock sensor. Is the repair complete?	-	Go to "Diagnostic System Check"	-
6	Replace the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-
7	Replace the knock sensor. Is the repair complete?	-	Go to "Diagnostic System Check"	-
8	Repair the wire from terminal B of the knock sensor to terminal D15 of the ECM. Is the repair complete?	-	Go to "Diagnostic System Check"	-



DIAGNOSTIC TROUBLE CODE (DTC) 19
58X SIGNAL ERROR (A AND B) (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The crankshaft position sensor (CPS) is a Hall-effect sensor which senses a slotted wheel that is attached to the crankshaft pulley. The slotted wheel interrupts a magnetic field and produces a reference signal from the sensor.

DTC 19 Will Set When

- **The revolutions of the 58X signal are fewer than 64.**
- **There are 10 or more consecutive missing pulses.**
- **The manifold absolute pressure (MAP) drops when the starter motor running is below 0.6 kPa for more than 3 seconds.**
- **Voltage drops when the starter motor is running below 0.5 v for more than 3 seconds.**

Diagnostic Aids

Check for poor connections at the electronic control module (ECM) and at the CPS.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

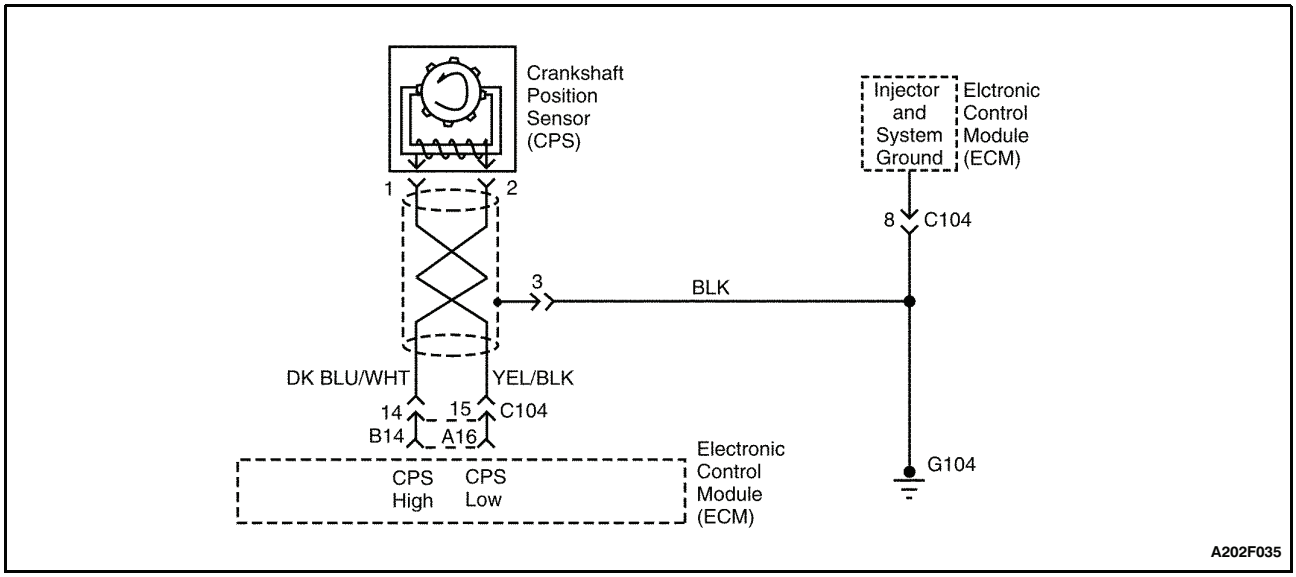
3. **It is important to inspect all of the connector terminals to prevent inaccurate diagnosis.**
6. **The specified value during cranking is an average voltage produced as the sensor voltage oscillates.**

DTC 19 - 58X Signal Error (A and B) (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Start the engine and allow it to idle. Does the engine start?	-	Go to Step 3	Go to "Engine Cranks But Will Not Start"
3	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Inspect the CPS terminals. Are any terminals damaged?	-	Go to Step 13	Go to Step 4

DTC 19 - 58X Signal Error (A and B) (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Inspect the CPS connector terminals. Are any connector terminals damaged?	-	Go to Step 5	Go to Step 6
5	1. Repair or replace any damaged terminals. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Connect the CPS connector. 2. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 3. Connect a voltmeter between ground and the ECM connector terminal A2 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 7	Go to Step 9
7	Connect a voltmeter between ground and the ECM connector terminal B3 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 8	Go to Step 10
8	1. Connect the DIS ignition coil connector 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	Check for an open or short in the wire between the CPS connector terminal 1 and the ECM connector terminal A2. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal B3. Is the problem found?	-	Go to Step 12	Go to Step 11
11	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 12	Go to Step 13
12	1. Connect the DIS ignition coil connector. 2. Repair the wiring needed. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Connect the DIS ignition coil connector. 2. Replace the CPS. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 19
58X SIGNAL ERROR (A AND B) (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The crankshaft position sensor (CPS) is a Hall-effect sensor which senses a slotted wheel that is attached to the crankshaft. The slotted wheel interrupts a magnetic field and produces a reference signal from the sensor.

DTC Will Set When

- **Starting manifold absolute pressure (MAP) is less than 0.600 kPa (0.178 inches Hg).**
- **Starting battery voltage is less than 0.5 volt for at least 3 seconds.**
- **There are 10 or more consecutive missing pulses.**
- **The revolutions of the 58X signal are fewer than 64.**

Diagnostic Aids

Check for poor connections at the electronic control module (ECM) and at the CPS.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. It is important to inspect all of the connector terminals to prevent inaccurate diagnosis.

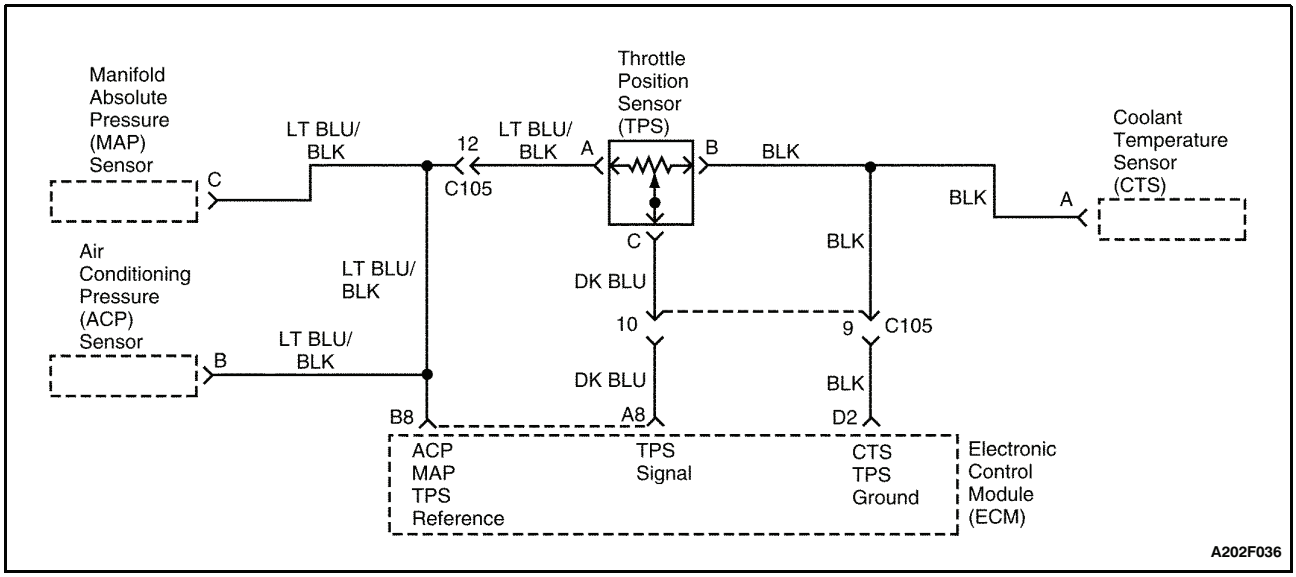
6. The specified value during cranking is an average voltage produced as the sensor voltage oscillates.

DTC 19 - 58X Signal Error (A and B) (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Start the engine and allow it to idle. Does the engine start?	-	Go to Step 3	Go to "Engine Cranks But Will Not Start"
3	1. Turn the ignition OFF. 2. Disconnect the crankshaft position sensor (CPS) connector. 3. Inspect the CPS terminals. Are any terminals damaged?	-	Go to Step 13	Go to Step 4

DTC 19 - 58X Signal Error (A and B) (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Inspect the CPS connector terminals. Are any connector terminals damaged?	-	Go to Step 5	Go to Step 6
5	1. Repair or replace any damaged terminals. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Connect the CPS connector. 2. Disconnect the direct ignition system (DIS) ignition coil connector to prevent the vehicle from starting. 3. Connect a voltmeter between ground and the ECM connector terminal B14 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 7	Go to Step 9
7	Connect a voltmeter between ground and the ECM connector terminal A16 by backprobing the ECM connector. Are the voltage readings near the values specified?	1.08 v with the ignition ON, 1.20 v during cranking	Go to Step 8	Go to Step 10
8	1. Connect the DIS ignition coil connector 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	Check for an open or short in the wire between the CPS connector terminal 1 and the ECM connector terminal B14. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for an open or short in the wire between the CPS connector terminal 2 and the ECM connector terminal A16. Is the problem found?	-	Go to Step 12	Go to Step 11
11	Check for an open or short in the wire between the CPS connector terminal 3 and ground. Is the problem found?	-	Go to Step 12	Go to Step 13
12	1. Connect the DIS ignition coil connector. 2. Repair the wiring needed. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
13	1. Connect the DIS ignition coil connector. 2. Replace the CPS. 3. Clear any DTCs from the ECM. 4. Road test the vehicle. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION SENSOR HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 21 Will Set When

- **Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.**
- **The engine speed is less than 1,750 rpm.**
- **The manifold absolute pressure (MAP) reading is below 65 kPa (19 inches Hg).**
- **The TPS reading is greater than 200 counts.**
- **All of the above conditions are present for 5 seconds.**

Diagnostic Aids

- **Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.**
- **Observe the TPS voltage on a scan tool with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.**

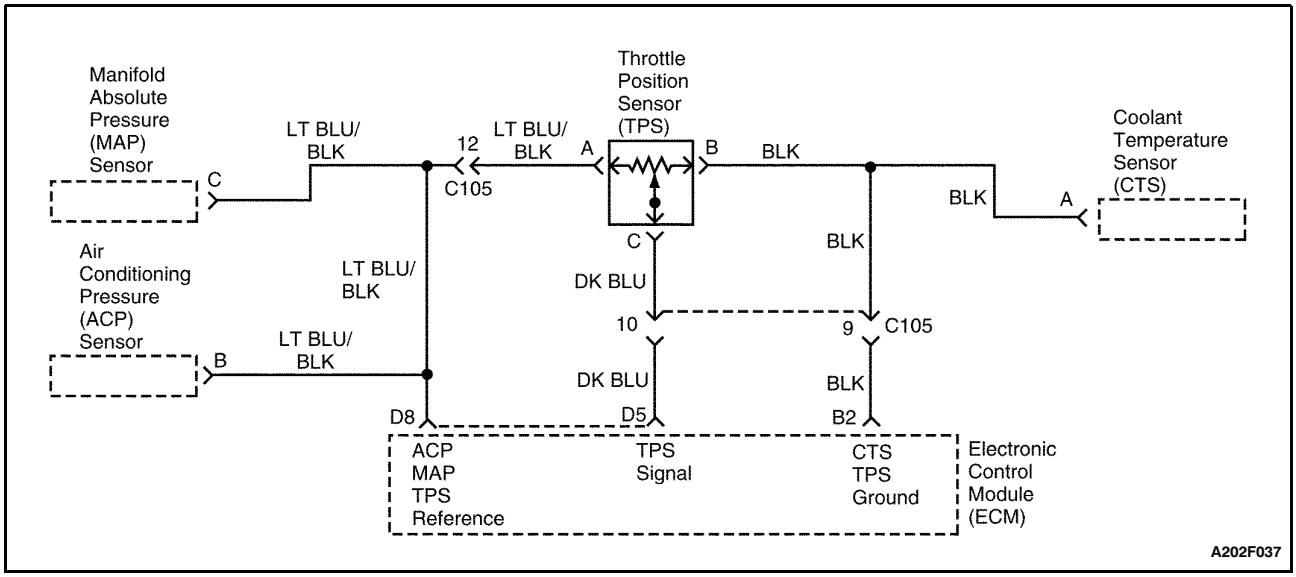
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **This step checks the voltage reference from the ECM and also the ground wire to the ECM.**
4. **This step checks the TPS signal wire. If the scan tool shows the TPS voltage above 4 volts, the signal wire is OK.**
10. **After checking the TPS wiring and confirming the ECM's ability to read a TPS signal, it can be determined that the TPS is at fault.**

DTC 21 - Throttle Position Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage change smoothly within the value specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Jumper the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4.0 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check for a short to battery voltage in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal D2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	Check for a short to battery voltage in the wire between the TPS connector terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for a short to voltage in the wire between the TPS connector terminal C and the ECM connector terminal A8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the TPS. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Replace the electronic control module. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 21
THROTTLE POSITION SENSOR HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 21 Will Set When

- **Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.**
- **The engine speed is less than 3,000 rpm.**
- **The manifold absolute pressure (MAP) reading is below 85 kPa (25 inches Hg).**
- **The TPS reading is greater than 240 counts.**
- **These conditions are present for 2 seconds.**

Diagnostic Aids

- **Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.**
- **Observe the TPS voltage on a scan tool with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.**

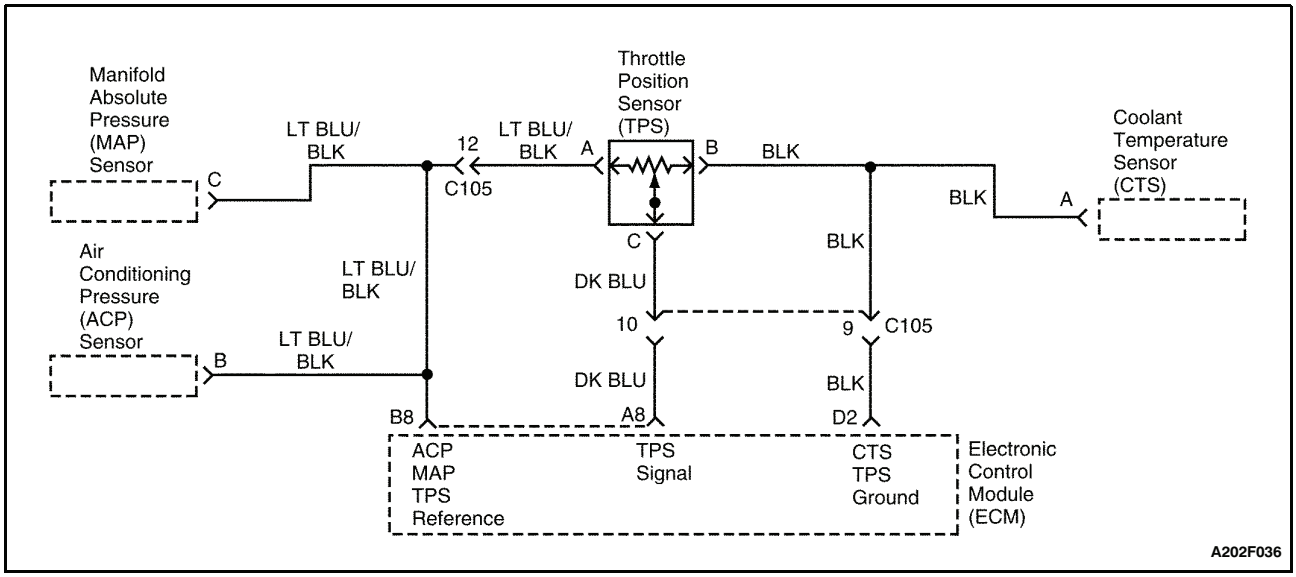
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **This step checks the voltage reference from the ECM and also the ground wire to the ECM.**
4. **This step checks the TPS signal wire. If the scan tool shows the TPS voltage above 4 volts, the signal wire is OK.**
10. **After checking the TPS wiring and confirming the ECM's ability to read a TPS signal, it can be determined that the TPS is at fault.**

DTC 21 - Throttle Position Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect a scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage change smoothly within the value specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Jumper the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4.0 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check for a short to battery voltage in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	Check for a short to battery voltage in the wire between the TPS connector terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	Check for a short to voltage in the wire between the TPS connector terminal C and the ECM connector terminal D5. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the TPS. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 22 THROTTLE POSITION SENSOR LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 22 Will Set When

- **Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.**
- **The TPS reading is less than 10 counts.**
- **The condition is present for 5 seconds.**

Diagnostic Aids

- **Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.**
- **Observe the TPS voltage on a scanner with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.**

Test Description

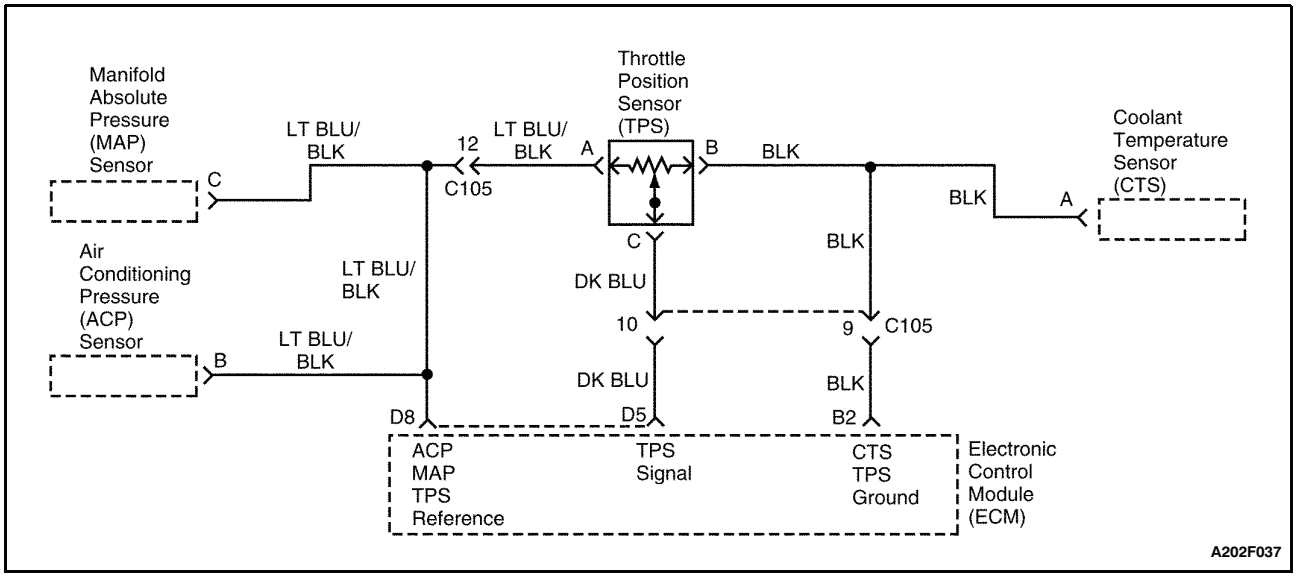
The number(s) below refer to step(s) on the diagnostic table.

1. **When measuring the voltage between the TPS terminals A and B, 4.5 to 5.5 volts confirms the 5-volt reference and ground from the ECM are OK.**

11. **If there is a problem with the voltage reference or the ground from the ECM, confirm that the wiring is OK. If there is no problem present in the wiring, the ECM is at fault.**

DTC 22 - Throttle Position Sensor Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage changing smoothly within the values specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Connect a fused jumper between the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and the ground. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Check for an open in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal D2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the TPS connector terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to ground between the TPS connector terminal C and the ECM connector terminal A8. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the TPS. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 22 THROTTLE POSITION SENSOR LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The throttle position sensor (TPS) provides a voltage signal that changes in relation to the throttle plate angle. The signal voltage will vary from about 0.4 to 0.8 volt at idle to nearly 5.0 volts at wide-open throttle. The TPS is one of the most important inputs used by the electronic control module (ECM) for fuel control and other functions such as idle, wide-open throttle, deceleration enleanment, and acceleration enrichment.

DTC 22 Will Set When

- **The TPS reading is less than 11 counts.**
- **Diagnostic Trouble Codes (DTCs) 33 and 34 are not set.**

Diagnostic Aids

- **Inspect the ECM connector terminals and the TPS connector terminals for improper mating and poor terminal-to-wire connections.**
- **Observe the TPS voltage on a scanner with the ignition ON and the engine stopped. Press the accelerator pedal while watching for smooth changes in the voltage readings of the TPS.**

Test Description

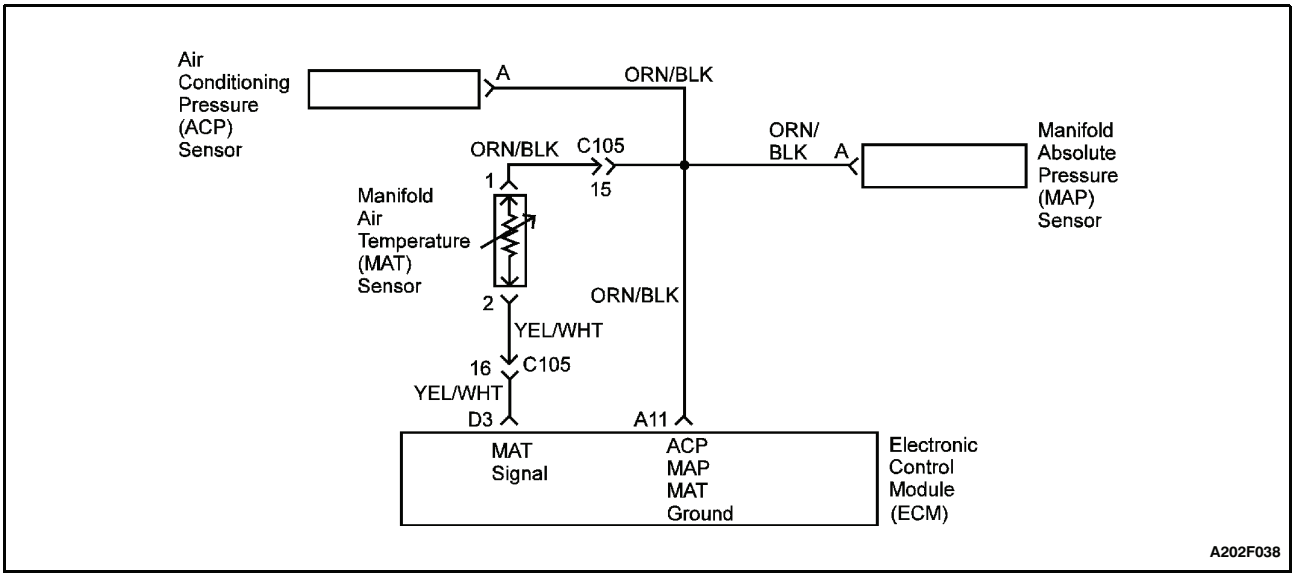
The number(s) below refer to step(s) on the diagnostic table.

1. **When measuring the voltage between the TPS terminals A and B, 4.5 to 5.5 volts confirms the 5-volt reference and ground from the ECM are OK.**

11. **If there is a problem with the voltage reference or the ground from the ECM, confirm that the wiring is OK. If there is no problem present in the wiring, the ECM is at fault.**

DTC 22 - Throttle Position Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. 3. Operate the throttle lever from closed to open while watching the throttle position sensor (TPS) voltage on the scan tool. Does the scan tool show the TPS voltage changing smoothly within the values specified?	0.10-0.90 v to 3.9-4.9 v	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the TPS connector. 3. Turn the ignition ON. 4. Measure the voltage between the TPS connector terminals A and B. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 4	Go to Step 5
4	Connect a fused jumper between the TPS connector terminals A and C. Does the scan tool show the TPS voltage above the value specified?	4 v	Go to Step 10	Go to Step 8
5	Measure the voltage between the TPS connector terminal A and the ground. Is the voltage within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Check for an open in the wire between the TPS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the problem found?	-	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the TPS connector terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 9	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to ground between the TPS connector terminal C and the ECM connector terminal D5. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Replace the TPS. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 23
MANIFOLD AIR TEMPERATURE HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 23 Will Set When

- The engine has been running longer than 50 seconds.
- The MAT sensor signal voltage indicates a temperature above 145°C (293°F).

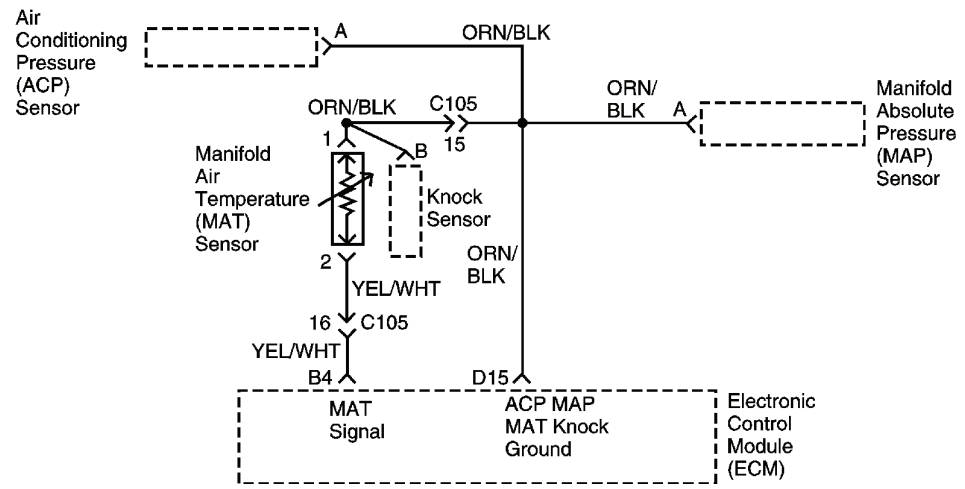
Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 23 - Manifold Air Temperature Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Turn the ignition ON. Does the scan tool show the MAT sensor reading below the value specified?	Lower Than * 35°C (* 31°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 7	Go to Step 8
5	Check the wire for a short to ground between the MAT connector terminal 2 and the electronic control module (ECM) connector terminal D3. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check the wire for a short to ECM reference voltage between the MAT connector terminal 1 and the ECM connector terminal A11. Is the problem found?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 2
8	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ECM. 3. Run the engine until it reaches operating temperature. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 23
MANIFOLD AIR TEMPERATURE HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 23 Will Set When

- The engine has been running longer than 120 seconds.
- The MAT sensor signal voltage indicates a temperature above 140°C (284°F).

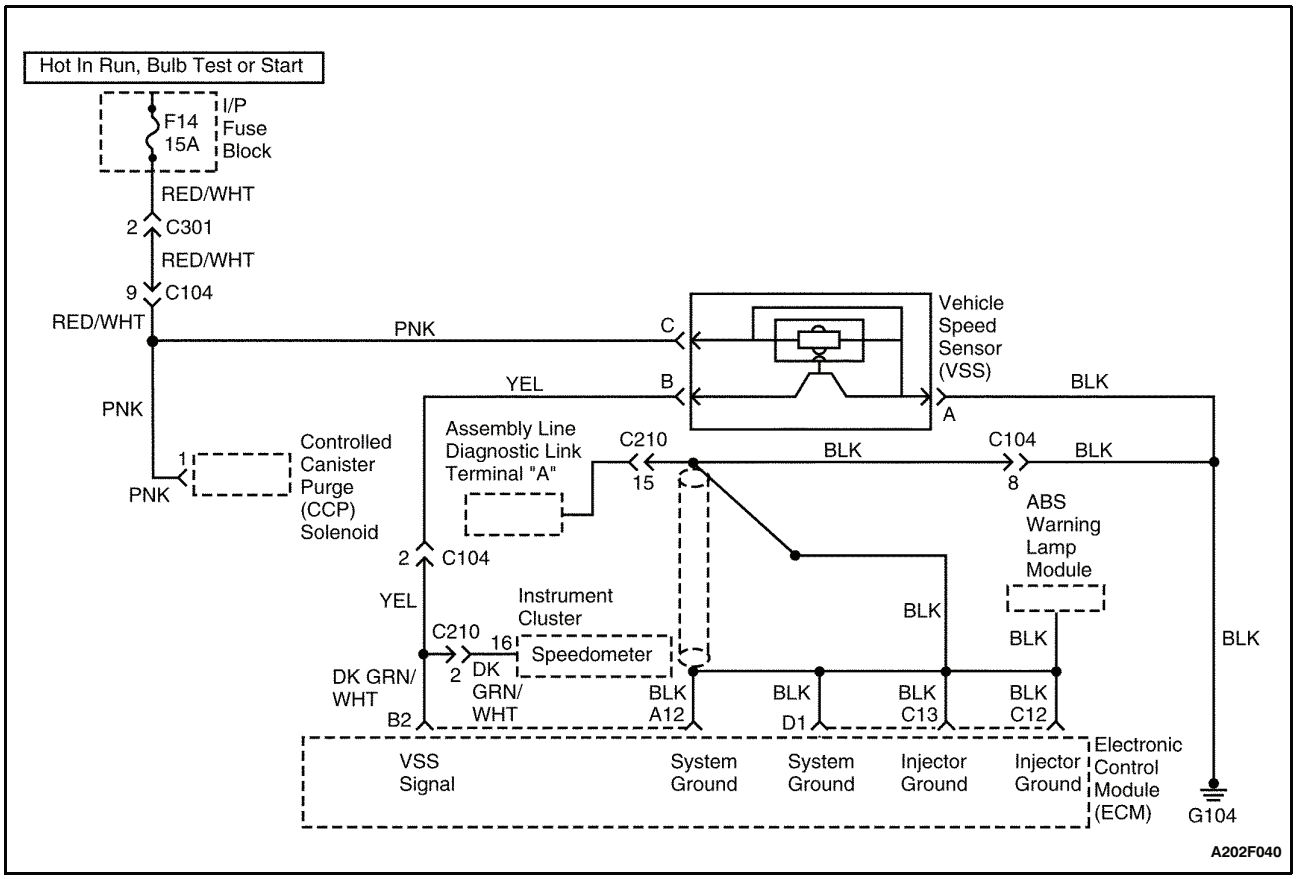
Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 23 - Manifold Air Temperature Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Turn the ignition ON. Does the scan tool show the MAT sensor reading below the value specified?	Lower Than * 35°C (* 31°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 7	Go to Step 8
5	Check the wire for a short to ground between the MAT connector terminal 2 and the electronic control module (ECM) connector terminal B4. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check the wire for a short to ECM reference voltage between the MAT connector terminal 1 and the ECM connector terminal D15. Is the problem found?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 2
8	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ECM. 3. Run the engine until it reaches operating temperature. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR ERROR - MANUAL TRANSAXLE
(1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) applies and monitors 12 volts on the signal wire between the vehicle speed sensor (VSS) and the ECM. The signal wire connects to the VSS which alternately grounds the signal wire when the drive wheels are turning. This pulsing action takes place 2,289 times per kilometer (3,683 times per mile). The ECM will calculate vehicle speed based on the time between the pulses. This information is also displayed by the vehicle speedometer.

DTC 24 Will Set When

- **Diagnostic Trouble Code (DTC) 34 is not set.**
- **The engine speed is between 1,600 rpm and 4,300 rpm.**
- **The VSS indicates a speed less than 8 km/h (5 mph).**
- **The manifold absolute pressure (MAP) sensor signal indicates less than 23 kPa (7 inches of Hg).**
- **These conditions are present for 10 seconds.**

Diagnostic Aids

- **Scan tool data should indicate a vehicle speed whenever the drive wheels are turning at more than 5 km/h (3 mph).**

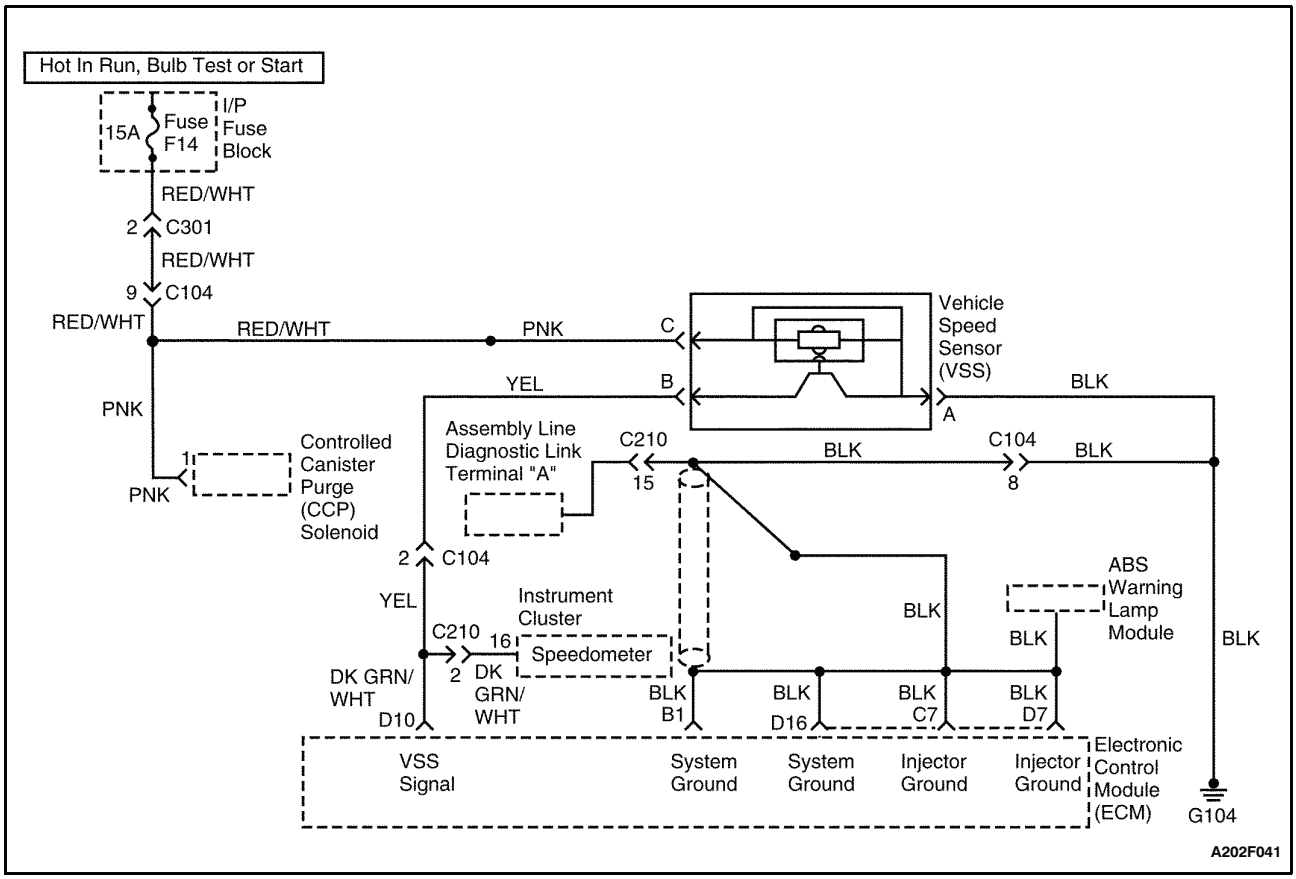
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **By momentarily touching the VSS connector terminal 2 several times a second, a simulated VSS signal is created. If voltage and ground are present at the VSS, the VSS is faulty.**

DTC 24 - Vehicle Speed Sensor Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. Does the scan tool read vehicle speed?	-	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the vehicle speed sensor (VSS) connector. 3. Turn the ignition ON. 4. Connect a test light between the VSS connector terminal B and ground. Is the test light on?	-	Go to Step 9	Go to Step 4
4	With a test light connected to ground, momentarily touch the VSS connector terminal B several times a second. Does the scan tool read vehicle speed?	-	Go to Step 5	Go to Step 11
5	Connect a test light between the VSS connector terminal C and ground. Is the test light on?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Connect a test light between the VSS connector terminal A and battery positive. Is the test light on?	-	Go to Step 10	Go to Step 8
7	Repair the open wire between the VSS connector terminal C and the ignition switch. Is the repair complete?	-	System OK	-
8	Repair the open wire between the VSS connector terminal A and ground. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in the wire between the VSS connector terminal B and the electronic control module (ECM) connector terminal B2. Is the repair complete?	-	System OK	-
10	Replace the VSS. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Check for an open wire between the VSS connector terminal B and the ECM connector terminal B2. Is the problem found?	-	Go to Step 12	Go to Step 13
12	Repair the open wire between the VSS connector terminal B and the ECM connector terminal B2. Is the repair complete?	-	System OK	-
13	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR ERROR - MANUAL TRANSAXLE
(1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) applies and monitors 12 volts on the signal wire between the vehicle speed sensor (VSS) and the ECM. The signal wire connects to the VSS which alternately grounds the signal wire when the drive wheels are turning. This pulsing action takes place 2,289 times per kilometer (3,683 times per mile). The ECM will calculate vehicle speed based on the time between the pulses. This information is also displayed by the vehicle speedometer.

DTC 24 Will Set When

- **Diagnostic Trouble Codes (DTCs) 21, 22, 33, and 34 are not set.**
- **The engine speed is between 2,000 rpm and 5,000 rpm.**
- **The VSS indicates a speed less than 6 km/h (4 mph).**
- **The manifold absolute pressure (MAP) sensor signal indicates less than 24 kPa (7 inches of Hg) for more than 4 seconds.**
- **These conditions are present for 4 seconds.**

Diagnostic Aids

- **Scan tool data should indicate a vehicle speed whenever the drive wheels are turning at more than 5 km/h (3 mph).**

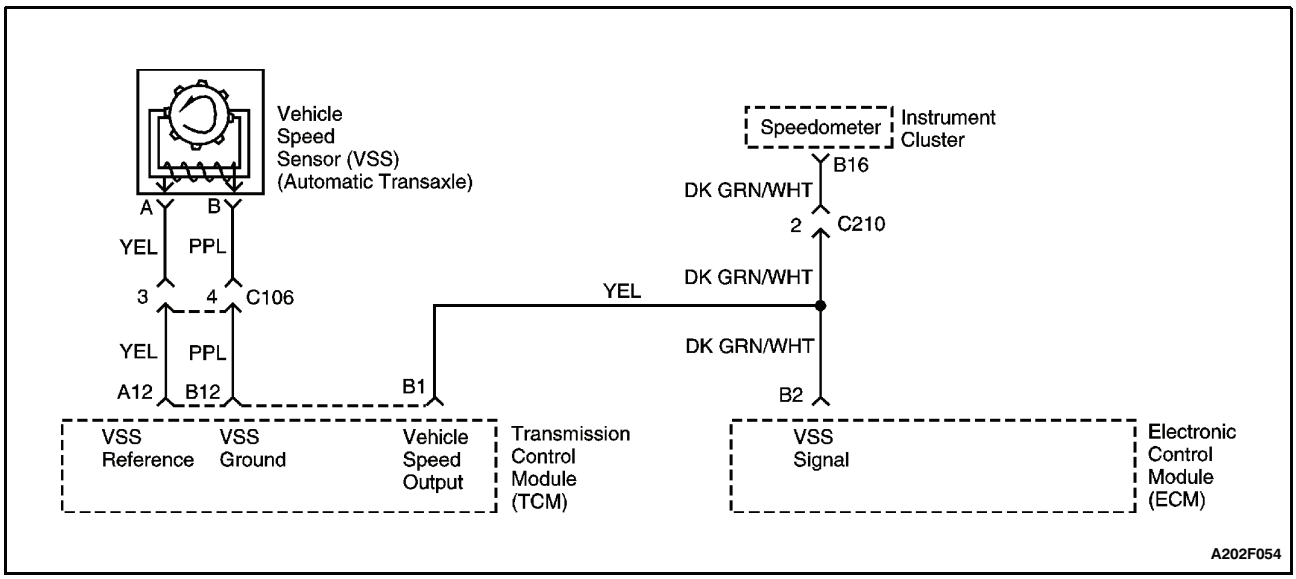
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **By momentarily touching the VSS connector terminal 2 several times a second, a simulated VSS signal is created. If voltage and ground are present at the VSS, the VSS is faulty.**

DTC 24 - Vehicle Speed Sensor Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. Does the scan tool read vehicle speed?	-	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the vehicle speed sensor (VSS) connector. 3. Turn the ignition ON. 4. Connect a test light between the VSS connector terminal B and ground. Is the test light on?	-	Go to Step 9	Go to Step 4
4	With a test light connected to ground, momentarily touch the VSS connector terminal B several times a second. Does the scan tool read vehicle speed?	-	Go to Step 5	Go to Step 11
5	Connect a test light between the VSS connector terminal C and ground. Is the test light on?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Connect a test light between the VSS connector terminal A and battery positive. Is the test light on?	-	Go to Step 10	Go to Step 8
7	Repair the open wire between the VSS connector terminal C and the ignition switch. Is the repair complete?	-	System OK	-
8	Repair the open wire between the VSS connector terminal A and ground. Is the repair complete?	-	System OK	-
9	Repair the short to voltage in the wire between the VSS connector terminal B and the electronic control module (ECM) connector terminal D10. Is the repair complete?	-	System OK	-
10	Replace the VSS. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Check for an open wire between the VSS connector terminal B and the ECM connector terminal D10. Is the problem found?	-	Go to Step 12	Go to Step 13
12	Repair the open wire between the VSS connector terminal B and the ECM connector terminal D10. Is the repair complete?	-	System OK	-
13	Replace the ECM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR ERROR - AUTOMATIC TRANSAXLE
(1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

Vehicle speed is provided to the transaxle control module (TCM) by the automatic transaxle output (shaft) vehicle speed sensor (VSS), which is a permanent magnet (PM) generator mounted to the transaxle case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, torque converter clutch (TCC) apply, TCC release, and gear ratio calculations. A digital output signal is then sent from the TCM to the electronic control module (ECM). This signal is also sent to the instrument panel for operation of the speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Code (DTC) 34 is not set.
- The engine speed is between 1,600 rpm and 4,300 rpm.
- The VSS indicates a speed less than 8 km/h (5 mph).
- The manifold absolute pressur (MAP) sensor signal indicates less than 23 kPa (7 inches of Hg).
- These conditions are present for 10 seconds.

Diagnostic Aids

- The condition may be intermittent. Check for a loose VSS mounting or poor connections.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing the test equipment for a change.

Test Description

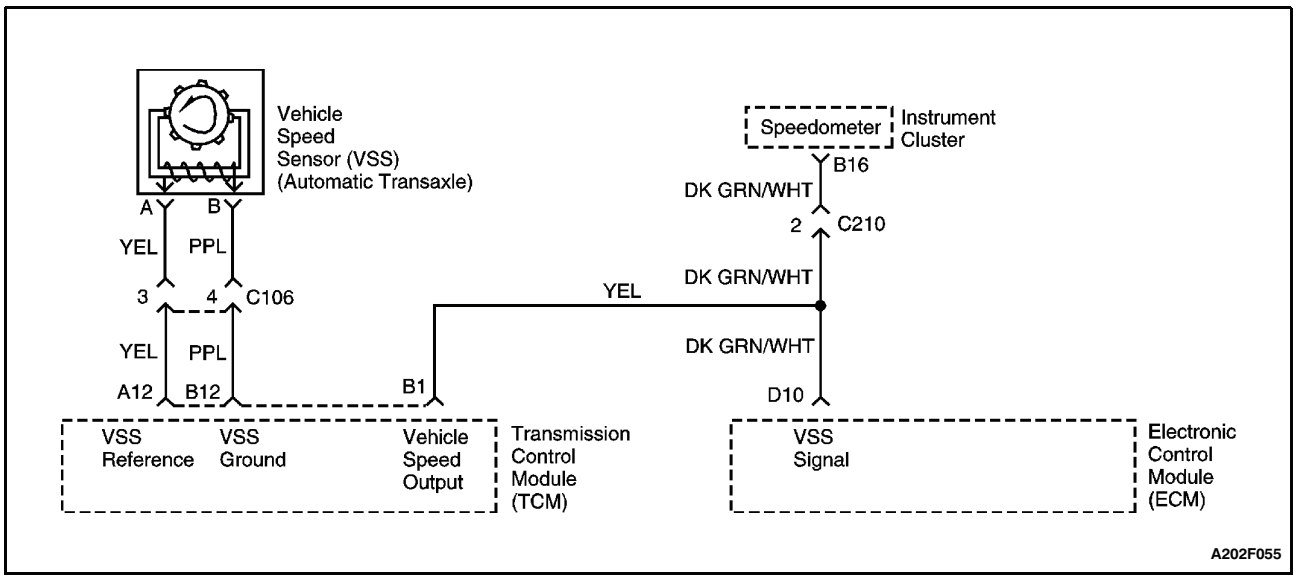
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for an output signal from the TCM to the electronic control module (ECM).
4. It is important to remember that the vehicle speed output is also sent to the instrument panel for speedometer operation.

DTC 24 - Vehicle Speed Sensor Error - Automatic Transaxle (1.3L and 1.5L SOHC IEFI-6)

Notice: In order to avoid damage to the drive axles when raising the drive wheels, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.

Step	Action	Value(s)	Yes	No
1	Check for the presence of any transaxle control module (TCM) diagnostic trouble code(s) (DTCs) for the vehicle speed sensor (VSS). Is a TCM DTC present?	-	Go to the applicable DTC Table	Go to Step 2
2	1. Turn the ignition OFF. 2. Raise and suitably support the drive wheels. 3. Measure the voltage by backprobing the electronic control module (ECM) 24-pin connector terminal B2. 4. Start the engine and allow the engine to idle. 5. Place the transaxle in drive (D). Is a fluctuating voltage present?	-	Go to Step 6	Go to Step 3
3	1. Turn the ignition OFF. 2. Check for an open or short in the wire between the ECM connector terminal B2 and the TCM connector terminal B1. Is the problem found?	-	Go to Step 5	Go to Step 4
4	Check for an open or short in the wire between the ECM connector terminal B2 and the instrument panel connector terminal B16. Is the problem found?	-	Go to Step 5	Go to Step 7
5	Repair the wire as needed. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-
7	Replace the TCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 24
VEHICLE SPEED SENSOR ERROR - AUTOMATIC TRANSAXLE
(1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Vehicle speed is provided to the transaxle control module (TCM) by the automatic transaxle output (shaft) vehicle speed sensor (VSS), which is a permanent magnet (PM) generator mounted to the transaxle case. The PM generator produces an AC voltage as the speed sensor rotor teeth pass in front of the sensor's magnetic field. The AC voltage level increases as the speed of the vehicle increases. The TCM then converts the AC voltage into a digital signal. The TCM uses the vehicle speed to determine shift timing, torque converter clutch (TCC) apply, TCC release, and gear ratio calculations. A digital output signal is then sent from the TCM to the electronic control module (ECM). This signal is also sent to the instrument panel for operation of the speedometer.

DTC 24 Will Set When

- Diagnostic Trouble Codes (DTCs) 21, 22, 33, and 34 is not set.
- The engine speed is between 2,000 rpm and 5,000 rpm.
- The VSS indicates a speed less than 6 km/h (3.5 mph).
- The manifold absolute pressure (MAP) sensor signal indicates less than 24 kPa (7 inches of Hg).
- These conditions are present for 4 seconds.

Diagnostic Aids

- The condition may be intermittent. Check for a loose VSS mounting or poor connections.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing the test equipment for a change.

Test Description

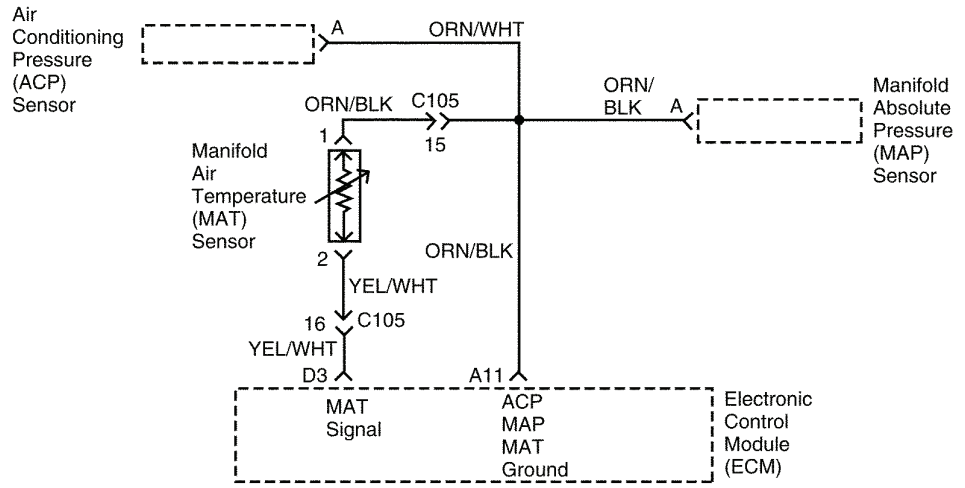
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for an output signal from the TCM to the ECM.
4. It is important to remember that the vehicle speed output is also sent to the instrument panel for speedometer operation.

DTC 24 - Vehicle Speed Sensor Error - Automatic Transaxle (1.3L SOHC and 1.6L DOHC ITMS-6F)

Notice: In order to avoid damage to the drive axles when raising the drive wheels, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.

Step	Action	Value(s)	Yes	No
1	Check for the presence of any transaxle control module (TCM) diagnostic trouble code(s) (DTCs) for the vehicle speed sensor (VSS). Is a TCM DTC present?	-	Go to the Applicable DTC Table	Go to Step 2
2	1. Turn the ignition OFF. 2. Raise and suitably support the drive wheels. 3. Measure the voltage by backprobing the electronic control module (ECM) 24-pin connector terminal D10. 4. Start the engine and allow the engine to idle. 5. Place the transaxle in drive (D). Is a fluctuating voltage present?	-	Go to Step 6	Go to Step 3
3	1. Turn the ignition OFF. 2. Check for an open or short in the wire between the ECM connector terminal D10 and the TCM connector terminal B1. Is the problem found?	-	Go to Step 5	Go to Step 4
4	Check for an open or short in the wire between the ECM connector terminal B2 and the instrument panel connector terminal B16. Is the problem found?	-	Go to Step 5	Go to Step 7
5	Repair the wire as needed. Is the repair complete?	-	System OK	-
6	Replace the ECM. Is the repair complete?	-	System OK	-
7	Replace the TCM. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 25
MANIFOLD AIR TEMPERATURE LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 25 Will Set When

- **The engine has been running longer than 50 seconds.**
- **The MAT sensor signal voltage indicates a temperature less than * 35°C (* 31°F).**

Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

Test Description

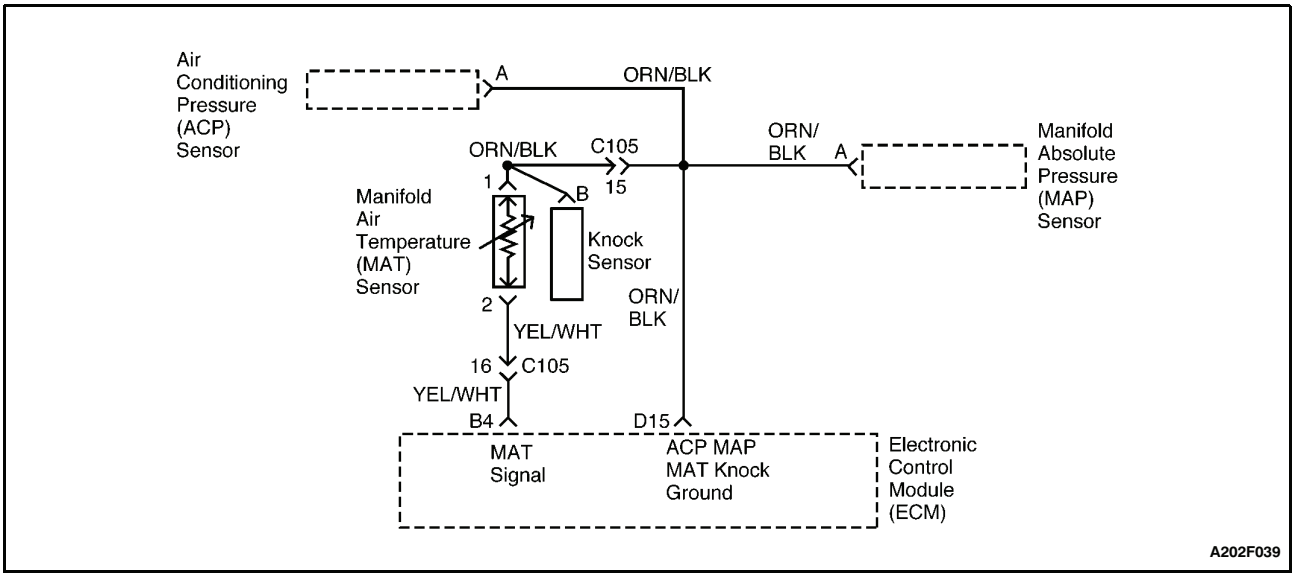
The number(s) below refer to step(s) on the diagnostic table.

6. This step checks for reference voltage and ground from the ECM.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 25 - Manifold Air Temperature Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Jumper the MAT connector terminals. 4. Turn the ignition ON. Does the scan tool show the MAT sensor reading above the value specified?	180°C (356°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 10	Go to Step 9
5	Measure the voltage between terminals 1 and 2 of the MAT connector. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 11	Go to Step 6
6	Measure the voltage between the MAT terminal 2 and the battery ground (negative) post. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 1 and the electronic control module (ECM) connector terminal A11. Is the problem found?	-	Go to Step 10	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 2 and the ECM connector terminal D3. Is the problem found?	-	Go to Step 10	Go to Step 11
9	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Run the vehicle until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 25
MANIFOLD AIR TEMPERATURE LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold air temperature (MAT) sensor is a thermistor which measures the temperature of the air entering the engine. The electronic control module (ECM) applies 5 volts through a pull-up resistor to the MAT sensor. When the temperature is cold, the MAT sensor resistance is high and the ECM will monitor a high signal voltage on the MAT circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage.

DTC 25 Will Set When

- **The engine has been running longer than 120 seconds.**
- **The MAT sensor signal voltage indicates a temperature less than * 38.5°C (* 37°F).**

Diagnostic Aids

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAT sensor display on the scan tool while moving the connectors and the wiring harnesses related to the MAT sensor. A change in the display will indicate the location of the fault.

Test Description

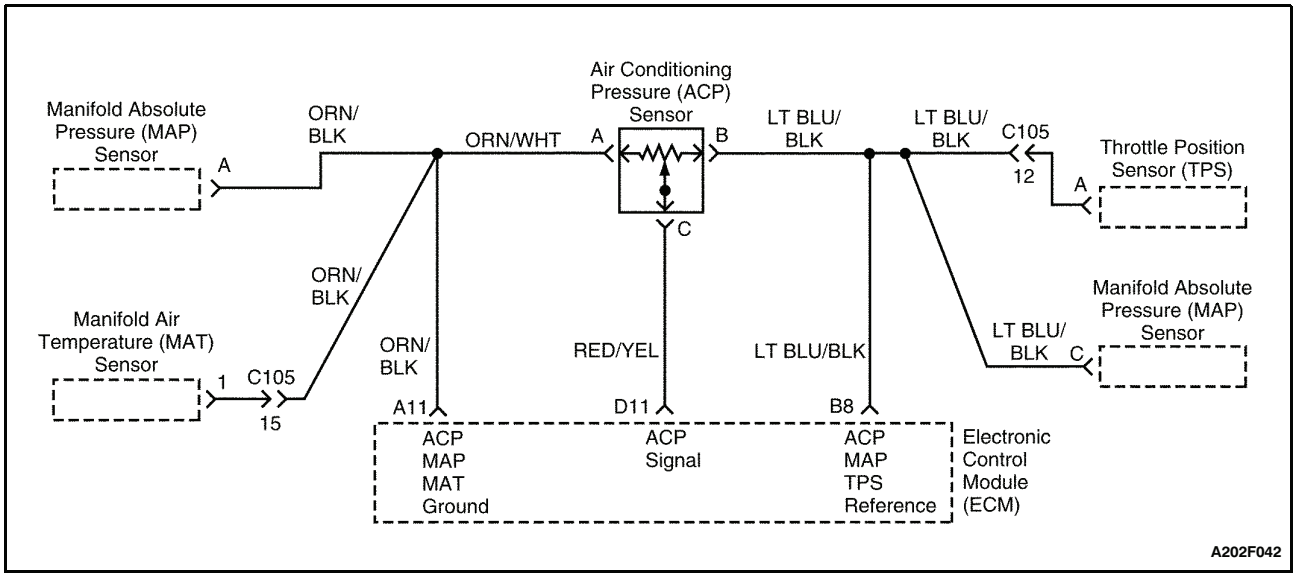
The number(s) below refer to step(s) on the diagnostic table.

6. This step checks for reference voltage and ground from the ECM.

MANIFOLD AIR TEMPERATURE SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
* 5	23	12300
* 10	14	16180
* 15	5	21450
* 20	* 4	28680
* 30	* 22	52700
* 40	* 40	100700

DTC 25 - Manifold Air Temperature Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. Does the scan tool show the manifold air temperature (MAT) sensor reading within the value specified?	10-80°C (50-176°F)	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the MAT sensor connector. 3. Jumper the MAT connector terminals. 4. Turn the ignition ON. Does the scan tool show the MAT sensor reading above the value specified?	180°C (356°F)	Go to Step 4	Go to Step 5
4	Check for a faulty connector or terminals at the MAT sensor connector. Is the problem found?	-	Go to Step 10	Go to Step 9
5	Measure the voltage between terminals 1 and 2 of the MAT connector. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 11	Go to Step 6
6	Measure the voltage between the MAT terminal 2 and the battery ground (negative) post. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 1 and the electronic control module (ECM) connector terminal D15. Is the problem found?	-	Go to Step 10	Go to Step 11
8	1. Turn the ignition OFF. 2. Check for an open or short to battery voltage in the wire between the MAT connector terminal 2 and the ECM connector terminal B4. Is the problem found?	-	Go to Step 10	Go to Step 11
9	1. Turn the ignition OFF. 2. Replace the MAT sensor. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Run the engine until it reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Run the engine until It reaches operating temperature. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Run the vehicle until it reaches operating temperature. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 27 AIR CONDITIONING PRESSURE SENSOR HIGH ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The air conditioning (A/C) system uses an air conditioning pressure (ACP) sensor mounted in the high-pressure side of the A/C refrigerant system to monitor the A/C refrigerant pressure. The electronic control module (ECM) uses this information to turn the cooling fans on at high speed when the A/C refrigerant pressure is high and to keep the A/C compressor disengaged when the A/C refrigerant pressure is excessively high or low.

DTC 27 Will Set When

- **The ACP sensor reading is above 3 115 kPa (452 psi).**
- **This condition is present for 10 seconds.**

Diagnostic Aids

- **Inspect the wiring harness for damage. If the wiring harness appears OK, observe the A/C pressure display on the scan tool while moving the connectors and the wiring harnesses related to the ACP sensor. A change in the A/C pressure display on the scan tool will indicate the location of the fault.**
- **A fault in the A/C system or inoperative cooling fans may set an ACP diagnostic trouble code (DTC).**

Test Description

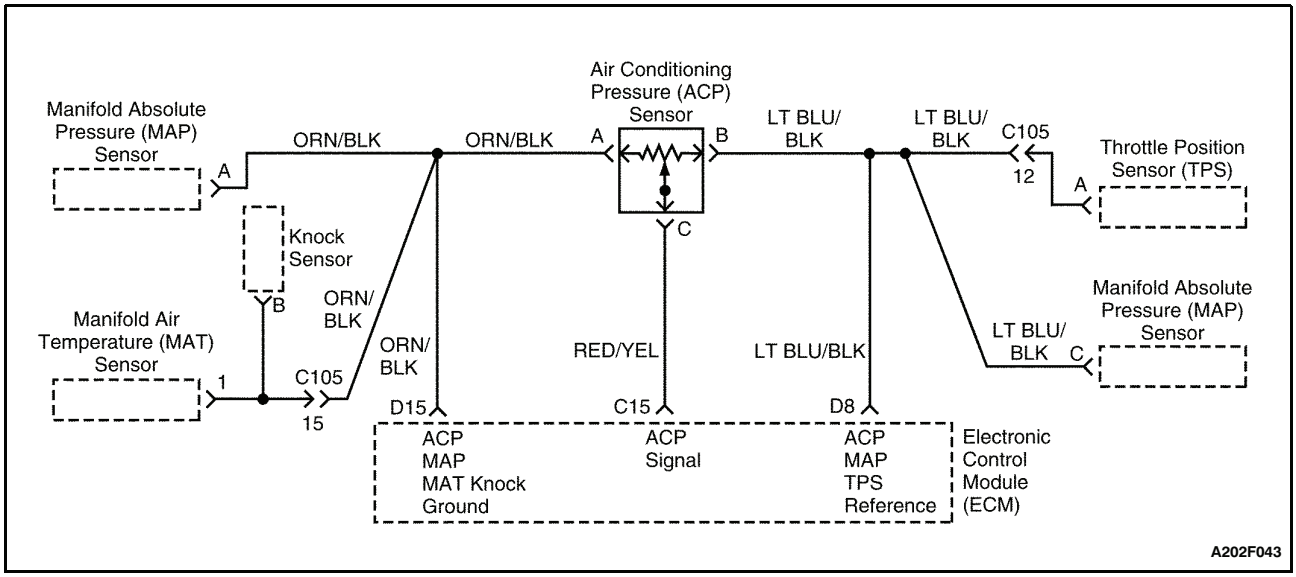
The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for reference voltage and ground from the ECM.

3. A voltage over 2 volts indicates an A/C refrigerant system pressure over 1 241 kPa (180 psi).

DTC 27 - Air Conditioning Pressure Sensor High Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning pressure (ACP) sensor connector. 2. Turn the ignition ON. 3. Measure the voltage between the ACP connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Connect the ACP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the electronic control module (ECM) connector terminal D11 by backprobing the connector. Does the voltage measure below the value specified?	2 v	Go to "Diagnostic Aids"	Go to Step 4
4	Check for a short to voltage in the wire between the ACP connector terminal C and the ECM connector terminal D11. Is the problem found?	-	Go to Step 8	Go to Step 9
5	Measure the voltage between the ACP connector terminal B and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check the wire between the ACP connector terminal A and the ECM connector terminal A11 for a short to the battery voltage. Is the problem found?	-	Go to Step 8	Go to Step 10
7	Check for a short to battery voltage in the wire between the ACP connector terminal B and the ECM connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 10
8	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ACP sensor. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 27 AIR CONDITIONING PRESSURE SENSOR HIGH ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The air conditioning (A/C) system uses an air conditioning pressure (ACP) sensor mounted in the high-pressure side of the A/C refrigerant system to monitor the A/C refrigerant pressure. The electronic control module (ECM) uses this information to turn the cooling fans on at high speed when the A/C refrigerant pressure is high and to keep the A/C compressor disengaged when the A/C refrigerant pressure is excessively high or low.

DTC 27 Will Set When

- **The ACP sensor reading is above 3 115 kPa (452 psi).**
- **This condition is present for 10 seconds.**

Diagnostic Aids

- **Inspect the wiring harness for damage. If the wiring harness appears OK, observe the A/C pressure display on the scan tool while moving the connectors and the wiring harnesses related to the ACP sensor. A change in the A/C pressure display on the scan tool will indicate the location of the fault.**
- **A fault in the A/C system or inoperative cooling fans may set an ACP diagnostic trouble code (DTC).**

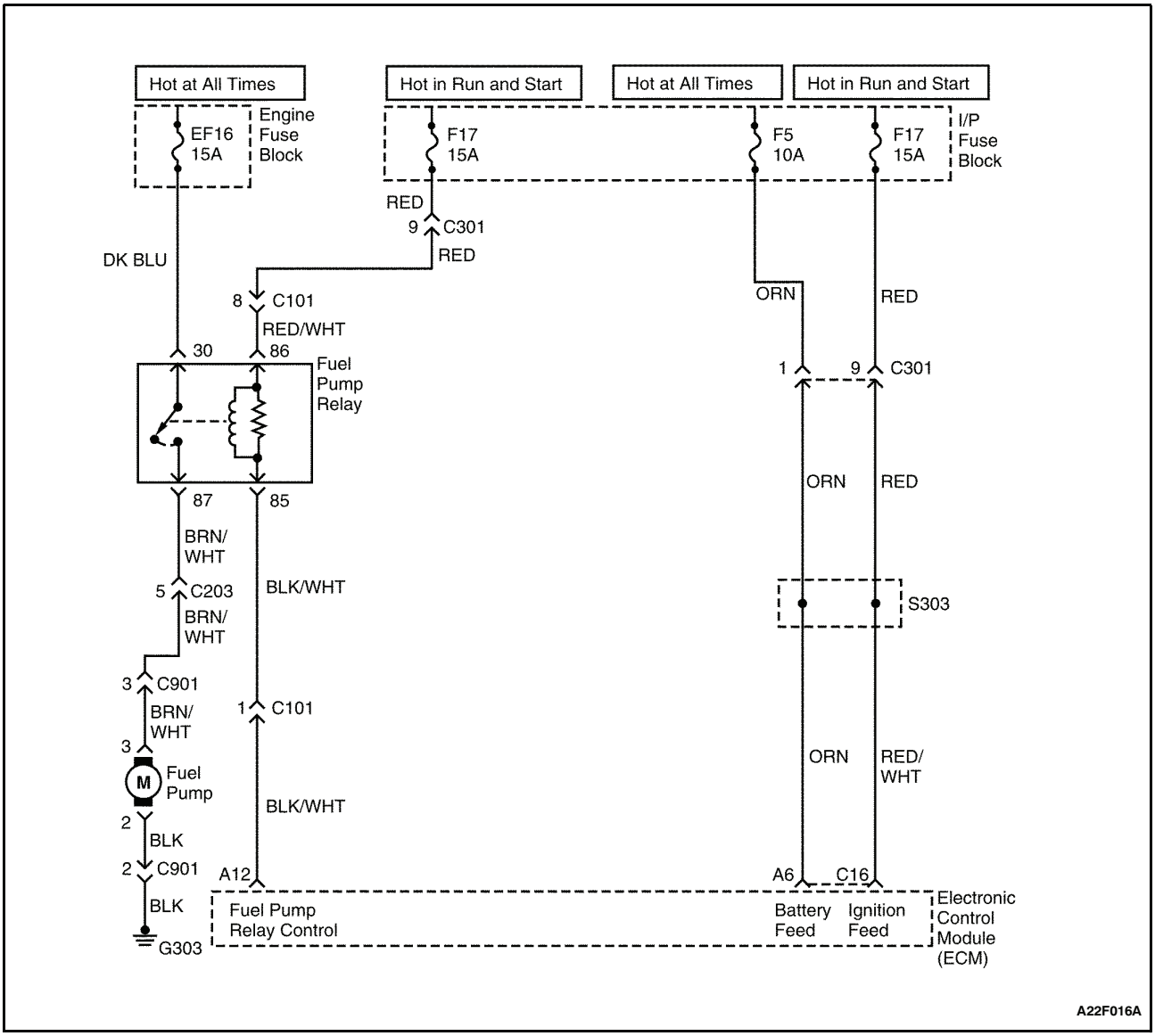
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **This step checks for reference voltage and ground from the ECM.**
3. **A voltage over 2 volts indicates an A/C refrigerant system pressure over 1 241 kPa (180 psi).**

DTC 27 - Air Conditioning Pressure Sensor High Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning pressure (ACP) sensor connector. 2. Turn the ignition ON. 3. Measure the voltage between the ACP connector terminals A and B. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Connect the ACP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage at the electronic control module (ECM) connector terminal C15 by backprobing the connector. Does the voltage measure below the value specified?	2 v	Go to "Diagnostic Aids"	Go to Step 4
4	Check for a short to voltage in the wire between the ACP connector terminal C and the ECM connector terminal C15. Is the problem found?	-	Go to Step 8	Go to Step 9
5	Measure the voltage between the ACP connector terminal B and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 6	Go to Step 7
6	Check the wire between the ACP connector terminal A and the ECM connector terminal D15 for a short to the battery voltage. Is the problem found?	-	Go to Step 8	Go to Step 10
7	Check for a short to battery voltage in the wire between the ACP connector terminal B and the ECM connector terminal D8. Is the problem found?	-	Go to Step 8	Go to Step 10
8	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Replace the ACP sensor. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 29
FUEL PUMP RELAY SHORT TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the electronic control module (ECM) applies ground to the fuel pump relay coil side. The ECM will apply this ground for 2 seconds or until reference pulses are received by the ECM from the crankshaft position sensor. This activates the fuel pump relay, applying battery voltage to the fuel pump.

DTC 29 Will Set When

The fuel pump relay circuit is shorted to ground for more than 1.6 seconds.

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, and a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the fuel pump relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

Test Description

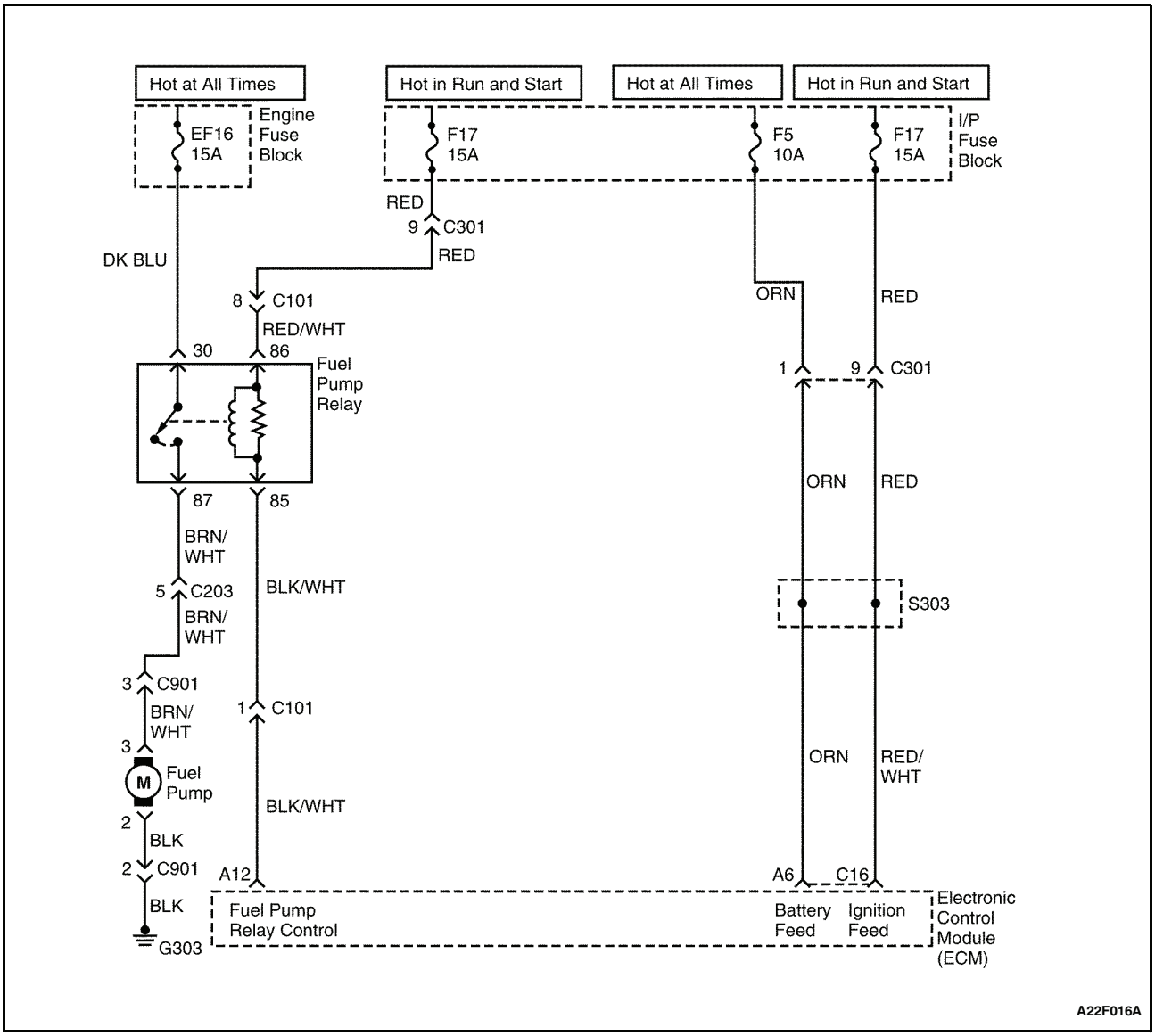
The number(s) below refer to step(s) on the diagnostic table.

2. With the ignition OFF, the ECM should not be applying ground to the fuel pump relay.

3. If the test light is still on after disconnecting the ECM red connector, the wire between the fuel pump relay and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.

DTC 29 - Fuel Pump Relay Short to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disconnect the fuel pump relay. 2. Connect a test light between the fuel pump relay connector terminal 85 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 32
FUEL PUMP RELAY SHORT TO BATTERY
(1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the electronic control module (ECM) applies ground to the fuel pump relay coil side. The ECM will apply this ground for 2 seconds or until reference pulses are received by the ECM from the crankshaft position sensor. This activates the fuel pump relay, applying battery voltage to the fuel pump.

DTC 32 Will Set When

The fuel pump relay circuit is shorted to battery for more than 1.6 seconds.

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, and a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the fuel pump relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

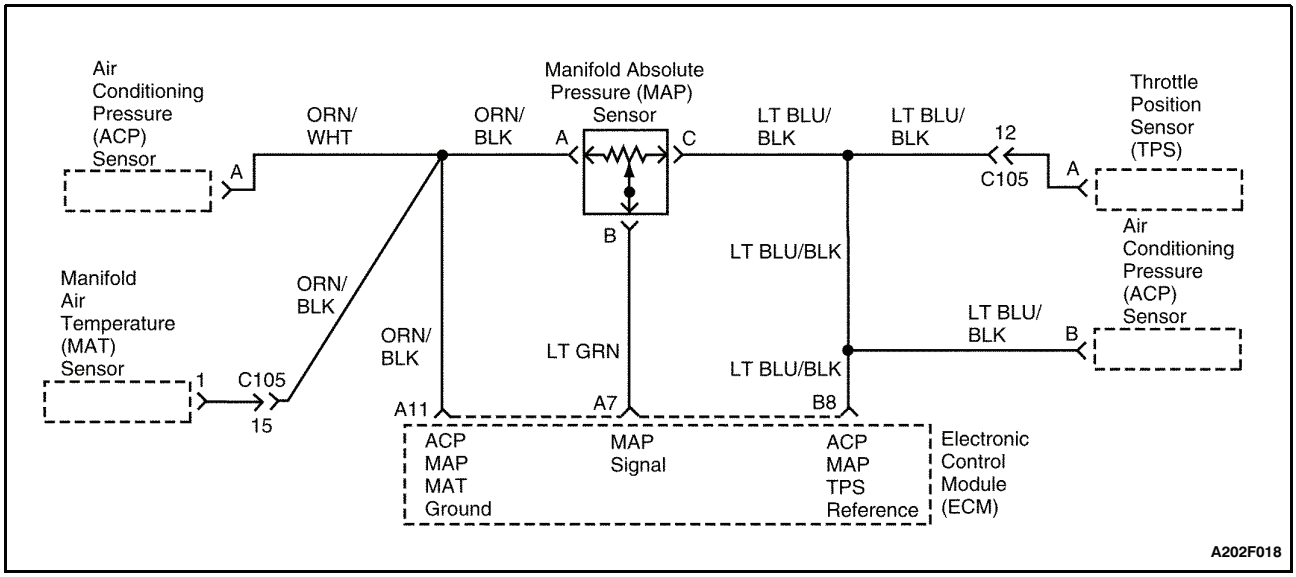
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the fuel pump relay and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 32 - Fuel Pump Relay Short to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Is the Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disconnect the fuel pump relay. 2. Measure the resistance between the fuel pump relay terminals 85 and 86. Does the resistance measure near the value specified?	90 W	Go to Step 6	Go to Step 3
3	Connect a test light between the fuel pump relay connector terminal 86 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the fuel pump relay connector terminal 85 and the ECM connector terminal A12. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the fuel pump relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 33 MANIFOLD ABSOLUTE PRESSURE SENSOR HIGH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 33 Will Set When

- **Diagnostic trouble codes (DTCs) 21 and 22 are not set.**
- **The throttle angle is below 3 percent.**
- **The MAP sensor signal indicates greater than 98 kPa (29 inches of Hg).**
- **These conditions are present for 5 seconds.**

Diagnostic Aids

- **If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.**
6. **This step checks for a reference voltage and a ground from the ECM.**
7. **This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.**

DTC 33 - Manifold Absolute Pressure Sensor High (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Check the vacuum line from the manifold absolute pressure (MAP) sensor for cracks, leaks, or restrictions. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the vacuum line as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 5	Go to Step 6
5	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 13	Go to Step 11
8	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 9	Go to Step 10
9	Check for a short to battery voltage in the wire between the MAP sensor connector terminal A and the ECM connector terminal A11. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for a short to battery voltage in the wire between the MAP sensor connector terminal C and the electronic control module (ECM) connector terminal B8. Is the problem found?	-	Go to Step 12	Go to Step 14
11	Check for a short to voltage in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 12	Go to Step 14

DTC 33 - Manifold Absolute Pressure Sensor High (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 5
13	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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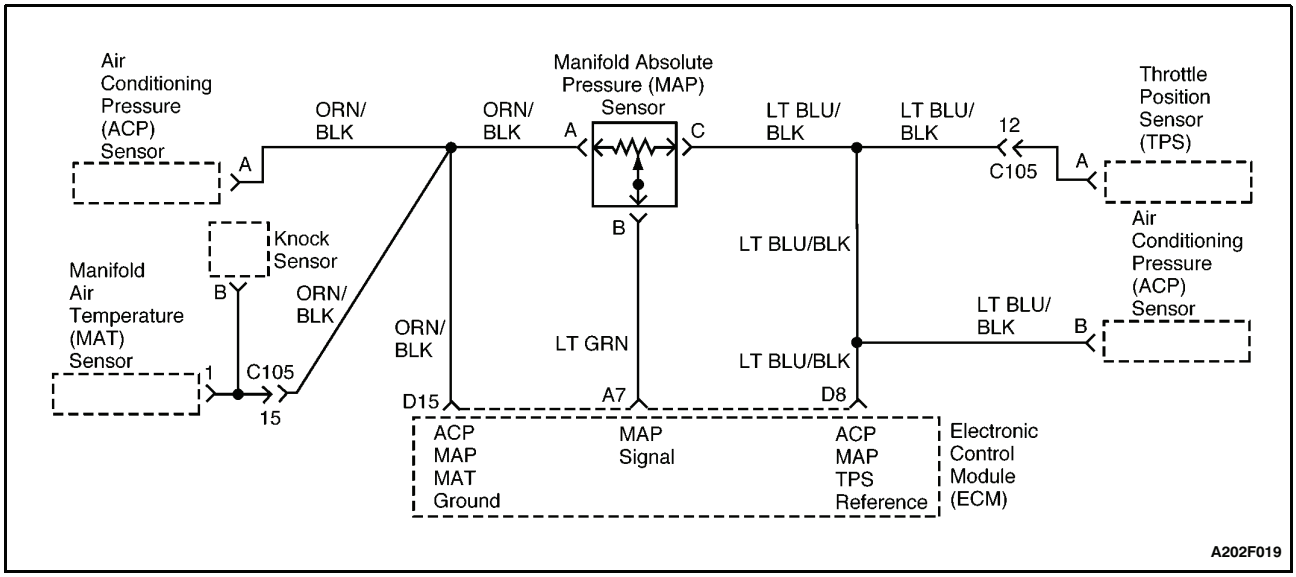

DIAGNOSTIC TROUBLE CODE (DTC) 33 MANIFOLD ABSOLUTE PRESSURE SENSOR HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 33 Will Set When

- **Diagnostic trouble codes (DTCs) 21 and 22 are not set.**
- **The throttle angle is below 5 percent.**
- **The MAP sensor signal indicates greater than 95 kPa (28 inches of Hg).**
- **These conditions are present for 5 seconds.**

Diagnostic Aids

- **If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.

6. This step checks for a reference voltage and a ground from the ECM.

7. This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.

DTC 33 - Manifold Absolute Pressure Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Check the vacuum line from the manifold absolute pressure (MAP) sensor for cracks, leaks, or restrictions. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the vacuum line as needed. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
4	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 5	Go to Step 6
5	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 13	Go to Step 11
8	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 9	Go to Step 10
9	Check for a short to battery voltage in the wire between the MAP sensor connector terminal A and the ECM connector terminal D15. Is the problem found?	-	Go to Step 12	Go to Step 11
10	Check for a short to battery voltage in the wire between the MAP sensor connector terminal C and the electronic control module (ECM) connector terminal D8. Is the problem found?	-	Go to Step 12	Go to Step 14
11	Check for a short to voltage in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 12	Go to Step 14

DTC 33 - Manifold Absolute Pressure Sensor High (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	Go to Step 5
13	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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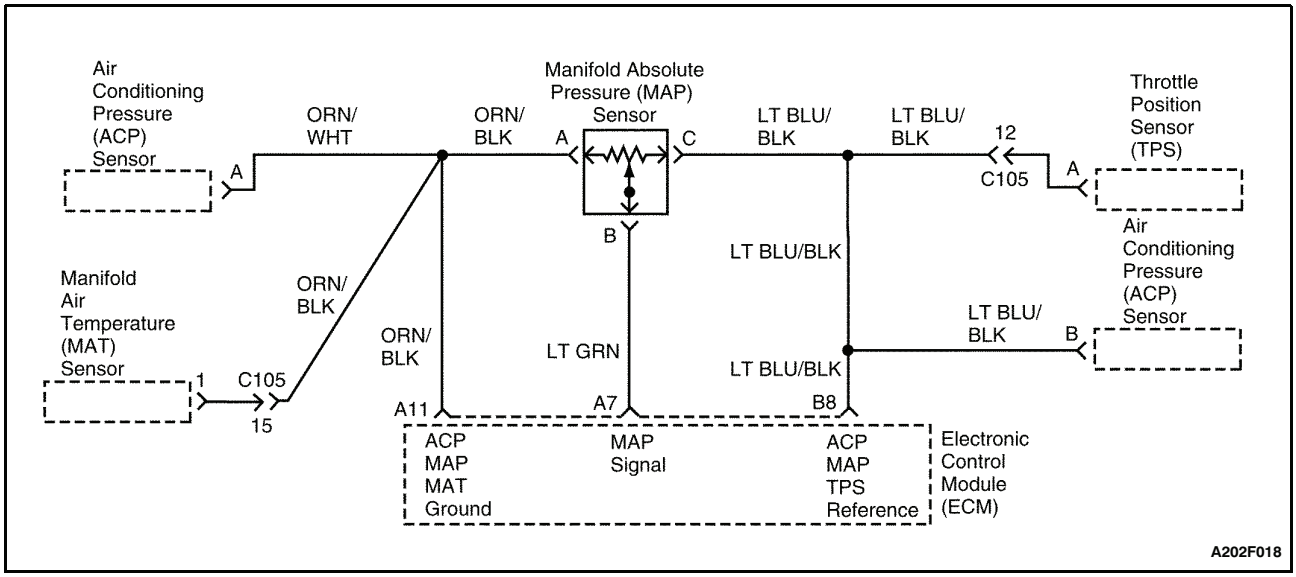

DIAGNOSTIC TROUBLE CODE (DTC) 34 MANIFOLD ABSOLUTE PRESSURE SENSOR LOW (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 34 Will Set When

- **Diagnostic trouble codes (DTCs) 21 and 22 are not set.**
- **The engine speed is less than 1,200 rpm or the engine speed is greater than 1,200 rpm and the throttle angle is greater than 15 percent.**
- **The MAP sensor signal voltage indicates less the 15 kPa (4.5 inches of Hg).**
- **These conditions have been present for 0.125 second.**

Diagnostic Aids

- **If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.**
4. **This step checks for a reference voltage and a ground from the ECM.**
5. **This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.**

DTC 34 - Manifold Absolute Pressure Sensor Low (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the manifold absolute pressure (MAP) sensor voltage above the value specified?	4 v	Go to Step 3	Go to Step 4
3	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between the MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 5	Go to Step 6
5	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 11	Go to Step 9
6	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open wire between the MAP sensor connector terminal A and the electronic control module (ECM) connector terminal A11. Is the problem found?	-	Go to Step 10	Go to Step 12
8	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal C and the ECM connector terminal B8. Is the problem found?	-	Go to Step 10	Go to Step 12
9	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 34 - Manifold Absolute Pressure Sensor Low (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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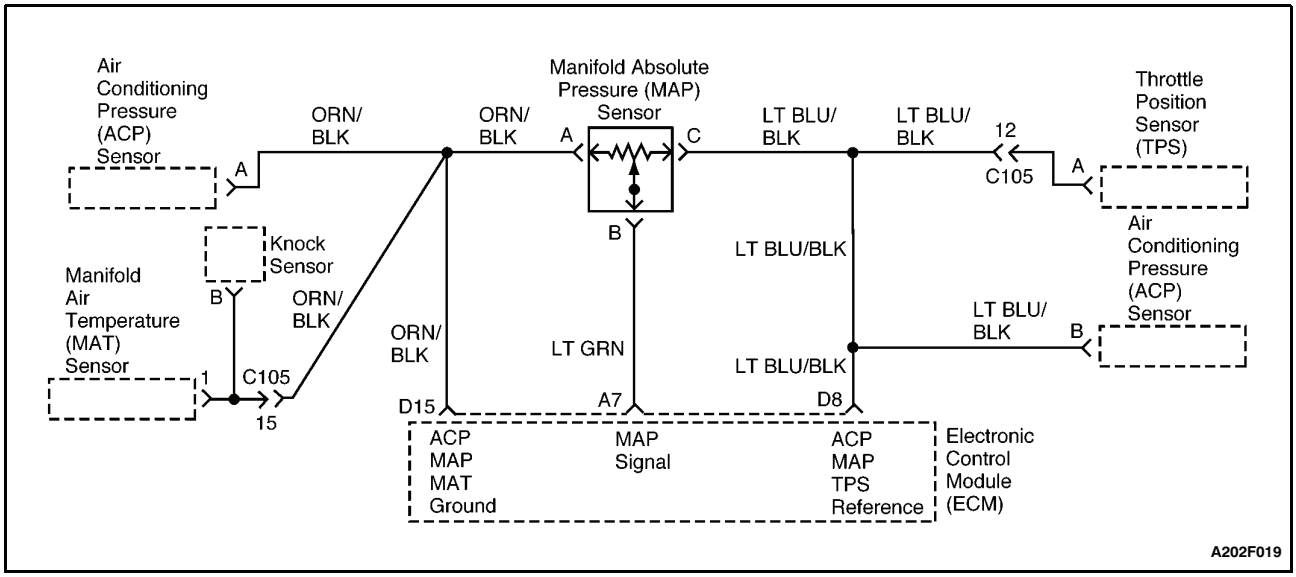

DIAGNOSTIC TROUBLE CODE (DTC) 34 MANIFOLD ABSOLUTE PRESSURE SENSOR LOW (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in the manifold vacuum. The electronic control module (ECM) receives this information as a signal voltage that will vary from about 1.0 to 1.5 volts at closed throttle (idle) to 4.5 to 5.0 volts at wide-open throttle.

DTC 34 Will Set When

- **Diagnostic trouble codes (DTCs) 21 and 22 are not set.**
- **The engine speed is less than 1,050 rpm or the engine speed is greater than 1,050 rpm and the throttle angle is greater than 19 percent.**
- **The MAP sensor signal voltage indicates less than 14 kPa (4.0 inches of Hg).**
- **These conditions have been present for 1 second.**

Diagnostic Aids

- **If the connections are OK, monitor the MAP sensor signal voltage while moving related connectors and the wiring harness. If the failure is induced, the display on the scan tool will change. This may help to isolate the location of an intermittent malfunction.**
- **With the ignition ON and the engine OFF, the MAP sensor pressure is equal to the atmospheric pressure. This information is used by the ECM as an indication of altitude. Comparison of these readings with a known good vehicle with the same MAP sensor is a good way to check the accuracy of a questionable MAP sensor. The readings should be the same within 0.4 volt.**

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **With the ignition ON and the engine OFF, the MAP sensor is reading atmospheric or barometric pressure. If this reading is below 4 volts, the ECM may prevent the engine from starting.**
4. **This step checks for a reference voltage and a ground from the ECM.**
5. **This step is checking the voltage reference and the signal return wire to the ECM. If the ECM recognizes the voltage reference and there is not a problem in the ground side of the circuit, the MAP sensor is faulty.**

DTC 34 - Manifold Absolute Pressure Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Turn the ignition ON. Does the scan tool show the manifold absolute pressure (MAP) sensor voltage above the value specified?	4 v	Go to Step 3	Go to Step 4
3	1. Disconnect the vacuum line from the MAP sensor. 2. Apply 68 kPa (20 in. of Hg) of vacuum to the MAP sensor. Does the scan tool show the MAP sensor voltage within the value specified?	1.0-1.5 v	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the MAP sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between the MAP sensor connector terminals A and C. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 5	Go to Step 6
5	Connect a fused jumper between the MAP sensor connector terminals B and C. Does the scan tool show the MAP sensor voltage above the value specified?	4 v	Go to Step 11	Go to Step 9
6	Measure the voltage between the MAP sensor connector terminal C and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Check for an open wire between the MAP sensor connector terminal A and the electronic control module (ECM) connector terminal D15. Is the problem found?	-	Go to Step 10	Go to Step 12
8	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal C and the ECM connector terminal D8. Is the problem found?	-	Go to Step 10	Go to Step 12
9	1. Turn the ignition OFF. 2. Check for an open or short to ground in the wire between the MAP sensor connector terminal B and the ECM connector terminal A7. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DTC 34 - Manifold Absolute Pressure Sensor Low (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Replace the MAP sensor. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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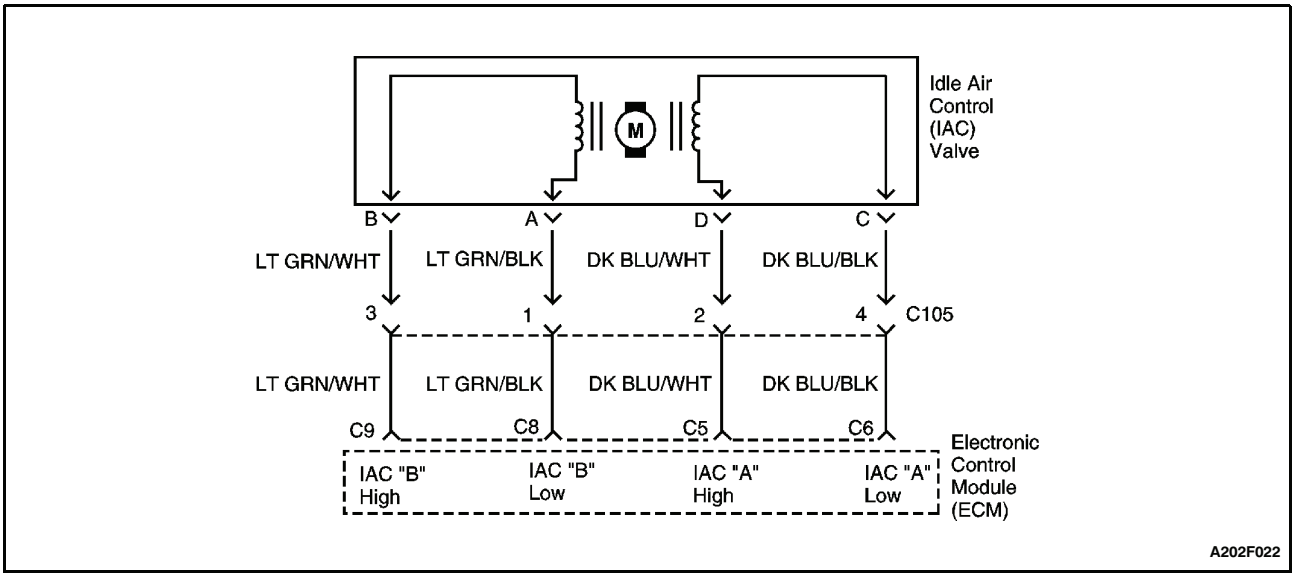

DIAGNOSTIC TROUBLE CODE (DTC) 35
IDLE AIR CONTROL ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) controls the idle speed to a calculated rpm based on inputs and the actual engine rpm. This is determined by the ignition reference pulses received by the ECM from the crankshaft position sensor. The ECM uses four circuits to move the idle air control (IAC) valve. The IAC valve allows varying amounts of air to flow into the intake manifold, controlling the idle speed.

DTC 35 Will Set When

- **Diagnostic trouble codes (DTCs) 21, 22, and 24 are not set.**
- **The throttle is closed.**
- **The engine speed is 150 rpm above or below the commanded idle speed for 30 seconds.**

Diagnostic Aids

- **Inspect for vacuum leaks, unconnected or brittle vacuum hoses, cuts, etc.**
- **Inspect the intake manifold and the throttle body gaskets for proper sealing.**
- **An IAC valve which does not respond to the ECM, an incorrect base idle adjustment, a damaged throttle body, or damage to the throttle body linkage could create the conditions for setting DTC 35.**

DTC 35 - Idle Air Control Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Monitor the engine rpm. 4. Disconnect the idle air control (IAC) valve connector. 5. Connect the IAC driver to the IAC valve. 6. Start the engine. Allow the engine to idle in park (P), or neutral (N) for the manual transaxle, with the air conditioning (A/C) off and the parking brake applied. 7. Using the IAC driver, extend and retract the IAC valve. Does the rpm change as the IAC driver is cycled?	-	Go to Step 5	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Remove the IAC valve from the throttle body. 4. Inspect the IAC passages for restrictions. Are the IAC passages restricted?	-	Go to Step 4	Go to Step 14
4	1. Clean the IAC passages. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	Cycle the IAC driver while monitoring the engine rpm. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC node light to the IAC connector. 3. Start the engine and cycle the IAC driver. Do both lights of the IAC node light cycle red and green but never turn off as the rpm is changed using the IAC driver?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Measure the resistance between IAC terminals A and B, then C and D. Is the resistance within the value specified?	40-80 W	Go to Step 8	Go to Step 14
8	Measure the resistance between IAC terminals B and C, then A and D. Does the resistance match the specified value?	R	Go to "Diagnostic Aids"	Go to Step 14
9	1. Turn the ignition OFF. 2. Disconnect the IAC node light from the IAC valve connector. 3. Check for faulty connector terminals. Is the problem found?	-	Go to Step 13	Go to Step 10

DTC 35 - Idle Air Control Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for any open circuits or open connections between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 11
11	Check for a short to ground between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 12
12	1. Turn the ignition ON. 2. Check for a short to voltage between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 15
13	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Perform the IAC valve reset procedure. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the IAC valve. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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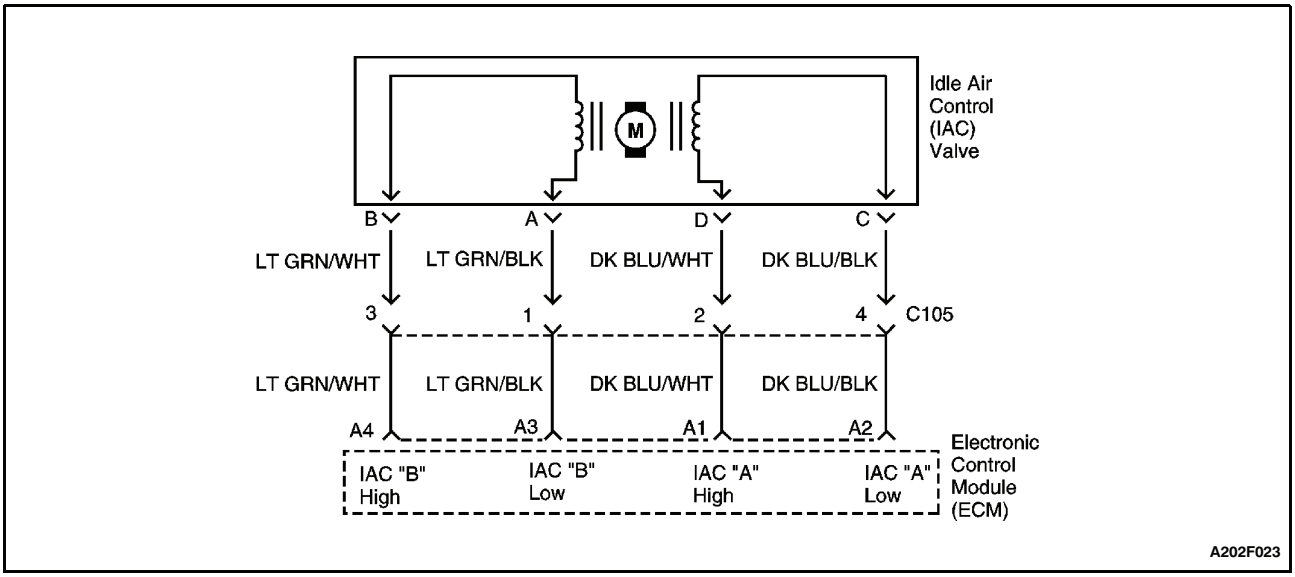

DIAGNOSTIC TROUBLE CODE (DTC) 35
IDLE AIR CONTROL ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) controls the idle speed to a calculated rpm based on inputs and the actual engine rpm. This is determined by the ignition reference pulses received by the ECM from the crankshaft position sensor. The ECM uses four circuits to move the idle air control (IAC) valve. The IAC valve allows varying amounts of air to flow into the intake manifold, controlling the idle speed.

DTC 35 Will Set When

- **Diagnostic trouble codes (DTCs) 21, 22 and 24 are not set.**
- **The throttle is closed.**
- **Rpm error (RPMVAR) is 175 rpm above or below the commanded idle speed for more than 20 seconds.**

Diagnostic Aids

- **Inspect for vacuum leaks, unconnected or brittle vacuum hoses, cuts, etc.**
- **Inspect the intake manifold and the throttle body gaskets for proper sealing.**
- **An IAC valve which does not respond to the ECM, an incorrect base idle adjustment, a damaged throttle body, or damage to the throttle body linkage could create the conditions for setting DTC 35.**

DTC 35 - Idle Air Control Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Turn the ignition OFF. 2. Connect the scan tool to the assembly line diagnostic link (ALDL). 3. Monitor the engine rpm. 4. Disconnect the idle air control (IAC) valve connector. 5. Connect the IAC driver to the IAC valve. 6. Start the engine. Allow the engine to idle in park (P), or neutral (N) for the manual transaxle, with the air conditioning (A/C) off and the parking brake applied. 7. Using the IAC driver, extend and retract the IAC valve. Does the rpm change as the IAC driver is cycled?	-	Go to Step 5	Go to Step 3
3	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Remove the IAC valve from the throttle body. 4. Inspect the IAC passages for restrictions. Are the IAC passages restricted?	-	Go to Step 4	Go to Step 14
4	1. Clean the IAC passages. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	Cycle the IAC driver while monitoring the engine rpm. Does the rpm change smoothly within the value specified with each flash of the IAC driver?	700-1500 rpm	Go to Step 6	Go to Step 3
6	1. Turn the ignition OFF. 2. Connect the IAC node light to the IAC connector. 3. Start the engine and cycle the IAC driver. Do both lights of the IAC node light cycle red and green but never turn off as the rpm is changed using the IAC driver?	-	Go to Step 7	Go to Step 9
7	1. Turn the ignition OFF. 2. Disconnect the IAC driver from the IAC valve. 3. Measure the resistance between IAC terminals A and B, then C and D. Is the resistance within the value specified?	40-80 W	Go to Step 8	Go to Step 14
8	Measure the resistance between IAC terminals B and C, then A and D. Does the resistance match the specified value?	R	Go to "Diagnostic Aids"	Go to Step 14
9	1. Turn the ignition OFF. 2. Disconnect the IAC node light from the IAC valve connector. 3. Check for faulty connector terminals. Is the problem found?	-	Go to Step 13	Go to Step 10

DTC 35 - Idle Air Control Error (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for any open circuits or open connections between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 11
11	Check for a short to ground between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 12
12	1. Turn the ignition ON. 2. Check for a short to voltage between the IAC valve connector terminals and the ECM. Is the problem found?	-	Go to Step 13	Go to Step 15
13	1. Turn the ignition OFF. 2. Repair the wire or the connector terminal as needed. 3. Clear any DTCs from the ECM. 4. Perform the IAC valve reset procedure. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
14	1. Replace the IAC valve. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
15	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the IAC valve reset procedure. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 36
EXHAUST GAS RECIRCULATION ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

A properly operating exhaust gas recirculation (EGR) system will directly affect the air/fuel requirements of the engine. Since the exhaust gas introduced into the air/fuel mixture cannot be used in combustion due to the lack of oxygen in the exhaust gas, less fuel is needed to maintain a correct air/fuel ratio. If the EGR system were to fail in a closed position, the exhaust gas would be replaced with air and the air/fuel mixture would be leaner. The electronic control module (ECM) would compensate for the lean condition by adding fuel, resulting in higher long term fuel trim values.

DTC 36 Will Set When

- The EGR valve is installed.
- Barometric pressure is above 90.0 kPa (26.65 inches Hg).
- Diagnostic trouble codes (DTCs) 21, 22, and 34 are not set.
- The engine coolant temperature is above 75°C (167°F).
- The long term fuel trim values are above 151 when the manifold absolute pressure (MAP) sensor indicates greater than 85 kPa (25.17 inches Hg) in open throttle.
- There is no vehicle speed present and the difference between the long term fuel trim values in open throttle and closed throttle is above 20.
- All conditions present for at least 60 seconds.

Diagnostic Aids

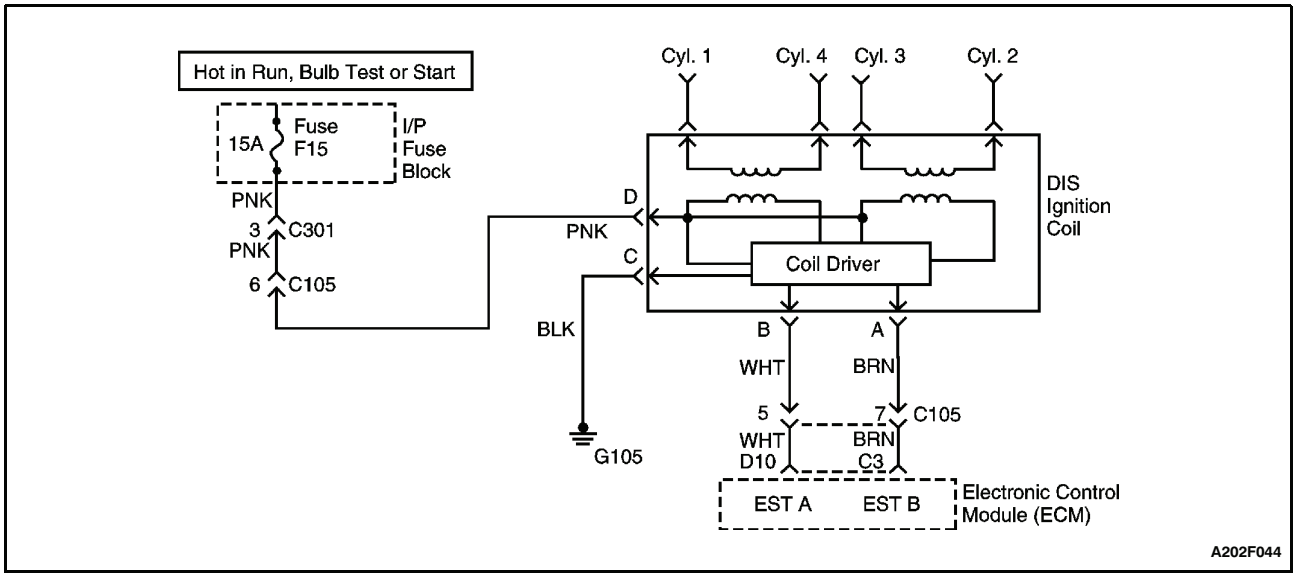
- The DTC 36 table is a functional check of the EGR system. If the EGR system is operating properly but a DTC 36 has been set, check other items that could result in high long term fuel trim values above idle.
- It is very common for the EGR valve spring to weaken over an extended period of time. As the EGR valve spring becomes weak, the EGR valve is allowed to open prematurely and excessively, causing excessive EGR flow. This can create the conditions needed to set the DTC 36.
- Check for restricted or blocked EGR passages.
- Perform a MAP sensor output check.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.

DTC 36 - Exhaust Gas Recirculation Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Inspect for looseness of the exhaust gas recirculation (EGR) valve by grasping the valve and trying to rotate it in both directions. Is there looseness in the EGR valve?	-	Go to Step 10	Go to Step 3
3	1. Disconnect the vacuum hose from the EGR valve. 2. Apply the specified value of vacuum to the EGR valve vacuum port. 3. Note the EGR valve diaphragm movement. Does the EGR valve diaphragm move?	33.77 kPa (10 in. Hg)	Go to Step 4	Go to Step 10
4	1. Disconnect the vacuum hose from the EGR valve. 2. Apply the specified value of vacuum to the EGR valve vacuum port. Does the EGR valve hold the vacuum?	33.77 kPa (10 in. Hg)	Go to Step 5	Go to Step 10

DTC 36 - Exhaust Gas Recirculation Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Place the transaxle in park (P) or neutral (N). 2. Run the warm engine at idle. 3. Push on the under side of the EGR valve diaphragm. Does the engine rpm decrease or does the engine stall?	-	Go to Step 6	Go to Step 11
6	1. Increase the engine rpm from idle to 2,000 rpm. 2. Note the EGR valve diaphragm movement. Does the EGR valve diaphragm move?	-	Go to "Diagnostic Aids"	Go to Step 7
7	1. Turn the ignition OFF. 2. Connect a vacuum gauge directly to the EGR valve vacuum source. 3. Start the engine. 4. Increase the engine rpm from idle to 2,000 rpm. 5. Note the vacuum gauge reading. Does the vacuum gauge read above the specified value?	20 kPa (6 in. Hg)	Go to Step 8	Go to Step 9
8	1. Turn the ignition OFF. 2. Check the EGR valve vacuum hose for a restriction or a leak. Is the repair complete?	-	System OK	-
9	1. Turn the ignition OFF. 2. Clean the EGR valve vacuum source at the throttle body vacuum port. Is the repair complete?	-	System OK	-
10	Replace the EGR valve. Is the repair complete?	-	System OK	-
11	1. Turn the ignition OFF. 2. Remove the EGR valve. 3. Inspect the EGR passages of the intake manifold for a restriction. Is the problem found?	-	Go to Step 12	Go to "Diagnostic Aids"
12	1. Clean the EGR passages of the intake manifold. 2. Clean the EGR valve passages. 3. Install the EGR valve. 4. Place the transaxle in park (P) or neutral (N). 5. Run the warm engine at idle. 6. Push on the under side of the EGR valve diaphragm. Does the engine rpm decrease or does the engine stall?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 41 ELECTRONIC SPARK TIMING "B" SHORTED TO BATTERY (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 41 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

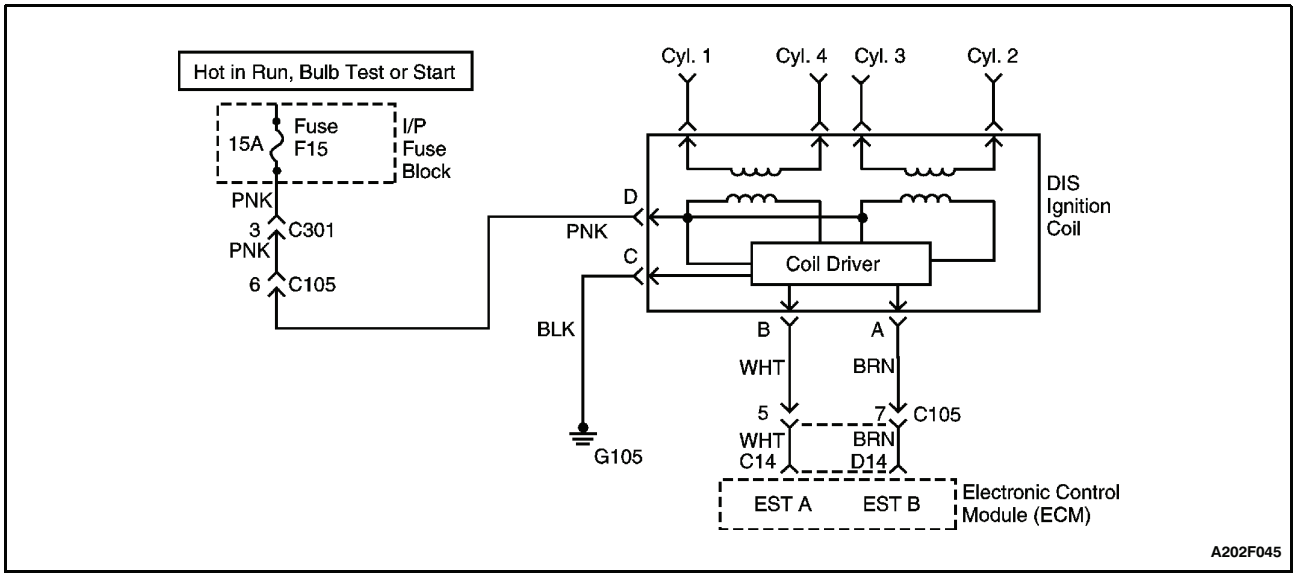
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 41 - Electronic Spark Timing "B" Shorted to Battery (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal A and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the value specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C3 or near terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal A. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal A while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal A and the ECM connector terminal C3. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 41 ELECTRONIC SPARK TIMING "B" SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 41 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

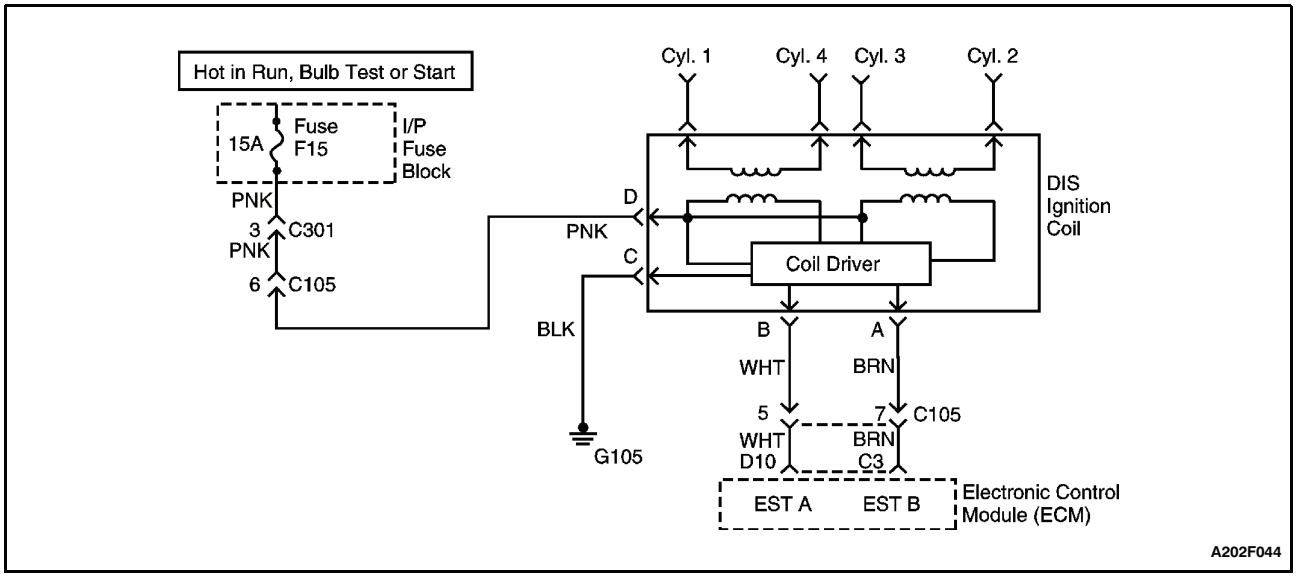
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 41 - Electronic Spark Timing "B" Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal A and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the value specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D14 or near terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal A. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal A while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal A and the ECM connector terminal D14. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 42 ELECTRONIC SPARK TIMING "A" SHORTED TO BATTERY (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 42 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

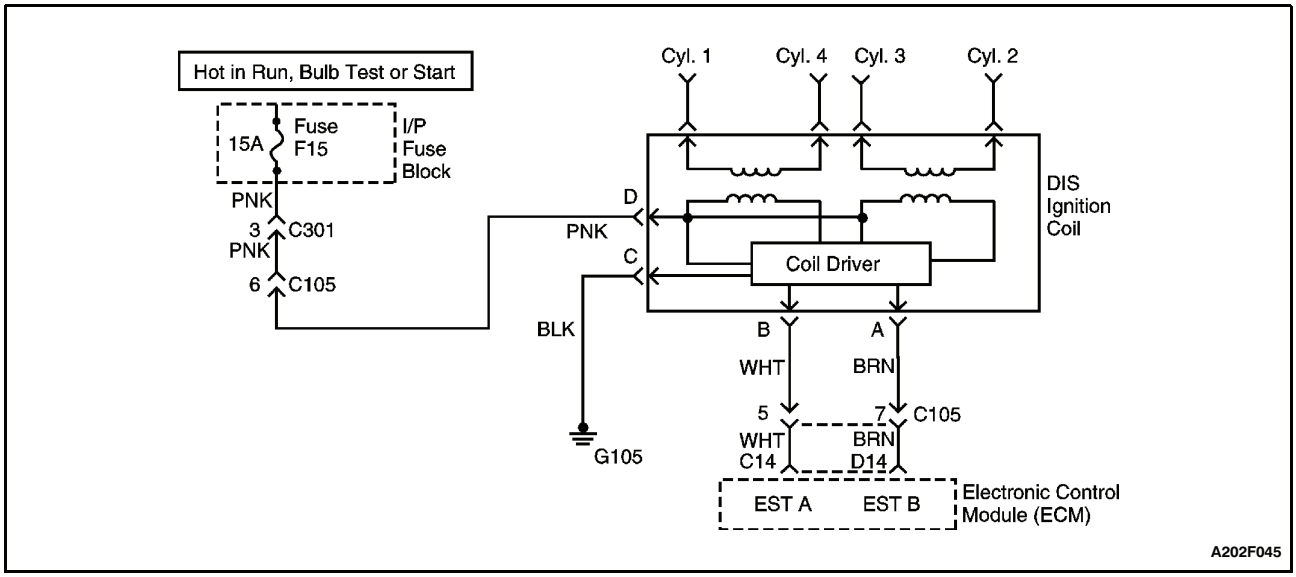
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "A" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "A" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 42 - Electronic Spark Timing "A" Shorted to Battery (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal B and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D10 or near terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal B. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal B while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal B and the ECM connector terminal D10. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and the harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 42 ELECTRONIC SPARK TIMING "A" SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 42 Will Set When

- The ECM receives voltage greater than 12 volts through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If the connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

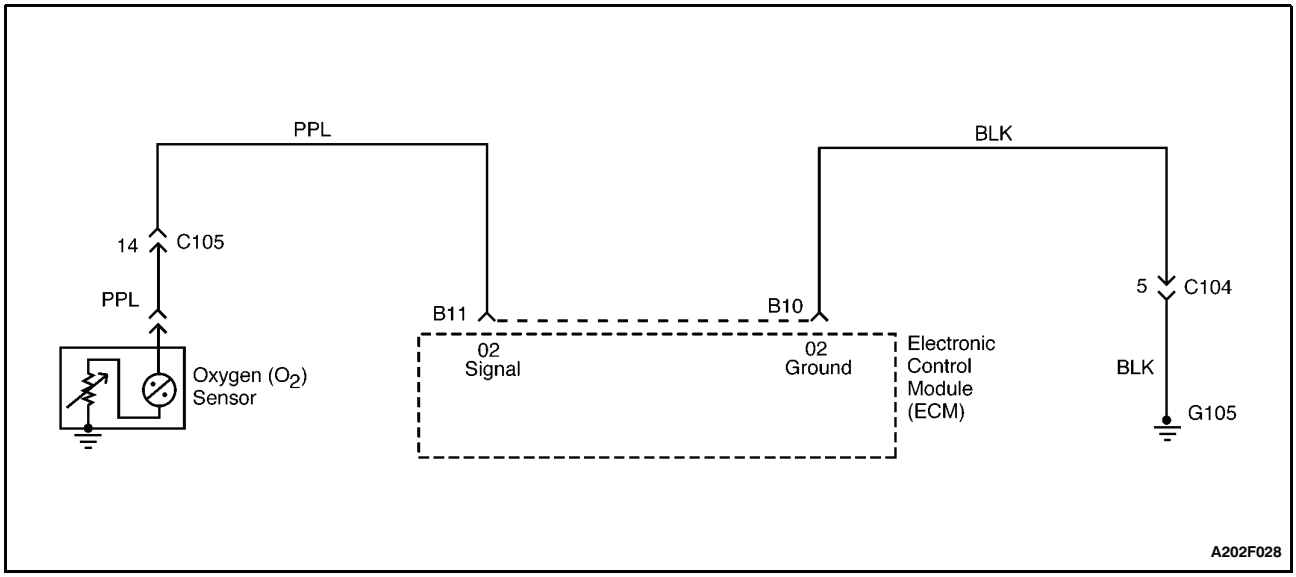
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "A" and the ground from the ECM.
6. A short to voltage that is intermittent may be at fault in the EST "A" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 42 - Electronic Spark Timing "A" Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Measure the voltage between terminal B and terminal C of the DIS ignition coil connector. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 10	Go to Step 4
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C14 or near terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	1. Turn the ignition ON. 2. Measure the voltage at the DIS ignition coil connector terminal B. Is any voltage present?	-	Go to Step 7	Go to Step 6
6	Measure the voltage at the DIS ignition coil connector terminal B while moving the connectors and the wiring harness of the ignition circuit. Is any voltage present?	-	Go to Step 7	Go to Step 8
7	1. Turn the ignition OFF. 2. Repair the short to voltage between the DIS ignition coil connector terminal B and the ECM connector terminal C14. 3. Clear any diagnostic trouble codes (DTCs) from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	1. Turn the ignition OFF. 2. Check the wires and the harnesses of the ignition circuit for any damage that could cause an intermittent short to voltage. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 44
OXYGEN SENSOR LEAN (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 44 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is below 200 millivolts for at least 30 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Inspect the O_2 sensor wire. The O_2 sensor pigtail may be positioned incorrectly and contacting the exhaust manifold.
- Check for an intermittent ground in the wire between the O_2 sensor and the ECM.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.
- An exhaust manifold gasket leak or a cracked exhaust manifold may cause outside air to be pulled into the exhaust and past the sensor.

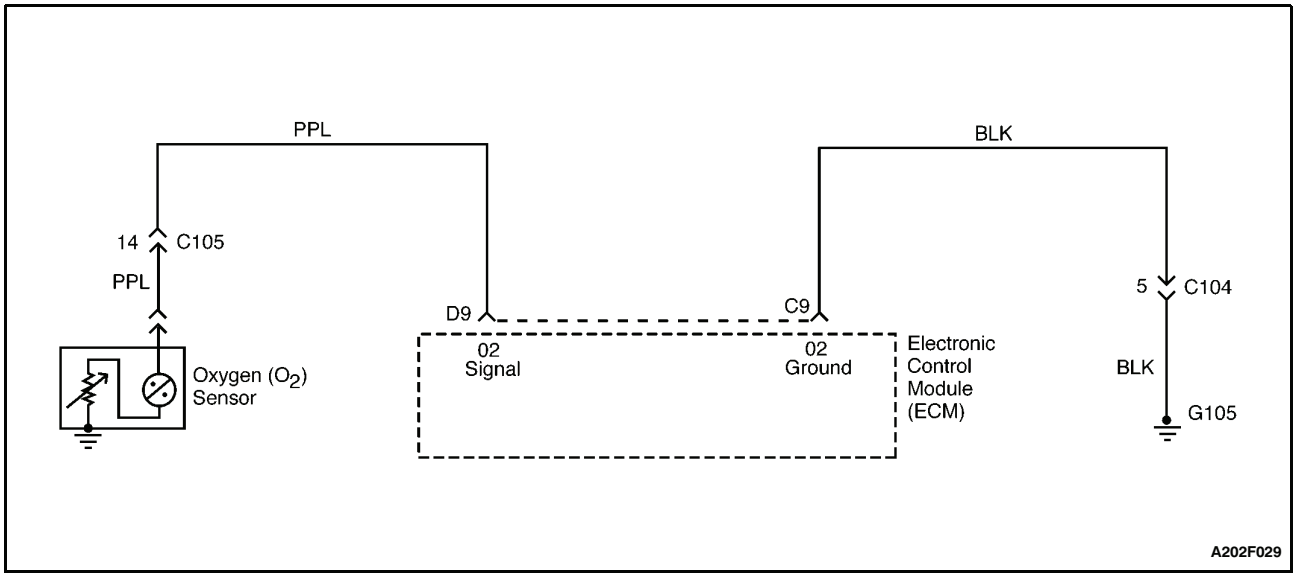
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
4. If the O_2 sensor voltage stays fixed below 350 millivolts after disconnecting the O_2 sensor, there is either a short to ground in the O_2 sensor wire to the ECM or a faulty ECM.

DTC 44 - Oxygen Sensor Lean (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed below the value specified?	220 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector. 2. Run the warm engine at idle. Does the scan tool read O_2 sensor voltage within the value specified?	350-550 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Check the O_2 sensor signal wire between the O_2 sensor and electronic control module (ECM) connector terminal B11 for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 44
OXYGEN SENSOR LEAN (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 44 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is below 274 millivolts.
- The conditions are present for 40 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Inspect the O_2 sensor wire. The O_2 sensor pigtail may be positioned incorrectly and contacting the exhaust manifold.
- Check for an intermittent ground in the wire between the O_2 sensor and the ECM.
- Perform an injector balance test to determine if a restricted fuel injector may be causing the lean running condition.
- Vacuum or crankcase leaks will cause a lean running condition.
- An exhaust manifold gasket leak or a cracked exhaust manifold may cause outside air to be pulled into the exhaust and past the sensor.

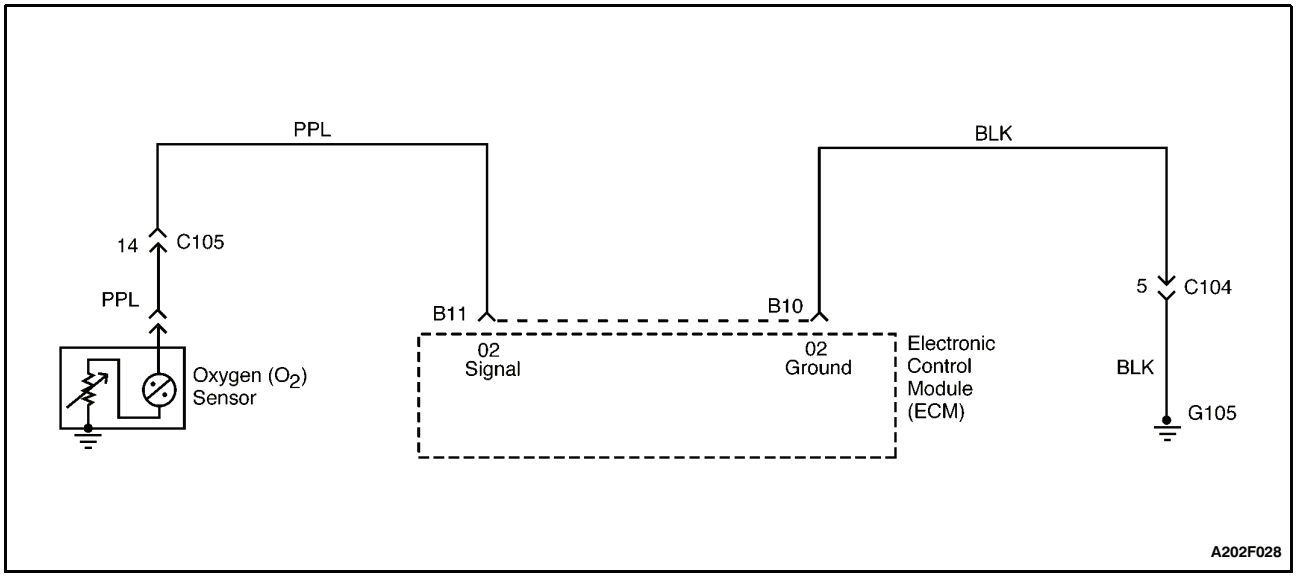
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
4. If the O_2 sensor voltage stays fixed below 350 millivolts after disconnecting the O_2 sensor, there is either a short to ground in the O_2 sensor wire to the ECM or a faulty ECM.

DTC 44 - Oxygen Sensor Lean (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed below the value specified?	274 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector. 2. Run the warm engine at idle. Does the scan tool read O_2 sensor voltage within the value specified?	350-550 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Check the O_2 sensor signal wire between the O_2 sensor and electronic control module (ECM) connector terminal D9 for a short to ground. Is the problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the wire or the connector terminal as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Road test the vehicle. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 45
OXYGEN SENSOR RICH (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals B11 and B10. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 45 Will Set When

- The engine has been running for at least 50 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 80°C (176°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is above 800 millivolts for at least 30 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Fuel pressure that is too high may cause a rich running condition.
- A leaking fuel pressure regulator diaphragm will cause a rich running condition.
- Check for leaking fuel injectors by performing a fuel injector balance test.
- An intermittent throttle position sensor output will cause a rich running condition due to a false indication of the engine accelerating.
- A false rich indication due to silicone contamination of the O_2 sensor. This will be indicated by the presence of the DTC 45 accompanied by lean driveability conditions and a powdery white deposit on the O_2 sensor.

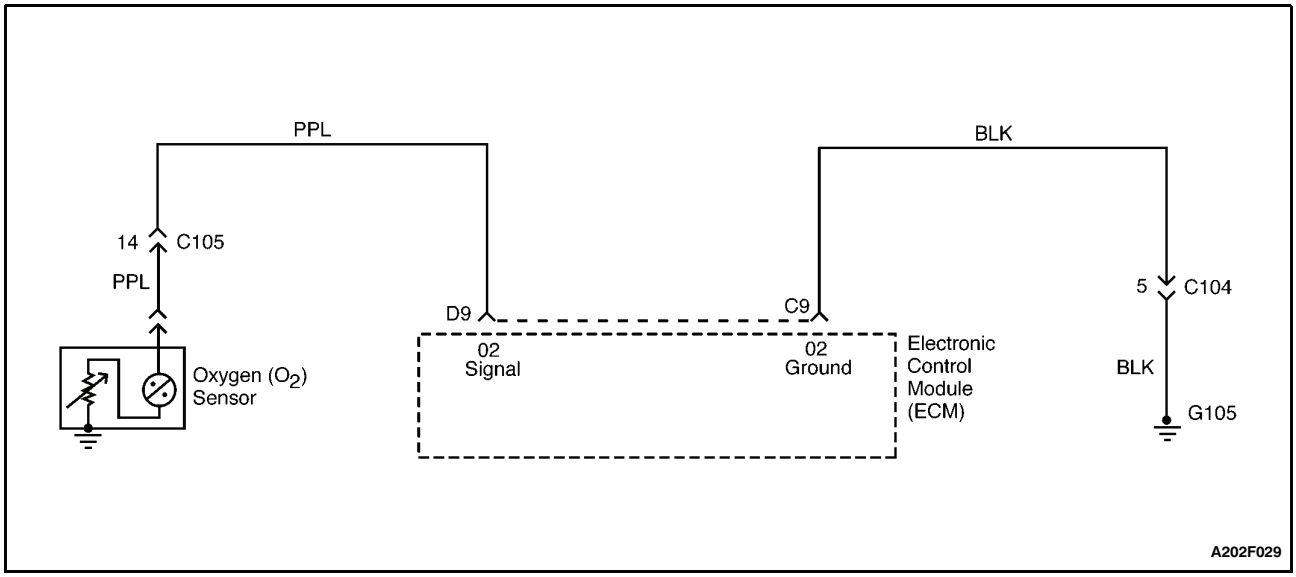
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
3. This step checks for the electronic control module ability to read a simulated lean O_2 sensor signal.

DTC 45 - Oxygen Sensor Rich (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed above the value specified?	800 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector and jumper the connector terminal to ground on the side of the electronic control module (ECM). 2. Run the warm engine at idle. Does the scan tool read the O_2 sensor voltage below the value specified?	350 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 45
OXYGEN SENSOR RICH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) supplies a voltage of about 450 millivolts between the ECM terminals D9 and C9. The oxygen (O_2) sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down to about 100 millivolts if the exhaust is lean. The O_2 sensor is like an open circuit and produces no voltage when it is below 360°C (680°F). An open O_2 sensor circuit or a cold O_2 sensor causes "open loop" operation.

DTC 45 Will Set When

- The engine has been running for at least 60 seconds.
- Diagnostic trouble codes (DTCs) 21, 22, 33, and 34 are not set.
- The throttle angle is above 5 percent.
- The coolant temperature is above 70°C (158°F).
- The engine controls system is in closed loop.
- The O_2 sensor voltage is above 865 millivolts.
- These conditions are present for more than 10 seconds.

Diagnostic Aids

- Normal scan tool voltage varies between 100 millivolts and 999 millivolts while in closed loop.
- Fuel pressure that is too high may cause a rich running condition.
- A leaking fuel pressure regulator diaphragm will cause a rich running condition.
- Check for leaking fuel injectors by performing a fuel injector balance test.
- An intermittent throttle position sensor output will cause a rich running condition due to a false indication of the engine accelerating.
- A false rich indication due to silicone contamination of the O_2 sensor. This will be indicated by the presence of the DTC 45 accompanied by lean driveability conditions and a powdery white deposit on the O_2 sensor.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. Running the engine at 1,200 rpm keeps the O_2 sensor hot so an accurate display voltage can be maintained.
3. This step checks for the electronic control module ability to read a simulated lean O_2 sensor signal.

DTC 45 - Oxygen Sensor Rich (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Run the engine until it reaches operating temperature. 3. Run the engine at 1,200 rpm. Does the scan tool read the oxygen (O_2) sensor voltage fixed above the value specified?	800 mv	Go to Step 3	Go to "Diagnostic Aids"
3	1. Disconnect the O_2 sensor connector and jumper the connector terminal to ground on the side of the electronic control module (ECM). 2. Run the warm engine at idle. Does the scan tool read the O_2 sensor voltage below the value specified?	350 mv	Go to "Diagnostic Aids"	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the ECM. 3. Road test the vehicle. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 49
BATTERY VOLTAGE TOO HIGH (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) monitors the battery voltage at the ECM connector terminal C16. If the ECM detects voltage above the tolerance, the diagnostic trouble code (DTC) 49 will be set.

DTC 49 Will Set When

- The battery voltage (ADBAT) is greater than 17.2 volts for more than 2 seconds.

Diagnostic Aids

- Charging the battery with a battery charger and starting the engine may set the DTC 49.
- Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, or a damaged harness.
- If the connections and the wiring harness check OK, monitor the battery voltage display on the scan tool while moving related connectors. If the fault is induced, the battery voltage will abruptly change. This may help to isolate the location of the problem.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. If the scan tool is showing incorrect battery voltage, the ECM is at fault.

DTC 49 - Battery Voltage Too High (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Start the engine and raise the engine speed to 1,200 rpm. 3. Monitor the battery voltage on the scan tool. Is the voltage at or above the value specified?	17.2 v	Go to Step 3	Go to Step 4
3	Measure the voltage across the battery. Is the voltage at or above the value specified?	17.2 v	Go to Step 5	Go to Step 6
4	1. Turn the headlamps ON. 2. Turn the air conditioning (A/C) ON. 3. Turn the blower switch to HIGH. 4. Raise the engine speed to 2,000 rpm. 5. Monitor the battery voltage on the scan tool. Is the voltage at or above the value specified?	17.2 v	Go to Step 5	Go to "Diagnostic Aids"
5	1. Turn the ignition OFF. 2. Repair the generator or the generator circuit as needed. 3. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Turn the ignition OFF. 2. Replace the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

DIAGNOSTIC TROUBLE CODE (DTC) 51
ECM ERROR (CHECKSUM OR KKPGMID ERROR)
(1.3L AND 1.5L SOHC IEFI-6, 1.3L SOHC AND 1.6L DOHC ITMS-6F)

DTC Will Set When

- KKPGMID is not set into $95 for the IEFI-6 ($99 for the ITMS-6F), or the calculated CHECKSUM is not consistent with the KKSUM.

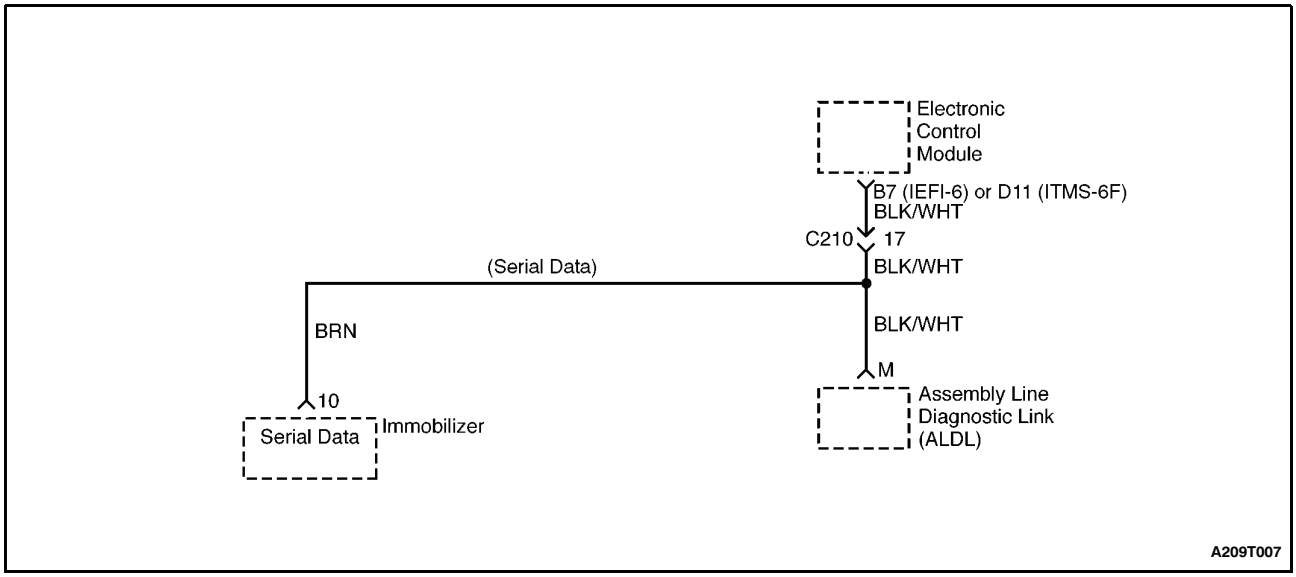
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. A programmable read-only memory (PROM) that is incorrectly installed will set the diagnostic trouble code (DTC) 51.

DTC 51 - ECM Error (CHECKSUM or KKPGMID Error)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Check that all of the programmable read-only memory (PROM) pins are fully inserted in the socket. Is the problem found?	-	Go to Step 3	Go to Step 4
3	1. Install the PROM correctly in the socket. 2. Clear any diagnostic trouble codes (DTCs) from the electronic control module (ECM). 3. Check for the presence of any DTCs. Does the DTC 51 reappear?	-	Go to Step 4	Go to "Diagnostic System Check"
4	1. Replace the PROM. 2. Clear any DTCs from the ECM. 3. Check for the presence of any DTCs. Does the DTC 51 reappear?	-	Go to Step 5	Go to "Diagnostic System Check"
5	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 53 ECM IMMOBILIZED ERROR (1.3L AND 1.5L SOHC IEFI-6, 1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the ignition is turned ON, the key is tested by the immobilizer anti-theft system. While the key code is being read by the immobilizer control unit, the engine can start and run with any key that will turn the lock cylinder. The key code is read and compared with key codes that have been stored in the memory of the immobilizer control unit. If a valid key is detected, the immobilizer control unit sends a serial data release message to the electronic control module (ECM). Included in the release message is an identification (ID) code which assures that neither the immobilizer control unit nor the ECM have been substituted to defeat the system. If the ECM receives an invalid release message, the ECM performs the following actions:

- **Disables the fuel injector circuit.**
- **Disables the fuel pump circuit.**

DTC 53 Will Set When

- **The ECM does not receive the signal from the immobilizer control module within .562 seconds when the vehicle is stationary, or within 1.5 seconds when the vehicle is moving.**
- **The ECM receives an incorrect release message from the immobilizer control unit more than five times.**

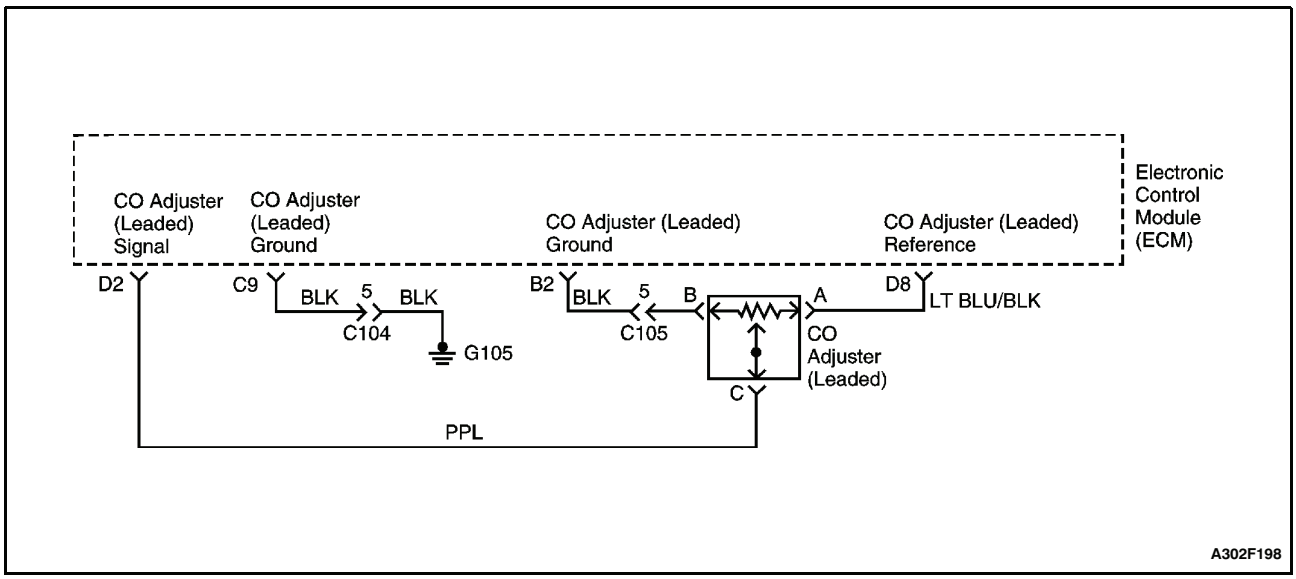
The above conditions are maintained until the ignition is switched OFF.

DTC 53 Will Clear When

- **The ignition switch is turned OFF or the scan tool CLEAR CODES command is issued.**

DTC 53 - ECM Immobilized Error (1.3L and 1.5L SOHC IEFI-6, 1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value	Yes	No
1	Connect the scan tool using the following procedure: 1. Insert the immobilizer data cartridge into the scan tool. 2. Turn the ignition switch OFF. 3. Connect the scan tool to the assembly line diagnostic link (ALDL). 4. Connect the scan tool's power cord to the cigar lighter socket. 5. Turn the ignition ON, but do not start the engine. Is communication established between the scan tool and the immobilizer control unit?	-	Go to Step 2	Go to Section 9T, Immobilizer Anti-Theft System
2	1. Select SYSTEM DIAGNOSIS from the scan tool menu. 2. Read the KEY STATUS message. Does the KEY STATUS message indicate POS NR (position number) 00?	-	Go to Section 9T, Immobilizer Anti-Theft System	Go to Step 3
3	1. Select SYSTEM DIAGNOSIS from the scan tool menu. 2. Read the IMMO & ECM ID CODE (immobilization and electronic control module identification code) message. Does the ID CODE DIFFERENT message appear?	-	Go to Section 9T, Immobilizer Anti-Theft System	Go to Step 4
4	Check for an open serial data wire between the immobilizer control unit and the electronic control module (ECM). Is the circuit open?	-	Go to Step 5	Go to Step 6
5	Repair the open serial data wire between the ECM and the immobilizer control unit. Is the repair complete?	-	System OK	-
6	1. Replace the ECM. 2. Reprogram the ID code. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 54
CO ADJUST ERROR (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The CO adjuster is only used on vehicles that use leaded fuel. The CO adjuster is used in place of the O_2 sensor.

DTC 54 Will Set When

- The engine control system is in open loop.
- The CO potentiometer is greater than 250 counts or less than 5 counts.

Diagnostic Aids

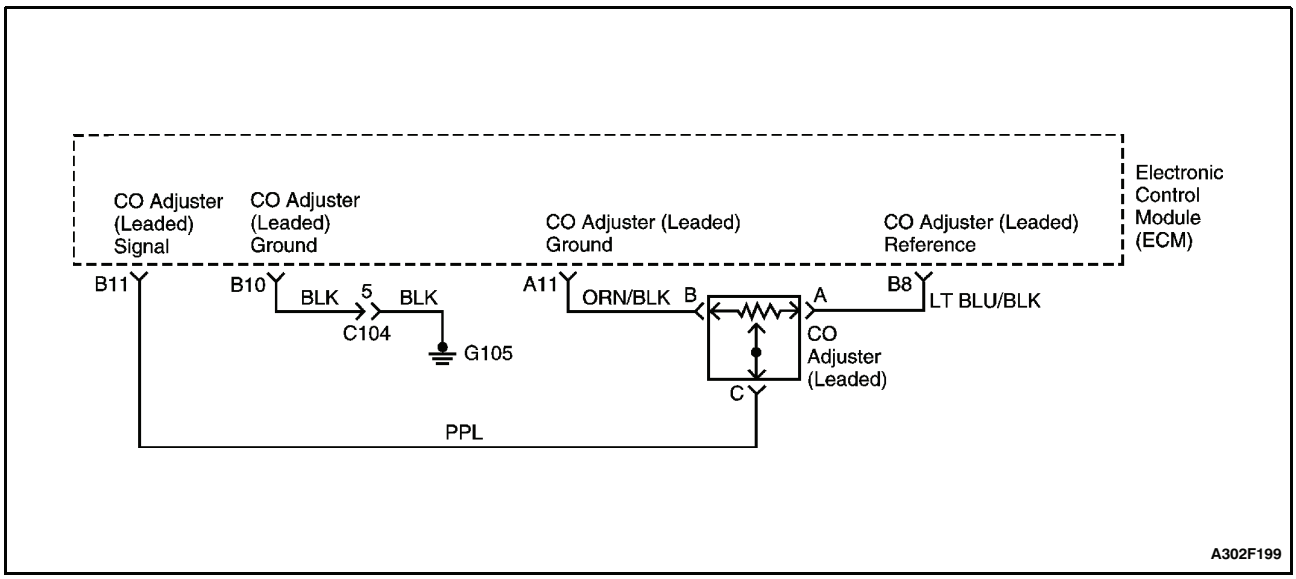
- Inspect the electronic control module (ECM) wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.

DTC 54 - CO Adjust Error (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Adjust the CO adjuster. Is the CO adjustable and in proper adjustment?	-	System OK	Go to Step 3
3	1. To check the ability of the electronic control module (ECM) to provide a 5-volt supply to the CO adjuster, begin by turning the ignition OFF. 2. Disconnect the electrical connector at the CO adjuster. 3. Turn the ignition ON. 4. Measure the voltage between the CO adjuster terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal A and the ECM connector terminal B8. Is the problem found?	-	Go to Step 8	Go to Step 7

DTC 54 - CO Adjust Error (1.3L and 1.5L SOHC IEFI-6) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal C and the ECM connector terminal B11. Is the problem found?	-	Go to Step 8	Go to Step 9
7	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal B and the ECM connector terminal A11. Is the problem found?	-	Go to Step 8	Go to Step 6
8	1. Repair the wire or the connector terminal, as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Disconnect the electrical connector at the CO adjuster. 2. Measure the resistance between terminal A and terminal B of the CO adjuster. Is the resistance the value specified?	12.6 W	Go to Step 10	Go to Step 11
10	To check the ability of the CO adjuster to vary the resistance in the circuit, begin by measuring the resistance between terminal A and terminal C of the CO adjuster. Does the resistance vary with the turn of the CO adjuster screw?	-	Go to Step 12	Go to Step 11
11	1. Replace the CO adjuster. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	Check for an open or a short to battery voltage between terminal B10 of the ECM and ground. Is the problem found?	-	Go to Step 8	Go to Step 5



DIAGNOSTIC TROUBLE CODE (DTC) 54
CO ADJUST ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The CO adjuster is only used on vehicles that use leaded fuel. The CO adjuster is used in place of the O_2 sensor.

DTC 54 Will Set When

- The engine control system is in open loop.
- CO potentiometer is greater than 250 counts or less than 5 counts.

Diagnostic Aids

- Inspect the electronic control module (ECM) wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.

DTC 54 - CO Adjust Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	Adjust the CO adjuster. Is the CO adjustable and in proper adjustment?	-	System OK	Go to Step 3
3	1. To check the ability of the electronic control module (ECM) to provide a 5-volt supply to the CO adjuster, begin by turning the ignition OFF. 2. Disconnect the electrical connector at the CO adjuster. 3. Turn the ignition ON. 4. Measure the voltage between the CO adjuster terminal A and ground. Does the voltage measure within the value specified?	4.5-5.5 v	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal A and the ECM connector terminal D8. Is the problem found?	-	Go to Step 8	Go to Step 7

DTC 54 - CO Adjust Error (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal C and the ECM connector terminal D2. Is the problem found?	-	Go to Step 8	Go to Step 9
7	Check for a short to battery voltage, a short to ground, or an open in the wire between the CO adjuster terminal B and the ECM connector terminal B2. Is the problem found?	-	Go to Step 8	Go to Step 6
8	1. Repair the wire or the connector terminal, as needed. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
9	1. Disconnect the electrical connector at the CO adjuster. 2. Measure the resistance between terminal A and terminal B of the CO adjuster. Is the resistance the value specified?	12.6 W	Go to Step 10	Go to Step 11
10	To check the ability of the CO adjuster to vary the resistance in the circuit, begin by measuring the resistance between terminal A and terminal C of the CO adjuster. Does the resistance vary with the turn of the CO adjuster screw?	-	Go to Step 12	Go to Step 11
11	1. Replace the CO adjuster. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	Check for an open or a short to battery voltage between terminal C9 of the ECM and ground. Is the problem found?	-	Go to Step 8	Go to Step 5

DIAGNOSTIC TROUBLE CODE (DTC) 55
EEPROM OR CONFIG REG ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) utilizes an electronically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine diagnostics operation.

DTC 55 Will Set When

- Microprocessor configuration register is not equal to $0B.

Diagnostic Aids

The diagnostic trouble code (DTC) 55 indicates that the contents of the EEPROM have changed since the ECM was programmed. The only possible repair is ECM replacement. Remember to program the replacement ECM with the correct software and calibration for the vehicle.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. When the ECM is being replaced, the new ECM must be programmed.

DTC 55 - EEPROM or Config Reg Error (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Replace the electronic control module (ECM). 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

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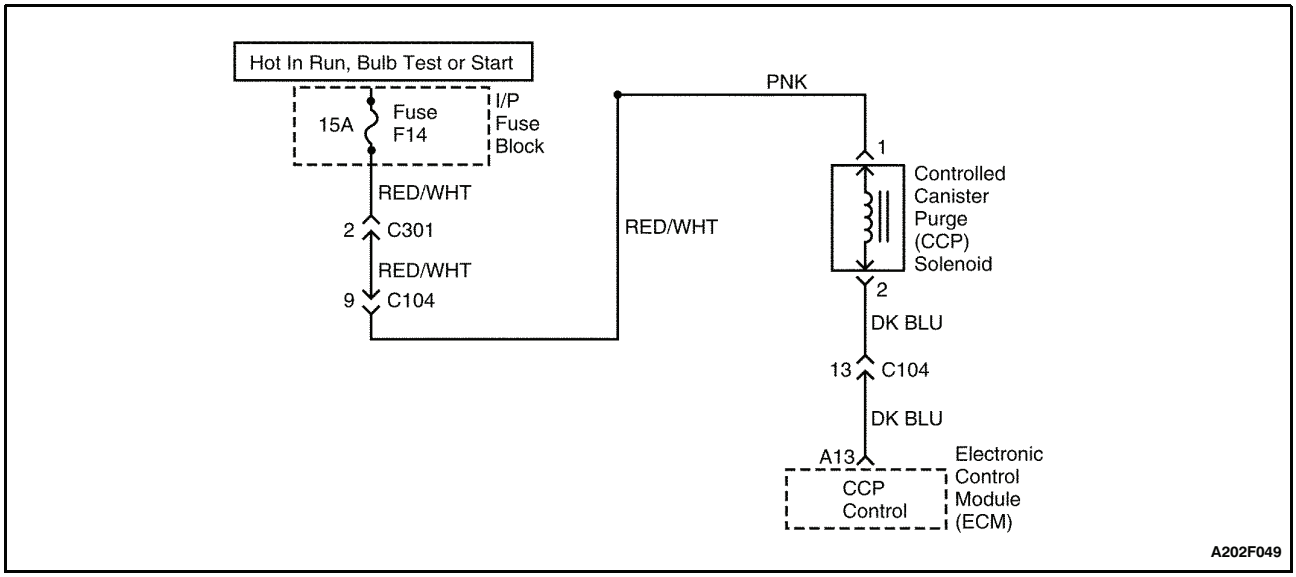


DIAGNOSTIC TROUBLE CODE (DTC) 61
CCP SOLENOID SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Evaporative canister purge is controlled by the electronic control module (ECM). The ECM applies a ground to the controlled canister purge (CCP) solenoid. The ECM determines when to activate the CCP solenoid depending on operating conditions, including throttle position, engine speed, coolant temperature, and ambient temperature.

DTC 61 Will Set When

- **A short to ground condition exits.**
- **This condition is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the CCP solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

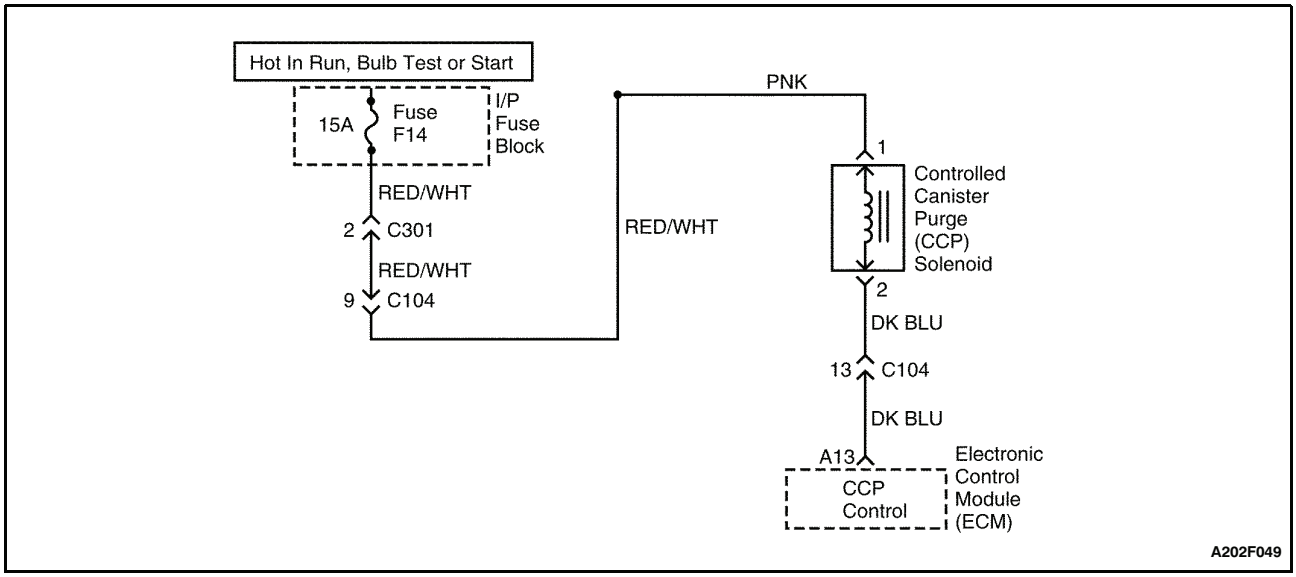
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **With the ignition OFF, the ECM should not be applying ground to the CCP solenoid.**
3. **If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.**

DTC 61 - CCP Solenoid Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the controlled canister purge (CCP) solenoid connector. 2. Connect a test light between the CCP solenoid connector terminal 2 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the CCP solenoid connector terminal 2 and the ECM connector terminal A13. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 62
CCP SOLENOID SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

Evaporative canister purge is controlled by the electronic control module (ECM). The ECM applies a ground to the controlled canister purge (CCP) solenoid. The ECM determines when to activate the CCP solenoid depending on operating conditions, including throttle position, engine speed, coolant temperature, and ambient temperature.

DTC 62 Will Set When

- **A short to battery voltage condition exits.**
- **This condition is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the CCP solenoid connector terminal 2 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

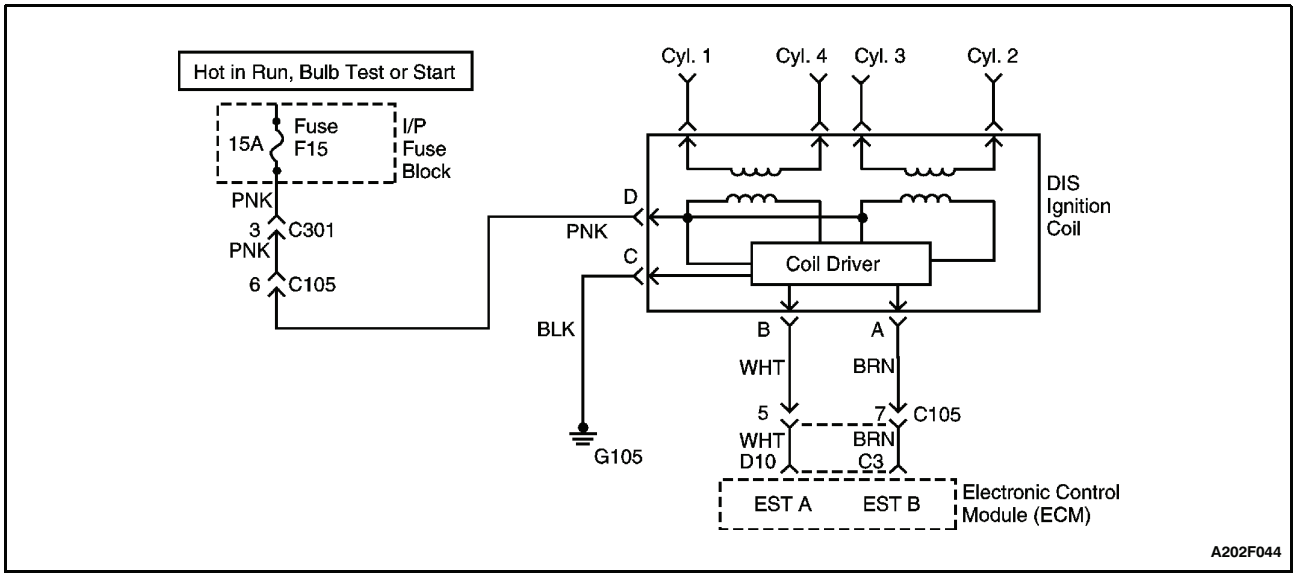
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. If the test light is still on after disconnecting the ECM red connector, the wire between the CCP solenoid and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.

DTC 62 - CCP Solenoid Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the controlled canister purge (CCP) solenoid connector. 2. Measure the resistance of the CCP solenoid. Does the resistance measure near the value specified?	[0 W	Go to Step 6	Go to Step 3
3	1. Disconnect the CCP solenoid connector. 2. Connect a test light between the CCP solenoid connector terminal 2 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the CCP solenoid connector terminal 2 and the ECM connector terminal A13. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the CCP solenoid. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 63 ELECTRONIC SPARK TIMING "B" SHORTED TO GROUND (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 63 Will Set When

- No voltage is supplied by the ECM through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 10 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

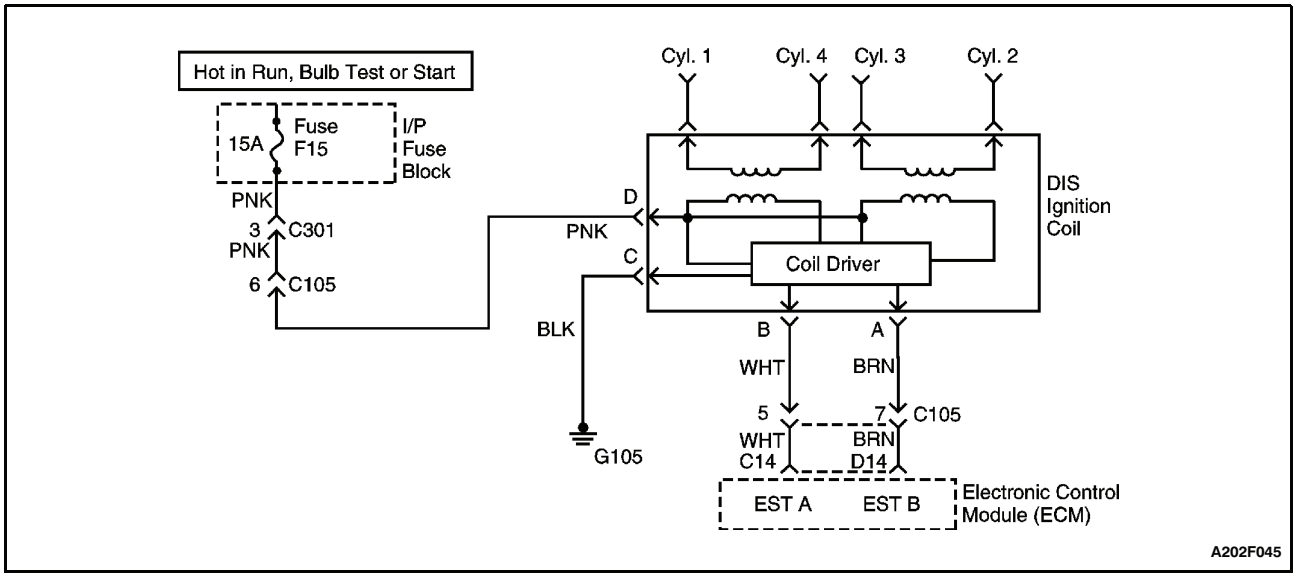
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 63 - Electronic Spark Timing "B" Shorted to Ground (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal A and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C3 or near terminal C3. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal C3. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 63 ELECTRONIC SPARK TIMING "B" SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 63 Will Set When

- No voltage is supplied by the ECM through the EST "B" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

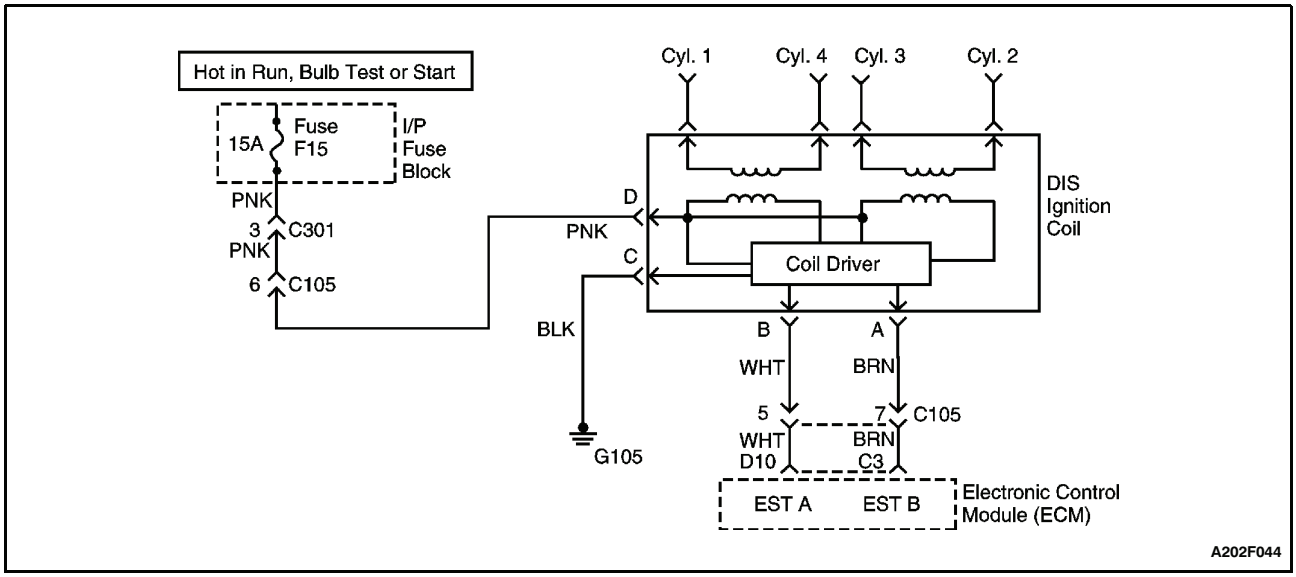
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "B" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "B" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 63 - Electronic Spark Timing "B" Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal A and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at or near the ECM connector terminal D14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal A and the ECM connector terminal D14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 64 ELECTRONIC SPARK TIMING "A" SHORTED TO GROUND (1.3L AND 1.5L SOHC IEFI-6)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 64 Will Set When

- **No voltage is supplied by the ECM through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.**
- **This error occurs over 10 times.**

Diagnostic Aids

- **Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.**
- **If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.**

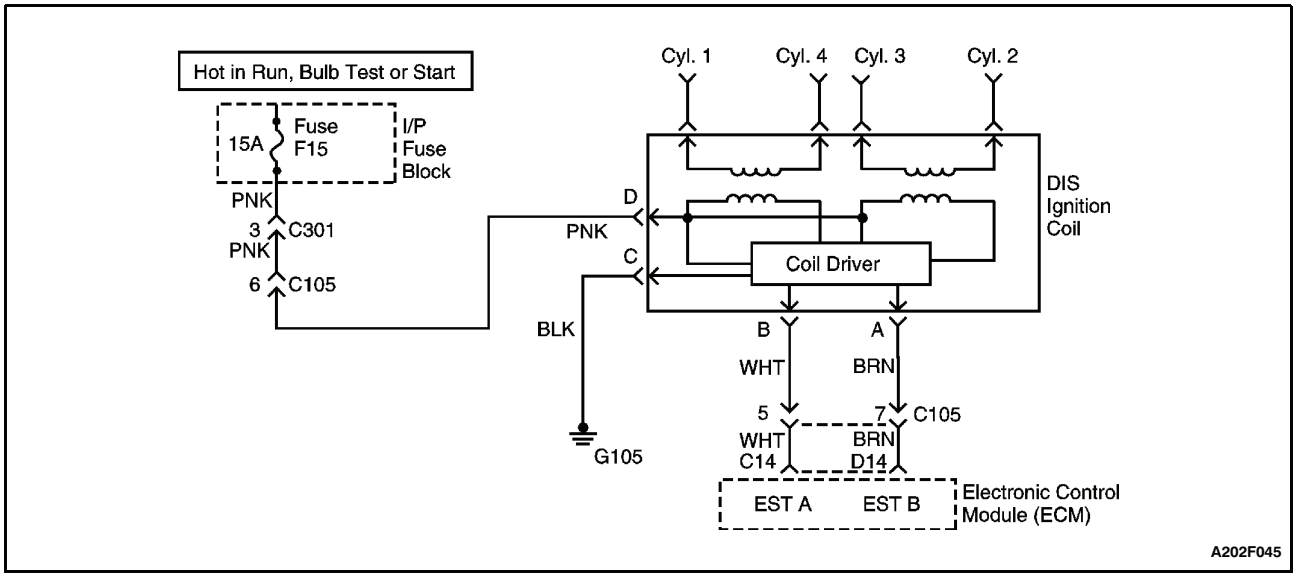
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. **This step checks both the EST "A" and the ground from the ECM.**
6. **An open circuit or short to ground that is intermittent may be at fault in the EST "A" wire from the ECM.**
11. **If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.**

DTC 64 - Electronic Spark Timing "A" Shorted to Ground (1.3L and 1.5L SOHC IEFI-6)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal B and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal D10 or near terminal D10. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal D10. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 64 ELECTRONIC SPARK TIMING "A" SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The direct ignition system (DIS) ignition coil is supplied with battery voltage when the ignition is ON. The electronic control module (ECM) triggers the circuit for the DIS ignition coil. Voltage is then induced in the secondary portion of the DIS ignition coil. Control of the DIS ignition coil is monitored separately for the two electronic spark timing (EST) lines.

DTC 64 Will Set When

- No voltage is supplied by the ECM through the EST "A" line while reference pulses are received by the ECM from the crankshaft position sensor.
- This error occurs over 6 times.

Diagnostic Aids

- Inspect the ECM harness connectors for backed-out terminals, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged wiring harness.
- If connections and the harness are OK, connect a digital voltmeter or an oscilloscope between the affected terminal and ground while moving the related connectors and the wiring harness. If the fault is induced, the voltage reading or the scope pattern will change.

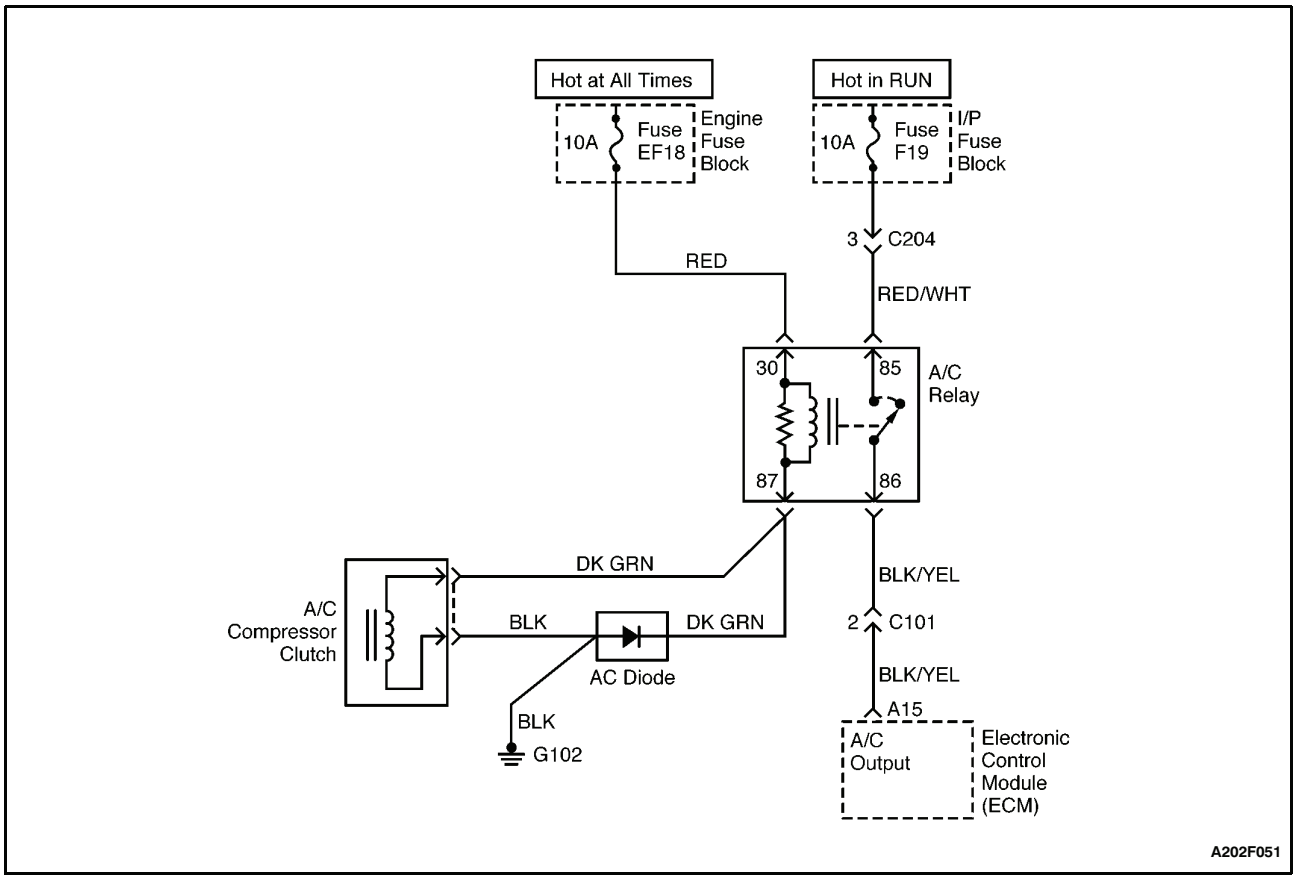
Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step checks both the EST "A" and the ground from the ECM.
6. An open circuit or short to ground that is intermittent may be at fault in the EST "A" wire from the ECM.
11. If there are not any problems in the wiring of the circuit, yet no output from the ECM, the ECM is faulty.

DTC 64 - Electronic Spark Timing "A" Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the direct ignition system (DIS) ignition coil connector. 2. Check the DIS ignition coil connector terminals to ensure that the terminals are correctly installed and none of them are touching. Is the problem found?	-	Go to Step 9	Go to Step 3
3	1. Connect a voltmeter between terminal B and terminal C of the DIS ignition coil. 2. Crank the engine. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to Step 4	Go to Step 10
4	1. Turn the ignition OFF. 2. Disconnect the electronic control module (ECM) white connector. 3. Check for any damaged pins or terminals at the ECM connector terminal C14 or near terminal C14. Is the problem found?	-	Go to Step 9	Go to Step 5
5	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14. Is the problem found?	-	Go to Step 7	Go to Step 6
6	Check for an open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14 while moving the connectors and the wiring harness of the ignition circuit. Is the problem found?	-	Go to Step 7	Go to Step 8
7	1. Repair the open or short to ground between the DIS ignition coil connector terminal B and the ECM connector terminal C14. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Check the wires and wiring harnesses of the ignition circuit for any damage that could cause an intermittent open or short to ground. Is the problem found?	-	Go to Step 9	Go to Step 11
9	1. Repair any wire or connector terminal as needed. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
10	1. Turn the ignition OFF. 2. Replace the DIS ignition coil assembly. 3. Clear any DTCs from the ECM. 4. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 87
A/C CUT SHORTED TO GROUND (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the air conditioning (A/C) switch is turned ON, the electronic control module (ECM) grounds the A/C compressor relay to initiate A/C compressor operation. Under various operating conditions, the ECM will interrupt A/C compressor operation.

DTC 87 Will Set When

- **A short to ground condition exits and is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the A/C compressor relay connector terminal 85 and battery positive while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

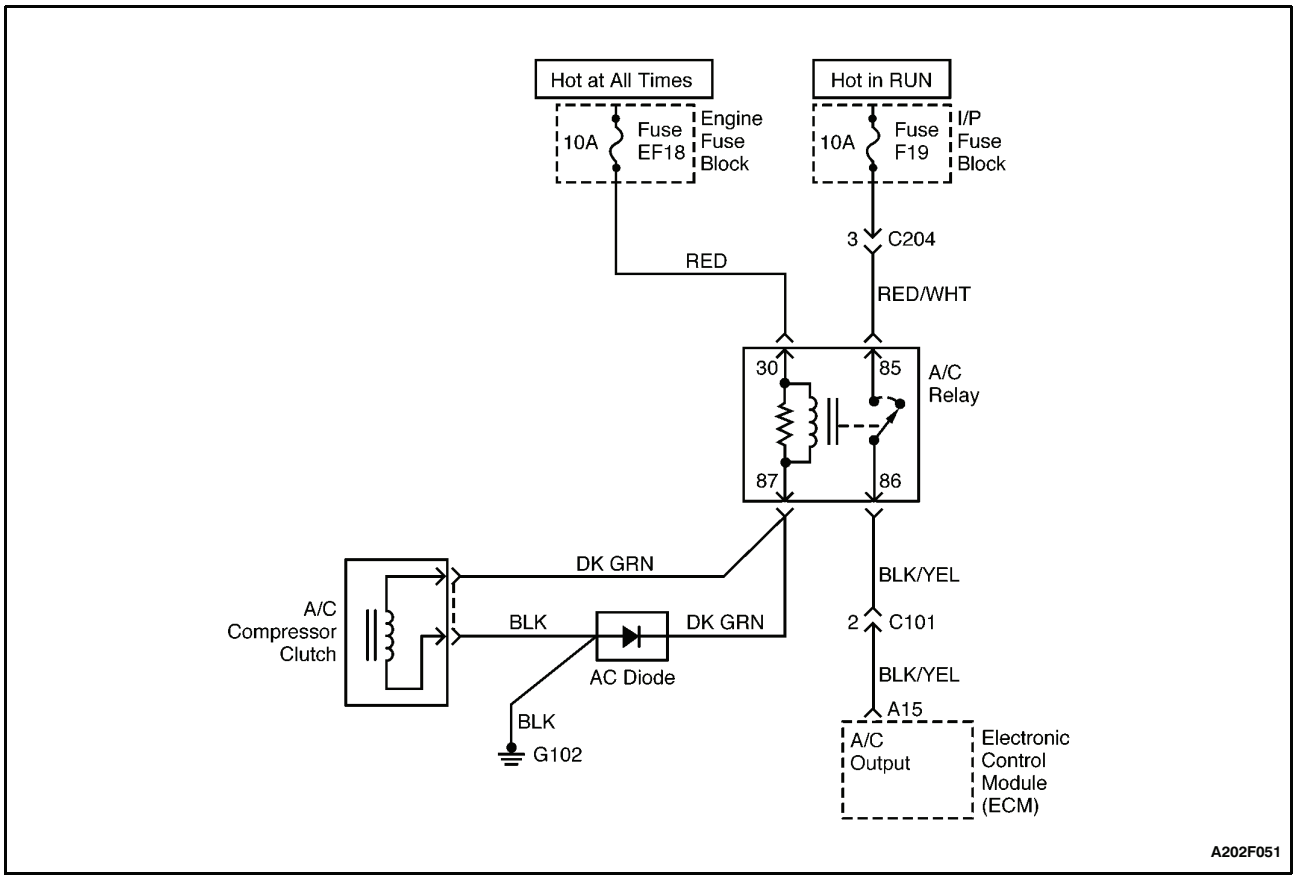
Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. **With the ignition OFF, the ECM should not be applying ground to the A/C compressor relay.**
3. **If the test light is still on after disconnecting the ECM red connector, the wire between the A/C compressor relay and the ECM is shorted to ground. If the test light goes off, the ECM is at fault.**

DTC 87 - A/C Cut Shorted to Ground (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning (A/C) compressor relay. 2. Connect a test light between the A/C compressor relay connector terminal 86 and battery positive. Is the test light on?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 4	Go to Step 5
4	1. Repair the short to ground in the wire between the A/C compressor relay connector terminal 86 and the ECM connector terminal A15. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
5	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 88
A/C CUT SHORTED TO BATTERY (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

When the air conditioning (A/C) switch is turned ON, the electronic control module (ECM) grounds the A/C compressor relay to initiate A/C compressor operation. Under various operating conditions, the ECM will interrupt A/C compressor operation.

DTC 88 Will Set When

- **A short to battery voltage condition exits and is present for more than 2 seconds.**

Diagnostic Aids

- **Inspect the ECM wiring harness connectors for improper mating, broken locks, improperly formed or damaged terminals, a poor terminal-to-wire connection, or a damaged harness.**
- **If the connections and the wiring harness are in good condition, connect a test light between the A/C compressor relay connector terminal 85 and ground while moving related connectors. If the fault is induced, the test light will turn on. This may help to isolate the location of an intermittent problem.**

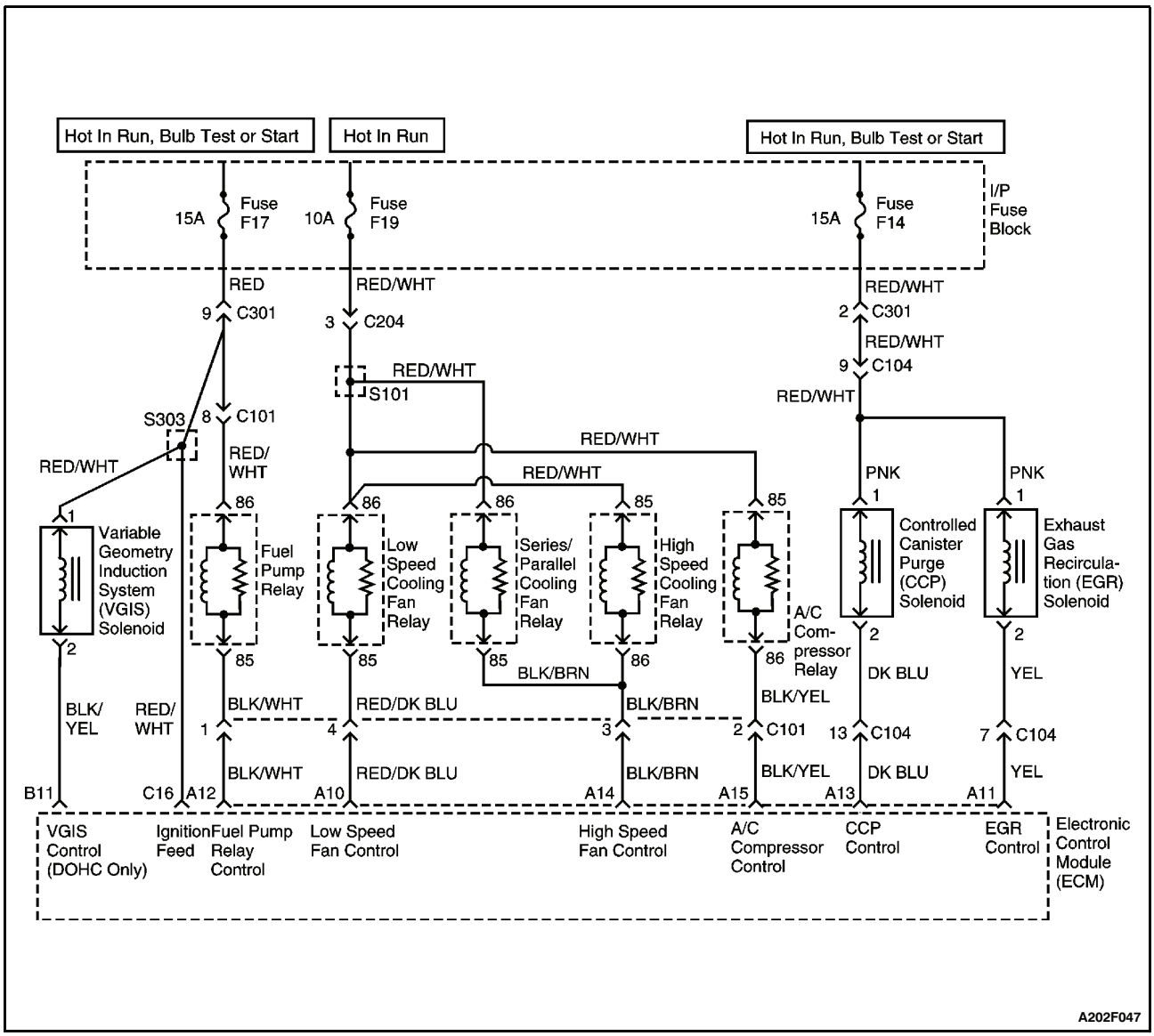
Test Description

The number(s) below refer to step(s) on the diagnostic table.

4. **If the test light is still on after disconnecting the ECM red connector, the wire between the A/C compressor relay and the ECM is shorted to voltage. If the test light goes off, the ECM is at fault.**

DTC 88 - A/C Cut Shorted to Battery (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Determine whether the Diagnostic System Check has been performed. Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the air conditioning (A/C) compressor relay. 2. Measure the resistance between the A/C compressor relay terminals 85 and 86. Does the resistance measure near the value specified?	[0 W	Go to Step 6	Go to Step 3
3	Connect a test light between the A/C compressor relay connector terminal 86 and ground. Is the test light on?	-	Go to Step 4	Go to "Diagnostic Aids"
4	Disconnect the electronic control module (ECM) red connector. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Repair the short to voltage in the wire between the A/C compressor relay connector terminal 86 and the ECM connector terminal A15. 2. Clear any diagnostic trouble codes (DTCs) from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
6	1. Replace the A/C compressor relay. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Replace the ECM. 2. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-



DIAGNOSTIC TROUBLE CODE (DTC) 93
QDM ERROR (1.3L SOHC AND 1.6L DOHC ITMS-6F)

Circuit Description

The electronic control module (ECM) is used to control several components such as those illustrated above. The ECM controls these devices through the use of a quad-driver module (QDM). When the ECM is commanding a component on, the voltage potential of the output circuit will be low (near 0 volts). When the ECM is commanding the output circuit to a component off, the voltage potential of the circuit will be high (near battery voltage). The primary function of the QDM is to supply the ground for the component being controlled.

The ECM has an internally protected QDM. This internal protection can be compared to a circuit breaker. If too much current flows in a controlled circuit, this type of QDM turns itself off. This allows the QDM to survive a shorted relay, solenoid, or wire. Repair the fault in the output circuit and the QDM will return to normal operation. It is not necessary to replace the ECM unless it is determined that the ECM itself is faulty.

Each QDM has a fault line which is monitored by the ECM. The ECM will compare the voltage at the QDM based on accepted values of the fault line. If the QDM fault detection circuit senses a voltage other than the accepted value, the diagnostic trouble code (DTC) 93 will be set.

DTC 93 Will Set When

- A QDM fault has been detected consecutively three times.

Diagnostic Aids

- Related symptoms of a QDM fault, such components on all the time or never on, will isolate the problem circuit.
- Monitor the voltage at connector terminals shown in the wiring diagram while moving related harness connectors, including the ECM harness. This may help in locating an intermittent condition.
- Check for bent connector terminals at the ECM connectors and the connectors of the relays and solenoids.
- Check for bent pins at the ECM.
- If the DTC 93 reoccurs with no apparent connector problem, replace the ECM.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. The ECM does not know which controlled circuit caused the DTC 93. This step will go through each of the circuits to determine which is at fault.
3. By grounding the assembly line diagnostic link (ALDL), this causes the ECM to actuate all relays and solenoids.
4. By removing the jumper from the ALDL, only the ignition feed should be present to the relay or solenoid. The ECM should no longer be supplying a ground to complete the circuit.
5. With the ECM connectors disconnected, only a short to ground in the wiring between the affected component and the ECM will allow the test light to turn on.
7. If there are no problems found in the wiring and the connections are OK, replace the affected relay or solenoid.
11. If there is no ignition feed to the affected component, check for a blown fuse or open in the wiring. If the fuse is blown, locate and repair the short to ground in that ignition feed circuit.

DTC 93 - QDM ERROR (1.3L SOHC and 1.6L DOHC ITMS-6F)

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	-	Go to Step 2	Go to "Diagnostic System Check"
2	1. Disconnect the electronic control module (ECM) red connector. 2. Turn the ignition ON. 3. Connect an ammeter (set to 2 amp scale) between each of the following ECM connector terminals and ground: • A10 - Fan low relay. • A14 - Fan high relay. • A15 - Air conditioning (A/C) compressor relay. • A12 - Fuel pump relay. • A13 - Controlled canister purge (CCP) solenoid. Does the amperage of all circuits measure within the value specified?	<0.75 amps but not 0.0 amps	Go to "Diagnostic Aids"	Go to Step 3
3	1. Turn the ignition OFF. 2. Connect the ECM red connector. 3. Use the wiring diagram to determine the specific component terminals to be tested. 4. Disconnect the relay/solenoid from the affected circuit. 5. Jumper terminals A and B of the assembly line diagnostic link (ALDL). 6. Turn the ignition ON. 7. Connect a test light between the connector terminals for the component of the affected circuit. Is the test light on?	-	Go to Step 4	Go to Step 8

DTC 93 - QDM ERROR (1.3L SOHC and 1.6L DOHC ITMS-6F) (Cont'd)

Step	Action	Value(s)	Yes	No
4	Remove the jumper from the ALDL. Is the test light on?	-	Go to Step 5	Go to Step 7
5	1. Turn the ignition OFF. 2. Disconnect the ECM red connector. 3. Turn the ignition ON. 4. Connect a test light between the connector terminals for the component of the affected circuit. Is the test light on?	-	Go to Step 6	Go to Step 12
6	1. Turn the ignition OFF. 2. Repair the short to ground between the component of the affected circuit and the ECM. 3. Connect the ECM red connector. 4. Clear any diagnostic trouble codes (DTCs) from the ECM. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
7	1. Turn the ignition OFF. 2. Check for poor connections and repair as needed. 3. If the connections are OK, replace the component of the affected circuit. 4. Clear any DTCs from the ECM. 5. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
8	Connect the test light between the ignition feed connector terminal for the component of the affected circuit and ground. Is the test light on?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Check for an open in the wiring between the component of the affected circuit and the ECM. Is the problem found?	-	Go to Step 10	Go to Step 12
10	1. Repair the open wire. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
11	1. Repair the open in the affected component ignition feed circuit. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-
12	1. Replace the ECM. 2. Clear any DTCs from the ECM. 3. Perform the Diagnostic System Check. Is the repair complete?	-	System OK	-

SYMPTOM DIAGNOSIS

IMPORTANT PRELIMINARY CHECKS

Important: Several symptom procedures call for a careful visual/physical inspection. Always perform the visual/physical test first. Visual inspections may lead to correcting a problem without further checks and can save valuable time.

Step	Action	Value(s)	Yes	No
1	Perform the Diagnostic System Check. Are any diagnostic trouble code(s) (DTCs) stored in the electronic control module (ECM) memory?	-	Go to Appropriate DTC Table	Go to Step 2
2	1. Inspect all of the ECM ground connections. 2. Inspect all of the vacuum hoses for splits, kinks, or improper connections. 3. Check for air leaks at all of the mounting areas of the intake manifold sealing surfaces. 4. Inspect the ignition wires for cracking, hardness, proper routing, or carbon tracking. 5. Inspect the wiring for proper connections, pinches, or cuts. Are all checks complete?	-	Go to Appropriate Symptom Table	-

INTERMITTENTS

Definition: The problem may or may not turn on the service engine soon (SES) warning or store a diagnostic trouble code (DTC).

Important: Do not use the DTC tables for intermittent problems. A fault must be present in order to locate the problem. If a fault is intermittent, use of DTC tables may result in the replacement of good parts.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Perform a careful inspection of any suspect circuits. 2. Inspect for poor mating of the connector halves, or terminals not fully seated into the connector body. 3. Inspect for improperly formed or damaged terminals. 4. Inspect for poor terminal-to-wire connections. This requires removing the terminal from the connector body to inspect it. Are any problems present?	-	Go to Step 3	Go to Step 4
3	Repair the electrical connections as needed. Is the repair complete?	-	System OK	-
4	Road test the vehicle with a voltmeter connected to a suspected circuit or a scan tool connected to the assembly line diagnostic link (ALDL). Does the voltmeter or the scan tool indicate an abnormal voltage or scan reading?	-	Go to Step 5	Go to Step 6

Intermittents (Cont'd)

Step	Action	Value(s)	Yes	No
5	Replace the sensor in the affected circuit, if a diagnostic trouble code (DTC) is stored for this circuit (except for the DTCs 44 and 45). Is the repair complete?	-	System OK	-
6	Does an intermittent service engine soon (SES) warning or a DTC occur?	-	Go to Step 7	Go to Step 8
7	1. Check for a faulty relay, electronic control module (ECM) driven solenoid, or switch. 2. Check for improper installation of electrical devices, such as lights, two-way radios, electric motors, etc. 3. Inspect the ignition control wires for proper routing away from ignition wires, ignition system components, and the generator. 4. Check for a short to ground in the SES circuit or the ALDL "test" terminal. 5. Inspect the ECM ground connections. 6. Correct or repair the affected circuits as needed. Is the repair complete?	-	System OK	-
8	1. Check for a loss of DTC memory. 2. Disconnect the throttle position sensor (TPS). 3. Run the engine at idle until the SES comes on. 4. Turn the ignition OFF. Is DTC 22 stored in memory?	-	Go to Step 10	Go to Step 9
9	Replace the ECM. Is the repair complete?	-	System OK	-
10	Does the vehicle stall while driving?	-	Go to Step 11	Go to Step 12
11	Monitor the oxygen (O_2) sensor and the injector base pulse width with the scan tool. Does the scan tool display a steady low voltage (about 0 mv) for the O_2 sensor with the control module commanding an injector base pulse width of the value specified?	8 ms	Go to Step 9	Go to Step 12
12	1. Check for an open diode across the air conditioning (A/C) clutch and for other open diodes. 2. Repair or replace any components as needed. Is the repair complete?	-	System OK	-

HARD START

Definition: The engine cranks OK, but does not start for a long time. The engine eventually runs or may start and immediately die.

Important: Ensure that the driver is using the correct starting procedure. Before diagnosing, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Check the coolant temperature sensor (CTS) and the manifold air temperature (MAT) sensor using the scan tool. 3. Compare the coolant temperature and the MAT with the ambient temperature when the engine is cold. Do the CTS and the MAT readings differ from the ambient temperature by more than the value specified?	3°C (5°F)	Go to Step 3	Go to Step 4
3	1. Measure the resistance of the CTS and the MAT sensor. 2. Compare the resistance value to specifications using the Temperature Vs. Resistance tables for diagnostic trouble codes (DTCs) 14 and 23. 3. If the resistance is not the same, replace the faulty sensor. Is the repair complete?	-	System OK	-
4	1. Check for a sticking throttle shaft or a binding linkage that may cause a high throttle position sensor (TPS) voltage. Repair or replace the parts as needed. 2. Check the TPS voltage reading with the throttle closed. Does the voltage measure within the value specified?	0.4-0.8 v	Go to Step 5	Go to Step 26
5	1. Check the manifold absolute pressure (MAP) sensor response and accuracy. 2. Replace the MAP sensor as needed. Is the repair complete?	-	System OK	Go to Step 6
6	Check the fuel pump operation. Does the fuel pump operate for the specified time when the ignition switch is turned ON?	2 sec	Go to Step 7	Go to "Fuel Pump Relay Circuit Check"
7	Check the fuel system pressure. Is the fuel pressure within the specifications?	284-325 kPa (41-47 psi)	Go to Step 29	Go to Step 8
8	Check for water contamination in the fuel. Is the fuel contaminated?	-	Go to Step 9	Go to Step 10
9	Replace the contaminated fuel. Is the repair complete?	-	System OK	-

Hard Start (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check the fuel injector driver circuit. 2. Disconnect all of the fuel injector harness connectors at the fuel injectors. 3. Connect an injector test light between the harness terminals of each fuel injector connector. 4. Note the test light while cranking the engine. Does the test light blink at all connectors?	-	Go to Step 13	Go to Step 11
11	Check the fuel injector driver wiring harness, the connectors, and the connector terminals for the proper connections. Is the problem found?	-	Go to Step 12	Go to Step 30
12	Repair the wiring harness, the connector, or the connector terminal as needed. Is the repair complete?	-	System OK	-
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified at 20°C (68°F)?	11.6-12.4 W	Go to Step 15	Go to Step 14
14	Replace any fuel injector with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
15	Perform an injector balance test. Is the problem found?	-	Go to Step 16	Go to Step 17
16	Replace any restricted or leaking fuel injectors as needed. Is the repair complete?	-	System OK	-
17	1. Check for the proper ignition voltage output for each cylinder with a spark tester. 2. Inspect the spark plugs for cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Inspect the ignition wires for short conditions. 4. Inspect all of the ignition grounds for loose connections. 5. Inspect the electronic control module (ECM) for the proper operation. Is the problem found?	-	Go to Step 18	Go to Step 19
18	Correct or replace any faulty ignition components. Is the repair complete?	-	System OK	-
19	Does the engine misfire or cut out under load or at idle?	-	Go to "Ignition System Check"	Go to Step 20
20	Does the engine start, but then immediately stall?	-	Go to Step 21	Go to Step 23
21	1. Remove the crankshaft position sensor (CPS). 2. Inspect for faulty connections and repair as needed. Is the problem found?	-	Go to Step 22	Go to Step 25
22	Repair the faulty connections as needed. Is the repair complete?	-	System OK	-

Hard Start (Cont'd)

Step	Action	Value(s)	Yes	No
23	1. Check for the proper valve timing. 2. Check the cylinder compression. 3. Inspect the pushrods, the rocker arms, the valve springs, and the camshaft lobes for excessive wear. 4. Inspect the intake manifold and the exhaust manifold passages for casting flash. Is the problem found?	-	Go to Step 24	Go to Step 25
24	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
25	Check the idle air control (IAC) valve operation. Repair or replace components as needed. Is the repair complete?	-	System OK	-
26	Check the base idle setting of the throttle body. Is the base idle setting properly adjusted?	-	Go to Step 27	Go to Step 28
27	Check the TPS circuit for proper operation. Repair or replace components as needed. Is the repair complete?	-	System OK	-
28	Adjust the base idle setting to specifications. Is the repair complete?	-	System OK	-
29	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
30	Replace the ECM. Is the repair complete?	-	System OK	-

SURGES OR CHUGGLES

Definition: Engine power varies under steady throttle or cruise and feels as if the vehicle speeds up and slows down with no change in the accelerator pedal position.

Important: Make sure the driver understands torque converter clutch (TCC) and air conditioning (A/C) compressor operation as described in the owner's manual.

The speedometer reading and the speed reading on the scan tool should be equal.

Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	Connect the scan tool to the assembly line diagnostic link (ALDL). Does the oxygen (O_2) sensor respond quickly to different throttle positions?	-	Go to Step 4	Go to Step 3
3	1. Check the O_2 sensor for silicone or other contaminants from fuel or use of improper room temperature vulcanizing (RTV) sealant. 2. Replace the contaminated O_2 sensor. Is the repair complete?	-	System OK	-

Surges or Chuggles (Cont'd)

Step	Action	Value(s)	Yes	No
4	1. Drive the vehicle at the speed of the complaint. 2. Monitor the long-term fuel trim reading using the scan tool. Is the long-term fuel trim reading within the value specified?	115-150 counts	Go to Step 7	Go to Step 5
5	Is the long-term fuel trim reading below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 6
6	Is the long-term fuel trim reading above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	-
7	Check the fuel system pressure while the condition exists. Is the fuel system pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 8	Go to Step 17
8	Check the in-line fuel filter. Is the filter dirty or plugged?	-	Go to Step 18	Go to Step 9
9	Perform an injector balance test. Does the injector balance test pinpoint the problem?	-	Go to Step 19	Go to Step 10
10	1. Check for proper ignition voltage output using a spark tester. 2. Inspect the spark plugs for cracks, wear, improper gap, burned electrodes, or heavy deposits. Is the problem found?	-	Go to Step 11	Go to Step 12
11	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
12	1. Inspect the electronic control module (ECM) grounds for being clean, tight, and in their proper locations. 2. Inspect the vacuum lines for kinks or leaks. Is the problem found?	-	Go to Step 13	Go to Step 14
13	Repair the electrical connections or the vacuum lines as needed. Is the repair complete?	-	System OK	-
14	Check the generator output voltage. Is the generator voltage within the value specified?	12-16 v	Go to Step 16	Go to Step 15
15	Repair the generator. Is the repair complete?	-	System OK	-
16	1. Check for intermittent exhaust gas recirculation (EGR) valve operation. 2. Check torque converter clutch (TCC) operation. 3. Repair or replace any components as needed. Is the repair complete?	-	System OK	-
17	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
18	Replace the fuel filter. Is the repair complete?	-	System OK	-
19	Replace the leaking or restricted fuel injectors. Is the repair complete?	-	System OK	-

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Definition: The engine delivers less than expected power. There is little or no increase in speed when the accelerator pedal is partially applied.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Verify the customer's complaint. 2. Compare the performance of the customer's vehicle with a similar unit. Does the problem exist?	-	Go to Step 3	System OK
3	1. Inspect the air filter for excessive contamination. 2. Replace the air filter as needed. 3. Check the transaxle shift pattern and downshift operation. Does the transaxle operate properly?	-	Go to Step 4	Go to Step 5
4	Check the fuel system pressure. Is the fuel system pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 7	Go to Step 6
5	Repair the transaxle as needed. Is the repair complete?	-	System OK	-
6	Repair the fuel system as needed. Is the repair complete?	-	System OK	-
7	Check for a restricted fuel filter or contaminated fuel. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
9	1. Check the ignition system output for all of the cylinders using a spark tester. 2. Check for proper ignition control operation. Is the ignition system operating properly?	-	Go to Step 10	Go to Step 11
10	1. With the engine at normal operating temperature, connect a vacuum gauge to a vacuum port on the intake manifold. 2. Operate the engine at 1,000 rpm. 3. Record the vacuum reading. 4. Increase the engine speed to 2,500 rpm. 5. Note the vacuum reading at a steady 2,500 rpm. Does the vacuum decrease more than the value specified?	10 kPa (3 in. Hg)	Go to Step 12	Go to Step 15
11	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
12	Inspect the exhaust system for restrictions and damaged or collapsed pipes. Is the problem found?	-	Go to Step 13	Go to Step 14
13	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
14	1. Check the cylinder compression and valve timing. 2. Inspect the camshaft for excessive wear. Is the problem found?	-	Go to Step 15	Go to Step 16

Lack of Power, Sluggishness, or Sponginess (Cont'd)

Step	Action	Value(s)	Yes	No
15	Repair or replace any engine components as needed. Is the repair complete?	-	System OK	-
16	1. Check the electronic control module (ECM) grounds for being clean, tight, and in their proper location. 2. Check the exhaust recirculation gas (EGR) valve for being open or partially open all the time. 3. Check the torque converter clutch (TCC) operation. 4. Check the air conditioning (A/C) system operation. 5. Check the generator output. 6. Repair the generator if the output is not within the specified range. Are all checks and repairs complete?	12-16 v	System OK	-

DETONATION/SPARK KNOCK

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Fill the fuel tank with a known good grade of gasoline that has the octane rating of the value specified. 2. Reevaluate the vehicle's performance. Does the detonation problem still exist?	87-89 octane	Go to Step 3	System OK
3	1. Inspect for low engine coolant. 2. Check for restricted airflow to the radiator or restricted coolant flow. 3. Check for a faulty thermostat. 4. Check for an incorrect coolant solution. Is the problem found?	-	Go to Step 4	Go to Step 5
4	Repair or replace any cooling system components as needed. Is the repair complete?	-	System OK	-
5	1. Check the voltage using the scan tool. 2. Replace the coolant temperature sensor (CTS) if the resistance is not within specifications as listed in the Diagnostic Aids for Diagnostic Trouble Code (DTC) 14. Is the problem found?	-	Go to Step 6	Go to Step 7
6	Replace the CTS or repair the circuit as needed. Is the repair complete?	-	System OK	-
7	1. Check the ignition system output with a spark tester. 2. Inspect the spark plugs for the proper heat range and gap. 3. Check for the proper operation of the ignition controls. Is the ignition system operating properly?	-	Go to Step 9	Go to Step 8

Detonation/Spark Knock (Cont'd)

Step	Action	Value(s)	Yes	No
8	Repair or replace the ignition system components as needed. Is the repair complete?	-	System OK	-
9	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle at the speed of the complaint. 3. Monitor the long-term fuel trim reading from the scanner data stream. Is the long-term fuel trim reading above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	Go to Step 10
10	Check the fuel system pressure. Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 11	Go to Step 12
11	Repair or replace the fuel system components as needed. Is the repair complete?	-	System OK	-
12	1. Inspect for carbon buildup inside the engine. 2. Remove the carbon with a top engine cleaner. Follow the instructions supplied with the product. 3. Check the basic engine parts such as the camshaft, the cylinder head, the pistons, etc. for excessive wear. 4. Replace any excessively worn parts. Is the procedure complete?	-	Go to Step 13	-
13	1. Check the exhaust gas recirculation (EGR) valve for proper operation. 2. Check the air intake system for proper operation. 3. Check the torque converter clutch (TCC) operation and transaxle shift points. 4. Check the service bulletins for programmable read-only memory (PROM) updates. 5. Check the cylinder compression. 6. Repair or replace any faulty components. Are all checks and repairs complete?	-	System OK	-

HESITATION, SAG, STUMBLE

Definition: There is a momentary lack of response as the accelerator is pushed down. This can occur at any vehicle speed. It is usually the most severe when first trying to make the vehicle move, as from a stop. Hesitation, sag, or stumble may cause the engine to stall if severe enough.

Important: Before diagnosing this condition, check service bulletins for programmable read-only memory (PROM) updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Check the fuel system pressure. If the pressure is not within the value specified, service the fuel system as needed. 2. Inspect the throttle position sensor (TPS) for binding or sticking. The TPS voltage should increase at a steady rate as the throttle is moved toward wide-open throttle (WOT). Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 3	Go to Step 4
3	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
4	1. Check the manifold absolute pressure (MAP) sensor response and accuracy. 2. Inspect the fuel for water contamination. 3. Check the canister purge system for proper operation. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
6	1. Disconnect all of the fuel injector harness connectors. 2. Connect an injector test light between the harness terminals of each fuel injector. 3. Note the test light while cranking the engine. Does the test light blink on all connectors?	-	Go to Step 8	Go to Step 7
7	1. Repair or replace the faulty fuel injector drive harness, the connector, or the connector terminal. 2. If the connections and the harnesses are good, replace the electronic control module (ECM) for an internal open in the fuel injector driver circuit. Is the repair complete?	-	System OK	-
8	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the fuel injector resistance within the value specified?	11.6-12.4 W	Go to Step 10	Go to Step 9
9	Replace any of the fuel injectors for which there is a resistance that is out of specifications. Is the repair complete?	-	System OK	-
10	Perform an injector balance test. Is the problem found?	-	Go to Step 11	Go to Step 12

Hesitation, Sag, Stumble (Cont'd)

Step	Action	Value(s)	Yes	No
11	Replace any restricted or leaking fuel injectors. Is the repair complete?	-	System OK	-
12	Check the fuel system pressure after a cold start or during moderate or full throttle acceleration. Is the fuel pressure within specifications?	284-325 kPa (41-47 psi)	Go to Step 14	Go to Step 13
13	Repair the restriction in the fuel system or replace the faulty fuel pump. Is the repair complete?	-	System OK	-
14	1. Check for faulty ignition wires. 2. Inspect for fouled spark plugs. 3. Check the ignition system output on each cylinder with a spark tester. Is the problem found?	-	Go to Step 15	Go to Step 16
15	Repair or replace any ignition components as needed. Is the repair complete?	-	System OK	-
16	1. Check the generator output voltage. 2. Repair or replace the generator if the generator output is less than the value specified. 3. Check the exhaust gas recirculation (EGR) valve operation. Are all checks and needed repairs complete?	12-16 v	System OK	-

CUTS OUT, MISSES

Definition: There is a steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	Check the ignition system output voltage for all of the cylinders using a spark tester. Is spark present on all of the cylinders?	-	Go to Step 3	Go to "Ignition System Check"
3	1. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 2. Check the resistance of the ignition wires. Replace any ignition wires that have a resistance greater than the value specified. Is the problem found?	30,000 W	Go to Step 4	Go to Step 5
4	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
5	With the engine running, spray the ignition wires with a fine water mist to check for arcing and shorting to ground. Is the problem found?	-	Go to Step 6	Go to Step 7
6	Replace the ignition wires. Is the repair complete?	-	System OK	-

Cuts Out, Misses (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Perform a cylinder compression test. 2. If the compression is low, repair the engine as needed. 3. Inspect for proper valve timing, bent pushrods, worn rocker arms, broken or weak valve springs, and worn camshaft lobes. 4. Inspect the intake manifold and the exhaust manifold passages for casting flash. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
9	1. Check the fuel system for a plugged in-line fuel filter. 2. Check the fuel system for low fuel pressure. If the fuel pressure is below the value specified, service the fuel system as needed. 3. Inspect for contaminated fuel. Is the problem found?	284-325 kPa (41-47 psi)	Go to Step 10	Go to Step 11
10	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
11	1. Disconnect all of the fuel injector harness connectors at the fuel injectors. 2. Connect an injector test light to the harness terminals of each fuel injector connector. 3. Note the test light while cranking the engine for each fuel injector. Does the test light blink for all of the fuel injectors?	-	Go to Step 13	Go to Step 12
12	1. Repair or replace the faulty injector drive circuit harness, the connector, or the connector terminal. 2. If the harness, the connectors, and the terminals are OK, replace the electronic control module (ECM). Is the repair complete?	-	System OK	-
13	Measure the resistance of each fuel injector. The resistance will increase slightly at higher temperatures. Is the injector resistance within the value specified?	11.6-12.4 W	Go to Step 15	Go to Step 14
14	Replace any fuel injectors with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
15	Perform an injector balance test. Is the problem found?	-	Go to Step 16	Go to Step 17
16	Replace any restricted or leaking fuel injectors. Is the repair complete?	-	System OK	-
17	1. Check for electromagnetic interference. 2. Monitor the engine rpm with a scan tool. Does the scan tool rpm change greatly with little change in actual engine rpm?	-	Go to Step 18	-
18	1. Inspect the routing of the ignition wires. 2. Inspect all of the ignition system grounds. 3. Correct the routing or repair the ground connections as needed. Are all checks and needed repairs complete?	-	System OK	-

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Important: Driving habits affect fuel economy. Check the owner's driving habits by asking the following questions:

1. Is the air conditioning (A/C) system (i.e. defroster mode) turned on all the time?
2. Are the tires at the correct air pressure?
3. Have excessively heavy loads been carried?
4. Does the driver accelerate too much and too often? Suggest the driver read the section in the owner's manual about fuel economy.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Inspect the air filter for excessive contamination. 2. Inspect for fuel system leaks. Are all needed checks complete?	-	Go to Step 3	-
3	1. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 2. Replace any faulty spark plugs. 3. Inspect the ignition wires for cracking, hardness, and proper connections. Are all needed checks and repairs complete?	-	Go to Step 4	-
4	1. Inspect the engine coolant level. 2. Check the thermostat for being always open or for an incorrect heat range. 3. Replace the thermostat as needed. Are all needed checks and repairs complete?	-	Go to Step 5	-
5	1. Check the transaxle shift pattern. Ensure that all transaxle gears are functioning. 2. Check the torque converter clutch (TCC) operation with a scan tool. The scan tool should indicate rpm drop when the TCC is commanded on. 3. Check for proper calibration of the speedometer. 4. Check the brakes for dragging. 5. Check the cylinder compression. 6. Repair, replace, or adjust any components as needed. Are all checks and needed repairs complete?	-	System OK	-

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If the condition is bad enough, the vehicle may shake. Also, the idle varies in rpm (called "hunting"). Either condition may be severe enough to cause stalling. The engine idles at incorrect idle speed.

Important: Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Monitor the oxygen (O_2) sensor reading at different throttle positions. Does the O_2 sensor change quickly from rich to lean at the different throttle positions?	-	Go to Step 5	Go to Step 3
3	Check the O_2 sensor for contamination from fuel or improper use of room temperature vulcanizing (RTV) sealant. Is the O_2 sensor contaminated?	-	Go to Step 4	Go to Step 5
4	Replace the contaminated O_2 sensor as needed. Is the repair complete?	-	System OK	-
5	1. Check for a sticking throttle shaft or binding throttle linkage that may cause incorrect throttle position sensor (TPS) voltage. 2. Check the TPS voltage reading with the throttle closed. Is the TPS voltage within the value specified?	0.4-0.8 v	Go to Step 6	Go to "Diagnostic Aids for DTC 21"
6	1. Check the coolant temperature sensor (CTS) voltage reading using the scan tool. 2. Compare the CTS reading with the ambient temperature when the engine is cold. Does the CTS temperature reading differ from the ambient temperature by more than the value specified?	3°C (5°F)	Go to Step 7	Go to Step 9
7	Check for high resistance in the CTS circuit or the sensor itself. Is the problem found?	-	Go to Step 8	Go to Step 9
8	Replace the CTS or repair the circuit as needed. Is the repair complete?	-	System OK	-
9	Check the manifold absolute pressure (MAP) sensor for response and accuracy. Is the problem found?	-	Go to Step 10	Go to Step 11
10	Replace the MAP sensor or repair the MAP sensor circuit as needed. Is the repair complete?	-	System OK	-
11	1. Road test the vehicle at the speed of the complaint. 2. Monitor the fuel trim reading using the scan tool. Is the fuel trim reading within the value specified?	115-150 counts	Go to Step 14	Go to Step 12
12	Is the fuel trim reading below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 13

Rough, Unstable, or Incorrect Idle, Stalling (Cont'd)

Step	Action	Value(s)	Yes	No
13	Is the fuel trim reading above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44□	-
14	1. Disconnect all of the fuel injector harness connectors at the fuel injectors. 2. Connect an injector test light between the harness terminals of each fuel injector connector. 3. Note the test light while cranking the engine. Does the test light blink for all of the fuel injectors?	-	Go to Step 16	Go to Step 15
15	1. Repair or replace the faulty injector drive circuit harness, the connector, or the connector terminals as needed. 2. If the harness, the connectors, and the terminals are OK, replace the electronic control module (ECM). Is the repair complete?	-	System OK	-
16	Measure the resistance of each of the fuel injectors. The resistance will increase slightly at higher temperatures. Is the resistance within the value specified?	11.6-12.4 W	Go to Step 18	Go to Step 17
17	Replace any fuel injectors with a resistance that is out of specifications. Is the repair complete?	-	System OK	-
18	Perform an injector balance test. Is the problem found?	-	Go to Step 19	Go to Step 20
19	Replace any leaking or restricted fuel injectors. Is the repair complete?	-	System OK	-
20	1. With the engine OFF, disconnect the fuel pressure regulator vacuum hose. 2. Thoroughly inspect the fuel pressure regulator vacuum port and the fuel pressure regulator vacuum hose for the presence of fuel. Is the problem found?	-	Go to Step 21	Go to Step 22
21	Replace the fuel pressure regulator as needed. Is the repair complete?	-	System OK	-
22	1. Check the ignition system output voltage for all of the cylinders using a spark tester. 2. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 3. Inspect the ignition wires for cracking, hardness, or improper connections. 4. Replace any ignition wires that have a resistance over the value specified. Is the problem found?	30,000 W	Go to Step 23	Go to Step 24
23	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
24	1. Inspect for vacuum leaks. 2. Check for proper positive crankcase ventilation (PCV) operation. 3. Check the idle air control (IAC) valve operation. 4. Inspect the ECM ground connections. Is the problem found?	-	Go to Step 25	Go to Step 26

Rough, Unstable, or Incorrect Idle, Stalling (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
26	1. Check the exhaust gas recirculation (EGR) valve for proper operation. 2. Inspect the battery cables and the ground straps for proper connections. 3. Check the generator voltage output. Repair or replace the generator if the voltage output is not within the value specified. Is the problem found?	12-16 v	Go to Step 27	Go to Step 28
27	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
28	1. Inspect for broken engine mounts. 2. Check for proper valve timing. 3. Perform a cylinder compression test. 4. Inspect for bent pushrods, worn rocker arms, broken or weak valve springs, and a worn camshaft. 5. Perform repairs as needed. Are all of the checks and needed repairs complete?	-	System OK	-

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Excessive exhaust emissions cause a vehicle to fail an emission test or have an excessive rotten egg smell. Excessive odors do not necessarily indicate excessive emissions.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Run the engine until it reaches operating temperature. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	Go to Step 3
3	1. Connect the scan tool to the assembly line diagnostic link (ALDL). 2. Road test the vehicle. 3. Monitor the long-term fuel trim memory. Is the long-term fuel trim memory within the value specified?	115-150 counts	Go to Step 6	Go to Step 4
4	Is the long-term fuel trim memory below the value specified?	115 counts	Go to "Diagnostic Aids for DTC 45"	Go to Step 5
5	Is the long-term fuel trim memory above the value specified?	150 counts	Go to "Diagnostic Aids for DTC 44"	-
6	1. Check for a properly installed fuel cap. 2. Check the fuel system pressure. 3. Perform an injector balance test. Is the problem found?	-	Go to Step 7	Go to Step 8

Excessive Exhaust Emissions or Odors (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Repair or replace any fuel system components as needed. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	-
8	1. Check the ignition system for proper operation. 2. Inspect the spark plugs for excessive wear, insulation cracks, improper gap, or heavy deposits. 3. Check the ignition wires for cracking, hardness, or improper connections. Is the problem found?	-	Go to Step 9	Go to Step 10
9	1. Repair or replace any ignition system components as needed. 2. Perform an emission test. Does the vehicle pass the emission test?	-	System OK	-
10	1. Inspect for vacuum leaks. 2. Inspect the catalytic converter for contamination. 3. Inspect for carbon buildup on the throttle body, the throttle plate, and inside the engine. Remove any carbon buildup with a top engine cleaner. 4. Check the exhaust gas recirculation (EGR) valve for not opening. 5. Check for proper positive crankcase ventilation (PCV) operation. Are all checks and needed repairs complete?	-	System OK	-

DIESELING, RUN-ON

Definition: Dieseling is a condition in which an engine continues to run after the ignition switch is turned OFF.

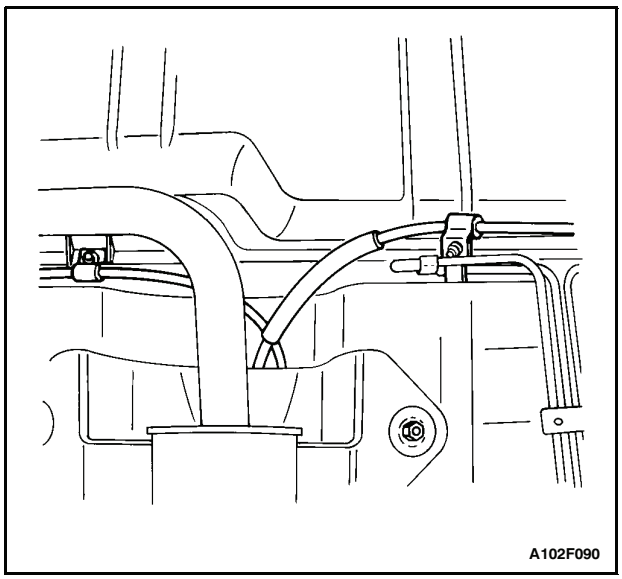
Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	Does the engine run smoothly after the ignition switch is turned OFF?	-	Go to Step 3	Go to Step 4
3	1. Check the ignition switch and the ignition switch adjustment. 2. Replace the ignition switch if needed. Is the repair complete?	-	System OK	-
4	1. Check the evaporative emission system. 2. Check for leaking fuel injectors. 3. Check the idle air control (IAC) valve operation. 4. Inspect for vacuum leaks. 5. Check for the proper base idle setting. Are all checks and repairs complete?	-	System OK	-

BACKFIRE

Definition: A backfire occurs when fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.

Important: Before diagnosing the symptom, check service bulletins for updates.

Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	-	Go to Step 2	Go to "Important Preliminary Checks"
2	1. Inspect for crossed or crossfiring ignition wires. 2. Check the ignition system output voltage for all cylinders using a spark tester. 3. Inspect the spark plugs for excessive wear, burned electrodes, improper gap, or heavy deposits. Is the problem found?	-	Go to Step 3	Go to Step 4
3	Repair or replace any ignition system components as needed. Is the repair complete?	-	System OK	-
4	1. Check the fuel system operation. 2. Check the fuel injectors by performing an injector balance test. Is the problem found?	-	Go to Step 5	Go to Step 6
5	Repair or replace any fuel system components as needed. Is the repair complete?	-	System OK	-
6	1. Inspect the exhaust gas recirculation (EGR) gasket for a leak or a loose fit. 2. Check the EGR valve for proper operation. 3. Inspect the intake manifold and the exhaust manifold for a casting flash. Is the problem found?	-	Go to Step 7	Go to Step 8
7	Repair or replace any components as needed. Is the repair complete?	-	System OK	-
8	1. Inspect the timing belt for proper installation and tension. 2. Check the engine compression. 3. Inspect the intake manifold gasket and the exhaust manifold gasket for leaks. 4. Check for sticking or leaking valves. 5. Repair or replace any components as needed. Are all checks and corrections complete?	-	System OK	-


A102F090

MAINTENANCE AND REPAIR

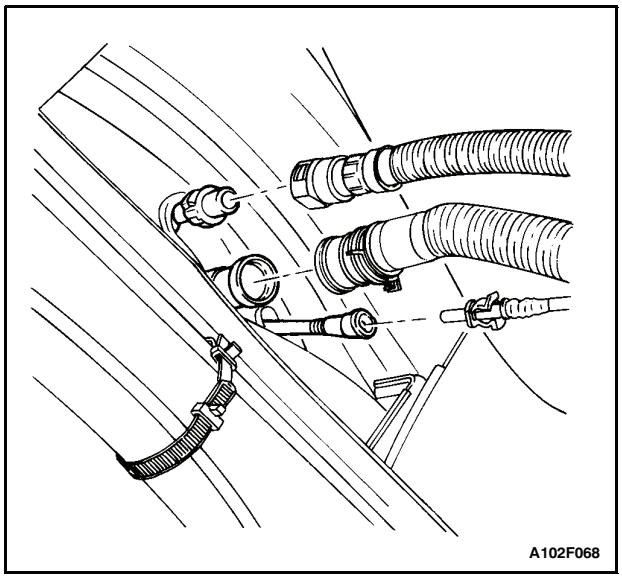
ON-VEHICLE SERVICE

FUEL TANK

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Disconnect the parking brake cable retainer clamps and the support along the fuel tank to provide clearance for the tank.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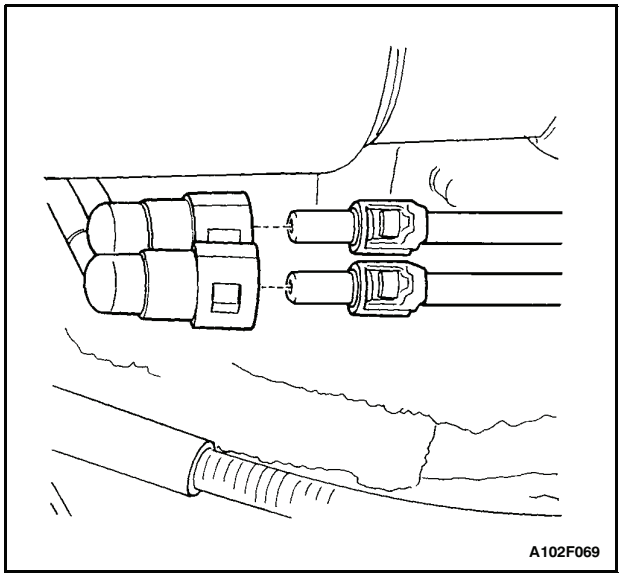
5. Remove the fuel tank filler tube clamp at the fuel tank.
6. Disconnect the fuel tank filler tube.
7. Disconnect the fuel tank vent tube at the fuel tank.
8. Disconnect the fuel vapor line near the fuel tank filler tube.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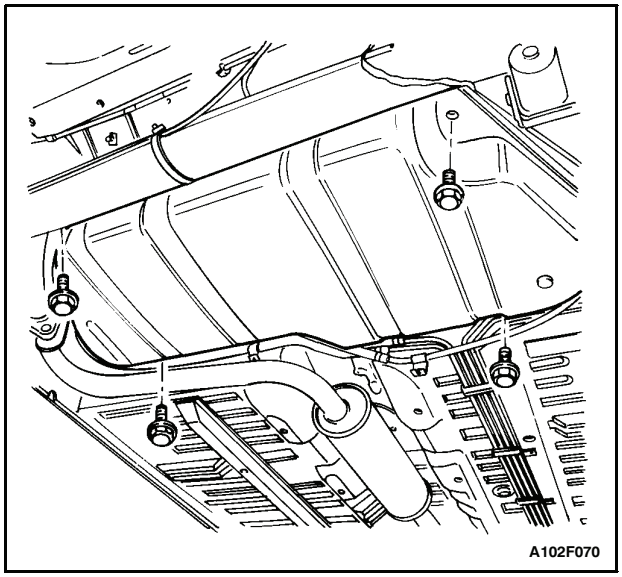
9. Disconnect the fuel pump harness connector at the right rear corner of the fuel tank.
10. Disconnect the fuel inlet line and the fuel return line near the right front of the fuel tank.
11. Disconnect the wiring harness clips and the fuel line clips as needed.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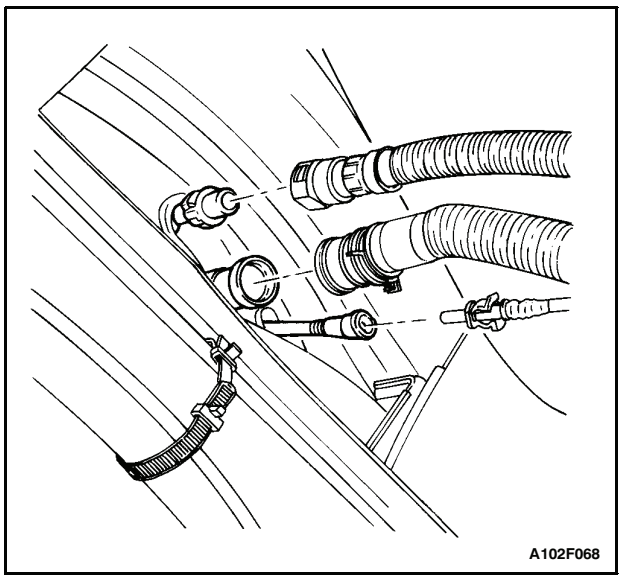
12. Support the fuel tank.
13. Remove the fuel tank retaining bolts.
14. Carefully lower the fuel tank.
15. Remove the fuel tank.
16. Transfer any parts as needed.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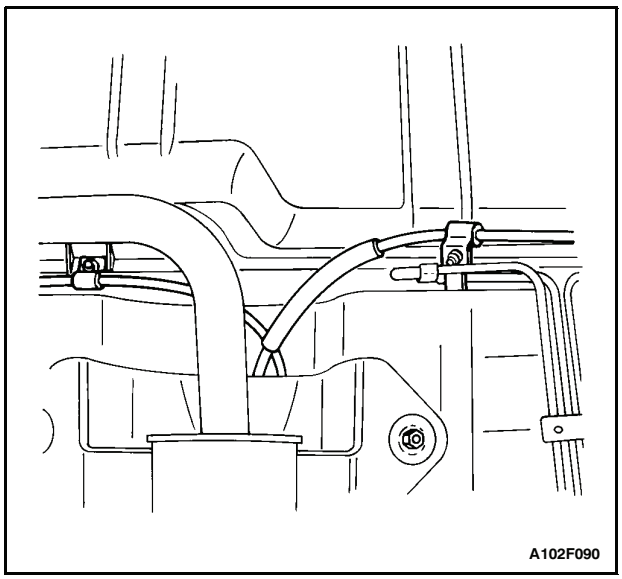
Installation Procedure

1. Raise the fuel tank into position.
2. Install the fuel tank mounting bolts.

Tighten

Tighten the fuel tank retaining bolts to 20 N•m (15 lb-ft).

3. Connect the fuel outlet line and the fuel return line.
4. Connect the wiring harness clips and the fuel line clips as needed.
5. Connect the fuel pump electrical connector.
6. Connect the fuel vapor line.
7. Connect the fuel tank filler tube.
8. Connect the fuel tank vent tube.
9. Install the fuel tank filler tube clamp at the fuel tank.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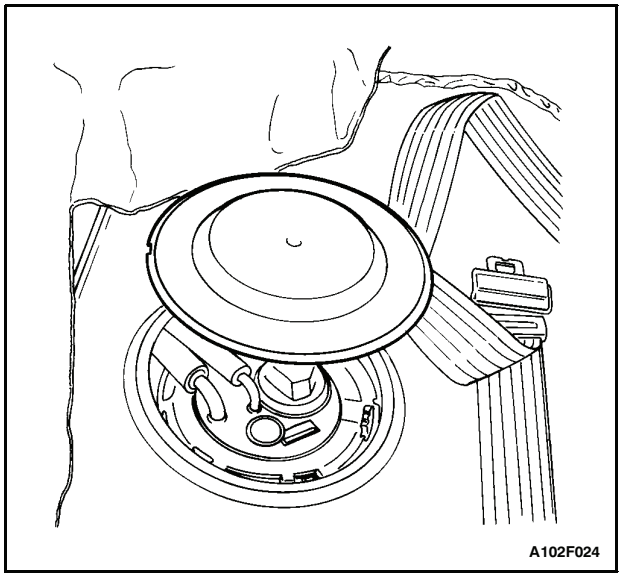
10. Install the parking brake cable retainer clamps and the support.

Tighten

Tighten the parking brake cable retainer clamps to 10 N•m (89 lb-in).

11. Connect the negative battery cable.
12. Fill the fuel tank.
13. Perform a leak check of the fuel tank and the fuel line connections.

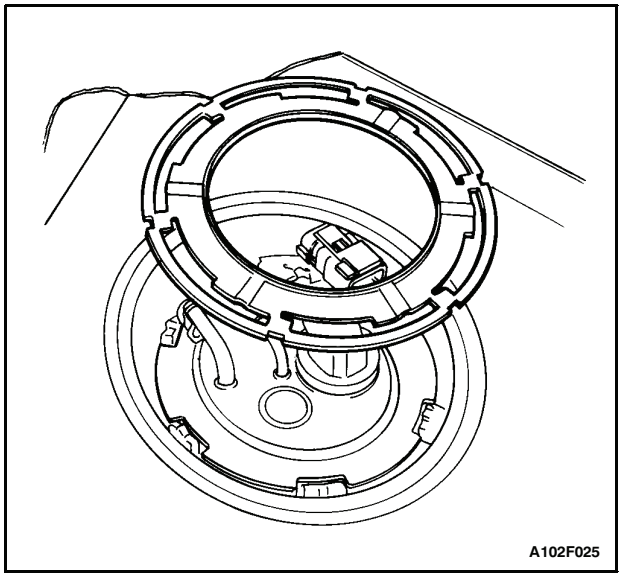

A102F024

FUEL PUMP

Removal Procedures

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure.
   1.1. Remove the fuel cap.
   1.2. Remove fuel pump fuse EF8 from the engine fuse block.
   1.3. Start the engine and allow the engine to stall.
   1.4. Crank the engine for an additional 10 seconds.
2. Disconnect the negative battery cable.
3. Remove the rear seat. Refer to Section 9H, Seats.
4. Remove the fuel pump access cover.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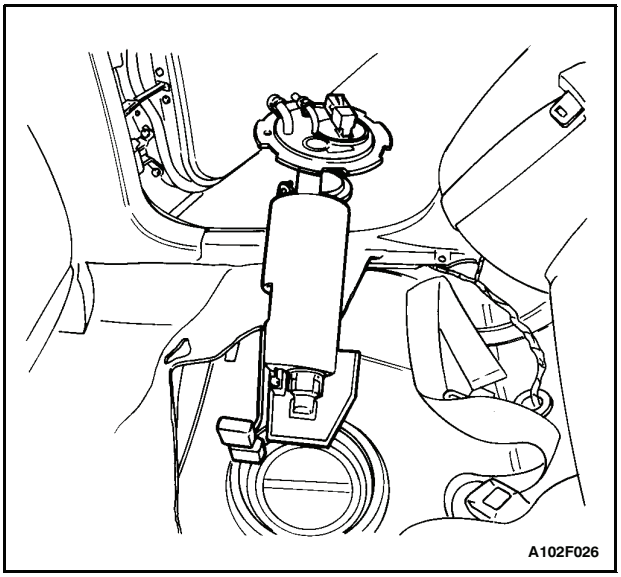
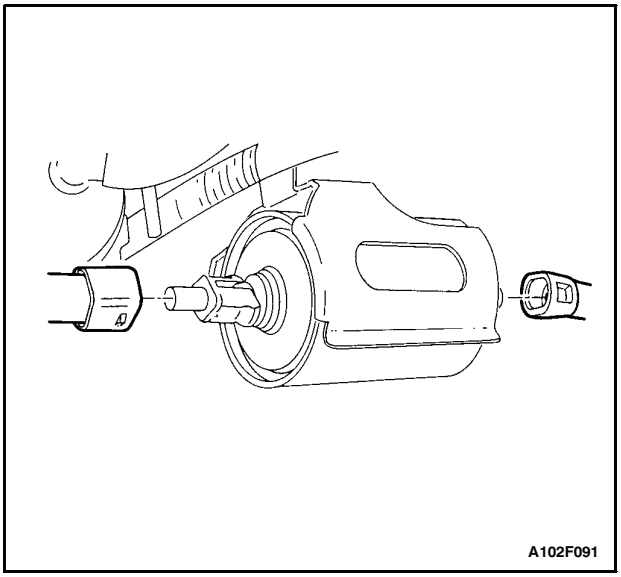
5. Disconnect the electrical connector at the fuel pump assembly.
6. Disconnect the fuel outlet line.
7. Disconnect the fuel tank return line.
8. Turn the lock ring counterclockwise to clear the tank tabs.
9. Remove the fuel pump assembly from the tank.
10. Remove and discard the gasket.


A102F026

Installation Procedure

1. Clean the gasket mating surface on the fuel tank.
2. Position the new gasket in place.
3. Install the fuel pump into the fuel tank in the same location as removed for ease of line and connector installation.
4. Position the lock ring in place and turn it clockwise until it contacts the tank stop.
5. Connect the fuel pump assembly connector.
6. Install the fuel pump outlet line.
7. Install the fuel tank return line.
8. Install the pump access cover.
9. Connect the negative battery cable.
10. Perform an operational check of the fuel pump.
11. Install the rear seat. Refer to Section 9H, Seats.

FUEL FILTER

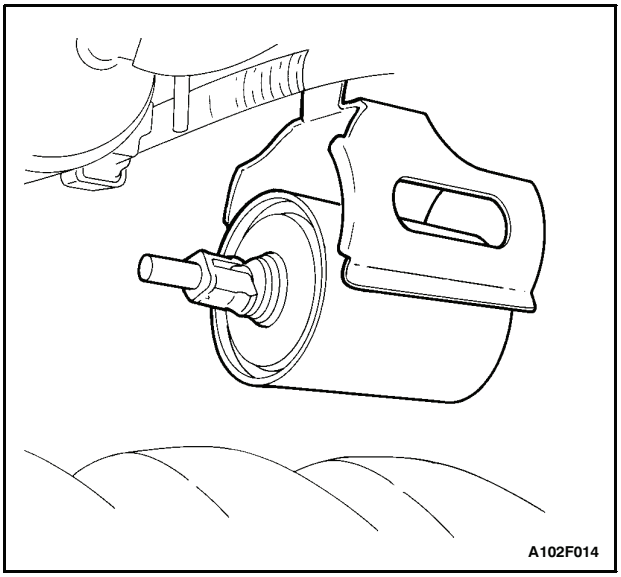

A102F091

Removal Procedure

1. Disconnect the negative battery cable.

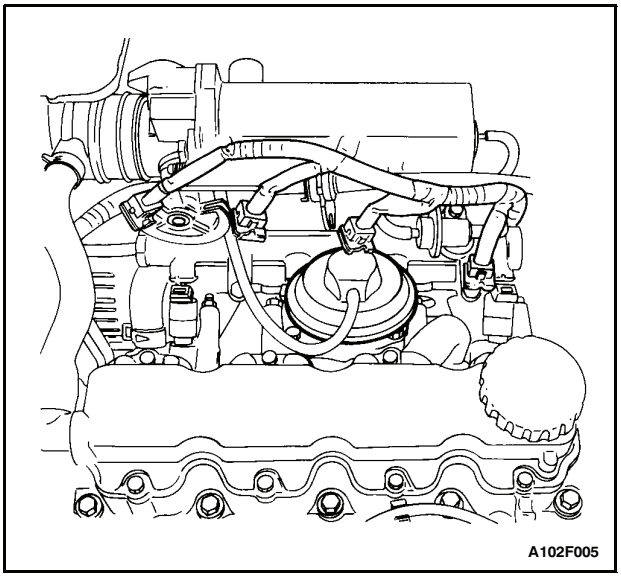
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to "Fuel Pump" in this section.
3. Disconnect the inlet/outlet fuel lines by moving the line connector lock forward and pulling the hose off of the fuel filter tube.
4. Pull the fuel filter out of the retaining clamp.


A102F014

Installation Procedure

1. Install the new fuel filter into the retaining clamp. Note the flow direction.
2. Connect the inlet/outlet lines. Secure the lines with the connector lock.
3. Connect the negative battery cable.
4. Perform a leak test of the fuel filter.



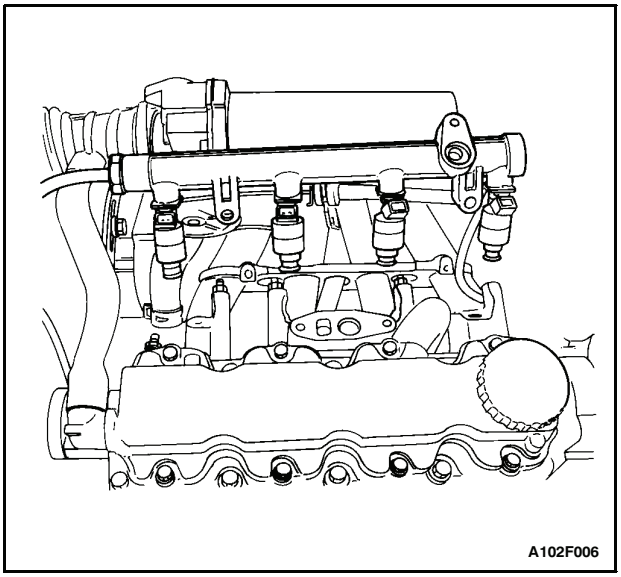
A102F005

FUEL RAIL AND INJECTORS (SOHC)

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the fuel injector harness connectors.
4. Remove the exhaust gas recirculation valve. Refer to "Exhaust Gas Recirculation Valve (SOHC)" in this section.
5. Remove the fuel pressure regulator. Refer to "Fuel Pressure Regulator (SOHC)" in this section.



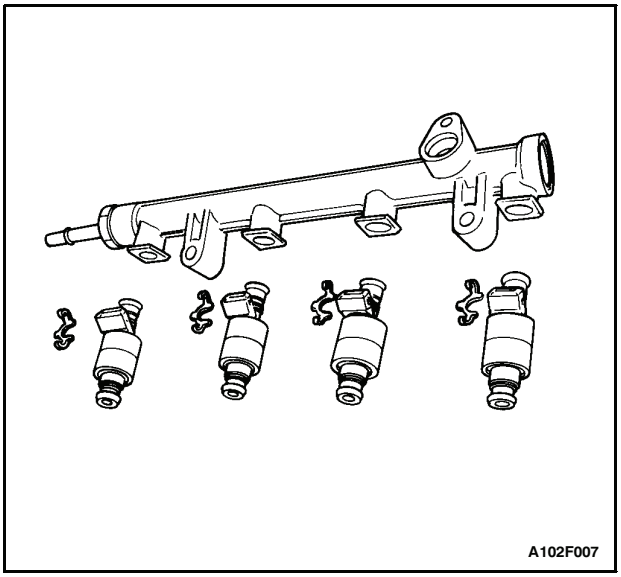
A102F006

6. Remove the fuel inlet line.
7. Remove the fuel rail mounting bolts.

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and the injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

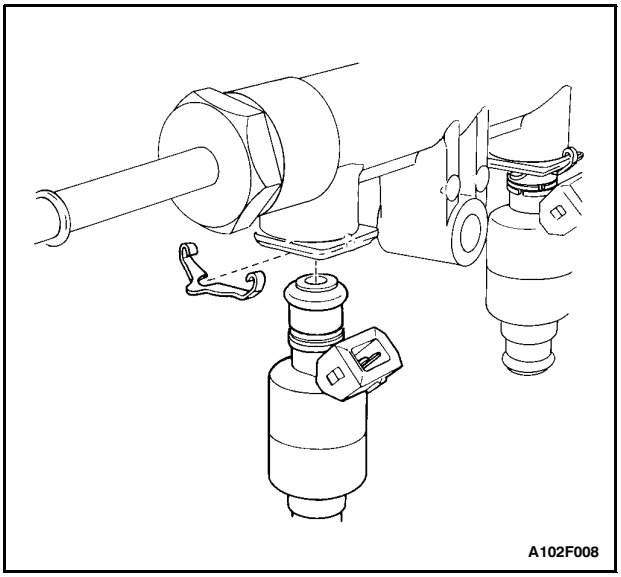
Important: If a fuel injector becomes separated from the fuel rail and remains in the cylinder head, replace the fuel injector O-ring seals and the retaining clip.

8. Remove the fuel rail with the fuel injectors attached.



A102F007

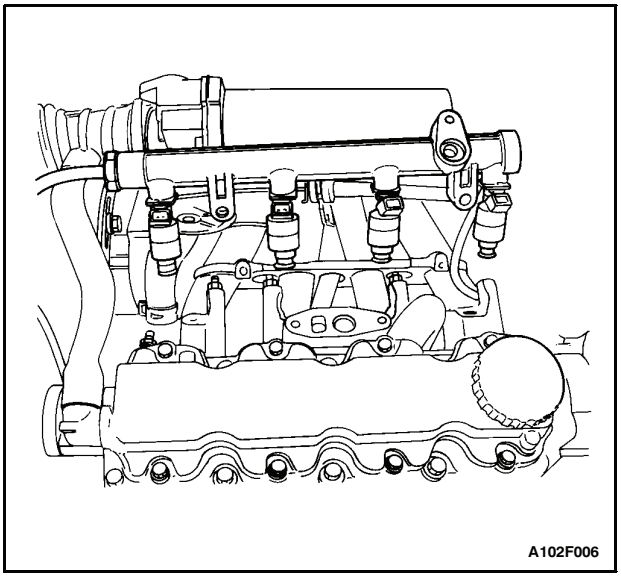
9. Remove the fuel injector retainer clips.
10. Remove the fuel injectors by pulling them down and out.
11. Discard the fuel injector O-rings.


A102F008

Installation Procedure

Important: Different fuel injectors are calibrated for different flow rates. When ordering new fuel injectors, be certain to order the identical part number that is inscribed on the old fuel injector.

1. **Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.**
2. **Install the fuel injectors into the fuel rail sockets with the fuel injector terminals facing outward.**
3. **Install the fuel injector retainer clips onto the fuel injectors and the fuel rail ledge.**
4. **Make sure that the clip is parallel to the fuel injector harness connector.**

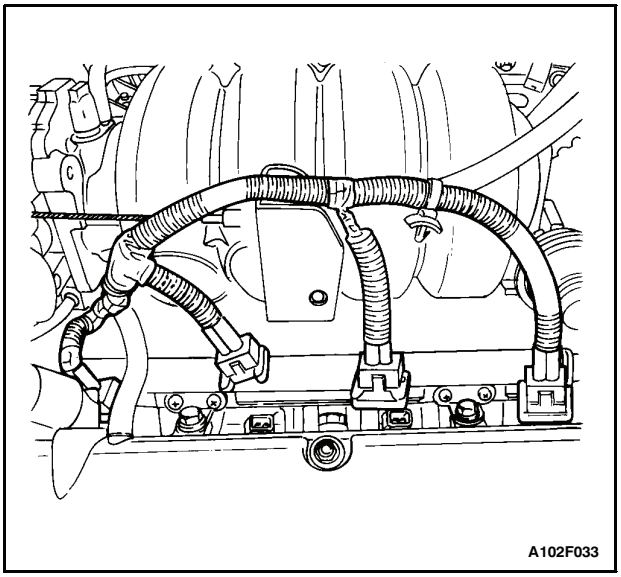

A102F006

5. **Install the fuel rail assembly into the cylinder head.**
6. **Install the fuel rail retaining bolts.**

Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

7. **Connect the fuel inlet hose line.**
8. **Connect the fuel injector harness connectors. Rotate the fuel injector as required to avoid stretching the wire harness.**
9. **Install the fuel pressure regulator. Refer to "Fuel Pressure Regulator (SOHC)" in this section.**
10. **Install the exhaust gas recirculation valve, if equipped. Refer to "Exhaust Gas Recirculation Valve (SOHC)" in this section.**
11. **Connect the negative battery cable.**
12. **Perform a leak check of the fuel rail and the fuel injectors.**

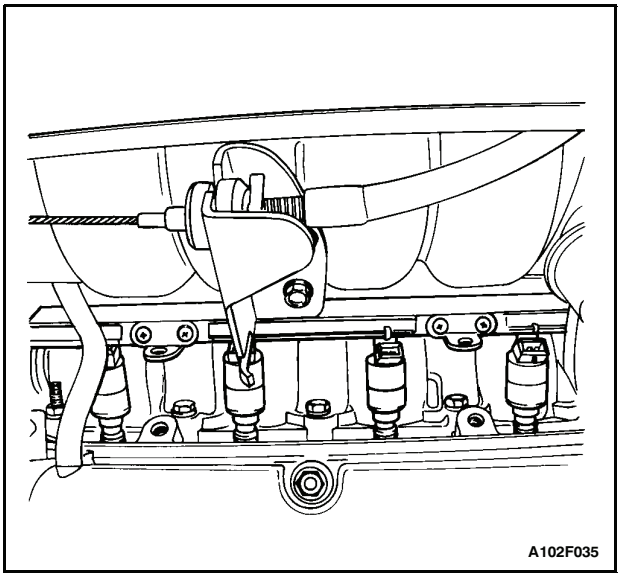

A102F033

FUEL RAIL AND INJECTORS (DOHC)

Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. **Relieve the fuel system pressure. Refer to "Fuel Pump" in this section.**
2. **Disconnect the negative battery cable.**
3. **Disconnect the fuel injector harness connectors.**
4. **Remove the fuel line at the fuel pressure regulator. Refer to "Fuel Pressure Regulator (DOHC)" in this section.**

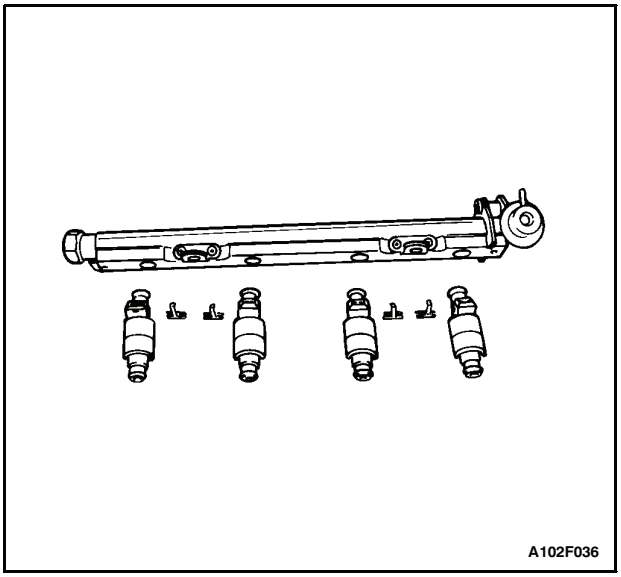

A102F035

5. Remove the fuel inlet line.
6. Remove the fuel rail mounting bolts.

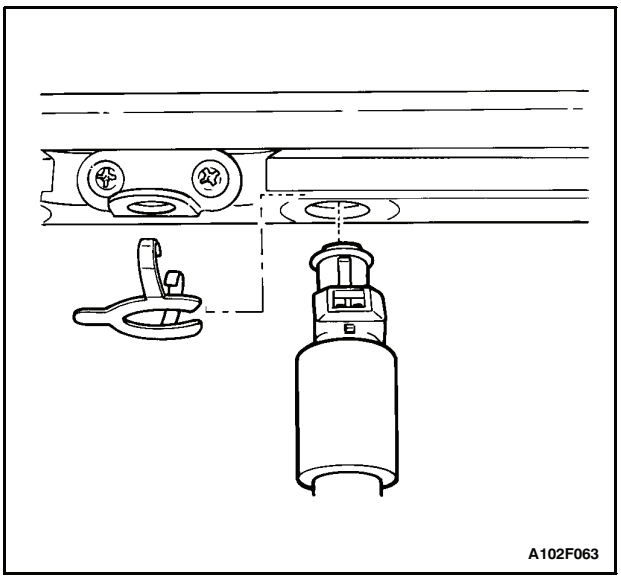
Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and the injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

7. Remove the fuel rail with the fuel injectors attached.


A102F036

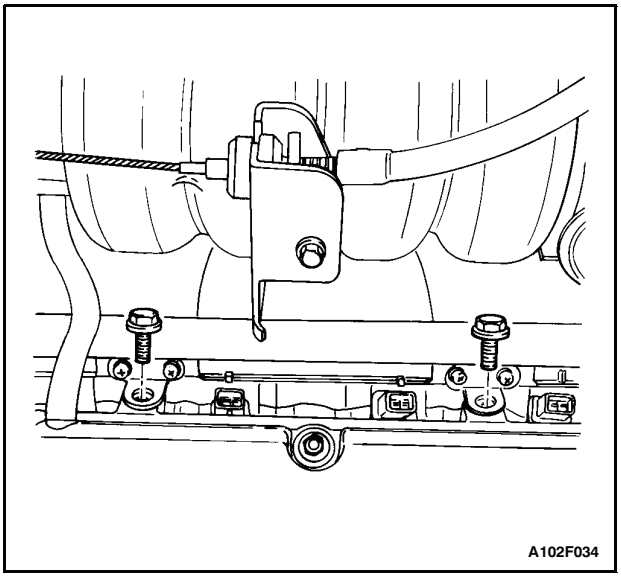
8. Remove the fuel injector retainer clips.
9. Remove the fuel injectors by pulling down and out.
10. Discard the fuel injector O-rings.


A102F063

Installation Procedure

Important: Different injectors are calibrated for different flow rates. When ordering new fuel injectors, be certain to order the identical part number that is inscribed on the old injector.

1. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
2. Install the fuel injectors into the fuel rail sockets with the fuel injector terminals facing outward.
3. Install the fuel injector retainer clips onto the fuel injectors and the fuel rail ledge.
4. Make sure that the clip is parallel to the fuel injector harness connector.

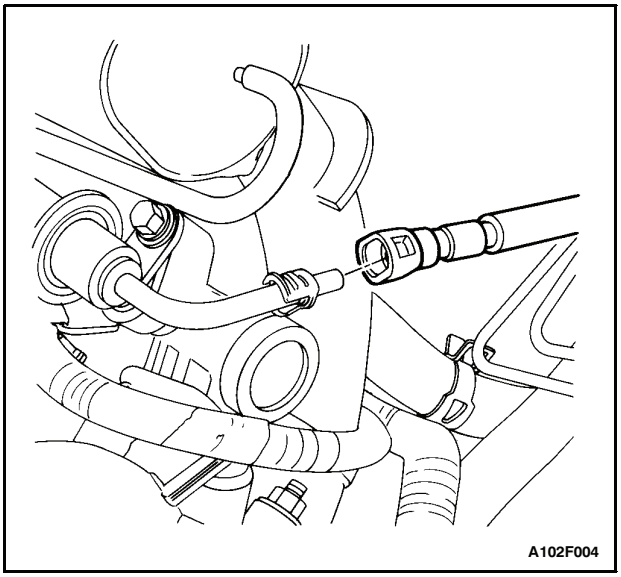

A102F034

5. Install the fuel rail assembly into the cylinder head.
6. Install the fuel rail retaining bolts.

Tighten

Tighten the fuel rail retaining bolts to 25 N•m (18 lb-ft).

7. Connect the fuel inlet hose.
8. Connect the fuel injector harness connectors. Rotate each fuel injector as required to avoid stretching the wire harness.
9. Install the fuel pressure regulator. Refer to "Fuel Pressure Regulator (DOHC)" in this section.
10. Connect the negative battery cable.
11. Perform a leak check of the fuel rail and fuel injectors.

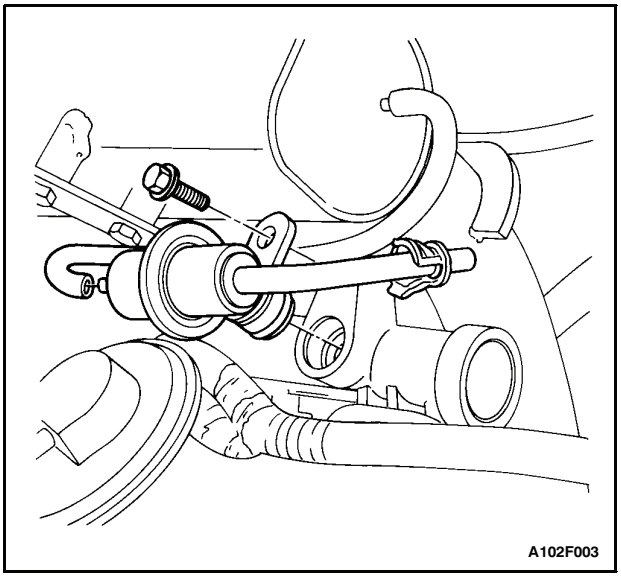

A102F004

FUEL PRESSURE REGULATOR (SOHC)

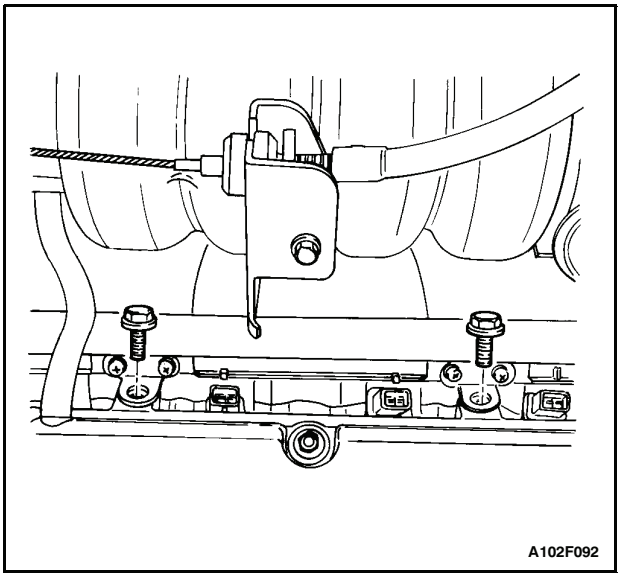
Removal Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Disconnect the fuel line at the fuel pressure regulator by sliding the connector lock forward and pulling the line off.


A102F003

4. Disconnect the vacuum hose from the fuel pressure regulator.
5. Remove the fuel pressure regulator retaining bolt.
6. Remove the fuel pressure regulator by turning it back and forth and then pulling it out.
7. Discard the O-ring.


A102F092

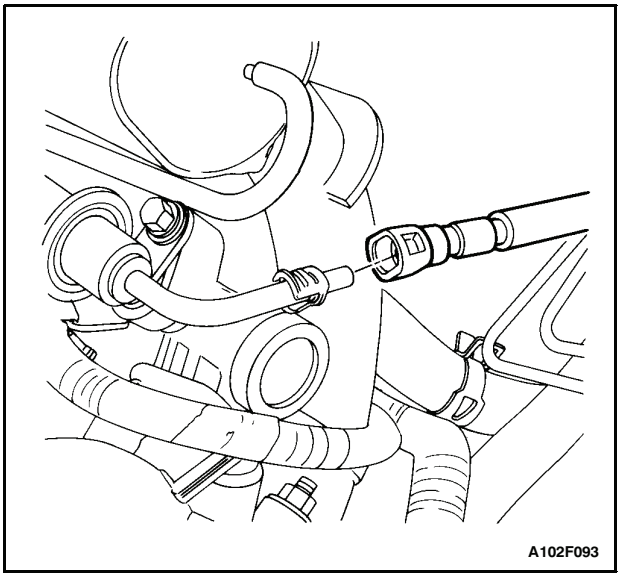
Installation Procedure

1. Lubricate a new O-ring with engine oil. Install the new O-ring onto the fuel pressure regulator body.
2. Insert the fuel pressure regulator into the fuel rail body.
3. Install the retaining bolt.

Tighten

Tighten the fuel pressure regulator retaining bolt to 12 N•m (106 lb-in).

4. Connect the vacuum hose to the fuel pressure regulator.
5. Connect the fuel line to the fuel pressure regulator by pushing the lock into place.
6. Connect the negative battery cable.
7. Perform a leak test of the fuel pressure regulator with the engine OFF and the ignition ON.

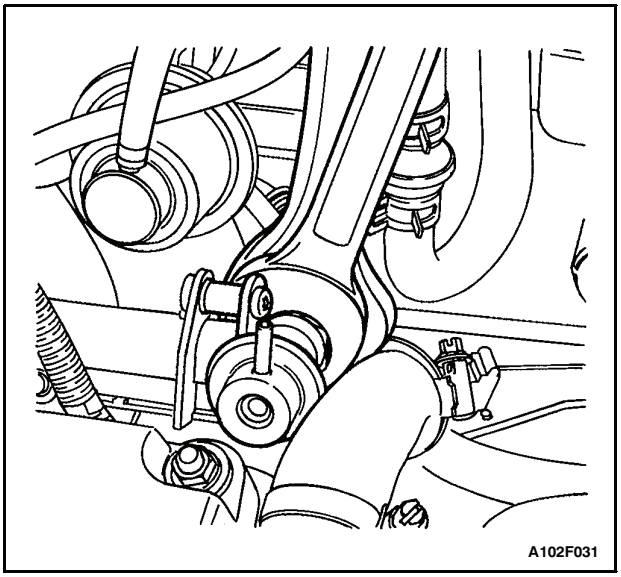

A102F093

FUEL PRESSURE REGULATOR (DOHC)

Removal Procedure

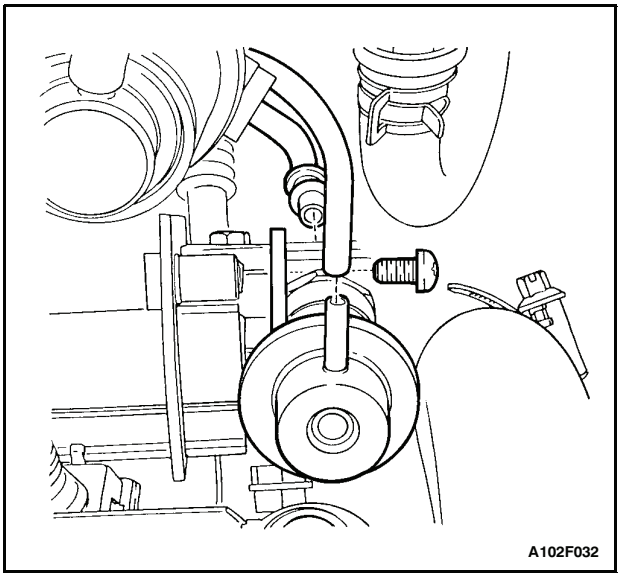
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to "Fuel Pump" in this section.
2. Disconnect the negative battery cable.
3. Remove the vacuum hose from the fuel pressure regulator.


A102F031

Notice: Use a backup wrench when removing or installing the fuel lines. Damage to the fuel rail can occur if two wrenches are not used.

3. Remove the fuel return line using two wrenches.
4. Remove the retaining screw.
5. Remove the fuel pressure regulator by turning it back and forth and then pulling it out.
6. Discard the O-ring.


A102F032

Installation Procedure

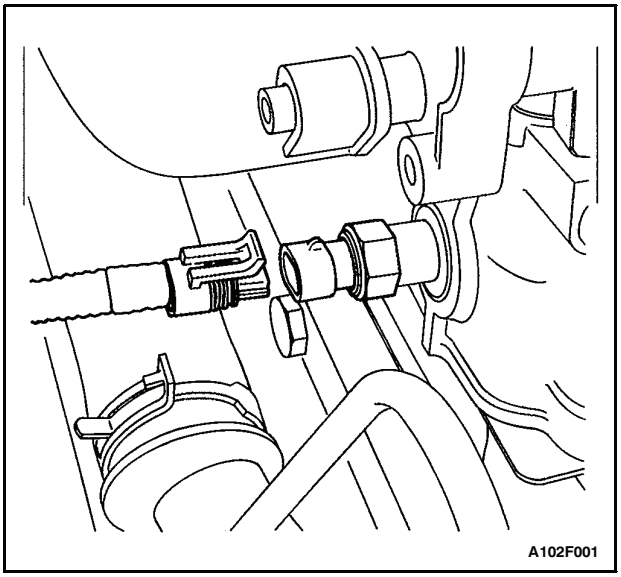
1. Lubricate a new O-ring with engine oil. Install the O-ring onto the fuel pressure regulator.
2. Insert the fuel pressure regulator into the fuel rail body.
3. Install the retaining screw.

Tighten

Tighten the fuel pressure regulator retaining screw to 12 N•m (106 lb-in).

4. Connect the fuel line using two wrenches.
5. Connect the vacuum hose to the fuel pressure regulator.
6. Connect the negative battery cable.
7. Perform a leak test of the fuel pressure regulator with the engine OFF and the ignition ON.

COOLANT TEMPERATURE SENSOR (SOHC)

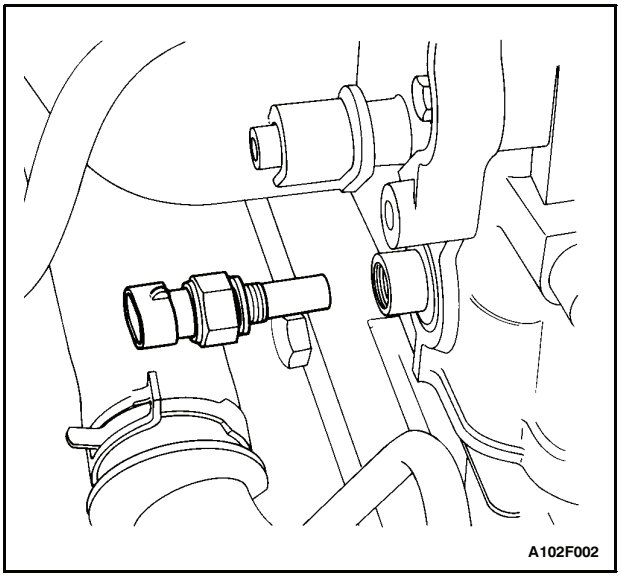

A102F001

Removal Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the coolant temperature sensor (CTS) connector.

Notice: Use care when handling the CTS. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Carefully remove the CTS from the cylinder head underneath the direct ignition system (DIS) ignition coil.


A102F002

Installation Procedure

1. Coat the threads on the CTS with sealer.

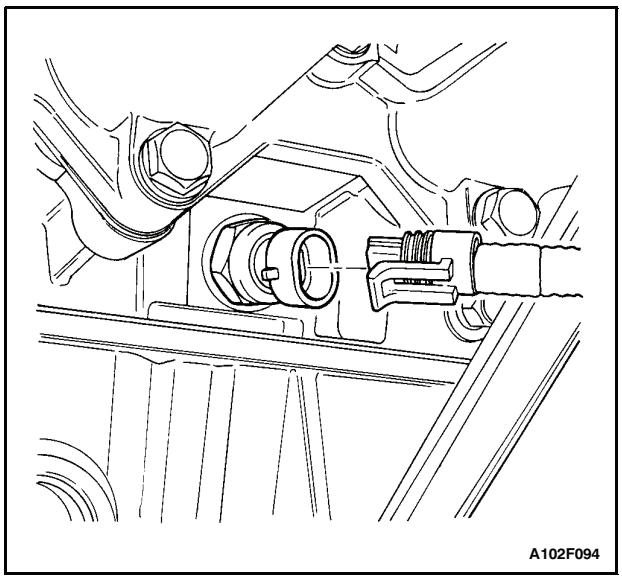
Notice: Use care when handling the CTS. Damage to the sensor will affect the proper operation of the fuel injection system.

2. Install the CTS into the cylinder head.

Tighten

Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).

3. Connect the CTS connector.
4. Fill the coolant system.
5. Connect the negative battery cable.


A102F094

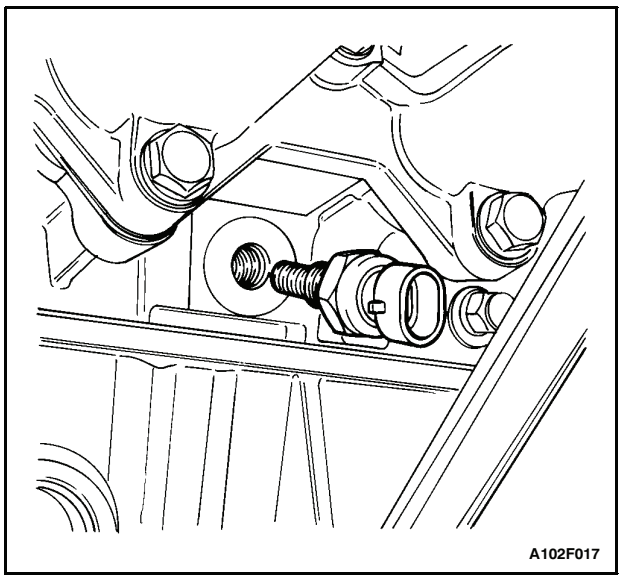
COOLANT TEMPERATURE SENSOR (DOHC)

Removal Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the coolant temperature sensor (CTS) connector.

Notice: Use care when handling the sensor. Damage will affect the proper operation of the fuel injection system.

4. Carefully remove the CTS from the cylinder head underneath the intake manifold.


A102F017

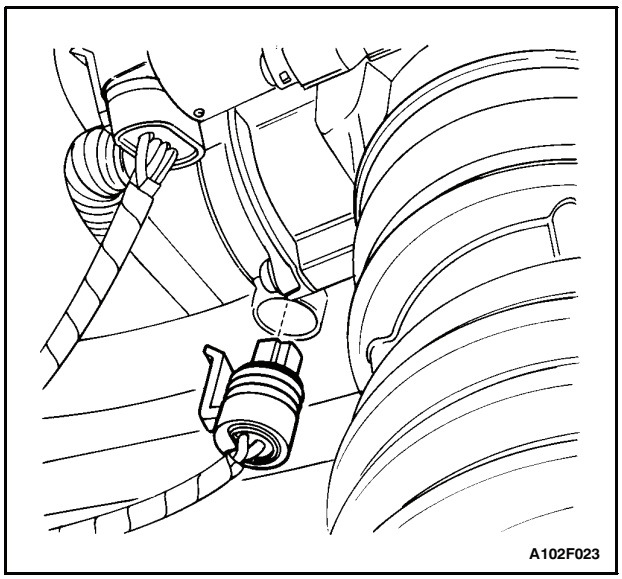
Installation Procedure

1. Coat the threads on the CTS with sealer.
2. Install the CTS into the cylinder head.

Tighten

Tighten the coolant temperature sensor to 20 N•m (15 lb-ft).

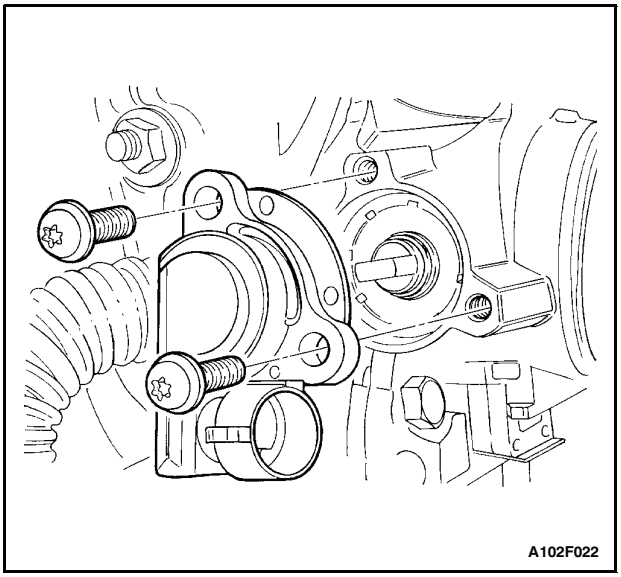
3. Connect the CTS connector.
4. Fill the cooling system.
5. Connect the negative battery cable.


A102F023

THROTTLE POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the throttle position sensor (TPS) connector.
3. Remove the TPS retaining bolts and the TPS.


A102F022

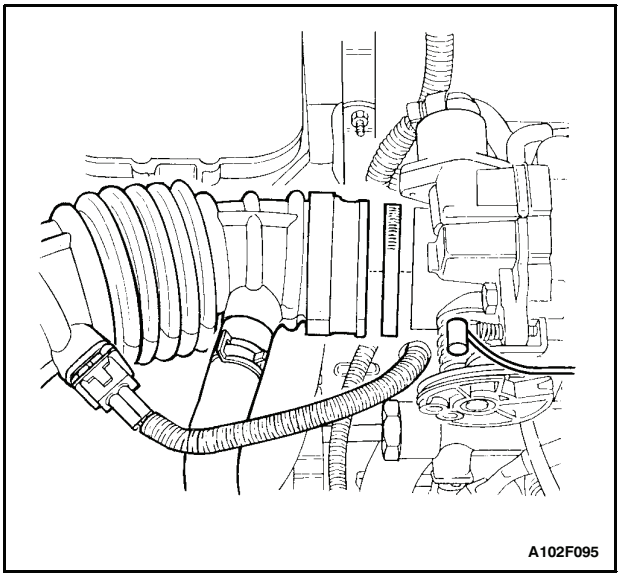
Installation Procedure

1. With the throttle valve closed, position the TPS on the throttle shaft. Align the TPS with the bolt holes.
2. Install the TPS retaining bolts.

Tighten

Tighten the throttle position sensor retaining bolts to 2 N•m (18 lb-in).

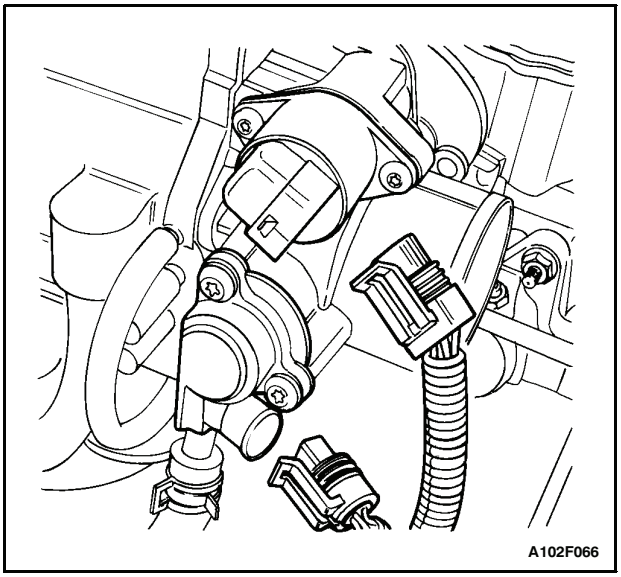
3. Connect the TPS connector.
4. Connect the negative battery cable.


A102F095

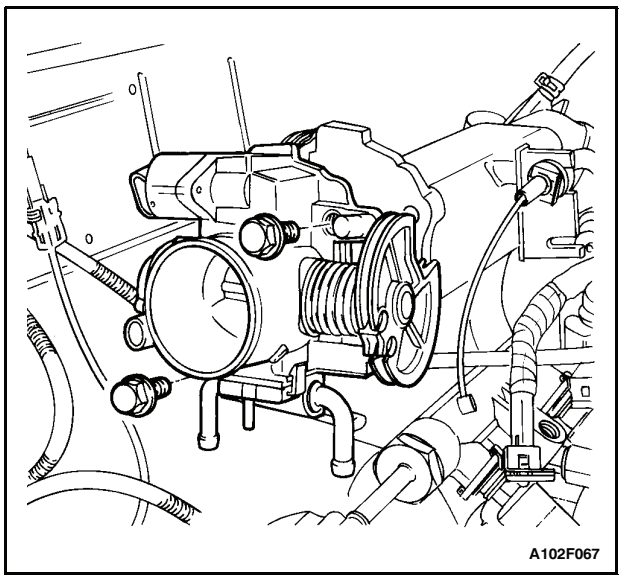
THROTTLE BODY (TYPICAL)

Removal Procedure

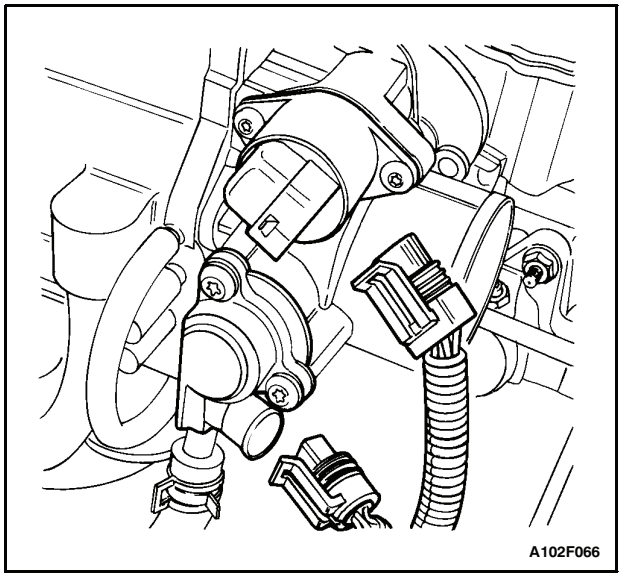
1. Disconnect the negative battery cable.
2. Remove the air intake tube from the throttle body.
3. Disconnect the throttle cables by opening the throttle and moving the cable through the release slot.


A102F066

4. Disconnect the vacuum hoses from the throttle body.
5. Disconnect the throttle position sensor (TPS) and the idle air control valve connectors.


A102F067

6. Remove the coolant hoses from the throttle body.
7. Remove the throttle body retaining bolts.
8. Remove the throttle body and discard the gasket.
9. Remove the TPS. Refer to "Throttle Position Sensor" in this section.
10. Remove the idle air control (IAC) valve. Refer to "Idle Air Control Valve" in this section.


A102F066

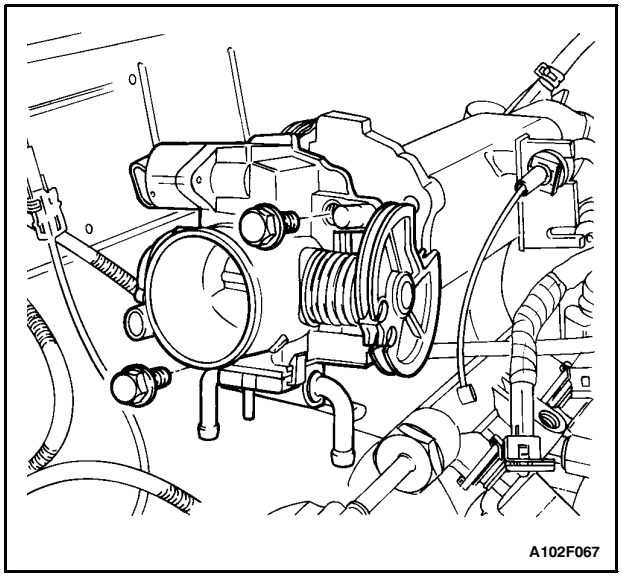
Installation Procedure

Notice: Use care in cleaning old gasket material from machined aluminum surfaces. Sharp tools may damage sealing surfaces.

1. Clean the gasket mating surface on the intake manifold.

Notice: The throttle body may be cleaned in a cold immersion-type cleaner following disassembly. The TPS and the IAC valve should not come in contact with any solvent or cleaner as they may be damaged.

2. Clean the throttle body.
3. Install the TPS. Refer to "Throttle Position Sensor" in this section.
4. Install the IAC valve. Refer to "Idle Air Control Valve" in this section.


A102F067

5. Install the throttle body assembly to the intake manifold with a new gasket.
6. Install the throttle body retaining bolts.

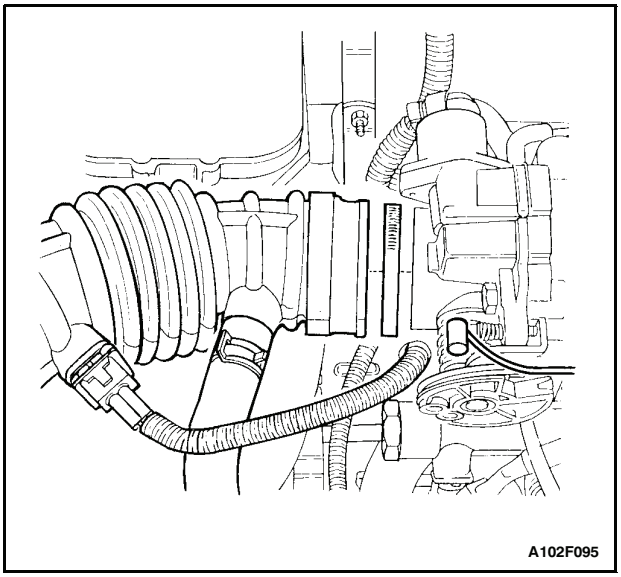
Tighten

Tighten the throttle body retaining bolts to 15 N•m (11 lb-ft).

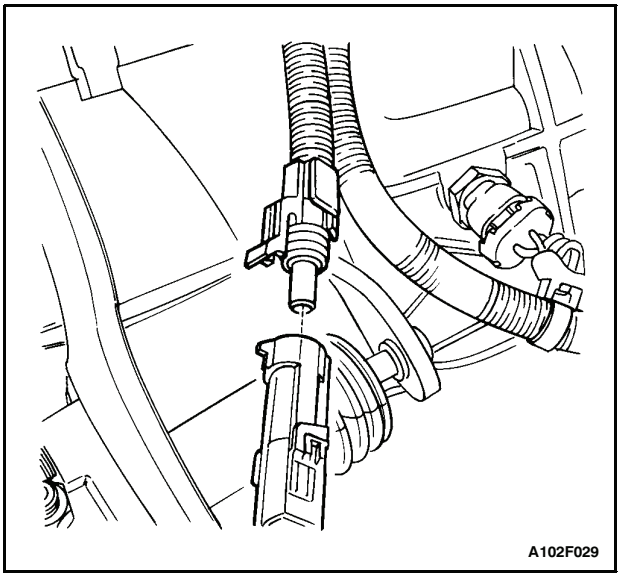
7. Install the coolant hoses.
8. Connect the vacuum hoses to the throttle body.

Important: Make sure the throttle control cables do not hold the throttle open. With the engine OFF, check to see that the accelerator pedal is free.

9. Connect the throttle cables.


A102F095

10. Install the air intake tube.
11. Connect the TPS connector and the IAC valve connector.
12. Connect the negative battery cable.
13. Fill the cooling system.


A102F029

OXYGEN SENSOR (TYPICAL)

Removal Procedure

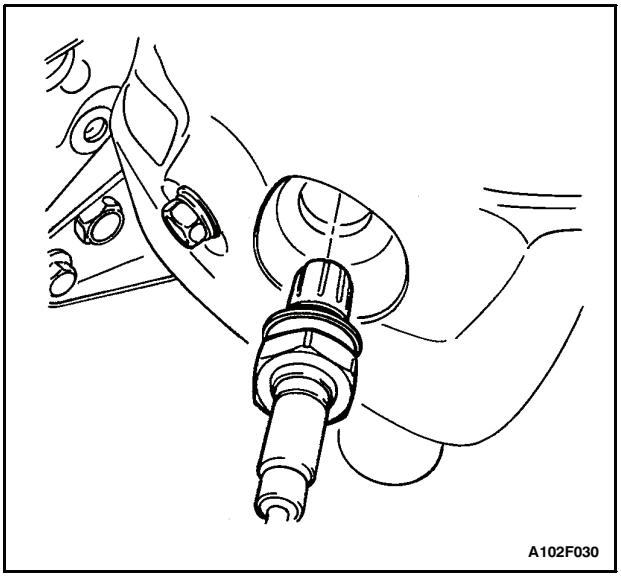
1. Disconnect the negative battery cable.

Notice: The oxygen (O_2) sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the O_2 sensor. Damage or removal of the pigtail or the connector could affect proper operation of the O_2 sensor. Take care when handling the O_2 sensor. Do not drop or the O_2 sensor.

2. Disconnect the O_2 sensor connector.

Notice: The O_2 sensor may be difficult to remove when engine temperature is below 48°C (118°F). Excessive force may damage threads in the exhaust manifold.

3. Carefully remove the O_2 sensor from the exhaust manifold.


A102F030

Installation Procedure

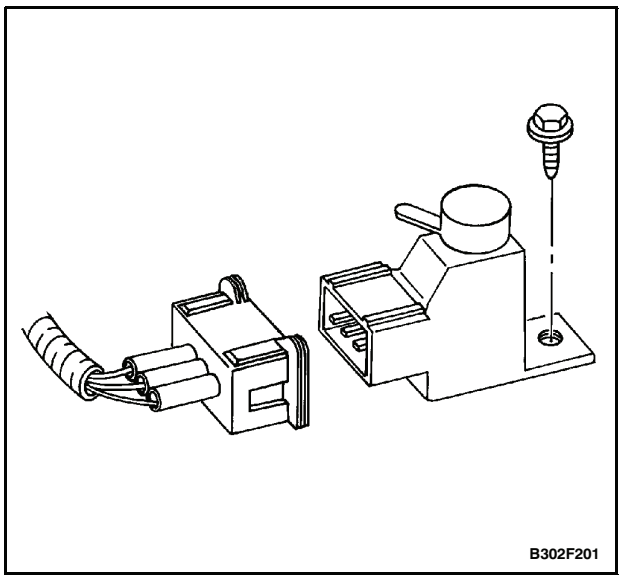
Important: A special anti-seize compound is used on the O_2 sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to the threads. If a sensor is removed from any engine and, if for any reason, it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the O_2 sensor with an anti-seize compound, if needed.
2. Install the O_2 sensor into the exhaust manifold.

Tighten

Tighten the oxygen sensor to 41 N•m (30 lb-ft).

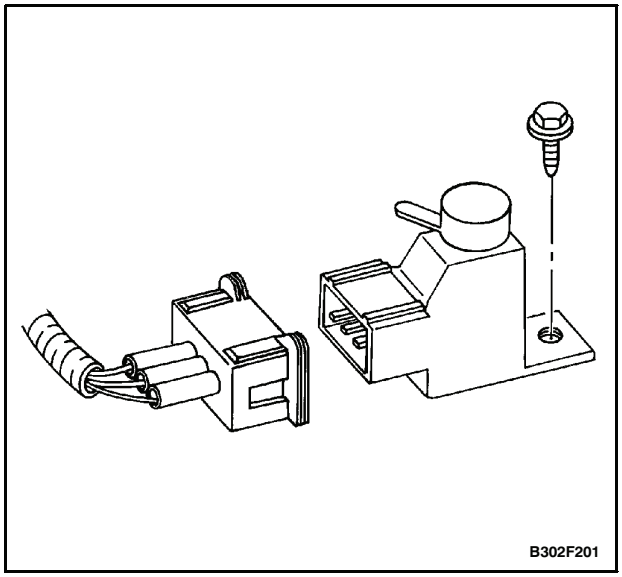
3. Connect the O_2 sensor connector.
4. Connect the negative battery cable.



CO POTENTIOMETER (LEADED FUEL ONLY)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the CO potentiometer mounting bolt.
3. Remove the electrical connector.



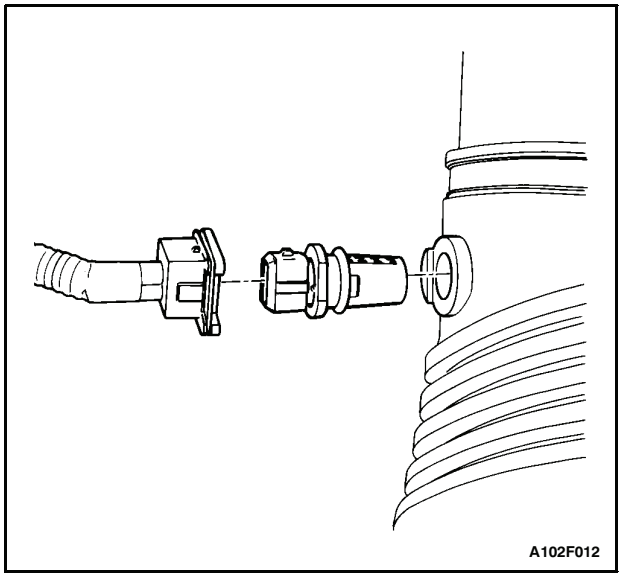
Installation Procedure

1. Install the electrical connector.
2. Install the CO potentiometer mounting.

Tighten

Tighten the CO potentiometer mounting bolt to 8 N•m (71 lb-in).

3. Connect the negative battery cable.



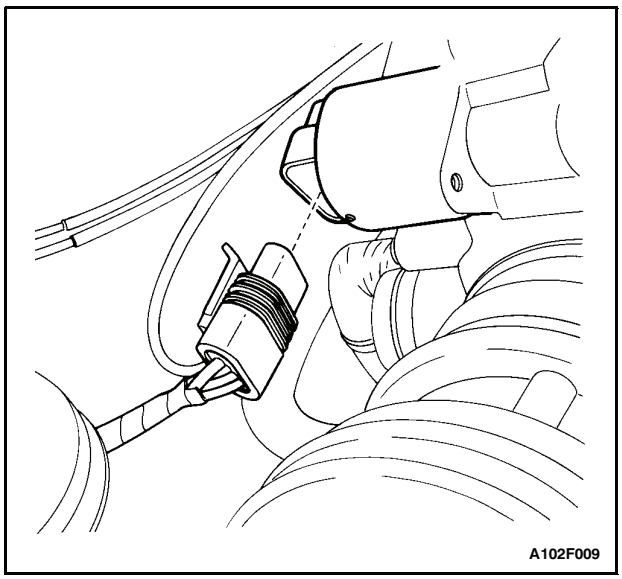
MANIFOLD AIR TEMPERATURE SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the manifold air temperature sensor (MAT) connector.
3. Remove the MAT sensor by pulling it out of the air intake tube.

Installation Procedure

1. Insert the MAT sensor into the air intake tube.
2. Connect the MAT connector.
3. Connect the negative battery cable.


A102F009

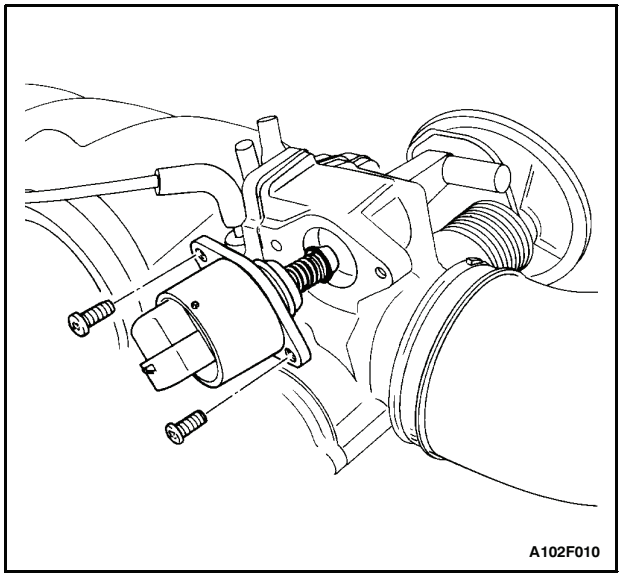
IDLE AIR CONTROL VALVE (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the idle air control (IAC) valve connector.
3. Remove the IAC valve retaining bolts.

Notice: On IAC valves that have been in service, do not push on the valve pintle. The force required to move the pintle may damage the threads on the worm drive.

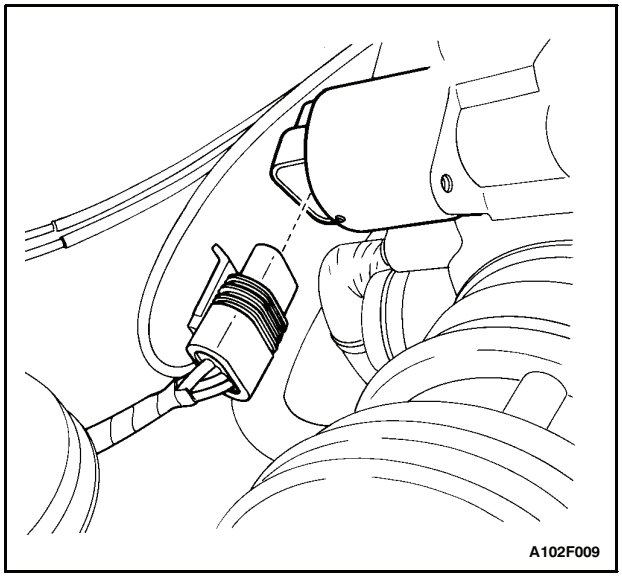
4. Remove the IAC valve.
5. Clean the IAC valve O-ring seal area, the pintle valve seat and the air passage with a suitable fuel system cleaner. Do not use methyl ethyl ketone.


A102F010

Installation Procedure

Important: If installing a new IAC valve, be sure to replace it with an identical part. The IAC valve pintle shape and diameter are designed for the specific application. Measure the distance between the tip of the IAC valve pintle and the mounting flange. If the distance is greater than 28 mm, use finger pressure to slowly retract the pintle. The force required to retract the pintle will not damage the IAC valve. The purpose of the 28 mm setting is to prevent the IAC pintle from bottoming out on the pintle seat. This 28 mm setting is also an adequate setting for controlled idle on a restart.

1. Lubricate a new O-ring with engine oil. Install the new O-ring onto the valve.
2. Install the IAC valve into the throttle body.

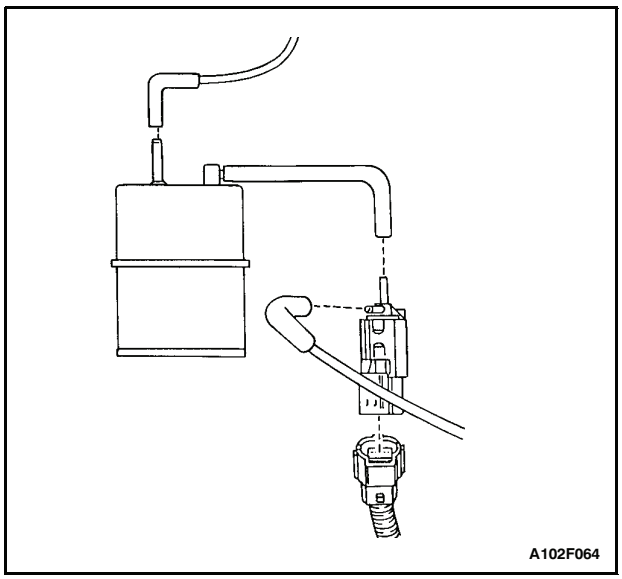

A102F009

3. Install the IAC valve retaining bolts.

Tighten

Tighten the idle air control valve retaining bolts to 3 N•m (27 lb-in).

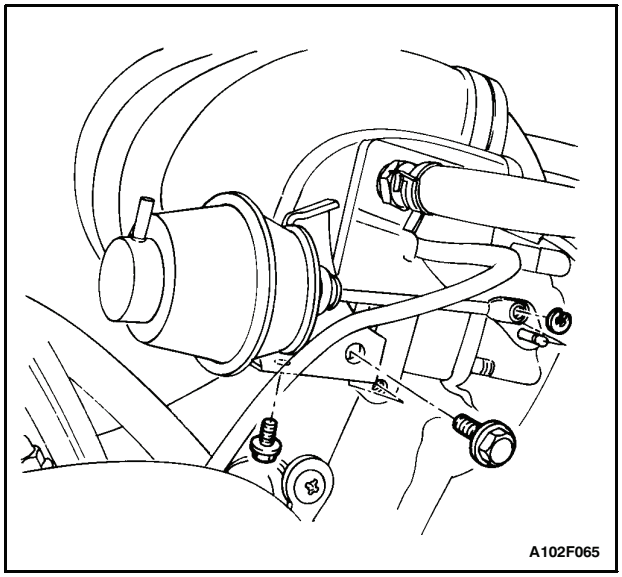
4. Connect the IAC valve connector.
5. Connect the negative battery cable.
6. Start the engine and check for the proper idle speed.


A102F064

VARIABLE GEOMETRY INDUCTION SYSTEM

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the vacuum hoses from the variable geometry induction system (VGIS) solenoid. Note the location of the hoses for ease of installation.
3. Disconnect the VGIS solenoid connector.
4. Remove the VGIS solenoid by pressing the lock in and pulling down on the solenoid.
5. Remove the VGIS vacuum canister.
6. Remove the circlip at the VGIS actuator lever.
7. Remove the VGIS actuator mounting bracket bolt.
8. Remove the VGIS actuator assembly.


A102F065

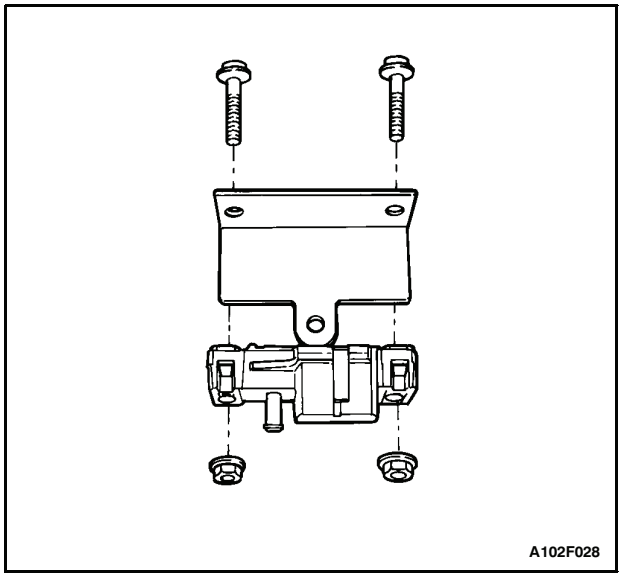
Installation Procedure

1. Install the VGIS actuator assembly on the plenum with the mounting bracket bolt.

Tighten

Tighten the variable geometry induction system actuator assembly mounting bracket bolt to 16 N•m (12 lb-ft).

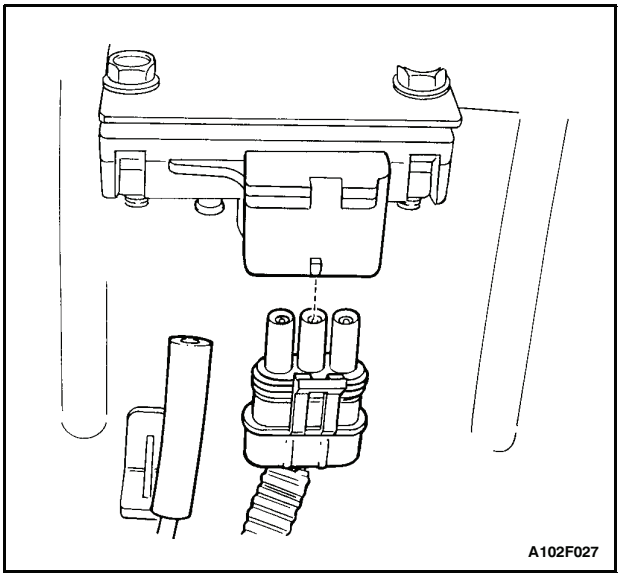
2. Connect the VGIS actuator assembly rod into the plenum lever.
3. Install the rod circlip.
4. Install the VGIS solenoid into the snap lock.
5. Push the vacuum canister into the bracket.
6. Connect the VGIS solenoid connector.
7. Connect the vacuum hoses.
8. Connect the negative battery cable.


A102F028

MANIFOLD ABSOLUTE PRESSURE SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the vacuum hose from the manifold absolute pressure (MAP) sensor.
3. Disconnect the MAP connector.
4. Remove the MAP sensor mounting bracket bolt.
5. Remove the bolts and the nuts that secure the MAP sensor to the mounting bracket.


A102F027

Installation Procedure

1. Insert the MAP sensor into the mounting bracket.
2. Install the bolts through the MAP sensor and the bracket. Install the retaining nuts.

Tighten

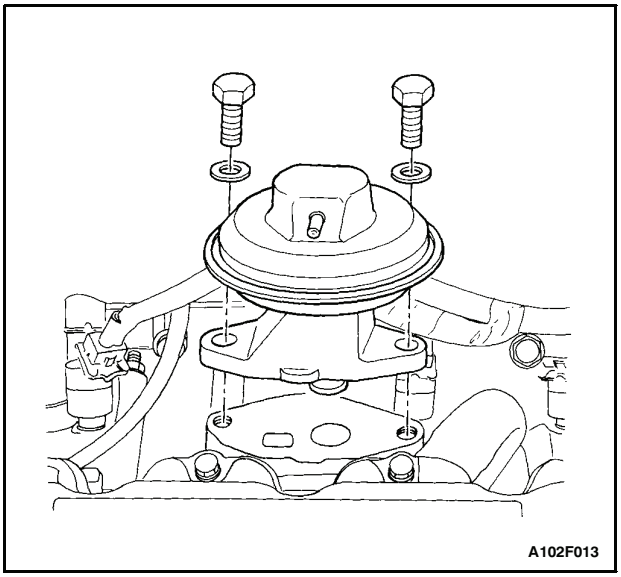
Tighten the manifold absolute pressure sensor retaining bolts and the nuts to 8 N•m (71 lb-in).

3. Install the MAP sensor and the mounting bracket to the fire wall with the mounting bracket bolt.

Tighten

Tighten the manifold absolute pressure sensor mounting bracket bolt to 10 N•m (89 lb-in).

4. Connect the MAP sensor connector.
5. Connect the vacuum hose to the MAP sensor.
6. Connect the negative battery cable.


A102F013

EXHAUST GAS RECIRCULATION VALVE (SOHC)

Removal Procedure

1. Disconnect the vacuum hose from the exhaust gas recirculation (EGR) valve.
2. Remove the bolts and the EGR valve.

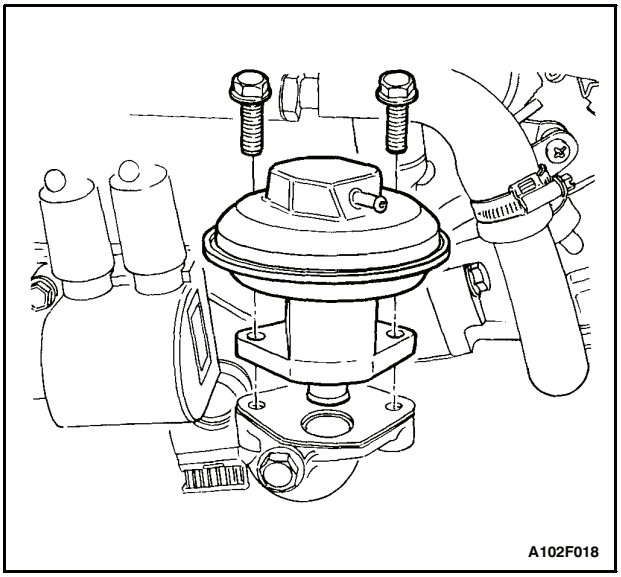
Installation Procedure

1. Clean the cylinder head mating surface.
2. Install the new EGR valve gasket.
3. Install the EGR valve with the retaining bolts.

Tighten

Tighten the exhaust gas recirculation valve retaining bolts to 20 N•m (15 lb-ft).

4. Connect the vacuum hose to the EGR valve.


A102F018

EXHAUST GAS RECIRCULATION VALVE (DOHC)

Removal Procedure

1. Disconnect the vacuum hose from the exhaust gas recirculation (EGR) valve.
2. Remove the bolts and the EGR valve.

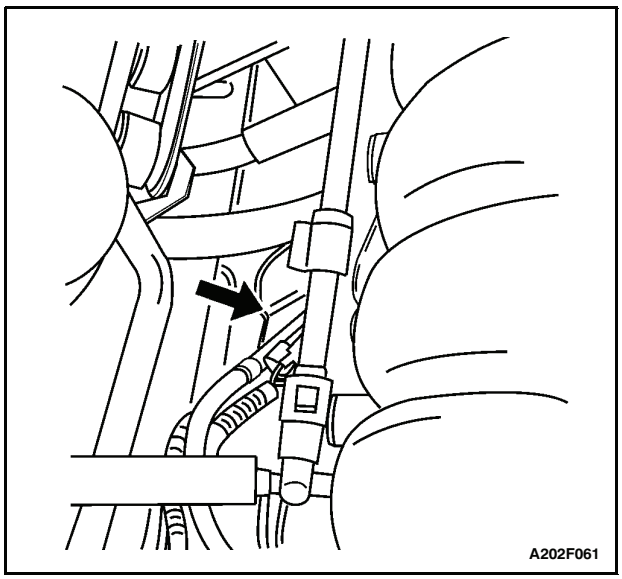
Installation Procedure

1. Clean the cylinder head mating surface.
2. Install a new EGR valve gasket.
3. Install the EGR valve with the retaining bolts.

Tighten

Tighten the exhaust gas recirculation valve retaining bolts to 20 N•m (15 lb-ft).

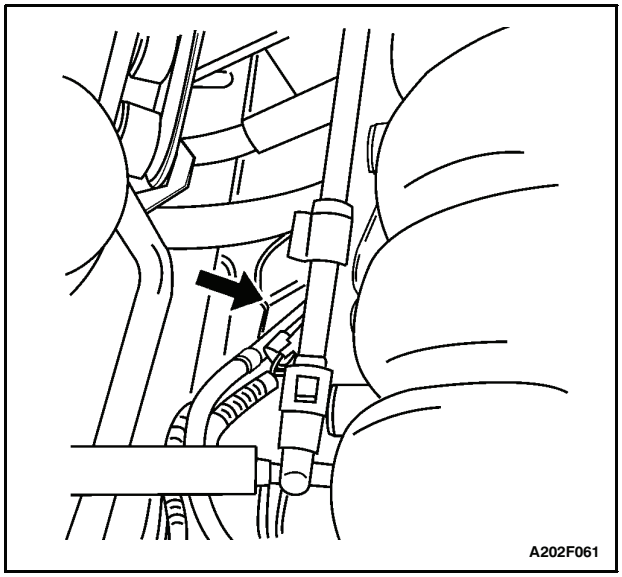
4. Connect the vacuum hose to the EGR valve.



EXHAUST GAS RECIRCULATION VALVE SOLENOID (TYPICAL)

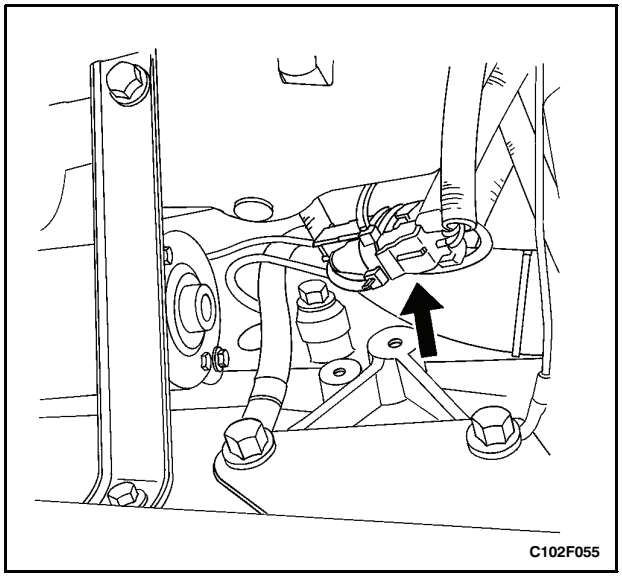
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the canister purge solenoid. Refer to "Canister Purge Solenoid" in this section.
3. Pry off the exhaust gas recirculation (EGR) valve solenoid from the mounting bracket.
4. Disconnect the electrical connector at the EGR valve solenoid.
5. Disconnect the vacuum lines at the EGR valve solenoid.



Installation Procedure

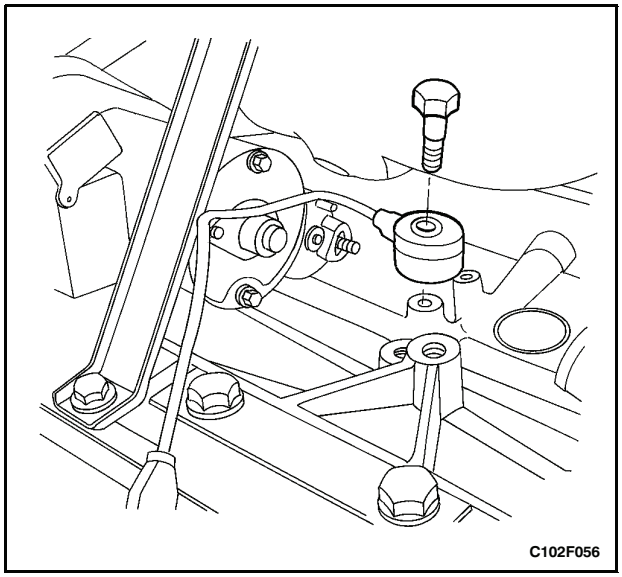
1. Connect the vacuum lines at the EGR valve solenoid.
2. Connect the electrical connector at the EGR valve solenoid.
3. Push the EGR valve solenoid onto the mounting bracket.
4. Install the canister purge solenoid. Refer to "Canister Purge Solenoid" in this section.
5. Connect the negative battery cable.



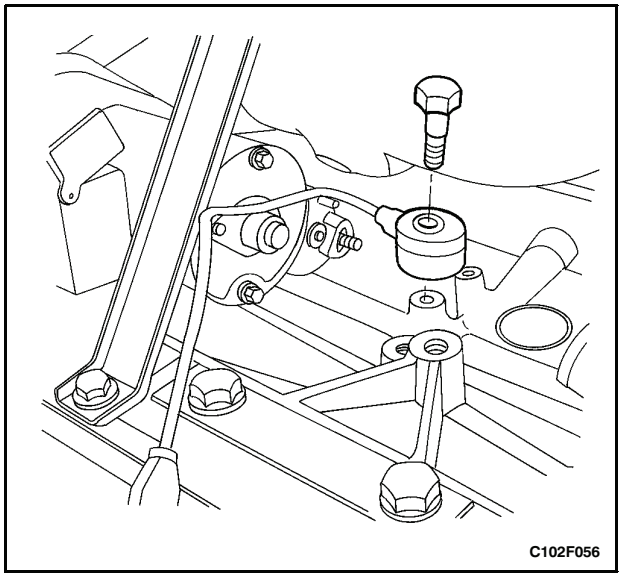
KNOCK SENSOR

Removal Procedure

1. Disconnect the negative battery cable.
2. For vehicles equipped with an automatic transaxle, remove the intake manifold. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
3. Disconnect the electrical connector at the knock sensor.



4. Remove the knock sensor.

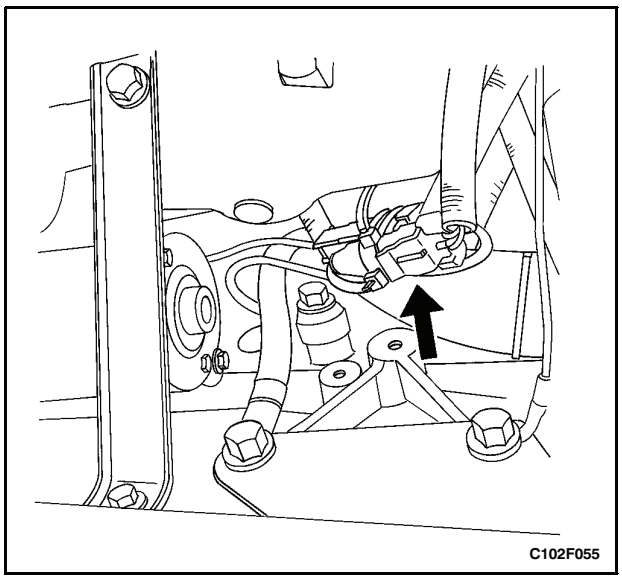


Installation Procedure

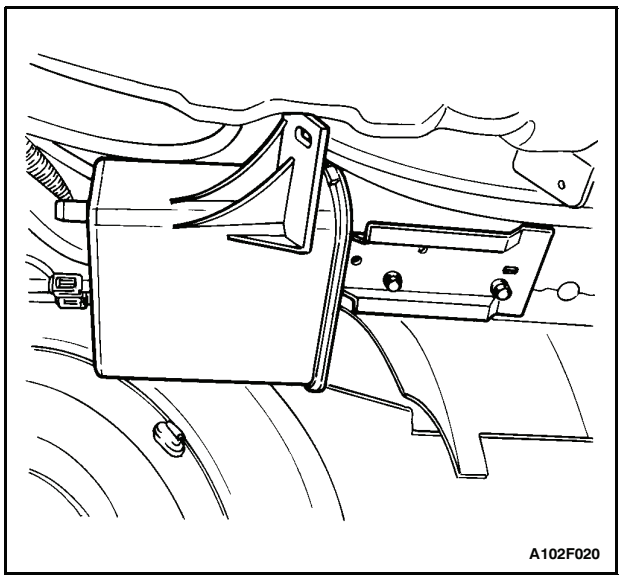
1. Install the knock sensor.

Tighten

Tighten the knock sensor bolt to 20 N•m (15 lb-ft).



2. Connect the electrical connector at the knock sensor.
3. For vehicles equipped with an automatic transaxle, remove the intake manifold. Refer to Section 1B, SOHC Engine Mechanical, or Section 1C, DOHC Engine Mechanical.
4. Connect the negative battery cable.

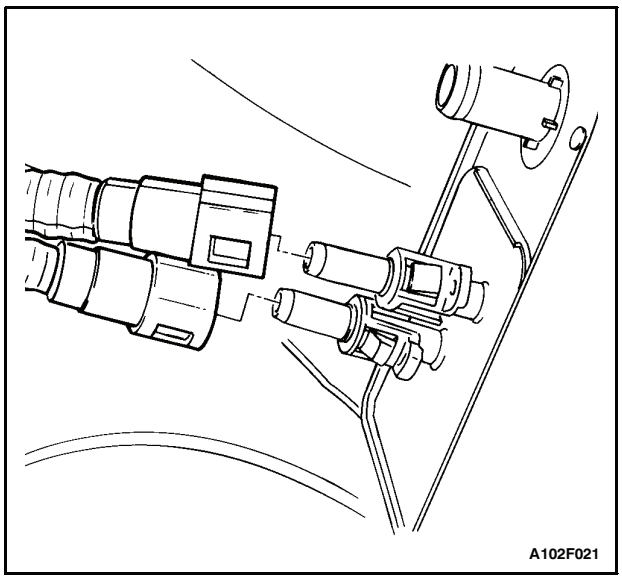

A102F020

EVAPORATIVE EMISSION CANISTER

Removal Procedure

Caution: Canister and vacuum hoses contain fuel vapors. To avoid injury, do not smoke in the area or permit an open flame.

1. Disconnect the canister fuel vapor hoses.
2. Remove the bolt that secures the canister flange to the vehicle.
3. Slide the canister out of the track holder.
4. Remove the canister.

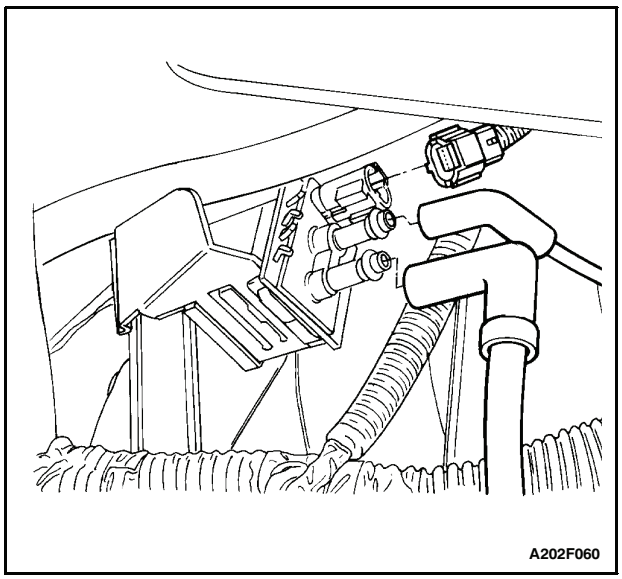

A102F021

Installation Procedure

1. Insert the canister into the track and slide it into position.
2. Install the canister flange bolt.

   #### Tighten

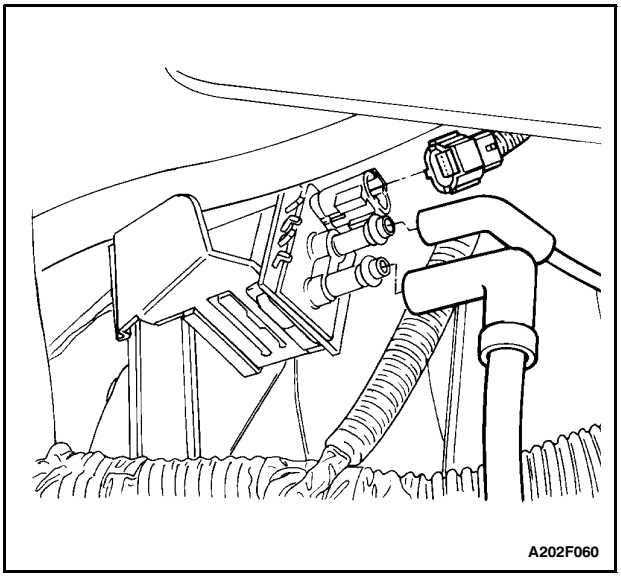
   Tighten the evaporative emission canister flange bolt to 20 N•m (15 lb-ft).
3. Connect the canister fuel vapor hoses.


A202F060

CANISTER PURGE SOLENOID (TYPICAL)

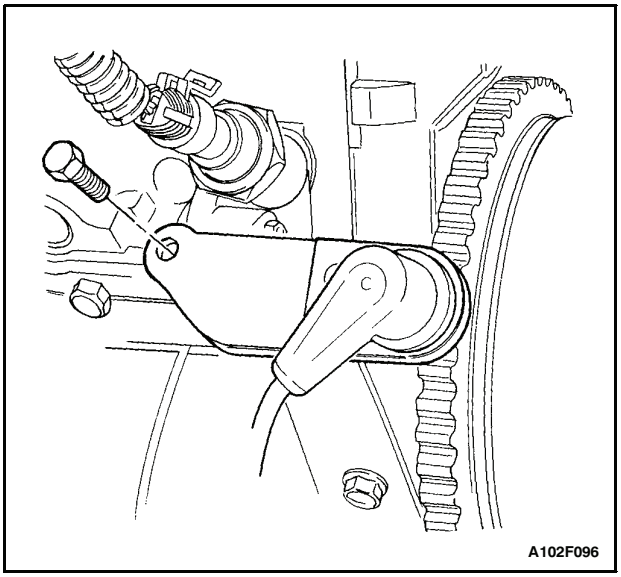
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the controlled canister purge (CCP) solenoid connector.
3. Disconnect the vacuum hoses from the CCP solenoid.
4. Unclip the CCP solenoid from the mounting bracket.


A202F060

Installation Procedure

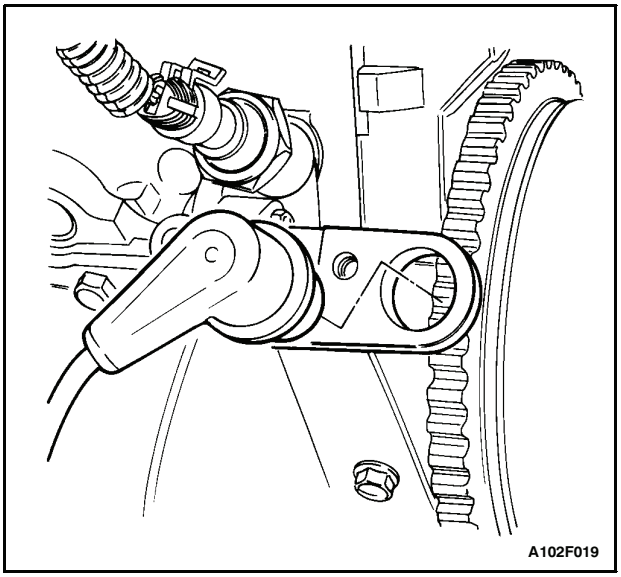
1. Attach the CCP solenoid to the mounting bracket.
2. Connect the CCP solenoid connector.
3. Connect the vacuum hoses to the CCP solenoid.
4. Connect the negative battery cable.


A102F096

CRANKSHAFT POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the crankshaft position sensor (CPS) connector at the frame bracket.
3. Remove the wiring tie straps as needed.
4. Remove the CPS retaining bolt.
5. Remove the CPS.

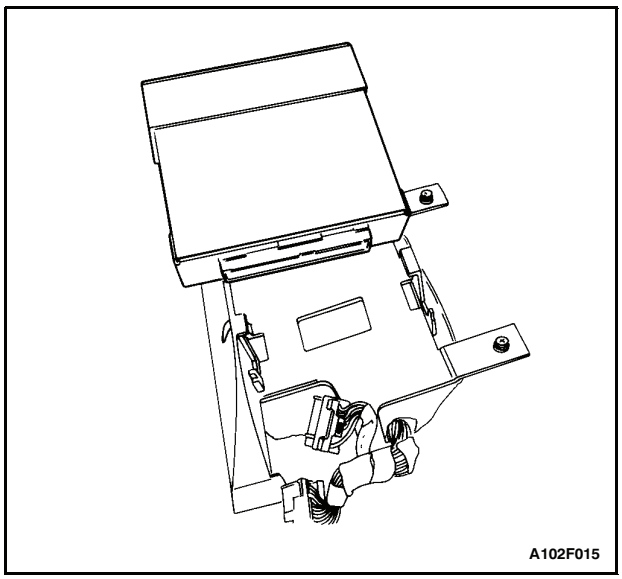

A102F019

Installation Procedure

1. Install the CPS with the retaining bolt.

   #### Tighten

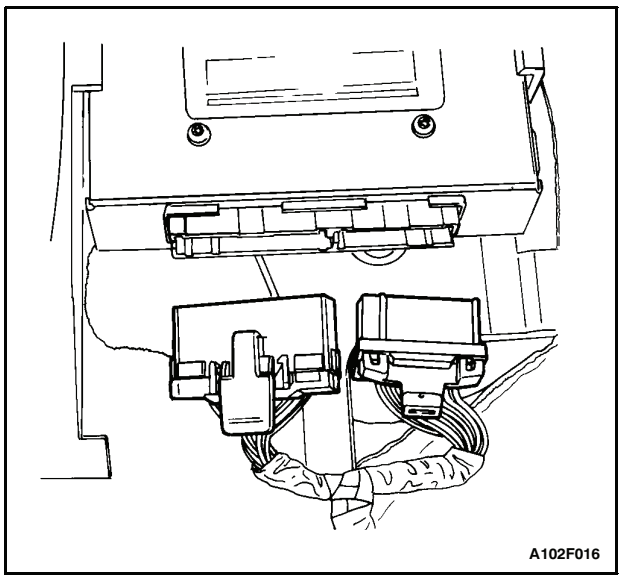
   Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).
2. Connect the CPS connector at the frame bracket.
3. Secure the wire with the tie straps as needed.
4. Connect the negative battery cable.


A102F015

ELECTRONIC CONTROL MODULE (TYPICAL)

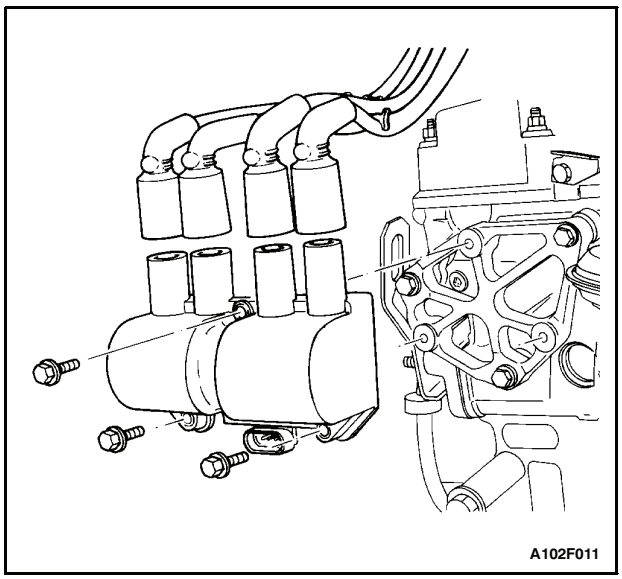
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the passenger seat. Refer to Section 9H, Seats.
3. Disconnect the electronic control module (ECM) connectors.
4. Remove the ECM from the ECM mount.


A102F016

Installation Procedure

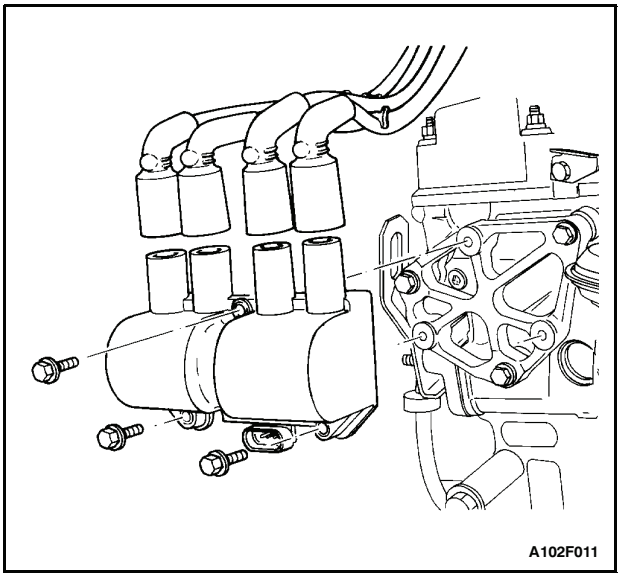
1. Position the ECM in place.
2. Install the ECM to the ECM mount.
3. Connect the ECM connectors.
4. Install the passenger seat. Refer to Section 9H, Seats.
5. Connect the negative battery cable.


A102F011

DIRECT IGNITION SYSTEM IGNITION COIL (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the direct ignition system (DIS) ignition coil connector.
3. Note the ignition wire location and remove the ignition wires.
4. Remove the DIS ignition coil retaining bolts.
5. Remove the DIS ignition coil.



Installation Procedure

1. Install the DIS ignition coil into the mounting location and install the retaining bolts.

Tighten

Tighten the direct ignition system ignition coil retaining bolts to 10 N•m (89 lb-in).

2. Connect the DIS ignition coil connector.
3. Install the ignition wires.
4. Connect the negative battery cable.

GENERAL DESCRIPTION AND SYSTEM OPERATION

IGNITION SYSTEM OPERATION

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor (CPS) input to the electronic control module (ECM). The ECM then determines electronic spark timing (EST) and triggers the direct ignition system (DIS) ignition coil.

This type of distributorless ignition system uses a "waste spark" method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-4 or 2-3). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).

DIRECT IGNITION SYSTEM IGNITION COIL

The direct ignition system (DIS) ignition coil is mounted near the rear of the camshaft carrier on the single overhead camshaft engine. On the dual overhead camshaft engine, the DIS ignition coil is mounted near the rear of the cylinder head. Each pair of terminals of the DIS ignition coil provides the spark for two spark plugs simultaneously. The DIS ignition coil is not serviceable and must be replaced as an assembly.

CRANKSHAFT POSITION SENSOR

This direct ignition system (DIS) uses a magnetic crankshaft position sensor (CPS) mounted just ahead of the block below the intake manifold. This sensor protrudes through its mount to within approximately 1.3 mm (0.05 inch) of the crankshaft reluctor. The reluctor is a special wheel attached to the crankshaft pulley with 58 slots machined into it, 57 of which are equally spaced in 6-degree intervals. The last slot is wider than the others and serves to generate a "sync pulse." As the crankshaft rotates, the slots in the reluctor change the magnetic field of the sensor, creating an induced voltage pulse. The longer pulse of the 58th slot identifies a specific orientation of the crankshaft and allows the electronic control module (ECM) to determine the crankshaft orientation at all times. The ECM uses this information to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.

IDLE AIR SYSTEM OPERATION

The idle air system operation is controlled by the base idle setting of the throttle body and the idle air control (IAC) valve.

The electronic control module (ECM) uses the IAC valve to set the idle speed dependent on conditions. The ECM uses information from various inputs, such as coolant temperature, manifold vacuum, etc., for the effective control of the idle speed.

FUEL CONTROL SYSTEM OPERATION

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The two main fuel control sensors are the manifold absolute pressure (MAP) sensor and the oxygen (O_2) sensor.

The MAP sensor measures or senses the intake manifold vacuum. Under high fuel demands, the MAP sensor reads a low vacuum condition, such as wide-open throttle. The electronic control module (ECM) uses this information to richen the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the vacuum increases. This vacuum change is sensed by the MAP sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O_2 sensor is located in the exhaust manifold. The O_2 sensor indicates to the ECM the amount of oxygen in the exhaust gas and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called "modes."

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 2 seconds. The fuel pump then builds fuel pressure. The ECM also checks the coolant temperature sensor (CTS) and the throttle position sensor (TPS) to determine the proper air/fuel ratio for starting the engine. This ranges from 1.5 to 1 at * 36°C (* 33°F) coolant temperature to 14.7 to 1 at 94°C (201°F) coolant temperature. The ECM controls the amount of fuel deliv-

ered in the starting mode by changing how long the fuel injector is turned on and off. This is done by "pulsing" the fuel injectors for very short times.

Clear Flood Mode

If the engine floods with excessive fuel, it may be cleared by pushing the accelerator pedal down all the way. The ECM will then completely turn off the fuel by eliminating any fuel injector signal. The ECM holds this injector rate as long as the throttle stays wide open and the engine is below approximately 400 rpm. If the throttle position becomes less than approximately 80 percent, the ECM returns to the starting mode.

Run Mode

The run mode has two conditions called "open loop" and "closed loop."

Open Loop

When the engine is first started and it is above 400 rpm, the system goes into "open loop" operation. In "open loop," the ECM ignores the signal from the O_2 sensor and calculates the air/fuel ratio based on inputs from the CTS and the MAP sensor. The sensor stays in "open loop" until the following conditions are met:

- The O_2 sensor has a varying voltage output, showing that it is hot enough to operate properly.
- The CTS is above a specified temperature.
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the electronically erasable programmable read-only memory (EEPROM). When these conditions are met, the system goes into "closed loop" operation. In "closed loop," the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

Battery Voltage Correction Mode

When the battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the fuel injectors when the ignition is OFF. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the crankshaft position sensor (CPS). This prevents flooding.

EVAPORATIVE EMISSION CONTROL SYSTEM OPERATION

The basic evaporative emission (EVAP) control system used is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake airflow and is consumed in the normal combustion process.

Gasoline vapors from the fuel tank flow into the tube labeled TANK. These vapors are absorbed into the carbon. The canister is purged by electronic control module (ECM) when the engine has been running for a specified amount of time. Air is drawn into the canister and mixed with the vapor. This mixture is then drawn into the intake manifold.

The ECM supplies a ground to energize the controlled canister purge (CCP) solenoid valve. This valve is pulse-width modulated (PWM) or turned on and off several times a second. The CCP PWM duty cycle varies according to operating conditions determined by mass airflow, fuel trim, and intake air temperature.

Poor idle, stalling, and poor driveability can be caused by the following conditions:

- An inoperative CCP valve.
- A damaged canister.
- Hoses that are split, cracked, or not connected to the proper tubes.

EVAPORATIVE EMISSION CANISTER

The evaporative emission canister is an emission control device containing activated charcoal granules. The evaporative emission canister is used to store fuel vapors from the fuel tank. Once certain conditions are met, the electronic control module (ECM) activates the controlled canister purge (CCP) solenoid, allowing the fuel vapors to be drawn into the engine cylinders and burned.

VARIABLE GEOMETRY INDUCTION SYSTEM OPERATION

The variable geometry induction system (VGIS) is used to add more responsive acceleration to the dual overhead camshaft (DOHC) engines. Under certain conditions, the electronic control module (ECM) activates the VGIS solenoid, allowing stored vacuum to actuate the

secondary throttle control valve. The secondary throttle control valve then opens the secondary throttle plates, which are internal to the intake manifold and plenum assembly. This allows for increased airflow into the engine, creating more responsive acceleration.

POSITIVE CRANKCASE VENTILATION CONTROL SYSTEM OPERATION

A positive crankcase ventilation (PCV) system is used to provide complete use of the crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase. The fresh air is mixed with blowby gases and then passes through a vacuum hose into the intake manifold.

Periodically inspect the hoses and the clamps. Replace any crankcase ventilation components as required.

A restricted or plugged PCV hose may cause the following conditions:

- Rough idle.
- Stalling or low idle speed.
- Oil leaks.
- Oil in the air cleaner.
- Sludge in the engine.

A leaking PCV hose may cause the following conditions:

- Rough idle.
- Stalling.
- High idle speed.

COOLANT TEMPERATURE SENSOR

The coolant temperature sensor (CTS) is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at * 40°C [* 40°F]) while high temperature causes low resistance (70 ohms at 130°C [266°F]).

The electronic control module (ECM) supplies 5 volts to the coolant sensor through a resistor in the ECM and measures the change in voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the change in voltage, the ECM can determine the coolant temperature. The engine coolant temperature affects most of the systems that the ECM controls. A failure in the coolant sensor circuit should set Diagnostic Trouble Code (DTC) 14 or 15. Remember, these DTCs indicate a failure in the coolant temperature circuit, so proper use of the chart will lead either to repairing a wiring problem or to replacing the sensor to repair a problem properly.

THROTTLE POSITION SENSOR

The throttle position sensor (TPS) is a potentiometer connected to the throttle shaft of the throttle body. The TPS electrical circuit consists of a 5-volt supply line and a ground line, both provided by the electronic control module (ECM). The ECM calculates the throttle position by monitoring the voltage on this signal line. The TPS output changes as the accelerator pedal is moved, changing the throttle valve angle. At a closed throttle position, the output of the TPS is low, about 0.5 volt. As the throttle valve opens, the output increases so that, at wide-open throttle (WOT), the output voltage will be about 5 volts.

The ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits should set DTC 21 or 22. Once the DTC is set, the ECM will substitute a default value for the TPS and some vehicle performance will return. A DTC 21 will cause a high idle speed.

OXYGEN SENSOR

The oxygen (O_2) sensor is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the sensor to produce a voltage output. This voltage ranges from approximately 0.1 volt (high O_2 - lean mixture) to 0.9 volt (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 megohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

The electronic control module (ECM) monitors the O_2 sensor output and determines what changes are necessary in the fuel mixture command.

The O_2 sensor circuit sets Diagnostic Trouble Code (DTC) 13 when it is open. A constant low voltage in the sensor circuit, indicating a lean mixture, sets DTC 44. A constant high voltage, indicating a rich mixture, sets DTC 45. Refer to the DTC charts for conditions that could cause a lean or a rich system.

CO POTENTIOMETER (LEADED FUEL ONLY)

The CO potentiometer is a manually adjustable variable resistor which controls carbon monoxide (CO) emissions in vehicles that use leaded fuel. In these vehicles, the CO potentiometer takes the place of the O_2 sensor in controlling the fuel injector pulse width. The electronic control module (ECM) supplies a 5V reference voltage to the CO potentiometer. The technician can adjust the voltage of the return signal back to the ECM by turning a small screw on the CO potentiometer. By adjusting the voltage, the ECM will adjust the pulse width of the fuel injectors to minimize CO emissions.

EXHAUST GAS RECIRCULATION VALVE AND SOLENOID

The exhaust gas recirculation (EGR) system is used on engines to lower NOX (oxides of nitrogen) emission

levels caused by high combustion temperature. The system is operated by the electronic control module (ECM) through the EGR solenoid. The EGR valve feeds small amounts of exhaust gas into the intake manifold to decrease combustion temperature. The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure. If too much exhaust gas enters, combustion will not take place. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle.

The EGR valve is usually open under the following conditions:

- Warm engine operation.
- Above idle speed.

Results of Incorrect Operation

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or to stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may occur:

- The engine stops after a cold start.
- The engine stops at idle after deceleration.
- The vehicle surges during cruise.
- Rough idle.

If the EGR valve stays open all the time, the engine may not idle. Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause the following conditions:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

MANIFOLD AIR TEMPERATURE SENSOR

The manifold air temperature (MAT) sensor is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance (100,000 ohms at * 40°C [* 40°F]), while high temperature causes a low resistance (70 ohms at 130°C [266°F]).

The electronic control module (ECM) provides 5 volts to the MAT sensor through a resistor in the ECM and measures the change in voltage to determine the MAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake MAT by measuring the voltage.

The MAT sensor is also used to control spark timing when the manifold air is cold.

A failure in the MAT sensor circuit sets a Diagnostic Trouble Code (DTC) 23 or 25.

IDLE AIR CONTROL VALVE

Notice: Do not attempt to remove the protective cap and readjust the stop screw. Misadjustment may result in damage to the idle air control (IAC) valve or to the throttle body.

The IAC valve is mounted on the throttle body where it controls the engine idle speed under the command of the electronic control module (ECM). The ECM sends voltage pulses to the IAC valve motor windings, causing the IAC valve pintle to move in or out a given distance (a step or count) for each pulse. The pintle movement controls the airflow around the throttle valves which, in turn, control the engine idle speed.

The desired idle speeds for all engine operating conditions are programmed into the calibration of the ECM.

These programmed engine speeds are based on the coolant temperature, the park/neutral switch status, the vehicle speed, the battery voltage, and the air conditioning (A/C) system pressure (if equipped).

The ECM "learns" the proper IAC valve positions to achieve warm, stabilized idle speeds (rpm) desired for the various conditions (park/neutral or drive, A/C on or off, if equipped). This information is stored in ECM "keep alive" memories (information is retained after the ignition is turned OFF). All other IAC valve positioning is calculated based on these memory values. As a result, engine variations due to wear and variations in the minimum throttle valve position (within limits) do not affect engine idle speeds. This system provides correct idle control under all conditions. This also means that disconnecting power to the ECM can result in incorrect idle control or the necessity to partially press the accelerator when starting until the ECM relearns idle control.

Engine idle speed is a function of total airflow into the engine based on the IAC valve pintle position, the throttle valve opening, and the calibrated vacuum loss through accessories. The minimum throttle valve position is set at the factory with a stop screw. This setting allows enough airflow by the throttle valve to cause the IAC valve pintle to be positioned a calibrated number of steps (counts) from the seat during "controlled" idle operation. The minimum throttle valve position setting on this engine should not be considered the "minimum idle speed," as on other fuel injected engines. The throttle stop screw is covered with a plug at the factory following adjustment.

If the IAC valve is suspected as being the cause of improper idle speed, refer to "Idle Air Control System Check" in this section.

MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts these to a voltage output.

A closed throttle on engine coast down produces a relatively low MAP output. MAP is the opposite of vacuum. When manifold pressure is high, vacuum is low. The

MAP sensor is also used to measure barometric pressure. This is performed as part of MAP sensor calculations. With the ignition ON and the engine not running, the electronic control module (ECM) will read the manifold pressure as barometric pressure and adjust the air/fuel ratio accordingly. This compensation for altitude allows the system to maintain driving performance while holding emissions low. The barometric function will update periodically during steady driving or under a wide open throttle condition. In the case of a fault in the barometric portion of the MAP sensor, the ECM will set to the default value.

A failure in the MAP sensor circuit sets a Diagnostic Trouble Code (DTC) 33 or 34.

The following tables show the difference between absolute pressure and vacuum related to MAP sensor output, which appears as the top row of both tables.

MAP

Volts	4.9	4.4	3.8	3.3	2.7	2.2	1.7	1.1	0.6	0.3	0.3
kPa	100	90	80	70	60	50	40	30	20	10	0
in Hg	29.6	26.6	23.7	20.7	17.7	14.8	11.8	8.9	5.9	2.9	0

VACUUM

Volts	4.9	4.4	3.8	3.3	2.7	2.2	1.7	1.1	0.6	0.3	0.3
kPa	0	10	20	30	40	50	60	70	80	90	100
in Hg	0	2.9	5.9	8.9	11.8	14.8	17.7	20.7	23.7	26.7	29.6

ELECTRONIC CONTROL MODULE

The electronic control module (ECM), located under the passenger seat, is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, alert the driver through the service engine soon (SES) warning, and store diagnostic trouble codes (DTCs) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the programmable read-only memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not come on when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 megohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the fuel injectors, the idle air control (IAC) valve, the A/C clutch relay, etc., by controlling the ground circuit through transistors or a device called a "quad-driver."

FUEL INJECTOR

The multi-port fuel injection (MPFI) assembly is a solenoid-operated device controlled by the electronic control module (ECM) that meters pressurized fuel to a single engine cylinder. The ECM energizes the fuel injector or solenoid to a normally closed ball or pintle valve. This allows fuel to flow into the top of the injector, past the ball or pintle valve, and through a recessed flow director plate at the injector outlet.

The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel from the tip is directed at the intake valve, causing the fuel to become further atomized and vaporized before entering the combustion chamber. A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned OFF.

KNOCK SENSOR

The knock sensor detects abnormal knocking in the engine.

The sensor is mounted in the engine block near the cylinders.

The sensor produces an AC output voltage which increases with the severity of the knock. This signal is sent to the electronic control module (ECM). The ECM then adjusts the ignition timing to reduce the spark knock.

OCTANE NUMBER CONNECTOR

The octane number connector is a jumper harness (White) that signals to the electronic control module (ECM) the octane rating of the fuel.

The connector is located under the passenger seat next to the ECM.

There are four different octane number connector settings available. The vehicle is shipped from the factory with a label attached to the jumper harness to indicate the octane rating setting of the ECM.

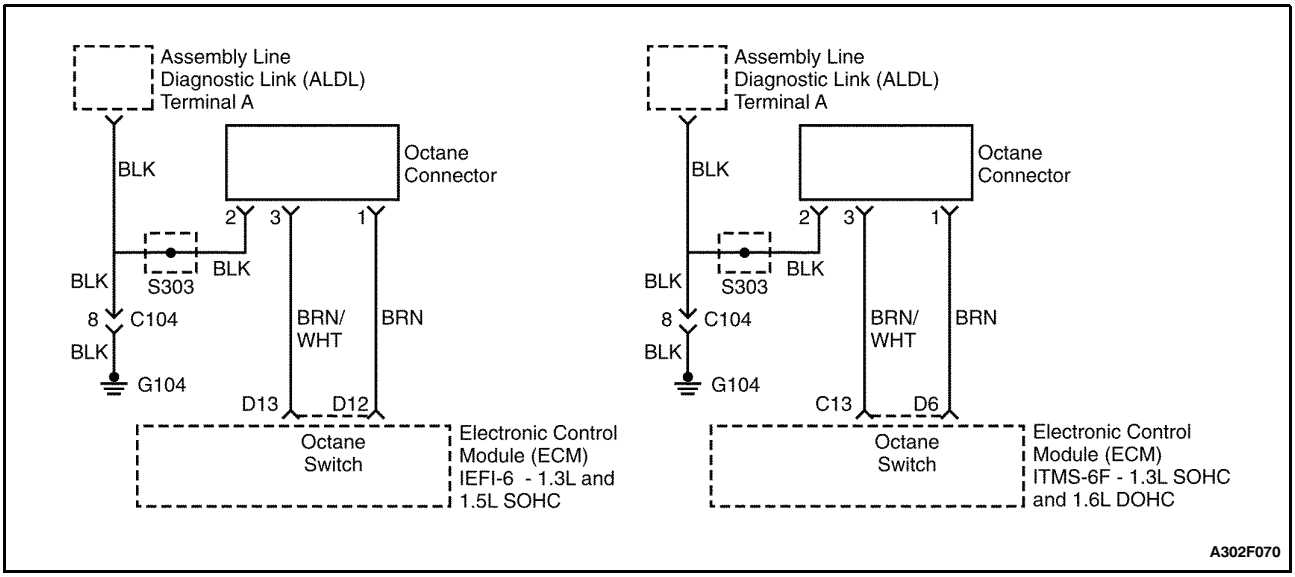
The ECM will alter fuel delivery and spark timing based on the octane number setting.

The following table shows which terminals to jump on the octane number connector in order to achieve the correct fuel octane rating. Terminal 2 is ground on the octane number connector.

To find the appropriate wiring diagram, refer to "ECM Wiring Diagrams" in this section.

Octane Number Selecting

	95	91	87	83
1.5L IEFI-6 (ECM) Terminal D12	Open	Open	Ground	Ground
1.5L IEFI-6 (ECM) Terminal D13	Ground	Open	Open	Ground
1.3L/1.6L ITMS-6F (ECM) Terminal D6	Open	Open	Ground	Ground
1.3L/1.6L ITMS-6F (ECM) Terminal C13	Ground	Open	Open	Ground



SECTION 1G

ENGINE EXHAUST

TABLE OF CONTENTS

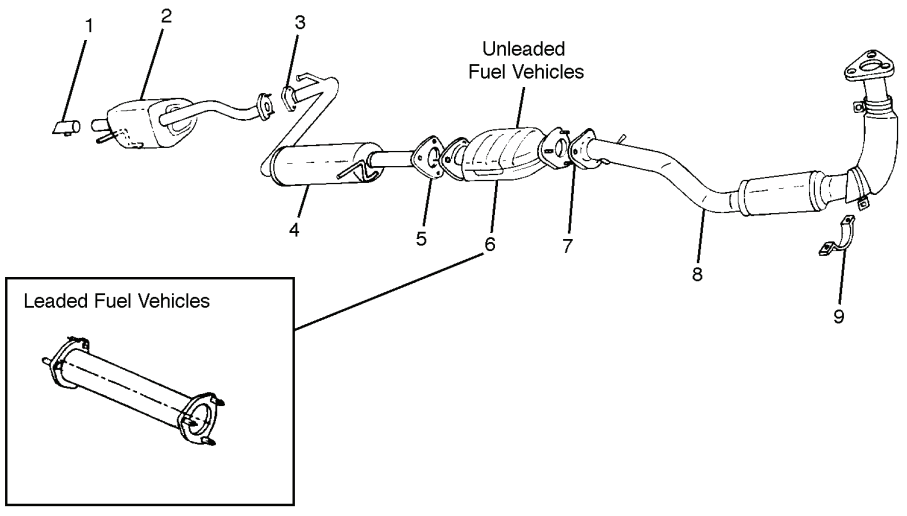
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Exhaust Pipe-to-Catalytic Converter/Connecting Pipe Nuts	30	22	-
Front Exhaust Pipe-to-Exhaust Manifold Nuts	40	30	-
Front Muffler-to-Catalytic Converter/Connecting Pipe Nuts	30	22	-
Front Muffler-to-Rear Muffler Nuts	30	22	-
Lower Front Exhaust Pipe Holding Bracket Nuts	30	22	-

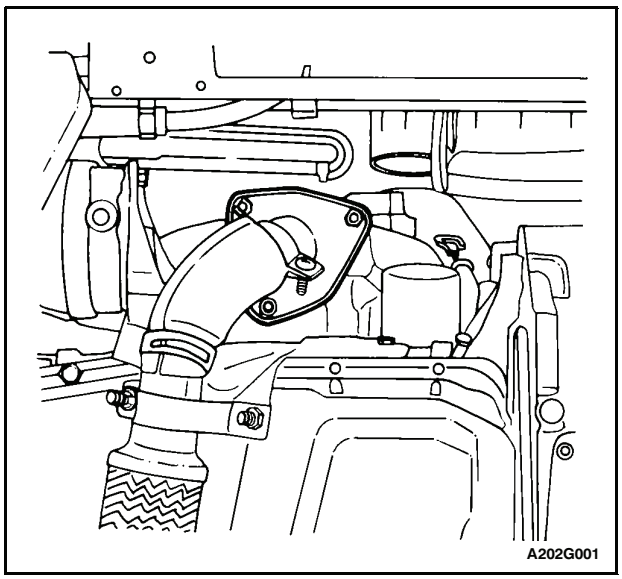
COMPONENT LOCATOR

EXHAUST SYSTEM



A302G001

1 Trim Ring
2 Rear Muffler
3 Metal Gasket
4 Front Muffler
5 Metal Gasket
6 Catalytic Converter or Connecting Pipe
7 Metal Gasket
8 Front Exhaust Pipe
9 Metal Holding Bracket


A202G001

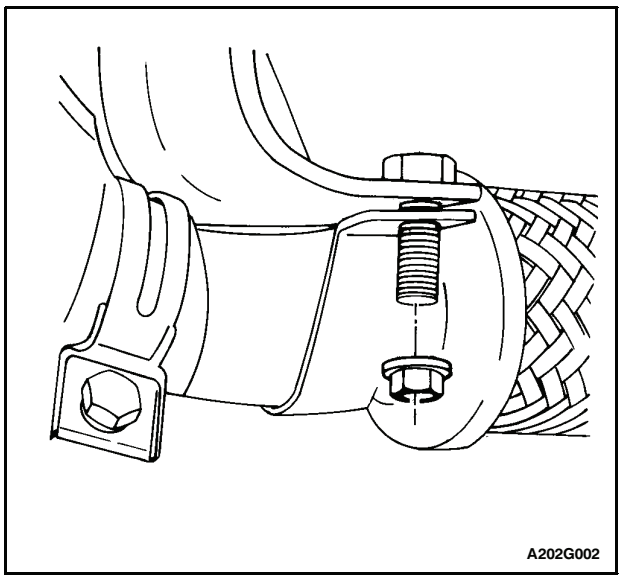
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

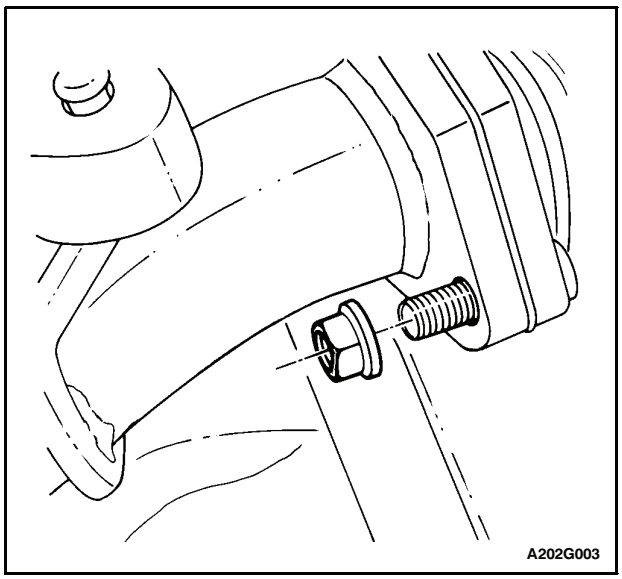
CATALYTIC CONVERTER/ CONNECTING PIPE

Removal Procedure

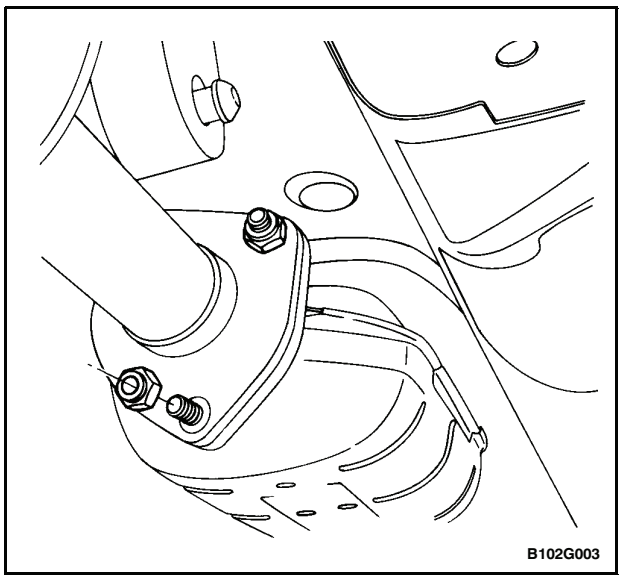
1. Remove the front exhaust pipe nuts and the gasket from the exhaust manifold.


A202G002

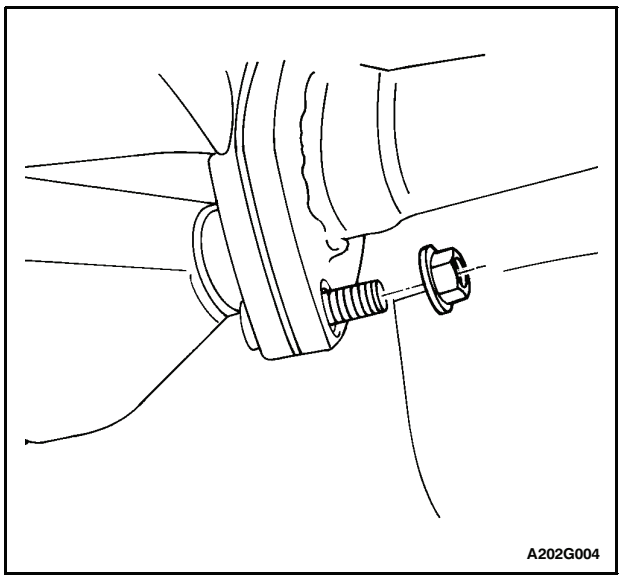
2. Remove the nuts from the holding bracket which secures the front exhaust pipe to the engine block bracket near the oil pan.
3. Remove the lower holding bracket.


A202G003

4. Disconnect the other end of the front exhaust pipe from the rubber hanger.
5. Remove the nuts from the front exhaust pipe to the catalytic converter or connecting pipe flange.
6. Remove the front exhaust pipe and the gasket.


B102G003

7. Remove the nuts from the front muffler pipe-to-catalytic converter or connecting pipe flange.
8. Remove the catalytic converter or the connecting pipe and the gasket.
9. Clean the sealing surfaces on the front exhaust pipe flange and the exhaust manifold.
10. Check the exhaust pipe and the catalytic converter or the connecting pipe for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment.

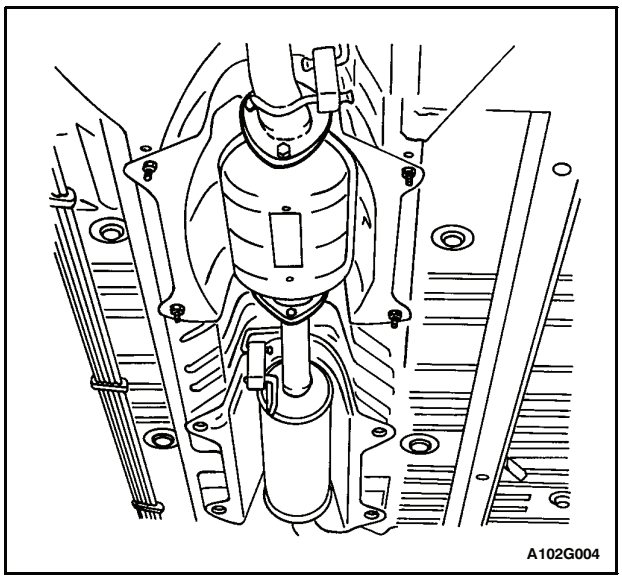

A202G004

Installation Procedure

1. Install the catalytic converter or the connecting pipe and the gasket to the front muffler pipe flange. Use the nuts to secure the converter or the connecting pipe.

Tighten

Tighten the front muffler-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).

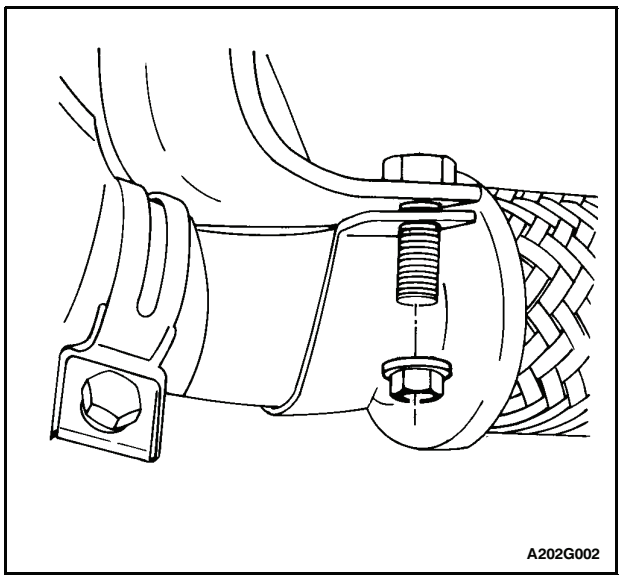

A102G004

2. Connect the front exhaust pipe to the rubber hanger.
3. Using the nuts and the gasket, secure the front exhaust pipe to the catalytic converter or the connecting pipe flange.

Tighten

Tighten the front exhaust pipe-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).

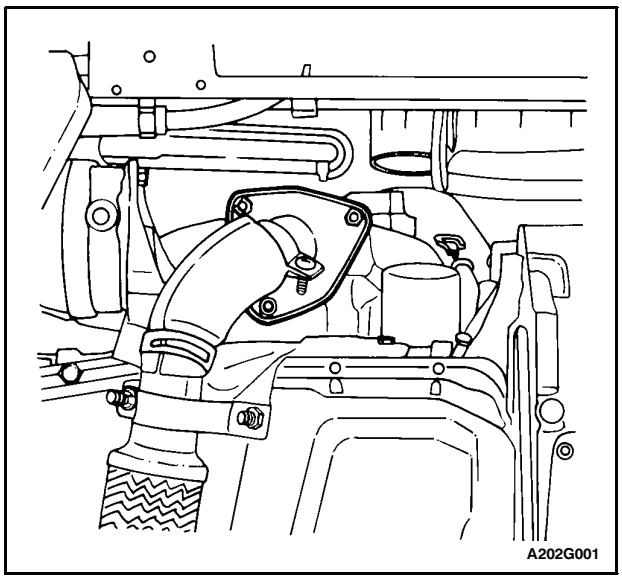
4. Place the front exhaust pipe in the engine block bracket near the oil pan.



5. Secure the front exhaust pipe with the lower holding bracket.

Tighten

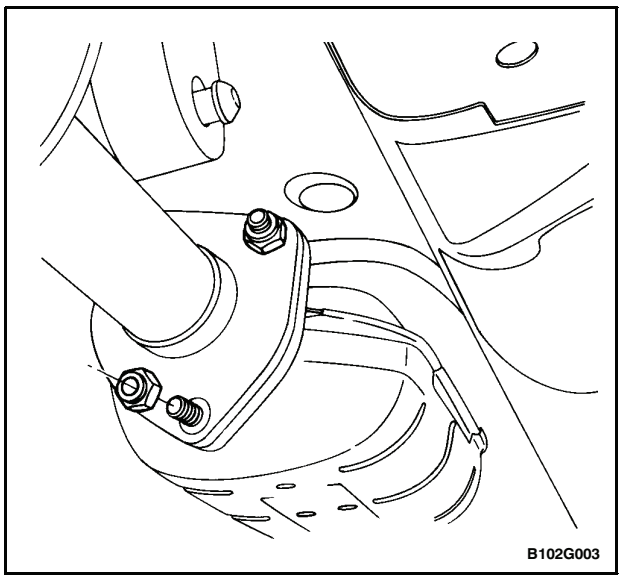
Tighten the lower front exhaust pipe holding bracket nuts to 30 N•m (22 lb-ft).



6. Using the nuts and the gasket, secure the front exhaust pipe to the exhaust manifold.

Tighten

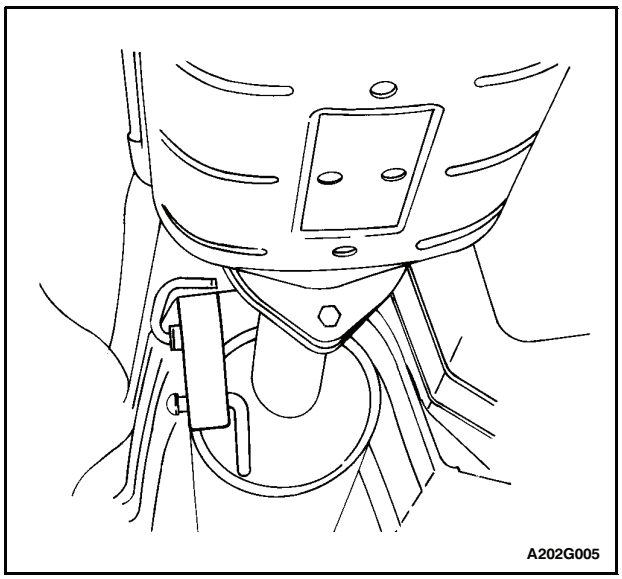
Tighten the front exhaust pipe-to-exhaust manifold nuts to 40 N•m (30 lb-ft).



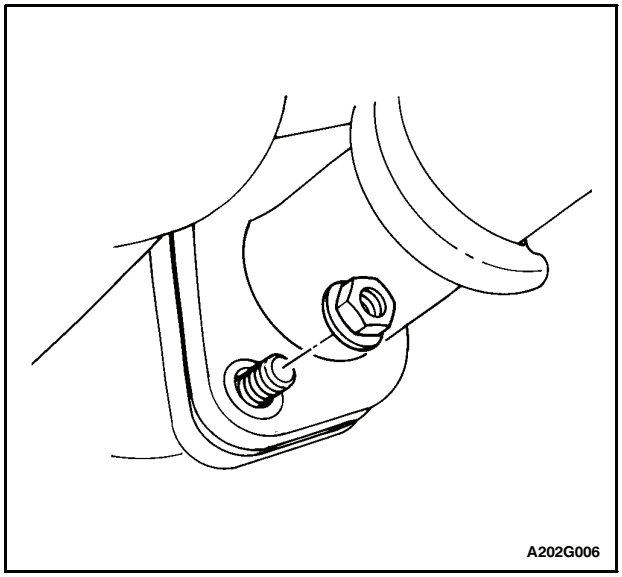
MUFFLER - FRONT

Removal Procedure

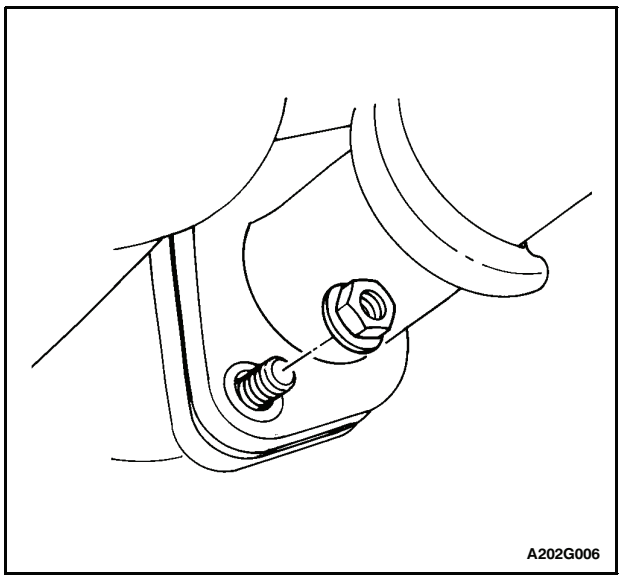
1. Remove the nuts and the gasket from the front muffler pipe to the catalytic converter or the connecting pipe flange.


A202G005

2. Detach the front muffler from the rubber hanger.


A202G006

3. Remove the nuts and the gasket from the the rear muffler pipe flange. Disconnect the front muffler from the rubber hanger.
4. Remove the front muffler.
5. Check the exhaust pipe and the front muffler for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment or the trunk.

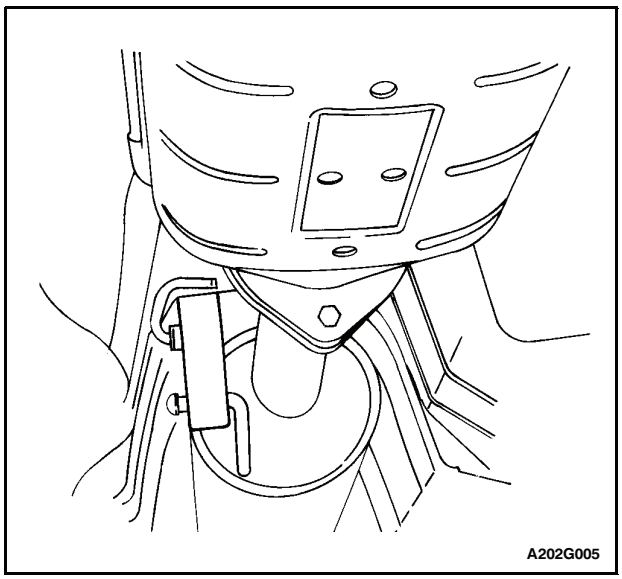

A202G006

Installation Procedure

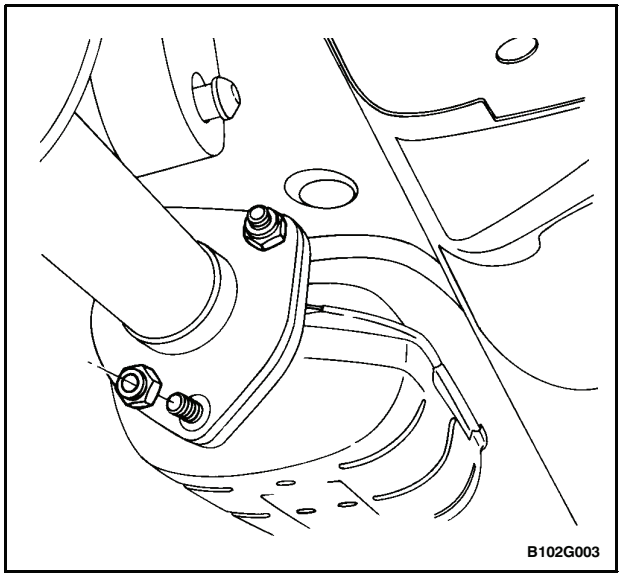
1. Attach the front muffler and the gasket to the rear muffler using the nuts. Secure the front muffler to the rubber hanger.

Tighten

Tighten the front muffler-to-rear muffler nuts to 30 N•m (22 lb-ft).


A202G005

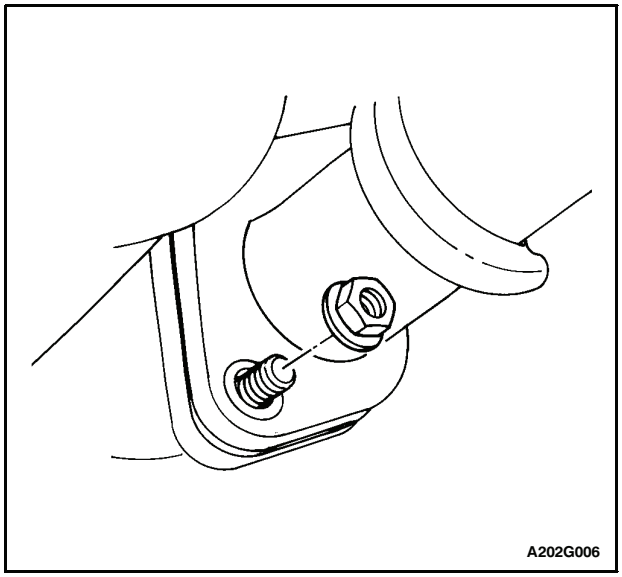
2. Attach the front muffler assembly to the rubber hanger. Loosely secure the front muffler assembly to the catalytic converter or connecting pipe flange.


B102G003

3. Secure the front muffler assembly to the catalytic converter or connecting pipe flange with the nuts.

Tighten

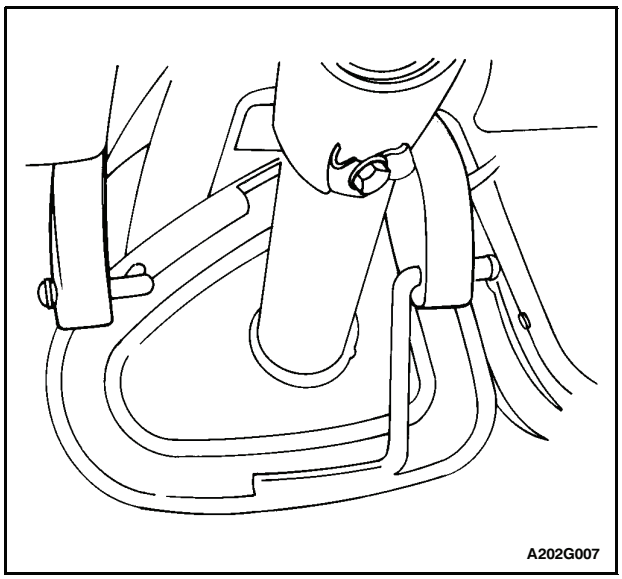
Tighten the front muffler-to-catalytic converter/connecting pipe nuts to 30 N•m (22 lb-ft).


A202G006

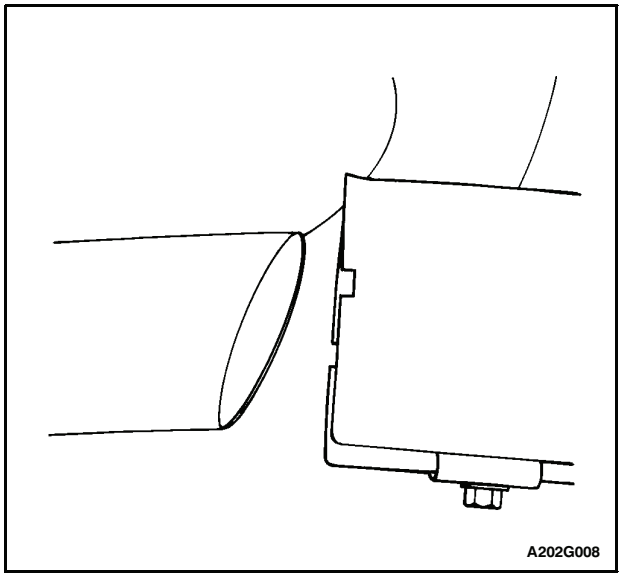
MUFFLER - REAR

Removal Procedure

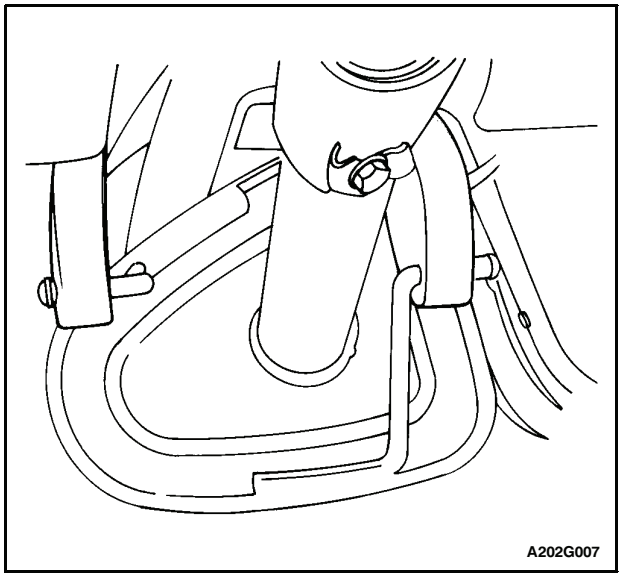
1. Remove the nuts and gasket from the rear muffler pipe flange-to-front muffler pipe flange.



2. Detach the rear muffler assembly from the rubber hangers on the tail pipe end.
3. Remove the rear muffler assembly.



4. Remove the trim ring from the rear muffler pipe.
5. Check the rear muffler and the pipes for holes, damage, open seams, and other deterioration which could permit exhaust fumes to seep into the passenger compartment or trunk.



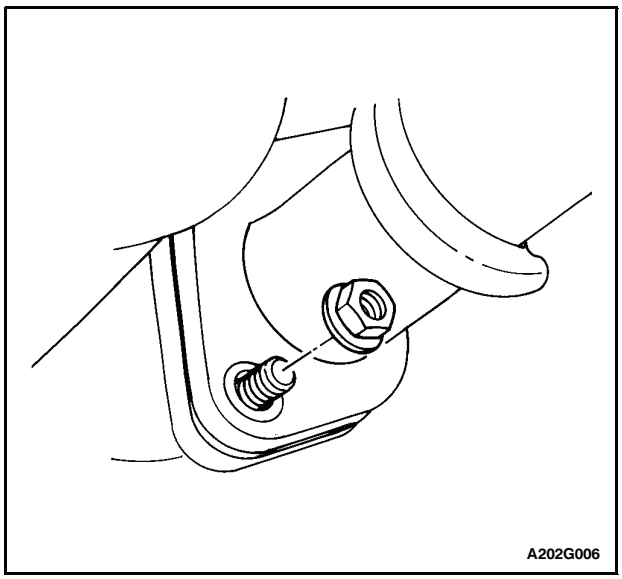
Installation Procedure

1. Install the trim ring on the rear muffler pipe.

Tighten

Tighten the trim ring bolt until it bottoms on the exhaust pipe. Tighten an additional quarter turn.

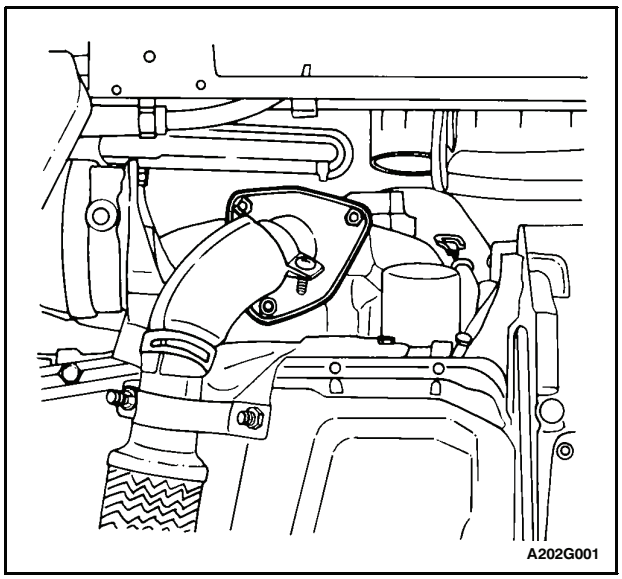
2. Secure the rear muffler assembly to the rubber hangers on the tail pipe end.



3. Secure the nuts and the gasket from the rear muffler pipe flange-to-front muffler pipe flange.

Tighten

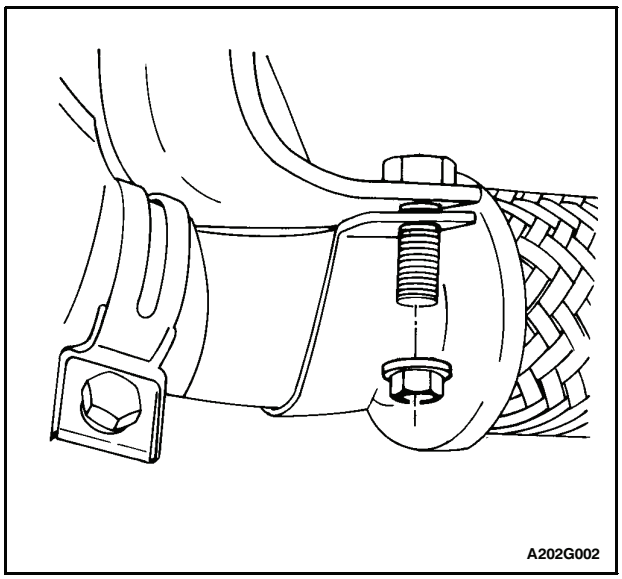
Tighten the front muffler-to-rear muffler nuts to 30 N•m (22 lb-ft).



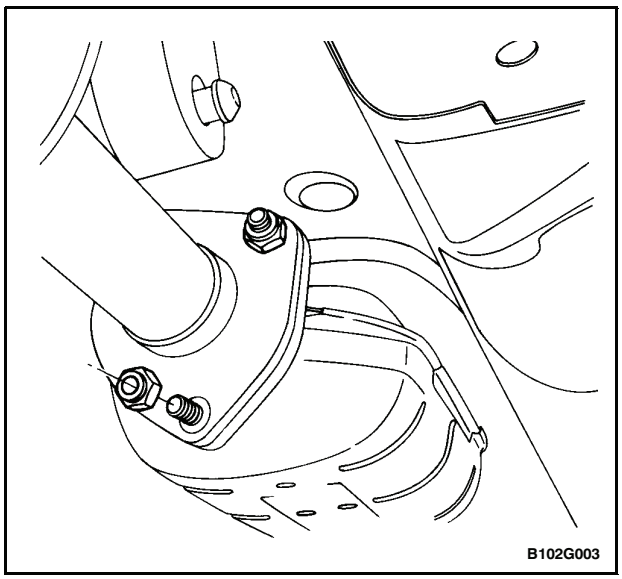
EXHAUST PIPE

Removal Procedure

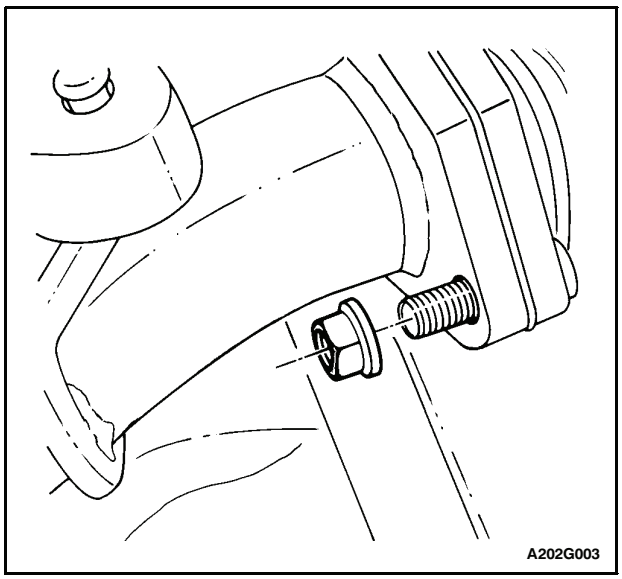
1. Remove the front exhaust pipe nuts and the gasket from the exhaust manifold.



2. Remove the nuts from the holding bracket which secures the front exhaust pipe to an engine block bracket near the oil pan.
3. Remove the holding bracket.


B102G003

4. Remove the nuts and the gasket from the converter flange or the connecting pipe and detach the front exhaust pipe from the rubber hanger.
5. Check the exhaust pipe for holes, damage, or other deterioration which could permit fumes to seep into the passenger compartment.
6. Clean the sealing surfaces on the front exhaust flange and the exhaust manifold.

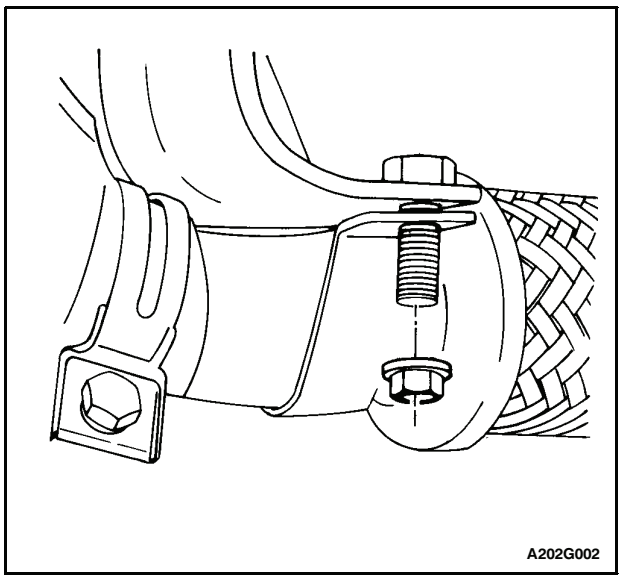

A202G003

Installation Procedure

1. Install the nuts and the gasket from the catalytic converter or the connecting pipe flange. Attach the front exhaust pipe to the rubber hanger.

Tighten

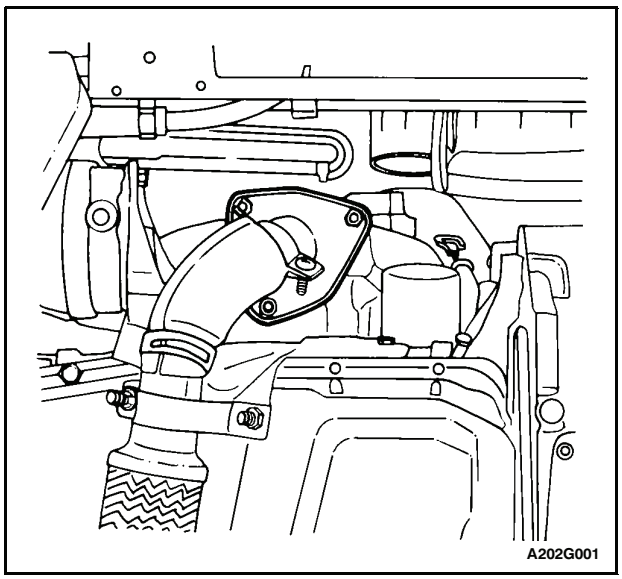
Tighten the front exhaust pipe-to-catalytic converter/ connecting pipe nuts to 30 N•m (22 lb-ft).


A202G002

2. Place the front exhaust pipe in the engine block bracket near the oil pan.
3. Secure the front exhaust pipe with the lower holding bracket.

Tighten

Tighten the lower front exhaust pipe holding bracket nuts to 30 N•m (22 lb-ft).



4. Using the nuts and the gasket, secure the front exhaust pipe to the exhaust manifold.

Tighten

Tighten the front exhaust pipe-to-exhaust manifold nuts to 40 N•m (30 lb-ft).

GENERAL DESCRIPTION AND SYSTEM OPERATION

EXHAUST SYSTEM

Notice: When you are inspecting or replacing the exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Caution: Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing, or mispositioned parts, open seams, holes, loose connections, or other deterioćration which could permit hazardous exhaust fumes to seep into the trunk or the passenger compartment. Dust or water in the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

The exhaust manifold-to-front exhaust pipe connection is of the flex joint type.

MUFFLER

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design as opposed to a slip joint coupling design with clamps and U-bolts. The exhaust manifold-to-exhaust pipe connection is of the flex joint type. If holes, open seams or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly.

Heat shields in the front and rear muffler assembly positions, as well as for the catalytic converter and front exhaust pipe, protect the vehicle and the environment from high temperatures the exhaust system develops.

CATALYTIC CONVERTER

Notice: When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter as this could damage the catalytic converter.

Notice: The catalytic converter requires the use of unleaded fuel only, or damage to the catalyst will result.

The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust pipes.

The oxidation catalyst is coated with a catalytic material containing platinum and palladium, which reduces levels of hydrocarbon (HC) and carbon monoxide (CO) from the exhaust gas. The three-way catalyst has coatings which contain platinum and rhodium, which additionally lower the levels of oxides of nitrogen (NOx).

CONNECTING PIPE

Connecting pipe is used in place of the catalytic converter for those vehicles using leaded fuel.