Chapter 42

Gasoline Injection Diagnosis and Repair

Name _____ Date _____

Instructor _____ Score _____

Objective: After studying this chapter, you will be able to troubleshoot and repair common problems associated with gasoline injection systems.

Gasoline Injection Problem Diagnosis

1. What must a technician use in order to diagnose problems in a gasoline injection system?

   _____

   _____

2. What four subsystems should a technician inspect when trying to locate problems?

   _____

3. On a modern EFI system, an engine ECM trouble code indicates a(n) _____ problem. _____

4. What happens when an O_2 sensor fails?

   _____

   _____

   _____

   _____

5. What is the purpose of a malfunction indicator light?

   _____

   _____

6. List the engine conditions that a fuel injection system monitors.

   _____

   _____

   _____

   _____

   _____

   _____

7. What are typical circuit values with the engine running at curb idle speed and full operating temperature called?

_____

8. Name three examples of readings indicating trouble in a fuel injection system.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

9. What should you look for when inspecting a gasoline injection system for problems?

_____

_____

_____

_____

_____

_____

_____

10. If your scan tool indicates a problem with a specific injector, listen to its operation with a(n)_____. _____

11. A(n) _____ sound means the injector is opening and closing. _____

12. *True or False?* A conventional lower pressure fuel injector clicks much louder than a direct gasoline injector. _____

_____ 13. Many systems can pressurize the gasoline to over _____ psi at idle and over _____ psi during acceleration or high rpms.
(A) 500, 1000
(B) 500, 2000
(C) 1000, 1500
(D) 1000, 2000

14. Vehicles equipped with OBD II systems can set _____ that pinpoint injector problems. _____

Name _____

15. Explain the term *fuel system monitoring*.

_____

_____

16. What is normally used to determine fuel mixture content in a gasoline injection system?

_____

_____

17. _____ fuel trim refers to the temporary adjustment of injector pulse width to correct the fuel mixture. _____

18. Define *long-term fuel trim*.

_____

_____

_____

19. A normal range for both short- and long-term fuel trim is typically plus or minus _____. _____

20. What is the purpose of oxygen sensor monitoring?

_____

_____

_____

_____

21. Why are many oxygen sensors in OBD II systems heated?

_____

22. An oxygen sensor _____ checks the action of the heating element in the sensor. _____

23. A (lean/rich) _____ trouble code will be set if an O_2 sensor detects high amounts of oxygen in the engine exhaust. _____

Fuel System Tests

24. What functions are served by a high-end scan tool?

_____

_____

_____

_____

_____

_____

Fuel Injector Problems

25. What problems can be caused by a bad fuel injector?

_____

_____

26. What are some of the possible causes of a leaking injector?

_____

_____

27. An inoperative EFI injector normally has _____ or _____ coil windings.

_____

_____

28. What test should be performed before condemning a fuel injector that tripped a trouble code?

_____

_____ 29. A failed injector coil winding will usually show up as _____.
- (A) infinite resistance
- (B) no resistance
- (C) Either A or B.
- (D) None of the above.

_____ 30. Low impedance fuel injectors should have an internal resistance of about _____ to _____ ohms.
- (A) 0.1, 3
- (B) 0.5, 3
- (C) 1, 3
- (D) None of the above.

_____ 31. High impedance fuel injectors should have between _____ and _____ ohms to be within specifications.
- (A) 1, 3
- (B) 3, 5
- (C) 5, 10
- (D) None of the above.

32. _____ fuel injectors can have an ohms reading of 150,000 ohms to 200 kilohms.

_____

_____ 33. EFI injector operating voltage is usually _____ volts dc for non-direct or port injection systems.
- (A) 5–10
- (B) 10–12.5
- (C) 12.5–15
- (D) 15–20

34. DEFI injector operating voltage will usually be (higher/lower) _____ than battery voltage, from 50–100 volts dc.

_____

35. Describe a fuel injector scope test.

_____

_____

Name _____

36. What is indicated when a fuel injector produces a rounded, malformed waveform without specific voltage variations over time?

_____

_____

37. The power transistor control circuit inside the ECM or injector amplifier ECM either _____ or applies voltage to the injector to make it spray fuel into the engine. _____

38. When performing a fuel injector scope test, set the scope frequency to _____. _____

39. How can the injector waveform be very helpful in finding injector problems quickly?

_____

_____

_____

_____

40. *True or False?* Never use jumpers to apply full battery voltage to an injector winding. _____

41. What problems will show up when the fuel injector waveform trace has major variations from normal?

_____

42. A PNP fuel injector waveform is similar to the _____ switch waveform, except that the waveform is inverted on the scope screen. _____

43. A peak-and-hold fuel injector circuit uses a (high/low)_____ amount of current to open the injector and a (high/low) _____ amount of current (less than one amp) to hold the injector open. _____

_____

44. A peak-and-hold fuel injector waveform will have _____ induced voltage spikes. _____

45. A pintle _____ is a slight variation in the injector waveform that occurs when the pintle opens or closes. _____

46. A slight voltage is induced in the circuit when metal pintle (opens/closes) _____. _____

47. Compare a conventional fuel injector to a piezo injector.

_____

_____

_____

_____

48. *True or False?* Exact injector waveforms will vary slightly with vehicle manufacturer. _____

49. Define *noid light*.

_____

50. What does it mean if the noid light does *not* flash *on* and *off*?

_____

51. An injector _____ involves the use of a scan tool, PC, or specialized fuel injector tester to measure the amount of fuel flowing through each injector. _____

52. What will a fuel injector balance test reveal?

_____

_____

_____

53. *True or False?* Always relieve fuel pressure after disconnecting any EFI fuel line, even with low-pressure port injection systems. _____

54. Name three ways to relieve fuel system pressure.

_____

_____

_____

_____

55. Most low-pressure EFI systems have a fuel pressure relief valve for _____ any remaining gasoline pressure in the fuel rail and injectors. _____

56. What type of valve is a fuel pressure relief valve?

_____

57. What should you do if a relief valve or a pressure regulator is not provided?

_____

58. When performing a manual fuel injector balance test on a pre-OBD II vehicle, connect a(n) _____ to the ignition system. _____

59. To perform an injector balance test with an EFI tester and a pressure gauge, connect a(n) _____ to the test fitting on the fuel rail. _____

_____ 60. If all injectors are working properly, there must be no more than _____ psi difference in pressure drop per injector.
(A) 1
(B) 1.5
(C) 2
(D) 2.5

61. If any injector has a (higher/lower) _____ than normal pressure drop, it is clogged or sticking closed; if any injector has a (higher/lower) _____ pressure drop than the others, it is leaking or sticking open. _____ _____

Name _____

62. Remember that a mechanical problem inside an OBD II engine could cause a cylinder to fail an injector test due to low _____. _____

63. What does an injector maximum flow test measure?

_____

_____

_____

64. Name four things where an injector maximum flow test will find problems.

_____

_____

_____

65. What is pintle response?

_____

_____

66. What does a fuel injector impedance test measure?

_____

_____

67. Since impedance and magnetic _____ are related, an impedance test indicates how quickly the injector will open to spray fuel. _____

68. What problems can a fuel injector impedance test find?

_____

_____

Replacing Multiport Fuel Injectors

69. Describe how to replace an EFI multiport injector.

_____

_____

_____

_____

_____

70. A fuel injector _____ is a soft rubber grommet or O-ring that fits between the fuel injector and its opening in the engine. _____

Electronic Fuel Injector Cleaning

71. What does a fuel injector cleaning tool use to force a cleaning solution through the injectors to remove deposits?

_____

Fuel Pressure Regulator Service

72. How can a faulty fuel pressure regulator affect engine operation?

_____

_____

73. Describe how to test fuel pressure regulator operation.

_____

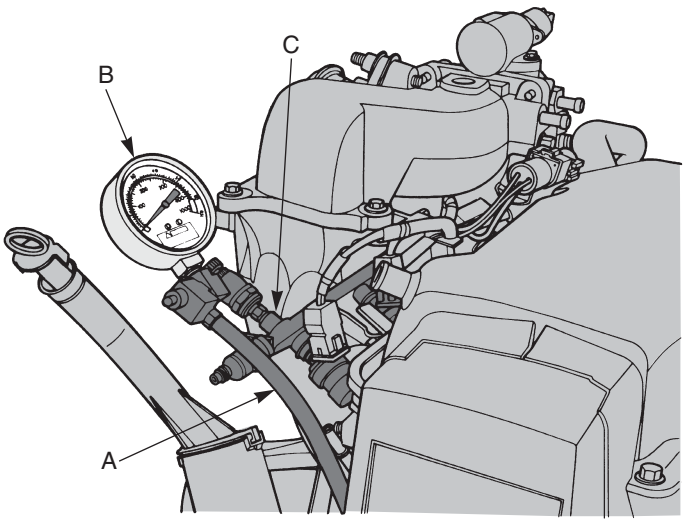
_____

_____

74. What should be done if a fuel pressure regulator test indicates low fuel pressure?

_____

75. Identify the components and test equipment in the drawing below depicting a fuel pressure, pump, and filter test.



(A) _____

(B) _____

(C) _____

Fuel System Sensor Service

76. Most EFI engine sensors can be checked with a(n) _____. _____

77. A failed O_2 sensor will upset an engine's _____. _____

78. Name some of the causes of oxygen sensor contamination.

_____

79. What type of meter should be used to measure oxygen sensor voltage?

_____

Name _____

80. Describe a quick test used to see if an oxygen sensor reacts to a change in air-fuel mixture.

_____

_____

_____

_____

81. How do you test an oxygen sensor circuit?

_____

For questions 82–85, match the color of the oxygen sensor with its description.

_____ 82. Might indicate a lean mixture or silicone contamination.

_____ 83. Normally indicates a rich mixture and carbon contamination.

_____ 84. Normal for an oxygen sensor.

_____ 85. Could be lead contamination.

(A) Light gray
(B) White
(C) Tan
(D) Black

86. An oxygen sensor signal generator is a tool for sending a(n) _____ 200–800 mV signal to the control module for testing purposes. _____

87. List eight rules to follow when installing an oxygen sensor.

(1)_____

(2)_____

(3)_____

(4)_____

(5)_____

(6)_____

(7)_____

(8)_____

88. When does the throttle position sensor (TPS) signal the control module?

_____

_____

_____

89. A throttle position sensor should produce a given amount of _____ for different throttle openings. _____

90. Many manuals recommend checking the resistance of the throttle position sensor at different _____. _____

91. A(n) _____ sensor provides an electric signal proportional to the pressure or vacuum inside an engine intake manifold. _____

92. The engine coolant temperature (ECT) sensor allows the ECM to _____ the fuel mixture on a cold engine. _____

_____ 93. Most ECT sensors are fed a _____ volt(s) dc reference voltage signal from the ECM.
(A) 1
(B) 3
(C) 5
(D) 12

94. Explain how to replace a coolant sensor.

_____

_____

_____

_____

_____

95. What measures the temperature of the outside air entering the engine?

_____

96. A faulty air temperature sensor can make the engine hard to start or cause the engine to run _____ after it has warmed up. _____

_____ 97. A bad mass airflow sensor can make the engine run a little _____.
(A) lean
(B) rich
(C) Either A or B.
(D) Neither A nor B.

_____ 98. A normal MAF frequency at idle is _____ kilohertz.
(A) 1–2
(B) 2–3
(C) 4–5
(D) 5–10

Control Module Service

99. Why is an EFI control module normally mounted under the dash?

_____

Idle Speed Motor Testing

100. A bad idle _____ may not be able to maintain the correct engine idle speed. _____

101. A(n) _____ energizes the solenoid or servo motor to check its effect on engine idle speed. _____

Multiport Throttle Body Service

102. What does multiport throttle body service normally include?

_____