



1. Diesel fuel ignition in a warm engine is being discussed. Technician A says diesel fuel is ignited by the heat of the compression. Technician B says diesel fuel is ignited by the glow plugs. Who is correct?

- A. **Technician A**
- B. Technician B
- C. Both A and B
- D. Neither A nor B

Answer Explanation: The average compression ratio of today's diesel engines are generally between 15.5:1 and 17:1. The combustion pressure produces an average pre-ignition temperature of 1000 degrees. When the diesel fuel is atomized in a cylinder under these pressures it will auto-ignite. The glow plugs are used to vaporize fuel on contact in a cold engine.

2. Which type of diesel injection produces less noise?

- A. Indirect injection (IDI)
- B. Common rail
- c. **Direct injection**
- d. Distributor injection

Answer Explanation: The direct injection uses a combustion chamber design that is shallow and wide. The "quiescent" shape creates very little turbulence which results in less noise.

3. Which diesel injection system requires the use of a glow plug?

- a. **Indirect injection (IDI)**
- b. High-pressure common rail
- c. Direct injection
- d. Distributor injection

Answer Explanation: Direct injection combustion systems typically do not require starting aids. Indirect injection systems require a glow plug starting aid.

4. The three phases of diesel ignition include
 - a. Glow plug ignition, fast burn, slow burn
 - b. Slow burn, fast burn, slow burn
 - c. **Ignition delay, rapid combustion, controlled combustion**
 - d. Glow plug ignition, ignition delay, controlled combustion

Answer Explanation: Higher combustion ratios convert energy into power. The diesel will not suffer from pre-ignition as only air is drawn into the cylinder during the intake stroke. The ignition delay, rapid combustion, and the controlled combustion are as result of the high pressure direct injection systems ability to deliver multiple shots of fuel during a single injection event. The pilot injection, main injections, and post injections of fuel will create the three phases of injection.

5. What fuel system component is used in a vehicle equipped with a diesel engine that is not usually used on the same vehicle when it is equipped with a gasoline engine?
 - a. Fuel filter
 - b. Fuel supply line
 - c. Fuel return line
 - d. **Water-fuel separator**

Answer explanation: water separators coalesce or clump smaller water droplets into larger droplets. This causes the water to fall out of the less dense fuel into the sump, where it can be drained. The water separator may be combined with fuel heaters, water in fuel sensors and fuel filters. The density of diesel fuel allows this process to function properly.

6. The diesel injection pump is usually driven by a _____.
 - a. **Gear off the camshaft**
 - b. Belt off the crankshaft
 - c. Shaft drive off of the crankshaft
 - d. Chain drive off of the camshaft

Answer explanation: The gear off of the camshaft allows for a direct connection to the engine. This allows the pump to more effectively operate the plungers in its pump. This also allows the manufacture, if needed, to time the pump to the engine for fuel delivery needs or to balance the engine and reduce unwanted vibrations.

7. Which diesel system supplies high-pressure diesel fuel to all of the injectors all of the time?
 - a. Distributor
 - b. Inline
 - c. **High-pressure common rail**
 - d. Rotary

Answer explanation: A distributor, inline, or rotary fuel delivery system provides fuel to a specific injector at a given time or in a given sequence. The common rail fuel delivery system provides fuel to a common source (the rail). When the injector is energized, it fuel supply is from the common rail.

8. Glow plugs should have high resistance when _____ and lower resistance when _____.
- Cold/warm
 - Warm/cold**
 - Wet/dry
 - Dry/wet

Answer explanation: Most glow plugs are made of materials such as platinum or iridium. These materials are corrosion resistant and stand up well to high temperatures. The lower resistance when cold allows the element to heat up quickly. As the unit warms the resistance increases, effectively limiting the current flow. Most modern glow plugs operate at about 5 amps of current. The controller monitors the current flow to determine if the unit is operating properly.

9. Technician A says that glow plugs are used to help start a diesel engine and are shut off as soon as the engine starts. Technician B says that the glow plugs are turned off as soon as a flame is detected in the combustion chamber. Which technician is correct?
- Technician A only
 - Technician B only
 - Both Technicians A and B
 - Neither Technician A nor B**

Answer explanation: Most glow plugs continue to operate for a time after start up. The amount of time is a function of engine combustion temperature or the design of the system. On most indirect injection system the glow plugs will no longer be needed after a few minutes of operation. On some instant start systems the glow plug is also to measure cylinder pressure and is therefore energized for a longer period of time.

10. What part should be removed to test cylinder compression on a diesel engine?
- An injector
 - An intake valve rocker arm and stud
 - A glow plug
 - A glow plug or injector**

Answer explanation: although rarely done on a diesel engine due to the possibility of hydro locking the engine during a wet test and that some ring designs require high pressure to seal. A compression test can be performed on most diesel engines by removing either an injector or a glow plug. An adapter can be used with the compression gauge to measure the pressure.

11. Diesel engines that use pre-combustion chambers to create velocity and promote atomization are being discussed. What type of diesel injection system uses a pre-combustion chamber?
- Common rail
 - Direct
 - High pressure
 - Indirect**

Answer explanation: An indirect combustion system injects fuel into smaller, spherical, highly turbulent chamber that is connected to the main chamber via a venture. The air and fuel mixture is ignited in the pre-chamber and then expands into the main combustion chamber where combustion is completed.

12. Diesel engines do not use spark plugs to start combustion. What do they use to start combustion?

- a. Glow plugs
- b. Ignition coils
- c. Fuel Control Actuators (FCA)
- d. **Compression**

Answer explanation: Compression pressures produce an average preignition cylinder temperature of 1,000 degrees. The heat will auto ignite the air/ fuel mixture starting the engine.

13. Cetane is a measure of a diesel fuel's ignition delay time. The higher a diesel fuel's cetane number, _____.

- a. the longer the delay
- b. the harder to ignite
- c. **the shorter the delay**
- d. the cheaper it is

Answer explanation: The cetane rating is a measure of the ignition quality of fuel and refers to the fuel's ignitability under compression. Fuel with a high cetane value will ignite sooner and burn faster than fuel with low cetane value.

14. Ultra Low Sulfur Diesel Fuel (ULSD) is federally regulated to have no more than _____ parts per million sulfur content.

- a. 500
- b. **15**
- c. 50
- d. 10

Answer explanation: Ultra-low sulfur diesel has had the sulfur content reduced from approximately 500 parts per million (ppm) in 2005 to 15 ppm beginning in 2006.

15. New EPA regulations in 2007 reduced allowable emissions of _____ and _____ in diesel engines by 90%.

- a. **PM and NOx**
- b. PM and HC
- c. CO2 and NOx
- d. CO and CO2

Answer explanation: The EPA enacted a PM emissions standard for new heavy-duty engines of 0.01 grams per brake-horsepower-hour (g/bhp-hr), to take full effect for diesels in the 2007. Additionally, they established standards for NOx and non-methane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/ bhp-hr, respectively. These NOx and NMHC standards will be phased in together between 2007 and 2010, for diesel engines. The phase-in will be on a percent of-sales basis: 50 percent from 2007 to 2009 and 100 percent in 2010.

16. The EGR system on newer design diesel engines _____ .
- a. increase combustion chamber temperatures by adding hot exhaust gasses
 - b. will assist in reducing PM emissions
 - c. **will assist in lowering NOx emissions**
 - d. use engine vacuum to open EGR valves

Answer explanation: The EGR system on a diesel engine operates much like a gasoline engine. When opened, the EGR valve allows exhaust gasses, which are largely inert, to flow into the intake manifold displacing combustible intake air. The exhaust gasses lower combustion pressure and temperature, effectively lowering the levels of oxides of nitrate (NOx).

17. Modern common rail fuel systems may use _____ to control high side fuel system pressure.
- a. an electronic solenoid valve
 - b. fuel rail pressure limiting valve
 - c. fuel control actuator (FCA)
 - d. **all of the above**

Answer explanation: Modern common rail systems use a tube or rail to store pressurized fuel. Electronic solenoids or actuators control the opening and closing of each injector. AN engine driven high pressure pump supplies the fuel to the rail. A microprocessor controls the fuel system operation and there is electronic control of pump pressure based on engine load.

18. Why are low ash oils required for current model year diesel engines?
- a. EGR system compatibility
 - b. Required use of ULSD fuels
 - c. EPA regulation of ash emissions
 - d. **Exhaust after-treatment compatibility**

Answer explanation: The API CJ-4 standard for diesel oil was introduced in 2010. It is designed to be compatible with biofuels and exhaust aftertreatment systems.

19. Which of the following factors does not account for diesel longevity and durability?
- a. slower engine speeds
 - b. lubricating properties of fuel
 - c. higher compression ratios
 - d. **fuel injection at the end of the compression stroke**

Answer explanation: Fuel injection at the end of the compression stroke is used to either create more power or to create the needed heat to reduce particulate matter to ash during a regeneration event.

20. Cavitation erosion is caused by which of the following?
- a. The use of cylinder sleeves
 - b. Loose or leaking radiator caps
 - c. **Vapor bubble implosion on the cylinder wall side of the water jacket**
 - d. High silicate levels in the antifreeze

Answer explanation: Coolant with low nitrate levels may allow vapor bubbles to collapse on the side of the cylinder walls because of rapid heat increase. These bubbles can have pressure that exceeds 60,000 PSI and can cause erosion to the cylinder wall.

21. Which of the following is the most common method for achieving consistent head gasket clamping force on today's cast iron diesel engines?
- a. Torqueing bolts to a fixed value
 - b. Using torque-yield head bolts
 - c. Using the torque-turn method
 - d. **Using MLS-type head gaskets**

Answer explanation: A MLS head gasket provides uniform sealing and load distribution. It requires reduced clamping force which results in less cylinder bore distortion. They are high strength and chemically resistant to oils, coolants, and combustion gasses.

22. Which of the following is the most recent engine oil for a diesel engine?
- a. SG-4
 - b. **CJ-4**
 - c. SJ
 - d. GC-4

Answer explanation: CJ-4 was released in 2010 to meet the biofuel and low emission requirements for exhaust aftertreatment. It meets or exceeds all previous performance requirements for diesel motor oil.

23. Which of the following ingredients is added to the engine coolant to prevent cavitation?
- a. **Nitrate**
 - b. Silicate
 - c. Ethylene glycol
 - d. Phosphate

Answer explanation: Cavitation is erosion caused by the collapse of tiny water vapor bubbles when coolant heats rapidly next to a hot surface or when there is a rapid drop in pressure. The pressure from these bubbles can exceed 60,000 PSI. This force can easily damage engine components. Nitrate is used in old and new coolant formulas. It forms a thin, slippery, protective film to surfaces the coolant comes in contact with to prevent erosion. Depending on the coolant formula, the nitrate level will require periodic service.

24. The term “retarded injection timing” refers best to injection timing occurring:
- a. **closer to TDC than normal**
 - b. Farther away from TDC than normal
 - c. At TDC
 - d. At BDC

Answer explanation: This is typically done during cold cranking to promote starting. Since the piston rises further before the fuel is injected there is more heat and this promotes better conditions for faster starting.

25. Which of the following is the force used to pressurize fuel for injection in the Hydraulically Actuated Electronic Unit Injector (HEUI)?
- a. **Pressurized engine oil**
 - b. Electrical energy
 - c. Camshaft rotation
 - d. Crankshaft rotation

Answer explanation: Hydraulically actuated electronic unit injectors use hydraulic force to pressurize fuel for injectors. The camshaft in a conventional system is replaced with pressurized oil. The advantage of this system is that it does not rely on engine speed to develop maximum injection pressure.

26. An engine with a HEUI fuel system that is hard to start and misfires is being discussed. Technician A says this may be caused by the engine oil and filter being past their recommended service interval. Technician B says this may be caused by the use of an incorrect oil filter and the wrong type of engine oil. Who is correct?
- a. Technician A
 - b. Technician B
 - c. **Both A and B**
 - d. Neither A nor B

Answer explanation: Oil Quality is critical to effective HEUI operation. If oil contains air, it will not properly pressurize the injectors. When the antifoaming additives in the oil wear out, poor fuel economy and low power result. The oil filter must contain the proper check valves so the filter does not drain on shut down.

27. Injector replacement on a late model diesel engine is being discussed. Technician A says the calibration code of the new injector must be programmed into the engine control module. Technician B says that the failure to use the correct calibration code may result in excessive emissions. Who is correct?

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

Answer explanation: Late model diesel injection has become so precise that the computer can make up for difference in flow rate from one injector to the next, resulting in a cleaner and smoother running engine. Each injector is flow tested on the bench and a calibration code is assigned to the injector. The failure to input the new injector calibration code may result in rough running engine or an emissions failure due to the incorrect flow rate of fuel.

28. A late model diesel engines lack of power is being discussed. A leaking air intake is believed to be the problem. Technician A says a smoke machine can be used to find the leak. Technician B says spraying ethyl ether while the engine is running and listening for RPM change will pinpoint the leak. Who is correct?

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

Answer explanation: Smoke is a great way to find leaks in the intake system. The system would need to be sealed. The locations where smoke escapes are potential leaks in the intake air system. Spraying ethyl ether may cause an uncontrolled increase of engine RPM and result in engine damage or injury to the technician and is not recommended.

29. A late model diesel engine equipped with a diesel particulate filter (DPF) has a yellow DPF warning lamp illuminated and lack power. Technician A says the vehicle needs to be driven under a load at a moderate speed for 20 to 40 minutes. Technician B says to tow the vehicle to a repair facility and replace the diesel particulate filter. Who is correct?

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

Answer explanation: Driving the vehicle under a moderate load for twenty to forty minutes will allow the truck to meet the requirements for a regeneration event. The regeneration event will allow for the reduction of particulate matter and the exhaust backpressure concern it has created. This is typically a concern that does not require the intervention of a service technician or the replacement of the particulate filter.

30. The operation of how a selective catalyst reduction (SCR) system works is being discussed. Technician A says a SCR catalyst converts urea into nitrogen gas. Technician B says the urea mixes with the exhaust gases and decomposes to form ammonia which reacts with the NOx. Who is correct?

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

Answer explanation: A mixture of 32.5% concentrated urea and 67.5% of deionized water is injected into the exhaust stream in a fine mist upstream from the SCR catalyst. When injected into the exhaust stream it vaporizes and decomposes in a process called hydrolysis to form ammonia and carbon dioxide. The ammonia is used to convert NOx to harmless nitrogen (N₂) and water H₂O through hydrolysis.