About oil

I am not a lubrication, filtering, chemical or mechanical engineer. I have a degree in engineering, but I studied electrical engineering. I now study physics. You may feel free to question my abilities to gather facts and draw conclusions in the area of oils and filters. In any case, this is a write up of what I learned in about 75 hours of research on this topic. My only interest is having my motorcycle run forever, never break, and be easy to maintain.

Why do we need oil?

We put oil in our engines to serve several purposes. First, obviously, oil acts as a lubricant. If your engine is operating correctly, there is almost no metal to metal contact - everything is riding on a thin film of oil. However, oil has several other important jobs to do. Oil circulates throughout your engine, and cools parts that cannot get near a water jacket. For example, it's becoming common in sport bikes to spray oil on the underside of the piston to cool it. There are no water jackets at all in your transmission. Motorcycle transmissions are oil cooled.

Your piston rings do not do a perfect job of sealing. Some combustion by products will slip past the rings into the engine. This can be little particles of carbon. Remember, diamond is carbon that was combined under heat and pressure. These little carbon particles can be quite damaging to your engine. Another job of your oil is to hold these particles in suspension until the oil filter can grab them. Also, if your gasoline has sulpher in it (it does), this sulpher can react with water and oxygen to make sulphuric acid. This is some stuff that is seriously bad for your engine. Your oil has special ingredients in it called buffers to neutralize acids. Finally, your engine can get internal build ups of tars, waxes, and other gunk. Your oil has solvents to try to dissolve this stuff and get and keep your engine clean.

Where Oil Comes From

Most of the bio-mass on earth is single cell plants and microscopic critters in the ocean. When these die, they sink to the bottom. Often they fall into a deep crevasse or trench, where they may become covered up by an underwater landslide. After a couple hundred million years of high pressure and no air, the critters get squished into oil. So, oil isn't really "dead dinosaurs," but Sinclair Oil stations just wouldn't be the same with a picture of algie on their sign. Today we like to find this stuff, pump it to the surface, and burn it.

The oil we pump to the surface is a mixture of gasoline, kerosene, light weight lubricating oil, motor oil, gear oil, tars, paraffins, waxes, asphalt, sand, dirt, organic stuff (called aromatics) and the occasional dead cockroach. We call this stuff crude oil, for reasons that I think are now self-explanatory. The oil companies have the singularly smelly job of separating the crude oil into its component parts. A hundred years ago we would just heat the stuff up in a complicated still, and catch stuff that boiled off at different temperatures. Fifty years ago we started processing the crude oil with clay and solvents to do a more precise job. Today, we use very complicated systems where we heat the crude oil to precise temperatures, put it under high pressure, and bubble hydrogen and other stuff through it. The idea of all this is to try to get pure chemicals out of this stuff that we just found laying around in the desert.

Most motor oil has a lot of different chemicals in it with very different properties. The temperature at which the oil will start burning, called the **flash point**, is determined by the

chemicals that burn at the lowest temperature. The higher the flash point, the more stable the oil is at high temperatures, and the less oil your engine will burn. The **pour point** is the temperature at which the oil stops flowing like a liquid. The lower this number is, the better protected your engine is when it's cold. The thickness of the oil, that is the resistance the oil offers to motion, is called the **viscosity**. The viscosity depends on all of the various chemicals in the oil and how they react to each other and to heat. Importantly, as the oil heats up, it thins out, that is the viscosity goes down. The better the oil is at retaining its viscosity at high temperatures, the higher the **viscosity index**. All of these properties depend on all the chemicals in the oil. If you could get only one precise kind of molecule out of the raw oil, you could do a lot better than you can do with a mix.

Refining Oil

The oil product you buy starts as a **base oil**. The base oil makes up about 85% of the oil you buy. The base oil can be refined from crude oil, chemically (synthetically) manufactured, or a blended combination.

Base oils that are refined from crude oil are colourless and pretty much odourless and are sold to the public as mineral oil. The crude oil is a combination of a lot of different chemicals, ranging from light gasoline types of fuels to waxes and tars. When you heat the crude oil, the gasoline and diesel oil boil off pretty early. Unfortunately, the mineral oil, paraffin, wax and tar molecules are all hooked up with each other, and it's not so easy to separate them from each other. Also, the crude oil contains the aforementioned aromatics, which are quite bad in your oil: they are very reactive, and when oxidized they cause all kinds of problems. Refining oil means trying to remove the bad stuff, while leaving the good stuff. The more bad stuff we remove, the better the oil works.

The simplest way to refine oil is to process it with a clay, a material a lot like kitty litter. The clay will soak up much of the aromatics and sulphur and nitrogen compounds. Then, you dilute the oil with solvent like MEK (Methyl-Ethyl-Keytone) and/or Toluene (that's the stuff in model airplane glue that's so popular with teenagers), and freeze the oil. The good stuff will mostly stay liquid, and the waxes will solidify and can then be filtered out. This clay-solvent refining process has been around since about 1930.

Oils refined with the clay-solvent process contain a fair amount of paraffin and wax. These molecules cause several problems in an engine: they sometimes fall out of solution, leading to build-ups in your engine that must be cleaned out somehow. Also, as these molecules get hot they thin out quite a bit, much more than mineral oil, so they make the oil's high temperature performance rather poor. Finally, at low temperatures the waxes and paraffins thicken the oil so much that you really couldn't call it a lubricant. If you're curious about this, buy a cheap quart of straight 30wt oil and put it in your refrigerator or freezer over night. You'll be amazed at how thick it becomes. More than half the motor oil sold in N.America in 2004 is made from base oils refined with the clay- solvent process (I like to call it the Kitty-litter and Kerosene refining method), but I don't think this is the type of oil you want to put into an engine you love. These oils are roughly 85% good stuff (oil) and 15% bad stuff (paraffin and wax). To put this in perspective, think of taking a gallon of really excellent oil, and melting a 12" dinner candle into it.

In 1959, Chevron developed a new method of refining base oils called Hydrocracking, where you process the raw oil at high temperatures and pressures with hydrogen and various

catalysts. In Hydrocracking, many of the paraffin and wax molecules are broken up into mineral oil molecules, which increase the performance of the base oil dramatically. Also, far more of the aromatics and sulphur and nitrogen compounds are removed from the oil.

Since 1990, Chevron's process has been improved. In 1993, Chevron invented the Hydro-Isomerization process, where wax and paraffin molecules are reshaped into useful lubricants instead of simply being broken up into smaller molecules. By increasing the severity of the hydrocracking process, increasing the temperature and pressure and processing time to process more and more of the unwanted wax and paraffin molecules, the oil's low and high temperature performance and resistance to oxidation can be improved to the point where the distinction between mineral oils and synthetics becomes blurred. Chevron now licenses this process, called Iso- DeWaxing. This process of oil refining is becoming more and more popular, and in 2004 accounts for almost half of all base oils. Iso- DeWaxing not only produces much higher-performance oil, but also allows you to start with lower quality crude oil, making us less dependent on the few countries that happen to produce the purest crude oils.

Group II and Group III oils

Base oils made with the Iso-DeWaxing process are called Group II, and are significantly more pure and have higher performance than Group I base oils. Chevron Delo 400, Mobil Delvac 1300, and Shell Rotella are made from pure Group II oils. Motor oils made with Group-II base oils leave far fewer wax and tar deposits in your engine, and have much better low and high temperature performance than Group I oils. The resulting oils are roughly 97% good stuff (oil) and 3% bad stuff (paraffin and wax). We just cut that 12" dinner candle down to about 2½".

The high and low temperature performances of oils are described by the Viscosity Index. The VI tells us how much the oil thins out as it gets hot. Oils with higher VIs maintain their viscosity better at high temperatures. If the VI is 90 to 100, we call it Group II; if it's refined to a VI of 110 to 115 we call it Group IIa. In the late '90s, an even more involved process was invented yielding base oils with VIs over 120. These base oils are called Group III or "**unconventional base oils**." The higher the VI, the fewer additives are necessary to achieve the required viscosity. For example fewer additives are needed to turn a Group III base oil into 10w-40 than are required for Group II base oils. Group III oils have essentially no paraffin and wax in them, at least as compared to the 12" dinner candle per gallon in Group I oils.

Group III oils have properties approaching or equaling synthetics, so long as the temperature is above about 40°. Group III based oils are often claimed to not perform as well as synthetics in a couple ways: their low temperature performance is not nearly as good, it is sometimes claimed on the basis of the "ball bearing test" that they offer lower impact resistance, and since their flash point is slightly lower it is claimed that they burn off more easily. However, most modern engines are water-cooled, so it's hard to see how the slightly better flash points of the synthetics ever come into play. I personally don't make a habit of dropping a handful of ball bearing into my oil pan, so I'm not completely clear on what the impact tests mean to me. The low temperature performance of the Group III oils can be improved enormously by blending in a relatively small amount of synthetic base stock and other additives.

Since about 2000, it has become possible at moderate extra cost to process Group II and Group III oils so that their performance below 32° nearly matches the performance of traditional synthetics. Because of this, the oil companies found they could now produce relatively inexpensive 5w-30 and 0w-20 oils. Car companies were quick to see that such oils would help reduce the fuel consumption of their vehicles by a percent or so, which is important as Detroit finds themselves selling more trucks than cars. So, these "fuel-efficient" oils are quickly becoming the factory recommendation in most cars. It's not at all clear that these new low- viscosity oils lead to the longest engine life, but it is clear that these oils help the car companies meet their CAFE federally- mandated fuel economy standards.

In the late 1990s, Castrol started selling an oil made from Group III base oil and called it SynTec Full Synthetic. Mobil sued Castrol, asserting that this oil was not synthetic, but simply a highly refined petroleum oil, and therefore it was false advertising to call it synthetic. In 1999, Mobil lost their lawsuit. It was decided that the word "synthetic" was a marketing term and referred to properties, not to production methods or ingredients. Castrol continues to make SynTec out of Group III base oils, that is highly purified mineral oil with most all of the cockroach bits removed.

Shortly after Mobil lost their lawsuit, most oil companies started reformulating their synthetic oils to use Group III base stocks instead of PAOs or diester stocks as their primary component. Most of the "synthetic oil" you can buy today is actually mostly made of this highly-distilled and purified dino-juice called Group III oil. Group III base oils cost about half as much as the synthetics. By using a blend of mostly Group III oils and a smaller amount of "true" synthetics, the oil companies can produce a product that has nearly the same properties as the "true" synthetics, and nearly the same cost as the Group III oil. The much more expensive traditional synthetics are now available in their pure forms only in more expensive and harder to obtain oils. To the best of my knowledge, Delvac-1, AMSOil, Redline, and Motul 5100 are the only oils made from pure traditional synthetics.

Synthetic Oils

Synthetic oils were originally designed for the purpose of having a very pure base oil with excellent properties. By starting from scratch and building up your oil molecules from little pieces, you can pretty much guarantee that every molecule in the oil is just like every other molecule, and therefore the properties are exactly what you designed in, not compromised by impurities from dead cockroach shells or whatever. Synthetics were thus originally a reaction to the relatively poor refining processes available from about 1930 to about 1990. The original synthetics were designed for the Army Air Force in WW II. They simply could not make their high- performance turbo-charged radial engines stay alive on the available motor oils of the time.

One process for making synthetic base oils is to start with a chemical called an olefin, and make new molecules by attaching them to each other in long chains, hence "poly." The primary advantage of Poly-Alpha-Olefin "**PAO**" base oil is that all the molecules in the base oil are pretty much identical, so it's easy to get the base oil to behave exactly as you like. PAOs are called Group IV base oils.

Until about 2000, these PAO base oils had an enormous advantage over mineral base oils in low temperature performance and in resistance to oxidation, which is critical in keeping the oil from forming acids. However, modern group-III oils can nearly match the performance of

PAOs at about half the price. Because of this, PAO based oils are rapidly disappearing. There are new processes being investigated which may significantly cut the cost of producing PAOs, and make them an important component of oil again.

Another type of base oil is made from refined and processed esters and is called Group V. Esters start life as fatty acids in plants and animals, which are then chemically combined into esters, diesters, and polyesters. Your vegetarian girlfriend should love that. Group V base stocks are the most expensive of all to produce. However, the esters are polar molecules and have very significant solvent properties - an ester base oil all by itself will do a very decent job of keeping your engine clean. So, people who are serious about making a superior oil will usually mix some Group V oils into their base stock.

PolyEster (RedLine) oils have by far the best performance in extreme high temperatures, and are the preferred oil in old "air- cooled" Nortons. I put "air-cooled" in parenthesis as one could also call these engines "prayer- cooled." The Norton 750 commando will destroy a Group I oil fill in 75 miles on a 100 degree day. No kidding. The Brits really did not understand until about 1990 that some of us live in places where the temperatures get over 80 degrees and cities are more than 10 miles apart. If you love those old British twins, you need to find a good supply for RedLine oil.

Finally, there are new chemicals emerging which are made from liquefied natural gas called GTL (gas to liquid) base oils. These will be called Group III+, and many people think they will become an important part of the oils you buy by 2010. These GTL base oils have natural VIs of 140 or more, meaning for most applications they won't require any VII package at all. Natural gas is primarily made up of only one type of molecule, so the refining is already done for you. Most oil wells throw off a lot of natural gas. In many cases, it's more expensive to transport this gas to a large city than the gas is worth, so it's just burned off. For example, Iran burns off enough natural gas each day to power their entire country, electricity, cars, ships, airplanes, the whole thing. So the next time you hear Iran's nuclear reactors are purely for peaceful production of energy, you can wonder like the rest of us why a country that burns off more than their entire energy needs must spend tens of billions of dollars developing alternative energy sources. Well, anyway, natural gas is a chemical looking for a use. All you have to do is chemically attach these molecules to each other to turn them into quite pure oil stocks.

"**Semi-synthetics**" are oils which are a blend of petroleum oil and no more than 30% synthetic oil. If the manufacturer adds no more than 30% synthetic oil and does not change the additive package, they do not have to recertify the oil. These days, since everyone has agreed that Group III base oils are "synthetic," I'm not sure "semi-synthetic" means anything at all. The manufacturers love this stuff: it costs about 15% more to make the oil, and they get to charge about double. I don't recommend semi-synthetics. Save your money and take your kids to McDonalds.

	Group I Mineral Oils				Group II Mineral Oils				Group III Mineral Oils				Group IV PAOs				Group V Diesters			
Base Oil	Visc.	Flash Point	Pour Point	VI	Visc.	Flash Point	Pour Point	VI	Visc.	Flash Point	Pour Point	VI	Visc.	Flash Point	Pour Point	VI	Visc.	Flash Point	Pour Point	VI

100 Neutral	4.1	380	+15 °F	97	4.1	410	+20 °F	102	4.2	410	+25 °F	127	3.8	437	-92° F	123	3.6	460	-67° F	148
200 Neutral	6.1	420	+15 °F	96	6.4	435	+25 °F	103	7.0	460	+20 °F	135	5.9	469	-83° F	135	5.5	485	-65° F	150
325 Neutral	8.4	435	+15 °F	95	---	---	---	---	---	--	---	---	8.4	507	-74° F	132	---	---	---	---
450 Neutral	10.	455	+15 °F	95	12.	500	+20 °F	101	---	---	---	---	9.5	527	-85° F	130	---	---	---	---

As you can see in the table above, synthetics offer real advantages when your engine is very cold and when your engine is very hot. The viscosity numbers shown above are at 212°F. At 32°F the PAOs and Diesters have about one third the viscosity of the mineral oils, meaning they pump through your engine three times better. Since about 75% of all the wear on your engine happens in the first five minutes after you start it up, synthetics offer an advantage in significantly reducing engine wear.

Making Multi-Grade Oil

A simple standard oil, for example a pure base stock, would be a single weight, like 30 weight. This pure oil would have no detergent additives to keep the engine clean. This oil would be relatively thick and difficult to pour at room temperature, and would thin out as the motor heated up. On a very cold day, say 10° below freezing, this oil would thicken to the point where you could not start your motor, and if you did, the oil pump could not pump the oil around to protect your motor. It used to be that to start their diesel trucks in the winter, truckers would add kerosene to their oil to thin it out. Then they had to hope the kerosene would burn off before it did any real damage. Today, synthetic oils that are rated 0W-40 flow normally down to 65° below zero and remove the need for engine block heaters or adding kerosene.

An oil sold as 10w-40 is no thicker than 10 weight oil under Winter (10w) conditions, meaning below freezing. The 40 means it is no thinner than 40 weight oil at 212° Fahrenheit. So, the first number tells us the performance of the oil at or below the temperature of freezing water, and the second number tells us the performance at the temperature of boiling water. The chemicals added to the oil to accomplish this are called Viscosity Index Improvers (VIIs).

To make a 10w-40 oil, the manufacturer would start out with a 10 weight oil as the base stock. All by itself, this oil would thin out so much at normal operating temperatures that the oil film would be useless. So, they add these very special very long molecules, the VIIs. The VII molecules are as much as 1000 times as long as an oil molecule. The VII molecules curl up in a little ball at room temperature, but as the temperature gets higher they uncurl and stretch out, like a cat sleeping in the sunlight. The more stretched out the molecule is, the more it impedes the normal flow of the oil, thus raising the effective viscosity. Now, this sounds just a little too good to be true. Well, there are two catches: first, these molecules are not lubricants, so the more of them that you add the less oil you have sitting around lubricating things. Secondly, these VII molecules can be broken into pieces by various

pressures and forces, like being squeezed through the transmission gears in a motorcycle or the hydraulic valves in a diesel engine. Every time a VII molecule gets broken, the oil loses some of its high temperature viscosity. Synthetic oils made from pure PAOs and/or Diesters typically have very few VIIs, so these oils are far less subject to viscosity breakdown due to shearing of the VII package. As a result, synthetics are far more stable in a motorcycle engine.

10w-30 oil increases its viscosity at high temperatures by a factor of three, which requires a significant amount of these VII molecules. 10w-40 oil increases its high temperature viscosity by a factor of four, which requires even more even longer molecules. 20w-50, which sounds a lot like 10w-40, only increases its high temperature viscosity by a factor of two and a half, so it requires fewer of these molecules than even 10w-30. 15w-40 also increases its high temperature viscosity by about two and a half, so this oil is also substantially more stable than 10w-40. Most passenger car oils today use inexpensive VII molecules that break apart relatively easily. Conversely, most diesel engine oil VIIs are chosen from more expensive chemicals that are more shear stable, since an oil change in a large diesel is expected to last for 15,000 to 150,000 miles.

One way to judge the VII content of your oil is to read the VI, the Viscosity Index, at the manufacturer's web page. The base oils all have similar VIs to start with, so generally speaking, the higher the VI in the blended oil, the more VIIs are present, and the less suitable the oil is for motorcycle usage. John Evans did just such a survey of Valvoline, Chevron, Exxon, Quaker State, Citgo, and Conoco oils. He found that the 5w-30 oils all had VI's in the range of 158-162; the 5w-20 oils had VIs of 148-154; the 10w-40 oils had VIs of 147 to 150; 10w-30 oils had VIs of 134 to 139; and 20w-50 oils had VIs of 120 to 125.

In 1994, Dr. John Woolum tested the viscosity of several 10w-40 oils in his motorcycle. He found that all of the petroleum oils had lost highly significant amounts of viscosity within 1500 miles. Only Mobil-1 held up in his test. I have personally tested Delvac-1 synthetic in my ST1300. It was 5w-40 when I put it in, and 5w-25 9,200 miles later. By 1500 miles, the petroleum oils Dr. Woolum tested were at 10w-25 equivalent. By contrast, Dr. Woolum tested a petroleum oil in his Honda Accord. After 3600 miles, the 10w-40 oil was 10w-37 equivalent. Motorcycles are indeed significantly harder on their oils than cars. Based on this result and the VI numbers above, it would seem that 10w-40, 5w-20, and 5w-30 oils cannot be safely used in motorcycles for more than 1,000 to 1,500 miles.

You might ask, if these viscosity index improvers are so expensive and fragile, why have them? Why not just run a straight 30 weight oil? If you live somewhere where the temperature never changes, like Maui, maybe that's a good idea. However, if your engine will ever see temperatures below 60 degrees or above 100 degrees, it's important to have a multi-weight oil. Multi-weight oils offer far superior protection during a cold engine start on a cold morning, and they also offer superior protection if your engine oil ever gets above about 230°. Of course, some old timers will tell you, "I always ran straight 50 weight oil. Yup. That was the stuff. All these new-fangled fancy oils, forget it, it's just marketing hype. All you need is straight 50 weight." Well, that may have been true when motorcycles were 1500ccs and made 18hp. Today, when you can casually buy an engine that makes 150hp per liter, things are just a little different.

Viscosity is not actually measured in "weights", but rather in units called "Stokes." If you're a famous scientist they name a unit after you, except for poor Albert who is considered famous enough all by himself. Stokes was a guy who worked on fluid flow. For oils, we use a

hundredth of a Stoke, called a centi-Stoke, abbreviated cSt. "Weights" are a classification invented by the American Petroleum Institute (API). A different unit of viscosity, the centi-Poise, is used at very low and very high temperatures. 10 weight oil refers to oils within a range of viscosities, so two different brands of 10 weight oil might actually be quite different. 75 weight gear oil is actually about the same viscosity as 10 weight motor oil. Don't ask me why, I'm not a petroleum engineer; although some might argue that I do belong in an institution.

SAE W viscosity grades for engine oils

Grade	cranking	pumping
0w	3250cP at -30°c	60,000cP at -40°c
5w	3500cP at -25°c	60,000cP at -35°c
10w	3500cP at -20°c	60,000cP at -30°c
15w	3500cP at -15°c	60,000cP at -25°c
20w	4500cP at -10°c	60,000cP at -20°c
25w	6000cP at -5°c	60,000cP at -15°c

SAE viscosity grades for engine oils

Grade	low shear	high shear
20	5.6 - 9.3 cSt at 100°c	2.6 cP at 150°c
30	9.3 - 12.5 cSt at 100°c	2.9 cP at 150°c
40[a]	12.5 - 16.3 cSt at 100°c	2.9 cP at 150°c
40[b]	12.5 - 16.3 cSt at 100°c	3.7 cP at 150°c
50	16.3 - 21.9 cSt at 100°c	3.7 cP at 150°c
60	21.9 - 26.1 cSt at 100°c	3.7 cP at 150°c

[a] (0w-40, 5w-40, 10w-40 grades)
[b] (15w-40, 20w-40, 25w-40, 40 grades)

The "High Shear" viscosity number is the one that actually correlates with oil film thickness on your bearings at operating temperature. You can see that, based on this, really there's only three choices for oil: 20; 30 or light 40; heavy 40 to 60. The cranking viscosities above show you the temperature at which you can start your engine safely. 20w oils are only safe down to about 28°f. 5W Rotella or Mobil-1 SUV oil are safer at -13°f than 20W is at 28°f.

Motor Oil Additive Packages

In addition to the base stock oil, oil manufacturers add what's called an additive package. Additive packages are typically not made up by the oil companies, but rather by a few companies that then sell them. Additive packages contain several different chemicals with several different purposes. Here's what the additive package is supposed to do for you:

- One component is detergents and dispersants. These chemicals are designed to hold onto foreign particles and chemicals in your engine, and sometimes break them into smaller pieces. These foreign chemicals may be combustion by products, or junk that slipped past your air filter. If the particles are large enough, then they will eventually be grabbed by the oil filter and taken out of circulation.
- Another component is buffers. This is typically calcium, magnesium, or boron. These chemicals are present to neutralize any acids which form in your engine. Acids are bad for your bearings and other important thingies.

- Your additive package will include solvents to break up deposits of tar and wax. In a premium oil, some of the base stock will be Group V diesters to help the solvent package. Where did the tar and wax come from? Remember, when you opened up your $1.09 quart of Spiffo-Magic SuperLube, you got oil, additives, tar, paraffin, wax, asphalt, ash, aromatics (sounds like perfume when they say that, doesn't it?), and the occasional stray bit of cockroach shell.
- Another component is emergency lubricants. This is typically zinc, phosphorous, and molybdenum. These chemicals are present in case your oil film completely breaks down, due to extreme temperatures or pressures. These chemicals are supposed to be a last resort defense against metal to metal contact in your engine. Oil companies are cutting back on zinc and phosphorous, as these metals are hard on your catalytic converters. They're substituting molybdenum disulfide, which lowers friction and improves gas mileage. It also causes problems for people with wet clutches, that is most motorcycles.
- The Viscosity Index Improvers are part of the additive package. As we learned above, these chemicals are present to make your oil stay thick at high temperatures.
- Finally, corrosion inhibitors. These chemicals are supposed to keep your oil from oxidizing or otherwise breaking down due to time or contamination. Yes, it's true, now even your oil has to take antioxidants.

API Oil Standards

The additive package is made to make the finished oil product meet one of the certifications. There are two classes of certification: S, for Service, and C, for commercial. The certification standards are maintained by the API, the American Petroleum Institute. Over the years, the API has improved and changed these standards. The most current S standards are SL and SM. These standards differ from earlier standards like SH by lowering phosphorus to improve catalytic converter life, and increasing molybdenum to lower internal engine friction and improve gas mileage. Phosphorus was originally added to oils to help protect high pressure areas like cam lobes and crankshaft bearings, so lowering phosphorus levels is a compromise of lower pollution, perhaps at the expense of engine life. Molybdenum is added to improve fuel economy due to the federal CAFE (Corporate Average Fuel Economy) standards, thereby helping GM and Ford keep selling large V8s to the American public, but can perhaps cause problems in engines with wet clutches. Most S additive packages are also designed to be inexpensive so that the resulting oil can be sold at a low price. SL and SM oils are both low phosphorus; SM oils which are labelled "energy conserving" are high molybdenum.

About every three years or so, the API releases a new S standard. The new standard supersedes the old standard, so, for example, the SH standard included extra high temperature deposit protection due to the popularity of turbo engines in the early '90s; SJ oils did not have this high temperature protection, as that portion of the standard was dropped. This means that for some cars, oils made to the older rating systems are sometimes better than oils made to the new standards. SH certified oils are probably the best of the S oils for motorcycles and high-performance sports cars, but you pretty much can't buy them anymore. Oils which are labelled "energy conserving" are bad for any vehicle with a wet clutch, meaning most motorcycles. Essentially all 0w-20, 5w-30, and 10w-30 oils are energy conserving and should not be used in your bike.

Most people blending S type automotive oils are buying their base oils from a company who is most likely using the Chevron Iso- DeWaxing process to make their oils, then buying their

additive package from another company that is highly constrained by the API standards. The cost of getting an API certification for a single S motor oil formulation is from $125,000 to $300,000. The cost for C certification is $275,000 to $500,000. Once testing is complete, the oil can be licensed for $825 per year, plus a small royalty fee per gallon sold for all gallons over one million. The length of time between new specifications is now approximately 2 to 3 years, which does not allow a great deal of time to recover testing costs.

Additive companies, such as Lubrizol, Ethyl, Infinium and Oronite develop licensed additive formulas that they offer to oil companies to re-license. It is inexpensive to re-license one of these formulas, and the majority of oil companies choose to do this to avoid the costs associated with testing. Thus, the same chemistry is being sold under many brand names. Because of this, S type automotive oils have pretty much turned into a commodity. Although the people selling a particular brand may wish you to believe their oil is superior to any other, in fact if it's got the API seal on it, it's probably about the same as any other similarly rated automotive oil.

Commercial (Diesel) Oil

The additive packages for C (commercial) certification are designed to promote engine life. The additive packages for C rated oils contain extra buffers and detergents to keep the engine clean and free of acids. C rated oils are far better than S oils at holding and dispersing combustion byproducts and other contaminants, and at not becoming acidic. Traditionally these oils are primarily used in diesel motors, which are very expensive and are expected to last a million miles or more. When an engine rebuild costs $10,000 - $15,000 and puts you out of work for a week or three, you don't mind paying a bit more for your oil. The C certification tests have been largely developed by Mack, Caterpillar, Detroit and Cummins to provide the additives necessary to keep these engines running a long time. The latest commercial certification is CI-4 Plus, which includes extra protection for high temperature high revving motors. Since it's designed for diesel motors, they don't care about no stinkin' catalytic thingies, and CAFE is a place where you get a cup of joe and a donut. CI-4 Plus differs from CI-4 with higher detergent requirements and better sheer stability. The shear stability is exactly what motorcycles need due to running the engine oil through the transmission.

Although C standards are changed every few years, the older standards are enhanced, not superceded. So, newer higher rated C oils are simply better than older lower rated oils.

Although few car owners test their oil regularly, most large trucking companies routinely do oil analysis on their diesel trucks. Used oils are checked for viscosity breakdown, for detergent and dispersant function, and for metal contamination that would indicate engine wear. C oils that don't measure up are quickly run off the market place. To prevent engine wear, the best strategy is to keep deposits off the pistons, rings, and bearings. Therefore, diesel oils typically contain half again more detergents, double the dispersants, and a much more expensive and robust VII package than S type oils. If you go to an auto parts store, convenience store, or grocery store, you'll see that there are dozens of brands of automotive oils, all claiming to be the best. If you look at truck stops, you'll see there are only a very few diesel oils sold, typically Rotella, Delo, and Delvac. Trucking companies find what works for them and won't switch. They're not interested in saving a dollar a gallon on some unknown oil.

The C certified oils are all also S certified, just as some S certified oils are also C certified. The best C certified oils are SG, usually SH, sometimes SJ. I don't know of a C certified oil which is SL. The best S certified oils are CF, which is a relatively old and obsolete C standard, and does not include the tests for high speed high temperature engines that CG, CH, and CI have. In fact, CF oil does not meet the current factory standards for Volkswagen or Mercedes diesel passenger cars.

The API charges serious money to test an oil and certify it. If the API really tested the oil in their independent lab, and the oil company pays their royalties on time, the oil company gets to display the API seal on their product. Some smaller companies don't pay the API to test their oils and certify them. In these cases, you won't see the API seal, instead you'll see some words like "Meets or exceeds all manufacturers warranty requirements. API Service SJ, SL, CF." It's up to you to decide if you trust this manufacturer to actually test their oil themselves and tell you the truth about the results.

JASO certified Oil

Another institute that certifies oils is called the Japanese Automotive Standards Organization, JASO. One wonders why this Japanese organization has an English name. . . In any case, they have two classifications for motorcycles, "MA" and "MB." MA is the one you want. MB is like the API SL category, it's got all those nasty friction reducing chemicals that may scare your clutch into misbehaving. Again, there is an official JASO seal if the oil has been independently tested. The seal is a rectangle; in the upper quarter of the rectangle will be a serial number, and the lower three quarters will just have the letters MA. If the oil manufacturer did their own testing, instead you'll see just words like "Meets or exceeds JASO MA standards."

Some manufacturers recommend JASO-MA certified oil. AMSOil and Golden Spectro are JASO-MA certified. Some people consider this important. Interestingly, although Honda recommends a JASO-MA oil, Honda oil is not JASO-MA certified. Mostly JASO-MA is pretty much equivalent to SH. In fact, the JASO spec is mostly a reaction to the decrease in zinc-phosphates in SJ and SL oils, and the added molybdenum disulphide in energy conserving oils. Personally, I don't care about JASO standards - they're really not on my radar.

Racing Oil, NASCAR oil, etc.

Some manufacturers also sell something they call "racing oil." Normally, this is actually fairly decent oil, but you should not be mislead into thinking racing cars use the best oils for you. Race drivers start their engine one time only, warm it up slowly and carefully, then run the engine near or at the red line for a couple hours. 100 to 500 miles later, they completely tear down the engine and replace all the worn parts, the oil, and the oil filter. If you think you might like to go more than 500 miles between major engine rebuilds, you might consider that your use of your engine is quite different from Michael Andretti's.

Why do we change our oil?

We're now in a position to discuss this. Your oil is a combination of one or more base oils and a complicated additive package. The base oils will actually last as long as your motorcycle - many hundreds of thousands of miles, several years. The reason we change our oil is the additive package wears out. The buffers get used up neutralizing acids. The detergents and

dispersants get used up clinging to gunk that's too small for your oil filter to pick out. The VII package gets shredded by your transmission. You could imagine a device that pulled out your oil, gave it a very thorough cleaning, replaced the buffers, detergents, and VII molecules, and put it back into your engine. Sort of a motor oil dialysis machine. However, in a country that has Texas and Alaska, in a world where oil is $30 / barrel, this makes no sense. So, we dump out our entire four quarts of oil because 3% of the oil is used up. It's really just a cheap way of getting a bunch of contaminants out of our engine. This is why it does make sense to recycle oil: if you can process the oil hundreds of gallons at a time, you can separate out the base stocks economically. If you use synthetic oils and bring your used oil to a recycling collection point, you can feel especially good: a bunch of school buses and city buses are going to get an extra little kick in their base oil because of you. In fact, you can tell your wife that's why you need this exotic, expensive synthetic oil: it's solely out of your concern for the children. If everybody used Spiffo-Magic SuperLube the recycled oil would be junk, and in no time flat the school buses would all break down and the kids would have to walk to school, 23 miles, in the snow, uphill both ways. Why, in no time flat the kids would lose weight, improve their cardiovascular conditioning, and just generally be more healthy and have more energy. What a nightmare!

Choosing an Oil for Your Motorcycle

There are a few special problem areas for motorcycle oil. Most motorcycles have wet clutches, which means the motor oil runs through the clutch. If the motor oil has too much molybdenum in it, there are fears that the clutch can start slipping. No one I know has ever actually had this happen to them, but the warnings are all over your owners' manual and the oil companies' web pages. On the back of all certified oil cans is a circular stamp with the certification. Avoid oils that say "energy conserving" in the bottom half of the donut. These oils contain friction modifier additives that could cause clutch slipping over time. Essentially all 0w-20, 5w-30 and 10w-30 oils are energy conserving, and should not be used in your motorcycle.

Most motorcycles run the engine oil through the transmission, and the transmission gears are very hard on the oil's VII package. This means that over a couple thousand miles, the oil's viscosity can break down. Standard car oils are only good for typically 1500 miles before they've lost about half of their viscosity. Remember, 10w-40 oils contain a lot of VIIs which tend to shear in your transmission, so I believe 10w-40 oils should be avoided. You can't use 10w-30 because of the friction modifiers. This doesn't leave much. Commercial 15w-40 oils are a good choice, because they have relatively few VIIs which are the more expensive shear-stable sort. Synthetics typically don't contain much of a VII package, so shear is not as big an issue with them.

Some people use their motorcycles only sporadically. This means the oil can all drain completely into the sump, leaving no protective film on the bearings. The first start after a long period of non-use can be particularly hard on an engine. Film strength is very important if you're a sporadic rider.

There are several key advantages to using Synthetic Oils:

Synthetic oils have a higher viscosity index than mineral base oils. Synthetics have better resistance to thinning at high temperatures and thickening at low temperatures. Since

synthetics have little or no VIIs, synthetics last longer in service without radical changes in viscosity.

Synthetics have a much higher film strength than petroleum oils, so it takes a lot longer for the oil to drain completely off your bearings and into your sump.

Diester synthetics are polar molecules with solvent properties which dissolve residues and combustion byproducts.

Choosing a Break-In Oil for Your Motorcycle

The theory that synthetic oils should not be used during break in is the same as the theory that your engine will break in better if you use synthetic oil but add a dinner candle to your four quarts of engine oil. Frankly, I find this theory, um, questionable. Oh, hell, laughable. Corvettes and Porsches come from the factory with Mobil-1 in their engines. Remember, these engineers have designed world-champion engines for F1, Indy, Le Mans 24 hours, etc.

There's a lot of mythology surrounding break-in oil. It's simply not the case that synthetic oils are more "slippery" than conventional oils. Also, break-in of a modern engine is completely different than break-in of an engine made before about 1980. Modern engines, by comparison to something made in the '60s, are pretty much already broken in from the factory due to the fact that today we hold much tighter machining tolerances. The exception, of course, would be the Ural, a motorcycle made on a production line unmodified since about 1935.

I recommend you change your break-in oil at 75 to 100 miles, 100 to 150 kilometers. Your engine does shed a fair amount of metal particles in the first 20-50 miles, and I really can't understand why you would want this stuff floating around your bearings for the first 600 miles, 1000 kilometers.

I put Shell Rotella "synthetic" (87% group III) oil in my DL650 at 75 miles. It burns no oil, gets great gas mileage, and runs great. I recommend you switch to a good synthetic at your first oil change.

Recommandations

I get a lot of email, "My buddy has 283,000 miles on his Yamazuki 867 Nintruder, and he's never used anything but 35¢ per quart grocery store oil changed every 48,000 miles." Here's the truth: modern Japanese engines are amazingly well engineered and can tolerate a surprising amount of abuse. However, putting automotive oils in your motorcycle and running them for more than 1500 miles is abuse. I abuse my motorcycle enough with the way I ride them without adding on the abuse of using cheap oil that will break down in 1500 miles.

The question of which oil is best is not settled. We know what we want: the oil is inexpensive, lasts a long time, and makes our engine never break. There are various articles in MCN which do a chemical analysis and make recommendations based on the content of the additive package. I am very sceptical of this, as the utility of these chemicals at various levels is never tested, and the base oils are not tested. There are a couple articles that actually test for viscosity breakdown, and standard petroleum oils don't do very well. Consumer Reports once did a 4,500,000 mile test of oils in NYC taxicabs, however these engines only start once per day and are water-cooled, so they mostly avoid cold start-ups and overheating. If you're using

a standard automotive petroleum oil in your motorcycle and running it for more than 1,500 miles, you are taking your chances. By 1,500 miles, the VII additives are pretty much all broken down, and the oil has therefore thinned out enormously.

Your engine will not explode if you use Spiffo-Magic Superlube for 4,000 miles. Your engine will not explode if you never use synthetic oils. However, any of these choices puts additional strain on your engine. You buy $65 tires for your car that last 45,000 miles, and $100 tires for your bike that last 8,000 miles. Why on earth would you try to save $5 on each oil change to buy an oil that can't hold up in a motorcycle engine? My DL650 runs its oil through the transmission, I run off-road (extreme environment due to silicon blow-by at the piston rings), I'm pretty much always revving my engine at 5500 rpm or more (red line on the Corvette, the one that comes with Mobil-1 as factory fill). I stress my little engine enough without making it use dinner candles as lubricants. Nor do I wish to make the bearings run in 10w-40 oil that's broken down to 10w-15 oil.

Some people should, in my opinion, clearly use a synthetic oil. You should be using a synthetic if:

- you routinely start your engine in temperatures under 40°f, 5°c.
- you live somewhere where it gets below -35 degrees, and you want to start your car. In this case you must use either Mobil-1 0w-30 or the Canadian 0w-40 Rotella. If you're riding your bike in -40 degrees, I want a picture just before you die.
- you leave your vehicle sit unused for months at a time.
- you are unable or unwilling to change your oil within 2000 miles.
- you have one of these new 4-stroke MX bikes. These MX bikes hold only about one quart of oil, all of them have marginal cooling systems, and if there's a more severe use of an engine than MX, I don't want to be physically present when it happens.

If it's below -55c, -65f, stay home. Really.

Three synthetics stand out from the rest: Mobil Delvac 1, Mobil-1 SUV and Shell Rotella T Synthetic. These are C certified industrial oils meant to be purchased in 55 gallon drums and used by companies which run a lot of diesel engines. The Commercial oils, as discussed above, have more expensive additive packages which are meant to prolong engine life and oil life, as opposed to being cheap to buy at Pep Boys and helping the car companies meet their CAFE requirements. These oils meet all the automobile requirements through SJ, and also have extra additives to help pick up gunk in the engine, to keep the oil from becoming acidic, and to maintain the oil's viscosity over a long time. In fact, the manufacturers talk about their oil's viscosity resistance to shear forces - exactly what a motorcycle needs. Shell Rotella-T Synthetic is available at Wal-Mart for $13 / gallon, so I consider this the motor oil of choice. Delvac-1 is very hard to get in the west - there are only two places in all of California where you can buy it. Mobil-1 SUV is readily available everywhere for about $4.50 / quart. When used with the correct filters, these oils are certified for 50,000 mile oil change intervals, and are frequently used for 100,000 to 150,000 miles in diesel long-haul trucks. Now, before you get all excited about the possibilities, you must also keep in mind that the diesel engines don't run their oil through their transmission, and the large diesels all have two oil filters, one a normal paper filter, and the other a 1 or 2 micron filter that catches pretty much everything. We don't have these secondary ultra-fine oil filters on our bikes. Also, the large diesel engines hold eleven gallons of oil - a oil and filter change costs these guys $350 if they use synthetics, $150 if they don't.

The synthetic diesel oils are 5w-40 oils. Some people have expressed concern to me that this doesn't match the 10w-40 specification for their engine. The 5w rating only applies when the oil is cold, below about 80° f. Once your oil and engine are up to operating temperature, these are 40 weight oils, just like all the others. In cold conditions, under 40° f, the 5w oils are much better for your engine than a 10w oil.

AMSOil, Motul 5100, Mobil-1 MX4T, Mobil-1, Redline, and Golden Spectro are apparently made with high quality additive packages, similar to the commercial synthetics. Personally, I would find it reassuring if these oils were CI-4 certified. However, many motorcyclists have used these oils for years with good results. They are all fine oils, and perfectly acceptable to run in your motorcycle. They are a bit on the pricey side. Delvac-1, AMSOil, Redline and Motul synthetics contain no petroleum oils - they're pure synthetic. To the best of my knowledge, all other synthetic oils contain some amount of Group III oil.

Mobil-1 automotive oils all contain small amounts of moly - about 100 to 200 ppm. This can cause clutch slippage in some motorcycles. I've only heard of this being a problem in Honda Shadows.

I'm sometimes asked if it's ok to blend your own oils. Yes, it is. Oils are all made out of pretty much the same chemicals, and nothing really bad will happen. If I wanted to blend my own oil, I expect I would use something like 25% Motul 5100 10W-40 and 75% Chevron Delo 15w-40, which would get me both the advantages of a lot of diester stock (5100 is pure diester) and the diesel additive package. In the winter, however, I would use 25% Motul and 75% Rotella synthetic, to get the superior low temperature performance. In fact, I just run Rotella synthetic in everything I own, year round: ST1300, DL650, Superhawk, Chevy Silverado, motorhome.

I'm also sometimes asked if it's ok to run non-Harley oils in Harley-Davidsons. In my opinion, yes. If you change your engine oil every 3,000 miles or so, you can run pretty much any decent oil. I ran Valvoline in my Harleys for 120,000 miles. For extended oil life or superior protection, I recommend AMSOil, Golden Spectro, Motul 5100 or Mobil-1. Harley recommends a 20w-50 oil, so Rotella or other synthetic diesel oils will not do. However, the 15w-40 diesel oils meet the same film strength standard as 20w-50 oil, and are just fine to run in your Harley. I'm told that the standard Harley oils are made by Sunoco, and the Syn-3 is made by Castrol. The Syn-3 Harley synthetic is primarily a Group III oil, and contains very little PAO or Diester stock. I don't consider the Syn-3 Harley oil either particularly excellent oil, nor a competitively priced oil.

If you live in another country, you'll have to do a bit of research to decide on an oil. Generally, any oil certified for use in a late model Volkswagen or Mercedes turbo diesel is a good choice. Another good idea is to go to a truck stop and ask the truckers about brands. Rotella is marketed all over the world, but in other countries it's called Rotella or Rimola or Helix Ultra, and the formulation may be a bit different, depending on local climate and preferences. It will likely also be a lot more expensive than it is here. Sorry. I don't make your tax policy. Nor ours. They would all be very different if I did.

If you prefer a less expensive petroleum oil, Chevron Delo 400, Mobil Delvac 1300, and Shell Rotella T are available at any auto parts store for under $7 per gallon, or at Sam's Club or Costco for under $6 per gallon. This price is reasonably competitive with passenger car oils, and you are getting a Group II oil with the superior commercial additive packages. Notice in

the table above that these oils have particularly good high shear film strength, meaning the protection you get for your bearings is much better than with a 10w-30 or 10w-40 oil. I don't have any information about how long you can run these oils before their viscosity breaks down, but I'm confident it's at least as long as the best consumer petroleum oil. If you're really into saving money, you can often find these oils locally in 10 gallon drums for about $50. This should keep your bike, your car, and your wife's car in good shape for at least a year. Farmers, ranchers and truckers buy these oils in large quantities, and we get to ride piggy-back on their economies of scale.

A comparison of a few oils. These numbers refer to the blended oils after VIIs are added.

	Rotella	Rotella	Syntec	GTX	Syntec	Mobil-1	Valvoline	Valvoline
	Synthetic		Synthetic		Blend	Synthetic	Synthetic	
Rating	5w-40	15w-40	10w-40	10w-40	10w-40	15w-50	10w-40	10w-40
pump Vs	39k	?	60k	60k!	60k!	?	?	30k*
Vs @ -30	6400	?	7000	7000	7000	?	3150*	6500
Vs @ 40	89	108	89	100	111	125	125	97
Vs @ 100	15	15.5	13	14	16	18	14	14
VI	176	141	148	150	152	153	155	148
Flash	246	213	232	213	213	230	230	216
Pour	-40	-24	-33	-30	-30	-45	-40	-33
Ash	1.3%	1.5%	?	?	?	1.3%	?	.8%
Neutral	10	11.5	?	?	?	?	?	?

* = @-20c
! = @-25c

If you want to do some research on oils yourself, here are some links. I read all this stuff and I'm still alive, but a bit weird. **Oil viscosity defined**. **API Service classifications**. **Everything you ever wanted to know about oil**, but were afraid to ask. Here's what an **additive package manufacturer** has to say about oils. **Chevron talks about base oils** and GF-4 oils. **Consumer Reports tests oils** for 4,500,000 miles in NYC taxis**. Lubricants primer by Red Line. All about oil by Ed Hackett, a college professor. Oil Advice from Mike Guillory, a petroleum engineer. More Oil Advice. Jeff Di Carlo also has an opinion. Check out the articles in MCN Jan-Feb '03. MCN '94 includes viscosity breakdown testing. Another article that includes viscosity breakdown testing. The history of synthetic oils, only *slightly* self-serving. Oil additives = snake oil? (yes) More on oil additives = snake oil**

Mobil wants your money, as does Shell, Valvoline, AMSOil and Spectro Oil. You may be sceptical about the oil companies interests, but they are the people making what we buy so it's interesting to hear who they think we are and what they think we need.

Are Harley oils the best?

FAQs about commercial oils answered by Shell. Are diesel oils really ok for motorcycles?

Do you recommend using ROTELLA in wet clutch applications?

ROTELLA T does not contain friction modifiers that are added to many passenger-car-only-oils, and it does not comply with all requirements of ILSAC GF-1, GF-2, GF-3 and GF-4 (the ILSAC oil specifications are often recommended by many gasoline passenger car engine manufacturers). That can be good for motorcycle/ATV use. Friction modifiers can upset wet clutch operation. And the ILSAC requirements limit phosphorus content.

Diesel engines and other engines with highly loaded valve trains, as well as transmissions, need extra (compared to passenger car engines) extreme pressure wear protection, which is provided by an additive that contains phosphorus.

One negative might be where the engine manufacturer recommends oil meeting JASO requirements. Part of the JASO requirement limits ash content to 1.2%.

Oil ash contributes to combustion chamber and spark plug deposits.

The ash content of CI-4 PLUS spec-ed ROTELLA T Synthetic SAE 5W-40 is 1.47%. However, the CJ-4 spec-ed Shell ROTELLA T with Triple Protection is now at 1.0% ash.

Motorcycle Motor Oil

by Mike Guillory, June 2002

Brief Introduction

Along with keeping things adjusted properly, using a good quality motor oil and changing it regularly is the key ingredient to keeping your motorcycle running happily for a long time. You cannot go wrong using one of the various "motorcycle-specific" oils, now available also from some of the major oil companies. However, many motorcyclists object to the higher prices of those oils and for convenience prefer to buy oil at their local automotive supply store, which is a still a good option. This article will provide you with information to make an informed choice.

Price of Motor Oil

So how do you make an intelligent choice? Will $1.00 a quart automotive oil work okay or do you need to pay $4 to $12 a quart for "motorcycle" oil? You have to answer that question yourself, but here are a few facts to help you make the best decision for your situation.

The owner's manual of your motorcycle probably says something very similar to the following:

Use only high detergent, premium quality motor oil certified to meet API Service Classification SF or SG (shown on container). The use of additives is unnecessary and will only increase operating expenses. Do not use oils with graphite or molybdenum additives as they may adversely affect clutch operation." That's pretty clear. But what do you do since automotive oils now say on the container "meets SL Service?" That's easy! By consensus of the API and the manufacturers, the current SL classification meet all requirements of SF, SG, SH, and SJ plus all earlier API gasoline categories. The current SL actually offers some additional benefits over the older classifications. So, if the motorcycle requirement says "SG", be confident that "SL" indeed meets that requirement.

The Vanishing Zinc and Phosphorous

It is a fact than many SL oils now contain lower levels of ZDDP (the zinc/phosphorous extreme pressure additive) and that is a big concern to a lot of motorcyclists. ZDDP is a last resort protection against metal-to-metal contact. Whereas a few years ago the zinc level was typically 0.12% to 0.15% in SG automobile oils, some SL oils now have as little

as 0.05%. However, this in itself may not be a problem since normal operation of a motorcycle on the street would never result in metal-to-metal contact any more than it would in your automobile. Remember these SL oils meet the most demanding protection requirements of modern, high-reving, powerful 4-stroke automobile engines (among others). And there is no reason to believe the lubrication requirements of street motorcycles is measurably different.

However, if you race you probably need higher levels of ZDDP and should use appropriate oils or ZDDP additives.

NEW Motorcycle Oils

Seeing an opportunity to bridge this perceived gap between motorcycle oils and automotive oils, many traditional oil marketers like Castrol, Mobil, Pennzoil, Quaker State, and Valvoline now sell their own "motorcycle" oils at very competitive prices, and alongside their automotive oils. I have found them at several of my local autoparts stores and even at one WalMart store. Call or visit the auto supply stores in your area and ask. Even if they don't routinely stock them, they probably can order a case for you at substantial savings because their mark-up is generally quite a bit less than motorcycle shops.

Although not a motorcycle oil, oils with the designation "Racing Oil" are not intended for street use, generally meets "SG" requirements and has somewhat higher levels of additives, like ZDDP. An example is Valvoline's VR1 Racing oil available in 20w50 weight. These should work fine in our motorcycles.

Energy-Conserving Oils

Some are concerned that the new "energy-conserving" motor oils may have "friction modifiers" which will cause clutch slippage. Since that is a legitimate concern it is best to use only oils which are NOT "energy-conserving for motorcycles with wet clutches." Read the back of the container. It clearly identifies this. In general, only the very lighter oils, like 10w30, 10w20, 5w20, are energy-conserving. All 5w40, 5w50, 10w40, 15w40, 15w50, and 20w50 oils which I have found are not energy-conserving and can be recommended for general motorcycle use.

It is commonly mis-stated that "SJ and SL oils have friction modifiers which will cause wet clutch slippage." In reality, all oils have a friction modifier, that's how they work. ZDDP itself is a friction modifier. The real issue is to avoid getting the friction so low, with very thin oils containing extra amounts of friction modifiers, that clutches will slip under normal use. Stay away from energy conserving oils and you should be fine, if your clutch is in good working order.

Synthetic or Conventional

What about synthetic vs. semi-synthetic vs. "dino" oils? All motor oils have several special additives formulated into the oil to protect from corrosion and wear, plus detergents to keep combustion products in the oil. For normal (non-extreme) use, "dino" oils protect as well as the synthetic oils. However, if you plan to race, run at

extremely high temperatures, or plan to extend oil-change intervals, or simply want the best, then a synthetic or semi-synthetic may be your best choice.

Real World Test Results

Are there any "real world" examples of long motorcycle engine life using automotive oils? There is a good one in the June 1996 issue of Sport Rider magazine in a report called the "100,000 mile Honda CBR900RR." The owner used conventional Castrol GTX oil, 10W40 in the winter, 20W50 in the summer. He changed it every 4,000 miles, changing the filter every OTHER oil change. No valve clearance adjustments were required after the initial one at 16,000 miles. And a dyno test against the same model with only 6,722 miles showed torque and horsepower virtually identical. The 100,000 mile bike was even used for some racing. In a subsequent follow-up, the same CBR had passed 200,000 miles and was still going strong! Plus, many motorcyclists have emailed me with their very positive results using nothing but automotive oils for years in a variety of rides. Oils have changed over the past 10 years, but that just means we need to be more careful in our choices.

Frequency Asked Questions

1. **What is a reasonable oil-change interval?**

   Most manuals recommend not exceeding 8,000 miles after break-in. But short-trip riding is considered severe service and the most common oil change interval is 3,000 to 4,000 miles. However, a long trip is the easiest service for the oil and going 6,000 to 8,000 miles between changes while on a cross-country ride is routine. Also, the uses of synthetic oils can easily double the oil-change interval.

2. **Will changing the oil even more frequently, like every 1,000 miles, prolong the life of the engine?**

   Not very likely, because even at 3,000 to 4,000 miles, the oil and additives are not degraded very much. Changing more often just wastes money.

3. **What about the claims that motorcycle-specific oils contain "special polymers which are resistant to breakdown caused by motorcycle transmissions?**

   Oils usually require the addition of polymers, called VI improvers, to create a multi-viscosity oil, like 10W-40. Whether it is a motorcycle oil or an automotive oil, all polymers are subject to some degradation in the transmission. Full synthetic oils tend to have fewer polymers than conventional oils and therefore degrade less.

4. **Why are motorcycle oils so much more expensive than automotive oils?**

Cost of doing business is higher per quart of motorcycle oil. Large oil companies make so much more product that their profit margin per quart does not have to be so high. That's why the newer motorcycle oils being marketed by some oil companies are only marginally more expensive than their automotive counterparts.

5. **What about the claims by specialty motorcycle oil manufacturers, that their oil is better?**

   That's a good one. Next time you hear that line, simply ask, "What evidence do you have?" I've never seen any. If you do get any, please let me know! I don't believe that there is any.

Now, armed with all this information, you are ready to make your choice between automotive oil and motorcycle oil. Either will work fine. Your motorcycle probably cannot tell any difference. There are many riders, the author included, who use nothing but good quality automotive motor oils. There also are many who use nothing but motorcycle oils. All indications are that both choices work equally well because motorcycle engines are designed so well that the oil really doesn't make any measurable difference. As long as it meets SG, SH, SJ, or SL service requirements.

Addendum

In the past several years, various reports went around regarding independent studies that showed "automotive" oils that are not energy-conserving (EC) work just as well as motorcycle-specific oil and in many cases better. In former revisions to this article I listed the oils I found locally (Houston, Tx) that were 10w40 and heavier and not energy-conserving. I've discontinued that as it adds little value. All one needs to do is look at the back of the oil container where the lower half of the identification circle will have the words "energy conserving" if it is. Don't use those in wet clutch motorcycle applications, as they may cause clutch slippage. If the lower half of that circle is blank, as all 10w40 and heavier oils should, that means it is NOT energy conserving and should be fine in wet clutch applications.

Heavy-Duty Oils

My favourite oils and the ones I most mostly recommend for motorcycle use, are the "heavy-duty" oils. They are commonly misunderstood, and often referred to as "diesel oils." They are NOT energy conserving, have higher zinc levels, as high as 0.16%, and by virtue of their multi-duty have a better engine protection package than an oil that is only rated "SL". These heavy-duty oils are rated SJ or SL, plus CH-4. They are currently closer in formulation to the motorcycle specific oils and to the "SG" oils that many motorcycle makers recommend. Following are some examples of these oils, generally 15w40 oils by industry convention. There may be several other 15w40 oils that I am not familiar with.

1. **Castrol RX Super 15w40**

2. **Chevron Delo 400 15w40**
3. **Mobil Delvac 1300 Super 15w40**
4. **Pennzoil Long-Life 15w40**
5. **Quaker State 4X4 Synthetic Blend 15w40**
6. **Shell Rotella-T 15w40 (my personal favourite)**
7. **SuperTech 2000 (WalMart) 15w40**
8. **Valvoline All Fleet 15w40**
9. **Castrol Syntec Blend Truck and 4X4 15w40**

Full Synthetics - for Maximum Protection

For years Mobil One 15w50 has been a favourite of motorcyclists. In recent years it has gone from its original formulation to an improved SJ "TriSynthetic", and more recently as SL "SuperSyn." In May and June of 2002 some emails have gone around about Mobil One 15w50 no longer being suitable for use in motorcycles. As far as I have been able to investigate, that is a false concern. I was assured by Mobil directly that Mobil One SuperSyn remains a suitable oil for motorcycle use, although they naturally recommend their motorcycle Mobil one.

In contrast to that, recently Castrol has been recommending that their 5w50 Syntec is NOT appropriate for motorcycle use because of additional levels of friction modifiers.

A fairly new player in the synthetic market is Shell with Rotella-T Full Synthetic 5w40. It is not energy-conserving and according to Shell performs competitively with Mobil Delvac One full synthtetic, which means it offers even more protection than does Mobil One 15w50. At least one motorcyclist has reported to me good results so far with his use of the new Synthetic Rotella-T. I haven't tried it yet.

Delvac One would be one of my highest recommendations but I don't know where to buy it. For those who may have connections with a long-haul trucking operation, where Delvac One is known to be used in oil change intervals up to 150,000 miles, I suggest trying to get some if you want a superior oil.

There are a number of other synthetic and semi-synthetic oils available and I have no reason to believe they are in any way inferior. Just follow the advice and use one which is not energy conserving.

Important Note: Be sure and use the recommended viscosity range, e.g. 10w40, 20w50, etc. for the climate in your area. In general, to protect your motor use the heaviest oil you can that still meets the manufacturer's guidelines. For example, 20w50 is better in warm weather than 10w40, because it gives you a thicker oil cushion between bearing surfaces at operating temperature. For racing, a thinner oil will offer less resistance and thus more power, but will offer less protection.

I personally believe in these oils and use nothing else in my motorcycles. As always, you have to make your own, informed decisions.

A Note on Warranties

Since it is generally accepted within the industry that current classifications also meet all older ones, there can legally be no warranty issue. In fact, some oils actually say on the package "SG" in addition to SH , SJ and SL. However, if any of the very newest motorcycles specify oil meeting the new JASO, or other motorcycle-specific oil specifications, and no reference to "SG" or similar automotive specs, then you may have a potential warranty issue so behave accordingly.

And finally, it is gratifying to have received so many emails the past three (3) years from motorcyclists finding this oil and oil filter information useful to them. Keep them coming. I am happy to help, and I plan further updates as things change significantly.

The author is a Chemist, retired from a major Oil and Chemical Company, after a career in the Quality Assurance of Fuels, Lubricants, and Chemical products. He and his wife both ride.