

# Re: Carnot cycle and gasoline octane

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David Lemper wrote:

It is said that :

1. a high compression internal combustion engine is more efficient as it goes out further on the Carnot cycle.
2. High octane gas ( eg 91 ) has less energy density than 87 octane.

Questions :

1. Will a high compression engine get more miles per gallon than a lower compression engine in the same vehicle ?
2. Considering the increased cost of 91 octane, does a high compression engine produce a saving or added cost to the economy ? Is there any data ?

David Lemper

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Dave,

The compression ratio of a motor has an impact on the thermal efficiency of the air/fuel burn and is approx equal to:

$e = 1 - 1/r^{.3}$  where  $e$ =thermal efficiency and  $r$ =compression ratio

Therefore, increasing the compression ration (CR) has the potential to make the engine more efficient for the same amount of fuel—which would mean more miles per gallon. Of course, its not quite that simple.

Other engine factors that weigh-in include detonation/pre-ignition points, ignition timing and air fuel ratios. All have to be balanced for best performance.

Octane aids in diminishing the air/fuel mixture from igniting spontaneously before the proper time in the compression cycle. Higher fuel octane numbers allow higher CR's (and higher thermal efficiencies) before this occurs. Alcohol fuels have higher octane ratings generally than gasoline (99 for ethanol/106 for methanol) and even though they

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have less heating value, the higher equivalent octane ratings provide thermal incentives in high CR racing engines.

So to answer your first question—yes, with conditions.

Second question—

Ethanol is used as an octane booster for cheaper gas. Today, regular 87 octane gas has generally about 10% ethanol in it for this purpose. Ethanol is cheaper than gasoline—(regardless of what you've heard), therefore to answer your 91 octane question would really depend on the composition of the 91 octane fuel and other factors to numerous to mention. In general terms, if a 12:1 CR gave 100% relative power, then 8:1 would yield about 88%, or 12% less power for the same fuel usage. I leave it to you to play with the numbers to answer your second question.

Hope this helps,

Tut

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