Octane rating

An **octane rating**, or **octane number**, is a standard measure of the performance of an engine or aviation fuel. The higher the octane number, the more <u>compression</u> the fuel can withstand before detonating (igniting). In broad terms, fuels with a higher octane rating are used in high-performance gasoline engines that require higher <u>compression ratios</u>. In contrast, fuels with lower octane numbers (but higher <u>cetane numbers</u>) are ideal for <u>diesel engines</u>, because diesel engines (also referred to as compression-ignition engines) do not compress the fuel, but rather compress only air and then inject fuel into the air which was heated by compression. Gasoline engines rely on ignition of <u>air and fuel</u> compressed together as a mixture, which is ignited at the end of the compression <u>stroke</u> using <u>spark</u> plugs. Therefore, high compressibility of the fuel matters mainly for gasoline engines. Use of gasoline with lower octane numbers may lead to the problem of engine knocking.^[1]

Contents
Principles
The problem: pre-ignition and knocking
Isooctane as a reference standard
Measurement methods
Research Octane Number (RON)
Motor Octane Number (MON)
Anti-Knock Index (AKI) or (R+M)/2
Difference between RON, MON, and AK
Observed Road Octane Number (RdON
Octane Index
Aviation gasoline octane ratings
Examples
Effects
Regional variations
See also
References
Further reading
External links

Principles

The problem: pre-ignition and knocking

4/11/2020

Octane rating - Wikipedia

In a normal <u>Otto cycle</u> spark-ignition engine, the air-fuel mixture is heated as a result of being compressed and is then triggered by the spark plug to burn rapidly. During this combustion process, if the unburnt portion of the fuel in the combustion chamber is heated (or compressed) too much, pockets of unburnt fuel may self-ignite (detonate) before the main flame front reaches them. Shockwaves produced by detonation can cause much higher pressures than engine components are designed for, and can cause a "knocking" or "pinging" sound. Knocking can cause major engine damage if severe.

The most typically used engine management systems found in automobiles today have a knock sensor that monitors if knock is being produced by the fuel being used. In modern computer-controlled engines, the ignition timing will be automatically altered by the engine management system to reduce the knock to an acceptable level.

Isooctane as a reference standard



2,2,4-Trimethylpentane (iso-octane) (upper) has an octane rating of 100, whereas *n*-heptane has an octane rating of 0.

Octanes are a family of hydrocarbons that are typical components of gasoline. They are colorless liquids that boil around 125 °C (260 °F). One member of the octane family, isooctane, is used as a reference standard to benchmark the tendency of gasoline or LPG fuels to resist self-ignition.

The octane rating of <u>gasoline</u> is measured in a test engine and is defined by comparison with the mixture of <u>2,2,4-trimethylpentane</u> (iso-octane) and <u>heptane</u> that would have the same anti-knocking capacity as the fuel under test: the percentage, by volume, of 2,2,4-trimethylpentane in that mixture is the octane number of the fuel. For example, gasoline with the same knocking characteristics as a mixture of 90% iso-octane and 10% heptane would have an octane

rating of 90.^[2] A rating of 90 does not mean that the gasoline contains just iso-octane and heptane in these proportions, but that it has the same detonation resistance properties (generally, gasoline sold for common use never consists solely of iso-octane and heptane; it is a mixture of many hydrocarbons and often other additives).

Octane ratings are not indicators of the energy content of fuels. (See <u>Effects</u> below and <u>Heat of</u> <u>combustion</u>). They are only a measure of the fuel's tendency to burn in a controlled manner, rather than exploding in an uncontrolled manner.^[3] Where the octane number is raised by blending in ethanol, energy content per volume is reduced. Ethanol energy density can be compared with gasoline in heat-of-combustion tables.

It is possible for a fuel to have a Research Octane Number (RON) more than 100, because iso-octane is not the most knock-resistant substance available. Racing fuels, avgas, LPG and alcohol fuels such as methanol may have octane ratings of 110 or significantly higher. Typical "octane booster" gasoline additives include MTBE, ETBE, isooctane and toluene. Lead in the form of tetraethyllead was once a common additive, but its use for fuels for road vehicles has been progressively phased-out worldwide, beginning in the 1970s.^[4]

Measurement methods

Research Octane Number (RON)

The most common type of octane rating worldwide is the **Research Octane Number (RON)**. RON is determined by running the fuel in a test <u>engine</u> with a variable <u>compression ratio</u> under controlled conditions, and comparing the results with those for mixtures of iso-octane and n-heptane. The Compression ratio is varied during the test in order to challenge the fuel's antiknocking tendency as an increase in the compression ratio will increase the chances of knocking.

Motor Octane Number (MON)

Another type of octane rating, called **Motor Octane Number** (**MON**), is determined at 900 rpm engine speed instead of the 600 rpm for RON.^[1] MON testing uses a



A US gas station pump offering five different (R+M)/2 octane ratings

similar test engine to that used in RON testing, but with a preheated fuel mixture, higher engine speed, and variable <u>ignition timing</u> to further stress the fuel's knock resistance. Depending on the composition of the fuel, the MON of a modern pump gasoline will be about 8 to 12 octane lower than the RON, but there is no direct link between RON and MON. Pump gasoline specifications typically require both a minimum RON and a minimum MON.

Anti-Knock Index (AKI) or (R+M)/2

In most countries in Europe (also in Australia, Pakistan and New Zealand) the "headline" octane rating shown on the pump is the RON, but in Canada, the United States, Brazil, and some other countries, the headline number is the simple mean or average of the RON and the MON, called the **Anti-Knock Index** (**AKI**), and often written on pumps as (**R**+**M**)/2.

Difference between RON, MON, and AKI

Because of the 8 to 12 octane number difference between RON and MON noted above, the AKI shown in Canada and the United States is 4 to 6 octane numbers lower than elsewhere in the world for the same fuel. This difference between RON and MON is known as the fuel's Sensitivity,^[5] and is not typically published for those countries that use the Anti-Knock Index labelling system.

See the table in the following section for a comparison.

Observed Road Octane Number (RdON)

Another type of octane rating, called **Observed Road Octane Number** (**RdON**), is derived from testing gasolines in real world multi-cylinder engines, normally at wide open throttle. It was developed in the 1920s and is still reliable today. The original testing was done in cars on the road but as technology developed the testing was moved to chassis dynamometers with environmental controls to improve consistency.^[6]

Octane Index

The evaluation of the octane number by the two laboratory methods requires a standard engine, and the test procedure can be both expensive and time-consuming. The standard engine required for the test may not always be available, especially in out-of-the-way places or in small or mobile laboratories. These and other considerations led to the search for a rapid method for the evaluation of the anti-knock quality of gasoline. Such methods include FTIR, near infrared on-line analyzers and others. Deriving an equation that can be used for calculating the octane quality would also serve the same purpose with added advantages. The term Octane Index is often used to refer to the calculated octane quality in contradistinction to the (measured) research or motor octane numbers. The octane index can be of great service in the blending of gasoline. Motor gasoline, as marketed, is usually a blend of several types of refinery grades that are derived from different processes such as straight-run gasoline, reformate, cracked gasoline etc. These different grades are considered as one group when blending to meet final product specifications. Most refiners produce and market more than one grade of motor gasoline, differing principally in their anti-knock quality. The ability to predict the octane quality of the blends prior to blending is essential, something for which the calculated octane index is specially suited.^[7]

Aviation gasoline octane ratings

Aviation gasolines used in piston aircraft engines common in general aviation have a slightly different method of measuring the octane of the fuel. Similar to an AKI, it has two different ratings, although it is referred to only by the lower of the two. One is referred to as the "aviation lean" rating and is the same as the MON of the fuel up to 100.^[8] The second is the "aviation rich" rating and corresponds to the octane rating of a test engine under forced induction operation common in high-performance and military piston aircraft. This utilizes a supercharger, and uses a significantly richer fuel/air ratio for improved detonation resistance.^[5]

The most commonly used current fuel, <u>100LL</u>, has an aviation lean rating of 100 octane, and an aviation rich rating of 130.^[9]

Examples

The RON/MON values of n-heptane and iso-octane are exactly 0 and 100, respectively, by the definition of octane rating. The following table lists octane ratings for various other fuels.^{[10][11]}

Fuel	RON	MON	AKI or (R+M)/2
hexadecane	< -30		
<i>n</i> -octane	-20	-17	-18.5
<i>n</i> -heptane (RON and MON 0 by definition)	0	0	0
diesel fuel	15–25		
2-methylheptane	23	23.8	23
<i>n</i> -hexane	25	26.0	26
1-pentene	34		
2-methylhexane	44	46.4	45.2
3-methylhexane		55.0	
1-heptene	60		
<i>n</i> -pentane	62	61.9	62
requirement for a typical two-stroke outboard motor ^[12]	69	65	67
Pertamina "Premium" in Indonesia	88	78	83
Pertamina "Pertalite" in Indonesia	90		
"Plus 91" (Regular) in <u>Costa Rica</u>	91		
"Súper" (Premium) in <u>Costa Rica</u>	95		
"Regular gasoline" in Japan (Japanese Industrial Standards)	90		
<i>n</i> -butanol	92	71	83
Neopentane (dimethylpropane)		80.2	
<i>n</i> -butane	94 ^[13]	90.1	92
Isopentane (methylbutane)		90.3	
"Regular Gasoline/Petroleum" in <u>Australia, New Zealand</u> , Canada and the United States	91-92	82-83	87
Pertamina "Pertamax" in Indonesia	92	82	87
"Shell Super" in Indonesia, "Total Performance 92" in Indonesia	92		
2,2-dimethylbutane		93.4	
2,3-dimethylbutane		94.4	
"Mid-Grade Gasoline" in the United States	94-95	84-85	89-90
"YPF Super" in Argentina	95	84	90
"Super/Premium" in New Zealand and Australia	95	85	90
"Aral Super 95" in Germany, "Aral Super 95 E10" (10% Ethanol) in Germany	95	85	90
"Shell V-Power" in Indonesia, "Total Performance 95" in Indonesia, "Shell FuelSave " in Malaysia	95		
"EuroSuper" or "EuroPremium" or "Regular unleaded" in Europe, "SP95" in France, "Super 95" in Belgium	95	85-86	90-91
"Premium" or "Super unleaded" gasoline in US (10% ethanol blend)	97	87-88	92-93
"Shell V-Power 97" in Malaysia and Chile	97		

Fuel	RON	MON	AKI or (R+M)/2
"Premium Gasoline" in the United States	96-98	86-88	91-93
"IES 98 Plus" in <u>Italy</u> , "Aral SuperPlus 98" in <u>Germany</u> , Pertamina "Pertamax Turbo" in <u>Indonesia</u>	98		
"YPF Infinia" in Argentina	98	87	93
"Corriente (Regular)" in Colombia	91.5 ^[14]	70	81 ^[15]
"Extra (Super/Plus)" in <u>Colombia</u>	95 ^[16]	79	87 ^[17]
"SuperPlus" in Germany	98	88	93
"Shell V-Power 98", "Caltex Platinum 98 with Techron", "Esso Mobil Synergy 8000" and "SPC LEVO 98" in <u>Singapore</u> , "BP Ultimate 98/Mobil Synergy 8000" in <u>New</u> Zealand, "SP98" in <u>France</u> , "Super 98" in <u>Belgium</u> , Great Britain, Slovenia and Spain	98	89-90	93-94
"Shell V-Power Nitro+ 99" "Tesco Momentum 99" In the United Kingdom	99	87	93
Pertamina "Pertamina Racing Fuel" (bioethanol blend) in Indonesia	100	86	93
"Premium" gasoline in Japan (Japanese Industrial Standards), "IP Plus 100" in Italy, "Tamoil WR 100" in Italy, "Shell V-Power Racing" in Australia - discontinued July 2008 ^[18]	100		
"Shell V-Power" in Italy and Germany	100	88	94
"Eni(or Agip) Blu Super +(or Tech)" in Italy	100	87	94
"isooctane" (RON and MON 100 by definition)	100	100	100
" Petron Blaze 100 Euro 4M " in Philippines and Malaysia	100		
"San Marco Petroli F-101" in Italy (northern Italy only, just a few gas stations)	101		
benzene	101		
2,5-Dimethylfuran	101.3 ^[19]	88.1 ^[19]	94.7 ^[19]
Petro-Canada "Ultra 94" in Canada ^[20]	101.5	88	94
Aral Ultimate 102 in Germany	102	88	95
Gulf Endurance 102 Racing Fuel (sold only at Silverstone Circuit in the United Kingdom)	102	93-94	97-98
ExxonMobil Avgas 100 ^[21]		99.5 (min)	
Petrobras Podium in Brazil ^[22]	102	88	97
E85 gasoline	102-105	85-87	94-96 ^[23]
<i>i</i> -butane	102 ^[13]	97.6	100
"BP Ultimate 102" - now discontinued ^[24]	102	93-94	97-98
<i>t</i> -butanol	103	91	97
2,3,3-trimethylpentane	106.1 ^[25]	99.4 ^[25]	103
ethane	108		
ethanol	108.6 ^[26]	89.7 ^[26]	99.15
methanol	108.7 ^[26]	88.6 ^[26]	98.65

Fuel	RON	MON	AKI or (R+M)/2
2,2,3-trimethylpentane	109.6 ^[25]	99.9 ^[25]	105
propane	112	97	105
2,2,3-trimethylbutane	112.1 ^[25]	101.3 ^[25]	106
xylene	118	115	116.5
isopropanol	118	98	108
1-propanol	118 ^[27]	98	108 ^[27]
toluene	121	107	114
VP C16 Race Fuel ^[28]	117	118	117.5
methane	120	120	120
ethylbenzene ^[29]	112	99	106
isopropylbenzene (cumene) ^[29]	112	102	107
hydrogen	> 130		

Effects

Higher octane ratings correlate to higher <u>activation energies</u>: the amount of applied energy required to initiate combustion. Since higher octane fuels have higher activation energy requirements, it is less likely that a given compression will cause uncontrolled ignition, otherwise known as autoignition or detonation.

Because octane is a measured and/or calculated rating of the fuel's ability to resist autoignition, the higher the octane of the fuel, the harder that fuel is to ignite and the more heat is required to ignite it. The result is that a hotter ignition spark is required for ignition. Creating a hotter spark requires more energy from the ignition system, which in turn increases the parasitic electrical load on the engine. The spark also must begin earlier in order to generate sufficient heat at the proper time for precise ignition. As octane, ignition spark energy, and the need for precise timing increase, the engine becomes more difficult to "tune" and keep "in tune". The resulting sub-optimal spark energy and timing can cause major engine problems, from a simple "miss" to uncontrolled detonation and catastrophic engine failure.

The other rarely-discussed reality with high-octane fuels associated with "high performance" is that as octane increases, the <u>specific gravity</u> and energy content of the fuel per unit of weight are reduced. The net result is that to make a given amount of power, more high-octane fuel must be burned in the engine. Lighter and "thinner" fuel also has a lower <u>specific heat</u>, so the practice of running an engine "rich" to use excess fuel to aid in cooling requires richer and richer mixtures as octane increases.

Higher-octane, lower-energy-dense "thinner" fuels often contain <u>alcohol</u> compounds incompatible with the stock fuel system components, which also makes them <u>hygroscopic</u>. They also evaporate away much more easily than heavier, lower-octane fuel which leads to more accumulated contaminants in the fuel system. Its typically the <u>hydrochloric acids that form due to that water</u> and the compounds in the fuel that have the most detrimental effects on the engine fuel system components, as such acids corrode many metals used in gasoline fuel systems.

4/11/2020

Octane rating - Wikipedia

During the compression stroke of an internal combustion engine, the temperature of the air-fuel mix rises as it is compressed, in accordance with the <u>ideal gas law</u>. Higher compression ratios necessarily add parasitic load to the engine, and are only necessary if the engine is being specifically designed to run on high-octane fuel. Aircraft engines run at relatively low speeds and are "<u>undersquare</u>". They run best on lower-octane, slower-burning fuels that require less heat and a lower compression ratio for optimum vaporization and uniform fuel-air mixing, with the ignition spark coming as late as possible in order to extend the production of cylinder pressure and torque as far down the power stroke as possible. The main reason for using high-octane fuel in air-cooled engines is that it is more easily vaporized in a cold carburetor and engine and absorbs less intake air heat which greatly reduces the tendency for <u>carburetor</u> icing to occur.

With their reduced densities and weight per volume of fuel, the other obvious benefit is that an aircraft with any given volume of fuel in the tanks is automatically lighter. And since many airplanes are flown only occasionally and may sit unused for weeks or months, the lighter fuels tend to evaporate away and leave behind fewer deposits such as "varnish". Aircraft also typically have dual "redundant" ignition systems which are nearly impossible to tune and time to produce identical ignition timing so using a lighter fuel that's less prone to autoignition is a wise "insurance policy". For the same reasons, those lighter fuels which are better solvents are much less likely to cause any "varnish" or other fouling on the "backup" spark plugs.

Because of the high cost of unleaded, high-octane <u>avgas</u>, and possible increased range before refueling, some general aviation pilots attempt to save money by tuning their fuel-air mixtures and ignition timing to run "lean of peak". Additionally, the decreased air density at higher altitudes (such as Colorado) and temperatures (as in summer) requires leaning (reduction in amount of fuel per volume or mass of air) for the most power (crucial for takeoff). In almost all general aviation piston engines, the fuel mixture is directly controlled by the pilot, via a knob and cable or lever similar to (and next to) the <u>throttle</u> control. Leaning must be done carefully, as some combinations of fuel mixture and throttle position (that produce the highest <u>EGT</u>) can cause detonation and/or pre-ignition, in the worst case destroying the engine within seconds. Pilots are taught in primary training to avoid settings that produce the highest exhaust gas temperatures, and run the engine either "rich of peak" (more fuel than can be burned with the available air) or "lean of peak" (less fuel, leaving some oxygen in the exhaust) as either will keep the fuel-air mixture from detonating prematurely.

Regional variations

The selection of octane ratings available at the pump can vary greatly from region to region.

- Australia: "regular" <u>unleaded</u> fuel is 91 RON, "premium" unleaded with 95 RON is widely available, and 98 RON fuel is also reasonably common. Shell used to sell 100 RON fuel (5% ethanol content) from a small number of service stations, most of which are located in major cities (stopped in August 2008). United Petroleum used to sell 100 RON unleaded fuel (10% ethanol content) at a small number of its service stations (originally only two, but then expanded to 67 outlets nationwide) (stopped in September 2014).^{[30][31]} All fuel in Australia is unleaded except for some aviation fuels. E85 unleaded fuel is also available at several United service stations across the country.^[32] Recently E10 fuel has become quite common,^[33] and is available at almost every major fuel station. The Australian government makes stations advertise E10 as 94 RON.^[33]
- Bahrain: 91 and 95 (RON), standard in all gasoline stations in the country and advertised as (Jayyid) for Regular or 91 and (Mumtaz) for Premium or 95 and 98 (RON) as super.
- Bangladesh: Two types of fuel are available at petrol stations in Bangladesh. Motor Gasoline Regular (marketed as "Petrol") which has RON 80 rating, and Motor Gasoline Premium (marketed as "Octane") which has RON 95 rating.^[34] Petrol stations in Bangladesh are privatised, but the prices

are regulated by the authorities and have a fixed price at BDT 86.00 (USD 1.04) and BDT 89.00 (USD 1.07) (as of 1 March 2018) per litre respectively.^[35]

- Brazil: As defined by federal law, the AKI standard is used and all types of gasoline sold in all gas stations throughout the country are unleaded (the latter since 1991). By default, it was defined by the federal government that the regular (and the lowest) octane standard in Brazil is 87 AKI, known in Portuguese as Gasolina Comum (English: "Common Gasoline") - Petrobras stations brand it as Gasolina Regular (English: "Regular Gasoline").^[22] This type of gasoline can be found in most Brazilian petrol stations and does not have any additives, except the inclusion of 25% of ethanol (as required by the Brazilian National Agency of Petroleum, Natural Gas and Biofuels - Portuguese: Agência Nacional do Petróleo, Gás Natural e Biocombustíveis or simply ANP - since 2011).^[36] Along with the "Common" gasoline, there is a second type of gasoline that can also be found in most stations in Brazil. This gasoline is also mixed with 25% of ethanol (to comply with the ANP regulation, that prohibits the sale of the 100% "pure gasoline" compound in all Brazilian stations).^[36] but a few detergent and dispersant additives are also included in the compound. This type of gasoline is known in Portuguese as Gasolina Aditivada (English: "Additived Gasoline") - Petrobras stations brand it as "Petrobras Grid";^[22] nevertheless, the octane rating is also 87 AKI (these additives are used to improve the performance and efficiency of the engine, but they are not indicative of a higher octane rating). However, higher octane levels of gasoline are found in many stations (all stations in Brazil, regardless of the octane rating, have to conform the ANP requirement of 25% of ethanol mixed with the gasoline, ^[36] and both "Common" and "Additived" gasolines can also be found in most of these stations), such as the "Premium Gasoline"^[22] (known in Portuguese as Gasolina Premium - 91 AKI), the "OctaPro" (96 AKI), sold at Ipiranga stations, and the "Petrobras Podium"^[22] (97 AKI), sold at Petrobras stations.
- China: 92 and 95 (RON) (previously 93 and 97^[37]) are commonly offered. In limited areas higher rating such as 98 RON is available. In some rural areas it can be difficult to find fuel with over 92 RON.
- Chile: 93, 95 and 97 RON are standard at almost all gas stations thorough Chile. The three types are unleaded.
- Colombia: "Ecopetrol", Colombia's monopoly of refining and distribution of gasoline establishes a minimum AKI of 81 octanes for "Corriente" gasoline^[15] and minimum AKI of 87 octanes for "Extra" gasoline.^[17] (91.5 RON corriente,^[14] and 91 RON for extra^[16])
- Costa Rica: RECOPE, Costa Rica's distribution monopoly, establishes the following ratings: Plus 91 (at least 91 RON) and Super (at least 95 RON).^[38]
- Croatia: All fuel stations offer unleaded "Eurosuper BS" (abbreviation "BS" meaning "no sulfur content") 95 RON fuel, many also offer "Eurosuper Plus BS" 98 RON.^{[39][40]} Some companies offer 100 RON fuel instead of 98.^[41]
- Cyprus: All fuel stations offer unleaded 95 and 98 RON and a few offer 100 RON as well.
- Denmark: 95 RON is a common choice, with 92 and 95 being widely available. However several fuel stations are phasing out 92 RON. By law, it is decided that all gasoline companies from July 2010 should use a mix containing 5% bioethanol in the gasoline.
- Ecuador: "Extra" with 87 and "Super" with 92 (RON) are available in all fuel stations. "Extra" is the most commonly used. All fuels are unleaded.^[42]
- Egypt: Egyptian fuel stations had 90 RON until July 2014 when the government found no remaining use for it, leaving only 92 RON and 95 RON. 80 RON is found in a very limited amount of fuel stations as they are used only for extremely old cars that cannot cope with high octane fuel. 95 RON was used limitedly due to its high price (more than twice the price of 92 RON).^[43] But after the increasing the prices again in 2018,^[44] 95 RON price became only 15% higher than 92 RON, so it started to gain popularity.
- Estonia: 95 RON and 98 RON are widely available.

- Finland: 95 and 98 (RON), advertised as such, at almost all gas stations. Most cars run on 95, but 98 is available for vehicles that need higher octane fuel, or older models containing parts easily damaged by high ethanol content. Shell offers V-Power, advertised as "over 99 octane", instead of 98. In the beginning of 2011 95 RON was replaced by 95E10 containing 10% ethanol, and 98 RON by 98E5, containing 5% ethanol. ST1 also offers RE85 on some stations, which is 85% ethanol made from biodegradable waste (from which the advertised name "ReFuel" comes). RE85 is only suitable for flexifuel cars that can run on high-percentage ethanol.^[45]
- Germany: "Super E10" 95 RON and "Super Plus E5" 98 RON are available practically everywhere. Big suppliers such as <u>Shell</u> or <u>Aral</u> offer 100 RON gasoline (<u>Shell V-Power</u>, Aral Ultimate) at almost every fuel station. "Normal" 91 RON is only rarely offered because lower production amounts make it more expensive than "Super" 95 RON. Due to a new European Union law, gas stations are being required to offer a minimum rate of the new mixture of "Super" 95 RON with up to 10% Ethanol branded as "Super E10". Producers are discontinuing "Super E5" 95 RON with <5% Ethanol so cars that are unable to use E10 must use 98 RON gasoline automotive fuel instead.
- Greece (Hellas): 95 RON (standard unleaded), 97+ & 100 RON unleaded offered by some companies (e.g. EKO, Shell, BP). Also available Super LRP 96 RON for older (non-catalytic) vehicles.
- Hong Kong: only 98 RON is available in the market. There have been calls to re-introduce 95 RON, but the calls have been rejected by all automotive fuel station chains, citing that 95 RON was phased out because of market forces.
- India: India's ordinary and premium petrol options are of 91 RON. The premium petrols are generally ordinary fuels with additives, that do not really change the octane value. Two variants, "Speed 93" and "Speed 97", were launched, with RON values of 93 and 97. Recently, Hindustan Petroleum launched poWer 99 with an RON value of 99 which is currently available only in Bangalore, Pune and now in Mumbai but expected to roll out in other major cities soon.^[46] India's economy-class vehicles usually have compression ratios under 10:1, thus enabling them to use lower-octane petrol without engine knocking.
- Indonesia: Indonesia's "Premium" gasoline rated at 88 RON. Other options are "Pertalite", rated at 90 RON, "Pertamax", rated at 92 RON and the "Pertamax Plus" rated at 95 RON, and "Pertamax Racing", a 100 RON fuel sold in few stations. Starting from August 2016 Pertamina has started selling a new fuel variant rated at 98 RON marketed by the name of Pertamax Turbo, serving as a replacement for Pertamax Plus. Total and Shell stations only sell RON 92 and 95 gasoline. However, in early 2018, Shell launched a new variant "Regular", rated at 90 RON and currently sold at certain locations. Petronas has decided to shut down its retail business in Indonesia in 2012, after years of sluggish sales.
- Iran: 87 RON (marketed as regular) and 95 RON (marketed as Super) are widely available in gas stations. Due to high air polution, a higher quality gas marketed as Euro-4 is introduced in some major cities with an octane rating of 91 RON and sulphur levels not exceeding 50 ppm.
- Ireland: 95 RON "unleaded" is the only gasoline type available through stations, although E5 (99 RON) is becoming more commonplace.
- Italy: 95 RON is the only compulsory gasoline offered (*verde*, "green"), only a few fuel stations (Agip, IP, IES, OMV) offer 98 RON as the premium type, many Shell and Tamoil stations close to the cities offer also V-Power Gasoline rated at 100 RON. Recently Agip introduced "Blu Super+", a 100 RON gasoline.
- Israel: 95 RON & 98 RON are normally available at most automotive fuel stations. 96 RON is also available at a large number of gas stations but 95 RON is more preferred because it's cheaper and performance differences aren't very wide and noticeable. "Regular" fuel is 95 RON. All variants are unleaded.
- Japan: Since 1986, "regular" is >=89 RON, and "high octane" is >=96 RON, lead free. Those values are defined in standard JIS K 2202. Sometimes "high octane" is sold under different names, such as "F-1".

- Latvia: 95 RON and 98 RON widely available.
- Lebanon: 95 RON and 98 RON are widely available.
- Lithuania: 95 RON and 98 RON widely available. In some gas stations E85 (bioethanol) gasoline, 98E15 (15% of ethanol), 98E25 (25% of ethanol) are available.
- Malaysia: 95 RON, 97 RON and 100 RON. "Regular" unleaded fuel is 95 RON; "Premium" fuel is rated at 97 RON (Shell's V-Power Racing is rated minimum 97 RON). Petron sells 100 RON in selected outlets.^[47]
- Mexico: The standard octane index is 87 AKI for "regular" fuel and 92 AKI for "high octane" fuel. From 1938 to 2018, the Mexican government held a monopoly in the distribution of fuel, and its brands for unleaded fuel were "Pemex Magna" and "Pemex Premium". Mexican regulations do not enforce any particular labels to identify different grades of fuel as long as each grade is clearly labeled with distinct names and colors,^[48] but the long history of Pemex's colors has established a tradition of labeling "regular" fuel with green, "high octane" fuel with red, and diesel with black. Gas station brands that use different colors include <u>Royal Dutch Shell</u>, <u>KPetrom</u> and Akron.
- Mongolia: 92 RON and 95 RON (advertised as A92 and A95 respectively) are available at nearly all stations while slightly fewer stations offer 80 RON (advertised as A80). 98 RON (advertised as A98) is available in select few stations.
- Montenegro: 95 RON is sold as a "regular" fuel. As a "premium" fuel, 98 RON is sold. Both variants are unleaded.
- Myanmar: Most petrol stations carry 92 RON as standard especially in rural areas. Most larger cities and highway stations have introduced 95 RON in the past few years. The highest grade available is 97 RON which is only sold by a few stations in Yangon and Nay Pyi Taw (e.g., PTT, MMTM, Petrotrans).
- Netherlands: 95 RON "Euro" is sold at every station, whereas 98 RON "Super Plus" is being phased out in favor of "premium" fuels, which are all 95 RON fuels with extra additives. Shell V-Power is a 97 RON (labelled as 95 due to the legalities of only using 95 or 98 labelling), some independent tests have shown that one year after introduction it was downgraded to 95 RON, whereas in neighboring Germany Shell V-Power consists of the regular 100 RON fuel.
- New Zealand: 91 RON "Regular" and 95 RON "Premium" are both widely available. 98 RON is available instead of 95 RON at some (BP, Mobil, Gull) service stations in larger urban areas (newer BP stations also offer 95 by blending 91 and 98 where 98 is available). 100 RON is available at selected NPD service stations in the South Island and in very limited locations in the North Island.^[49]
- Norway: 95 RON are widely available, but 98 RON is also available at Shell; it is 10-20% more expensive as 95 RON fuel. <u>Statoil</u> has discontinued production and sale due to low demand.^[50]
- Pakistan: 3 types of fuel available. 92, HOBC 95 & HOBC 97 RON. Super marketed as 92 RON, 95 RON marketed by Shell as V-Power and 97 RON by Total Parco Pakistan & Pakistan State Oil (PSO). Due to proximity to Iran, low quality of fuel is often mixed by pump owners with Super & HOBC products in southern regions of Pakistan. It is openly available throughout the province of Balochistan as it is 30-40% cheaper than govt. issued pricing for Super. HOBC pricing was deregulated in October, 2016.
- Philippines: A brand of Petron, Petron Blaze is rated at 100 RON (the only brand of gasoline in the Philippines without an <u>ethanol</u> blend). Other "super premium" brands like Petron XCS, Caltex Gold, Shell V-Power are rated at 95-97 RON, while Petron Xtra Unleaded, Caltex Silver, and Shell Super Unleaded are rated at 93 RON.
- Poland: Eurosuper 95 (RON 95) is sold in every gas station. Super Plus 98 (RON 98) is available in most stations, sometimes under brand (Orlen - Verva, BP - Ultimate, Shell - V-Power) and usually containing additives. Shell offers V-Power Racing fuel which is rated RON 100.
- Portugal: 95 RON "Euro" is sold in every station and 98 RON "Super" being offered in almost every station.

- Russia and <u>CIS</u> countries: 92 RON is the minimum available, the standard is 95 RON is sold in every gas station. 98 RON is available in most stations. As a "premium" fuel, 100 RON is sold, Gazpromneft and Lukoil both variants are unleaded.
- Saudi Arabia: Two types of fuel are available at all petrol stations in Saudi Arabia. "Premium 91" (RON 91) where the pumps and liquid (look <u>fuel dyes</u>) are coloured green, and "Super Premium 95" (RON 95) where the pumps and liquid are coloured red. While petrol stations in Saudi Arabia are privatised, the prices are regulated by the authorities and have a fixed at <u>SR</u> 1.44 (USD 0.38) and SR 2.10 (USD 0.56) (as of 14 April 2019) per litre respectively; and is currently being increased at a quarterly rate to bring it up to the worldwide average by 2020. Prior to 2006, only Super Premium RON 95 was available and the pumps weren't coloured in any specific order. The public didn't know what Octane rating was, therefore big educating campaigns were spread, telling the people to use the "red petrol" only for high end cars, and save money on using the "green petrol" for regular cars and trucks.
- Singapore: All four providers, <u>Caltex</u>, <u>ExxonMobil</u>, <u>SPC</u> and <u>Shell</u> have 3 grades of gasoline. Typically, these are 92, 95, and 98 RON. However, since 2009, <u>Shell</u> has removed 92 RON.
- South Africa: "regular" unleaded fuel is 95 RON in coastal areas. Inland (higher elevation) "regular" unleaded fuel is 93 RON; once again most fuel stations optionally offer 95 RON.
- South Korea: "regular" unleaded fuel is 91~94 RON, "premium" is 95+ RON nationally. However, not all gas stations carry "premium."
- Spain: 95 RON "Euro" is sold in every station with 98 RON "Super" being offered in most stations. Many stations around cities and highways offer other high-octane "premium" brands.
- Sri Lanka: In Ceypetco filling stations, 92 RON is the regular automotive fuel and 95 RON is called 'Super Petrol',^[51] which comes at a premium price. In LIOC filling stations, 90 RON remains as regular automotive fuel and 92 RON is available as 'Premium Petrol'. The cost of premium gasoline is lower than the cost of super gasoline. (Sri Lanka switched their regular gasoline from 90 RON to 92 RON on January 1, 2014)
- Sweden: 95 RON, 98 RON and E85 are widely available.
- Taiwan: 92 RON, 95 RON and 98 RON are widely available at gas stations in Taiwan.
- Thailand: 91 RON and 95 RON are widely available. 91 RON automotive fuel withdrawn on January 1, 2013 to increase uptake of gasohol fuels.
- Trinidad and Tobago: 92 RON (Super) and 95 RON (Premium) are widely available.
- Turkey: 95 RON and 95+ RON widely available in gas stations. 91 RON (Regular) has been dropped in 2006. 98 and 100 RON (Shell V-Power Racing) has been dropped in late 2009. The Gas which has been advertised 97 RON has been dropped in 2014 and renamed 95+.
- Ukraine: 80 RON and 98 RON gasoline is available. The standard gasoline is 95 RON, but 92 RON gasoline is also widely available and popular for older cars. There is no government regulation for gasoline with RON higher than 98 so some stations are marketing 100 RON gasoline when in reality this can be anything above 98 RON with extra cleaning additives.
- United Kingdom: 'regular' gasoline has an octane rating of 95 RON, with 97 RON fuel being widely available as the Super Unleaded. Tesco and Shell both offer 99 RON fuel. In April 2006, BP started a public trial of the super-high octane gasoline BP Ultimate Unleaded 102, which as the name suggests, has an octane rating of 102 RON.^[52] Although BP Ultimate Unleaded (with an octane rating of 97 RON) and BP Ultimate Diesel are both widely available throughout the UK, BP Ultimate Unleaded 102 was available throughout the UK in only 10 filling stations, and was priced at about two and half times more than their 97 RON fuel. In March 2010, BP stopped sales of Ultimate Unleaded 102, citing the closure of their specialty fuels manufacturing facility.^[24] Shell V-Power is also available, but in a 99 RON octane rating, and Tesco fuel stations also supply the Greenergy produced 99 RON "Momentum⁹⁹".
- United States: in the US octane rating is displayed in AKI. In most areas, the standard grades are 87, 89-90 and 91-94 AKI. In the Rocky Mountain (high elevation) states, 85 AKI (90 RON) is the

Octane rating - Wikipedia

minimum octane, and 91 AKI (95 RON) is the maximum octane available in fuel.^[53] The reason for this is that in higher-elevation areas, a typical <u>naturally aspirated engine</u> draws in less air mass per cycle because of the reduced density of the atmosphere. This directly translates to less fuel and reduced absolute compression in the cylinder, therefore deterring knock. It is safe to fill a carbureted car that normally takes 87 AKI fuel at sea level with 85 AKI fuel in the mountains, but at sea level the fuel may cause damage to the engine. However, since virtually all cars produced since the 1990s have fuel injection, 85 AKI fuel is not recommended for modern automobiles and may cause damage to the engine and decreased performance.^[54] Another disadvantage to this strategy is that most turbocharged vehicles are unable to produce full power, even when using the "premium" 91 AKI fuel. In some east coast states, up to 94 AKI (98 RON) is available.^[55] As of January 2011, over 40 states and a total of over 2500 stations offer <u>ethanol</u>-based <u>E-85</u> fuel with 94-96 AKI.^[56] Often, filling stations near US racing tracks will offer higher octane levels such as 100 AKI.

- State standard gasoline grades: U.S. State Fuel Octane Standards
- Venezuela: 91 RON and 95 RON gasoline is available nationwide, in all PDV gas stations. 95 RON gasoline is the most widely used in the country, although most cars in Venezuela would work with 91 RON gasoline. This is because gasoline prices are heavily subsidized by the government (0.\$083 per gallon 95 RON, vs 0.\$061 per gallon 91 RON). All gasoline in Venezuela is unleaded.
- Vietnam: 92 is in every gas station and 95 is in the urban area. They start selling A92-E5 gasoline (A92 with 5 percent of Ethanol) at 2017. On January 1, 2018, Vietnamese government forced every gas station stop selling 92 and sell 95 + A92-E5 instead.
- Zimbabwe: 93 octane available with no other grades of fuels available, E10 which is an ethanol blend of fuel at 10% ethanol is available the octane rating however is still to be tested and confirmed but it is assumed that its around 95 Octane. E85 available from 3 outlets with an octane rating AKI index of between 102-105 depending on the base gasoline the ethanol is blended with.

See also

- Avgas
- Cetane number

References

- Werner Dabelstein, Arno Reglitzky, Andrea Schütze and Klaus Reders "Automotive Fuels" in Ullmann's Encyclopedia of Industrial Chemistry 2007, Wiley-VCH, Weinheim.<u>doi</u>:10.1002/14356007.a16_719.pub2 (https://doi.org/10.1002%2F14356007.a16_719.pub 2)
- Kemp, Kenneth W.; Brown, Theodore; Nelson, John D. (2003). <u>Chemistry: the central science (http</u> <u>s://archive.org/details/studentlectureno00theo)</u>. Englewood Cliffs, N.J: Prentice Hall. p. 992. <u>ISBN 0-</u> 13-066997-0.
- Harwood, Richard; Coates, Christopher; Talbot, Christopher (2015-07-31). <u>Chemistry for the IB</u> Diploma Second Edition (https://books.google.com/?id=ygVsCgAAQBAJ&pg=PT853&dq=Octane+ra tings+are+not+indicators+of+the+energy+content+of+fuels.#v=onepage&q=Octane%20ratings%20a re%20not%20indicators%20of%20the%20energy%20content%20of%20fuels.&f=false). Hodder Education. ISBN 9781471829222.
- "Leaded Gas Phaseout" (https://web.archive.org/web/20080603152013/http://yosemite.epa.gov/R10/ airpage.nsf/webpage/Leaded%2BGas%2BPhaseout). U.S. EPA, Region 10. June 1995. Archived from the original (http://yosemite.epa.gov/R10/airpage.nsf/webpage/Leaded+Gas+Phaseout) on 2008-06-03. Retrieved 2012-06-15.

- "Octane determination in Piston Engines" (http://www.vintagebonanza.com/octane.htm). vintagebonanza.com. Archived (https://web.archive.org/web/20131029190552/http://www.vintagebon anza.com/octane.htm) from the original on 2013-10-29.
- "Octane Explanation" (http://www.runyard.org/jr/CFR/OctaneExplanation.htm). runyard.org. Archived (https://web.archive.org/web/20110727224512/http://www.runyard.org/jr/CFR/OctaneExplanation.ht m) from the original on 2011-07-27.
- 7. H. Al-Haj Ibrahim and M. Al-Kassmi, Determination of calculated octane index for motor gasoline, The Arabian Journal for science and engineering, vol. 25, No. 2B, Oct. 2000, pp. 179-186.
- 8. "Replacing Leaded Aviation Gasoline" (http://www.txideafarm.com/unpublished_blend_paper.pdf) (PDF). *Txideafarm.com*. Archived (https://web.archive.org/web/20160304211600/http://www.txideafar m.com/unpublished_blend_paper.pdf) (PDF) from the original on 2016-03-04. Retrieved 2017-01-06.
- 9. "Standard Specification for Aviation Gasolines" (https://web.archive.org/web/20160415123705/http:// www.aviation-fuel.com/pdfs/avgas100llspecsastmd910_2011.pdf) (PDF). *Aviation-fuel.com*. Archived from the original (http://www.aviation-fuel.com/pdfs/avgas100llspecsastmd910_2011.pdf) (PDF) on 2016-04-15. Retrieved 2017-01-06.
- 10. "Archived copy" (https://web.archive.org/web/20090425075157/http://chemed.chem.purdue.edu/gen chem/topicreview/bp/1organic/coal.html). Archived from the original (http://chemed.chem.purdue.ed u/genchem/topicreview/bp/1organic/coal.html) on 2009-04-25. Retrieved 2009-03-28.
- Balaban, Alexandru T. (1983). "Topological Indices based on Topological Distances in Molecular Graphs" (http://www.iupac.org/publications/pac/1983/pdf/5502x0199.pdf) (PDF). Pure and Applied Chemistry. IUPAC. 55 (2): 199–206. doi:10.1351/pac198855020199 (https://doi.org/10.1351%2Fpac 198855020199). Archived (https://web.archive.org/web/20170830045002/https://www.iupac.org/publi cations/pac/1983/pdf/5502x0199.pdf) (PDF) from the original on 2017-08-30.
- 12. Johnson Operation and Maintenance Manual, 1999
- Henig, Y. "SciTech Connect: Autoignition of n-butane/isobutane blends in a knock research engine". Osti.gov. OSTI 5509255 (https://www.osti.gov/biblio/5509255).
- "Ecopetrol Energía para el Futuro" (http://www.ecopetrol.com.co/contenido.aspx?catID=129&conID =36288&pagID=127462). ecopetrol.com.co. Archived (https://web.archive.org/web/2012061909325 1/http://ecopetrol.com.co/contenido.aspx?catID=129&conID=36288&pagID=127462) from the original on 2012-06-19.
- 15. "Ecopetrol Energía para el Futuro" (http://www.ecopetrol.com.co/contenido.aspx?catID=216&conID =37366). ecopetrol.com.co.
- "Ecopetrol Energía para el Futuro" (http://www.ecopetrol.com.co/contenido.aspx?catID=129&conID =36288&pagID=127463). ecopetrol.com.co. Archived (https://web.archive.org/web/2012061909331 4/http://ecopetrol.com.co/contenido.aspx?catID=129&conID=36288&pagID=127463) from the original on 2012-06-19.
- 17. "Ecopetrol Energía para el Futuro" (http://www.ecopetrol.com.co/contenido.aspx?catID=216&conID =37367). ecopetrol.com.co.
- Shell phases out V-Power Racing fuel (100 RON) (http://mrtperformance.com.au/about-us/news/1/43 7-shell-phases-out-v-power-racing-fuel-100-ron) Archived (https://web.archive.org/web/20110222165 241/http://mrtperformance.com.au/about-us/news/1/437-shell-phases-out-v-power-racing-fuel-100-ron n) 2011-02-22 at the Wayback Machine – MRT
- Daniel, Ritchie (2012). "Combustion performance of 2,5-dimethylfuran blends using dual-injection compared to direct-injection in an SI engine". *Applied Energy*. **98**: 59–68. doi:10.1016/j.apenergy.2012.02.073 (https://doi.org/10.1016%2Fj.apenergy.2012.02.073).
- "FAQs Questions, Answers, Gasoline Products Petro-Canada" (http://retail.petro-canada.ca/en/in dependent/2069.aspx). *Retail.petro-canada.ca*. Archived (https://web.archive.org/web/20151122172 811/http://retail.petro-canada.ca/en/independent/2069.aspx) from the original on 2015-11-22. Retrieved 2017-01-06.

- 21. "ExxonMobil Avgas" (http://www.exxonmobil.com/USA-English/GFM/PDS/GLXXENCMFEMAvgas.as p). Exxonmobil.com. Retrieved 2017-01-06.
- 22. http://www.petrobras.com.br/en/products-and-services/products/automotive/gasoline/
- "Archived copy" (http://webarchive.loc.gov/all/20120802001152/http://www.ethanolrfa.org/page/-/rfaassociation-site/ChangesinGasolineManualIV-UpdatedLogo.pdf) (PDF). Archived from the original (h ttp://www.ethanolrfa.org/page/-/rfa-association-site/ChangesinGasolineManualIV-UpdatedLogo.pdf) (PDF) on 2012-08-02. Retrieved 2011-08-27.
- 24. "Archived copy" (https://web.archive.org/web/20100724222831/http://www.bp.com/sectiongenericarti cle.do?categoryId=6621&contentId=7060376). Archived from the original (http://www.bp.com/section genericarticle.do?categoryId=6621&contentId=7060376) on 2010-07-24. Retrieved 2010-12-21.
- 25. A. T. Balaban, L. B. Kier, and N. Josh, MATCH (Commun. Math. Chem.) 28 (1992) 13–27.
- Eyidogan, Muharrem (2010). "Impact of alcohol–gasoline fuel blends on the performance and combustion characteristics of an SI engine". *Fuel.* 89 (10): 2713–2720. doi:10.1016/j.fuel.2010.01.032 (https://doi.org/10.1016%2Fj.fuel.2010.01.032).
- "Biofuels Types of Biofuels Bioalcohols" (http://biofuel.org.uk/bioalcohols.html). biofuel.org.uk. Archived (https://web.archive.org/web/20140416180242/http://biofuel.org.uk/bioalcohols.html) from the original on 2014-04-16.
- "All DragRace Fuel Available at VPFuel" (https://vpracingfuels.com/master-fuel-tables). *vpracingfuels.com*. Archived (https://web.archive.org/web/20200330043335/https://vpracingfuels.co m/master-fuel-tables/) from the original on 2020-03-31.
- James J. Spivey; K. M. Dooley (August 2007). <u>Catalysis (https://books.google.com/books?id=YhK14 mBmNgAC&pg=PA33)</u>. Royal Society of Chemistry. pp. 33–. ISBN 978-0-85404-244-9.
- "Archived copy" (https://web.archive.org/web/20100830065746/http://www.unitedpetroleum.com.au/i ndex.asp?pgID=65). Archived from the original (http://www.unitedpetroleum.com.au/index.asp?pgID =65) on 2010-08-30. Retrieved 2010-09-01.
- "Archived copy" (https://web.archive.org/web/20100902062128/http://www.unitedpetroleum.com.au/d istributor-premium100-locations.asp). Archived from the original (http://www.unitedpetroleum.com.au/ distributor-premium100-locations.asp) on 2010-09-02. Retrieved 2010-09-01.
- 32. "Ethanol 85" (http://www.unitedpetroleum.com.au/united/fuel/ethanol-85). Unitedpetroleum.com.au. Archived (https://web.archive.org/web/20161223102114/http://www.unitedpetroleum.com.au/united/f uel/ethanol-85) from the original on 2016-12-23. Retrieved 2017-01-06.
- Roberts, Natalie (2018-07-04). "Why E10 petrol may not be driving your car, or your dollar, further" (h ttps://www.abc.net.au/news/2018-07-04/e10-cheapest-petrol-fuel-emissions-biofuels-ethanol-australi a/9922938). ABC News. Retrieved 2019-07-26.
- 34. "Product Specification Petroleum" (http://pocl.gov.bd/?page_id=951). Padma Oil Company Limited. Retrieved 2018-03-06.
- 35. <u>"Petroleum Local Price" (http://www.bpc.gov.bd/contactus.php?id=39)</u>. *www.bpc.gov.bd*. Retrieved 2018-03-06.
- 36. "MEDIDA PROVISÓRIA nº 532, de 2011" (http://www.senado.gov.br/atividade/materia/detalhes.asp? p_cod_mate=100053). senado.gov.br. Archived (https://web.archive.org/web/20110919030421/http:// www.senado.gov.br/atividade/materia/detalhes.asp?p_cod_mate=100053) from the original on 19 September 2011.
- "China V gasoline and diesel fuel quality_standards" (http://www.theicct.org/sites/default/files/publicati ons/ICCTupdate_ChinaVfuelquality_jan2014.pdf) (PDF). International Council on Clean Transportation. Archived (https://web.archive.org/web/20150927064315/http://www.theicct.org/sites/ default/files/publications/ICCTupdate_ChinaVfuelquality_jan2014.pdf) (PDF) from the original on 27 September 2015. Retrieved 7 February 2016.

- "Manual de Productis" (https://www.recope.go.cr/wp-content/uploads/2013/07/Manual_Productos.pd f) (PDF). Recope.go.cr. 2011. Archived (https://web.archive.org/web/20170107010050/https://www.re cope.go.cr/wp-content/uploads/2013/07/Manual_Productos.pdf) (PDF) from the original on 2017-01-07. Retrieved 2017-01-06.
- 39. "INA d.d." (http://www.ina.hr/default.aspx?id=204) *ina.hr*. Archived (https://web.archive.org/web/2014 0222140334/http://www.ina.hr/default.aspx?id=204) from the original on 2014-02-22.
- 40. "Lukoil Hrvatska" (http://www.lukoil.hr). *lukoil.hr*. Archived (https://web.archive.org/web/20140218080 333/http://www.lukoil.hr/) from the original on 2014-02-18.
- 41. <u>"Crodux derivati" (https://web.archive.org/web/20140221074851/http://crodux-derivati.hr/cijene-gorival/</u> <u>a/)</u>. *crodux-derivati.hr*. Archived from <u>the original (http://www.crodux-derivati.hr/cijene-goriva/)</u> on 2014-02-21.
- 42. "Archived copy" (https://web.archive.org/web/20160304070707/http://www.arch.gob.ec/index.php/de scargas/leyes-y-reglamentos/doc_download/292-norma-inen-935-2012.html). Archived from the original (http://www.arch.gob.ec/index.php/descargas/leyes-y-reglamentos/doc_download/292-norma -inen-935-2012.html) on 2016-03-04. Retrieved 2012-06-21.
- 43. "الحكومة المصرية ترفع أسعار الوقود بنسبة تقترب من الضعف" (https://www.bbc.co.uk/arabic/middleeast/2014/07/140 704_egypt_fuel_prices). BBC Arabic. Archived (https://web.archive.org/web/20141201103611/http:// www.bbc.co.uk/arabic/middleeast/2014/07/140704_egypt_fuel_prices) from the original on 2014-12-01.
- 44. "الحكومة المصرية ترفع أسعار الوقود"" (https://www.skynewsarabia.com/business/1056999-%D8%A7%D9%8 4%D8%AD%D9%83%D9%88%D9%85%D8%A9-%D8%A7%D9%84%D9%85%D8%B5%D8%B1% D9%8A%D8%A9-%D8%AA%D8%B1%D9%81%D8%B9-%D8%A7%D9%94%D8%B3%D8%B9%D 8%A7%D8%B1-%D8%A7%D9%84%D9%88%D9%82%D9%88%D8%AF). Sky News Arabic.
- 45. "Archived copy" (https://web.archive.org/web/20120308020531/http://www.vtt.fi/news/2009/0331200 9b.jsp). Archived from the original (http://www.vtt.fi/news/2009/03312009b.jsp) on 2012-03-08. Retrieved 2012-04-13.
- 46. "Hindustan Petroleum Launches High Performance 99 Octane Fuel NDTV CarAndBike" (https://www.team-bhp.com/news/hindustan-petroleum-launches-99-octane-fuel-high-end-cars). CarAndBike. Retrieved 2018-04-12.
- 47. "Not all fuels are the same, we dig deeper into shell v power" (https://paultan.org/2010/09/28/not-all-f uels-are-the-same-we-dig-deeper-into-shell-v-power/).
- 48. http://dof.gob.mx/nota_detalle.php?codigo=5241707&fecha=30/03/2012
- 49. <u>"100 Plus high octane petrol" (https://npd.co.nz/100plus-high-octane-petrol/)</u>. *npd.co.nz*. Retrieved 2018-01-14.
- 50. "Tømmer tanken for 98 oktan" (http://www.altaposten.no/lokalt/nyheter/article9516487.ece). *Altaposten.no.* 2014-04-15. Archived (https://web.archive.org/web/20170407090426/http://www.altaposten.no/lokalt/nyheter/article9516487.ece) from the original on 2017-04-07. Retrieved 2017-01-06.
- "Ceylon Petroleum Corporation" (https://web.archive.org/web/20140531180434/http://ceypetco.gov.l k/Ceypetco_Products.htm). ceypetco.gov.lk. Archived from the original (http://www.ceypetco.gov.lk/C eypetco_Products.htm) on 2014-05-31.
- 52. "BP" (https://web.archive.org/web/20101214104236/http://www.bp.com/liveassets/bp_internet/bp_ulti mate/STAGING/brand_assets/downloads_pdfs/pq/bp_ultimate_uk_102_final_press_release.pdf) (PDF). *bp.com*. Archived from the original (http://www.bp.com/liveassets/bp_internet/bp_ultimate/ST AGING/brand_assets/downloads_pdfs/pq/bp_ultimate_uk_102_final_press_release.pdf) (PDF) on 2010-12-14.
- "Archived copy" (https://web.archive.org/web/20140110154625/http://www.aaa.com/aaa/006/EnCom pass/2007/mar/mar_AutoTalk.htm). Archived from the original (http://www.aaa.com/aaa/006/EnComp ass/2007/mar/mar_AutoTalk.htm) on 2014-01-10. Retrieved 2013-06-04.

- 54. Mark Phelan (2013-05-29). <u>"Vacationers, beware: Bad gas can damage your car" (https://www.usato day.com/story/money/cars/2013/05/29/bad-gasoline-low-octane-too-much-ethanol/2369579/)</u>. Usatoday.com. Archived (https://web.archive.org/web/20161120013630/http://www.usatoday.com/story/money/cars/2013/05/29/bad-gasoline-low-octane-too-much-ethanol/2369579/) from the original on 2016-11-20. Retrieved 2017-01-06.
- Sunoco, Inc. "GoSunoco Partner With Sunoco" (https://web.archive.org/web/20070430173204/htt p://www.sunocoinc.com/site/Consumer/RetailMarketing/Products.aspx). sunocoinc.com. Archived from the original (http://www.sunocoinc.com/site/Consumer/RetailMarketing/Products.aspx) on 2007-04-30.
- 56. "Archived copy" (https://web.archive.org/web/20081207175827/http://www.e85refueling.com/). Archived from the original (http://www.e85refueling.com/) on 2008-12-07. Retrieved 2008-10-22.

Further reading

 McAllister, Sara; Chen, Jyh-Yuan; Fernandez-Pello, A. Carlos (2011). Fundamentals of Combustion Processes (https://books.google.com/?id=-onCX7u4 VcC&pg=PA208&lpg=PA208&dg=Another+typ e+of+octane+rating,+called+Motor+Octane+Number+(MON),+is+determined+at+900+rpm+engine+s peed+instead+of+the+600+rpm+for+RON.%5B1%5D+MON+testing+uses+a+similar+test+engine+to +that+used+in+RON+testing,+but+with+a+preheated+fuel+mixture,+higher+engine+speed,+and+var iable+ignition+timing+to+further+stress+the+fuel's+knock+resistance.+Depending+on+the+compositi on+of+the+fuel,+the+MON+of+a+modern+pump+gasoline+will+be+about+8+to+12+octane+lower+t han+the+RON.+but+there+is+no+direct+link+between+RON+and+MON.+Pump+gasoline+specificat ions+typically+require+both+a+minimum+RON+and+a+minimum+MON.#v=onepage&g=Another%2 0type%20of%20octane%20rating,%20called%20Motor%20Octane%20Number%20(MON),%20is%2 Odetermined%20at%20900%20rpm%20engine%20speed%20instead%20of%20the%20600%20rp m%20for%20RON.%5B1%5D%20MON%20testing%20uses%20a%20similar%20test%20engine%2 0to%20that%20used%20in%20RON%20testing,%20but%20with%20a%20preheated%20fuel%20mi xture,%20higher%20engine%20speed,%20and%20variable%20ignition%20timing%20to%20furthe r%20stress%20the%20fuel's%20knock%20resistance.%20Depending%20on%20the%20compositio n%20of%20the%20fuel,%20the%20MON%20of%20a%20modern%20pump%20gasoline%20will%2 0be%20about%208%20to%2012%20octane%20lower%20than%20the%20RON.%20but%20there% 20is%20no%20direct%20link%20between%20RON%20and%20MON.%20Pump%20gasoline%20sp ecifications%20typically%20require%20both%20a%20minimum%20RON%20and%20a%20minimu m%20MON.&f=false). Springer Science & Business Media. ISBN 978-1-4419-7943-8.

External links

Research Octane Number by Hydrocarbon Structure

Gasoline Refining and Testing, Table 3.1, page 32 (https://www.chevron.com/-/media/chevron/operations/documents/motor-gas-tech-review.pdf#page=32)

Information in general

- Why are Octane levels important (http://www.motorcycle.in.th/article.php/Why-are-the-Fuel-Octane-le vels-important)
- Gasoline FAQ (http://www.faqs.org/faqs/autos/gasoline-faq/part1/)
- How Octane Works at HowStuffWorks.com (http://auto.howstuffworks.com/question90.htm)

Retrieved from "https://en.wikipedia.org/w/index.php?title=Octane_rating&oldid=949928019"

This page was last edited on 9 April 2020, at 09:05 (UTC).

Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy. Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.