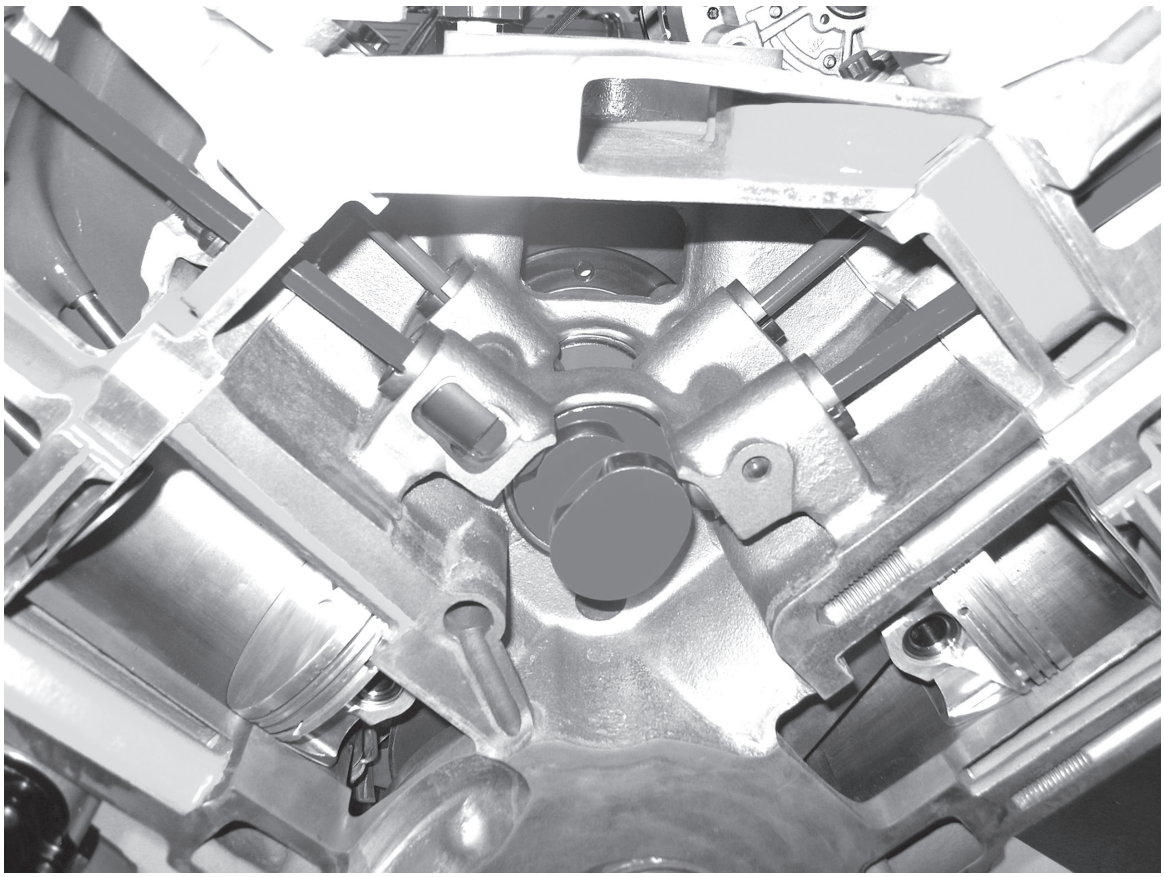
Engine Repair (A1)



ENGINE REPAIR TEST CONTENT AREAS

This ASE study guide for Engine Repair (A1) is divided into the sub-content areas that correlate to the actual ASE certification test as follows:

CONTENT AREA	NUMBER OF QUESTIONS IN TEST	NUMBER OF STUDY GUIDE QUESTIONS
A. General Engine Diagnosis	15	32 (1–32)
B. Cylinder Head and Valve Train Diagnosis and Repair	10	43 (33–75)
C. Engine Block Diagnosis and Repair	10	43 (76–118)
D. Lubrication and Cooling Systems Diagnosis and Repair	8	17 (119–135)
E. Fuel, Electrical, Ignition, and Exhaust Systems Inspection and Service	7	18 (136–153
TOTAL	**50**	**153**

TIME ALLOWED TO TAKE THE TEST

The allocated time to take the Engine Repair Certification test is 75 minutes. ASE adds 10 additional questions to the test for research purposes. These questions do not count toward your score, but they are embedded within the test and there is no way of knowing which ones do not count. As a result, the technician needs to answer 60 questions in 75 minutes, or about one question per minute.

If taking the recertification A1 test, there are just 25 questions with no additional research questions included. The time allocated to take the recertification test is 30 minutes, which means about one minute per question.

BEFORE USING THIS STUDY GUIDE

Before trying to answer the questions and looking at the explanations, look over the following list of the content that ASE states will be covered in the certification test. For best results using this study guide, check service information or consult an automotive textbook for details on any of the content areas that are not familiar before trying to answer the questions. For additional information about the ASE test, visit the website at **www.ase.com**.

ENGINE REPAIR (A1) CERTIFICATION TEST

A. GENERAL ENGINE DIAGNOSIS (15 QUESTIONS)

1. Verify the driver's complaint and/or road-test the vehicle; determine needed action.
2. Determine if the no-crank, no-start, or hard starting condition is an ignition system, cranking system, fuel system, or engine mechanical problem.
3. Inspect the engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
4. Listen to engine noises; determine needed action.
5. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color, odor, and sound; determine needed action.
6. Perform engine vacuum tests; determine needed action.
7. Perform cylinder power balance tests; determine needed action.
8. Perform cylinder compression tests; determine needed action.
9. Perform cylinder leakage tests; determine needed action.

B. CYLINDER HEAD AND VALVE TRAIN DIAGNOSIS AND REPAIR (10 QUESTIONS)

1. Remove cylinder heads, disassemble, clean, and prepare for inspection.
2. Visually inspect cylinder heads for cracks, warpage, corrosion, leakage, and the condition of passages; determine needed repairs.
3. Inspect and repair damaged threads where allowed; install core and gallery plugs.
4. Inspect, test, and verify valve springs for squareness, pressure, and free height comparison; replace as necessary.
5. Inspect valve spring retainers, rotators, locks/keepers, and lock grooves.
6. Replace valve stem seals.
7. Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed repairs.
8. Inspect valves and valve seats; determine needed repairs.
9. Check valve spring installed (assembled) height and valve stem height; determined needed repairs.
10. Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages; repair or replace as required.
11. Inspect and replace hydraulic or mechanical lifters/lash adjusters.
12. Adjust valves on engines with mechanical or hydraulic lifters.
13. Inspect and replace camshaft(s) (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components).
14. Inspect and measure camshaft journals and lobes; measure camshaft lift.
15. Inspect and measure camshaft bore for wear, damage, out-of-round, and alignment; determine needed repairs.
16. Inspect valve timing; time camshaft(s) to crankshaft.
17. Inspect cylinder head mating surface condition and finish; reassemble and install gasket(s) and cylinder head(s); replace/torque bolts according to manufacturers' procedures.

C. ENGINE BLOCK DIAGNOSIS AND REPAIR (10 QUESTIONS)

1. Disassemble engine block and clean and prepare components for inspection.
2. Visually inspect engine block for cracks, corrosion, passage condition, core and gallery plug holes, and surface warpage; determine needed action.
3. Inspect and repair damaged threads where allowed; install core and gallery plugs.
4. Inspect and measure cylinder walls; remove cylinder wall ridges; hone and clean cylinder walls; determine need for further action.
5. Visually inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; check crankshaft sensor reluctor ring (where applicable); determine needed action.
6. Inspect and measure main bearing bores and cap alignment and fit.
7. Install main bearings and crankshaft; check bearing clearances and end play; replace/retorque bolts according to manufacturers' procedures.
8. Inspect camshaft bearings for unusual wear; remove and replace camshaft bearings; install camshaft, timing chain, and gears; check end play.
9. Inspect auxiliary (balance, intermediate, idler, counterbalance, or silencer) shaft(s) and support bearings for damage and wear; determine needed action.
10. Inspect, measure, service, repair, or replace pistons, piston pins, and pin bushings; identify piston and bearing wear patterns that indicate connecting rod alignment problems; determine needed action.
11. Inspect connecting rods for damage, alignment, bore condition, and pin fit; determine needed action.
12. Inspect, measure, and install or replace piston rings; assemble piston and connecting rod; install piston/rod assembly; check bearing clearance and sideplay; replace/retorque fasteners according to manufacturers' procedures.
13. Inspect, reinstall, or replace crankshaft vibration damper (harmonic balancer).
14. Inspect crankshaft flange and flywheel mating surfaces; inspect and replace crankshaft pilot bearing/bushing (if applicable); inspect flywheel/flexplate for cracks and wear (includes flywheel ring gear); measure flywheel runout; determine needed action.
15. Inspect and replace pans, covers, gaskets, and seals.
16. Assemble engine parts using formed-in-place (tube-applied) sealants or gaskets, according to manufacturers' specifications; reinstall engine.

D. LUBRICATION AND COOLING SYSTEMS DIAGNOSIS AND REPAIR (8 QUESTIONS)

1. Diagnose engine lubrication system problems; perform oil pressure tests; determine needed action.
2. Disassemble and inspect oil pump (includes gears, rotors, housing, and pick-up assembly); measure oil pump clearance; inspect pressure relief devices and pump drive; determine needed action.
3. Inspect, test, and replace internal and external engine oil coolers.
4. Fill crankcase with oil and install engine oil filter.
5. Perform cooling system pressure tests; perform coolant dye test; determine necessary action.
6. Inspect and test radiator, heater core, pressure cap, and coolant recovery system; replace as required.
7. Inspect, replace, and adjust drive belt(s), tensioner(s), and pulleys.
8. Inspect and replace engine cooling system and heater system hoses, pipes and fittings.
9. Inspect, test, and replace thermostat, coolant bypass, and thermostat housing.
10. Inspect and test coolant; drain, flush, and refill cooling system with recommended coolant; bleed air as required.
11. Inspect and replace water pump.
12. Inspect and test fan (both electrical and mechanical), fan clutch, fan shroud, air dams, and cooling fan electrical circuits; repair or replace as required.
13. Verify proper operation of engine-related warning indicators.

E. FUEL, ELECTRICAL, IGNITION, AND EXHAUST SYSTEMS INSPECTION AND SERVICE (7 QUESTIONS)

1. Inspect, clean, or replace fuel injection system components, intake manifold, and gaskets.
2. Inspect, service, or replace air filters, filter housings, and intake ductwork.
3. Inspect turbocharger/supercharger; determine needed action.
4. Test engine cranking system; determine needed repairs.
5. Inspect and replace crankcase ventilation system components.
6. Inspect and install ignition system components; adjust timing.
7. Inspect and diagnose exhaust system; determine needed repairs.

ENGINE REPAIR (A1)

CATEGORY: GENERAL ENGINE DIAGNOSIS

1. Technician A says that oil should be squirted into all of the cylinders before taking a compression test. Technician B says that if the compression greatly increases when some oil is squirted into the cylinders, it indicates defective or worn piston rings. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

2. Two technicians are discussing oil leaks. Technician A says that an oil leak can be found using a fluorescent dye in the oil with a black light to check for leaks. Technician B says that a white spray powder can be used to locate oil leaks. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

3. Technician A says that a worn (stretched) timing chain and worn gears will cause the valve timing to be retarded. Technician B says that if the timing chain slack is over ½ inch (13 mm), the timing chain and gears should be replaced. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

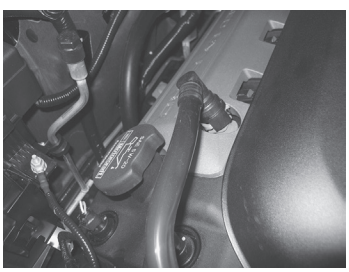
4. Leaking antifreeze can be what color?

a. Green
b. Orange
c. Red
d. Any of the above

5. An increase in oil viscosity can be due to _____.

a. wear metals in the oil
b. fuel dilution of the oil
c. a clogged air filter
d. any of the above

6. Oil is discovered inside the air cleaner assembly. Technician A says that the cause could be excessive blowby past the piston rings. Technician B says that the cause could be a clogged PCV valve, hose, or passage. Which technician is correct?



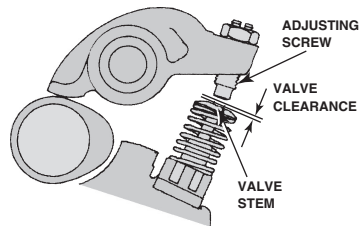
a. Technician A
b. Technician B
c. Both A and B
d. Neither A nor B

7. Two technicians are discussing the cause of low oil pressure. Technician A says that a worn oil pump could be the cause. Technician B says that worn main or rod bearings could be the cause. Which technician is correct?

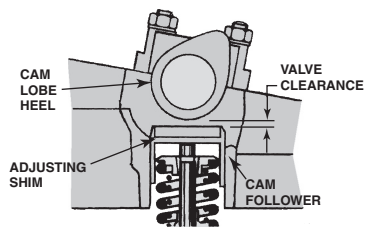
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

8. A noisy valve train is being diagnosed. Technician A says that the rocker arm may be adjusted too tightly. Technician B says that the rocker arm may be adjusted too loosely or may be worn. Which technician is correct?

   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B



(a)



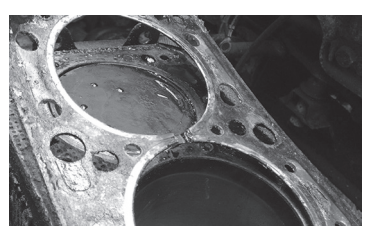
(b)

9. Two technicians are diagnosing a problem with an OHV V-8 with flat-bottom lifters. The valve covers have been removed and the engine is running. One pushrod is not rotating. Technician A says that the camshaft is worn and must be replaced. Technician B says that the lifter is worn and must be replaced. Which technician is correct?

   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

10. A head gasket failure is being diagnosed. Technician A says that an exhaust analyzer can be used to check for HC when the tester probe is held above the radiator coolant. Technician B says that a combustion tester liquid changes color in the presence of combustion gases. Which technician is correct?

   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B



11. Excessive exhaust system back pressure has been measured. Technician A says that the catalytic converter may be clogged. Technician B says that the muffler may be clogged. Which technician is correct?

   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

12. Technician A says that black exhaust smoke is an indication of a too-rich air-fuel mixture. Technician B says that white smoke (steam) is an indication of coolant being burned in the engine. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

13. Technician A says that cranking vacuum should be the same as idle vacuum. Technician B says that a sticking valve is indicated by a floating valve gauge needle reading. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

14. Two technicians are discussing a cylinder power balance test. Technician A says the more the engine RPM drops, the weaker the cylinder. Technician B says that all cylinder RPM drops should be within 50 RPM of each other. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

15. A cylinder leakage (leak-down) test indicates 30% leakage, and air is heard coming out of the air inlet. Technician A says that this is a normal reading for a slightly worn engine. Technician B says that one or more intake valves are defective. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

16. During a cylinder leakage (leak-down) test, air is noticed coming out of the oil fill opening. Technician A says that the oil filter may be clogged. Technician B says that the piston rings may be worn or defective. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

17. The low oil pressure warning light usually comes on _____.

a. whenever an oil change is required
b. whenever oil pressure drops dangerously low (3 to 7 psi)
c. whenever the oil filter bypass valve opens
d. whenever the oil filter anti-drain-back valve opens

18. Two technicians are discussing a compression test. Technician A says that the engine should be cranked over with the pressure gauge installed for "3 puffs." Technician B says that the maximum difference between the highest-reading cylinder and the lowest-reading cylinder should be 20%. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

19. A compression test gave the following results:
cylinder #1 = 155, cylinder #2 = 140, cylinder #3 = 110, cylinder #4 = 105. Technician A says that a defective (burned) valve is the most likely cause. Technician B says that a leaking head gasket could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

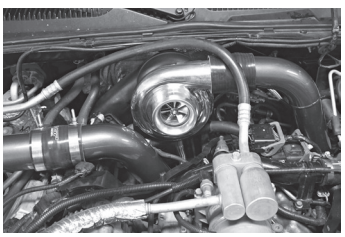
20. An engine noise is being diagnosed. Technician A says that a double knock is likely to be due to a worn rod bearing. Technician B says that a knock only when the engine is cold is usually due to a worn piston pin. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

21. Two technicians are discussing how to perform a road test to verify the customer's concerns about noise from the engine. Technician A says that the owner should drive and the technician ride along to verify the problem. Technician B says that the vehicle should be driven next to a building to better hear engine noise as it bounces off the walls. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

22. An engine equipped with a turbocharger is burning oil (blue exhaust smoke all the time). Technician A says that a defective wastegate could be the cause. Technician B says that a plugged PCV system could be the cause. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

23. An engine cranks rapidly but does not start. Technician A says that a defective coil on a waste-spark-type ignition could be the cause. Technician B says that a broken timing belt could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

24. An engine uses an excessive amount of oil. Technician A says that clogged oil drain-back holes in the cylinder head could be the cause. Technician B says that worn piston rings could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

25. Two technicians are discussing engine and transmission/transaxle mounts. Technician A says that a defective (collapsed) mount can cause an engine or driveline vibration. Technician B says that some mounts are fluid filled and should be checked for leakage. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

26. An engine is misfiring. A power balance test indicates that when the spark to cylinder #4 is grounded, there is no change in the engine speed. Technician A says that a burned valve is a possible cause. Technician B says that a defective cylinder #4 injector or spark plug wire could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

27. Technician A says that white exhaust can be caused by a defective cylinder head gasket allowing coolant to enter the combustion chamber. Technician B says a leaking fuel injector can be the cause of white exhaust smoke. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

28. Cranking vacuum should be _____.

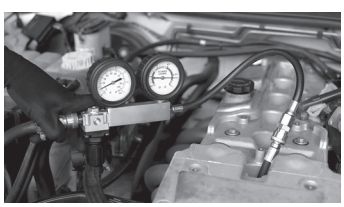
a. 2.5 inches Hg or higher
b. over 25 inches Hg
c. 17 to 21 inches Hg
d. 6 to 16 inches Hg

29. Technician A says that during a power balance test, the cylinder that causes the biggest RPM drop is the weak cylinder. Technician B says that if one spark plug wire is grounded out and the engine speed does not drop, a weak or dead cylinder is indicated. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

30. A good reading for a cylinder leakage test would be _____.

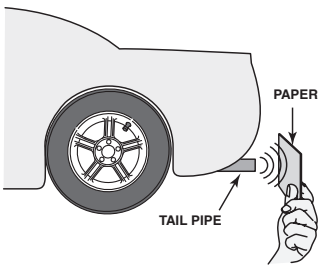
a. within 20% among cylinders
b. all cylinders below 20% leakage
c. all cylinders above 20% leakage
d. all cylinders above 70% leakage and within 7% of each other



31. A smoothly operating engine depends on _____.

a. high compression on most cylinders
b. equal compression among cylinders
c. cylinder compression levels above 100 psi (700 kPa) and within 70 psi (500 kPa) of each other
d. compression levels below 100 psi (700 kPa) on most cylinders

32. Technician A says that the paper test shown could detect a burned valve. Technician B says that a grayish-white stain could be a coolant leak. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

CATEGORY: CYLINDER HEAD AND VALVE TRAIN DIAGNOSIS AND REPAIR

33. Two technicians are discussing torquing cylinder head bolts. Technician A says that many engine manufacturers recommend replacing the head bolts after their first use. Technician B says that many manufacturers recommend tightening the head bolts to a specific torque, then turning the bolts an additional number of degrees. Which technician is correct?

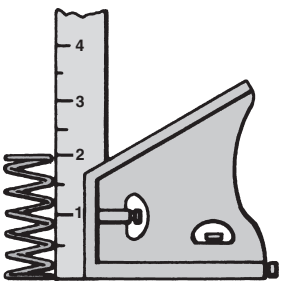
a. A only
b. B only
c. Both A and B
d. Neither A nor B

34. Two technicians are discussing timing the camshaft to the crankshaft. Technician A says that marks are often provided on the cam and crank gears or pulley so that the engine can be properly timed. Technician B says that some engines use a camshaft sprocket or gear that is not keyed to the camshaft. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

35. The setup shown is being used to check _____.

a. valve spring installed height
b. valve stem height
c. valve spring squareness and free height
d. valve spring tension



36. Cleaning chemicals are usually either a alkaline (caustic) material or an acid material. Which of the following statements is true?

a. Both alkaline and acids have a pH of 7 if rated according to distilled water.
b. An acid is lower than 7 and a alkaline is higher than 7 on the pH scale.
c. An acid is higher than 7 and a alkaline is lower than 7 on the pH scale.
d. Pure water is a 1 and a strong acid is a 14 on the pH scale.

37. Many cleaning methods involve chemicals that are hazardous to use and expensive to dispose of after use. The least hazardous method is generally considered to be the _____.

a. pyrolytic oven
b. hot vapor tank
c. hot soak tank
d. cold soak tank

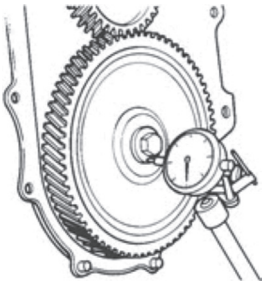
38. Magnetic crack detection _____.

a. uses a red dye to detect cracks in aluminum
b. uses equal compression among cylinders
c. uses a fine iron powder to detect cracks in iron parts
d. uses a magnet to remove cracks from iron parts

39. Technician A says that engine parts should be cleaned before a thorough test can be done to detect cracks. Technician B says that pressure testing can be used to find cracks in blocks or cylinder heads. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

40. A cylinder head should be removed by loosening the head bolts in which order?



a. Any order as long as all bolts are removed
b. In the same order as the tightening sequence
c. In the reverse order of the tightening sequence
d. Loosen each a quarter of a turn and then one-half a turn in the same order as the tightening sequence

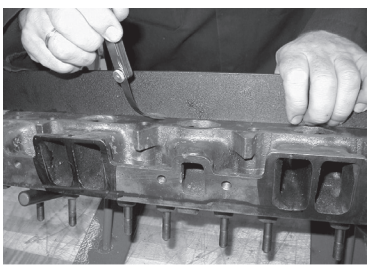
41. Technician A says that damaged threads in a hole of a cylinder head can be repaired using a die. Technician B says that an insert may be required to restore a damaged thread. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

42. Pushrods should be checked for _____.

a. weight
b. straightness
c. diameter
d. All of the above

43. A 0.015 inch feeler gauge is able to be inserted between the straight edge and the cylinder head. What should the service technician do?



a. Reinstall on the engine if a copper gasket is used
b. Resurface or replace the cylinder head
c. Grind the valves and seats and reinstall the cylinder head on the engine
d. Clean the head surface with brake cleaner and sandpaper to remove any dirt and reinstall on the engine.

44. The typical valve stem-to-valve guide clearance is _____.

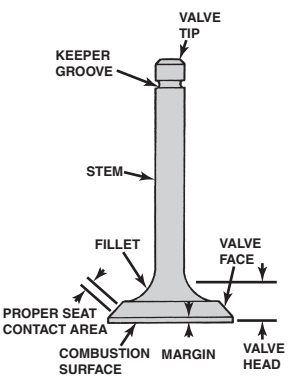
a. 0.030 to 0.045 inches (0.8 to 0.10 millimeters)
b. 0.015 to 0.020 inches (0.4 to 0.5 millimeters)
c. 0.005 to 0.010 inches (0.13 to 0.25 millimeters)
d. 0.001 to 0.003 inches (0.03 to 0.08 millimeters)

45. Which statement is true about surface finish?

a. Cast-iron surfaces should be smoother than aluminum surfaces.
b. The rougher the surface is, the higher the micro inch finish measurement.
c. The smoother the surface is, the higher the micro inch finish measurement.
d. A cylinder head should be a lot smoother than a crankshaft journal.

46. A valve should be discarded if the margin is less than _____ after refacing.

a. 0.001 inch
b. 0.006 inch
c. 0.030 inch
d. 0.060 inch



47. To lower and narrow a valve seat that has been cut at a 45º angle, use a cutter or stone of what angle?

a. 60º
b. 45º
c. 30º
d. 15º

48. Valve spring inserts (shims) are designed to _____.

a. increase installed height of the valve
b. decrease stem height of the valve
c. adjust the correct installed height
d. decrease valve spring pressure to compensate for decreased installed height

49. When aligning the timing marks on an overhead valve (cam-in-block) engine, what is the most likely method?

a. The timing mark on the camshaft should be at the 12 o'clock position and the mark on the crankshaft should be at the 6 o'clock position.
b. The timing mark on the camshaft should be at the 12 o'clock position and the mark on the crankshaft should be at the 12 o'clock position.
c. The timing mark on the camshaft should be at the 6 o'clock position and the mark on the crankshaft should be at the 12 o'clock position.
d. The timing mark on the camshaft should be at the 6 o'clock position and the mark on the crankshaft should be at the 6 o'clock position.

50. Umbrella-type valve stem seals _____.

a. fit tightly onto the valve guide
b. fit on the valve face to prevent combustion leaks
c. fit tightly onto the valve stem
d. lock under the valve retainer

51. Many technicians always use new hollow pushrods because:

a. It is less expensive to buy than clean
b. All of the dirt cannot be cleaned out from the hollow center
c. Pushrods wear at both ends
d. Pushrods shrink in length if removed from an engine

52. The cylinder head bolts should be tightened (torqued) in what general sequence?

a. The four outside bolts first, then from the center out
b. From the outside bolts to the inside bolts
c. From the inside bolts to the outside bolts
d. From the front of the engine and torquing bolts from front to rear

53. Most bolt torque specifications are for _____.

a. clean threads only
b. clean and lubricated threads
c. dirty threads
d. new bolts with dry threads

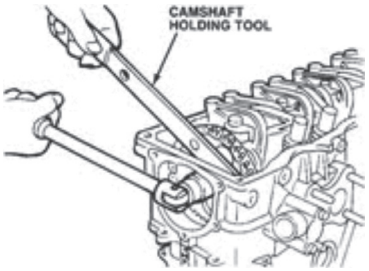
54. Before the valves are removed from the cylinder head, what operation is NOT needed to be done?

a. Remove valve locks (keepers)
b. Remove cylinder head(s) from the engine
c. Remove burrs from the stem of the valve(s)
d. Remove the valve stem seals

55. Technician A says that all valve train parts that are to be reused should be kept together. Technician B says that before testing valve springs for tension, the damper spring should be removed if used. Which technician is correct?

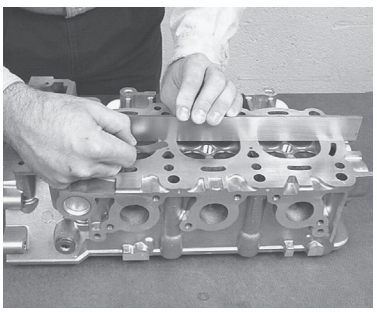
a. A only
b. B only
c. Both A and B
d. Neither A nor B
Incorrect

56. What is this technician doing?



a. Tightening the camshaft sprocket retaining bolt
b. Adjusting the cam timing
c. Adjusting the timing chain tension
d. Adjusting the camshaft end play

57. An aluminum cylinder head is checked for warpage using a straightedge and a feeler (thickness) gauge. The amount of warpage on a V-8 cylinder head was 0.002 inch (0.05 millimeter). Technician A says that the cylinder head should be resurfaced. Technician B says that the cylinder head should be replaced. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

58. Technician A says the valve guide should be reconditioned or replaced *before* the valve seats are reconditioned. Technician B says the valve seats should be replaced before replacing or reconditioning the valve guides. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

59. Technician A says that a dial indicator (gauge) is often used to measure valve guide wear by measuring the amount by which the valve head is able to move in the guide. Technician B says that a ball gauge can be used to measure the valve guide. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

60. Technician A says that a worn valve guide can be reamed and a valve with an oversize stem can be used. Technician B says that a worn valve guide can be replaced with a bronze insert to restore the cylinder head to useful service. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

61. Technician A says that worn integral guides can be repaired. Technician B says that worn integral guides can be replaced. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

62. Valve-to-valve guide is measured using a _____.

a. micrometer
b. feeler gauge
c. dial indicator
d. plastigage

63. Before a valve spring is reused, it should be checked for _____.

a. squareness
b. free height
c. tension
d. All of the above

64. Many manufacturers recommend that valves be ground with an interference angle. This angle is the difference between the _____.

a. valve margin and valve face angles
b. valve face and valve seat angles
c. valve guide and valve face angles
d. valve head and margin angles

65. Technician A says that cooling system plugs in a cylinder head are usually driven in using a driver and a hammer. Technician B says that the cooling system plugs are usually threaded into the cylinder head. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

66. Coolant passages in the cylinder head should be inspected for _____.

a. corrosion
b. restrictions (blockages)
c. leakage
d. All of the above

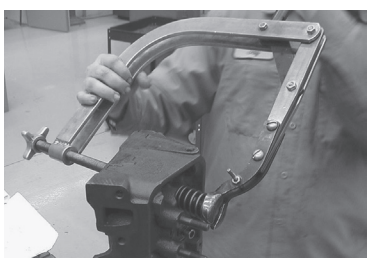
67. Technician A says that valve stem height and installed height mean the same thing. Technician B says the installed height can be corrected by grinding the stem of the valve. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

68. Technician A says that valve stem seals of the O-ring type are installed on top of the valve locks (keepers). Technician B says that a vacuum pump can be used to determine if the valve stem seal is correctly seated. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

69. Before the valves are removed from the cylinder head, what operations need to be completed?

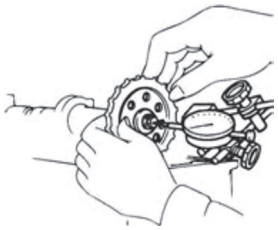


a. Remove valve keepers (locks)
b. Remove cylinder head(s) from the engine
c. Remove burrs from the stem of the valve(s)
d. All of the above

70. Technician A says that the fluorescent penetrant test method can be used to detect cracks in iron, steel, or aluminum parts. Technician B says that the dye penetrant test can only be used with aluminum parts. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

71. What is this technician doing?



a. Measuring the camshaft bearing clearance
b. Checking the camshaft end play
c. Measuring camshaft for runout
d. Positioning the camshaft sprocket onto the camshaft in the specified location

72. The camshaft bore should be inspected on which type(s) of engines?

a. Single overhead camshaft engines
b. Dual overhead camshaft engines
c. Cam-in block engines
d. All of the above

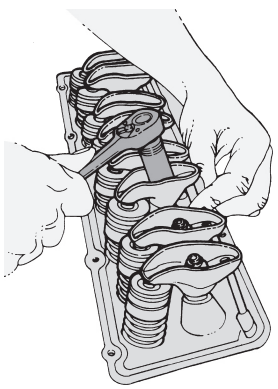
73. What is this technician installing?

a. A valve spring insert
b. A valve spring seat
c. A valve stem seal
d. A valve guide

74. What other engine component may have to be machined if the cylinder heads are machined on a V-type engine?

a. Exhaust manifold
b. Intake manifold
c. Block deck
d. Distributor mount (if the vehicle is so equipped)

75. What is this technician doing?



a. Removing the pushrod
b. Determining zero lash
c. Adjusting the pushrod length
d. Adjusting the ratio of the rocker arm

CATEGORY: ENGINE BLOCK DIAGNOSIS AND REPAIR

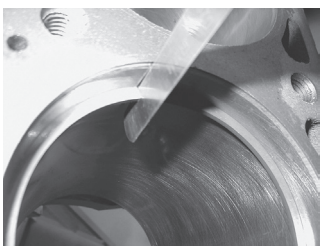
76. A cylinder head is being installed. Technician A says to use a form-in-place sealant between the block and the head. Technician B says that the "front" on a head gasket indicates that it should be installed toward the auxiliary drive belt end of the engine. Which technician is correct.

a. A only
b. B only
c. Both A and B
d. Neither A nor B

77. The torque-angle method involves _____.

a. turning all bolts the same number of turns
b. torquing to specifications and loosening by a specified number of degrees
c. torquing to one-half specifications, then to three-quarter torque, then to full torque
d. turning bolts a specified number of degrees after initial torque

78. The feeler gauge shown is thinner than specification. Technician A says that the cylinder should be honed until the piston ring end gap is within specifications. Technician B says the piston ring should be replaced with an oversize ring. Which technician is correct?

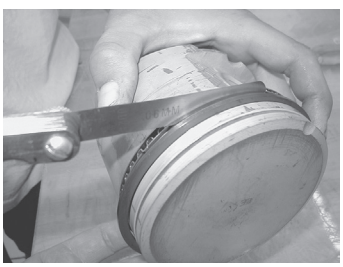


a. A only
b. B only
c. Both A and B
d. Neither A nor B

79. Piston ring end gap can be *increased* by _____.

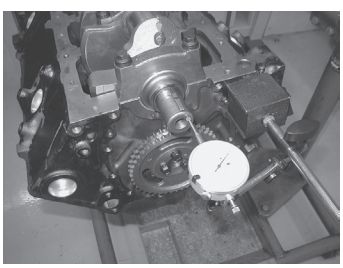
a. filing the ring to make the gap larger
b. installing oversize rings
c. sleeving the cylinder
d. knurling the piston

80. What is this technician measuring?



a. Piston ring back spacing
b. Piston ring end gap
c. Piston ring side clearance
d. Piston groove surface finish

81. What is being measured with this tool setup?

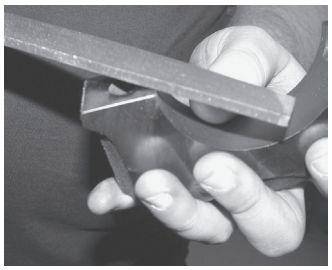


a. Checking the runout of the crankshaft
b. Measuring the front bearing oil clearance
c. Locating top dead center
d. Measuring crankshaft end play

82. The most common cause of premature bearing failure is _____.

a. misassembly
b. dirt
c. lack of lubrication
d. overloading

83. Technician A says the main bearing cap is being de-burred proper to assembly. Technician B says that the bearing cap is being cleaned. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

84. To check a crankshaft journal for taper and out-of-round, the journal should be measured in at least how many locations?

a. One
b. Two
c. Four
d. Six

85. Piston ring end gap should only be measured _____.

a. after all cylinder work has been performed
b. after installing the piston in the cylinder
c. after installing the rings on the piston
d. Both a and c

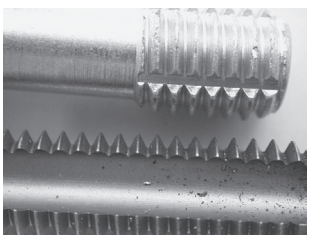
86. Piston ring side clearance is a measure taken between the _____ and the _____.

a. piston (side skirt); cylinder wall
b. piston pin; piston pin retainer (clip)
c. piston ring; piston ring land
d. compression ring; oil control ring

87. Before the timing chain on an OHV engine can be inspected and removed, the following component(s) must be removed:

a. Valve cover (rocker arm cover)
b. Vibration damper
c. Cylinder head(s)
d. Intake manifold (V-type engines only)

88. Technician A says the part on the top of the photo is a thread chaser. Technician B says the part at the bottom of the photo is a tap. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

89. Lower than normal oil pressure could be caused by _____.

a. a worn oil pump
b. worn rod bearings
c. worn main bearing
d. any of the above

90. The ridge at the top of the cylinder _____.

a. is caused by wear at the top of the cylinder by the rings
b. represents a failure of the top piston ring to correctly seal against the cylinder wall
c. should not be removed before removing pistons except when reboring the cylinders
d. means that a crankshaft with an incorrect stroke was installed in the engine

91. Technician A says that the dye penetrant test method can be used to detect cracks in iron, steel, or aluminum parts. Technician B says that the dye penetrant test can only be used with aluminum parts. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

92. Connecting rod caps should be marked (if they were not marked at the factory) before the piston and connecting rod assembly is removed from the engine_____.

a. because they are balanced together
b. because they are machined together
c. to make certain that the heavier rod is matched to the heavier piston
d. to make certain that the lighter rod is matched to the lighter piston

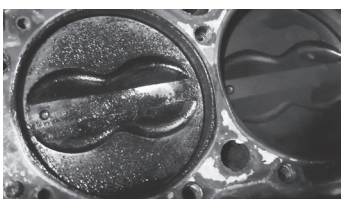
93. Protective covers should be placed over the connecting rod threads to help prevent damage to the _____.

a. connecting rod
b. crankshaft
c. cylinder wall
d. camshaft

94. A misaligned connecting rod causes what type of engine wear?

a. Cylinder taper
b. Barrel-shaped cylinders
c. Ridge wear
d. Angle wear on the piston skirt

95. Piston damage as shown is most likely to be caused by _____.



a. valves hitting the piston head
b. abnormal combustion
c. lugging the engine during operation
d. high engine speeds that can break piston heads

96. The diameter of the piston is measured _____.

a. across the top (head) of the piston
b. across the piston pin
c. across the thrust surface
d. between the top and second piston ring

97. A worn piston pin causes what type of problem?

a. Engine burns an excessive amount of oil (blue smoke)
b. Engine produces a knocking noise that will disappear if the cylinder is grounded out
c. Engine produces a double knocking noise that will not disappear if the cylinder is grounded out
d. Engine knock when warm only

98. Two technicians are discussing removing and installing a crankshaft vibration damper (harmonic balancer). Technician A says that a puller is often needed to remove a vibration damper. Technician B says that an installation tool is often needed to install a vibration damper. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

99. The typical journal-to-bearing clearance is _____.

a. 0.00015 to 0.00018 inch
b. 0.0005 to 0.0025 inch
c. 0.150 to 0.250 inch
d. 0.020 to 0.035 inch

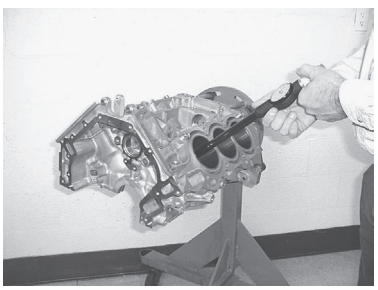
100. Camshaft bearings in a cam-in block engine are being discussed. Technician A says that Plastigage should be used to check for proper bearing clearance. Technician B says that a special tool is required to install cam bearings in a cam-in-block engine. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

101. Typical piston-to-cylinder clearance is _____.

a. 0.001 to 0.003 inch
b. 0.010 to 0.023 inch
c. 0.100 to 0.150 inch
d. 0.180 to 0.230 inch

102. What is this technician doing?

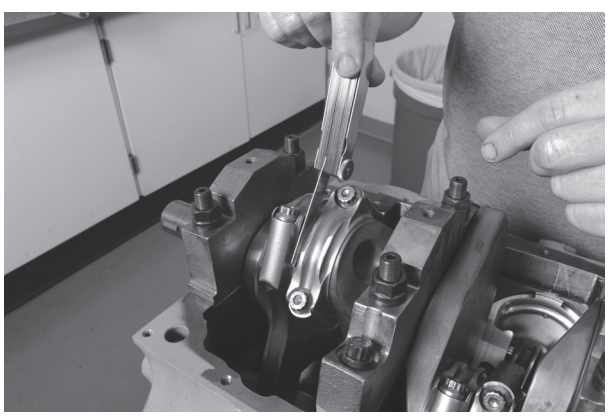


a. Deglazing the cylinder bore
b. Measuring the cylinder bore for out-of-round and taper
c. Honing the cylinder
d. Measuring the surface finish of the cylinder wall

103. If the gauging plastic strip (Plastigage®) is wider than specified after the bearings are tightened, this results _____.

a. in excessive oil clearance
b. from using old, dried Plastigage
c. insufficient oil clearance
d. in a small side (thrust) clearance

104. What is this technician measuring?



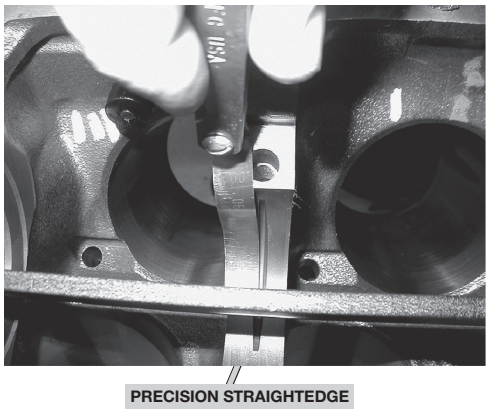
a. Rod bearing oil clearance
b. Connecting rod side clearance
c. Crankshaft end play
d. Thrust bearing clearance

105. Typical thrust bearing clearance is:

a. 0.001 to 0.003 inch
b. 0.002 to 0.012 inch
c. 0.025 to 0.035 inch
d. 0.050 to 0.100 inch

106. A 0.010 inch feeler gauge is able to slide between the straight edge and the main bearing bore (saddle bore) as shown. Technician A says that the block should be replaced. Technician B says that oversize main bearings should be used. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B



107. If the bell housing is not properly torqued to the engine block, _____.

a. the bell housing will distort
b. the engine block will crack
c. the rear cylinder can be distorted (become out-of-round)
d. the crankshaft will crack

108. If the bore of an engine is increased without any other changes except for the change to proper-size replacement pistons, the displacement will _____ and the compression ratio will _____.

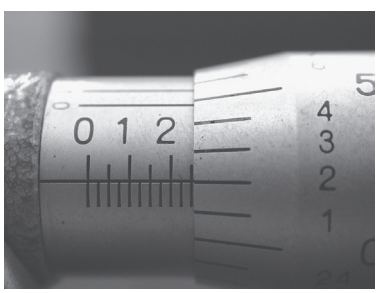
a. increase; increase
b. increase; decrease
c. decrease; increase
d. decrease; decrease

109. Technician A says that pistons should be removed from the crankshaft side (bottom) of the cylinder when disassembling an engine to prevent possible piston or cylinder damage. Technician B says that the rod assembly should be marked before disassembly. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

110. The micrometer reading is _____.

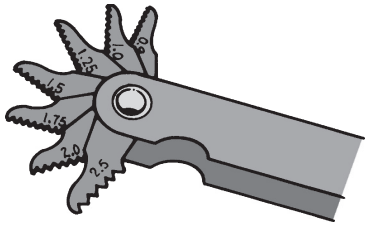
a. 0.252 inch
b. 0.025 inch
c. 0.00252 inch
d. 2.52 inch



111. A cylinder is 0.004 inch out-of-round. Technician A says that the block should be bored and oversize pistons installed. Technician B says that oversize piston rings should be used. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

112. Technician A says that the tool shown is used to dress (restore) a grinder wheel. Technician B says that it is used to determine the thread pitch of metric fasteners. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

113. After the engine block has been machined, the block should be cleaned with _____.

a. a stiff brush and soap and water
b. a clean cloth and engine oil
c. WD-40
d. spray solvent washer

114. Technician A says that piston rings should be installed with the dot or mark up (toward the cylinder head). Technician B says that the mark on the piston rings is used to identify the position (groove) in which the ring should be installed. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

115. Two technicians are discussing ring gap. Technician A says that the ring should be checked in the same cylinder in which it is to be installed. Technician B says that the ends of the piston ring can be filed if the clearance is too small. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

116. Two technicians are discussing bearing clearance measurement. Technician A says that the main and rod bearing clearance can be measured with plastic gauging material (Plastigage). Technician B says that the engine crankshaft should be rotated for two complete revolutions when Plastigage is used between the crankshaft and the main or rod bearings. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

117. When pistons are installed in the block, the notch or arrow on the piston should be facing _____.

a. toward the lifter side of the block
b. toward the front of the engine
c. toward the rear of the engine
d. away from the lifter side of the block

118. A bearing shell is being installed in a connecting rod. The end of the bearing is slightly above the parting line. Technician A says that this is normal. Technician B says that the bearing is too big. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

CATEGORY: LUBRICATION AND COOLING SYSTEMS DIAGNOSIS AND REPAIR

119. A water pump has been replaced three times in three months on a rear-wheel-drive vehicle. Technician A says that the drive belt(s) may be installed too tightly. Technician B says that a cooling fan may be bent or out of balance. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

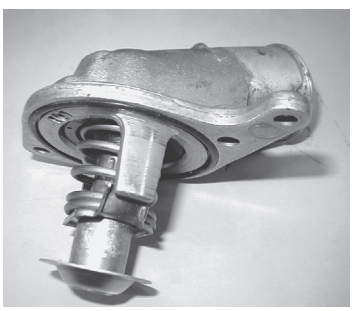
120. As the percentage of antifreeze in the coolant increases, _____.

a. the freeze point decreases (up to a point)
b. the boiling point decreases
c. the heat transfer increases
d. all of the above

121. The procedure that should be used when refilling an empty cooling system includes the following: _____.

a. determine capacity, and then fill the cooling system half with antifreeze and the rest of the way with water.
b. fill completely with antifreeze, but mix a 50/50 solution for the overflow bottle.
c. fill the block and one half of the radiator with 100% pure antifreeze and fill the rest of the radiator with water.
d. fill the radiator with antifreeze, start the engine, drain the radiator, and refill with a 50/50 mixture of antifreeze and water.

122. Which statement is *true* about thermostats?



a. The temperature marked on the thermostat is the temperature at which the thermostat should be fully open
b. Thermostats often cause overheating
c. The temperature marked on the thermostat is the temperature at which the thermostat should start to open
d. Both a and b

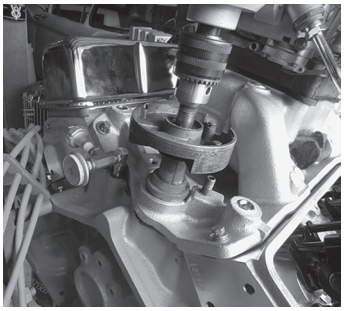
123. Technician A says that the radiator should always be inspected for leaks and proper flow before installing a rebuilt engine. Technician B says that overheating during slow city driving can be due to a defective electric cooling fan. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

124. Technician A says the positive crankcase ventilation (PCV) system uses a valve located between the intake manifold and the valve cover (cylinder head cover). Technician B says that about 20% of the air needed by the engine at idle speed flows through the PCV system. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

125. Turning the oil pump before starting the engine should be done _____.



a. to lubricate engine bearings
b. to lubricate valve train components
c. to supply oil to the camshaft
d. All of the above

126. An engine oil cooler should be inspected for _____.

a. engine oil leaks
b. coolant leaks
c. air leaks
d. Both a and b

127. Which antifreeze coolant should be used if the manufacturer specifies coolant that is both silicate and phosphate free?

a. Organic acid technology (OAT), e.g., DEX-COOL (orange)
b. Ethylene glycol (green)
c. Asian red
d. European pink

128. The "hot" light on the dash is being discussed by two technicians. Technician A says that the light comes on if the cooling system temperature is too high for safe operation of the engine. Technician B says that the light comes on whenever there is a decrease (drop) in cooling system pressure. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

129. Technician A says that an electric cooling fan should come on at the same temperature that the thermostat opens. Technician B says that a defective electric fan can cause overheating, especially in city driving. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

130. A customer complains that the heater works sometimes, but sometimes only cold air comes out while driving. Technician A says that the water pump is defective. Technician B says that the cooling system could be low on coolant. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

131. Normal operating temperature is reached when _____.

a. the radiator cap releases coolant into the overflow
b. the upper radiator hose is hot and pressurized
c. the electric cooling fan has cycled at least once (if the vehicle is so equipped)
d. either b or c occur

132. For best results, the oil should be drained when the engine is_____?

a. at normal operating temperature
b. at room temperature
c. cold—not yet started
d. run for 30 seconds, then turned off before draining the oil

133. Two technicians are discussing engine oil. Technician A says that the higher the viscosity, the better. Technician B says that a SAE 20W-50 will work better in a new vehicle instead of the specified SAE 5W-20. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

134. Normal oil pump pressure in an engine is _____.

a. 3 to 7 psi
b. 10 to 60 psi
c. 100 to 150 psi
d. 180 to 210 psi

135. In typical engine lubrication systems, what components are the last to receive oil?

a. Main bearings
b. Rod bearings
c. Valve trains
d. Oil filters

CATEGORY: FUEL, ELECTRICAL, IGNITION, AND EXHAUST SYSTEMS INSPECTION AND SERVICE

136. An engine cranks but will not start. No spark is available at the end of a spark plug wire with a spark tester connected and the engine cranked. Technician A says that a defective crankshaft position (CKP) sensor could be the cause. Technician B says that a defective ignition module could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

137. Two technicians are discussing a waste spark-type of ignition system. Technician A says that a defective coil can cause a crank, but no-start condition. Technician B says that a defective coil could affect the spark output to two spark plugs. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

138. Battery voltage during cranking is below specifications. Technician A says that a defect in the engine may be the cause. Technician B says that the starter motor may be defective. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

139. Technician A says that a leaking intake manifold gasket can cause a vacuum leak. Technician B says that a clogged air filter can cause a low power concern. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

140. A starter motor cranks the engine too slowly to start. Technician A says that the cause could be a weak or defective battery. Technician B says that the cause could be loose or corroded battery cable connections. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

141. Technician A says that a clogged port fuel injector can cause a misfire. Technician B says that a leaking injector lower O-ring can cause a vacuum leak. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

142. Which computer sensor may have to be replaced if the engine had been found to have a defective head gasket or cracked head?

a. Throttle position sensor
b. Oxygen sensor
c. Manifold absolute pressure sensor
d. Engine coolant temperature sensor

143. Technician A says that a defective PCV valve could cause a rough idle. Technician B says that an EGR valve stuck open could cause a rough idle. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

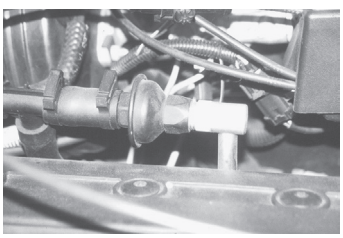
144. Technician A says the catalytic converter must be replaced if it rattles when tapped. Technician B says a catalytic converter can be defective and not working yet not be clogged. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

145. A supercharged engine lacks power. What is *not* a possible cause?

a. Clogged air filter
b. Restricted intercooler
c. Clogged condenser
d. Restricted exhaust

146. Technician A says that a defective one-way exhaust check valve could cause the air pump to fail. Technician B says that the air should stop flowing to the exhaust manifold when the engine is warm and operating in closed loop. Which technician is correct?



a. A only
b. B only
c. Both A and B
d. Neither A nor B

147. Two technicians are discussing positive crankcase ventilation (PCV) valves. Technician A says that if the valve rattles, it is good. Technician B says the PCV valve may still require replacement even if it rattles. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

148. A spark plug has dry, black fluffy deposits. Technician A says this is caused by the engine burning oil. Technician B says that the engine may be operating with a rich air-fuel mixture. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

149. A 2-foot-long spark plug wire is being tested using an ohmmeter. The wire measures 7.86 kΩ (7,860 ohms). Technician A says the wire is okay. Technician B says that the wire resistance is higher than the specification for most vehicles. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

150. Technician A says that moving the position of the crankshaft position (CKP) sensor can be used to adjust the ignition timing on an engine equipped with coil-on-plug (COP)-type ignition. Technician B says that a misfire can be caused by a defective coil on a COP system. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

151. A turbocharged engine is burning oil. Technician A says that a defective turbocharger could be the cause. Technician B says that a clogged PCV system could be the cause. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

152. Technician A says that low fuel pressure can cause the engine to produce low power. Technician B says that all fuel pumps should be able to pump at least 2 pints (1 liter) per minute. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B
Incorrect

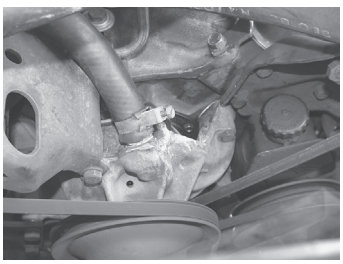
153. An engine misfire is being diagnosed. One spark plug wire measured "OL" on a digital ohmmeter set to the auto range scale. Technician A says that the spark plug wire should be replaced. Technician B says that the spark plug wire is okay. Which technician is correct?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

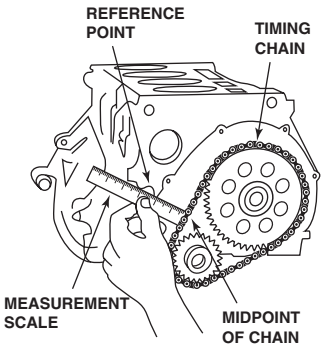
CATEGORY: GENERAL ENGINE DIAGNOSIS

1. **The correct answer is b.** Technician B is correct that if the compression reading is greatly increased with a couple of squirts of oil in the cylinder, then when the compression test is first performed without the oil, the piston rings are worn or broken. Technician A is not correct because oil should only be squirted into those cylinders that achieved a lower than normal compression test reading to help determine the reason for the low compression. Answers c and d are not correct because only Technician B is correct.

2. **The correct answer is c.** Both technicians are correct. Technician A is correct that a fluorescent dye can be added to the engine oil and allowed to circulate. A black light is then turned on and any leaks will show as a bright yellow-green area. This is the preferred method for locating fluid leaks. Technician B is correct because a white powder spray (such as foot spray) will show the location of leaks by turning dark where the liquid contacts the white powder. Answers a, b, and d are not correct because both technicians are correct.



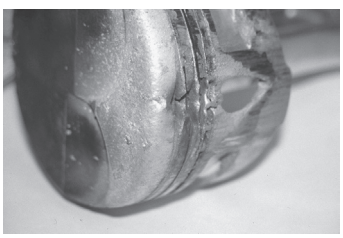
3. **The correct answer is c.** Both technicians are correct. Technician A is correct because as the timing chain stretches, the camshaft will lag behind the rotation of the crankshaft (retarded). Technician B is correct because the timing chain and gears should all be replaced as a set if the slack is greater than factory specifications (usually less than ½ in.). Answers a, b, and d are not correct because both technicians are correct.



4. **The correct answer is d.** Antifreeze can be green (older IAT-type or phosphate organic acid technology, which is a dark green), as well as orange (DEX-COOL), or red (Asian red). Answers a, b, and c are not correct because any of the colors could indicate a coolant (antifreeze) leak.

5. **The correct answer is a.** Small particles of steel, cast iron, and other metals in an engine can react chemically to increase the viscosity (thickness) of the oil. Answer b is not correct because if fuel were added to oil, it would become thinner (lower viscosity). Answer c is not correct because a clogged air filter does not have a direct effect on the viscosity of the oil. It is true that dirt could get into the oil, which will make the oil thicker but this is not a direct result of the air filter itself. Answer d is not correct because it includes b and c, which are not correct.

6. **The correct answer is c.** Both technicians are correct. Technician A is correct because if the piston rings are worn or defective, blowby gases will force oil fumes out of the PCV system inlet and into the air cleaner assembly. Technician B is correct because if the PCV valve or hose is clogged, all crankcase vapors have only one place to go and that is through the PCV system inlet hose that gets its fresh air from the air cleaner assembly. Answers a, b, and d are not correct because both technicians are correct.



7. **The correct answer is c.** Both technicians are correct. Technician A is correct because a worn oil pump can cause low oil pressure. An oil pump wears because it is the only engine part that operates on unfiltered oil. Technician B is correct because worn bearings allow an excessive amount of oil to escape and return to the oil pan resulting in a drop in oil pressure. Answers a, b, and d are not correct because both technicians are correct.

8. **The correct answer is b.** Technician B is correct because noise is created by the rocker arm pounding onto the end of the valve when the clearance (lash) is greater than specified by the vehicle manufacturer. Technician A is not correct because the engine will not create noise if the valve clearance is too tight. The valves may not close all the way if the clearance is too tight which could lead to a burned valve. Answers c and d are not correct because only Technician B is correct.

9. **The correct answer is c.** Both technicians are correct. Technician A is correct because it is the slight angle on the cam lobe that helps create a rotating force on flat-bottomed lifters. If the lobe is worn, the lifter and the pushrod will not rotate. Technician B is also correct because the bottom of a lifter is slightly convex which helps rotate the lifter as it rides over the cam lobe. If the bottom of the lifter is worn, it will not rotate. Answers a, b, and d are not correct because both technicians are correct.

10. **The correct answer is c.** Both technicians are correct. Technician A is correct because if exhaust gases are escaping from the combustion chamber and into the coolant past a defective head gasket, HC (hydrocarbons) or CO (carbon monoxide) emissions will be able to be measured above the coolant with the engine running. Technician B is correct because combustion tester liquid that changes color when exposed to exhaust gases can also be used to verify a defective head gasket. Answers a, b, and d are not correct because both technicians are correct.

11. **The correct answer is c.** Both technicians are correct. Technician A is correct because a clogged catalytic converter can be the cause of an exhaust system restriction. Technician B is correct because a clogged (or damaged) muffler can cause an exhaust system restriction. A muffler can be clogged by parts broken from the internal baffles. If the catalytic converter is replaced and the exhaust is still restricted, a clogged muffler (or resonator) could be the cause. Answers a, b, and d are not correct because both technicians are correct.

12. **The correct answer is c.** Both technicians are correct. White smoke or steam is an indication that coolant is getting into the combustion chamber and is being vaporized by the heat of combustion. Technician A is correct because an excessively rich air-fuel mixture will create black exhaust smoke. A slightly rich engine may not emit black smoke because the catalytic converter will usually oxidize the unburned fuel (hydrocarbons) into H_2O (water) and CO_2 (carbon dioxide). Answers a, b, and d are not correct because both technicians are correct.

13. **The correct answer is d.** Neither technician is correct. Technician A is not correct because the specification for cranking vacuum is greater than 2.5 in. Hg. Even though a sound engine with a completely closed throttle may be able to produce 17 in. Hg to 21 in. Hg vacuum (at sea level) during cranking, it is not the specification for cranking vacuum. Technician B is not correct because a floating vacuum gauge needle is an indication of an overly rich or lean air-fuel mixture, not a sticking valve. A sticking valve will cause the vacuum gauge needle to move rapidly up and down. Answer c is not correct because neither technician is correct.

14. **The correct answer is b.** Technician B only is correct. All cylinders should drop the same (within 50 RPM) when they are canceled or grounded out. This indicates that each cylinder was contributing an equal amount of the operation of the engine. If a cylinder drops the RPM less than others, the cylinder is weak. Technician A is not correct because the more the engine RPM drops when a cylinder is canceled, the more that cylinder is contributing to the operation of the engine. Answers c and d are not correct because only Technician B is correct.

15. **The correct answer is b.** A leakage of 30% is excessive and if air is heard escaping from the engine air inlet, then one or more intake valves must be leaking. It is also possible that the cylinder being tested is not at TDC on the compression stroke. If the cylinder were at TDC of the exhaust stroke, both intake and exhaust valves would be open and air would also be heard coming from the tailpipe. Technician A is not correct because 30% leakage is too much for a slightly worn engine. Leakage should not exceed 20%. Answers c and d are not correct because only Technician B is correct.

16. **The correct answer is b.** Technician B is correct because if the piston rings were worn (or broken), compressed air could escape past the rings and flow into the crankcase. The air would then escape from the engine through the oil drain-back holes and other openings in the block and eventually be heard at the oil fill opening. Technician A is not correct because the oil filter is not being tested and the compressed air entering the combustion chamber could not get into or past the oil filter. Answers c and d are not correct because only Technician B is correct.

17. **The correct answer is b.** The oil pressure light comes on whenever the pressure drops to between 3 and 7 psi. Answer a is not correct because the oil pressure light is not the same as the amber "change oil soon" light. Answer c is not correct because there is no indication when the bypass valve opens, which often occurs when the oil is cold or the oil filter is dirty and creates a restriction. Answer d is not correct because this valve simply keeps oil from draining back into the oil pan after the engine stops running.

18. **The correct answer is b.** Technician B is correct because the maximum difference, as specified by most vehicle manufacturers, is 20%. If the highest reading is 160 psi, then the lowest cylinder compression should be greater than 128 psi (160 × 20% = 32 psi. 160 psi – 32 psi = 128 psi). Technician A is not correct because the engine should be cranked through at least four compression events or 4 to 5 "puffs" (not 3 "puffs"). Answers c and d are not correct because only Technician B is correct.

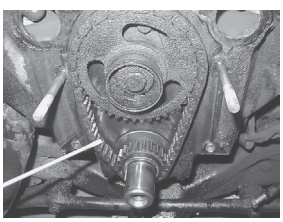
19. **The correct answer is b.** Technician B is correct because if the head gasket were leaking between cylinder number 3 and 4, the compression on these cylinders would be lower than normal. The defective gasket would allow compression to escape to the adjacent cylinders. Technician A is not correct because a burned valve would only affect one cylinder. It would be very rare that two cylinders side-by-side would both have a burned valve and is, therefore, not a "likely" cause. Answers c and d are not correct because only Technician B is correct.

20. **The correct answer is d.** Neither technician is correct. Technician A is not correct because a double knock is usually caused by a worn piston pin, which causes one click when the piston stops at TDC and another as the crankshaft pulls the piston downward after reaching TDC. Technician B is not correct because a worn piston pin will make noise at all temperatures and not change when the cylinder is grounded out. Answers a, b, and c are not correct because neither technician is correct.

21. **The correct answer is c.** The correct answer is that both Technicians A and B are correct. Technician A is correct because the customer can more easily drive the vehicle under the exact conditions, such as speed and throttle position, to create the noise concern. The technician can also concentrate on listening for the noise without having to worry about traffic conditions. Technician B is also correct because noise from the vehicle would tend to bounce off walls or buildings making engine noise easier to hear. Answers a, b, and d are not correct because both technicians are correct.

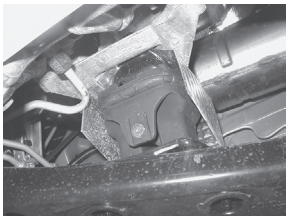
22. **The correct answer is b.** Technician B is correct because if the PCV system were clogged, crankcase pressure would increase and force oil into the combustion chamber through the air cleaner assembly where the PCV system normally receives fresh air. The increased crankcase pressure can also cause oil to be forced from the turbocharger bearing (bushing) area into the intake or exhaust side of the turbocharger. Technician A is not correct because the wastegate simply directs the exhaust through the turbocharger or into the exhaust manifold bypassing the turbocharger. If the wastegate were to fail, it could cause a lack of turbo boost or the possibility of over boost. An over boost condition *could* cause excessive oil consumption (it would not be a direct cause). Answers a, c, and d are not correct because only Technician B is correct.

23. **The correct answer is b.** Technician B only is correct because the engine is cranking rapidly, which means that the engine lacks compression. A broken timing belt would allow many of the valves to be either closed all the time or partially open all the time. Answer a is not correct because even though a defective coil on a waste spark-type ignition system could cause a misfire, it would not likely cause a no-start condition. Answers c and d are not correct because only Technician B is correct.



24. **Both technicians are correct.** Technician A is correct because if the oil drain-back holes were clogged, oil would eventually cover the valves and oil would be drawn into the combustion chamber past the valve guides. Technician B is correct because oil can be drawn into the combustion chamber past the worn piston rings during the intake stroke. Answers a, b, and d are not correct because both technicians are correct.

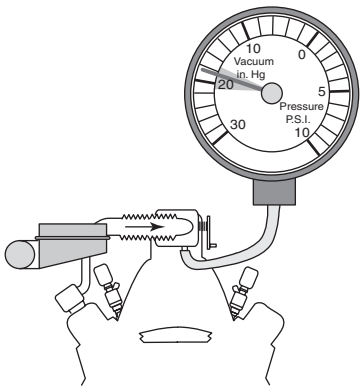
25. **The correct answer is c.** Technician A is correct because a defective engine mount can cause the engine to be out of position in the vehicle causing a vibration. Technician B is correct because some mounts are filled with fluid and should be inspected for leakage. Answers a, b, and d are not correct because both technicians are correct.



26. **The correct answer is c.** Both technicians are correct. Technician A is correct because a burned valve will cause the cylinder to produce less than normal power. Technician B is correct because a fault in either the injector or the spark plug wire can cause the cylinder to misfire. Answers a, b, and d are not correct because both technicians are correct.

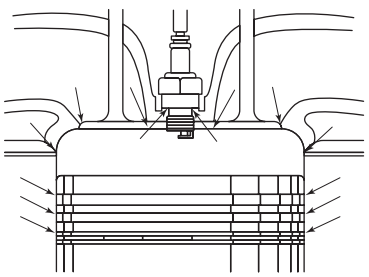
27. **The correct answer is a.** Technician A only is the correct answer. When coolant enters into the combustion chamber past a defective head gasket, the water turns to steam during the combustion process. This steam is then seen as white exhaust smoke when it exits the tail pipe. Answer b is not correct because a leaking fuel injector would cause a rich air-fuel mixture, which would cause black or gray exhaust smoke and not white smoke. Answers c and d are not correct because only technician A is correct.

28. **The correct answer is a.** Vacuum measured during cranking should be *at least* 2.5 in. Hg. Obviously, the higher the cranking vacuum, the better the engine cylinder is sealed. Answer b is not correct because the only time that vacuum in an engine can be near 25 in. Hg. is during deceleration. Answer c is not correct because even though it is possible for some engines to produce 17–21 in. Hg. during cranking, it should not be considered the specification for cranking vacuum. Answer d is not correct for the same reason as given for answer c.



29. **The correct answer is b.** Technician B only is correct. If the engine speed (RPM) drops when a cylinder is canceled (spark plug wire is grounded), the cylinder is producing power and contributing to the engine speed at idle. Answer a is not correct because the biggest drop in engine RPM is created by the strongest cylinder, not the weakest. Answers c and d are not correct because only Technician B is correct.

30. **The correct answer is b.** A good mechanically sound engine should measure less than 20% leakage. The lower the amount of leakage, the better the engine. Answer a is not correct because all cylinders should be *less than* 20%, not within 20% of each other. Answer c is not correct because the leakage should be *less than* 20%, not *more* than 20%. Answer d is not correct because the leakage should be very low. A 70% leakage rate means that 70% of the air entering the cylinder is escaping past the piston rings or valves.



31. **The correct answer is b.** A good mechanically sound engine should measure less than 20% leakage. The lower the amount of leakage, the better the engine. Answer a is not correct because all cylinders should be *less than* 20%, not within 20% of each other. Answer c is not correct because the leakage should be *less than* 20%, not *more* than 20%. Answer d is not correct because the leakage should be very low. A 70% leakage rate means that 70% of the air entering the cylinder is escaping past the piston rings or valves.

32. **The correct answer is c.** Both technicians are correct. Technician A is correct because any misfire will cause paper held at the tailpipe to "puff." A burned valve will cause one cylinder to not produce as strong an exhaust stream as the others creating the uneven exhaust detected by holding the paper at the tailpipe. Technician B is correct because antifreeze tends to leave a gray/white stain on the engine where coolant has leaked and then evaporated by the engine heat. Answers a, b, and d are not correct because both technicians are correct.

CATEGORY: CYLINDER HEAD AND VALVE TRAIN DIAGNOSIS AND REPAIR

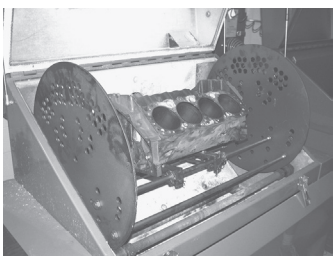
33. **The correct answer is c.** Both technicians are correct. Technician A is correct because many vehicle manufacturers recommend replacing the head bolts after use because they are stretched during use and cannot be reused. Technician B is correct because many vehicle manufacturers recommend an initial torque setting, and then turning the fasteners additional degrees. This is called torque-angle or torque-to-yield method. Answers a, b, and d are not correct because both technicians are correct.

34. **The correct answer is c.** Both technicians are correct. Technician A is correct because most cam and crank gears or pulleys are equipped with a mark used to correctly time the camshaft/crankshaft timing. Technician B is also correct because some camshaft sprockets or gears are not keyed to the camshaft but are tightened in position. These types of camshafts require a special tool to properly position the camshaft before the retaining bolt is tightened. Answers a, b, and d are not correct because both technicians are correct.

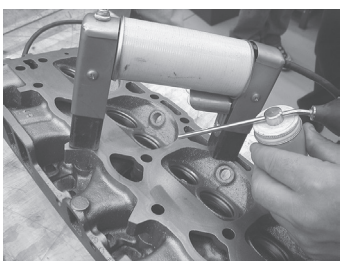
35. **The correct answer is c.** All valve springs must be checked that they are square and of equal height. Answer a is not correct because the installed height of a spring is measured from the bottom of the retainer and locks in place to the valve seat. Answer b is not correct because stem height is a measurement of the valve itself from the spring seat, not a measure of the spring. Answer d is not correct because the setup shown is not placing a load on the spring and, therefore, cannot be used to measure spring tension.

36. **The correct answer is b.** Pure water is a 7 on the pH scale with acids represented by numbers lower than 7 and caustic materials (bases) represented by numbers higher than 7. Answers a, c, and d are not correct because these statements do not correctly represent the pH scale.

37. **The correct answer is a.** The pyrolytic oven is the least hazardous method of cleaning. Answers b, c, and d are not correct because the chemicals used in these cleaning methods represent hazards to the service technician during their use and may also create a hazardous waste problem.



38. **The correct answer is c.** Magnetic lines of force tend to get stronger at edges and, therefore, a fine powder can be used to locate cracks in iron parts. Answer a is not correct because aluminum parts cannot be checked using a magnetic field. Answer b is not correct because a magnetic method can be used on iron, but not on aluminum parts. Answer d is not correct because the answer states that the magnet removes the cracks rather than simply detecting the cracks.



39. **The correct answer is c.** Both technicians are correct. Technician A is correct because the parts must be clean to be able to see small cracks or faults. Technician B is correct because pressure testing using air will detect cracks in engine parts that are under water by observing bubbles from the fault area. Answers a, b, and d are not correct because both technicians are correct.

40. **The correct answer is c.** The correct answer is that all engine part fasteners should be removed in the reverse order of the tightening sequence. This method helps reline any built-up stress in the part and helps reduce the possibility of warpage when the part is removed. Answers a, c, and d are not correct because any of these methods could result in warpage when the part is removed.

41. **The correct answer is b.** Technician B only is correct. Damaged threads in a cylinder head may require that a thread repair insert be installed to allow a bolt to be used again in the threaded hole. Answer a is not correct because a die is used to make or repair threads on a rod and cannot be used to repair threads in a hole in the cylinder head. Answers c and d are not correct because only Technician B is correct.

42. **The correct answer is b.** Most vehicle manufacturers specify that warpage and out of straightness of less than 0.002 in. The best way to determine if the pushrods are straight is to roll them on a flat surface and check for any light under the pushrod as it is rolled. Answer a is not correct because the length would be affected if bent and are different length for different cylinders or valves in some engines. Answer c is not correct because the diameter is determined by the vehicle manufacturer and does not change with use. Answer d is not correct because only answer b is correct.

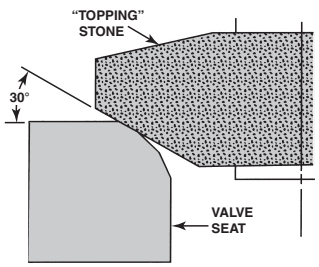
43. **The correct answer is b.** The cylinder head surface should be machined or the cylinder head replaced because the head is warped beyond the normal maximum allowed. Normal maximum warpage is less than 0.004 in. for a V-8 cylinder head. Answer a is not correct because the cylinder head is distorted beyond specifications. Answer c is not correct because even though the valves and the seats can be ground, the cylinder head must still be resurfaced before it is installed on the engine. Answer d is not correct because using sandpaper will not straighten a warped cylinder head and may even cause waviness in the head after it has been properly resurfaced.

44. **The correct answer is d.** Typical valve guide clearance is between one and three thousandths of an inch (0.001 to 0.003 in.). Answers a, b, and c are not correct because these figures represent a much greater clearance than is generally accepted.

45. **The correct answer is b.** The higher the micro inch finish measurement, the rougher the surface. For example, a surface finish of 90 micro-inches (m in.) is rougher than a surface that measures 30 m in. Answer a is not correct because an aluminum surface should be slightly smoother than a cast iron surface although the specifications are often close. Answer c is not correct because a smooth surface has a lower micro-inch finish measurement. Answer d is not correct because a crankshaft journal is smoother than a cylinder head surface.

46. **The correct answer is c.** Most vehicle manufacturers recommend that the margin be at least 0.030 in. Answers a and b are too small and could cause the valve to burn if used in an engine. Answer d is not correct because even though 0.060 in. could be used without harm in an engine, 0.060 in. is not the discard dimension.

47. **The correct answer is c.** A 30° stone will remove material from the top part of the valve seat, which will narrow and lower the seat. Answer a is not correct because a 60° stone will cut the bottom of the seat and while it too will narrow the seat, the seat will be raised as the 60° angle is being cut. Answer b is not correct because a 45° angle will simply widen the seat because it is the same angle as the seat. Answer d is not correct because it would narrow and lower the seat, but the low angle would remove more material around the seat than desirable.



48. **The correct answer is c.** Valve spring inserts (shims) placed under the valve springs restore the original spring height that was lengthened when the valves were ground and the valves moved upward in the head. Answer a is not correct because when installing a valve spring insert, the installed height of the spring would be decreased (compressing the spring more) rather than increased (compressing the spring less). Answer b is not correct because the valve spring insert will not change the location of the tip (stem height) of the valve. Answer d is not correct because the valve spring insert would increase (not decrease) valve spring pressure to compensate for an increased (not decreased) installed height.

49. **The correct answer is c.** The crankshaft/camshaft relationship on most overhead valve engines involve aligning the two timing marks together with the camshaft mark at the 6 o'clock position and the crankshaft mark at the 12 o'clock position. Answers a, b and d are not correct because they do not represent the usual position of the timing marks for an OHV engine.

50. **The correct answer is c.** An umbrella-type valve stem seal fits snugly on the stem of the valve and moves up and down with the valve. Answer a is not correct because umbrella seals are not attached to the guides like positive-type seals. Answer b is not correct because the valve seals are used on the stem of the valve, not on the head or a valve. Answer d is not correct because the O-ring-type valve stem seals are locked into place under the retainer, not umbrella-type seals.

51. **The correct answer is b.** It is almost impossible to remove all of the dirt or varnish from inside the hollow pushrods. If reused in a new or rebuilt engine, the trapped dirt or varnish may become dislodged and cause wear or damage to the engine parts. Answer a is not correct because the cleaning time or cost of replacement pushrods is not the reason why most engine rebuilders recommend the replacement rather than the cleaning of hollow pushrods. Answer c is not correct because even though they do wear, this is not the primary reason why they are replaced. Answer d is not correct because pushrods do not change length when removed from the engine.

52. **The correct answer is c.** All fasteners should be tightened from the center of the component toward the outside to prevent stress buildup that could cause a cylinder head or other component being tightened to crack. Answers a, b, and d are not correct because they do not include tightening from the center outward.

53. **The correct answer is b.** The torque specification for engine bolts prescribes that the threads are clean and lubricated with engine oil. Answer a is not correct because even though threads must be clean, they must also be lightly oiled. Answer c is not correct because dirty threads would interfere with proper rotating torque and result in less clamp force. Answer d is not correct because new bolts are not necessary for all engines and the threads should be lubricated, not dry.

54. **The correct answer is d.** The valve stem seals do not need to be removed to remove the valves from the cylinder head. Answer **a** is not correct because the keepers have to be removed before the valves will be released from the retainer. Answer b is not correct because the cylinder head from the block before the valves can be removed from the head. Answer **c** is not correct because the burrs should be remove from the stem of the valve to avoid damaging the guide.

55. **The correct answer is c.** Both technicians are correct. Technician A is correct because parts wear together and they should be kept together to avoid creating additional wear to the parts that contact each other. Technician B is correct because the valve spring tension specifications are for the valve spring only. Answers a, b, and d are not correct because both technicians are correct.

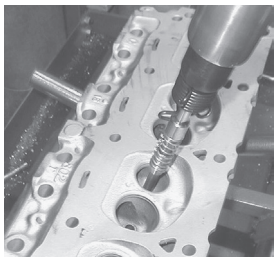
56. **The correct answer is a.** The camshaft is being held to keep it from rotating as the retaining bolt is being tightened. Answer b is not correct because cam timing is achieved by using offset keys or other devices on the camshaft sprocket that varies the relationship between the camshaft and the crankshaft. Answer c is not correct because the chain tension is determined by the tensioner and is not adjustable at the camshaft sprocket. Answer d is not correct because a replacement camshaft bearing or shim is needed to change the end play.

57. **The correct answer is d.** Neither technician is correct. Technician A is not correct because 0.002 in. out-of-flatness is generally considered to be within factory specifications and, therefore, even though the cylinder head *could* be resurfaced, it would not be *required*. Technician B is not correct because replacement is not necessary if the cylinder head is within factory specifications. Answer c is not correct because neither technician is correct.

58. **The correct answer is a.** Technician A only is correct because the valve guide must be straight and true because the guide is used to control the cutter for the seats. Technician B is not correct because the valve guide(s) should be serviced first since the tools used for seat conditioning are installed in the valve guide. Answers c and d are not correct because only Technician A is correct.

59. **The correct answer is c.** Both technicians are correct. Technician A is correct because some vehicle manufacturers specify that the valve be opened a certain distance and the play in the guide be measured at the edge of the head of the valve using a dial indicator. Technician B is correct because a ball gauge (small hole gauge) can be used to measure the inside diameter of the guide. The ball gauge is then measured with a micrometer. Answers a, b, and d are not correct because both technicians are correct.

60. The correct answer is c. Both technicians are correct. Technician A is correct because many vehicle manufacturers recommend that the old guide be reamed oversize and that oversize stem valves be used to restore the cylinder head to useful service. Technician B is correct because a bronze insert can be used to restore the guide and allow the use of the stock valves. Answers a, b, and d are not correct because both technicians are correct.

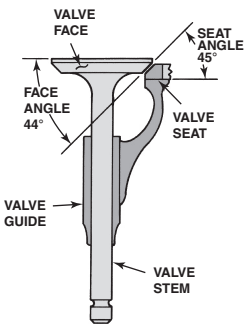


61. The correct answer is c. Both technicians are correct. Technician A is correct because worn integral guides to useful service by an automotive machine shop. Technician B is correct because replacement guides can be inserted in the cylinder head that has integral guides after the guides have been reamed to the proper size for the replacement guide. Answers a, b, and d are not correct because both technicians are correct.

62. The correct answer is a. The valve-to-guide clearance between is measured using a micrometer to measure the diameter of the valve stem and to measure the inside diameter of the valve guide that is determined using a small ball gauge. The difference between these two is the valve-to-guide clearance. Answers b, c, and d are not correct because they cannot be used to measure the clearance between the valve stem and the valve guide.

63. The correct answer is d. A valve spring should be checked for squareness, proper free height, and tension. The tension should be checked at the designated height and without the dampener spring installed, if equipped. Answers a, b, and c are not correct because all three are correct, so the best answer is d.

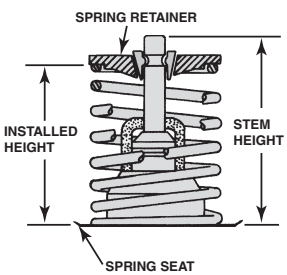
64. The correct answer is b. The difference between the valve face angle and the valve seat angle is called the interference angle and it is usually specified as being 1°. Answer a is not correct because the margin in the area above the valve face and this angle is not the interference angle. Answers c and d are also not correct because they do not describe the interference angle.



65. The correct answer is a. Technician A only is correct. Plugs that are installed to cover the cooling passage opening, where the core sand was removed during production, are usually driven into the opening using a hammer and a driver. Answer b is not correct because the cooling passage openings are not threaded. Answers c and d are not correct because only Technician A is correct.

66. The correct answer is d. The correct answer is all of the above. The coolant passages in the cylinder head should be inspected for corrosion, restriction, blocking, or signs of leakage. Answers a, b, and c are not correct because all of the items listed should be checked.

67. The correct answer is d. Neither technician is correct. Technician A is not correct because valve stem height is the distance from the spring seat to the top of the valve stem, whereas installed height is the distance from the valve seat to the bottom part of the valve spring retainer. Technician B is not correct because the valve stem height can be changed by grinding the stem, but not the installed height. Answers a, b, and c are not correct because neither technician is correct.



68. The correct answer is b. Technician B only is correct. O-ring-type valve stem seals can be checked using a hand-operated vacuum pump and a sealing cup to check whether the seal has been correctly installed. Technician A is not correct because the O-ring is installed under the keeper, not on top of the keeper. Answers a, c, and d are not correct because only Technician B is correct.

69. **The correct answer is d.** All of the answers are correct. Before valves can be removed, the keepers have to be removed and the cylinder head has to be off of the block. To avoid damage to the grinder, any burrs on the valve stems should be removed before removing the valve from the head. Answers a, b, and c are not correct because all are correct and, therefore, answer d is the best answer.

70. **The correct answer is a.** Technician A only is correct because fluorescent dye can be used on aluminum or iron parts to check for cracks. Technician B is not correct because even though it is commonly used to check aluminum parts, dye penetrant testing can also be used on iron parts. Answers c and d are not correct because only Technician A is correct.

71. **The correct answer is b.** The dial indicator is positioned to read movement of the camshaft, which is the end play. Answer a is not correct because a micrometer or Plastigage® is required to measure the camshaft bearing clearance. Answer c is not correct because the dial indicator is not positioned correctly to read runout. Answer d is not correct because a dial indicator is not used to properly locate the camshaft sprocket.

72. **The correct answer is d.** The camshaft bore should be inspected on all types of engines regardless of design. Answers a, b, and c are not correct because the camshaft bores on all types of engines should be inspected.

73. **The correct answer is b.** A steel spring seat is being installed on this aluminum head to protect the surface of the head from damage that the valve spring could cause during normal engine operation. Some engines use a combination of spring seat and valve stem seal. Answer a is not correct because even though they look similar, a valve spring insert is used to restore the proper valve spring installed height. Answer c is not correct because the part does not include a seal. Answer d is not correct because the seat is being installed around the valve guide.

74. **The correct answer is b.** The intake manifold may require machining to fit onto the cylinder heads after they have been machined. A formula is used to determine the amount that needs to be removed to allow the intake manifold to align properly with the parts in the head. Answers a, c, and d are not correct because these surfaces do not have to be machined when the cylinder heads are machined.

75. **The correct answer is b.** Zero lash is being determined by tightening the rocker arm adjusting nut until the pushrod cannot be rotated. Answer a is not correct because even though the technician is turning the adjusting nut, the rocker arm would have to be moved in order to remove the pushrod. Answer c is not correct because pushrod length is not adjustable. Answer d is not correct because the ratio of the rocker arm is not adjustable.

CATEGORY: ENGINE BLOCK DIAGNOSIS AND REPAIR

76. **The correct answer is b.** Technician B only is correct. A head gasket is labeled "front" if it has to be placed on the block correctly to avoid blocking coolant passages. The word "front" does mean toward the front of the engine, which is the accessory drive belt end. Answer a is not correct because form-in-place sealant is only used to seal parts that experience low pressure and are not designed to take the place of a cylinder head gasket. Answers c and d are not correct because only Technician B is correct.

77. **The correct answer is d.** The torque-angle method of tightening involves torquing the fasteners to a specified torque and then turning them a specified number of degrees. Answer a is not correct because even though all bolts should be turned the same number of degrees (not turns), this answer does not include a specified initial torque as a starting point. Answer b is not correct because this answer includes loosening the fasteners after torquing instead of tightening after the initial torquing. Answer c is the usual method to tighten a fastener using a torque wrench instead of using the torque-angle method as specified in the question.

78. **The correct answer is d.** Neither technician is correct. Technician A is not correct because the proper method is to file the ends of the ring to achieve the proper end gap. Technician B is not correct because an oversize ring would make the gap smaller, not larger. Answers a, b, and c are not correct because neither technician is correct.

79. **The correct answer is a.** The piston ring end gap can be increased by filing the ends of the piston ring. Answer b is not correct because oversize rings would decrease the piston ring end gap. Answer c is not correct because a sleeve is used to restore the cylinder and while a slightly larger bore would cause the piston ring end gap to increase, the installation of a sleeve by itself would not necessarily increase piston ring end gap. Answer d is not correct because knurling the piston would increase the diameter of the piston skirt and would not increase the piston ring end gap.

80. **The correct answer is c.** The feeler gauge is being used to measure the clearance between the piston ring and the piston ring groove. Normal clearance is usually between 0.001 in. and 0.003 in. Answer a is not correct because back spacing is determined by measuring the depth of the piston ring groove, not the width. Answer b is not correct because piston ring end gap is measured with a feeler gauge with the ring installed in the cylinder bore. Answer d is not correct because the surface finish is not measured using a feeler gauge.

81. **The correct answer is d.** The dial indicator is positioned to show the amount of movement that the crankshaft moves as it is pried forward and rearward. This movement is called the crankshaft end play or thrust bearing clearance. Answer a is not correct because the dial indicator is not in the right position to measure runout. It has to be 90° (right angle) to the crankshaft to measure runout. Answer b is not correct because a dial indicator is not used to check main bearing oil clearance. Oil clearance is measured using a micrometer or Plastigage. Answer c is not correct because the dial indicator needs to be touching the piston or valve lifter to determine top dead center.

82. **The correct answer is b.** According to engine bearing manufacturers, the most common cause of premature bearing failure is dirt. Answers a, c, and d are each a possible cause of premature engine bearing failure, but they are not the most common cause.

83. **The correct answer is a.** Technician A only is correct. If the block was machined, such as aligned honed, the bearing caps need to be de-burred proper to assembly to ensure that the parts fit correctly to the block without interference or gaps. Technician b is not correct because cleaning does not require that a file be used on parts. Answers c and d are not correct because only Technician A is correct.

84. **The correct answer is d.** To check for taper, the crankshaft journal has to be measured at a minimum of six locations. Answers a, b, and c are not correct because when measuring taper, there must be at least two measurements so the difference (taper) can be determined and this does not allow enough measurements to determine out-of-round. To be able to determine accurately whether or not a crankshaft journal is out-of-round or tapered, at least six measurements must be taken 120° apart.

85. **The correct answer is a.** The cylinder should be bored and/or honed and thoroughly cleaned before the piston ring end gap is checked. Answers b, c, and d are not correct because the ring gap cannot be checked after the piston has been installed in the cylinder.

86. **The correct answer is c.** The side clearance is between the piston ring and piston ring groove. This clearance allows the piston ring to twist during engine operation. Answer a is not correct because this is the piston-to-cylinder wall clearance, not the piston ring side clearance. Answers b and d are not correct because they do not represent the difference between the piston ring and the piston ring groove.

87. **The correct answer is b.** The vibration damper (harmonic balancer) has to be removed on an OHV engine to gain access to the timing gear and chain. Answers a, c, and d are not correct because removing the valve cover, cylinder head, or intake manifold will not allow access to the timing chain.

88. **The correct answer is c.** Both technicians are correct. Technician A is correct because a thread chaser will not remove any material from the metal, but will simply clean the threads. Technician B is correct because the bottom photo shows a tap. Answers a, b, and d are not correct because both technicians are correct.

89. **The correct answer is d.** Answer a is correct because lower than normal oil pressure can be caused by a worn oil pump because it may not be able to supply enough oil to keep the bearing clearance filled with oil. Answers b and c are correct because if the rod bearings were worn, an excessive amount of engine oil can escape from between the bearing and the crankshaft journal, thereby reducing oil pressure.

90. **The correct answer is a.** The ridge is the untouched area (original diameter of the cylinder) above where the piston rings contact the sides of the cylinder. Answer b is not correct because the top piston ring has been contacting the cylinder wall. Answer c is not correct because the ridge should be removed before removing the piston to avoid damage to the pistons. Answer d is not correct because the ridge is normal wear due to the piston ring and does not indicate that the stroke of the crankshaft is not correct.

91. **Technician A is correct.** Dye penetrant is primarily used to check pistons and other nonmagnetic materials for cracks, but it can be used to check iron and steel parts. Answer b is not correct because even though these are other methods that can be used to check iron and steel parts for cracks, the dye penetrant method can be used on other materials besides aluminum. Answers c and d are not correct because they do not state that Technician A only is correct.

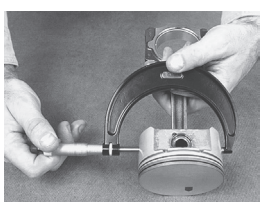
92. **The correct answer is b.** The rod and cap are machined together, and then separated. They should always be kept together and the cap reattached in the proper direction. Answer a (balanced together) is a true statement, but the weight would not be the same if the cap was reinstalled backward. It is for this reason that the two are machined together. Answers c and d are not correct because the rod cap and rod itself are being discussed, not the rod piston assembly.

93. **The correct answer is b.** While the protective caps would protect all parts of the engine, the most likely part to be damaged is the crankshaft as the piston-rod assembly is being installed into the engine. Answers a, c, and d are not correct because b is the best answer.

94. **The correct answer is d.** If the connecting rod is bent or misaligned, it creates an angled force applied to the piston as it moves up and down in the cylinder creating angled wear. Answer a is not correct because a tapered cylinder is caused by normal wear of the piston rings against the cylinder wall. Answer b is not correct because crankshaft journals can wear in a barrel shape, but not cylinders. Answer c is not correct because a ridge is normally created in a high-mileage engine due to wear created by the piston rings.

95. **The correct answer is b.** Abnormal combustion (ping, preignition, spark knock, or detonation) raises the temperature and the pressure inside the combustion chamber, which can cause pistons to melt and even blow holes through the top of the pistons. Answer a, while this could occur, would only be a factor if there were a failure of the timing belt or chain. Answer c is not correct because lugging can cause harm to connecting rod bearings, not pistons. Answer d is not correct because high speeds can most stretch connecting rods and damage main bearings, not break pistons, except indirectly.

96. **The correct answer is c.** The diameter of a piston is measured 90° from the piston pin across the thrust surface. Answer a is not correct because the head of the piston is smaller in diameter than the lower part of the piston to allow for heat expansion. Answers b and d are not correct.



97. **The correct answer is c.** A worn piston pin will cause a double knock sound. The first sound occurs when the piston stops at top dead center and the second sound occurs as the piston is pulled downward by the connecting rod after top dead center. Answer a is not correct because piston rings and valve stem seals are used to control oil consumption. Answer b is not correct because unlike a rod bearing, the noise of a piston pin does not stop when the cylinder is grounded out. Answer d is not correct because it often occurs when the engine is cold.

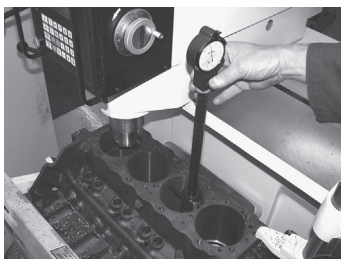
98. **The correct answer is c.** Both technicians are correct. Many crankshaft vibration dampeners (harmonic balancers) are a light press fit on the end of the crankshaft, which requires the use of a puller to safely remove, and an installation tool to safely install, to prevent causing damage to the balancer. Answers a, b, and d are not correct because both technicians are correct.

99. **The correct answer is b.** Most bearing oil clearance specifications are usually close to 0.001″ to 0.003″ and 0.0005″ (one-half thousandth) to 0.0025″ (two and a half thousandth) is a typical clearance specification. Answer a is too small a clearance and answers c and d represent too much clearance.

100. **The correct answer is b.** Technician B only is correct. The cam bearings used in a cam-in-block engine requires the use of a long tool that holds the cam bearing so it can be properly placed and then driven into location. Answer a is not correct because the cam bearings used in a cam-in-block engine are full round and are not two sections where Plastigage can be used. Bearing clearance is determined by measuring the inside diameter of the bearing and subtracting the outside diameter of the camshaft bearing journal. Answers c and d are not correct because Technician B only is correct.

101. **The correct answer is a.** Typical piston-to-cylinder clearance is one to three thousandth of an inch (0.001″ to 0.003″), which is the best answer. Answers b, c, and d are too great a clearance.

102. **The correct answer is b.** A dial bore gauge is being used to measure the difference in the cylinder at various places to determine the amount of cylinder taper and to determine if it is out-of-round. Answer a is not correct because a dial bore gauge is being shown and this tool is used to measure the cylinder bore only. It is not a tool equipped with an abrasive which is needed to be used to remove the cylinder wall glaze. A dial bore gauge is used to measure the difference within a cylinder bore. Answer c is not correct because a dial bore gauge is not used to remove material from the cylinder. Answer d is not correct because a dial bore gauge is being used and this tool does not measure the surface finish.



103. **The correct answer is c.** If the Plastigage strip has been squeezed so that it is wider than specified, the oil clearance is insufficient. Answer a is not correct because a large oil clearance will not squeeze the plastic strip as much and the clearance will be larger than specified. Answer b is not correct because, even though this could cause an inaccurate reading, the best answer is still c. Answer d is not correct because side clearance is not measured using Plastigage.

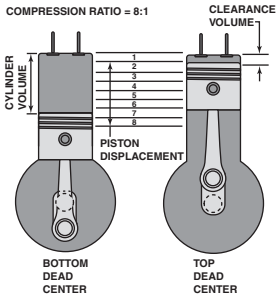
104. **The correct answer is b.** The connecting rod side clearance is the distance between the connecting rods and the sides (check) of the crankshaft journal. Answer a is not correct because oil clearance is between the bearing and the rod journal, not between the check of the rod journal and the connecting rod. Answers c and d are not correct because the feeler gauge is measuring between the connecting rods and not the thrust bearing clearance.

105. **The correct answer is b.** Most engine manufacturers specify a crankshaft thrust bearing clearance between two and twelve thousandth of an inch (0.002 in. to 0.012 in.). Answer a is not correct because this clearance is too small. Answers c and d are not correct because they are too great and usually outside of the specified measurements for thrust bearing clearance.

106. **The correct answer is d.** Neither technician is correct. Technician A is not correct because the block can be restored to useful service if it is line bored or honed. Technician B is not correct because oversize bearings will not restore the alignment of the main bearing bores. Answers a, b, and c are not correct because neither technician is correct.

107. **The correct answer is c.** The rear cylinder(s) can become distorted if the bell housing bolts are not properly torqued. Answer a is not correct because, even though it may be possible to distort the bell housing, the most correct and most important reason for torquing the bell housing is to prevent distortion of the block. Answer b is not correct because while cracking the block may be possible, it is very unlikely to occur. Answer d is not correct because the crankshaft is not affected when the bell housing is being attached to the back of the engine block.

108. **The correct answer is a.** Both the compression and the displacement will be increased if the cylinder bore is increased. When the cylinder bore is increased, the volume of the cylinder is increased when the piston is at bottom dead center, yet the combustion chamber volume has not been increased, so the larger cylinder volume is being compressed into the same volume when the piston is at top dead center. Answer b is not correct because while the displacement will increase, the compression rate will be increased instead of being decreased. Answer c is not correct because the displacement is increased when the bore (cylinder diameter) is increased. Answer d is not correct because both are increased, not decreased.



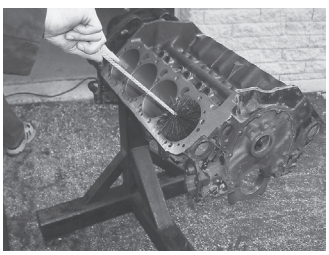
109. **The correct answer is b.** Technician B is correct because the connecting rod and cap should be marked for proper reassembly if they are not marked at the factory. Technician A is not correct because while it may be possible to do this on some engines, damage to the piston could still occur as it passes the lower part of the cylinder that may be rusted or corroded. Answers c and d are not correct because Technician B is correct.

110. **The correct answer is a.** The correct answer is 0.252 in. because the number 2 (0.200 of an inch) is showing as well as two vertical lines each representing 0.025 of an inch (0.200 + 0.025 + 0.025 = .250 in.) plus another 2 on the barrel equals 0.252 in. Answers b, c, and d are not correct answers.

111. **The correct answer is a.** Technician A is correct. It is wise to bore the cylinder to an oversize and use an oversize piston in any engine that has a cylinder that is out-of-round by 0.004 in. Most factory specifications call for a maximum out-of-round of 0.0015 in. or less. All cylinders should have the same bore, so all cylinders should be bored to the same size. Technician B is not correct because the out-of-round of the cylinder is excessive according to most vehicle manufacturer's specifications. Answers c and d are not correct because Technician A is correct.

112. **The correct answer is b.** Technician B is correct because the part shown is a metric thread pitch gage. The numbers represent the measurement in millimeters (mm) between the threads. Technician A is not correct because the tool used to dress the grinder stones uses a wheel rather than individual blades. Answers c and d are not correct because only Technician B is correct.

113. **The correct answer is a.** Soap (or detergent) and water should be used to clean a block after machining because the soapsuds will lift any grit remaining in the machined grooves. Answer b is not correct because while a clean cloth and engine oil can be used to prepare an engine block for assembly, it will not remove the grit from the small grooves left from the machining or grinding operation. Answer c is not correct because WD-40 will help prevent rust from forming but it will not clean as well as soap and water. Answer d is not correct because it requires the soap or detergent and water rather than a solvent (oil-based product) to lift the grit from the block surfaces.

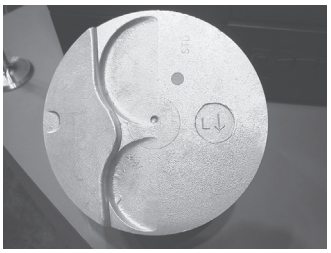


114. **The correct answer is c.** Both technicians are correct. Technician A is correct because the mark on the piston rings usually indicates the upward direction so the ring will twist correctly in the groove during engine operation. Technician B is correct because the mark may be different between the top and the second ring. Answers a, b, and d are not correct because both technicians are correct.

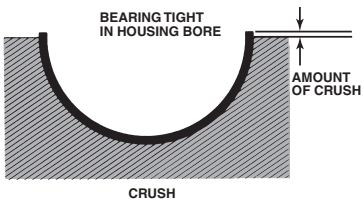
115. **The correct answer is c.** Both technicians are correct. Technician A is correct because the cylinder bore diameter can vary slightly and the end gap of the piston ring should always be checked in the cylinder in which it is to be installed to make sure that the gap is within factory specifications. Technician B is correct because the end gap can be increased by filing the ends of the ring using a hand file or a rotary ring gap filing tool. Answers a, b, and d are not correct because both technicians are correct.

116. **The correct answer is a.** Technician A only is correct. The oil bearing clearance can be checked using plastic gauge material (Plastigage). While some vehicle manufacturers recommend that direct measurement of the bearings as installed be subtracted from the diameter of the bearing journal to determine the oil clearance, it is possible to use Plastigage. Answer b is not correct because the crankshaft should not be moved (rotated) when the Plastigage is being used. Answers c and d are not correct because Technician A only is correct.

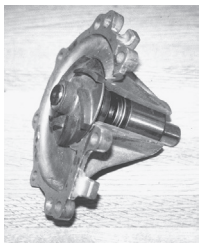
117. The correct answer is b. The notch, arrow, or other mark on a piston should be installed facing toward the front (accessory drive belt end) of the engine. The piston pin is offset on many pistons and this ensures that the piston is correctly installed. Answer a is not correct because the piston mark cannot be pointed toward the side of the engine. Answer c is not correct as explained for answer b. Answer d is not correct because the arrow should face the front of the engine.



118. A only is correct. The insert bearing should extend slightly above the bearing cap to provide the necessary crush when assembled to keep the bearing from spinning during engine operation. Answer b is not correct because the bearing size is determined by the thickness of the insert and the difference between a standard and a 0.010 in. undersize bearing (thicker shell) insert may not be visible. Answers c and d are not correct because they do not indicate that Technician A only is correct.



CATEGORY: LUBRICATION AND COOLING SYSTEMS DIAGNOSIS AND REPAIR



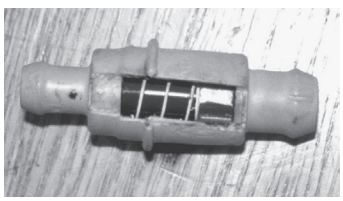
119. The correct answer is c. Both technicians are correct. Technician A is correct because the drive belt(s) could have been installed and tightened too tightly creating an excessive force on the water pump bearing. Technician B is also correct because the cooling fan blade(s) may be bent causing a vibration, which could also damage the water pump bearing. Answers a, b, and d are not correct because both technicians are correct.

120. The correct answer is a. The freezing point of the coolant decreases as the percentage of antifreeze increases up to a point (about 70%) and then it starts to increase. Antifreeze by itself freezes at about 0°F (-18°C). Answer b is not correct because the boiling point increases rather than decreases as the percentage of antifreeze is increased. Answer c is not correct because the heat transferability of the coolant is decreased as the percentage of antifreeze is increased in the coolant. Answer d is not correct because answers b and c are not correct.

121. The correct answer is a. Most vehicle manufacturers recommend that a 50/50 mix of antifreeze and water be used for the cooling system. Filling half the system with 100% antifreeze and the rest with water will result in a 50/50 mix. Answers b and c are not correct because these methods will not result in a 50/50 antifreeze to water mix. Answer d will result in a 50/50 mix if all of the coolant can be drained from the system before refilling it with the 50/50 mix. However, this method uses more antifreeze coolant than is necessary and, therefore, is not the recommended method and not the best answer to this question.

122. The correct answer is c. The temperature on the thermostat is the temperature that it starts to open and is fully opened about 20° higher. Answer a is not correct because the temperature on the thermostat is when it starts to open not when it is fully open. Answer b is not correct because even though thermostats can cause overheating, they most often fail in the open position causing the engine to not reach operating temperature. Answer d is not correct because it involves both answers a and b which were not correct.

123. The correct answer is c. Both technicians are correct. Technician A is correct because the radiator should always be checked for proper operation before using it in a vehicle with a new or rebuilt engine. Technician B is correct because an inoperative electric cooling fan can cause overheating during slow, city driving. Answers a, b, and d are not correct because both technicians are correct.



124. The correct answer is c. Both technicians are correct. Technician A is correct because the PCV valve is located between the intake manifold and the valve (cylinder head) cover. Technician B is correct because about 20% of the air needed by the engine at idle speed flows through the PCV valve. Answers a, b, and d are not correct because both technicians are correct.

125. The correct answer is d. Answer a is correct because the oil pump should be rotated before starting the engine after a rebuild to lubricate the bearings as well as the valve train components (answer b) including the camshaft (answer c).

126. The correct answer is d. Both answers a and b are correct. Answer a is correct because an engine oil cooler has engine oil circulated through the passages and these passages should not leak oil. Answer b is correct because most engine oil coolers use engine coolant to cool as well as warm the engine coil. Coolant should not leak from the cooler or any of the lines or fittings. Answer c is not correct because air is not used in most engine oil coolers and if so, would be just passing through the cooling fins and an air leak is not a factor.

127. The correct answer is a. Coolant that uses organic acid technology such as DEX-COOL does not contain any silicates or phosphates. Answers b, c, and d all contain either silicates or phosphates.

128. The correct answer is a. Technician A is correct because the HOT light (engine coolant temperature warning lamp) will come on about 258°F (125°C) to warn the driver that the engine coolant temperature is too high for safe engine operation. Technician B is not correct because the warning light does not react to cooling system pressure, just temperature. Answers c and d are not correct because only Technician A is correct.

129. The correct answer is b. Technician B only is correct. The purpose and function of the electric cooling fan is to provide airflow through the radiator at low vehicle speeds. When the vehicle exceeds about 35 mph (56 km/h), there is enough airflow to keep the engine cool and the electric cooling fan shuts off. If the electric cooling fan is not operating, the engine could overheat during slow city-type driving conditions. Answer a is not correct because the thermostat opens about 20° lower than the temperature that is fully open and the cooling fan will come on at a higher than the fully open temperature of the thermostat. Answer c and d are not correct because only Technician B is correct.

130. The correct answer is b. Technician B is correct because the heater will have coolant flowing through the core when the water pump is operating slowly such as during engine idle. However, when the engine speed increases, the coolant will be taking the path of lower resistance and bypass the heater core unless the coolant level is properly filled. Technician A is not correct because even though the water pump could have worn the impeller blades, the most likely cause is low coolant level. Answers c and d are not correct because only Technician B is correct.

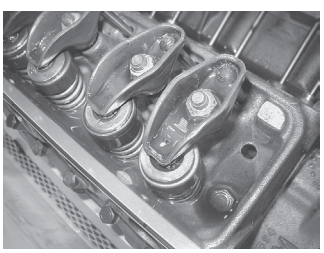
131. The correct answer is d. Answer d is correct because normal operating temperature causes the upper hose to become hot and pressurized and will cause the cooling fans to cycle on and off. Answer a is not correct because the radiator cap will only release coolant to the overflow if the pressure exceeds the rating of the cap and does not represent what normally occurs when the engine reaches normal operating temperature. Answers b and c are not correct alone because either can be an indication of when normal operating temperature has been achieved and, therefore, answer d is the best answer.

132. The correct answer is a. The engine oil flows best when it is warm and also is able to hold dirt in suspension best at normal operating temperature. Answers b and c are not correct because the oil can hold more dirt and flow best if the oil is at normal operating temperature. Answer d is not correct because this procedure will not ensure that the oil is at normal operating temperature.

133. The correct answer is d. Neither technician is correct. The thickness (viscosity) is the measure of the resistance to flow and is not an indicator of quality. The API rating indicates quality. Technician A is not correct because even though a thicker oil (higher viscosity) may cause an increase in oil pressure, the thickness of the oil is not an indication of quality. The higher viscosity could keep vital engine parts from receiving oil at start up, especially in cold weather. Technician B is not correct because a higher viscosity oil would decrease fuel economy and is not recommended by the vehicle manufacturers in most cases. Answer c is not correct because both technicians are wrong.

134. The correct answer is b. Normal oil pressure is generally 10 psi per 1000 RPM and, therefore, oil pressure between 10 psi and 60 psi would be the best answer. Answer a is not correct because the pressure is too low and represents the oil pressure that could turn on the oil pressure warning light but is not high enough to be considered normal. Answers c and d are both too high for normal oil pressure.

135. The correct answer is c. The valves components are the last to receive oil from the oil pump. The oil first flows to bearings (cam, main, and rod), and then to the rocker arms. Answer a is not correct because the main bearings are usually one of the first components to receive oil after it leaves the oil pump. Answer b is not correct because the rod bearings receive engine oil from the main bearings and are one of the first locations in the engine to receive oil. Answer d is not correct because the oil filter is the first place the oil is pumped when leaving the oil pump.



CATEGORY: FUEL, ELECTRICAL, IGNITION, AND EXHAUST SYSTEMS INSPECTION AND SERVICE

136. The correct answer is c. Both technicians are correct. Technician A is correct because a defective crankshaft position (CKP) sensor will prevent the necessary signal to the ignition module to trigger the ignition coil, which would cause a no spark condition. Technician B is also correct because a defective ignition module can cause a no spark condition. Answers a, b, and d are not correct because both technicians are correct.

137. The correct answer is b. Technician B is correct because each coil fires two spark plugs at the same time. If the coil is defective and not capable of supplying a spark, both spark plugs attached to the coil will not fire. Answer a is not correct because even if two spark plugs will not fire, most engines will still start and run, even though the engine will not produce normal power. Answers c and d are not correct because Technician B only is correct.

138. The correct answer is c. Both technicians are correct. Technician A is correct because a fault in the engine itself such as worn bearings or other mechanical fault can cause the engine to require a greater force to rotate. Technician B is also correct because a defective starter motor will often draw an excessive amount of current from the battery thereby reducing the battery voltage during cranking. Answers a, b, and d are not correct because they do not include that both technicians are correct.

139. The correct answer is c. Both technicians are correct. Technician A is correct because air can enter through a gap in the intake manifold, which is called a vacuum leak. Technician B is correct because a reduction in the amount of air entering the engine is similar to what occurs if the throttle plate is not opened. Answers a, b, and d are not correct because both technicians are correct.

140. The correct answer is c. Both technicians are correct. Technician A is correct because a weak or defective battery will cause a starter to rotate slower than normal. Technician B is also correct because a loose or corroded battery cable will cause a voltage drop in the cranking circuit, which will reduce the current flow to the starter. Answers a, b, and d are not correct because they do not include that both technicians are correct.

141. The correct answer is c. Both technicians are correct. Technician A is correct because a clogged port fuel injector can cause a lack of fuel to one cylinder, which would cause a misfire condition. Technician B is correct because a leaking lower injector O-ring will cause outside air to enter the intake manifold. Air leaking into the intake manifold is commonly called a vacuum leak. Answers a, b, and d are not correct because both technicians are correct.

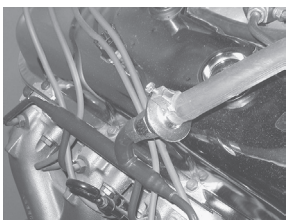
142. The correct answer is b. The oxygen sensor should be replaced if the engine has a blown head gasket. Additives in conventional coolant such as silicates and phosphates can coat the oxygen sensor causing the sensor to incorrectly sense the oxygen content in the exhaust. Answer a is not correct because the throttle position sensor would not be directly related to a fault with the head gasket nor be affected by the condition, as would the oxygen sensor.

Answer c is not correct because a blown head gasket would not affect the MAP sensor directly. While it is possible for some coolant to get into the sensor through the intake system, this would be very unlikely. Answer d is not correct because a blown head gasket would not affect the ECT sensor since it is already exposed to coolant normally. A defective ECT sensor could be the cause of the blown head gasket if it had not accurately measured engine coolant temperature.

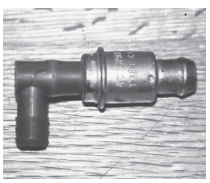
143. The correct answer is c. Both technicians are correct. Technician A is correct because up to 20% of the air needed by the engine at idle speed flows though the PCV valve. If the flow is not correct, the engine idle will be affected. Technician B is also correct because if the EGR valve was stuck partially open at idle, the exhaust gases would dilute the air-fuel mixtures by displacing oxygen. The engine idle would be unstable because of the incorrect mixture. Answer c and d are not correct because both Technicians A and B are correct.

144. The correct answer is c. Both technicians are correct. Technician A is correct because if the catalytic converter rattles when tapped, the substrate is broken and the converter should be replaced. Technician B is also correct because the converter can be poisoned by lead or other chemicals and the active material rendered unable to start the chemical reactions as designed, but yet not be physically clogged. Answers c and d are not correct because both Technicians A and B are correct.

145. The correct answer is c. A clogged condenser would affect the operation of the air conditioning system and could increase the coolant temperature by restricting airflow through the radiator, but would not cause a reduction in engine power. Answers a, b, and d are not correct because each of these could cause a reduction in engine power. A clogged air filter would reduce the amount of air entering the engine. A restricted intercooler would also reduce the amount of air entering the engine. A restricted exhaust would reduce the amount of exhaust exiting the engine and create higher than normal backpressure, thereby reducing engine power.



146. The correct answer is c. Both technicians are correct. Technician A is correct because the exhaust could travel up through the defective one-way check valve and damage the air pump as well as the switching valves and hoses. Technician B is also correct because the airflow from the air pump should be switched from the exhaust manifold to the catalytic converter when the engine is operating in closed loop. If the air were to continue to flow to the exhaust manifold, the oxygen sensor would read the air from the air injection reaction (AIR) pump as being caused by a lean air-fuel mixture; then the vehicle computer would try to incorrectly enrich the mixture. Answers c and d are not correct because both Technicians A and B are correct.



147. The correct answer is b. Technician B only is correct. The spring inside the PCV valve can lose tension due to heating and cooling cycles during normal engine operation. If the valve does not rattle, then it is defective and should be replaced, but this does not mean that it is serviceable just because it does rattle when shaken. Technician A is not correct saying because the valve rattles, the valve is good. The valve should be replaced when it does not rattle when shaken or whenever recommended to be replaced by the vehicle manufacture interval. Answers c and d are not correct because Technician B only is correct.

148. The correct answer is b. Technician B only is correct. Dry, fluffy deposits on spark plugs are usually an indication of a rich air-fuel mixture. Technician A is not correct because the deposits are usually wet when the engine is burning oil because oil does not burn very well. Answers c and d are not correct because they do not indicate that Technician B only is correct.

149. The correct answer is a. Technician A only is correct. The spark plug wire should measure less than 10,000 ohms per foot of length and a reading of 7.86k ohms (7,860 ohms) is well below the maximum allowable 20,000 ohms (two feet times 10,000 = 20,000 ohms). Technician B is not correct because the resistance is within the specifications for most vehicle manufacturers. Answers c and d are not correct because Technician A only is correct.

150. The correct answer is b. Technician B only is correct. Technician B is correct because a coil-on-plug ignition system uses a coil for each spark plug and if it fails, a misfire will occur. Technician A is not correct because adjusting the crankshaft position (CKP) sensor just adjusts the air gap and does not affect when the signal occurs. Ignition timing is not adjustable on an engine equipped with a waste-spark or COP-type ignition. Answers c and d are not correct because only Technician B is correct.

151. The correct answer is c. Both technicians are correct. Technician A is correct because if the bushings are worn in the turbocharger, engine oil can get past and be drawn into the turbocharger where the oil will then flow into the cylinder and be consumed. Technician B is correct because a clogged positive crankcase ventilation (PCV) system can cause crankcase pressure to increase, which can cause engine oil to be forced into the intake manifold. Answers a, b, and d are not correct because both technicians are correct.

152. **The correct answer is c.** Both technicians are correct. Technician A is correct because an engine will produce less than normal torque and power if not supplied with an adequate amount of fuel under the pressure. Technician B is also correct because most vehicle specifications require that the fuel pump be capable of supplying one-half pint of fuel in 15 seconds or two pints (1 liter) every minute (60 seconds). Answers a, b, and d are not correct because both technicians are correct.

153. **The correct answer is a.** Technician A only is correct. The reading on the ohmmeter (OL, or over limit) indicates that the spark plug wire is electrically open and lacks continuity. The wire should be replaced. Technician B is not correct because a good spark plug wire should measure less than 10,000 ohms per foot or less than 30,000 ohms for most spark plug wires. The wire being tested did not register any continuity and is, therefore, electrically open and should be replaced. Answers b, c, and d are not correct because only Technician A is correct.