SECTION 1

ENGINE CIELO EURO III

SECTION 1A

GENERAL ENGINE INFORMATION

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DIAGNOSIS

COMPRESSION TEST

Important: Disconnect the Crankshaft Position (CKP) Sensor 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 the 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 specified value?	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 specified values?	Crankshaft 0.005 mm (0.002 in.) Connecting Rod 0.019 ~ 0.070 mm (0.0007 ~ 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 installed improperly?	–	Go to *Step 25*	Go to *Step 26*
25	Install the plugs or repair them, 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. 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. Thoroughly clean the area.
   - 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. 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:

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

Seals:

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged, scratched, burred or nicked.
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the component.
- The shaft surface is scratched, nicked or damaged.
- 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 specified value?	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 specified value?	45 N•m (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 specified value?	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 specified value?	0.019 ~ 0.070 mm (0.0007 ~ 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 specified value?	45 N•m (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 specified value?	0.019 ~ 0.070 mm (0.0007 ~ 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 Last 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 specified value?	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 specified value?	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 only operated for 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 specified value?	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 the rods, as necessary. Is the repair complete?	–	Go to *Step 1*	–
14	Inspect the piston-to-bore clearance. Is the clearance within the specified value?	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 specified value?	0.5 ~ 0.7 mm (0.020 ~ 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 specified value?	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 specified value?	–	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 the 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.

BLANK

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:	
1.5 SOHC	1 498 cm^3 (91.44 in^3)
Bore Stroke:	
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):	
1.5 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	0.5 0.7 mm (0.019 0.027 in.)
Camshaft:	
Lift Intake: 1.5 SOHC	6.12 mm (0.240 in.)
Lift Exhaust	6.12 mm (0.240 in.)
End Play	0.09 0.21 mm (0.0035 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)	54.982 54.994 mm (2.164 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)	42.971 42.987 mm (1.691 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)	0.019 0.070 mm (0.0007 0.0027 in.)
Rod Side Clearance	0.070 0.242 mm (0.0027 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	1.3 1.5 mm (0.051 0.059 in.)
Exhaust	1.6 1.8 mm (0.063 0.071 in.)
Valve Guide Inside Diameter (All)	7.030 7.050 mm (0.276 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	0.400 0.484 mm (0.0157 0.0191 in.)
Out Rotor Side Clearance	0.045 0.100 mm (0.0018 0.0039 in.)
Inner Rotor Side Clearance	0.035 0.085 mm (0.0014 0.0033 in.)
Relief Valve Spring Free Length	81 mm (3.2 in.)

FASTENER TIGHTENING SPECIFICATIONS

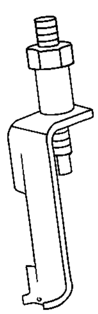
Application	N m	Lb-Ft	Lb-In
A/C Compressor Hose Assembly Retaining Bolt	33	24	–
A/C Compressor Mounting Bolts	27	20	–
A/C Compressor Mounting Bracket Bolts	50	37	–
Air Filter Housing Bolts	8	–	71
Alternator Adjusting Bolt	25	18	–
Alternator Adjusting Bracket Retaining Bolt	25	18	–
Auxiliary Catalytic Converter-to-Exhaust Manifold Nuts and Bracket Bolts	40	30	–
Camshaft Gear Bolt	45	33	–
Camshaft Pressure Plate Bolts	10	–	89
Connecting Rod Bearing Cap Bolts	25 + 30	18 + 30	–
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 + 70 + 70 + 30	18 + 70 + 70 + 30	–
Electronic Ignition System Ignition Coil Mounting Bolts	10	–	89
Electronic Ignition System 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 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	26 + 30 + 15	–
Flywheel Inspection Cover Bolts	12	–	106
Front Muffler-to-Main Catalytic Converter Nuts	30	22	–
Fuel Rail Retaining Bolts	25	18	–
Intake Manifold Retaining Nuts	25	18	–

FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application	N m	Lb-Ft	Lb-In
Intake Manifold Support Bracket Retaining Bolts	22	16	–
Lower Timing Belt Cover Bolts	10	–	89
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 Bolt	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	44	–
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	65	48	–
Upper Timing Belt Cover Bolts	10	–	89
Valve Cover Bolts	9	–	80

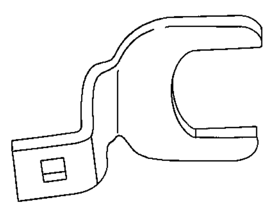
SPECIAL TOOLS

SPECIAL TOOLS TABLE



A102B150

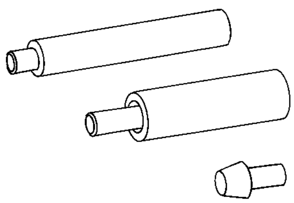
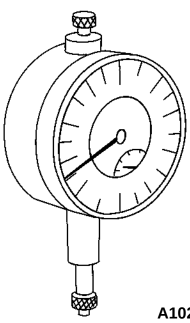
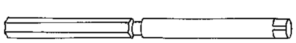
KM-565-A Valve Spring Compressor

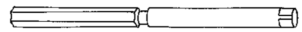
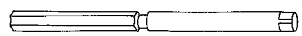
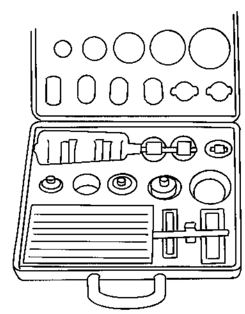
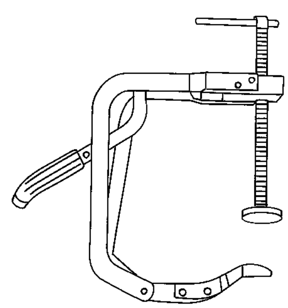


A102B151

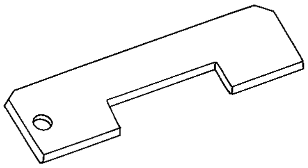
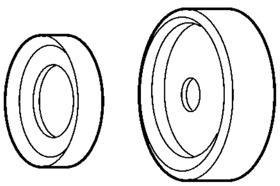
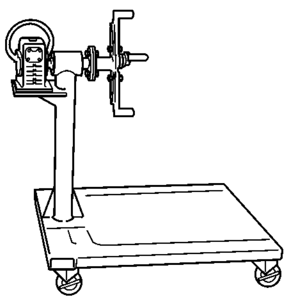
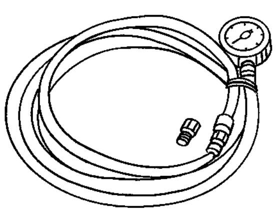
J-42492 Timing Belt Adjuster

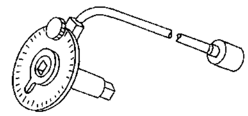
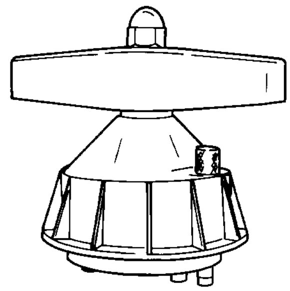
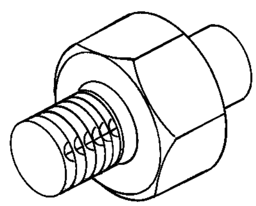
SPECIAL TOOLS TABLE (Cont'd)

 A102B152	**KM -263-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**

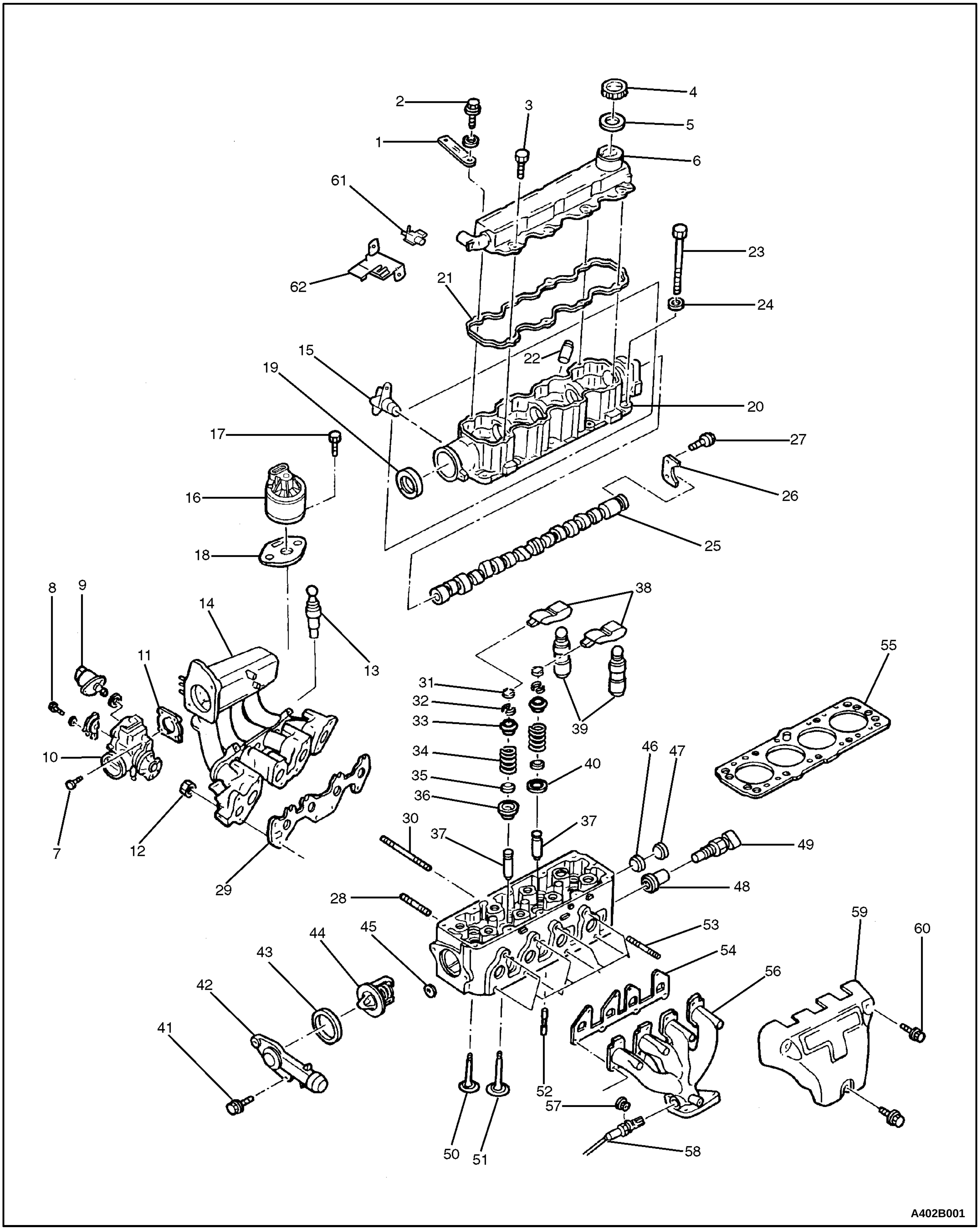
SPECIAL TOOLS TABLE (Cont'd)

 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**

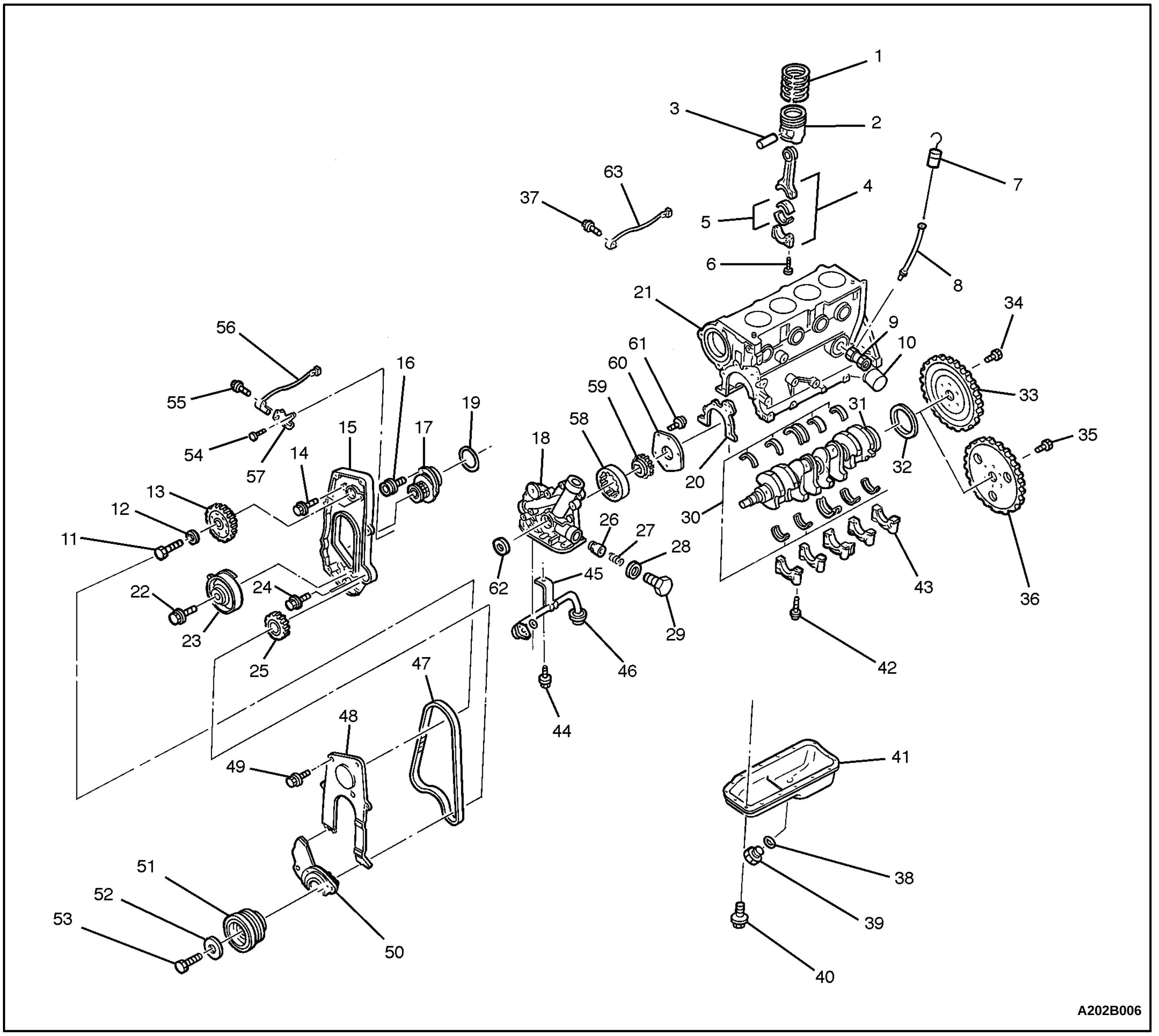
COMPONENT LOCATOR

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 Camshaft Position Sensor
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

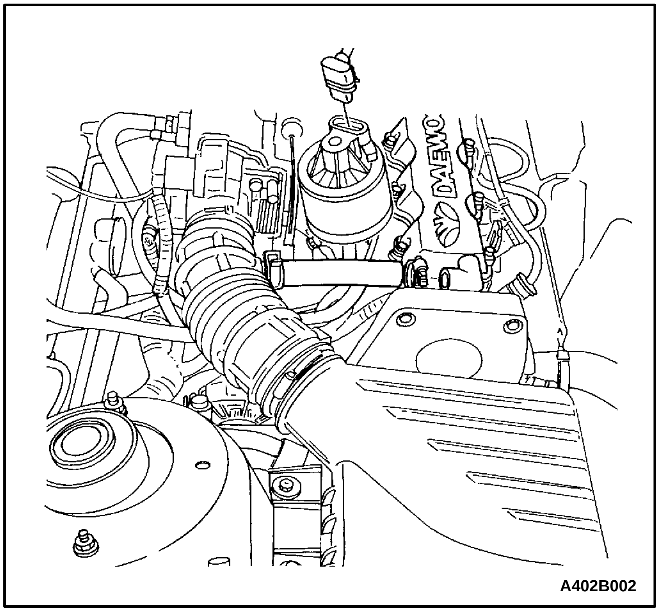
1 Piston Ring Seat
2 Piston
3 Piston Pin
4 Connecting Rod
5 Connecting Rod Bearing Set
6 Connecting Rod Bolt
7 Oil Level Gauge Stick
8 Gauge Stick Tube
9 Connecting Piece
10 Oil Filter
11 Camshaft Pulley Bolt
12 Washer
13 Camshaft Gear
14 Rear Cover Bolt
15 Rear Timing Belt Cover
16 Bolt
17 Coolant Pump
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

MAINTENANCE AND REPAIR

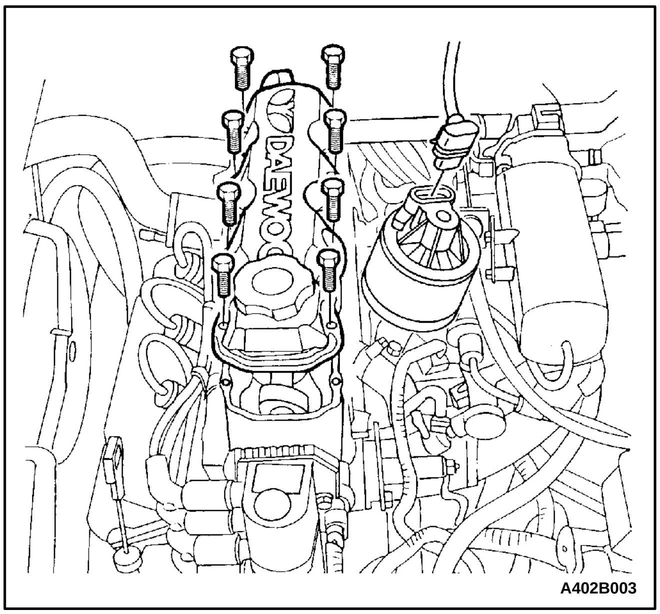
ON-VEHICLE SERVICE

VALVE COVER

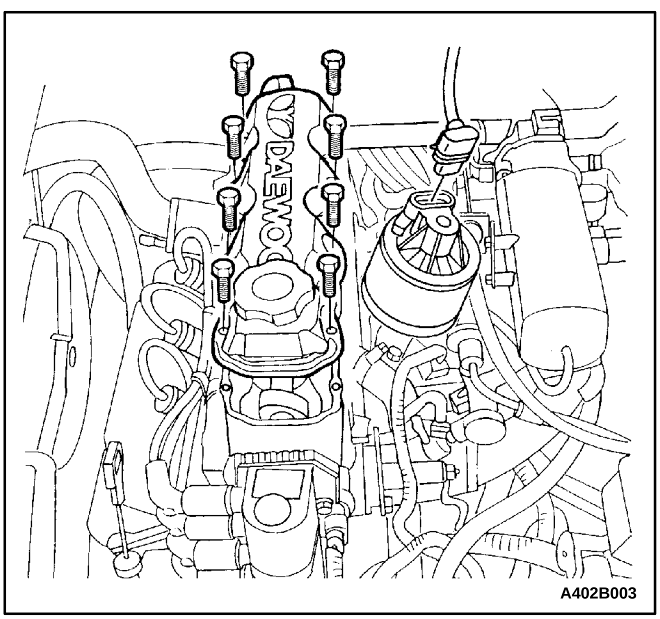
Removal Procedure



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



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.

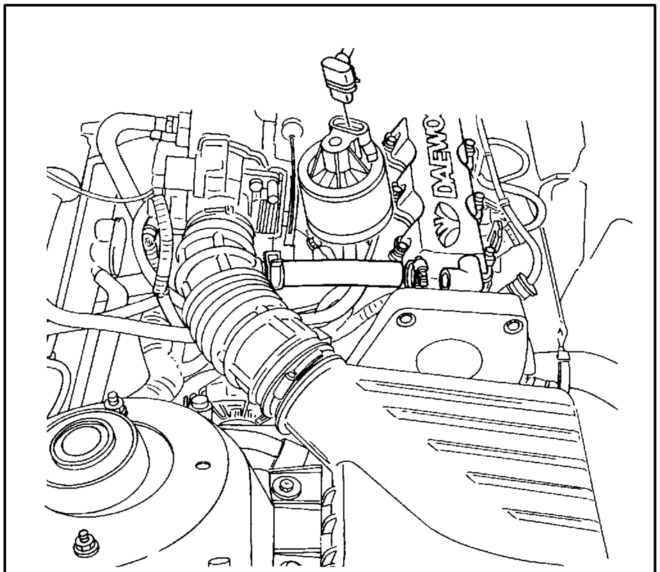


Installation Procedure

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 9 N•m (80 lb-in).



A402B002

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

CYLINDER HEAD AND GASKET

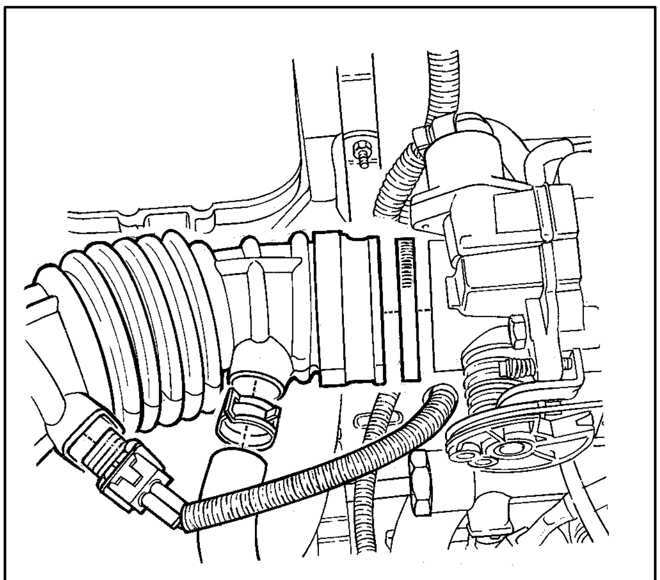
Tools Required

J-42492 Timing Belt Adjuster

KM-470-B Angular Torque Gauge

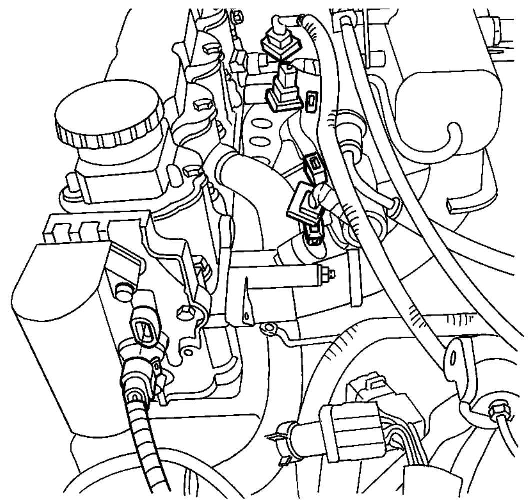
Removal Procedure

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 engine control module (ECM) ground terminal from the intake manifold.



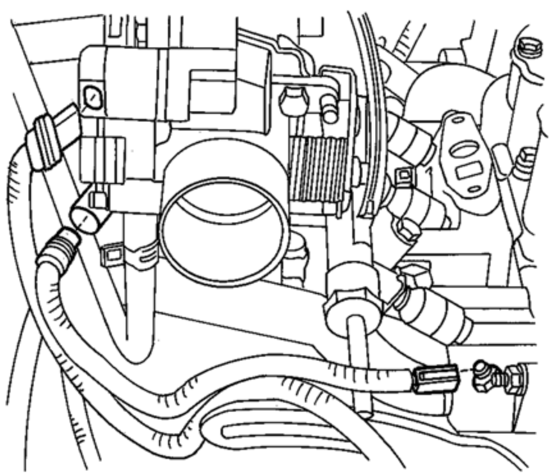
A102B001

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



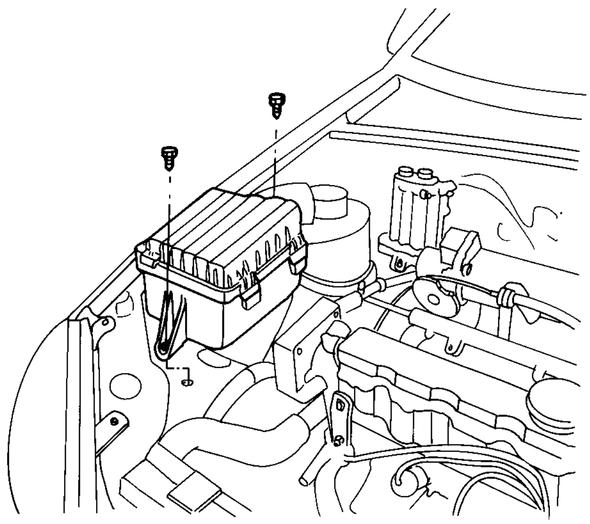
A102B092

9. Disconnect the electronic ignition (EI) system ignition coil connector.
10. Disconnect the oxygen (O_2) sensor connector.
11. Disconnect the fuel injector harness connectors.



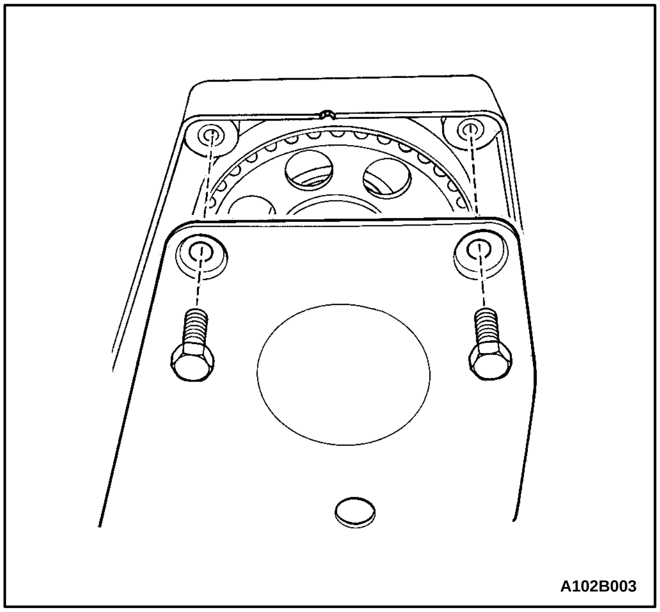
A102B016

12. Disconnect the idle air control (IAC) valve connector.
13. Disconnect the throttle position (TP) sensor connector.
14. Disconnect the engine coolant temperature (ECT) sensor connector.
15. Disconnect the coolant temperature sensor (CTS) connector.
16. Remove the camshaft position (CMP) sensor.

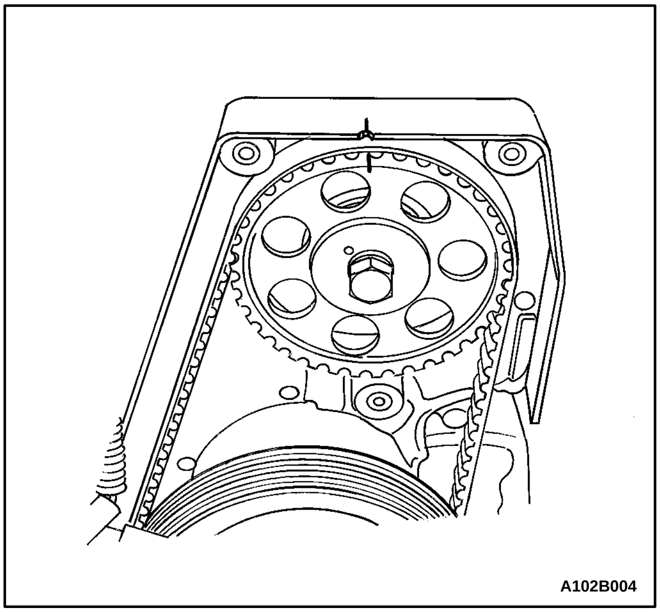


A102B002

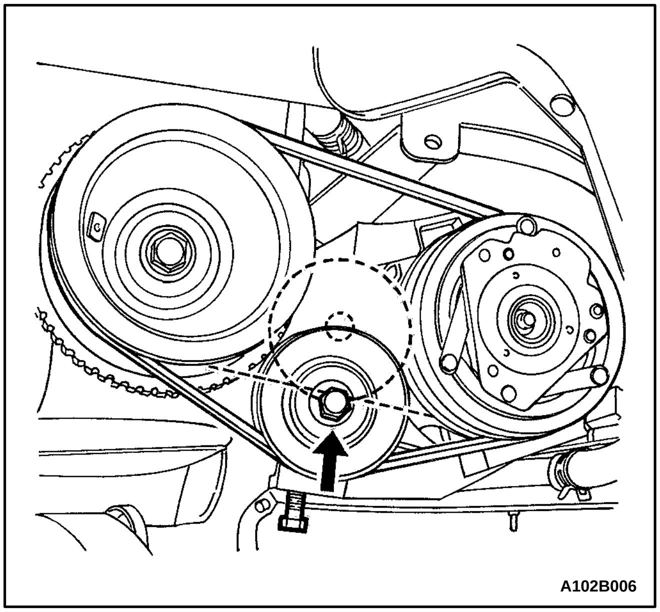
17. Remove the air cleaner housing bolts.
18. Remove the air cleaner housing.



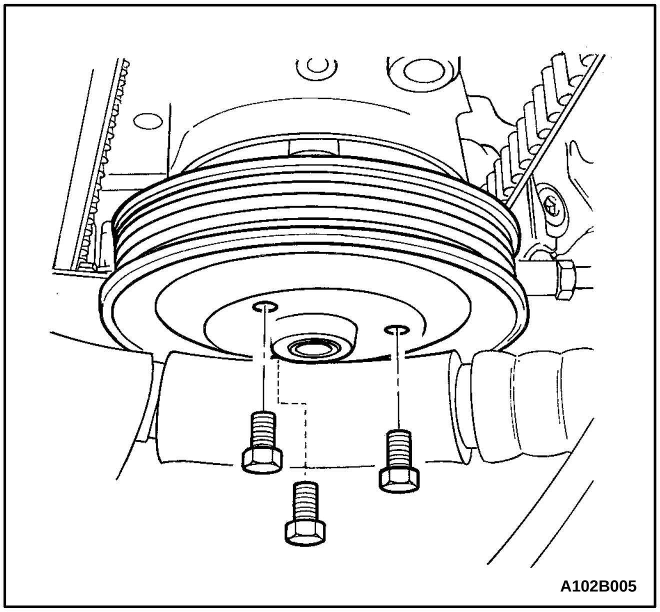
19. Remove the upper timing belt cover bolts.
20. Remove the upper timing belt cover.



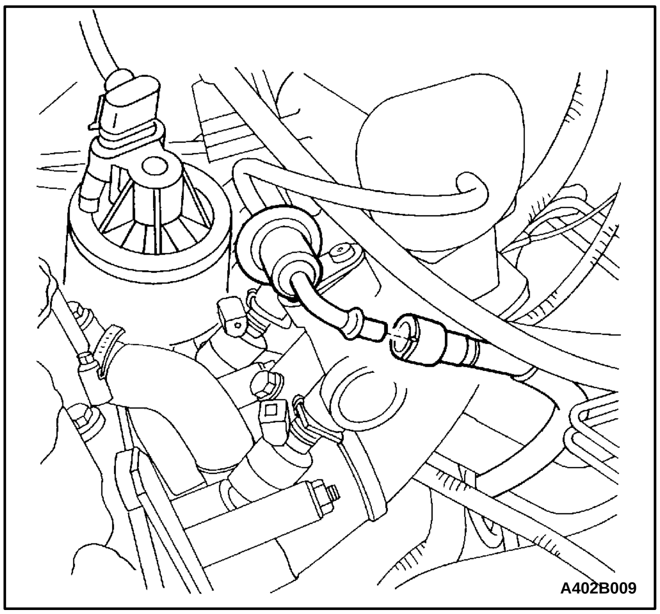
21. Align the camshaft gear timing mark to the notch in the rear timing belt cover.



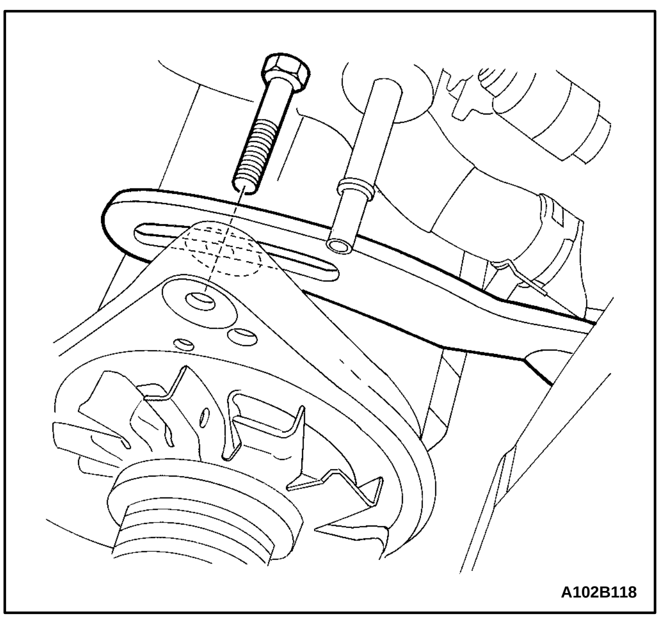
22. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels.*
23. Remove the right front wheel well splash shield.
24. Remove the A/C compressor drive belt, if equipped.



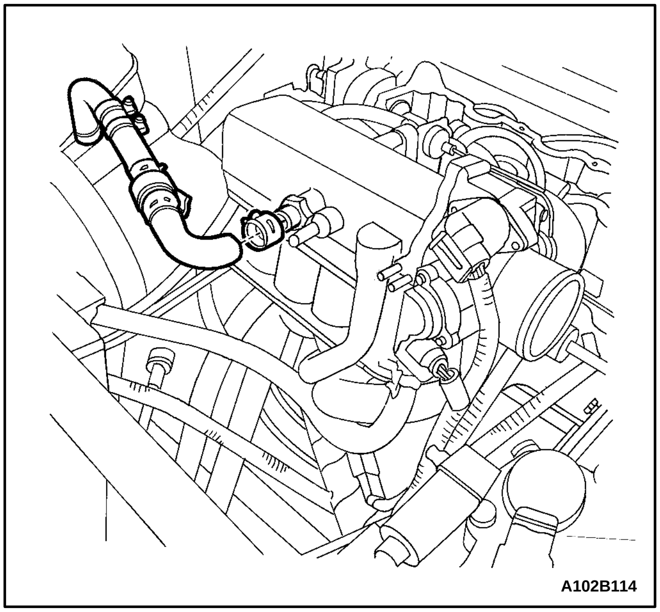
25. Remove the alternator drive belt.
26. Remove the power steering pump pulley bolts, if equipped.
27. Remove the power steering pump pulley, if equipped.



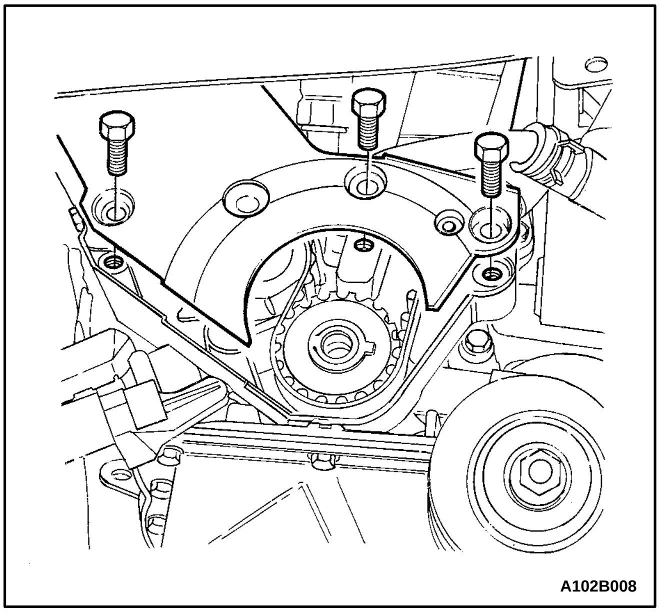
28. Disconnect the fuel return line at the fuel pressure regulator.
29. Disconnect the fuel feed line at the fuel rail.



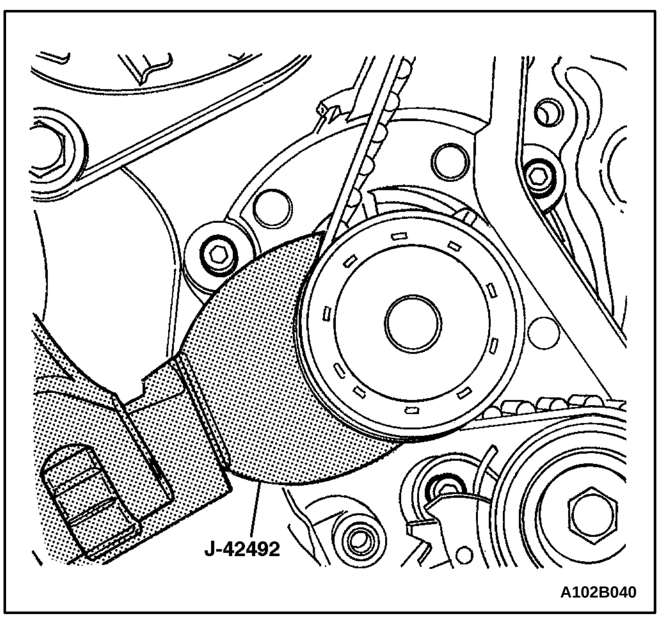
30. Remove the alternator adjusting bolt.
31. Remove the alternator adjusting bracket retaining bolt.
32. Remove the alternator adjusting bracket.



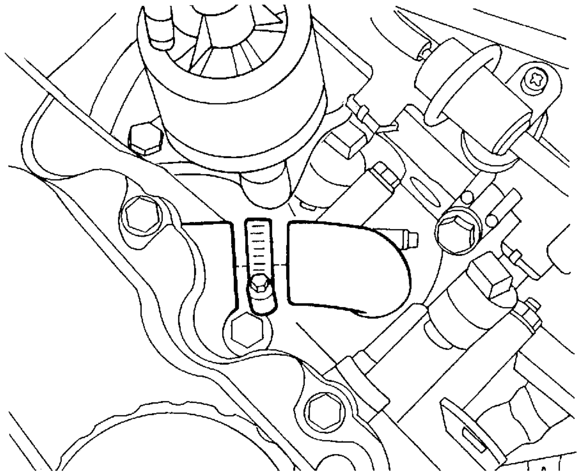
33. Disconnect the upper radiator hose at the thermostat housing.
34. Disconnect the brake booster vacuum hose at the intake manifold.
35. Disconnect all of the necessary vacuum hoses.



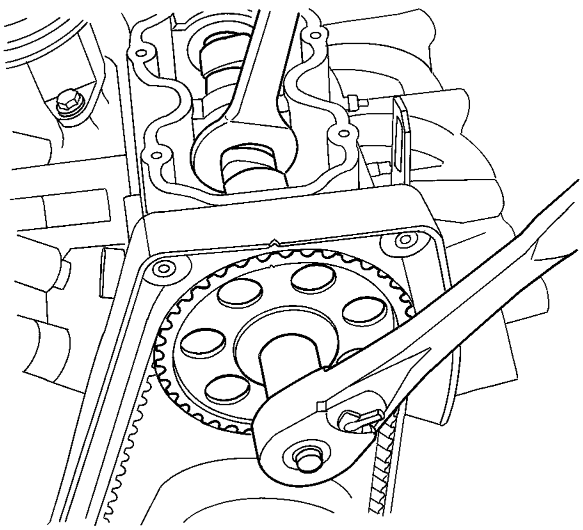
36. Remove the crankshaft pulley bolt.
37. Remove the crankshaft pulley.
38. Remove the power steering pump, if equipped. Refer to *Section 6B, Power Steering Pump.*
39. Install the engine mount bracket-to-engine mount retaining bolts and tighten the bolts to secure the engine, if the power steering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



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


A402B004

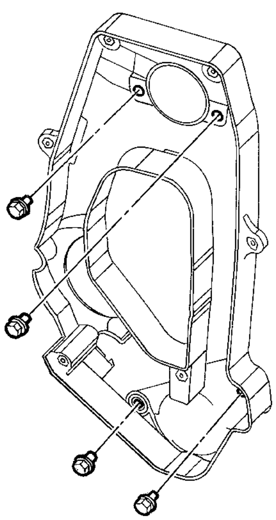
45. Disconnect the crankcase ventilation tube at the camshaft housing.


A102B111

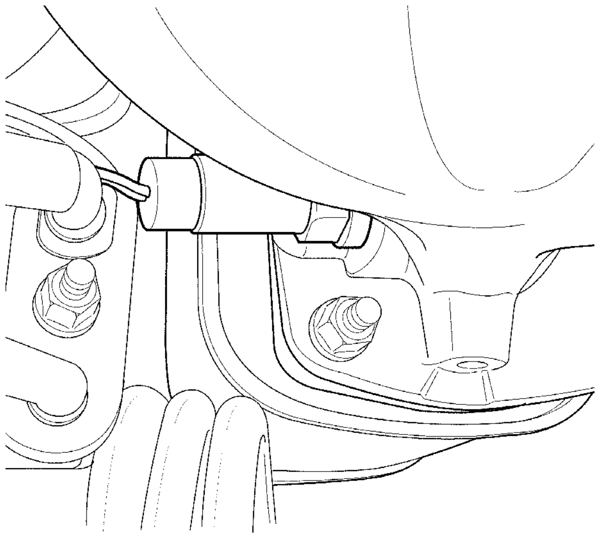
46. Remove the valve cover bolts.
47. Remove the valve cover and the valve cover gasket.

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

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


A102B046

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



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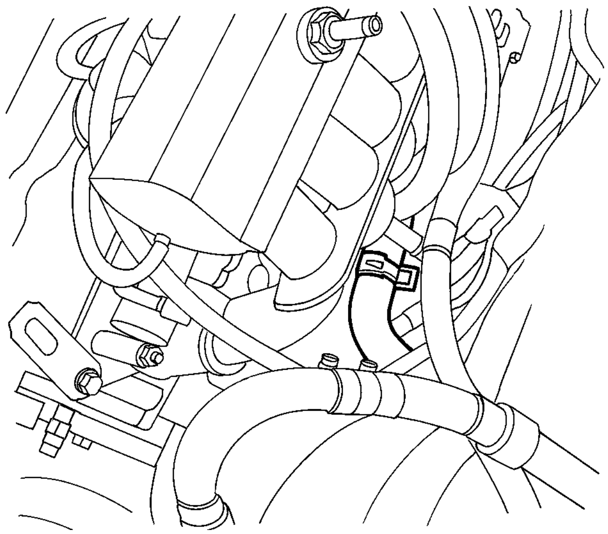
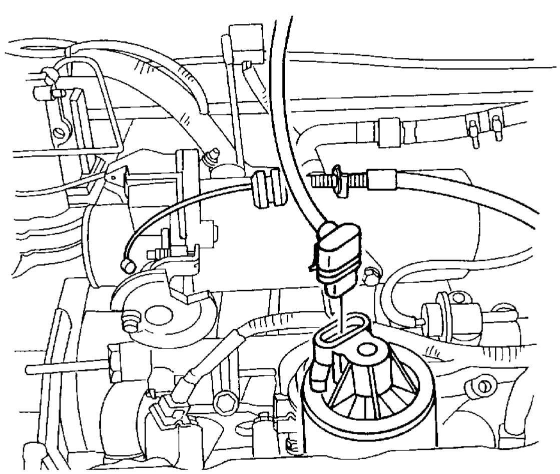
54. Disconnect the ignition wires at the spark plugs.
55. Remove the retaining nuts from the auxiliary catalytic converter at the exhaust manifold flange.



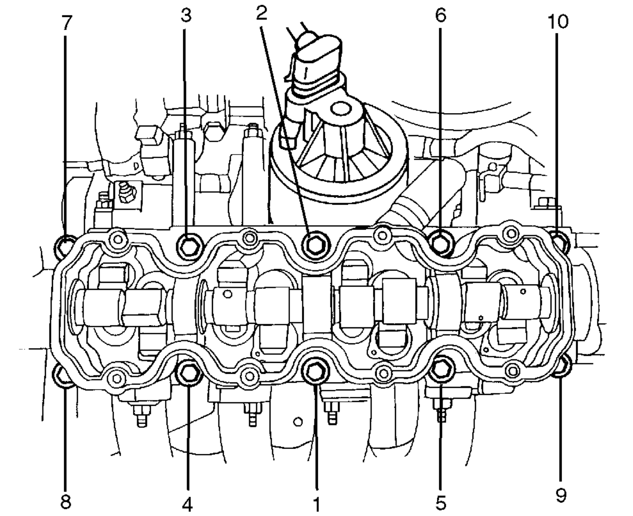
A102B119

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



A402B005

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

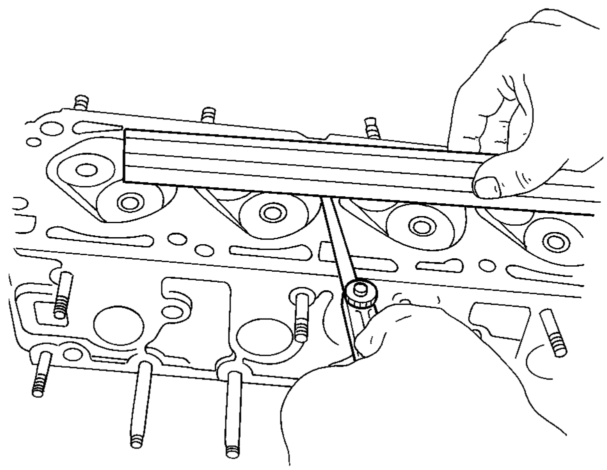


A402B006

60. Gradually loosen all of the cylinder head bolts in the sequence shown.
61. Remove the cylinder head bolts.
62. 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.

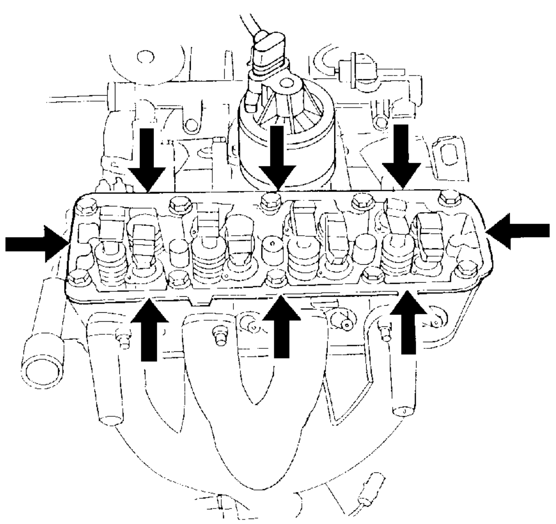
63. Remove the cylinder head with the intake manifold and the exhaust manifold attached.
64. Remove the cylinder head gasket.



A102B122

Cleaning Procedure

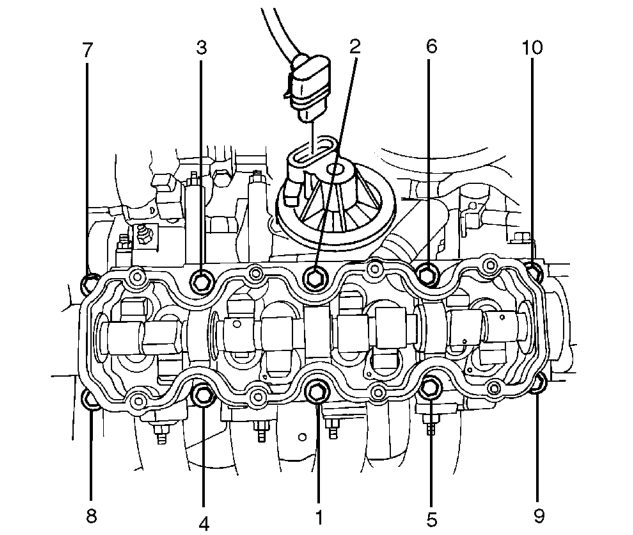
1. Clean the gasket surfaces of the cylinder head and the engine block.
2. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
3. Clean the cylinder head bolts.
4. Inspect the cylinder head for warpage. Refer to “Cylinder Head and Valve Train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



A402B007

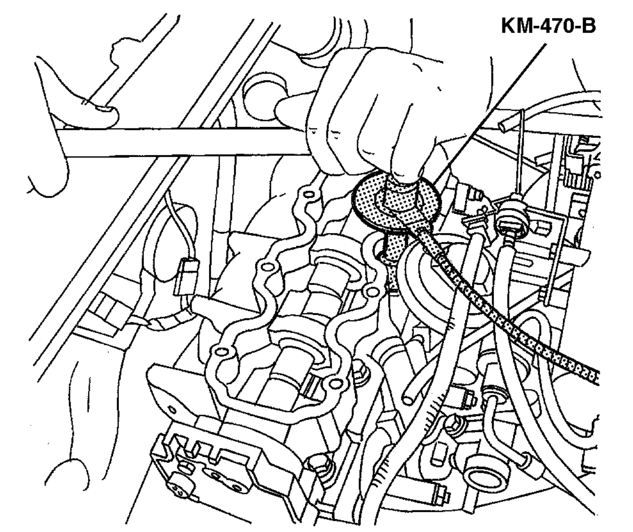
Installation Procedure

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.



A402B008

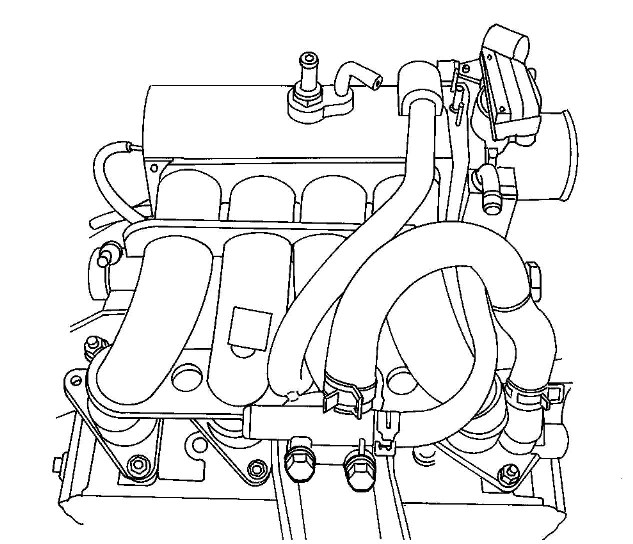
5. Install the cylinder head bolts in the sequence shown.



A102B172

Tighten

Tighten the cylinder head bolts in the sequence previously shown to 25 N m (18 lb-ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the cylinder head bolts another 70 degrees plus 70 degrees plus 30 degrees.

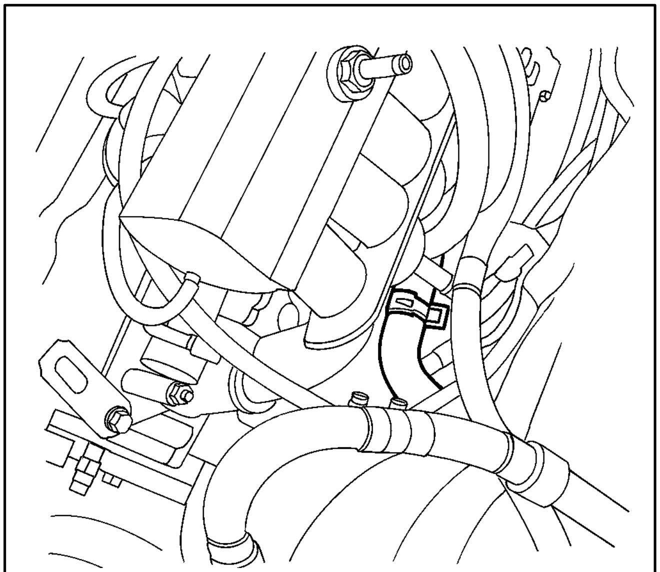


A102B029

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.

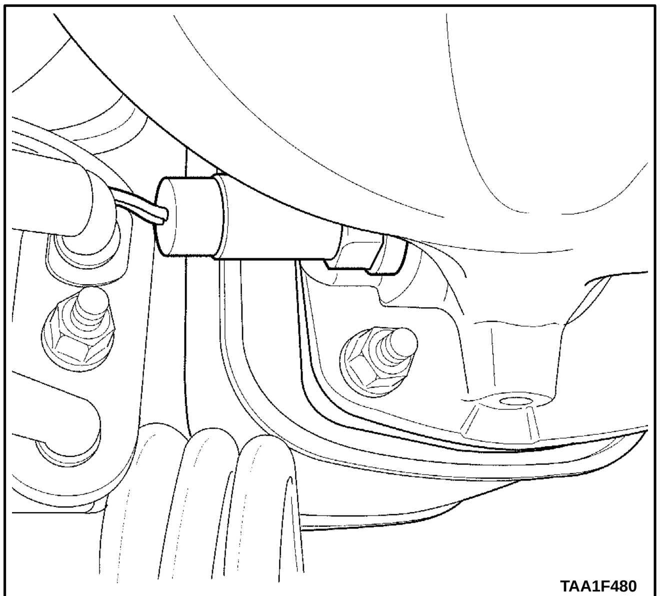
Tighten

Tighten the intake manifold support bracket retaining bolts to 22 N m (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.

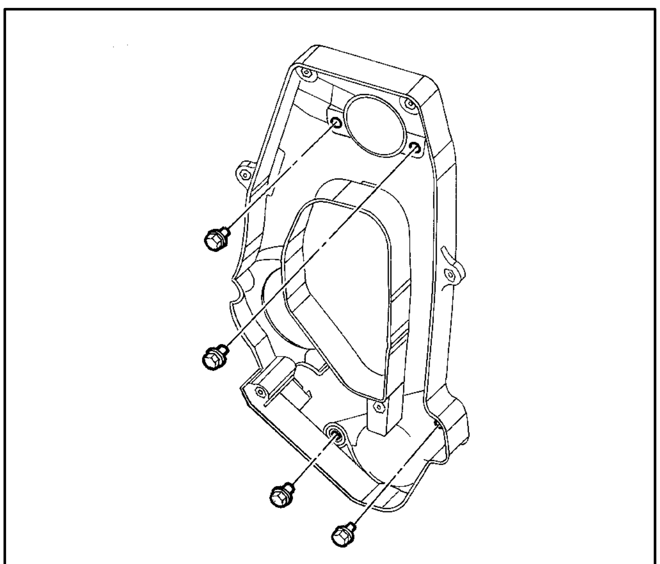


TAA1F480

10. Install the auxiliary catalytic converter nuts at the exhaust manifold flange.

Tighten

Tighten the auxiliary catalytic converter-to-exhaust manifold nuts to 40 N m (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.

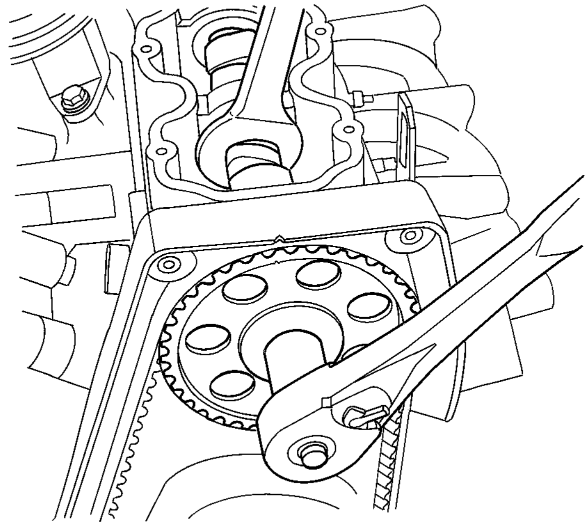
Tighten

Tighten the rear timing belt cover bolts to 10 N m (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 N m (15 lb-ft).



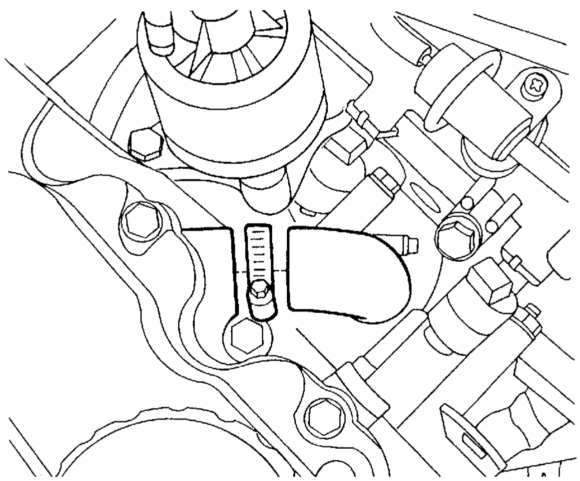
A102B111

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 N m (33 lb-ft).



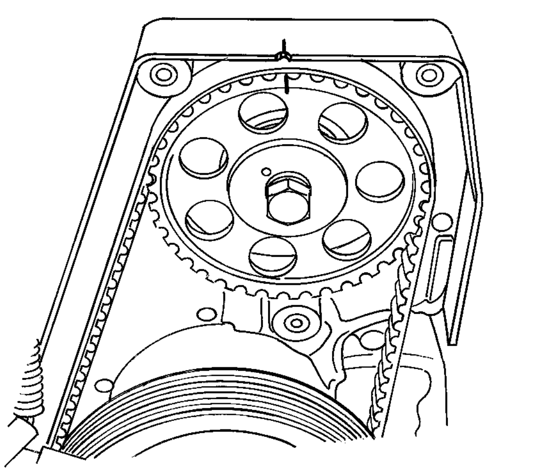
A402B004

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

Tighten

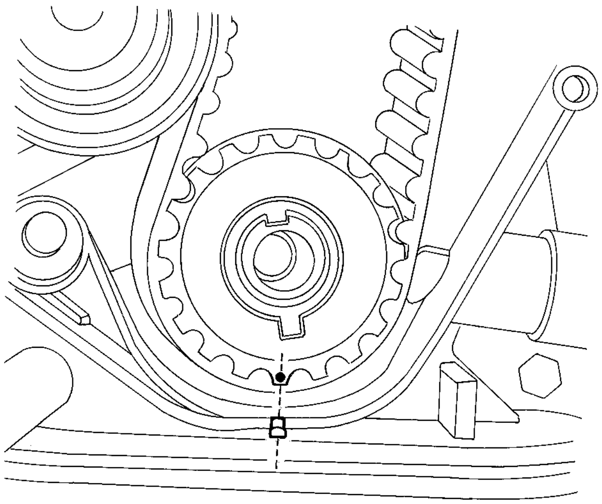
Tighten the valve cover bolts to 9 N m (80 lb-in).

20. Connect the crankcase ventilation tube to the camshaft housing.



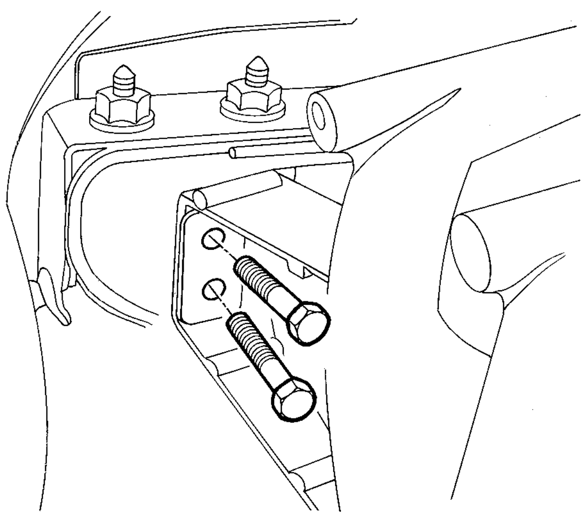
A102B004

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.

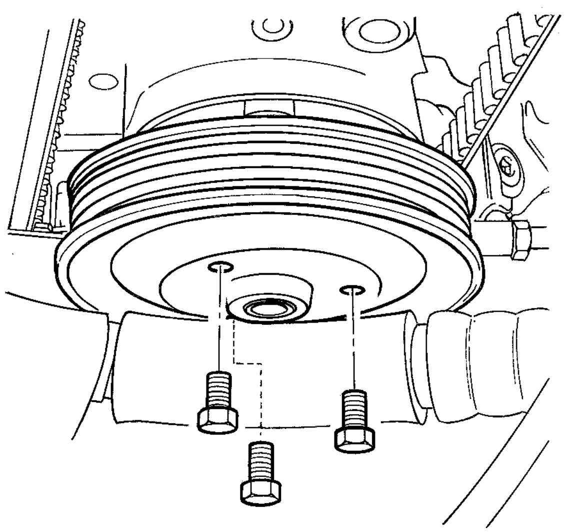
Tighten

Tighten the lower timing belt cover bolts to 10 N m (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 N m (44 lb-ft).



A102B005

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

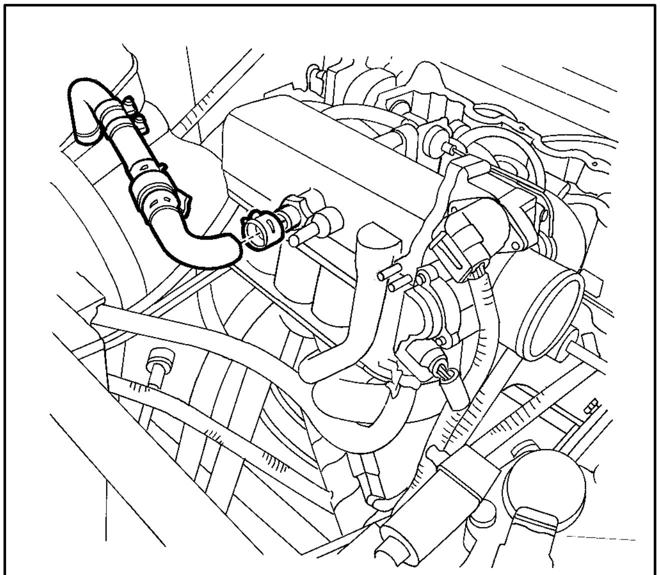
Tighten

Tighten the crankshaft pulley bolt to 95 N m (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.

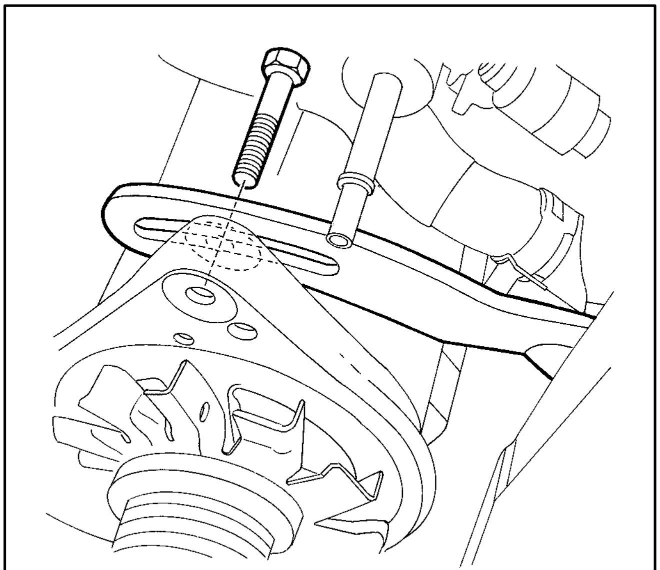
Tighten

Tighten the power steering pump pulley bolts to 25 N m (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.



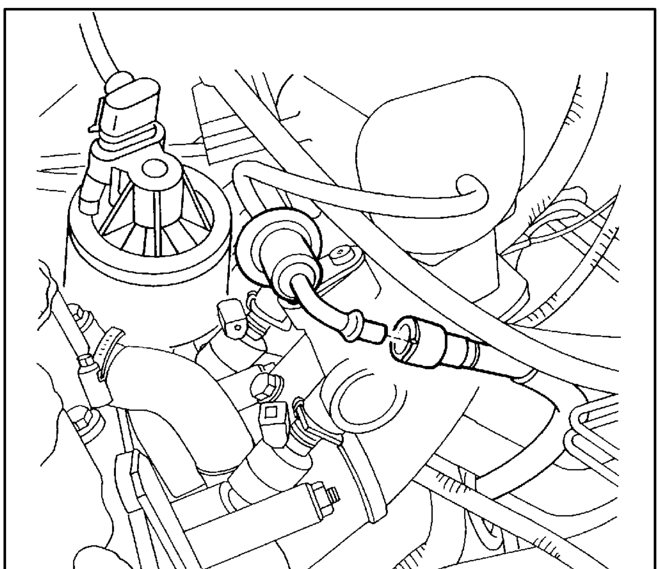
A102B118

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

Tighten

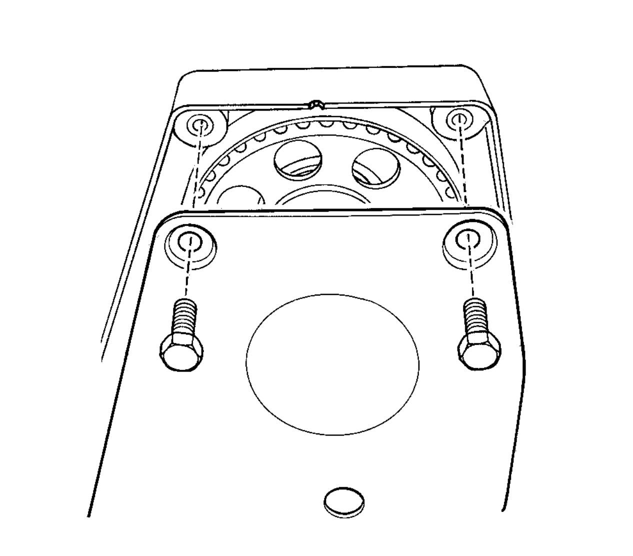
Tighten the alternator adjusting bracket retaining bolt to 25 N m (18 lb-ft).

38. Install the alternator adjusting bolt. Do not tighten.



A402B009

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

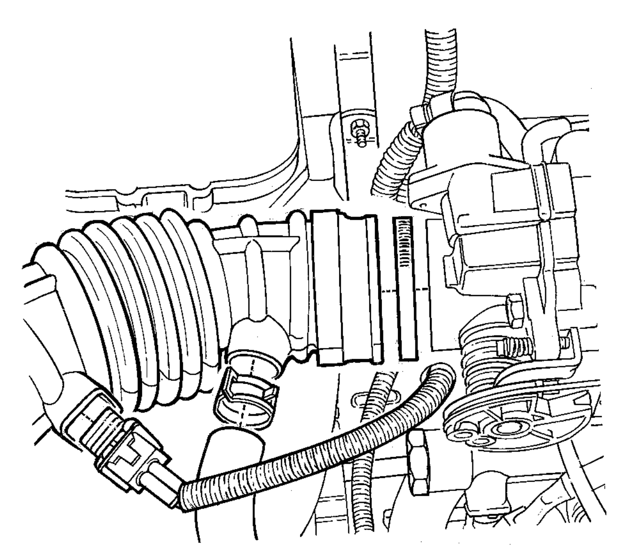
Tighten the alternator adjusting bolt to 20 N m (15 lb-ft).

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 N m (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.*



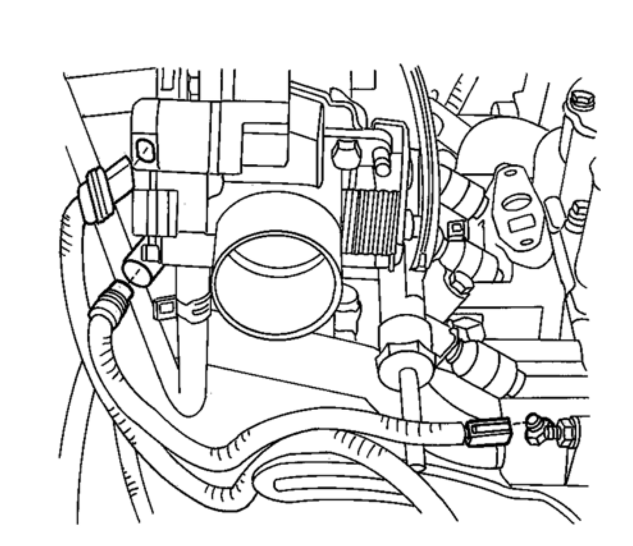
A102B001

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

Tighten

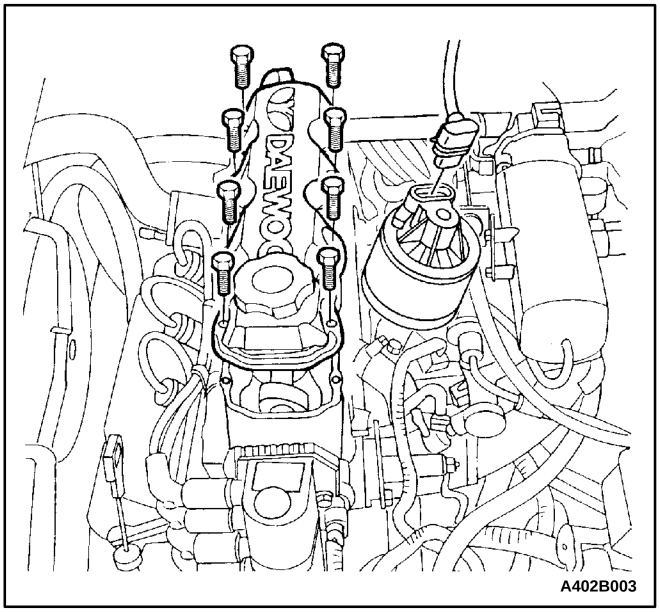
Tighten the air filter housing bolts to 8 N m (71 lb-in).

49. Connect the air intake tube to the throttle body.
50. Connect the breather tube to the valve cover.
51. Connect the IAT sensor connector.
52. Install the CMP sensor.



A102B016

53. Connect the CTS connector.
54. Connect the ECT sensor connector.
55. Connect the IAC valve connector.
56. Connect the TP sensor connector.
57. Connect the EI system ignition coil connector.
58. Connect the fuel injector harness connectors.
59. Connect the O_2 sensor connector.
60. Connect the ECM ground terminal at the intake manifold.
61. Connect the negative battery cable.
62. Install the fuel pump fuse.
63. Refill the engine cooling system. Refer to *Section 1D, Engine Cooling.*



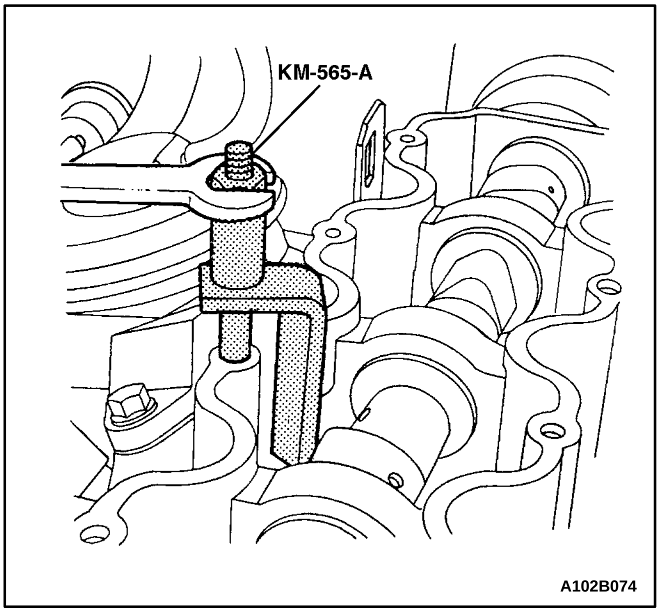
CAMSHAFT

Tools Required

KM-565-A Valve Spring Compressor

Removal Procedure

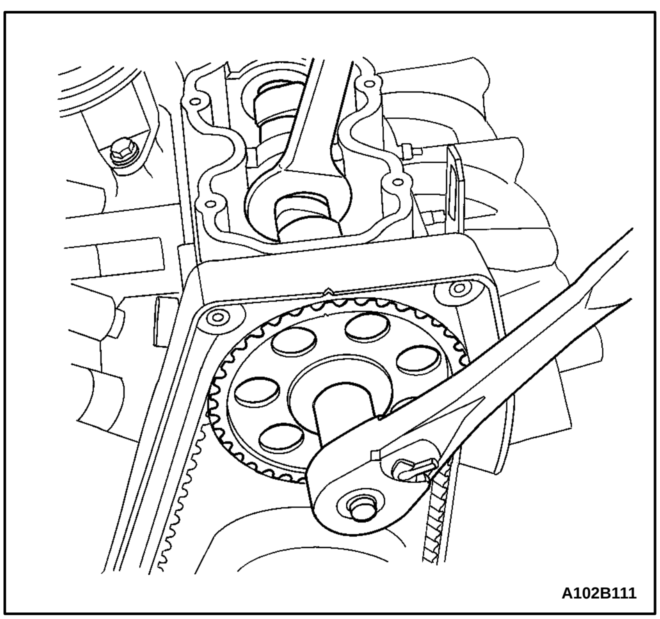
1. Remove the timing belt. Refer to “Timing Belt” in this section.
2. Disconnect the air breather tube at the valve cover.
3. Remove the valve cover bolts.
4. Remove the valve cover.
5. Remove the valve cover gasket.



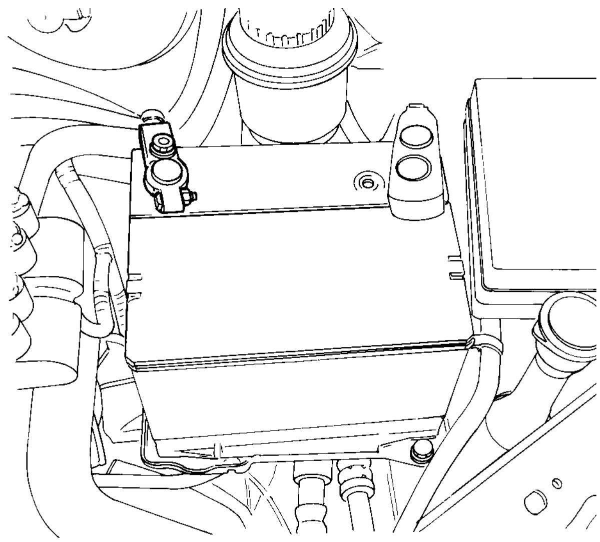
6. Install the valve spring compressor KM-565-A.

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.

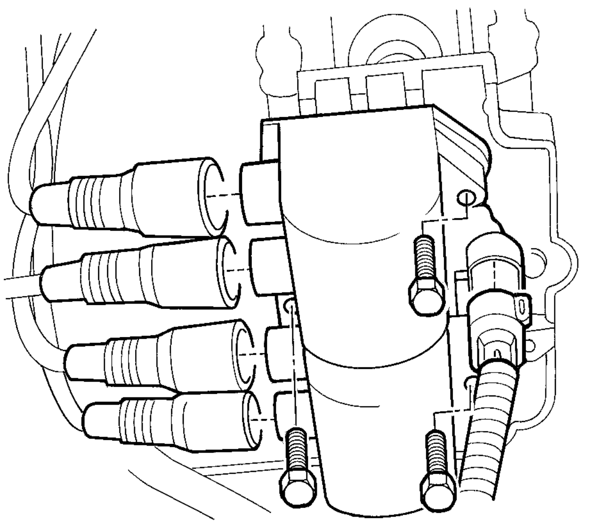


8. While holding the camshaft firmly in place, remove the camshaft gear bolt.
9. Remove the camshaft gear.



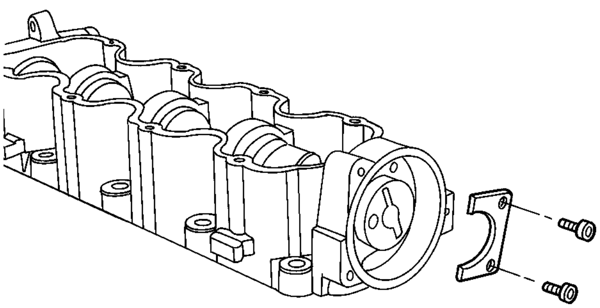
A102C034

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



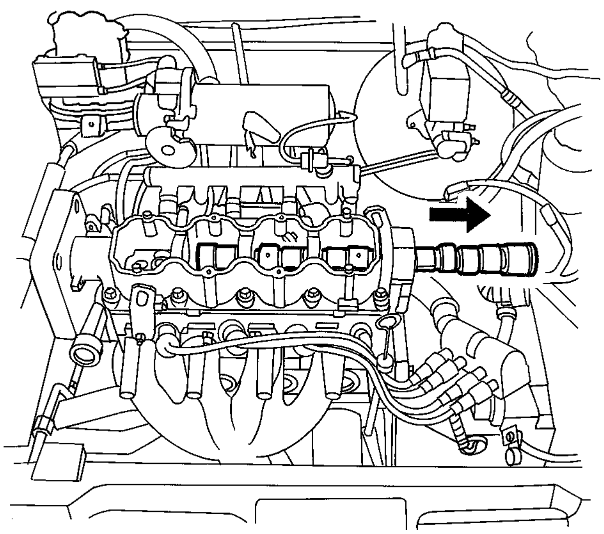
A102B075

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



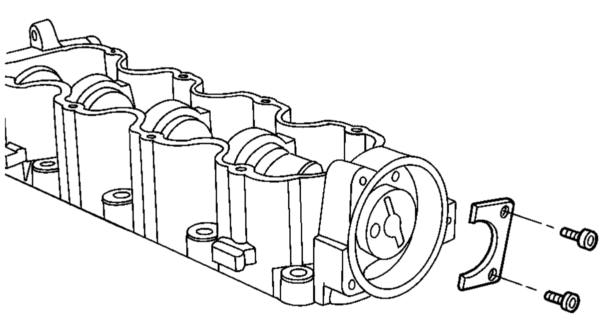
A102B076

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



A102B077

20. Remove the camshaft.



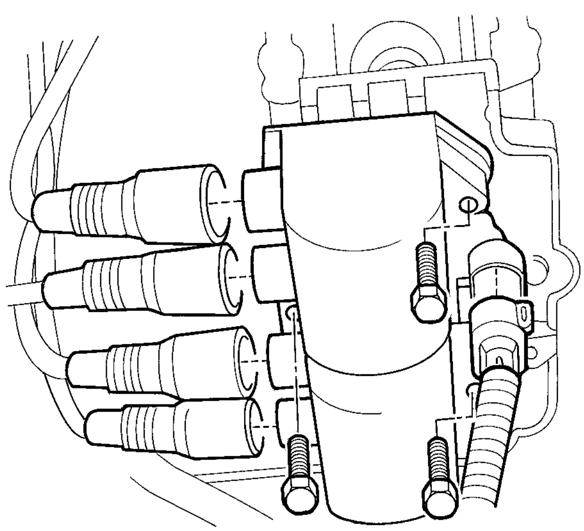
A102B076

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 N m (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 EI system ignition coil mounting plate.
6. Install the EI system ignition coil mounting plate bolts.

Tighten

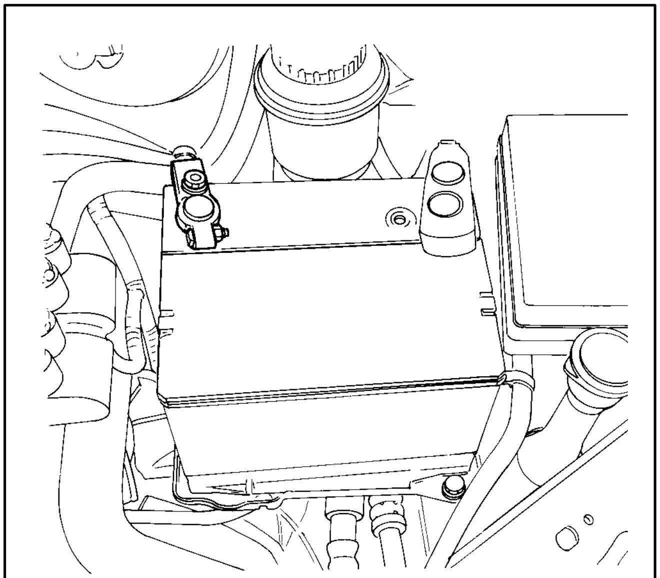
Tighten the EI system ignition coil mounting plate bolts to 10 N m (89 lb-in).

7. Install the EI system ignition coil.
8. Install the EI system ignition coil mounting bolts.

Tighten

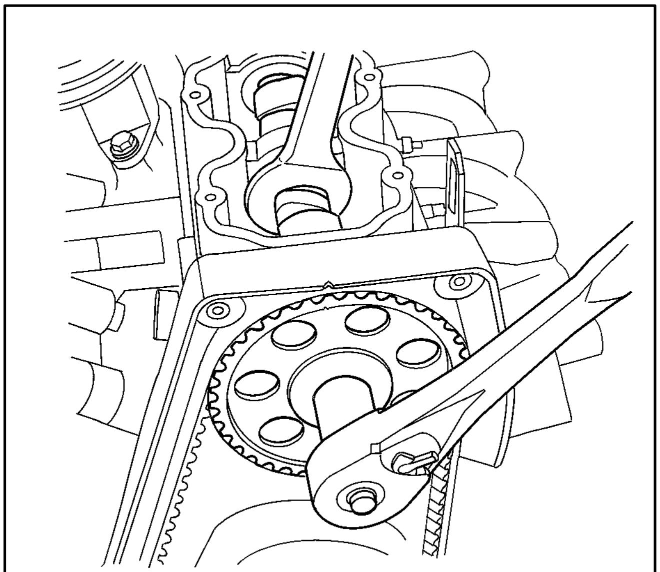
Tighten the EI system ignition coil mounting bolts to 10 N m (89 lb-in).

9. Connect the ignition wires at the EI system ignition coil.
10. Connect the EI system 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.



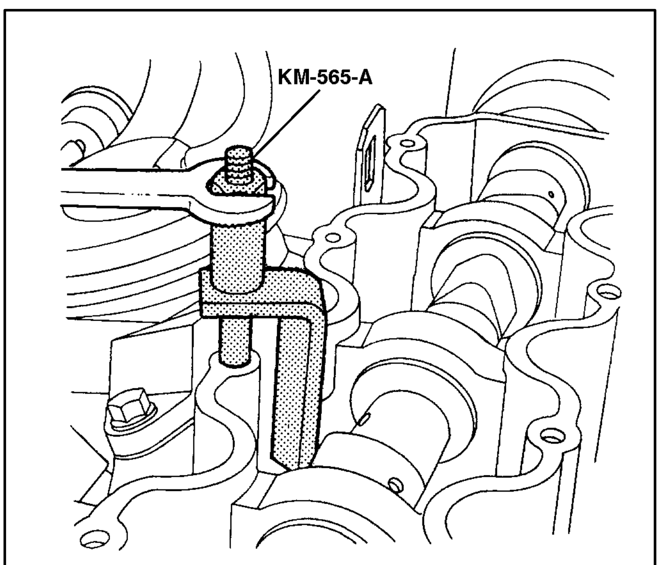
A102B111

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.

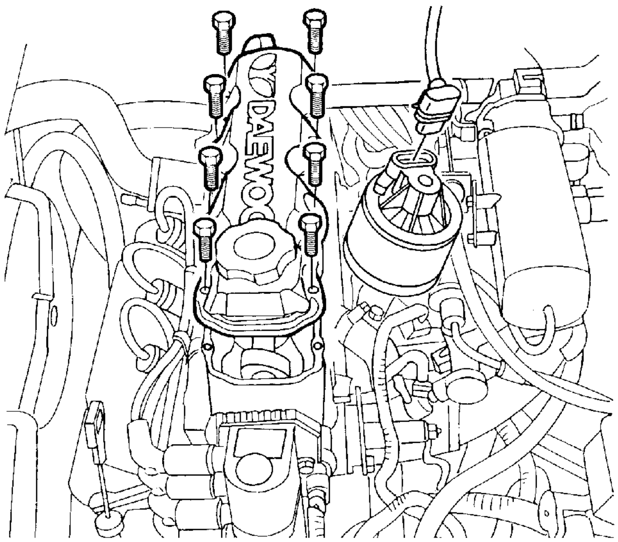
Tighten

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



A102B074

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



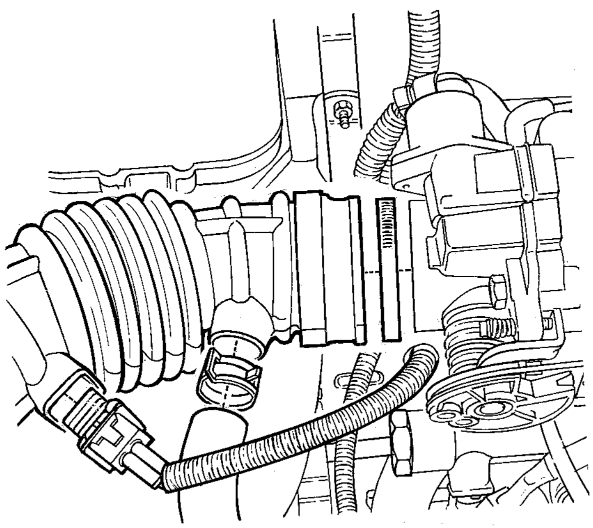
A402B003

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

Tighten

Tighten the valve cover bolts to 9 N m (80 lb-in).

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


A102B001

TIMING BELT CHECK AND ADJUST

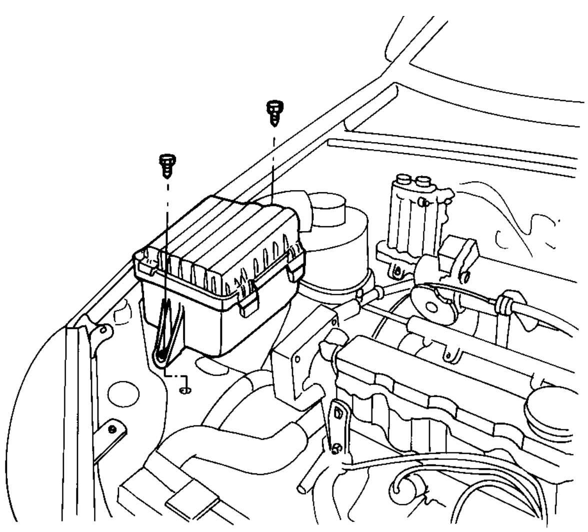
Tools Required

J-42492 Timing Belt Adjuster

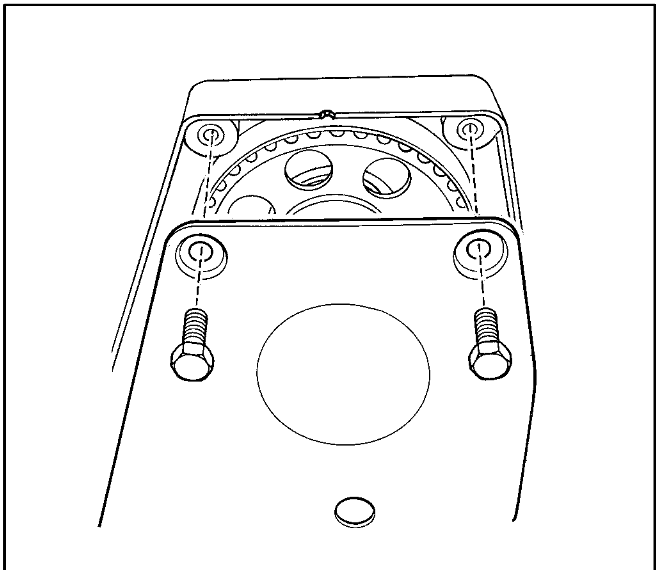
KM-470-B Angular Torque Gauge

Adjustment Procedure

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

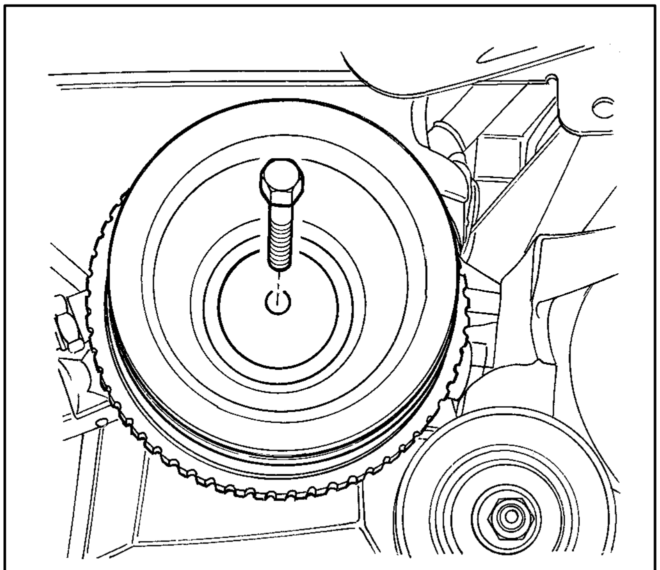

A102B002

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.



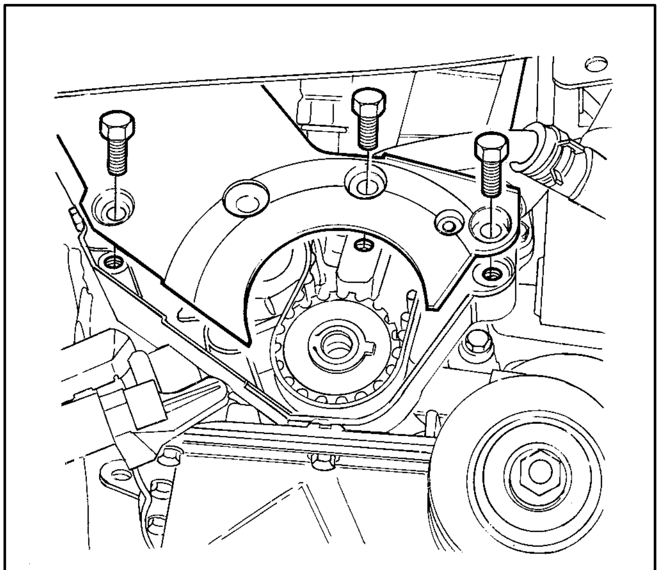
A102B003

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



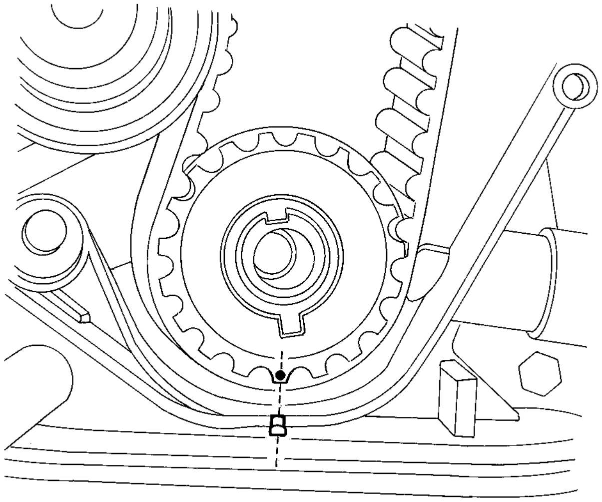
A102B018

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



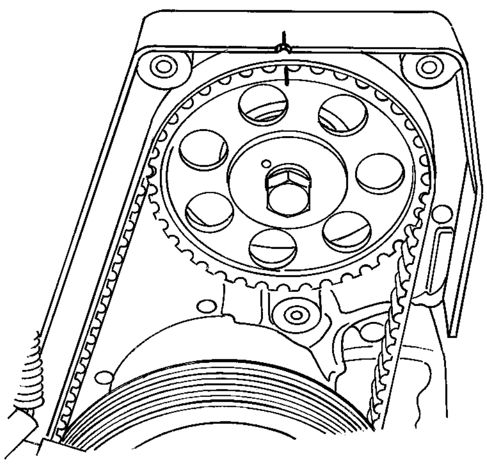
A102B008

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



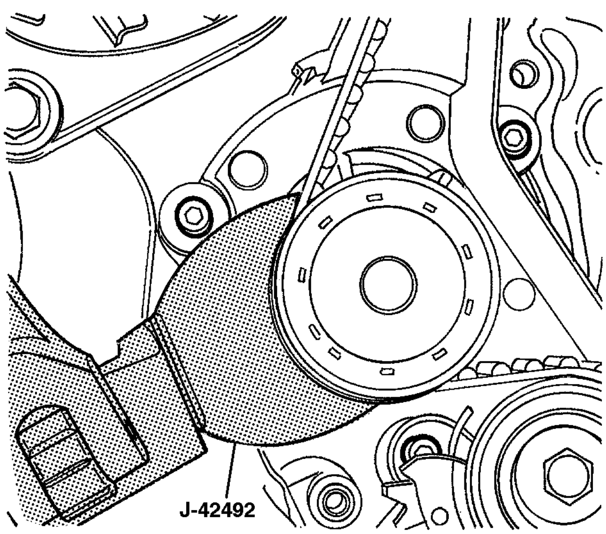
A102B030

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.



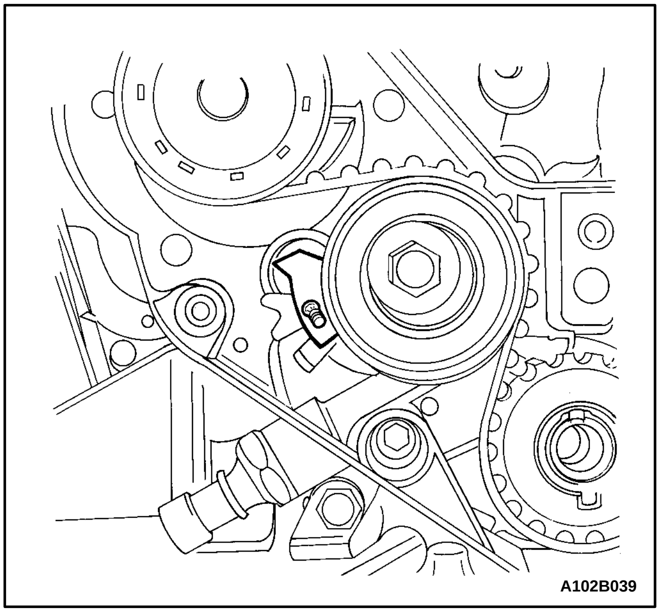
A102B004

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

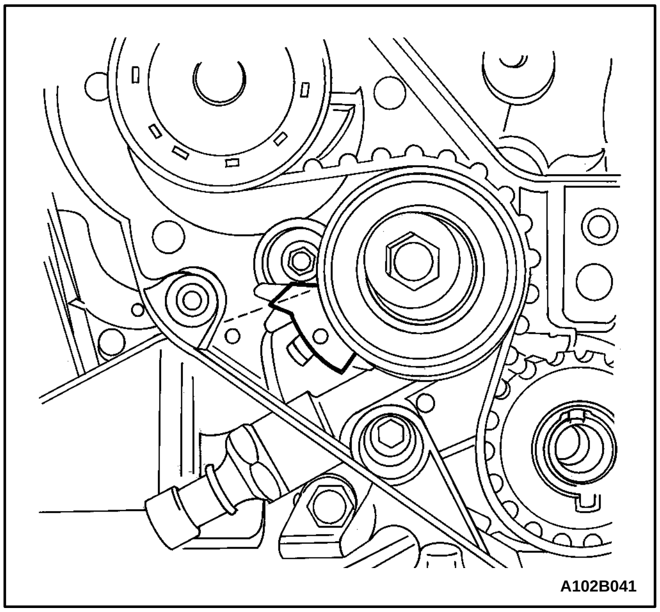


A102B040

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 loosely.



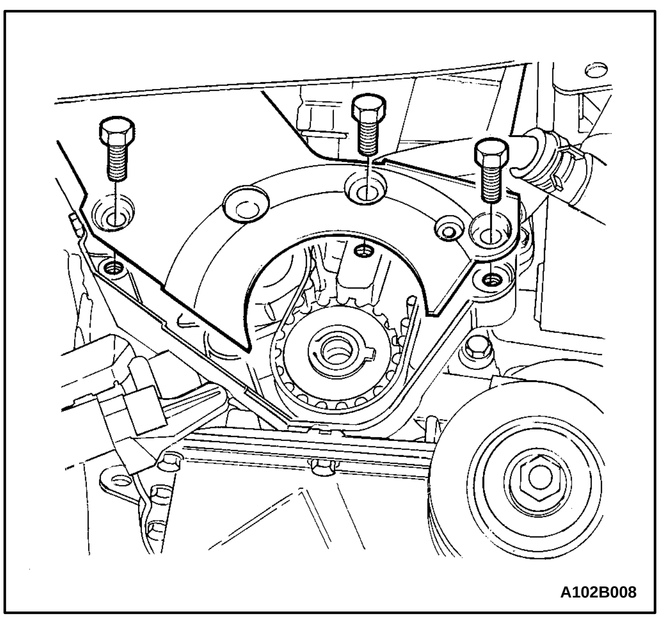
27. Align the adjust arm hole of the timing belt automatic tensioner to the hole in the timing belt automatic tensioner bracket.
28. Insert a 4.5 mm driver through the adjust arm hole and the tensioner bracket hole.
29. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
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.



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

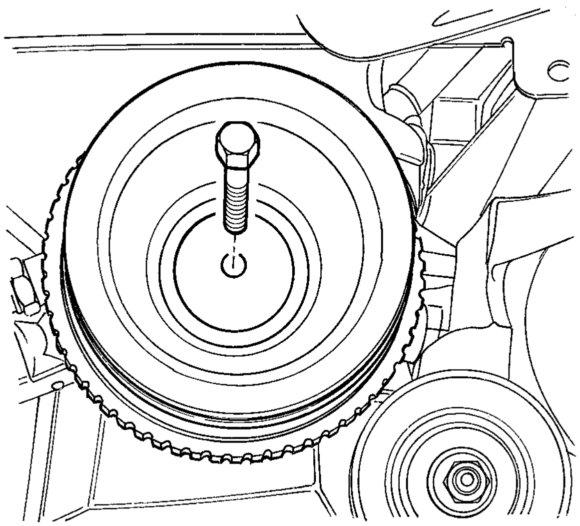
Tighten the coolant pump retaining bolts to 10 N m (89 lb-in).



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 N m (89 lb-in).

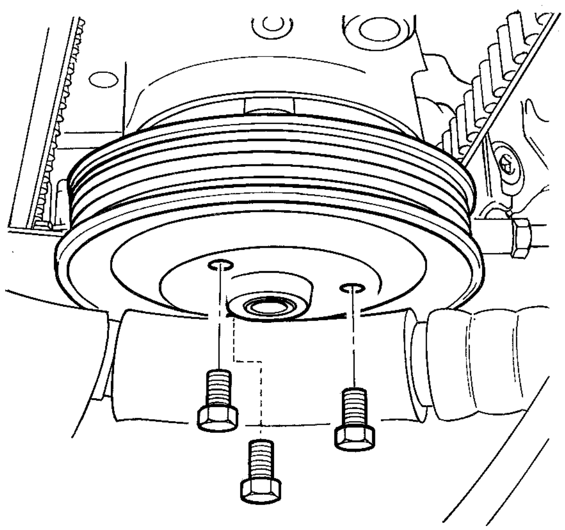


A102B018

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

Tighten

Tighten the crankshaft pulley bolt to 95 N m (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 N m (89 lb-in).

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

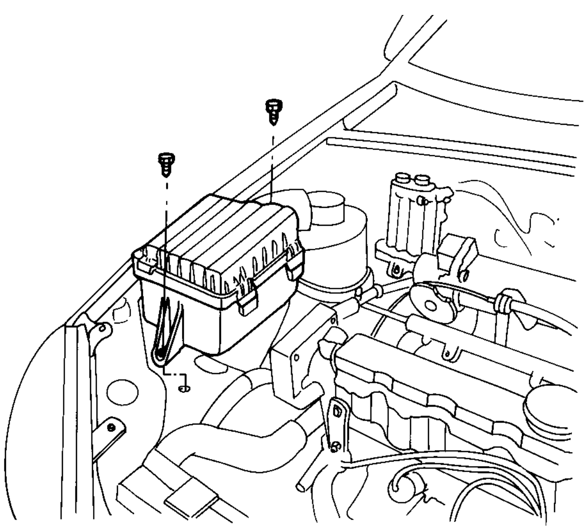
Tighten

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



A102B002

45. Install the alternator drive belt.

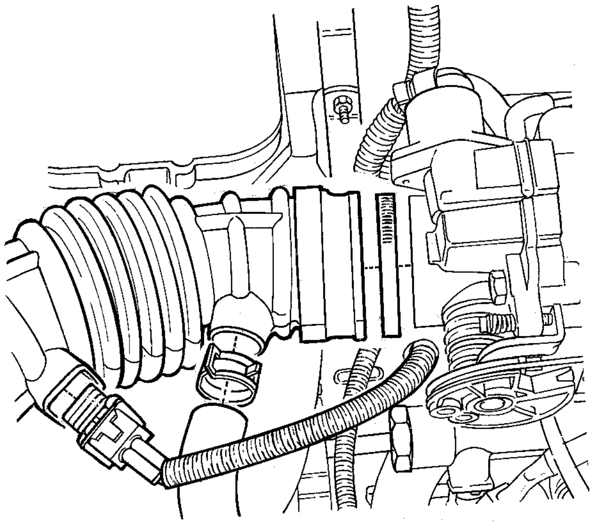
Tighten

Tighten the alternator adjusting bolt to 25 N m (18 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.

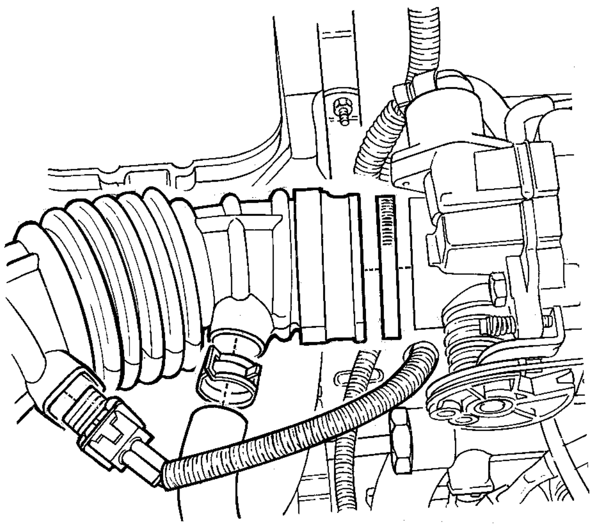
Tighten

Tighten the air filter housing bolts to 8 N m (71 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 IAT sensor connector.
54. Connect the negative battery cable.



A102B001

TIMING BELT

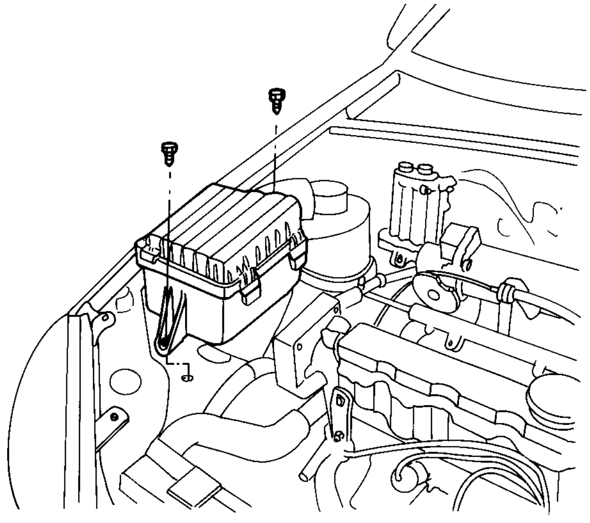
Tools Required

J-42492 Timing Belt Adjuster

KM-470-B Angular Torque Gauge

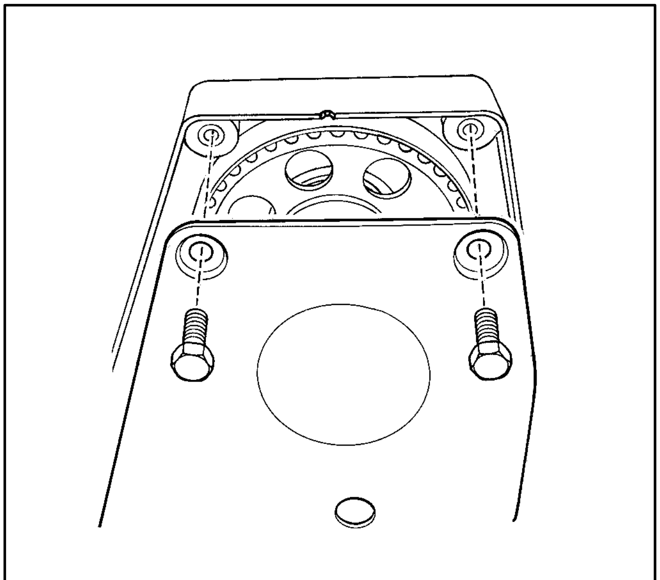
Removal Procedure

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

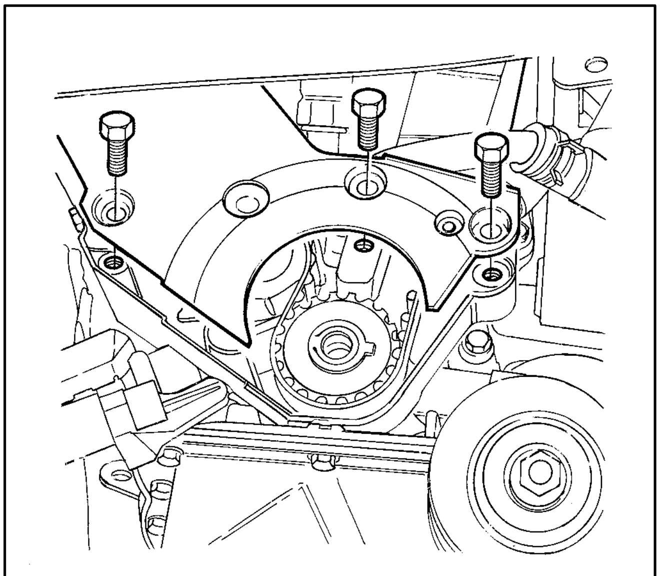


A102B002

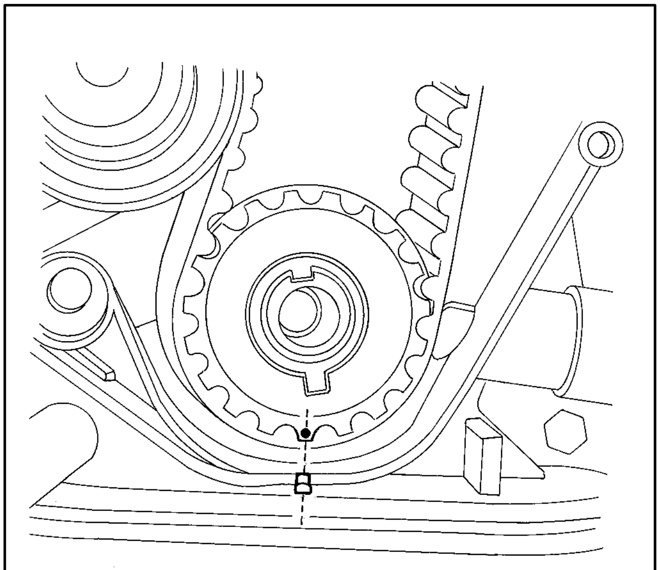
5. Remove the air cleaner housing bolts.
6. Remove the air cleaner housing.
7. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels.*
8. Remove the right front wheel well splash shield.


A102B003

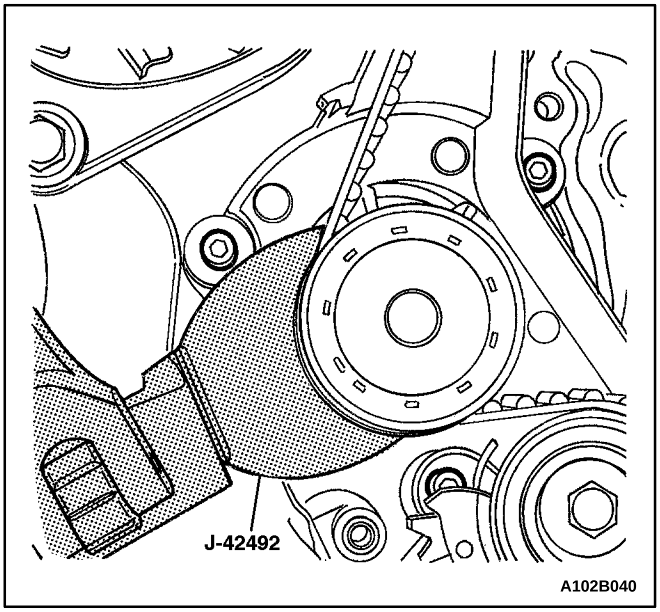
9. Remove the A/C compressor drive belt, if equipped.
10. Remove the alternator drive belt.
11. Remove the power steering pump, if equipped. Refer to *Section 6B, Power Steering Pump*.
12. Remove the upper timing belt cover bolts.
13. Remove the upper timing belt cover.


A102B008

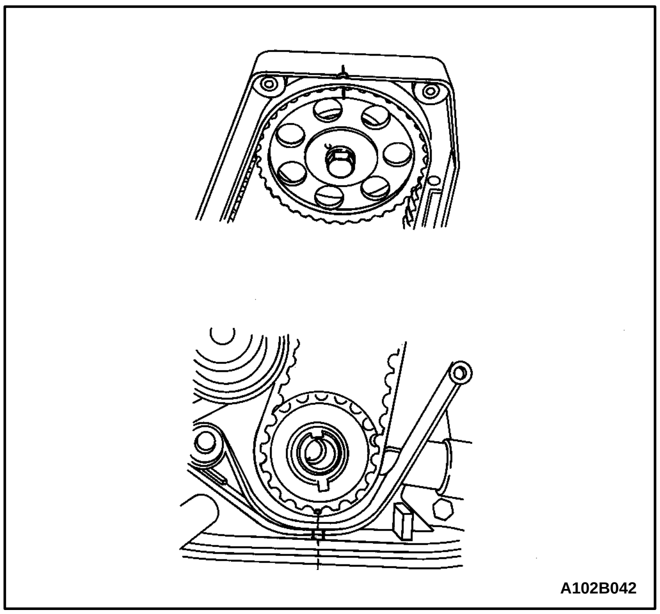
14. Remove the crankshaft pulley bolt.
15. Remove the crankshaft pulley.
16. Remove the lower timing belt cover bolts.
17. Remove the lower timing belt cover.


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.

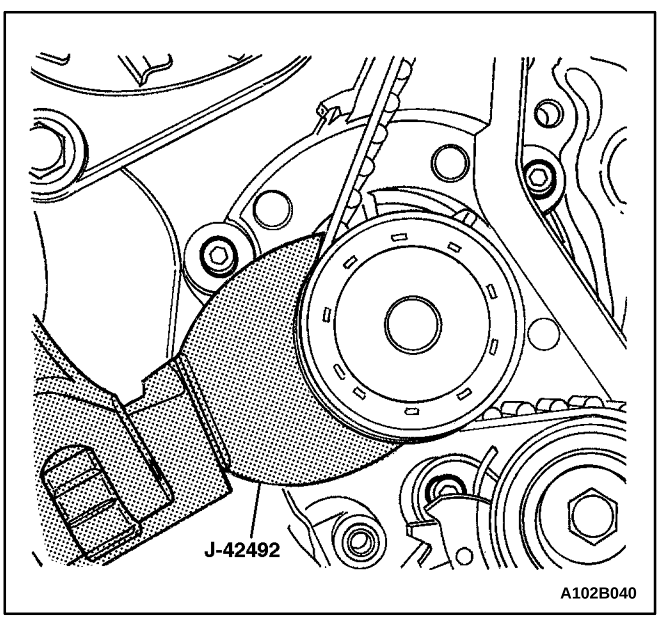


20. Slightly loosen the coolant pump retaining bolts.
21. Using the timing belt adjuster J-42492, rotate the coolant pump counterclockwise to release the tension on the timing belt.
22. Remove the timing belt.

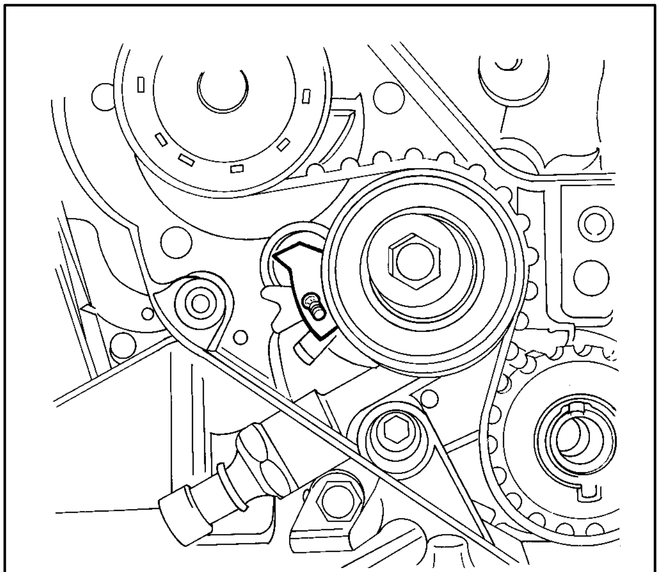


Installation Procedure

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.

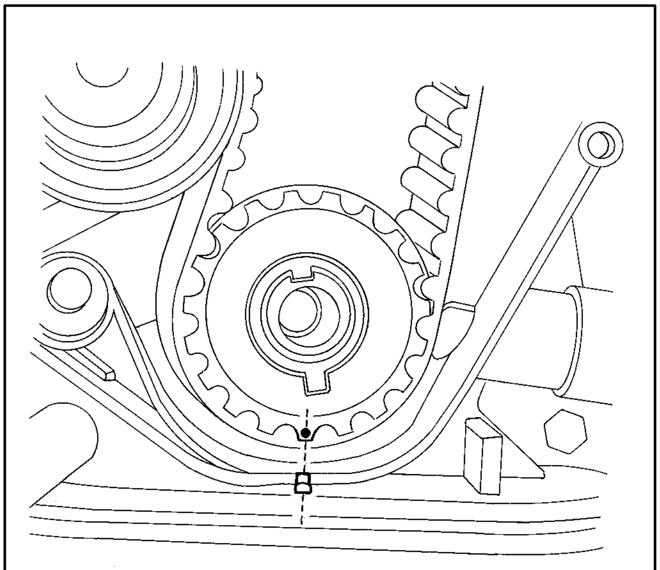


4. Using the timing belt adjuster J-42492, rotate the coolant pump clockwise to add the highest tension to the timing belt.
5. Tighten the coolant pump retaining bolts loosely.



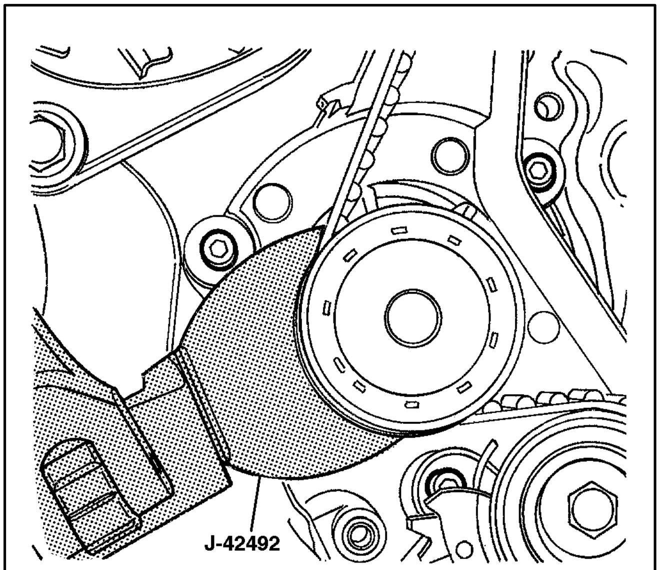
A102B039

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.



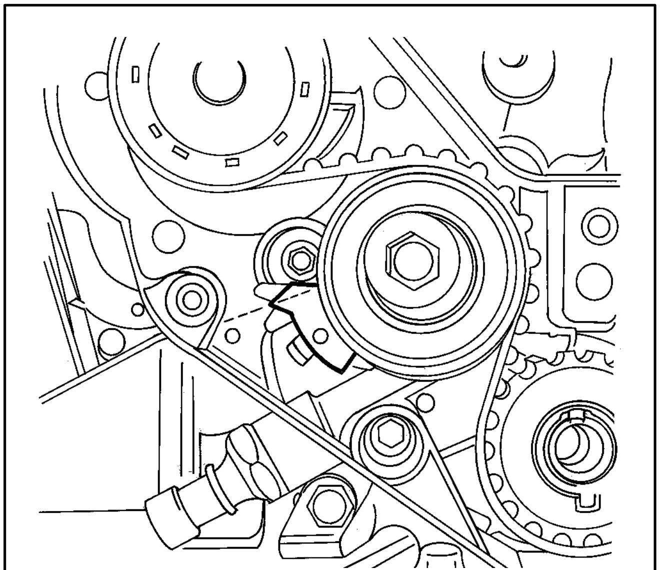
A102B030

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.

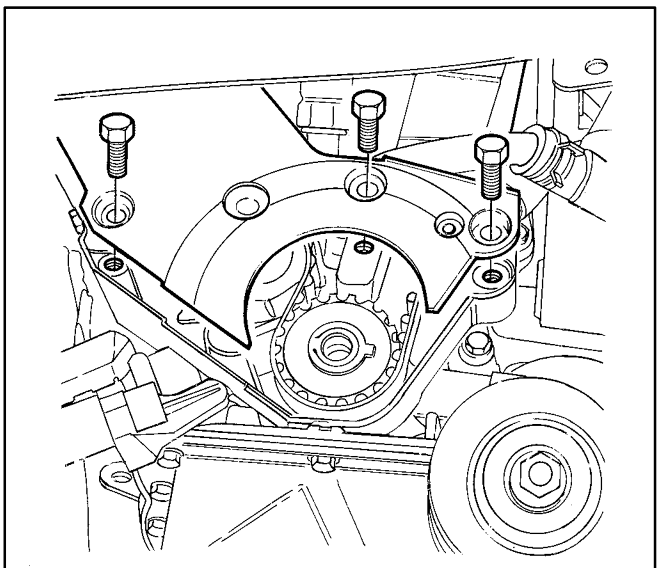


A102B041

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 N m (89 lb-in).

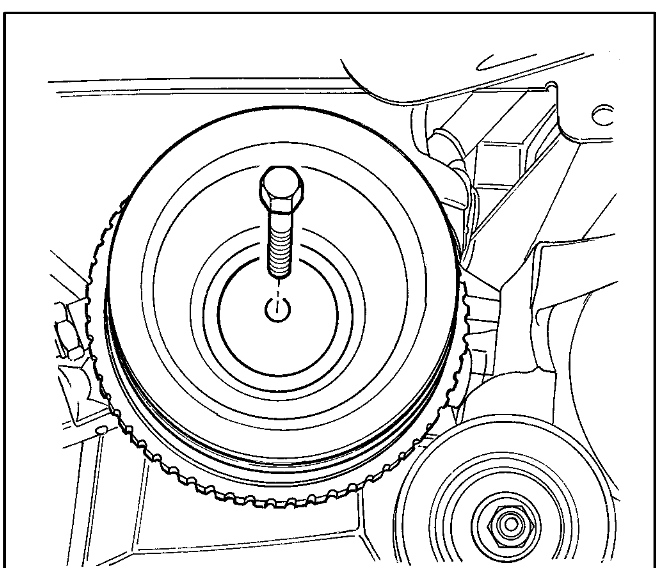


A102B008

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 N m (89 lb-in).

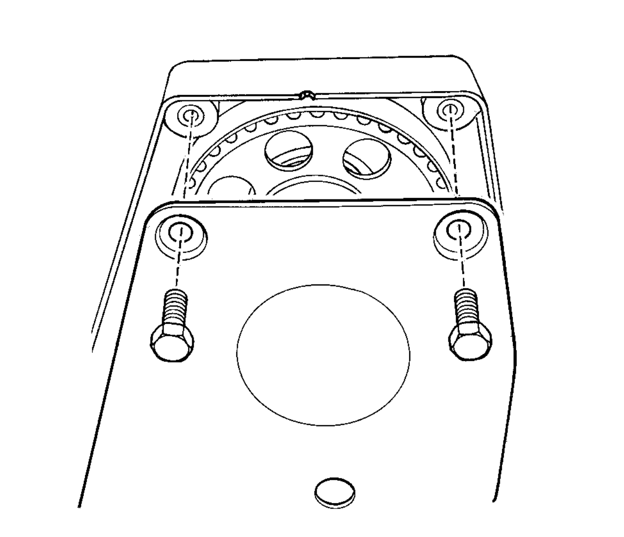


A102B018

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

Tighten

Tighten the crankshaft pulley bolt to 95 N m (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.

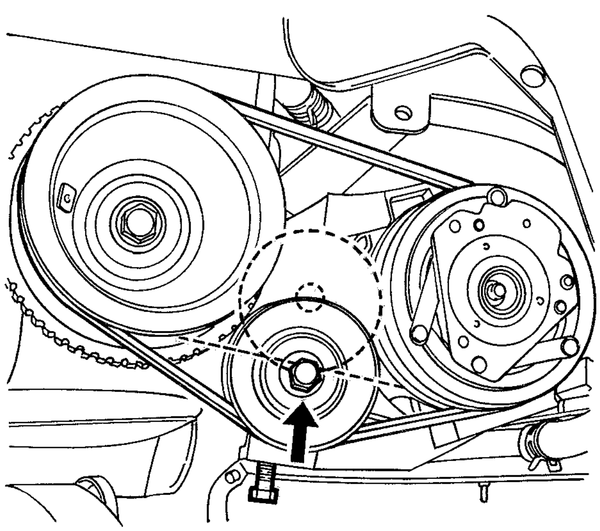


A102B003

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

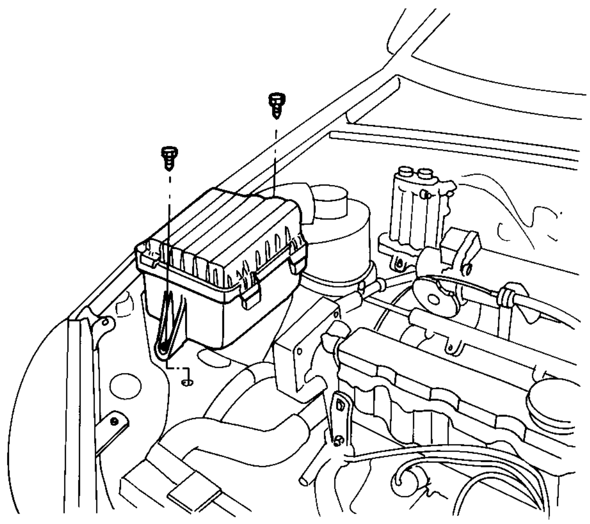
Tighten

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



A102B006

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.

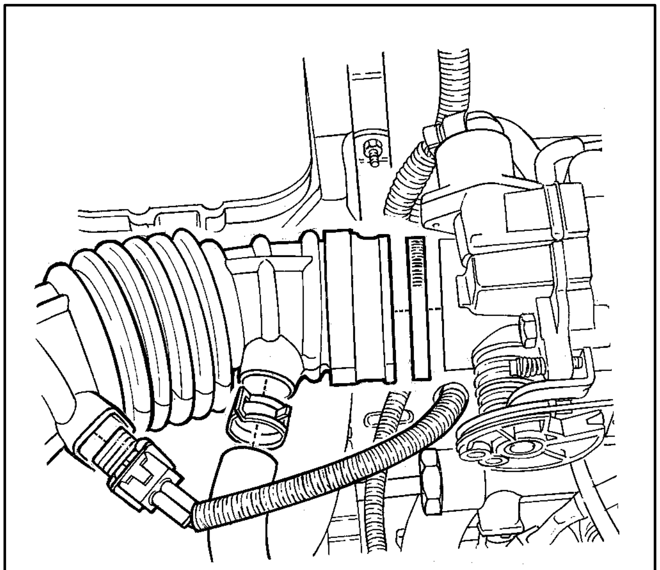


A102B002

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.

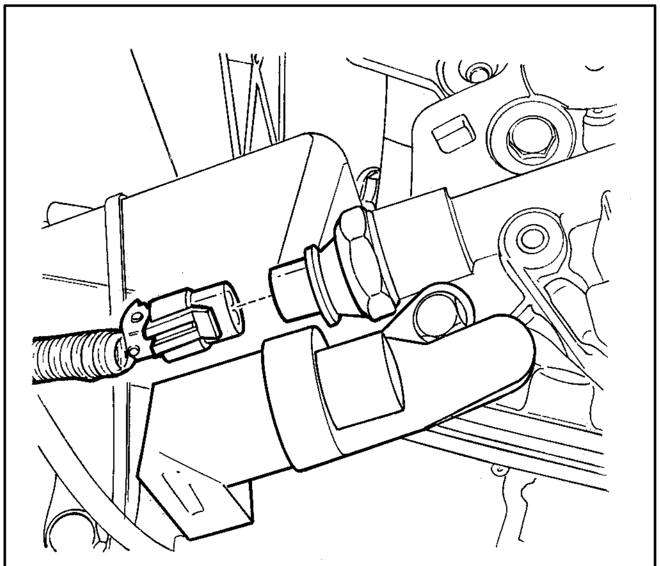
Tighten

Tighten the air filter housing bolts to 8 N m (71 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 IAT sensor connector.
32. Connect the negative battery cable.



A102B019

OIL PUMP

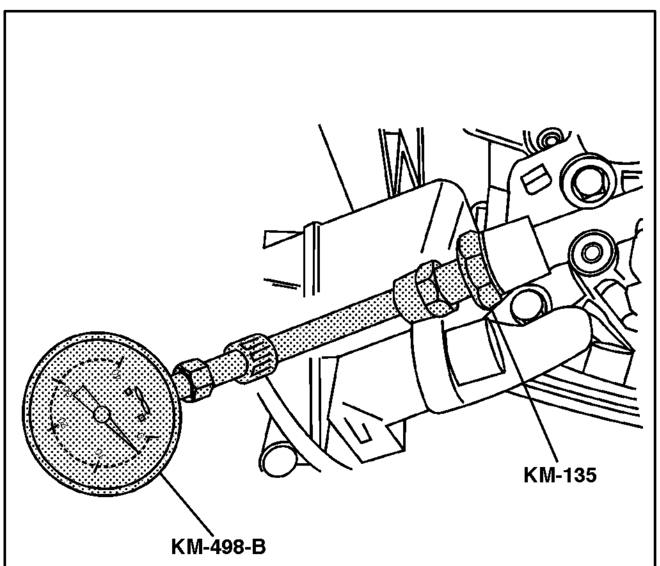
Tools Required

KM-498-B Pressure Gauge

KM-135 Adapter

Engine Oil Pressure Inspection Procedure

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

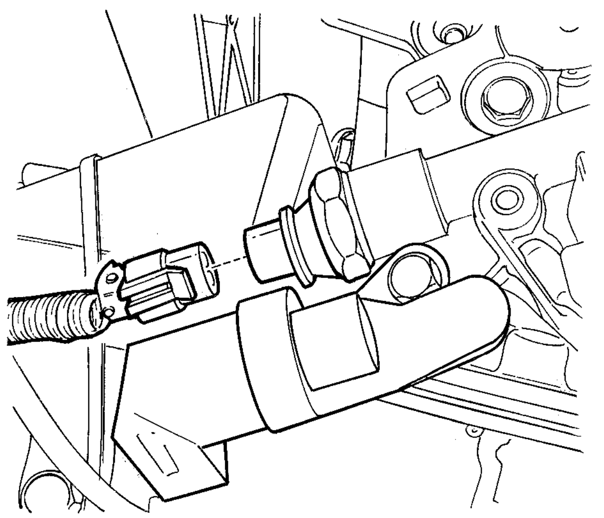


A202B003

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.



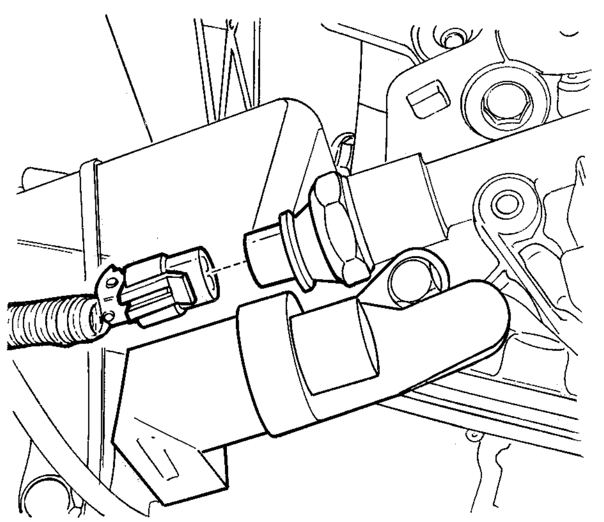
A102B019

7. Install the oil pressure switch.

Tighten

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

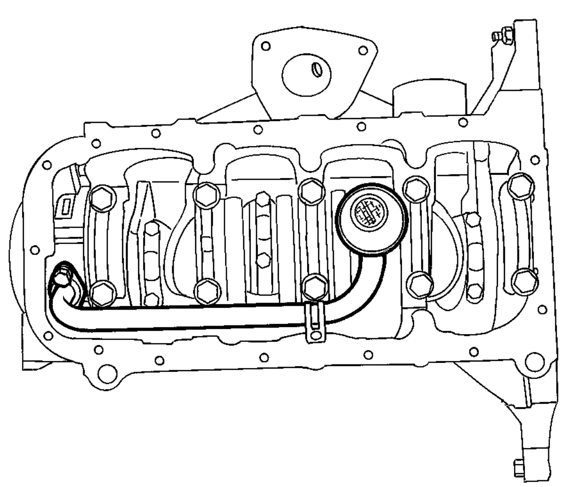
8. Connect the electrical connector to the oil pressure switch.
9. Install the right-hand wheel well splash shield.
10. Check the oil level and fill the oil to the FULL mark.



A102B019

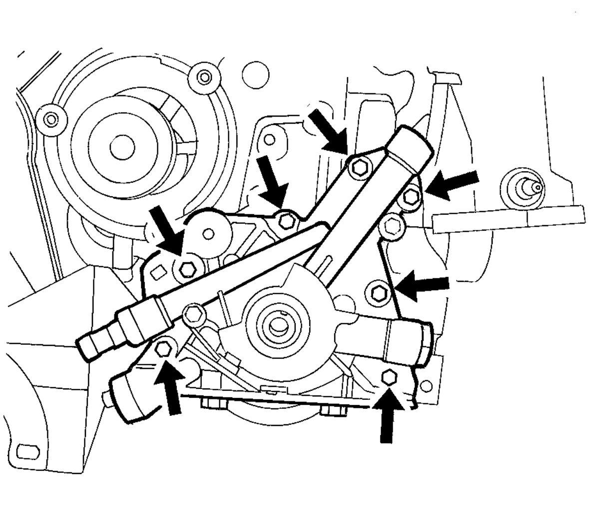
Removal Procedure

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.



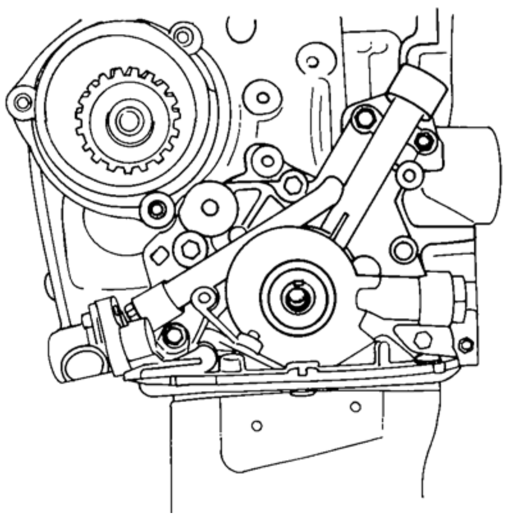
A102B064

6. Remove the crankshaft position (CKP) sensor bolt.
7. Remove the CKP 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

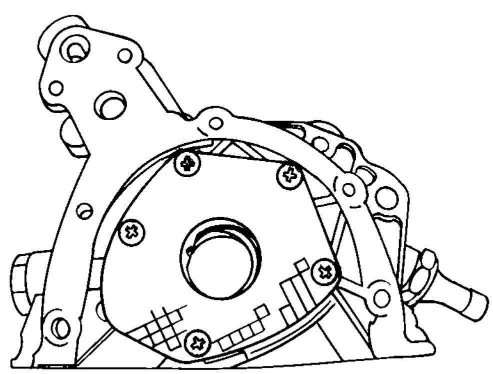
11. Remove the oil pump retaining bolts.
12. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
13. Remove the oil pump.



A202B002

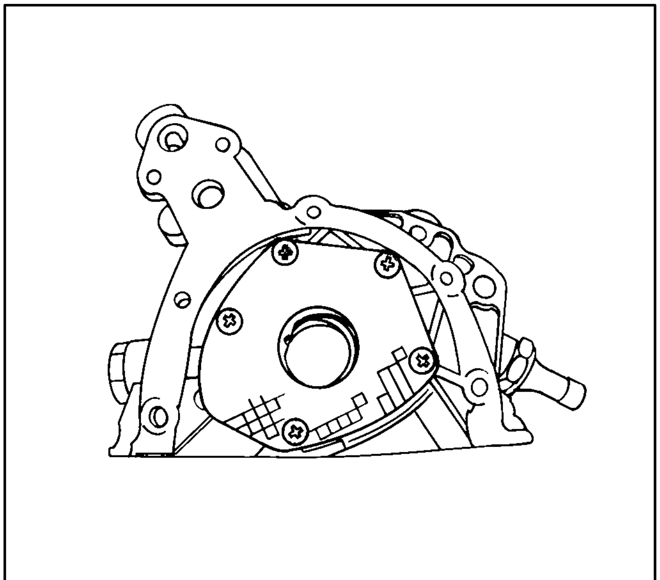
Inspection Procedure

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.

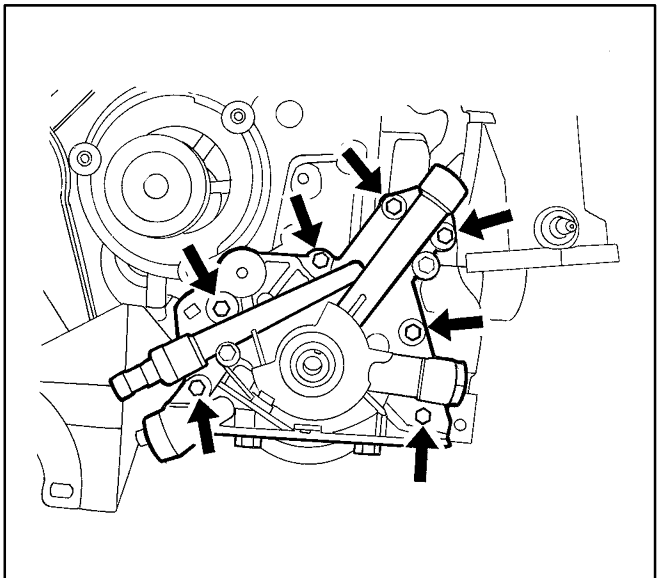
Tighten

Tighten the oil pump rear cover bolts to 6 N m (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 N m (22 lb-ft).

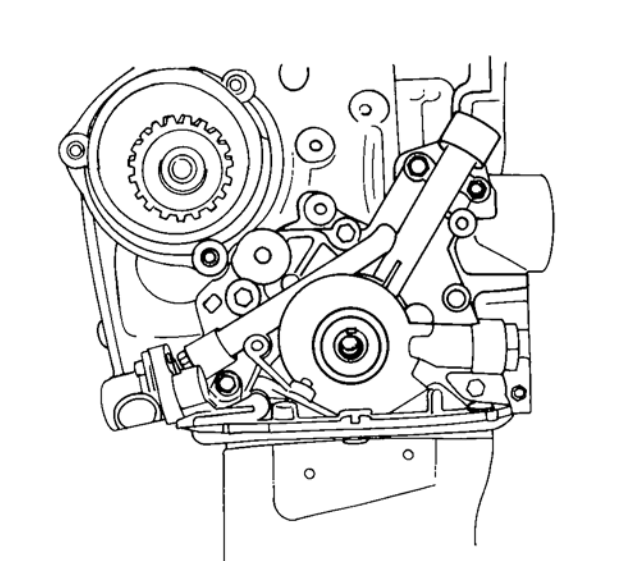

A102B065

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.

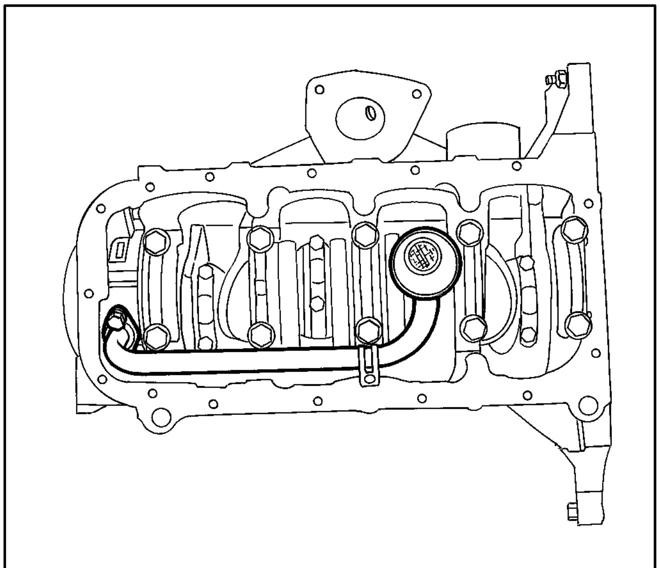
Tighten

Tighten the oil pump retaining bolts to 10 N m (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.

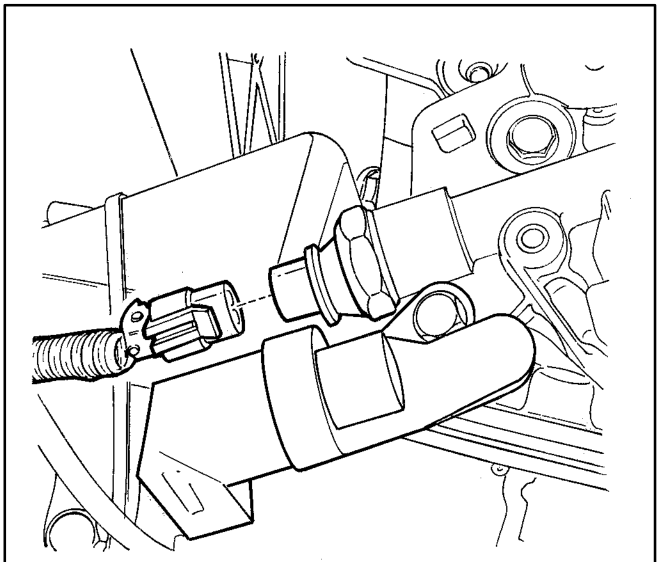


A102B064

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 N m (89 lb-in).



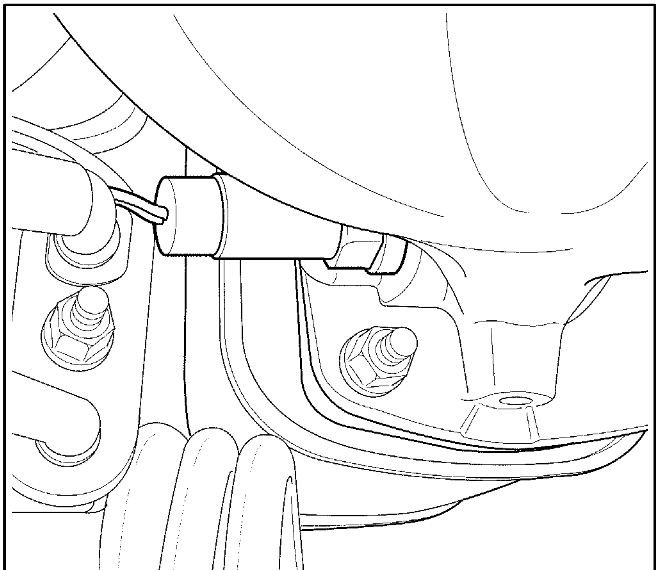
A102B019

9. Install the oil pan. Refer to “Oil Pan” in this section.
10. Install the CKP sensor and the bolt.

Tighten

Tighten the crankshaft position sensor retaining bolt to 10 N m (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.

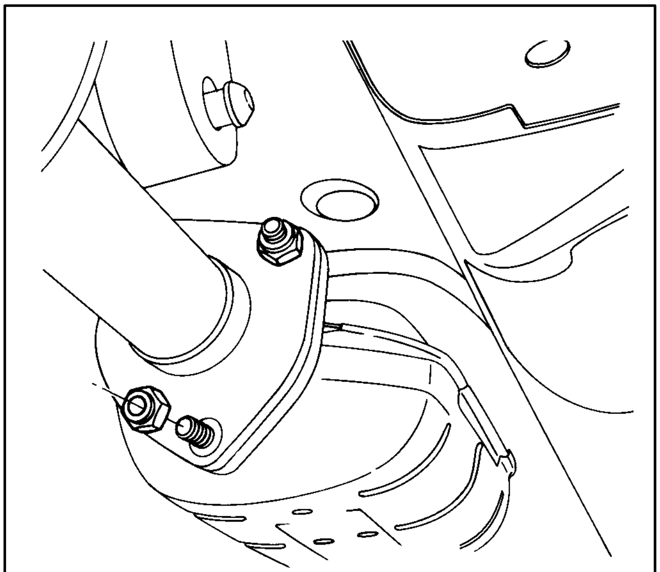


TAA1F480

OIL PAN

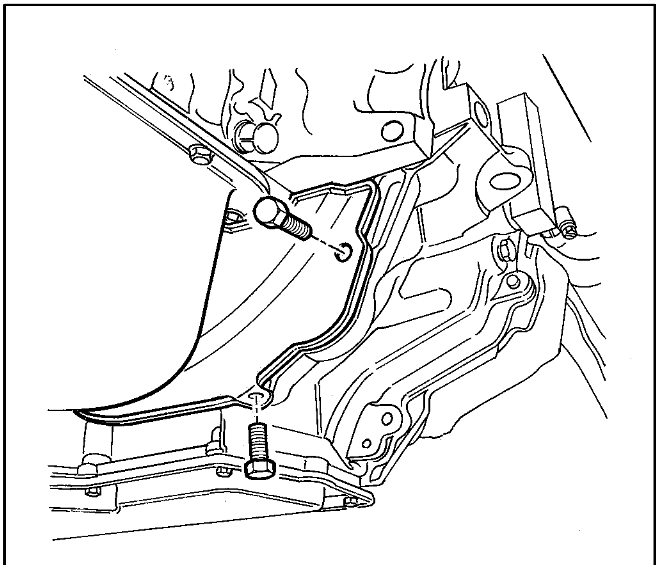
Removal Procedure

1. Disconnect the negative battery cable.
2. Drain the engine oil from the engine crankcase.
3. Disconnect the post-converter heated oxygen (O_2) sensor.
4. Remove the auxiliary catalytic converter upper flange nuts from the exhaust manifold and the bolts from the bracket.



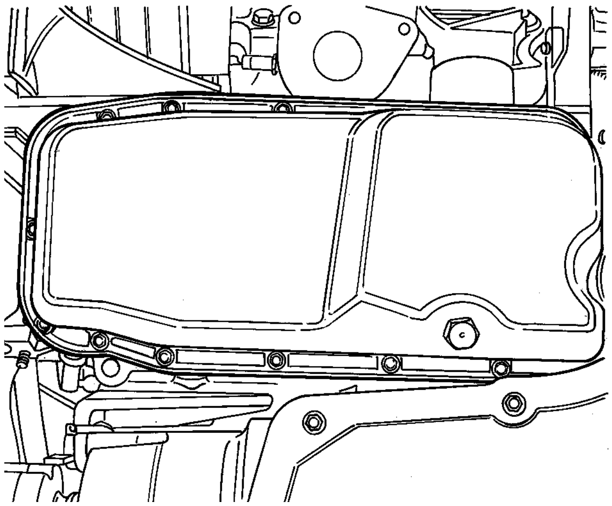
B102G003

5. Remove the nuts from the front muffler pipe to the main catalytic converter.
6. Remove both catalytic converters as a unit.



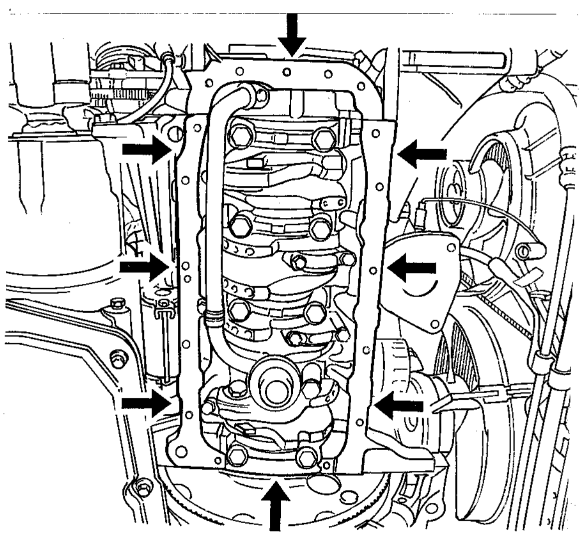
A102B021

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



A102B043

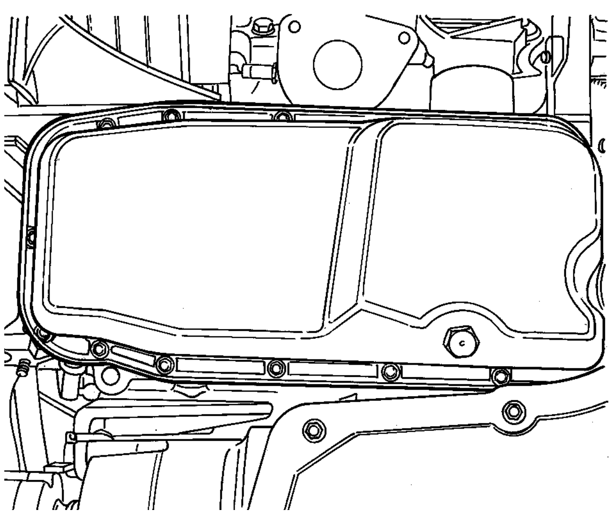
9. Remove the oil pan retaining bolts.
10. Remove the oil pan from the engine block.



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

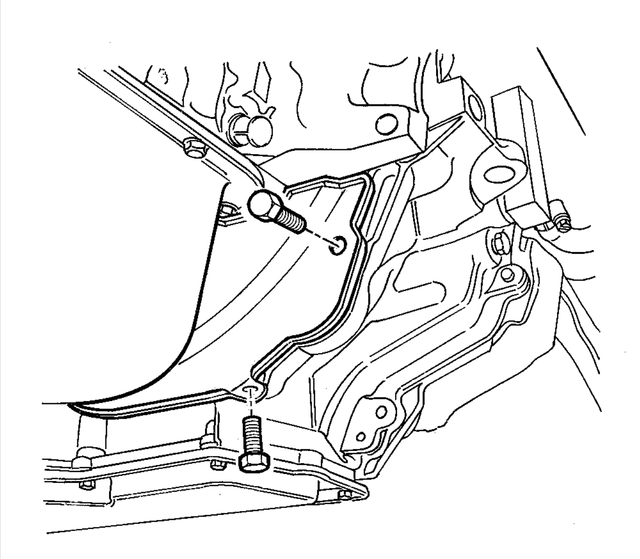
1. Install the oil pan gasket to the oil pan.
2. Install the oil pan to the engine block.

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 N m (89 lb-in).

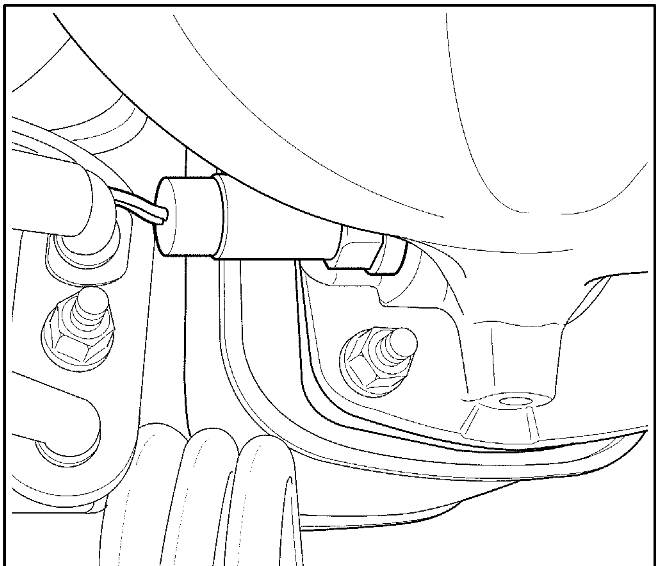


A102B021

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 N m (106 lb-in) or the flexible plate inspection cover bolts to 10 N m (89 lb-in).

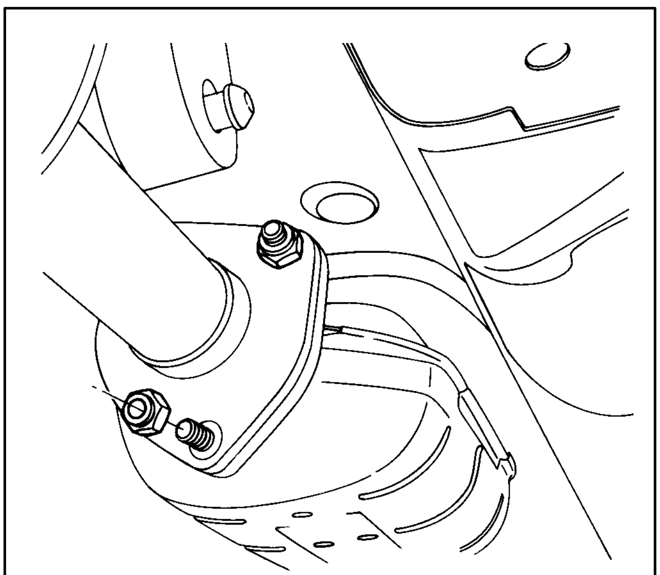


TAA1F480

6. Install the catalytic converters.

Tighten

Tighten the auxiliary catalytic converter-to-exhaust manifold nuts and bracket bolts to 40 N m (30 lb-ft).



B102G003

Tighten

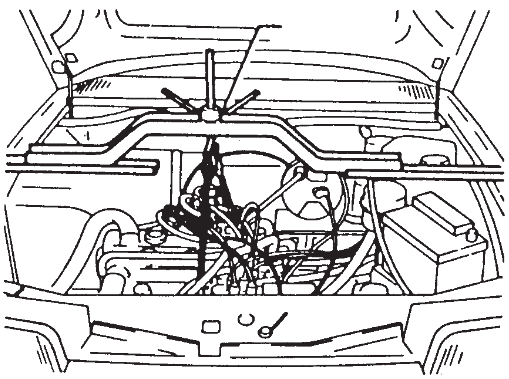
Tighten the front muffler-to-main catalytic converter nuts to 30 N m (22 lb-ft).

7. Connect the post-converter heated oxygen sensor connector.
8. Connect the negative battery cable.
9. Install the oil pan drain plug.

Tighten

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

10. Refill the engine crankcase with engine oil.



A105B012

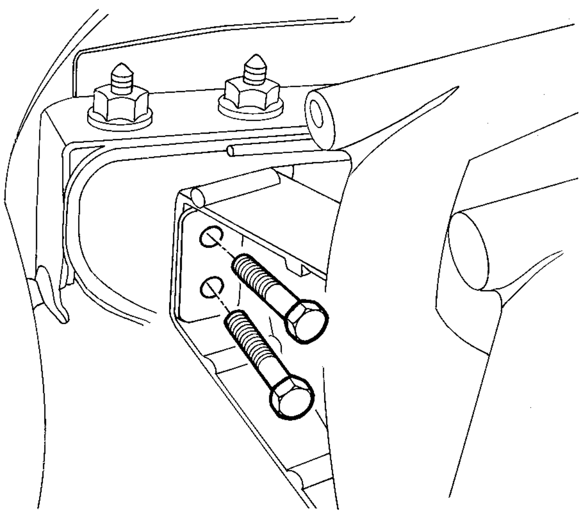
ENGINE MOUNT

Tools Required

KM-263-B Engine Assembly Support Fixture

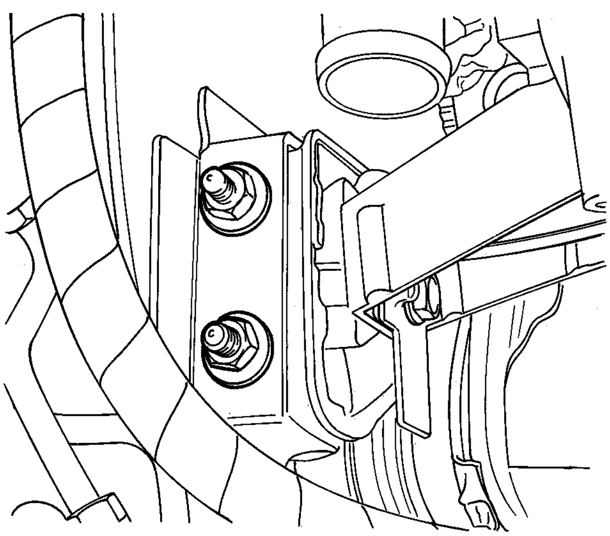
Removal Procedure

1. Disconnect the negative battery cable.
2. Support the engine assembly using the engine assembly support fixture KM-263-B



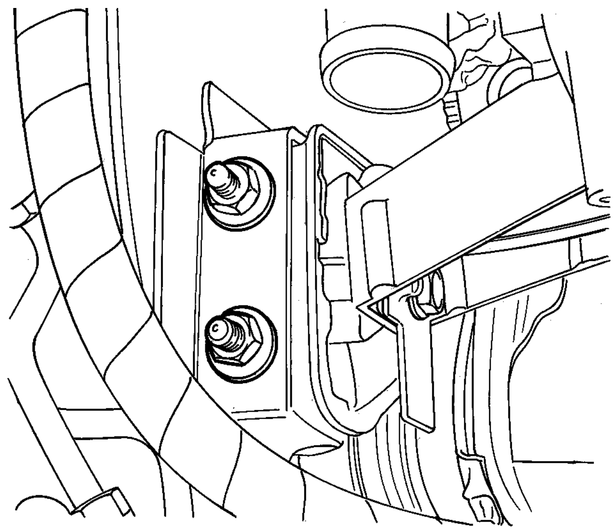
A102B020

3. Remove the engine mount bracket retaining bolts.



A102B045

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



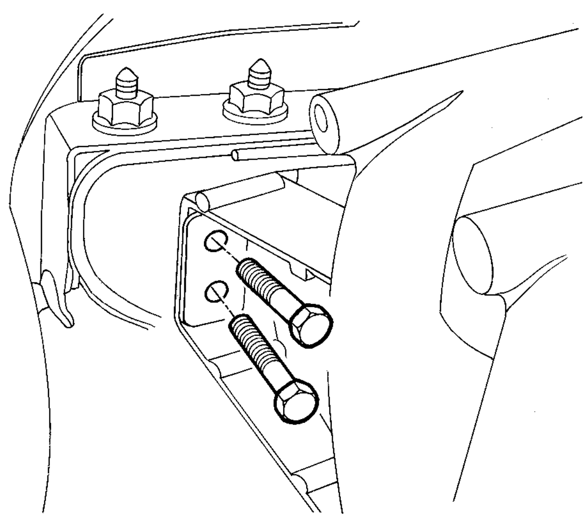
A102B045

Installation Procedure

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

Tighten

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

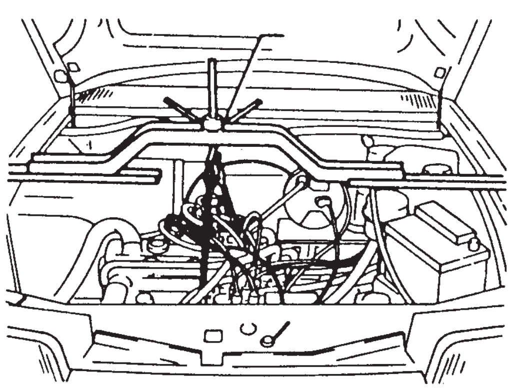


A102B020

3. Install the engine mount bracket retaining bolts.

Tighten

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



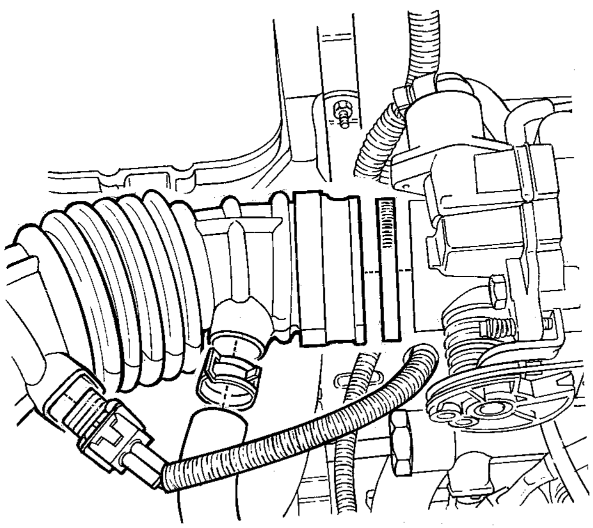
A105B012

4. Remove the engine assembly support fixture KM-263-M
5. Connect the negative battery cable.

INTAKE MANIFOLD

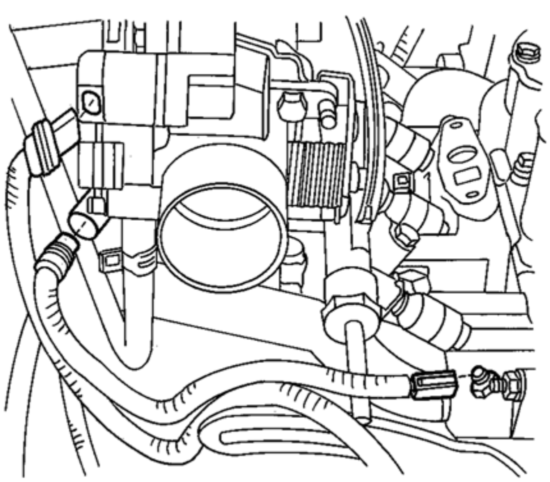
Removal Procedure

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 engine control module (ECM) ground terminal from the intake manifold.



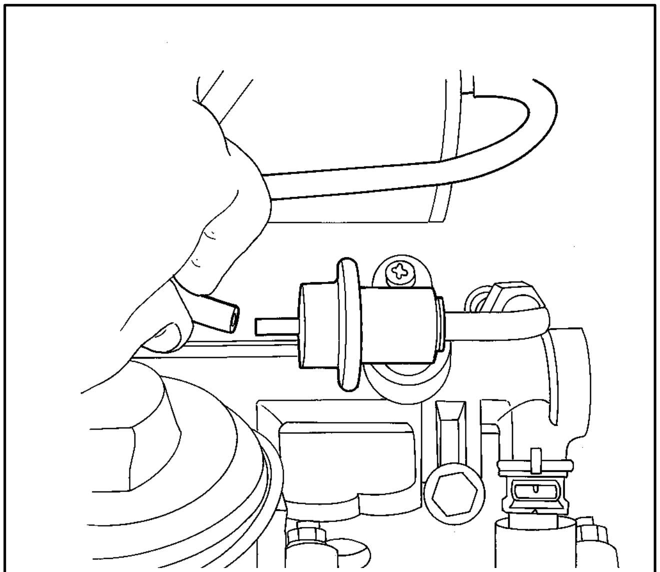
A102B001

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



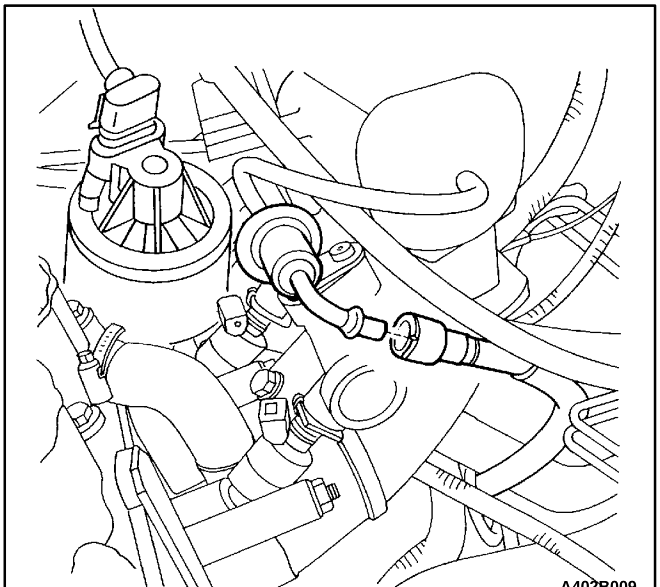
A102B016

8. Disconnect the idle air control valve (IAC) connector.
9. Disconnect the throttle position (TP) sensor connector.
10. Disconnect the engine coolant temperature (ECT) sensor connector.



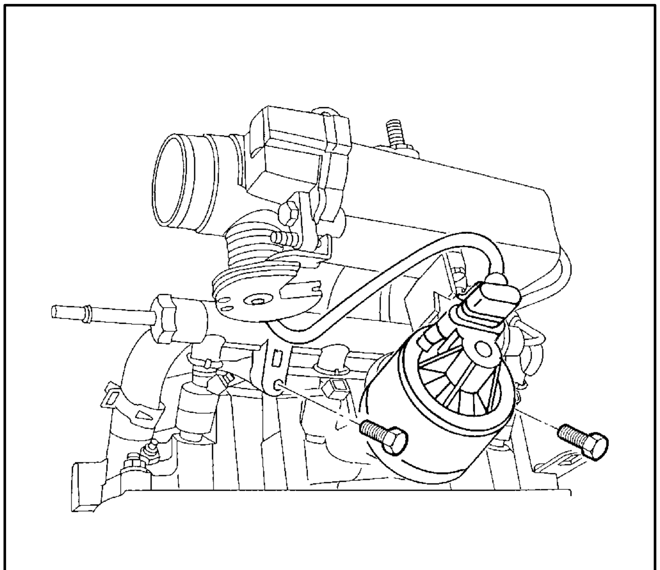
A102B031

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.



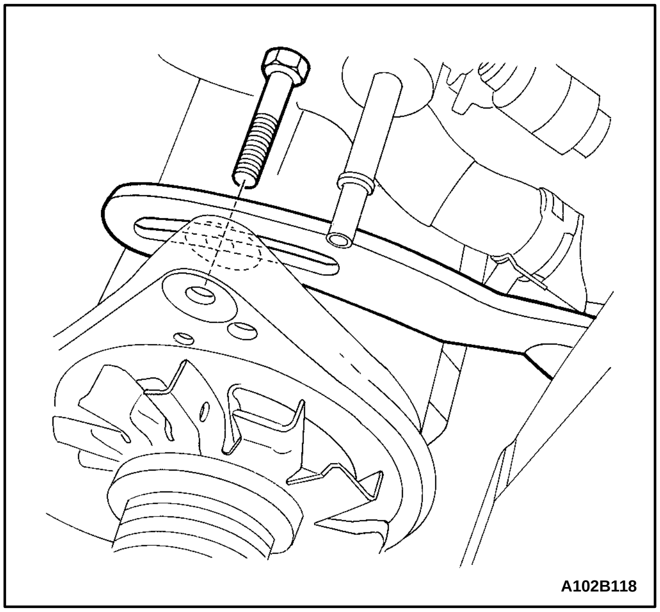
A402B009

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.

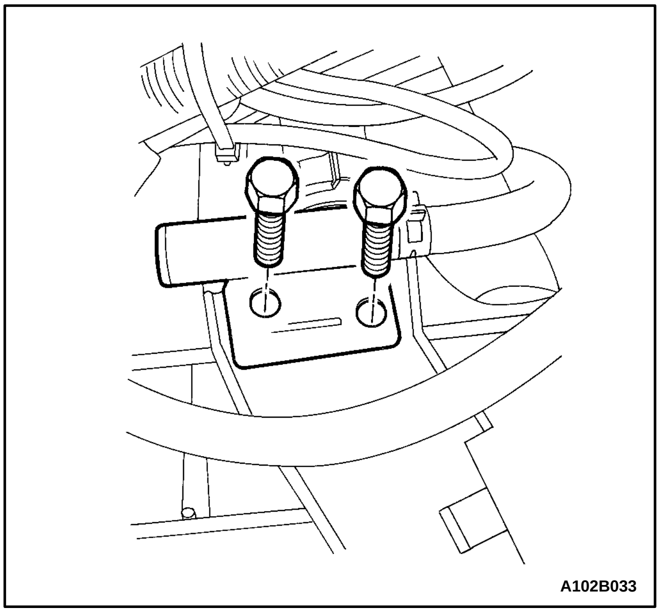


A402B010

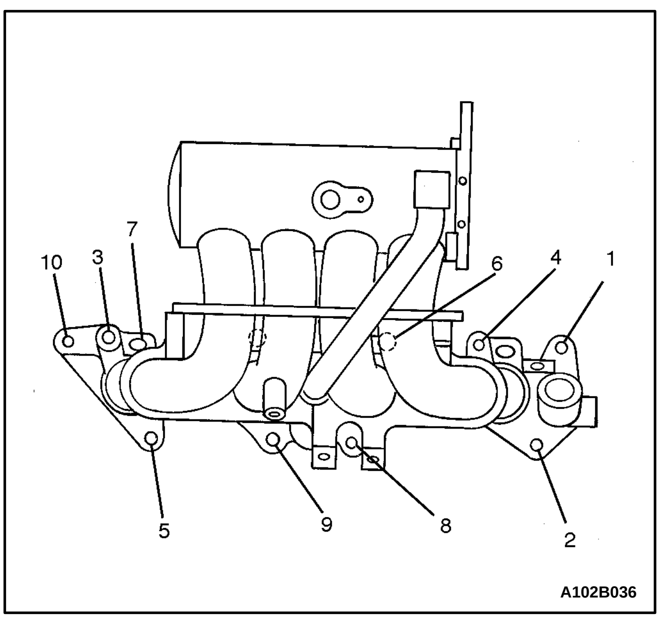
18. Disconnect the fuel injector connectors from the fuel injectors.
19. Remove the two retaining bolts from the fuel injector rail.
20. Remove the fuel injector rail and fuel injectors as an assembly. Refer to *Section 1F, Engine Controls.*



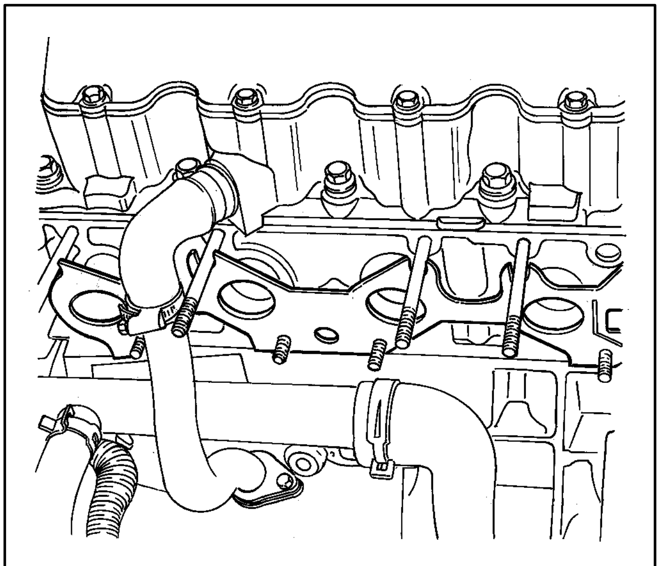
21. Remove the alternator drive belt.
22. Remove the alternator adjusting bracket and the bolts.



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.

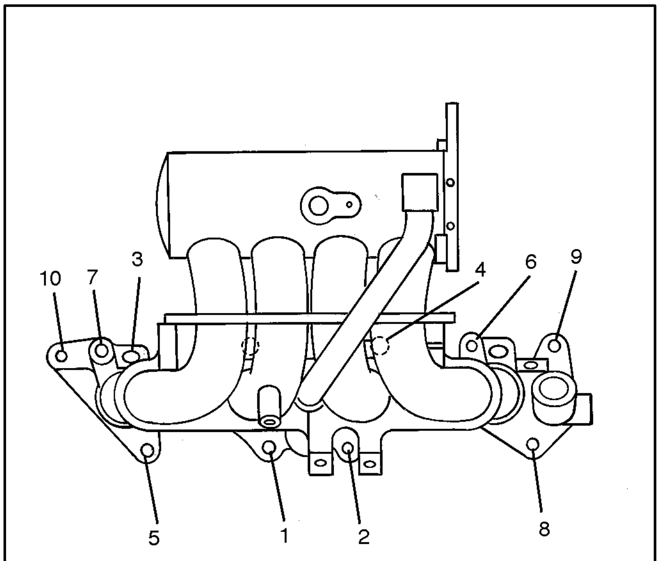


25. Remove the intake manifold retaining nuts and the engine lift bracket bolt in the sequence shown.



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

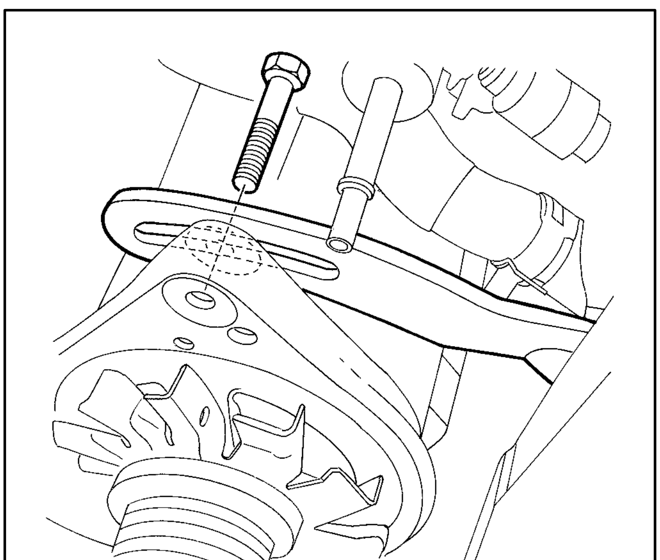
Installation Procedure

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 N m (18 lb-ft).

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



A102B118

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

Tighten

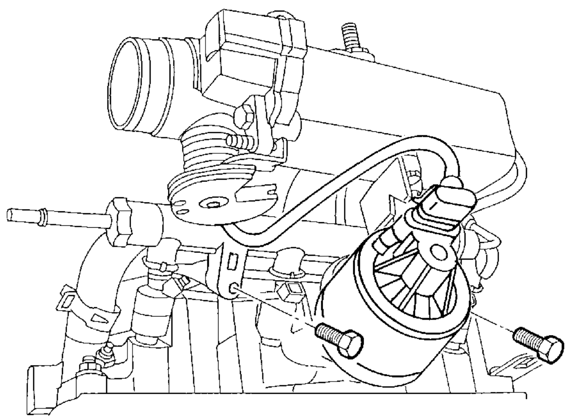
Tighten the intake manifold support bracket retaining bolts to 22 N m (16 lb-ft).

6. Install the alternator adjusting bracket and the bolts.

Tighten

Tighten the alternator adjusting bracket retaining bolts to 25 N m (18 lb-ft).

7. Install the alternator drive belt.

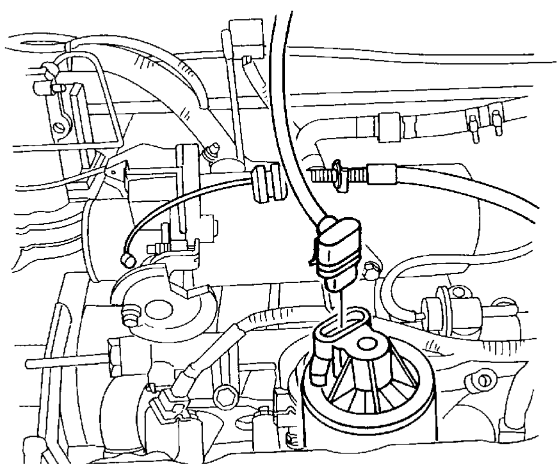


A402B010

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 N m (18 lb-ft).



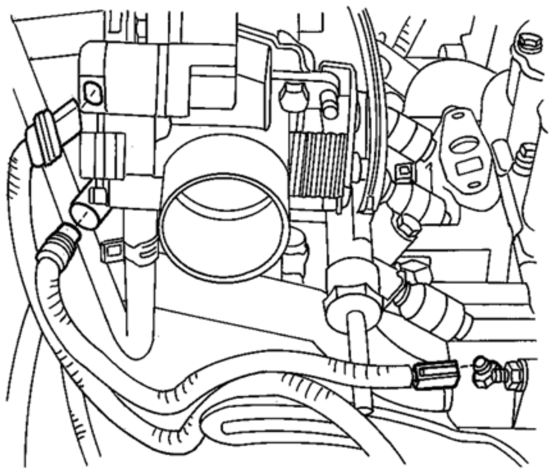
A402B005

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

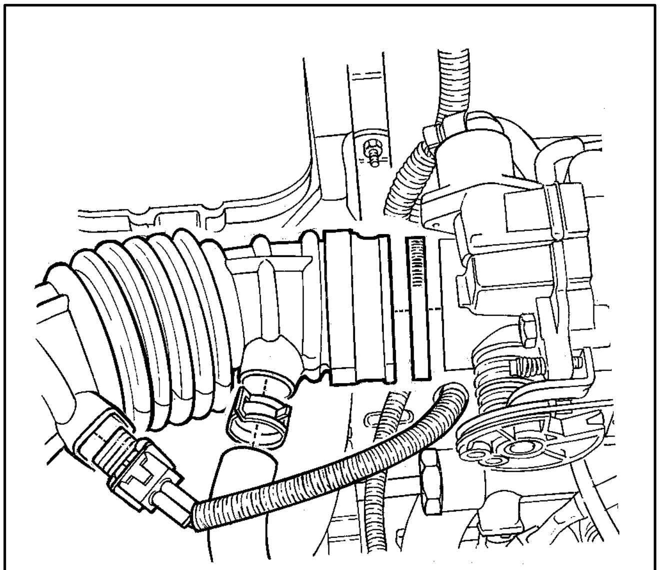
Tighten the throttle cable bracket bolts to 8 N m (71 lb-in).

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



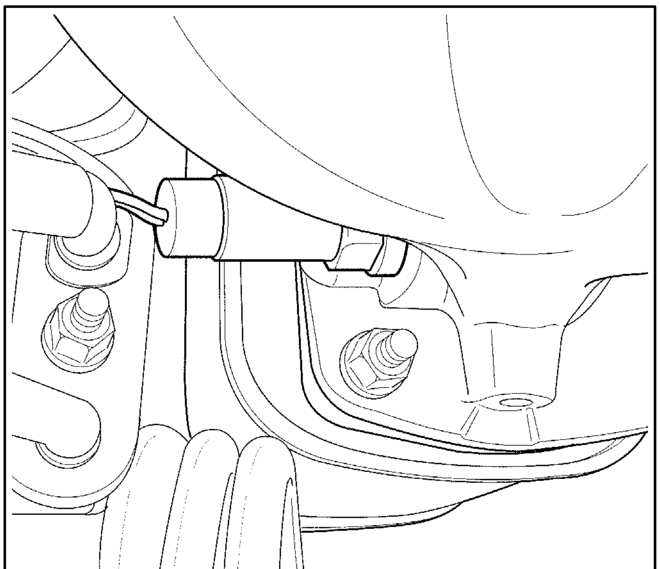
A102B016

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 ECT sensor connector.
19. Connect the IAC valve connector.
20. Connect the throttle position sensor connector.



A102B001

21. Connect the air intake tube to the throttle body.
22. Connect the IAT 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.*

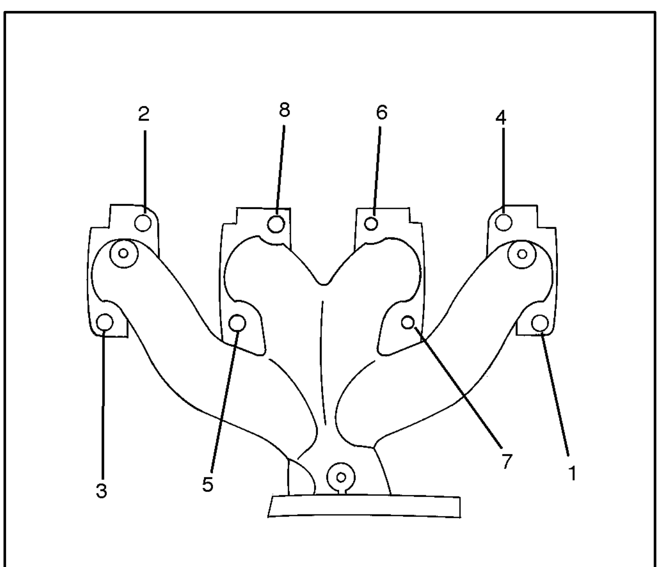


TAA1F480

EXHAUST MANIFOLD

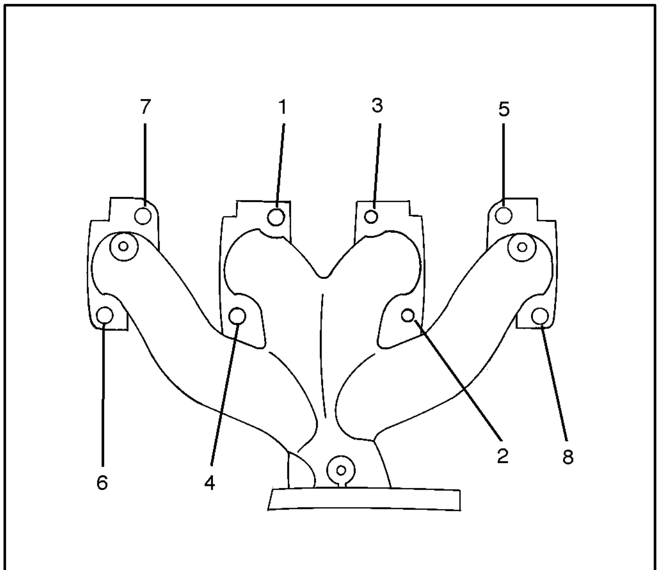
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition wires from the spark plugs.
3. Disconnect the oxygen (O_2) sensor.
4. Remove the exhaust manifold heat shield bolts.
5. Remove the exhaust manifold heat shield.
6. Remove the auxiliary catalytic converter upper flange nuts.



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.



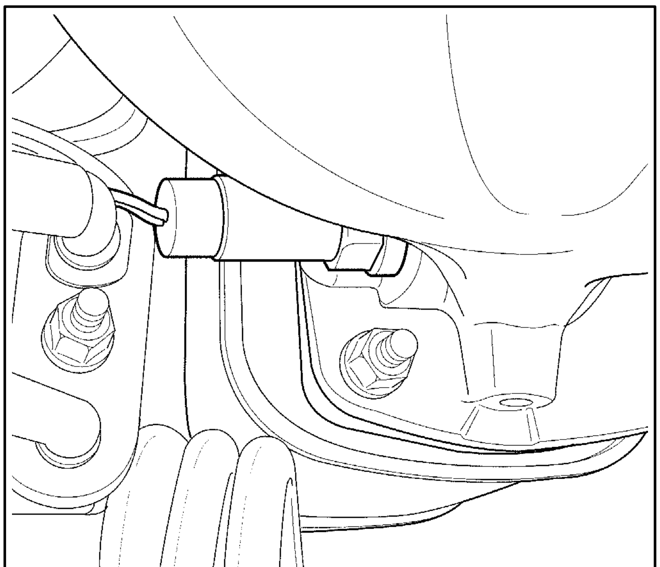
A102B038

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 N m (18 lb-ft).



TAA1F480

4. Install the auxiliary catalytic converter-to-exhaust manifold nuts.

Tighten

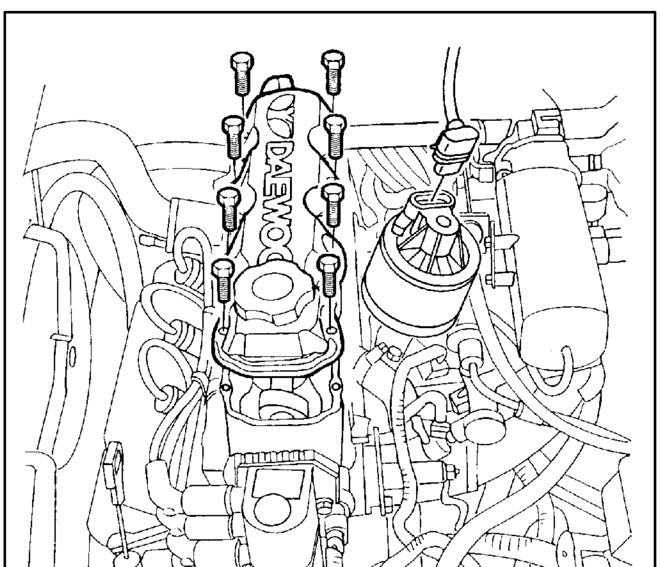
Tighten the auxiliary catalytic converter-to-exhaust manifold nuts to 50 N m (37 lb-ft).

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 N m (11 lb-ft).

7. Connect the O_2 sensor.
8. Connect the ignition wires to the spark plugs.
9. Connect the negative battery cable.

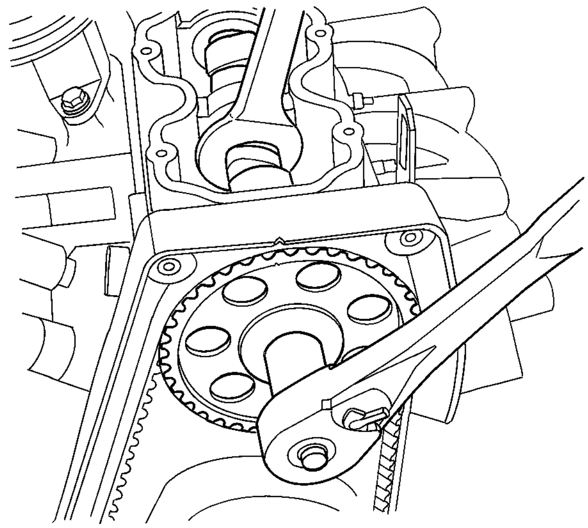


A402B003

CAMSHAFT GEAR

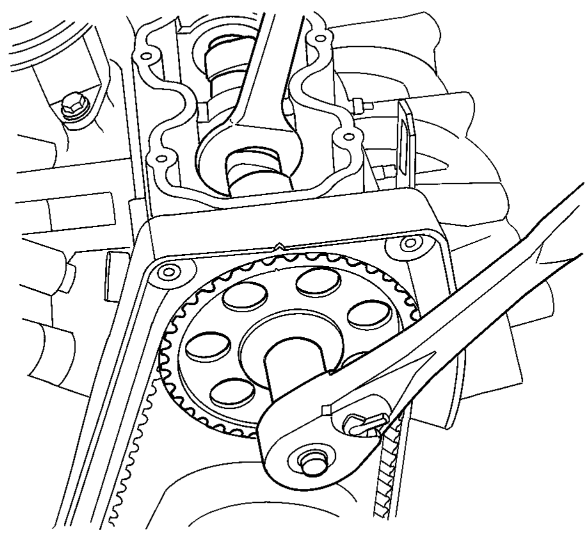
Removal Procedure

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

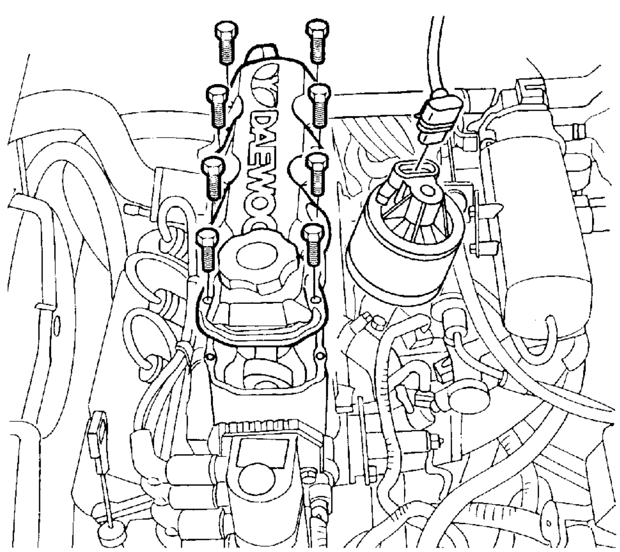
Installation Procedure

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 N m (33 lb-ft).



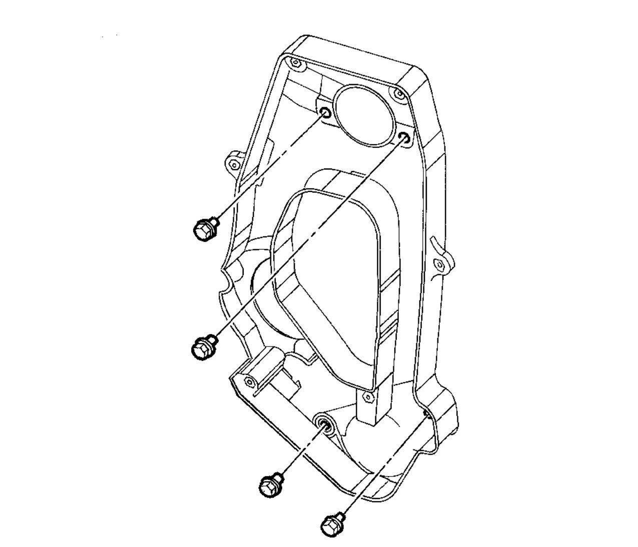
A402B003

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

Tighten

Tighten the valve cover bolts to 9 N m (80 lb-in).

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



A102B046

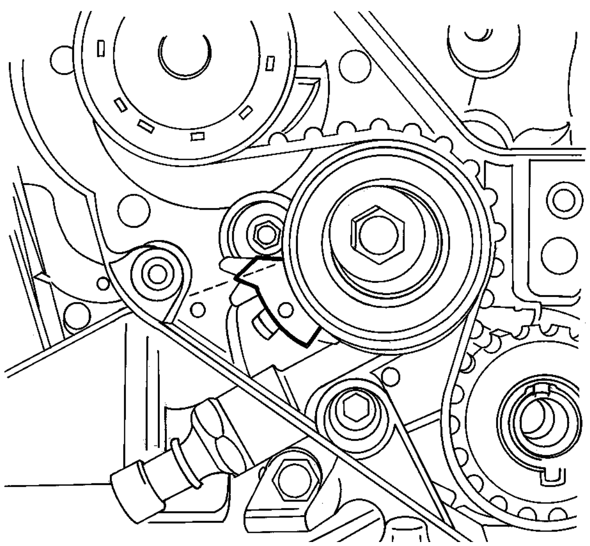
REAR TIMING BELT COVER

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.



A102B041

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 N m (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 N m (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

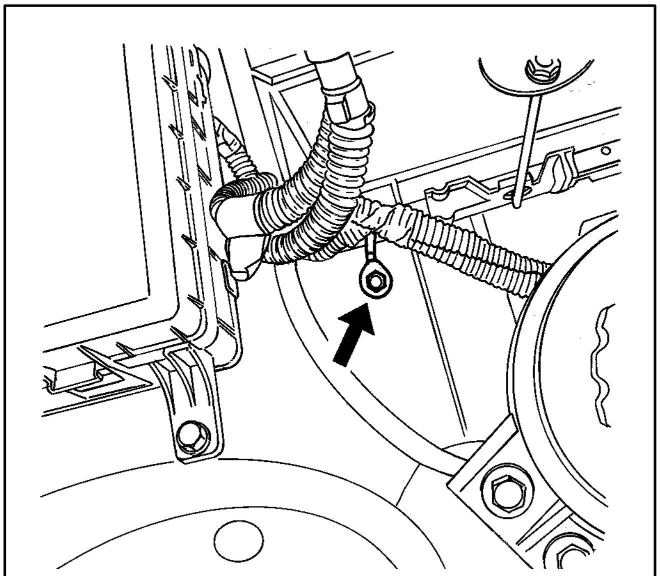
Tools Required

KM-470-B Angular Torque Gauge

Removal Procedure

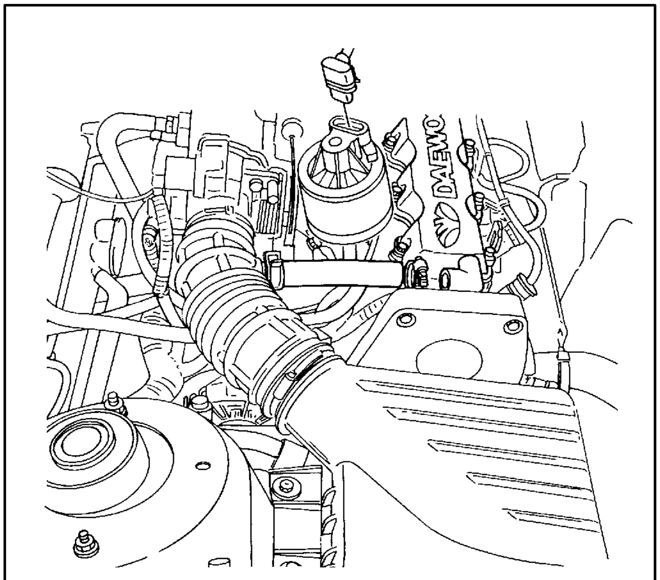
Important: On vehicles equipped with a manual transaxle, the manual transaxle must be removed before engine removal. Refer to *Section 5B, Five-Speed Manual Transaxle.*

1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine 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.



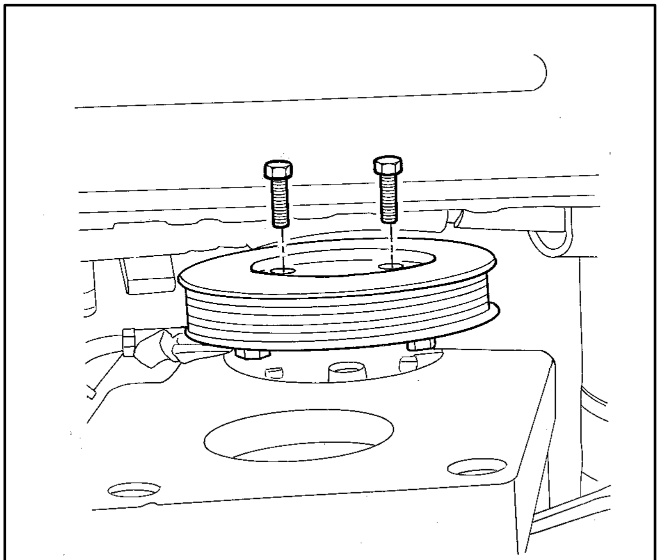
A102B013

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

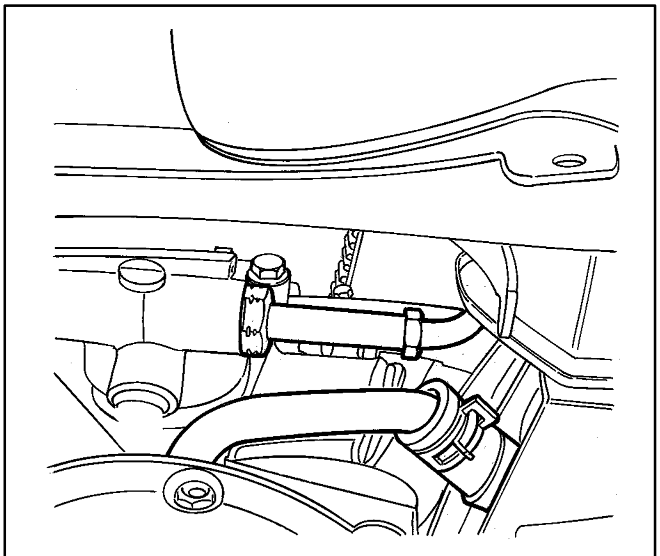


A402B002

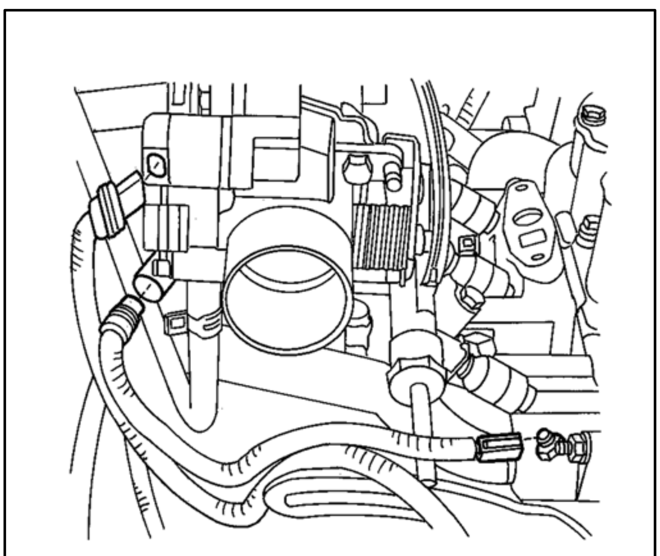
8. Discharge the air conditioning (A/C) system, if equipped. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System*.
9. Disconnect the intake air temperature (IAT) sensor connector.
10. Remove the air intake tube from the throttle body and the air filter housing.
11.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



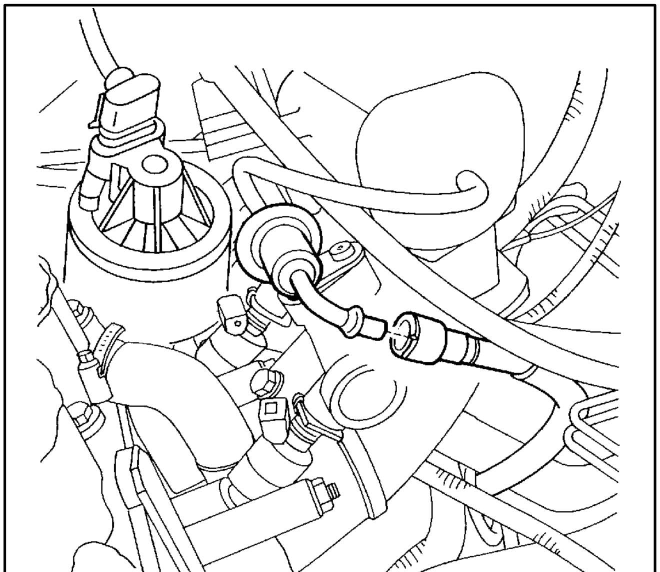
12. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels.*
13. Remove the right front wheel well splash shield.
14. Remove the A/C compressor drive belt, if equipped.
15. Remove the alternator drive belt.
16. Remove the power steering pump pulley bolts.
17. Remove the power steering pump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



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.

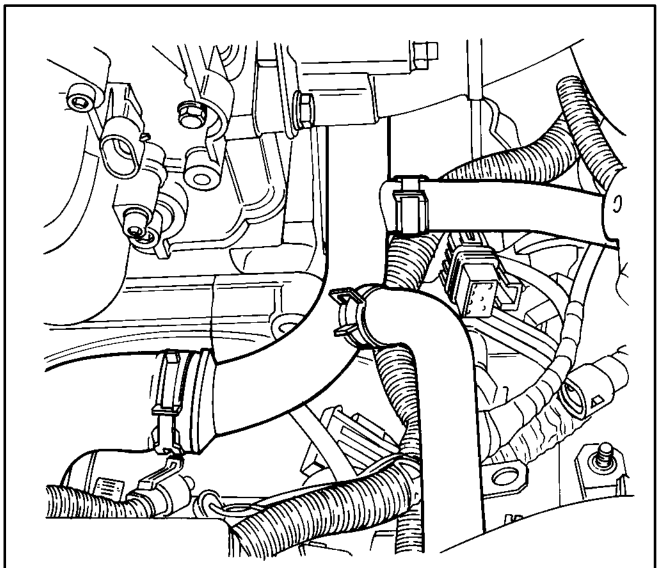


25. Disconnect the electrical connector at the electronic ignition (EI) system ignition coil, and the engine ECM ground terminal at the intake manifold and at the starter motor.
26. Disconnect the pre-converter oxygen (O_2) sensor connector.
27. Disconnect the electrical connectors at the fuel injectors.
28. Disconnect the idle air control (IAC) valve connector.
29. Disconnect the throttle position (TP) sensor connector.
30. Disconnect the engine coolant temperature (ECT) sensor connector.
31. Disconnect the coolant temperature sensor (CTS) connector and the knock sensor, if equipped.



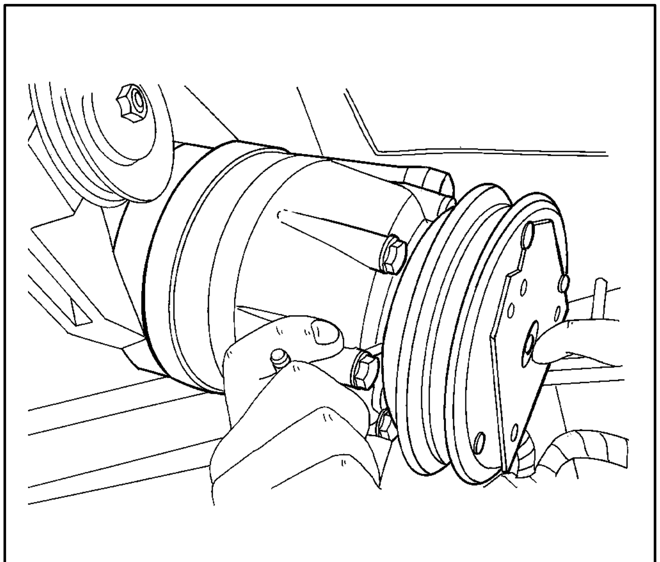
A402B009

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.
37. Disconnect the camshaft position (CMP) sensor connector.



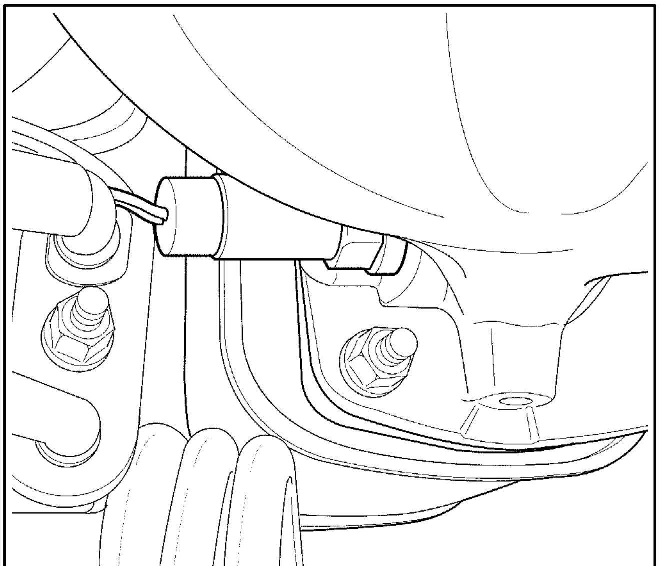
A102B017

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



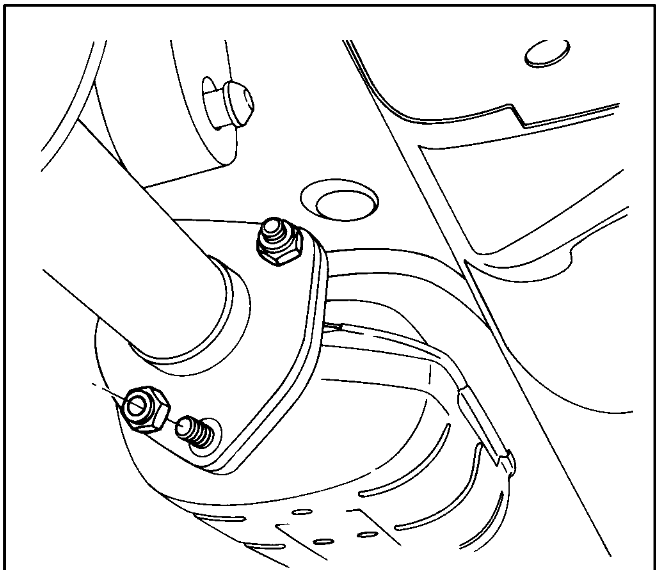
A102B025

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



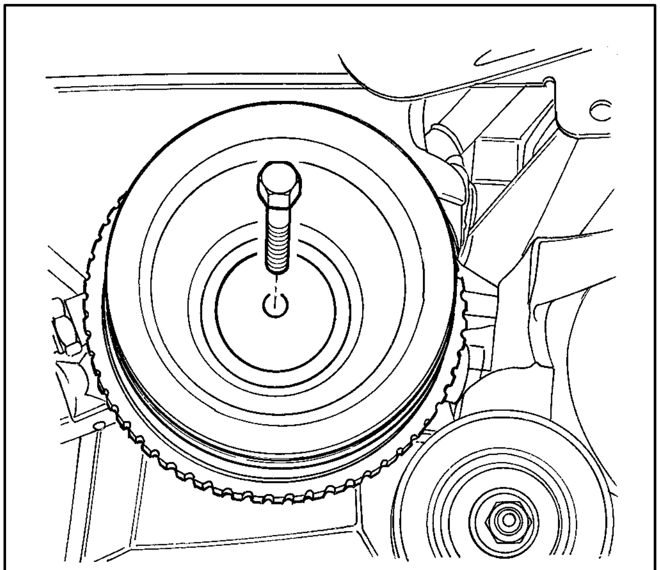
TAA1F480

51. Remove the auxiliary catalytic converter nuts from the exhaust manifold and the bolts at the bracket.



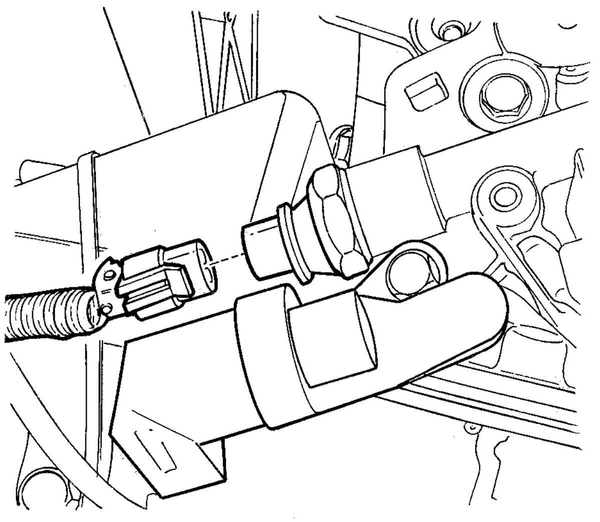
B102G003

52. Remove the nuts from the front muffler pipe to the main catalytic converter.
53. Remove both catalytic converters as a unit.



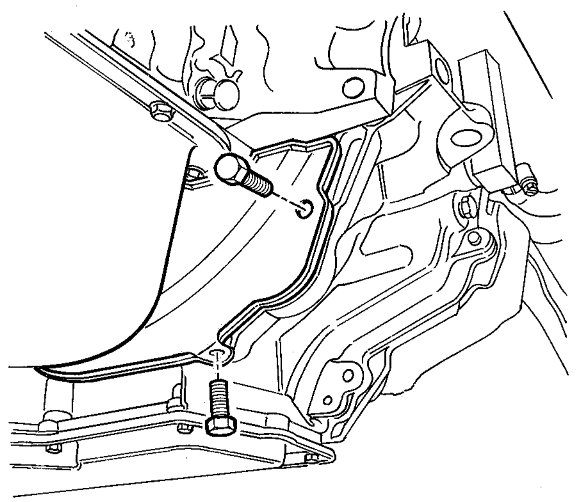
A102B018

54. Remove the engine crankshaft pulley bolt.
55. Remove the engine crankshaft pulley.



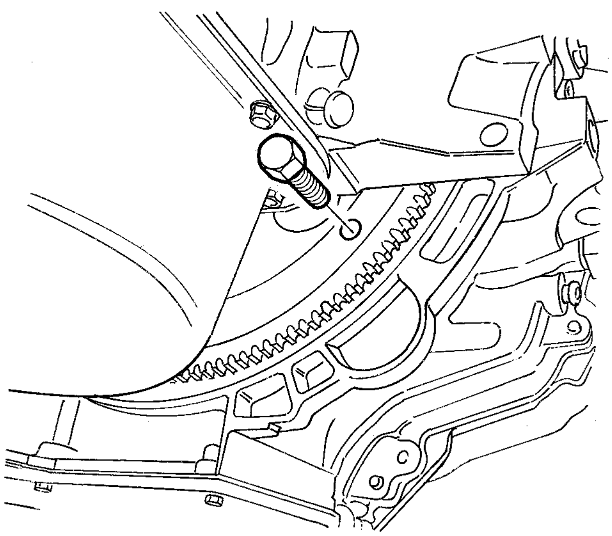
A102B019

56. Disconnect the vacuum lines at the evaporative (EVAP) emission canister purge.
57. Disconnect the electrical connector at the EVAP emission canister purge solenoid and the knock sensor.
58. Disconnect the electrical connector at the oil pressure switch.
59. Disconnect the crankshaft position (CKP) sensor connector and the CMP sensor connector.
60. Remove the CKP sensor retaining bolt.
61. Remove the CKP sensor.
62. Remove the right transaxle brace bolts from the transaxle.



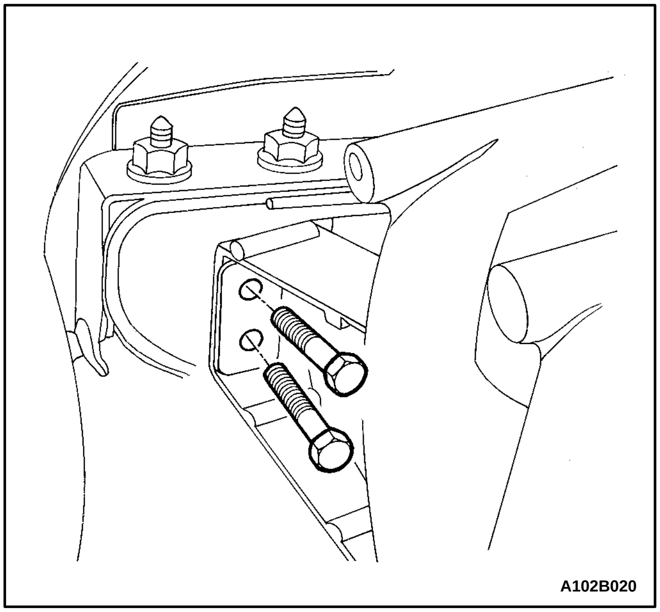
A102B021

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

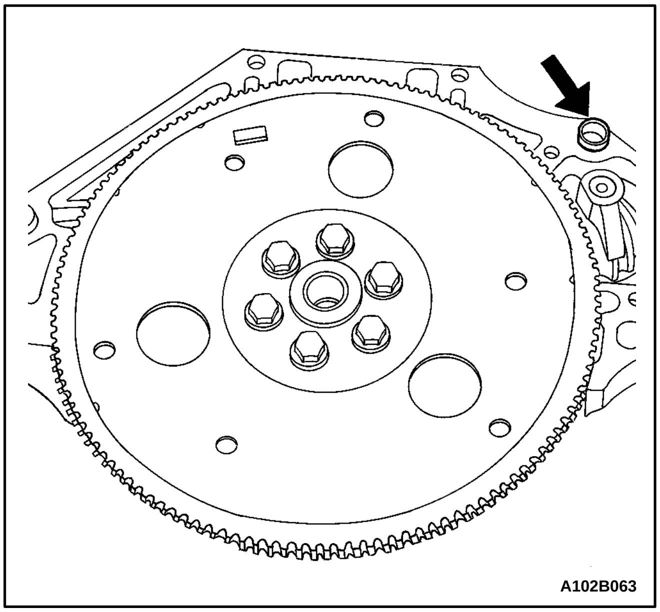


A102B022

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



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

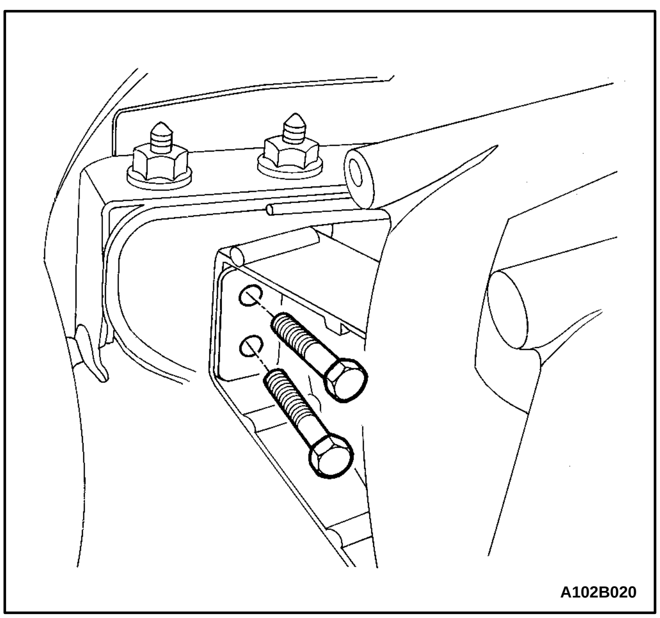


Installation Procedure

1. Install the engine into the 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 N m (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

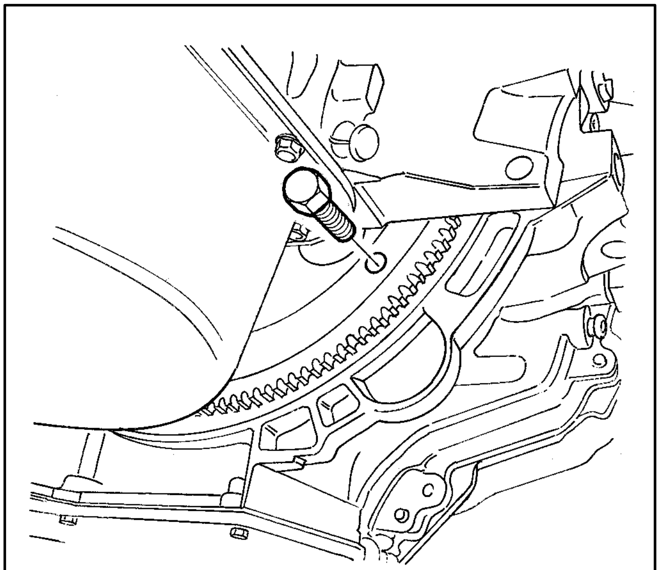
Tighten the engine mount bracket retaining bolts to 60 N m (44 lb-ft).

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

Tighten

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

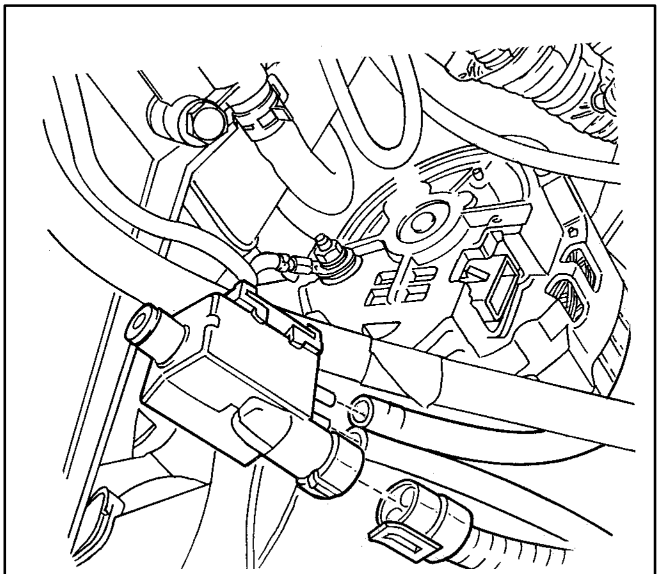
7. Remove the floor jack used for support of the transaxle.
8. Remove the engine lifting device.


A102B022

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

Tighten

Tighten the transaxle torque converter bolts to 65 N m (48 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

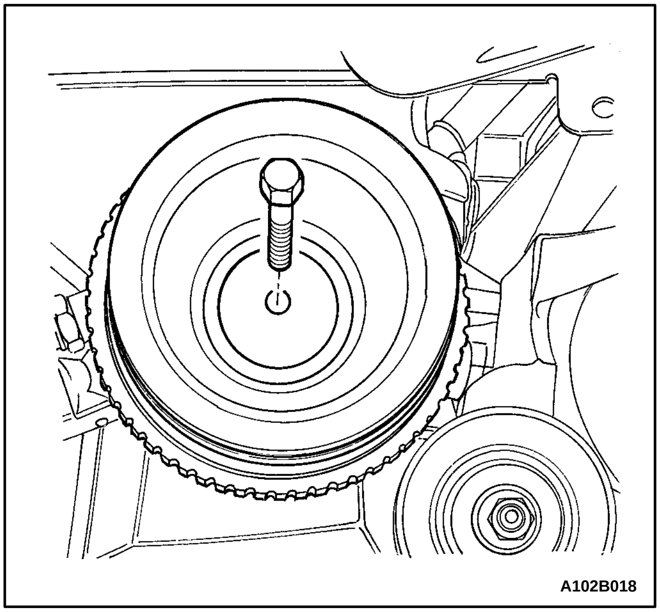
Tighten the flywheel inspection cover bolts to 12 N m (106 lb-in) or the flexible plate inspection cover bolts to 10 N m (89 lb-in).

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

Tighten

Tighten the right transaxle brace bolts to 60 N m (44 lb-ft).

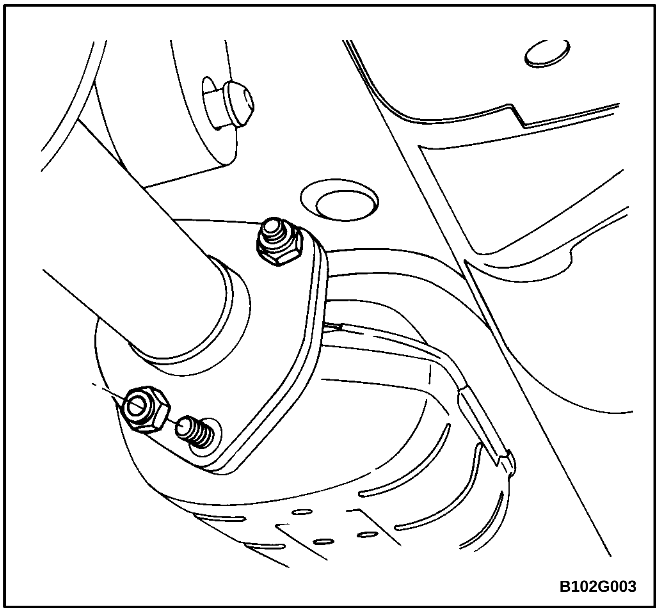
13. Connect the vacuum lines at the EVAP emission canister purge solenoid.
14. Connect the electrical connectors at the EVAP emission canister purge solenoid.



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 N m (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.



18. Install the CKP sensor and the CKP sensor retaining bolt.

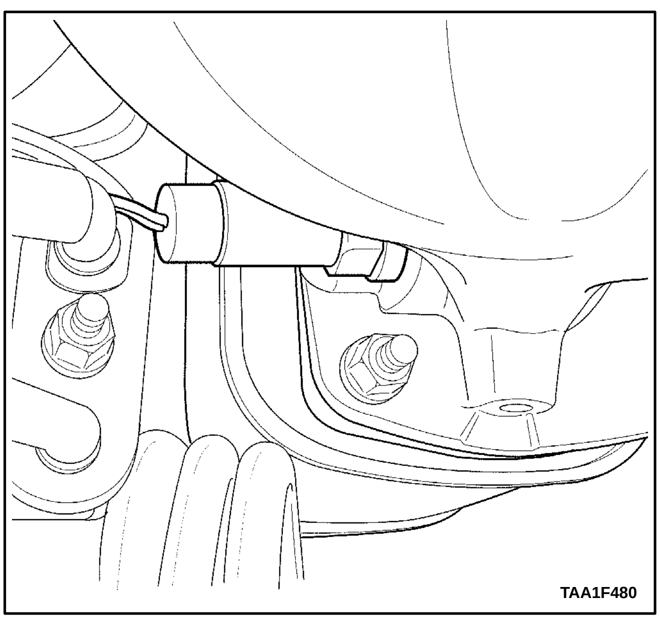
Tighten

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

19. Connect the CKP sensor connector.
20. Install the catalytic converters.

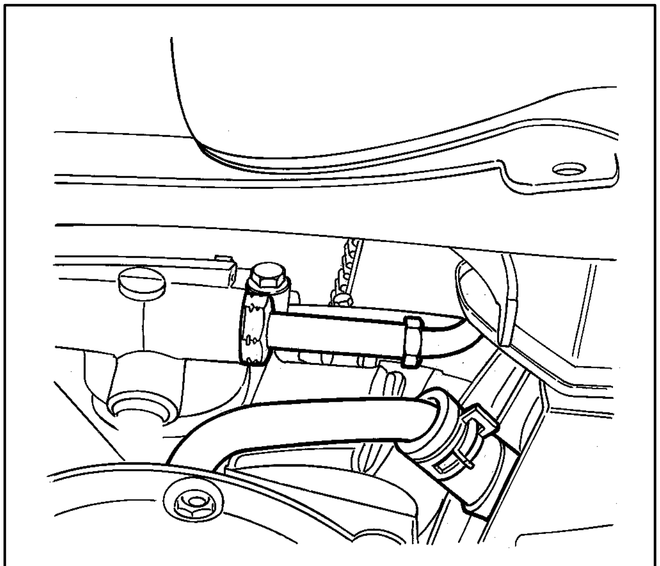
Tighten

Tighten the front muffler-to-main catalytic converter nuts to 30 N m (22 lb-ft).



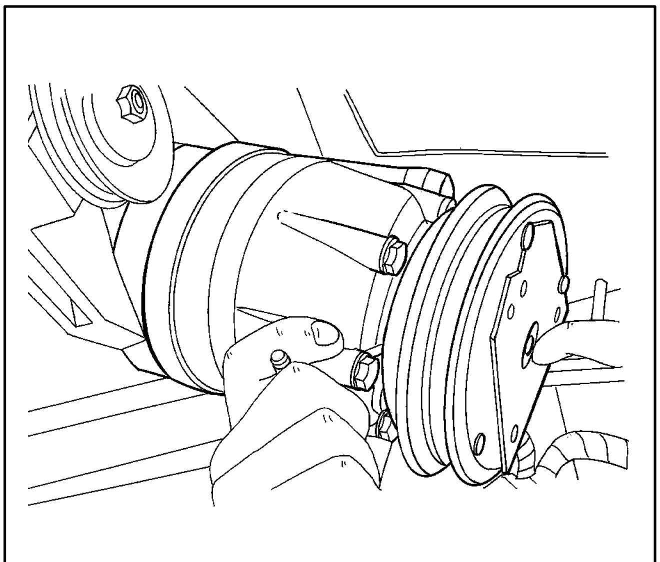
Tighten

Tighten the auxiliary catalytic converter-to-exhaust manifold nuts and the bracket bolts to 40 N m (30 lb-ft).



A102B015

21. Connect the power steering pressure hose, if equipped.
22. Connect the power steering return hose, if equipped.



A102B025

23. Install the A/C compressor mounting bracket, if equipped.
24. Install the A/C compressor mounting bracket bolts, if equipped.

Tighten

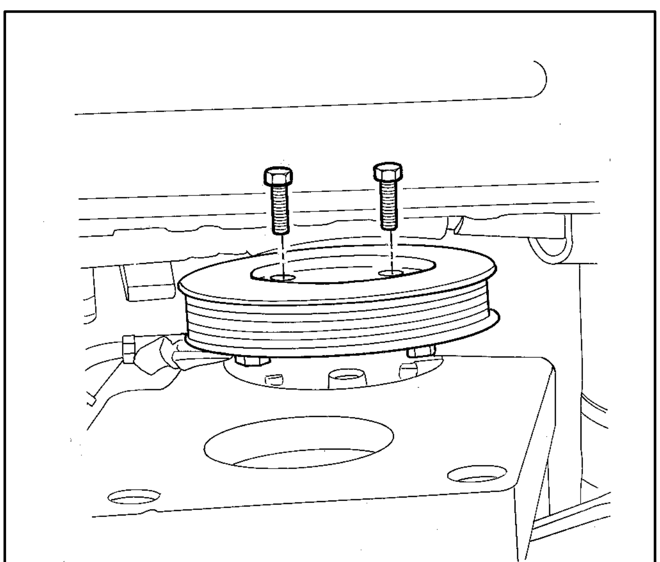
Tighten the A/C compressor mounting bracket bolts to 50 N m (37 lb-ft).

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

Tighten

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

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



A102B014

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

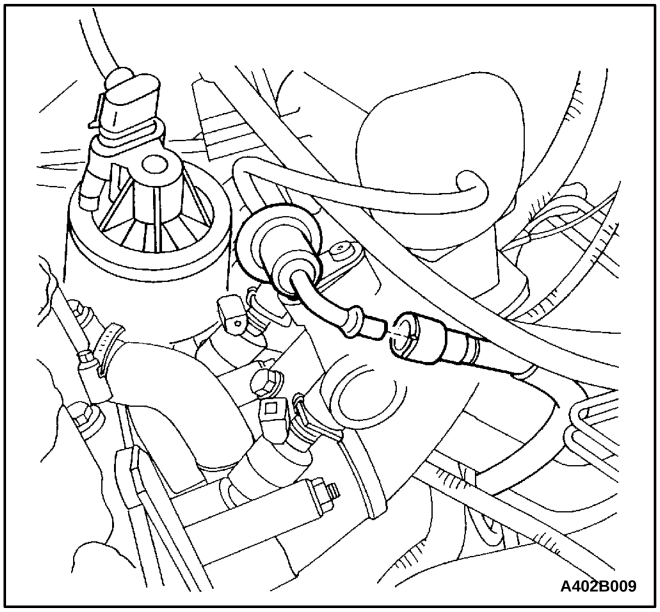
Tighten

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

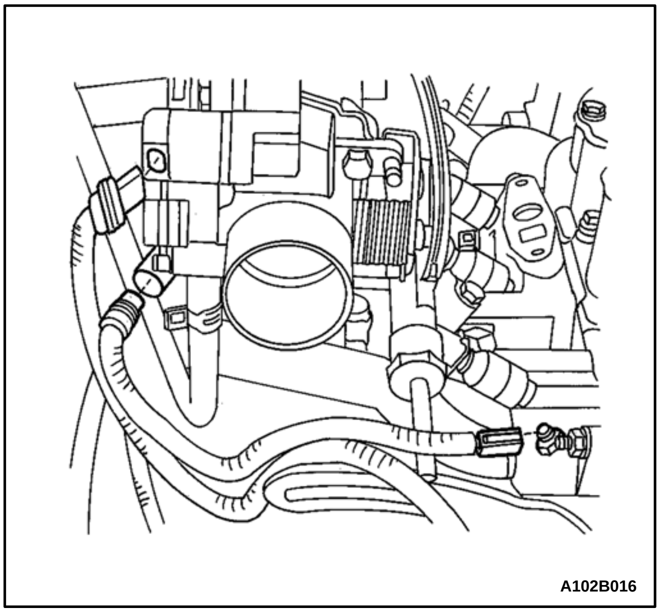
31. Install the power steering pump pulley, if equipped.
32. Install the power steering pump pulley bolts, if equipped.

Tighten

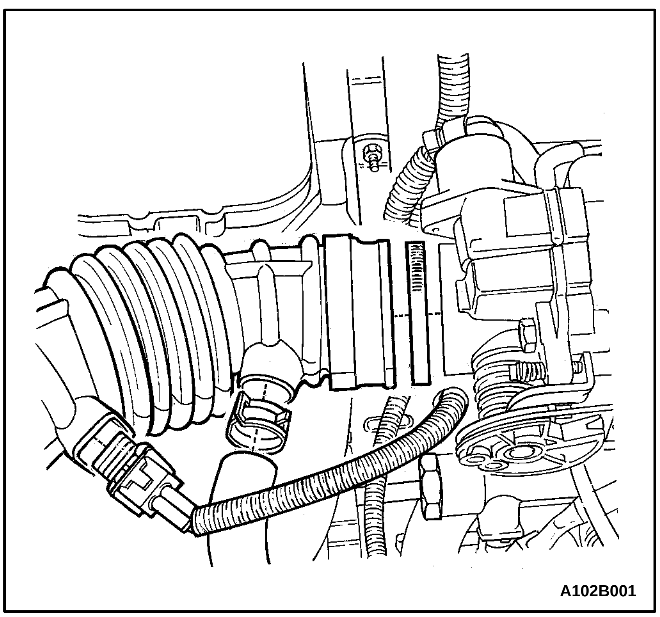
Tighten the power steering pump pulley bolts to 25 N m (18 lb-ft).



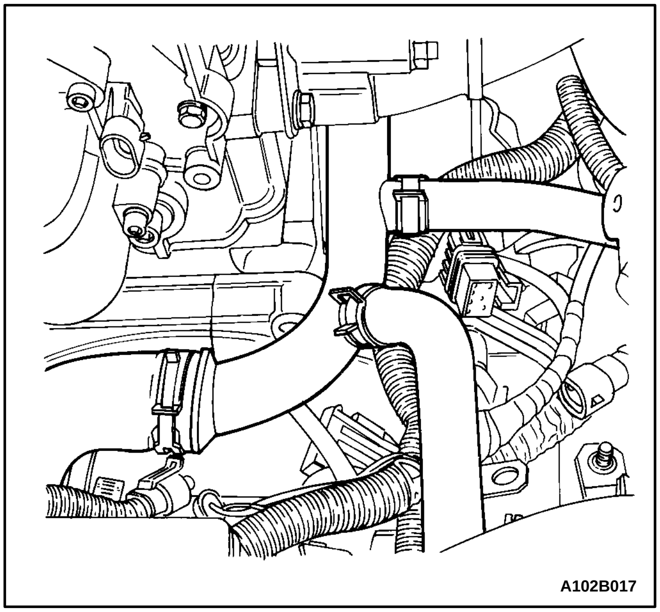
33. Install the right front wheel well splash shield.
34. Install the right front wheel. Refer to *Section 2E, Tires and Wheels*
35. Connect the fuel feed line to the fuel rail.
36. Connect the fuel return line to the fuel pressure regulator.
37. Connect all of the necessary vacuum lines, including the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



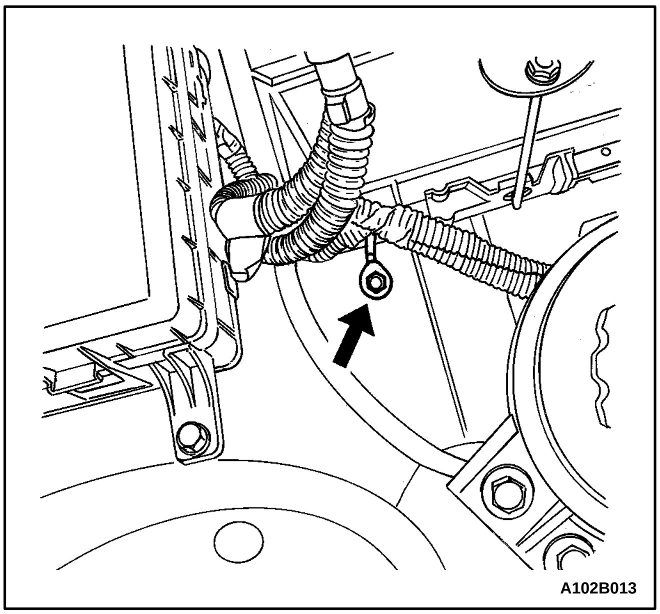
38. Connect the pre-converter O_2 sensor connector.
39. Connect the starter solenoid "S" terminal wire.
40. Connect the alternator voltage regulator connector.
41. Connect the CTS connector.
42. Connect the ECT sensor connector and the knock sensor connector, if equipped.
43. Connect the TP sensor connector.
44. Connect the IAC valve connector.
45. Connect the CMP sensor connector.



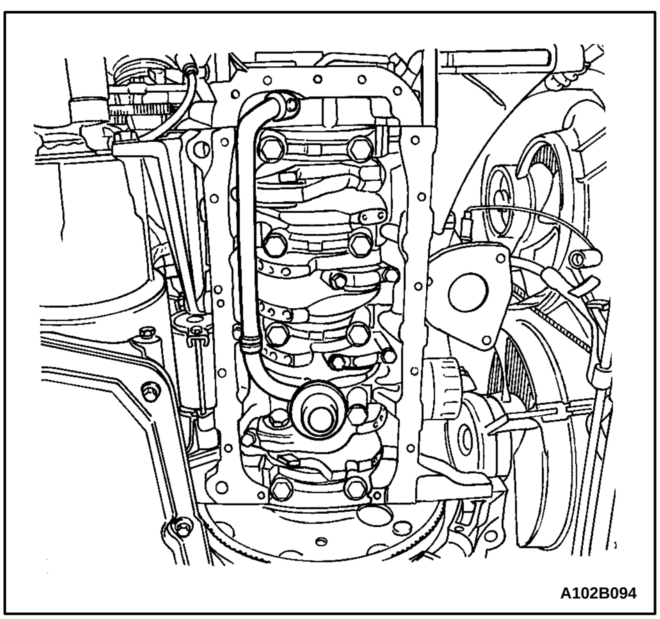
46. Connect the electrical connectors at the fuel injectors.
47. Connect the electrical connector at the EI system ignition coil and the ECM ground terminal at the intake manifold.
48. Install the air intake tube between the throttle body and the air filter housing.
49. Connect the breather tube to the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



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



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 to the battery.
63. Connect and assemble the battery positive 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 as necessary. Refer to *Section 6A, Power Steering System.*
67. Refill the A/C refrigerant system as necessary. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.*
68. Install the hood. Refer to *Section 9R, Body Front End.*



PISTONS AND RODS

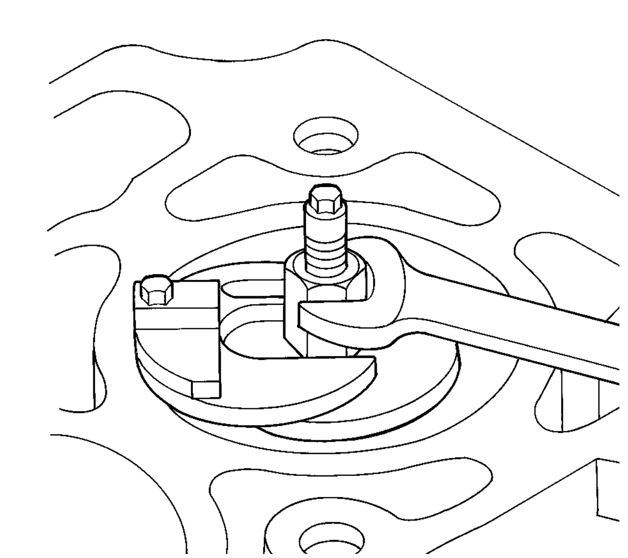
Tools Required

KM-427 Piston Pin Service Set

KM 470-B Angular Torque Gauge

Removal Procedure

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.



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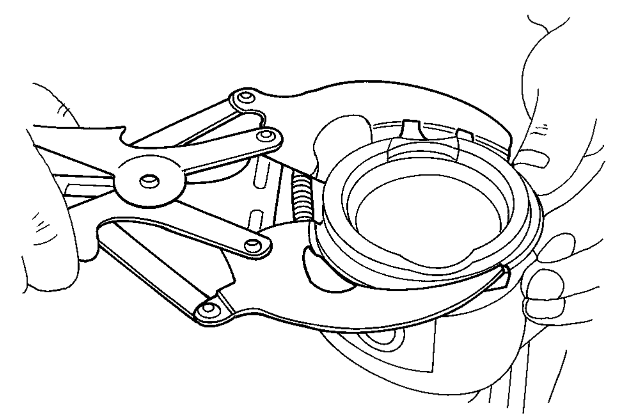
5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.



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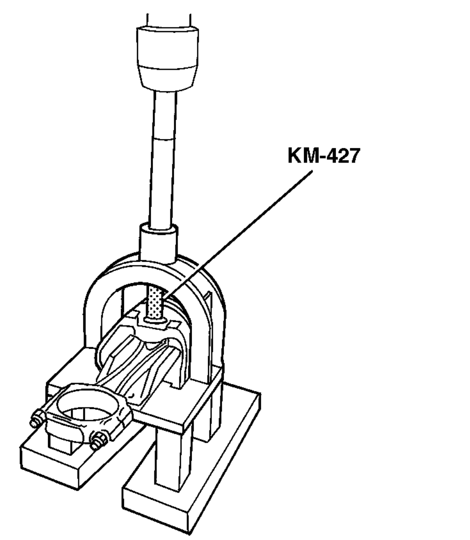
Caution: Use care when handling the piston. Worn piston rings are sharp and may cause injury.

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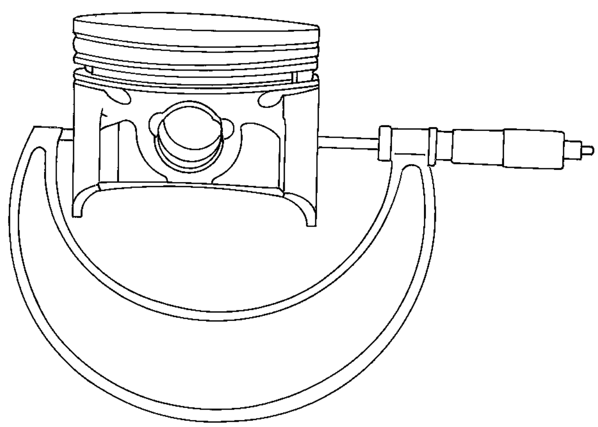
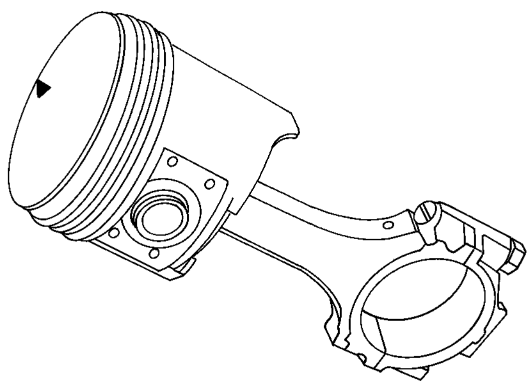
14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.



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 piston for scoring, cracks and wear.
6. Inspect the piston for taper using a micrometer.



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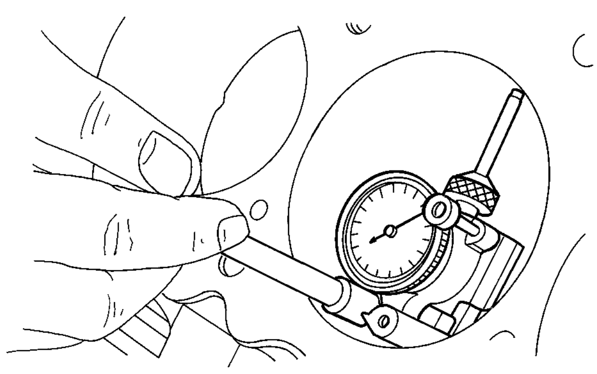
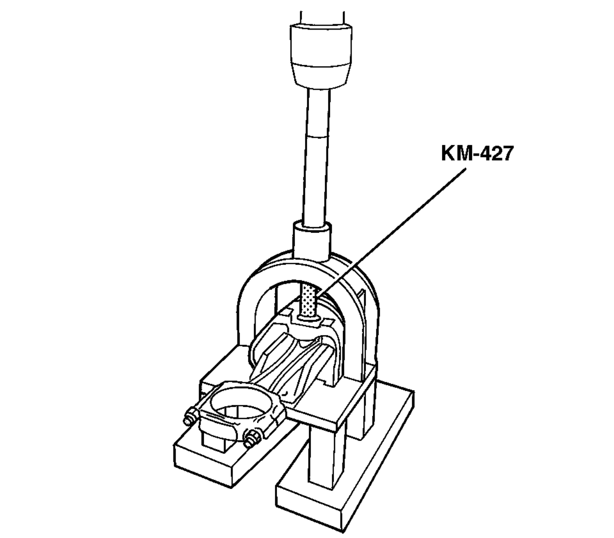
7. Inspect the piston for fit to the connecting rod.



A102B083

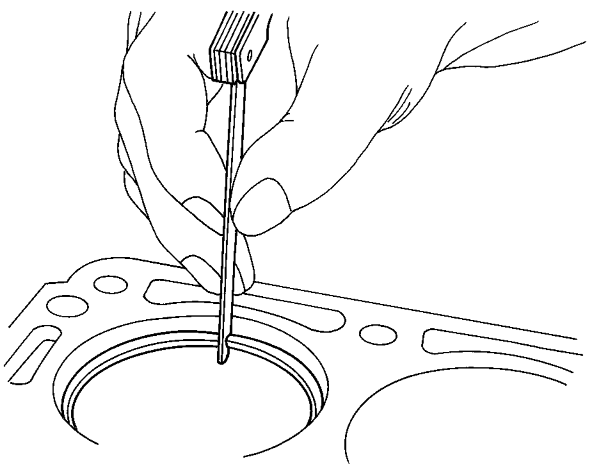
8. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to “Engine Specifications” in this section.
9. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to “Engine Specifications” in this section. If beyond specifications, replace the engine block.
10. Inspect the engine block cylinder bore for wear, runout, 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

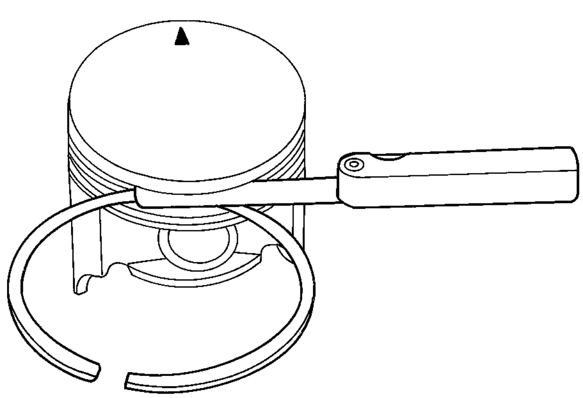
Installation Procedure

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.



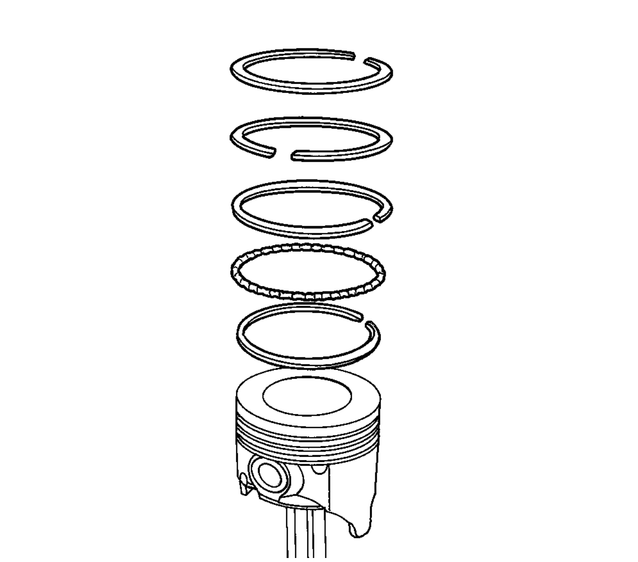
A102B084

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.



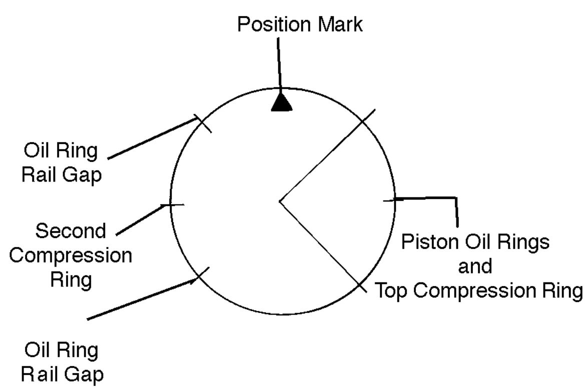
A102B085

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, and 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.



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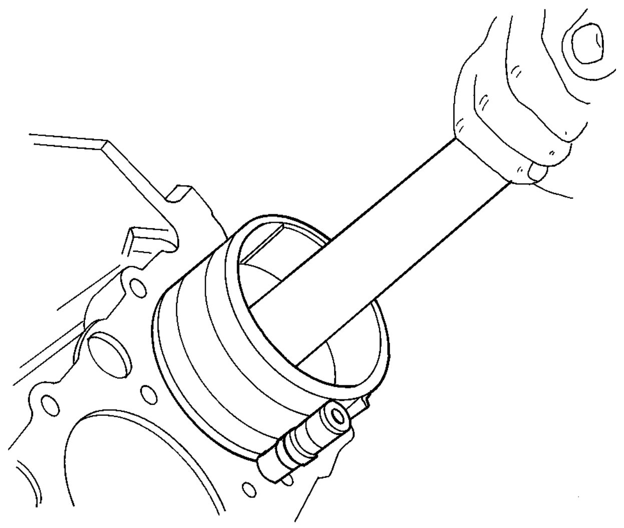
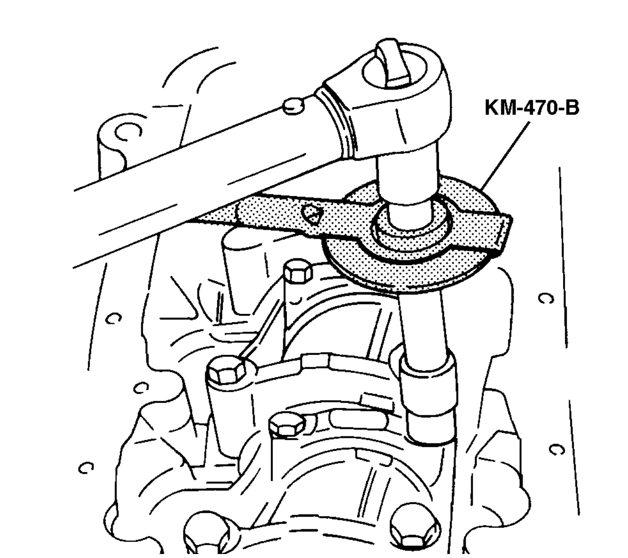
15. Use a piston ring expander to install the piston rings. Do not expand the piston rings beyond the expansion necessary for installation.
16. Stagger the piston oil rings, the oil ring rail gaps, the second compression ring, and the top compression ring in relation to the notch on the top of the piston.



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 the bearings. Refer to “Crankshaft Bearings and Connecting Rod Bearings – Gauging Plastic” in this section.

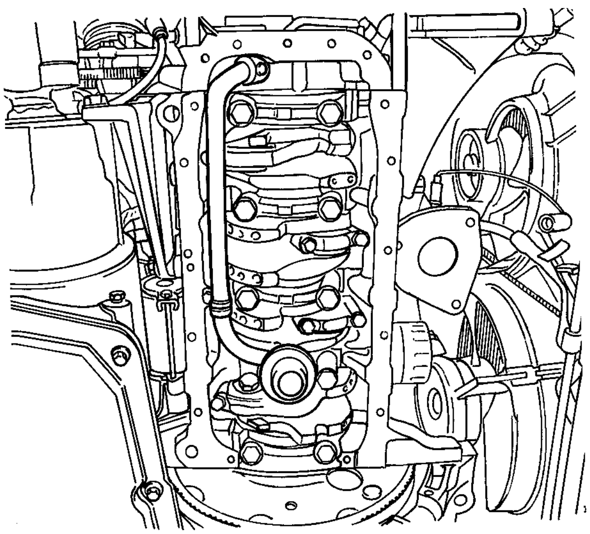


A102C151

20. Install the connecting rod bearing cap bolts.

Tighten

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



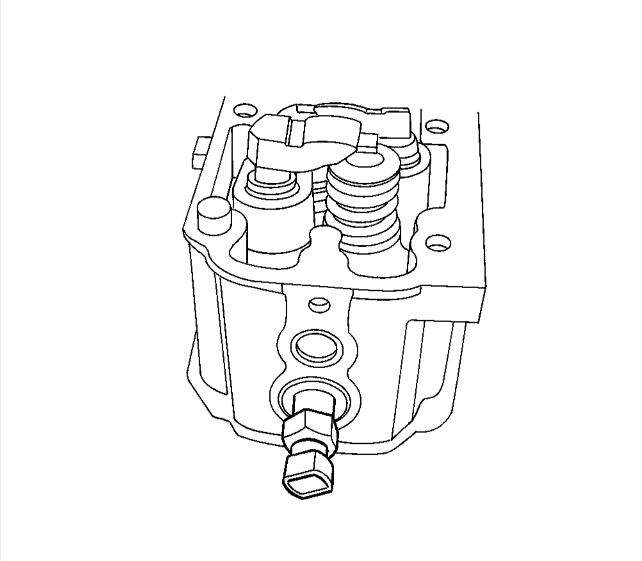
A102B094

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

Tighten

Tighten the oil pump/pickup tube and support bracket bolts to 10 N m (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

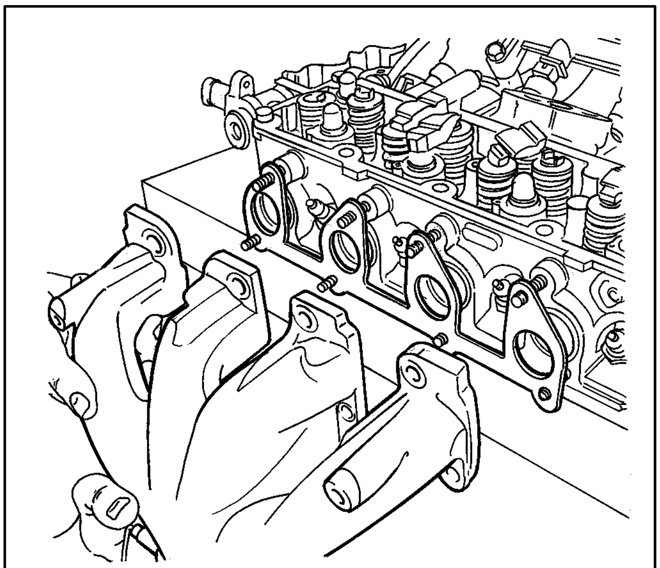
CYLINDER HEAD AND VALVE TRAIN COMPONENTS

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.



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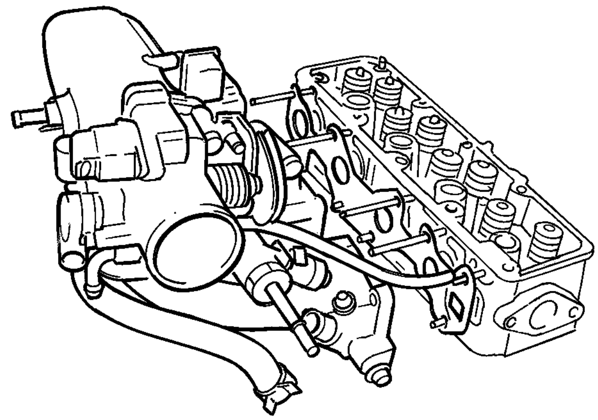
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold nuts.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.
9. Remove the spark plugs.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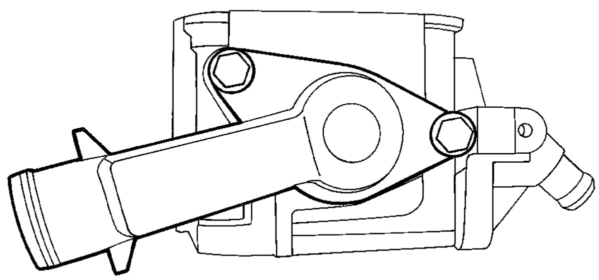
10. Remove the intake manifold retaining nuts.
11. Remove the intake manifold.
12. Remove the intake manifold gasket.
13. Remove the intake manifold studs.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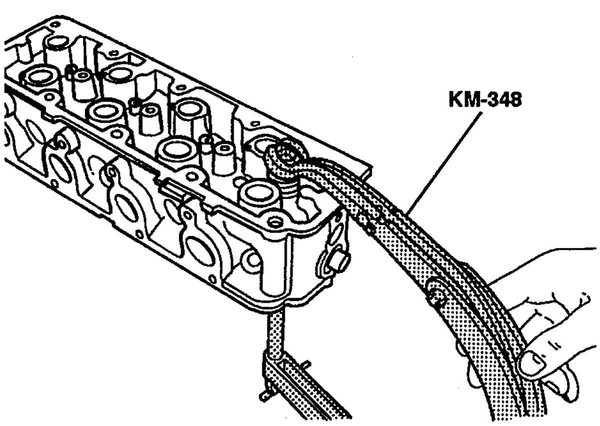
14. Remove the thermostat housing mounting bolts.
15. Remove the thermostat housing.
16. Remove the thermostat and thermostat gasket.



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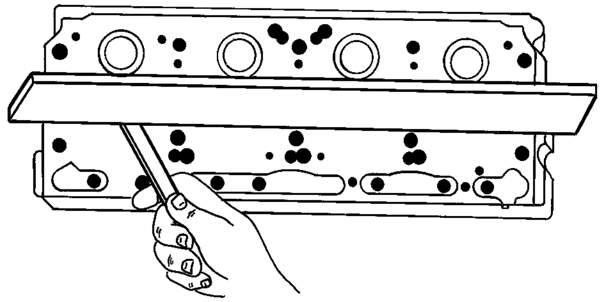
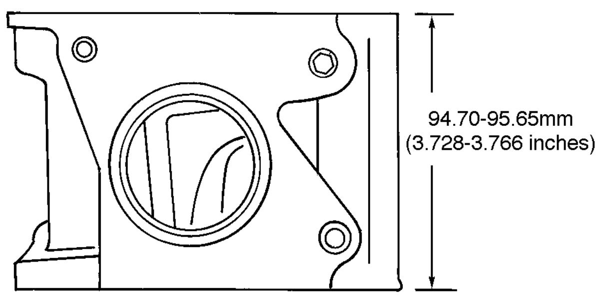
17. Using the valve spring compressor KM-348, compress the valve springs.
18. Remove the valve keepers.
19. Remove the valve spring cap.
20. Remove the valve springs.
21. Remove the valves.
22. Remove the valve stem oil seals.
23. Remove camshaft carrier alignment pins.



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.



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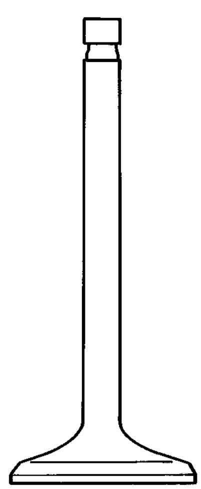
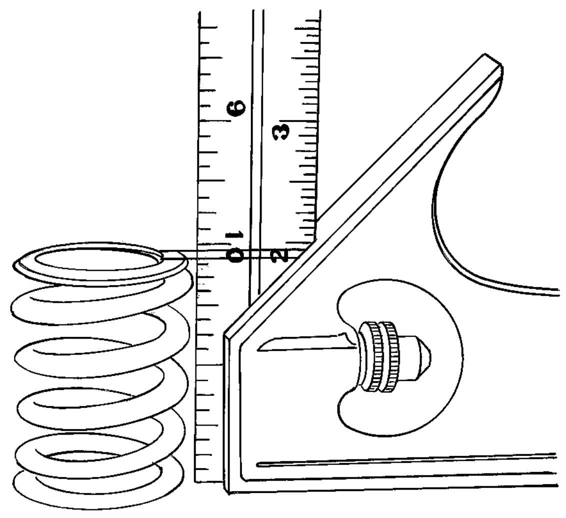
6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 94.70 to 95.65 mm (3.728 to 3.766 inches). If the cylinder head height is less than 94.70 mm (3.728 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect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



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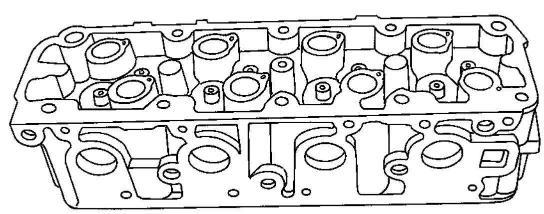
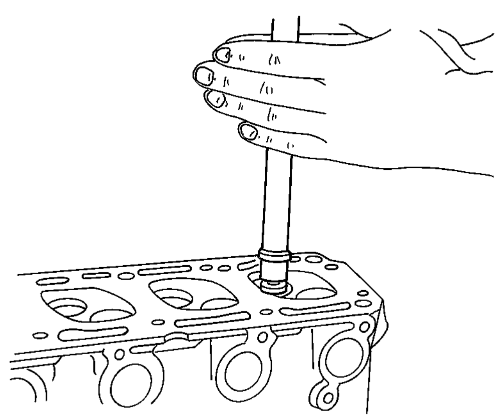
7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to “Engine Specifications” in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating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



A102B055

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.

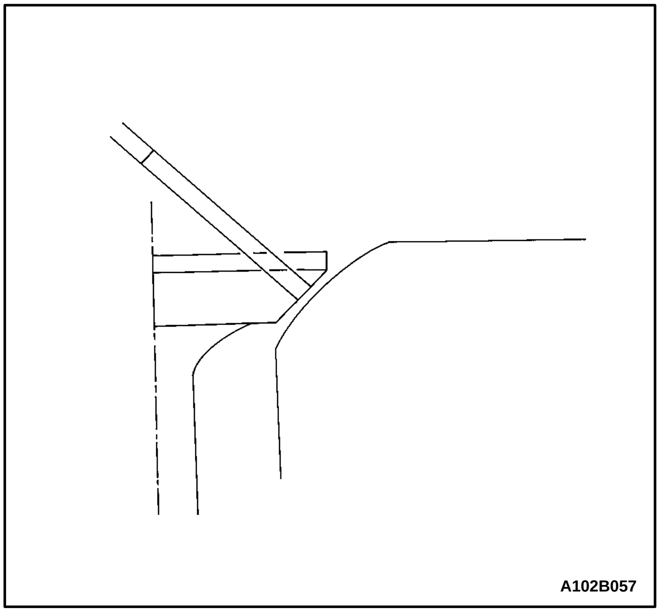


A102B056

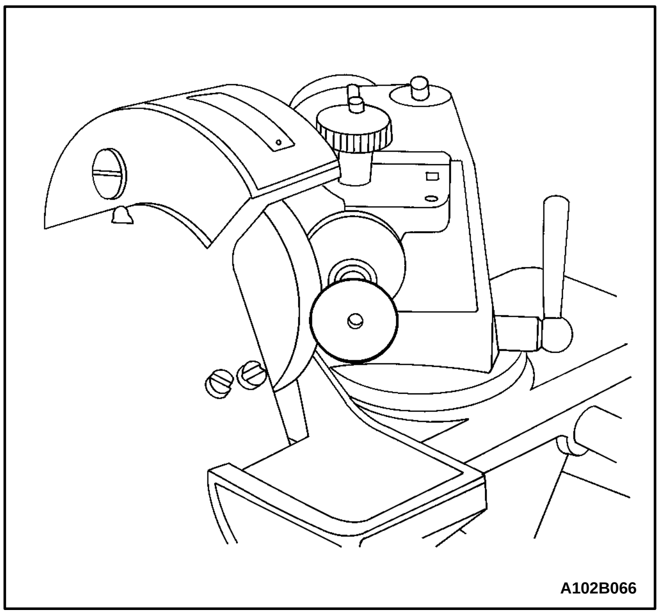
Cylinder Head Overhaul

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.

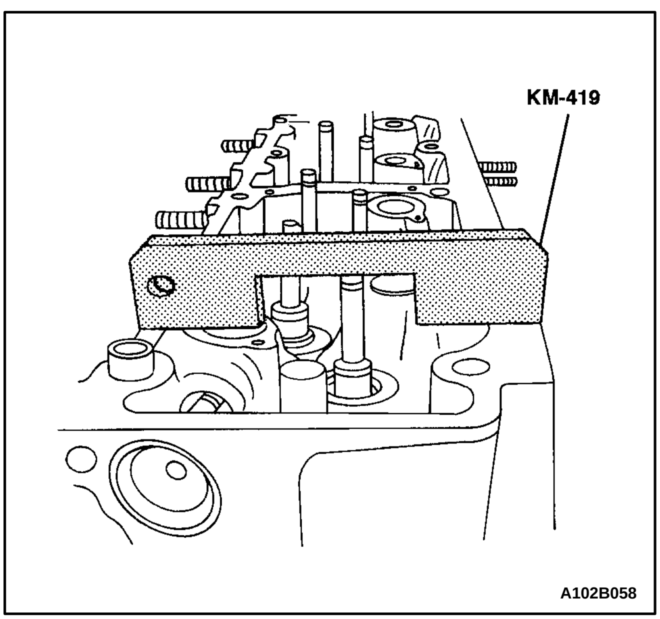


3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.

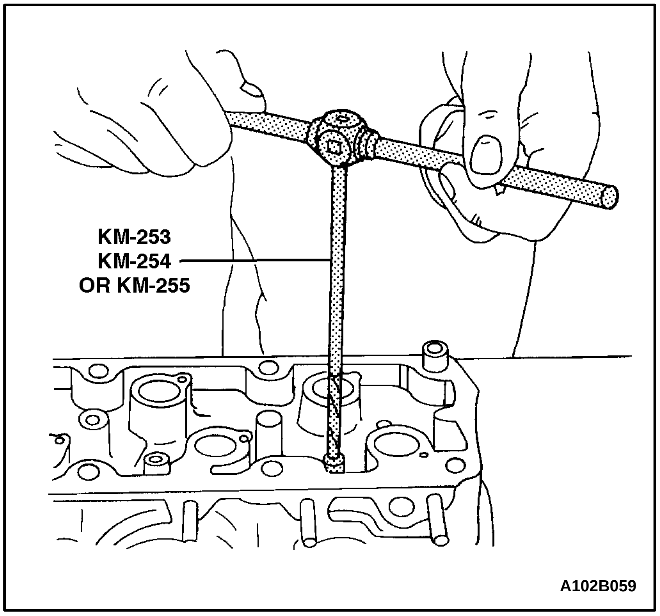


Valve Grind

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.



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



Valve Guide Ream

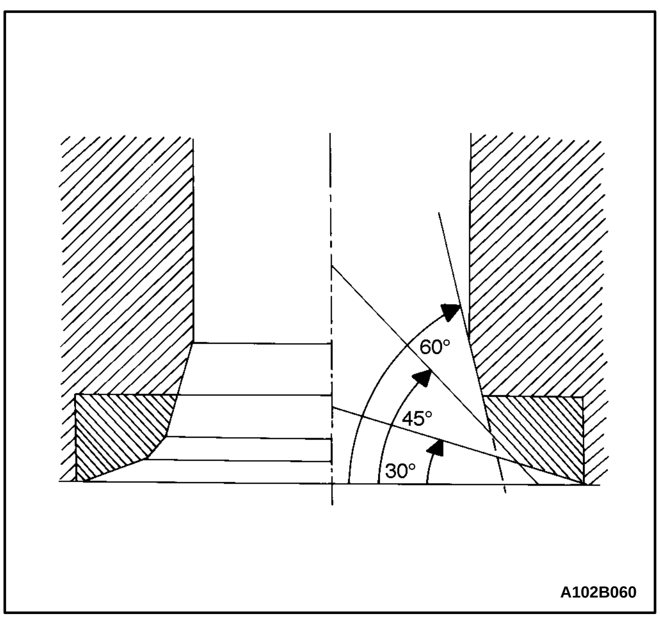
1. Measure the diameter of the valve guide using the gauge MKM-571-B and a commercially available inside micrometer.

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.



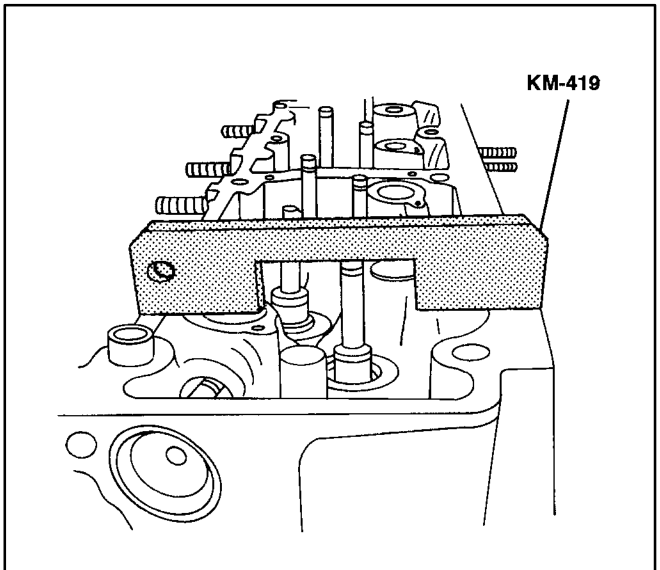
Valve Seat — Cut

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.

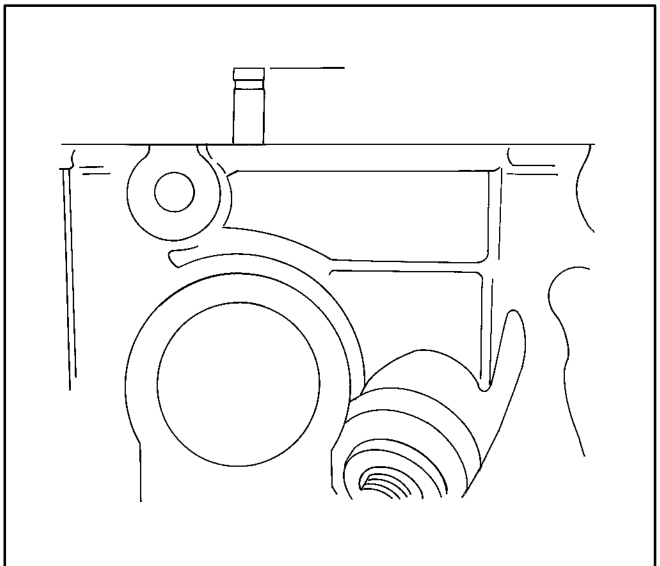
   Upper correction angle: a 30-degree side using the cutter KM-340-13.

   Lower correction angle: a 60-degree side using the cutter KM-340-26.

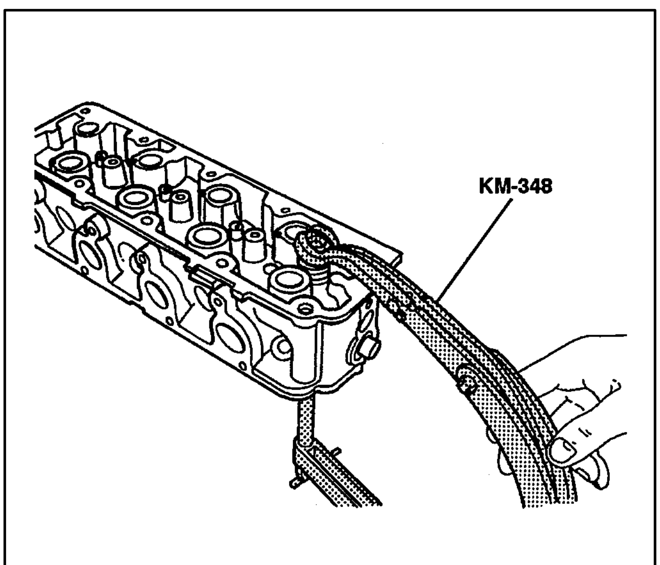


A102B058

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.


A102B061

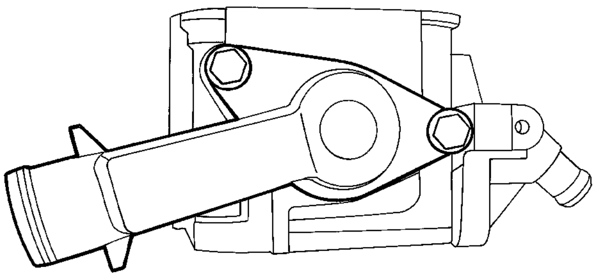
6. If the dimension is exceeded, install new valves and then check the valve stem projection again. Refer to “Valve Grind” and “Valve Grind-In” in this section.
7. If the valve stem projection is still too large despite replacing the valves, replace the cylinder head.



A102B051

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.

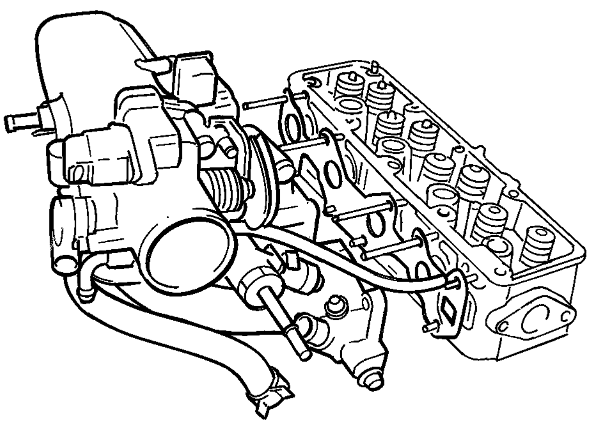


A102B050

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 N m (15 lb-ft).

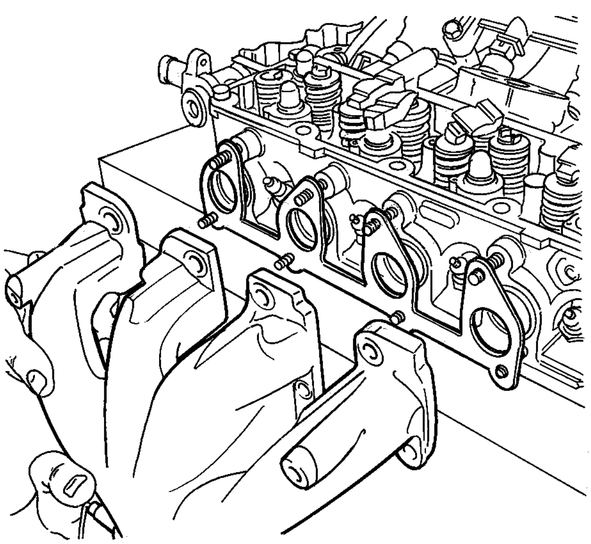


A102B048

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 N m (18 lb-ft).



A102B047

16. Install the spark plugs.

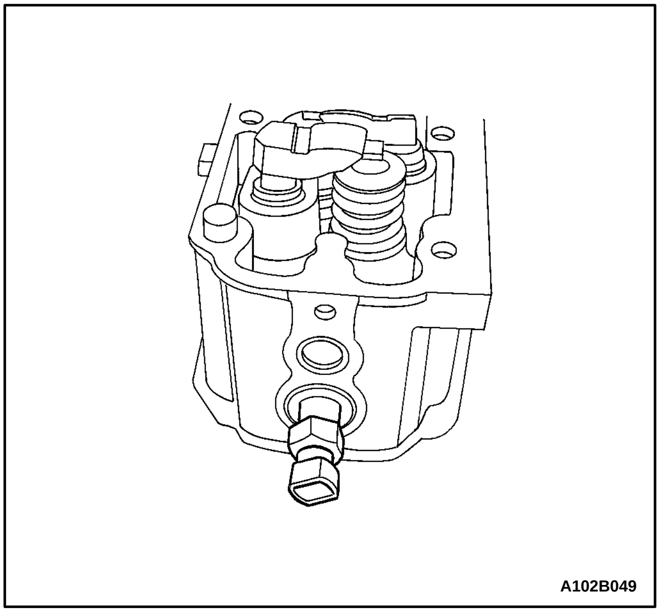
Tighten

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


A102B049

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

Tighten

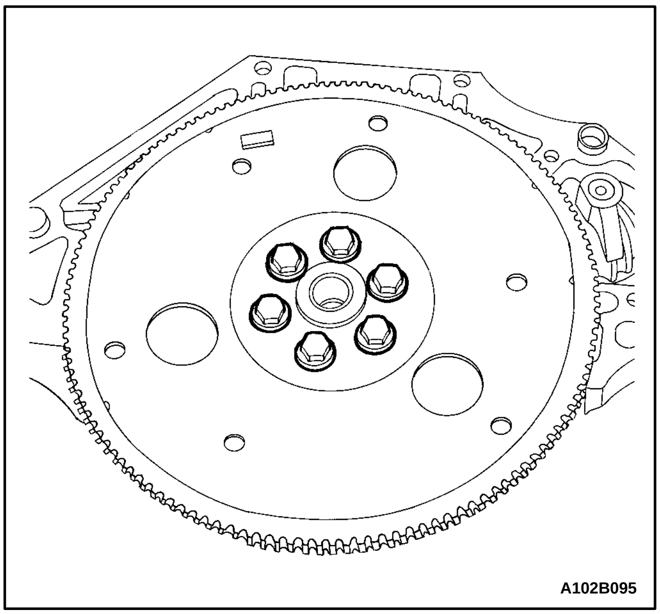
Tighten the exhaust manifold heat shield bolts to 15 N m (11 lb-ft).

23. Install the coolant temperature sensor.

Tighten

Tighten the coolant temperature sensor to 20 N m (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

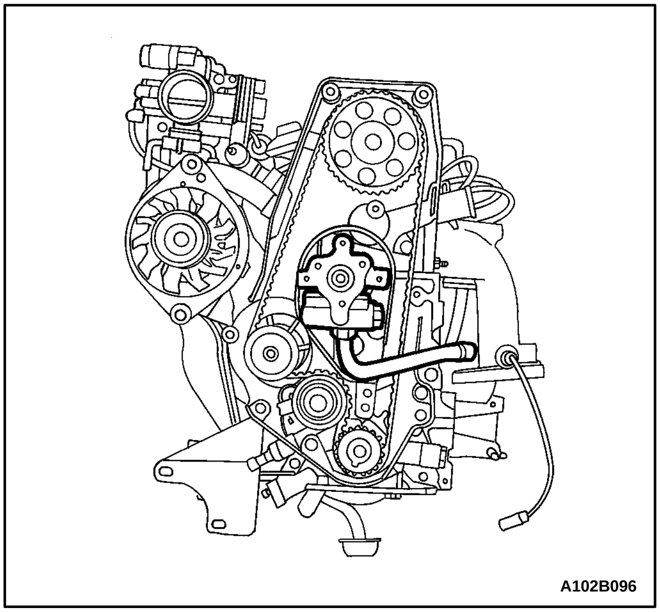
KM-470-B Angular Torque Gauge

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

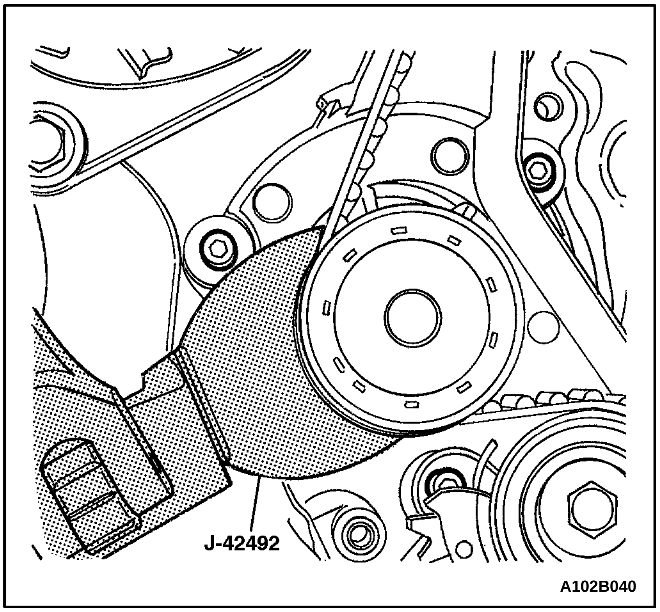
Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

Disassembly Procedure

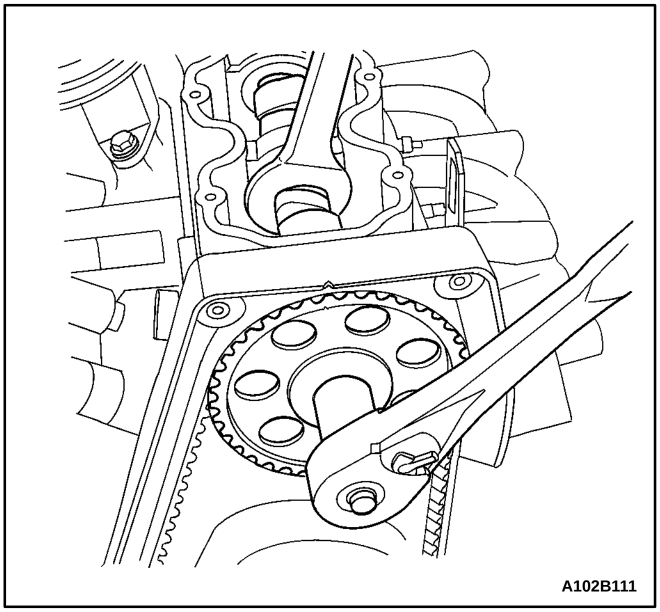
1. Remove the engine. Refer to “Engine” in this section.
2. Remove the flywheel bolts.
3. Remove the flywheel.
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand MKM-412.



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.



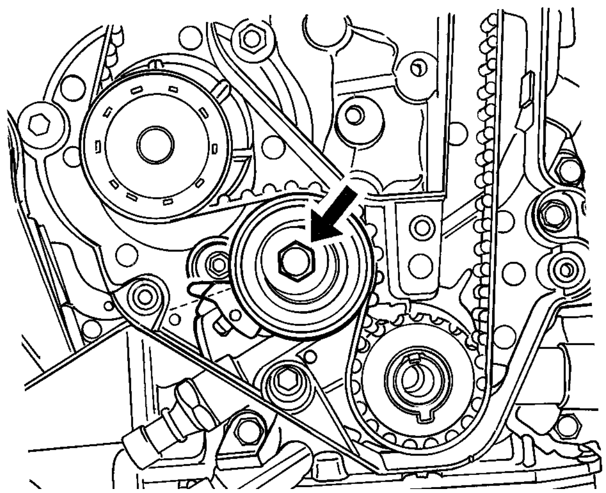
12. Slightly loosen the three coolant pump retaining bolts.
13. Rotate the coolant pump using timing belt adjuster J-42492 to remove the tension from the timing belt.
14. Remove the timing belt.



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

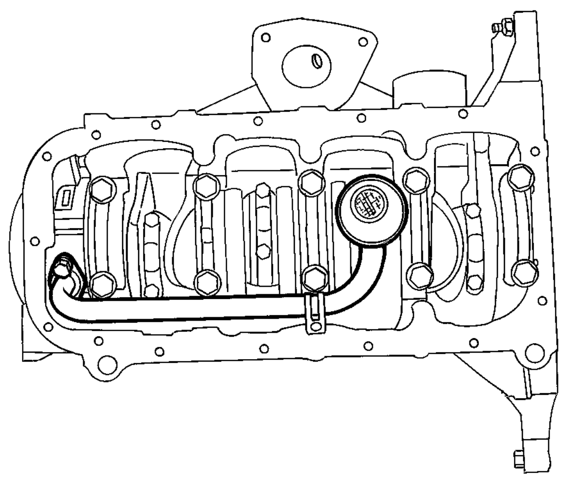
Notice: Take extreme care to prevent any scratches, nicks, or damage to the camshaft. Such damage can impair vehicle operation.

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



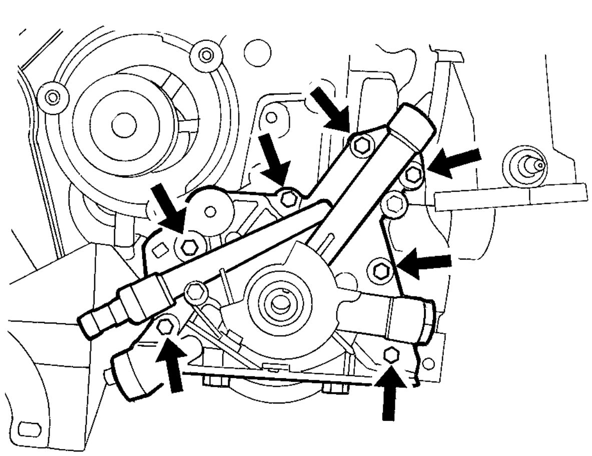
A102B093

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.



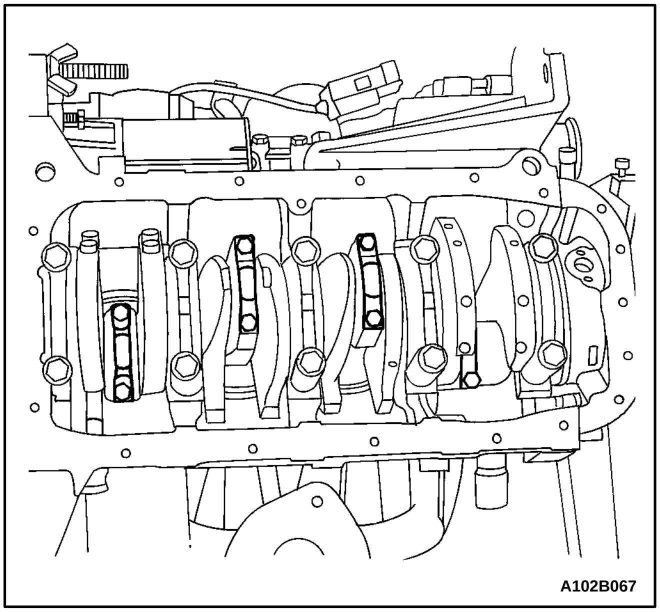
A102B064

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.

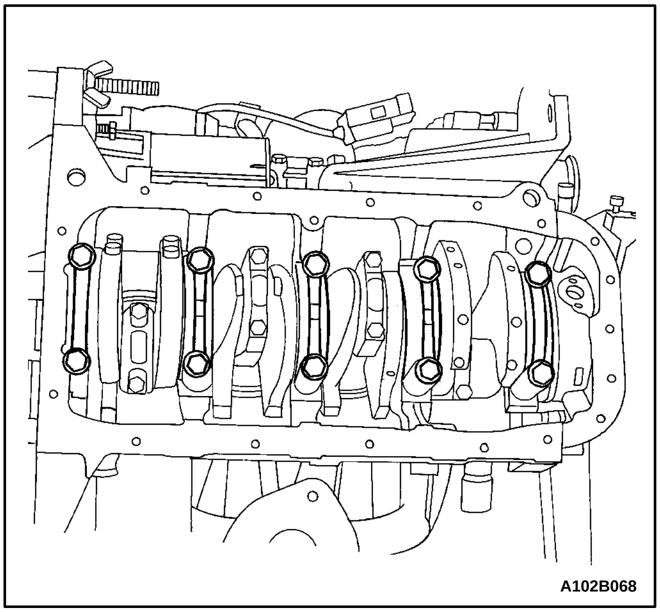


A102B065

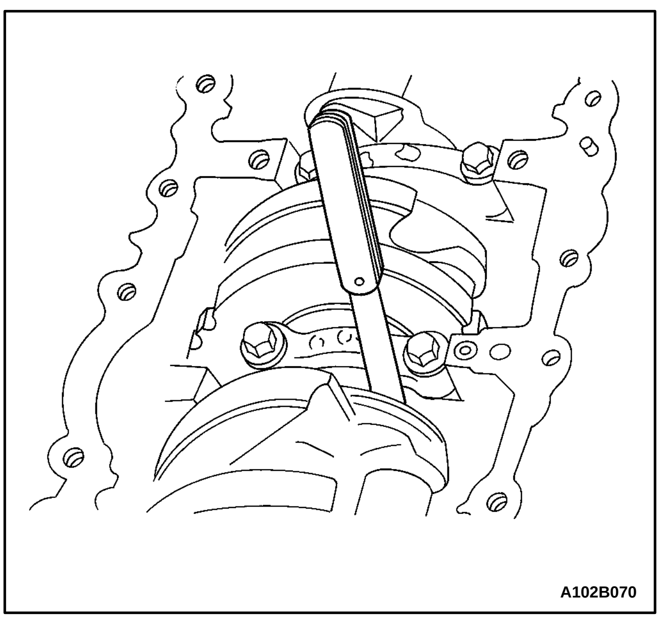
29. Remove the oil pump retaining bolts.
30. Remove the oil pump.



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.

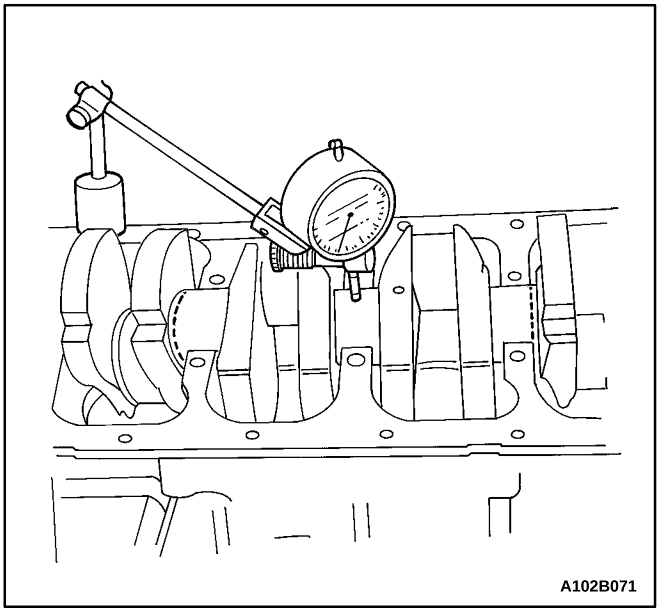


35. Mark the order of the crankshaft bearing caps.
36. Remove the crankshaft bearing cap bolts.
37. Remove the crankshaft bearing caps.
38. Remove the crankshaft bearings from the crankshaft bearing caps.
39. Remove the crankshaft.
40. Remove the crankshaft bearings from the engine block.
41. Clean the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

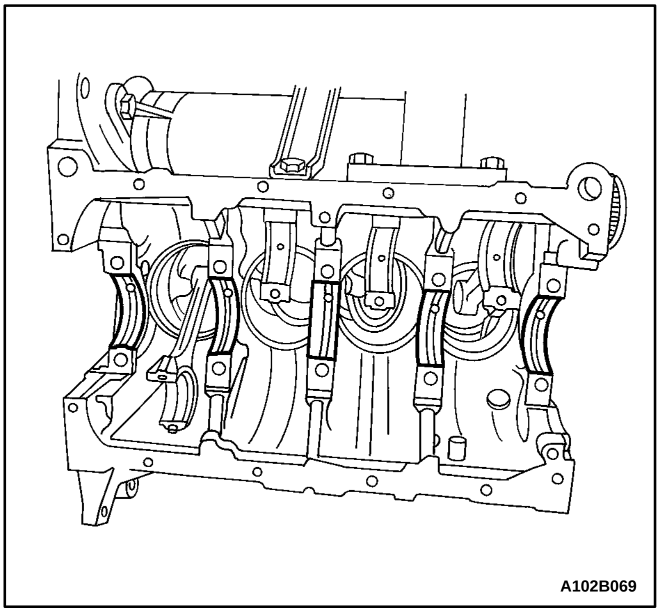


Assembly Procedure

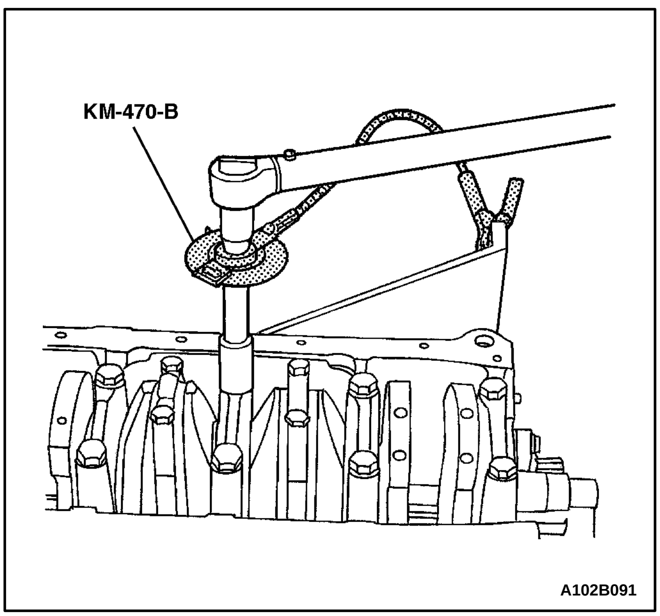
1. With crankshaft and bearings in place, plastic gauge all bearing clearances. Refer to “Crankshaft Bearings and Connecting Rod Bearings – Gauging Plastic” in this section.
2. Inspect the crankshaft end play with the crankshaft bearings installed.
3. Check for permissible crankshaft end play. Refer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



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.



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.



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

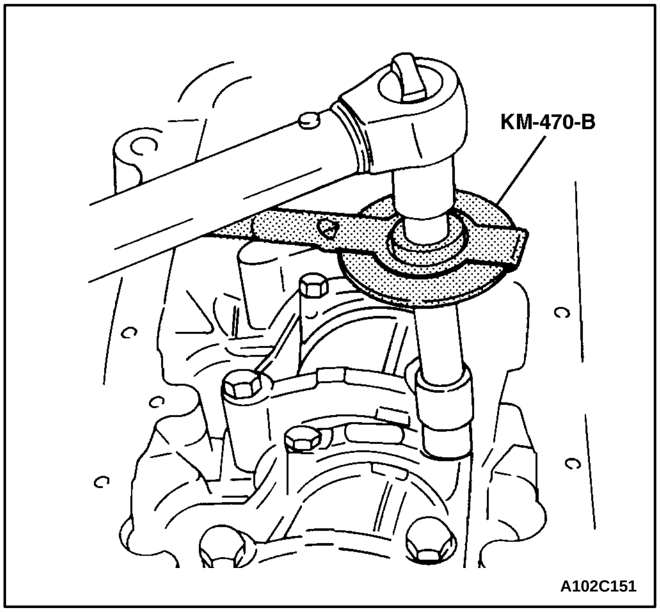
Notice: Do not reuse the old crankshaft bearing cap bolts. Damage to the engine could result.

11. Install new crankshaft bearing cap bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 N m (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



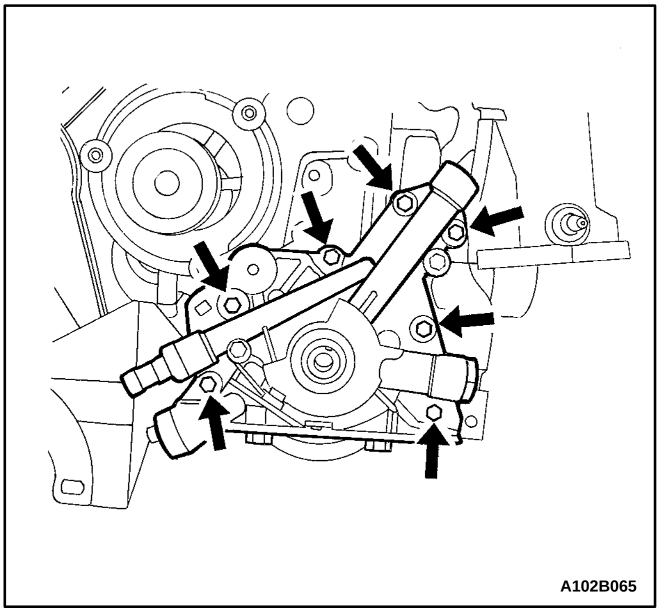
14. Install the connecting rod bearing caps to the connecting rods.

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

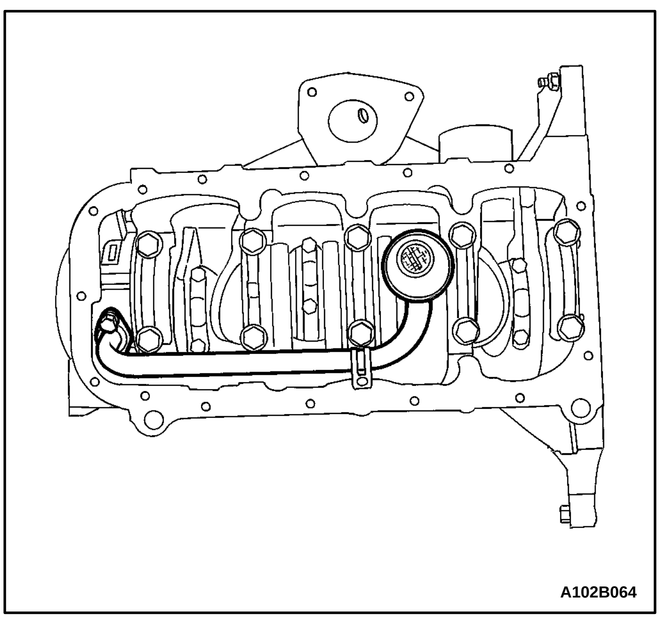
Tighten the connecting rod bearing cap bolts to 25 N m (18 lb-ft). Using the angular torque gauge KM-470-B, tighten the connecting rod bearing cap bolts another 30 degrees plus 15 degrees.



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

Tighten

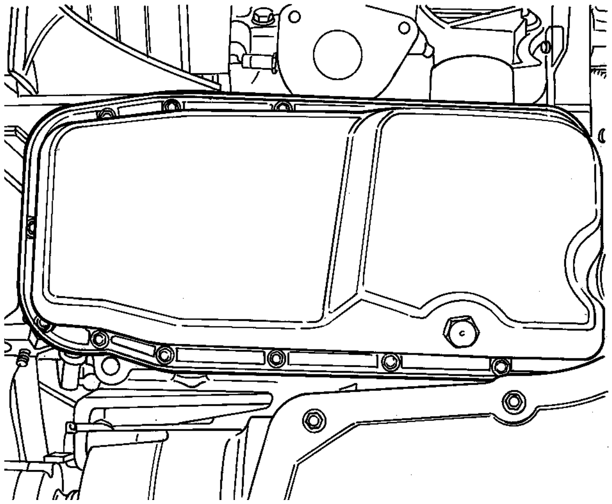
Tighten the oil pump retaining bolts to 10 N m (89 lb-in).



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

Tighten

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



A102B043

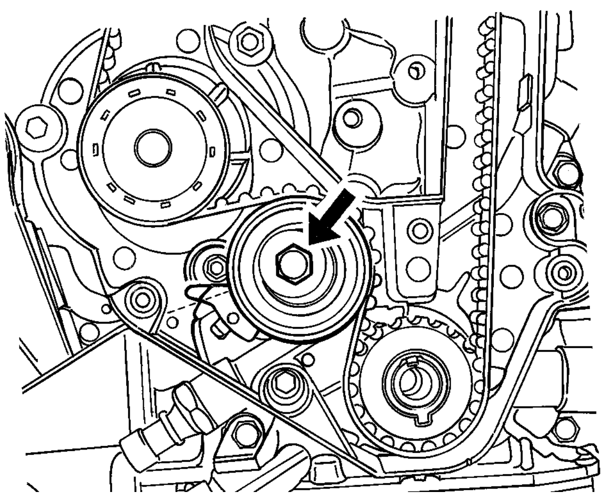
20. Install the oil pan gasket to the oil pan.
21. Install the oil pan.

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 N m (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.

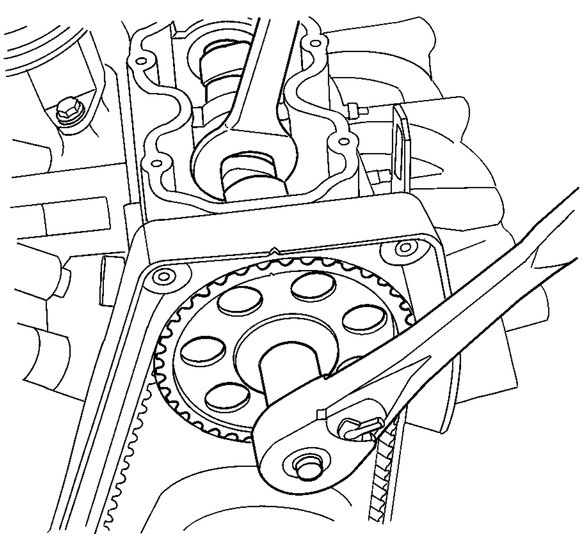
Tighten

Tighten the rear timing belt cover bolts to 10 N m (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 N m (15 lb-ft).



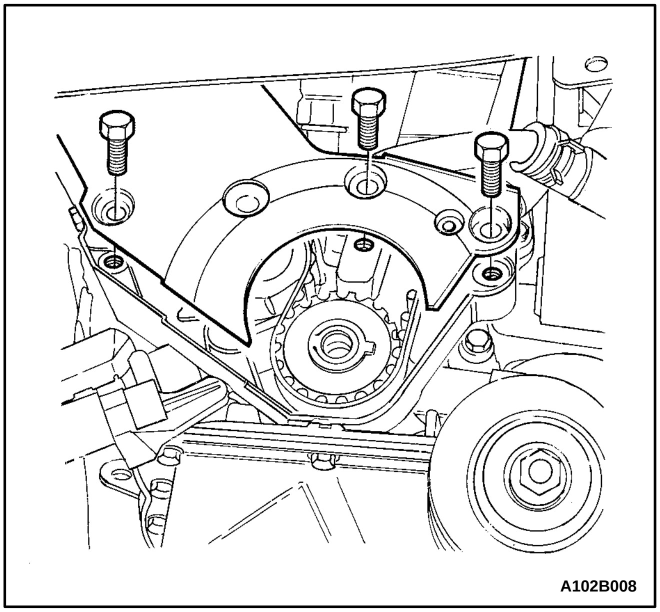
A102B111

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 N m (33 lb-ft).



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.

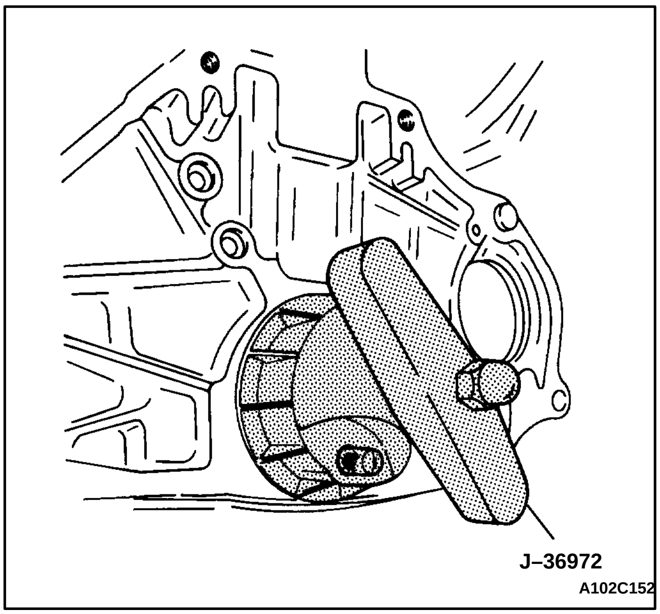
Tighten

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



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

Tighten

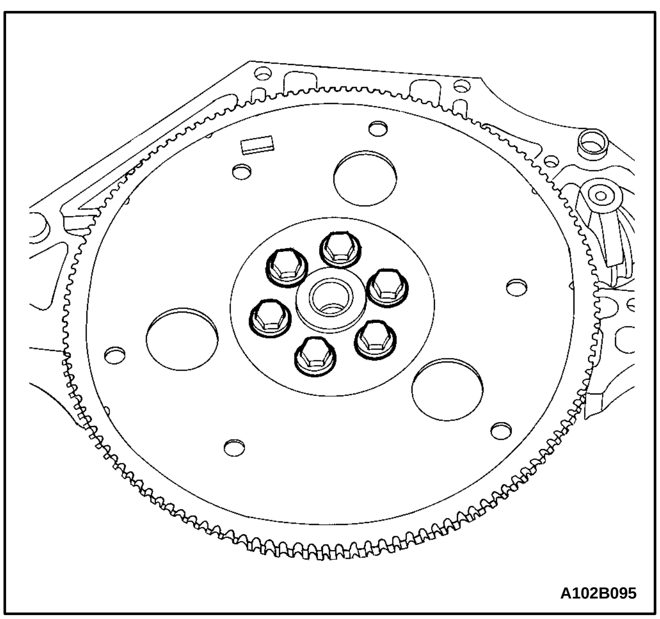
Tighten the power steering pump mounting bolts to 25 N m (18 lb-ft).

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 N m (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.

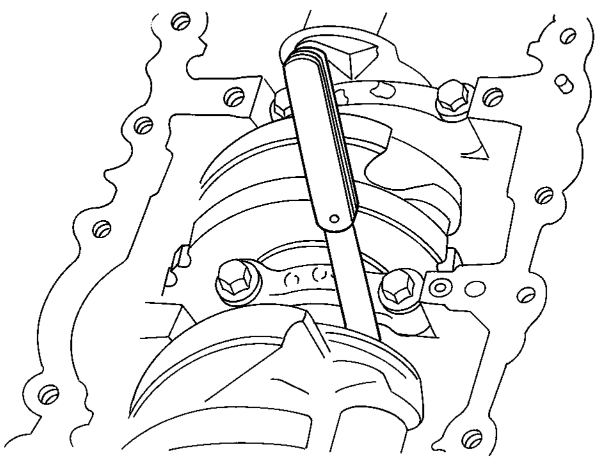


43. Install the flywheel.
44. Install the flywheel bolts.

Tighten

Tighten the flywheel bolts to 35 N m (26 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

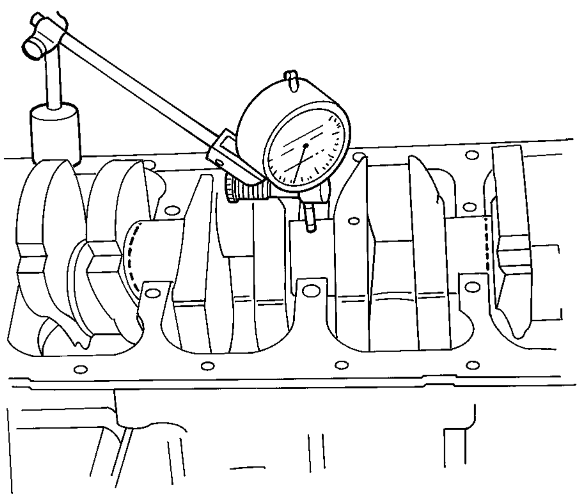
CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS — GAUGING PLASTIC

Tools Required

KM-470-B Angular Torque Gauge

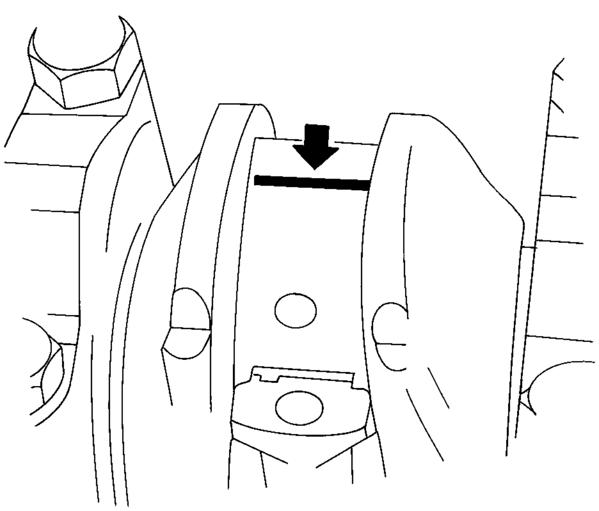
Inspection Procedure – Crankshaft

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

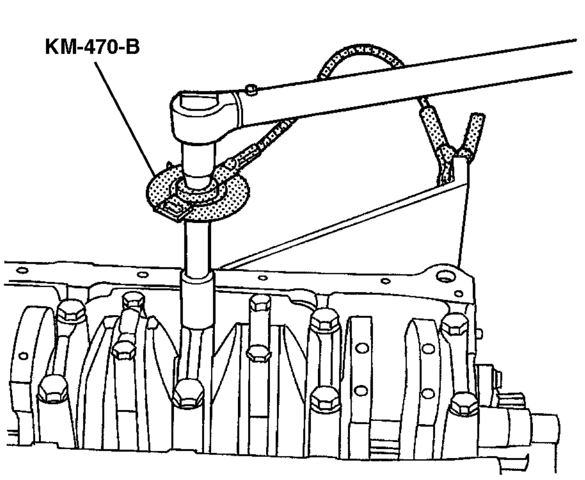
7. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.



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.

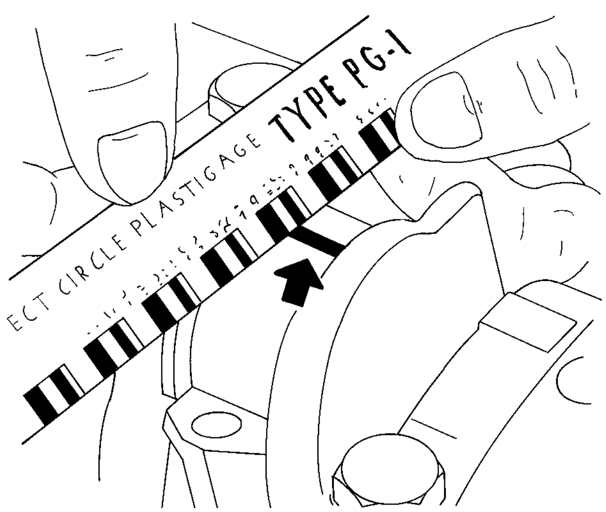


A102B091

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

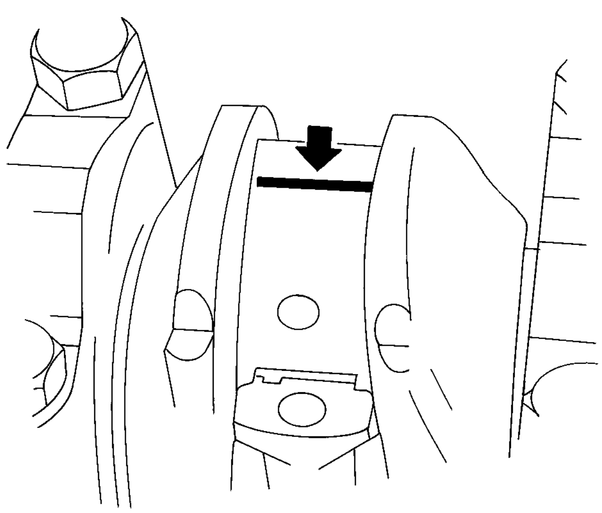
Tighten

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



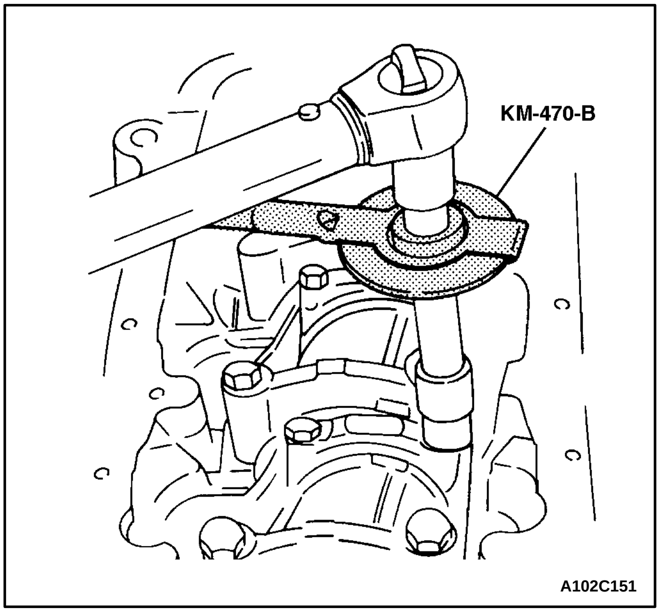
A102B072

Inspection Procedure – Connecting Rods

1. Coat the connecting rod bearings with engine oil.

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).

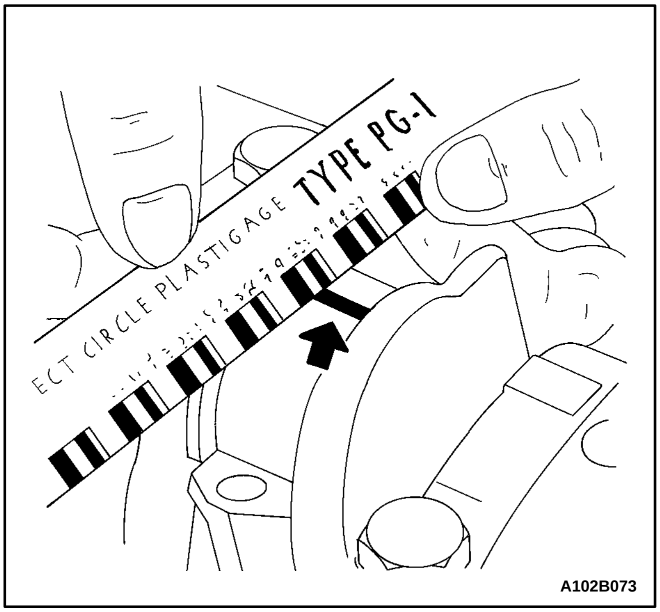


A102C151

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



A102B073

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 accessory 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 open and narrow constantly, 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 (NO_X) 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

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

CAPACITY

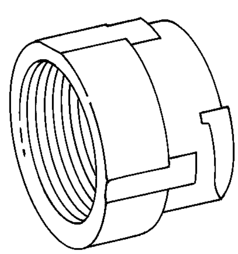
Application	Description
Coolant in the Cooling System (SOHC MPFI System)	7.0L

FASTENER TIGHTENING SPECIFICATIONS

Application	N m	Lb-Ft	Lb-In
Coolant Pump Mounting Bolts	10	–	89
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
	20	15	–
Engine Coolant Temperature Sensor (SOHC)	20	15	–
Lower Transaxle Cooler Pipe Bolt	12	–	106
Negative Battery Terminal Retainer Bolt	15	11	–
Surge Tank Attaching Nuts	10	–	89
	20	15	–
Thermostat Housing Mounting Bolts (SOHC)	20	15	–
Upper Left Radiator Retaining Bolt	4	–	35
Upper Right Radiator Retaining Bolt	4	–	35
Upper Transaxle Cooler Pipe Bolt	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 (216 F). If it does not open at these temperatures, replace the thermostat.

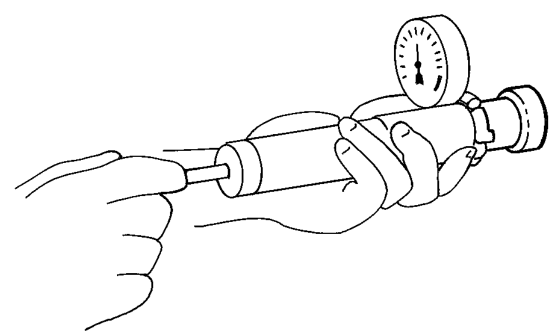
SURGE TANK CAP TEST

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 open. 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.



A102D021

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 a code diagnosis using the engine control module (ECM) for a vehicle with a manual transaxle. 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.

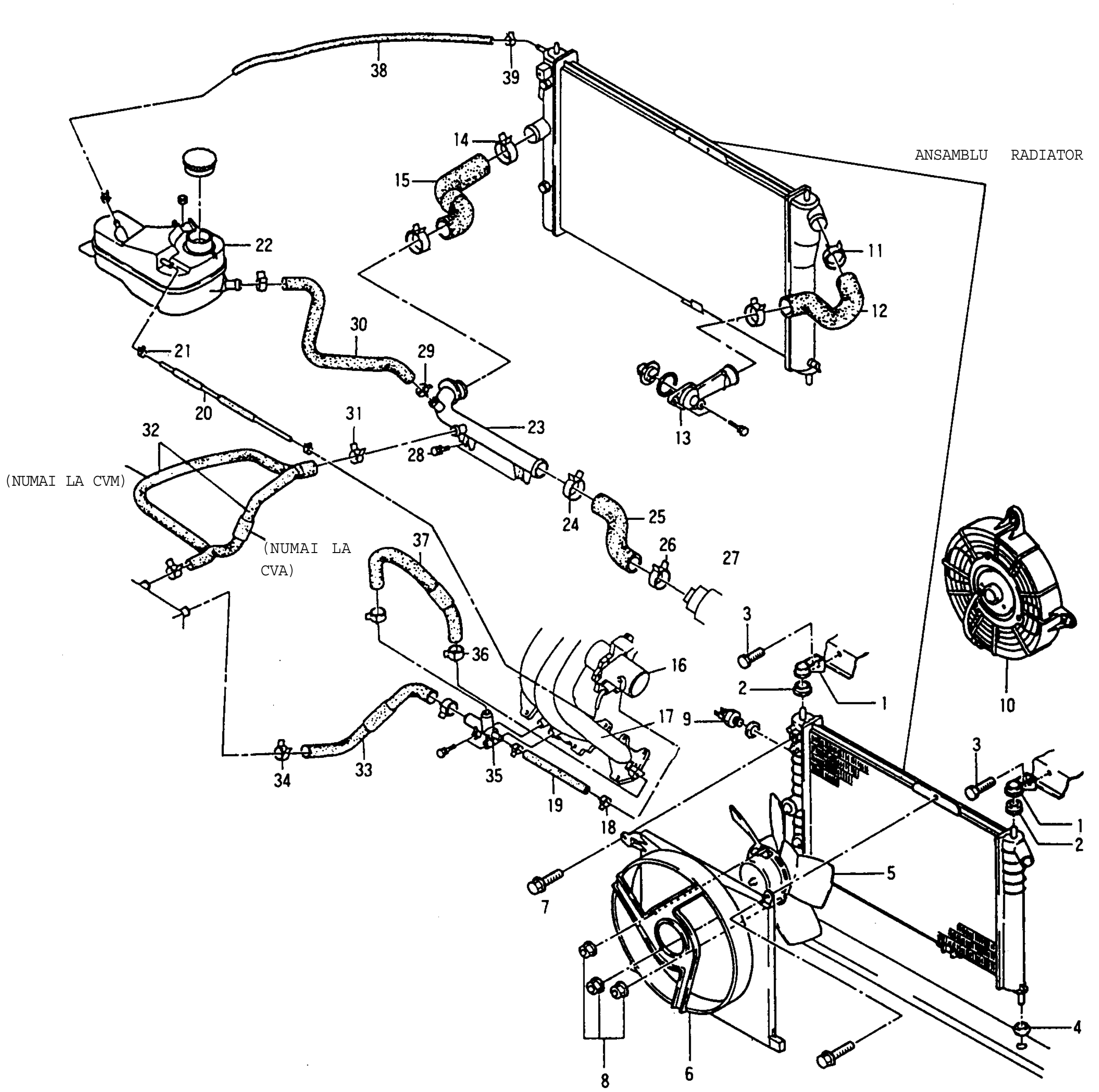
Loss of Coolant

Checks	Action
Check for a leak in the radiator.	Replace a damaged radiator.
Check for a leak in the following locations: Surge tank. Hose.	Replace the following parts: Surge tank. Hose.
Check for the following loose or damaged parts: Radiator hoses. Heater hoses. 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 following locations: Intake manifold. Cylinder head gasket. Cylinder block plug. Heater core. 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

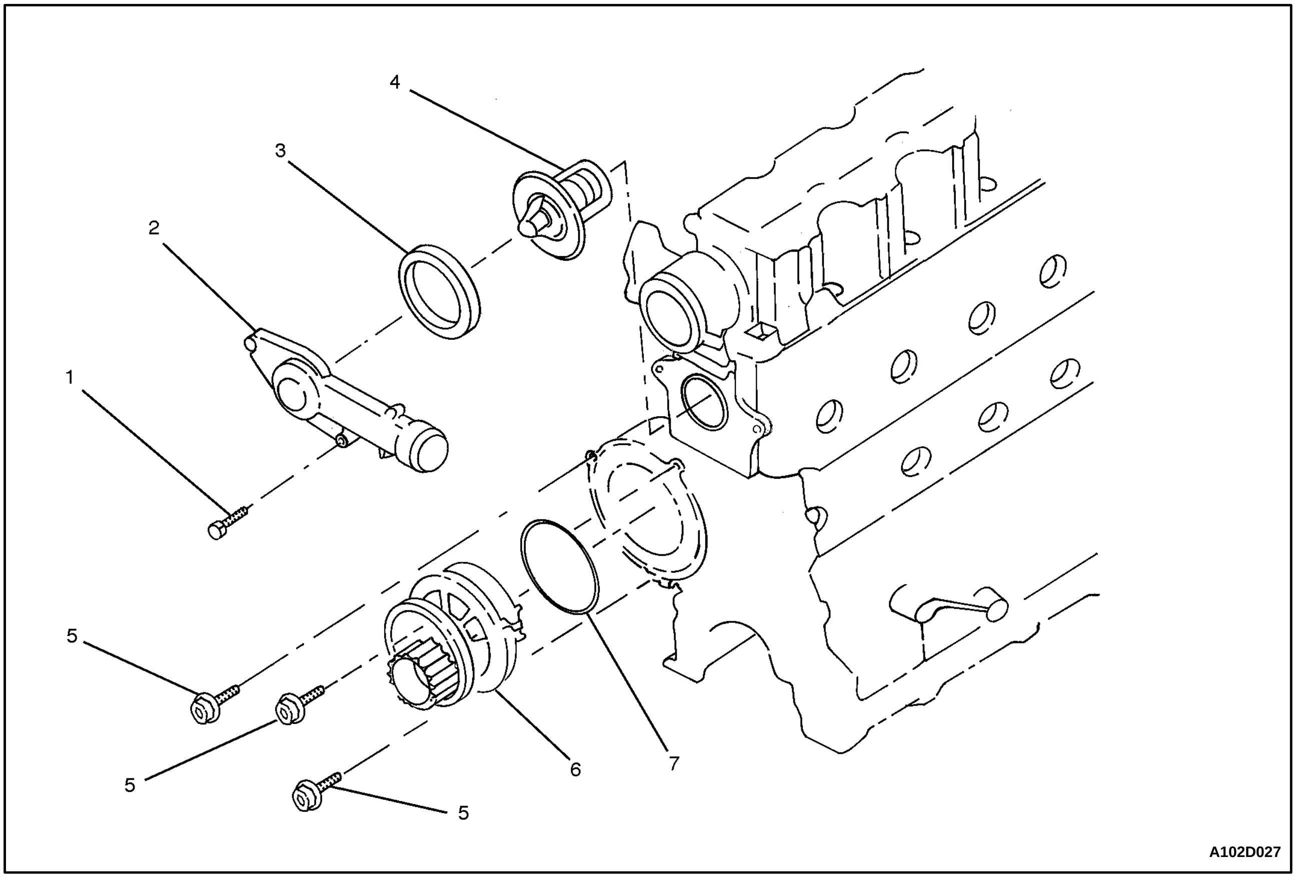
Checks	Action
Check to determine if the thermostat is stuck open, or if it is the wrong type of thermostat.	Install a new thermostat of the correct type and heat range.
Check the coolant level to determine if it is below the MIN mark on the surge tank.	Add sufficient coolant to raise the fluid to the specified mark on the surge tank.

COMPONENT LOCATOR



1. BRID^ FIXARE RADIATOR
2. TAMPOANE AMORTIZARE
3. "URUB
4. TAMPON AMORTIZARE
5. MOTORUL ELECTRIC AL VENTILATORULUI
6. SUPORT VENTILATOR
7. "URUB
8. "URUB
9. TERMOCONTACT (TURA IE SC^ZUT^)
10. VENTILATORUL AUXILIAR AL CONDENSORULUI A/C
11. COLIER
12. FURTUNUL SUPERIOR AL RADIATORULUI
13. CARCASA TERMOSTATULUI
14. COLIER
15. FURTUNUL INFERIOR AL RADIATORULUI
16. CORPUL CLAPETEI DE AER
17. GALERIA DE EVACUARE
18. COLIER
19. FURTUN INTRARE LA CORPUL CLAPETEI DE AER
20. FURTUN IE"IRE LA CORPUL CLAPETEI DE AER
21. COLIER
22. VAS DE EXPANSIUNE
23. CONDUCT^
24. COLIER
25. FURTUN
26. COLIER
27. POMP^ DE AP^
28. "URUB
29. COLIER
30. FURTUN
31. COLIER
32. FURTUN IE"IRE CALORIFER
33. FURTUN INTRARE CALORIFER
34. COLIER
35. ROBINET CALORIFER
36. COLIER
37. FURTUN
38. FURTUN AUXILIAR
39. COLIER

COOLANT PUMP/THERMOSTAT (SOHC)

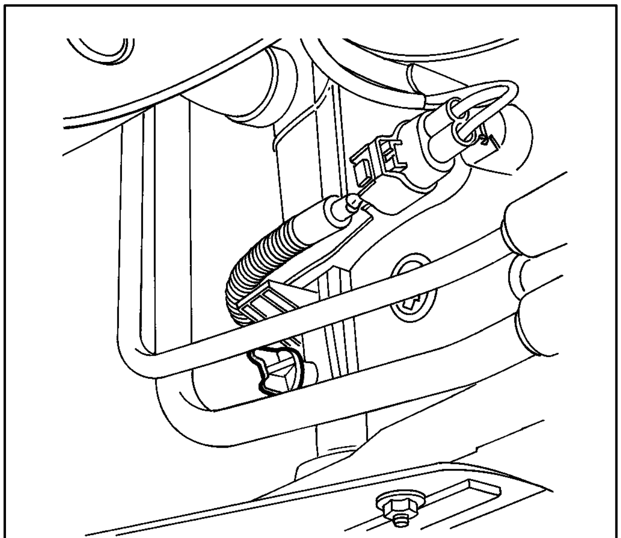


1 Thermostat Housing Bolt
2 Thermostat Housing
3 Seal Ring
4 Thermostat
5 Coolant Pump Mounting Bolts
6 Coolant Pump
7 O-Ring

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

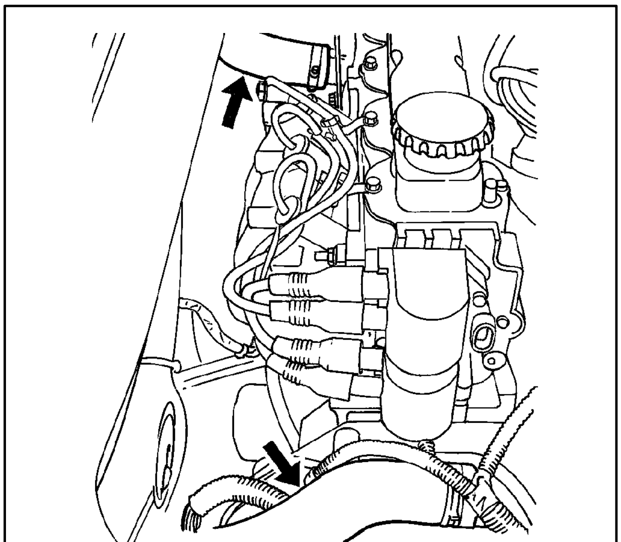
DRAINING AND REFILLING THE COOLING SYSTEM



A102D001

Caution: To avoid injury, 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.

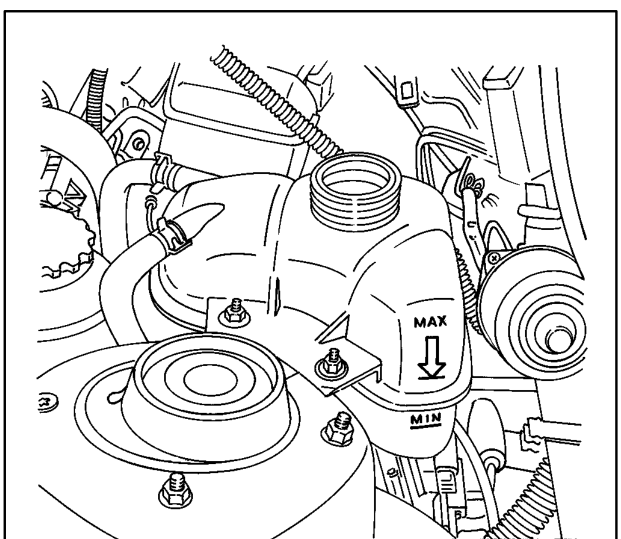
1. Place a pan below the vehicle to catch the draining coolant.
2. Remove the surge tank cap.
3. Unplug the drain cock.



A102D029

Caution: Dispose of the used coolant in 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.
11. Stop the engine.
12. Repeat Steps 1 through 9 until the drained water is clear and free of coolant and rust.



A102D017

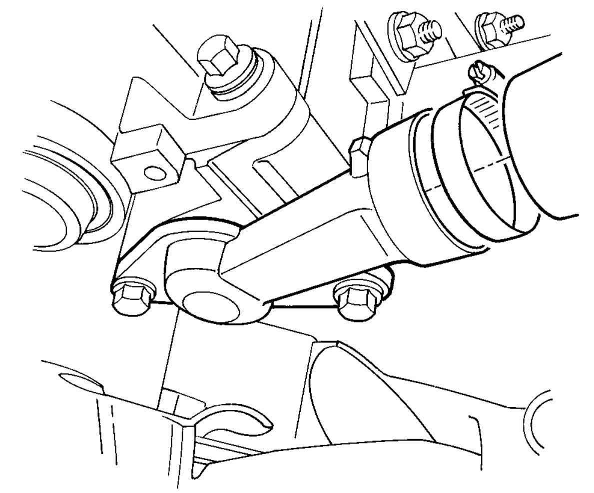
Notice: To avoid damaging the vehicle, never use an antifreeze mixture more concentrated than 60 percent antifreeze to 40 percent water. The solution freezing point increases above this concentration.

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.

THERMOSTAT

Single Overhead Cam Engine

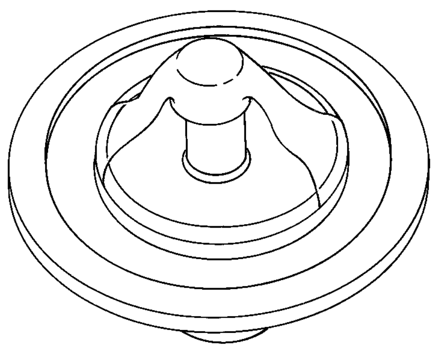
Removal Procedure



A102D002

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.

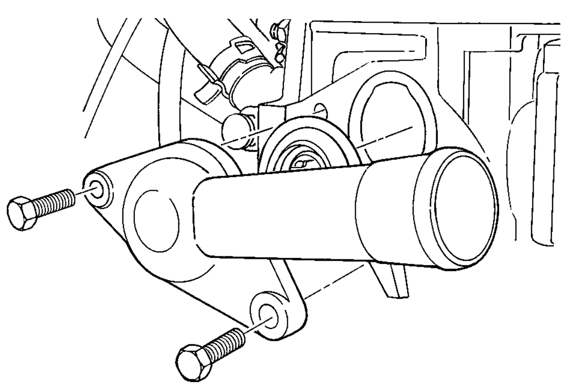
1. Drain the coolant. Refer to “Draining and Refilling the Cooling System” in this section.
2. Remove the rear timing belt cover. Refer to *Section 1B, SOHC Engine Mechanical*.
3. Loosen the hose clamp on the upper radiator hose at the thermostat housing.
4. Disconnect the upper radiator hose from the thermostat housing.



A102D014

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



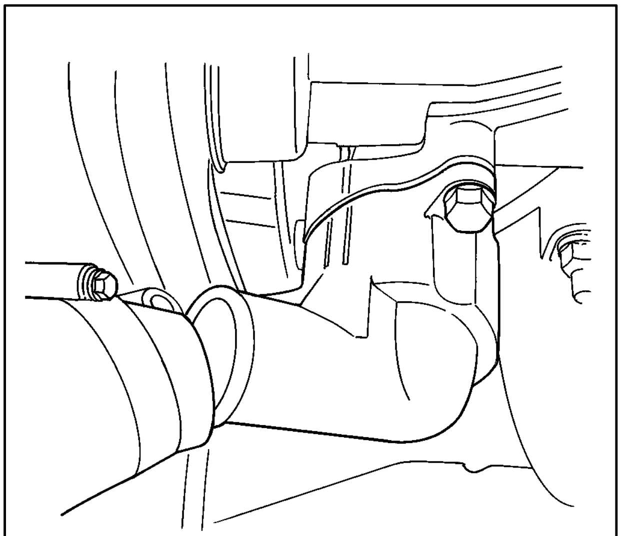
A102D040

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 N m (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.

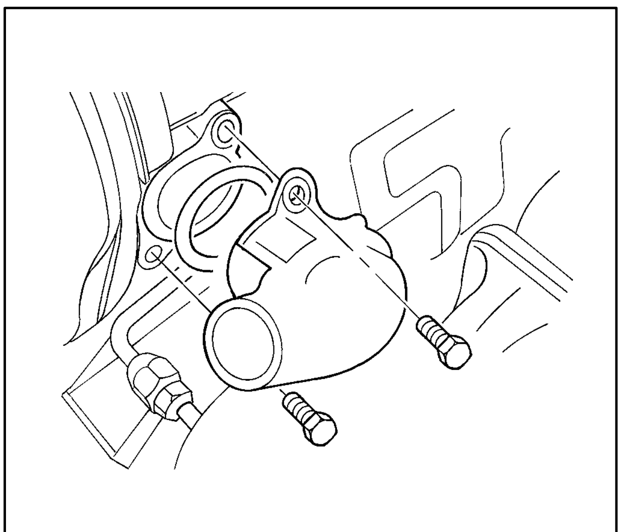

A102D003

Dual Overhead Cam Engine

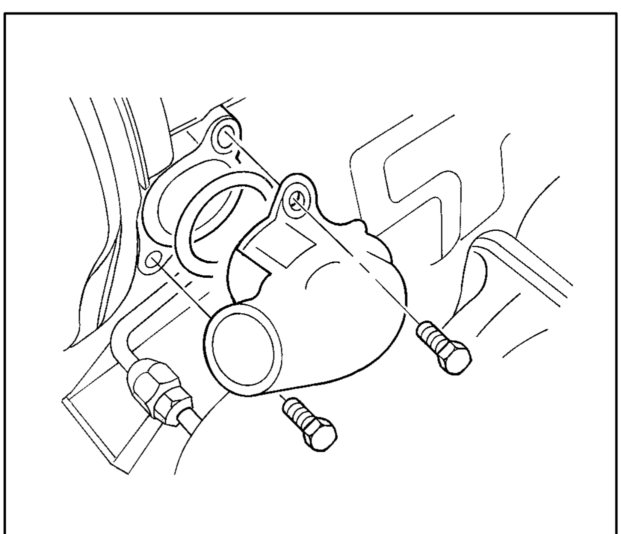
Removal Procedure

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.
4. Loosen the clamp on the bypass hose.
5. Disconnect the bypass hose from the thermostat adapter.


E21D004

6. Remove the mounting bolts that hold 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. Check the valve seat for foreign matter that could prevent the valve from seating properly.
10. Check the thermostat for proper operation. Refer to “Thermostat Test” in this section.
11. Clean the thermostat housing and cylinder head mating surfaces.

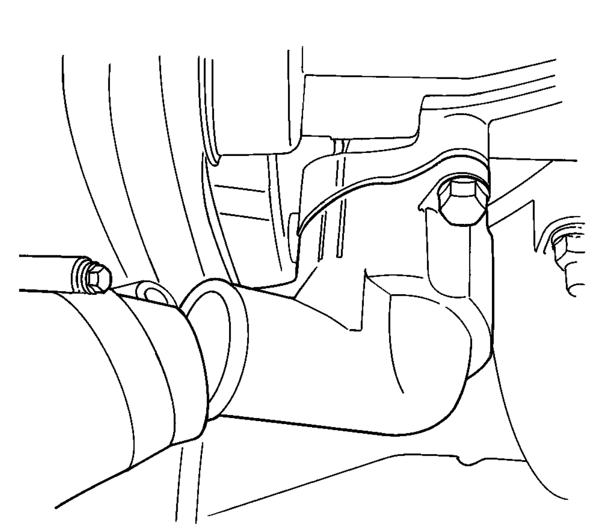

E21D004

Installation Procedure

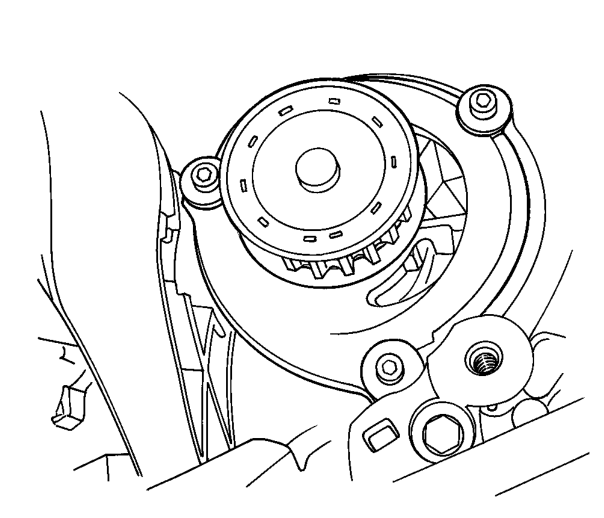
1. Coat the sealing surface of a new O-ring seal with Lubriplate .
2. Install a new O-ring seal into the recess in the cylinder head.
3. Secure the thermostat housing to the cylinder head with the mounting bolts.

Tighten

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


A102D003

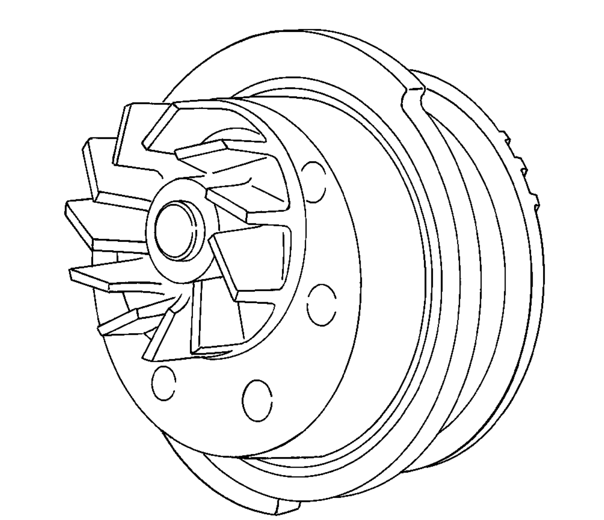
4. Connect the bypass hose to the thermostat adapter.
5. Secure the bypass hose with a hose clamp.
6. Connect the upper radiator hose to the thermostat housing.
7. Secure the upper radiator hose to the thermostat housing with a hose clamp.
8. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.


A102D005

COOLANT PUMP

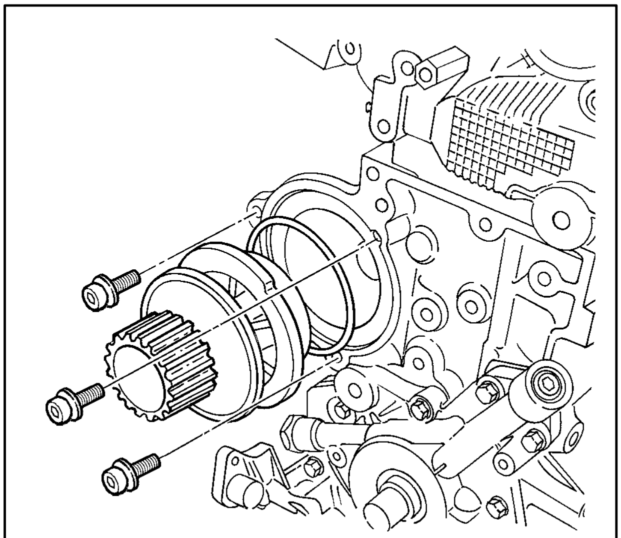
Removal Procedure

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.


A102D042

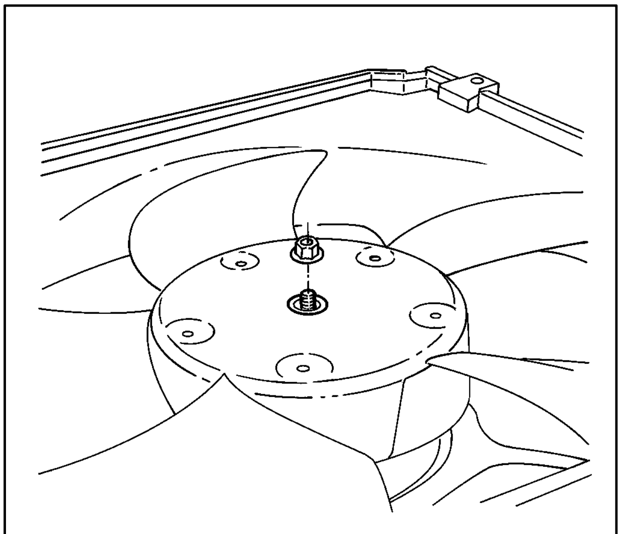
Installation Procedure

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 N m (89 lb-in).

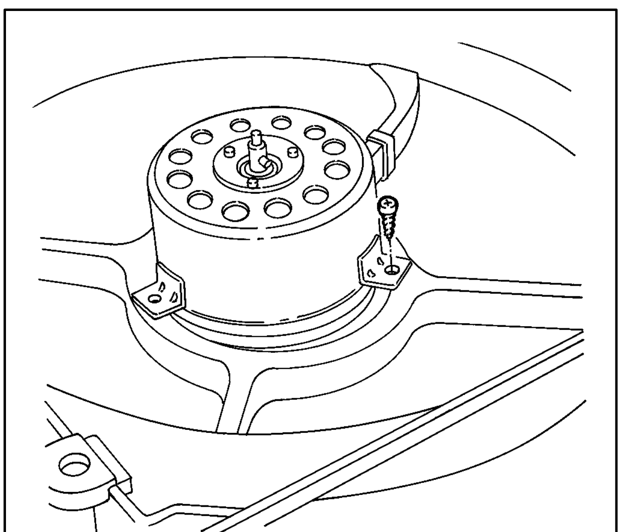
5. Install the rear timing belt cover. Refer to *Section 1B, DOHC Engine Mechanical.*
6. Refill the engine cooling system. Refer to “Draining and Refilling the Cooling System” in this section.


A102D006

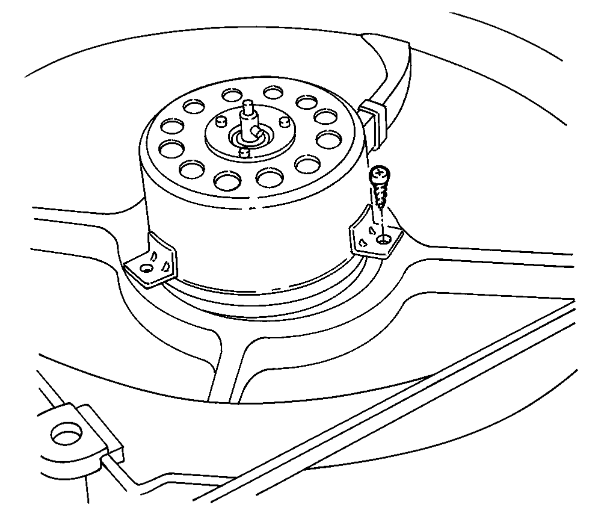
ELECTRIC COOLING FAN – MAIN

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 blade from the fan motor by removing the nut at the center of the fan hub.


A102D007

6. Remove the fan motor retaining screws.
7. Remove the fan motor from the shroud.



A102D007

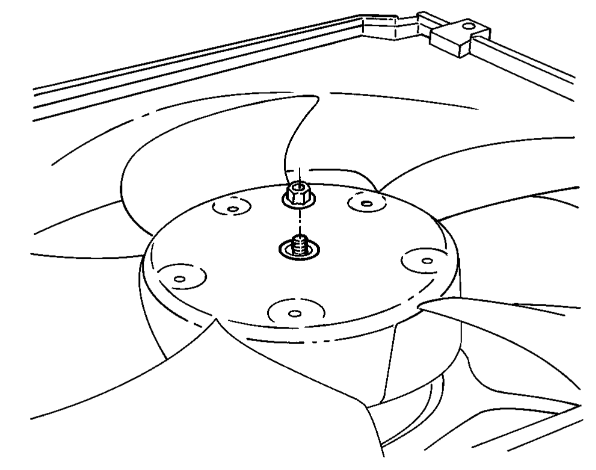
Installation Procedure

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 electric cooling fan (main) motor retaining screws to 4 N m (35 lb-in).

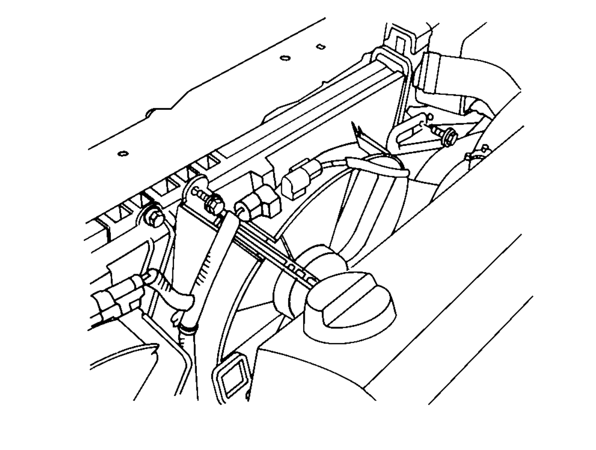


A102D006

3. Install the fan to the motor with the single nut in the center of the fan hub.

Tighten

Tighten the electric cooling fan (main) motor nut to 3.2 N m (28 lb-in).



B102D010

4. Install the electric cooling fan shroud assembly to the radiator.

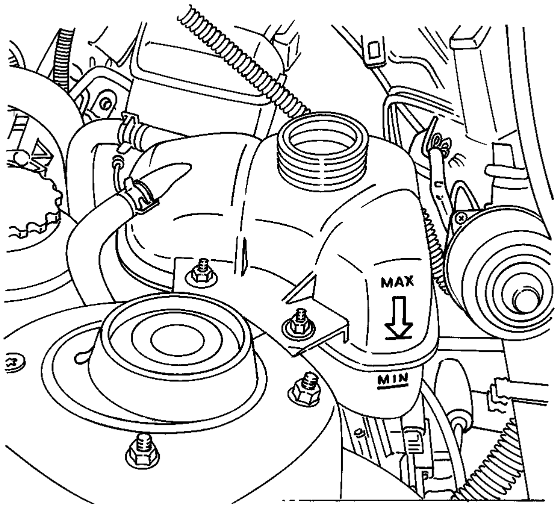
Important: Be careful to seat the mounting post on the fan shroud into the socket at the radiator left tank. Be sure to slip the tab at the bottom edge of the shroud into the retaining clip near the center of the radiator.

5. Secure the shroud to the top of the radiator with the mounting bolts.

Tighten

Tighten the electric cooling fan assembly (main) mounting bolts to 4 N m (35 lb-in).

6. Install the electrical connector to the cooling fan.
7. Connect the negative battery cable.



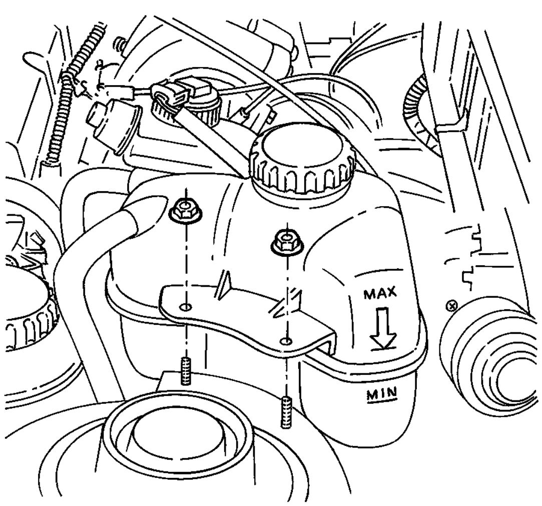
A102D017

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.



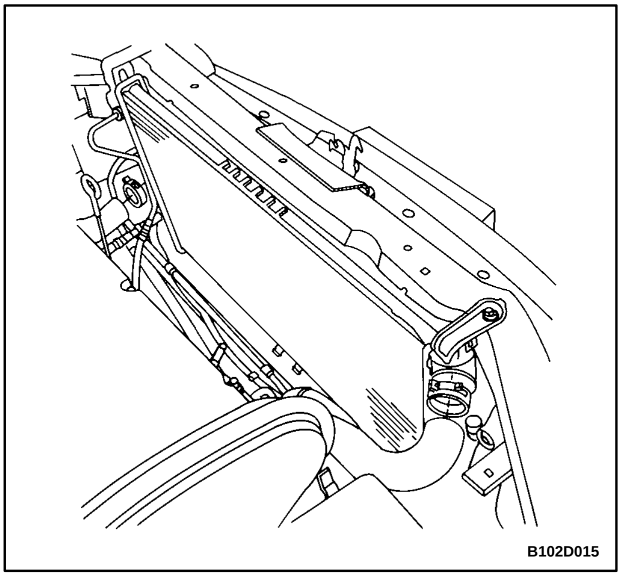
A102D043

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 10 N m (89 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.

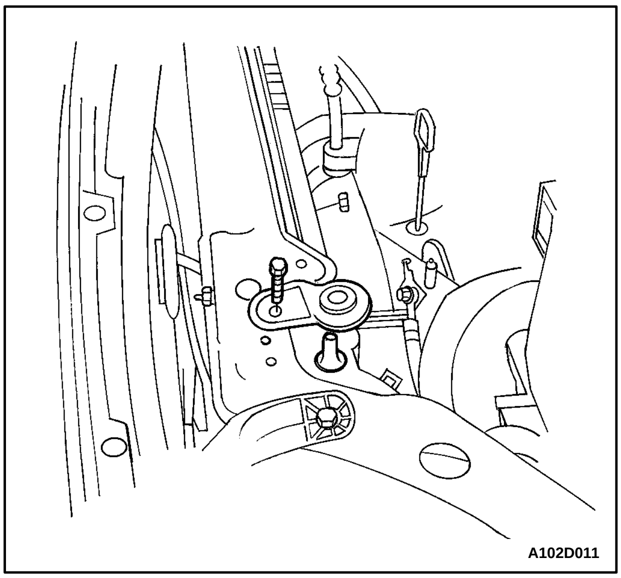


RADIATOR

Removal Procedure

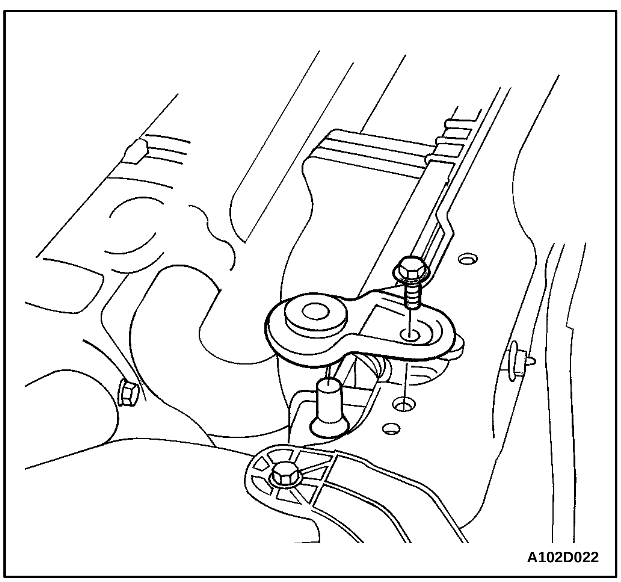
1. Disconnect the negative battery cable.
2. Drain the engine cooling system. Refer to “Draining and Refilling the Cooling System” in this section.
3. Remove the main cooling fan. Refer to “Electric Cooling Fan-Main” in this section.

5. Remove the lower radiator hose clamp.
6. Disconnect the lower radiator hose from the radiator.
7. Remove the upper radiator hose clamp.
8. Disconnect the upper radiator hose from the radiator.



9. Remove the hose clamp from the surge tank hose at the radiator.
10. Disconnect the surge tank hose from the radiator.

12. Remove the left upper radiator retaining bolt.
13. Remove the left upper radiator retaining bracket.



14. Remove the right upper radiator retaining bolt.
15. Remove the right upper radiator retaining bracket.
16. 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.

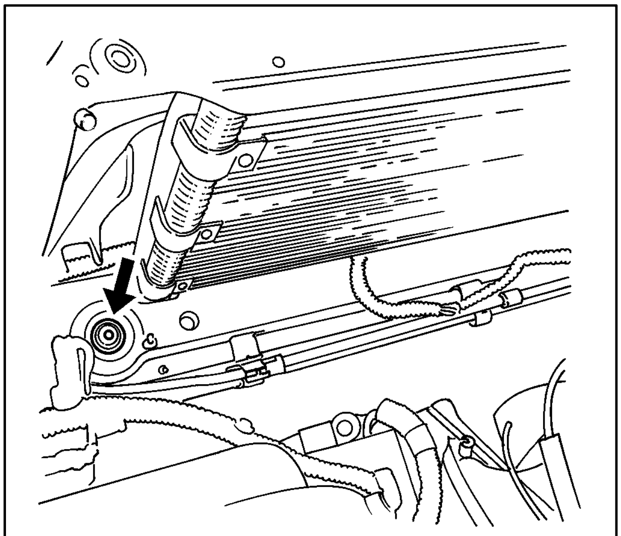
Installation Procedure

1. If installing a new radiator, remove the transaxle cooler pipes from the old radiator and install them onto the left tank of the new radiator.

Tighten

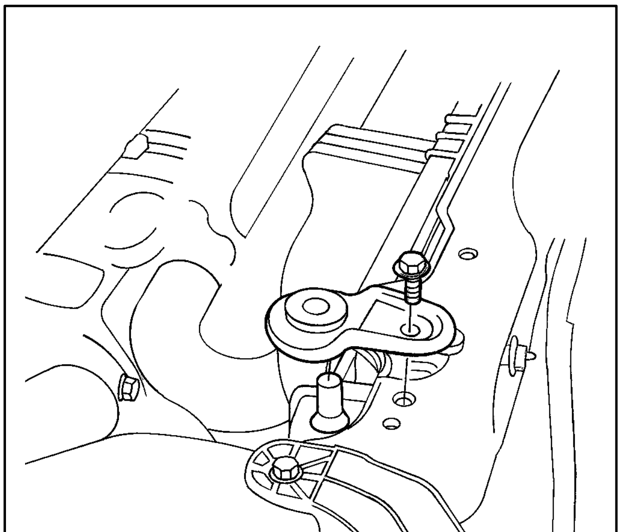
Tighten the upper transaxle cooler pipe bolt to 12 N m (106 lb-in).

3. Install the pipe holder as it was in the old radiator.



A102D012

5. Set the radiator into place in the vehicle with the radiator bottom posts in the rubber shock bumpers.

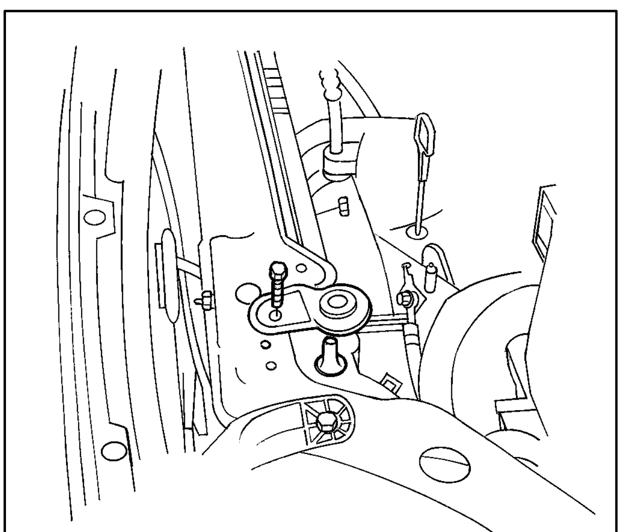


A102D022

6. Position the radiator retainers in place.
7. Install the upper right radiator retainer bracket.
8. Install the upper right radiator retaining bolt.

Tighten

Tighten the upper right radiator retaining bolt to 4 N m (35 lb-in).

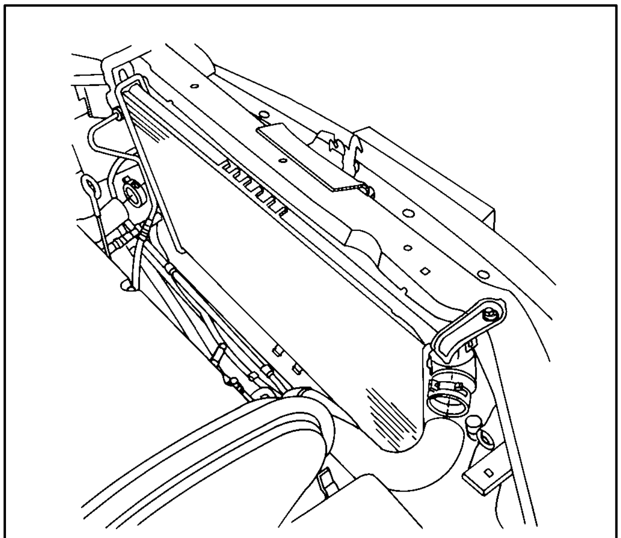


A102D011

9. Install the upper left radiator retainer bracket.
10. Install the upper left radiator retaining bolt.

Tighten

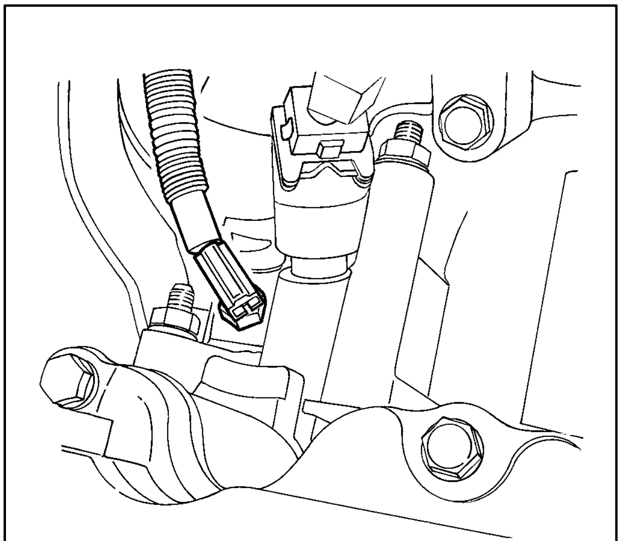
Tighten the upper left radiator retaining bolt to 4 N m (35 lb-in).



B102D015

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.
15. Secure each hose with a hose clamp.
16. Install the main cooling fan. Refer to “Electric Cooling Fan – Main” in this section.

18. Refill the engine cooling system. Refer to “Draining and Refilling the Cooling System” in this section.
19. Connect the negative battery cable.



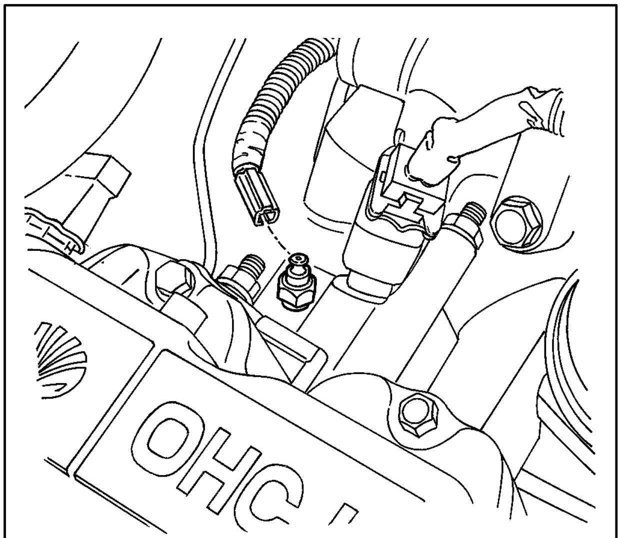
A102D013

COOLANT TEMPERATURE GAUGE

Single Overhead Cam Engine

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain the coolant below the coolant temperature gauge level.
3. Disconnect the electrical connector from the coolant temperature gauge.
4. Remove the coolant temperature gauge from the intake manifold.



A102D044

Installation Procedure

1. Install the coolant temperature gauge into the threaded hole in the intake manifold.

Tighten

Tighten the coolant temperature gauge (SOHC) to 20 N m (15 lb-ft).

2. Connect the electrical connector to the coolant temperature gauge.
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. Three models of radiators are available: small, standard, and heavy duty. The three models vary only by capacity. 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 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 (216 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 in-

jury. 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 airflow 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 engine 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(s) 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 115 C (239 F) or high-side A/C pressure reaches 1 882 kPa (273 psi).

The cooling fans will return to low speed when the coolant temperature reaches 112 C (234 F) and high-side A/C pressure reaches 1 448 kPa (210 psi).

ENGINE COOLANT TEMPERATURE SENSOR

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the engine control module (ECM).

COOLANT TEMPERATURE GAUGE

The coolant temperature gauge controls the instrument panel temperature indicator. The coolant temperature gauge 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.

BLANK

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.

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SPECIFICATIONS

STARTER SPECIFICATIONS

Application	Description
Starter	
No Load Test @ 12.2 volts	Minimum 40 – Maximum 90 amps
Drive Pinion Speed at:	3,200-4,800 rpm
Solenoid	
Hold-in Windings @ 12.2 volts	12-20 amps
Pull-in Windings @ 12.2 volts	60-90 amps

GENERATOR SPECIFICATIONS

Application	Description
Types	CS-121D

BATTERY SPECIFICATIONS

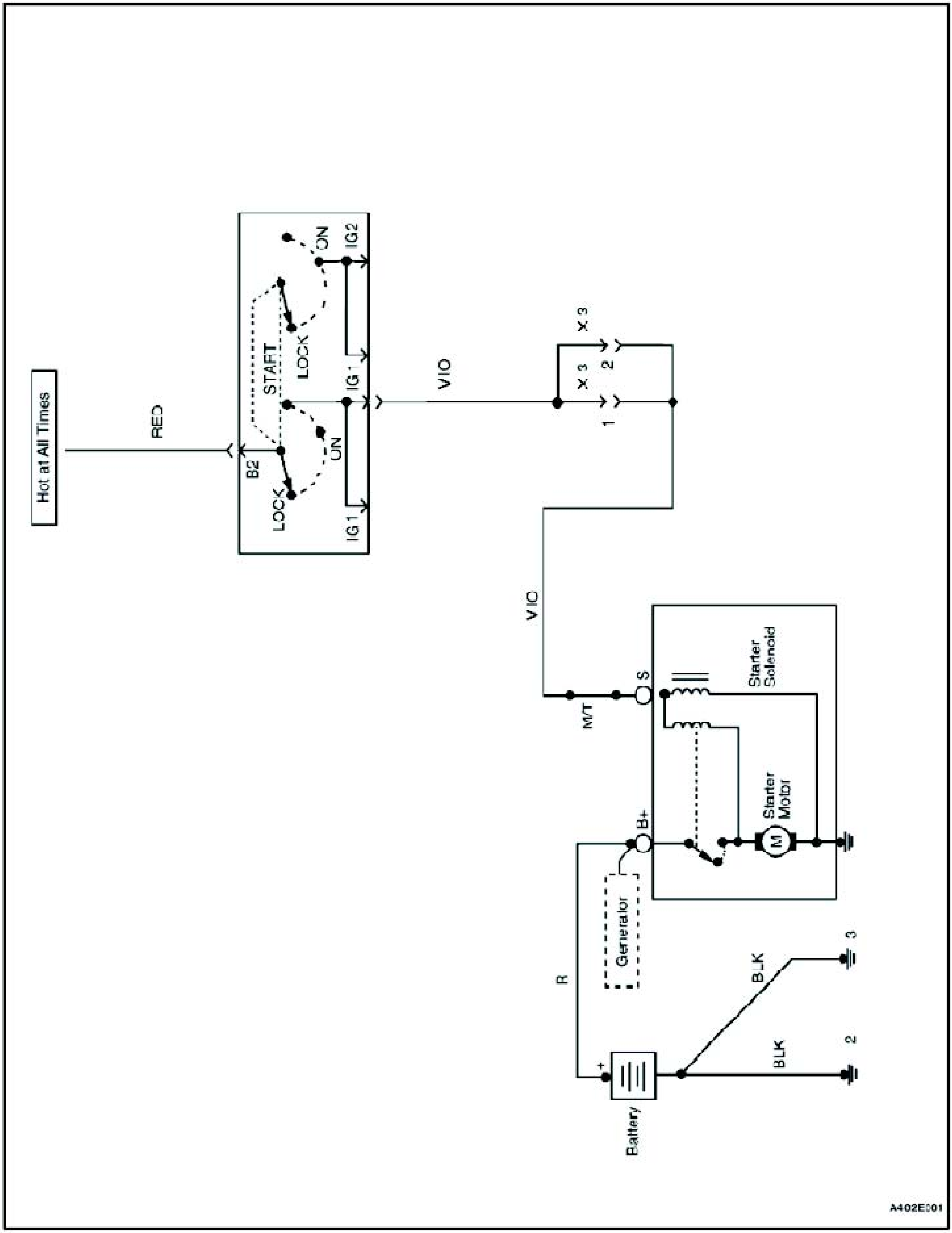
Application	Description
L4 Engine	
Cold Cranking Amps	550 amps
RC (Minimum)	90 minutes
Load Test	270 amps
Replacement	85B-60
Minimum Voltage: 9.6 9.4 9.1 8.8 8.5 8.0	Estimated Temperature: 21°C (70°F) 20°C (68°F) 0°C (32°F) –10°C (14°F) –18°C (0°F) Below –18°C (Below 0°F)

FASTENER TIGHTENING SPECIFICATIONS

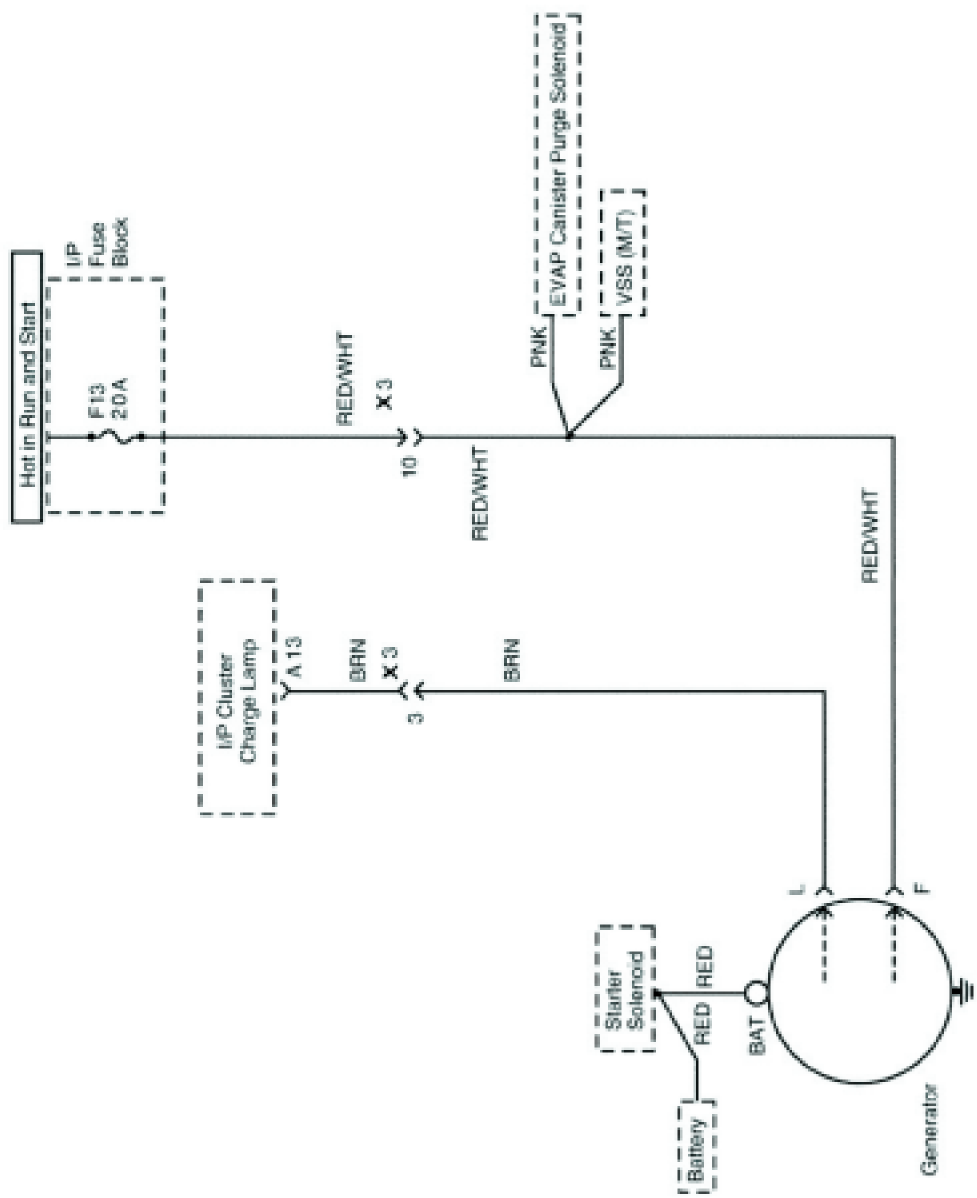
Application	N•m	Lb-Ft	Lb-In
Battery Cable Nuts	4.5	–	40
Battery Carrier Tray Lower Bolts	20	15	–
Battery Carrier Tray Upper Bolts	20	15	–
Battery Retainer Clamp-to-Battery Rod Nuts	4	–	35
Fuel Rail Retaining Bolts	20	15	–
Generator Battery Lead Nut	15	11	–
Generator Drive End Bearing Nut	81	60	–
Generator Lower Bracket-to-Generator Nuts	20	15	–
Generator Shackle Bracket Bolt	20	15	–
Generator Through-Bolts	10	–	89
Starter Field Coil Connector Nut	8	–	71
Starter Mounting Bolts	43	32	–
Starter Solenoid Assembly Screws	8	–	71
Starter Solenoid Nuts	15	11	–
Starter Through-Bolts	6	–	53

SCHEMATIC AND ROUTING DIAGRAMS

STARTING SYSTEM



CHARGING SYSTEM



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DIAGNOSIS

NO CRANK

Step	Action	Value(s)	Yes	No
4	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 5*	Go to *Step 11*
5	Check the battery state of charge. Is the green eye showing from the built–in hydrometer?	–	Go to *Step 6*	Go to “Charging Procedure”
6	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 7*
7	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 8*	Go to *Step 9*
8	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	–
9	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 10*	Go to *Step 16*
10	Clean, tighten, or replace the positive battery cable. Is the repair complete?	–	System OK	–
13	Check the connection at the starter “S” terminal. Is the connection in good condition?	–	Go to *Step 15*	Go to *Step 14*

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
14	Repair the starter "S" terminal. Is the repair complete?	–	System OK	–
15	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 16*	Go to *Step 17*
16	Repair or replace the starter. Is the repair complete?	–	System OK	–

NO CRANK (Cont'd)

Step	Action	Value(s)	Yes	No
42	1. Disconnect connector X3 2. Connect the voltmeter positive lead to terminal 1 of connector X3 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 43*	Go to *Step 46*
43	Check terminal 2 on both sides of connector X3 Is one of them faulty?	–	Go to *Step 44*	Go to *Step 45*
44	Repair the faulty terminal. Is the repair complete?	–	System OK	–
45	Repair the open in RED wire from terminal 2 tconector X3 la terminal S starter	–	System OK	–
46	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 48*	Go to *Step 47*
47	Replace the ignition switch. Is the repair complete?	–	System OK	–
48	Check terminal ST on the ignition switch and terminal 3 of the ignition switch connector. Are the terminals in good condition?	–	Go to *Step 49*	Go to *Step 50*
49	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	–
50	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 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 the 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 obvious damage is noted, 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” 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

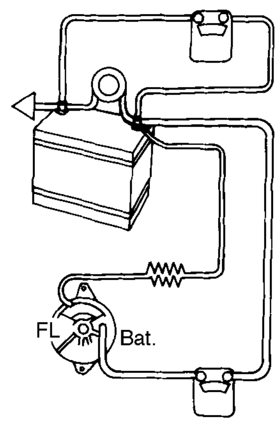
1. Perform the generator system test. Refer to “Generator System Check” in this section.
2. Replace the generator if it fails that test. Refer to “Generator” in the On-Vehicle Service section. If it passes the test, perform the on-vehicle output check which follows.

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.

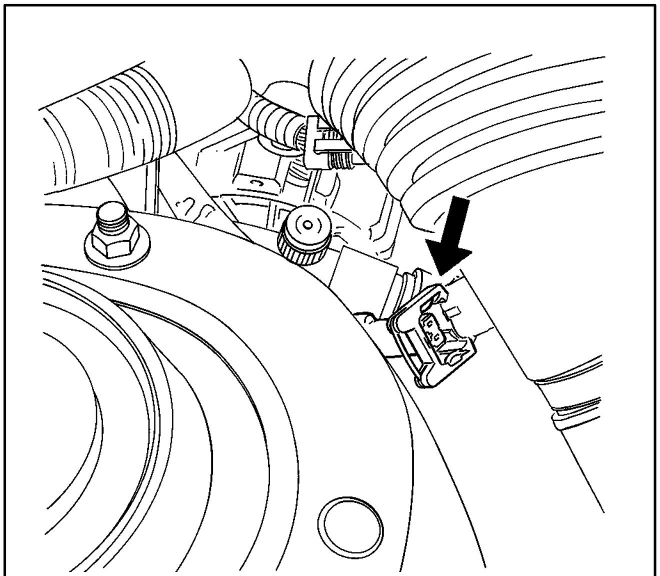
Important: Always check the generator for output before assuming that a grounded “L” terminal circuit has damaged the regulator. Refer to “Generator” in the Unit Repair section.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

GENERATOR

Removal Procedure



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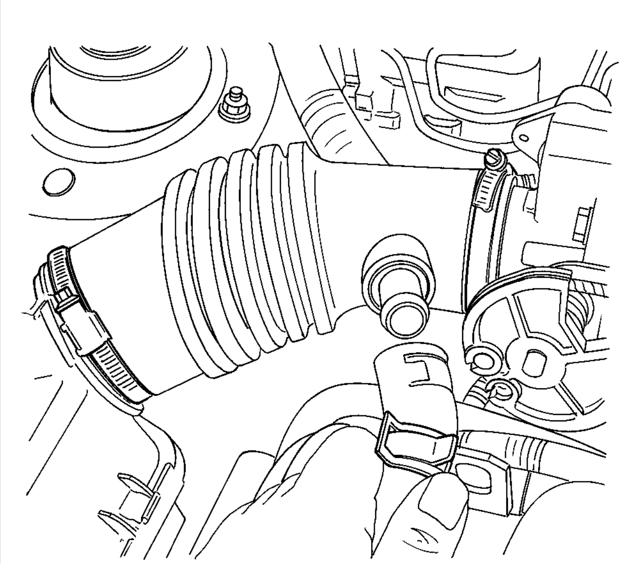
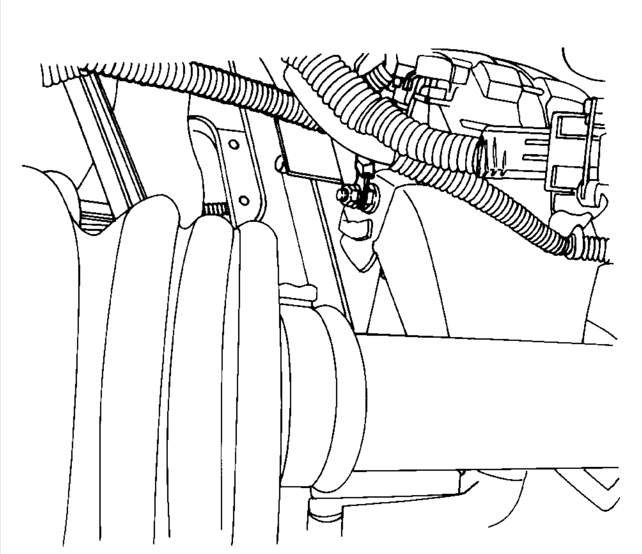
1. Disconnect the negative battery cable.
2. Disconnect the intake air temperature (IAT) sensor electrical connector from the air intake tube.



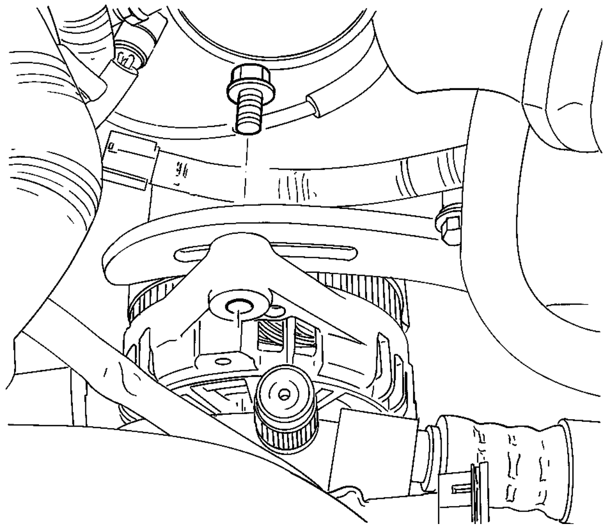
A202E002

3. Remove the breather tube clamp and all other clamps to remove the air intake tube.



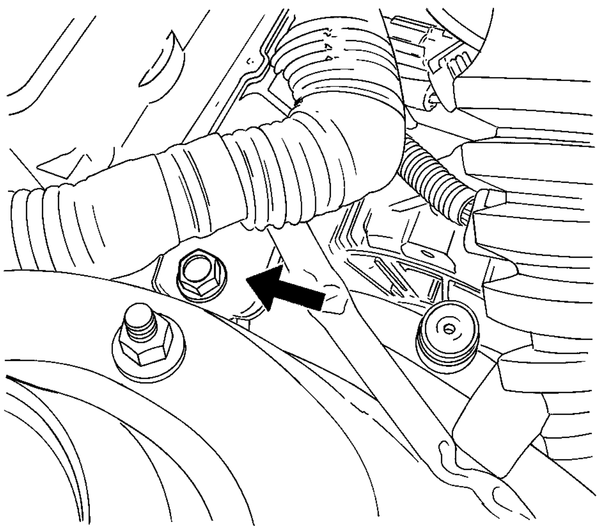
A102E232

4. Remove the battery harness connector nut from the generator.



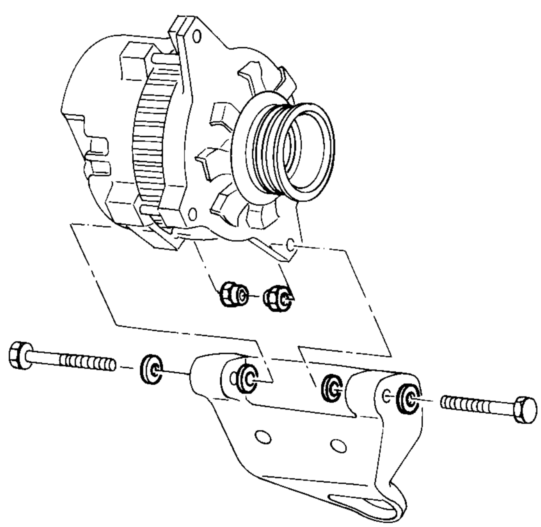
A202E003

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.*



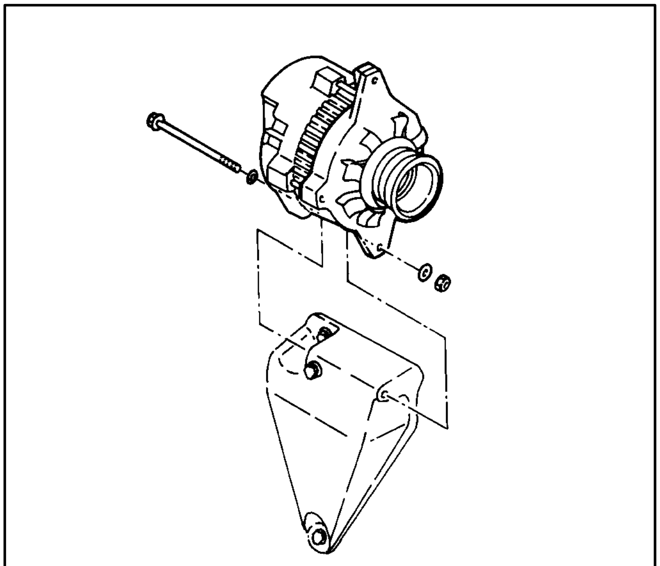
A202E004

7. Remove the bolt and the retaining clamp of the harness.



A102E234

8. For vehicles with the SOHC engine, remove the nuts and the washers which hold the generator lower bracket-to-generator bolts.

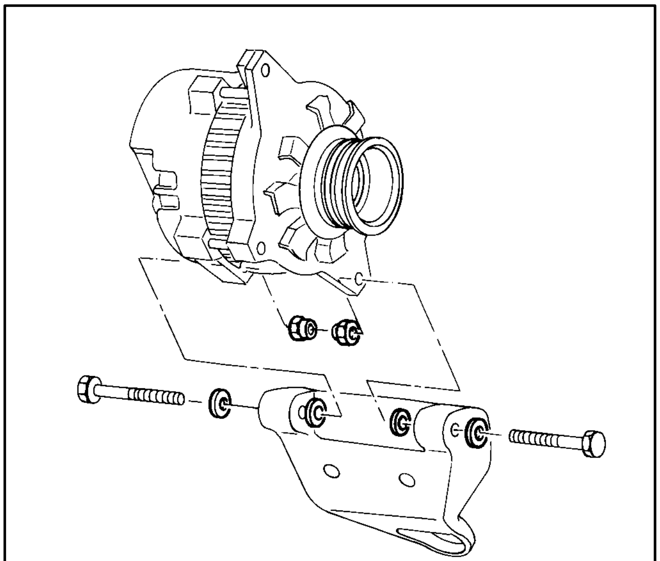


A102E254

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.



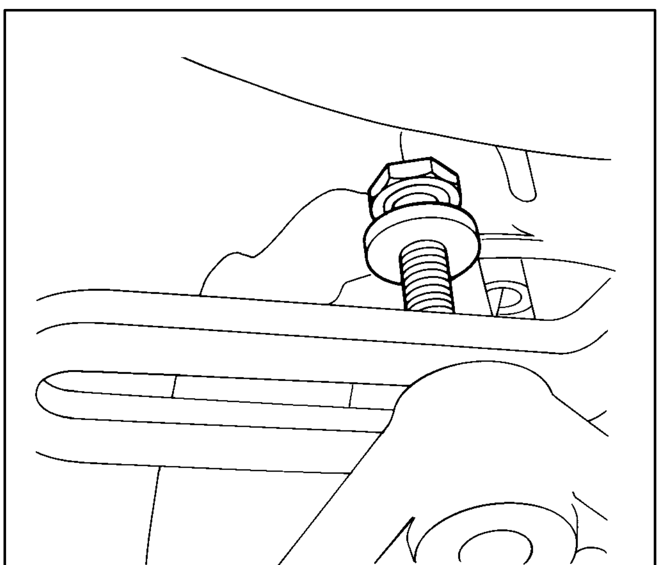
A102E234

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 N•m (15 lb-ft).

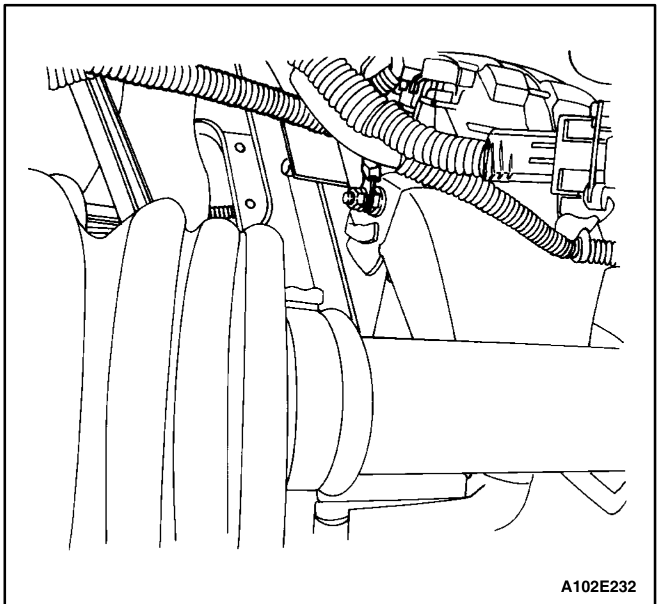


A102E231

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 *Section 6B, Power Steering Pump.*

Tighten

Tighten the generator shackle bracket bolt to 20 N•m (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

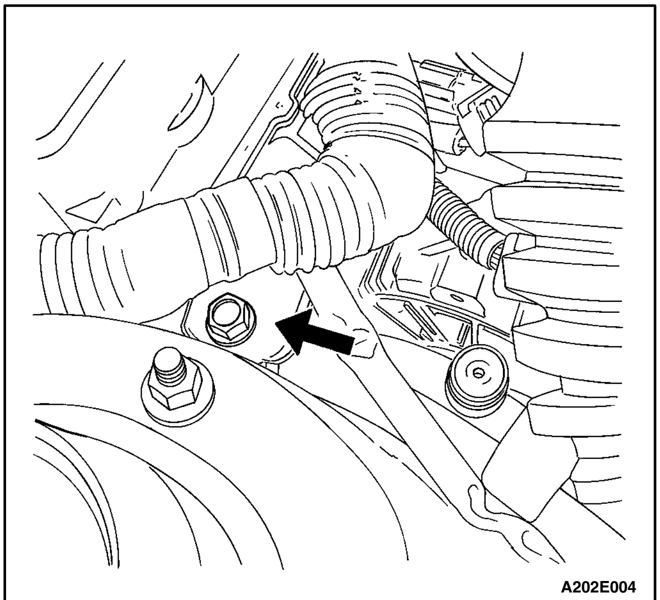
Tighten the generator battery lead nut to 15 N•m (11 lb-ft).

7. Lubricate the injector O-rings on the DOHC engine with engine oil.
8. Install the fuel rail assembly.

Tighten

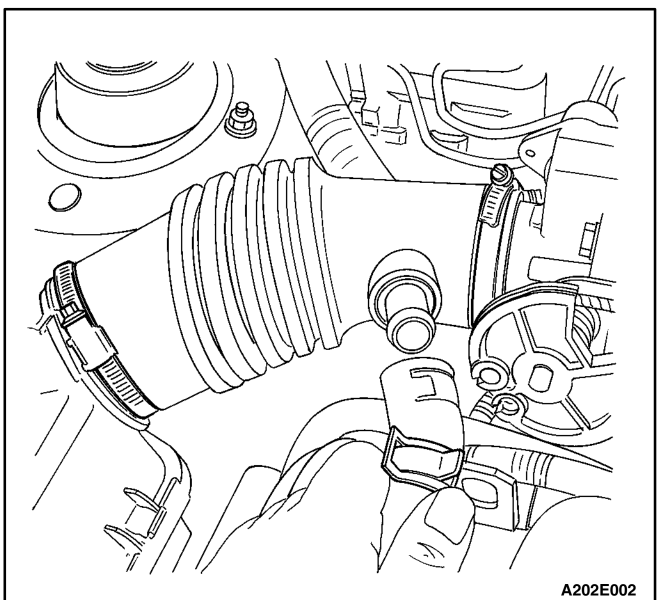
Tighten the fuel rail retaining bolts to 20 N•m (15 lb-ft).

9. Install the throttle body. Refer to *Section 1F, Engine Controls.*



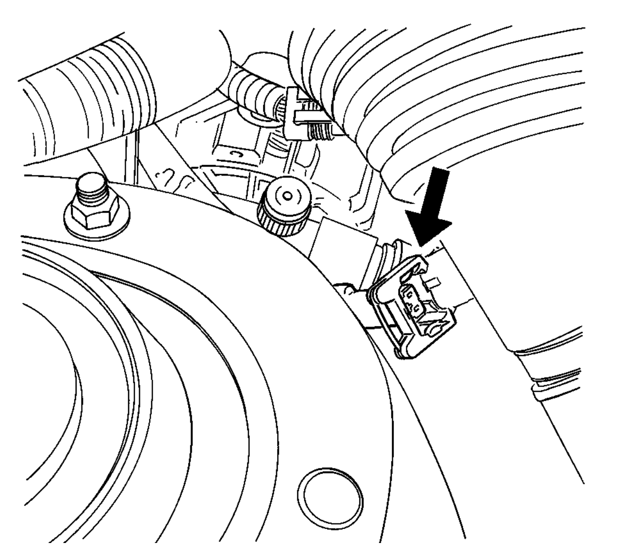
A202E004

10. Install the harness retaining clamp bolt.

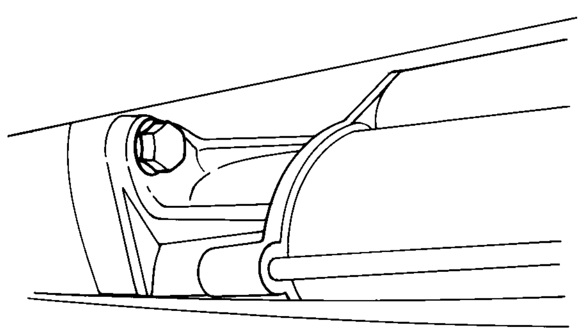


A202E002

11. Install the air intake tube and the connector.


A202E001

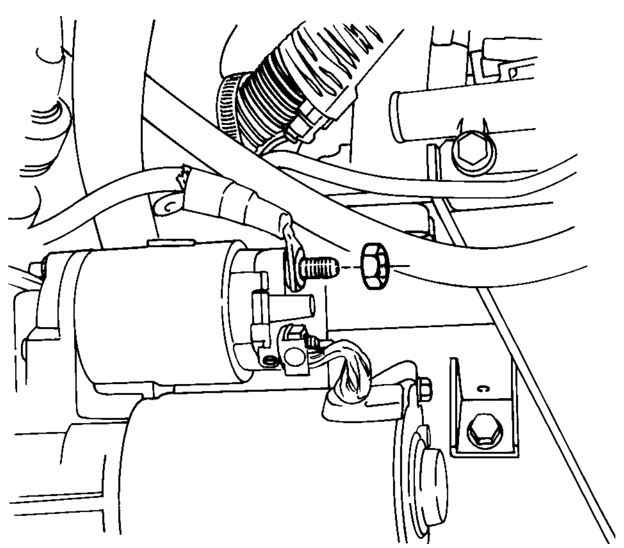
12. Install the IAT electrical connector to the air intake tube.
13. Connect the negative battery cable.


A102E235

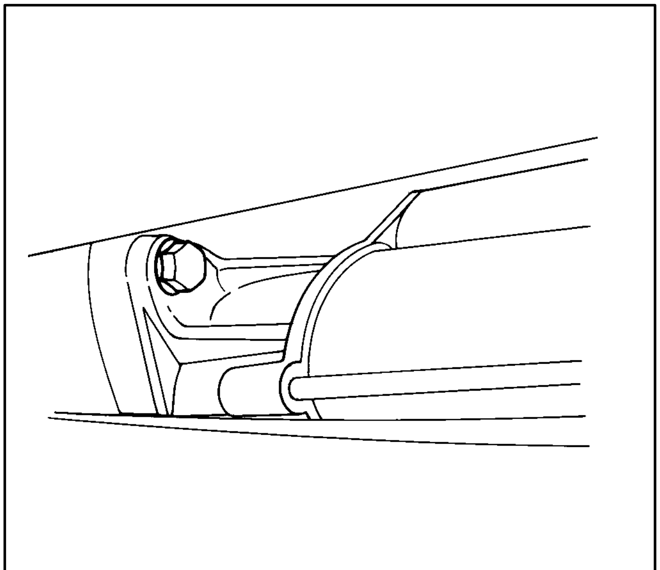
STARTER

Removal Procedure

1. Remove the upper and the lower starter mounting bolts.


A102E236

2. Remove the starter solenoid nuts to disconnect the electrical cable.
3. Remove the starter assembly.

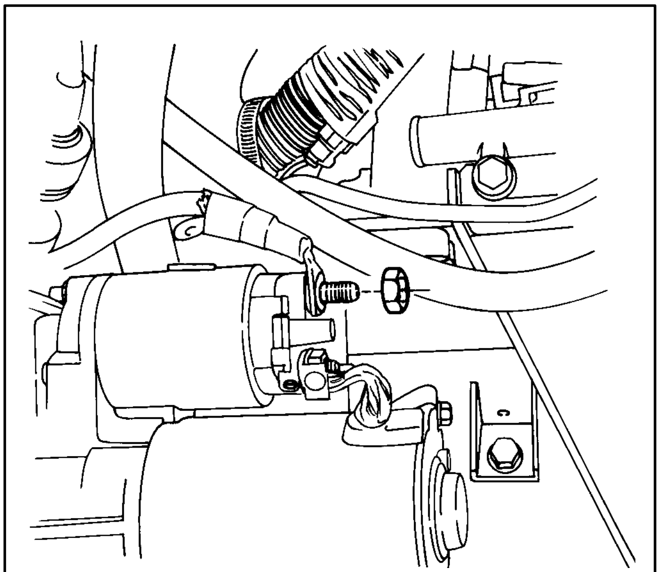

A102E235

Installation Procedure

1. Place the starter assembly in position.
2. Install the upper and the lower starter mounting bolts.

Tighten

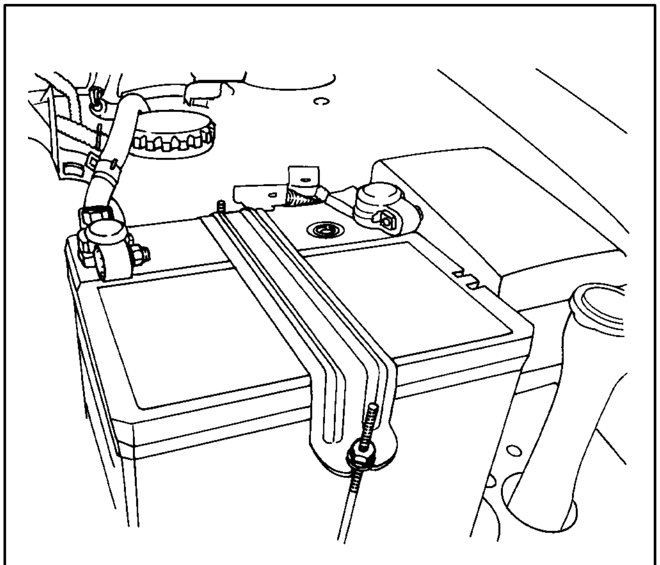
Tighten the starter mounting bolts to 43 N•m (32 lb-ft).


A102E236

3. Position the starter electrical wire on the solenoid terminal.
4. Install the starter solenoid nuts.

Tighten

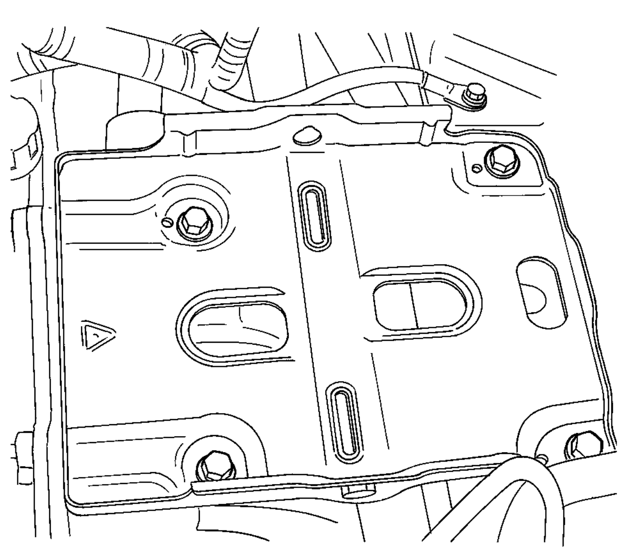
Tighten the starter solenoid nuts to 15 N•m (11 lb-ft).


A102E241

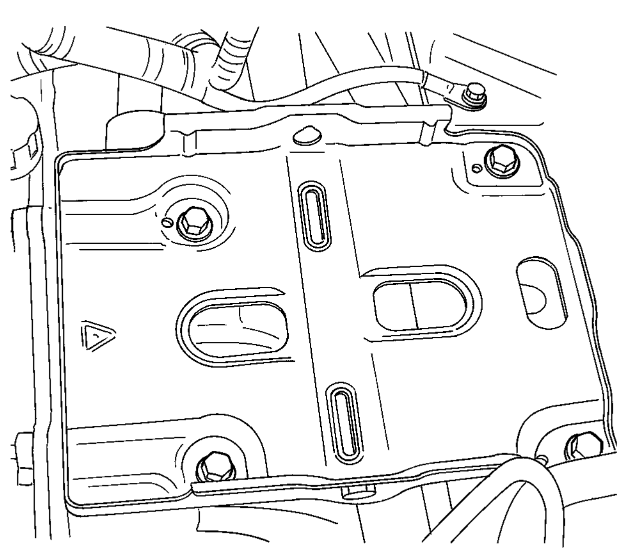
BATTERY/BATTERY TRAY

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.

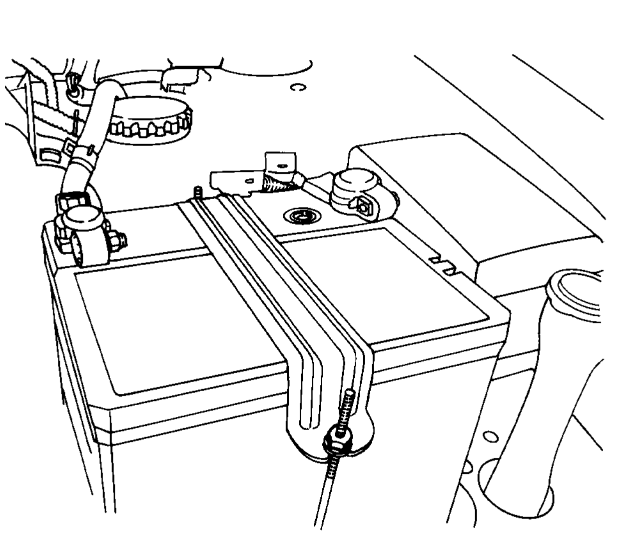

A202E005

Installation Procedure

1. Install the battery carrier by fastening the carrier tray upper and lower bolts.

Tighten

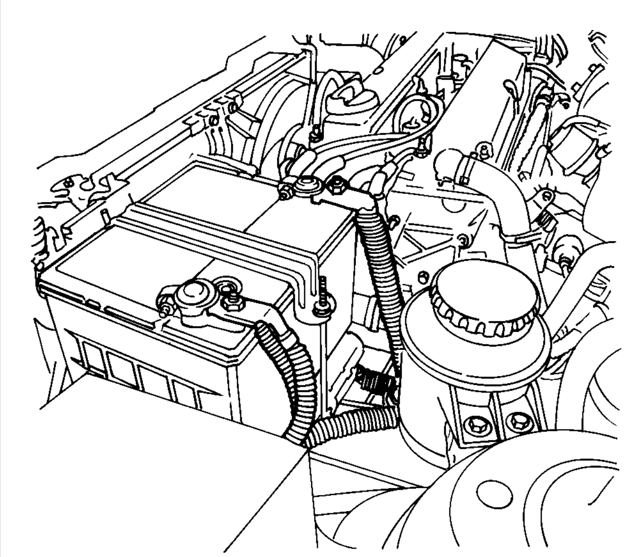
Tighten the battery carrier tray upper and lower bolts to 20 N•m (15 lb-ft).


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 4 N•m (35 lb-in).

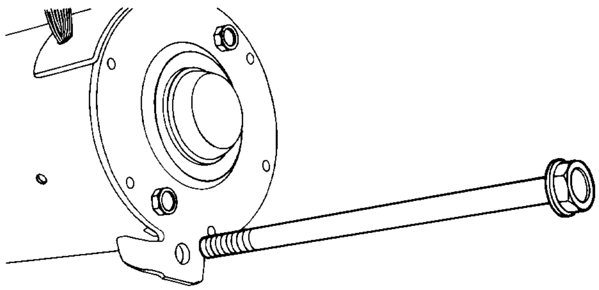


A102E240

4. Connect the negative and the positive battery cables.

Tighten

Tighten the battery cable nuts to 15 N•m (11 lb-ft).



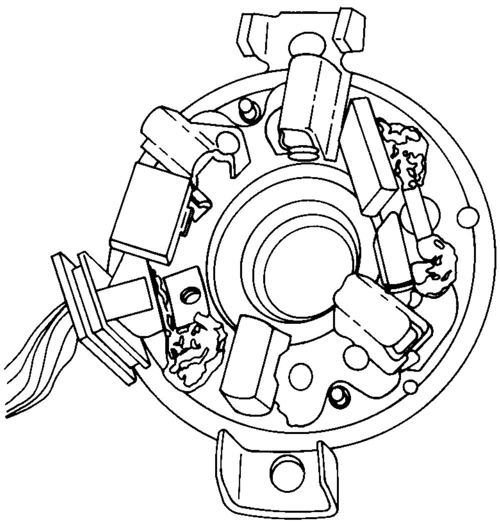
A102E239

UNIT REPAIR

STARTER MOTOR

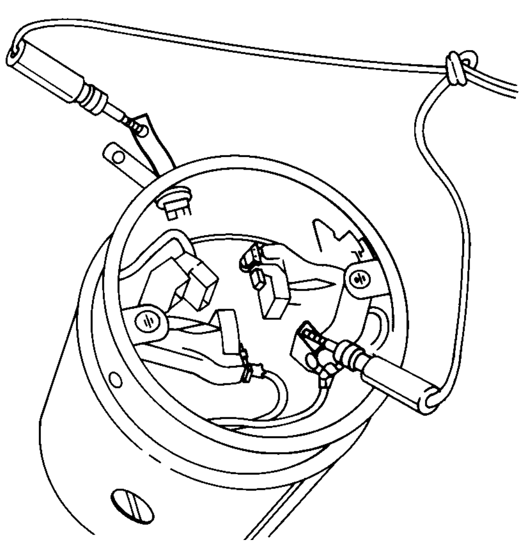
Disassembly Procedure

1. Remove the starter. Refer to "Starter" in this section.
2. Remove the starter through-bolts.



A102E215

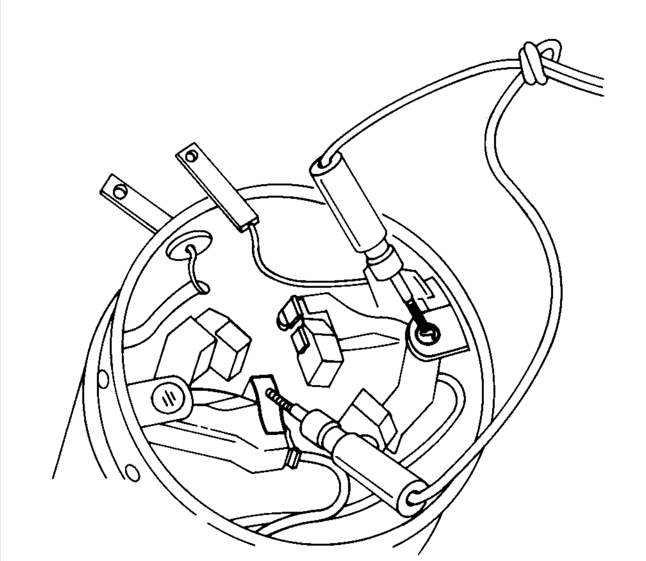
3. Remove the commutator end frame/brush holder assembly.
4. Inspect the brushes, the pop-out springs, and the brush holders for wear and damage. Replace the assembly, if necessary.



A102E216

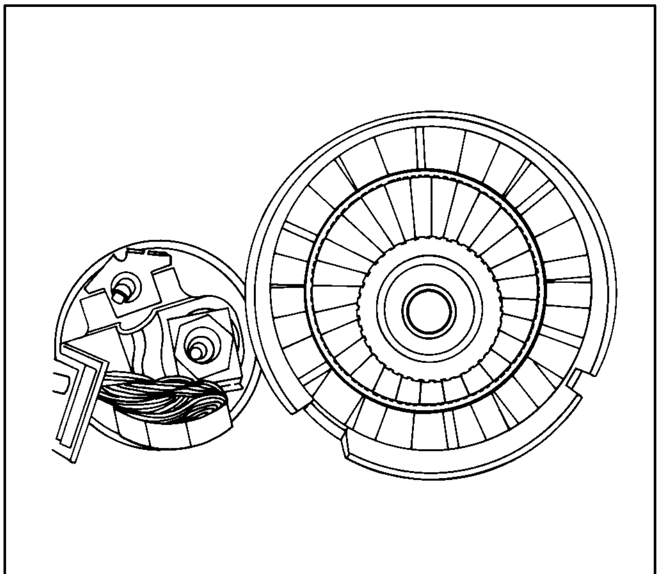
Important: This test should be made for each ground or insulated brush to ensure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

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.



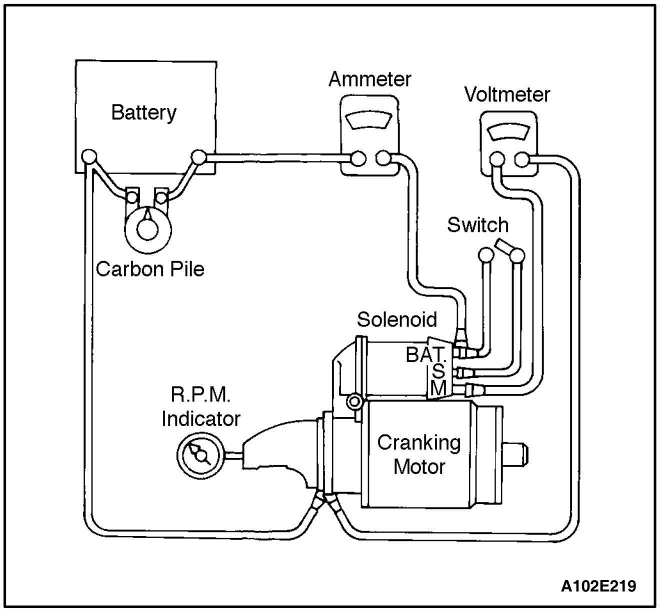
A102E217

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, place 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

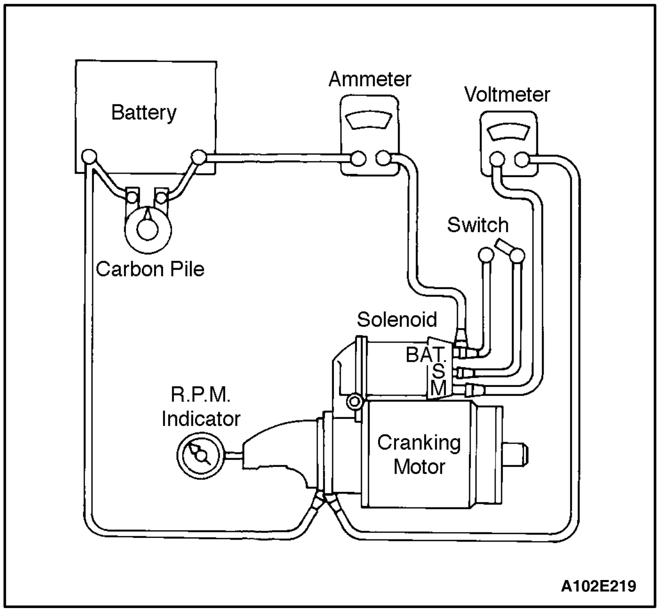
7. Check the armature to see if it turns freely. If the armature does not turn freely, break down the assembly immediately, starting with Step 14. Otherwise, give the armature a no-load test.



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.

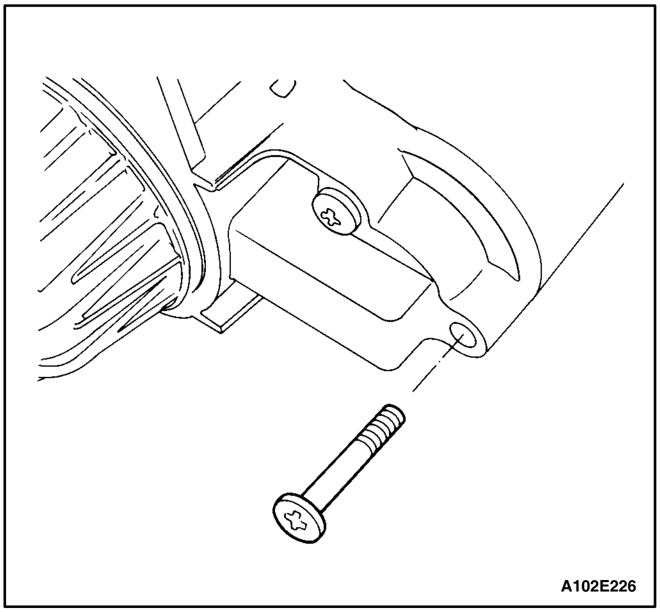
8. To begin the no-load test, close the switch and compare the rpm, the current, and the voltage readings with the specifications. Refer to "Starter Specifications" in this section. Make disconnections only with the switch open. Use the test results as follows:
   - 8.1 Rated current draw and no-load speed indicate a normal condition for the starter motor.
   - 8.2 Low rpm combined with high current draw is an indication of excessive friction caused by tight, dirty, or worn bearings; a bent armature shaft; a shorted armature; or shorted field coils.



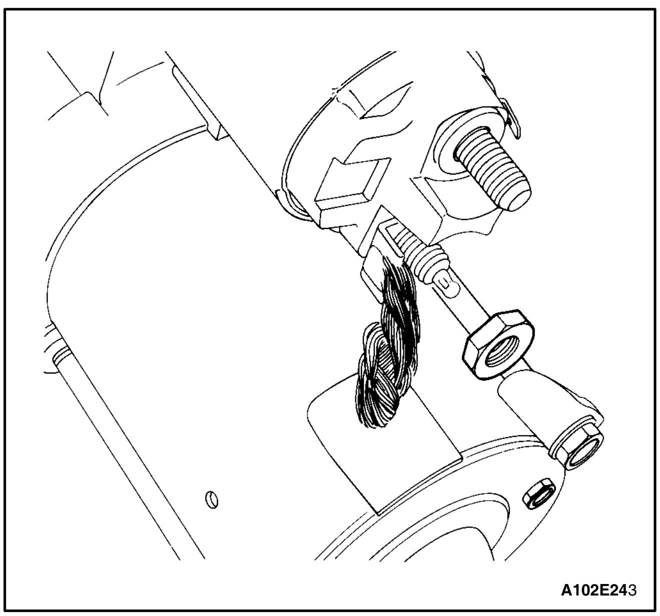
8.3 Failure to operate with high current draw indicates a direct ground in the terminal or fields, or "frozen" bearings.

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.

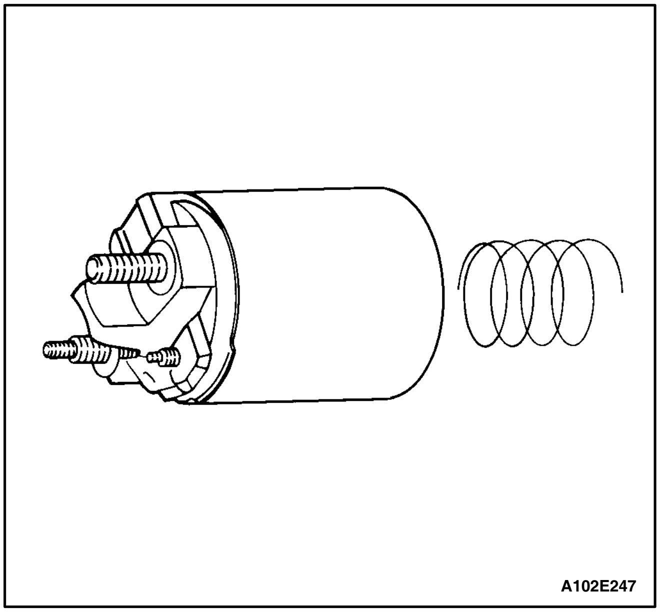
8.5 Low no-load speed and low current indicate high internal resistance and high current draw, which usually mean shorted fields.



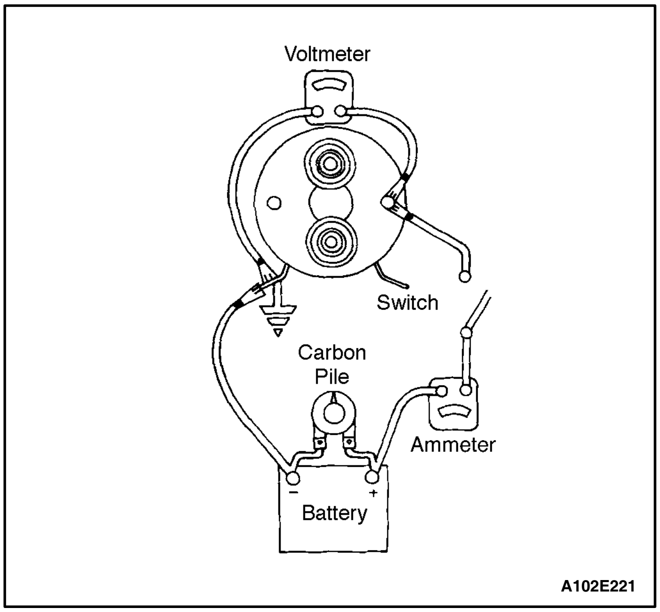
9. Remove the solenoid assembly screws.



10. Remove the field connector nut. Disconnect the field connector.

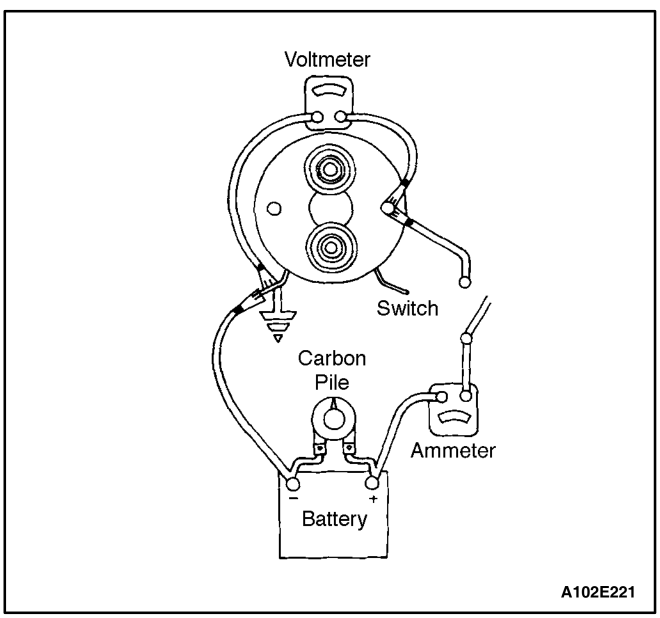


11. Rotate the solenoid 90 degrees and remove it along with the plunger return spring.



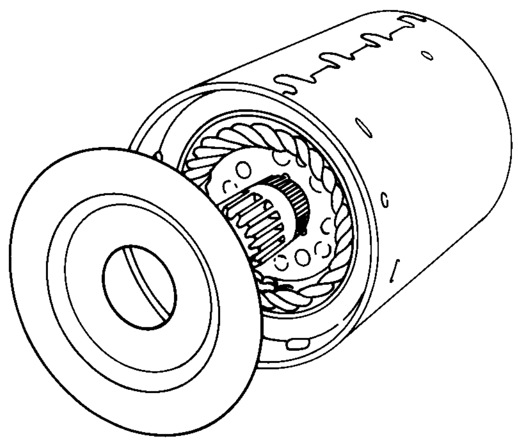
Important: If the solenoid is not removed from the starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests.

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 10 volts. The ammeter reading should be 13 to 19 amperes.



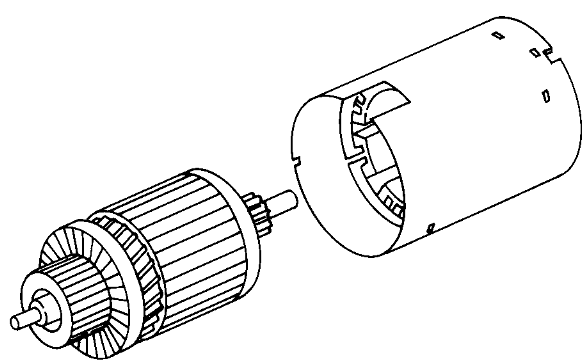
Important: Current will decrease as the windings heat up. Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid. Both conditions require replacement of the solenoid. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit.

13. Check both windings, connecting them according to 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 necessary.



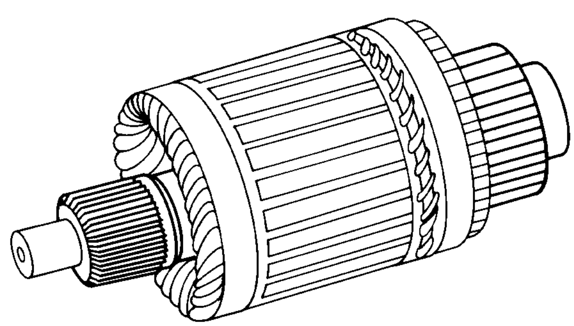
A102E222

14. Slide the field frame with the enclosed armature assembly away from the starter assembly.
15. Remove the shield.



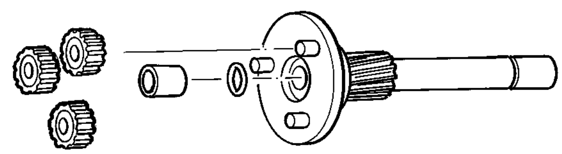
A102E242

16. Separate the field frame from the armature.



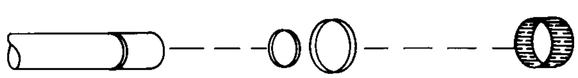
A102E223

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.



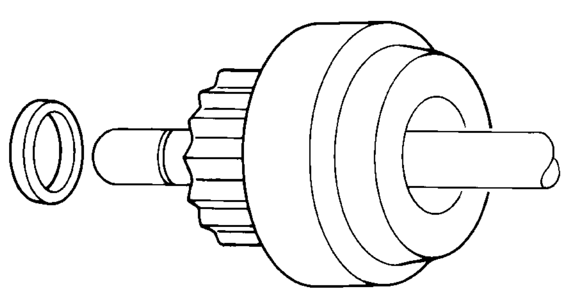
A202E006

22. Remove the gears, the bushings, and the washer.
23. Remove the cushion and the driveshaft assembly from the starter housing.



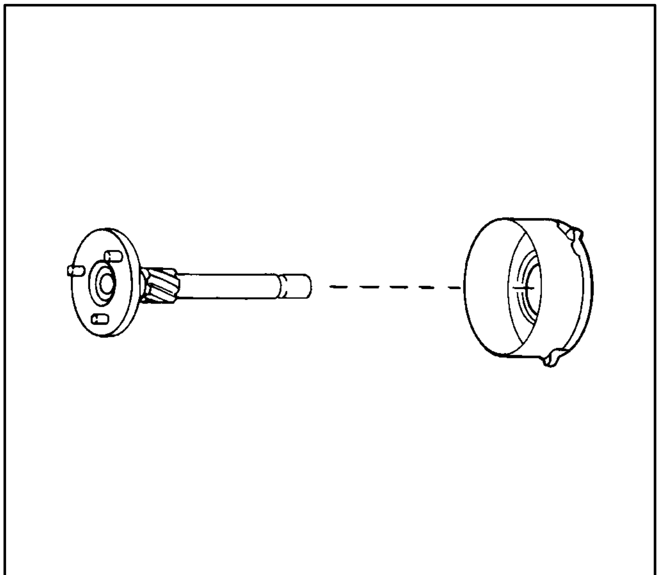
A102E220

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.

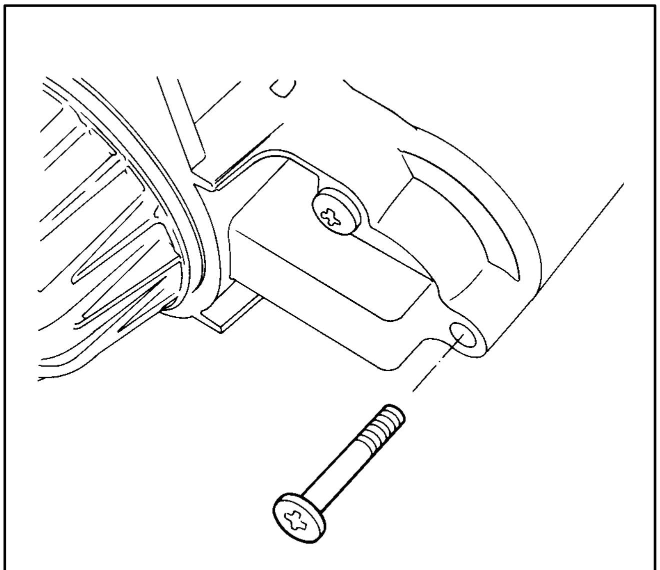


A102E248

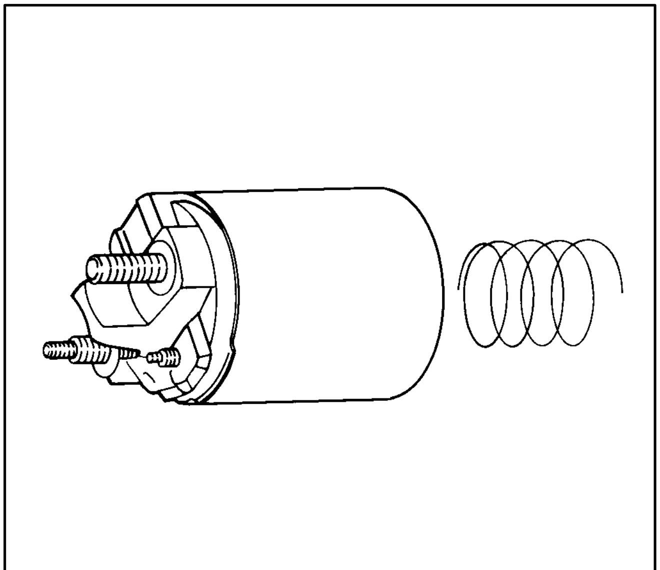
26. Remove the pinion stop and the drive from the driveshaft.


A102E249

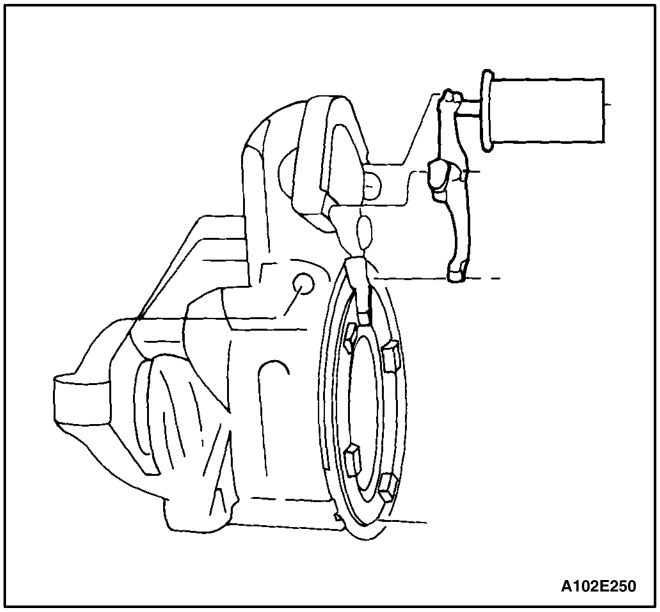
27. Remove the gear support from the driveshaft.


A102E226

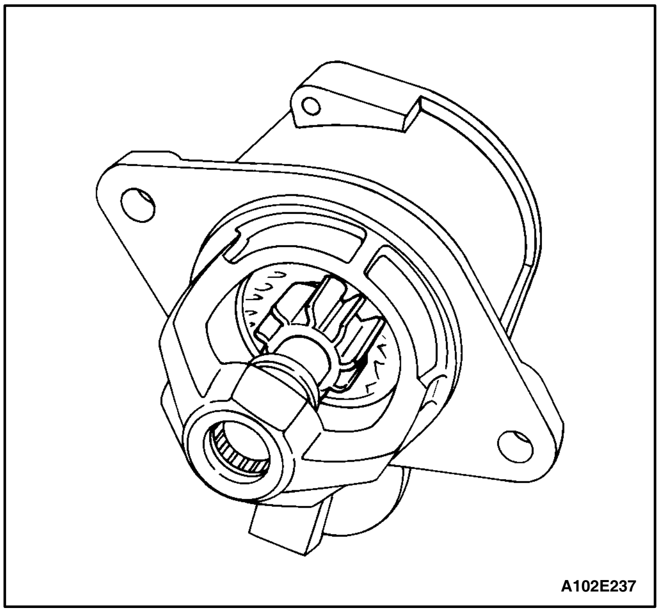
28. If not done in the previous steps, remove the screws that hold the solenoid assembly into the housing, and remove the nut from the field coil connector.


A102E247

29. Rotate the solenoid 90 degrees and remove it along with the return spring.

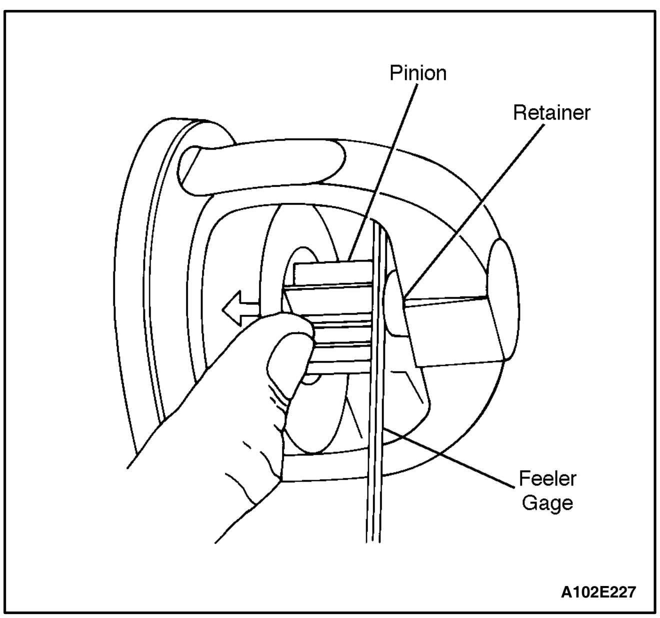


30. Remove the plunger with the boot and the shift lever assembly. Test the solenoid windings, if not done in Step 12.



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.

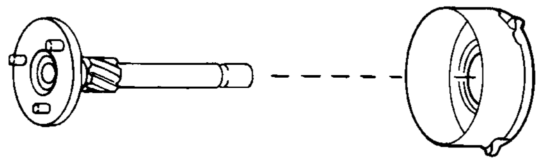
31. When the starter motor is disassembled and the solenoid is replaced, it is necessary to check the pinion clearance.



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.

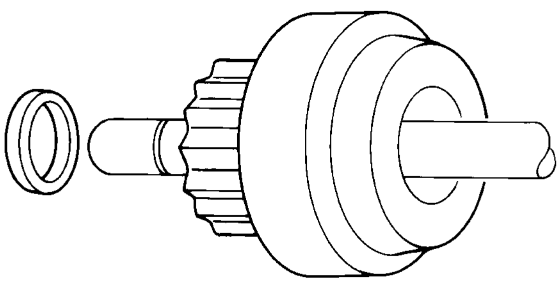
Important: A means for adjusting the pinion clearance is not provided on the starter motor. If the clearance does not fall within the limits, check for improper installation and replace all worn parts.

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).

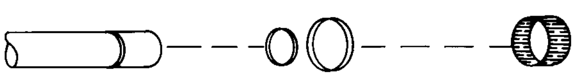

A102E249

Assembly Procedure

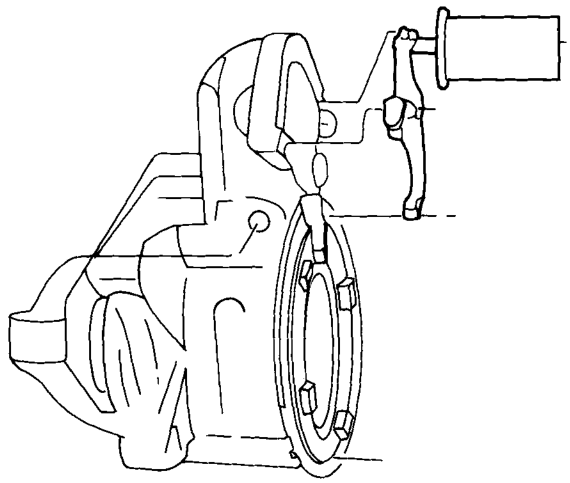
1. Clean all of the starter motor parts, but do not use grease-dissolving solvents for cleaning the armature and the field coils.
2. Lubricate the gears with lubricant. (Begin at Step 7 if proceeding with just the reassembly of the solenoid.)
3. If full disassembly of the starter and the solenoid was performed, begin reassembly by placing the gear support on the driveshaft assembly.


A102E248

4. Install the drive and the pinion stop on the driveshaft.

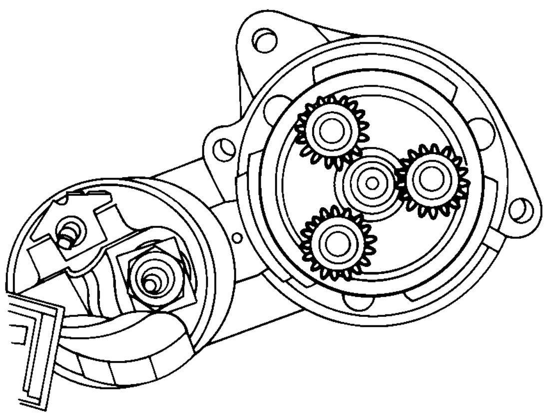

A102E220

5. Install the lock ring into the groove on the driveshaft and insert the collar.
6. Install the needle bearing.



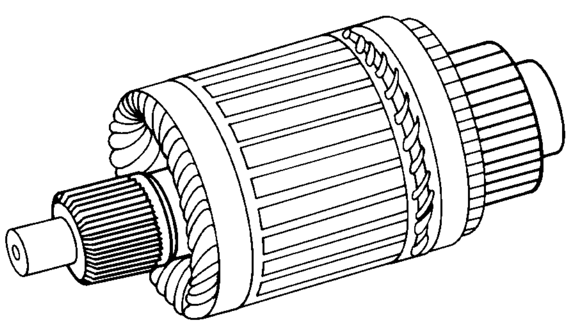
A102E250

7. Install the shift lever assembly with the plunger and the boot.



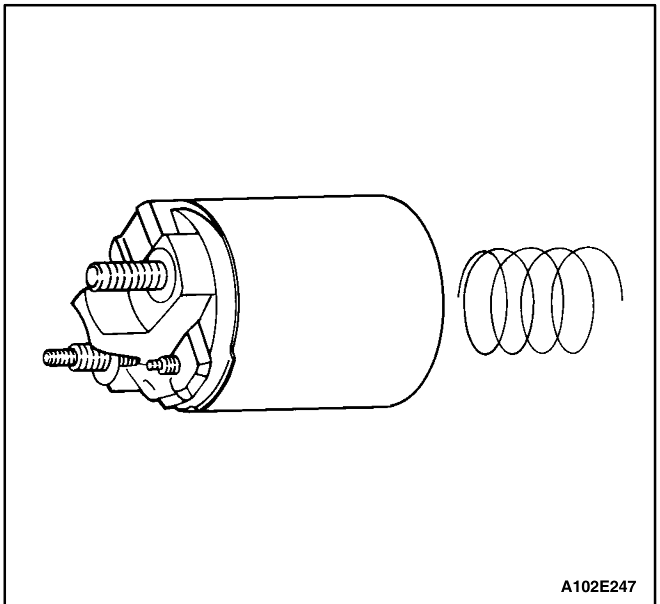
A102E224

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.



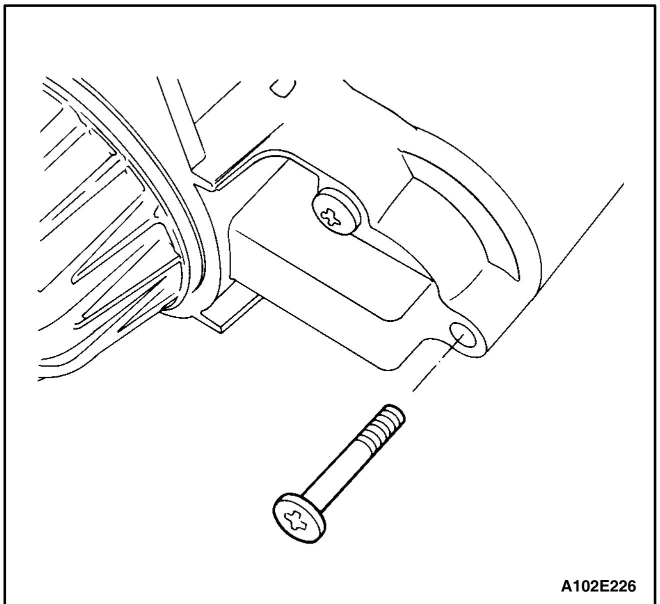
A102E223

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.

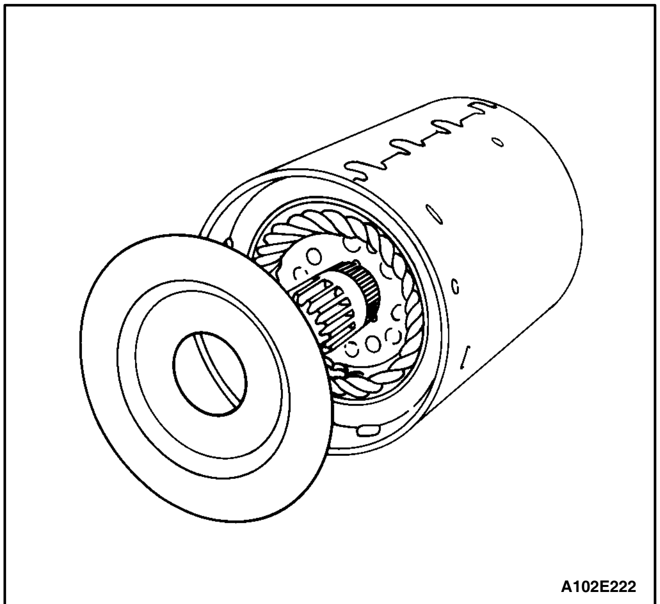
Tighten

Tighten the starter solenoid assembly screws to 8 N•m (71 lb-in).

13. Install the field coil connection to the starter terminal. Install the nut.

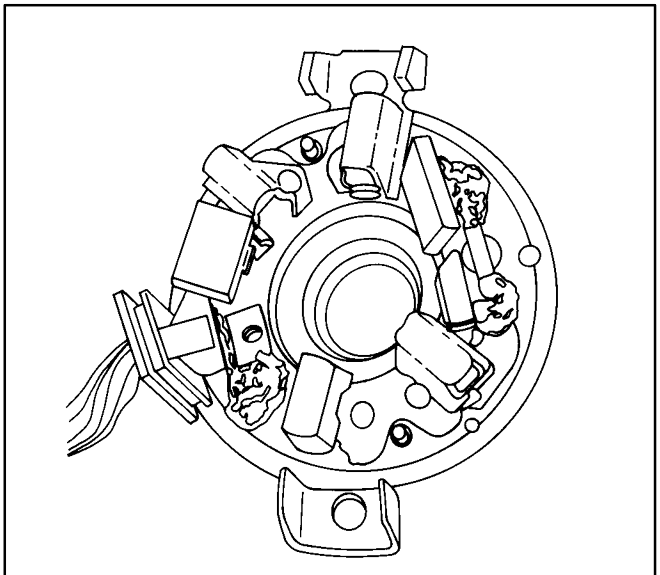
Tighten

Tighten the starter field coil connector nut to 8 N•m (71 lb-in).



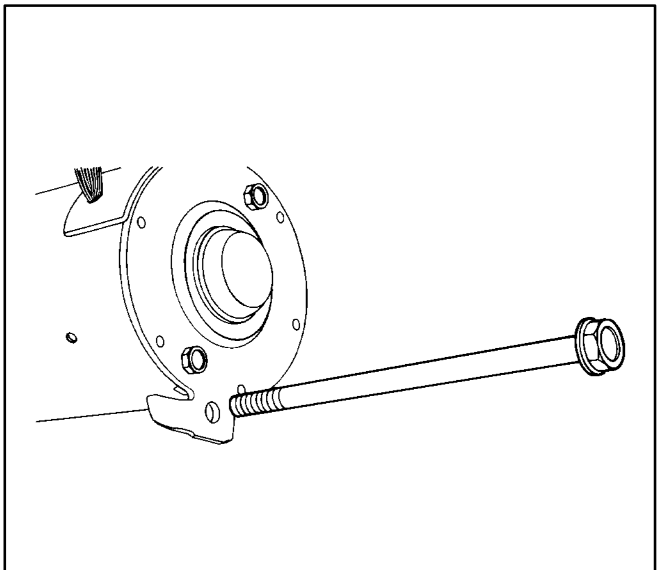
A102E222

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.

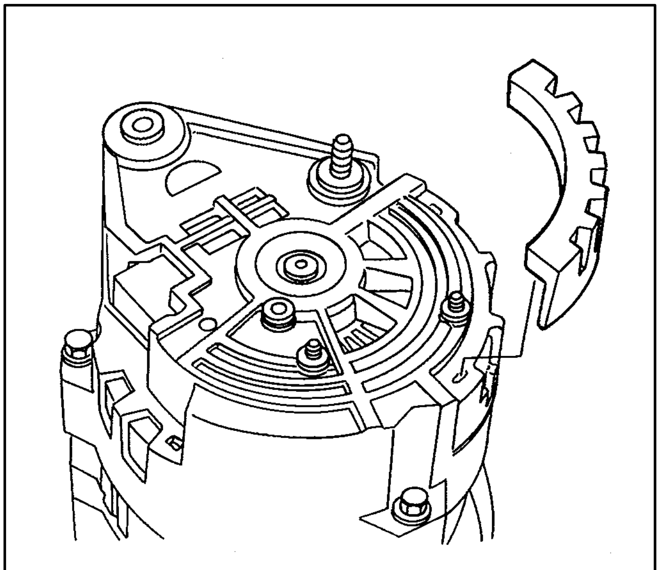


A102E239

18. Install the starter through-bolts.
19. Install the starter. Refer to “Starter” in this section.

Tighten

Tighten the starter through-bolts to 6 N•m (53 lb-in).

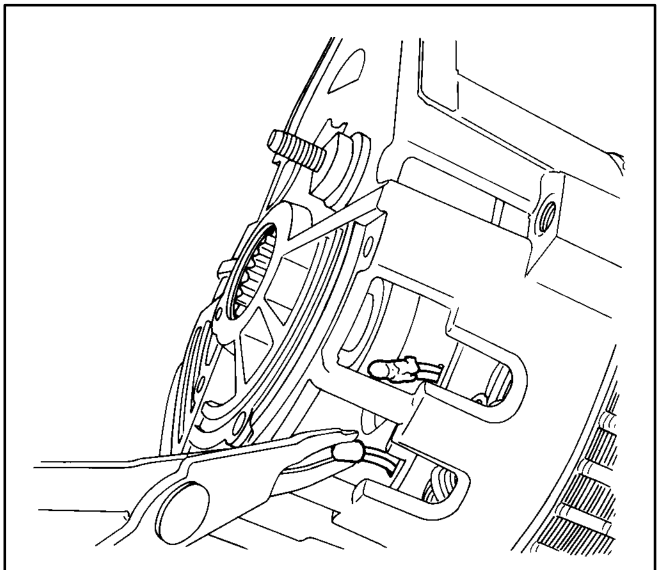


A102E201

GENERATOR

Disassembly Procedure

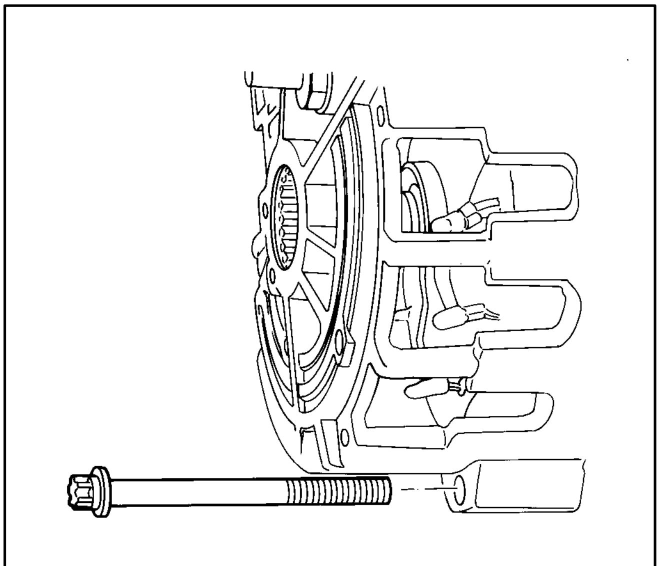
1. Remove the generator. Refer to “Generator” in the On-Vehicle Service section.
2. Mark a match line that cannot easily be removed on the end frame to make assembly easier.
3. Pry off the plastic cover to expose the stator connections.



A102E258

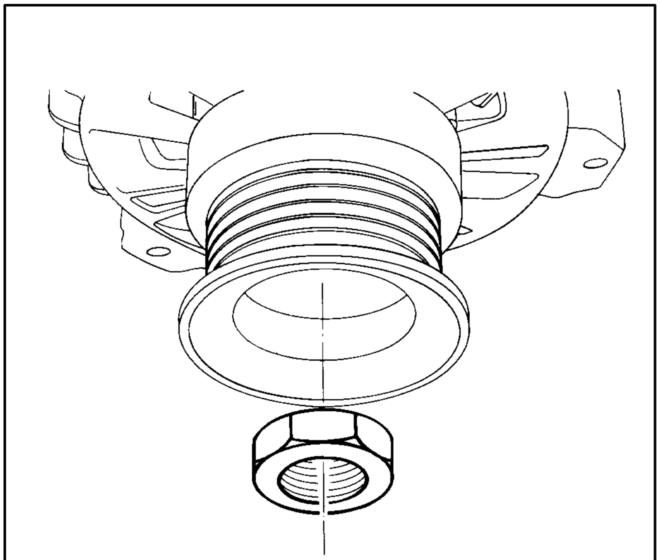
Notice: If the stator connections are not welded, melt the lead. Avoid excessive heating, as it can damage the diodes in the rectifier bridge.

4. Remove the stator connections from the rectifier bridge terminals by cutting the wires.



A102E203

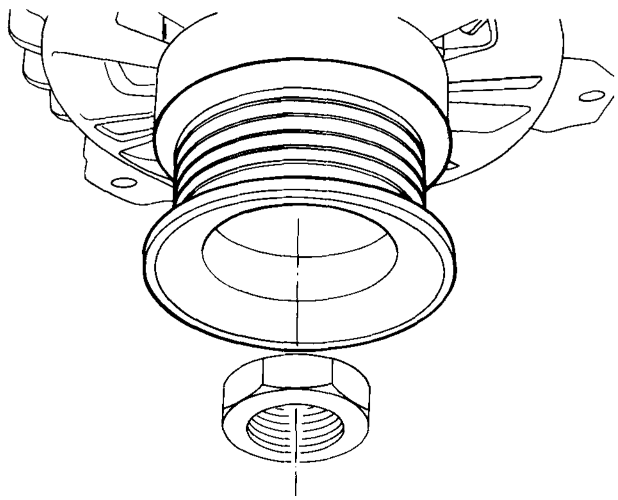
5. Remove the generator through-bolts.



A102E251

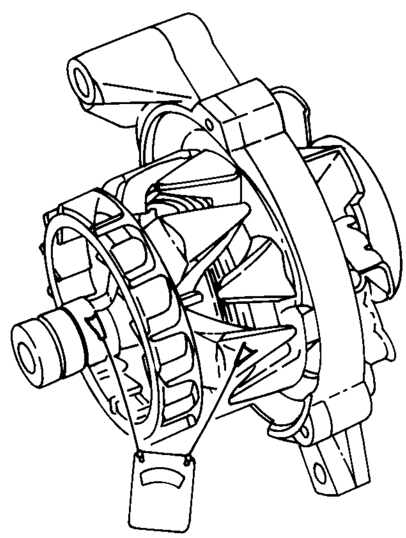
Important: The fastening torque of this nut is 81 N•m (60 lb-ft) and may not normally be unfastened using hand strength.

6. Move to the drive end of the generator and remove the drive end bearing nut.



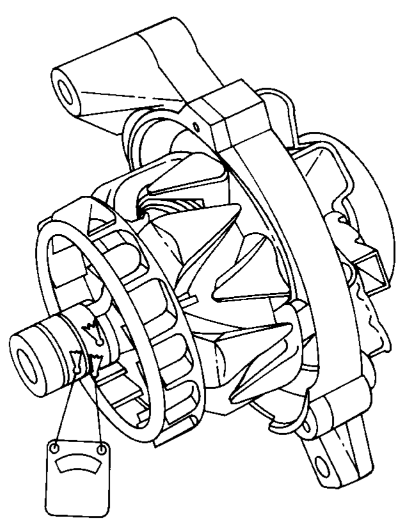
A102E259

7. Remove the pulley and the collars.



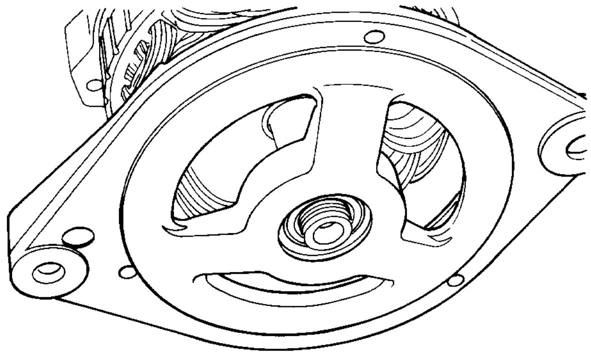
A102E252

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.



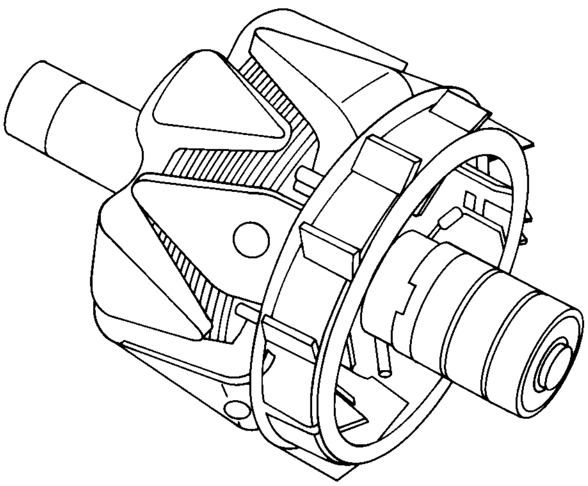
A102E205

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.



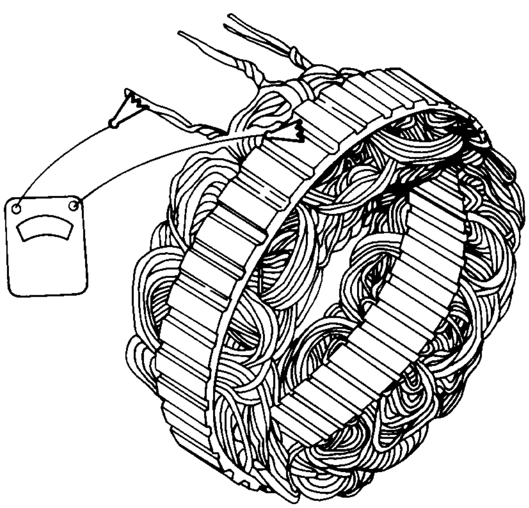
A102E206

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.



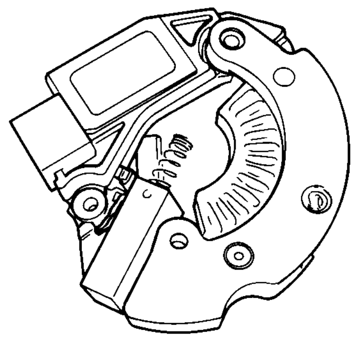
A102E207

12. Remove the rotor assembly.



A102E208

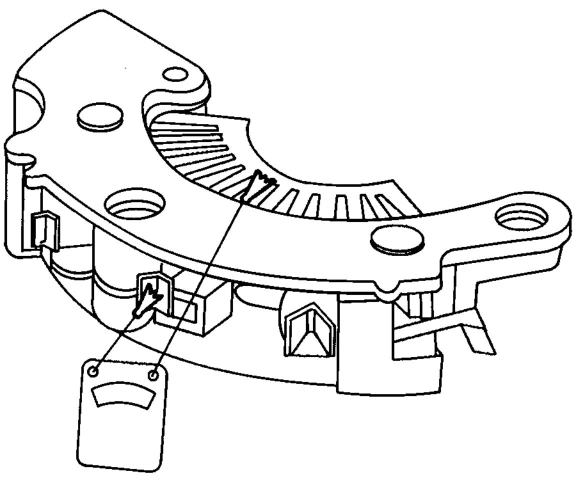
13. Remove the stator.
14. Test the stator for an open circuit using the ohmmeter.



A102E256

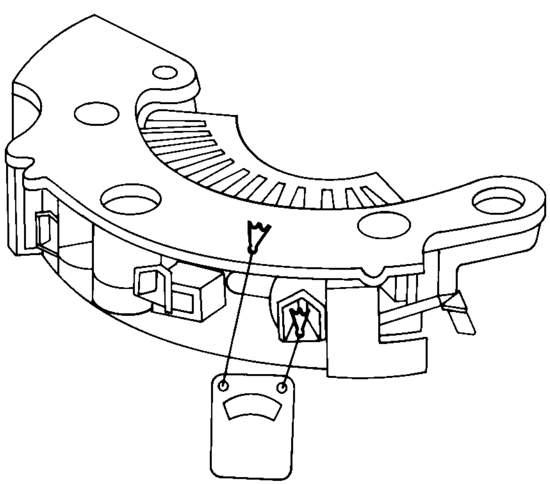
15. Pry off the baffle.
16. Remove the rectifier/regulator/brush holder assembly screws.
17. Remove the brush holder assembly and the regulator, cutting the terminal between the regulator and the rectifier bridge.

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.



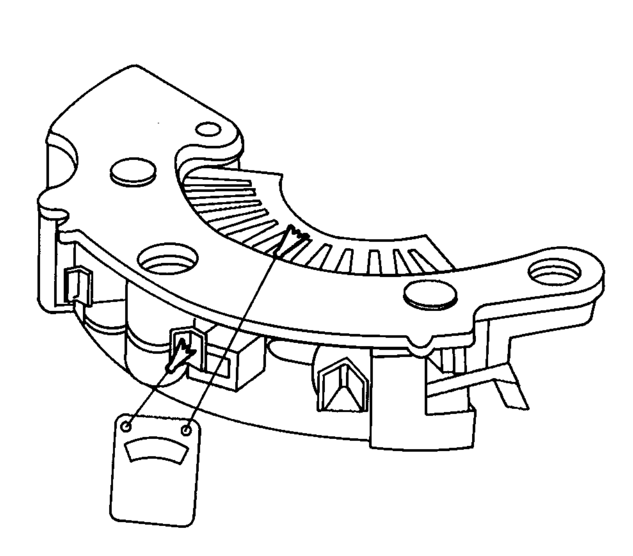
A102E211

18. Test the rectifier bridge by connecting the ohmmeter terminals to the bridge and the heat sink.



A102E204

19. Retest by connecting the ohmmeter terminals in reverse.

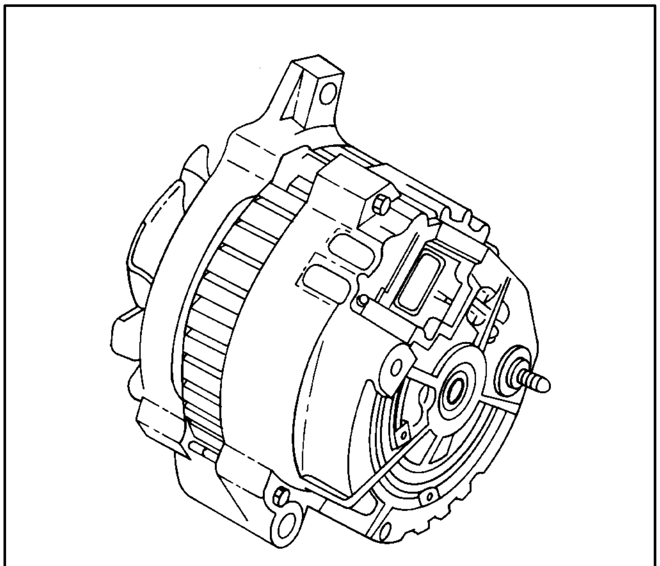


A102E211

20. Replace the rectifier bridge, if each reading is the same.
21. Test the remaining two diodes after the above procedure.

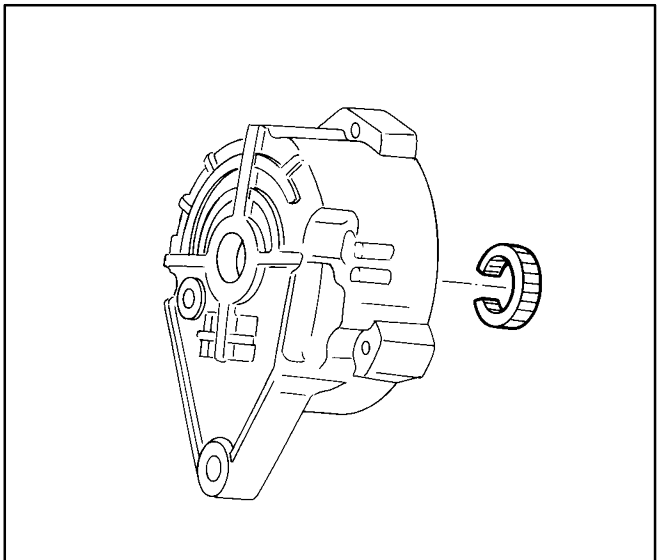
Notice: Some kinds of digital ohmmeters are not suited for the test of the bridge diode. In this case, consult the manufacturer regarding the test capacity.

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

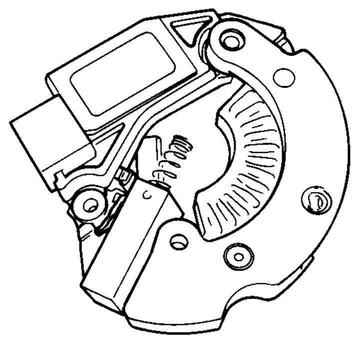
23. Remove the ring in the slip ring end frame.



A102E257

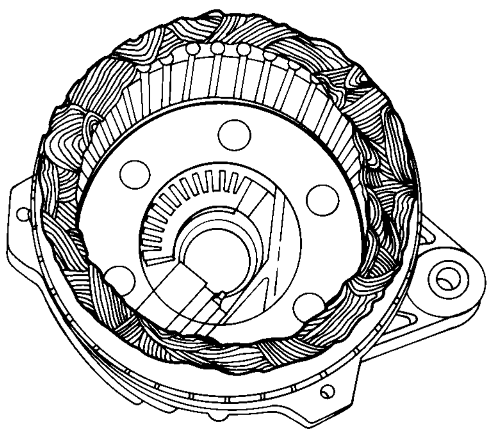
Assembly Procedure

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.



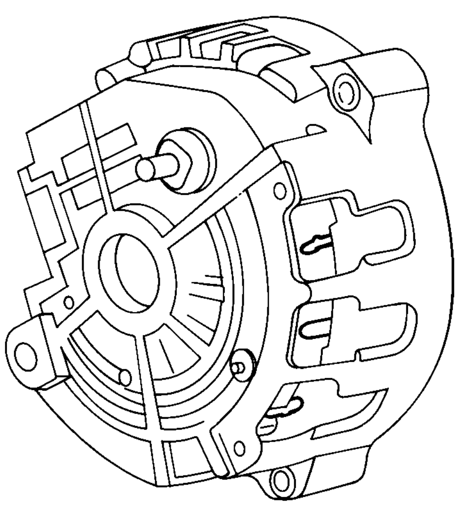
A102E256

3. Weld the brush holder terminal to the regulator terminal, if removed.
4. Fix the brush holder with the retainer pin, and weld 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

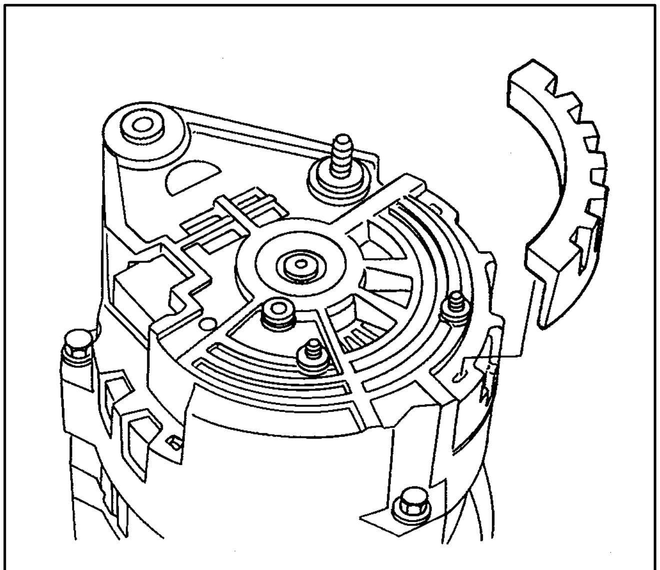
8. Install the stator.



A102E202

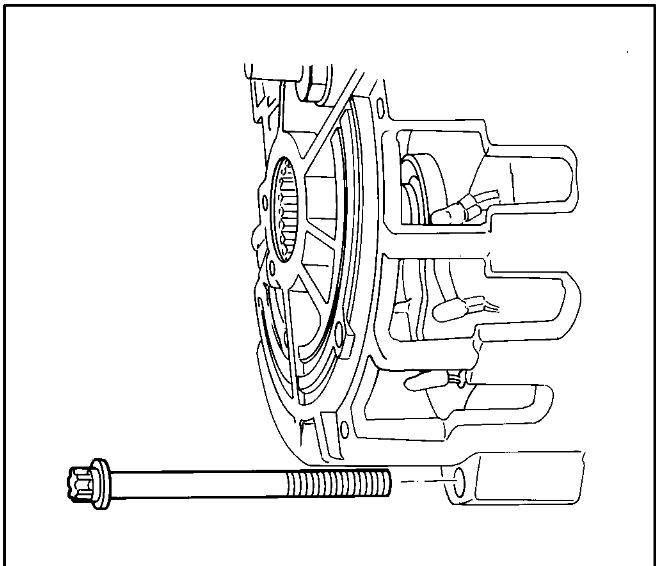
Notice: Take care to prevent damage to the vehicle by protecting the diode in the rectifier bridge from excessive heat while welding.

9. Weld the connectors of the rectifier bridge.



A102E201

10. Install the outside cover.

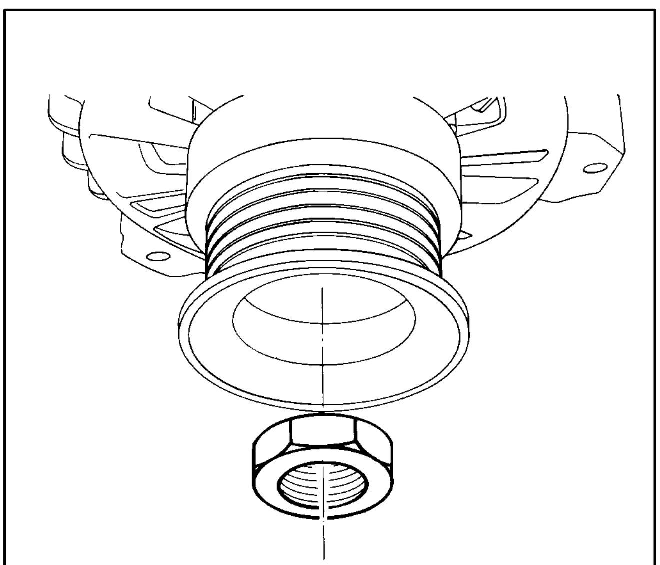


A102E203

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 N•m (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 N•m (60 lb-ft).

14. Install the generator. Refer to “Generator” in the On-Vehicle Service 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 are left on overnight.
- Slow average driving speeds are used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- There are defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- There has been battery abuse, including failure to keep the battery cable terminals clean and tight, or a loose battery hold-down.
- There are mechanical problems in the electrical system, such as shorted or pinched wires.

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 charger 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:

- **Size of Battery** – A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- **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.
- **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.
- **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 charger 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

- If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- 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 (RC) rating as the number of ampere hours of charge usually brings the green dot into view.

- If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.
- 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. Turn on the hazard flasher, if there may be other traffic, and leave on 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, or a manual transaxle to NEUTRAL.

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 possible battery explosion.

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. 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 fan are used. There is no test hole.

Unlike three-wire generators, the CS-121D may be used with only two connections: battery positive and an “L” terminal to the charge indicator lamp. Use of the “P,” “I,” and “S” terminals is optional. The “P” terminal is connected to the stator and may be connected externally to a tachometer or other device.

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 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, 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, 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. 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 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

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

SCAN TOOL DATA TABLE

Parameter	Scaling	Value
Desired Idle Speed	RPM	ECM idle command (varies with temperature)
Engine RPM	RPM	±50 RPM from desired RPM in drive (A/T) ±50 RPM from desired RPM in neutral (M/T)
MAP	kPa	29 – 55 (varies with manifold and barometric pressure)
Throttle Position Volt	V	0 v
Start–up IAT	C	varies
Intake Air Temperature	C	10 – 90 C
Coolant Temperature (Start–up)	C	varies
Engine Coolant Temperature	C	85 – 105 C
IAC Motor Position	–	1 – 50
O2 Sensor (B1–S1)	mV	1–1000 mV (varies continuously)
O2 Sensor (B1–S2)	mV	1–1000 mV (varies continuously)
Fuel System Status	Closed Loop/Open Loop	“Closed Loop” (may enter “Open Loop” at extended idle)
Rich/Lean (B1–S1)	Rich/Lean	varies
Lean to Rich Average	mS	10 –211 ms or 0 ms
Rich to Lean Average	mS	10 –211 ms or 0 ms
Engine Load Value	%	0 – 100 % (varies)
Short Term Fuel Trim	%	-30 – 30%
Long Term Fuel Trim	%	-30 – 30%
Linear EGR Feedback	V	varies
EGR Duty Cycle	%	0 %
EGR EWMA Result	–	< = 0
Spark Advance		varies
MIL Odometer	Km	0 Km
MIL On Time	Min	0 Min
Base Injection PWM	mS	1.0 – 5.0 ms
Barometric Pressure	kPa	varies with altitude
Ignition Voltage	V	13.5 – 14.8 V
Air/Fuel Ratio	Ratio	14.6 (Closed Loop Enable)
Calculated Air Flow	G/S	varies
Total Misfire (Current)	–	0
Misfire History Cyl. 1	–	0
Misfire History Cyl. 2	–	0
Misfire History Cyl. 3	–	0
Misfire History Cyl. 4	–	0
Vehicle Speed	Km/H	0 Km/H
A/C Pressure	V	varies
A/C Request	Yes/No	No
A/C Clutch	On/Off	Off

* Condition: Warmed up, idle, park or neutral, A/C off

SCAN TOOL DATA TABLE (Cont'd)

Parameter	Scaling	Value
Fuel Pump Command	On/Off	On
Closed Loop	Yes/No	Yes
Throttle At Idle	Yes/No	No
O2 Ready (B1–S1)	Yes/No	Yes
Knock Present	Yes/No	No
Fan Low	On/Off	On/Off
Fan High	On/Off	On/Off
Park/Neutral (Only AT)	P/N and R/N/D	P/N
Fuel Level Input	V	varies
Fuel Level Output	%	varies
Fuel Trim Cell	–	18
G–Sensor	V	1.1 – 3.7 V (Non–ABS Only)
Engine Runtime	HH:MM:SS	Hours:Minutes:Seconds

* Condition: Warmed up, idle, park or neutral, A/C off

ENGINE DATA DISPLAY TABLE DEFINITIONS

ECM Data Description

The following information will assist in diagnosing emission or driveability problems. A first technician can view the displays while the vehicle is being driven by second technician. Refer to Powertrain On-Board Diagnostic (EOBD) System Check for addition information.

A/C Clutch

The A/C Relay represents the commanded state of the A/C clutch control relay. The A/C clutch should be engaged when the scan tool displays ON.

A/C Pressure

The A/C High Side displays the pressure value of the A/C refrigerant pressure sensor. The A/C High Side helps to diagnose the diagnostic trouble code (DTC) P0533.

A/C Request

The A/C Request represents whether the air conditioning is being requested from the HVAC selector. The input is received by the instrument panel cluster and then sent serial data to the ECM and finally to the scan tool over KWP 2000 serial data.

Air Fuel Ratio

The Air Fuel Ration indicates the air to fuel ratio based on the Oxygen Sensor (O2S 1) inputs. The ECM uses the fuel trims to adjust fueling in order to attempt to maintain an air fuel ratio of 14.7:1.

BARO

The Barometric Pressure (BARO) sensor measures the change in the intake manifold pressure which results from altitude changes. This value is updated at ignition ON and also at Wide Open Throttle (WOT).

Base Injection PWM

Indicates the base Pulse Width Modulation (PWM) or ON time of the indicated cylinder injector in milliseconds. When the engine load is increased, the injector pulse width will increase.

Calculated Air Flow

The calculated air flow is a calculation based on manifold absolute pressure. The calculation is used in several diagnostics to determine when to run the diagnostics.

Desired Idle Speed

The ECM commands the idle speed. The ECM compensates for various engine loads in order to maintain the desired idle speed. The actual engine speed should remain close to the desired idle under the various engine loads with the engine idling.

Engine Coolant Temperature

The Engine Coolant Temperature (ECT) sensor sends engine temperature information to the ECM. The ECM supplies 5 volts to the engine coolant temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high voltage which it interprets as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the ECM will interpret the lower voltage as a warm engine.

EGR Desired Position

The desired exhaust gas recirculation (EGR) position is the commanded EGR position. The ECM calculates the desired EGR position. The higher the percentage, the longer the ECM is commanding the EGR valve ON.

Engine Load

Indicates engine load based on manifold absolute pressure. The higher the percentage, the more load the engine is under.

Engine Run Time

The engine run time is a measure of how long the engine has been running. When the engine stops running, the timer resets to zero.

Engine Speed

Engine Speed is computed by the ECM from the fuel control reference input. It should remain close to desired idle under the various engine loads with the engine idling.

Fan

The Fan Control (FC) Relay is commanded by the ECM. The FC Relay displays the command as ON or OFF.

Fuel Level Sensor

The Fuel Level Sensor monitors the fuel level in the tank. The Fuel Level Sensor monitors the rate of change of the air pressure in the EVAP system. Several of the Enhanced EVAP System diagnostics are dependent upon the correct fuel level.

Fuel System Status

The Closed Loop is displayed indicating that the ECM is controlling the fuel delivery according to the Oxygen Sensor (O2S 1) voltage as close to an air/fuel ratio of 14.7 to 1 as possible.

IAC Position

The scan tool displays the ECM command for the Idle Air Control (IAC) pintle position in counts. The higher the number of counts, the greater the commanded idle speed reads. The Idle Air Control responds to changes in the engine load in order to maintain the desired idle rpm.

Ignition 1 (Voltage)

The ignition volts represent the system voltage measured by the ECM at the ignition feed circuit.

Intake Air Temperature

The ECM converts the resistance of the Intake Air Temperature (IAT) sensor to degrees in the same manner as the engine coolant temperature (ECT) sensor. Intake air temperature is used by the ECM to adjust fuel delivery and spark timing according to incoming air density.

Knock Present

The KS Noise Channel indicates when the ECM detects the KS signal. The ECM should display NO at idle.

Long Term FT

The Long Term Fuel Trim (FT) is derived from the short term fuel trim value. The Long Term FT is used for the long term correction of the fuel delivery. A value of 128 counts (0%) indicates that the fuel delivery requires no compensation in order to maintain a 14.7:1 air to fuel ratio. A value below 128 counts means that the fuel system is too rich and the fuel delivery is being reduced. The ECM is decreasing the injector pulse width. A value above 128 counts indicates that a lean condition exists for which the ECM is compensating.

MAP

The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure which results from engine load and speed changes. As the intake manifold pressure increases, the air density in the intake also increases and the additional fuel is required.

Misfire History #1-4

Indicates the number of misfires that have occurred after 195 current misfires have been counted. The current misfire counter will add its misfires to the history misfire counter after 195 total misfires have taken place. If 1 cylinder is misfiring, the misfiring current counter will have 195 misfires counted before adding to its history counter. If 2 cylinders are misfiring, the misfiring current counter will add to their history counters after 97 misfires. The counter increments only after a misfire diagnostic trouble code (DTC) has been set.

Oxygen Sensor Bank 1 Sensor 1

The pre-converter Oxygen Sensor (O2S 1) reading represents the exhaust oxygen sensor output voltage. This voltage will fluctuate constantly between 100 mv (lean exhaust) and 900 mv (rich exhaust) when the system is operating in a Closed Loop.

Oxygen Sensor Bank 1 Sensor 2

The post-converter Heated Oxygen Sensor (HO2S 2) represents the exhaust oxygen output voltage past the catalytic converter. This voltage remains inactive, or the voltage will appear lazy within a range of 100 mv (lean exhaust) and 900 mv (rich exhaust) when operating in a Closed Loop.

Short Term FT

The Short Term FT represents a short term correction to fuel delivery by the ECM in response to the amount of time the oxygen sensor voltage spends above or below the 450 mv threshold. If the oxygen sensor has mainly been below 450 mv, indicating a lean air/fuel mixture, short term fuel trim will increase to tell the ECM to add fuel. If the oxygen sensor voltage stays mainly above the threshold, the ECM will reduce fuel delivery to compensate for the indicated rich condition.

Spark Advance

This is a display of the spark advance Ignition Coil (IC) calculation which the ECM is programming in the ignition system. It computes the desired spark advance using data such as engine temperature, rpm, engine load, vehicle speed and operating mode.

Total Misfire Current Counter

Indicates the total number of misfires that have been detected in all the cylinders after 100 engine cycles. One cycle equals one complete 4 stroke cycle. The total misfire only increments during the steady state cruise conditions.

TP Sensor

The ECM uses the TP Sensor in order to determine the amount of the throttle demanded by the vehicle's operator. The TP Sensor reads between 0.36-0.96 volts at idle to above 4 volts at WOT.

FASTENER TIGHTENING SPECIFICATIONS

Application	N m	Lb-Ft	Lb-In
Camshaft Position Sensor	12	–	106
Crankshaft Position Sensor Retaining Bolt	10	–	89
Electronic Ignition System Ignition Coil Retaining Bolts	10	–	89
Engine Control Module (ECM) Retaining Bolt – SOHC	5	–	44
Engine Coolant Temperature Sensor	20	15	–
Evaporative Emission Canister Flange Bolt	20	15	–
Exhaust Gas Recirculation Valve Retaining Bolts	20	15	–
Fuel Pressure Regulator Retaining Bolt – SOHC	12	–	106
Fuel Rail Mounting Bolts	25	18	–
Fuel Rail Retaining Bolts	25	18	–
Fuel Tank Retaining Bolts	20	15	–
Heated Oxygen Sensor	41	30	–
Idle Air Control Valve Retaining Bolts	3	–	27
Knock Sensor Bolt	20	15	–
MAP Sensor Mounting Bracket Bolt	4	–	35
MAP Sensor Retaining Bolts and Nuts	8	–	71
Oxygen Sensor	41	30	–
Parking Brake Cable Retainer Clamps	4	–	89
Throttle Body Retaining Bolts	15	11	–
Throttle Position Sensor Retaining Bolts	2	–	18
VGIS Actuator Assembly Mounting Bracket Bolt	16	12	–

FUEL SYSTEM SPECIFICATIONS

Gasoline

All engines are designed to use unleaded fuel only. Unleaded fuel must be used for proper emission control system operation. Its use will also minimize spark plug fouling and extend engine oil life. Using leaded fuel can damage the emission warranty coverage. The fuel should meet specification ASTM D4814 for the U.S. or CGSB 3.5 M93 for Canada. All engines are designed to use unleaded fuel with a minimum U(R+M)/2e (pump) octane number of 87, where R=research octane number, and M=motor octane number.

Ethanol

You may use fuel containing ethanol (ethyl alcohol) or grain alcohol providing that there is no more than 10 percent ethyl alcohol by volume.

Methanol

Do not use fuels containing methanol. Methanol can corrode metal parts and cause damage to plastic and rubber parts in the fuel system.

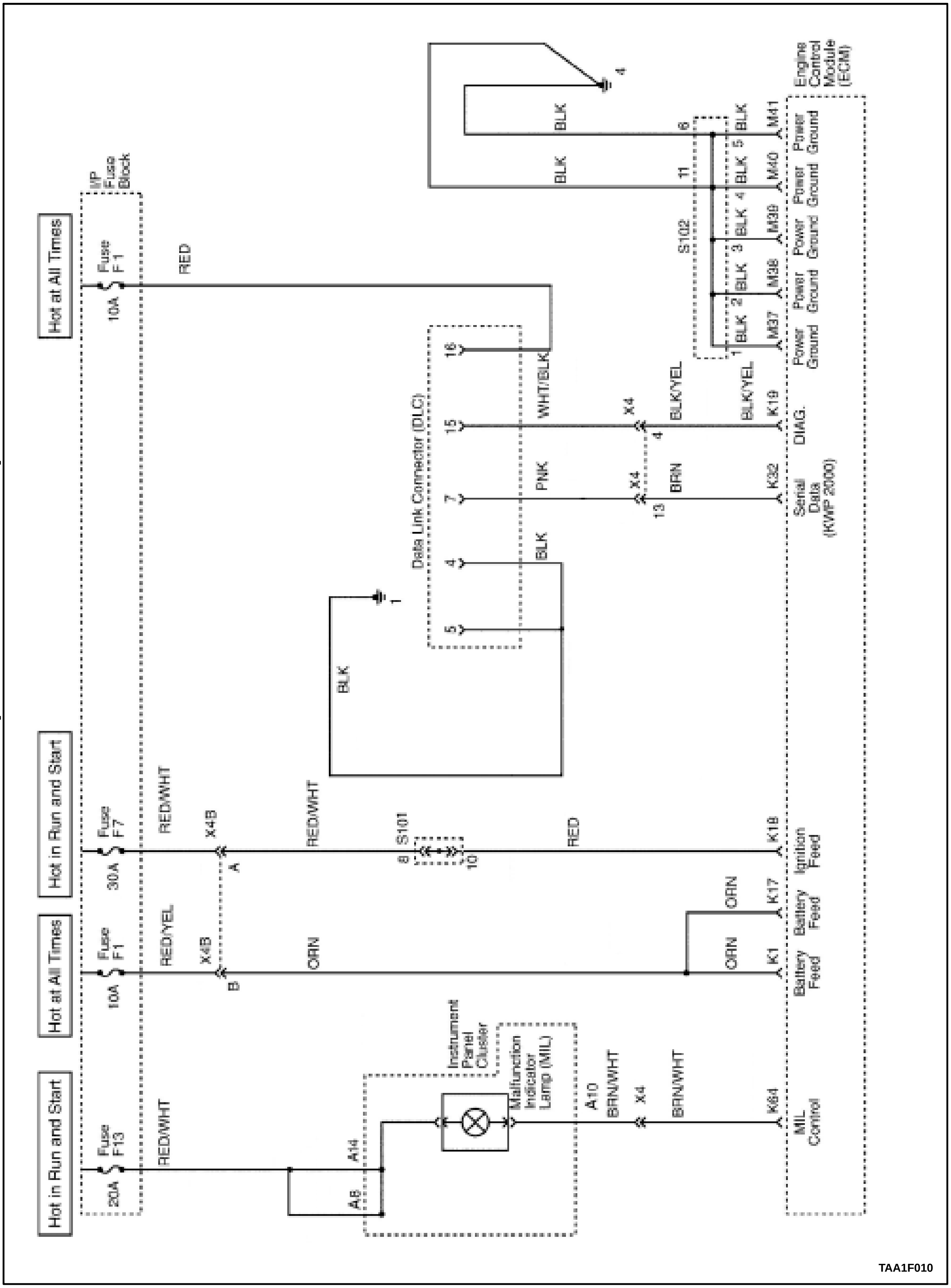
Methyl Tertiary–Butyl Ether (MTBE)

You may use fuel containing Methyl Tertiary-Butyl Ether (MTBE) providing there is no more than 15 percent MTBE by volume.

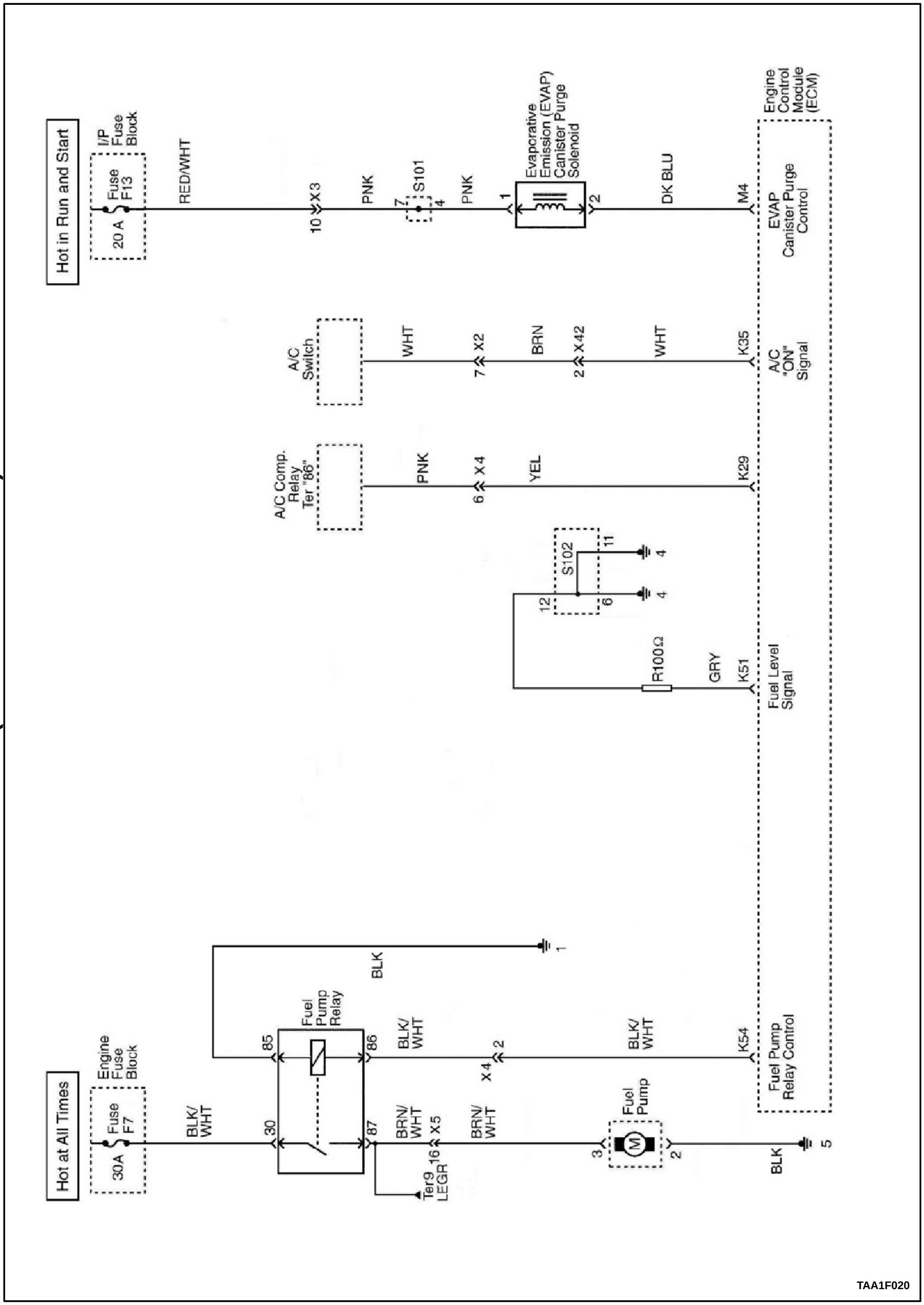
TEMPERATURE VS RESISTANCE

C	F	ECT Sensor	IAT Sensor
		OHMS	
Temperature vs Resistance Values (Approximate)			
100	212	177	187
90	194	241	246
80	176	332	327
70	158	467	441
60	140	667	603
50	122	973	837
45	113	1188	991
40	104	1459	1180
35	95	1802	1412
30	86	2238	1700
25	77	2796	2055
20	68	3520	2500
15	59	4450	3055
10	50	5670	3760
5	41	7280	4651
0	32	9420	5800
-5	23	12300	7273
-10	14	16180	9200
-15	5	21450	11722
-20	-4	28680	15080
-30	-22	52700	25600
-40	-40	100700	45300

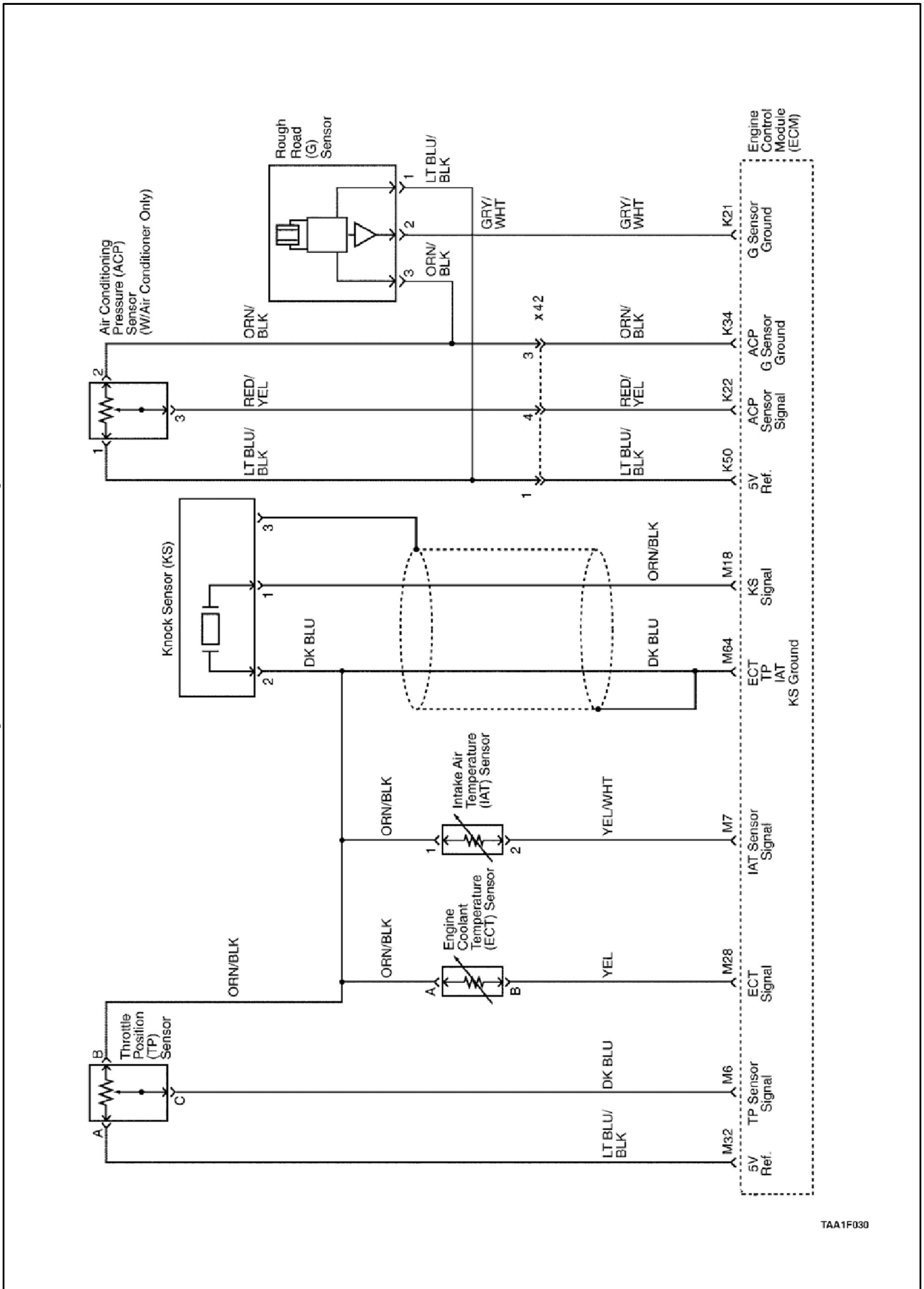
SCHEMATIC AND ROUTING DIAGRAMS



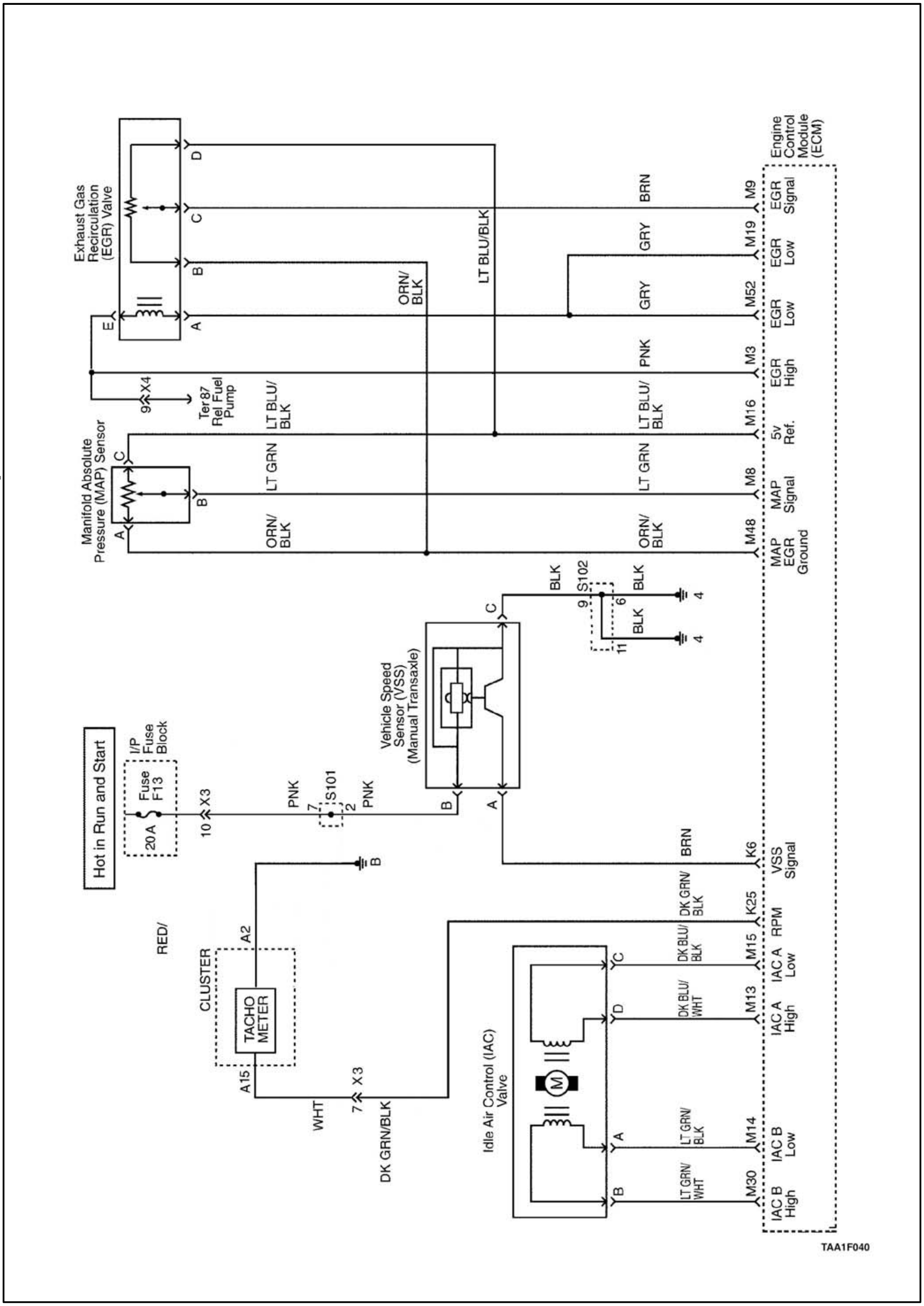
ECM WIRING DIAGRAM (1.5L SOHC - 2 OF 6)



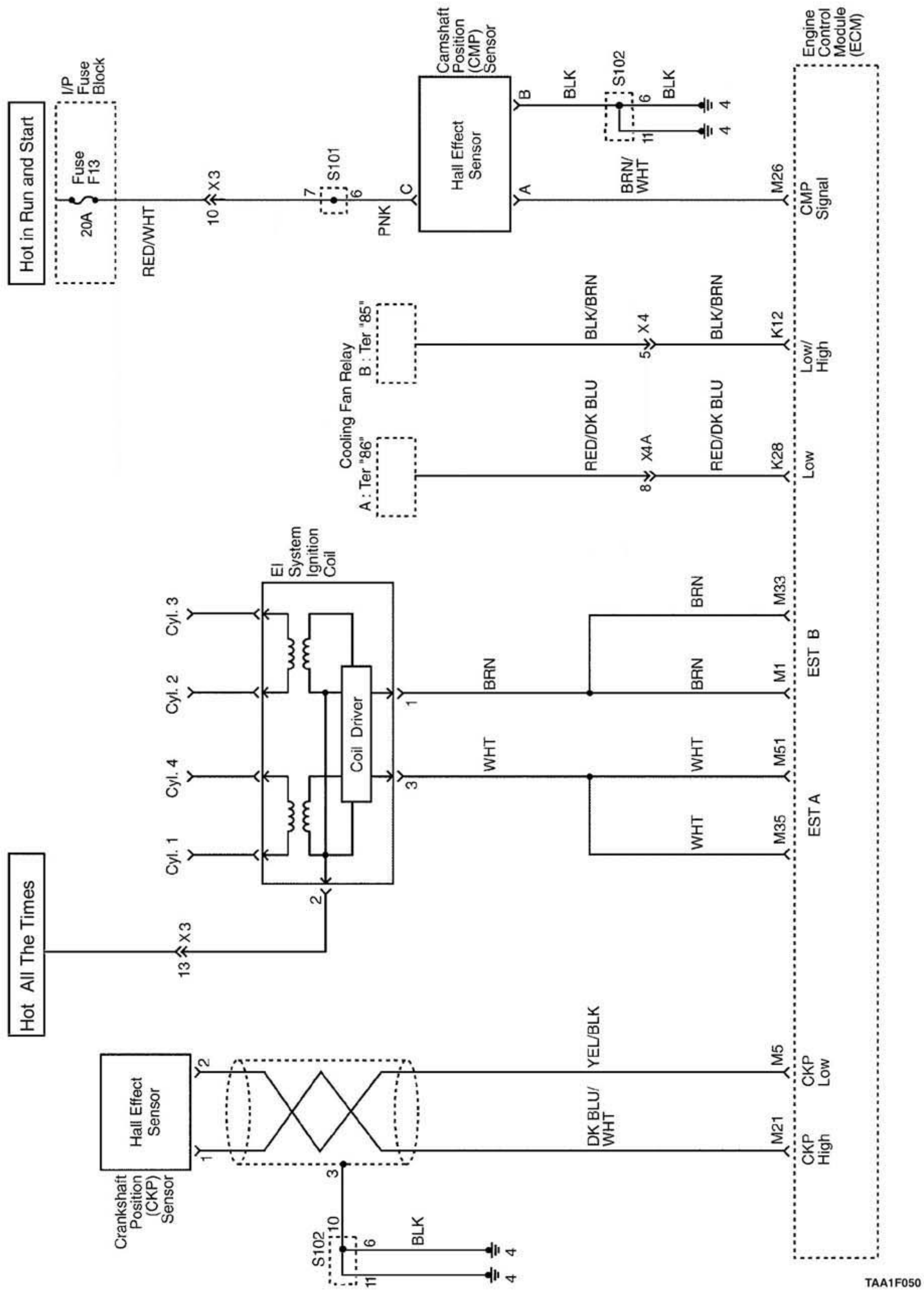
ECM WIRING DIAGRAM (1.5L SOHC - 3 OF 6)



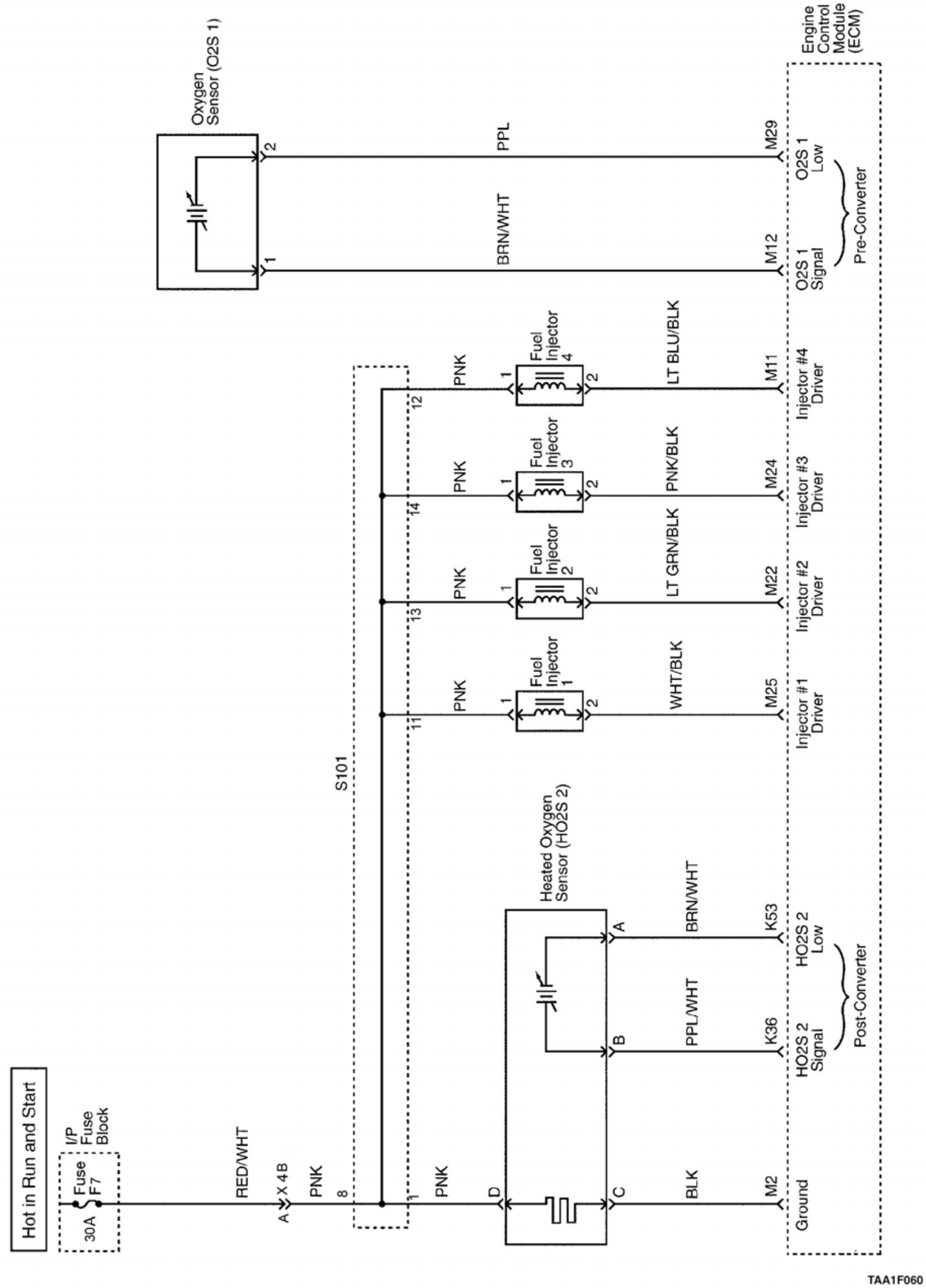
ECM WIRING DIAGRAM（1.5L SOHC - 4 OF 6）



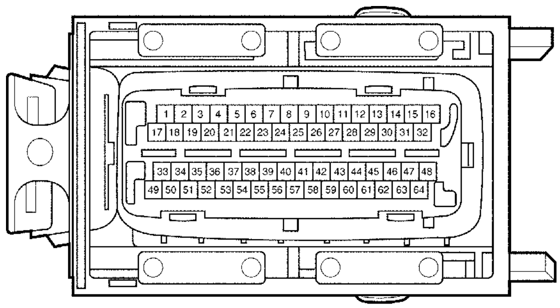
ECM WIRING DIAGRAM (1.5L SOHC - 5 OF 6)



ECM WIRING DIAGRAM（1.5L SOHC - 6 OF 6)

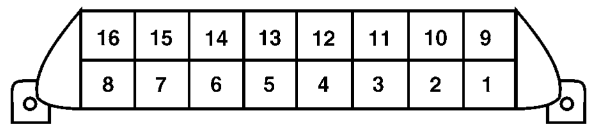


CONNECTOR END VIEW



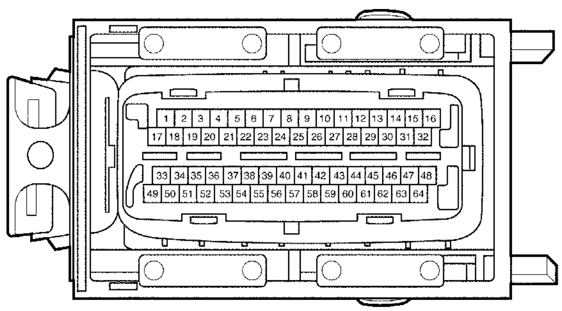
Engnie Control Module (ECM)
Connector M (Engine)
(1.3L SOHC / 1.5L SOHC)

TAA1F520



Date Link Connector (DLC)

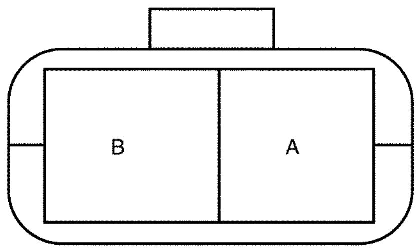
C1F0409A



Engnie Control Module (ECM)
Connector K (Vehiele)
(1.3L SOHC / 1.5L SOHC)

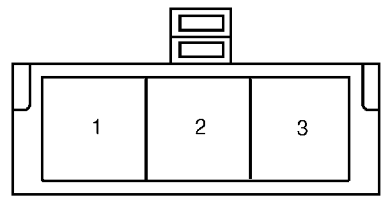
TAA1F530

CONNECTOR END VIEW (Cont'd)



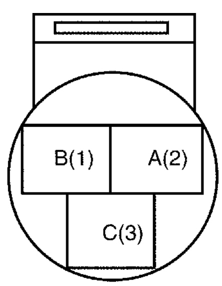
Engine Coolant Temperature (ECT)
Sensor Connector

A402F081



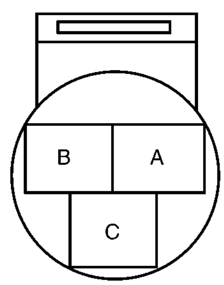
Electronic Ignition (EI) System
Ignition Coil
Connector
(1.3L SOHC / 1.5L SOHC)

TAA1F550



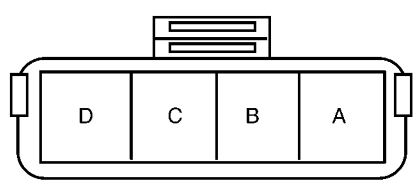
Air Conditioning
Pressure (ACP) Sensor
Connector
( ) : 1.5L SOHC

TAA1F610



Throttle Position
Sensor (TPS) Connector

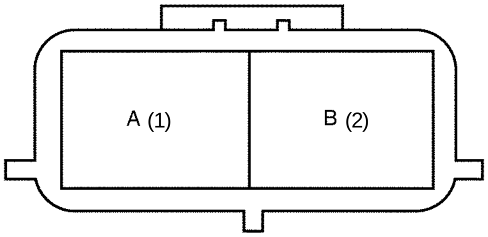
A102F074



Idle Air Control (IAC) Valve
Connector

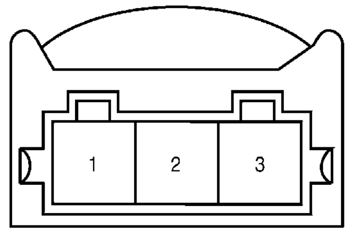
A102F076

CONNECTOR END VIEW (Cont'd)



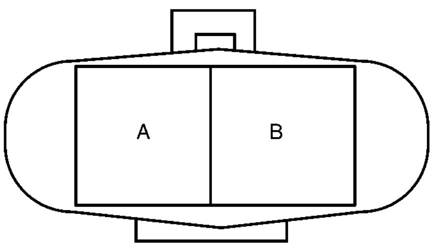
Evaporative Emission (EVAP) Canister
Purge Solenoid
Connector
(   ) : 1.5L SOHC

TAA1F590



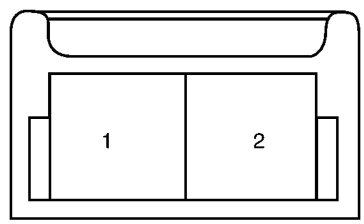
Knock Sensor Connector

TAA1F620



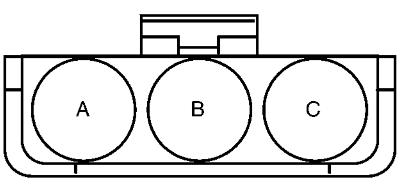
Cooling Fan
Connector

A102F089



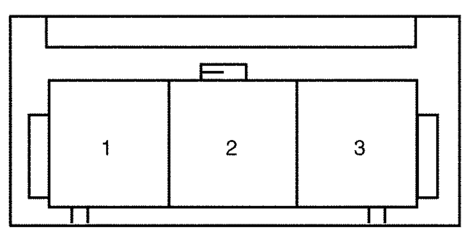
Fuel Injector
Connector

A102F082



Manifold Absolute
Pressure (MAP) Sensor
Connector

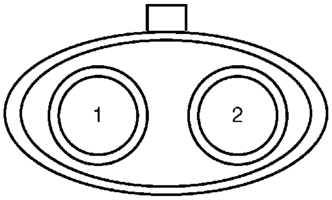
A102F075



Crankshaft Position
(CKP) Sensor Connector

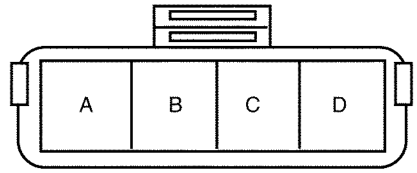
A402F020

CONNECTOR END VIEW (Cont'd)



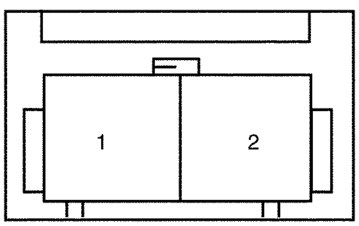
Pre Converter
Oxygen Sensor (O2S 1)
Connector

TAA1F560



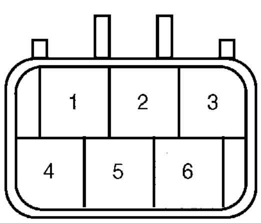
Post- Converter Heated
Oxygen Sensor (HO2S 2)
Connector

A402F022



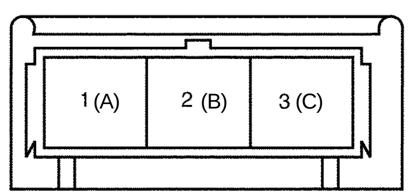
Intake Air
Temperature (IAT) Sensor
Connector

A402F017



Fuel Level Sensor
Connector

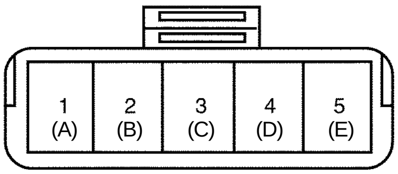
TAA1F570



Camshaft Position
(CMP) Sensor Connector

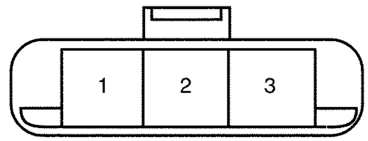
TAA1F600

CONNECTOR END VIEW (Cont'd)



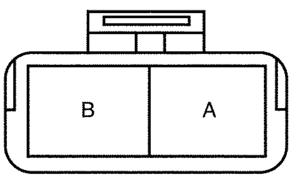
Exhaust Gas Recirculation
(EGR) Value
Connector
(   ) : 1.5L SOHC

TAA1F580



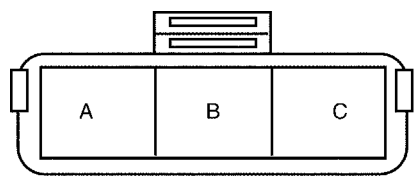
Rough Road (G)
Sensor Connector

A402F028



Automatic Transaxle
Vehicle Speed
Sensor (A/T VSS)
Connector

A402F019



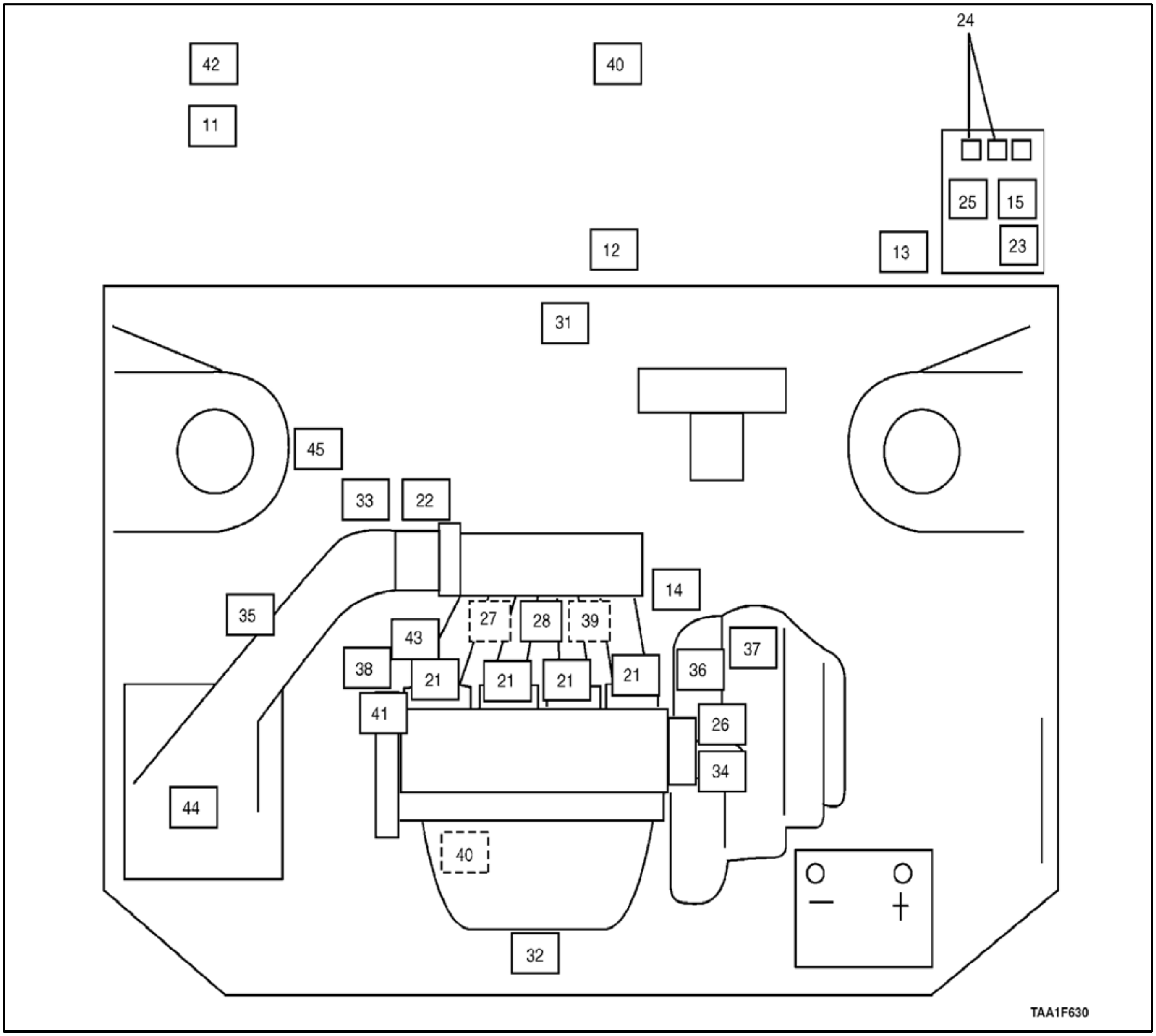
Vehicle Speed
Sensor (VSS) (M/T)
Connector

A102F086

BLANK

COMPONENT LOCATOR

COMPONENT LOCATOR – SOHC



Components on ECM Harness

11 Engine
Control Module (ECM)
12 Data Link Connector (DLC)
13 Malfunction Indicator Lamp

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 Electronic Ignition System Ignition Coil
27 Evaporative Emission (EVAP) Canister
Purge Solenoid
28 Variable Geometry Induction System (VGIS)
29 Exhaust Gas Recirculation (EGR) Valve

Information Sensors

31 Manifold Absolute Pressure (MAP) Sensor
32 Pre-Converter Oxygen Sensor (O2S 1)
33 Throttle Position (TP) Sensor
34 Engine Coolant Temperature (ECT) Sensor
35 Intake Air Temperature (IAT) Sensor
36 Vehicle Speed Sensor (VSS)
(Manual Transaxle)

38 Crankshaft Position (CKP) Sensor
39 Knock Sensor
40 Post-Converter Heated Oxygen Sensor
(HO2S 2)
41 Camshaft Position (CMP) Sensor

Not ECM Connected

42 Evaporative Emission (EVAP) Canister
(under vehicle, behind right rear wheel)
43 Oil Pressure Switch
44 Air Cleaner
45 G Sensor

DIAGNOSIS
SYSTEM DIAGNOSIS

DIAGNOSTIC AIDS

If an intermittent problem is evident, follow the guidelines below.

Preliminary Checks

Before using this section you should have already performed the "On-Board 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

- Engine control module (ECM) grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks, collapsing and proper 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, proper routing, and carbon tracking.
- Wiring for proper connections.
- Wiring for pinches or cuts.

Diagnostic Trouble Code Tables

Do not use the Diagnostic Trouble Code (DTC) tables to try and 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 P0171 and DTC P0172, replace the sensor.

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 that is advertising the lowest price? If so, check the fuel tank for signs of debris, water, or other contamination.

IDLE LEARN PROCEDURE

Whenever the battery cables, the engine control module (ECM), or the 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 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral.
5. Allow the engine to run until the engine coolant is above 85 C (185 F).
6. Turn the 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 depressing the brake pedal, place the transaxle in D (drive).
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.

TEC (TOOTH ERROR CORRECTION) LEARN PROCEDURE

When an ECM is reflashed, initialized or replaced, and driveplate of flywheel has been replaced, follow these procedures to relearn the Crankshaft Position (CKP) system variation:

Caution: To avoid personal injury when performing the TEC learn procedure, always set the vehicle parking brake and block the drive wheels. Release the throttle immediately when the engine starts to decelerate. Once the learning procedure is completed, engine control will be learned to the operator, and the engine will respond to throttle position.

1. Stay the gear parking or neutral.
2. Install the scan tool and select “TEC (Toth Error Correction) LEARN” menu.
3. Start the engine with A/C off.
4. Keep the engine coolant temperature above 65 °C (149 °F)
5. Put the acceleration pedal above 4000 RPM until the fuel cut-off occurs.
6. Wait 10–15 seconds.
7. Fulfill this procedure again if the scan tool does not display “OK” message.
8. Turn the ignition switch OFF.
9. Turn the ignition swtich ON and then clear the DTC code.

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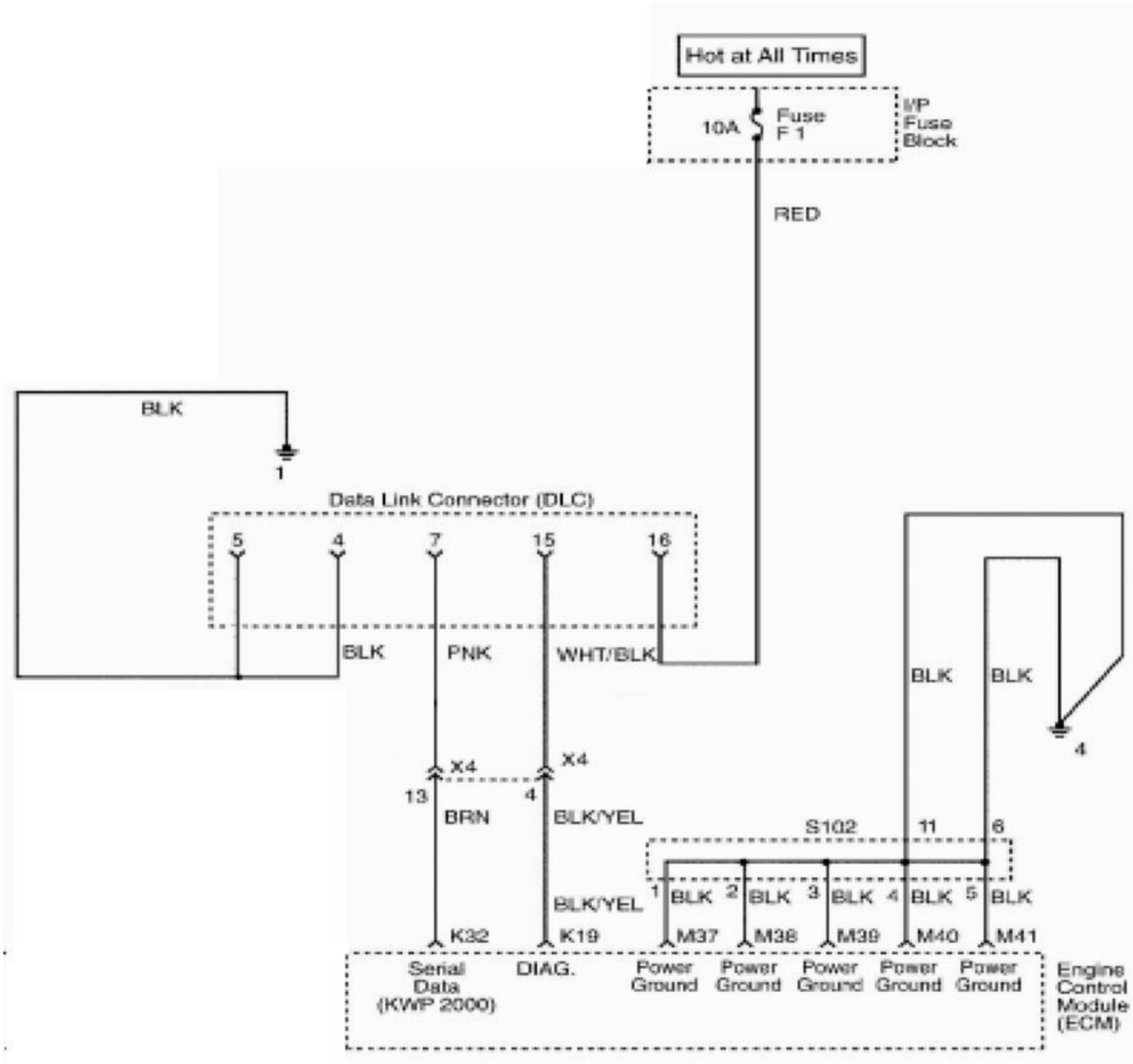
Hot at All Times
10A
Fuse
F 1
I/P
Fuse
Block
RED
BLK
1
Data Link Connector (DLC)
5
4
7
15
16
BLK
PNK
WHT/BLK
BLK
BLK
4
X4
X4
13
4
BRN
BLK/YEL
S102
11
6
1 BLK
2 BLK
3 BLK
4 BLK
5 BLK
BLK/YEL
K32
K19
M37
M38
M39
M40
M41
Serial
Data
(KWP 2000)
DIAG.
Power
Ground
Power
Ground
Power
Ground
Power
Ground
Power
Ground
Engine
Control
Module
(ECM)

TTA1F250

ON-BOARD DIAGNOSTIC (EOBD) SYSTEM CHECK

Circuit Description

The On-Board Diagnostic (EOBD) system check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the engine control module (ECM) and the engine grounds for cleanliness and tightness.

The EOBD system check is an organized approach to identifying a problem created by an electronic engine control system malfunction.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

Numbers below refer to the step number on the Diagnostic Chart:

1. The Malfunction Indicator Lamp (MIL) should be ON steady with the ignition ON and the engine OFF. If not, go to “Diagnostic Aids”.
2. Checks the serial data circuit and ensures that the ECM is able to transmit serial data.
3. This test ensures that the ECM is capable of controlling the MIL and that the MIL driver circuit is not shorted to ground.
4. If the engine will not start, refer to “Engine Cranks But Will Not Run” in this section.
7. A scan tool parameter which is not within the typical range may help to isolate the area which is causing the problem.
10. This vehicle is equipped with a ECM which utilizes an Electrically Erasable Programmable Read Only Memory (EEPROM). The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

On-Board Diagnostic (EOBD) System Check

Step	Action	Value(s)	Yes	No
1	1. Ignition ON, engine OFF. 2. Observe the Malfunction Indicator Lamp (MIL) Is the MIL ON?	–	Go to *Step 2*	Go to “No Malfunction Indicator Lamp”
2	1. Ignition OFF. 2. Install the scan tool. 3. Ignition ON. 4. Attempt to display the engine control module (ECM) engine data with the scan tool. Does the scan tool display the ECM engine data?	–	Go to *Step 3*	Go to *Step 8*
3	1. Using the scan tool output test function, select MIL dash lamp control and command the MIL OFF. 2. Observe the MIL. Did the MIL turn OFF?	–	Go to *Step 4*	Go to “Malfunction Indicator Lamp on Steady”
4	Attempt to start the engine. Did the engine start and continue to run?	–	Go to *Step 5*	Go to “Engine Cranks But Will Not Run”
5	Select TROUBLE CODE with the scan tool. Are any DTCs stored?	–	Go to *Step 6*	Go to *Step 7*
6	Check the display for DTCs P0107, P0108, P0113, P0118, P0122, P0123, P1392. Are two or more of the following DTCs stored?	–	Go to “Multiple ECM Information Sensor DTCs Set”	Go to applicable DTC table

On-Board Diagnostic (EOBD) System Check (Cont'd)

Step	Action	Value(s)	Yes	No
7	Compare the ECM data values displayed on the scan tool to the typical engine scan data values. Are the displayed values normal or close to the typical values?	–	System OK	Go to indicated component system check
8	1. Ignition OFF, disconnect the ECM. 2. Ignition ON, engine OFF. 3. Check the serial data circuit for an open, short to ground, or short to voltage. Also, check the Data Link Connector (DLC) ignition feed circuit for an open or short to ground and the DLC ground circuits for an open. Is a problem found?	–	Go to *Step 9*	Go to *Step 10*
9	Repair the open, short to ground or short to voltage In the class data circuit or the DLC ignition feed circuit. Is the repair complete?	–	System OK	–
10	1. Attempt to reprogram the ECM. 2. Attempt to display the ECM data with the scan tool. Does the scan tool display ECM engine data?	–	Go to *Step 2*	Go to *Step 11*
11	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	System OK	–

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MULTIPLE ECM INFORMATION SENSOR DTCS SET

System Description

The engine control module (ECM) monitors various sensors to determine engine operating conditions. The ECM controls fuel delivery, spark advance, transaxle operation, and emission control device operation based on the sensor inputs.

The ECM provides a sensor ground to all of the sensors. The ECM applies 5 volts through a pull–up resistor and monitors the voltage present between the sensor and the resistor to determine the status of the Engine Coolant Temperature (ECT) sensor, the Intake Air Temperature (IAT) sensor, and the Transmission Fluid Temperature (TFT) sensor. The ECM provides the Exhaust Gas Recirculation (EGR) Pintle Position sensor, the Throttle Position (TP) sensor, the Manifold Absolute Pressure (MAP) sensor, and the Fuel Tank Pressure sensor with a 5 volt reference and a sensor ground signal. The ECM monitors the separate feedback signals from these sensors to determine their operating status.

Diagnostic Aids

Be sure to inspect the ECM and engine grounds for being secure and clean.

A short to voltage in one of the sensor circuits can cause one or more of the following diagnostic trouble codes (DTCs) to be set: P0108, P0113, P0118, P0123, P1106, P1111, P1115, P1121.

If a sensor input circuit has been shorted to voltage, ensure that the sensor is not damaged. A damaged sensor will continue to indicate a high or low voltage after the affected circuit has been repaired. If the sensor has been damaged, replace it.

An open in the sensor ground circuit between the ECM and the splice will cause one or more of the following DTCs to be set: P0108, P0113, P0118, P0123, P1106, P1111, P1115, P1121.

A short to ground in the 5 volt reference circuit or an open in the 5 volt reference circuit between the ECM and the splice will cause one or more of the following DTCs to be set: P0107, P0112, P0117, P0122, P1107, P1112, P1114, P1122.

Check for the following conditions:

Inspect for a poor connection at the ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Inspect the wiring harness for damage. If the harness appears to be OK, observe an affected sensor's displayed value on the scan tool with the ignition ON and the engine OFF while moving connectors and wiring harnesses related to the affected sensors. A change in the affected sensor's displayed value will indicate the location of the fault.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The powertrain On-Board Diagnostic (EOBD) system check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

9. A faulty EGR valve can leak a small amount of current from the ignition feed circuit to the 5 volt reference circuit. If the problem does not exist with the EGR valve disconnected, replace the EGR valve.

11 – 19. If a sensor input circuit has been shorted to voltage, ensure that the sensor has not been damaged. A damaged IAT or ECT sensor will continue to indicate a high voltage or low temperature after the affected circuit has been repaired. A damaged TP, MAP, fuel tank pressure, or EGR Pintle Position sensor will indicate a high or low voltage or may be stuck at a fixed value after the affected circuit has been repaired. If the sensor has been damaged, replace it.

20. ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

Multiple ECM Information Sensor DTCs Set

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Ignition OFF, disconnect the engine control module (ECM). 2. Ignition ON, check the 5 volt reference circuit for the following conditions: Poor connection at the ECM. Open between the ECM connector affected sensors shorted to ground or voltage. 3. If a problem is found, locate and repair the open or short circuit as necessary. Is a problem found?	–	Go to *Step 21*	Go to *Step 3*
3	1. Check the sensor ground circuit for the following conditions: Poor connection at the ECM or affected sensors. Open between the ECM connector and the affected sensors. 2. If a problem is found, repair it as necessary. Is a problem found?	–	Go to *Step 21*	Go to *Step 4*
4	Measure the voltage between the Exhaust Gas Recirculation (EGR) Pintle Position Sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 5*	Go to *Step 9*
5	Measure the voltage between the Manifold Absolute Pressure (MAP) sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 6*	Go to *Step 12*
6	Measure the voltage between the Throttle Position (TP) sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 7*	Go to *Step 13*
7	Measure the voltage between the Intake Air Temperature (IAT) sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 8*	Go to *Step 14*
8	Measure the voltage between the Engine Coolant Temperature (ECT) sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 10*	Go to *Step 15*
9	1. Disconnect the EGR valve. 2. Measure the voltage between the EGR Pintle Position sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 11*	Go to *Step 16*
10	Measure the voltage between the Transmission Fluid Temperature (TFT) sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 18*	Go to *Step 17*

Multiple ECM Information Sensor DTCs Set (Cont'd)

Step	Action	Value	Yes	No
11	Replace the EGR valve. Is the repair complete?	–	Go to *Step 21*	–
12	Locate and repair short to voltage in the MAP sensor signal circuit. Is the repair complete?	–	Go to *Step 21*	–
13	Locate and repair short to voltage in the TP sensor signal circuit. Is the repair complete?	–	Go to *Step 21*	–
14	Locate and repair short to voltage in the IAT sensor signal circuit. Is the repair complete?	–	Go to *Step 21*	–
15	Locate and repair short to voltage in the ECT sensor signal circuit. Is the repair complete?	–	Go to *Step 21*	–
16	Locate and repair short to voltage in the EGR Pintle Position sensor circuit. Is the repair complete?	–	Go to *Step 21*	–
17	Locate and repair short to voltage in TFT sensor circuit. Is the repair complete?	–	Go to *Step 21*	–
18	Measure the voltage between the Fuel Tank Pressure sensor signal circuit at the ECM harness connector and ground. Does the voltage measure near the specified value?	0 v	Go to *Step 20*	Go to *Step 19*
19	Locate and repair short to voltage in the Fuel Tank Pressure sensor signal circuit. Is the repair complete?	–	Go to *Step 21*	–
20	Replace the ECM. Is the repair complete?	–	Go to *Step 21*	–
21	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting the DTCs as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 22*	Go to *Step 2*
22	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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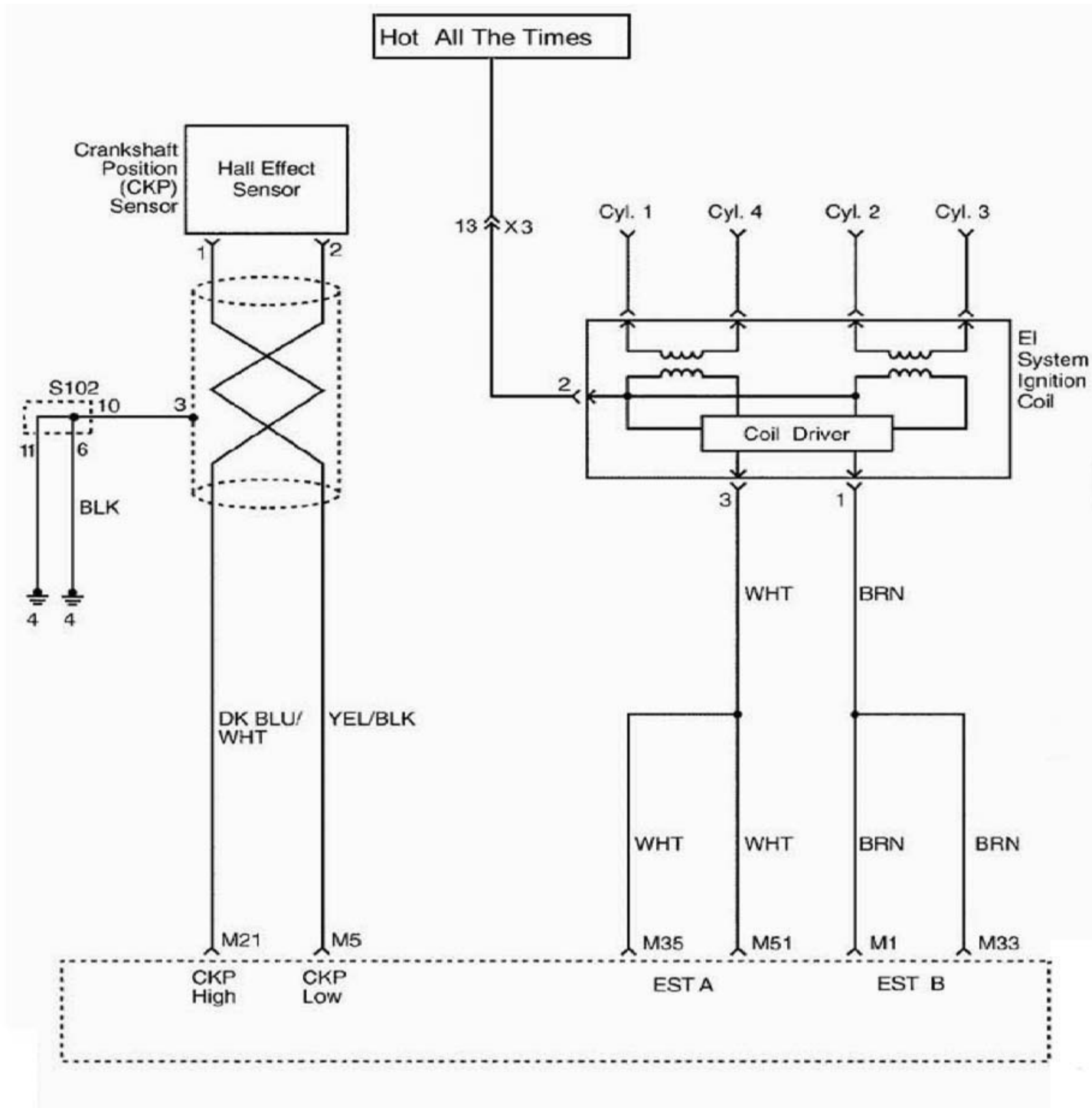
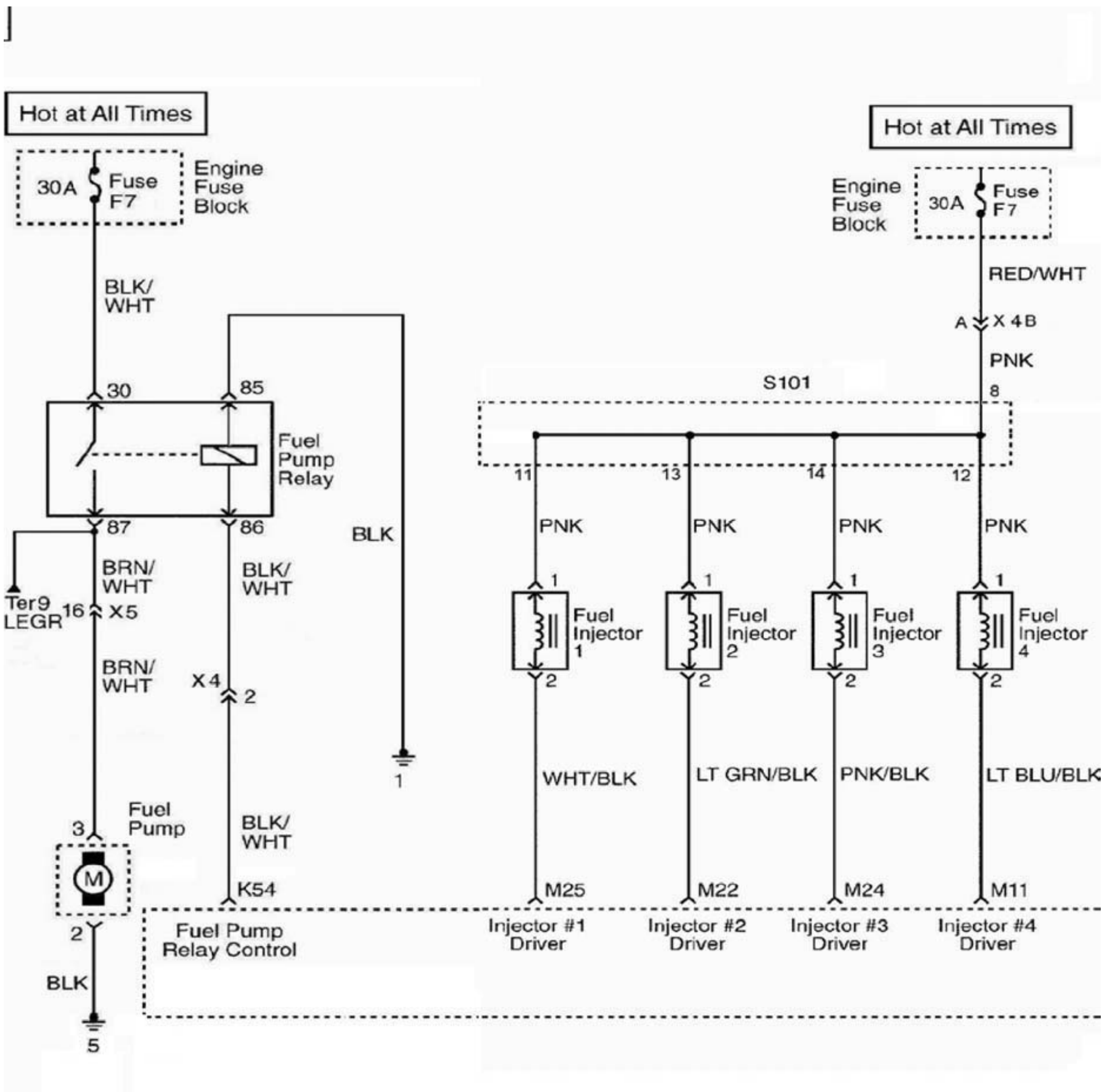

Hot All The Times
Crankshaft Position (CKP) Sensor
Hall Effect Sensor
1
2
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
3
1
S102
10
3
11
6
BLK
4
4
WHT
BRN
DK BLU/ WHT
YEL/BLK
WHT
WHT
BRN
BRN
M21
M5
M35
M51
M1
M33
CKP High
CKP Low
EST A
EST B

TAA1F240


Hot at All Times
30A
Fuse F7
Engine Fuse Block
BLK/WHT
30
85
Fuel Pump Relay
87
86
BLK
BRN/WHT
BLK/WHT
Ter9 LEGR
16
X5
BRN/WHT
X4
2
1
Fuel Pump
3
M
2
BLK
5
BLK/WHT
K54
Fuel Pump Relay Control
Hot at All Times
Engine Fuse Block
30A
Fuse F7
RED/WHT
A
X 4B
PNK
S101
8
11
13
14
12
PNK
PNK
PNK
PNK
1
Fuel Injector 1
2
1
Fuel Injector 2
2
1
Fuel Injector 3
2
1
Fuel Injector 4
2
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
M25
M22
M24
M11
Injector #1 Driver
Injector #2 Driver
Injector #3 Driver
Injector #4 Driver

TAA1F260

ENGINE CRANKS BUT WILL NOT RUN

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the occurred. The information is then stored on the scan tool for later reference.
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 (CKP) sensor is OK.
19. In checking the engine 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 Run

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	Perform an On-Board Diagnostic (EOBD) System Check. Was the check performed?	–	Go to *Step 2*	Go to "On-Board Diagnostic (EOBD) System Check"
2	Check for set Diagnostic Trouble Code (DTC) P0601. Is the DTC set?	–	Go to applicable DTC table	Go to *Step 4*
3	Crank the engine. Does the engine start and continue to run?	–	System OK	Go to *Step 5*
4	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 8*	Go to *Step 5*
5	Inspect the timing belt alignment. Is the timing belt in alignment?	–	Go to *Step 7*	Go to *Step 6*
6	Align or replace the timing belt as needed. Is the repair complete?	–	Go to *Step 3*	–
7	Repair the internal engine damage as needed. Is the repair complete?	–	Go to *Step 3*	–
8	Inspect the fuel pump fuse. Is the problem found?	–	Go to *Step 9*	Go to *Step 10*
9	Replace the fuse. Is the repair complete?	–	Go to *Step 3*	–

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Install a scan tool. 2. Turn the ignition ON, the engine OFF and close the throttle. Does the Throttle Position (TP) sensor read less than the specified value.	1.0 v	Go to *Step 11*	Go to "DTC P0123 Throttle Position Sensor High Voltage"
11	Compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT). Is the ECT relatively close to the IAT?	–	Go to *Step 12*	Go to "DTC P0118 Engine Coolant Temperature High Voltage"
12	1. Check if the Manifold Absolute Pressure (MAP) sensor reading is over the specified reading. 2. Crank the engine while watching the MAP sensor reading. Does the MAP sensor read above the specified value and then change while cranking the engine?	4 v	Go to *Step 13*	Go to *Step 14*
13	Crank the engine. Does the Crankshaft Position (CKP) Active Counter increment while cranking?	–	Go to *Step 16*	Go to *Step 18*
14	Check the scan data for serial data. Was serial data lost while cranking the engine?	–	Go to *Step 15*	Go to "MAP Sensor Output Check"
15	Repair voltage loss to the engine control module (ECM) from the ignition switch. Is the repair complete?	–	System OK	–
16	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 41*	Go to *Step 17*
17	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	Go to *Step 3*	Go to *Step 18*
18	1. Turn the ignition OFF. 2. Disconnect the Crankshaft Position (CKP) sensor connector. 3. Turn the ignition ON. 4. Measure the voltage between the CKP connector terminals 1 and 3. Does the voltage measure near the value specified?	2.5 v	Go to *Step 19*	Go to *Step 20*
19	Measure the voltage between the CKP connector terminals 2 and 3. Does the voltage measure near the value specified?	2.5 v	Go to *Step 26*	Go to *Step 21*
20	Measure the voltage between the CKP connector terminals 1 and ground. Does the voltage measure near the value specified?	2.5 v	Go to *Step 22*	Go to *Step 23*
21	Measure the voltage between the CKP connector terminals 2 and ground. Does the voltage measure near the value specified?	2.5 v	Go to *Step 22*	Go to *Step 24*

Engine Cranks But Will Not Run (Cont’d)

Step	Action	Value(s)	Yes	No
22	Check for an open or short in the wire between the CKP connector terminal 3 and ground. Is the problem found?	–	Go to *Step 25*	Go to *Step 40*
23	Check for an open or short in the wire between the CKP connector terminal 1 and the ECM connector terminal M21. Is the problem found?	–	Go to *Step 25*	Go to *Step 40*
24	Check for an open or short in the wire between the CKP connector terminal 2 and the ECM connector terminal M5. Is the problem found?	–	Go to *Step 25*	Go to *Step 40*
25	Repair the wiring as needed. Is the repair complete?	–	Go to *Step 3*	–
26	1. Disconnect the Electronic Ignition (EI) system ignition coil connector to prevent the vehicle from starting. 2. Measure the voltage at the ECM connector terminal M21 by backprobing the ECM connector. Are the voltage readings near the values specified?	2.5 v with ignition ON, 2.6 v during cranking	Go to *Step 27*	Go to *Step 28*
27	Measure the voltage at the ECM connector terminal M5 by backprobing the ECM connector. Are the voltage readings near the values specified?	2.5 v with ignition ON, 2.6 v during cranking	Go to Step 29	Go to *Step 28*
28	Replace the CKP sensor. Is the repair complete?	–	Go to *Step 3*	–
29	1. Turn the ignition OFF. 2. Disconnect the electrical connector at the EI system ignition coil. 3. Connect a test light between terminal 2 of the EI system ignition coil connector and ground. 4. Turn the ignition ON. Is the test light on?	–	Go to *Step 30*	Go to *Step 31*
30	Connect a test light between terminal 4 of the EI system ignition coil connector and battery positive. Is the test light on?	–	Go to *Step 34*	Go to *Step 32*
31	Check for an open in the wiring between the ignition switch and the EI system ignition coil connector terminal 1. Is the problem found?	–	Go to *Step 33*	–
32	Check for an open in the wire from the EI system ignition coil to ground. Is the problem found?	–	Go to *Step 33*	–

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
33	1. Repair the wiring as needed. 2. Connect the EI system 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 3*	Go to *Step 34*
34	1. Turn the ignition OFF. 2. Disconnect the EI system ignition coil connector. 3. While cranking the engine, measure the voltage at the EI system ignition coil connector terminal 3. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to *Step 35*	Go to *Step 36*
35	While cranking the engine, measure the voltage at the EI system ignition coil connector terminal 1. Does the voltage fluctuate within the values specified?	0.2-2.0 v	Go to *Step 39*	Go to *Step 37*
36	Check for an open in the wire from the EI system ignition coil connector terminal 3 to the ECM connector terminal M51. Is the problem found?	–	Go to *Step 38*	Go to *Step 40*
37	Check for an open in the wire from the EI system ignition coil connector terminal 1 to the ECM connector terminal M1. Is the problem found?	–	Go to *Step 38*	Go to *Step 40*
38	1. Repair the wiring as needed. 2. Connect the EI system 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 3*	Go to *Step 39*
39	Replace the EI system ignition coil. Is the repair complete?	–	Go to *Step 3*	–
40	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 3*	–
41	1. Turn the ignition OFF. 2. Connect a fuel pressure gauge. 3. Crank the engine. Is any fuel pressure present?	–	Go to *Step 44*	Go to *Step 42*
42	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 43*	Go to *Step 53*
43	Replace the fuel pump. Is the repair complete?	–	Go to *Step 3*	–
44	Is the fuel pressure within the value specified?	283-324 kPa (41-47 psi)	Go to *Step 48*	Go to *Step 45*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
45	1. Check the fuel filter for a restriction. 2. Inspect the fuel lines for kinks and restrictions. Is the problem found?	–	Go to *Step 46*	Go to *Step 47*
46	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 3*	Go to *Step 47*
47	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 50*	Go to *Step 51*
48	Check the fuel for contamination. Is the fuel contaminated?	–	Go to *Step 49*	Go to *Step 65*
49	1. Remove the contaminated fuel from the fuel tank. 2. Clean the fuel tank as needed. Is the repair complete?	–	Go to *Step 3*	–
50	Replace the fuel pressure regulator. Is the repair complete?	–	Go to *Step 3*	–
51	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 52*	Go to *Step 43*
52	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 3*	–
53	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 54*	Go to *Step 55*
54	Repair the open wire between the fuel pump connector terminal 2 and ground. Is the repair complete?	–	Go to *Step 3*	–
55	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?	2 sec	Go to *Step 56*	Go to *Step 62*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
56	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?	–	Go to *Step 57*	Go to *Step 61*
57	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 58*	Go to *Step 64*
58	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 59*	Go to *Step 60*
59	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 3*	–
60	Replace the fuel pump relay. Is the repair complete?	–	Go to *Step 3*	–
61	1. Check for an open in the wiring between the fuel pump relay connector terminal 85 and ground. Is the problem found?	–	Go to *Step 72*	–
62	Check the wire between the fuel pump relay connector terminal 86 to the ECM connector terminal K54 for an open. Is the problem found?	–	Go to *Step 63*	Go to *Step 40*
63	Repair the wire between the fuel pump relay connector terminal 86 to the ECM connector terminal K54. Is the repair complete?	–	Go to *Step 3*	–
64	Repair the wire between the fuel pump relay connector terminal 30 and the fuse F7. Is the repair complete?	–	Go to *Step 3*	–
65	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 66*	Go to *Step 69*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
66	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 two and three for each of the remaining fuel injectors. Does the test light flash for all of the fuel injectors?	–	Go to *Step 67*	Go to *Step 70*
67	Measure the resistance of each fuel injector. Is the resistance within the value specified (the resistance will increase slightly at higher temperatures)?	11.6-12.4	System OK	Go to *Step 68*
68	Replace any of the fuel injectors with a resistance out of specification. Is the repair complete?	–	Go to *Step 3*	–
69	Repair the open wire(s) between the fuel injector harness connector(s) terminal 1 and the engine harness X4B terminal A. Is the repair complete?	–	Go to *Step 3*	–
70	1. Check for an open between the #1 fuel injector harness connector terminal 2 and the ECM connector terminal M25. 2. Check for an open between the #2 fuel injector harness connector terminal 2 and the ECM connector terminal M22. 3. Check for an open between the #3 fuel injector harness connector terminal 2 and the ECM connector terminal M24 4. Check for an open between the #4 fuel injector harness connector terminal 2 and the ECM connector terminal M11 Is the problem found?	–	Go to *Step 71*	Go to *Step 73*
71	Repair the open fuel injector harness wire(s). Is the repair complete?	–	Go to *Step 3*	–
72	Replace the fuse or repair the wiring as needed. Is the repair complete?	–	Go to *Step 3*	–
73	1. Inspect the I/P fuse F7 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 72*	–

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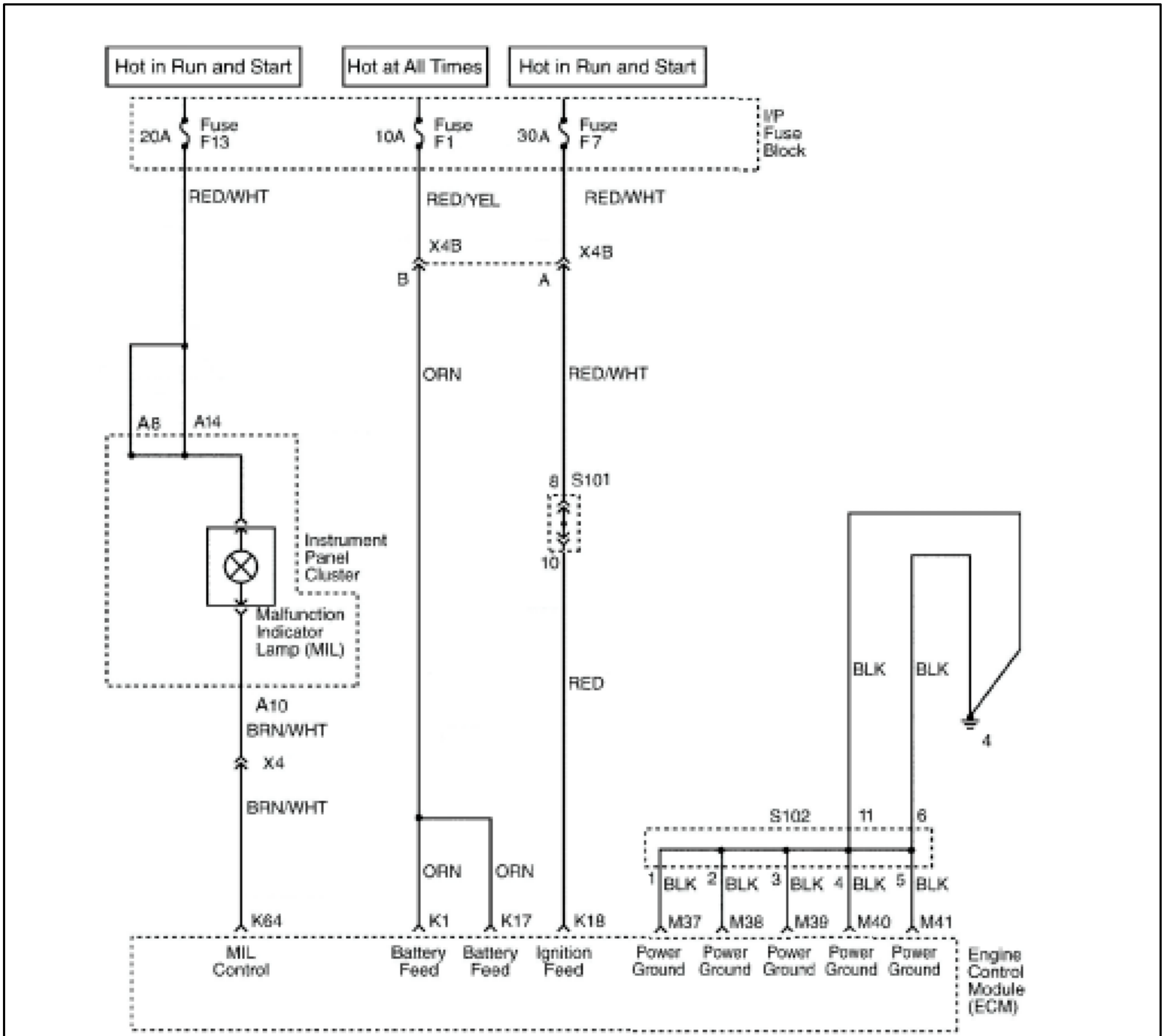


Hot in Run and Start
Hot at All Times
Hot in Run and Start
20A Fuse F13
10A Fuse F1
30A Fuse F7
I/P Fuse Block
RED/WHT
RED/YEL
RED/WHT
X4B
X4B
B
A
ORN
RED/WHT
A8
A14
S101
8
10
Instrument Panel Cluster
Malfunction Indicator Lamp (MIL)
RED
BLK
BLK
4
A10
BRN/WHT
X4
BRN/WHT
S102
11
6
ORN
ORN
1 BLK
2 BLK
3 BLK
4 BLK
5 BLK
K64
K1
K17
K18
M37
M38
M39
M40
M41
MIL Control
Battery Feed
Battery Feed
Ignition Feed
Power Ground
Power Ground
Power Ground
Power Ground
Power Ground
Engine Control Module (ECM)

TAA1F230

NO MALFUNCTION INDICATOR LAMP

Circuit Description

When the ignition is turned ON, the Malfunction Indicator Lamp (MIL) will be turned ON and remain ON until the engine is running, if no Diagnostic Trouble Codes (DTCs) are stored. Battery voltage is supplied through the ignition switch directly to the MIL telltale. The engine control module (ECM) controls the MIL by providing a ground path through the MIL control circuit to turn on the MIL.

Diagnostic Aids

An open ignition F11 fuse will cause the entire cluster to be inoperative.

Check the battery and ignition feed circuits for poor connections if the MIL is intermittent.

Any circuitry that is suspected as causing an intermittent complaint should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminals to wiring connections, or physical damage to the wiring harness.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table.

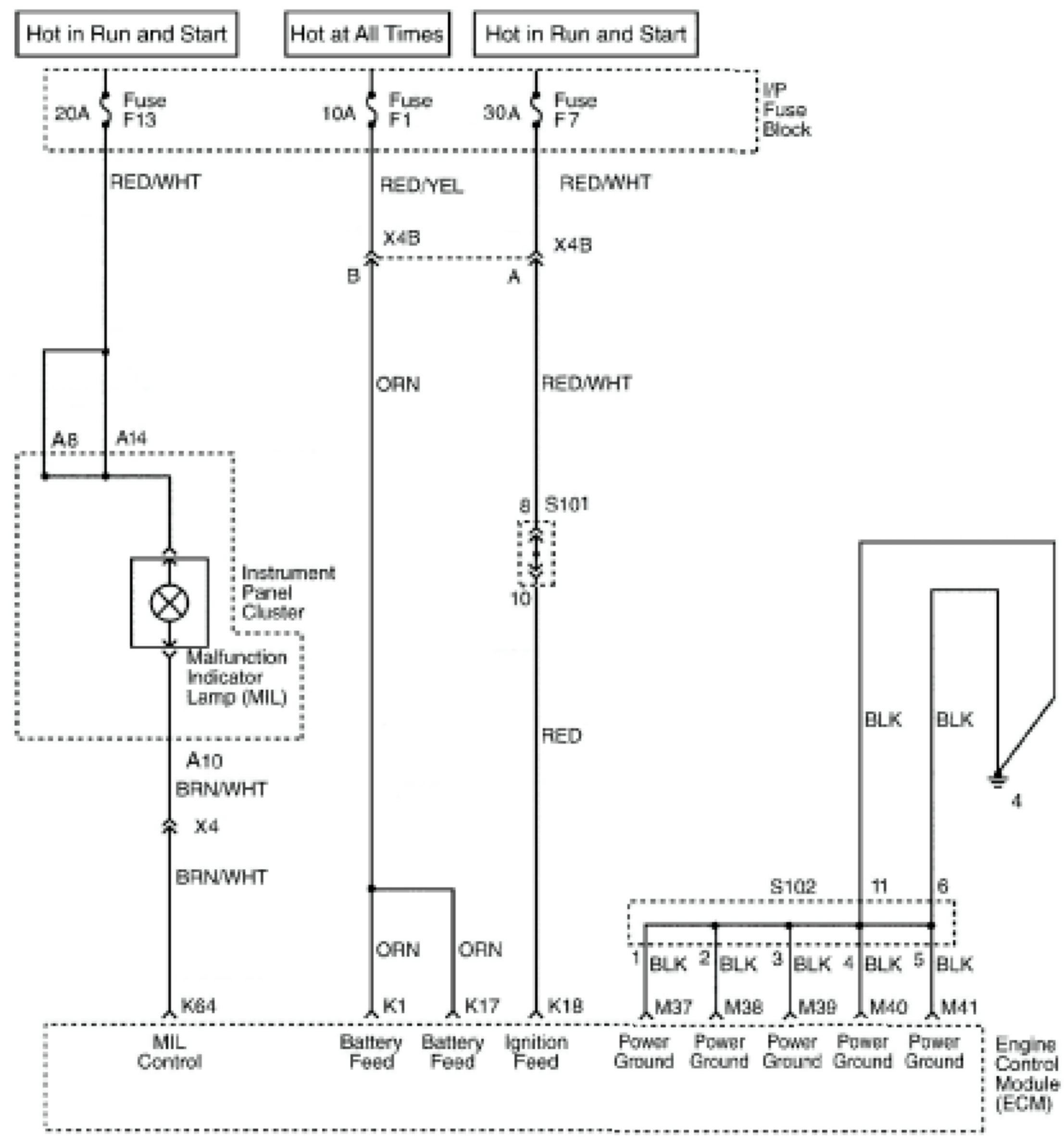
1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool, if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is stored in the scan tool for later reference.
3. Connections that are suspected of being faulty should be thoroughly checked as described in the diagnostic aids.
4. If the engine fails to start and the MIL is inoperative, then the fault can be isolated to either the ECM ignition feed, the battery feed, or a poor ground at the engine block or at the ECM.
8. It takes very little resistance for the battery and the ignition feed circuits to cause an intermittent condition and should also be checked for a poor connection as described in diagnostic aids.
9. Probing the MIL circuit with a test light to ground stimulates the ECM's control of the MIL. If the MIL illuminates, then the malfunction can be isolated to the control of the MIL or a poor connection at the MIL terminal to the ECM. Connections that are suspected of being faulty should be thoroughly checked as described in the diagnostic aids.
12. Before replacing the ECM, check for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wiring harness. Replacement ECMs must be reprogrammed. Refer to the latest Techline information for reprogramming procedures.
21. ECM grounds will only cause a problem if all of the grounds are not making a good connection. If a ECM ground problem is suspected, the most probable place to check is at the engine block, where all the grounds meet.
22. If not faults have been found at this point and no DTCs were set, refer to the diagnostic aids for additional checks and information.

No Malfunction Indicator Lamp

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Turn the ignition switch ON, with the engine OFF. Is the Malfunction Indicator Lamp (MIL) on?	–	Go to *Step 3*	Go to *Step 4*
3	Check for a poor connection at the battery feed K1 or the ignition feed terminal K18. Is a problem found and repaired?	–	Go to *Step 22*	Go to *Step 5*
4	Attempt to start the engine. Does the engine start?	–	Go to *Step 6*	Go to *Step 7*
5	Check for a faulty ngine control module (ECM) ground connection at the engine block or ECM connector ground terminals and repair as necessary. Is the repair complete?	–	Go to *Step 22*	–
6	1. Turn the ignition OFF. 2. Disconnect the ECM connectors from the ECM. 3. Turn the ignition switch ON. Is the MIL ON?	–	Go to *Step 9*	Go to *Step 8*
7	Inspect the ignition and the battery feed fuses. Are the fuses OK?	–	Go to *Step 10*	Go to *Step 11*
8	Check for a poor connection in the battery feed terminal (K1, ignition feed terminal K18, or the MIL control circuits and repair as necessary. Is the repair necessary?	–	Go to *Step 22*	Go to *Step 12*
9	Probe the MIL control circuit with a test light connected to ground. Is the test light illuminated?	–	Go to *Step 13*	Go to *Step 14*
10	1. Turn the ignition switch OFF. 2. Disconnect the ECM connectors from the ECM. 3. Turn the ignition switch ON. 4. Probe the battery feed terminal K1 with a test light connected to ground. Does the test light illuminate?	–	Go to *Step 15*	Go to *Step 16*
11	1. Check for a short to ground in the circuit of the fuse that was open and repair if necessary. 2. Replace the open fuse. Is the repair complete?	–	Go to *Step 22*	–
12	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 22*	–
13	Repair the short to voltage in the MIL control circuit. Is the repair complete?	–	Go to *Step 22*	–
14	Check for an open or a poor connection in the MIL control circuit and repair as necessary. Is the repair necessary?	–	Go to *Step 22*	Go to *Step 17*

No Malfunction Indicator Lamp (Cont'd)

Step	Action	Value	Yes	No
15	With a test light still connected to ground, probe the ignition feed terminal K18. Does the test light illuminate?	–	Go to *Step 18*	Go to *Step 19*
16	Repair the open battery feed circuit. Is the repair complete?	–	Go to *Step 22*	–
17	Check for an open ignition feed circuit or fuse to the MIL and repair as necessary. Is the repair necessary?	–	Go to *Step 22*	Go to *Step 20*
18	Check for a poor connection in the battery feed terminal K1 or the ignition feed terminal K18 and repair as necessary. Is the repair necessary?	–	Go to *Step 22*	Go to *Step 21*
19	Repair the open in the ignition feed circuit from terminal K18. Is the repair complete?	–	Go to *Step 22*	–
20	Replace the instrument panel cluster. Refer to *Section 9E, Instrumentation and Driver Information*. Is the repair complete?	–	Go to *Step 22*	–
21	Check for a faulty ECM ground connection at the engine block or ECM connector and repair as necessary. Was the repair necessary?	–	Go to *Step 22*	Go to *Step 12*
22	1. Allow the engine to idle until normal operating temperature is reached. 2. Check if any DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to the applicable DTC table	System OK


Hot in Run and Start
Hot at All Times
Hot in Run and Start
20A
Fuse F13
10A
Fuse F1
30A
Fuse F7
I/P Fuse Block
RED/WHT
RED/YEL
RED/WHT
X4B
X4B
B
A
ORN
RED/WHT
A6
A14
8
S101
10
Instrument Panel Cluster
Malfunction Indicator Lamp (MIL)
RED
BLK
BLK
4
A10
BRN/WHT
X4
BRN/WHT
S102
11
6
ORN
ORN
1 BLK
2 BLK
3 BLK
4 BLK
5 BLK
K64
K1
K17
K18
M37
M38
M39
M40
M41
MIL Control
Battery Feed
Battery Feed
Ignition Feed
Power Ground
Power Ground
Power Ground
Power Ground
Power Ground
Engine Control Module (ECM)
TAB1F230

MALFUNCTION INDICATOR LAMP ON STEADY

Circuit Description

When the ignition is turned ON, the Malfunction Indicator Lamp (MIL) will be turned on and remain on until the engine is running, if no Diagnostic Trouble Codes (DTCs) are stored. Battery voltage is supplied through the ignition switch directly to the MIL telltale. The engine control module (ECM) controls the MIL by providing a ground path through the MIL control circuit to turn ON the MIL.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on then scan tool, if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is stored in the scan tool for later reference.
2. When the ignition is turned ON, the MIL should be turned on and remain on until the engine is running or until an emission related DTC is stored.
3. This step checks the ability of the ECM to control the MIL. The scan tool has the ability to command the MIL on and off.
5. A shorted MIL circuit can be diagnosed with a scan tool.
7. The replacement ECM must be reprogrammed. Refer to the latest Techline information for reprogramming procedures.

Malfunction Indicator Lamp On Steady

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Turn the ignition switch ON, with the engine OFF. Is the Malfunction Indicator Lamp (MIL) ON?	–	Go to *Step 3*	Go to “No Malfunction Indicator Lamp”
3	1. Install the scan tool. 2. Command the MIL on and off. Does the MIL turn on and off when commanded?	–	Go to *Step 8*	Go to *Step 4*
4	1. Turn the ignition switch OFF. 2. Disconnect the engine control module (ECM) connectors. 3. Turn the ignition switch ON. Is the MIL off?	–	Go to *Step 7*	Go to *Step 5*
5	Check the MIL control circuit for a short to ground and repair as necessary. Is the repair necessary?	–	Go to *Step 8*	Go to *Step 6*
6	Replace the instrument panel cluster. Refer to *Section 9E, Instrumentation and Driver Information*. Is the repair complete?	–	Go to *Step 8*	–
7	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Attempt to start the engine. Does the engine start and continue to run?	–	Go to *Step 9*	Go to *Step 1*
9	1. Allow the engine to idle until normal operating temperature is reached. 2. Check if any DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to the applicable DTC table	System OK

FUEL SYSTEM DIAGNOSIS

System 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 engine control module (ECM) is receiving reference pulses from the crankshaft position (CKP) sensor. If there are no reference pulses, the ECM will turn off the fuel pump two seconds after the ignition switch is turned ON or two 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 flooding.

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 F7 from the engine fuse box.
3. Start the engine and allow the engine to stall.
4. Crank the engine for an additional 10 seconds.

Fuel System Diagnosis

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. Did 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. Did 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 Diagnosis (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. Repair the fuel inlet for leaking. 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 Diagnosis (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. Did 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 19*	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 6*	–
19	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	–

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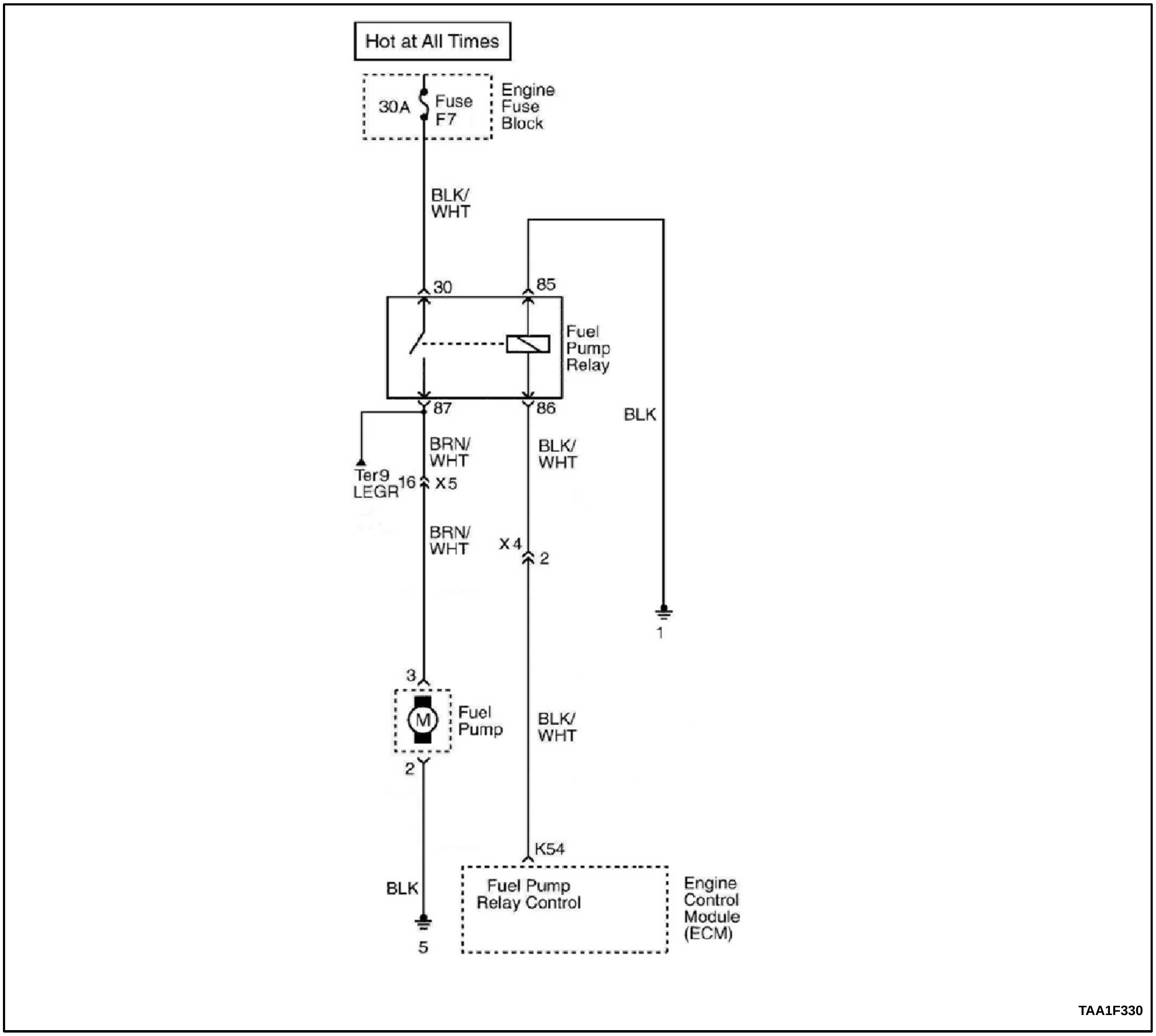

FUEL PUMP RELAY CIRCUIT CHECK

Circuit Description

When the ignition switch is turned ON, the engine 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.
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

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 30 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 86 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 30 and the battery. Is the problem found?	–	Go to *Step 13*	–
9	Check for an open wire between the fuel pump relay connector terminal 86 to the engine control module (ECM)connector terminal K54. Is the problem found?	–	Go to *Step 10*	Go to *Step 12*

Fuel Pump Relay Circuit Check (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Repair the wire between the fuel pump relay connector terminal 86 to the ECM connector terminal K54. 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 F7 or repair the wire between the fuel pump relay connector terminal 30 and the battery. 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. Turn the ignition OFF. 2. Replace the ECM. 3. Turn the ignition ON. Does the fuel pump operate for the time specified?	2 sec	System OK	–
13	1. Replace the fuse F7 or repair the wire between the fuel pump relay connector terminal 30 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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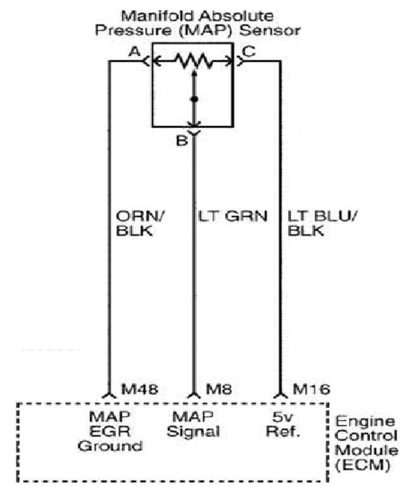

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MANIFOLD ABSOLUTE PRESSURE CHECK

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 engine 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.

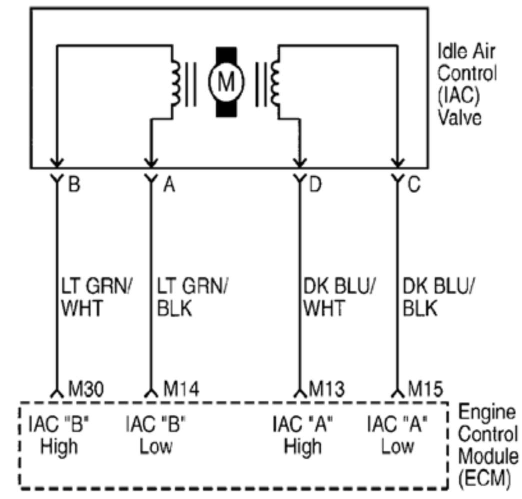
Test Description

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

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition OFF. 2. Connect a scan tool to the Data Link Connector (DLC). 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 DLC. 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	–



IDLE AIR CONTROL SYSTEM CHECK

Circuit Description

The engine 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 body. 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 a 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 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 10 seconds.
3. Turn the ignition ON for 5 seconds.
4. Start the engine in park/neutral.
5. Allow the engine to run until the engine coolant is above 85 C (185 F).
6. Turn the 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 D (drive).
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.

Idle Air Control System Check

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the check completed?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition OFF. 2. Connect the idle air control driver to the Idle Air Control (IAC) valve. 3. Connect a scan tool to the Data Link Connector (DLC). 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	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?		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 (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 engine control module (ECM) connector terminal M30. 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 (M14. 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 M13. 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 M15 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	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	System OK	–
19	1. Turn the ignition OFF. 2. Replace the IAC valve. Is the repair complete?	–	System OK	–

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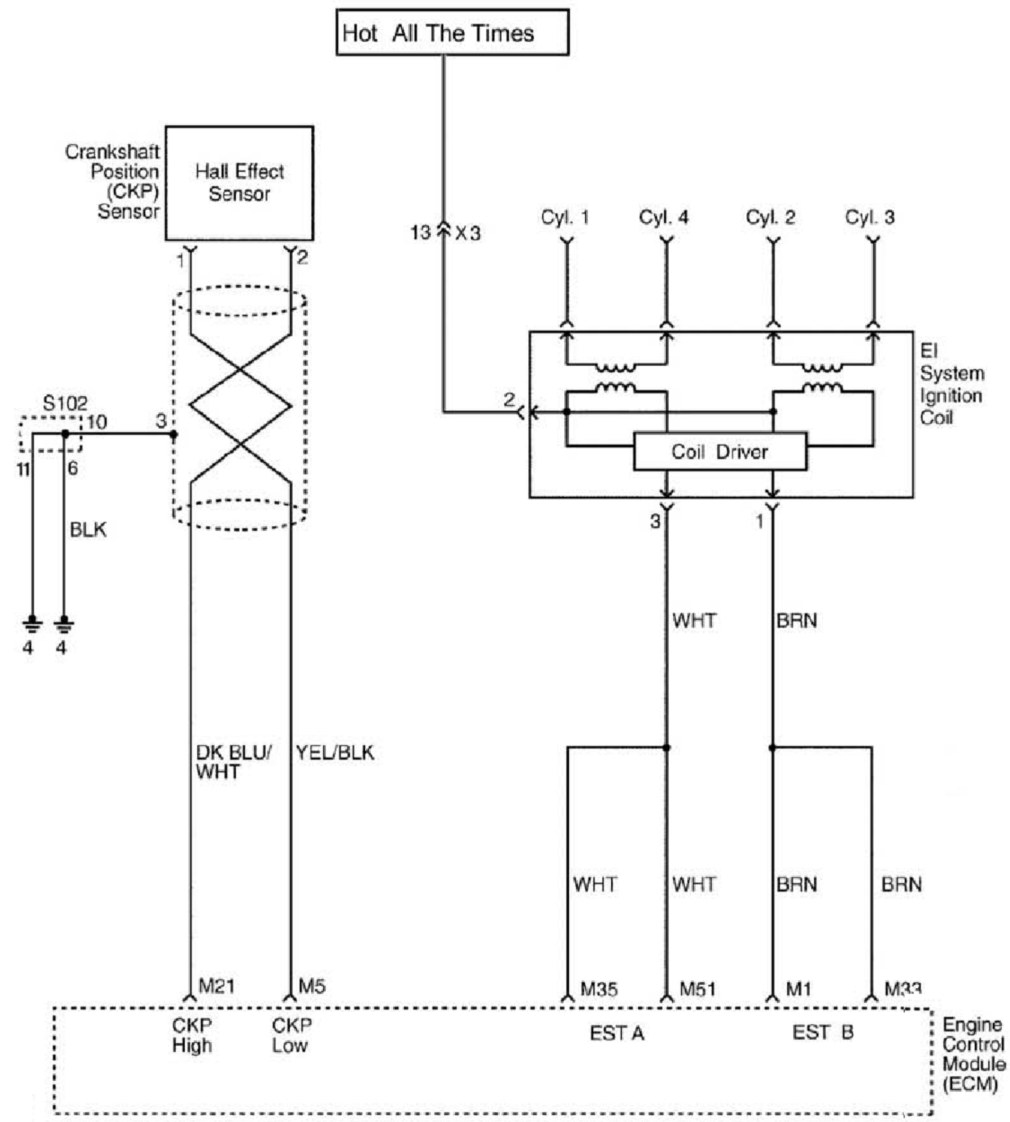

Hot All The Times
Crankshaft Position (CKP) Sensor
Hall Effect Sensor
1
2
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
Coil Driver
2
3
1
S102
10
3
11
6
BLK
4
4
WHT
BRN
DK BLU/ WHT
YEL/BLK
WHT
WHT
BRN
BRN
M21
M5
M35
M51
M1
M33
CKP High
CKP Low
EST A
EST B
Engine Control Module (ECM)

TAA1F240

IGNITION SYSTEM CHECK

Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. In this type of EI system, the Crankshaft Position (CKP) sensor is mounted to the oil pump near a slotted wheel that is a part of the crankshaft pulley. The CKP sensor sends reference pulses to the engine contro module (ECM).
The ECM then triggers the EI system ignition coil.
Once the ECM triggers the EI
system 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 CKP sensor 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 EI system 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 EI system ignition coil are OK, it can be determined that a faulty EI system ignition coil is at fault.
11. After confirming proper CKP sensor inputs to the ECM and no wiring problems present, 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 EI system ignition coil.

Ignition System Check

Caution: Use only electrically insulated pliers when handling ignition wires with the engine running to prevent an electrical shock.

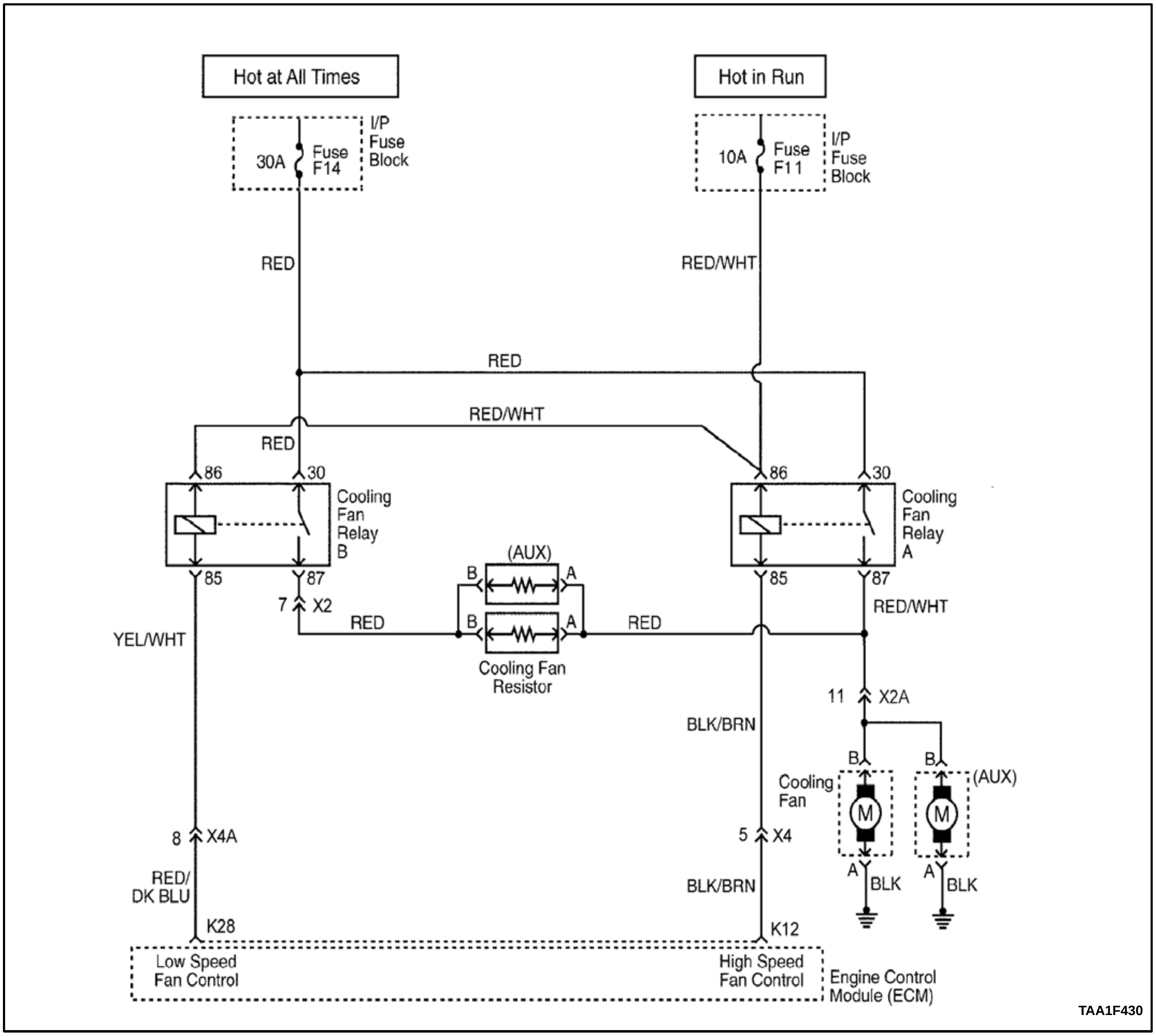
Step	Action	Value(s)	Yes	No
1	1. Remove the spark plugs. 2. Inspect for wet spark plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. 3. Replace the spark plugs as needed. Is the repair complete?	–	System OK	Go to *Step 2*
2	Check for the presence of spark from all of the ignition 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	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*

Ignition System Check (Cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition OFF. 2. Disconnect the Electronic Ignition (EI) system ignition coil connector. 3. While cranking the engine, measure the voltage at the EI system ignition coil connector terminal 3. 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 EI system ignition coil connector terminal 1. 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 EI system ignition coil connector terminal 3 to the engine control module (ECM) connector terminal M35 or M51. Is the problem found?	–	Go to *Step 9*	Go to *Step 11*
8	Check for an open in the wire from the EI system ignition coil connector terminal 1 to the ECM connector terminal M1 or M33. Is the problem found?	–	Go to *Step 9*	Go to *Step 11*
9	1. Repair the wiring as needed. 2. Connect the EI system 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	–
10	1. Turn the ignition OFF. 2. Replace the electronic ignition system ignition coil. 3. Connect the EI system ignition coil connector. 4. 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. Turn the ignition OFF. 2. Replace the ECM. 3. Connect the EI system ignition coil connector. 4. 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 (CKP) sensor connector. 3. Measure the resistance between the CKP sensor terminals 1 and 2. Is the resistance within the value specified?	400-600	Go to *Step 13*	Go to *Step 28*
13	1. Measure the resistance between the CKP sensor terminals 1 and 3. 2. Measure the resistance between the CKP sensor terminals 2 and 3. Is the resistance infinite (open circuit)?	–	Go to *Step 14*	Go to *Step 28*

Ignition System Check (Cont'd)

Step	Action	Value(s)	Yes	No
14	1. Turn the ignition ON. 2. Measure the voltage between the CKP sensor connector terminals 1 and 3. Is the voltage within the value specified?	2.4-2.7 v	Go to *Step 20*	Go to *Step 15*
15	Measure the voltage between the CKP sensor connector terminal 1 and ground. Is the voltage within the value specified?	2.4-2.7 v	Go to *Step 17*	Go to *Step 16*
16	Check the wire between the CKP sensor connector terminal 1 and the CM connector terminal M21 for an open or short. Is the problem found?	–	Go to *Step 18*	Go to *Step 11*
17	Check the wire between the CKP sensor 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 CKP sensor connector terminal 1 and the ECM connector terminal M21. Is the repair complete?	–	System OK	–
19	Repair the wire between the CKP sensor connector terminal 3 and ground. Is the repair complete?	–	System OK	–
20	1. Turn the ignition ON. 2. Measure the voltage between the CKP sensor connector terminals 2 and 3. Is the voltage within the value specified?	.4-2.7 v	Go to *Step 24*	Go to *Step 21*
21	Measure the voltage between the CKP sensor connector terminal 2 and ground. Is the voltage within the value specified?	2.4-2.7 v	Go to *Step 17*	Go to *Step 22*
22	Check the wire between the CKP sensor connector terminal 2 and the ECM connector terminal M5 for an open or short. Is the problem found?	–	Go to *Step 23*	Go to *Step 11*
23	Repair the wire between the CKP sensor connector terminal 2 and the ECM connector terminal M5. Is the repair complete?	–	System OK	–
24				
25				
26				



ENGINE COOLING FAN CIRCUIT CHECK – WITHOUT A/C

Circuit Description

The engine cooling fan circuit operates the cooling fan. The cooling fan is controlled by the engine control module (ECM) based on input from the Engine Coolant Temperature (ECT) sensor. The ECM controls the low speed cooling fan operation by internally grounding the ECM connector terminal K28. 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 K12. 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 F14 or fuse F11 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 K28. This should create low speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals C13 and C12 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 K28 and K12, the cooling fan should run at high speed.

Engine Cooling Fan Circuit Check – Without A/C

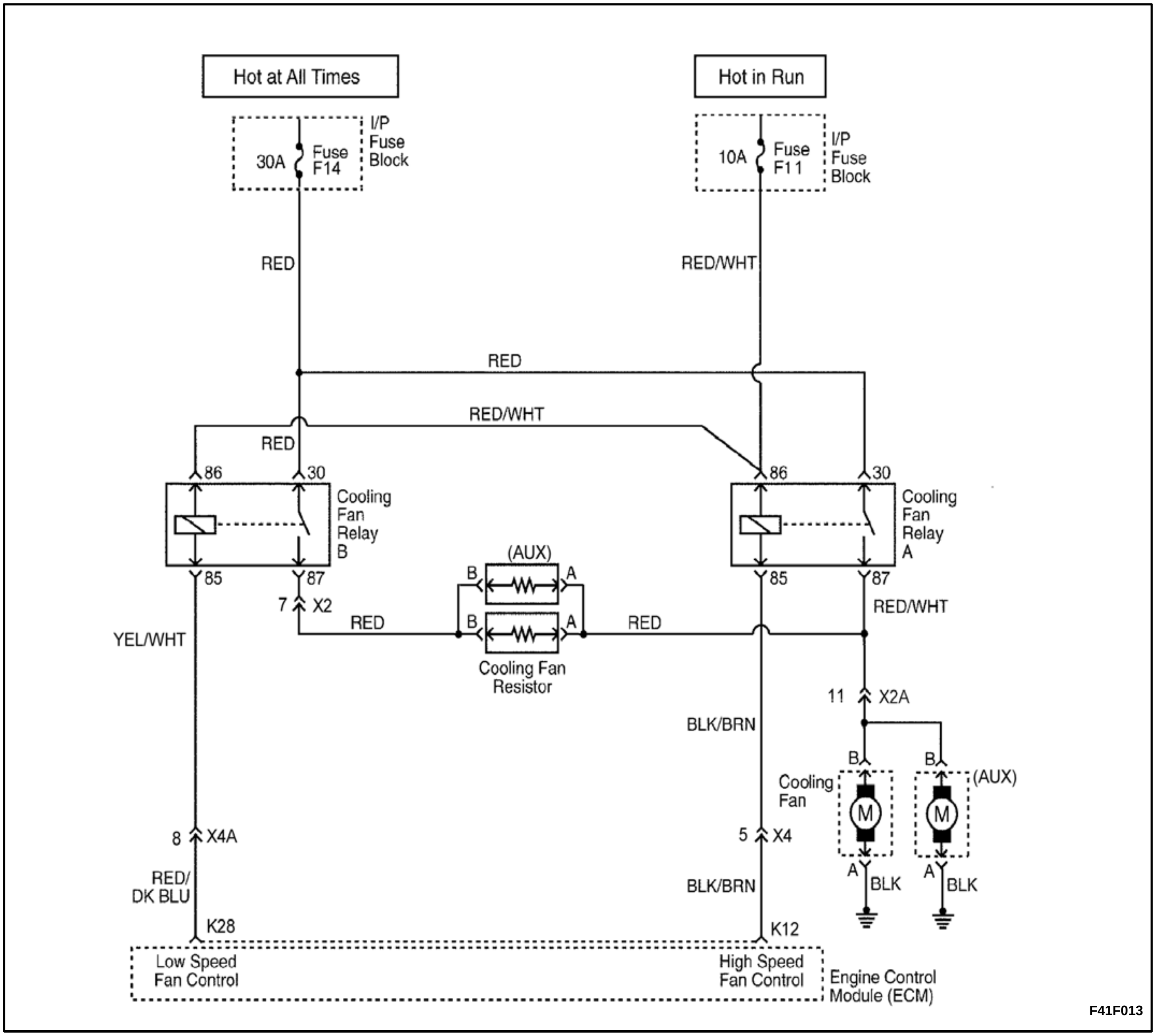
Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the check completed?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Check the I/P fuse block fuse F11. 2. Replace the fuse as needed. Is the fuse OK?	–	Go to *Step 3*	Go to “Diagnostic Aids”
3	1. Check the engine fuse block fuse F14. 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 Data Link Connector (DLC). 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 DLC. 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 engine control module (ECM) connector. 3. Connect a fused jumper between the ECM connector terminal k28 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 K28 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 (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 cooling fan relay B. 3. Connect a test light between the cooling fan relay B 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 cooling fan relay B 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 cooling fan relay B 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 C13 and ground. 2. Connect a test light between the cooling fan relay B 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 cooling fan relay B connector terminal 86 and the ignition switch. Is the repair complete?	–	System OK	–
14	Repair the open wire between the cooling fan relay B connector terminal 30 and the fuse F14. Is the repair complete?	–	System OK	–
15	Repair the open wire between the cooling fan relay B connector terminal 85 and the ECM connector terminal K28 Is the repair complete?	–	System OK	–
16	Check for an open wire between the cooling fan relay B 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 cooling fan relay B. 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 (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 2 3. Connect a fused jumper between the ECM connector terminal K28 and ground. 4. Connect a fused jumper between the ECM connector terminal K12 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 cooling fan relay A. 3. Connect a test light between the cooling fan relay B 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 cooling fan relay A 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 cooling fan relay A 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 K12 and ground. 2. Connect a test light between the cooling fan relay A connector terminal 85 and battery positive. Is the test light on?	–	Go to *Step 27*	Go to *Step 31*
27	Replace the cooling fan relay A. Is the repair complete?	–	System OK	–
28	Repair the open wire between the cooling fan relay A connector terminal 86 and the ignition switch. Is the repair complete?	–	System OK	–
29	Repair the open wire between the cooling fan relay A connector terminal 30 and the fuse F14. Is the repair complete?	–	System OK	–
30	Repair the open wire between the cooling fan relay A connector terminal 87 and the cooling fan connector terminal A. Is the repair complete?	–	System OK	–
31	Repair the open wire between the cooling fan relay A connector terminal 85 and the ECM connector terminal K12. Is the repair complete?	–	System OK	–



ENGINE COOLING FAN CIRCUIT CHECK – WITH A/C

Circuit Description

The engine cooling fan circuit operates the main cooling fan and the auxiliary cooling fan. The cooling fans are controlled by the engine control module (ECM) based on inputs from the Engine Coolant Temperature (ECT) sensor and the Air Conditioning Pressure (ACP) sensor. The ECM controls the low speed cooling fan operation by internally grounding the ECM connector terminal K28. 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 K28 and the ECM connector terminal K12 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 F14 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. The ECM will turn the cooling fans off when the coolant temperature is 90 C .

The ECM will turn the cooling fans on at high speed when the coolant temperature is 97 C. The ECM will change the cooling fans from high speed to low speed when the coolant temperature is 94 C .

The ECM will turn the cooling fans on at low speed when the 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 (244 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 connector 2 and grounding the connector terminal K28. This should create low speed cooling fan operation with the ignition ON. By grounding the ECM connector terminals K28 and K12 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 cooling fan relay A, by jumpering connector terminals 30 and 87 it will be determined 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 K28 and K12, the main and auxiliary cooling fans should run at high speed.

Engine Cooling Fan Circuit Check – With A/C

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the check completed?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Check the engine fuse block fuse F14. 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 F11. 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 A/C switch OFF. 3. Connect a scan tool to the data link connector (DLC). 4. Start the engine. 5. The cooling fans should run at low speed when the coolant temperature reaches 93 C. Do the cooling fans run at low speed?	–	Go to *Step 5*	Go to *Step 10*

Engine Cooling Fan Circuit Check – With A/C (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 DLC. 4. Start the engine. 5. The cooling fans should run at high speed when the coolant temperature reaches 97 C. 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 DLC. 3. The coolant temperature should be above 93 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 DLC. 3. The coolant temperature should be above 93 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 cooling fan relay A. 3. Connect a test light between the cooling fan relay A 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 (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Turn the ignition OFF. 2. Connect the cooling fan relay A. 3. Disconnect the engine control module (ECM) white connector. 4. Connect a fused jumper between the ECM connector terminal K28 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 K28. Is the problem found?	–	Go to *Step 25*	Go to *Step 15*
15	1. Turn the ignition OFF. 2. Disconnect the cooling fan relay A. 3. Connect a test light between the cooling fan relay A 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 cooling fan relay A 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 cooling fan control relay. 2. Connect a fused jumper between the cooling fan relay A connector terminals 30 and 87. 3. Connect a fused jumper between the cooling fan control 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 cooling fan relay A 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 cooling fan control 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 cooling fan control relay connector terminal 87A 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 cooling fan relay A connector terminal 30 and the fuse F14. Is the repair complete?	–	System OK	–
24	Repair the open between the cooling fan relay A connector terminal 86 and the ignition switch. Is the repair complete?	–	System OK	–

Engine Cooling Fan Circuit Check – With A/C (Cont'd)

Step	Action	Value(s)	Yes	No
25	Repair the open wire between the cooling fan relay A connector terminal 85 and the ECM connector terminal K28. Is the repair complete?	–	System OK	–
26	Replace the cooling fan relay A. Is the repair complete?	–	System OK	–
27	Replace the cooling fan control 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 cooling fan relay B. 3. Connect a test light between the cooling fan relay B 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 cooling fan relay B connector terminal 30 and ground. Is the test light on?	–	Go to *Step 35*	Go to *Step 45*
35	1. Disconnect the cooling fan control relay. 2. Connect a test light between the cooling fan control 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 cooling fan control 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 (Cont'd)

Step	Action	Value(s)	Yes	No
37	1. Connect the main cooling fan connector. 2. Connect the cooling fan relay B. 3. Connect the cooling fan control relay. 4. Disconnect the ECM connector. 5. Connect a fused jumper between the ECM connector terminal K28 and ground. 6. Connect a fused jumper between the ECM connector terminal K12 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 cooling fan relay B connector terminal 85 and the ECM connector terminal K12. Is the problem found?	–	Go to *Step 22*	Go to *Step 39*
39	1. Disconnect the cooling fan relay B. 2. Connect a test light between the cooling fan relay B 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 2. Connect a fused jumper between the ECM connector terminal K12 and ground. 3. Disconnect the cooling fan control relay. 4. Connect a test light between the cooling fan control relay connector terminal 85 and battery positive. Is the test light on?	–	Go to *Step 41*	Go to *Step 49*
41	1. Connect the cooling fan control relay. 2. Connect a fused jumper between the ECM connector terminal K12 and ground. 3. Disconnect the cooling fan relay B. 4. Connect a fused jumper between the cooling fan relay B 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 C12 and ground. 3. Disconnect the cooling fan control relay. 4. Connect a fused jumper between the cooling fan control 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 (Cont'd)

Step	Action	Value(s)	Yes	No
43	Replace the cooling fan relay B. Is the repair complete?	–	System OK	–
44	Repair the open wire between the cooling fan relay B connector terminal 86 and the ignition switch. Is the repair complete?	–	System OK	–
45	Repair the open wire between the cooling fan relay B connector terminal 30 and the battery. Is the repair complete?	–	System OK	–
46	Repair the open wire between the cooling fan control relay connector terminal 86 and the ignition switch. Is the repair complete?	–	System OK	–
47	Repair the open wire between the cooling fan control relay connector terminal 87 and ground. Is the repair complete?	–	System OK	–
48	Repair the open wire between the cooling fan relay B connector terminal 87 and the auxiliary cooling fan connector terminal B. Is the repair complete?	–	System OK	–
49	Repair the open wire between the cooling fan control relay connector terminal 85 and the ECM connector terminal K12. Is the repair complete?	–	System OK	–

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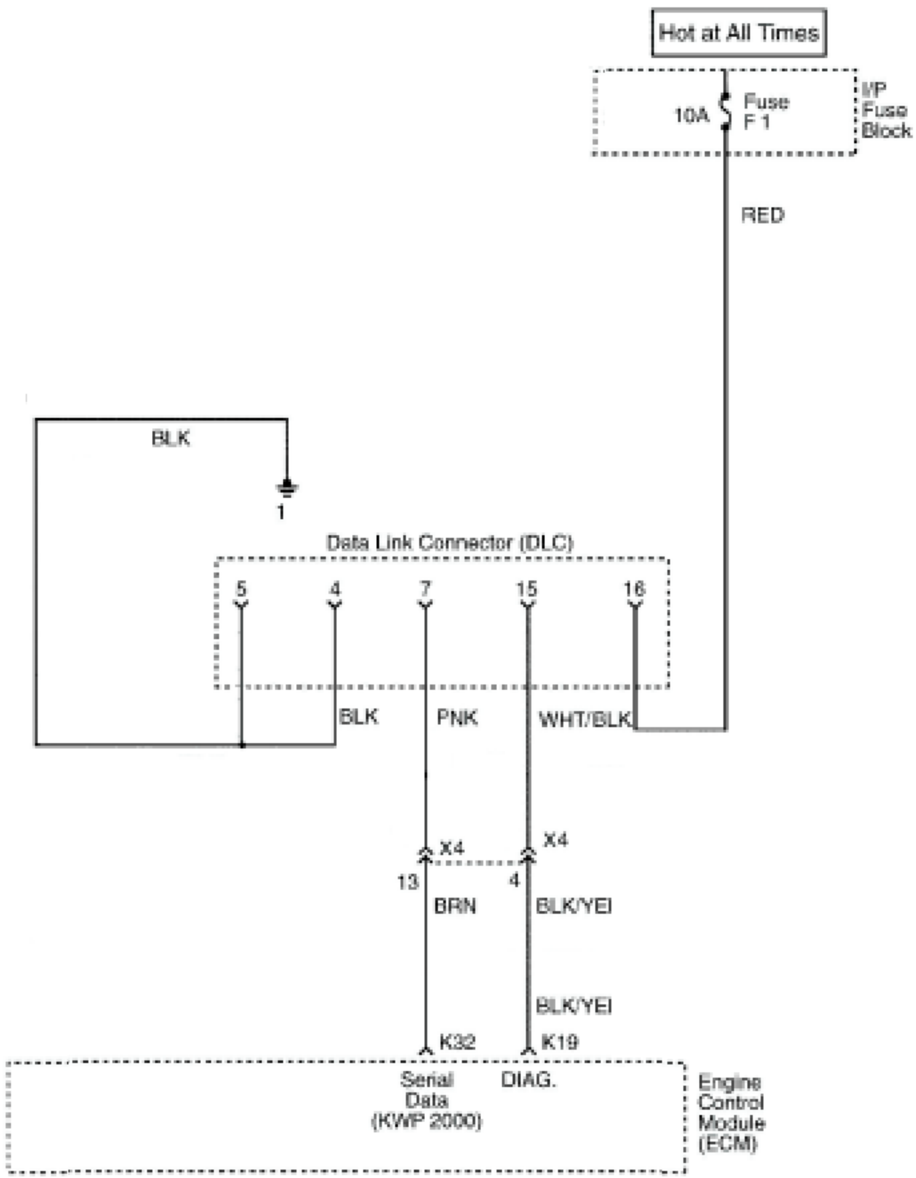
Hot at All Times
10A
Fuse
F 1
I/P
Fuse
Block
RED
BLK
1
Data Link Connector (DLC)
5
4
7
15
16
BLK
PNK
WHT/BLK
X4
X4
13
4
BRN
BLK/YEI
BLK/YEI
K32
K19
Serial
Data
(KWP 2000)
DIAG.
Engine
Control
Module
(ECM)

TAA1F250

DATA LINK CONNECTOR DIAGNOSIS

Circuit Description

The provision for communicating with the engine control module (ECM) is the Data Link Connector (DLC). It is located under the instrument panel. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. The serial data circuit to the DLC allows the ECM to communicate with the scan tool.

Diagnostic Aids

Ensure that the correct application (model line, car year, etc.) has been selected on the scan tool. If communication still cannot be established, try the scan tool on another vehicle to ensure that the scan tool, or cables are not the cause of the condition.

An intermittent may be caused by a poor connection, rubbed through wire insulation, or a broken wire inside the insulation.

Any circuitry that is suspected of causing an intermittent complaint should be thoroughly checked for the following conditions:

Backed-out terminals.

Improper mating of terminals.

Broken locks.

Improperly formed or damaged terminals.

Poor terminals to wiring connection.

Physical damage to the wiring harness.

Corrosion.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The Powertrain On-Board (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. Unlike the UART serial data circuit, the only time a serial data circuit has any voltage on it is when a scan tool asks the ECM for information and sends the information out.
8. Locate and repair any shorts that may have caused the fuse to open before replacement, if the no voltage condition was due to an open fuse.
11. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.
16. The scan tool or associated cables could be malfunctioning. Refer to the scan tool's manual for repair information.

Data Link Connector Diagnosis

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Ignition ON, engine OFF. 2. Install the scan tool. Does the scan tool power up?	–	Go to *Step 3*	Go to *Step 4*
3	1. Disconnect the scan tool. 2. With a test light connected to ground, probe the serial data terminal 7 at the Data Link Connector (DLC). Does the test light remain OFF?	–	Go to *Step 5*	Go to *Step 6*
4	With the test light connected to ground, probe the DLC battery feed circuit terminal 16. Does the test light remain OFF?	–	Go to *Step 8*	Go to *Step 7*
5	With the test light connected to B+, probe the Class II serial data terminal 7 at the DLC. Does the test light remain OFF?	–	Go to *Step 9*	Go to *Step 10*

Data Link Connector Diagnosis (Cont'd)

Step	Action	Value	Yes	No
6	Check the serial data circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 17*	Go to *Step 11*
7	With the test light connected to B+, probe the DLC ground circuit terminals 4 and 5. Does the test light illuminate for both circuits?	–	Go to *Step 15*	Go to *Step 12*
8	Repair the open or short to ground in the DLC battery feed circuit. Is the repair complete?	–	Go to *Step 17*	–
9	Check the serial data circuit for an open or a poor connection and repair as necessary. Is a repair necessary?	–	Go to *Step 17*	Go to *Step 13*
10	Check the serial data circuit for short to ground and repair as necessary. Is a repair necessary?	–	Go to *Step 17*	Go to *Step 11*
11	1. Turn the ignition OFF. 2. Replace the engine control module (ECM). Is the repair complete?	–	Go to *Step 17*	–
12	Repair the open or poor connection(s) in the DLC ground circuit(s). Is the repair complete?	–	Go to *Step 17*	–
13	Reinstall the scan tool. Can the scan tool communicate with the ECM?	–	Go to *Step 17*	Go to *Step 14*
14	Install the scan tool on another vehicle with a Class II serial data terminal and check for proper operation. Does the scan tool work properly on a different vehicle?	–	Go to *Step 11*	Go to *Step 16*
15	Check the DLC electrical terminals for proper tension or excessive resistance and repair as necessary. Is a repair necessary?	–	Go to *Step 17*	Go to *Step 16*
16	1. The scan tool is malfunctioning. 2. Refer to the scan tool's manual for repair. Is the repair complete?	–	Go to *Step 17*	–
17	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Attempt to start the engine. Does the engine start and continue to run?	–	Go to *Step 18*	Go to *Step 1*
18	1. Allow the engine to idle until normal operation temperature is reached. 2. Check if any DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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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 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 engine 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 that 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.

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TROUBLE CODE DIAGNOSIS

CLEARING TROUBLE CODES

Notice: To prevent engine control module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, ECM pigtail connector, ECM fuse, jumper cables, etc.).

When the ECM sets a diagnostic trouble code (DTC), the Malfunction Indicator Lamp (MIL) 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.

DIAGNOSTIC TROUBLE CODES

DTC	Description	Type		Illuminate MIL
		1.5S		
P0106	Manifold Absolute Pressure (MAP) Sensor Rationality	E		Yes
P1106	Manifold Absolute Pressure (MAP) Sensor Intermittent High Voltage	Cnl		No
P0107	Manifold Absolute Pressure (MAP) Sensor Low Voltage	A		Yes
P1107	Manifold Absolute Pressure (MAP) Sensor Intermittent Low Voltage	Cnl		No
P0108	Manifold Absolute Pressure (MAP) Sensor High Voltage	A		Yes
P1111	Intake Air Temperature (IAT) Sensor Intermittent High Voltage	Cnl		No
P0112	Intake Air Temperature (IAT) Sensor Low Voltage	E		Yes
P1112	Intake Air Temperature (IAT) Sensor Intermittent Low Voltage	Cnl		No
P0113	Intake Air Temperature (IAT) Sensor High Voltage	E		Yes
P1114	Engine Coolant Temperature (ECT) Sensor Intermittent Low Voltage	Cnl		No
P1115	Engine Coolant Temperature (ECT) Sensor Intermittent High Voltage	Cnl		No
P0117	Engine Coolant Temperature (ECT) Sensor Low Voltage	A		Yes
P0118	Engine Coolant Temperature (ECT) Sensor High Voltage	A		Yes
P1121	Throttle Position (TP) Sensor High Voltage	Cnl		No
P0122	Throttle Position (TP) Sensor Low Voltage	A		Yes
P1122	Throttle Position (TP) Sensor High Voltage	Cnl		No
P0123	Throttle Position (TP) Sensor High Voltage	A		Yes
P0125	Engine Coolant Temperature (ECT) Insufficient for Closed Loop Fuel Control	E		Yes
P0131	Oxygen Sensor (O2S 1) Low Voltage	A		Yes
P0132	Oxygen Sensor (O2S 1) High Voltage	A		Yes
P0133	Oxygen Sensor (O2S 1) Slow Response	E		Yes
P1133	Oxygen Sensor (O2S 1) Too Few Transitions	E		Yes
P0134	Oxygen Sensor (O2S 1) No Activity	A		Yes

Diagnostic Trouble Codes (Cont'd)

DTC	Description	Type		Illuminate MIL
		1.5S		
P1134	Oxygen Sensor (O2S 1) Transition Ratio	E		Yes
P0137	Heated Oxygen Sensor (HO2S 2) Low Voltage	E		Yes
P0138	Heated Oxygen Sensor (HO2S 2) High Voltage	E		Yes
P0140	Heated Oxygen Sensor (HO2S 2) No Activity	E		Yes
P0141	Heated Oxygen Sensor (HO2S 2) Heater	E		Yes
P0171	Fuel Trim System Too Lean	B		Yes
P1171	Fuel Trim System Lean During Power Enrichment	B		Yes
P0172	Fuel Trim System Too Rich	B		Yes
P0201	Injector 1 Output Circuit Fault	A		Yes
P0202	Injector 2 Output Circuit Fault	A		Yes
P0203	Injector 3 Output Circuit Fault	A		Yes
P0204	Injector 4 Output Circuit Fault	A		Yes
P0300	Multiple Cylinder Misfire	B		Yes
P0301	Cylinder 1 Misfire	B		Yes
P0302	Cylinder 2 Misfire	B		Yes
P0303	Cylinder 3 Misfire	B		Yes
P0304	Cylinder 4 Misfire	B		Yes
P0317	Rough Road Sensor Source Not Detected (1.5L SOHC)	Cnl		No
P0325	Knock System Internal Malfunction	E		Yes/No
P0327	Knock Sensor Circuit Fault	E		Yes/No
P0336	58x Crankshaft Position (CKP) Sensor Extra/Missing Pulses	E		Yes
P1336	58x Crankshaft Position (CKP) Sensor Tooth Error Not Learned	A		Yes
P0337	58x Crankshaft Position (CKP) Sensor No Signal	A		Yes
P0341	Camshaft Position (CMP) Sensor Rationality	E		Yes
P0342	Camshaft Position (CMP) Sensor No Signal	A		Yes
P0351	Ignition Control Circuit A Fault (Cylinder 2 and 3)	A		Yes
P0352	Ignition Control Circuit B Fault (Cylinder 1 and 4)	A		Yes
P1391	G Sensor Rough Road Rationality	Cnl		No
P1392	G Sensor Rough Road Low Voltage	Cnl		No
P1393	G Sensor Rough Road High Voltage	Cnl		No
P0401	Exhaust Gas Recirculation (EGR) Insufficient Flow	Cnl		No
P0402	Exhaust Gas Recirculation (EGR) Excessive Flow	E		Yes
P0404	Exhaust Gas Recirculation (EGR) Opened	E		Yes
P1404	Exhaust Gas Recirculation (EGR) Closed	E		Yes
P0405	Exhaust Gas Recirculation (EGR) Pintle Position Sensor Low Voltage	E		Yes

Diagnostic Trouble Codes (Cont'd)

DTC	Description	Type		Illuminate MIL
		1.5S		
P0406	Exhaust Gas Recirculation (EGR) Pintle Position Sensor High Voltage	E		Yes
P0420	Catalyst (Oxygen Sensor) Low Efficiency	A		Yes
P0443	Evaporative Emission (EVAP) Purge Control Circuit Fault	E		Yes
P0461	Fuel Level Stuck	Cnl		No
P0462	Fuel Level Sensor Low Voltage	Cnl		No
P0463	Fuel Level Sensor High Voltage	Cnl		No
P0502	Vehicle Speed No Signal (M/T only)	E		Yes
P0506	Idle Speed RPM Lower Than Desired Idle Speed	E		Yes
P0507	Idle Speed RPM Higher Than Desired Idle Speed	E		Yes
P0532	A/C Pressure Sensor Low Voltage	Cnl		No
P0533	A/C Pressure Sensor High Voltage	Cnl		No
P0562	System Voltage (Engine Side) Too Low	Cnl		No
P0563	System Voltage (Engine Side) Too High	Cnl		No
P0601	ECM Checksum Error	A		Yes
P0607	Lower Power Counter Error (1.5L SOHC)	Cnl		No
P1607	Lower Power Counter Reset (1.5L SOHC)	Cnl		No
P1626	Immobilizer No Password	Cnl		No
P1631	Immobilizer Incorrect Password	Cnl		No
P1650	SPI Communications Between Error with SIDM chip (1.5L SOHC)	Cnl		No
P1655	SPI Communications Between Error with PSVI chip (1.5L SOHC)	E		Yes

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DIAGNOSTIC TROUBLE CODE (DTC) P0106
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR RATIONALITY

Circuit Description

The engine control module (ECM) uses the Manifold Absolute Pressure (MAP) sensor to control the fuel delivery and the ignition timing.

The MAP sensor measures the changes in the intake manifold pressure which results from engine load (intake manifold vacuum) and the rpm changes due to Throttle Position (TP) changes; and converts these changes into voltage outputs. The ECM can detect if the MAP sensor is not responding to the TP changes by comparing the actual MAP change to a predicted MAP change based on the amount of TP change that occurs. If the ECM does not see the expected MAP change or more, a Diagnostic Trouble Code (DTC) P0106 will set.

Conditions for Setting the DTC

DTCs P0107, P0108, P0117, P0118, P0122, P0123, P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0402, P0404, P0405, P0406, P0506, P0507, P1404 not set.

Engine running.

Valid barometric pressure update.

A/C steady state.

The rpm is between 1300 and 4000.

No TP sensor fail conditions present.

No MAP fail conditions present.

The coolant temperature is greater than -10 C (14 F).

1.5L SOHC

DTC P0125 is not set.

The change in rpm is less than 200.

The change in the TP sensor is less than 3%.

The change in Exhaust Gas Recirculation (EGR) is less than 6%.

The change in Idle Air Control (IAC) is less than 5%.

All the above are stabilized for 1.5 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC)consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a fixed MAP value and use TP to control the fuel delivery (the scan tool will not show a defaulted value.)

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

With the ignition ON and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude. Comparison of this reading with a known good vehicle with the same sensor is a good way to check the accuracy of a suspect sensor. Readings should be the same 0.4 volt.

The MAP sensor vacuum source should be thoroughly checked for restrictions at the intake manifold.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the occurred. The information is then stored on the scan tool for later reference.
2. A sensor that displays an ignition ON, engine OFF BARO value that does not appear normal for the altitude the vehicle is in should be considered to be malfunctioning.
3. While starting the engine, the MAP sensor should detect any changes in the manifold pressure. This test is to determine if the sensor is stuck at a value.
4. A normal MAP sensor will react as quickly to the throttle changes as the changes can be made. A sensor should not appear to be lazy or catch up with the throttle movements.

5. This step checks if the reason for no MAP change was due to a faulty sensor or vacuum source to the sensor.
6. The MAP sensor vacuum source should be thoroughly checked for restrictions. A drill bit can be used to clean out any casting flash that may exist in the vacuum port.
7. The MAP sensor vacuum source should be thoroughly checked for restrictions. A drill bit can be used to clean out any casting flash that may exist in the vacuum port.
9. The MAP Sensor System Performance diagnostic may have to complete several tests before determining if the diagnostic has passed or failed the last test. Operate the vehicle in the Conditions for Setting the DTC several times to ensure that the diagnostic runs enough tests to pass or fail.
10. If no faults have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0106 Manifold Absolute Pressure (MAP) Sensor Rationality

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool. 2. Turn the ignition switch ON with the engine not running. 3. Compare the Barometric Pressure (BARO) reading with a known good vehicle. Is the BARO reading normal for your altitude?	–	Go to *Step 3*	Go *Step 8*
3	Start the engine while watching the Manifold Absolute Pressure (MAP) sensor value. Does the MAP sensor value change while starting the engine?	–	Go to *Step 4*	Go to *Step 5*
4	With the engine still running, snap the throttle while watching the MAP sensor display on the scan tool. Does the MAP sensor value change rapidly with the throttle position changes?	–	Go to *Step 9*	Go to *Step 6*
5	1. Turn the ignition switch OFF. 2. Disconnect the MAP sensor vacuum hose and install a vacuum gauge to the MAP sensor. 3. Turn the ignition switch ON, with the engine OFF. 4. Apply 51 kPa (15 in.Hg) to the MAP sensor. Does the MAP sensor value on the scan tool change?	–	Go to *Step 7*	Go to *Step 8*
6	1. Turn the ignition switch OFF. 2. Remove the MAP sensor vacuum hose from the manifold port. 3. Inspect the port and the hose for restrictions and repair as necessary. Is the action complete?	–	Go to *Step 9*	Go to *Step 8*
7	Repair the restriction in the MAP sensor vacuum port or hose. Is the action complete?	–	Go to *Step 9*	–
8	Replace the MAP sensor. Is the action complete?	–	Go to *Step 9*	–

DTC P0106 Manifold Absolute Pressure (MAP) Sensor Rationality (Cont'd)

Step	Action	Value	Yes	No
9	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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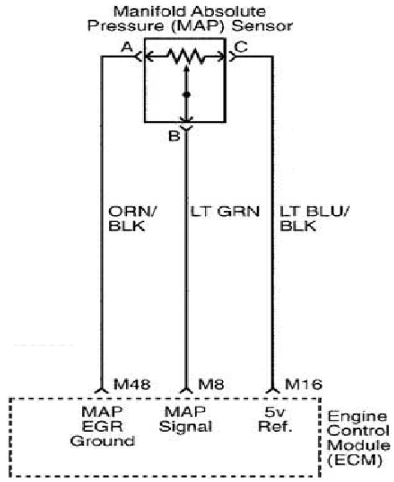


TAA1F140

DIAGNOSTIC TROUBLE CODE (DTC) P1106 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INTERMITTENT HIGH VOLTAGE

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP signal voltage to the engine control module (ECM) varies from below 2 volts at idle (high vacuum) to above 4 volts with the key in the ON position, engine not running or at wide-open throttle (WOT) (low vacuum).

A “speed density” method of determining engine load is used. This is calculated using inputs from the MAP sensor, the rpm (58X), and the Intake Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

The MAP sensor is also used to determine manifold pressure changes while the linear Exhaust Gas Recirculation (EGR) flow test diagnostic is being run (refer to DTC P0401). This determines the engine vacuum level for some other diagnostics and determines Barometric Pressure (BARO). The ECM compares the MAP sensor signal to calculated MAP based on throttle position and various other engine load factors. If the ECM detects a MAP signal voltage that is intermittently above the calculated value, DTC P1106 will set.

Conditions for Setting the DTC

No TP sensor fail conditions present.

Engine running time is greater than 10 seconds.

1.5L SOHC

The MAP is greater than 103.0 kPa.

TP sensor is less than 20% if rpm is less than 3000.

TP sensor is less than 30% if rpm is greater than 3000.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored in the Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Leaking or plugged vacuum supply line to the MAP sensor.

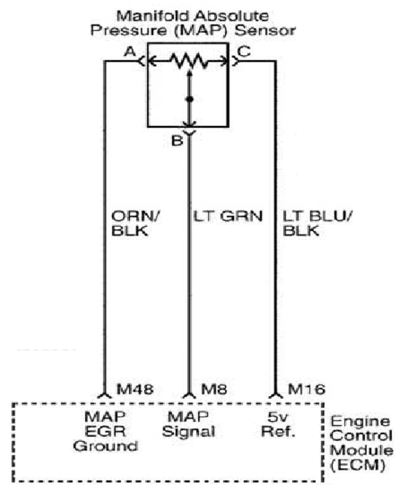
Inspect ECM harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

DTC P1106 Manifold Absolute Pressure (MAP) Sensor Intermittent High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Select Diagnostic Trouble Code (DTC) information. 2. Check Last Test Fail and note any other DTCs set. Is DTC P0108 also set.	–	Go to applicable DTC table	Go *Step 3*
3	Check for a poor sensor ground circuit terminal A connection at the Manifold Absolute Pressure (MAP) sensor. Is a repair necessary?	–	Go to *Step 8*	Go to *Step 4*
4	Check the MAP signal circuit between the MAP sensor connector and the engine control module (ECM) for an intermittent short to voltage. Is a problem found.	–	Go to *Step 9*	Go to *Step 5*
5	Check for an intermittent short to voltage on the 5 volt reference B1 circuit between the ECM and the MAP Sensor Is a problem found?	–	Go to *Step 9*	Go to *Step 6*
6	Check for a poor sensor ground circuit terminal M48 connection at the ECM. Is a problem found?	–	Go to *Step 8*	Go to *Step 7*
7	Check for an intermittent open or a faulty splice in the sensor ground circuit. Is a problem found?	–	Go to *Step 10*	Go to “Diagnostic Aids”
8	Replace the faulty harness connector terminal for sensor ground circuit. Is the repair complete?	–	Go to *Step 10*	–
9	Locate and repair intermittent open/short circuit in the wiring harness as necessary. Is the repair complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 2*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



TAA1F140

DIAGNOSTIC TROUBLE CODE (DTC) P0107
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR LOW VOLTAGE

Circuit Description

The engine control module (ECM) uses the Manifold Absolute Pressure (MAP) sensor to control the fuel delivery and the ignition timing. The MAP sensor measures the changes in the intake manifold pressure which results from engine load (intake manifold vacuum) and the rpm changes, and it converts these into voltage outputs. The ECM sends a 5 volt reference voltage to the MAP sensor. As the manifold pressure changes, the output voltage of the MAP sensor also changes. By monitoring the MAP sensor output voltage, the ECM knows the manifold pressure. A low pressure (low voltage) output voltage will be about 1.0 to 1.5 volts at idle, while higher pressure (high Voltage) output voltage will be about 4.5 to 4.8 at Wide Open Throttle (WOT). The MAP sensor is also used, under certain conditions, to measure barometric pressure, allowing the ECM to make adjustments for different altitudes.

Conditions for Setting the DTC

No Throttle Position (TP) sensor fail conditions present.

System Voltage is greater than 11.0 volts.

1.5L SOHC

The MAP is less than 12.0 kPa.

The TP sensor is greater than or equal to 0% if the rpm is less than or equal to 1500.

The TP sensor is greater than 10.0% if the rpm is greater than 1500.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a fixed MAP value and use TP to control the fuel delivery (the scan tool will not show defaulted value.)

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

With the ignition ON and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high.

This information is used by the ECM as an indication of vehicle altitude. Comparison of this reading with a known good vehicle with the same sensor is a good way to check the accuracy of a suspect sensor. Readings should be the same ±0.4 volt.

If a DTC P0107 is intermittent, refer to "Manifold Absolute Pressure Check" in this section for further diagnosis.

Important: After repairs, use the scan tool BLOCK LEARN RESET function to reset long-term fuel trim to 128 (0%).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step will determine if DTC P0107 is the result of a hard failure or an intermittent condition.
3. Jumpering harness terminals B to C (signal circuit to 5 volts) will determine if the sensor is malfunctioning or if there is a problem with the ECM or wiring.
6. The scan tool may not display 5 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the and the signal circuit are OK.
7. A short to ground in the 5 volt reference circuit could also set additional DTCs.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for the ECM reprogramming.

DTC P0107 Manifold Absolute Pressure (MAP) Sensor Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	With engine idling, install a scan tool. Does the scan tool display Manifold Absolute Pressure (MAP) voltage below the specified value?	12 kPa	Go to *Step 3*	Go *Step 4*
3	1. Turn the ignition switch OFF. 2. Disconnect the MAP sensor electrical connector. 3. Jumper the MAP signal circuit at terminal B to the 5 volt reference circuit at terminal C. 4. Turn the ignition switch ON. Does the MAP sensor read more than the specified value?	96 kPa	Go to *Step 5*	Go to *Step 6*
4	1. Turn the ignition switch ON with the engine OFF, review the Freeze Frame data, and note the parameters. 2. Operate the vehicle within the freeze frame conditions and Conditions For Setting the DTC as noted. Does the scan tool display MAP sensor below the specified value?	12 kPa	Go to *Step 3*	Go to “Diagnostic Aids”
5	Inspect the MAP sensor harness electrical connector terminals for the following conditions: Poor connections Proper contact tension Poor terminal to wire connection Is a problem found?	–	Go to *Step 8*	Go to *Step 9*
6	1. Turn the ignition switch OFF. 2. Remove the jumper wire. 3. Probe the MAP sensor signal circuit terminal B with a test light to B+. 4. Turn the ignition switch ON. Does the scan tool read over the specified value?	90 kPa	Go to *Step 7*	Go to *Step 12*

DTC P0107 Manifold Absolute Pressure (MAP) Sneosr Low Voltage (Cont'd)

Step	Action	Value	Yes	No
7	Check the MAP sensor 5 volt reference circuit for an open or short to ground. Is a problem found?	–	Go to *Step 10*	Go to *Step 11*
8	Repair the connection terminals as necessary. Is the action complete?	–	Go to *Step 14*	–
9	1. Turn the ignition OFF. 2. Replace the MAP sensor. Is the action complete?	–	Go to *Step 14*	–
10	Repair the MAP sensor 5 volt reference circuit. Is the action complete?	–	Go to *Step 14*	–
11	1. Turn the ignition OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 14*	–
12	Check the MAP sensor signal circuit for the following conditions: Open Short to ground Short to sensor ground Is a problem found?	–	Go to *Step 13*	Go to *Step 11*
13	Repair the MAP sensor signal circuit. Is the action complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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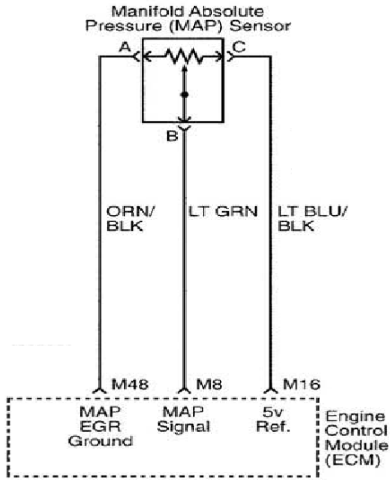


TAA1F140

DIAGNOSTIC TROUBLE CODE (DTC) P1107 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INTERMITTENT LOW VOLTAGE

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP signal voltage to the engine control module (ECM) varies from below 2 volts at idle (high vacuum) to above 4 volts with the key ON, engine not running or at wide–open throttle (WOT) (low vacuum).

A “speed density” method of determining engine load is used. This is calculated using inputs from the MAP sensor, the rpm (58X), and the Intake Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

The MAP sensor is also used to determine manifold pressure changes while the linear Exhaust Gas Recirculation (EGR) flow test diagnostic is being run (refer to DTC P0401). This determines engine vacuum level for some other diagnostics and determines Barometric Pressure (BARO). The ECM compares the MAP sensor signal to calculated MAP based on Throttle Position (TP) and various other engine load factors. If the ECM detects a MAP signal voltage that is intermittently below the calculated value, DTC P1107 will set.

Conditions for Setting the DTC

No TP sensor fail conditions present.

System voltage is greater than 11 volts.

1.5L SOHC

The MAP is less than 12.0 kPa.

TP sensor is greater than or equal to 0% if rpm is less than or equal to 1500.

TP sensor is greater than 10.0% if rpm is greater than 1500.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored in the Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Leaking or plugged vacuum supply line to the MAP sensor.

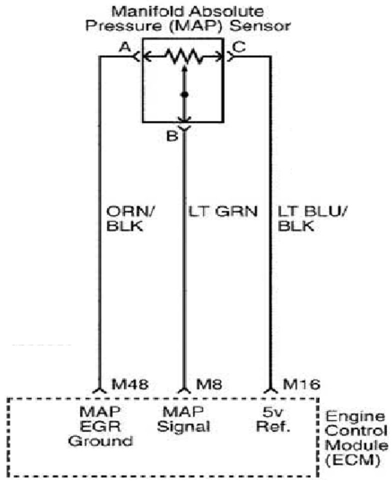
Inspect ECM harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

DTC P1107 Manifold Absolute Pressure (MAP) Sensor Intermittent Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Select Diagnostic Trouble Code (DTC) information. 2. Check Last Test Fail and note any other DTCs set. Is DTC P0107 also set.	–	Go to applicable DTC table	Go *Step 3*
3	Check for a poor 5 volt reference circuit or Manifold Absolute Pressure (MAP) signal circuit terminal connection at the MAP sensor Is a repair necessary?	–	Go to *Step 5*	Go to *Step 4*
4	Check the (MAP) signal circuit between the MAP sensor connector and the engine control module (ECM) for an intermittent open or short to ground. Is a problem found.	–	Go to *Step 6*	Go to *Step 7*
5	Replace the faulty harness connector terminal for the 5 volt reference circuit and/or the MAP signal circuit. Is the repair complete?	–	Go to *Step 7*	–
6	Repair intermittent open/short circuit in the wiring harness. Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



TAA1F140

DIAGNOSTIC TROUBLE CODE (DTC) P0108
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR HIGH VOLTAGE

Circuit Description

The engine control module (ECM) uses the Manifold Absolute Pressure (MAP) sensor to control the fuel delivery and the ignition timing. The MAP sensor measures the changes in the intake manifold pressure which results from engine load (intake manifold vacuum) and the rpm changes; and converts these into voltage outputs. The ECM sends a 5 volt reference voltage to the MAP sensor. As the manifold pressure changes, the output voltage of the MAP sensor also changes. By monitoring the MAP sensor output voltage, the ECM knows the manifold pressure. A low pressure (low voltage) output voltage will be about 1.0 to 1.5 volts at idle, while higher pressure (high Voltage) output voltage will be about 4.5 to 4.8 at Wide Open Throttle (WOT). The MAP sensor is also used, under certain conditions, to measure barometric pressure, allowing the ECM to make adjustments for different altitudes.

Conditions for Setting the DTC

No Throttle Position (TP) sensor fail conditions present.

The Engine run time is greater than 10 seconds.

1.5L SOHC

The MAP is greater than 103 kPa.

The TP sensor is less than 20% if the rpm is less than or equal to 3000.

The TP sensor is less than 30% if the rpm is greater than 3000.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a fixed MAP value and use Throttle Position (TP) to control the fuel delivery (scan tool will not show defaulted value.)

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

With the ignition ON and the engine stopped, the manifold pressure is equal to atmospheric pressure, and the signal voltage will be high.

This information is used by the ECM as an indication of vehicle altitude. Comparison of this reading with a known good vehicle with the same sensor is a good way to check the accuracy of a suspect sensor. Readings should be the same 0.4 volt.

If a DTC P0108 is intermittent, refer to MAP Sensor Output Check for further diagnosis.

DTC P0108 may set as a result of a misfire. If misfire is present, repair the cause of misfire before using this table. The misfire counters may be used to determine which cylinder(s) is misfiring.

Important: After repairs, use the scan tool BLOCK LEARN RESET function to reset long term fuel trim to 128 (0%).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step will determine if DTC P0108 is the result of a hard failure or an intermittent condition.
3. This step simulates conditions for a DTC P0107. If the ECM recognizes the change, the ECM, the 5 volt reference and the sensor signal circuits are OK.
5. This step also looks for an open in the sensor ground circuit. If the circuit was open, additional DTCs will also be set. If no other DTCs are set and the circuit is found to be open, then the open must be between the MAP sensor and the electrical connector ground splice.
6. When the sensor signal circuit is shorted to battery voltage, the TP will be displayed above 0% at all times and A/C High Side will be displayed high. The vehicle will also remain in Open Loop.
8. The MAP sensor vacuum source should only supply vacuum to the MAP sensor. Check the vacuum port for a restriction caused by casting flash.
9. Disconnect all sensors that use a 5 volt reference one at a time while monitoring the short on the 5 volt reference circuit. Replace any sensor that may have caused the short on the 5 volt reference circuit.
12. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for the ECM reprogramming.

DTC P0108 Manifold Absolute Pressure (MAP) Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool. 2. Engine idling. Does the scan tool display a Manifold Absolute Pressure (MAP) voltage of the specified value or less?	85 kPa	Go to *Step 3*	Go *Step 4*
3	1. Turn the ignition switch OFF. 2. Disconnect the MAP sensor electrical connector. 3. Turn the ignition switch ON. Does the scan tool display a MAP voltage of the specified value or less?	28 kPa	Go to *Step 5*	Go to *Step 6*
4	1. Turn the ignition switch ON, with the engine OFF, review the Freeze Frame data and note the parameters. 2. Operate the vehicle within the freeze frame conditions and Conditions For Setting the DTC as noted. Does the scan tool display a MAP voltage equal to or greater than the specified value?	85 kPa	Go to *Step 3*	Go to “Diagnostic Aids”

DTC P0108 Manifold Absolute Pressure (MAP) Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
5	Probe the MAP signal ground circuit at terminal A with a test light connected to battery voltage. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 11*
6	Check the MAP sensor signal circuit at terminal B for a short to voltage and repair as necessary. Is a action complete?	–	Go to *Step 14*	Go to *Step 12*
7	With a Digital Volt Meter (DVM) connected to ground, probe the 5 volt reference circuit at terminal C. Does the DVM display near the specified value?	5 v	Go to *Step 8*	Go to *Step 9*
8	Check the MAP sensor vacuum source for being plugged or leaking. Is a problem found?	–	Go to *Step 10*	Go to *Step 13*
9	Check the 5 volt reference circuit for a short to voltage and repair as necessary. Is a action complete?	–	Go to *Step 14*	Go to *Step 12*
10	Repair the vacuum source as necessary. Is the action complete?	–	Go to *Step 14*	–
11	Check for an open in the MAP sensor ground circuit at terminal A and repair as necessary. Is a action complete?	–	Go to *Step 14*	Go to *Step 12*
12	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 14*	–
13	1. Turn the ignition OFF. 2. Replace the MAP sensor. Is the action complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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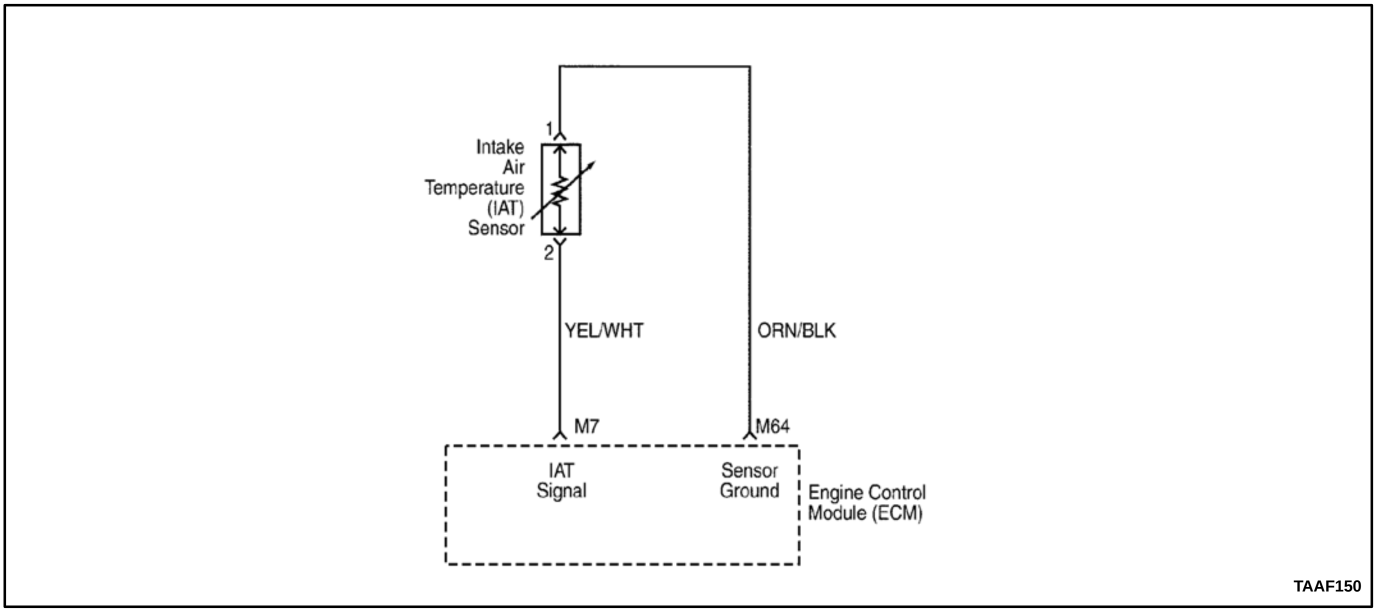

DIAGNOSTIC TROUBLE CODE (DTC) P1111 INTAKE AIR TEMPERATURE (IAT) SENSOR INTERMITTENT HIGH VOLTAGE

Circuit Description

The Intake Air Temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the resistance is high, and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the ECM to monitor a lower voltage. DTC P1111 will set when the ECM detects an excessively high signal voltage on the intake air temperature sensor signal circuit.

Conditions for Setting the DTC

DTC P0502 is not set.

Engine run time is greater than 120 Seconds.

1.5L SOHC

IAT is less than –38 C (–36.4 F).

Vehicle speed is less than 18.6 mph (25 km/h).

Engine coolant temperature is greater than 70 C (158 F).

Airflow is less than 15 g/s.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Intake Air Temperature Sensor

C	F	OHMS
Temperature Vs. Resistance Values (approximate)		
100	212	187
80	176	327
60	140	603
45	113	991
35	95	1412
25	77	2055
15	59	3055
5	41	4651
5	23	7273
15	5	11722
30	22	25600
40	40	45300

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

DTC P1111 Intake Air Temperature Intermittent (IAT) Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON. 2. Install the scan tool. Is DTC P0113 set?	–	Go to applicable DTC table	Go *Step 3*
3	1. Check for a poor sensor ground circuit terminal 1 connection at the Idle Air Temperature (IAT) sensor. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to *Step 4*
4	1. Check for a poor IAT signal circuit terminal 2 connection at the IAT sensor. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to *Step 5*
5	1. Check the IAT signal circuit between the IAT sensor connector and the engine control module (ECM) for an intermittent open. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to *Step 6*
6	1. Check the IAT signal circuit between the IAT sensor connector and the ECM for an intermittent short to voltage. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to *Step 7*

DTC P1111 Intake Air Temperature Intermittent (IAT) Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
7	1. Check for a poor sensor ground circuit terminal M64 connection at the ECM. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to *Step 8*
8	1. Check for an intermittent open or a faulty splice in the sensor ground circuit. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 9*	Go to "Diagnostic Aids"
9	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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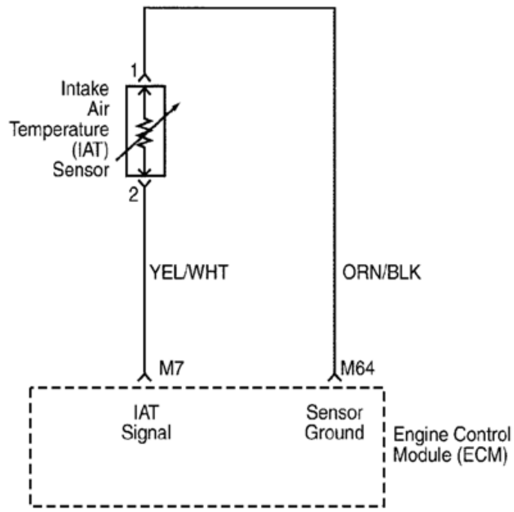


DIAGNOSTIC TROUBLE CODE (DTC) P0112
INTAKE AIR TEMPERATURE (IAT) SENSOR LOW VOLTAGE

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the engine control module (ECM). The ECM supplies a 5 volt reference and a ground to the sensor.

When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Conditions for Setting the DTC

The IAT is greater than 149 C (300.2 F).

DTC P0502 is not set.

1.5L SOHC

Vehicle speed is greater than or equal to 31.1 mph (50 km/h).

Engine run time is greater than 120 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate (1.5L SOHC) consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a default value for intake air temperature. The scan tool will not show the defaulted value.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

If the vehicle is at ambient temperature, compare the IAT sensor to the engine coolant temperature (ECT) sensor. The IAT sensor and the ECT sensor should be relatively close to each other.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

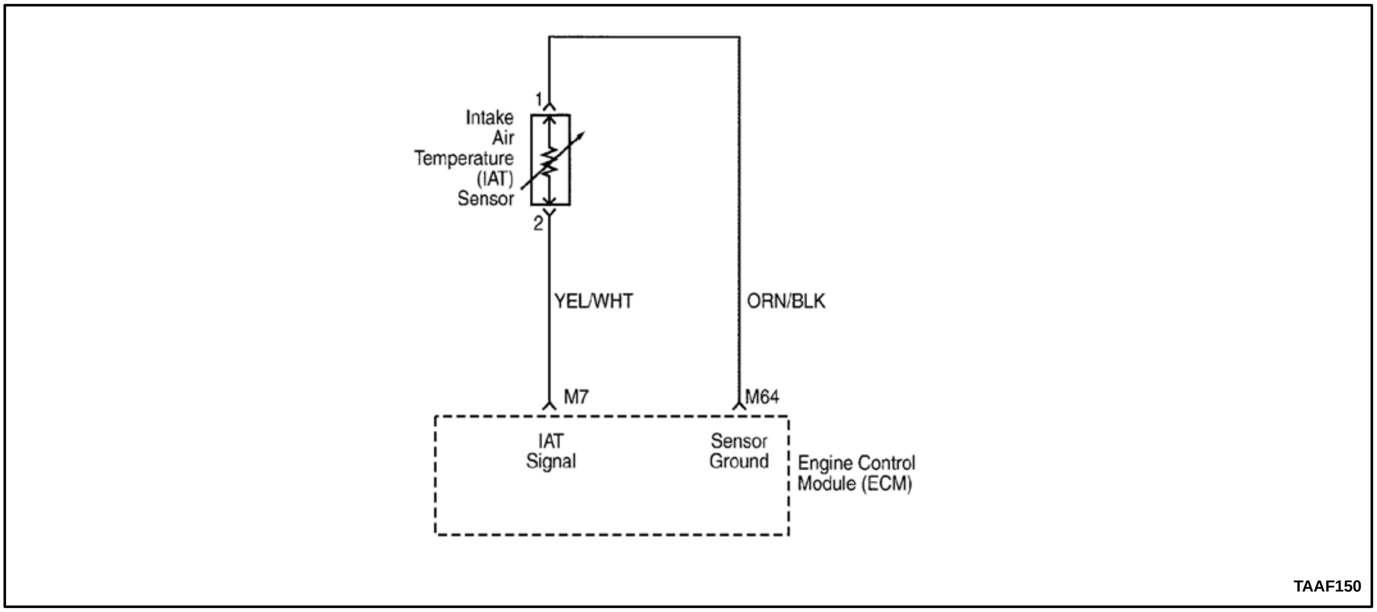
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
4. This step simulates a DTC P0113 condition. If the scan tool displays the specified value, the IAT signal circuit, and the ECM are OK.
8. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0112 Intake Air Temperature (IAT) Sensor Low Voltage

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool Is the Intake Air Temperature (IAT) value greater than the specified value?	128 C (262 F)	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition switch ON with the engine OFF, review Freeze Frame data, and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the IAT sensor value greater than the specified value?	128 C (262 F)	Go to *Step 4*	Go to “Diagnostic Aids”
4	1. Turn the ignition switch OFF. 2. Disconnect the IAT sensor electrical connector. 3. Turn the ignition switch ON. Is the IAT sensor value below the specified value?	-30 C (-22 F)	Go to *Step 5*	Go to *Step 6*
5	1. Turn the ignition switch OFF. 2. Replace the IAT sensor. Is the action complete?	–	Go to *Step 9*	–
6	1. Turn the ignition switch OFF. 2. Disconnect the Engine Control Module (ECM) connector. 3. With a test light connected to B+, probe the IAT sensor signal circuit, terminal 2 at the IAT sensor electrical connector. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 8*
7	Repair the short to ground in the IAT sensor signal circuit as necessary. Is the repair complete?	–	Go to *Step 9*	–
8	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 9*	–
9	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P1112
INTAKE AIR TEMPERATURE (IAT) SENSOR INTERMITTENT LOW VOLTAGE

Circuit Description

The Intake Air Temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the resistance is high, and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the ECM to monitor a lower voltage. DTC P1112 will set when the ECM detects an intermittently low signal voltage on the intake air temperature sensor signal circuit.

Conditions for Setting the DTC

The IAT is greater than 149 C (300.2 F).

DTC P0502 is not set.

/1.5L SOHC

Vehicle speed is greater than or equal to 31.1 mph (50 km/h).

Engine run time is greater than 120 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Intake Air Temperature Sensor

C	F	OHMS
Temperature Vs. Resistance Values (approximate)		
100	212	187
80	176	327
60	140	603
45	113	991
35	95	1412
25	77	2055
15	59	3055
5	41	4651
5	23	7273
15	5	11722
30	22	25600
40	40	45300

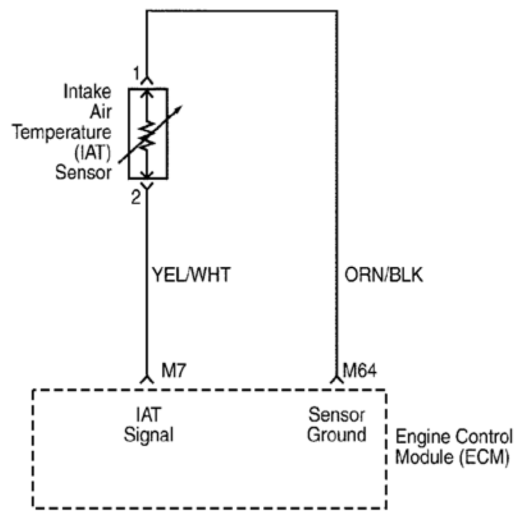
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Verifies the fault is present.
3. If DTC P1112 can be repeated only by duplicating the Fail Records conditions, refer to the Temperature Vs. Resistance Value Chart. The chart may be used to test the IAT sensor at various temperatures to evaluate the possibility of a “shifted” sensor that may be shorted above or below a certain temperature. If this is the case, replace the IAT sensor.

DTC P1112 Intake Air Temperature (IAT) Sensor Intermittent Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the Ignition ON. 2. Install the scan tool. Is DTC P0112 also set?	–	Go to applicable DTC table	Go *Step 3*
3	1. Check the Idle Air Temperature (IAT) signal circuit between the IAT sensor connector and the engine control module (ECM) for an intermittent short to ground. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 4*	Refer to “Diagnostic Aids”
4	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 5*	Go to *Step 2*
5	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0113 INTAKE AIR TEMPERATURE (IAT) SENSOR HIGH VOLTAGE

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the engine control module (ECM). The ECM supplies a 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Conditions for Setting the DTC

DTC P0502 is not set.

Engine run time is greater than 120 Seconds.

1.5L SOHC

IAT is less than –38 C (–36.4 F).

Vehicle speed is less than 18.6 mph (25 km/h).

Engine coolant temperature is greater than 70 C (158 F).

Airflow is less than 15 g/s.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a default value for IAT. The scan tool will not show the defaulted value.

Conditions for Clearing the MIL/DTC

The MIL will turn OFF after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

If the vehicle is at ambient temperature, compare the IAT sensor to the Engine Coolant Temperature (ECT) sensor. The IAT sensor and the ECT sensor should be relatively close to each other.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

4. This step simulates a DTC P0112. If the ECM senses the change, the ECM and wiring are OK.
5. This step will determine if the reason the ECM did not sense the change was due to a open ground or signal circuit or malfunctioning ECM.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0113 Intake Air Temperature (IAT) Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. Is the Intake Air Temperature (IAT) value less than the specified value?	-30 C (-22 F)	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF, review Freeze Frame data and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the IAT sensor value less than the specified value?	-30 C (-22 F)	Go to *Step 4*	Go to “Diagnostic Aids”
4	1. Disconnect the IAT sensor electrical connector. 2. Jumper the IAT sensor signal circuit at terminal 2 and the IAT sensor ground circuit at terminal 1 together at the IAT sensor electrical connector. Is the IAT sensor value greater than the specified value?	130 C (266 F)	Go to *Step 6*	Go to *Step 5*
5	Jumper the IAT sensor signal circuit at terminal 2 to ground. Is the IAT sensor value greater than the value specified?	130 C (266 F)	Go to *Step 7*	Go to *Step 8*
6	Check for a poor connection at the IAT sensor electrical connector and replace any malfunctioning terminals if necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
7	Check the IAT sensor ground circuit for an open and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 9*
8	Check the IAT sensor signal circuit for an open or short to battery and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 9*
9	Check for a poor IAT sensor ground circuit at terminal M64 or a poor IAT sensor signal circuit terminal B8 (M7)* connection at the engine control module (ECM) and repair if necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 11*
10	1. Tur the ignition switch OFF. 2. Replace the IAT sensor. Is the action complete?	–	Go to *Step 12*	–

DTC P0113 Intake Air Temperature (IAT) Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
11	1. Tur the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 12*	–
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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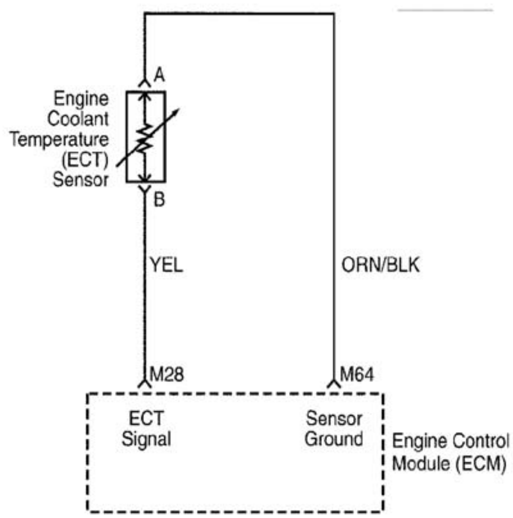


DIAGNOSTIC TROUBLE CODE (DTC) P1114 ENGINE COOLANT TEMPERATURE (ECT) SENSOR INTERMITTENT LOW VOLTAGE

Circuit Description

The Engine Coolant Temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5.0 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor resistance is high, and the ECM will monitor a high signal voltage. As the engine coolant warms, the sensor resistance is less, and the ECT signal voltage measured at the ECM drops. With a fully warmed up engine, the ECT signal voltage should measure about 1.5 to 2.0 volts. If the ECM detects an ECT signal that is intermittently below the range of the ECT sensor, a DTC P1114 will set.

Conditions for Setting the DTC

Engine run time longer than 1 minute.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Engine Coolant Temperature Sensor

C	F	OHMS
Temperature Vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
5	23	12300
15	5	21450
30	22	52700
40	40	100700

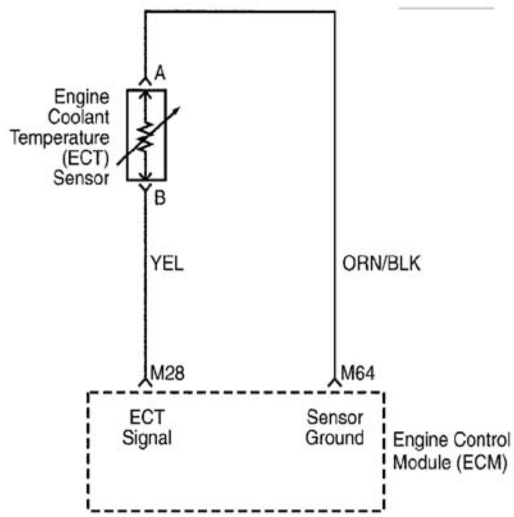
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference

DTC P1114 Engine Coolant Temperature (ECT) Sensor Intermittent Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the Ignition ON. 2. Install the scan tool. Is DTC P0117 set?	–	Go to applicable DTC table	Go *Step 3*
3	1. Check the Engine Coolant Temperature (ECT) signal circuit between the ECT sensor connector and the engine control module (ECM) for an intermittent short to ground. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 4*	Refer to “Diagnostic Aids”
4	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 5*	Go to *Step 2*
5	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P1115
ENGINE COOLANT TEMPERATURE (ECT) SENSOR INTERMITTENT HIGH VOLTAGE

Circuit Description

The Engine Coolant Temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5.0 volts) through a pull–up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor resistance is high, and the ECM will monitor a high signal voltage. As the engine coolant warms, the sensor resistance is less, and the ECT signal voltage measured at the ECM drops. With a fully warmed up engine, the ECT signal voltage should measure about 1.5 to 2.0 volts. If the ECM detects an ECT signal that is intermittently above the range of the ECT sensor, a DTC P1115 will set.

Conditions for Setting the DTC

Engine run time is greater than 90 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Engine Coolant Temperature Sensor

C	F	OHMS
Temperature Vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
5	23	12300
15	5	21450
30	22	52700
40	40	100700

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

DTC P1115 Engine Coolant Temperature (ECT) Sensor Intermittent High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON. 2. Install the scan tool. Is DTC P0118 set?	–	Go to applicable DTC Table	Go to *Step 3*
3	Check the scan tool. Is DTC P1121 also set?	–	Go to *Step 8*	Go to *Step 4*
4	1. Check for a poor sensor ground circuit terminal A connection at the Engine Coolant Temperature (ECT) sensor. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to *Step 5*
5	1. Check for a poor ECT signal circuit terminal B connection at the ECT sensor. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to *Step 6*
6	1. Check the ECT signal circuit between the ECT sensor connector and the engine control module (ECM) for an intermittent open. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to *Step 7*
7	1. Check the ECT signal circuit between the ECT sensor connector and the ECM for an intermittent short to voltage. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to *Step 8*

DTC P1115 Engine Coolant Temperature (ECT) Sensor Intermittent High Voltage (Cont'd)

Step	Action	Value	Yes	No
8	1. Check for a poor sensor ground circuit terminal M64 connection at the ECM. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to *Step 9*
9	1. Check for an intermittent open or a faulty splice in the sensor ground circuit. 2. If a problem is found, repair as necessary. Is the repair complete?	–	Go to *Step 10*	Go to "Diagnostic Aids"
10	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 2*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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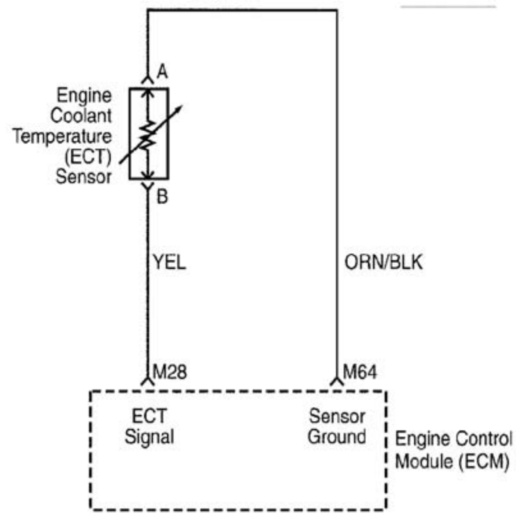

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DIAGNOSTIC TROUBLE CODE (DTC) P0117
ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOW VOLTAGE

Circuit Description

The Engine Coolant Temperature (ECT) Sensor uses a thermistor to control the signal voltage to the engine control module (ECM).
The ECM supplies a voltage on the signal circuit to the sensor. When the air is cold, the resistance is high; therefore the ECT signal voltage will be high.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature, the voltage will be between 1.5 and 2.0 volts at the ECT signal terminal.

The ECT sensor is used to control the following items:

- Fuel delivery.
- Ignition.
- Evaporative Emission (EVAP) canister purge valve.
- Idle Air Control (IAC) valve.
- Electric cooling fan.

Conditions for Setting the DTC

- The engine run time is greater than 60 seconds.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.
- Both cooling fan turns ON.
- The ECM will substitute a default value for ECT. The scan tool may not show the defaulted value.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

After the engine has started, the ECT should rise steadily to about 90 C (194 F) then stabilize when the thermostat opens.

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

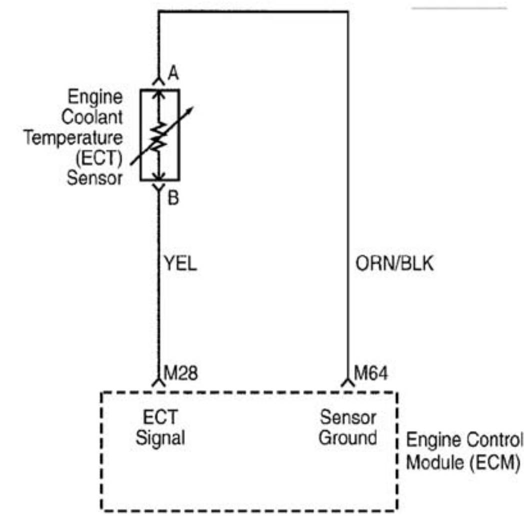
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
4. This step simulates a DTC P0118 condition. If the ECM senses the change, then the ECM and the ECT wiring are OK.
7. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0117 Engine Coolant Temperature (ECT) Sensor Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. Is the Engine Coolant Temperature (ECT) sensor value greater than the specified value?	130 C (266 F)	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the ECT sensor value greater than the specified value?	130 C (266 F)	Go to *Step 4*	Go to "Diagnostic Aids"
4	Disconnect the ECT sensor electrical connector. Is the ECT sensor value less than the specified value?	–30 C (–22 F)	Go to *Step 6*	Go to *Step 5*
5	Check the ECT sensor signal circuit at terminal B 2 for a short to ground and repair as necessary. Is a repair necessary?	–	Go to *Step 8*	Go to *Step 7*
6	1. Tur the ignition switch OFF. 2. Replace the ECT sensor. Is the action complete?	–	Go to *Step 8*	–
7	1. Tur the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 9*	Go to *Step 2*
9	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0118
ENGINE COOLANT TEMPERATURE (ECT) SENSOR HIGH VOLTAGE

Circuit Description

The Engine Coolant Temperature (ECT) Sensor uses a thermistor to control the signal voltage to the engine control module (ECM).
The ECM supplies a voltage on the signal circuit to the sensor. When the air is cold, the resistance is high; therefore the ECT signal voltage will be high.

As the engine warms, the sensor resistance becomes less and the voltage drops. At normal engine operating temperature, the voltage will be between 1.5 and 2.0 volts at the ECT signal terminal.

The ECT sensor is used to control the following items:

Fuel delivery.

Ignition.

Evaporative Emission (EVAP) canister purge valve.

Idle Air Control (IAC) valve.

Electric cooling fan.

Conditions for Setting the DTC

The engine run time is greater than 90 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Both cooling fan turns ON.

The ECM will substitute a default value for ECT. The scan tool may not show the defaulted value.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Normal operating temperature for the engine cooling system is between 90 C (194 F) and 95 C (203 F).

Use the Temperature vs. Resistance Values table to evaluate the possibility of a skewed sensor. Refer to “Temperature vs. Resistance” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
4. This step simulates a DTC P0117 condition. If the ECM senses the change, then the ECM and the ECT wiring are OK.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0118 Engine Coolant Temperature (ECT) Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. Is the Engine Coolant Temperature (ECT) sensor value less than the specified value?	-30 C (-22 F)	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the ECT sensor value less than the specified value?	-30 C (-22 F)	Go to *Step 4*	Go to "Diagnostic Aids"
4	1. Disconnect the ECT sensor electrical connector. 2. Jumper the ECT sensor signal circuit at terminal 2 and the ECT sensor ground circuit at terminal 1 together at the ECT electrical connector. Is the ECT sensor value greater than the specified value?	130 C (266 F)	Go to *Step 6*	Go to *Step 5*
5	Jumper the ECT sensor signal circuit at terminal 2 to chassis ground. Is the ECT sensor value greater than the specified value?	130 C (266 F)	Go to *Step 7*	Go to *Step 8*
6	Check for poor connections at the ECT sensor and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
7	Check the ECT sensor ground circuit for an open and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 9*
8	Check the ECT sensor signal circuit for an open or short to battery and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 9*
9	Check for a poor ECT sensor ground circuit at terminal M64 or a poor ECT sensor signal circuit at terminal M28 connection at the engine control module (ECM) and replace the terminals if necessary. Do any of the terminal(s) need to be replaced?	–	Go to *Step 12*	Go to *Step 11*
10	1. Tur the ignition switch OFF. 2. Replace the ECT sensor. Is the action complete?	–	Go to *Step 12*	–
11	1. Tur the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 12*	–

DTC P0118 Engine Coolant Temperature (ECT) Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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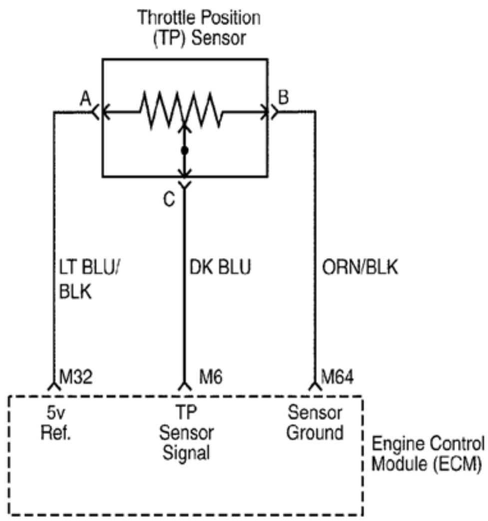


DIAGNOSTIC TROUBLE CODE (DTC) P1121
THROTTLE POSITION (TP) SENSOR INTERMITTENT HIGH VOLTAGE

Circuit Description

The Throttle Position (TP) sensor circuit provides a voltage signal that changes relative to throttle blade angle. The TP sensor sends a voltage signal back to the engine control module (ECM) relative to the throttle plate opening. The voltage signal will vary from approximately 1 volt at closed throttle, to over 4.9 v at Wide Open Throttle (WOT).

The TP signal is used by the ECM for fuel control and for most of the ECM controlled outputs. The TP signal is one of the most important inputs used by the ECM for fuel control and most of the ECM controlled outputs. If the ECM detects a TP signal that is intermittently above the range of the TP sensor, a DTC P1121 will be set.

Conditions for Setting the DTC

TP sensor voltage indicates a throttle voltage intermittently greater than 4.86 volts.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The history DTC will clear after 40 consecutive warm-up cycles in which the diagnostic runs without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears OK, observe the throttle position display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the display will indicate the location of the fault.

If DTC P1121 cannot be duplicated, reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

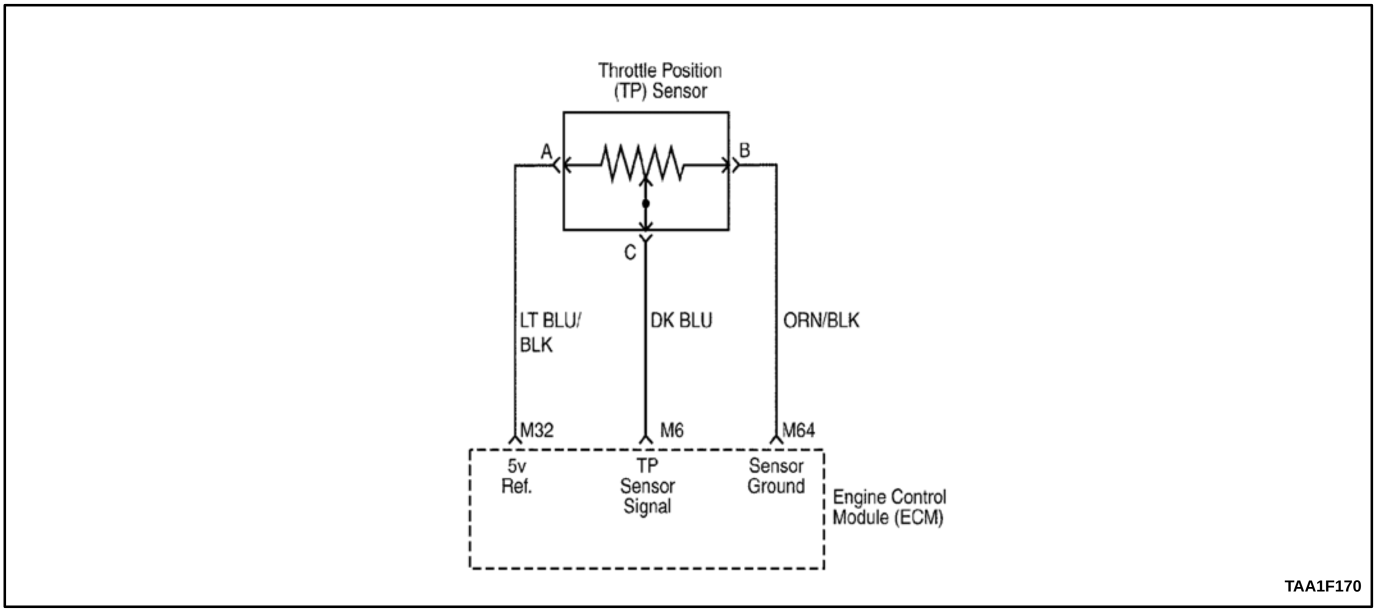
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

DTC P1121 Throttle Position (TP) Sensor Intermittent High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON. 2. Install the scan tool. Is DTC P0123 also set?	–	Go to applicable DTC table	Go to *Step 3*
3	Check for a poor sensor ground circuit terminal B connection at the Throttle Position (TP) sensor. Is a problem found?	–	Go to *Step 7*	Go to *Step 4*
4	Check the TP signal circuit between the TP sensor connector and the engine control module (ECM) for an intermittent short to voltage. Is a problem found?	–	Go to *Step 8*	Go to *Step 5*
5	Check for a poor sensor ground terminal M64 connection at the ECM. Is a problem found?	–	Go to *Step 7*	Go to *Step 6*
6	Check for an intermittent open or a faulty splice in the sensor ground circuit. Is a problem found?	–	Go to *Step 8*	Go to "Diagnostic Aids"
7	Replace the faulty harness connector terminal for sensor ground circuit. Is action complete?	–	Go to *Step 9*	–
8	Repair the intermittent open/short circuit in wiring harness as necessary. Is the action complete?	–	Go to *Step 9*	–
9	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0122
THROTTLE POSITION (TP) SENSOR LOW VOLTAGE

Circuit Description

The engine control module (ECM) supplies a 5 volt reference signal and a ground to the Throttle Position (TP) sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The voltage signal will vary from approximately 0.45 volts at closed throttle, to over 4.5 volts at Wide Open Throttle (WOT).

Conditions for Setting the DTC

TP sensor is less than 0.14 volts.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a default value for TP. The scan tool may not show the defaulted value.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared using the scan tool.

Diagnostic Aids

If a DTC P0122 cannot be duplicated, the information included in the Freeze Frame data can be useful. Use the scan tool DTC information data to determine the status of the DTC. If the DTC occurs intermittently, using the DTC P0121 Diagnostic table may help isolate the problem.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The TP sensor has an auto zeroing feature. If the voltage reading is between 0.2 to 0.9 volts, the ECM will assume the TP sensor is at a closed throttle position (0%).
4. Simulates a high voltage signal which will identify an open in the signal circuit.
5. If additional DTCs are set, check the 5 volt reference circuits for a short to ground.
6. If the test light illuminates while probing the TP signal circuit, then the TP signal circuit is shorted to ground.
8. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

11. If no faults have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0122 Throttle Position (TP) Sensor Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Turn the ignition switch ON, with the engine OFF. Install a scan tool. Is the Throttle Position (TP) sensor voltage below the specified value?	0.2 v	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the TP sensor voltage below the specified value?	0.2 v	Go to *Step 4*	Go to *Step 12*
4	1. Disconnect the TP sensor electrical connector. 2. Jumper the 5 volt reference circuit, terminal A and the TP sensor signal circuit, terminal C together at the TP sensor electrical connector. Is the TP sensor voltage above the specified value.	4 v	Go to *Step 10*	Go to *Step 5*
5	Connect a test light between B+ and the TP sensor signal circuit at terminal C. Is the TP sensor voltage greater than the specified value?	4 v	Go to *Step 6*	Go to *Step 8*
6	Check the 5 volt reference circuit for an open or short to ground and repair as necessary. Is the action complete?	–	Go to *Step 12*	Go to *Step 7*
7	Check the 5 volt reference circuit for a poor connection at the engine control module (ECM), terminal M32 and repair the terminal as necessary. Is the action complete?	–	Go to *Step 12*	Go to *Step 11*
8	Check the TP sensor signal circuit, terminal M6 for an open or a short to ground and repair as necessary. Is the action complete?	–	Go to *Step 12*	Go to *Step 9*
9	Check the TP sensor signal circuit, terminal M6 for a poor connection at the ECM and repair as necessary. Is the action complete?	–	Go to *Step 12*	Go to *Step 11*
10	1. Tur the ignition switch OFF. 2. Replace the TP sensor. Is the action complete?	–	Go to *Step 12*	–
11	1. Tur the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 12*	–

DTC P0122 Throttle Position (TP) Sensor Low Voltage (Cont'd)

Step	Action	Value	Yes	No
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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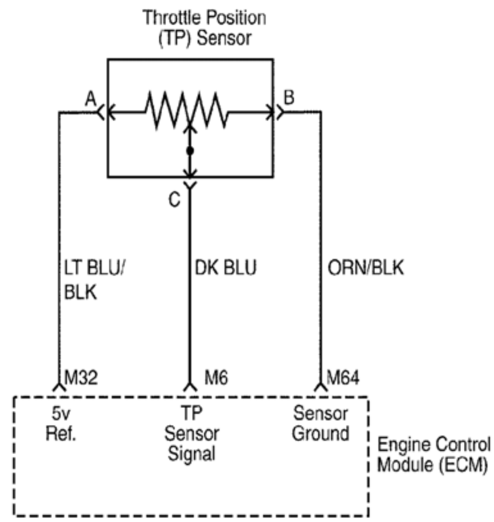


DIAGNOSTIC TROUBLE CODE (DTC) P1122
THROTTLE POSITION (TP) SENSOR INTERMITTENT LOW VOLTAGE

Circuit Description

The Throttle Position (TP) sensor circuit provides a voltage signal that changes relative to throttle blade angle. The TP sensor sends a voltage signal back to the engine control module (ECM) relative to the throttle plate opening. The voltage signal will vary from approximately 1 volt at closed throttle, to over 4.9 v at Wide Open Throttle (WOT). The TP signal is used by the ECM for fuel control and for most of the ECM controlled outputs. The TP signal is one of the most important inputs used by the ECM for fuel control and most of the ECM controlled outputs. If the ECM detects a TP signal that is intermittently below the range of the TP sensor, a DTC P1122 will be set.

Conditions for Setting the DTC

TP sensor indicates a TP signal intermittently less than 0.14 volt.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The history DTC will clear after 40 consecutive warm up cycles in which the diagnostic runs without a fault.

DTC P1122 can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

Poor connection at the ECM. Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness. Inspect the wiring harness for damage. If the harness appears OK, observe the throttle position display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the display will indicate the location of the fault.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

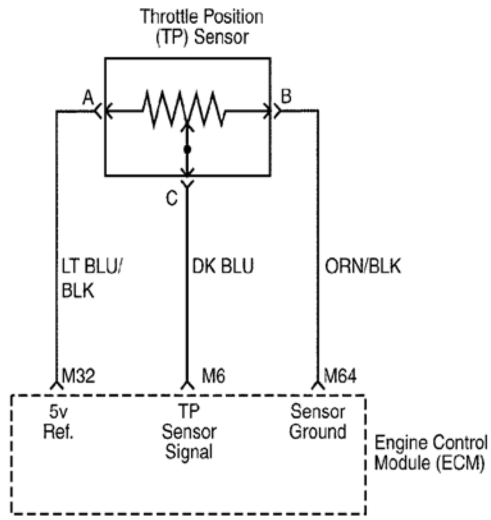
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

DTC P1122 Throttle Position (TP) Sensor Circuit Intermittent Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON. 2. Install the scan tool. Is DTC P0122 also set?	–	Go to applicable DTC table	Go to *Step 3*
3	Check for a poor 5 volt reference circuit terminal A connection at the TP sensor. Is a problem found?	–	Go to *Step 7*	Go to *Step 4*
4	Check the Throttle Position (TP) signal circuit between the TP sensor connector and the engine control module (ECM) for an intermittent open or short to ground. Is a problem found?	–	Go to *Step 8*	Go to *Step 5*
5	Check for a poor 5 volt reference circuit terminal M32. connection at the ECM. Is a problem found?	–	Go to *Step 7*	Go to *Step 6*
6	Check for an intermittent open or a faulty splice in the 5 volt reference circuit. Is a problem found?	–	Go to *Step 8*	Go to “Diagnostic Aids”
7	Replace the faulty harness connector terminal for the 5 volt reference circuit and/or the TP signal circuit as necessary. Is the repair complete?	–	Go to *Step 9*	–
8	Repair the intermittent open/short circuit in wiring harness as necessary. Is the repair complete?	–	Go to *Step 9*	–
9	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0123 THROTTLE POSITION (TP) SENSOR HIGH VOLTAGE

Circuit Description

The engine control module (ECM) supplies a 5 volt reference signal and a ground to the Throttle Position (TP) sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The voltage signal will vary from approximately 0.45 volts at closed throttle, to over 4.5 volts at Wide Open Throttle (WOT).

Conditions for Setting the DTC

TP sensor voltage is greater than 4.86 volts.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The ECM will substitute a default value for TP. The scan tool may not show the defaulted value.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

If a DTC P0123 cannot be duplicated, the information included in the Freeze Frame data can be useful. Use the scan tool DTC information data to determine the status of the DTC. If the DTC occurs intermittently, using the DTC P0121 diagnostic table may help isolate the problem.

With the ignition ON and the throttle at closed position, the voltage should read between 0.20 v and 0.90 v and increase steadily to over 4.5 v at WOT.

DTCs P0123 and P0113 stored at the same time could be the result of an open sensor ground circuit.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. With the throttle closed, the TP sensor voltage should read less than 0.90 v. If the TP sensor voltage does not read less than 0.90 v, check for a binding or sticking throttle cable.
4. With the TP sensor disconnected, the TP sensor voltage should be less than 0.2 v if the ECM and wiring are OK.
5. Probing the ground circuit with a test light checks the circuit for high resistance which will cause a DTC P0123 to set.

7. A shorted 5 volt reference circuit will also set additional DTCs.

11. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0123 Throttle Position (TP) Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check performed?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. Is the Throttle Position (TP) sensor voltage greater than the specified value?	1 v	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the TP sensor voltage greater than the specified value?	3.9 v	Go to *Step 4*	Go to *Step 12*
4	Disconnect the TP sensor electrical connector. Is the TP sensor voltage less than the specified value?	0.2 v	Go to *Step 5*	Go to *Step 6*
5	Probe the TP sensor ground circuit, terminal B at the TP sensor harness connector with a test light connected to B+. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 9*
6	Check the TP sensor signal circuit, terminal C for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 11*
7	Check the 5 v reference circuit, terminal A for a short to B+ and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 8*
8	Check the TP sensor electrical connector for a poor connection and repair the terminals as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
9	Check the TP sensor ground circuit for an open and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 11*
10	1. Tur the ignition switch OFF. 2. Replace the TP sensor. Is the action complete?	–	Go to *Step 12*	–
11	1. Tur the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 12*	–

DTC P0123 Throttle Position (TP) Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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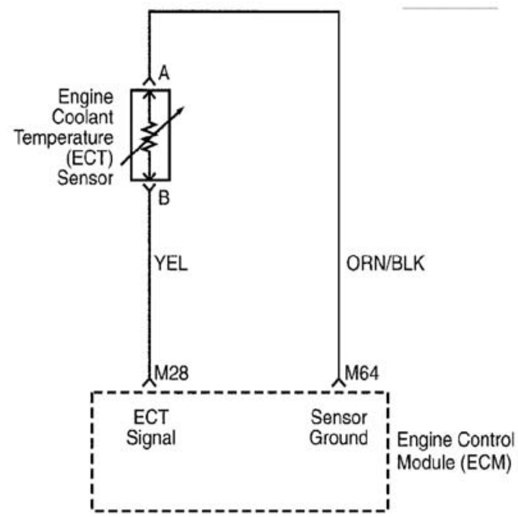

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DIAGNOSTIC TROUBLE CODE (DTC) P0125 ENGINE COOLANT TEMPERATURE (ECT) INSUFFICIENT FOR CLOSED LOOP FUEL CONTROL

Circuit Description

When the vehicle is first started, it operates in Open Loop, ignoring the Oxygen Sensor (O2S 1) signal and calculating the fuel/air ratio based on inputs from the Engine Coolant Temperature (ECT), Throttle Position (TP), and Manifold Absolute Pressure (MAP) sensors only. The engine control module (ECM) will begin using the O2S 1 signal for controlling fuel delivery (Closed Loop) when the following conditions are met:

The engine has run a minimum amount of time based on ECT at engine start up.

The O2S 1 has a varying voltage output showing that it is hot enough to operate properly.

The ECT has increased a minimum amount based on ECT at engine start up.

Conditions for Setting the DTC

Engine Running.

DTCs P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0201, P0202, P0203, P0204, P0351, P0352 and P0502 are not set.

1.5L SOHC

If ambient temperature is greater than 10 °C (50 °F), the time for coolant to reach closed loop value (20 °C) is greater than 2 minutes.

If ambient temperature is between –7 °C (20 °F) and 10 °C (50 °F), the time for coolant to reach a stabilized closed loop value (11 °C) is grater than 5 minutes.

Start-up coolant temperature is less than or equal to 32 °C (89.6 °F).

If the ambient temperature is greater than to equal to 10 °C (50 °F), the accumulated airflow is greater than 850 grams and accumulated idle time is less than 90 seconds.

If the ambient temperature is between –7 °C (20 °F) and 10 °C (50 °F), the accumulated airflow is greater than 2500 grams and accumulated idle time is less than 225 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Both cooling fan turns ON.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

When DTC P0125 is set, a skewed ECT sensor or a stuck open thermostat is indicated.

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation.

Check for a poor connection or damaged ECM harness. Inspect the ECT sensor signal circuit and ground circuit terminals for the following conditions:

Improper mating.

Broken locks.

Improperly formed.

Damaged terminals.

Poor terminal to wire connection.

Damaged harness.

Perform an intermittent test. If the connections and the harness check OK, monitor a Digital Voltmeter (DVM) connected between ECT sensor signal circuit and ground circuit terminals while moving the related connectors and the wiring harness. If a fault is induced, the resistance reading will change. This may help to isolate the location of the malfunction.

Use the Temperature vs. Resistance table to evaluate the possibility of a skewed sensor.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

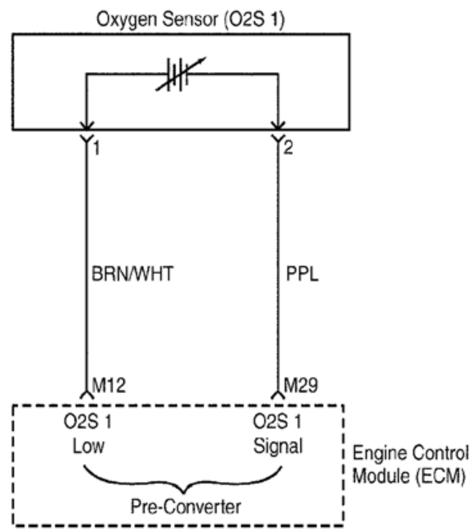
1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The engine must be allowed to cool fully before the ECT and Idle Air Temperature (IAT) sensors will read close to the ambient temperature in order to check for a possible skewed sensor.
3. Measure the engine coolant temperature with a thermometer to determine the actual value the ECT sensor should be. Take into consideration if the engine has been run and the engine coolant has been warmed without opening the thermostat.
5. This step simulates a DTC P0117. If the ECM senses the change, the ECM and wiring are OK.
6. The ECT sensor, ECM and wiring have checked OK at this point. Check for a proper thermostat and cooling fan operation.
10. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0125 Engine Coolant Temperature (ECT) Insufficient for Closed Loop Fuel Control

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Allow the engine to cool fully to ambient temperature. 2. Turn the ignition switch ON, with the engine OFF and Install a scan tool. 3. Compare the Engine Coolant Temperature (ECT) sensor reading to the Intake Air Temperature (IAT) sensor readings. Are the temperature readings close?	–	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition OFF. 2. Disconnect the ECT sensor electrical connector. 3. Turn the ignition ON, engine OFF. 4. Using a Digital Voltmeter (DVM), measure the resistance across the ECT sensor terminals A and B. 5. Check the ECT sensor value to actual coolant temperature using the Temperature vs. Resistance table. Does the ECT sensor accurately reflect the actual engine coolant temperature?	Refer to “Temperature vs Resistance Table”	Go to *Step 4*	Go to *Step 11*
4	1. Turn the ignition OFF. 2. Disconnect the ECT sensor electrical connector. 3. Turn the ignition ON, engine OFF. Is the ECT sensor value less than the specified value?	-30 C (-22 F)	Go to *Step 5*	Go to *Step 8*
5	Jumper the ECT sensor signal circuit terminal B and the sensor ground circuit terminal A together at the ECT sensor connector. Is the ECT sensor value greater than the specified value?	130 C (266 F)	Go to *Step 6*	Go to *Step 7*
6	Check for proper cooling system operation and repair as necessary. Is the repair complete?	–	Go to *Step 12*	Go to “Diagnostic Aids”
7	Check the ECT sensor electrical connector terminals A and B and Engine Control Module (ECM) electrical connector terminals M28 and M64 for poor connectors or malfunctioning terminals and repair as necessary. Is the repair complete?	–	Go to *Step 12*	Go to *Step 8*
8	Check the ECT sensor signal circuit for an open or short to ground and repair as necessary. Is the repair complete?	–	Go to *Step 12*	Go to *Step 9*
9	Check the ECT ground circuit for an open and repair as necessary. Is the repair complete?	–	Go to *Step 12*	Go to *Step 10*
10	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 12*	–

DTC P0125 Engine Coolant Temperature (ECT) Insufficient for Closed Loop Fuel Control (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Replace the ECT sensor. Is the repair complete?	–	Go to *Step 12*	–
12	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0131 OXYGEN SENSOR (O2S 1) LOW VOLTAGE

Circuit Description

The engine control module (ECM) supplies a voltage of about 0.45 volts between terminals M12 and M29 (if measured with a 10 M :digital voltmeter, this may read as low as 0.32 volts). The Oxygen Sensor (O2S 1) varies the voltage within a range of about 1 volt if the exhaust is rich, down through about 0.10 volts if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315 C (600 F). An open sensor circuit or cold sensor causes Open Loop operation.

If the O2S 1 pigtail wiring, connector, or terminal is damaged, the entire O2S 1 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the O2S 1 wire(s). Any attempt to repair the wires, connector or terminals could result in the obstruction of the air reference and degrade the O2S 1 performance. Refer to “Oxygen Sensor” in this section.

Conditions for Setting the DTC

Closed loop stoichometry.

The Engine Coolant Temperature (ECT) is greater than 60 C (140F).

DTCs P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0171, P0172, P0201, P0202, P0203, P0204, P0300, P0336, P0337, P0351, P0352, P0402, P0404, P0405, P0406, P0506, P0507 and P1404 are not set.

1.5L SOHC

O2S 1 voltage is less than 0.1 volt.

System voltage is greater than 10 volts.

DTC P0443 is not set.

A 3 seconds delay after conditions met.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The vehicle will operate in Open Loop.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Fuel pressure – The system will be lean if the fuel pressure is too low. It may be necessary to monitor the fuel pressure while driving the vehicle at various road speeds and/or loads to confirm. Refer to “Fuel System Diagnosis” in this section.

MAP sensor – An output that causes the ECM to sense a lower than normal manifold pressure (high vacuum) can cause the system to go lean. Disconnecting the MAP sensor will allow the ECM to substitute a fixed (default) value for the MAP sensor. If the lean condition is gone when the sensor is disconnected, substitute a known good sensor and recheck.

Fuel contamination – Water, in even small amounts, near the in-tank fuel pump inlet, can be delivered to the injector. The water causes a lean exhaust and can set DTC P0131.

Sensor harness – The O2S 1 sensor pigtail may be mispositioned and contacting the exhaust manifold.

Engine misfire – A misfiring cylinder will result in unburned oxygen in the exhaust, which could cause DTC P0131 to set. Refer to “DTC P0300 Multiple Cylinder Misfire Detected” in this section.

Cracked Oxygen Sensor (O2S 1) – A cracked O2S 1 or poor ground at the sensor could cause a DTC P0131. Refer to Symptoms.

Plugged fuel filter – A plugged fuel filter can cause a lean condition and cause a DTC P0131 to set.

Plugged Oxygen Sensor (O2S 1) – A plugged reference port on the Oxygen Sensor (O2S 1) will indicate a lower than normal voltage output from the O2S 1.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0131 is the result of a hard failure or an intermittent condition. It may be necessary to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction detected by the ECM.
4. This step simulates DTC P0134. If the ECM senses the change, the ECM and the wiring are OK.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
8. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” for additional checks and information.

DTC P0131 Oxygen Sensor (O2S 1) Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Engine at operating temperature. Does the Oxygen Sensor (O2S 1) voltage remain below the specified value?	100 mv	Go to *Step 4*	Go to *Step 3*
3	1. Review the Freeze Frame data and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted? Does the O2S 1 voltage stay below the specified value?	100 mv	Go to *Step 4*	Go to *Step 7*
4	1. Turn the ignition switch ON, with the engine OFF. 2. Disconnect the O2S 1 electrical connector. Does the scan tool indicate the O2S 1 voltage within the specified values?	407-509 mv	Go to “Diagnostic Aids”	Go to *Step 5*
5	Check the O2S 1 sensor signal circuit, terminal 2 for a short to ground and repair as necessary. Is a repair necessary?	–	Go to *Step 7*	Go to *Step 6*

DTC P0131 Oxygen Sensor (O2S 1) Low Voltage (Cont'd)

Step	Action	Value	Yes	No
6	1. Turn the ignition OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 7*	–
7	1. If disconnected, reconnect the O2S 1 electrical connector. 2. Using the scan tool, clear the DTCs. 3. Start the engine and idle at normal operating temperature. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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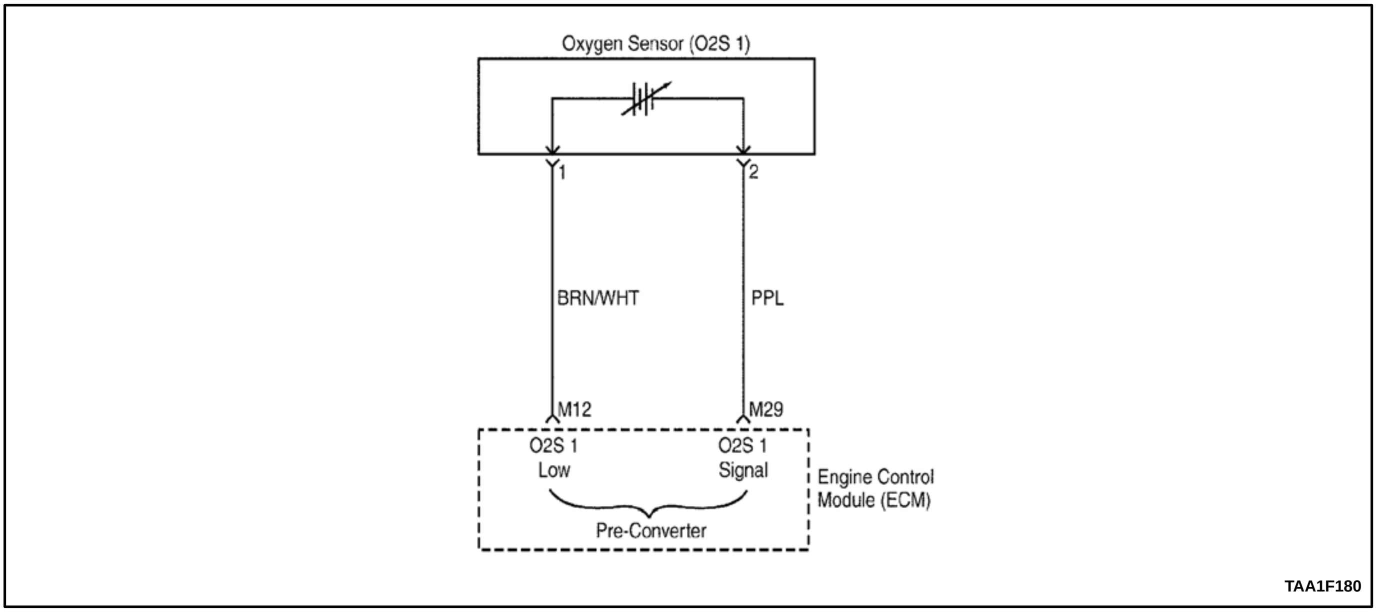

DIAGNOSTIC TROUBLE CODE (DTC) P0132 OXYGEN SENSOR (O2S 1) HIGH VOLTAGE

Circuit Description

The engine control module (ECM) supplies a voltage of about 0.45 volts between terminals M12 and M29 (if measured with a 10 MΩ digital voltmeter, this may read as low as 0.32 volts). The Oxygen Sensor (O2S 1) varies the voltage within a range of about 1 volt if the exhaust is rich, down through about 0.10 volts if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315 °C (600 °F). An open sensor circuit or cold sensor causes Open Loop operation.

If the O2S 1 pigtail wiring, connector, or terminal is damaged, the entire O2S 1 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the O2S 1 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade the O2S 1 performance. Refer to “Oxygen Sensor” in this section.

Conditions for Setting the DTC

O2 sensor voltage is greater than 0.952 volts.

Closed loop stoichometry.

The Engine Coolant Temperature (ECT) is greater than 60 °C (140 °F).

No related malfunctions. (See P0131)

1.5L SOHC

System volage is greater than 10 volts.

A 3 seconds delay after conditions met.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The vehicle will operate in Open Loop.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

The DTC P0132 or rich exhaust is most likely caused by one of the following items:

Fuel pressure – System will go rich if fuel pressure is too high. The ECM can compensate for some increase, but if it gets too high, a DTC P0132 will be set.

Leaking injector – A leaking or malfunctioning injector can cause the system to go rich causing a DTC P0132.

Manifold Absolute Pressure (MAP) sensor – An output that causes the ECM to sense a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to substitute a fixed value for the MAP sensor. Substitute a different a MAP sensor, if the rich condition is gone while the sensor is disconnected.

Pressure regulator – Check for a leaking fuel pressure regulator diaphragm by checking for the presence of liquid fuel in the vacuum line to the regulator.

TP sensor – An intermittent TP sensor output will cause the system to go rich due to a false indication of the engine accelerating.

O2S 1 contamination – Inspect the O2S 1 for silicone contamination from fuel or the use of improper Room Temperature Vulcanizing (RTV) sealant. The sensor may have a white powdery coating which may result in a high but false voltage signal (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe surge or driveability problem.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0132 is the result of a hard failure or an intermittent condition. It may be necessary to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction detected by the ECM.
4. This step simulates a DTC P0131. If the PCM senses the change, the ECM and the wiring are OK.
6. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.
8. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0132 Oxygen Sensor (O2S 1) High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. With the ignition ON, and the engine OFF, install a scan tool. 2. Engine at operating temperature. Does the Oxygen Sensor (O2S 1) voltage remain above the specified value?	952 mv	Go to *Step 4*	Go to *Step 3*
3	1. Review the Freeze Frame data and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted? Does the O2S 1 voltage stay above the specified value?	952 mv	Go to *Step 4*	Go to *Step 7*
4	1. Disconnect the O2S 1 electrical connector. 2. Jumper the O2S 1 electrical connector ECM side) to ground. Does the scan tool indicate the O2S 1 voltage below the specified value?	500 mv (0.50 v)	Go to “Diagnostic Aids”	Go to *Step 5*
5	Check the O2S 1 sensor signal circuit, terminal 2 for a short to voltage and repair as necessary. Is a repair necessary.	–	Go to *Step 7*	Go to *Step 6*
6	1. Turn the ignition OFF. 2. Replace the /ECM. Is the action complete?	–	Go to *Step 7*	–

DTC P0132 Oxygen Sensor (O2S 1) High Voltage (Cont'd)

Step	Action	Value	Yes	No
7	1. If disconnected, reconnect the O2S 1 electrical connector. 2. Using the scan tool, clear the DTCs. 3. Start the engine and idle at normal operating temperature. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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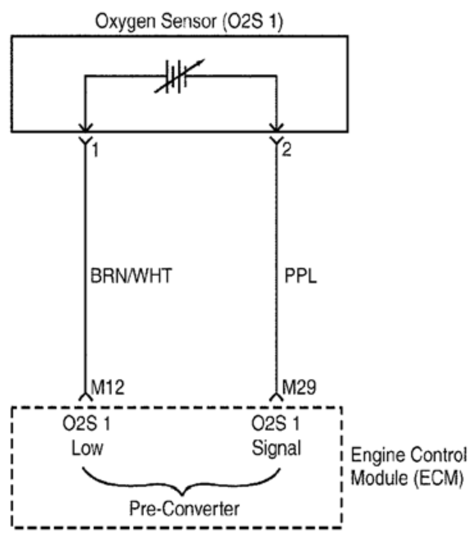


DIAGNOSTIC TROUBLE CODE (DTC) P0133
OXYGEN SENSOR (O2S 1) SLOW RESPONSE

Circuit Description

The engine control module (ECM) continuously monitors the Oxygen Sensor (O2S 1) activity for 100 seconds. During the monitor period, the ECM counts the number of times that the O2S 1 switches from rich to lean and from lean to rich and adds the amount of time it took to complete all switches. With this information, an average time for all switches can be determined. If the average time to switch is too slow, a DTC P0133 will set.

If the O2S 1 pigtail wiring, connector, or terminal is damaged, the entire O2S 1 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the O2S 1 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade O2S 1 performance.

Conditions for Setting the DTC

Closed loop stoichiometry.

The engine run time is greater than 60 seconds

1.5L SOHC

The O2S 1 average transition time between 0.3–0.6 volts: lean to rich is greater than 175 milliseconds or rich to lean is greater than 93 milliseconds.

The engine coolant temperature is greater than 70 C (158 F).

The system voltage is greater than 10 volts.

The purge duty cycle (D.C) is less than 20%.

The rpm is between 1500 and 4000.

The airflow is between 9 and 40 g/sec.

Engine running status within certain range (rpm, TPS).

No related malfunctions (See P0131) and DTCs P0131, P0132, P0134, P1171, P1167 are not set.

A 3 seconds delay after conditions met.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

DTC P0133 or slow response is most likely caused by one of the following items:

Fuel pressure – The system will go rich if fuel pressure is too high. The ECM can compensate for some increase, but if it gets too high, a DTC P0133 may set. Refer to "Fuel System Diagnosis" in this section.

Leaking injector – A leaking or malfunctioning injector can cause the system to go rich.

Manifold Absolute Pressure (MAP) sensor – An output that causes the ECM to sense a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the MAP sensor. Substitute a different MAP sensor if the rich condition is gone while the sensor is disconnected.

Pressure regulator – Check for a leaking fuel pressure regulator diaphragm by checking for the presence of liquid fuel in the vacuum line to the pressure regulator.

Throttle Position (TP) sensor – An intermittent TP sensor output can cause the system to go rich due to a false indication of the engine accelerating.

O2S 1 contamination – Inspect O2S 1 for silicone contamination from fuel or use of improper Room Temperature Vulcanizing (RTV) sealant. The sensor may have a white powdery coating, resulting in a high but false voltage signal (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine causing a severe surge or driveability problem.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

14. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

17. If no malfunctions have been found at this point and no additional DTCs were set, refer to "Diagnostic Aids" for additional checks and information.

DTC P0133 Oxygen Sensor (O2S 1) Slow Response

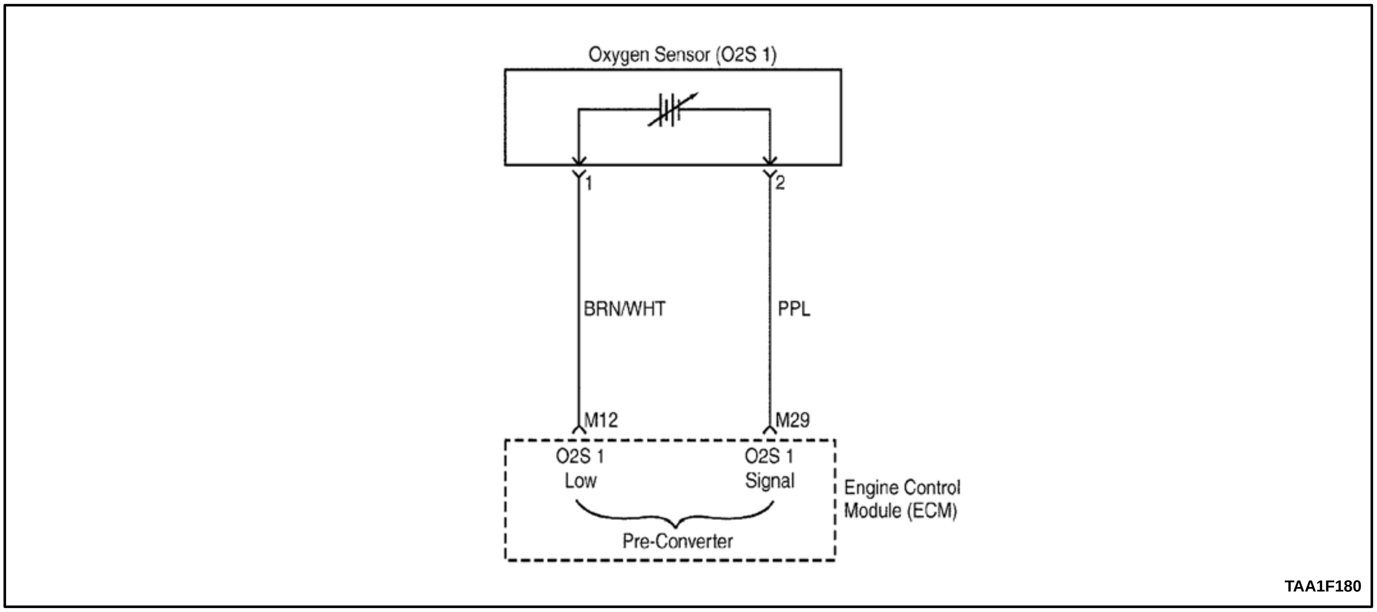
Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. Are any additional Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Start the engine and idle at normal operating temperature. 2. Operate the vehicle within the specified parameters under Conditions for Setting the DTC. 3. Using the scan tool monitor the specific DTC information for DTC P0133 until DTC P0133 test runs. Does the scan tool indicate DTC P0133 failed this ignition cycle?	–	Go to *Step 4*	Go to "Diagnostic Aids"
4	Did the scan tool indicate that DTC P1133 or P1134 failed this ignition cycle?	–	Go to applicable DTC table	Go to *Step 5*

DTC P0133 Oxygen Sensor (O2S 1) Slow Response (Cont'd)

Step	Action	Value(s)	Yes	No
5	Check the exhaust manifold/catalytic converter for a leak and repair as necessary. Is the repair complete?	–	Go to *Step 16*	Go to *Step 6*
6	Visually/physically inspect for the following items: Oxygen Sensor (O2S 1) is securely installed. Corrosion on the terminals. Terminal tension (at the Engine Control Module [ECM] and the O2S 1). O2S 1 wiring harness for poor terminal connection or damaged wiring. Is a problem found in any of the above areas?	–	Go to *Step 9*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Disconnect the O2S 1 electrical connector. 3. Jumper the O2S 1 low circuit, terminal 1 to ground. 4. Start the engine. Does the scan tool indicate the voltage between the specified value?	400 – 500 mv	Go to *Step 8*	Go to *Step 10*
8	1. Jumper the O2S 1 signal and low circuits terminals 1 and 2 to ground. Does the scan tool indicate the voltage below the specified value?	200 mv	Go to *Step 15*	Go to *Step 13*
9	Repair the condition as necessary. Is the repair complete?	–	Go to *Step 16*	–
10	1. Turn the ignition OFF. 2. Disconnect the ECM engine connector. 3. Check the O2S 1 low circuit for an open or poor connection and repair as necessary. Is the repair complete?	–	Go to *Step 16*	Go to *Step 11*
11	Check the ECM terminal M12 for a poor connection and repair as necessary. Is the repair complete?	–	Go to *Step 16*	Go to *Step 14*
12	Check the O2S 1 signal circuit for an open or a short to ground and repair as necessary. Is the repair complete?	–	Go to *Step 16*	Go to *Step 13*
13	Check the ECM terminal M29 for a poor connection and repair as necessary. Is the repair complete?	–	Go to *Step 16*	Go to *Step 14*
14	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 16*	–
15	1. Turn the ignition OFF. 2. Replace the O2S 1. Is the repair complete?	–	Go to *Step 16*	–

DTC P0133 Oxygen Sensor (O2S 1) Slow Response (Cont'd)

Step	Action	Value(s)	Yes	No
16	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 17*	Go to *Step 2*
17	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P1133
OXYGEN SENSOR (O2S 1) TOO FEW TRANSITIONS

Circuit Description

The engine control module (ECM) constantly monitors the oxygen sensor (O2S 1) activity for 100 seconds. During the monitor period, the ECM counts the number of times that the O2S 1 switches from rich to lean and from lean to rich. With this information, a total for all switches can be determined. If the number of switches is too low, DTC P1133 will set.

Conditions for Setting the DTC

Close loop stoichometry.

Engine run time is greater than 60 seconds.

1.5L SOHC

O2S 1 swtiches from 0.3 to 0.6 volt and from 0.6 to 0.3 volt are less than 10 within 90 seconds of monitoring period.

The engine coolant temperature is greater than 70 °C (158 °F).

The system voltage is greater than 10 volts.

The purge duty cycle (D.C.) is less than 20%.

The rpm is between 1500 and 3000.

The airflow is between 9 and 30 g/sec.

Engine running status within certain range (rpm, TPS).

No related malfunctions (see P0131) and DTCs P0131, P0132, P0134, P1167, P1171 are not set.

A 3 second delay after conditions met.

Action T

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

Open loop fuel control will be in effect.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL OFF on the third (fourth – 1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm-up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool .

Diagnostic Aids

DTC P1133 is most likely caused by one of the following items:

Fuel Pressure – The system will go rich if the fuel pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a DTC P1133 may set. Refer to “Fuel System Diagnosis” in this section.

Leaking injector – A leaking or malfunctioning injector can cause the system to go rich.

Manifold Absolute Pressure (MAP) sensor – An output that causes the ECM to sense a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the MAP sensor. Substitute a different MAP sensor if the rich condition is gone while the sensor is disconnected.

Pressure regulator – Check for a leaking fuel pressure regulator diaphragm by checking for the presence of liquid fuel in the vacuum line to the pressure regulator.

Throttle Position (TP) sensor – An intermittent TP sensor output can cause the system to go rich due to a false indication of the engine accelerating.

O2S 1 contamination – Inspect O2S 1 for silicone contamination from fuel or improper use of RTV sealant. The sensor may have a white powdery coating and result in a high but false voltage signal (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine causing a severe surge or driveability problem.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

14. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

16. If no malfunctions have been found at this point and no additional DTCs are set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P1133 - Oxygen Sensor (O2S 1) Too Few Transitions

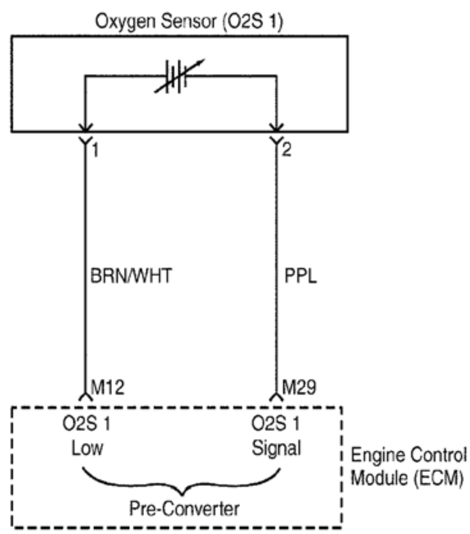
Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON. 2. Install the scan tool. Are any DTCs set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Engine running at operating temperature. 2. Operate the vehicle within the parameters specified under Conditions for Setting the DTC. 3. Monitor the LEAN/RICH TRANSITION and RICH/LEAN TRANSITION noting the number of switches. Do the parameters show fewer transitions than the specified value.	20 (10)*	Go to *Step 4*	Go to *Step 15*
4	Visually/physically inspect the following items: Oxygen Sensor (O2S 1) is securely installed. Corrosion on terminals. Terminal tension (at O2S 1 and at the ECM). Damaged wiring. Is a problem found in any of the above areas?	–	Go to *Step 9*	Go to *Step 5*

DTC P1133 - Oxygen Sensor (O2S 1) Too Few Transitions (Cont'd)

Step	Action	Value	Yes	No
5	Check the exhaust manifold for a leak near the engine and repair as necessary. Is a leak found and repaired?	–	Go to *Step 3*	Go to *Step 6*
6	1. Turn the ignition OFF. 2. Disconnect the O2S 1 electrical connector. 3. Jumper the O2S 1 low circuit, terminal 1 to ground. 4. Turn the ignition ON, with the engine OFF. 5. Using a scan tool, monitor the O2S 1 voltage. Does the scan tool voltage indicate the O2S 1 voltage within the specified value?	400-500 mV	Go to *Step 7*	Go to *Step 10*
7	1. Jumper the O2S 1 signal and low circuits, terminal 1 and 2 to ground. 2. Using a scan tool, monitor the O2S 1 voltage. Does the scan tool voltage indicate the voltage below the specified value?	200 mV	Go to *Step 8*	Go to *Step 11*
8	1. Turn the ignition OFF. 2. Replace the O2S 1. **Notice:** Before replacing the sensor, the cause of the contamination must be determined and corrected in order to prevent further damage to the sensor. Check for the following: Fuel contamination. Use of improper Room Temperature Vulcanizing (RTV) sealant. Engine oil/coolant consumption. Is the repair complete?	–	Go to *Step 15*	–
9	Repair the condition as necessary. Is the repair complete?	–	Go to *Step 15*	–
10	Repair the O2S 1 sensor signal circuit for a short to ground. Is the repair complete?	–	Go to *Step 15*	–
11	1. Remove the jumper wire. 2. Using a Digital Voltmeter (DVM) measure the voltage between the O2S 1 signal circuit, terminal 2 and ground. Does the O2S 1 voltage measure above the specified value?	407 mv	Go to *Step 12*	Go to *Step 13*
12	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connectors and check the O2S 1 low circuit, at terminal M12 for continuity. 3. If the O2S 1 low circuit measures over the specified value, repair the open or poor connection as necessary. Is an O2S 1 low circuit problem found and corrected?	5 :	Go to *Step 15*	Go to *Step 14*

DTC P1133 - Oxygen Sensor (O2S 1) Too Few Transitions (Cont'd)

Step	Action	Value	Yes	No
13	1. Turn the Ignition OFF. 2. Disconnect the ECM connectors and check the O2S 1 sensor signal circuit, at terminal M29 for continuity. 3. If the O2S 1 sensor signal circuit measures over the specified value, repair the open or poor connection as necessary. Is an O2S 1 sensor signal circuit problem found and corrected?	5 :	Go to *Step 15*	Go to *Step 14*
14	1. Turn the Ignition switch OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 15*	–
15	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 16*	Go to *Step 2*
16	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0134 OXYGEN SENSOR (O2S 1) NO ACTIVITY

Circuit Description

The /engine control module (ECM) supplies a voltage of about 0.45 volts between terminals M29 and M12 (if measured with a 10 M :digital voltmeter, this may read as low as 0.32 volts). The Oxygen Sensor (O2S 1) varies the voltage within a range of about 1 volt if the exhaust is rich, down through about 0.10 volts if the exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315 C (600 F). An open sensor circuit or cold sensor causes Open Loop operation.

If the O2S 1 pigtail wiring, connector, or terminal is damaged, the entire O2S 1 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the O2S 1 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade the O2S 1 performance. Refer to “Oxygen Sensor” in this section.

Conditions for Setting the DTC

The system voltage is greater than 10 volts.

The engine run time is greater than 60 seconds.

No related malfunctions. (See P0131)

1.5L SOHC

The O2S 1 voltage is stuck in range 0.3 – 0.6 volt.

The engine coolant temperature is greater than 60 C (140 F).

The airflow is greater than 9 g/s.

A 3 seconds delay after exit Decel Fuel Cut-Off (DFCO).

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

The vehicle will operate in Open Loop.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Normal scan tool voltage varies between 150 mv to 850 mv (0.15 volts to 0.85 volts) while in Closed Loop. If DTC P0134 is intermittent, refer to “Intermittents” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when

the malfunction occurred. The information is then stored on the scan tool for later reference.

2. During engine warm-up, the O2S 1 should warm up, and its voltage output should vary between 150 mv and 850 mv. When the O2S 1 voltage varies, the engine will go into Closed Loop. This determines if the O2S 1 is operating properly.
4. This will determine if the sensor is malfunctioning or the wiring or ECM is the cause of the DTC P0134.
6. Use only a high impedance Digital Voltmeter (DVM) for this test. The test checks the continuity of the O2S 1 signal and the ground circuits; if the ground circuit is open, the ECM voltage on the circuit will be over 0.6 volts (600mv).
10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0134 Oxygen Sensor (O2S 1) No Activity

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Run the engine to above the specified operating temperature. 2. Install a scan tool. 3. Operate the engine above the specified rpm for 2 minutes. Does the scan tool indicate CLOSED LOOP?	80 °C (176 °F) 1200 rpm	Go to *Step 3*	Go *Step 4*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted? Does the scan tool indicate CLOSED LOOP?	–	Go to *Step 12*	Go to *Step 4*
4	1. Turn the ignition swtich OFF. 2. Disconnect the O2S 1 electrical connector and jumper the O2S 1 sensor harness cnnector (engine control module [ECM] side), terminal 1 to ground. 3. Turn the ignition swtich ON. Is the O2S 1 voltage displayed on the scan tool as specified value?	400 – 500 mv	Go to *Step 5*	Go to *Step 8*
5	Check the O2S 1 electrical connector (ECM side) for malfunctioning terminals or poor connection and repair as necessary. Is a repair necessary.	–	Go to *Step 12*	Go to *Step 6*
6	1. Turn the ignition switch ON, with the engine OFF. 2. Remove the jumper wire. 3. Using a Digital Voltmeter (DVM), measure the voltage between the O2S 1 sensor harness connector (sensor side) terminal 2 and ground. Does the O2S 1 voltage measure above the specified value?	600 mv	Go to *Step 7*	Go to *Step 11*
7	1. Turn the engine OFF. 2. Using a Digital Voltmeter (DVM), measure the voltage between the O2S 1 sensor harness connector (sensor side) terminal 2 and ground. Does the DVM display a voltage below the specified value?	300 mv	Go to *Step 9*	Go to *Step 8*

DTC P0134 Oxygen Sensor (O2S 1) No Activity (Cont'd)

Step	Action	Value(s)	Yes	No
8	Check the O2S 1 low circuit for an open or short to ground between the O2S 1 harness connector terminal 1 and the ECM harness connector terminal M12 and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
9	Check the O2S 1 signal circuit for an open or short to ground between the O2S 1 harness connector terminal 2 and the ECM harness connector terminal M29 and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
10	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 12*	–
11	Replace the O2S1. Is the repair complete?	–	Go to *Step 12*	–
12	1. If disconnected, reconnect the O2S 1 electrical connector. 2. Using the scan tool, clear the DTCs. 3. Start the engine and idle at normal operating temperature. 4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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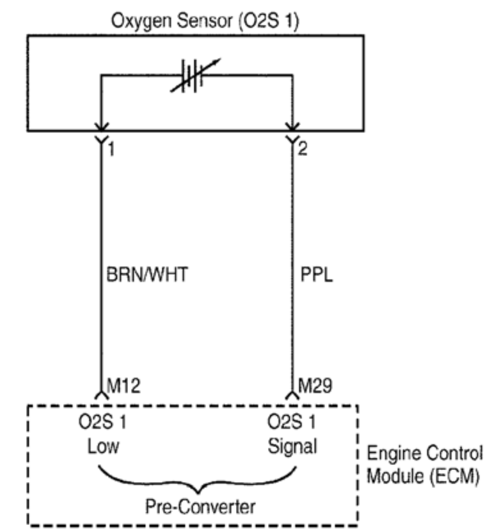

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DIAGNOSTIC TROUBLE CODE (DTC) P1134
OXYGEN SENSOR (O2S 1) TRANSITION RATIO

Circuit Description

The engine control module (ECM) monitors the Oxygen Sensor (O2S 1) activity for 60 seconds after closed loop and stoichiometric operation have been established. During the monitoring period the ECM counts the number of times that the O2S 1 responds from rich-to-lean and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. The ECM then divides the rich-to-lean average by the lean-to-rich average to obtain a ratio. If the O2S 1 transition time ratio is not within this range, DTC P1134 will be set, indicating that the O2S 1 is not responding as expected to changes in exhaust oxygen content.

Conditions for Setting the DTC

Closed loop stoichiometry.

The engine run time is greater than 60 seconds.

1.5L SOHC

O2S 1 transition ratio lean-to-rich to rich-to lean is out of range (0.4395, 3.8).

Engine coolant temperature is greater than 70 C (158 F).

The purge duty cycle (D.C.) is less than 20%.

Engine speed is between 1500 and 3000 rpm.

The airflow is between 9 and 30 g/sec.

Engine running status within certain range (rpm, TPS).

No related malfunctions (See P0131) and DTCs P0131, P0132, P0134, P1167, P1171 are not set.

3 second delay after conditions met.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL OFF on the third (fourth – 1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm-up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

A malfunction in the O2S 1 ignition feed or ground circuit may cause a DTC P1134 to set. Check O2S 1 circuitry for intermittent faults or poor connections. If connections and wiring are OK and DTC P1134 continues to set, replace the Bank 1 Sensor 1 (O2S 1).

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
4. This step checks for conditions which may cause the oxygen sensor to appear faulty. Correct any of the described conditions if present.
10. A condition that affects pre-converter and post-converter oxygen sensors indicates probable contamination. To avoid damaging replacement sensors, correct the condition which caused the contamination before replacing the affected sensors.
13. To avoid damaging replacement sensors, correct the condition which caused the contamination before replacing the affected sensors

DTC P1134 - Oxygen Sensor (O2S 1) Transition Ratio

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	**Important**: If any Diagnostic Trouble Codes (DTCs) are set, refer to those DTCs before proceeding with this diagnostic chart. 1. Idle the engine at operating temperature. 2. Operate the vehicle within parameters specified under Conditions for Setting the DTC. 3. Using a scan tool, monitor specific DTC info for DTC P1134 until the DTC P1134 test runs. 4. Note the test result. Does the scan tool indicate DTC P1134 failed this ignition?	–	Go *Step 3*	Refer to “Diagnostic Aids”
3	1. Perform an exhaust system leak test. 2. If an exhaust leak is found, repair as necessary. Is the exhaust leak isolated?	–	Go to *Step 14*	Go to *Step 4*
4	Visually/physically inspect the following items: O2S 1 is securely installed. Corrosion on terminals. Terminal tension (at the O2S 1 and at the ECM). Damaged wiring. Is a problem found in any of the above areas?	–	Go to *Step 7*	Go to *Step 5*
5	1. Disconnect the O2S 1. 2. Turn the ignition switch ON. 3. Using a Digital Voltmeter (DVM) at the engine control module (ECM) side of the O2S 1 connector, measure the voltage between the signal circuit, terminal 2 and ground. 4. Also measure the voltage between the low circuit, terminal 2 and ground. Are both voltages in the specified range?	3-5 v	Go to *Step 6*	Go to *Step 8*

DTC P1134 - Oxygen Sensor (O2S 1) Transition Ratio (Cont'd)

Step	Action	Value	Yes	No
6	1. With the O2S 1 disconnected, jumper the signal and low circuits, terminals 2 and 1 to ground. 2. Turn the ignition ON 3. Using a scan tool, monitor the O2S 1 voltage. Does the scan tool indicate less than 10 mv and immediately return to about 450 mv when the jumper is removed?	–	Go to *Step 10*	Go to *Step 11*
7	Repair condition as necessary. Is the action complete?	–	Go to *Step 14*	–
8	Check for faulty ECM connections or terminal damage. Is the action complete?	–	Go to *Step 14*	Go to *Step 9*
9	Repair open, short, or grounded signal circuit. Is the action complete?	–	Go to *Step 14*	Go To *Step 11*
10	Remove the O2S 1 and examine it for signs of: Fuel contamination. Improper Room Temperature Vulcanizing (RTV) sealant (white powdery coating on sensor). Engine oil/coolant consumption. Are signs of contamination observed?	–	Go To *Step 13*	Go To *Step 12*
11	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 14*	Go To *Step 12*
12	1. Turn the ignition switch OFF. 2. Replace the O2S 1. Is the action complete?	–	Go to *Step 14*	–
13	Determine and correct the cause of contamination before replacing the O2S 1. Is the action complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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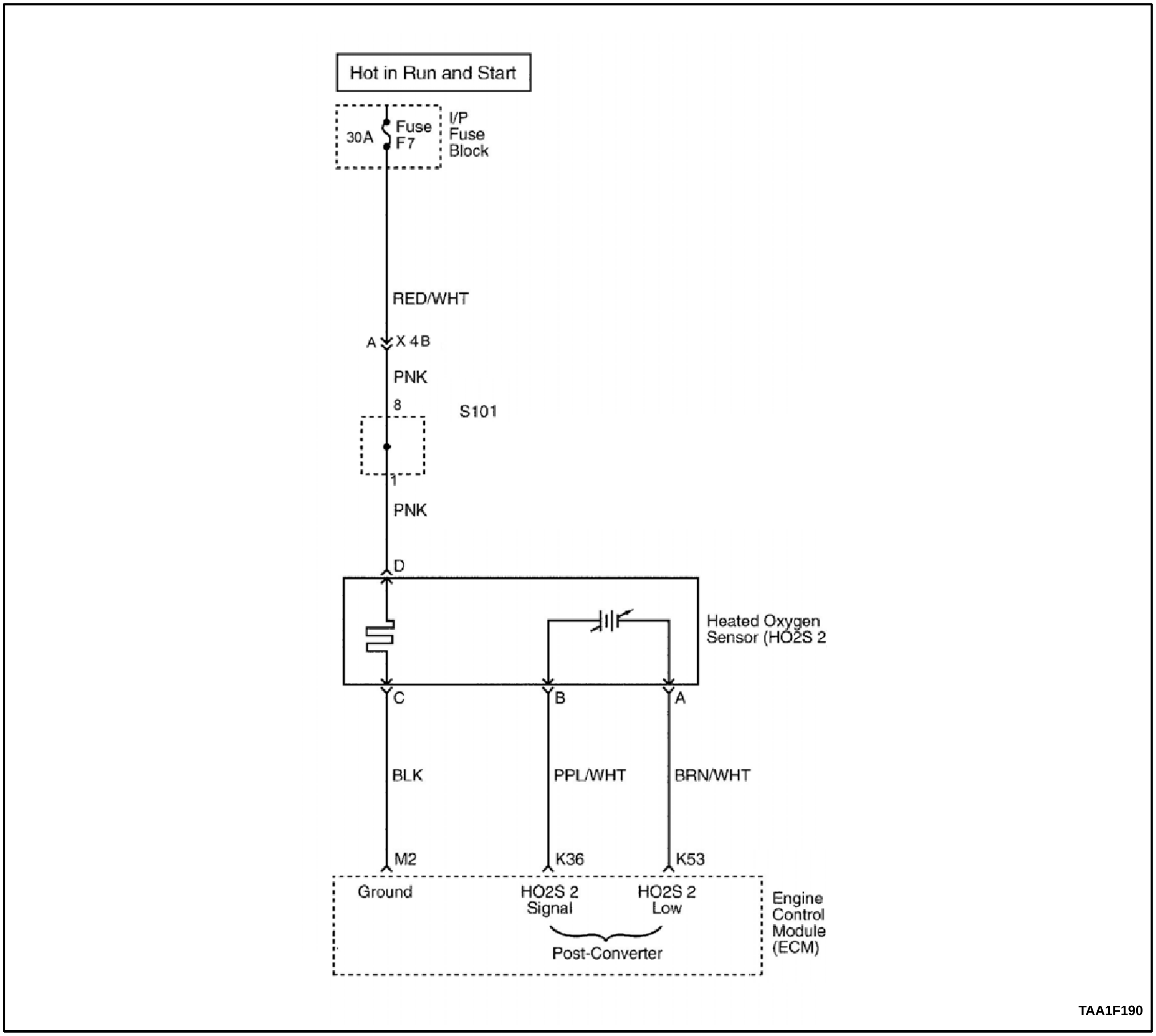

DIAGNOSTIC TROUBLE CODE (DTC) P0137
HEATED OXYGEN SENSOR (HO2S 2) LOW VOLTAGE

Circuit Description

In order to control emissions, a catalytic converter is used to convert harmful emissions into harmless water vapor and carbon dioxide.

The engine control module (ECM) has the ability to monitor this process by using a Heated Oxygen Sensor (HO2S 2). The HO2S 2, located in the exhaust stream past the catalytic converter, produces an output signal which indicates the storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust emissions effectively. If the catalyst is functioning properly, the HO2S 2 signal will be far less active than the signal produced by the Oxygen Sensor (O2S 1).

If the HO2S 2 pigtail wiring, connector, or terminal is damaged, the entire HO2S 2 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the HO2S 2 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade the HO2S 2 performance.

Conditions for Setting the DTC

- The engine coolant temperature is greater than 60 °C (140 °F).

1.5L SOHC

System voltage is greater than 10 volts.

No related malfunctions (See P0131) and DTC P0141 is not set.

Closed loop (C/L) test:

HO2S 2 voltage is less than 0.1 volt.

3 second delay after in close loop.

Power Enrichment (PE) test:

HO2S 2 voltage is less than 0.42 volt.

Air/fuel ratio is less than or equal to 13.5:1.

3 second delay after in Decel Fuel Cut-Off (DFCO).

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by rubbed-through wire insulation or a wire contacting the exhaust.

Check for the following conditions:

Exhaust system – Inspect the exhaust system for leaks. Check the exhaust between the three-way catalytic converter and the flange for leaks, corrosion, or for loose or missing hardware and repair as necessary.

Poor connection or damaged harness – Ensure that the HO2S 2 pigtail is not contacting the exhaust. Check for the following conditions:

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal to wire connection

Damaged harness

Intermittent test – Observe HO2S 2 on scan tool while moving related connections and the wiring harness with the ignition ON. If the failure is induced, the HO2S 2 display will change. This may help isolate the location of the malfunction.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0137 is the result of a hard failure or an intermittent condition.
4. Jumping circuit A to ground is necessary to allow the ECM to display the supplied bias voltage. If the voltage is between 0.35 and 0.55 volts, then the wiring and the ECM are OK.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0137 Heated Oxygen Sensor (HO2S 2) Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diag-nostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. Is the Heated Oxygen Sensor (HO2S 2) voltage less than the specified value?	100 mv (0.10 v)	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted? Is the HO2S 2 voltage less than the specified value?	400 mv (0.40 v)	Go to *Step 4*	Go to *Step 8*
4	1. Disconnect the HO2S 2 electrical connector. 2. Jumper the HO2S 2 low circuit, terminal A to ground. Does the scan tool indicate the HO2S 2 voltage within the specified value?	350 mv-550 mv (0.35 v-0.55 v)	Go to *Step 7*	Go to *Step 5*
5	1. Turn the ignition switch OFF. 2. Disconnect the engine control module (ECM) electrical connectors and check the HO2S 2 signal circuit, terminal K36 for a short to ground or short to the HO2S 2 low circuit terminal K53 and repair as necessary. Is a repair necessary?	–	Go to *Step 8*	Go to *Step 6*
6	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 8*	–
7	1. Turn the ignition switch OFF. 2. Replace the HO2S 2. Is the action complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for Setting the DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has ran and passed?	–	Go to *Step 9*	Go to *Step 2*
9	Check if any additional DTCs are set. Are any DTCs displayed that have not been diag-nosed?	–	Go to applicable DTC table	System OK

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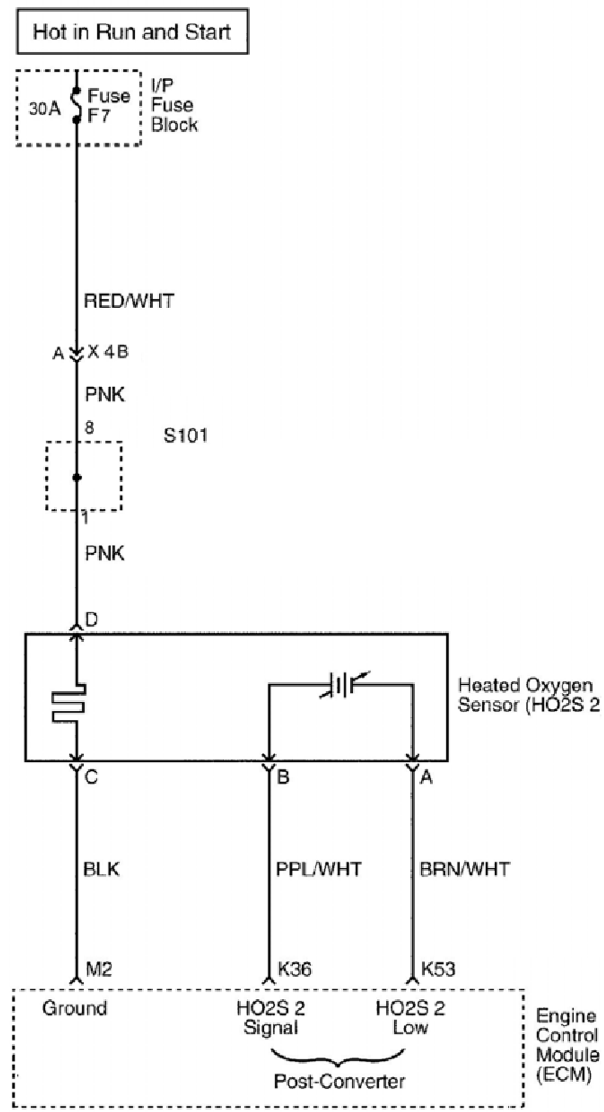

TAA1F190

DIAGNOSTIC TROUBLE CODE (DTC) P0138 HEATED OXYGEN SENSOR (HO2S 2) HIGH VOLTAGE

Circuit Description

In order to control emissions, a catalytic converter is used to convert harmful emissions into harmless water vapor and carbon dioxide.

The engine control module (ECM) has the ability to monitor this process by using a Heated Oxygen Sensor (HO2S 2). The HO2S 2, located in the exhaust stream past the catalytic converter, produces an output signal which indicates the storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust emissions effectively. If the catalyst is functioning properly, the HO2S 2 signal will be far less active than the signal produced by the Oxygen Sensor (O2S 1).

If the HO2S 2 pigtail wiring, connector, or terminal is damaged, the entire HO2S 2 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the HO2S 2 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade the HO2S 2 performance.

Conditions for Setting the DTC

The engine coolant temperature is greater than 60 °C (140 °F).

1.5L SOHC

System voltage is greater than 10 volts.

No related malfunctions (See P0131) and DTC P0141 is not set.

Closed loop (C/L) test:

HO2S 2 voltage is greater than 0.952 volts.

3 second delay after in C/L.

Decel Fuel Cut-Off (DFCO) test:

HO2S 2 is greater than 0.478 volt. In DFCO.

3 second delay after in DFCO.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Rich exhaust – An overly rich exhaust may load the catalyst, causing high HO2S 2 signal voltages.

Silicone contamination – A false rich condition may be caused by silicone contamination of the HO2S 2. This will be indicated by a powdery white deposit on the sensor.

Faulty HO2S 2 – If HO2S 2 is internally shorted, the HO2S 2 voltage displayed on a scan tool will be over 1 volt. Disconnect the HO2S 2 and jumper the sensor low circuit to engine ground; if the displayed voltage goes from over 1000 mv to around 450 mv, replace the HO2S 2.

Intermittent test – Observe HO2S 2 on scan tool while moving related connectors and the wiring harness with the key ON. If the failure is induced, the HO2S 2 display will change. This may help isolate the location of the malfunction.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0138 is the result of a hard failure or an intermittent condition.
5. Disconnecting the HO2S 2 and jumpering the sensor signal circuit and the sensor low circuit to ground should cause the scan tool to display HO2S 2 voltage below 100 mv (0.1 v). If the signal voltage is still high, the ECM is malfunctioning.
8. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0138 Heated Oxygen Sensor (HO2S 2) High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. Is the Heated Oxygen Sensor (HO2S 2) voltage above the specified value?	900 mv	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted. Is the HO2S 2 voltage above the specified value?	900 mv	Go to *Step 4*	Go to *Step 9*
4	1. Turn the ignition switch OFF. 2. Disconnect the HO2S 2 electrical connector. 3. Disconnect the engine control module (ECM) electrical connector. 4. With a Digital Voltmeter (DVM) connected to ground, probe the HO2S signal circuit, terminal K36 Does the DVM indicate a voltage of the specified value?	0 v (0.5 v)	Go to *Step 5*	Go to *Step 6*
5	1. Reconnect the ECM electrical connectors. 2. Turn the ignition switch ON, with the engine OFF. 3. Jumper the high and low circuits at the HO2S 2 electrical connector, terminals A and B to ground. Does the scan tool indicate the HO2S 2 voltage below the specified value?	100 mv (0.10 v)	Go to *Step 7*	Go to *Step 8*
6	Repair the short to voltage in the HO2S 2 signal circuit. Is the action complete?	–	Go to *Step 9*	–
7	1. Turn the ignition switch OFF. 2. Replace the HO2S 2. Is the action complete?	–	Go to *Step 9*	–
8	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 9*	–
9	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 10*	Go to *Step 2*
10	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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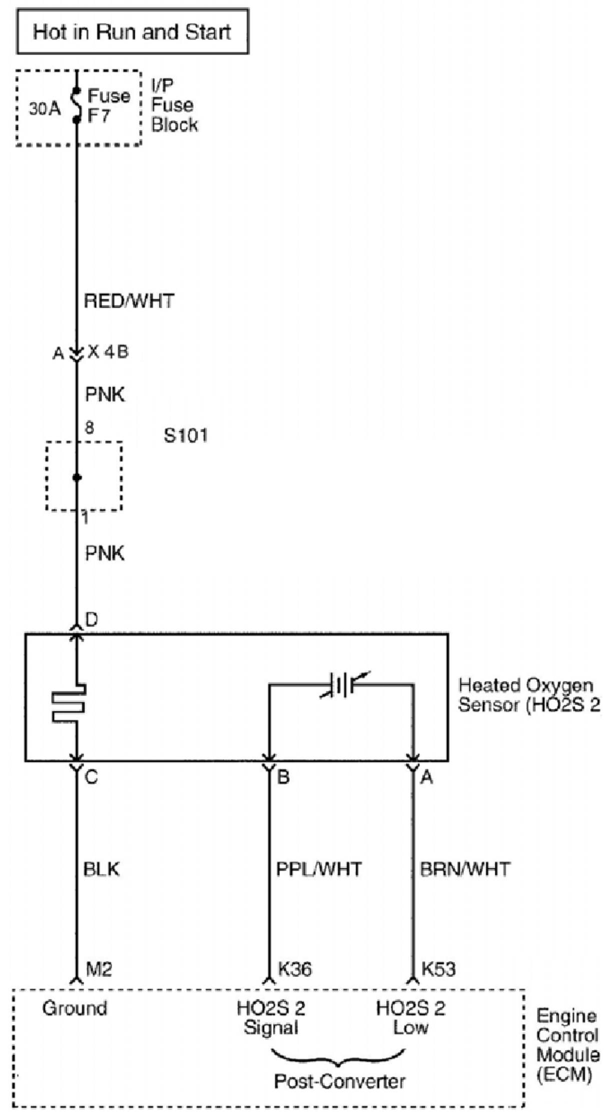


TAA1F190

DIAGNOSTIC TROUBLE CODE (DTC) P0140
HEATED OXYGEN SENSOR (HO2S 2) NO ACTIVITY

Circuit Description

In order to control emissions, a catalytic converter is used to convert harmful emissions into harmless water vapor and carbon dioxide.

The engine control
module (ECM) has the ability to monitor this process by using a Heated Oxygen Sensor (HO2S 2). The HO2S 2, located in the exhaust stream past the catalytic converter, produces an output signal which indicates the storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust emissions effectively. If the catalyst is functioning properly, the HO2S 2 signal will be far less active than the signal produced by the Oxygen Sensor (O2S 1).

If the HO2S 2 pigtail wiring, connector, or terminal are damaged, the entire HO2S 2 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the HO2S 2 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade HO2S 2 performance.

Conditions for Setting the DTC

Engine run time is greater 60 seconds.

System voltage is greater than 10 volts.

Closed loop stoichiometry.

1.5L SOHC

The HO2S 2 voltage is between 0.4222 and 0.478 volt.

3 second delay after exit Decel Fuel Cut-Off (DFCO).

Airflow is greater than 7 g/sec.

No related malfunctions (See P0131) and DTC P0141 is not set.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a rubbed-through wire insulation or a wire contacting the exhaust.

Check for the following conditions:

A poor connection or a damaged harness – Inspect the harness for a short to ground in the sensor signal circuit. Ensure that the HO2S 2 pigtail is not contacting the exhaust. Check for the following conditions:

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal to wire connection

Damaged harness

Intermittent test – Observe HO2S 2 on the scan tool while moving the related connections and the wiring harness with the ignition ON. If the failure is induced, the HO2S 2 display will change. This may help isolate the location of the malfunction.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

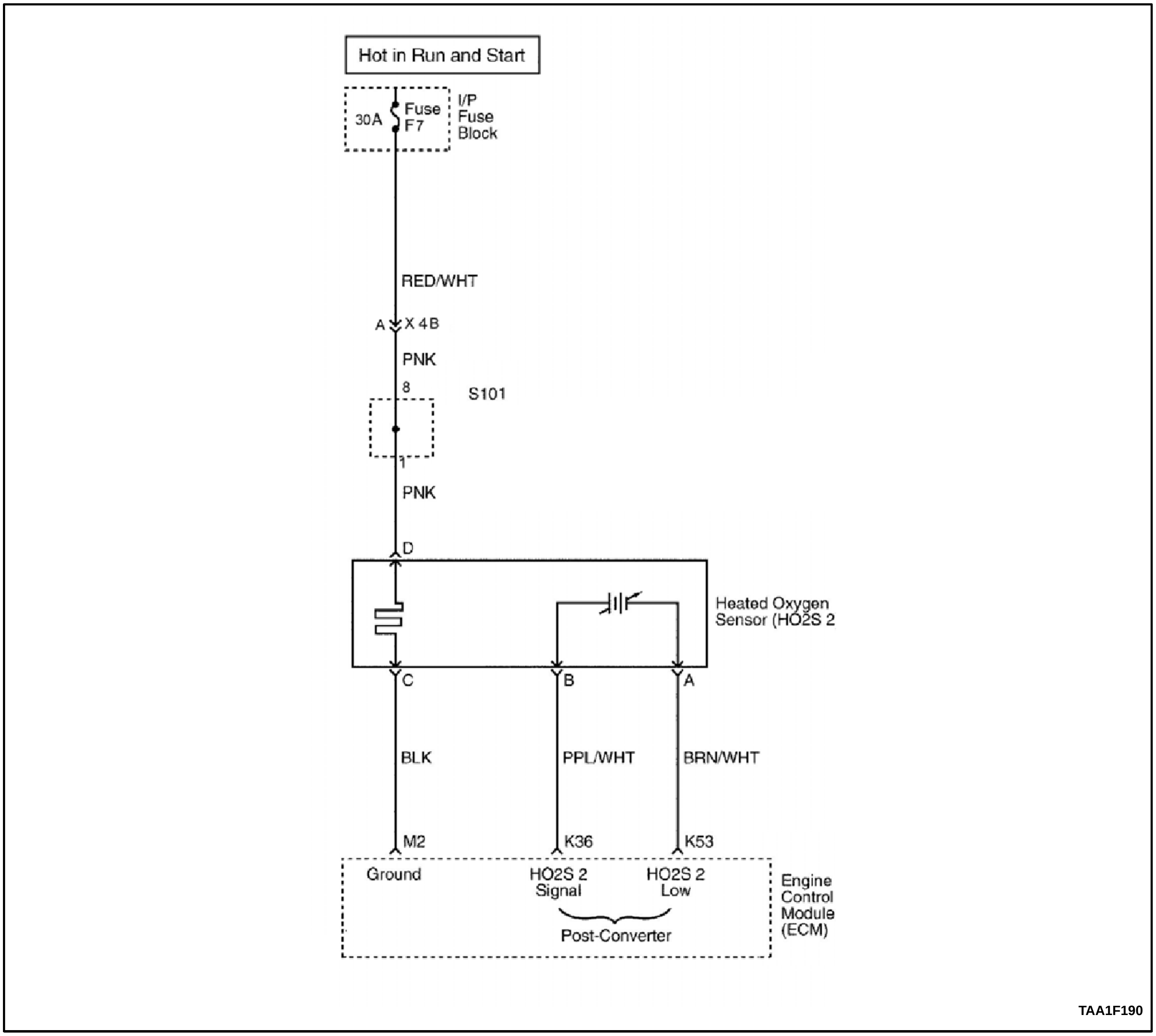
1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0140 is the result of a hard failure or an intermittent condition.
4. Disconnecting the HO2S 2 and jumpering the sensor signal circuit and the sensor low circuit to ground will determine if the ECM or wiring or HO2S 2 is malfunctioning.
6. Determines which circuit the malfunction is in. If the sensor signal circuit and the sensor low circuit are OK, then the ECM connection or ECM is malfunctioning.
10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0140 Heated Oxygen Sensor (HO2S 2) No Activity

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool with the engine above normal specified operating temperature. 2. Run the engine above the specified rpm for two minutes. Does the scan tool display a Heated Oxygen Sensor (HO2S 2) voltage between the specified value?	80°C (176°F) 1200 rpm 425 mv-460 mv (0.425 v-0.460 v)	Go to *Step 4*	Go *Step 3*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions For Setting The DTC as noted? Does the scan tool display the HO2S 2 voltage steady around the specified value?	425 mv-460 mv (0.425 v-0.460 v)	Go to *Step 4*	Go to *Step 11*
4	1. Turn the ignition on, with the engine OFF. 2. Disconnect the HO2S 2 electrical connector. 3. Jumper the HO2S 2 high and low circuits, terminals A and B to ground. Does the scan tool indicate the HO2S voltage below the specified value?	100 mv (0.10 v)	Go to *Step 5*	Go to *Step 6*
5	1. Turn the ignition OFF. 2. Check for a malfunctioning connection at the HO2S 2 (ECM side) and repair as necessary. Is a repair necessary?	–	Go to *Step 11*	Go to *Step 7*
6	1. Turn the ignition switch OFF. 2. Remove the jumper wire. 3. With a Digital Voltmeter (DVM) connected to ground, probe the HO2S 2 high signal circuit, terminal B. Does the DVM indicate near the specified value?	4.5 v	Go to *Step 8*	Go to *Step 9*
7	1. Turn the ignition switch OFF. 2. Replace the HO2S 2 Sensor. Is the action complete?	–	Go to *Step 11*	–
8	Check for an open in the HO2S 2 low circuit or poor connection and repair as necessary. is a repair necessary?	–	Go to *Step 11*	Go to *Step 10*
9	1. Turn the ignition OFF. 2. Disconnect the ECM connector. 3. Check the HO2S 2 high circuit for continuity and repair as necessary. Is the repair complete?	–	Go to *Step 11*	–
10	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 11*	–

DTC P0140 Heated Oxygen Sensor (HO2S 2) No Activity (Cont'd)

Step	Action	Value	Yes	No
11	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 12*	Go to *Step 2*
12	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0141 HEATED OXYGEN SENSOR (HO2S 2) HEATER

Circuit Description

In order to control emissions, a catalytic converter is used to convert harmful emissions into harmless water vapor and carbon dioxide.

The engine control module (ECM) has the ability to monitor this process by using a Heated Oxygen Sensor (HO2S 2). The HO2S 2, located in the exhaust stream past the catalytic converter, produces an output signal which indicates the storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust emissions effectively. If the catalyst is functioning properly, the HO2S 2 signal will be far less active than the signal produced by the Oxygen Sensor (O2S 1).

If the HO2S 2 pigtail wiring, connector, or terminal is damaged, the entire HO2S 2 assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the HO2S 2 wire(s). Any attempt to repair the wires, connector, or terminals could result in the obstruction of the air reference and degrade the HO2S 2 performance.

Conditions for Setting the DTC

1.5L SOHC

Heater electrical current is less than 0.1 amperes.

Engine run time is greater than 60 seconds.

Engine Coolant Temperature (ECT) is greater than –40 °C (–40 °F).

Intake Air Temperature (IAT) is less than –40 °C (–40 °F).

The ignition voltage is between 11 and 18 volts.

The average airflow is less than 14 g/sec.

The Throttle Position (TP) sensor is less than 50% with a 0.4 second delay.

The change in IAT and coolant is less than 7 °C (44.6 °F).

The start-up coolant is less than or equal to 32 °C (89.6 °F).

DTCs P0131, P0132, P0134 is not set.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or
consecutive trip with a fail.

The/ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1
1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a rubbed-through wire insulation or a wire contacting the exhaust.

Check for a poor connection or a damaged harness – inspect the harness connectors for the following conditions:

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal to wire connection

Damaged harness

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0141 is the result of a hard failure or an intermittent condition. With the ignition ON, engine OFF, the HO2S 2 voltage displayed on the scan tool should change within several minutes towards 0 or 1 volt, indicating that the heater is working properly.
3. Probing terminal D of the HO2S 2 connector verifies if voltage is available to the HO2S 2 heater.
4. If voltage is available at the connector, it becomes a good voltage source to check for a ground at terminal C.
5. Determines if voltage is not available at the HO2S 2 due to an open fuse or open ignition feed circuit. If the fuse is open, determine if it was due to a short in the ignition feed circuit before replacing the fuse.

DTC P0141 Heated Oxygen Sensor (HO2S 2) Heater

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	**Notice:** If the engine has just been operating, allow the engine to cool for about one-half hour before proceeding. 1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. Does the Heated Oxygen Sensor (HO2S 2) voltage gradually change towards the specified voltage?	0 v or 1 v	Go to *Step 13*	Go *Step 3*
3	1. Disconnect the HO2S 2 electrical connector. 2. With a test light connected to ground, probe the ignition feed circuit, terminal D of the connector. Does the test light illuminate?	–	Go to *Step 4*	Go to *Step 5*
4	Connect a test light between the ignition feed and ground circuits, terminals D and C of the connector. Does the test light illuminate?	–	Go to *Step 6*	Go to *Step 7*
5	Inspect the fuse F7 in the I/P fuse block. Is the fuse open?	–	Go to *Step 8*	Go to *Step 9*
6	Check the connections at the HO2S 2 connector and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 10*
7	Check the connections at the HO2S 2 connector and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 11*
8	1. Check for a short to ground in the HO2S 2 ignition feed circuit and repair as necessary? 2. Replace open fuse. Is the action complete?	–	Go to *Step 13*	–
9	Check the connections at the HO2S 2 connector and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 12*
10	1. Turn the ignition switch OFF. 2. Replace the HO2S 2 sensor. Is the action complete?	–	Go to *Step 13*	–
11	Repair the open in the ground circuit. Is the action complete?	–	Go to *Step 13*	–
12	Repair the open in the ignition feed circuit. Is the action complete?	–	Go to *Step 13*	–
13	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 14*	Go to *Step 2*
14	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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DIAGNOSTIC TROUBLE CODE (DTC) P1167 OXYGEN (O2) SENSOR RICH IN DECEL FUEL CUT–OFF (DFCO) (1.5L SOHC)

System Description

The Oxygen Sensor (O2S) varies the voltage within a range of about 1 volt if the exhaust is rich, down through about 0.10 volts if the exhaust is lean.

In internal circuitry of the Engine control Module (ECM) can identify if the vehicle fuel system is capable of cutoff amount of the fuel supply during deceleration. When a Decel Fuel Cut-off (DFCO) mode of operation is requested during Closed Loop operation, the ECM will cut-off the fuel supply to the engine. Under these conditions the ECM should detect a lean condition. If the ECM detect a rich condition at this time, Diagnostic Trouble Code (DTC) P1167 will set. Damaged fuel pressure regulator and faulty injector will be the cause of this DTC.

Conditions For Setting The DTC

In DFCO mode.

Engine coolant temperature is greater than 60 C (140 F).

System voltage is greater than 10 volts.

Engine run time is greater than 60 seconds.

No related malfunctions (See P0131).

3 seconds delay after in DFCO mode.

Action Taken When The DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions For Clearing The DTC

The MIL will turn off after four consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm-up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

The DTC P1167 or rich exhaust is most likely caused by one of the following items:

Leaking injector – A leaking or malfunctioning injector can cause the system to go rich causing a DTC P0132.

Pressure regulator – Check for a leaking fuel pressure regulator diaphragm by checking for the presence of liquid fuel in the vacuum line to the regulator.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
5. The replacement ECM must be reprogrammed. Refer to the least Techline procedure for ECM reprogramming.

DTC P1167 – Oxygen (O2) Sensor Rich in Decel Fuel Cut-Off (DFCO) (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool to the Data Link Connector (DLC). 2. Turn the ignition ON. Any other component related Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Using a scan tool, observe the Oxygen Sensor (O2S 1) voltage while decelerating the engine. 2. The O2S voltage should vary from specified voltage (100–900 mV) and while decelerating occasionally toggle below the specified voltage. Is the O2S voltage toggle?	442 mV	Go to *Step 4*	Go to “DTC P0134 Oxygen Sensor No Activity”
4	Check the items in “Diagnostic Aids” and repair or replace component as needed. Refer to “Fuel System Diagnosis” Is the repair complete?	–	Go to *Step 6*	Go to *Step 5*
5	1. Turn the ignition OFF. 2. Replace the Engine Control Module (ECM). Is the repair complete?	–	Go to *Step 6*	–
6	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 7*	Go to *Step 2*
7	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0171 FUEL TRIM SYSTEM TOO LEAN

System Description

To provide the best possible combination of driveability, fuel economy, and emission control, a Closed Loop air/fuel metering system is used. While in Closed Loop, the engine control module (ECM) monitors the oxygen sensor (O2S 1) signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the long and short term fuel trim values which can be monitored with the scan tool. Ideal fuel trim values are around 128 (0%). If the O2S 1 signal is indicating a lean condition, the ECM will add fuel resulting in fuel trim values above 128 (0% to 100%). If a rich condition is detected, the fuel trim values will be below 128 (0% to –100%), indicating that the ECM is reducing the amount of fuel delivered. If exhaust emissions reach an excessive level due to a lean or rich condition, a fuel trim Diagnostic Trouble Code (DTC) is set.

Conditions for Setting the DTC

No intrusive tests active.

The Intake Air Temperature (IAT) is between –40 °C (–40 °F) and 120 °C (248 °F).

The system is in Closed Loop (C/L).

The adaptive index ready.

1.5L SOHC

The average of short term fuel trim values is greater than or equal to 0.94 and the average of adaptive index multiplier values is greater than or equal to 1.28.

DTC(s) P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0300, P0336, P0337, P0341, P0342, P0402, P0404, P0405, P0406, P0443, P0506, P0507, P1167, P1171 and P1404 are not set.

The Throttle position (TP) is less than 80%.

The engine speed is between 700 and 6000 rpm.

The Barometric Pressure (BARO) is greater than 72.0 kPa.

The coolant temperature is between 70 °C (158 °F) and 105 °C (221 °F).

The vehicle speed is less than 87 mph (140 km/h).

The system voltage is greater than 11 volts.

The airflow is between 1.5 and 45 g/sec.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after two consecutive ignitions in which the diagnostic runs with the fault active.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Important: After repairs, use the scan tool Fuel Trim Reset function to reset the long term fuel trim to 128 (0%).

Fuel pressure – The system will be lean if the pressure is too low. It may be necessary to monitor fuel pressure while driving the vehicle at various road speeds and/or loads to confirm.

Map sensor – An output that causes the ECM to sense a lower than normal manifold pressure (high vacuum) can cause the system to go lean. Disconnecting the MAP sensor will allow the ECM to substitute a fixed (default) value for the MAP sensor. If the lean condition is gone when the sensor is disconnected, substitute a known good sensor and recheck.

Fuel contamination – Water, in even small amounts, near the in-tank fuel pump inlet, can be delivered to the injector. The water causes a lean exhaust and can set DTC P0171.

Check for poor O2S 1 or MAP sensor connection at the ECM. Inspect the harness connectors for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal to wire connection

Inspect the wiring harness for damage. If the harness appears to be OK, observe the O2S 1 display on the scan tool while moving the connectors and the wiring harness related to the engine harness. A change in the display will indicate the location of the fault.

Check the brake power booster check valve for possible leaks.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
5. Visually/physically checking items which may cause a lean condition may determine the cause of the DTC being set and save diagnosis time.
9. A vacuum leak can change the Fuel Trim Index and set DTC P0171. This step checks the intake manifold for vacuum leaks.
11. Contaminants in fuel, such as alcohol or water, can create a lean condition setting DTC P0171. Checking for these contaminants could identify the malfunction.
17. If no faults have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” for additional checks and information.

DTC P0171 Fuel Trim System Too Lean

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Install the scan tool. Are any component related Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	With the engine running, operate the vehicle until the LOOP STATUS indicates closed. Is the Fuel Trim Index below the specified value?	25%	Go to *Step 4*	Go to *Step 5*
4	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Does the Fuel Trim Index go below the specified value while operating under the specified conditions?	25%	Go to *Step 16*	Go to *Step 5*

DTC P0171 Fuel Trim System Too Lean (Cont'd)

Step	Action	Value	Yes	No
5	Visually/physically check the following items: Vacuum hoses for splits, kinks and improper connections. Crankcase ventilation oil/air separator for proper installation. Exhaust system for corrosion, leaks, loose or missing hardware. Exhaust system for corrosion, leaks, loose or missing hardware. Oxygen Sensor (O2S 1) is installed securely and the pigtail harness is not contacting exhaust manifold or engine. Fuel for excessive water, alcohol, or other contaminants. Engine control module (ECM) and sensor grounds are clean, tight, and in their proper locations. Do any of the above checks isolate a condition requiring repair?	–	Go to *Step 7*	Go to *Step 6*
6	1. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector. 2. Operate the vehicle in Closed Loop while monitoring the Fuel Trim Index. Is the Fuel Trim Index below the specified value?	25%	Go to *Step 15*	Go to *Step 9*
7	1. Repair the malfunction found in Step 5. 2. Recheck the Fuel Trim Index while operating the engine. Is the Fuel Trim Index below the specified value?	25%	Go to *Step 8*	Go to *Step 9*
8	Lean condition is not present. Does a driveability problem exist?	–	Go to "Symptom Diagnosis"	Go to *Step 16*
9	Visually and physically inspect the following items for vacuum leaks: Intake manifold. Throttle body. Injector O-rings. Repair any leaks found. Do any of the above checks isolate a condition requiring a repair?	–	Go to *Step 16*	Go to *Step 10*
10	Allow the engine to idle. Are the Idle Air Control (IAC) counts above the specified value?	5	Go to *Step 11*	Go to *Step 12*
11	Check the fuel for excessive water, alcohol, or other contaminants and correct the contaminated fuel condition if present. Is the fuel contaminated?	–	Go to *Step 16*	Go to *Step 13*
12	1. Check the IAC valve performance. Refer to "DTC P0506 Idle Speed RPM Lower Than Desired Idle Speed" or "DTC P0507 Idle Speed RPM Higher Than Desired Idle Speed" in this section. 2. Repair as necessary. Was a repair necessary?	–	Go to *Step 16*	Go to *Step 13*

DTC P0171 Fuel Trim System Too Lean (Cont'd)

Step	Action	Value	Yes	No
13	1. Connect a fuel pressure gauge to the fuel system. 2. Turn the ignition switch OFF for at least 10 seconds. 3. Turn the ignition switch ON, the fuel pump will run for approximately 2–3 seconds. It may be necessary to cycle the ignition switch ON more than once to obtain maximum fuel pressure. 4. Note the fuel pressure with the fuel pump running. The pressure should be within the specified value. When the fuel pump stops, the pressure may vary slightly then hold steady. Is the fuel pressure steady and does the fuel pressure hold?	241-276 kPa (35-40 psi)	Go to *Step 14*	Go to "Fuel System Diagnosis"
14	1. Start and idle the engine at normal operating temperature. 2. The fuel pressure noted in the above step should drop by the indicated value. Does the fuel pressure drop by the indicated value?	21-69 kPa (3-10 psi)	Go to "Fuel Injector Balance Test"	Go to "Fuel System Diagnosis"
15	1. Turn the ignition switch OFF. 2. Replace the MAP sensor. Is the action complete?	–	Go to *Step 16*	–
16	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 17*	Go to *Step 2*
17	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P1171 FUEL TRIM SYSTEM LEAN DURING POWER ENRICHMENT

System Description

The internal circuitry of the powertrain control module engine control module (ECM) can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). When a power enrichment mode of operation is requested during Closed Loop operation (by heavy acceleration), the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a rich condition. If this rich exhaust is not detected at this time, a DTC P1171 will set. A plugged fuel filter or restricted fuel line can prevent adequate amounts of fuel from being supplied during power enrichment mode.

Conditions for Setting the DTC

No related malfuntions (see P0131).

Engine is operating in power enrichment (PE) mode.

Engine coolant temperature is greater than 60 C (140 F).

1.5L SOHC

Air-to-fuel ratio is less than or equal to 13.5:1.

System voltage is greater than 10 volts.

Engine run time is greater than 60 seconds.

3 second delay after in PE mode.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after second consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the freeze frame and failure records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm-up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

A restricted fuel filter can supply adequate amounts of fuel at idle, but may not be able to supply enough fuel during heavy acceleration.

Water or alcohol in fuel may cause low O2S 1 voltage during acceleration.

Check for adequate amount of fuel in the Tank.

When the engine is idling or at steady cruise, the O2S 1 voltage should vary from between approximately 100 mv to 900 mv. During power enrichment mode, more fuel is needed and O2S 1 should rise above 447 mv.

Check for faulty or plugged injector(s).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
4. This step checks to see if the O2S 1 is operating properly.
6. If no faults have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P1171 Fuel Trim System Lean During Power Enrichment

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON, with engine OFF. 2. Install the scan tool. Are any component related Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Check the vehicle for an adequate amount of fuel. 2. Add fuel to the vehicles fuel tank if the tank is almost empty. Does the fuel tank require fuel?	–	Go to *Step 5*	Go to *Step 4*
4	1. Using the scan tool, observe the Oxygen Sensor (O2S 1) voltage while running the engine at the specified temperature and rpm. 2. The O2S 1 voltage should vary from the specified voltage and occasionally toggle above the specified voltage. Does the O2S 1 toggle?	75 C-95 C (167 F-203 F) 1200 rpm 100-900 mv 447 mv	Go to “Fuel System Diagnosis”	Go to “DTC P0134 O2 Bank 1 Sensor 1 No Activity”
5	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 6*	Go to *Step 2*
6	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0172 FUEL TRIM SYSTEM TOO RICH

System Description

To provide the best possible combination of driveability, fuel economy, and emission control, a Closed Loop air/fuel metering system is used. While in Closed Loop, the engine control module (ECM) monitors the Oxygen Sensor (O2S 1) signal voltage and adjusts fuel delivery based on signal voltage. A change made to fuel delivery will be indicated by the long and short term fuel trim values which can be monitored with the scan tool. Ideal fuel trim values are around 128 (0%). If the O2S 1 signal is indicating a lean condition, the ECM will add fuel resulting in fuel trim values above 128 (0% to 100%). If a rich condition is detected, the fuel trim values will be below 128 (0% to -100%), indicating that the ECM is reducing the amount of fuel delivered. If exhaust emissions reach an excessive level due to a lean or rich condition, a fuel trim Diagnostic Trouble Code (DTC) is set.

Conditions for Setting the DTC

No intrusive tests active.

The Intake Air Temperature (IAT) is between –40 °C (–40 °F) and 120 °C (248 °F).

The system is in Closed Loop (C/L).

The adaptive index ready.

1.5L SOHC

The average of short term fuel trim values is less than or equal to 1.06 and the average of adaptive index multiplier values is less than or equal to 0.72.

DTC(s) P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0131, P0132, P0133, P0134, P0300, P0336, P0337, P0341, P0342, P0402, P0404, P0405, P0406, P0443, P0506, P0507, P1167, P1171 and P1404 are not set.

The Throttle Position (TP) is less than 80%.

The engine speed is between 700 and 6000 rpm.

The Barometric Pressure (BARO) is greater than 72.0 kPa.

The coolant temperature is between 50 °C (122 °F) and 125 °C (257 °F).

The vehicle speed is less than 87 mph (140 km/h).

The system voltage is greater than 11 volts.

The airflow is between 1.5 and 45 g/sec.

The Manifold Air Pressure (MAP) is between 25 and 90 kPa.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Important: After repairs, use the scan tool Fuel Trim Reset function to reset the long term fuel trim to 128 (0%).

Check for poor connection at the ECM. Inspect the harness connectors for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal to wire connection

Inspect the wiring harness for damage. If the harness appears to be OK, observe the O2S 1 display on the scan tool while moving the connectors and the wiring harness related to the engine harness. A change in the display will indicate the location of the fault.

If a DTC P1404 is also set, check the 5 volt reference circuits for a short to voltage.

Check for a restricted exhaust system.

A shorted 5 volt reference circuit may cause a DTC P0172 to set. Check the 5 volt reference sensors for abnormal readings.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
5. A clogged air cleaner filter element restricts the airflow coming into the engine. This step checks the condition of the air cleaner filter.
17. A leaky injector can cause a rich condition and set DTC P0172. Refer to "Fuel injector Balance Test" in this section.
19. A loose TP sensor may not set a TP sensor related DTC, but may cause the system to become rich by a higher-than-actual TP reading.
22. If no faults have been found at this point and no additional DTCs were set, refer to "Diagnostic Aids" for additional checks and information.

DTC P0172 Fuel Trim System Too Rich

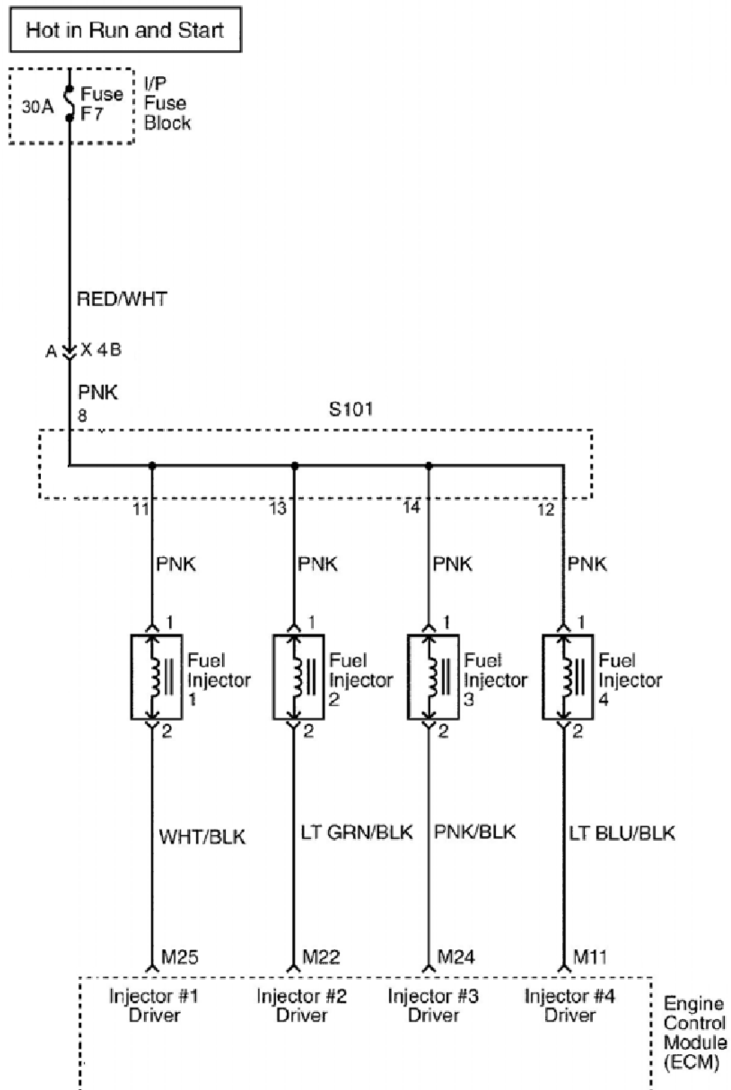
Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Install the scan tool. Are any component related Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	With the engine running, operate the vehicle while in Closed Loop Is the Fuel Trim Index above the specified value?	–20%	Go to *Step 4*	Go to *Step 5*
4	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is the Fuel Trim Index above the specified value while operating under the specified conditions?	–20%	Go to *Step 21*	Go to *Step 5*
5	1. Visually and physically check the air cleaner filter for excessive dirt or being plugged. 2. Repair as necessary. Does the air cleaner filter require replacement?	–	Go to *Step 21*	Go to *Step 6*
6	1. Visually and physically check the air intake system for being collapsed or restricted. 2. Repair as necessary. Does the air intake system require repair?	–	Go to *Step 21*	Go to *Step 7*
7	Inspect the throttle body inlet for damage or foreign objects which may partially block the airflow and correct any problem found. Does the inspection of the throttle body reveal a condition requiring a repair or replacement?	–	Go to *Step 21*	Go to *Step 8*

DTC P0172 Fuel Trim System Too Rich (Cont'd)

Step	Action	Value	Yes	No
8	1. Turn the ignition switch OFF and inspect the throttle body, throttle plate and Idle Air Control (IAC) passages for choking and foreign objects. 2. Repair as necessary. Does the inspection reveal a condition requiring a repair?	–	Go to *Step 21*	Go to *Step 9*
9	Start the engine with the vehicle in park or neutral and the A/C OFF and note the idle quality. Is a low or unsteady idle being experienced?	–	Go to *Step 10*	Go to *Step 12*
10	Idle the engine. Are the IAC counts below the specified value?	100	Go to *Step 12*	Go to *Step 11*
11	1. Disconnect the MAP sensor. 2. Operate the vehicle while in Closed Loop. Does the Fuel Trim Index increase above the specified value?	–20%	Go to *Step 20*	Go to *Step 12*
12	1. Check the IAC valve performance. Refer to "DTC P0506 Idle Speed RPM Lower Than Desired Idle Speed" or "DTC P0507 Idle Speed RPM Higher Than Desired Idle Speed" in this section 2. Repair as necessary. Does the inspection reveal a condition requiring a repair?	–	Go to *Step 21*	Go to *Step 13*
13	1. Disconnect the vacuum hose from the fuel pressure regulator and inspect the hose for the presence of fuel. 2. If fuel is present in the vacuum hose, replace the fuel pressure regulator. Does the fuel pressure regulator require replacement?	–	Go to *Step 21*	Go to *Step 14*
14	1. Turn the ignition switch ON, with the engine OFF. 2. Slowly depress the accelerator pedal. Does the Throttle Position (TP) display increase steadily and evenly from its minimum voltage at closed throttle to its maximum voltage at wide–open throttle (WOT)?	–	Go to *Step 15*	Go to *Step 19*
15	1. Perform the Fuel System Diagnosis. 2. If the table isolates a problem, repair as necessary. Does the table isolate a problem requiring a repair?	–	Go to *Step 21*	Go to *Step 16*
16	1. Perform the Evaporative (EVAP) Emission Control System Diagnosis. 2. If the table isolates a problem, repair as necessary. Is a problem isolated that requires a repair?	–	Go to *Step 21*	Go to *Step 17*
17	1. Perform the Fuel Injector Balance Test. 2. If the table isolates a problem, repair as necessary. Does the table isolate a problem requiring a repair?	–	Go to *Step 21*	Go to *Step 18*

DTC P0172 Fuel Trim System Too Rich (Cont'd)

Step	Action	Value	Yes	No
18	1. Remove and visually/physically inspect the Oxygen Sensor (O2S 1) for silicone contamination. This will be indicated by a powdery white deposit on the portion of the O2S 1 sensor exposed to the exhaust stream. 2. If contamination is present on the O2S 1 sensor, find the source of the contamination and repair and also replace the contaminated O2S 1 sensor. Is the problem found and corrected?	–	Go to *Step 21*	Go to "Diagnostic Aids"
19	1. Check the TP sensor mounting screws 2. If they are loose or missing tighten or replace them as necessary. 3. If the screws are OK, replace the TP sensor. Is the action complete?	–	Go to *Step 21*	–
20	1. Turn the ignition switch OFF. 2. Replace the MAP sensor. Is the action complete?	–	Go to *Step 21*	–
21	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 22*	Go to *Step 2*
22	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK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Fuse
F7
I/P
Fuse
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PNK/BLK
LT BLU/BLK
M25
M22
M24
M11
Injector #1
Driver
Injector #2
Driver
Injector #3
Driver
Injector #4
Driver
Engine
Control
Module
(ECM)

FAA1F210

DIAGNOSTIC TROUBLE CODE (DTC) P0201 INJECTOR 1 OUTPUT CIRCUIT FAULT

Circuit Description

The engine control module (ECM) has four individual injector driver circuits, each of which controls an injector. When a driver circuit is grounded by the ECM, the injector is activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic Trouble Code (DTC) is set. This DTC detects a short to ground and/or an open circuit and short to battery conditions for low-side drive injector outputs.

Conditions for Setting the DTC

- Engine is in run mode.
- Engine speed is greater than 700 rpm (1.5L SOHC).
- The battery voltage is more than 9 volts.
- The above conditions are met for 5 seconds.

Action Taken When the DTC Sets

- The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.
- The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0201 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC should also be set indicating which injector is inoperative.

Long-term and short-term fuel trims that are excessively high or low are a good indication that an injector is malfunctioning. Refer to “Fuel Injector Balance Test” in this section to check for malfunctioning injectors.

The injector resistance tested at the ECM connection is slightly more than if tested directly at the injector because it includes resistance of the harness wires. The normal value is about 13.5 :

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. This step determines if DTC P0201 is the result of a hard failure or an intermittent condition.
5. This step tests the wiring harness and the ECM control of the injectors using a test light.
7. This step determines if the circuitry is shorted to voltage or if the ECM is faulty.
9. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0201 Injector 1 Output Circuit Fault

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Will the engine start?	–	Go to *Step 3*	Go to “Engine Cranks But Will Not Run”
3	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTCs). 2. Idle the engine for one minute. Does DTC P0201 reset?	–	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition ON and the engine OFF and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does DTC P0201 reset?	–	Go to *Step 5*	Go to “Diagnostic Aids”
5	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector (white) for injector 1. 3. Turn the ignition ON, with the engine OFF. 4. With a test light connected to ground, probe the driver circuit, terminal M25. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 6*
6	Repair the short to ground or open in the injector driver circuit. Is the action complete?	–	Go to *Step 10*	–
7	1. Disconnect the injector 1 wiring connection. 2. With a test light connected to ground, probe the driver circuit, terminal 2. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
8	Repair the short to voltage in the injector driver circuit. Is the repair complete?	–	Go to *Step 10*	–
9	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 3*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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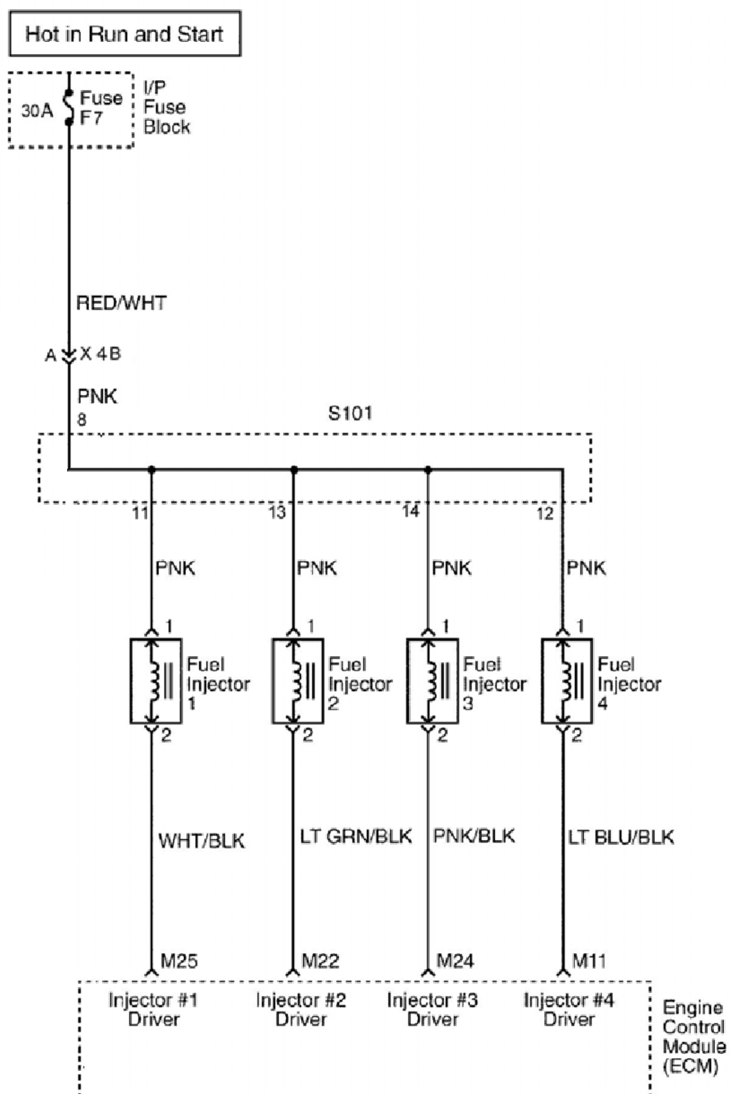

Hot in Run and Start
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I/P Fuse Block
RED/WHT
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X 4B
PNK
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S101
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PNK
PNK
PNK
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1
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Fuel Injector 1
Fuel Injector 2
Fuel Injector 3
Fuel Injector 4
2
2
2
2
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
M25
M22
M24
M11
Injector #1 Driver
Injector #2 Driver
Injector #3 Driver
Injector #4 Driver
Engine Control Module (ECM)

FAA1F210

DIAGNOSTIC TROUBLE CODE (DTC) P0202 INJECTOR 2 OUTPUT CIRCUIT FAULT

Circuit Description

The engine control module (ECM) has four individual injector driver circuits, each of which controls an injector. When a driver circuit is grounded by the ECM, the injector is activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic Trouble Code (DTC) is set. This DTC detects a short to ground and/or an open circuit and a short to battery conditions for low-side drive injector outputs.

Conditions for Setting the DTC

Engine is in run mode.

Engine speed is greater than 700 rpm (1.5L SOHC).

The battery voltage is more than 9 volts.

The above conditions are met for 5 seconds.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

The ECM will turn OFF the MIL on the third (fourth – 1.5L SOHC) consecutive trip cycle in which the diagnostic has been run and the fault is no longer present.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0202 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC should also be set indicating which injector is inoperative.

Long-term and short-term fuel trims that are excessively high or low are a good indication that an injector is malfunctioning. Use Fuel Injector Balance Test to check for malfunctioning injectors.

Injector resistance tested at the ECM connection is slightly more than if tested directly at the injector because it includes resistance of the harness wires. The normal value is about 13.5 :

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. This step determines if DTC P0202 is the result of a hard failure or an intermittent condition.
5. This step tests the wiring harness and the ECM control of the injectors using a test light.
7. This step determines if the circuitry is shorted to voltage or if the ECM is faulty.
9. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0202 Injector 2 Output Circuit Fault

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Will engine start?	–	Go to *Step 3*	Go to “Engine Cranks But Will Not Run”
3	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTC). 2. Idle the engine for one minute. Does DTC P0202 reset?	–	Go to *Step 5*	Go to *Step 4*

DTC P0202 Injector 2 Output Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
4	1. Review the Freeze Frame data with the ignition ON and the engine OFF and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0202 reset?	–	Go to *Step 5*	Go to "Diagnostic Aids"
5	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector (white) for injector 2. 3. Turn the ignition ON, with engine OFF. 4. With a test light connected to ground, probe the driver circuit, terminal M22. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 6*
6	Repair the short to ground or open in the injector driver circuit. Is the action complete?	–	Go to *Step 10*	–
7	1. Disconnect the injector 2 wiring connection. 2. With a test light connected to ground, probe the driver circuit, terminal 2. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
8	Repair the short to voltage in the injector driver circuit. Is the repair complete?	–	Go to *Step 10*	–
9	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 3*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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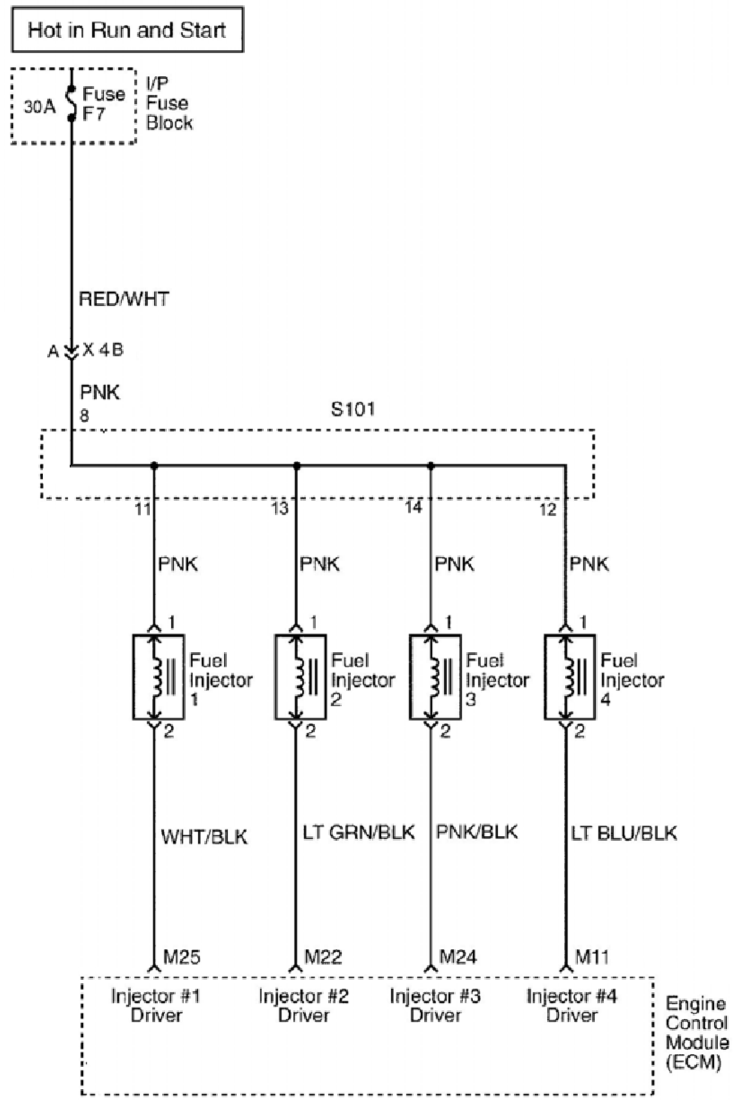
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F7
I/P
Fuse
Block
RED/WHT
A
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PNK
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PNK
PNK
PNK
PNK
1
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2
Fuel
Injector
3
Fuel
Injector
4
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2
2
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
M25
M22
M24
M11
Injector #1
Driver
Injector #2
Driver
Injector #3
Driver
Injector #4
Driver
Engine
Control
Module
(ECM)

FAA1F210

DIAGNOSTIC TROUBLE CODE (DTC) P0203 INJECTOR 3 OUTPUT CIRCUIT FAULT

Circuit Description

The engine control module (ECM) has four individual injector driver circuits, each of which controls an injector. When a driver circuit is grounded by the ECM, the injector is activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic Trouble Code (DTC) is set. This DTC detects a short to ground and/or an open circuit and a short to battery conditions for low-side drive injector outputs.

Conditions for Setting the DTC

Engine is in run mode.

Engine speed is greater than 700 rpm (1.5L SOHC).

The battery voltage is more than 9 volts.

The above conditions are met for 5 seconds.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

The ECM will turn OFF the MIL on the third (fourth – 1.5L SOHC) consecutive trip cycle in which the diagnostic has been run and the fault is no longer present.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0203 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC should also be set indicating which injector is inoperative.

Long-term and short-term fuel trims that are excessively high or low are a good indication that an injector is malfunctioning. Refer to “Fuel Injector Balance Test” in this section to check for malfunctioning injectors.

Injector resistance tested at the ECM connection is slightly more than if tested directly at the injector because it includes resistance of the harness wires. The normal value is about 13.5 :

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. This step determines if DTC P0203 is the result of a hard failure or an intermittent condition.
5. This step tests the wiring harness and the ECM control of the injectors using a test light.
7. This step determines if the circuitry is shorted to voltage or if the ECM is faulty.
9. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0203 Injector 3 Output Circuit Fault

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Will engine start?	–	Go to *Step 3*	Go to “Engine Cranks But Will Not Run”
3	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTCs). 2. Idle the engine for one minute. Does DTC P0203 reset?	–	Go to *Step 5*	Go to *Step 4*

DTC P0203 Injector 3 Output Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
4	1. Review the Freeze Frame data with the ignition ON and the engine OFF and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does DTC P0203 reset?	–	Go to *Step 5*	Go to "Diag-nostic Aids"
5	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector (white) for injector 3. 3. Turn the ignition ON, with the engine OFF. 4. With a test light connected to ground, probe the driver circuit, terminal M24. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 6*
6	Repair the short to ground or open in the injector driver circuit. Is the action complete?	–	Go to *Step 10*	–
7	1. Disconnect the injector 3 wiring connection. 2. With a test light connected to ground, probe the driver circuit, terminal 2. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
8	Repair the short to voltage in the injector driver circuit. Is the repair complete?	–	Go to *Step 10*	–
9	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan to0l indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 3*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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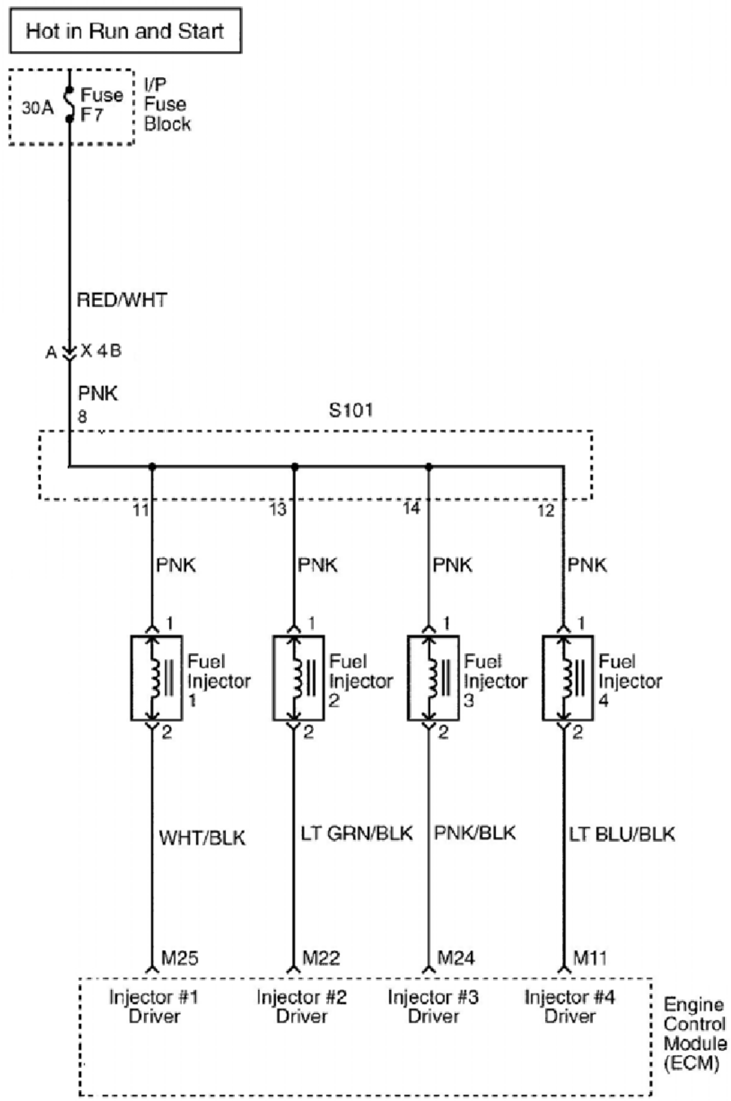
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Fuse
F7
I/P
Fuse
Block
RED/WHT
A
X 4B
PNK
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S101
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Injector
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2
2
2
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
M25
M22
M24
M11
Injector #1
Driver
Injector #2
Driver
Injector #3
Driver
Injector #4
Driver
Engine
Control
Module
(ECM)

FAA1F210

DIAGNOSTIC TROUBLE CODE (DTC) P0204 INJECTOR 4 OUTPUT CIRCUIT FAULT

Circuit Description

The engine control module (ECM) has four individual injector driver circuits, each of which controls an injector. When a driver circuit is grounded by the ECM, the injector is activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic Trouble Code (DTC) is set. This DTC detects a short to ground and/or an open circuit and a short to battery conditions for low-side drive injector outputs.

Conditions for Setting the DTC

Engine is in run mode.

Engine speed is greater than 700 rpm (1.5L SOHC).

The battery voltage is more than 9 volts.

The above conditions are met for 5 seconds.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

The ECM will turn OFF the MIL on the third (fourth – 1.5L SOHC) consecutive trip cycle in which the diagnostic has been run and the fault is no longer present.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0204 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC should also be set indicating which injector is inoperative.

Long-term and short-term fuel trims that are excessively high or low are a good indication that an injector is malfunctioning. Refer to “Fuel Injector Balance Test” in this section to check for malfunctioning injectors.

Injector resistance tested at the ECM connection is slightly more than if tested directly at the injector because it includes resistance of the harness wires. The normal value is about 13.5 :

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. This step determines if DTC P0204 is the result of a hard failure or an intermittent condition.
5. This step tests the wiring harness and ECM control of the injectors using a test light.
7. This step determines if the circuitry is shorted to voltage or if the ECM is faulty.
9. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0204 Injector 4 Output Circuit Fault

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Will engine start?	–	Go to *Step 3*	Go to “Engine Cranks But Will Not Run”
3	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTC). 2. Idle the engine for one minute. Does DTC P0204 reset?	–	Go to *Step 5*	Go to *Step 4*

DTC P0204 Injector 4 Output Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
4	1. Review the Freeze Frame data with the ignition ON and the engine OFF and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does DTC P0204 reset?	–	Go to *Step 5*	Go to "Diagnostic Aids"
5	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector (blue) for injector 4. 3. Turn the ignition ON, with the engine OFF. 4. With a test light connected to ground, probe the driver circuit, terminal M11. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 6*
6	Repair the short to ground or open in the injector driver circuit. Is the action complete?	–	Go to *Step 10*	–
7	1. Disconnect the injector 4 wiring connection. 2. With a test light connected to ground, probe the driver circuit, terminal 2. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
8	Repair the short to voltage in the injector driver circuit. Is the repair complete?	–	Go to *Step 10*	–
9	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 3*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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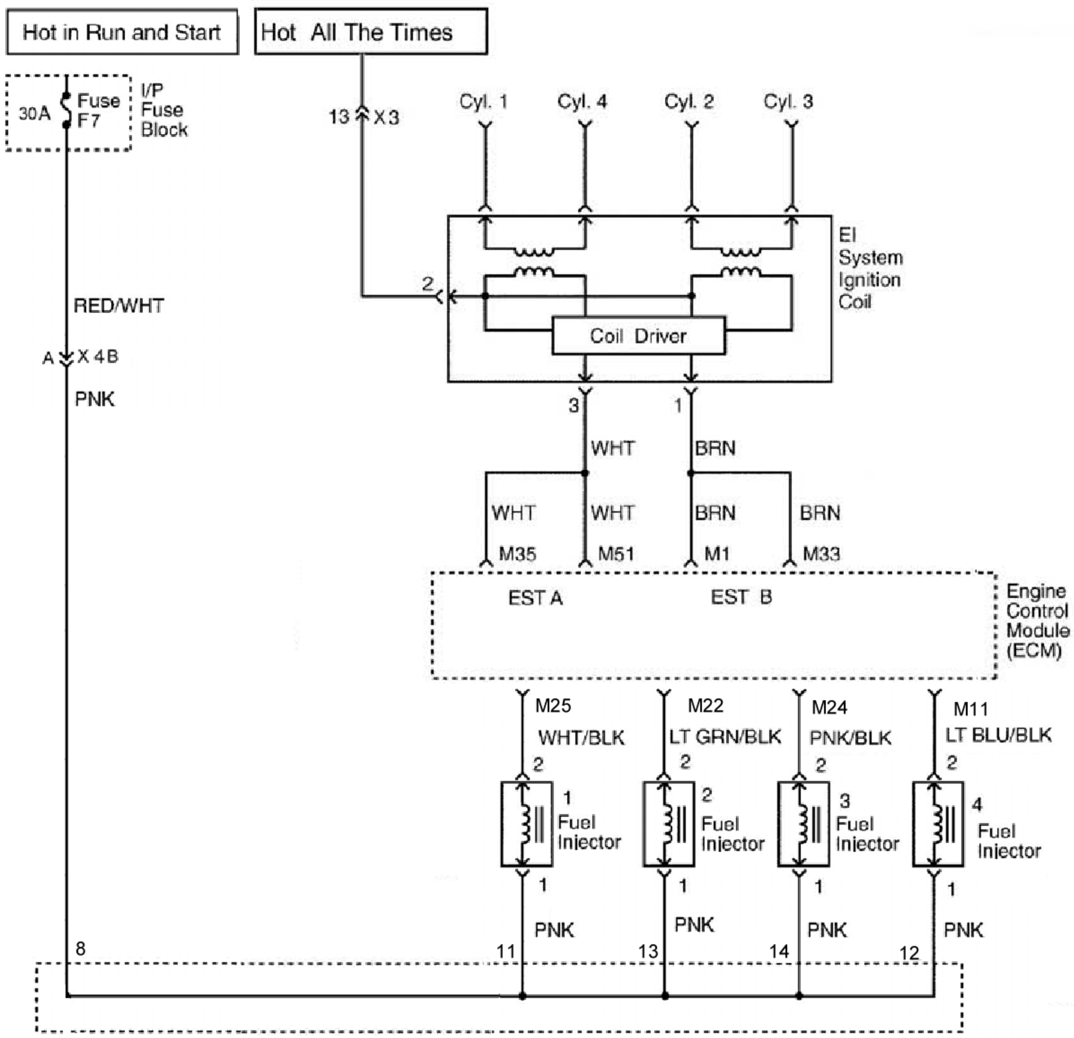
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F7
I/P
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X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI
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Ignition
Coil
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Coil Driver
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BRN
M35
M51
M1
M33
EST A
EST B
Engine
Control
Module
(ECM)
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LT GRN/BLK
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PNK
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FAA1F220

DIAGNOSTIC TROUBLE CODE (DTC) P0300 MULTIPLE CYLINDER MISFIRE

Circuit Description

The engine control module (ECM) monitors the crankshaft and camshaft position to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. This test is executed in blocks of 100 camshaft revolution tests. It may take between one to several tests to store a Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL). Under light misfire conditions, it may also take more than one trip to set a DTC. Severe misfire will flash the MIL indication that catalyst damage is possible. The Torque Converter Clutch is disabled momentarily to determine if the misfire was due to a rough road condition (automatic transaxle only).

Conditions for Setting the DTC

DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0336, P0337, P0341, P0342 and P0502 are not set.

A/C compressor clutch has not just engaged or disengaged.

Engine load and engine speed is in a detectable region and is at or above zero torque.

Camshaft Position (CMP) sensor is in synchronization.

Exhaust Gas Recirculation (EGR) flow diagnostic is not is progress.

Decel Fuel Cut-Off (DFCO) is not active.

An automatic transmission is not shifting.

Crankshaft speed patterns are normal.

Vehicle voltage is between 11 and 16 volts.

Coolant temperature is between –7 °C (19.4 °F) and 120 °C (248 °F).

There is the correct ratio between Crankshaft Position (CKP) sensor pulses and CMP sensor pulses.

1.5L SOHC

Engine run time is greater than and equal to 20 engine cycles (3 second at 800 rpm).

Fuel level is greater than 11% rated tank capacity.

Fuel is not shutoff from high engine speed of 6500 rpm for M/T or 6500 rpm for A/T in drive and 6250 rpm in park for A/T vehicle.

The change of positive throttle position is less than 3.0% / 125 milliseconds and the change of minus throttle position is less than 3.0% / 125 milliseconds.

Have not encountered an abusive engine speed of 7000 rpm.

Engine acceleration rate is less than or equal to 10 consecutive powerstrokes.

Engine deceleration rate is less than or equal to 12 consecutive powerstrokes.

Throttle position is less than 4.0% when the vehicle is greater than 6.2 mph (10 km/h).

Engine speed is between 600 and 4500 rpm.

Engine speed is less than or equal to 1600 rpm or the crank angle sensing error has been learned.

Fuel is not shutoff at 158.4 mph (255 km/h).

Action Taken When the DTC Sets

The MIL will illuminate after two consecutive ignition cycles in which the diagnostic runs with the fault active.

Or

The MIL will illuminate immediately and flash if catalyst damaging level misfire is present.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (for – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent can also be the result of a defective reluctor wheel. Remove the CKP sensor and inspect the reluctor wheel through the sensor mount hole. Check for porosity and the condition of wheel. If DTC is intermittent refer to “Symptoms Diagnosis” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1 The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

3. A visual/physical inspection should include checking the following components:

    The wiring for proper connections, pinches or cuts.

    The ECM grounds for being clean and tight.

    The vacuum hoses for splits, kinks, and improper connections as shown on the Vehicle Emission Information label.

    Check thoroughly for any type of leak or restriction.

    Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.

5. When all the accumulators are relatively equal, then the misfire is being caused by something that affects the entire engine. When they are not, then the misfire is being caused by something that is specific to two or more cylinders.
6. Whenever the misfire is not present, operating the vehicle may be necessary to duplicate the conditions in the Freeze Frame Data in order to detect misfire. Depending on the engine load, the conditions may have to be maintained for up to 20 seconds. Whenever the misfire accumulators start to increment, then misfire is present. A history misfire counter will store the number of misfires that have occurred until the DTC is cleared.
8. Check fuel for water, alcohol, etc.
9. A basic engine problem that affects all cylinders is the only possibility at this point. (Cam timing, throttle body leak, restricted air flow, etc.)
11. Tests the ignition system voltage output using a spark tester.
12. Replace any spark plugs that are worn, cracked or fouled.
13. Checks for voltage at the ignition feed circuit.
18. Whenever the driver circuit is shorted to ground, the light will be on steady. When the driver circuit is shorted to voltage or open, the light will be off.
19. Since voltage is supplied to the fuel injector on a single circuit, the malfunction can only be a poor connection or open in the fuel injector harness. An open before the harness would result in a “Engine Cranks But Will Not Run” complaint.
27. Before replacing the ECM, check terminals for improper mating, broken locks, or physical damage to the wiring harness. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0300 Multiple Cylinder Misfire

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Install a scan tool. Are Diagnostic Trouble Codes (DTCs) P0201, P0202, P0203, P0204 set?	–	Go to applicable DTC	Go to *Step 3*
3	1. Perform a visual/physical inspection. 2. Make any repairs that are necessary. Were any repairs necessary?	–	Go to *Step 27*	Go to *Step 4*
4	Start the engine and allow it to idle. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to *Step 6*
5	Are all counters equal (within a percentage of each other)?	–	Go to *Step 7*	Go to *Step 11*
6	1. Turn the ignition ON, engine OFF and review the Freeze Frame data and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions and conditions for setting this DTC as noted. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to "Diagnostic Aids"
7	1. Turn the engine OFF. 2. Install a fuel pressure gauge. 3. Observe the fuel pressure with the engine running. Is the fuel pressure within the specified value?	284-325 kPa (41 to 47 psi)	Go to *Step 8*	Go to "Fuel System Diagnosis"
8	Check the fuel for contamination. Is the fuel OK?	–	Go to *Step 9*	Go to *Step 10*
9	Check for a basic engine problem. Is the action complete?	–	Go to *Step 27*	–
10	Replace the contaminated fuel. Is the action complete?	–	Go to *Step 27*	–
11	1. Turn the engine OFF. 2. Disconnect the fuel injector harness connector. 3. Install a spark tester on cylinder #1 spark plug cable. 4. Crank the engine and check for spark. 5. Repeat the above procedure on cylinders #2, #3, #4. Is spark observed on all four spark plug cables?	–	Go to *Step 12*	Go to *Step 20*
12	Replace all malfunctioning spark plugs. Are any malfunctioning?	–	Go to *Step 27*	Go to *Step 13*
13	1. Turn the engine OFF. 2. Disconnect the 4 fuel injector connectors from the injectors. 3. Install an injector test light on the injector harness connector for the cylinders that had misfired. 4. Crank the engine and note the test light. Does the injector test light blink?	–	Go to *Step 14*	Go to *Step 15*
14	Perform the Fuel Injector Balance Test. Are the fuel injectors OK?	–	Go to *Step 9*	Go to *Step 16*

DTC P0300 Multiple Cylinder Misfire (Cont'd)

Step	Action	Value	Yes	No
15	1. Disconnect the injector test light. 2. With a test light connected to ground, probe the ignition feed terminal 1 of the injector harness connector for each cylinder that had misfire. 3. Crank the engine. Does the test light illuminate?	–	Go to *Step 17*	Go to *Step 19*
16	Replace any malfunctioning fuel injectors. Is the action complete?	–	Go to *Step 27*	–
17	Check the affected fuel injector driver circuit at terminals M25, M22, M24 and M11 for an open, short or short to voltage. Is a problem found?	–	Go to *Step 18*	Go to *Step 24*
18	Repair the open or the shorted fuel injector driver circuit. Is the action complete?	–	Go to *Step 27*	–
19	Repair the open ignition feed circuit between the fuel injector harness connector and the fuel injector connector. Is the action complete?	–	Go to *Step 27*	–
20	Measure the resistance of the spark plug cable that the spark plug tester did not spark. Is the resistance of the spark plug cable less than the specified value?	30,000 :	Go to *Step 21*	Go to *Step 25*
21	Inspect the engine control module (ECM) connector and connections. Are the connections OK?	–	Go to *Step 22*	Go to *Step 23*
22	Check the affected cylinders ignition control circuit for an open or short and repair as necessary. Is a repair necessary?	–	Go to *Step 27*	Go to *Step 26*
23	1. Turn the ignition OFF. 2. Repair the connector or connections. Is the action complete?	–	Go to *Step 27*	–
24	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 27*	–
25	Replace the spark plug cable. Is the action complete?	–	Go to *Step 27*	–
26	Replace the faulty ignition coil. Is the action complete?	–	Go to *Step 27*	–
27	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 28*	Go to *Step 2*
28	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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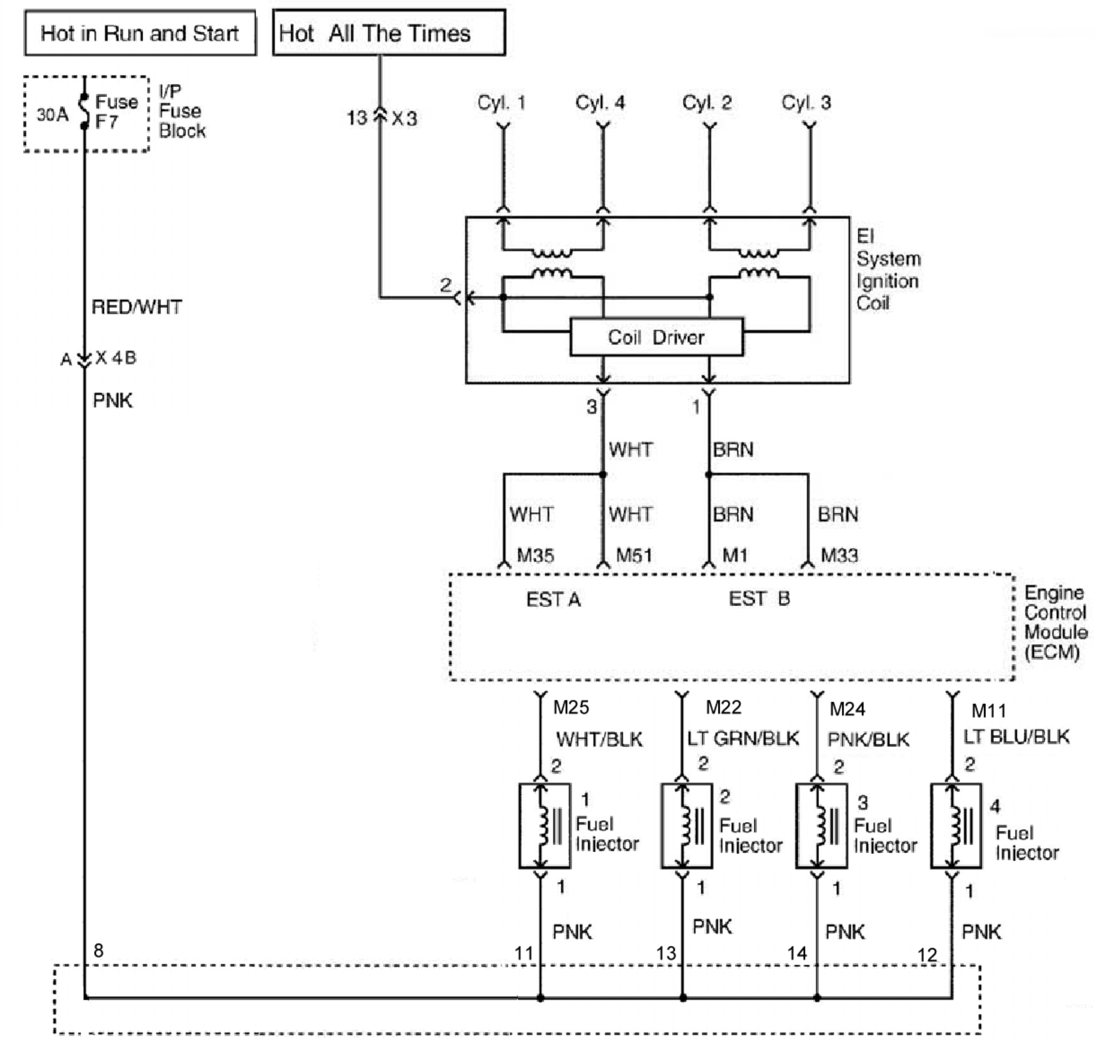

Hot in Run and Start
Hot All The Times
30A
Fuse F7
I/P Fuse Block
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Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
RED/WHT
A X 4B
PNK
3
1
WHT
BRN
WHT
WHT
BRN
BRN
M35
M51
M1
M33
EST A
EST B
Engine Control Module (ECM)
M25
M22
M24
M11
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
2
1 Fuel Injector
2 Fuel Injector
3 Fuel Injector
4 Fuel Injector
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PNK
8
11
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14
12

FAA1F220

DIAGNOSTIC TROUBLE CODE (DTC) P0301 CYLINDER 1 MISFIRE

Circuit Description

The engine control module (ECM) monitors the crankshaft and camshaft position to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. This test is executed in blocks of 100 camshaft revolution tests. It may take between one to several tests to store a Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL). Under light misfire conditions, it may also take more than one trip to set a DTC. Severe misfire will flash the MIL indication that catalyst damage is possible. The Torque Converter Clutch is disabled momentarily to determine if the misfire was due to a rough road condition (automatic transaxle only).

Conditions for Setting the DTC

DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0336, P0337, P0341, P0342 and P0502 are not set.

A/C compressor clutch has not just engaged or disengaged.

Engine load and engine speed is in a detectable region and is at or above zero torque.

Camshaft Position (CMP) sensor is in synchronization.

Exhaust Gas Recirculation (EGR) flow diagnostic is not is progress.

Decel Fuel Cut-Off (DFCO) is not active.

An automatic transmission is not shifting.

Crankshaft speed patterns are normal.

Vehicle voltage is between 11 and 16 volts.

Coolant temperature is between –7 °C (19.4 °F) and 120 °C (248 °F).

There is the correct ratio between Crankshaft Position (CKP) sensor pulses and CMP sensor pulses.

1.5L SOHC

Engine run time is greater than and equal to 20 engine cycles (3 second at 800 rpm).

Fuel level is greater than 11% rated tank capacity.

Fuel is not shutoff from high engine speed of 6500 rpm for M/T or 6500 rpm for A/T in drive and 6250 rpm in park for A/T vehicle.

The change of positive throttle position is less than 3.0% / 125 milliseconds and the change of minus throttle position is less than 3.0% / 125 milliseconds.

Have not encountered an abusive engine speed of 7000 rpm.

Engine acceleration rate is less than or equal to 10 consecutive powerstrokes.

Engine deceleration rate is less than or equal to 12 consecutive powerstrokes.

Throttle position is less than 4.0% when the vehicle is greater than 6.2 mph (10 km/h).

Engine speed is between 600 and 4500 rpm.

Engine speed is less than or equal to 1600 rpm or the crank angle sensing error has been learned.

Fuel is not shutoff at 158.4 mph (255 km/h).

Action Taken When the DTC Sets

The MIL will illuminate after two consecutive ignition cycles in which the diagnostic runs with the fault active.

Or

The MIL will illuminate immediately and flash if catalyst damaging level misfire is present.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent can also be the result of a defective reluctor wheel. Remove the crankshaft sensor and inspect reluctor wheel through sensor mount hole. Check for porosity and condition of wheel. If DTC is intermittent, refer to “Symptoms Diagnosis” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. A visual/physical inspection should include checking the following components:
   - The wiring for proper connections, pinches or cuts.
   - The ECM grounds for being clean and tight.
   - The vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Information label.
   - Check thoroughly for any type of leak or restriction.
   - Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
5. When all the accumulators are relatively equal, then the misfire is being caused by something that affects the entire engine. When they are not, then the misfire is being caused by something that is specific to two or more cylinders.
6. Whenever the misfire is not present operating the vehicle may be necessary to duplicate the conditions in the Freeze Frame Data in order to detect misfire. Depending on the engine load, the conditions may have to be maintained for up to 20 seconds. Whenever the misfire accumulators start to increment, then misfire is present. A history misfire counter will store the number of misfires that have occurred until the DTC is cleared.
8. Check the fuel for water, alcohol, etc.
9. A basic engine problem that affects all cylinders is the only possibility at this point. (Cam timing, throttle body leak, restricted airflow, etc.)
11. Tests the ignition system voltage output using a spark tester.
12. Replace any spark plugs that are worn, cracked or fouled.
13. Checks for voltage at the ignition feed circuit.
18. Whenever the driver circuit is shorted to ground, the light will be ON steady. When the driver circuit is shorted to voltage or open, the light will be OFF.
19. Since voltage is supplied to the fuel injector on a single circuit, the malfunction could only be a poor connection or open in the fuel injector harness. An open before the harness would result in a “Engine Cranks But Will Not Run” complaint.
27. Before replacing the ECM, check terminals for improper mating, broken locks, or physical damage to the wiring harness. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0301 Cylinder 1 Misfire

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Install a scan tool. Are Diagnostic Trouble Codes (DTCs) P0201 or P0300 set?	–	Go to applicable DTC	Go to *Step 3*
3	1. Perform a visual/physical inspection. 2. Make any repairs that are necessary. Are any repairs necessary?	–	Go to *Step 27*	Go to *Step 4*
4	Start the engine and allow it to idle. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to *Step 6*
5	Are all counters equal (within a percentage of each other)?	–	Go to *Step 7*	Go to *Step 11*
6	1. Turn the ignition ON, engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and conditions for setting this DTC as noted. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to “Diagnostic Aids”
7	1. Turn the engine OFF. 2. Install a fuel pressure gauge. 3. Observe the fuel pressure with the engine running. Is the fuel pressure within the specified value?	284 - 325 kPa (41 - 47 psi)	Go to *Step 8*	Go to “Fuel System Diagnosis”
8	Check the fuel for contamination. Is the fuel OK?	–	Go to *Step 9*	Go to *Step 10*
9	Check for a basic engine problem. Is the action complete?	–	Go to *Step 27*	–
10	Replace the contaminated fuel. Is the action complete?	–	Go to *Step 27*	–
11	1. Turn the engine OFF. 2. Disconnect the fuel injector harness connector. 3. Install a spark tester on cylinder #1 spark plug cable. 4. Crank the engine and check for spark. Is spark observed on all four spark plug cables?	–	Go to *Step 12*	Go to *Step 20*
12	Replace the malfunctioning spark plug. Are any malfunctioning?	–	Go to *Step 27*	Go to *Step 13*
13	1. Turn the engine OFF. 2. Disconnect the cylinder 1 fuel injector connector from the injector. 3. Install an injector test light on the injector harness connector, terminal 2. 4. Crank the engine and note the test light. Does the injector test light blink?	–	Go to *Step 14*	Go to *Step 15*
14	Perform the Fuel Injector Balance Test. Is the fuel injector OK?	–	Go to *Step 9*	Go to *Step 16*

DTC P0301 Cylinder 1 Misfire (Cont'd)

Step	Action	Value	Yes	No
15	1. Disconnect the injector test light. 2. With a test light connected to ground, probe the ignition feed terminal 1 of the injector harness connector for the cylinder that had misfired. 3. Crank the engine. Does the test light illuminate?	–	Go to *Step 17*	Go to *Step 19*
16	Replace the malfunctioning fuel injector. Is the action complete?	–	Go to *Step 27*	–
17	Check the affected fuel injector driver circuit for an open, short or short to voltage. Is a problem found?	–	Go to *Step 18*	Go to *Step 24*
18	Repair the open or the shorted fuel injector driver circuit. Is the action complete?	–	Go to *Step 27*	–
19	Repair the open ignition feed circuit between the fuel injector harness connector and the fuel injector connector. Is the action complete?	–	Go to *Step 27*	–
20	Measure the resistance of the spark plug cable. Is the resistance of the spark plug cable less than the specified value?	30,000 :	Go to *Step 21*	Go to *Step 25*
21	Inspect the engine control module (ECM) connector and connections. Are the connections OK?	–	Go to *Step 22*	Go to *Step 23*
22	Check the affected cylinder ignition control circuit for an open or short and repair as necessary. Is a repair necessary?	–	Go to *Step 27*	Go to *Step 26*
23	Repair the connector or connections. Is the action complete?	–	Go to *Step 27*	–
24	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 27*	–
25	Replace the spark plug cable. Is the action complete?	–	Go to *Step 27*	–
26	Replace the faulty ignition coil. Is the action complete?	–	Go to *Step 27*	–
27	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 28*	Go to *Step 2*
28	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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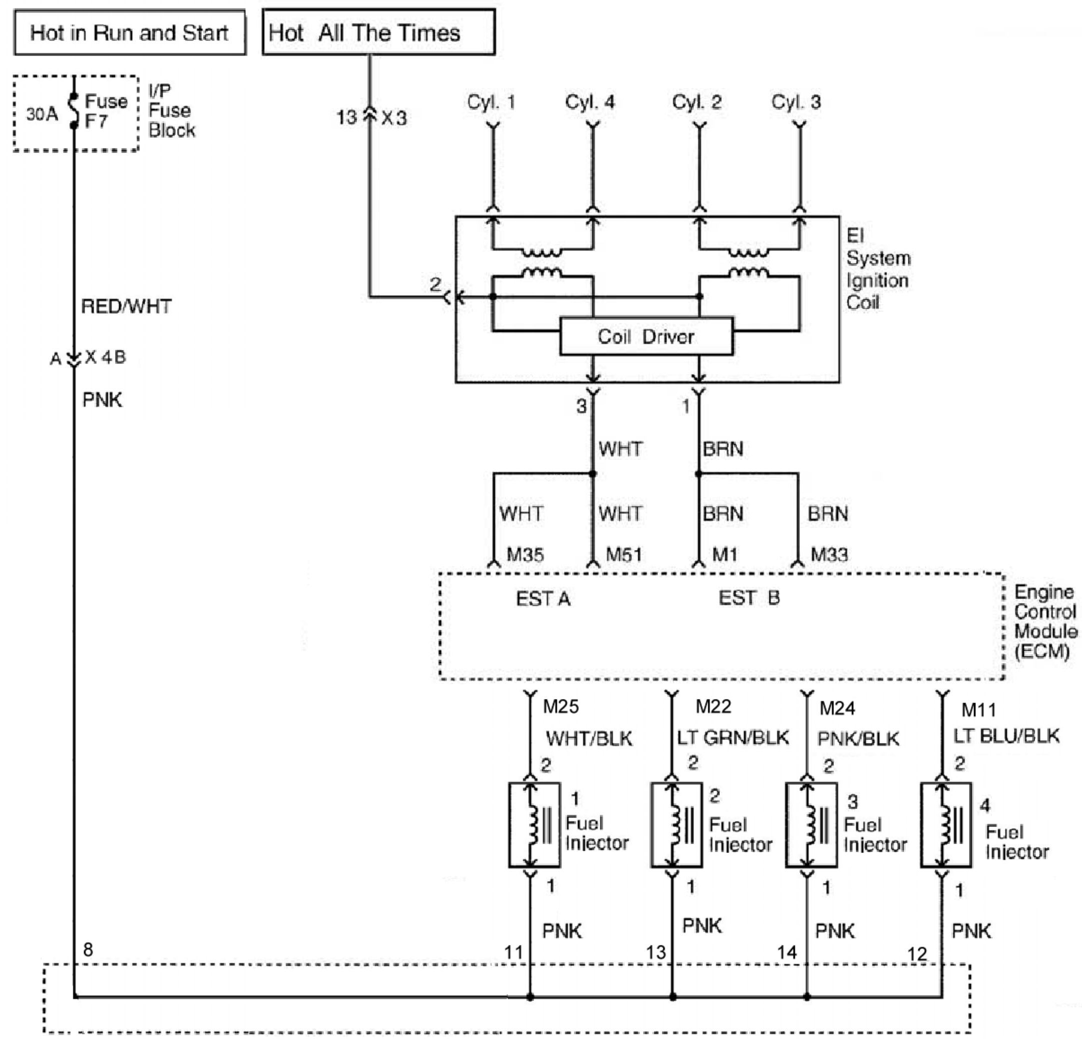

Hot in Run and Start
Hot All The Times
30A
Fuse F7
I/P Fuse Block
13 X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
RED/WHT
A X 4B
PNK
3
1
WHT
BRN
WHT
WHT
BRN
BRN
M35
M51
M1
M33
EST A
EST B
Engine Control Module (ECM)
M25
M22
M24
M11
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
1 Fuel Injector
2 Fuel Injector
3 Fuel Injector
4 Fuel Injector
PNK
PNK
PNK
PNK
8
11
13
14
12

FAA1F220

DIAGNOSTIC TROUBLE CODE (DTC) P0302 CYLINDER 2 MISFIRE

Circuit Description

The engine control module (ECM) monitors the crankshaft and camshaft position to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. This test is executed in blocks of 100 camshaft revolution tests. It may take between one to several tests to store a Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL). Under light misfire conditions, it may also take more than one trip to set a DTC. Severe misfire will flash the MIL indication that catalyst damage is possible. The Torque Converter Clutch is disabled momentarily to determine if the misfire was due to a rough road condition (automatic transaxle only).

Conditions for Setting the DTC

DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0336, P0337, P0341, P0342 and P0502 are not set.

A/C compressor clutch has not just engaged or disengaged.

Engine load and engine speed is in a detectable region and is at or above zero torque.

Camshaft Position (CMP) sensor is in synchronization.

Exhaust Gas Recirculation (EGR) flow diagnostic is not is progress.

Decel Fuel Cut-Off (DFCO) is not active.

An automatic transmission is not shifting.

Crankshaft speed patterns are normal.

Vehicle voltage is between 11 and 16 volts.

Coolant temperature is between –7 °C (19.4 °F) and 120 °C (248 °F).

There is the correct ratio between Crankshaft Position (CKP) sensor pulses and CMP sensor pulses.

1.5L SOHC

Engine run time is greater than and equal to 20 engine cycles (3 second at 800 rpm).

Fuel level is greater than 11% rated tank capacity.

Fuel is not shutoff from high engine speed of 6500 rpm for M/T or 6500 rpm for A/T in drive and 6250 rpm in park for A/T vehicle.

The change of positive throttle position is less than 3.0% / 125 milliseconds and the change of minus throttle position is less than 3.0% / 125 milliseconds.

Have not encountered an abusive engine speed of 7000 rpm.

Engine acceleration rate is less than or equal to 10 consecutive powerstrokes.

Engine deceleration rate is less than or equal to 12 consecutive powerstrokes.

Throttle position is less than 4.0% when the vehicle is greater than 6.2 mph (10 km/h).

Engine speed is between 600 and 4500 rpm.

Engine speed is less than or equal to 1600 rpm or the crank angle sensing error has been learned.

Fuel is not shutoff at 158.4 mph (255 km/h).

Action Taken When the DTC Sets

The MIL will illuminate after two consecutive ignition cycles in which the diagnostic runs with the fault active.

Or

The MIL will illuminate immediately and flash if catalyst damaging level misfire is present.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent can also be the result of a defective reluctor wheel. Remove the CKP sensor and inspect reluctor wheel through sensor mount hole. Check for porosity and condition of wheel. If DTC is intermittent, refer to "Symptoms Diagnosis" in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. A visual/physical inspection should include checking the following components:
   - The wiring for proper connections, pinches or cuts.
   - The ECM grounds for being clean and tight.
   - The vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Information label.
   - Check thoroughly for any type of leak or restriction.
   - Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
5. When all the accumulators are relatively equal, then the misfire is being caused by something that affects the entire engine. When they are not then the misfire is being caused by something that is specific to two or more cylinders.
6. Whenever the misfire is not present operating the vehicle may be necessary to duplicate the conditions in the Freeze Frame Data in order to detect misfire. Depending on the engine load, the conditions may have to be maintained for up to 20 seconds. Whenever the misfire accumulators start to increment, then misfire is present. A history misfire counter will store the number of misfires that have occurred until the DTC is cleared.
8. Check fuel for water, alcohol, etc.
9. A basic engine problem that affects all cylinders is the only possibility at this point. (cam timing, throttle body leak, restricted airflow, etc.)
11. Tests the ignition system voltage output using a spark tester.
12. Replace any spark plugs that are worn, cracked or fouled.
13. Checks for voltage at the ignition feed circuit.
18. Whenever the driver circuit is shorted to ground, the light will be on steady. When the driver circuit is shorted to voltage or open, the light will be off.
19. Since voltage is supplied to the fuel injector on a single circuit, the malfunction could only be a poor connection or open in the fuel injector harness. An open before the harness would result in a "Engine Cranks But Will Not Run" complaint.
27. Before replacing the ECM, check terminals for improper mating, broken locks, or physical damage to the wiring harness. The replacement ECM must be programmed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0302 Cylinder 2 Misfire

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Install a scan tool. Are Diagnostic Trouble Codes (DTCs) P0202 or P0300 set?	–	Go to applicable DTC	Go to *Step 3*
3	1. Perform a visual/physical inspection. 2. Make any repairs that are necessary. Are any repairs necessary?	–	Go to *Step 27*	Go to *Step 4*
4	Start the engine and allow it to idle. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to *Step 6*
5	Are all counters equal (within a percentage of each other)?	–	Go to *Step 7*	Go to *Step 11*
6	1. Turn the ignition ON, engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and conditions for setting this DTC as noted. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to “Diagnostic Aids”
7	1. Turn the engine OFF. 2. Install a fuel pressure gauge. 3. Observe the fuel pressure with the engine running. Is the fuel pressure within the specified value?	284-325 kPa (41-47 psi)	Go to *Step 8*	Go to “Fuel System Diagnosis”
8	Check the fuel for contamination. Is the fuel OK?	–	Go to *Step 9*	Go to *Step 10*
9	Check for a basic engine problem. Is the action complete?	–	Go to *Step 27*	–
10	Replace the contaminated fuel. Is the action complete?	–	Go to *Step 27*	–
11	1. Turn the engine OFF. 2. Disconnect the fuel injector harness connector. 3. Install a spark tester on cylinder #2 spark plug cable. 4. Crank the engine and check for spark. Is spark observed on all four spark plug cables?	–	Go to *Step 12*	Go to *Step 20*
12	Replace the malfunctioning spark plug. Are any malfunctioning?	–	Go to *Step 27*	Go to *Step 13*
13	1. Turn the engine OFF. 2. Disconnect the cylinder 2 fuel injector connector from the injector. 3. Install an injector test light on the injector harness connector, terminal 2 for the cylinder that had misfired. 4. Crank the engine and note the test light. Does the injector test light blink?	–	Go to *Step 14*	Go to *Step 15*
14	Perform the Fuel Injector Balance Test. Is the fuel injector OK?	–	Go to *Step 9*	Go to *Step 16*

DTC P0302 Cylinder 2 Misfire (Cont'd)

Step	Action	Value	Yes	No
15	1. Disconnect the injector test light. 2. With a test light connected to ground, probe the ignition feed terminal 1 of the injector harness connector for the cylinder that had misfired. 3. Crank the engine. Does the test light illuminate?	–	Go to *Step 17*	Go to *Step 19*
16	Replace the malfunctioning fuel injector. Is the action complete?	–	Go to *Step 27*	–
17	Check the affected fuel injector driver circuit for an open, short or short to voltage. Is a problem found?	–	Go to *Step 18*	Go to *Step 24*
18	Repair the open or the shorted fuel injector driver circuit. Is the action complete?	–	Go to *Step 27*	–
19	Repair the open ignition feed circuit between the fuel injector harness connector and the fuel injector connector. Is the action complete?	–	Go to *Step 27*	–
20	Measure the resistance of the spark plug cable. Is the resistance of the spark plug cable less than the specified value?	30,000 :	Go to *Step 21*	Go to *Step 25*
21	Inspect the engine control module (ECM) connector and connections. Are the connections OK?	–	Go to *Step 22*	Go to *Step 23*
22	Check the affected cylinder ignition control circuit for an open or short and repair as necessary. Is a repair necessary?	–	Go to *Step 27*	Go to *Step 26*
23	Repair the connector or connections. Is the action complete?	–	Go to *Step 27*	–
24	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 27*	–
25	Replace the spark plug cable. Is the action complete?	–	Go to *Step 27*	–
26	Replace the faulty ignition coil. Is the action complete?	–	Go to *Step 27*	–
27	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 28*	Go to *Step 2*
28	Check if any additional DTCs are set. Are any DTCs displayed that have not been diag-nosed?	–	Go to applicable DTC table	System OK

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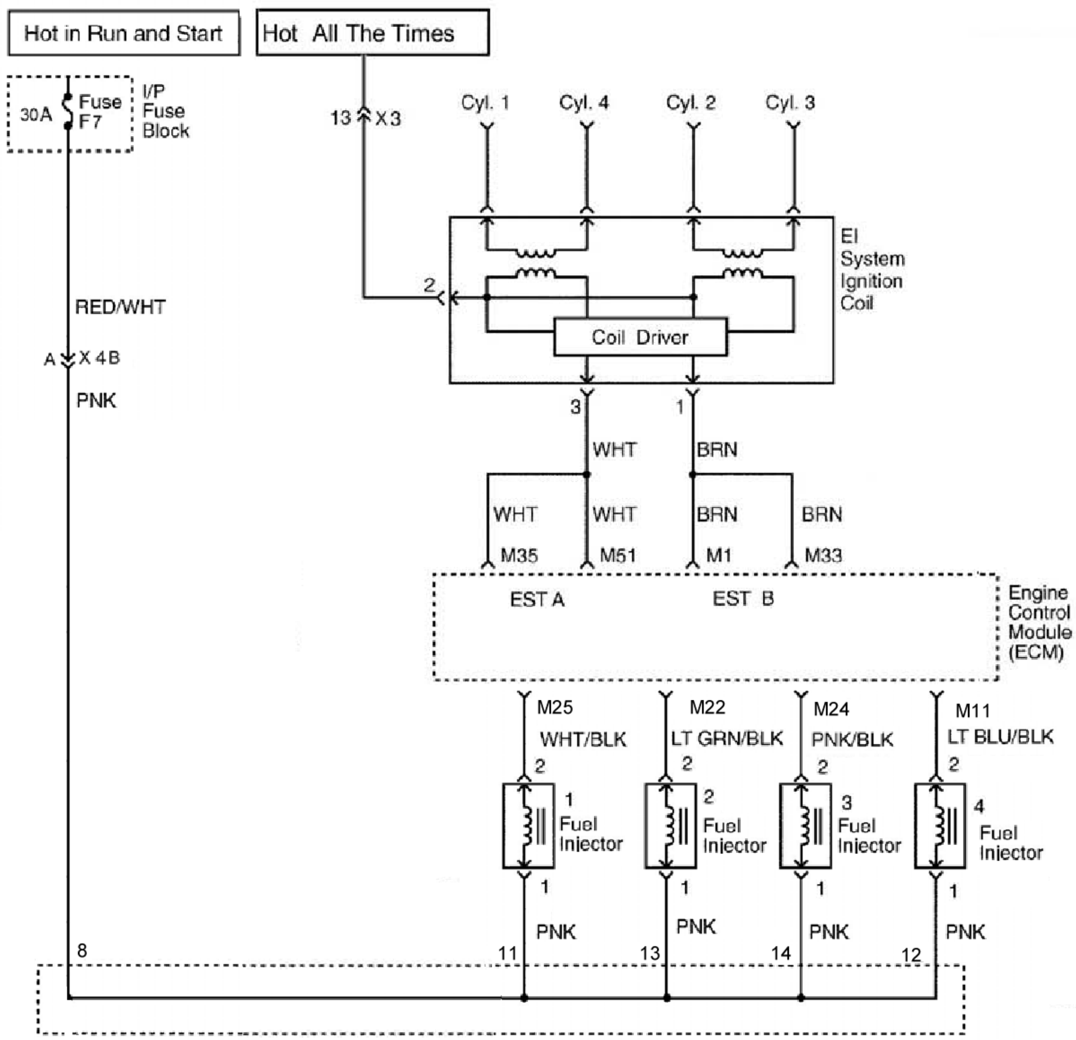

Hot in Run and Start
Hot All The Times
30A
Fuse F7
I/P Fuse Block
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
3
1
WHT
BRN
RED/WHT
A
X 4B
PNK
WHT
WHT
BRN
BRN
M35
M51
M1
M33
EST A
EST B
Engine Control Module (ECM)
M25
M22
M24
M11
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
2
1 Fuel Injector
2 Fuel Injector
3 Fuel Injector
4 Fuel Injector
1
PNK
8
11
13
14
12

FAA1F220

DIAGNOSTIC TROUBLE CODE (DTC) P0303 CYLINDER 3 MISFIRE

Circuit Description

The engine control module (ECM) monitors the crankshaft and camshaft position to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. This test is executed in blocks of 100 camshaft revolution tests. It may take between one to several tests to store a Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL). Under light misfire conditions, it may also take more than one trip to set a DTC. Severe misfire will flash the MIL indication that catalyst damage is possible. The Torque Converter Clutch is disabled momentarily to determine if the misfire was due to a rough road condition (automatic transaxle only).

Conditions for Setting the DTC

- DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0336, P0337, P0341, P0342 and P0502 are not set.
- A/C compressor clutch has not just engaged or disengaged.
- Engine load and engine speed is in a detectable region and is at or above zero torque.
- Camshaft Position (CMP) sensor is in synchronization.
- Exhaust Gas Recirculation (EGR) flow diagnostic is not is progress.
- Decel Fuel Cut-Off (DFCO) is not active.
- An automatic transmission is not shifting.
- Crankshaft speed patterns are normal.
- Vehicle voltage is between 11 and 16 volts.
- Coolant temperature is between –7 °C (19.4 °F) and 120 °C (248 °F).
- There is the correct ratio between Crankshaft Position (CKP) sensor pulses and CMP sensor pulses.

1.5L SOHC

- Engine run time is greater than and equal to 20 engine cycles (3 second at 800 rpm).
- Fuel level is greater than 11% rated tank capacity.
- Fuel is not shutoff from high engine speed of 6500 rpm for M/T or 6500 rpm for A/T in drive and 6250 rpm in park for A/T vehicle.
- The change of positive throttle position is less than 3.0% / 125 milliseconds and the change of minus throttle position is less than 3.0% / 125 milliseconds.
- Have not encountered an abusive engine speed of 7000 rpm.
- Engine acceleration rate is less than or equal to 10 consecutive powerstrokes.
- Engine deceleration rate is less than or equal to 12 consecutive powerstrokes.
- Throttle position is less than 4.0% when the vehicle is greater than 6.2 mph (10 km/h).
- Engine speed is between 600 and 4500 rpm.
- Engine speed is less than or equal to 1600 rpm or the crank angle sensing error has been learned.
- Fuel is not shutoff at 158.4 mph (255 km/h).

Action Taken When the DTC Sets

- The MIL will illuminate after two consecutive ignition cycles in which the diagnostic runs with the fault active.

Or

- The MIL will illuminate immediately and flash if catalyst damaging level misfire is present.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent can also be the result of a defective reluctor wheel. Remove the CKP sensor and inspect reluctor wheel through sensor mount hole. Check for porosity and condition of wheel. If DTC is intermittent, refer to “Symptoms Diagnosis” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. A visual/physical inspection should include checking the following components:
   - The wiring for proper connections, pinches or cuts.
   - The ECM grounds for being clean and tight.
   - The vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Information label.
   - Check thoroughly for any type of leak or restriction.
   - Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
5. When all the accumulators are relatively equal, then the misfire is being caused by something that affects the entire engine. When they are not, then the misfire is being caused by something that is specific to two or more cylinders.
6. Whenever the misfire is not present operating the vehicle may be necessary to duplicate the conditions in the Freeze Frame Data in order to detect misfire. Depending on the engine load, the conditions may have to be maintained for up to 20 seconds. Whenever the misfire accumulators start to increment, then misfire is present. A history misfire counter will store the number of misfires that have occurred until the DTC is cleared.
8. Check fuel for water, alcohol, etc.
9. A basic engine problem that affects all cylinders is the only possibility at this point. (Cam timing, throttle body leak, restricted airflow, etc.)
11. Tests the ignition system voltage output using a spark tester.
12. Replace any spark plugs that are worn, cracked or fouled.
13. Checks for voltage at the ignition feed circuit.
18. Whenever the driver circuit is shorted to ground, the light will be on steady. When the driver circuit is shorted to voltage or open, the light will be off.
19. Since voltage is supplied to the fuel injector on a single circuit, the malfunction could only be a poor connection or open in the fuel injector harness. An open before the harness would result in a “Engine Cranks But Will Not Run” complaint.
27. Before replacing the ECM, check terminals for improper mating, broken locks, or physical damage to the wiring harness. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0303 Cylinder 3 Misfire

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Install a scan tool. Are Diagnostic Trouble Codes (DTCs) P0203 or P0300 set?	–	Go to applicable DTC	Go to *Step 3*
3	1. Perform a visual/physical inspection. 2. Make any repairs that are necessary. Are any repairs necessary?	–	Go to *Step 27*	Go to *Step 4*
4	Start the engine and allow it to idle. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to *Step 6*
5	Are all counters equal (within a percentage of each other)?	–	Go to *Step 7*	Go to *Step 11*
6	1. Turn the ignition ON, engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and conditions for setting this DTC as noted. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to "Diagnostic Aids"
7	1. Turn the engine OFF. 2. Install a fuel pressure gauge. 3. Observe the fuel pressure with the engine running. Is the fuel pressure within the specified value?	284-325 kPa (41-47 psi)	Go to *Step 8*	Go to "Fuel System Diagnosis"
8	Check the fuel for contamination. Is the fuel OK?	–	Go to *Step 9*	Go to *Step 10*
9	Check for a basic engine problem. Is the action complete?	–	Go to *Step 27*	–
10	Replace the contaminated fuel. Is the action complete?	–	Go to *Step 27*	–
11	1. Turn the engine OFF. 2. Disconnect the fuel injector harness connector. 3. Install a spark tester on cylinder #3 spark plug cable. 4. Crank the engine and check for spark. Is spark observed on all four spark plug cables?	–	Go to *Step 12*	Go to *Step 20*
12	Replace the malfunctioning spark plug. Are any malfunctioning?	–	Go to *Step 27*	Go to *Step 13*
13	1. Turn the engine OFF. 2. Disconnect the cylinder 3 fuel injector connector from the injector. 3. Install an injector test light on the injector harness connector, terminal 2 for the cylinder that had misfired. 4. Crank the engine and note the test light. Does the injector test light blink?	–	Go to *Step 14*	Go to *Step 15*
14	Perform the Fuel Injector Balance Test. Is the fuel injector OK?	–	Go to *Step 9*	Go to *Step 16*

DTC P0303 Cylinder 3 Misfire (Cont'd)

Step	Action	Value	Yes	No
15	1. Disconnect the injector test light. 2. With a test light connected to ground, probe the ignition feed terminal 1 of the injector harness connector for the cylinder that had misfired. 3. Crank the engine. Does the test light illuminate?	–	Go to *Step 17*	Go to *Step 19*
16	Replace the malfunctioning fuel injector. Is the action complete?	–	Go to *Step 27*	–
17	Check the affected fuel injector driver circuit for an open, short or short to voltage. Is a problem found?	–	Go to *Step 18*	Go to *Step 24*
18	Repair the open or the shorted fuel injector driver circuit. Is the action complete?	–	Go to *Step 27*	–
19	Repair the open ignition feed circuit between the fuel injector harness connector and the fuel injector connector. Is the action complete?	–	Go to *Step 27*	–
20	Measure the resistance of the spark plug cable. Is the resistance of the spark plug cable less than the specified value?	30,000 :	Go to *Step 21*	Go to *Step 25*
21	Inspect the engine control module (ECM) connector and connections. Are the connections OK?	–	Go to *Step 22*	Go to *Step 23*
22	Check the affected cylinder ignition control circuit for an open or short and repair as necessary. Is a repair necessary?	–	Go to *Step 27*	Go to *Step 26*
23	Repair the connector or connections. Is the action complete?	–	Go to *Step 27*	–
24	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 27*	–
25	Replace the spark plug cable. Is the action complete?	–	Go to *Step 27*	–
26	Replace the faulty ignition coil. Is the action complete?	–	Go to *Step 27*	–
27	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 28*	Go to *Step 2*
28	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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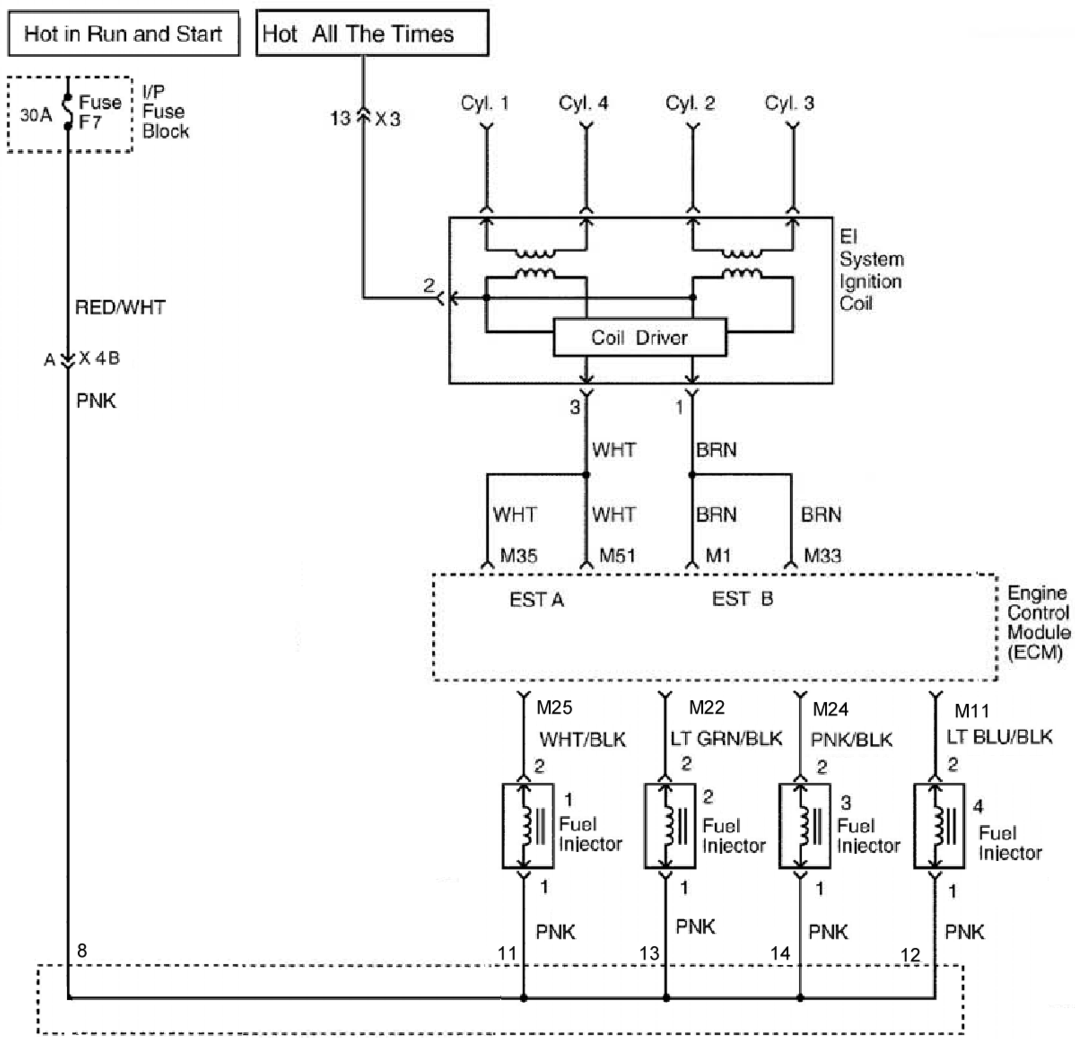

Hot in Run and Start
Hot All The Times
30A
Fuse F7
I/P Fuse Block
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
RED/WHT
A
X 4B
PNK
3
1
WHT
BRN
WHT
WHT
BRN
BRN
M35
M51
M1
M33
EST A
EST B
Engine Control Module (ECM)
M25
M22
M24
M11
WHT/BLK
LT GRN/BLK
PNK/BLK
LT BLU/BLK
2
1 Fuel Injector
2 Fuel Injector
3 Fuel Injector
4 Fuel Injector
1
PNK
8
11
13
14
12

FAA1F220

DIAGNOSTIC TROUBLE CODE (DTC) P0304 CYLINDER 4 MISFIRE

Circuit Description

The engine control module (ECM) monitors the crankshaft and camshaft position to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. This test is executed in blocks of 100 camshaft revolution tests. It may take between one to several tests to store a Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL). Under light misfire conditions, it may also take more than one trip to set a DTC. Severe misfire will flash the MIL indication that catalyst damage is possible. The Torque Converter Clutch is disabled momentarily to determine if the misfire was due to a rough road condition (automatic transaxle only).

Conditions for Setting the DTC

- DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0336, P0337, P0341, P0342 and P0502 are not set.
- A/C compressor clutch has not just engaged or disengaged.
- Engine load and engine speed is in a detectable region and is at or above zero torque.
- Camshaft Position (CMP) sensor is in synchronization.
- Exhaust Gas Recirculation (EGR) flow diagnostic is not is progress.
- Decel Fuel Cut-Off (DFCO) is not active.
- An automatic transmission is not shifting.
- Crankshaft speed patterns are normal.
- Vehicle voltage is between 11 and 16 volts.
- Coolant temperature is between –7 °C (19.4 °F) and 120 °C (248 °F).
- There is the correct ratio between Crankshaft Position (CKP) sensor pulses and CMP sensor pulses.

1.5L SOHC

- Engine run time is greater than and equal to 20 engine cycles (3 second at 800 rpm).
- Fuel level is greater than 11% rated tank capacity.
- Fuel is not shutoff from high engine speed of 6500 rpm for M/T or 6500 rpm for A/T in drive and 6250 rpm in park for A/T vehicle.
- The change of positive throttle position is less than 3.0% / 125 milliseconds and the change of minus throttle position is less than 3.0% / 125 milliseconds.
- Have not encountered an abusive engine speed of 7000 rpm.
- Engine acceleration rate is less than or equal to 10 consecutive powerstrokes.
- Engine deceleration rate is less than or equal to 12 consecutive powerstrokes.
- Throttle position is less than 4.0% when the vehicle is greater than 6.2 mph (10 km/h).
- Engine speed is between 600 and 4500 rpm.
- Engine speed is less than or equal to 1600 rpm or the crank angle sensing error has been learned.
- Fuel is not shutoff at 158.4 mph (255 km/h).

Action Taken When the DTC Sets

- The MIL will illuminate after two consecutive ignition cycles in which the diagnostic runs with the fault active.

Or

- The MIL will illuminate immediately and flash if catalyst damaging level misfire is present (automatic only).
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent can also be the result of a defective reluctor wheel. Remove the CKP sensor and inspect reluctor wheel through sensor mount hole. Check for porosity and condition of wheel. If DTC is intermittent, refer to “Symptoms Diagnosis” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. A visual/physical inspection should include checking the following components:
   - The wiring for proper connections, pinches or cuts.
   - The ECM grounds for being clean and tight.
   - The vacuum hoses for splits, kinks, and proper connections as shown on the Vehicle Emission Information label.
   - Check thoroughly for any type of leak or restriction.
   - Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
5. When all the accumulators are relatively equal, then the misfire is being caused by something that affects the entire engine. When they are not then the misfire is being caused by something that is specific to two or more cylinders.
6. Whenever the misfire is not present operating the vehicle may be necessary to duplicate the conditions in the Freeze Frame Data in order to detect misfire. Depending on the engine load, the conditions may have to be maintained for up to 20 seconds. Whenever the misfire accumulators start to increment, then misfire is present. A history misfire counter will store the number of misfires that have occurred until the DTC is cleared.
8. Check the fuel for water, alcohol, etc.
9. A basic engine problem that affects all cylinders is the only possibility at this point. (Cam timing, throttle body leak, restricted airflow, etc.)
11. Tests the ignition system voltage output using a spark tester.
12. Replace any spark plugs that are worn, cracked or fouled.
13. Checks for voltage at the ignition feed circuit.
18. Whenever the driver circuit is shorted to ground, the light will be on steady. When the driver circuit is shorted to voltage or open, the light will be off.
19. Since voltage is supplied to the fuel injector on a single circuit, the malfunction could only be a poor connection or open in the fuel injector harness. An open before the harness would result in a “Engine Cranks But Will Not Run” complaint.
27. Before replacing the ECM, check terminals for improper mating, broken locks, or physical damage to the wiring harness. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0304 Cylinder 4 Misfire

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	Install a scan tool. Are Diagnostic Trouble Codes (DTCs) P0204 or P0300 set?	–	Go to applicable DTC	Go to *Step 3*
3	1. Perform a visual/physical inspection. 2. Make any repairs that are necessary. Are any repairs necessary?	–	Go to *Step 27*	Go to *Step 4*
4	Start the engine and allow it to idle. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to *Step 6*
5	Are all counters equal (within a percentage of each other)?	–	Go to *Step 7*	Go to *Step 11*
6	1. Turn the ignition ON, engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and conditions for setting this DTC as noted. Are any Misfire Current counters incrementing?	–	Go to *Step 5*	Go to “Diagnostic Aids”
7	1. Turn the engine OFF. 2. Install a fuel pressure gauge. 3. Observe the fuel pressure with the engine running. Is the fuel pressure within the specified value?	284-325 kPa (41-47 psi)	Go to *Step 8*	Go to “Fuel System Diagnosis”
8	Check the fuel for contamination. Is the fuel OK?	–	Go to *Step 9*	Go to *Step 10*
9	Check for a basic engine problem. Is the action complete?	–	Go to *Step 27*	–
10	Replace the contaminated fuel. Is the action complete?	–	Go to *Step 27*	–
11	1. Turn the engine OFF. 2. Disconnect the fuel injector harness connector. 3. Install a spark tester on cylinder #4 spark plug cable. 4. Crank the engine and check for spark. Is spark observed on all four spark plug cables?	–	Go to *Step 12*	Go to *Step 20*
12	Replace the malfunctioning spark plug. Are any malfunctioning?	–	Go to *Step 27*	Go to *Step 13*
13	1. Turn the engine OFF. 2. Disconnect the cylinder 4 fuel injector connector from the injector. 3. Install an injector test light on the injector harness connector, terminal 2 for the cylinder that had misfired. 4. Crank the engine and note the test light. Does the injector test light blink?	–	Go to *Step 14*	Go to *Step 15*
14	Perform the Fuel Injector Balance Test. Is the fuel injector OK?	–	Go to *Step 9*	Go to *Step 16*

DTC P0304 Cylinder 4 Misfire (Cont'd)

Step	Action	Value	Yes	No
15	1. Disconnect the injector test light. 2. With a test light connected to ground, probe the ignition feed terminal 1 of the injector harness connector for the cylinder that had misfired. 3. Crank the engine. Does the test light illuminate?	–	Go to *Step 17*	Go to *Step 19*
16	Replace the malfunctioning fuel injector. Is the action complete?	–	Go to *Step 27*	–
17	Check the affected fuel injector driver circuit for an open, short or short to voltage. Is a problem found?	–	Go to *Step 18*	Go to *Step 24*
18	Repair the open or the shorted fuel injector driver circuit. Is the action complete?	–	Go to *Step 27*	–
19	Repair the open ignition feed circuit between the fuel injector harness connector and the fuel injector connector. Is the action complete?	–	Go to *Step 27*	–
20	Measure the resistance of the spark plug cable. Is the resistance of the spark plug cable less than the specified value?	30,000 :	Go to *Step 21*	Go to *Step 25*
21	Inspect the engine control module (ECM) connector and connections. Are the connections OK?	–	Go to *Step 22*	Go to *Step 23*
22	Check the affected cylinder ignition control circuit for an open or short and repair as necessary. Is a repair necessary?	–	Go to *Step 27*	Go to *Step 26*
23	Repair the connector or connections. Is the action complete?	–	Go to *Step 27*	–
24	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 27*	–
25	Replace the spark plug cable. Is the action complete?	–	Go to *Step 27*	–
26	Replace the faulty ignition coil. Is the action complete?	–	Go to *Step 27*	–
27	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 28*	Go to *Step 2*
28	Check if any additional DTCs are set. Are any DTCs displayed that have not been diag-nosed?	–	Go to applicable DTC table	System OK

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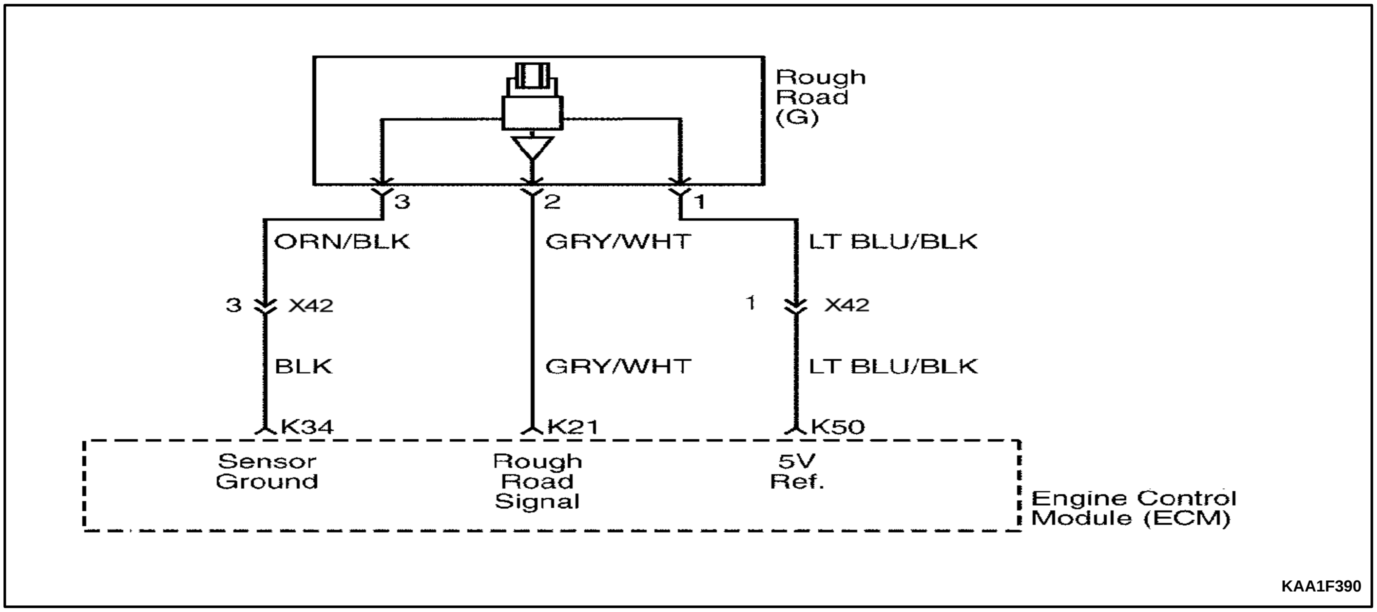

DIAGNOSTIC TROUBLE CODE (DTC) P0317
ROUGH ROAD SENSOR SOURCE NOT DETECTED (1.5L SOHC)

Circuit Description

The Engine Control Module (ECM) identifies engine misfire by detecting variations in crankshaft speed. Crankshaft speed variations can also occur when a vehicle is operating over a rough road. The ECM receives rough road signal by gravity sensing rough road (G) sensor or Electronic Brake Control Module (EBCM) if equipped with the Anti-Lock Brake System (ABS). The ABS can detect if the vehicle is on the rough surface based on wheel acceleration/deceleration data supplied by each wheel speed sensor. This information sent to the ECM by EBCM through Pulse Width Modulation (PWM) serial data line. The G sensor is vertical low g–acceleration sensor. By sensing vertical acceleration caused by bumps or portholes in the road, the ECM determine if the changes in crankshaft speed are due to engine misfire or are driveline induced. If the ECM can not receive any of those signal, a historic Diagnostic Trouble Code (DTC) will be stored.

Conditions for Setting the DTC

ECM cannot detect any rough road source.

Engine run time is greater than or equal to 10 seconds.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will not illuminate.

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

A history DTC will clear after 40 consecutive warm-up cycles without a fault.

The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An open signal circuit of G sensor or open PWM serial data line between the ECM and the EBCM will be the cause of this DTC.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0317 – Rough Road Sensor Source Not Detected (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool to the Data Link Connector (DLC). 2. Turn the ignition ON, with the engine OFF. 3. Request Diagnostic Trouble Codes (DTCs) Are DTCs P1380, P1381, P1391, P1392 or P1393 set?	–	Go to applicable DTC table	Go to *Step 3*
3	Is the vehicle equipped with the Anti-lock Brake System (ABS)?	–	Go to *Step 8*	Go to *Step 4*
4	1. Disconnect the gravity sensing rough road (G) sensor connector. 2. Disconnect the Engine control Module (ECM) connector. 3. Measure resistance between G sensor connector terminal 2 and Engine Control Module (ECM) connector terminal K21. Is the resistance near the specified value?	0 :	Go to *Step 6*	Go to *Step 5*
5	Check for an open or short in the wiring between G sensor connector terminal 2 and ECM connector terminal K21 and repair as necessary. Is the repair complete?	–	Go to *Step 11*	–
6	1. Reconnect the ECM and G sensor connectors. 2. Turn the ignition ON. 3. Probe the voltage at terminal 2 of G sensor. Is the voltage within the specified value?	2.35–2.65 v	Go to *Step 10*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Replace the G sensor. Is the repair complete?	–	Go to *Step 11*	–
8	1. Turn the ignition OFF. 2. Disconnect the Electronic Brake Control Module (EBCM) connector and the ECM connector. 3. Measure the resistance between EBCM connector terminal 24 and ECM connector terminal M53. Is the resistance near the specified value?	0 :	Go to *Step 10*	Go to *Step 9*
9	Check for an open or short in the wiring between EBCM connector terminal 24 and ECM connector terminal M53 and repair as necessary. Is the repair complete?	–	Go to *Step 11*	–
10	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 11*	–
11	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 12*	Go to *Step 2*

DTC P0317 – Rough Road Sensor Source Not Detected (1.5L SOHC) (Cont'd)

Step	Action	Value	Yes	No
12	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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DIAGNOSTIC TROUBLE CODE (DTC) P0325 KNOCK SENSOR INTERNAL MALFUNCTION

System Description

The Knock Sensor (KS) system is used to detect engine detonation, allowing the engine control module (ECM) to retard ignition control spark timing based on the KS signal being received. The KS produces an AC signal so that under a no knock condition the signal on the KS circuit measures about 0.007 v AC. The KS 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 KS 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, a DTC P0325 will set.

Conditions for Setting the DTC

1.5L SOHC

Minimum difference between cylinders is greater than 0.4%.

Vacuum is less than 10 to 50 kPa, based on rpm.

RPM is greater than 1600.

Engine Coolant Temperature (ECT) is greater than 50 C(122 F).

Action Taken When the DTC Sets

The MIL will illuminate after three consecutive trip with a fail (1.5L SOHC).

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after four consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed (1.5L SOHC).

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check and correct any abnormal engine noise before using the diagnostic table.

Any circuitry that is suspected as causing the complaint should be thoroughly checked for the following conditions:

Backed-out terminals

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal-to-wire connection

Physical damage to the wiring harness

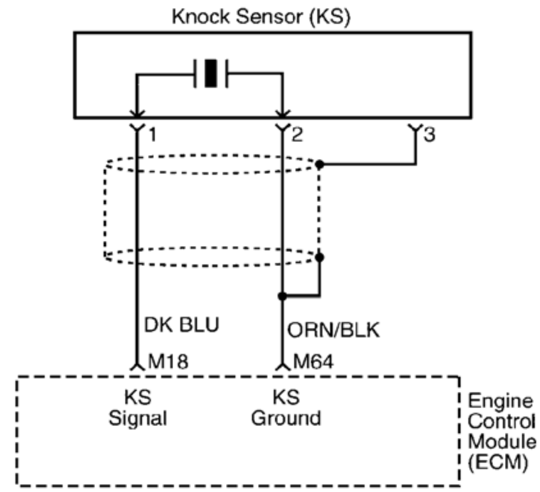
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. If the conditions for the test as described above are met, a DTC P0325 will set.
4. If the engine has an internal knock or audible noise that causes a knocking type noise on the engine block, the KS may be responding to the noise.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0325 Knock Sensor Internal Malfunction

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Start the engine. 2. Install a scan tool. 3. Clear the Diagnostic Trouble Codes (DTCs). 4. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is DTC P0325 set?	–	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is DTC P0325 set?	–	Go to *Step 4*	Go to *Step 7*
4	Listen to the engine while raising and lowering the engine speed. Is a knock or audible noise present?	–	Go to *Step 5*	Go to *Step 6*
5	Repair the mechanical engine problem or a loose bracket or component. Is the action complete?	–	Go to *Step 7*	–
6	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0327
KNOCK SENSOR CIRCUIT FAULT

System Description

The Knock Sensor (KS) system is used to detect engine detonation, allowing the engine control module (ECM) to retard ignition control spark timing based on the KS signal being received. The KS produces an A/C signal so that under a no knock condition the signal on the KS circuit measures about 0.007 volts A/C. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM monitors the KS signal and can diagnose the KS sensor and circuitry.

Conditions for Setting the DTC

1.5L SOHC

- Average reading is less than 1% or greater than 80% for any of the 4 cyliner.
- Vacoom is less than 10 to 50 kPa based on rpm.
- RPM is greater than 1600.
- The coolant temperature is greater than 50 °C (122 °F).

Action Taken When the DTC Sets

- The MIL will illuminate after three consecutive trip with fail (1.5L SOHC).
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history Diagnostic Trouble Code (DTC) is stored.
- The ECM will use a calculated spark retard value to minimize knock during conditions when knock is likely to occur. The calculated value will vary based on engine speed and load.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after four consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed (1.5L SOHC).
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check and correct any abnormal engine noise before using the diagnostic table.

Any circuitry, that is suspected as causing the complaint, should be thoroughly checked for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals

Poor terminal-to-wire connection

Physical damage to the wiring harness

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. If the conditions for the test as described above are met, a DTC P0327 will set.
4. If the engine has an internal knock or audible noise that causes a knocking type noise on the engine block, the KS may be responding to the noise.
6. Checking the internal resistance of the KS or the wiring to the KS is OK.
7. Any circuitry, that is suspected as causing the complaint, should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.
8. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0327 Knock Sensor Circuit Fault

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Start the engine. 2. Install a scan tool. 3. Clear the Diagnostic Trouble Codes (DTCs). 4. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is DTC P0327 set?	–	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition switch ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting The DTC as noted. Is DTC P0327 set?	–	Go to *Step 4*	Go to *Step 12*
4	Listen to the engine while raising and lowering the engine speed. Is a knock or audible noise present?	–	Go to *Step 5*	Go to *Step 6*
5	Repair the mechanical engine problem or a loose bracket or component. Is the action complete?	–	Go to *Step 12*	–
6	1. Turn the ignition switch OFF. 2. Disconnect the engine control module (ECM) connectors at the ECM. 3. With a Digital Voltmeter (DVM) connected to ground, measure the resistance of the knock sensor through the knock sensor signal circuit, terminal M18. Is the measured value within the specified value?	4.6-4.8 M :	Go to *Step 7*	Go to *Step 9*

DTC P0327 Knock Sensor Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
7	Check for a poor connection at the ECM connector, Knock Sensor (KS) signal circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 8*
8	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 12*	–
9	Check the KS electrical connector for a poor connection and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 10*
10	Check the KS signal circuit for an open or a short to ground or voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 12*	Go to *Step 11*
11	1. Turn the ignition switch OFF. 2. Replace the KS. Is the action complete?	–	Go to *Step 12*	–
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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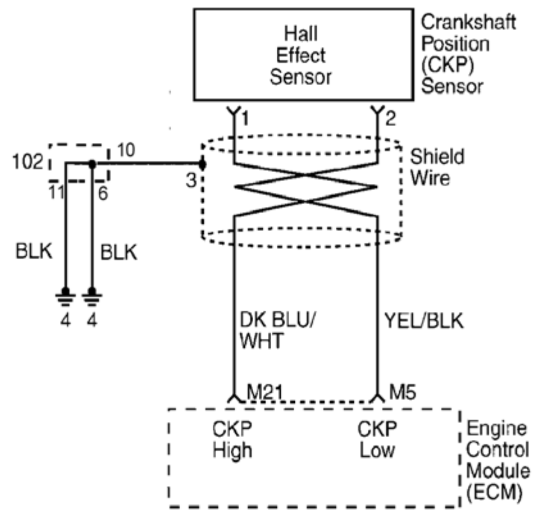

DIAGNOSTIC TROUBLE CODE (DTC) P0336
58X CRANKSHAFT POSITION (CKP) SENSOR EXTRA/MISSING PULSES

Circuit Description

The 58X reference signal is produced by the Crankshaft Position (CKP) sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The engine control module (ECM) uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, DTC P0336 will set.

Conditions for Setting the DTC

Engine is running.

Extra or missing pulses is detected between consecutive 58X reference pulses.

The number of extra or missing teeth are greater than or equal to 2 per revolution.

Above condition is detected in 10 of 100 crankshaft rotations.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL off on the third (fourth –1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

Poor connection – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, disconnect the ECM, turn the ignition ON and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving the connectors and the wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure re-

cords data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0336 58X Crankshaft Position (CKP) Sensor Extra/Missing Pulses

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Attempt to start the engine. Does the engine start?	–	Go to *Step 3*	Refer to "Engine Cranks But Will Not Run"
3	1. Review and record Failure Records information. 2. Clear DTC P0336. 3. Start the engine and idle for 1 minute. 4. Observe the Diagnostic Trouble Codes (DTCs). Is DTC P0336 set?	–	Go to *Step 4*	Refer to "Diagnostic Aids"
4	1. Disconnect the engine control module (ECM) and the Crankshaft Position (CKP) sensor. 2. Check for an open or a short to ground in the 58X high circuit between the CKP sensor connector and the ECM harness connector. Is a problem found?	–	Go to *Step 5*	Go to *Step 6*
5	Repair the open or short to ground in the 58X high circuit between the CKP sensor connector and the ECM harness connector. Is the repair complete?	–	Go to *Step 11*	–
6	1. Reconnect the ECM and CKP sensor. 2. Connect a digital voltmeter (DVM) to measure voltage on the 58X high circuit, terminal M21 at the ECM connector. 3. Observe the voltage while cranking the engine. Does the voltage fluctuate between the specified value?	2.4 – 2.7 v	Go to *Step 9*	Go to *Step 7*
7	Check the connections at the CKP sensor and replace the terminals if necessary. Do any terminals require replacement?	–	Go to *Step 11*	Go to *Step 8*
8	1. Turn the ignition switch OFF. 2. Replace the CKP sensor. Is the action complete?	–	Go to *Step 11*	–
9	Check the connections at the ECM and replace the terminals if necessary. Do any terminals require replacement?	–	Go to *Step 11*	Go to *Step 10*
10	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 11*	–

DTC P0336 58X Crankshaft Position (CKP) Sensor Extra/Missing Pulses (Cont'd)

Step	Action	Value	Yes	No
11	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 12*	Go to *Step 2*
12	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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DIAGNOSTIC TROUBLE CODE (DTC) P1336 58X CRANKSHAFT POSITION (CKP) SENSOR TOOTH ERROR NOT LEARNED

System Description

In order to detect engine misfire at higher engine speeds, the engine control module (ECM) must know of any variation between the crankshaft sensor pulses. Most variations are due to the machining of the crankshaft reluctor wheel. However, other sources of variation are also possible. A Crankshaft Position (CKP) system variation learning procedure must be performed any time a change is made to the crankshaft sensor to crankshaft relationship of if the ECM is replaced or reprogrammed. The ECM measures the variations and then calculates compensation factors needed to enable the ECM to accurately detect engine misfire at all speeds and loads. A scan tool must be used to command the ECM to learn these variations. If for any reason the ECM is unable to learn these variations or they are out of an acceptable range, the ECM will set a DTC P1336. A ECM that has not had the CKP system variation learning procedure performed due to replacement or reprogramming will also set a DTC P1336.

Conditions for Setting the DTC

1.5L SOHC

DTCs P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0132, P0201, P0202, P0203, P0204, P0336, P0337, P0341, P0342, P0351, P0352, P0402, P1404, P0405, P0406, and P0502 are not set.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffer.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn OFF after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTCs can be cleared by using the scan tool.

Diagnostic Aids

Caution: To avoid personal injury when performing the crankshaft position system variation learning procedure always set the vehicle parking brake and block the drive wheels. Release the throttle immediately when the engine starts to decelerate. Once the learn procedure is completed, engine control will be returned to the operator and the engine will respond to throttle position.

DTC P1336 will only set if the ECM has not learned the CKP system variation. The ECM only needs to learn this variation once per life cycle of the vehicle unless the crank sensor to crankshaft relationship is disturbed. Removing a part is considered a disturbance. A fully warmed up engine is critical to learning the variation correctly. If a valid learn occurs, no other learns can be completed that ignition cycle.

If the engine cuts out before the specified learn procedure engine speed or at normal fuel cutoff rpm, the ECM is not in the learn procedure mode.

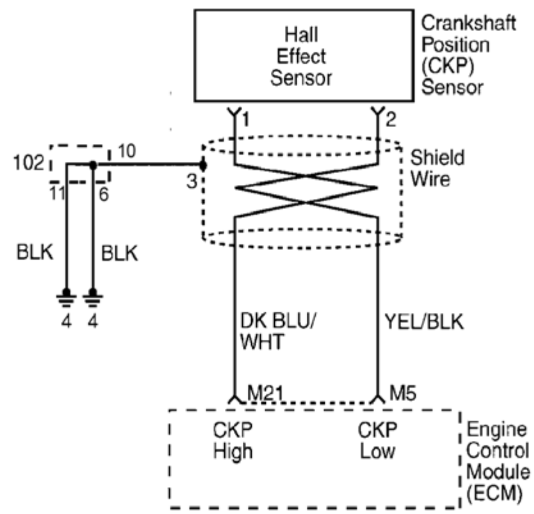
Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored on the scan tool for later reference.
2. Engine temperature is critical to properly learn the CKP system variation. Failure to properly warm the engine before performing this procedure will result in an inaccurate measurement of the CKP system variation. The ECM learns this variation as the engine is decelerating and then allows engine control to be returned to the operator. All accessories must be OFF when learning the CKP system angle variation. If the A/C is not disabled when the learn procedure is enabled, the ECM will disable the A/C.
3. If after the specified number attempts the ECM cannot learn the CKP system variation, then the variation is too large and no further attempts should be made until the variation problem is corrected.
4. Being unable to learn the procedure indicates that the variation is out of range.
5. After the CKP system variation has been learned, wait above 10 seconds with ignition switch OFF to prevent being cleared the learned value (1.5L SOHC).

DTC P1336 – 58X Crankshaft Position (CKP) Sensor Tooth Error Not Learned

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install the scan tool. 2. Put the vehicle in PARK or NEUTRAL. 3. Run the engine until it is above the specified temperature. 4. Set the vehicle parking brake and block the wheels. 5. Turn all accessories OFF. 6. Enable the TEC (Tooth Error Correction) LEARN PROCEDURE with the scan tool. 7. Raise the engine rpm to the specified value, then release the throttle as soon as the engine cuts out. Does the scan tool indicate that the Crankshaft Position (CKP) system variation has been learned?	65 C (149 F) 4000 rpm	Go to *Step 5*	Go to *Step 3*
3	Attempt the CKP system variation procedure as many times as the specified value. Does the scan tool indicate that the CKP system variation has been learned?	10	Go to *Step 5*	Go to *Step 4*
4	Check for a problem with the crankshaft sensor to crankshaft relationship. Is a repair necessary?	–	Go to *Step 5*	–
5	1. Turn the ignition OFF and wait above specified value. 2. Turn the ignition ON, with engine OFF. 3. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 4. Start the engine and idle at normal operating temperature. 5. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	10 seconds	Go to *Step 6*	Go to *Step 2*
6	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



TAA1F310

DIAGNOSTIC TROUBLE CODE (DTC) P0337
58X CRANKSHAFT POSITION (CKP) SENSOR NO SIGNAL

Circuit Description

The 58X reference signal is produced by the Crankshaft Position (CKP) sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The engine control module (ECM) uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, DTC P0337 will set.

Conditions for Setting the DTC

Engine cranking.

No CMP sensor DTCs are set (P0341 and P0342).

1.5L SOHC

The change of voltage drop is greater than 0.5 volt and the change of Manifold Absolute Pressure (MAP) is greater than 0.28 kPa.

Test failed if 58x reference pulse not seen for 8 seconds.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) after the first trip in which the fault is detected.

The ECM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL OFF on the third (fourth – /1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

Poor connection – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, disconnect the ECM, turn the ignition on, and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving connectors and wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
9. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0337 58X Crankshaft Position (CKP) Sensor No Signal

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Operate the vehicle within the Freeze Frame conditions for setting the DTC as noted. Is Diagnostic Trouble Code (DTC) P0337 set?	–	Go to *Step 3*	Go to *Step 10*
3	1. Turn the ignition OFF. 2. Disconnect the Crankshaft Position (CKP) sensor connector. 3. Turn the ignition ON, with the engine OFF. 4. Using a Digital Voltmeter (DVM), check the voltage between the CKP sensor wiring harness connector (Powertrain Control Module Engine Control Module [ECM] side) terminal 1 and ground. Does the DVM indicate the specified value?	2.5 v	Go to *Step 4*	Go to *Step 5*
4	Using a DVM, check the voltage between the CKP sensor wiring harness connector (ECM side) terminal 2 and ground. Does the DVM indicate the specified value?	2.5 v	Go to *Step 6*	Go to *Step 5*
5	1. Turn the ignition OFF. 2. Disconnect the ECM connector (white, engine – 1.5L SOHC). 3. Turn the ignition ON, with the engine OFF. 4. Using a DVM, check the output voltage of the ECM terminals M5 and M21. Does the DVM indicate the specified value?	11-16 volts	Go to *Step 8*	Go to *Step 9*
6	1. Reconnect the CKP sensor. 2. Using a DVM backprobe the ECM (white) connector, terminal M5 or M21. 3. Observe the voltage while cranking the engine. Does the voltage fluctuate between the specified value?	2.4 – 2.7 v	Go to "Diagnostic Aids"	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Replace the CKP sensor. Is the repair complete?	–	Go to *Step 10*	–
8	Check the CKP sensor High or Low circuits for an open, short to ground or short to voltage and repair as necessary. Is the repair complete?	–	Go to *Step 10*	–

DTC P0337 58X Crankshaft Position (CKP) Sensor No Signal (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 10*	–
10	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 11*	Go to *Step 2*
11	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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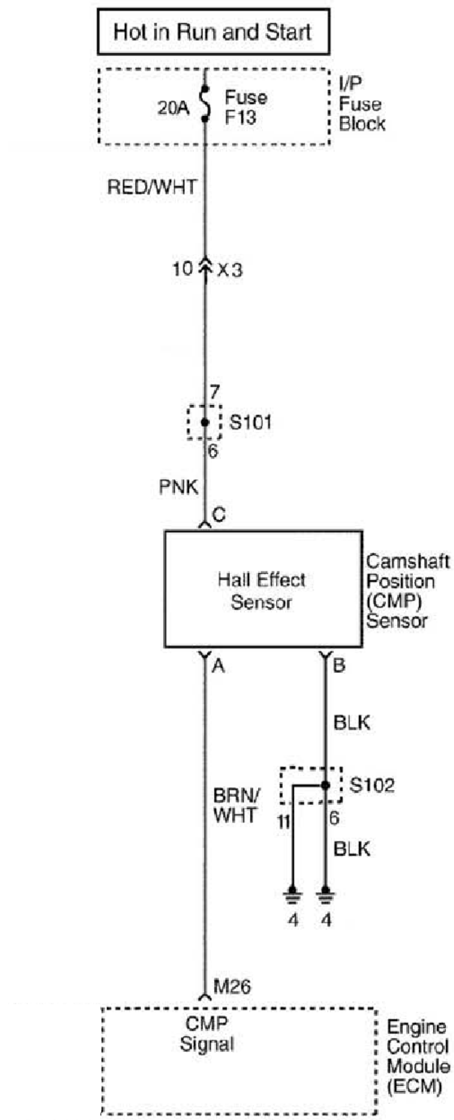

TAA1F320

DIAGNOSTIC TROUBLE CODE (DTC) P0341
CAMSHAFT POSITION (CAM) SENSOR RATIONALITY

System Description

The Camshaft Position (CMP) Sensor is used to correlate crankshaft to camshaft position so that the engine control module (ECM) can determine which cylinder is ready to be fueled by the injector. The CMP is also used to determine which cylinder is misfiring when misfire is present. If the ECM receives an intermittent signal from the CMP, then the CMP Resync Counter will increment. When the ECM cannot use the information from the CMP sensor, a Diagnostic Trouble Code (DTC) is set, and the ECM will fuel the engine using the Alternating Synchronous Double Fire (ASDF) method.

Conditions for Setting the DTC

Engine is running.

Action Taken When the DTC Sets

The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) or consecutive trip with a fail.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed-through wire insulation, or a wire that is broken inside the insulation.

Any circuitry, that is suspected as causing the complaint, should be thoroughly checked for the following conditions:

Backed-out terminals

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal-to-wire connection

Physical damage to the wiring harness

Anytime a poor connection is present, the CMP Reference Activity counter will stop incrementing.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0341 is the result of a hard failure or an intermittent condition.
3. This step checks for a voltage supplied by the ECM to the CMP.
   A poor connection in any of the circuits at the CMP will cause the CMP Active Counter will stop incrementing.
14. The replacement ECM must be reprogrammed.
   Refer to the latest Techline Procedure for ECM reprograming.

DTC P0341 Camshaft Position (CAM) Sensor Rationality

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Operate the vehicle within the Freeze Frame conditions for setting the DTC as noted. Is Diagnostic Trouble Code (DTC) P0341 set?	–	Go to *Step 3*	Go to “Diagnostic Aids”
3	1. Turn the ignition OFF. 2. Disconnect the Camshaft Position (CMP) sensor electrical connector. 3. Turn the ignition ON, with the engine OFF. 4. Using a Digital Voltmeter (DVM), check the voltage between the CMP harness connector (Engine Control Module [ECM] side) terminal A and ground. Does the DVM indicate near the specified value?	5 volts	Go to *Step 4*	Go to *Step 5*
4	Using a DVM, check the voltage between the CMP sensor wiring harness connector terminal C and ground. Is the DVM indicate over the specified value?	10 volts	Go to *Step 6*	Go to *Step 10*
5	With a test light connected to ground, probe the CMP harness connector terminal A. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
6	With a test light connected to B+, probe the CMP harness connector terminal B. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 11*

DTC P0341 Camshaft Position (CMP) Sensor Rationality (Cont'd)

Step	Action	Value(s)	Yes	No
7	Check for poor connections at the CMP electrical connectors and repair as necessary. Is the repair complete?	–	Go to *Step 15*	Go to *Step 13*
8	1. Turn the ignition OFF. 2. Disconnect the Engine Control Module (ECM) connector (white). 3. Repair the short to voltage on the CMP signal circuit. Is the repair complete?	–	Go to *Step 15*	Go to *Step 14*
9	Check the CMP signal circuit for an open or short to ground and repair as necessary. Is the repair complete?	–	Go to *Step 15*	Go to *Step 12*
10	Check for a poor connection or open in the CMP B+ feed circuit and repair as necessary. Is the repair complete?	–	Go to *Step 15*	–
11	Check for a poor connection or open in the CMP ground circuit and repair as necessary. Is the repair complete?	–	Go to *Step 15*	–
12	Check for a poor connection in the CMP signal circuit terminal and repair as necessary. Is the repair complete?	–	Go to *Step 15*	Go to *Step 14*
13	1. Turn the ignition OFF. 2. Replace the CMP. Is the repair complete?	–	Go to *Step 15*	–
14	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 15*	–
15	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 16*	Go to *Step 2*
16	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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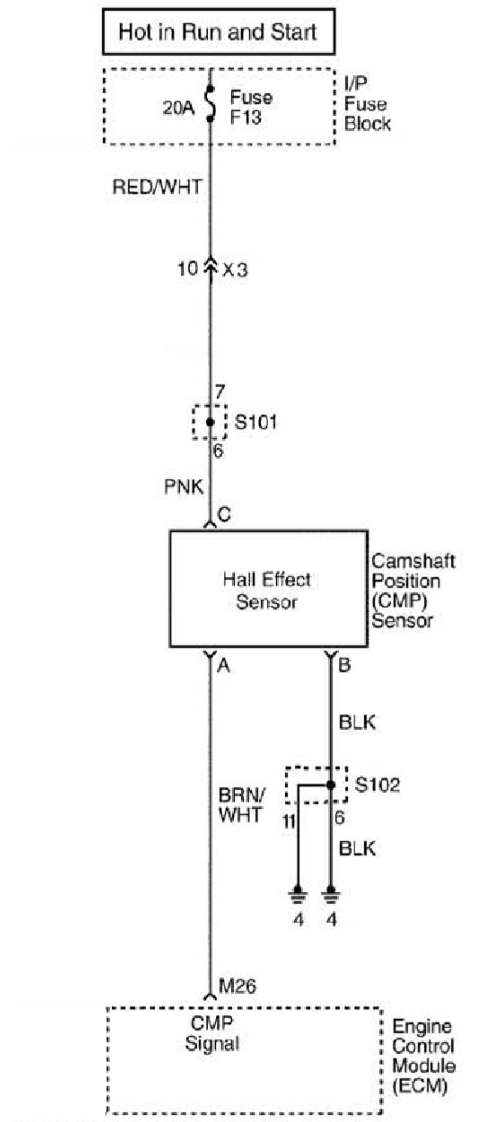

DIAGNOSTIC TROUBLE CODE (DTC) P0342 CAMSHAFT POSITION (CMP) SENSOR NO SIGNAL

System Description

The Camshaft Position (CMP) Sensor is used to correlate crankshaft to camshaft position so that the engine control module (ECM) can determine which cylinder is ready to be fueled by the injector. The CMP is also used to determine which cylinder is misfiring when misfire is present. If the ECM receives an intermittent signal from the CMP, then the CMP Resync Counter will increment. When the ECM cannot use the information from the CMP sensor, a Diagnostic Trouble Code (DTC) is set and the ECM will fuel the engine using the Alternating Synchronous Double Fire (ASDF) method.

Conditions for Setting the DTC

Engine is running.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.

A history DTC will clear after 40 consecutive warm up cycles without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed-through wire insulation, or a wire that is broken inside the insulation.

Any circuitry, that is suspected as causing the complaint, should be thoroughly checked for the following conditions:

Backed-out terminals

Improper mating

Broken locks

Improperly formed

Damaged terminals

Poor terminal-to-wire connection

Physical damage to the wiring harness

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This step determines if DTC P0342 is the result of a hard failure or an intermittent condition.
4. Determines if voltage is available to the CMP.
7. This step checks for a voltage supplied by the ECM to the CMP.
12. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0342 Camshaft Position (CMP) Sensor No Signal

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Idle the engine. 2. Install a scan tool. Is the Camshaft Position (CMP) Active Counter incrementing?	–	Go to *Step 3*	Go to *Step 4*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting this DTC. Is the CMP Active Counter incrementing?	–	Go to *Step 13*	Go to *Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the CMP sensor electrical connector. 3. Turn the ignition ON, with the engine OFF. 4. With a test light connected to ground probe the CMP harness connector, terminal C. Does the test light illuminate?	–	Go to *Step 5*	Go to *Step 6*
5	With a test light connected to B+ probe the CMP harness connector, terminal B. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 8*
6	Check for a poor connection or open in the CMP ignition feed circuit and repair as necessary. Is the repair complete?	–	Go to *Step 13*	Go to “Diagnostic Aids”
7	Using a Digital Voltmeter (DVM), check the voltage between the CMP harness connector, terminal A and ground. Does the DVM display near the specified values?	5 volts	Go to *Step 11*	Go to *Step 9*

DTC P0342 Camshaft Position (CMP) Sensor No Signal (Cont'd)

Step	Action	Value(s)	Yes	No
8	Check for a poor connection or open in the CMP ground circuit and repair as necessary. Is the repair complete?	–	Go to *Step 13*	–
9	1. Turn the ignition OFF. 2. Disconnect Engine Control Module (ECM) connector (white, engine – 1.5L SOHC). 3. Check the CMP signal circuit for an open or short to ground or short to B+ and repair as necessary. Is the repair complete?	–	Go to *Step 13*	Go to *Step 10*
10	Check for a poor connection in the CMP signal circuit terminal and repair as necessary. Is the repair complete?	–	Go to *Step 13*	Go to *Step 12*
11	1. Turn the ignition OFF. 2. Replace the CMP. Is the repair complete?	–	Go to *Step 13*	–
12	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 13*	–
13	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting the DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 14*	Go to *Step 2*
14	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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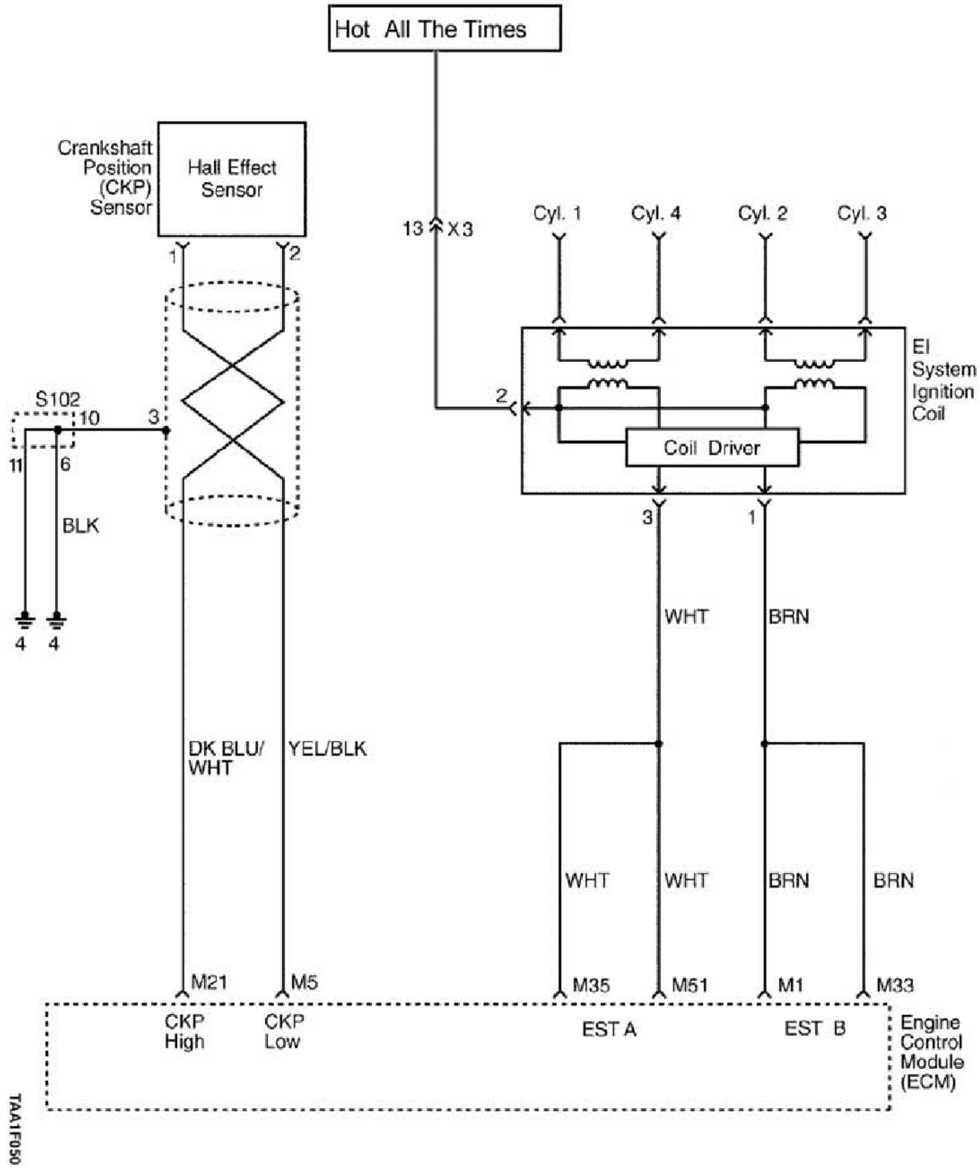
Hot All The Times
Crankshaft Position (CKP) Sensor
Hall Effect Sensor
1
2
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
EI System Ignition Coil
2
Coil Driver
3
1
S102
10
3
11
6
BLK
4
4
WHT
BRN
DK BLU/ WHT
YEL/BLK
WHT
WHT
BRN
BRN
M21
M5
M35
M51
M1
M33
CKP High
CKP Low
EST A
EST B
Engine Control Module (ECM)
TAA1F050

TAA1F240

DIAGNOSTIC TROUBLE CODE (DTC) P0351 IGNITION CONTROL CIRCUIT A FAULT (CYLINDER 1 AND 4)

Circuit Description

The engine control module (ECM) provides a ground for the electronic spark timing A circuit. When the ECM removes the ground path of the ignition primary coil, the magnetic field produced by the coil collapses. The collapsing magnetic field produces a voltage in the secondary coil which fires the spark plug. The circuit between the ECM and the electronic ignition system is monitored for an open circuit, short to voltage, and short to ground. When the ECM detects a problem in the spark timing B circuit, it will set DTC P0351.

Conditions for Setting the DTC

Ignition ON.

1.5L SOHC

Fault flag increments fail count.

Must receive more than 20 failure within 40 test cycles.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will store conditions which were present when the Diagnostic Trouble Code (DTC) was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL OFF on the third (fourth – 1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

Poor connection – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, disconnect the ECM, turn the ignition on, and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving connectors and wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) system check prompts the technician to complete some backs and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
7. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0351 Ignition Control Circuit A Fault (Cylinder 2 and 3)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Check for a faulty connection or a damaged terminal 3 at the ignition coil. Is a problem found?	–	Go to *Step 8*	Go to *Step 3*
3	Check for a faulty connection or a damaged terminal M35 and M51 at the engine control module (ECM) connector. Is a problem found?	–	Go to *Step 8*	Go to *Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the ECM 3. Check the ignition control circuit for a short to ground. Is a problem found?	–	Go to *Step 8*	Go to *Step 5*
5	Check the ignition control circuit for a short to voltage. Is a problem found?	–	Go to *Step 8*	Go to *Step 6*
6	Check for an open in the ignition control circuit. Is a problem found?	–	Go to *Step 8*	Go to *Step 7*
7	Replace the ECM. Is the action complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 9*	Go to *Step 2*
9	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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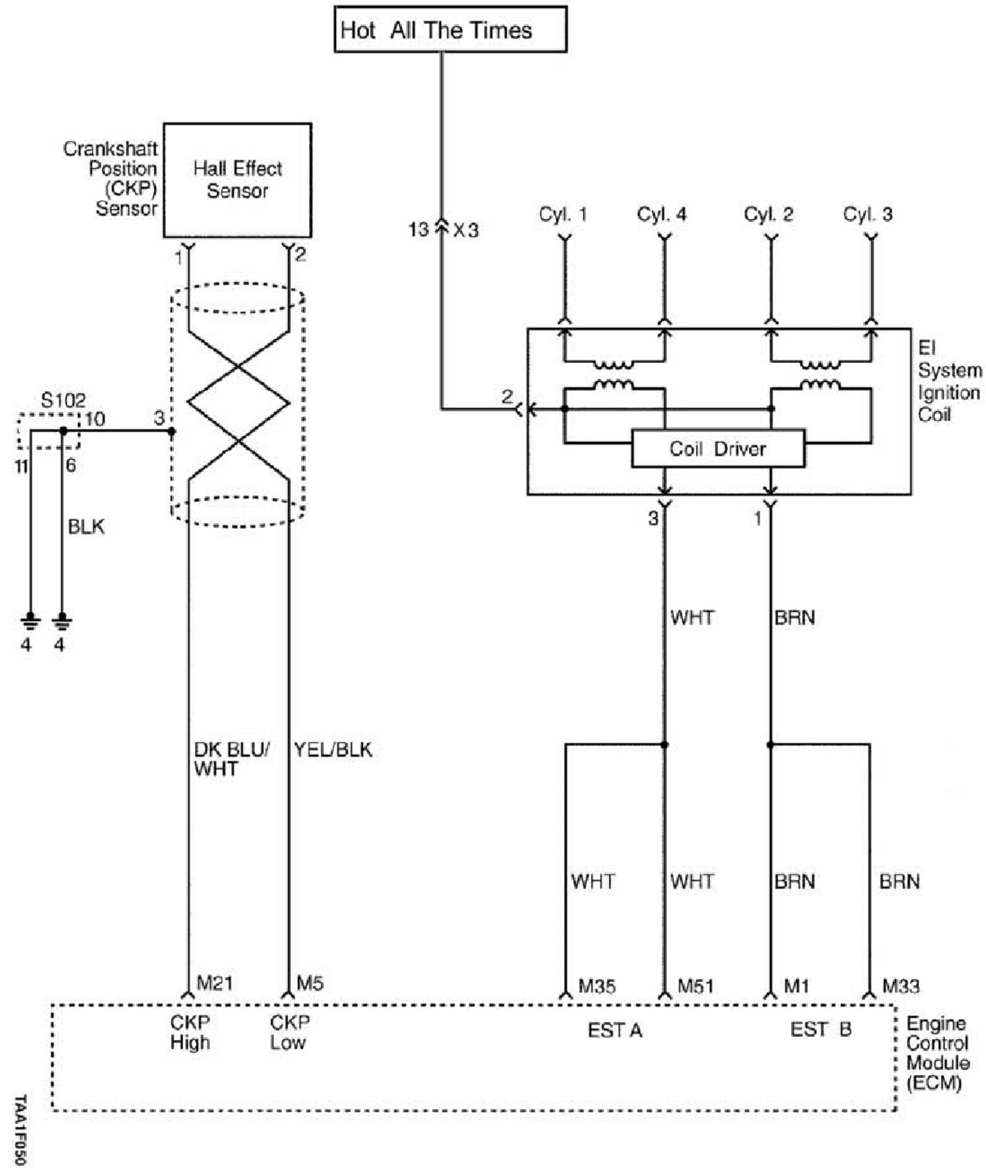
Hot All The Times
Crankshaft Position (CKP) Sensor
Hall Effect Sensor
1
2
13
X3
Cyl. 1
Cyl. 4
Cyl. 2
Cyl. 3
S102
10
3
11
6
BLK
4
4
2
EI System Ignition Coil
Coil Driver
3
1
WHT
BRN
DK BLU/ WHT
YEL/BLK
WHT
WHT
BRN
BRN
M21
M5
M35
M51
M1
M33
CKP High
CKP Low
EST A
EST B
Engine Control Module (ECM)
TAA1F050

TAA1F240

DIAGNOSTIC TROUBLE CODE (DTC) P0352 IGNITION CONTROL CIRCUIT B FAULT (CYLINDER 2 AND 3)

Circuit Description

The engine control module (ECM) provides a ground for the electronic spark timing B circuit. When the ECM removes the ground path of the ignition primary coil, the magnetic field produced by the coil collapses. The collapsing magnetic field produces a voltage in the secondary coil which fires the spark plug. The circuit between the ECM and the electronic ignition system is monitored for an open circuit, short to voltage, and short to ground. When the ECM detects a problem in the spark timing A circuit, it will set DTC P0352.

Conditions for Setting the DTC

Ignition ON.

1.5L SOHC

Fault flag increments fail count.

Must receive more than 20 failure within 40 test cycles.

Action Taken When the DTC Sets

The ECM will illuminate the Malfunction Indicator Lamp (MIL) the first time the fault is detected.

The ECM will store conditions which were present when the Diagnostic Trouble Code (DTC) was set as Freeze Frame and in the Failure Records data.

A history DTC is stored.

Conditions for Clearing the MIL/DTC

The ECM will turn the MIL OFF on the third (fourth – 1.5L SOHC) consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.

A history DTC will clear after 40 consecutive warm up cycles have occurred without a fault.

DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

Poor connection – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, disconnect the ECM, turn the ignition on, and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving connectors and wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Number(s) below refer to the step number(s) on the Diagnostic Table.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) system check prompts the technician to complete some backs and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
7. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0352 Ignition Control Circuit B Fault (Cylinder 1 and 4)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Check for a faulty connection or a damaged terminal 1 at the ignition coil. Is a problem found?	–	Go to *Step 8*	Go to *Step 3*
3	Check for a faulty connection or a damaged terminal M1 and M33 at the engine control module (ECM) connector. Is a problem found?	–	Go to *Step 8*	Go to *Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the ECM 3. Check the ignition control circuit for a short to ground. Is a problem found?	–	Go to *Step 8*	Go to *Step 5*
5	Check the ignition control circuit for a short to voltage. Is a problem found?	–	Go to *Step 8*	Go to *Step 6*
6	Check for an open in the ignition control circuit. Is a problem found?	–	Go to *Step 8*	Go to *Step 7*
7	Replace the ECM. Is the action complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 9*	Go to *Step 2*
9	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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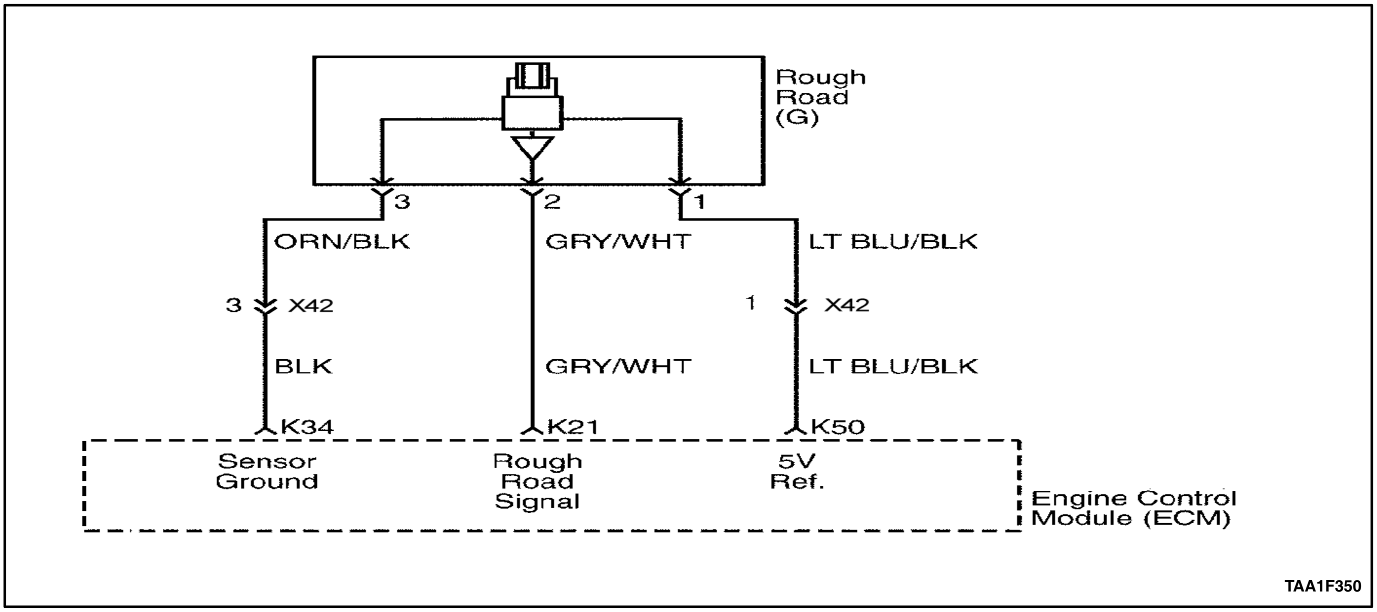

DIAGNOSTIC TROUBLE CODE (DTC) P1391
G SENSOR ROUGH ROAD RATIONALITY

Circuit Description

The G sensor is a vertical low g-acceleration sensor. By sensing vertical acceleration caused by bumps or potholes in the road, the engine control module (ECM) can determine if the changes in crankshaft speed are due to engine misfire or are driveline induced. If the G sensor detects a rough road condition, the ECM misfire detection diagnostic will be deactivated. The G sensor at rest output should be between 2.35-2.65 volts (+1G). During a rough road condition, the voltage output can vary between 0.5 (– 1G) and 4.5 volts (+3G).

Conditions for Setting the DTC

1.5L SOHC

- Engine running.
- Vehicle speed is less than or equal to 3.1 mph (5 km/h).
- G sensor output at idle is below –0.39 G or above 2.21 G.

OR

- Vehicle speed is between 18.6 mph (30 km/h) and 43.5 mph (70 km/h).
- G sensor movement is less than 0.00024 G while driving.
- Engine Runtime is greater than or equal to 10 seconds.

Action Taken When DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history Diagnostic Trouble Code (DTC) will clear after 40 consecutive warm-up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at the ECM – Inspect the harness connections for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the G sensor display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

The G sensor will give correct voltages only if it is level and mounted securely to its bracket.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

13. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1391 – G Sensor Rough Road Rationality

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON engine OFF. 2. Review and record the scan tool Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using the scan tool, monitor specific Diagnostic Trouble Code (DTC) info for DTC P1391. Does the scan tool indicate that DTC P1391 failed?	–	Go to *Step 4*	Go to *Step 3*
3	1. Check for the following conditions: • G sensor seal missing or damaged. • G sensor mounting flanges cracked, missing, or incorrectly installed. 2. If a problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to “Diagnostic Aids”
4	1. Disconnect the G sensor electrical connector. 2. Observe the G sensor value displayed on the scan tool. Is the G sensor value near the specified value?	0.0 v	Go to *Step 5*	Go to *Step 12*
5	1. Jumper the 5 volt reference circuit, at terminal 1 and the G sensor signal circuit, at terminal 2 together at the G sensor harness connector. 2. Observe the G sensor value displayed on the scan tool. Is the G sensor value near the specified value?	4.95 v	Go to *Step 6*	Go to *Step 7*
6	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) and check the sensor ground circuit terminal K34 for high resistance, an open between the ECM and the G sensor, or for a poor connection at the ECM. 3. If the problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to *Step 10*

DTC P1391 – G Sensor Rough Road Rationality (Cont'd)

Step	Action	Value	Yes	No
7	1. Check the 5 volt reference circuit, terminal K50 for high resistance, an open between the ECM and the G sensor, or a poor connection at the ECM. 2. If a problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to *Step 8*
8	1. Turn the ignition OFF. 2. Disconnect the ECM and check the G sensor signal circuit for high resistance, an open, a short to ground, or a short to the sensor ground circuit. 3. If a problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to *Step 9*
9	1. Check the G sensor signal circuit for a poor connection at the ECM. 2. If a problem is found, repair as necessary. Is a problem found.	–	Go to *Step 14*	Go to *Step 13*
10	1. Check for a poor connection at the G sensor. 2. If a problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to *Step 11*
11	1. Turn the ignition OFF. 2. Replace the G sensor. Is the repair complete?	–	Go to *Step 14*	–
12	1. Turn the ignition OFF. 2. Disconnect the ECM. 3. Turn the ignition ON. 4. Check the G sensor signal circuit for a short to voltage or a short to the 5 volt reference circuit. 5. If a problem is found, repair as necessary. Is a problem found?	–	Go to *Step 14*	Go to *Step 13*
13	1. Turn the ignition OFF. 2. Replace the ECM Is the repair complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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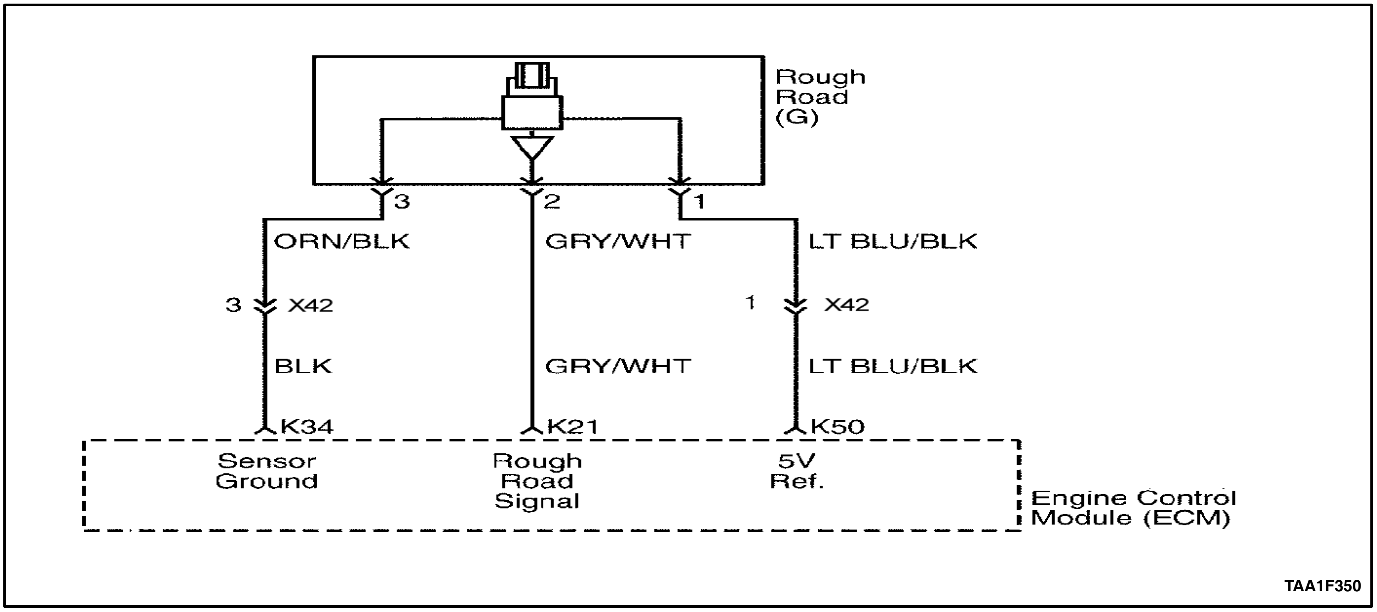

DIAGNOSTIC TROUBLE CODE (DTC) P1392
G SENSOR ROUGH ROAD LOW VOLTAGE

Circuit Description

The G sensor is a vertical low g-acceleration sensor. By sensing vertical acceleration caused by bumps or potholes in the road, the engine control module (ECM) can determine if the changes in crankshaft speed are due to engine misfire or are driveline induced. If the G sensor detects a rough road condition, the ECM misfire detection diagnostic will be deactivated. The G sensor at rest output should be between 2.35-2.65 volts (+1G). During a rough road condition, the voltage output can vary between 0.5 (– 1G) and 4.5 volts (+3G).

Conditions for Setting the DTC

1.5L SOHC

- G sensor output is less than 2%.
- Engine runtime is greater than or equal to 10 seconds.

Action Taken When DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history Diagnostic Trouble Code (DTC) will clear after 40 consecutive warm-up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at the ECM – Inspect the harness connections for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the G sensor display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

The G sensor will give correct voltages only if it is level and mounted securely to its bracket.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1392 – G Sensor Rough Road Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON, engine OFF. 2. Observe the ROUGH ROAD value displayed on the scan tool. Is the ROUGH ROAD value near the specified value?	0.0 v	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition ON, engine OFF. 2. Review and record the scan tool Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using the scan tool, monitor specific Diagnostic Trouble Code (DTC) info for DTC P1392. Does the scan tool indicate that DTC P1392 failed?	–	Go to *Step 4*	Go to "Diagnostic Aids"
4	1. Disconnect the G sensor electrical connector. 2. Jumper the 5 volt reference circuit, terminal 1 and the G sensor signal circuit, terminal 2 together at the G sensor harness connector. 3. Observe the G sensor value displayed on the scan tool. Is the G sensor value near the specified value?	4.95 v	Go to *Step 9*	Go to *Step 5*
5	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) and check the 5 volt reference circuit for an open or short to ground. 3. If the problem is found, repair as necessary. Is a problem found?	–	Go to *Step 11*	Go to *Step 6*
6	Check the 5 volt reference circuit for a poor connection at the ECM and replace the terminal if necessary. Does the terminal require replacement?	–	Go to *Step 11*	Go to *Step 7*
7	1. Turn the ignition OFF. 2. Disconnect the ECM and check the sensor signal circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the problem is found, repair as necessary. Is a problem found?	–	Go to *Step 11*	Go to *Step 8*
8	Check the G sensor signal circuit for a poor connection at the ECM and replace the terminal if necessary. Did the terminal require replacement?	–	Go to *Step 11*	Go to *Step 10*
9	1. Turn the ignition OFF. 2. Replace the G sensor. Is the repair complete?	–	Go to *Step 11*	–
10	1. Turn the ignition OFF. 2. Replace the ECM Is the repair complete?	–	Go to *Step 11*	–

DTC P1392 – G Sensor Rough Road Low Voltage (Cont'd)

Step	Action	Value	Yes	No
11	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 12*	Go to *Step 2*
12	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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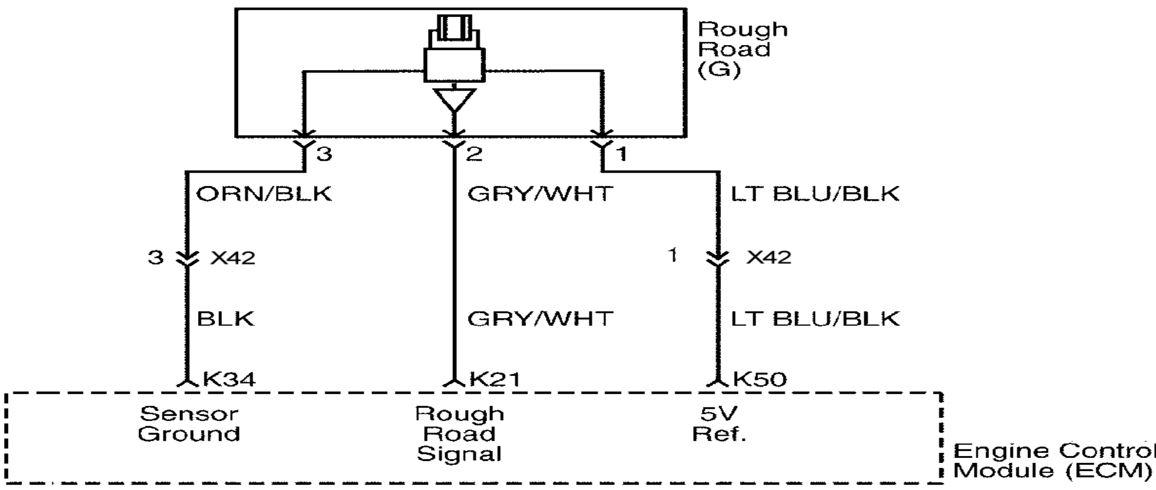

DIAGNOSTIC TROUBLE CODE (DTC) P1393
G SENSOR ROUGH ROAD HIGH VOLTAGE

Circuit Description

The G sensor is a vertical low g-acceleration sensor. By sensing vertical acceleration caused by bumps or potholes in the road, the engine control module (ECM) can determine if the changes in crankshaft speed are due to engine misfire or are driveline induced. If the G sensor detects a rough road condition, the ECM misfire detection diagnostic will be de-activated. The G sensor at rest output should be between 2.35-2.65 volts (+1G). During a rough road condition, the voltage output can vary between 0.5 (– 1G) and 4.5 volts (+3G).

Conditions for Setting the DTC

1.5L SOHC

- G sensor output is greater than 98%.
- Engine runtime is greater than or equal to 10 seconds.

Action Taken When DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at the ECM – Inspect the harness connections for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the G sensor display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

The G sensor will give correct voltages only if it is level and mounted securely to its bracket.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

10. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1393 – G Sensor Rough Road High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Idle the engine. 2. Observe the ROUGH ROAD value displayed on the scan tool. Is the ROUGH ROAD value near the specified value?	4.5 v	Go to *Step 4*	Go to *Step 3*
3	1. Turn the ignition ON, engine OFF. 2. Review and record the scan tool Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using the scan tool, monitor specific Diagnostic Trouble Code (DTC) info for DTC P1393. Does the scan tool indicate that DTC P1393 failed?	–	Go to *Step 4*	Go to “Diagnostic Aids”
4	1. Disconnect the G sensor electrical connector. 2. Note the G sensor voltage displayed on the scan tool. Is the G sensor voltage near the specified value?	0.0 v	Go to *Step 5*	Go to *Step 6*
5	Probe the sensor ground circuit terminal 3 with a test light to B+. Is the test light ON?	–	Go to *Step 7*	Go to *Step 9*
6	1. Check the G sensor signal circuit for a short to voltage or a short to the 5 volt reference circuit. 2. If the G sensor signal circuit is shorted, repair the circuit as necessary. Is the G sensor signal circuit shorted?	–	Go to *Step 12*	Go to *Step 10*
7	1. Check for a poor sensor ground terminal connection at the G sensor electrical connector. 2. If a problem is found replace the faulty terminal. Did the terminal require replacement?	–	Go to *Step 12*	Go to *Step 11*
8	Check for a poor sensor ground terminal connection at the engine control module (ECM) and replace the terminal if necessary. Does the terminal require replacement?	–	Go to *Step 12*	Go to *Step 10*
9	1. Check the continuity of the G sensor ground circuit. 2. If the G sensor ground circuit measures over the specified value, repair the open or poor connection. Is a condition found and corrected?	–	Go to *Step 12*	Go to *Step 8*
10	1. Turn the ignition OFF. 2. Replace the ECM Is the repair complete?	–	Go to *Step 12*	–
11	1. Turn the ignition OFF. 2. Replace the G sensor. Is the repair complete?	–	Go to *Step 12*	Go to *Step 10*

DTC P1393 – G Sensor Rough Road High Voltage (Cont'd)

Step	Action	Value	Yes	No
12	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTC displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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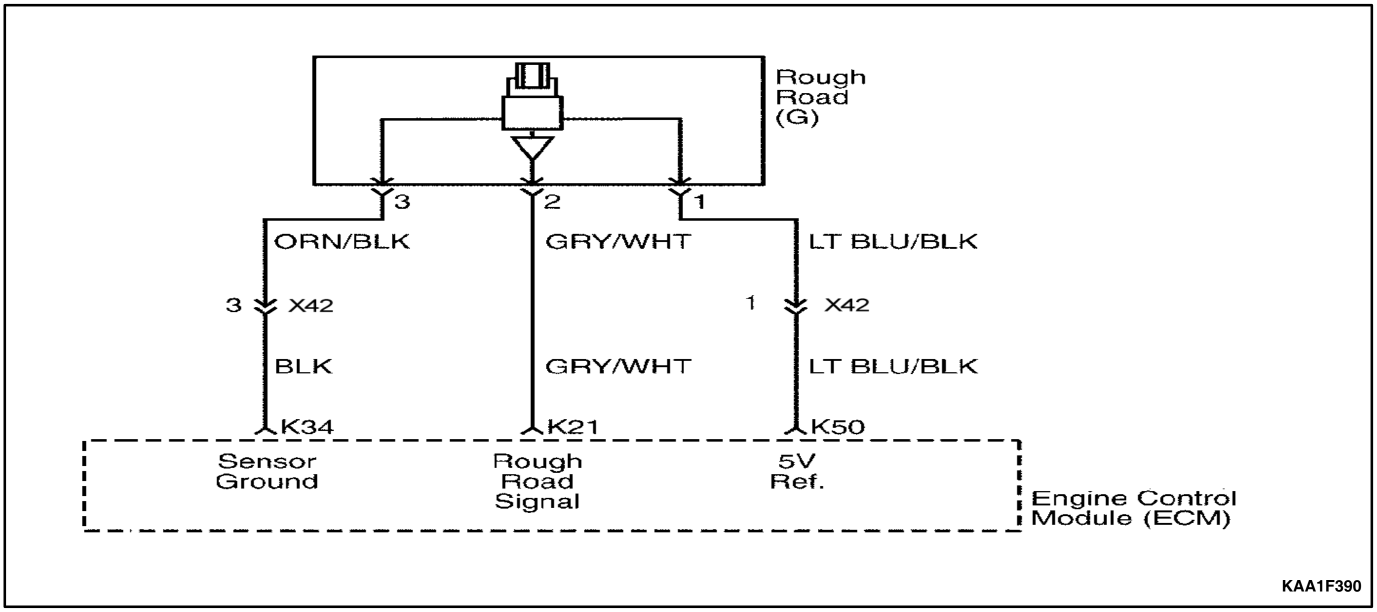


DIAGNOSTIC TROUBLE CODE (DTC) P1396 WSSD ROUGH ROAD SYSTEM FAULT (1.5L SOHC)

Circuit Description

The Engine Control Module (ECM) determines linear wheel speed excessive variation. The wheel speed variation test detects at least one missing edge from the wheel speed sensor signal.

Conditions for Setting the DTC

- DTCs P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0125, P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0402, P0404, P1404, P0405 and P0406 are not set.
- Coolant temperature is greater than or equal to 60°C (140°F).
- Vehicle voltage is between 11 and 16 volts.
- Engine state is run.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at the ECM – Inspect the harness connections for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the G sensor display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

An open signal circuit of open PWM serial data line between the ECM and the EBCM will be the cause of this DTC.

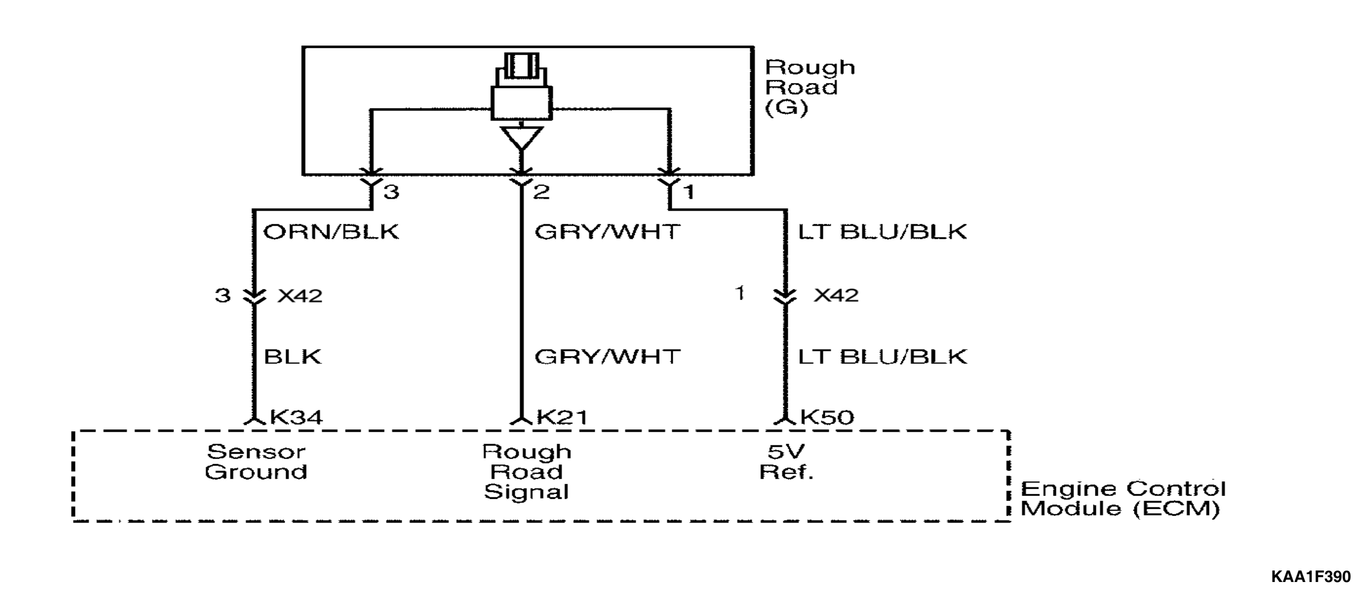
Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1396 – WSSD Rough Road System Fault (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. Are any additional Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Review and record the scan tool Failure Records data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using the scan tool, monitor specific DTC info for DTC 1391. Does the scan tool indicate that DTC P1391 failed?	–	Go to *Step 4*	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) and check for an open or short in the wire between ECM connector terminal M53 and Electronic Brake Control Module (EBCM) connector terminal 24. Is a problem found?	–	Go to *Step 5*	Go to *Step 6*
5	Repair an open or short in the wire between ECM connector terminal M53 and EBCM connector terminal 24. Is the repair complete?	–	Go to *Step 7*	–
6	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P1397 WSSD ROUGH ROAD (1.5L SOHC)

Circuit Description

The Engine Control Module (ECM) determines linear wheel speed fail threshold. The ECM detects a good or failed wheel speed sensor under power conditions.

Conditions for Setting the DTC

- DTCs P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0125, P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0402, P0404, P1404, P0405 and P0406 are not set.
- Coolant temperature is greater than or equal to 60°C (140°F).
- Vehicle voltage is between 11 and 16 volts.
- Engine state is run

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at the ECM – Inspect the harness connections for backed–out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal–to–wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the G sensor display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

An open signal circuit of open PWM serial data line between the ECM and the EBCM will be the cause of this DTC.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1397 – WSSD Rough Road (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diag-nostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. Are any additional Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC table	Go to *Step 3*
3	1. Review and record the scan tool Failure Records data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using the scan tool, monitor specific DTC info for DTC 1391. Does the scan tool indicate that DTC P1391 failed?	–	Go to *Step 4*	Go to “Diagnostic Aids”
4	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) and check for an open or short in the wire between ECM connector terminal M53 and Electronic Brake Control Module (EBCM) connector terminal 24. Is a problem found?	–	Go to *Step 5*	Go to *Step 6*
5	Repair an open or short in the wire between ECM connector terminal M53 and EBCM connector terminal 24. Is the repair complete?	–	Go to *Step 7*	–
6	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0401 EXHAUST GAS RECIRCULATION (EGR) INSUFFICIENT FLOW

System Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

This diagnostic will determine if there is a reduction in EGR flow.

Conditions for Setting the DTC

- DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0125, P0201, P0202, P0203, P0204, P0351, P0352, P0402, P1404, P0405, P0406 and P0502 are not set.
- Test run in Decel Fuel Cut-Off (DFCO) mode.
- A/C clutch or transmission clutch are unchanged.

1.5L SOHC

- Barometric Pressure (BARO) is greater than 72 kPa.
- Vehicle speed is greater than 12.4 mph (20 km/h).
- Engine speed is between 1600 and 3200 rpm.
- Compensated MAP within range is between 10.3 and 50 kPa.

Start test:

- TPS is less than 1%.
- EGR is less than 1%.
- The change in the MAP is less than 1.2 kPa.

Test will be aborted when:

- The change in the vehicle speed is greater than 5 mph (8 km/h).
- The change in the rpm is greater than 50.
- EGR opened less than 90% commanded position.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

The EGR Decel Filter value can be a great aid in determining if a problem exists and to verify repairs. The EGR Decel Filter is an average of the difference in the expected MAP change and the actual MAP change caused by opening the EGR valve during a deceleration. By driving the vehicle up to approximately 60 mph (97 km/h) and decelerating to 20 mph (32 km/h), it can be determined if the EGR system is OK, partially restricted, or fully restricted.

A more negative number (less than – 3) indicates that the system is working normally, whereas a positive number indicates that the system is being restricted and that the expected amount of EGR flow is was not seen. A number that falls between negative 3 and positive 2 indicates that the system is partially restricted but not restricted enough to cause an emissions impact.

The EGR Decel Filter value should always be a – 3 or lower. If the EGR Decel Filter number becomes more positive (towards 0 or more), then the EGR system is becoming restricted. Look for possible damage to the EGR pipe or for a restriction caused by carbon deposits in the EGR passages or on the EGR valve.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system is totally restricted or partially restricted.
3. Visually and physically inspect the EGR passages and valve for excessive carbon deposits or damage.
4. Be sure all gasket material is removed from the EGR mounting surface. Even a small amount of material may cause a DTC P0401 to set.
5. This step verifies if the fault is present and if a repair corrected the problem. If the EGR Decel Filter value stays near 0 or a positive number after several tests have been run, then a small restriction may still exist. Be sure to check the EGR pipe for damage or dents and the EGR valve for any excessive carbon build up. Only 1 test per ignition cycle will run unless a DTC P0401 has been cleared or the battery has been disconnected.
6. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.

DTC P0401 Exhaust Gas Recirculation (EGR) Insufficient Flow

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Start the engine and allow the engine to idle. 2. Install a scan tool. 3. Command the exhaust gas recirculation (EGR) valve to the specified value. Does the engine stall or attempt to stall.	50%	Go to *Step 5*	Go to *Step 3*
3	1. Turn the engine OFF. 2. Remove the EGR valve assembly. 3. Inspect the EGR valve, passages and pipe for a restriction or damage and repair as necessary. Is a repair necessary?	–	Go to *Step 5*	Go to *Step 4*
4	Replace the EGR valve. Is the action complete?	–	Go to *Step 5*	–

DTC P0401 Exhaust Gas Recirculation (EGR) Insufficient Flow (Cont'd)

Step	Action	Value	Yes	No
5	1. Start the engine. 2. Disconnect the battery for the specified time. 3. Drive the vehicle up to the specified value. 4. Release the throttle and allow the vehicle to decelerate to the specified value. Is the EGR Decel Filter value less than the specified value?	10 seconds 60 mph (97 km/h) 20 mph (32 km/h) 0 mph	Go to *Step 3*	Go to *Step 6*
6	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 7*	Go to *Step 2*
7	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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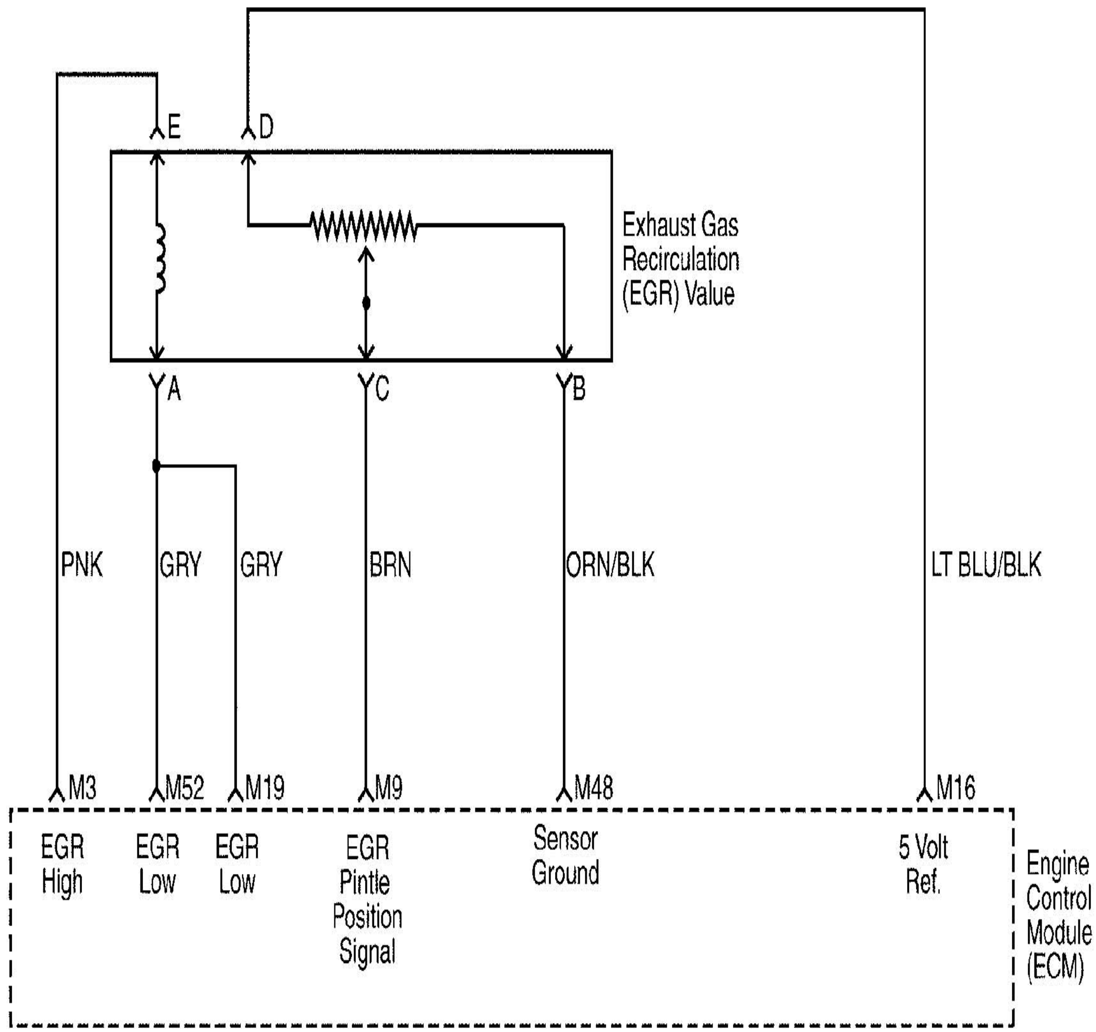

E
D
Exhaust Gas
Recirculation
(EGR) Value
A
C
B
PNK
GRY
GRY
BRN
ORN/BLK
LT BLU/BLK
M3
M52
M19
M9
M48
M16
EGR
High
EGR
Low
EGR
Low
EGR
Pintle
Position
Signal
Sensor
Ground
5 Volt
Ref.
Engine
Control
Module
(ECM)
TAA1F290

DIAGNOSTIC TROUBLE CODE (DTC) P0402 EXHAUST GAS RECIRCULATION (EGR) EXCESSIVE FLOW

Circuit Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced.

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

This Diagnostic Trouble Code (DTC) will detect an EGR open to a large value during crank. Crank time may be excessive with an open EGR valve.

Conditions for Setting the DTC

- Engine cranking (not running).

1.5L SOHC

- Ignition voltage is between 10 and 16 volts.
- EGR position is greater than 70% for 3 second during crank.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Due to moisture associated with exhaust systems, the EGR valve may freeze and stick in cold weather at times. After the vehicle is brought into a warm shop for repairs, the valve warms and the problem disappears. By watching the Actual EGR and Desired EGR Positions on a cold vehicle with a scan tool, the fault can be easily verified. Check the freeze frame data to determine if the DTC set when the vehicle was cold by viewing the Engine Coolant Temperature (ECT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and to store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system can control the EGR valve accurately and if the fault is present. The difference between the current and commanded position is greater than 15%.
3. When the EGR valve electrical connector is disconnected, the scan tool should display the Actual EGR Position as 0%. If it does not, the fault lies either in the EGR signal circuit or the ECM.
4. There may be a slight delay for the voltage displayed on the DVM to change after the scan commands the EGR valve to operate. This time the engine must be runned (1.5L SOHC only).
5. An open or poor connection condition may have caused this DTC to set. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
7. The test light will have glowed brightly in the previous step if the EGR control circuit was shorted to B+ and the Actual EGR Position on the scan tool will display 100%. A test light that did not illuminate, indicates that the circuit may be open or shorted to ground.

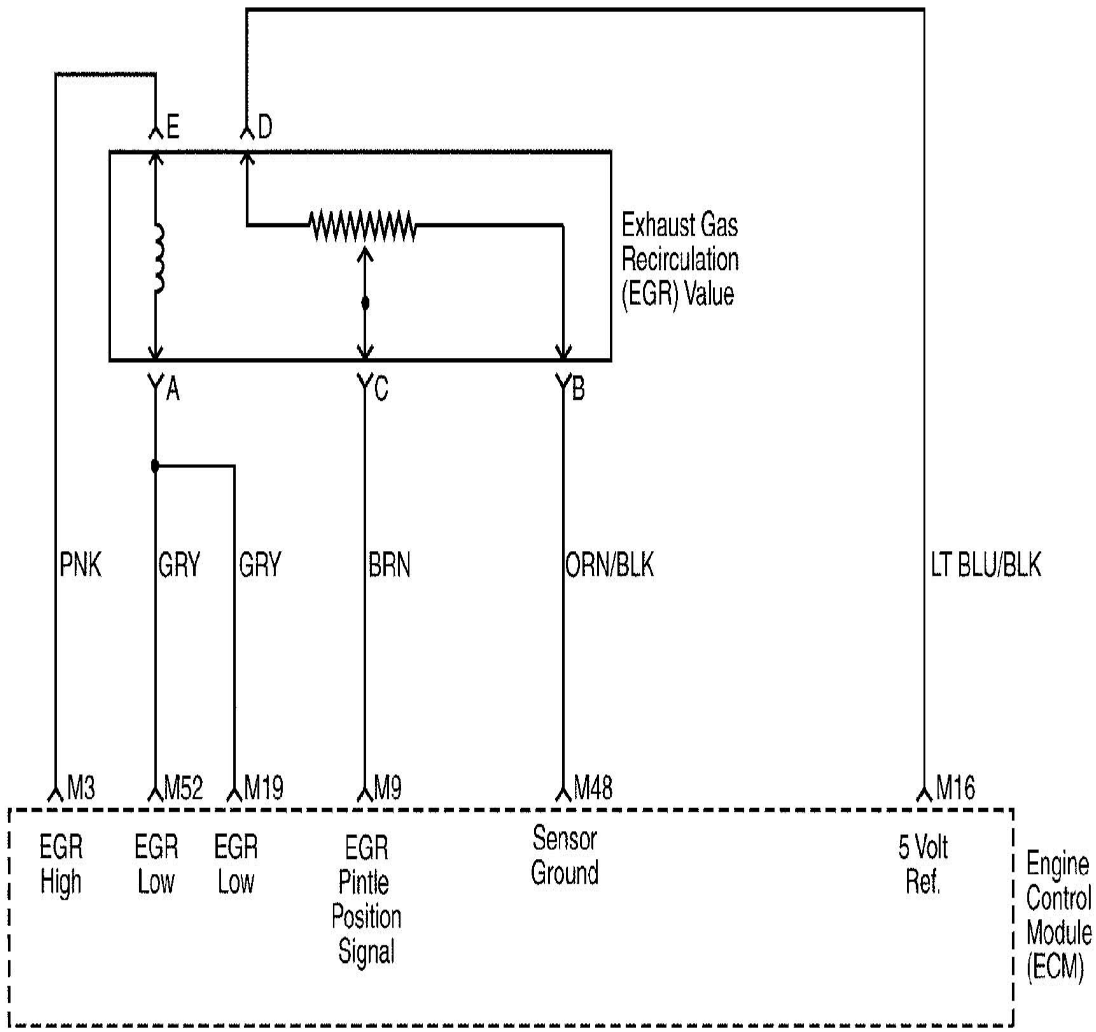
9. If the EGR valve 5 volt reference is shorted to voltage, the Digital Voltmeter (DVM) will read battery voltage, and additional DTCs may be set and the engine performance will be poor.
12. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
13. Although the circuitry acted correctly when checked, a problem may still lie within the terminals which would not show up in probe-type testing. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
17. All circuits to the EGR valve are OK at this point. The fault lies internally in the EGR valve and, therefore, must be replaced. Be sure all gasket material is removed from the EGR mounting surface. Even a small amount of material may cause a DTC P0401 to set.
18. Check the terminals for being backed out, improperly formed or damaged, and for poor tension.
19. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.
20. If no malfunctions have been found at this point and no additional DTCs were set, refer to "Diagnostic Aids" in this section for additional checks and information.

DTC P0402 Exhaust Gas Recirculation (EGR) Excessive Flow

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON with the engine OFF. 2. Install a scan tool. 3. Command the Exhaust Gas Recirculation (EGR) valve to the specified values. Does the Actual EGR Position follow the Desired EGR Position?	25%, 50%, 75%, 100%	Go to *Step 19*	Go to *Step 3*
3	1. Disconnect the EGR valve electrical connector. 2. With a test light connected to B+, probe the ground circuit at terminal B to the EGR valve. Does the test light illuminate?	–	Go to *Step 4*	Go to *Step 5*
4	1. Connect the EGR valve electrical connector. 2. With a Digital Voltmeter (DVM) connected to ground, probe the EGR control circuit at terminal A to the EGR valve. 3. Command the EGR valve to the specified values using a scan tool. After the command is raised, is the voltage changed?	–	Go to *Step 6*	Go to *Step 7*
5	Repair the open or poor connection in the EGR ground circuit. Is the action complete?	–	Go to *Step 19*	–
6	With a test light connected to ground, probe the signal circuit at terminal C. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
7	With the test light connected to ground, again probe the control circuit at terminal A without commanding the EGR valve with the scan tool. Does the test light illuminate?	–	Go to *Step 10*	Go to *Step 11*

DTC P0402 Exhaust Gas Recirculation (EGR) Excessive Flow (Cont'd)

Step	Action	Value	Yes	No
8	Check the signal circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
9	With a Digital Voltmeter (DVM) connected to ground, probe the 5 v reference circuit at terminal D. Is the voltage measured near the specified value?	5 v	Go to *Step 13*	Go to *Step 14*
10	Check the control circuit for a short to voltage and repair as necessary. Is a repair necessary.	–	Go to *Step 19*	Go to *Step 12*
11	Connect the test light to B+ and again probe the control circuit at terminal 1. Does the test light illuminate?	–	Go to *Step 15*	Go to *Step 16*
12	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 19*	–
13	Check the EGR ground circuit for a poor connection or proper terminal tension at the ECM and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 17*
14	Check the 5 v reference circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
15	Check the control circuit at terminal 1 for a short to ground and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
16	Check the control circuit at terminal 1 for an open or poor connection at the EGR valve electrical connector and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 18*
17	1. Turn the ignition switch OFF. 2. Replace the EGR valve. Is the action complete?	–	Go to *Step 19*	–
18	Check the ECM electrical connector for a poor connection and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
19	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 20*	Go to *Step 2*
20	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK


E
D
Exhaust Gas
Recirculation
(EGR) Value
A
C
B
PNK
GRY
GRY
BRN
ORN/BLK
LT BLU/BLK
M3
M52
M19
M9
M48
M16
EGR
High
EGR
Low
EGR
Low
EGR
Pintle
Position
Signal
Sensor
Ground
5 Volt
Ref.
Engine
Control
Module
(ECM)
TAA1F290

DIAGNOSTIC TROUBLE CODE (DTC) P0404 EXHAUST GAS RECIRCULATION (EGR) OPENED

Circuit Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced.

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

This Diagnostic Trouble Code (DTC) will detect an open valve position.

Conditions for Setting the DTC

- Ignition voltage is between 11.7 volts and 16 volts.
- Desired EGR position is greater than 0.
- Engine is running.
- Difference between current and commanded position is greater than 15%.

1.5L SOHC

- The change of desired EGR position is less than 3%.
- The air temperature is greater than 3°C (37.4°F).
- DTCs P0112, P0113, P0405, P0406 and P0502 are not set.

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Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.
- EGR is disabled.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Due to moisture associated with exhaust systems, the EGR valve may freeze and stick in cold weather at times. After the vehicle is brought into a warm shop for repairs, the valve warms and the problem disappears. By watching the Actual EGR and Desired EGR Positions on a cold vehicle with a scan tool, the fault can be easily verified. Check the freeze frame data to determine if the DTC set when the vehicle was cold by viewing the Engine Coolant Temperature (ECT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system can control the EGR valve accurately and if the fault is present. The difference between the current and commanded position is greater than 15%.
3. When the EGR valve electrical connector is disconnected, the scan tool should display the Actual EGR Position as 0%. If it does not, the fault lies either in the EGR signal circuit or the ECM.
4. There may be a slight delay for the voltage displayed on the DVM to change after the scan commands the EGR valve to operate. This time the engine must be runned (1.5L SOHC only).
5. An open or poor connection condition may have caused this DTC to set. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
7. The test light will have glowed brightly in the previous step if the EGR control circuit was shorted to B+, and the Actual EGR Position on the scan tool will display

100%. A test light that did not illuminate, indicates that the circuit may be open or shorted to ground.

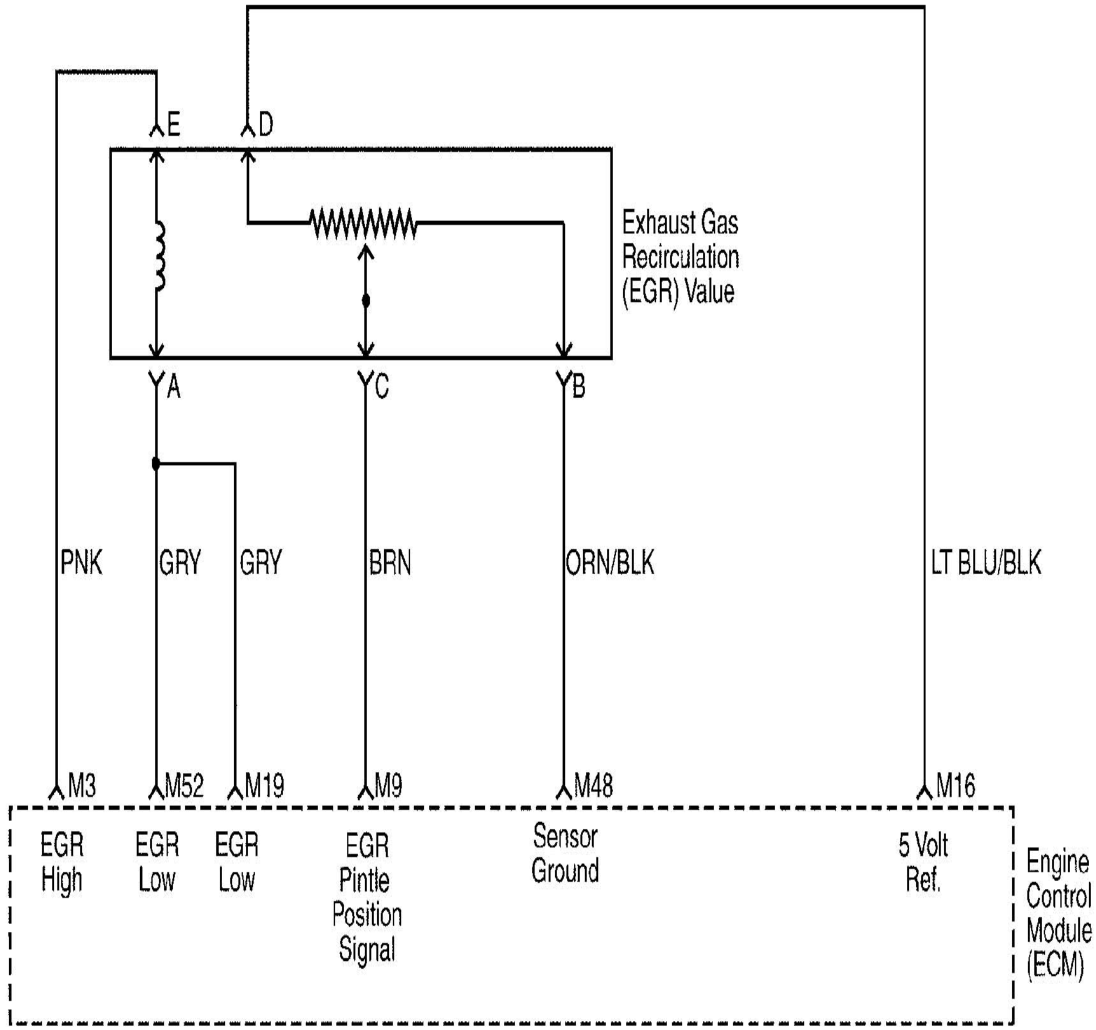
9. If the EGR valve 5 volt reference is shorted to voltage, the DVM will read battery voltage, and additional DTCs may be set and the engine performance will be poor.
12. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
13. Although the circuitry acted correctly when checked, a problem may still lie within the terminals which would not show up in probe type testing. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
17. All circuits to the EGR valve are OK at this point. The fault lies internally in the EGR valve and, therefore, must be replaced. Be sure all gasket material is removed from the EGR mounting surface. Even a small amount of material may cause a DTC P0401 to set.
18. Check the terminals for being backed out, improperly formed or damaged, and for poor tension.
19. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.
20. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0404 Exhaust Gas Recirculation (EGR) Opened

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. 3. Command the Exhaust Gas Recirculation (EGR) valve to the specified values. Does the Actual EGR Position follow the Desired EGR Position?	25%, 50%, 75%, 100%	Go to *Step 19*	Go to *Step 3*
3	1. Disconnect the EGR valve electrical connector. 2. With a test light connected to B+, probe the ground circuit at terminal B to the EGR valve. Does the test light illuminate?	–	Go to *Step 4*	Go to *Step 5*
4	1. Connect the EGR valve electrical connector. 2. With a Digital Voltmeter (DVM) connected to ground, probe the EGR control circuit at terminal A to the EGR valve. 3. Command the EGR valve to the specified values using a scan tool. After the command is raised, is voltage changed?	–	Go to *Step 6*	Go to *Step 7*
5	Repair the open or poor connection in the EGR ground circuit. Is the action complete?	–	Go to *Step 19*	–
6	With a test light connected to ground, probe the signal circuit at terminal C. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
7	With the test light connected to ground, again probe the control circuit at terminal A without commanding the EGR valve with the scan tool. Does the test light illuminate?	–	Go to *Step 10*	Go to *Step 11*

DTC P0404 Exhaust Gas Recirculation (EGR) Opened (Cont'd)

Step	Action	Value	Yes	No
8	Check the signal circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
9	With a Digital Voltmeter (DVM) connected to ground, probe the 5 volt reference circuit at terminal D. Is the voltage measured near the specified value?	5 v	Go to *Step 13*	Go to *Step 14*
10	Check the control circuit for a short to voltage and repair as necessary. Is a repair necessary.	–	Go to *Step 19*	Go to *Step 12*
11	Connect the test light to B+ and again probe the control circuit. Does the test light illuminate?	–	Go to *Step 15*	Go to *Step 16*
12	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 19*	–
13	Check the EGR ground circuit at terminal M48 for a poor connection or proper terminal tension at the ECM and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 17*
14	Check the 5 volt reference circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
15	Check the control circuit for a short to ground and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 12*
16	Check the control circuit for an open or poor connection at the EGR valve electrical connector and repair as necessary. Is a repair necessary?	–	Go to *Step 19*	Go to *Step 18*
17	1. Turn the ignition switch OFF. 2. Replace the EGR valve. Is the action complete?	–	Go to *Step 19*	–
18	Check the ECM electrical connector for a poor connection and repair as necessary.	–	Go to *Step 19*	Go to *Step 12*
19	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 7*	Go to *Step 2*
20	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK


E
D
Exhaust Gas
Recirculation
(EGR) Value
A
C
B
PNK
GRY
GRY
BRN
ORN/BLK
LT BLU/BLK
M3
M52
M19
M9
M48
M16
EGR
High
EGR
Low
EGR
Low
EGR
Pintle
Position
Signal
Sensor
Ground
5 Volt
Ref.
Engine
Control
Module
(ECM)

TAA1F290

DIAGNOSTIC TROUBLE CODE (DTC) P1404
EXHAUST GAS RECIRCULATION (EGR) CLOSED

Circuit Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced.

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

Conditions for Setting the DTC

- Engine running.
- Ignition voltage is between 11.7 and 16 volts.
- Desired EGR position is equal to 0.

1.5L SOHC

- Intake air temperature is greater than 3°C (37.4°F).
- DTCs P0112, P0113, P0405, P0406 and P0502 are not set.
- Difference between current and learned low position is greater than 6.29%.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history Diagnostic Trouble Code (DTC) is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Due to moisture associated with exhaust systems, the EGR valve may freeze and stick in cold weather. After the vehicle is brought into a warm shop for repairs, the valve warms and the problem disappears. By watching the Actual EGR and Desired EGR Positions on a cold vehicle with a scan tool, the fault can be easily verified. Check the freeze frame data to determine if the DTC set when the vehicle was cold by viewing the Engine Coolant Temperature (ECT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system can control the EGR valve accurately and if the fault is present.
3. When the EGR valve electrical connector is disconnected, the scan tool should display the Actual EGR Position as 0%. If it does not, the fault lies either in the EGR signal circuit or the ECM.
5. If the ERG valve 5 volt reference is shorted to voltage, the Digital Voltmeter (DVM) will read battery voltage and additional DTCs may be set and engine performance will be poor.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
10. An open or poor connection condition may have caused this DTC to set. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
11. All circuits to the EGR valve are OK at this point. The fault lies internally in the EGR valve and therefore must be replaced. Be sure all gasket material is removed from the EGR mounting surface. Even a

small amount of material may cause a DTC P0401 to set.

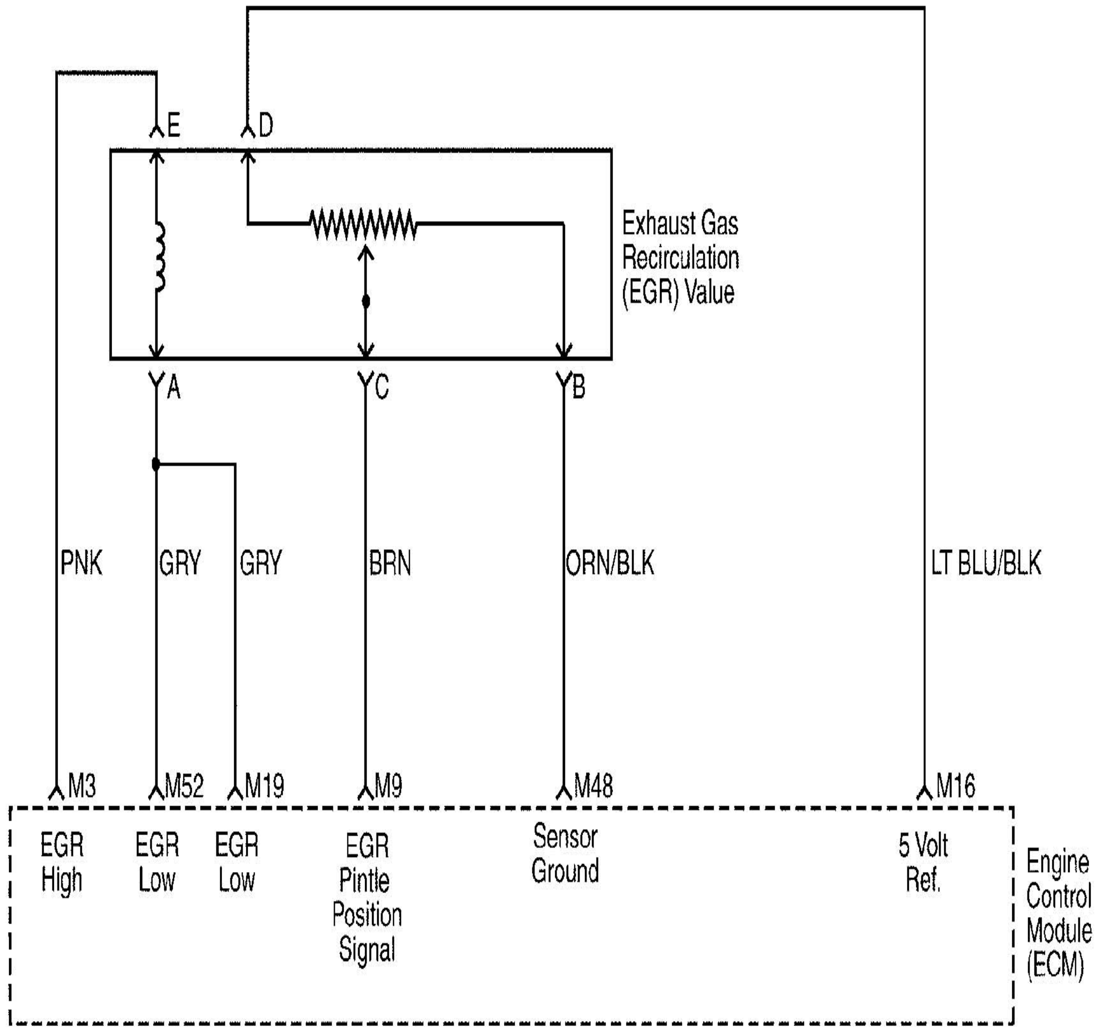
12. Check the terminals for being backed out, improperly formed or damaged, and for poor tension.
13. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.
14. If no malfunctions have been found at this point and no additional DTCs were set, refer to "Diagnostic Aids" in this section for additional checks and information.

DTC P1404 Exhaust Gas Recirculation (EGR) Closed

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON with the engine OFF. 2. Install a scan tool. 3. Command the Exhaust Gas Recirculation (EGR) valve to the specified values. Does the Actual EGR Position follow the Desired EGR Position?	25%, 50%, 75%, 100%	Go to *Step 13*	Go to *Step 3*
3	Disconnect the EGR valve electrical connector. Is the Actual EGR Position near the specified value?	100%	Go to *Step 4*	Go to *Step 5*
4	Check the signal circuit terminal C for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 6*
5	With a Digital Voltmeter (DVM) connected to ground, probe the 5 volt reference circuit terminal D to the EGR valve. Does the DVM read near the specified value?	5 v	Go to *Step 7*	Go to *Step 8*
6	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 13*	–
7	1. Connect a test light to ground. 2. Probe the EGR control circuit to the EGR valve harness connector. Does the test light illuminate?	–	Go to *Step 9*	Go to *Step 10*
8	Check the 5 volt reference circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 6*
9	Check the control circuit for a short to voltage and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 6*
10	Check the EGR sensor ground circuit for an open or poor connection at the EGR valve electrical connector and repair as necessary. Is a repair necessary.	–	Go to *Step 13*	Go to *Step 12*
11	1. Turn the ignition switch OFF. 2. Replace the EGR valve. Is the action complete?	–	Go to *Step 13*	–

DTC P1404 Exhaust Gas Recirculation Closed Valve Pintle Error (Cont'd)

Step	Action	Value	Yes	No
12	Check the ECM electrical connector for a poor connection and repair as necessary. Is a repair necessary?	–	Go to *Step 13*	Go to *Step 11*
13	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 14*	Go to *Step 2*
14	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



E
D
Exhaust Gas Recirculation (EGR) Value
A
C
B
PNK
GRY
GRY
BRN
ORN/BLK
LT BLU/BLK
M3
M52
M19
M9
M48
M16
EGR High
EGR Low
EGR Low
EGR Pintle Position Signal
Sensor Ground
5 Volt Ref.
Engine Control Module (ECM)

TAA1F290

DIAGNOSTIC TROUBLE CODE (DTC) P0405 EXHAUST GAS RECIRCULATION (EGR) PINTLE POSITION SENSOR LOW VOLTAGE

Circuit Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced.

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and the Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

This Diagnostic Trouble Code (DTC) will detect an open or short circuit.

Conditions for Setting the DTC

- Ignition voltage is between 11.7 and 16 volts.

1.5L SOHC

- EGR position is less than 2%.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.
- EGR is disabled.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Due to moisture associated with exhaust systems, the EGR valve may freeze and stick in cold weather at times. After the vehicle is brought into a warm shop for repairs, the valve warms and the problem disappears. By watching the Actual EGR and Desired EGR Positions on a cold vehicle with a scan tool, the fault can be easily verified. Check the freeze frame data to determine if the DTC set when the vehicle was cold by viewing the Engine Coolant Temperature (ECT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system can control the EGR valve accurately and if the fault is present.
3. If the EGR valve 5 volt reference is shorted to ground, the Digital Voltmeter (DVM) will read no voltage and additional DTCs may be set and the engine performance will be poor. When this circuit is open, only a DTC P0405 will be set.
4. Jumpering the 5 volt reference circuit to the signal circuit checks the signal circuit and the ECM. The scan tool should display the Actual EGR Position as 100% if the signal circuit and ECM are OK.
6. Although the ECM and circuitry acted correctly in the previous step, a problem may still lie within the terminals which would not show up in probe type testing. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
10. All circuits to the EGR valve are OK at this point. The fault lies internally in the EGR valve and therefore must be replaced. Be sure all gasket material is removed from the EGR mounting surface. Even a

small amount of material may cause a DTC P0401 to set.

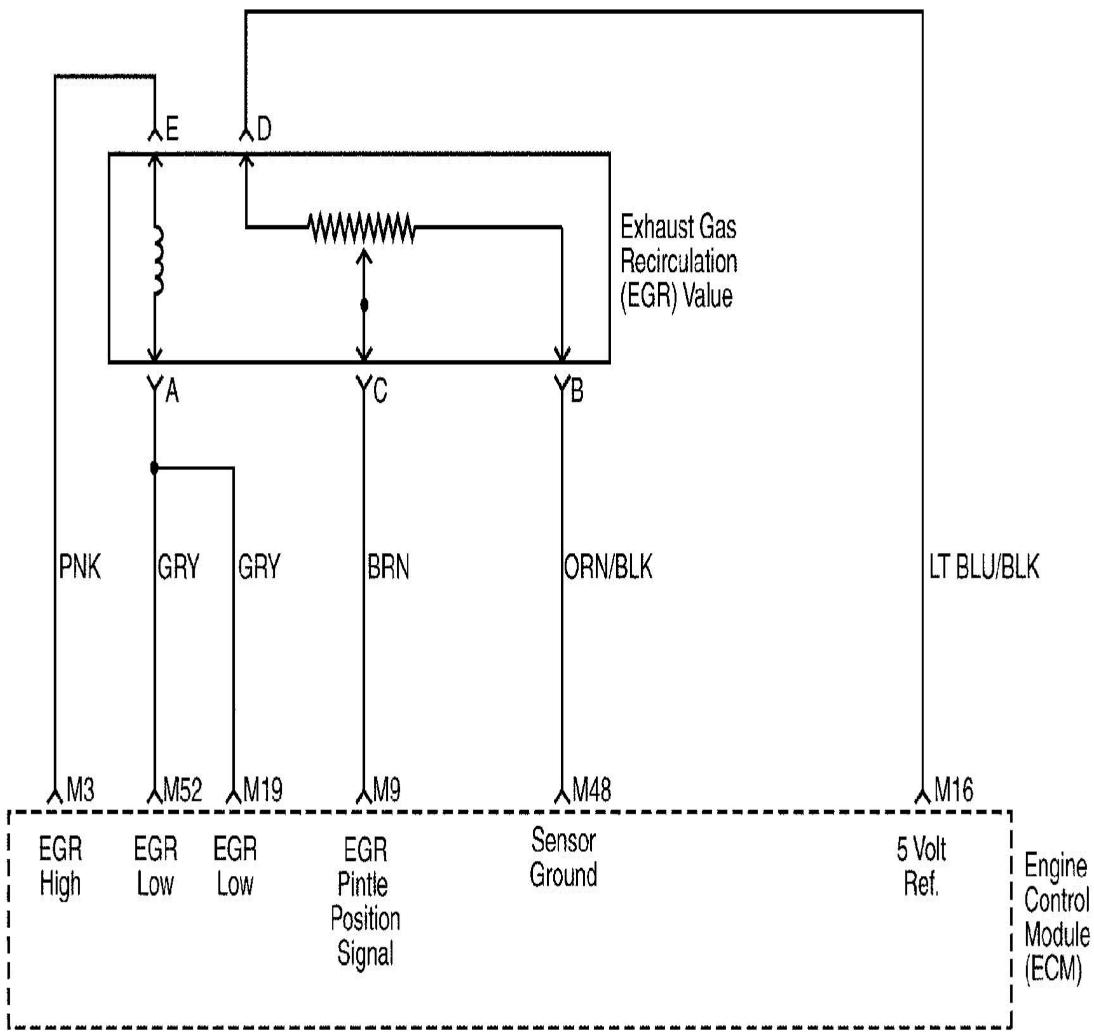
13. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
14. Check the terminals for being backed out, improperly formed or damaged, and for poor tension.
15. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.
16. If no malfunctions have been found at this point and no additional DTCs were set, refer to Diagnostic Aids for additional checks and information.

DTC P0405 Exhaust Gas Recirculation (EGR) Pintle Position Sensor Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. 3. Command the Exhaust Gas Recirculation (EGR) valve to the specified values. Does the Actual EGR Position follow the Desired EGR Position?	25%, 50%, 75%, 100%	Go to *Step 15*	Go to *Step 3*
3	1. Turn the ignition switch ON with the engine OFF. 2. Disconnect the EGR valve electrical connector. 3. With a digital voltmeter (DVM) connected to ground, probe the 5 volt reference circuit at terminal D to the EGR valve. Does the DVM read near the specified value?	5 v	Go to *Step 4*	Go to *Step 5*
4	Jumper the 5 volt reference circuit to the signal circuit at terminals D and C. Does the Actual EGR Position display the specified value?	100%	Go to *Step 6*	Go to *Step 7*
5	1. Connect the test light to B+. 2. Probe the 5 volt reference circuit to the EGR valve. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
6	Check the 5 volt reference and signal circuit for a poor connection or proper terminal tension and repair as necessary. Was a repair necessary?	–	Go to *Step 15*	Go to *Step 10*
7	1. Connect the test light to B+. 2. Probe the signal circuit at terminal C to the EGR valve. Does the test light illuminate?	–	Go to *Step 11*	Go to *Step 12*
8	Check for a short to ground in the EGR valve 5 volt reference circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 13*
9	Check for an open in the EGR 5 volt reference circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 14*

DTC P0405 Exhaust Gas Recirculation (EGR) Pintle Position Sensor Low Voltage (Cont'd)

Step	Action	Value	Yes	No
10	1. Turn the ignition switch OFF. 2. Replace the EGR valve. Is the action complete?	–	Go to *Step 15*	–
11	Check for a short to ground in the EGR valve signal circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 13*
12	Check for an open in the EGR valve signal circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 14*
13	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 15*	–
14	Check the affected circuit for a poor connection or proper terminal tension at the ECM and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 13*
15	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 16*	Go to *Step 2*
16	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK


E
D
Exhaust Gas
Recirculation
(EGR) Value
A
C
B
PNK
GRY
GRY
BRN
ORN/BLK
LT BLU/BLK
M3
M52
M19
M9
M48
M16
EGR
High
EGR
Low
EGR
Low
EGR
Pintle
Position
Signal
Sensor
Ground
5 Volt
Ref.
Engine
Control
Module
(ECM)

TAA1F290

DIAGNOSTIC TROUBLE CODE (DTC) P0406 EXHAUST GAS RECIRCULATION (EGR) PINTLE POSITION SENSOR HIGH VOLTAGE

Circuit Description

An Exhaust Gas Recirculation (EGR) system is used to lower Oxides of Nitrogen (NOx) emission levels caused by high combustion temperatures. It accomplishes this by feeding small amounts of exhaust gases back into the combustion chamber. When the air/fuel mixture is diluted with the exhaust gases, combustion temperatures are reduced.

A linear EGR valve is used on this system. The linear EGR valve is designed to accurately supply exhaust gases to the engine without the use of intake manifold vacuum. The valve controls exhaust flow going into the intake manifold from the exhaust manifold through an orifice with a engine control module (ECM) controlled pintle. The ECM controls the pintle position using inputs from the Throttle Position (TP) and Manifold Absolute Pressure (MAP) sensors. The ECM then commands the EGR valve to operate when necessary by controlling an ignition signal through the ECM. This can be monitored on a scan tool as the Desired EGR Position.

The ECM monitors the results of its command through a feedback signal. By sending a 5 volt reference and a ground to the EGR valve, a voltage signal representing the EGR valve pintle position is sent to the ECM. This feedback signal can also be monitored on a scan tool and is the actual position of the EGR pintle. The Actual EGR Position should always be near the commanded or Desired EGR Position.

Conditions for Setting the DTC

- Ignition voltage is between 11.7 and 16 volts.

1.5L SOHC

- EGR position is greater than 98%.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history Diagnostic Trouble Code (DTC) is stored.
- EGR is disabled.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Due to moisture associated with exhaust systems, the EGR valve may freeze and stick in cold weather at times. After the vehicle is brought into a warm shop for repairs, the valve warms and the problem disappears. By watching the Actual EGR and Desired EGR Positions on a cold vehicle with a scan tool, the fault can be easily verified. Check the freeze frame data to determine if the DTC set when the vehicle was cold by viewing the Engine Coolant Temperature (ECT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Commanding the EGR valve open determines whether the EGR system can control the EGR valve accurately and if the fault is present.
3. If the EGR valve 5 volt reference is shorted to ground, the Digital Voltmeter (DVM) will read no voltage and additional DTCs may be set and the engine performance will be poor. When this circuit is open, only a DTC P0405 will be set.
4. Jumpering the 5 volt reference circuit to the signal circuit checks the signal circuit and the ECM. The scan tool should display the Actual EGR Position as 100% if the signal circuit and ECM are OK.
6. Although the ECM and circuitry acted correctly in the previous step, a problem may still lie within the terminals which would not show up in probe type testing. Be sure to check the terminals for being backed out, improperly formed or damaged, and for poor tension.
10. All circuits to the EGR valve are OK at this point. The fault lies internally in the EGR valve and therefore must be replaced. Be sure all gasket material is removed from the EGR mounting surface. Even a

small amount of material may cause a DTC P0401 to set.

12. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
13. Check the terminals for being backed out, improperly formed or damaged, and for poor tension.
14. Clearing DTCs is a very important step for this diagnostic. The clearing function allows the EGR valve to relearn a new pintle position as the old pintle position was inaccurate due to the failure that caused the DTC. The DTC must be cleared with the ignition ON, engine OFF or when the engine is idling. If the ECM sees a EGR command, the new pintle will not be learned.
15. If no malfunctions have been found at this point and no additional DTCs were set, refer to Diagnostic Aids for additional checks and information.

DTC P0406 Exhaust Gas Recirculation (EGR) Pintle Position Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition switch ON, with the engine OFF. 2. Install a scan tool. 3. Command the Exhaust Gas Recirculation (EGR) valve to the specified values. Does the Actual EGR Position follow the Desired EGR Position?	25%, 50%, 75%, 100%	Go to *Step 14*	Go to *Step 3*
3	1. Turn the ignition switch ON with the engine OFF. 2. Disconnect the EGR valve electrical connector. 3. With a Digital Voltmeter (DVM) connected to ground, probe the 5 v reference circuit at terminal D to the EGR valve. Does the DVM read near the specified value?	5 v	Go to *Step 4*	Go to *Step 5*
4	Jumper the 5 volt reference circuit to the signal circuit at terminals D and C. Does the Actual EGR Position display the specified value?	100%	Go to *Step 6*	Go to *Step 7*
5	1. Connect the test light to B+. 2. Probe the 5 v reference circuit to the EGR valve. Does the test light illuminate?	–	Go to *Step 8*	Go to *Step 9*
6	Check the 5 v reference and signal circuit for a poor connection or proper terminal tension and repair as necessary. Is a repair necessary?	–	Go to *Step 14*	Go to *Step 10*
7	1. Connect the test light to ground. 2. Probe the signal circuit at terminal C to the EGR valve wiring harness connector. Does the test light illuminate?	–	Go to *Step 11*	Go to *Step 13*
8	Check for a short to ground in the EGR valve 5 v reference circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 14*	Go to *Step 12*
9	Check for an open in the EGR 5 v reference circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 14*	Go to *Step 13*

DTC P0406 Exhaust Gas Recirculation (EGR) Pintle Position Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
10	1. Turn the ignition switch OFF. 2. Replace the EGR valve. Is the action complete?	–	Go to *Step 14*	–
11	Check for a short to voltage in the EGR valve signal circuit and repair as necessary. Is a repair necessary?	–	Go to *Step 14*	Go to *Step 12*
12	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 14*	–
13	Check the affected circuit for a poor connection or proper terminal tension at the ECM and repair as necessary. Is a repair necessary?	–	Go to *Step 14*	Go to *Step 12*
14	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0420 CATALYST (OXYGEN SENSOR) LOW EFFICIENCY

System Description

In order to control exhaust emissions of Hydrocarbons (HC), Carbon Monoxide (CO) and Oxides of Nitrogen (NOx), a three-way catalytic converter is used. The catalyst within the converter promotes a chemical reaction which oxidizes the HC and CO present in the exhaust gas, converting them into harmless water vapor and carbon dioxide, and it reduces NOx, converting it into nitrogen. The catalytic converter also has the ability to store oxygen. The engine control module (ECM) has the capability to monitor this process using a Heated Oxygen Sensor (HO2S 2) located in the exhaust stream past the three-way catalytic converter. The HO2S 2 produces an output signal which indicates the oxygen storage capacity of the catalyst; this in turn indicates the catalyst's ability to convert exhaust emissions effectively. The ECM monitors the catalyst efficiency by first allowing the catalyst to heat up, waiting for a stabilization period while the engine is idling, and then adding and removing fuel while monitoring the reaction of the HO2S 2. When the catalyst is functioning properly, the HO2S 2 response to the extra fuel is slow compared to the O2S 1. When the HO2S 2 response is close to that of the O2S 1, the Oxygen storage capability or efficiency of the catalyst is considered to be bad, and the Malfunction Indicator Lamp (MIL) will be illuminated.

Conditions for Setting the DTC

- Oxygen storage capacity index time is less than 0.8 second.
- DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0137, P0138, P0140, P0141, P0171, P0172, P0201, P0202, P0203, P0204, P0300, P0336, P0337, P0341, P0342, P0351, P0352, P0402, P0404, P0405, P0406, P0502, P0506, P0507, P0562, P1133, P1134, P1167, P1171 and P1404 are not set.
- Before idle test, vehicle needs to be driven for at least: 10 seconds at airflow is greater than 7 g/sec.

Oxygen sensor storage test conditions:

- At idle and Closed Loop (C/L) stoichiometry.
- The Purge concetration learned.
- The engine run time is greater than 360 seconds.
- The airflow is between 1.6 and 6.0 g/sec.
- The Throttle Position (TP) is less than 1.5%.
- The coolant temperature is between 70°C (158°F) and 105°C (221°F).
- The Intake Air Temperature (IAT) is between –7°C (19.4°F) and 70°C (158°F).
- The Barometric Pressure (BARO) is greater than 72.0kPa.
- The catalyst temperature is between 450°C (842°F) and 850°C (1562°F).
- C/L integrator change is less than 0.04.
- The idle time is less than 1 minute.
- The vehicle speed is less than 2 mph (3 km/h).
- The BLM learned.
- Above stabilized for 5 seconds.

Test is aborted for this idle if:

- The change in the engine speed is greater than 100 rpm.
- A/C state changed.
- FAN state changed.
- Insufficient A/F shift.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be

stored in the Freeze Frame and Failure Records buffers.

- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

The catalyst test may abort due to a change in the engine load. Do not change the engine load (i.e. A/C, coolant fan, heater motor) while a catalyst test is in progress.

An intermittent problem may be caused by a poor connection, rubbed-through wire insulation, or a wire that is broken inside the insulation.

Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal-to-wire connection

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. If any component DTCs are set, diagnose those DTCs first. A fault in a component can cause the converter to appear degraded or may have caused its failure.
3. This step includes checks for conditions that can cause the three-way catalytic converter to appear degraded. Repair any problems found before proceeding with this table.
5. If the three-way catalytic converter needs to be replaced, make sure that another condition is not present which would cause the converter to become damaged. These conditions may include: misfire; high engine oil or coolant consumption; retarded spark timing or weak spark. To avoid damaging the replacement converter, correct any possible causes of converter damage before replacing the catalytic converter.
6. Clearing DTCs allows the catalyst test to be run up to 6 times this ignition cycle. Once the ignition is cycled, the test will run only once. Driving the vehicle heats the catalyst to a test temperature. The ECM must see predetermined amount of time at above idle before allowing the catalyst test to run at idle. Once at idle, the ECM will allow the system to stabilize and then test the catalyst in 2 stages.
7. If no faults have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information

DTC P0420 Catalyst (Oxygen Sensor) Low Efficiency

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Install a scan tool. Were any component Diagnostic Trouble Codes (DTCs) set?	–	Go to applicable DTC tables	Go to *Step 3*
3	Visually/physically check the following: ● Exhaust system for leaks. ● Post Heated Oxygen Sensor (HO2S 2). Is a problem found?	–	Go to *Step 4*	Go to *Step 5*
4	Repair the exhaust system as necessary. Is the action complete?	–	Go to *Step 6*	–
5	Repair the three-way catalytic converter. Is the action complete?	–	Go to *Step 5*	–
6	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 7*	Go to *Step 2*
7	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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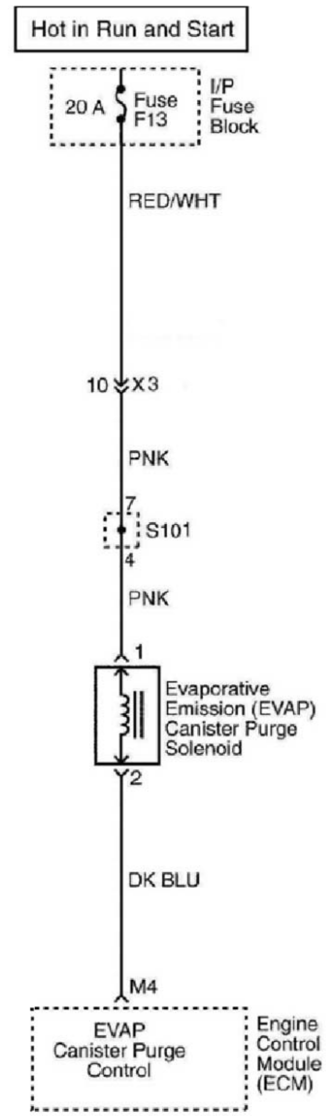

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DIAGNOSTIC TROUBLE CODE (DTC) P0443 EVAPORATIVE EMISSION (EVAP) PURGE CONTROL CIRCUIT FAULT

Circuit Description

The engine control module (ECM) supplies a ground to energize the Evaporative Emission (EVAP) canister purge solenoid valve. This solenoid valve is Pulse Width Modulated (PWM) or turned on and off several times a second. The EVAP canister purge PWM duty cycle varies according to operation conditions determined by mass air temperature. If the ECM detects open or shorted EVAP canister control circuits, DTC P0443 will set.

Conditions for Setting the DTC

- Ignition ON.
- Read the fault feedback signal from the output driver to determine short battery / ground faults.

1.5L SOHC

- Ignition voltage is greater than 11 volts.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history Diagnostic Trouble Code (DTC) is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- DTC(s) can be cleared by disconnecting the battery.
- Using a scan tool.

Diagnostic Aids

Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and the Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate the vehicle within the same freeze frame conditions (rpm, load, vehicle speed, temperature, etc.) that were noted. This will isolate when the DTC failed.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. Listen for an audible click when the solenoid operates. Be sure that both the ON and the OFF states are commanded. Repeat the commands as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open (amps drop to 0), or short (amps go above 0.75).

13. If no trouble is found in the control circuit the connection at the ECM, the ECM may be faulty, but this is an extremely unlikely failure. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0443 Evaporative Emission (EVAP) Purge Control Circuit Fault

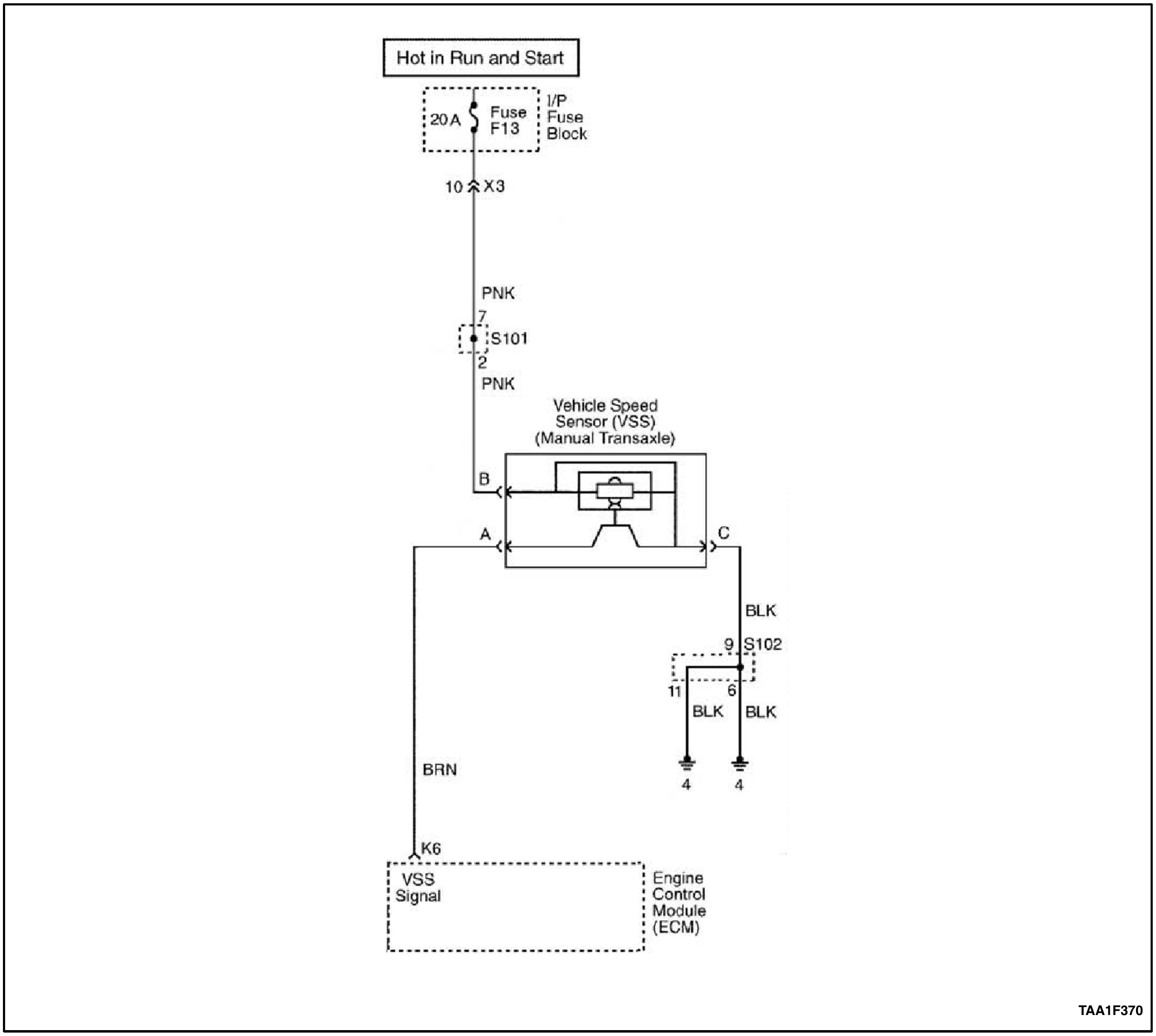
Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition ON engine OFF. 2. Install the scan tool. 3. Command the Evaporative Emission (EVAP) Purge Solenoid ON and OFF. Does the solenoid turn ON and OFF with each command?	–	Go to *Step 3*	Go to *Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the engine control module (ECM) connector containing the solenoid control circuit (red connector, engine connector – 1.5L SOHC). 3. Turn the ignition ON. 4. Using a Digital Voltmeter (DVM) on a 10 amp scale, measure the current from the solenoid control circuit, at terminal M4 in the ECM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value?	0.75 amps	Go to “Diagnostic Aids”	Go to *Step 4*

DTC P0443 Evaporative Emission (EVAP) Purge Control Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
4	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Using a DVM, measure resistance from the solenoid control circuit, at terminal M4 in the ECM harness connector to ground. Does the DVM display infinite resistance?	–	Go to *Step 12*	Go to *Step 10*
5	1. Turn the ignition OFF. 2. Disconnect the solenoid. 3. Connect a test light between the terminals 1 and 2 in the solenoid harness connector. 4. Turn the ignition ON. 5. Using the scan tool, command the solenoid ON and OFF. Does the test light turn ON and OFF with each command?	–	Go to *Step 8*	Go to *Step 6*
6	With the test light connected to ground, probe the ignition feed circuit, at terminal 1 in the solenoid harness connector. Does the test light illuminate?	–	Go to *Step 7*	Go to *Step 11*
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the ECM connector containing the solenoid control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit at terminal M4 in the ECM harness. Does the solenoid operate?	–	Go to *Step 9*	Go to *Step 10*
8	Check the connections at the solenoid. Is a problem found and corrected?	–	Go to *Step 14*	Go to *Step 12*
9	Check the connections at the ECM. Is a problem found and corrected?	–	Go to *Step 14*	Go to *Step 13*
10	Repair the faulty solenoid control circuit. Is the repair complete?	–	Go to *Step 14*	–
11	Repair the faulty solenoid ignition feed circuit. Is the repair complete?	–	Go to *Step 14*	–
12	1. Turn the ignition OFF. 2. Replace the solenoid. Is the repair complete?	–	Go to *Step 14*	–
13	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 15*	Go to *Step 2*

DTC P0443 Evaporative Emission (EVAP) Purge Control Circuit Fault (Cont'd)

Step	Action	Value	Yes	No
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0502 VEHICLE SPEED NO SIGNAL (M/T ONLY)

Circuit Description

Vehicle speed information is provided to the engine control module (ECM) by the Vehicle Speed Sensor (VSS). The VSS is a permanent magnet generator that is mounted in the transaxle and produces a pulsing voltage whenever vehicle speed is over 3 mph (5 km/h). The A/C voltage level and the number of pulses increases with vehicle speed. The ECM converts the pulsing voltage into mph (km/h) and than supplies the necessary signal to the instrument panel for speedometer/ odometer operation and to the cruise control module and multi-function alarm module operation. This Diagnostic Trouble Code (DTC) will detect if vehicle speed is reasonable according to engine rpm and load.

Conditions for Setting the DTC

- DTC(s) P0106, P0107, P0108, P0117, P0118, P0122, P0123, P0125 S P0123, P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0402, P0404, P0405, P0406 are not set.
- Engine running.
- Ignition voltage is between 11 and 16 volts.
- Coolant temperature is greater than 60°C (140°F).

1.5L SOHC

Power Test

- Indicated vehicle speed is less than 3.1 mph (5 km/h).
- Engine load is greater than 60 kPa.

- Throttle Position (TP) sensor is between 25 and 60%.
- The rpm is between 1200 and 4000.

Deceleration Test

- Indicated vehicle speed is less than 3.1 mph (5 km/h).
- Manifold Air Pressure (MAP) is less than 30 kPa.
- TP sensor is less than or equal to 0.8 %.
- The rpm is between 1200 and 6000.
- The change in RPM is less than or equal to 50 RPM/cycle.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC)consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed-through wire insulation, or a wire that is broken inside the insulation.

VSS signal circuit should be thoroughly checked for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal-to-wire connection
- Physical damage to the wiring harness

Ensure the VSS is correctly torqued to the transmission housing.

Refer to “Intermittents” in this section.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

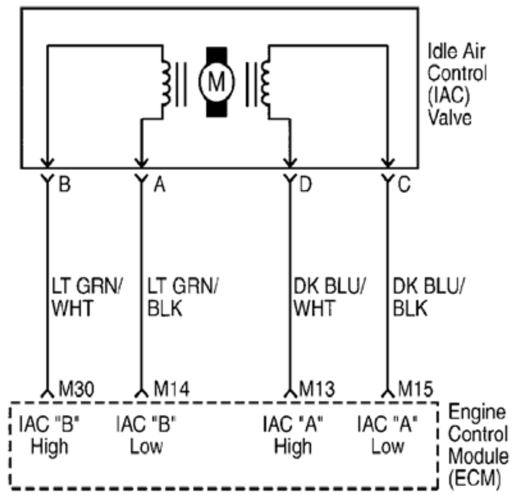
1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The permanent magnet generator only produces a signal if the drive wheels are turning greater than 3 mph (5 km/h). This step determines if DTC P0502 is the result of a hard failure or an intermittent condition.
3. Proper engine loads cannot be achieved in a shop environment to properly run the vehicle within the Freeze Frame Data conditions. It will be necessary to drive the vehicle on the road to obtain the proper engine loads.
4. This step verifies that the ECM is receiving a signal from the VSS.
6. A resistance reading that is higher than the specified value indicates that the VSS circuitry is open.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0502 Vehicle Speed No Signal (M/T Only)

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	**Notice:** Running the vehicle in gear with the wheels hanging down at full travel will damage the drive axles. 1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Raise the drive wheels. 4. Support the lower control arms so that the drive axles are in a horizontal (straight) position. 5. Allow the engine to idle in gear. Does the scan tool display vehicle speed above the specified value?	0 mph	Go to *Step 3*	Go to *Step 4*
3	1. Turn the ignition ON, with the engine OFF. 2. Review the Freeze Frame data and note the parameters. 3. Operate the vehicle within the Freeze Frame conditions and Conditions for Setting this DTC. Does the scan tool display the vehicle speed above the specified value?	0 mph	Go to *Step 12*	Go to *Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the Vehicle Speed Sensor (VSS) connector. 3. Turn the ignition ON, with the engine OFF. 4. Using a Digital Voltmeter (DVM) connected to ground, measure the voltage in the VSS signal circuit, at terminal B. Is the voltage near the specified value?	10.1 volts	Go to *Step 5*	Go to *Step 7*
5	Using a DVM, measure the voltage at terminal C of the VSS harness connector. Is the voltage near the specified value?	11-14 volts	Go to *Step 6*	Go to *Step 8*
6	Using a DVM, measure the resistance at terminal A of the VSS harness connector. Is the resistance near the specified value?	0.4k :	Go to *Step 10*	Go to *Step 9*
7	Check the VSS signal circuit for an open or short to ground and repair as necessary. Is the repair complete?	–	Go to *Step 12*	Go to *Step 11*
8	Check the ignition circuit for an open and repair as necessary. Is the repair complete?	–	Go to *Step 12*	–
9	Check the VSS ground circuit for an open and repair as necessary. Is the repair complete?	–	Go to *Step 12*	–
10	1. Turn the ignition OFF. 2. Replace the VSS. Is the repair complete?	–	Go to *Step 12*	–
11	1. Turn the ignition OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 12*	–

DTC P0502 Vehicle Speed No Signal (M/T Only) (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed.?	–	Go to *Step 13*	Go to *Step 2*
13	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



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DIAGNOSTIC TROUBLE CODE (DTC) P0506
IDLE SPEED RPM LOWER THAN DESIRED IDLE SPEED

Circuit Description

The engine control module (ECM) controls the air entering into the engine with an Idle Air Control (IAC) Valve. To increase the idle rpm, the ECM commands the pintle inside the IAC valve away from the throttle body seat. This allows more air to bypass through the throttle blade. To decrease the rpm the ECM commands the pintle towards the throttle body seat. This reduces the amount of air by-passing the throttle blade. A scan tool will read the IAC valve pintle position in counts. The higher the counts, the more air that is allowed to bypass the throttle blade. This Diagnostic Trouble Code (DTC) determines if a low idle condition exists as defined as 100 rpm below the desired idle rpm.

Conditions for Setting the DTC

- Idle engine speed error is greater than 100 rpm for 10 seconds.

1.5L SOHC

- No intrusive tests are active.
- DTC(s) P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0502, P0122, P0123, P0131, P0132, P0133, P1133, P1134, P0141, P1171, P0171, P0172, P0201, P0202, P0203, P0204, P0300, P0336, P0337, P0341, P0342, P0351, P0352, P0402, P0404, P1404, P0405, P0406 and P0443 are not set.
- Engine run time is greater than 60 seconds.
- Barometric Pressure (BARO) is greater than 72 kPa.
- Engine coolant temperature is greater than 60°C (140°F).
- Ignition voltage is between 11 and 16 volts.
- Intake Air Temperature (IAT) is greater than –20°C (–4°F).
- IAC valve is controlled fully open.
- All of the above must be met for greater than 5 seconds.
- Manifold Air Pressure (MAP) is less than 60 kPa.

Action Taken When the DTC Sets

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Inspect the IAC valve electrical connection for proper mating.

Inspect the wiring harness for damage.

Inspect throttle stop screw for signs of tampering.

Inspect throttle linkage for signs of binding or excessive wear.

A slow, or unstable idle may be caused by one of the following conditions:

- Fuel system too rich or too lean.
- Foreign material in the throttle body bore or in the air induction system.
- A leaking or restricted intake manifold.
- Excessive engine overloading. Check for seized pulleys, pumps, or motors on the accessory drive,
- Overweight engine oil.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

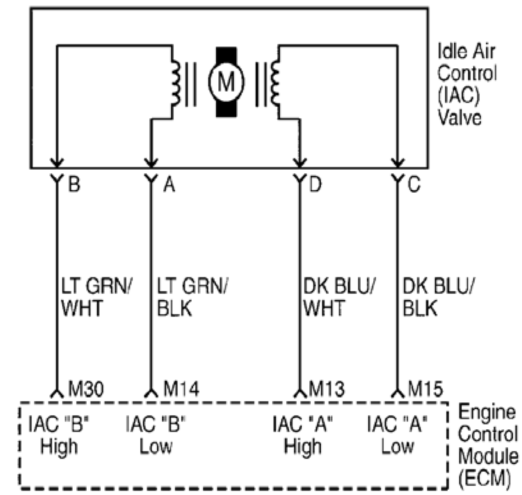
1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. A normally operating IAC system will be able to be extended and retracted by a scan tool and change the engine idle rpm. Valve movement is verified by an engine rpm change.
3. If the scan tool was able to command the IAC valve smoothly, a malfunction may still exist internally within the IAC valve. This can be checked by checking the IAC valves internal resistance.
5. The IAC circuits always have ground or voltage signals on them in pairs. If the test light illuminates on more or less than 2 terminals, 1 of the circuits is shorted to voltage or open.
6. The IAC circuits always have ground or voltage signals on them in pairs. If the test light illuminates on more or less than 2 terminals, 1 of the circuits is shorted to ground or open
8. The IAC circuits are constantly switched between ground and voltage so the test light should blink on all circuits when connected to ground.
10. Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.
12. A test light that remains ON constantly indicates that the circuit is shorted to voltage.
14. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
16. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0506 Idle Speed RPM Lower Than Desired Idle Speed

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition switch ON with the engine OFF. 2. Engine at normal operating temperature. 3. Transmission in park or neutral and the parking brake set. 4. A/C is Off. 5. Install a scan tool and command the Idle Air Control (IAC) valve up and down between the specified values. Does the engine rpm change smoothly when commanded by the scan tool?	900-2000 rpm	Go to *Step 3*	Go to *Step 5*
3	1. Turn the ignition switch OFF. 2. Disconnect the IAC valve electrical connector. 3. Measure the resistance across the IAC valve terminals A and B. 4. Measure the resistance across the IAC terminals C and D. Is the resistance across terminals A and B and terminals C and D within the specified value?	40-80 :	Go to *Step 4*	Go to *Step 13*
4	1. Measure the resistance across the IAC valve terminals B and C. 2. Measure the resistance across the IAC terminals A and D. Is the resistance across terminals B and C and terminals A and D infinite?	–	Go to *Step 15*	Go to *Step 13*
5	1. Turn the Ignition switch ON with the engine OFF. 2. Disconnect the IAC valve electrical connector. 3. With a test light connected to ground, probe the IAC electrical connector terminals. Does the test light illuminate on 2 terminals.	–	Go to *Step 6*	Go to *Step 7*
6	With a test light connected to B+, probe the IAC electrical connector terminals. Does the test light illuminate on 2 terminals?	–	Go to *Step 8*	Go to *Step 9*
7	Check for an open or short to ground in the IAC valve high and low circuits and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 10*
8	1. Idle the engine. 2. Connect a test light to ground, probe the IAC electrical connector terminals. Does the test light flash ON and OFF for all terminals?	–	Go to *Step 11*	Go to *Step 12*
9	Check for an open or a short to voltage in the IAC valve high and low circuits and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 10*
10	Check the engine control module (ECM) electrical connector for poor connections and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 14*

DTC P0506 Idle Speed RPM Lower Than Desired Idle Speed (Cont'd)

Step	Action	Value	Yes	No
11	Inspect the IAC valve passages. Is a problem found?	–	Go to *Step 15*	Go to *Step 13*
12	Check the test light. Does the test light remain ON constantly for the terminals that did not blink?	–	Go to *Step 9*	Go to *Step 7*
13	1. Turn the ignition OFF. 2. Replace the IAC valve. Is the action complete?	–	Go to *Step 15*	–
14	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 15*	–
15	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 16*	Go to *Step 2*
16	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0507 IDLE SPEED RPM HIGHER THAN DESIRED IDLE SPEED

Circuit Description

The engine control module (ECM) controls the air entering into the engine with an Idle Air Control (IAC) Valve. To increase the idle rpm, the ECM commands the pintle inside the IAC valve away from the throttle body seat. This allows more air to bypass through the throttle blade. To decrease the rpm the ECM commands the pintle towards the throttle body seat. This reduces the amount of air bypassing the throttle blade. A scan tool will read the IAC valve pintle position in counts. The higher the counts, the more air that is allowed to bypass the throttle blade. This Diagnostic Trouble Code (DTC) determines if a high idle condition exists as defined as 200 rpm above the desired idle rpm.

Conditions for Setting the DTC

- Idle engine speed error is greater than 200 rpm for 10 seconds.

1.5L SOHC

- No intrusive tests are active.
- DTC(s) P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0502, P0122, P0123, P0131, P0132, P0133, P1133, P1134, P0141, P1171, P0171, P0172, P0201, P0202, P0203, P0204, P0300, P0336, P0337, P0341, P0342, P0351, P0352, P0402, P0404, P1404, P0405, P0406 and P0443 are not set.
- Engine run time is greater than 60 seconds.
- Barometric Pressure (BARO) is greater than 72 kPa.
- Engine coolant temperature is greater than 60°C (140°F).
- Ignition voltage is between 11 and 16 volts.
- Intake Air Temperature (IAT) is greater than –20°C (–4°F).
- IAC valve is controlled fully closed.
- All of the above must be met for greater than 5 seconds.
- Manifold Air Pressure is greater than 30 kPa.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate after three (1.5L SOHC) consecutive trip with a fail.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Inspect the IAC valve electrical connection for proper mating.

Inspect the wiring harness for damage.

Inspect throttle stop screw for signs of tampering.

Inspect throttle linkage for signs of binding or excessive wear.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. A normally operating IAC system will be able to be extended and retracted by a scan tool and change the engine idle rpm. Valve movement is verified by an engine rpm change.
3. If the scan tool was able to command the IAC valve smoothly, a malfunction may still exist internally within the IAC valve. This can be checked by checking the IAC valves internal resistance.
5. The IAC circuits always have ground or voltage signals on them in pairs. If the test light illuminates on more or less than 2 terminals, 1 of the circuits is shorted to voltage or open.
6. The IAC circuits always have ground or voltage signals on them in pairs. If the test light illuminates on more or less than 2 terminals, 1 of the circuits is shorted to ground or open
8. The IAC circuits are constantly switched between ground and voltage so the test light should blink on all circuits when connected to ground.
10. Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wiring connections or physical damage to the wiring harness.
12. A test light that remains ON constantly indicates that the circuit is shorted to voltage.
14. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
16. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0507 Idle Speed RPM Higher Than Desired Idle Speed

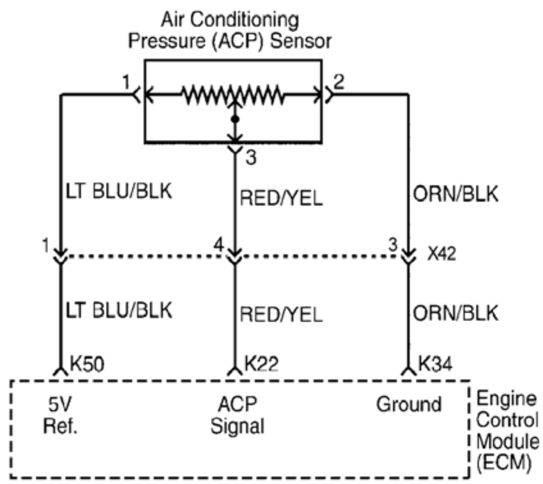
Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition switch ON, with the engine OFF. 2. Engine at normal operating temperature. 3. Transmission in park or neutral and the parking brake set. 4. A/C is Off. 5. Install a scan tool and command the Idle Air Control (IAC) valve up and down between the specified values. Does the engine rpm change smoothly when commanded by the scan tool?	900-2000 rpm	Go to *Step 3*	Go to *Step 5*

DTC P0507 Idle Speed RPM Higher Than Desired Idle Speed (Cont'd)

Step	Action	Value	Yes	No
3	1. Turn the ignition switch OFF. 2. Disconnect the IAC valve electrical connector. 3. Measure the resistance across the IAC valve terminals A and B. 4. Measure the resistance across the IAC terminals C and D. Are the resistance across terminals A and B and terminals C and D within the specified value?	40-80 :	Go to *Step 4*	Go to *Step 13*
4	1. Measure the resistance across the IAC valve terminals B and C. 2. Measure the resistance across the IAC terminals A and D. Is the resistance across terminals B and C and terminals A and D infinite?	–	Go to *Step 15*	Go to *Step 13*
5	1. Turn the Ignition switch ON with the engine OFF. 2. Disconnect the IAC valve electrical connector. 3. With a test light connected to ground, probe the IAC electrical connector terminals. Does the test light illuminate on 2 terminals.	–	Go to *Step 6*	Go to *Step 7*
6	With a test light connected to B+, probe the IAC electrical connector terminals. Does the test light illuminate on 2 terminals?	–	Go to *Step 8*	Go to *Step 9*
7	Check for an open or short to ground in the IAC valve high and low circuits and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 10*
8	1. Idle the engine. 2. Connect a test light to ground, probe the IAC electrical connector terminals. Does the test light flash ON and OFF for all terminals?	–	Go to *Step 11*	Go to *Step 12*
9	Check for an open or a short to voltage in the IAC valve high and low circuits and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 10*
10	Check the engine control module (ECM) electrical connector for poor connections and repair as necessary. Is a repair necessary?	–	Go to *Step 15*	Go to *Step 14*
11	Inspect the IAC valve passages. Is a problem found?	–	Go to *Step 15*	Go to *Step 13*
12	Check the test light. Does the test light remain ON constantly for the terminals that did not blink?	–	Go to *Step 9*	Go to *Step 7*
13	1. Turn the ignition OFF. 2. Replace the IAC valve. Is the action complete?	–	Go to *Step 15*	–
14	1. Turn the ignition OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 15*	–

DTC P0507 Idle Speed RPM Higher Than Desired Idle Speed (Cont'd)

Step	Action	Value	Yes	No
15	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 16*	Go to *Step 2*
16	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P0532 A/C PRESSURE SENSOR LOW VOLTAGE

Circuit Description

The A/C system uses an A/C refrigerant pressure sensor mounted in the high pressure side of the A/C refrigerant system to monitor A/C refrigerant pressure. The engine control module (ECM) uses this information to turn ON the engine coolant fans when the A/C refrigerant pressure is high and to keep the compressor disengaged when A/C refrigerant pressure is excessively high or low.

The Air Conditioning Pressure (ACP) sensor operates like other 3-wire sensors. The ECM applies a 5.0 volt reference and a sensor ground to the sensor. Changes in the A/C refrigerant pressure will cause the ACP sensor input to the ECM to vary. The ECM monitors the ACP sensor signal circuit and can determine when the signal is outside of the possible range of the sensor. When the signal is out of range for a prolonged period of time, the ECM will not allow the A/C compressor clutch to engage. This is done to protect the compressor.

Conditions for Setting the DTC

1.5L SOHC

- Raw A/C pressure is less than 1% of sensor reading scale
- Engine running.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- The A/C compressor operation will be disabled while the low voltage indication exists.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection at the ECM.

Inspect the wiring harness for damage. If the harness appears to be OK, observe the A/C pressure display on the scan tool while moving the connectors and wiring harnesses related to the ACP sensor. A change in the A/C pressure display will indicate the location of the fault.

If DTC P0532 cannot be duplicated, reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to set occurs. This may assist in diagnosing the condition.

Test Description

Numbers below refer to the step numbers on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This

creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

2. Normal ACP sensor signal voltage is between 0.1 and 4.9 volts. If A/C voltage is within range, review Fail Records data to determine the conditions that were present when DTC P0532 set.
6. The scan tool may not display 5 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and the signal circuit are OK. A test light that illuminates indicates a short to ground in the signal circuit.
7. A short to ground in the 5 volt reference circuit could also set additional DTCs.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0532 A/C Pressure Sensor Low Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	With engine idling, install a scan tool. Does the scan tool display Air Conditioning Pressure (ACP) voltage below the specified value?	0.06 v	Go to *Step 3*	Go *Step 4*
3	1. Turn the ignition switch OFF. 2. Disconnect the ACP sensor electrical connector. 3. Jumper the ACP signal circuit, terminal 3 to the 5 volt reference circuit, terminal 1. 4. Turn the ignition switch on. Does the ACP voltage read more than the specified value?	4.9 v	Go to *Step 5*	Go to *Step 6*
4	1. Turn the ignition switch ON, with the engine OFF, review the Freeze Frame data and note the parameters. 2. Operate the vehicle within the freeze frame conditions and Conditions For Setting the DTC as noted. Does the scan tool display ACP voltage below the specified value?	0.06 v	Go to *Step 3*	Go to "Diagnostic Aids"
5	Inspect the ACP sensor harness electrical connector terminals for the following conditions: ● Poor connections ● Proper contact tension ● Poor terminal-to-wire connection Is a problem found?	–	Go to *Step 8*	Go to *Step 9*
6	1. Turn the ignition switch OFF. 2. Remove the jumper wire. 3. Probe the ACP sensor signal circuit terminal 3 with a test light to B+. 4. Turn the ignition switch ON. Does the scan tool read over the specified value?	4.0 v	Go to *Step 7*	Go to *Step 12*
7	Check the ACP sensor 5 volt reference circuit for an open or short to ground. Is a problem found?	–	Go to *Step 10*	Go to *Step 11*
8	Repair the connection terminals as necessary. Is the action complete?	–	Go to *Step 14*	–

DTC P0532 A/C Pressure Sensor Low Voltage (Cont'd)

Step	Action	Value	Yes	No
9	1. Turn the ignition switch OFF. 2. Replace the ACP sensor. Is the action complete?	–	Go to *Step 14*	–
10	Repair the ACP sensor 5 volt reference circuit. Is the action complete?	–	Go to *Step 14*	–
11	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 14*	–
12	Check the ACP sensor signal circuit for the following conditions: ● Open ● Short to ground ● Short to sensor ground Is a problem found?	–	Go to *Step 13*	Go to *Step 11*
13	Repair the ACP sensor signal circuit. Is the action complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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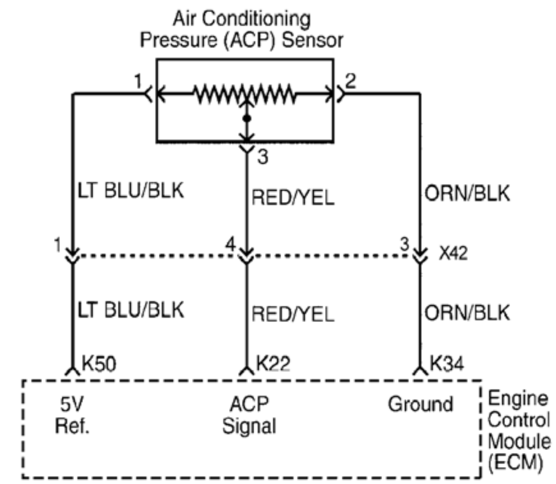

T/A1F340

DIAGNOSTIC TROUBLE CODE (DTC) P0533
A/C PRESSURE SENSOR HIGH VOLTAGE

Circuit Description

The A/C system uses an A/C refrigerant pressure sensor mounted in the high pressure side of the A/C refrigerant system to monitor A/C refrigerant pressure. The engine control module (ECM) uses this information to turn ON the engine coolant fans when the A/C refrigerant pressure is high and to keep the compressor disengaged when A/C refrigerant pressure is excessively high or low.

The Air Conditioning Pressure (ACP) sensor operates like other 3-wire sensors. The ECM applies a 5.0 volt reference and a sensor ground to the sensor. Changes in the A/C refrigerant pressure will cause the ACP sensor input to the ECM to vary. The ECM monitors the ACP sensor signal circuit and can determine when the signal is outside of the possible range of the sensor. When the signal is out of range for a prolonged period of time, the ECM will not allow the A/C compressor clutch to engage. This is done to protect the compressor.

Conditions for Setting the DTC

1.5L SOHC

- Raw A/C pressure is greater than 99% of sensor reading scale.
- Engine running.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- The A/C compressor operation will be disabled while the low voltage indication exists.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection at the ECM.

Inspect the wiring harness for damage. If the harness appears to be OK, observe the A/C pressure display on the scan tool while moving the connectors and wiring harnesses related to the ACP sensor. A change in the A/C pressure display will indicate the location of the fault.

If DTC P0533 cannot be duplicated, reviewing the Fail Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to set occurs. This may assist in diagnosing the condition.

Test Description

Numbers below refer to the step numbers on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This

creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.

2. Normal ACP sensor signal voltage is between 0.1 and 4.9 volts. If A/C voltage is within range, review Fail Records data to determine the conditions that were present when DTC P0533 set.
6. The scan tool may not display 5 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and the signal circuit are OK. A test light that illuminates indicates a short to ground in the signal circuit.
7. A short to ground in the 5 volt reference circuit could also set additional DTCs.
11. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0533 A/C Pressure Sensor High Voltage

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	With engine idling, install a scan tool. Does the scan tool display Air Conditioning Pressure (ACP) voltage below the specified value?	4.9 v	Go to *Step 3*	Go *Step 4*
3	1. Turn the ignition switch OFF. 2. Disconnect the ACP sensor electrical connector. 3. Jumper the ACP signal circuit, terminal 3 to the 5 volt reference circuit, terminal 1. 4. Turn the ignition switch ON. Does the ACP voltage read more than the specified value?	4.9 v	Go to *Step 5*	Go to *Step 6*
4	1. Turn the ignition switch ON, with the engine OFF, review the Freeze Frame data, and note the parameters. 2. Operate the vehicle within the freeze frame conditions and Conditions For Setting the DTC as noted. Does the scan tool display ACP voltage above the specified value?	4.9 v	Go to *Step 3*	Go to "Diagnostic Aids"
5	Inspect the ACP sensor harness electrical connector terminals for the following conditions: • Poor connections • Proper contact tension • Poor terminal to wire connection Is a problem found?	–	Go to *Step 8*	Go to *Step 9*
6	1. Turn the ignition switch OFF. 2. Remove the jumper wire. 3. Probe the ACP sensor signal circuit terminal 3 with a test light to B+. 4. Turn the ignition switch ON. Does the scan tool read over the specified value?	4.0 v	Go to *Step 7*	Go to *Step 12*
7	Check the ACP sensor 5 volt reference circuit for an open or short to ground. Is a problem found?	–	Go to *Step 10*	Go to *Step 11*
8	Repair the connection terminals as necessary. Is the action complete?	–	Go to *Step 14*	–

DTC P0533 A/C Pressure Sensor High Voltage (Cont'd)

Step	Action	Value	Yes	No
9	1. Turn the ignition switch OFF. 2. Replace the ACP sensor. Is the action complete?	–	Go to *Step 14*	–
10	Repair the ACP sensor 5 volt reference circuit. Is the action complete?	–	Go to *Step 14*	–
11	1. Turn the ignition switch OFF. 2. Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 14*	–
12	Check the ACP sensor signal circuit for the following conditions: ● Short to voltage ● Short to sensor 5 volt reference circuit Is a problem found?	–	Go to *Step 13*	Go to *Step 11*
13	Repair the ACP sensor signal circuit. Is the action complete?	–	Go to *Step 14*	–
14	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the Conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 15*	Go to *Step 2*
15	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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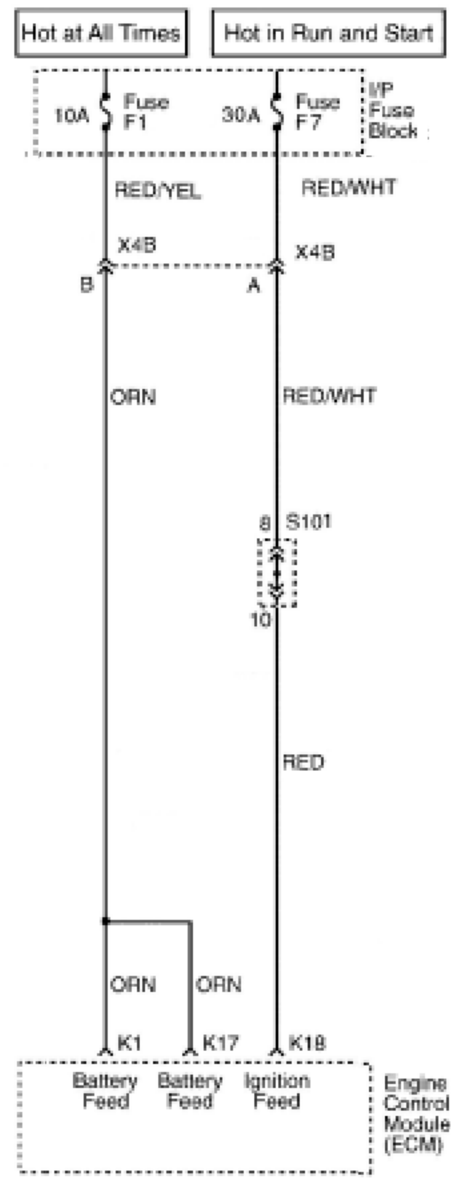

TAA1F200

DIAGNOSTIC TROUBLE CODE (DTC) P0562 SYSTEM VOLTAGE (ENGINE SIDE) TOO LOW

Circuit Description

The engine control module (ECM) monitors the ignition voltage on the ignition feed circuit to terminal K18 1.5L SOHC at the ECM. A system voltage Diagnostic Trouble Code (DTC) will set whenever the voltage is below a calibrated value.

Conditions for Setting the DTC

- Ignition ON.
- The system voltage is less than 11 volts 1.5L SOHC).

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.

Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal-to-wiring connections
- Physical damage to the wiring harness

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This checks if the generator is malfunctioning under load conditions.
4. Checks the ignition feed circuit for excessive resistance. An open circuit will cause a no start condition.
7. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
9. If no malfunctions have been found at this point and no additional DTCs were set, refer to “Diagnostic Aids” in this section for additional checks and information.

DTC P0562 System Voltage (Engine Side) Too Low

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and raise the engine speed to the specified value. 3. Load the electrical system by turning on the headlights, high blower motor, etc. Is the ignition voltage less than the specified value?	1400 rpm 10 v	Go to *Step 3*	Go to *Step 8*
3	1. With the engine still running at the specified value. 2. Using a Digital Voltmeter (DVM), measure the battery voltage at the battery. Is the battery voltage greater than the specified value?	1400 rpm 12 v	Go to *Step 4*	Go to “Diagnostic Aids”
4	1. Turn the ignition switch OFF. 2. Disconnect the engine control module (ECM) connector at the ECM. 3. Turn the ignition switch ON with the engine OFF. 4. Using a DVM, measure the ignition voltage at the ignition feed circuit, terminal K18. Is the ignition voltage greater than the specified value?	10 v	Go to *Step 5*	Go to *Step 6*
5	Check for a malfunctioning connection at the ECM harness terminals and repair as necessary. Is a repair necessary?	–	Go to *Step 8*	Go to *Step 7*

DTC P0562 System Voltage (Engine Side) Too Low (Cont'd)

Step	Action	Value	Yes	No
6	Repair the poor connection (high resistance) in the ignition feed circuit. Is the action complete?	–	Go to *Step 8*	–
7	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the action complete?	–	Go to *Step 8*	–
8	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to Step 9	Go to Step 2
9	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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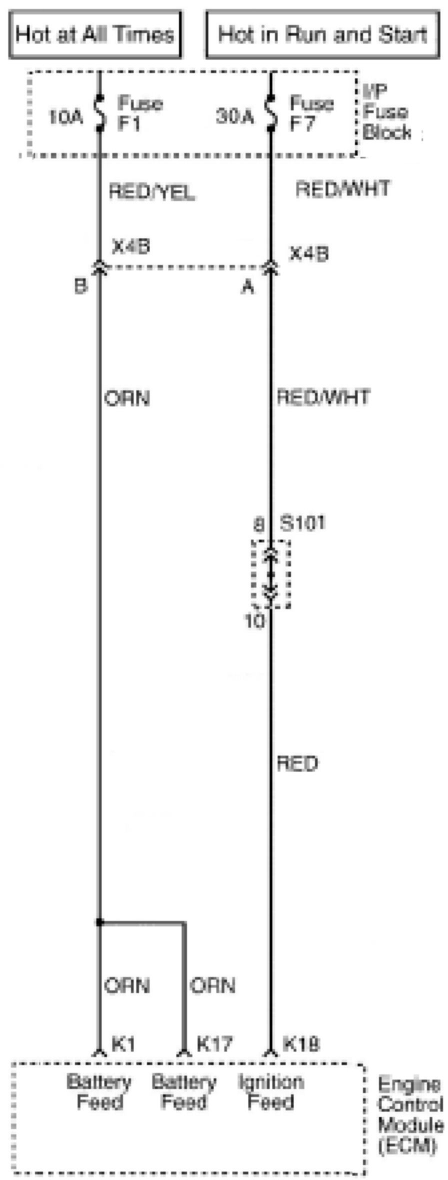

TAA1F200

DIAGNOSTIC TROUBLE CODE (DTC) P0563 SYSTEM VOLTAGE (ENGINE SIDE) TOO HIGH

Circuit Description

The engine control module (ECM) monitors the ignition voltage on the ignition feed circuit to terminal K18 1.5L SOHC at the ECM. A system voltage Diagnostic Trouble Code (DTC) will set whenever the voltage is below a calibrated value.

Conditions for Setting the DTC

- Ignition ON.
- The ignition voltage is greater than 16 volts.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Diagnostic Aids

If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.

Any circuitry, that is suspected as causing the intermittent complaint, should be thoroughly checked for the following conditions:

- Backed-out terminals
- Improper mating
- Broken locks
- Improperly formed
- Damaged terminals
- Poor terminal-to-wiring connections
- Physical damage to the wiring harness

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. This checks if the generator is malfunctioning under load conditions.
4. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.
6. If no malfunctions have been found at this point and no additional DTCs were set, refer to "Diagnostic Aids" in this section for additional checks and information.

DTC P0563 System Voltage (Engine Side) Too High

Step	Action	Value(s)	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Install a scan tool and clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and raise the engine speed to the specified value. 3. Load the electrical system by turning on the headlights, high blower motor, etc. Is the ignition voltage greater than the specified value?	1400 rpm 16 v	Go to *Step 3*	Go to *Step 5*
3	1. With the engine still running at the specified value. 2. Using a Digital Voltmeter (DVM), measure the battery voltage at the battery. Is the battery voltage less than the specified value?	1400 rpm 16 v	Go to *Step 4*	Go to "Diagnostic Aids"
4	1. Turn the ignition switch OFF. 2. Replace the ECM. Is the repair complete?	–	Go to *Step 5*	–
5	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 6*	Go to *Step 2*
6	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0601 ECM CHECKSUM ERROR

Circuit Description

The engine control module (ECM) is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM also performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the Malfunction Indicator Lamp (MIL) (Check Engine), and store a Diagnostic Trouble Code (DTC) or DTCs which identify the problem areas to aid the technician in making repairs. An Electrically Erasable Programmable Read Only Memory (EEPROM) is used to house the program information and the calibrations required for engine, transmission, and powertrain diagnostics operation. The ECM uses a value called a checksum for error detection of the software. The checksum is a value that is equal to all the numbers in the software added together. The ECM adds all the values in the software and if that value does not equal the checksum value, a checksum error is indicated.

Conditions for Setting the DTC

- The ECM detects incorrect checksums.
- Program ID is not equal to value in S/W.

Action Taken When the DTC Sets

- The MIL will illuminate.
- The ECM will attempt to record operating conditions at the time the failure is detected. However, since this is an internal ECM failure, this information may or may not be reliable. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The MIL will turn off after three (four – 1.5L SOHC) consecutive ignition cycles in which the diagnostic runs without a fault.
- A history DTC will clear after 40 consecutive warm up cycles without a fault.
- DTC(s) can be cleared by using the scan tool.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

1. The On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P0601 ECM Checksum Error

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	Replace the engine control module (ECM). Is the action complete?	–	Go to *Step 3*	–
3	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic has run and passed?	–	Go to *Step 4*	Go to *Step 2*
4	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P0607 LOWER POWER COUNTER ERROR (1.5L SOHC)

System Description

Engine Control Module (ECM) verifies operation of Lower Power Counter (LPC) I/C and communication between LPC and main CPU. The ECM monitors Serial Peripheral Interface (SPI) bits and countdown rate of I/C once per key cycle. If test fails, Diagnostic Trouble Code (DTC) P0607 will be set.

Conditions For Setting The DTC

- Ignition ON.
- Ignition voltage is greater than 11 volts.
- Engine runtime is greater than 10 seconds.

Action Taken When The DTC Sets

- The Malfunction Indicator Lamp will not illuminate.
- The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored in the Freeze Frame data.
- A history DTC is stored.

Conditions For Clearing The DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The replacement ECM must be reprogrammed. Refer to the least Techline procedure for ECM reprogramming.

DTC P0607 – Lower Power Counter Error (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition OFF. 2. Replace the Engine Control Module (ECM). Is the repair complete?	–	Go to *Step 3*	–
3	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 4*	Go to *Step 2*
4	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P1607
LOWER POWER COUNTER RESET (1.5L SOHC)

System Description

Engine Control Module (ECM) detects if Lower Power Counter (LPC) I/C has been reset due to battery disconnect or LPC I/C malfunction. The ECM monitors NVRAM reset flag and LPC I/C overflow bit once per key cycle. If test fails, Diagnostic Trouble Code (DTC) P1607 will be set.

Conditions For Setting The DTC

- Ignition ON.
- Engine not running.

Action Taken When The DTC Sets

- The Malfunction Indicator Lamp will not illuminate.
- The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored in the Freeze Frame data.
- A history DTC is stored.

Conditions For Clearing The DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
2. The replacement ECM must be reprogrammed. Refer to the least Techline procedure for ECM reprogramming.

DTC P1607 – Lower Power Counter Reset (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diagnostic System Check”
2	1. Turn the ignition OFF. 2. Replace the Engine Control Module (ECM). Is the repair complete?	–	Go to *Step 3*	–
3	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 4*	Go to *Step 2*
4	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

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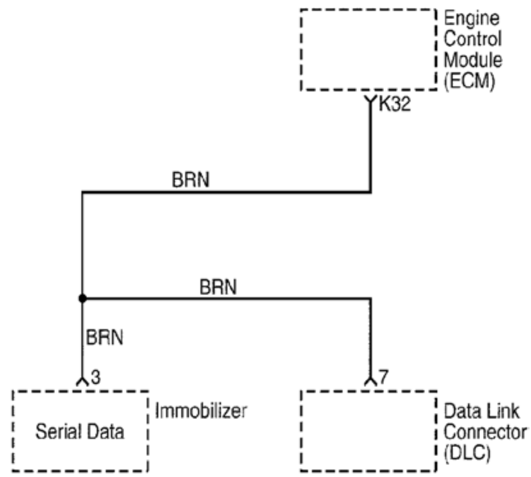


DIAGNOSTIC TROUBLE CODE (DTC) P1626 IMMOBILIZER NO PASSWORD

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 anti-theft 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 defect 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.
- Disables the ignition coil.

Conditions for Setting the DTC

- Ignition ON.
- ECM release time window expired.

1.5L SOHC

- Immobilizer option auto detected.
- Vehicle Speed Sensor (VSS) is less than 318 mph (512 km/h).

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

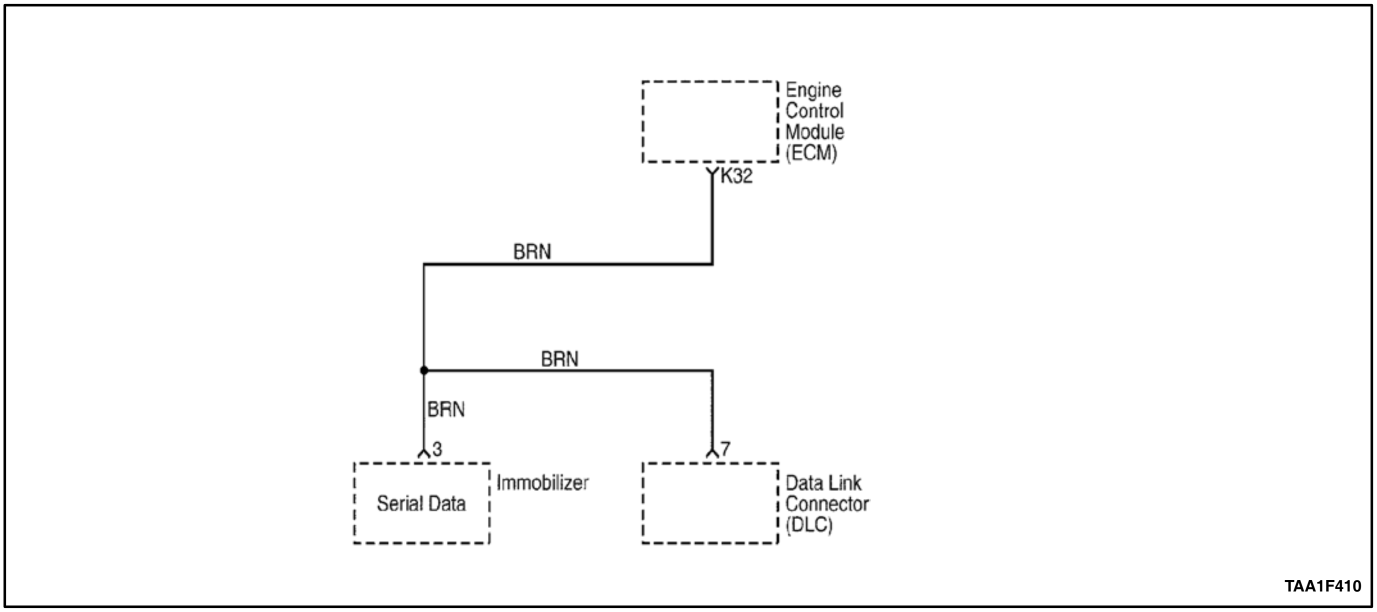
Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1626 Immobilizer No Password

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install the scan tool. Is communication established between the scan tool and the immobilizer control unit?	–	Go to *Step 3*	Go to *Section 9T "Communication Between Immobilizer and Test Equipment"*
3	Select IMMOBILIZER DIAGNOSIS STATUS from the scan tool menu. Does the KEY STATUS message indicate "THIS KEY IS GOOD?"	–	Go to *Step 4*	Go to *Section 9T "Key Status Errors"*
4	1. Select IMMOBILIZER DIAGNOSIS STATUS from the scan tool menu. 2. Read the IMMO & ECM–CODE message. Does the message ID–CODES ARE SAME appear?	–	Go to *Step 5*	Go to *Section 9T "Identification (ID) Code Re-programming"*
5	Check for an open serial data wire between the immobilizer control unit and the engine control module (ECM) and repair as necessary. Is the repair complete?	–	Go to *Step 7*	Go to *Step 6*
6	1. Turn the ignition OFF. 2. Replace the ECM. 3. Reprogram the identification (ID) code. Refer to Section *9T, Immobilizer Anti-Theft System*. Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK



DIAGNOSTIC TROUBLE CODE (DTC) P1631 IMMOBILIZER INCORRECT PASSWORD

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 anti-theft 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 defect 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.
- Disables the ignition coil.

Conditions for Setting the DTC

- Ignition ON.
- ECM release time window expired.
- Immobilizer option selected.

1.5L SOHC

- Vehicle Speed Sensor (VSS) is less than 318 mph (512 km/h).

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
6. The replacement ECM must be reprogrammed. Refer to the latest Techline procedure for ECM reprogramming.

DTC P1631 – Immobilizer Incorrect Password

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to “On-Board Diag-nostic System Check”
2	1. Turn the ignition ON, with the engine OFF. 2. Install the scan tool. Is communication established between the scan tool and the immobilizer control unit?	–	Go to *Step 3*	Go to *Section 9T “Communication Between Immobilizer and Test Equipment”*
3	Select IMMOBILIZER DIAGNOSIS STATUS from the scan tool menu. Does the KEY STATUS message indicate “THIS KEY IS GOOD?”	–	Go to *Step 4*	Go to *Section 9T “Key Status Errors”*
4	1. Select IMMOBILIZER DIAGNOSIS STATUS from the scan tool menu. 2. Read the IMMO & ECM–CODE message. Does the message ID–CODES ARE SAME appear?	–	Go to *Step 5*	Go to *Section 9T “Identification (ID) Code Re-programming”*
5	Check for an open serial data wire between the immobilizer control unit and the engine control module (ECM) and repair as necessary. Is the repair complete?	–	Go to *Step 7*	Go to *Step 6*
6	1. Turn the ignition OFF. 2. Replace the ECM. 3. Reprogram the identification (ID) code. Refer to *Section 9T, Immobilizer Anti-Theft System.* Is the repair complete?	–	Go to *Step 7*	–
7	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as supported in the text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 8*	Go to *Step 2*
8	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P1650 SPI COMMUNICATIONS BETWEEN ERROR WITH SIDM CHIP (1.5L SOHC)

System Description

Engine Control Module (ECM) detects if Serial Peripheral Interface (SPI) communication between main CPU and output driver I/C is corrupted. The ECM monitors specific bits in the SPI message structure. If bits are corrupted, fail counter incremented.

Conditions For Setting The DTC

- Ignition ON.
- Ignition voltage is greater than 11 volts.

Action Taken When The DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The ECM will store conditions which were present when the DTC was set as Failure Records data only. This information will not be stored in the Freeze Frame data.
- A history DTC is stored.

Conditions For Clearing The DTC

- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. The replacement ECM must be reprogrammed. Refer to the least Techline procedure for ECM reprogramming.

DTC P1650 – SPI Communications Between Error with SIDM Chip (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Install the scan tool and clear the Diagnostic Trouble Code (DTC). 2. Review the Failure Record data with the ignition ON and the engine OFF and note the parameters. 3. Operate the vehicle with the Failure Record conditions as noted. Does DTC P1650 reset?	–	Go to *Step 3*	–
3	1. Turn the ignition OFF. 2. Replace the Engine Control Module (ECM). Is the repair complete?	–	Go to *Step 4*	–
4	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 5*	Go to *Step 2*
5	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

DIAGNOSTIC TROUBLE CODE (DTC) P1655 SPI COMMUNICATIONS BETWEEN ERROR WITH PSVI CHIP (1.5L SOHC)

System Description

Engine Control Module (ECM) detects if Serial Peripheral Interface (SPI) communication between main CPU and output driver I/C is corrupted. The ECM monitors specific bits in the SPI message structure. If bits are corrupted, fail counter incremented.

Conditions For Setting The DTC

- Ignition ON.
- Ignition voltage is greater than 11 volts.

Action Taken When The DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate.
- The ECM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame and Failure Records buffers.
- A history DTC is stored.

Conditions For Clearing The DTC

- The MIL will turn off after four consecutive ignition cycles in which the diagnostic runs without a fault within the freeze frame conditions that the DTC failed.
- A history DTC will clear after 40 consecutive warm-up cycles without a fault.
- The DTC(s) can be cleared by using the scan tool.

Test Description

The number(s) below refer to specific step(s) on the diagnostic table.

1. On-Board Diagnostic (EOBD) System Check prompts the technician to complete some basic checks and store the freeze frame and failure records data on the scan tool if applicable. This creates an electronic copy of the data taken when the malfunction occurred. The information is then stored on the scan tool for later reference.
3. The replacement ECM must be reprogrammed. Refer to the least Techline procedure for ECM reprogramming.

DTC P1655 – SPI Communications Between Error with PSVI Chip (1.5L SOHC)

Step	Action	Value	Yes	No
1	Perform an On-Board Diagnostic (EOBD) System Check. Is the system check complete?	–	Go to *Step 2*	Go to "On-Board Diagnostic System Check"
2	1. Install the scan tool and clear the Diagnostic Trouble Code (DTC). 2. Review the Failure Record data with the ignition ON and the engine OFF and note the parameters. 3. Operate the vehicle with the Failure Record conditions as noted. Does DTC P1655 reset?	–	Go to *Step 3*	–
3	1. Turn the ignition OFF. 2. Replace the Engine Control Module (ECM). Is the repair complete?	–	Go to *Step 4*	–
4	1. Using the scan tool, clear the Diagnostic Trouble Codes (DTCs). 2. Start the engine and idle at normal operating temperature. 3. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text. Does the scan tool indicate that this diagnostic ran and passed?	–	Go to *Step 5*	Go to *Step 2*
5	Check if any additional DTCs are set. Are any DTCs displayed that have not been diagnosed?	–	Go to applicable DTC table	System OK

SYMPTOM DIAGNOSIS

IMPORTANT PRELIMINARY CHECKS

Before Starting

Before using this section you should have performed the On-Board Diagnostic (EOBD) System Check and determined that:

- The engine control module (ECM) and the Malfunction Indicator Lamp (MIL) are operating correctly.
- There are no Diagnostic Trouble Codes (DTCs) stored.
- The scan tool data is within normal operating range.

Verify the customer complaint, and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. The importance of this step cannot be stressed too strongly. It can lead to correcting a problem without further checks and can save valuable time. This check should include:

- ECM grounds for being clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks and proper connections. Check thoroughly for any type of leak or restriction.
- Air leaks at throttle body mounting area and intake manifold sealing surfaces.

Wiring for proper connections, pinches and cuts.

INTERMITTENTS

Important: The problem may or may illuminate the Malfunction Indicator Lamp (MIL) or store a Diagnostic Trouble Code (DTC). Do not use the DTC tables for intermittent problems. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check. Check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector.
- Improperly formed or damaged terminal.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body to check.

The vehicle may be driven with a Digital Voltmeter (DVM) connected to the suspected circuit. An abnormal voltage when a malfunction occurs is a good indication that there is a fault in the circuit being monitored.

A scan tool can be used to help detect intermittent conditions.

Using a scan tool's Freeze Frame buffer can aid in locating an intermittent condition. Review and record the information in the freeze frame associated with the intermittent DTC being diagnosed. The vehicle can be driven within the conditions that were present when the DTC originally set.

To check loss of DTC memory, disconnect the Throttle Position (TP) sensor and idle the engine until the MIL comes ON. DTC P0122 should be stored in memory and kept in memory when ignition is turned OFF. If not, the engine control module (ECM) is faulty. When this test is completed, make sure that you clear the DTC from memory.

An intermittent MIL with no stored DTC may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL wire to ECM shorted to ground.
- Poor ECM grounds.

Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can caused a sharp electrical surge. Normally the problem will occur when the faulty component is operated.

Check for improper installation of electrical options such as lights, cellular phones, etc.

Check for open diode across the A/C compressor clutch and check for other open diodes.

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 data link connector (DLC). 2. Check the Engine Coolant Temperature (ECT) sensor and the Intake Air Temperature (IAT) sensor using the scan tool. 3. Compare the ECT and the IAT with the ambient temperature when the engine is cold. Do the ECT and the IAT readings differ from the ambient temperature by more than the value specified?	3°C (37°F)	Go to *Step 3*	Go to *Step 4*
3	1. Measure the resistance of the ECT and the IAT sensor. 2. Compare the resistance value to specifications using the Temperature Vs. Resistance table for DTCs P1111 and P1114. 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 (TP) sensor voltage. Repair or replace as needed. 2. Check the TP sensor 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 8*	Go to *Step 29*
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. Is the fuel injector resistance within the value specified (20°C [68°F] – the resistance will increase slightly at higher temperatures)?	11.6-12.4 Ω	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 engine 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 (CKP) sensor. 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 TP sensor 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 variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.

Important:
 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 Data Link Connector (DLC). Does the Pre-converter Oxygen Sensor (O2S 1) respond quickly to different throttle positions?	–	Go to *Step 4*	Go to *Step 3*
3	1. Check the O2S 1 for silicone or other contaminants from fuel or use of improper RTV sealant. 2. Replace the contaminated O2S 1. 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?	–20%~25%	Go to *Step 7*	Go to *Step 5*
5	Is the long term fuel trim reading below the value specified?	–20%	Go to "Diagnostic Aids for DTC P0172"	Go to *Step 6*
6	Is the long term fuel trim reading above the value specified?	25%	Go to "Diagnostic Aids for DTC P0171"	–
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. Did 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 engine 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. 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 down shift 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 1000 rpm. 3. Record the vacuum reading. 4. Increase the engine speed to 2500 rpm. 5. Note the vacuum reading at a steady 2500 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 engine control module (ECM) grounds for being clean, tight, and in their proper location. 2. Check the Exhaust Gas Recirculation (EGR) Valve for being open or partially open all the time. 4. Check the 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?	81-95 octane	Go to *Step 3*	System OK
3	1. Inspect for low engine coolant. 2. Check for restricted air flow 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 Engine Coolant Temperatue (ECT) sensor if the resistance is not within specifications as listed in DTC P1114. Is the problem found?	–	Go to *Step 6*	Go to *Step* 7
6	Replace the ECT sensor 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 Data Link Connector (DLC). 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?	25%	Go to "Diagnostic Aids for DTC P0171"	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. 4. Check the service bulletins for 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: 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 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 (TP) sensor for binding or sticking. The TP sensor 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 engine 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. Is the fuel injector resistance within the value specified (the resistance will increase slightly at higher temperatures)?	11.6-12.4 Ω	Go to *Step 10*	Go to *Step 9*
9	Replace any of the fuel injectors with 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*
11	Replace any restricted or leaking fuel injectors. Is the repair complete?	–	System OK	–

Hesitation, Sag, Stumble (Cont'd)

Step	Action	Value(s)	Yes	No
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: 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 Ω	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 engine control module (ECM). Is the repair complete?	–	System OK	–
13	Measure the resistance of each fuel injector. Is the injector resistance within the value specified? (The resistance will increase slightly at higher temperatures.)	11.6-12.4 Ω	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 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 all transaxle gears are functioning. 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 Data Link Connector (DLC). 2. Monitor the pre-converter oxygen sensor (O2S 1) reading at different throttle positions. Does the O2S 1 sensor change quickly from rich to lean at the different throttle positions?	–	Go to *Step 5*	Go to *Step 3*
3	Check the O2S 1 for contamination from fuel or improper use of RTV sealant. Is the O2S 1 contaminated?	–	*Go to Step 4*	Go to *Step 5*
4	Replace the contaminated O2S 1 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 (TP) sensor voltage. 2. Check the TP sensor voltage reading with the throttle closed. Is the TP sensor voltage within the value specified?	0.4-0.8 v	Go to *Step 6*	Go to "Diagnostic Aids for DTC P0123"
6	1. Check the Engine Coolant Temperature (ECT) sensor voltage reading using the scan tool. 2. Compare the ECT reading with the ambient temperature when the engine is cold. Does the ECT 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 ECT circuit or the sensor itself. Is the problem found?	–	Go to *Step* 8	Go to *Step 9*
8	Replace the ECT 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?	–20%~25%	Go to *Step 14*	Go to *Step 12*
12	Is the fuel trim reading below the value specified?	–20%	Go to "Diagnostic Aids for DTC P0171"	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?	25%	Go to "Diagnostic Aids for DTC P0172"	–
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 engine control module (ECM). Is the repair complete?	–	System OK	–
16	Measure the resistance of each of the fuel injectors. Is the resistance within the value specified (the resistance will increase slightly at higher temperatures)?	11.6-12.4 Ω	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 with a resistance over the value specified. Is the problem found?	30,000 Ω	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: A vehicle fails an emission test. The vehicle has 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. Did the vehicle pass the emission test?	–	System OK	Go to *Step 3*
3	1. Connect the scan tool to the Data Link Connector (DLC). 2. Road test the vehicle. 3. Monitor the long term fuel trim memory. Is the long term fuel trim memory within the value specified?	–20%~25%	Go to *Step 6*	Go to *Step 4*
4	Is the long term fuel trim memory below the value specified?	–20%	Go to "Diagnostic Aids for DTC P0172"	Go to *Step 5*
5	Is the long term fuel trim memory above the value specified?	25%	Go to "Diagnostic Aids for DTC P0171"	–
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. Did 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. Did 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 and the throttle plate and inside the engine. Remove 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: An engine continues to run after the ignition switch is turned OFF.

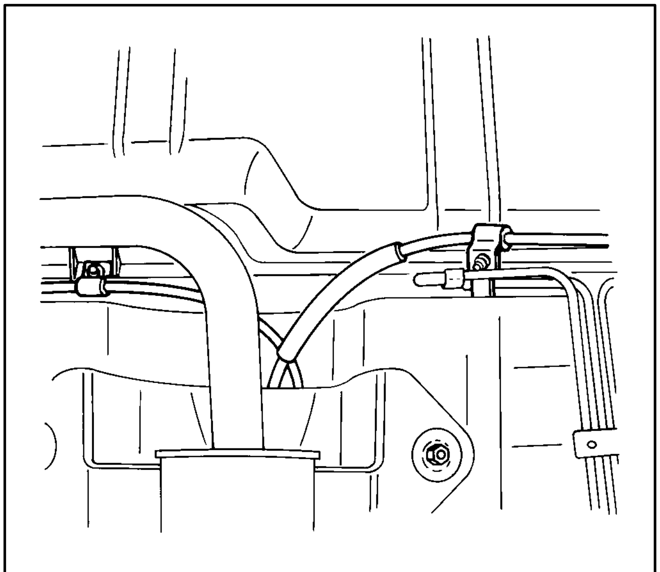
Step	Action	Value(s)	Yes	No
1	Were the Important Preliminary Checks performed?	–	Go to *Step 2*	Go to "Important Preliminary Checks"
2	Does the engine run smoothly after the ignition switch is turned OFF?	–	Go to *Step 3*	Go to *Step 4*
3	1. Check the ignition switch and the ignition switch adjustment. 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: 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	–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MAINTENANCE AND REPAIR

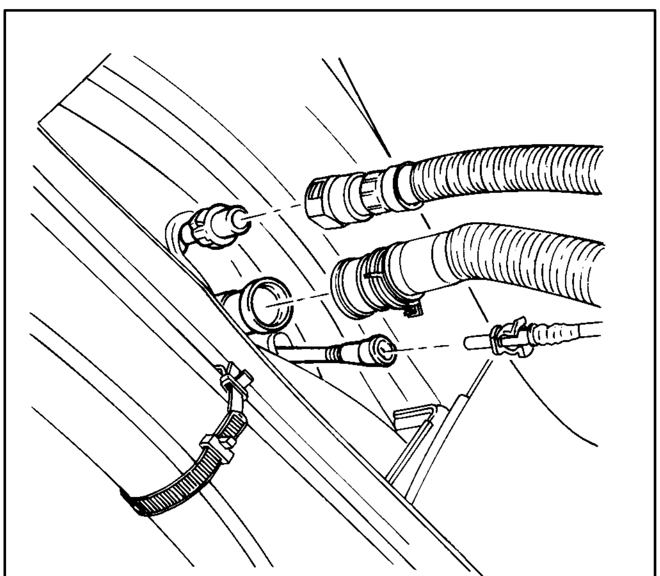
ON-VEHICLE SERVICE

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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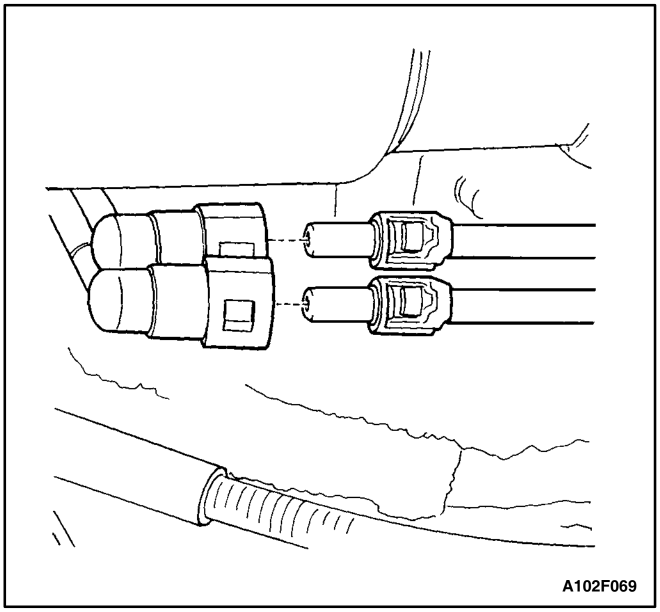
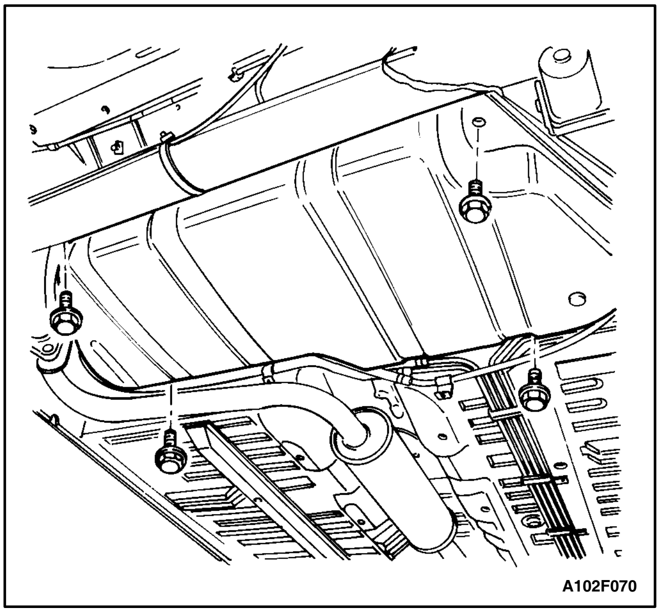
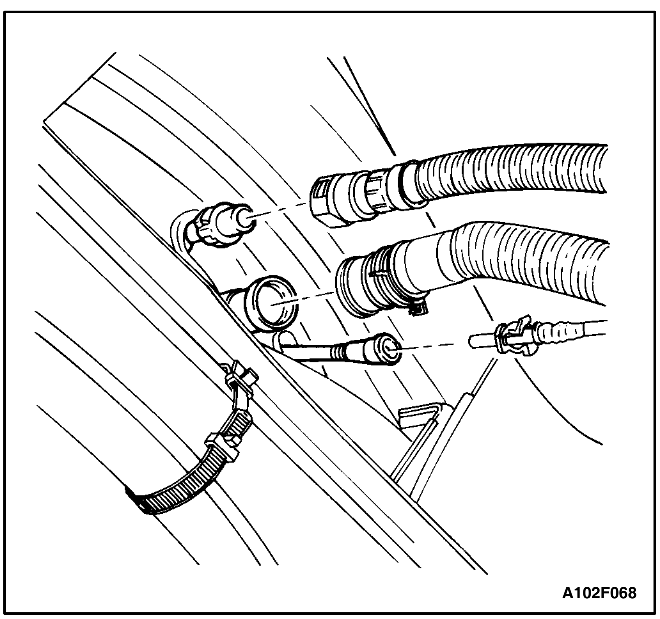
5. Remove the fuel tank filler tube clamp at the fuel tank.
6. Disconnect the fuel tank filler tube.
7. Disconnect the fuel tank vent tube at the fuel tank.
8. Disconnect the fuel vapor line near the fuel tank filler tube.



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.



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.



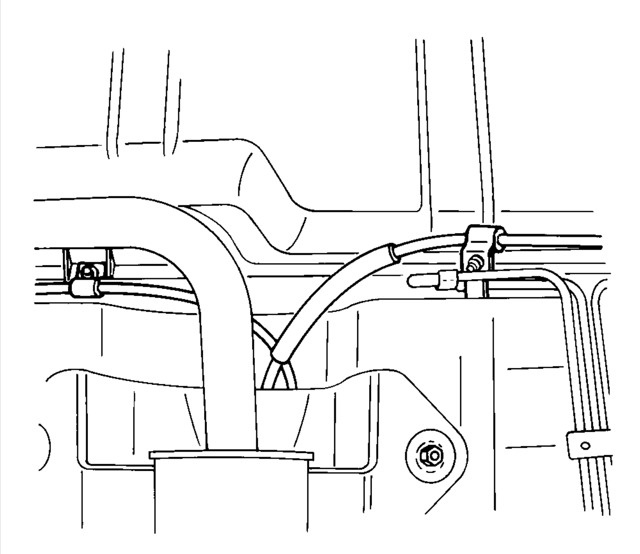
Installation Procedure

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 and fuel tank vent tube.
8. Install the fuel tank filler tube clamp at the fuel tank.



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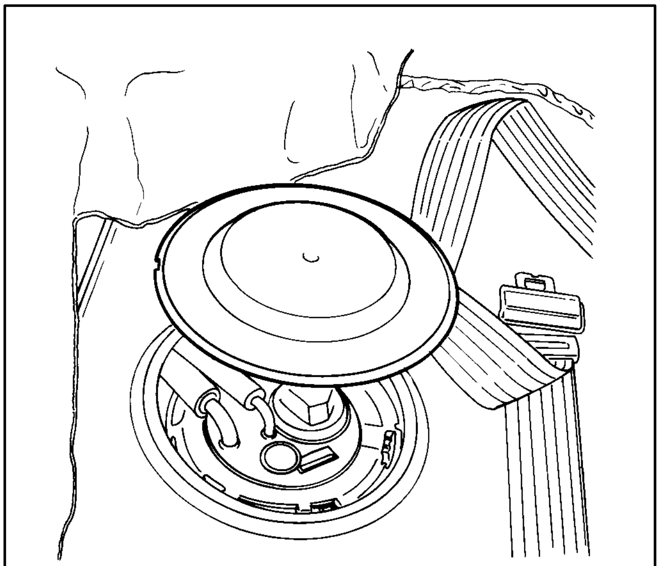
9 Install the parking brake cable retainer clamps and the support.

Tighten

Tighten the parking brake cable retainer clamps to 10 N•m (89 lb-in).

10. Connect the negative battery cable.
11. Fill the fuel tank.
12. Perform a leak check of the fuel tank and the fuel line connections.



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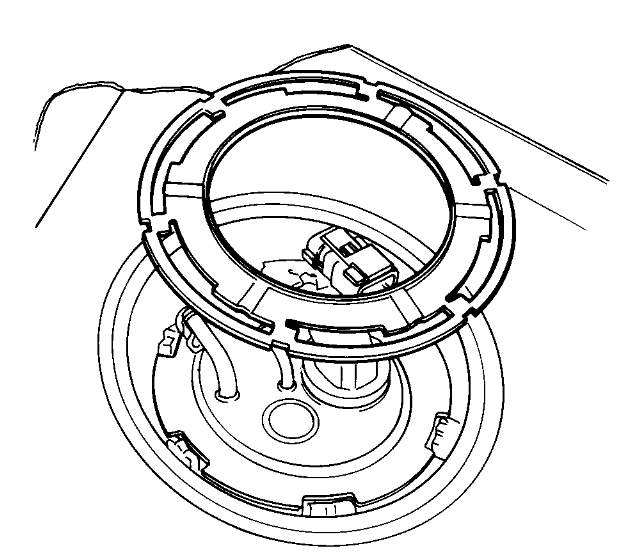
FUEL PUMP

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 F7 from the engine fuse block.
   1.3. Start the engine and allow the engine to stall.
   1.4. Crank the engine for an additional ten seconds.
2. Disconnect the negative battery cable.
3. Remove the rear seat. Refer to *Section , Seats.*
4. Remove the fuel pump access cover.



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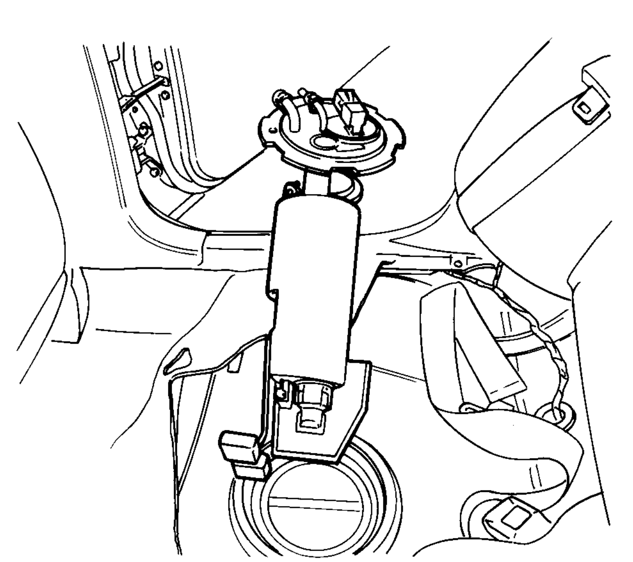
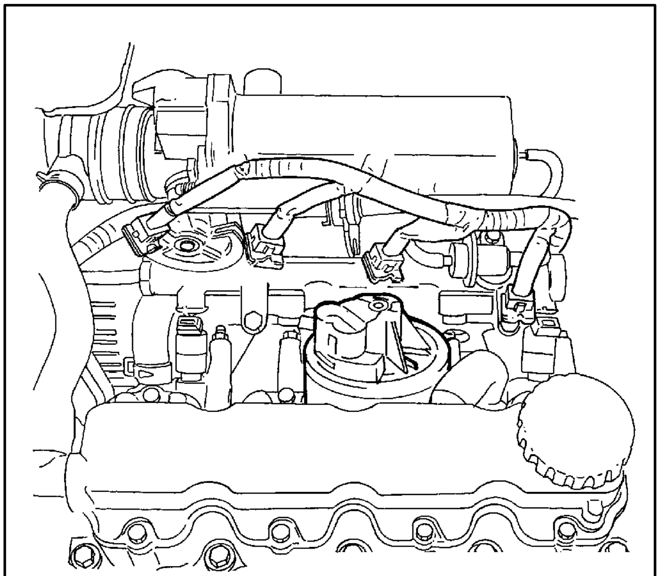
5. Disconnect the electrical connector at the fuel pump assembly.
6. Disconnect the fuel outlet line.
7. Disconnect the fuel tank return line.
8. Turn the lock ring counterclockwise to clear the tank tabs.
9. Remove the fuel pump assembly from the tank.
10. Remove and discard the gasket.



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.*



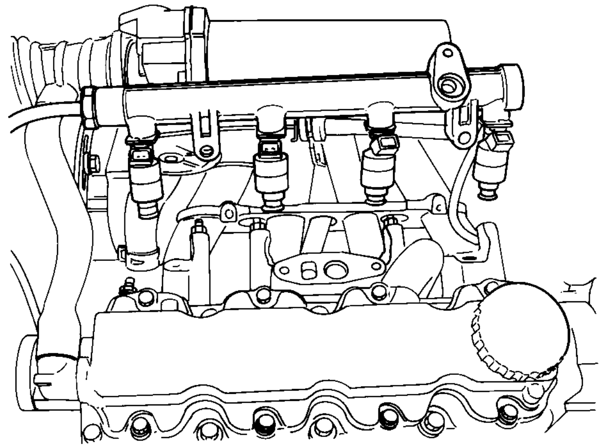
A402F066

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.



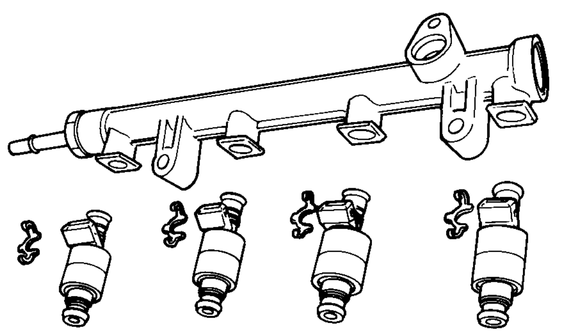
A102F006

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.

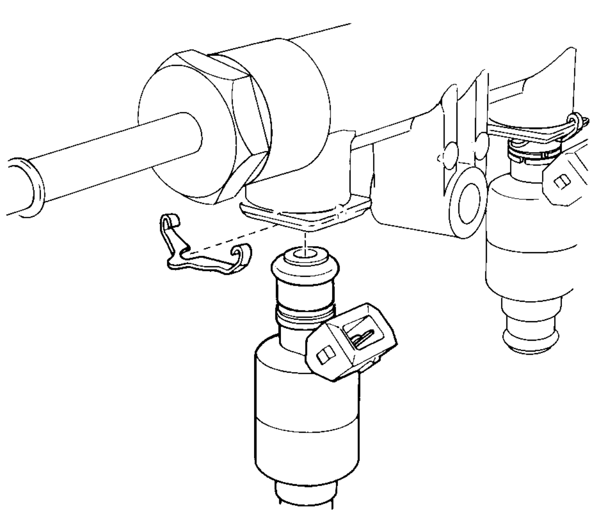
Important: If a fuel injector becomes separated from the fuel rail and remains in the cylinder head, replace the fuel injector O-ring seals and the retaining clip.

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.

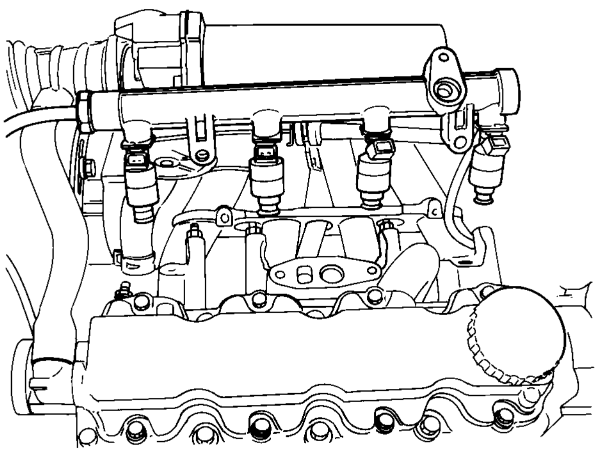


A102F008

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.

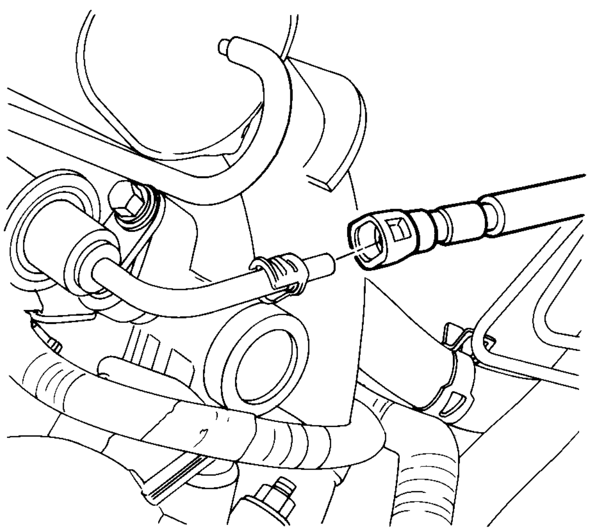


5. Install the fuel rail assembly into the cylinder head.
6. Install the fuel rail retaining bolts.

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.

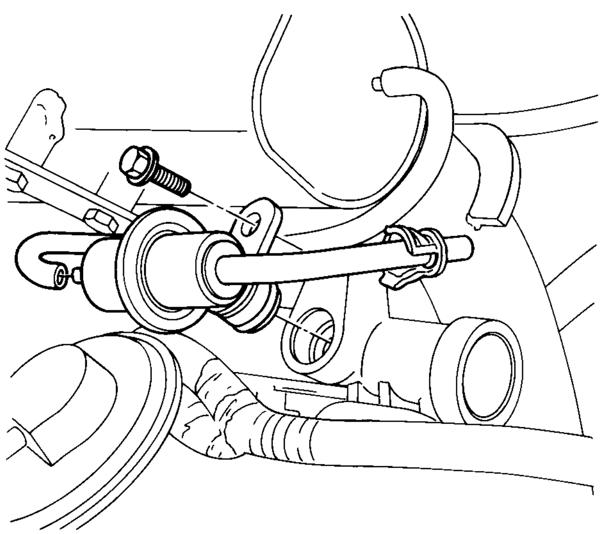

A102F004

FUEL PRESSURE REGULATOR (SOHC)

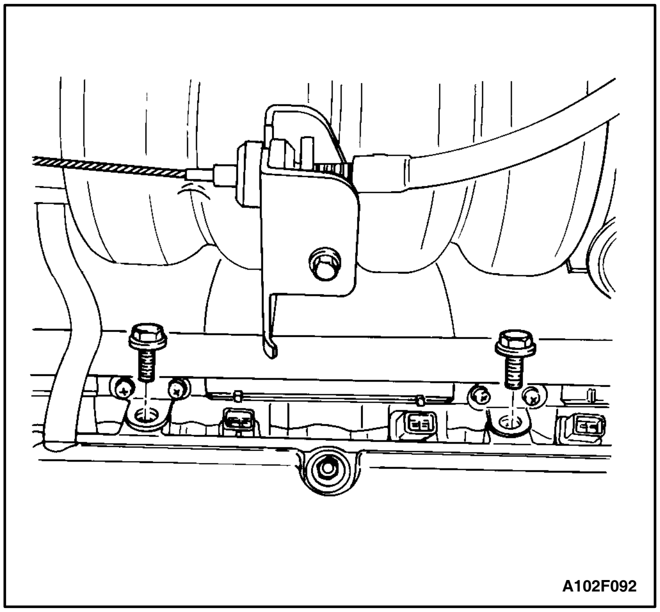
Removal Procedure

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.



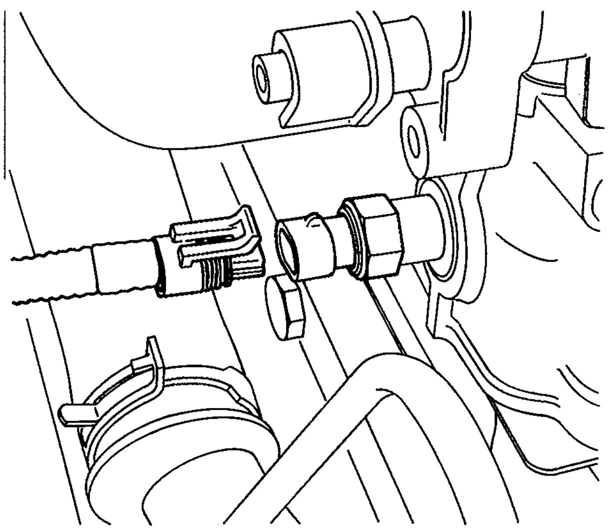
Installation Procedure

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.



A102F001

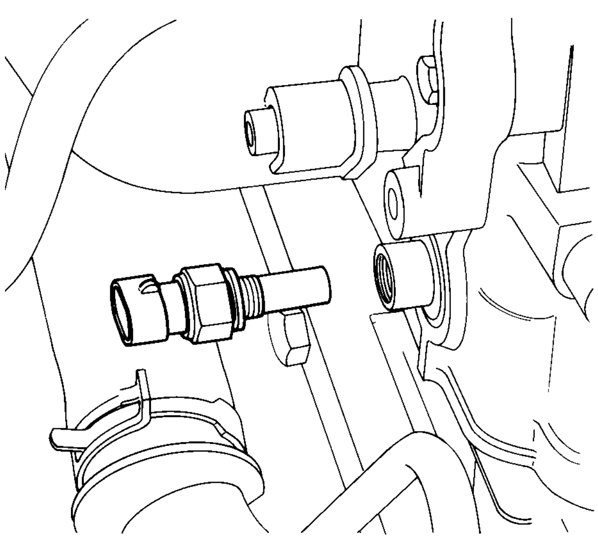
ENGINE COOLANT TEMPERATURE SENSOR (SOHC)

Removal Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature (ECT) sensor connector.

Notice: Use care when handling the ECT sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Carefully remove the ECT sensor from the cylinder head underneath the electronic ignition (EI) system ignition coil.



A102F002

Installation Procedure

1. Coat the threads on the ECT sensor with sealer.

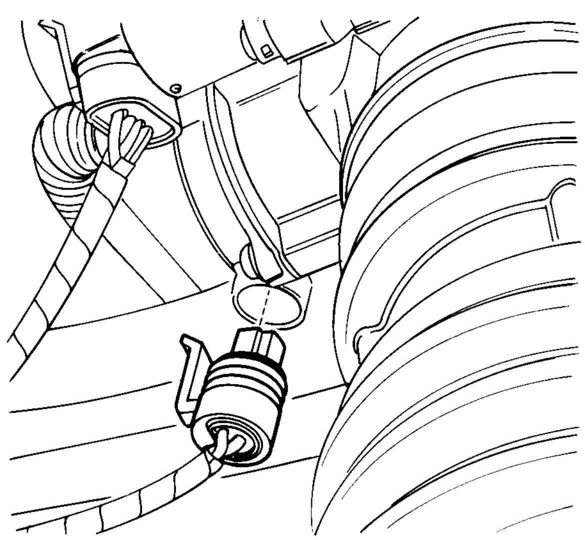
Notice: Use care when handling the ECT sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

2. Install the ECT into the cylinder head.

Tighten

Tighten the engine coolant temperature sensor to 20 N•m (15 lb-ft).

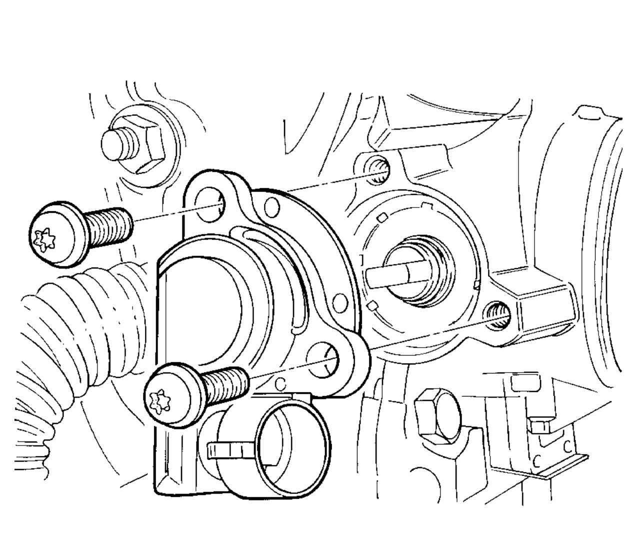
3. Connect the ECT sensor connector.
4. Fill the coolant system.
5. Connect the negative battery cable.


A102F023

THROTTLE POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the throttle position (TP) sensor connector.
3. Remove the TP sensor retaining bolts and the TP sensor.


A102F022

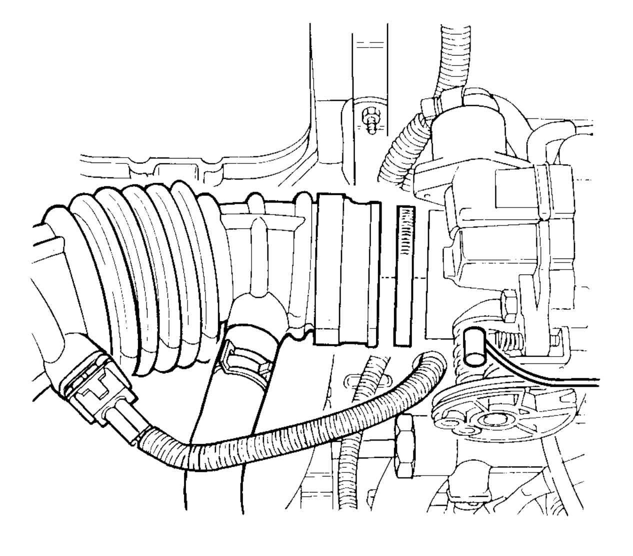
Installation Procedure

1. With the throttle valve closed, position the TP sensor on the throttle shaft. Align the TP sensor with the bolt holes.
2. Install the TP sensor retaining bolts.

Tighten

Tighten the throttle position sensor retaining bolts to 2 N•m (18 lb-in).

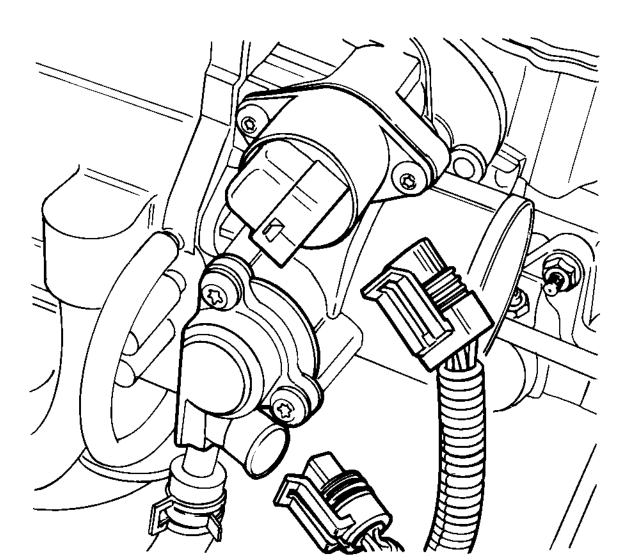
3. Connect the TP sensor connector.
4. Connect the negative battery cable.


A102F095

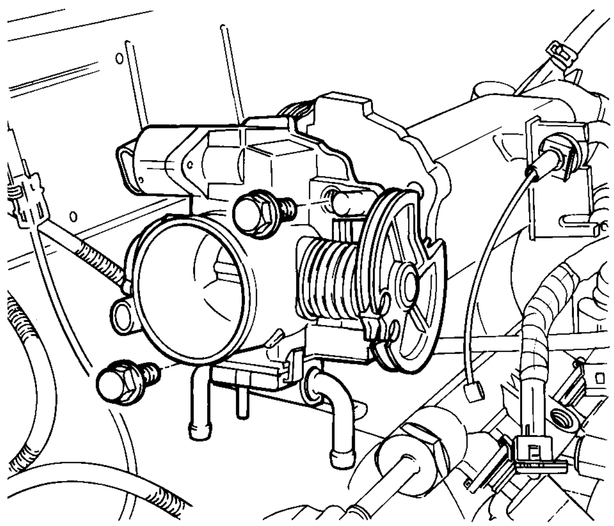
THROTTLE BODY (TYPICAL)

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.

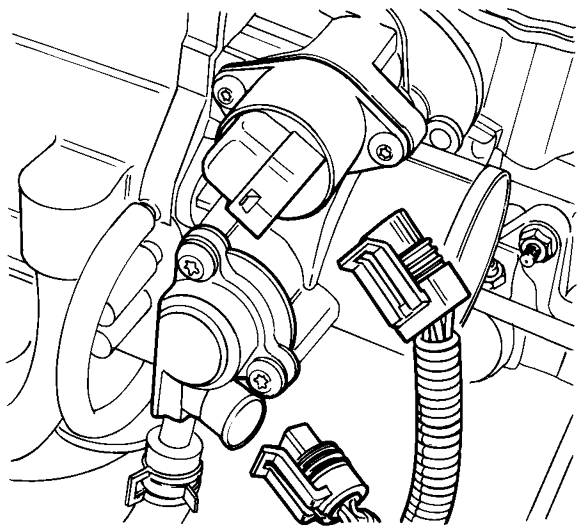

A102F066

4. Disconnect the vacuum hoses from the throttle body.
5. Disconnect the throttle position (TP) sensor 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 TP sensor. 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

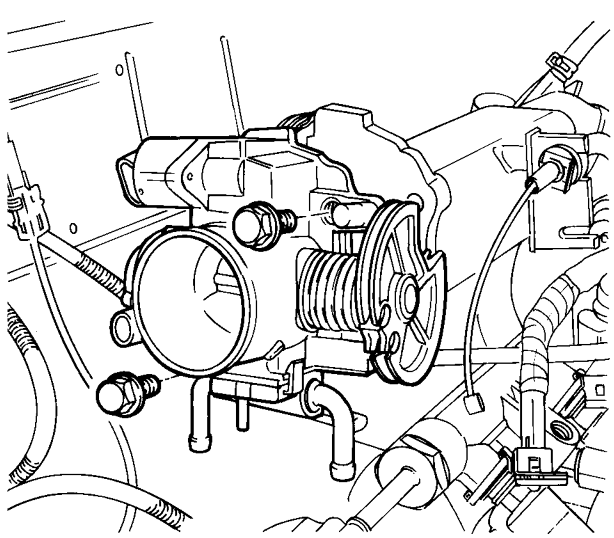
Installation Procedure

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 following disassembly in a cold immersion-type cleaner. The throttle position sensor and the idle air control valve should not come in contact with any solvent or cleaner as they may be damaged.

2. Clean the throttle body.
3. Install the TP sensor. 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 with a new gasket to the intake manifold.
6. Install the throttle body retaining bolts.

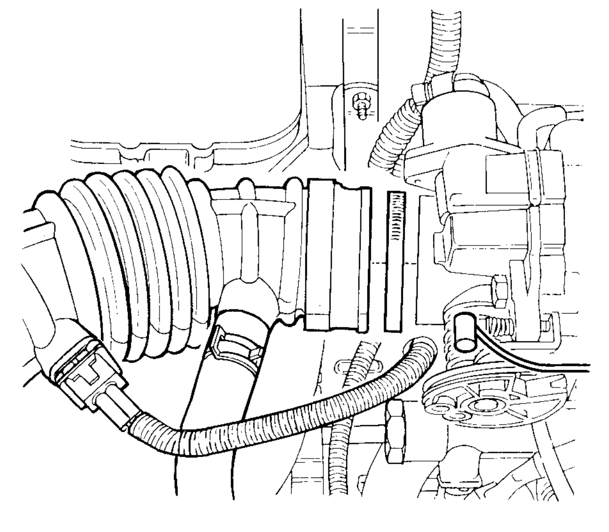
Tighten

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.

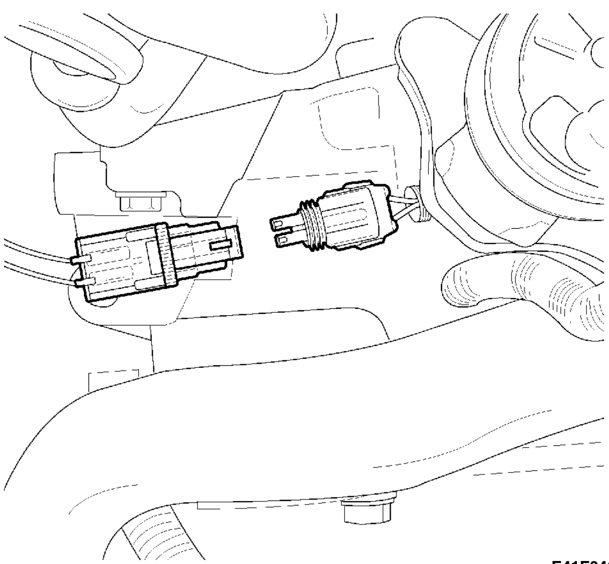
Important: Make sure the throttle control cables do not hold the throttle open. With the engine OFF, check to see that the accelerator pedal is free.

9. Connect the throttle cables.



A102F095

10. Install the air intake tube.
11. Connect the TP sensor connector and the IAC valve connector.
12. Connect the negative battery cable.
13. Fill the cooling system.



E41F040

OXYGEN SENSOR (O2S 1) (TYPICAL)

Removal Procedure

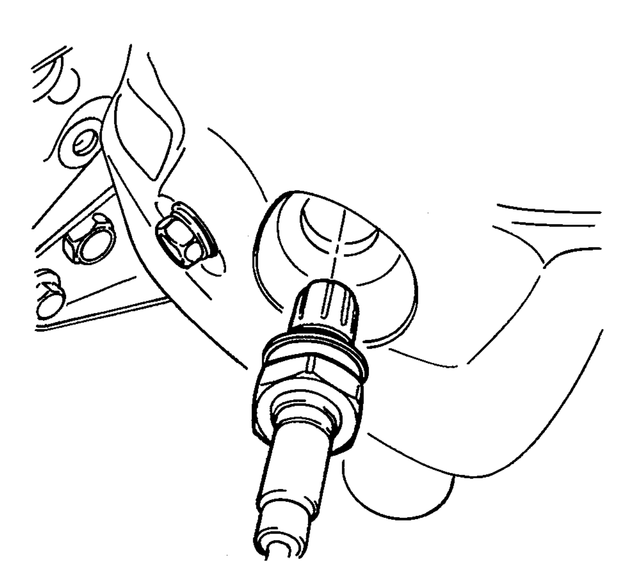
1. Disconnect the negative battery cable.

Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Take care when handling the oxygen sensor. Do not drop the oxygen sensor.

2. Disconnect the oxygen sensor (O2S 1) connector.

Notice: The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F). Excessive force may damage threads in the exhaust manifold.

3. Carefully remove the O2S 1 from the exhaust manifold.


A102F030

Installation Procedure

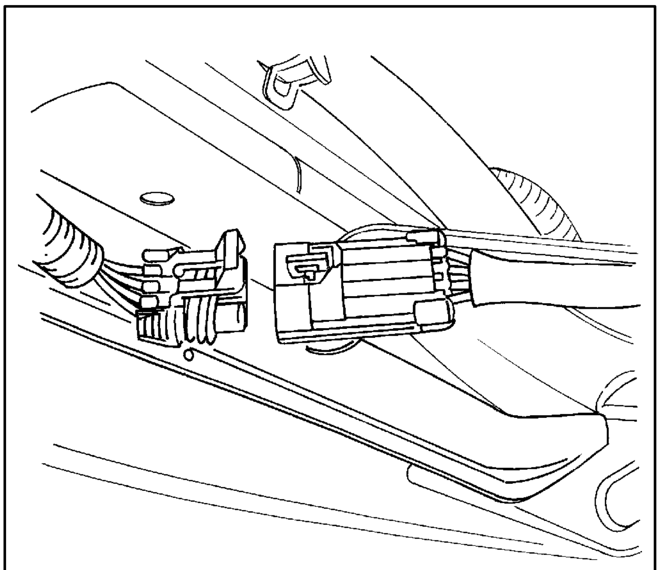
Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to 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 O2S 1 with an anti-seize compound, if needed.
2. Install the O2S 1 into the exhaust manifold.

Tighten

Tighten the oxygen sensor to 41 N•m (30 lb-ft).

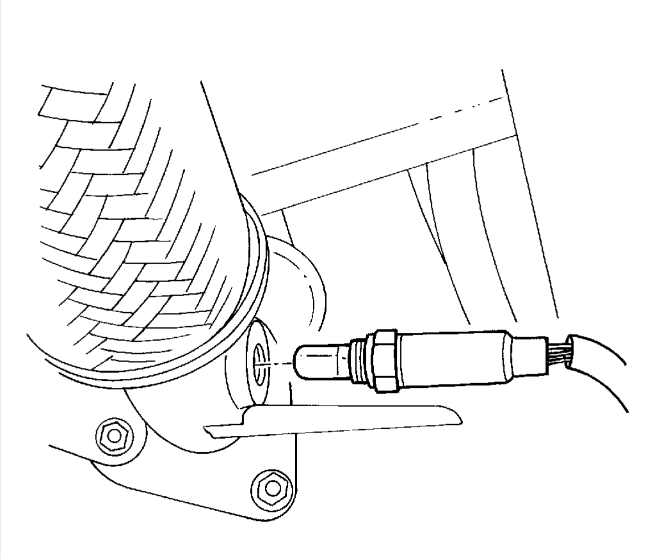
3. Connect the O2S 1 connector.
4. Connect the negative battery cable.


A402F067

HEATED OXYGEN SENSOR (HO2S 2) (TYPICAL)

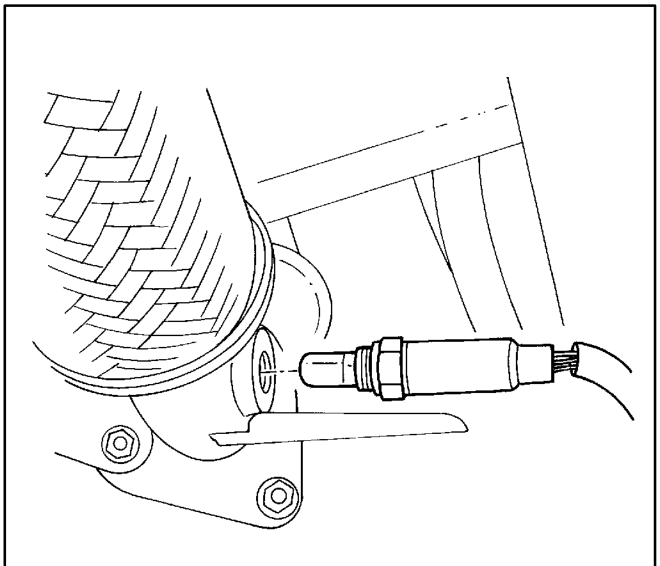
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector.



A402G002

3. Remove the heated oxygen sensor (HO2S 2).



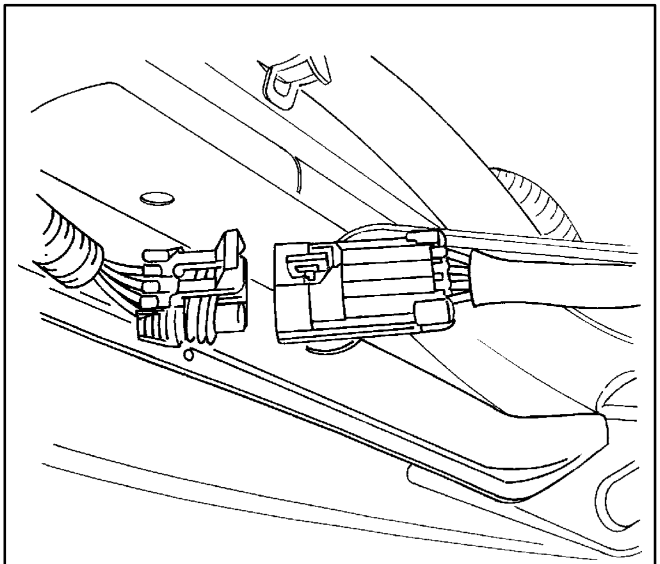
A402G002

Installation Procedure

1. Install the HO2S 2.

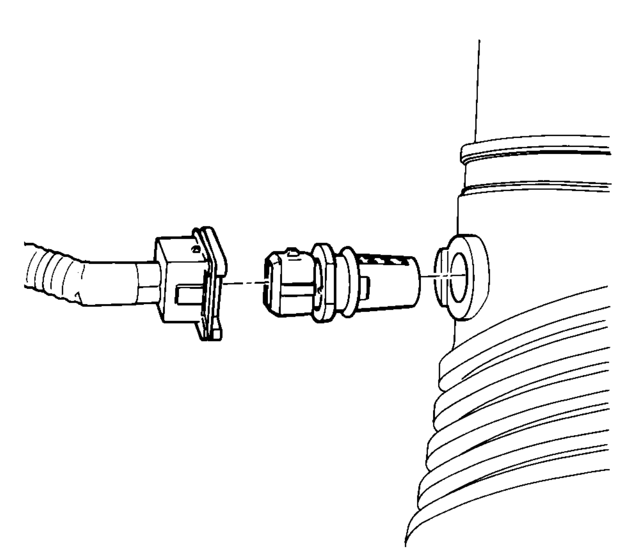
Tighten

Tighten the heated oxygen sensor to 41 N•m (30 lb-ft).



A402F067

2. Connect the electrical connector.
3. Connect the negative battery cable.



A102F012

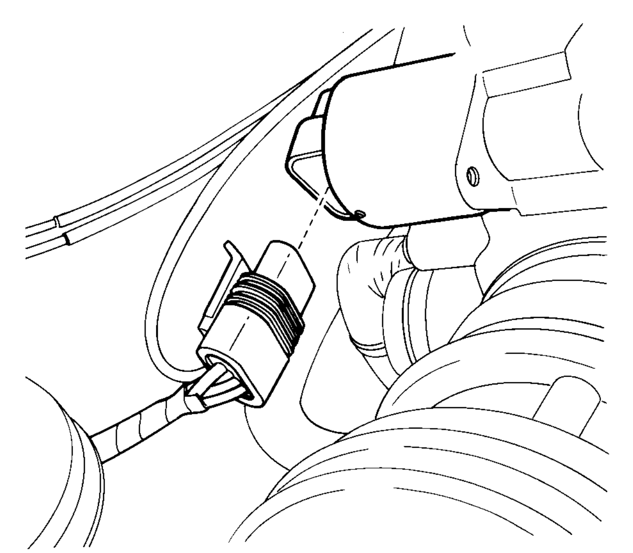
INTAKE AIR TEMPERATURE SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the intake air temperature (IAT) sensor connector.
3. Remove the IAT sensor by pulling it out of the air intake tube.

Installation Procedure

1. Insert the IAT sensor into the air intake tube.
2. Connect the IAT connector.
3. Connect the negative battery cable.



A102F009

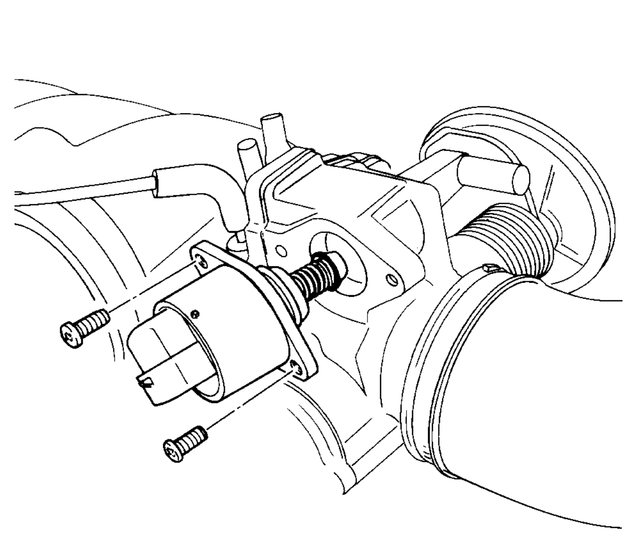
IDLE AIR CONTROL VALVE (TYPICAL)

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.

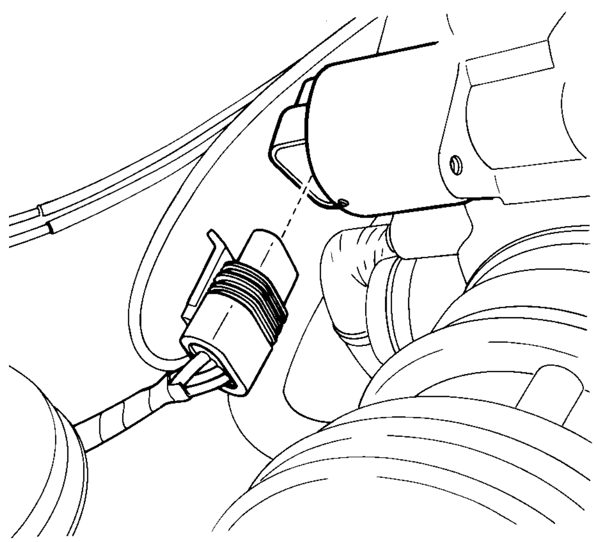


A102F010

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.



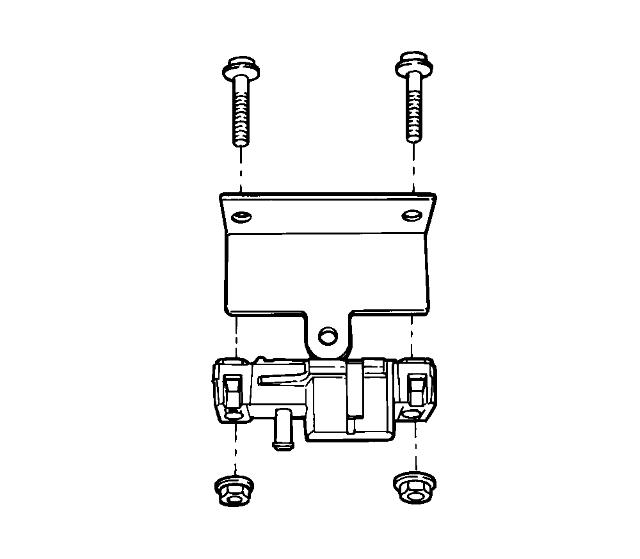
A102F009

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.

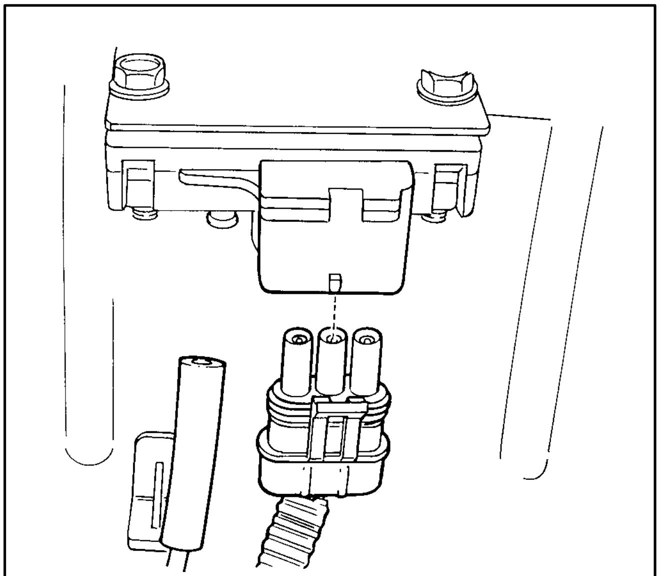


A102F028

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 nuts securing 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

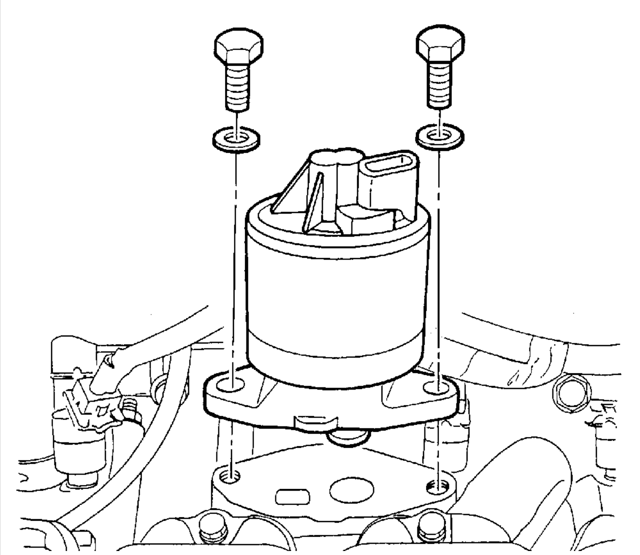
Tighten the MAP sensor retaining bolts and nuts to 8 N•m (71 lb-in).

3. Install the MAP sensor and the mounting bracket to the firewall with the mounting bracket bolt.

Tighten

Tighten the MAP sensor mounting bracket bolt to 4 N•m (35 lb-in).

4. Connect the MAP sensor connector.
5. Connect the vacuum hose to the MAP sensor.
6. Connect the negative battery cable.



A402F069

EXHAUST GAS RECIRCULATION VALVE (SOHC)

Removal Procedure

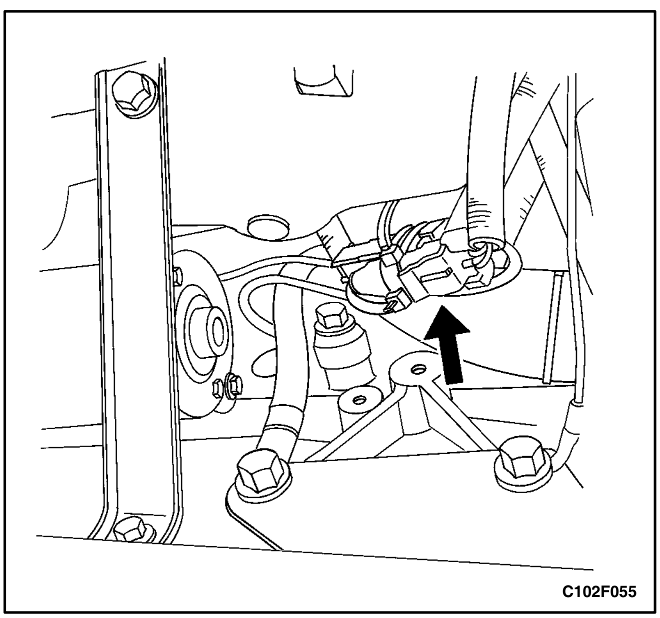
1. Disconnect the negative battery cable.
2. Disconnect the exhaust gas recirculation (EGR) valve electrical connector.
3. Remove the bolts and the EGR valve.

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

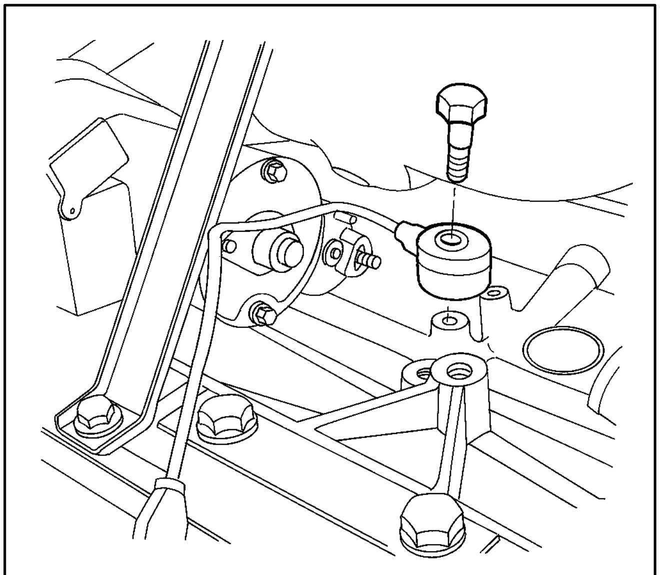
   Tighten the exhaust gas recirculation valve retaining bolts to 20 N•m (15 lb-ft).
4. Connect the EGR valve electrical connector.
5. Connect the negative battery cable.



KNOCK SENSOR

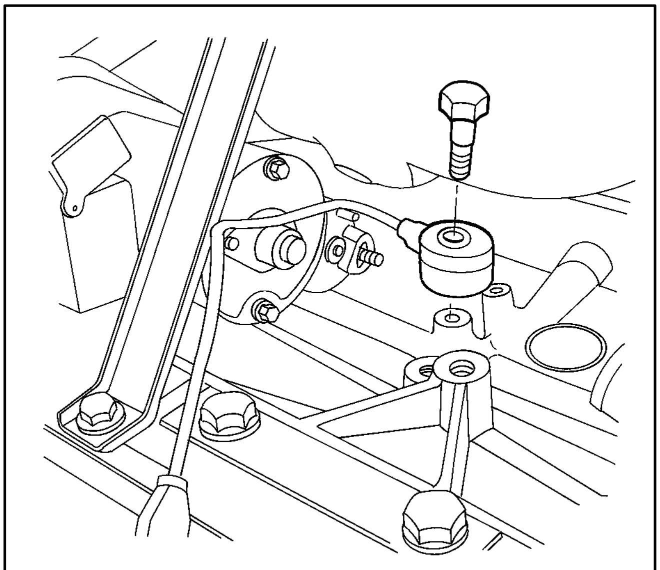
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the intake manifold. Refer to *Section 1B, SOHC Engine Mechanical,*
3. Disconnect the electrical connector at the knock sensor.



C102F056

4. Remove the knock sensor.



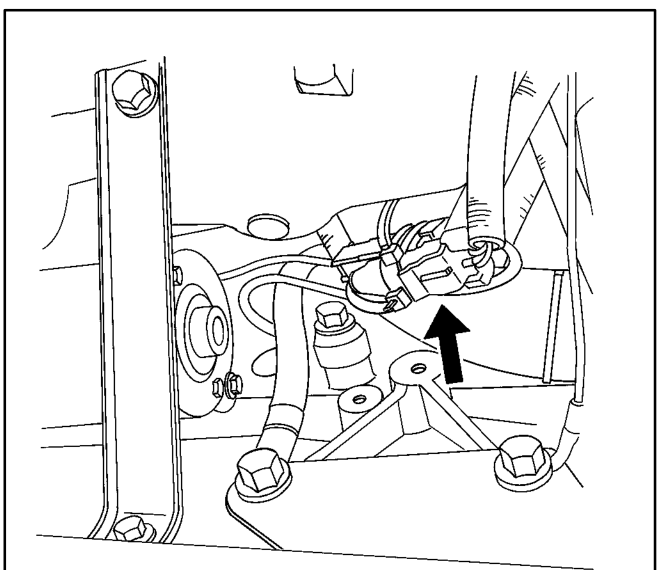
C102F056

Installation Procedure

1. Install the knock sensor.

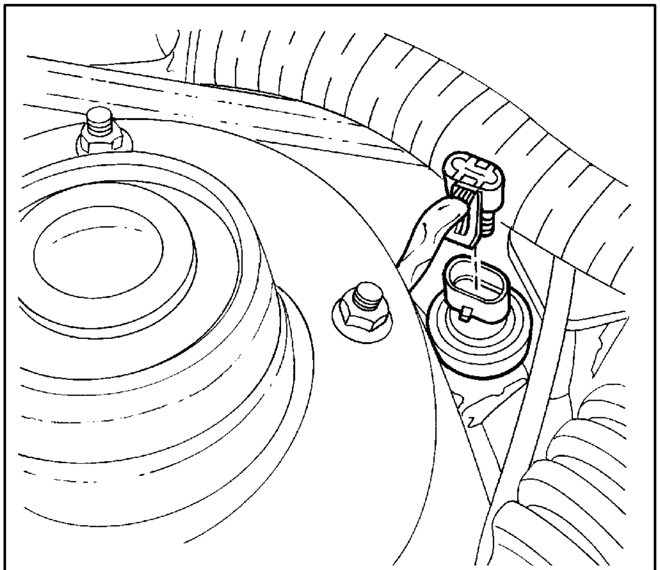
   Tighten

   Tighten the knock sensor bolt to 20 N•m (15 lb-ft).



C102F055

2. Connect the electrical connector at the knock sensor.
3. Remove the intake manifold. Refer to *Section 1B, SOHC Engine Mechanical*,
4. Connect the negative battery cable.

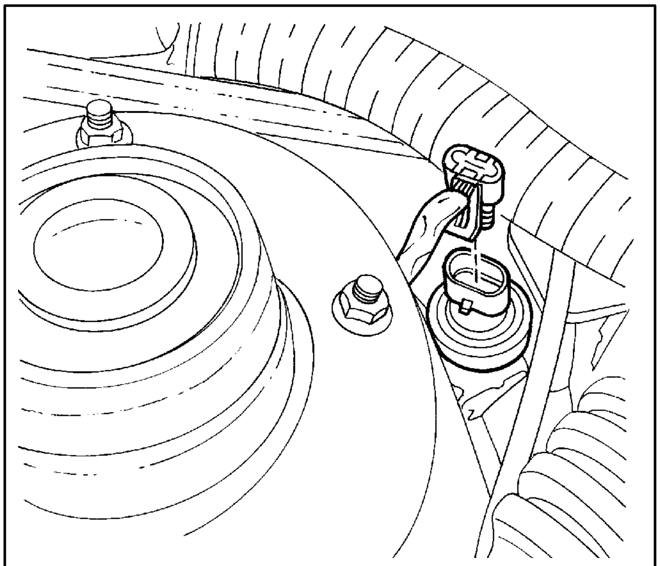


A402F071

G SENSOR

Removal Procedure

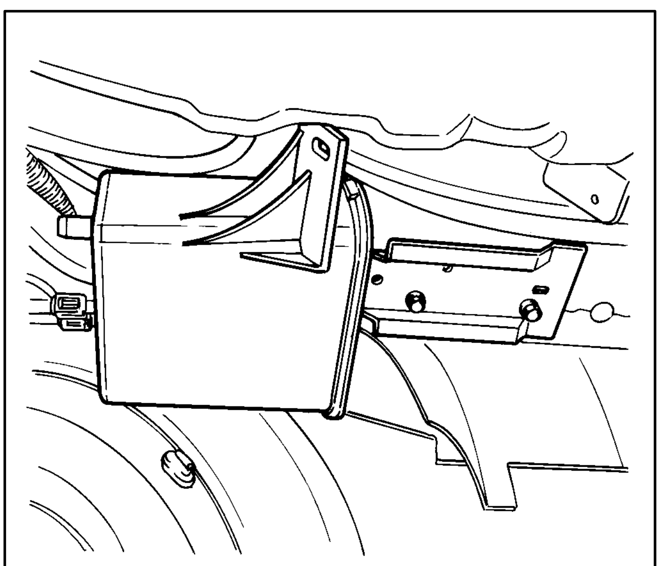
1. Disconnect the negative battery cable.
2. Disconnect the G sensor electrical connector and remove the G sensor.



A402F071

Installation Procedure

1. Install the G sensor and connect the electrical connector.
2. Connect the negative battery cable.



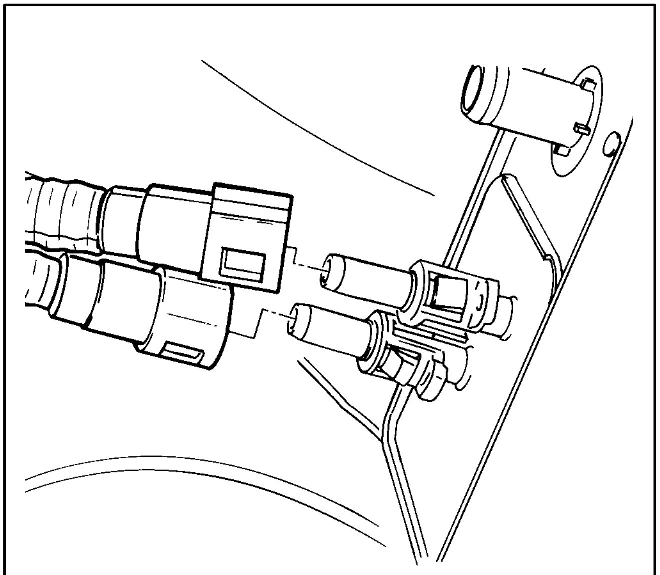
A102F020

EVAPORATIVE EMISSION CANISTER

Removal Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the evaporative (EVAP) emission canister fuel vapor hoses.
2. Remove the bolt securing the EVAP emission canister flange to the vehicle.
3. Slide the EVAP emission canister out of the track holder.
4. Remove the EVAP emission canister.



A102F021

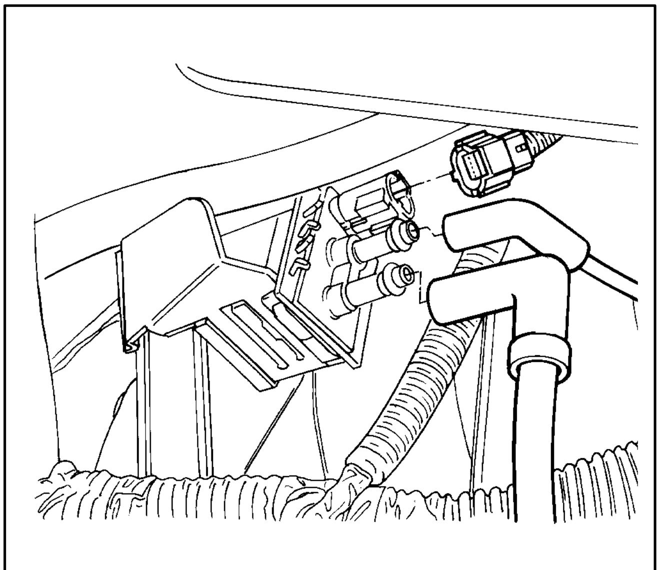
Installation Procedure

1. Insert the EVAP emission canister into the track and slide it into position.
2. Install the EVAP emission 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.

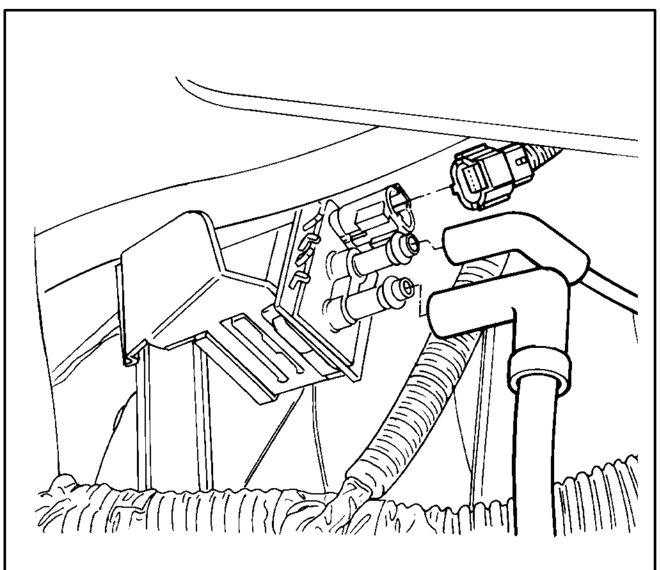


A202F060

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID (TYPICAL)

Removal Procedure

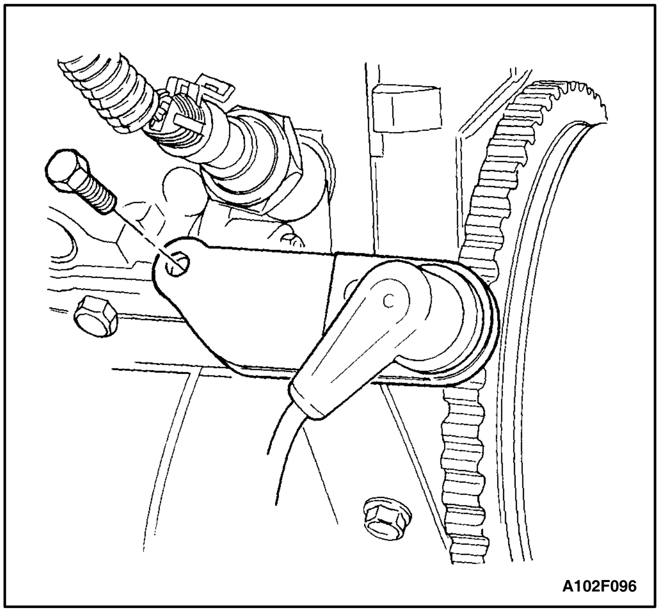
1. Disconnect the negative battery cable.
2. Disconnect the evaporative (EVAP) emission canister purge solenoid connector.
3. Disconnect the vacuum hoses from the EVAP emission canister purge solenoid.
4. Unclip the EVAP emission canister purge solenoid from the mounting bracket.



A202F060

Installation Procedure

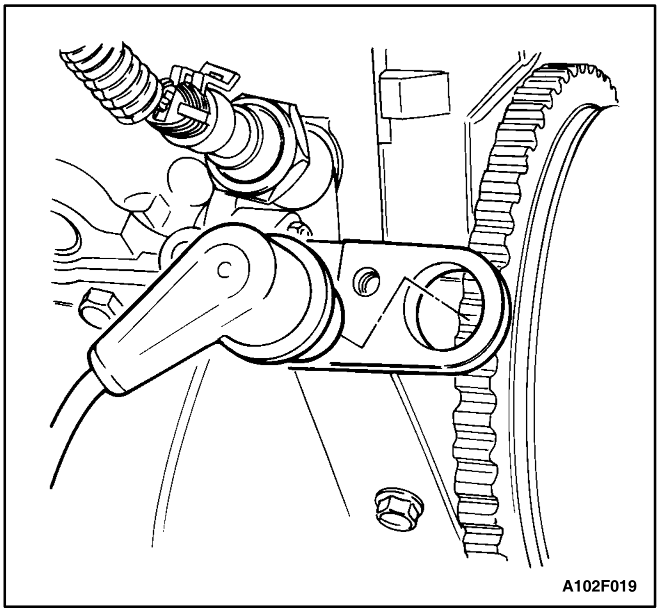
1. Attach the EVAP emission canister purge solenoid to the mounting bracket.
2. Connect the EVAP emission canister purge solenoid connector.
3. Connect the vacuum hoses to the EVAP emission canister purge solenoid.
4. Connect the negative battery cable.



CRANKSHAFT POSITION SENSOR (TYPICAL)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the crankshaft position (CKP) sensor connector at the frame bracket.
3. Remove the wiring tie straps as needed.
4. Remove the CKP sensor retaining bolt.
5. Remove the CKP sensor.

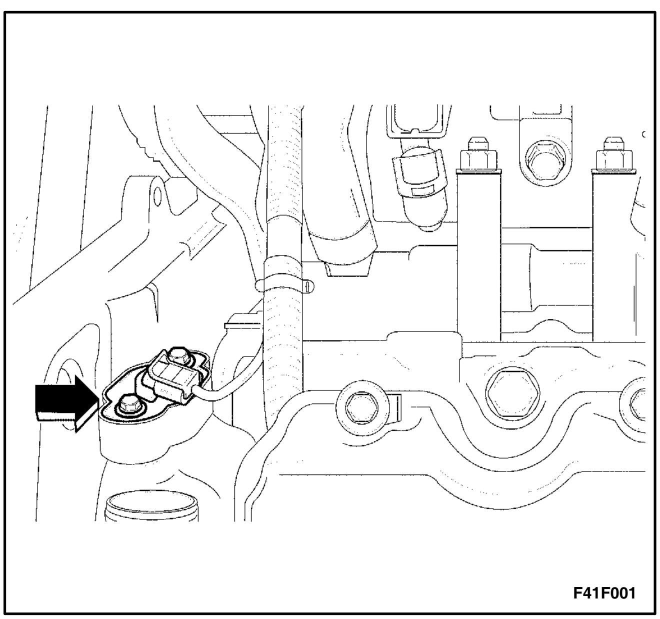


Installation Procedure

1. Install the CKP sensor with the retaining bolt.

   Tighten

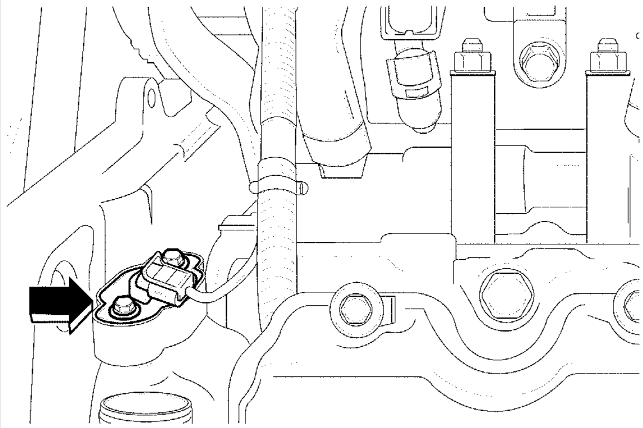
   Tighten the crankshaft position sensor retaining bolt to 10 N•m (89 lb-in).
2. Connect the CKP sensor connector at the frame bracket.
3. Secure the wire with the tie straps as needed.
4. Connect the negative battery cable.



CAMSHAFT POSITION SENSOR (SOHC)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the sensor electrical connector.
3. Remove the camshaft position (CMP) sensor bolts and sensor.



F41F001

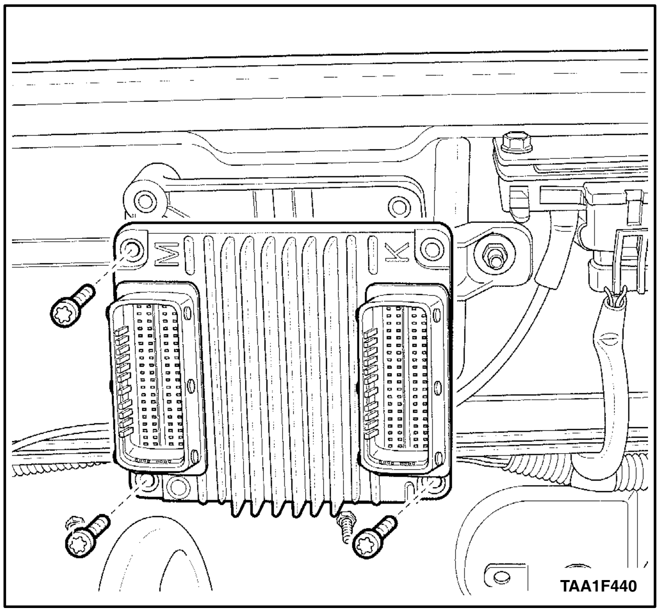
Installation Procedure

1. Install the CMP sensor and bolts.

Tighten

Tighten the camshaft position sensor bolts to 12 N•m (106 lb-in).

2. Connect the sensor electrical connector.
3. Connect the negative battery cable.

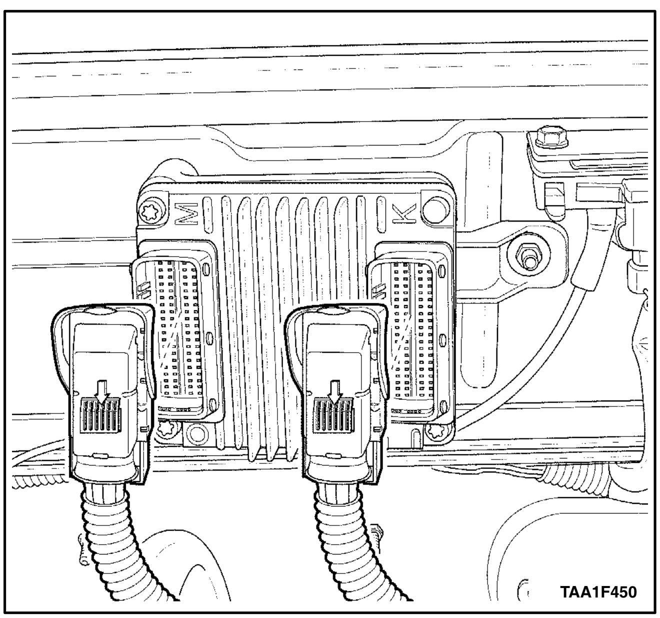


TAA1F440

ENGINE CONTROL MODULE (SOHC)

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the engine control module (ECM) connectors.
3. Remove the ECM retaining bolts.
4. Remove the ECM from the ECM mount.



TAA1F450

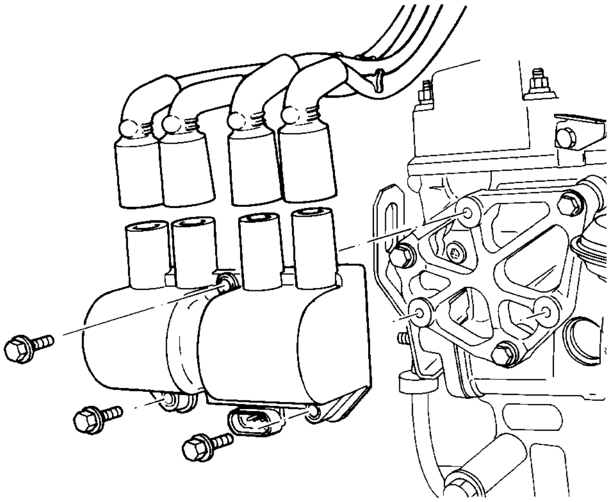
Installation Procedure

1. Position the ECM in place.
2. Install the ECM to the ECM mount and install the retaining bolts.

Tighten

Tighten the ECM retaining bolts to 5 N•m (44 lb–in).

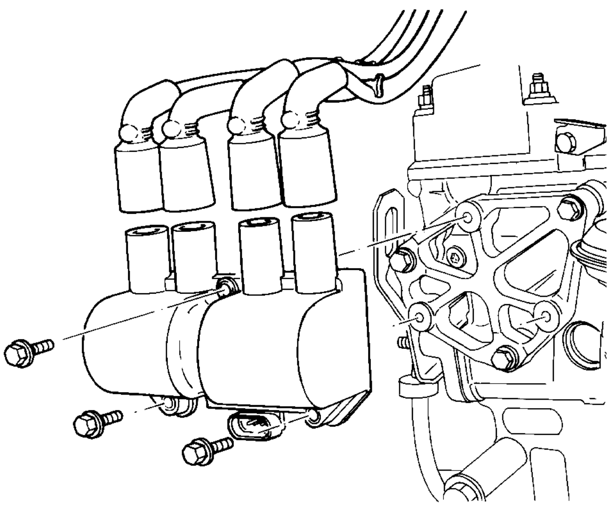
3. Connect the negative battery cable.
4. Perform a crankshaft position system variation learning procedure. Refer to “DTC P1336” in this section.


A102F011

ELECTRONIC IGNITION SYSTEM IGNITION COIL

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electronic ignition (EI) system ignition coil connector.
3. Note the ignition wire location and remove the ignition wires.
4. Remove the EI system ignition coil retaining bolts.
5. Remove the EI system ignition coil.


A102F011

Installation Procedure

1. Install the EI system ignition coil into the mounting location and install the retaining bolts.

Tighten

Tighten the electronic ignition system ignition coil retaining bolts to 10 N•m (89 lb-in).

2. Connect the EI system 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 input to the engine control module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system 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 electronic spark timing. 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).

ELECTRONIC IGNITION SYSTEM IGNITION COIL

The Electronic Ignition (EI) system ignition coil is mounted near the rear of the camshaft carrier on the single overhead camshaft engine. On the dual overhead camshaft engine, the EI system ignition coil is mounted near the rear of the cylinder head. Each pair of terminals of the EI system ignition coil provides the spark for two spark plugs simultaneously. The EI system ignition coil is not serviceable and must be replaced as an assembly.

CRANKSHAFT POSITION SENSOR

This electronic ignition system uses a magnetic crankshaft position sensor 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 machines into it, 57 of which are equally spaced in 6 degree intervals. The last slot is wider 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 engine 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.

CAMSHAFT POSITION SENSOR

The Camshaft Position (CMP) sensor sends a CMP sensor signal to the engine control module (ECM). The ECM uses this signal as a "sync pulse" to trigger the injectors in the proper sequence. The ECM uses the CMP sensor signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation. If the ECM detects an incorrect CMP sensor signal while the engine is running, DTC P0341 will set. If the CMP sensor signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine will continue to run. As long as the fault is present, the engine can be restarted. It will run in the calculated sequential mode with a 1-in-6 chance of the injector sequence being correct.

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 engine 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 (O2S 1) 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 engine 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 O2S 1 sensor is located in the exhaust manifold. The O2S 1 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 two seconds. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines 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 delivered 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%, 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 O2S 1 and calculates the air/fuel ratio based on inputs from the ECT and the MAP sensors. The sensor stays in “open loop” until the following conditions are met:

- The O2S 1 sensor has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor 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 electrically 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 oxygen 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 air flow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and air flow 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 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 Cut-Off 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 CKP sensor. This prevents flooding.

EVAPORATIVE EMISSION CONTROL SYSTEM OPERATION

The basic evaporative (EVAP) emission control system is a duty control linear type and uses the EVAP emission canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) 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 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 the engine 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 EVAP emission canister purge solenoid valve. This valve is Pulse Width Modulated (PWM) or turned on and off several times a second. The EVAP emission canister purge 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 EVAP emission canister purge valve.
- A damaged canister.
- Hoses that are split, cracked, or not connected to the proper tubes.

EVAPORATIVE EMISSION CANISTER

The evaporative (EVAP) emission canister is an emission control device containing activated charcoal granules. The EVAP emission canister is used to store fuel vapors from the fuel tank. Once certain conditions are met, the engine control module (ECM) activates the EVAP emission canister purge solenoid, allowing the fuel vapors to be drawn into the engine cylinders and burned.

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 blow-by gases and is then passed 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.

ENGINE COOLANT TEMPERATURE SENSOR

The Engine Coolant Temperature (ECT) sensor 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 engine control module (ECM) supplies 5 volts to the coolant temperature 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 a diagnostic trouble code P0117 or P0118. Remember, these diagnostic trouble codes 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 (TP) sensor is a potentiometer connected to the throttle shaft of the throttle body. The TP sensor electrical circuit consists of a 5 volt supply line and a ground line, both provided by the engine control module (ECM).

The ECM calculates the throttle position by monitoring the voltage on this signal line. The TP sensor output changes as the accelerator pedal is moved, changing the throttle valve angle. At a closed throttle position, the output of the TP sensor 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 TP sensor can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM senses the throttle is moving. A problem in any of the TP sensor circuits should set a diagnostic trouble code P0122 or P0123. Once the diagnostic trouble code is set, the ECM will substitute a default value for the TP sensor and some vehicle performance will return.

CATALYST MONITOR OXYGEN SENSORS

Three-way catalytic converters are used to control emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converters promotes a chemical reaction. This reaction oxidizes the HC and CO present in the exhaust gas and converts them into harmless water vapor and carbon dioxide. The catalyst also reduces NOx by converting it to nitrogen. The engine control module (ECM) can monitor this process using the Bank 1 Sensor 1 and Bank 1 Sensor 2 sensors. These sensors produce an output signal which indicates the amount of oxygen present in the exhaust gas entering and leaving the three-way converter. This indicates the catalyst's ability to efficiently convert exhaust gasses. If the catalyst is operating efficiently, the Bank 1 Sensor 1 sensor signals will be more active than the signals produced by the Bank 1 Sensor 2 sensor. The catalyst monitor sensors operate the same way as the fuel control sensors. The sensors' main function is catalyst monitoring, but they also have a limited role in fuel control. If a sensor output indicates a voltage either above or below the 450 mv bias voltage for an extended period of time, the ECM will make a slight adjustment to fuel trim to ensure that fuel delivery is correct for catalyst monitoring.

A problem with the Bank 1 Sensor 1 sensor circuit will set DTC P0131, P0132, P0133 or P0134 depending on the special condition. A problem with the Bank 1 Sensor 2 sensor signal will set DTC P0137, P0138, P0140 or P0141 depending on the special condition.

A fault in the heated oxygen sensor heater element or its ignition feed or ground will result in lower oxygen sensor response. This may cause incorrect catalyst monitor diagnostic results.

EXHAUST GAS RECIRCULATION VALVE

The Exhaust Gas Recirculation (EGR) system is used on engines to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperature. The EGR valve is a duty control linear type that is operated by the engine control module (ECM). 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.

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 engine control module (ECM). The ECM then adjusts the ignition timing to reduce the spark knock.

G SENSOR

The engine control module (ECM) receives rough road information from the G sensor. The ECM uses the rough road information to enable or disable the misfire diagnostic. The misfire diagnostic can be greatly affected by crankshaft speed variations caused by driving on rough road surfaces. The G sensor generates rough road information by producing a signal which is proportional to the movement of a small metal bar inside the sensor.

If a fault occurs which causes the ECM to not receive rough road information between 30 and 80 mph (50 and 132 km/h), DTC P1391 will set.

INTAKE AIR TEMPERATURE SENSOR

The Intake Air Temperature (IAT) 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 engine control module (ECM) provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the intake air temperature. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake air temperature by measuring the voltage.

The IAT sensor is also used to control spark timing when the intake air is cold.

A failure in the IAT sensor circuit sets a diagnostic trouble code P0112 or P0113.

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 idle air control (IAC) valve is mounted on the throttle body where it controls the engine idle speed under the command of the engine 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, controls 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 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 depress 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 air flow 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 engine 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 P0106, P0107 or P0108.

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

ENGINE CONTROL MODULE

The engine control module (ECM), located in passenger comportment, 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 Reminder Indicator (SRI), and store diagnostic trouble code(s) 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 powertrain control module engine 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 it 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.

STRATEGY-BASED DIAGNOSTICS

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician on how to proceed with a diagnosis:

- Verify the customer complaint. To verify the customer complaint, the technician should know the normal operation of the system.
- Perform preliminary checks as follows:
  - Conduct a thorough visual inspection.
  - Review the service history.
  - Detect unusual sounds or odors.
  - Gather diagnostic trouble code information to achieve an effective repair.
- Check bulletins and other service information. This includes videos, newsletters, etc.
- Refer to service information (manual) system check(s).
- Refer to service diagnostics.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

Re-examine the complaint.

When the complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in "Intermittents", or could be normal.

After isolating the cause, the repairs should be made. Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:

- Conditions noted by the customer.

- If a Diagnostic Trouble Code (DTC) was diagnosed, verify a repair by duplicating conditions present when the DTC was set as noted in the Failure Records or Freeze Frame data.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with On-Board Diagnostic (EOBD) system diagnostics. Following a repair, the technician should perform the following steps:

Important: Follow the steps below when you verify repairs on EOBD systems. Failure to follow these steps could result in unnecessary repairs.

- Review and record the Failure Records and the Freeze Frame data for the DTC which has been diagnosed (Freeze Fame data will only be stored for an A or B type diagnostic and only if the Malfunction Indicator Lamp has been requested).
- Clear the DTC(s).
- Operate the vehicle within conditions noted in the Failure Records and Freeze Frame data.
- Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

EOBD SERVICEABILITY ISSUES

Based on the knowledge gained from On-Board Diagnostic (EOBD) experience, this list of non-vehicle faults that could affect the performance of the EOBD system has been compiled. These non-vehicle faults vary from environmental conditions to the quality of fuel used. With the introduction of EOBD across the entire passenger car and light-duty truck market, illumination of the Malfunction Indicator Lamp (MIL) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and customer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Fuel Quality

Fuel quality is not a new issue for the automotive industry, but its potential for turning on the MIL with EOBD systems is new.

Fuel additives such as “dry gas” and “octane enhancers” may affect the performance of the fuel. If this results in an incomplete combustion or a partial burn, it will set DTC P0300. The Reed Vapor Pressure of the fuel can also create problems in the fuel system, especially during the spring and fall months when severe ambient temperature swings occur. A high Reed Vapor Pressure could show up as a Fuel Trim DTC due to excessive canister loading. High vapor pressures generated in the fuel tank can also affect the Evaporative Emission diagnostic as well.

Using fuel with the wrong octane rating for your vehicle may cause driveability problems. Many of the major fuel companies advertise that using “premium” gasoline will improve the performance of your vehicle. Most premium fuels use alcohol to increase the octane rating of the fuel. Although alcohol–enhanced fuels may raise the octane rating, the fuel’s ability to turn into vapor in cold temperatures deteriorates. This may affect the starting ability and cold driveability of the engine.

Low fuel levels can lead to fuel starvation, lean engine operation, and eventually engine misfire.

Non–OEM Parts

All the EOBD parts have been calibrated to run with Original Equipment Manufacturer (OEM) parts. Something as simple as a high performance-exhaust system that affects exhaust system back pressure could potentially interfere with the operation of the Exhaust Gas Recirculation (EGR) valve and thereby turn on the MIL. Small leaks in the exhaust system near the post catalyst oxygen sensor can also cause the MIL to turn on.

Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may radiate Electromagnetic Interference (EMI) into the control system if they are improperly installed. This may cause a false sensor reading and turn on the MIL.

Environment

Temporary environmental conditions, such as localized flooding, will have an effect on the vehicle ignition system. If the ignition system is rain-soaked, it can temporarily cause engine misfire and turn on the MIL.

Vehicle Marshaling

The transportation of new vehicles from the assembly plant to the dealership can involve as many as 60 key cycles within 2 to 3 miles of driving. This type of operation contributes to the fuel fouling of the spark plugs and will turn on the MIL with a set DTC P0300.

Poor Vehicle Maintenance

The sensitivity of the EOBD will cause the MIL to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to EOBD. Poor vehicle maintenance can not be classified as a “non-vehicle fault”, but with the sensitivity of the EOBD, vehicle maintenance schedules must be more closely followed.

Severe Vibration

The Misfire diagnostic measures small changes in the rotational speed of the crankshaft. Severe driveline vibrations in the vehicle, such as caused by an excessive amount of mud on the wheels, can have the same effect on crankshaft speed as misfire and therefore may set DTC P0300.

Related System Faults

Many of the EOBD system diagnostics will not run if the engine control module (ECM) detects a fault on a related system or component. One example would be that if the ECM detected a Misfire fault, the diagnostics on the catalytic converter would be suspended until the Misfire fault was repaired. If the Misfire fault is severe enough, the catalytic converter can be damaged due to overheating and will never set a Catalyst DTC until the Misfire fault is repaired and the Catalyst diagnostic is allowed to run to completion. If this happens, the customer may have to make two trips to the dealership in order to repair the vehicle.

SERIAL DATA COMMUNICATIONS

KWP 2000 Serial Data Communications

Government regulations require that all vehicle manufacturers establish a common communication system. This vehicle utilizes the “KWP 2000” communication system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a single wire. The messages carried on Class II data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that it provides scan tool manufacturers with the capability to access data from any make or model vehicle that is sold.

The data displayed on the other scan tool will appear the same, with some exceptions. Some scan tools will only be able to display certain vehicle parameters as values that are a coded representation of the true or actual value. On this vehicle, the scan tool displays the actual values for vehicle parameters. It will not be necessary to perform any conversions from coded values to actual values.

ON-BOARD DIAGNOSTIC (EOBD)

On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

Remember, a fuel trim Diagnostic Trouble Code (DTC) may be triggered by a list of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

COMPREHENSIVE COMPONENT MONITOR DIAGNOSTIC OPERATION

Comprehensive component monitoring diagnostics are required to monitor emissions-related input and output powertrain components.

Input Components

Input components are monitored for circuit continuity and out-of-range values. This includes rationality checking. Rationality checking refers to indicating a fault when the signal from a sensor does not seem reasonable, i.e. Throttle Position (TP) sensor that indicates high throttle position at low engine loads or Manifold Absolute Pressure (MAP) voltage. Input components may include, but are not limited to, the following sensors:

- Vehicle Speed Sensor (VSS)
- Crankshaft Position (CKP) sensor
- Throttle Position (TP) sensor
- Engine Coolant Temperature (ECT) sensor
- Camshaft Position (CMP) sensor
- Manifold Absolute Pressure (MAP) sensor

In addition to the circuit continuity and rationality check, the ECT sensor is monitored for its ability to achieve a steady state temperature to enable closed loop fuel control.

Output Components

Output components are diagnosed for proper response to control module commands. Components where functional monitoring is not feasible will be monitored for circuit continuity and out-of-range values if applicable. Output components to be monitored include, but are not limited to the following circuit:

- Idle Air Control (IAC) Motor
- Control module controlled Evaporative Emission (EVAP) Canister Purge Valve
- A/C relays
- Cooling fan relay
- VSS output
- MIL control
- Cruise control inhibit

Refer to ECM and Sensors in General Descriptions.

Passive and Active Diagnostic Tests

A passive test is a diagnostic test which simply monitors a vehicle system or component. Conversely, an active test, actually takes some sort of action when performing diagnostic functions, often in response to a failed passive test. For example, the Exhaust Gas Recirculation (EGR) diagnostic active test will force the EGR valve open during closed throttle deceleration and/or force the EGR valve closed during a steady state. Either action should result in a change in manifold pressure.

Intrusive Diagnostic Tests

This is any on-board test run by the Diagnostic Management System which may have an effect on vehicle performance or emission levels.

Warm-Up Cycle

A warm-up cycle means that engine at temperature must reach a minimum of 70°C (160°F) and rise at least 22°C (40°F) over the course of a trip.

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emissions-related fault is stored in memory and when the Malfunction Indicator Lamp (MIL) is commanded on. These data can help to identify the cause of a fault.

Failure Records

Failure Records data is an enhancement of the EOBD Freeze Frame feature. Failure Records store the same vehicle information as does Freeze Frame, but it will store that information for any fault which is stored in on-board memory, while Freeze Frame stores information only for emission-related faults that command the MIL on.

COMMON EOBD TERMS

Diagnostic

When used as a noun, the word diagnostic refers to any on-board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification. There are many diagnostics, shown in the following list:

- Misfire
- Oxygen sensors (O2S 1)
- Oxygen sensor (HO2S 2)
- Exhaust Gas Recirculation (EGR)
- Catalyst monitoring

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run.

"Enable criteria" is another way of saying "conditions required".

The enable criteria for each diagnostic is listed on the first page of the DTC description under the heading "Conditions for Setting the DTC." Enable criteria varies with each diagnostic, and typically includes, but is not limited to the following items:

- Engine speed
- Vehicle speed
- Engine Coolant Temperature (ECT)
- Manifold Absolute Pressure (MAP)
- Barometric Pressure (BARO)
- Intake Air Temperature (IAT)
- Throttle Position (TP)
- High canister purge
- Fuel trim
- A/C on

Trip

Technically, a trip is a key-on run key-off cycle in which all the enable criteria for a given diagnostic are met, allowing the diagnostic to run. Unfortunately, this concept is not quite that simple. A trip is official when all the enable criteria for a given diagnostic are met. But because the enable criteria vary from one diagnostic to another, the definition of trip varies as well. Some diagnostics are run when the vehicle is at operating temperature, some when the vehicle first start up; some require that the vehicle be cruising at a steady highway speed, some run only when the vehicle is at idle;

Some run only immediately following a cold engine startup.

A trip then, is defined as a key on-run-key off cycle in which the vehicle was operated in such a way as to satisfy the enables criteria for a given diagnostic, and this diagnostic will consider this cycle to be one trip. However, another diagnostic with a different set of enable criteria (which were not met) during this driving event, would not consider it a trip. No trip will occur for that particular diagnostic until the vehicle is driven in such a way as to meet all the enable criteria

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self–diagnosis on certain control functions. This diagnostic capability is complimented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) is required by On-Board Diagnostics (EOBD) that it illuminates under a strict set of guide lines.

Basically, the MIL is turned on when the engine control module (ECM) detects a Diagnostic Trouble Code (DTC) that will impact the vehicle emissions.

The MIL is under the control of the Diagnostic Executive. The MIL will be turned on if an emissions-related diagnostic test indicates a malfunction has occurred. It will stay on until the system or component passes the same test, for three (four – 1.5L SOHC) consecutive trips, with no emissions related faults.

Extinguishing the MIL

When the MIL is on, the Diagnostic Executive will turn off the MIL after three consecutive trips that a “test passed” has been reported for the diagnostic test that originally caused the MIL to illuminate. Although the MIL has been turned off, the DTC will remain in the ECM memory (both Freeze Frame and Failure Records) until forty (40) warm-up cycles after no faults have been completed.

If the MIL was set by either a fuel trim or misfire-related DTC, additional requirements must be met. In addition to the requirements stated in the previous paragraph, these requirements are as follows:

- The diagnostic tests that are passed must occur with 375 rpm of the rpm data stored at the time the last test failed.
- Plus or minus ten percent of the engine load that was stored at the time the last test failed. Similar engine temperature conditions (warmed up or warming up) as those stored at the time the last test failed.

Meeting these requirements ensures that the fault which turned on the MIL has been corrected.

The MIL is on the instrument panel and has the following functions:

- It informs the driver that a fault that affects vehicle emission levels has occurred and that the vehicle should be taken for service as soon as possible.
- As a system check, the MIL will come on with the key ON and the engine not running. When the engine is started, the MIL will turn OFF.
- When the MIL remains ON while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, a EOBD System Check must be performed. The procedures for these checks are given in EOBD System Check. These checks will expose faults which may not be detected if other diagnostics are performed first.

Data Link Connector (DLC)

The provision for communicating with the control module is the Data Link Connector (DLC). The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Performing output control tests.
- Reading serial data.

DTC TYPES

Each Diagnostic Trouble Code (DTC) is directly related to a diagnostic test. The Diagnostic Management System sets DTC based on the failure of the tests during a trip or trips. Certain tests must fail two consecutive trips before the DTC is set. The following are the three types of DTCs and the characteristics of those codes:

Type A

- Emissions related.
- Requests illumination of the Malfunction Indicator Lamp (MIL) of the first trip with a fail.
- Stores a History DTC on the first trip with a fail.
- Stores a Freeze Frame (if empty).
- Stores a Fail Record.
- Updates the Fail Record each time the diagnostic test fails.

Type B

- Emissions related.
- “Armed” after one trip with a fail.
- “Disarmed” after one trip with a pass.
- Requests illumination of the MIL on the second consecutive trip with a fail.
- Stores a History DTC on the second consecutive trip with a fail. (The DTC will be armed after the first fail.)
- Stores a Freeze Frame on the second consecutive trip with a fail (if empty.)

Type E (1.5L SOHC)

- Emissions related.
- “Armed” after two trip with a fail.
- “Disarmed” after one trip with a pass.
- Request illumination of the MIL on third consecutive trip with a fail.
- Stores a History DTC on the third consecutive trip with a fail (The DTC will be armed after the second fail).
- Stores a Freeze Frame on the third consecutive trip with a fail (if empty).

Type D (Type D non-emissions related are not utilized on certain vehicle applications).

- Non-Emissions related.
- Does not request illumination of any lamp.

- Stores a History DTC on the first trip with a fail .
- Does not store a Freeze Frame.
- Stores Fail Record when test fails.
- Updates the Fail Record each time the diagnostic test fails.

Important: Only four Fail Records can be stored. Each Fail Record is for a different DTC. It is possible that there will not be Fail Records for every DTC if multiple DTCs are set.

Special Cases of Type B Diagnostic Tests

Unique to the misfire diagnostic, the Diagnostic Executive has the capability of alerting the vehicle operator to potentially damaging levels of misfire. If a misfire condition exists that could potentially damage the catalytic converter as a result of high misfire levels, the Diagnostic Executive will command the MIL to “flash” at a rate of once per second during those the time that the catalyst damaging misfire condition is present.

Fuel trim and misfire are special cases of Type B diagnostics. Each time a fuel trim or misfire malfunction is detected, engine load, engine speed, and Engine Coolant Temperature (ECT) are recorded.

When the ignition is turned off, the last reported set of conditions remain stored. During subsequent ignition cycles, the stored conditions are used as a reference for similar conditions. If a malfunction occurs during two consecutive trips, the Diagnostic Executive treats the failure as a normal Type B diagnostic, and does not use the stored conditions. However, if a malfunction occurs on two non–consecutive trips, the stored conditions are compared with the current conditions. The MIL will then illuminate under the following conditions:

- When the engine load conditions are within 10% of the previous test that failed.
- Engine speed is within 375 rpm, of the previous test that failed.
- ECT is in the same range as the previous test that failed.

PRIMARY SYSTEM-BASED DIAGNOSTICS

There are primary system-based diagnostics which evaluate system operation and its effect on vehicle emissions. The primary system–based diagnostics are listed below with a brief description of the diagnostic function:

Oxygen Sensor Diagnosis

The fuel control Oxygen Sensor (O2S 1) is diagnosed for the following conditions:

- Slow response
- Response time (time to switch R/L or L/R)
- Inactive signal (output steady at bias voltage approx. 450 mv)
- Signal fixed high
- Signal fixed low

The catalyst monitor Heated Oxygen Sensor (HO2S 2) is diagnosed for the following conditions:

- Heater performance (time to activity on cold start).
- Signal fixed low during steady state conditions or power enrichment (hard acceleration when a rich mixture should be indicated).
- Signal fixed high during steady state conditions or deceleration mode (deceleration when a lean mixture should be indicated).
- Inactive sensor (output steady at approx. 438 mv).

If the oxygen sensor pigtail wiring, connector or terminal are damaged, the entire oxygen sensor assembly must be replaced. Do not attempt to repair the wiring, connector or terminals. In order for the sensor to function properly, it must have clean reference air provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector or terminals could result in the obstruction of the reference air and degrade oxygen sensor performance.

Misfire Monitor Diagnostic Operation

The misfire monitor diagnostic is based on crankshaft rotational velocity (reference period) variations. The engine control module (ECM) determines crankshaft rotational velocity using the Crankshaft Position (CKP) sensor and the Camshaft Position (CMP) sensor. When a cylinder misfires, the crankshaft slows down momentarily. By monitoring the CKP and CMP sensor signals, the ECM can calculate when a misfire occurs.

For a non-catalyst damaging misfire, the diagnostic will be required to monitor a misfire present for between 1000-3200 engine revolutions.

For catalyst-damaging misfire, the diagnostic will respond to misfire within 200 engine revolutions.

Rough roads may cause false misfire detection. A rough road will cause torque to be applied to the drive wheels and drive train. This torque can intermittently decrease the crankshaft rotational velocity. This may be falsely detected as a misfire.

A rough road sensor, or “G sensor,” works together with the misfire detection system. The G sensor produces a voltage that varies along with the intensity of road vibrations. When the ECM detects a rough road, the misfire detection system is temporarily disabled.

Misfire Counters

Whenever a cylinder misfires, the misfire diagnostic counts the misfire and notes the crankshaft position at the time the misfire occurred. These “misfire counters” are basically a file on each engine cylinder. A current and a history misfire counter are maintained for each cylinder. The misfire current counters (Misfire Cur #1-4) indicate the number of firing events out of the last 200 cylinder firing events which were misfires. The misfire current counter will display real time data without a misfire DTC stored. The misfire history counters (Misfire Hist #1-4) indicate the total number of cylinder firing events which were misfires. The misfire history counters will display 0 until the misfire diagnostic has failed and a DTC P0300 is set. Once the misfire DTC P0300 is set, the misfire history counters will be updated every 200 cylinder firing events. A misfire counter is maintained for each cylinder.

If the misfire diagnostic reports a failure, the diagnostic executive reviews all of the misfire counters before reporting a DTC. This way, the diagnostic executive reports the most current information.

When crankshaft rotation is erratic, a misfire condition will be detected. Because of this erratic condition, the data that is collected by the diagnostic can sometimes incorrectly identify which cylinder is misfiring.

Use diagnostic equipment to monitor misfire counter data on On-Board Diagnostic (EOBD) compliant vehicles. Knowing which specific cylinder(s) misfired can lead to the root cause, even when dealing with a multiple cylinder misfire. Using the information in the misfire counters, identify which cylinders are misfiring. If the counters indicate cylinders numbers 1 and 4 misfired, look for a circuit or component common to both cylinders number 1 and 4.

The misfire diagnostic may indicate a fault due to a temporary fault not necessarily caused by a vehicle emission system malfunction. Examples include the following items:

- Contaminated fuel.
- Low fuel.
- Fuel–fouled spark plugs.
- Basic engine fault.

Fuel Trim System Monitor Diagnostic Operation

This system monitors the averages of short-term and long-term fuel trim values. If these fuel trim values stay at their limits for a calibrated period of time, a malfunction is indicated. The fuel trim diagnostic compares the averages of short-term fuel trim values and long-term fuel trim values to rich and lean thresholds. If either value is within the thresholds, a pass is recorded. If both values are outside their thresholds, a rich or lean DTC will be recorded.

The fuel trim system diagnostic also conducts an intrusive test. This test determines if a rich condition is being caused by excessive fuel vapor from the Evaporative (EVAP) Emission canister. In order to meet EOBD requirements, the control module uses weighted fuel trim cells to determine the need to set a fuel trim DTC. A fuel trim DTC can only be set if fuel trim counts in the weighted fuel trim cells exceed specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e., engine idle high due to a small vacuum leak or rough idle due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S 2 DTC may set). Use a scan tool to observe fuel trim counts while the problem is occurring.

A fuel trim DTC may be triggered by a number of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

Fuel Trim Cell Diagnostic Weights

No fuel trim DTC will set regardless of the fuel trim counts in cell 0 unless the fuel trim counts in the weighted cells are also outside specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e. engine idle high due to a small vacuum leak or rough due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S 2 DTC may set). Use a scan tool to observe fuel trim counts while the problem is occurring.

SECTION 1G

ENGINE EXHAUST

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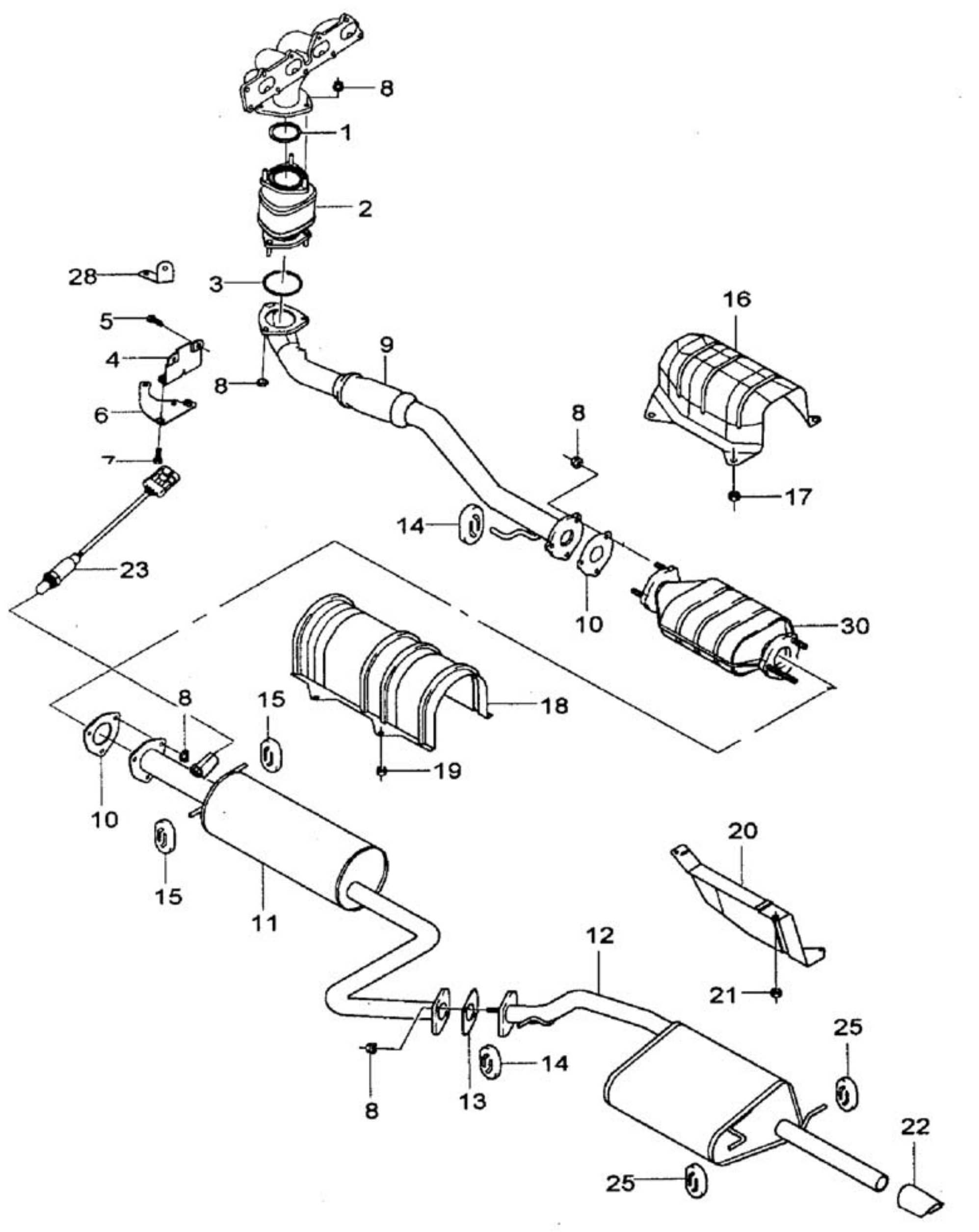
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Auxiliary Catalytic Converter-to-Exhaust Manifold Nuts	50	37	–
Exhaust Manifold Cover Bolts	15	11	–
Front Exhaust Pipe-to-Auxiliary Catalytic Converter Nuts	50	37	–
Front Exhaust Pipe-to-Connecting Pipe Nuts (1.5L SOHC)	30	22	–
	30	22	–
Front Muffler-to-Connecting Pipe Nuts (1.5L SOHC)	30	22	–
	30	22	–
Front Muffler-to-Rear Muffler Nuts	30	22	–
Heat Shield Mounting Bolts	10	–	89
Post-Converter Heated Oxygen Sensor	41	30	–

COMPONENT LOCATOR

EXHAUST SYSTEM (1.5L SOHC)



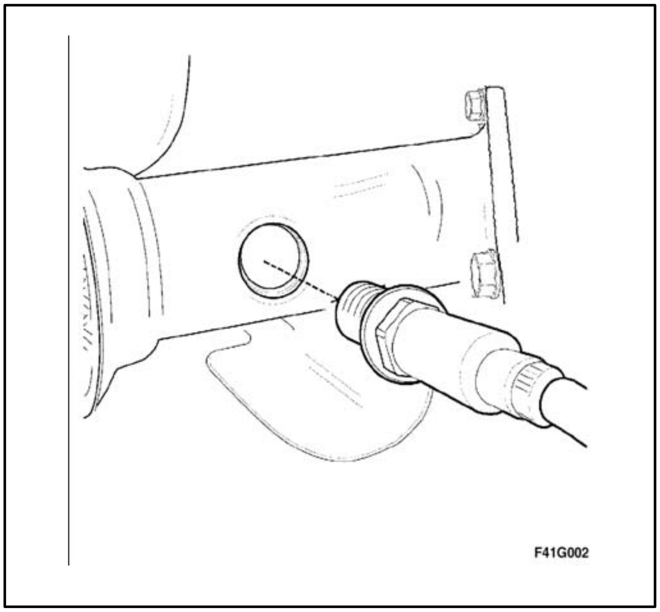
1. Garnitură evacuare	10. Garnitură catalizator	19. Piuliță
2. Convertor	11. Tobă față	20. Scut tobă
3. Garnitură convertor	12. Tobă	21. Piuliță
4. Suport superior	13. Garnitură tobă	22. Inel
5. Șurub	14. Clemă cauciuc	23. Senzor încălzit O2
6. Suport inferior	15. Clemă cauciuc	25. Clemă cauciuc
7. Șurub	16. Scut catalizator	28. Suport senzor O2
8. Piuliță	17. Piuliță	30. Catalizator
9. Conductă evacuare	18. Scut tobă față	

MAINTENANCE AND REPAIR

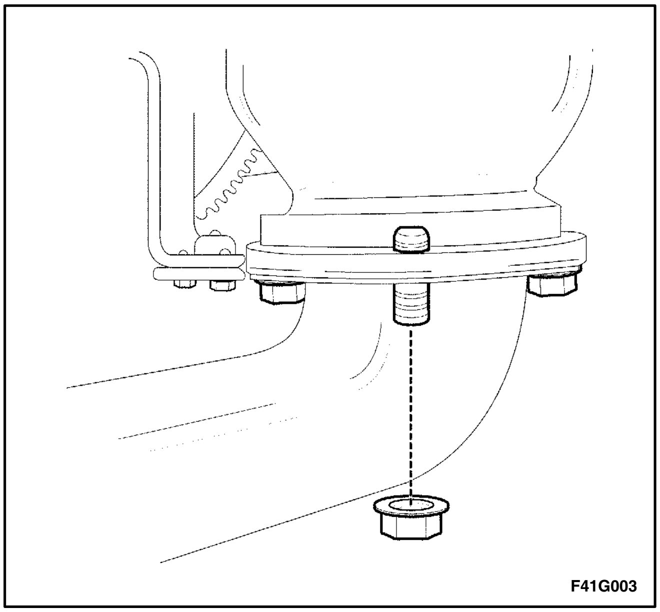
ON-VEHICLE SERVICE

FONT EXHAUST PIPE AND MAIN CATALYTIC CONVERTER (CONNECTING PIPE – 1.5L SOHC)

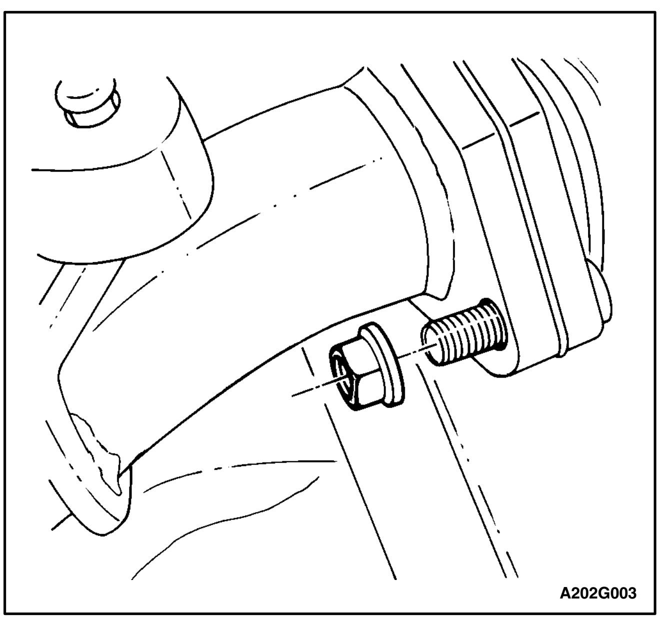
Removal Procedure



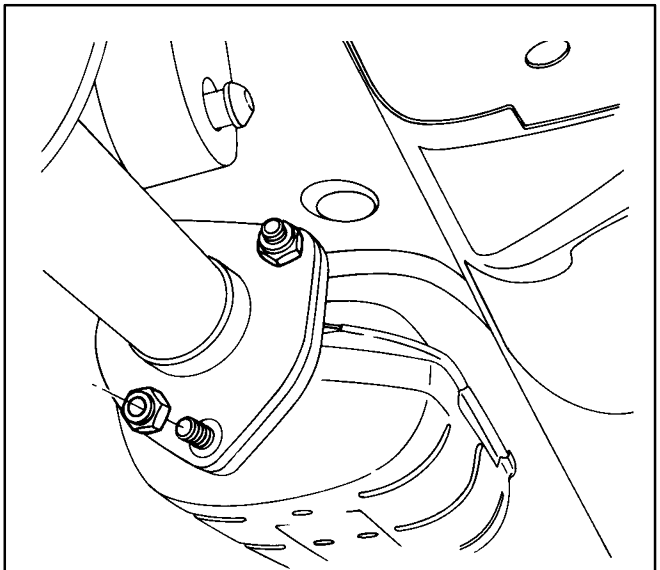
1. Remove the post-converter heated oxygen sensor.



2. Remove the front exhaust pipe nuts and the gasket from the auxiliary catalytic converter.

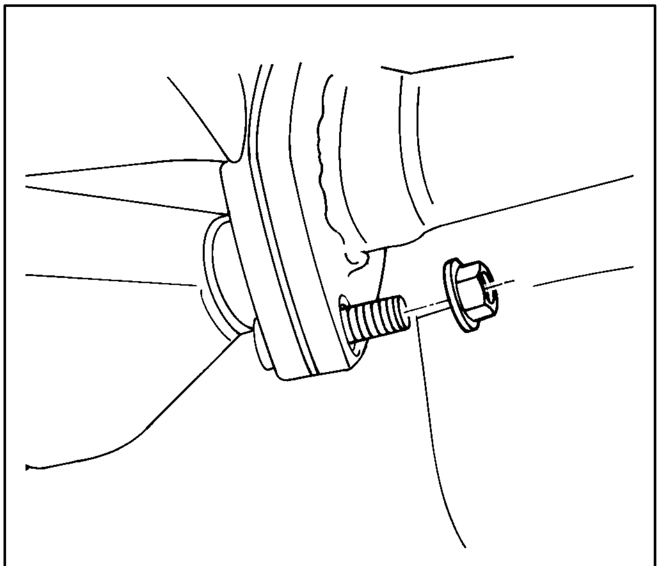


3. Disconnect the front exhaust pipe from the rubber hanger.
4. Remove the nuts from the front muffler pipe to the main catalytic converter (connecting pipe – 1.5L SOHC).



B102G003

5. Remove the front exhaust pipe and main catalytic converter (connecting pipe – 1.5L SOHC) and the gasket.
6. Clean the sealing surfaces on the front muffler pipe flange and the auxiliary catalytic converter.
7. Check the front exhaust pipe and main catalytic converter (connecting pipe – 1.5L SOHC) for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment.



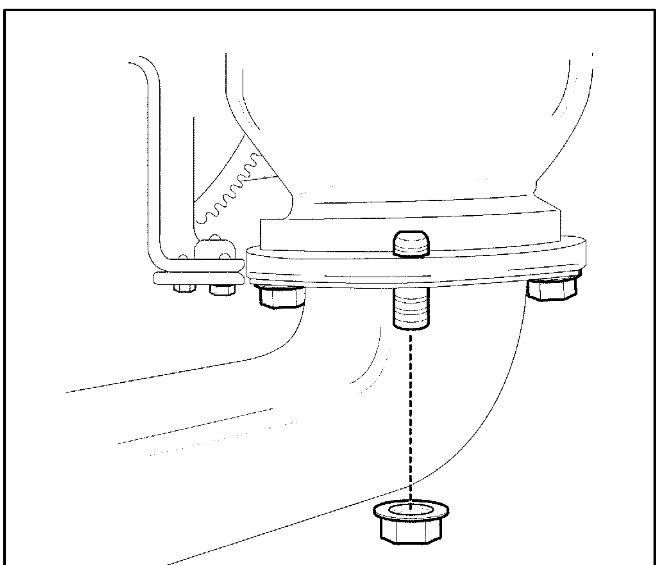
A202G004

Installation Procedure

1. Install the front exhaust pipe and main catalytic converter (connecting pipe – 1.5L SOHC) and the gasket to the front muffler pipe flange. Use the nuts to secure the converter and the front exhaust pipe.

Tighten

Tighten the front muffler-to-front exhaust pipe and main catalytic converter (connecting pipe – 1.5L SOHC) nuts to 30 N•m (22 lb-ft).

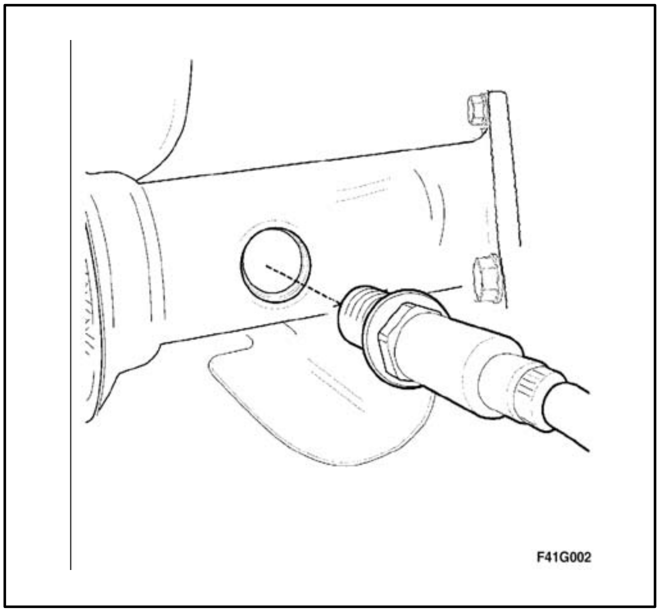


F41G003

2. Connect the front exhaust pipe to the rubber hanger.
3. Using the nuts and the gasket, secure the front exhaust pipe to the auxiliary catalytic converter.

Tighten

Tighten the front exhaust pipe-to-auxiliary catalytic converter nuts to 50 N•m (37 lb-ft).

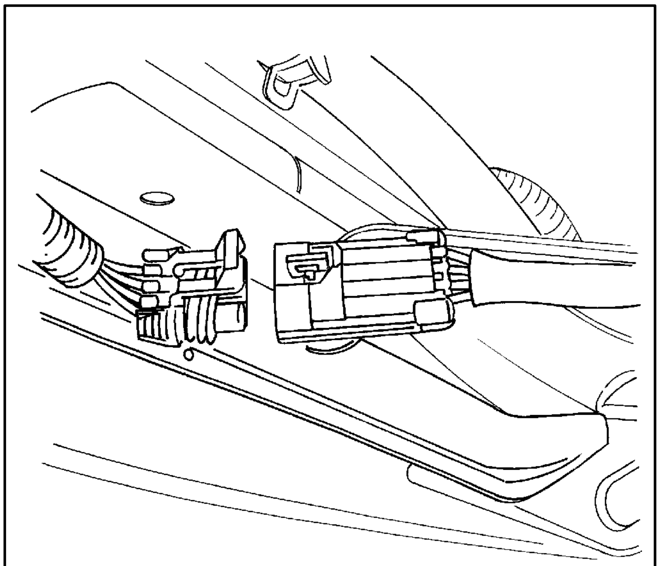


F41G002

4. Install the post-converter heated oxygen sensor.

Tighten

Tighten the post-converter heated oxygen sensor to 41 N•m (30 lb-ft).

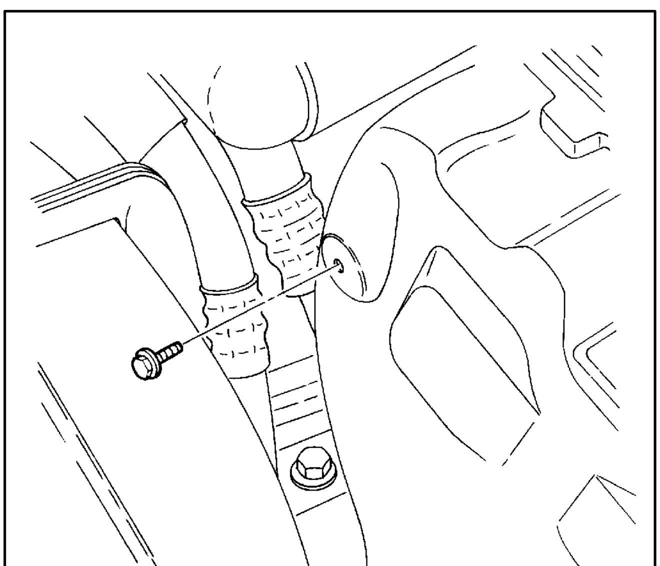


A402F067

AUXILIARY CATALYTIC CONVERTER

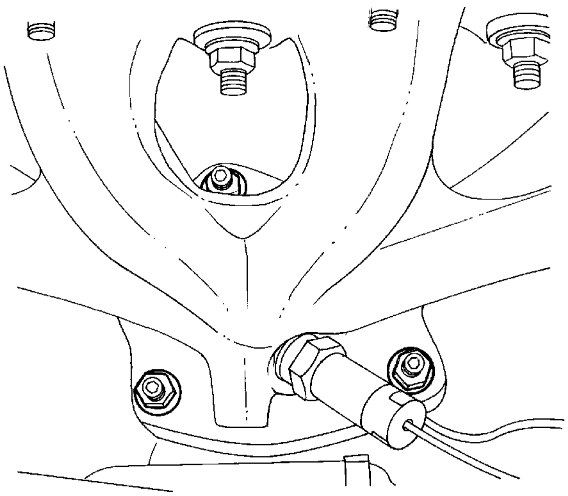
Removal Procedure

1. Disconnect the post-converter oxygen sensor electrical connector.



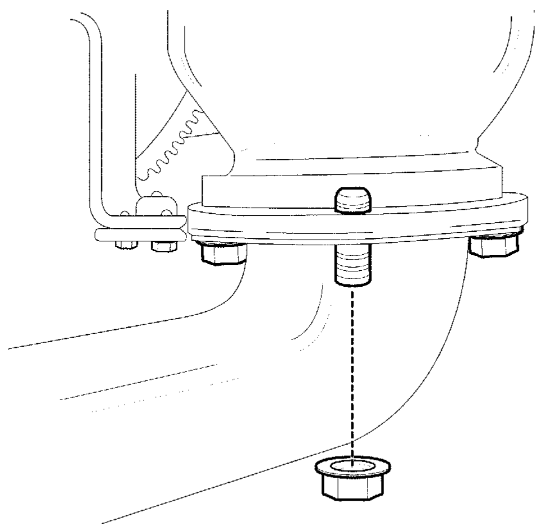
A402G004

2. Remove the heat shield mounting bolts and the exhaust manifold cover.



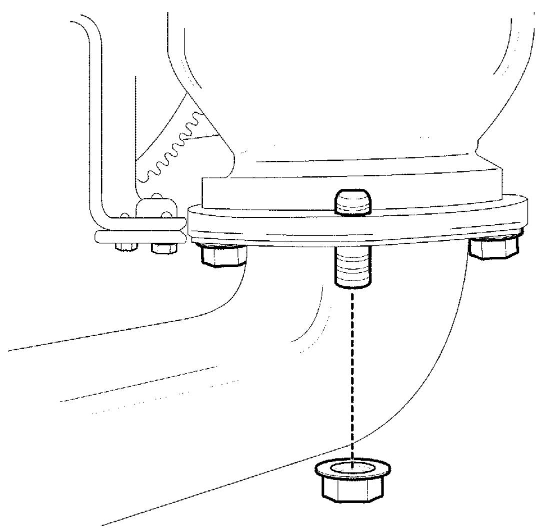
A402G005

3. Remove the auxiliary catalytic converter upper flange nuts.



F401G003

4. Remove the auxiliary catalytic converter lower flange nuts.
5. Remove the auxiliary catalytic converter and the gaskets.



F401G003

Installation Procedure

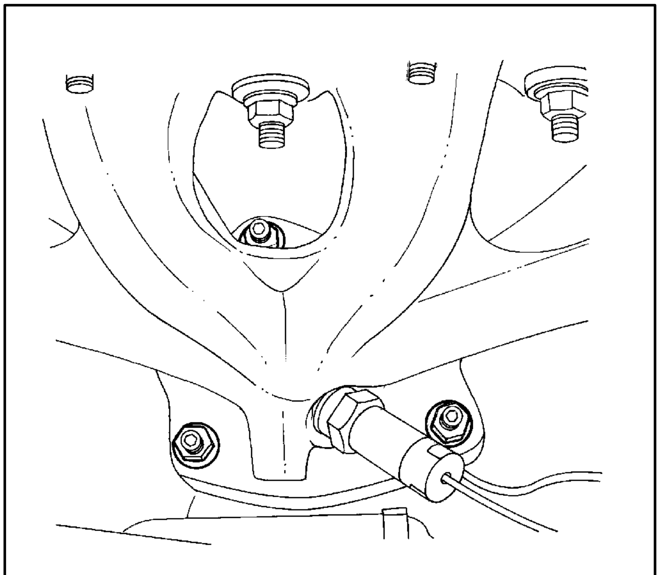
1. Install the auxiliary catalytic converter and the gaskets.

Important: Position the auxiliary catalytic converter onto the exhaust manifold flange with one upper flange nut and bolt.

2. Install the auxiliary catalytic converter lower flange nuts and the bolts.

Tighten

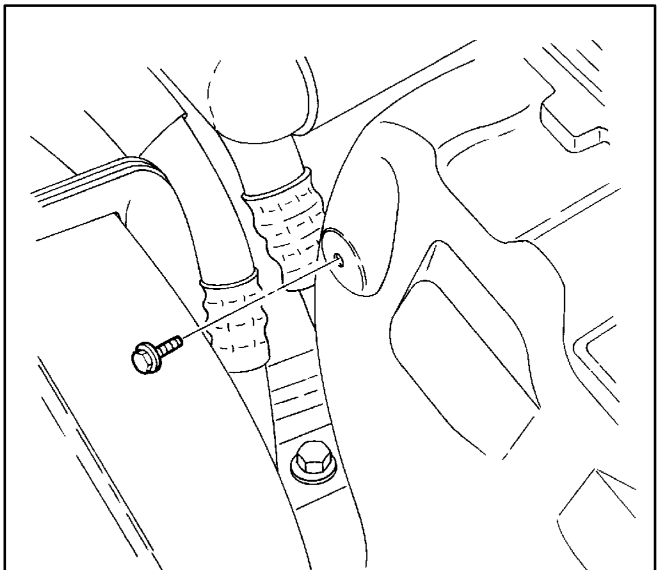
Tighten the front exhaust pipe-to-auxiliary catalytic converter nuts to 50 N•m (37 lb-ft).


A402G005

3. Install the remaining auxiliary catalytic converter upper flange nuts.

Tighten

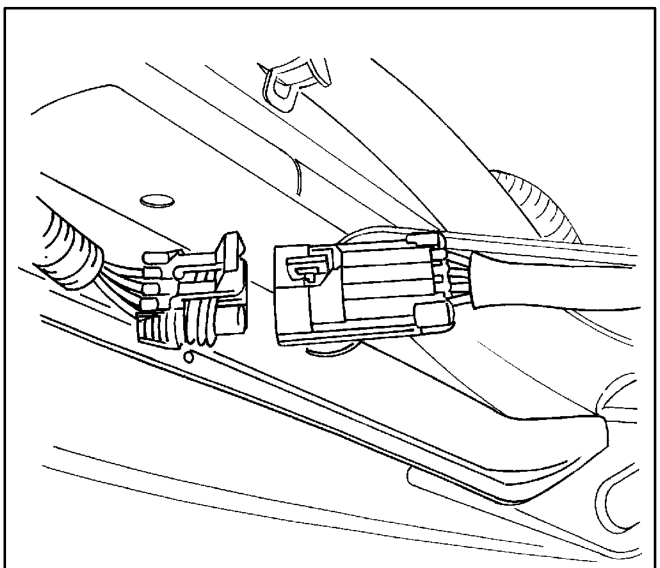
Tighten the auxiliary catalytic converter-to-exhaust manifold nuts to 50 N•m (37 lb-ft).


A402G004

4. Install the heat shield and the heated shield mounting bolts.

Tighten

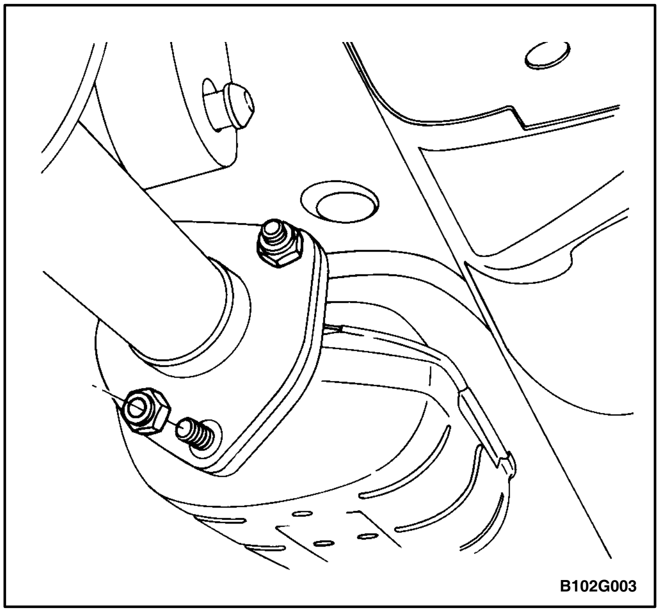
Tighten the exhaust manifold cover bolts to 10 N•m (89 lb-in).


A402F067

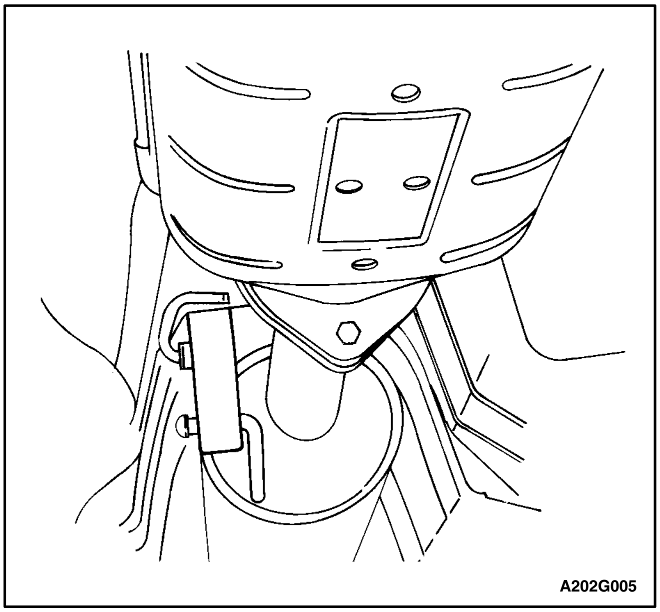
5. Connect the post-converter oxygen sensor electrical connector.

MUFFLER – FRONT

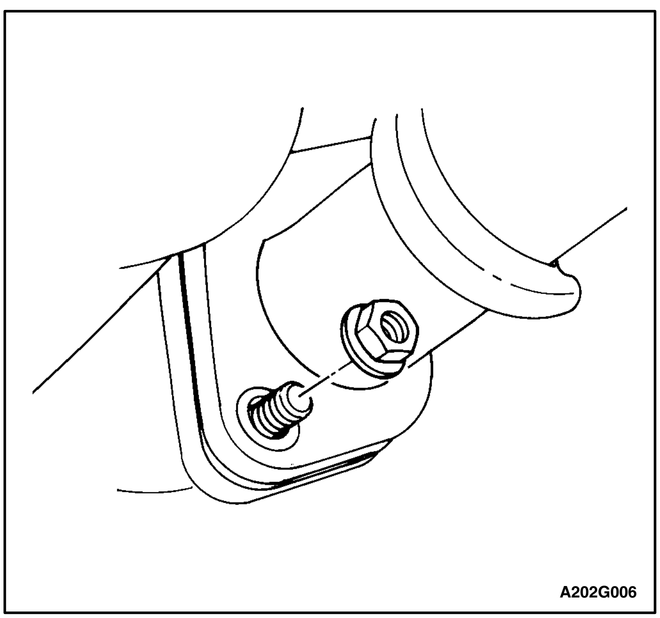
Removal Procedure



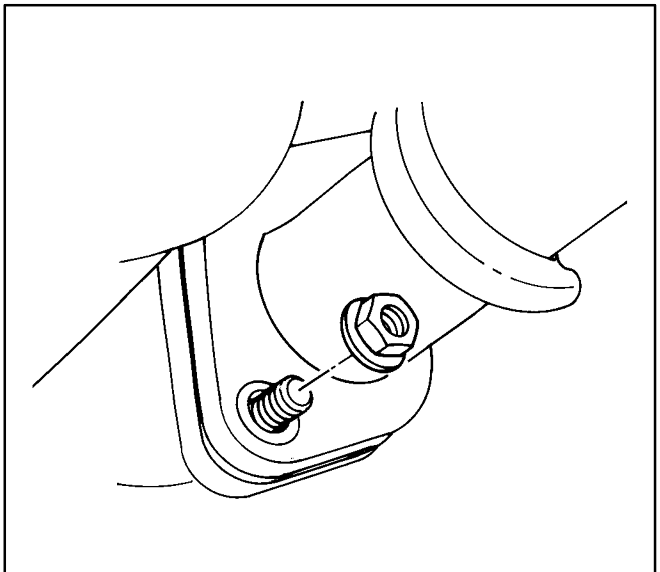
1. Remove the nuts and the gasket from the front muffler pipe to the main catalytic converter (connecting pipe – 1.5L SOHC) flange.



2. Detach the front muffler from the rubber hanger.



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.



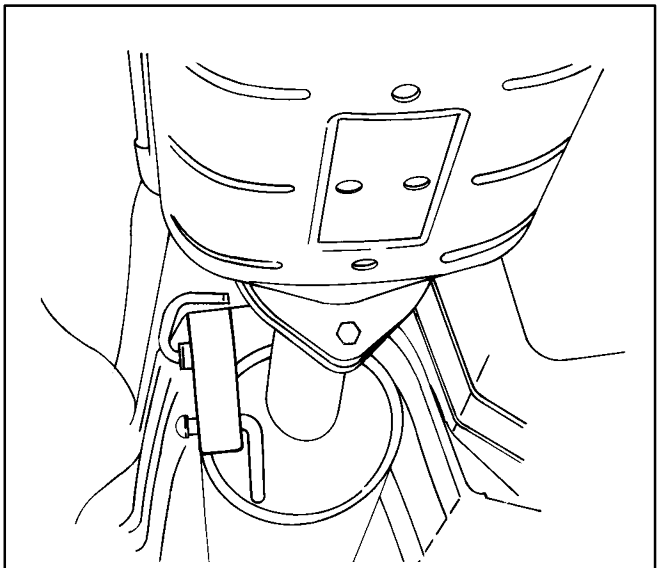
A202G006

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.

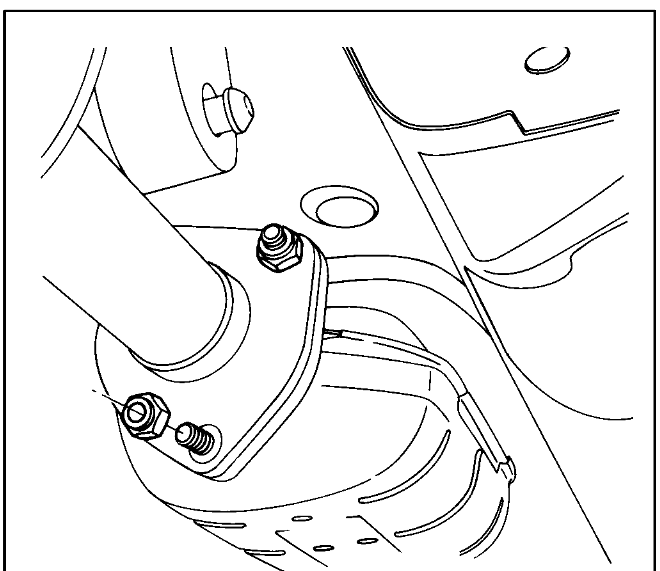
Tighten

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 the connecting pipe flange.



B102G003

3. Secure the front muffler assembly to the main catalytic converter (connecting pipe – 1.5L SOHC) flange with the nuts.

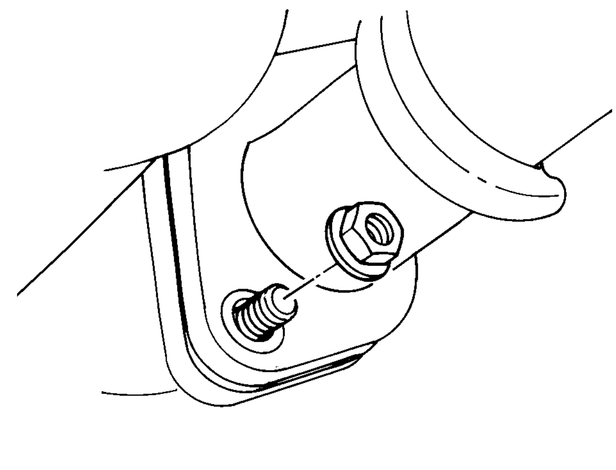
Tighten

Tighten the front muffler-to-main catalytic converter (connecting pipe – 1.5L SOHC) nuts to 30 N•m (22 lb-ft).

MUFFLER – REAR

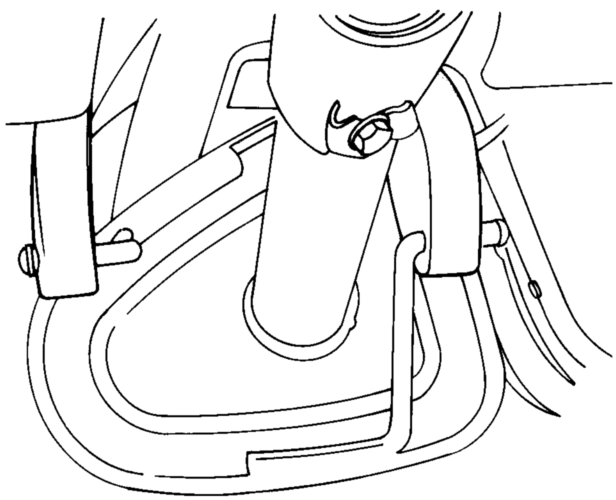
Removal Procedure

1. Remove the nuts and the gasket from the rear muffler pipe flange-to-front muffler pipe flange.



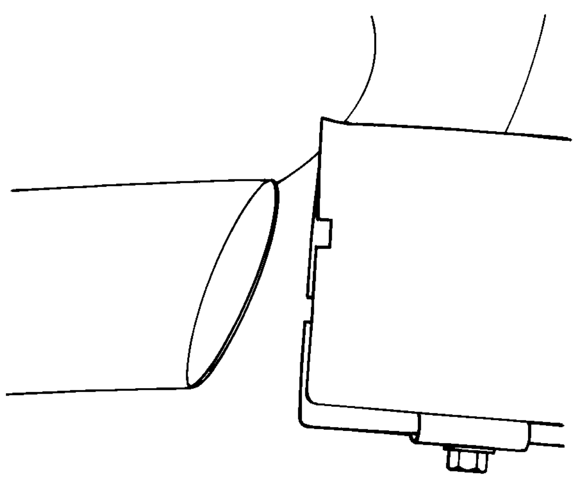
A202G006

2. Detach the rear muffler assembly from the rubber hangers on the tail pipe end.
3. Remove the rear muffler assembly.

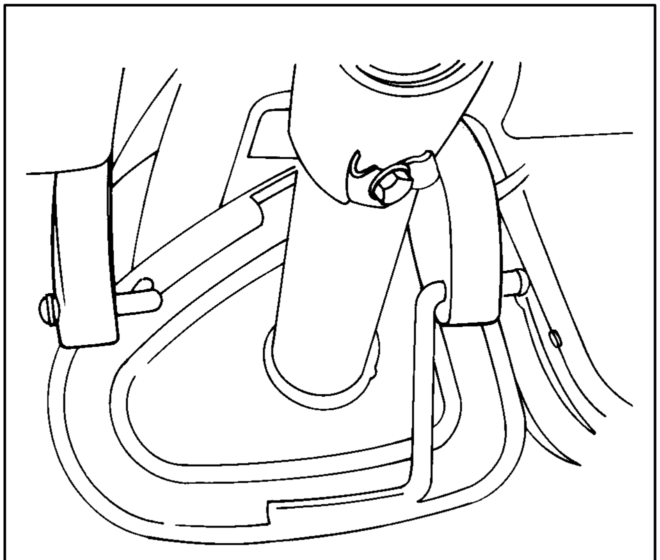


A202G007

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 the trunk.



A202G008



A202G007

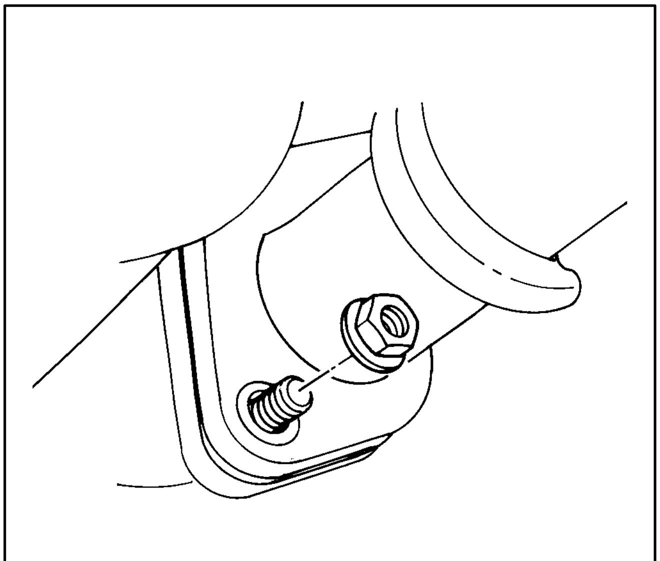
Installation Procedure

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.



A202G006

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).

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 the trunk lid for broken, damaged, missing, or mispositioned parts, open seams, holes, loose connections, or other deterioration 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.

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. 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 the rear muffler assembly positions, as well as for the main catalytic converter and the connecting pipe, protect the vehicle and the environment from high temperatures the exhaust system develops.

CATALYTIC CONVERTERS

Notice: When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the main catalytic converter as this could damage the main catalytic converter.

Notice: The catalytic converter requires the use of unleaded fuel only, or damage to the catalyst will result.

The catalytic converters are emission control devices 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).