GASOLINE OCTANE RATING METHODS
AND OPERATIONAL CONDITIONS IN TWO STROKE ENGINES

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Since so many of you have asked for an interpretation of the numbers posted on the side of the pump where you fill up, I've decided to "distill" this info down to a useable size. I've also come up with another snappy title, as you can see above. LOLOL. As you can imagine, there are volumes and volumes of scholarly works on this subject but I'll try to make it as simple as possible and keep things in layman's terms.

What is an octane rating (or number) anyway ?

The simplest definition is that such rating/number is a measure of a fuel's resistance to detonation during combustion.....or the fuel's anti-knock quality.

What's "detonation" and why should I be concerned about it ?

Detonation, or "spark knock" or "ping", is defined as an uncontrolled and abrupt explosion of the fuel/air mixture in the engine cylinder(s) due to excessive pressure and/or temperature. Normally the fuel/air mixture in an engine's cylinder(s) burns and expands in a controlled and linear fashion, spreading outwards from the spark at the spark plug at the time of ignition. This is considered "normal" combustion. When the fuel/air mixture burns/explodes instantaneously, you get detonation which creates shock pressure waves and thus an audible "knock". If left unchecked, knock can do all kinds of damage to your engine, sometimes quite quickly. Broken pistons are an extreme result of detonation or knock. Detonation is to be devoutly avoided, especially in a two stroke engine where combustion events happen twice as fast as in a four stroke engine.

How do I interpret those numbers on the gas pump ?

Well, here's where I let the experts take over. This next section is lifted bodily from the Esso Canada Fuels and Lubricants Handbook and is copyrighted, so don't steal/use it without giving proper credit to them. My comments are in brackets thus [xxxx].

There are two commonly used methods of determining the octane number of motor gasoline: the Motor Method and the Research Method. Both methods use the same type of laboratory single cylinder engine, which is equipped with a variable [displacement] head and a knock-meter to indicate knock intensity. Using the test sample as fuel, the engine compression ratio and the air/fuel [ratio] are adjusted to develop a specified knock intensity. Two primary standard reference fuels, normal heptane and iso-octane, arbitrarily assigned 0 and 100 octane numbers respectively, are then blended [and run in the test engine] to produce the same knock intensity as the [original] test sample. The percentage of iso-octane in the blend [ed reference fuel] is considered the octane number of the [original] test sample. Thus, if the matching reference blend is made up of 15% n-heptane and 85% iso-octane, the test sample is rated 85 Motor or Research octane, according to the test method used.

The test conditions for the Research Method are less severe than for the Motor Method. Accordingly, commercial gasolines have a higher octane number by the Research Method than by the Motor Method. [If you think about it, a little dishonesty by someone is evident here. The world, until recently, relied upon the Motor Method for octane ratings and the public became used to seeing the M(otor) O(ctane) N(umber) on the side of the pump. Nowadays, in Europe, the results on the pump are the R(esearch) O(ctane) N(umber) and everyone thinks they've suddenly got really great fuel. In reality, the European fuel is the same old stuff, or worse, that we've always been used to. Read on.]
Both ratings are required to predict the performance of the gasoline in actual road usage, but the relative importance depends on the type of engine and operating conditions. In truck and bus applications where the gasoline must perform at high temperatures and under maximum throttle [gosh, just like two stroke motorcycle engines, LOL] the MON is more significant than the RON. Similarly in passenger cars with automatic transmissions under full load and part throttle the MON is more significant, particularly in engines of more recent manufacture. In passenger cars with manual transmissions at full throttle where the engine can be [highly] loaded at low engine speed [like four stoke V twin cruiser bikes] the RON is more significant, while at part throttle, the reverse is true.
Road Octane Number [not to be confused with RON] is the rating of the gasoline, in terms of reference fuels, by a test car under full throttle acceleration from 10 to 50 MPH. However, Road Octane [Number] tests are too expensive for routine testing and are reserved mainly for special octane requirement surveys. An approximation [of the Road Octane Number] may be made by calculation of the average of RON and MON thusly: RON + MON divided by 2. [this rating is now becoming more widely used in North America but you can see, again, how it inflates the number].

What did I learn from all this ?

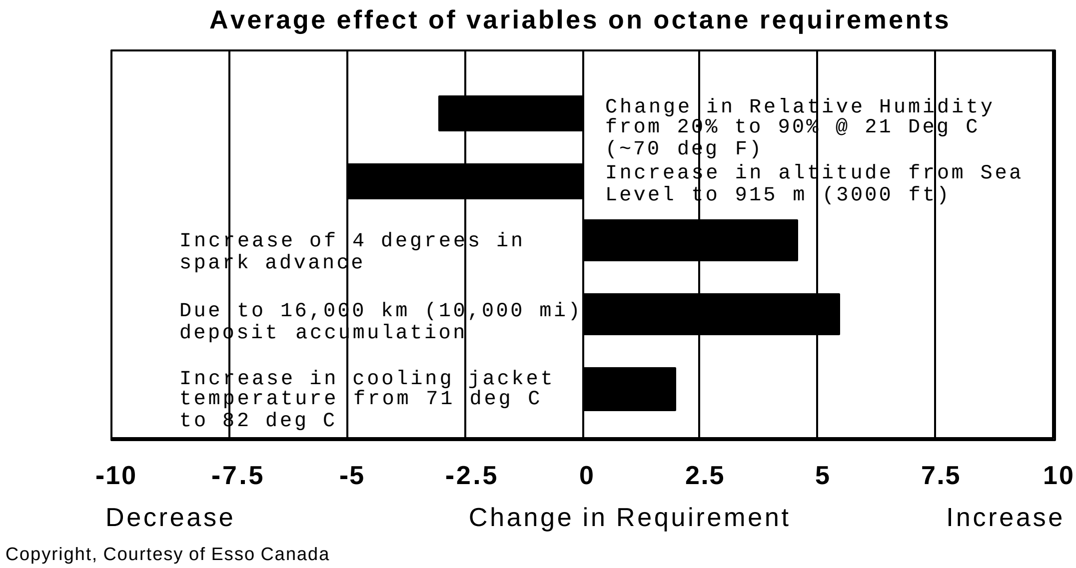
If you currently own and ride a high performance two stroke motorcycle, you may have problems with detonation when you use regular unleaded gasoline. This is especially true if you have increased the compression ratio by shaving the head or reducing head gasket thickness....or have changed the port timing.

What else do I need to know to keep my two stroke happy and healthy, fuel-wise ?

As a matter of comparison, my Suzi GT550A manual calls for fuel of "85 - 95 octane in Research Method" for an engine with a 6.7:1 corrected compression ratio, whereas the manual for my Suzi PE250B (single cylinder) enduro racer/dirt bike calls for "95 Research Octane or higher" for an engine with a 7.0:1 corrected compression ratio. Hmmmm....for the relatively low compression/performance stock 550 under normal conditions, any old gasoline is OK....but for the relatively high compression, high performance 250, you need the "good" stuff. If you are running a ~ 7.0:1, or higher, (corrected) compression ratio engine, you'd better use the "good stuff" or you're probably going to have detonation more often than you'd prefer. This is especially true in conditions of high ambient temperatures when you have an air cooled engine or you've advanced your spark somewhat or you haven't pulled the head(s) for awhile to clean up those nasty deposits off the piston crown and inside the head. See the first chart on the next page for more octane facts.

What other engine operational conditions do I have to watch for ?

Here is a chart that's very instructive regarding octane requirements. Look it over carefully two or three times and you'll see what I mean.



Another chart that compares octane numbers is also very instructive:

Properties of Esso Gasolines

	Esso 2000 Unleaded (Regular)	Esso (Leaded) (what leaded Regular used to be)	Esso Extra Unleaded (Premium)
R. O. N. *	93	94	96
M. O. N. *	84	85	87

* = lower for high altitude areas

Keep in mind this chart is from 1983 but the ratio of MON to RON will remain the same even if the absolute numbers change somewhat. Most jurisdictions in North America supply 87 octane fuel but this is mostly a Road Octane number nowadays, so is somewhat of a "cheater" number.

From all of this you should be able to get a fairly accurate idea of what your bike's octane requirements are at any given time. You can see that gasoline has a very complex job to do under many varied operating conditions and still give you the power and performance you expect. Choose the right octane rating and you'll get that power and performance without detonation/pinging.