

Chapter 3: Preventing Energy Losses that Drain your Vehicle of Power and Increase Fuel Consumption



Types of Losses

Energy management is the key to fuel efficiency. Prevent your vehicle from losing too much of the energy produced by your engine to friction and other forces, and you have made a big step in creating a more fuel efficient vehicle.

There are inherent and ever-present forces always draining energy from your vehicle. The three basic types of losses are as follows:

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| Friction | wind resistance, rolling resistance, mechanical friction (two parts moving against each other), and hydraulic friction (force required to push or pump a liquid) |
| Mechanical Load | the combination of losses incurred by the engine due to powering accessories such as air conditioning, electrical, and power steering as well as vehicle weight and payload |
| Heat & Noise | loss of energy in the form of heat loss or vibrational noise |

Always being aware of and reducing any of these energy draining forces will allow more of the energy produced by the engine to be transferred directly to turn the wheels and propel your vehicle more efficiently.

An increased level of any of these draining forces adds to the burden your engine must carry as it attempts to power your vehicle. For example, a heavier payload causes the engine to work harder under load, just as tires with low pressure create extra resistance and make the engine work harder.

This section will address each of these types of losses and offer recommendations for reducing or even eliminating some sources of the ever-present losses that drain energy from your vehicle.

Reducing Friction Losses

Wind and Rolling Resistance

Aerodynamics plays a very important part in the efficiency and fuel economy of your vehicle. You have noticed that sports cars are sleek and streamlined, and for a reason. The car's shape is more finely tuned to allow air to pass more cleanly over these vehicles with a minimal amount of turbulence.

The smoother and better managed the air flow over a surface, the less turbulence is formed, and the less air resistance or friction that needs to be constantly overcome. Of course, since you probably have a gas guzzler, it is probably not as streamlined or aerodynamic as a sports car. In fact, most SUV's and trucks can be more closely called "rolling-bricks!"

Larger vehicles are made with another purpose in mind other than for low wind resistance. Many trucks and vans are box-like in shape to accommodate cargo and big engines. The same goes for SUV's which are generally designed to carry many passengers and large-volumes of cargo as well.

These vehicles are not very aerodynamic and as a result tend to have bigger engines and more horsepower to overcome the increased air resistance. In fact, engineers will tell you the drag or wind resistance of a vehicle is *proportional to the square of the speed*. In other words, if you double your speed, you quadruple the aerodynamic drag you must overcome – *that's four times more resistance!!*

And here's the kicker – the power needed to overcome that drag increases proportionally to the cube of the speed. So, if you double your vehicle speed, *you need eight times the horsepower to overcome four times the drag*.

Here's another example. If you increase your speed from 40 to 60 miles per hour, that's 1.5 times faster. You get 2.25 times more resistance ($1.5 \times 1.5 = 2.25$). Your engine needs to come up with 3.4 times the horsepower ($1.5 \times 1.5 \times 1.5$) to keep the vehicle moving along at 60 than it did at 40 miles per hour.

You now start to get a feeling for why trucks and SUV's require such big engines, and why mileage experts tell you to drive slower to conserve fuel.

Rolling resistance is exactly what it sounds like. It is the resistance of the rubber tires rolling over the road surface, combined with the friction of the brakes and wheel bearings.

Amazingly, *one third of the total energy output* of the engine is consumed by rolling resistance. Other factors playing into

rolling resistance are the pressure, quality and type of tires, your alignment and the weight of your vehicle.

New radial tires have the best of both worlds with a comfortable ride as well as much lower rolling resistance than the older bias ply tires - *almost double the efficiency!*

Taller and fatter tires obviously offer higher wind resistance than smaller and narrower tires. A lighter vehicle presses down on the tires less and reduces road friction.

Tire pressure is the *single largest factor you can immediately control*. When temperatures drop, the pressure in your tires decreases. For every 10 degrees reduction in outside temperature, cold tire pressure is estimated to drop one pound per square inch (PSI).

According to Goodyear Tire Company, "Running a tire 20 percent under inflated – only 5 to 7 pounds per square inch – can increase fuel consumption by 10 percent. That can easily cost motorists two or three miles per gallon. Not only that, but the tire's tread life is reduced by 15 percent".

Here is a good source of additional knowledge for tire care, including advice for tire selection, inflation, rotation and tread wear inspection.

<http://www.goodyear tires.com/kyt/>

<http://www.michelin.com>

Mechanical Friction

Rubbing parts are the source of mechanical friction. Any time two moving parts move against one another as in the case of engine crank-shafts, connecting rods, camshafts,

valves, bearings, gears, belts, and brakes, there is friction, heat loss, and resulting losses as energy is created in the vehicle's engine combustion chambers and transferred from each cylinder through the engine, drive-train, tires, and to the ground.



Science... or Science Fiction?

Did you know that the science of rubbing parts is called Tribology? There is an entire industry with its own science out there just for rubbing parts! They even make up their own big words. To us, Tribology sounds like the art of caring for Tribles (as seen many years ago on Star Trek)...

There is a tremendous amount of research looking into creating frictionless machines, bearings and lubricants. Modern technology has made some major advances and has produced a number of materials and lubricants that greatly reduce the amount of friction encountered in a vehicle. We are seeing Teflon coatings and synthetic bearing grease, among other products, available today.

Wear and tear is a natural by-product of mechanical friction. Gears wear out, belts crack and break, bearings wear thin and brake pads wear out, all because of friction.

We will show you some alternative methods of applying high tech lubricants in your vehicle and perform other adjustments to greatly reduce friction and enhance fuel efficiency.

Hydraulic Friction

Pressure and viscosity of a fluid being forced through a channel dictate how much hydraulic friction is present, as does the material the channel is made of.



That Sucks!

If you've ever tried to drink a thick milkshake or smoothie through a straw, you know what we're talking about. If the milkshake is too thick, it takes a tremendous personal effort to suck that viscous fluid up through the straw (and maybe get a hernia, too!).

The same principle applies in your vehicle. Engine oil is designed to be a certain thickness, or viscosity under varying conditions of heat and cold. The more viscous the oil, the harder the engine has to work to continually power the oil pump to circulate the oil throughout the engine.

In general, we want to *use the lowest viscosity oil* that will protect and lubricate our engine based on the climate and temperature extremes in which we operate.

The higher the pressure of the system in which the fluid is being circulated, the more energy required to move it. Many fluid systems work under pressure in your vehicle including the oil, braking, power steering, air conditioning and coolant systems.

All of these systems draw energy from the engine to allow them to work. So, the cleaner and more efficient each of these systems is, the lower the overall energy drain on the engine.

Tips and Techniques for Reducing Friction Losses

Solution #1 Keep your tires inflated properly



Make sure to check your tire pressure any time there is a change in temperature outside and keep them filled up near the highest pressure listed on the tire. It's good practice to check them every week, if possible or if you have experienced a greater than 30 degree temperature change.

Check for abnormal wear, typically along the center line of the tire if over-inflated and along the edges if under-inflated. Uneven wear or cupping of the tread along one or both edges is an indication of an alignment problem or an issue with your shocks or struts.

This may be one of the most important ways for you to keep your fuel mileage high. Remember, adjusting your tire pressure for *your specific vehicle load* is important for optimum fuel mileage.

How many times have those of you with work trucks loaded the bed with 1,000 to 1,500 pounds of cargo or trailer tongue weight and just driven on, unaware of the consequences. Have you ever noticed your work trucks' tires protesting this increased rolling resistance load and squished like pancakes!

We've all seen this at one time or another. Both safety and efficiency are clearly at risk

and are sacrificed every time you see this situation.

Solution #2 Don't drive with your windows down



In another section, we will suggest driving without Air Conditioning unless you really need it. There is a trade-off here. If it is too warm to keep the A/C off AND keep your windows up, you are better off running your A/C than you are driving with at highway speeds with your windows down because of the excessive drag created by the open windows.

Solution #3 Apply synthetic bearing grease to your wheel bearings



Good quality synthetic bearing grease will greatly reduce the friction around your wheel bearings and will help decrease overall rolling resistance.

Try products from Mobil 1, Red Line and Amsoil and follow the minimum recommended specifications for all lubricants including bearing grease. They are all 25+ years in the business with NO F.T.C. (Federal Trade Commission) complaints levied against them. As in this case and others in this book, the “good ones” seem to be those that have the staying power of tens of years in this market with no complaints. Remember the old saying, “Don’t discuss it and let the actions speak for themselves?” These three have done a good job of doing

just what they say they are going to do. There are so many others that shout from the highest perch about what they can do and levy outrageous claims. Our experience tells us the quiet performer stands the test of time, not the “town-crier”.

Solution #4 Use synthetic oil in your transmission, differential and transfer case



Good quality synthetic ATF or appropriate gear oil will dramatically reduce the friction and operating temperature inside your automatic or manual transmission, differential(s) or transfer case.

It could also last up to 50,000 miles, or 3 to 5 times longer than conventional petroleum based oils. Some manufacturers are already placing full-warranty maintenance in new 2006 vehicles at up to 100,000 miles for transmissions. Please review your owner’s manual and/or visit your local dealership to get their advice.

If you choose to explore this, talk to your service writer or mechanic. *They are a huge wealth of information.* We have been talking with mechanics like this for over 25 years. *This is where you find out what’s really going on. You can get the inside scoop about your vehicle. You find out what works and what doesn’t work. You learn about typical problems and the solutions they use to fix them.* Remember, in many cases it is not what you know but who you know.

There are hundreds of millions of dollars spent rebuilding and replacing “worn-out” or under-maintained transmissions each year. Having the correct knowledge from the experts here can go a very long way toward increasing your transmission’s efficiency and longevity.

Here are a few transmission and gear lubricant manufacturers who create quality products that meet or exceed all automaker’s specifications for transmission and gear box lubricants:

- AMSOIL Long Life Synthetic Gear Lube SAE 75W-90 (change interval up to 500,000 miles!) as well as ATF.
- AMSOIL SEVERE GEAR™ Synthetic EP Gear Lube SAE 75W-90 (change interval up to 100,000 miles) for heavy duty or severe operations as well as ATF.
- Red Line 75W90 High Performance Gear oil as well as ATF.

Solution #5 Make sure your wheels are aligned to reduce rolling resistance



Maintaining your vehicle's alignment is paramount to the operational efficiency and safety of your vehicle. How many times have you (or your significant other) bumped a curb or hit a pretty significant bump? Did you know one small uneventful bump from a curb can significantly mis-align your car?

Most people are un-aware that if you have a "cantered" steering wheel while driving straight down the road, you are probably in need of an alignment. We see drivers most every day "crabbing" down the road. This is a big sign you need to have your alignment checked and possibly tuned.

The next time you are going down the highway take notice of the position of your steering wheel. It should be in alignment and as level and straight as the level road you are traveling down. If your steering wheel is not straight then imagine it straight. **DO NOT DO THIS WHILE DRIVING** as it is unsafe - But imagine if you were to center the wheel from its canted position, then how far from straight would the car deviate?

Constantly traveling down the road "sideways" (figure of speech, but you get the point) is horribly inefficient and a big cause of premature wearing of your tires. This can be a double whammy in that you pay more

out of your pocket for each inch you travel because of poor gas mileage caused by an out of alignment vehicle AND having to buy new tires more often. Sounds a bit simplistic but this is a commonly overlooked mileage eater.

Solution #6 Maintain your brakes and make sure your emergency brake is disengaged



There are two parts to the brake equation - your standard brakes and your emergency brakes. Both are absolute critical systems and the highest priority should be given to their maintenance and effectiveness. But what do brakes have to do with getting better gas mileage? The answer is simple - worn and improperly maintained brakes can cause excess drag and may become a driving hazard.

The brake pad contact points can fall out of alignment, ever so slightly, and create unwanted friction between the pads and the rotors. In most cases, you will hear a slight chatter or chirp telling you there is a problem. You may also feel this as slight vibration or chatter with your foot as you apply pressure on the brakes.

Additionally, today's newer cars, with 4-wheel disc brakes, have a second-set of brake shoes (emergency brakes), used to keep the car from rolling when parked and to stop the car in the event the primary system has failed.

All too many times drivers leave the parking brake partially engaged and do not figure this out until they see smoke. If the emergency brakes get so hot they begin to fuse the shoe to the friction material it is in contact with, you may feel a distinct chatter or vibration in the car.

Solution #7 Make your vehicle more aerodynamic



Anything attached to the outside of your vehicle will add extra wind resistance. A car-top carrier, a bike rack on the back, even your luggage rack will add wind resistance. If your luggage rack is removable, take it off when you don't need it.

Here's a good one for truck owners. It is common thinking that if you take the tailgate off, you will decrease the wind resistance and get better gas mileage. That is the reason you see so many trucks with a cargo net across the back of the truck bed instead of the tailgate.

We learned from an aerospace engineer the truth about this tailgate mystery. It seems that with the tailgate on, there is a "bubble" of air that forms in the truck bed. The air passing over the top of the truck also passes over that bubble of air, as if it were a part of the vehicle, making a fairly smooth path for the passing air. We already learned the smoother the flow of air, the less wind resistance there is.

Now, if you remove the tailgate, the bubble of air collapses and the passing air swirls and becomes turbulent in and around the truck bed, causing more wind resistance.

We were pretty amazed at this explanation, but it makes a lot of sense. Bottom line – keep your tailgates in fully upright and “locked” position, truck owners!

A lot of long-haul truckers are learning the value of streamlining their trucks, and the same lessons apply to regular cars, trucks and SUV’s. Race car drivers know this too. If you can add an air dam, spoilers, or fairings around the bottom of the vehicle to minimize the amount of air that can pass underneath, the vehicle will be more aerodynamic and the engine won’t need to work so hard to move it. Obviously, if you truly go off-road in your SUV or truck then this may not be the option for you.