A Study of Compressor Oils

White Paper 7-1
G-1592
AMSOIL Industrial Division
November 2005

Table of Contents

Overview

Compressed air is a critical part of many manufacturing facilities; without it, production would cease. Reliable air compressor operation is essential to manufacturing production. Lubrication is key to keeping air compressors running and is sometimes called the compressor's "life-blood." Compressor lubricants are produced by many lubricant manufacturers, ranging in quality from poor to excellent. Poor air compressor oil could cause the compressor to have a very short life, but excellent quality air compressor oil reduces maintenance and can extend compressor life. Some end users find comfort in using the manufacturer recommended oil because of perceived quality.

The American Petroleum Institute (API) governs the minimum quality standards for engine oils. Air compressor oils are not governed by any organization, so no official performance standards exist. This leaves the responsibility for producing a satisfactory product to the individual lubricant manufacturers.

Air compressor original equipment manufacturers (OEM) help eliminate some confusion by publishing minimum oil specifications required for their individual air compressors. These minimum oil specifications insure minimum lubricant performance. Any oil that meets or exceeds the minimum specifications can be used without voiding the standard or regular compressor warranty (usually one or two years). While OEMs do not manufacture their own compressor oil, they frequently market their own brand of compressor oil and have often been able to tie separately purchased extended warranty requirements to the use of their own branded oil.

Air compressor companies must contract with a lubricant company to manufacture oil for them. When the air compressor manufacturers purchase oil from a lubricant manufacturer they become the middlemen and the cost is increased to the consumer. OEM branded compressor oils provide the allure of quality, but in many cases the price of these oils is unnecessarily inflated and is frequently exorbitant. In addition, these oils often do not have the best performance characteristics that are available on the market.

Purpose

The purpose of this paper is to inform consumers about the performance and cost differences between compressor oils, including OEM branded and popular aftermarket products. These evaluations will provide consumers the confidence in which to purchase high-quality compressor oil at the lowest possible price.

Method

The testing by which these oils are evaluated is done in accordance with American Society for Testing and Materials (ASTM) procedures. The results of these tests can be duplicated and verified by laboratories that conduct these ASTM tests. A notarized affidavit certifying the results are correct is included in the appendix. Compressor oil pricing was determined by contacting the manufacturer or the distributor and requesting a quote on a five-gallon pail and a fifty-five gallon drum of their lubricant. Price quotes obtained are listed in the pricing section.

Scope

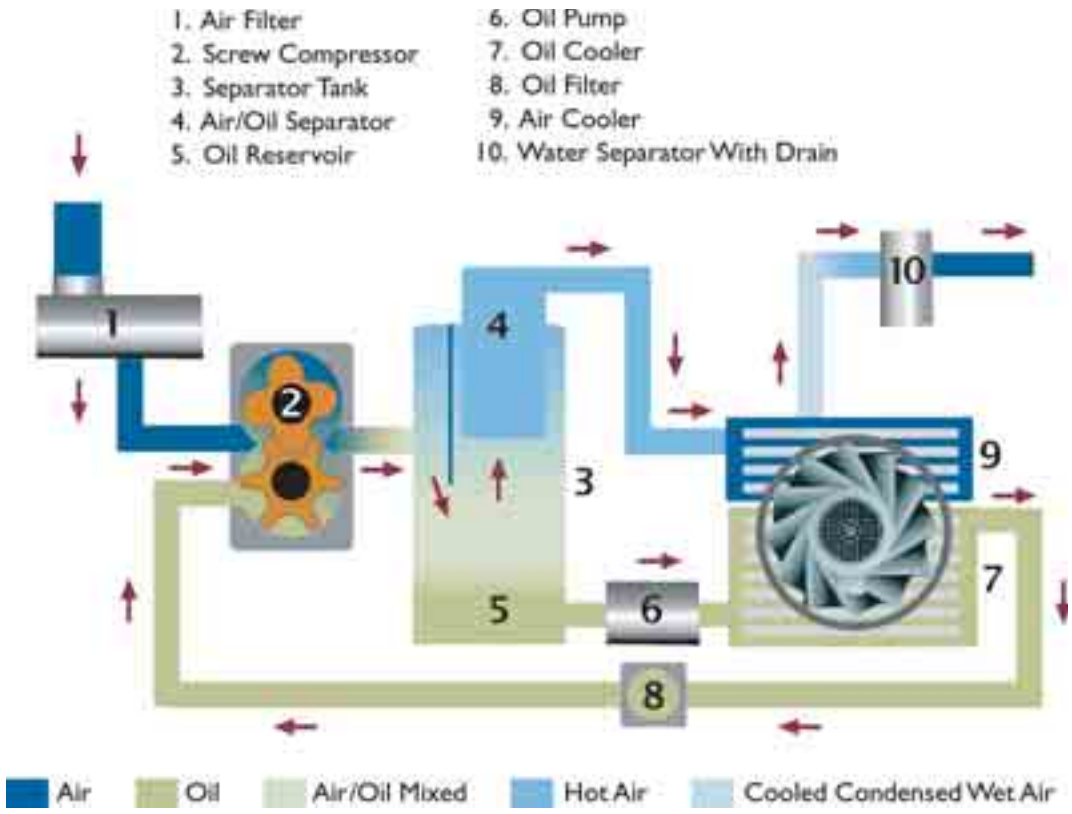
This paper is focused on rotary screw type compressor oils. Rotary screw compressors are widely used in all types of industries, and synthetic compressor oils are recognized as superior to mineral-based compressor oils by compressor manufacturers as well as most oil companies and consumers. ASTM tests conducted were chosen respective of rotary screw compressor environments. While there are many tests by which oils could be measured, the information provided by the tests and included in this paper gives a well-rounded view of the compressor oil's performance.

Desired Performance Characteristics and Results

Oils used in rotary screw compressors operate in severe environments. In order to list the desired performance characteristics of compressor oils, it is important to first understand the environment the oil must withstand inside the screw compressor (see diagram I). Air enters the compressor through an air intake filter. The air compressor oil is injected into the compressor and is compressed with the air. During the air compression process heat is generated and small amounts of moisture contained in the air mix with the oil. Moisture, when mixed with oil, can cause oil water emulsions, rust and foaming. The compressed air/oil mixture then enters the air/oil separator where the hot oil and air are separated by the oil separator element. The compressed hot air then goes through a cooler, where the moisture in the air condenses and can be drained off. The air then goes to the plant to run production equipment. The hot oil goes through the oil cooler and is then injected back into the compressor once again. This process can be continuous for up to 8,000 hours or more. Oil degradation can result in acid buildup, hydrolysis and oxidation. Through the compression process the oil is expected to provide the following functions:

- Oxidation resistance from the heated air/oil compression
- Resist acid buildup due to oxidation from extended oil drain intervals, moisture and heat
- Exhibit good demulsibility to separate the water from the oil
- Prevent against internal rust formation
- Resist foaming
- Control air entrainment
- Reduce wear
- Maintain viscosity parameters
- Extend oil drain intervals
- Provide low temperature fluidity protection

Diagram I



Oxidation Resistance

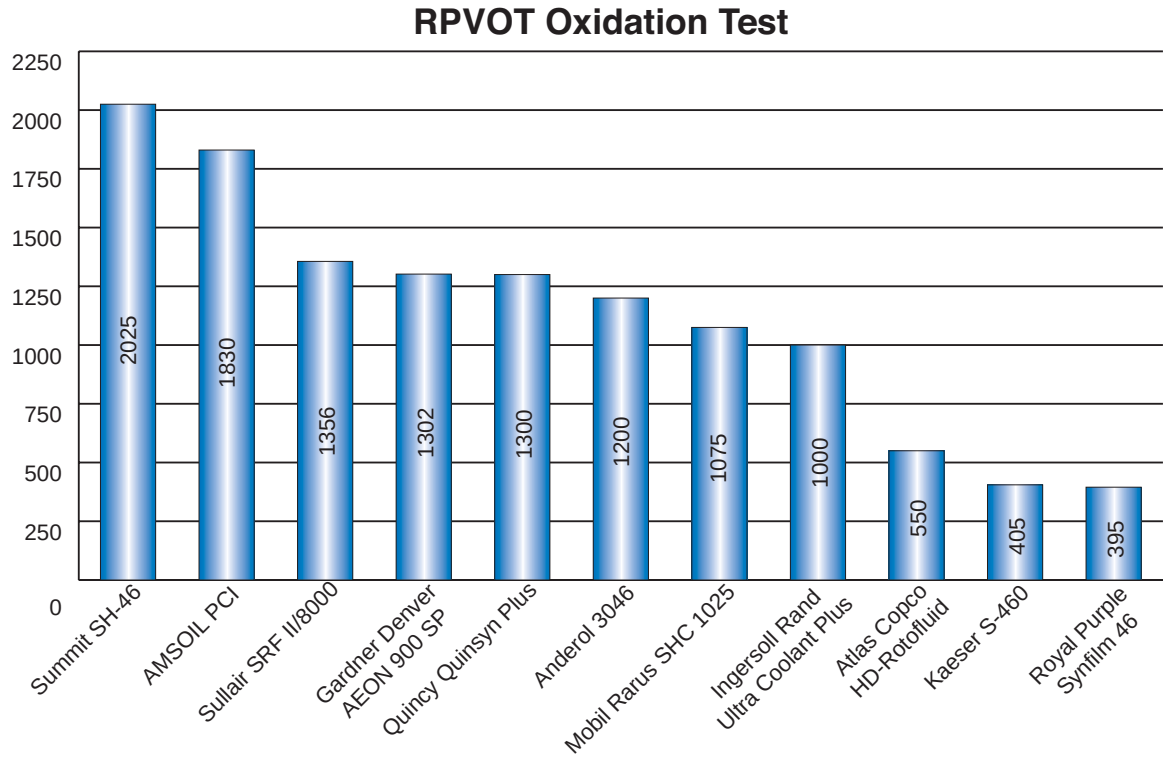
The high-speed rotors in rotary screw air compressors compress large volumes of air. At the same time, oil is injected into the rotors to lubricate the moving parts during compression. The hot oil and air mixture can increase the rate of lubricant degradation through oxidation. The evaluated oils were subjected to the Rotating Pressure Vessel Oxidation Test in order to simulate air compressor oil oxidation while in service.

Rotating Pressure Vessel Oxidation Test (RPVOT) ASTM D-2272

The Rotating Pressure Vessel Oxidation Test is a rapid method of comparing the oxidation life of new or in-service lubricants. The vessel is initially charged with 50 grams of test oil and five grams of distilled water. A copper catalyst is added, and the vessel is pressurized with oxygen to 90 PSI at room temperature and submerged into a 150° C (302° F) temperature bath. The bath temperature causes this pressure to increase to approximately 200 PSI. The vessel is rotated and as oxygen is absorbed into the oil from oxidation, a pressure drop occurs. The failure point is taken as a 25-PSI drop from the maximum pressure attained at 150° C (302° F). The results are reported as the number of minutes until a 25-PSI loss occurs.

Correlation to Field Service

The Rotating Pressure Vessel Oxidation Test (RPVOT) is useful in estimating the oxidation stability of oils. The RPVOT can also be used to compare new oils to provide a correlation between the RPVOT value and an oil's useful life before oxidation occurs. A high RPVOT number correlates to high oxidation resistance and long oil life. A low RPVOT number correlates to low resistance to oxidation and short oil life.



Water Resistance

When air or process gases are compressed, moisture from humidity condenses and collects in the oil, creating the need for the oil to have good hydrolytic stability. Good hydrolytic stability is important as this helps prevent oil degradation from hydrolysis, which forms acids and contributes to foaming.

Hydrolytic Stability ASTM D-2619

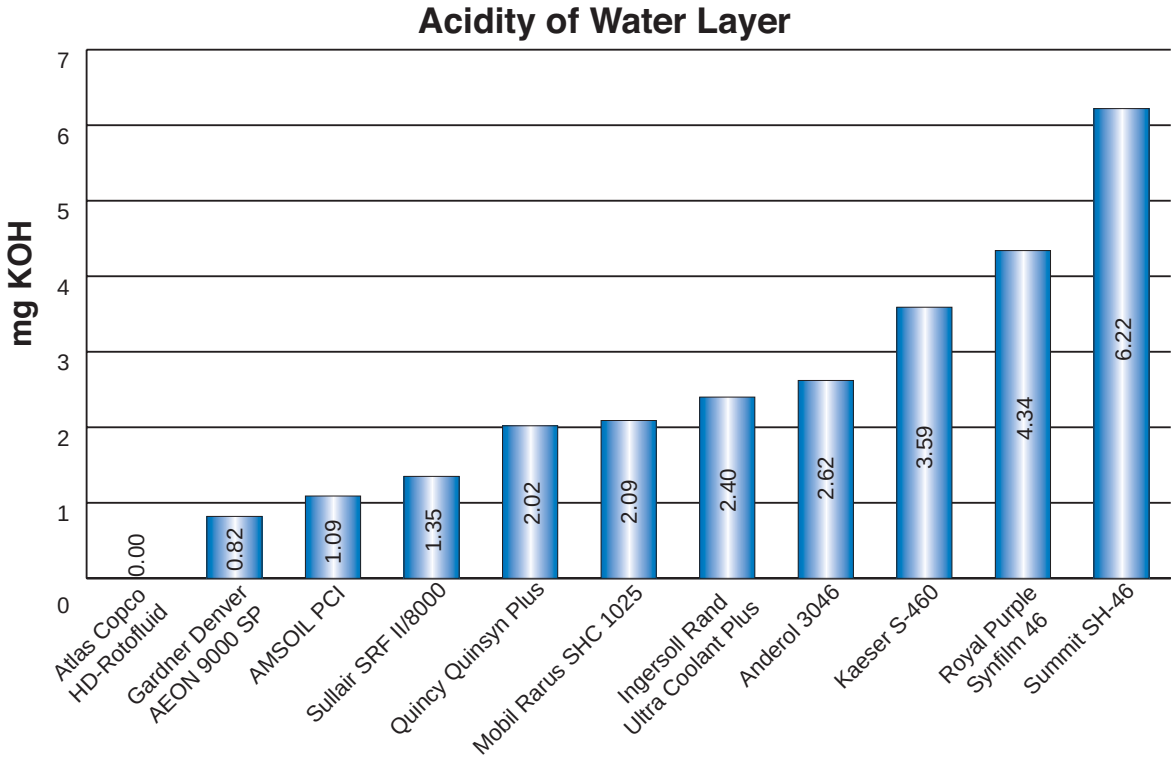
This test is used to determine the stability of oils in contact with water. It depends upon the catalytic effect of copper at elevated temperatures in the presence of water to accelerate the rate of hydrolysis. This test is conducted by incorporating 75 grams of test oil along with 25 grams of water and a polished, weighed copper strip catalyst sealed in a six-ounce pressure-type beverage bottle. The bottle is rotated at five rpm, end over end, for 48 hours in an oven at 93.5° C (200° F).

At test end, the four most important results were evaluated.

1. Acidity of water layer
2. Appearance of copper panel
3. Weight change of copper panel
4. Percent change in oil viscosity

Acidity of Water Layer

Generally oil analysis laboratories flag the acidity of air compressor oil when the acid number is greater than 2.0 to 2.5 above the new oil acid value. Acidic air compressor oil can shorten the oil life and corrode internal parts. Since acid increase in the water layer can affect the acidity of the oil, lower acidity of the water layer is desirable. The following chart identifies the acidity of the water layer for the oils tested. The values are listed as milligrams of potassium hydroxide (mg KOH) required to neutralize all acidic constituents present in one gram of sample.

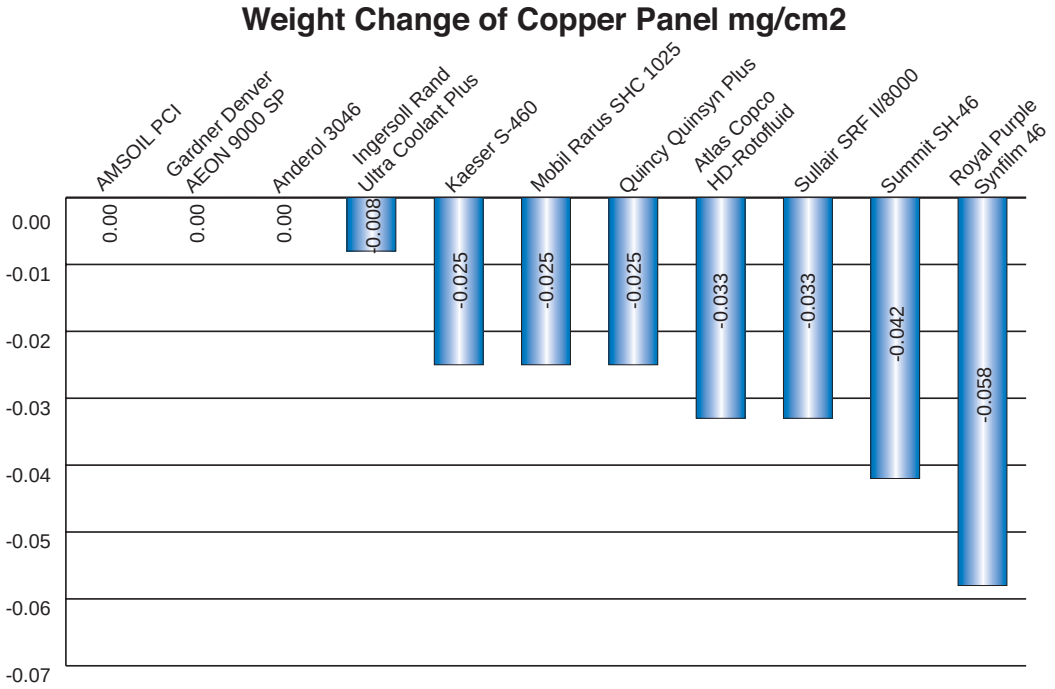


The Appearance of the Copper Panel

All but one of the oils recorded good copper panel values of shiny 1B. Atlas Copco HD-Rotofluid was not as good and recorded a value of shiny 3B. The ASTM copper panel test scale is, from best to worst, 1A, 1B, 2A, 2B, 2C, 2D, 2E, 3A, 3B, 4A, and 4C.

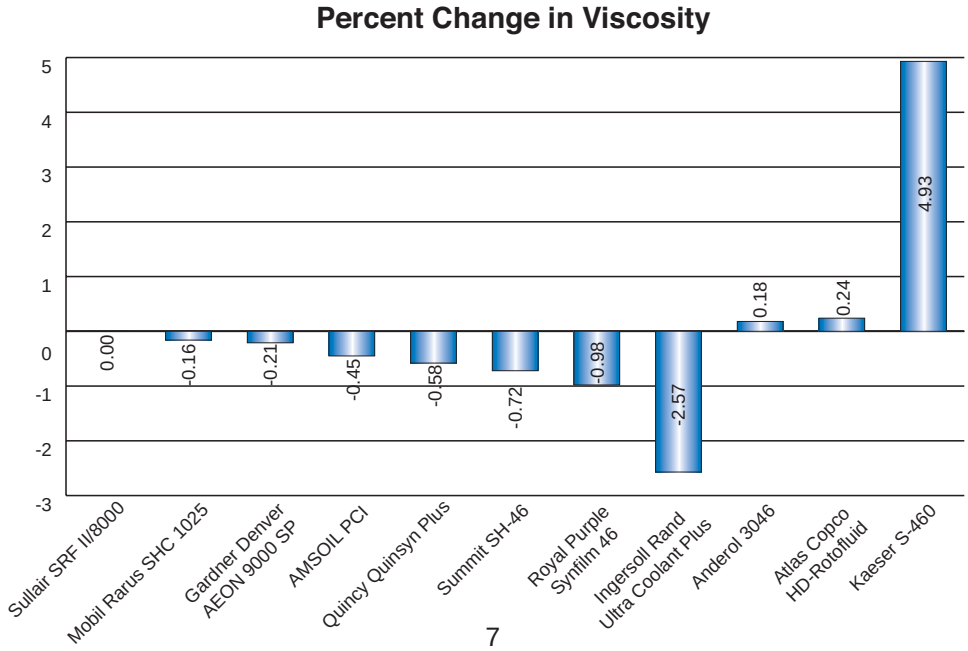
Weight Change of Copper Panel

Copper panels were weighed before the test and then again after the test. The difference in copper weight is the loss of copper due to corrosion. Three oils recorded a value of 0.000 mg/cm^2 and exhibit no corrosiveness to the copper panels. All other oils tested recorded copper loss due to corrosion. Copper loss due to corrosion is much the same as copper loss due to rubbing wear and is equally destructive. The following chart provides the weight change of the copper panels due to copper corrosion.



Percent Change in Viscosity

Most air compressor manufacturers recommend oil viscosity of ISO-46. ISO-46 viscosity is measured in centistokes (cSt), and the cSt range is 41.4 to 50.6. Significant increases or decreases in viscosity are undesirable as they can contribute to greater energy consumption or increased wear. This chart shows the percent change in viscosity that occurred during the test. Changes in viscosity can be attributed to water solubility of either the light or heavy components of the oil.



Water Emulsion

Water contamination in rotary screw compressors can develop from large amounts of ingested air containing small amounts of moisture. This moisture can build up and cause water/oil emulsions causing shortened oil drain intervals.

Demulsibility ASTM D-1401

The demulsibility test is used to determine the ability of oil such as air compressor oil to separate from water. In this test, 40 ml of distilled water and 40 ml of oil are measured into a properly cleaned 100 ml graduated cylinder and immersed in a bath at 54.4° C (130° F). The oil and water are mixed for five minutes at 1500 rpm with a special stirrer. The amounts of separated oil, water and emulsion are recorded at five-minute intervals for up to one hour, then reported as ml oil/ml water/ml emulsion (minutes). Most specifications require separation, so that less than three ml of emulsion (cuff) remain after 30 minutes.

Correlation to Field Service

Emulsification of air compressor oil can cause sludge, plug filters, shorten oil life, cause foaming and reduce lubricant performance. it is important for air compressor oil to maintain good demulsibility in order for excess water to be drained off. Complete demulsibility minimizes environmental discharge. All of the oils tested recorded zero emulsion cuff within 30 min., providing good demulsibility. Some oils shed water faster than others.

Demulsibility ASTM D-1401

AMSOIL PCI	40-40-0 (5)
Royal Purple Synfilm 46	40-40-0 (5)
Kaeser S-460	40-40-0 (5)
Gardner Denver AEON 9000 SP	40-40-0 (5)
Summit SH-46	40-40-0 (5)
Atlas Copco HD-Rotofluid	40-40-0 (5)
Anderol 3046	40-40-0 (5)
Quincy Quinsyn Plus	40-40-0 (10)
Sullair SRF II/8000	40-40-0 (20)
Ingersoll Rand Ultra Coolant Plus	40-40-0 (30)
Mobil Rarus SHC 1025	40-40-0 (30)

Internal Component Rusting

Oil in its neat state, without additives, does a poor job of preventing rust. In many instances, such as in air compressors, water can become mixed with the lubricant and rusting of ferrous parts can occur. The air compressor oil needs to be formulated with additives that will inhibit the formation of rust. Rust is very abrasive and once formed on bearings and critical components it will significantly shorten component life. The ASTM rust test was developed as an evaluation of the oil's ability to aid in preventing rust.

Rust Prevention in Synthetic Sea Water ASTM D-665B

The test consists of stirring a mixture of 300 ml of water, either distilled or seawater, at 60° C (140° F) for 24 hours. A special cylindrical steel test specimen made from #1028 cold finished carbon steel is polished and then completely immersed in the test fluid. At the conclusion of the 24-hour period the specimen is removed, washed with solvent and rated for rust. In order to pass the ASTM D-665 Rust Test, the specimen must be completely free from visible rust when examined without magnification under normal light. When conducted in synthetic seawater, this test is more severe than in distilled water. It helps identify the oils with superior rust protection.

Correlation to Field Service

Internal component rusting can flake off and contaminate the oil causing filter plugging, increased wear and shortened oil life. This test indicates how well the oil will aid in preventing this type of rusting.

	Rod A	Rod B
AMSOIL PCI	Pass (No Corrosion)	Pass (No Corrosion)
Royal Purple Synfilm 46	Pass (No Corrosion)	Pass (No Corrosion)
Kaeser S-460	Pass (No Corrosion)	Pass (No Corrosion)
Atlas Copco HD-Rotofluid	Pass (No Corrosion)	Pass (No Corrosion)
Ingersoll Rand Ultra Coolant Plus	Pass (No Corrosion)	Pass (No Corrosion)
Mobil Rarus SHC 1025	Pass (No Corrosion)	Pass (No Corrosion)
Summit SH-46	Pass (Slight Staining)	Pass (Slight Staining)
Anderol 3046	Fail (Several Spots of Corrosion)	Fail (Several Spots of Corrosion)
Sullair SRF II/8000	Fail (5% Corrosion)	Fail (5% Corrosion)
Gardner Denver AEON 9000 SP	Fail (15% Corrosion)	Fail (25% Corrosion)
Quincy Quinsyn Plus	Fail (50% Corrosion)	Fail (30% Corrosion)

Foaming

The oil in a rotary screw compressor experiences severe air/oil churning, therefore foaming of the oil is likely to occur. The tendency of compressor oil to foam can be a serious problem in screw-type air compressors. In these situations, increased wear and shortened oil life is likely to occur.

Foam Stability ASTMD-892

This ASTM test consists of a 1000 ml graduated cylinder, 200 ml of oil and an air inlet tube which is fastened to a gas diffuser placed at the bottom. Air flows through the diffuser at a rate of 94 ml/min. The test is conducted in three sequences.

1. Sequence I is conducted at 24° C (75° F)
2. Sequence II is conducted at 93.5° C (200° F)
3. Sequence III is conducted at 24° C (75° F)

The foam results are reported in milliliters (ml) of foam during the test and after 10 minutes settling time.

Correlation to Field Service

Foam causes increased oxidation by exposing more of the oil surface area to oxygen. Foam also increases heat by acting like a blanket and not allowing the oil to dissipate the heat. Foam reduces the lubricating qualities of oil when the bubbles entrained in the oil collapse, reducing the oil film in critical areas and resulting in less than full-film lubrication.

Oils that foam during the test could exhibit a tendency to foam inside the compressor during operation. Oil that still contains foam after 10 minutes of settling time exhibits very poor antifoaming ability.

Foam Tendency ASTM D-892			
	Sequence I During test/after 10 min. settle time	**Sequence II** During test/after 10 min. settle time	**Sequence III** During test/after 10 min. settle time
AMSOIL PCI	0/0	0/0	0/0
Summit SH-4	0/0	0/0	0/0
Atlas Compco HD-Rotofluid	0/0	0/0	0/0
Ingersoll Rand Ultra Coolant Plus	0/0	0/0	0/0
Anderol 3046	0/0	0/0	0/0
Mobil Rarus SHC 1025	0/0	0/0	0/0
Royal Purple Synfilm 46	10/0	25/0	10/0
Kaeser S-460	310/0	30/0	280/0
Quincy Quinsyn Plus	360/0	25/0	120/0
Sullair SRF II/8000	400/0	20/0	350/0
Gardner Denver AEON 9000 SP	500/30	20/0	420/40

Wear Reduction

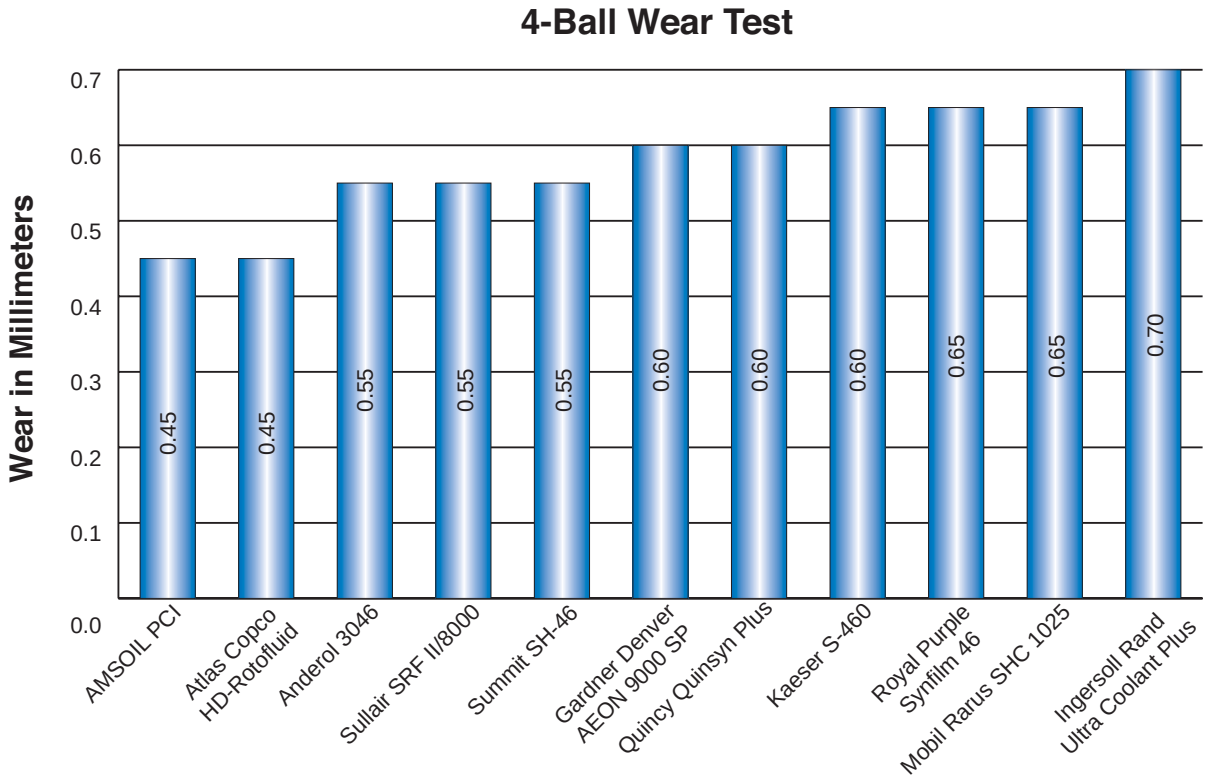
Wear reduction is one of the most important qualities sought after by consumers of all types of equipment including air compressors. in order to extend air compressor component life, some lubricant manufacturers have incorporated anti-wear chemistries into their oils. Anti-wear chemistries are not used in all compressor oils. Since the choice to use anti-wear chemistries is left to the oil manufacturers, and many have chosen to incorporate it, the anti-wear performance of each was measured. The ASTM D-4172 4-Ball wear test is widely used to determine anti-wear fluid qualities and is the test of choice for air compressor oil comparisons.

Wear Preventative Characteristics of Lubricating Fluid ASTM D-4172 (4-Ball Method)

This test method is used to determine the anti-wear or wear preventive properties of a fluid. It is conducted with three steel balls clamped together and covered with the lubricant to be evaluated. The fourth ball is pressed with force into the cavity formed by the three balls clamped together. The temperature of the test lubricant is regulated and the fourth ball is rotated. Wear is measured in millimeters by calculating the average wear scars of the three lower clamped balls. Standard ASTM test parameters of 75° C (167° F), 1200 RPM and 40 Kg of force were used.

Correlation to Field Service

Low wear scar measured by millimeters in the 4-Ball wear test correlates to better anti-wear oil qualities. A low wear rate in-service can extend oil life, reduce maintenance, extend equipment life and reduce maintenance costs.



Copper Corrosion ASTM D-130

Corrosion resistance is an important consideration in compressor oils. Copper corrosion characteristics were measured using the ASTM D-130 test. This test operates for three hours at 100° C (212° F) with a copper strip submerged in the candidate oil. **All oils tested were non-corrosive and achieved a perfect score 1A.**

Entrained Air

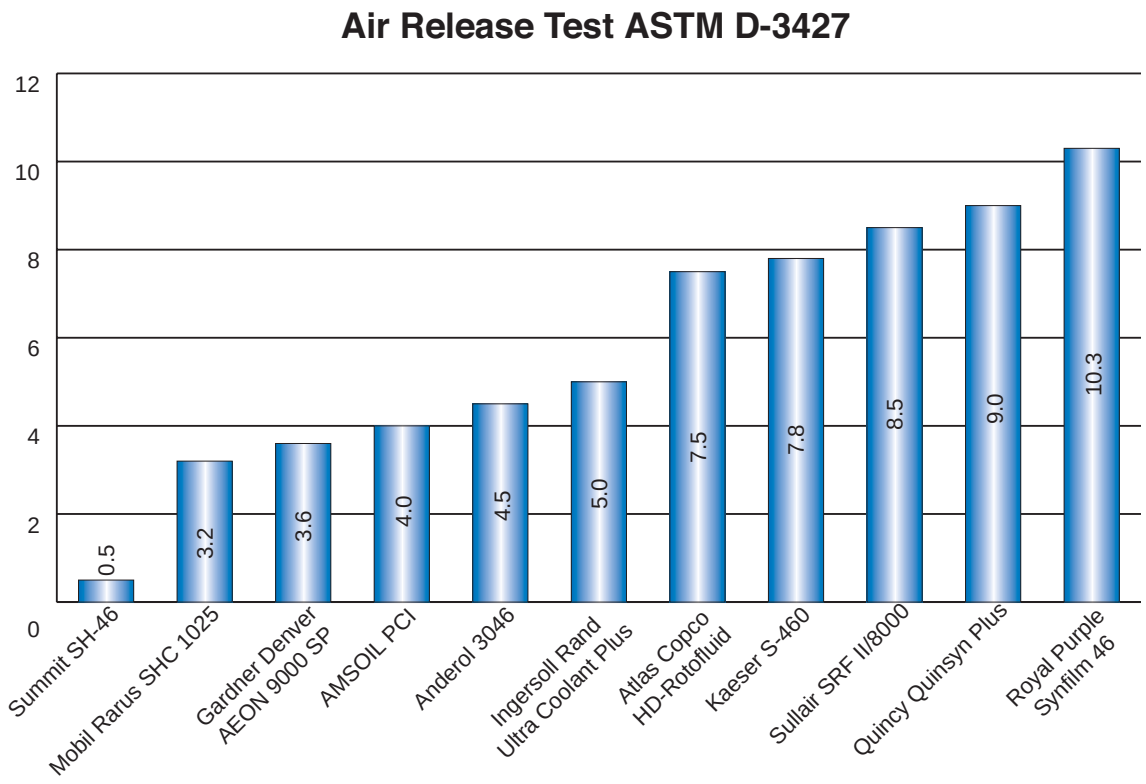
Agitation of lubricating oil in air compressors can cause air entrainment. Air entrained oil contains finely divided air bubbles in the oil that reduce the lubricating quality in service.

Air Release ASTM D-3427

The air release test determines the ability of oil to separate entrained air. In the test, compressed air is blown through the test oil, which has been heated to a temperature of 50°C (122° F). After the airflow is stopped, the time required for the entrained air to reduce in volume to 0.2% is recorded as the air release time.

Correlation to Field Service

In order to lubricate and cool rotary screw air compressors, oil is injected directly into the rotary screws and mixed with the air. This can cause air entrainment, which can cause an inability to maintain oil pressure, reduce oil films on bearings, increase wear and cause poor air compressor performance. A short air release time is desirable.



Physical Data

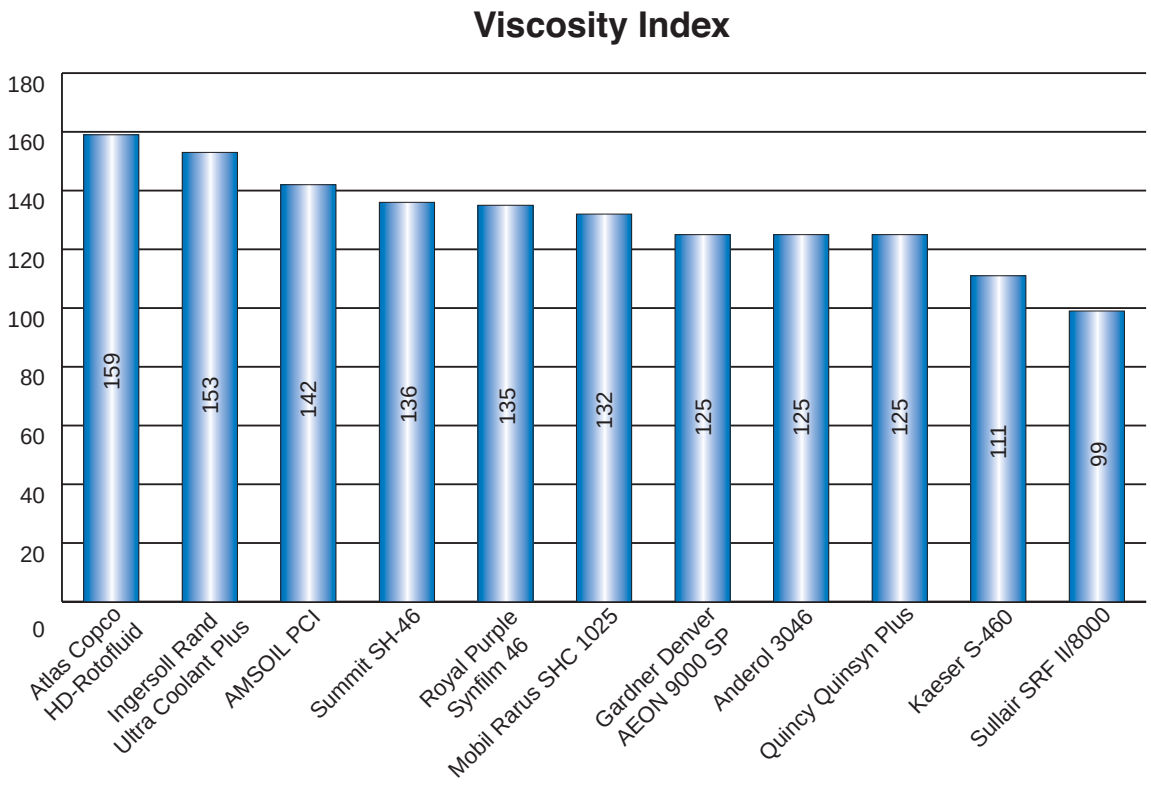
Three areas of physical data have been included to describe the important properties of the various oils. This data provides an indication of performance in certain areas such as viscosity change with temperature change, viscosity and cold temperature operation.

Viscosity Index ASTM D-2270

Viscosity Index (VI) indicates the degree of change in viscosity of an oil within a given temperature range. High VI reflects a relatively small change in viscosity, whereas a low VI reflects a larger change in viscosity. High viscosity index is more desirable for air compressors and will result in less oil thickening at cold temperatures as well as less thinning at higher temperatures.

Correlation to Field Service

High viscosity index will provide air compressor oil with viscosity stability over a wider temperature range, providing better protection in high temperatures as well as better oil flow at lower temperatures.



Viscosity at 40° C ASTM D-445

Air compressor manufacturers recommend specific viscosity grades based on the International Organization for Standardization (ISO). The most common viscosity grade for rotary screw air compressors is ISO-46. According to the ISO, viscosity is measured in centistokes (cSt) and the acceptable viscosity range for ISO-46 oil is 41.1 cSt to 50.6 cSt. Viscosity is measured and recorded at 40° C (104° F).

Correlation to Field Service

Correct viscosity is important based on the compressor manufacturer's recommended viscosity at given temperatures.

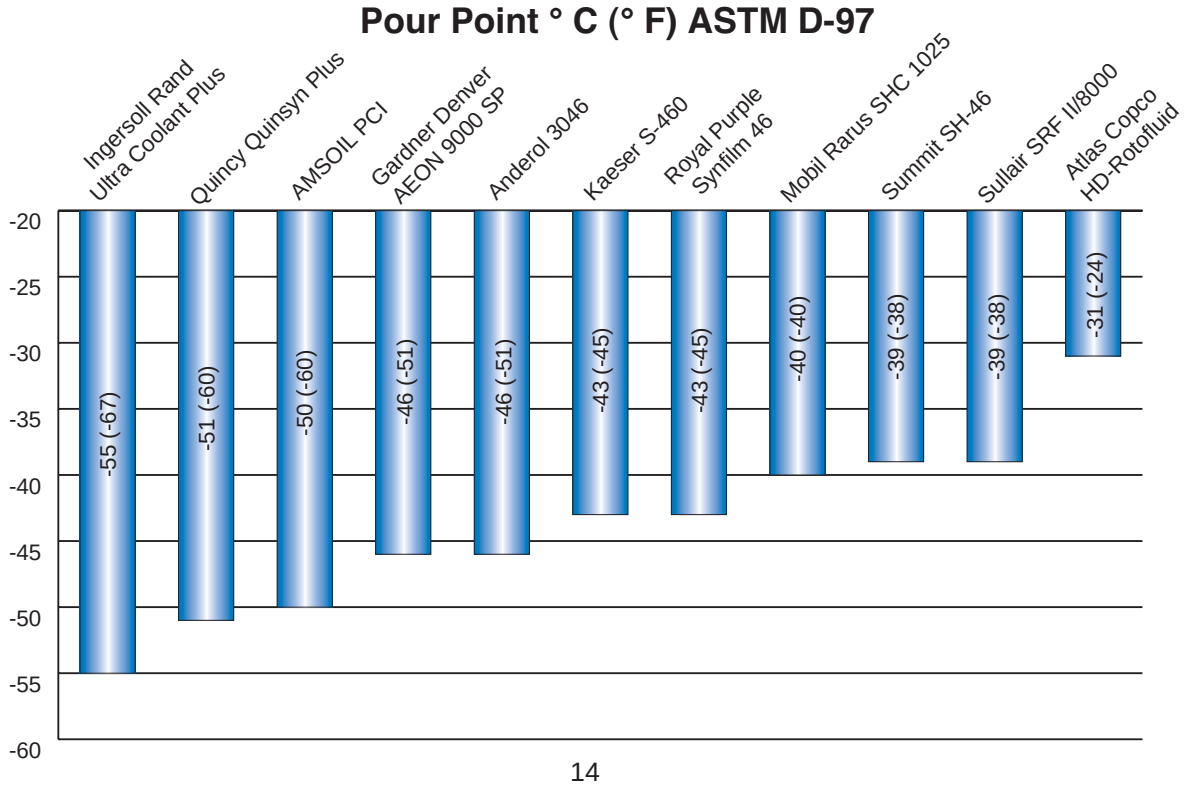
Viscosity in cSt at 40° C ASTM D-445	
Product	**Viscosity at 40° C**
Ingersoll Rand Ultra Coolant Plus	34.42
Sullair SRF II/8000	40.32
Atlas Copco HD-Rotofluid Plus	41.61
AMSOIL PCI	43.66
Summit SH-46	43.70
Mobil Rarus SHC 1025	43.73
Kaeser S-460	44.70
Anderol 3046	44.72
Quincy Quinsyn Plus	45.48
Gardner Denver AEON 9000 SP	48.03
Royal Purple Synfilm 46	48.07

Pour Point ASTM D-97

Pour point is a physical measurement of the oil's fluidity at cold temperatures. This test provides the temperature at which oil will no longer flow. Typically, 11° C (20° F) above the pour point is the recommended limit at which a compressor can be safely started for operation. Oil starvation could occur at colder temperatures and result in equipment damage.

Correlation to Field Service

Air compressors are sometimes installed outside to control noise and gain manufacturing floor space. Installing the air compressor outside subjects the compressor to cold winter temperatures, which can thicken some oils to the point of becoming solid and causing compressor damage.



Pricing

Paying a high price for air compressor oil does not necessarily mean getting the best quality. Purchasing air compressor oil should include choosing an overall high quality product at the lowest price obtainable. This will insure getting the best value for your investment. Pricing was obtained April of 2005.

Pail Pricing

Brand	Product	Price
AMSOIL	AMSOIL PCI	$86.50
Anderol	Anderol 3046	$144.85
Summit	Summit SH-46	$145.00
Mobil	Mobil Rarus SHC 1025	$166.25
Sullair	Sullair SRF II/8000	$169.50
Royal Purple	Royal Purple Synfilm 46	$181.00
Atlas Copco	Atlas Copco HD-Rotofluid Plus	$185.00
Kaeser	Kaeser S-460	$229.00
Gardner Denver	Gardner Denver AEON 9000 SP	$229.03
Quincy	Quincy Quinsyn Plus	$275.66
Ingersoll Rand	Ingersoll Rand Ultra coolant Plus	$455.00

Drum Pricing

Brand	Product	Price
AMSOIL	AMSOIL PCI	$854.00
Summit	Summit SH-46	$1,054.00
Anderol	Anderol 3046	$1,507.14
Mobil	Mobil Rarus SHC 1025	$1,770.45
Royal Purple	Royal Purple Synfilm 46	$1,782.50
Atlas Copco	Atlas Copco HD-Rotofluid Plus	$1,900.00
Kaeser	Kaeser S-460	$2,157.00
Gardner Denver	Gardner Denver AEON 900 SP	$2,339.53
Quincy	Quincy Quinsyn Plus	$2,573.31
Ingersoll Rand	Ingersoll Rand Ultra Coolant Plus	$3,999.00
Sullair	Sullair SRF II/8000	N/A

Test Results Summary

The ratings chart that follows ranks the performance and price for each oil. Oils that ranked the best in the test were marked with a one (1), second best with a two (2), and so forth. Oils that performed the same received the same rank. The lowest score represents the best product and price overall. All tests were weighted equally for purposes of developing this score.

Ranking the rust test pass/fail was simply done by assigning a one (1) for a pass, and a two (2) for a pass with slight staining, followed by higher numbers for increased corrosion percentage.

Ratings Chart

	AMSOIL PCI	Mobil Rarus 1025	Anderol 3046	Summit SH-46	Gardner Denver AEON 9000 SP	Atlas Copco HD-Rotofluid	Sullair SRF II/8000	Ingersoll Rand Ultra Coolant Plus	Quincy Quinsyn Plus	Royal Purple Synfilm 46	Kaeser S-460
OXIDATION TEST											
RPVOT	2	7	6	1	4	9	3	8	5	11	10
HYDROLYTIC STABILITY TEST											
Acidity of Water Layer mg/KOH	3	6	8	11	2	1	4	7	5	10	9
Appearance of Copper Panel	2	2	2	2	2	9	2	2	2	2	2
Weight Change of Copper Panel	1	3	1	5	1	4	4	2	3	6	3
Percent Change in Viscosity	6	2	3	8	4	5	1	10	7	9	11
DEMULSIBILITY											
0 Cuff Within 30 Min.	1	1	1	1	1	1	1	1	1	1	1
RUST PREVENTION											
Rod A and Rod B	1	1	3	2	5	1	4	1	6	1	1
FOAM STABILITY											
During Test/After 10 Min. Settle Time	1	1	1	1	6	1	5	1	4	2	3
WEAR REDUCTION											
4-Ball Wear Test	1	4	2	2	3	1	2	5	3	4	4
AIR RELEASE											
Min.	4	2	5	1	3	7	8	6	10	11	9
PHYSICAL DATA											
Viscosity Index (VI)	3	6	7	4	7	1	9	2	7	5	8
Viscosity @ 40° C	1	1	1	1	1	1	1	1	1	1	1
Pour Point ° C	3	6	4	7	4	8	7	1	2	5	5
PRICE											
Price per Pail	1	4	2	3	9	7	5	11	10	6	8
TOTAL SCORE (Lower is Better)	**30**	**46**	**46**	**49**	**52**	**56**	**56**	**58**	**66**	**74**	**75**

Discussion

Compressor oils perform many functions. These include oxidation stability, hydrolytic stability, rust protection, foam resistance, copper corrosion resistance and anti-wear performance. There was not one oil that did perfectly in all categories. As different chemistries are introduced to achieve a particular performance parameter, sacrifices are often-times made in other areas. For example, chemistry that is good for rust protection may cause foaming, and chemistry that is good for anti-wear may not be good for oxidation resistance.

Without established performance standards for consumers to refer to, aftermarket compressor oil performance is left to each individual oil manufacturer. The test data clearly provides documentation of a number of compressor oils on the market with a wide variance in performance and price.

After evaluating the test data it is evident that the highest quality oil is also the least expensive. AMSOIL specializes in manufacturing high quality synthetic oil and sells factory direct. This eliminates the multiple steps of distribution that unnecessarily inflates other oil pricing.

It is important to have a balanced air compressor oil that will perform all functions well. AMSOIL PCI demonstrated excellent performance and is a well-balanced oil that delivers consistent, dependable air compressor operation.

For more information regarding AMSOIL PCI Synthetic Compressor Oil, contact your AMSOIL Dealer or contact AMSOIL INC. at 1-800-777-8491.

Affidavit

I hereby affirm that I personally obtained the prices quoted in the document entitled "A Study of Compressor Oils" also known as Whitepaper # 7-1 prepared for the AMSOIL Industrial Division in November of 2005. I further affirm that the pricing in this paper was correct and was quoted to me by the manufacturers of distributors of the product for one of each package size indicated. Written support of this information is on file at AMSOIL, Inc.

Kevin L. Dinwiddie

STATE OF Wisconsin
COUNTY OF Douglas

Subscribed and sworn to before me this 13th day of March 2005.

[SEAL]

NOTARY PUBLIC

Name: Judith A. Greely
My commission expires: 10-14-07

JUDITH GREELY
NOTARY PUBLIC
STATE OF WISCONSIN

Affidavit

I hereby affirm that to the best of my knowledge all of the test results reported in the document entitled "A Study of Compressor Oils" also known as Whitepaper # 7-1 prepared for the AMSOIL Industrial Division in November of 2005 are correct. I further affirm that the tests requested followed procedures approved by the American Society of Testing and Materials (ASTM) or other recognized procedures that are referenced in the paper. Written documentation of test results are on file at AMSOIL, Inc.

Dave E. Leitten

STATE OF Wisconsin
COUNTY OF Douglas

Subscribed and sworn to before me this 13th day of March 2005.

[SEAL]

NOTARY PUBLIC

Name: Judith A. Greely
My commission expires: 10-14-07

JUDITH GREELY
NOTARY PUBLIC
STATE OF WISCONSIN

The First in Synthetics®