

Save Money !

National Bestseller

Get  
Smart



Fuel Conservation Tips  
And **Secrets**  
Your Mechanic Won't Tell You!

E . U . R a n d o l p h

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**Thank you very much**

I pray you find some information of value in the course of reading this book and assure you that part of the money you spent purchasing the book will be used to subsidize the training of technical graduates and road side mechanics to provide jobs and better service to all vehicle users.

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# **PART A**

A decorative flourish consisting of symmetrical scrollwork on either side of a central, downward-pointing teardrop-shaped ornament.

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**Don't skip this**



The primary aim of this book is to assist the reader in making decisions that will help him save a lot of money on petrol .

A lot of people in developing countries buy fairly used vehicles. Most of these vehicles have been driven for over one hundred thousand miles or one hundred and sixty thousand kilometers and therefore are already subject to a lot of wear and tear . This greatly increases the maintenance and running cost of these vehicles.

The current cost of fuel is high relative to the income of the average car owner and the cost of petrol keeps increasing every other year. To improve their profit margin , importers of refined fuel often do not import the highest grade of fuel.

The bottom line is that several factors conspire to make an already difficult situation more unbearable. As a vehicle owner, the best thing to do is to increase your knowledge of the factors that affect the fuel consumption of your vehicle so that you can make optimal decisions on how to counter these issues in a way best tailored to your particular circumstance.

The secondary aim of this book is to educate the average driver on aspects of the vehicle that should be known to him and how to manage the maintenance of his vehicle in a way that is practical and cost effective. This is because quite a lot of vehicle owners cannot afford to repair their vehicles in specialist shops and have to resort to the proverbial road side mechanics .

The road side mechanics deserve special thanks from vehicle owners because without them most cars will not be on the road. Though many of them have limited education , experience has proven that a lot of them are very intelligent. The main reason they fail to repair modern vehicles is because they lack information and proper training.

It is my hope that you, the vehicle owner, will be able to educate yourself in order to provide certain critical information to your own mechanic in a non confrontational manner, as well as obtain some service tools for your vehicle so that you can achieve the service quality of specialist shops at an affordable price.

The author will consider this book a success if its entertaining enough to make you laugh at certain issues you may no doubt have encountered in the course of driving and servicing your vehicle.

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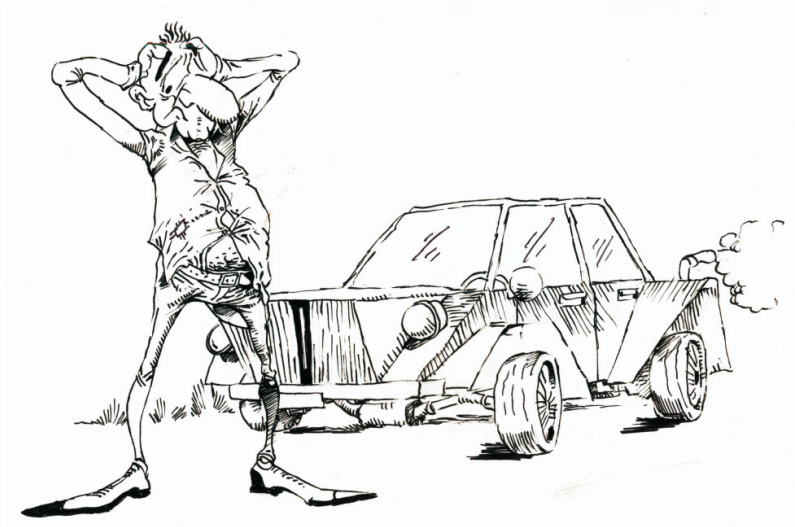
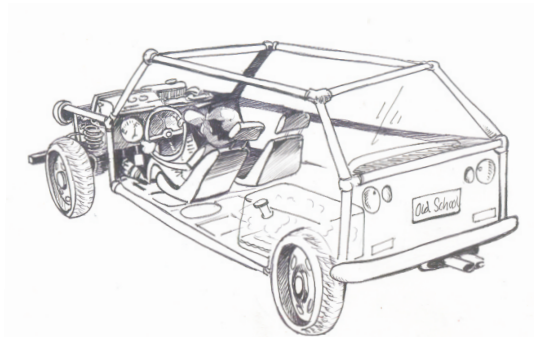
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## Anatomy of poverty

*Cheiii!!!*

*I haven't been able to buy a new shirt since I bought this car.*



**Believe me, Your car can make you poor !**

To estimate the fuel cost for a year of a small vehicle, I used a four cylinder Volkswagen Golf with a 55 liter fuel tank capacity and a 1.8L (one-point-eight-liter) engine. Turning the trip odometer to zero at full tank, I found that after approximately 200 kilometers of actual city driving (frequent start and stop, potholes, traffic jam, low grade fuel), I ran out of fuel.

The average cost of filling a fifty five liter tank is about Four thousand Naira (N4000.00) and the total distance traveled by the average car user in a year is about twenty thousand kilometers. This distance does not apply to transporters or regular travelers as most will cover this distance in about four months.

So, from the estimate above , for every Two hundred kilometers (200km) , approximately Four Thousand Naira (N4,000.00) is spent on fuel. For Twenty thousand kilometers (20000km), about N400,000.00 will be spent on fuel ( $20,000/200 = 100$  .  $100 \times N4000 = 400,000$ ).

Surprisingly, this happens to be more than the amount I bought the fairly used vehicle. Unless you take out time to calculate how much you are spending on fuel in a year , and gain more knowledge about how you can be more efficient with fuel, you might end up very wretched after buying a fairly used car.

The above description is the estimated yearly fuel cost of a twenty year old Volkswagen , it would not be very difficult to imagine the fuel cost of a twenty year old, six cylinder Mercedes or a large, fairly used four wheel drive vehicle.

After applying some of the information contained in this book , I was able to improve the distance I could drive on a full tank to about Two hundred and Seventy Five (275)kilometers of actual city driving . This represents about twenty five percent reduction in my fuel consumption and a one hundred thousand naira per year saving on fuel cost.( $20,000/275 = 72.72$  ,  $72.72 \times 4000 = \text{N}300,000$  approximately).

## Why you should read this book

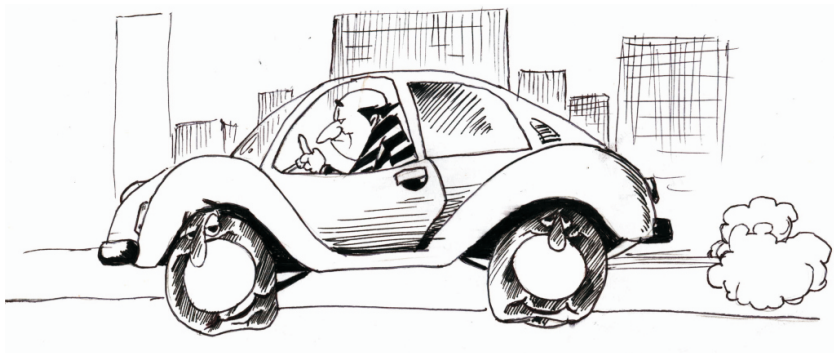
- 👉 To save money on fuel during the life time of your vehicle
- 👉 To ensure you can get to a given destination on a given quantity of fuel
- 👉 To reduce the amount of money spent on vehicle maintenance
- 👉 To increase your knowledge in order to reduce the downtime of your car

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# 1

***Don't Let  
That Innocent Looking Tire  
Fool You!***



## Tires and Pressure

Under-inflated tires dramatically increases the fuel consumption of a vehicle. This is most noticeable when traveling very long distances.

The maximum inflation pressure of a particular tire is embossed on the tire side walls. Each vehicle manufacturer specifies in the vehicle owner manual or on the driver side door pillar(B-pillar), the proper pressure for the particular vehicle because the same type of tire can be used in different vehicles of different weights and load carrying capacities.

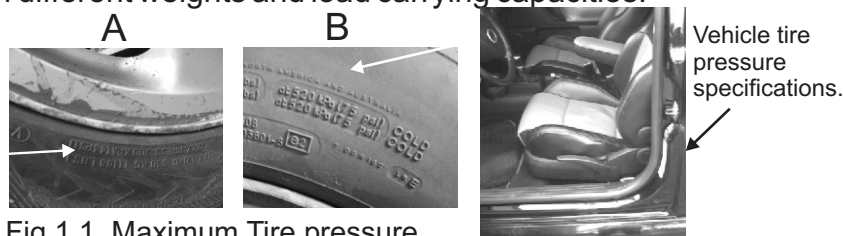


Fig 1.1 Maximum Tire pressure.

As an example , The tire in Fig 1.1 ( A )has a maximum inflation pressure of forty four Pounds per Square Inch (44 Psi). However the owner manual specifies, 36Psi for the front wheels and 32 Psi for the rear wheels .

(N.B the same tire is used on all the wheels though the tire pressures are different. This is because of the differences in the weight of the front and rear of the vehicle.)

Fig 1.1 (B) shows the tire of a Pickup truck , the maximum inflation pressure is Seventy five Pounds per Square Inch (75Psi). Regardless of the load this tire is carrying , the pressure must not exceed this value. Refusing to follow the recommended tire pressure specification can also lead to the

following:

- ☛ Early tire wear
- ☛ High possibility of blow-out at high speed
- ☛ Excessive ride harshness on uneven road surfaces.

## Physics 101

To understand how tire pressure can affect fuel economy, an understanding of some fundamentals of physics is needed.

### Reduced Rolling radius

When your tire is under inflated, the effective size of your tire decreases. It's like putting smaller tires on your vehicle. This means that one complete revolution of your tire will translate to reduced forward distance.

The net effect is that the engine is turning the shaft connected to the wheel but the tire size determines how far the vehicle will travel for each rotation of the shaft . A good analogy of this process is the unrolling of a tissue paper from the roll . One complete rotation will result in a longer tissue if the roll is big and a shorter tissue if the roll is small.

Therefore , for the same amount of fuel the vehicle travels a smaller distance if the tire is partially deflated and hence fuel consumption is increased.

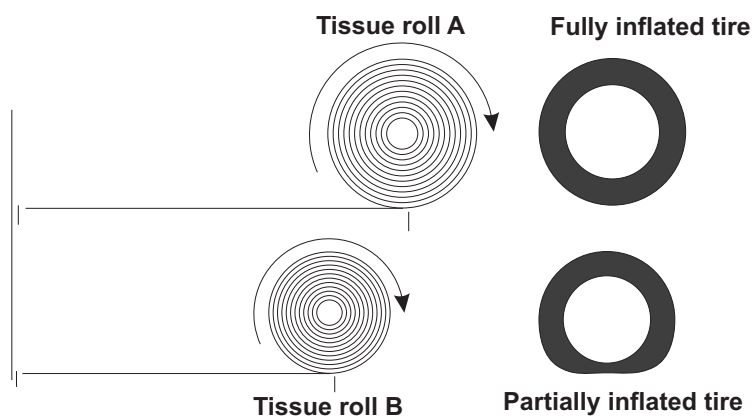


Fig 1.2

You may have started wondering at this point why the manufacturers do not just fit very large tires to every vehicle if fuel consumption can be reduced by this singular act. Like all things in life, there are limitations to every design decision. Vehicle stability, aesthetics, space constraints and the power output of the engine are all taken into consideration before the tire size is chosen. In sports car applications, you will easily wonder how the tires never get to touch the body of the vehicle under different driving conditions since the tires practically fill up the wheel well.



### Increased friction

The drawing in Fig1.3 represents a man attempting to roll two drums. Which of the drums do you think will be easier to roll?

It would take far more energy to roll the drum in diagram B, than the drum in diagram A. A partially inflated tire is similar to the drum in diagram B.

To get more energy from your car to turn the partially inflated tire, the vehicles' throttle pedal has to be depressed more than if the tire was fully inflated. This leads to more fuel consumption and a lot of lost cash.

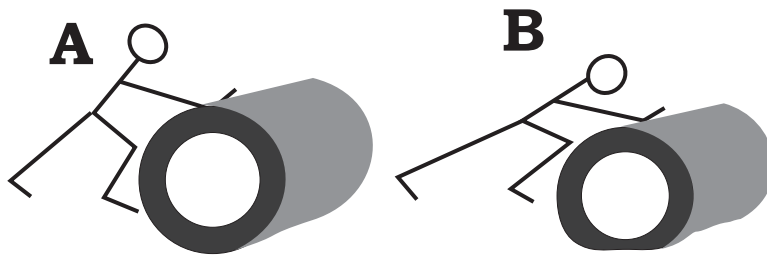


Fig 1. 3

### The root of the problem

Ever been to a local vulcanizer? one of those road side rigs where you pump air into your vehicle tires. The device they use to measure tire pressure is a sliding pressure gauge like the one shown in Figure 1. 4.

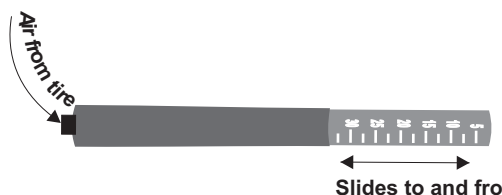


Figure 1.4 : Sliding pressure gauge

### How it works.

Air pressure from the tire enters the sliding pressure gauge from the valve at one end and pushes a calibrated slider to indicate the tire pressure.

### ‘Issues !’

The main problem with gauges of this type is that after some time they give totally inaccurate readings due to wear and calibration errors. Also, the dusty environment, dirt and grime on the hands of the ‘vulcanizer’ cause the gauge to stick every so often, resulting in very inaccurate readings.

I went to different locations to test the tire pressure of my vehicle and found that it was difficult to get a consistent pressure reading.

I also observed that few vehicle owners have a clue of the tire pressure specification of their vehicles. The ‘vulcanizer’ pumps all tires to a default value of 40Psi with a sliding pressure gauge as dirty as a refuse dump.

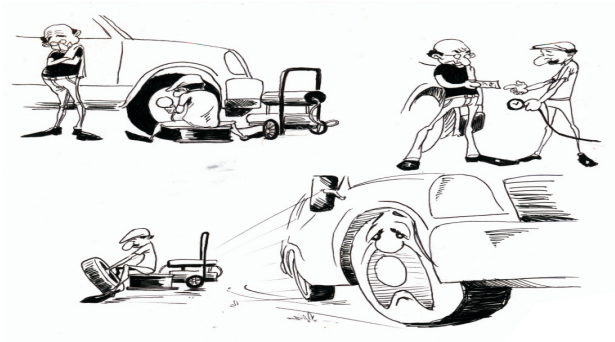


Fig 1. 5

The table in Fig 1.6 contains different tire pressures of common vehicles found in some developing countries. Please consult the owner manual of your vehicle or visit [www.yourcarlab.net/car care](http://www.yourcarlab.net/car%20care)

	Front (Psi)	Back (Psi)	Tire size
VW Jetta 1.8	29	26	185/60R14
Toyota Camry 2.2	31	29	205/65/R15
Honda Civic 1.8	35	32	185/65R14 82H
Peugeot 307	33	33	195/65R15 91T
Lexus LS 450	35	35	225/55R17 97W

Fig 1.6

(Note: Tire pressures also vary with the type of tire fitted to a vehicle and also with the ambient temperature of the region where the tire is to be used.. )

It's best to check the tire pressure of your vehicle with a dial pressure gauge like the one shown in Fig1. 7.

Some major fuel service stations use this type of gauge.

Always check the tire pressure before traveling.

For anyone interested in saving fuel, a portable tire pressure tester is an indispensable tool. Even if you do not have one, ensure that the person checking the tire pressure of your vehicle uses the type shown in Fig 1.7. Over-inflation is very unsafe as the tires are stressed beyond their designed limit and as such can fail Unexpectedly.



[www.google.com/images](http://www.google.com/images)

Fig1. 7.

### **Do you own an SUV?**

If you own an SUV (Sports Utility Vehicle), it is very likely that the tires of your vehicle are over-inflated. The 'vulcanizer' usually determines the tire pressure by the size of the tire and the vehicle cost.

There have been cases where stability problems in these SUV's were traced to over-inflation. The tires of these vehicles were pumped to over 55Psi, in line with the 'Vulcanizers' assumptions stated above.

In general, most SUV,s have tire pressure specifications less than 40Psi ( Nissan Pathfinder - 35psi, Hummer III - 38psi)

### **Always do this !**

Check the tire pressure before embarking on a long trip because tire pressure increases as temperature of the tire increases. Also check the tire pressures of your vehicle weekly in order to catch pressure losses due to condensation and minor leakages through the valves.

## Other things to watch out for

Some tire manufacturers like Michellin have special thread designs on some of their tires - ‘the Latitude series’- that claim to reduce fuel consumption by three percent or a savings of almost one hundred thousand naira during the life time of the tire. (See [www.michelin.com](http://www.michelin.com) and remember the word ‘claim’)

There is also the safety issue of using different tires with different thread patterns on front wheels of a Front-Wheel-Drive vehicle. Use of tires with different thread patterns can cause the vehicle to veer excessively to one side under heavy acceleration .

Misaligned tires also contribute to increased fuel consumption because with misaligned tires, the two front tires are not moving exactly in your direction of travel and a lot of steering adjustment have to be made in order to drag the tires along. This increases the friction between the wheels and the road thereby increasing fuel consumption.

Regular wheel alignment is necessary every time work is carried out on either the suspension or steering mechanism of your vehicle as even a slight misalignment will lead to early tire wear as well as increased fuel consumption

### **Finally**

The tire manufacturer Bridgestone recently reported that over five billion liters of fuel is wasted in Europe due to incorrect tire pressures.

For developing nations with even a less literate population, the effect of incorrect tire pressures is likely to be much worse on the economy of these nations.

# 2

## Air conditioners

*Are You Really  
Saving Fuel  
By  
Turning It Off?*



This is one of the most controversial topics when it comes to fuel economy. A large number of vehicle owners as well as road side mechanics insist that air conditioning not only consumes more fuel but leads to early engine wear especially on long trips.

This has led many drivers to turn off the air conditioner on long trips while turning it on while driving inside the city. All myths of course contain some truth . It is the separation of the wheat from the chaff that we are faced with here.

Car engines, like all engines, are built to overcome some load, force or resistance in whatever form they appear. The engine considers the following as essentially the same thing

- ☛ Having an extra person in your car
- ☛ Carrying a ( 50kg) bag of cement in the trunk
- ☛ Climbing a very steep hill
- ☛ Turning on the Air conditioner

None of the first three conditions above can be blamed for early engine wear because vehicles in general are designed to perform these functions. As far as engine loading is concerned, the air conditioner applies an equivalent load on the engine and cannot be blamed for early engine wear.

My guess is that the squeaky sound emitted by bad compressor bearings and misaligned drive belts - *really sounds like somebody dying* - may be responsible for this



widely held opinion.

Also, most aftermarket installers of air conditioners do not include sensors to compensate for the engine idle speed when the air conditioner is turned on. This leads to excessive vibration of the engine, intermittent stalling and high idle speed.

### **What about fuel?**

Any load applied to the engine will require more fuel and air mixture for the engine to overcome the load.

Yes, turning on the air conditioner will result in more fuel consumption but...

### **That's not the whole story...**

A greater load to fight is the wind. Wind resistance is such a problem that at very high speed, the car uses over one third of the power generated by the engine to overcome the load imposed by the wind.

Added to this, the faster you go the heavier the wind loading gets. In techno-speak, the wind drag on your car is proportional to the square of the velocity (speed).

To get a feel of this, stretch your hand and open your palm to the wind on a speeding vehicle and you will be amazed at the amount of wind load pushing your palm backwards.

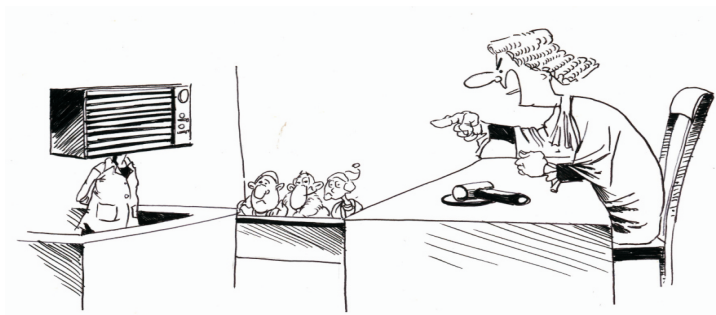
### **Lowering the sound of speed**

The main factor affecting wind resistance is the shape of the vehicle or more specifically, the ability of the air to easily flow around the vehicle.

When the windows on the vehicle are wound up, air does not enter the passenger compartment and air flow around the vehicle is much better. This reduces the load on the engine. The moment the windows are wound down at higher road speed, air rushes into the vehicle and cannot easily flow around the vehicle and as such increases wind resistance and subsequent load on the engine.

So, the question boils down to: Which is greater? , the amount of power the air conditioner draws from the car , or the amount of additional power needed to overcome wind resistance (drag), in a fast moving vehicle, with the windows wound down.

### **Cut the crap: Guilty or not Guilty?**



Do not worry about early engine wear except your vehicle engine is already in a bad condition.

## Disclaimer...

## More!

Whereas , if it is not set at maximum ( coolest ) , then the load on the engine will be intermittent as the air conditioner compressor unit switches on and off in order to maintain the desired temperature.

In the tropics , setting your Air Conditioner switch to about twenty two degrees (somewhere between the highest and the coolest setting ) even on a hot day provides a comfortable and

There is really no point setting the air conditioner switch at the lowest point and then donning a three piece suit to act cool, except, of course, you are a banker and image means everything.

So, if you are driving those Armada-like SUVs or HE-trucks like the Chevrolet Avalanche, there is really no point in not using your air conditioner all the time. Money should not be a problem. I hope!!!

# 3

## Speed kills - *if you are poor*



## To speed or not to speed

It's quite easy to assume that driving faster will save you more fuel, or on the other hand that driving slower - since you are not stepping hard on the throttle pedal - will save you fuel. However like all things in life there is an optimum speed at which you save the most fuel.

## I don't like graphs

Fig 3.1 is a graph relating the speed of a vehicle in kilometers per hour and the number of kilometers travelled with a gallon of fuel.

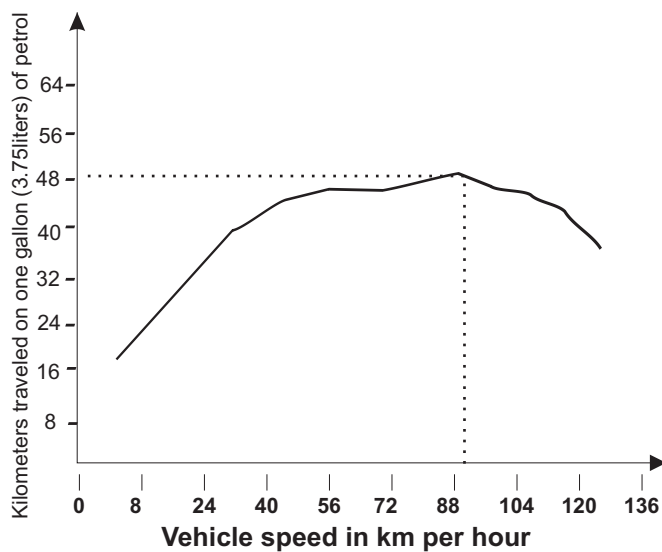


Fig 3.1

### Follow the dotted line

The best way to understand this graph is to look at the highest point on the curve and follow the dotted line to see the vehicle speed that is represented by this point of highest fuel economy (saving).

Driving at just under one hundred kilometers per hour, your vehicle consumes the least amount of fuel for the distance traveled.

Also from the graph , it can be seen that there is a rapid drop in economy at vehicle speeds in excess of one hundred kilometers per hour and below this speed your vehicle is consuming too much fuel for the distance traveled.



Fig 3.2

The vehicle speedometer in Fig 3.2 shows this optimal speed in miles per hour at which the best fuel saving is obtained. Notice that the number (55mph or 88 km per hour) is deliberately written to help the driver remember this fact .

Most new vehicle specifications include the number of miles you can drive on a gallon of fuel and the speed at which this

milage can be achieved. However, it is not likely that you can achieve these economy figures advertised by the manufacturers because the test conditions under which these results were obtained and your actual driving conditions are rarely the same.

For example, the average fuel economy figure for the 2005 Honda Civic with manual transmission is listed as follows

**32mpg city 38mpg highway**

Here , the manufacturer claims that you can drive up to about fifty two kilometers with a gallon of fuel if you are driving around in the city or sixty one kilometers with a gallon of fuel if you are cruising on the high way at about ninety kilometers per hour.

Please note that this economy figure cannot be obtained in a typical developing country. Some parts of the highway in these countries look like ploughed farm lands with food crops. Most cities have uncovered military grade trenches dug for water pipes encroaching on heavily trafficked roads.

The fuel economy figures above are at best misleading but still provides enough information to allow you compare economy figures with other vehicle manufacturers.

Whenever any vehicle manufacturer lists a lower economy figure you can safely assume that the manufacturer's vehicle is less fuel efficient. However, the specification (engine size, chassis type and weight) of both vehicles has to be similar in order to make an accurate comparison.



The following information, obtained from the Department of Energy (DOE), USA, will be closer to what most drivers will experience.

The moment you exceed one hundred kilometers per hour, every extra eight kilometers per hour you add to your vehicle speed results in a serious increase in fuel consumption of your vehicle.

This means that you might be wasting over one gallon of fuel for every four gallons of fuel in your vehicles fuel tank.

If you are unrepentant and continue in this mode of driving for a one year period, please do not complain to your neighbors about the bad economy or quarrel about school fees for your children.

## Don't believe everything you read about...

I actually tried this with my Volkswagen Golf some years ago on a one hundred kilometer trip and luckily was able to cruise at one hundred kilometers per hour. No police checkpoints because it was on a Sunday morning - yes policemen go to church. -No road bumps cause the road was just resurfaced before the rains- and I was able to average fifty eight kilometers on four liters of petrol.

On a later run at an average of one hundred and forty kilometers per hour, the fuel consumption was so high that I have never tried it again.

## World Gallon (Cup) America Vs Europe

It is important to note that the measurement of a gallon varies between the two sides of the Atlantic. To the Europeans 4.546 liters represents a gallon, while to the Americans 3.75 liters represents a gallon. The imperial gallon is about 1.2 times the size of the US gallon.

Whenever fuel economy figures are listed in miles per gallon, ensure you know which side of the Atlantic the information is coming from in order to avoid errors in judgement .

The current standard adopted in Europe to avoid this confusion

is to measure vehicle fuel economy as the number of liters used for a one hundred kilometer trip .

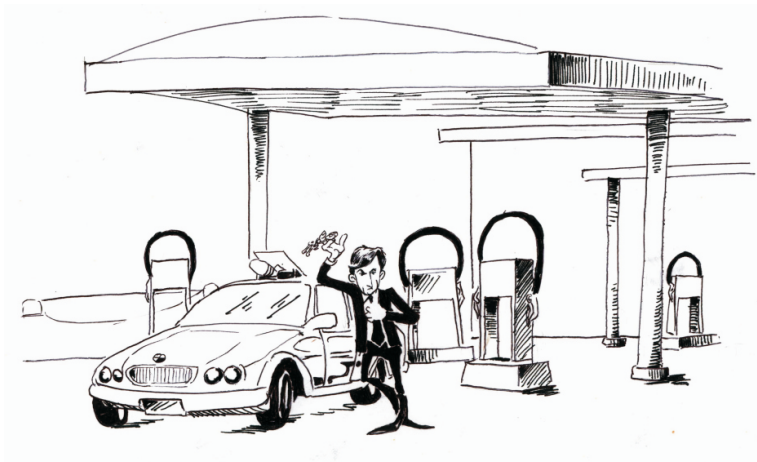
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# 4

## The 007 effect

*Aggressive driving*



**Law of nature**

Accelerating a car all the time leads to very high fuel consumption. A vehicle needs a lot of energy to accelerate. The vehicle needs even more energy if it is accelerated from a stationary position. This is in line with the basic laws of physics. Also, the heavier the vehicle the more fuel needed to get the car moving..

**Customer satisfaction**

To respond to the driver's intent to accelerate, the vehicle manufacturers install a variety of sensors that tell the engine that you need extra power- - *extra fuel*.

The wide open throttle switch or Kick down switch is a small switch -just like the one in your home electrical outlet - that tells the injectors or the accelerator pump on the carburetor that the car needs more fuel to cope with the power demands of the driver.

In vehicles equipped with automatic transmission (gear box) the moment the throttle pedal is depressed fully, it activates the kick down switch which is usually located under the throttle pedal. This causes your vehicle to accelerate just like the space shuttle. However, remember that the Space Shuttles' solid rocket boosters consumes about two million liters of fuel for its eight and half minute flight into orbit.

Hope you get the idea because the only place you are accelerating to is the nearest Petrol station.

**My name is Bond, James Bond!**

While driving aggressively (heavy acceleration and braking), fuel is consumed at least three times the normal rate. If its fuel

economy you are looking for, please don't do James Bond.

The movie producer pays for his fuel and then pays him for wasting fuel. You pay the movie producer to watch Bond waste fuel and possibly accelerated your car while going to watch the Bond movie. If you are broke , Get smart !

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# 5

## Do It Yourself

*There is no such thing  
as free lunch*



**it always pays to do it your self**

In general, vehicles equipped with manual transmission are usually more economical than those with automatic transmission. This is even more likely if you are a used car owner or buyer.

The energy (fuel) required to get an automatic transmission equipped vehicle moving is greater than that of a manual transmission equipped vehicle. This is because there is no direct mechanical linkage between the engine and the road wheels.

Most auto transmission equipped vehicles use fluid (viscous coupling) to connect the engine with the road wheels and as such power transmission to the road wheels is not as efficient as the clutch plate of the manual transmission equipped vehicle.

Further more, the speed at which the transmission shifts to another gear is fixed during the manufacturing of the automatic transmission .This predetermined speed which the transmission shifts ( changes gear) does not usually result in the best shift point under certain conditions.

The Table in Fig 5.1 shows the fuel consumption rate for different vehicles with both manual and automatic transmission installed

### City Driving

Average number of kilometers traveled on a gallon(3.75litres)  
of petrol for 2005 models for city driving

Make	Model	Year	Engine size	AUTOMATIC (Km per gallon)	MANUAL (Km per gallon)
HONDA	Civic	2005	1.7 Litres	49.6	51.2
TOYOTA	Corolla	2005	1.8 Litres	48	51.2
KIA	Rio	2005	1.6 Litres	38.4	40
VW	Jetta	2005	1.8 Litres	35.2	38.4

Data from [www.fueleconomy.gov](http://www.fueleconomy.gov)

Table 5.1

From Table 5.1 , the fuel economy advantage of the manual transmission over the automatic transmission is consistent regardless of the vehicle manufacturer. However , some recent vehicles fitted with automatic transmission have the same or slightly better fuel economy advantage over their manual equivalents.

### Beware!!! Used car buyer

Used car buyers that are really interested in saving fuel should avoid automatic transmission equipped vehicles. This is primarily because the number of components that make up the transmission is a lot more

These components are subject to a lot of wear after the first one hundred and sixty thousand kilometers of driving and due to the high wear rate , the fuel consumption of a used automatic transmission equipped vehicle is likely to be even much higher than a vehicle equipped with manual transmission.

### **Adopt a NEUTRAL attitude**

Most automatic transmission equipped vehicles have shift positions on the gear lever labeled : **P** - park , **R** - Reverse , **N** - neutral , **D** Drive and optionally , **S** , **L** , **2** , **3** , **1** - for limiting the gear change to the **first** , **second** or **third** gear.

The **N** or neutral shift position is very important. This is because whenever the shift lever is in the **D,R,S,L,2,3** positions , the engine is under load as the transmission is already trying to turn the drive wheels.

Drivers will experience the vehicle jerk slightly and creep forward on level ground. Depending on the state of the vehicle, you have to step on the foot brake to keep the vehicle stationary.

If you have to stop the car from moving by stepping on the brake pedal then the vehicle is wasting energy (fuel) while trying to move.

### **The moral of this whole tech speech is :**

Any time you have to stop or wait for a few seconds for the traffic light, it is in your best interest to switch your gear lever to the Neutral position. The cumulative savings of fuel over a long period of time is quite appreciable though hard to estimate.

### **Smile when you see CVT**

If you are very serious about fuel economy and you really love automatic transmission equipped vehicles then look for any vehicle that has the CVT badge stamped on it.

CVT is an acronym for Continuously Variable Transmission. It

is a simple state-of-the-art automatic transmission that has been in limited use since the late eighties.

Fellow perennial used car owners hunting the used car market should not expect this transmission to be fitted to their dream BMWs and Lexus cars .

This transmission is usually hidden in small fuel efficient Picanto-like cars like the Ford fiesta , Fiat Uno and Subaru Justy. Some of these vehicles can travel up to one hundred kilometers on a gallon of fuel . With these vehicles, you will not even remember you have a fuel tank. Seriously consider buying any of these vehicles for city-roaming-operations .

Daimler Chrysler calls this type of transmission the AutoTronic Transmission and installs it in the fuel efficient A-Class series (A 160 , A180). This transmission is so efficient that it has an overall length of just thirty three centimeters ( about the size of the standard mathematicians ruler).

Due to technical and cost issues , this transmission currently does not support the high power and torque output produced by larger engines as such most applications are restricted to subcompact cars but should you find them in the larger vehicles, they are likely to be very expensive (see prices of the latest model Honda, Nissan vehicles equipped with this transmission -Acura MDX, Nissan FX 35/45 e.t.c ).

### **Knowledge is ....** *Fuel economy*

From the mid eighties, Mercedes Benz cars equipped with automatic transmission have a switch near the gear selector lever . This switch has two positions : S- for sports mode and E -for economy mode (Fig 5.2).

Ensure you have invested heavily in the Shares of major Oil and Gas producing companies if you intend to leave the switch

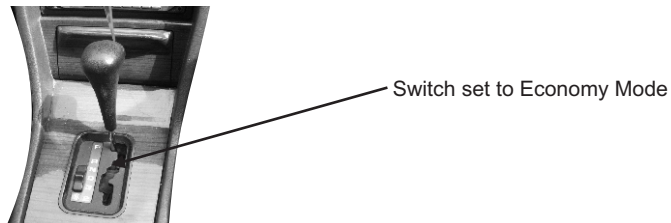


Fig 5.2 1986 Mercedes 230 E with Fuel Economy switch

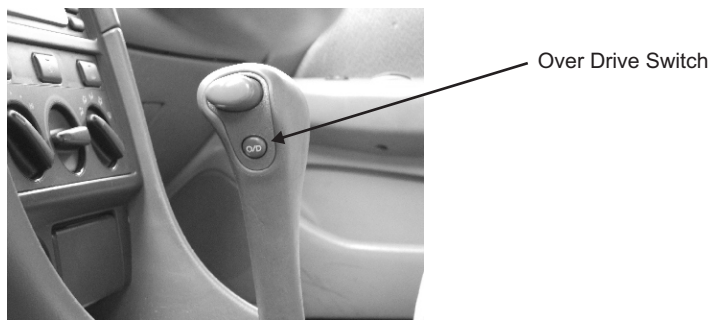


Fig 5.3 1999 Toyota Camry with OD- switch