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Bell Performance Technical Bulletin - Common Factors Affecting Fuel Mileage

Introduction

With the cost of gasoline and diesel skyrocketing in the last two years, consumers are more concerned than ever with maximizing the miles gained from their fuel. Fuel mileage is subject to many outside factors and unless these factors are accounted for, the answer to the question of whether a consumers' mileage increased or decreased (irrespective of whether a fuel additive was used) is cloudy at best. So it may be useful to summarize some of the factors known to affect fuel mileage.

When looking at a real-world situation and trying to figure out what has caused a difference in miles, keep in mind that it is very likely to be a mixture of competing factors, some causing a mileage reduction with others causing a mileage increase.

Summer Fuel vs. Winter Fuel

Sometimes consumers will note a decrease in mileage over a period of consecutive months going from summer to winter. What is not considered is that refineries will vary fuel composition from season to season. Gasolines sold in the summer contain about 2% more energy value than those sold in the winter, which means more potential mileage during the summer and a mileage reduction as winter fuel is introduced to the vehicle. The main reason for the difference is that winter fuels must be blended to be more volatile (in order to vaporize more easily in cold weather for better cold starting) and this means adding more "aromatic" molecules to the blend. Unfortunately this lowers the energy value of the winter blend at the same time, hence less mileage in the winter than in the summer (all other things being equal).

Variation from Station to Station

The properties of fuel vary much more than typically thought from station to station and even batch to batch at the same station. While it is true that gasoline and diesel have to meet certain specifications to be sold, this does not stop variation in specs like energy value which can product variations in mileage simply from batch to batch, even at the same station. During a 2006 fuel survey conducted by the Department of Energy, it was found that summer fuels sold by the same station and same supplier varied in energy content as much as 3.4% while winter fuels varied almost by 5%. Most consumers who look for reasons behind a supposed drop in fuel mileage do not consider that the fuel they are using in a before/after comparison may not have the same energy value, even if they bought it from the same gas station.

Reformulated Gasolines vs Conventional Gasolines

So-called "reformulated" gasolines (RFG) are fuels which have oxygenates added to them, such as ethanol or MTBE. An oxygenate will be added to gasoline to increase the oxygen content of the fuel, which reduces environmental emissions. Such gasolines are mandatory in some states including California. While they are better for the environment, the addition of an oxygen-rich substance to gasoline means the total energy value of the fuel is less, which means mileage for the consumer is reduced. A gallon of RFG will contain up to 3% less energy than a gallon of conventional fuel. This difference will be most pronounced in the winter, when the gap between conventional fuel and RFG is the greatest.

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Mechanical and Environmental Conditions

There are both environmental conditions and the vehicle condition elements which can significantly impact fuel mileage. Many consumers are oblivious to the extent to which simple factors they don't normally consider reduce their fuel consumption. The University of Wisconsin undertook to study the issue and figured out how much various factors can be expected to impact fuel mileage.

Effect	Conditions	Average Fuel Economy Reduction	Maximum Fuel Reduction
Temperature	**20F vs 77F**	**5.3%**	**13%**
The above results mean that air at 77 degrees reduces fuel economy by 5.3-13%. Air temperature can affect mileage because cold air is denser than hot air, and denser air means more oxygen for combustion per unit of air (and therefore more energy). So, all other things being equal, this means the fuel mileage can be decreased during the summer compared to the winter.			
Head Wind	**20 mph**	**2.3%**	**6%**
Most drivers know from experience that driving into the wind reduces mileage due to the increased resistance caused by the air making the engine work harder and burn more fuel.			
Hills/Mountains	**7% road grade**	**1.9%**	**25%**
Driving up steep hills reduced mileage by as much as 25% in the Wisconsin study.			
Poor road conditions	**Gravel, curves, slush, snow, etc.**	**4.3%**	**50%**
Straight highway roads in good, smooth condition have the least effect on fuel mileage, while curvy roads with poor, un-even surfaces (which increase drag on tires) have the greatest effect.			
Traffic Congestion	**20 vs 27 mph average speed**	**10.6%**	**15%**
Most drivers know this as well, that traffic congestion (which normally is paired with stop-and-go driving) significantly reduces fuel mileage. Driving on open highway roads allows the greatest fuel conservation because the engine requires more fuel to increase speed than it does to maintain speed, even at highway speeds.			
Highway speed	**70 vs 55 mph**	**N/A**	**25%**
With each mph above a baseline of 55 mph, fuel mileage drops; this decrease increases exponentially (the drop going from 70-71 is greater than the drop going from 55-56 mph).			
Acceleration Rate	**"Hard" vs "Easy"**	**11.8%**	**20%**

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Smooth acceleration compared to "gunning it" has one of the greatest effects on your car's mileage, between 11 and 20% difference in mileage.

Wheel Alignment	**1/2 inch**	**<1%**	**10%**

Wheel alignment has a small but measurable effect on mileage, with wheels out-of-alignment causing slightly more drag on the road.

Tire Type	**non-radial vs radial**	**<1%**	**4%**

Radial tires have a small but measurable effect on mileage due to their superior construction.

Tire Pressure	**15 psi vs 26 psi**	**3.3%**	**6%**

Tires are something consumers may not typically associate with fuel mileage. Keeping proper tire pressure is an easy way to maximize your fuel mileage. Softer tire pressures result in more drag on the road by the tire, which makes the engine work harder to maintain the same speed.

Air Conditioning	**Extreme Heat**	**21%**	**N/A**

Running the vehicle air conditioner causes the engine to work harder and burn more fuel. This contributes to a difference in fuel mileage between the winter and the summer (or temperate conditions vs. extreme hot and cold).

Defroster	**Extreme Use**	**Analogous to A/C on some vehicle**	

Running the defroster has the same type of effect on fuel mileage as the air conditioner does.

Idling/Warmup	**Winter vs Summer**	**Variable with Driver**	**20%**

Vehicles burn more fuel in the winter than in the summer during warmup because it takes longer for the engine to reach normal operating temperature. Before this point, the engine does not run as efficiently, hence there is a longer period of inefficient operation and thus, more fuel consumption.

Windows	**Open vs Closed**	**Unknown but likely small**

Conclusion

It can be difficult to make truly accurate conclusions about "real world" comparisons in fuel mileage, because many of these factors are not corrected for, nor can they be truly equalized on both sides (elements such as weather, traffic patterns and terrain are not typically controllable). A second conclusion is that many factors which impact fuel mileage to a greater level than one might think can be easily corrected or maintained by the consumer provided they know the potential impact to their fuel mileage and the potential savings for doing so.