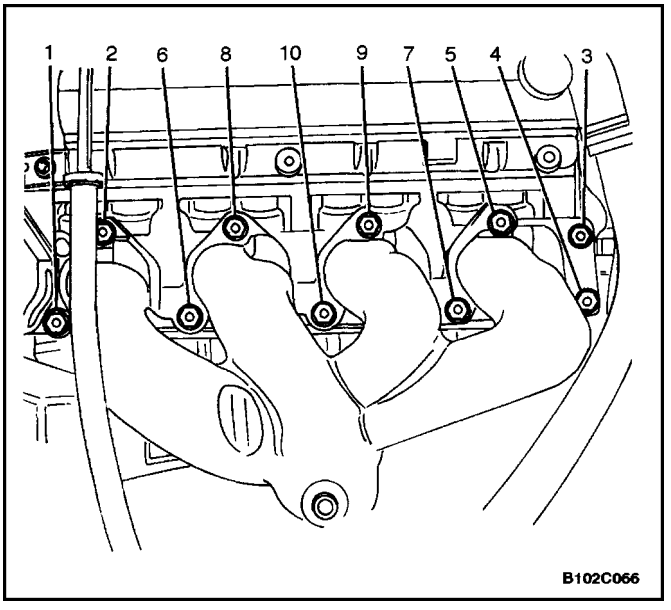
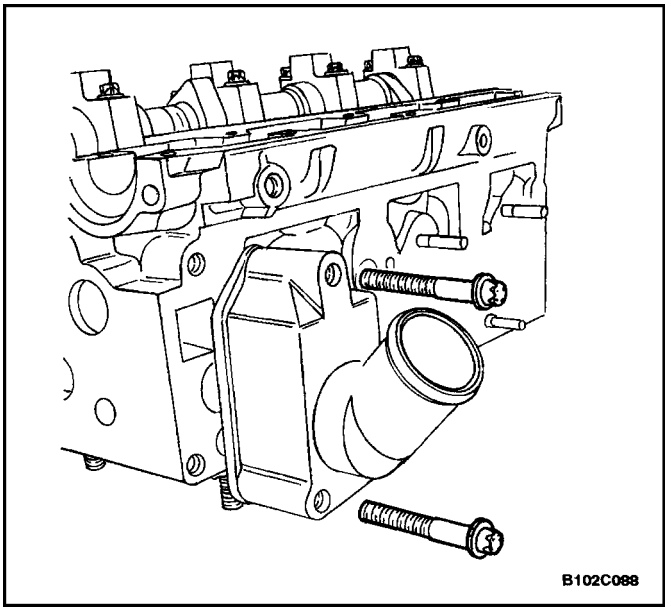
UNIT REPAIR

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

Tools Required

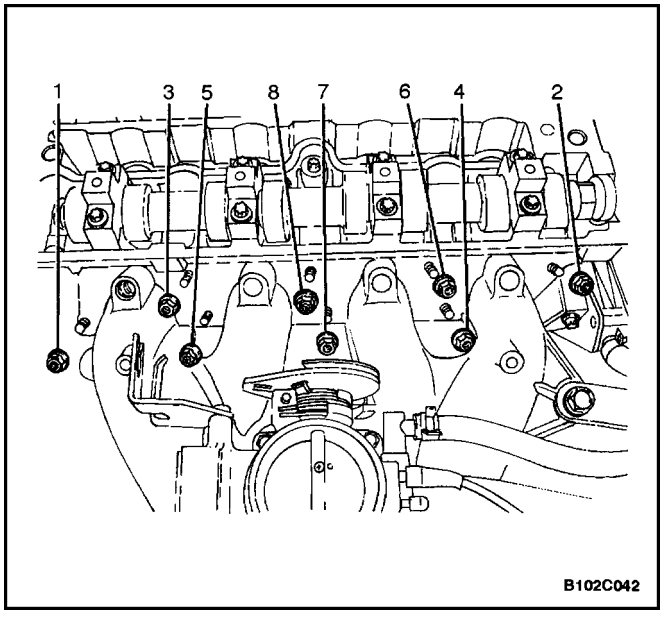
MKM–571–B Gauge
KM–340–0 Cutter Set
KM–340–7 Guide Drift
KM–340–13 Cutters
KM–340–26 Cutters
KM–348 Valve Spring Compressor
KM–653 Adapter
KM–805 Valve Guide Reamer



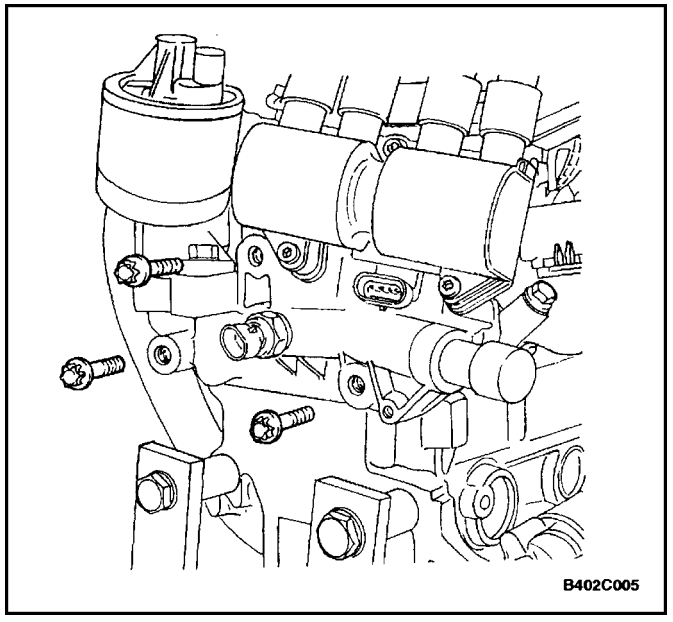


Disassembly Procedure

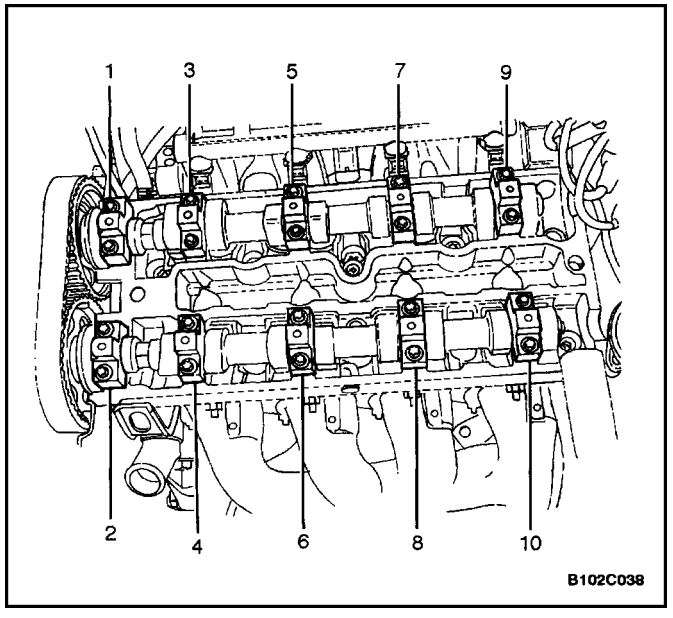
1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to ”Cylinder Head and Gasket” in this section.
2. Remove the coolant temperature sensor (CTS).
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold retaining nuts in the sequence shown.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.
9. Remove the thermostat housing mounting bolts.
10. Remove the thermostat housing assembly.
11. Remove the fuel rail assembly. Refer to *Section 1F, Engine Controls.*
12. Remove the coolant bypass housing mounting bolts and the housing.



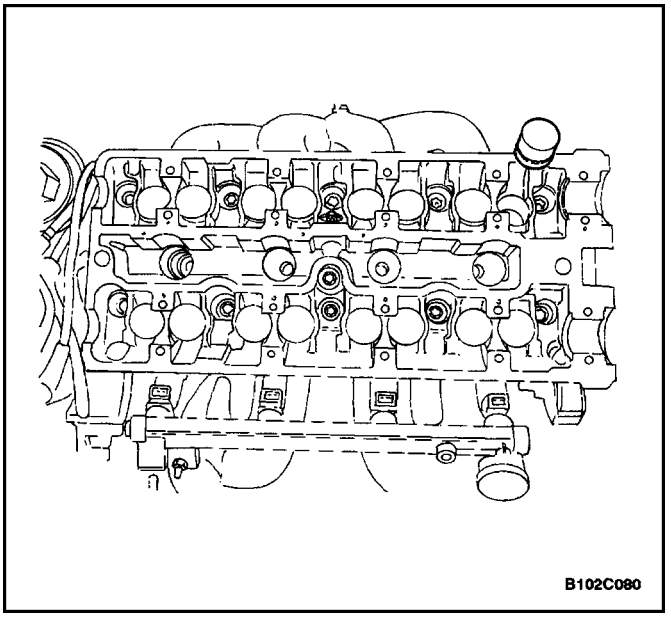
13. Remove the intake manifold retaining nuts and the bolts in the sequence shown.
14. Remove the intake manifold.
15. Remove the intake manifold gasket.



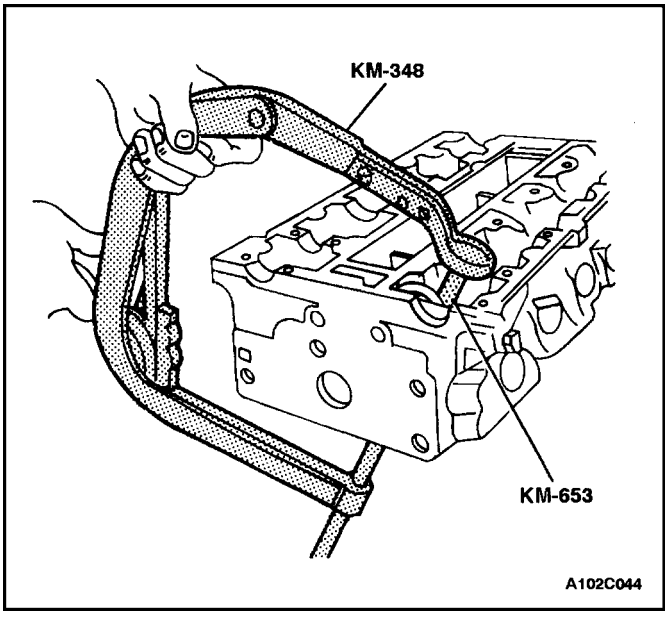
16. Remove the electronic ignition (EI) system ignition coil and exhaust gas recirculation (EGR) mounting bracket bolts.
17. Remove the EI system ignition coil, the EGR mounting bracket, and the ignition wires.
18. Remove the intake manifold studs.
19. Remove the spark plugs.



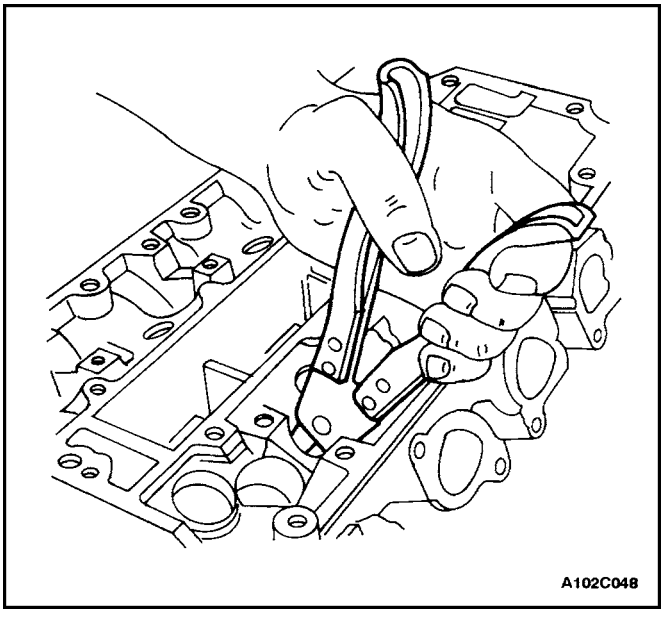
20. Remove the camshaft bearing cap bolts gradually and in the sequence shown for each camshaft cap.



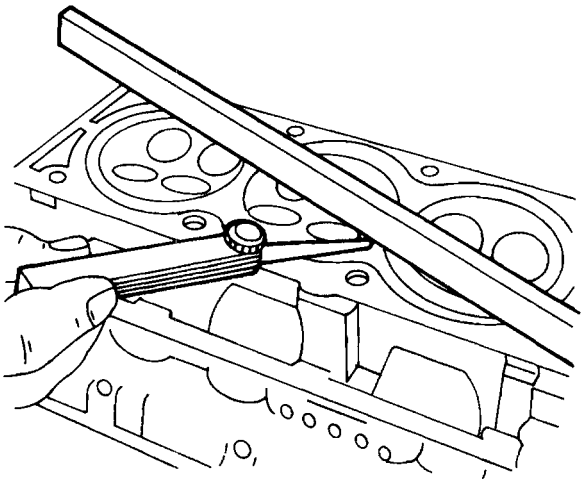
21. Remove the intake camshaft caps. Maintain the correct positions for installation.
22. Remove the intake camshaft.
23. Remove the intake valve lash adjusters.
24. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
25. Remove the exhaust camshaft.
26. Remove the exhaust valve lash adjusters.



27. Compress the valve springs with the valve spring compressor KM–348 and the adapter KM–653.
28. Remove the valve retainers.
29. Remove the valve spring compressor KM–348 and the adapter KM–653.
30. Remove the valve spring caps.
31. Remove the valve springs. Maintain the original position of the valve springs for installation.



32. Remove the valves. Maintain the original position of the valves for installation.
33. Remove the valve stem seals.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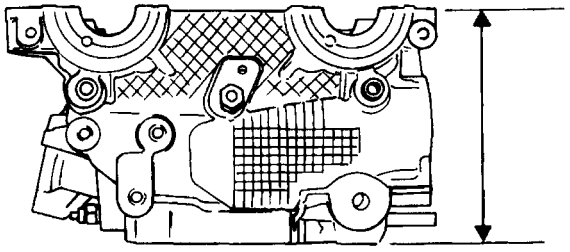
Cylinder Head Inspection

1. Clean the sealing surfaces.
2. Inspect the cylinder head gasket and the mating surfaces for leaks, corrosion, and blowby.
3. Inspect the cylinder head for cracks.
4. Inspect the length and the width of the cylinder head using a feeler gauge and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within 0.025 mm (0.001 inch) maximum.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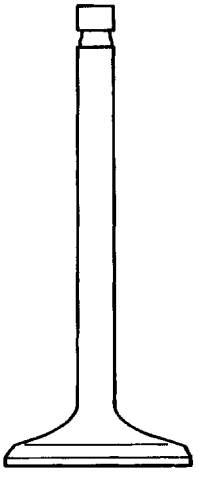
6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 133.975 to 134.025 mm (5.274 to 5.276 inches). If the cylinder head height is less than 133.9 mm (5.271 inches), replace the cylinder head.
7. Inspect all threaded holes for damage.
8. Inspect the valve seats for excessive wear and burned spots.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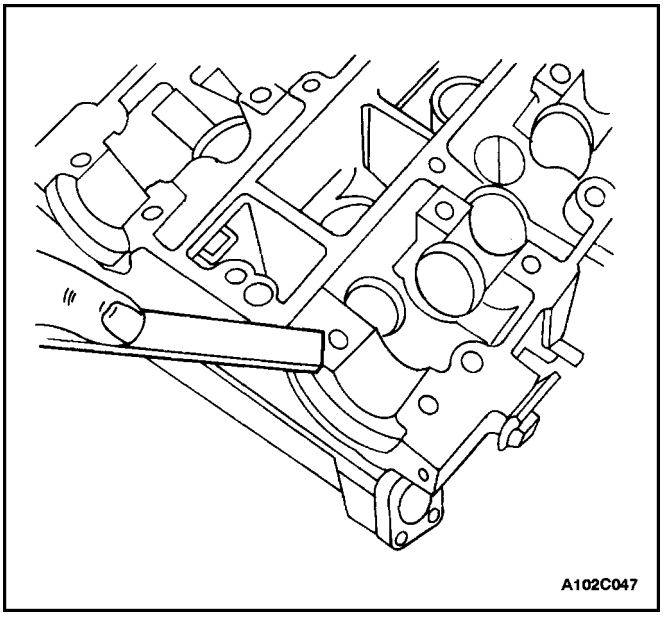
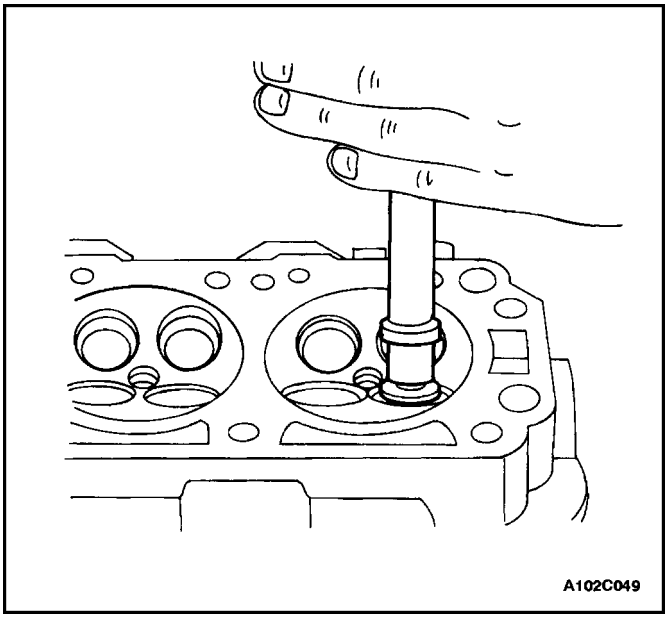
Valve Inspection

1. Inspect the valve stem tip for wear.
2. Inspect the valve retainer grooves and the oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.
4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep that refacing the valve would result in a sharp edge, replace the valve.
7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.



Cleaning Procedure

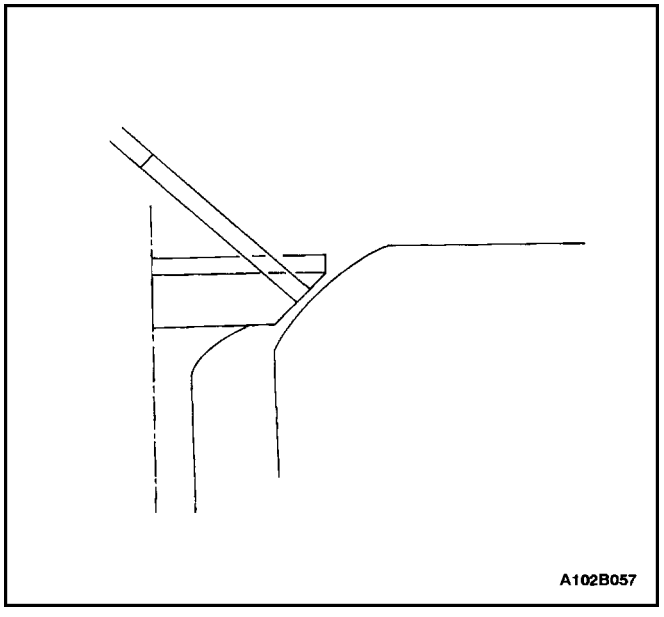
1. Clean the cylinder head.
2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil, and varnish.



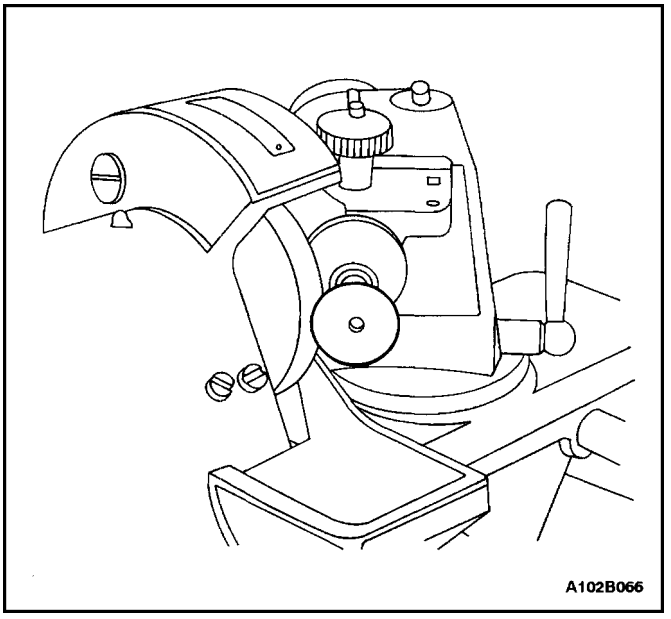
Cylinder Head Overhaul

Valve Grind–in

1. Lubricate the valve seat 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.

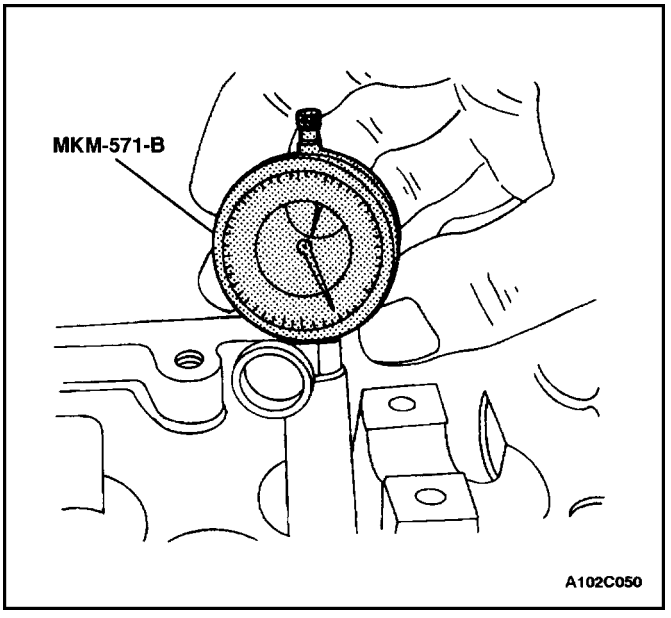


3. Check the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.



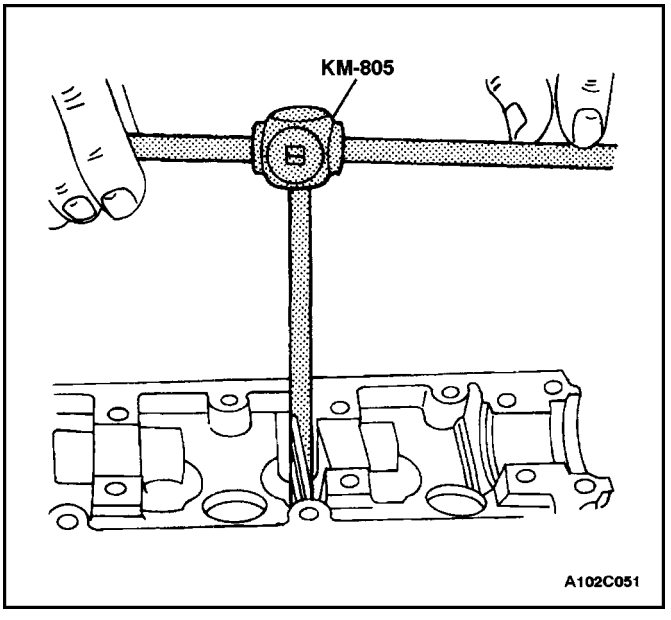
Valve Grind

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. Ensure that 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 gauge MKM–571–B and a commercially available inside micrometer.

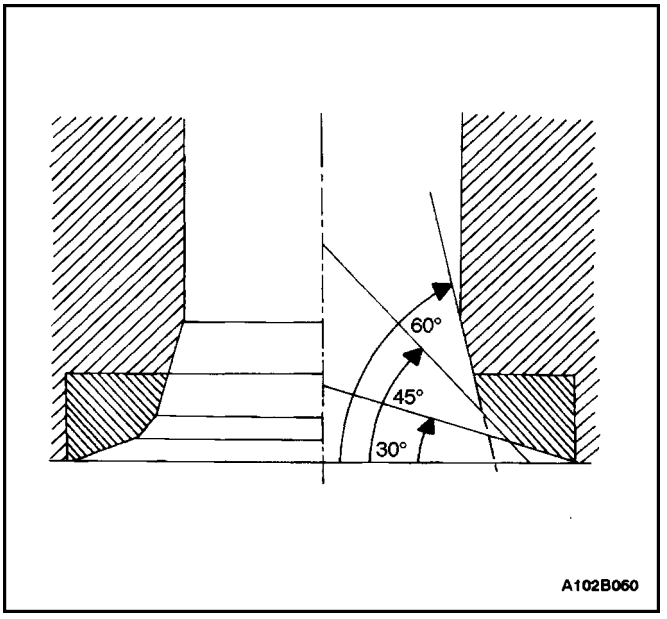


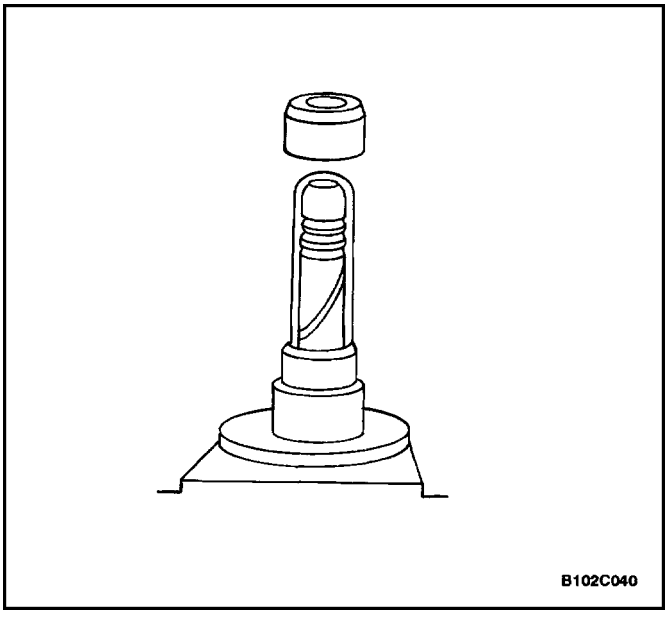
Important : Valve oversizes may already have been fitted in production.

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



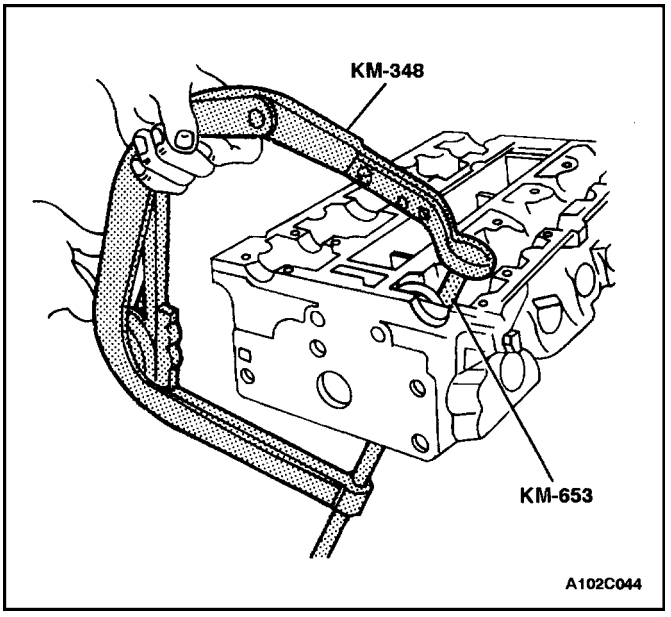


Valve Seat – Cut

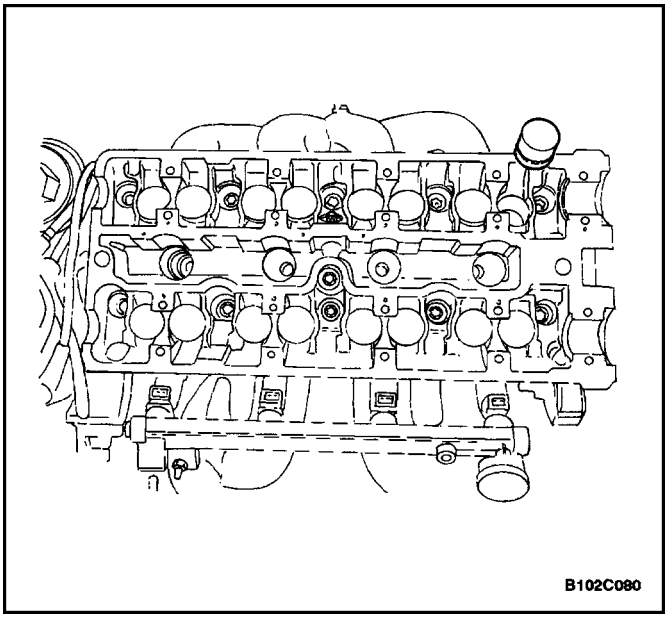
1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the guide drift KM–340–7 as follows:
   - Valve seat – A 45–degree surface using the cutter KM–340–13.
   - Upper correction angle – A 30–degree surface using the cutter KM–340–13.
   - Lower correction angle – 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: 1.2 to 1.4 mm (0.047 to 0.055 inch).
   - Exhaust: 1.4 to 1.8 mm (0.055 to 0.070 inch).
5. Inspect the assembly height of the intake valves and the exhaust valves. If the specified 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

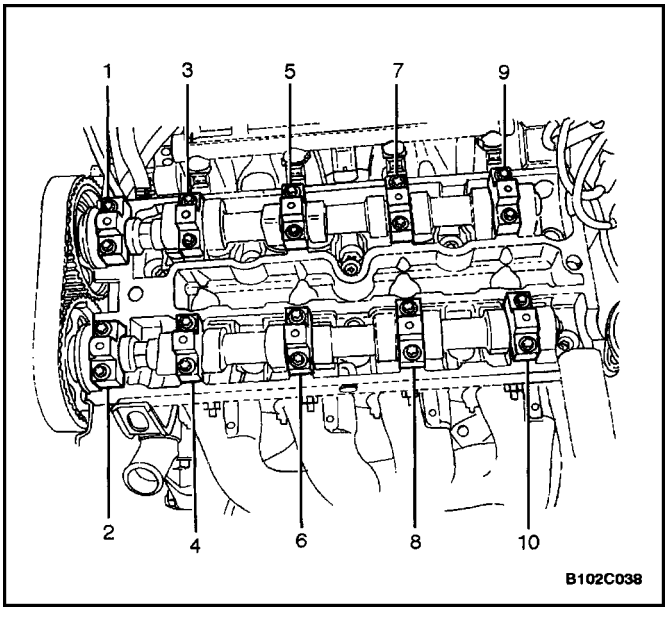
1. Coat the valve stems with engine oil.
2. Insert the valves in the cylinder head in their original positions.
3. Insert the valve spring seats.
4. Push the accompanying assembly sleeve onto the valve stem.
5. Insert the new valve stem seat.
6. Carefully drive the valve stem seal onto the stop with light taps.
7. Install the valve springs in their original positions.
8. Install the valve spring caps.



9. Compress the valve springs with the valve spring compressor KM–348 and adapter KM–653.
10. Install the valve retainers.
11. Remove the valve spring compressor KM–348 and adapter KM–653.



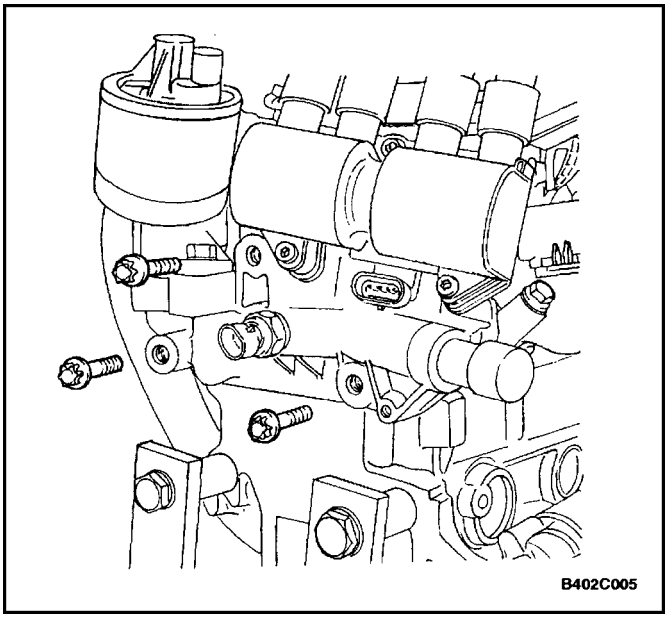
12. Lubricate the valve lash adjusters with engine oil.
13. Install the valve lash adjusters.



14. Install the intake camshaft.
15. Install the intake camshaft bearing caps in their original positions.
16. Install the exhaust camshaft.
17. Install the exhaust camshaft bearing caps in their original positions.
18. Install the camshaft bearing cap bolts.
19. Tighten the camshaft bearing cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten

Tighten the camshaft bearing cap bolts to 8 N•m (71 lb–in).



20. Install the spark plugs.

Tighten

Tighten the spark plugs to 20 N•m (15 lb–ft).

21. Install the EI system ignition coil and the EGR mounting bracket.

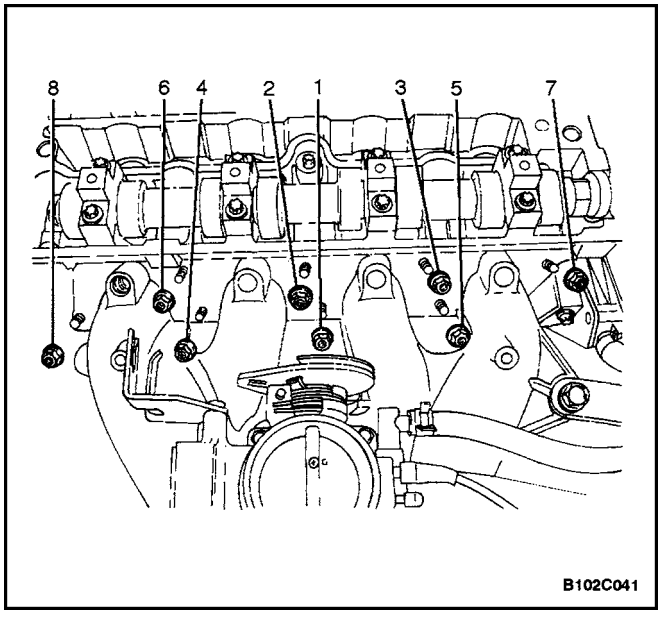
Tighten

Tighten the EI system ignition coil and EGR mounting bracket bolts to 25 N•m (18 lb–in).

22. Install the EI system ignition coil and EGR.

Tighten

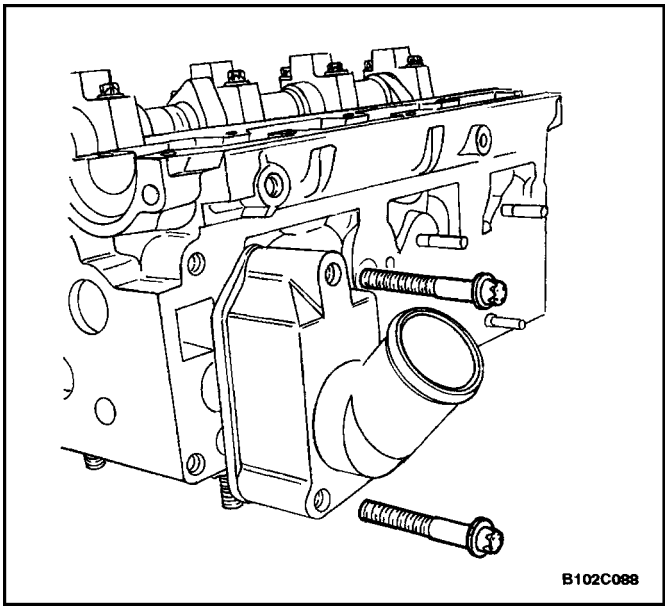
Tighten the EI system ignition coil and EGR to 10 N•m (89 lb–in).



23. Install the intake manifold studs.
24. Install the intake manifold gasket.
25. Install the intake manifold.
26. Install the intake manifold retaining nuts and bolts in the sequence shown.

Tighten

Tighten the intake manifold retaining nuts and bolts to 22 N•m (16 lb–ft).



27. Install the exhaust manifold studs.
28. Install the exhaust manifold gasket.
29. Install the exhaust manifold.
30. Install the exhaust manifold retaining nuts in the sequence shown and tighten four complete passed and tighten 1,2 and 3 bolt one more time.
31. Install the fuel rail assembly. Refer to *Section 1F, Engine Controls.*
32. Install the thermostat housing assembly.
33. Install the thermostat housing mounting bolts.

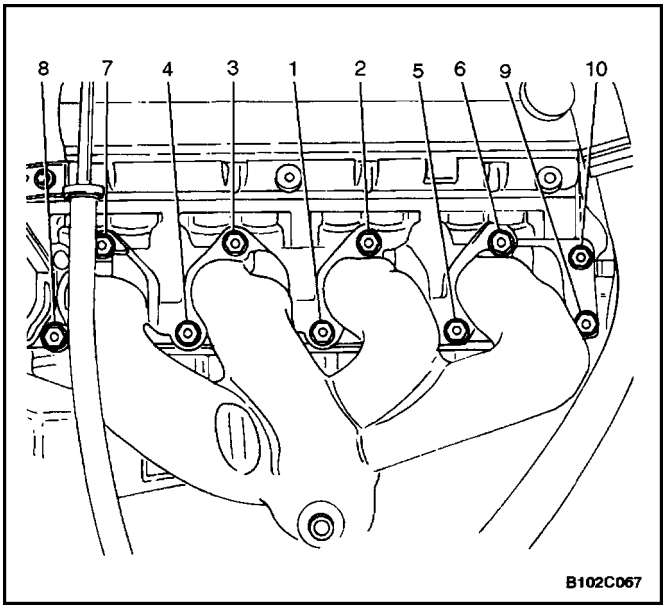
Tighten

Tighten the thermostat housing mounting bolts to 15 N•m (11 lb–ft).

34. Install the coolant bypass housing bolts.

Tighten

Tighten the coolant bypass housing bolts to 15 N•m (11 lb–ft).



Tighten

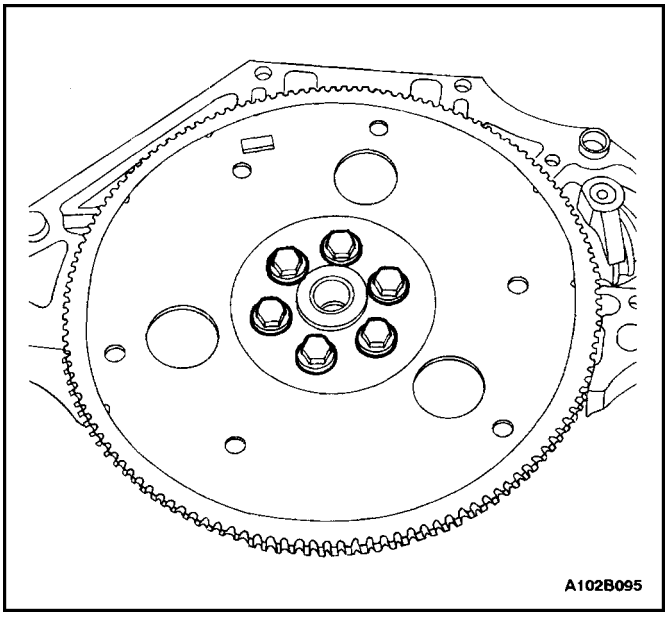
Tighten the exhaust manifold retaining nuts to 15 N•m (11 lb–ft).

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

Tighten

Tighten the exhaust manifold heat shield bolts to 8 N•m (71 lb–in).

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



CRANKSHAFT

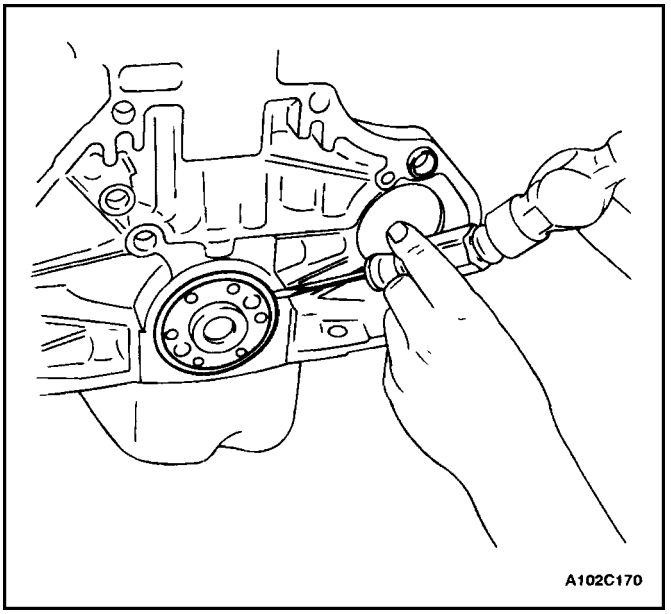
Tools Required

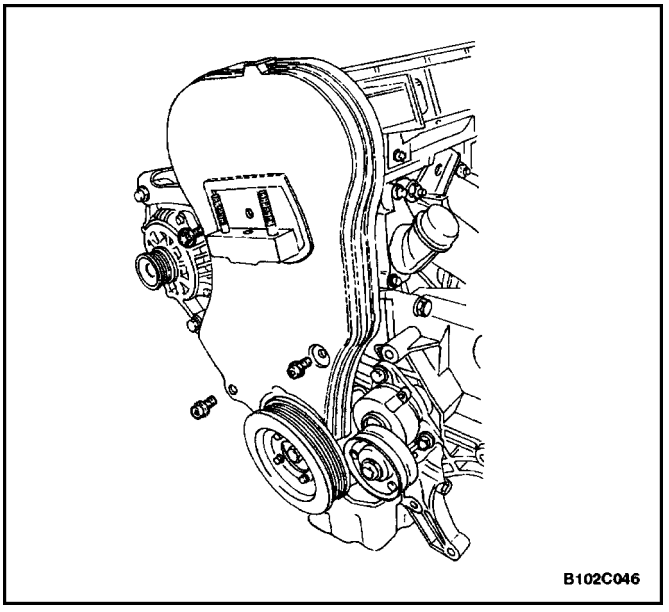
KM–412 Engine Overhaul Stand
KM–470–B Angular Torque Gauge
J–36792 or KM–635 Crankshaft Rear Oil Seal Installer

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

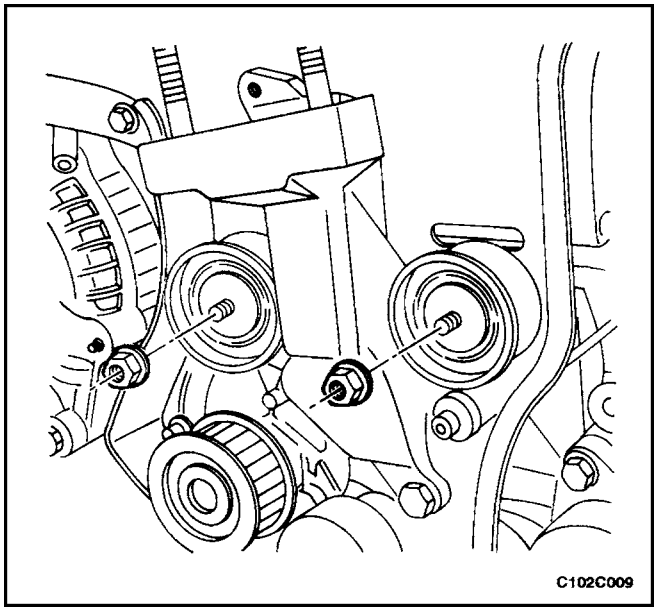
Disassembly Procedure

1. Remove the engine. Refer to ”Engine” in this section.
2. Remove the flywheel, or the flexible plate bolts for the automatic transaxle.
3. Remove the flywheel, or the flexible plate for the automatic transaxle.
4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the engine overhaul stand KM–412.

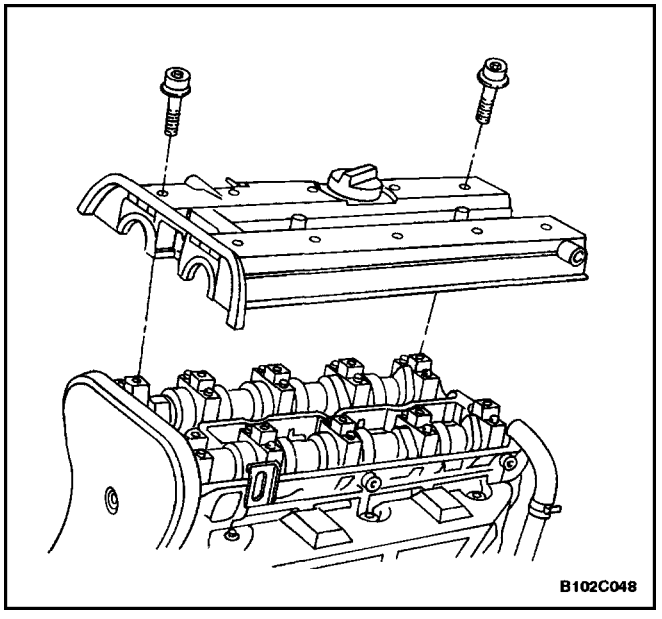




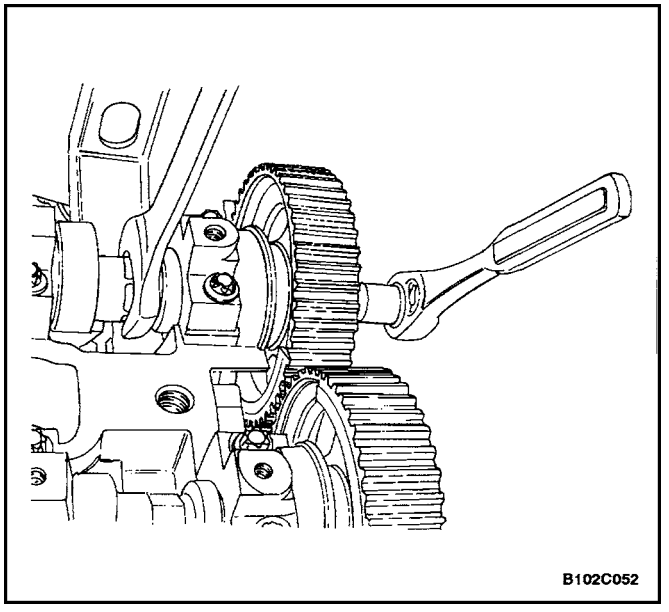
6. Remove the front timing belt cover bolts.
7. Remove the front timing belt cover.
8. Remove the crankshaft pulley bolts.
9. Remove the crankshaft pulley.



10. Loosen the timing belt automatic tensioner bolt.
11. Rotate the timing belt automatic tensioner hex–key clockwise to release the tension.
12. Remove the timing belt idler pulley nuts.
13. Remove the timing belt idler pulleys.
14. Remove the timing belt.
15. Remove the engine mount retaining bolts.
16. Remove the engine mount.

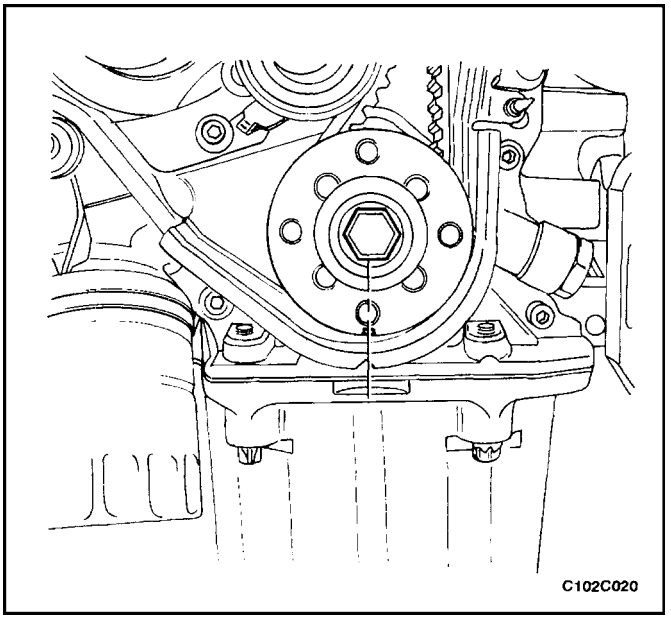


17. Disconnect the crankcase breather tubes from the valve cover.
18. Remove the spark plug cover bolts.
19. Remove the spark plug cover.
20. Disconnect the ignition wires from the spark plugs.
21. Remove the valve cover bolts.
22. Remove the valve cover washers.
23. Remove the valve cover and the valve cover gasket.

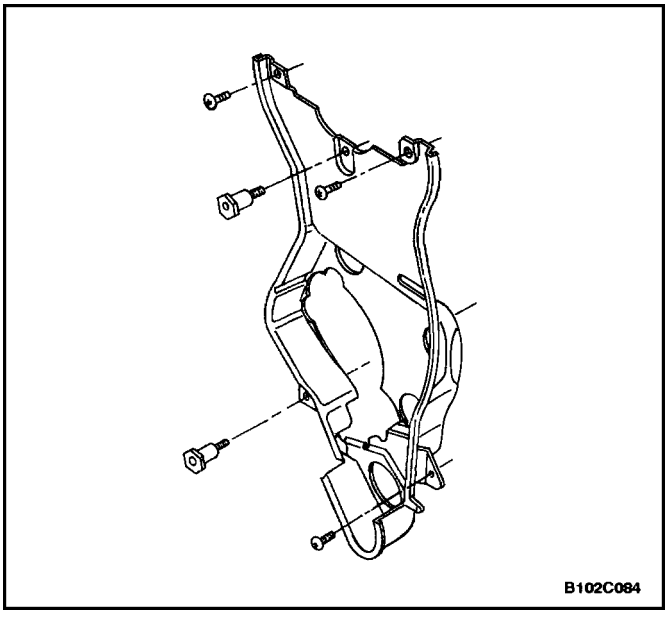


Notice : Take extreme care to prevent any scratches, nicks, or damage to the camshafts.

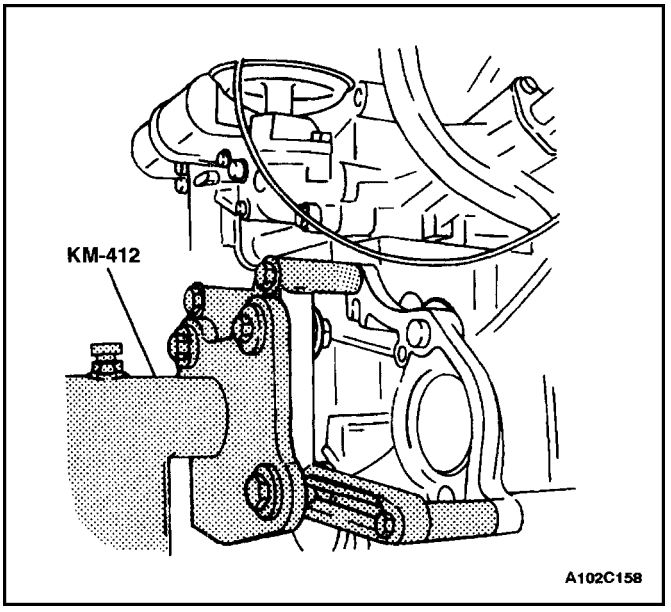
24. While holding the intake camshaft firmly in place, remove the intake camshaft bolt.
25. Remove the intake camshaft gear.
26. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft bolt.
27. Remove the exhaust camshaft gear.



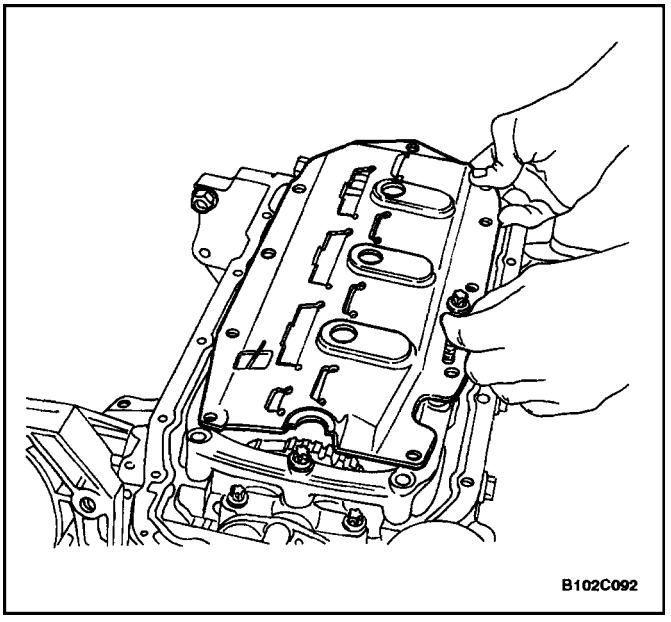
28. Remove the crankshaft timing belt gear.



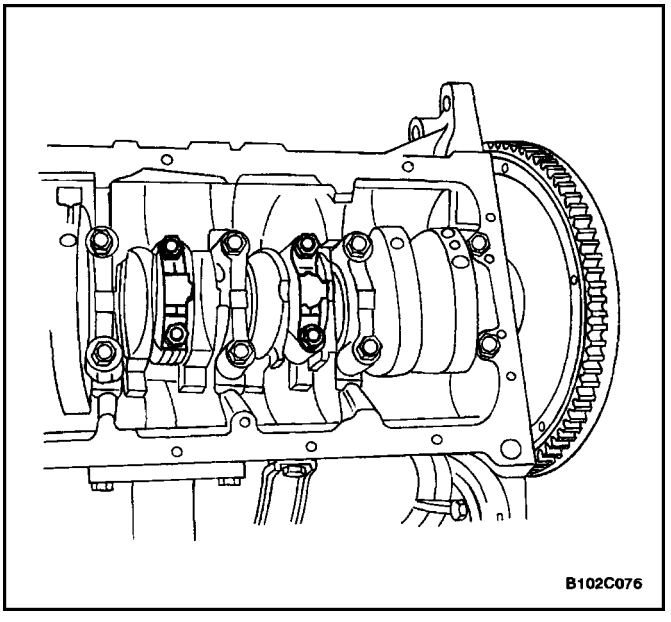
29. Remove the rear timing belt cover bolts and cover.



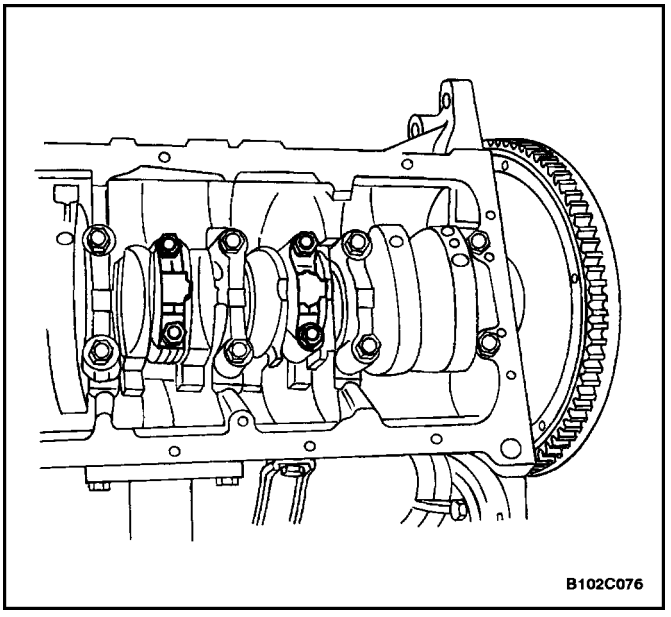
30. Rotate the engine on the engine overhaul stand KM–412.



31. Remove the oil pan retaining bolts.
32. Remove the oil pan.
33. Remove the oil pump pickup tube bolts.
34. Remove the oil pump pickup tube.
35. Remove the lower block support bracket/splash shield bolts.
36. Remove the splash shield.
37. Remove the lower block support bracket bolts.
38. Remove the lower block support bracket.



39. Remove the oil pump retaining bolts.
40. Remove the oil pump.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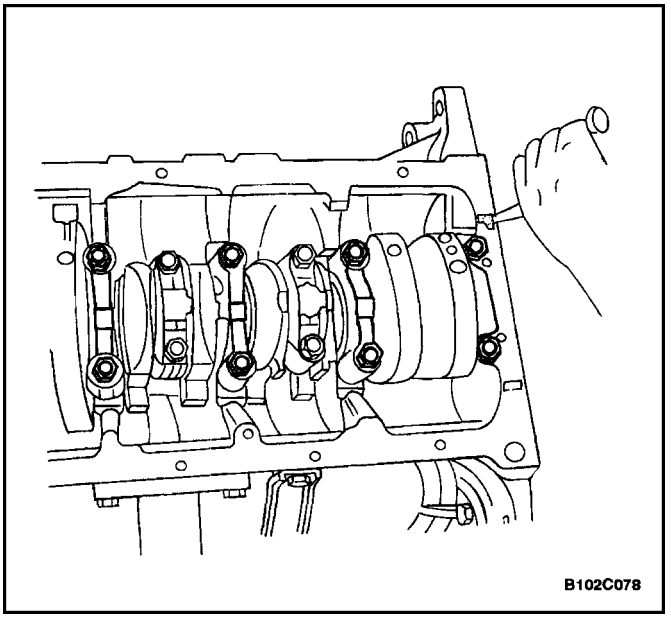
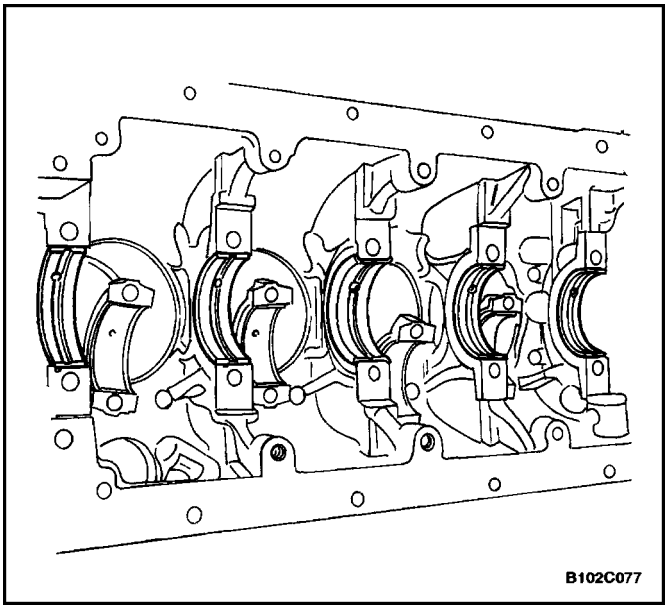
41. Mark the order of the connecting rod bearing caps.
42. Remove the connecting rod bearing cap bolts for all of the pistons.
43. Remove the connecting rod bearing caps and the lower connecting rod bearings.


B102C078

44. Mark the order of the crankshaft bearing caps.
45. Remove the crankshaft bearing cap bolts.
46. Remove the crankshaft bearing caps and the lower crankshaft bearings.
47. Remove the crankshaft.
48. Clean those parts that need it.

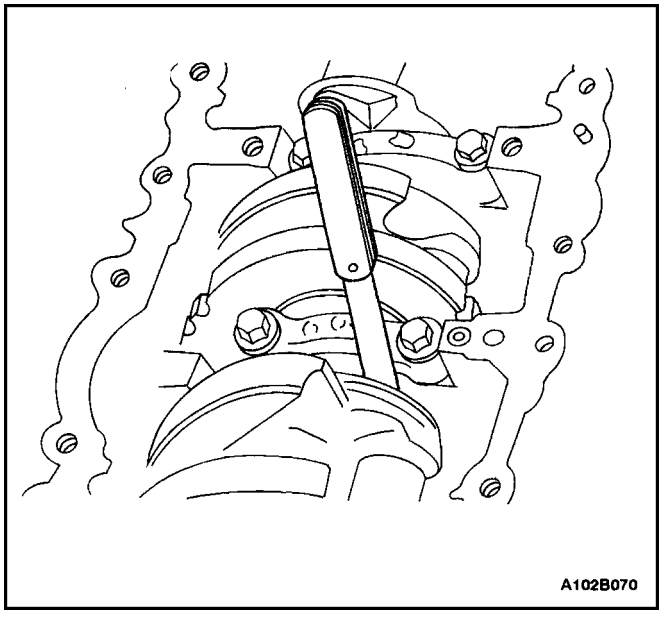

B102C077

Assembly Procedure

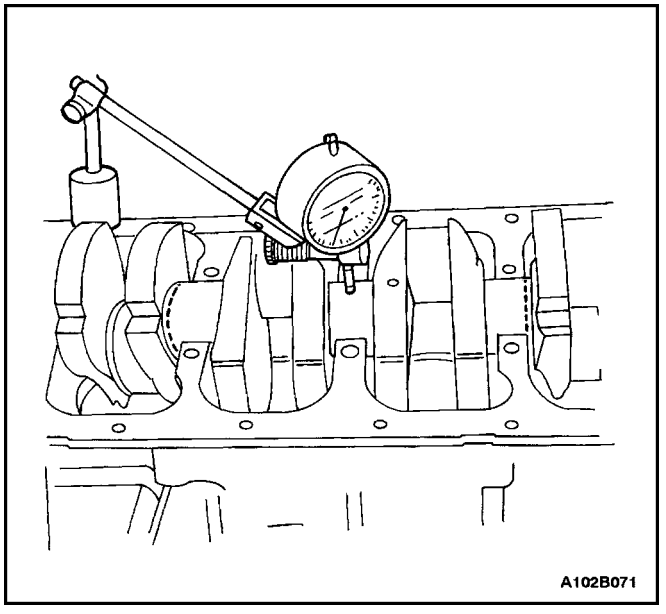
1. Coat the crankshaft bearings with engine oil.
2. If replacing the crankshaft, transfer the pulse pickup sensor disc to the new crankshaft.

Tighten

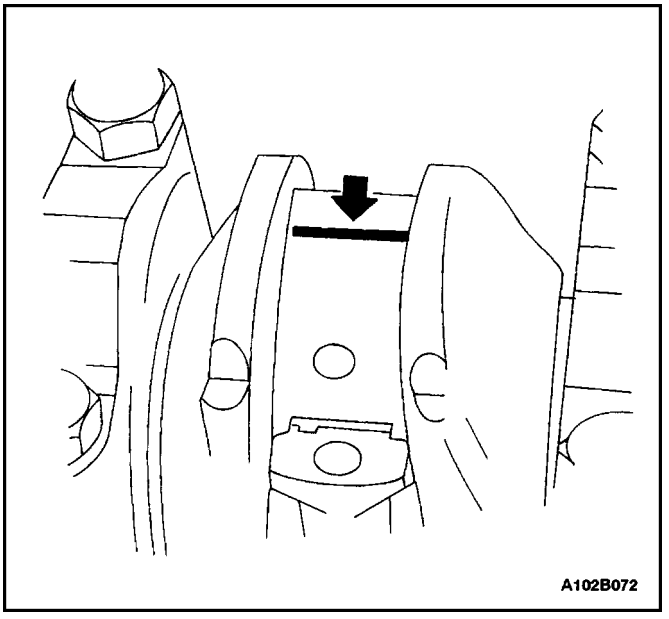
Tighten the pulse pickup sensor disc to 13 N•m (115 lb–in).


A102B070

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


A102B071

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

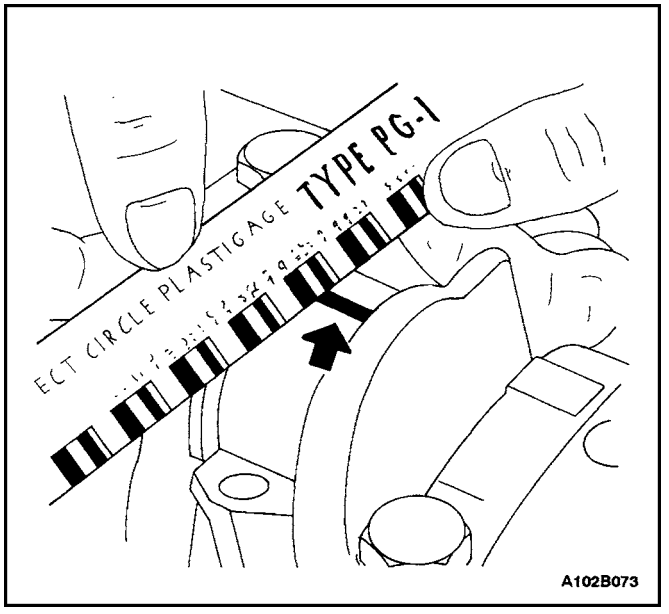

A102B072

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

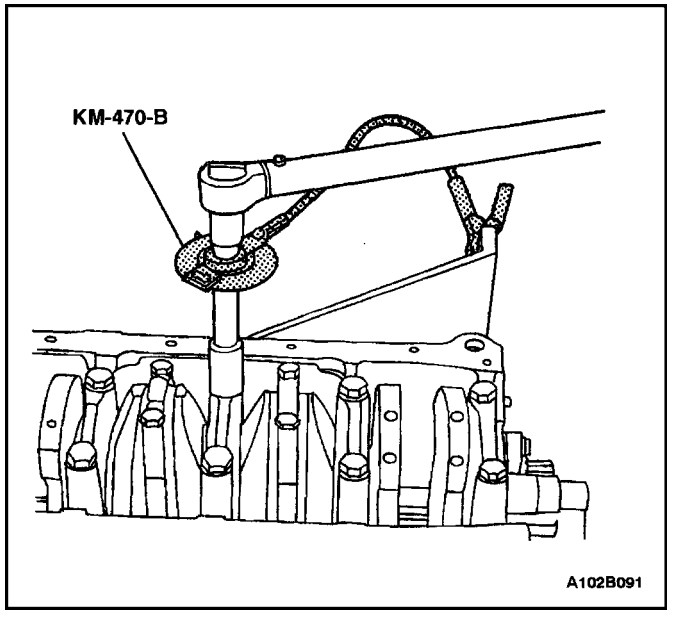
8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.
10. Install the crankshaft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

Tighten

Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb–ft). Using the angular torque gauge KM–470–B, tighten the bolt an additional turn of 45 degrees, plus another turn of 15 degrees.



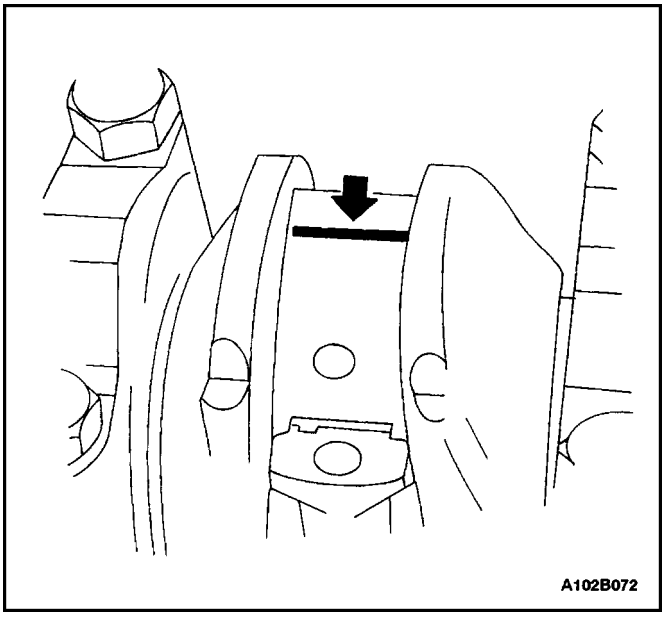
11. Remove the crankshaft bearing cap bolts and the caps.
12. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
13. Inspect the bearing clearance for permissible tolerance ranges. Refer to ”Engine Specifications” 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. Using the angular torque gauge KM–470–B, tighten the bolts an additional turn of 45 degrees, plus another turn of 15 degrees.

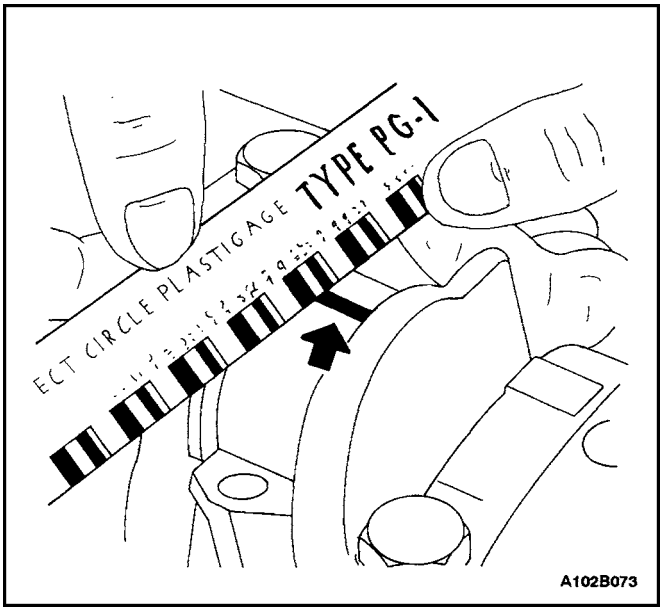


Important : Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gauging thread does not tear when the connecting rod bearing caps are removed.

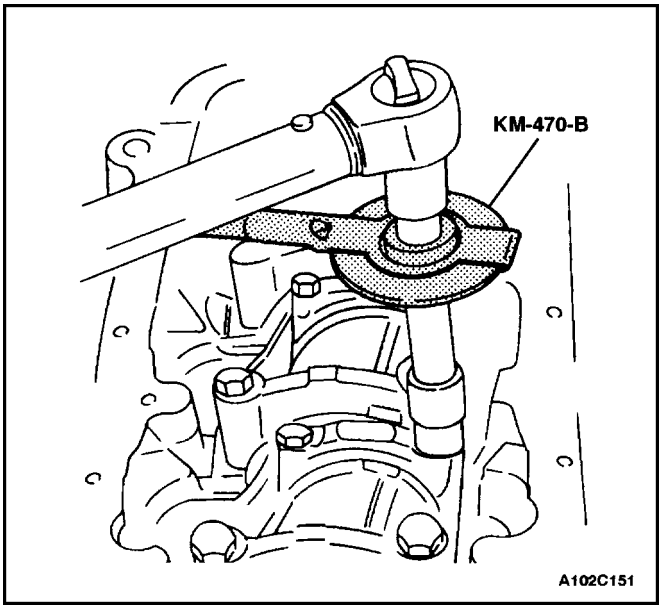
17. Inspect all of the connecting rod bearing clearances using a commercially available plastic gauging (ductile plastic threads).
18. Cut the plastic gauging threads to the length of the connecting rod bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.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

Tighten

Tighten the connecting rod bearing cap bolts to 35 N•m (26 lb–ft) using a torque wrench. Use the angular torque gauge KM–470–B to tighten the connecting rod bearing cap bolts another 45 degrees.



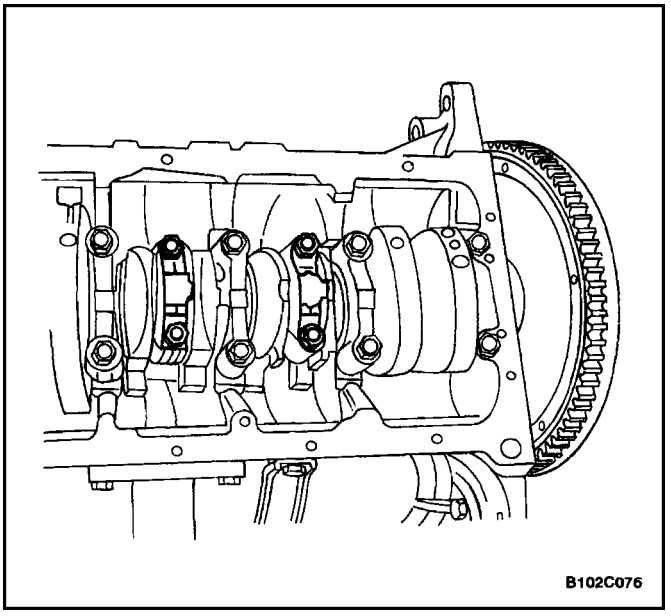
20. Remove the connecting rod bearing caps.
21. Measure the width of the flattened plastic thread of the plastic gauging using a ruler. (Plastic gauging is available for different tolerance ranges.)
22. Inspect the bearing clearance for permissible tolerance ranges. Refer to ”Engine Specifications” in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



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

Tighten

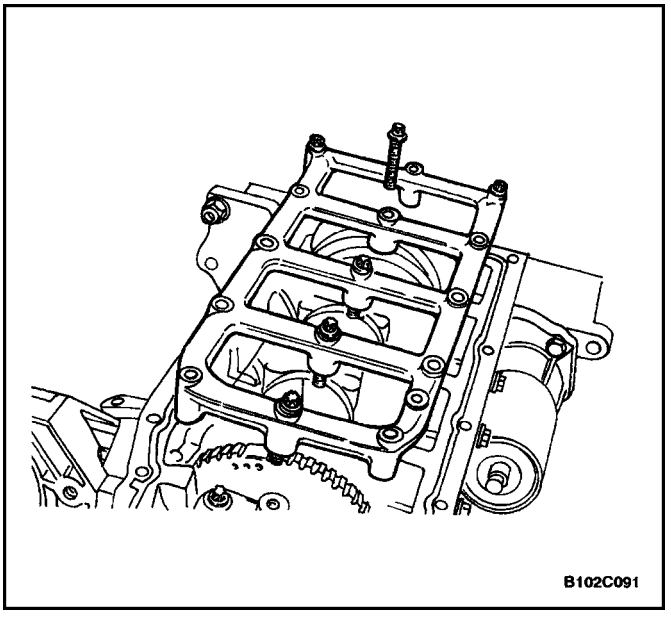
Tighten the connecting rod bearing cap bolts to 35 N•m (26 lb–ft) using a torque wrench. Use the angular torque gauge KM–470–B to tighten the connecting rod cap bolts another 45 degrees plus 15 degrees.



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).


B102C091

27. Install the engine block lower support bracket and the bolts.

Tighten

Tighten the engine block lower support bracket bolts to 35 N•m (26 lb–in).

28. Install the engine block lower support bracket splash shield and the bolts.

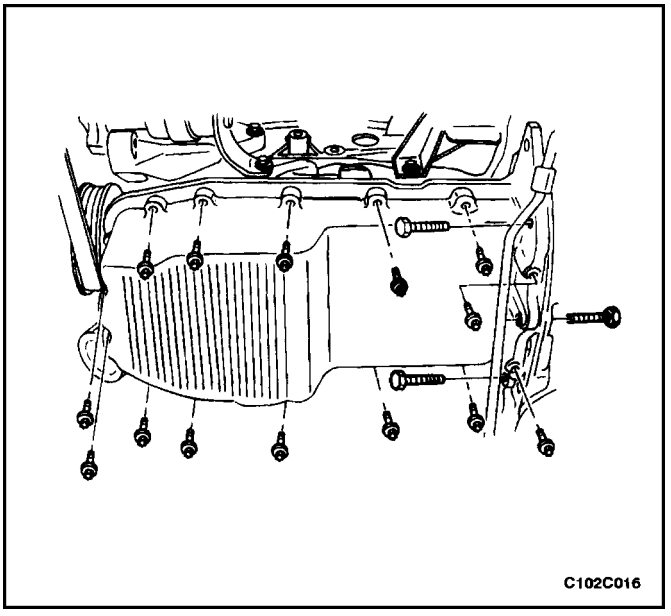
Tighten

Tighten the engine block lower support bracket splash shield bolts to 35 N•m (26 lb–ft).

29. Install the oil pump pickup tube.
30. Install the oil pump pickup tube bolts.

Tighten

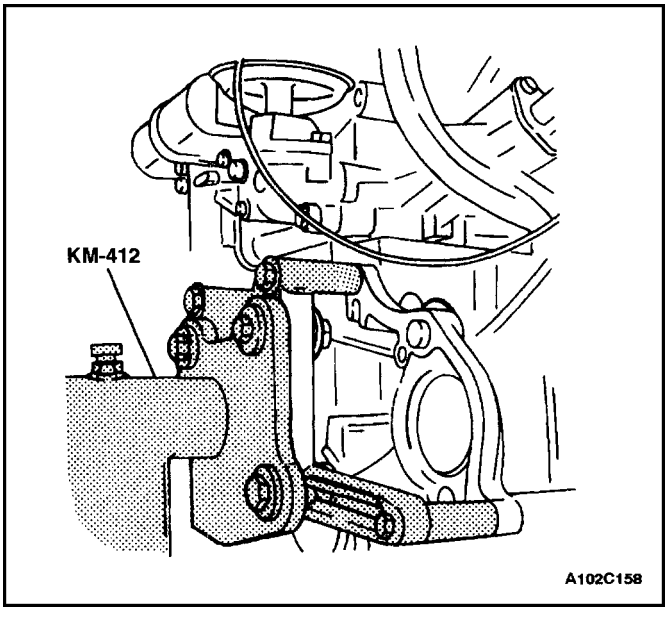
Tighten the oil pump pickup tube bolts to 8 N•m (71 lb–in).


C102C016

31. Coat the new oil pan gasket with the sealant.
32. Install the oil pan gasket to the oil pan.
33. Install the oil pan.
34. Install the oil pan retaining bolts.

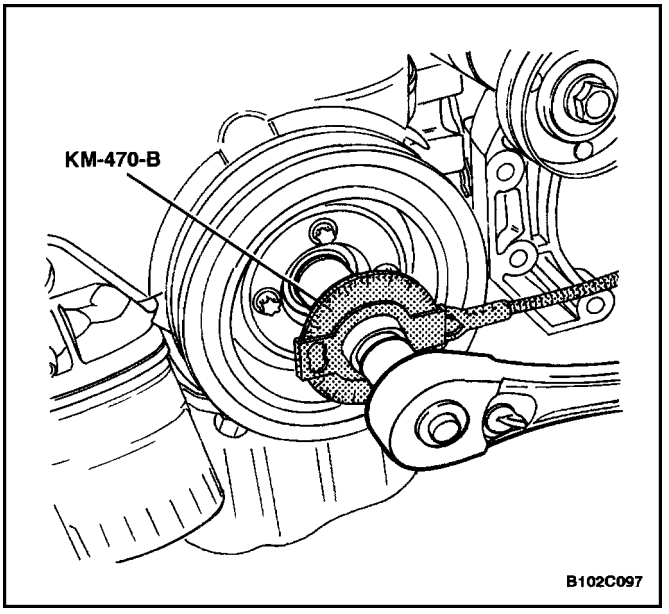
Tighten

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



A102C158

35. Rotate the engine on the engine overhaul stand KM–412.



36. Install the rear timing belt cover.
37. Install the rear timing belt cover bolts.

Tighten

Tighten the rear timing belt cover bolts to 6 N•m (53 lb–in).

38. Install the crankshaft timing belt drive gear and the bolt.

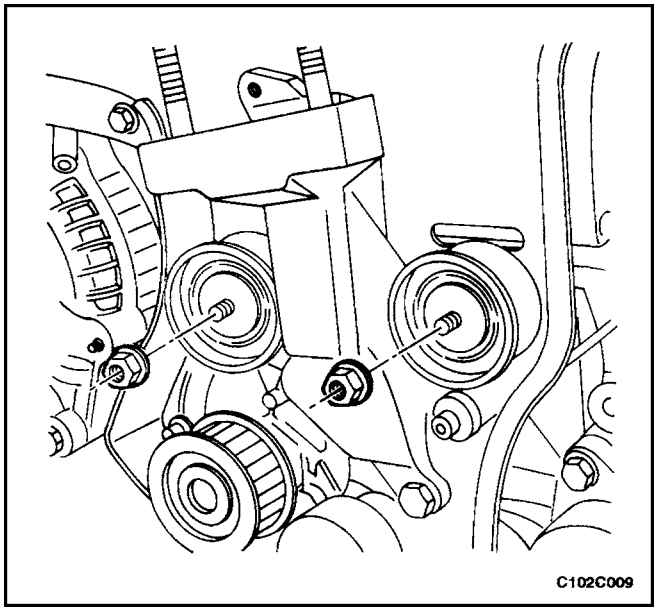
Tighten

Tighten the crankshaft timing belt drive gear bolt to 130 N•m (96 lb–ft). Using the angular torque gauge KM–470–B, tighten the bolt an additional turn of 40 to 50 degrees.

39. Install the engine mount and the retaining bolts.

Tighten

Tighten the engine mount bolts to 60 N•m (44 lb–ft).



40. Install the timing belt automatic tensioner.
41. Install the timing belt automatic tensioner bolts.

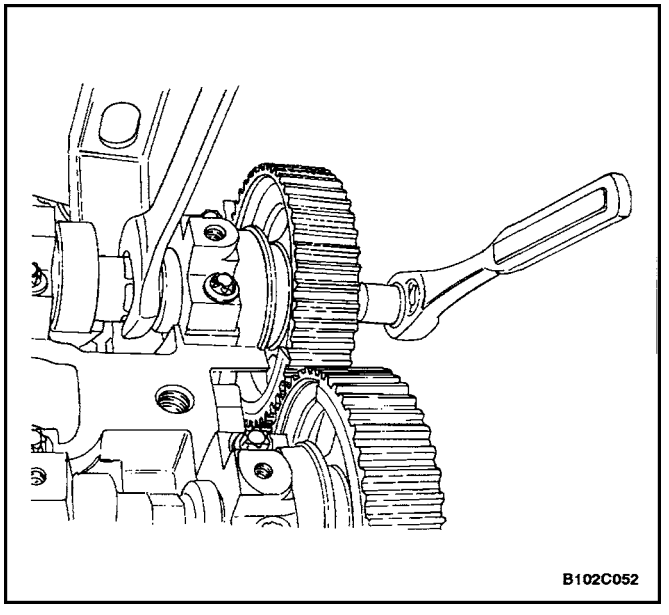
Tighten

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

42. Install the timing belt idler pulley.
43. Install the timing belt idler pulley nuts.

Tighten

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



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

44. Install the intake camshaft gear.
45. Install the intake camshaft gear bolt while holding the intake camshaft firmly in place.

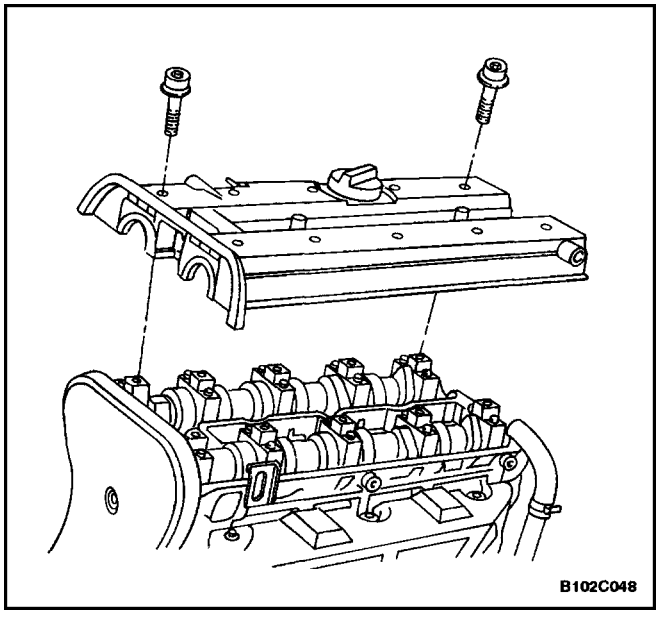
Tighten

Tighten the intake camshaft gear bolt to 50 N•m (37 lb–ft). Using the angular torque gauge KM–470–B, tighten the bolt an additional turn of 60 degrees, plus another turn of 15 degrees.

46. Install the exhaust camshaft gear.
47. Install the exhaust camshaft gear bolt while holding the exhaust camshaft firmly in place.

Tighten

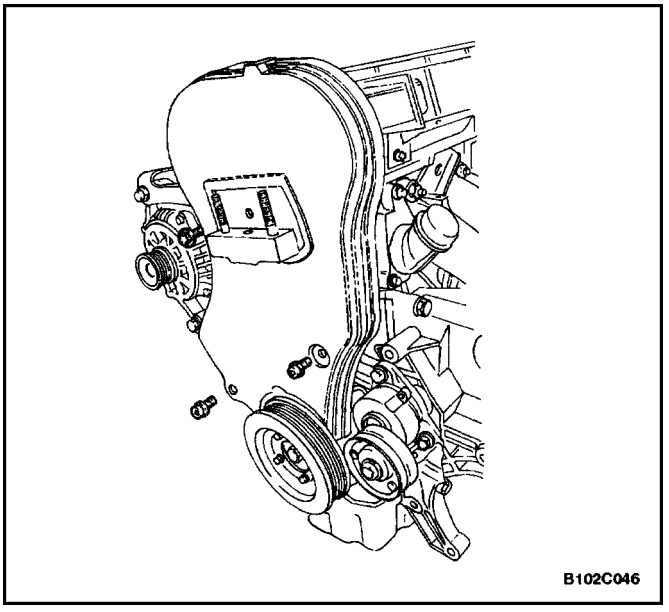
Tighten the exhaust camshaft gear bolt to 50 N•m (37 lb–ft). Using the angular torque gauge KM–470–B, tighten the bolt an additional turn of 60 degrees, plus another turn of 15 degrees.



48. Install the timing belt. Refer to ”Timing Belt” in this section.
49. Adjust the timing belt tension. Refer to ”Timing Belt Check and Adjust” in this section.
50. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear valve cover to the cylinder head seal.
51. Install the valve cover and the valve cover gasket.
52. Install the valve cover washers.
53. Install the valve cover bolts.

Tighten

Tighten the valve cover bolts to 8 N•m (71 lb–in).



54. Connect the ignition wires to the spark plugs.
55. Install the spark plug cover.
56. Install the spark plug cover bolts.

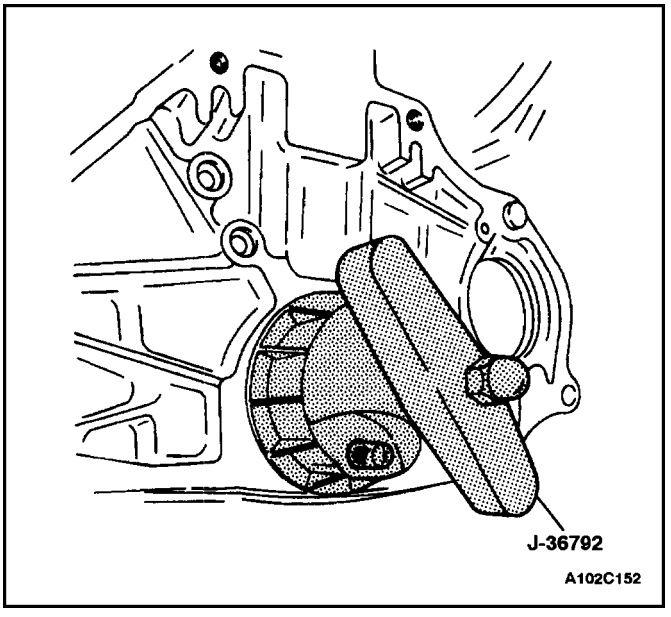
Tighten

Tighten the spark plug cover bolts to 3 N•m (27 lb–in).

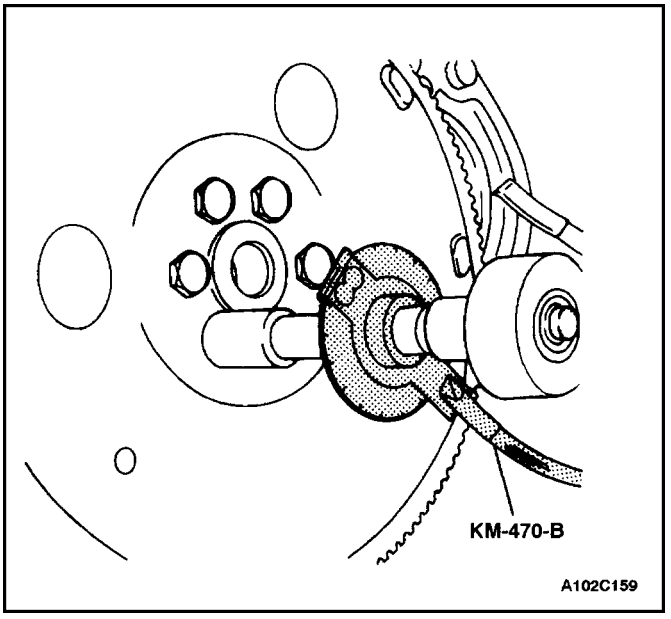
57. Connect the crankcase breather tube to the valve cover.
58. Install the front timing belt cover.
59. Install the front timing belt cover bolts.

Tighten

Tighten the front timing belt cover bolts to 8 N•m (71 lb–in).



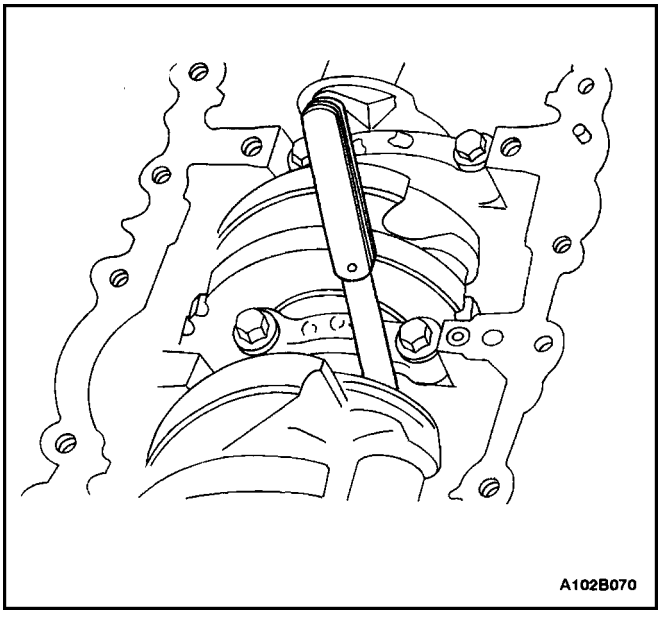
60. Install the engine lifting device.
61. Remove the engine from the engine overhaul stand KM–412.
62. Install a new crankshaft rear oil seal using installer J–36792 or KM–635.

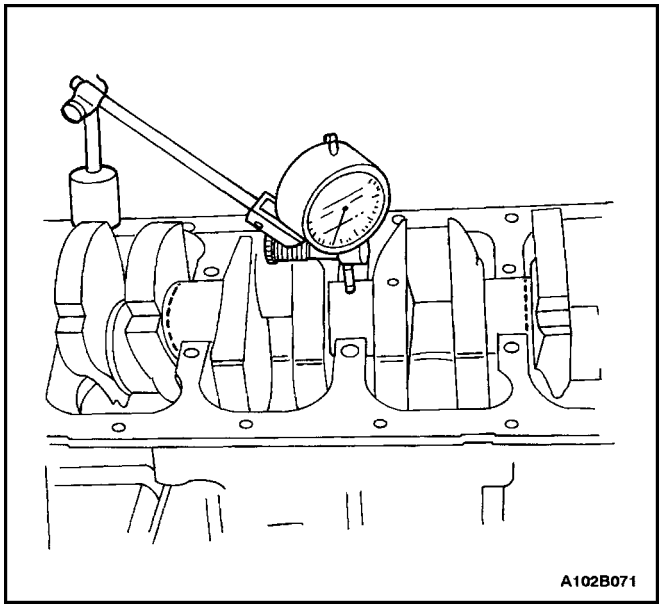


63. Install the flywheel, or flexible plate for a vehicle with an automatic transaxle.
64. Install the flywheel, or the flexible plate bolts for a vehicle with an automatic transaxle.

    Tighten

    Tighten the flywheel bolts to 65 N•m (48 lb–ft). Use the angular torque gauge KM–470–B to tighten the flywheel bolts another 30 degrees plus 15 degrees. For the automatic transaxle, tighten the flexible plate bolts to 65 N•m (48 lb–ft).
65. Install the engine. Refer to ”Engine” in this section.





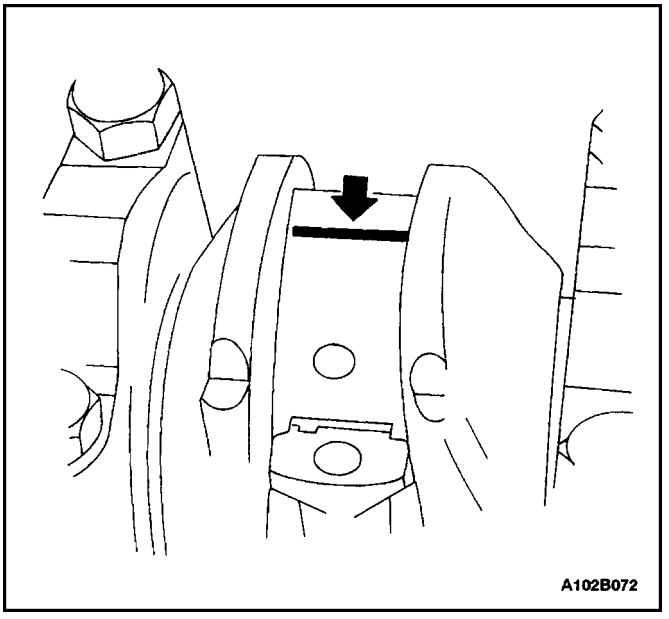
CRANKSHAFT BEARINGS AND CONNECTING ROD BEARINGS – GAUGING PLASTIC

Tools Required

KM–470–B Angular Torque Gauge

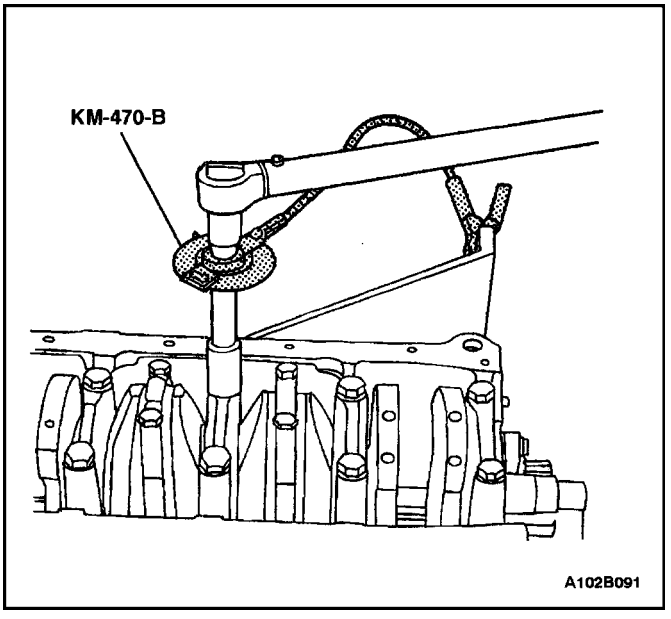
Inspection Procedure – Crankshaft

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 the rear crankshaft bearings, check the middle crankshaft journal for permissible out–of–round (runout). Refer to ”Engine Specifications” in this section.



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

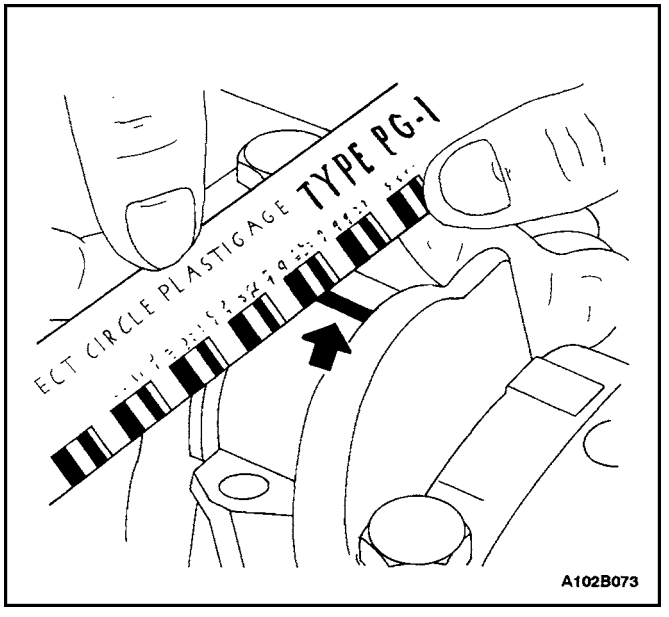
8. Inspect all of the crankshaft bearing clearances using a commercially available plastic gauging (ductile plastic threads).
9. Cut the plastic gauging threads to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.



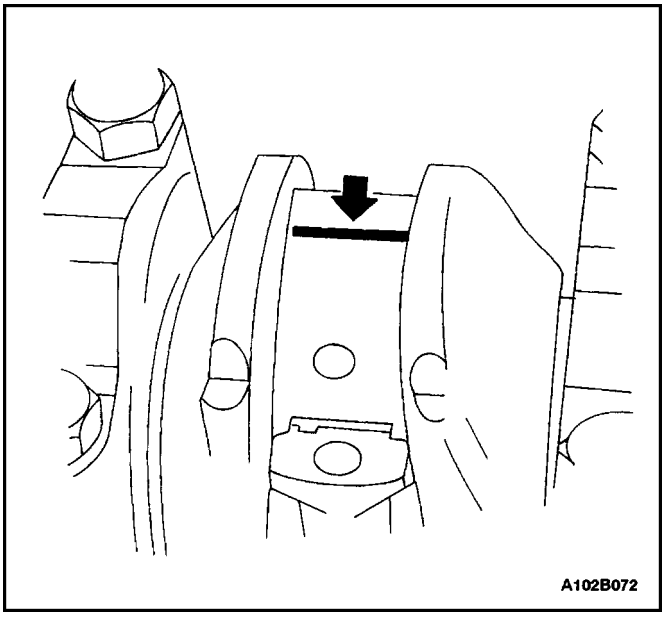
10. Install the crankshaft bearing caps.
11. Install the crankshaft bearing cap bolts.

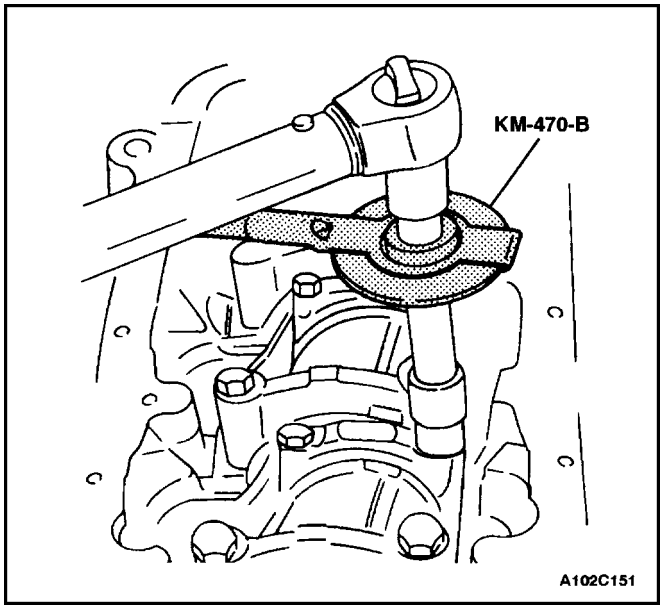
Tighten

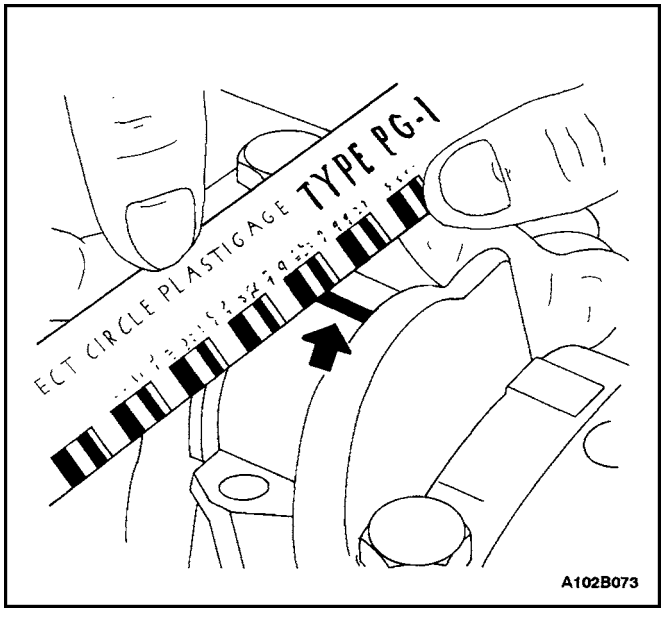
Tighten the crankshaft bearing cap bolts to 50 N•m (37 lb–ft). Using the angular torque gauge KM–470–B, tighten the bolts an additional turn of 45 degrees, plus another turn of 15 degrees.



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.

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.

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 35 N•m (26 lb–ft). Using the angular torque gauge KM–470–B, tighten the connecting rod cap bolts another 45 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.