THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXTENSION SERVICE

SP268L

Small Engines

Octane Ratings of Gasoline

James B. Wills Jr., Associate Professor, Agricultural Engineering

Gasoline Additives

Additives have become essential ingredients in modern gasolines. Widespread use of additives has occurred during the past decade. Tetraethyl lead (TEL) was used as an additive to gasoline for more than 40 years. Today, gasoline containing lead is difficult to find. The Environmental Protection Agency (EPA) had lead removed from gasoline to reduce toxic emissions from automobile exhaust gases. Lead was initially used as an additive to increase the octane rating of gasoline. The addition of 3 ml of TEL per gallon of gasoline raised the octane level about 10 points.

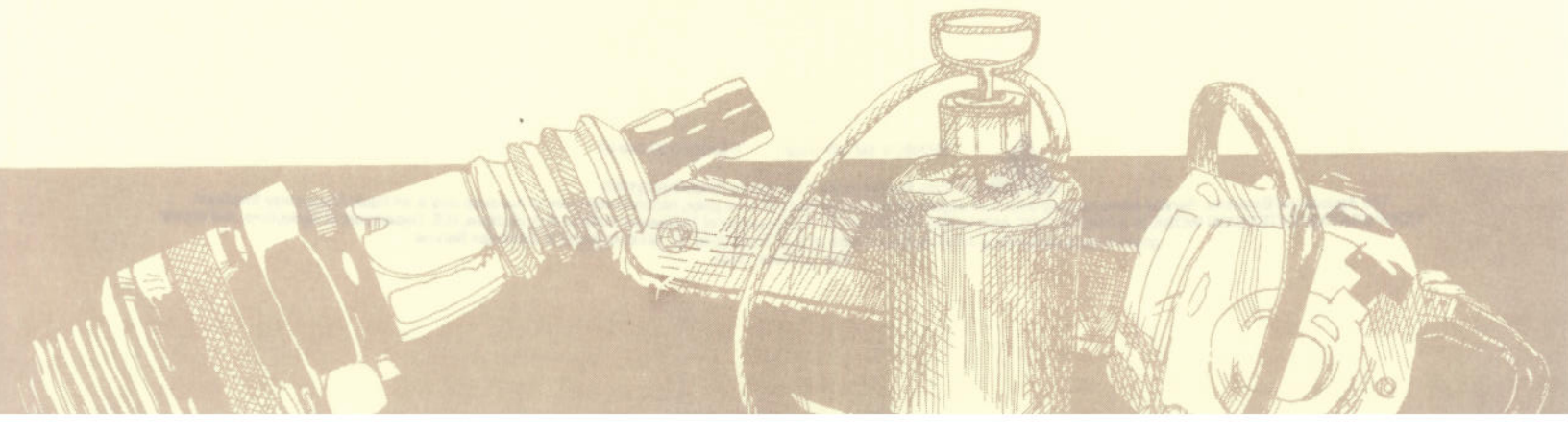
Removal of TEL as an additive to gasoline has created some problems for owners of older gasoline engines. In addition to increasing octane levels, TEL had a secondary benefit of lubricating the valves in engines it was used in. Without lubrication from the TEL, valves and valve seats would experience accelerated wear. Manufacturers started using hard metal alloys for valves and valve seats in 1974 and 1975. TEL was not necessary for lubrication in engines containing the hard alloy valve components. Therefore, most engines built after 1975 do not need leaded fuel for valve lubrication. Most engines built before 1975 will experience excessive valve wear if leaded fuel is not used.

Additives are available to replace lead in gasoline. Many have not been tested to determine effectiveness as compared to TEL. Owners of older (pre 1975) engines should burn leaded fuel as long as it is available or until a valve job is required for the engine. New valves and valve seats will be made of alloys that no longer require leaded fuels for lubrication.

Octane Ratings of Gasoline

The primary criteria used by most consumers to gauge the quality of gasoline is the octane rating. High octane ratings do not mean high quality. The octane rating of a fuel is a method of comparing the antiknock qualities of that fuel to a standard test fuel. The octane rating scale was developed by the American Society for Testing Materials (ASTM). The scale begins at zero and runs to numbers above 100. Fuels on the lower end of the scale (0 to 85) tend to "knock" during the combustion process inside an engine. Engine "knock" is a pinging or knocking sound produced by the engine while running, usually under loaded conditions. Knock is a serious problem because valves, pistons and bearings are subjected to abnormal forces and temperatures.

Octane rating recommendations for a given engine are usually stated by the engine manufacturer. The compression ratio of an engine usually determines the recommended octane rating of the fuel to be used in the engine. Engines with high compression ratios, such as 8.5 to 1, can use higher octane fuels more efficiently. The higher the compression of an engine, the higher the power output of the engine. This is because more of the fuel energy is converted to useful power.



Engines with lower compression ratios (7 to 1) may not need high octane fuel. If the engine performs satisfactorily without knocking on lower octane fuels, use of higher octane fuels is not only more expensive, but wasteful. More crude oil is needed to make one gallon of high octane fuel than is needed to make one gallon of low octane fuel.

Octane ratings found on gasoline pumps at gas stations will usually be an average of the motor octane rating and the research octane rating. Both motor and research ratings are test methods used to determine octane ratings of fuels. Premium, regular and super grades of fuel are rough measures of octane ratings. Regular unleaded fuel will usually have an octane rating of 87. Premium grades will have an octane rating of 89 and super grades will be 91 octane or more.

Gasoline Volatility

Gasoline companies blend gasoline for the season of the year it will be used. Summer blends of gasoline are low in volatility (tendency to evaporate). Winter blends are high in volatility so sufficient vapor is present to easily start the engine. Gasoline with high volatility is prone to carburetor icing and vapor lock under adverse atmospheric conditions. Gasoline with low volatility can cause engine starting problems. Use gasoline during the season for which it was blended for best results. Holding summer fuel in storage for winter use can result in low volatility starting problems.

SP268L-2.5M-3/91(Rep.) E12-2015-00-049-91

A State Partner in the Cooperative Extension System