CHAPTER 16

SPARK IGNITION AND COMPRESSION IGNITION ENGINES

Conventional gasoline-fueled, spark ignition engines and multipurpose diesel-fueled engines differ in their principles of operation. Before-, starting-, and during-operation procedures also differ for conventional and diesel engines.

SPARK IGNITION ENGINES

Operating Principles

In spark ignition engines, the vehicle’s ignition provides the spark that ignites the fuel-air mixture in the engine’s cylinder. The battery provides current to produce the spark. Once the current leaves its source, it flows in a definite path to the cylinders. When the fuel mixture ignites, it causes the expanding gases of the burning fuel to force the piston down on its power stroke.

Starting Procedures

It is always a good policy to check your technical manual or manufacturer’s instructions before trying to operate an unfamiliar vehicle.

Before beginning the starting procedure, make sure the seat is adjusted so you can comfortably manipulate the vehicle controls. Be sure the parking brake is set and the transmission is in the neutral or park position. If the vehicle is equipped with special attachments, be sure all power control levers are in neutral. Then –

- Depress the clutch pedal to release the transmission load.
- Turn on the ignition key or switch.
- Pull out the choke if applicable. During warm weather or when the engine is warm, you generally do not need to use the choke. In extremely cold weather, pull the choke control out all the way. (Some vehicles have an automatic choke that you can set by pressing the accelerator to the floor and releasing it before starting the engine.)
- Engage the starter. If the engine does not start within 10 seconds, release the starter and check to see if you have performed the other operations correctly. (If the 10- to 15-second time limit is exceeded the battery and starting motor may be damaged. If the starter has been engaged without results, wait at least 30 seconds; then engage the starter again. Notify your supervisor if your engine fails to start after repeated attempts.)
- As soon as the engine starts, push in the choke control partway and adjust the throttle for a smooth idle. Use the choke only as necessary to start the engine and bring it to operating temperature. (Do not race a cold engine. It takes time for the oil to circulate to all parts. If the engine is raced while cold, the lack of lubrication may seriously damage the pistons, bearings, and cylinder walls. Racing the engine also wastes fuel.)
- Note the oil pressure and charging system indicators. The charging system shows some charge unless the engine is idling slowly. The oil pressure indicator should show some pressure. In vehicles with oil pressure and generator light indicator the lights should go out immediately after the engine is started. If the gauges do not show the proper indication or the light indicators do not go out after the engine has started, stop the engine and notify your supervisor.

COMPRESSION IGNITION ENGINES

Operating Principles

Multifuel Engines. The multifuel engine is a diesel (compression ignition) engine. Unlike the conventional gasoline engine, it has no spark plugs. The heat of compression ignites the fuel. A piston coming up on the compression stroke compresses the air in the cylinder until it reaches an extremely high temperature. At this time, fuel is injected into the cylinder under high
The temperature within the cylinder ignites the fuel. The expanding gases of the burning fuel force the piston down on its power stroke.

**CAUTION**

Always park a diesel/multifuel-powered vehicle in neutral with the emergency brake applied (except in extreme cold weather) and chock the wheels. If you parked it in gear, a slight bump by another vehicle may start the engine, causing the vehicle to move out of control. Complete details on the operation of diesel multifuel engines are in TM 9-2815-210-34-1.

A variety of fuels may be used in multifuel engines. Acceptable types are as follows. First choices are VV-F-800 diesel fuel, MIL-F-16884 marine fuel oil, and CITE MIL-F-46005 compression ignition fuel. Second choices are SPEC MIL-J-5624 jet fuel and jet A and jet A-1 commercial aviation kerosene. The third choice is MIL-G-3056 combat gasoline. (This is considered emergency fuel since it does not perform as well as other acceptable fuels in multifuel engines. It may even shorten the life of the engine.)

Figure 16-2 shows the multifuel engine models found in 2 1/2-ton and 5-ton trucks. The four engines shown in Figure 16-2 operate similarly. One important difference, however, is the fuel filter arrangement. Both multifuel engines have three filters – primary, secondary, and final. The location and type of filters are different in some cases. Figure 16-3 shows the locations of filters on the different model engines shown in Figure 16-2.

Diezel Fuel Engines. Figure 16-4 shows the diesel fuel engines found in 5-ton trucks. Diesel fuel engines use grades DF1 or DF2 diesel fuel.

On the M939-series vehicles, the filter is located under the left-front fender. On the M915, the filter is located on the left side of the engine. Both require daily maintenance.
Before-, Starting-, and During-Operation Procedures

Drivers converting from vehicles powered by conventional spark ignition gasoline engines to vehicles powered by compression ignition engines should become thoroughly familiar with the before-, starting-, and during-operation procedures required by compression ignition engines. Consult the vehicle technical manual before trying to start or operate the vehicle.
Before-Operation Procedures. The vehicle technical manual prescribes before-operation services. Most of these apply to both gasoline and multifuel vehicles. The fuel falters, however, require special attention. Before operating a multifuel vehicle, the following filter service is mandatory:

- After ensuring that the engine stop lever is pulled out, turn on the vehicle accessory switch to start the in-tank fuel pump.

- Open the drain cock on the bottom of the primary fuel filter. (On scraper types, give the handle on top of the filter two complete turns to loosen any foreign matter in the filter element.) Drain off 1 pint of the contents into a clean jar or can. Examine the drained-off fuel for dirt or water. (Water will form as small globules or blobs.)

- If fuel drained from the primary filter is contaminated with dirt or water, drain the secondary filter.

- If the final filter shows that the fuel is contaminated, turn off the accessory switch and report the condition to your supervisor.

Hydrostatic lock occurs when fuel, water, or other liquid is on top of one or more of the pistons. When the piston rams this fluid against the cylinder head, it can ruin or seriously damage the engine. The procedure to check for hydrostatic lock is simple. With the gearshift in neutral, hand brake applied, fuel off, and accessory switch on, push the clutch pedal to the floor. Then depress the starter button with a hard, firm push for 2 or 3 seconds. Look for these signs of hydrostatic lock: hard thud in the engine as it turns over, engine turning over and quitting with a thunk, or engine not turning over at all. If there is any evidence of hydrostatic lock, remove your fingers from the starter button at once and report the problem to your supervisor.

Starting-Operation Procedures. After determining the engine is free of hydrostatic lock, start the engine. Follow these procedures:

- Make sure that the transmission is in neutral and the parking brake is applied.

- Push the engine stop lever all the way in.

- Turn the accessory switch to the on position.

- Depress the clutch while operating the starter.

- Press the starter button with a hard, firm push. (Not firmly closing the starter switch may damage the starting motor and switch.) Release the starter button as soon as the engine fires. Never depress the starter switch for longer than 10 seconds at one time. Usually 10 seconds is sufficient. If the engine does not start, wait at least 2 minutes and try again. If the multifuel engine does not start in three tries, report the condition to your supervisor. Do not start multifuel engines by towing or pushing, except in an emergency.

- After the engine has started, let it idle for 3 to 5 minutes or until the engine heat reaches 140°F. Engine idling speed should not exceed the RPM prescribed in the vehicle technical manual. Too slow an idle creates vibrations that will loosen some parts and may break others. The warm-up benefits the
entire engine, but it is especially important for the turbo-supercharger. Exhaust gas turns the turbo-supercharger at approximately 30,000 RPM at idle speed and up to 60,000 RPM at operating speed. Idling at a low speed allows time for the oil to circulate.

Observe the oil pressure gauge closely during the first 20 seconds of idling. If pressure does not reach 15 pounds per square inch (psi) at 800 to 1,000 RPM, stop the engine immediately and report the condition to your supervisor.

Allow engine coolant temperature to reach 140°F before putting the vehicle in motion. Drive at moderate speed until the temperature reaches 170° to 200°F.

Heavy black smoke, engine missing, and power loss may indicate a dirty air cleaner. When the red flag in the air cleaner is up over halfway, cleaning is required. Follow instructions in your vehicle technical manual or technical order when cleaning the air cleaner.

If the vehicle is equipped with air or air hydraulic brakes, do not move it until the air pressure reaches the required level. When the buzzer stops, there is enough pressure to operate the brakes. Changes in air pressure are registered on the pressure gauge. The vehicle manual specifies the amount of air pressure that should be maintained.

(For Air Force Only: Operating instructions and operating maintenance requirements are contained in the -1 technical order for each vehicle.)

**During-Operation Procedures.** Do not idle the engine of a parked vehicle except when necessary to keep the engine warm in extremely cold weather.

**WARNING**

Keep windows, curtains, and tarps open to prevent dangerous accumulation of carbon monoxide inside vehicle while the engine is idling.

Never let the vehicle idle for long periods of time. In addition to wasting fuel, excess idling allows carbon formation and oil dilution to take place in the engine. Never run the engine to recharge a rundown battery unless your immediate supervisor specifically instructs you to do so. Never leave a vehicle unattended with the engine running.

Do not exceed allowable speeds indicated on the vehicle instruction plate (if applicable) or operate at an engine speed low enough to cause the engine to labor. Vehicle instruction plates are usually located on the instrument panel.