polarity results in excessive center electrode wear. To equalize the wear of both polarity and capacitance after-firing, after removing and cleaning plugs, swap them so that top and bottom plugs change places and long and short lead plugs change places. Figure 4-11 illustrates a method of doing so.

Fouling deposits are the biggest problem in spark plug operation. Carbon fouling—which is a dry, dull black color—is the result of an excessively rich mixture, especially at idle. Spending too much time at idle and on the ground will cause significant carbon fouling of the plugs. Another possible cause is a plug with a heat range that is too cold to burn off the combustion deposits. As the carbon builds, risk of misfiring during full-power application increases. To reduce the potential for carbon deposits, operate the engine at the highest possible power setting and leanest carburetor setting conducive with safe ground-handling conditions. Periodically apply a momentary higher power to cleanse the plugs. Similarly, a faulty carburetor can lead to carbon fouling.

Oil fouling shows up as wet, black carbon deposits. Mild deposits are common on lower plugs, especially if the aircraft is seldom used, because the oil tends to drain past the rings. New engines also will experience oil fouling, indicating that the rings haven't properly seated yet; the problem should correct itself in a short time. If oil fouling appears on the upper plugs, there are several possible causes, none of which is very good. They include worn or broken rings, damaged piston, worn valve guide, sticking valve guide, and faulty ignition supply. It is especially worth noting that oil is electrically conductive, and fouling will lead to misfiring under all power conditions.

Even, fluffy fouling that ranges from tan to dark brown in color is indicative of lead fouling. It always will be present in some limited amount, but excessive lead fouling is typically caused by one of the following: high lead content in the fuel; poor fuel vaporization, which can be caused by carburetor air being too cold; operating the engine too cold; or the plug's heat range being too cold. If left unchecked, eventually lead will fill up the end of the plug and cause the plug to operate colder. This leads to misfire at high power settings, carbon collection, and then additional misfire trouble from the carbon!

Pilots seldom are aware of the delicate relationship between dust and spark plug health. Lead oxide, one of the least objectionable spark plug deposits because of its high melting point, considers silica found in dust a delicacy. It digests it and forms lead silicate with as little as 3 to 5% silica ingestion through the air induction system. Lead silicate has a melting point several hundred degrees below the original lead oxide. It causes a free-flowing spark plug contaminant, leading to misfiring at normal temperatures! The process takes from 20 to 50 hours of engine operation to develop. Therefore, it is critical to frequently clean air filters when operating in dusty environments.

During winter months, if cold air with a relatively high moisture content enters a warm cylinder during shutdown, moisture condenses on the electrodes and freezes. The ice can form a conductive bridge to the electrode and prevent the engine from starting the next time. The only options are to remove and thaw the spark plugs or apply external preheat to the engine.

Removal and installation of plugs is not as simple as it sounds. Aircraft spark plugs are amazingly delicate considering the conditions they are required to operate in.