

SECTION : 1C1

1.4L/1.6L DOHC 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.*

TABLE OF CONTENTS

SPECIFICATIONS	1C1-2	Oil Pan	1C1-38
Engine Specifications	1C1-2	Oil Pump	1C1-40
Fastener Tightening Specifications	1C1-5	Engine Mount	1C1-43
SPECIAL TOOLS	1C1-7	Camshaft Gears	1C1-45
Special Tools Table	1C1-7	Rear Timing Belt Cover	1C1-46
COMPONENT LOCATOR	1C1-9	Engine	1C1-48
Cylinder Head	1C1-9	Pistons and Rods	1C1-53
Cylinder Block	1C1-10	UNIT REPAIR	1C1-58
Intake & Exhaust Manifold	1C1-12	Cylinder Head and Valve Train Components .	1C1-58
Timing Belt	1C1-13	Crankshaft	1C1-65
Engine Mounting	1C1-14	Crankshaft Bearing and Connecting Rod Bearings – Gauging Plastics	1C1-74
MAINTENANCE AND REPAIR	1C1-15	GENERAL DESCRIPTION AND SYSTEM	
ON-VEHICLE SERVICE	1C1-15	OPERATION	1C1-77
Engine Cover	1C1-15	Cylinder Head and Gasket	1C1-77
Camshaft Cover	1C1-15	Crankshaft	1C1-77
Intake Manifold	1C1-16	Timing Belt	1C1-77
Exhaust Manifold	1C1-20	Oil Pump	1C1-77
Cylinder Head and Gasket	1C1-21	Oil Pan	1C1-77
Camshaft	1C1-29	Exhaust Manifold	1C1-77
Timing Belt Check and Adjust	1C1-30	Intake Manifold	1C1-77
Timing Belt	1C1-34	Camshaft	1C1-77

SPECIFICATIONS

ENGINE SPECIFICATIONS

Application	Description (Manual and Automatic)	
	1.4L DOHC	1.6L DOHC
General Data:		
Engine Type	F14D	F16D
Displacement	1399 cm ³	1598 cm ³ (97.51 in ³)
Bore Stroke	77.9 x 73.4 mm (3.01 in. x 2.89 in.)	79.0 x 81.5 mm (3.1 in. X 3.21 in.)
Compression Ratio	9.5 ± 0.2:1	9.5 ± 0.2:1
Firing Oder	1–3–4–2	1–3–4–2
Cylinder Bore:		
Diameter	77.9 mm (3.07 in.)	79 mm (3.1 in.)
Out of Round (Maximum)	0.0065 mm (0.00025 in.)	0.0065 mm (0.00025 in.)
Taper (Maximum)	0.07 x 30°	0.0065 mm (0.00025 in.)
Piston:		
Diameter	77.87 mm (3.07 in.)	78.970 mm (3.1090 in.)
Clearance to Bore	0.030 mm (0.0012 in.)	0.030 mm (0.0012 in.)
Piston Rings:		
Ring, End Gap:		
Top Compression	0.15–0.30 mm (0.0059–0.0118 in.)	0.2–0.3 mm (0.008–0.012 in.)
2nd Compression	0.3–0.5 mm (0.0118–0.0197 in.)	0.5–0.6 mm (0.02–0.024 in.)
Groove Clearance:		
Top Compression	0.05–0.09 mm (0.00197–0.00354 in.)	0.016 mm (0.0006 in.)
2nd Compression	0.06–0.1 mm (0.00236–0.00393 in.)	0.066 mm (0.0026 in.)
Piston Pin:		
Diameter	18.00 mm (0.708 in.)	18.00 mm (0.708 in.)
Pin Off–Set	0.5 ± 0.1 mm (0.0197 ± 0.00787 in.)	0.7–0.9 mm (0.028–0.036 in.)
Camshaft:		
Lift Intake	7.2 mm (0.283 in.)	8.5 mm (0.335 in.)
Lift Exhaust	7.2 mm (0.283 in.)	8.5 mm (0.335 in.)
End Play	0.1–0.25 mm (0.00394–0.00787 in.)	0.10–0.25 mm (0.004–0.0089 in.)
Journal OD:		
No. 1	29.94 mm (1.179 in.)	30 mm (1.18 in.)
No. 2	26.94 mm (1.061 in.)	27 mm (1.06 in.)
No. 3	26.94 mm (1.061 in.)	27 mm (1.06 in.)
No. 4	26.94 mm (1.061 in.)	27 mm (1.06 in.)
No. 5	26.94 mm (1.061 in.)	27 mm (1.06 in.)

Application	Description (Manual and Automatic)	
	1.4L DOHC	1.6L DOHC
Crankshaft:		
Main Journal:		
Diameter (All)	55 mm (2.71 in.)	54.982–54.994 mm (2.164–2.165 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)	0.004 mm (0.0001 in.)
Main Bearing Clearance (All)	0.026–0.042 mm (0.001–0.002 in.)	0.026–0.042 mm (0.001–0.002 in.)
Crankshaft End Play	0.1 mm (0.003 in.)	0.05–0.28 mm (0.002–0.011 in.)
Connecting Rod Journal:		
Diameter (All)	43 mm (1.69 in.)	42.971–42.987 mm (1.691–1.692 in.)
Taper (Maximum)	0.005 mm (0.0001 in.)	0.005 mm (0.0001 in.)
Out of Round (Maximum)	0.004 mm (0.0001 in.)	0.004 mm (0.0001 in.)
Rod Bearing Clearance (All)	0.019–0.070 mm (0.0007–0.0028 in.)	0.019–0.071 mm (0.0007–0.0028 in.)
Rod Side Clearance	0.070–0.242 mm (0.0027–0.009 in.)	0.070–0.242 mm (0.0027–0.009 in.)
Valve System:		
Valve Lash Compensators	Hydraulic	Hydraulic
Face Angle (All)	45°~45.25°	90°~90.5°
Seat Angle (All)	44.5°~45°	89°~90°
Seat Runout (Maximum, All)	0.05 mm (0.002 in.)	0.05 mm (0.002 in.)
Face Runout (Maximum, All)	0.03 mm (0.0012 in.)	0.03 mm (0.0012 in.)
Seat Width:		
Intake	1.17–1.57 mm (0.046–0.062 in.)	1.17–1.57 mm (0.046–0.062 in.)
Exhaust	1.4–1.8 mm (0.055–0.071 in.)	1.4–1.8 mm (0.055–0.071 in.)
Valve Guide Inside Diameter (All)	6.00–6.02 mm (0.236–0.237 in.)	6.00–6.02 mm (0.236–0.237 in.)
Valve Stem Diameter (All)	6 mm (0.236 in.)	6 mm (0.236 in.)
Valve Diameter (All):		
Intake	28.57 mm (1.125 in.)	28.6 mm (1.126 in.)
Exhaust	27.24 mm (1.074 in.)	27.2 mm (1.072 in.)
Valve Spring Loads:		
Valve Open	580 ± 29N (426 ± 21 lbs)	580–26N (428–19 lbs) @23.0 mm(0.90 in.)
Valve Closed	260 ± 13N (191 ± 9.6 lbs)	260”13N(192” 9 lbs) @ 32.0mm(1.25 in.)
Valve Spring Free Length	41.2 mm (1.622 in.)	41.2 mm (1.622 in.)
Oil Pump:		
Gap Between Oil Pump Body and Out Rotor	0.400~0.484 mm (0.0157~0.019 in.)	0.400~0.484 mm (0.0157~0.019 in.)
Out Rotor Side Clearance	0.045~0.100 mm (0.0018~0.0039 in.)	0.045~0.100 mm (0.02~0.004 in.)

1C1 – 4 1.4L/1.6L DOHC ENGINE MECHANICAL

Application	Description (Manual and Automatic)	
	1.4L DOHC	1.6L DOHC
Inner Rotor Side Clearance	0.035~0.085 mm (0.001~0.003 in.)	0.035~0.085 mm (0.001~0.003 in.)
Relief Valve Spring Free Length	81 mm (3.2 in.)	81 mm (3.2 in.)
Sealants and Adhesives:		
Rear Main Bearing Cap	GE p/n RTV 159	
Camshaft Carrier to Cylinder Head	HN 1581 (Loctite® 515)	
Oil Pan Bolts	HN 1256 (Loctite® 242)	
Oil Pump Bolts	HN 1256 (Loctite® 242)	
Oil Pan Pickup Tube Bolts	HN 1256 (Loctite® 242)	
Oil Gallery Plug	HN 1256 (Loctite® 242)	
Coolant Jacket Caps and Plugs (Freeze Plugs)	HN 1756 (Loctite® 176)	
Exhaust Manifold Studs/Nuts	Anti-seize Compound (HMC Spec HN1325)	

FASTENER TIGHTENING SPECIFICATIONS

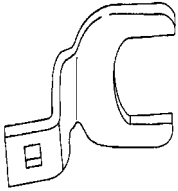
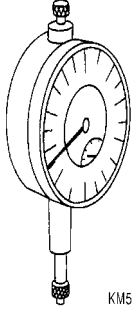
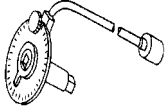
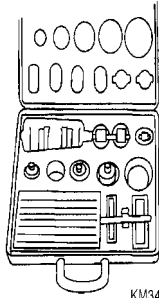
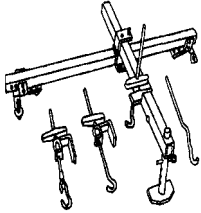
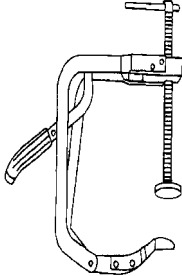
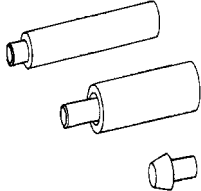
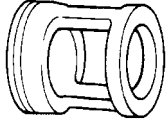
Application	N•m	Lb–Ft	Lb–In
Air Cleaner Housing Bolts	10	–	89
Camshaft Cap Bolts	16	12	–
Camshaft Cover Nuts	10	–	89
Connecting Rod Bearing Cap Bolts	25 + 30° + 15°	18 + 30° + 15°	–
Coolant Temperature Sensor	20	15	–
Crankshaft Bearing Cap Bolts	50 + 45° + 15°	37 + 45° + 15°	–
Crankshaft Cover Nuts	5–8	–	44~71
Crankshaft Pulley Bolt	95 N•m + 30° + 15°	–	–
Cylinder Head Bolts (Cylinder Head Mounting Bolts)	25 + 70° + 70° + 50°	18 + 70° + 70° + 50°	–
Direct Ignition System Coil Mounting Bolts	10	–	89
Direct Ignition System Coil Mounting Bracket Bolts	10	–	89
Engine Mount Attaching Bolts	30	22	–
Engine Mount Bracket Attaching Bolts/Nuts	50	37	–
Exhaust Camshaft Gear Bolt	67.5	49	–
Exhaust Flex Pipe–to–Catalytic Converter or Connecting Pipe Retaining Nut	35	26	–
Exhaust Flex Pipe–to–Exhaust Manifold Retaining Nuts	35	26	–
Exhaust Gas Recirculation Valve Adapter Bolts	25	18	–
Exhaust Manifold Heat Shield Bolts	15	11	–
Exhaust Manifold Retaining Nuts	25	18	–
Flexible Plate Bolts	60	44	–
Flexible Plate Inspection Cover Bolts	10	–	89
Flywheel Bolts	35 + 30° + 15°	25 + 30° + 15°	–
Flywheel Inspection Cover Bolts	12	–	106
Front Timing Belt Cover Bolts (Upper and Lower)	10	–	89
Fuel Rail Assembly Retaining Bolts	25	18	–
Fuel Rail Retaining Bolts	25	18	–
Generator Upper Retaining Bolt	20	15	–
Intake Camshaft Gear Bolt	67.5	49	–
Intake Manifold Retaining Bolts/Nuts	25	18	–
Intake Manifold Support Bracket Lower Bolt	25	18	–
Intake Manifold Support Bracket Upper Bolts	25	18	–
Lower Front Timing Belt Cover Bolts	10	–	89
Oil Pan Flange Bolts	75	55	–
Oil Pan Retaining Bolts	10	–	89
Oil Pan Drain Plug	35	26	–
Oil Pressure Switch	40	30	–

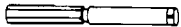
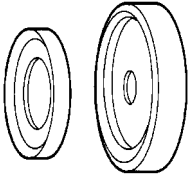
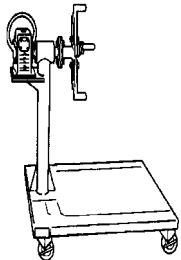
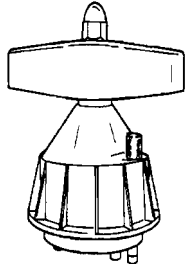
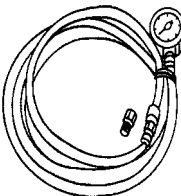
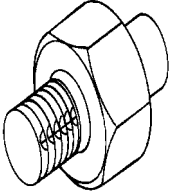
1C1 – 6 1.4L/1.6L DOHC ENGINE MECHANICAL

Application	N•m	Lb–Ft	Lb–In
Oil Pump Bolts	10	–	89
Oil Pump Rear Cover Bolts	8	–	71
Oil Pump Retaining Bolts	10	–	89
Oil Suction Pipe or Support Bracket Bolts	10	–	89
Rear Timing Belt Cover Bolts	10	–	89
Safety Relief Valve Bolt	30	3022	–
Spark Plugs	25	18	–
Thermostat Housing Mounting Bolts	20	15	–
Timing Belt Automatic Tensioner Bolts	25	18	–
Timing Belt Idler Pulley Bolt	40	30	–
Transaxle Bell Housing Bolts	75	55	–
Transaxle Torque Converter Bolts	45	33	–
Upper Front Timing Belt Cover Bolts	10	–	89
Water Pump Retaining Bolts	10	–	89

SPECIAL TOOLS

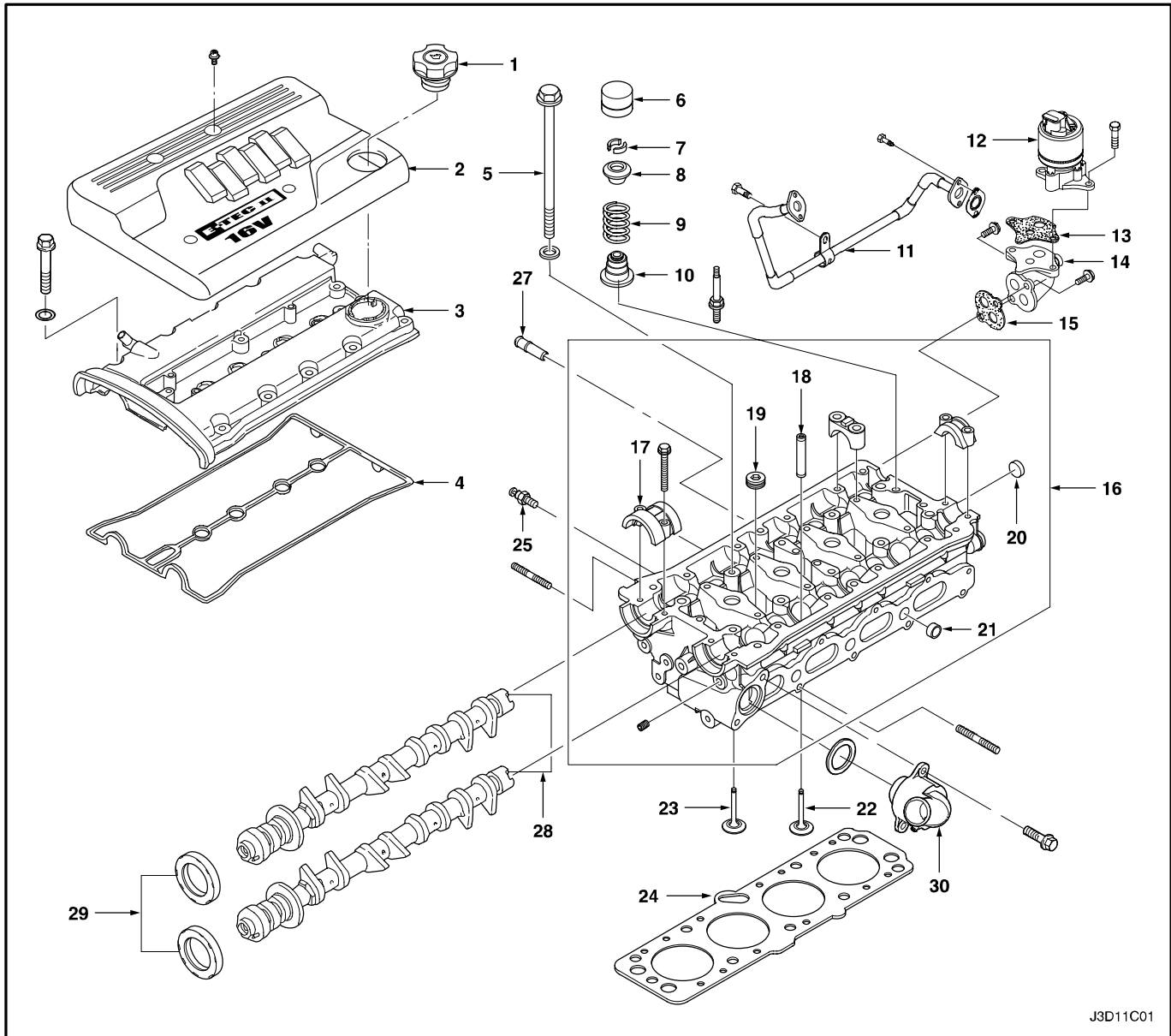
SPECIAL TOOLS TABLE

 <p>J42492</p>	<p>J-42492 Timing Belt Adjuster</p>	 <p>KM571B</p>	<p>KM-571-B Gauge</p>
 <p>KM470B</p>	<p>KM-470-B Angular Torque Gauge</p>	 <p>KM3400</p>	<p>KM-340-0 Cutter Set Includes: KM-340-7 Guide Drift KM-340-13 Cutters KM-340-26 Cutters</p>
 <p>J28467B</p>	<p>J-28467-B Engine Assembly Support Fixture</p>	 <p>KM348</p>	<p>KM-348 Valve Spring Compressor</p>
 <p>KM427</p>	<p>KM-427 Piston Pin Service Set</p>	 <p>J3B11C01</p>	<p>KM-653 Adapter</p>

 <p>J3B11C02</p>	<p>KM-805 Valve Guide Reamer</p>	 <p>KM635</p>	<p>KM-635 Crankshaft Rear Oil Seal Installer</p>
 <p>KM412</p>	<p>KM-412 Engine Overhaul Stand</p>	 <p>J36972</p>	<p>J-36792 Crankshaft Rear Oil Seal Installer</p>
 <p>KM498B</p>	<p>KM-498-B Pressure Gauge</p>	 <p>KM135</p>	<p>KM-135 Adapter</p>

COMPONENT LOCATOR

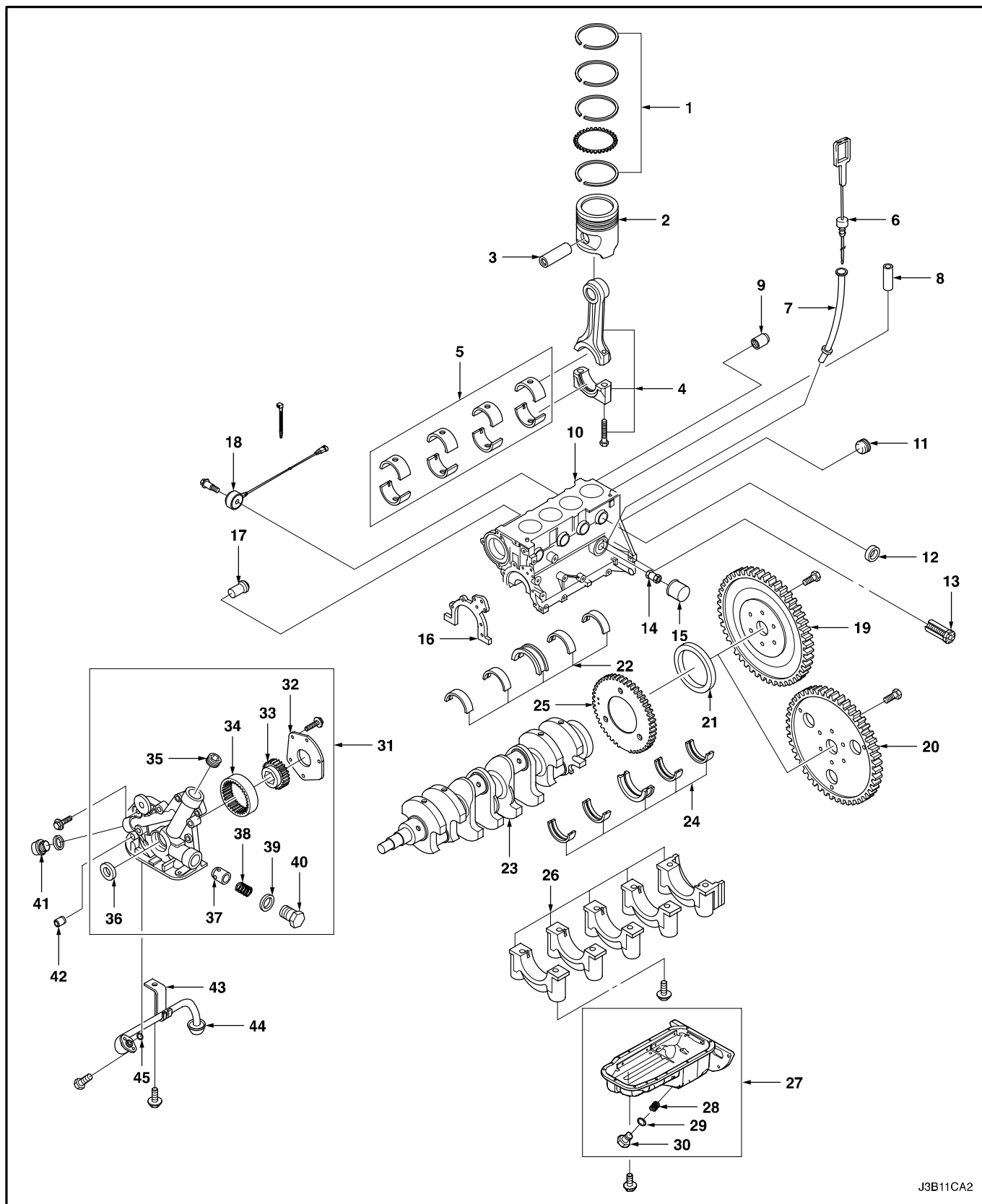
CYLINDER HEAD



J3D11C01

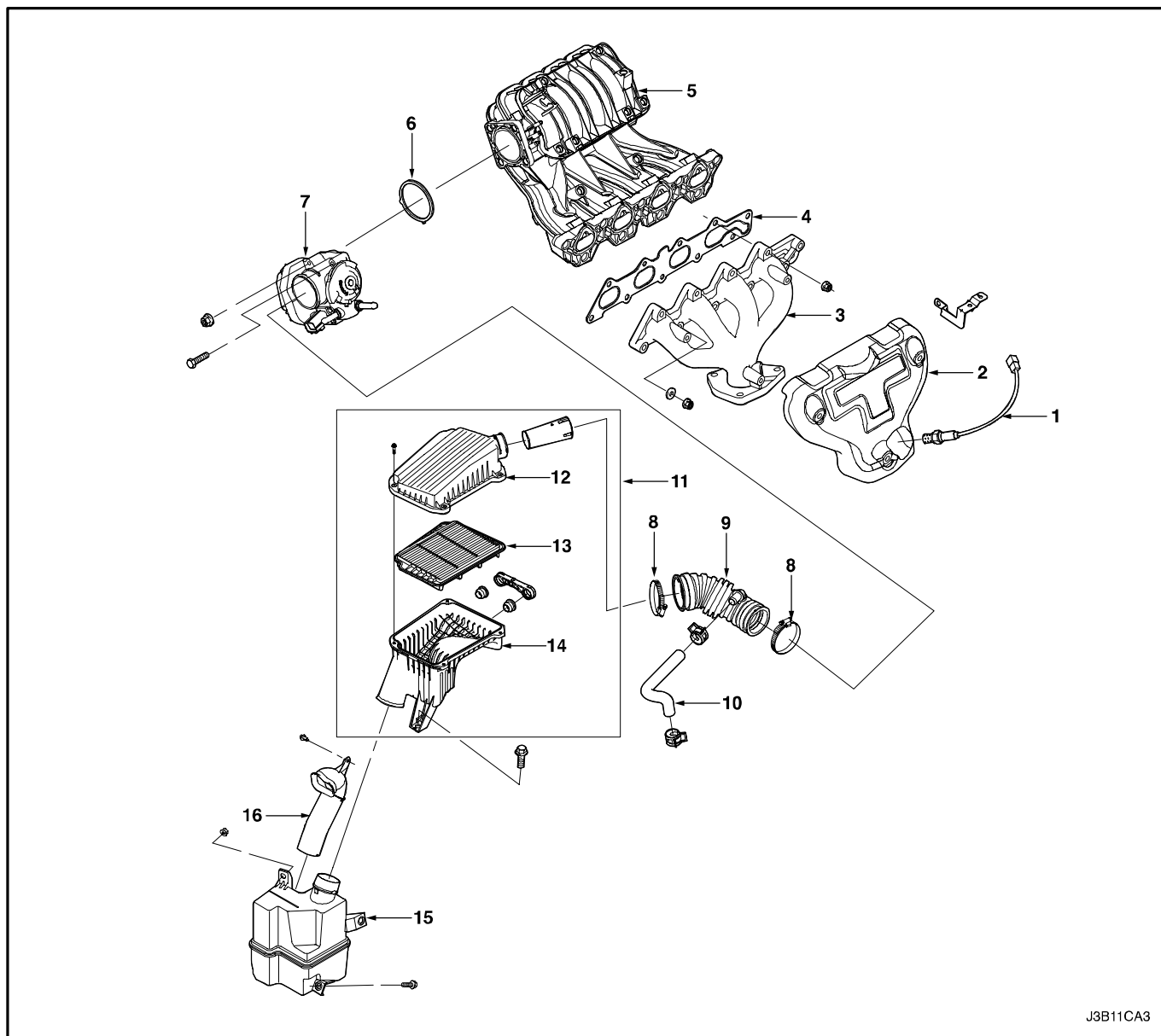
- | | |
|------------------------------|---------------------------------------|
| 1. Oil Filler Cap | 16. Cylinder Head |
| 2. Engine Cover | 17. Front Camshaft Cap |
| 3. Camshaft Cover | 18. Valve Guide |
| 4. Camshaft Cover Gasket | 19. Plug |
| 5. Camshaft Cover Bolt | 20. Freeze Plug |
| 6. Hydraulic Tappet Adjuster | 21. Oil Duct Cap |
| 7. Valve Key | 22. Intake Valve |
| 8. Valve Spring Cap | 23. Exhaust Valve |
| 9. Valve Spring | 24. Cylinder Head Gasket |
| 10. Valve Stem Seal | 25. Engine Coolant Temperature Sensor |
| 11. EGR Vacuum Hose | 26. Heat Take Off Pipe |
| 12. EGR Valve | 27. Camshaft |
| 13. EGR Valve Gasket | 28. Camshaft Seal |
| 14. EGR Valve Adaptor | 29. Thermostat |
| 15. EGR Valve Adaptor Gasket | |

CYLINDER BLOCK



- | | |
|-----------------------------------|-----------------------------------|
| 1. Piston Ring Set | 24. Crank Shaft Lower Bearing Set |
| 2. Piston | 25. Transmitter Disc |
| 3. Piston Pin | 26. Crankshaft Bearing Cap |
| 4. Connecting Rod | 27. Oil Pan |
| 5. Connecting Rod Bearing Set | 28. Threaded Ring |
| 6. Oil Level Gauge Stick | 29. Washer |
| 7. Gauge Stic Tube | 30. Oil Pan Drain Plug |
| 8. Sleeve | 31. Oil Pump |
| 9. Clutch Housing Sleeve | 32. Oil Pump Cover |
| 10. Cylinder Block | 33. Oil Pump Inner Rotor |
| 11. Plug | 34. Oil Pump Outer Rotor |
| 12. Gap | 35. Oil Pump Plug |
| 13. Bypass Valve | 36. Shaft Sealing |
| 14. Connecting Piece | 37. Pressure Relief Valve Plunger |
| 15. Oil Filter | 38. Relief Valve Spring |
| 16. Oil Pump Body Gasket | 39. Sealing |
| 17. Water Inlet Neck | 40. Relief Valve |
| 18. Knock Sensor | 41. Oil Pressure Switch |
| 19. Fly Wheel (M/T) | 42. Sleeve |
| 20. Flexible Plate (A/T) | 43. Oil Suction Pipe Bracket |
| 21. Shaft Seal Ring | 44. Oil Suction Pipe |
| 22. Crank Shaft Upper Bearing Set | 45. Sealing |
| 23. Crank Shaft | |

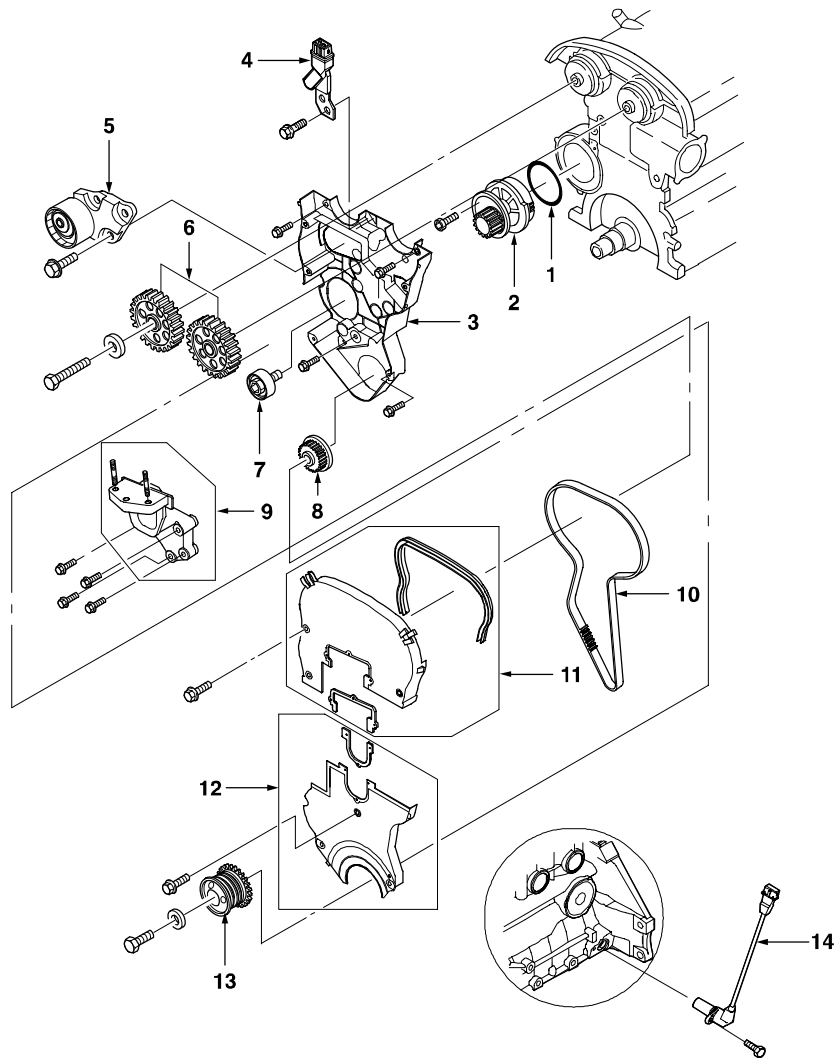
INTAKE & EXHAUST MANIFOLD



J3B11CA3

- | | |
|--|------------------------------|
| 1. Oxygen Sensor | 9. Intake Air Tube |
| 2. Heat Shield | 10. Breathe Hose |
| 3. Exhaust Manifold | 11. Aircleaner Assembly |
| 4. Exhaust Manifold Gasket | 12. Aircleaner Upper Hosing |
| 5. Intake Manifold | 13. Aircleaner Element |
| 6. Main Throttle Idle Actuator (MTIA) Gasket | 14. Aircleaner Lower Housing |
| 7. MTIA | 15. Resonator |
| 8. Clamp | 16. Air Intet Hose |

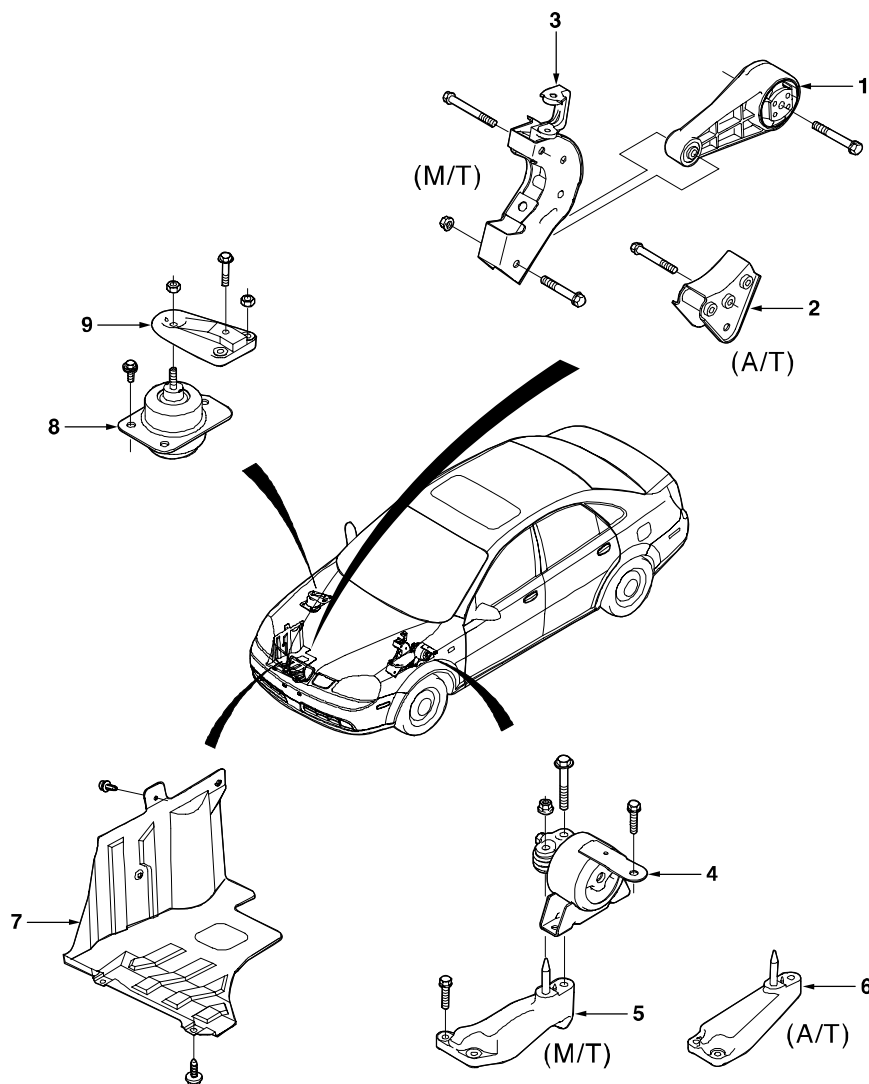
TIMING BELT



J3B11CA4

- | | |
|-----------------------------|-----------------------------------|
| 1. Water Pump Sealing | 8. Crankshaft Gear |
| 2. Water Pump | 9. Torque Roll Axis Support |
| 3. Timing Belt Rear Cover | 10. Timing Belt |
| 4. Camshaft Position Sensor | 11. Timing Belt Front Upper Cover |
| 5. Auto Tensioner | 12. Timing Belt Front Lower Cover |
| 6. Camshaft Gear | 13. Crankshaft Pulley |
| 7. Idler pulley | 14. Crankshaft Position Sensor |

ENGINE MOUNTING

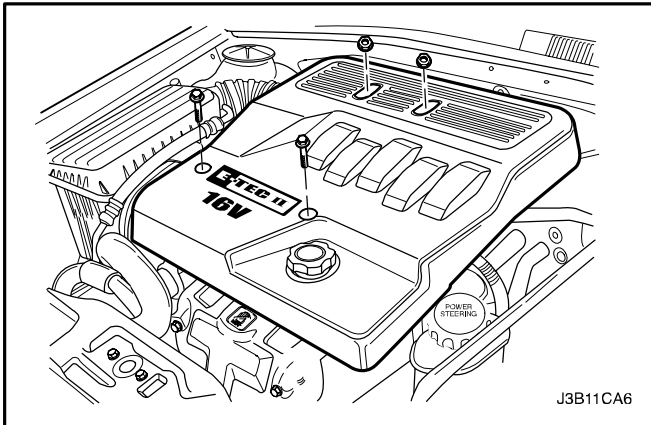


J3B11CA5

- | | |
|--|-------------------------------------|
| 1. Rear Power Unit Damping Block | 6. Transaxle Mounting Bracket (A/T) |
| 2. Rear Transaxle Mounting Bracket (A/T) | 7. Engine Undercover |
| 3. Rear Transaxle Mounting Bracket (M/T) | 8. Hydro Mounting |
| 4. Transaxle Mounting Cage | 9. Engine Mounting Bracket |
| 5. Transaxle Mounting Bracket (M/T) | |

MAINTENANCE AND REPAIR

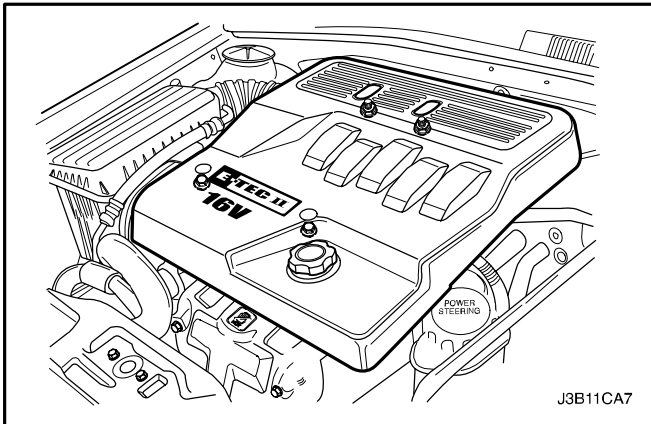
ON-VEHICLE SERVICE



ENGINE COVER

Removal Procedure

1. Remove the bolts and nuts from the engine cover.
2. Remove the engine cover.

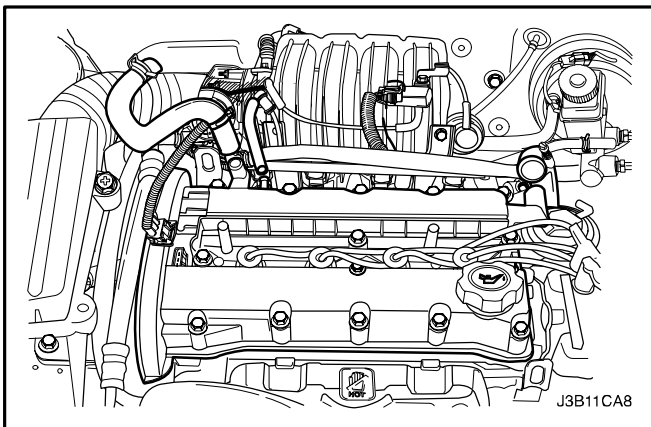


Installation Procedure

1. Position the engine cover on the engine.
2. Install the engine cover bolts and nuts.

Tighten

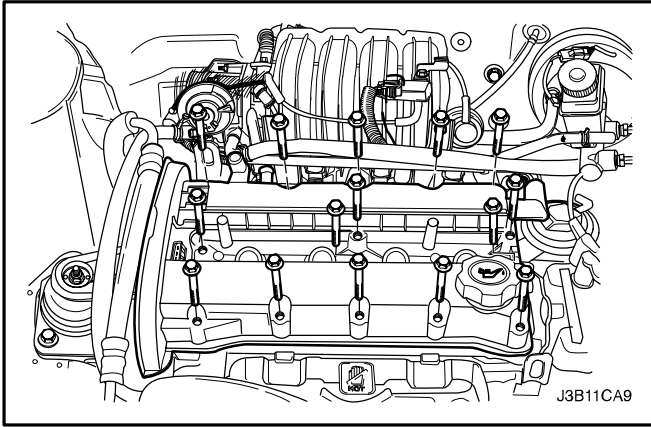
Tighten the engine cover bolts and nuts to 10 N•m(89 lb–ft).



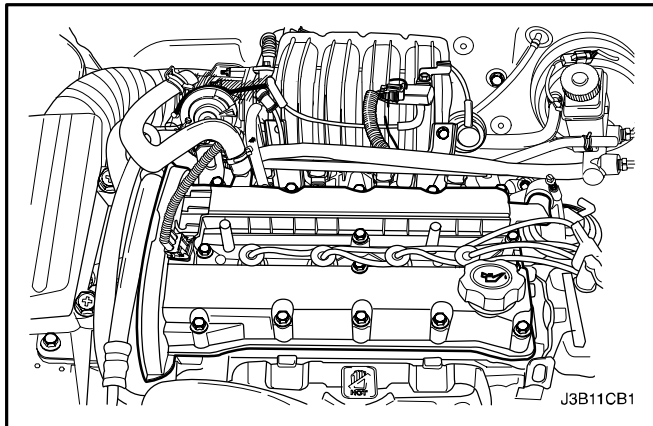
CAMSHAFT COVER

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the engine cover. Refer to "Engine" in this section.
3. Remove the breather hose, ventilation hose and cam position sensor wiring connector from the camshaft cover.



4. Remove the ignition wires from the spark plug.
5. Remove the camshaft cover bolts and camshaft cover.
6. Remove the camshaft cover gasket.



Installation Procedure

1. Install the camshaft cover gasket on the camshaft cover.
2. Position the camshaft cover on the engine block.
3. Install the camshaft cover bolts.

Tighten

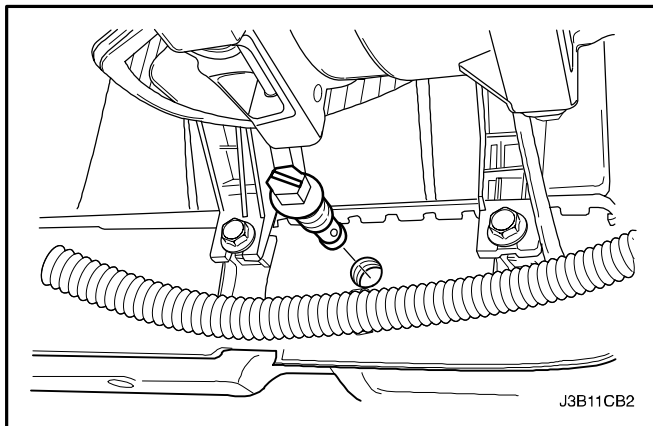
Tighten the camshaft cover bolts to 10 N•m(89 lb–ft).

4. Install the ignition wires to the spark plugs and connect the breather hose, ventilation hose and cam position sensor wiring connector to the camshaft cover.
5. Install the engine cover.
6. Connect the negative battery cable.

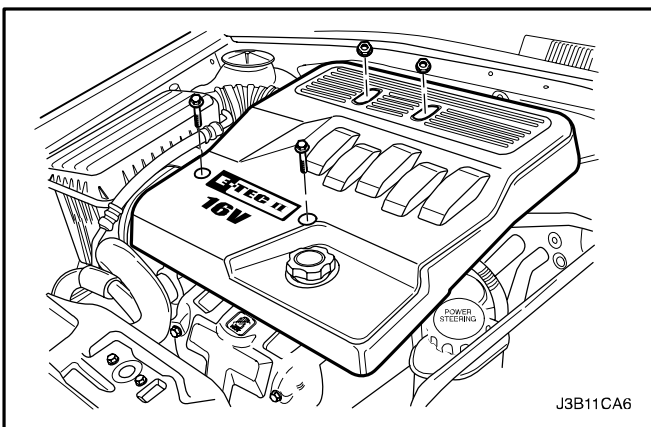
INTAKE MANIFOLD

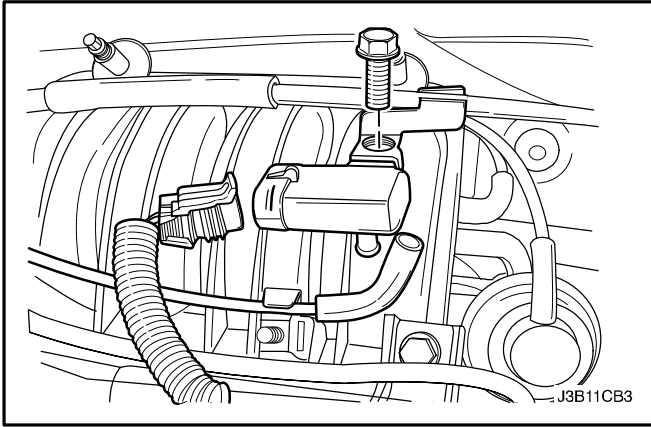
Removal Procedure

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. Drain the engine coolant. Refer to *Section 1D, Engine Cooling*.

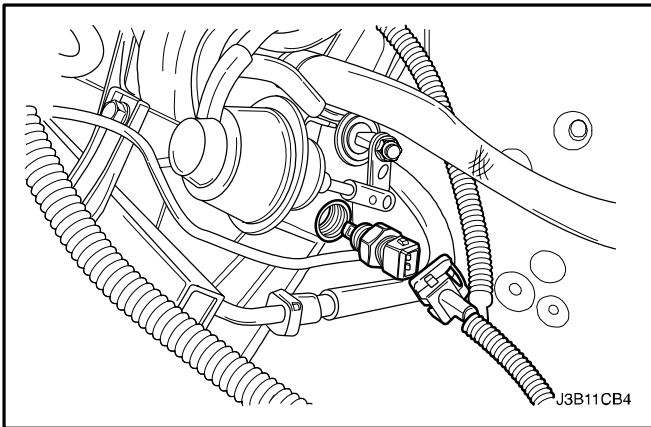


5. Remove the engine cover and throttle body. Refer to *Section 1F, Engine Control*.

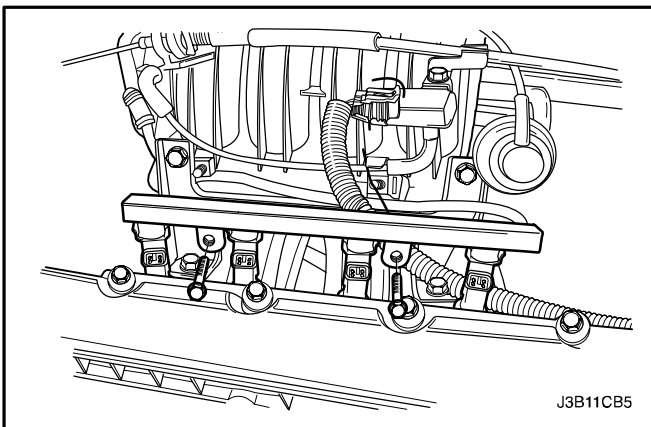




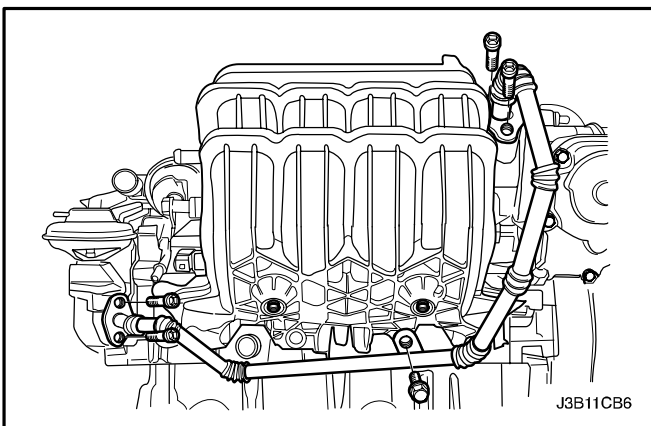
6. Disconnect the intake manifold pressure sensor connector, attaching bolt and vacuum hose.



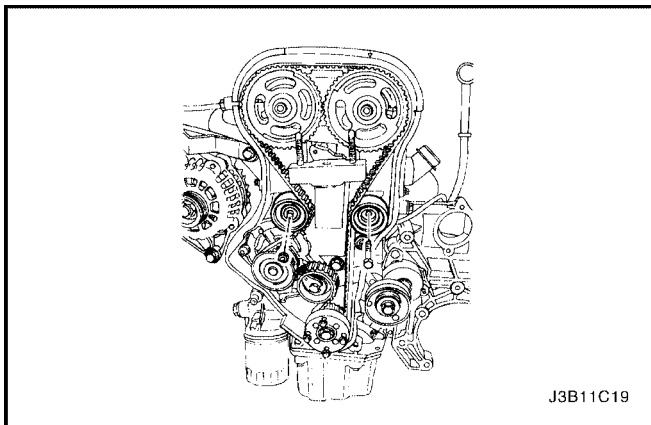
7. Disconnect the intake manifold air temperature sensor (MAT) connector and remove the MAT sensor.



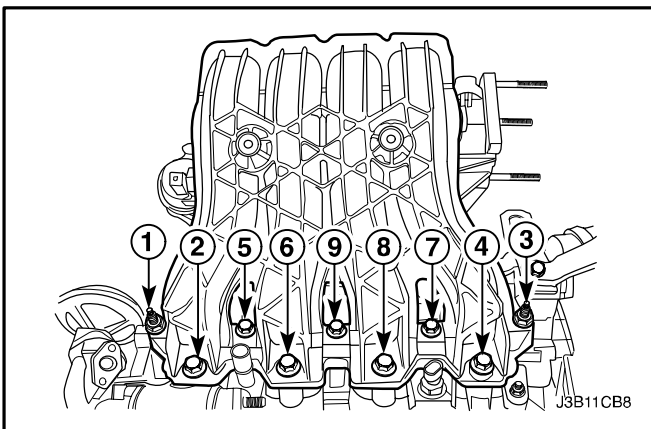
8. Remove the intake manifold upper bracket.
9. Remove the fuel rail bolt and the fuel rail.



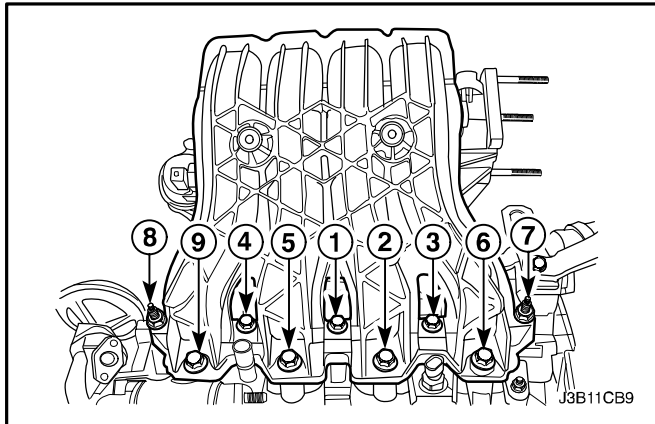
10. Remove the all the vacuum hoses from the intake manifold including PCV hose and brake booster vacuum hose.
11. Remove the exhaust gas recirculation (EGR) pipe.



12. Remove the alternator. Refer to *Section 1E, Engine Electrical*.
13. Remove the intake manifold support bracket.

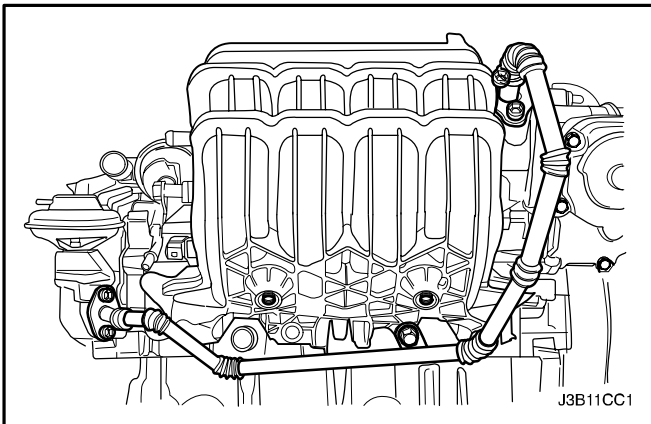


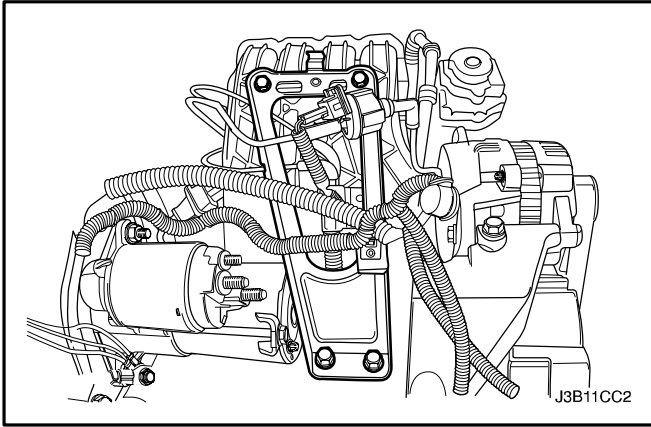
14. Remove the intake manifold retaining bolts/nuts in the sequence shown.
15. Remove the intake manifold and gasket.
16. Clean the sealing surfaces of the intake manifold and the cylinder head.



Installation Procedure

1. Install the fuel rail.
Tighten
Tighten the fuel rail bolts to 25 N•m (18 lb–ft).
2. Install the new intake manifold gasket and intake manifold.
Tighten
Tighten the intake manifold bolts and nuts to 25 N•m (18 lb–ft).
3. Install the exhaust gas recirculation(EGR) pipe.
Tighten
Tighten the exhaust gas recirculation(EGR) pipe bolts to 10 N•m (89 lb–ft).



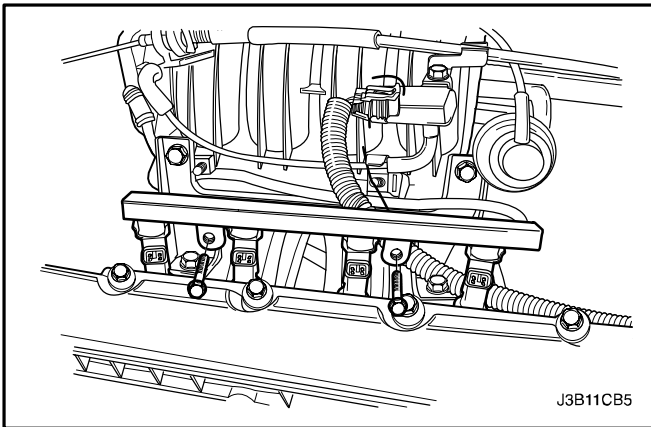


4. Install the intake manifold support bracket.

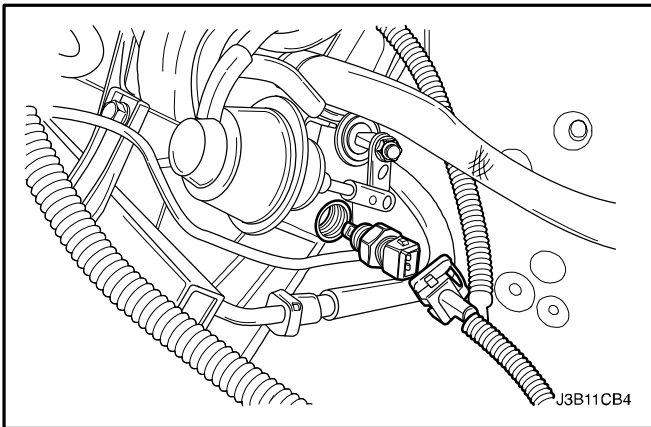
Tighten

Tighten the intake manifold support bracket upper bolts to 25 N•m (18 lb–ft) and lower bolts to 45 N•m (33 lb–ft).

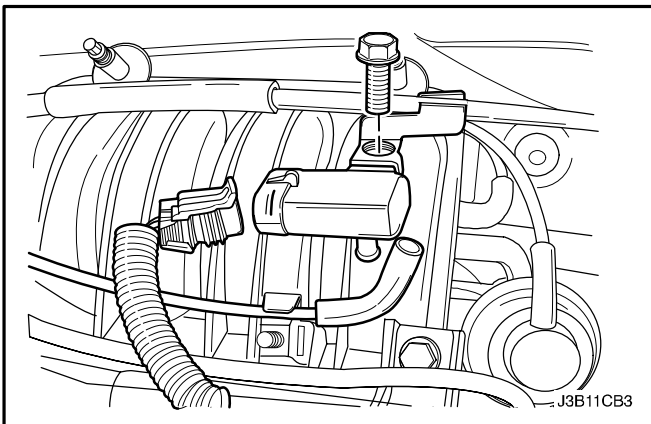
5. Install the alternater.



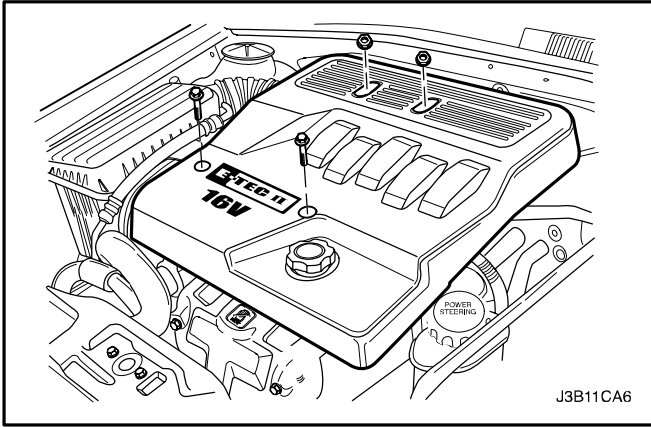
6. Install the fuel rail.
7. Install the fuel rail bolts.
8. Install the intake manifold upper bracket.
9. Install the intake manifold upper bracket bolts.



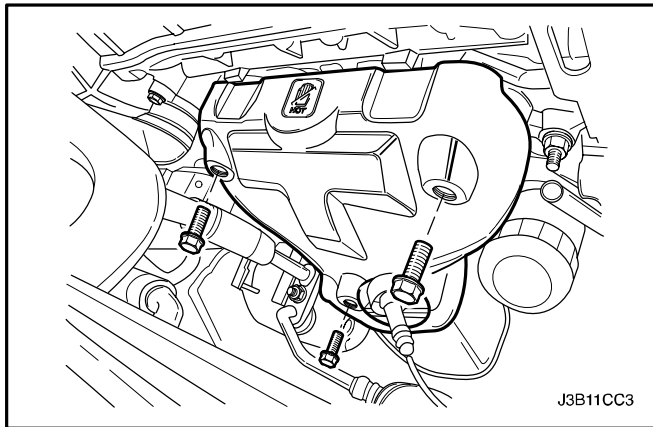
10. Install the intake manifold air temperature sensor(MAT) and connect the MAT sensor connector.



11. Install the intake manifold pressure sensor and vacuum hose.



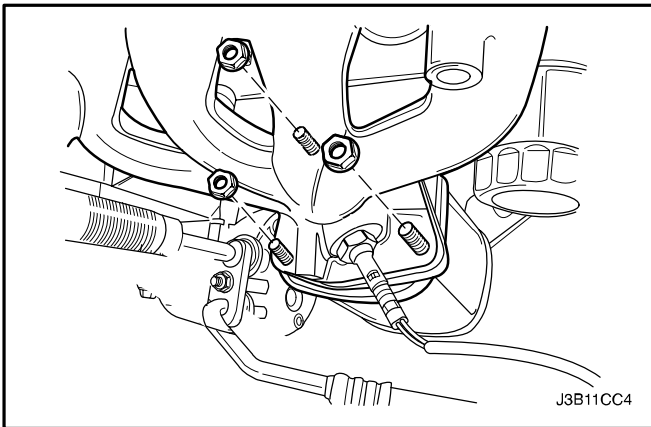
12. Install the throttle body and engine cover.
13. Refill the engine cooling system. Refer to *Section 1D, Engine Cooling*.
14. Install the fuel pump fuse and connect the negative battery cable.



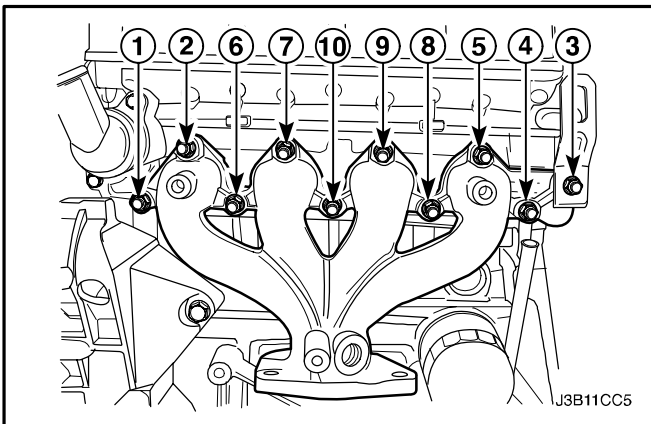
EXHAUST MANIFOLD

Removal Procedure

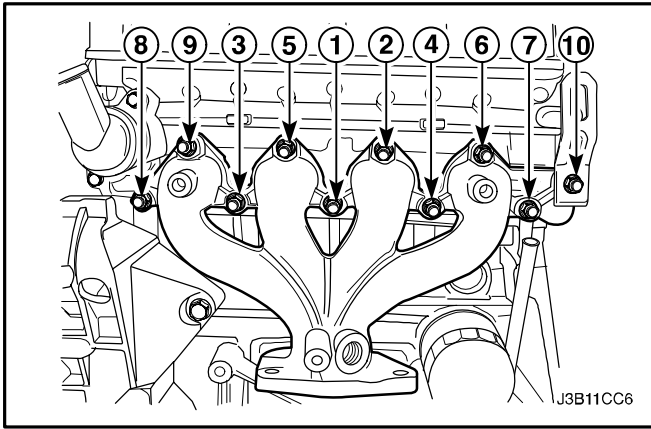
1. Disconnect the negative battery cable.
2. Disconnect the oxygen sensor connector.
3. Remove the exhaust manifold heat shield.



4. Remove the exhaust manifold nuts from the pup converter.



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

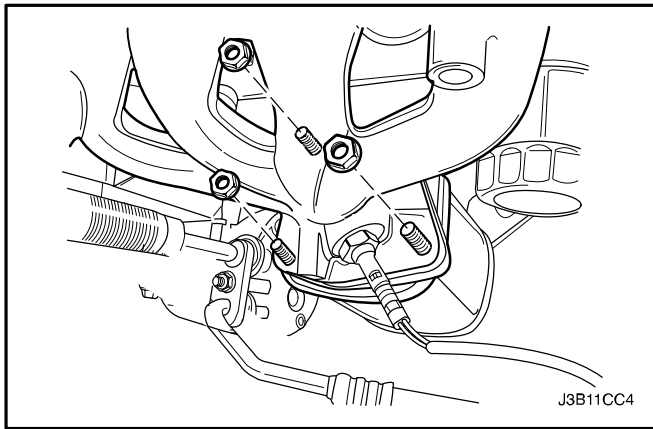


Installation Procedure

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

Tighten

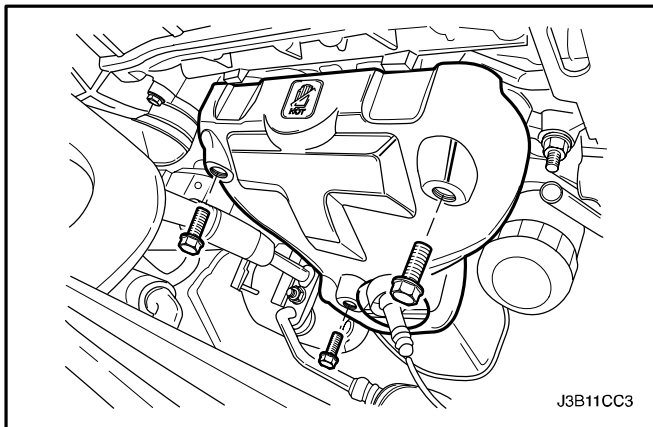
Tighten the exhaust manifold retaining nuts to 25 N•m (18 lb–ft).



3. Install the exhaust manifold nuts to the catalytic converter.

Tighten

Tighten the exhaust manifold nuts to 40 N•m (30 lb–ft).

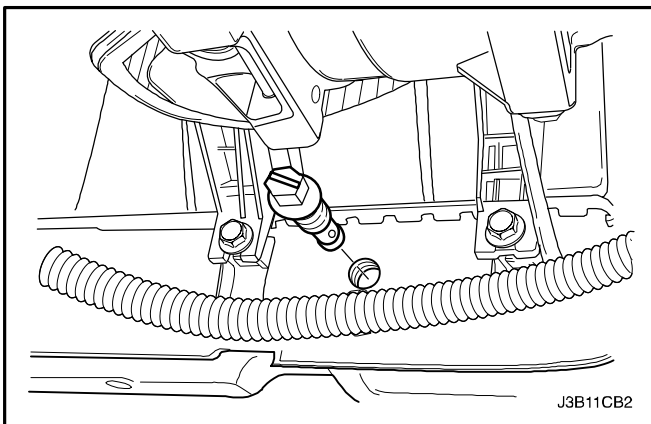


4. Install the heat shield.

Tighten

Tighten the the heat shield bolts to 13 N•m (10 lb–ft).

5. Connect the oxygen sensor connector.
6. Connect the negative battery cable.



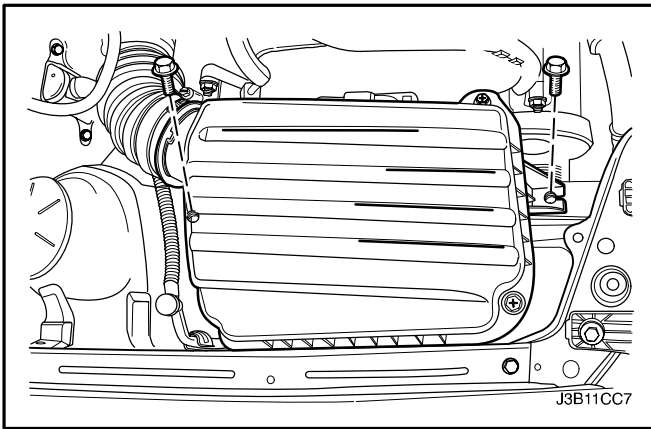
CYLINDER HEAD AND GASKET

Tools Required

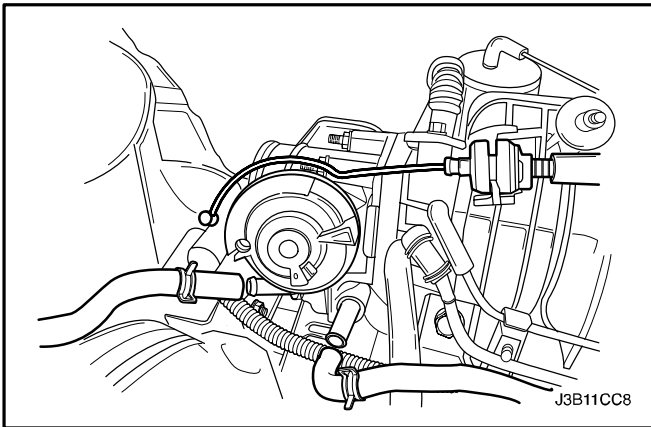
J-42492 Timing Belt Adjuster
KM-470-B Angular Torque Gauge

Removal Procedure

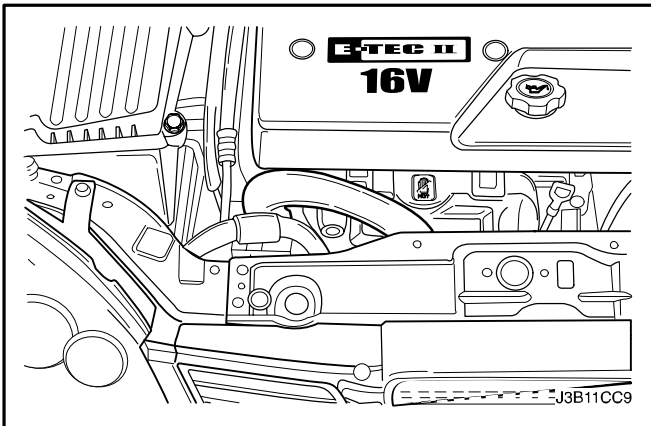
1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine for 10 seconds to rid the fuel system of fuel pressure.
3. Disconnect the negative battery cable.
4. Disconnect the electronic control module(ECM) ground terminal from the intake manifold.
5. Drain the engine coolant.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



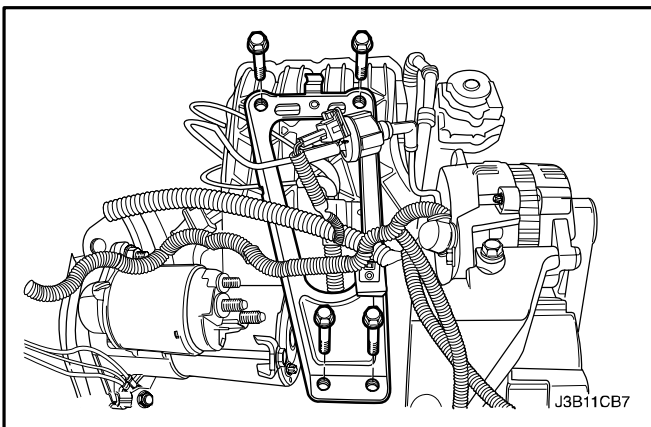
6. Drain the engine oil and remove the camshaft cover. Refer to this section.
7. Remove the air cleaner housing.



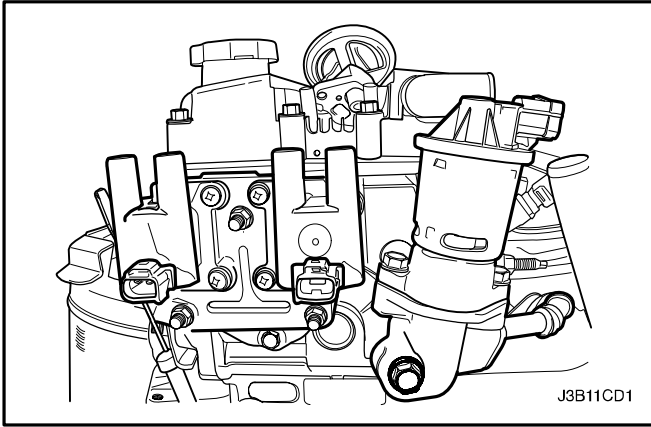
8. Remove the throttle cable and inlet/outlet coolant hoses.



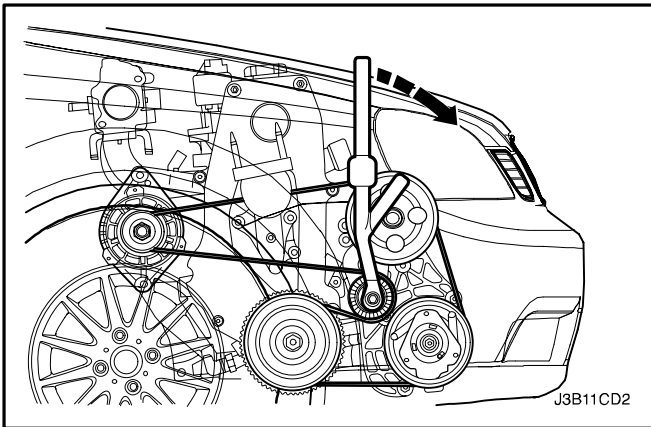
9. Remove the thermostat upper hose.



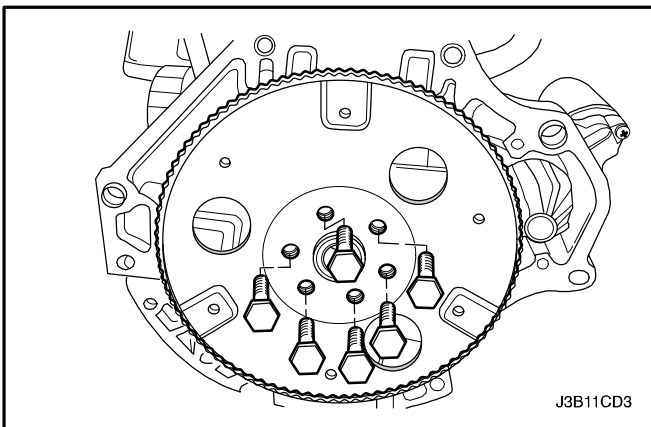
10. Remove the intake manifold pressure sensor, intake air temperature sensor and coolant temperature sensor.
11. Remove the intake manifold support bracket.



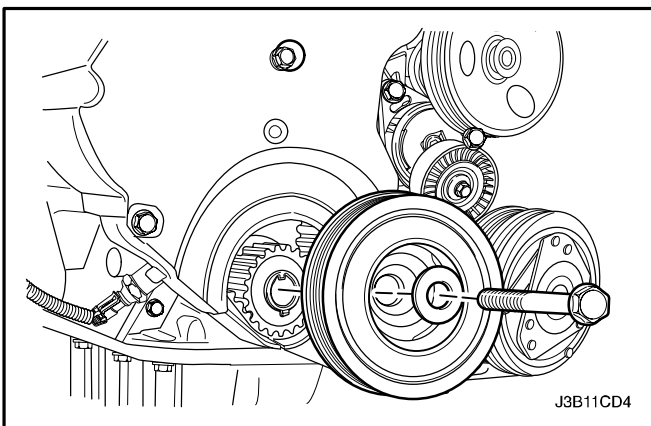
12. Remove the all the vaccum hoses from the intake manifold including brake booster vaccum hose.
13. Remove the ignition cables from the spark plugs.
14. Remove the direct ignition coil(DIS) and the bracket from the cylinder head.



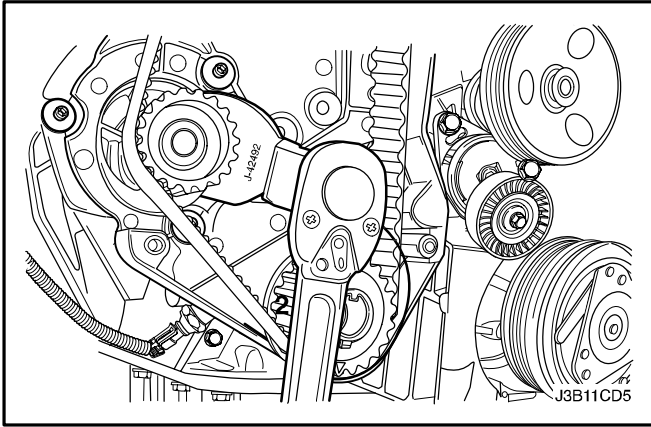
15. Remove the serpentine accessory drive belt by rotating the tensioner pulley bolt to clockwise using DW110-080. Refer to *Section 6B, Power Steering Pump*.



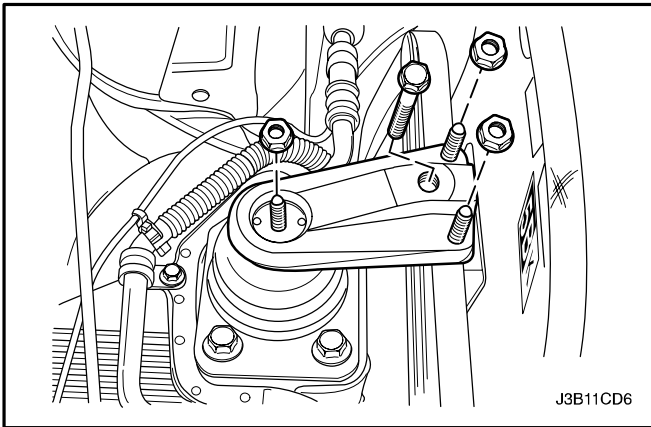
16. Remove the front passenger side tire. Refer to *Section 2E, Tires and Wheels*.
17. Remove front wheel housing shield.



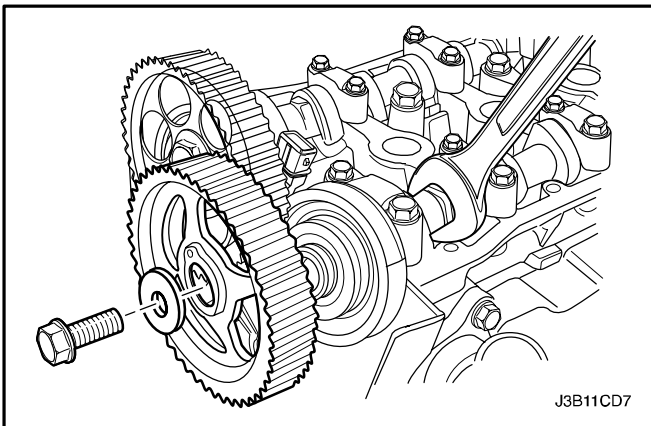
18. Remove the upper front timing belt cover bolts.
19. Remove the upper front timing belt cover.
20. Align the camshaft gear timing marks.
21. Remove the crank shaft pulley.
22. Remove the lower front timing belt cover bolts and cover.



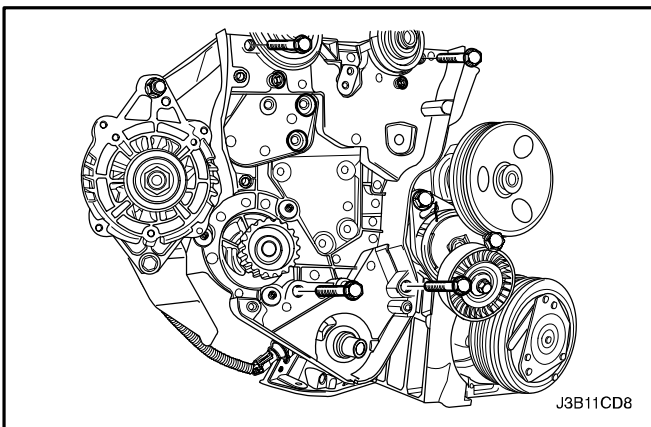
23. Slightly loosen the water pump retaining bolts.
24. Rotate the water pump counterclockwise using the timing belt adjuster J-42492 to relieve the timing belt tension.
25. Remove the timing belt. Refer to "Timing Belt" in this section.



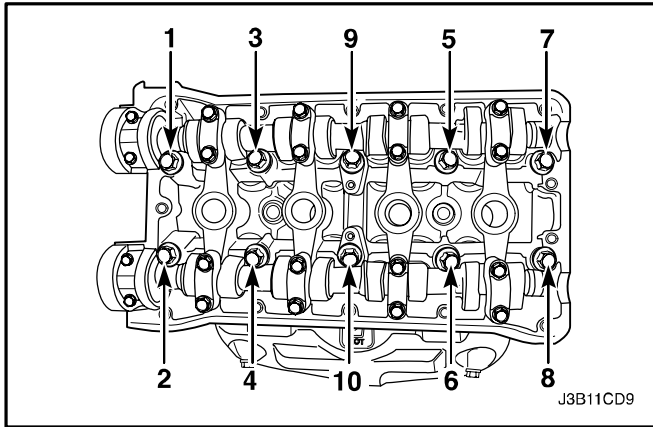
26. Remove the engine mounting bracket. Refer to "Engine Mount" in this section.
27. Remove the camshaft cover. Refer to "Camshaft Cover" in this section.



28. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt and gear.
 29. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt and gear.
- Notice :** Take extreme care to prevent any scratches, nicks or damage to the camshafts.



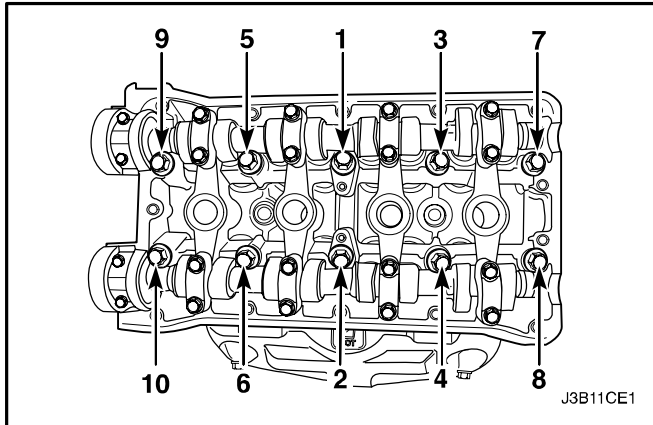
30. Remove the timing belt automatic tensioner.
31. Remove the timing belt idler pulley.
32. Remove the right engine mount. Refer to "Engine Mount" in this section.
33. Remove the rear timing belt cover.



34. Remove the intake/exhaust manifold. Refer to "Intake/Exhaust Manifold" in the section.
35. Remove the cylinder head bolts gradually in the sequence shown and remove the cylinder head.

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

36. Remove the cylinder head gasket.



Cleaning Procedure

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

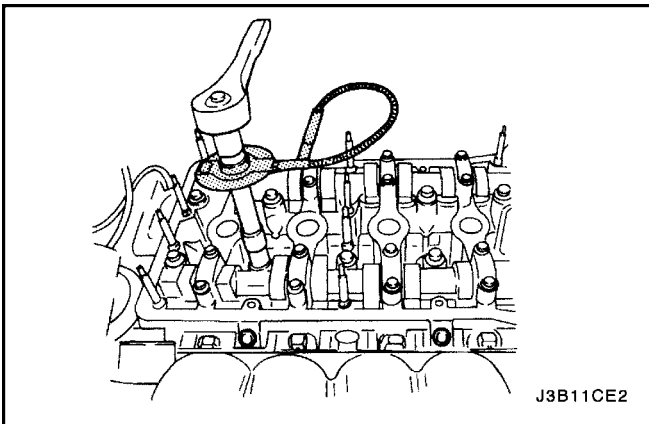
Installation Procedure

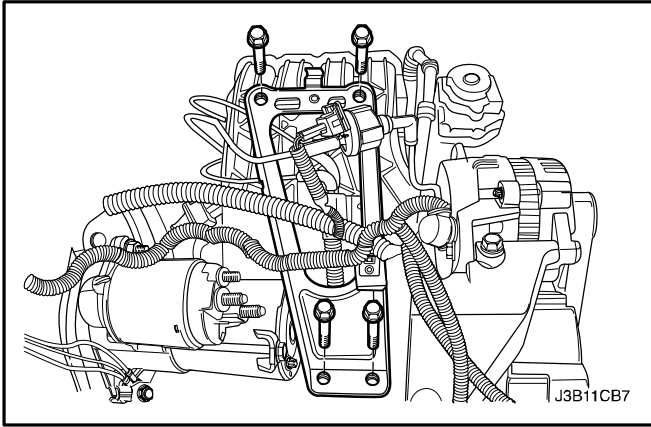
1. Install the new cylinder head gasket.
2. Install the intake/exhaust manifold to the cylinder head. Refer to "Intake/Exhaust Manifold" in the section.
3. Install the cylinder head bolts gradually in the sequence shown.

Tighten

Tighten the cylinder head bolts to 25 N•m (18 lb–ft) and retighten the cylinder head bolts 70 degrees plus 70 degrees plus 50 degrees using the angular torque gauge KM–470–B.

4. Install the right engine mount. Refer to "Engine Mount" in this section.



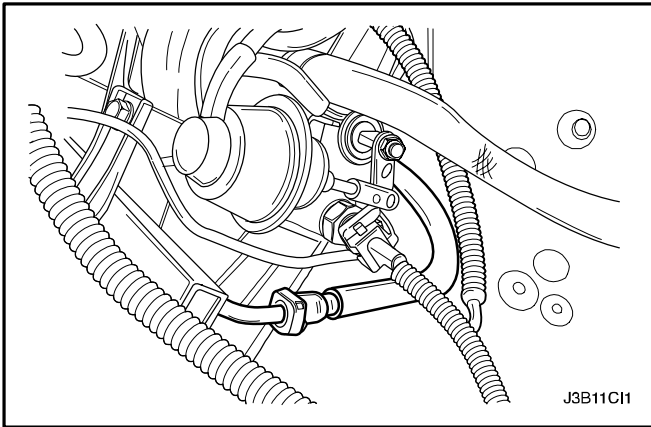


5. Connect the throttle cable at the throttle body and the intake manifold.
6. Install the intake manifold support bracket upper bolts to the intake manifold.

Tighten

Tighten the intake manifold support bracket upper bolts to the intake manifold to 25 N•m (18 lb–ft).

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

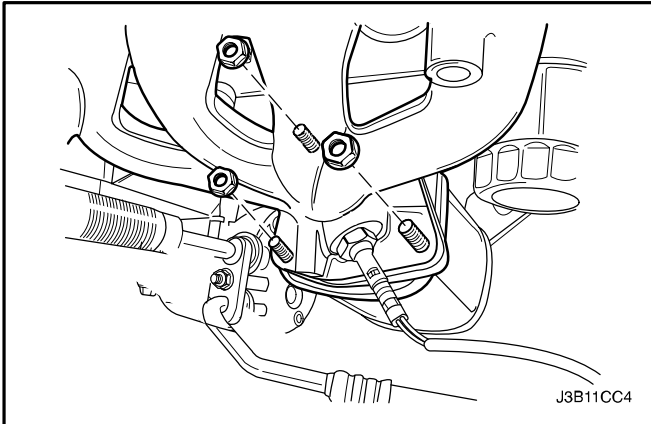


9. Install the generator upper retaining bolt.

Tighten

Tighten the generator upper retaining bolt to 20 N•m (15 lb–ft).

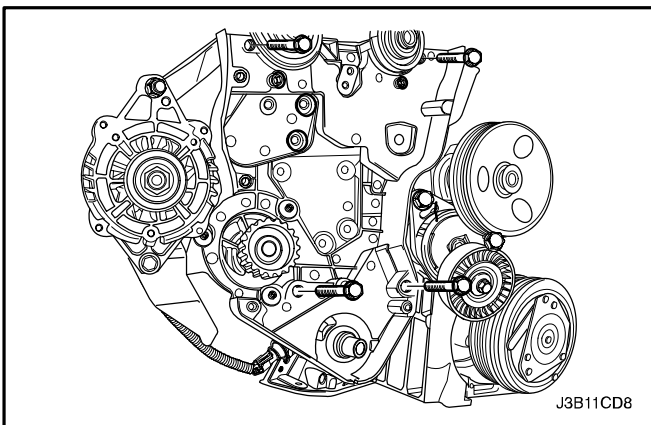
10. Connect the fuel feed line at the fuel rail.
11. Connect all the disconnected vacuum hoses and the brake booster vacuum hose at the intake manifold.



12. Install the catalytic converter retaining nuts at the exhaust manifold flange.

Tighten

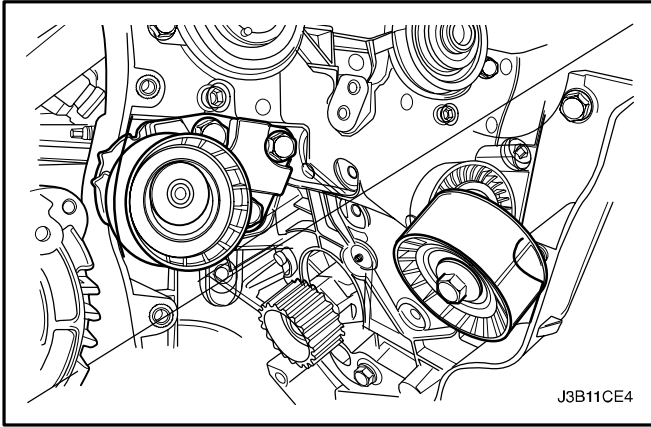
Tighten the catalytic converter to exhaust manifold flange nuts to 40 N•m (30 lb–ft).



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

Tighten

Tighten the rear timing belt cover bolts to 10 N•m (89 lb–in).



15. Install the timing belt automatic tensioner.

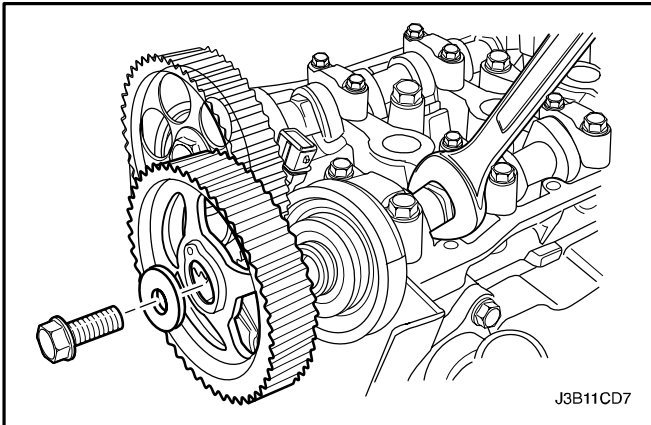
Tighten

Tighten the timing belt automatic tensioner bolts to 25 N•m (18 lb–ft).

16. Install the timing belt idler pulley.

Tighten

Tighten the timing belt idler pulley bolt to 25 N•m(18 lb–ft).

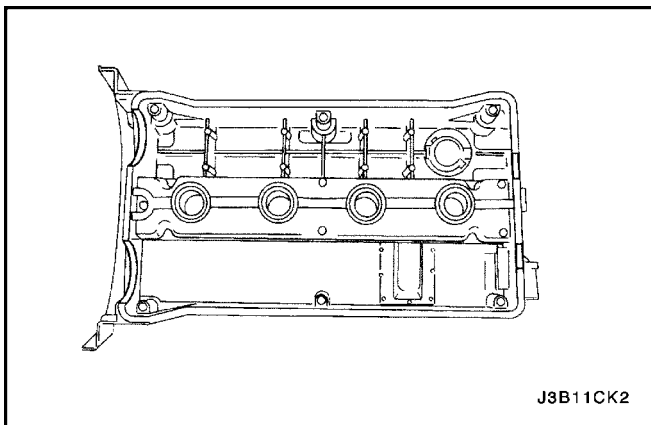


Notice : Take extreme care to prevent any scratches, nicks or damage to the camshafts.

17. Install the intake/exhaust camshaft gear.

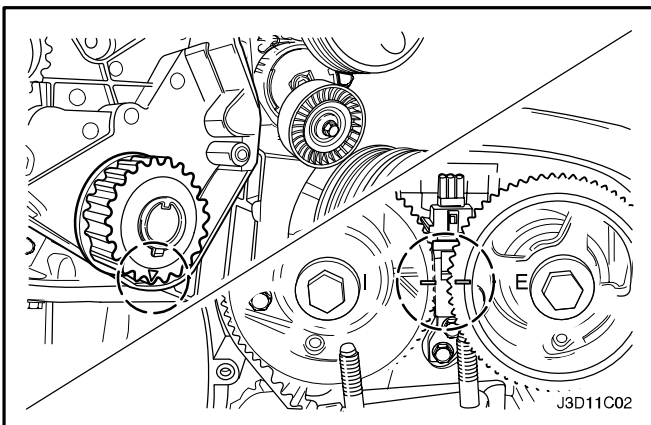
Tighten

Tighten the intake/exhaust camshaft gear bolts to 67.5 N•m (49 lb–ft).



18. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear camshaft cover-to-cylinder head seal.

19. Install the camshaft cover and the gasket. Refer to "Camshaft Cover" in this section.



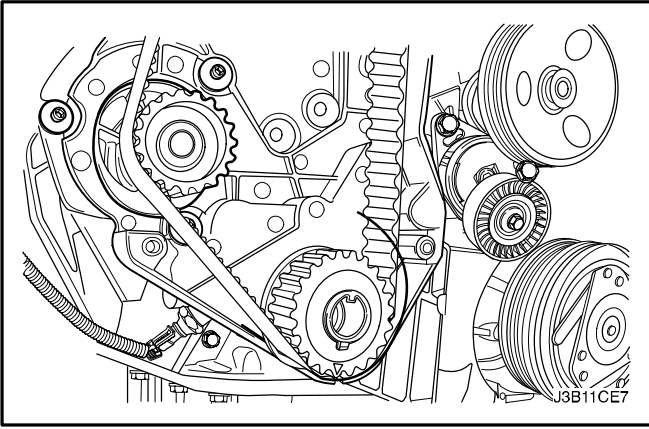
20. Connect the ignition wires to the spark plugs.

21. Install the oil filler cap.

22. Connect the engine ventilation hose to the camshaft cover.

23. Align the timing marks on the camshaft gears.

24. Align the mark on the crank shaft gear with the notch at the bottom of the rear timing belt cover.

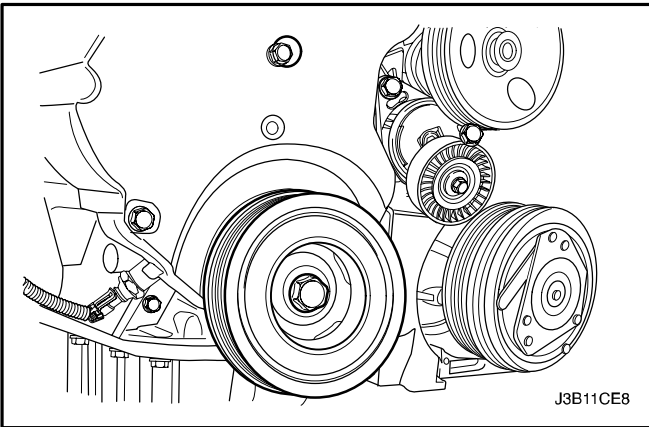


25. Install the timing belt.
26. Rotate the water pump clockwise using the timing belt adjuster J-42492 to apply tension to the timing belt.

Tighten

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

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



28. Install the upper and lower front timing belt covers.

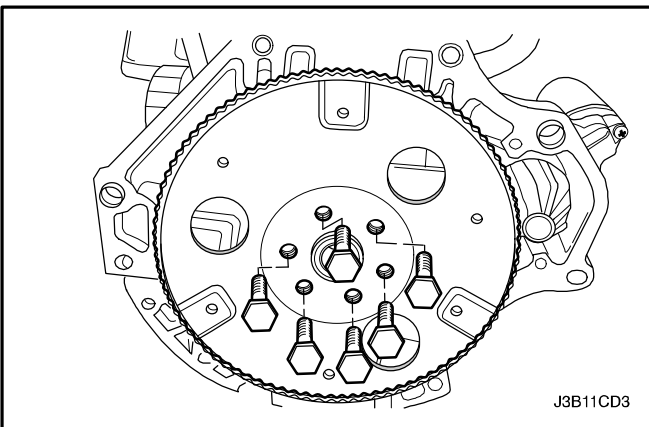
Tighten

Tighten the upper and lower front timing belt covers bolts to 10 N•m (89 lb-in).

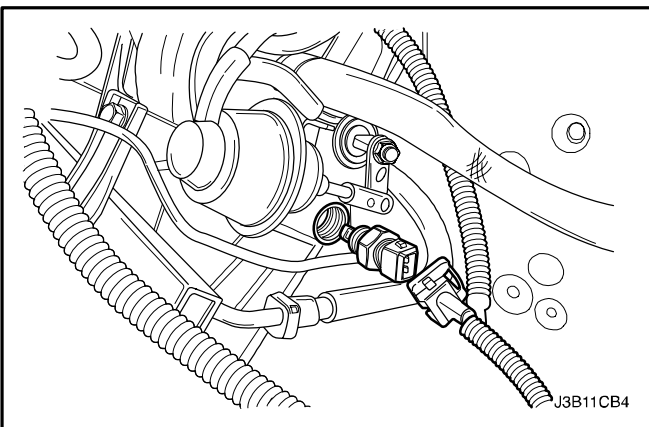
29. Install the crank shaft pulley bolt.

Tighten

Tighten the crank shaft pulley bolt to 95 N•m (70 lb-ft) and retighten 30 degrees plus 15 degrees.



30. Install the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
31. Connect the upper radiator hose to the thermostat housing.
32. Install the front wheel and splash shield. Refer to *Section 2E, Tires and Wheels*.

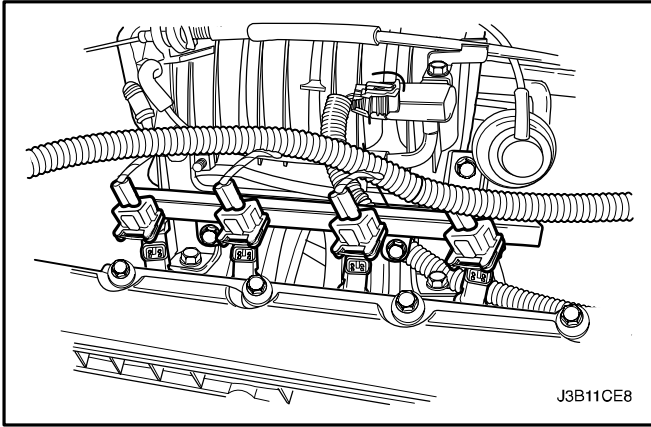


33. Install the air cleaner housing.

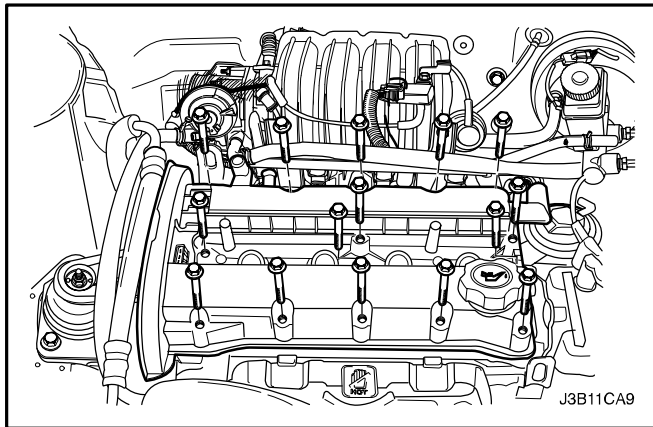
Tighten

Tighten the air cleaner housing bolts to 10 N•m (89 lb-in).

34. Connect the breather tube to the cam shaft cover.
35. Install the crank shaft pulley bolt.
36. Connect the MAT sensor connector.
37. Connect the intake manifold pressure sensor, intake air temperature sensor and coolant temperature sensor connector.



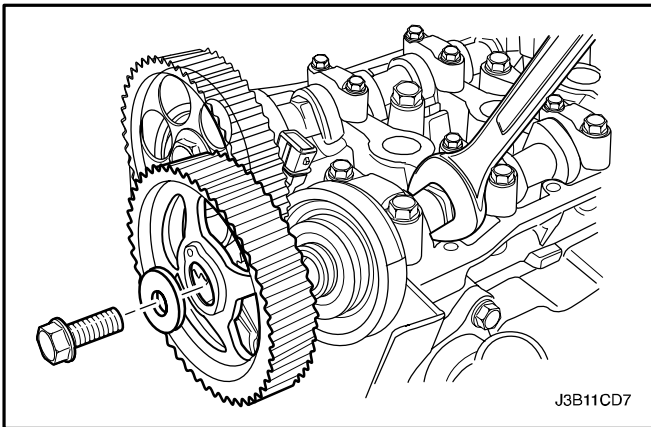
38. Connect the DIS coil connector.
39. Connect the fuel injector harness connectors.
40. Connect the oxygen sensor connector and the ECM ground terminal at the intake manifold.
41. Install the fuel pump fuse.
42. Connect the negative battery ground cable.
43. Refill the engine cooling system. Refer to Section 1D, Engine Cooling.



CAMSHAFTS

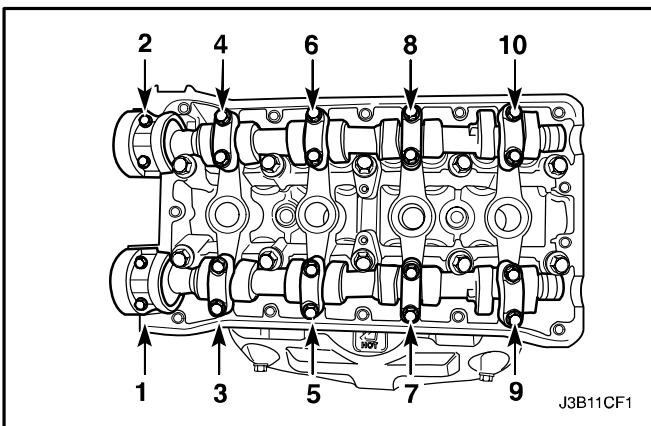
Removal Procedure

1. Remove the camshaft cover. Refer to "Camshaft Cover" in this section.
2. Remove the timing belt. Refer to "Timing Belt" in this section.

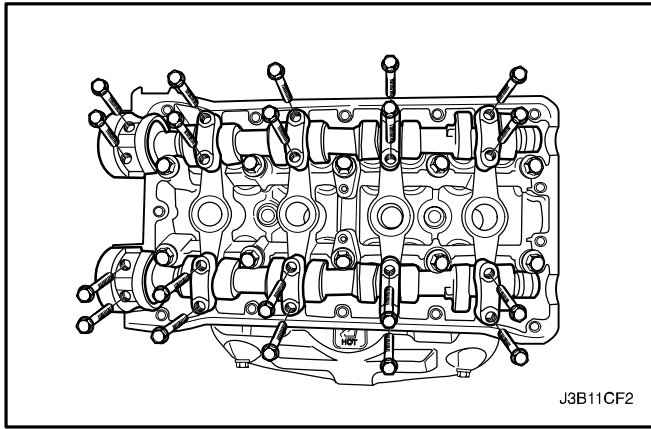


Notice : Take extreme care to prevent any scratches, nicks or damage to the camshafts.

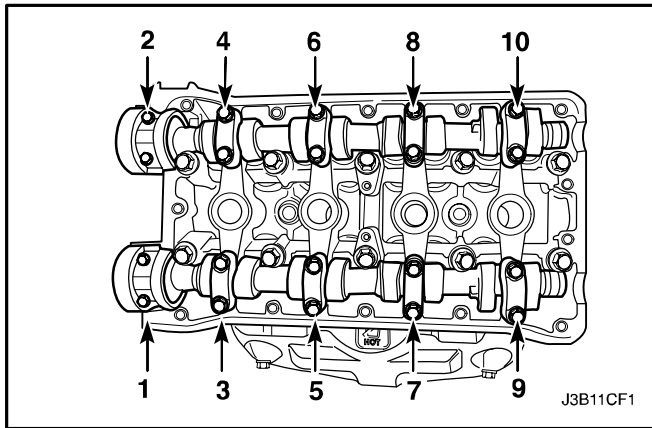
3. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt and gear.
4. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt and gear.



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



6. Remove the intake/exhaust camshaft caps. Maintain the correct positions for installation.
7. Remove the intake/exhaust camshaft.



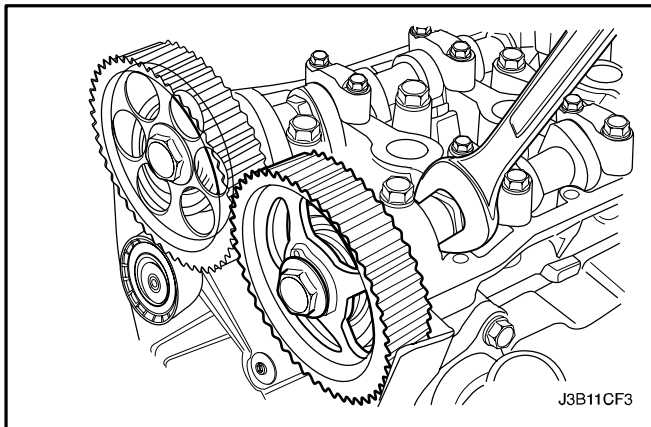
Installation Procedure

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

1. Lubricate the camshaft journals and the camshaft caps with engine oil.
2. Install the intake/exhaust camshafts.
3. Install the intake/exhaust camshaft caps in their original positions.

Tighten

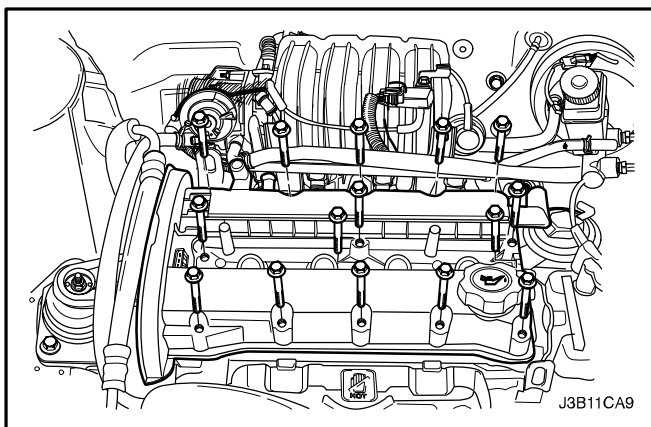
Tighten the intake/exhaust camshaft caps bolts to 16 N•m (12 lb–ft).



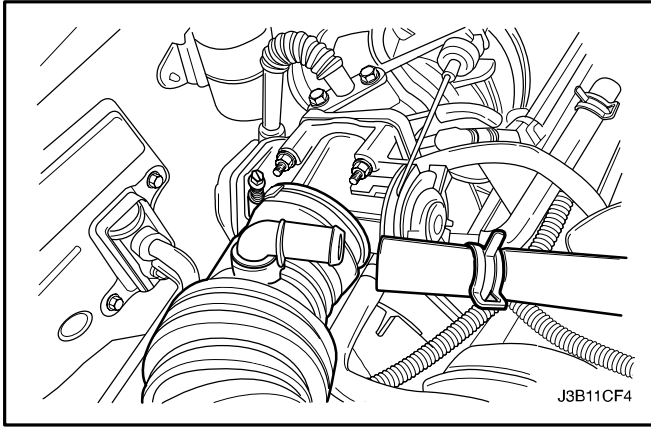
4. Measure the intake/exhaust camshaft end play. Refer to the "Engine Specifications" in this section.
5. Install the intake/exhaust camshaft gear.
6. While holding the intake/exhaust camshafts firmly in place, install the intake/exhaust camshaft gear bolts.

Tighten

Tighten the intake/exhaust camshaft gear bolts to 67.5 N•m (49 lb–ft).



7. Install the timing belt. Refer to "Timing Belt" in this section.
8. Install the camshaft cover. Refer to "Camshaft Cover" in this section.



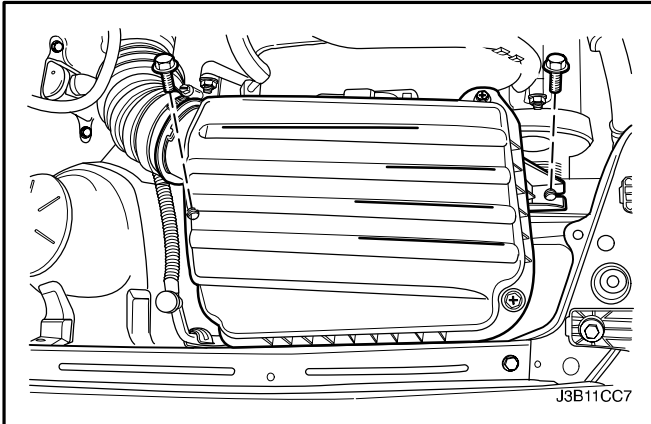
TIMING BELT CHECK AND ADJUST

Tools Required

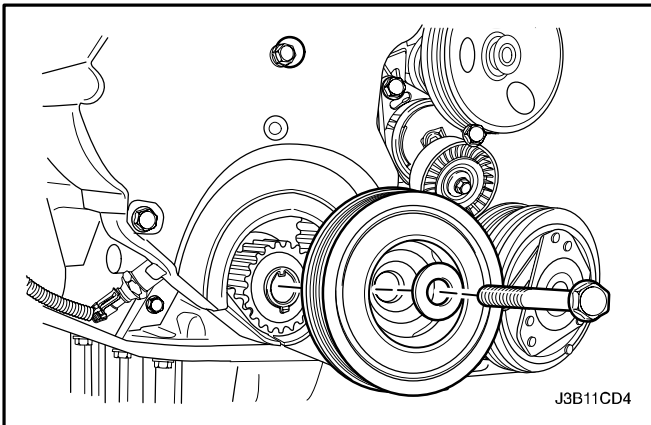
J-42492 Timing Belt Adjuster
KM-470-B Angular Torque Gauge

Adjustment Procedure

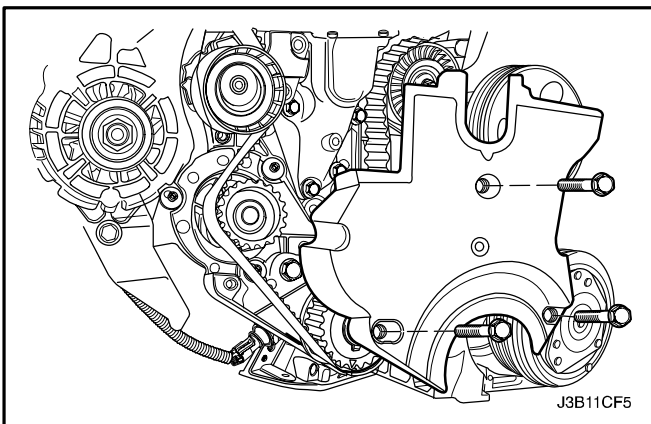
1. Disconnect the negative battery cable.
2. Remove the air cleaner outlet hose from the throttle body.
3. Remove the breather tube from the camshaft cover.
4. Remove the air cleaner housing bolts.
5. Remove the air cleaner housing.
6. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels*.
7. Remove the right front wheel well splash shield.

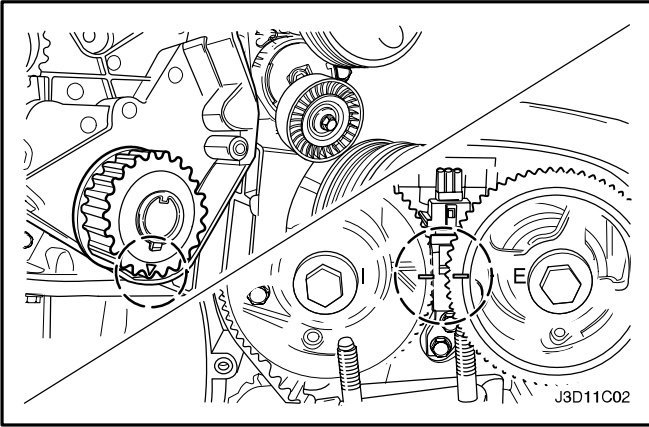


8. Remove the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
9. Remove the crankshaft pulley bolt.
10. Remove the crankshaft pulley.

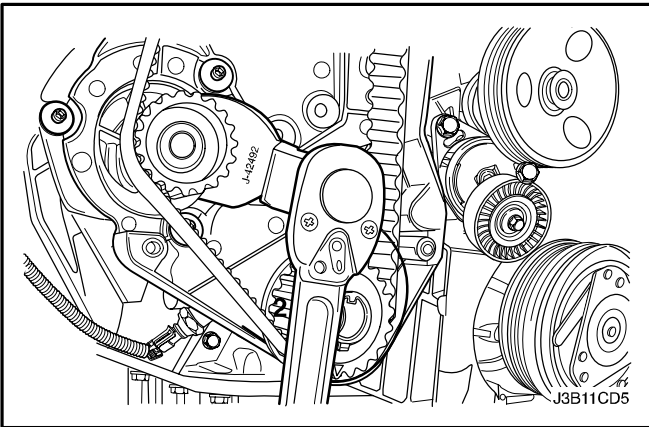


11. Remove the upper front timing belt cover bolts.
12. Remove the upper front timing belt cover.
13. Remove the lower front timing belt cover bolts.
14. Remove the lower front timing belt cover.
15. Install the crankshaft pulley bolt.

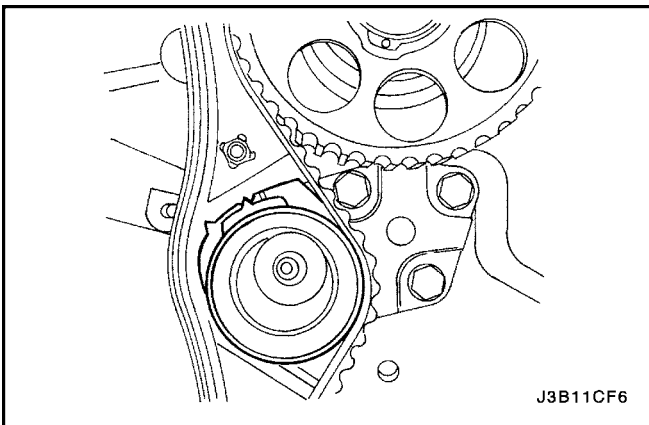




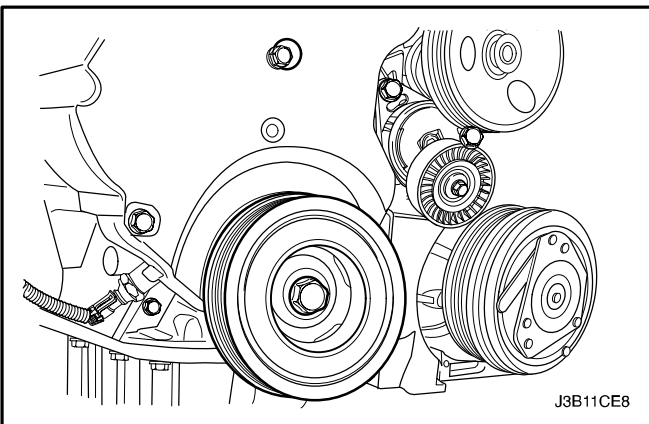
16. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
17. Align the mark on the crankshaft gear with the notch at the bottom of the rear timing belt cover.
18. Align the camshaft gear timing marks.



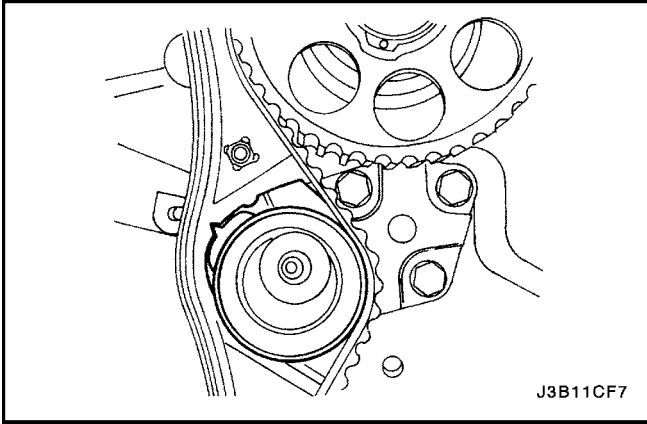
19. Slightly loosen the water pump retaining bolts.
20. Rotate the water pump clockwise using the timing belt adjuster J-42492.



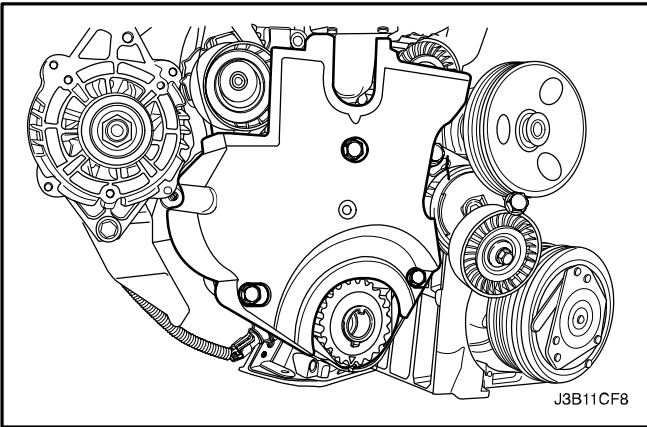
21. Rotate the water pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.



22. Tighten the water pump retaining bolts.
23. Rotate the crankshaft two full turns clockwise using the crankshaft pulley.
24. Loosen the water pump retaining bolts.



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



26. Tighten the water pump retaining bolts.

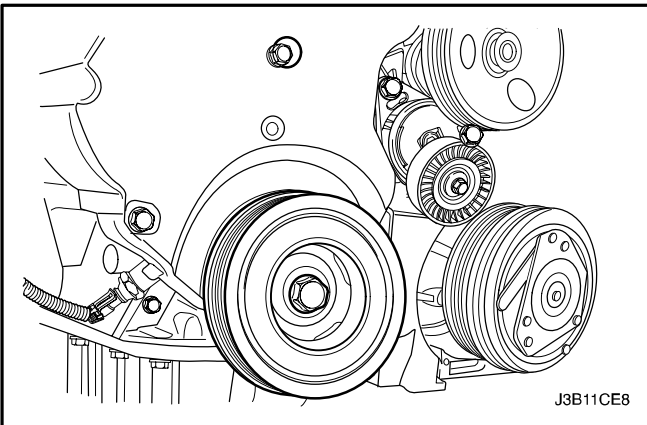
Tighten

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

27. Remove the crankshaft pulley bolt.
28. Install the upper and lower front timing belt covers.
29. Install the upper and lower front timing belt cover bolts.

Tighten

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

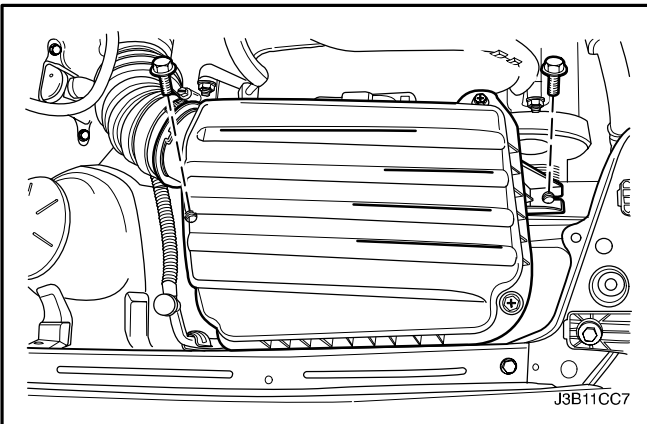


30. Install the crankshaft pulley.
31. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb-ft) and retighten 30 degrees plus 15 degrees.

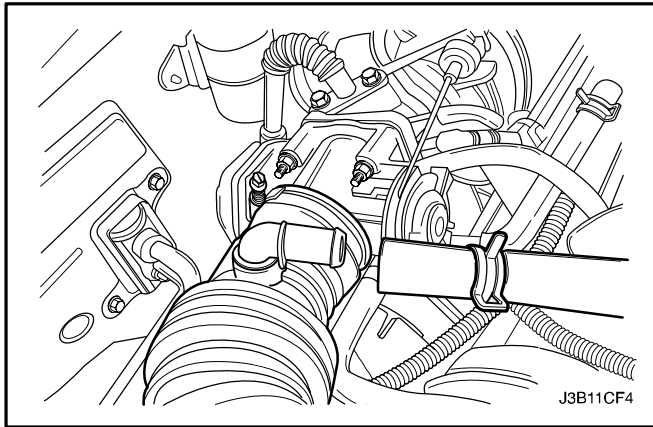
32. Install the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.



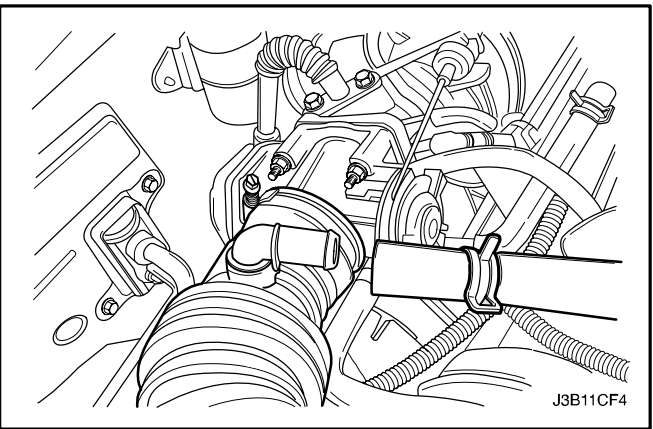
33. Install the right front wheel well splash shield.
34. Install the right front wheel. Refer to *Section 2E, Tires and Wheels*.
35. Install the air cleaner housing.
36. Install the air cleaner housing bolts.

Tighten

Tighten the air cleaner housing bolts to 10 N•m (89 lb-in).



37. Connect the air cleaner outlet hose to the throttle body.
38. Connect the breather tube to the camshaft cover.
39. Connect the negative battery cable.



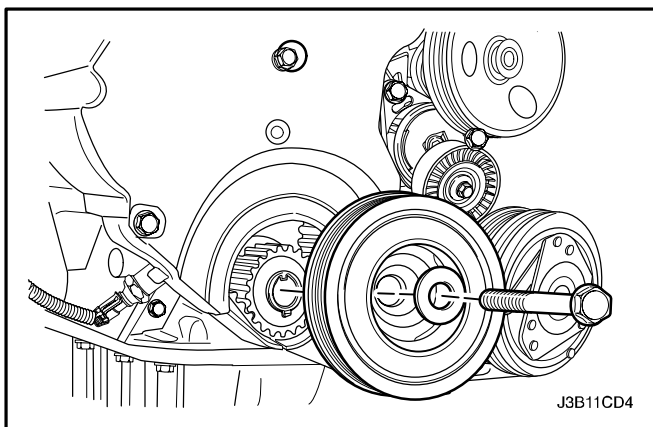
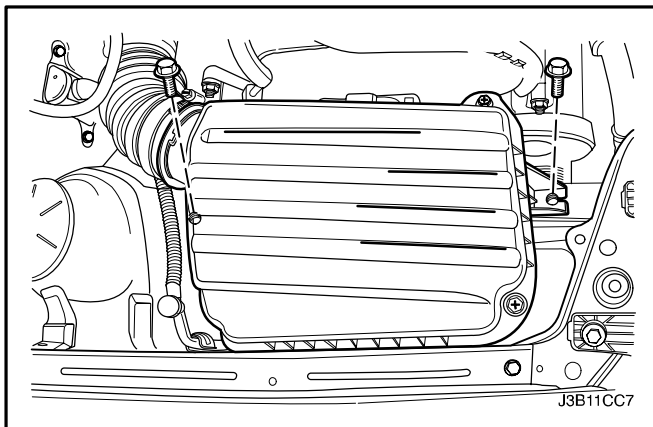
TIMING BELT

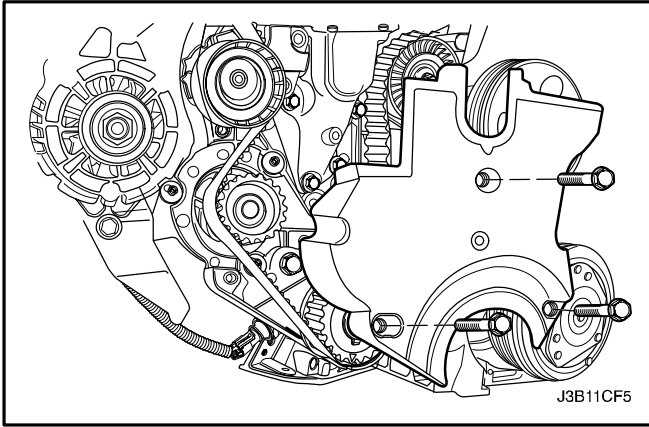
Tools Required

J-42492 Timing Belt Adjuster
KM-470-B Angular Torque Gauge

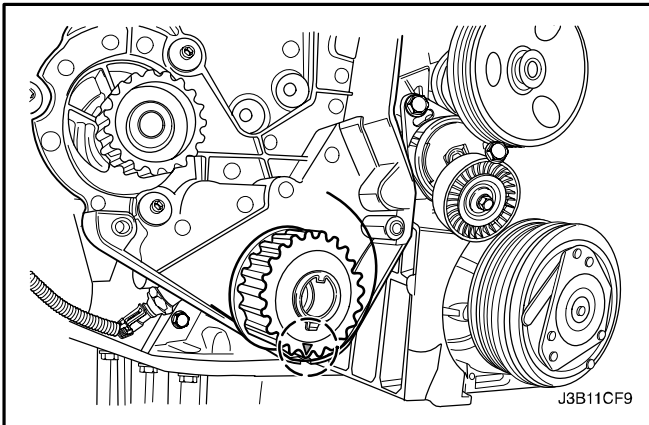
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the air cleaner outlet hose from the throttle body.
3. Disconnect the breather tube from the camshaft cover.
4. Remove the air cleaner housing bolts.
5. Remove the air cleaner housing.
6. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels*.
7. Remove the right front wheel well splash shield.
8. Remove the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
9. Remove the crankshaft pulley bolt.
10. Remove the crankshaft pulley.

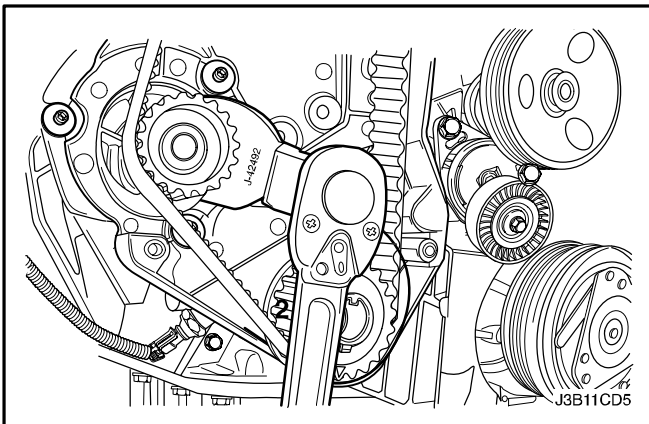




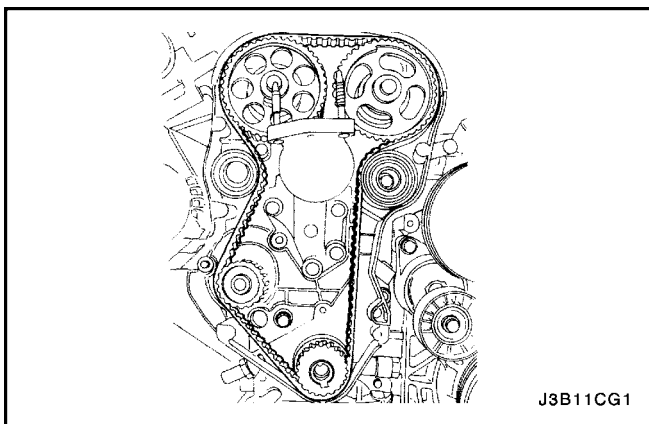
11. Remove the upper front timing belt cover bolts.
12. Remove the upper front timing belt cover.
13. Remove the lower front timing belt cover bolts.
14. Remove the lower front timing belt cover.
15. Install the crankshaft pulley bolt.



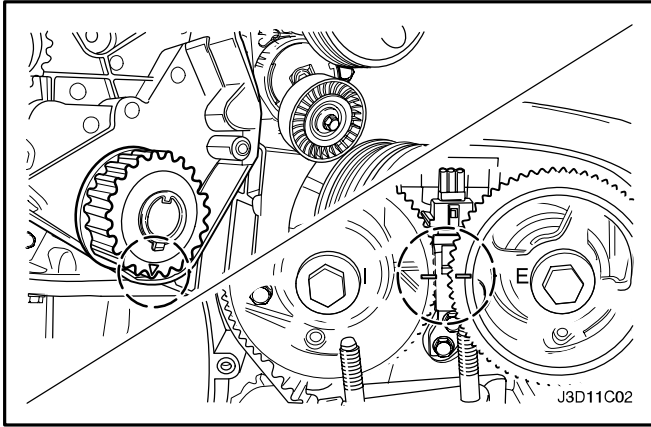
16. Using the crankshaft pulley bolt, rotate the crankshaft clockwise until the timing mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.



17. Slightly loosen the water pump retaining bolts.
18. Using the timing belt adjuster J-42492, rotate the water pump counterclockwise to release the tension on the timing belt.
19. Remove the right engine mount bracket. Refer to "Engine Mount" in this section.

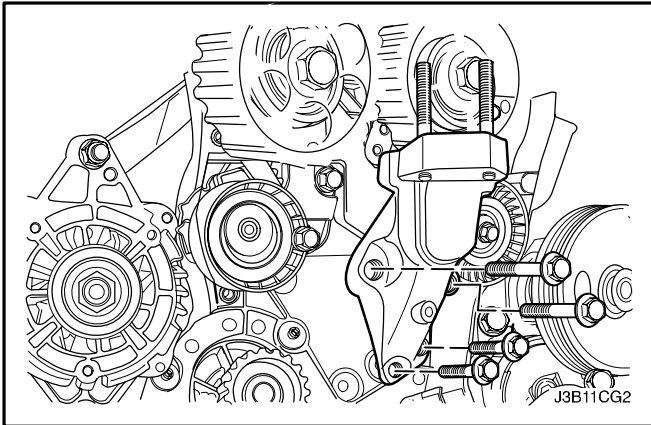


20. Remove the timing belt.

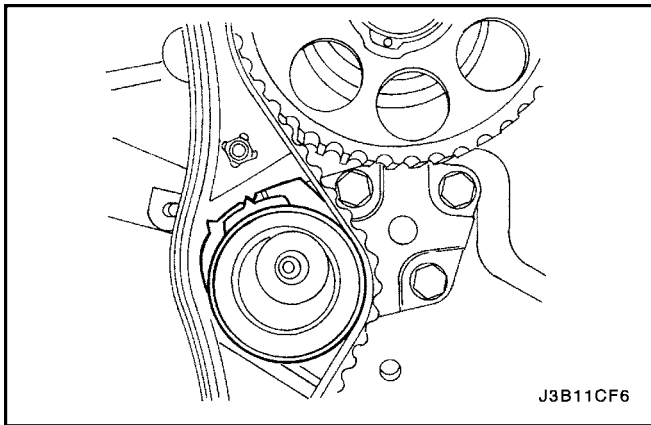


Installation Procedure

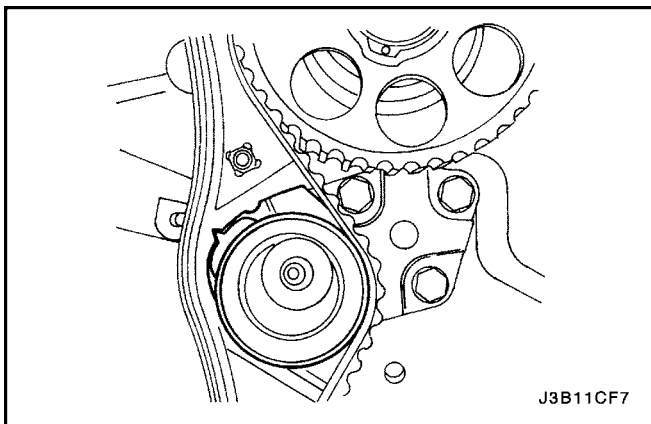
1. Align the timing mark on the crankshaft gear with the notch on the bottom of the rear timing belt cover.
2. Align the timing marks on the camshaft gears.



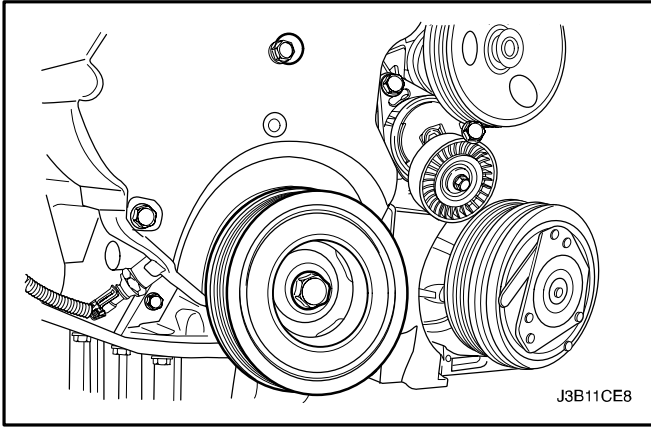
3. Install the timing belt.
4. Install the right engine mount bracket. Refer to "Engine Mount" in this section.



5. Rotate the water pump clockwise using the timing belt adjuster J-42492.
6. Rotate the water pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.



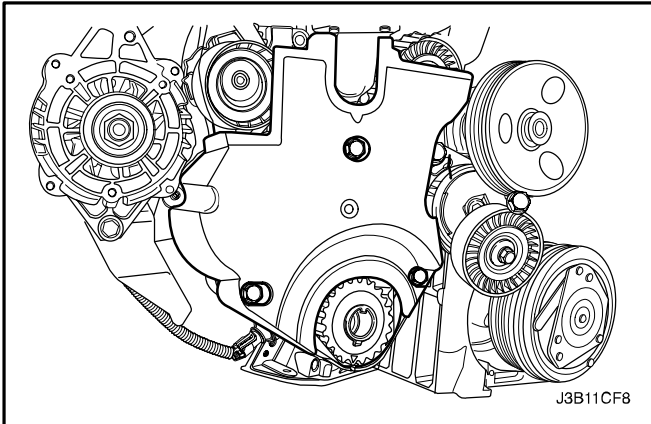
7. Tighten the water pump retaining bolts.
8. Rotate the crankshaft two full turns clockwise using the crankshaft pulley bolt.
9. Loosen the water pump retaining bolts.
10. Rotate the water pump until the adjust arm pointer of the timing belt automatic tensioner is aligned with the pointer on the timing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



11. Tighten the water pump retaining bolts.

Tighten

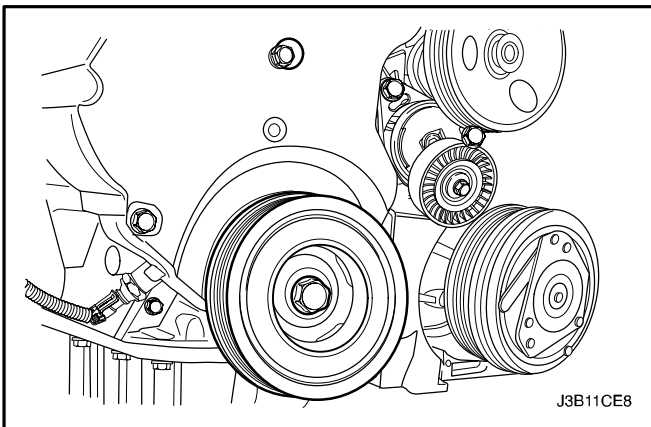
Tighten the water pump retaining bolts to 10 N•m (89 lb–in).



12. Remove the crankshaft pulley bolt.
 13. Install the upper and lower front timing belt covers.
 14. Install the upper and lower front timing belt cover bolts.

Tighten

Tighten the front timing belt cover bolts to 10 N•m (89 lb–in).

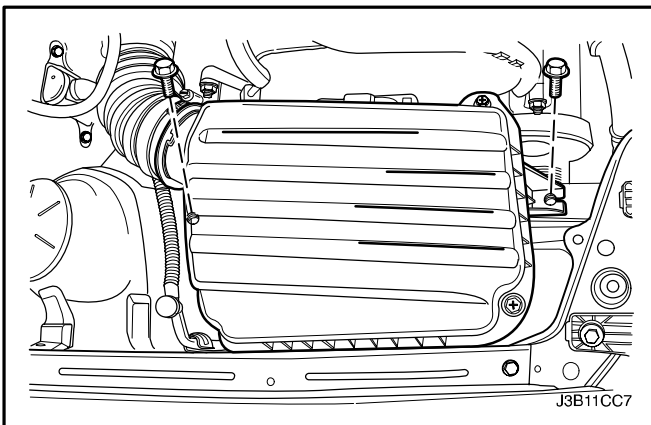


15. Install the crankshaft pulley.
 16. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N•m (70 lb–ft) and retighten 30 degrees plus 15 degrees.

17. Install the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
 18. Install the right front wheel well splash shield.
 19. Install the right front wheel. Refer to *Section 2E, Tires and Wheels*.

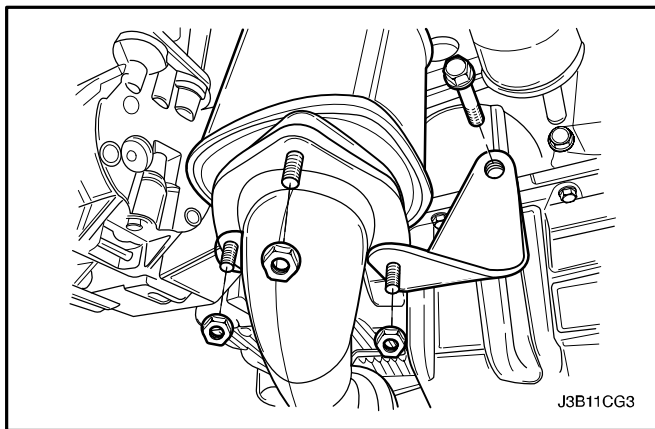


20. Install the air cleaner housing.
 21. Install the air cleaner housing bolts.

Tighten

Tighten the air cleaner housing bolts to 10 N•m (89 lb–in).

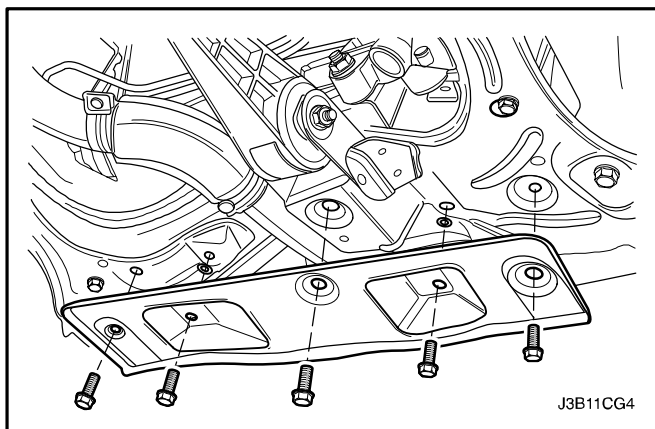
22. Connect the air cleaner outlet hose to the throttle body.
 23. Connect the breather tube to the camshaft cover.
 24. Connect the negative battery cable.



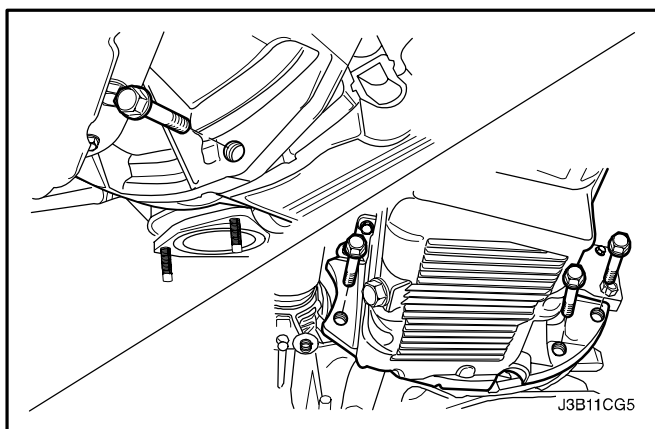
OIL PAN

Removal Procedure

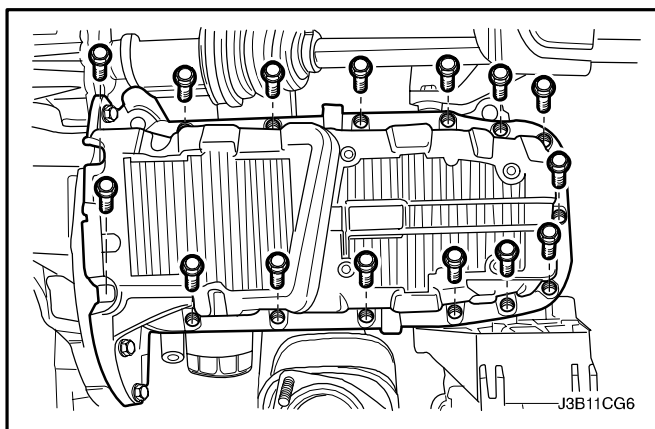
1. Disconnect the negative battery cable.
2. Drain the Engine oil from the engine crankcase.
3. Remove the catalytic converter retaining nuts from the exhaust pipe.



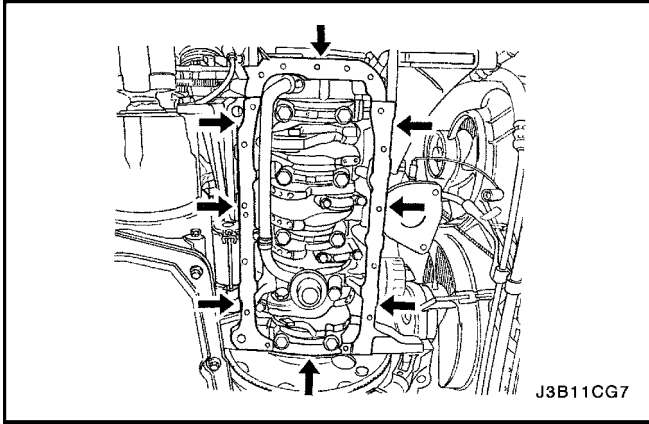
4. Remove the lower crossmember bracket.
5. Remove the exhaust connecting pipe.



6. Remove the oil pan bolts to the transaxle case.

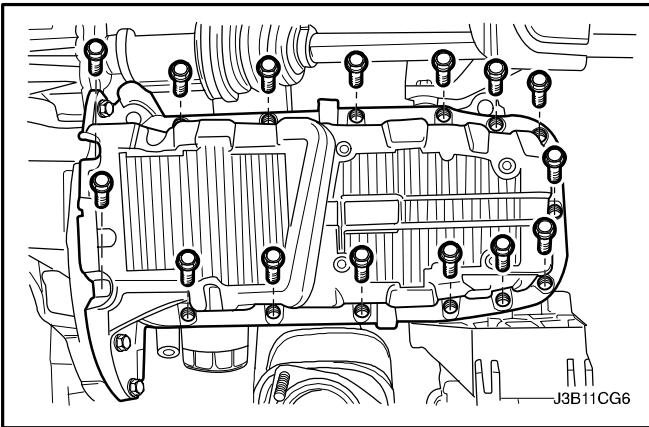


7. Remove the oil pan retaining bolts to the engine block.
8. Remove the oil pan from the engine block.



Cleaning Procedure

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



Installation Procedure

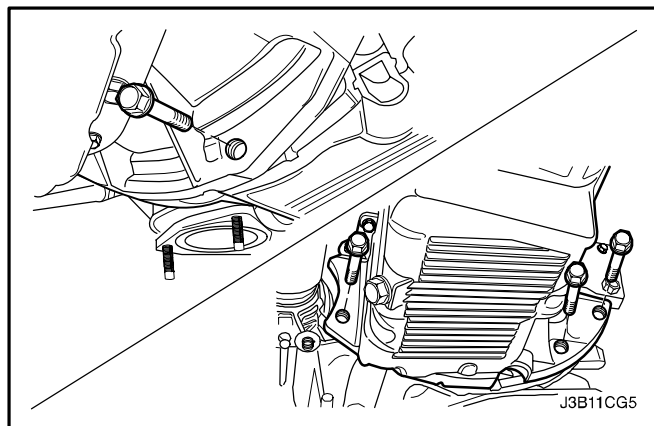
1. Coat the new oil pan gasket with sealant.

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

2. Install the oil pan to the engine block.
3. Install the oil pan retaining bolts.

Tighten

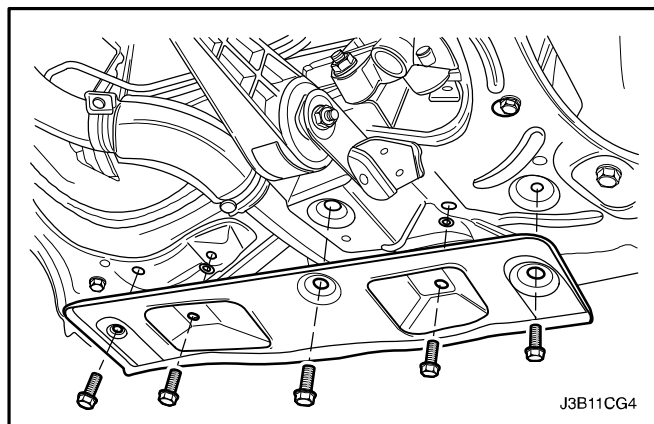
Tighten the oil pan retaining bolts to 10 N•m (89 lb-in).



4. Install the oil pan bolts to the transaxle case.

Tighten

Tighten the oil pan to the transaxle case bolts to 31 N•m (23 lb-ft).



5. Install the exhaust connecting pipe.
6. Install the catalytic converter retaining nuts to the exhaust pipe.

Tighten

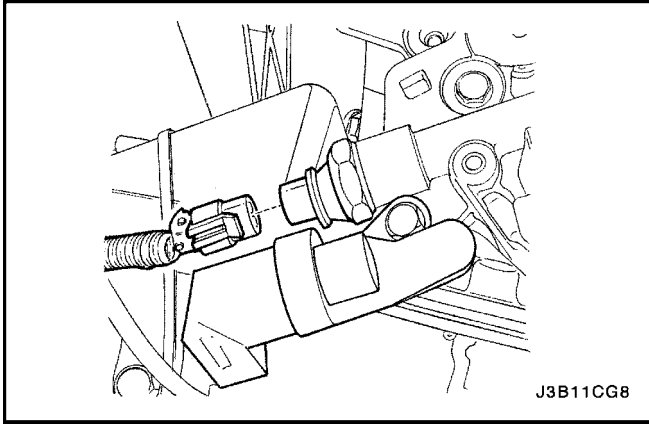
Tighten the catalytic converter to exhaust pipe retaining nuts to 40 N•m (30 lb-ft).

7. Install the lower crossmember bracket.
8. Connect the negative battery cable.
9. Install the oil pan drain plug.

Tighten

Tighten the oil pan drain plug to 55 N•m (40 lb-ft).

10. Refill the engine crankcase with engine oil.



OIL PUMP

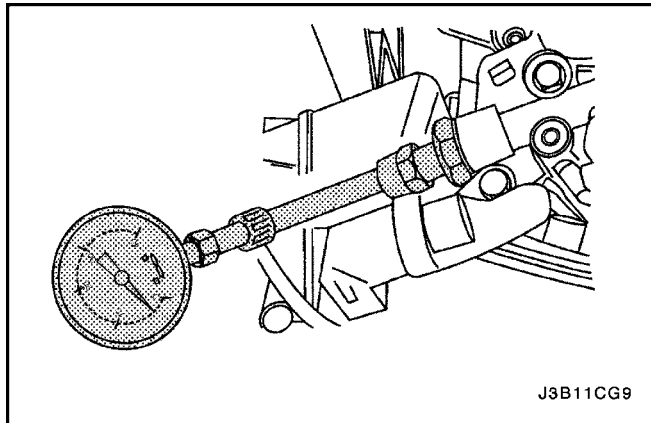
Tools Required

KM-498-B Pressure Gauge

KM-135 Adapter

Engine Oil Pressure Inspection Procedure

1. Remove the right front wheel, wheel well splash shield and engine undercover.
2. Disconnect the oil pressure switch connector.
3. Install the adapter KM-135 in place of the oil pressure switch.
4. Connect the pressure gauge KM-498-B to the adapter.
5. Start the engine and check the oil pressure at idle speed and engine temperature of 80°C (176°F). The minimum oil pressure should be 30 kPa (4.35 psi).
6. Stop the engine and remove the pressure gauge KM-498-B and the adapter KM-135.

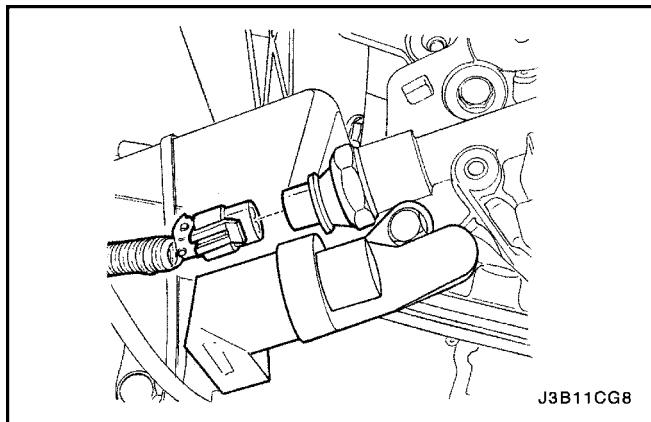


7. Install the oil pressure switch.

Tighten

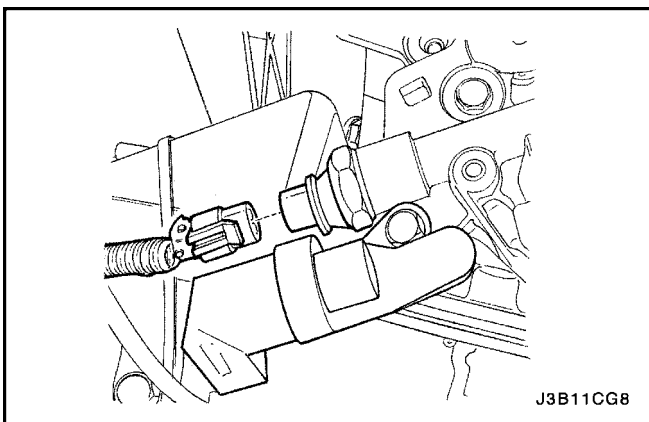
Tighten the oil pressure switch to 40 N•m (30 lb-ft).

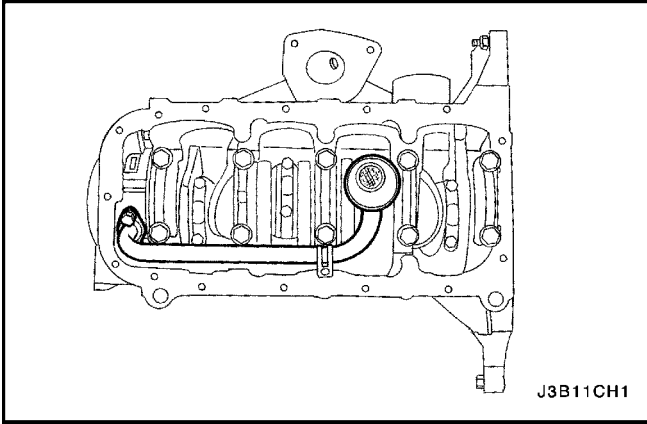
8. Connect the oil pressure switch connector.
9. Install the right front wheel well splash shield, engine undercover and wheel.
10. Check the oil level. Pour oil until it reaches the full mark.



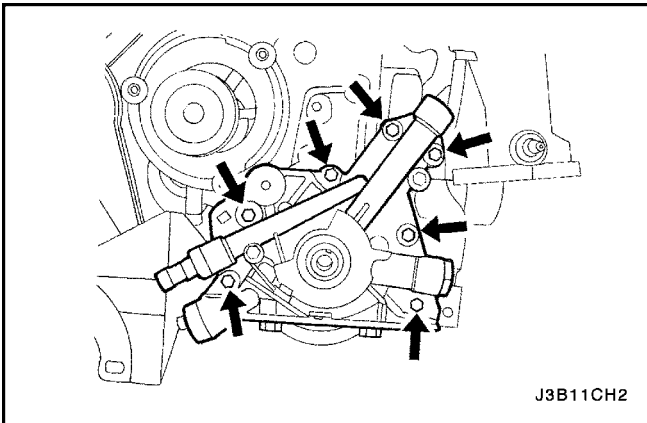
Removal Procedure

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.

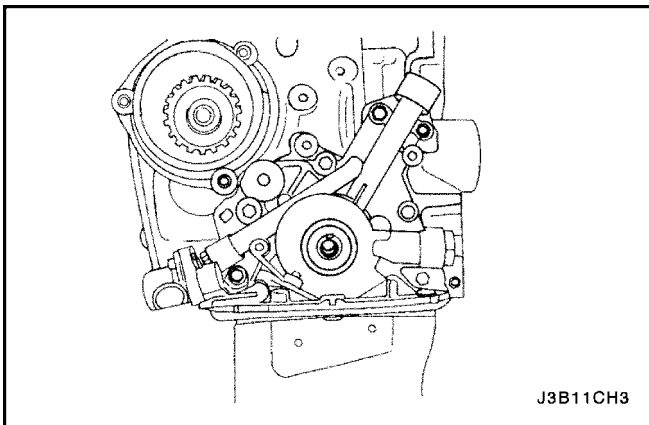




6. Remove the oil pan. Refer to "Oil Pan" in this section.
7. Remove the oil suction pipe and support bracket bolts.
8. Remove the oil suction pipe.

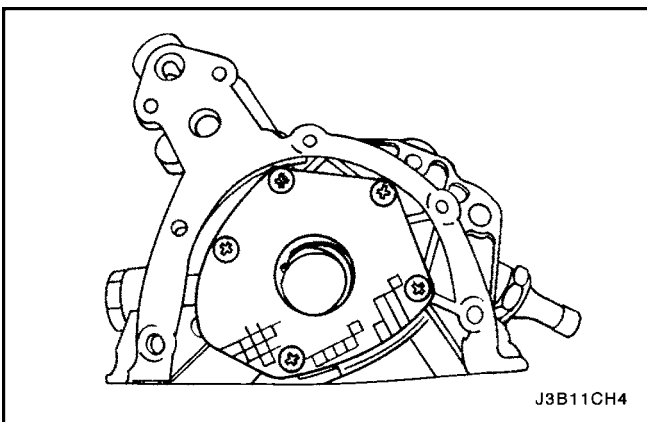


9. Remove the oil pump retaining bolts.
10. Carefully separate the oil pump and gasket from the engine block and the oil pan.
11. Remove the oil pump.

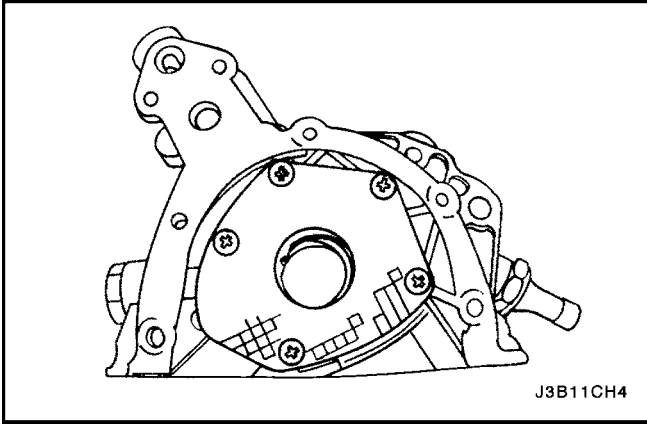


Inspection Procedure

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



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



7. Clean the oil pump housing and all the oil pump parts.
8. Inspect all the oil pump parts for signs of wear. Refer to "Engine Specifications" in this section. Replace the worn oil pump parts.

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

9. Coat all the oil pump parts with clean engine oil. Install the oil pump parts.
10. Apply Loctite® 242 to the oil pump rear cover bolts and install the cover and bolts.

Tighten

Tighten the oil pump rear cover bolts to 8 N•m (71 lb-in).

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

Tighten

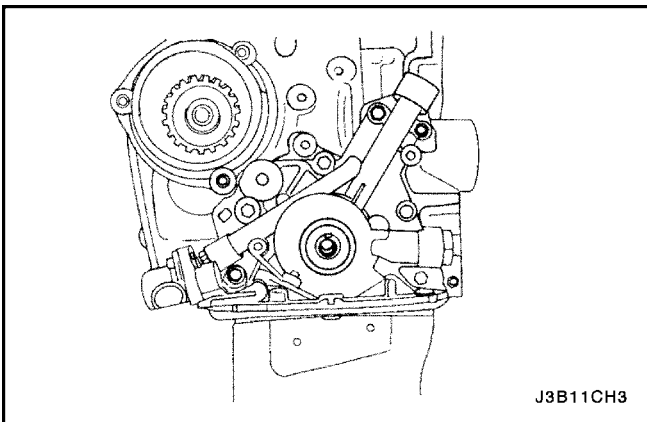
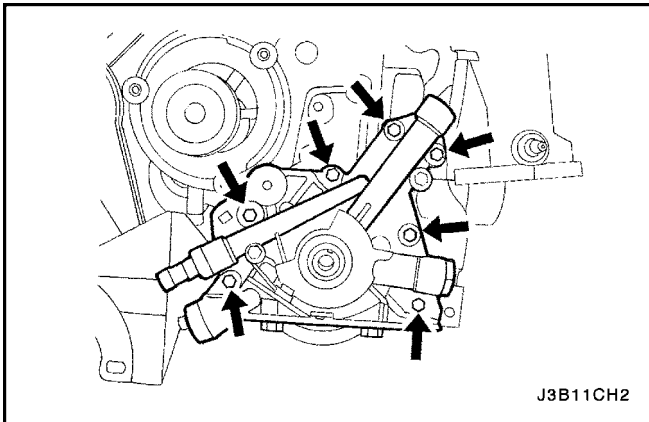
Tighten the safety relief valve bolt to 30 N•m (22 lb-ft).

Installation Procedure

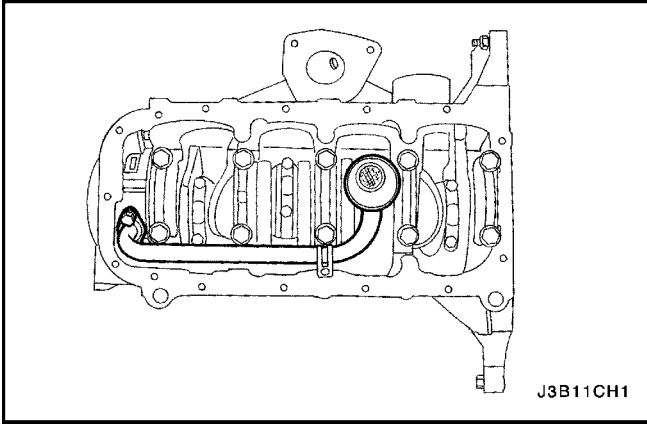
1. Apply Loctite® 242 to the oil pump bolts and room temperature vulcanizing (RTV) sealant to the new oil pump gasket.
2. Install the gasket to the oil pump and install the oil pump to the engine block with the bolts.

Tighten

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



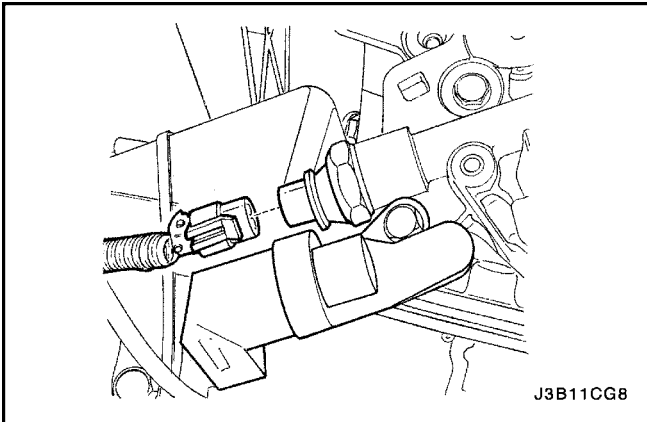
3. Install a new oil pump-to-crankshaft seal. Coat the lip of the seal with a thin coat of grease.



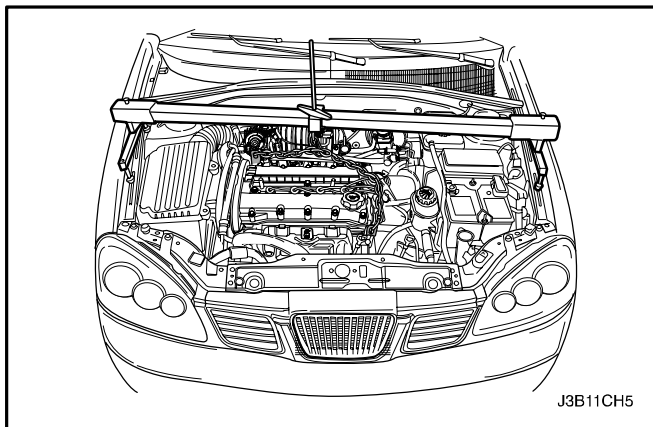
4. Coat the threads of the oil suction pipe and support bracket bolts with Loctite® 242.
5. Install the oil suction pipe and bolts.

Tighten

Tighten the oil suction pipe and support bracket bolts to 10 N•m (89 lb-in).



6. Install the oil pan. Refer to "Oil Pan" in this section.
7. Connect the oil pressure switch connector.
8. Install the rear timing belt cover. Refer to "Rear Timing Belt Cover" in this section.
9. Install the timing belt. Refer to "Timing Belt" in this section.
10. Install the power steering pump, if equipped. Refer to *Section 6A, Power Steering System*.
11. Connect the negative battery cable.



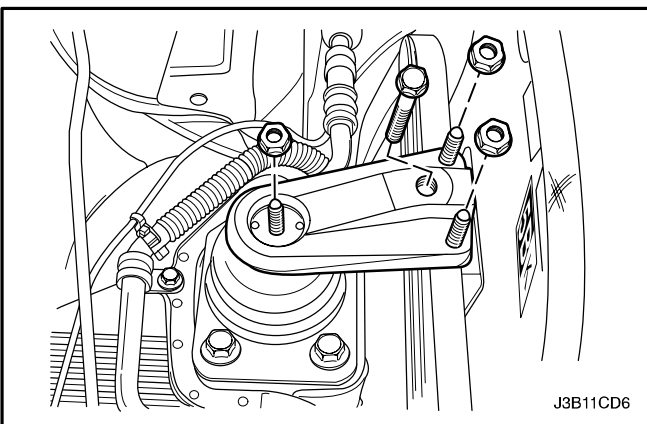
ENGINE MOUNT

Tools Required

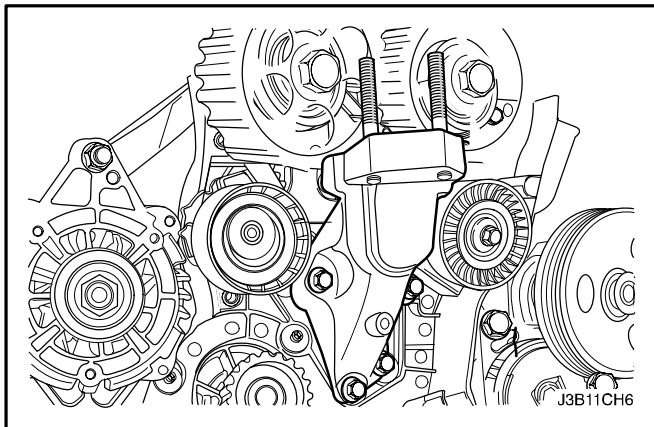
DW110-060 Engine Support Fixture

Removal Procedure

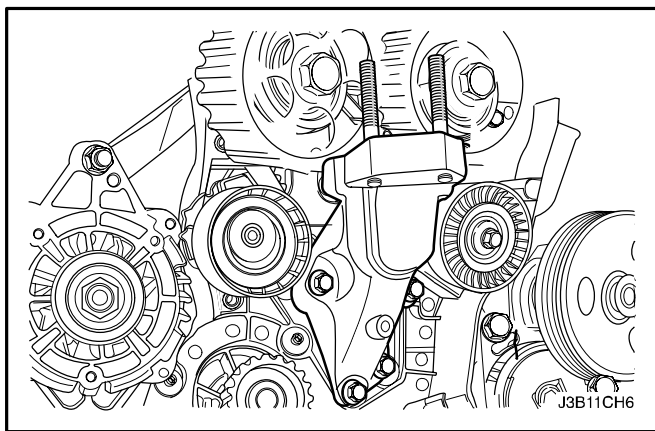
1. Disconnect the negative battery cable.
2. Support the engine assembly using the engine support fixture DW110-060.



3. Remove the engine mount bracket attaching bolts/nuts.
4. Remove the front timing belt cover. Refer to "Timing Belt" in this section.



5. Remove the engine mount attaching bolts/nuts.
6. Remove the engine mount.



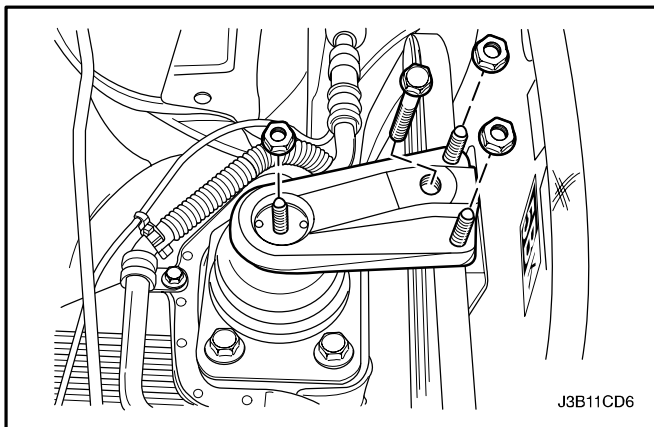
Installation Procedure

1. Install the engine mount.
2. Install the engine mount retaining bolts.

Tighten

Tighten the engine mount attaching bolts to 30 N•m (22 lb–ft).

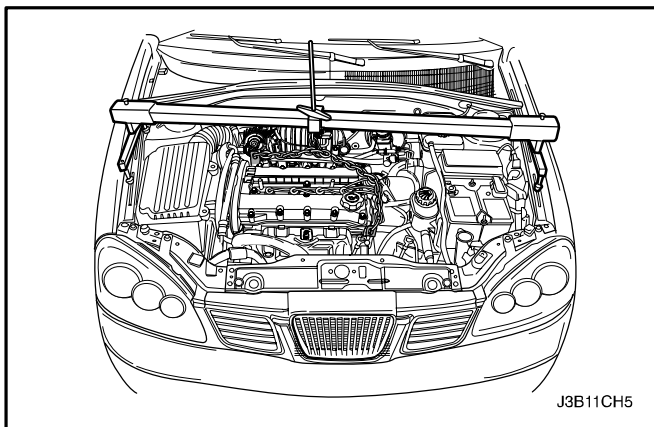
3. Install the front timing belt cover. Refer to "Timing Belt" in this section.



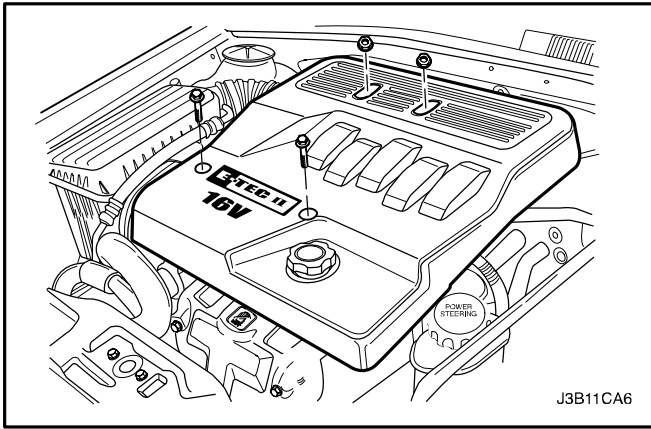
4. Install the engine mount bracket attaching bolts/nuts.

Tighten

Tighten the engine mount bracket attaching bolts/nuts to 55 N•m (41 lb–ft).



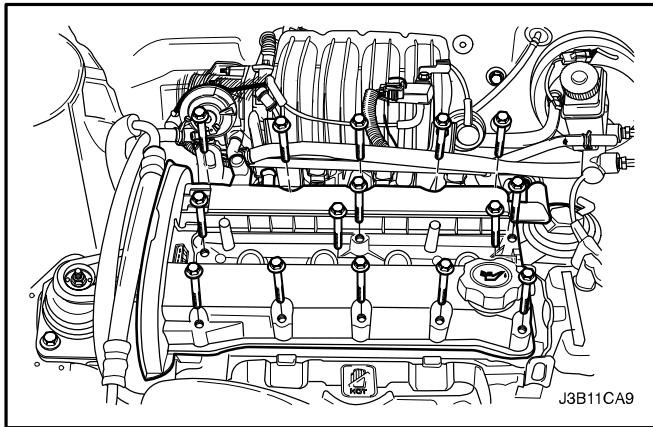
5. Remove engine assembly support fixture DW110–060.
6. Connect the negative battery cable.



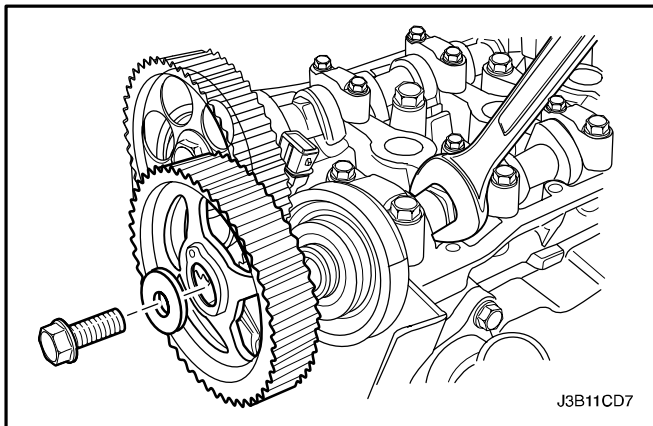
CAMSHAFT GEARS

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Remove the timing belt. Refer to "Timing Belt" in this section.
4. Disconnect the ignition wires from the spark plugs.
5. Disconnect the engine ventilation hoses from the camshaft cover.

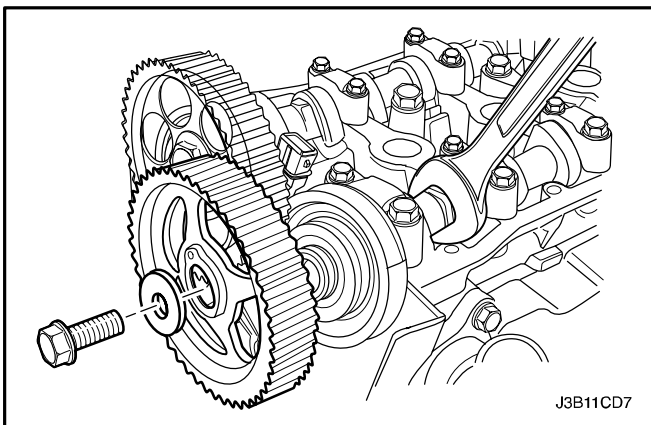


6. Remove the camshaft cover bolts.
7. Remove the camshaft cover and the camshaft cover gasket.



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

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



Installation Procedure

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

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

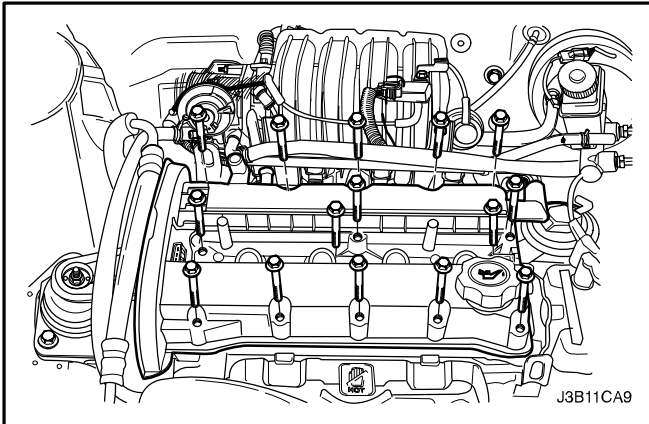
Tighten

Tighten the intake camshaft gear bolt to 67.5 N•m (49 lb–ft).

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

Tighten

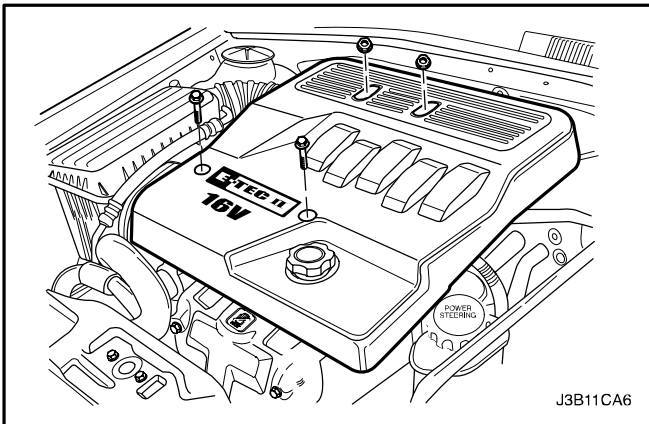
Tighten the exhaust camshaft gear bolt to 67.5 N•m (49 lb–ft).



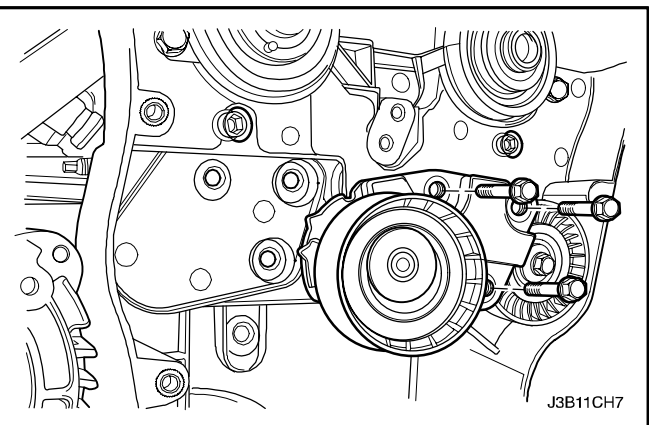
5. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear camshaft cover-to-cylinder head seal.
6. Install the camshaft cover and the camshaft cover gasket.
7. Install the camshaft cover bolts.

Tighten

Tighten the camshaft cover nuts to 10 N•m (89 lb–in).



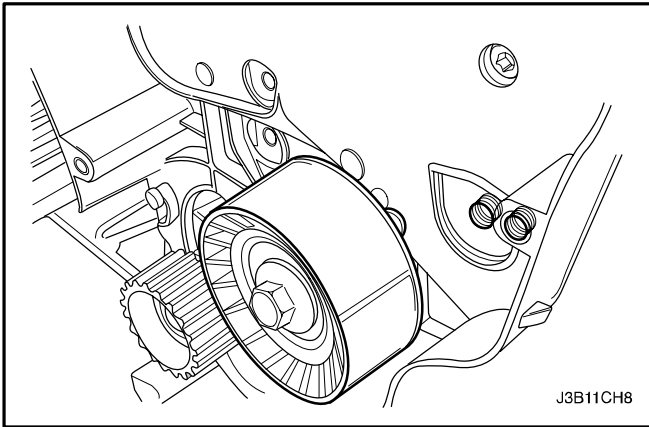
8. Connect the engine ventilation hoses to the camshaft cover.
9. Connect the ignition wires to the spark plugs.
10. Install the timing belt. Refer to "Timing Belt" in this section.
11. Install the engine cover. Refer to "Engine Cover" in this section.
12. Connect the negative battery cable.



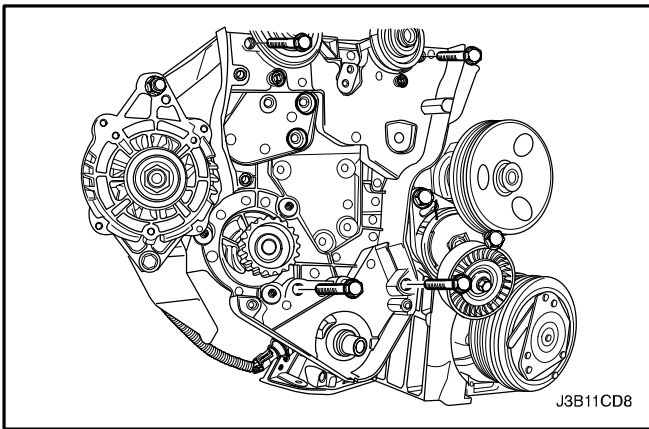
REAR TIMING BELT COVER

Removal Procedure

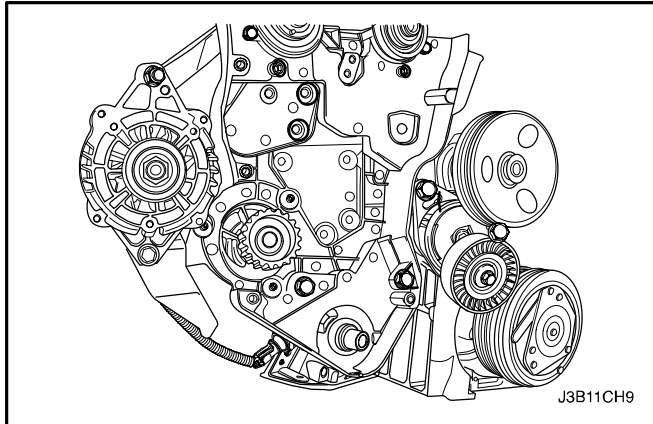
1. Remove the timing belt and the timing belt cover. Refer to "Timing Belt" in this section.
2. Remove the camshaft gears. Refer to "Camshaft Gears" in this section.
3. Remove the crankshaft gear.
4. Remove the timing belt automatic tensioner bolts.
5. Remove the timing belt automatic tensioner.



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



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

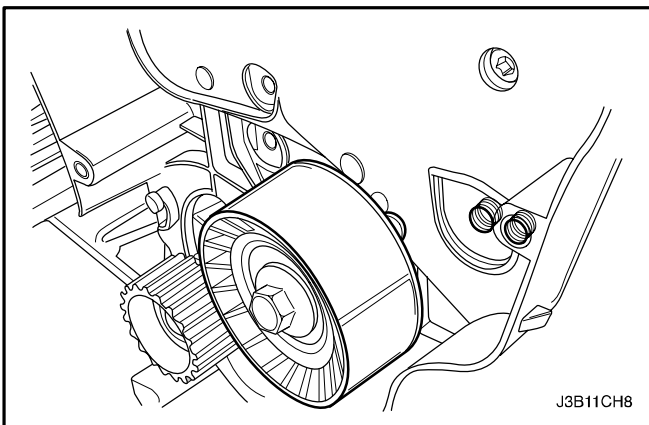


Installation Procedure

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

Tighten

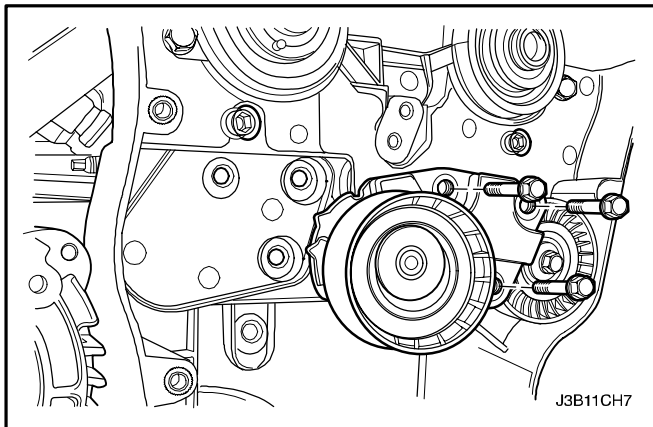
Tighten the rear timing belt cover bolts to 10 N•m (89 lb-in).



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

Tighten

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



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

Tighten

Tighten the timing belt automatic tensioner bolts to 25 N•m (18 lb–ft).

7. Install the crankshaft gear.

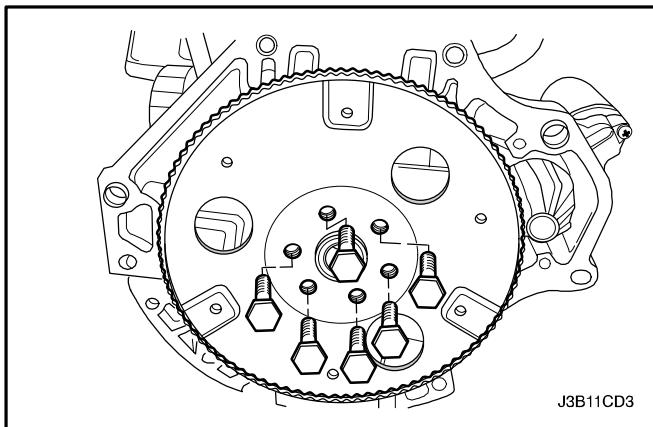
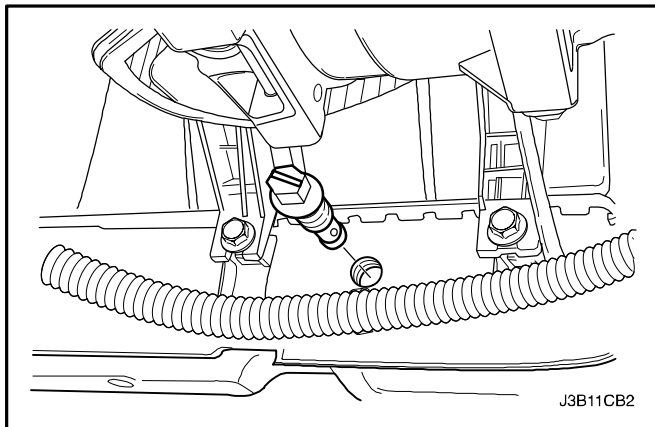
Notice : Take extreme care to prevent any scratches, nicks or damage to the camshafts.

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

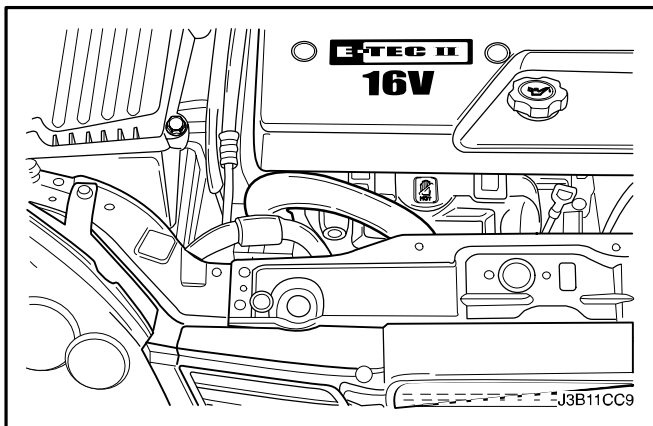
ENGINE

Removal Procedure

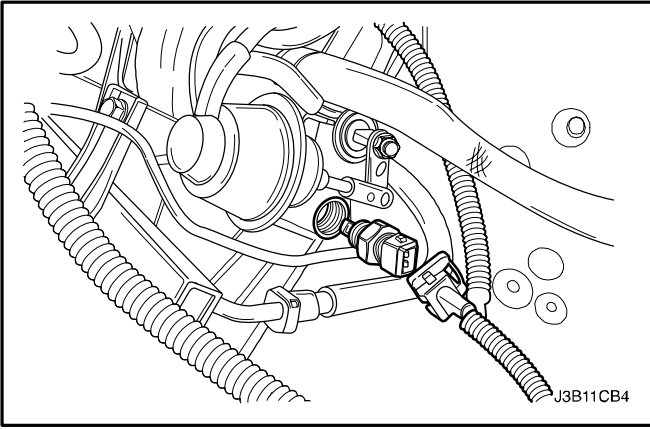
1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine for 10 seconds to rid the fuel system of fuel pressure.
3. Remove the hood. Refer to *Section 9R, Body Front End*.
4. Drain the engine oil.
5. Disconnect the negative battery cable.



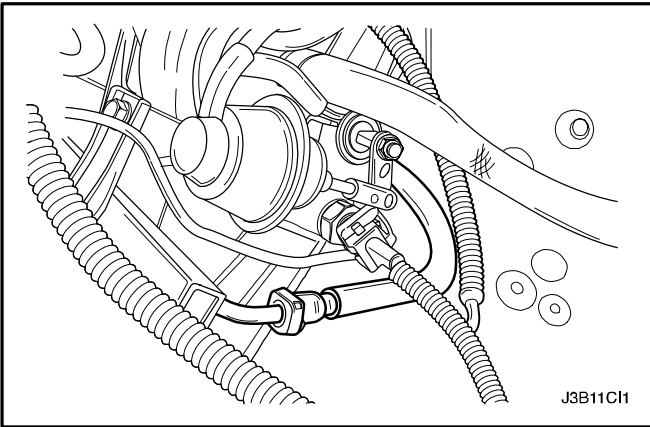
6. Remove the air cleaner outlet hose from the throttle body and air cleaner housing.
7. Disconnect the breather tubes from the camshaft cover.
8. Remove the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
9. Remove the right front wheel. Refer to *Section 2E, Tires and Wheels*.
10. Remove the right front wheel well splash shield.



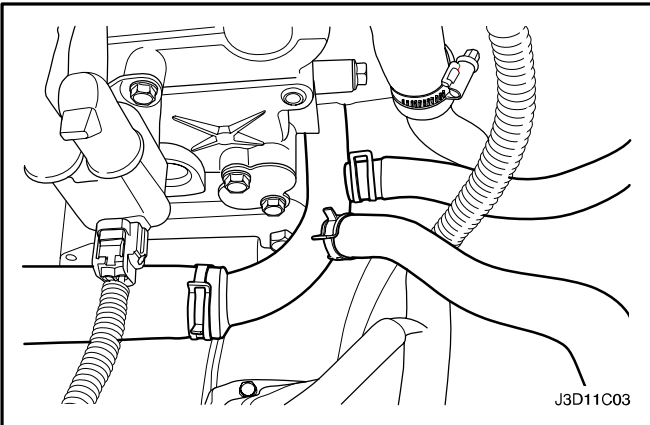
11. Drain the engine coolant. Refer to *Section 1D, Engine Cooling*.
12. Remove the cooling system radiator and the engine cooling fans. Refer to *Section 1D, Engine Cooling*.
13. Disconnect the upper radiator hose from the thermostat housing.
14. Disconnect the power steering return hose from the power steering pump. Refer to *Section 6A, Power Steering System*.
15. Disconnect the power steering pressure hose from the power steering pump. Refer to *Section 6A, Power Steering System*.
16. Disconnect the electrical connector at the direct ignition system (DIS) coil and the electronic control module (ECM) ground terminal at the intake manifold and at the starter motor.



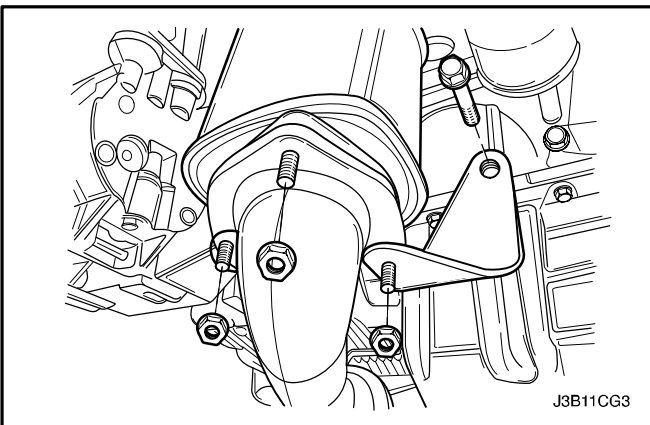
17. Disconnect the oxygen (O₂) sensor connector, if equipped.
18. Disconnect the fuel injector harness connectors.
19. Disconnect the MAT, MAP sensor connectors.
20. Disconnect the throttle position sensor (TPS) connector.
21. Disconnect the generator voltage regulator connector and power lead.
22. Remove the electrical harness clamp bolt.



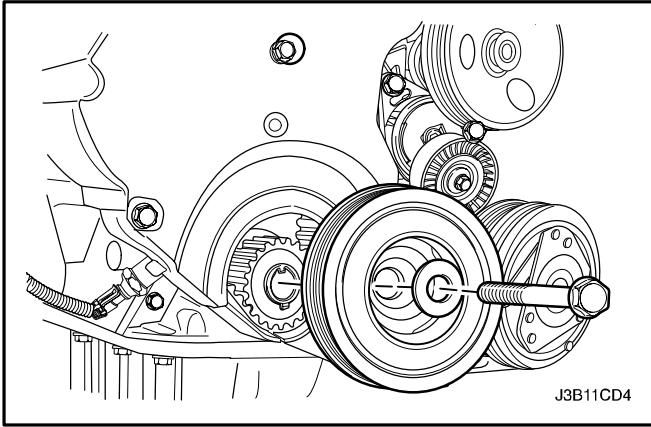
23. Disconnect all of the necessary vacuum lines, including the brake booster vacuum hose.
24. Disconnect the fuel feed line at the fuel rail.



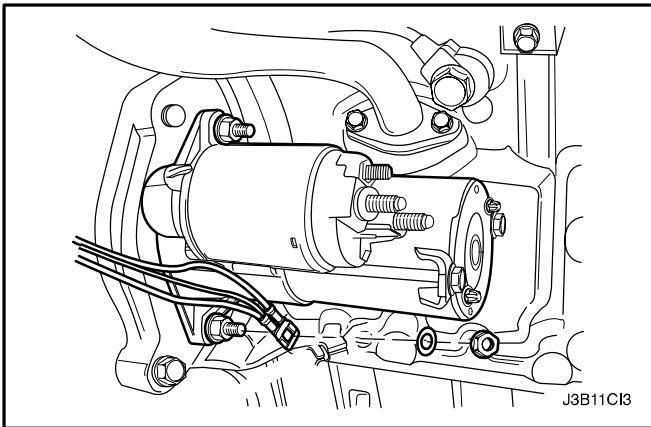
25. Disconnect the throttle cable from the throttle body and the intake manifold bracket.
26. Disconnect the surge tank coolant hose at the throttle body.
27. Disconnect the heater outlet hose at the coolant pipe.
28. Disconnect the heater inlet hose from the cylinder head.
29. Disconnect the surge tank coolant hose from the coolant pipe.
30. Disconnect the lower radiator hose from the coolant pipe. Disconnect the starter solenoid "S" terminal wire. Remove the A/C compressor, if equipped. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning Systems*.



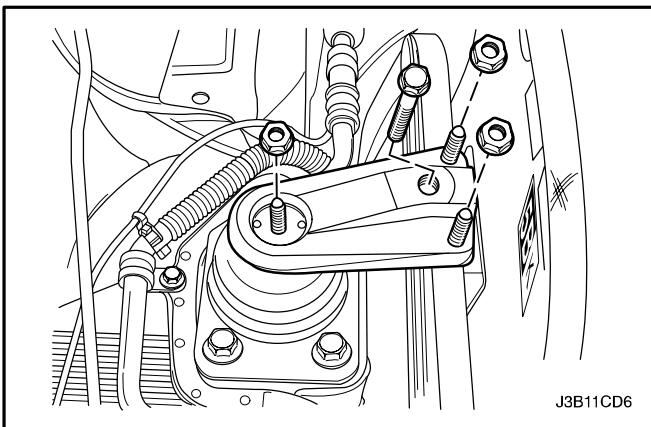
31. Remove the catalytic converter retaining nuts from the exhaust pipe.
32. Remove the exhaust pipe.



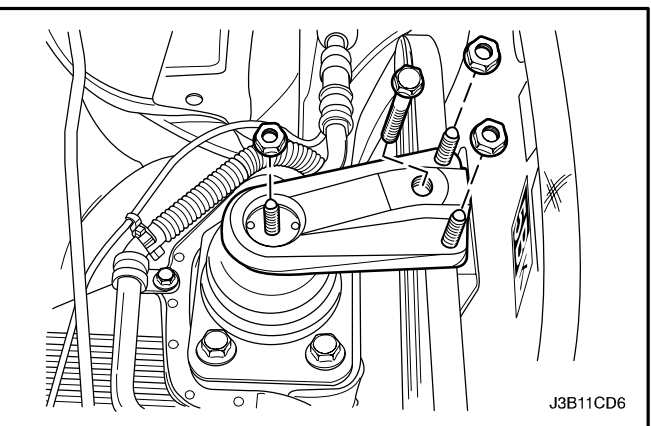
33. Remove the crankshaft pulley bolt.
34. Remove the crankshaft pulley.
35. Disconnect the vacuum lines at the charcoal canister purge solenoid.
36. Disconnect the electrical connector at the charcoal canister purge (CCP) solenoid and at the knock sensor.
37. Disconnect the electrical connector at the oil pressure switch and at the exhaust gas recirculation (EGR) solenoid.
38. Disconnect the crankshaft position sensor (CPS) connector.



39. Remove the transaxle torque converter bolts, if automatic transaxle equipped.
40. Remove the stator motor. Refer to *Section 1E, Engine Electrical*.
41. Remove the transaxle bell housing bolts.
42. Support the transaxle with a floor jack.
43. Install the engine lifting device.



44. Disconnect the right engine mount bracket from the engine mount and the engine by removing the attaching bolts and the nuts.
45. Remove the right engine mount from the engine block. Refer to "Engine Mount" in this section.
46. Separate the engine block from the transaxle.
47. Remove the engine.



Installation Procedure

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

Tighten

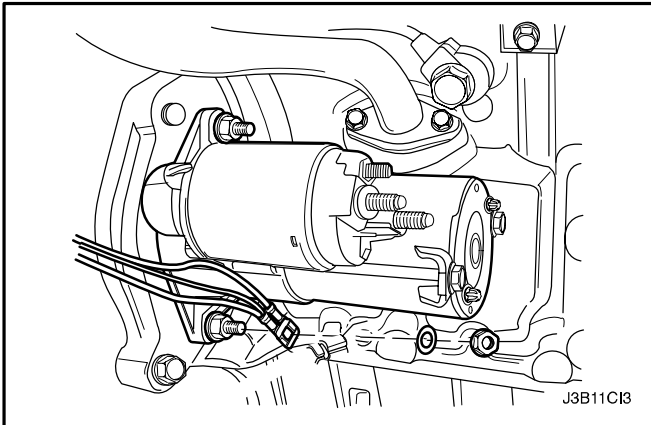
Tighten the transaxle bell housing bolts to 75 N•m (55 lb–ft).

4. Install the right engine mount to the engine block. Refer to "Engine Mount" in this section.

5. Connect the right engine mount bracket to the engine mount and the engine by installing the attaching bolts and the nuts.

Tighten

Tighten the engine mount bracket attaching bolts and the nuts to 55 N•m (41 lb–ft).

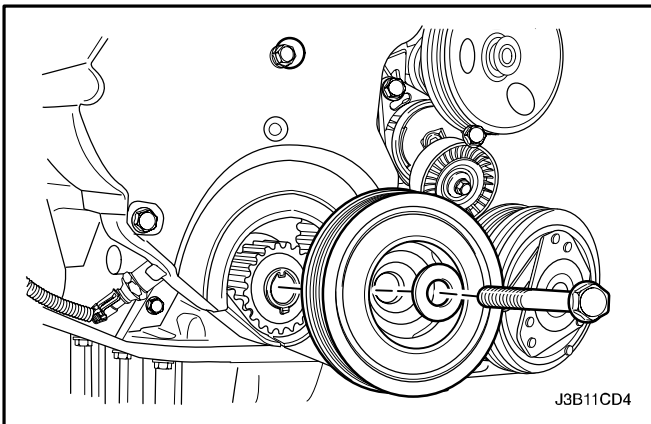


6. Remove the floor jack used for support of the trans-axle.
7. Remove the engine lifting device.
8. Install the transaxle torque converter bolts, if auto-matic transaxle equipped.

Tighten

Tighten the transaxle torque converter bolts to 45 N•m (33 lb–ft).

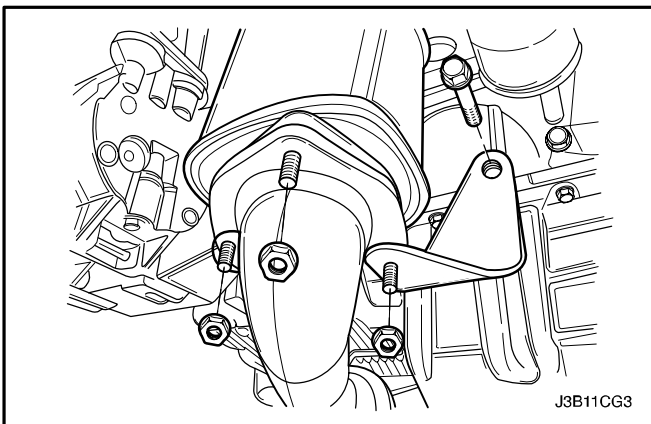
9. Install the starter motor. Refer to *Section 1E, Engine Electrical*.



10. Connect the vacuum lines at the CCP solenoid.
11. Connect the electrical connector at the CCP solenoid and at the knock sensor.
12. Connect the oil pressure switch and the EGR solenoid connectors.
13. Install the crankshaft pulley.
14. Install the crankshaft pulley bolt.

Tighten

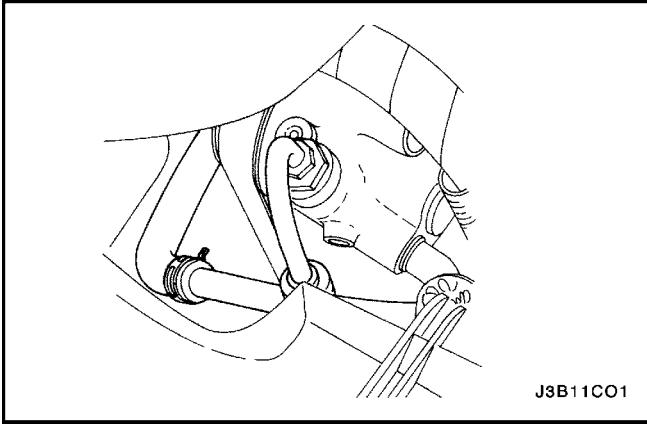
Tighten the crankshaft pulley bolt to 95 N•m (70 lb–ft) and retighten 30 degrees plus 15 degrees.



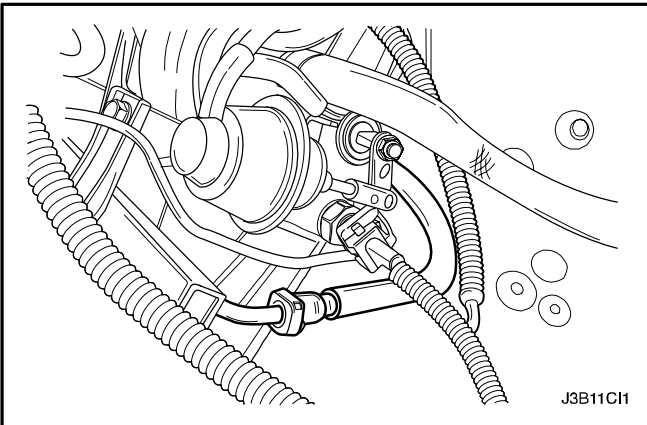
15. Connect the CPS connector.
16. Install the exhaust front pipe.
17. Install the catalytic converter retaining nuts to the exhaust pipe.

Tighten

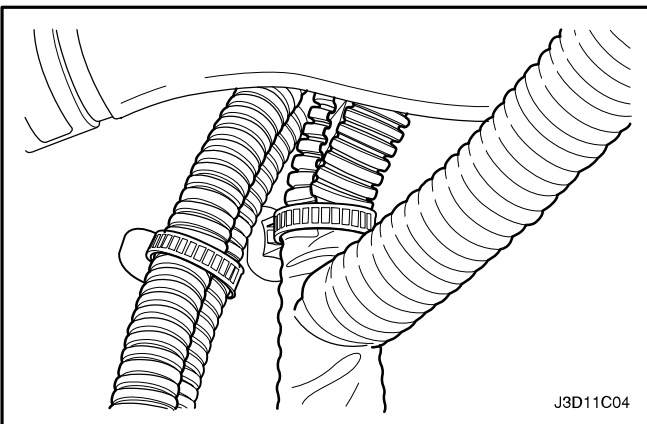
Tighten the catalytic converter to exhaust pipe retaining nuts to 35 N•m (26 lb–ft).



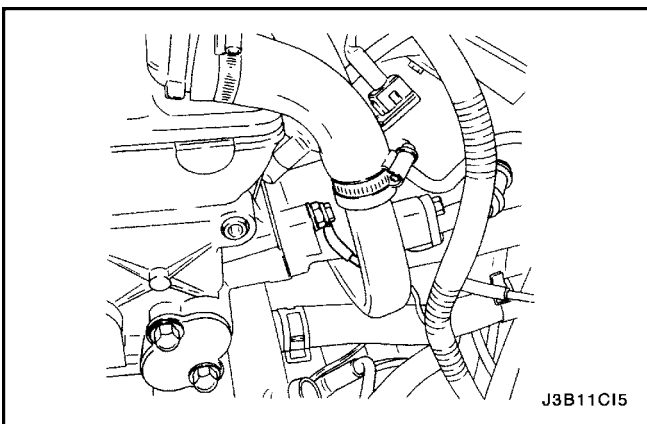
18. Connect the power steering pressure hose.
19. Connect the power steering return hose.
20. Install the A/C compressor, if equipped. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning Systems*.



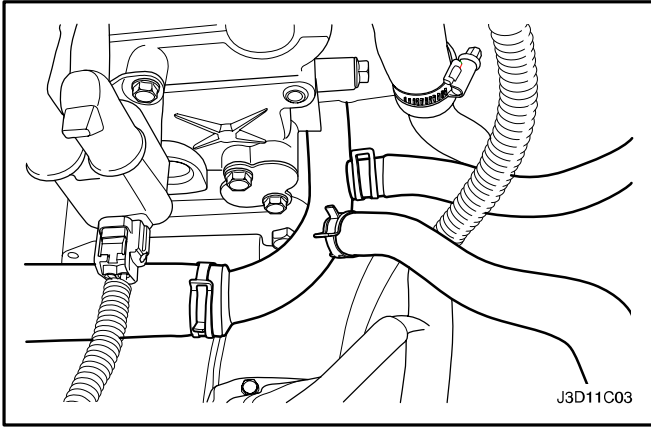
21. Install the generator. Refer to *Section 1E, Engine Electrical*.
22. Install the serpentine accessory drive belt. Refer to *Section 6B, Power Steering Pump*.
23. Install the right front wheel well splash shield.
24. Install the right front wheel. Refer to *Section 2E, Tires and Wheels*.
25. Connect the fuel feed line to the fuel rail.



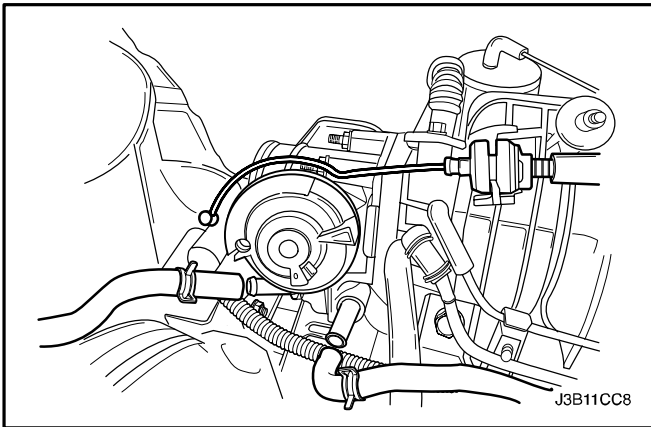
26. Connect all of the necessary vacuum lines, including the brake booster vacuum hose.
27. Connect the O2 sensor connector, if equipped.
28. Connect the starter solenoid "S" terminal wire and power lead.
29. Connect the generator voltage regulator connector and power lead.
30. Connect the CTS connector.
31. Connect the MAP, MAT sensor connectors.
32. Connect the TPS connector.
33. Install the electrical wiring harness clamp at the intake manifold support bracket.



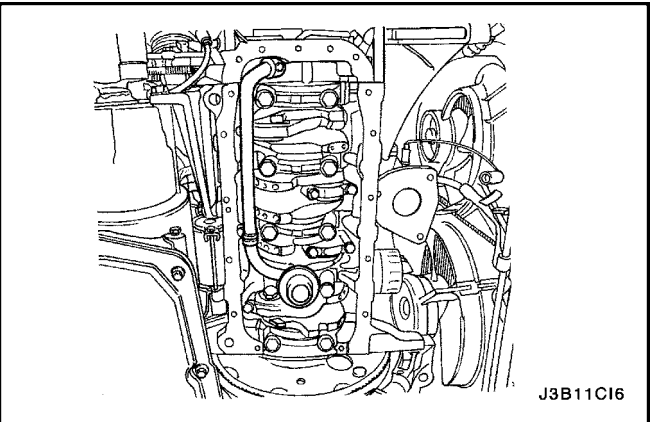
34. Connect the fuel injector harness connectors.
35. Connect the electrical connector at the DIS coil and the ECM ground terminal at the starter.
36. Install the air cleaner outlet hose between the throttle body and the air cleaner housing.
37. Connect the breather tubes to the camshaft cover.
38. Install the cooling system radiator and the engine cooling fans. Refer to *Section 1D, Engine Cooling*.



39. Connect the lower radiator hose to the coolant pipe.
40. Connect the upper radiator hose to the thermostat housing.
41. Connect the surge tank coolant hose to the radiator.
42. Connect the heater inlet hose to the cylinder head.
43. Connect the heater outlet hose to the coolant pipe.
44. Connect the coolant surge tank hose to the coolant pipe.
45. Connect the surge tank coolant hose to the throttle body.



46. Connect the throttle cable to the throttle body and the intake manifold bracket.
47. Install the fuel pump fuse.
48. Connect the negative battery cable.
49. Refill the engine crankcase with engine oil.
50. Refill the engine coolant system. Refer to *Section 1D, Engine Cooling*.
51. Bleed the power steering system. Refer to *Section 6A, Power Steering System*.
52. Refill the A/C refrigerant system, if equipped. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System*.
53. Install the hood. Refer to *Section 9R, Body Front End*.



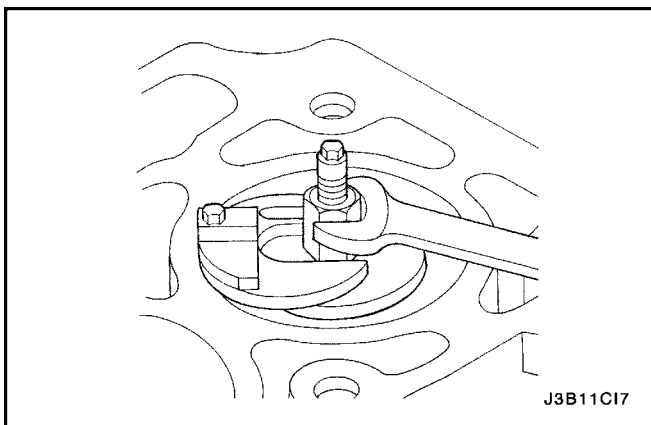
PISTONS AND RODS

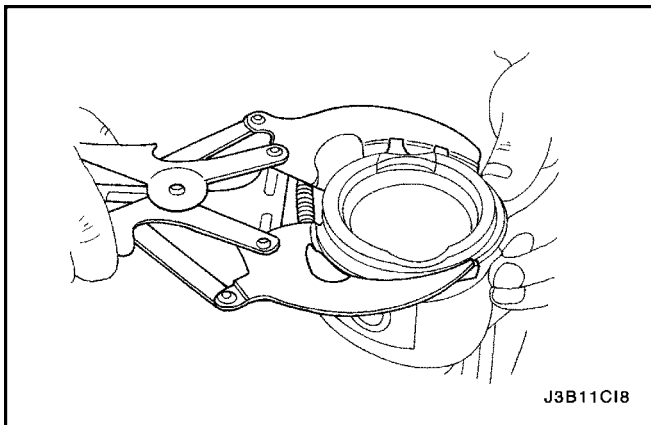
Tools Required

KM-427 Piston Pin Service Set
KM 470-B Angular Torque Gauge

Removal Procedure

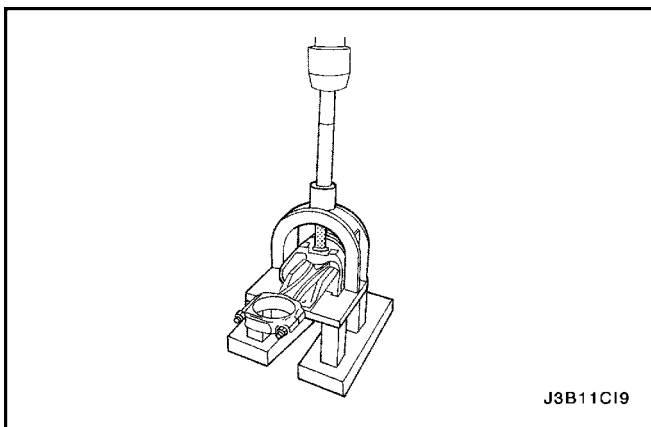
1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the oil pan. Refer to "Oil Pan" in this section.
3. Remove the oil suction pipe bolts.
4. Remove the oil suction pipe.
5. Move the piston to the bottom of the piston stroke.
6. Mark the connecting rod cap for position.
7. Remove the connecting rod cap bolts.
8. Remove the connecting rod cap and the lower connecting rod bearing.
9. Remove the upper piston connecting rod bearing.
10. Ridge ream the cylinder wall.



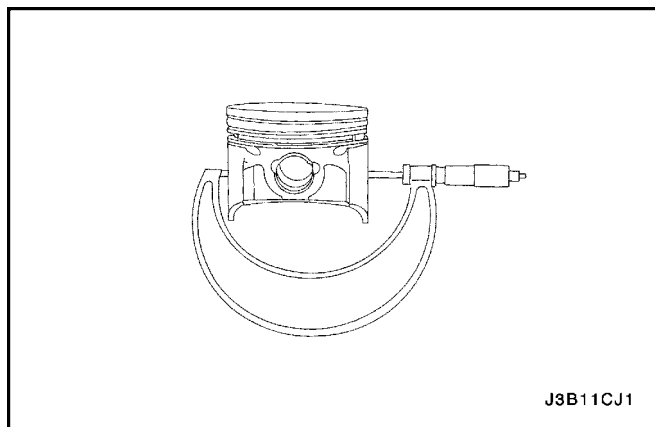


CAUTION : Use care when handling the piston. Worn piston rings are sharp and may cause injury.

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

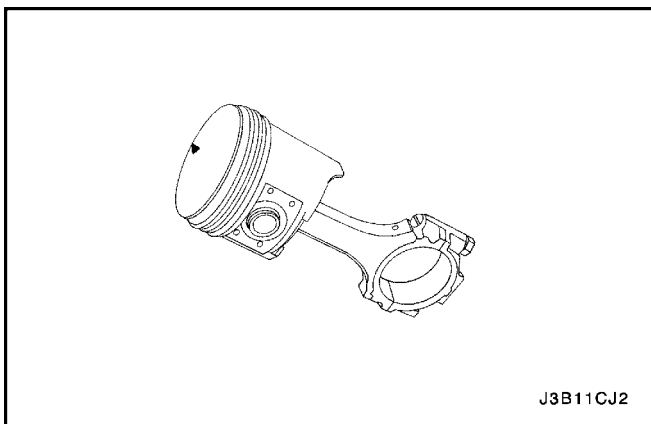


14. Remove the piston pin from the piston and connecting rod assembly using the piston pin service set KM-427.
15. Separate the piston from the connecting rod.

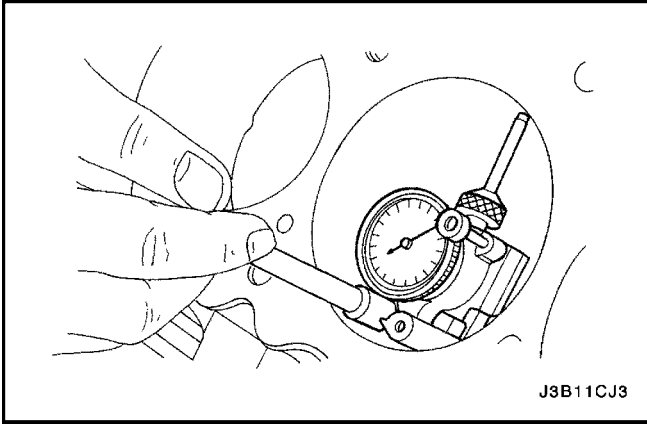


Inspection Procedure

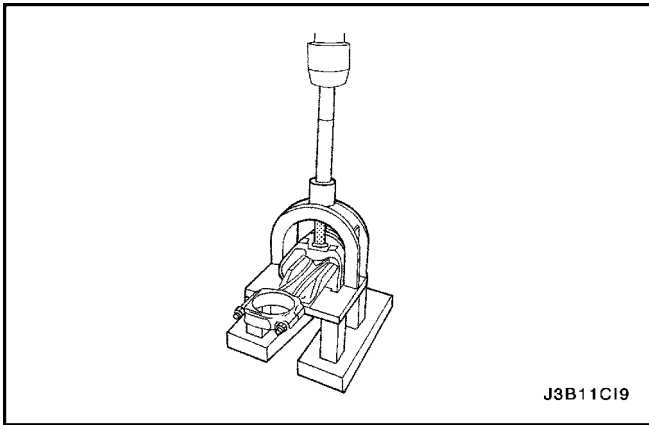
1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the crankshaft rod bearing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



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

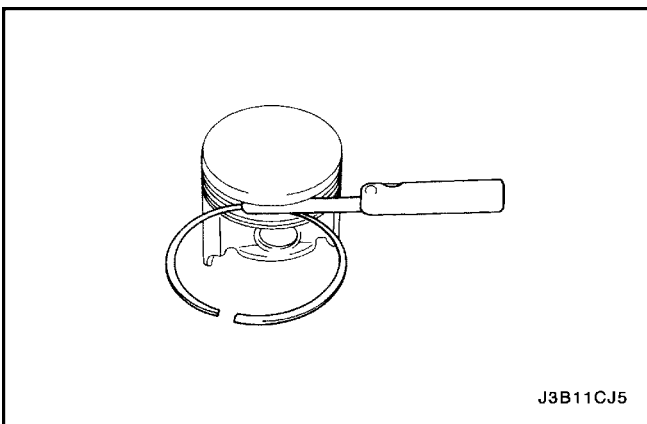
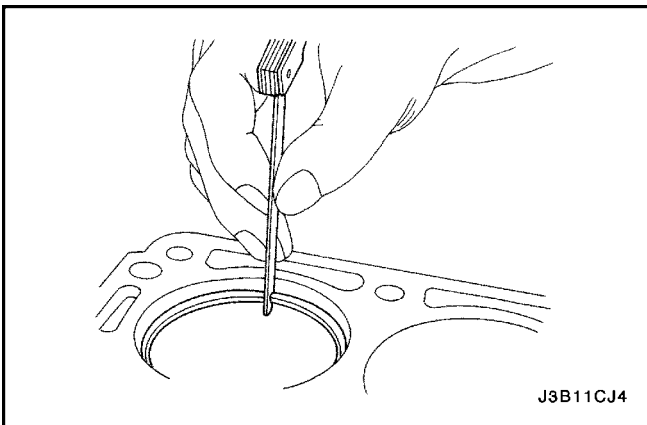


9. Inspect the engine block deck surface for flatness using a straight edge and a feeler gauge. Refer to "Engine Specifications" in this section.
10. Inspect the bearing bore for concentricity and alignment using a bore gauge. Refer to "Engine Specifications" in this section. If the bearing bore is beyond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

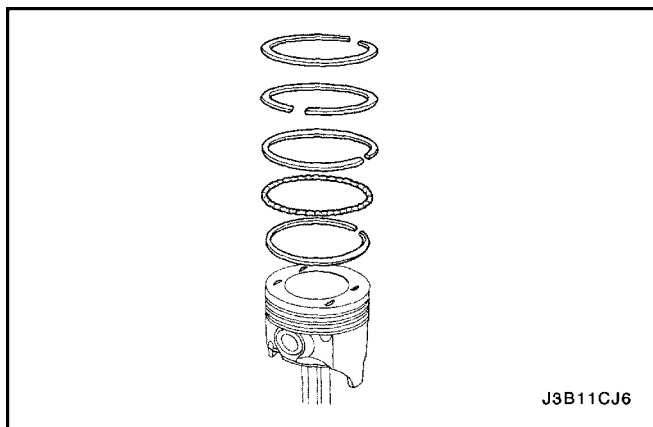


Installation Procedure

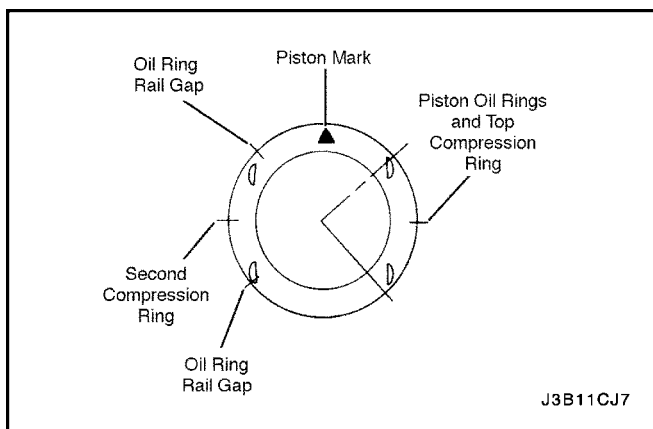
1. Align the notch on the piston and the connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.
5.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



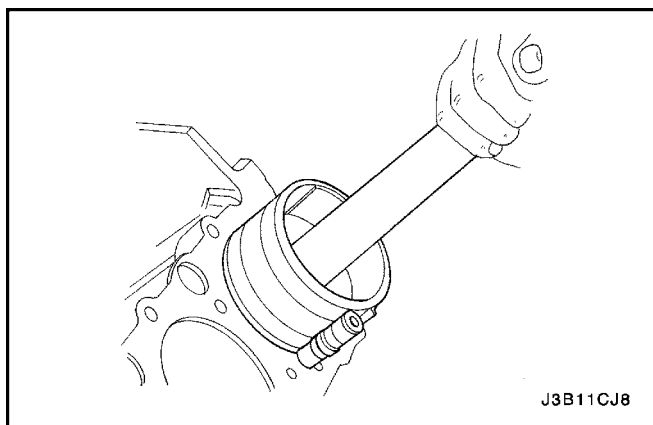
9. Measure the piston ring side clearance using a feeler gauge. Refer to "Engine Specifications" in this section.
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed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



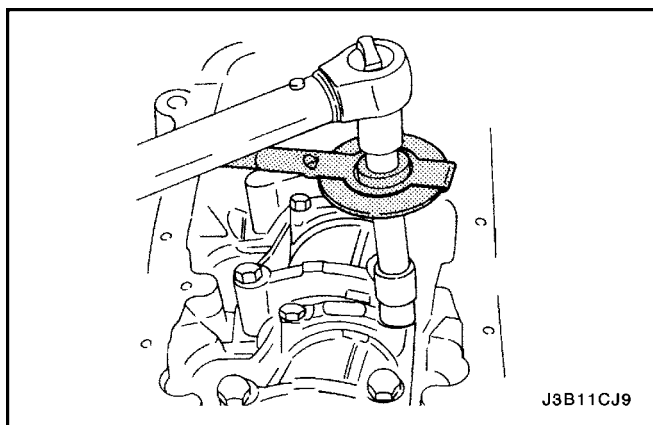
12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.



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



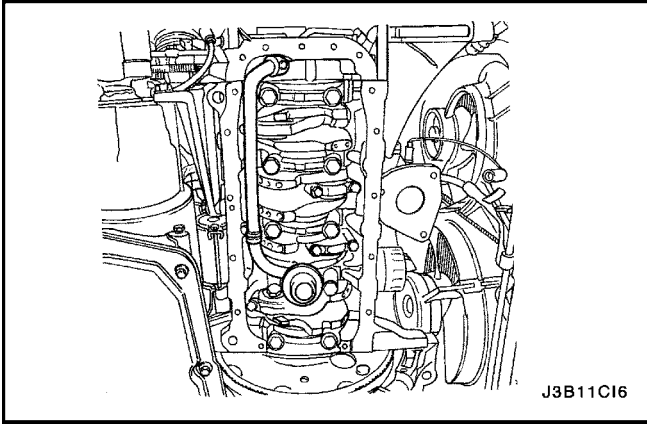
17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using a ring compressor and a wood handle. Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and bearings. Refer to "Crankshaft Bearings and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



20. Install the connecting rod 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 bolts one turn of 30 degrees plus one turn of 15 degrees.



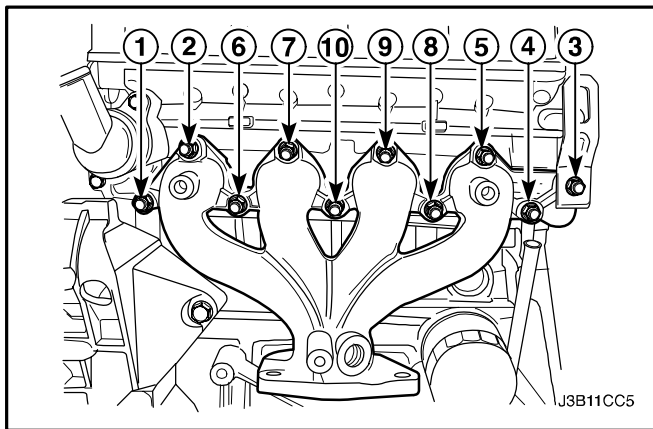
21. Install the oil suction pipe.
22. Install the oil suction pipe bolts.

Tighten

Tighten the oil suction pipe 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.

UNIT REPAIR



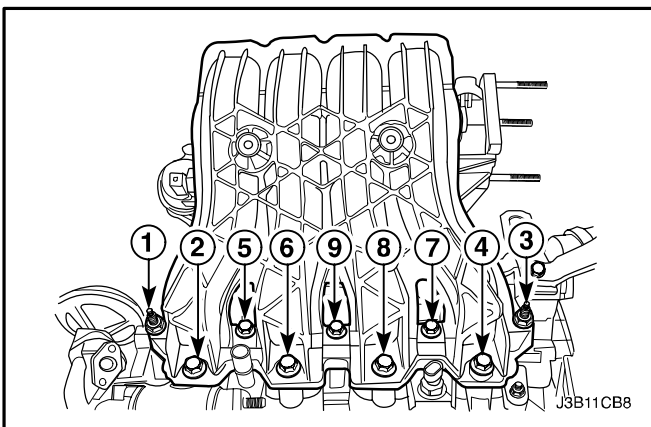
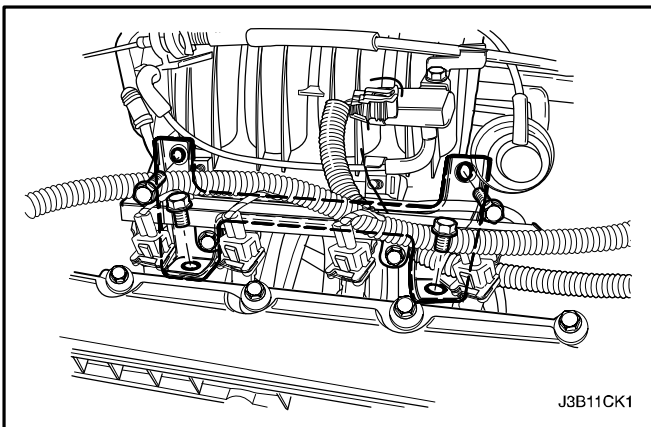
CYLINDER HEAD AND VALVE TRAIN COMPONENTS

Tools Required

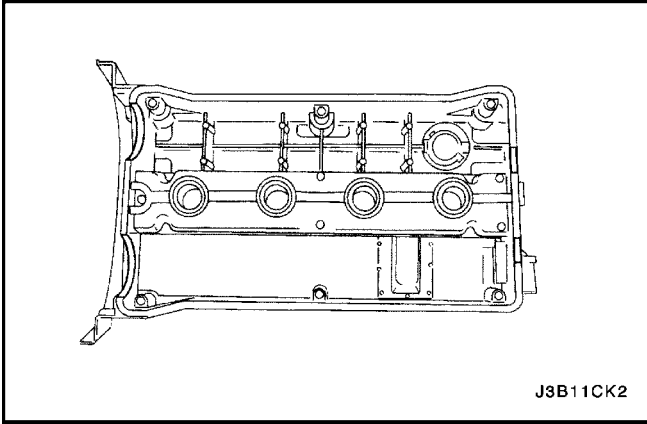
MKM-571-B Gauge
 KM-340-0 Cutter Set
 KM-340-7 Guide Drift
 KM-340-13 Cutters
 KM-340-26 Cutters
 KM-348 Valve Spring Compressor
 KM-653 Adapter
 KM-805 Valve Guide Reamer

Disassembly Procedure

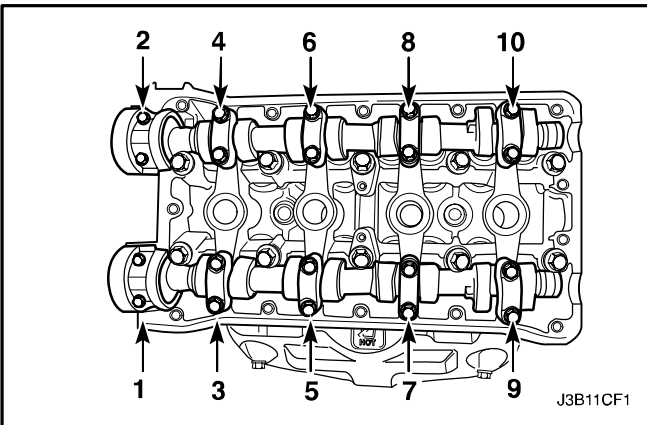
1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to "Cylinder Head and Gasket" in this section.
2. Remove the engine coolant temperature sensor.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold retaining nuts in the sequence shown.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.
9. Remove the thermostat housing mounting bolts.
10. Remove the thermostat housing assembly.
11. Remove the fuel rail retaining bolts and the fuel rail assembly.



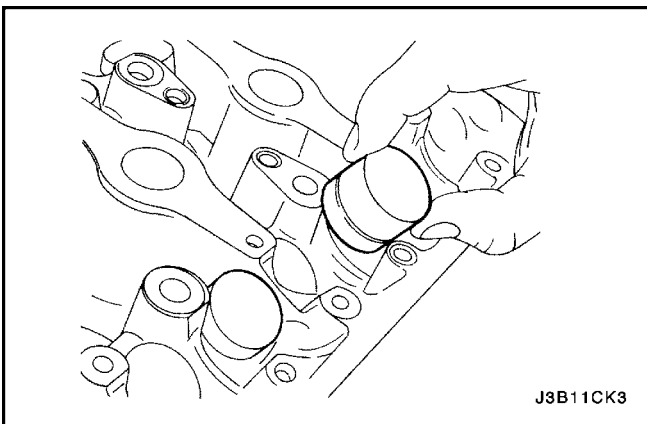
12. Remove the intake manifold retaining nuts and retaining bolts in the sequence shown.
13. Remove the intake manifold.
14. Remove the intake manifold studs.



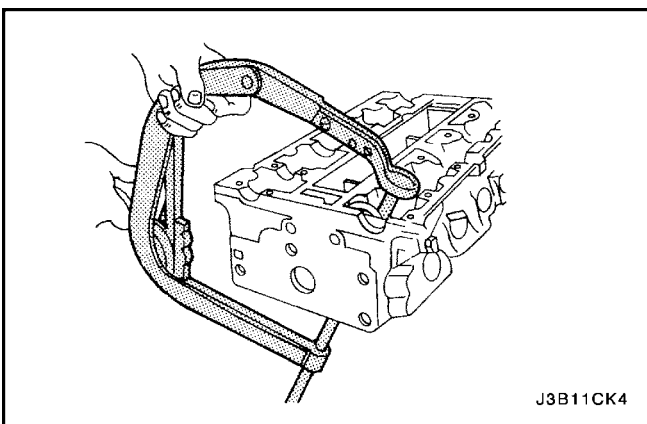
15. Remove the direct ignition system (DIS) coil mounting bolts.
16. Remove the DIS coil with the ignition wires attached.
17. Remove the DIS coil mounting bracket bolts.
18. Remove the DIS coil mounting bracket.
19. Remove the electrical exhaust gas recirculation (EEGR) valve adapter bolts.
20. Remove the EEGR valve adapter.
21. Remove the EEGR valve adapter gasket.
22. Remove the spark plugs.



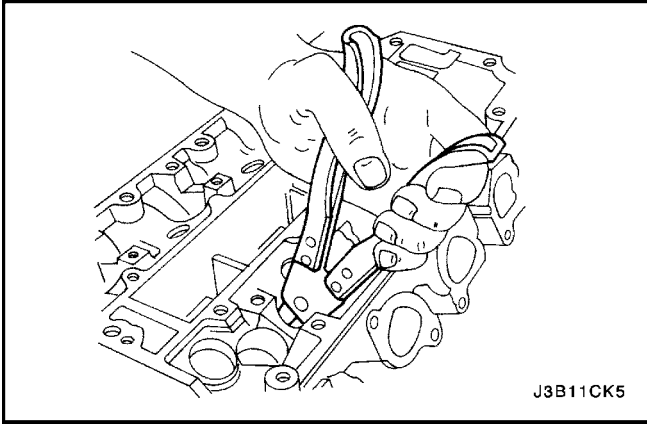
23. Remove the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.



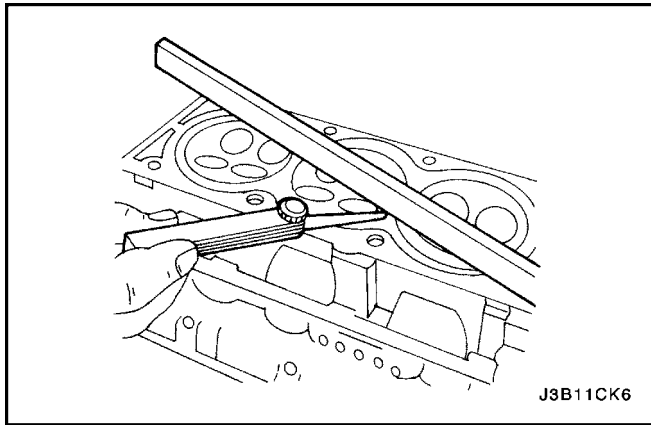
24. Remove the intake camshaft caps. Maintain the correct positions for installation.
25. Remove the intake camshaft.
26. Remove the intake valve tappet adjusters.
27. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
28. Remove the exhaust camshaft.
29. Remove the exhaust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



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

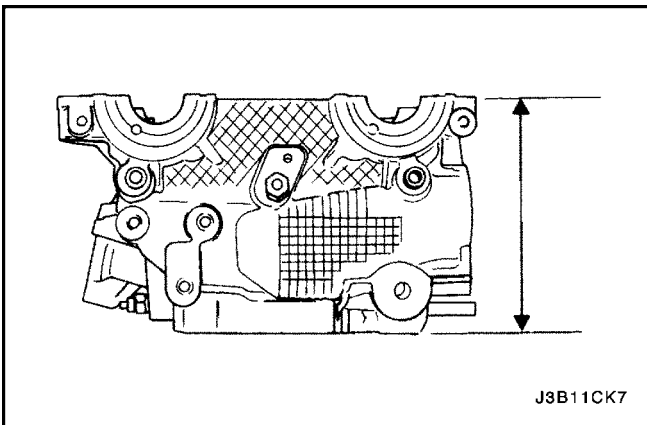


35. Remove the valves. Maintain the original position of the valves for installation.
36. Remove the valve stem seals.

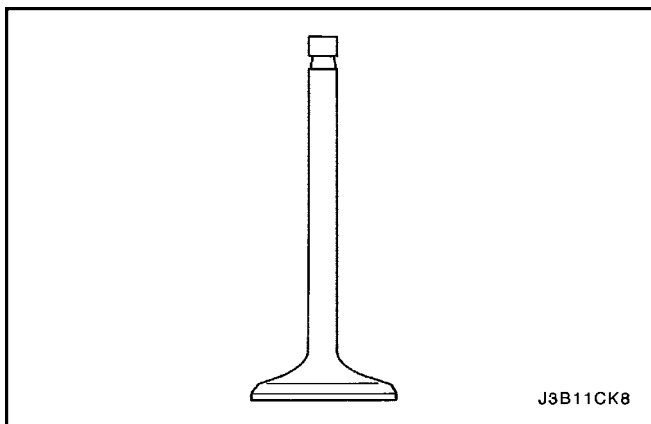


Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion, and 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 0.050 mm (0.002 inch) maximum.

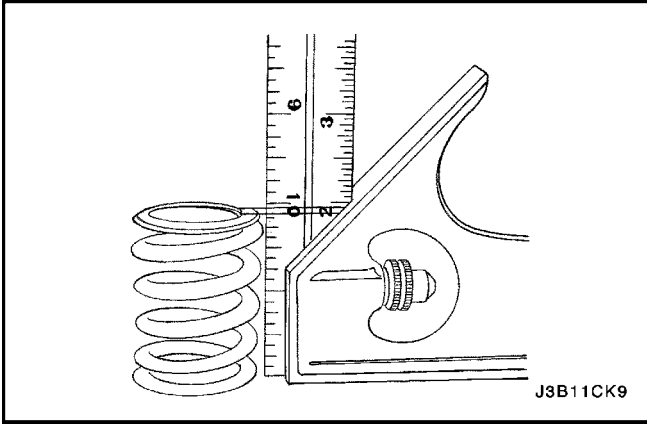


6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 134.08 to 134.23 mm. If the cylinder head height is less than 134.08 mm, replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect valve seats for excessive wear and burned spots.

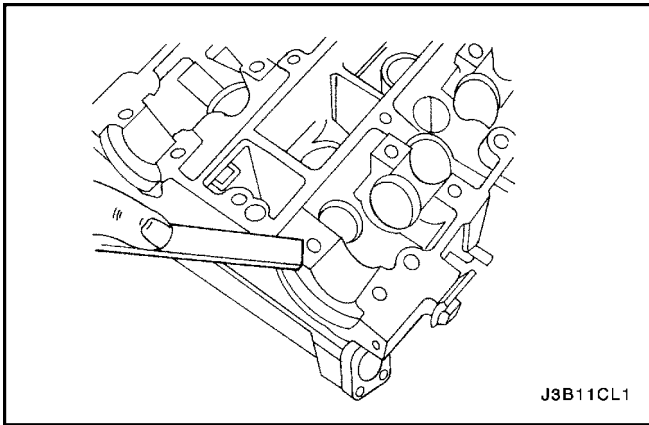


Valve Inspection

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

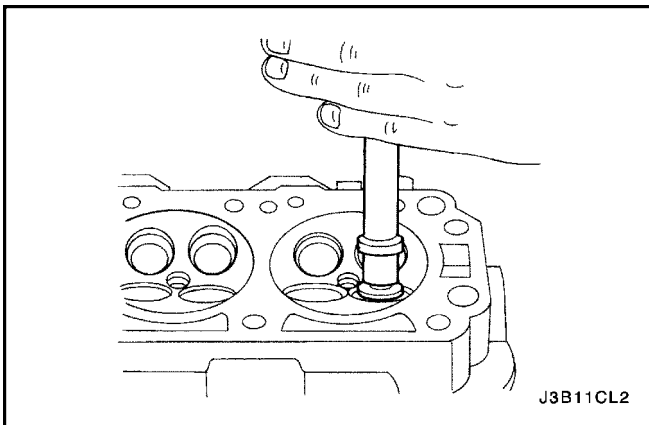


7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to "Engine Specifications" in this section. If the valve spring height does not match the specifications, replace the valve spring.
9. Inspect the valve spring seating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



Cleaning Procedure

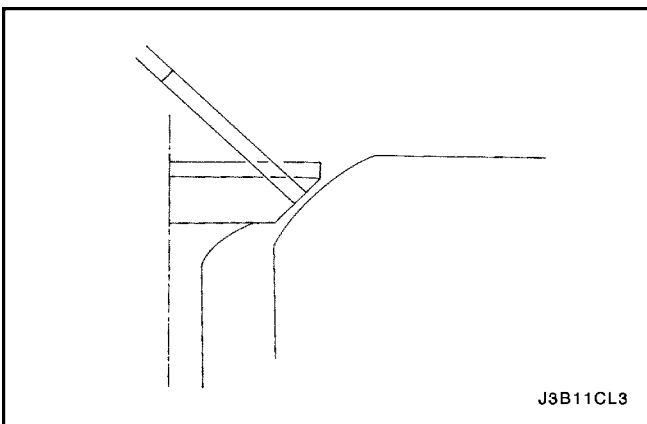
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil, and varnish.



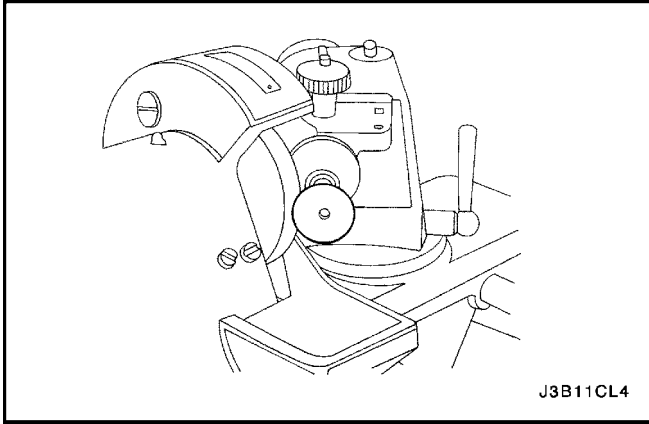
Cylinder Head Overhaul

Valve Grind-in

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

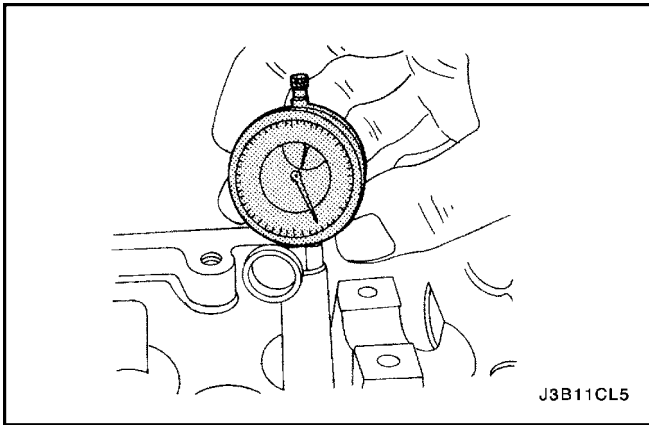


3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.



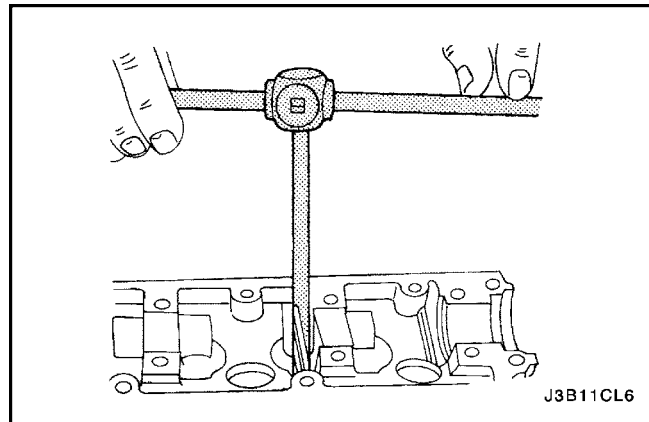
Valve Grind

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 is 45 degrees.
4. Inspect the assembly height of the intake valves and the exhaust valves.



Valve Guide – Ream

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

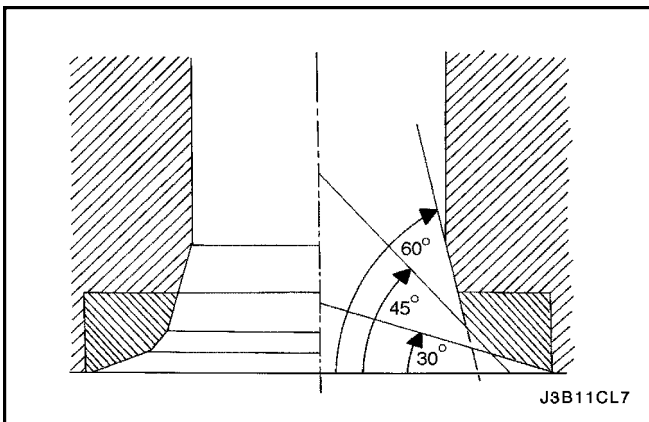


Important : Valve oversizes may already have been fitted in production.

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

Size	Reamer	Production Code	Service Code
Normal	–	–	K
0.075	KM-805	1	K1
0.150	–	2	K2

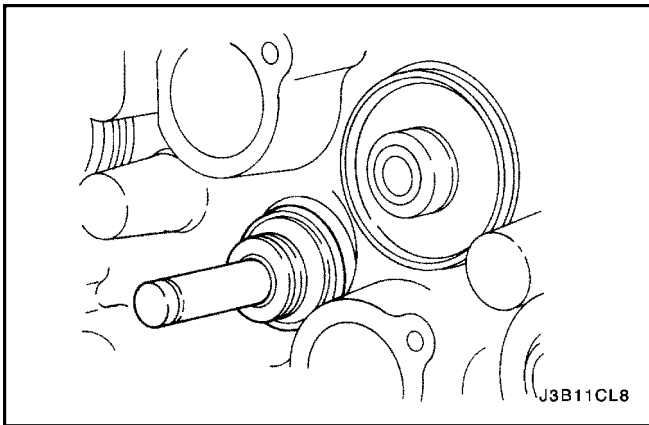
3. Ream the valve guide from the upper side of the cylinder head to the next oversize.
4. After reaming, cross out the code and emboss the valve guide with the new code.



Valve Seat – Cut

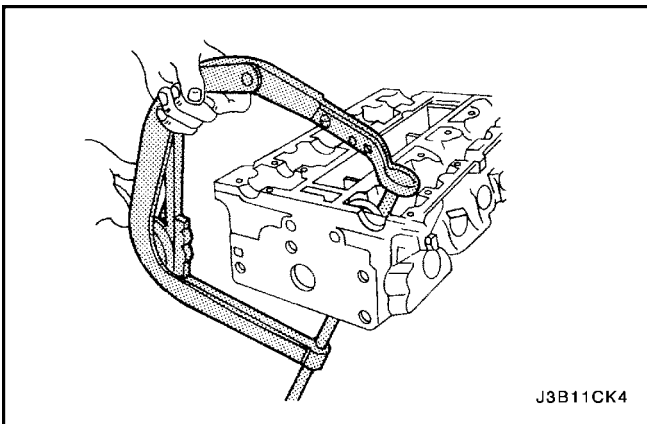
1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the guide drift KM-340-7 as follows:
 - Valve seat – A 45-degree surface using the cutter KM-340-13.
 - Upper correction angle – A 30-degree surface using the cutter KM-340-13.
 - Lower correction angle –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

4. Inspect the dimension for the valve seat width.
 - Intake: 1.17 to 1.57 mm (0.046 to 0.062 inch).
 - Exhaust: 1.4 to 1.8 mm (0.055 to 0.071 inch).
5. Inspect the assembly height of the intake valves and the exhaust valves. If the dimension is exceeded, install new valves. Inspect the assembly height of the intake valves and the exhaust valves again. If the valve assembly height is still too large despite replacing the valves, replace the cylinder head.

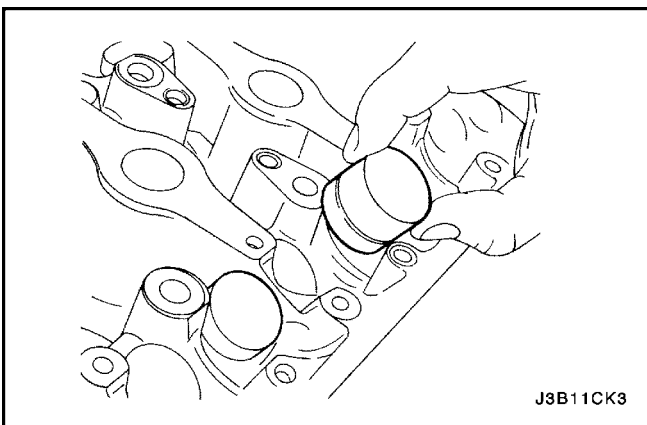


Assembly Procedure

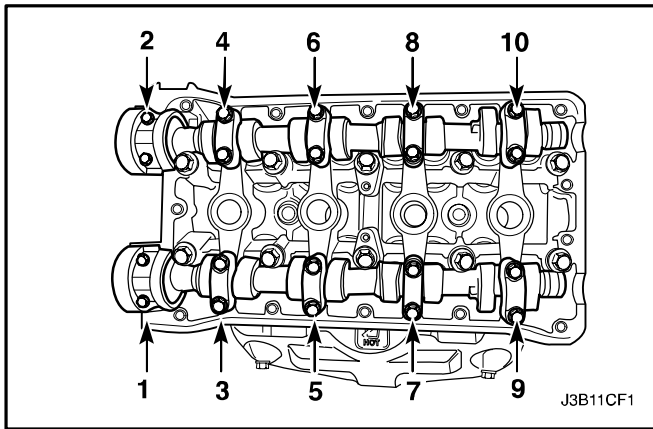
1. Install the valve stem seals.
2. Lubricate the valve stems with engine oil.
3. Carefully install the valves in their original positions. Do not damage the valve stem seals.
4. Install the valve springs in their original positions.
5. Install the valve spring caps.



6. Compress the valve springs with the valve spring compressor KM-348 and adapter KM-653.
7. Install the valve keys.
8. Remove the valve spring compressor KM-348 and adapter KM-653.



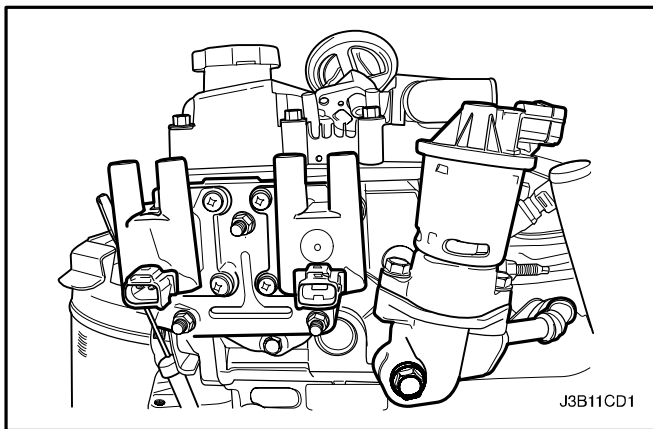
9. Lubricate the valve tappet adjusters with engine oil.
10. Install the valve tappet adjusters.



11. Install the intake camshaft.
12. Install the intake camshaft caps in their original positions.
13. Install the exhaust camshaft.
14. Install the exhaust camshaft caps in their original positions.
15. Install the camshaft cap bolts.
16. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

Tighten the camshaft cap bolts to 16 N•m (12 lb–ft).



17. Install the spark plugs.

Tighten

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

18. Install the EGR valve adapter gasket.
19. Install the EGR valve adapter.
20. Install the EGR valve adapter bolts.

Tighten

Tighten the exhaust gas recirculation valve adapter bolts to 25 N•m (18 lb–ft).

21. Install the DIS coil mounting bracket.
22. Install the DIS coil mounting bracket bolts.

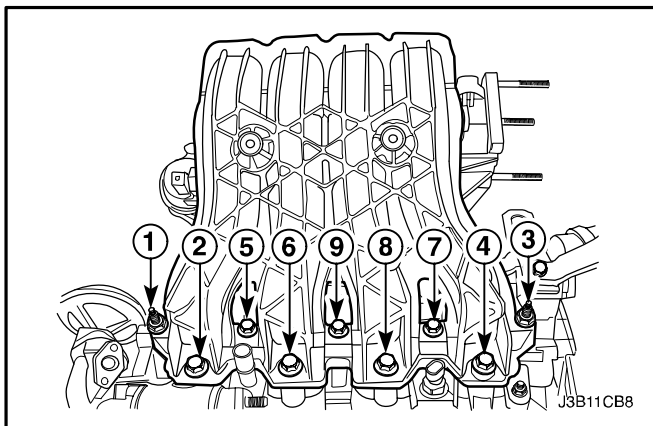
Tighten

Tighten the direct ignition system coil mounting bracket bolts to 10 N•m (89 lb–in).

23. Install the DIS coil with the ignition wires attached.
24. Install the DIS coil mounting bolts.

Tighten

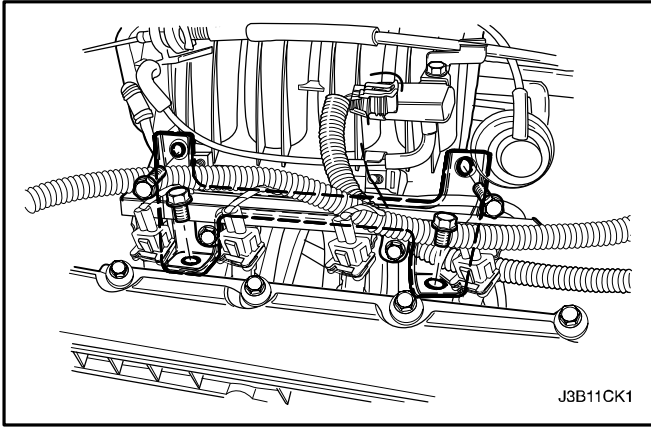
Tighten the direct ignition system coil mounting bolts to 10 N•m (89 lb–in).



25. Install the intake manifold studs.
26. Install the intake manifold.
27. Install the intake manifold retaining nuts and retaining bolts in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts and retaining bolts to 25 N•m (18 lb–ft).



28. Install the fuel rail assembly with the bolts.

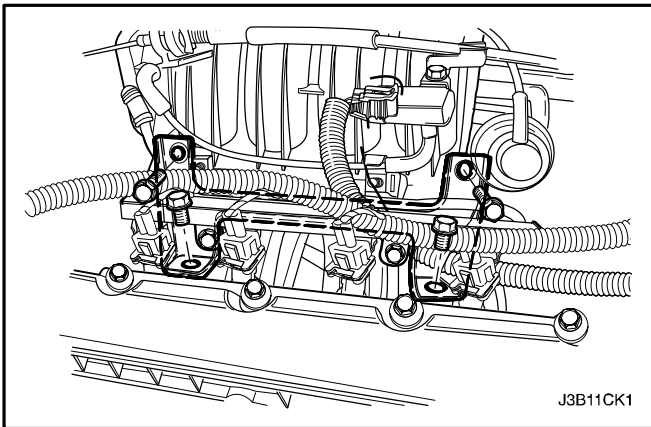
Tighten

Tighten the fuel rail assembly retaining bolts to 25 N•m (18 lb–ft).

29. Install the thermostat housing assembly.
30. Install the thermostat housing mounting bolts.

Tighten

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



31. Install the exhaust manifold studs.
32. Install the exhaust manifold gasket.
33. Install the exhaust manifold.
34. Install the exhaust manifold retaining nuts in the sequence shown.

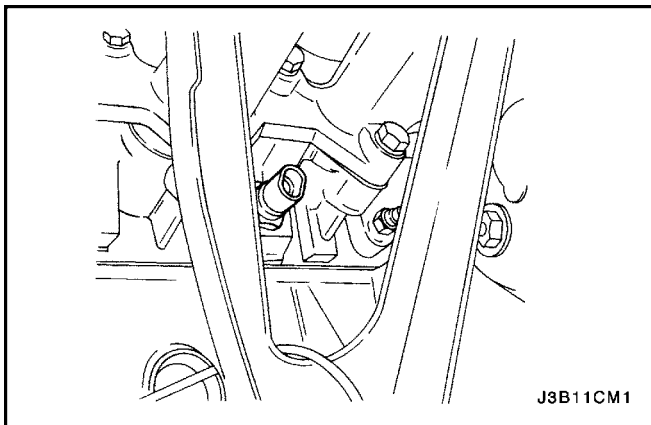
Tighten

Tighten the exhaust manifold retaining nuts to 25 N•m (18 lb–ft).

35. Install the exhaust manifold heat shield.
36. Install the exhaust manifold heat shield bolts.

Tighten

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

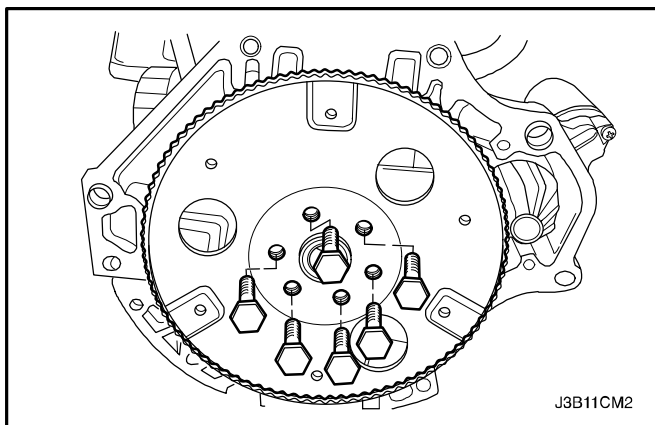


37. Install the ECT sensor.

Tighten

Tighten the engine coolant temperature sensor to 20 N•m (15 lb–ft).

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



CRANKSHAFT

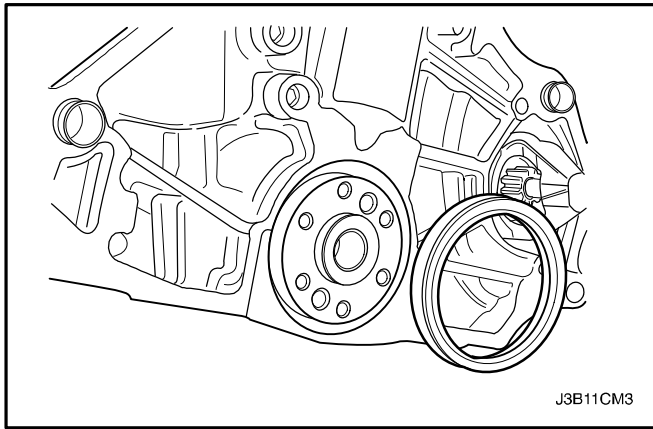
Tools Required

KM-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

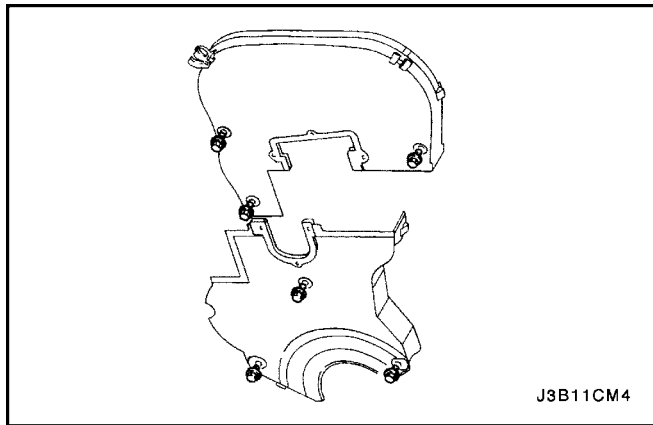
Notice : Take extreme care to prevent any scratches, nicks, or damage to the camshafts.

Disassembly Procedure

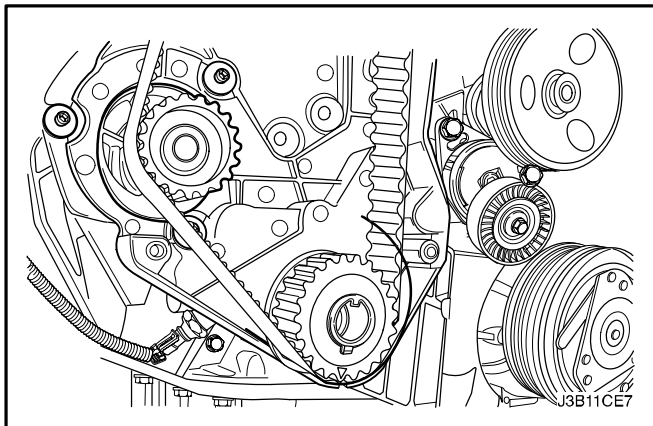
1. Remove the engine. Refer to "Engine" in this section.
2. Remove the flywheel or flexible plate bolts.
3. Remove the flywheel or the flexible plate.



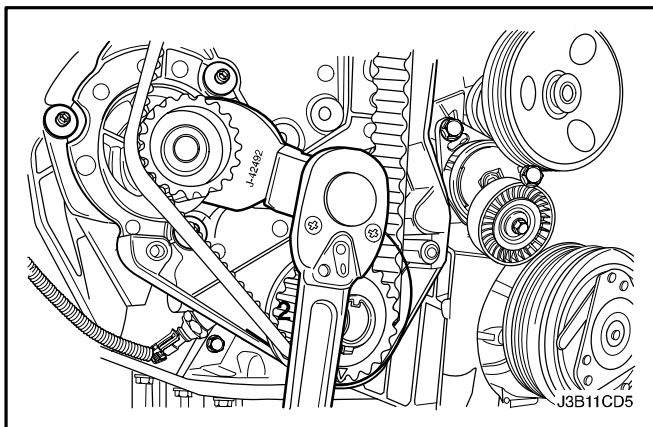
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand KM-412.



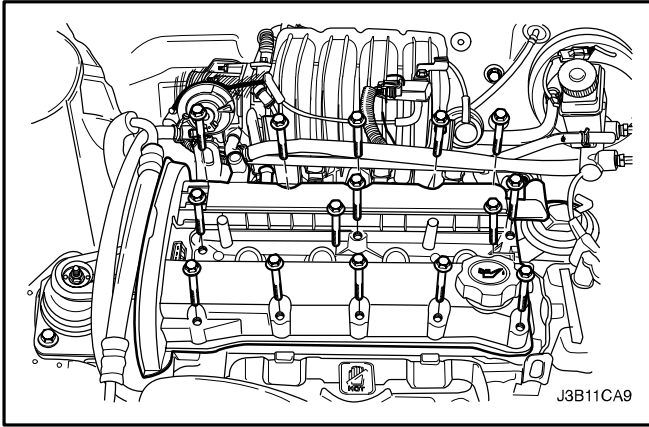
6. Remove the upper and the lower front timing belt cover bolts.
7. Remove the upper and the lower front timing belt cover.



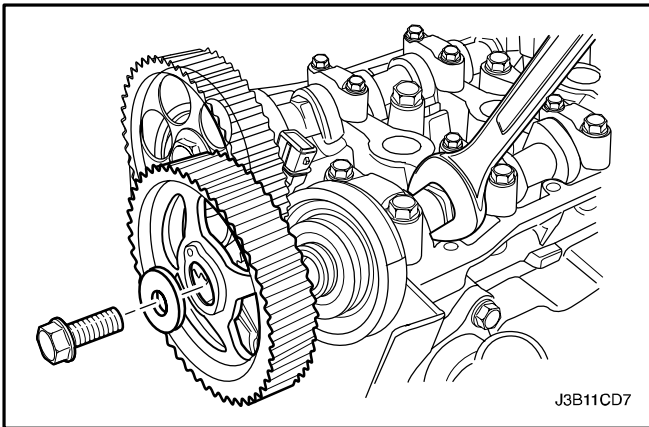
8. Slightly loosen the water pump retaining bolts.



9. Rotate the water pump using the timing belt adjuster J-42492 to remove the tension from the timing belt.
10. Remove the spark plug cover bolts.

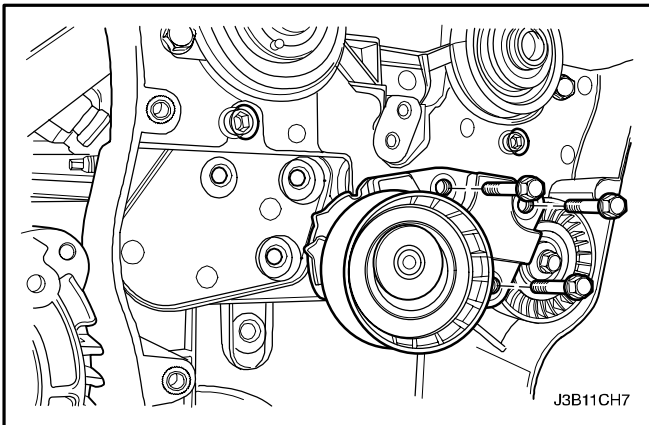


11. Disconnect the engine ventilation hoses from the camshaft cover.
12. Disconnect the oil filler cap.
13. Remove the spark plug cover bolts.
14. Remove the spark plug cover.
15. Disconnect the ignition wires from the spark plugs.
16. Remove the camshaft cover nuts.
17. Remove the camshaft cover washers.
18. Remove the camshaft cover and the camshaft cover gasket.

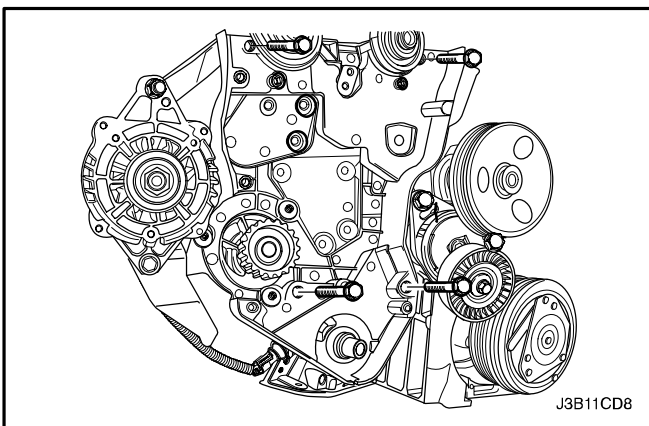


Notice : Take extreme care to prevent any scratches, nicks or damage to the camshafts.

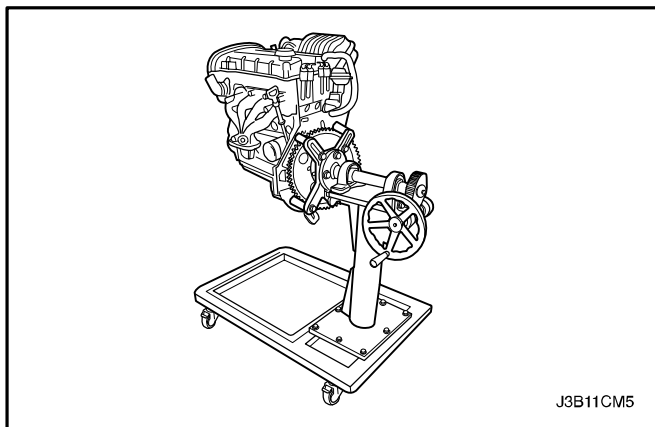
19. While holding the intake camshaft firmly in place, remove the intake camshaft bolt.
20. Remove the intake camshaft gear.
21. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft bolt.
22. Remove the exhaust camshaft gear.



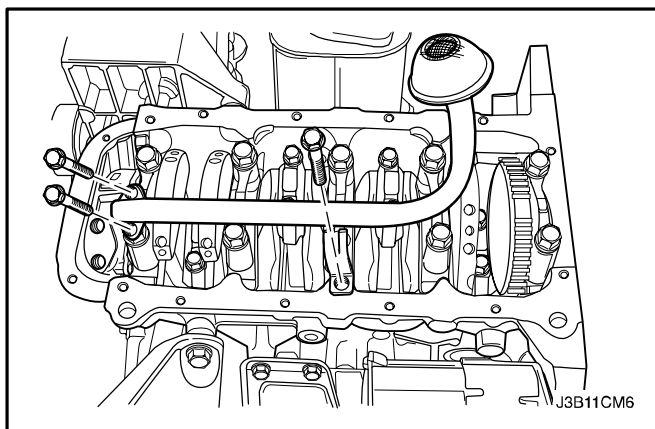
23. Remove the timing belt automatic tensioner bolts.
24. Remove the timing belt automatic tensioner.
25. Remove the timing belt idler pulley bolt.
26. Remove the timing belt idler pulley.



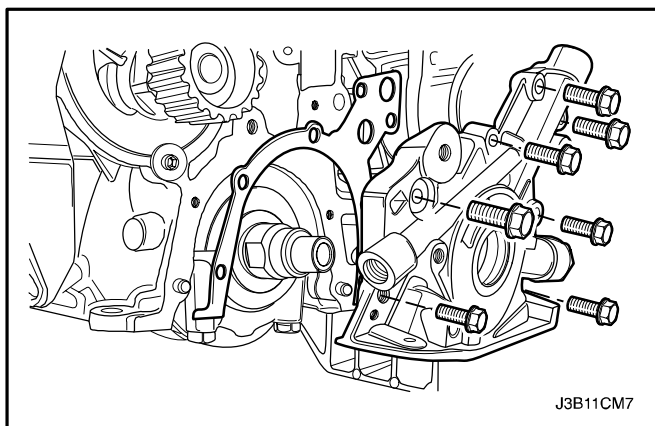
27. Remove the crankshaft timing belt gear.
28. Remove the rear timing belt cover bolts.
29. Remove the rear timing belt cover.



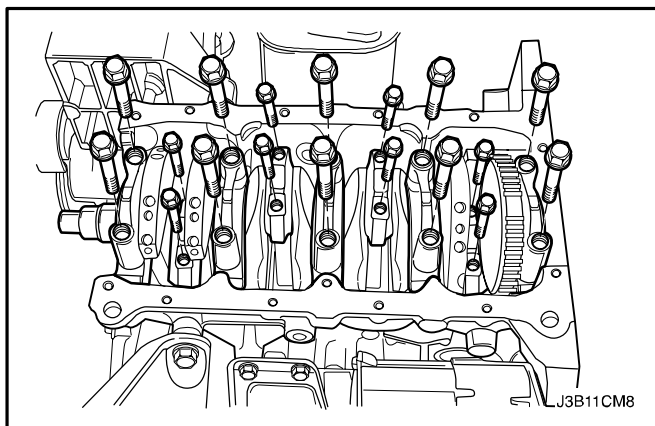
30. Rotate the engine on the engine overhaul stand KM-412.



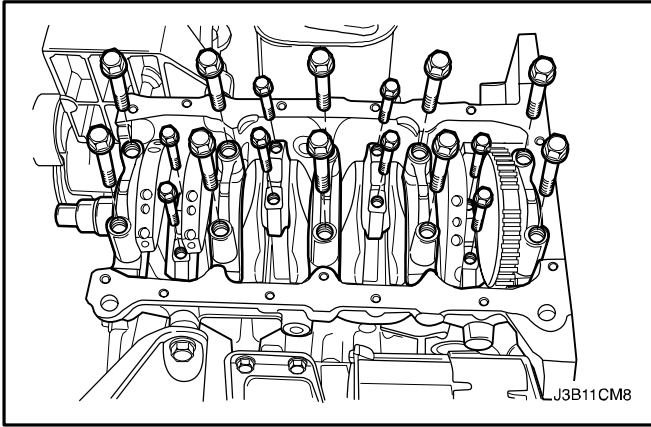
31. Remove the oil pan retaining bolts.
32. Remove the oil pan.
33. Remove the oil suction pipe bolts.
34. Remove the oil suction pipe.



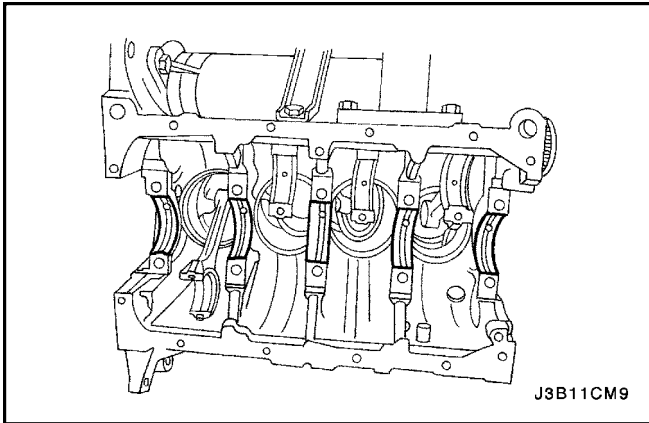
35. Remove the oil pump retaining bolts.
36. Remove the oil pump.



37. Mark the order of the connecting rod bearing caps.
38. Remove the connecting rod bearing cap bolts for all of the pistons.
39. Remove the connecting rod bearing caps and the lower connecting rod bearings.
40. Remove the upper connecting rod bearings.

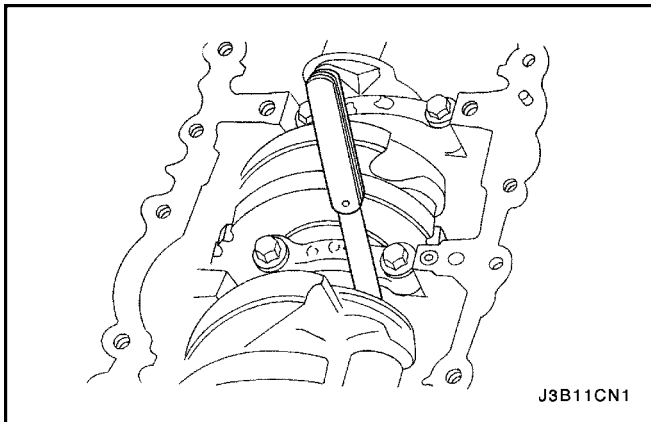


41. Mark the order of the crankshaft bearing caps.
42. Remove the crankshaft bearing cap bolts.
43. Remove the crankshaft bearing caps and the lower crankshaft bearings.
44. Remove the crankshaft.
45. Remove the upper crankshaft bearings.
46. Clean the parts, as needed.

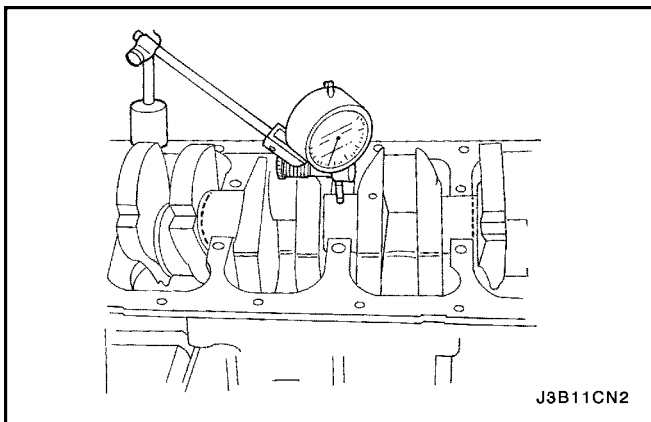


Assembly Procedure

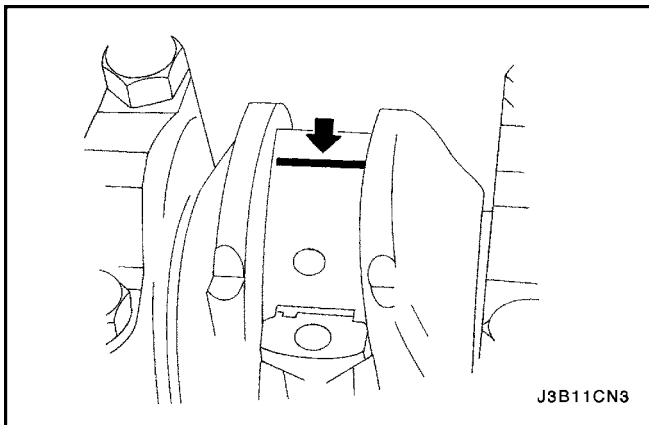
1. Coat the crankshaft bearings with the engine oil.
2. Install the upper crankshaft bearings in the engine block.



3. Install the crankshaft.
4. Install the lower crankshaft bearings in the bearing caps.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.



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



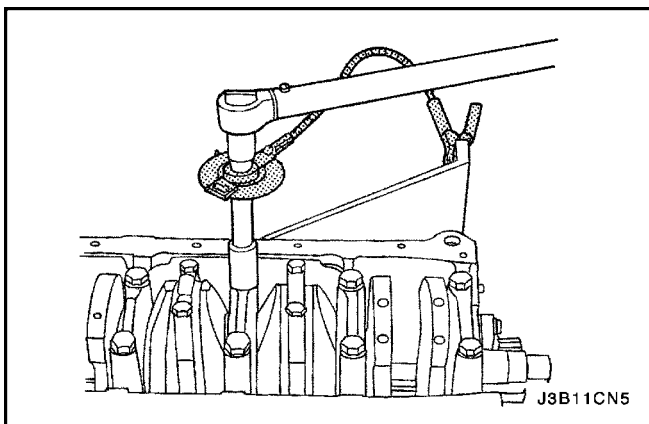
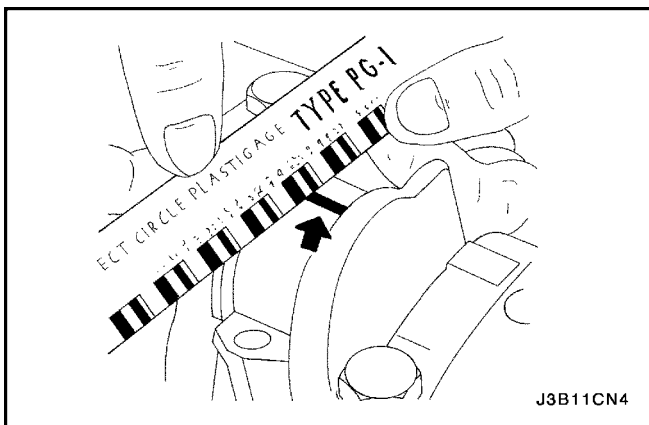
Important : Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gauging thread does not tear when the crankshaft bearing caps are removed.

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

Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb–ft) plus 45 degrees plus 15 degrees.

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



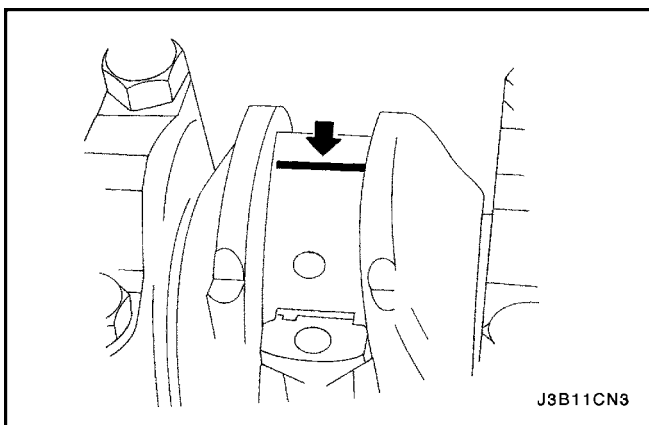
14. Apply a bead of adhesive sealing compound to the grooves of the crankshaft bearing caps.
15. Install the crankshaft bearing caps to the engine block.
16. Tighten the crankshaft bearing caps using new bolts.

Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb–ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the crankshaft bearings 45 degrees plus 15 degrees.

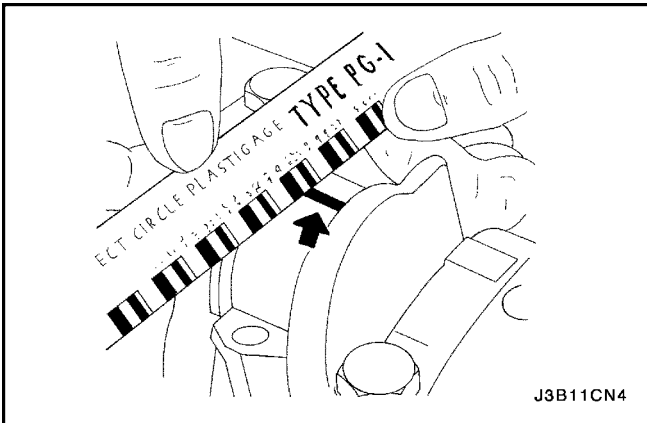
Important : Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

17. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).
18. Cut the plastic gauging threads to the length of the connecting rod bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
19. Install the connecting rod bearing caps.

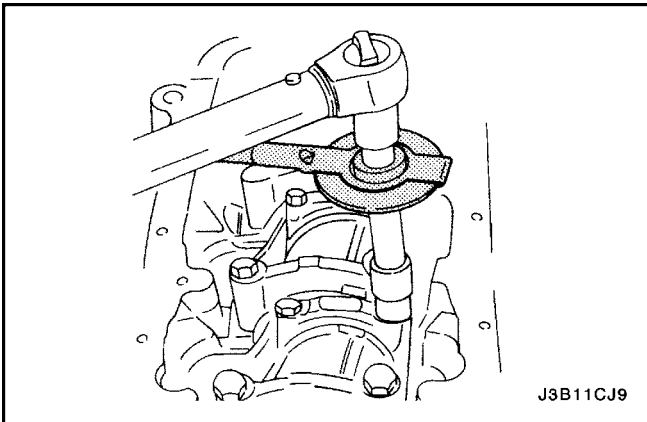


Tighten

Tighten the connecting rod bearing cap bolts to 25 N•m (18 lb–ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod bearing cap bolts 30 degrees plus 15 degrees.



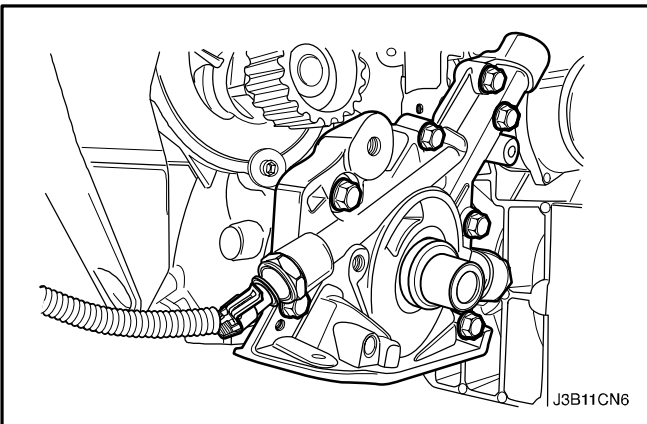
20. Remove the connecting rod bearing caps.
21. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
22. Inspect the bearing clearance for permissible tolerance ranges. Refer to "Engine Specifications" in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



23. Install the connecting rod bearing caps to the connecting rods.
24. Tighten the connecting rod bearing caps using new bolts.

Tighten

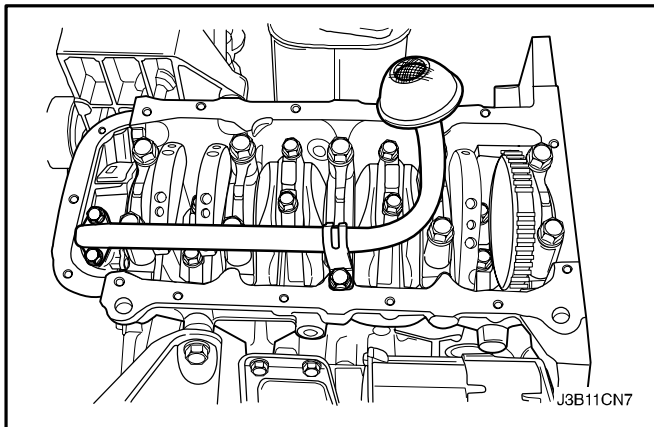
Tighten the connecting rod bearing cap bolts to 25 N•m (18 lb–ft) using a torque wrench. Use the angular torque gauge KM-470-B to tighten the connecting rod cap bolts 30 degrees plus 15 degrees.



25. Install the oil pump.
26. Install the oil pump retaining bolts.

Tighten

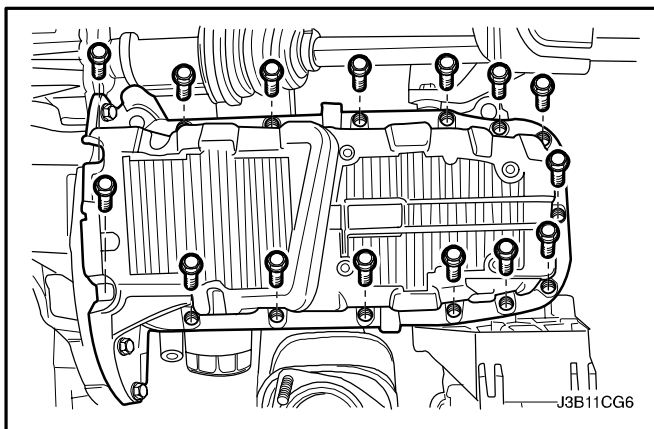
Tighten the oil pump retaining bolts to 10 N•m (89 lb–in).



27. Install the oil suction pipe.
28. Install the oil suction pipe bolts.

Tighten

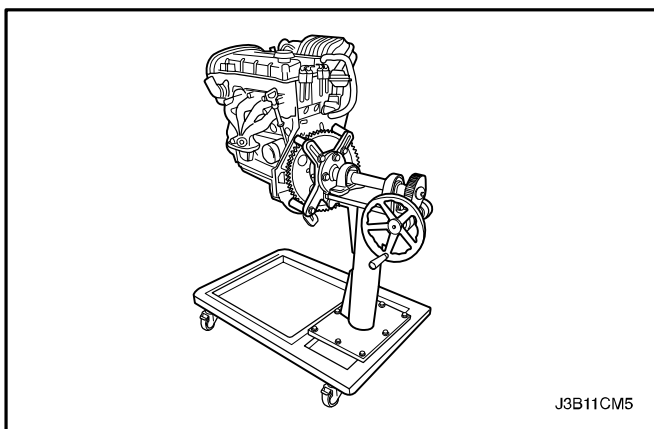
Tighten the oil suction pipe bolts to 10 N•m (89 lb-in).



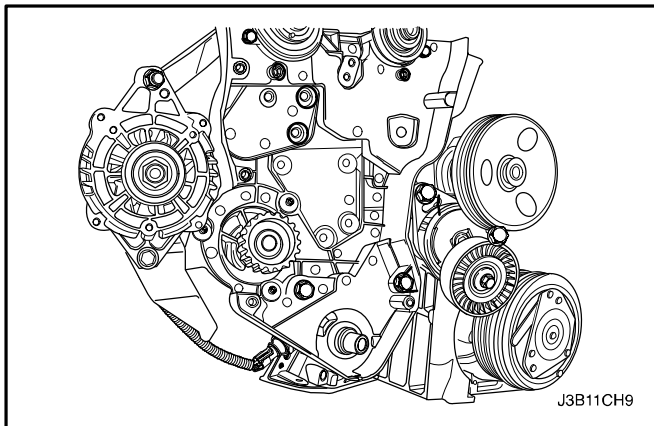
29. Coat the new oil pan gasket with sealant.
30. Install the oil pan gasket to the oil pan.
31. Install the oil pan.
32. Install the oil pan retaining bolts.

Tighten

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



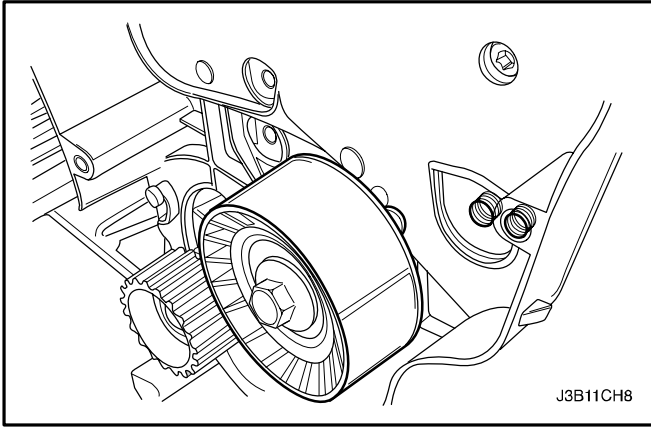
33. Rotate the engine on the engine overhaul stand KM-412.



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

Tighten

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



36. Install the crankshaft timing belt gear.
37. Install the timing belt automatic tensioner.
38. Install the timing belt automatic tensioner bolts.

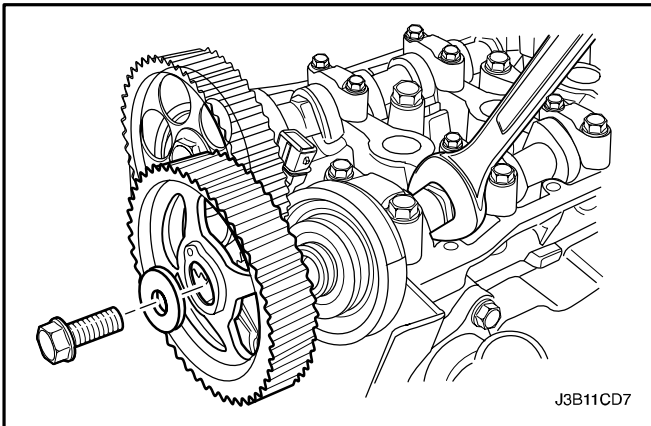
Tighten

Tighten the timing belt automatic tensioner bolts to 25 N•m (18 lb–ft).

39. Install the timing belt idler pulley.
40. Install the timing belt idler pulley bolt.

Tighten

Tighten the timing belt idler pulley bolt to 40 N•m (30 lb–ft).



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

41. Install the intake camshaft gear.
42. Install the intake camshaft gear bolt while holding the intake camshaft firmly in place.

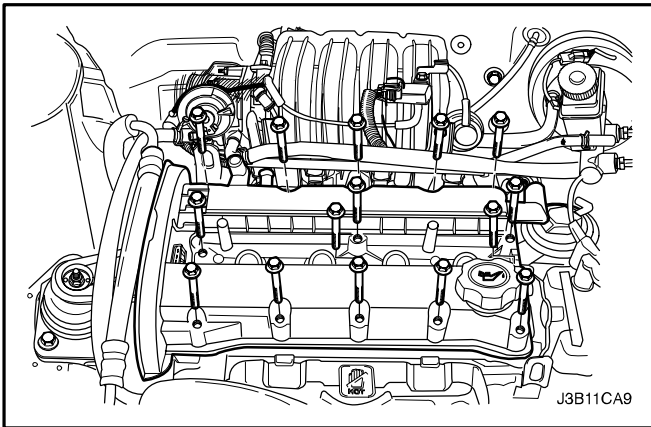
Tighten

Tighten the intake camshaft gear bolt to 67.5 N•m (49 lb–ft).

43. Install the exhaust camshaft gear.
44. Install the exhaust camshaft gear bolt while holding the exhaust camshaft firmly in place.

Tighten

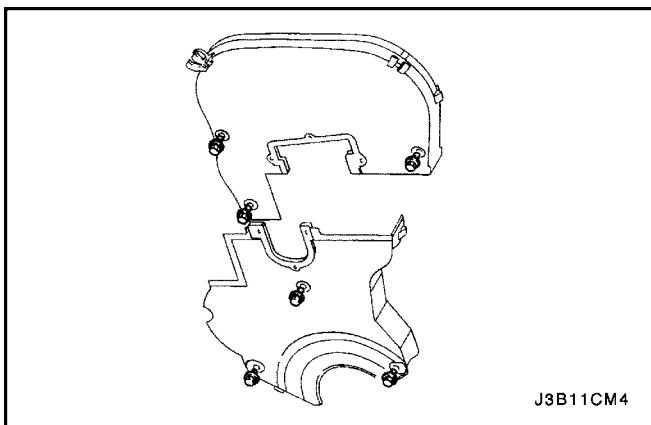
Tighten the exhaust camshaft gear bolt to 67.5 N•m (49 lb–ft).



45. Install the timing belt. Refer to "Timing Belt" in this section.
46. Adjust the timing belt tension. Refer to "Timing Belt Check and Adjust" in this section.
47. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear camshaft cover-to-cylinder head seal.
48. Install the camshaft cover and the camshaft cover gasket.
49. Install the camshaft cover washers.
50. Install the camshaft cover nuts.

Tighten

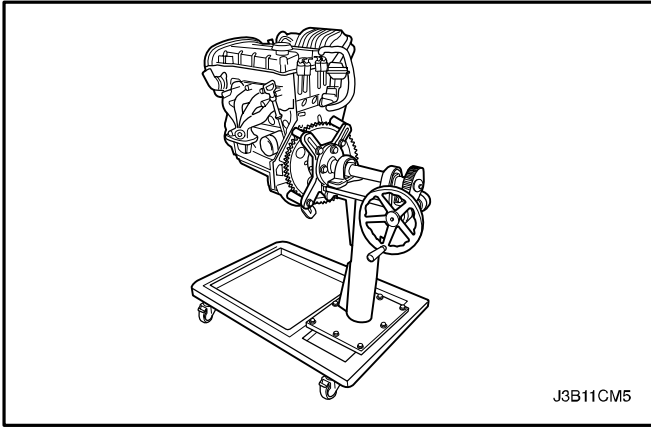
Tighten the camshaft cover nuts to 10 N•m (89 lb–in).



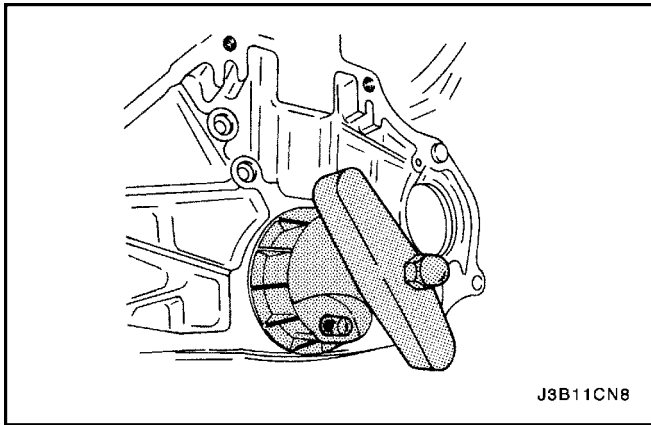
51. Connect the ignition wires to the spark plugs.
52. Connect the oil filler cap.
53. Connect the engine ventilation hose to the camshaft cover.
54. Install the upper and the lower front timing belt covers.
55. Install the upper and the lower front timing belt cover bolts.

Tighten

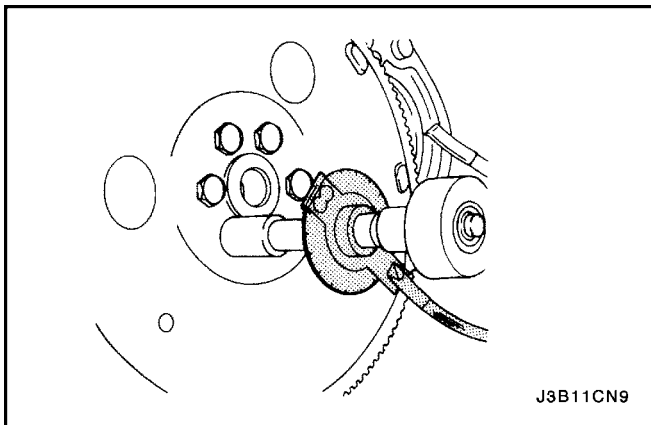
Tighten the upper and the lower front timing belt cover bolts to 10 N•m (89 lb–in).



56. Install the engine lifting device.
57. Remove the engine from the engine overhaul stand KM-412.



58. Install a new crankshaft rear oil seal using the installer J-36792 or KM-635.

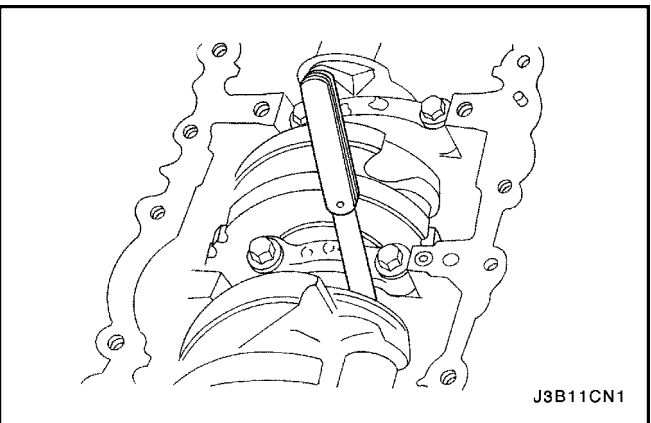


59. Install the flywheel or the flexible plate.
60. Install the flywheel or the flexible plate bolts.

Tighten

Tighten the flywheel bolts to 35 N•m (25 lb–ft). Use the angular torque gauge KM-470-B to tighten the flywheel bolts another 30 degrees plus 15 degrees. If the vehicle is equipped with an automatic transaxle, tighten the flexible plate bolts to 45 N•m (33 lb–ft).

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



CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS – GAUGING PLASTIC

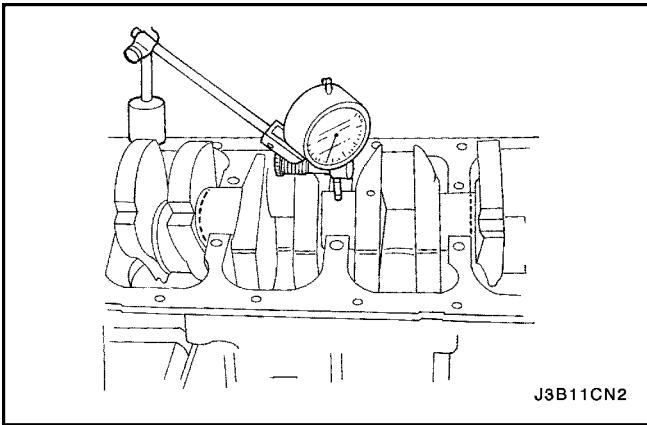
Tools Required

KM-470-B Angular Torque Gauge

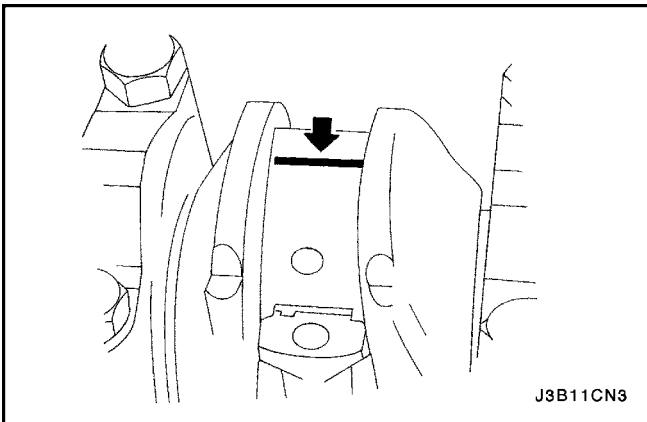
Inspection Procedure – Crankshaft

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.

4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to "Engine Specifications" in this section.

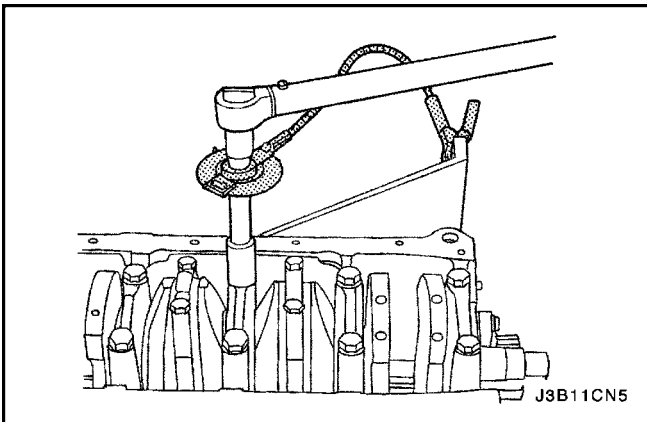


7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round (runout). Refer to "Engine Specifications" in this section.



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

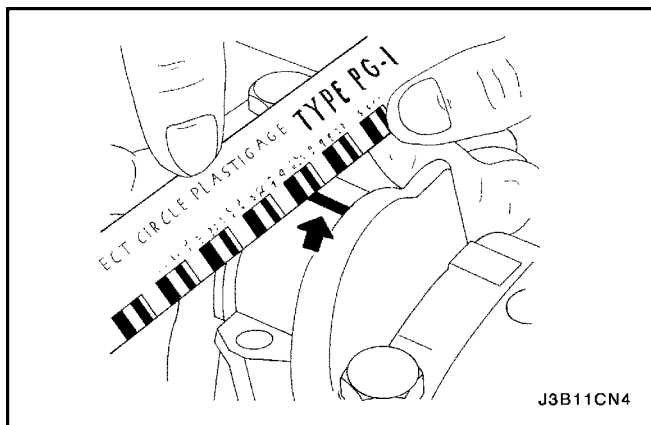
8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.



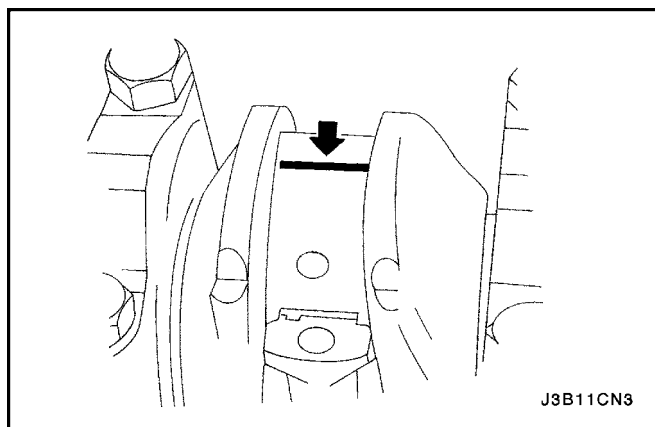
10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

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 45 degrees plus 15 degrees.



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



Inspection Procedure – Connecting Rods

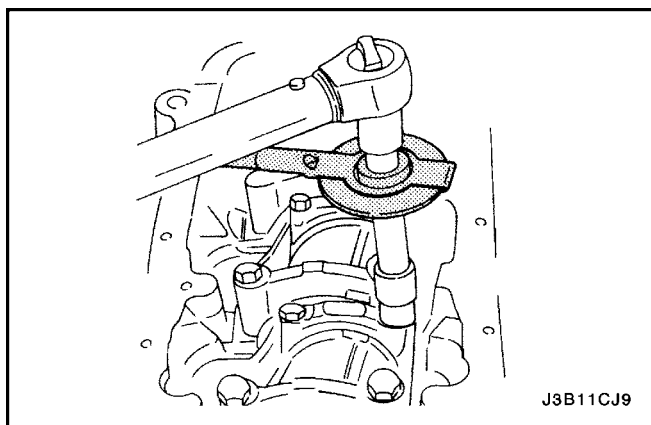
1. Coat the connecting rod bearings with engine oil.
2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.

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

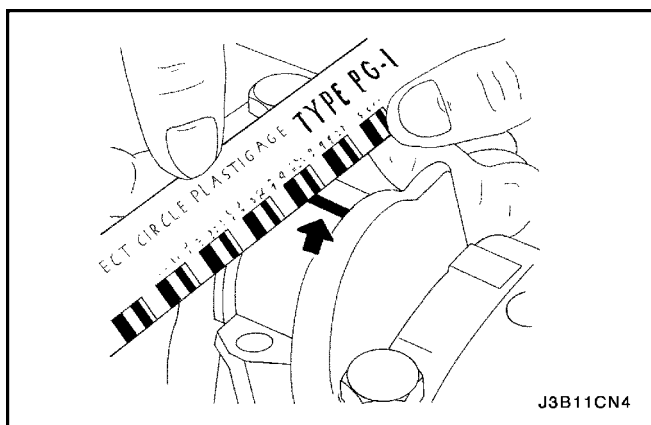
4. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).
5. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
6. Install the 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 connecting rod bearing cap bolts another 30 degrees plus 15 degrees.



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



GENERAL DESCRIPTION AND SYSTEM OPERATION

CYLINDER HEAD AND GASKET

The cylinder head is made of an aluminum alloy. The cylinder head uses cross-flow intake and exhaust ports. A spark plug is located in the center of each combustion chamber. The cylinder head houses the dual camshafts.

CRANKSHAFT

The crankshaft has eight integral weights which are cast with it for balancing. Oil holes run through the center of the crankshaft to supply oil to the connecting rods, the bearings, the pistons, and the other components. The end thrust load is taken by the thrust washers installed at the center journal.

TIMING BELT

The timing belt coordinates the crankshaft and the dual overhead camshafts and keeps them synchronized. The timing belt also turns the water pump. The timing belt and the pulleys are toothed so that there is no slippage between them. There are two idler pulleys. An automatic tensioner pulley maintains the timing belt's correct tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine 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 other engine components. When the drive gear rotates, the driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows.

At high engine speeds, the oil pump supplies a much higher amount of oil than is required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages. During normal oil supply, a coil spring and valve 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 engine oil pan is mounted to the bottom of the cylinder block. The engine oil pan houses the crankcase and is made of cast metal.

Engine oil is pumped from the oil pan by the oil pump. After it passes through the oil filter, it is fed through two paths to lubricate the cylinder block and 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. It then drains back to the oil pan. In the second path, the oil is pumped through the oil passages to the camshaft. The oil passes through the internal passages in the camshafts to lubricate the valve assemblies before draining back to the oil pan.

EXHAUST MANIFOLD

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

INTAKE MANIFOLD

The intake manifold has four independent long ports and uses inertial supercharging to improve engine torque at low and moderate speeds. The plenum is attached to the intake manifold.

CAMSHAFTS

This engine is a dual overhead camshaft (DOHC) type, which means there are two camshafts. One camshaft operates the intake valves, and the other camshaft operates the exhaust valves. The camshafts sit in journals on the top of the engine in the cylinder head and are held in place by camshaft caps. The camshaft journals of the cylinder head are drilled to create oil passages. Engine oil travels to the camshafts under pressure where it lubricates each camshaft journal. The oil returns to the oil pan through drain holes in the cylinder head. The camshaft lobes are machined into the solid camshaft to open and close the intake and the exhaust valves precisely the correct amount at the correct time. The camshaft lobes are oiled by splash action from pressurized oil escaping from the camshaft journals.