SYNTHETIC **MOTOR OIL :** A WHITE PAPER

Mission

THE INFORMATION ON THS WEBSITE WILL BE UPDATED PERIODICALLY.
PLEASE RETURN AND LOOK OVER THE INFORMATION OFTEN!!

The mission of this White Paper is threefold:

1) to promote the understanding of synthetic motor oils;
2) to discuss the environmental benefits of these synthetic oils; and 3) provide you with a great deal of information about Synthetic oils so that you might gain an understanding the potential of synthetic oils to save our economy billions of dollars. **Since synthetic oils can last 8 to 12 times longer than petroleum based oils , the need to use resources to both PRODUCE and DISPOSE of motor oils is significantly reduced for synthetic oils relative to petroleum oils.**

Thus, the following white paper gives significant information about the superiority of synthetic oils and many links to encourage your purchase and use of synthetic oil for both personal and societal benefits. It is hoped that this white paper will help you with the purchase decision. The use of synthetic oils can begin our {Internationally} "march" toward improved vehicle performance as well as significant environmental benefits.

ENVIRONMENTAL DISCUSSION OF SYNTHETIC MOTOR OIL

Our mechanized society cannot function without lubricants. The dilemma is that oil is both necessary for our life-style and potentially destructive to nature. Quite simply, we must select innovative, efficient products that will help solve our pollution problems.

The introduction of synthetic motor oils, by the Germans during World War II represented a major breakthrough. Synthetic oils are specially designed to protect engine components, reduce emissions, last longer, reduce fuel consumption and prevent environmental pollution.

According to the U.S. Department of Energy's Pollution Prevention Requirements, the first step in revitalizing a cleaner nation is pollutant source reduction. Synthetic oils accomplishes this by extending the interval between motor oil changes which can reduce the source of motor oil pollution by more than eleven times.

Consider this: in 1994 an estimated 190.8 million motorized vehicles were on the road in the United States alone, with an estimated 700 million motorized vehicles were in operation throughout the world. If, by petroleum oil manufacturer's recommendations, these vehicles have their oil changed every 3,000 miles, with an average five-quart system, almost 1 billion quarts of used oil will be generated each month. Dumping 240 million gallons of oil is nearly the same as two Exxon Valdez spills each month.

How dangerous is used oil? Just one So are we drowning in oil? It is estimated at present that over **240 million gallons of oil are improperly discarded annually.** One

gallon of oil can make one million gallons of water too foul to drink and 35 ppm of oil will kill fish. Improperly disposed used oil is dangerous.

Improperly dumped used oil seeps through landfills into ground water, disrupts bacterial digestion in sewer treatment plants and washes into lakes and harbors. At present, used motor oil is the largest single source of oil pollution in our nation's waterways. Certainly the first thing we can do is not create so much used oil to begin with . . . and the United States Department of Energy seems to agree.

Where Does All the Used Oil Go?
40% is dumped on the ground or down the sewer.
21% is thrown out with the trash, ending up in landfills.
6% is burned.
19% is reused for miscellaneous purposes and 14% is recycled.

We can Prevent Billions of Quarts From Being Dumped

Most automobile manufacturers/oil producers recommend oil change intervals of 3,000 (+-) miles for petroleum oils. Synthetic oils have recommended oil changes of(central tendency) 9,000 miles to as much as 30,000 miles, which is 3 to 10 times fewer oil changes. Can you imagine the positive environmental impacts if, for example, the 200 million automobiles (not including commercial vehicles) in the United States, used synthetic motor oils ! Assuming an average engine-life of 100,000 miles and an oil capacity of 5 quarts each, 12 to 25 billion quarts (or more) of used oil will be generated during a regular service lifetime (with regular oil changes every 3,000 to 6,000 miles). ***THE POSITIVE ENVIRONMENTAL IMPACT OF SYNTHETIC MOTOR OILS IS STAGGERING!!***

Each year nearly 900 million gallons of motor oil are burned-up and exit through the tail pipes of cars and trucks, creating emissions pollution. Petroleum oils volatilize (burn off) more readily than synthetic oils, thus, creating significantly more pollution.

Further discussion of the benefits of synthetic vs. petroleum oil follow; however, the **quoted/cited**, and highlighted text below is important enough to be part of this white paper. It represents research and opinion by the United States Military. This, to be sure, is one of the most unbiased “reads” you will get on synthetic oils.

Alternative For: Conventional oils
Compliance Impact: Low
Applicable EPCRA Targeted Constituents and CAS Numbers: N/A
Overview: Synthetic motor oils are blends of synthesized hydrocarbon fluids (SHFs) and esters derived from petrochemicals, and are manufactured by combining the various organic chemicals. They can be used in place of conventional motor oil. Other synthetic hydrocarbon compounds are also suitable for lubricating oils, and manufacturers may blend two or more of these compounds together to achieve the desired properties. While they appear chemically similar to mineral oils refined from crude, they are pure chemicals that do not contain the impurities or waxes inherent in conventional mineral oils. Conventional mineral oils thicken or thin dramatically with changes in temperature. As a result, manufacturers add thickeners to conventional multigrade oils to slow thinning as engine temperatures rise. Synthetic oils have high resistance to changes in viscosity due to temperature, and thus have less of a requirement for thickeners. As such they provide a heavier, more stable protective oil film for engine bearings and piston rings than that provided by similar SAE-grade mineral oils.

Synthetic oil is superior to petroleum oil because it permits better cold weather performance and longer endurance. Synthesized compounds continue to flow at low temperatures. Synthetic 10W-30 oils flow at temperatures as low as -54°C (-65°F) and pump at lower temperatures than similar SAE viscosity conventional oils. Synthetic 15W-50 oils flow at -48°C (-55°F) and pump at temperatures as low as many conventional SAE 5W-30 oils. According to the San Antonio Air Logistics Center (SA-ALC), the primary benefit of synthetic oil is this superior performance at low temperatures.

Synthetics are also more thermally stable. Manufacturers claim that synthetic oils help improve fuel economy, reduce friction and wear, decrease oil consumption, better engine performance at lower temperatures and extend oil change intervals. However, since synthetic oil has improved fluidity, oil loss will occur more quickly through leaks because the thinner fluid will flow through a bad seal or worn ring. SA-ALC reports that the use of synthetic oils has not enabled them to reduce oil change intervals.

Although some synthetic compounds are not compatible with conventional oils adding a quart of synthetic oil to conventional oil produces a compatible mixture. However, the lower friction resulting from the use of synthetic lubricants makes them unsuitable for break-in.

Compliance Benefit: The substitution of synthetic oil for conventional oil may allow longer intervals between change outs, thereby reducing oil consumption and waste disposal. The decrease in the amount of used oil generated may decrease the management requirements for used oil under 40 CFR 279 or 40 CFR 262 and may help a facility to meet the goals of Executive Order (EO) 13148. Moreover, since less oil should be stored on site, a facility will decrease the likelihood of reaching reporting thresholds under SARA Title III (40 CFR 300, 355, 370, and 372). A decrease in oil stored on site may also put a facility below threshold amounts for the requirement to develop and implement a Spill Prevention, Control and Countermeasure Plan under 40 CFR 112.

The compliance benefits listed here are only meant to be used as general guidelines and are not meant to be strictly interpreted. Actual compliance benefits will vary depending on the factors involved, e.g., the amount of workload involved.

Materials Compatibility: No materials compatibility issues were identified.

Safety and Health: The use of synthetic oil poses minimal safety and health concern. Care must be taken when handling hot oil. Proper personal protective equipment is recommended. Consult your local industrial health specialist, your local health and safety personnel, and the appropriate MSDS prior to implementing this technology.

Benefits:
$ Synthetic oil lasts two to five times longer than conventional oil; thus, waste oil generation can be reduced two to five times if synthetic oil is used.
$ Synthetic oils have high resistance to changes in viscosity due to temperature. As a result, they provide a heavier, more stable protective oil film for engine bearings and piston rings than is provided by similar SAE-grade mineral oils.
$ Synthetic oil permits better cold weather performance and longer endurance.
$ Manufacturers claim that synthetic oil yields better fuel economy, reductions in friction and wear, decreased oil consumption, improved performance, and extended drain intervals.

Disadvantages:

$ Synthetic oil costs more than conventional oil. However, the higher cost is typically offset by reduced waste generation.
$ Since synthetic oil has improved fluidity, oil loss will occur more quickly through leaks because the thinner fluid will flow through a bad seal or worn ring.
$ Some synthetic compounds are not compatible with conventional oils.
$ The lower friction resulting from the use of a synthetic lubricant makes them unsuitable for break-in.

Economic Analysis An economic analysis assuming synthetic oil lasts three times as long as conventional oil is presented below for a 12-quart capacity vehicle. Oil and filter disposal information was based on estimates from the San Antonio Air Logistics Center. Lubricant and filter price information was provided by the vendors.

Assumptions:

$ 30 vehicles in fleet.
$ abor cost: $20/hr.
$ abor: 0.5 hour per oil change.
$ il disposal: oils are recycled at no cost to the facility.
$ il cost: Synthetic - $14.51/gallon, Conventional - $4.42/gal.
$ conventional oil is changed three times per year, synthetic oil is changed once per year.
$ Filters cost $6.00 each.
$ Filter disposal: estimated at $100 per drum, 100 filter per drum
$ il capacity of vehicle is an average of 12 quarts (or 3 gallons).

Table 1. Annual Operating Cost Comparison for Synthetic Oil verses Conventional Oil Use

Operational Costs	Synthetic	Conventional
Labor:	$300	$900
Oil Costs:	$1,305	$1,193
Filter Cost:	$180	$540
Filter Disposal:	$30	$90
Total Costs:	$1,816	$2,723
Total Income:	$0	$0
Annual Benefit	-$1,816	-$2,723

Economic Analysis Summary:

$ Annual Savings for Synthetic Oils: $908
$ Capital Cost for Diversion Equipment/Process: $0
$ Payback Period for Investment in Equipment/Process: Immediate

Click Here to view an Active Spreadsheet for this Economic Analysis and Enter Your Own Values.
To return from the Active Spreadsheet, click the Back arrow on the Tool Bar.

NSN/MSDS: None identified.

Approving Authority: Appropriate authority for making process changes should always be sought and obtained prior to the procuring or implementing of any technologies described herein.

Points of Contact: For more information

Vendors: This is not meant to be a complete list, as there may be other suppliers of this type of equipment.

Chevron Corp.
6001 Bollinger Canyon Road
San Ramon, CA 94583
Phone: (925) 842-1000
URL: http://www.chevron.com/

Castrol Industrial North America, Inc.
1001 W. 31st.
Downers Grove, IL 60515

Phone: (800) 621-2661 or (630) 241-4000
FAX: (630) 241-1957
URL: http://www.castrolindustrialna.com/

Mobil Corporation
3225 Gallows Road
Fairfax, VA 22037
Phone: (800) 662-4525
FAX: (703) 849-6065
URL: http://www.mobil.com/

AMSOIL Inc.
AMSOIL Building
Superior, WI 54880
Phone: (715) 392-7101
FAX: (715) 392-5225
URL: http://www.amsoil.com/

Related Links:

None

Sources: Mr. Michael Schleider, Robins Air Force Base, January 1999.
Mr. David Elliot, San Antonio Air Logistics Center, January 1999.

[http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/6_II_4.html]

We could examine the environmental issues further, but LINKS are provided at the end of this white paper for your perusal.

WHY SYNTHETIC LUBRICANTS?

Synthetic motor oils provide a variety of benefits that help keep your engine running at optimal performance for many years and thousands of miles. To obtain a basic understanding of synthetic motor oils, we will first examine petroleum oils and their origins. Conventional oils [will sometimes be referred to as: mineral oil, conventional oil, dino oil and petroleum oil] are produced from crude oil that is pumped from the ground. Crude oil is made up of a complex mixture of molecules that form chains and rings of different sizes and shapes. Long molecular chains produce a thick, viscous oil that flows slowly. Shorter molecular chains produce oil that is less viscous and that flows more easily.

Petroleum oil is produced in an oil refinery, where crude oil is separated into fractions. These fractions become the basis for lubricating oils and fuels. Thick tangled masses of carbon chains become asphaltic materials used in roofing tar and road work; whereas, short molecular chain and ring compounds of carbon are volatile and can be refined into gasoline and other types of products.

Petroleum refining is a complex science, wherein, small amounts of contaminants, including sulfur and other reactive hydrocarbons, cannot be completely removed from the crude oil. Thus, these contaminants remain in petroleum oil base stocks.

All motor oils are made up of base oils and additives. In general, most fully synthetic motor oils contain some non-conventional oil because of the additive packages. Synthetic blends use both petroleum and synthetic BASE oils in combination with the additive package.

To meet the demanding requirements of current automotive specifications (and customers' expectations), many oil blenders are moving to synthetic oils. Several of these companies are manufacturing synthetic oils utilizing group IV bases oils (polyalphaolefins)-PAOs and group V bases oils (primarily esters), in conjunction with proprietary additive packages. Each synthetic oil represents a particular viscosity grade, and uses unique combinations of synthetic base oils and selected additives to tailor specific oils for specific applications.

Examples of excellent blenders of synthetic oils and lubricants are (in no particular order): Amsoil, Mobil 1, Neo, Motul, Pentosin, Elf, Synergyn, Silkolene,Maxima, Fuchs, Redline, and others.

Synthetic oils are superior to mineral oils!!

There are two basic reasons for this. Synthetic engine oils provide improved excellent low temperature pumping and cranking ability, and greatly improved high temperature stability and durability. Additionally, synthetic oils reduce oxidation (burn-off), and shearing. Shearing is the “breaking down” of the oil due to heat and mechanical forces. Moreover, synthetic oils reduce, or almost eliminate, varnish and sludge because of their purity and reduced oxidation.

Blending (manufacturing) Conventional and Synthetic Engine Oils

Synthetic and Conventional oils are formulated similarly. Various chemicals (additives) are added to base oil(s) to provide the protection that your engine needs. The additive technology used for synthetic and conventional oils is very similar. Dispersants, detergents, anti-oxidants, anti-wear additives, pour-point suppressants, viscosity index improvers (VIIs), etc. are all utilized in both synthetic and conventional oils. For synthetic oils; however, the additives used in their formulation are likely to be of higher quality and quantity than those used in dino or mineral oils.

Synthetic base oils are engineered to be purer substances with uniformly sized and shaped molecular structures. Conventional oils are made from crude oil in a refinery where they are hydro-cracked, hydroisomerized and filtered to reduce the “natural” contaminants in the oil.

Discussion of Base Oils

As indicated earlier, motor oils are comprised of two parts, the base oil and additive package. The base oil comprises 80-90% of the oil by volume and the additives the

remaining 10-20%. There are five groups of base oils: Group I, II, III, IV and V. Groups I to III are refined from crude oil containing tars, asphalts, waxes ,aromatics and other "bad things". These crude oils are "cleaned up", to the extent possible, by hydro-cracking and filtering with something akin to "kitty litter". The group III base oils are the better of this genre. However, they still contain variably-sized molecules and some contaminants that can result in sludge, varnish and other deposits in your engine. Moreover their pour-point and thermal properties are inferior to synthetic oils.

Synthetic oils are group IV (PAOs) and group V (esters) base oils. These synthetic oils are "man-made" synthesized uniform molecular structures that significantly improve the efficiency and effectiveness of these oils relative to their petroleum oil competitors. Consider rubbing your hands over a layer of marbles; and then rubbing you hands over a another layer made up of marbles, golf balls, and footballs. Obviously, the layer of marbles is more slippery (possesses less friction) than the layer containing marbles, golf balls and footballs because they are of the same size and shape. The marble example, above, is used to illustrate why the uniform molecular structure of synthetic oil is superior.

More specifically,, these synthetic oils have lower coefficients of friction and superior thermal (heat) and pour-point (cold weather performance) properties than do petroleum oils. Finally, synthetic oils have no waxes, tars, or other contaminants to sludge or varnish your engine.

Another way of viewing synthetic vs. mineral oils is the following analogy.
You could make excellent, pure drinking water by combining two atoms of hydrogen with one atom of oxygen, and ergo, pure water. Or, you can take water from a lake, boil it, filter it, chlorinate it; and then if all goes well, you can drink it. Combining hydrogen an oxygen is like synthesizing synthetic oil. Filtering and "cooking" represents the refining of crude oil to be used in lubrication.

While synthetic lubricants are initially more expensive, when you consider their extended oil-life, and engine-life extension capabilities, the overall long-terms costs are likely to be reduced.

Synthetic Oils & Their Low Temperature Advantage

Why is synthetic engine oil better at low temperatures? It has been incorrectly assumed, by many, that synthetic engine oils must be thinner (possess a lower viscosity) to provide this improved performance at low ambient and operating temperatures. Since oils are characterized by their SAE viscosity. A 5W-30 synthetic oil has the same viscosity as a 5W-30 conventional. The reason synthetic oils flow better at low temperatures is because they have no wax molecules in the base oil. Wax molecules crystalize at low temperatures which makes their pour points at higher temperatures.

Mineral oils are basically cleaned up crude oil, which has a considerable amount of wax. Consider the candles that you burn for ambience in your home, the wax or paraffin in these candles, most likely came from the same refinery where mineral base oil was

produced. Many of the manufacturing processes utilized to produce mineral oils are aimed at removing the wax and paraffin molecules. Unfortunately, it is difficult and expensive to remove ALL of the of wax and paraffin from the crude oil; therefore, some wax is always present in the finished product.

To reiterate, these waxes form a crystalline structure at very low temperatures, and that is why mineral base oils will actually solidify at about 0°F. Additives called pour point depressants, can help lower the pour point down to approximately –30°F to -40 Fin the finished conventional oil product. However, these waxy molecules, will nevertheless, contribute to reduced pumping capabilities, even at temperatures above the pour point.

Since synthetic base oils have no wax molecules, there is no opportunity for wax crystallization. Synthetic engine oils generally have extremely low pour points, sometimes as low as minus 50 degrees (or more)Fahrenheit(F) . As indicated earlier, this is due to the fact that synthetic base oils are constructed of uniformly shaped and sized molecules. It is a pure oil designed for excellent low temperature flow properties.

40% or more of engine wear occurs during the time in which the engine is started and reaches operating pressure and temperature. If you live in a very cold climate in which the ambient temperatures consistently fall below 32°F, synthetic motor oil can become a necessity to minimize start-up wear and “startability”.

Synthetics Possess Excellent (Superior to Petroleum Oils) High Temperature Capabilities

Synthetic oils provide superior protection against thermal (high temperature) breakdown. . While dino oils perhaps provide “acceptable” protection under normal operating conditions; once again, the non-uniform (small, medium, large and differently shaped) molecular structure “rears its ugly head” which reduce its thermal stability. Generally speaking, larger molecules are too viscous, and small molecules aren’t strong enough. However, medium-sized molecules are “just right” for production of motor oil (the three bears). There are problems with the small and large molecules, however. At high engine temperatures, small molecules tend to oxidize (burn-off) which causes increased oil consumption. Moreover, it also causes the oil to thicken (viscosity increases) because there are less small molecules to cancel out large molecules. Large molecules tend to possess weak molecular bonds. These weaker molecular bonds cause the oil to shear or break-down. Free oxygen can tie up this bond and start a process known as polymerization. This means that the molecule will grow as it “hooks up” with other free molecules. What you end up with is a “humongous” molecule. This can potentially produce sludge and varnish.

Formulation of Additive Package

Although mineral and synthetic motor oils are formulated similarly, there are some differences between the two that affect the performance of the oil. Additive packages found in synthetic oils are usually of higher quality than that of mineral oils. These

higher quality additive packages promote improved performance for the synthetic oil.

When an additive is added to an oil, it displaces some of the base oil. In mineral oils, the high cost additives displace low cost base oils which substantially increases the cost of the oil. To meet specific price-points, dino oils are blended with minimum cost additives to meet minimum protection standards. Obviously, this does not lead to the "best" motor oil possible.

Synthetic base oils are very expensive. Thus, including costly additives is not as cost prohibitive as with mineral oils. This promotes oil formulations of superior quality.

Which Synthetic Oil Should I use?

This is a difficult question. As mentioned earlier, synthetic oils are Group IV (PAOs) and Group V (All others than Group I to IV technically). However, most people consider Group V to be esters. This definition is held by most individuals. Most, if not all Tribologists (lubrication engineers), consider synthetic lubricants to be superior to petroleum based lubricants.

Notwithstanding this, in a court case 1999), arbitrated by the National Advertising Division (NAD)of the Better Business Bureau (BBB);with Mobil suing Castrol, the Arbiters decided that a Group III petroleum oil can be termed a SYNTHETIC OIL, and marketed as a SYNTHETIC OIL. If you are interested, you should read more about the above mentioned court case.

Although the courts (NAD/BBB) concluded that there is some(?) equivalence among Groups III, IV and V base oils, the "technical reality flies in the face" of their (the courts) decision.

The American Petroleum Institute (API), even subsequent to the above cited case, still does not classify "severely" hydroprocessed petroleum oil as synthetic. This is particularly important because this body is made of scientists (engineers), not marketers.

The major problem of these group III petroleum oils is that the QUALITY may vary "greatly" due to the differences and combinations of the petroleum feedstocks and refining methods utilized to produce these oils.

There really is not much of an industry standard definition when it comes to synthetic oil, so be careful. The term, SYNTHETIC OIL, has become more generic and uncertain these days and has more to do with the"court definition" of synthetic oil than the actual quality of the oil itself. **Do your "due diligence"** before buying synthetic oil. Do some research to satisfy yourself, that what oil your considering is, in fact, a **"real" synthetic oil**.

Manufacturers' warranty & Oil Quality

Finally, if your vehicle is still under the manufacturer's warranty, make sure that your choice of lubricants meets the specifications as enunciated in the owner's manual. Consulting the owner's manual is necessary to explain the necessary **viscosity**, **certification [**API (American Petroleum Institute), ACEA (Association of the European Automobile Manufacturers) , ILSAC (International Lubricant Standardization and Approval Committee) , and JASO (Japanese Vehicle Manufacturers Organization)**]** ratings to meet the warranty requirements. Make sure that the oil you choose meets the API service category.

While API certification does suggest some minimum standard, it should not be interpreted as an absolute measure of an oil's quality. API certification can cost hundreds of thousands of dollars. This fact, all but eliminates many of the smaller blenders that produce the "best" synthetic oils. Of course, this benefits the "big boys (Exxon-Mobil, Chevron, BP, Shell, chevron-Phillips...etc. Many of the best synthetic oils are not API certified because of these costs.

The **Magnusson-Moss Warranty Act** is the federal law that governs consumer product warranties. Passed by Congress in 1975, the Act requires manufacturers and sellers of consumer products to provide consumers with detailed information about warranty coverage. The "bottom-line" for this act is that your automobile manufacturer is required to prove that some part, equipment, oil, fluid, etc. that you used in your car **caused** a particular malfunction. Otherwise, they must stand behind their warranty.

The "Push" toward Improved Fuel Economy/Reduced Emissions

Since the 1990s, the momentum toward improving fuel economy and reducing emissions has been at the "forefront" of API/ILSAC's rule propagation and certification. These criteria do not always pave the way to lubricants that maximize engine, transmission and differential life and reduce wear.

Reducing engine/transmission/differential wear and emissions while simultaneously increasing fuel economy and equipment life; all variables simultaneously being optimized, is an extremely difficult, if not impossible, task to achieve. This is especially true in light of monetary constraints!!!

I do wish to leave this area leaving the reader with a suspicion that certified oils are somehow sub-par, rather, I simply wanted to impart the knowledge that certification is subject to certain constraints. Moreover, I wanted the reader to recognize that API/other **certification is not a surrogate measure of lubricant quality.**

Automobile & Vehicle Manufacturers Enter the "Fray"

The manufacturers have recently entered the labeling and certification "game". What does this mean? For example, General Motors several year ago required(strongly suggested) that Corvette buyers use Mobil 1 motor oil. Mercury Marine for many years warned customers against using synthetic oil. Of course, they labeled their own oil and it was petroleum oil. Miraculously, after they began labeling and marketing a synthetic blend oil, it was now OK for Mercury Marine customers to use synthetic oil. Need I go on? The time is approaching when the only oil specified by automobile manufacturers will be their own brand available at their dealerships.

I do not believe that this approach will lead to "bad" oils; but rather, probably not the "best" oils, and not 100% synthetic oils. One thing that you can bet on, is that the oils will be very expensive indeed!!

Technical Specifications of Oil

You may want to do some research into the specification of the lubricants to analyze their quality. The following data are typical of the specifications that you should examine and compare among oils:

$ ***KINEMATIC VISCOSITY*** of the oil - Thickness or "flowability" of an oil at both 40 and 100 degrees Celsius.

$ ***The POUR POINT*** _ The lowest temperature in Celsius/Fahrenheit(F) at which the oil remains fluid and will pour.

$ ***The FLASH POINT*** - the temperature at which the oil will begin to "burn - off" or oxidize.

$ ***HIGH TEMPERATURE/HIGH SHEAR(HT/HS)*** - how the oil "stands-up" against high temperature and extreme mechanical loads (a measure of how the oil will resist "break-down".

$ ***The NOACK VOLATILITY TEST*** - What percentage of the weight of the oil burns off under specified conditions.

$ ***COLD CRANKING SIMULATOR (CCS)*** - The force required to spin a stator (rotor) around in oil at given temperatures.

$ ***COLD PUMPING POINT*** - Similar to pour point, but represents the lowest temperature that the oil will flow and lubricate the engine.

$ ***4-BALL WEAR TEST*** - The size of the "scar" that is produced on a steel ball when "rubbed against" three other steel balls.

$ ***VISCOSITY INDEX (VI)*** - A measure of the oils' ability to "handle" wide temperature ranges.

$ ***TOTAL BASE NUMBER (TBN)*** - The ability of the oil to neutralize combustion acids as well as an "indicator" of the expected life of the oil.

While none of these tests singularly indicate the absolute quality of an oil, they nevertheless, jointly suggest an oil's efficacy. Moreover, oils should be compared to other oils to assess or judge their relative quality.

DISCUSSION OF SPECIFICATIONS & STATISTICAL MEASUREMENT

Before leaving this topic lets discuss the requisites for "valuable" statistical measurements. First, the measurement must be **UNBIASED**. And second, the measurement must posses **VALIDITY**. Let us examine the first requisite. An unbiased statistical measurement is one that is repeatable, in which there is little statistical variation from sample to sample. This is relatively easy to achieve if "good scientific methods" are used.

Validity, on the other hand, is more difficult to achieve. Validity indicates that the statistical measurement, in fact, "measures" what it claims to measure. For example, does the Stanford-Binet I.Q. test measure innate intelligence; or, does it measure aptitude? These are very different variables. I.Q. can be thought of as the "RAM"(random access memory) of a computer; whereas, aptitude can be thought of as how much "programming has been placed in the RAM.

The rationale for the receding discussion is because of discussions on many of the **"oil**" forums. Many individuals in these forums will say..."the four ball test, timken (falex) test; among other tests, is (are) useless, irrelevant, meaningless, etc.. ***NO THEY ARE NOT!!*** There are not any, perfect, **single** measures of lubricant quality. Yes, it would be nice to do a longitudinal study with 10,000 vehicles test over a range of applications and conditions, climate, etc.. However, this type of research is not possible even for a huge company like Exxon-Mobil.

The ten measures (specifications) that were listed above are not intended to represent a panacea; but rather, are measures that reveal several attributes of oils that are MEANINGFUL when examined individually and especially meaningful when examines as a group.

Synthetic Base Oils

Currently, there are three base oils that are **marketed and sold as** synthetic oils, and they are:

$
“Severely” hydro processed petroleum oil(group III base oils);
$ Polyalphaolefins(PAOs); and
$ esters(Group V base ester oils).

PAOs and esters are both considered by the American Petroleum Institute (API) and most engineers/tribologists as “synthetic” oils. It is difficult to positively identify one as “better than the other. PAOs have excellent high/low temperature properties, but, neither (PAOs/Group IIIs) are quite as good as esters with respect to these properties. However esters are more sensitive to water (hydrolysis) than PAOs and Group IIIs. PAOs, on the other hand, possess negative seal and gasket attributes when used exclusively.(google PAOs vs. esters) and you will find good discussions of the pros and cons of each of these potential base oils.

The reality is that the OPTIMAL oil contains (at least currently) both PAOS AND ESTERS to “capture” the best properties of both.

PAOs are synthesized from hydrocarbons, whereas esters are synthesized from the combination of alcohols and acids. The reaction products of the alcohols and acids are water and ester.

Severely Hydro-cracked oil(napthenic oil) is a more recent base oil used for synthetic engine oil. This oil is severely dydrocracked mineral oil that has been processed to remove small and large molecules and thus, paraffins and waxes. While not all of the “bad stuff” is removed, the remaining oil is much more stable at high temperatures and provides good service for high temperature engine operation. Unfortunately, it provides little or no improvement for low temperature operation, unless “pour point” additives are utilized.

The Superiority of synthetic Oils Relative to Dino oils

As often-times suggested, oil is the LIFEBLOOD of your engine, transmission, rear differential, etc.

As mentioned earlier, synthetic oils are a MUST when your vehicle is operated in very cold and/or extreme operating conditions.

Petroleum oil represents a panacea (financial boom) for the oil industry because it produces more wear and tear on the engine and calls for relatively short OCIs (oil change intervals). Dino oil MEANS MONEY for the oil industry.

In Europe, the usage of synthetic oil is approximately 30-35%. In the states, this usage is only about 5%. We in America, have a long way to go, when it comes to synthetic oil utilization.
Finally, the objective of this white paper was to pinpoint the many advantages of synthetic oil both on a personal and macro level. In other words, the use of ***synthetic oil is desirable for both our vehicles and our environment.*** ***If this White***

Paper has convinced you to , or at least consider, the use of synthetic oils, then your cars and the environment will thank you for it, and I will have done my job [MATRIX SYNTHETIC OILS.Com].

FOLLOWING IS A LIST OF LINKS HAVING TO DO WITH SYNTHETIC OILS

To summarize, the following oils represent excellent (OUR OPINION) oils: Redline, Motul, Elf, Total, Amsoil, Maxima, Mobil 1,Neo, Pentosin, Synergyn, Silkolene, and Fuchs, and others.

FORUMS ABOUT OIL

The following sites offer a tremendous wealth of information for synthetic motor oils:

[Bob is the Oil Guy]

www.bobistheoilguy.com

www.noria.com

http://themotoroilsite.com/forums/ Motor Oil Site

WEB SITES OF SOME OIL MANUFACTURERS

www.motul.com Motul

www.elfmoto.us Elf Moto

www.total-us.com Total

www.redlineoil.com Redline

www.amsoil.com Amsoil

Www.silkolene.com Silkolene

www.neosyntheticoil.com Neo

www.mobiloil.com Mobil

www.maximausa.com Maxima

www.americanagip.com Agip

www.motul.com Motul

www.royalpurple.com Royal Purple

www.fuchs.com Fuchs

LINKS TO SYNTHETIC OIL ARTICLES

www.mr2.com/TEXT/synth_oil.txt Long Discussion Text (old)

www.hotrod.com/techarticles/synthetic_vs_mineral_motor_oil
Hot Rod Magazine Article

www.bimmerzone.com/motoroil.htm Good Oil Discussion

www.nordicgroup.us/oil.htm Oil Facts & Myths-Long

www.automedia.com/Synthetic/or/Conventional/Oil/ccr20050201so/1
Short Article

www.240sx.org/faq/articles/oil.htm Good Article-Long

www.geocities.com/Yosemite/Gorge/6770/motor_oils.htm
Very Good Read

www.fd3s.net/oil.html Oil Article-General

www.kitcarmag.com/techarticles/synthetic_mineral_based_oil_tech
Synthetic & Petroleum oil Article

Www.speedarticles.com/auto_racing_article-55.html Synthetic Oil

www.wootbike.com/articles.php?article_id=7&page=6
Additive Packages

www.motorpoint.com.au/syntheticlubrication.asp Synthetic Oil

www.automedia.com/Oil_Change_101/ccr20010901oc/
Oil Change 101

www.carcraft.com/techarticles/synthetic_vs_conventional_oil/
Carcraft Magazine Article

http://www.dirtroadmagazine.com/oil2.htm
The Synthetic Advantage

www.imakenews.com/lng/e_article000330895.cfm?x=b16kqbNJ,b16kqbN
ILSAC GF-4 Questions

www.micapeak.com/info/oiled.html Dated, But Interesting

http://www.articlebiz.com/article/4715-1 Good Short Article

www.hotrod.com/techarticles/synthetic_vs_mineral_motor_oil
Is Synthetic Worth It?

www.organicanews.com/news/article.cfm?story_id=211

When are Synthetics Better?

http://power-lubricants.com/synoils.html Excellent Read

http://www.motorcycleanchor.com/motorcycle/how_to/mc_oil.html
Motorcycle Oils - Excellent Discussion Must Read

www.pt-tuning.com/policies/Magn-Moss-Act.html
Magnusson warranty Act - Excellent Information

http://home.mindspring.com/~ed_white/id7.html Oil Filters

http://www.crownvic.net/tech/oilartcl03.htm Good Discussion of Synthetic Oil

LINKS TO SYNTHETIC OILS AND THE ENVIRONMENT

http://environment.about.com/od/earthtalkcolumns/a/motoroil.htm

www.environment.about.com/od/earthtalkcolumns/a/motoroil.htm

http://ohv.parks.ca.gov/default.asp?page_id=1240

www.ciwmb.ca.gov/Publications/UsedOil/61105002.pdf
MUST READ-EXCELLENT

http://www.p2pays.org/ref/34/33375.pdf Good Read

Www.sowhatcanido.blogspot.com/2006/05/consider-synt

www.sowhatcanido.blogspot.com/2006/05/consider-synthetic-oil.html A MUST READ-COPY & POST

http://www.amsoil.com/lit/lng_article/dec_03_mcfall.pdf

ALL OF THESE ARTICLES (ABOVE) ON THE ENVIRONMENT ARE A MUST READ FOR ALL OF US.