OIL SALES GUIDE

JOHN DEERE

FALL 2008 EDITION

GENERAL INFORMATION

	Page
Oil and Lubricant Basics	4–8
Base Oil	4
Facts About Oil and Its Usage	5
Storing and Handling Oils	6
Disposing of Oil	6
Glossary of Oil Terminology	7–8
Engine Oil	9–16
Engine Oil Requirements	9–10
Oil Must Reduce Friction and Wear	9
Oil Must Cool Moving Parts	9
Oil Must Help Seal the Cylinders	10
Oil Must Keep Parts Clean	10
Engine Oil Classifications	10
SAE Viscosity Grades	10–11
SAE J300 Engine Oil Viscosity Classification	11
Viscosity Test	11
Multi-Viscosity Oils	11
Summary of SAE Viscosity Grades	11
Performance Ratings	11
Engine Manufacturer's Oil Specifications	11
ASTM Test Methods	11
API Service Categories	11
API Service Categories For Engine Oils — Chart	12
Military Specifications	13
Engine Oil Additives	13–14
Engine Oil Contaminants	14
Dust, Dirt, Soot, and Metallic Particles	14
Water	15
Anitfreeze	15
Fuel	15
Heat	16
Transmission — Hydraulic Oil	16–18
Transmission — Hydraulic Oil Properties	17
Hydraulic Oil Requirements	17
Hydraulic Oil Properties	17–18
Gear Oil	18–20
Gear Oil Requirements	18
Gear Oil Ratings	18
API Gear Oil Service Classifications	18
Military or Manufacturer's Specifications	19
SAE Gear Oil Classification	19–20
Mixing Gear Lubricants	20

PRODUCT INFORMATION

	Page
Engine Oil	21–29
Plus-50™	21–25
Reduces Engine Wear	22
Reduces Piston Deposits	22
Extends Drain Intervals by 50 Percent	23
Provides Cold-Weather Protection	23
Improves Soot Handling	23
Performance-Level Comparison	24–25
Plus-50 0W-40 Synthetic Oil	25
Break-In Motor Oil	25
Torq-Gard Supreme™ Motor Oil	26
Plus-4™ Automotive Engine Oil	26
Turf-Gard™ 4-Cycle Motor Oil	27
Air Temperature Chart	27
Engine Oil Service Classifications and Explanations — Chart	28
Oil Service Classification Ratings	28
Chemical and Physical Properties	29
Transmission and Hydraulic Oil	30–36
Hy-Gard™ and Low-Viscosity Hy-Gard™ Transmission and Hydraulic Oil	30–34
Wet Brake Test	32
Wet Clutch Test	32
Gear Test	33
Slow-Cool Fluidity Test	33
Hy-Gard For Competitive Equipment	34
Chemical and Physical Properties	34
Air Temperature Chart	34
Bio Hy-Gard™ Hydraulic Transmission Oil	35
Vickers V104C Performance	35
Vickers 35VQ25 Performance	36
Chemical and Physical Properties	36
Greases	37–41
Polyurea (Non-Clay) High-Temperature Extreme-Pressure (EP) Grease	37
Multi-Purpose Heavy-Duty (HD) Lithium Complex Grease	37
Multi-Purpose Extreme-Duty Synthetic Grease	38
Golf and Turf Cutting Unit Grease	38
Multi-Purpose Lithium Grease	39
Special-Purpose Heavy-Duty (HD) Water-Resistant Grease	39
Special-Purpose Corn Head Grease	40
Special-Purpose Heavy-Duty (HD) Moly Grease	40–41

OILSCAN™

Program Explanation 41
Oilscan Kits 41
Customer Benefits 41
Dealer Benefits 41
Marketing Ideas 41
Oil Sample Test Report 42
Spectrochemical Analysis 43

FILTER CADDY

How It Works 44
Order Information 45
Marketing the Filter Caddy 45

MARKETING

Analyze the Competition 46
Buy Smart 46
Develop a Sales Strategy 46
Sell in the Field 46
Sell at the Parts Counter 47
Related Selling 47
Telephone Marketing 47
Plus-50 48
Price Comparison Form 48

QUESTION-AND-ANSWER REVIEW

Introduction 49
Storing and Handling Oils 49
Requirements 49
Ratings 49
Engine Oil Additives 49
Engine Oil Contamination 49
Transmission Hydraulic Oil 50
Gear Oil 50
Grease 50
Hydraulic Oil 50
Plus-50 50–53
Hy-Gard Hydraulic and Transmission Oil 53–54
Frequently Asked Questions (FAQs) 54
Oilscan Preventative Maintenance 54
Conclusion 55

BASE OIL

Crude petroleum oil is a mixture of a wide variety of hydrocarbon compounds of different molecular sizes, determined by the number of carbon atoms linked together with hydrogen atoms to form a chain-like structure. In general, the longer the hydrocarbon chain, the higher its boiling temperature is. Through the oil-refining process of distillation, crude oil can be separated into its various components due to the fact that they vaporize, or boil off, at different temperatures. These vapors are then cooled and condensed back into liquids such as solvents, gasoline, diesel fuel, and lubricating oils. These lubricating oils are called base stocks, which are further purified and blended with various performance ingredients to make finished engine oils, hydraulic oils, transmission fluids, and gear lubes.

API Group Classifications
Lubricating oil base stocks are classified according to their chemical structure and sulfur content. A carbon atom can have up to four other atoms attached to it. Natural gas, or methane, is the simplest hydrocarbon compound, with four hydrogen atoms attached to one carbon atom. Lubricating oils are long chains of carbon atoms linked together, with hydrogen atoms attached to all the other available spots on the carbon chain. Sometimes the carbon atoms can be joined together in what are called double or even triple bonds, with fewer spots for hydrogen atoms to attach to the chain. Unfortunately in these situations, the hydrocarbon molecules are less stable and can react with other compounds inside an operating engine to form gums, varnishes, sludge, and other harmful engine deposits.

API Group I
API Group I base stocks were for many years the main component in engine oil, and performed adequately in yesterday's engine operating conditions. Group I base stocks contained hydrocarbon chains with significant amounts of multiple bonds and higher amounts of sulfur contaminants. As engine operating temperatures and horsepower outputs have increased, it has been found that engine oils made with Group I base stocks are not capable of withstanding these harsh operating conditions. They break down to form gums, varnishes, and carbon deposits.

API Group II and Group III
API Group II and Group III base stocks are further refined to remove almost all sulfur content and reduce the number of multiple bonds in the hydrocarbon molecules. This process is called hydrotreating. In addition, a more severe refining process called hydrocracking can be used to break apart extremely long hydrocarbon chains to produce a very pure and stable base stock. These two processes produce base stocks that are much more stable and capable of resisting high-temperature breakdown and deposit formation. John Deere Plus-50 Supreme SAE 15W-40 engine oil is blended using only the highest-quality Group II and Group III base stocks to help keep engines clean and free of harmful and performance-robbing deposits.

Group IV
Lubricating oils can be formulated using synthetically made base stocks instead of those refined from crude oil. There are sophisticated chemical processes that can link together carbon and hydrogen atoms to produce very uniform hydrocarbon molecules with very precise chemical and physical properties. Classified as Group IV base stocks, these synthetic lubricants can offer performance advantages over mineral oil base stocks. These advantages include better high-temperature performance by resisting high-temperature oil breakdown, oxidation thickening, and deposit formation, and better cold-temperature performance by retaining more fluid to quickly flow to moving parts at start-up, in very cold conditions building oil pressure and lessening start-up wear. John Deere Plus-50 Supreme SAE 0W-40 Synthetic engine oil, blended with the highest-quality synthetic base stocks, is the best choice for use in extremely cold environments to ensure maximum engine-lubrication protection.

FACTS ABOUT OIL AND ITS USAGE

Off-road engines have different needs:

- The off-road engine (farm or industrial) has less stop-and-go operation and operates most of the time at normal operating temperatures. Load factors range from 70 to 80 percent of the continuous rated load.
- An on-highway engine (truck and automobile) is subjected to more stop-and-go operation, idling, and cold-engine operation. It is seldom subjected to the off-road engine's extended high-load operation. Load factors range from 40 to 50 percent of the continuous rated load.
- **Manufacturer's engine oil specifications take into consideration these differences when formulating oils for their engines.**

Operator's manual recommendations are critical:

- Lubrication recommendations in operator's manuals ensure good performance over a long period of time. Refer to the operator's manual and follow the recommended lubrication practices.
- Oil changes are necessary.
- Oil loses many of its lubrication qualities as it absorbs contaminants and its additives are depleted.
- Oil thickens as it breaks down and oxidizes. If it gets thinner during use, fuel dilution or coolant leak may occur.
- Oil oxidation and excessive contamination cause the oil to eventually become unfit for further use.

Oil color does not determine replacement need:

- In a diesel engine, oil should turn dark with use to be effective. Detergent and dispersant additives in oil attract and hold soot and other combustion products in suspension for removal at the time oil is drained.
- Some new diesel oils (such as John Deere Plus-50) are dark-colored due to special additives.

Cheap oil does not save money:

- Too many people are trying to save money on oil when they should be saving their equipment. Ten dollars saved through buying cheap oil can result in hundreds or thousands of dollars of expense incurred prematurely.

Use manufacturer's recommended filter:

- Buy quality oil filters as recommended in your operator's manual. The money saved by buying cheap "will-fit" filters is negligible compared to the damage that can possibly result from their use. Filters meeting exact operating specifications are critical to the life of the machine.

Additional oil additives may reduce protection:

- John Deere has adopted a general policy of not approving the use of additional or supplemental oil additives, oil treatments, or engine treatments.
- Additional oil additives and engine treatments could produce more problems than benefits. These products could create a general chemical imbalance in the oil formulation and adversely affect the performance of the oil.
- There is no need to add anything to improve John Deere oils, which already deliver superior performance.

Synthetic oils:

- Synthetic oils are composed of products altered from their natural state through chemical changes in their structure.
- Synthetic base stocks like petroleum base stocks require the addition of the proper additives for the optimum performance of the finished engine oil. Synthetic oils perform the same functions as mineral oil and require regular oil-drain intervals.
- The value of operating with synthetic oils is most apparent under extreme operating conditions — very cold and very hot ambient temperatures.

Re-refined oils:

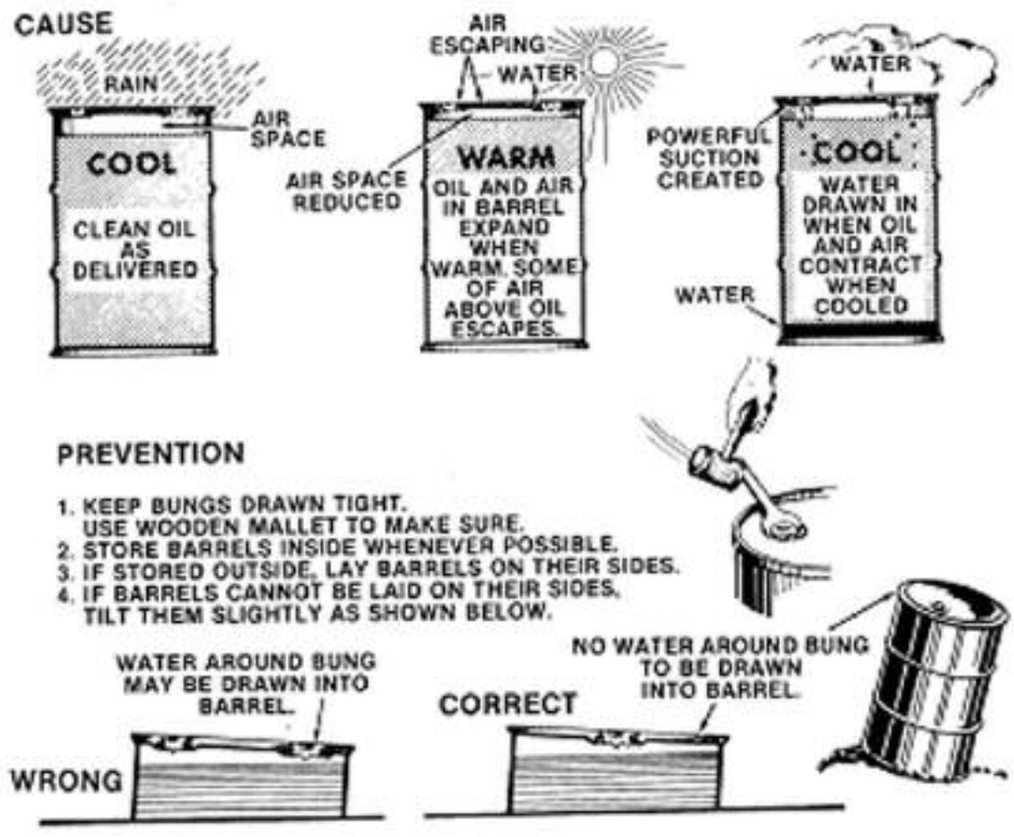
- John Deere supports the recycling of used oils. Since re-refined engine and transmission oils must provide the same performance levels as other lubricants, they also must meet the requirements for: (1) physical and chemical specifications and (2) all performance test requirements.

STORING AND HANDLING OILS

- Follow these easy storing and handling tips to reduce the chance of dirt and moisture contamination in oil.
- Store oil inside clean, closed areas.
- Keep oil relatively warm. Changes in temperature can draw water into oil barrels.
- Lay oil barrels on their sides if stored outside, or tilt them slightly so the opening is away from any water collection.
- Keep barrel openings drawn tight using a bung tool and wooden mallet.
- Clean all dirt and moisture from around the filler cap before removing it when adding oil. Do the same before opening oil containers or removing filters.

DISPOSING OF OIL

- Improper disposal of drained oil can harm the environment and ecology. Never pour oil on the ground, down a drain, or into a waterway, stream, lake, or pond.
- Always observe environmental regulations. John Deere recommends that all used oil be returned to responsible recyclers.



GLOSSARY OF OIL TERMINOLOGY

Additive
A chemical added to a base oil to improve desirable properties or suppress undesirable properties

Alkalinity
Having the ability to neutralize acids

Antifreeze
A compound added to a liquid to lower its freezing point

API
American Petroleum Institute

Ash level
The amount of ash formed when oil is burned

ASTM
American Society for Testing and Materials

Baseline
The standard by which test results are compared

Brake chatter
Brakes that operate with an irregularity that causes rapid intermittent noise or vibration

Classification
A systematic arrangement of oils in groups or categories according to established criteria

Combustion
The act of burning fuel, as in engines

Composition
A product of mixing or combining various elements or ingredients

Congeal
To change from a fluid to a semisolid state

Consumption
To use up or waste away

Contaminant
Undesirable element which can make oil unfit for use

Corrosion
The process of wearing away gradually by chemical action

Crude oil
Oil in its natural state unaltered by processing

Decompose
To undergo chemical breakdown

Density
A measure of the oil's weight per unit volume

Depressant
An agent that reduces the activity or moves to a lower position

Dispersant
A substance for promoting the suspension (as fine particles) more or less evenly throughout

Distillation
A process that separates hydrocarbon fractions according to their boiling range

EPA
Environmental Protection Agency

Flash point
The temperature at which oil vapors will ignite momentarily with a flame

Formulate
To prepare according to a set method or mixture

Fractionation
To separate (as a mixture) into different portions

Friction
The rubbing of one body against another

Fuel oil
An oil that is used as fuel

Gel
To change into or take on a more solid form

Grade
A position in a scale of, as in oil

Inhibitor
An agent that slows or interferes with a chemical reaction, such as rusting

Kinematic viscometer
An instrument used to determine the viscosity grade of an oil

Lubricant
A substance that lessens or prevents friction, heat, and wear

Natural gas
Gas issuing from the earth's crust used chiefly as a fuel and raw material

Neutralize
To counteract the activity or effect of

OEM
Original Equipment Manufacturer

Oxidation
The process of combining with oxygen or the thickening of oil

Petroleum
An oily, flammable, bituminous liquid that is a complex mixture of hydrocarbons prepared for use as gasoline, naphtha, or other products by various refining processes

Polymer
A chemical compound or mixture of compounds consisting of repetitive structural units

Pour point
The lowest temperature at which a substance flows under specified conditions

GLOSSARY OF OIL TERMINOLOGY (continued)

Premature wear
Wear occurring before the usual time

Rating
A classification according to grade

Reference fluid
A fluid by which performance is compared

Refinery
A building and the equipment used for separating the material in crude oil and producing useful products from it

Resin
Natural organic substance soluble in organic solvents (ether) but not in water

Retention
The act of holding secure or intact

Rust
The reddish, brittle coating (iron oxide) formed when chemically attacked by moist air

Saybolt
An instrument used to determine the viscosity of an oil; a unit of measure

Sludge
A precipitate or material setting (as a mixture of impurities and acid) from an oil

Stability
Resistance to chemical change or physical disintegration

Suspension
The state of a substance when its particles are mixed with but remain un-dissolved in a fluid or solid

TBN
Total Base Number; a measure of the alkalinity level of oil

Viscosity
Resistance to flow

Viscosity index (VI)
A number assigned as a measure of the change of the viscosity of a lubricating oil with change of temperature, with higher numbers indicating viscosities that change little with temperature

Wear
The progressive loss of substance from the surface of a body occurring as a result of relative motion at the surface

Zinc
Oil additives containing zinc minimize engine wear and oil oxidation

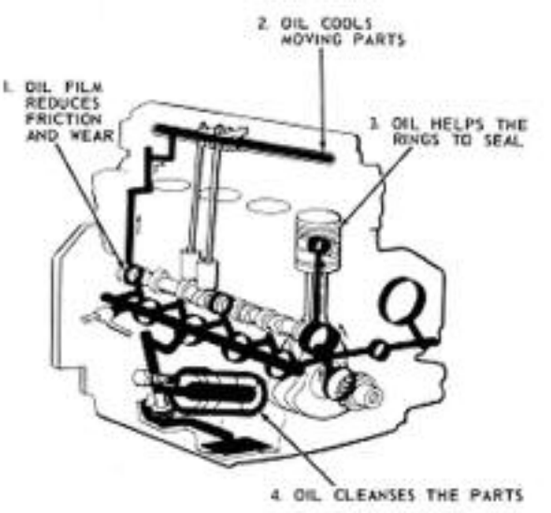
ENGINE OIL

There exists a complex group of ratings, classifications, grades, etc. surrounding today's engine oils. Engine oils have become more sophisticated, as have the engines in which these oils are used. This section, ENGINE OIL, will discuss these complex engine oil specifications. But first we will look at the demands today's engines place on lubricating oils.

Engine Oil Requirements

We all know that, basically, lubricants reduce friction and wear between moving parts. Refined oil was adequate when the horse and buggy were the primary means of transportation, but today's equipment requires more sophisticated lubricants. The development of more powerful engines is constantly changing our technology, and lubricants must be formulated to perform under new conditions.

Today's high-performance automotive, light-duty, and heavy-duty engines demand a great deal from a lubricating oil. Here are the four most important demands:



1. Oil Must Reduce Friction and Wear

Engine friction and wear are caused by the interference contact of moving parts. Combustion by-products and other contaminants carried in the oil also add to engine wear. To prevent metal-to-metal contact, the oil must maintain enough viscosity or film thickness to provide a cushion between moving parts under all operating temperatures.
In spite of high, localized operating temperatures, the viscosity under other conditions must be no higher than necessary and still provide good starting and the least friction under sustained running.

2. Oil Must Cool Moving Parts

Engine oil is largely responsible for piston cooling. This is done by direct heat transfer through the oil film to the cylinder walls and into the cooling system, and by carrying heat from the underside of the piston crown and skirt to the engine crankcase. Oils of equal viscosities have the same heat transfer capabilities, but the oil must have enough heat stability to resist decomposition when it comes into contact with hot surfaces**.**

Engine Oil Requirements — continued

3. Oil Must Help Seal the Cylinders
During combustion, pressures in the cylinder may be 18,000 kPa (2,600 psi) or higher. Oil helps the piston rings to seal these pressures in the combustible chamber by forming an oil film on the piston rings and cylinder walls.

4. Oil Must Keep Parts Clean
Contrary to popular opinion, engine oils do wear out. Extended service depletes the additives and oxidizes the base oils, forming harmful compounds. While good filtration will prolong oil life, many contaminants are soluble in oil and can pass through the filter. These contaminants are primarily unburned or partially burned fuel; additionally, corrosive acids and water are frequently present. The oil must prevent the formation of these materials or, once formed, keep them in suspension so they do not settle on the engine's internal surfaces.

Engine oil must fulfill all these requirements, not only when new, but throughout the complete drain interval:

- Keep a protective oil film on moving parts.
- Resist high temperatures.
- Resist corrosion.
- Prevent ring-sticking deposits.
- Prevent sludge formation.
- Flow easily at low temperatures.
- Resist thickening after prolonged use.
- Resist foaming.
- Suspend insolubles.
- Minimize deposits.

ENGINE OIL CLASSIFICATIONS

A number of separate organizations cooperate to provide standards and classification systems so engine oil performance can be tested and rated:

- Society of Automotive Engineers (SAE)
- American Petroleum Institute (API)
- American Society for Testing and Materials (ASTM)
- Various engine manufacturers and the military also provide their own specifications

All of these classification systems define minimum performance.

Selecting the right oil may often seem confusing given the various classifications provided by these organizations. To simplify this confusion, let's first look at viscosity grades that share a common rating for all engine oils.

SAE VISCOSITY GRADES

- The Society of Automotive Engineers has developed a viscosity grade classification system for engine oils, which is SAE J300.
- Viscosity is a measure of the oil's fluidity at a given temperature.
- Oils vary in viscosity as the temperature changes; oils become more fluid as the temperature increases and less fluid as the temperature decreases. Having fluid oil for cold morning starts is very critical. Engine oil must provide lubrication before the operating temperature is reached or severe component wear will occur.
- The SAE standard assigns numbers called viscosity grades to identify the oil's resistance to flow; examples are 20, 30, 40, 50, and 60.
- Viscosity grades 20 and above must meet a high-temperature viscosity requirement.
- The letter "W" after the viscosity grade number indicates the oil has met a low-temperature (winter) requirement; examples are 0W, 5W, 10W, 15W, 20W, and 25W.
- John Deere recommends following the manufacturer's suggestions for oil selection.
- SAE 15W-40 provides the best engine performance and protection for all climates above –15 degrees C (+5 degrees F).
- Plus 50 SAE 0W-40 is an all-season engine oil providing outstanding performance and protection for all diesel and gasoline engines in John Deere equipment down to –40 degrees C.
- John Deere prefers the use of SAE 10W30 in all gasoline-engine-powered units.
- SAE 10W-30 provides the best engine performance and protection for all climates above –20 degrees C (–4 degrees F).
- SAE 5W-30 oils may be used in cold-weather operations between –30 degrees C (–22 degrees F) and +40 degrees C (+104 degrees F) with drain-interval restrictions.
- Arctic oils may be required in some locations where ambient operating temperatures are considerably colder than –40 degrees C.

The chart below shows the temperatures at which any oil must meet the respective requirements of its SAE viscosity grade.

SAE J300 ENGINE OIL VISCOSITY CLASSIFICATION

SAE Viscosity Grade	Low-Temperature Viscosities		High-Temperature Viscosities		
	Cranking (cP) at °C	Pumping (cP) at °C	Kinematic (cSt) at 100°C		High Shear (cP) at 150°C and 10^6 s^{-1}
	Max.	Max. (with no yield stress)	Min.	Max.	Min.
0W	6,200 at -35	60,000 at -40	3.8	–	–
5W	6,600 at -30	60,000 at -35	3.8	–	–
10W	7,000 at -25	60,000 at -30	4.1	–	–
15W	7,000 at -20	60,000 at -25	5.6	–	–
20W	9,500 at -15	60,000 at -20	5.6	–	–
25W	13,000 at -10	60,000 at -15	9.3	–	–
20	–	–	5.6	<9.3	2.6
30	–	–	9.3	<12.5	2.9
40	–	–	12.5	<16.3	3.5 (0W-40, 5W-40, and 10W-40 grades)
40	–	–	12.5	<16.3	3.7 (15W-40, 20W-40, 25W-40, and 40 grades)
50	–	–	16.3	<21.9	3.7
60	–	–	21.9	<26.1	3.7

Revised: November 2007.
Note: 1 cP = 1 mPa·s; 1 cSt = 1 mm^2/s. All values are critical specifications as defined by ASTM D-3244.
For specific test methods, see the full SAE J300 standard.

VISCOSITY TEST

- In the viscosity test, a measured quantity of the oil is brought to the test measurement temperature. Viscosity is determined by the length of time it takes a specified volume of oil to flow through a small orifice in an instrument such as a Saybolt or Kinematic Viscometer.
- Low-temperature viscosity is measured in two tests: the Low-Temperature Cranking Test and the Low-Temperature Pumping Test. As the name implies, the Low-Temperature Cranking Test simulates engine cranking and is conducted at the various temperatures listed above for the "W" grades.
- The Low-Temperature Pumping Test measures oil pumpability at temperatures 5 degrees C below those specified for the Low-Temperature Cranking Test. Satisfactory performance in the latter test is required to ensure oil flow is not restricted to critical areas of the engine after a cold engine start.
- High-Temperature, High-Shear (HTHS) viscosity relates to the viscosity under heavy loads, high temperatures, and high shear rates where viscosity index improver additives are stressed.

MULTI-VISCOSITY OILS

- For engines subjected to a wide range of operating temperatures, multi-viscosity oil should be used. Multi-grade or multi-viscosity oils are formulated to meet both low-temperature and high-temperature viscosity requirements.
- These oils are identified as 10W-30, 15W-40, and so on.
- These oils are formulated by blending various base oils to obtain a viscosity grade such as 15W and adding polymers called viscosity index improvers. These polymers do not significantly affect oil viscosity at low temperatures, but they expand when the oil temperature rises. This expansion causes an increase in viscosity at higher temperatures that yields multi-grade oil such as 15W-40.
- Some oils may use synthetic oil or mixtures of petroleum-base and synthetic oil to obtain the multi-viscosity rating.

SUMMARY OF SAE VISCOSITY GRADES

In summary, the SAE viscosity grade indicates how oil flows at specified temperatures. It makes no attempt to define the oil's quality, additive content, performance, or suitability for specific service conditions.

PERFORMANCE RATINGS

Engine Manufacturer's Oil Specifications
The most important part of selecting engine oil is using the equipment manufacturer's recommendations found in the operator's manual. If oil with the incorrect rating is used, the engine may not get the protection it needs and the warranty may be void.

John Deere Plus-50, Torq-Gard Supreme, Plus-4, and Turf-Gard Engine Oils are some of the products that have been developed for John Deere engines.

ASTM Test Methods
The American Society for Testing and Materials (ASTM) develops standardized test methods for evaluating lubricants. These test methods contain strict controls on hardware, operating conditions, repeatability, and reproducibility. Surveillance groups continually review test results for severity. These standardized tests and minimum acceptable performance limits are used by the American Petroleum Institute (API) to define ratings.

API Service Categories
The API service ratings define minimum oil quality. Ratings beginning with the letter "C" are oils intended for diesel engines, while ratings beginning with the letter "S" are oils intended for gasoline engines.

The second letter indicates a rating update; the "C**J-4**" rating is more current than "C**I-4**," and "S**M**" is more current than "S**L**," etc.

Lubricants meeting more than one service rating may be identified "For Service C**J-4**/S**M**," etc. When dual ratings are indicated, the first rating is the primary use rating. In the above example, the oil "C**J-4**/S**M**" is primarily a diesel oil which also meets a gasoline rating.

The chart on the next page provides a brief summary of the ratings and service oil descriptions.

API SERVICE CATEGORIES FOR ENGINE OILS

Category Designation (Gasoline Engines)	Status	API Service Description (Gasoline Engines)
SM	Current	For all automotive engines currently in use. Introduced in 2004. SM oils are designed to provide improved resistance and deposit protection, and better wear protection and low-temperature performance over the life of the oil. Some SM oils may also meet the latest ILSAC specification and/or qualify as Energy Conserving.
SL	Current	For 2004 and older automotive engines.
SJ	Current	For 2001 and older automotive engines.
SH	Obsolete	For 1996 and older engines.
SG	Obsolete	For 1993 and older engines.
SF	Obsolete	For 1988 and older engines.
SE	Obsolete	**Caution:** Not suitable for use in gasoline-powered automotive engines built after 1979.
SD	Obsolete	**Caution:** Not suitable for use in gasoline-powered automotive engines built after 1971. Use in more modern engines may cause unsatisfactory performance or equipment harm.
SC	Obsolete	**Caution:** Not suitable for use in gasoline-powered automotive engines built after 1967. Use in more modern engines may cause unsatisfactory performance or equipment harm.
SB	Obsolete	**Caution:** Not suitable for use in gasoline-powered automotive engines built after 1951. Use in more modern engines may cause unsatisfactory performance or equipment harm.
SA	Obsolete	**Caution:** Contains no additives. Not suitable for use in gasoline-powered automotive engines built after 1930. Use in more modern engines may cause unsatisfactory performance or equipment harm.
Category Designation (Diesel Engines)	**Status**	**API Service Description (Diesel Engines)**
CJ-4	Current	Introduced in 2006. For high-speed, four-stroke engines designed to meet 2007 model year on-highway exhaust emission standards. CJ-4 oils are compounded for use 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 aftertreatment system durability and/or oil-drain interval. CJ-4 oils are effective at sustaining emission control system durability where particulate filters and other advanced aftertreatment systems are used. Optimum protection is provided for control of catalyst 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 PLUS	Current	Used in conjunction with API CI-4, the CI-4 PLUS designation identifies oils formulated to provide a higher level of protection against soot-related viscosity increase and viscosity loss due to shear in diesel engines.
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 engines meeting 1994 emission standards. Can be used in place of CD, CE, and CF-4 oils.
CF-4	Current	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.
CE	Obsolete	Introduced in 1985. For high-speed, four-stroke, naturally aspirated, and turbocharged engines. Can be used in place of CC and CD oils.
CD-II	Obsolete	Introduced in 1985. For two-stroke cycle engines.
CD	Obsolete	Introduced in 1955. For certain naturally aspirated and turbocharged engines.
CC	Obsolete	**Caution:** Not suitable for use in diesel-powered engines built after 1990.
CB	Obsolete	**Caution:** Not suitable for use in diesel-powered engines built after 1961.
CA	Obsolete	**Caution:** Not suitable for use in diesel-powered engines built after 1959.

MILITARY SPECIFICATIONS

In 1941, the military began qualifying engine oils. The U.S. Army 2104 specification was issued that year to cover oils meeting both Caterpillar and General Motors requirements. The military has continued to evaluate and classify engine oils as engines became more sophisticated. Caterpillar engine tests have continued to be the backbone of any diesel engine oil evaluation program for the military.

Military specifications also include gasoline engine tests to evaluate the effect of engine oil quality on bearing corrosion, engine wear, and engine deposits such as rust, sludge, and varnish. **Recent changes in military procurement regulations now allow the purchase of lubricants meeting applicable industry specifications for use in most military equipment.**

Military Specifications	API "Equivalent"
U.S. Military MIL-PRF-2104H	CI-4
Non-current	
U.S. Military MIL-PRF-2104G	CG-4
U.S. Military MIL-L-2104F	CF-4
U.S. Military MIL-L-2104E	CE/SG
U.S. Military MIL-L-2104D	CD/SF
U.S. Military MIL-L-2104C	CD/SC
U.S. Military MIL-L-2104B	CD/SC
U.S. Military MIL-L-46152E	SG
U.S. Military MIL-L-46152D	SG
U.S. Military MIL-L-46152C	SF
U.S. Military MIL-L-46152B	SF/CC
U.S. Military MIL-L-46152A	SE/CC
U.S. Military MIL-L-45199B	CD

ENGINE OIL ADDITIVES

John Deere does not recommend the addition of any aftermarket oil additives. Oil is formulated with the correct balance based on oil treatment or engine treatment performance testing. Adding additional chemicals could cause an imbalance or have an adverse effect on engine performance.

During the 1930s, engine tests to evaluate the performance properties of engine oils were developed. Ring sticking and ring and cylinder scuffing problems became epidemic; through cooperation with several oil companies, the first additized oil was made available commercially in 1935.

Today, special oil additives are put into lubricating oils to provide the extra performance required of today's high-speed engines. Each additive, or combination of additives, is included in an oil for a specific reason based on the service expected from that oil.

Additives enhance or impart new oil properties in three ways: protect engine surfaces, modify oil properties, and protect the base stock.

An oil may contain some or all of the additives described below. Each of the additives shown may include a number of different chemical compounds. These chemicals are chosen depending on their specific performance and compatibility with other chemicals in the lubricant.

Detergent-dispersant additives:

- Help keep metal surfaces clean and prevent deposit formation.

Particles of soot and oxidized oil or fuel are kept suspended in the oil. Suspension is so fine that it passes through the oil filter and continues to be carried by the oil. Regular drain periods result in the removal of suspended contaminants. Black oil is evidence that an oil is helping keep the engine clean by carrying combustion particles in the oil rather than letting them accumulate as sludge inside the engine.

Extreme-pressure anti-wear and friction-modifier additives:

- Ensure lubrication where extreme pressures between close tolerance and metal-to-metal surface contact are encountered.
- Reduce friction; prevent galling, scoring, seizure, and wear.

Anti-rust additive:

- Prevents rusting of metal parts during storage periods and downtime.
- Neutralizes acids so they are no longer harmful.

Oxidation-inhibitor additives:

- Inhibit oil molecules from combining with oxygen, which causes oxidation or thickening of the oil.
- Prevent acid, varnish, and sludge formation.
- Protect alloy bearings from corrosion.

Anti-corrosion additives:

- Help prevent failure of alloy bearings from the corrosive acid which is formed as a normal by-product of combustion.
- Protect metal surfaces from corrosive attack.

Viscosity index improvers:

- Help an oil perform properly through a wide temperature range.
- Give oil the beneficial properties of both light and heavy oils.

Multi-grade oils with this additive span an extra-wide range of viscosity grades compared to single-grade oils. Lighter single-grade oils make starting easier at lower temperatures but thin out as oil heats up. Heavier single-grade oils give good protection at moderate temperatures but thicken in cold temperatures, reducing protection and causing hard starting and improper lubrication.

Foam inhibitor additive:

- Prevents lubricants from forming a persistent foam, by reducing surface tension to speed the collapse of the foam. Foaming oil increases the oxidation rate and reduces the oil thickness, increasing wear rates in bearings, rings, and gears.

Seal swell additives:

- Prevent deterioration of seals.

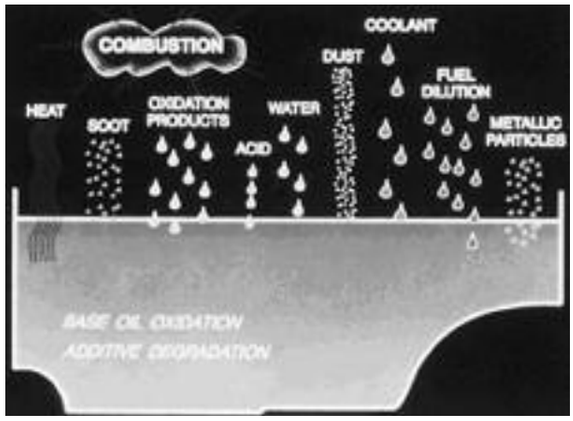
Many different types of elastomers are used to retain lubricants in today's equipment. Seals must maintain their properties and not shrink, crack, revert to some other form, or swell excessively. A seal swell additive along with proper blending procedures helps maintain the properties of the sealing material throughout the wide temperature changes encountered.

Pour point depressant additives:

- Prevent wax crystals from congealing in cold weather and forming clumps.

Some paraffin wax is present in lubricating oil, although most wax is removed during refining processes. These wax crystals tend to congeal in cold weather, interfering with oil flow and causing lubrication difficulties.

ENGINE OIL CONTAMINANTS



The quality of oil is important. But using uncontaminated oil is just as important. In fact, oil contamination can hamper engine performance as much as using poor quality oil. With this in mind, review the different types of oil contaminants, the problems contaminants cause, and ways to prevent oil contamination.

Dust, Dirt, Soot, and Metallic Particles

Dust is taken into the engine with combustion air. Dirt may accidentally be introduced into the engine during oil additions. In diesels, fuel soot from combustion also enters the crankcase oil with blow-by gases. Microscopic metal particles get into the oil as a result of normal engine wear.

Problem

Dust, dirt, soot, and metallic particle contaminants cause abrasive wear. Fuel soot thickens the oil and interferes with lubrication. An abnormal buildup of contaminants causes damage to bearings, pistons, and rings.

Prevention

Service the engine regularly. Operators can help prevent early engine failure with regular service of the air cleaner, oil filter breather cap, and crankcase ventilator that restrict dirt particles from entering the engine. Filler caps, funnels, and other equipment used to add oil to the system should be cleaned before additions are made.

Change oil and filters regularly. Operator's manuals give complete change intervals and capacity listings for oils, lubricants, and filters.

Water

Water can contaminate oil. Water vapor is a by-product of combustion. Each gallon of fuel consumed produces more than a gallon of water. Operating a cold engine condenses water that collects in the crankcase. As the water condenses, it is scraped down into the crankcase oil by the piston ring. The water does not start to vaporize until the cylinder wall reaches 63 degrees C (145 degrees F).

Problem

A buildup of water in used oil can result in soot particles forming larger molecules or sludge and plugging filters. When the filter plugs, a by-pass valve opens and allows unfiltered oil to circulate through the engine. If abrasive contaminants are present in the by-passed oil, damage to close-fitting components can result. Water can also cause metal surfaces to rust or corrode.

Prevention

Warm up the engine properly each time it is used and before a heavy load is applied. [Significantly more engine wear occurs in a cold engine operating at 38 degrees C (100 degrees F) than in a warm engine at 71 degrees C (160 degrees F).] Use a proper thermostat to heat the engine to the correct temperature as quickly as possible. Check engine temperature frequently.

Drain the crankcase oil only when the engine is warm to maximize contaminant removal and help prevent severe engine damage.

Antifreeze

Antifreeze is a contaminant of oil. It can enter the engine oil system through leaking head gaskets, damaged cylinder liners, oil coolers, and cylinder liner packings.

Problem

Antifreeze contamination in used oil can cause the problems discussed previously for water contamination: soot collection, sludge formation, and plugged filters. In addition, antifreeze contamination can cause bearing corrosion.

Antifreeze contamination usually indicates the need for major engine repairs.

Prevention

Follow specified service-manual procedures when torquing head bolts during overhaul. NOTE: Be sure to re-torque bolts when specified.

Use the recommended coolant to prevent cylinder liner damage. Guard against incorrect timing and improper use of starting fluids that can result in head-gasket damage:

- Never use automotive coolant in a heavy-duty diesel engine.

Fuel

When partially oxidized and unburned fuel mix with oil in the crankcase of gasoline or diesel engines, varnish deposits appear on piston surfaces.

In diesel engines, a cracked fuel pump diaphragm, faulty injectors, or a leaking fuel-injection pump-shaft seal causes oil contamination.

In gasoline engines, over-choking, engine misfiring, carburetor flooding, and cold engine operation allow gasoline to seep into the oil.

Problem

Diesel fuel in the crankcase reduces viscosity, leading to piston seizure, decreased bearing life, high oil consumption, and piston deposits. Deposits on pistons cause rings to stick, resulting in accelerated engine wear and increased oil contamination.

Raw fuel or gasoline may run down the cylinder walls, past the rings. This washes away the lubricating oil and increases engine wear.

Prevention

Keep the diesel fuel system in good condition.

Bring the engine to normal operating temperature each time it is used.

Avoid over-choking the engine, running the engine when it’s misfiring, and excessive idling of diesel engines.

Repair faulty carburetors and fuel-injector systems.

Heat

High operating temperatures caused by heavy loads, faulty cooling systems, bad timing, pre-ignition and detonation speed up the oxidation of oils.

Problem

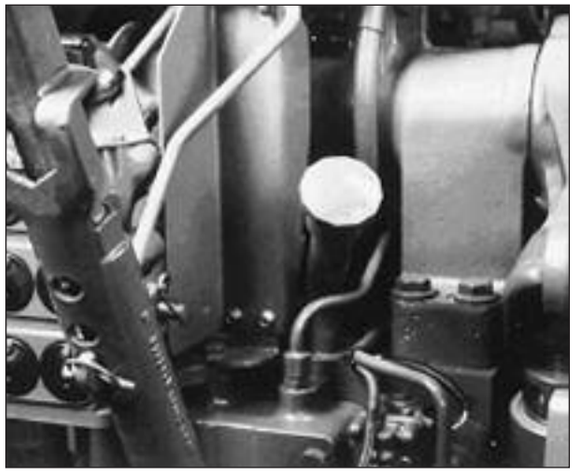
The effect of oxidation is thickened oil and the reduced capability to neutralize the combustion by-products. The result will be an oil containing acids which may corrode bearing metals and also form resins which may deposit on the pistons and hot metal parts as varnish. The results may be ring sticking, valve sticking and sludge formation.

Prevention

Make sure the cooling system is properly maintained and the temperature gauges are working properly. Check engine temperature frequently. Have engine timing checked periodically.

Antioxidants in new oil help protect the oil from oxidation and reduce oil breakdown. (The antioxidants in John Deere Plus-50 Engine Oil excel in delaying oxidation in high-heat, heavy-duty operations.)

TRANSMISSION — HYDRAULIC OIL



- John Deere equipment may have a common or separate reservoir for the transmission, differential, brake, and hydraulic system.
- John Deere Hy-Gard™ is a multi-functional lubricant recommended for use in all of these systems.
- Some machines have hydraulic systems separate from the transmission. John Deere Hy-Gard is also recommended for these applications.
- Industry standards defining performance requirements for transmission – hydraulic fluid do not exist. Manufacturers' standards are used instead.

TRANSMISSION — HYDRAULIC OIL PROPERTIES

The key properties of transmission-hydraulic oils are listed below:

Contain Anti-Wear Extreme-Pressure Additives:

• For reduced wear in operation of gears and pumps.

High Oxidation Stability:

• For long life and deposit protection.

Friction Modified:

• Minimizes chatter in wet-brake systems.
• Provides smooth clutch operation.

Contain Rust and Corrosion Inhibitors:

• Protects when fluid becomes slightly wet.

High Viscosity Index:

• Provides best viscosity under a wide range of operating temperatures.

Contain Foam Suppressors:

• Reduces oil foaming as it circulates through the systems.

Compatible with All Types of Seals:

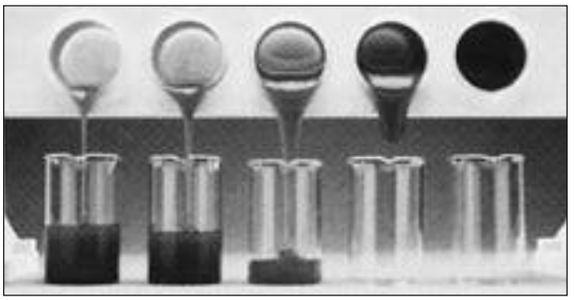
• Seals do not shrink, crack, revert to some other form, or swell excessively.

Low Pour Point:

• For low-temperature service.

Low-Temperature Fluidity:

• Meets special low-temperature fluidity tests to ensure functionality in low-temperature operations.



Low-temperature fluidity test comparing different oils

HYDRAULIC OIL REQUIREMENTS

• The primary function of hydraulic oil is to transmit power.
• However, the fluid must also be stable over long periods and protect the machine against corrosion and oxidation.
• Hydraulic oil must act as a lubricant and a heat absorber for the working parts.
• Some equipment has hydraulic systems separate from the transmission. John Deere Hy-Gard is also recommended for these applications.

HYDRAULIC OIL PROPERTIES

Viscosity

Viscosity is probably the single most important property of hydraulic oil. Parts within a hydraulic system depend on close fits to create and maintain the necessary pressures.

Oils with viscosities that are too low can cause leakage, resulting in low system efficiency and a rise in temperature. Oils with viscosities that are too high can cause sluggish operation, overheating, and high pressure.

Cleanliness

Fluid cleanliness is also very important. Debris can cause excessive wear and is a common cause of valve sticking. A fluid should meet the cleanliness requirements of the components in the hydraulic system.

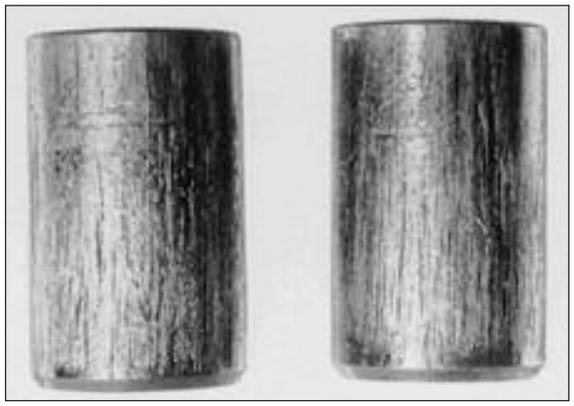
Stability

Hydraulic oils are subject to heat, moisture, agitation, and aeration, ideal conditions for oxidation and deterioration. In well-kept systems where there is little fluid loss and the oils will be in service for long periods, oxidation inhibitors are very necessary. The rate of oil oxidation increases with a rise in temperature. Because of this, some manufacturers provide coolers to control the oil temperature and reduce oxidation.

Corrosion Resistance

Since hydraulic systems are vented, it is impossible to prevent the reservoir “breathing” and intake of moisture that can result in the corrosion of metal parts.

Since only a very small degree of corrosion and its resultant pitting can adversely affect the operation of the finely machined parts in the system, hydraulic oil must contain very potent corrosion inhibitors.



Contaminated hydraulic oil scored these hydraulic pump pistons

Pour Point

Pour point is of prime importance to mobile and outdoor equipment. In some northern areas, winter temperatures fall far below the natural pour point of most oils. Therefore, the oil must be properly formulated and fortified with pour-point depressants to allow it to flow at sub-zero temperatures.

Anti-Foam

Foaming in hydraulic oils can be caused by excessive agitation in the presence of air, or by air leaking into the system. Chronic foaming is a design problem and should be treated as such. For added protection, most hydraulic fluids contain a small amount of foam suppressant. This does not prevent foaming but causes the foam to be very unstable and to break down rapidly.

Compatible with Seals

Seals in the hydraulic system contain rubber and other materials, which could deteriorate if oil contains harmful materials. For this reason, the oil must be made compatible with the seals in the system.

Anti-Wear

Hydraulic pumps and motors are very susceptible to wear. Many service instructions recommend using only oils containing anti-wear compounds.

GEAR OIL

- One of the most important gear lubricant performance characteristics is load-carrying capacity.
- Some gears are operated under loads and speeds at which the very low load-carrying capacity of untreated oil is adequate.
- However, most gears require lubricants of greater load-carrying capacity, which is provided through the use of additives.
- Gear lubricants compounded to achieve increased load-carrying capacity are referred to as “extreme-pressure” (EP) lubricants.
- However, when this term is applied to a gear lubricant, it means only that the load-carrying capacity of the lubricant is greater than that of untreated oil, with no distinction as to how much greater it may be. Therefore, to differentiate among EP lubricants of various load-carrying capacities, it is necessary to classify them further.
- The Component Manufacturers and ASTM have developed tests and the American Petroleum Institute (API) has assigned designations to aid in determining lubricant application.

GEAR OIL REQUIREMENTS

- Today’s high-speed, high-torque powertrains use relatively small gears. The result is high sliding speeds and contact loads between mating parts. This makes lubrication more critical.
- In some applications and gear designs, the gear oil must contain special anti-wear agents.

GEAR OIL RATINGS

API Gear Oil Service Classifications

The API System designates gear lubricants by the types of service for which they may be suitable. **This is not a rating of performance.**

API GL-1 (Obsolete)

For service in automotive-type spiral bevel, worm gear axles, and some standard transmissions, and operating under conditions of low pressures and sliding velocities. Rust and oxidation inhibitors, foam suppressors, and pour-point depressants may be used, while friction reducers and extreme-pressure agents must not.

API GL-2 (Obsolete)

For automotive-type worm gear axle service, under conditions of load, temperature, and sliding velocities where gear oils for Service GL-1 are not adequate.

API GL-3 (Obsolete)

For service in manual transmissions and spiral-bevel gear axles, under moderate conditions of speed and load. The service conditions are more severe than those of API GL-1 services, but not as demanding as those for GL-4.

API GL-4

GL-4 is used for manual transmission spiral-bevel and hypoid gears in moderate service.

API GL-5

This is the preferred oil in John Deere components when gear oils are recommended. API GL-5 is for service similar to GL-4 but for more severe conditions. It applies to conditions encountered in hypoid gears. Other equipment operated under high-speed, shock-load; high-speed, low-torque; and low-speed, high-torque conditions may specify API GL-5.

API GL-6 (Obsolete)

API GL-6 is an obsolete classification.

API MT-1

API MT-1 provides additional oxidation resistance and seal-compatibility testing. It is intended for nonsynchronized manual transmissions used in trucks and buses.

MILITARY (MIL) OR MANUFACTURER'S SPECIFICATIONS

MIL-L-2105

This has been a long-standing performance level of gear oils determined by test sequences which define MIL-L-2105 standards. Products meeting this specification are of the API GL-5 type.

While the specification MIL-L-2105 is now obsolete, replaced by the current specification MIL-PRF-2105E, it is still widely used to indicate a performance level for some gear oils.

MIL-PRF-2105E

This is the current performance specification of a multi-purpose gear lubricant used under more severe operation than those covered by MIL-PRF-2105. These gear oils are under API designation GL-5. SAE J2360 has been written to replace MIL-PRF-2105E.

SAE GEAR OIL CLASSIFICATION

SAE J2360

SAE J2360 has been written to replace MIL-PRF-2105E and it is equivalent to MIL-PRF-2105E when all requirements are met.

SAE J306

Society of Automotive Engineers (SAE) gear oil classification is based on viscosity alone and is no indication of quality or service (see chart).

Automotive Gear Lubricant Viscosity Classification

SAE Viscosity Grade	Maximum Temperature for Viscosity of 150 000 cP, °C[1,2]	Kinematic Viscosity at 100°C, cSt[3] Minimum[4]	Kinematic Viscosity at 100°C, cSt[3] Maximum
70W	–55[5]	4.1	–
75W	–40	4.1	–
80W	–26	7.0	–
85W	–12	11.0	–
80	–	7.0	<11.0
85	–	11.0	<13.5
90	–	13.5	<18.5
110	–	18.5	<24.0
140	–	24.0	<32.5
190	–	32.5	<41.0
250	–	41.0	–

Note: 1 cP = 1 mPa·s; 1 cSt = 1 mm^2/s

1. Using ASTM D 2983.
2. Additional low-temperature viscosity requirements may be appropriate for fluids intended for use in light-duty synchronized manual transmissions. See text.
3. Using ASTM D 445.
4. Limit must also be met after testing in CEC L-45-A-99, Method C (20 hours).
5. The precision of ASTM Method D2983 has not been established for determinations made at temperatures below –40°C. This fact should be taken into consideration in any producer-consumer relationship.

While the SAE numbers of gear oils are higher than those of engine crankcase oils, gear oils are not necessarily that much higher in viscosity. To avoid confusion, higher numbers are assigned to gear oils. For example, SAE 80 gear oil actually has about the same viscosity as SAE 20 engine oil when measured at 100 degrees C (see chart on next page).

Approximate Engine Oil and Gear Oil Viscosity Comparison	
Engine Oil Viscosity	**Gear Oil Viscosity**
SAE 0W	
SAE 5W	
	SAE 70W
SAE 10W	SAE 75W
SAE 20W	
	SAE 80W
SAE 30	
SAE 40	SAE 90
SAE 50	
	SAE 140

To avoid confusion, higher SAE viscosity numbers are assigned to gear oils.

Multi-grade gear oils are presently available from some suppliers in grades of SAE 75W-90 and SAE 80W-140.

Some manufacturers recommend engine crankcase oils for use in standard transmission service, while some transmissions may use SAE 50 engine oil as an alternate for SAE 90 gear oil. As a result, some gear-oil containers are marked SAE 50-90, indicating that the viscosity requirements of SAE 50 engine oil are met.

MIXING GEAR LUBRICANTS

- **As a general practice, the mixing of lubricants should be avoided.**
- Mixing gear lubricants with even small amounts of other types of lubricants can result in antagonistic reactions between the additive chemicals in the mixture. Such reactions may result in a significant loss of gear protection.
- However, the mixing of SAE J2360-approved lubricants as in a top-up situation should not impair lubricant performance.
- SAE J2360 lubricants are required to demonstrate satisfactory storage stability when mixed with previously qualified gear lubricants as a condition of the SAE J2360 approval process.

PLUS-50 ENGINE OIL (15W-40, 10W-30, and 0W-40)

Applications:

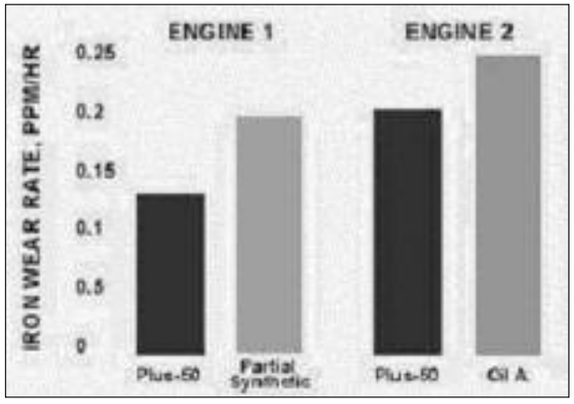
- Plus-50 Engine Oil has been developed to meet the exact needs of John Deere engines.
- It is an exclusive John Deere formula that also meets or exceeds the current industry requirements and can be highly recommended for use in all engines requiring oil with API service classifications of CI-4 PLUS, CI-4, CH-4, CG-4, CF-4, CE, CD, as well as SL and SJ.

Features:

- Exclusive unique additives formulated to exceed the needs of heavy-duty off-road equipment.
- A balanced additive system that controls oxidation and corrosion, and results in lower deposits. Exclusive additive package lowers engine wear and provides superior protection against high-temperature thickening as compared to competitive oils.
- Meets John Deere JDQ78X high-temperature engine test standards.
- Formulated specifically to reduce wear, oxidation, and deposits; and provide corrosion protection with superior soot control.
- Approved Mack EO-N Premium Plus 03.

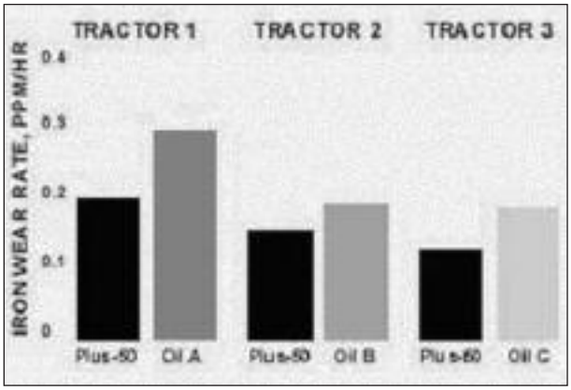
REDUCES ENGINE WEAR

Lab Tests — Engine Wear



In lab tests* using two different engines, Plus-50 Engine Oil showed 53-percent less wear in one test and 15-percent less wear in the second test.

Field Tests — Engine Wear



In field tests using three different tractors, Plus-50 Engine Oil showed 47-percent, 33-percent, and 43-percent less wear. These tests were run with high-quality and popular industry engine oils meeting or exceeding current API standards.

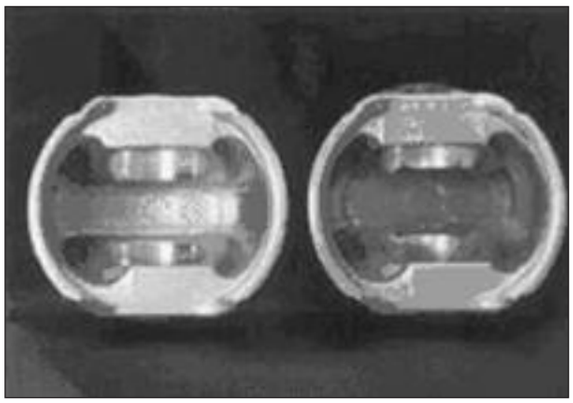
Feature: Plus-50 contains superior anti-wear additives.

Advantage: Plus-50 shows 40-percent less wear than competitive oils.

Benefit: Less wear increases the productive life of the engine.

REDUCES PISTON DEPOSITS

John Deere Plus-50 Engine Oil | **Competitive Oil**



John Deere Plus-50 Engine Oil | **Competitive Oil**

These photos show actual results of using Plus-50 Engine Oil compared to a high-quality, competitive, over-the-road diesel truck engine oil. Cleaner engines last longer and provide consistent power and less oil comsumption over the life of the engine.

*Test results obtained using 15W-40.

EXTENDS DRAIN INTERVALS BY 50 PERCENT

Feature: Plus-50 has a balanced blend of additives and base oils that inhibit oxidation, corrosion,
and wear.
Advantage: Plus-50 maintains its original viscosity longer than competitive oils and minimizes oil breakdown.

Benefit: Plus-50 reduces maintenance costs and extends engine life:

- Plus-50 has an improved ability to inhibit oxidation or high-temperature thickening and minimize the oil's breakdown. Breakdown results in thick oil that does not readily flow to vital engine parts. Plus-50 can extend drain-interval periods without danger of breakdown.
- Plus-50 has a balanced blend of additives to reduce oxidation, corrosion, and wear. When used with John Deere filters in John Deere engines, Plus-50 provides a 50-percent increase in the drain interval over what is stated in the operator's manual for **current API diesel engine oil performance categories.** This results in reduced maintenance costs for customers.
- The maximum drain interval recommended is 500 hours.

PROVIDES COLD-WEATHER PROTECTION

Summary of Low-Temperature Performance

Property	Units	ASTM Method	Plus-50		
			15W-40	10W-30	0W-40
Cranking Viscosity @ Temp, °C (SAE J300 Spec)	cP	D 5293	6,400 @ -20°C (7,000 @ -25°C)	6,581 @ -25°C (7,000 @ -25°C)	4,668 @ -35°C (6,200 @ -35°C)
Pumping Viscosity @ Temp, °C (SAE J300 Spec)	cP	D 4684	19,800 @ -20°C (60,000 @ -25°C)	24,700 @ -30°C (60,000 @ -30°C)	13,600 @ -40°C (60,000 @ -40°C)
Pour Point	°C	D 5950	-36	-33	-51
Cold Seal 35 mm/Sec @ Temp, °C	Second	JDQ 73**	7.9 seconds @ -25°C	14.4 seconds @ -35°C	8.3 seconds @ -45°C

John Deere Test Method

Feature: Plus-50 has a viscosity index improver, which provides excellent low-temperature performance.

Advantage: Plus-50 exceeds industry low-temperature fluidity requirements. Competitive oils may solidify and not provide adequate start-up lubrication.

Benefit: Good lubrication at low temperatures prevents damage to pistons and liners, rod and main bearings, and rocker arms during cold start.

IMPROVES SOOT HANDLING

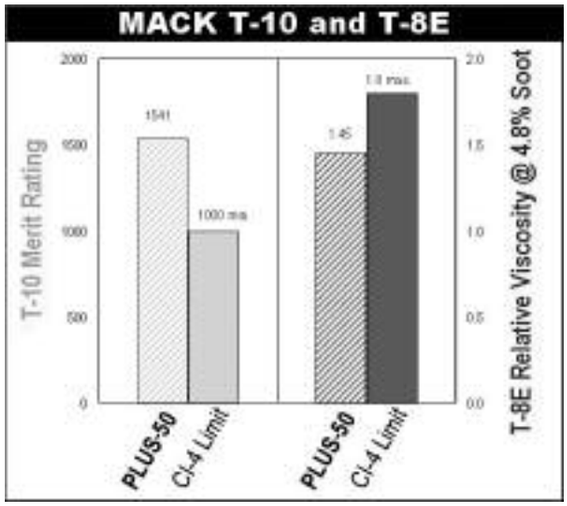
- Soot is a combustion by-product that collects in the oil and can cause excessive wear on engine parts.
- To reduce the adverse effects of soot, soot particles must be dispersed evenly in the oil throughout the drain interval.
- If soot is not dispersed in oil properly, the soot particles stick to each other and form larger agglomerates.
- The larger soot agglomerates form sludge that causes the oil to thicken and plugs filters; the soot particles then behave as an abrasive that reduces the lubricating capability of the oil.

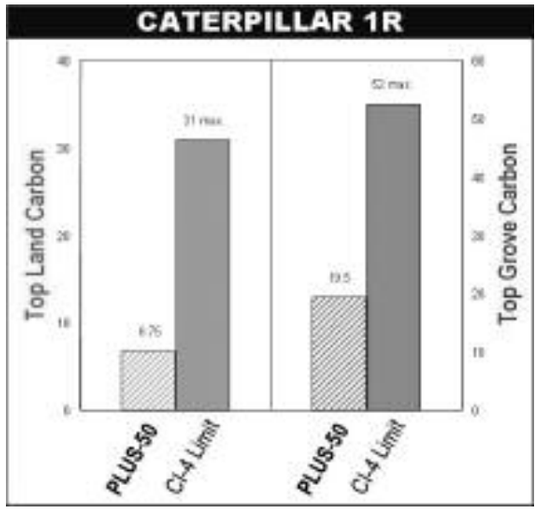
Feature: Plus-50 has excellent soot-handling capability.

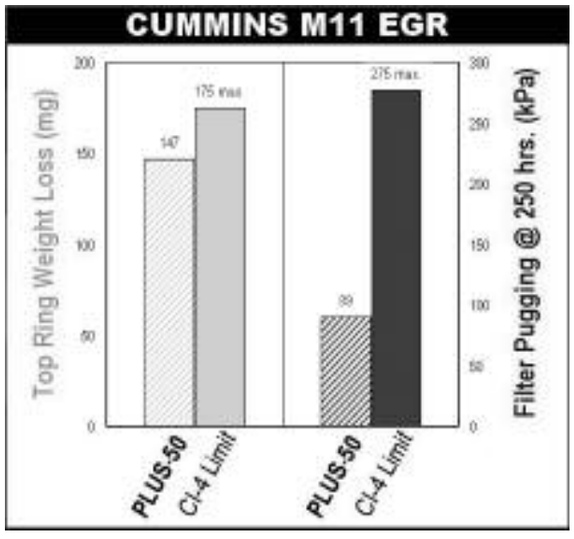
Advantage: Plus-50 retains its viscosity and protects better than industry CG-4, CH-4, CI-4, and CI-4 PLUS oils.

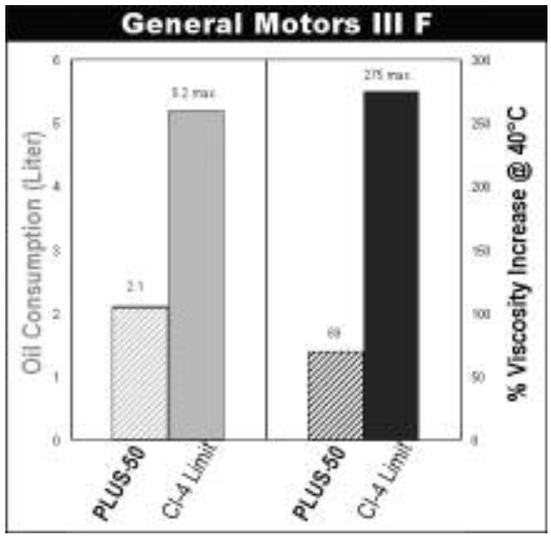
Benefit: Plus-50 provides superior lubrication for longer engine life and drain intervals, resulting in cost savings.

As illustrated in the graphs, Plus-50 clearly exceeds API engine test requirements for the latest CI-4 service category. These engine tests, the backbone of the CI-4 category, rigorously evaluate oil from all critical aspects. Plus-50 not only demonstrates longer oil life with minimal viscous thickening and consumption rate, more importantly it reduces engine wear and piston deposits, thus significantly extending engine life.









PERFORMANCE-LEVEL COMPARISON

- Oil is not just oil. There is a difference in high-performance oils and oils that just meet the minimum industry requirements.
- Universal competitive oils in the marketplace only have to meet minimum performance levels set by the API. Using minimum-level oils will result in reduced performance and shorter engine life.
- John Deere Plus-50 Engine Oil exceeds all industry requirements, plus it meets the high standards set by John Deere engineers.
- John Deere oils are developed to give the engine maximum protection and the longest life possible.

During the course of engine development, we test the oil under extreme conditions using the JDQ78X engine text.

- This test was developed by John Deere as a standardized test. It is the most severe oil oxidation test in the industry!
- It involves running a John Deere engine for 500 continuous hours at very high temperatures with no make-up oil added.
- Objectives of the test are to stress the oil by making it oxidize, and to measure the deposits and wear.
- This is primary engine oil test used by John Deere to determine how well an oil will perform in a heavy-duty, off-road application.

PLUS-50 0W-40 SYNTHETIC OIL

Applications:

- Excellent for all diesel engines requiring 0W-40 viscosity and API Service Classification CI-4 PLUS oil.

Features:

- Unique to John Deere — formulated with exclusive Plus-50 additive and synthetic base oil.
- Plus-50 0W-40 can be used in temperature ranges of 122 to –40 degrees F (50 to –40 degrees C).
- Drain intervals can be extended by 50 percent over the operator's manual recommendation when John Deere filters are used.

BREAK-IN MOTOR OIL

A special-blend oil developed to be used in rebuilt or remanufactured engines and new John Deere engines during the break-in period. Identical to John Deere factory-fill break-in oil:

- The first 100 hours of operation are critical to the life and performance of an engine.
- During the first hours of operation, the rings and liners must seat (establish a pattern of surface mating) for proper performance. If this does not occur, the life of the engine can be adversely affected.

High-quality premium engine oils should **not** be used as break-in oil. The superior anti-wear characteristics of premium oils will inhibit the proper matching of components, which could result in excessive oil consumption.

Applications:

Excellent oil for new or rebuilt non-John Deere engines. Engine-rebuild instructions should be consulted to determine if special requirements are needed.

Features:

- Contains special additives to control piston ring and liner seating without scuffing.
- Special anti-wear additive system to protect valve train, bearings, and gears during the break-in period.
- Piston rings and liners establish a good wear pattern for maximum performance and extended engine life.

TORQ-GARD SUPREME MOTOR OIL

Applications:

SAE 5W-30

High-performance oil that offers maximum protection for diesel and gasoline engines where excellent low-temperature pumpability is required.

SAE 10W

Exclusively formulated for cold weather, on- and off-highway, diesel and gasoline engine, and some hydraulic applications.

SAE 10W-30

Premium quality; recommended for both diesel and gasoline engines in all types of service; ideal for mixed commercial fleets.

SAE 30

Recommended for all diesel, gasoline, as well as natural gas engines, with superior wear, oxidation, and deposit characteristics.

Features:

- Specifically developed by John Deere for use in hard-working machines that must operate under full-load conditions for sustained periods of time.
- Meets the most stringent, low-temperature fluidity requirements. This ensures oil will perform as expected in cold weather.
- Contains a high-performance additive system for outstanding piston cleanliness, with little ash or lacquer deposited.
- Effectively neutralizes acid to reduce corrosion.

PLUS-4 AUTOMOTIVE ENGINE OIL

Applications:

SAE 10W-30 and 5W-30

Recommended for automobiles, trucks, lawn and garden tractors, and other four-cycle gasoline engines requiring the API SM service classification.

Features:

- Multi-viscosity provides rapid oil circulation in cold and hot weather for maximum performance.
- Outstanding wear protection for longer service.
- Keeps engine clean for increased life.
- Exceeds the requirement of API service classification SM.
- Meets “Energy Conservation Classification” for improved fuel economy.

TURF-GARD 4-CYCLE MOTOR OIL

Applications:

Recommended for all 4-cycle gasoline engines used in lawn and garden tractors, riders, walk-behinds, edgers, shredders, commercial mowers, tillers, generators, and other outdoor powered equipment.

SAE 10W-30 and 5W-30

Recommended for automotive gasoline engines requiring SM classification oil.

SAE 10W-40

Recommended for automotive gasoline engines requiring SL classification oil.

SAE 15W-40

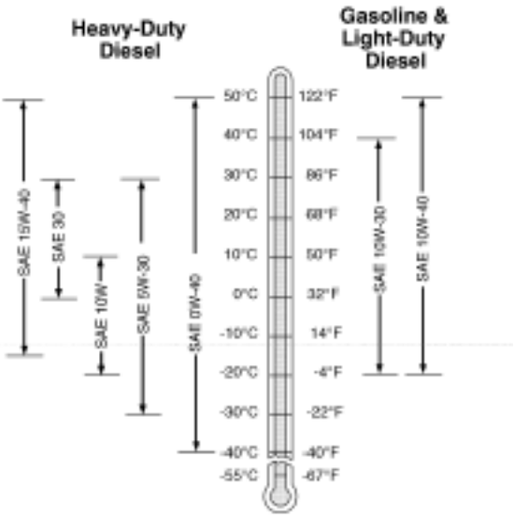
Recommended for automotive gasoline engines requiring SJ classification oil.

Features:

- Keeps engine clean.
- Provides long-lasting engine wear protection.
- Provides superior fuel efficiency.
- Multi-viscosity produces rapid oil circulation in cold and hot weather for maximum performance.
- Recommended for John Deere equipment; meets or exceeds manufacturers' engine warranty requirements.

AIR-TEMPERATURE CHART — JOHN DEERE ENGINE OILS

Determine oil viscosity based on the expected air-temperature range during the period between changes.



For heavy-duty diesel engines:

John Deere Plus-50
SAE 15W-40
SAE 10W-30
SAE 0W-40
John Deere Torq-Gard Supreme
SAE 5W-30
SAE 30

For gasoline and light-duty diesel engines:

John Deere Turf-Gard
SAE 5W-30
SAE 10 W-30
SAE 10 W-40
John Deere Plus-4
SAE 10W-30
SAE 10W-40
John Deere Plus-50
John Deere Torq-Gard

ENGINE OIL SERVICE CLASSIFICATIONS AND EXPLANATIONS

The American Petroleum Institute (API) has established service classifications for gasoline and diesel engine oil performance ratings. In addition, the military and some equipment manufacturers have performance specifications for their equipment. The chart shown at right identifies which classifications John Deere Plus-50, Torq-Gard Supreme, Plus-4, and Turf-Gard engine oils meet.

OIL SERVICE CLASSIFICATION RATINGS

Notes

1) Plus-50 and Torq-Gard Supreme are subjected to special tests exceeding industry requirements for API Category engine oils. These tests include:
   – Quality control, low-temperature performance, life tests, slow cool fluidity, and field tests.
   – 1,500-hour extended durability.
2) Plus-50 is subjected to a special high-temperature engine test (JDQ78X) that exceeds industry requirements for viscosity increase, deposits, and wear.

How to use chart

- Read down the chart to locate the service classification required by the application.
- Read across the chart to determine the John Deere oils with category equivalent.

	Service Classification	Plus 50			Torq-Gard Supreme					Plus-4		Turf-Gard			
		15W-40	10W-30	0W-40	15W-40▲	10W-30●	5W-30	30	10W	10W-30	5W-30	15W-40	10W-40	10W-30	5W-30
API	**CJ-4**				■	●									
	CI-4 PLUS	■	■	■	■										
	CI-4	■	■	■	■	■									
	CH-4	■	■	■	▲	■									
	CG-4	■	■	■	■		■								
	CF-4	■	■	■	■	■	■	■							
	CF-2							■							
	CF	■	■	■	■	■	■	■	■			■			
API (Gasoline)	**SM**				■	●				■	■			■	■
	SL	■	■	■	■	■	■	■		■	■		■	■	■
	SJ	■	■	■	■	■	■	■	■	■	■	■	■	■	■
ACEA	**E7**	■	■		■										
	E5	■	■		■										
	E4	■	■												
	E3	■	■	■	■										
	E2	■	■	■	■										
JASO DH-1		■	■												
Global DHD-1		■	■		■										
John Deere JDQ78A		■	■	■	■	■	■	■	■						
Mack	**EO-O Premium Plus 07**				■										
	EO-N Premium Plus 03	■	■	■	■										
	EO-M Plus	■	■	■	■	■									
	EO-M	■	■	■		■									
	EO-K/2					■		■	■						
Cummins	**CES 20081**				■										
	CES 20078	■	■	■		■									
	CES 20077	■	■			■									
	CES 20076	■	■	■		■									
MB	**228.5**	■													
	228.3	■	■	■	■										
Volvo	**VDS-4**				■										
	VDS-3	■													
	VDS-2	■	■												
Man M3275		■			■										
MTU Type 2		■			■										
DDC	**93K218**				■										
	93K214	■													
Renault	**RLD**	■			■										
	RXD	■			■										
	RD	■			■										
Allison C-4		■	■	■		■	■	■	■						
Cat	**ECF-3**				■										
	ECF-2	■	■		■										
	ECF-1-a	■	■	■											
	TO-2	■	■	■		■	■	■	■						
Mil	**CIDA-A-52306**	■		■				■	■						
	CIDA-A-52039B	■				■	■			■	■		■	■	■
GM6094M										■	■			■	■
ILSAC GF-4										■	■			■	■
ILSAC GF-3										■	■		■	■	■

Note: Boldface classifications are current; whereas lightface classifications are obsolete.
▲Torque-Gard Supreme 15W-40 marketed in Europe is API CH-4 / ACEA E5, but not CJ-4.
● Torque-Gard Supreme 10W-30 marketed in Canada is API CJ-4 / SM.

CHEMICAL AND PHYSICAL PROPERTIES

Plus-50 and Torq-Gard Supreme

Property	Units	ASTM Method	Plus-50			Torq-Gard Supreme				
			0W-40	10W-30	15W-40	5W-30	10W	10W-30	30	15W-40
Viscosity	mm^2/s (cSt)	D 445								
@ 40º C			85.7	80.1	117.0	65.0	46.1	74.8	86.9	107.0
@ 100º C			15.2	11.7	15.4	10.9	7.2	11.3	10.7	14.5
Viscosity Index	—	D 2270	187	138	139	160	116	141	107	139
Pour Point	ºC	D 97	–51	–33	–36	–38	–35	–36	–30	–33
Flash Point	ºC	D 92	230	218	218	207	219	204	241	230
Total Base Number	mg KOH/g	D 2896	12.8	13.5	13.6	10.0	6.6	9.5	8.7	10.8
Sulfated Ash	mass%	D 874	1.57	1.60	1.60	1.20	0.84	1.23	0.97	1.40
HTHS, @ 150º C	cP	D 4683	4.0	3.4	4.4	—	—	—	3.2	—

Plus-4, Turf-Gard, and Break-In

Property	Units	ASTM Method	Plus 4			Turf-Gard				Break-In
			5W-30	10W-30	10W-40	5W-30	10W-30	10W-40	15W-40	10W-30
Viscosity	mm^2/s (cSt)	D 445								
@ 40º C			67.0	72.8	104.3	65.5	72.8	104.3	105.4	65.5
@ 100º C			10.4	10.8	15.0	10.9	10.8	15.0	13.9	10.4
Viscosity Index	—	D 2270	145	136	150	158	136	150	132	145
Pour Point	ºC	D 97	–33	–37	–39	–40	–37	–39	–30	–33
Flash Point	ºC	D 92	210	226	227	218	226	227	220	215
Total Base Number	mg KOH/g	D 2896	6.5	6.7	6.7	7.0	6.7	6.7	—	7.5
Sulfated Ash	mass%	D 874	0.80	0.88	0.91	0.89	0.88	0.91	—	1.02
HTHS, @ 150º C	cP	D 4683	—	—	—	—	—	—	—	3.0

Note: Definitions of terms used in these charts can be found in the Glossary on pages 7–8.

HY-GARD AND LOW-VISCOSITY HY-GARD TRANSMISSION AND HYDRAULIC OIL

Hy-Gard and Low-Viscosity Hy-Gard transmission and hydraulic oils are unique oils developed by John Deere engineers to meet the exact needs of John Deere machines. Both Hy-Gard fluids are multi-viscosity fluids with high-viscosity index. Low-Viscosity Hy-Gard has an ISO 32 Viscosity Grade. Hy-Gard viscosity places it between ISO 46 and 68 grades. Hy-Gard may be used in many applications specifying either of these grades. Low-Viscosity Hy-Gard has the same performance specifications as Hy-Gard and can be used as a replacement for Hy-Gard in cold weather.

Applications:

- The exclusive Hy-Gard formula was designed for use in John Deere equipment; however, it can also be used in many non-John Deere transmission and hydraulic systems.
- Low-Viscosity Hy-Gard is used for factory fill in many machines. Consult the machine's operator's manual to determine what machines require Low-Viscosity Hy-Gard. It is also used as a replacement for Hy-Gard in cold-weather applications.
- Low-Viscosity Hy-Gard replaces John Deere All-Weather Hydrostatic Fluid and should be used as a direct replacement for all applications recommending hydrostatic fluid.
- Low-Viscosity Hy-Gard is compatible with hydrostatic fluid and can be added to systems which contain hydrostatic fluid.

Features:

- Performance tested both in the lab and in the field, and approved by John Deere engineers to meet the increased demands for performance and protection of transmissions and hydraulic systems.
- A polymeric viscosity improver helps Hy-Gard to retain its proper viscosity over a wide range of operating temperatures. For Hy-Gard to work efficiently, it must flow readily through any part of the system. Oil that is too light can cause increased wear. Oil that is too heavy will cause sluggish operation and lower mechanical efficiency.
- Reduces wet-brake chatter and ensures high braking capacity.
- Superior wet-clutch performance smoothes clutch operation.
- High tolerance to water contamination without sludge formation, which could cause filter clogging and hydraulic-system malfunction. The anti-oxidation capability allows the oil to work properly at high temperatures, helping keep transmissions and hydraulic system parts clean.
- Provides protection against rust and corrosion, particularly during low-use periods.
- Anti-wear additives keep gear and bearing wear to a minimum. The extreme-pressure film in Hy-Gard helps prevent metal-to-metal contact.

Functions:

Because transmission and hydraulic oil must perform many different tasks at the same time, there is very little margin for error. To understand the complexity of transmission – hydraulic oil, let's review its functions:

1) Prevents wear of high-torque, heavy-loaded gears and bearings.

2) Provides wear and corrosion protection for the hydraulic pump.

3) Provides proper friction for clutches to engage and absorb shock loads without excessive slipping or abrupt shifts.

4) Withstands extreme pressures in the hydraulic system without breaking down.

5) Prevents the formation of deposits on all internal parts.

6) Prevents foam and water damage to all internal parts.

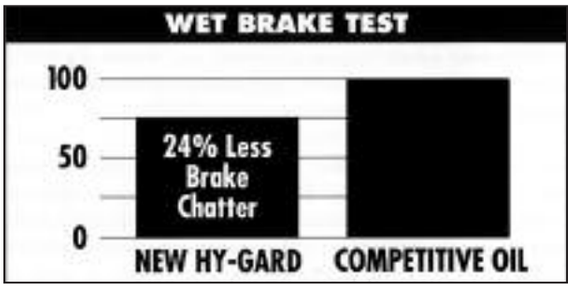
7) Provides proper friction for brakes to ensure low chatter, long life, and high capacity.

HY-GARD AND LOW-VISCOSITY HY-GARD TRANSMISSION AND HYDRAULIC OIL (continued)

- John Deere does not monitor competitive or "will-fit" oils. While claiming to meet John Deere requirements, it is possible that the competitive or "will-fit" oils do not meet even the minimum performance requirements for John Deere machines, which could result in premature failures. **(NOTE: An industry classification for hydraulic – transmission oil does not exist. Each manufacturer establishes a minimum requirement that oils should meet for use in their equipment. John Deere has established a JDM J20 specification for minimum tractor hydraulic fluid performance. John Deere Hy-Gard and John Deere Low-Viscosity Hy-Gard exceed the performance of their JDM-J20 specification counterparts.)** The performance requirements for Hy-Gard are higher, and many more performance tests are mandatory.
- Hy-Gard oil can be used in most applications calling for 10W-30 or 5W-30 engine oil for transmission and hydraulic oils. NOTE: Hy-Gard should be used in all applications calling for JDM J20C.
- Low-Viscosity Hy-Gard should be used in all applications calling for JDM J20D.
- Low-Viscosity Hy-Gard and Hy-Gard are compatible with hydrostatic oil and can be added to systems that contain hydrostatic oil.

WET BRAKE TEST

Result: Customers can expect up to 24-percent better brake-chatter control using John Deere Hy-Gard Transmission and Hydraulic Oil compared to oils meeting the minimum performance JDM J20 Specification.



Competitive Oil Tested to Meet John Deere Current JDM J20 Specifications

Hy-Gard has been formulated to ensure wet brakes have high braking capacity with minimum brake chatter. Three elements are considered in the wet brake test:

1) Braking capacity — the ability of the brake system to absorb energy, which is measured in torque.
2) Torque variation — the ability of the brake system to maintain smooth frictional operation without vibration or brake chatter.
3) Wear — low wear to ensure long life.

Feature:

Hy-Gard Oil is formulated to maximize brake capacity with minimum brake chatter and wear.

Advantage:

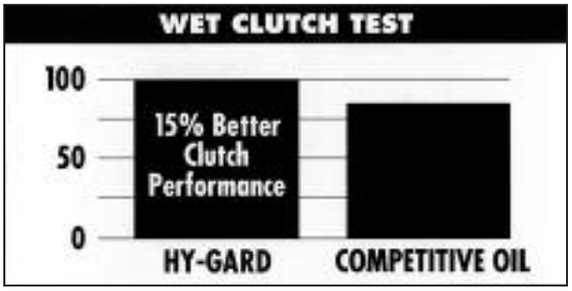
This formula provides 24-percent better brake-chatter control than competitive oil.

Benefit:

Better brake-chatter control provides smooth stopping, reduced damage from vibration, less noise, and longer brake life.

WET CLUTCH TEST

Result: Customers can expect up to 15-percent better clutch performance (smoother engagement, less slippage, and reduced wear) when using John Deere Hy-Gard Transmission and Hydraulic Oil.



Competitive Oil Tested to Meet John Deere Current JDM J20 Specifications

Hy-Gard allows limited clutch slippage for smooth engagement, which reduces clutch wear and provides long life. Too little clutch slippage results in rough, jerky engagement, while too much slippage can cause clutch surfaces to burn or glaze.

Three elements are compared in the wet clutch test:

1) The ability of the clutch to provide smooth engagement under maximum load.
2) The ability of the clutch to resist slippage.
3) The ability of the clutch to resist wear.

Feature:

Hy-Gard's friction modifiers provide smooth clutch engagement.

Advantage:

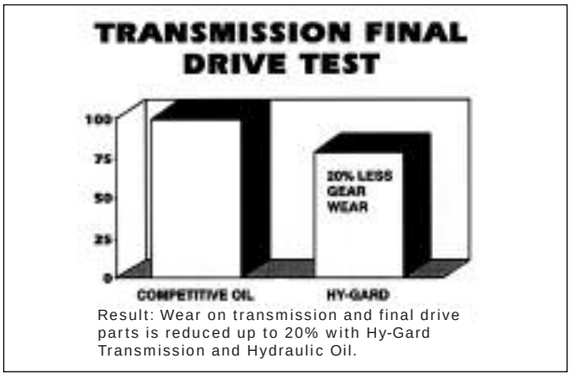
Smooth clutch engagement provides 15-percent better clutch performance than competitive oils.

Benefit:

Better clutch performance provides longer clutch life with reduced maintenance costs. Hy-Gard allows limited clutch slippage for smooth engagement, which reduces clutch wear and provides long life. Too little clutch slippage results in rough, jerky engagement, while too much slippage can cause clutch surfaces to burn or glaze.

GEAR TEST

Result: Wear on transmission and final drive parts is reduced up to 20 percent with Hy-Gard Transmission and Hydraulic Oil.



Competitive Oil Tested to Meet John Deere Current JDM J20 Specifications

Anti-wear extreme-pressure additives play a vital role in keeping gear and bearing wear to a minimum. Oil without these additives lacks the qualities to properly lubricate transmission parts.

The JDQ95 spiral bevel/final drive-gear test measures a fluid's ability to prevent destructive wear of gear contact surfaces.

Feature:
Hy-Gard contains superior anti-wear additives.

Advantage:
These additives provide up to 20-percent less gear wear.

Benefit:
Less gear wear extends component life and reduces downtime.

John Deere Hy-Gard **Competitive Oil**

SLOW-COOL FLUIDITY TEST

Hy-Gard and Low-Viscosity Hy-Gard are checked for proper viscosities using the slow-cool fluidity test in addition to industry-standard tests. The slow-cool fluidity test (developed by John Deere engineers and recognized by the oil industry as a valid testing procedure) ensures Hy-Gard's proper viscosity performance, which reduces downtime and lowers the cost of operation. Few competitive hydraulic-transmission oils are tested for this type of low-temperature viscosity performance.

Viscosity is one of the most important characteristics of transmission and hydraulic oil. Temperature changes outside and within the system will cause oil to become thicker at low temperatures and thinner at high temperatures. A polymeric viscosity index improver is added to Hy-Gard to help it retain its proper viscosity over a wide range of operating temperatures.

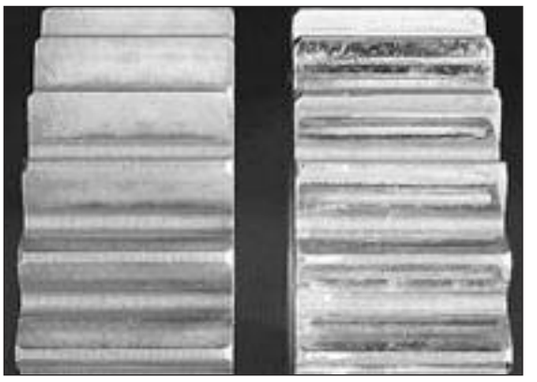
Oil that is too thin can cause increased wear, excessive leakage, loss of pressure, lack of hydraulic control, and lower overall efficiency.

Oil which is too thick can cause sluggish operation, lowered mechanical efficiency, and higher power consumption.

Feature:
Hy-Gard contains a polymeric viscosity index improver additive.

Advantage:
This additive ensures proper viscosity at all operating temperatures; competitive oils may not contain this additive.

Benefit:
The proper viscosity at all temperatures increases efficiency and decreases wear, resulting in lower operating costs and reduced downtime. It also reduces the cost of the multiple oil changes associated with single viscosity oils due to changes in operating temperatures.



John Deere Hy-Gard **Competitive Oil**

HY-GARD CAN BE USED WHEN THE FOLLOWING OILS ARE SPECIFIED:

AGCO

Massey Ferguson M1135, M1141, M1139, M1143, M1145

White Q-1722, Q-1766, Q-1766B, Q-1802, Q-1826

Allis-Chalmers, Deutz-Allis, AGCO Allis . . . . . Power fluid 821XL

CNH

Case, Case IH . . . . . MS 1207, MS 1209, MS 1210, MAT3505

Ford/New Holland ESN-M2C41-B, M2C134-D, M2C48-B, M2C48-C, M2C159-B/C, M2C86-B, FNHA-2C-200, MAT3526, FNHA-2C-201, MAT3525

Caterpillar TO-2

Clark MS-68

Deutz . . . . . Hydraulic transmission fluid

Dresser . . . . . Transmission hydraulic fluid (HMS B806-0002)

Eaton Hydraulic Division . . . . . Hydraulic transmission (Form 3-401-123)

IHC B-6

John Deere . . . . . All-weather hydraulic fluid (JDM J21A)

Kubota . . . . . UDT hydraulic transmission fluid, Super UDT

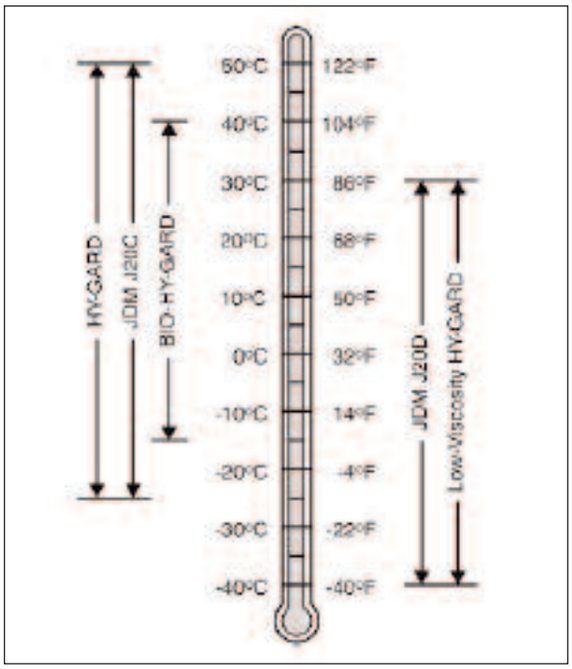
Oliver . . . . . Type 55

Sunstrand . . . . . Hydrostatic transmission

Zetor . . . . . OT-H, GL-4

ZF TE-ML03E, 06D, 06E

Check the operator's manual for specific applications. Low-Viscosity Hy-Gard should be used in place of an SAE 10W oil in John Deere combine hydraulic transmission systems.



***Check the operator's manual for specific applications. Some applications are restricted in this temperature range.**

Chemical and Physical Properties of Hy-Gard Fluids

Property	Units	ASTM Method	Hy-Gard	Low-Viscosity Hy-Gard
Viscosity	mm^2/s (cSt)	D-445		
@ 40º C			59	33
@ 100º C			9.4	7.2
Pour Point	ºC		–40	–51
Flash Point (typical)	ºC		227	180
Base Number	mg KOH/g		8.5	8.5
Viscosity Index	—		140	195

BIO HY-GARD HYDRAULIC TRANSMISSION OIL

Bio Hy-Gard protects your land and your equipment in the safest natural way. Recommended replacement for mineral oil base hydraulic/ transmission oil. For multi-functional systems including transmissions, hydraulics, wet brakes, clutches, and final drives. Recommended for use in environmentally sensitive areas.

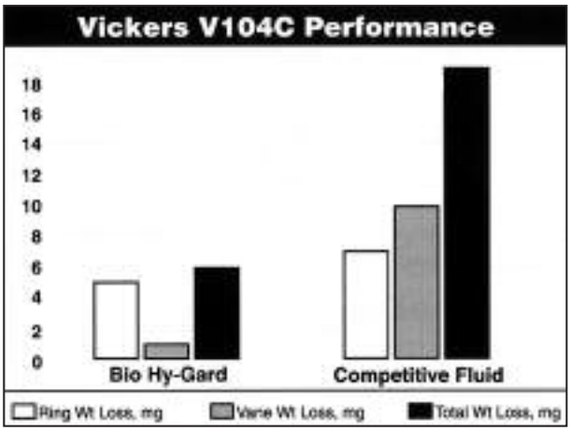
Applications:

Forestry, turf care (golf courses/cemeteries), construction, city services (garbage collection/street services), waterway operations, orchards, and farming operations.

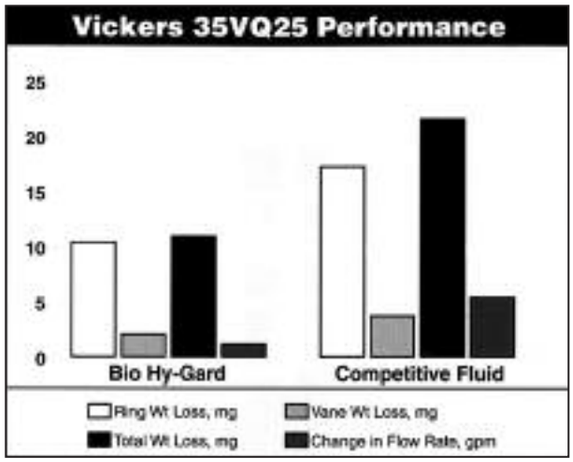
Features:

- Base oil from farm-grown products.
- Formulated from canola-based oil.
- Over 80-percent biodegradable.
- Exceed environmental eco-toxicity performance requirements.
- Brake chatter suppressed while superior brake performance maintained.
- Excellent corrosion protection.
- Over 13,000 hours of trouble-free field-testing.
- Compatible with mineral-based oils.

Outstanding hydraulic performance has been observed during this test cycle.



- The Vickers V104C = ASTM D2882 test was performed on Bio Hy-Gard and a competitive biodegradable fluid.
- The objective of this test was to determine the wear characteristics of treated mineral oils or emulsion-type fluids in an 8-gpm vane-type pump.
- 15 gallons of hydraulic fluid are circulated through a pump rig for 250 hours at 2,000 psi and 150 degrees F or 175 degrees F inlet temperature, depending on the procedure.
- Pump rpm is maintained at 1,200. Inspections occur at 50, 100, 150, 200, and 250 hours.
- Hydraulic oil performance is rated on the basis of weight loss of ring, vanes, rotor, and side plates. Any unusual wear patterns or corrosion are also noted.



- Also, the Vickers 35VQ25 test was performed on Bio Hy-Gard and competitive biodegradable oil.
- This test evaluates fluid in high-pressure operation using a Vickers 35VQ25 vane pump with the test fluid at a specified speed, pressure, and temperature.
- Three runs of 50 hours each are performed using a new pump cartridge for each run.
- The test consists of operating a Vickers 35VQ25 vane pump at high-pressure conditions for 50 hours. Test pressure is 3,000 psi, inlet fluid temperature is 200 degrees F, and pump speed is 2,400 rpm.
- The required horsepower input is in the range of 100.
- Evaluation of test results is done by a visual qualitative review of pump parts and weight-loss determinations.

BIO HY-GARD CHEMICAL AND PHYSICAL PROPERTIES

Property	Units	ASTM Method	Bio Hy-Gard
Viscosity	mm^2/s (sSt)	D-445	
40º C			46.5
100º C			10.3
Pour Point	ºC		–44
Flash Point (min.)	ºC		251
ISO Viscosity			46

- Bio Hy-Gard has the following biodegradability and eco-toxicity properties:
  - –OECD 301b (Sturm) fast biodegradability 75 percent.
  - –OECD 202 EC50 >100mg/l.
  - –CEC L33-A-93 biodegradability 94 percent.
  - –WGK rating 1.

POLYUREA (NON CLAY) HIGH-TEMPERATURE EXTREME-PRESSURE (EP) GREASE

Applications:
- High-temperature, extreme-pressure grease.
- Ideal in rolling-contact applications.
- –15 to 380 degrees F (–26 to 193 degrees C).
- Used for initial lubrication at the factory in U-joints and axle bearings.
- For excellent protection in corrosive and wet conditions.
- Compatible with most other types of grease.
- Excellent for all-purpose applications, especially those requiring a severe-duty grease.
- Our best multi-purpose grease.

Service rating:
- Equipment manufacturers' extended-service intervals.
- NLGI no. 2.
- JDM J13E1, J13E4, J13E5, and J25C.
- GC-LB.

Physical properties:
- Green color (emerald).
- Polyurea thickened.
- Paraffinic-base oil with extreme-pressure and anti-rust additives.

MULTI-PURPOSE HEAVY-DUTY LITHIUM COMPLEX GREASE

Applications:
- High-temperature and extreme-pressure grease.
- –15 to 350 degrees F (–26 to 177 degrees C).
- Heavy-duty long-lasting grease.
- High-quality grease in heavy-duty applications where lithium greases are recommended or preferred.
- For wheel bearings, universal joints, suspension systems, ball joints, and anti-friction plain bearings.
- A very good multi-purpose grease.

Service ratings:
- Meets equipment manufacturer's extended-service interval.
- NLGI no. 2.
- JDM J13C3, J13C3A, and J13C6.
- GC-LB.

Physical properties:
- Amber color.
- Lithium complex thickened.
- Formulated to prevent corrosion and water washout.
- Paraffinic-base oil with extreme-pressure and anti-rust additives.

MULTI-PURPOSE EXTREME-DUTY SYNTHETIC GREASE

Applications:

- –45 to 450 degrees F (–43 to 232 degrees C).
- Farm, construction, and commercial equipment — universal joints, wheel bearings, suspension systems, and brake calipers.
- Marine — inboard/outboard drives and prop shafts.
- General-purpose — windows, garage doors, hinges, bicycles, shop tools, locks, and many other applications.

Service rating:

- Outlasts petroleum-based greases and oils.
- GC-LB.
- NLGI no. 2.

Physical properties:

- Synthetic with Teflon™, no silicone.
- USDA-rated H-1 for incidental food contact.
- Repels dirt, dust, and grime.
- Prevents rust and corrosion.
- Water- and saltwater resistant.
- Will not drip, run, or evaporate.
- Non-staining.

GOLF AND TURF CUTTING UNIT GREASE

Applications:

- –30 to 330 degrees F (–34 to 165 degrees C).
- John Deere reel mower gearboxes.
- Excellent at high and low temperatures.
- Competitive machines requiring NLGI no. 0 grease.

Service ratings:

- NLGI no. 0.
- JDM J13A5, J13E6, and J25A.

Physical properties:

- Green color.
- Contains extreme-pressure properties.
- Contains anti-rust properties.
- Resists moisture and water washout.
- Polyurea-thickened grease.