HEAVY DUTY CATALOG

CONTENT

CONTENT

LUBRICANTS

Different engines have different needs

New technology, higher kilometers, different driving conditions and extended service intervals all have a real impact on engine oil demands. That's why Valvoline products go beyond industry specifications to achieve maximum performance and provide superior protection. With Valvoline, innovative chemistry is linked with recognized brands making it easy to choose the right products.

ENGINE OIL

Why is engine oil important?

The primary function of engine oil is to keep metal from touching metal. An engine contains hundreds of moving parts that must be protected if metal surfaces come in contact, wear occurs and friction will increase dramatically. With friction comes heat, which causes more wear and distorts moving engine parts. The oil in your engine maintains a thin, lubricating film on all metal parts that lets them glide over each other, minimizing friction.

FULLY SYNTHETIC MOTOR OILS

Superior performance to help reduce operating costs

Ultra high performance diesel (UHPD) oils are designed to provide superior lubricant performance for the latest and next generation low-emission diesel engines. The ProFleet™ range of engine oils are developed to maintain outstanding cleanliness in both engines and exhaust after treatment systems. This range of engine oils also meet manufacturers' extended drain requirements, to help lower overall operating costs.

ProFleet engine oils

> Fully synthetic motor oils
> Meets or exceeds leading engine manufacturers' latest specification
> Long drain oil refreshment period
> Low emission with exhaust after treatment device protection
> Reduces oil consumption
> Better engine performance leading to improved fuel economy and lower general operating costs
> Emission control: Fulfills the requirements of the EU Euro I/II/III/IV/V emission standards

ProFleet LS 10W-40

> Suitable for use in high-performance trucks, buses and industrial applications
> Lower SAPS formula content to protect the latest after treatment systems
> Compatible with EGR (Exhaust Gas Recirculation), SCR (Selective Catalytic Reduction) and DPF (Diesel Particulate Filter) systems
> Capable of providing long-drain service intervals for trucks driving long distances (consult OEM recommendations)

ProFleet 5W-30

> Formulated to provide extra long-drain oil refreshment periods for trucks, buses and industrial engines
> Exceptional fuel economy
> Contains an ultra-modern additive system providing protection and a clean engine over the whole oil drain period
> Compatible with EGR and SCR systems
> Unique formulation prevents deposit formation and protects against soot build-up
> Fulfills the UHPD recommendations of major engine builders

ProFleet 10W-40

> Total protection over extended drain intervals
> Compatible with EGR and SCR exhaust after treatment systems
> Not for DPF systems

Approvals / Performance Levels

Product name	Viscosity	API	ACEA	MB*	MAN*	Renault*	MTU*	Volvo*	Scania*	DAF*	Deutz*
ProFleet	10W-40	CF	E4/E7	228.5	3277	RLD-2/RXD	3	VDS-3	LDF-2		
ProFleet LS	10W-40		E4/E6/E7	228.5/228.51	3277/ 3477	RLD-2/RXD	3	VDS-3	Low Ash	DAF MX	DQC II 05
ProFleet	5W-30		E4-08/E7-08	228.5	3277	RXD	3	VDS-2		HP1/ HP2	

Material number table

Product name	Viscosity	4x5L	20L	60L	208L	1000L
ProFleet	5W-30		VE614447		VE13938	VE13935
ProFleet	10W-40	VE13911	VE13906	VE13917	VE 13918	
ProFleet LS	10W-40	VE13971	VE13976		VE13978	VE13975

*Trademark owned by third party

LUBRICANTS | ENGINE OIL | FULLY SYNTHETIC MOTOR OILS

FULLY SYNTHETIC MOTOR OILS

Superior performance to help reduce operating costs

Benefits of synthetic motor oils

Conventional oils, which are usually called mineral oils, are refined from crude oil in a process of physically separating light oil from heavy oil components. All conventional oils contain naturally occurring substances that cannot be completely removed and thus are present in the final product, having a negative impact on finalized product.

Low cost is the main advantage of mineral oils. The main limitation of mineral oils is that the lubricant-sized molecules have a variety of structures ranging from the best to the worst (in terms of wear control).

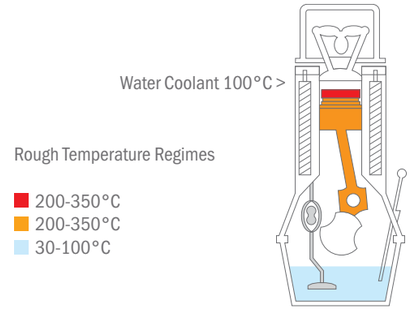
Synthetic base stocks are designed to provide certain predictable properties as they are a chemical reaction of lower molecular weight materials.

The synthetics base stocks do not contain elements that invite the formation of sludge and other products of lubricant breakdown. Synthetic lubricants can be used in higher temperatures without breaking down. Additionaly, their resistance to breakdown is greater, so synthetic lubricants can be used longer. Lubricated systems stay cleaner and last longer with synthetic lubricants. Molecular uniformity also helps synthetics resist thinning in heat and thickening in cold, which helps them protect better than mineral oils over a system's operating temperature range and helps ensure secure sealing.

The main benefits of synthetic motor oil can be explained as improved energy efficiency, wider operating temperature range, reduced maintenance, better reliability and safer operation.

High temperature resistance

Mineral motor oils break down at temperatures above 200°C, while synthetic motor oils will break down at temperatures higher than 300°C.



Volatility

The Noack Volatility Test determines the evaporation loss of lubricants in a high-temperature service. The more motor oil vaporizes, the thicker and heavier it becomes, contributing to poor circulation, reduced fuel economy and increased oil consumption, wear and emissions. The lower Noack value can indicate lower oil consumption. Volatility is measured by the Noack Evaporation Test, which measures the mass of oil lost in a vacuum can. To determine the percentage of mass lost, oil is placed in a reaction can at 250°C for one hour.

Market trends

Three main factors that impact the European engine market today are: extended drain, fuel economy and emissions.

Extended drain

The main aim is to reduce the quantity of used oil and to reduce the cost of maintenance.

Fuel economy

Fuel economy is a combination of environmental and cost requirements. The general idea is to lower CO2 emissions and fuel consumption while reducing the running costs of vehicles.

Emissions

European Union legislation defines the maximum permissible emissions of a range of substances; current legislation is known as Euro 4. For detailed information, see General Information, page 51.

FULLY SYNTHETIC MOTOR OILS

Superior performance to help reduce operating costs

Impact of these factors on oil formulation

Extended drain

To achieve extended drain, advanced engine lubricants are needed, which have great thermal and oxidation stability, lower oil consumption rates and greater TBN retention. These demands require a greater use of fully synthetic and semi-synthetic base oils, in the place of mineral base oils. This also means the move from higher (20W-50, 15W-40) to lower viscosity grades (5W-30, 5W-40).

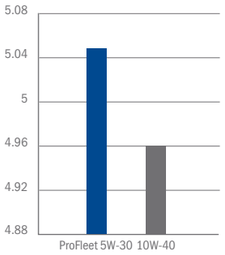
Some OEMs already extend the oil drain periods, like DaimlerChrysler (up to 100.000 km with MB 228.5), MAN (up to 80.000 km with M3277) and Scania (up to 120.000 km with LDF). However, these specifications demand the highest oil quality and oil drain periods are related to the type of service. The extended drain oils performance package should prevent solids agglomeration and oil thickening, control engine sludge and varnish formation, as well as provide high-temperature deposit control during the whole drain interval. New additive chemistry should be used, providing for longer performance.

Oil pan unacceptable | Oil pan acceptable

Piston unacceptable | Piston acceptable
High oil quality at extended drain interval

Fuel economy

Increasing demand for lower fuel consumption increases the use of low-viscosity motor oil grades even in a heavy-duty service. This promotes the use of 5W-xx and 10W-xx motor oils. The best way to prove fuel economy is to perform a field test. The fuel economy of a bus fleet with Cummins ISBe engines was measured over a 100,000 km period, the fleet had four oil changes over this course. ProFleet 5W-30 was compared with an equivalent SAE 10W-40 motor oil according to ACEA E3, Scania LDF and Volvo VDS-2 performance level. The results show that with 1.000 liters of fuel, the bus using ProFleet 5W-30 motor oil will pass 5.050 km and with comparable 10W-40 motor oil 4.960 km. About 90 liters of fuel are saved every 25.000 km with Valvoline oil compared to the competitive oil. Over 100.000 km, it makes a difference of about 360 liters of fuel, multiplied by the number of buses in service, the resulting savings have the potential to be significant.



Fuel Economy Test Results
5,05 km is driven with one litre of fuel with ProFleet 5W-30; 4,96 km is driven with one litre of fuel with referent 10W-40

Low SAPS technologies

Sulphated ash, sulphur and phosphorus are commonly used in motor oil formulation, but these substances are some of the biggest contributors to air pollution. Therefore, new additive chemistry should be used in motor oil formulation, reducing or fully replacing the use of standard additive technology. Products with such technology are compatible for use in engines equipped with after treatment devices, and are suitable to fulfill Euro IV standards. Depending on the quantity of SAPS used, they are called Low SAPS or Medium SAPS oils. For more explanation see General information page 55.

SEMI-SYNTHETIC MOTOR OILS

Extra durability for long-drain performance

Developed for a wide range of heavy-duty engines, All-Fleet® engine oils help prevent the higher levels of contamination and soot created in extended–and long-drain operation to maintain advanced levels of engine protection and cleanliness. The All-Fleet range of super high performance diesel (SHPD) engine oils exceeds required specifications, and helps fleet owners optimize engine life cycle cost and performance.

All-Fleet engine oils

> Advanced additive technology reduces oil consumption and component wear
> Outstanding protection over long-drain intervals
> Superior soot control and corrosion protection
> The optimum choice when maximizing life cycle costs
> Compatible with EGR and SCR systems

All-Fleet Extreme 10W-40

> Synthetic technology
> Improved thermal and oxidation stability
> Easy start-up under very cold circumstances
> Compatible with EGR and SCR systems

Approvals / Performance Levels

All-Fleet Extreme 10W-40 I ACEA E7-04 Issue 2, E5-02, E3-96/4, API CI-4, CH-4, CG-4, MAN 3275, MB 228.3, Volvo VDS-3, Renault RLD/ RLD-2, Cummins 20.076/77/78, Mack EO-M+, DHD-1, MTU Typ 2, Caterpillar ECF1,2, Deutz DQC III

Material number table

Product name	5L	20L	60L	208L	1000L	BULK
All-Fleet Extreme 10W-40		VE13766	VE13777	VE13778	VE13775	

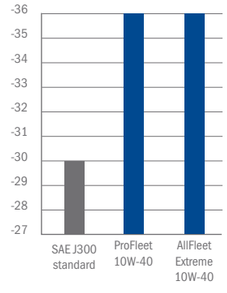
SEMI-SYNTHETIC MOTOR OILS

Extra durability for long-drain performance

The semi-synthetic motor oils combine the advantages of low viscosity, strong oil film and durable oils with price. They even can be used in some Euro IV engines.

Cold weather starts advantages

Cold weather start-up is especially difficult for engines. To protect bearings, cam lobes, lifters and other components from sustained metal-to-metal contact, the engine oil must flow freely and quickly from the oil pump inlet to the most distant point of the valvetrain. Therefore the low temperature pumpability of engine oil is important to determine its performance in cold weather starts.
The Society of Automotive Engineers (SAE) defines the maximal borderline pumpability for each “W” (winter) viscosity grade. This ensures that engine oil labeled with the SAE viscosity grade will have sufficient cold temperature properties. ProFleet 10W-40 and All-Fleet Extreme 10W-40 oils are designed to provide improved pumpability under these tough conditions for greater cold-start protection, surpassing SAE J 300 standard limits.



SAEJ300 Standard prescribes for 10W motor oil a maximal borderline pumping temperature of -30°C.

Valvoline ProFleet and All Fleet Extreme motor oils, with maximal borderline pumping temperature of -36°C surpass the limits.

Chemistry upgrade advantages

Upgraded additive chemistry used in formulation of high quality Valvoline motor oils allows extension of drain intervals, according to the performance levels, OEM recommendations and service type.

CF-4 Chemistry
48.000 Km/30.000 mile
oil drains

CG-4 Chemistry
81.000 Km/50.000 mile
oil drains

CH-4 Chemistry
81.000 Km/50.000 mile
oil drains

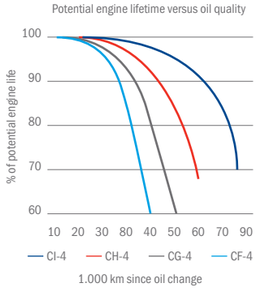
SEMI-SYNTHETIC MOTOR OILS

SEMI-SYNTHETIC MOTOR OILS

Extra durability for long-drain performance

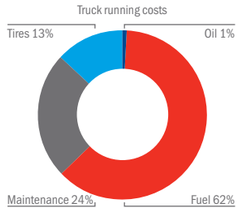
Engine lifetime expectations

The quality of oil used, drain period and engine lifetime is interdependent. Only high-quality oils allow oil drain extension without significantly impacting engine life. With adequate lubricants, the mechanism will usually perform well and last for long time.
With poor lubrication the service life will be significantly less than the designed life. However, with superior lubricants the same mechanism may last many years longer.



The impact of oil quality and drain intervals on the potential lifetime of an engine

All engines are designed and manufactured with a specific service interval in mind. This differs for equipment and manufacturer, plus design quality, materials used and other factors.
For example, passenger cars and light-duty trucks sold in the U.S. are currently designed, tested and certified for a useful service life of up to 15 years or 150,000 miles.
Presuming truck engine lifetime (as 100% of the potential lifetime), the graph shows how the use of proper oil quality and drain interval can fulfill these expectations, and also how low quality oil and prolonged drains can shorten.
Take for example, engine lifetime at 100.000 km, using an CI-4 motor oil with oil drain of 40.000 km, the expectations could be 100% achievable.
However, using the same engine CF-4 oil at the same drain interval, it can be expected to achieve 60% of potential engine lifetime.



Truck running costs

The choice of the lubricant used and the oil filter change frequency has a strong impact on the potential engine lifetime. The usage of poor lubricants or too far extended drains can shorten potential engine lifetime dramatically.

MINERAL MOTOR OILS

Proven performance for heavy-duty applications

Developed for a wide range of heavy-duty engines, All-Fleet® engine oils combat the higher levels of contamination and soot created in extended–and long drain operation to maintain advanced levels of engine protection and cleanliness. The All-Fleet range of super high performance diesel (SHPD) engine oils exceeds required specifications, and helps fleet owners optimize engine life cycle cost and performance.

All-Fleet engine oils

> Advanced additive technology reduces oil consumption and component wear
> Outstanding protection over long-drain intervals
> Superior soot control and corrosion protection
> The optimum choice when maximizing life cycle costs
> Compatible with EGR and SCR systems

All-Fleet Extra LE 15W-40

> Fulfils the requirements of the EU Euro V emission standards
> Mid SAP oil compatible with SCR, EGR, and DPF exhaust systems
> Maximizes engine durability

All-Fleet Extra 15W-40

> Mineral base provides proven benefits at optimum costs
> Fulfills the requirements of the EU Euro IV standards for truck engines
> Maximizes engine durability
> Compatible with EGR and SCR systems

All-Fleet 15W-40/20W-50

> Proven formula for mixed fleet applications

Approvals / Performance Levels

All-Fleet Extra 15W-40 I ACEA E7-04, E5-02, E3-96/4, API CF-4, CG-4, CH-4, CI-4, Cummins 20.076/77/78, MB 228.3, Volvo VDS-3, MAN 3275, Mack EO-M plus, Global DHD-1, Renault RVI/RLD-2

All-Fleet Extra LE 15W-40 I ACEA E7-04/ACEA E9-08, API CF-4, CG-4, CH-4, CI-4, CJ-4, Cummins CES 20081, DaimlerChrysler 228.31, Volvo VDS-4, VDS-3, MAN 3275, MTU 2.1, Mack EO-O premium plus, Caterpillar ECF-3, Renault RLD-3

All-Fleet Extra 20W-50 I ACEA E3-96/4, API CF-4, CG-4, MAN 271, Mack EO-M+

All-Fleet 15W-40 I ACEA A2-96, B3-98/2, E2-96/4, API CF-4, CG-4, MB 228.1, 229.1, VW 505.00, MAN 271, Volvo VDS, Mack EO-L

All-Fleet 20W-50 I ACEA A2-96/3, B2-98/2, E2-96/4, API CF-4, CG-4, MB 228.1, MAN 271

Material number table

Product name	5L	20L	60L	208L	1000L	BULK
All-Fleet Extra 15W-40	VE13711	VE13706		VE13718	VE13715	VE13719
All-Fleet Extra LE 15W-40		VE703678		VE707479		
All-Fleet Extra 20W-50		VE13726	VE13737	VE13738	VE13739	
All-Fleet 15W-40	VE12671	VE12666	VE12677	VE12678	VE12675	VE12679
All-Fleet 20W-50	VE12711	VE12705		VE12718		VE12719

MINERAL MOTOR OILS

Proven performance for heavy-duty applications

Valvoline HD engine oils provide unrivalled value across a variety of commercial vehicle and off-highway applications with a broad range of available viscosities. Valvoline HD engine oils are mineral based, with advanced additive technology and are backed by millions of kilometers of proven performance in combatting sludge build-up and component wear to give high-quality performance at an economical operating cost.

Valvoline HD multi-grade engine oils

> Unrivalled value and protection for mixed fleet applications
> Advanced chemistry reduces friction and engine component wear
> Additive technology prevents black sludge and maintains engine cleanliness
> Suitable for on-road and off-highway applications
> Recommended for use in high-and low-speed four-stroke diesel engines
> Suitable for industrial engines

Valvoline HD mono-grade engine oils

> Designed for use in gasoline and diesel engines where a single grade motor oil is recommended by the engine manufacturer.
> Specially engineered for use in service fleets where it helps prevent formation of sludge, caused by frequent stop-and-go driving conditions.
> Can also be used in some cases as hydraulic or transmission oil, where specified by the manufacturer.

Valvoline HD 15W-40, 20W-50, 10W, 30, 50

Approvals/Performance Levels

Valvoline HD 15W-40, 20W-50, 10W, 30, 50
(15W-40) API CF-4, (10W) API CF-4, SG, Caterpillar TO-2, (30) API CF-4, SG, Caterpillar TO-2, API CF-4, (50) API CF-4

Material number table

Product name	Viscosity	4x5L	20L	60L	208L	1000L	BULK
All-Fleet Extra	15W-40	VE13711	VE13706	VE13717	VE13718	VE13715	VE13719
All-Fleet Extra	20W-50		VE13726	VE13737	VE13738	VE13739	
All-Fleet	15W-40	VE12671	VE12666	VE12677	VE12678	VE12675	VE12679
All-Fleet	20W-50	VE12711	VE12705		VE12718		VE12719
HD	15W-40	VE13812	VE13756		VE13758	VE13815	VE13819
HD	20W-50		VE13796		VE13798		
HD	10W		VE12606			VE12615	VE90188
HD	20W-20						
HD	30		VE12726		VE12738		VE12739
HD	40		VE12726				
HD	50				VE12778		VE90428

MINERAL MOTOR OILS

Proven performance for heavy-duty applications

Neutralizing acid is a balancing act

Sulfur from unburned diesel fuel, along with other combustion byproducts and oxidation compounds from aged oil, combine with water to form corrosive acids. Acids must be neutralized by an engine oil before they attack metal parts.

Total Base Number (TBN) is a measure of an oil's ability to neutralize these acids and maximize the performance of your (direct-injection) diesel engines.

All-Fleet Extra with TBN rating 10,1 is recommended for most on- and -off-highway applications.
It is also recommended for the most severe applications and offers the most protection.

The right chemistry

Why not just increase the TBN? Unfortunately, the additives used to increase TBN also raise the sulfated ash content of the oil. Engine oils with a high ash content may increase piston crown carbon, valve and injector deposits. These deposits can lead to increased oil consumption, higher emissions and poor engine performance. That's why most engine manufacturers recommend oil ash limits for their engines.
All-Fleet Extra features the right balance of additives for corrosion and deposit control to keep your engine running at the optimum level.

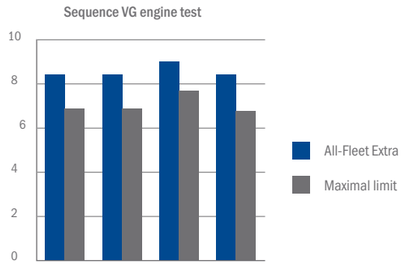
Going the distance

It's the job of a quality heavy-duty engine oil to control acids over the whole length of an oil change interval. All-Fleet Extra CI-4 chemistry has been field tested in Cummins, Mack and Caterpillar engines with proven performance.

Sludge protection

The sludge is a soft material formed in the cooler parts of an engine and is formed by a combination of water, combustion byproducts and oil insolubles. Sludge deposits on oil pump screens, in oil passages or on the valve train can restrict oil flow and cause excessive engine wear.

The Sequence VG engine test measures an oil's ability to prevent sludge deposits, varnish and cam lobe wear. Valvoline All-Fleet Extra provides lower average engine sludge, rocker cover sludge, average engine varnish and average piston skirt varnish protection.



MINERAL MOTOR OILS

Proven performance for heavy-duty applications

Research and development

Ashland Consumer Markets - Valvoline Engine Laboratory was established in September 1953. The early years were focused on fuels, followed by lubricants and metal coating technology. During the late 1950s' and early 1960s' Valvoline recognized the changing market demands and began focusing on the development of premium engine oils. Today, the laboratory is devoted to research, development and mechanical testing of lubricants and coolants, providing effective product evaluations using stationary engine tests and fleet test programs.

Here are some of ASTM engine oil test methods conducted at the Ashland Consumer Markets Engine Laboratory :

GM 3.8L Sequence IIIF test

This test method was developed to evaluate automotive engine oils for protection against oil thickening and engine wear, during moderately high-speed, high-temperature service. Such oils include both single and multi-viscosity grade oils. These oils are used in both gasoline (SI) engines, as well as in diesel (CI) engines. The test method was developed to correlate with field experience using oils of known good and poor protection against oil thickening and engine wear.

Ford 4.6L Sequence VG test

This test method has been correlated with vehicles used in stop-and-go service, particularly with regard to sludge and varnish formation. It is used to evaluate an engine oil's control of deposits under operating conditions deliberately selected to accelerate deposit formation. The test engine is a Ford 4.6L, V8 engine. This method was correlated with field service data, determined from side-by-side comparisons of two or more oils, in police, taxi fleets and delivery van services.

Nissan 2.4L Sequence IVA test

This test method measures the ability of crankcase oils to prevent camshaft and rocker arm follower wear encountered during stop-and-go driving conditions and extended engine idling, similar to taxi or commuter service. The test utilizes a Nissan KA24E 2.389 L, four cylinder, gasoline engine. Results include camshaft lobe wear and cam lobe nose wear, assessment of wear metal concentration and fuel dilution in the used engine oil, as well as oil consumption.

Ford 4.6L Sequence VIB test

This test evaluates the effects of engine oils on the fuel economy of passenger cars and light duty trucks. The test is conducted using a specified 4.6-L engine on a dynamometer test stand. It applies to multi-viscosity grade oils used in passenger cars and light-duty trucks. The data obtained from this test method provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions.

Caterpillar Sequence 1K/1N test

The CAT 1K is used to determine acceptability of oils for Caterpillar engines. The acceptability of the oils are based on average oil consumption and piston deposits that include top groove fill percentage, top-land heavy carbon, and weighted deposits. Additionally, test requirements prohibit stuck piston rings and distressed pistons, rings, and/or liners. Test operations involve control of the single-cylinder diesel engine for a total of 252 hours at specified speeds and fuel input using the test oil as a lubricant.
The 1K uses a high-sulfur fuel, while the 1N uses a low-sulfur fuel.

CLR Sequence VIII test

This engine oil test method covers the evaluation of automotive engine oils (SAE grades 5W, 10W, 20, 30, 40, and 50, and multi-viscosity grades). Oils are evaluated for protection against engine and oil deterioration under high-temperature, heavy-duty service conditions. The test method can also be used to evaluate the viscosity stability of multi-viscosity-grade oils.

Additional tests and in-depth research for lubricants, fuels, coolants and other fluids are performed ensuring high success ratio of newly launched products. The Ashland Consumer Markets laboratory is fully approved and equipped to find solutions for the most demanding contemporary market demands.

PREMIUM BLUE® ENGINE OIL

The technology behind Premium Blue engine oils was developed in partnership with Cummins Inc., the world's largest producer of commercial diesel engines above 50 horsepower. By combining the innovation and proven performance of premium Valvoline lubricants with Cummins' unparalleled expertise in diesel engines, we have taken engine design and lubricant technology to new performance levels. This partnership continues to create high-performance products such as Premium Blue engine oils, which are designed for extended engine life and increased protection in all heavy-duty diesel applications.

Premium Blue 15W-40

> Premium Blue engine oil is exclusively recommended and endorsed by Cummins Inc. Premium Blue oil is designed to provide advanced lubricant performance in modern, low-emissions diesel engines, including those with cooled exhaust gas recirculation (EGR). It is a higher total base number (TBN) product designed for the latest diesel engine specifications from API, ACEA and OEMs (including Cummins) that allow for higher sulfated ash products. The advanced technology of Premium Blue oil offers a long-life, extended drain capability through a balanced formulation that helps maximize engine durability.

Approvals/Performance Levels

Premium Blue 15W-40
E5, E3, ACEA E7-04, API CF-4, CG-4, CH-4, CI-4, SL, MB 228.3, Volvo VDS-3, MAN 3275, Cummins CES 20.071/2/6/7/8, Mack EO-M Plus, Global DHD-1, Renault RVI RLD/RLD-2, MTU-2, Caterpillar ECF a, 2

Premium Blue Extreme 5W-40

> Premium Blue engine oil is formulated with high-quality synthetic basestocks and a boosted additive system to meet the stringent demands of modern diesel engines including EGR and diesel particulate filter (DPF) control systems, operating under standard and extended service intervals. Premium Blue oil provides fuel economy benefits for on-highway Class 8 trucks (weight > 15.000 kg). Statistically significant test results find up to 3% maximum improvement in fuel economy using SAE J1321/TMC RMP 1103, Type II techniques tested by independent laboratory.

Approvals/Performance Levels

Premium Blue Extreme 5W-40
API CJ-4, API CI-4 Plus, API CI-4, API CH-4, CG-4, CF-4, CF/SM, ACEA E9-08, ACEA E7-08, Cummins CES 20081, Mack EO-O Premium Plus, Volvo VDS-4, Detroit Diesel 93K218, Caterpillar ECF-3, Jaso DH -2, Global DHD-1, MAN 3275, MB 228 - 3/31, MTU -2, Renault RLD - 3

Premium Blue GEO 15W-40

> Premium Blue motor oil is designed for dedicated natural gas engines and for vehicular applications. This product is suitable for gas engines where the OEM allows the use of engine oils with a sulphated ash content of < 1% wt. OEM specifications should be checked before use. Valvoline Premium Blue GEO keeps the engine clean and protects against corrosion and wear. It also has the ability to neutralize acids and resist oxidation and nitration which helps to prevent oil thickening. Premium Blue GEO 15W-40 is a high-quality mineral motor oil with an advanced additive system for a longer engine life.

Approvals/Performance Levels

Premium Blue GEO 15W-40
API CD, Cummins 20074, Caterpillar*, Detroit Diesel*, John Deere*

Product name	5L	20L	208L	1000L	BULK
Premium Blue Extreme 5W-40		703679	VE17778		
Premium Blue 15W-40	VE17711	VE17706	VE17718	VE17715	VE17719

Premium Blue GEO-LA 40 /GEO-MA 40

> Premium Blue universal motor oil is designed for stationary engines running on natural gas and bio-gas, and is suitable for gas engines where the OEM allows the use of engine oils with a sulphated ash content of < 1% wt. (OEM specifications should be checked before use). Keeps the engine clean and protects against corrosion and wear, and also has the ability to neutralize acids, and resist oxidation and nitration, which helps to prevent oil thickening. Premium Blue GEO-LA 40 /GEO MA 40 are high-quality mineral motor oils with an advanced additive system for a longer engine life.

Approvals/Performance Levels

Premium Blue GEO-LA 40/GEO-MA 40
API CD, Cummins, Caterpillar, Dresser-Rand*, Waukesha*; API CO

Product name	5L	20L	208L	BULK
Premium Blue GEO-LA 40			VE17758	VE17759
Premium Blue GEO-MA 40			VE17798	VE17799

PREMIUM BLUE

Recommended and endorsed by Cummins for diesel engines

Field tested

The field test of Premium Blue CI-4 category oil, was conducted at 300.000-mile field test using Caterpillar C15/500 hp equipped trucks, with 65.000 miles oil drain. The study was designed to determine engine oil effects on wear, deposit control and oil consumption at extended oil drains. The summary of results:

1. Total test miles accumulated
2. No lubricant-related failures or engine problems developed during the program
3. Overall sludge deposits averaged 9.6 (CRC 10=clean merit scale)
4. Overall piston deposits rated 175. 200 demerits is a relative benchmark for field testing, depending on test conditions
5. No significant wear found, wear was minimal, with ratings of trace to light in nearly all categories
6. Wear on camshaft lobes, both valve and injector, was characterized as trace to light
7. Piston ring end gaps remained within manufacturers' service specifications

EGR Engines

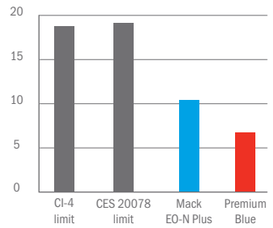
Most engine manufacturers including Cummins, Mack, Volvo and Detroit Diesel have indicated that they will use the cooled EGR technology to meet the 2004 emission standards. As in EGR technology, the exhaust gases directed back into the combustion chamber for second burning, the oil is submitted to intensive pollution by soot. Cummins M-11 EGR test measures an oil's ability to minimize wear of sliding valve-train components at high soot levels. Engine sludge and filter plugging are also inspected.
Premium Blue formulations have shown exceptional cross-head wear protection, engine cleanliness and reduced filter restrictions in the Cummins M-11 EGR test.

Valve train crosshead wear scar comparisons

New crosshead	CI-4 limit 20 mg loss	Falling X head 57 mg loss	Premium Blue 9,72 mg loss	New crosshead

Wear on the crosshead is a simple indicator of wear that occurs throughout the valve train system.

Cummins M-11 EGR Test



Cummins M-11 EGR Test measures an oil's ability to minimize wear of sliding valve-train components. Engine sludge and filter plugging are also inspected. Results have shown exceptional cross-head wear protection and engine cleanliness. Valvoline Premium Blue oils protect these engines without significant change to drain intervals.

MARINE AND GAS APPLICATIONS

Reliability and trust

Valmarin TP 1230, 1240

Valmarin TP-1230 and 1240 are premium heavy-duty oils specially designed for medium- and high-speed marine trunk piston gas, oil and marine diesel engines. Valmarin TP oils prevent ring-sticking, wear and deposit formation and keep the engine clean. The Valmarin TP oils fulfill the requirements of most major marine diesel engine manufacturers.

All-Fleet DD-40

All-Fleet DD-40 is a low-ash, high-quality, extra heavy-duty detergent motor oil formulated to provide optimum performance in GM-Detroit two-cycle diesel engines in marine and industry services.

All-Fleet DD-40 motor oil advantages

- **Low-ash content**: Helps prevent deposit formation on the exhaust valves with low ash content
- **Anti-wear**: Excellent anti-wear properties
- **Keeps the engine clean**: Prevents sludge formation and lacquer deposits
- **Stability**: High oxidation stability

ProFleet GEO motor oil

ProFleet GEO motor oil SAE 15W-40 is a specially formulated for truck- and bus engines running on compressed natural gas (CNG), or liquid petroleum gas (LPG). The oil has very high oxidation stability and thermal stability, and a strong acid neutralizing ability. ProFleet GEO keeps the engine clean and prevents deposit forming on pistons, valves and in exhaust channels. The additive system provides an effective protection against valve wear down. The oil has a long-life and protects the engine against wear during virtually all working conditions.

ProFleet GEO motor oil advantages

- **Keeps the engine clean**: Prevents deposit forming in the combustion chamber and on pistons and valves
- **Long-life character**: Engine protection during the whole oil refreshment period
- **Prevents wear and tear**: Prevents valve-train wear and acid reactions
- **Protection**: Excellent protection against corrosion and oxidation

Approvals / Performance Levels

Product name	Viscosity	Performance levels
All-Fleet DD	40	API CF-2.CF, GM Detroit Diesel series 53, 71, 92, 149
Valmarine TP 1240	40	API CF, MAK, MAN B&W, SEMT Pielstick, New Sulzer Diesel, Wartsila
Valmarine TP 1230	30	API CF, MAK, MAN B&W, SEMT Pielstick, New Sulzer Diesel, Wartsila
ProFleet GEO	15W-40	MB 226.9, MAN 3271-1

Material number table

Product name	Viscosity	4x5L	20L	60L	208L	1000L	BULK
All-Fleet DD	40				VE16158		
Valmarin TP 1240	40				VE16138		VE16139
Valmarin TP 1230	30				VE16118		VE16119
ProFleet GEO	15W-40				VE13958		

TRANSMISSION/ GEAR OIL

Higher performance means higher demands.

Today's gearboxes and transmissions are designed to perform at higher levels than ever before. This in turn demands that high quality and increasingly complex gear lubricants must be used. Valvoline gear oils have been developed following many years of research, development, and field experience.
The result is a range of oils that are designed to meet the extreme performance demands of today's gearboxes and transmissions.

SYNPOWER® GEAR OIL

Full Synthetics - SynPower Gear Oils

SynPower Gear Oils are high-performance fully synthetic lubricants specially formulated to meet the needs of modern, as well as conventional gear boxes and transmissions of trucks, buses and other heavy-duty applications.

Features/benefits

> Formulated with the most advanced additive technology
> Provides outstanding thermal stability over a wide temperature range
> Improves easier shifting at low temperatures
> Superior protection against wear and corrosion
> Ensuring compatibility with a variety of seals
> For cars, trucks, buses and industrial vehicles

SynPower TDL 75W-90

SynPower TDL gear oil is a premium automotive gear oil with performance capabilities that match current and future needs. Today's engines and drive trains must run efficiently for longer periods often at high speeds and under maximum load. SynPower TDL was designed to withstand the most severe conditions to ensure the reliable operation of commercial vehicles. In addition, the SynPower TDL technology provides a higher level of protection and can be used in both final drives and manual transmissions, bringing significant benefits to the full market range of gear lubricants.

Features/benefits

> Total drive line oil capabilities
> Helps storage rationalization
> Specially formulated for superior extreme temperature service
> Superior oil film strength suppresses noise
> Provides smooth shifting of gears
> Reduction in ground water contamination from oil leakage due to improved seal protection

SynPower GL-5 75W-140

SynPower gear oil GL-5 75W-140 is a fully synthetic gear oil specially developed for severe operating environments in today's heavy-duty drive axels. With exceptional thermal durability, it protects gears from damage at high temperatures and high pressure. Excellent seal compatibility prevents seal material degradation and resulting fluid loss. The number of tests that were passed by this gear oil meets the highest demands of today's equipment.

Features/benefits

> Specially formulated for extreme temperature and service protection
> Excellent protection against wear and corrosion
> Supports longer drain intervals

Approvals / Performance Levels

Product name	Viscosity	API	Scania	ZF
SynPower TDL GL-4/5	75W-90	GL-3,4,5; MT-1		TE-ML
SynPower GL-5	75W-140	GL-5	STO 1:0	

Material number table

Product name	Viscosity	1L	20L	60L	208L
		vSW			
SynPower TDL GL-4/5	75W-90	VE15000	VE15006	VE15017	VE15018
SynPower GL-5	75W-140				VE15838

DURABLEND® GEAR OIL

DuraBlend gear oils are specifically designed to provide boosted protection and high performance, at both high and low temperatures. DuraBlend oils are formulated with a unique blend of synthetic and premium base oils with an advanced additive system to provide superior extreme pressure benefits and extra durability for tough driving conditions. Recommended for cars, trucks and buses.

DuraBlend GL-5 LS 75W-90

> For use in all limited slip, hypoid and other gears where API GL-5 type lubricant is specified
> Special additives reduces noise in differentials
> Protects against wear under all conditions

DuraBlend GL-5 75W-90

> For use in all hypoid transmissions and transaxles where API GL-5 gear oil is specified
> Provides excellent protection under all weather conditions
> Protects against rust and corrosion

DuraBlend GL-4 75W-90

> For use in all transmissions and transaxles where API GL-4 gear oil is specified
> Provides enhanced protection and lubrication for smooth running gear operation
> Protects against rust and corrosion

Approvals / Performance Levels

Product name	Viscosity	API	MAN	MIL-L	Volvo*	Eaton	ZF	Peugeot/Citroen/Renault*
DuraBlend GL-4	75W-80	GL-4	341 TL, 341 TYP Z-3, E-3		97305	long drain	TE-ML02D	x
DuraBlend GL-4	75W-90	GL-4		2105				
DuraBlend GL-5	75W-90	GL-5		2105D				
DuraBlend GL-LS	75W-90	GL-5 LS		2105D				

Material number table

Product name	Viscosity	1L	20L	60L	208L	1000L	BULK
		vSW					
DuraBlend GL-4	75W-80	VE15420	VE15426		VE15438		VE15429
DuraBlend GL-4	75W-90	VE15400	VE15406	VE15417			
DuraBlend GL-5	75W-90	VE15300	VE15306	VE15317			VE15319
DuraBlend GL-5 LS	75W-90	VE15320	VE15326		VE15338		

*Trademark owned by third party

HIGH-PERFORMANCE GEAR OIL

High-performance (HP) gear oils are formulated with premium base stocks and additives to provide excellent gearbox performance and protection. They offer smooth running gear operation under various temperature conditions, as well as provide protection against wear and corrosion. Recommended for use in cars, trucks and buses.

High Performance gear oils

> Formulated with a special additive system to provide optimal performance and protection
> Offers smooth shifting under various temperature conditions
> Protection against wear and corrosion

High Performance Plus GL-5 80W-90

> Prevents component failure, reduction of film thickness, changes to low-temperature performance, deposit formation, and creation of harmful acidic components and seal leakage

High Performance GL-5 LS 80W-90

> For limited slip axles
> Special additives reduces noise in limited slip hypoid and other gears where the manufacturer specifies an API GL-5 type lubricant

High Performance GL-5 80W-90/ 85W-140

> For rear axles and transaxles

Material number table

Product name	Viscosity	1L	1L	5L	20L	60L	208L	BULK
		vSW	v3					
HP Plus GL-5	80W-90				VE15676		VE15678	VE15679
HP LS GL-5	80W-90	VE15500			VE15506	VE15517	VE15518	VE15519
HP GL-4	80W		VE15722				VE15738	
HP GL-4	80W-90	VE15700			VE15706	VE15717	VE15718	VE15719
HP GL-5	85W-140				VE15626	VE15637	VE15638	VE15639
HP GL-5	80W-90	VE15600		VE15611*	VE15606	VE15617	VE15618	VE15619
HP PC GL-5	75W-80	VE17400				VE17417		
DT Transmission Oil	10W						VE17818	
DT Transmission Oil	30						VE17838	
DT Transmission Oil	30						VE17858	

*v1

LUBRICANTS | GEAR OIL | DIFFERENTIAL AND TRANSMISSION OILS

HIGH-PERFORMANCE GEAR OIL

High Performance PC GL-5 75W-80

> Specially developed to meet the latest Peugeot, Citroen and Renault requirements for manual transmissions

High Performance GL-4 80W-90, 80W

> For use in most types of manual transmissions and transaxles with API GL-4 specification
> Offers smooth running gear operation under various temperature conditions
> Protects against rust and corrosion

DT Transmission Oil 10W, 30, 50

> A heavy-duty lubricant designed and recommended for applications requiring oils meeting the Caterpillar TO-4 or the Allison C-4 specifications
> Formulated from premium base stocks and a select additive system to meet the challenging demands of modern equipment
> Designed for use only in transmissions and drive trains, and should not be used as an engine oil.
> Suitable for Caterpillar's road building equipment with wet brakes.

Approvals / Performance Levels

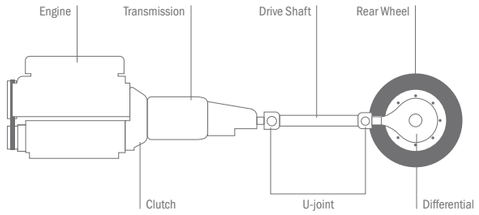
Product name	Viscosity	API	Allison	Caterpillar	MB	MAN	Scania*	ZF-TE ML	Mack	Peugeot/Citroen/ Renault*
HP PLUS GL-5	80W-90	GL-5, MT 1			235.20	342 ML, 342 TYP M-2	STO 1:0			
HP LS GL-5	80W-90	GL-5								
HP GL-4	80W	GL-4								
HP GL-4	80W-90	GL-4			235.1			02/17		
HP GL-5	85W-140	GL-5							GO-J	
HP GL-5	80W-90	GL-5			235.0				GO-J	
HP PC GL-5	75W-80	GL-5								x
DT Transmission Oil	10W		C-4	TO-4		TO-4				
DT Transmission Oil	30		C-4	TO-4		TO-4				
DT Transmission Oil	30			TO-4		TO-4				

*Trademark owned by third party

TRANSMISSION AND DIFFERENTIAL OIL

Powertrain

In a vehicle, the term “drivetrain” or “powertrain” refers to the group of components that generate and deliver power to the road surface, water or air. This includes the engine, transmission, driveshafts, differentials and the final drive (drive wheels, caterpillar track, propeller, etc.). Sometimes “powertrain” is used simply refer to the engine and transmission, including other components that are integral to the transmission.



Differential

The differential has three functions:
> To direct engine power to the wheels
> To act as the final gear reduction in the vehicle, slowing the rotational speed of the transmission a final time before it hits the wheels
> To transmit the power to the wheels while allowing them to rotate at different speeds (this function is the one that earned the differential its name).

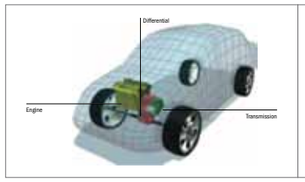
Car wheels spin at different speeds, especially when turning. As a result, each wheel travels a different distance through the turn - the inside wheels travel a shorter distance than the outside wheels. Since speed is equal to the distance traveled divided by the time it takes to go that distance, the wheels that travel a shorter distance travel at a lower speed. Also the front wheels travel a different distance than the rear wheels. The device called differential, splits engine torque two ways, allowing each output to spin at a different speed.

The differential is found on all modern cars and trucks, and also in many all-wheel-drive vehicles. These all-wheel-drive vehicles need a differential between each set of drive wheels, and they need one between the front and the back wheels as well, as the front wheels travel a different distance through a turn than the rear wheels.

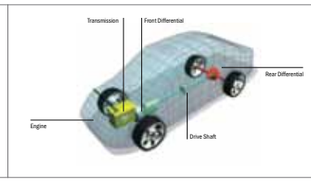
The usage of hypoid gears and an offset pinion in the differential reduces noise.
At the same time however there is greater sliding which increases heat. Therefore the GL-5 gear oils with higher content of extreme pressure additives should be used.

Differential

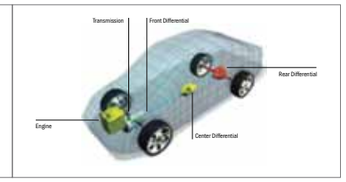
Front Wheel Drive



Rear Wheel Drive



All-Wheel Drive

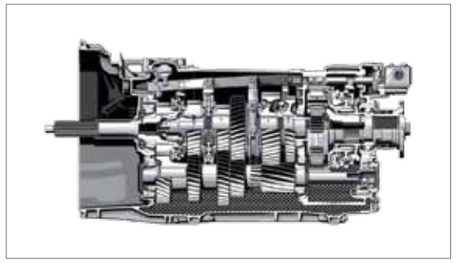


LUBRICANTS | GEAR OIL | DIFFERENTIAL AND TRANSMISSION OILS

TRANSMISSION AND DIFFERENTIAL OIL

Transmissions

Vehicles need transmissions because of the physics of the internal combustion engines. First, any engine has a redline - a maximum rpm value above which the engine cannot go without exploding. Second, engines have narrow rpm ranges where horsepower and torque are at their maximum. For example, an engine might produce its maximum horsepower at 5.500 rpm. The transmission allows the gear ratio between the engine and the drive wheels to change as the car speeds up and slows down. You shift gears so the engine can stay below the redline and near the rpm band of its best performance. Due to the construction and the gear types used, manual transmissions mostly demand the use of GL-4 gear oils, with a medium level of extreme pressure additives and compatibility with a variety of materials used in construction.



Manual transmission

API Service classifications for gear oils

GL-1 some transfer boxes
> Straight mineral oil, no additive system
> Transmissions under mild conditions

GL-3 industrial gear boxes
> Mild E.P. gear oil with low level of additives
> Transmissions under moderate conditions

GL-4 hand-shifted gear box
> Mild E.P. gear oil with medium level of additive
> Manual transmissions and selected transaxles
> Moderate speeds and loads

GL-5 rear axles differentials
> Heavy E.P. gear oil with high level of additives
> Hypoid gears and axles under severe conditions
> High speed and/or low speed. Low torque conditions

AUTOMATIC TRANSMISSION OIL

SynPower® ATF

> A high-performance fully synthetic automatic transmission fluid exceeding many leading OEM specifications
> Specially formulated for long-drain interval requirements and ideal for all automatic and powershift transmissions; it is also suitable for industrial and hydraulic systems
> Provides excellent low-friction properties, outstanding high and low temperature fluidity, and high thermal stability

MaxLife® ATF

Higher kilometer transmissions have different needs. As automatic transmissions age, seals can harden and crack causing leaks. Furthermore, deposit and varnish build-up can cause wear, slippage and rough shifting. MaxLife ATF is the only automatic transmission fluid formulated for vehicles with over 100.000 kilometers.
The advanced formulation helps keep the transmission functioning properly and enhances the performance and life of high-kilometer transmissions.

MaxLife ATF advantages

> Conditions automatic transmission seals to prevent leaks
> Reduces varnish formation and wear
> Improves and maintains smooth shifting longer than conventional ATF's
> Provides excellent flow at low temperatures and greater film protection at high temperatures
> Maximizes the life of higher kilometer automatic transmissions

Material number table

Product name	1L	1L			5L	20L	60L	208L	1000L	BULK
	vSW	v1	v2	v3						
SynPower ATF	VE14800							VE14818	630307	VE14819
MaxLife ATF	VE14920					VE14926	VE14937	VE14938		VE90384
ATF Dex/Merc	VE14820					VE14826	VE14837	VE14838		VE14839
ATF Type D		VE14840	VE14841	VE14842	VE14851	VE14846	VE14857	VE14858		VE14859
ATF Type FE	VE14860									

AUTOMATIC TRANSMISSION OIL

ATF Dex/Merc

> Specially formulated to meet the needs of today's more compact transmissions, running at higher operating temperatures and with electronic control
> Recommended for use in automatic transmissions, where the manufacturer prescribes a GM Dexron IIE, Dexron III or Ford Mercon fluid

ATF Type D

> Recommended for use in all automatic transmissions where GM Dexron II, Dexron IID, MB 236.6, ZF TE-ML-/04D/11A/14A/17C, and MAN 339 z-1, v-1 (former type D) fluids are specified
> Can also be used where an ATF Type A is specified, but it is not recommended for Ford M2C-33F/G applications
> Excellent low-friction properties, even under very cold conditions

ATF F/A

> Specially formulated for all transmission where a Ford M2C-33F/G fluid is specified
> High-quality non-friction modified fluid

Approvals / Performance Levels

Product name	Allison**	Audi**	BMW**	Chrysler**	Ford**	GM**	Honda**	Hyundai**	JWS**	Kia**	MAN
SynPower ATF	C-4				Mercon	DEXRON II-E					339 Z-2, 339 V-2
MaxLife ATF	C-4, TRANSSYND, TES-293	G-052-025-A2	LT 71141, LA 2634	ATF+3, ATF+4	Mercon, Mercon V	IID, E, III, VI	ATF-Z1*	X	3309	SP-II/III	339 typ F
ATF Dex/Merc	C-4				Mercon M, 020602	DEXRON III G-34221					
ATF Type D	C-4				Mercon	II-D					339 Z-1, V-1
ATF Type F/A					Ford M2C-3F/G						

Product name	Mazda**	Mini Cooper**	MB**	Mitsubishi**	Nissan**	Toyota**	Voiht**	Volvo**	VW**	ZF**	Catepillar**	Suzuki**
SynPower ATF			236.8				H55.633633			TE-ML	TO-2	
MaxLife ATF	X	CVT EXL 799	236.x*	Dimand SP-II, SP-III	D, J, K, -MATIC	T, T-III, T-IV	H55.633633/ 633	1161521, 1161540	TL52162	TE-ML		X
ATF Dex/Merc					X						TO-2	
ATF Type D			236.8				H55.633633			TE-ML	TO-2	

* MB 236.1, 236.2, 236.6, 236.8, 236.9, 236.11
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AGRICULTURE

Effective solutions for agriculture needs and high-tech machinery protection

We understand the importance lubricants play over the lifetime of a farm tractor. Tractors are more than a piece of equipment, they are a critical element of your operation's productivity and success. The superior performance of Valvoline® products are designed to help maintain and protect your investment in both the high- and low-tech equipment you depend on every day. The wide range of Valvoline lubricants and fluids are specifically designed for use in today's modern agricultural machinery.

AGRICULTURE OILS

The reliable, versatile and unique solution for farmers

Super Tractor Oil Universal (STOU)

Valvoline's premium, multi-functional SAE 10W-30/15W-30/15W-40 oils are specially formulated for use in agricultural equipment engines, transmissions, as well as wet brake and integral hydraulic systems. STOU can be used for total tractor lubrication, and its versatility helps you avoid misapplication by limiting the lubricant inventory you need to keep on hand. A special additive package enables greater lubricant flow, transmitting power throughout the system to ensure smooth operation. Documented testing shows that STOU helps reduce cam and bore wear, and promotes longer engine life and durability. A scientifically engineered universal additive technology performs and protects in both conventional powershift and new infinitely variable tractor transmissions. The farmers' investment and livelihood are further assured through reduced engine soot build-up and filter blockage.

Unitrac

Unitrac 80W is a premium multi-purpose fluid designed for year-round service in tractor hydraulic systems, transmissions and differentials with wet brake systems. Unitrac[1] protects against wear and corrosion of tractor components and has excellent friction properties.

[1] The product is not designed for use as an engine lubricant.

Approvals / Performance Levels

Product name	API	Case* IH	Massey Ferguson*	Ford*	Caterpillar	New Holland* FNHA	John Deere*	ZF
STOU 10W-30	GL-4, CF-4, CE/SF		M1139/44/45	M2C-159B, 30, 40	TO-2		JDM J27	TE-ML
STOU 15W-30	GL-4, CF-4, CE/SF		M1139/44/45	M2C-159B, 30, 40	TO-2		JDM J27	TE-ML
STOU 15W-40	GL-4, CF-4, CE/SF		M1139/44/45	M2C-159B, 30, 40	TO-2		JDM J27	TE-ML
Valvoline UNITRAC	GL-4+	S-1207, 1209	M1135, M1141, M1143/45	M2C-134 A/B/C/D, M2C86-B/C	TO-2	FNH A2C-200/ A,201	J20 A/B/C J14B/C J21A	TE-ML

Material number table

Product name	20L	60L	208L
STOU 10W-30	VE17006		VE17018
STOU 15W-30	VE17026		VE17038
STOU 15W-40	VE17046		VE17058
UNITRAC	VE17106	VE17117	VE17118

*Trademark owned by third party

AGRICULTURE FLUIDS

The reliable, versatile and unique solution for farmers

Why STOU?

Valvoline STOU agricultural or “tractor” fluids were developed to reduce misapplication and simplify the inventory of products required by farmers.

Classification of agricultural fluids

There are multi-purpose fluids in two general classifications:
> Super Tractor Oil Universal (STOU) - a fluid for all sumps, including the engine
> Universal Tractor Oils (UTTO) a fluid for all gear boxes, hydraulics and final drives. Not for use in engines.

STOU			
	TOU		
Wet Brakes	Transmission & Hydraulics	Naturally Aspirated Diesel	Turbo Diesel
UTTO			

STOU = **S**uper **T**ractor **O**il Universal
U(T)TO = **U**niversal (Tractor) **T**ransmission **O**il
TOU = **T**ractor **O**il **U**niversal (Old)

Tractor fluid’s special demands

> Must have friction modification for wet brake systems
> Must be tolerant of water contamination and air entrapment
> Must be able to flow over a wide temperature range and have shear stable viscosity
> Must provide adequate extreme pressure load and anti-wear protection
> Must keep all mechanical components clean
> Must meet the needs of multiple OEMs special engineering, metallurgical design and materials (especially seals) selection

Additional benefits

Valvoline agricultural lubricants have balanced formulations and may be recommended where multiple OEM requirements are specified. However, the use of these lubricants is not limited to agriculture: Unitrac is recommended and can be used in a wide range of heavy-duty transmissions, with wet brake road building equipment.

INDUSTRIAL

INDUSTRIAL

Reliability and trust

Industrial lubricants like hydraulic fluids, gear oils and other lubricants, normally used in industrial, manufacturing and plant equipment.

HYDRAULIC FLUIDS

Ultramax™

The stringent requirements of industrial environments demand special lubricants. Ultramax products are specially formulated to provide modern hydraulic systems with superior anti-wear protection and heavy-duty service performance.

Ultramax HLP ISO 32, 46, 68, 150

> For use in a variety of hydraulic systems, including cranes, forklifts, loading ramps, tail-boards, etc.

Approvals/Performance Levels

Ultramax HLP
DIN 51524 (part 2), Sperry Vickers M-2950-S/I-286-S, US Steel 127, Thysen-TH N-256132

Ultramax HVLP

> Superior anti-wear protection and heavy-duty service performance even in extreme climatic conditions
> Excellent low-temperature properties
> Available in ISO 32, 46, 68 viscosity grades

Approvals/Performance Levels

Ultramax HVLP
DIN 51524 (part 3), ISO 11158 HV, Sperry Vickers M-2950-S/I-286-S, US Steel 127, Thysen-TH N-256132

Ultraplant ES 46 S

Ester-based biodegradable hydraulic fluid with improved anti-oxidant, anti-wear and anti-corrosion properties. Intended for all applications where environmental losses may occur (forest working machines, waterway locks, mining, etc.). Meets the requirements of the “clean lubricants” act, as defined by the City of Gothenburg, Sweden.

> Available in an ISO 46 viscosity grade
> Fully biodegradable

Approvals/Performance Levels

Ultraplant ES
CEC-L-330A92, Swedish Standard SS 155434

INDUSTRIAL
Reliability and trust

INDUSTRIAL GEAR OIL

Valvoline E.P.G. ISO 68, 220, 320

Industrial gear oil which offers excellent extreme pressure resistance, heavy load-carrying capability, high thermal stability and good water separation ability.

> Suitable for industrial gearboxes and reduction gear units
> Excellent shock load resistance to meet variable load and RPM conditions
> Does not affect or stain copper and bronze

Approvals/Performance Levels

Valvoline E.P.G.
ISO, DIN 51502/DIN 51517-3, US-Steel 224, AGMA 250.04

Material number table

Product name	20L	60L	208L	Bulk
ULTRAMAX HVLP 32	VE16206		VE16218	VE16219
ULTRAMAX HVLP 46	VE16226		VE16238	VE16239
ULTRAMAX HVLP 68	VE16246		VE16258	
ULTRAMAX HLP 22		VE16417	VE16418	
ULTRAMAX HLP 32	VE16426	VE16437	VE16438	VE16439
ULTRAMAX HLP 46	VE16446	VE16457	VE16458	VE16459
ULTRAMAX HLP 68	VE16466		VE16478	VE16479
ULTRAMAX HLP 100			VE16498	
ULTRAMAX HLP 150			VE16518	
EPG 68		VE16717	VE90783	
EPG 220		VE16757	VE16758	
EPG 320			VE16778	
ULTRAPLANT ES 46 S			VE16618	

INDUSTRIAL

General requirements for hydraulic fluids:

> Adequate flow properties
> High viscosity index
> Lubricity
> Material compatibility
> Chemical stability
> Corrosion protection
> Heat transfer abilities
> Environmentally friendly

It is not possible to have a product meet all above mentioned requirements.
The right product selection can only be recommended when a detailed sales/application investigation has taken place.

Definition of the fluids according ISO 6743 and DIN 51502

Description	ISO-L	DIN
Pure mineral oil, no additives	HH	H
Type HH + oxidation / corrosion inhibitor	HL	H-L
Type HL + AW additives	HM	H-LP
Type H-LP + detergent	/	HLP-D
Type HM + VI Improver	HV, HR	HVLP
Tip HM + anti stick/slip additives	HG	/
Synthetics fluids (not fire-resistant)	HS	/
Emulsions oil in water (95% water)	HFAE	HS-A
Water emulsions of chemicals	HFAS	/
Emulsions oil in water (40% water)	HFB	HS-B
Water emulsions of polymers (40% water)	HFC	HS-C
Synthetics fluids, phosphate esters	HFDR	HS-D
Synthetics fluids, chlorate hydrocarbons	HFDS	HS-D
Synthetics fluids, mixture of HFDR/HFDS	HFDT	HS-D
Other synthetics fluids, (waterless)	HFDU	HS-D

The percentage of the hydraulic oils in use (worldwide):

> HM - 45%
> HV - 20%
> HH - 20%
> HL - 15%

GREASES

The Valvoline range of greases includes products specially designed for use in automotive, heavy-duty, marine and industrial equipment. Developed using the highest quality base stocks and the latest additive technology, Valvoline greases provide superior lubrication properties. Unique mixed-complex soap structures are used in Sienna grease and Dipperstick grease, to provide the ultimate protection against wear and corrosion, even under the most severe conditions.

Multi Purpose grease

> Universal heavy-duty lithium complex EP grease, developed for lubrication of automotive and industrial equipment, such as trucks, road construction equipment and industrial machinery
> Suitable to lubricate marine equipment working in a damp environment
> Can be applied over a wide temperature range
> Mechanically very stable and easily pumpable, due to its smooth structure

Approvals/Performance Levels

Multi Purpose grease
NLGI Grade - 2, Emcor test DIN 51802 pass, Copper corr. Test ASTM D-4048 pass

Marine grease

> Multi-functional calcium/lithium grease with extreme pressure properties, specially formulated for lubricating machinery working in damp or wet conditions
> Highly resistant against oxidation, corrosion and wear
> Performs very well in marine applications like stern tubes, bearings, gears and a variety of deck machinery
> Good mechanical stability, high load-carrying capacity, applicable within a wide temperature range

Approvals/Performance Levels

Marine grease
NLGI grade 2/3, SKF Emcor test DIN 51802 pass,
Copper corr. Test ASTM D-4048 pass, Water wash-out(%) at 80°C. 2.5, ASTM D-1264, Water resistance DIN 51807 0-90

Moly Fortified MP grease

> Universal lithium EP grease with molybdenum disulphide to reduce friction
> For lubrication of automotive and industrial equipment, especially when working under wet conditions
> Can be applied over a wide temperature range and used for chassis lubrication of trucks, tractors, bulldozers and other on– and off-road, and industrial equipment
> Mechanically very stable and easily pumpable, due to its smooth structure

Approvals/Performance Levels

Moly Fortified MP grease
NLGI Grade - 2, Water washout test % at 80°C. pass

Dipperstick grease

> Strong adhesion to metal surfaces, resists water washing and prevents rust and corrosion
> Excellent wear-resistant properties suitable for working in damp, or wet conditions
> Easy to apply at low temperatures
> Excellent load-carrying capacity and good corrosion prevention properties
> Recommended for lubrication of dippersticks, open gears, cables and coupling devices of trucks and trailers

Approvals/Performance Levels

Dipperstick grease
NLGI Grade - 2, 4-ball Weld Load test (DIN 51350) >790 kg.

GREASES

Sienna grease

> Complex grease based on a combination of naphtenic and paraffinic base oils
> Good anti-oxidation and anti-corrosion properties
> Excellent load-carrying capacity and good protective and adhesive properties, suitable for high-load/high-pressure applications
> Lubricating ability up to +140°C

Approvals/Performance Levels

Sienna grease
NLGI Grade - 2/3

Semi-fluid grease

> Lithium grease of soft consistency for lubrication of bearings and closed industrial gearboxes where a semi-fluid grease is required
> Suitable for automatic lubrication systems of trucks and in applications where a double-zero grease is prescribed
> Mechanically very stable and easily pumpable due to its smooth structure

Approvals/Performance Levels

Semi-fluid grease
NLGI Grade - 00, SKF Emcor test pass, Copper corr. Test ASTM D-4048 pass

Stern tube grease

> Special grease for the lubrication of stern tubes
> Possible to use for other purposes, such as lubrication of bearings and a variety of deck machinery
> Good anti-corrosion and anti-oxidation properties; excellent resistance to both fresh- and salt-water

Approvals/Performance Levels

Stern tube grease
NLGI Grade - 3, SKF Emcor test pass

Lithium No. 2 EP grease

> Universal lithium EP grease developed for lubrication of automotive and industrial equipment
> Can be applied over a wide temperature range
> Good water resistance and protects against rust and corrosion
> Mechanically very stable and easily pumpable, due to its smooth structure

Approvals/Performance Levels

Lithium No. 2 EP grease
NLGI Grade - 2, SKF Emcor test pass, Copper corr. Test ASTM D-4048 pass

Material number table

Product name	12 X 500GR	24 X 400GR	10KG	18KG	50KG	180KG
Multi Purpose grease	VE40026	VE40020		VE40034	VE40036	VE40038
Lithium No. 2 EP grease				VE40054	VE40056	VE40058
Moly Fortified MP grease	VE40006	VE40000		VE40014	VE40016	VE40018
Semi-fluid EP 00 grease				VE40074		VE40078
Dipperstick grease				VE40154		
Sienna grease		VE40180		VE40194	VE40196	VE40198
Marine grease				VE40174		VE40178
Stern tube grease			VE40093			

GREASES

Definition
Greases are consistent lubricants formed from lubricating oil, thickener and additives.

Structure of lubricating greases

Base oil
Determines high and low temperature grease behavior, dropping point and pumpability, and grease service life. According to the base oil(s) used, greases can be mineral or synthetic.

Thickener
Produces grease structure by fastening base oil, determines behavior against water, gives consistency, determines flow abilities and helps in production of lubricating film. Depending on the thickener used, greases can be soap and non-soap. Soap thickeners used can be metal soaps (lithium), complex metal soaps (aluminium, lithium, calcium, sodium) and as non-soap thickeners organic and inorganic solids (bentonite, bentone, polyurea, sylica, etc.) are used.

Additives
Creates properties that base greases do not have, as well as improve desired properties and minimize undesired properties. The most common are anti-wear additives, extreme pressure additives, corrosion inhibitors and adhesive additives.

The NLGI grade
The NLGI grade is a widely used classification for lubricating greases. It was established by the National Lubricating Grease Institute, in the U.S. Greases are classified in one of nine grades based on their consistency.

> NLGI #000 Fluid grease, almost a heavy gear oil; NLGI#00 Fluid; NLGI#0 Very soft; NLGI#1 Soft; NLGI #2 Moderately soft; NLGI#3 Soft to hard; NLGI#4 Semi hard; NLGI#5 Hard; NLGI#6 Very hard, block grease

NLGI Grades 000 to 1 are used in applications requiring low viscosity, such as enclosed gear drives operating at low speeds, open gearing and central lubrication systems. Grades 0, 1 and 2 are used in highly loaded gearing. Grades 1 through 4 are often used in rolling contact bearings, where grade 2 is the most common.

The general guidelines for grease use

	Lithium soap grease	Lithium complex grease	Lithium-Calcium soap	Complex
Mechanical stability	+	++	+	++
Thermal stability	+	++	+	++
Water resistance	+	+	++	++
Adhesion	+	+	++	++
Load carrying ability	++	++	++	+++
Lubricating ability	++	++	+	++
Pumpability	++	++	+	+
Storage stability	++	++	+	+
Temperature range	+	++	+	++
Compatibility	+	+	+	+
Valvoline Greases	Lithium no. 2 EP grease Moly fortified MP grease Stern tube grease Semi fluid grease 00	Multi purpose grease	Marine grease	Sienna grease Dipperstick grease

COOLANT ANTIFREEZE

Combat the main cause of vehicle breakdowns

The primary cause of vehicle breakdown is cooling system failure due to:

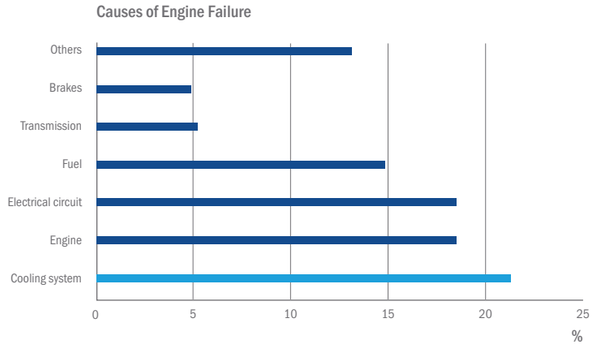
> Inadequate cooling system maintenance
> Utilization of the wrong coolant or water

Choosing the right coolant is essential to engine protection, and Valvoline offers a complete range of premium coolants that keep system components in top condition. Most vehicle manufacturers have particular coolant specifications and recommend different coolant technologies, including Organic Acid Technology (OAT) or Hybrid Organic Acid Technology (HOAT). In addition to meeting the specifications of these approved technologies, Valvoline coolants offer additional benefits so you can ensure that your vehicle has the best protection available.

HD EXTENDED LIFE COOLANT AF THE UNIVERSAL COOLANT SOLUTION

The colorful choice of coolants

Cooling systems safeguard an engine and extend its life by protecting it from corrosion, overheating and freezing. It's a vital function that cannot be ignored. Research clearly shows that the prime cause of vehicle breakdowns is a faulty cooling system. That's why it's essential to use the right coolant for each vehicle make and model.



For nearly a decade, vehicle manufacturers have been developing and using a wide variety of long-life coolants. The only thing these coolants have in common is different formulations and colors. This has created a great deal of confusion amongst mechanics about what type of coolant should be used to top up or refill late-model cooling systems.

Which type of coolant should be used?

The technical answer to this question is the type specified by the vehicle manufacturer. However, fleet owners and industrial customers do not have storage space to stock coolant for each type of vehicle. Besides the various colors that OEMs recommend, there are essentially five types of coolant chemistries:

> Traditional British Standard coolant. The original formula that everybody used until the introduction of aluminum engines. The fast-acting silicate and phosphate corrosion inhibitors provide quick protection for bare iron surfaces.

> Hybrid Organic Acid Technology coolants, also known as HOAT. This formulation includes silicates to provide quick-acting protection for aluminum surfaces. Silicate also helps repair surface erosion caused by cavitation in the water pump. Until approximately 1996 this technology was predominantly used in the market place.

> Organic Acid Technology (OAT) based extended-life coolants. Since 1996 until 2008 this technology was mainly applied. OAT based coolants do not include silicates or phosphates and are often dyed in different colors to enable product differentiation. The corrosion inhibitors in OAT coolants are slower acting but much longer-lived than those in traditional coolants. Consequently, OAT coolants typically have a recommended service life of five years or 250.000 kilometers. OAT corrosion inhibitors provide excellent long-term protection for aluminum and cast iron.

> Silicated Organic Acid Technology (SOAT) based coolants. This formulation includes silicates to protect aluminum surfaces against cavitation. In 2008, all types of vehicles counted under the VW Group were changed over to this new technology on the production lines; some models with large engines were even changed over slightly earlier (vehicles built from 2006).

> Asian Phosphated Organic Acid Technology (P-OAT) coolants simply added phosphate to traditional OAT fluids in 2008 to create a marginal but marketable distinction. Colors can be green, purple and blue. These coolant types claim a long-life of 5 to 10 years, but actual warranties are much shorter.

THE VALVOLINE UNIVERSAL SOLUTION

Valvoline has witnessed the increasing complexity in this field and as a result, over the last few years has enhanced its proprietary formulation to offer universal chemistry in the marketplace. Today, HD Extended Life coolant is a unique product that provides universal coverage and eliminates confusion about color and chemistry.

The patented HD Extended Life coolant formula provides the best of ALL worlds. Its unique formula combines the advantages of standard, hybrid, OAT, SOAT and P-OAT chemistries. Similar to standard, HOAT and SOAT formulations, it contains fast-acting additives for bare iron and aluminum surface protection. What's more, HD Extended Life coolant provides superior longer life properties using non-depleting organic acid technology. It also contains lubrication additives to protect seals and gaskets.

The benefits of a single coolant are obvious: full coverage, less inventory and no confusion for automotive distributors and workshops. Additionally, HD Extended Life coolant works in any vehicle, regardless of model and year.

Protection under tough conditions

Bonneville Transloaders Inc. hauls soda ash from mines in the Rocky Mountains to a rail terminal in Shoshone, Wyoming, USA. Equipped with Caterpillar* 3406 engines, the trucks routinely carry loads in excess of 70 tons. These trucks operate at tougher conditions than those required by the Caterpillar EC-1 test, so they served as an excellent test case for evaluating HD Extended Life coolant.

After 15 months and 3.2 million kilometers, seven engines were dismantled, inspected, rated and photographed in strict compliance with Caterpillar EC-1 guidelines. Particular attention was paid to cylinder liners, with depth measurements made and recorded as a percentage of wall thickness. Other critical components also were taken apart and inspected, including water pumps, radiators and thermostat housings. Below pictures of components after this test.

Radiator Heater
No deposits, no plugging evident. The cooling system operates at peak flow for optimum engine efficiency, even after 500,000 km with no silicate buildup.

Cylinder Liner
Shows little signs of pitting with no cavitation. HD Extended Life eliminates this serious and expensive problem while reducing scheduled maintenance and associated costs.

Water Pump
No deterioration of impellers, well protected with no cavitation. Integrity of seals well maintained.

Radiator Bottom
Clean, no deposits, well protected by HD Extended Life antifreeze/coolant.

THE VALVOLINE UNIVERSAL SOLUTION

COOLANTS

HD Extended Life Coolant AF benefits

- Helps lower cost of operation
- Prevents scaling and system deposits
- Protects seals, gaskets and aluminium
- Prevents housing and system metals from corrosion
- Increased drain intervals (500.000 kilometers)

Material number table

Product name	1L	5L	20L	60L	208L
HD Extended Life Ready To Use	VE56130	VE56131	VE56132	VE56133	VE56135
HD Extended Life - 67 Ready To Use					VE56243
HD Extended Life Concentrate					VE56253

Approvals/Performance Levels

HD Extended Life Coolant AF
ASTM D-6210, ASTM D-4985, ASTM D-3306 (D-4656), Afnor 15-601, 1991, BS 6580, 1992, Caterpillar EC-1, Cummins 14603, 3666286, Cuna NC956-16, DAF, Detroit Diesel 7SE298, Deutz MWM, Federal Spec. A.A.870A, Leyland, Link Belt* , MAN 324 type NF, MB 325.0, 2,3, MAN B&W, TU, O-Norm V5123, Renault RVI, Scania, Volvo, SAE J 814, J 814C, J 1034, J 1941, TMC of ATA, Thermo King*, TEREX* , RP- 329B.

HEAVY DUTY CHEMICALS

Effective workshop solutions for increased customer satisfaction

Valvoline® – the oil industry's first brand and a recognized leader in automotive aftercare – offers a complete range of high-performance chemicals that deliver superior results and convenience, generate new revenue opportunities and business growth, and build marketplace loyalty and customer satisfaction. You can count on the innovative, premium formulations and unrivaled performance of Valvoline automotive and heavy duty chemicals.

HD CHEMICALS

Inexpensive and cost-effective way to improve performance, downtime and profit

VPS HD Diesel System Complete

Valvoline VPS HD Diesel System Complete cleans and restores the complete fuel system of the heavy duty diesel engine, restoring the engine back to its original power and performance, without the need for a higher cetane number fuel. The product demulsifies the fuel from condensation water and protects against rust and corrosion, while the implemented flow improver guarantees a smooth start at cold temperatures. The chemical composition of the product stabilizes the fuel and prevents fuel aging and bacterial contamination.
VPS HD Diesel System Complete reduces downtime for maintenance by keeping the engine clean, reducing wear, and helping the engine run smoother and more efficiently. Add VPS HD Diesel System Complete to the fuel tank before refilling. One bottle is enough for 1.000 liters of fuel.

- Cleans the entire fuel injection system
- Maximizes power and performance of all heavy duty diesel engines
- Removes deposits, cleans injectors and restores spray patterns
- Reduces emissions caused by deposits and incomplete combustion
- Lubricates injectors and fuel pumps if running on low-sulphur diesel
- Helps maintain cold-start properties
- Provides corrosion protection to fuel system
- Removes bacteria in fuel tank caused by water contamination
- Reduces downtime and maintenance costs by keeping fuel system clean and reducing wear

VPS HD Radiator Flush

VPS HD Radiator Flush is a powerful combination of surfactants, detergent cleaners and acid neutralizers formulated to quickly emulsify oil, scum and sludge, as well as remove loose rust and scale throughout the cooling system. It helps maintain cooling system efficiency and effectiveness by assisting antifreeze to do a better job of protecting the system. By removing contaminants from the cooling system, heat transfer is improved and the antifreeze can more effectively cool vital engine parts. If contaminants are allowed to accumulate, they not only interfere with heat transfer but also can cause galvanic corrosion. Each time antifreeze coolant is changed in a vehicle, the cooling system should be flushed with VPS HD Radiator Flush to clean and remove harmful contaminants before adding new antifreeze coolant. VPS HD Radiator Flush can be used in any cooling system, regardless of what type of antifreeze coolant is used. A 1-liter bottle is enough for a 20-25 liter cooling system.

- Emulsifies oil and sludge
- Removes loose rust and scale
- Maintains cooling system efficiency
- Prevents build-up of acids and contaminants
- Safe and easy to use
- Safe for gaskets and other seals
- Specially developed for cooling systems of heavy-duty diesel engines

VPS HD Engine Flush

VPS HD Engine Flush is a professional formulation designed to dissolve sludge and clean the crankcase to enhance the life of fresh engine oil. VPS HD Engine Flush is mixed with the used motor oil and allowed to clean for 20-30 minutes (depending on the severity of the contamination) in an idling engine. Since VPS HD Engine Flush contains no chlorinated solvents, it is safe for use. VPS HD Engine Flush will not harm gaskets or other seals if used as directed. Always follow the label directions. For engines with accumulated deposits for 160.000 km. or more, it is recommended that the oil screen is checked for any blockage before using VPS HD Engine Flush. A 1-liter bottle is enough for a 10-12 liter oil sump.

- Dissolves sludge and power robbing deposits
- Cleans the engine in 20-30 minutes
- Opens restricted oil passages
- Frees sticky lifters
- Improves oil circulation
- Safe for gaskets and other seals
- Specially developed for heavy-duty diesel engines

Product name	Package	Material number table
VPS HD Radiator Flush	12 x 1L	VE55189
VPS HD Engine Flush	12 x 1L	VE55129
VPS HD Diesel System Complete	6 x 500ml	VE55340
VPS HD Diesel System Complete	208L	VE55341

HD CHEMICALS

Inexpensive and cost-effective way to improve performance, downtime and profit

Benefits of a clean fuel system

Clean fuel system reduces the downtime and wear of an engine. Fuel additives (detergents) can easily clean injectors and pistons, prevent injector tip corrosion /erosion without requiring downtime for the engine, qualified persons or specialized tools.

Cleaning the fuel system helps:

> Restore the spray pattern (preventing deterioration of fuel economy),
> Provide better performance (more power output)
> Reduce emissions, maintenance and repair cost (injector system & engine life)
> Decrease oil consumption

Spray pattern

Before

After

Injector fueling: Cummins (DI)

Base fuel + VPS HD

Base fuel

Piston cleanliness - MWM-B test, Test method: CEC L-12-A76 injector cleanliness lubricant and base fuel in both tests identical

Traditional additive

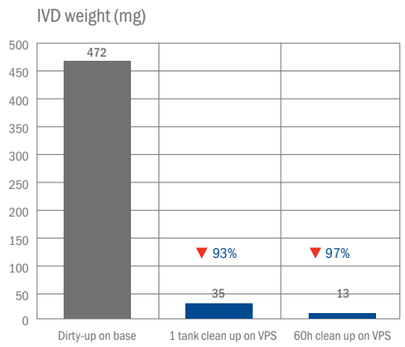
VPS HD

Clean injector

Dirty injector

Intake valve deposits cleanup

The Mercedes-Benz test M102 E results show the efficiency of Valvoline fuel system cleaners. The test is performed on a new engine intake valve that has been dismantled and weight measured on scale. After this measurement, the engine is started and works for 60 hours. The intake valve is then dismantled again and weighed to measure the weight of deposits (in mg). A Valvoline fuel system cleaner is added to fuel tank and after 15 hours of working the weight of deposits on intake valves is again measured. The intake valve is then mounted again and the engine works for next 60 hours. As the last stage, the intake valve weight is measured again.

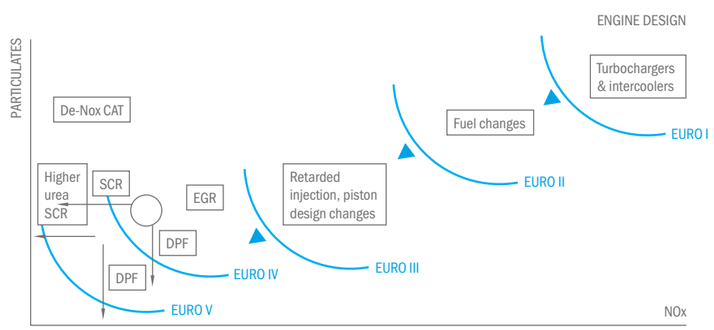


MB M102E test: 60-hour dirty-up; 15-hour and 60-hour clean up

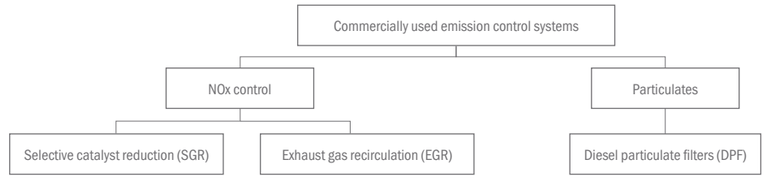
GENERAL INFORMATION

On-road emission legislations and their impact on lubricants

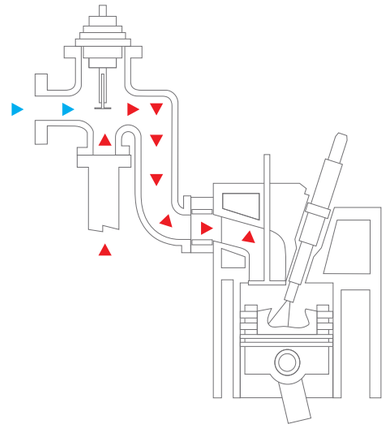
For more than 10 years the EU has issued directives to reduce gaseous air pollutions from vehicles focusing on particulates and NOx.



To meet the requirements of EU legislation, vehicle manufacturers have developed new engine designs that, in turn, have created a demand for improved lubricant performance, resulting in the development of new engine oil formulations.



OEMs use different types of after treatment systems to meet Euro IV emission standards and are currently considering a range of new technologies to meet Euro V standards. There are several technology options designed to control NOx and particulates.



Until now, vehicle manufacturers have used two principal methods of exhaust after treatment systems that focus on NOx reduction.

Exhaust gas recirculation (EGR)

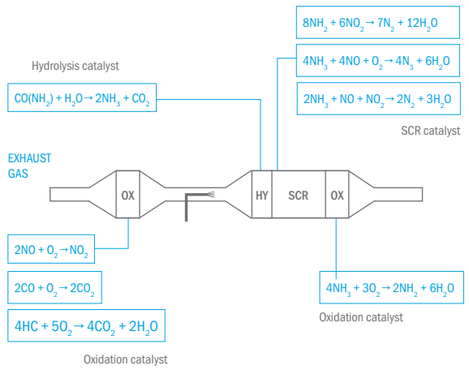
EGR is a technique that re-directs a controlled percentage of the exhaust gas back into the air intake. These gases have already been consumed by the engine so they have a lower oxygen level. Consequently there is less oxygen available to allow nitrogen oxides to form. The exhaust gas in the air intake also absorbs more energy during the combustion process, resulting in lower levels of NOx (high temperatures are needed for NOx).

GENERAL INFORMATION

On-road emission legislations and their impact on lubricants

Selective catalyst reduction (SCR)

SCR is an effective way to reduce NOx emissions. It utilizes a chemical called urea (a source of ammonia) to reduce the nitrogen oxides down to nitrogen. The urea tank is fitted to a vehicle. The urea is consumed proportionally according to fuel consumption.

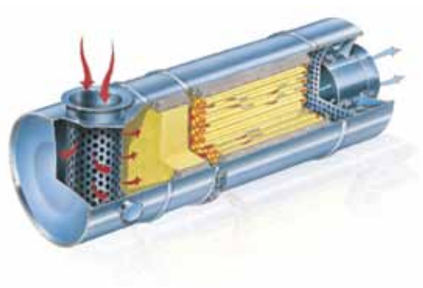


To reduce diesel vehicle exhaust particulates, there is currently one system that is most commonly used by vehicle manufacturers.

It is called a diesel particulate filter

Diesel particulate filters (DPF)

A DPF captures the particulates and prevents discharge into the environment. Particulates and soot that are collected are removed from the filter by burning them off at high temperatures. In DPF, precious metals are used to create a catalyst to reduce the temperatures required for the burning of soot and carbon based particulates, converting them into water, carbon dioxide and nitrogen.



GENERAL INFORMATION

On-road emission legislations and their impact on lubricants

	FROM:	IMPACT ON AFTER TREATMENT SYSTEM:
SULPHATED ASH (SA)	Metals containing additive, detergents, anti-wear additives	Blocks and restricts the performance of the DPF
PHOSPHORUS (P)	Anti-oxidants, anti-wear additives	Blocks and restricts the performance of the DPF; decreases catalytic conversion (SCR)
SULPHUR (S)	Anti-oxidants, anti-wear additives; detergents; base oil	Deactivates catalyst

ACEA E4
Oils designed for use in severe-duty, long-drain applications with additional performance requirements in areas such as wear protection.

ACEA E6
ACEA E4 quality level with new additional performance technology that helps to control valve train wear and piston deposits. The chemical limit restrictions of ACEA E6 make it suitable to be classified as a new low-SAPS lubricant.

ACEA E7
Includes additional anti-wear performance, and is not a low-SAPS lubricant, but is classified as a high-ash formulation.

ACEA E9
A new, lower-SAPS requirement for super high performance diesel (SHPD) lubricants for use in mid-drain applications. ACEA E9 will contain many elements of the API CJ-4 specification. ACEA is expected to recommend ACEA E9 for use in vehicles fitted with advanced after treament systems for the reduction of particulate matter (DPFs) and the oxides of nitrogen (EGR and/or SCR).

GENERAL INFORMATION

The API diesel oil sequence

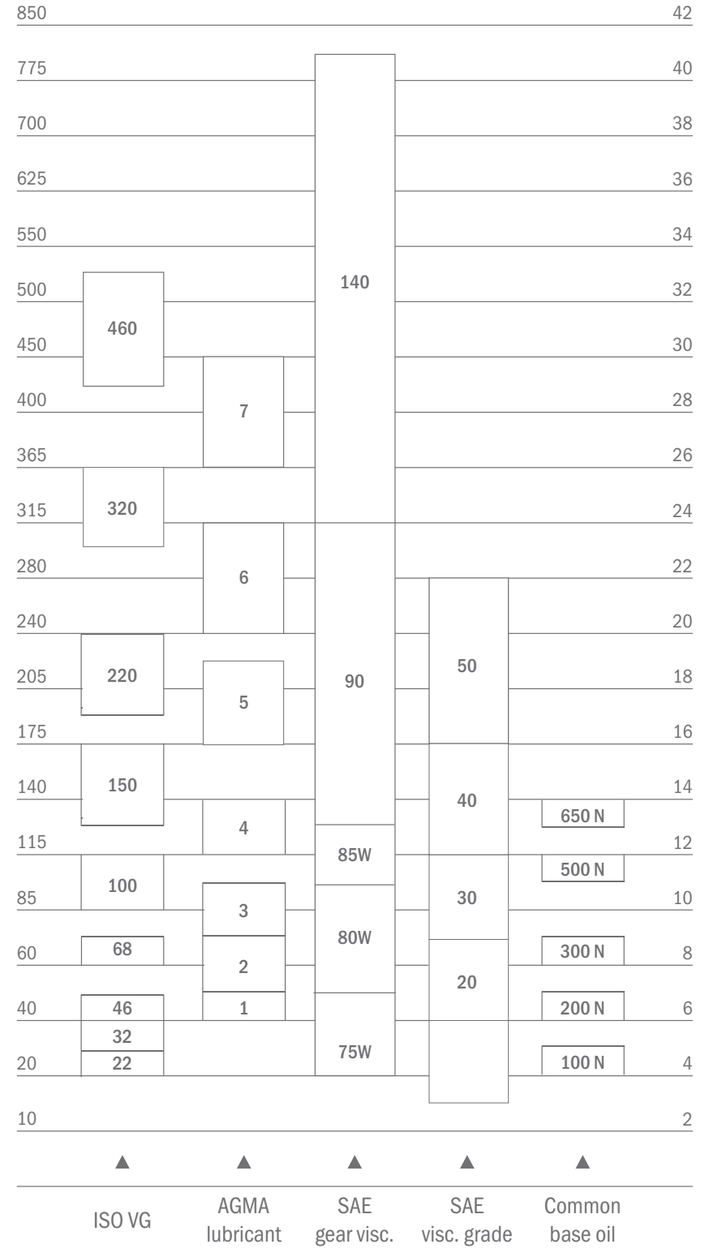
DIESEL ENGINES		
Category	Status	Service
CJ-4	Current	Introduced in 2006. For high-speed, four-stroke engines designed to meet 2007 model year on-highway exhaust emission standards being implemented for 2007 model year. CJ-4 oils are compounded for in all applications with diesel fuels ranging in sulfur content up to 500 ppm (0.05% by weight). However, use of these oils with greater than 15 ppm (0.0015% by weight) sulfur fuel may impact exhaust after treatment system durability and/or oil drain interval. CJ-4 oils are effective at sustaining emission control system durability where particulate filters and other advanced after treatment systems are used. Optimum protection is provided for control of catlyst poisoning, particulate filter blocking, engine wear, piston deposits, low-and-high temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear. API CJ-4 oils exceed the performance criteria of API CI-4 with CI-4 PLUS, CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories. When using CJ-4 oil with higher than 15 ppm sulfur fuel, consult the engine manufacturer for service interval.
CI-4	Current	Introduced in 2002. For high-speed, four-stroke engines designed to meet 2004 exhaust emission standards implemented in 2002. CI-4 oils are formulated to sustain engine durability where exhaust gas recirculation (EGR) is used and are intended for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE,CF-4, CG-4 and CH-4 oils. Some CI-4 oils may also qualify for the CI-4 PLUS designation.
CH-4	Current	Introduced in 1998. For high-speed, four-stroke engines designed to meet 1998 exhaust emission standards. CH-4 oils are specifically compounded for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4 and CG-4 oils.
CG-4	Current	Introduced in 1995. For severe duty, high speed, four-stroke engines using fuel with less than 0.5% weight sulfur. CG-4 oils are required for various engines meeting 1994 emission standards. Can be used in place of CD, CE, and CF-4 oils.
CF-4	Obsolete	Introduced in 1990. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CD and CE oils.
CF-2	Current	Introduced in 1994. For severe duty, two-stroke cycle engines. Can be used in place of CD-II oils.
CF	Current	Introduced in 1994. For off-road indirect-injected and other diesel engines including those using fuel with over 0.5% weight sulfur. Can be used in place of CD oils.

SAE J 300 standard

	LOW TEMP. VISCOSITY		VISC. @ 100°C		HTHS 150°C
SAE vicsosity grade	max. visc. ASTM D5293 DIN 51337	max. borderline pumping temp. ASTM D4684	min.	max.	min.
	cP	°C	mm2/S		mPa.s
0W	6200@-35°C	-40	3,8		-
5W	6600@-30°C	-35	3,8		-
10W	7000@-25°C	-30	4,1		-
15W	7000@-20°C	-25	5,6		-
20W	9500@-15°C	-20	5,6		-
25W	13000@-10°C	-15	9,3		-
20			5,6	<9,3	2,6
30			9,3	<12,5	2,9
40			12,5	<16,3	2,91[1)]
40			12,5	<16,3	3,7 [2)]
50			c	<21,9	3,7
60			21,9	<26,1	3,7
			1) valid for 0W-40, 5W-40, 10W-40		
			2) valid for 15W-40, 20W-40, 25W-40, 40		

GENERAL INFORMATION

Viscosity comparison table



GENERAL INFORMATION

Glossary

ACEA > Association des Constructeurs Européens d'Automobiles. The European Committee responsible for lubricant classification and specification.

Antiwear Additives > Antiwear additives or their reaction products, form thin, tenacious films on highly loaded parts to prevent metal to metal contact and wear.

API > American Petroleum Institute.

API EOLCS > API Engine Oil Licensing and Certification System

ASTM > American Society for Testing and Materials

Detergent > An additive to keep engine parts clean. These are normally metallic soaps with a reserve of basicity to neutralize acids formed during combustion.

DI > Direct Injection

Dispersant > An additive that helps keep solid contamination in the oil in a colloidal suspension, preventing sludge and varnish.

DPF > Diesel Particulate Filter

EGR > Exhaust Gas Recirculation

EMA > Engine Manufacturers Association

ISO > International Organization for Standardization

JAMA > Japan Automobile Manufacturers Association

Low SAPS > A term being used to describe new formulation lubricants which are designed to be compatible with DPF systems. They take the name low-SAPS from their reduced content of sulphated ash, phosphorous and sulphur chemicals.

NLGI > National Lubricating Grease Institute (U.S.)

GENERAL INFORMATION

GENERAL INFORMATION

Glossary

NOx > Oxides of nitrogen. NOx is one of the most critical emissions produced from diesel engines. It is an invisible greenhouse gas that can cause respiratory problems

OEM > Original Equipment Manufacturer

SCR > Selective Catalytic Reduction

Sulphated ash > The ash content of oil. This is a measure of the ash antiwear metals contained in the components in the oil

TBN > Total Base Number is the measure of pH of the oil. It is calculated from the amount of the alkaline needed to neutralize the oil's acidity.

UREA > A crystalline powder derived from the decomposition of ammonium carbamate, also known as carbamide. Used as an agent in vehicles fitted with SCR after treatment systems.

UHPD > Ultra High-Performance Diesel. Top-tier lubricants meeting the highest Daimler* service-fill performance claim of Sheet 228.5 or 228.51 for long oil drain intervals. Lubricants of this quality are also approved against the respective ACEA performance level (ACEA E4 with MB 228.5; ACEA E6 with MB 228.51) and other key OEM claims such as MAN and Volvo. UHPD lubricants are typically SAE 10W-40 viscosity grades (although there is a small niche market for 5W-30 viscosity grades) and are formulated with high levels of modern additive technology and performance base oils (100% Group III) to give the end-user maximum engine protection. For OEM engines fitted with DPF to meet the latest emission regulations, the use of MB 228.51 lubricants (formulated with low SAPS without compromising the lubricant performance) are an essential part of protecting the longevity and durability of the expensive after treatment device.

SHPD > Super High-Performance Diesel lubricant. Top-tier lubricants meeting Daimler service-fill performance claim Sheet 228.3 Lubricants of this quality are deemed to provide the maximum engine protection for vehicles running to standard OEM approved oil drain intervals.
They are also approved against the respective ACEA and API performance levels (ACEA E7 & API CI-4 respectively) and other key OEM claims such as MAN and Volvo. SHPD lubricants are typically SAE 15W-40 viscosity grades formulated with mineral base oils to maintain cost-effective performance but there is also a growing demand in the market place for 10W-40/10W-30 part-synthetic lubricants formulated with performance base oils (Group III) meeting the same SHPD performance requirements.

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