THE GREAT OIL DEBATE: EXXON-MOBIL

The designer of Mobil I V Twin 20W 50 joins in

BY CHUCK GOLDMANN

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Chuck has worked for Exxon Mobil for almost 30 years. Since joining the company immediately after receiving his master's degree in chemical engineering, he has spent his entire career in research, working on the development and testing of automotive engine oils, both Mobil I and conventional mineral oil products. Most recently, Chuck led the Mobil 1 Motorcycle Oil development effort. Chuck is also a Harley-Davidson owner and rider. His current_ bike is a 1999 Low Rider with big bore kit, flat-top pis tons, Mikuni carburetor, SE 203 cam, SE performance valve springs and SE air cleaner kit, all feeding into a Hooker 2-into-I exhaust system. Chuck runs Mobil I V Twin 20W-50 in his engine, Mobil 1 75W90 Synthetic Gear Lubricant in the transmission, and Mobil I MX4T I OW-40 in the primary. He changes all of these at the factory recommended 5,000-mile interval.

Donny, as a big fan of your Techline articles, I'm sorry to say I can't completely agree with your advice. I don't believe that automotive oils are just fine for your Harley. On the other hand, I do agree that synthetics are better than mineral oils, as long as we can agree on what we mean by synthetic.

AUTO OILS FOR MOTORCYCLES???

Simply put, automotive engine oils are not designed with motorcycle engine and/or transmission requirements in mind. With that said, one should always attempt to use a motorcycle engine oil as a first choice. Now, that's not to say that automotive engine oil would not work in a Harley engine.

However, our recommendation here is similar to what The Motor Company recommends (outside of HD 360 oil) in that any motor oil run in a Harley engine should meet the performance requirements of an API C category (e.g. API CF, CF-4, CG-4, CH-4, etc.) oil. Oils that provide API C-type quality are formulated with the proper chemistry to provide some level of high temperature diesel engine protection, depending on the category. As long as API C performance is met, then an oil also rated as an API SH or SG quality product should function properly in an air-cooled H-D engine. So, on this point, The Motor Company and I are in agreement from the standpoint that using automotive oils that do not meet the performance requirements of an API C category in your bike is probably not a good idea.

However, Harley continues in this area by stating that there are virtually no dual-qualified automotive motor oils on the market (i.e. passenger car products which also offer API diesel performance). The reason for this is that the higher level of deposit control additives required for API C performance often works to the detriment of fuel economy, and fuel economy is the primary focus behind API SH and SJ. These points are true; however, Mobil 1 motorcycle oils, as well as all of the Mobil I automotive engine oils, meet the requirements of API SG, SH and CF So, there are at least a few oils currently on the market that offer both API S and C performance.

Bottom line: I personally use Mobil I V Twin 20W-50 in my bike. If I were on the road and down a quart, and I could not find Mobil I V Twin 20W-50, then I'd use Mobil I Tri-Synthetic Formula 15W-50. If I couldn't find that I'd use HD 360 20W-50. For me, any other automotive oil would only be an avenue of last resort.

MOTOR OIL FORMULATIONS – ADDITIVES

When discussing additives that are used in engine oil formulations, the entire system must be taken into account, not just the individual components. After all, an engine oil formulation is like an engine: if you don't have all of the right components in the right sizes/quantities and all working together in harmony, your engine won't run.

Why is that? Well, there are several reasons. First, almost all additives are multifunctional, which means they do more than one thing. Sometimes this multifunctionality is beneficial; sometimes it's not. For example, zinc and phosphorus containing anti-wear additives are also excellent antioxidants. Some of the most effective ashless dispersants, which keep sludge and dirt particles suspended in the oil, attack certain seal materials causing them to harden and potentially leak. Friction modifiers like molybdenum, which help improve fuel economy in energy-conserving oils, promote high temperature deposit formation and must be compensated for with other additives. Also, just like base oils, additives are subject to oxidation and thermal degradation. They can break down and actually contribute to deposit formation. Additionally, additives can compete with each other. If a friction modifier, for example, is too active it can keep the anti wear additive from reaching the metal surfaces, leading to excessive wear. As you can see, the additive system used in any engine oil is more than just the sum of its parts. It is a complicated system that has been carefully formulated to provide maximum performance, usually at a specific cost. To make matters more complicated, when additives are mixed together before or as they are added to a base fluid, they can react with each other and form new compounds that may have properties different from the original additives. Therefore, the order and temperature at which additives are mixed together is also important and must be controlled during manufacture.

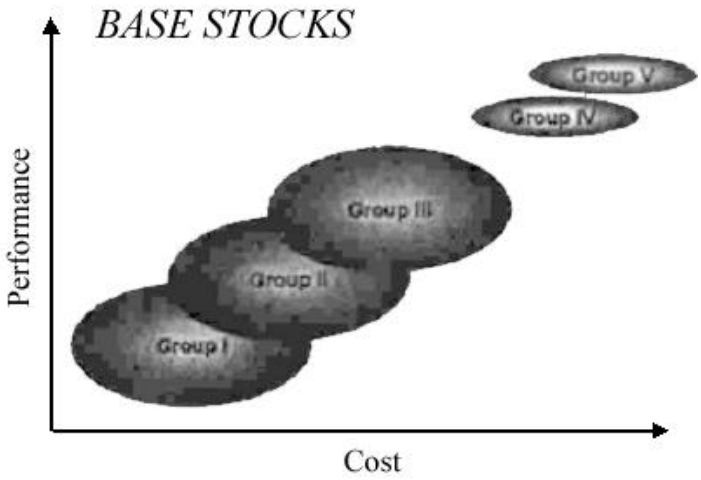
Okay, now let's look at the other half of the puzzle, base stocks.

MOTOR OIL FORMULATIONS – BASESTOCKS

The American Petroleum Institute (API) has divided all base stocks into five major groups. In general terms, as the group number increases so does the performance of the base stock and the cost of manufacture. However, one must keep in mind that, at the end of the day, it's the overall formulation (i.e. additives included) that dictates the performance of engine oil.

Group I base stocks are your standard solvent refined mineral oils that have been around for years. They contain sulfur and aromatics - some sulfur compounds have natural anti-wear and antioxidant properties while others can produce deposits, which is good and bad. Aromatics provide good solvency, which aids in additive solubilization and provides some natural dispersancy. This is also good. However, aromatics are also easily oxidized, leading to oil thickening, which is bad. Group I base stocks have a wide molecular weight distribution. This means they contain molecules that are both smaller and larger than you want for best

performance. The smaller molecules boil off at lower temperatures, and the level to which this occurs is referred to as the oil's volatility. Oil consumption in an engine is related to an oil's volatility level in that lower volatility typically means lower oil consumption (this is provided the engine itself is in good mechanical condition). The larger molecules are more prone to thermal and oxidative degradation, leading to greater high temperature deposit formation.



Group II and Group III base stocks are more refined via hydrofinishing or hydrocracking. This lowers or removes sulfur and aromatics. While this helps minimize the bad features of Group I base stocks, mixed some of the positive features are also must be removed and must be compensated for with additives. Also, the molecular half weight distribution is narrowed, which helps to improve volatility.

Most conventional mineral oils marketed in the U.S. use Group I base stocks. Group II base stocks will probably see (API) increased use with the introduction of o five the new API SL and ILSAC GF-3 specifications likely to be issued next year. Group II stocks may be required to meet significantly lower volatility requirements for low viscosity energy conserving oils. Group III base stocks are more prevalent in the European market where they are used primarily in mid-grade and semi-synthetic products. In general, whether Group I, II, or III stocks are used, it's the combination of the additive system with the base fluid system that will determine how well a motor oil formulation will perform.

This brings us to Group IV and V base stocks. These types of base stocks are synthesized from basic chemical building blocks. The advantage with this approach is that you end up with a base stock molecule that is specifically tailored for motor oil. In most parts of the world, Group IV and V base stocks are accepted as being synthetic, while Group I through III are referred to as mineral oils. The problem is that there is no industry-accepted definition of the term synthetic and, more importantly, in the U.S. there is no legally accepted definition for what the term synthetic means. So when I refer to synthetic, I mean either a Group IV or V base stock. However, other marketers in the U.S. may consider products based on Group III and even Group II stocks as synthetic.

Mobil 1 synthetic lubricants are based on one of three types of Group IV and V base stocks: polyalphaolefins (PAO) esters, or alkylated napthalenes. PAO's are the basis of Mobil I synthetic engine oils. They are made by taking ethylene - a clear, colorless gas consisting of two carbon and four hydrogen atoms - and reacting these molecules to form a 10-carbon atom chain, called decene (for 10). Decene becomes the basic building block for all the PAO molecules. By hooking more and more of the decene chains together, you can tailor the viscosity grade from very thin to very thick. However, even though PAO molecules have