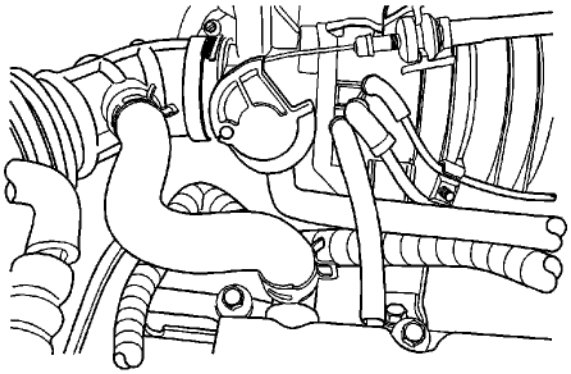
Timing Belt Inspection

Special Tools

- J 42492-A (KM-421-A) Timing Belt Adjuster
- J 45059 Angle Meter
- KM-470-B Angular Torque Gage

Adjustment Procedure

Warning: Refer to Battery Disconnect Warning in the Preface section.



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

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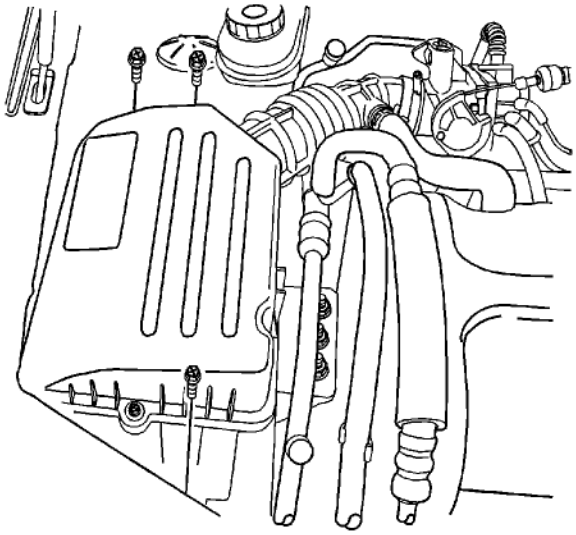
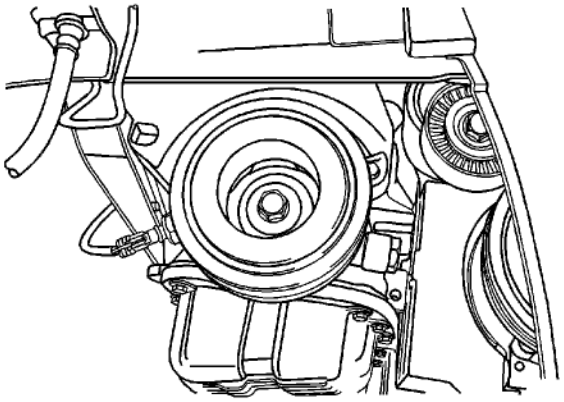
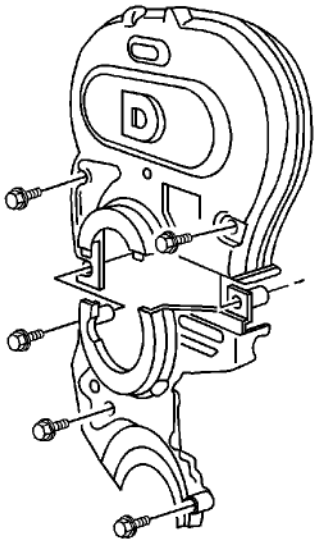


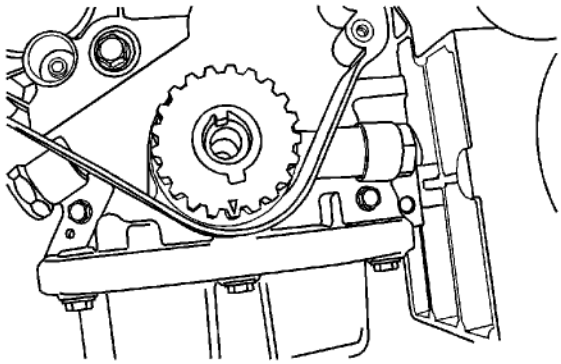
5. Remove the air filter housing bolts.
6. Remove the air filter housing.
7. Remove the right front wheel. Refer to Tire and Wheel Removal and Installation.
8. Remove the right front splash shield.



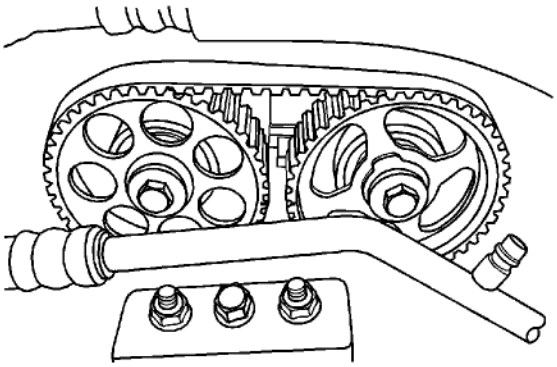
9. Remove the accessory drive belt.
10. Remove the crankshaft pulley bolt.
11. Remove the crankshaft pulley.



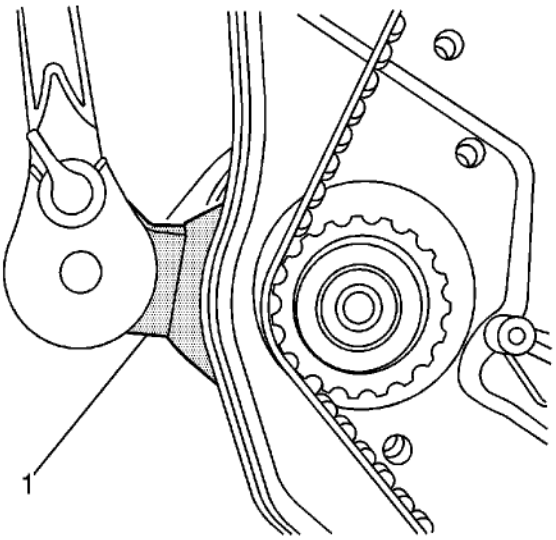
12. Remove the upper front timing belt cover bolts.
13. Remove the upper front timing belt cover.
14. Remove the lower front timing belt cover bolts.
15. Remove the lower front timing belt cover.
16. Remove the power steering pump mounting bolts, if equipped.
17. Install the crankshaft pulley bolt.



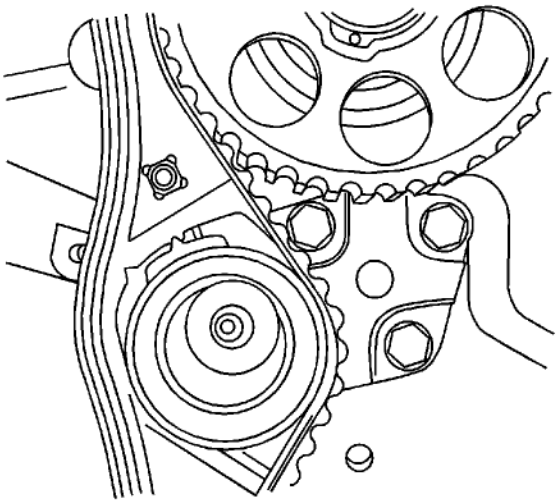
18. Rotate the crankshaft at least one full turn clockwise using the crankshaft pulley bolt.
19. Align the mark on the crankshaft gear to the notch at the bottom of the rear timing belt cover.



20. Align the camshaft gear timing marks.

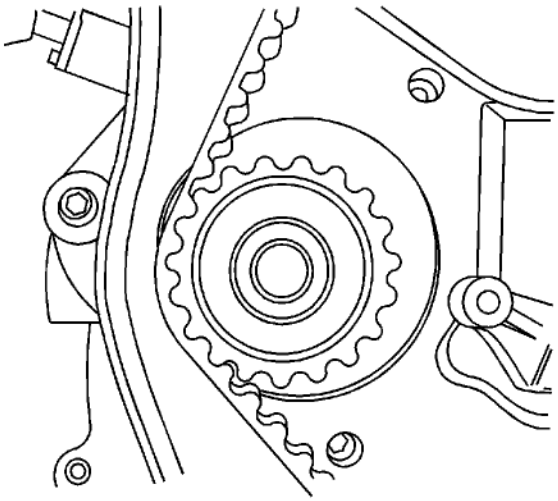


21. Slightly loosen the coolant pump retaining bolts.
22. Rotate the coolant pump clockwise using the J 42492-A (1).

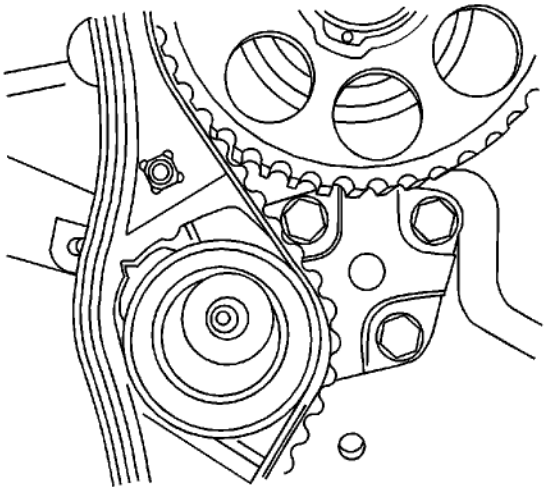


23. Rotate the coolant pump clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned to the notch in the timing belt automatic tensioner bracket.

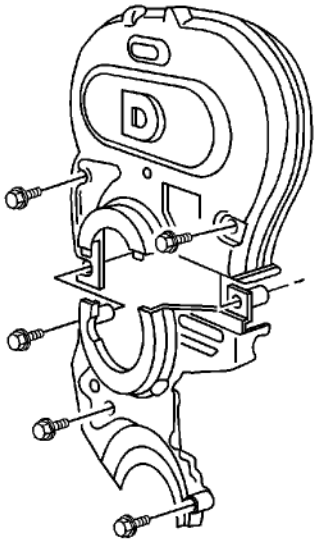
Caution: Refer to Fastener Caution in the Preface section.



24. Tighten the coolant pump retaining bolts.
25. Rotate the crankshaft 2 full turns clockwise using the crankshaft pulley.
26. Loosen the coolant pump retaining bolts.



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



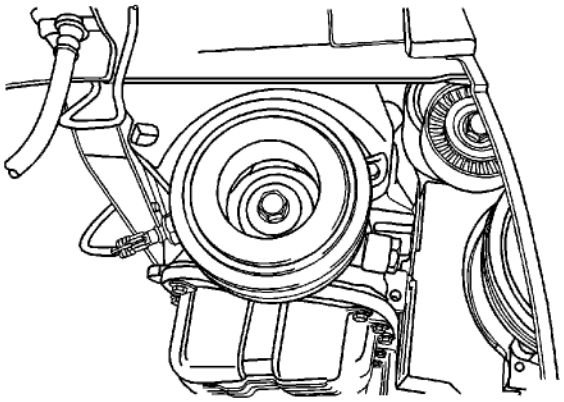
28. Tighten the coolant pump retaining bolts.

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

29. Remove the crankshaft pulley bolt.
30. Install the upper and lower front timing belt cover.
31. Install the upper and lower front timing belt cover bolts.

Tighten

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

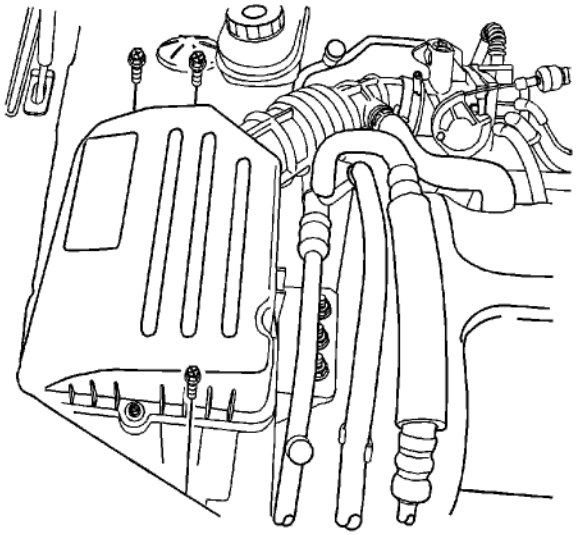


32. Install the crankshaft pulley.
33. Install the crankshaft pulley bolt.

Tighten

Tighten the crankshaft pulley bolt to 95 N·m (70 lb ft) using a torque wrench. Using the J 45059 or KM-470-B , tighten the crankshaft pulley bolt 30 degrees plus 15 degrees.

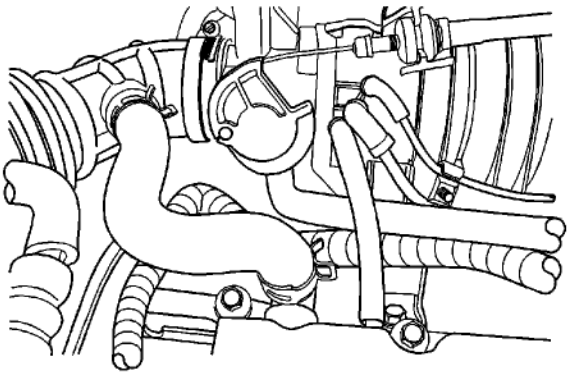
34. Install the accessory drive belt.



35. Install the right front wheel. Refer to Tire and Wheel Removal and Installation.
36. Install the air filter housing.

37. Install the air filter housing bolts.

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



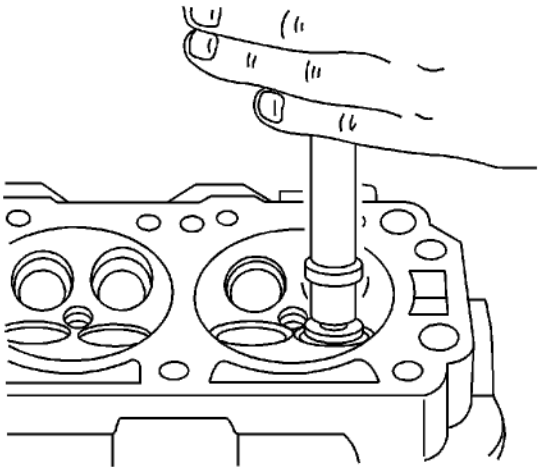
38. Connect the air intake tube to the throttle body.
39. Connect the breather tube to the valve cover.
40. Connect the IAT sensor connector.
41. Connect the negative battery cable.

Valve Guide Reaming, and Valve and Seat Grinding

Tools Required

- KM-571-B Gage or equivalent
- KM-805 Valve Guide Reamer
- KM-340-1-C Cutter Set

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.

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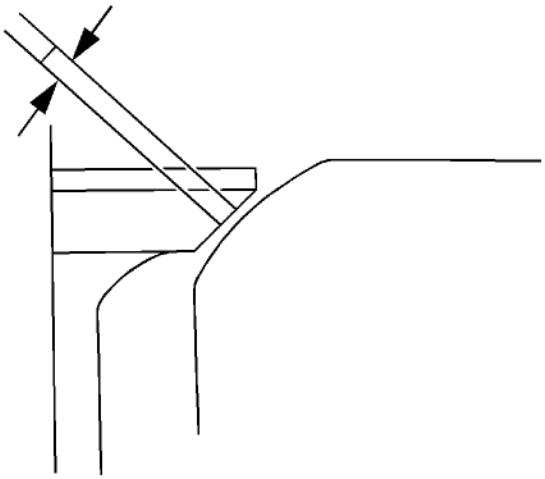
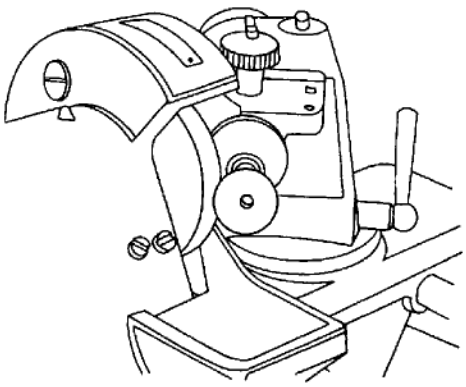


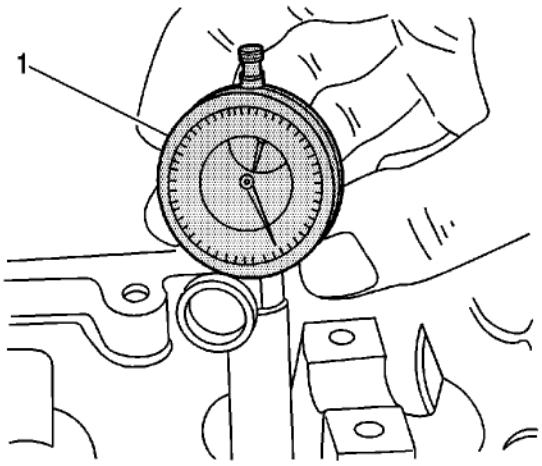
3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.

Valve Grind

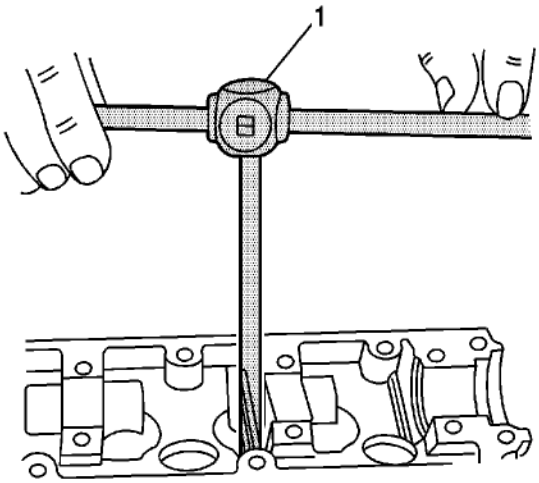


1. Ensure there are no crater line burns on the valve cone.
2. The valve may be reground only 2 times. Do not grind the valve stem end.
3. The angle at the valve face is 45 degrees.
4. Inspect the assembly height of the intake valves and the exhaust valves.

Valve Guide - Ream



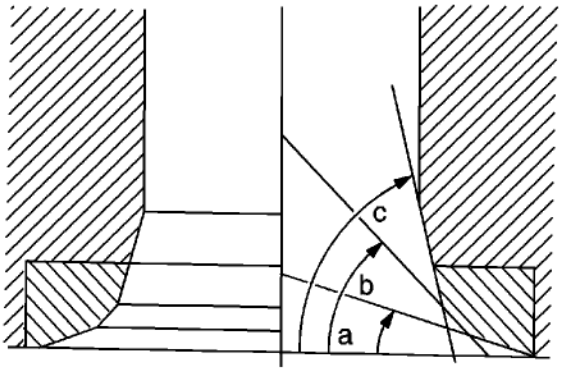
1. Measure the diameter of the valve guide using the KM-571-B (1) and a commercially available inside micrometer.



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 Valve Guide Reaming Table give the correct size, reamer, and production codes for each service. Refer to the Valve Guide Reaming Table in Engine Mechanical Specifications .
3. Ream the valve guide from the upper side of the cylinder head to the next oversize using the KM-805 (1).
4. After reaming, cross out the code and emboss the valve guide with the new code.

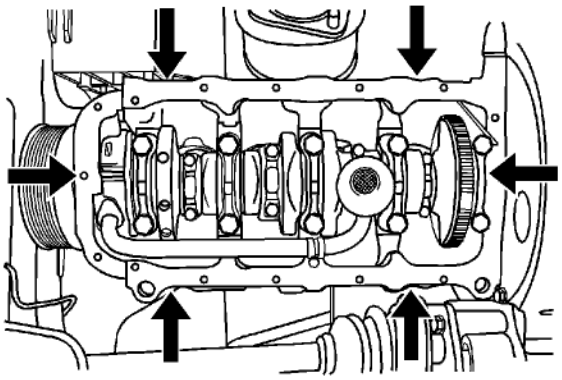
Valve Seat - Cut



1. Place the cylinder head on wooden blocks.
2. Cut the intake and exhaust valve seats using the KM-340-7 included in the KM-340-1-C as follows:
   - Valve seat: A 45-degree side (b) using the KM-340-13 included in the KM-340-1-C
   - Upper correction angle: A 30-degree side (a) using the KM-340-13 included in the KM-340-1-C
   - Lower correction angle: A 60-degree side (c) using the KM-340-26 included in the KM-340-1-C
3. Clean the chippings from the cylinder head.
4. Inspect the dimensions to make sure the valve seat width is as follows:
   - Intake: 1.17-1.57 mm (0.046-0.062 in)
   - Exhaust: 1.07-1.47 mm (0.042-0.058 in)
5. Inspect the assembly height of the intake valves and the exhaust valves.
6. If the dimension is exceeded, install new valves.
7. Inspect the assembly height of the intake valves and the exhaust valves again.
8. If the valve assembly height is still too large despite replacing the valves, replace the cylinder head.

Oil Pan Cleaning and Inspection

Warning: Refer to Safety Glasses Warning in the Preface section.



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

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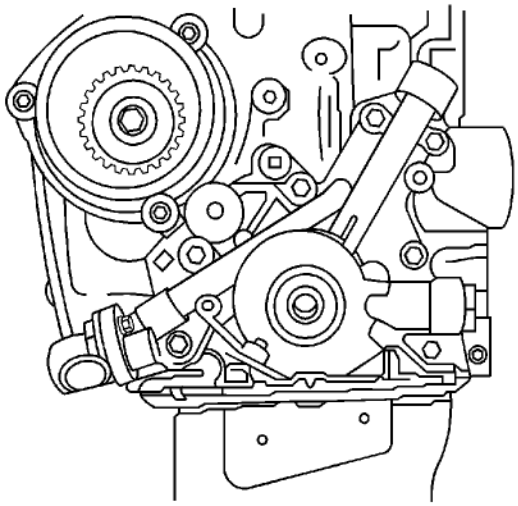
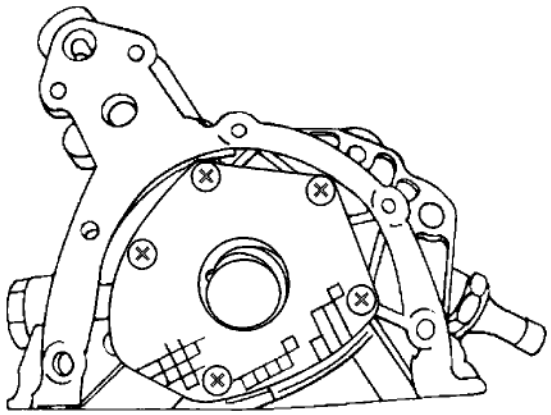
Oil Pump Cleaning and Inspection

Warning: Refer to Safety Glasses Warning in the Preface section.



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



5. Remove the oil pump rear cover bolts.

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6. Remove the rear cover.
7. Clean the oil pump housing and all of the parts.
8. Inspect all of the parts for signs of wear. Refer to Engine Mechanical Specifications.
9. Coat all of the oil pump parts with clean engine oil.
10. Reinstall all of the oil pump parts.

Caution: Refer to Fastener Caution in the Preface section.

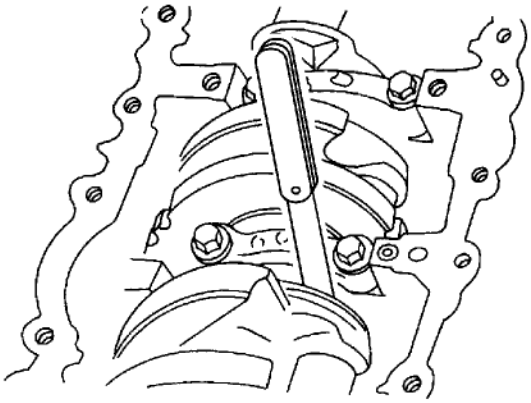
Caution: Fill oil pump cavities with petroleum jelly prior to installation. This will ensure that there is oil pressure immediately on start-up and will prevent engine damage.

11. Install the oil pump rear cover and the bolts and tighten to **6 N·m (53 lb in)**.
12. Install the safety relief valve, the spring, the washer, and the bolt and tighten to **30 N·m (22 lb ft)**.

Crankshaft and Bearing Cleaning and Inspection

Special Tools

- J 45059 Angle Meter
- KM-470-B Angular Torque Gage



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 Mechanical Specifications.

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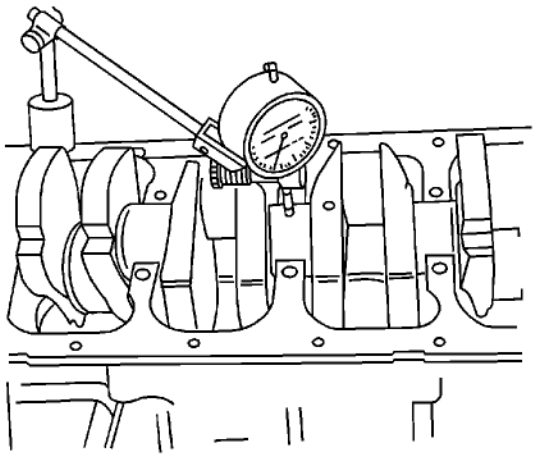
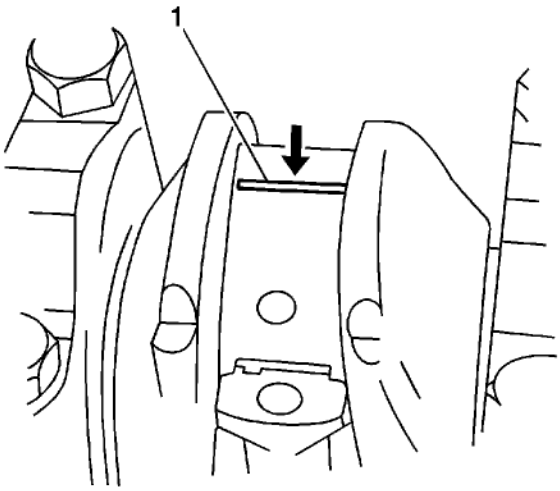
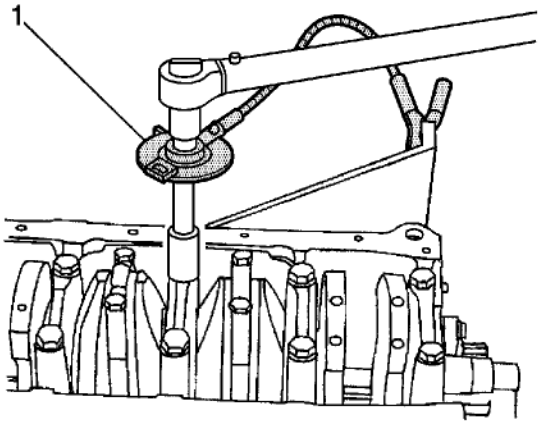


7. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round runout. Refer to Engine Mechanical Specifications.



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

8. Measure all of the crankshaft bearing clearance using a commercially available plastic gaging, ductile plastic threads.
9. Cut the plastic gaging threads to the length of the bearing width (1). Lay them axially between the crankshaft journals and the crankshaft bearings.

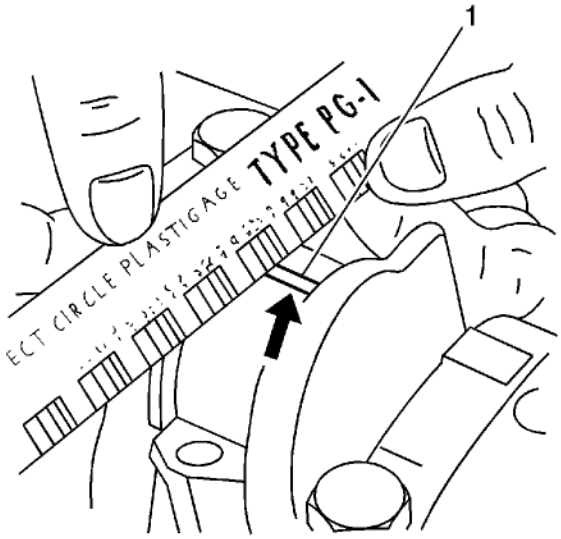


10. Install the crankshaft bearing caps.

Caution: Refer to Fastener Caution in the Preface section.

11. Install the crankshaft bearing cap bolts.

Tighten
Tighten the crankshaft bearing cap bolts to 50 N·m (37 lb ft). Using the J 45059 or the KM-470-B (1), tighten the crankshaft bearing cap bolts another 45 degrees plus 15 degrees.



12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread (1) of the plastic gaging using the scale

printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.

14. Inspect the bearing clearances for permissible tolerance ranges. Refer to Engine Mechanical Specifications.

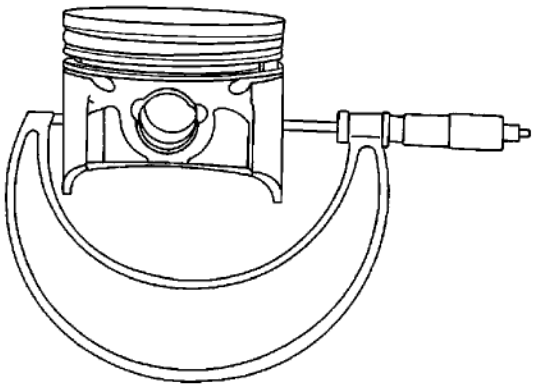
Piston, Connecting Rod, and Bearing Cleaning and Inspection

Special Tools

- KM-470-B Angular Torque Gage
- J 45059 Angle Meter

Piston Inspection

Warning: Refer to Safety Glasses Warning in the Preface section.



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

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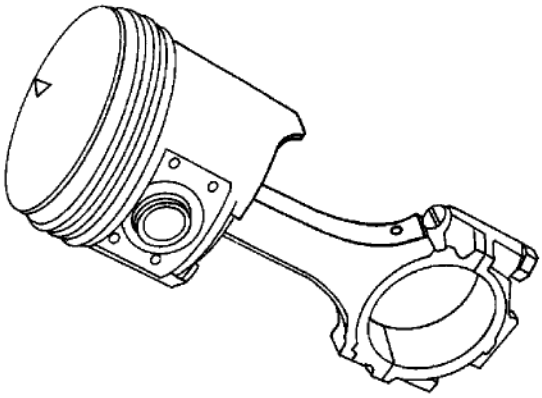
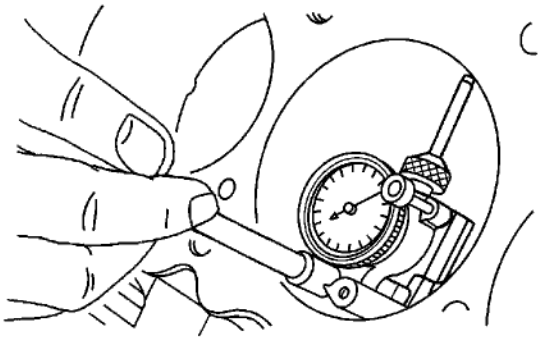


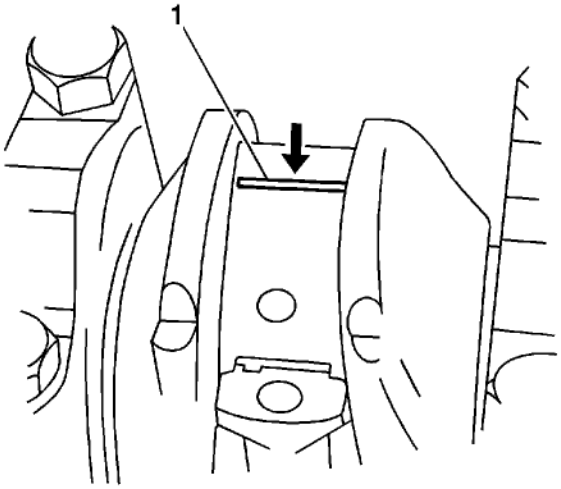
8. Inspect the piston for fit to the connecting rod.



9. Inspect the engine block deck surface for flatness using a straight edge and a feeler gage. Refer to Engine Mechanical Specifications.
10. Inspect the bearing bore for concentricity and alignment using a bore gage. Refer to Engine Mechanical Specifications. If beyond specifications, replace the engine block.
11. Inspect the engine block cylinder bore for wear, runout, ridging, and taper using a bore gage. Refer to Engine Mechanical Specifications.
12. Inspect the engine block cylinder bore for glazing.

Connecting Rod Bearing Inspection

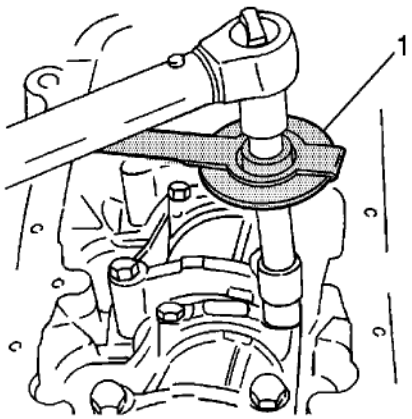
Warning: Refer to Safety Glasses Warning in the Preface section.



1. Coat the connecting rod bearings with engine oil.

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

2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.
4. Measure all of the connecting rod bearing clearances using a commercially available plastic gaging, ductile plastic threads (1).



5. Cut the plastic gaging threads to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.

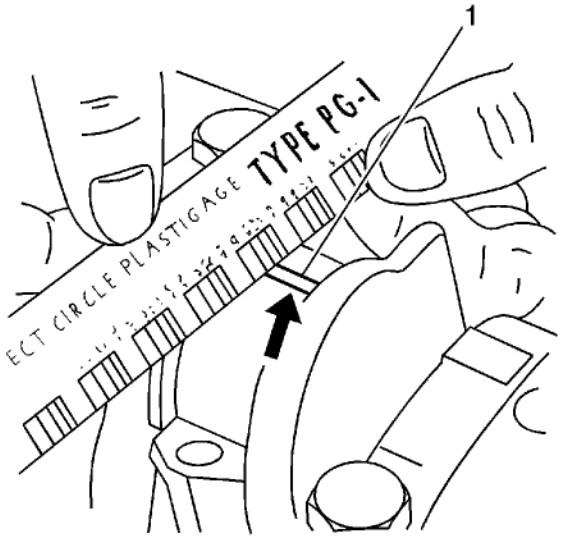
6. Install the connecting rod bearing caps.

   Caution: Refer to Fastener Caution in the Preface section.

7. Install the connecting rod bearing cap bolts.

   Tighten
   Tighten the connecting rod bearing cap bolts to 25 N·m (18 lb ft).

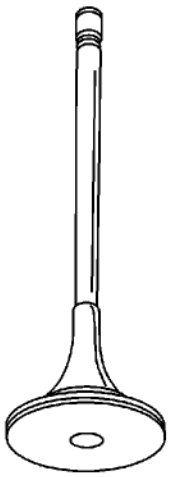
8. Using the J 45059 or the KM-470-B (1), tighten the crankshaft cap bolts another 30 degrees plus 15 degrees.



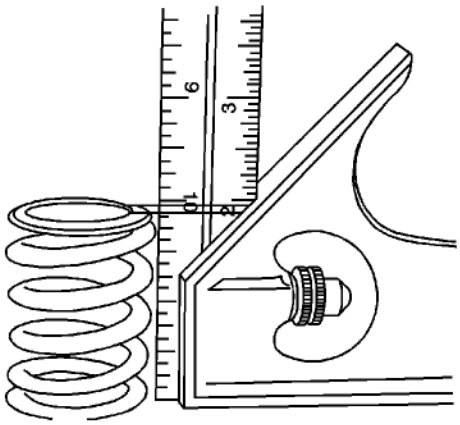
9. Remove the connecting rod bearing caps.
10. Measure the width of the flattened plastic thread of the plastic gaging (1) using the scale printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.
11. Inspect the bearing clearance for permissible tolerance ranges. Refer to Engine Mechanical Specifications

Valve Rocker Arm Cleaning and Inspection

Warning: Refer to Safety Glasses Warning in the Preface section.



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



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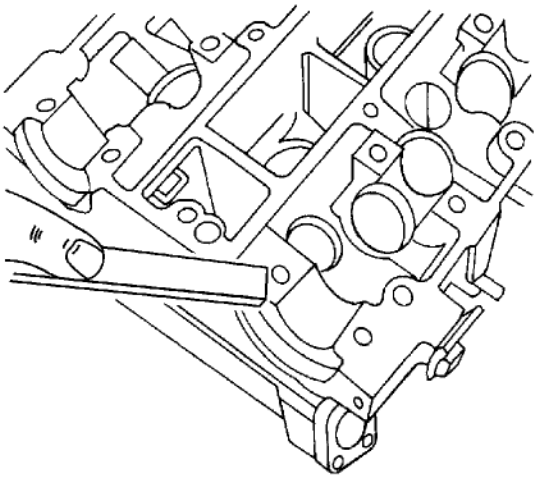
7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Measure the valve spring height. Refer to Engine Mechanical Specifications. If the valve spring height does not match the specifications, replace the valve spring.

Cleaning Procedure

Warning: Refer to Safety Glasses Warning in the Preface section.



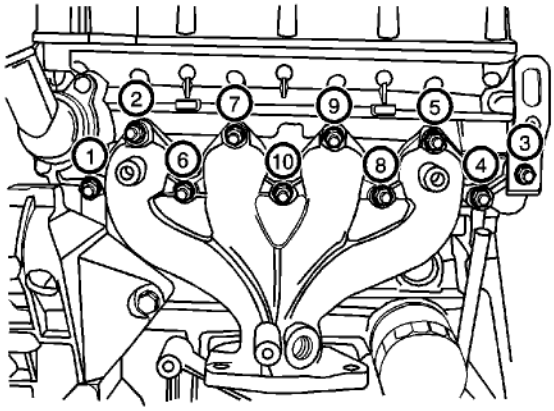
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil, and varnish.

Cylinder Head Disassemble

Special Tools

- J 8062 (KM-348) Valve Spring Compressor - Head Off
- KM-653-A Adapter

Disassembly Procedure



1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to Camshaft Replacement.
2. Remove the coolant temperature sensor (CTS).
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.

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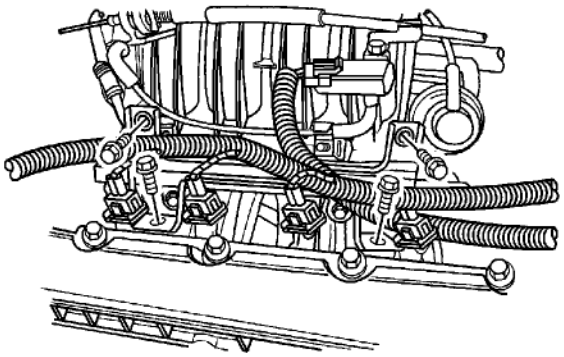
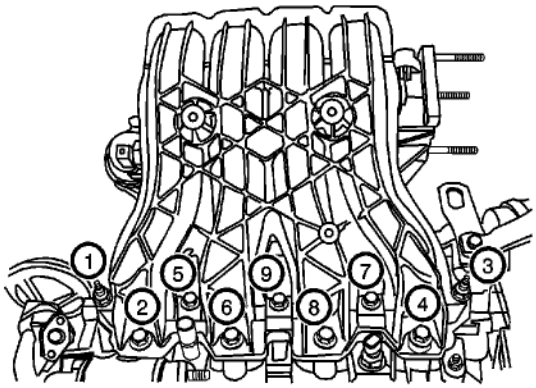
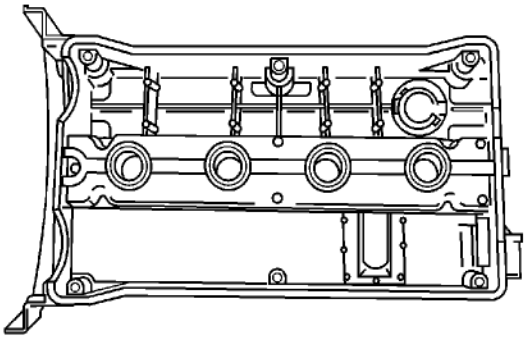


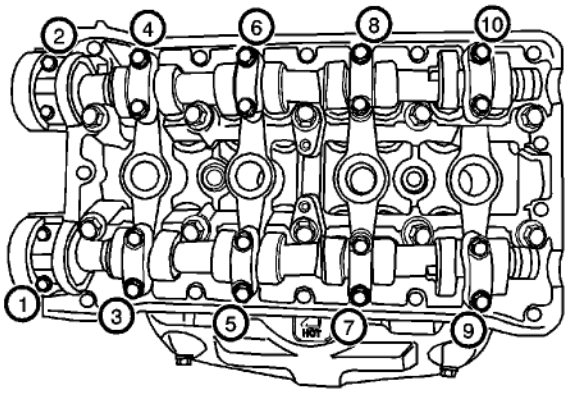
9. Remove the thermostat housing mounting bolts.
10. Remove the thermostat housing assembly.
11. Remove the fuel rail retaining bolts and the fuel rail assembly.



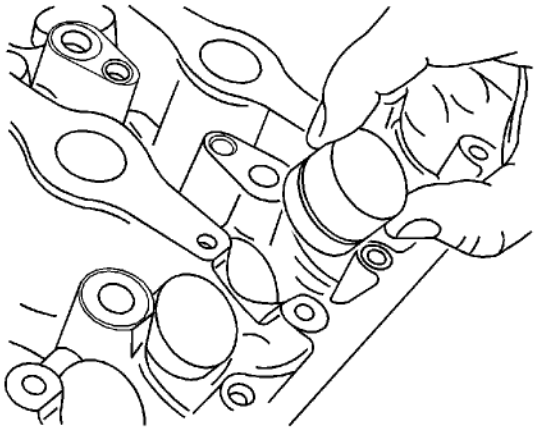
12. Remove the intake manifold retaining nuts and retaining bolts in the sequence shown.
13. Remove the intake manifold.
14. Remove the intake manifold studs.



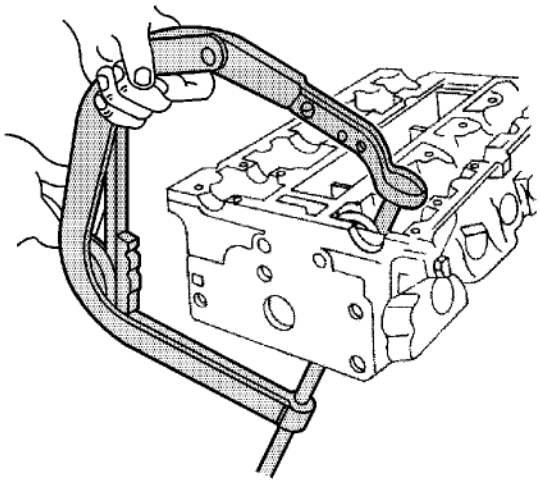
15. Remove the direct ignition system (DIS) coil mounting bolts.
16. Remove the DIS coil with the ignition wires attached.
17. Remove the DIS coil mounting bracket bolts.
18. Remove the electrical exhaust gas recirculation (EEGR) valve adapter bolts.
19. Remove the EEGR valve adapter.
20. Remove the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



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



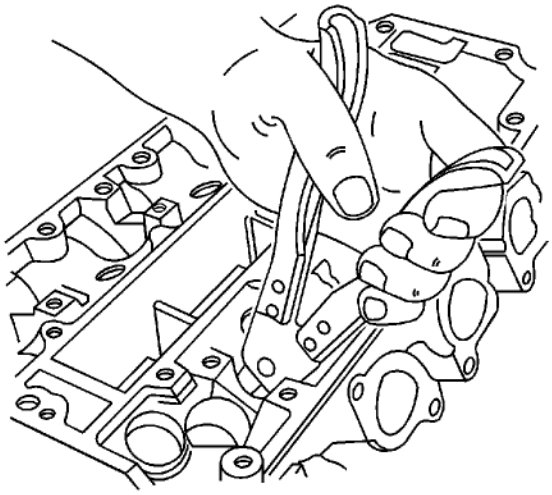
23. Remove the intake camshaft caps. Maintain the correct positions for installation.
24. Remove the intake camshaft.
25. Remove the intake valve tappet adjusters.
26. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
27. Remove the exhaust camshaft.
28. Remove the exhaust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



Warning: Valve springs can be tightly compressed. Use care when removing the retainers and plugs. Personal injury could result.

29. Compress the valve springs with the J 8062 and the KM-653-A .
30. Remove the valve keys.
31. Remove the J 8062 and KM-653-A .

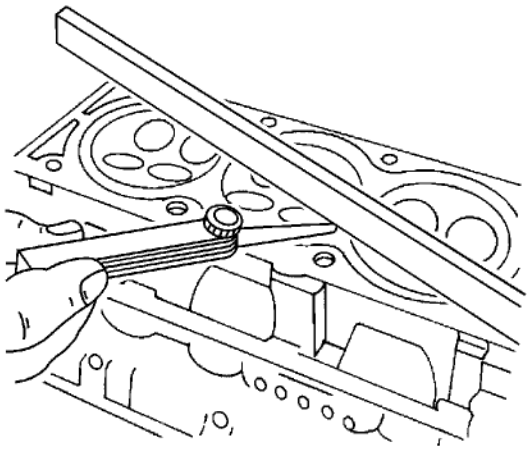
32. Remove the valve spring caps.
33. Remove the valve springs. Maintain the original position of the valve springs for installation.



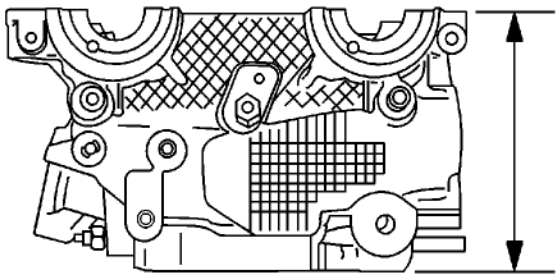
34. Remove the valves. Maintain the original position of the valves for installation.
35. Remove the valve stem seals.

Cylinder Head Cleaning and Inspection

Warning: Refer to Safety Glasses Warning in the Preface section.



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 width of the cylinder head using a feeler gage and a straight edge.
5. Inspect the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat, within 0.05 mm (0.002 in) maximum.



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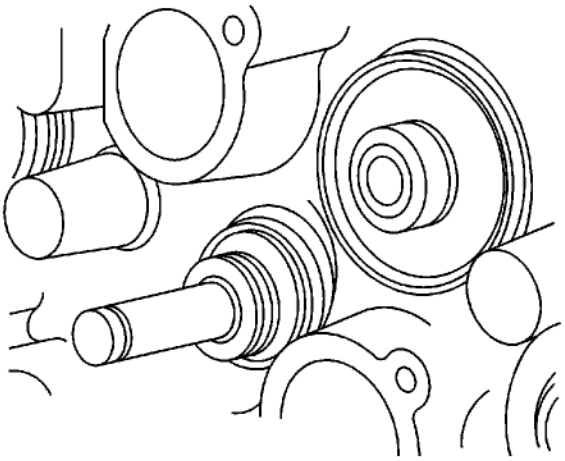
6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 138.13-138.18 mm (5.438-5.440 in). If the cylinder head height is less than 138.13 mm (5.438 in), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect all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

Cylinder Head Assemble

Special Tools

- J 8062 (KM-348) Valve Spring Compressor - Head Off
- KM-653-A Adapter



1. Install new 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.

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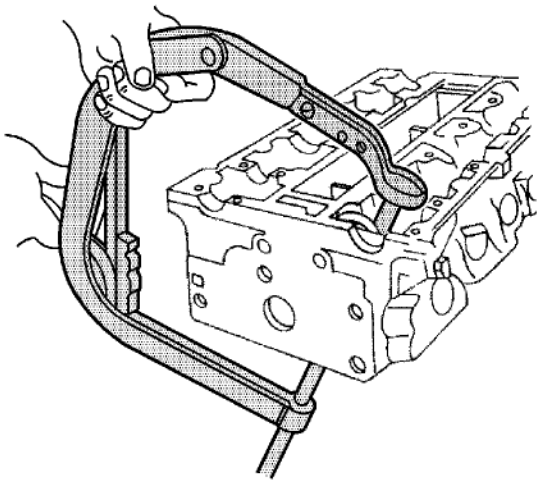
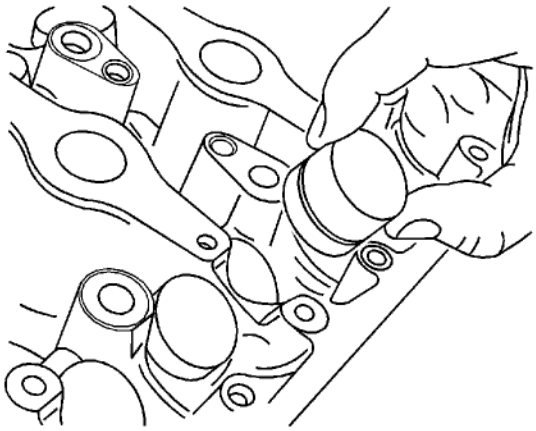
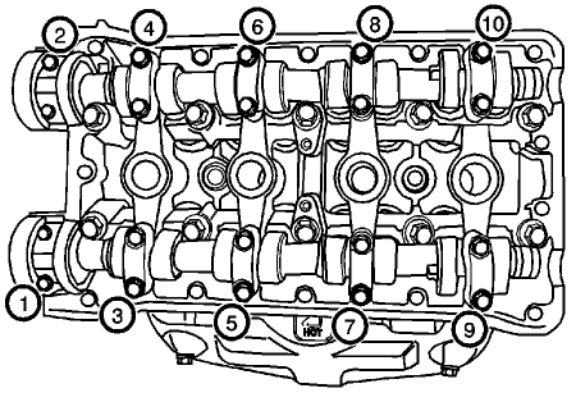


6. Compress the valve springs with J 8062 and KM-653-A .
7. Install the valve keys.
8. Remove J 8062 and KM-653-A .



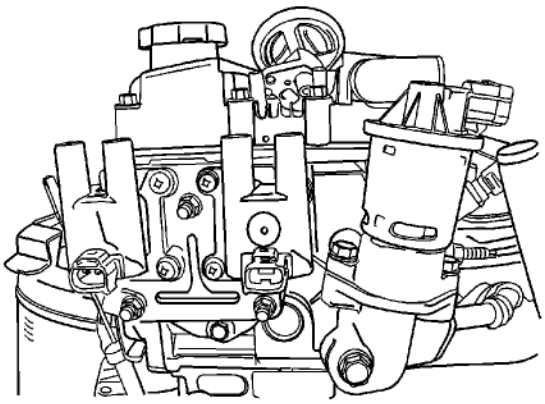
9. Lubricate the valve tappet adjusters with engine oil.
10. Install the valve tappet adjusters.



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.

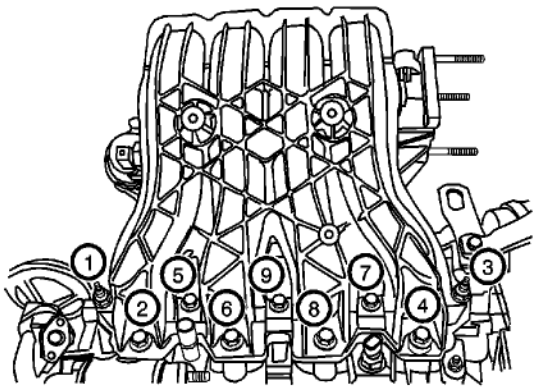
Caution: Refer to Fastener Caution in the Preface section.

16. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap to **16 N·m (12 lb ft)**.

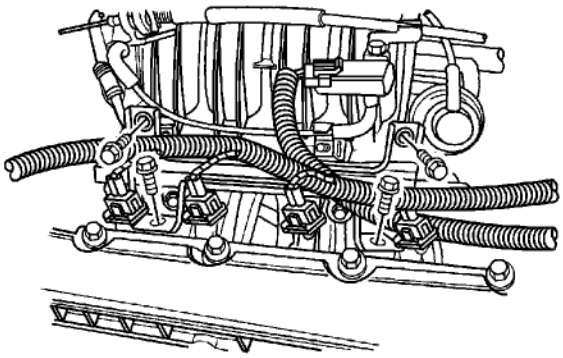


17. Install the spark plugs and tighten to **25 N·m (18 lb ft)**.
18. Install the exhaust gas recirculation (EGR) valve adapter gasket.
19. Install the EGR valve adapter.

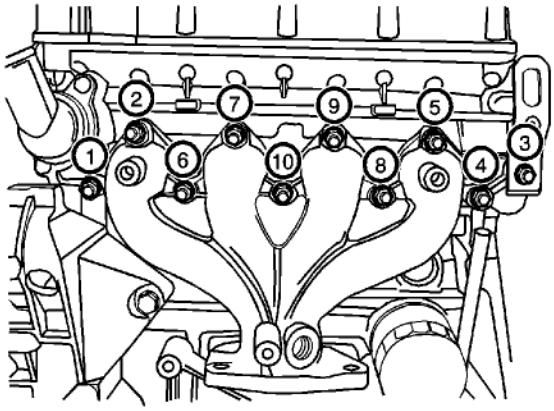
20. Install the EGR valve adapter bolts and tighten to **25 N·m (18 lb ft)**.
21. Install the direct ignition system (DIS) coil mounting bracket.
22. Install the DIS coil mounting bracket bolts and tighten to **10 N·m (89 lb in)**.
23. Install the DIS coil with the ignition wires attached.
24. Install the DIS coil mounting bolts and tighten to **10 N·m (89 lb in)**.



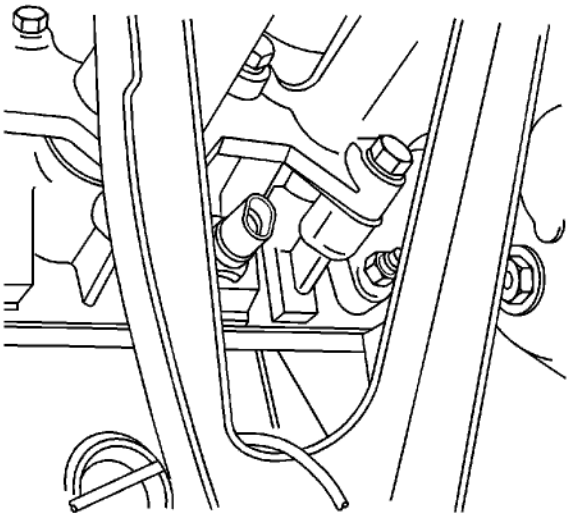
25. Install the intake manifold studs.
26. Install the intake manifold.
27. Install the intake manifold retaining nuts and retaining bolts in the sequence shown and tighten to **25 N·m (18 lb ft)**.



28. Install the fuel rail assembly with the bolts and tighten to **25 N·m (18 lb ft)**.
29. Install the thermostat housing assembly.
30. Install the thermostat housing mounting bolts and tighten 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 and tighten to **25 N·m (18 lb ft)**.
35. Install the exhaust manifold heat shield.
36. Install the exhaust manifold heat shield bolts and tighten to **15 N·m (11 lb ft)**.



37. Install the coolant temperature sensor and tighten 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 Replacement.